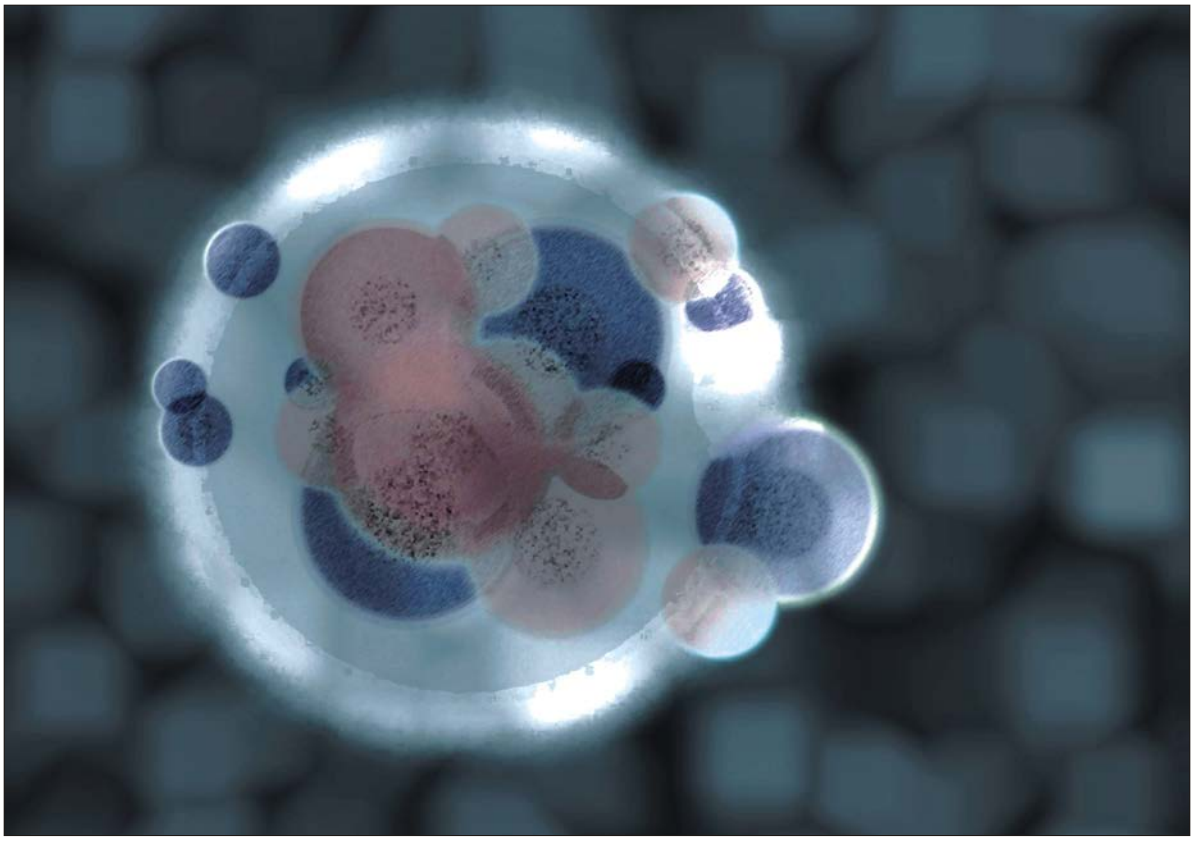

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Diets and Forage Preference of Communally Grazed Range Goats in an *Acacia* Bush Savanna in Southeast Botswana

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Abstract: The study was aimed at determining the botanical diet composition of goats foraging in *Acacia* bush savanna rangeland in southeast Botswana. The dominant species in the study area were of the genus *Acacia* with an understory of mostly perennial grasses. *Acacia* were the dominant plant species consumed by goats. Certain perennial grasses also featured prominently in their diets, but only during the wet season. Preference ratings for the plants comprising diets of goats were positive for about 80% of the woody plants during the dry season and 50% during the wet season. Less than 30% of the grasses were selected for during the wet season while all were discriminated against in the dry season.

Key words: Botswana, goats, diet composition, diet preference, savanna

INTRODUCTION

Increase in human population has over the years resulted in the reduction of land designated as rangelands in Botswana. The demand for more arable land, for growth of villages, towns and industry has contributed significantly to this reduction. On the other hand, the reduction in the amount of land available for grazing has not been accompanied by a similar reduction in livestock numbers. Alternatives to livestock ranching are hampered by the arid nature of the local climate which restricts potential for dry land agriculture. This situation makes livestock ranching more attractive than crop agriculture[1]. Because of the suitability of the environment to ranching, livestock numbers have increased exponentially with increases in human population[2]. Research, however, has not paid attention to studying feeding habits of free-ranging animals despite the need for such information. Knowledge of plant species consumed by grazing animals is fundamental to proper grazing management[3,4] as such information allows assessment of diets of animals and evaluation of potential competition for forage among herbivores[5,6]. This study was undertaken to determine botanical composition of the diets of free-ranging goats utilizing an *Acacia* savanna in southeastern Botswana.

MATERIALS AND METHODS

Study site: The study area (roughly 25000 ha) is located in an *Acacia* bush savanna in southeastern Botswana. The area falls within the Mixed *Acacia/Combretum* tree savanna, an eastern extension of the southern, northern and central Kgalagadi tree and bush savanna. This narrow strip of land lies between latitude 23° and 26° S along the east and southeast border with the Republic of South Africa. The vegetation is mixed *Acacia* bush savanna with a rich understory of perennial grasses. Soils are mainly sandy to sandy loam[7].

Precipitation ranges from 350-500 mm^{-1} and occurs mainly between November and March. Temperatures range from 19°C in winter and 33°C in summer with occasional heat extremes of as much as 39°C.

Vegetation sampling: The relative abundance of both browse and herbaceous plants were assessed using the line intercept method[8]. Five transects (100 m each) were randomly located in each of the five range sites in the study area. A total of 25 transects were evaluated. Cover was determined every second month from December 1998 to October 1999. Samples of individual plants found in the study area were collected for use as reference material.

Fecal sampling and analysis for diet estimation: Fecal samples were collected during the same sampling periods as were vegetation samples. Fifty goats (5 from each of the 10 kraals) were sampled. The ears of the study goats were tagged with numbers from 1 to 5 in each kraal. Sampling was conducted in the morning (between 7:00 and 8:30 am) before the goats were turned out on the range to forage. Samples were collected from kraals of goats not given any form of supplementary feed throughout the year. The pellet samples were collected

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directly from the recta and put in zipped sandwich bags, which were immediately frozen in a cooler box to prevent further microbial activity.

Laboratory procedures: Both the vegetation and fecal samples were dried at 50°C in a forced draught oven for 72 h. Following drying, the samples were individually ground through a 1.0 mm screen Wiley mill. The dung samples were then thoroughly mixed to form a composite sample from which microscopic slides were developed[9]. Reference microscopic slides were also developed for each plant part of the plant species found in the study area.

Twenty-five fields were read from each of the five slides making a total of 125 fields per composite sample. A fragment was recorded if it had at least 2 identifiable characteristics in a microscopic field. Where there was doubt regarding species identity, characteristics were matched against reference slides for confirmation[10].

An average percent Frequency (%F) of occurrence of a forage species was computed by using the formula:

$$F = (X/Y)100$$

Where:

X= Number of fields in which the plant species occurred and

Y= Total number of fields in all five slides.

The density (D) of the discerned fragments was then estimated from the frequency using the formula:

$$D = \ln(1-F/100)$$

Where:

In = Natural logarithm and

F = Frequency (%).

For a given Frequency (F), a mean Density (D) of the identified fragments of a forage species per microscopic field was converted to a Relative Density (RD) using the formula:

$$RDi = (Di/\Sigma^{i}_{j=1} D_i)100$$

Where:

RD = Relative density of discerned fragments in the diets and

ΣD_i = Sum of densities of discerned fragments of all forage species in the diet.

Since the relationship between relative density and dry weight for most plant species is highly correlated[10], the RDs were not converted to dry weights. However, requirements as spelt out by Curtis and McIntosh[11] were met.

Diet preference indexes: Seasonal dietary preference indexes for the different plant species were determined via the Ivlev's Electivity Index[12]:

$$Ei = \frac{r_i - n_i}{r_i + n_I}$$

Where:

Ei = Ivlev's electivity measure of species I

ri = Percent of species in the diet

ni = Percent of species in the range

Statistical analysis: Following calculations for the RDi and Ei, the main effects of seasons were determined using the GLM procedure[13]. Where differences were significant, Turkey's HSD procedure was used to separate the means. All differences are significant at the 5% level unless indicated otherwise.

RESULTS AND DISCUSSION

Diet composition: Thirty-five plant species were identified from goat pellets (Table 1). Of those, 45% were herbaceous while 55% were woody plants. Goats utilized all plants in the study area at some stage during the study period. However, contributions of the herbaceous and woody plants to the diets of goats varied by season. Contributions >1.0% RD by herbaceous plants were 10 and 39% during the dry and wet seasons, respectively, while those by woody were 78 and 88% in the respective seasons. These results signify the importance of woody plants as forage for goats in the study area and stress the need to curb indiscriminate felling of these plants.

Apart from the accelerated decline in nutrient content of the herbaceous (cf: woody) plants in the dry season, availability of herbaceous plants seriously declined by the middle of the dry season further increasing dependency of goats on woody plants as a source of forage. Present observations are consistent with those reported by Bartolome *et al.*[14] in Spain where woody plants comprised greater than 79% of the diets of goats while grasses and forbs accounted for the balance.

Preference indices: At least 47 and 77% of the woody plants were selected for during the wet and dry seasons, respectively, while zero and only 23% of their herbaceous counterparts were selected for in the same periods (Fig. 1). The rejection of the herbaceous plants and the increased preference for woody plants during the dry season coincides with period when nutrient content of the former is at its lowest in most parts of Botswana. Aganga *et al.*[3] showed that the decline in the nutrient content of grasses exceeded that of the woody overstory in the same area. Their observations that tree leaves provided part of the

Table 1: Seasonal average relative densities (%) of plant species in faecal samples of goats on an *Acacia* bush savanna, southeastern Botswana

	Season			Season	
Herbaceous	Dry	Wet	Woody	Dry	Wet
Anthephora pubescens (Anpu)	0.00b	0.29a	*Acacia erubescens* (Acer)	6.46a	4.01a
Enneapogon cenchroides (Ance)	0.00b	0.81a	*Acacia fleckii* (Acfl)	4.12a	1.62b
Brachiaria nigropedata (Brni)	0.00b	1.01a	*Acacia mellifera* (Acme)	7.53a	7.81a
Chloris virgata (Chvi)	0.00b	2.93a	*Acacia nilotica* (Acni)	3.10a	1.29b
Cynodon dactylon (Cyda)	0.32b	1.90a	*Acacia tortilis* (Acto)	9.06a	6.42a
Digitaria milanjiana (Dimi)	1.22b	4.29a	*Boscia albitrunca* (Boal)	3.87a	2.21a
Eragrostis lemanniana (Erle)	0.46b	5.51a	*Boscia foetida* (Bofo)	2.80a	1.78a
Eragrostis rigidior (Erri)	1.74a	0.05b	*Combretum apiculatum* (Coap)	3.95a	2.14a
Eragrostis superba (Ersu)	1.08b	1.67a	*Combretum hereroense* (Cohe)	0.91a	0.17a
Heteropogon contortus (Heco)	0.00b	0.73a	*Combretum imberbe* (Coim)	0.32a	0.00a
Panicum maximum (Pama)	0.30b	3.59a	*Dichrostachys cenerea* (Dici)	3.53a	3.22a
Perotis patens (Pepa)	0.00a	0.00a	*Grewia bicolor* (Grbi)	4.98a	3.23a
Pogonarthria squarrosa (Posq)	0.00a	0.00a	*Grewia flava* (Grfl)	5.73a	2.21a
Rhyncelytrium repens (Rhre)	0.00a	0.00a	*Maytenus selegalencens* (Mase)	2.96a	1.68a
Schmidtia pappophoroides (Scpa)	0.00b	4.68a	*Peltophorum africanum* (Peaf)	0.12a	0.00a
Tragus racemosus (Trra)	0.00a	0.00a	*Terminalia serecia* (Tese)	3.41a	2.27a
Urochloa trichopus (Urtr)	0.00b	3.52a	*Uclea undulata* (Ucun)	0.77a	0.00a
Tribulus terristris (Trte)	0.23a	0.00a	*Ziziphus mucronata* (Zimu)	1.08a	0.66a

Means in the same row followed by a different letter are statistically different at the 5% level

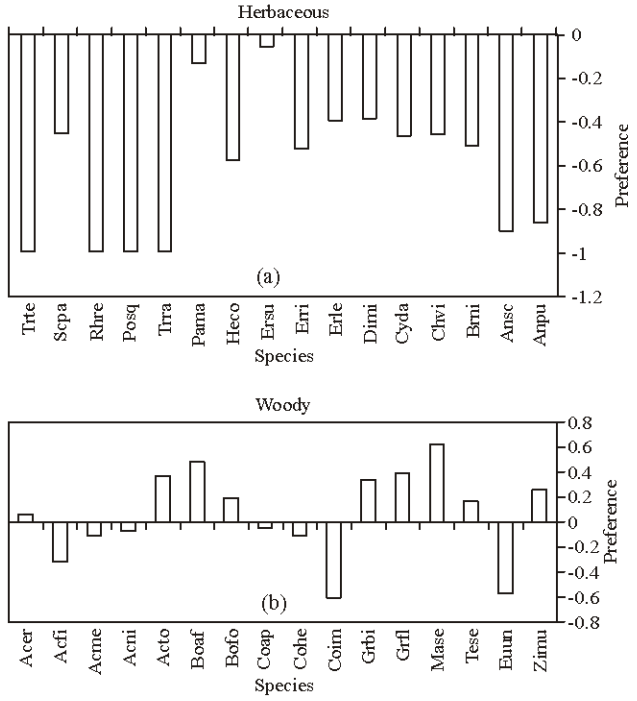

Fig. 1: Preference indices of herbaceous (a) and woody (b) plant species occurring in both the diets of goats and vegetation of the study area in southeastern Botswana

solution to deficiency of protein and other nutrients during the dry season and could possibly supplement other low quality forages used by goats.

Goats were more willing to forage on browse and avoided herbaceous plants. We therefore conclude that goats are better adapted to using browse instead of herbaceous plants despite greater abundance and ease of harvest of the latter. Two of the 3 highly rejected browse plants were available at greater (though not >3 m) heights than the average height of the shrubs in the study area and it is possible that goats had difficulty accessing them. The third is an evergreen that rarely shows signs of utilization. It is, however, possible that other factors other availability are responsible for it being avoided. We further conclude that goats may be an important inclusion in multi-herbivore ranging system in communal ranges of

eastern Botswana where they possibly serve to suppress encroachment by shrubs.

As the study area is also characterized by indiscriminate felling of trees and shrubs for construction of bush and wooden fences, we propose that farmers and ranchers desist from the practice or carefully select the shrub species they cut to minimize damage to those highly preferred by goats.

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