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Seasonal Diets of the Porcupine Caribou Herd

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ABSTRACT: Microhistological techniques were used to quantify the diet of the Porcupine Caribou Herd of the northern Yukon during seven phenological periods. Winter diet was characterized by a dominance of lichens (66.7%) and mosses (28.8%). The shift from winter to summer diet was marked by a large increase in the use of vascular vegetation. Sedges comprise the bulk (55.5%) of the spring diet with orthophyll shrubs assuming dominance (over 98%) during the postcalving period. The use of orthophyll shrubs begins to decline during August and by autumn the diet is essentially similar to that during winter.

INTRODUCTION

A large number of developments have been proposed for the northern Yukon (*e.g.*, gas pipelines, the Dempster Highway, mineral developments). The majority of these impinge upon the range of the Porcupine Caribou Herd. This international herd consists of approximately 105,000 animals (Bente and Roseneau, 1978) and is currently the largest herd in Alaska and probably the third largest in Canada. As a result, considerable research effort has focused on the herd since the early 1970's. The purpose of this paper is to describe the seasonal diet of caribou of the Porcupine Herd (*Rangifer tarandus granti*) in the northern Yukon.

METHODS

Information regarding the seasonal diet of caribou was obtained from histological analysis of pellet (feces) material.

The annual cycle of the Porcupine Herd may be divided into seven phenologic periods: winter, spring migration, calving, postcalving, summer movements, August dispersal and autumn migration (Jakimchuk *et al.*, 1974; Jakimchuk and McCourt, 1975; Roseneau and Curatolo, 1975, 1976). The approximate dates of each phenologic period during 1973, the year of this study, are given in Table 1. Groups of fresh

TABLE 1.—Approximate length of each phenologic period and dates of sample collections during 1973

Phenologic period	Approximate length of period	Dates of collection of fecal samples
Winter	mid-November to early April	3, 6 and 11 April
Spring migration	early April to late May	20, 23 and 29 May
Calving	late May to mid-June	4, 7 and 10 June
Postcalving	mid-June to early July	21 and 27 June
Summer movements	early July to early August	16, 18, 25 and 28 July
August dispersal	early August to mid-September	2, 23, 26 and 30 August
Autumn migration	mid-September to November	29 and 30 September

pellets were collected during each of these phenological periods in the course of a larger study of the distribution and movements of the Porcupine Herd. The location of the herd was closely monitored as part of the larger study. At regular intervals during each phenologic period a helicopter was used to land near caribou herds to collect fecal samples. A maximum of two pellets were collected from each recently deposited pellet group located. These pellets were then air-dried. Pellets from different pellet groups were combined into a composite sample for each phenologic period.

Percent composition of plants within the seasonal diets was estimated by his-

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tological analysis of pellet material. The technique was described initially by Baumgartner and Martin (1939), and was successively refined by Dusi (1949) and Sparks and Malechek (1968). The analysis was performed by experienced technicians at the Composition Analysis Laboratory, Department of Range Science, University of Colorado, Fort Collins, under subcontract to Renewable Resources Consulting Services Ltd.

In the laboratory, composite pellet samples were ground in a mill over a 1.0-mm screen and then were washed over a 0.1-mm screen (Sparks and Malechek, 1968). This procedure ensures that particles will be randomly distributed when slides are prepared. Twenty slides from each sample were then prepared with Hertwig's solution and Hoyer's solution (Baker and Wharten, 1952); then, they were dried at 60 C for approximately 72 hr.

Tissues of plants collected in the study area were mounted on microscope slides according to Brusven and Mulkern (1960). Identification of plant remains in the pellets was based on epidermal characteristics of known sample plant tissues on the study slide (Davies, 1959; Brusven and Mulkern, 1960; Storr, 1961). Plant fragments were identified to genus and species when possible.

A plant collection composed of species collected in the same areas where the pellets were collected was available in the Composition Analysis Laboratory to assist with the identification of plant remains in the pellets.

Twenty microscope fields were located on each of the 20 slides prepared from each pellet mixture. A compound microscope was used at 100x magnification. Each recognized plant species within each field was recorded. Percent frequency for each plant species was determined as the number of fields in which a species occurred, expressed as a percent of the total number of fields examined (400). Percent frequency was then converted to particle density per field using a table developed by Fracker and Brischle (1944). Relative density was calculated for each food item: relative density equals the number of particles of a plant species expressed as a percent of the total number of particles of all plant species (Curtis and McIntosh, 1950). Relative density was then used as an estimate of the percent dry weight of each food item in the diet (Sparks and Malechek, 1968).

RESULTS

To facilitate interpretation of the results, the identified material was grouped (Table 2). The two types of moss (*Selaginella* and *Sphagnum*) which were identified have been grouped as mosses. Lichens were not identifiable to genus and have all been grouped. The orthophyll shrubs include *Betula* and *Salix*. *Carex* and *Eriophorum* have been grouped as sedges. The evergreens *Dryas, Picea* and *Vaccinium* were grouped, as were the grasses *Calamagrostis* and *Festuca*. *Equisetum* and arthropod parts comprise "Other."

Winter.—The winter diet was restricted in large part (95.5%) to lichens and mosses (Table 2). Lichens were highest at 66.7%; mosses made up 28.8% of the identified materials. Sedges, the third most important category, comprised only 2.1% of the identified material.

Spring migration.—The shift from winter to spring migration was marked by a large increase in the proportion of sedges which comprised the bulk (55.5%) of the spring diet. Lichens, although declining markedly from their winter peak, continued important and contributed 37.3% of the diet.

Calving.—Sedges peaked in importance in the diet during the calving period when they comprised 77.5% of the identified material (Table 2), 77.4% consisting of *Eriophorum* spp. The importance of lichens continued to decline during the calving period with lichens accounting for 13.2% of the total during this period.

Postcalving.—The postcalving period was marked by a rapid shift in the diet

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TABLE 2.—Percent relative density of identified plant fragments in caribou fecal samples deposited in northern Yukon during various phenologic periods of 1973. (N = number of pellet groups sampled)

Species	PHENOLOGIC PERIOD						
	Winter (N = 100)	Spring migration (N = 800)	Calving (N = 90)	Postcalving (N = 60)	Summer movements (N = 70)	August dispersal (N = 50)	Autumn migration (N = 50)
Selaginella-type moss	0.2	0.1				0.1	
Sphagnum-type moss	28.6	6.4	7.9	0.8	1.4	8.2	37.8
Lichen spp.	66.7	37.3	13.2		1.8	68.5	59.1
Betula spp.	0.8	0.1					0.1
Salix spp.		0.1	0.6	98.8	95.7	20.7	0.6
Carex spp.			0.1			0.1	0.1
Eriophorum spp.	2.1	55.5	77.4		0.9	1.5	1.7
Dryas spp.			0.1				
Picea spp.	0.1						
Vaccinium spp.	0.3						
Calamagrostis spp.	0.7		0.1	0.1	0.1		0.1
Festuca spp.	0.4						
Equisetum spp.	0.1	0.5	0.6	0.3		0.8	0.5
Arthropod parts						0.1	
Group totals							
Mosses	28.8	6.5	7.9	0.8	1.4	8.3	37.8
Lichens	66.7	37.3	13.2	0.0	1.9	68.5	59.1
Orthophyll shrubs	0.8	0.2	0.6	98.8	95.7	20.7	0.7
Sedges	2.1	55.5	77.5	0.0	0.9	1.6	1.8
Evergreen shrubs	0.4	0.0	0.1	0.0	0.0	0.0	0.0
Grasses	1.1	0.0	0.1	0.1	0.1	0.0	0.1
Other	0.1	0.5	0.6	0.3	0.0	0.9	0.5

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from primarily sedges to primarily orthophyll shrubs (Table 2). Orthophyll shrubs, chiefly *Salix* spp. comprised over 98% of the diet during the postcalving period.

Summer movements.—The diet of caribou during the period of summer movements was essentially the same as that noted during postcalving. Orthophyll shrubs continued to account for the vast majority of the diet during this period.

August dispersal.—A decline in orthophyll shrubs and an increase in lichens and mosses marked the August dispersal period (Table 2). Lichens increased to 68.5% of the total, approximately equal to their winter level, while orthophyll shrubs declined to 20.7%.

Autumn migration.—The diet during autumn migration was essentially similar to that during winter (Table 2). The diet during autumn migration was restricted in large part (96.9%) to lichens and mosses. Lichens were highest at 59.1%; mosses made up 38.7% of the identified material. Sedges comprised 1.8% of the identified material.

DISCUSSION

The food habits of the Porcupine Herd exhibited a clear seasonal progression from primarily lichens in the winter to primarily sedges in the spring, mainly willows in the summer, then shifting back to lichens during the autumn.

Thompson *et al.* (1978) have described the diets of caribou on Boothia Peninsula and the northern and southern District of Keewatin. Lichens comprised 41% of the winter diet of caribou on Boothia Peninsula, with 41% and 61% of the diets of caribou in the northern and southern District of Keewatin, respectively, being lichens.

The dominance of lichens in the winter diets of other mainland Canadian caribou herds is also well-established (Banfield, 1954; Kelsall, 1960, 1968). Similarly, the consensus of opinion of Russian caribou biologists appears to be that lichens constitute the bulk of winter forage (Sdobnikov, 1935; Igoshina, 1937; Glinka, 1939; Formozov, 1946; Shaposhnikov, 1955; Karev, 1961; Segal, 1962).

Russian authors also generally stress the need for green forage in the winter diet of caribou, considering it to be essential to the well-being of animals (Karev, 1961; Zhigunov, 1961). Feeding trials conducted by Palmer (1944), Kennedy and Titus (*in* Courtright, 1959) and Ahti (*in* Kelsall, 1968) suggest that lichens alone do not provide an adequate diet for caribou or reindeer. This results from the fact that lichens are relatively low in nutrient quality despite their high palatability (Courtright, 1959; Kelsall, 1968; Skoog, 1968).

The bases of the leaves of *Carex* and *Eriophorum* maintain live, green tissue during the winter; these species are often used as winter feed. Thompson *et al.* (1978) report that sedges supply 0.9% of the winter diet of caribou on Boothia Peninsula, increasing to 8.3% in the northern District of Keewatin and 9.9% in the southern District of Keewatin. Relatively heavy winter use of sedges has also been reported by both Alaskan and Russian workers (Chatelain, 1951; Lent, 1960; Karev, 1961; Skoog, 1968). Winter green feed may also be obtained from the buds and terminal twigs of willows (Thompson *et al.*, 1978).

Most authors have considered that mosses are eaten only incidentally and in trace amounts (Palmer, 1926; Murie, 1935; Banfield, 1954; Skoog, 1956; Kelsall, 1960; Edwards and Ritcey, 1960; Scotter, 1967). However, Aleksandrova (1937) found that 39% of the winter diet on Novaya Zemlya was moss, while Shaposhnikov (1955) found that mosses were also used by reindeer in the Ahtai Mountains. Rumen analysis done by Thomas *et al.* (1976) indicated that mosses were among the species taken most frequently in winter. Thompson *et al.* (1978) report that the winter diet of caribou on Prince of Wales Island was 56.1% moss; the proportion of moss in the winter diet declined to 51.4%, 46.2% and 22.7% on Boothia Peninsula and in the northern and southern District of Keewatin, respectively. On the basis of the somewhat high relative densities encountered and those reported by other studies,

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it does not seem likely that mosses were only accidentally eaten. Indeed, caribou have long been regarded as fastidious eaters, capable of selecting portions of a plant and even sorting out desired items in snow craters (Palmer, 1944; Skoog, 1956; Kelsall, 1968). It is possible that mosses would tend to be over-estimated in their relative contribution to the dry-weight diet due to the analytical technique used. The thick cuticle of mosses may resist digestion more than other plant species (White *et al.*, 1975); mosses fragment more than plants and even minute fragments are easy to identify (Dearden and Hansen, 1972; Dearden *et al.*, 1975).

In spring and summer, the energy requirements of caribou increase rapidly; juvenile caribou resume body growth after a period of winter dormancy (Skoog, 1968), cows require adequate nutrition for milk production, and fat reserves must be replenished for the following winter. Lichens, although adequate for winter maintenance, are not sufficiently nutritious for periods of high energy requirements (Kuitkin, 1950; Segal, 1962; Skoog, 1968). The change from winter to the spring and summer diet is therefore characterized mainly by the increased use of more highly nutritious, green vegetation.

Eriophorum is among the first species to produce green shoots in spring. Lent (1966) and Skoog (1968) both report that this species becomes almost an exclusive food item of northern Alaska herds during much of May and early June. The heavy use of sedges during the calving period is likely partially the result of their extremely high availability within the extensive sedge meadows which typify the calving ground of the herd.

Skoog (1968) notes that caribou exhibit a great fondness for willow and dwarf birch. This preference is evidenced by the rapid switch of caribou from primarily sedges to primarily orthophyll shrubs during the summer. The green shoots and leaves of willows appear to be highly preferred food in summer throughout the range of caribou (Banfield, 1954; Shaposhnikov, 1955; Herre, 1955; Kelsall, 1968; Skoog, 1968; Thompson *et al.*, 1978). Where available, sedges are also heavily used during the summer months (Loughrey, 1957; Sablina, 1960; Skoog, 1956, 1968; Kelsall, 1968). In addition, caribou graze upon a variety of forb species; the proportion of forbs in the diet varies considerably, depending upon the area being utilized (Skoog, 1968).

Lichens continue to be a component of the summer diet, despite the availability of green feed (Banfield, 1954; Shaposhnikov, 1955; Kelsall, 1968; Skoog, 1968; Thompson, *et al.*, 1978). Kelsall (1968) notes that consumption of willows and sedges declines as the leaves become more mature and tough. This is perhaps apparent in the decline of the importance of orthophyll shrubs and increase in lichens in the diet during the August dispersal period.

By the beginning of the autumn migration, the food habits of the Porcupine Herd are essentially similar to those of winter.

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