FIRE - CARIBOU RELATIONSHIPS: (I) PHYSICAL CHARACTERISTICS OF THE BEVERLY HERD, 1980-87

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SUMMARY

We investigated adequacy of forested winter range of the Beverly herd of barren-ground caribou (*Rangifer tarandus groenlandicus*) to support the then-current population. A concern was that forest fires in the past 20 years, and particularly in 1979, had destroyed too much range. Range condition was evaluated indirectly by comparing over-winter changes in condition variables of the Beverly herd with those measured in 1966-68 in the adjacent Kaminuriak herd, when only a small percentage of that herd's winter range had burned in the previous 50 years or so. Samples were obtained from 856 female and 402 male caribou in December (1982-1986) and March (1980-87). The over-winter trends in condition indicated stability (females) and slight decreases (males) in total body weight, approximate stability in back-fat depths, and increases in kidney fat. In a comparable study in the late 1960s, declines occurred in all those variables in the adjacent Kaminuriak herd. We concluded, therefore, that winter range of the Beverly herd was adequate for the population in the 1980s. Condition indices based on kidney fat should be adjusted to compensate for body size of caribou by using body weight or femur lengths rather than kidney weights. For unknown reasons, kidney weights increased sharply and then decreased over the period of this study. Therefore, we prefer a body size index such as femur length that is easily and accurately measured and is independent of the nutritional state of an animal. Antler weight changes reflected varying environmental conditions during the non-winter period. Condition of caribou in December was affected by degree of warble fly (*Oedemagena tarandi*) harassment as reflected by numbers of warble larvae. Changes in condition during winter were less pronounced than during the remainder of an annual cycle. Two segments of the Beverly herd sampled in March 1984 differed significantly in condition indices and pregnancy rates. Therefore, the two groups varied in fat reserves at the rut in October. There was no indication that parasites and diseases other than warble flies were a factor in the well-being of the herd.

RÉSUMÉ

Nous avons cherché à déterminer si l'aire forestière d'hivernage du troupeau de Beverly de caribous de la toundra (*Rangifer tarandus groenlandicus*) suffisait aux besoins du troupeau au moment de l'étude. Plus spécifiquement, nous avons cherché à vérifier si les incendies de forêt des 20 années précédentes, notamment ceux de 1979, n'avaient pas détruit une trop grande étendue de cette aire d'hivernage. Nous avons évalué l'état de l'aire indirectement, en comparant les variations hivernales de certains paramètres de l'état physiologique du troupeau de Beverly aux variations analogues mesurées en 1966-1968 dans le troupeau adjacent de Kaminuriak; seule une faible proportion de l'aire d'hivernage de ce troupeau avait brûlé dans les quelque 50 années précédentes. Des échantillons ont été prélevés sur 856 femelles et 402 mâles en décembre (1982 à 1986) et en mars (1980 à 1987). L'évaluation de la tendance hivernale des variables mesurées indique une stabilité (femelles) ou une légère baisse (mâles) de la masse corporelle totale, une stabilité relative de l'épaisseur de la graisse dorsale et une augmentation du taux de graisse rénale. Dans une étude comparable effectuée à la fin des années 60, une diminution avait été observée pour chacun de ces paramètres dans le troupeau adjacent de Kaminuriak. Nous avons donc conclu que l'aire de répartition du troupeau de Beverly subvenait adéquatement aux besoins de la population dans les années 80. Toutefois, nous recommandons que les indices d'état physiologique basés sur le taux de graisse rénale soient pondérés en fonction de la taille de l'animal en utilisant la masse corporelle ou la longueur du fémur plutôt que la masse des reins. En effet, nous avons observé au cours de cette étude une augmentation brusque puis une diminution inexpliquées de la masse des reins.

C'est pourquoi il est préférable de remplacer la masse des reins par un indice de masse corporelle tel que la longueur du fémur, qui est facile à mesurer avec précision et indépendante de l'état nutritionnel de l'animal. Les variations de la masse des bois reflétaient les modifications des conditions environnementales pendant la période non hivernale. L'état physiologique des caribous en décembre était affecté par le degré de harcèlement par les hypodermes du caribou (*Oedemagena tarandi*), évalué d'après le nombre de larves. Les variations de l'état physiologique étaient moins marquées au cours de l'hiver que durant le reste de l'année. Nous avons observé une différence significative des indices d'état physiologique et du taux de gravidité de deux sous-groupes du troupeau échantillonnés en mars 1984. D'après les différences de fécondité, ces deux sous-groupes avaient des réserves en graisse différentes pendant le rut, en octobre. Rien n'indique que des parasites ou des agents pathogènes autres que l'hypoderme du parasites ou des agents pathogènes autres que l'hypoderme du caribou aient affecté la santé du troupeau.

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INTRODUCTION

In 1979, 179 forest fires in the Fort Smith District of the Northwest Territories (NWT) burned approximately 1 402 950 ha (Murphy et al. 1980). Most of the area burned was on caribou winter range east and northeast of Fort Smith. The Fort Smith HTA, among others, requested that fires be fought and afterward requested an investigation of fire suppression in 1979 and fire management policies in the NWT. The Minister of Indian Affairs and Northern Development struck a review panel composed of Peter J. Murphy (Chairman), Stanley R. Hughes, and John S. MacTavish. With respect to caribou, the panel concluded that more information was needed on adequacy of winter range to support the Beverly herd and on the effect of fires on caribou movement patterns: (1) "The immediate questions are to determine the effect of large burns on possible deflection of herd movements, the utilization of "stringers" and non-burned residuals, use of emerging vegetation, and the effect of snow conditions on feeding"; and (2) "continued observation of caribou movements in relation to burns of various ages and conditions should continue until clear indications of fire effects are apparent" (Murphy et al. 1980). Hereafter, the panel will be referred to as the "Murphy panel".

The Canadian Wildlife Service (CWS) proposed studies of caribou winter range in 1978. In anticipation of the study being approved and funded, preliminary studies on caribou diet and forage digestibilities were conducted in March of 1980 and 1981 (Thomas and Kroeger 1981, Thomas et al. 1984, Thomas and Hervieux 1986). Such data were needed in order to know what forage species must be considered in range studies, to obtain some indication of relative importance of plant species to groups of wintering caribou, and to ascertain to what degree nutrients were removed from forages by caribou rumen micro-organisms.

The study was planned to begin in winter 1982-83 but when funds came available in February 1982, a start was made in March. Fuel sufficient for the duration of the project was placed at three locations and an initial sample of 132 caribou was obtained to begin an assessment of range adequacy based on seasonal changes in physical condition.

Three study phases were planned to answer as well as possible (within the limitations on budget, personnel, and time) some major data deficiencies identified by the Murphy panel as follows:

1) Adequacy of winter range to support the then-current population of caribou;
2) Herd movements in relation to burns and snow conditions; and
3) Regeneration of caribou forages after fire.

The third phase was not stated explicitly by the panel but it was implied in statements concerning use of emerging vegetation and estimates of lichen rejuvenation and decline after fire (Murphy et al. 1980).

This report concerns the first information deficiency identified by the Murphy panel. The only feasible way of addressing the question of range adequacy was to use the caribou as an indicator. The concept was to use animal "quality" as an indicator of range quality in general and over-winter changes in animal fat stores as an indicator of winter range quality in particular. A major advantage of this method was that user groups could be involved in data collection. Hunters could see first hand the physical condition of caribou on what remained of forested winter range and they could observe caribou movements in relation to burns. This cooperative collection of samples also facilitated exchange of information that was vital to success of the project.

Further, there was a training component. Youngsters learned how to handle caribou in traditional and scientific ways.

An alternative approach was to sample vegetation on winter range in summer and attempt to estimate carrying capacity of winter range. This approach was deemed to be impracticable with available resources. Another approach was to examine winter range at numerous locations and attempt to detect if it was over-used by caribou. That method requires a great deal of experience in evaluating range condition, including experience where caribou numbers or "performance" (condition, fertility, and mortality) declined because of range overuse. That method is too qualitative; individual judgement plays too large a part and peer evaluation of any conclusions is impossible. These and other topics on winter ecology of barren-ground caribou were reviewed early in the study (Thomas 1982). A more-extensive review of winter ecology of caribou was published by Russell and Martell (1984).

Objective of this first phase of the study was to assess adequacy of forested winter range of the Beverly herd in the NWT by sampling caribou near the start and end of their occupation of winter range. The plan was to measure changes in body weight and fat reserves over several winter periods and compare results with those of previous studies where fire was not considered to be a factor. Fortunately, the best comparative data were for the adjacent Kaminuriak herd. That study included data on 943 caribou obtained from April 1966 to July 1968 (Dauphiné 1976). Our strategy was to compare information on fat reserves, body growth, age-specific fertility, and major parasites of the Beverly herd, which winters in Saskatchewan and northward in the NWT, with that of the Kaminuriak herd, which winters in northern Manitoba and District of Keewatin, NWT. The average, annual percentage of forested winter range in northern Manitoba and Keewatin District that burned in the 10 years prior to a 1966-68 study of the Kaminuriak herd was 0.15% (Miller 1976a). Corresponding "burn rates" on winter range of the Beverly herd in northern Saskatchewan and the NWT prior to this study were approximately 1.1% (1973-82) and 1.0% (1966-82), respectively (MacAuley 1983, Ferguson 1983).

The only other information on "normal" physical condition of barren-ground caribou east of the Mackenzie River was information on fertility of the Beverly herd from 1958 through 1961 (McEwan 1963), some weights from caribou sampled from the Bluenose herd (Hawley et al. 1979), and miscellaneous weights from caribou sampled from several central Canadian mainland herds between 1940 and 1958 (Kelsall 1968).

This report includes data obtained on 1171 caribou sampled by us (*n* = 1139) and by others (*n* = 32) from March 1982 through March 1987 and 87 caribou obtained in 1980 and 1981 during preliminary work leading up to this major study of the effects of fire on caribou and their winter range.

METHODS

In cooperation with the Fort Smith HTA, caribou were sampled each March from 1980 through 1987 and each November/December from 1982 through 1986. Collections in 1980 and 1981 were incidental to studies of caribou diet and forage digestibilities. In 1980 and 1981, a single-engine Otter aircraft was used to hunt caribou and return them whole to Fort Smith where they were necropsied at a laboratory. Some information was obtained in March 1981 from caribou collected by the HTA, who operated a camp at Quinn Lake.

The first of 11 systematic collections began in March 1982. A first step was to conduct reconnaissance aerial surveys in order to plot caribou movements and distribution. A field camp then was established in the region of highest caribou density if there was little directional movement or near the front of a migration or winter movement. Timing of each early-winter hunt was based on waiting for sufficient lake ice thickness to support "single" or Twin Otter aircraft (36 and 46 cm, respectively). The 1982 camp was established on 24 November but thereafter we had to wait until early December. A later start was not only necessary to ensure there was sufficient ice on lakes but was preferred because embryos were easily detected in uteri and better information was obtained on age-specific fertility. Hereafter, all early-winter samples will be referred to as December collections. Exceptions to the usual practice of hunting from field camps were use of aircraft to hunt caribou and establish two "fly" camps in December 1984 and to hunt caribou on 29 March and 6 December 1984, and on 15 December 1986.

Snowmobiles were used to hunt caribou from field camps or after landing an aircraft with one on board. Blood was collected in 25 ml vials from cuts to blood vessels in the neck or heart soon after caribou were shot. Less success was obtained when a collection was made after a carcass was dragged to a camp. Blood was kept in a vest to prevent freezing. Whole weights were obtained with a dial scale and tripod. Tie-down rings on wings of Otter aircraft were sometimes used in place of a tripod. After weighing a caribou, the mandible was removed and tagged and age was estimated from teeth eruption patterns and degree of wear. Girth was measured until 1985 but discontinued thereafter because its measurement was subject to error and it was time consuming to obtain. Antlers and right hind legs were tagged using tags in a plastic bag containing sufficient pre-numbered tags and plastic bags for all required samples. This bag was inserted in a slit in an ear after weights were obtained.

After a "skinner" removed the hide, warble larvae on it were counted, or on half the hide if large (50+) numbers were present on an entire hide. Depth of back fat was measured in millimeters at its maximum thickness along a cut forward and lateral from base of tail.

Kidneys, with surrounding fat trimmed according to Riney (1955), and the reproductive tract of females were removed and placed on the hide for packaging. A 10-30 cm length of colon with contained pellets sufficient for two samples of 30-50 pellets was also placed on the hide. One pellet sample was used for parasite studies; the other for microhistological analyzes of dietary components. About 1 liter of rumen contents was obtained for the same purpose. Any fetuses present in March collections were removed, tagged, bagged, and frozen. The remainder of the reproductive tract was discarded. In 1987, the uterus and its contents were weighed with a spring scale.

Bones of each right hind leg were retained after all flesh was removed from them. Antlers were removed from the skull, tagged, and retained for weight measurements.

The liver was removed and its surface inspected for parasite larvae. Lungs were inspected visually for hydatid cysts and palpated for internal cysts. The esophagus was cut open and retropharyngeal pouches examined for presence of throat bots (*Cephenemyia nasalis*). In March 1986, about 500 g of muscle and liver were retained from 30 caribou for deposition in the National Tissue Bank. In December 1986 and March 1987, samples of muscle and other tissues were retained for analyzes of radioactive cesium and plutonium after a nuclear accident at Chernobyl, Russia, on 26 April 1986. Tissues collected in March 1986 proved to be valuable in evaluating additional radioactivity (16%) caused by the nuclear accident.

In the laboratory, antlers, kidneys, and kidney fat were weighed and standard measurements (weight, total length, crown-rump length, girth, and hind leg) were obtained from fetuses. Remaining flesh and tendons were removed from each leg bone and lengths of femur, tibia, and metatarsus were measured by vernier caliper to the nearest millimeter. Standard measurements were obtained from the mandible: length, height, and lengths of tooth row, diastema, and exposed portion of the first incisor. A first incisor and first molar were removed from each mandible for age determination.

Marrow from a 10 cm section from a central portion of frozen femurs, and in some cases tibias and metatarsals, was removed, weighed, and dried in a pre-weighed dish for 3 days at 55° C in order to measure water content. Percent fat content was estimated by a formula: $\% fat = ((95 - \%water)/0.97) \times 100$ (Neiland 1970). Marrow of tibias and metatarsals were examined in the same manner in March of 1982, 1983, and 1987. Marrow was removed from each mandible and its water content measured by the same technique (Thomas et al. 1977, Thomas and Broughton 1978).

Rumen and fecal subsamples were sent to the Composition Analyzes Laboratory in Fort Collins, Colorado. Three pellets from each of the 10 females collected at each collection site were pooled. Sex and age differences in diets were explored by pooling samples from each of calves and adult males and comparing results of those composite samples with results for adult females.

Frozen reproductive tracts from females collected in November and December were thawed and uterine contents were inspected. Embryos were fixed in alcohol/formalin/acetic acid (AFA) (Humason 1962) and then measured (crown-rump) and sex recorded. Ovaries were fixed in AFA and then sliced at 1-mm intervals with a razor blade. Any corpora lutea, pigmented corpora albicantia, and large follicles were recorded and maximum diameters in millimeters were measured in two dimensions.

Age was estimated from eruption schedules to age 2 years (Miller 1974). Ages of older caribou were estimated from numbers of annuli in cementum of lower roots of a first incisor and first molar. Teeth were decalcified in 10% formic acid, neutralized in lithium carbonate or sodium bicarbonate, and transverse sections were cut at 16 microns on a cryostat (Thomas and Kiliaan 1985). Sections were placed on a slide, stained with Toluidine Blue 0, and viewed with a compound microscope. Sections of incisors and molars were viewed independently by two viewers experienced in the technique. They were viewed a second time if there were discrepancies in numbers of annulations.

Choice of statistical tests (ANOVA, *t*, Chi-square, G test, Mann-Whitney, Wilcoxon, or Kruskal-Wallis) depended on distribution of the variable, equality of variances, and previous studies involving similar data (Dauphiné 1976, Clutton Brock et al. 1982). Calculation of standard error (SE) was initially based on standard deviation (SD) values generated by REFLEX database packages, where $SD = sq.\ root\ [nEx^2 - (Ex)^2]/n^2$. In most tables and appendices, a correction for small sample sizes was made by calculating *SE = SD/square root(n-1)*. Sample weights in Appendices 1-4 were based on sample weights in pounds converted to kilograms with 1 decimal place. Subsequently, such values were converted to integers in the database and therefore mean weights and SEs may vary slightly among tables and appendices.

RESULTS

Age structure

The sample comprised 1258 caribou obtained from March 1980 to March 1987 at 25 locations on winter range of the Beverly herd (**Table 1, Fig. 1**). Age distributions for 845 females and 402 males were different (**Tables 2 and 3**). The age structures of females in all six winters (**Fig. 2**) differed (ANOVA, $P < 0.05$). Males were excluded from the analysis because those older than 3 years usually were not present in collection areas and therefore were under-represented in the samples. Caribou less than 2 years old were selected against by hunters because of their smaller carcass size and low fat content. Other age classes of females are indistinguishable by hunters and their sampling was judged to be representative.

Age structure and cohort relative strengths

A composite of 716 female caribou greater than (>) 2 years old, collected over the eight winters, resulted in a age-frequency plot that was almost linear (**Fig. 3**, curve "A"). A curve was fitted through points by least squares and age class frequencies calculated at February 21, the weighted mean date of December (n = 197) and March (n = 519) collections. Relative proportions of each age class (2.71 ... 14.71)

Table 1. Dates and locations in the Northwest Territories of 1258 caribou sampled from the Beverly herd between 1980 and 1987.

Collection number	Year	Month	Dates	Location	Number of caribou
1	1980	Mar	16-25	Several (8)	50
2	1981	Mar	19 & 23	Hurricane, Quinn[1]	37
3	1982	Mar	13-19	Halliday	144
4	1982	Nov	25-28	Porter	75
5	1983	Mar	17-21	Tent	159
6	1983	Dec	11-15	Tent	75
7	1984	Mar	18-22	Porter	115
			29	Sifton	35
8	1984	Dec	2 & 3	Wholdaia	30
			4	Striding	15
			5	Firedrake	20
			6	Veira	12
9	1985	Mar	17-21	Jones[2]	162
10	1985	Dec	12-14	Nonacho	75
11	1986	Mar	19-22	Cobb[3]	155
12	1986	Dec	11-15	Tent	49
13	1987	Mar	23-25	Tent	50

[1] 20 km east of Alcantara Lake.
[2] 20 km west of Tent Lake.
[3] 20 km west of Gray Lake.

the composite data (**Table 4**) were then used to calculate "expected" numbers in each age class in each winter sample (**Table 5**). This calculation was the average age class proportion multiplied by sample size for each winter, excluding under-represented calves and yearlings. Strong and weak cohorts could then be

Figure 1

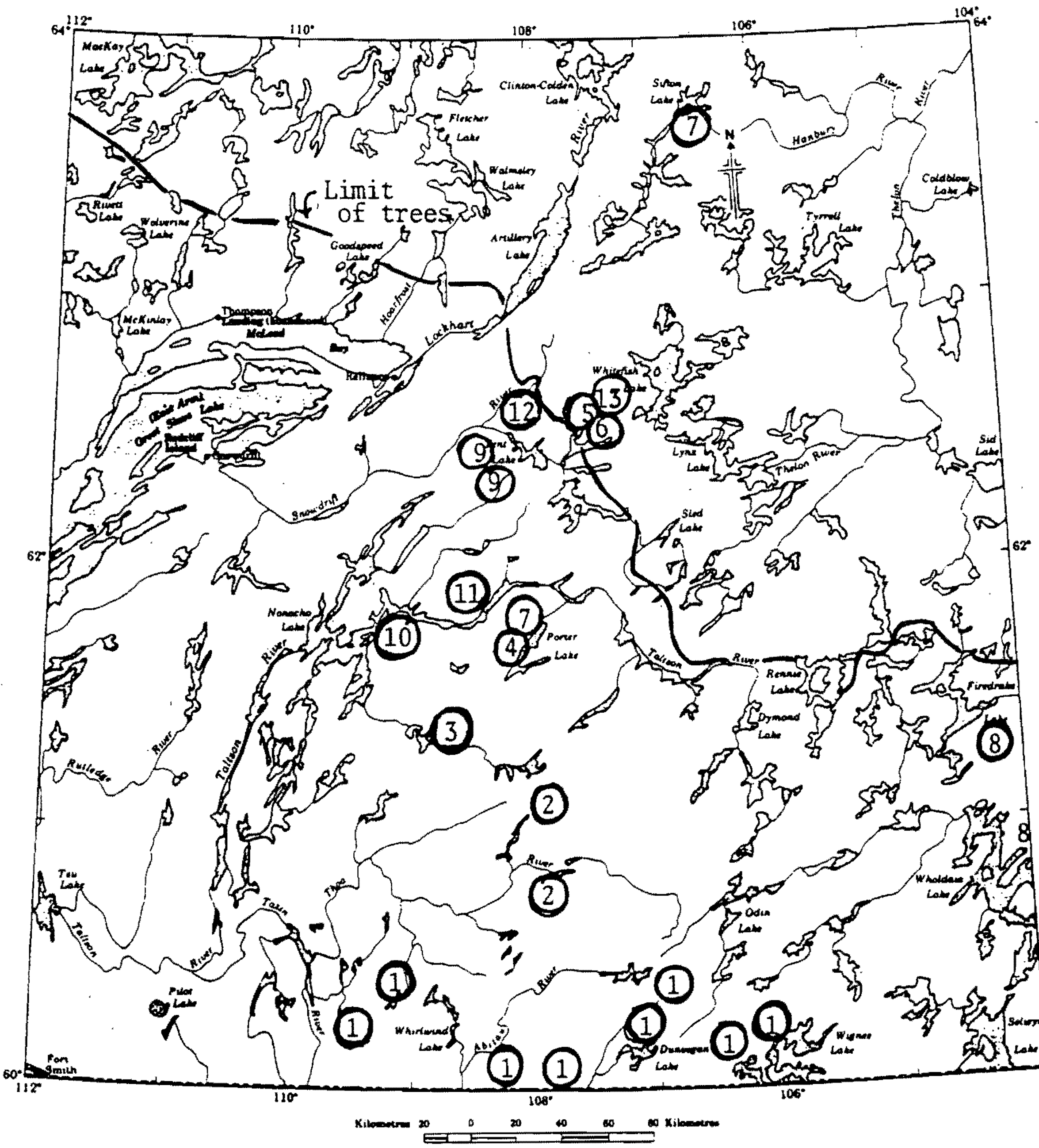

Figure 1. Locations of 13 collections of barren-ground caribou obtained from the Beverly herd from March 1980 through March 1987. (Dates, lake names, and sample sizes are in Table 1).

Table 2. Age distribution of 845 female caribou sampled from the Beverly herd between 1980 and 1987.

	Number in each age class							
Age (yr)	1979-80	1980-81	1981-82	1982-83	1983-84	984-85	1985-86	1986-87
0.5-1	2	1	13	5	4	5	5	2
1.5-2	4	1	13	23	19	16	13	3
2.5-3	10	1	11	15	19	29	20	15
3.5-4	2	3	4	17	13	31	28	11
4.5-5	0	1	10	10	17	15	14	16
5.5-6	2	1	5	19	19	28	14	13
6.5-7	3	2	5	7	20	10	15	8
7.5-8	2		10	19	7	10	5	6
8.5-9	2	3	6	8	6	12	11	4
9.5-10	3	3	6	9	7	3	13	1
10.5-11			3	5	9	1	3	
11.5-12			4	7	3	10	5	2
12.5-13			2	2	2	1	5	
13.5-14				1	2	2	4	
14.5-15						2		
15.5-16				1		1		
Not aged		10		1				
Totals	30	26	92	149	147	176	155	81

evaluated visually (Fig. 2). A strong or weak cohort in a sample from 1 year should continue in the next (older) age class of the following year's sample or its deviation from the average line could be attributed to chance. Such relationships are

Table 3. Age distribution of 402 male caribou sampled from the Beverly herd between 1980 and 1987.

	Number in each age class							
Age (yr)	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
0.5-1	1	4	7	8	11	8	1	1
1.5-2	1	7	12	28	15	14	15	3
2.5-3	5	0	27	24	27	26	26	7
3.5-4	2	0	2	15	13	8	15	2
4.5-5	1		3	6	5	5	9	4
5.5-6	3		1	3	2	1	6	
6.5-7				1	4	1	2	1
7.5-8	2							
8.5-9	2						1	
9.5-10	2							
10.5-11	1				1			
Totals	20	11	52	85	78	63	75	18

more apparent when an array of observed and expected numbers are tabulated (Table 5).

Figure 2

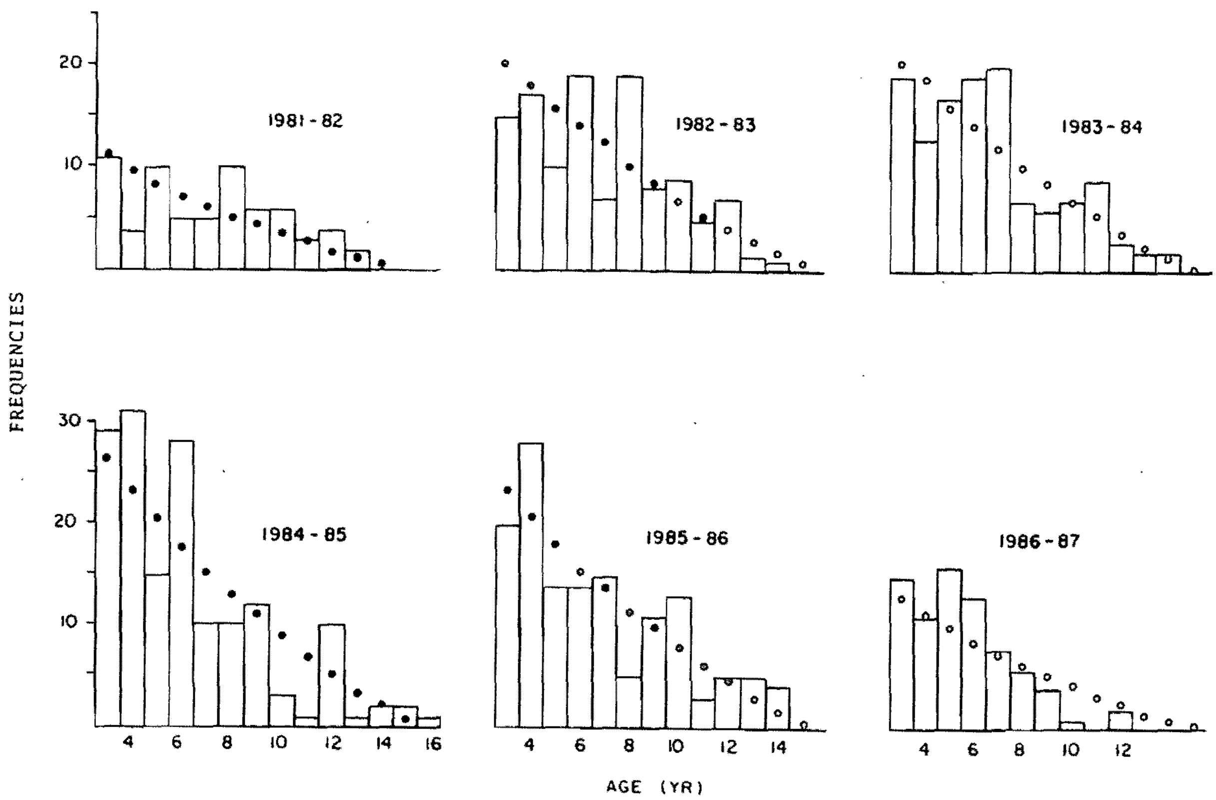

Figure 2. Age distributions of female caribou >2 years old sampled from the Beverly herd from 1982 through 1987 and the smoothed age distribution of 716 females collected from 1980 through 1987 that was fitted to each distribution.

Figure 3

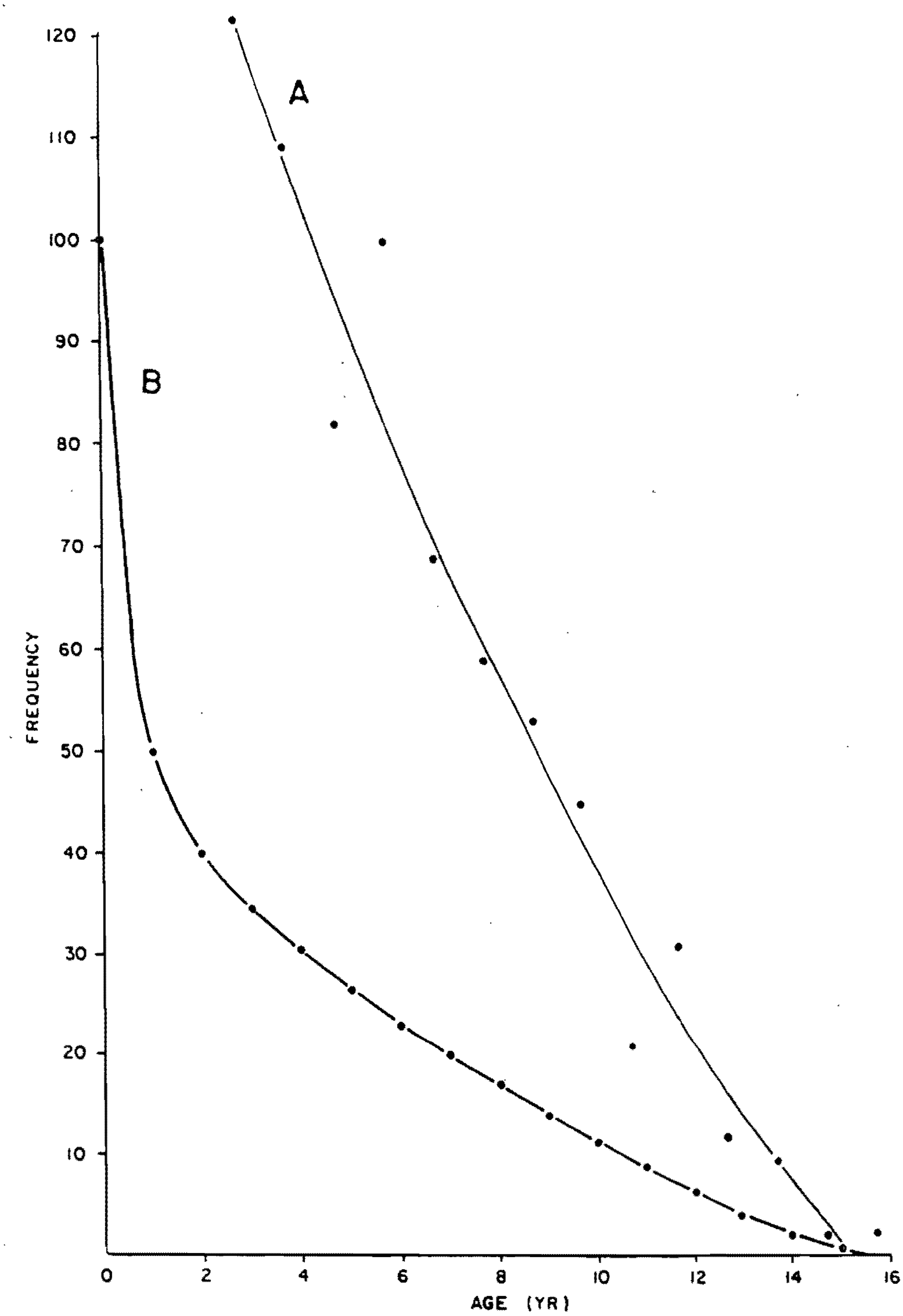

Figure 3. Smoothed survivorship curves of female caribou based on composite age data collected from 1980 through 1987 for ages >2.5 years (A) and that curve fitted to expected average survival of caribou <2 years old (B).

Table 4. Composite age distributions of 716 female caribou collected from 1980 through 1987 and statistics derived from a smooth line fitted through the data points.

		Numbers from			
	Observed	Fitted curve		Frequency (%)	
Age (yr)	number	Feb 21	Jun 8	Feb 21	Jun 8
2.5 - 3	120	121.4	117.4	16.9	17.2
3.5 - 4	109	107.9	104.2	15.0	15.3
4.5 - 5	83	95.2	91.6	13.2	13.5
5.5 - 6	101	83.0	79.6	11.6	11.7
6.5 - 7	70	71.6	68.4	10.0	10.0
7.5 - 8	59	60.8	57.8	8.5	8.5
8.5 - 9	52	50.6	47.8	7.0	7.0
9.5 - 10	45	41.2	38.5	5.7	5.6
10.5 - 11	21	32.3	29.9	4.5	4.4
11.5 - 12	31	24.2	21.9	3.4	3.2
12.5 - 13	12	16.7	14.6	2.3	2.1
13.5 - 14	9	9.8	8.0	1.4	1.2
14.5 - 15	2	3.7	2.0	0.5	0.3
15.5 - 16	2				
Totals	716	718.4	681.7	100.0	100.0

Table 5. Analysis of cohort relative strengths in samples obtained from the Beverly herd of caribou from 1981-82 through 1986-87.

Cohort	1981-82		1982-83		1983-84		1984-85		1985-86		1986-87		Total	
	0[1]	E[2]	0	E	0	E	0	E	0	E	0	E	0	E
1984											15	13	15	13
1983									20	23	11	11	31	34
1982							29	26	28	21	16	10	73	57
1981					19	21	31	23	14	18	13	9	77	71
1980			15	20	13	19	15	20	14	16	8	8	65	83
1979	11	11	17	18	17	16	**28**	18	15	14	6	6	94	83
1978	4	10	10	16	19	14	10	16	**5**	12	4	5	**52**	73
1977	10	9	19	14	[1]**20**	12	10	13	11	10	1	4	71	62
1976	5	8	7	12	7	11	12	11	13	8	0	3	44	53
1975	5	7	[2]<u>**19**</u>	10	6	9	**3**	9	3	6	2	3	38	44
1974	10	6	8	8	7	7	**1**	7	5	5	0	2	31	35
1973	6	5	9	7	9	6	**10**	5	5	3	0	1	<u>**39**</u>	27
1972	6	4	5	5	3	4	1	4	4	2	0	0	19	19
1971	3	3	7	4	2	3	2	2	0	1	0	0	14	13
1970	4	2	2	3	2	2	2	1	0	0	0	0	10	8
1969	2	2	1	2	0	1	1	0	0	0	0	0	4	5
1968	0	1	0	1	0	0	0	0	0	0	0	0	0	2
1967	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Totals	66	68	120	120	124	125	155	155	137	139	76	75	678	682

[1] The observed (0) numbers are females >1.5 years old in the sample.
[2] Expected (E) numbers are derived from the smooth curve of age distributions from all samples obtained from 1980 through 1987 (Fig. 3). E.g., in the 3 year class, *0.169 x 137 = 23.2* expected from the 1983 cohort in the 1985-86 sample.
[1] **Bold** = $P < 0.05$ (Chi square).
[2] <u>**Bold**</u> = $P < 0.01$ (Chi square).

Expected values for each cohort were based on a smooth curve of age distributions in Figure 3. Small samples from winters 1979-80 and 1980-81 were excluded from this analysis.

Relatively strong cohorts were 1982, 1977, and 1973. The 1980 and 1978 cohorts were relatively weak. In 1979-80, most of the Beverly herd wintered in northern Saskatchewan. Fat reserves and pregnancy rates in small numbers wintering in the NWT just north of 60°N were below average in March. There was a thick, hard, icy layer on lichen mats in many locations in the NWT. In June 1978, relatively large numbers of dead calves were noted on calving grounds (Heard pers. commun.).

A time-specific life table for females

The sample size from any one collection or winter sample was judged to be inadequate for life table construction. The six age distributions of female caribou for winters 1981-82 through 1986-87 (Fig. 2) differed statistically ($P < 0.05$, G test) largely because of sampling error and recruitment variations. They were pooled to increase sample size and smooth those variations. Zammuto and Sherman (1986) found time-specific and cohort-specific life tables gave results that were statistically indistinguishable. Furthermore, changes in mortality and reproduction did not appreciably alter age-specific survival and fecundity.

A contracted life table was constructed (**Table 6**) for females >2.5 years old using a fitted curve (Fig. 3). Intercepts were for February 21 (Table 4), the weighted mean date of winter samples, which equates to 0.71 of a caribou year beginning June 8 (approximate average date when 50% of calves are born). A good fit ($r^2 = 0.96$) was

Table 6. Contracted life table for female caribou >2.5 years old based on composite age distributions of samples obtained from 1980 through 1987.

Age (yr) x	Frequency observed[1] f_x	Frequency from fitted curve[2] at June 8 f_x	Survival[3] l_x	Mortality[4] d_x	Mortality rate[5] qx	Survival rate[6] p_x
2.71/3	120	117.4	100.0	11.2	11.2	88.8
3.71/4	109	104.2	88.8	10.8	12.2	87.8
4.71/5	83	91.6	78.0	10.2	13.1	86.9
5.71/6	101	79.6	67.8	9.5	14.0	86.0
6.71/7	70	68.4	58.3	9.1	15.6	84.4
7.71/8	59	57.8	49.2	8.5	17.3	82.7
8.71/9	52	47.8	40.7	7.9	19.4	80.6
9.71/10	45	38.5	32.8	7.3	22.2	77.8
10.71/11	21	29.9	25.5	6.8	26.7	73.3
11.71/12	31	21.9	18.7	6.3	33.7	66.3
12.71/13	12	14.6	12.4	5.6	45.2	54.8
13.71/14	9	8.0	6.8	5.1	75.0	25.0
14.71/15	2	2.0	1.7	1.7	100.0	0.0
15.71/16	2					
Totals	716	680.6	579.7	100.0		

[1] Numbers of caribou in composite samples from 1980 through 1987.
[2] Figure 3.
[3] Each frequency relative to 117.4.
[4] Differences between survival at successive age classes.
[5] d_x/l_x.
[6] $100 - q_x$.

achieved with a quadratic equation: $frequency = 0.33\ age^2 - 15.558\ age + 161.113$.

Age-class frequencies were then calculated for the birth pulse (Caughley 1977) by substituting age at June 8 (3.0 ... 15.0) in the quadratic equation.

The expected number of caribou 2 years old in this average population was extrapolated by curve extension. Mortality of caribou 1.71-2.71 years old was assumed to equal that of the next age class. Once again, values were derived and a life table produced for caribou >1.5 years old (**Table 7**). It could be considered slightly less reliable than the one for caribou >2.5 years old, hence its separate construction.

A life table applicable to all ages of caribou was constructed (**Table 8**) from data on calf recruitment (survival to age 1 year) and an estimate of mortality between age 1 and 2 years. Data from Kelsall (1968), Thomas (1969) and Heard (pers. commun.) provided a long-term average recruitment value of about 16% for the Beverly herd (**Table 9**). The average for potential cohorts in our sample was 15.3%. This value equates to a calf:cow ratio of 35.6:100 in the spring, according to the formula $y = 2.624x - 6.417$, where x = % of 1-year-olds and y = calves:100 cows (Graf and Heard pers. commun.). Some mortality would occur between the dates of recruitment counts in February, March, or April and their first birthday in June. Therefore, a ratio of 35 calves to 100 cows was assumed for June 1. This value represents an average mortality of 50%, as about 70% of females >1 year old are breeders (Parker 1972, this study).

The point on the graph for 2-year-old females (Fig. 3, curve "B") was estimated, assuming mortality of 20% between 1 and 2 years of age. It should be higher than the weighted mean annual mortality for females >2.5 years old (q_x = 19.0%). Some yearlings are small and have low fat reserves. Their mortality is expected to be higher than that of all ages except calves and old females.

Table 7. Contracted life table for female caribou >1.5 years old based on composite age distributions of samples obtained from the Beverly herd, 1980 through 1987.

Age (yr) x	Frequency observed f_x	Frequency at June 8 from smooth curve f_x	Survival l_x	Mortality q_x	Mortality rate q_x	Survival rate p_x
2		131.3[1]	100.0	10.6	10.6	89.4
3	120	117.4	89.4	10.0	11.3	88.7
4	109	104.2	79.4	9.6	12.1	87.9
5	83	91.6	69.8	9.2	13.0	87.0
6	101	79.6	60.6	8.5	14.1	85.9
7	70	68.4	52.1	8.1	15.5	84.5
8	59	57.8	44.0	7.6	17.2	82.8
9	52	47.8	36.4	7.1	19.4	80.6
10	45	38.5	29.3	6.5	22.4	77.6
11	21	29.9	22.8	6.1	26.6	73.4
12	31	21.9	16.7	5.6	33.3	66.7
13	12	14.6	11.1	5.0	45.4	54.6
14	9	8.0	6.1	4.6	75.0	25.0
15	2	2.0	1.5	1.5	100.0	0.0
16	2					
Totals	716	813.0		100.0		

[1] Extrapolated from curve for females >2.5 years old.

Extrapolation of the quadratic to age 1 year yields 145.9 caribou as a starting number and a mortality rate of 10.0% from age 1 to 2 years. These values are provided as recent results from radio-collared caribou in Alaska indicated that mortality rates

Table 8. A life table for female caribou in the Beverly herd based on sampling from 1980 through 1987.

Age x	Frequency f_x	Survival l_x	Mortality d_x	Mortality rate q_x	Survival rate p_x
0	100.0	100.0	50.0	50.0	50.0
1	50.0[1]	50.0	10.0	20.0	80.0
2	40.0[2]	40.0	4.2	10.6	89.4
3	35.8[3]	35.8	4.0	11.3	88.7
4	31.8	31.8	3.9	12.1	87.9
5	27.9	27.9	3.7	13.0	87.0
6	24.2	24.2	3.4	14.1	85.9
7	20.8	20.8	3.2	15.5	84.5
8	17.6	17.6	3.0	17.2	82.8
9	14.6	14.6	2.9	19.4	80.6
10	11.7	11.7	2.6	22.4	77.6
11	9.1	9.1	2.4	26.6	73.4
12	6.7	6.7	2.3	33.3	66.7
13	4.4	4.4	2.0	45.4	54.6
14	2.4	2.4	1.8	75.0	25.0
15	0.6	0.6	0.6	100.0	0.0
Totals			100.0		

[1] Approximate value based on data in the literature (see text).
[2] Assumes mortality rate of 20% between ages 1 and 2 years.
[3] Values for ≥3 years calculated using mortality rates in Table 6.

Table 9. Recruitment statistics for the Beverly and Kaminuriak herds.

Year[1]	Number of years	Percent calves, Beverly herd	Source	Percent calves, Kaminuriak herd	Source[4]
1947-61	14	15.8[2]	1		
1962	1		2		
1966-69	3		3	10	3
1967	1		4		
1977	1			10	5
1978	1	20	5		
1979	1	10	5	10	5
1980	1			21	5
1981	1	11		21	5
1982	1	21	5	20	5
1983	1	21	5	15	5
1984	1	12	5	18	5
1985[3]	1	15.3	6	21	5
1986	1	21	5	25	7
1987	1	17	7	17	7
1988	1	23	7	16	7
1989	1	18	7	21	7
1990	1	16	7	18	7
Weighted ave.		16.4		16.4	

[1] Cohort is a year earlier.
[2] Corrected from 15.9 in Kelsall (1968); applies to western herds and not just the Beverly.
[3] Last cohort year yielding data for the life table.
[4] Sources: 1. Kelsall (1968); 2. McEwan (1963); 3. Parker (1972); 4. Thomas (1969); 5. Beverly and Kaminuriak Caribou Management Board (1987); 6. Thomas unpubl. data; 7. Heard pers. commun.

Note: Not all these data were corrected for missing components, e.g., adult males, nor were calves always subtracted from the total count, however, these corrections tend to cancel one another.

were similar in age classes 8-12, 12-24, and >24 months (Davis et al. 1988). Readers can construct a new life table where mortality rates are given (Caughley 1977).

The data in the life table are valuable for several reasons. First, they provide clues to the probable causes of adult mortality. For example, females 3-10 years old generally were in good condition and mortality from undernourishment is unlikely. A likely explanation for the l4.5% calculated ($q_{3\text{-}10} = d_3 + d_4...d_{10}/l_3 + l_4...l_{10}$) average mortality rate in that group is losses from hunting and predation. Hunting (retrieved kills plus wounding and non-retrieved caribou) is thought to account for about 5-7% of the herd annually. The natural mortality rate is believed to be in the order of 8-10% annually.

Second, the life table data, when combined with age-specific fecundity information, are used to calculate intrinsic rates of increase and expected numbers of offspring produced by various age classes. Expected numbers of calves of each sex can be calculated if information is known about the sex ratio of calves produced by various age classes of females (Thomas et al. 1990).

Third, the information can be used to calculate the expected survival of tagged or radio-collared individuals if their ages are obtained. For example, the expected mortalities of females $\geq$5 years old and $\geq$10 years old in the Beverly herd are 20.0% and 33.4%, respectively.

Finally, life table information is needed for various modeling exercises, including calculation of minimum viable population sizes of isolated threatened species, where sufficient data are available on fecundity, mortality, recruitment, etc. A discussion of this and other life caribou tables is in a separate report (Thomas and Barry 1990).

Whole body weight (WT)

Sex differences

Male calves averaged heavier ($P < 0.05$) than females in the two samples (March 1982 and 1984) where the sample size was adequate for comparisons (**App. 1** and **2**). Male yearlings averaged heavier than female counterparts in eight of nine samples where the sample size was at least four for each sex. Differences were significant ($P < 0.05$) only in December 1983 and 1984 and in March 1982 and 1983. Males 2.5-3 years old were heavier than the corresponding females in all 10 cases in which at least four individuals were collected. They were significantly heavier than females ($P < 0.05$) in samples from December 1983, 1984, and 1985, and from March 1982, 1983, and 1985. Males 3.5-4 years old were significantly heavier than the same-aged females in all six samples where the sample size was adequate. This differential increased in older caribou. Thus, the sexes must be treated separately.

Age differences

Whole WT (less blood) in November/December increased with age of females to the 3.5-4 year age-class and in males to about 6 or 7 years (**Fig. 4,** App. 1). Numbers of males over 5 years old were too few to clearly define the WT curve. Three males 10 and 11 years old were lighter than four males 7-9 years old (114.8 *vs.* 104.5 kg) in the March 1980 sample. The inference is that bulls over 10 years old were declining physically, for longevity of the hardiest males is about 13 years.

The WT curves for March (**Fig. 5**) showed greater spreads than those for December samples. A peculiarity of the curves for females in March was a dip or flattening of the curve from age 2.7 (3) years to 3.7 (4) years. In terms of whole WTs, age classes should not be grouped up to age 3.5 years in females and

Figure 4

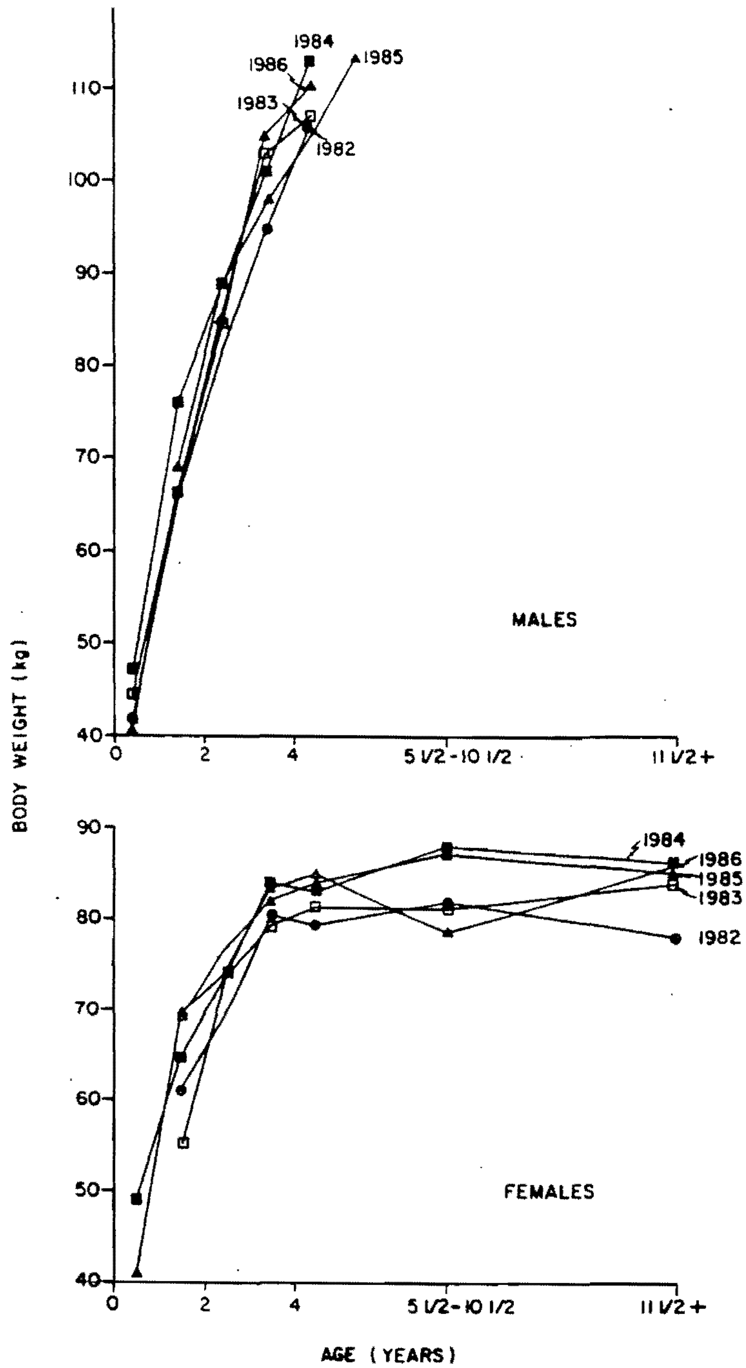

Figure 4. Mean whole body weights of caribou sampled from the Beverly herd in early December from 1982 through 1986.

Figure 5

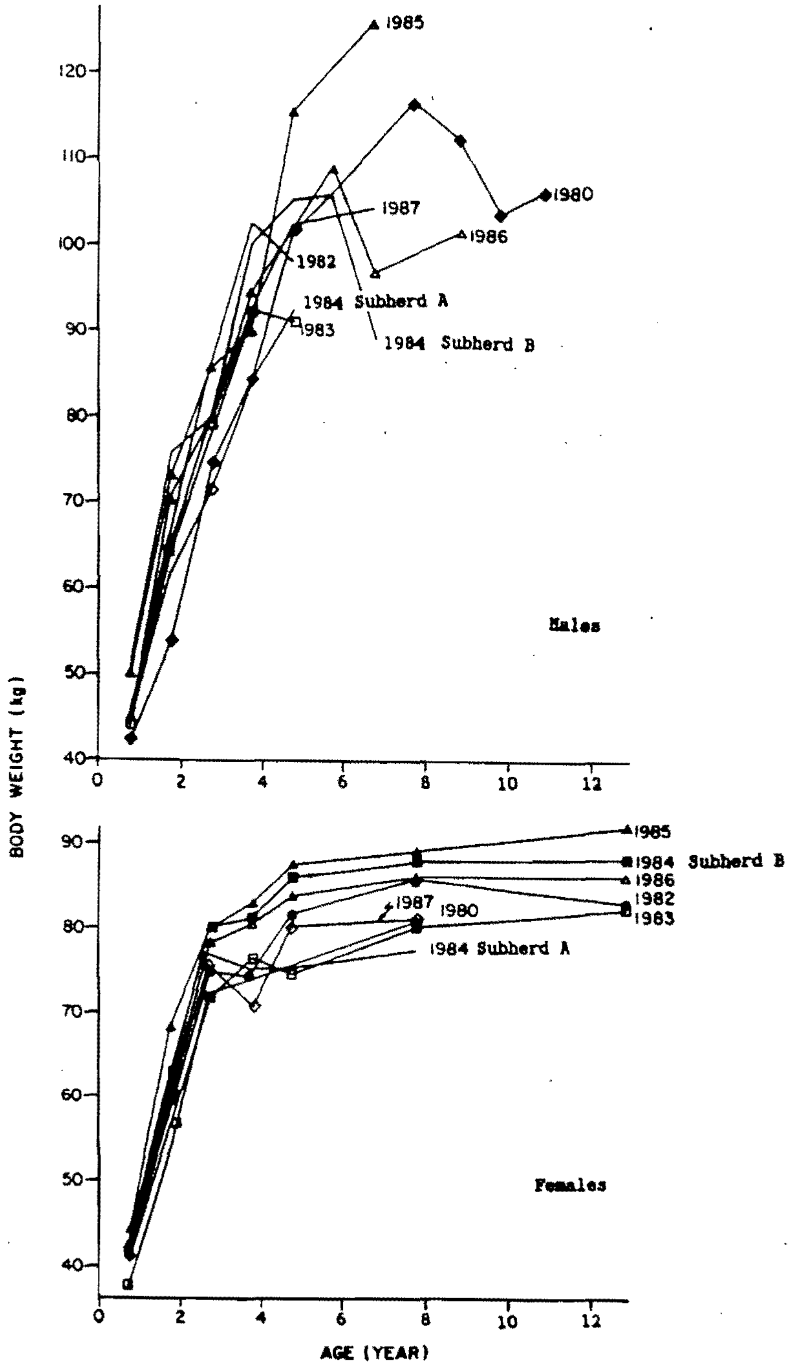

Figure 5. Mean whole body weights of caribou sampled from the Beverly herd of caribou each March from 1980 through 1987.

perhaps to age 5 or 6 years in males.

Weight adjustment in pregnant females

Weights of female caribou in March were separated into three categories in order to assess changes from year to year and between December and March and to compare weights of pregnant and non-pregnant females in the same age class. The three categories were: pregnant females; pregnant females, less weight of the uterine contents; and non-pregnant females (**App. 3**). The relationship between weights (kg) of fetuses (*x*) and the uteri and their contents (*y*) was $y = 2.34x + 0.47$ ($r = 0.84$) for fetuses 1.26 kg to 1.97 kg ($n = 26$) (**Fig. 6**). Lighter fetuses at 0.77 kg and 0.87 kg were associated with uteri weighing 4.0 and 3.5 kg, respectively. Either the relationship is different for lighter fetuses or they were stunted and weights of uteri and their contents relate more to stage of pregnancy than size of fetus. The correlation in Figure 6 is spurious if the former situation is true. Without an objective basis for adjusting weights of females carrying fetuses lighter than 1 kg in March, we corrected their weights by 2.8 kg. That was the correction for fetuses weighing 1 kg, where the regression is extrapolated beyond the data points. No adjustments were made for weights of uteri containing embryos in November and December. Gravid uteri collected from November 25 to 27 averaged 118 g (±14.0 g SE, $n = 8$); those collected December 2 to 6 weighed 200 g (±14.0 g SE, $n = 24$); and those sampled 11-15 December averaged 271 ± 7.9 g. Of those collected 11-15 December, mean uterine weights were heaviest in the 1985 sample (288 ± 11.9 g), followed by the 1983 sample (270 ± 12.1 g), and the 1986 sample (252 ± 17.5 g). The order in weights correlates with physical condition variables described in this report.

Figure 6

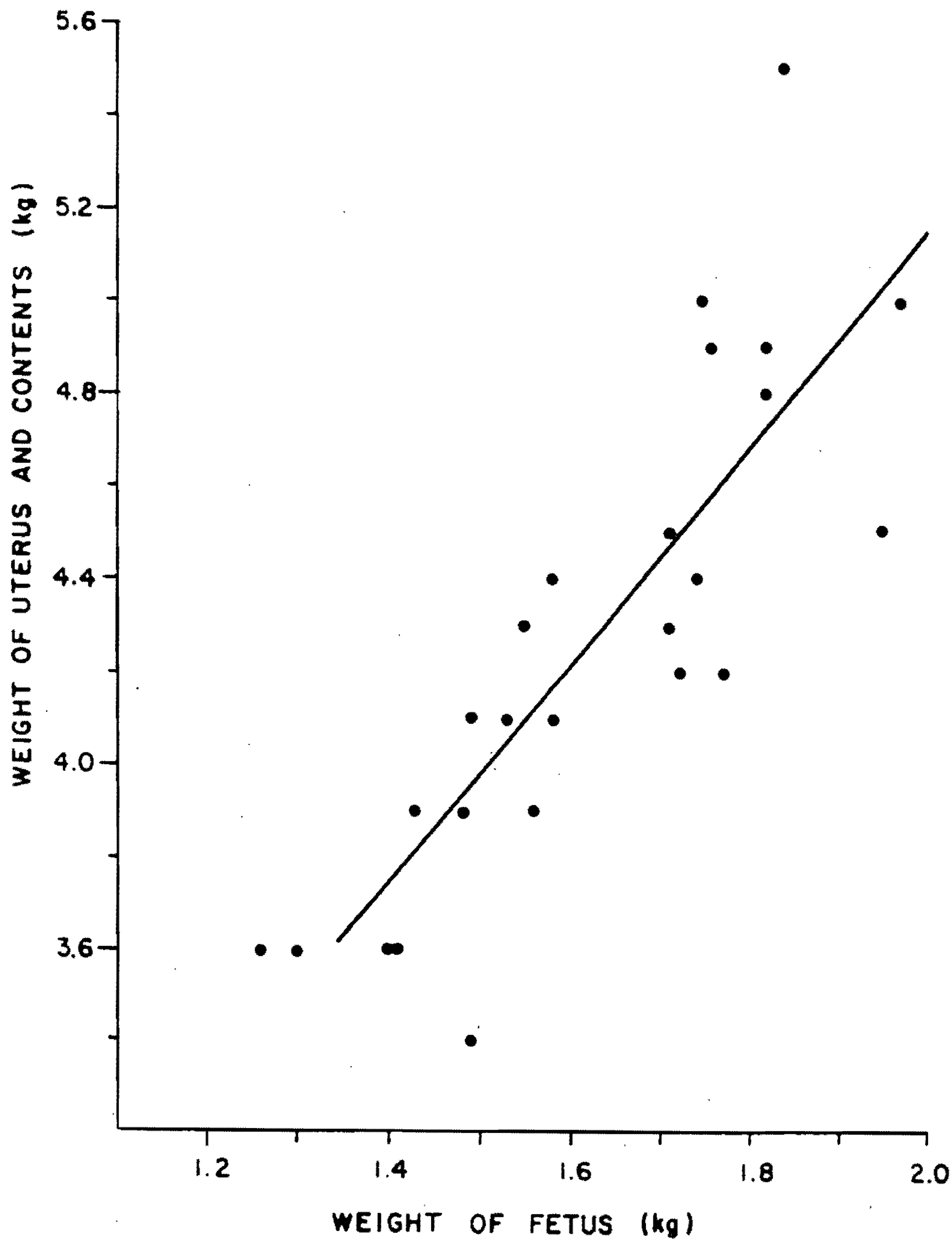

Figure 6. Regression of weight of uterus and its contents on weight of the associated fetus.

The nutritional state of breeding females may influence timing of the rut and growth of embryos in the first 7 weeks of pregnancy.

Over-winter changes in body weight

Average whole WTs of all females, regardless of reproductive status, in various age classes changed little from December to March in samples from individual winters (**Table 10**). Increases (*n* = 10) about equaled decreases (*n* = 11) where *n* >4 and only one difference was significant. Overall trends of weight changes in females in the five winters were slight declines in 1982-83 and 1983-84, a slight gain in 1984-85, and approximate stability in 1985-86 and 1986-87. The December 1983 sample was compared with the March 1984 sample obtained at Sifton Lake because they were from the same subherd (A), whose movements were monitored about monthly during winter 1983-84. Pooled data for females >4 years old revealed stability or slight declines in weight in 1982-83, 1985-86, and 1986-87; an increase in 1984-85; and a decline in 1983-84 (subherd A) (App. 1 and 2; **Fig. 7**).

We compared over-winter changes in the WT of pregnant and non-pregnant females with March weights adjusted by the estimated weight of the uterus and its contents (**App. 4**): $y = 2.34x + 0.47$, where *y* was weight of the reproductive tract and *x* was weight of the fetus ($r = 0.84$, $P < 0.01$) (unpubl. data for the Kaminuriak herd from F.L. Miller). Where sample sizes were as least four, declines in weight outnumbered increases by 15 to 7 (**Table 11**) but only three differences were significant ($P < 0.05$).

Whole WTs of males generally decreased from December to March but not significantly (**Table 12**). The exception was winter 1983-84 when declines generally were large and significant for ages 2.5-3 and 3.5-4 years.

Table 10. Whole body weights of female caribou sampled from the Beverly herd each December and March from 1982-83 through 1986-87.

Age class (yr)	Month	Body weight (kg) 1982-1983 Mean	SE	*n*	1983-1984[1] Mean	SE	*n*	1984-1985 Mean	SE	*n*	1985-1986 Mean	SE	*n*	1986-1987 Mean	SE	*n*
0.5-1	Dec							47.5	2.5	2	36.8		1	40.8	4.3	2
	Mar	40.8	1.2	5				44.5	1.3	3	44.0	2.5	4			
1.5-2	Dec	60.9	2.6	8	54.6	1.6	7	65.3	1.3	6	69.2	2.2	4	69.5		1
	Mar	57.6	1.0	15	59.2	2.1	3	68.5	2.3	10	65.4	2.3	9	61.5	3.5	2
2.5-3	Dec	70.3	0.7	3	73.8	1.7	6	74.3	3.4	7	76.6	1.9	6	74.2	2.2	8
	Mar	71.7	1.8	12	76.8	3.8	2	80.3	1.6	22	78.0	2.3	14	75.7	3.9	7
3.5-4	Dec	80.6	1.4	6	79.1	3.6	5	83.9	2.1	11	81.8	1.6	13	83.6	2.1	6
	Mar	76.4	2.6	11	76.4	1.6	5	83.2	1.7	20	80.4	2.2	15	70.6	2.6	5
4.5-5	Dec	79.4	3.7	4	81.0	3.3	4	83.4	3.5	5	83.5	3.7	4	84.8	3.3	8
	Mar	74.7	5.0	6	78.0		1	87.6	2.0	10	83.7	2.5	10	80.5	2.8	8
5.5-11	Dec	81.8	1.6	21	81.4	2.0	16	88.5	1.4	15	87.2	1.7	18	78.6	2.0	11
	Mar	80.5	1.0	44	77.7	2.5	8	89.2	0.9	49	86.1	1.2	42	81.4	1.9	21
>11	Dec	77.7	2.4	3	83.5	2.5	2	85.5	2.8	6	84.8	3.3	6	85.8	1.8	2
	Mar	82.3	2.4	8				91.7	2.4	10	86.4	1.6	8			
>2.5	Dec	81.0	1.1	34	81.3	1.4	27	86.1	1.1	37	85.0	1.1	41	82.3	1.4	27
	Mar	79.6	0.9	69	77.3	1.4	14	88.1	0.8	89	84.9	0.9	75	79.9	7.5	34
>3.5	Dec	80.8	1.3	28	81.5	1.5	22	86.7	1.2	26	86.2	1.4	28	81.6	1.7	21
	Mar	80.2	1.0	58	77.7	1.8	9	89.5	0.8	69	85.9	0.9	60	81.2	1.5	29

[1] March data for Sifton Lake sample (subherd A).

Figure 7

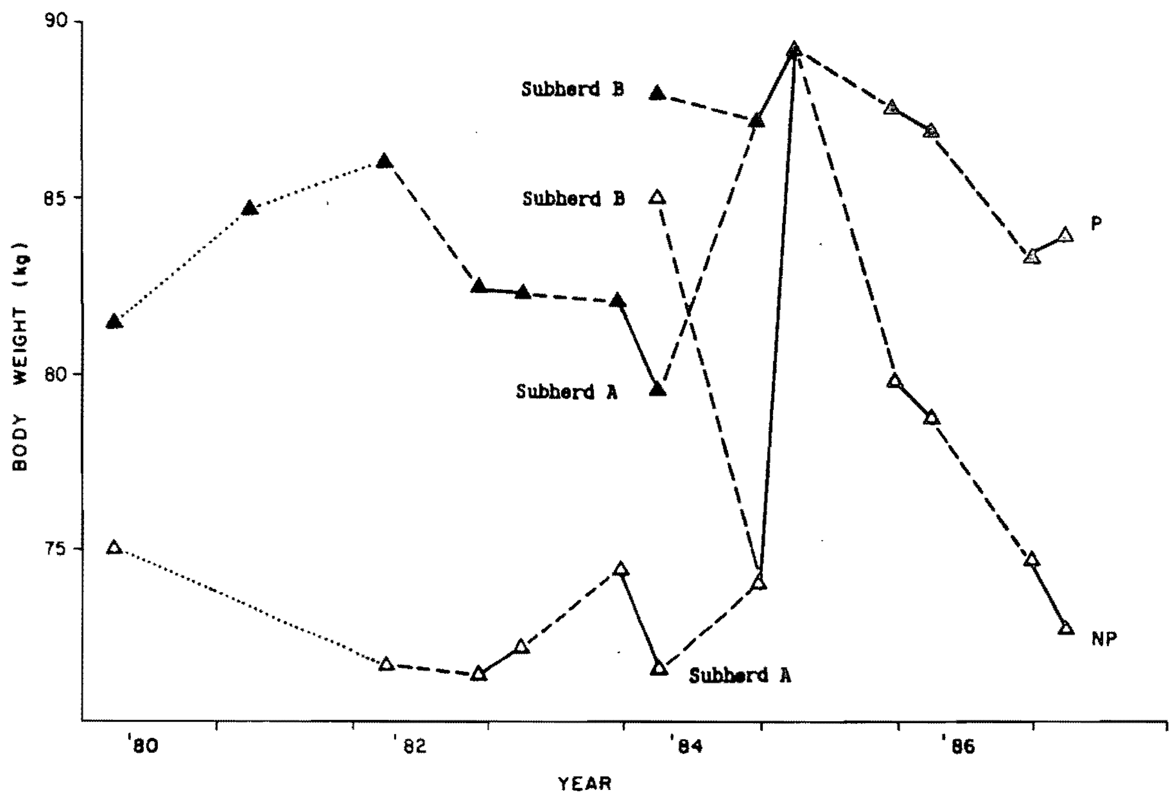

Figure 7. Mean body weight of pregnant and non-pregnant female caribou >4 years old sampled from the Beverly herd in December (1982-86) and March (1980-87).

Table 11. Over-winter changes in mean weights of pregnant (P) and non-pregnant (NP) female caribou sampled from the Beverly herd each winter from 1982-83 through 1986-87.

			Body weight (kg)[1]						Significance	
	Age class		December			March				
Winter	(yr)	State[2]	Mean	SE	*n*	Mean	SE	*n*	*t*	*U*[3]
1982-83	3.5- 4	P	80.6	1.4	6	78.6	3.1	8	NS	NS
	5.5-11	P	82.9	1.5	19	78.9	1.0	36	NS	NS
1983-84	3.5- 4	P	79.0	4.6	4	72.3	1.5	5	NS	NS
	5.5-11	P	83.0	1.7	12	73.6	2.3	8	*P***	NS
1984-85	2.5- 3	P	77.8	3.4	5	79.0	1.6	19	NS	NS
	3.5- 4	P	84.4	2.3	8	80.0	1.7	20	*P***	NS
	4.5- 5	P	83.4	3.5	5	83.7	2.0	10	NS	NS
	5.5-11	P	89.1	1.1	14	86.1	1.0	43	*P***	NS
	>11	P	85.7	2.8	6	88.6	2.5	9	NS	NS
1985-86	3.5- 4	P	82.1	2.0	9	79.6	1.6	12	NS	NS
	5.5-11	P	88.3	1.9	15	**83.8**	1.1	37	*P***	*P**
	>11	P	85.9	3.8	5	84.0	1.5	6	NS	NS
1986-87	2.5- 3	P	78.1	1.8	5	74.6	2.7	6	NS	
	4.5- 5	P	84.8	3.3	8	76.9	3.0	7	*P**	
	5.5-11	P	80.8	2.2	7	81.2	1.4	15	NS	
1982-83	1.5- 2	NP	60.1	2.9	7	57.6	1.0	15	NS	NS
1984-85	1.5- 2	NP	65.2	1.6	5	63.3	2.6	6	NS	NS
1985-86	1.5- 2	NP	69.2	2.2	4	65.4	2.3	9	NS	NS
1986-87	5.5-11	NP	74.8	3.3	4	72.5	3.1	6	NS	NS

[1] Adjusted for weight of the uterus and its contents. March 1984 data from subherd A sampled at Sifton Lake.
[2] P = pregnant; NP = not pregnant.
[3] Mann-Whitney U and Wilcoxon Rank Sum W tests.
* $P < 0.05$.
** $P < 0.01$.

Table 12. Whole body weights of male caribou sampled from the Beverly herd each December and March from 1982-83 through 1986-87.

Age class (yr)	Month	Body weight (kg)														
		1982 - 1983			1983 - 1984[1]			1984 - 1985			1985 - 1986			1986 - 1987		
		Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
0.5-1	Dec	42.0	2.2	5	44.1	1.4	7	47.1	0.3	4				40.5		1
	Mar	45.8	2.2	3				50.9	1.0	4	44.0		1			
1.5-2	Dec	65.6	3.3	7	67.0	2.1	6	76.3	3.7	5	69.1	1.5	6	66.3	1.8	2
	Mar	64.5	0.8	21	61.8	2.3	4	73.7	1.8	9	70.7	2.0	9	76.0		1
2.5-3	Dec	82.2	2.6	5	84.5	2.0	14	89.3	3.0	7	88.8	3.0	10	84.2	5.4	5
	Mar	79.8	1.6	19	71.8	2.5	6	86.0	2.1	19	80.6	1.6	15	79.8	8.6	2
3.5-4	Dec	94.9	2.4	7	102.8	2.9	6	100.9	3.2	5	98.1	2.8	6	105.0		1
	Mar	93.1	2.1	8	85.0	2.4	3	90.5	7.6	3	95.0	3.7	9	93.0		1
4.5-5	Dec	106.0	3.5	2	106.8	2.5	2	113.0	10.2	3	104.8	2.5	2	110.0	4.5	2
	Mar	95.0	0.6	3				115.8	3.8	2	100.1	1.1	7	102.5	7.5	2
>5	Dec	106.5	9.0	2				115.0		1	112.7	1.2	3			
	Mar	112.8	3.0	2	92.7	3.0	3	126.0		1	104.0	3.7	6	104.5		1

[1] March sample from subherd A sampled at Sifton Lake.

Yearly differences

A perusal of mean body weight statistics for December samples (App. 1) indicates increased weights in 8 of 11 age/sex classes from 1982 to 1983 but not in 5.5-10.5 year-old females, where sample sizes were largest. Average WTs increased from December 1983 to December 1984 in all but one age/sex class. However, differences were significant ($P < 0.05$) only in male calves, yearlings of both sexes, and 5.5-10.5 year-old females. Differences among 1984, 1985, and 1986 samples were slight with one exception: the 5.5-10.5 year-old females in 1986 were considerably lighter.

Data from collections in March of 1980 through 1987 (App. 2) indicated an upward trend in WTs from 1980 through 1982 and lower values from 1982 to 1983 in all age/sex classes where n >4. March 1984 data were complicated by samples from two subherds with large differences in WT statistics. Caribou obtained from subherd A at Sifton Lake were lighter but similar to the results from 1983. That subherd wintered in the forest-tundra ecotone north of the East Arm of Great Slave Lake. The Porter Lake sample (subherd B) indicated higher weights in 1984 compared with 1983 in all 13 age/sex classes and values similar to those obtained in 1982. That subherd spent late winter in the Manchester Lake area and, based on high fecundity (pregnancy rates), had larger energy reserves during the rut in the previous October. Average WTs in March 1985 were larger than in the 1984 Porter Lake sample in 11 of 13 classes. The March 1987 samples indicated a downward trend in all four classes where n >4 and an upward trend (8 of 11) if all the means were used, i.e., including all sample sizes.

Pooled samples from all December and all March collections revealed slight differences in weights for all sex/age classes (**Table 13**). We therefore combined

Table 13. Whole body weights of male and female caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Body weight (kg) December Mean	SE	*n*	March Mean	SE	*n*	All Mean	SE	*n*
F 0.5-1	42.8	2.3	5	42.4	0.7	31	42.4	0.6	36
M 0.5-1	44.2	0.9	17	**48.0***	0.8	22	46.3	0.7	39
F 1.5-2	61.9	1.4	26	61.7	0.9	65	61.8	0.8	91
M 1.5-2	68.9	1.4	26	67.0	1.0	64	67.5	0.8	90
F 2.5-3	74.4	1.1	30	76.9	0.8	87	76.2	0.7	117
M 2.5-3	86.2	1.3	41	**82.2***	0.8	100	83.4	0.7	141
F 3.5-4	82.3	0.9	41	**79.4***	1.0	65	80.5	0.7	106
M 3.5-4	99.3	1.4	25	**93.3****	1.5	32	95.9	1.1	57
F 4.5-5	83.0	1.5	25	83.4	1.1	57	83.3	0.9	82
M 4.5-5	108.6	2.6	11	**101.4***	1.8	21	103.9	1.6	32
F 5.5-11	83.8	0.9	81	85.2	0.5	256	84.9	0.4	337
M >5	111.2	2.5	6	108.1	2.0	28	108.6	1.7	34
F >11	84.1	1.5	19	87.2	1.2	37	86.1	1.0	56
F >2	82.0	0.6	196	83.0	0.4	502	82.7	0.3	698
F >3	83.4	0.6	166	84.2	0.4	415	84.0	0.3	581
F >4	83.7	0.7	125	85.1	0.4	350	84.8	0.4	475
F >5	83.9	0.7	100	85.5	0.4	293	85.1	0.4	393

* Differs from December mean, $P < 0.05$.
** Differs from December mean, $P < 0.01$.

samples from the two periods (**Table 14**) to facilitate among-winter comparisons.

The general changes among years in body weight of adult females (>4 years) were upward trends from March 1980 to March 1982 and from March 1983 to March 1985, and downward trends from March 1982 to March 1983 and from March 1985 to March 1987 (**Fig. 7**). A closer inspection of changes in body weights of adult females indicates relatively favorable non-winter periods (NWP) in 1980, 1983, and particularly in 1984. Relatively unfavorable NWPs included 1982, 1985, and 1986. From December to March, the average loss in weight of adult females was 0.6 kg. If slight over-winter decreases in total weight are normal, then winter 1984-85 was favorable and winter 1983-84 was unfavorable for subherd A that wintered north of Great Slave Lake. In adult females the largest changes in weight occurred during the NWP, suggesting that weight was influenced more by the NWP environment than the winter period.

Annual changes in body weight were simplified and sample sizes increased by combining December and March samples (**Fig. 8**). Annual changes were similar except that weights of young males in 1983-84 were depressed compared with those of females and the opposite condition prevailed in 1986-87. Males approaching 3 years of age in March 1980 were more than 5 kg lighter than in later years. Males 2.5-3 years old were the same weight as females over 3 years old (Fig. 8).

Back fat (BF)

Sex differences

Mean depths of BF were greater in females than in males in all 27 cases where n >4 (**Table 15**). The largest differences were in the 2.5-4 year age classes; the least in

Table 14. Weights of caribou sampled from the Beverly herd each winter from 1981-82 through 1986-87.

Sex/age (yr)	Whole body weight (kg) 1981-1982			1982-1983			1983-1984[1]			1983-1984[2]			1984-1985			1985-1986			1986 - 1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	42.6	1.1	13	40.8	1.1	5				41.8	0.9	4	45.7	1.1	5	42.6	2.1	5	41.0	4.0	2
M 0.5-1	50.1	1.3	7	43.4	1.6	8	44.1	1.3	7	44.6	0.9	11	49.0	0.8	8	44.0		1	41.0		1
F 1.5-2	59.4	1.7	13	58.8	1.1	23	56.0	1.3	10	59.4	1.8	19	67.3	1.5	16	66.6	1.7	13	64.7	3.2	3
M 1.5-2	66.7	2.0	12	64.8	1.1	28	64.9	1.6	10	65.0	2.2	15	74.6	1.1	14	70.1	1.3	15	70.0	3.6	3
F 2.5-3	75.2	2.3	8	71.4	1.4	15	74.6	1.4	8	78.0	1.2	19	78.8	1.5	29	77.6	1.7	20	75.1	2.1	15
M 2.5-3	85.7	1.2	27	80.3	1.3	24	80.7	2.0	20	80.7	1.8	27	86.9	1.7	26	84.0	1.6	25	83.1	4.1	7
F 3.5-4	74.3	2.1	2	78.0	1.8	17	77.8	1.8	10	78.5	1.6	13	83.5	1.3	31	81.0	1.3	28	77.9	2.6	11
M 3.5-4	96.0	5.0	2	93.8	1.5	15	96.9	3.4	9	97.9	2.4	13	97.0	3.4	8	96.2	2.3	15	99.0	6.0	2
F 4.5-5	81.8	2.4	10	76.6	3.1	10	80.3	2.4	5	84.7	1.8	17	86.2	1.7	15	83.6	1.9	14	82.9	2.2	16
M 4.5-5	95.0	3.4	3	99.3	2.7	5	106.8	0.3	2	105.8	4.0	5	114.1	5.1	5	101.2	1.1	9	106.5	4.3	4
F 5.5-11	86.4	1.0	35	80.8	0.9	65	86.3	1.0	60	85.3	1.0	68	88.9	0.8	64	87.2	1.6	60	80.7	1.4	32
F >11	88.3	4.3	6	81.0	1.9	11	86.8	2.1	7	86.8	2.1	7	89.4	1.9	16	85.5	1.5	14	86.0	2.0	2
F >4	85.4	0.9	50	80.3	0.8	86	80.4	1.3	31	85.3	0.8	91	88.6	0.7	95	86.1	0.8	88	81.6	1.1	50
F >5	86.3	0.9	40	80.8	0.8	76	80.4	1.4	26	85.4	0.9	74	89.0	0.7	80	86.5	0.8	74	81.0	1.3	34
M >4	96.7	2.9	4	103.9	2.8	9	98.3	3.6	5	106.5	3.7	12	115.9	4.0	7	104.0	1.6	18	105.9	2.9	5
M >5	101.8		1	109.6	3.9	4	92.7	3.0	3	107.0	5.6	7	120.5	3.9	2	106.9	2.7	9	105.0		1

[1] Subherd A samples obtained at Tent "2" and Sifton L.

[2] Subherd A and B (Porter L.) samples.

Figure 8

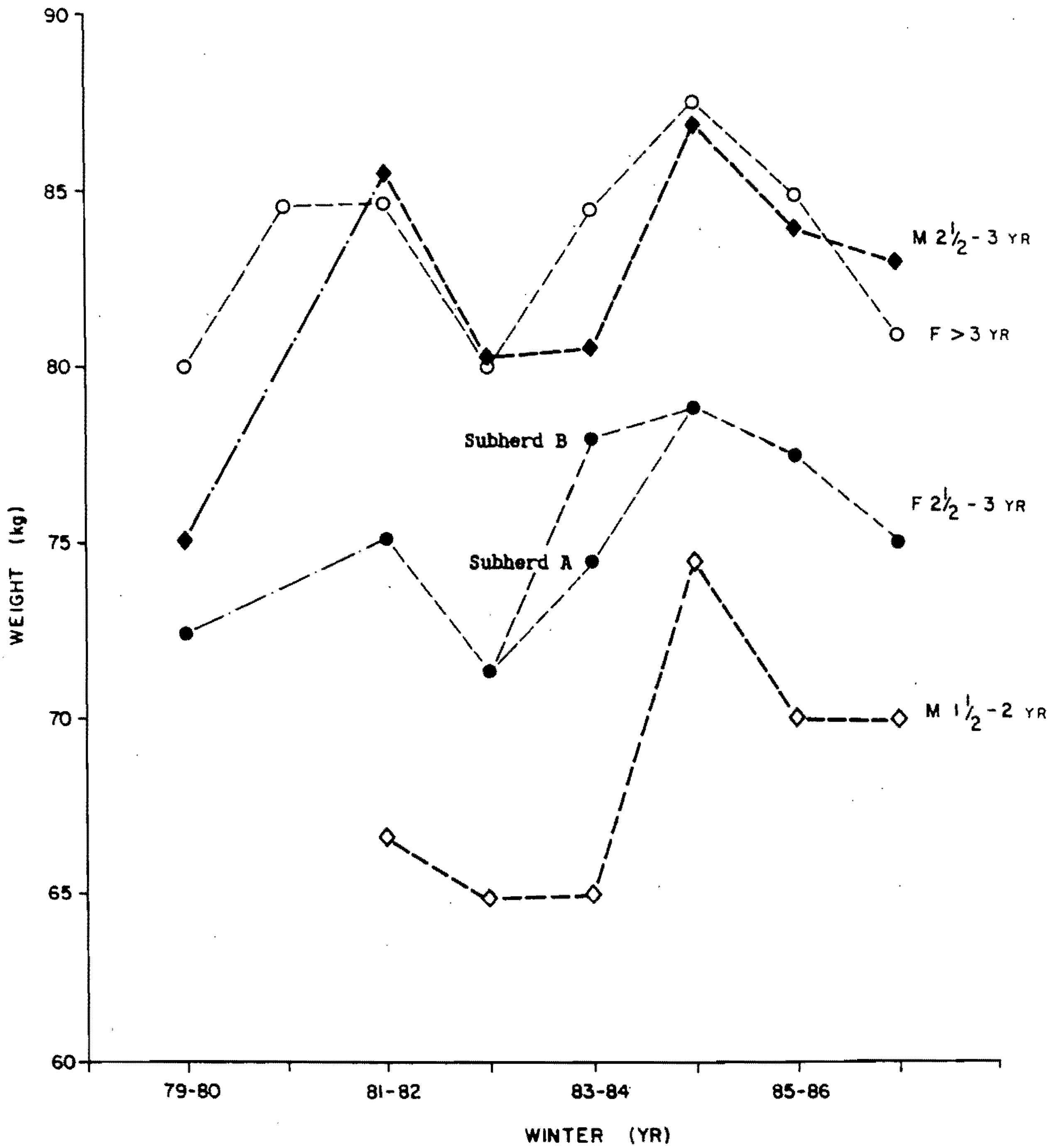

Figure 8. Mean body weights of four age classes of caribou sampled from the Beverly herd each winter from 1979-80 through 1986-87.

Table 15. Sex differences in mean depths of back fat of caribou sampled from the Beverly herd.

		Back fat depths (mm)[1]						
Age		Females			Males			
(yr)	Month/yr	Mean	SE	*n*	Mean	SE	*n*	Significance[2]
1	Mar 1982	1.2	0.4	13	0.4	0.2	7	NS
1.5	Nov 1982	5.0	1.7	8	**0.3**	0.2	6	$P < 0.05$
1.5	Dec 1983	6.7	2.2	7	**1.2**	0.6	6	$P < 0.05$
1.5	Dec 1984	8.8	2.4	6	**0.8**	0.4	5	$P < 0.05$
2	Mar 1982	2.8	0.9	12	1.3	0.5	11	NS
2	Mar 1983	1.9	0.5	15	1.2	0.4	23	NS
2	Mar 1984	8.0	3.0	9	1.2	0.5	5	NS
2	Mar 1985	7.4	1.9	10	**2.0**	1.0	9	$P < 0.05$
2	Mar 1986	3.7	0.8	9	1.9	0.5	9	NS
2.5	Dec 1983	13.3	4.4	6	**0.6**	0.1	14	$P < 0.001$
2.5	Dec 1984	20.9	4.1	7	**1.3**	0.5	7	$P < 0.01$
2.5	Dec 1985	8.8	4.2	6	**1.1**	0.2	11	$P < 0.01$
2.5	Dec 1986	10.9	3.7	8	**0.4**	0.2	5	$P < 0.01$
3	Mar 1980	4.0	2.0	10	0.4	0.2	5	NS
3	Mar 1982	17.9	4.7	7	**1.1**	0.3	26	$P < 0.001$
3	Mar 1983	8.9	2.9	12	**0.4**	0.2	18	$P < 0.01$
3	Mar 1984	19.7	3.3	11	**1.8**	0.6	6	$P < 0.001$
3	Mar 1985	18.0	1.7	22	**3.1**	0.6	19	$P < 0.001$
3	Mar 1986	10.3	2.1	14	**2.1**	0.5	15	$P < 0.01$
3.5	Dec 1983	14.6	5.7	5	3.0	1.6	6	NS
3.5	Dec 1984	19.5	2.9	11	**0.6**	0.4	5	$P < 0.001$
3.5	Dec 1985	9.9	2.3	13	**1.3**	0.3	6	$P < 0.01$
4	Mar 1983	12.5	2.5	11	**0.3**	0.2	8	$P < 0.001$
4	Mar 1986	12.5	2.1	15	**3.8**	1.0	9	$P < 0.01$
5	Mar 1986	10.4	2.5	10	**4.1**	1.4	7	$P < 0.05$
6-11	Mar 1980	3.5	1.2	12	1.2	0.4	10	NS
6-11	Mar 1986	12.0	1.2	42	**4.7**	1.4	6	$P < 0.05$

[1] Minimum $n = 4$.
[2] Bold means differ significantly with Mann-Whitney U and Wilcoxon Rank Sum W tests. NS is not significant.

calves. Significant differences ($P < 0.05$) occurred in 4 of 8 comparisons in yearlings (1.5-2 years), in 9 of 10 comparisons of caribou 2.5-3 years old, and in 4 of 5 in the next age class. The high variability in females, particularly in those >4 years old, necessitated a large difference in the means and a large sample size before sex-related differences became significant.

Back fat depths vs. age

Average depths of BF in female caribou usually increased with age until 2.5-3.5 years and thereafter were similar but variable (**Fig. 9, App. 5 and 6**). In all five samples obtained in late November and December, there was a decrease in average depths from age 3.5 to 4.5 years. That reduction was attributed to the high energy demands on young females that produced successive calves at ages 3 and 4 years and probable higher early mortality of calves in females initially pregnant at age 2.5-3 years. Early loss of calves results in rapid recovery of energy reserves in mature females. Over the study period, pregnancy rates in females 2.5-3 years old and 3.5-4 years old averaged 72 and 80%, respectively, compared with 86% in the 4.5-5 year class.

Average BF depths in males in December usually ranged between 0 and 2 mm and reached a maximum of 5 mm (**Fig. 10**). About the same depths occurred in March of 1980, 1981, 1982, 1984A (subherd A), and 1987. In 1984B (subherd B), 1985, and 1986, fat depths increased with age in males and reached average depths of 14.3, 6.0, and 4.7 mm, respectively, in age class 5.5-11 years. Maximum average depth of 19.3 mm was recorded in four males >11 years old collected at Porter Lake in 1984 (subherd B).

Over-winter changes in depths of back fat

Trends in depths of BF from November 1982 to March 1983 were decreases in

Figure 9

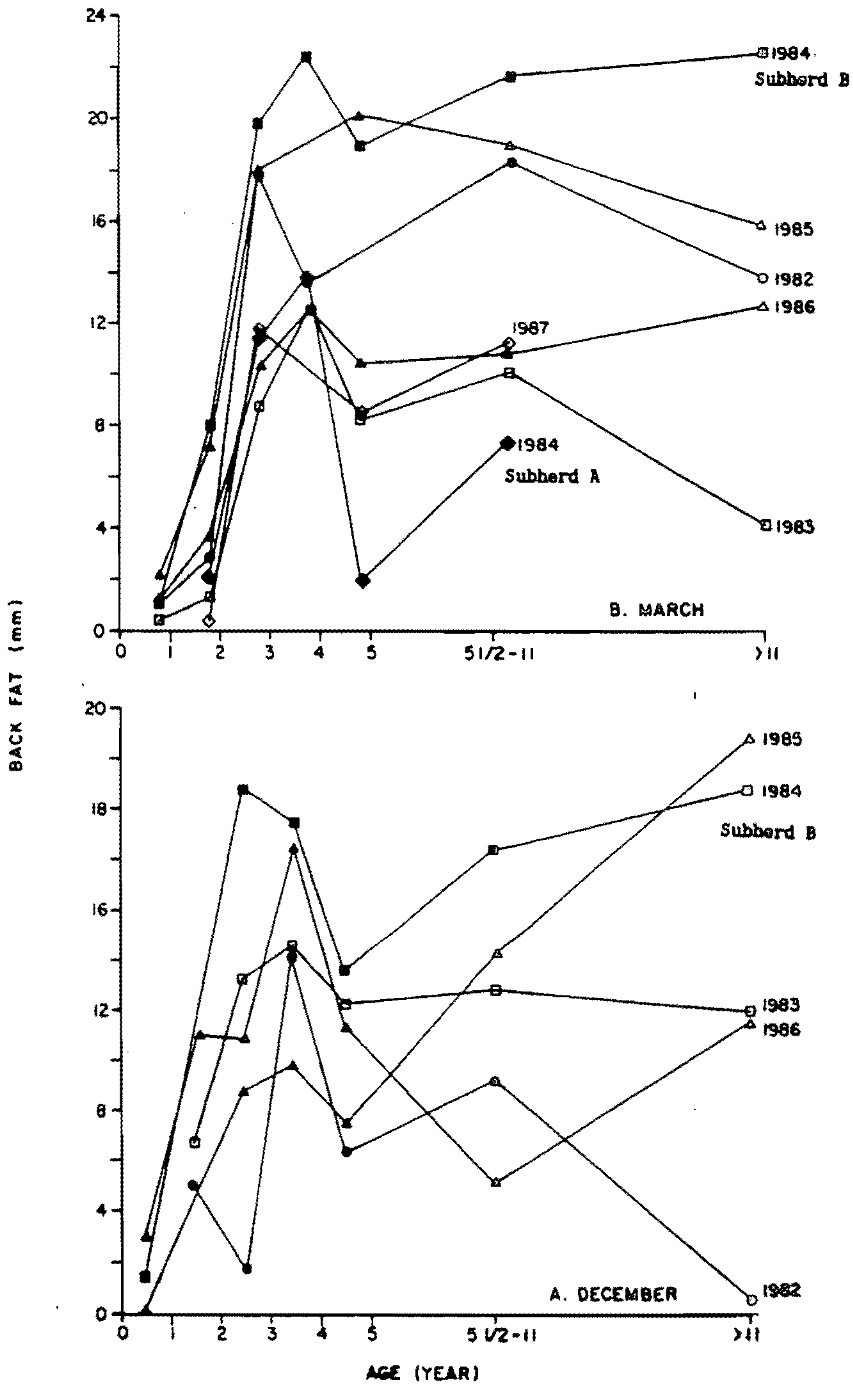

Figure 9. Mean back fat depths of female caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Figure 10

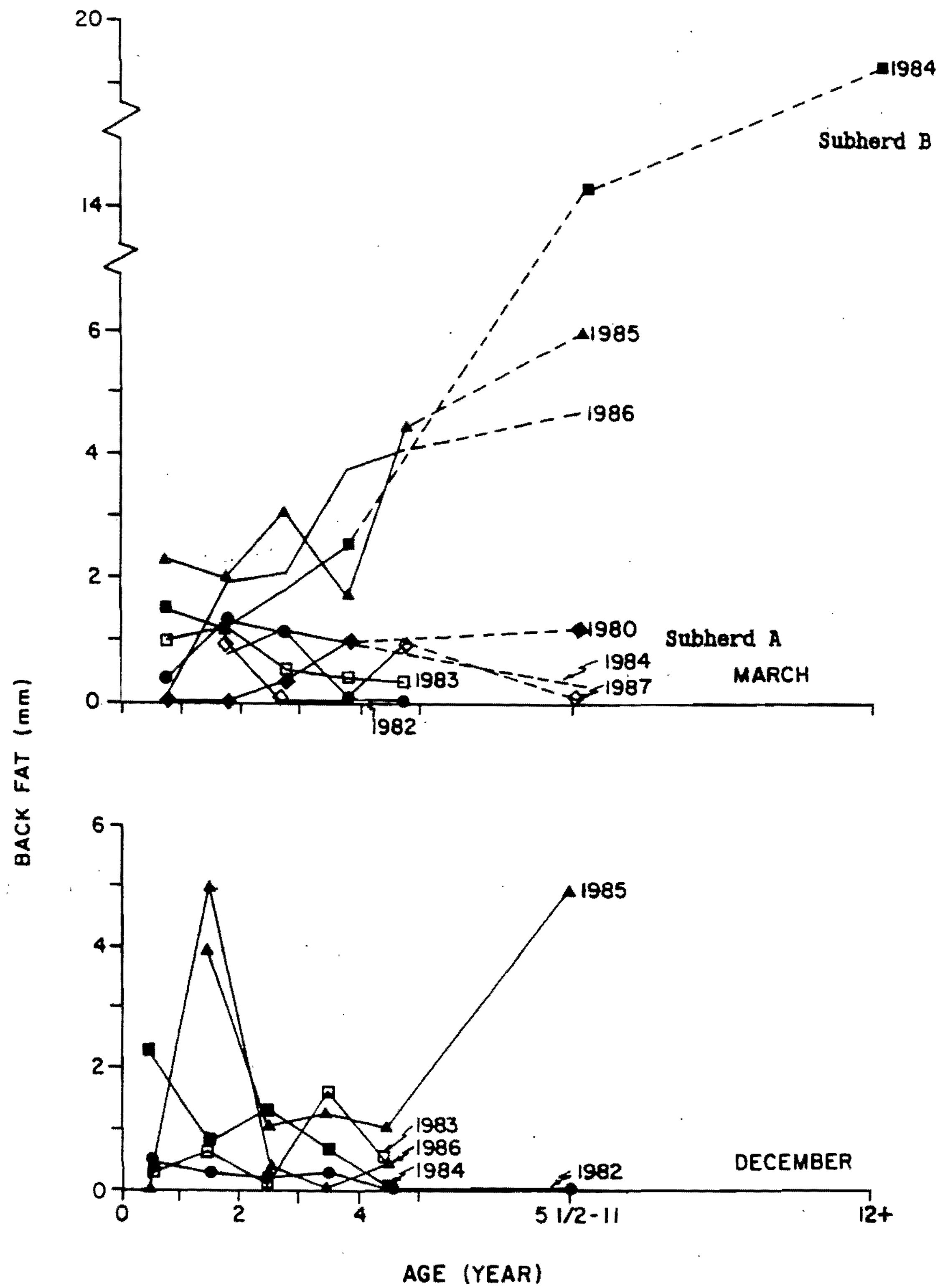

Figure 10. Mean back fat depths of male caribou in December (1982-86) and March (1980-87) in six age classes.

females aged 1.5-2 to 4.5-5 years and increases in older females (App. 5 & 6). Depths increased in all five age classes of males for which there were data (App. 5). The only significant differences in seasonal comparisons where minimum $n = 4$ (**Tables 16** and **17**) were in females 3.5-4 years old in 1986-87, yearling males in 1984-85, and males 3.5-4 years old in 1985-86 ($P < 0.05$).

Trends in BF depths from December 1983 to March 1984 were unreliable because of the small sample obtained in March from subherd A at Sifton Lake and the possibility of other caribou mixing with subherd A during the winter. Decreases occurred in seven of eight age classes, including females 5.5-11 years old, the largest sample. Changes were small in all age classes except in females over 4 years old.

From December to March in winter 1984-85, BF reserves decreased in four of six age classes of females (Table 16). Changes were slight in all classes except for rather large, yet insignificant increases in females 4.5-5 years old and decreases in those over 11 years old. Average BF depths remained about stable from December to March in males to 4 years of age (Table 17).

Over winter 1985-86, changes in BF reserves of females were insignificant in all age classes. Declines in three age classes were counterbalanced by increases in three. The largest change was in females >11 years, where average depths declined from 23 to 11 mm. The former value was atypical when compared with an average of 14.3 mm in females 5.5-10.5 years old.

Table 16. Over-winter changes in the depths of back fat in female caribou sampled from the Beverly herd, 1982-83 through 1986-87.

Winter	Age class (years)	Back fat depth (mm) December Mean	SE	n[1]	March Mean	SE	n[1]
1982-83	1.5 - 2	5.0	1.7	8	**1.9**[2]	0.5	15
1982-83	3.5 - 4	17.5	5.1	4	12.5	2.5	11
1982-83	4.5 - 5	5.3	3.9	4	8.2	4.8	6
1982-83	5.5 - 11	9.2	2.0	22	10.1	1.2	45
1983-84[3]	3.5 - 4	14.6	5.7	5	13.8	1.3	4
1983-84[3]	5.5 - 11	12.9	3.0	16	**7.5***	3.3	8
1984-85	1.5 - 2	8.8	2.4	6	7.4	1.9	10
1984-85	2.5 - 3	20.9	4.1	7	18.0	1.7	22
1984-85	3.5 - 4	19.5	2.9	11	18.9	1.9	20
1984-85	4.5 - 5	16.6	5.2	5	20.1	2.0	10
1984-85	5.5 - 11	18.3	3.2	16	19.0	1.3	49
1984-85	>11	20.8	4.5	6	15.8	2.7	10
1985-86	1.5 - 2	4.3	2.0	4	3.7	0.8	9
1985-86	2.5 - 3	8.8	4.2	6	10.3	2.1	14
1985-86	3.5 - 4	9.9	2.3	13	12.5	2.1	15
1985-86	4.5 - 5	7.5	3.7	4	10.4	2.5	10
1985-86	5.5 - 11	14.3	2.1	18	12.0	1.2	42
1985-86	>11	22.8	5.2	6	**11.1***	2.6	8
1986-87	2.5 - 3	10.9	3.7	8	11.9	2.3	7
1986-87	3.5 - 4	18.5	4.3	6	**3.0***	2.3	5
1986-87	4.5 - 5	11.4	2.6	8	8.5	2.0	8
1986-87	5.5 - 11	5.2	1.5	11	**11.4***	1.9	20

[1] Minimum $n = 4$.
[2] Bold indicates significant difference (*=$P < 0.05$) between means for March & December.
[3] Sample from subherd A.

Table 17. Over-winter changes in depths of back fat in male caribou sampled from the Beverly herd, 1982-83 through 1986-87.

Winter	Age class (years)	Back fat depth (mm) December Mean	SE	n[1]	March Mean	SE	n[1]	Significance[2]
1982-83	1.5 - 2	0.3	0.2	6	1.2	0.4	21	NS
1982-83	2.5 - 3	0.2	0.2	5	0.4	0.2	18	NS
1982-83	3.5 - 4	0.3	0.3	7	0.5	0.2	8	NS
1983-84[3]	1.5 - 2	1.2	0.6	6	0.8	0.3	4	NS
1983-84[3]	2.5 - 3	0.6	0.1	14	1.2	0.6	6	NS
1984-85	0.5 - 1	2.3	1.3	4	2.3	1.3	4	NS
1984-85	1.5 - 2	0.8	0.4	5	**2.0**	1.0	9	$P < 0.05$
1984-85	2.5 - 3	1.3	0.5	7	3.1	0.6	19	NS
1985-86	1.5 - 2	4.0	0.8	6	1.9	0.5	9	NS
1985-86	2.5 - 3	1.1	0.2	11	2.1	0.5	15	NS
1985-86	3.5 - 4	1.3	0.3	6	**3.8**	1.0	9	$P < 0.05$

[1] Minimum $n = 4$.
[2] NS = not significant.
[3] Subherd A.

Once again, there was no distinct trend in BF depths from December 1986 to March 1987. Declines occurred in two of four age classes of females (Table 16). A significant decline ($P < 0.05$) in females 3.5-4 years old was countered by a significant ($P < 0.05$) increase in BF in females 5.5-11 years old. Males had virtually no mantle fat in December and they failed to recover any fat during the winter. Males with cast antlers, and therefore >3 years old, that wintered south of Snowdrift, and were sampled by Arctic College in March, had BF depths of 14 to 25 mm (mean = 17.0 $\pm$ 1.4 (SE), $n = 7$) (Gainer pers. commun.).

The general picture of changes in BF depth from December to March in the five winters was stability in females and slight increases in males (**Fig. 11**). A review of all data where the sample size was four or greater revealed 13 declines and 9 increases in females (Table 16). Most of the changes were small. Only two declines and one increase were significant ($P < 0.05$). Females in the 5.5-11 years class had stable BF over winter except in 1986-87. The significant difference found in that comparison was attributed to chance sampling of relatively small and thin females in December 1986. Their weights and fat reserves were atypically low when compared with other age/sex classes in the sample.

Increases in BF depths in young males outnumbered decreases by seven to two (Table 17). Prime (>4 years) males were rare in our samples because most of them winter separately from the others. A look at data for March 1980 and March 1984 (App. 5) indicate poor recovery of back fat in some winters and excellent recovery in others. The data for the March 1984 sample obtained at Porter Lake indicate that over-winter recovery of fat in males >4 years was much better than in younger males. Changes in fat depths from December to March in females >2 years old and in males

Figure 11

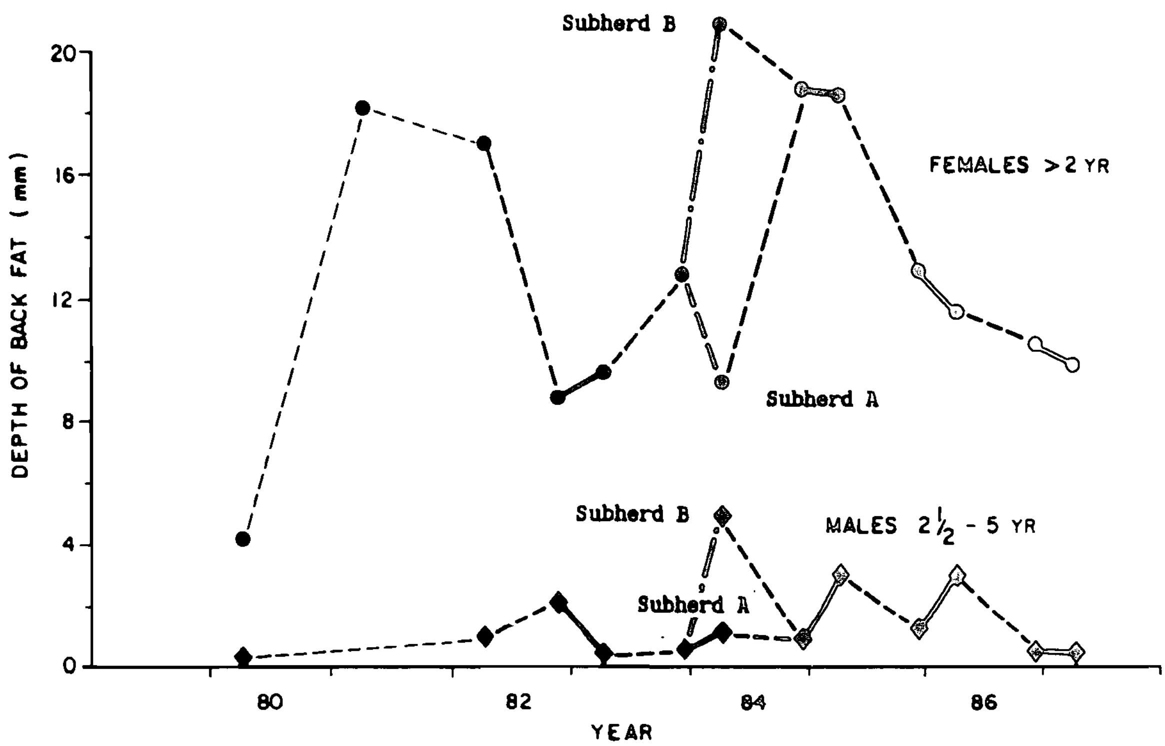

Figure 11. Mean back fat depths of female caribou >2 years old and males 2.5-5 years old in samples from the Beverly herd each December (1982-86) and March (1980-87).

2.5-5 years indicate general trends over the five winters (Fig. 11).

Annual changes

In December, the three sex/age classes (M 2.5, F 3.5, and F 5.5-10.5 years) that contained at least four individuals in each sample suggested the following ranking of annual BF depths, highest to lowest: 1984, 1985, 1983, 1982, and 1986. In March samples, the only sex/age class represented in all 8 years was females 6-11 years old. The ranking was 1984 (subherd B, Porter L.), 1981, 1985, 1982, 1986, 1987, 1983, 1984 (subherd A, Sifton L.), and 1980. There was little difference among the first 4 years listed, and among the next three (where minimum $n = 4$), without exception, the poorest back fat reserves were in 1980. Grouped data for >1.5 year females collected in December (App. 5) suggests the following descending order of BF depths: 1984, 1985, and 1983 (all equal), 1986, and 1982. Similar groupings for March samples produced the following order: 1984 (subherd B, Porter L.) ≥1985 ≥1981 ≥1982 (all excellent); 1986 ≥1987 ≥1983 ≥1984 (subherd A, Sifton L.) (good); and 1980 (fair).

Among-year comparisons for females >2 years and males 3-5 years collected in March (**Fig. 12**) indicate large BF reserves in 1981, 1982, 1984 (subherd B, Porter Lake sample), and 1985 and relatively low reserves in 1980 and 1987 (males 3-5 years only).

Lack of differences from December to March in BF depths (**Table 18**) allowed us to pool data and enhance among-year comparisons (**Table 19**). Similarly, data for females 1.5-2 years and over 2 years old and for males 2.5-5 years old were pooled for the same reason. Trends in BF depths among the years were simplified (**Fig. 13**).

Figure 12

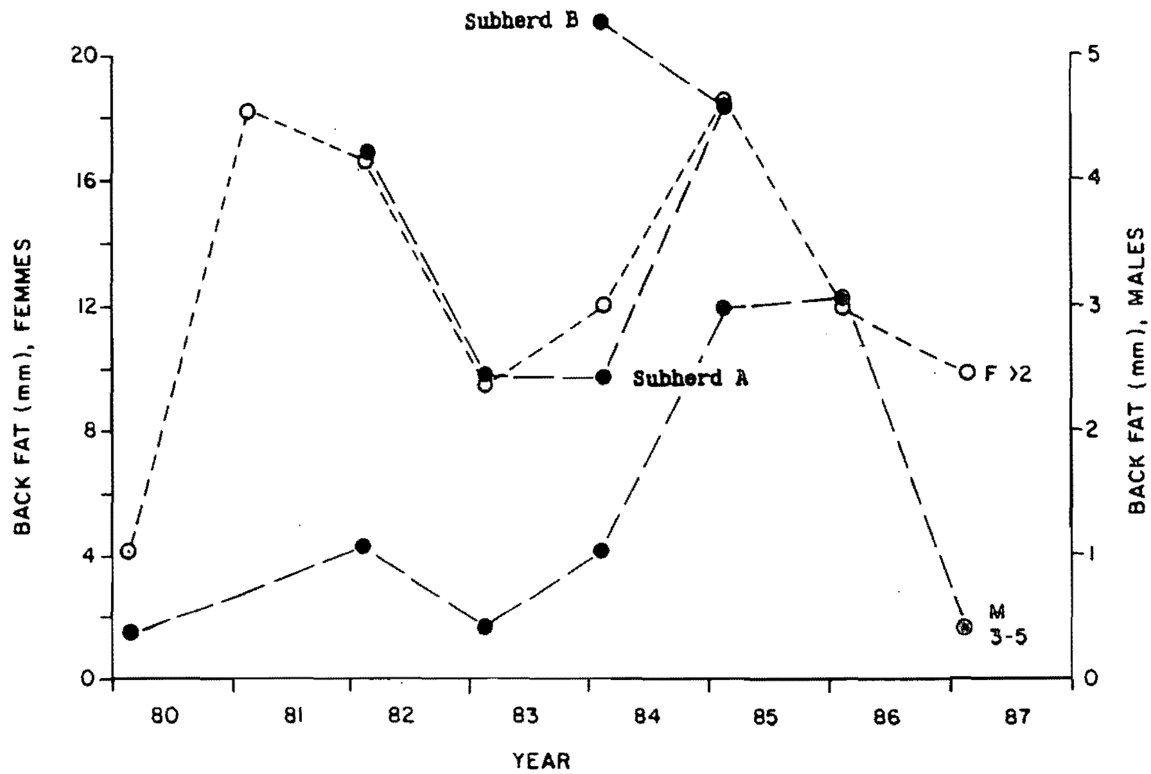

Figure 12. Mean back fat depths of female caribou >2 years old and males 3-5 years old that were sampled from the Beverly herd each March from 1980 through 1987.

Table 18. Depths of back fat in caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Back fat depth (mm)								
	December			March			All		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	1.8	1.0	5	1.0	0.2	31	1.1	0.2	36
M 0.5-1	1.1	0.4	16	1.0	0.3	24	1.0	0.2	40
F 1.5-2	6.5	1.0	26	**4.1***	0.6	65	4.7	0.5	91
M 1.5-2	1.9	0.5	25	1.4	0.2	67	1.5	0.2	92
F 2.5-3	12.4	2.0	30	13.1	1.0	87	12.9	0.9	117
M 2.5-3	0.8	0.1	42	**1.6****	0.2	98	1.3	0.1	140
F 3.5-4	15.3	1.6	39	14.5	1.1	66	14.8	0.9	105
M 3.5-4	1.2	0.4	25	1.8	0.4	32	1.5	0.3	57
F 4.5-5	10.4	1.6	25	13.9	1.2	57	12.8	1.0	82
M 4.5-5	0.4	0.1	11	**4.0***	1.4	21	2.8	1.0	32
F 5.5-11	12.1	1.2	82	**15.0***	0.6	260	14.3	0.6	342
M >5	2.5	1.4	6	4.8	1.4	28	4.4	1.2	34
F >11	17.2	2.8	18	13.0	1.5	37	14.4	1.4	55
F >2	13.1	0.8	194	14.3	0.4	507	14.0	0.4	701
F >5	13.0	1.1	100	14.7	0.6	297	14.3	0.5	397

* Differs from December mean, $P < 0.05$.
** Differs from December mean, $P < 0.01$.

Table 19. Mean depths of back fat in caribou sampled from the Beverly herd each winter from 1982-83 through 1986-87.

Sex/age class (yr)	Depth of back fat (mm) in winter																	
	1982 - 1983			1983 - 1984[1]			1983 - 1984[2]			1984 - 1985			1985 - 1986			1986 - 1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	0.3	0.2	4				1.0	0.0	4	1.8	0.2	5	1.0	0.3	5	3.0	2.1	2
M 1.5-1	0.7	0.3	7	0.9	0.3	7	1.1	0.3	11	2.3	0.8	8	0		1	0		1
F 1.5-2	3.0	0.7	23	5.4	1.6	10	6.6	1.6	19	7.9	1.4	16	3.8	0.8	13	4.0	2.9	3
M 1.5-2	1.0	0.3	27	1.0	0.4	10	1.1	0.3	15	1.6	0.3	14	3.3	0.6	15	3.7	2.2	3
F 2.5-3	7.5	2.3	15	12.6	3.1	8	16.7	1.8	19	18.7	1.6	29	9.9	1.8	20	11.3	2.1	15
M 2.5-3	0.4	0.1	23	0.8	0.2	20	1.0	0.2	27	2.6	0.5	26	1.7	0.3	26	0.3	1.7	7
F 3.5-4	13.8	2.2	15	14.7	2.6	10	16.9	2.6	12	19.1	1.5	31	11.3	1.5	28	11.5	3.3	11
M 3.5-4	0.4	0.2	15	2.3	1.0	9	2.4	0.8	13	1.0	0.4	8	2.8	0.6	15	0	0	2
F 4.5-5	7.0	3.0	10	10.2	2.8	5	16.3	2.1	17	17.9	2.2	15	9.6	2.0	14	9.9	1.6	16
M 4.5-5	0.2	0.2	6	0.5	0.4	2	8.8	4.6	5	1.8	1.2	5	3.4	1.1	9	0.8	0.4	4
F 5.5-11	9.8	1.0	67	11.1	2.3	24	17.8	1.3	67	18.8	1.3	64	12.7	1.1	60	9.2	1.4	31
M >4.5	1.3	0.8	4	0.3	0.3	3	11.1	11.1	7	3.0	2.1	2	4.8	1.1	9			
F >11	3.4	1.3	10	12.0	0.7	2	19.4	2.9	7	17.7	2.3	16	16.1	2.9	14	11.5	6.0	2
F >2	9.2	0.8	117	12.0	1.4	49	17.4	0.9	122	18.6	0.8	155	12.0	0.7	136	10.2	1.0	75
M >2	0.4	0.1	48	1.1	0.3	34	3.5	0.9	52	2.2	0.4	41	2.7	0.4	59	0.4	0.2	14
M 2.5-5	0.4	0.1	44	1.2	0.3	31	2.3	0.7	45	2.2	0.4	39	2.3	0.3	50	0.4	0.2	13

[1] Samples from subherd A at Tent and Sifton lakes.

[2] Samples taken from Tent and Sifton lakes (subherd A) and Porter Lake (subherd B).

Figure 13

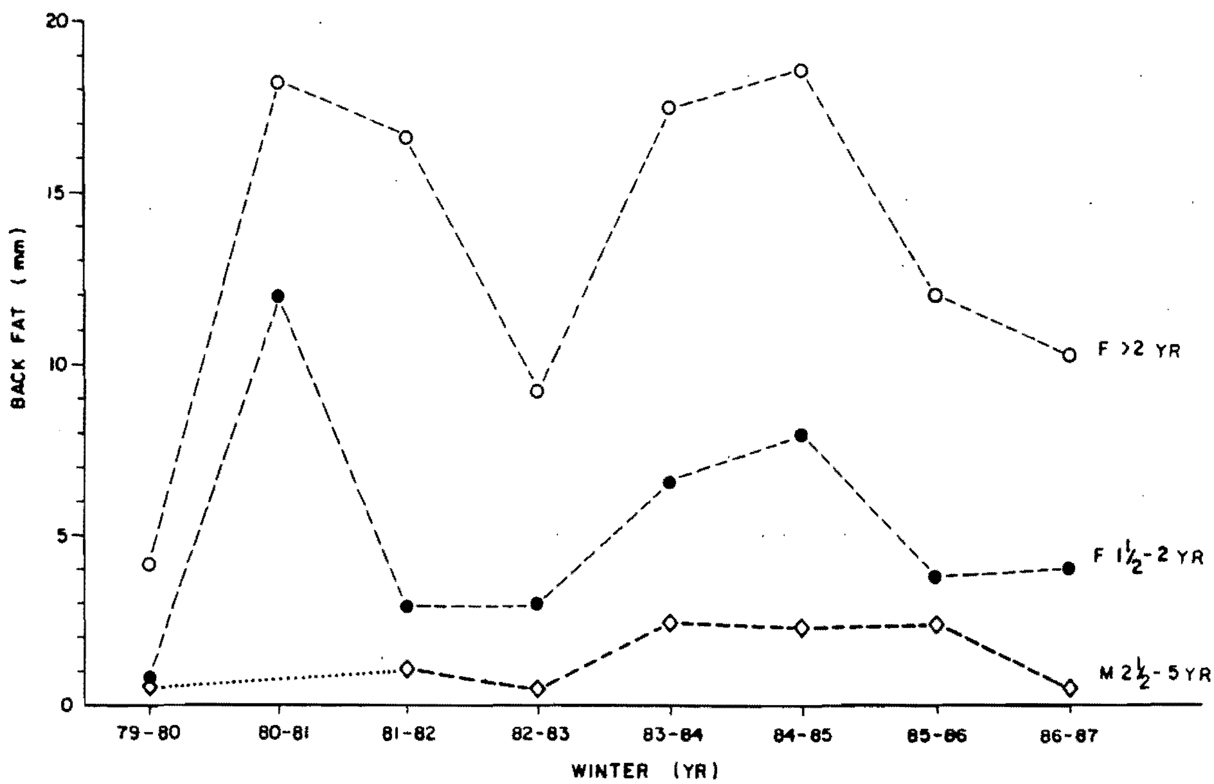

Figure 13. Mean back fat depths in three sex/age classes of caribou sampled from the Beverly herd each winter from 1979-80 through 1986-87.

Kidney fat and derived indices

Kidney fat (KF)

Sex differences in kidney fat

Analyses of data for KF (**App. 7 and 8**) where *n* >4 revealed that sex differences were age related (**Table 20**). Males had more kidney fat than females in the two samples of calves and one difference, in December 1983, was significant. Female yearlings had more KF than males in five of seven cases and differences were significant in four of those. Females 2.5-3 years had more KF than males in eight of nine cases and in seven of those the difference was significant ($P < 0.05$). A similar trend prevailed in older caribou. Few old males were obtained in the early-winter samples when differences between the sexes should be large. By March, those differences had narrowed in caribou over 4 years. Nevertheless, data for the two sexes should not be pooled at any age.

Age differences

Mean KF weight increased with age in females until age 2.7 years or 3.5 years (**Fig. 14**) depending on which sampling period was examined. It increased in males until age 3.5 years in December samples and age 4.7 years in March collections (**Fig. 15**). Mean weight differences between ages generally were significant until age 3 years where $n \geq 4$ (**Table 21**).

A consistent trend in December samples of females was successive decreases and increases in KF after age 3.5 years. Fat weights were higher in 3.5-year-old females than in those 4.5 year old in all five December samples and in three of four March samples where $n \geq 4$. Fat weights generally were higher and more variable in March than in December. Small decreases in KF occurred from age class 5.5-11 years to class >11 years in 9 of 10 samples (**App. 8**).

Table 20. Sex differences in the weight of fat around both kidneys of caribou in various age classes sampled from the Beverly herd from 1980 through 1987.

			Weight of kidney fat (grams)[1]						
			Females			Males			
Year	Month	Age	Mean	SE	*n*	Mean	SE	*n*	Significance
1983	Dec	0.5	31.4	3.3	7	**52.4**[2]	6.0	7	$P < 0.05$
1982	Mar	1	29.3	3.7	9	32.5	3.3	7	NS
1982	Nov	1.5	48.8	9.6	6	**31.6**	2.7	6	$P < 0.05$
1983	Dec	1.5	52.7	11.7	6	99.8	17.6	6	$P < 0.05$
1982	Mar	2	48.2	3.5	9	**56.7**	3.5	9	$P < 0.01$
1983	Mar	2	46.9	2.8	15	40.6	3.2	21	NS
1984	Mar	2	73.4	12.2	9	**40.6**	5.1	5	$P < 0.05$
1985	Mar	2	79.3	10.9	10	**53.8**	4.6	9	$P < 0.01$
1986	Mar	2	51.1	5.8	9	42.6	4.0	9	NS
1983	Dec	2.5	52.9	4.8	14	**83.6**	16.0	5	$P < 0.01$
1984	Dec	2.5	79.3	14.0	7	**41.1**	2.5	7	$P < 0.01$
1985	Dec	2.5	55.3	9.2	5	39.7	3.4	11	NS
1986	Dec	2.5	76.1	18.7	8	42.9	2.8	5	NS
1980	Mar	3	57.8	7.6	9	**35.4**	5.4	5	$P < 0.01$
1982	Mar	3	95.8	6.9	7	**56.8**	5.0	22	$P < 0.01$
1984	Mar	3	109.4	10.4	11	**74.3**	7.1	6	$P < 0.01$
1985	Mar	3	115.9	8.0	22	**72.0**	4.1	19	$P < 0.001$
1986	Mar	3	93.1	12.4	14	**58.7**	5.1	15	$P < 0.001$
1982	Nov	3.5	88.0	8.1	6	**36.2**	4.5	7	$P < 0.001$
1984	Dec	3.5	79.0	7.7	11	**48.8**	7.3	5	$P < 0.01$
1985	Dec	3.5	66.1	9.6	13	55.0	2.9	6	NS
1983	Mar	4	81.3	8.7	11	**59.4**	5.4	10	$P < 0.01$
1986	Mar	4	88.5	7.3	15	**63.3**	7.1	9	$P < 0.001$
1986	Mar	5	92.2	12.3	10	75.6	6.0	7	NS
1980	Mar	6-11	72.5	3.9	12	65.5	6.8	10	NS
1986	Mar	6-11	101.3	5.6	42	**79.7**	8.6	6	$P < 0.01$

[1] Minimum $n = 5$.

[2] **Bold** indicates significant difference between means for males and females.

Figure 14

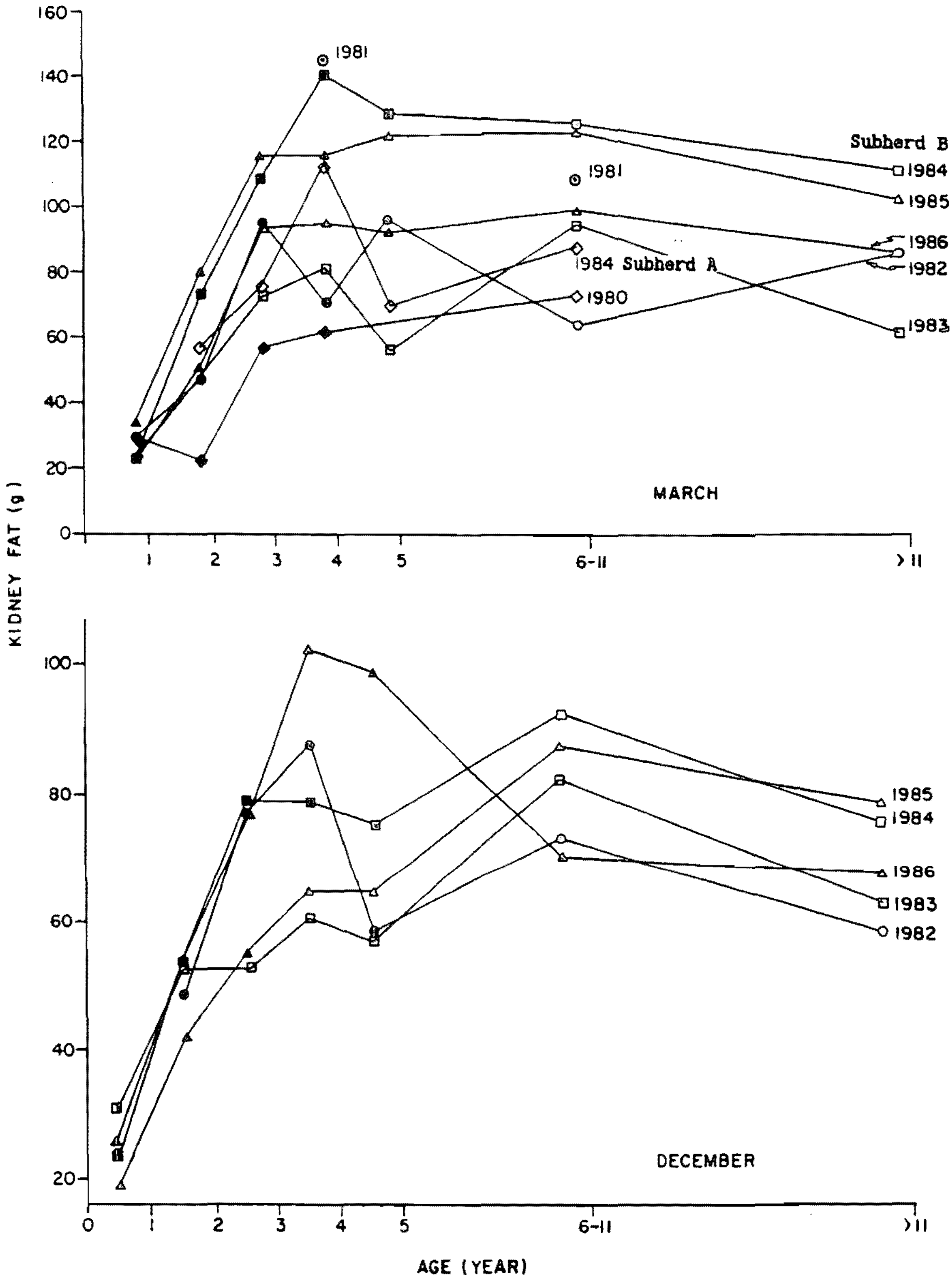

Figure 14. Mean kidney fat weights in age classes of female caribou sampled from the Beverly herd in December and March (1980-86).

Figure 15

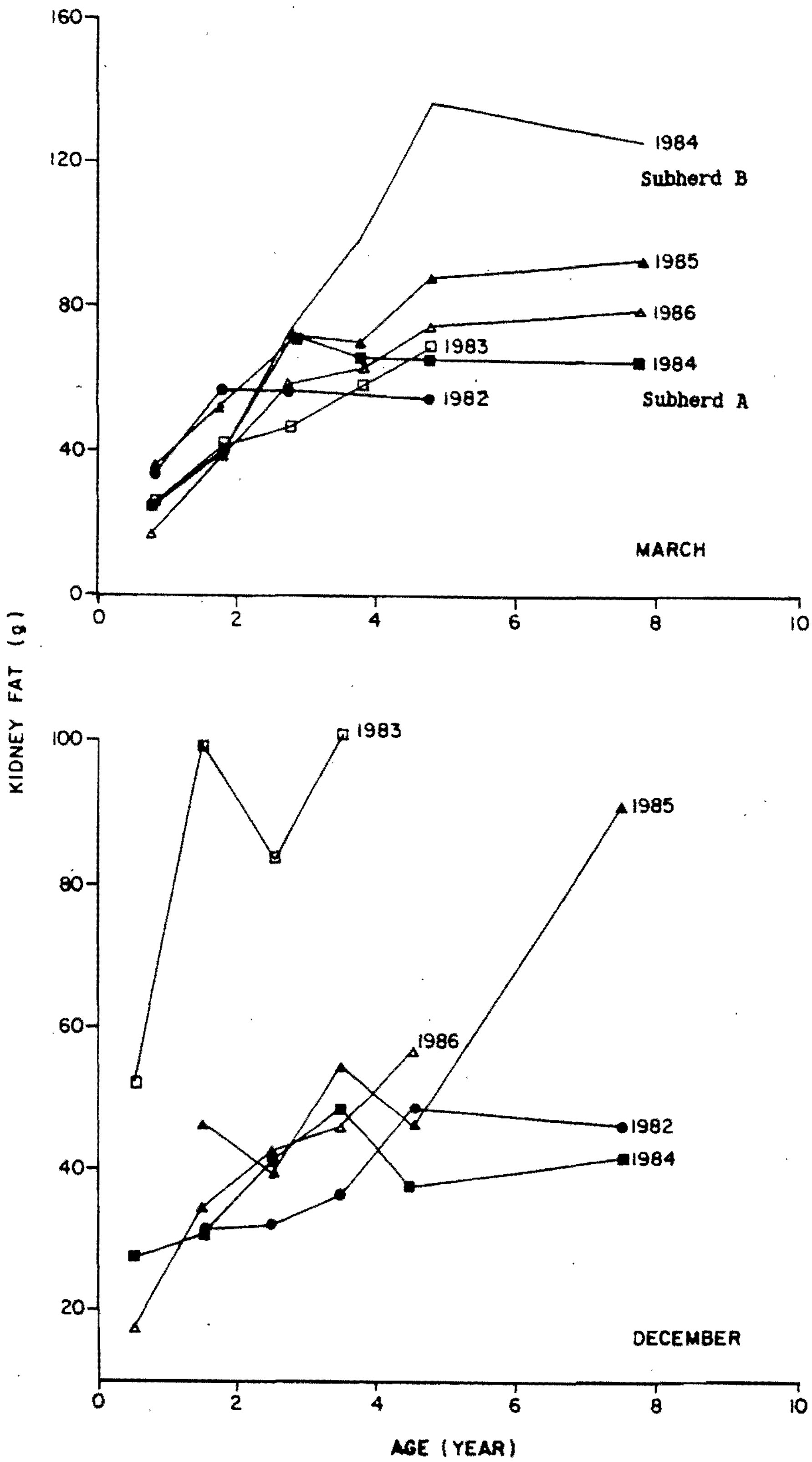

Figure 15. Mean kidney fat weights in age classes of male caribou sampled from the Beverly herd in December (1982-86) and March (1982-86).

Table 21. Significant differences in kidney fat weights between consecutive age classes in samples obtained from the Beverly herd in December (1982-86) and March (1980-87).

Year	Month	Sex	Age classes (years)	Kidney fat weight (g) Older age class Mean	SE	n[1]	Younger age class Mean	SE	n[1]	Significance
1983	Dec	M	2 > 1[2]	99.8	17.6	6	**52.4**[3]	6.0	7	$P < 0.01$
1982	Mar	F	2 > 1	48.2	5.0	9	**29.3**	3.7	9	$P < 0.001$
1982	Mar	M	2 > 1	56.7	3.5	9	**32.5**	3.3	7	$P < 0.001$
1983	Mar	F	2 > 1	46.9	2.8	15	**24.0**	3.3	4	$P < 0.001$
1984	Mar	F	2 > 1	73.4	12.2	9	**24.5**	3.5	4	$P < 0.001$
1986	Mar	F	2 > 1	51.1	5.8	9	**23.3**	4.3	4	$P < 0.001$
1982	Mar	F	3 > 2	95.8	6.9	7	**48.2**	5.0	9	$P < 0.001$
1983	Mar	F	3 > 2	74.7	10.7	12	**46.9**	2.8	15	$P < 0.001$
1984	Mar[4]	F	3 > 2	109.4	10.4	11	**73.4**	12.2	9	$P < 0.001$
1984	Mar[4]	M	3 > 2	74.3	7.1	6	**40.6**	5.1	5	$P < 0.001$
1984	Mar[5]	M	3 > 2	72.6	5.8	5	**40.5**	6.2	4	$P < 0.001$
1985	Mar	F	3 > 2	115.9	8.0	22	**79.3**	10.9	10	$P < 0.001$
1986	Mar	F	3 > 2	93.1	12.4	14	**51.1**	5.8	9	$P < 0.001$
1986	Mar	M	3 > 2	58.7	5.1	15	**42.6**	4.0	9	$P < 0.001$

[1] Minimum $n = 4$.
[2] 1.5 > 0.5 years.
[3] **Bold** indicates significant difference between age-class means.
[4] Sample from Porter Lake.
[5] Sample from Sifton Lake.

Over-winter changes in kidney fat

Comparisons of KF weights in December and March where $n \geq 4$ indicate over-winter increases of KF in females in most years (**Table 22**). There were significant increases in at least one age class in all five winters. In 1984-85, there were significant increases in all six age classes for which there were data. The high variability in KF weights ruled out significant differences except where the means were vastly different. Variation was reduced by comparing KF only in pregnant females between the two collection periods. For example, the difference between KF weights in December 1986 and March 1987 for females 4.5-5 years old was then significant ($P < 0.05$).

In males, there were significant increases in KF in 3 of the 4 years for which there were adequate samples (**Table 23**). There was a significant decline in KF of yearlings in the other year (1983-84). Over the 4 years, increases occurred in 7 of the 10 cases (6 significant) where $n \geq 4$ in each collection period.

Pooled data from all December and March samples indicate significant increases in KF from December to March after age 1 year in males and 2 years in females (**Table 24**).

Annual changes in kidney fat

Plotting of mean kidney fat weights by sex, age, and year (Figures 14 and 15) indicated that: (1) the first four age classes of females had lower KF than average in December 1985; (2) inconsistency among age classes of females in December 1983; (3) high values in females aged 3.5 and 4.5 years in December 1983; (4) consistently high values in females in March 1985 and March 1984 (subherd B,

Table 22. Over-winter changes in weight of kidney fat of female caribou sampled from the Beverly herd each winter from 1982-83 through 1986-87.

Year	Age class (yr)	Weight of kidney fat[1] (g) December Mean	SE	n^2	March Mean	SE	n^2	Significance
1982-83	1.5-2	48.8	9.6	6	46.9	2.8	15	NS
	3.5-4	88.0	8.6	6	81.3	8.7	11	NS
	5.5-11	75.4	5.2	22	**95.0**	5.7	44	$P < 0.001$
1983-84[3]	3.5-4	60.7	11.5	6	**113.3**	13.6	4	$P < 0.001$
	5.5-11	82.9	8.8	16	88.6	12.8	8	NS
1984-85	1.5-2	54.8	7.0	6	**79.3**	10.9	10	$P < 0.05$
	2.5-3	79.3	14.0	7	**115.9**	8.0	22	$P < 0.001$
	3.5-4	79.0	7.7	11	**116.5**	7.5	20	$P < 0.001$
	4.5-5	76.4	8.3	5	**121.9**	9.6	10	$P < 0.001$
	5.5-11	92.9	7.2	15	**123.2**	5.3	49	$P < 0.001$
	>11	75.8	15.1	6	**102.7**	9.0	10	$P < 0.05$
1985-86	1.5-2	42.2	6.8	4	51.1	5.8	9	NS
	2.5-3	55.3	9.2	5	**93.1**	12.4	14	$P < 0.05$
	3.5-4	65.1	9.6	13	**88.5**	7.3	15	$P < 0.001$
	4.5-5	65.0	15.6	4	92.2	12.3	10	NS
	5.5-11	88.0	7.9	16	**101.3**	5.6	42	$P < 0.001$
	>11	78.7	10.9	6	**107.5**	8.0	20	$P < 0.001$
1986-87	2.5-3	76.1	18.7	8	96.2	15.2	7	NS
	3.5-4	102.5	11.2	6	**58.3**	12.2	5	$P < 0.001$
	4.5-5	98.8	13.2	8	93.1	9.5	8	NS
	5.5-11	70.6	8.0	11	**98.3**	11.0	21	$P < 0.001$

[1] Riney's method.
[2] Minimum $n = 4$.
[3] Subherd A.

Table 23. Changes in weight of kidney fat of male caribou sampled from the Beverly herd each winter from 1982-83 through 1986-87.

		Kidney fat (grams)						
		December			March			
Winter	Age class (yr)	Mean	SE	n[1]	Mean	SE	n[1]	Significance
1982-83	1.5-2	31.6	2.7	6	**40.6**	3.2	21	$P < 0.001$
	2.5-3	32.3	2.9	5	**47.1**	4.0	4	$P < 0.001$
	3.5-4	36.2	4.5	7	**59.4**	5.4	10	$P < 0.001$
1983-84[2]	1.5-2	99.8	17.6	6	**40.5**	6.3	4	$P < 0.05$
	2.5-3	83.1	16.0	5	72.6	5.8	5	NS
1984-85	1.5-2	30.8	5.4	4	**53.8**	4.6	9	$P < 0.001$
	2.5-3	44.1	2.5	7	**72.0**	4.1	19	$P < 0.001$
1985-86	1.5-2	46.7	4.7	6	42.6	4.0	9	NS
	2.5-3	39.7	3.4	11	**58.7**	5.1	15	$P < 0.001$
	3.5-4	55.0	2.9	6	63.3	7.1	9	NS

[1] Minimun $n = 4$.
[2] Subherd A sampled at Sifton lake.

Table 24. Weight of fat around both kidneys of caribou sampled in December (1982-86) and March (1980-87).

Sex/age (yr)	Kidney fat weight (g) December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5-1	24.0	2.3	5	26.4	1.9	26	NS
M 0.5-1	27.8	2.0	16	30.5	2.4	23	NS
F 1.5-2	50.6	3.4	24	56.5	3.4	62	NS
M 1.5-2	40.2	3.5	25	**44.9**	1.8	63	$P < 0.05$
F 2.5-3	78.3	7.3	29	**94.8**	4.2	85	$P < 0.01$
M 2.5-3	44.0	2.6	42	**59.5**	2.1	96	$P < 0.05$
F 3.5-4	80.0	4.8	41	**100.1**	4.7	65	$P < 0.001$
M 3.5-4	49.4	2.7	25	**64.1**	4.0	31	$P < 0.01$
F 4.5-5	82.8	6.4	25	**106.1**	5.5	55	$P < 0.01$
M 4.5-5	48.5	3.6	11	**75.8**	9.6	20	$P < 0.05$
F 5.5-11	81.2	3.3	81	**107.3**	2.4	257	$P < 0.001$
M >5	68.2	12.0	6	**79.2**	4.9	28	$P < 0.05$
F >11	71.4	5.8	19	88.7	5.2	36	NS
F >2	79.8	2.3	195	**102.7**	1.7	498	$P < 0.001$
F >3	80.0	2.3	166	**104.4**	1.9	413	$P < 0.001$
F >5	79.3	2.9	100	**105.0**	2.3	273	$P < 0.05$

Porter L.); (5) high values in males in December 1983, in March 1984 (subherd B, Porter L.), and March 1985; and (6) relatively low values in March 1984.

Kidney fat weights in females >3 years old were relatively low in March 1980 and December 1982 and 1985 and high in March 1981, 1984 (subherd B, Porter Lake sample), and 1985 (**Fig. 16**).

In males >3 years old, relatively high KF weights were recorded in March 1985 and March 1986 and relatively low weights in November 1982 and November 1984.

Increases occurred in the KF of both sexes in all winters but particularly in 1984-85. Sharp decreases in KF occurred in the summers of 1982, 1984, 1985, and particularly in 1981, assuming an increase from December 1981 to 1982.

Kidney weights (KW)

The traditional kidney fat index (KFI) (Riney 1955) is the ratio of weights of trimmed fat around the kidneys and the kidneys expressed as a percentage:

KFI = (100 x weight of peri-renal fat/weight of kidneys). It is used in an attempt to avoid or reduce body size differences among age classes and even within an age class. Thus, comparisons can be made between males and females and between young and old animals. The kidney weights (KW) of specific sex and age classes must remain about constant from season to season and year to year if seasonal and annual comparisons are to be made. Dauphiné (1975, 1976) showed that seasonal variations occurred in his sample of kidneys from the Kaminuriak herd of caribou. We further investigated seasonal and annual changes.

*Seasonal kidney weights **(App. 9** and **10)***

A plot of KW of males 2.5-3 years old and females 5.5-11 years old (**Fig. 17**)

Figure 16

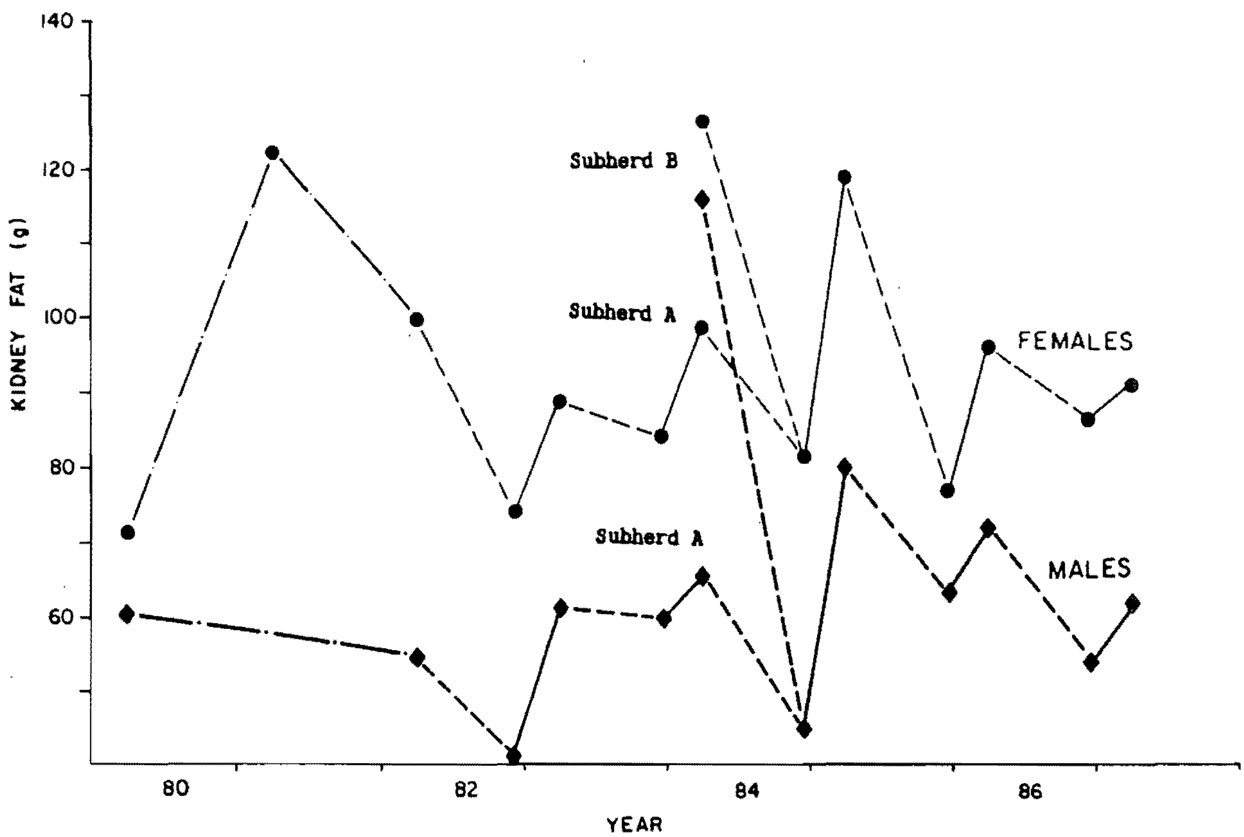

Figure 16. Mean kidney fat weights of female and male caribou >3 years old that were sampled in December (1982-86) and March (1980-87).

Figure 17

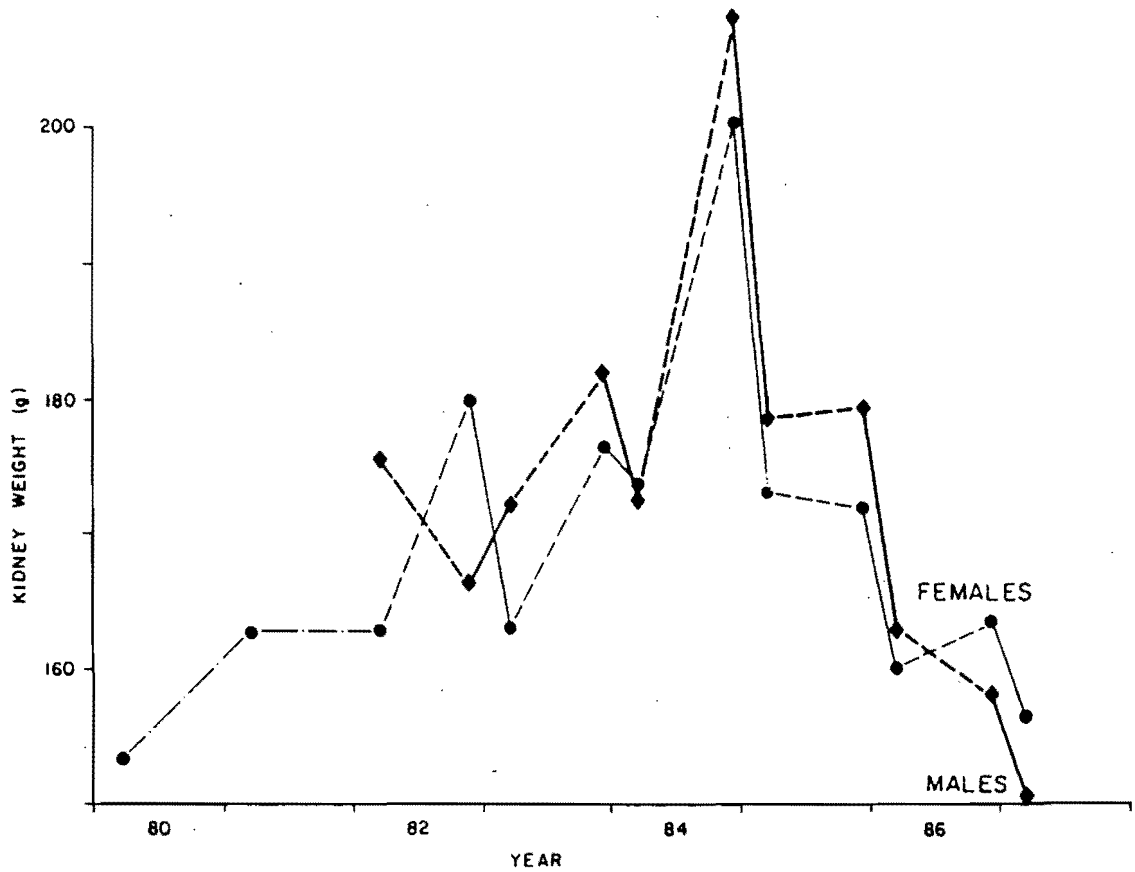

Figure 17. Mean kidney weights of male caribou 2.5-3 years old and females 5.5-11 years old that were sampled in December (1982-86) and March (1980-87).

indicated parallel upward then downward trends in kidney weights from 1980 through 1987. Those age classes had the largest sample sizes for each sex. Kidney weights decreased from November/December to March with one exception. Over-winter differences in 1982-83 (females only) and 1984-85 were significant. Data obtained in March 1984 from subherds A and B at Sifton and Porter lakes, respectively, were combined because the mean values for age classes were similar (e.g., females 6-11 years old: Porter sample 173 g, Sifton sample 177 g). The cause of seasonal and annual changes was unrelated to sex. Plots for other age classes revealed comparable trends.

The high November 1982 KW values in females perhaps could be attributed to the earlier collection period. Seasonal KW in caribou are known to peak in September and decline throughout the winter (Dauphiné 1975). The peak in December 1984 cannot be explained by temporal (time) or known ecological factors. The collection period was similar to that of 1983, 1985, and 1986. Caribou were traveling parallel to and in the vicinity of the tree line, as they were in December 1983 and December 1986. Early-winter snow conditions were similar in all years.

From March to December, changes in KW ranged from sharp increases to modest decreases. In most cases the changes in males 2.5-3 years old and females 5.5-11 years old were harmonious, i.e., the trends were the same.

Sex and age

Within age classes, kidneys of males were consistently heavier than those of females. The KWs generally increased with age until the 5.5-11 year age class, although differences were small after age 3 years.

In pooled samples from all years, KWs in December were heavier than in

March in caribou over 1 year old (**Table 25**).

Condition

There was a crude positive relationship between KW and condition indices in December. For example, in the 5.5-10.5 year age class of females, the sample with heaviest kidneys (1984) also had the greatest body weight, and the most back fat. Conversely, the lightest kidneys (1986) were associated with the lowest condition indices in that age class.

Condition in March did not appear to be correlated with KW. The KWs of caribou in the two samples obtained in March 1984 were similar (175 g *vs.* 170 g in males 3 years old; 174 g *vs.* 177 g in females 6-11 years old) but condition indices were vastly different.

Riney's kidney fat index (KFIR)

A review of indices in December samples indicated that weight differences among age classes were masked to a large extent by use of kidney weights to standardize body size among age classes (**App. 11**). For example, in November 1982, the mean KFIR (Riney 1955) of females ranged between only 33 and 49; those of males between only 17 and 24. There were no significant differences among age classes. Values for calves deviated from the other age classes in 1984, 1985, and 1986 and should be excluded from any pooling of age classes. Sex differences were large after the first year. Data for the March samples (**App. 12**) indicated that KFI values were similar after age 1 and 2 years for males and females, respectively.

Among-year differences were small and insignificant: e.g., KFIR of males 1.5-2 years ranged between 20 and 30; KFIR of females 5.5-10.5 years old

Table 25. Kidney weights of male and female caribou collected in December (1982-86) and March (1980-87).

Sex/age (yr)	Kidney weight (g) December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5-1	96.4	7.8	5	94.0	2.1	26	NS
M 0.5-1	106.6	1.8	16	112.0	2.9	23	NS
F 1.5-2	138.3	3.4	24	**131.7**	1.9	62	$P < 0.05$
M 1.5-2	155.4	3.9	25	**145.9**	2.2	63	$P < 0.05$
F 2.5-3	151.8	2.5	29	**142.5**	2.1	85	$P < 0.01$
M 2.5-3	181.8	3.8	42	**170.8**	2.4	96	$P < 0.05$
F 3.5-4	167.5	2.7	41	**147.7**	1.8	65	$P < 0.001$
M 3.5-4	212.4	5.7	25	**187.0**	4.5	31	$P < 0.01$
F 4.5-5	170.8	4.3	25	**156.1**	2.6	55	$P < 0.01$
M 4.5-5	233.4	11.7	11	**204.3**	5.2	20	$P < 0.05$
F 6-11	179.1	2.7	81	**165.5**	1.3	257	$P < 0.001$
M >5	260.2	11.8	6	**224.2**	5.3	28	$P < 0.05$
F >11	179.5	4.3	19	174.6	3.0	36	NS
F >4	177.5	2.1	125	**164.9**	1.1	348	$P < 0.001$
F >5	179.2	2.1	100	**166.6**	1.2	293	$P < 0.001$
M >4	242.8	9.2	17	**215.9**	4.0	48	$P < 0.05$

ranged between 42 and 52.

A plot of KFIR values for male and female caribou >2 years old (**Fig. 18**) reflected the increases in KF from December to March, particularly in 1984-85. The KFIR of both sexes were relatively high in March 1985 and high in females in March 1981 (no males >2 years old were sampled in March 1981). Low KFIR values were evident in both sexes in November 1982 and December 1984 and in females in December 1985. The low value in 1982 and particularly in 1984 was influenced significantly by the heavy kidneys in those samples.

A pooling of all data for December and March samples (**Table 26**) reveals the sharp increases in KFIR in both sexes older than 1 year.

Mitchell's kidney fat index (KFIM)

The kidney fat index developed by Mitchell et al. (1976) was weight of kidney fat plus weight of the kidneys divided by the weight of the kidneys. We multiplied the values by 10 (**App. 13 and 14**) to make them more comparable with the results from Riney's (1955) method. The Mitchell formula reduced age difference in the KFI of the first three age classes of females (Table 26). The variation in relation to the mean (coefficient of variation, CV) was much lower for KFIM than for KFIR. However, annual trends in the two indices were identical (**Figs.** 18 and **19**).

Kidney fat/body weight index (KF/WT)

Body weights were not as variable among years as kidney weights and therefore ratios of kidney fat to body weight (x 100) should yield a better indices than those based on KW. Indices were similar among age classes >2 years in females and among all age classes of males (**App. 15 and 16**). Differences between December

Figure 18

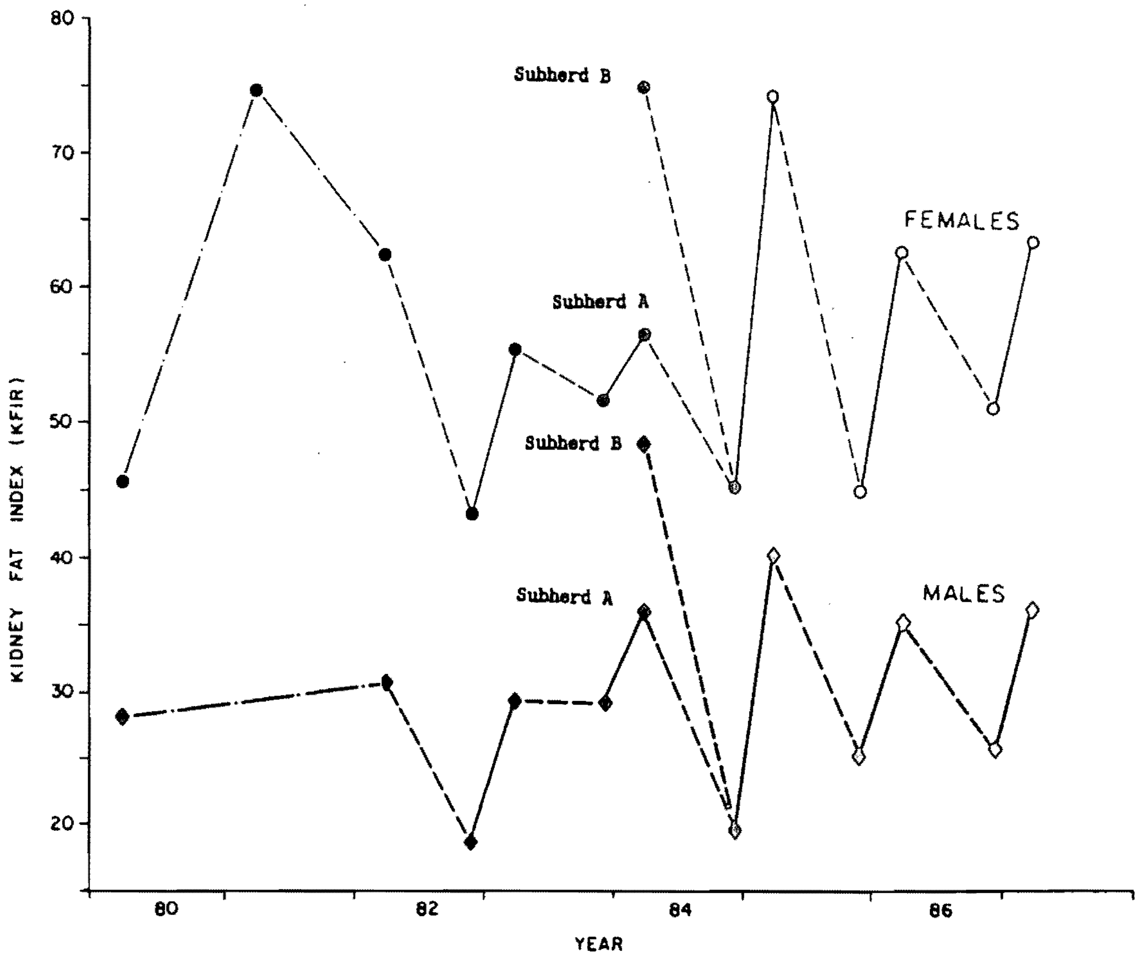

Figure 18. Mean kidney fat indices (Riney 1955) of male and female caribou >2 years old that were sampled in December (1982-86) and March (1980-87).

Table 26. Two kidney fat indices of male and female caribou sampled from the Beverly herd in December (1982-86) and March 1980-87).

Sex/age	KFIR[1]						KFIM[2]					
	December			March			December			March		
(yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	25.4	2.6	5	28.7	2.4	26	12.5	0.3	5	12.9	0.2	26
M 0.5-1	26.2	2.0	16	27.2	2.0	23	12.6	0.2	16	12.8	0.2	23
F 1.5-2	36.7	2.4	24	42.5	2.4	62	13.7	0.2	24	14.3	0.2	62
M 1.5-2	26.3	2.3	25	30.9	1.2	63	12.6	0.2	25	13.1	0.1	63
F 2.5-3	51.7	4.9	29	67.1	3.0	85	15.2	0.5	29	16.7	0.3	85
M 2.5-3	24.7	1.4	42	34.9	1.2	96	12.5	0.1	42	13.5	0.1	96
F 3.5-4	47.9	2.9	41	67.8	3.1	65	14.8	0.3	41	16.8	0.3	65
M 3.5-4	23.5	1.8	25	34.4	2.0	31	12.3	0.2	25	13.4	0.2	31
F 4.5-5	48.7	3.7	25	68.5	3.7	55	14.9	0.4	25	16.9	0.4	55
M 4.5-5	21.2	2.5	11	36.7	2.5	20	12.1	0.2	11	13.7	0.3	20
F 5.5-11	45.7	1.8	81	65.2	1.4	257	14.6	0.2	81	16.5	0.1	257
M >5	26.8	5.2	6	35.3	2.0	28	12.7	0.5	6	13.5	0.2	28
F >11	39.8	3.1	19	50.9	3.0	36	14.0	0.3	19	15.1	0.3	36
F >2	46.9	1.4	195	65.2	1.1	498	14.7	0.1	195	16.5	0.1	498
F >4	45.4	1.5	125	64.2	1.3	348	14.5	0.2	125	16.4	0.1	348
F >5	44.6	1.6	100	63.4	1.4	293	14.5	0.2	100	16.3	0.2	293
M >2	24.0	1.0	84	35.1	0.9	175	12.4	0.1	84	13.5	0.1	175

[1] *KFIR = 100 KF/KW* where KF is kidney fat (g) and KW is kidney weight (g) (Riney 1955).
[2] *KFIM = 10 (KF + KW)/KW* (Mitchell et al. 1976).

Figure 19

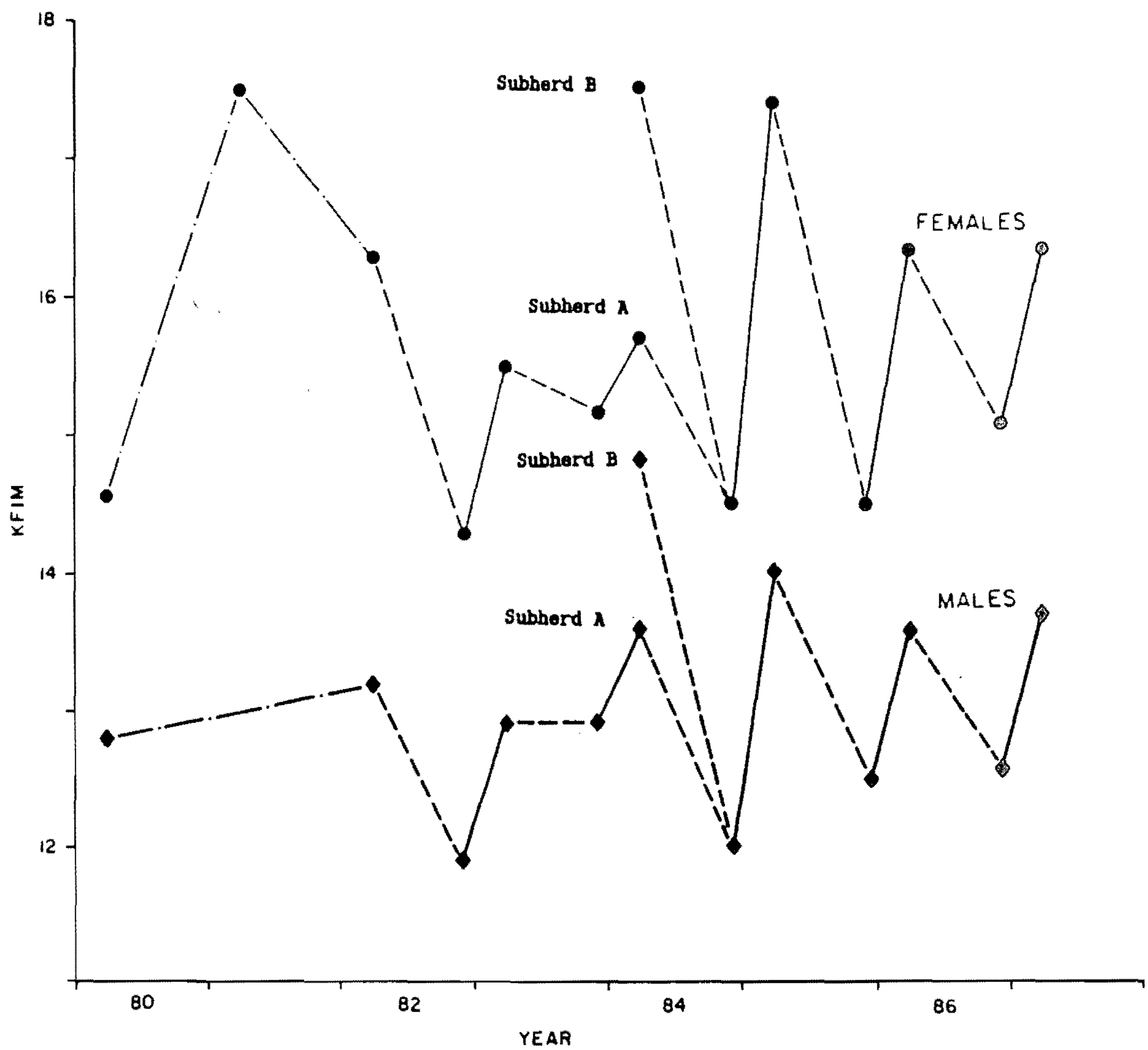

Figure 19. Mean kidney fat indices (Mitchell et al. 1976) of male and female caribou >2 years old that were sampled in December (1982-86) and March (1980-87).

and March values generally were significantly different after age 2 years in individual winter samples and pooled samples from all years (**Table 27**).

Graphed data for males and females >2 years of age reveal overwinter increases, declines in most summers, and high values in March 1981 and 1985 (**Fig. 20**). The general trends with time were virtually identical to that produced by the two KF indices.

Kidney fat/femur length index (KF/FEL)

Kidney fat weight relative to femur length (FEL) should be a better index than either kidney indices or body weight. It should reflect size well and tend to even out age differences. Furthermore, KF/FEL is stable seasonally, unlike body and kidney weights, and it is not influenced by degree of rumen fill, amount of blood loss, reproductive tract weights, and antler weights (cast or not) as is body weight. Data for collections in December (**App. 17**) and March (**App. 18**) revealed similar values after age 2 years in females and 1 or 2 year in males depending on the sample (**Table 28**). Annual and over-winter changes were similar to the other kidney fat indices. Indices were high in March 1981 and 1985 and low in March 1980 (females) and November 1982 (**Fig. 21**).

Femur marrow fat (FEF)

Results from Peary caribou (Thomas et al. 1975, 1976) indicated that the femur was the preferred long bone of the hind leg for evaluation of fatness. Fat content was almost always lower in the femur than in the tibia and metatarsus of undernourished caribou. We therefore analyzed water content in marrows of all femurs and only in a subsample of marrow from tibia and metatarsus bones in order to establish the fat

Table 27. Kidney fat/body weight ratios of caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Kidney fat/body weight ratio (x 100) December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5-1	55.9	4.0	5	61.8	4.1	26	NS
M 0.5-1	61.6	3.7	16	61.5	4.8	21	NS
F 1.5-2	82.8	5.8	24	89.0	4.6	61	NS
M 1.5-2	58.9	5.0	25	67.0	2.5	61	NS
F 2.5-3	103.9	9.0	29	121.5	4.9	85	NS
M 2.5-3	51.6	2.8	41	**71.8**	2.5	96	$P < 0.001$
F 3.5-4	96.2	5.4	41	**122.7**	5.1	64	$P < 0.01$
M 3.5-4	49.7	3.5	25	**68.2**	3.7	31	$P < 0.05$
F 4.5-5	99.4	7.3	25	**125.1**	6.0	54	$P < 0.05$
M 4.5-5	45.0	5.1	11	**74.9**	5.3	19	$P < 0.01$
F 6-11	96.5	3.5	80	**124.2**	2.5	252	$P < 0.001$
M >5	60.8	10.3	6	72.9	4.0	28	NS
F >11	83.8	5.6	19	**101.5**	5.7	36	$P < 0.05$
F >2	96.7	2.6	194	**122.0**	1.9	491	$P < 0.001$
F >5	94.0	3.1	99	**121.4**	2.4	288	$P < 0.001$
M >2	50.8	2.0	83	**71.7**	1.8	174	$P < 0.001$

Figure 20

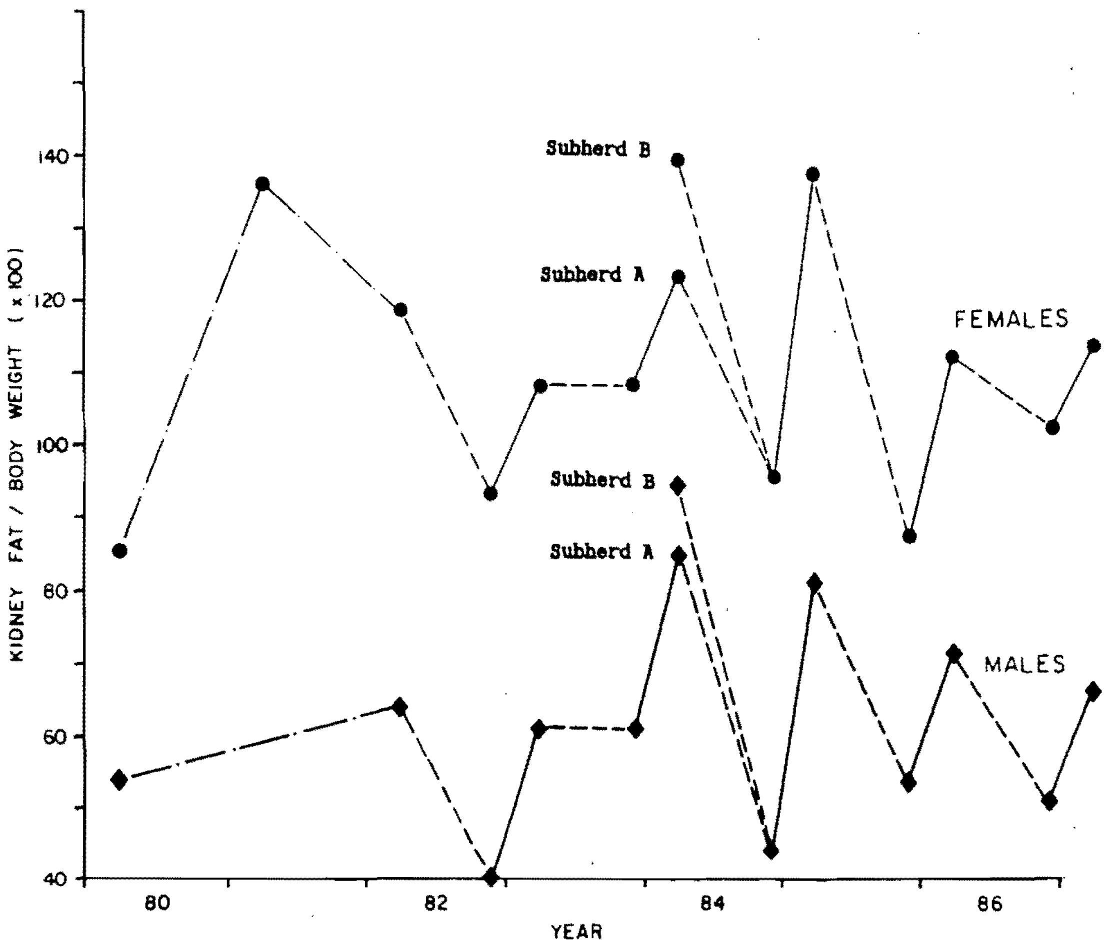

Figure 20. Mean kidney fat/body weight ratios of caribou >2 years old that were sampled in December (1982-86) and March (1980-87).

Table 28. Kidney fat/femur length ratios of caribou collected from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Kidney fat/femur length ratio (x 10) December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5-1	10.3	0.9	5	10.5	1.0	23	NS
M 0.5-1	11.7	0.8	16	11.6	1.1	17	NS
F 1.5-2	19.0	1.4	22	20.7	1.3	52	NS
M 1.5-2	15.3	1.4	22	16.6	0.7	55	NS
F 2.5-3	28.7	2.7	28	34.2	1.5	80	NS
M 2.5-3	15.2	0.8	41	**19.7**	0.8	81	$P < 0.001$
F 3.5-4	28.7	1.7	41	**35.5**	1.7	61	$P < 0.01$
M 3.5-4	16.0	1.1	23	**21.4**	1.5	26	$P < 0.01$
F 4.5-5	29.7	2.5	23	**37.4**	2.0	52	$P < 0.05$
M 4.5-5	16.0	1.7	11	**25.9**	2.0	18	$P < 0.01$
F 6-11	29.3	1.2	77	**38.7**	0.9	232	$P < 0.001$
M >5	22.4	4.0	6	26.4	1.7	26	NS
F >11	25.6	2.2	18	**32.3**	2.0	33	$P < 0.05$
F >2	28.8	0.8	188	**36.9**	0.6	458	$P < 0.001$
F >5	28.6	1.1	95	37.9	0.9	265	$P < 0.001$
M >2	16.1	0.7	81	21.9	1.8	152	$P < 0.01$

Figure 21

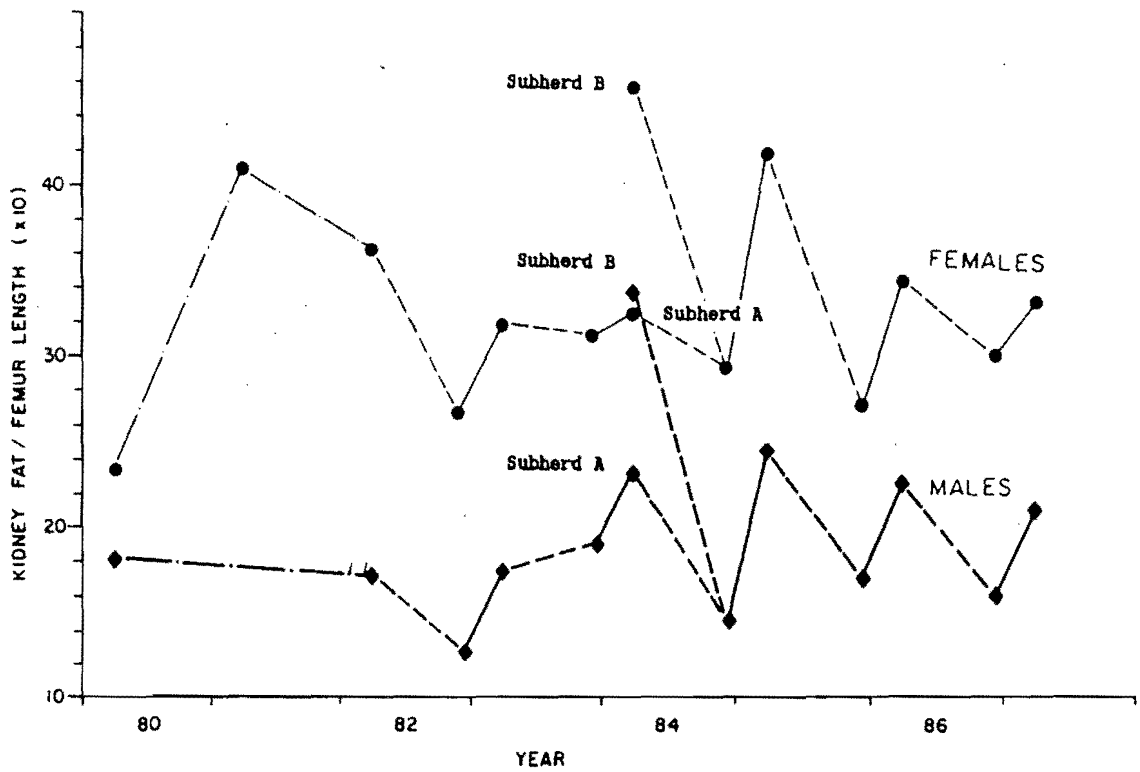

Figure 21. Mean kidney fat/femur length ratios of caribou >2 years old that were sampled from the Beverly herd in December (1982-86) and March (1980-87).

content relationships among them.

Percent FEF in females in December were similar after age 1 year except in 1984 (**App. 19**). Values were similar in males 1.5 through 3.5 year old and generally lower in older males. In March samples, FEF in femurs of males were similar in all age classes except for the 1983 sample. Samples from females could be pooled after the first age class (**App. 20**). Fat content of femur marrows in females and males generally increased from December to March and some increases were significant (**App. 21**). With a few exceptions, most notably in 1983-84 in subherd A, femur marrow fat was 85-91% in March. December values were lower in males of all ages than in females but that difference had disappeared by March.

Graphed data for all collections indicated sharp increases in FEF content from December to March in males and declines from March to December (**Fig. 22**). Females >1.5 years old had small increases over winter with one exception (1986-87). Relatively low values were found in the December 1983 sample of females. Pooled samples for all December and March collections revealed relatively low values only in calves and often significant over-winter recovery of femur marrow fat to means of 84-89% in both sexes >1 year old (**Table 29**).

Mandibular water (MAW)

Analysis of fat content in mandibular marrow of Peary caribou sampled in 1976 indicated a close relationship to that in femur marrow (Thomas et al. 1977). Similar results were obtained the following year when results were expressed as water content because percent non-fatty residue was not measured (Thomas and Broughton 1978). Mandibular tissue contains large blood vessels and non-fatty

Figure 22

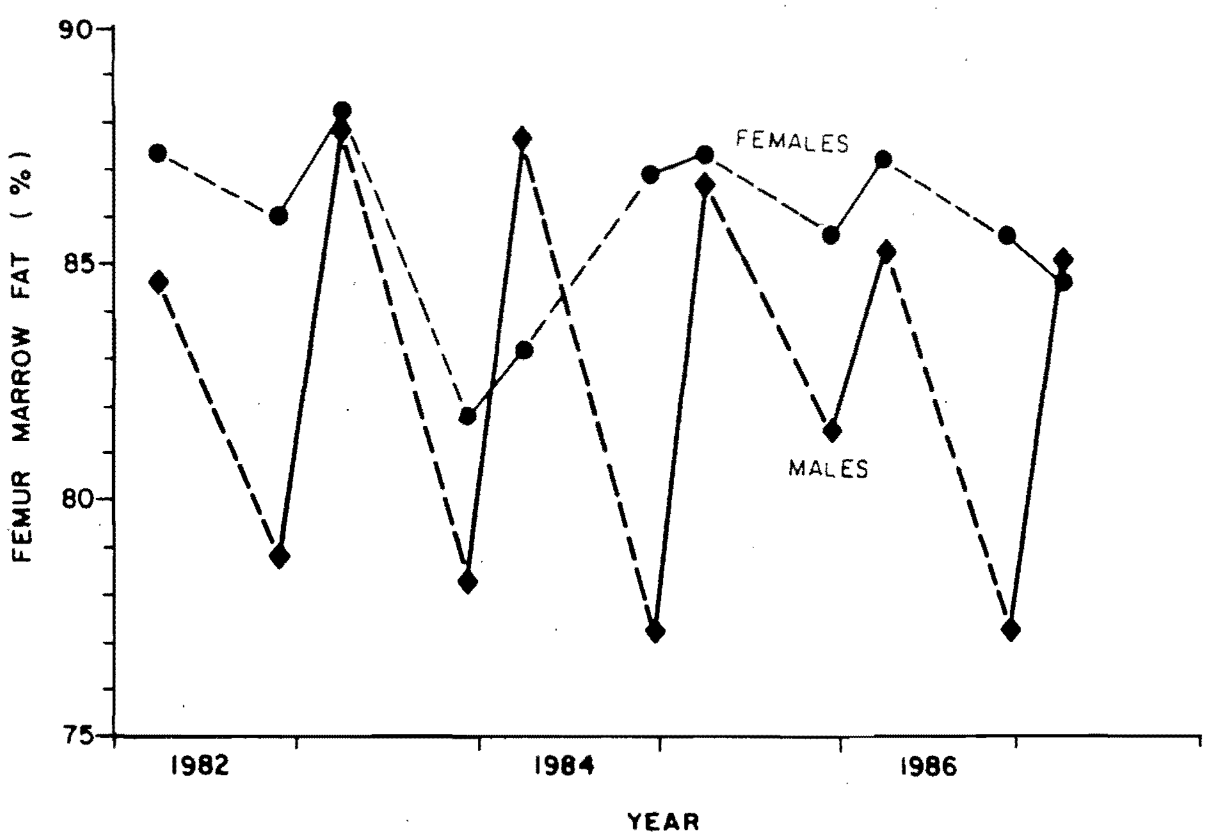

Figure 22. Mean percent fat in femur marrow of female caribou >1.5 years old and males 1.5-4 years old that were collected from the Beverly herd in December (1982-86) and March (1982-87).

Table 29. Percent fat in femur marrow of caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Femur marrow fat (%) December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5-1	78.3	2.6	5	79.8	1.3	24	NS
M 0.5-1	74.0	2.2	16	80.4	2.9	19	NS
F 1.5-2	84.7	0.9	23	86.7	0.8	49	NS
M 1.5-2	82.6	1.2	23	84.4	1.2	55	NS
F 2.5-3	84.3	1.0	28	**87.7**	0.5	81	$P < 0.01$
M 2.5-3	78.5	1.3	40	**85.3**	0.8	83	$P < 0.001$
F 3.5-4	85.9	0.7	37	**88.5**	0.6	59	$P < 0.01$
M 3.5-4	76.1	2.2	23	**84.1**	1.7	27	$P < 0.01$
F 4.5-5	86.8	1.1	18	87.8	0.6	54	NS
M 4.5-5	67.0	3.9	10	**87.4**	0.8	21	$P < 0.001$
F 6-11	85.2	0.9	65	86.9	0.5	228	NS
M >5	66.3	7.4	6	**86.1**	2.0	25	$P < 0.05$
F >11	85.8	0.6	15	86.6	0.5	33	NS
F >2	85.4	0.5	163	**87.4**	0.3	455	$P < 0.001$
F >5	85.3	0.8	80	86.9	0.4	261	NS
M >2	75.4	1.3	79	**85.5**	0.6	156	$P < 0.001$

residue content is undoubtedly higher than in leg bone marrows.

In December and March collections, water content of mandibular soft tissue generally was higher in calf and yearling females than in older females (**App. 22 and 23**).

Graphed data for males and females >2 years old indicated decreases in water content from December to March with one exception (Fig. 23). December 1983 and 1984 values for females were relatively high; December 1985 values relatively low for males. March 1983 values were relatively high for both sexes.

Pooled data from December and March collections revealed three significant over-winter declines in water content in individual age classes and significant declines in large age groupings (**Table 30**). Declines in water content presumably reflect increases in fat but the relationship between the two components has yet to be established. Until it is, the safest approach is to measure water content.

Annual changes in mandibular water differed somewhat from those of other condition indices. For example, March 1982 values for males and females >2 years old were lower than the others (**Fig. 23**).

Condition index CONINDEX

CONINDEX is a combination of the kidney fat index and percentage fat in the femur: *(KFI - 20) + FEF*. Connolly (1981) developed the index for mule deer (*Odocoileus hemionus hemionus*). Huot and Goudreault (1985) found high correlations ($r = 0.93$ to 0.96) between the index and the percent fat content of "dressed" carcasses (*100 x fat weight/dressed weight*) of caribou (*R. t. caribou*) sampled in October and April in Quebec. Unlike some other fat indices, the correlation was equally high ($r = 0.96$) in combined October and March samples.

Figure 23

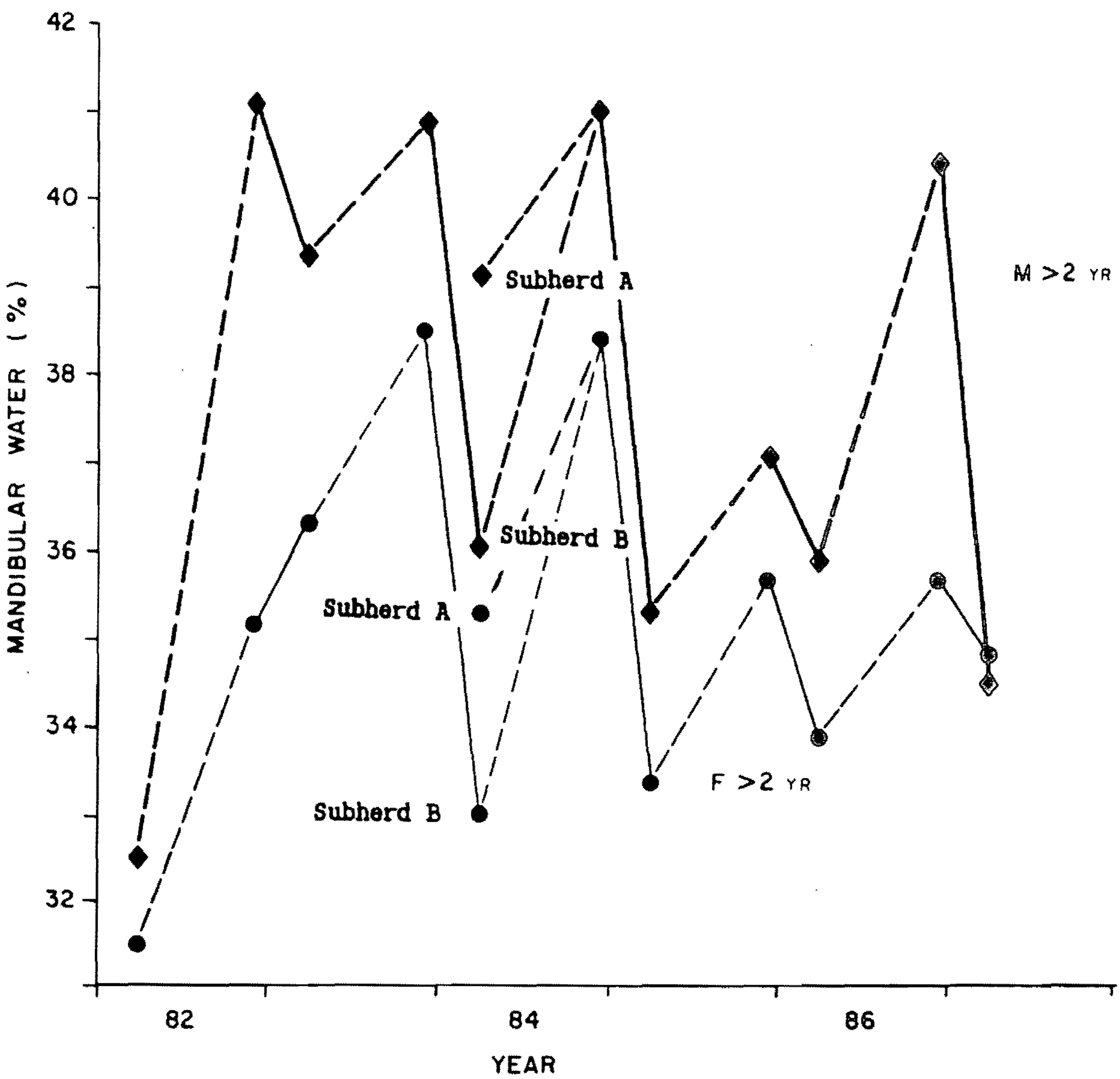

Figure 23. Mean percent water in mandibular soft tissue of male and female caribou >2 years old that were collected in December (1982-86) and March (1980-87).

Table 30. Percent water in mandibular soft tissues of caribou sampled from the Beverly herd in December (1982-86) and March (1982-87).

Sex/age (yr)	Percent water in mandibular tissue						Significance
	December			March			
	Mean	SE	*n*	Mean	SE	*n*	
F 0.5-1				41.1	2.4	6	NS
M 0.5-1	45.7	2.2	5	46.3	1.4	4	NS
F 1.5-2	42.0	1.0	26	40.6	0.9	43	NS
M 1.5-2	42.9	1.2	25	42.7	0.8	52	NS
F 2.5-3	37.7	0.9	26	35.9	0.7	67	NS
M 2.5-3	39.5	0.8	39	**36.4**	0.7	82	$P < 0.01$
F 3.5-4	37.5	1.5	34	**33.7**	0.8	55	$P < 0.005$
M 3.5-4	39.5	1.1	21	36.4	1.5	23	NS
F 4.5-5	33.9	1.0	20	33.8	0.9	47	NS
M 4.5-5	40.2	2.2	10	35.4	1.3	20	NS
F 5.5-11	36.2	1.1	67	**33.4**	0.5	209	$P < 0.05$
M >5				35.3	1.6	17	NS
F >11	35.5	1.2	13	33.2	1.0	32	NS
F >2	36.4	0.6	160	**33.9**	0.3	410	$P < 0.001$
F >5	36.1	1.0	80	**33.4**	0.4	241	$P < 0.01$
M >2	40.0	0.8	76	**36.1**	0.5	142	$P < 0.001$

Indices were similar in males and females after age class 2 years (**App. 24** and **25**). No further analysis of the data was justified because CONINDEX is used to generate percent body fat (FATP) in the next section.

Condition index FATP

Percent body fat of dressed carcasses, (*100 x fat weight/dressed body weight*), of caribou was predicted accurately (r = 0.96) from CONINDEX by Huot and Goudreault (1985) using the formula *FATP = 0.845 + 0.091 CONINDEX*. It is generated here (**App. 26** and **27**) to compare it with other indices of body fat. Indices were similar among age classes >2 years for both sexes (**Table 31**). March values generally were significantly higher than December values after age 2 years.

Calculated percent body fat increased sharply in most winters as indicated by pooled samples of males and females over 2 years old (**Fig. 24**). Lowest values were in the November 1982 samples; highest in the March 1985 sample.

Condition index FAT

FAT is an estimate of percent fat in relation to dressed body weight where *FAT = 3.73 ln KFI - 3.29* (Huot and Goudreault 1985) for caribou in Quebec. They termed it FATP but here FATP is used for the index derived from CONINDEX.

The results for FAT (**App. 28** and **29**) are of course comparable to those for KFI and indicate sharp increases from December to March (**Fig. 25**). The FAT values are similar in males and females up to age 2 years (**Table 32**) after which females have higher values.

Dissectible fat (DFAT)

Dissectible fat of the sampled caribou was estimated from an equation

Table 31. Condition index fat percentage (FATP) of caribou sampled from the Beverly herd in December (1982-86) and March (1982-87).

Sex/age (yr)	FATP[1] December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5-1	8.5	0.31	5	8.8	0.31	20	NS
M 0.5-1	8.1	0.31	15	**8.9**	0.28	18	$P < 0.05$
F 1.5-2	10.0	0.25	23	**10.8**	0.29	45	$P < 0.05$
M 1.5-2	9.0	0.29	23	9.6	0.19	53	NS
F 2.5-3	11.5	0.50	27	**13.1**	0.30	79	$P < 0.01$
M 2.5-3	8.4	0.19	40	**9.9**	0.16	79	$P < 0.001$
F 3.5-4	11.2	0.31	37	**13.2**	0.30	58	$P < 0.001$
M 3.5-4	8.0	0.28	23	**9.8**	0.31	27	$P < 0.001$
F 4.5-5	11.5	0.50	18	**13.1**	0.36	51	$P < 0.05$
M 4.5-5	7.1	0.47	10	**10.4**	0.27	19	$P < 0.001$
F 6-11	11.0	0.23	64	**12.9**	0.17	223	$P < 0.001$
M >5	7.5	1.08	6	10.1	0.32	25	NS
F >11	10.6	0.37	15	11.5	0.31	32	NS
F >2	11.2	0.16	161	**12.9**	0.12	443	$P < 0.001$
F >5	10.9	0.20	79	**12.7**	0.11	255	$P < 0.001$
M >2	8.1	0.17	79	**10.0**	0.12	150	$P < 0.001$

[1] *FATP = 0.845 + 0.091 (KFIR - 20) + FEF)* (Huot and Goudreault 1985) where *KFIR = 100 x kidney fat (g)/kidney weight (g)* and FEF is percent fat in femur marrows.

Figure 24

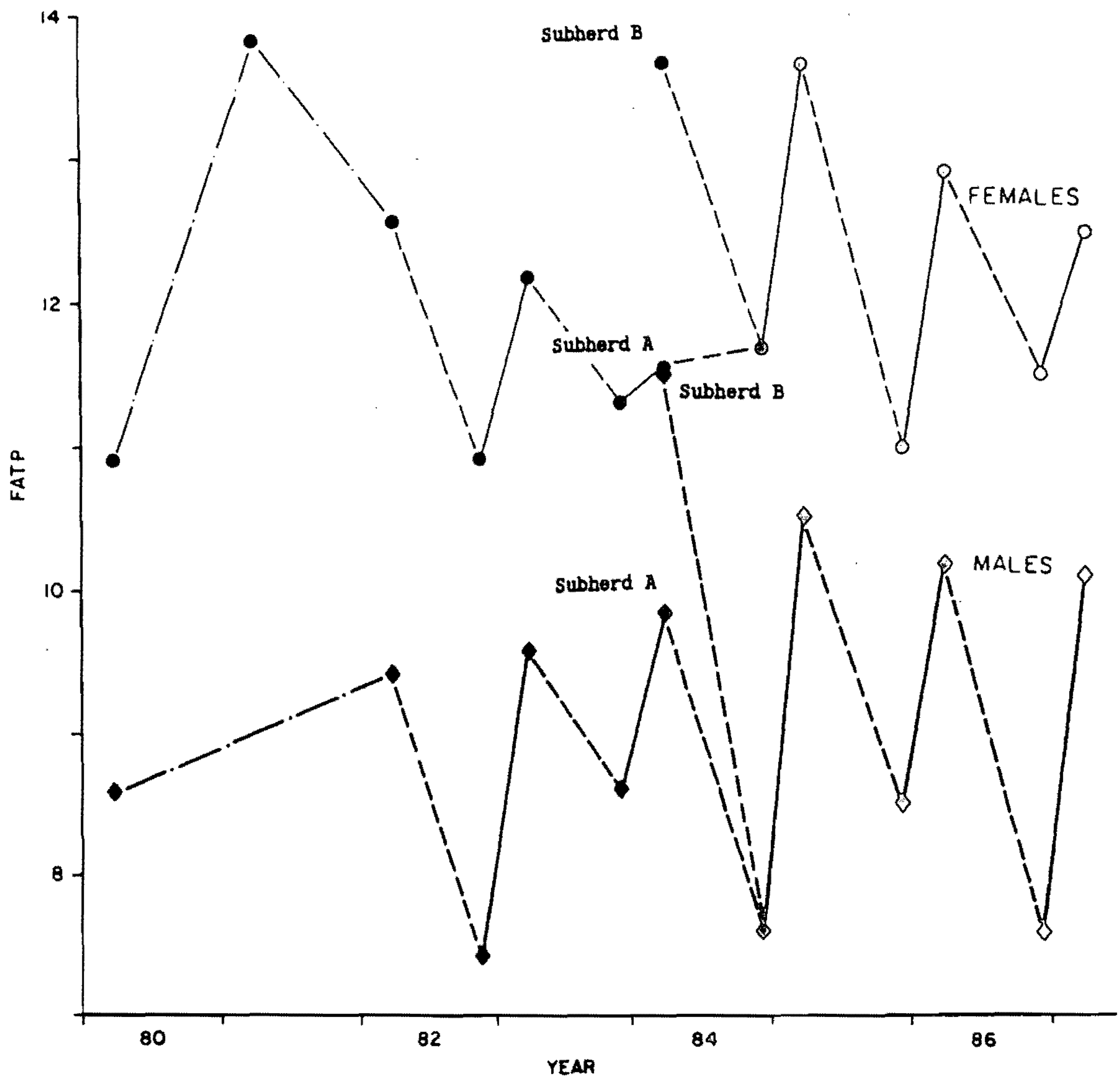

Figure 24. Condition index FATP (*0.845 + 0.091 [KFIR - 20] + FEF*) (Huot and Goudreault 1985) in male and female caribou >2 years old that were sampled in December (1982-86) and March (1982-87).

Figure 25

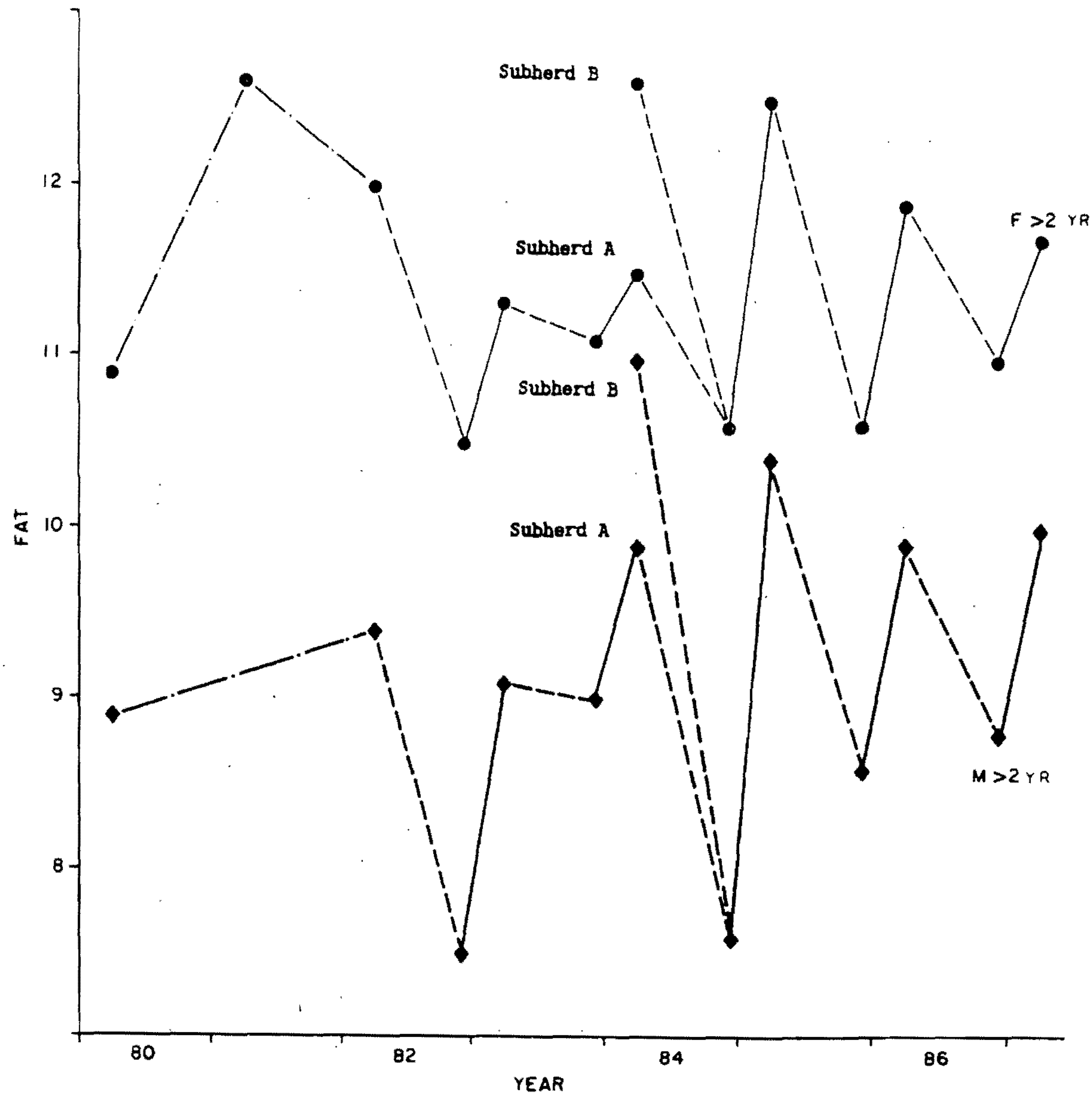

Figure 25. Estimates of percent body fat (*FAT = 3.73 ln KFIR - 3.29*, Huot and Goudreault 1985) of female caribou >2 years old that were sampled from the Beverly herd in December (1982-86) and March (1980-87).

Table 32. Estimates of percent body fat (FAT) of caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Percent body fat (FAT)[1] December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5 - 1	8.7	0.57	5	8.9	0.37	26	NS
M 0.5 - 1	8.7	0.26	16	8.7	0.33	23	NS
F 1.5 - 2	9.9	0.36	24	10.4	0.20	62	NS
M 1.5 - 2	8.6	0.30	25	9.3	0.15	63	NS
F 2.5 - 3	11.0	0.32	29	**12.0**[2]	0.19	85	$P < 0.05$
M 2.5 - 3	8.4	0.20	42	**9.7**	0.15	96	$P < 0.001$
F 3.5 - 4	10.8	0.23	41	**12.2**	0.14	65	$P < 0.001$
M 3.5 - 4	8.3	0.25	25	**9.7**	0.22	31	$P < 0.001$
F 4.5 - 5	10.9	0.35	25	**12.2**	0.21	55	$P < 0.01$
M 4.5 - 5	7.8	0.42	11	**10.0**	0.22	20	$P < 0.001$
F 6 - 11	10.7	0.11	219	**12.1**	0.09	257	$P < 0.001$
M >5	8.6	0.71	6	9.8	0.22	28	NS
F >11	10.3	0.26	19	**11.1**	0.24	36	$P < 0.05$
F >1	10.7	0.20	219	**11.8**	0.07	560	$P < 0.001$
F >2	10.8	0.11	195	**12.0**	0.07	498	$P < 0.001$
F >5	10.6	0.14	100	**11.9**	0.09	293	$P < 0.001$
M >1	8.4	0.13	109	**9.8**	0.08	238	$P < 0.001$
M >2	8.2	0.15	84	**8.3**	0.10	175	$P < 0.001$

[1] *FAT = 3.73 ln KFIR - 3.29* (Huot and Goudreault 1985), where KFI is the kidney fat index (Riney 1955).

[2] **Bold** indicates significant difference between means for December and March.

developed by Adamczewski et al. (1987) for barren-ground caribou sampled on Coats Island: *DFAT (kg) = (1.151 DBF) + (26.401 KF) - 0.246*, where DBF is depth of back fat (cm) and KF is kidney fat (kg). Unlike FAT, the values in yearling females were much higher than in male counterparts (**App. 30** and **31, Table 33**). Values of DFAT in females were similar after age 2 years but in pooled samples they gradually increased with age in males (Table 33). The results for males were highly variable within individual samples.

Pooled samples for males and females over 2 years old indicate over-winter increases in DFAT with the exception of females in 1983-84. Relatively low values were evident in March 1980 (females only) and in November 1982 (**Fig. 26**). High DFAT values were found in March 1981, March 1984 (Porter Lake sample of subherd B), and March 1985.

Calculated weight of DFAT in males and females >2 years old increased from December to March in all cases except for females in 1983-1984 (Fig. 26). It decreased from March to December except in 1983 and in 1984 for the females in Subherd A sampled at Sifton Lake compared with those collected in December 1984.

Condition index A (CIA)

We developed CIA to incorporate the four primary condition variables: weight (WT), back fat (BF), kidney fat (KF), and femur fat (FEF) with femur length (FEL) as a compensator for body size. We gave each variable about equal weighting by multiplying depth of back fat by 10. Therefore, *CIA = (WT + 10 BF + KF + FEF)/FEL*. The index avoids the problem of using kidney weights, which vary seasonally as well as annually, as a size compensator or body weights. Body weight is influenced by body size and extent of fat reserves. Use of four variables should smooth out

Table 33. Estimates of dissectible fat (DFAT) of caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Calculated dissectible fat (DFAT)[1] December Mean	SE	*n*	March Mean	SE	*n*	Significance
F 0.5 - 1	0.59	0.17	5	0.58	0.07	26	NS
M 0.5 - 1	0.61	0.07	16	0.67	0.08	23	NS
F 1.5 - 2	1.79	0.19	24	1.71	0.16	62	NS
M 1.5 - 2	1.03	0.12	25	1.11	0.06	63	NS
F 2.5 - 3	3.27	0.40	29	3.75	0.21	85	NS
M 2.5 - 3	1.00	0.06	42	**1.50**[2]	0.07	96	$P < 0.001$
F 3.5 - 4	3.54	0.29	41	4.10	0.23	65	NS
M 3.5 - 4	1.20	0.12	25	**1.65**	0.13	31	$P < 0.05$
F 4.5 - 5	3.13	0.30	25	**4.14**	0.27	55	$P < 0.05$
M 4.5 - 5	1.08	0.15	11	**2.22**	0.33	20	$P < 0.01$
F 6 - 11	3.27	0.20	327	**4.04**	0.11	338	$P < 0.001$
M >5	1.84	0.47	6	2.30	0.24	34	NS
F >11	3.52	0.44	19	3.57	0.24	55	NS
F >2	3.33	0.13	195	**3.89**	0.07	693	$P < 0.001$
F >5	3.32	0.19	100	**3.98**	0.10	393	$P < 0.001$
M >2	1.13	0.07	84	**1.75**	0.08	175	$P < 0.001$

[1] *DFAT = (1.151 DBF) + (26.401 KF) - 0.246*, where DBF is depth of back fat (cm) and KF is kidney fat (kg) (Adamczewski et al. 1987).
[2] **Bold** indicates significant difference between means for December and March.

Figure 26

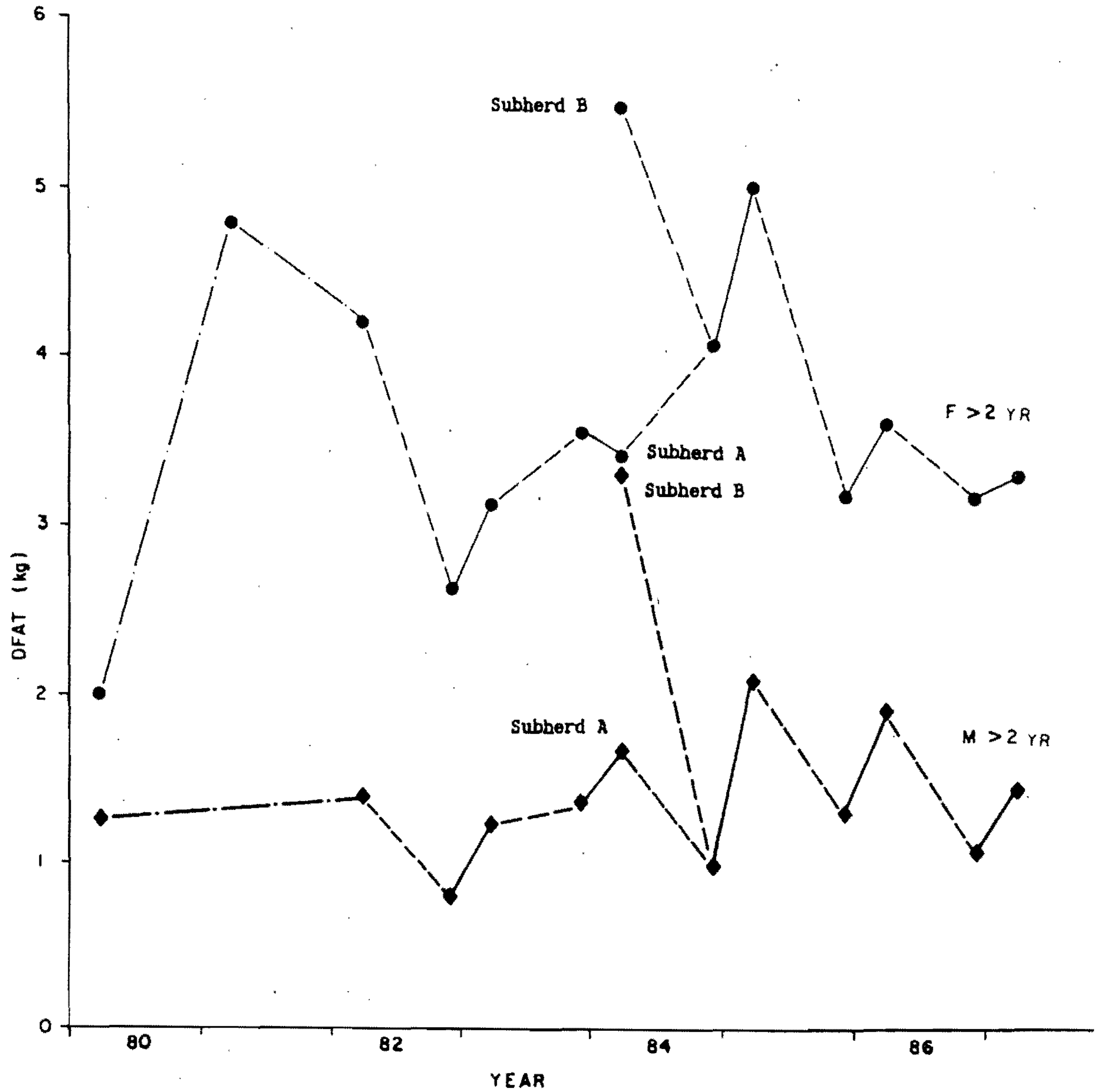

Figure 26. Estimates of dissectible fat (DFAT) of male and female caribou >2 years old that were sampled from the Beverly herd in December (1982-86) and March (1980-87).

atypical values in any one condition variable.

The CIA values for December (**App. 32**) and March (**App. 33**) indicate similar indices among ages >2 years for both males and females, except for males in Subherd B, the March 1984 Porter Lake sample. Indices increased progressively with age after age 2 years in that sample. In pooled samples from all collections, the index was higher in females than males after age 1 year (**Table 34**).

Graphed data for males and females over 2 years old (**Fig. 27**) revealed declines in CIA of subherd A from December 1983 to March 1984 (Sifton Lake sample) and a sharp increase from December 1984 to March 1985.

Condition index B (CIB)

A condition index CIB was generated for females from body weight (kg), back fat depths (mm), and kidney fat (g) by subtracting from each the mean value for each variable above which most females >2 years old were pregnant and below which most were not pregnant. Further, the variables were weighted by factors of one, two, and one half, respectively. The condition formula was thus: $CIB = (WT - 75) + [2 \times (BF - 10)] + [0.5 \times (KF - 70)]$. There was no compensation for size. The results are negative in the first two age classes and highly variable in older females (**App. 34** and **35**).

The means of pooled samples from March collections were larger than means for pooled December samples in the 4.5-5 years, 6-11 years, and all groupings of females older than 3, 4, and 5 years (**Table 35**).

Annual variations were large with low values in March 1980 and December 1986 (6-11 year class) and high values in March 1981, March 1984 (subherd B, Porter Lake sample), and March 1985 (**Fig. 28**). The December 1986 sample of 6-11 year

Table 34. Condition Index A of caribou sampled from the Beverly herd in December (1982-86) and March (1982-87).

Sex/age (yr)	Condition index A (CIA)[1]						Significance
	December			March			
	Mean	SE	*n*	Mean	SE	*n*	
F 0.5 - 1	7.0	0.6	5	6.2	0.3	26	NS
M 0.5 - 1	6.4	0.3	17	6.7	0.3	18	NS
F 1.5 - 2	9.5	0.6	23	8.4	0.4	56	NS
M 1.5 - 2	7.8	0.3	22	7.5	0.2	57	NS
F 2.5 - 3	13.0	1.0	29	14.0	0.5	82	NS
M 2.5 - 3	7.3	0.2	41	**8.1**[2]	0.2	85	$P < 0.05$
F 3.5 - 4	13.9	0.7	41	14.5	0.6	62	NS
M 3.5 - 4	7.9	0.3	23	**8.8**	0.3	26	$P < 0.05$
F 4.5 - 5	12.0	0.9	24	**14.3**	0.6	55	$P < 0.05$
M 4.5 - 5	7.3	0.3	11	**9.9**	0.8	20	$P < 0.05$
F 5.5 - 11	11.8	0.6	78	**15.2**	0.3	235	$P < 0.01$
M >5	8.9	1.1	6	10.4	0.7	26	NS
F >11	13.8	0.3	18	14.1	0.7	34	NS
F >2	13.1	0.4	189	**14.7**	0.2	467	$P < 0.01$
F >5	13.0	0.7	96	**15.1**	0.3	269	$P < 0.05$
M >2	7.6	0.2	81	**8.8**	0.2	158	$P < 0.01$
M >3	7.9	0.3	40	**9.7**	0.4	73	$P < 0.001$
M >4	7.9	0.5	17	**10.2**	0.6	47	$P < 0.01$

[1] *CIA = (WT + [10 x BF] + KF + FEF)/FEL*, where WT is body weight (kg), BF is depth of back fat (mm), KF is kidney fat (g), FEF is femur marrow fat (%), and FEL is femur length (cm).

[2] **Bold** indicates significant difference between means for December and March.

Figure 27

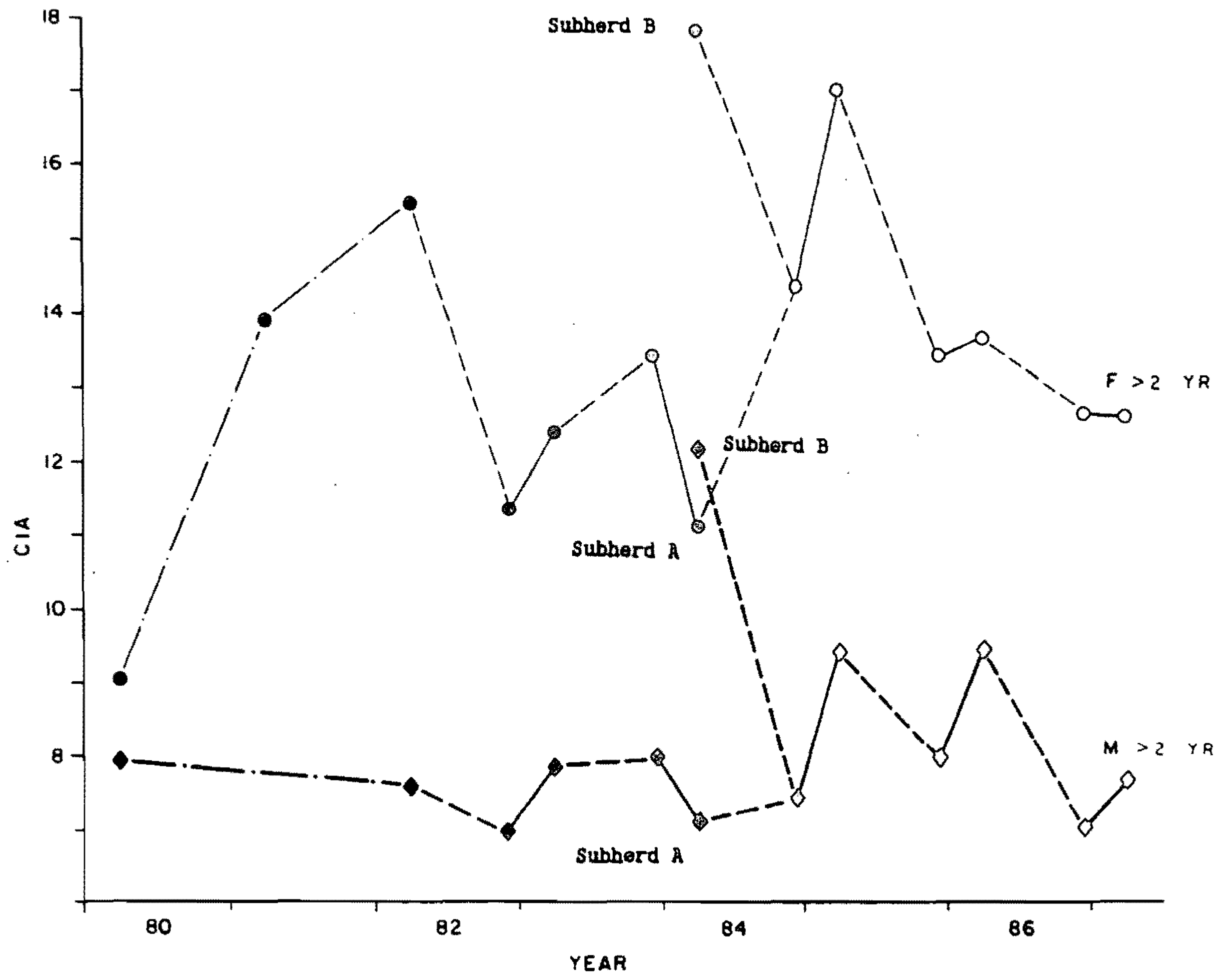

Figure 27. Condition index A (CIA) of male and female caribou >2 years old in samples obtained from March 1980 through March 1987.

Table 35. Condition Index B of female caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Condition index B (CIB)[1] December Mean	SE	n	March Mean	SE	n	Significance
F 0.5-1	-71.6	4.7	5	-71.6	1.6	25	NS
F 1.5-2	-30.8	3.8	24	-31.9	3.6	60	NS
F 2.5-3	8.9	7.8	29	20.3	4.5	84	NS
F 3.5-4	23.3	6.0	39	28.1	4.8	64	NS
F 4.5-5	15.1	6.5	25	**35.3**	5.8	53	$P < 0.05$
F 6-11	18.5	4.3	80	**38.4**	2.6	250	$P < 0.001$
F >11	24.7	9.4	18	27.3	5.7	36	NS
F >2	18.2	2.8	191	**32.8**	1.9	487	$P < 0.001$
F >3	19.9	3.4	162	**35.4**	2.0	403	$P < 0.001$
F >4	18.8	2.2	123	**36.7**	2.2	339	$P < 0.001$
F >5	19.7	3.9	98	**37.0**	2.4	286	$P < 0.001$

[1] *CIB = (WT - 75) + 2(BF - 10) + 0.5 (KF - 70)*, where WT is body weight (kg), BF is depth of back fat (mm), KF is kidney fat (g).

old females was, by chance, relatively lean. The values for females >2 years old are more reliable.

Antler weights

Weights of left and right antlers

The left and right antlers of female caribou were remarkably similar in weight within age classes as shown by data for individual winters and age classes where $n \geq 20$ (**Table 36**). Those data included caribou with single antlers (right or left). Weights were obtained for one antler only in 78 of 531 females over 2 years old. No weights

Figure 28

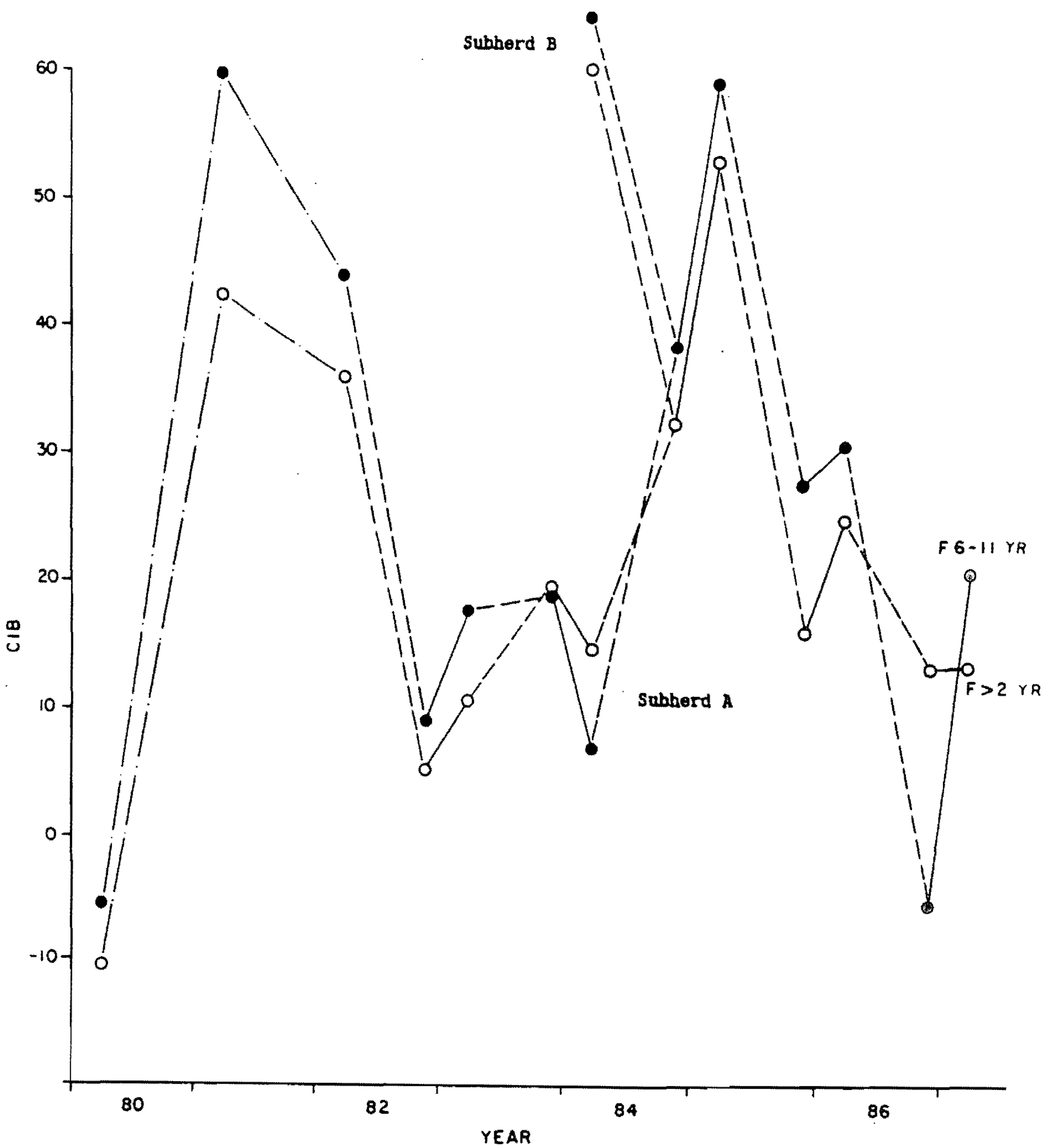

Figure 28. Condition index B (CIB) of female caribou in two age classes sampled from the Beverly herd in December (1982-86) and March (1980-87).

Table 36. Weights of left and right antlers of female caribou in age classes with sample sizes of at least 20.

Year	Age class (years)	Left antler (g)[1] Mean	SE	n	Right antler (g)[1] Mean	SE	n
1981-82	5.5 - 11	181	10	30	181	12	30
1982-83	5.5 - 11	115	6	59	116	6	57
1983-84	5.5 - 11	148	8	51	140	8	48
1984-85	2.5 - 3	124	12	24	116	11	25
1984-85	3.5 - 4	120	11	26	117	10	25
1984-85	5.5 - 11	172	8	57	173	9	57
1985-86	3.5 - 4	118	9	25	105	10	27
1985-86	5.5 - 11	134	7	55	137	7	57
1986-87	5.5 - 11	125	11	30	110	8	30

[1] Includes caribou with single antler.

were available in 41 cases and 16 were classified as "bald" on the field forms. Those data overestimate the percentage of females with one antler or none in the population. One or both antlers were broken off the skulls of a few caribou while transporting them from the kill site to the camp area. The equality in weights is indicated by all data for females having two antlers (**Table 37**).

Weight of single antlers versus two antlers

If single antlers were half the weight of two antlers, weights of singles could be doubled and added to the sample of caribou with two antlers. This procedure would help overcome a problem of obtaining adequate sample sizes in individual age and sex classes. Data for females 5.5-11 years old were tabulated for each winter and totaled (**Table 38**).

Table 37. Weights of left, right, and both antlers of 578 female caribou carrying two antlers when collected from the Beverly herd, 1982 through 1987.

Age class (yr)	Sample size	Antler weights (g) Left antler Mean	SE	Right antler Mean	SE	Both antlers Mean	SE
1	7	19	3	18	3	36	6
2	39	66	5	65	5	131	10
3	74	104	5	101	5	205	10
4	81	118	6	112	6	230	11
5	65	112	6	112	6	224	11
6	77	142	7	138	7	281	13
7	55	130	9	128	9	258	18
8	44	141	8	140	9	281	17
9	40	160	10	155	10	314	20
10	34	155	8	156	8	311	15
11	13	157	14	160	20	317	33
12	25	179	14	177	13	356	26
13	11	168	28	165	29	333	57
14	9	177	16	182	19	359	35
15	2	243	49	213	61	456	110
16	2	144	5	163	5	253	10

Pooled data suggested no difference between the weights of single antlers that were doubled and weights of two antlers.

Antler weights and age

There was a rapid increase in antler weights in females until age 2-2.5 years and then a slow but progressive increase until at least age 13.5 years (Table 39, Fig. 29).

Table 38. Weights of single antlers (L or R), singles doubled (x 2), and both antlers of female caribou 5.5 through 11 years old.

Winter	Weight (g) single antler			Double weight (g) of single antler	Weight (g) of two antlers		
	Mean	SE	*n*		Mean	SE	*n*
1981-82	146	30	6	292	370	22	27
1982-83	107	26	8	214	232	12	54
1983-84	143	21	9	286	289	16	45
1984-85	143	25	4	286	347	18	55
1985-86	203	28	4	406	266	13	54
1986-87	125	66	4	250	233	17	28
All	140	13	35	280	287	7	263

There was a minor slowdown in antler weight growth after age 9 years. Thus growth may have three phases in females with inflections at age 2.5 and 9.5 years, but large sample sizes are needed to evaluate it statistically.

Antler weights in males increased progressively to the oldest male (7 years) still bearing antlers in late November-early December. In March samples, most 3-year-old males still retained their antlers, whereas most older males had shed theirs. Some males older than 4 years had shed their antlers by late November and most of them had shed them by mid December.

Annual changes in antler weights

Antler weights declined from 1981-82 to 1982-83, increased through 1983-84 to 1984-85, and then declined to 1985-86 (**Fig. 30**). Changes from 1985-86 to 1986-87 were inconsistent (there was a minor reduction in antler weight). The general trend in antler weights was consistent with changes in the other condition indices.

Table 39. Weights of two antlers of female and male caribou sampled from the Beverly herd, 1982 through 1987.

Age class (yr)	Weights of two antlers (g)					
	Females			Males		
	Mean	SE	*n*	Mean	SE	*n*
1	37	5	13	35	3	26
2	117	8	61	228	15	77
3	203	9	94	645	65	117
4	225	10	91	895	64	41
5	222	10	75	1496	225	13
6	279	13	89	1386		1
7	265	18	61	2984		1
8	281	16	48			
9	303	19	45			
10	314	15	36			
11	306	32	19			
12	356	24	28			
13	336	52	12			
14	359	35	9			
15	456	110	2			
16	307	10	2			

Figure 29

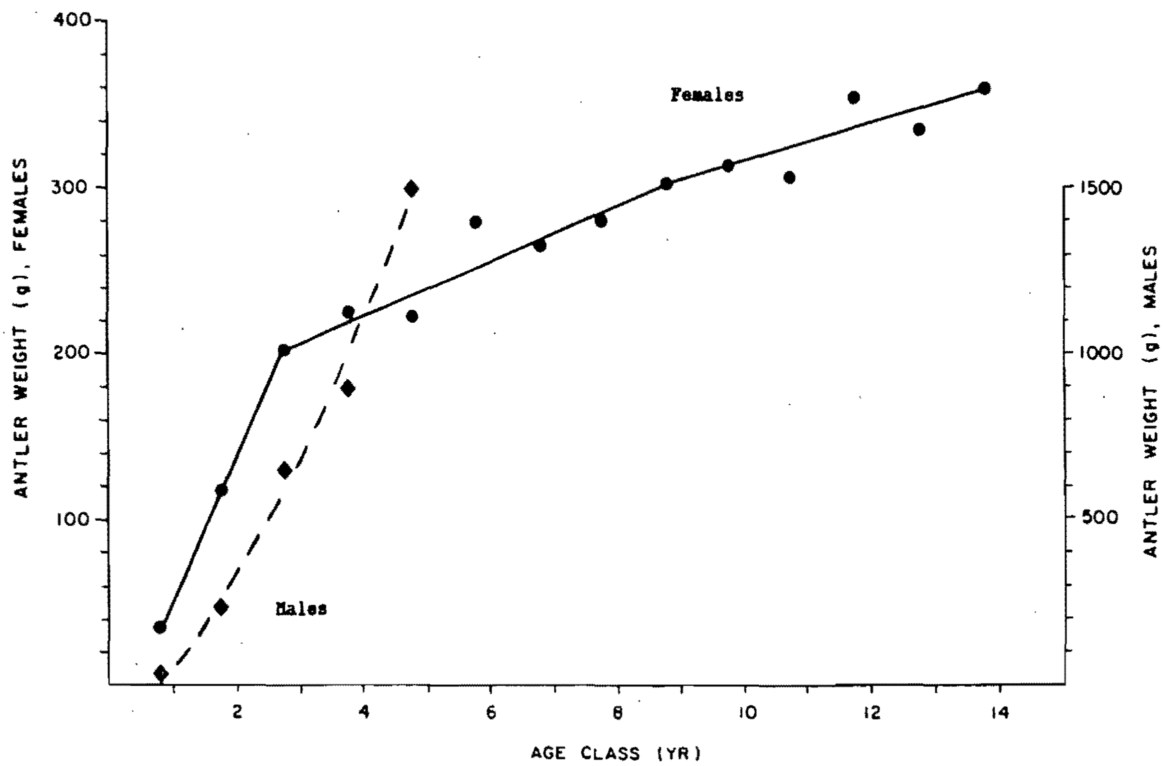

Figure 29. Mean weights of two antlers of female and male caribou sampled from the Beverly herd from 1982 through 1987.

Figure 30

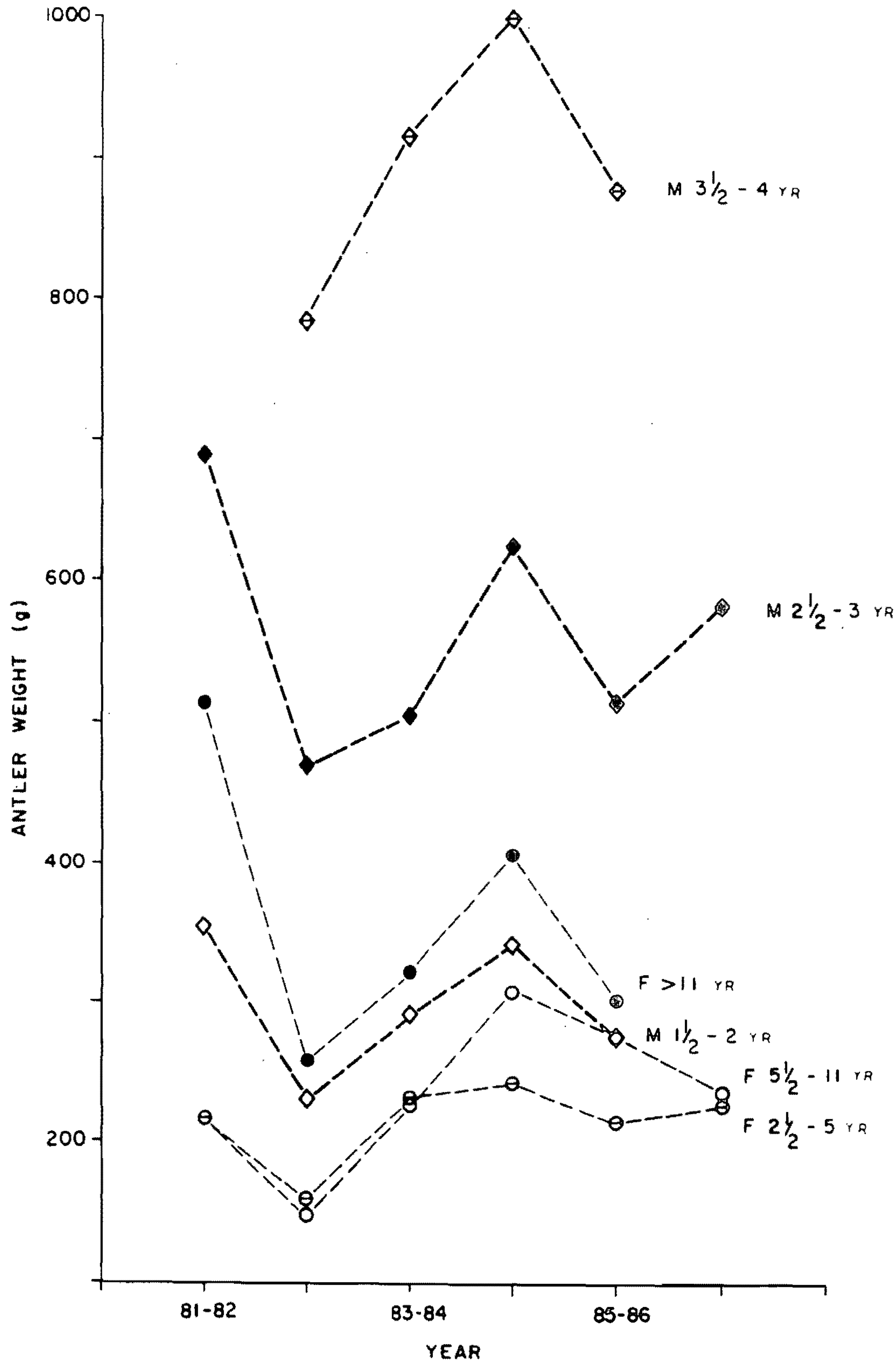

Figure 30. Mean antler weights of caribou sampled from the Beverly herd each winter from 1981-82 through 1986-87.

Lengths of leg bones

Lengths of femur, tibia, and metatarsus varied little from year to year (**App. 37-39**) and are summarized in **Table 40**. Growth of the metatarsus in females was essentially complete by age 1.5 years and at 2.5 years in males (**Fig. 31**). The tibia and femur of females had stabilized in length by age 2.5 years but in males they continued to lengthen until age 4.5 years.

Growth of the long bones of calves continued from December to March. Growth of the three bones increased from 1.4 to 2.2% in females and 4.6 to 4.9% in males (**Table 41**).

Ratios of metatarsus and femur lengths (MTL/FEL) indicated slight differences among years in age classes 1-8 years and negligible differences in older caribou. A relatively high or low ratio in calves was not consistently evident in yearlings the following year.

Mandible size

Mandibular and diastama lengths (Banfield 1961) continued to increase with age in both sexes but length of the mandibular tooth row stabilized after eruption of permanent dentition at age 2 years (**App. 40** and **41**). Mandibular length increased sharply until age 4.5 years (**Fig. 32**). Diastema growth corresponded to and accounted for about 45% of the growth of the mandible.

Girth

Girth measurements were obtained from 1982 through 1984 (**App. 42**). Early analysis indicated they were a poor index of condition and therefore we stopped taking such measurements. They provide a crude index of relative body size of

Table 40. Femur, tibia, and metatarsus lengths (mm) of caribou collected from the Beverly herd, 1982 through 1987.

Sex/age (yr)	Femur length			Tibia length			Metatarsus length		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	235.0	1.2	31	272.6	1.3	32	238.6	0.9	30
M 0.5-1	240.4	1.7	35	276.7	1.9	35	242.0	1.4	38
F 1.5-2	267.0	1.0	79	303.7	1.0	80	264.4	0.9	77
M 1.5-2	275.2	1.1	80	316.0	1.1	80	272.9	0.8	85
F 2.5-3	275.9	0.7	111	308.7	0.8	110	265.1	0.7	111
M 2.5-3	290.6	0.8	128	326.0	0.8	129	280.1	0.7	128
F 3.5-4	277.4	0.6	103	310.9	0.8	100	266.2	0.7	98
M 3.5-4	298.7	1.1	50	333.5	1.3	50	282.5	1.0	49
F 4.5-5	278.0	0.9	78	310.9	0.8	79	267.5	0.9	78
M 4.5-5	302.3	1.3	31	336.7	1.3	32	282.2	1.4	30
F >5	277.5	0.4	367	309.8	0.5	367	265.9	0.4	370
M >5	304.1	1.4	32	336.3	1.7	34	281.9	1.4	33
F >2	277.3	0.3	658	310.0	0.3	656	266.0	0.3	657
F >3	277.6	0.3	547	310.2	0.4	546	266.3	0.3	546
M >2	295.6	0.7	241	330.3	0.7	240	281.1	0.5	240
M >3	301.2	0.8	113	335.2	0.8	116	282.3	0.7	112

Figure 31

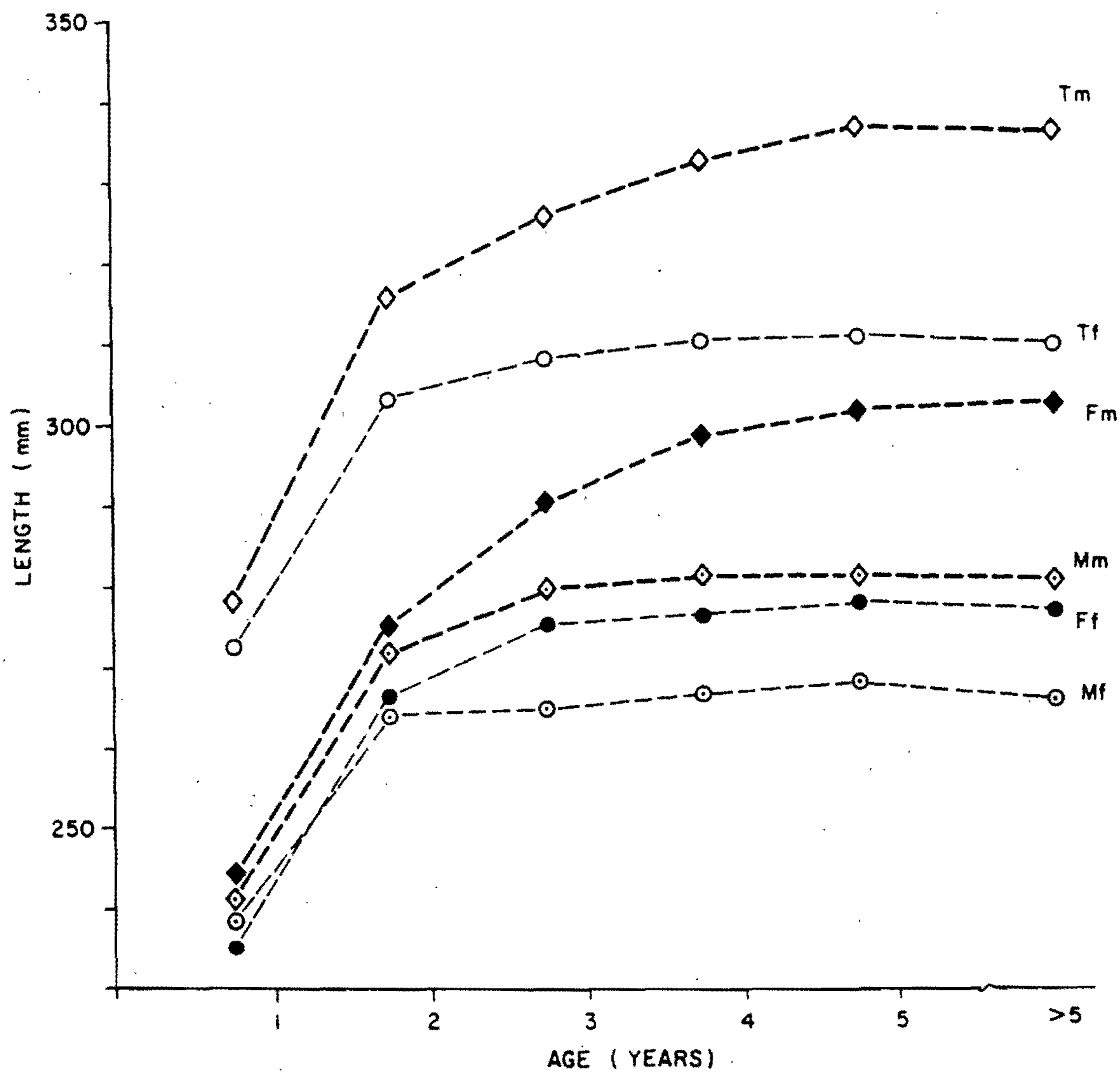

Figure 31. Mean femur (F), tibia (T), and metatarsus (M) lengths of male (m) and female (f) caribou in six age classes.

Table 41. Growth of the femur, tibia, and metatarsus in male (M) and female (F) caribou from approximately 6 to 9 months of age.

		Age	Femur			Tibia			Metatarsus		
Sex	Mo.	(mo.)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F	Dec	6	232.2	3.0	5	267.6	2.7	5	235.5	1.3	4
F	Mar	9	235.5	1.3	26	273.5	1.4	27	239.1	0.9	26
M	Dec	6	234.8	2.2	17	269.6	2.1	16	235.9	1.6	17
M	Mar	9	245.7	1.9	18	282.7	2.1	19	246.9	1.3	21

subspecies or caribou in different herds. A spring scale and a standard tension of say 2 kg should be applied to measurements of girth.

Parasites and diseases

Warble larvae

Numbers of larvae in December samples was highly variable (**App. 43**). In most cases, males had higher numbers than females within age classes and sampling periods. Generally, the numbers declined with age after age 1 year in females, whereas young and old males had the largest numbers. Numbers of larvae increased sharply from December to March (**App. 44, Table 42**). Sex differences continued in March samples as did age trends except that a decline with age in females was slight after age 2 years.

Warble larvae were detected in 74.6% (n = 240) and 98.4% (n = 123) of female and male caribou collected in December (**Table 43**). Incidences increased to 92.2% (n = 603) and 99.6% (n = 238) in females and males sampled in March.

Figure 32

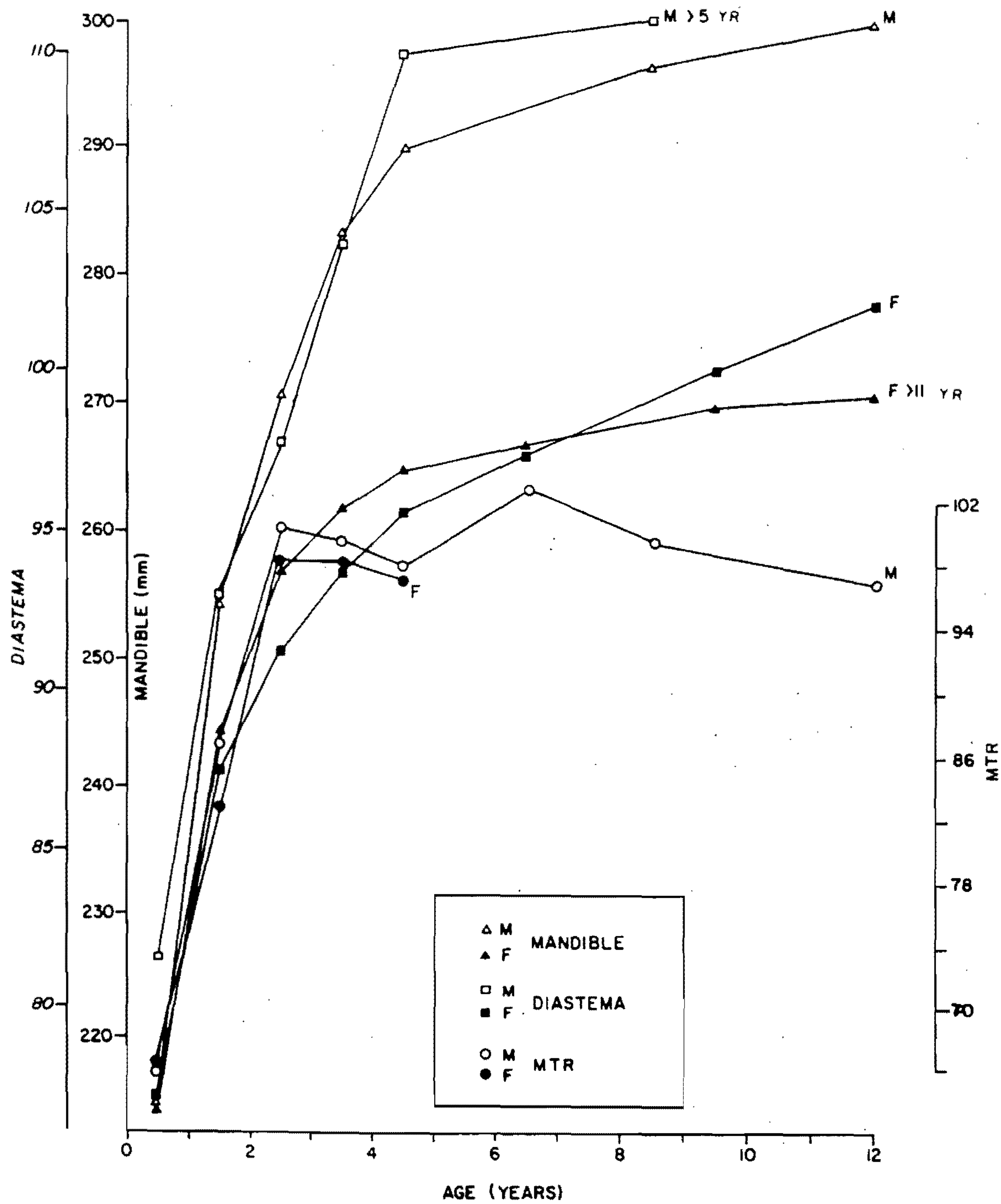

Figure 32. Mean lengths of the mandible, diastema, and molariform tooth row (MTR) of eight age classes of male and female caribou sampled from the Beverly herd from 1982 through 1987.

Table 42. Numbers of warble larvae under skin of caribou sampled from the Beverly herd in December (1982-86) and March (1980-87).

Sex/age (yr)	Numbers of warble larvae					
	December			March		
	Mean	SE	*n*	Mean	SE	*n*
F 0.5 - 1	18.8	3.7	5	124.7	13.9	29
M 0.5 - 1	65.3	13.5	15	118.7	17.8	20
F 1.5 - 2	23.7	4.0	26	114.2	11.5	59
M 1.5 - 2	47.6	6.3	26	171.1	15.9	57
F 2.5 - 3	14.1	2.9	30	45.7	5.1	82
M 2.5 - 3	18.4	2.8	42	93.1	9.3	90
F 3.5 - 4	5.8	1.5	38	46.2	4.9	61
M 3.5 - 4	25.9	5.2	24	80.8	10.1	28
F 4.5 - 5	12.2	7.0	25	28.3	3.8	56
M 4.5 - 5	77.0	20.9	10	145.5	42.6	20
F 5.5 - 8	10.5	2.5	58	36.1	3.7	153
F 8.5 - 11	4.2	1.2	22	37.1	4.9	91
F >11	5.4	2.3	18	35.9	5.4	36
F >5	8.2	1.6	98	36.4	2.7	280
M >5	147.7	48.9	6	222.6	35.6	23

Table 43. Frequency occurrence of warble larvae under skin of 1204 caribou sampled from the Beverly herd in December (1982-86) and March 1980-87).

Sex/age (yr)	Incidence of warble larvae: December samples, Percent	December samples, Sample size	March samples, Percent	March samples, Sample size
F 0 - 1	100	5	100	29
M 0 - 1	100	15	100	20
F 1.5 - 2	92	26	100	59
M 1.5 - 2	100	26	100	57
F 2.5 - 3	87	30	98	82
M 2.5 - 3	95	42	99	90
F 3.5 - 4	61	38	97	61
M 3.5 - 4	100	24	100	28
F 4.5 - 5	84	25	98	56
M 4.5 - 5	100	10	100	20
F 5.5 - 11	71	98	98	244
M >5	100	6	100	23
F >11	61	18	97	36
F >3	70	161	97	397
F totals	75	240	98	603
M totals	98	123	100	238

The high variability precluded significant differences among years. The 1983 values in females over 1 years old generally were higher than in most other years. Pooling of age classes of females 3 and 4 years and >4 years revealed relatively high values in March 1983 and low values from 1984 through 1986 (**Fig. 33**). Numbers of warble larvae in females 3 and 4 years old were relatively high in March of 1982, 1983, and 1984 and relatively low in March 1980, 1985, and 1986 (Fig. 33). Number of larvae in females >4 years old were relatively high in March of 1983 and remarkably uniform in other years. Numbers in 1981 were believed to be above average after considering the two curves and the small sample sizes (five and four).

Relationship between numbers of warble larvae and condition

Previous analysis of data from the December 1985 sample indicated a progressive decrease in numbers of warble larvae with age >1 year (Thomas et al. 1986). The hypothesis that a build-up of resistance occurred in older caribou was not supported but not rejected by data for males. The progressive decline in warble numbers was not evident in March samples, leading to speculation that development of larvae in December was retarded in older females. Analysis of data from the March 1986 sample revealed significant ($P < 0.05$) differences in back fat depths and kidney fat indices between females with greater than and less than the median number (equal numbers on each side) of warble larvae for age classes 3-5 years and >2 years.

We pooled data for all years and compared condition variables of individuals with more than and less than the mean number of warble larvae for individual sex and age classes. The results for December samples indicated a slight trend for more back fat in males with greater than average numbers of warble larvae. Generally,

Figure 33

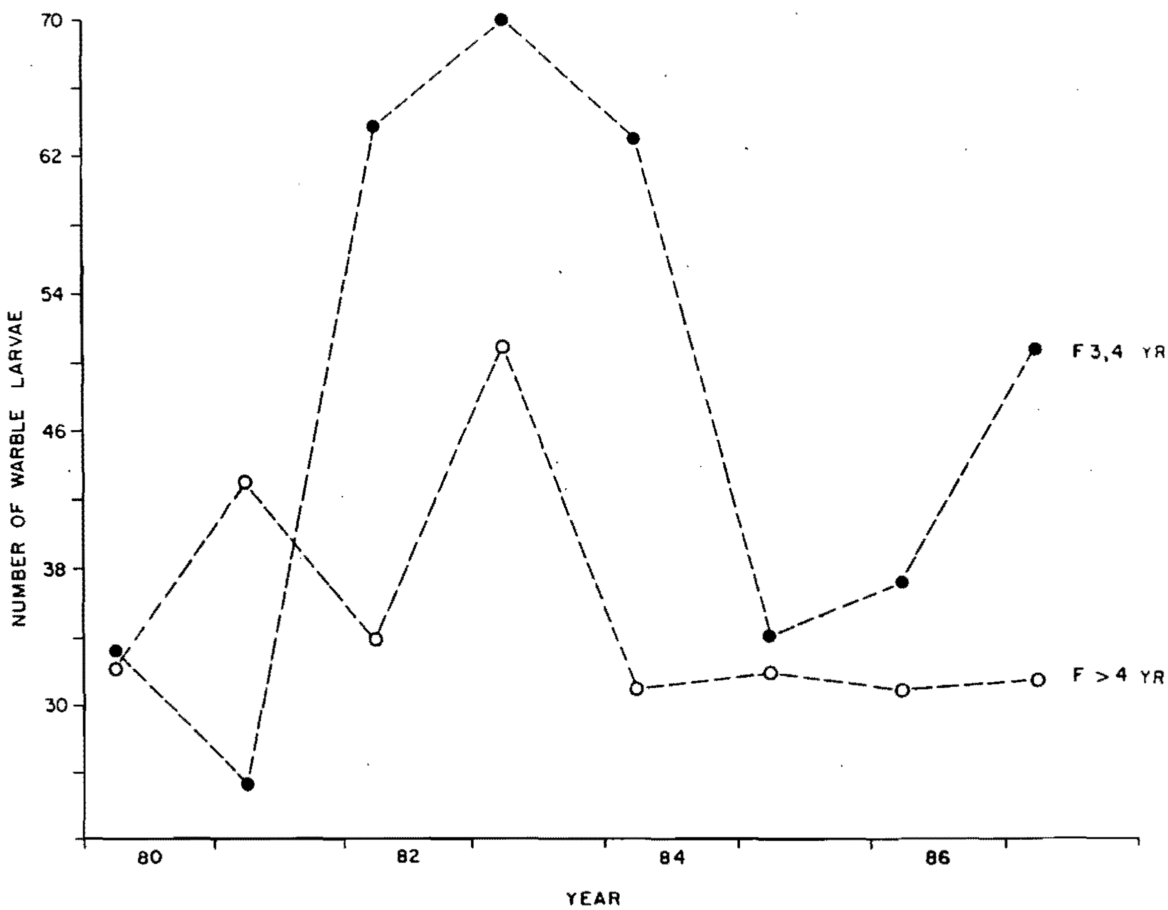

Figure 33. Average numbers of warble larvae in two age classes of female caribou sampled each March from 1980 through 1987.

females with greater than average back fat and kidney fat had fewer warble larvae (**Table 44**). Differences in body weight were less pronounced. In March samples, those differences were reduced and even removed in some classes of females (**Table 45**). Significant differences in the opposite direction occurred in two age classes of males.

Our results suggest that it is not warble larvae that caused lower fat reserves in females. Numbers and size of larvae are much greater in March than in December. It must be the response of caribou to harassment by the fly that results in lower fat reserves. Dieterich and Hass (1981) suggested that warble larvae could affect the health of caribou through nutritional imbalance, allergenic responses, and secondary infections.

These topics are discussed in a separate paper (Thomas and Kiliaan 1990). The only other review of possible effects of this parasite in caribou in Canada was published by Kelsall (1975).

Lung cysts

Two caribou in a sample of 115 obtained at Porter Lake in March 1984 were infected with hydatid cysts (*Echinococcus granulosis*). There was no systematic search of lungs for cysts and therefore small cysts may have not been detected by the skinners. Beginning in March 1985, all lungs were searched for cysts by palpation. Incidence of cysts varied between 2 and 4.7% in five samples obtained in 1985 through 1987 (**Table 46**). Overall incidence was 3.9%.

Details of 23 infected caribou revealed that 20 of them were females, the youngest was approaching 3 years of age, and most (78%) were older than 5 years (**App. 45**). The incidence in caribou over 5 years old was 10.1%.

Table 44. Primary condition variables in caribou having fewer than (<) and more than (>) the mean number of warble larvae for that sex and age class in December samples obtained from the Beverly herd, 1982 through 1986.

Sex/ age (yr)	Mean no. of larvae	Body weight (kg)		Back fat (mm)		Kidney fat (g)	
		<mean	>mean	<mean	>mean	<mean	>mean
F 0.5	18.8	44.0	41.0	2.3	1.0	26.0	21.0
M 0.5	65.3	44.1	44.3	0.8	1.4	29.3	25.7
F 1.5	23.7	61.1	62.9	8.1	4.5	56.6	43.5
M 1.5	47.6	69.8	67.5	1.4	2.7	38.8	42.2
F 2.5	14.1	74.0	75.8	13.6	9.0	82.2	68.0
M 2.5	18.4	84.0	89.0	0.8	0.8	45.3	42.2
F 3.5	5.8	83.6	**78.7***	18.1	8.2	87.0	**60.6***
M 3.5	25.9	97.5	102.0	1.0	1.6	50.0	48.4
F 4.5	12.2	83.2	82.3	11.8	3.0	86.7	62.3
M 4.5	77.0	106.2	112.9	0.3	0.5	52.1	42.3
F >4.5	8.2	85.6	**78.6****	15.4	6.0	83.1	68.0
M >4.5	147.7	107.7	114.7	1.7	3.3	53.7	82.7

* $P < 0.05$.
** $P < 0.01$.

There was evidence that some caribou with numerous large cysts were in poorer than average condition (App. 45, Thomas and Kiliaan 1990). Cause and effect remain speculative but infection is unlikely to be related to condition but rather to chance ingestion of a variable number of eggs of the parasite on vegetation

Table 45. Primary condition variables in caribou having fewer than (<) and more than (>) the mean number of warble larvae for that sex and age class in March samples obtained from the Beverly herd, 1982 through 1987.

Sex/ age (yr)	Mean no. of larvae	Body weight (kg)		Back fat (mm)		Kidney fat (g)	
		<mean	>mean	<mean	>mean	<mean	>mean
F 1	124.7	42.5	42.2	1.0	1.1	27.6	24.8
M 1	118.7	46.6	49.4	0.7	1.3	29.4	31.6
F 2	114.2	60.3	64.0	3.9	4.3	55.8	57.6
M 2	171.1	67.0	66.9	1.5	1.1	44.6	45.6
F 3	45.7	77.3	76.1	13.4	12.5	100.5	83.9
M 3	93.1	80.9	**84.8***	1.3	2.0	57.8	62.4
F 4	46.2	81.8	**76.1***	16.7	10.0	110.0	**79.4***
M 4	80.8	92.7	94.5	1.4	2.5	66.6	59.6
F 5	28.3	84.1	81.7	13.7	14.3	110.4	95.4
M 5	145.5	99.7	108.8	2.8	9.5	69.9	99.5
F >5	36.4	86.0	84.4	15.9	11.9	111.0	**90.8****
M >5	222.6	107.3	109.4	2.3	9.3	70.0	95.8*

* $P < 0.05$.
** $P < 0.01$.

or in water. Wolves, foxes, and dogs are host of a small (2-8 mm) adult tapeworm. About 20-30% of wolves usually are infected and probably most old wolves harbor worms.

Table 46. Incidence of liver and lung cysts in caribou of the Beverly herd sampled from March 1985 through March 1987.

Month/ year	*Taenia hydatigena* Sample size	Cyst(s) present	Percent frequency	*Echinococcus granulosis* Sample size	Cyst(s) present	Percent frequency
Mar 85	169	25	15	162	8	4.3
Dec 85	77	23	30	78	2	2.6
Mar 86	149	32	21	150	7	4.7
Dec 86	50	11	22	49	1	2.0
Mar 87	40	9	23	49	1	2.0

Liver cysts

Cysts of the tapeworm *Taenia hydatigena* were not detected in livers of 17 calves. Incidence in older caribou ranged from 11.3% (4.5-5 years) to 27.2% (5.5-11 years). There was no difference between the sexes. Incidence in 11 caribou 1.5-5 years old was 17.5% (n = 177). Most of the livers were examined quickly for obvious cysts on or near the surface.

In December 1985, a cursory look at livers of 33 caribou sampled the first day of the collection period revealed only four with cysts. A careful examination of livers of 44 caribou collected on the second and third days revealed 19 with one or more cysts. The much higher incidence was attributed in part to the closer inspection and also to a higher incidence of cysts in caribou obtained after the first day.

Cysts are small (5-7 mm) but they are readily detected because of a white center. Cysts are almost exclusively confined to the surface of livers. The adult tapeworm occurs in most wolves older than pups.

Nose bots

Nose bots result from development of larvae after eggs are deposited in nostrils of caribou by the parasitic fly (*Cephenemyia tarandus*). The larynx and particularly the retro-pharyngeal pouches of caribou were carefully checked for larvae. One was reported by an aboriginal employee while removing flesh from heads of seven caribou retained in March 1984 for skull measurements. It may have been a warble larva. No bots were found in the 367 caribou examined intensively for them in March of 1985 through 1987. Larvae may go undetected in December samples because of their small size at that time.

Hookworms

Fecal samples from each collection, 1982 through 1987, were sent to Dr. Murray Lankester, an authority on the round worm *Elaphostronglylus* spp. Infection incidence of *E. andersoni* was high. For example, in December 1983 and March 1984, incidences were 35% (n = 142) and 60% (n = 53), respectively. The incidence in age classes 1, 2, 3, 4, 5, 6-11, and >11 were 94, 77, 65, 50, 41, 46, and 31%, respectively. Thus, some resistance to the parasite may be acquired with age. Data from the Beverly herd served as a basis for a master's thesis that was published (Fruetel and Lankester 1989, Lankester and Hauta 1989).

Besnoitia

A protozoan parasite *Besnoitia tarandi* was observed in some caribou examined in November 1982 by veterinarian Dr. Eric Broughton. That parasite causes surface of bones and tendons to become granular and rough to the touch. Usually there is some discoloration at an infected site. The parasite cycles through caribou and a carnivore (dog, wolf, or fox). Choquette et al. (1967) first reported the parasite's occurrence in caribou in northern Canada.

Brucellosis

In March 1983, two of 118 caribou tested positive for antigen of brucella (*Brucella suis*) and two others were suspect. Broughton et al. (1970) found 14 reactors among 320 caribou tested in the 1960s in the Kaminuriak herd. We found no evidence of swollen joints, abortion, or other clinical signs associated with the disease in some herds. Brucellosis is a problem in caribou on Baffin Island with incidences of 20% (17-35%) in 1983 and 1984 (E. Broughton, pers. commun.).

Diet

Results from macrohistological analyzes of rumen contents of caribou obtained in 1980 and 1981 were reported (Thomas and Hervieux 1986). Fecal and rumen samples were collected at each sample period. Results of a microhistological analysis of all samples collected from 1980 through 1987 are in a separate paper (Thomas and Barry 1991). Lichens usually comprised 85-90% of plant fragments in rumen and fecal pellets in December and March. Many earlier results based on analyzes of rumens probably underestimated proportionate intake of lichens and their relative value.

Reproduction

Age-specific fecundity and relationships between condition variables and fertility are treated in the second report in this series (Thomas and Kiliaan 1998b) and in a publication (Thomas et al. 1990).

Fecundity of females increased with age and was closely related to physical condition. There was no decrease in pregnancy rate of females >11 years of age. In fact, they had the highest mean pregnancy of all the "standard" age classes. There was a low rate of embryo loss and fetal abortions.

DISCUSSION

Age structure and life table

Caughley (1966, 1977) set out conditions that should be met before a life table is constructed from data on mortality or survivorship (our data): a stable age distribution, samples obtained at or near the "birth pulse", and adequate sample sizes.

The Beverly herd was approximately stable in numbers throughout our study and back to 1967 (**Table 47**). Our life table was based on cohorts up to 1984. Population estimates were obtained by the NWT Wildlife Service every 2-4 years based on estimated numbers of caribou on the calving grounds in early June, estimated composition of caribou on the calving grounds, estimated composition of males and females in the population, and estimated fecundity (Heard pers. commun.).

Estimates of numbers of caribou on calving grounds are based on visual strip surveys and strip photographic counts (Table 47). Only estimates based on visual surveys provide long-term trend data; photographic counts are available only for 1982, 1984, 1985, and 1988. Photo counts generally produce estimates 1.5-2.5 times larger than visual estimates and occasionally much higher (Heard 1985). The wide confidence limits (approximately 40-60% of the mean and twice the standard error) in herd estimates lead to no firm conclusion about population change during the current study. Heard and Jackson (1990) concluded that the Beverly herd was stable in numbers from 1984 through 1990 based on recruitment and kill data and photo-based herd estimates (x 1000) of 200 (150-240 = ± SE) in 1982, 335 (250-420) in 1984, and 190 (120-260) in 1988 (Heard et al. 1990).

Data on recruitment, the proportion of 1-year-old caribou added to the

Table 47. Estimated size of the Beverly herd based on visual and photographic, aerial, strip surveys on calving grounds in June (young calves excluded).

	Visual survey				Photographic survey			
	Calving ground		Herd size		Calving ground		Herd size	
Year	Total[1]	Breed.F	Mean	SE	Total	Breed.F	Mean	SE
1967[1]			159,000					
1971	84,900	65,300	187,900					
1974	71,000	54,600	157,100					
1974	69,500	53,400	153,900					
1978	52,400	42,500	125,600					
1980	46,600	37,300	114,300					
1982[2]	55,663	43,166	120,484	51,932	93,539	73,597	164,338	72,332
1984[2]	57,552	45,786	131,823	27,378	139,786	114,484	263,691	80,652
1987[2]	49,109	32,491	93,546	19,423				
1988[2]	23,994	17,600	50,673	16,653	108,270	82,300	189,561	70,961
1993[3]	Not conducted				52,500	37,700	87,000	17,900
1994[3]	Not conducted				151,000	120,000	276,000	106,000

[1] Thomas 1969, survey of caribou in spring migration.
[2] Heard and Jackson 1990.
[3] Williams pers. commun.

population annually, for the period 1978 to 1987, indicates values ranging from about 10% to 21% with an average of 16.5% (Table 9).

The age distribution differed (G test) among winter periods for several reasons, including sampling error, variations in calf survival, and perhaps, changes in population size (related to calf survival and hunting mortality).

A statistician's requirement for life table construction and analyzes is a stationary age distribution, which means that not only does the proportion of individuals in each age class remain constant but the numbers in age classes are also static. This restriction implies zero growth and constant recruitment, which never occurs in nature. Adjustments can be made for population growth (Caughley and Birch 1971) and variations in recruitment (and sampling error) are accommodated by fitting a smooth curve through the data points (Caughley 1977).

Our pooling of data for 8 years produced a remarkably-smooth curve that represents the average age distribution of females >2 years old for that period. The resulting fitted survivorship curve is a best estimate of the real age distribution, although it does not satisfy all statistical requirements. A problem of sampling at the birth pulse (Caughley 1977) was overcome by constructing the survivorship curve for the interval data and extracting data from the polynomial for the birth period (ages 3.0, 4.0 years, etc.).

Shooting of animals that are indistinguishable because of size should provide a bias-free sample. Such was the case with females >2.5 years. Ages of females in the collection area might not have been representative of the population. This potential bias was minimized by sampling for several days as caribou passed by our camp. The life table and derived mortality statistics are discussed in a separate paper (Thomas and Barry 1990).

Condition of the Beverly *versus* other herds

November/December body weights for three herds suggest that individuals in the Beverly herd are the lightest in most sex/age categories (**Table 48**). Caribou sampled from the Bluenose herd in 1976 generally were the heaviest, although sample sizes were small and absence of variation statistics precludes statistical comparisons. In some classes, particularly calves, caribou in the Bluenose herd

Table 48. Mean body weights of male and female barren-ground caribou sampled from three herds in late November-early December (sample sizes in parentheses).

Age (yr)	Body weight (kg) Females Bluenose[1]	Beverly	Kaminuriak[2]	Males Bluenose[1]	Beverly	Kaminuriak[2]
0.5	60.5 (3)	42.8 (5)	42.4 (13)	64.2 (2)	44.2 (17)	47.4 (12)
1.5	68.9 (7)	61.9 (26)	64.1 (10)	86.7 (6)	68.9 (26)	69.8 (13)
2.5	91.1 (3)	74.4 (30)	75.9 (22)	107.8 (4)	86.2 (41)	90.2 (14)
3.5	83.9 (3)	82.3 (41)	85.7 (16)	102.2 (1)	99.3 (25)	102.4 (32)
>3.5	97.5 (10)	83.7 (125)	89.8 (50)	116.6 (7)	109.5 (17)	107.5 (24)

[1] Extrapolated from Fig. 26 of Hawley et al. 1979.
[2] Extrapolated from Fig. 11 of Dauphiné 1976.

were much heavier than in others. In fact, they were approximately the weight of caribou a year older in other herds.

A review of back fat depths in the three herds revealed similar values for male caribou and females >2.5 years (**Table 49**). Females 0.5, 1.5, and 2.5 years in the Bluenose herd had thicker back fat than their counterparts in other herds. Yearling females in the Kaminuriak herd had comparatively little back fat.

Kidney fat weights and kidney fat indices of caribou in the three herds in November/December revealed small differences among age classes of both sexes (**Tables 50** and **51**), except that yearling females from the Kaminuriak herd had less kidney fat than their counterparts in the other herds.

The lighter weights of Beverly herd caribou may indicate a slightly smaller

Table 49. Mean depths of back fat in male and female barren-ground caribou sampled from three herds in late November-early December.

Age (yr)	Mean depth of back fat (mm)					
	Females			Males		
	Bluenose[1]	Beverly	Kaminuriak[2]	Bluenose[1]	Beverly	Kaminuriak[2]
0.5	6.0 (2)	0.9 (5)	1.8 (5)	0.9 (3)	0.2 (12)	1.1 (16)
1.5	16.0 (7)	1.0 (8)	6.5 (26)	4.5 (6)	0.6 (13)	1.9 (25)
2.5	22.0 (5)	12.4 (22)	12.4 (30)	0.7 (5)	0.8 (14)	0.8 (42)
3.5	12.0 (1)	12.4 (16)	15.3 (39)	0 (3)	0.4 (30)	1.2 (25)
>3.5	9.7 (3)	12.4 (50)	12.5 (125)	0 (3)	0.2 (24)	1.1 (17)
>1.5	16.8 (9)	12.4 (87)	13.1 (194)			

[1] Extrapolated from Fig. 27 in Hawley et al. (1979)
[2] Dauphiné 1976.

body size in light of similar fat reserves among the herds. Changes in weight from one November/December to the next were similar for females in the Kaminuriak and Beverly herds (**Table 52**). Male caribou in the Beverly herd stopped increasing in weight at an earlier age than Kaminuriak males.

Mandible and diastema lengths of caribou >2 years old in the Kaminuriak (Miller 1974) and Beverly herds were almost identical (**Table 53**). Sample sizes ranged from 31 to 186.

Girth of females >3 years old averaged respectively 113.5 cm and 114.4 cm for samples from the Beverly herd (n = 280) and Kaminuriak herd (n = 310) (Dauphiné 1976).

Metatarsal length were measured differently and are not comparable between herds. Measurements of hard tissues are preferable to others for size comparisons.

Table 50. Mean weights of kidney fat of male and female barren-ground caribou sampled from three herds in late November-early December.

	Weight of kidney fat (g)					
Age	Females			Males		
(yr)	Bluenose[1]	Beverly	Kaminuriak[2]	Bluenose[1]	Beverly	Kaminuriak[2]
0.5	31.9 (2)	24.4 (11)	24.0 (5)	33.8 (3)	25.7 (12)	28.7 (16)
1.5	52.3 (7)	38.2 (9)	50.6 (24)	52.2 (6)	48.6 (13)	40.2 (25)
2.5	69.7 (5)	63.8 (22)	78.3 (29)	48.7 (5)	57.0 (14)	44.0 (42)
3.5	70.3 (1)	73.7 (16)	80.0 (41)	49.3 (3)	53.6 (30)	49.2 (25)
>3.5	73.7 (3)	71.6 (50)	79.3 (100)	62.2 (3)	48.9 (22)	55.5 (17)

[1] Extrapolated kidney fat indices (Fig. 28 of Hawley et al. 1979) converted to kidney fat using kidney weights from this study.
[2] From Tables A.3 and A.4 and Fig. 16 in Dauphiné (1976).

Table 51. Mean kidney fat indices of male and female barren-ground caribou sampled from three herds in late November-early December.

	Kidney fat index					
Age	Females			Males		
(yr)	Bluenose[1]	Beverly	Kaminuriak[2]	Bluenose[1]	Beverly	Kaminuriak[2]
0.5	33.1 (2)	25.3 (11)	25.4 (5)	31.7 (3)	25.3 (12)	26.2 (16)
1.5	37.8 (7)	28.4 (9)	36.7 (24)	33.6 (6)	31.6 (13)	26.3 (25)
2.5	45.9 (5)	38.2 (22)	51.7 (29)	26.8 (5)	33.2 (14)	24.7 (42)
3.5	42.1 (1)	44.1 (16)	47.9 (41)	23.2 (3)	27.5 (30)	23.5 (25)
>3.5	41.5 (3)	42.9 (50)	45.4 (125)	25.6 (3)	24.6 (22)	23.2 (17)

[1] From Fig. 28 in Hawley et al. 1979 (assuming sample size was the same as in Fig. 27).
[2] Dauphiné 1976.

Table 52. Mean weight changes at 1 year intervals in male and female caribou sampled from the Kaminuriak herd in November, 1966-68, and the Beverly herd in December, 1982-86.

Age interval (yr)	Percent change in weight			
	Kaminuriak[1]		Beverly	
	Males	Females	Males	Females
0.5 to 1.5	46	51	56	45
1.5 to 2.5	28	18	25	20
2.5 to 3.5	14	12	15	11
3.5 to 4.5	15	6	9	9
4.5 to 5.5	19	0	1	-3

[1] Dauphiné 1976.

Condition changes over winter between caribou herds

Female caribou in the Kaminuriak herd lost significant (6-11%) weight from November/December to April (Dauphiné 1976). Females in our samples changed little in weight from early December to late March (**Fig. 34**).

Depths of back fat were quite stable from December to March in caribou sampled from the Beverly herd. Mean depth of back fat declined from 16 mm in November/December to 7 mm in April in pregnant females 3-9 years old that were collected in 1966-68 from the Kaminuriak herd (Dauphiné 1976).

Kidney fat weights increased sharply from December to March in adult females collected from the Beverly herd. In females 3-9 years old collected from the Kaminuriak herd, mean kidney fat of pregnant and non-pregnant classes decreased from 74 to 54 g and from 45 to 37 g, respectively (Dauphiné 1976).

Figure 34

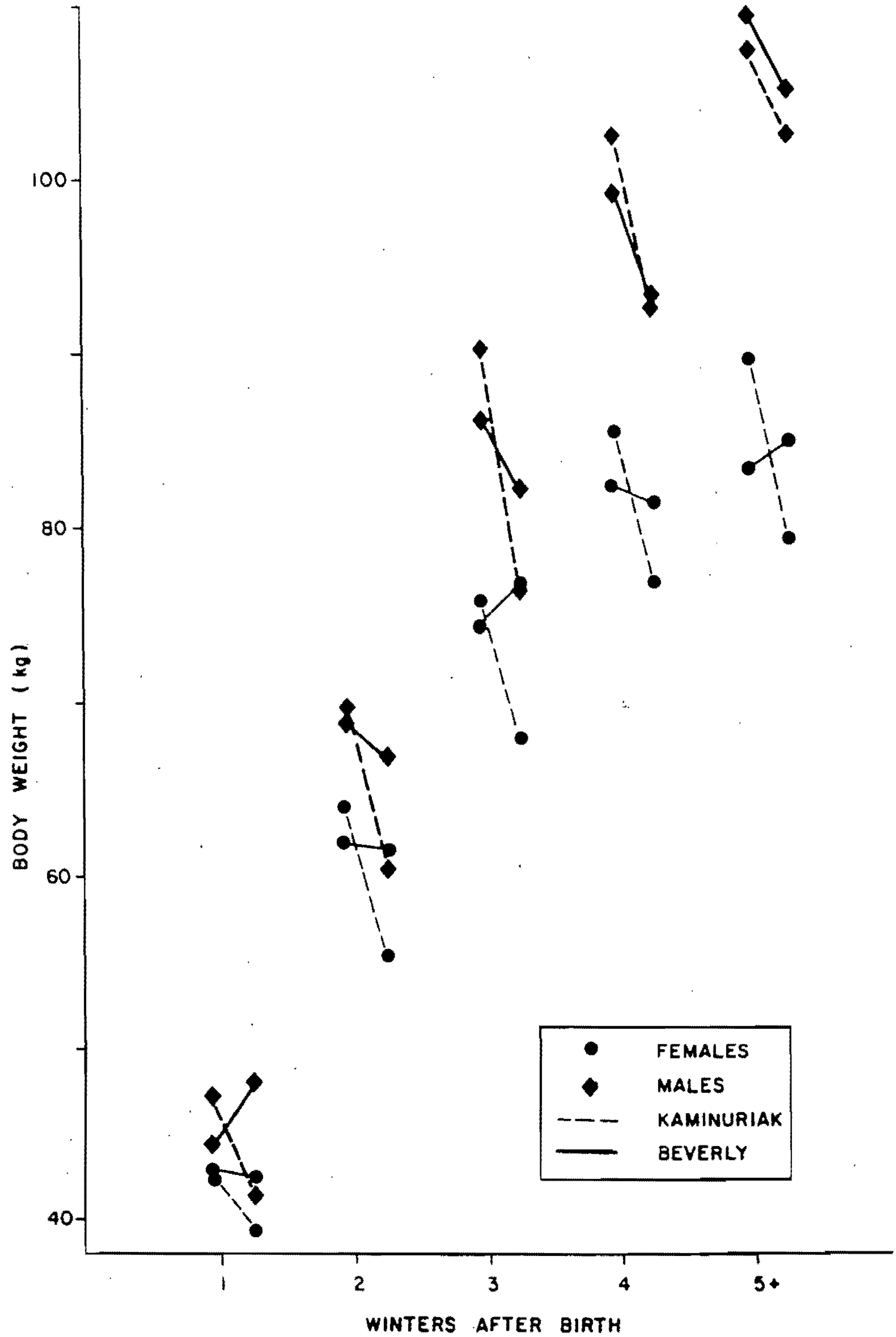

Figure 34. Over-winter changes in weight of male and female caribou in their first through fifth-plus winters that were collected from the Kaminuriak (Dauphiné 1976) and Beverly herds.

Table 53. Mandibular and diastema lengths of caribou sampled from the Beverly and Kaminuriak herds.

Sex/ age (yr)	Mandible length (mm)[1] Beverly	Kaminuriak[2]	Diastema length (mm) Beverly	Kaminuriak
F 2	244	254	88	91
M 2	254	265	93	96
F 3-5	261	259	93	94
M 3-5	277	279	101	104
F 6-9	267	264	98	98
M 6-9	293	289	111	113
F >9	271	264	102	100

[1] Anterior bone to base of ramus (Banfield 1961).
[2] Miller 1974.

Those data all indicate that the Beverly herd experienced better winter range conditions from 1980 through 1987 than did the Kaminuriak herd from 1966 through 1968. Therefore, there was no evidence that winter range of the Beverly herd was inadequate for the population of caribou in spite of vast areas burned since 1969 in the western and southern portions of historical winter range.

Relationships among condition variables

It became obvious in the field and was confirmed during this analysis that condition variables were closely related. The degree of correlation will be explored in subsequent publications.

CONCLUSIONS

1. Winter range of the Beverly herd was judged to be adequate in quantity and quality for the 1980-87 caribou population based on changes in condition variables from December to March compared with changes in the same variables in the Kaminuriak herd in 1966-68. The Kaminuriak population was estimated to be much smaller (68,000) and its winter range was lightly burned in the several decades before the 1960s.

2. Body weight of both sexes tended to decline slightly from December to March but rarely were the differences significant in the six (males) and seven (females) age classes selected for this study. In contrast, female caribou 3-9 years old in the Kaminuriak herd lost several kilograms from late November to April (Dauphiné 1976).

3. Back fat depths remained about constant from December to March in contrast to significant ($P < 0.05$) declines (16 to 7 mm) in pregnant females in the Kaminuriak herd.

4. From December to March, weight of kidney fat increased sharply and significantly in both sexes and in almost all age classes over 2 years. In sharp contrast, kidney fat of females in the Kaminuriak herd decreased over winter, e.g., from 78 to 54 g in pregnant females 3-9 years old (Dauphiné 1976).

5. Kidney weights declined significantly from December to March and most considerably in 1984-85; increased in the non-winter periods of 1982, 1983, and particularly 1984; and then decreased by 1987 for unknown reasons.

6. Variations in kidney weights decreased the value of kidney fat indices related to kidney weights as well as estimates of body fat based entirely on them (FAT) or in part on them (CONINDEX and FATP). This problem was overcome by using body

weight and femur length as a means of reducing age differences and thus permitting larger groupings of age classes.

7. The best indices of condition based on two or more variables were DFAT (based on depth of back fat and weight of kidney fat) and CIA (based on weight, back fat, kidney fat, and femur fat). Deletion of femur fat would not reduce the value of the CIA index.

8. Antler weights appear to be a useful indicator of environmental conditions during the summer period.

9. Warble larvae were particularly numerous in March 1982, 1983, and 1984 in females 3 and 4 years old and in March 1983 in older females. Numbers of larvae in December and, to a lesser extent, in March was related to degree of fatness. Harassment of caribou by warble flies rather than effects of larvae was believed to affect condition of caribou.

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Appendix 1. Average whole body weights of Beverly herd caribou sampled in late November and early December from 1982 through 1986.

Sex/age	Body weight (kg)[1]														
	1982[2]			1983[3]			1984			1985			1986		
(yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							47.5	2.5	2	36.8		1	40.8	4.3	2
M 0.5	42.0	2.2	5	44.1	1.4	7	47.1	0.3	4				40.5		1
F 1.5	60.9	2.6	8	54.6	1.6	7	65.3	1.3	6	69.2	2.2	4	69.5		1
M 1.5	65.8	3.3	7	67.0	2.1	6	76.3	3.7	5	69.1	1.5	6	66.3	1.3	2
F 2.5	70.3	0.7	3	73.8	1.7	6	74.3	3.4	7	76.6	1.9	6	74.2	2.2	8
M 2.5	82.2	2.6	5	84.5	2.0	14	89.3	3.0	7	88.8	3.0	10	84.2	5.4	5
F 3.5	80.6	1.4	6	79.1	3.6	5	83.9	2.1	11	81.8	1.6	13	83.6	2.1	6
M 3.5	94.9	2.4	7	102.8	2.9	6	100.9	3.2	5	98.1	2.8	6	105.0		1
F 4.5	79.4	3.7	4	81.0	3.3	4	83.4	3.5	5	83.5	3.7	4	84.8	3.3	8
M 4.5	106.0	3.5	2	106.8	2.5	2	113.0	10.2	3	104.3	2.5	2	110.0	4.5	2
F5.5-10.5	81.8	1.6	21	81.6	2.0	16	88.5	1.4	15	87.2	1.7	18	78.6	2.0	11
M5.5-10.5	106.5	9.0	2				115.0		1	112.7	1.2	3			
F >10.5	77.7	2.4	3	83.5	2.5	2	85.8	2.8	6	84.8	3.3	6	85.8	1.8	2
F >2.5	81.0	1.1	34	81.3	1.4	27	86.1	1.1	37	85.0	1.1	41	82.3	1.4	27
F >3.5	80.8	1.3	28	81.5	1.5	22	86.7	1.2	26	86.2	1.4	28	81.6	1.7	21
F >4.5	81.1	1.4	24	81.7	1.7	18	87.5	1.3	21	86.6	1.5	24	79.7	1.7	13

[1] Means calculated from values with one decimal place. Other data concerning weights may be based on weights rounded upward to nearest integer, a quirk of the data base program.
[2] Late-November sample.
[3] Subherd A sampled at Sifton Lake.

Appendix 2. Average whole body weights of caribou sampled from the Beverly herd each March from 1980 through 1987.

Sex/age	Mean body weight (kg)[1]																										
	Mar 1980			Mar 1981			Mar 1982			Mar 1983			Mar 1984B[2]			Mar 1984A[3]			Mar 1985			Mar 1986			Mar 1987		
(yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	37.5	2.5	2				42.6	1.1	13	40.8	1.2	5	41.8	0.5	4				44.5	1.3	3	44.0	2.5	4			
M 1	42.5		1	47.5	2.5	2	50.1	1.3	7	45.8	2.2	3	45.3	0.6	4				50.9	1.0	4	44.0		1			
F 2	54.4	2.3	4				59.4	1.7	13	57.6	1.0	15	63.2	3.1	9	59.2	2.1	3	68.5	2.3	10	65.4	2.3	9	61.5	3.5	2
M 2	54.0		1	59.8	0.3	2	66.7	2.0	12	64.5	0.8	21	65.2	6.4	5	61.8	2.3	4	73.7	1.8	9	70.7	2.0	9	76.0		1
F 3	72.4	1.8	10	62.3		1	75.2	2.3	8	71.7	1.8	12	80.5	1.4	11	76.8	3.8	2	80.3	1.6	22	78.0	2.3	14	75.7	3.9	7
M 3	75.0	2.7	5				85.7	1.2	27	79.8	1.6	19	80.9	4.3	7	71.8	2.5	6	86.0	2.1	19	80.9	1.6	15	79.8	8.6	2
F 4	74.0	3.0	2	84.1	3.2	2	74.3	2.1	2	76.4	2.6	11	81.2	5.1	3	76.4	1.6	5	83.2	1.7	20	80.4	2.2	15	70.6	2.6	5
M 4	84.8	2.3	2				96.0	5.0	2	93.1	2.1	8	100.3	1.0	4	85.0	2.4	3	90.5	7.6	3	95.0	3.7	9	93.0		1
F 5							81.8	2.4	10	74.7	5.0	6	86.8	2.2	12	78.0		1	87.6	2.0	10	83.7	2.5	10	80.5	2.8	8
M 5	101.5		1				95.0	3.4	3	95.0	0.6	3	105.2	8.2	3				115.8	3.8	2	100.1	1.1	7	102.5	7.5	2
F 6-11	81.0	1.8	12	84.7	5.1	3	86.0	0.9	34	80.3	1.0	44	88.0	1.0	43	77.7	2.5	8	89.2	0.9	49	86.1	1.2	42	81.4	1.9	21
M >5	109.1	2.4	10				102.0		1	113.0	4.0	2	117.8	5.0	4	92.7	3.0	3	126.0		1	104.0	3.7	6	104.5		1
F >11							86.0	3.7	6	82.3	2.4	8	88.1	2.9	5				91.7	2.4	10	86.4	1.6	8			
F >3	80.0	1.6	14	84.6	2.6	5	84.7	0.9	52	79.6	0.9	69	87.5	0.9	63	77.3	1.4	14	88.1	0.8	89	84.9	0.9	75	79.9	1.5	34
F >4	81.0	1.8	12	84.7	5.1	3	85.1	0.9	50	80.2	1.0	58	87.8	0.9	60	77.8	2.0	9	89.5	0.8	69	85.9	0.9	60	81.4	1.5	29
F >5	81.0	1.8	12	84.7	5.1	3	86.3	1.0	40	80.7	0.9	52	88.1	0.9	48	77.7	2.3	8	89.6	0.8	59	85.1	1.9	51	81.7	1.8	21

[1] Means calculated from values with 1 decimal place. Other data concerning weights may be rounded up to the nearest integer.
[2] Subherd B sampled at Porter Lake.
[3] Subherd A sampled at Sifton Lake.

Appendix 3. Body weights of female caribou sampled from the Beverly herd each March from 1980 through 1987: (A) pregnant, unadjusted; (B) pregnant, less weight of uterine contents; and (C) not pregnant.

		Body weight (kg)[1]																							
Age		March 1980			March 1981			March 1982			March 1983			March 1984[2]			March 1985			March 1986			March 1987		
(yr)	State	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
2	A							62.7	-	1				72.7	4.3	3	73.6	2.7	4						
	B							59.0		1				69.6	4.3	3	70.6	2.7	4						
	C	54.4	2.3	4				59.2	1.8	12	57.6	1.0	15	58.7	1.8	9	65.3	2.6	6	65.4	2.3	9	61.5	3.5	2
3	A	76.1	2.3	5				78.1	1.8	6	75.8	2.4	6	79.9	1.3	13	81.8	1.6	19	80.8	2.3	11	78.7	2.9	6
	B	72.8	2.4	5				75.1	1.8	6	72.5	2.4	6	76.3	1.3	13	78.2	1.6	19	77.5	2.2	11	74.6	2.7	6
	C	68.6	1.3	5	62.3		1	66.6	0.5	2	67.6	1.4	6				70.7	3.0	3	67.7	2.5	3	58.0		1
4	A	77.0		1	84.1	3.9	2	76.4		1	78.6	3.1	8	78.2	1.6	8	83.4	1.8	20	83.3	1.7	12	79.0		1
	B	74.2		1	79.1	2.8	2	73.2		1	75.2	3.1	8	73.8	1.7	8	79.7	1.7	20	79.6	1.6	12	74.3		1
	C	71.0		1				72.3		1	70.3	3.5	3							60.5	4.1	3	68.5	1.9	4
5	A							83.4	2.1	9	89.8	1.3	2	86.0	2.4	12	87.6	2.0	10	84.3	2.5	8	81.1	3.2	7
	B							79.9	2.1	9	85.9	1.1	2	82.1	2.4	12	83.7	2.0	10	80.7	2.4	8	76.7	3.2	7
	C							67.3		1	67.1	2.2	4	84.5		1				81.5	1.0	2	76.5		1
6-11	A	81.5	1.9	11	84.7	5.1	3	86.3	0.9	33	81.8	1.0	36	86.8	1.0	49	88.8	1.0	40	87.4	1.1	37	85.2	1.5	15
	B	77.9	1.9	11	80.7	4.9	3	83.3	0.9	33	78.6	1.0	36	82.9	1.0	49	85.1	1.0	40	83.8	1.1	37	81.2	1.4	15
	C	75.0		1				74.5		1	74.0	2.4	8	71.5[3]	8.5	2	89.3[4]	2.5	6	76.6	3.5	5	72.0	3.1	6
>11	A							88.6	3.7	5	83.0	2.7	7	88.1	2.9	5	92.5	2.6	9	87.6	1.5	6			
	B							85.4	3.9	5	79.6	2.7	7	84.3	3.0	5	88.6	2.5	9	84.0	1.5	6			
	C							73.2		1	77.0		1							81.8	1.3	2			
>4	A	81.5	1.8	11	84.7	5.1	3	86.1	0.8	47	82.3	0.9	45	86.8	0.9	66	89.2	0.8	59	86.9	0.9	51	83.9	1.4	22
	B	77.9	1.8	11	80.7	4.9	3	82.7	0.8	47	79.1	0.9	45	82.9	0.9	66	85.4	0.8	59	83.3	0.9	51	79.8	1.4	22
	C	75.0		1				71.6	2.0	3	72.1	1.7	13	75.8	5.4	3	89.3	2.3	6	78.8	2.5	9	72.6	2.6	7
>5	A	81.5	1.8	11	84.7	5.1	3	86.6	0.8	38	82.0	0.9	43	86.9	0.9	54	89.5	0.9	49	87.4	1.0	43	85.2	1.4	15
	B	77.9	1.8	11	80.7	4.9	3	83.4	0.8	38	78.8	0.9	43	83.0	0.9	54	85.7	0.9	49	83.8	1.0	43	81.2	1.4	15
	C	75.0		1				73.8	0.7	2	74.3	2.0	9	71.5	6.0	2	89.5	2.3	6	78.1	2.4	7	72.0	2.9	6

[1] Means calculated from values with one decimal place. Other data concerning weights may be rounded up to the nearest integer.
[2] Combined samples from Subherds A and B (Sifton and Porter lakes).
[3] Excluding 7-year-old barren female (never had given birth).
[4] Excluding 6-year-old female with no uterus.

Appendix 4. Overwinter and annual changes in weight of non-pregnant (NP) and pregnant (P) female caribou sampled from the Beverly herd, with adjustments for weight of the uterus and its contents in March.

			Body weight (kg)[1]														
Age			1982-83			1983-84[2]			1984-85			1985-86			1986-87		
(yr)	Month	State	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
1.5-2	Dec	P	66.5		1				66.0		1						
	Mar	P							70.6	2.7	4						
	Dec	NP	60.1	2.9	7	54.6	1.6	7	65.2	1.6	5	69.2	2.2	4	69.5		1
	Mar	NP	57.6	1.0	15	59.3	1.8	3	63.5	2.5	5	65.4	2.3	9	61.5	3.5	2
2.5-3	Dec	P	71.5		1	74.6	2.5	4	77.3	3.4	4	78.0	3.5	2	78.1	1.8	5
	Mar	P	72.5	2.4	6	73.0	2.8	2	78.2	1.6	19	77.5	2.2	11	74.6	2.7	6
	Dec	NP	69.8	0.8	2	72.3	2.3	2	66.0	9.0	2	76.0	2.5	4	67.7	1.4	3
	Mar	NP	67.6	1.4	6				70.7	3.0	3	67.7	2.5	3	58.0		1
3.5-4	Dec	P	80.6	1.4	6	79.0	4.6	4	84.4	2.3	8	82.1	2.0	9	83.2	2.5	5
	Mar	P	75.2	3.1	8	75.6	1.5	5	79.7	1.7	19	79.6	1.6	12	74.3		1
	Dec	NP				79.5		1	82.5	6.8	3	81.0	2.8	4			
	Mar	NP	70.3	3.5	3							60.5	4.1	3	68.5	2.0	4
4.5-5	Dec	P	84.8	4.3	2	81.0	3.3	4	83.4	3.5	5	86.5	3.2	3	84.8	3.3	8
	Mar	P	85.9	1.1	2	73.8		1	83.7	2.0	10	80.7	2.4	8	76.5	3.0	7
	Dec	NP	74.0	2.0	2							74.5		1			
	Mar	NP	67.1	2.2	4	84.5		1				81.5	1.0	2	76.5		1
5.5-11	Dec	P	82.9	1.5	19	83.8	1.7	12	89.1	1.1	14	88.3	1.9	15	80.8	2.2	7
	Mar	P	78.6	1.0	36	75.6	1.6	6	85.1	1.0	40	83.8	1.1	37	81.2	1.4	14
	Dec	NP	68.5	1.0	2	74.3	4.9	4	74.0		1	81.9	0.5	3	74.8	3.3	4
	Mar	NP	74.0	2.4	8	71.5	6.0	2	89.3	2.5	6	76.6	3.5	5	72.0	3.1	6
>11	Dec	P	75.3	0.3	2	83.5	2.5	2	85.7	2.8	6	85.9	3.8	5	85.8	1.8	2
	Mar	P	79.6	2.7	7				88.6	1.5	9	84.0	1.5	6			
	Dec	NP										79.1		1			
	Mar	NP	77.0		1							81.8	1.3	2			
>4	Dec	P	82.4	1.3	23	82.1	1.7	19	87.2	1.2	25	87.6	1.5	23	83.3	1.8	17
	Mar	P	79.1	0.9	45	75.6	1.4	7	85.4	0.8	59	83.3	0.9	43	79.8	1.4	22
	Dec	NP	71.3	1.8	4	74.3	4.9	4	74.0		1	79.8	1.5	5	74.8	3.3	4
	Mar	NP	72.1	1.7	13	75.8	6.0	3	89.3	2.3	6	78.8	2.5	9	72.6	2.6	7

[1] Means calculated from values with 1 decimal place. Other data concerning weights may be rounded up to nearest integer.

[2] March values from subherd A, the Sifton Lake sample.

Appendix 5. Average depths of back fat in caribou sampled from the Beverly herd in December of 1982 through 1986.

Sex/ age (yr)	Nov 1982 Mean	SE	*n*	Dec 1983[1] Mean	SE	*n*	Dec 1984 Mean	SE	*n*	Dec 1985 Mean	SE	*n*	Dec 1986 Mean	SE	*n*
	Back fat depths (mm)														
F 0.5							1.5	0.5	2	0.0		1	3.0	3.0	2
M 0.5	0.5	0.3	4	0.9	0.3	7	2.3	1.3	4				0.0		1
F 1.5	5.0	1.7	8	6.7	2.2	7	8.8	2.4	6	4.3	2.0	4	11.0		1
M 1.5	0.3	0.2	6	1.2	0.6	6	0.8	0.4	5	4.0	0.8	6	5.0	4.0	2
F 2.5	1.7	0.3	3	13.3	4.4	6	20.9	4.1	7	8.8	4.2	6	10.9	3.7	8
M 2.5	0.2	0.2	5	0.6	0.1	14	1.3	0.5	7	1.1	0.2	11	0.4	0.2	5
F 3.5	17.5	5.1	4	14.6	5.7	5	19.5	2.9	11	9.9	2.3	13	18.5	4.3	6
M 3.5	0.3	0.3	7	3.0	1.6	6	0.6	0.4	5	1.3	0.3	6	0.0		1
F 4.5	5.3	3.9	4	12.3	3.0	4	13.6	5.2	5	7.5	3.7	4	11.4	2.6	8
M 4.5	0.0		2	0.5	0.5	2	0.0		3	1.0	0.0	2	0.5	0.5	2
F5.5-10.5	9.2	2.0	22	12.9	3.0	16	18.1	3.4	15	14.3	2.1	18	5.2	1.5	11
M >4.5	0.0		2				0.0		1	5.2	2.3	3			
F >10.5	0.5	0.5	2	12.0	1.0	2	20.8	4.5	6	22.8	5.2	6	11.5	8.5	2
F >1.5	8.5	1.6	35	13.1	1.8	33	18.8	1.7	44	12.9	1.5	47	10.5	1.5	35
F >2.5	9.2	1.7	32	13.1	2.0	27	18.4	1.9	37	13.5	1.6	41	10.4	1.7	27
F >3.5	8.0	1.7	28	12.7	2.2	22	17.9	2.4	26	15.1	2.0	28	8.1	1.5	21
F >4.5	8.5	1.9	24	12.8	2.7	18	18.9	2.7	21	16.4	2.1	24	6.2	1.7	13
M >1.5	0.2	0.1	16	1.2	0.5	22	0.8	0.3	16	1.7	0.4	22	0.4	0.2	8
M 2.5-4.5	0.2	0.2	14	1.2	0.5	22	0.8	0.3	15	1.2	0.2	19	0.4	0.2	8

[1] Subherd A sampled at Sifton Lake.

Appendix 6. Average depths of back fat of caribou sampled from the Beverly herd each March from 1980 through 1987.

Sex/ age (yr)	Back fat depths (mm)																										
	Mar 1980			Mar 1981			Mar 1982			Mar 1983			Mar 1984B[1]			Mar 1984A[2]			Mar 1985			Mar 1986			Mar 1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	0.5	0.5	2	0.0		1	1.2	0.4	13	0.3	0.3	4	1.0	0.0	4				2.0	0	3	1.3	0.3	4			
M 1	0.0		1	0.5	0.5	4	0.4	0.2	7	1.0	0.6	3	1.5	0.5	4				2.3	1.3	4	0.0		1			
F 2	0.8	0.3	4	12.0		1	2.8	0.9	12	1.9	0.5	15	8.0	3.0	9	2.3	0.3	3	7.4	1.9	10	3.7	0.8	9	0.5	0.5	2
M 2	0.0		1	0.2	0.2	6	1.3	0.5	11	1.2	0.4	21	1.2	0.5	5	0.8	0.3	4	2.0	0.3	9	2.8	0.9	9	0.0		1
F 3	4.0	2.0	10	3.0		1	16.3	4.3	8	8.9	2.9	12	19.7	1.5	11	10.5	3.5	2	18.0	1.7	22	10.3	2.1	14	11.9	2.3	7
M 3	0.4	0.2	5				1.2	0.3	26	0.4	0.2	18	1.7	0.5	7	1.2	0.6	6	3.1	0.6	19	2.1	0.5	15	0.0		2
F 4	9.0	8.0	2	19.3	3.2	3	13.5	12.5	2	12.5	2.5	11	22.3	6.9	3	14.8	1.4	5	18.9	1.9	20	12.5	2.1	15	3.0	2.3	5
M 4	0.0	0.0	2				0.0	0.0	2	0.5	0.2	8	2.5	1.5	4	1.0	0.0	3	1.7	0.7	3	3.8	1.0	9	0.0		1
F 5				7.0		1	14.8	3.0	9	8.2	4.8	6	18.8	2.4	12	2.0		1	20.1	2.0	10	10.4	2.5	10	8.5	2.0	8
M 5	0.0		1				0.0	0.0	2	0.3	0.3	4	14.3	7.1	3				4.5	2.5	2	4.1	1.4	7	1.0	1.0	2
F 6-11	3.5	1.2	12	21.1	2.7	8	17.7	1.9	33	10.1	1.2	45	21.5	1.3	43	7.5	3.3	8	19.0	1.3	49	12.0	1.2	42	11.4	1.9	20
M >5	1.2	0.4	10				6.0		1	2.5	1.5	2	19.3	5.0	4	0.3	0.3	3	6.0		1	4.7	1.4	6	0.0		1
F >11							14.8	4.3	6	4.1	1.7	8	22.4	3.5	5				15.8	2.7	10	11.1	2.6	8			
F >2	4.2	1.1	24	18.2	2.4	13	16.6	1.4	58	9.5	0.9	82	20.9	0.9	74	9.8	1.9	16	18.6	0.8	111	11.6	0.8	89	9.8	1.2	40
F >3	4.3	1.4	14	19.5	2.2	12	16.6	1.5	50	9.6	1.0	70	21.1	1.1	63	9.7	2.1	14	18.8	0.9	89	11.8	0.9	75	9.4	1.4	33
F >4	3.5	1.2	12	19.6	2.8	9	16.8	1.5	48	9.1	1.1	59	21.0	1.1	60	6.9	2.9	9	18.7	1.1	69	11.6	1.0	60	10.5	1.5	28
F >5	3.5	1.2	12	21.1	2.7	8	17.2	1.7	39	9.2	1.1	53	21.6	1.2	48	7.5	3.3	8	18.5	1.2	59	11.9	1.1	50	11.4	1.9	20
M 3-5	0.4	0.2	8				1.1	0.2	30	0.4	0.1	30	4.6	2.0	14	1.1	0.4	9	3.0	0.5	24	3.1	0.5	31	0.4	0.4	5
M >2	0.8	0.3	18				1.2	0.3	31	0.6	0.2	32	7.9	2.3	18	0.9	0.3	12	3.2	0.5	25	3.3	0.5	37	0.3	0.3	6

[1] Sample from Subherd B, Porter Lake.
[2] Sample from Subherd A, Sifton Lake.

Appendix 7. Statistics for weight of fat around both kidneys of caribou sampled from the Beverly herd each December from 1982 through 1986.

	Kidney fat weight (g)														
Sex/	Nov 1982			Dec 1983[1]			Dec 1984			Dec 1985			Dec 1986		
age (yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							24.0	2.0	2	20.0		1	26.0	7.0	2
M 0.5	25.5	3.3	4	31.4	3.3	7	26.0	3.7	4				18.0		1
F 1.5	48.8	9.5	6	52.4	6.0	7	54.8	7.1	6	42.5	6.8	4	55.0		1
M 1.5	31.8	2.7	6	52.7	11.7	6	29.4	4.4	5	46.7	4.8	6	35.0	2.0	2
F 2.5	77.0	9.5	3	99.8	17.6	6	79.3	14.0	7	55.4	9.2	5	76.1	18.8	8
M 2.5	32.4	2.9	5	52.9	4.8	14	41.1	2.5	7	40.1	3.5	11	43.0	2.7	5
F 3.5	88.2	8.7	6	83.6	16.0	5	79.0	7.7	11	65.2	9.6	13	102.5	11.3	6
M 3.5	36.3	2.4	7	60.7	11.4	6	48.8	7.3	5	54.2	2.9	6	47.0		1
F 4.5	58.8	9.5	4	100.8	16.3	4	76.4	8.3	5	64.8	15.5	4	98.8	13.1	8
M 4.5	49.0	14.0	2	57.0	33.0	2	37.7	3.9	3	47.0	6.0	2	57.5	5.5	2
F 5.5-10.5	75.5	5.1	22	82.9	8.8	16	87.7	8.5	15	88.1	7.4	17	70.6	7.9	11
M >4.5	46.5	15.5	2				42.0		1	91.3	15.7	3			
F >10.5	55.7	1.9	3	63.0	11.0	2	75.8	15.1	6	78.8	10.9	6	68.0	11.0	2
F >1.5	74.3	3.7	38	87.1	6.1	33	81.3	4.5	44	74.5	4.7	45	83.6	6.3	35
F >2.5	74.0	4.0	35	84.2	6.4	27	81.7	4.8	37	76.9	5.1	40	85.9	6.2	27
F >3.5	71.1	4.3	29	84.4	7.2	22	82.8	6.1	26	82.6	5.7	27	81.1	7.1	21
F 2.5-4.5	76.5	6.2	13	94.7	9.4	15	78.5	5.6	23	62.9	6.4	22	91.6	8.9	22
M >1.5	37.9	2.8	16	55.4	4.8	22	42.9	2.7	16	51.5	4.5	22	47.1	3.0	8
M >2.5	40.5	3.6	11	59.8	10.5	8	44.3	4.4	9	63.0	6.9	11	54.0	4.7	3

[1] Subherd A sampled at Sifton Lake.

Appendix 8. Statistics for weight of fat around both kidneys of caribou sampled from the Beverly herd each March from 1980 through 1987.

Sex/ age (yr)	Kidney fat (g)																										
	Mar 1980			Mar 1981			Mar 1982			Mar 1983			Mar 1984B[1]			Mar 1984A[2]			Mar 1985			Mar 1986			Mar 1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	30		1				29.3	3.7	9	20.0	4.7	5	24.5	3.5	4				34.0	2.7	3	23.3	4.3	4	42.1		1
M 1				33.8	5.0	4	32.4	3.3	7	25.7	6.1	3	25.5	5.7	4				35.8	10.2	4	17.0		1			
F 2	23.3	3.7	4	80		1	48.2	5.0	9	46.9	2.8	15	73.4	12.2	9	57.0	18.2	3	79.3	10.9	10	51.1	5.8	9	53.5	1.5	2
M 2	27		1	41.3	7.9	4	56.8	3.5	9	40.6	3.2	21	40.6	5.1	5	40.5	6.3	4	53.8	4.6	9	42.6	4.0	9	42.0		1
F 3	58.9	6.9	9	79.0		1	95.9	7.0	7	74.7	10.7	12	109.4	10.4	11	75.5	4.5	2	115.9	8.0	22	93.1	12.4	14	96.3	15.2	7
M 3	35.4	7.7	5				57.0	4.6	24	47.8	3.7	19	73.4	6.1	7	72.6	5.8	5	72.1	4.1	19	58.8	5.1	15	62.5	11.5	2
F 4	62.0		1	145.3	23.1	3	71.5	27.7	2	81.3	8.7	11	141.3	26.9	3	120.2	12.6	5	116.5	7.5	20	88.5	7.3	15	58.2	12.1	5
M 4	36.5	5.5	2				46.0		1	57.3	6.2	8	98.0	10.0	4	66.3	4.3	3	70.3	11.9	3	63.3	7.1	9	38.0		1
F 5				102.0		1	97.4	11.7	8	91.2	36.8	5	128.4	10.6	12	70.0		1	121.9	9.6	10	92.2	12.3	10	93.1	9.5	8
M 5	56.0		1				50.0	5.0	2	58.5	6.3	4	136.5	51.5	2				87.5	3.5	2	75.9	6.0	7	73.5	17.5	2
F 6-11	72.5	3.9	12	116.5	12.9	8	103.8	4.7	33	94.9	5.6	43	126.7	5.8	43	88.6	12.8	8	123.2	5.3	47	101.3	5.6	42	98.3	11.0	21
M >5	65.5	6.8	10				72.0		1	81.0	4.0	2	125.8	5.5	4	64.3	8.7	3	93.0		1	79.7	8.6	6	62.0		1
F >11							86.4	15.3	5	61.0	10.8	8	111.0	5.4	5				102.7	9.0	10	86.4	10.1	8			
F >2	66.5	3.7	22	119.2	10.3	13	99.1	3.8	55	86.3	4.5	79	103.9	4.2	74	95.7	8.5	16	118.5	3.3	109	95.5	3.9	89	92.1	6.8	41
F >3	71.7	3.6	13	122.5	10.6	12	99.5	4.2	48	88.4	4.9	67	126.5	4.6	63	98.6	9.5	14	119.1	3.7	87	96.0	4.0	75	91.2	7.6	34
F 3-5	59.2	6.1	10	123.4	18.8	5	93.7	6.8	17	80.2	8.3	28	121.9	7.3	26	102.8	10.4	8	117.3	4.7	52	91.1	6.0	39	85.5	7.7	20
M >2	53.4	5.4	18				56.7	4.0	28	53.4	3.0	33	98.9	8.3	17	68.6	3.6	11	74.0	3.5	25	66.5	3.4	37	62.0	7.6	6
M >3	60.3	6.0	13				54.5	6.3	4	61.0	4.5	14	116.8	10.2	10	65.3	4.4	6	79.8	6.9	6	71.8	4.3	22	61.8	11.0	4

[1] Sample from Subherd B (Porter Lake).
[2] Sample from Subherd A (Sifton Lake).

Appendix 9. Kidney weights of caribou in the Beverly herd sampled each December from 1982 through 1986.

	Kidney weight (g)														
Sex/	Nov 1982[1]			Dec 1983[2]			Dec 1984			Dec 1985			Dec 1986		
age (yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							115.0	9.0	2	89.0		1	81.5	9.5	2
M 0.5	108.0	2.3	4	105.9	3.5	7	107.8	4.3	4				102.0		1
F 1.5	130.5	7.0	6	129.3	5.1	7	155.8	6.5	6	138.8	3.6	4	141.0		1
M 1.5	153.2	10.3	6	148.7	6.2	6	176.8	4.8	5	150.5	7.1	6	144.0	3.0	2
F 2.5	158.7	6.1	3	146.7	2.4	6	159.0	6.2	7	140.4	7.0	5	153.8	4.4	8
M 2.5	166.8	8.0	5	181.9	4.5	14	208.3	13.7	7	179.6	5.0	11	164.8	9.6	5
F 3.5	171.8	6.6	6	172.0	9.6	5	171.9	6.2	11	162.5	4.7	13	162.5	3.2	6
M 3.5	218.0	9.8	7	204.5	15.2	6	218.8	13.1	5	211.3	12.3	6	194.0		1
F 4.5	154.8	10.1	4	176.5	17.4	4	182.6	8.9	5	167.5	3.2	4	170.4	7.5	8
M 4.5	206.0	5.0	2	201.0	27.0	2	280.7	19.3	3	235.5	27.5	2	220.0	19.0	2
F5.5-10.5	181.2	4.3	22	176.5	7.0	16	198.3	6.3	15	171.9	4.3	17	163.4	6.0	11
M >4.5	264.5	24.5	2				263.0		1	256.3	24.8	3			
F >10.5	171.1	14.6	3	191.5	5.5	2	187.2	7.9	6	169.0	7.1	6	189.1	12.0	2
F >2.5	175.7	3.6	35	176.8	5.0	27	186.5	3.9	37	168.0	2.6	40	167.2	3.6	27
F >3.5	176.5	4.1	29	177.9	5.9	22	192.7	4.5	26	170.6	3.1	27	168.5	4.5	21
F >4.5	180.0	4.1	25	178.2	6.3	18	195.1	5.0	21	171.2	3.6	23	167.3	5.9	13

[1] Late-November sample.
[2] Subherd A sampled at Sifton Lake.

Appendix 10. Kidney weights of caribou sampled from the Beverly herd each March from 1980 through 1987.

Sex	Weight of both kidneys (g)																							
Age	March 1980			March 1981			March 1982			March 1983			March 1984[1]			March 1985			March 1986			March 1987		
(yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	83.0		1				93.0	3.1	9	88.0	4.1	5	98.3	8.4	4	95.7	6.1	3	101.0	5.9	4			
M 1				110.0	10.3	4	116.6	5.1	7	106.7	9.2	3	112.0	4.8	4	115.0	6.2	4	92		1			
F 2	119.0	4.3	4	151.0		1	132.0	4.3	9	125.0	2.5	15	136.8	4.7	12	137.6	4.1	10	132.9	5.7	9	131.0	26.0	2
M 2	114.0		1	126.8	5.4	4	147.4	5.9	9	148.0	3.8	21	142.3	5.8	9	156.1	5.0	9	145.8	4.8	9	137.0		1
F 3	133.0	6.2	9	138.0		1	140.0	4.4	7	140.2	3.9	12	150.8	5.6	13	149.5	4.4	22	143.8	5.2	14	122.1	4.1	7
M 3	148.4	5.2	5				173.9	4.8	24	172.2	5.4	19	172.7	4.5	12	178.7	6.9	19	162.9	5.0	15	151.5	8.5	2
F 4	157.0		1	161.7	1.7	3	152.0	11.0	2	148.7	4.0	11	155.9	5.2	8	152.8	2.6	20	137.2	3.0	15	132.0	5.8	5
M 4	178.0	9.0	2				198.0		1	192.5	7.8	8	191.9	7.9	7	169.0	11.5	3	188.9	11.6	9	154.0		1
F 5				167.0		1	156.3	7.6	8	150.4	6.1	5	169.8	4.9	13	154.6	5.7	10	146.0	4.6	10	150.6	8.0	8
M 5	183.0		1				214.5	32.5	2	192.0	6.7	4	242.0	23.0	2	232.5	28.5	2	198.3	4.2	7	184.5	5.5	2
F 6-11	153.5	5.5	12	162.5	5.6	8	163.0	3.5	33	163.2	2.9	43	173.4	2.9	51	173.1	3.1	47	160.0	2.6	42	156.7	4.5	21
M >5	208.6	4.4	10				195.0		1	230.0	43.0	2	250.8	11.6	5	267.0		1	222.3	7.7	6	192.0		1
F >11							163.0	9.6	5	165.9	6.7	8	183.8	4.0	5	187.1	5.6	10	169.3	3.5	8			
F >3	153.8	5.1	13	162.7	3.7	12	161.4	2.9	48	160.2	2.3	67	171.6	2.3	77	167.9	2.3	87	154.5	2.1	75	151.6	3.7	34
F >4	153.5	5.5	12	163.0	4.9	9	161.8	3.0	46	162.5	2.5	56	173.5	2.4	69	172.5	2.7	67	158.9	2.2	60	155.0	3.9	29
F >5	153.5	5.5	12	162.5	5.6	8	163.0	2.6	38	164.2	3.1	51	174.3	2.7	56	175.6	3.1	57	161.5	2.3	50	156.7	4.5	21

[1] Combined samples from Sifton (Subherd A) and Porter (Subherd B) lakes.

Appendix 11. Kidney fat indices of caribou sampled from the Beverly herd each December from 1982 through 1986.

	Kidney fat index[1]														
Sex/	Nov 1982[2]			Dec 1983[3]			Dec 1984			Dec 1985			Dec 1986		
age (yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							20.9	0.1	2	22.5		1	31.3	5.0	2
M 0.5	23.7	3.5	4	30.1	3.6	7	24.1	3.2	4				17.7		1
F 1.5	36.6	5.6	6	44.1	5.1	7	35.3	4.5	6	30.8	5.2	4	39.1		1
M 1.5	21.5	2.8	6	35.4	7.2	6	16.6	2.2	5	31.0	2.9	6	24.4	1.7	2
F 2.5	48.5	5.5	3	68.5	12.6	6	50.6	9.8	7	39.3	5.8	5	48.9	12.0	8
M 2.5	19.7	2.2	5	29.8	3.3	14	20.5	2.3	7	22.3	1.7	11	26.6	2.6	5
F 3.5	51.7	5.5	6	49.3	9.9	5	46.9	5.2	11	39.3	5.1	13	63.6	7.8	6
M 3.5	16.6	0.9	7	29.1	5.2	6	23.1	4.5	5	26.0	2.1	6	24.0		1
F 4.5	38.7	7.8	4	56.3	5.1	4	41.6	3.2	5	38.2	8.5	4	59.7	8.8	8
M 4.5	23.6	6.2	2	26.6	12.9	2	13.6	1.9	3	20.0	0.1	2	26.1	1.5	2
F5.5-10.5	42.1	2.9	22	47.3	4.8	16	44.8	4.8	15	51.7	4.3	17	42.6	4.0	11
M >4.5	17.2	4.3	2				16.0		1	36.7	7.6	3			
F >10.5	33.2	4.0	3	32.8	4.8	2	40.0	6.8	6	46.7	6.6	6	35.8	3.6	2
F >1.5	43.1	2.2	38	51.7	3.8	33	45.3	2.7	44	44.9	2.6	45	51.2	4.0	35
F >3.5	0.7	2.5	29	47.6	3.8	22	43.1	3.2	26	48.6	3.3	27	48.5	4.3	21
M >0.5	19.3	1.1	22	30.6	2.5	28	19.0	1.5	21	26.4	1.5	28	25.8	1.3	10
F >1.5	18.5	1.2	16	29.3	2.6	22	19.7	1.9	16	25.1	1.7	22	26.2	1.5	8

[1] *KFI = 100 X KF/KID*, where KF is perinephric fat of both kidneys (g) and KID is weight of both kidneys in grams (Riney 1955).

[2] Late-November sample.

[3] Subherd A.

Appendix 12. Kidney fat indices (KFIR) of caribou sampled from the Beverly herd each March from 1982 through 1987.

Sex/age (yr)	KFIR[1]																				
	1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	32.5	5.2	9	23.2	5.7	5	98.3	8.4	4				36.2	5.0	3	22.7	3.2	2			
M 1	27.6	2.2	7	24.1	5.8	3	22.9	9.0	4				31.7	8.9	4	18.5		1			
F 2	36.3	3.3	9	37.8	4.4	15	137.8	6.1	9	134.0	6.8	3	58.6	8.8	10	38.4	4.1	9	42.3	7.2	2
M 2	38.8	2.8	9	27.5	2.2	21	28.5	5.4	5	29.2	9.4	4	34.9	3.3	9	29.3	2.6	9	30.7		1
F 3	69.0	5.8	7	53.0	7.0	12	147.2	4.2	11	170.5	32.5	2	78.9	5.6	22	65.6	8.8	14	78.3	11.4	7
M 3	33.2	2.7	24	27.9	2.0	19	42.1	8.2	7	43.0	8.1	5	40.6	2.1	19	35.7	2.7	15	41.8	9.9	2
F 4	48.6	6.8	2	56.1	7.2	11	148.3	0.7	3	160.4	7.8	5	76.7	5.3	20	64.4	5.2	15	44.6	10.0	5
M 4	23.3		1	29.8	3.0	8	51.0	11.6	4	36.0	6.7	3	41.1	4.8	3	33.7	3.0	9	24.7		1
F 5	61.6	6.1	8	63.3	26.6	5	171.8	4.9	12	145.0		1	80.2	7.3	10	63.3	8.2	10	63.5	7.6	8
M 5	23.2	2.0	2	30.8	4.2	4	54.9	16.1	2				38.0	3.0	2	38.3	3.0	7	39.6	8.3	2
F 6-11	64.1	2.8	33	58.2	3.2	43	172.7	3.3	43	177.4	5.8	8	73.0	3.6	47	62.9	3.0	42	62.0	6.5	21
M >5	36.9		1	36.8	8.6	2	51.4	4.6	4	25.4	4.3	3	34.8		1	35.7	3.4	6	32.2		1
F >11	52.8	8.3	5	37.1	6.5	8	183.8	4.0	5				55.7	6.0	10	51.5	6.5	8			
F >2	62.8	2.3	55	55.3	2.9	79	168.5	2.5	74	169.2	5.3	16	73.9	2.4	109	62.5	2.4	89	63.0	4.4	41
F >4	61.9	2.5	48	55.7	3.2	67	172.2	2.5	63	169.0	5.6	14	72.7	2.6	87	62.0	2.4	75	59.8	4.7	34
M >2	32.6	2.4	28	29.3	1.5	33	47.9	10.9	17	36.3	10.0	11	40.2	1.7	25	35.7	1.5	37	36.6	4.4	6

[1] *KFIR = KF/KID X 100*, where KF is kidney fat (grams) and KID is kidney weight (grams) (Riney 1955).
[2] Subherd B, the Porter Lake sample.
[3] Subherd A, the Sifton Lake sample.

Appendix 13. Kidney fat index (KFIM) of caribou sampled each December from 1982 through 1986 from the Beverly herd.

	Mitchell's kidney fat index[1]														
Sex/	Nov 1982			Dec 1983[2]			Dec 1984			Dec 1985			Dec 1986		
age (yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							12.1	0.1	2	12.3		1	13.1	0.5	2
M 0.5	12.4	0.3	4	13.0	0.3	7	12.4	0.3	4				11.8		1
F 1.5	13.7	0.5	6	14.1	0.5	7	13.5	0.5	6	13.1	0.5	4	13.9		1
M 1.5	12.1	0.3	6	13.5	0.7	6	11.7	0.2	5	13.1	0.3	6	12.4	0.2	2
F 2.5	14.9	0.5	3	16.9	1.3	6	15.1	1.0	7	13.9	0.6	5	14.9	1.2	8
M 2.5	12.0	0.2	5	13.0	0.3	14	12.1	0.2	7	12.2	0.2	11	12.7	0.3	5
F 3.5	15.2	0.5	6	14.9	0.9	5	14.7	0.5	11	13.9	0.5	13	16.4	0.8	6
M 3.5	11.7	0.1	7	12.9	0.5	6	12.3	0.5	5	12.6	0.2	6	12.4		1
F 4.5	13.9	0.8	4	15.6	0.5	4	14.2	0.3	5	13.8	0.9	4	16.0	0.9	8
M 4.5	12.4	0.6	2	12.7	1.3	2	11.4	0.2	3	12.0	0.0	2	12.6	0.0	2
F 5.5-10.5	14.2	0.3	22	14.7	0.5	16	14.5	0.5	15	15.2	0.4	17	14.3	0.4	11
M >4.5	11.7	0.4	2				11.6		1	13.7	0.8	3			
F >10.5	13.3	0.4	3	13.3	0.5	2	14.0	0.7	6	14.7	0.7	6	13.6	0.4	2
F >1.5	14.3	0.2	38	15.2	0.4	33	14.5	0.3	44	14.5	0.3	45	15.1	0.4	35
F >3.5	14.1	0.2	29	14.8	0.4	22	14.3	0.3	26	14.7	0.3	27	14.9	0.4	21
F >4.5	14.1	0.3	25	14.6	0.4	18	14.3	0.4	21	15.0	0.4	23	14.2	0.3	13
M >1.5	11.9	0.1	16	12.9	0.3	22	12.0	0.2	16	12.5	0.2	22	12.6	0.2	8

[1] *KFIM = 10 (KF + KID)/KID* (Mitchell 1976), where KF is kidney fat (g) and KID is kidney weight (g).
[2] Subherd A sampled at Sifton Lake.

Appendix 14. Kidney fat indices KFIM of caribou sampled from the Beverly herd in March each year from 1982 through 1987.

Sex/age (yr)	KFIM[1] 1982 Mean	SE	*n*	1983 Mean	SE	*n*	1984B[2] Mean	SE	*n*	1984A[3] Mean	SE	*n*	1985 Mean	SE	*n*	1986 Mean	SE	*n*	1987 Mean	SE	*n*
F 1	13.3	0.5	9	12.3	0.6	5	12.6	0.5	4				13.6	0.5	3	12.3	0.3	4			
M 1	12.8	0.2	7	13.1	0.8	3	12.3	0.5	4				13.2	0.9	4	11.9		1			
F 2	13.6	0.3	9	13.8	0.2	15	15.2	0.7	9	14.2	1.2	3	15.9	0.9	10	13.8	0.4	9	14.2	0.7	2
M 2	13.9	0.3	9	12.8	0.2	21	12.9	0.3	5	12.9	0.5	4	13.5	0.3	9	12.9	0.3	9	13.1		1
F 3	16.9	0.6	7	15.3	0.7	12	17.5	0.7	11	14.5	0.6	2	17.9	0.6	22	16.6	0.9	14	17.8	1.1	7
M 3	13.3	0.3	24	12.8	0.2	19	14.2	0.3	7	14.3	0.4	5	14.1	0.2	19	13.6	0.3	15	14.2	1.0	2
F 4	14.9	2.2	2	15.6	0.7	11	19.5	1.8	3	17.5	0.7	5	17.7	0.5	20	16.4	0.5	15	14.5	1.0	5
M 4	12.3		1	13.0	0.3	8	15.1	0.7	4	13.6	0.5	3	14.1	0.5	3	13.4	0.3	9	12.5		1
F 5	16.2	0.6	8	16.4	2.7	5	17.6	0.7	12	14.8		1	18.0	0.7	10	16.3	0.8	10	16.4	0.8	8
M 5	12.3	0.2	2	13.1	0.4	4	15.5	1.6	2				13.8	0.3	2	13.8	0.3	7	14.0	0.8	2
F 6-11	16.4	0.3	33	15.8	0.3	43	17.5	0.4	43	15.1	0.8	8	17.3	0.4	47	16.3	0.3	42	16.2	0.7	21
M >5	13.7		1	13.7	0.9	2	15.1	0.3	4	12.5	0.3	3	13.5		1	13.6	0.3	6	13.2		1
F >11	15.3	0.8	5	13.7	0.7	8	16.1	0.4	5				15.6	0.7	10	15.2	0.7	8			
F >2	16.3	0.2	55	15.5	0.3	79	17.5	0.3	74	15.7	0.5	16	17.4	0.2	109	16.3	0.2	89	16.3	0.4	41
F >4	16.2	0.3	46	15.6	0.4	56	17.4	0.3	60	15.0	0.7	9	17.2	0.3	67	16.1	0.3	60	16.2	0.5	29
F >5	16.3	0.3	38	15.5	0.4	51	17.3	0.3	48	15.1	0.8	8	17.0	0.3	57	16.1	0.3	50	16.2	0.7	21
M all	13.3	0.2	44	12.9	0.1	57	14.0	0.3	26	13.4	0.3	15	13.8	0.2	38	13.4	0.1	47	13.4	0.4	7
M >2	13.2	0.2	28	12.9	0.2	33	14.8	0.2	17	13.6	0.3	11	14.0	0.2	25	13.6	0.4	37	13.7	0.5	6

[1] *KFIM = 10 (KF + KID)/KID*, where KF is kidney fat (g) and KID is kidney weight (g) (Mitchell et al. 1976).
[2] Subherd B, the Porter Lake sample.
[3] Subherd A, the Sifton Lake sample.

Appendix 15. Kidney fat/body weight ratios of caribou sampled from the Beverly herd each December from 1982 through 1986.

	100 x kidney fat /body weight ratio[1]														
Sex/	Nov 1982			Dec 1983[2]			Dec 1984			Dec 1985			Dec 1986		
age (yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							50.4	1.6	2	54.1		1	62.3	11.0	2
M 0.5	57.6	7.5	4	70.1	4.8	7	55.1	7.9	4				43.9		1
F 1.5	81.3	14.0	6	96.9	12.3	7	83.1	9.9	6	61.1	8.5	4	78.6		1
M 1.5	50.1	.5.1	6	77.9	15.8	6	38.2	4.2	5	67.9	7.3	6	52.6	1.8	2
F 2.5	108.7	12.5	3	134.0	22.6	6	105.0	17.4	7	71.7	11.7	5	98.8	21.3	8
M 2.5	39.7	4.3	5	63.0	6.0	14	46.5	3.6	7	44.8	4.2	10	52.0	5.0	5
F 3.5	109.2	10.9	6	103.4	16.5	5	93.0	8.7	11	78.7	11.1	13	121.1	11.0	6
M 3.5	38.0	1.9	7	59.7	12.1	6	48.7	7.6	5	55.2	2.8	6	44.8		1
F 4.5	73.3	10.7	4	122.5	15.9	4	91.6	9.7	5	75.5	14.9	4	117.6	16.1	8
M 4.5	46.5	14.7	2	53.3	30.8	2	34.0	5.3	3	44.9	4.7	2	52.2	2.9	2
F 5.5-10.5	93.2	5.7	21	100.1	9.5	16	98.4	9.1	15	100.4	7.3	17	88.8	9.1	11
F >11	71.4	2.4	3	75.9	15.4	2	86.4	14.0	6	91.5	10.5	6	79.4	14.6	2
M >5	42.5	10.9	2				36.5		1	81.1	13.7	3			
F >1.5	93.1	4.3	37	108.0	7.1	33	95.7	5.0	44	87.6	4.9	45	102.7	7.1	35
F >4.5	90.5	5.2	24	97.4	8.7	18	95.0	7.6	21	98.1	6.0	23	87.3	7.9	13
M >0.5	42.9	2.3	22	64.8	5.4	28	42.7	2.6	21	56.3	3.6	27	51.4	2.5	10
M >1.5	40.0	0.2	16	61.1	0.5	22	44.4	0.3	16	53.3	0.4	21	51.1	0.3	8

[1] Kidney fat in grams; body weight in kilograms.
[2] Subherd A sampled at Sifton Lake.

Appendix 16. Kidney fat/body weight ratio of caribou sampled from the Beverly herd each March from 1982 through 1987.

Sex/	age	100 x kidney fat/body weight																				
		1982			1983			1984B[1]			1984A[2]			1985			1986			1987		
(yr)		Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F	1	68	7.6	9	50	12.2	5	58	7.9	4				76	6.6	3	52	8.7	4			
M	1	65	5.9	7	57	15.5	3	56	12.6	4				69	19.0	4	39		1			
F	2	80	7.9	9	82	4.9	15	113	15.2	9	95	27.8	3	114	13.8	10	79	9.3	9	86	1.8	2
M	2	86	4.2	9	63	4.9	21	64	8.1	5	67	11.6	4	73	6.0	9	60	4.7	9	55		1
F	3	129	10.8	7	102	12.5	12	135	12.2	11	98	0.8	2	144	9.9	22	116	12.8	14	127	18.3	7
M	3	66	5.5	24	60	4.3	19	91	5.4	7	99	9.4	5	83	4.0	19	72	6.1	15	77	7.6	2
F	4	96	34.6	2	105	10.3	11	173	29.6	3	156	14.0	5	140	8.8	20	108	7.5	15	81	15.9	5
M	4	52		1	61	6.4	8	98	10.2	4	78	6.8	3	76	7.4	3	66	5.5	9	41		1
F	5	116	10.9	8	111	26.4	9	150	13.9	12	90		1	138	10.2	10	108	12.5	10	115	11.1	8
M	5	55	6.7	2	65	8.7	3	121	33.2	2				75	0.4	2	76	5.9	7	71	11.9	2
F	6-11	120	4.7	33	117	6.1	43	143	6.1	43	112	14.5	8	138	5.8	47	116	5.4	42	117	11.6	21
M	>5	71		1	72	6.1	2	107	6.1	4	69	6.7	3	74		1	76	7.7	6	59		1
F	>11	102	15.8	5	73	11.5	8	126	6.1	5				113	10.4	10	101	12.4	8			
F	>2	118	3.9	55	108	4.9	79	143	4.7	74	123	10.1	16	137	3.9	109	112	3.9	89	114	7.4	41
F	>4	117	4.2	46	110	6.1	56	143	5.2	60	110	13.0	9	134	4.7	67	113	4.6	60	116	8.8	29
F	>5	118	4.6	38	110	5.8	51	141	5.5	48	112	14.5	8	134	5.3	57	114	5.0	50	117	11.6	21
M	all	69	3.5	44	62	2.6	56	86	5.5	26	80	5.7	15	78	3.1	38	69	2.8	47	65	6.0	7
M	>1	70	4.0	37	62	2.7	53	92	5.3	22	80	5.7	15	79	2.8	34	70	2.8	46	65	6.0	7
M	>2	65	4.8	28	61	3.1	32	100	5.0	17	85	6.2	11	81	3.2	25	72	3.2	37	66	6.8	6

[1] Subherd B, Porter Lake sample.

[2] Subherd A, Sifton Lake sample.

Appendix 17. Kidney fat/femur length ratios of caribou from the Beverly herd sampled each December, 1982 through 1986.

Sex/ age (yr)	100 x kidney fat/femur length [1]														
	Nov 1982			Dec 1983[1]			Dec 1984			Dec 1985			Dec 1986		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							10.1	0.5	2	8.8		1	11.2	2.8	2
M 0.5	11.1	1.4	4	13.2	1.2	7	10.7	1.6	4				7.8		1
F 1.5	18.7	4.1	5	19.8	2.6	6	20.6	2.7	6	15.7	2.5	4	19.6		1
M 1.5	12.7	1.3	4	21.2	4.6	5	10.4	1.5	5	17.0	1.8	6	12.7	0.5	2
F 2.5	27.9	3.9	3	39.3	6.7	5	28.9	5.0	7	20.2	3.4	5	27.4	6.6	8
M 2.5	11.2	1.0	5	19.0	1.7	13	13.9	0.9	7	13.5	1.2	11	15.0	1.1	5
F 3.5	31.6	3.4	6	30.0	5.5	5	28.5	2.8	11	23.6	3.4	13	36.5	4.0	6
M 3.5	12.1	0.8	7	18.2	4.1	5	16.8	3.4	4	18.0	1.1	6	15.8		1
F 4.5	20.8	3.6	4	39.2	8.4	3	26.4	3.2	4	23.3	5.4	4	35.5	4.8	8
M 4.5	15.9	4.5	2	18.8	10.9	2	12.6	1.4	3	15.5	2.1	2	19.0	1.5	2
F 5.5-10.5	27.4	2.0	21	28.3	3.3	14	31.9	3.1	15	32.9	2.6	16	25.6	2.8	11
F >10.5	19.8	0.6	3	22.4	4.2	2	27.4	6.6	5	28.3	3.9	6	24.5	4.2	2
M > 4.5	14.8	4.9	2				13.6		1	30.3	5.1	3			
F >1.5	26.8	1.4	37	31.2	2.4	29	29.5	1.7	42	27.2	1.7	44	30.1	2.2	35
F >3.5	25.6	1.6	28	29.4	2.9	19	30.0	2.4	24	30.4	2.1	26	29.3	2.6	21
F >4.5	26.4	1.8	24	27.6	2.9	16	30.7	2.8	20	31.7	2.2	22	25.4	2.4	13
M >1.5	12.6	0.9	16	18.8	1.6	20	14.4	1.0	15	17.2	1.5	22	16.1	1.0	8

[1] *100 x kidney fat (g)/femur length (cm).*

Appendix 18. Kidney fat/femur length ratios of caribou from the Beverly herd sampled each March, 1982 through 1987.

Sex/	age (yr)	Kidney fat/femur length ratio[1] 1982 Mean	SE	*n*	1983 Mean	SE	*n*	1984B[2] Mean	SE	*n*	1984A[3] Mean	SE	*n*	1985 Mean	SE	*n*	1986 Mean	SE	*n*	1987 Mean	SE	*n*
F	1	13.2	2.0	7	8.8	2.1	5	10.2	1.4	4				13.6	1.5	2	8.1	1.2	3			
M	1	13.2	1.4	6	10.5	2.6	3	7.9	2.5	2				13.0	5.5	3	7.0		1			
F	2	17.4	2.1	8	18.2	1.3	12	25.4	3.4	7	21.2	6.8	3	30.0	4.8	8	18.9	2.2	9	19.8	0.5	2
M	2	20.6	1.3	9	15.4	1.4	16	15.9	2.2	4	14.9	2.5	4	19.1	1.6	9	15.2	1.4	9	14.3		1
F	3	33.2	2.1	6	28.1	4.3	10	40.8	3.9	10	26.9	0.7	2	41.0	2.8	21	33.4	4.4	14	34.7	5.4	7
M	3	17.5	1.1	21	16.1	1.4	15	25.5	2.4	6	25.8	3.6	3	24.1	1.5	16	20.4	1.8	15	21.9	4.1	2
F	4	26.1	10.2	2	29.1	3.2	11	52.5	9.9	3	41.6	5.3	4	41.8	2.8	19	31.9	2.5	15	20.6	4.3	5
M	4	15.0		1	17.7	1.8	7	32.8	3.4	4	22.9	2.9	2	20.7	3.8	2	21.2	2.2	9	13.2		1
F	5	36.5	4.3	7	32.6	13.1	5	43.1	4.2	10	24.9		1	43.6	3.5	10	33.2	4.5	10	33.7	3.4	8
M	5	15.4		1	19.9	2.8	3	45.2	16.2	2				28.4	0.7	2	25.4	2.2	7	24.3	5.1	2
F	6-11	38.0	1.9	28	34.9	2.2	38	46.2	2.2	41	30.3	4.9	7	43.1	2.0	43	36.8	2.0	40	35.0	3.8	21
F	>11	31.8	5.6	5	22.5	5.1	6	40.1	1.8	5				36.4	3.6	9	30.9	3.8	8			
M	>5				26.6	1.2	2	41.4	1.7	4	21.2	2.9	3	29.2		1	26.4	2.7	6	19.8		1
F	>2	36.9	1.5	48	31.8	1.8	70	44.8	1.6	69	32.6	3.2	14	41.9	1.2	102	34.4	1.4	87	32.9	2.4	41
F	>4	37.0	1.7	40	33.2	2.2	49	45.1	1.8	56	29.6	4.3	8	42.2	1.6	62	35.3	1.7	58	34.6	2.9	29
F	>5	37.1	1.9	33	33.2	2.1	44	45.5	2.0	46	30.3	4.9	7	42.0	1.8	52	35.8	1.8	48	35.0	3.8	21
M	>2	17.3	1.0	23	17.7	1.1	27	33.8	2.7	16	23.3	1.8	8	24.5	1.3	21	22.5	1.1	37	20.9	2.4	6

[1] *Ratio = 10 x KF/FEL*, where KF is kidney fat (g) and FEL is femur length (cm).
[2] Subherd B, Porter Lake sample.
[3] Subherd A, Sifton lake sample.

Appendix 19. Percent fat in marrow of femur bones of caribou sampled from the Beverly herd each December from 1982 through 1986.

Sex/ age (yr)	Femur marrow fat (percent)[1]														
	Nov 1982[2]			Dec 1983[3]			Dec 1984			Dec 1985			Dec 1986		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							81.0		1	80.0		1	74.7	5.1	2
M 0.5	80.2	1.5	5	69.3	2.5	6	78.8	3.4	4				52.4		1
F 1.5	86.0	1.6	6	83.0	1.3	6	83.2	2.3	6	86.7	1.9	4	89.2		1
M 1.5	82.4	1.6	5	82.8	1.3	5	77.0	4.4	5	87.2	0.9	6	83.4	1.0	2
F 2.5	86.0	3.1	3	84.4	1.5	5	86.7	1.2	6	84.0	1.7	6	82.0	2.7	8
M 2.5	80.2	3.9	5	79.7	2.3	13	75.7	2.0	7	80.2	2.5	11	72.6	5.0	4
F 3.5	88.3	0.8	6	84.0	2.2	5	86.6	1.5	7	84.7	1.2	13	86.6	1.6	6
M 3.5	75.3	4.3	7	70.0	7.3	5	80.0	1.1	4	78.0	3.3	6	83.3		1
F 4.5	86.7	2.0	3	84.0	2.6	3	91.0		1	84.5	4.5	4	88.8	0.7	7
M 4.5	81.5	8.5	2	64.5	8.5	2	64.0	0.0	2	73.0	6.0	2	52.1	8.8	2
F 5.5-10.5	85.4	0.9	21	81.4	3.9	13	86.5	1.9	4	87.3	1.1	16	85.6	1.4	11
M >4.5	44.0	3.0	2				60.0		1	85.3	3.2	3			
F >10.5	84.3	1.5	3	83.0	2.0	2	87.5	0.5	2	86.7	0.9	6	86.2	0.7	2
F >1.5	86.0	0.6	36	82.8	1.9	28	86.9	0.7	20	85.7	0.7	45	85.6	0.9	34
F >2.5	86.0	3.7	33	82.4	2.2	23	87.0	0.9	14	86.0	0.8	39	86.7	0.8	26
F >3.5	85.4	0.7	27	82.0	2.8	18	87.4	1.2	7	86.7	0.9	26	86.8	0.9	20
F 2.5-4.5	87.3	0.9	12	84.2	1.1	13	86.9	0.9	14	84.5	1.1	23	85.6	1.3	21
F >4.5	85.3	0.8	24	81.6	3.4	15	86.8	1.2	6	87.1	0.8	22	85.7	1.2	13
M 1.5-3.5	87.8	2.2	17	78.3	2.1	23	77.2	1.6	16	81.4	1.6	23	77.2	3.5	7

[1] Neiland 1970.
[2] Late-November sample.
[3] Subherd A.

Appendix 20. Percent fat in the marrow of femur bones of caribou sampled from the Beverly herd each March from 1982 through 1987.

Sex/ age (yr)	Femur marrow fat (percent)[1]																				
	1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	79.9	1.7	11	82.6	2.7	5	78.7	2.0	3				86.0	4.0	2	74.0	1.0	2			
M 1	84.8	1.6	6	81.0	1.5	3	83.6	0.9	3				87.0	2.5	3	62.0		1			
F 2	86.6	0.6	12	87.7	1.8	11	88.8	1.7	5	81.0	1.0	2	87.6	0.7	8	90.0	1.1	7	79.0	9.5	2
M 2	84.1	1.0	11	88.0	0.9	17	84.7	0.9	3	71.5	5.6	4	87.6	1.7	8	83.6	3.5	8	91.3		1
F 3	86.3	2.2	7	89.7	1.2	9	89.0	0.9	11	86.5	0.5	2	87.0	1.0	20	89.2	1.2	14	89.0	0.9	7
M 3	84.9	1.2	23	88.1	1.2	15	86.5	1.0	6	83.0	2.5	3	86.1	1.0	15	86.2	1.4	15	87.0	0.8	2
F 4	89.5	0.5	2	89.4	1.4	11	89.0	1.7	3	88.0	2.0	2	88.2	0.8	18	90.9	0.4	14	86.5	2.1	5
M 4				86.7	1.3	7	89.5	1.2	4	82.5	1.5	2	87.5	2.5	2	84.8	2.8	9	75.3		1
F 5	87.8	0.9	9	89.5	1.0	6	88.2	0.9	10	83.0		1	89.2	0.5	10	84.4	3.0	10	88.9	0.6	8
M 5	85.5	1.5	2	86.8	1.7	4	89.7	0.9	3				83.5	4.5	2	88.4	1.5	7	87.7	0.5	2
F 6-11	87.4	0.5	28	87.8	0.7	40	87.4	0.6	39	79.9	4.2	5	86.9	0.9	44	90.0	0.5	38	81.5	3.2	21
M >5				91.0	1.0	2	88.5	0.5	4	72.0		1	87.0		1	89.5	0.8	6	85.9		1
F >11	86.7	1.0	6	85.7	1.4	7	83.7	2.3	3				86.6	0.8	9	88.4	0.9	8			
F >1	87.2	0.4	64	88.1	0.5	84	87.8	0.4	71	82.8	1.9	12	87.4	0.5	109	89.2	0.5	91	84.6	0.2	43
F >2	87.3	0.4	52	88.2	0.5	73	87.7	0.5	66	83.2	2.3	10	87.3	0.5	101	89.2	0.5	84	84.8	0.2	41
F >4	87.4	0.4	43	87.7	0.6	53	87.3	0.5	52	80.5	3.5	6	87.2	0.7	63	88.7	0.7	56	83.5	2.4	29
F 3-5	87.4	1.0	18	89.5	0.7	26	88.7	0.6	24	86.4	1.1	5	87.9	0.5	48	88.6	1.0	38	88.3	0.7	20
F >5	87.3	0.5	34	87.5	0.7	47	87.1	0.6	42	79.9	4.2	5	86.8	0.8	53	89.7	0.4	46	81.5	0.3	21
M >1	84.7	0.8	36	87.8	0.6	45	88.7	0.6	20	77.1	2.9	10	86.5	0.8	28	86.2	1.0	45	86.0	1.9	7
M 2-4	84.7	0.8	34	87.8	0.6	39	87.0	0.8	13	77.7	3.1	9	86.7	0.8	25	85.2	1.3	32	85.1	3.5	4

[1] Neiland 1970.
[2] Subherd B, Porter Lake sample.
[3] Subherd A, Sifton Lake sample.

Appendix 21. Percent femur marrow fat in caribou of the Beverly herd sampled in December and March of the same winter, 1982-83 through 1986-87.

		Percent fat in femur marrow						
		December			March			
Sex/ year	Age class	Mean	SE	n[1]	Mean	SE	n[1]	Signif- icance
Females								
1982-83	1.5-2	86.0	1.6	6	87.7	1.8	11	NS
	3.5-4	88.3	0.8	6	89.4	1.4	11	NS
	5.5-11	85.4	0.9	21	87.8	0.7	40	NS
1983-84[2]	5.5-11	81.4	3.9	13	79.9	4.2	5	NS
1984-85	1.5-2	83.2	2.3	6	**87.6**[3]	0.7	8	$P < 0.05$
	2.5-3	86.7	1.2	6	87.0	1.0	20	NS
	3.5-4	86.6	1.5	7	88.2	0.8	18	NS
	5.5-11	86.5	1.9	4	86.9	0.9	44	NS
1985-86	1.5-2	86.7	1.9	4	90.0	1.1	7	NS
	2.5-3	84.0	1.7	6	**89.2**	1.2	14	$P < 0.05$
	3.5-4	84.7	1.3	13	**90.9**	0.4	14	$P < 0.01$
	4.5-5	84.5	4.5	4	84.4	3.0	10	NS
	5.5-11	87.3	1.0	16	**90.0**	0.5	38	$P < 0.05$
	>11	86.7	0.9	6	88.4	0.9	8	NS
1986-87	2.5-3	82.0	2.7	8	**89.0**	0.9	7	$P < 0.05$
	3.5-4	86.6	1.6	6	86.5	2.1	5	NS
	4.5-5	88.8	0.7	7	88.9	0.6	8	NS
	5.5-10.5	85.6	1.4	11	81.5	3.2	21	NS
Males								
1982-83	1.5-2	82.4	1.5	5	**88.0**	0.9	17	$P < 0.05$
	2.5-3	80.2	3.9	5	88.1	1.2	15	NS
	3.5-4	75.3	4.3	7	**86.7**	1.3	7	$P < 0.05$
1983-84[2]	1.5-2	82.8	1.3	5	71.4	5.6	4	NS
1984-85	1.5-2	77.0	4.4	5	87.6	1.7	8	NS
	2.5-3	75.7	2.0	7	**86.1**	1.0	15	$P < 0.01$
1985-86	1.5-2	87.2	0.9	6	83.6	3.5	8	NS
	2.5-3	80.2	2.5	11	86.2	1.4	15	NS
	3.5-4	78.0	3.3	6	84.8	2.8	9	NS

[1] Minimum $n = 4$.
[2] Subherd A, the Sifton Lake sample.
[3] Means in bold differ significantly from December means.

Appendix 22. Percent water in the soft tissues of mandibles of caribou sampled from the Beverly herd each December from 1982 through 1986.

Sex/ age (yr)	1982 Mean	1982 SE	1982 n	1983[1] Mean	1983[1] SE	1983[1] n	1984 Mean	1984 SE	1984 n	1985 Mean	1985 SE	1985 n	1986 Mean	1986 SE	1986 n
M 0.5	43.2	6.4	2	47.4	1.7	3									
F 1.5	41.7	1.6	8	43.3	1.1	7	43.7	1.6	6	40.7	4.5	4	29.9		1
M 1.5	44.4	2.5	7	44.9	1.9	6	42.1	2.2	5	38.1	2.8	6	52.3		1
F 2.5	35.9	2.1	3	38.4	1.0	5	38.9	1.3	5	36.0	2.4	5	38.4	2.3	8
M 2.5	40.3	1.9	5	40.1	1.4	14	38.8	0.7	6	39.7	2.4	9	37.4	0.7	5
F 3.5	32.7	2.1	5	40.1	1.6	5	41.4	6.1	7	38.2	1.4	11	33.5	2.6	6
M 3.5	36.2	1.7	6	43.0	1.3	5	43.6	2.2	5	36.0	1.7	5			
F 4.5	33.9	0.9	4	36.2	2.1	4	27.4		1	34.5	3.9	4	33.3	1.6	7
M 4.5	35.7	0.4	2	39.6	0.7	2	45.1	7.9	2	32.8	4.8	2	47.7	3.0	2
F 5.5-10.5	36.1	2.2	22	38.7	2.7	13	35.6	3.1	4	34.4	1.7	18	36.5	2.5	10
M >4.5	63.3	15.9	2				39.4		1	34.1	3.0	3			
F >10.5	33.1	2.3	3	38.2		1	37.8		1	35.6	2.1	6	36.5	3.8	2
F > 1.5	35.2	1.4	37	38.5	1.3	28	38.4	2.5	18	35.7	0.9	44	35.7	1.1	33
F > 3.5	35.5	1.7	29	38.1	2.0	18	34.6	2.5	6	34.7	1.3	28	35.3	1.5	19
F > 4.5	35.8	1.9	25	38.6	2.5	14	36.0	2.5	5	34.7	1.4	24	36.5	2.1	12
M >1.5	41.1	3.0	15	40.8	1.0	21	41.4	1.3	14	37.1	1.4	19	40.3	2.1	7

Water in mandibular tissue (%)

[1] Subherd A.

Appendix 23. Percent water in the soft tissue of mandibles of caribou sampled from the Beverly herd each March from 1982 through 1987.

Sex/ age (yr)	Mandibular water (%) 1982			1983			1984B[1]			1984A[2]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	29.8		1	45.8	2.6	2	42.3	1.6	3												
M 1				48.0		1	45.7	1.7	3												
F 2	38.0	1.8	4	44.4	1.9	9	43.7	2.6	8	46.2	1.3	3	36.4	1.2	9	37.2	1.8	8	39.4	3.5	2
M 2	37.9	1.6	8	43.4	1.2	17	45.9	2.3	5	52.3	2.6	4	39.9	1.4	9	42.2	1.8	8	43.5		1
F 3	35.3	1.9	6	39.0	1.7	10	35.3	1.6	10	37.7	0.7	2	35.2	1.6	19	34.4	1.9	13	36.6	1.6	7
M 3	32.4	1.6	23	41.2	0.8	15	35.5	2.6	5	38.6	1.9	6	36.9	1.4	17	37.0	1.4	14	33.0	0.7	2
F 4	33.3	2.6	2	34.3	1.6	10	35.4	2.7	3	36.0	1.1	4	32.0	1.3	19	33.1	1.8	12	38.3	3.6	5
M 4	37.9		1	38.4	2.1	7	44.4	8.2	2	37.6	1.0	3				34.1	2.6	8	34.5		1
F 5	30.4	2.0	10	34.6	2.9	4	33.1	2.1	9	36.2		1	36.4	2.1	9	35.0	2.8	8	34.0	2.7	6
M 5	31.8	5.6	2	36.9	0.5	4	33.7	3.1	3				31.3	5.5	2	36.8	2.6	7	38.1	4.2	2
F 6-11	30.8	1.0	31	36.7	1.0	37	32.7	1.3	36	34.3	3.1	8	32.4	0.9	39	33.7	1.1	38	33.6	1.7	20
M > 5				34.6	6.3	2	34.5	2.7	4	41.8	3.4	3	29.1		1	34.8	2.7	6	30.4		1
F > 11	31.6	0.5	4	34.6	3.0	8	30.5	3.2	5				34.0	1.9	8	33.6	1.3	7			
F > 2	31.4	0.8	53	36.3	0.7	69	33.1	0.9	63	35.3	1.8	15	33.4	0.6	94	33.9	0.7	78	34.8	1.1	38
F > 4	30.8	0.8	45	36.1	0.9	49	32.5	1.1	50	34.5	2.9	9	33.3	0.8	56	33.9	0.9	53	33.7	1.4	26
F > 5	30.9	0.9	35	36.3	0.9	45	32.4	1.2	41	34.3	3.3	8	32.7	0.8	47	33.7	0.9	45	33.6	1.7	20

[1] Subherd B, Porter Lake sample.
[2] Subherd A, Sifton Lake sample.

Appendix 24. Condition index CONINDEX of caribou sampled from the Beverly herd each December from 1982 through 1986.

Sex/ age (yr)	CONINDEX[1] 1982 Mean	SE	n	1983[2] Mean	SE	n	1984 Mean	SE	n	1985 Mean	SE	n	1986 Mean	SE	n
F 0.5							82	6.1	2	83		1	86	9.9	2
M 0.5	83	3.7	4	80	5.7	6	83	6.2	4				50		1
F 1.5	103	6.1	6	102	5.8	6	99	6.4	6	98	5.8	4	108		1
M 1.5	85	4.5	5	102	8.0	5	74	5.9	5	98	3.4	6	88	0.9	2
F 2.5	115	8.5	3	139	12.8	5	122	10.3	6	102	5.7	5	111	13.5	8
M 2.5	80	4.0	5	91	9.3	13	76	3.6	7	83	3.2	11	78	7.9	4
F 3.5	120	5.8	6	113	11.8	5	115	7.2	7	104	5.6	13	130	8.1	6
M 3.5	72	4.3	7	77	11.3	5	83	5.8	4	84	5.0	6	88		1
F 4.5	107	13.0	3	123	5.2	3	109		1	103	12.2	4	129	10.4	7
M 4.5	85	14.7	2	71	21.3	2	56	0.8	2	73	5.8	2	58	9.1	2
F 5.5-10.5	109	3.3	21	106	8.0	13	124	10.6	4	121	5.1	15	108	4.1	11
M >4.5	41	7.3	2				56		1	100	9.0	3			
F >11	98	4.4	3	96	6.8	2	116	22.2	2	114	7.2	6	102	2.9	2
F >1.5	110	2.6	36	114	5.3	28	119	4.7	20	111	3.1	43	117	4.5	34
F >3.5	107	2.9	27	108	6.1	18	119	7.8	7	117	4.1	25	115	4.8	20
F >4.5	107	3.0	24	105	7.0	15	121	9.0	6	119	4.2	21	107	3.5	13
M >2	72	4.2	16	85	4.4	20	74	3.6	14	85	2.7	22	74	6.3	7

[1] *CONINDEX = (KFI - 20) + FEF* (Connelly 1981), where KFI is the kidney fat index (Riney 1955) and FEF is percent fat in the femur marrow.

[2] Subherd A, sampled at Sifton Lake.

Appendix 25. Condition index CONINDEX of caribou sampled from the Beverly herd each March from 1982 through 1987.

Sex/	age (yr)	CONINDEX[1]																				
		1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
		Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F	1	94	7.8	7	86	6.6	5	80	4.5	3				98	1.1	2	75	0.4	2			
M	1	93	3.7	6	85	7.1	3	87	7.9	3				95	11.6	3	60		1			
F	2	102	3.9	8	106	4.5	11	121	11.2	5	109	17.2	2	129	11.0	8	108	4.5	7	101	2.3	2
M	2	103	3.6	9	97	2.9	17	91	4.6	3	80	11.0	4	103	4.2	8	93	5.7	8	101		1
F	3	130	4.8	6	126	9.8	9	144	7.5	11	112	6.5	2	145	6.9	20	135	9.1	14	147	11.6	7
M	3	95	3.2	20	95	2.8	15	109	4.3	6	109	9.0	2	107	2.5	15	102	3.6	15	109	10.7	2
F	4	118	21.1	2	125	7.7	11	164	18.0	3	143	4.3	2	146	5.5	18	138	5.3	14	111	11.2	5
M	4				95	3.7	7	120	7.6	4	100	9.1	2	104	5.6	2	98	5.3	9	80		1
F	5	131	6.7	7	133	27.6	5	136	5.2	10	111		1	149	7.6	10	128	9.5	10	132	7.9	8
M	5	88		1	98	5.4	4	125	16.6	2				102	1.4	2	107	4.3	7	107	8.8	2
F	6-11	132	3.4	27	126	4.0	38	142	4.3	39	112	12.8	5	139	4.4	42	134	3.4	38	124	9.1	21
M	>5				108	7.6	2	120	2.3	4	72		1	102		1	105	3.0	6	98		1
F	>11	120	8.6	5	103	8.1	7	120	6.7	3				122	6.5	9	120	6.4	8			
F	>2	130	2.5	47	124	3.5	70	141	3.1	66	118	8.1	10	141	2.8	99	133	2.6	84	128	5.6	41
F	>4	130	2.9	39	124	4.2	50	140	3.5	52	112	10.5	6	138	3.5	61	131	3.0	56	126	6.9	29
M	>2	95	21.1	21	97	18.6	28	117	3.1	16	98	7.1	5	106	24.2	20	103	17.1	37	102	4.6	6

[1] *CONINDEX = (KFI - 20) + FEF* (Connolly 1981) where KFI = kidney fat index and FEF = percent fat in femur marrow.
[2] Subherd B, Porter Lake sample.
[3] Subherd A, Sifton Lake sample.

Appendix 26. Condition index FATP (percent body fat) of caribou sampled from the Beverly herd each December, 1982 through 1986.

Sex/ age (yr)	FATP[1] 1982 Mean	SE	n	1983[2] Mean	SE	n	1984 Mean	SE	n	1985 Mean	SE	n	1986 Mean	SE	n
F 0.5							8.3	0.6	2	8.4		1	8.7	0.9	2
M 0.5	8.4	0.3	4	8.1	0.5	6	8.4	0.6	4				5.4		1
F 1.5	10.2	0.6	6	10.2	0.5	6	9.8	0.6	6	9.7	0.4	4	10.7		1
M 1.5	8.5	0.4	5	10.1	0.7	5	7.5	0.5	5	9.8	0.3	6	8.8	0.8	2
F 2.5	11.3	0.8	3	13.5	1.2	5	12.0	0.9	6	10.2	0.5	5	10.9	1.2	8
M 2.5	8.1	0.4	5	9.1	0.4	13	7.8	0.3	7	8.4	0.3	11	8.0	0.7	4
F 3.5	11.8	0.5	6	11.2	1.1	5	11.3	0.7	7	10.3	0.5	13	12.7	0.7	6
M 3.5	7.4	0.4	7	7.8	1.0	5	8.4	0.5	4	8.5	0.5	6	8.8		1
F 4.5	10.5	1.2	3	12.0	0.5	3	10.7	0.0	1	10.2	1.1	4	12.6	1.0	7
M 4.5	8.6	1.3	2	7.3	1.9	2	5.9	0.1	2	7.5	0.5	2	6.1	0.8	2
F 5.5-10.5	10.7	0.3	21	10.5	0.7	13	12.1	1.0	4	11.9	0.5	15	10.7	0.4	11
F >10.5	9.7	0.4	3	9.6	0.6	2	11.4	2.0	2	11.2	0.7	6	10.1	0.3	2
M >5.5	4.6	0.7	2				5.9		1	10.0	0.8	3			
F All	10.7	0.2	43	11.1	0.4	34	11.0	0.4	28	10.8	0.3	48	11.3	0.4	37
F >1.5	10.9	0.2	36	11.2	0.5	28	11.6	0.4	20	11.0	0.3	43	11.5	0.4	34
F >3.5	10.6	0.3	27	10.6	0.6	18	11.7	0.7	7	11.5	0.4	25	11.3	0.4	20
M All	7.8	0.3	25	8.8	0.3	31	7.7	0.3	23	8.8	0.2	28	7.6	0.5	10
M >1.5	7.4	0.4	16	8.6	0.4	20	7.6	0.3	14	8.5	0.3	22	7.6	0.6	7

[1] *FATP = 0.845 + [0.091 X CONINDEX]*, where *CONINDEX = (KFI - 20) + FEF*, where KFI is the kidney fat index and FEF is percent fat in femur marrows.
[2] Subherd A.

Appendix 27. Condition index FATP of caribou sampled from the Beverly herd each March, 1982 through 1987.

Sex/	FATP[1]																				
age	1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
(yr)	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	9.4	0.7	7	8.7	0.6	5	8.1	0.4	3				9.8	0.1	2	7.7	0.1	2			
M 1	9.3	0.3	6	8.6	0.6	3	8.8	0.7	3				9.5	1.1	3	6.4		1			
F 2	10.1	0.4	8	10.5	0.4	11	11.9	1.0	5	10.8	1.6	2	12.6	1.0	8	10.6	0.4	7	10.1	0.2	2
M 2	10.2	0.3	9	9.7	0.3	17	9.1	0.4	3	8.2	1.0	4	10.3	0.4	8	9.3	0.5	8	10.1		1
F 3	12.7	0.4	6	12.3	0.9	9	13.9	0.7	11	11.0	0.6	2	14.0	0.6	20	13.1	0.8	14	14.2	1.1	7
M 3	9.5	0.3	20	9.5	0.3	15	10.7	0.4	6	10.8	0.8	2	10.5	0.2	15	10.1	0.3	15	10.7	1.0	2
F 4	11.6	1.9	2	12.3	0.7	11	15.8	1.6	3	13.9	0.4	2	14.2	0.5	18	13.4	0.5	14	11.0	1.0	5
M 4				9.5	0.3	7	11.8	0.7	4	10.0	0.8	2	10.3	0.5	2	9.8	0.5	9	8.1		1
F 5	12.8	0.6	7	12.9	2.5	5	13.2	0.5	10	11.0		1	14.4	0.7	10	12.5	0.9	10	12.9	0.7	8
M 5	8.9		1	9.7	0.5	4	12.3	1.5	2				10.1	0.1	2	10.6	0.4	7	10.6	0.8	2
F 6-11	12.9	0.3	27	12.4	0.4	38	13.8	0.4	39	11.1	1.2	5	13.5	0.4	42	13.0	0.3	38	12.1	0.8	21
M >5				10.7	0.7	2	11.8	0.2	4	7.4		1	10.1		1	10.4	0.4	6	9.8		1
F >11	11.8	0.8	5	10.2	0.7	7	11.8	0.6	3				12.0	0.6	9	11.8	0.6	8			
F >2	12.7	0.2	47	12.2	0.3	70	13.7	0.3	66	11.6	0.7	10	13.7	0.3	99	12.9	0.2	84	12.5	0.5	41
F >4	12.7	0.3	39	12.1	0.4	50	13.6	0.5	5	11.0	0.9	6	13.4	0.3	61	12.7	0.4	56	12.3	0.6	29
F >5	12.7	0.3	32	12.0	0.3	45	13.6	0.4	42	11.1	1.2	5	13.2	0.4	51	12.8	0.3	46	12.1	0.8	21
M >2	9.4	0.3	21	9.6	0.2	28	11.5	0.3	16	9.8	0.7	5	10.5	0.2	20	10.2	0.2	37	10.1	0.5	6

[1] See Appendix 26 for formula.
[2] Sample from Subherd B, Porter Lake.
[3] Sample from Subherd A, Sifton Lake.

Appendix 28. Estimates of percent body fat (FAT) of caribou sampled from the Beverly herd each December from 1982 through 1986.

Sex/ age (yr)	FAT[1]														
	1982			1983[2]			1984			1985			1986		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							8.0	0.0	2	8.3		1	9.5	0.6	2
M 0.5	8.4	0.5	4	9.3	0.4	7	8.5	0.5	4				7.4		1
F 1.5	9.9	0.6	6	10.4	0.5	7	9.8	0.6	6	9.3	0.7	4	10.4		1
M 1.5	8.0	0.5	6	9.6	0.7	6	7.0	0.5	5	9.4	0.3	6	8.6	0.3	2
F 2.5	11.1	0.5	3	12.2	0.7	6	10.9	0.8	7	10.2	0.6	5	10.6	0.8	8
M 2.5	7.7	0.4	5	9.1	0.4	14	7.8	0.4	7	8.2	0.3	11	8.9	0.4	5
F 3.5	11.3	0.4	6	10.9	0.8	5	10.7	0.6	11	10.0	0.5	13	12.0	0.5	6
M 3.5	7.2	0.2	7	9.0	0.7	6	8.2	0.6	5	8.8	0.3	6	8.6		1
F 4.5	10.1	0.7	4	11.7	0.3	4	10.6	0.3	5	10.0	0.8	4	11.6	0.6	8
M 4.5	8.4	1.0	2	8.5	2.0	2	6.4	0.5	3	7.9	0.0	2	8.9	0.1	2
F5.5-10.5	10.4	0.3	22	10.8	0.4	16	10.5	0.5	15	11.2	0.4	17	10.5	0.4	11
M >4.5	7.2	1.0	2				7.0		1	10.0	0.9	3			
F >10.5	9.7	0.4	3	9.7	0.6	2	10.2	0.8	6	10.9	0.5	6	10.0	0.4	2
F >0.5	10.5	0.2	44	11.0	0.3	40	10.5	0.2	50	10.5	0.2	49	11.0	0.3	36
F >1.5	10.5	0.2	38	11.1	0.3	33	10.6	0.3	44	10.6	0.2	45	11.0	0.3	35
M >0.5	7.6	0.2	22	9.1	0.3	28	7.5	0.3	21	8.7	0.2	28	8.8	0.2	10
M >1.5	7.5	0.2	16	9.0	0.3	22	7.6	0.3	16	8.6	0.3	22	8.8	0.2	8

[1] *FAT = (3.73 ln KFI) - 3.29*, an estimate of 100 X fat weight/dressed weight (Hout and Goudreault 1985).
[2] Subherd A.

Appendix 29. Estimates of percent body fat (FAT) of caribou sampled from the Beverly herd each March from 1982 through 1987.

Sex/ age (yr)	FAT[1]																				
	1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	9.4	0.5	9	7.6	1.5	5	8.6	0.6	4				10.0	0.5	3	8.2	0.5	4			
M 1	9.0	0.3	7	8.4	0.9	3	8.1	0.9	4				8.9	1.6	4	7.6		1			
F 2	10.0	0.3	9	10.1	0.3	15	11.2	0.5	9	10.4	1.0	3	11.5	0.6	10	10.1	0.5	9	10.6	0.7	2
M 2	10.3	0.2	9	8.9	0.3	21	9.1	0.4	5	9.0	0.9	4	9.8	0.4	9	9.2	0.3	9	9.5		1
F 3	12.4	0.3	7	11.1	0.6	12	12.6	0.4	11	10.9	0.5	2	12.7	0.4	22	11.9	0.5	14	12.7	0.6	7
M 3	9.5	0.3	24	8.9	0.3	19	10.6	0.3	7	10.7	0.4	5	10.4	0.2	19	9.9	0.3	15	10.5	0.9	2
F 4	10.8	1.8	2	11.4	0.5	11	13.6	0.7	3	12.7	0.4	5	12.7	0.3	20	12.1	0.3	15	10.5	0.8	5
M 4	8.4		1	9.2	0.4	8	11.3	0.5	4	10.0	0.5	3	10.5	0.4	3	9.7	0.4	9	8.7		1
F 5	11.9	0.5	8	11.1	1.4	5	12.7	0.4	12	11.2		1	12.9	0.4	10	11.9	0.6	10	12.0	0.5	8
M 5	8.4	0.3	2	9.4	0.5	4	11.5	1.1	2				10.3	0.3	2	10.2	0.3	7	10.3	0.8	2
F 6-11	12.1	0.2	33	11.6	0.2	43	12.6	0.2	43	10.9	0.7	8	12.5	0.2	47	12.0	0.2	42	11.6	0.5	21
F >11	11.3	0.7	5	9.8	0.6	8	12.0	0.2	5				11.5	0.3	10	11.2	0.5	8			
M >5	10.2		1	10.1	0.9	2	11.4	0.2	4	8.7	0.5	3	10.0		1	10.0	0.4	6	9.7		1
F >1	11.7	0.2	64	11.1	0.2	94	12.4	0.2	83	11.3	0.4	19	12.4	0.1	119	11.7	0.1	98	11.7	0.3	43
F >2	12.0	0.2	55	11.3	0.2	79	12.6	0.2	74	11.5	0.4	16	12.5	0.1	109	11.9	0.2	89	11.7	0.3	41
F >4	12.0	0.2	46	11.3	0.2	56	12.5	0.2	60	11.0	0.6	9	12.4	0.2	67	11.8	0.2	60	11.7	0.4	29
M >1	9.6	0.2	37	9.0	0.2	54	10.6	0.3	22	9.7	0.3	15	10.3	0.2	34	9.8	0.2	46	9.9	0.4	7
M >2	9.4	0.3	28	9.1	0.2	33	11.0	0.2	17	10.0	0.3	11	10.4	0.2	25	9.9	0.2	37	10.0	0.4	6

[1] FAT = (3.73 ln KFI) - 3.29 (Huot and Goudreault 1985).
[2] Subherd B, the Porter Lake sample.
[3] Subherd A, the Sifton Lake sample.

Appendix 30. Estimates of dissectible fat (DFAT) of caribou from the Beverly herd collected in December, 1982 through 1986.

Sex/ age (yr)	DFAT [1] (kg) 1982 Mean	SE	n	1983[2] Mean	SE	n	1984 Mean	SE	n	1985 Mean	SE	n	1986 Mean	SE	n
F 0.5							0.56	0.00	2	0.28		1	0.79	0.53	2
M 0.5	0.49	0.09	4	0.68	0.12	7	0.70	0.18	4				0.23		1
F 1.5	1.41	0.26	6	1.91	0.39	7	2.22	0.44	6	1.37	0.37	4	2.47		1
M 1.5	0.63	0.07	6	1.28	0.32	6	0.62	0.16	5	1.47	0.18	6	1.25	0.41	2
F 2.5	1.98	0.24	3	3.92	0.96	6	4.25	0.83	7	2.32	0.80	5	3.02	0.88	8
M 2.5	0.63	0.06	5	1.22	0.13	14	0.99	0.11	7	0.94	0.11	11	0.94	0.06	5
F 3.5	3.42	0.78	6	3.64	1.07	5	4.09	0.50	11	2.62	0.48	13	4.59	0.76	6
M 3.5	0.74	0.06	7	1.70	0.41	6	1.11	0.18	5	1.34	0.09	6	0.99		1
F 4.5	1.91	0.66	4	3.82	0.70	4	3.34	0.67	5	2.33	0.83	4	3.67	0.61	8
M 4.5	1.05	0.37	2	1.32	0.93	2	0.75	0.10	3	1.11	0.16	2	1.33	0.09	2
M >4.5	0.98	0.41	2				0.86		1	2.74	0.68	3			
F 5.5-10.5	2.80	0.33	22	3.43	0.55	16	4.15	0.56	15	3.62	0.38	17	2.22	0.34	11
F >10.5	1.26	0.08	3	2.80	0.41	2	4.15	0.83	6	4.46	0.86	6	2.87	1.27	2
F >1.5	2.62	0.25	38	3.56	0.35	33	4.06	0.29	44	3.18	0.19	45	3.18	0.32	35
F >3.5	2.52	0.28	29	3.45	0.42	22	3.99	0.39	26	3.61	0.34	27	2.83	0.33	21
F >4.5	2.62	0.31	25	3.36	0.49	18	4.15	0.45	21	3.84	0.36	23	2.32	0.33	13
M >1.5	0.78	0.07	16	1.36	0.15	22	0.97	0.08	16	1.31	0.16	22	1.04	0.07	8

[1] *DFAT (kg) = 1.151 DBF + (26.401 KF) - 0.246* (Adamczewski et al. 1987) where DBF is depth of back fat (cm) and KF is weight (kg) of trimmed kidney fat.
[2] Subherd A.

Appendix 31. Estimates of dissectible fat (DFAT) of caribou from the Beverly herd collected in March, 1982 through 1987.

Sex/ age (yr)	DFAT[1] (kg)																				
	1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	0.69	0.15	9	0.31	0.13	5	0.52	0.09	4				0.88	0.07	3	0.51	0.14	4			
M 1	0.66	0.09	7	0.55	0.09	3	0.60	0.20	4				0.96	0.38	4	0.20		1			
F 2	1.28	0.18	9	1.21	0.11	15	2.61	0.65	9	1.53	0.52	3	2.70	0.49	10	1.53	0.22	9	1.22	0.02	2
M 2	1.41	0.11	9	0.97	0.11	21	0.96	0.17	5	0.91	0.17	4	1.40	0.14	9	1.20	0.12	9	0.98		1
F 3	3.81	0.47	7	2.75	0.60	12	4.91	0.42	11	2.96	0.52	2	4.88	0.38	22	3.40	0.55	14	3.66	0.54	7
M 3	1.39	0.13	24	1.07	0.10	19	1.89	0.19	7	1.81	0.21	5	2.02	0.13	19	1.55	0.17	15	1.40	0.30	2
F 4	3.20	2.17	2	3.33	0.44	11	6.06	1.43	3	4.63	0.48	5	5.00	0.38	20	3.52	0.38	15	1.64	0.52	5
M 4	0.97		1	1.32	0.16	8	2.63	0.39	4	1.62	0.11	3	1.80	0.33	3	1.86	0.21	9	0.76		1
F 5	3.78	0.70	8	3.27	1.57	5	5.31	0.49	12	1.83		1	5.29	0.44	10	3.39	0.58	10	3.19	0.44	8
M 5	1.07	0.13	2	1.33	0.16	4	5.60	2.34	2				2.58	0.20	2	2.23	0.25	7	1.81	0.58	2
F 6-11	4.48	0.30	33	3.40	0.27	43	5.57	0.27	3	2.96	0.64	8	5.20	0.27	47	3.81	0.26	42	3.59	0.44	21
F >11	3.81	0.93	5	1.84	0.34	8	5.26	0.46	5				4.28	0.42	10	3.31	0.42	8			
M >5	2.35		1	2.18	0.28	2	5.29	0.68	4	1.49	0.22	3	2.90		1	2.39	0.32	6	1.39		1
F >2	4.19	0.24	55	3.13	0.21	79	5.43	0.19	74	3.41	0.41	16	5.02	0.16	109	3.60	0.18	89	3.29	0.28	41
F >4	4.29	0.27	46	3.17	0.26	56	5.49	0.22	60	2.83	0.57	9	5.08	0.21	67	3.67	0.21	60	3.48	0.34	29
F >5	4.39	0.29	38	3.16	0.25	51	5.54	0.25	48	2.96	0.64	8	5.04	0.24	57	3.73	0.23	50	3.59	0.44	21
M >2	1.39	0.12	28	1.23	0.09	33	3.30	0.48	17	1.67	0.12	11	2.07	0.12	25	1.89	0.12	37	1.43	0.23	6

[1] *DFAT = 1.151 DBF + 26.401 KF - 0.246* (Adamczewski et al. 1987) where DBF is depth of back fat (cm) and KF is weight (g) of kidney fat.
[2] Subherd B, Porter Lake sample.
[3] Subherd A, Sifton Lake sample.

Appendix 32. Condition index A (CIA) of caribou from the Beverly herd sampled in December, 1982-86.

Sex/ age (yr)	CIA[1] 1982 Mean	SE	*n*	1983[2] Mean	SE	*n*	1984 Mean	SE	*n*	1985 Mean	SE	*n*	1986 Mean	SE	*n*
F 0.5							7.1	0.0	2	6.0		1	7.4	1.9	2
M 0.5	6.5	0.3	5	6.1	0.6	7	7.2	0.7	4				4.8		1
F 1.5	7.9	0.6	6	9.6	1.1	6	11.0	1.2	6	8.9	1.1	4	11.6		1
M 1.5	6.8	0.2	4	8.2	0.5	5	6.8	0.4	5	8.8	0.4	6	8.6	1.5	2
F 2.5	9.0	0.6	3	15.1	2.5	5	15.9	2.4	7	10.8	1.9	6	12.3	2.0	8
M 2.5	6.8	0.2	5	7.8	0.2	13	7.4	0.3	7	7.2	0.3	11	6.6	0.7	5
F 3.5	13.4	2.2	6	14.1	2.7	5	14.9	1.5	11	12.0	1.1	13	16.3	2.0	6
M 3.5	7.0	0.2	7	8.6	1.1	5	8.1	0.3	4	8.1	0.4	6	7.9		1
F 4.5	9.1	2.2	4	14.5	2.4	3	12.4	2.5	4	11.1	2.0	4	13.4	1.5	8
M 4.5	7.7	0.6	2	7.7	1.5	2	6.5	0.8	3	7.7	0.1	2	7.4	0.3	2
F 5.5-10.5	11.9	1.0	21	12.4	1.3	14	13.8	1.7	15	14.7	1.0	17	10.4	0.8	11
M >4.5	6.3	0.9	2				7.0		1	11.2	1.3	3			
F >10.5	7.9	0.2	3	12.4	0.9	2	14.4	3.1	5	17.2	2.3	6	12.8	3.5	2
F >1.5	11.3	0.8	37	13.4	0.9	29	14.4	0.9	42	13.4	0.7	46	12.7	0.8	35
F >3.5	11.1	0.9	28	12.8	1.0	19	13.7	1.3	24	14.7	0.9	27	11.8	0.8	21
F >4.5	11.4	1.0	24	12.4	1.2	16	14.0	1.5	20	15.4	0.9	23	10.8	0.8	13
M >0.5	6.9	0.1	20	8.0	0.3	25	7.2	0.2	20	8.2	0.3	28	7.3	0.5	10
M >1.5	6.9	0.2	16	8.0	0.3	20	7.4	0.2	15	8.0	0.4	22	7.0	0.5	8

[1] *CIA = (WT + [10 x BF] + KF + FEF)/FEL*, where WT is body weight (kg); BF is depth of back fat (mm); KF is kidney fat (g); FEF is femur marrow fat (%); and FEL is femur length (cm).

[2] Subherd A.

Appendix 33. Condition index A of caribou from the Beverly herd sampled in March, 1982-87.

Sex/ age (yr)	Condition Index A[1]																				
	1982			1983			1984B[2]			1984A[3]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	6.5	0.5	11	6.3	0.3	5	5.6	0.7	4				7.7	4.0	2	5.1	1.2	3			
M 1	7.0	0.2	6	6.6	0.1	3	6.8	0.2	2				7.9	1.3	3	5.1		1			
F 2	7.5	0.4	12	7.8	0.4	12	9.9	1.8	7	7.2	1.7	3	11.5	1.3	8	8.3	0.8	9	7.4	2.3	2
M 2	7.6	0.4	11	7.5	0.3	16	7.0	0.9	4	6.6	0.5	4	8.0	0.5	9	7.7	0.5	9	7.5		1
F 3	15.2	1.5	7	11.5	1.7	10	17.6	0.9	10	12.2	1.1	2	16.7	1.0	21	13.0	1.2	14	13.7	1.2	7
M 3	7.7	0.2	22	7.5	0.2	15	8.9	0.4	6	7.3	1.3	4	9.2	0.3	16	8.6	0.4	15	8.0	0.7	2
F 4	13.5	5.7	2	13.3	1.2	11	19.9	3.2	3	13.6	1.9	4	17.1	1.0	19	13.7	1.1	15	8.7	1.2	5
M 4				7.9	0.3	7	10.5	0.8	4	8.4	0.3	2	8.7	1.1	22	9.4	0.5	9	7.2		1
F 5	14.1	1.6	9	11.5	3.0	6	16.3	0.9	10	8.9		1	17.9	1.0	10	13.1	1.4	10	12.6	1.0	8
M 5	6.9	0.8	2	7.0	1.1	3	14.3	0.4	3				10.8	0.6	2	10.3	0.7	7	9.1	0.9	2
F 6-11	16.5	0.9	28	12.9	0.7	39	18.6	0.7	41	9.6	1.4	7	17.1	0.7	45	14.3	0.6	40	13.2	1.1	21
M >5				10.2	0.4	2	17.3	1.9	4	6.1	0.6	3	11.5		1	10.6	0.6	6	8.1		1
F >11	14.5	2.1	6	10.1	0.9	6	17.1	1.2	5				15.7	1.1	9	13.3	1.1	8			
F >2	15.5	0.7	52	12.4	0.6	72	18.1	0.5	69	11.1	1.0	14	17.0	0.4	104	13.7	0.4	87	12.6	0.7	41
F >4	15.7	0.8	43	12.4	0.7	51	18.1	0.5	56	9.6	1.3	8	17.0	0.5	64	13.9	0.5	58	13.0	0.8	29
F >5	16.1	0.8	34	12.5	0.6	45	18.4	0.6	46	9.6	1.4	7	16.9	0.6	54	14.1	0.5	48	13.2	1.1	21
M >2	7.6	0.2	24	7.8	0.2	27	12.2	1.1	17	7.1	0.6	9	9.4	0.3	21	9.4	0.3	37	8.3	0.4	6
M >4	6.9	0.8	2	8.3	1.0	5	16.0	1.9	7	6.1	0.6	3	11.0	0.1	3	10.4	0.5	13	8.8	0.6	3

[1] *CIA = (WT + [10 x BF] + KF + FEF)/FEL*, with weight in kg; back fat in mm; kidney fat in grams; femur fat in percent; and femur length in cm.
[2] Subherd B, Porter Lake sample.
[3] Subherd A, Sifton Lake sample.

Appendix 34. Condition index B of female caribou from the Beverly herd sampled in December, 1982-86.

Sex/ age (yr)	Condition Index B (CIB)[1]														
	1982			1983[2]			1984			1985			1986		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							-67.5	2.5	2	-83.0		1	-70.0	13.5	2
F 1.5	-39.3	7.3	6	-35.6	6.7	7	-19.6	8.9	6	-31.3	8.1	4	-10.5		1
F 2.5	-17.5	5.3	3	20.8	18.2	6	25.8	17.0	7	-5.7	14.8	5	4.2	17.9	8
F 3.5	35.0	15.3	4	20.4	22.1	5	32.6	10.6	11	4.4	9.5	13	42.1	15.3	6
F 4.5	-10.6	13.4	4	26.1	15.7	4	19.0	15.0	5	1.1	18.6	4	27.1	11.7	8
F 5.5-10.5	9.2	7.2	21	18.9	11.2	16	38.4	10.9	15	27.7	7.8	17	-5.4	7.7	11
F >10.5	-26.0	3.0	2	9.0	5.0	2	35.4	17.7	6	40.1	18.5	6	13.0	20.0	2
F >2	5.5	5.6	34	19.7	7.1	33	32.3	5.9	44	16.5	5.5	45	13.4	6.6	35
F >3	7.7	6.0	31	19.5	7.8	27	33.6	6.3	37	19.3	5.8	40	16.2	6.7	27
F >4	3.7	6.2	27	19.3	8.5	22	34.0	7.9	26	26.5	7.0	27	8.7	6.9	21
F >5	6.2	6.9	23	17.8	9.9	18	37.6	9.0	21	30.9	7.3	23	-2.6	7.1	13

[1] *CIB = (WT - 75) + 2(BF - 10) + 0.5 (KF - 70)*, where weight is in kg; back and kidney fat in grams.
[2] Subherd A.

Appendix 35. Condition Index B of female caribou from the Beverly herd sampled in March, 1982-87.

Sex/ age (yr)	1982 Mean	1982 SE	1982 *n*	1983 Mean	1983 SE	1983 *n*	1984B[2] Mean	1984B[2] SE	1984B[2] *n*	1984A[3] Mean	1984A[3] SE	1984A[3] *n*	1985 Mean	1985 SE	1985 *n*	1986 Mean	1986 SE	1986 *n*	1987 Mean	1987 SE	1987 *n*
	Condition index B (CIB)[1]																				
F 1	-69.4	3.3	9	-79.1	3.1	4	-73.8	1.7	4				-64.3	1.4	3	-71.9	3.7	4			
F 2	-39.8	4.5	8	-44.9	2.5	15	-13.9	13.4	9	-37.5	9.4	3	-6.8	9.9	10	-31.6	4.2	9	-40.3	1.9	2
F 3	21.1	10.3	6	-3.0	12.0	12	44.7	8.1	11	5.8	9.4	2	44.3	7.6	22	15.4	11.6	14	17.7	11.6	7
F 4	6.8	28.8	2	12.0	9.5	11	66.7	23.2	3	36.1	9.3	5	49.3	7.5	20	19.8	8.5	15	-24.1	10.2	5
F 5	30.4	15.5	7	11.2	30.5	5	58.6	8.3	12	-13.0		1	59.0	8.7	10	20.9	11.8	10	14.3	9.0	8
F 6-11	43.7	6.1	32	17.8	5.6	43	64.3	5.4	43	7.1	12.5	8	59.2	5.1	47	31.0	5.4	42	20.7	9.7	20
F >11	27.8	16.7	5	-8.9	7.3	8	58.7	9.8	5				44.8	8.4	10	21.8	7.0	8			
F >2	36.3	5.1	52	10.7	4.4	79	60.2	3.9	74	14.7	8.0	16	53.0	2.3	109	24.7	3.8	89	13.3	6.2	40
F >3	38.3	5.5	46	13.2	4.7	67	62.9	4.3	63	16.0	8.9	14	55.2	3.6	87	26.4	3.9	75	12.4	7.0	33
F >4	39.8	5.5	44	13.4	5.4	56	62.7	4.4	60	4.8	12.0	9	57.0	4.1	67	28.1	4.4	60	18.9	7.6	28
F >5	41.5	5.8	37	13.7	5.0	51	63.7	5.0	48	7.1	12.5	8	56.7	4.5	57	29.5	4.7	50	20.7	9.7	20

[1] *CIB = (WT - 75) + 2 (BF - 10) + 0.5 (KF - 70)*, where WT is body weight (kg), BF is back fat depth (mm) and KF is kidney fat (g).
[2] Sample from subherd B at Porter Lake.
[3] Sample from subherd A at Sifton Lake.

Appendix 36. Weights of two antlers of caribou sampled from the Beverly herd from 1982 through 1987.

Sex/ age (yr)	Antler weights (g)[1]																				
	1981-82			1982-83			1983-84			1984-85			19 85-86			1986-87			All		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	42	10	5				44	2	3	18	8	2	45	1	27	4		2	37	5	13
M 0.5-1	50	6	6	36	2	4	31	5	7	29	3	8				20		1	35	3	26
F 1.5-2	103	23	9	112	15	16	113	17	8	95	13	13	150	17	13	168	48	2	117	8	61
M 1.5-2	219	28	11	141	14	25	224	31	9	309	37	14	276	36	15	376	76	3	228	15	77
F 2.5-3	190	39	6	132	11	13	311	17	15	236	20	26	208	17	19	197	15	15	203	9	94
M 2.5-3	689	57	20	470	52	23	507	62	20	623	53	22	517	40	25	585	98	7	559	24	117
F 3.5-4	224	19	2	186	17	16	279	40	8	235	19	27	222	18	28	229	29	10	225	10	91
M 3.5-4	969		1	784	63	14	918	189	7	1002	278	6	878	85	11	1329	41	2	895	64	41
F 4.5-5	230	38	9	157	29	9	219	16	16	252	20	14	200	26	12	248	20	15	222	10	75
M 4.5-5				1084	338	2	903	341	3	2466	261	3	999	156	3	2091	368	2	1496	225	13
F 5.5-11	356	21	33	230	12	62	288	15	54	342	17	59	276	14	58	235	21	32	286	7	298
M >5				2984		1				1386		1							2185	799	2
F >11	516	82	5	260	36	10	322	13	7	408	28	15	302	30	14	479	52	2	354	19	53
F 5.5-8	341	24	18	226	14	41	273	17	37	340	21	44	247	20	31	239	24	27	275	9	198
F 8.5-11	373	36	15	237	24	21	323	27	17	351	26	15	309	17	27	214	20	5	307	12	100
F 2.5-5	215	25	17	161	11	38	228	13	39	239	12	67	213	12	59	224	12	40	216	6	260

[1] Includes individuals with single antlers, where *antler weight = weights of single antlers x 2.2*.

Appendix 37. Femur bone lengths of caribou sampled from the Beverly herd each winter from 1981-82 through 1986-87.

Sex/ age (yr)	Femur lengths (mm) 1981-82 Mean	SE	n	1982-83 Mean	SE	n	1983-84 Mean	SE	n	1984-85 Mean	SE	n	1985-86 Mean	SE	n	1986-87 Mean	SE	n
F 0.5-1	235	1.8	11	230	2.8	5	240	2.9	4	236	3.8	4	237	5.0	4	231	4.0	2
M 0.5-1	250	3.4	6	234	4.2	8	236	3.0	9	245	1.7	7	242		1	230		1
F 1.5-2	270	2.6	12	263	1.9	18	263	2.3	16	270	1.6	14	270	2.4	13	274	3.2	3
M 1.5-2	275	2.0	11	273	2.1	20	272	2.6	13	281	2.5	14	279	1.7	15	281	6.4	3
F 2.5-3	274	2.9	7	277	2.3	13	276	1.6	17	274	1.7	28	277	1.4	20	277	1.6	15
M 2.5-3	291	1.8	24	290	1.6	20	288	2.5	23	293	1.9	23	292	1.8	26	287	3.1	7
F 3.5-4	275	1.5	2	280	2.1	17	276	2.0	12	277	1.0	30	276	1.1	28	282	2.0	11
M 3.5-4	307		1	300	2.3	14	299	1.9	11	296	2.6	6	299	2.6	15	292	5.0	2
F 4.5-5	278	2.9	9	280	2.3	10	278	1.8	14	279	2.0	14	278	1.7	14	278	2.0	16
M 4.5-5	301	8.5	2	307	1.1	5	300	2.5	5	302	4.5	5	300	2.6	9	301	4.4	4
F >5	276	1.3	35	276	0.8	69	278	1.0	69	279	0.9	74	278	0.9	71	278	1.3	34
M >5				309	2.7	4	304	1.6	7	314	5.5	2	301	3.5	9	313		1
F >2	276	1.0	53	277	0.7	109	277	0.7	112	278	0.6	146	277	0.6	133	278	0.8	76
F >3	276	1.1	46	277	0.8	96	277	0.8	95	278	0.7	118	278	0.7	113	279	1.0	61
M >2	292	1.8	27	297	1.5	43	294	1.7	46	296	1.7	36	296	1.3	59	294	3.0	14
M >3	303	5.4	3	303	1.7	23	301	1.2	23	301	2.7	13	300	1.6	33	300	3.7	7

Appendix 38. Length of tibia bones of caribou sampled from the Beverly herd, 1982-87.

Sex/ age (yr)	Tibia lengths (mm) 1981-82 Mean	SE	n	1982-83 Mean	SE	n	1983-84 Mean	SE	n	1984-85 Mean	SE	n	1985-86 Mean	SE	n	1986-87 Mean	SE	n
F 0.5-1	274	2.1	12	271	4.3	5	276	3.5	4	273	3.6	4	272	5.2	4	267	1.5	2
M 0.5-1	286	3.9	6	273	5.7	7	270	2.8	10	281	2.7	7	275		1	271		1
F 1.5-2	306	2.8	12	303	1.9	18	300	2.0	18	306	2.0	14	306	2.3	11	310	2.0	3
M 1.5-2	316	2.0	11	317	1.9	21	311	4.2	13	317	3.1	14	319	1.8	15	321	7.7	3
F 2.5-3	306	3.7	7	308	2.6	13	307	2.7	18	309	1.9	27	310	1.5	20	309	2.1	14
M 2.5-3	326	1.7	26	326	2.2	20	326	2.7	23	328	1.7	22	325	1.9	26	325	2.8	7
F 3.5-4	306	8.0	2	314	2.8	17	308	2.3	12	310	1.2	29	311	1.3	27	312	2.1	10
M 3.5-4	344	3.0	2	334	2.4	14	335	2.1	10	332	3.4	6	333	2.2	15	326	9.0	2
F 4.5-5	310	2.6	9	310	2.2	10	308	1.7	15	313	1.8	15	311	1.9	14	313	2.0	16
M 4.5-5	331	3.8	3	340	1.9	5	335	2.8	5	337	3.3	5	338	2.8	9	334	4.2	4
F >5	308	1.2	36	309	0.9	67	309	9.1	69	312	1.0	74	311	1.1	71	311	1.4	34
M >5	347		1	342	2.2	4	336	3.4	7	345	6.0	2	334	4.0	9	346		1
F >2	308	1.1	54	310	0.8	107	308	0.9	114	311	0.7	145	311	0.7	132	311	0.9	74
M >3	338	3.7	6	337	1.7	23	335	1.8	22	336	2.4	13	335	1.6	33	333	3.9	7

Appendix 39. Lengths of metatarsal bones of caribou collected from the Beverly herd, 1982 through 1987.

Sex/ age (yr)	Metatarsus length (mm)																	
	1981-82			1982-83			1983-84			1984-85			1985-86			1986-87		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1	240	1.3	13	236	2.7	5	243	0.5	3	236	1.7	3	238	1.7	3	236	0.4	2
M 0.5-1	247	1.6	7	239	3.2	8	237	2.5	10	245	2.9	6	244		1	245		1
F 1.5-2	266	2.4	12	262	1.8	19	262	1.5	14	267	1.6	12	265	2.3	12	271	2.2	3
M 1.5-2	273	1.8	11	271	1.6	21	270	2.7	14	275	1.5	13	275	1.4	15	274	7.3	3
F 2.5-3	265	2.9	8	264	2.3	13	266	1.7	18	264	1.5	27	266	1.7	20	264	1.9	14
M 2.5-3	279	1.5	26	279	2.0	20	281	2.2	22	280	1.4	24	281	1.8	25	281	1.1	7
F 3.5-4	263	7.2	2	267	2.5	17	263	1.5	11	266	1.2	29	266	1.3	27	269	1.8	9
M 3.5-4	292	3.9	2	282	1.8	13	280	2.6	10	286	1.2	6	284	1.9	15	277	4.6	2
F 4.5-5	267	1.9	10	268	2.6	10	266	1.9	14	268	2.1	14	267	1.9	14	269	1.3	15
M 4.5-5	275	3.7	3	285	3.8	5	280	1.3	4	280	1.3	5	285	2.2	8	281	4.3	4
F >5	264	1.2	37	266	0.9	68	265	0.9	69	267	1.0	71	266	1.0	70	269	1.7	34
M >5	285		1	286	1.9	4	280	2.1	7	283	3.5	2	279	3.9	8	281		1
F >2	264	1.0	57	266	0.8	108	265	0.7	112	266	0.7	141	266	0.7	131	268	1.0	72
M >3	282	3.7	6	283	1.5	22	280	1.4	21	283	1.2	13	283	1.5	31	280	2.9	7

Appendix 40. Mandible lengths of caribou sampled from the Beverly herd from 1982 through 1987.

Sex/ age (yr)	Mandible length (mm)																				
	1981-82			1982-83			1983-84			1984-85			1985-86			1986-87			All		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5-1				212	2.8	2	216	3.6	3										214	2.6	5
M 0.5-1				222		1	214	2.1	6	217		1							216	1.8	8
F 1.5-2				242	2.0	16	237	2.4	18	249	1.8	15	250	2.4	12	250	1.1	3	244	1.2	64
M 1.5-2				251	1.8	22	250	1.6	13	160	1.8	14	257	2.0	13	265		1	254	1.0	63
F 2.5-3	256	2.1	8	253	1.9	11	257	1.9	16	258	1.9	26	258	1.4	18	257	1.8	15	257	0.8	94
M 2.5-3	273	1.4	27	271	1.3	20	269	1.6	24	271	1.8	23	271	1.6	23	275	4.2	7	271	0.7	124
F 3.5-4	265	0.4	2	262	1.3	13	264	1.8	11	262	1.3	30	260	1.1	27	266	1.5	11	262	0.7	94
M 3.5-4	284	0.7	2	282	1.7	13	282	3.0	10	284	3.6	6	284	2.0	15	281	5.0	2	283	1.1	48
F 4.5-5	261	2.0	10	264	2.3	7	266	1.6	16	267	1.8	15	265	2.4	13	265	1.5	14	265	0.8	75
M 4.5-5	284	1.0	3	289	2.4	5	290	2.2	4	296	4.5	5	292	2.2	8	281	4.8	4	290	1.4	29
F 5.5-11	266	1.4	33	268	1.0	53	267	1.1	59	269	1.0	56	270	1.0	54	267	1.2	31	268	0.5	286
M >5	282		1	305	2.1	2	291	3.1	7	292	1.4	2	293	3.5	8	305		1	294	2.1	21
F >11	264	1.5	5	270	2.7	10	267	1.5	7	273	1.8	13	274	1.6	13	275		1	271	1.0	49
F 5.5-8	264	1.7	18	267	1.2	36	266	1.2	40	269	1.2	42	268	1.3	30	268	1.3	26	267	0.5	192
F 8.5-11	268	2.3	15	270	1.6	17	271	2.0	19	270	1.8	14	271	1.4	24	267	3.0	5	270	0.8	94

Appendix 41. Diastema and mandibular tooth row lengths in caribou sampled from the Beverly herd, 1980 through 1987.

Sex/age (yr)	Diastema length (mm)			Mandibular row (mm)		
	Mean	SE	n	Mean	SE	n
F 0.5-1	76.8	1.0	5	64.4	1.4	5
M 0.5-1	81.7	1.3	11	66.0	3.6	11
F 1.5-2	87.7	0.6	62	82.9	0.9	62
M 1.5-2	92.9	0.6	65	87.1	0.8	68
F 2.5-3	91.3	0.4	101	98.2	0.3	100
M 2.5-3	97.8	0.4	131	100.3	0.3	130
F 3.5-4	93.8	0.4	96	98.0	0.4	99
M 3.5-4	104.1	0.6	51	99.5	0.7	51
F 4.5-5	95.7	0.5	79	97.0	0.4	80
M 4.5-5	110.0	0.7	31	97.8	0.8	31
F 5.5-8	97.4	0.3	205	96.4	0.3	207
F 8.5-11	100.2	0.5	99	94.7	0.4	99
F >11	102.2	0.6	53	93.4	0.5	53
M >5	111.2	1.1	23	97.4	1.0	24
F >2	96.5	0.2	633	96.5	0.2	638
M >2	102.1	0.3	236	99.5	0.3	236

Appendix 42. Girth of caribou sampled from the Beverly herd of caribou, 1980 through 1985.

Sex/age (years)	Girth (cm)		
	Mean	SE[1]	*n*
F 0.5-1	91.3	0.3	25
M 0.5-1	93.9	1.0	28
F 1.5-2	103.6	1.1	60
M 1.5-2	106.7	0.7	58
F 2.5-3	109.8	0.9	51
M 2.5-3	115.2	0.6	84
F 3.5-4	111.9	0.9	37
M 3.5-4	120.7	1.0	31
F >4	113.8	0.3	243
M >4	121.8	0.8	37

[1] SE = standard error.

Appendix 43. Number of warble larvae under the skin of caribou sampled from the Beverly herd in December, 1982 through 1986.

Sex/ age (yr)	Number of warble larvae														
	1982			1983[1]			1984			1985			1986		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 0.5							19	5	2	31		1	12	2	2
M 0.5	94	9	3	73	25	7	38	16	4				42		1
F 1.5	39	9	8	14	3	7	10	4	6	34	4	4	9		1
M 1.5	60	14	7	34	6	6	50	16	5	44	14	6	49	12	2
F 2.5	12	4	3	25	9	6	6	2	7	17	9	6	11	3	8
M 2.5	20	6	5	24	7	14	10	4	7	20	4	11	10	5	5
F 3.5	10	7	3	9	3	5	4	3	11	8	3	13	1	1	6
M 3.5	34	12	7	26	7	6	30	28	5	13	4	5	12		1
F 4.5	56	37	4	4	2	4	3	10	5	4	2	4	5	2	8
M 4.5	30	8	2	75	33	2	73	11	2	118	79	2	90	34	2
F 5.5-7.5	20	7	15	12	3	11	2	1	11	1	0	10	13	5	11
F 8.5-10.5	7	3	6	3	2	5	1	1	4	4	2	7			
F >10.5	25	9	2	14	7	2	1	1	6	2	1	6	0	0	2
M >5	24	72	2												

[1] Subherd A.

Appendix 44. Number of warble larvae under the skin of caribou sampled from the Beverly herd in March, 1982 through 1987.

Sex/ age (yr)	Femur lengths (mm)																	
	1982			1983			1984[1]			1985			1986			1987		
	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*	Mean	SE	*n*
F 1	137	22	13	120	22	4	117	27	3	56	26	3	183	34	4			
M 1	139	32	6	185	55	3	112	63	2	104	23	4	150		1			
F 2	106	18	11	145	25	14	101	20	9	90	25	10	154	39	9	117	66	2
M 2	146	24	10	193	36	19	199	38	5	201	42	9	152	26	9	29		1
F 3	56	15	7	74	19	11	74	20	10	28	5	22	34	7	14	48	19	7
M 3	94	17	24	85	19	18	189	59	7	101	13	19	74	19	15	21	5	2
F 4	91	1	2	66	17	11	26	4	3	41	8	20	40	5	15	55	20	5
M 4	206		1	87	17	8	62	17	4	56	8	3	81	19	9	63		1
F 5	23	7	10	58	16	6	25	9	12	37	8	10	22	6	10	16	4	8
M 5	926		1	72	19	4	169	50	3	118	31	2	93	22	7	90	24	2
F 6-8	32	5	18	46	9	25	38	15	27	34	7	37	34	7	22	31	8	16
F 9-11	37	7	14	62	19	16	27	8	15	23	6	12	26	8	20	59	30	5
F >11	51	14	6	35	7	7	20	11	5	30	9	10	44	15	8			
M >5	71		1	251	129	2	436	112	4	208		1	234	38	6	320		1
F 3&4	64	13	9	70	13	22	63	16	13	34	5	42	37	4	29	51	14	12
F >4	34	4	48	51	7	54	31	7	59	32	4	69	31	4	60	32	7	29
F >5	37	4	38	50	8	48	32	9	47	31	5	59	33	5	50	38	10	21

[1] Subherd B, Porter Lake sample.

Appendix 45. Details of 23 caribou whose lungs contained hydatid cysts (*Echinococcus granulosis*), including the individual's indices and average condition indices for the sex and age class.

Month/ year	Sex/ age (yr)	No. of cysts	Ave. dia. (cm)	Condition index: individual vs. average					
				Weight (kg)		Back fat (mm)		Kidney fat (g)	
				Indiv.	Ave.[1]	Indiv.	Ave.	Indiv.	Ave.
Nov 82	F 10.5	2		82.0	81.8	1	9.2	99	75.5
Mar 83	M 3	1		77.0	79.8	1	0.4	35	47.8
Dec 83	M 1.5	Sev.		66.0	67.0	0	1.2	29	31.6
Mar 84	F 6	Many	5	86.0	88.0	12	21.6	37	126.0
Mar 84	F 8	2		84.0	88.0	6	21.6	64	126.0
Mar 85	F 9	1	2	96.0	89.2	33	19.0	137	123.2
Mar 85	F 7	1	2	91.5	89.2	1	19.0	44	123.2
Mar 85	F 6	1	1.5	98.5	89.2	26	19.0	122	123.2
Mar 85	F 6	1	3.0	90.5	89.2	22	19.0		123.3
Mar 85	F 4	1	2.1	88.0	83.2	14	18.9	78	115.4
Mar 85	F 14	2	5	102.5	91.7	18	15.8	132	102.7
Mar 85	F 8	1	7	105.5	89.2	40	19.0	131	123.2
Dec 85	F 3.5	1	4	79.7	81.8	22	9.9	84	65.1
Dec 85	F 9.5	3	6	82.7	87.2	2	14.3	46	88.1
Mar 86	F 13	2	2.2	85.0	88.1	12	11.1	58	86.4
Mar 86	F 7	2	1	89.0	86.1	7	12.0	81	101.3
Mar 86	F 6	1	7.5	86.0	86.1	9	12.0	101	101.3
Mar 86	F 10	6	1.5	86.0	86.1	5	12.0	102	101.3
Mar 86	F 3	1	1.5	68.0	78.0	0	10.3	54	93.1
Mar 86	F 9	2	2.8	83.0	86.1	18	12.0	138	101.3
Mar 86	F 5	1	2.8	71.5	83.7	1	10.4	32	92.2
Dec 86	F 5.5	7	4	84.5	78.6	11	5.2	125	70.6
Mar 87	M 7	1	5	105.0	104.5	0	0	62	57.4

[1] Average for age class.