FORAGE PREFERENCE OF BOER GOATS IN THE HIGHLAND SAVANNA OF NAMIBIA DURING THE DRY SEASON

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ABSTRACT

Forage preference of a single goat doe, roaming freely in Namibian Highland savannah veld within a flock of goats, was determined by bite count and compared to the botanical composition of the natural veld as determined by systematic step-point sampling. Plants were grouped into woody, grass and ephemeral plants, with the woody plants being further subdivided into three height groups: tall, medium and low. Woody plants were much preferred by the goat to ephemeral plants and grasses (85.4%, 9.0% and 5.4% respectively, $P<0.001$). Woody plants of medium height (60 - 120 cm) formed the single most important group of plants selected by the goat (42,9%, $P<0,20$), with *Phaeoptilum spinosum* being the preferred species (31,4%, $P<0,001$), followed by *Eriocephalus luederitzianum* (10,6%) and the invasive *Acacia mellifera* (10,3%). In contrast, woody plants constituted only 15,1% of the natural veld, which was dominated by grasses (69,7%), indicating that woody plants were specifically selected by the goat. The trial confirms that dietary overlap between goats and grazing species of livestock is minimal, at least during the dry season, in Namibian Highland savannah veld in fair condition.

INTRODUCTION

Goats are predominantly browsers that do not seem to compete with cattle and sheep when roaming free in the natural veld, because the latter two livestock species are predominantly grazers. However, goats are opportunistic feeders and utilize a wide spectrum of vegetation, including many non-woody, herbaceous plants, especially when their preferred browse species are in short supply. Under such conditions they might compete with grazing livestock (Devendra & McLeroy, 1988; Devendra, 1990). More needs to be known about the forage preference of goats to determine under what conditions they might compete with grazing livestock in Namibia and how they can be employed to utilize the woody component of savannah vegetation effectively (Bester & Reed, 1998).

Savannah veld types, consisting of a continuous, grass-dominated layer of herbaceous plants and a discontinuous layer of woody plants (Skarpe, 1991), offer an opportunity to keep goats in addition to grazing livestock, effectively increasing the carrying capacity of the veld; a concept based solely on the consumption of grass (Meissner et al., 1983; Hardy, 1996). Complementary resource use increases animal production (Danckwerts & Tainton, 1996; Bester & Reed, 1998). African savannahs are highly seasonal and feed supply from woody and herbaceous components fluctuates widely (Skarpe, 1991; Trollope et al., 1996) and may cause more competition between browsers and grazers in some years than others. Many Namibian savannah veld types, which cover 64% of the country, are encroached by bush due to grazing mismanagement. An estimated 30 - 50% of the grazing potential of about 10 million ha of commercial farmland has been lost as a result, equivalent to N$100 million annually (Moyo et al., 1993). These conditions may offer goats an ideal environment.

Goats are popular in Namibia and are nearly as numerous as cattle (2,0 million) and sheep (2,2 million). However, 70% of the goat population of 1,8 million occurs in communal areas (MAWRD, 1997), indicating that goats are still under-utilized in commercial areas encroached by bush. Possibly there is a lingering fear amongst commercial farmers that goats compete with grazing livestock more than is generally assumed. This trial attempts to clarify the forage preference of goats in a typical savannah veld type in Namibia.

MATERIALS AND METHODS

An adult boer goat doe from within a whole flock was identified and followed closely to study its forage preference. She was observed undisturbed within a flock of about 150 other non-lactating goat does without bucks in attendance during her daily feeding regime in natural veld at Neudamm. The flock roamed freely in 12 camps (E21 to E32) of, in total, 636 ha of typical Highland savannah (Giess, 1971) at an altitude of 1834 m above sea level, receiving a standard protein-mineral lick block supplement. The goats were not restricted in their movement by the stock-proof fences surrounding the camps and could select their forage freely because of a low stocking rate (approx. 25 ha/LSU in veld with an estimated carrying capacity of 6 ha/LSU in 1997). When stocked lightly, goats can express their true forage preference (Mbuti et al., 1996).

The selected doe as well as the flock was accustomed to the observer at close range (<5m) on foot while feeding. During an adaptation period of several days, it was established that the periods of greatest feeding activity of the flock were between 06:30 - 10:00 and 13:00 - 16:30. Consequently, data collection commenced, when it was considered that the presence of the observer did not cause deviating behaviour by the doe or flock, at 10 different opportunities (5 times in the morning and 5 times in the afternoon) during these periods of peak feeding activity, in May and June of 1997.

The observer followed the selected doe closely enough to see what vegetation was consumed and to identify it.

"Consumption" was defined as vegetation bitten off and actually ingested. When several bites were taken off the same plant before swallowing, this was recorded as one observation only. Bite counting to quantify the relative amounts of different plant species utilized by goats is a standard technique to investigate the botanical composition of the diet, but is of limited value in identifying herbaceous species (Narjisse, 1991). Utilized plants were therefore grouped into **woody, grass** and **ephemeral plants**, with only woody plants being identified at species level. Woody plants were also sub-divided into three groups according to height (<60 cm, 60 cm - 120 cm and >120 cm). Grasses were identified on the basis of their perenniality (annual/perennial). Ephemerals included all non-grass herbaceous plants like herbs and bulbs. Frequency of consumption was calculated on a percentage basis for species as well as groups of plants.

The forage preference of the goat doe was then compared to the botanical composition of the natural veld, as determined by systematic step-point sampling (Tothill, 1987). A transect was followed through the middle of the feeding area, cutting across most major topographical features. Every 3 m along this transect, an observation was made of the percentage ground cover and of the species of plant growing on that spot. If the strike occurred on bare ground, the plant growing closest to the strike was identified. "Bare ground" was any ground not covered by a living plant. All plant species were identified and grouped into the same groups as before, viz. **woody plants** (three subgroups: <60 cm, 60 cm - 120 cm and >120 cm), **grasses** (two subgroups: annual and perennial grasses) and **ephemeral plants.**

Analysis of variance (Kruskal-Wallis) was performed on the frequency of plants consumed by the doe. Significant differences between individual plant species and groups of plants were calculated (Steel & Torrie, 1980). The frequency of plants ingested by the goat doe was then compared to the frequency of these plants in the feeding area. Whenever the "contribution" of a plant or a plant group to the goat's diet is discussed, it refers to contribution in numerical terms (frequency), not in terms of mass, volume or energy value, since the trial was based on bite counting.

RESULTS AND DISCUSSION

The composition of the diet of the goat doe, as determined by bite counting, is presented in Table 1. The goat flock encountered different ecological and vegetational units with roughly similar main features but substantially different micro-features as it meandered across the 636 ha feeding area. The large standard deviation of the average consumption per observation is explained by the heterogeneous nature of the Highland savannah (hilly with many different slope aspects) and differences between individual camps due to previous grazing treatments. Despite the observed variability, differences between plant groups were highly significant (P<0,001) with woody plants contributing more to the diet of the goat (85,4%) than either grasses (5,6%) or ephemeral plants (9,0%).

The woody plant subgroup that supplied the largest proportion of forage (42,9%) was between 60 and 120 cm high, a convenient browsing height for the boer goat which, due to its bipedal stance, is able to utilize vegetation normally out of reach of small ruminants (Devendra, 1990). Taller (21,6%) and smaller (20,9%) woody plants made an approximately equal contribution to total consumption, but the differences between height subgroups of woody plants was not statistically significant (P>0,20).

Different plant species contributed significantly different proportions to the goat's diet (P<0,001). The medium-tall shrub Phaeoptilum spinosum (31,4%) by far made the largest contribution, a bush popular with other browsers (e.g. kudu) too. The second-largest contribution was made in about equal parts by a small shrub, *Eriocephalus luederitzianum* (10,6%), belonging to a genus not normally considered very palatable (Le Roux et al., 1994) and the tall-growing, invasive *Acacia mellifera* (10,3%), known to be palatable to livestock and game (Coates-Palgrave, 1983). Together, these three woody plant species supplied half the goat's forage intake! The next-largest contribution to the goat's diet was made by ephemerals as a group (9,0%), a medium-tall bush *Catophractes alexandri* (8,9%) and the shrub *Lebeckia spinescens* (8,6%). The latter is known to be very palatable (Le Roux et al., 1994), while *C. alexandri* is thought to be slightly less palatable. More than three-quarters of the goat's forage intake was supplied by only 5 woody species and various ephemeral pants, confirming that the boer goat is primarily a browser.

In total, more than 15 woody species contributed to the diet of the goat. The bulk of the forage was supplied by only 5 woody species, while 10 supplied minor (less than 8%) amounts of forage. Noteworthy amongst these is the *Grewia* genus, because it contributed so little (0,7%), although being a highly palatable genus, especially at this time of the year when it is bearing fruit (Coates-Palgrave, 1983; Mogorosi et al., 1996). Also interesting is how little a shrub generally regarded as a "fodder bush" amongst farmers, *Leucosphaera bainesii*, features in the diet (1,4%).

It is interesting to note the relatively high proportion of ephemerals in the diet of the goat at this time of the year (autumn to early winter). Normally, ephemeral plants do not contribute substantially to veld forage in autumn because they complete their lifecycle early, wither and die before the onset of the cold and dry winter months (Tainton, 1988). However, the 1996/97 rainy season, although an average one (330,7 mm or 91% of the long-term average rainfall of 363,0±158,03 mm), brought good late rains in March, probably explaining the persistence of ephemeral vegetation late into autumn. Goats are known to select positively for ephemerals (Devendra & McLeroy, 1988) and this preference was confirmed in this study. Unfortunately, due to the manner of visual observation, the individual ephemeral species could not be identified. Ephemerals as a group contributed more to total consumption than grasses (9,0% vs. 5,6%), although this difference was not statistically significant (P>0,20).

Grass was plentiful in the feeding area due to a favourable

rainy season, yet it contributed only 5,6% to the total intake of vegetation by the goat, significantly less than any of the 5 major browse species discussed earlier (P<0,05). Most of the grass consumed was perennial, which at this time of the year was still slightly green at the base, compared to the annual grasses which had already withered and died.

The percentage ground cover and botanical composition of the natural veld is presented in Table 2. The botanical composition of the veld is typical of Namibian Highland savannah as described by Giess (1971). The veld was in a fair condition according to the standard score sheet of Fourie (1974) which was adapted slightly for the purpose of this trial. Nearly two-thirds of the ground was covered by living vegetation, with grasses (69,7% occurrence) and especially annual grasses (43,1% occurrence) dominant within the plant community. The perennial grasses (26,6%) so favoured by sheep and cattle occurred more frequently than either ephemerals (15,1%) or woody plants (15,1%) as a group. The most frequently occurring annual grasses were *Eragrostis cylindriflora, Melinis villosum, Enneapogon cenchroides* and *Chloris virgata* while the most frequently occurring perennial grasses were *Eragrostis nindensis, Anthephora pubescens, Aristida meridionalis, Cenchrus ciliaris* and *Eragrostis lehmanniana*. Medium and tall woody plants, including invasive species such as *A. mellifera*, covered less than one-tenth of the feeding area, another characteristic of savannah veld in good condition (Skarpe, 1991).

Table 1. Percentage ground cover and plant groups occurring in the feeding area of the goat flock

% ground cover/plant group	Strikes	Frequency (%)
Bare ground	109	35,9
Covered ground	195	64,1
1. Woody plants: all	**46**	**15,1**
Woody plants: > 120 cm	14	4,6
Woody plants: 60 - 120 cm	13	4,3
Woody plants: < 60 cm	19	6,3
2. Grasses: all	**212**	**69,7**
Annual grasses	131	43,1
Perennial grasses	81	26,6
3. Ephemeral plants	**46**	**15,1**
Total	**304**	**100,0**

The goat actively sought out woody plants for foraging, as can be inferred from the contrast between the frequency of woody plants occurring in the veld (15,1%) and their occurrence in the goat's diet (85,4%). In contrast, grasses of any perenniality, which dominated the veld (69,7%), were avoided by the goat (5,6% of total consumption). Ephemeral plants were consumed in a slightly higher proportion (15,1%) than they occurred in the veld (9,0%). The most favoured forage species, *P. spinosum* (31,4% consumption) was part of the smallest vegetative component of the veld, viz. woody plants 60 - 120 cm high (4,3% occurrence). The reversed order of dominance of plant frequencies in the veld and plant

Table 2. Forage preference of a goat in the highland savanna of Namibia in the dry season

Forage species	Consumption (average per observation)	Consumption (total)	Frequency of consumption (%)
1. Woody plants: all	**2384,1±1042,47**	**23841**	**85,4[a]**
1a. Woody plants: >120 cm	**602,2±434,59**	**6022**	**21,6[b]**
Acacia erioloba	26,9±58,72	269	1,0
Acacia mellifera	288,0±337,67	2880	10,3
Acacia tortillis/ A. hebeclada	67,6±147,16	676	2,4
Peltophorum africanum	6,3±11,64	63	0,2
Tarchonanthus camphoratus	142,8±158,34	1428	5,1
Ziziphus mucronata	70,6±135,31	706	2,5
1b. Woody plants: 60 - 120 cm	**1198,1±814,14**	**11981**	**42,9[b]**
Catophractes alexandri	249,6±285,09	2496	8,9
Grewia spp.	18,8±25,84	188	0,7
Phaeoptilum spinosum	875,6±613,09	8756	31,4
Phaeoptilum spp.	54,1±66,11	541	1,9
1c. Woody plants: < 60 cm	**583,8±367,83**	**5838**	**20,9[b]**
Eriocephalus luederitzianum	297,1±299,90	2971	10,6
Justicia guerkeana	7,5±20,33	75	0,3
Lebeckia spinescens	239,0±229,66	2390	8,6
Leucosphaera bainesii	40,2±58,12	402	1,4
2. Grasses: all	**158,2±66,24**	**1582**	**5,6[c]**
Annual grasses	8,6±9,34	86	0,3
Perennial grasses	149,6±61,32	1496	5,4
3. Ephemeral plants	**250,1±240,19**	**2501**	**9,0[c]**
Total	**2792,4±1158,32**	**27924**	**100,0%**

[a,b,c]figures with different superscripts differ significantly (P<0,001)

frequencies in the diet selected by the goat confirms that the goat prefers to browse, even if herbaceous material is in oversupply. Although the feeding area of the goat flock was not grazed simultaneously by other, grazing livestock species and this study was performed during the dry season only, the preference of browse to grasses is plain and goats would therefore not have competed for forage with grazing livestock under these conditions. The need remains to repeat this trial during the rainy season, since browsing and grazing preferences of goats are known to be affected by season (Raats et al., 1996) and dietary overlap with grazing livestock might be more pronounced at different times of the year (Narjisse, 1991).

CONCLUSION

The goat in this study was offered a free choice of forage in veld dominated by grass, i.e. ideal conditions for predominantly grazing livestock such as cattle and sheep. The results indicate that the goat would not have competed for forage with grazing livestock under these conditions, as it concentrated to a large extent on the browse production of woody plants and virtually ignored grasses. Goats can be expected to compete even less with grazing livestock when bush densifies, as is the case with vast areas of commercial farmland in Namibia. The results of this trial are in agreement with other forage preference trials in semi-arid areas of southern Africa (Du Toit & Blom, 1995; Du Toit et al., 1995) and Africa (Abate et al., 1995; Nolan, 1996) in which the goat was found not to compete significantly with grazing livestock species for forage.

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REFERENCES

ABATE, A.L., WAKHUNGU, J.W. & SAID, A.M. 1995. Cattle, goats, sheep and camel production on range: The Kenya experience. *Bull. Anim. Hlth Prod. Afr.* 43: 145 - 156.

BESTER, F.V. & REED, E.R. 1998. Bush encroachment: Goats a solution or a menace? Spotlight on Agriculture no. 6, MAWRD, Windhoek, Namibia.

COATES-PALGRAVE, K. 1983. *Trees of Southern Africa* (2nd ed.). Struik, Cape Town, South Africa.

DANCKWERTS, J.E. & TAINTON, N.M. 1996. Range management: Optimizing forage production and quality. *Bull. Grassld Soc. Sth Afr.* 7 (Suppl. 1): 36 - 43.

DEVENDRA, C. 1990. Goats. In: W.J.A. PAYNE (ed.) *An Introduction to Animal Husbandry in the Tropics* (4th ed.) ch. 8. ELBS Longman, Harlow, UK.

DEVENDRA, C. & McLEROY, G.B. 1988. *Goat and Sheep Production in the Tropics*. ELBS Longman, Harlow, UK.

DU TOIT, P.C.V. & BLOM, C.D. 1995. Diet selection by sheep and goats in the Noorsveld. *Afr. J. Range For. Sci.* 12: 27 - 37.

DU TOIT, P.C.V., BLOM, C.D. & IMMELMAN, W.F. 1995. Diet selection by sheep and goats in the Arid Karoo. *Afr. J. Range For. Sci.* 12: 16 - 26.

FOURIE, J.H. 1974. [Veld assessment.] Veld and Livestock Husbandry Course notes, Glen Agric. Dev. Inst., Dept. Agriculture, Bloemfontein, South Africa.

GIESS, W. 1971. Eine vorläufige Vegetationskarte von Südwestafrika. *Dinteria* 4: 31 - 45.

HARDY, M.B. 1996. Grazing capacity and large stock unit equivalents: Are they compatible? *Bull. Grassld Soc. Sth Afr.* 7 (Suppl. 1): 43 - 47.

LE ROUX, P.M., KOTZÉ, C.D., NEL, G.P. & GLEN, H.F. 1994. *Bossieveld: Grazing Plants of the Karoo and Karoo-like Areas.* Bull. 428, Dept. Agriculture, Pretoria, South Africa.

MAWRD 1997. *Agricultural Statistics Bulletin*. Dir. Planning, Windhoek, Namibia.

MEISSNER, H.H., HOFMEYR, H.S., VAN RENSBURG, W.J.J. & PIENAAR, J.P. 1983. Classification of livestock for realistic prediction of substitution values in terms of a biologically defined Large Stock Unit. Tech. Comm. no. 175, Dept. Agriculture, Pretoria, South Africa.

MOGOROSI, C.K., SEGOALE, N., NGWAZI, F.N., MAHLANGU, J.P., MAFU, J.V., MGXASHE, N.P., PEPE, D. & WEBBER, L.N. 1996. Harvesting rate of different bush species by goats. *Bull. Grassld Soc. Sth Afr.* 7 (Suppl. 1): 72.

MOYO, S., O'KEEFE, P. & SILL, M. 1993. *The Southern African Environment: Profiles of the SADC Countries* ch. 6: Namibia. Earthscan Publications, London, UK.

MBUTI, M.C., SCOGINGS, P.F., RAATS, J.G. & BECKERLING, A.C. 1996. The effect of stocking rate and time on species selection by goats. *Bull. Grassld Soc. Sth Afr.* 7 (Suppl. 1): 77.

NARJISSE, H. 1991. Feeding behaviour of goats on rangelands. In: P. MORAND-FEHR (ed.) *Goat Nutrition* ch. 2. Pudoc, Wageningen, The Netherlands.

NOLAN, T. 1996. Perspective: Animal - vegetation relations which optimize production, utilization and protection of natural resources: An African experience. *Afr. J. Range For. Sci.* 13: 42 - 48.

RAATS, J.G., WEBBER, L.N., PEPE, D. & TAINTON, N.M. 1996. Feeding behaviour of fistulated boer goats as affected by period of occupation and season. *Bull. Grassld Soc. Sth Afr.* 7 (Suppl. 1): 74.

SKARPE, C. 1991. Impact of grazing in savannah ecosystems. *Ambio* 20: 351 - 356.

STEEL, R.D. & TORRIE, J.H. 1980. *Principle and Procedures of Statistics: A Biometrical Approach*. McGraw Hill Kogakusha, Tokyo, Japan.

TAINTON, N.M. 1988. The ecology of the main grazing lands of South Africa. In: N.M. TAINTON (ed.) *Veld and Pasture Management in South Africa* (2nd ed.) ch. 2. Shuter & Shooter, Pietermaritzburg, South Africa.

TOTHILL, J.C. 1987. Measuring botanical composition of grasslands. In: L. t'MANNETJE (ed.) *Measurement of Grassland Vegetation and Animal Production*. Bull. 52, CAB International, Berkshire, UK.

TROLLOPE, W.S.W., DE BRUYN, T.D., WEBBER, L.N. & MBELU, M. 1996. Reconciling stocking rate and grazing capacity in the False Thornveld of the Eastern Cape. *Bull. Grassld Soc. Sth Afr.* 7 (Suppl. 1): 85.