Diet of free ranging Angora goats in a False Upper Karoo veld type

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The diet of free ranging Angora goats in a False Upper Karoo veld type in the south-western Orange Free State is described. Angora goats are inherent browsers feeding on a wide variety of plants. Based on utilization frequency and feeding duration, six shrub and/or tree species, namely *Melolobium calycinum, Olea europaea, Protasparagus* sp., *Rhus burchellii, R. ciliata* and *Tarchonanthus camphoratus,* constitute approximately two-thirds of their diet. Compared with ewes and kids, castrated males and rams utilized *O. europaea* and *R. burchellii* to a greater extent. Based on utilization frequency, grasses are utilized mainly during the wet season and leaves of woody plant species during the dry season. For the optimal utilization of the available vegetation the judicious, simultaneous use of goats and sheep in Karroid foraging systems of the south-western Free State is recommended. As a consequence of their feeding behaviour Angora goats can potentially play an important role in an integrated control system against the Karoo paralysis tick.

Die dieet van vrylopende Angorabokke in 'n Skyn Hoër Karoo veldtipe in die suidwestelike deel van die Oranje-Vrystaat word beskryf. Angorabokke is inherent blaarvreters wat 'n wye verskeidenheid plantsoorte benut. Gebaseer op die benuttingsfrekwensie en weiduurte maak ses boom- en/of struiksoorte, naamlik *Melolobium calycinum, Olea europaea, Protasparagus* sp., *Rhus burchellii, R. ciliata* en *Tarchonanthus camphoratus*, nagenoeg twee derdes van hul dieet uit. In vergelyking met ooie en lammers word O. *europaea* en *R. burchellii* tot 'n groter mate deur kapaters en ramme benut. Frekwensiegewys word grasse veral gedurende die nat seisoen bewei, terwyl die blare van houtagtige plantsoorte gedurende die droë seisoen benut word. Vir die optimale benutting van die beskikbare plantegroei word die oordeelkundige, gesamentlike gebruik van bokke en skape in Karoo-agtige weidingstelsels van die Suidwes-Vrystaat aanbeveel. As uitvloeisel van hul voedingsgedrag kan Angorabokke potensieel 'n belangrike rol in 'n geïntegreerde beheerstelsel teen die verlammingsbosluis speel.

Keywords: Angora goats, diet, False Upper Karoo, semi-arid region.

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Introduction

The planning and management of an effective foraging system should be based on a sound knowledge of the foraging behaviour of stock animals. Despite the importance of domestic goats *Capra hircus* in many extensive farming practices (Campbell *et al.*, 1962), relatively little detailed information is available on their diet (Knight, 1965). Contradictory statements on whether domestic goats are mainly grazers (Bryant *et al.*, 1979; Knight, 1965; Malechek & Leinweber, 1972; Talbot & Talbot, 1962), browsers (Aucamp, 1976; Campbell *et al.*, 1962; Donaldson, 1979; Grunow, 1980; Nge'the & Box, 1976; Owen-Smith & Cooper, 1985; Warren *et al.*, 1984; Wilson *et al.*, 1975) or mixed feeders (Du Toit, 1972; McMahan, 1964; Roux, 1973; Staples *et al.*, 1942) are found in the literature. In South Africa most of the relevant studies have been conducted primarily to assess the influence of domestic goat foraging on wooded areas and to ascertain their role in curbing bush encroachment (Aucamp, 1976; Campbell *et al.*, 1962; Donaldson, 1979; Du Toit, 1972; Grunow, 1980; Owen-Smith & Cooper, 1985; Roux, 1973). Although the south-western regions of the Orange Free State are traditionally sheep farming areas, high mohair prices influenced many farmers to purchase Angora goats. The purpose of this study was to investigate the dietary composition of these goats in a False Upper Karoo veld type.

Study area

The study was conducted on the farm Preezfontein situated about 10 km from the town of Fauresmith (20°46'S; 25°19'E) in the south-western region of the Orange Free State, Republic of South Africa. The farm encompasses an area of about 6000 ha characterized by vast grass plains and flattened hills and ridges at 1382 – 1533 m above sea level. The vegetation on the hilly areas is heterogeneous, consisting of grass patches interspersed with woody plant species such as *Olea europaea* L., *Rhus burchellii* Sond. ex Engl., *R. erosa* Thunb., *R. ciliata* Licht. ex Schult. and *Tarchonanthus camphoratus* L. *Aristida* and *Eragrostis* grasses together with dwarf shrubs such as *Chrysocoma ciliata* L. and *Pentzia globosa* Less. dominate the low-lying flats. According to Acocks (1988) the vegetation can be classified as False Upper Karoo (veld type no.36).

Meteorological data from the nearest weather station at Fauresmith was used to compile a climatogram for the study area. In general, the climate can be considered as semi-arid. Owing to the erratic rainfall, especially during November and December, mild to severe droughts occur periodically. Approximately half of the mean annual rainfall of 441 mm occurs from January to March (Figure 1). Mean daily maximum and minimum temperatures vary from 30.4°C in January to –1.8°C in July, while absolute temperatures range from 37.7 to –10.1°C.

Based on the climatogram of the area, the wet season commences in November when the rainfall curve exceeds the tem-

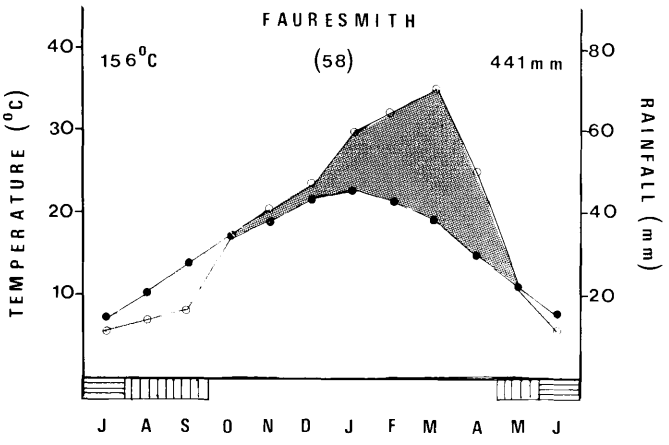

Figure 1 Climatogram of Fauresmith, the nearest weather station to the Preezfontein study area in the south-western Orange Free State. Numbers below name of weather station refer to the mean annual temperature (left), mean annual rainfall (right) and number of years of observation since 1927 (brackets). Mean monthly rainfall (○); mean monthly temperature (●); wet season, dark hatching; dry season, light hatching; months with mean minimum temperature below 0°C, horizontally striped area; months with absolute minimum below 0°C, vertically striped area.

perature curve (Figure 1). The six-month period ending in April thus represents the active growing season of most plant species. Owing to the low rainfall during the dry season, May – October, early spring can be considered the most critical period with regard to foraging, which is aggravated by the 120–150 frost days/year experienced from the middle of May to the middle of September (Anon. 1984). During the year of study, however, exceptionally heavy rainfall occurred, specifically from September 1988 until February 1989, when almost double the long-term average was experienced.

Material and Methods

Field observations on the feeding behaviour of Angora goats were limited to a 190-ha, fenced area consisting of 65% hilly and 35% flat terrain. Forty experimental animals were used, including 10 adult ewes, 10 adult castrated males (4 years), 10 young castrated males (<2 years) and 10 kids. Observations on two adult rams were also made during the mating season in April and May. The various groups of animals were marked with coloured ear tags to aid rapid identification. For the duration of the study, 40 free-ranging Merino sheep were also kept in the same camp, giving a low stocking rate of 19.0 ha/large stock unit based on the classification system of Meissner (1982).

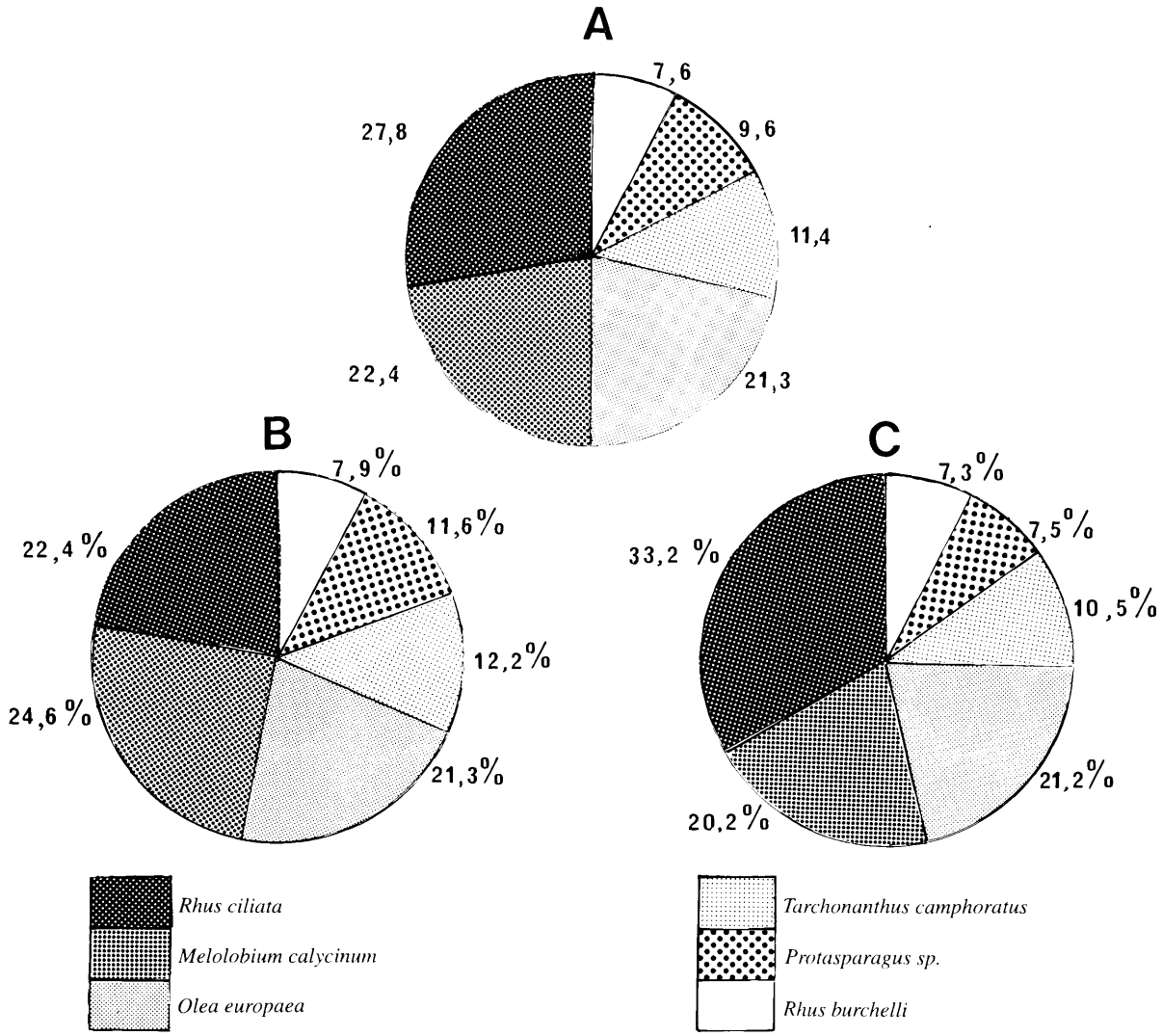

Figure 2 Relative importance of the six dominant plant species in the diet of Angora goats in a False Upper Karoo veld type. A. Calculated relative importance (Utilization frequency + Relative feeding duration/plant species ÷ 2); B. Utilization frequency (23 578 observations); C. Relative feeding duration (5 728 recordings).

Table 1 Seasonal variation in the diet of Angora goats at Preezfontein, district Fauresmith, during 1988/89

	Dry season						Wet season					
Food plants	M	J	J	A	S	O	N	D	J	F	M	A
Trees												
Boscia albitrunca			x									
Buddleia saligna	x	x	x	x		x	x	x		x	x	
Cussonia paniculata											x	
Heteromorpha arborescens						x		x				
Maytenus heterophylla	x	x	x	x	x	x	x	x	x		x	x
Olea europaea	x	x	x	x	x	x	x	x	x	x	x	x
Osyris lanceolata	x		x	x		x	x	x	x	x	x	x
Rhus lancea				x								
Tarchonanthus camphoratus	x	x	x	x	x	x	x	x	x	x	x	x
Shrubs												
Diospyros austro-africana	x	x	x	x	x	x	x		x	x	x	x
D. lycoides	x				x		x					
Ehretia rigida	x	x			x	x				x	x	x
Eriocephalus ericoides		x	x	x	x	x	x					
Euclea crispa	x	x	x	x	x	x		x	x		x	x
Felicia filifolia				x								
Melolobium calycinum	x	x	x	x	x	x	x	x	x	x	x	x
Pentzia globosa			x	x	x	x	x					
Protasparagus sp.	x	x	x	x	x	x	x	x	x	x	x	x
Rhus burchellii	x	x	x	x	x	x	x	x	x	x	x	x
R. ciliata	x	x	x	x	x	x	x	x	x	x	x	x
R. erosa					x			x	x			
Sutherlandia microphylla			x	x	x	x				x	x	
Viscum rotundifolium	x	x		x	x	x		x				
Herbs												
Anthospermum pumilum					x							
Berkheya onopordifolia		x	x	x	x	x	x					
Cheilanthes quadripinnata			x	x								
Cineraria lobata	x			x	x	x	x	x	x	x	x	x
Dimorphotheca cuneata				x								
Freesia andersoniae					x							
Hermannia multiflora				x	x	x		x				
Hibiscus trionum	x	x			x		x					
Homeria pallida			x	x	x	x	x					
Lactuca serriola						x	x					
Lightfootia nodosa		x	x	x	x	x	x	x	x			
Lotononis sp.				x								
Medicago laciniata							x	x				
Myosotis sylvatica		x	x	x	x	x	x	x	x	x	x	x
Oxalis sp.				x								
Pelargonium minima		x		x		x						
Ruschia clavata					x	x						
Salvia verbenaca					x							
Solanum incanum				x								
S. retroflexum				x			x					
S. tomentosum										x	x	
Stachys linearis		x			x	x		x	x		x	x
Sutera albiflora					x							
Unidentified grasses	x	x	x	x	x	x	x	x	x	x	x	x

Fortnightly field censusses, normally from sunrise to sunset, were conducted for a period of one year (May 1988 to April 1989). Initially, direct observations on the feeding behaviour of the Angora goats were made from a vantage point with the aid of a pair of 7 × 35 binoculars. Subsequently, as the goats became used to the presence of the observer, it was possible to make observations on foot at distances of less than 5m. Whenever an individual fed on a specific plant it was recorded as a feeding record for the plant species concerned. When more than one individual fed on the same plant simultaneously, the entry recorded agreed with the number of goats present. Utilization frequency for the different plant species was calculated as the total number of feeding records per plant expressed as a percentage of all observations. The cumulative duration of separate 'bites', defined as the time required by a goat to sample a mouthful of plant material, was used to determine the actual feeding duration per plant. All time recordings were made with a stopwatch. For each plant species the separate feeding durations were combined and expressed as a percentage of all time recordings. The relative importance (RI) of food plants was determined according to the method of Van Aarde & Skinner (1975), namely:

$$RI = \frac{\text{Percentage utilization} + \text{Percentage feeding duration}}{2}$$

Since the Angora goats frequented hilly terrain almost exclusively throughout the year, vegetation surveys were limited to these areas. The occurrence of shrubs and trees was quantified by means of 12 quadrants (25 m × 25 m) arranged in four transects across the hillock ridges. Following Tidmarsh & Havenga (1955) the wheel-point method was used to obtain quantitative data on grass species.

Results

Angora goats utilized 46 different herb and woody plant species during the study period (Table 1). Of these, shrubs and trees constituted 50%. Fifteen of 23 herb species, as well as four tree and three shrub species, were utilized infrequently during three or less months of the year. As opposed to this, ten shrub and/or tree species and two herb species were regularly utilized during ten or more months of the year.

Based on the utilization frequency and duration of feeding, *Melolobium calycinum* Benth., *Olea europaea, Protasparagus* sp., *Rhus burchellii, R. ciliata* and *Tarchonanthus camphoratus* formed the bulk of the diet of the Angora goats. Collectively these food plants constituted almost two thirds of all those observed. If the grass component is excluded (28.3% of the total diet), the contribution of the six plant species concerned increases to 86.6% of the goats' diet. Taken separately, *R. ciliata* has the highest relative importance value (27.8), followed by *M. calycinum* (22.4) and *O. europaea* (21.3) (Figure 2A). Although *M. calycinum* is utilized most often (Figure 2B), the time spent feeding on the herb is generally less than that of *R. ciliata* or *O. europaea* (Figure 2C). If the utilization frequency alone is compared to the relative occurrence of woody plants in the study area (Table 2), only *O. europaea* and *M. calycinum*, and to a lesser extent *T. camphoratus*, are positively sought after.

Table 2 Composition of the woody plants and grass community in the study area at Preezfontein, district Fauresmith, during 1988/89

Shrub and tree species	% Occurrence	Grass species	% Occurrence
Boscia albitrunca	0.1	*Aristida congesta*	19.3
Buddleia saligna	2.1	*A. diffusa*	16.5
Chrysocoma ciliata	2.6	*Cymbopogon plurinodis*	8.5
Cussonia paniculata	0.1	*Cynodon hirsutus*	0.1
Diospyros austro-africana	4.8	*Digitaria eriantha*	0.9
D. lycioides	0.4	*Elionurus muticus*	1.4
Ehretia rigida	0.3	*Enneapogon scoparius*	0.6
Eriocephalus ericoides	0.3	*Eragrostis annulata*	0.6
Euclea crispa	12.4	*E. chloromelas*	1.5
Felicia filifolia	0.1	*E. curvula*	2.7
Heteromorpha arborescens	0.2	*E. lehmanniana*	19.4
Maytenus heterophylla	1.4	*E. obtusa*	0.5
Melolobium calycinum	3.4	*Eustachys paspaloides*	1.4
Olea europaea	1.0	*Heteropogon contortus*	5.3
Osyris lanceolata	0.6	*Sporobulus fimbriatus*	7.2
Pentzia globosa	4.1	*Themeda triandra*	2.7
Protasparagus sp.	20.6	*Tragus koelerioides*	10.1
Rhus burchellii	18.7	*T. racemosus*	1.3
R. ciliata	17.7		
R. erosa	4.1		
R. lancea	0.1		
Sutherlandia microphylla	0.2		
Tarchonanthus camphoratus	4.7		

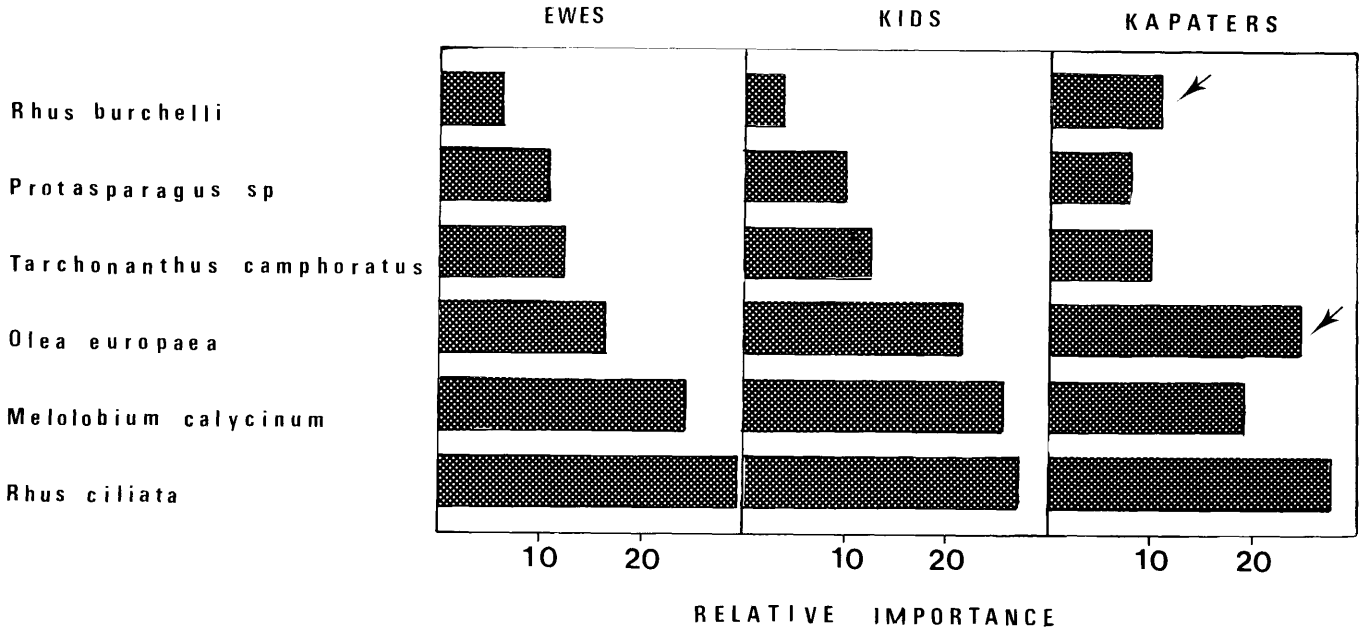

Figure 3 Sex and age related differences in the relative importance of the six dominant plant species in the diet of Angora goats.

As shown in Figure 3, there is to a large extent agreement in the relative importance of the six dominant plant species in the diet of ewes and kids. A marked increase in the importance of *O. europaea* and *R. burchellii* was, however, evident in the case of the castrated males (to which the feeding records of the two rams during April and May have been added). Increased browsing pressure resulted in the formation of distinct browse lines for the larger food plants such as *O. europaea* trees (Figure 4A). On occasion, a maximum feeding bout of 19 minutes by a ram standing on his hind legs was recorded for *O. europaea*. It was also repeatedly observed that the smaller-sized ewes and kids immediately rushed in to browse when branches, which are normally inaccessible to them, were bent down by larger individuals.

A marked seasonal variation was recorded in the diet of the Angora goats (Figure 5). Unidentified grasses were mainly utilized during the spring and early summer while shrubs, and to a lesser extent, evergreen trees, were more intensively utilized during the winter months. A peak in the consumption of herbs coincided with the most critical period of food availability at the end of the dry season. Overall, a larger variety of plant species were utilized during the relative food shortage of the winter months than during the wet season (43 compared with 32 plant species) (Table 1). A concurrent increase in the mean duration of feeding on the six dominant food plants, from 128 ± 32 to 167 ± 70 seconds, was also recorded. As *Protasparagus* sp. retain their needle-like leaves until late in the dry season, they were heavily browsed (Figure 4B) during this time of the year.

Figure 4 Browsing effects of Angora goats on some preferred food plants. A. Distinct browse line of a wild olive tree at a height of about 1.5 m.

Figure 4 Browsing effects of Angora goats on some preferred food plants. B. Sparse growth form of a heavily browsed wild asparagus.

Discussion

From the results obtained, it is evident that Angora goats utilize a wide spectrum of food plants. All the available strata of the vegetation, including grasses, herbs, dwarf, medium and tall shrubs and trees, are utilized. In practice this means that goats can do equally well on bushveld, Karoo bush, grassveld or even lucerne pastures (Roux, 1973). Based on the arbitrary classification of Grunow (1980), Angora goats should be considered to be mainly browsers since grass constitutes less than 40% of their diet. It must, however, be stressed that the botanical composition of the diet can be influenced to a large extent by individual preferences (Du Toit, 1972; Van Dyne & Heady, 1965) and seasonal variation in the availability of food plants (Hoppe *et al.*, 1977; Malechek & Leinweber, 1972; Nge'the & Box, 1976; Owen-Smith & Cooper, 1985; Scifres, 1980; Warren *et al.*, 1984). In this respect it was, for instance, found that grasses were utilized most frequently during their active growing season in summer, but that the utilization of woody vegetation predominated during the cold winter months. Implicitly this means that Angora goats are opportunistic feeders and will utilize food plants in relation to their abundance. Contradictory statements on the feeding behaviour of goats in the literature can thus be explained on the basis of divergent ecological conditons pertaining to the various study areas. In addition, many conclusions made in the past were based on small sample sizes which are subject to bias (Knight, 1965; Malechek & Leinweber, 1972; McMahan, 1964).

The browsing habits of domestic goats result in a foraging strategy which focuses, to a large extent, on the vertical level when compared with either sheep or cattle (Aucamp, 1976; Grunow, 1980; Staples *et al.*, 1942; Warren *et al.*, 1984). This

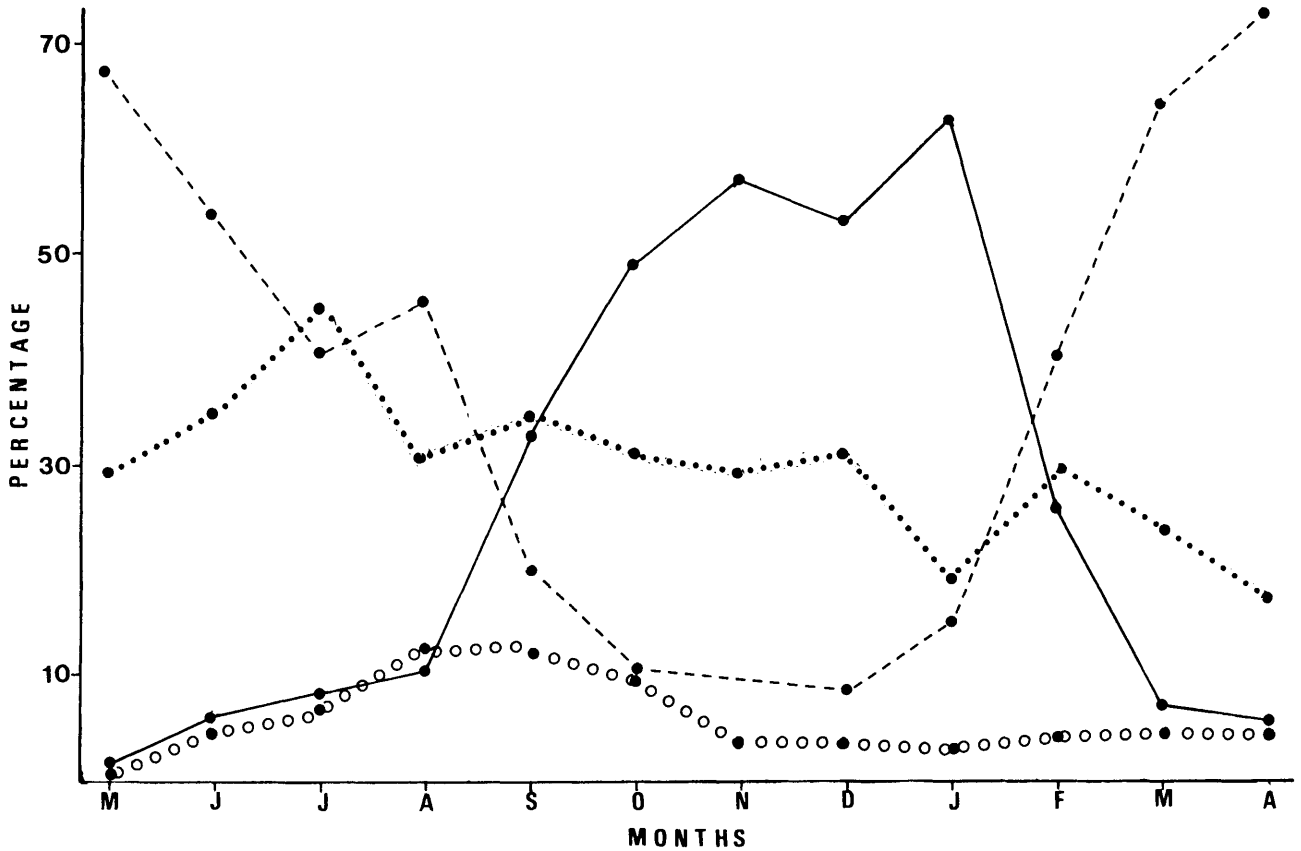

Figure 5 Monthly variation in the utilization frequency of the various plant growth forms in the diet of Angora goats at Preezfontein during 1988/89. Shrubs, broken line; grasses, continuous line; trees, dotted line; herbs, open circle line.

affords them the opportunity to utilize the natural vegetation optimally within a production system. From a physiognomic perspective, the sheep farming areas in the south-western Orange Free State are characterized by grasslands and flattened hills and ridges covered with lush woody vegetation (Acocks, 1988). By including Angora goats in the foraging system a more discreet utilization of the available vegetation can be accomplished than with sheep alone as they seldom, if ever, frequent hilly terrain. In this way, the full production potential of the False Upper Karoo veld type can be achieved to the benefit of the small stock industry. An additional source of income can thus be realized, as plant material, which otherwise would have been left unused, can now be converted to introduce a commercial system of animal production.

Where Angora goats are incorporated into a Karroid foraging system, their susceptibility to tick-induced diseases should also be considered (Donaldson, 1979; Owen-Smith & Cooper, 1985). In the Karoo areas of South Africa the Karoo paralysis tick *Ixodes rubicundus* presents a problem of considerable magnitude to stock farmers. Sheep, goats, cattle and wild artiodactylids are paralysed and may die after infestation with this tick (Spickett & Heyne, 1988). Angora goats are normally more easily infested with the Karoo paralysis tick than sheep which frequent the same general area. This may result in early cases of paralysis. The phenomenon has been attributed to differences in the temporal and spatial distribution of the hosts which can either increase or decrease host-tick contact and hence infestation densities (Fourie & Kok, 1992). A survey on the spatial distribution of the tick in a False Upper Karoo veld type has shown that adults are closely associated with shrubs and trees with a dense canopy cover and decaying litter underneath (Fourie *et al.*, 1991). Of these, wild olive trees were involved in more than two-thirds of the cases. As one of the preferred food plants of Angora goats, heavy browsing of wild olive trees quickly results in the formation of distinct browse lines. This results in greater penetration of sun-rays which will increase the temperature underneath the canopy and decrease soil moisture. These factors are known to affect tick survival (De Jager, 1988). *I. rubicundus* populations in association with *O. europaea* trees, which were mechanically manipulated to simulate the browsing effect of goats and monitored over three years, were significantly smaller than those at control trees (Fourie, unpub. data). Therefore, Angora goats may also play an important role in an integrated control system against the Karoo paralysis tick.

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