

A comparison of plant form and browsing height selection of four small stock breeds – Preliminary results

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Abstract

A direct observation technique was used to establish the foraging behaviour of Boer goats, Nguni goats, Pedi sheep and Dorper sheep. According to the Chi-square dissimilarity measure, plant-form (grass, forbs, woody) differences between the diets of goats and sheep were greater than differences between the goat breeds and sheep breeds. The results from this study confirm that goats and sheep exhibit different foraging strategies. Sheep tend to forage more frequently from the herbaceous layer compared to goats, which also browse substantially from woody plants. Both goats and sheep increase their relative intake of woody plant products in winter. Goats tend to increase their woody browsing height in winter, probably adapting their foraging behaviour to fit differences in the canopy structures of prominent summer and winter forage species. Further research should be conducted to determine whether subtle differences in the foraging habits of different goat and sheep breeds exist.

Keywords: Browse, foraging behaviour, optimal resource use, savanna, stocking rate

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Introduction

The inclusion of small stock breeds is often perceived to complement cattle production systems due to the alternative use of foraging types by different animals. These differences should be quantified to assure optimal and responsible resource use. Furthermore, goats have been promoted as a biological remedy for the bush encroachment problem in southern Africa (Du Toit, 1972; Cooper, 1982). There are, however, indications that limitations imposed by the absolute intake of browse (Orihuela & Solana, 1999) and the height range (Dziba *et al.*, 2003) of woody plant impact might limit the practicality of using goats as bush control agents.

The aims of this study were to compare four small stock breeds in terms of the diet overlap in plant-form (grass, forbs, woody) composition and browsing height selection patterns.

Materials and Methods

The study was conducted on the eastern section of the Mara Research Station (23° 05' S and 29° 25' E; 961 m.a.s.l.). The Una official rainfall station (situated in the study area) measured a mean of 423.4 mm per annum from 1945 to 2002. Rainfall in the study area is concentrated in the hot summer months. Winter temperatures are mild and frost an infrequent occurrence. Mara is situated in the Arid Sweet Bushveld (Acocks, 1988). The vegetation in the study area comprises a short, shrubby structure that varies from open to closed woodland. Prominent woody species include *Combretum apiculatum*, *Commiphora pyracanthoides*, *Acacia tortilis*, *Grewia* species and *Boscia albitrunca*. The herbaceous layer includes the graminoid species; *Eragrostis rigidior*, *Panicum maximum*, *P. coloratum* and *Urochloa mosambicensis* and various forbs species.

A direct observation technique was used to study the foraging behaviour of Boer goats, Nguni goats, Pedi sheep and Dorper sheep. Animals were kept overnight in a holding pen and released into grazing camps in the mornings. Animals were habituated to human presence to such an extent that observations from a distance nearer than 5 m were possible. Four randomly selected foraging animals per breed were observed per session. Record was kept of the number of bites taken per plant species per focal animal. The height at which feeding took place from woody plants was also recorded. A minimum of 100 bites was observed per

focal animal per observation session and in total two observation sessions were conducted in summer (February and March) and four in winter (June to September).

The overlap in plant-form (grass, forbs, woody) selection between breeds was analysed with a Chi-square dissimilarity distances test (SPSS, 2002). Differences in foraging height between sheep and goats were analysed with the Kruskal-Wallis and Man-Whitney tests (SPSS, 2002) with animal type, season, plant form and browsing height as the main factors.

Results and Discussion

The dissimilarity distances between species (sheep vs. goats) were far greater (>17%) than between breeds of the same species (<9%) during both summer (Table 1) and winter (Table 2). This indicates that the goat breeds selected for a similar plant-form composition as did the two sheep breeds. The difference between the composition of sheep and goat diets is consistent with the results obtained in the Arid Karoo (Du Toit *et al.*, 1995a) and in the Noorsveld (Du Toit *et al.*, 1995b). In the present study the magnitude in plant-form dissimilarity between sheep and goats, which was the greatest between Nguni goats and Pedi sheep in winter (27.96%, Table 2), suggests considerable overlap in plant-form diet composition in both seasons studied. The narrowing of the dissimilarity distance between the goat breeds and the Dorper sheep during the winter (Table 2) suggests an increase in plant-form diet overlap relative to the diet overlap between goats and Pedi sheep. It follows that competition between different sheep and goat breeds is likely during times of forage shortages, e.g. dry seasons and droughts. The large overlap in the diet also indicates the futility of using both species to complement cattle in multi species production systems aimed at optimal resource utilisation.

Grazer stocking rates should also be adapted to accommodate the inclusion of small stock in a farming enterprise.

Table 1 Dissimilarity matrix for the plant-form (grass, forbs, woody) forage selection patterns of Boer goats, Nguni goats, Pedi sheep and Dorper sheep in summer

	Chi-square between sets of frequencies		
	Boer goats	Nguni goats	Pedi sheep
Nguni goats	4.03		
Pedi sheep	25.46	25.10	
Dorper sheep	23.39	22.71	7.73

Table 2 Dissimilarity matrix for the plant-form (grass, forbs, woody) forage selection patterns of Boer goats, Nguni goats, Pedi sheep and Dorper sheep in winter

	Chi-square between sets of frequencies		
	Boer goats	Nguni goats	Pedi sheep
Nguni goats	5.56		
Pedi sheep	27.09	27.96	
Dorper sheep	17.35	19.21	8.81

Predictably a larger ($P < 0.05$) proportion of bites from woody plants was observed for goats compared to sheep. Sheep tended to restrict their foraging to the herbaceous layer (forbs and grass) (Figure 1). Both species, however, tended to increase utilizing woody plants in winter (Figure 1).

Sheep and goats preferred to forage below a height of 1.0 m above ground in both seasons, with only a small proportion of bites taken from above 1 m height (Figure 1). The marked preference of sheep for feeding in the herbaceous layer precluded further analysis of height selection patterns in woody plant use by this species. Goats, in contrast, foraged extensively from woody plants and differences ($P < 0.05$) in the height stratification of bites from woody plants were evident between seasons (Figure 1). In the summer observations, goats preferred foraging in the 0-0.5 m stratum and shifted their feeding behaviour to forage

from higher strata during winter when a greater ($P < 0.05$) proportion of bites was taken from above 0.5 m. It was only during winter that goats were observed foraging higher than 1 m above ground (Figure 1). The presumption that all browse up to a height of approximately 1.6 m is available to goats, as suggested by (Aucamp & Du Toit, 1980) for goats in the Eastern Cape, might not hold for other vegetation types and/or light stocking rates. The shift in browsing height, which tends to be at higher levels in winter, might be linked to a general decline in woody foliage availability due to the shedding of foliage of deciduous species and a decline in the nutritive value of the grass component. Under these conditions the remaining acceptable forage resources might be temporary under pressure. The depletion of foliage resources at preferred height levels might subsequently force animals to increase the height of feeding. A contributing factor in our study, which could probably help explain the foraging-height behaviour of goats, might be linked to canopy shape differences between staple woody species in the study area. In the study area *C. pyracanthoides* is a low-growing, early deciduous, spiny shrub that tends to have a skirt of branches resting on the ground with a tapering crown. *Boscia albitrunca* constitutes an evergreen tree species, which usually has a single trunk (which might branch into several stems) and a well-developed canopy. *Commiphora pyracanthoides* (ca. 40% of goat bites) and *B. albitrunca* (ca. 35% of goat bites) were the woody species selected most frequently during the summer and winter, respectively. It appears that goats adapted their feeding height in correspondence to the vertical arrangement of foliage resources on the respective woody species (Figure 2). A higher ($P < 0.05$) frequency of bites was taken below 0.5 m from *C. pyracanthoides* than from *B. albitrunca* while a higher ($P < 0.05$) frequency of bites was taken between 0.5 and 1.0 m from *B. albitrunca* than from *C. pyracanthoides*. These results are consistent with that of Du Toit (1972) that goats adapt easily to changes in the availability of forage. However, Dziba *et al.* (2003) did not find breed or season effects on browsing height preferences of goats.

Both Donaldson (1979) and Erasmus (2000) concluded that goats complement grazers in savanna areas by utilizing the woody component, but doubted their efficiency as bush control agents in extensive production systems and in the absence of fire. An overlooked factor might be the role that goats can play in controlling woody seedlings, which might over time shape woody plant communities, and in the long term reverse bush thickening. The apparent preference of goats to forage at levels close to the ground (<0.5 m) in this study (summer) and in a feeding height experiment (Haschick & Kerley, 1996) might predispose woody seedlings to goat herbivory at a vulnerable time in a woody plant's life cycle.

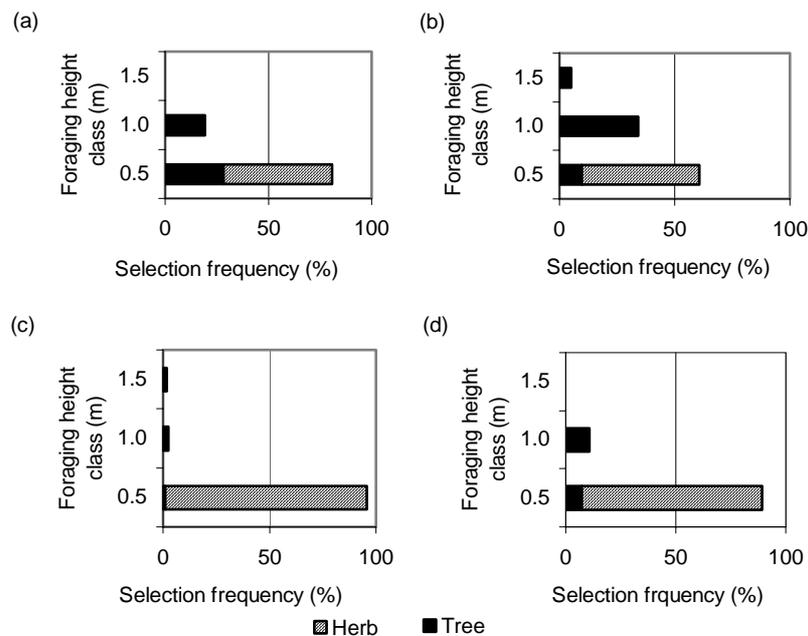


Figure 1 Preferred foraging height for goats (panels a and b) and sheep (panels c and d) during the summer (panels a and c) and winter (panels b and d) based on all the forage plant types

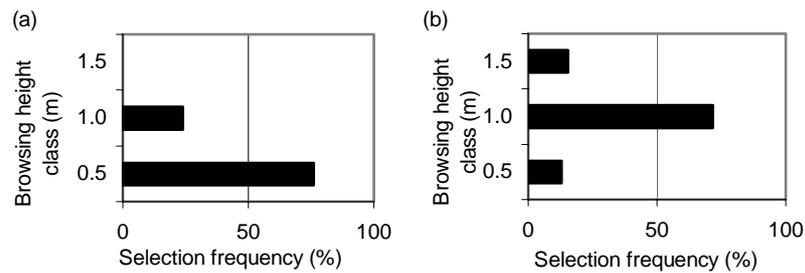


Figure 2 Preferred foraging height for the goats browsing *Commiphora pyracanthoides* (panel a) and *Boscia albitrunca* (panel b)

Conclusion

Although goats and sheep have diet dissimilarities, they also have a large overlap in diet selection, resulting in inter-species competition for available forage under heavy stocking rates. Although goats can readily change their foraging behaviour according to changes in vegetation and plant growth form, both goats and sheep prefer to forage at levels below 0.5 m. It is thus recommended that where goats are used in conjunction with other grazing animals, correct stocking rates should be adhered to. The design of this study did not allow for subtle differences in foraging behaviour of the respective sheep and goat breeds to be established. Further research should therefore be conducted in an effort to quantify such possible differences.

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