

Use of summer habitat by caribou on the north slope of a mountain near the Macmillan Pass, N.W.T.

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Abstract: Habitat use by woodland caribou was investigated by counting pellet-groups, sampling phytomass, and evaluating topography in nine habitat-types on the north slope of an unnamed mountain near Macmillan Pass, N.W.T. Caribou pellets were most abundant in high elevation habitat-types, and pellet density was greatest in an alpine Lichen-Grass habitat-type with a slope of $<1^\circ$. The high density of pellets in alpine areas may have resulted from the use of cool, windy, alpine habitats by caribou seeking relief from insect harassment. There were no apparent relationships between pellet abundance, and phytomass of mosses, lichens, or graminoids, possibly as a result of caribou feeding and defecating in different habitats. The occurrence of pellets with a coalesced morphology in the barren Lichen-Grass habitat-type provided indirect evidence in support of a feeding cycle, whereby caribou visit lush habitats to feed, and return to open, alpine habitats to rest and ruminate.

Key words: woodland caribou, Mackenzie Mountains, Northwest Territories

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Introduction

Food preference and availability are important in the selection of habitat exercised by caribou (Kelsall, 1968; Skoog, 1968; White *et al.*, 1975; Skogland, 1980; Servheen & Lyon, 1989). Summering caribou are known to favor areas characterized by lush vegetation types, including forbs, sedges, and willows (Stelfox *et al.*, 1978; Bloomfield, 1980; Oosenbrug & Theberge, 1980; Skogland, 1980; Brown *et al.*, 1986).

On warm, calm summer days, the caribou's apparent preference for green, succulent plants can be compromised when harassment by insects in moist meadows, wetlands, and riparian areas reaches unbearable levels (Skogland, 1980; Roby, 1978). At these times, woodland caribou are known to retreat to sparsely vegetated areas such as windy ridge tops and snowpatches for relief (Downes *et al.*, 1986; Ion & Kershaw, 1989). Thus, it seems probable that selection of summer habitat by woodland caribou involves partitioning between those resources that provide relief, and those that provide forage (Bergerud, 1974).

The primary purpose of this study was to investigate the use of summer habitat-types by woodland caribou (*Rangifer tarandus caribou*) in an alpine area of the Mackenzie Mountains, Northwest

Territories. A comparison of caribou evidence with vegetation and physical characteristics in different habitat-types forms the basis for discussion.

Study Area

Research took place on an unnamed mountain 15 km east of the Macmillan Pass (Lat. $63^\circ 18'$, Long. $130^\circ 17'$). The Pass is an east-west running corridor which traverses the Mackenzie/Selwyn Mountains above timber-line. Concentrations of woodland caribou, believed to belong to the Redstone herd, occupy the vicinity of Macmillan Pass between June and September, but are rarely seen at other times of year (Miller, 1976, Farnell & Nette, 1981). Other large vertebrates in the study area include moose (*Alces alces*), Dall's sheep (*Ovis dalli*), grizzly bears (*Ursus arctus*), wolves (*Canis lupus*), wolverines (*Gulo gulo*), and golden eagles (*Aquila chrysaetos*).

The Macmillan Pass area experiences a continental climatic regime modified by an alpine environment. Mean annual precipitation is 490 mm, and snow may fall during any month of the year. July, with a mean monthly temperature of 10°C , is the warmest month of the year.

With regard to vegetation, Erect Deciduous Shrub Tundra dominates at low elevation. Plant communities are characterized by birch (*Betula glan-*

dulosa) in association with lichens and mosses on drier sites, and several species of willow (*Salix* spp.) in association with mosses, sedges, and forbs on wetter sites.

Moderate to high elevation sites are frequently occupied by low-growing heath (*Cassiope tetragona*) interspersed within mats of lichens, particularly on rolling, moderately-sloped terrain. High elevation plateau areas appear as a rich, green mosaic of alpine and forb meadows, enriched by meltwater flowing from late-lying snowpatches. On the windswept dome of the study mountain, cobble-dominated sorted circles lie adjacent to a sparsely vegetated lichen-grass community.

Methods

Habitat-type designation

Transect blocks, each made up of six 100 m long transects, were flagged in nine habitat-types on the shoulder of the unnamed mountain. Sites were selected on the north face as caribou tend to favor cool, north-facing slopes in summer (Oosenbrug, 1976; Bloomfield, 1980; Skogland, 1980). Sites were located by walking up the fall-line of the mountain flagging transect blocks along an approximately evenly-spaced gradient between the base and summit, and deviating from a straight course only enough to include all prominent plant communities mapped by Kershaw & Kershaw (1983). Within each habitat-type, transects were oriented parallel to one another to maximize vegetation homogeneity. Descriptions of each habitat-type included aspect, slope, elevation, topography, and proximity of ecotones.

Phytomass collection

Above-ground phytomass samples were collected in early August using nine randomly-placed quadrats in each habitat-type. To speed sorting, a 10x10 cm quadrat was used for non-vascular plants while a larger 25x25 cm quadrat was used for all other live plants. All six transects within a habitat-type were sampled once, and three transects were sampled a second time based on the roll of a die. Phytomass samples were sorted into mosses, lichens, graminoids, forbs and shrubs. All samples were dried in a 60°C oven before being weighed.

Pellet-group counts

All transects were surveyed for pellet-groups twice, once in early July and again in early August. During the first survey, all fecal matter was removed from the 4 m-wide belt transects. Pellet-groups were categorized on the basis of morphology as either: 1. a single, coalesced mass, 2. a discrete, scattering of pellets, or 3. a transitional or intermediate character.

Data analysis

All phytomass values were converted to gm⁻² and summary statistics were calculated for shrubs, forbs, graminoids, lichens, mosses, and total phytomass in each habitat-type.

The time between clearing of fecal matter and resurveying of transects was standardized to 38 days in order to equalize the opportunity for caribou to use each habitat type. All pellet-group counts were converted from a value based on the area of the transect (400 m²) to pellet-groups per hectare.

Analysis of variance (ANOVA) based on habitat-type was performed on pellet-group data sets for both July and August. Similar ANOVA's were performed on the phytomass data for shrubs, forbs, graminoids, lichens, mosses, and total phytomass.

Results

Physical characteristics

Habitat-types selected for transect blocks occupied a range of plant communities and elevations from 1218 m to 1970 m (Table 1). The steepest study slope was on a late-lying snowpatch just below the summit dome; several other sites had slopes <1°. All habitat-types had northern aspects.

Vegetation characteristics

Variability within plant groups in a habitat-type was high - many standard deviations exceeded 70% of their associated mean values (Fig. 1a, 1b). This was a consequence of using a small sample size when variability inherent within the system was high. In order to make use of the data, values were assumed to reflect the grosser differences in phytomass among habitat-types. The least variability in phytomass occurred in the Forb Meadow, where the standard deviation was notably low for forbs.

With regard to relative amounts of phytomass, the Lichen-Grass habitat type had the lowest total phytomass, composed mainly of mosses and lichens (Fig. 1a,

Table 1. Gross characteristics of nine habitat-types surveyed for pellet-groups in July and August.

Plant Community	Terrain	Elev.(m)	Slope(°)	Aspect
Riparian willow	Riverbank	1218	<1	-
Birch-moss	Hillside	1316	5	N
Birch-lichen	Plain	1318	<1	-
Willow-forb	Lakeside	1328	<1	-
Lichen-heath	Rolling hills	1480	8	NE
Lichen-heath	Alpine slope	1650	5	NW
Forb meadow	Alpine plateau	1725	8	N
Snowpatch	Alpine slope	1880	22	NE
Lichen-grass	Summit plateau	1970	<1	-

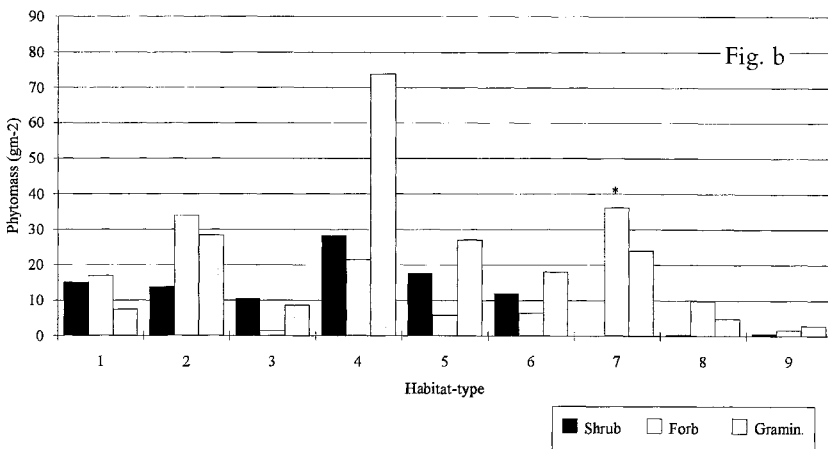
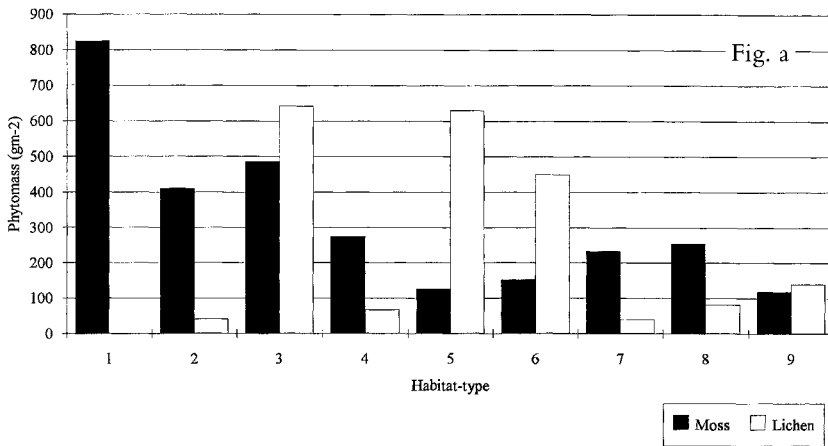


Fig. 1a, b. Mean phytomass (gm⁻²) of mosses, lichens, shrubs, forbs, graminoids in nine habitat-types, numbered from lowest to highest elevation. 1=Riparian Willow, 2=Birch Moss, 3=Birch-Lichen, 4=Willow-Forb, 5=Lichen-Heath, 6=Alpine Lichen-Heath, 7=Forb Meadow, 8=Snowpatch, 9=Lichen-Grass. Gram.=Graminoids. Standard deviation exceeds 70% of the mean value in all cases, except where * is shown.

1b). Woody plants were nearly absent from all the alpine habitats. Shrubs and graminoids were most abundant in the Willow-Forb habitat-type, despite a relatively low overall phytomass. Graminoids were also abundant in the Forb Meadow which also had the greatest forb phytomass. In contrast, forbs were most rare in the Birch-Lichen habitat-type even though this community had the highest overall phytomass, due to an abundance of shrubs, mosses, and lichens. Similarly, lichens in combination with shrubs constituted a large portion of the phytomass of both Lichen-Heath habitat-types. Between-group variance significantly exceeded within-group variance for phytomass of shrubs, forbs, graminoids, mosses, lichens and all plants ($F=2.22 @ P=0.04$, $F=6.19 @ P=0.00$, $F=2.30 @ P=0.03$, $F=3.93 @ P=0.00$, $F=8.39 @ P=0.00$, and $F=4.83 @ P=0.00$ respectively).

Pellet-group counts

There appeared to be a direct relationship between pellet-groups and elevation (Fig. 1c, 1d). In both early July and early August, the largest mean num-

ber of pellet-groups were recorded on the summit of the mountain while there was an absence of pellets in two low elevation habitat-types, specifically the Riparian Willow and Birch-Lichen.

Coalesced, scattered, and transitional pellet-groups were found in both July and August surveys; however, as pellets in the August survey were known to be deposited during July 1993, only these are presented in categories (Fig. 1d). Scattered and transitional pellet-groups were absent from low elevation habitat types while there appeared to be disproportionately large number of coalesced pellets-groups in the Forb Meadow habitat-type, which contained the greatest mass of forbs. Generally, the lower phytomass for all plants, and specifically shrubs, graminoids, mosses, and lichens in alpine habitat-types was accompanied by a higher abundance of pellet-groups (Fig. 1a, 1b, 1c, 1d). There was significant variability in the mean number of pellet-groups among habitat-types, with minimal variability within each habitat-type ($F=30.44 @ P=0.00$, $F=45.94 @ P=0.00$ for July and August respectively).

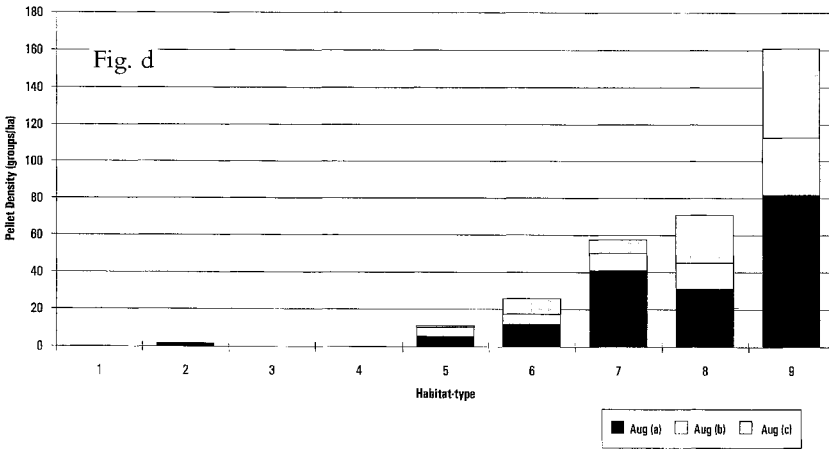
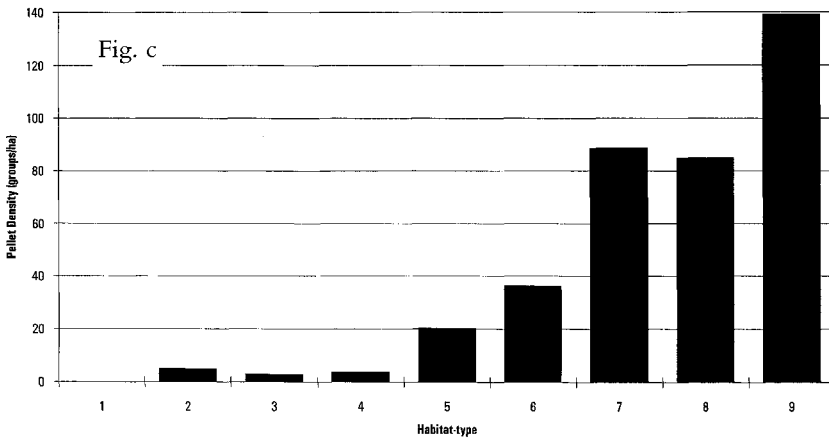


Fig. 1c, d. Mean caribou pellet-groups per hectare counted in nine habitat-types during early July and August. August pellet-groups are subdivided based on morphology into coalesced pellet-groups (a), transitional pellet-groups (b), and scattered pellet-groups (c). Standard deviation is less than 50% of the mean value for habitat-types 5 - 9.

Discussion

Pellet-group counts

Unlike track counts, pellet-group counts are not dependent on the hardness of the ground surface, or on the difficulties of distinguishing between sign of separate animals (Fischer *et al.*, 1977). In contrast to both ground and aerial surveys, pellet-group counts can be an inexpensive way to assess the relative habitat use of an animal virtually in absentia. This technique is not without drawbacks, and chief among these is a fundamental and possibly-erroneous assumption that the number of pellet groups found within a habitat indicate of the amount of time an animal spends there (Robinette *et al.*, 1958). For this reason, previous caribou studies have been careful to qualify that the interpretation of pellet-group counts may be clouded by the high mobility of the subject animal (e.g. Fischer *et al.*, 1977).

Given this limitation of pellet group surveys, it is best to proceed cautiously from reporting pellet abundance to discussion of actual habitat use, parti-

cularly when habitat availability information is limited to a site description as in the present study. However, as cervids tend to follow an extremely regular cycle of consumption, rumination and defecation (Oldemeyer & Franzmann, 1981; Dinerstein & Dublin, 1982), pellet group counts inevitably provide some indication of the habitats utilized regularly by a species. Furthermore, the regular occurrence of an animal in a specific habitat for whatever purpose provides insight into the larger, more general question of habitat use. Because of this, ungulate pellet-group counts have been employed successfully by many researchers as an index of relative habitat use (e.g. Collins, 1981).

Because the study area is believed to be used exclusively as summer range by caribou, the early July pellet-group count is a survey of pellets dropped in previous summers, and the similarity between July and August pellet data implies a consistent trend in pellet deposition between the nine habitat-types (Fig. 1c, 1d). The only exception was in alpine Lichen-Grass habitat-type in which there were

more pellets counted in August than in July. Most likely, this disparity was due to the greater age and exposure of the pellet-groups counted in early July which frequently appeared scattered by snowmelt run-off and animals, particularly in heavily-used habitats. This made it difficult to correctly identify discrete pellet groups, and may have resulted in an underestimation of the number of groups in the Lichen-Grass habitat-type in July. This reflects little on the relative number of pellet-groups among habitat-types.

Physical characteristics

If pellet-group density reflects habitat use, alpine habitat-types were used more than low elevation ones (Fig. 1c, 1d). However, this is not necessarily a valid assumption as an unbalanced distribution may be the result of many possible influences. As a simple example, the conical shape of a mountain will concentrate animals and their evidence into alpine areas while allowing them to disperse over greater areas in the subalpine. In light of this, it is better to approach discussion from a more functional perspective, and examine why high elevation habitats would contain high densities of pellets.

The Lichen-Grass habitat-type was on the flattened summit of the mountain. It supported the highest pellet-group densities, indicating it was regularly used by caribou (Fig. 1c, 1d). This habitat-type also had the highest elevation and a negligible slope (Table 1). An inverse relationship has been reported between elevation and insect activity, and thus summering caribou have been reported to avoid insect pests by utilizing high elevation areas in west central Alberta, central British Columbia, and the eastern Yukon (Stelfox *et al.*, 1978; Bloomfield, 1980; Downes *et al.*, 1986). Caribou have been witnessed to seek ridge tops and snowpatches in the Mackenzie Mountains to apparently take advantage of wind conditions that are unfavorable to blood-sucking insects (Gill, 1978; Ion & Kershaw, 1989). Both the exposed Lichen-Grass habitat-type and the neighboring Snowpatch habitat-type might have been attractive to caribou as sanctuaries from mosquitos and flies. Furthermore, Oosenbrug (1976) found caribou to have a preference for high elevations, but also for "flat-to rolling terrain" with slopes of <20°: topography similar to that of the Lichen-Grass habitat-type.

Vegetative characteristics

Gill (1978) conducted counts of individual caribou pellets in the Macmillan Pass and found little connection between pellet abundance and phytomass. This study achieved similar results concerning the

lack of an obvious relationship between phytomass and the occurrence of pellet-groups (Fig. 1a, 1b, 1c, 1d). This may stem, in part, from the relatively small number of samples used. As well, it is entirely possible that the level of vegetative sampling selected for phytomass is inappropriate to the level of forage selection expressed by caribou. Sampling of plant groups from one point in time does not allow comparison to specifically sought-after species, nor change in preferential forage over the summer.

Nonetheless, certain generalizations can still be formed. In general, those communities with the least phytomass had the greatest evidence of use (Fig. 1a, 1b, 1c, 1d). To some degree, this is consistent with other studies which show that consumption of shrubs and lichens by caribou may reach its lowest level in summer (Stelfox *et al.*, 1978; Bloomfield, 1980). Skogland (1980) found a significant correlation between above-ground phytomass and time spent feeding in a vegetation type when animals were allowed to express selection uninterrupted by insect harassment. In contrast, insect harassment of caribou was frequently observed in the study area (Ion, 1986; Quayle, 1994).

Skogland (1980) found that forbs were the most selected of any plant in alpine areas, a finding reiterated by Stelfox *et al.*, (1978) and Bloomfield (1979). The relatively high density of pellets found in the Forb Meadow may also indirectly support use of forbs by caribou (Fig. 1d). The Forb Meadow habitat-type had the greatest forb phytomass (Fig. 1b), occurring at 1725 m on a moist plateau beneath a steep snowy slope. Caribou are opportunistic feeders, taking advantage of new growth as it appears, and such areas can be especially attractive to them (Gill, 1978; Stelfox *et al.*, 1978; Bloomfield, 1980; Skogland, 1980). August pellet data from the Forb Meadow may be indicative of regular visits by caribou. Many of the pellets present also showed a coalesced morphology which may be associated with the sort of lush forage found in this habitat-type (Fig. 1d).

Shrubs, particularly willow, have also been suggested as preferred summer forage for caribou; however, the results of this study indicate shrub phytomass was low or absent where pellet density was high (Fig. 1b, 1d). In fact, the only communities where both shrubs and pellets figure prominently were the Lichen- and Alpine-Heath habitat-types in which the dominant shrubs (*Cassiope tetragona* and *Vaccinium uliginosum*) were low growing. Differential pellet visibility between habitat-types is probably responsible to an extent for differences; however, given that both bear scat and numerous moose pellets were recorded in shrubby communities, visibility was likely not the only explanation.

As discussed earlier, a foraging cycle, in which animals browse on shrubs at low elevation, but ruminate and defecate in open, alpine areas would produce similar results.

A foraging cycle is given more indirect support by the morphology of the pellets found in the Lichen-Grass habitat-type. A large number of coalesced pellet-groups were found in the Lichen Grass habitat-type, despite an absence of any lush vegetation normally associated with this pellet morphology (Fig. 1b, 1d). This makes plain that pellet-group density is not always indicative of relative use between habitat-types. As well, although pellet density suggests that caribou consistently visit the Lichen-Grass habitat-type, they appear to feed elsewhere on more lush forage which is clearly not available on the windswept mountain-top. It is easy to speculate that the animals cycle back and forth between those habitat-types where they forage, and those where they ruminate, rest, and defecate. This would result in an abundance of pellets being deposited in alpine areas as animals defecate following periods of bedding, even though caribou may not necessarily spend more time in bedding habitat. Following this train of thought, the large number of coalesced pellets in the Lichen-Grass habitat-type may be from resting or ruminating animals, possibly seeking solace from insect harassment in windy, alpine areas after returning from feeding visits to more lush communities. Such behaviour patterns have previously been reported (Archibald, 1973; Ion, 1986; Quayle, 1994).

Conclusions

1. Woodland caribou pellet-groups were more abundant in habitat-types at higher elevations than those at lower elevations, with the greatest density of pellets occurring in a habitat-type with a slope of $<1^\circ$. Assuming pellets are indicative of regular use by caribou, high elevations may be sought in summer for relief from insect harassment.
2. This study could not determine any relationship between pellet-group abundance and phytomass. This may be due to vegetative sampling which was inappropriate to forage selection by caribou in the study area; it may also be the result of caribou feeding and defecating in different habitats.
3. The abundance of coalesced pellets found in the dry, barren Lichen-Grass habitat-type suggested both that pellet-group densities were not always indicative of relative habitat use, and that caribou must have made feeding visits to more lush habitat-types. This suggests that the distribution of pellet-groups may be the result of a feeding-

ruminating cycle, whereby caribou feed in lush habitats and retreat to open, high elevation habitats to rest, ruminate and, defecate.

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