The late winter diets of barren-ground caribou in North-Central Canada

Donald C. Thomas[1] and **David P. Hervieux**[2]

Abstract: Rumen samples from 104 barren-ground caribou *(Rangifer tarandus groenlandicus)* collected in March 1980 and 1981 at 18 sites on the winter range in south-central Northwest Territories (NWT) and northern Saskatchewan were examined microscopically for relative occurrence of plant fragments. The composition of plant fragments in the rumens of calves did not differ from that in older caribou. Samples were homogeneous within sites and among them. Therefore we analyzed composite samples for each site and then pooled the data. Terricolous fruticose and foliose lichens averaged 68.5 ± 1.5% (SE) of tallied fragments at all 18 sites, followed by conifer needles (11.9 ± 1.2%), green leaves of *Vaccinium* spp., *Ledum* spp., and other shrubs and forbs (5.6 ± 0.6%), twigs and bark (5.5 ± 0.4%), bryophytes (4.9 ± 0.6%) and 3.6% unidentified. The lichen component consisted of 8.4 ± 1.5% *Stereocaulon* spp., 46.9 ± 2.6% other fruticose lichens (largely *Cladina* spp., *Cladonia* spp., and *Cetraria* spp.), and 13.2 ± 1.5% foliose lichens (largely *Peltigera* spp.). A comparison of rumen contents with the average relative abundance of plants found in feeding craters at 13 sites suggests that use of plant species was not always proportionate to their occurrence.

Key words: caribou, winter diets, Northwest Territories, *Rangifer*, rumen samples.

[1] Canadian Wildlife Service, 2nd Floor, 4999 - 98 Avenue, Edmonton, Alberta, Canada T6B 2X3
[2] Present address: 11445 - 125 Street, Edmonton, Alberta, Canada T5M 0N1

Rangifer, Special Issue No. 1, 1986: 305 - 310

Introduction

In 1980, the Canadian Wildlife Service began a study of the winter ecology of barren-ground caribou *(Rangifer tarandus groenlandicus)*. The Beverly Herd was selected as the study herd because hunters and trappers, notably in Fort Smith, Northwest Territories (NWT), voiced concern over the effects on the herd of the extensive fires that occurred on the winter ranges in the summer of 1979 (Northern Affairs Program, 1980).

The first priority was to obtain information on the winter diet of the study herd. The only existing data for caribou herds in north-central Canada were analyses of rumen contents of: 1) 302 caribou collected from the adjacent Kaminuriak Herd in November (126), February (14), and April (162) of 1967-1968 (Miller, 1976a); 2) 28 caribou killed in northern Manitoba and Saskatchewan in February and April of 1972 and 1973 (Miller, 1976b); and 3) 20 caribou collected from various locations in Manitoba, Saskatchewan, and the NWT (Scotter, 1967).

Data on feeding locations and the frequency occurrence of plants in craters dug in the snow by caribou can provide insights into their food habits. Some conclusions about food preferences are possible if such data are combined with information from rumen analyses.

Miller (1976a) provided data on the frequency occurrence of plant genera at feeding sites in northwestern Manitoba and northeastern Saskatchewan in early, mid, and late winter. Miller (1976b) also obtained cover values of species at feeding sites used by caribou in February and April in the same region. The sites were fenced for examination in the summer.

Kelsall (1968) collated data on frequency occurrence of vegetation at several sites cratered by caribou in the NWT and northern Saskatchewan. He also compared data on frequency of occurrence of plants in craters with their frequency in the same general region.

This report gives the results of an analysis of the rumen contents of 104 caribou obtained in March 1980 and 1981 in conjunction with a study of *in vitro* digestibilities of plants using rumen fluids of caribou (Thomas and Kroeger, 1981; Thomas *et al.*, 1984). We also sampled vegetation in caribou craters to investigate the relationship between crater and rumen contents.

Methods

In March 1980, 75 rumen samples (50 fresh and 25 frozen) were obtained from 12 locations in the NWT and one in Saskatchewan. A year later, 29 samples were obtained from five locations in the NWT.

The site locations were on the following lakes which are named on 1:500 000 scale National Topographic Series maps of the area: Bedareh, 22 km south of Bedareh, 10 km southwest of Van Dyke, Van Dyke (two locations), Imogen, Brazen, Huntington, Dardier, Dunvegan, Carleton, and Scott (two sites). The sites were in a 58 x 160 km rectangle between 59°48'N and 60°20'N and between 106°09'W and 109°38'W.

In the laboratory, the half litre samples were thawed and 120 ml subsamples were thoroughly washed in a no. 20 sieve (0.85 mm) (Bergerud and Russell 1964) to remove particulate matter. A sample of the sieved material was spread in a dish and examined under a stereomicroscope (6X) equipped with a grid ocular. Plant fragments under 50 grid intersections were recorded and the process was repeated on another five sub-subsamples to yield data for 300 point samples from each rumen subsample.

Species fragments were grouped in the following categories: terrestrial fruticose lichens except *Stereocaulon* spp., *Stereocaulon* spp., terrestrial foliose lichens, conifer needles, bryophytes, leaves of *Ledum* spp., leaves of *Vaccinium vitis-idaea* var. *minus*, other evergreen leaves (e.g. *Arctostaphylos* spp. and *Empetrum nigrum*), twigs and bark, and unidentified fragments. Other species groups, including arboreal lichens, graminoids, and forbs were not present or not detected.

Age, site and yearly difference were tested by: (1) comparing the results from three calves and six older caribou obtained at one site in 1980 (*t* test); (2) degree of homogeneity within two sites (five and nine samples) and among sites (N=13) examined in 1980 (ANOVA and Kruskal-Wallis); and (3) comparing the results of pooled samples in 1980 (N=13 sites) with those of 1981 (N=5 sites) (*t* test).

Several hands-full of vegetation present at the base of 100 craters dug by caribou in late March, 1980 were placed in paper bags, labelled and returned to the laboratory for sorting. Ten bags were obtained at each of seven sites and five bags at each of six sites. Four of the sites were at caribou collection sites and the other nine in the same study region.

The relative abundance of plant species in feeding craters were subjectively rated at four levels and given a class symbol: 1 = trace amount, 2 = scarce, 3 = moderately abundant, and 4 = abundant. Average abundance values were then calculated for each site by pooling the data. Average relative abundance values were obtained by pooling the data from all 13 sites.

Snow thicknesses were measured adjacent to the 10 caribou craters that were sampled for plant species abundance at each site. At a few additional sites a minimum of 10 measurements were obtained in small clearings where the forest canopy and drifting did not affect snow thickness.

Results

Age, site and year variations

The fragment composition in rumens of three calves did not differ ($P<0.5$) from that of six older caribou. Fragment proportions of *Stereocaulon* spp., other fruticose lichens and foliose lichens were 7.3 and 9.8%, 61 and 59% and 4.7 and 5.2% in calves and older caribou, respectively.

Variations in fragment composition of the five most abundant plant groups within the two sites examined were not significant.

Variations in rumen composition were not significant among the 13 and 5 sites examined in 1980 and 1981, respectively. Much of the variability among sites in 1980 was caused by the sites at Dunvegan and Carleton lakes where 24% of the fragments were *Stereocaulon* spp. compared with a high of 14% elsewhere. The proportions of other lichen species at those two

sites, located in a region of drumlins (ridges of till), were the lowest of all sites. Proportions of *Stereocaulon* spp. were low (2-7%) at the seven sites west of 108°W but the total lichen values were similar at all sites, varying from 55-80% of all fragments.

The results for the five sites obtained in March 1981 were similar ($P<0.05$ for all classes) to those for 1980. The results for identified plant groups were all within 3% of one another except that fruticose lichens varied from 44% in 1980 to 54% in 1981, and *Stereocaulon* spp. decreased from 13 to 8%.

Diet

Pooled results from March 1980 and 1981 (Table 1) reveal the importance of terricolous lichens to caribou in the study herd. We believe that the conifer needles (mostly dead) are eaten incidentally because they are interspersed among the lichens. Similarly mosses are intertwined with lichens and cannot be avoided. Exclusion of those two groups increases the relative importance of the other components.

Frequency, relative abundance and availability of forage

Lichen genera and species occupied 7 of the 10 top positions in the list of the most frequent and most abundant species present in craters dug by caribou in search of forage in March 1980 (Table 2). *Cladina mitis* was by far the most abundant species in the craters.

Average snow thichnesses in 1980 at 14 sites varied from 31 to 56 cm and averaged 42 cm. The thickest snow was in the southeast in the Grollier and Robbins lakes region of Saskatchewan and the thinnest in the southwestern limits of the study area. Snow thicknesses in March 1981 averaged 31 cm (range 27-36 cm) at four sites (Brazen, Abitau, Hurricane and Porter lakes).

Table 1. Proportionate occurrence (percent) of plant fragments in composite samples of rumen contents obtained in March 1980 and 1981 from barren-ground caribou at 18 locations on the winter range east of Fort Smith, NWT.

Plant species or groups	% occurrence		
	Mean	SE	Range
Fruticose lichens	46.9	2.6	25-70
Foliose lichens	13.2	1.5	3-24
Conifer needles	11.9	1.2	3-23
Stereocaulon spp.	8.4	1.5	2-24
Twigs and bark	5.5	0.4	2- 9
Bryophytes	4.9	0.6	0-10
Vaccinium vitis-idaea	2.4	0.3	1- 4
Evergreen leaves[a]	1.4	0.3	0- 4
Ledum spp.	1.8	0.3	0- 4
Unidentified	3.6	0.5	0- 7
Total lichens	68.5	1.5	55-80

[a] Other than conifer needles, *Vaccinium* spp., and *Ledum* spp.

Discussion

Age, location and year variables

Minor differences in diet between calves and older caribou reflect use by calves of craters dug by older caribou, the close association of calves with their mothers, the limited variability in major vegetation groups among sites and the probable need to eat a variety of plant species to meet nutritional requirements. Miller (1976a) also found no dietary differences between sexes of caribou and therefore age and sex differences can be ignored in comparisons between individuals or in pooling rumen samples from a site.

The insignificant regional and annual differences in diet reflect the similarity of vegetation throughout the study area and the similar snow conditions in both years. Snow was relatively shallow compared with average range-wide values between 53 cm and 57 cm in March of 1982 through 1985 (Thomas, unpublised data). Miller (1976a) found a few significant differences between sites in a given season and differences between years in the proportion of lichens in rumens obtained in April.

Diet

Our findings differed little from those of Scotter (1967) who found that lichens accounted for 69% of the dry weight of plants in the rumens of 20 caribou collected in the winter in Saskatchewan, Manitoba, and the NWT. Woody plants (24%), bryophytes and fungi (4%), and grass-like plants (3%) completed the list.

Miller (1976a, 1976b) obtained data on the relative dry weights of plants in the rumens of 28 caribou obtained in February and April of

1972 and 1973 in northern Manitoba and Saskatchewan. The major difference was in total lichens (46-49% versus our 68%) and grass-like plants (8%) and mushrooms (2-3%) in Miller's (1976a) samples and not detected in ours.

Miller's (1976a) data for 302 rumen samples from barren-ground caribou collected on winter ranges in northern Manitoba from 1966 to 1968 are also comparable to ours. The approximate average composition by dry weight was lichens 49%, twigs 20%, leaves 21%, grass-like plants 8%, and mushrooms 2% (Miller, 1976a). The lower proportion of lichens in his samples may relate to the much deeper snow in semi-open coniferous stands in midwinter (February): 74-79 cm in 1967 and 60-80 cm in 1968 (Miller 1976a). Data extracted from his Fig. 5 indicate virtually no difference in broad classes of forages consumed by the Kaminuriak Herd between February and April of those years.

The proportionate ingestion of terricolous lichens is undoubtedly higher than is indicated by the above results because of their relatively rapid digestion (Bergerud and Russell, 1964; White and Trudell, 1980). Furthermore, the relative value of lichens as an energy source is higher than that of most other forages because lichens are highly digested by caribou (Person *et al.*, 1980a, 1980b; Thomas and Kroeger, 1981; Thomas *et al.*, 1984). Those factors in combination with the data on rumen contents provide overwhelming evidence that terricolous lichens are the most important forage item for barren-ground caribou on winter ranges in north-central Canada.

Our data on frequency of occurrence of plants in caribou craters differs markedly from Miller's (1976a) data. In general, the occurrences of lichens were much higher in our samples. For example, *Cladina mitis* occurred in 96% of the craters we examined compared with 56 and 61% for *Cladina* spp. in his February and April-May samples, respectively. *Peltigera* spp. occured in 39% of the craters we sampled compared with 0 and 4% for combined *Peltigera* spp. and *Nephroma* spp. in his February and April-May sampling periods. *Vaccinium vitis-idaea* occurred in 76% of craters that we examined compared

Table 2. Frequency of occurrence and average relative abundance[a] of plant genera and species in 100 caribou craters examined in March 1980 at 13 sites on the winter range of the Beverly Herd in the southern NWT and northern Saskatchewan.

Plant genus, species or group	% occurrence		Relative abundance[a]	
	Mean	SE	Mean	SE
Cladina mitis	96	14	3.6	0.1
Vaccinium vitis-idaea	76	6	1.7	0.2
Cetraria nivalis	69	8	2.0	0.3
Cladonia spp.[b]	69	6	1.1	0.2
Cetraria ericetorum	59	7	1.2	0.1
Stereocaulon spp.	57	8	1.6	0.3
Needles	42	11	1.4	0.2
Cladonia uncialis	40	7	1.1	0.4
Peltigera spp.	39	8	0.9	0.2
Cladonia cornuta	34	5	0.7	0.1
Cladonia amaurocraea	24	6	0.7	0.2
Cladina rangiferina	24	7	0.7	0.2
Ptilidium ciliare	24	6	0.9	0.2
Ledum spp.	23	8	0.5	0.2
Cladina gracilis	19	4	0.4	0.1
Cladonia coccifera	10	3	0.2	0.1

[a] Where 1 = trace, 2 = scarce, 3 = moderately abundant, and 4 = abundant

[b] Exclusive of *Cladonia amaurocraea*, *C. cornuta*, *C. coccifera* and *C. uncialis*, which were treated as individual species.

with 13 and 23% occurrence in Miller's (1976a) samples for the two periods. Kelsall's (1968) data on occurrence of plants in 428 feeding craters also varies considerably from ours, with much lower frequencies in most categories, except for *Carex* spp. Sampling differences may account for these differences in crater contents. We removed vegetation from the surface of the ground at the base of the crater whereas Miller (1976a) recorded the species occurrence of grazed and browsed plants.

Rumen contents versus crater contents

A conclusion derived from examination of the data in Tables 1 and 2 is that caribou ingested less *Vaccinium vitis-idaea*, *Ledum* spp., and bryophytes than would be expected by their frequency in the craters. For example, *Vaccinium vitis-idaea* occurred in 76% of the craters but its fragments constituted only 2.4% of all fragments tallied in rumen samples. Habitat studies in summer reveal that it is the most common vascular plant on the winter range (Miller 1976a), occurring in almost every ½ x ¼ m quadrat used for cover and biomass estimations (Thomas, unpublished data). *Ledum* spp. are usually not browsed when exposed in craters. There appears to be selection for foliose lichens, a group dominated by *Peltigera* spp. in the study area.

Conclusions

1. The diet of calves and older caribou were similar.
2. There was little variation in the diet of barren-ground caribou among years and on different parts of forested winter ranges in north-central Canada.
3. Rumen contents of barren-ground caribou indicate that lichens that grow on the ground dominate the diet in late winter on forested ranges in north-central Canada.
4. Shrubs and bryophytes were not eaten to the extent that they are available at caribou feeding sites.

Acknowledgements

Aircraft support was received from the Northwest Territories Wildlife Service and Indian and Northern Affairs Canada. We thank the Fort Smith Hunters and Trappers Association for help during the collection of samples and Dr. W.E. Stevens and E.S. Telfer for manuscript reviews.

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