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Brief communication

A Comparison of digestive Tract Morphology in muskoxen and caribou from Victoria Island, Northwest Territories, Canada

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In areas of Canada, Greenland and Alaska where muskoxen (*Ovibos moschatus*) and caribou (*Rangifer tarandus* subspp.) coexist, there is a potential for overlap in foraging, particularly at high population densities (Vincent & Gunn, 1981; Staaland & Riis Olesen, 1992). The potential for competition should be greatest in winter, when plant senescence and snow cover restrict foraging choices. To date, studies of food habits in sympatric caribou and muskoxen generally have provided little evidence of competition (Wilkinson *et al.*,1976; Thomas & Edmonds, 1984). The numbers of caribou and muskoxen on Victoria Island, Northwest Territories increased from 1970 to 1990 (Gunn, 1990) and the two species have been observed in relatively close proximity (1–2 km) near Cambridge Bay at the southern end of the island. Based on their digestive anatomy, ruminant species have been classified along a grazer-intermediate feeder-concentrate selector continuum (Hofmann, 1989). Grazers are identified by relatively large rumens and omasa and relatively small hindguts (caecum+large intestine), while concentrate selectors tend to have relatively small rumens and omasa and more pronounced hindguts (Hofmann, 1989). Hofmann (1989) has suggested a substantial correlation between digestive anatomy of ruminants and their ability to digest particular forages, although Gordon & Illius (1994) and Robbins *et al.* (1995) have challenged the strength of this correlation.

We examined the digestive tracts of 10 muskox cows ≥3 years old and 10 caribou cows ≥2 years old shot by Inuit hunters in November 1992 near Cambridge Bay, to provide a physiological background for comparisons of digestion and foraging strategies of the two species, under winter condition with restricted foraging choices. The digestive tracts of the study animals were removed at a field camp and measured within 2–5 hours of death, following the methods of Staaland & White (1991) and Staaland & Thing (1991). Mean species values (±S.D.) were compared by *t*-test with significance at $P<0.01$.

The mean body mass of the muskoxen (216±20 kg) was three times greater than that of the caribou (72±4 kg), and total (wet) alimentary fill was greater in both absolute and proportionate terms: 50.4±5.9 kg *vs.* 13.5±2.3 kg, and 234±29 g kg^{-1}

Table 1. Content and tissue weight of sections of the alimentary tract of 10 female muskoxen and 10 female caribou from Victoria Island. Values are expressed as % of rotal fill or as % total tissue weight.

	Rumen/retic.	Omasum	Abomasum	Small int.	Hindgut
		Content			
Muskoxen	72.9±2.3	6.6±1.6a	1.5±1.0	8.9±1.1	10.1±1.0a
Caribou	70.1±3.8	4.0±0.9b	1.6±0.6	9.5±2.2	14.8±2.7b
		Tissue			
Muskoxen	47.6±1.1a	15.0±1.0a	5.3±0.4a	17.6±1.2a	14.5±1.3
Caribou	60.2±2.4b	5.5±0.6b	4.4±0.6b	15.6±1.9b	14.3±1.4

Figures followed by different letrers are significantly different ($P<0.01$).

BM *vs.* 188±33 g kg^{-1} ($P<0.01$) in the caribou. Distribution of alimentary content differed between the two species (Table 1), with a greater omasal fill in the muskoxen and a greater hindgut fill in the caribou, but similar proportions in the ruminoreticulum, abomasum and small intestine.

The total mass of alimentary tissue, stripped of fat, was greater in absolute terms in the muskoxen (9.4±0.8 kg *vs.* 4.4±0.4 kg) but smaller in proportionate terms (43.3±3.1 g *vs.* 60.7±4.8 g tissue kg^{-1} BM). The greatest difference in distribution of tissue weights was found in the omasum, which was nearly 3 times as large in the muskoxen as in the caribou (Table 1).

The relative mass of rumen tissue was greater in the caribou than in the muskoxen. This may, however, simply be a consequence of the relatively larger surface area of a spherical organ (like the rumen) with a smaller volume. The total length of the intestine was 40.7±5.1 m in the muskoxen and 26.6±1.2 in the caribou; of the total, the hindgut (caecum to anus) was a smaller proportion ($P<0.01$) in the muskoxen than in the caribou (34.6±2.9% *vs.* 40.8±2.4%).

The alimentary fill and tissue characteristics of muskoxen are consistent with their designation as "grazers" (*sensu* Hofmann, 1989) as shown in Greenland by Staaland & Thing (1991). In much of the Canadian arctic archipelago, northern Greenland and the Svalbard islands, lichens are scarce and the vegetation has a preponderance of graminoids, forbs and bryophytes. During winter, muskox diets are dominated by sedges and grasses on Victoria Island (Schaefer, 1995) as in Greenland (Thing, 1984), and graminoids are among the most widely available forages. Muskoxen have also been shown to have the slow rate of passage (Adamczewski *et al*, 1994a) and exceptional ability to digest graminoid forages (White *et al*, 1984; Adamczewski *et al.*, 1994b) predicted by Hofmann's (1989) model. Combining these traits with a low metabolic rate (Nilssen *et al.*, 1994) muskoxen can be relatively sedentary in winter (Jingfors, 1981; Wilkinson et al., 1976), remaining in areas with relatively high biomass.

Caribou, in contrast, are continuously nomadic in their feeding (Thomas & Edmonds, 1984), Russell *et al.* 1993). With a relatively high metabolic rate (Tyler & Blix, 1990) and a relatively rapid rate of passage (Valtonen *et al.*, 1983), they are less able to subsist on slowly fermenting, fibrous graminoids and tend to forage in areas with relatively low biomass, selecting the most nutritious parts of plants such as flowerheads, seed heads and winter-green leaves (Thomas & Edmonds, 1984). Despite the low biomass, the quality of the selected diet can be relatively good with high concentrations of minerals and good digestibility (Staaland *et al.*, 1983). Results of this study suggest, however, a substantial ability of Victoria Island caribou to adapt to lower quality forages in winter. As in Svalbard reindeer (*R. t. platyrhynchus*) (Staaland & White, 1991), the fill of the hindgut is relatively larger than in Norwegian reindeer (*R. t. tarandus*). Alimentary characteristics of Victoria Island caribou are consistent with those of intermediate feeders (sensu Hofmann, 1989), as the omasum is substantially larger than in concentrate selectors like roe deer (*Capreolus capreolus*) (Holand & Staaland 1992).

Because arctic island caribou and reindeer tend to have larger hindguts and omasa than Norwegian reindeer (Staaland & Riis Olesen, 1992), these subspecies may be better adapted to being "grazer-like" than more southerly subspecies. However, the studies of Gordon & Illius (1994) and Robbins et al. (1995) indicate that the correlation between digestive anatomy and function in ruminants is in many cases limited. Feeding trials with domestic reindeer fed unsupplemented hay suggest that their ability to digest fibrous graminoid forage is mediocre

(Syrjälä-Quist, 1985), supporting Hofmann's (1989) views. Further physiological studies may be needed to fully understand how ruminant alimentary tracts and their functions are adapted to different diets and foraging strategies.

Although caribou and muskoxen coexist in close proximity on southeastern Victoria Island, they appear primarily adapted to different diets and foraging strategies. Visual inspection and analysis of rumen contents for fiber and lignin from the study (unpubl.) also indicate a predominantly graminoid diet in the muskoxen and a more varied diet with a substantial browse component in the caribou.This should reduce the likelihood of competition for limited food resources in winter, as suggested for Peary caribou and muskoxen on Melville Island (Thomas & Edmonds, 1984).

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