

Seasonal Diets of Camels, Cattle, Sheep, and Goats in a Common Range in Eastern Africa

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Abstract

Although there have been several reports on the food habits of domestic herbivores in various semiarid regions of the world, there has been no previous report on the partitioning of forage resources by camels (*Camelus dromedarius*) and sheep (*Ovis aries*), goats (*Capra hircus*) and cattle (*Bos indicus*) using a common range. In the semiarid region of northern Kenya, the seasonal exploitation by these herbivores resulting from herding by the nomadic Rendille pastoralists makes the system for management of these rangelands very complex. Information on the food habits of animals utilizing a common range is important in offering a basis for assessing the usefulness of the range components to the animals. Consequently, food habits information becomes an important tool in making management decisions. Camels were predominantly browsers while cattle were predominantly grazers. Sheep and goats were intermediate feeders. Cattle browsed most during the 'green' season when the browse shoots were most abundant and easiest for their large mouth parts to harvest. Camels grazed most during the very dry season when most trees and shrubs had shed their leaves. The observed variations in food habits among the 4 herbivores suggest that they may require different management to obtain optimum production.

Key Words: common use, forage selection, diet similarity, Kenya livestock, pastoralists

Animal husbandry is the most productive use of arid and semi-arid areas of the world. More than 2/3 of Kenya is classified as rangeland (over 492,100 km²). More than half of this area averages less than 370 mm of rainfall annually. The Rendille pastoralists utilize such an area in the lowlands of northern Kenya in their nomadic way of life. Knowledge of plant species commonly selected by grazing and browsing herbivores at different times of the year is fundamental to effective grazing management. The Rendille keep camels, cattle, sheep, and goats, the first 2 being the chief source of milk and the last 2 used mainly for barter. A large increase in human population in recent times, due to a better standard of living, has been accompanied by a tremendous increase in the total livestock numbers in the area. This has resulted in range degradation, especially around settlements and wells (bore holes).

Food habits of single species in semiarid areas of eastern Africa have been described for goats (Edwards 1948, Hornby et al. 1948, Wilson 1957, Knight 1965), cattle (Harker et al. 1956, Lampkin and Quarterman 1962, Payne and McFarlane 1963), and camels (Knoess 1976, Field 1978, Newman 1979). Food habits studies on mixed species in the same region have been described for goats and cattle (Staples et al. 1942) and for camels, sheep, and goats (Field 1979). However, no seasonal diets have previously been reported for common use of camels, goats, sheep, and cattle. The objective of this study was to gather this information as a basis for better management of the semiarid rangelands of eastern Africa used in common by these 4 livestock species. The study was conducted from March 1982 to February 1983.

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The study area is located in northern Kenya between latitudes 1° 7' and 2° 37' north and longitudes 37° 13' and 37° 52' east. It covers an area of approximately 3,450 km² through which pastoralists roam with their livestock in search of good pastures. The study period covered 2 wet (green seasons) and 2 dry seasons. McCown (1980) suggested that 'green season' be used instead of 'wet season' when discussing temporal patterns of forage condition since even after the rains have ceased plants continue to grow as long as there is sufficient moisture remaining in the soil. The sequence of seasons during the period of study was the first green season (April–June 1982), first dry season (July–September 1982), second green season (October–December 1982), and second dry season (January–March 1983).

Forage biomass of dwarf shrubs, grasses and herbs (Table 1) was

Table 1. The mean \pm standard deviation of major (>5%) plant genera found in the diets of livestock species in the Rendille region of northern Kenya during the first green season (April to June, 1982).

Genus of Plants	Livestock species			
	Camels	Goats	Cattle	Sheep
Trees				
<i>Commiphora</i>	10 \pm 5	7 \pm 1	—	—
<i>Euphorbia</i>	7 \pm 3	—	—	—
Shrubs				
<i>Grewia</i>	10 \pm 6	7 \pm 3	—	—
Dwarf Shrubs				
<i>Duosperma</i>	10 \pm 4	—	—	—
<i>Heliotropium</i>	6 \pm 2	6 \pm 2	—	—
<i>Indigofera</i>	8 \pm 3	7 \pm 3	—	—
<i>Justicia</i>	6 \pm 4	6 \pm 3	—	—
<i>Sericocomopsis</i>	10 \pm 5	8 \pm 2	—	—
Grasses				
<i>Aristida</i>	—	7 \pm 2	19 \pm 6	13 \pm 5
<i>Brachiaria</i>	—	—	7 \pm 4	—
<i>Cenchrus</i>	—	—	6 \pm 4	—
<i>Enneapogon</i>	—	—	—	—
<i>Eragrostis</i>	—	—	5 \pm 2	7 \pm 7
<i>Sporobolus</i>	—	—	5 \pm 2	7 \pm 7
<i>Tragus</i>	—	—	—	7 \pm 5
<i>Chloris</i>	—	—	6 \pm 2	—

sampled once every month using 1-m² quadrat (Brown 1954, Manntje 1978). Clipped vegetation was divided and sacked in the field on the basis of species, standing dead, herbaceous litter and woody litter. The samples were air dried for 1 month at daytime temperatures of 20° C to 40° C and then weighed. Foliage biomass of trees and shrubs (Table 1) was estimated using the wandering quarter method (Catane 1963) for estimating tree density (Mueller-Dombois and Ellenberg 1973) by taking crown measurements of each tree or shrub encountered along the transect and converting the crown area to foliage dry weight using correction factors developed for species in the area of study (Lamprey, unpublished).

Once a week 40 individuals from each of the 4 livestock species were randomly selected to provide fecal samples. These were about 2 g each for cattle, 1 pellet for camels, and 4 pellets for sheep and goats. The samples were dried in the shade at daytime temperatures of 20° C to 40° C for a minimum period of 1 week. They were then ground in a Wiley mill through a 1-mm screen. The seasonal

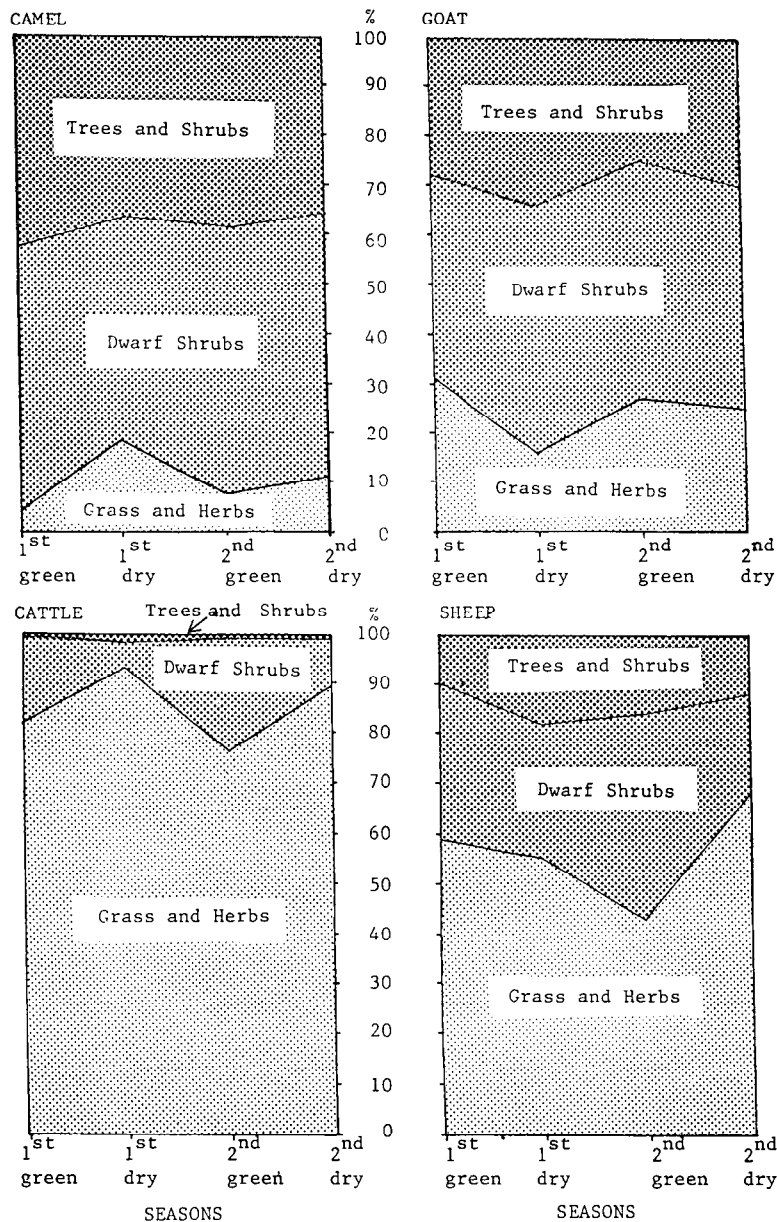


Fig. 1. Seasonal forage components (%) of the diets of camels, cattle, sheep and goats in the Rendille region of northern Kenya.

samples of each animal species were composited and a subsample of this was used for the microhistological analysis to get the percent relative density of forage fragments, which is a good approximation for the relative amount of each plant eaten. Five microscope slides were prepared for each seasonal sample and 20 slide fields read per slide.

Although the microhistological technique of diet analysis (Sparks and Malechek 1968) used in this study has been criticized, especially in estimation of diets consisting largely of leafless shrubs (Gill et al. 1983), Holechek and Valdez 1985), the procedure has been shown to be most accurate when the technician has had special training, is experienced in the technique, and has field related experience with the plant species in the area of study (Holechek et al. 1982, Holechek and Gross 1982, Mukhtar and Hansen 1983). If necessary, correction factors may be applied (Vavra and Holechek 1980). The technician (Migongo-Bake) had been taught to identify and quantify plant fragments until all her determinations for hand compounded mixtures of plants from the study area were less than $\pm 5\%$ of their dry weight. It was observed

in the study area that in the dry season when the drought-deciduous browse species had lost their leaves, they became brittle and unpalatable so that only the palatable grasses and drought-tolerant leafy woody plants were selected.

Results

The forages in the diets of the 4 livestock species were categorized as trees-and-shrubs, dwarf shrubs and grass-and-herbs components for each of the 4 seasons (Fig. 1). The major forage species ($>5\%$) in the seasonal diets of the livestock species are shown in Tables 1 to 4. While no individual grass or herb species contributed more than 5% to the diet of camels in any 1 season (Tables 1 to 4) grass-and-herbs as a diet component (Fig. 1) contributed more than 10% of their diet during both dry seasons. The same tendency was observed for goats. Trees-and-shrubs and dwarf shrubs contributed substantially ($>10\%$) to the diets of cattle in the green seasons (Fig. 1). However, no browse species contributed more than 5% to the diet of cattle in any one season (Tables 1 to 4). Individual browse species contributed more than 5% to the diet of sheep in the very green season (October–December). As a forage

Table 2. The mean \pm standard deviation of major (>5%) plant genera found in the diets of livestock species in the Rendille region of northern Kenya during the first dry season (July to September, 1982).

Genus of Plants	Livestock species			
	Camels	Goats	Cattle	Sheep
Shrubs				
<i>Cadaba</i>	9 \pm 6	6 \pm 2	—	—
<i>Balanites</i>	7 \pm 4	—	—	—
<i>Grewia</i>	—	8 \pm 4	—	—
Dwarf Shrubs				
<i>Duosperma</i>	11 \pm 6	12 \pm 6	—	—
<i>Heliotropium</i>	7 \pm 6	7 \pm 5	—	—
<i>Indigofera</i>	9 \pm 4	—	—	—
<i>Sericocomopsis</i>	—	6 \pm 3	—	—
Grasses				
<i>Aristida</i>	—	—	23 \pm 6	16 \pm 6
<i>Cenchrus</i>	—	—	—	—
<i>Chloris</i>	—	—	7 \pm 5	—
<i>Enneapogon</i>	—	—	—	—
<i>Eragrostis</i>	—	—	17 \pm 8	7 \pm 3
<i>Sporobolus</i>	—	—	6 \pm 5	—
<i>Tetrapogon</i>	—	—	7 \pm 4	—
<i>Tragus</i>	—	—	9 \pm 6	9 \pm 5

Table 3. The mean \pm standard deviation of major (>5%) plant genera found in the diets of livestock species in the Rendille region of northern Kenya during the second green season (October to December, 1982).

Genus of Plants	Livestock species			
	Camels	Goats	Cattle	Sheep
Trees				
<i>Commiphora</i>	10 \pm 2	—	—	6 \pm 2
<i>Euphorbia</i>	7 \pm 3	—	—	—
Shrubs				
<i>Grewia</i>	—	6 \pm 2	—	—
Dwarf Shrubs				
<i>Duosperma</i>	—	7 \pm 1	—	—
<i>Heliotropium</i>	9 \pm 1	7 \pm 4	—	—
<i>Indigofera</i>	16 \pm 4	9 \pm 4	—	6 \pm 2
<i>Justicia</i>	—	—	—	6 \pm 4
<i>Seddera</i>	—	—	—	6 \pm 2
<i>Sericocomopsis</i>	8 \pm 2	9 \pm 2	—	7 \pm 4
Grasses				
<i>Aristida</i>	—	—	17 \pm 6	7 \pm 3
<i>Brachiaria</i>	—	—	6 \pm 3	—
<i>Chloris</i>	—	—	7 \pm 2	—
<i>Eragrostis</i>	—	—	10 \pm 5	—
<i>Sporobolus</i>	—	—	7 \pm 4	—
<i>Tragus</i>	—	—	6 \pm 3	—

component browse contributed more than 30% to the diet of sheep in all 4 seasons (Fig. 1).

Discussion

Although cattle ate predominantly grasses, the browse component of their diet was higher in the green seasons than in the dry season. The amount of browse in the diet was highest during the second green season, which was exceptionally wet and consequently had the highest forage biomass observed in the study period. However, no single browse species made a major (>5%) contribution to cattle diets for any single season. Cattle grazed most during the driest of the 4 seasons (July–September) although grass biomass was at its lowest then. An explanation for this behavior could be that because of their large mouth parts, cattle

Table 4. The mean \pm standard deviation of major (>5%) plant genera found in the diets of livestock species in the Rendille region of northern Kenya during the second dry season (January to March 1983).

Genus of Plants	Livestock species			
	Camels	Goats	Cattle	Sheep
Trees				
<i>Commiphora</i>	6 \pm 3	—	—	—
Shrubs				
<i>Cadaba</i>	6 \pm 4	6 \pm 4	—	—
Dwarf Shrubs				
<i>Duosperma</i>	9 \pm 3	8 \pm 5	—	—
<i>Heliotropium</i>	6 \pm 2	—	—	—
<i>Indigofera</i>	12 \pm 3	6 \pm 5	—	—
<i>Justicia</i>	6 \pm 6	—	—	—
<i>Sericocomopsis</i>	10 \pm 5	11 \pm 5	—	—
Grasses				
<i>Aristida</i>	—	—	22 \pm 3	18 \pm 7
<i>Enneapogon</i>	—	—	6 \pm 8	6 \pm 3
<i>Eragrostis</i>	—	—	12 \pm 3	11 \pm 4
<i>Sporobolus</i>	—	—	7 \pm 3	—
<i>Tragus</i>	—	—	—	9 \pm 4

Table 5. Seasonal average rainfall (mm) and forage biomass (kg/ha) in the Rendille region of northern Kenya.

	Seasons			
	First green	First dry	Second green	Second dry
Rainfall	76	0	182	17.5
Forage Types				
Trees-and shrubs ¹	26	16	28	19
Dwarf shrubs	981	442	1061	812
Grass-and-herbs	172	127	225	139

¹Leaf biomass estimate

were not able to select for leaves and twigs from amongst the dry-season-hardened branches of browse. Although more than 50% of the diet of sheep consisted of grasses for all except one season, the browse component of their diet tended to increase during both the very dry season (July–September) and the very green season (October–December). The increase in the very dry season was most likely caused by the much greater decrease in grass relative to browse, while that in the green season was most likely a result of the greater increase in browse biomass relative to grass due to the unusually high rainfall in that season (see Table 5). Goats also tended to browse relatively more during the driest season. However, for camels, which like sheep and goats have mouth parts adapted for browsing, the grass component of the diet was greatest during the driest season. Most trees and shrubs and even some dwarf shrubs, in these semiarid rangelands are drought deciduous. This reduction in leafy browse might have caused the camels to graze, especially in localized stands of *Aristida* spp., common in these rangelands, in order to meet their dietary requirements, which are greater than those of the other 4 livestock species. This dry-season grazing behavior by camels had been observed earlier in this region (Sato 1976, Field 1979) and also in the northwest Sahara (Gauthier-Pilters 1958).

Since most trees in the area of study are drought deciduous, they are important as a diet component only in the green seasons. In the dry season dwarf shrubs thus become major contributors of browse diet to camels, goats and, to some extent, sheep. Most of the grass species in the area of study are annuals and remain either

in the form of standing-dead or litter in the dry season. Although grass biomass is very low in the dry seasons it is still the major diet contributor to the diet of cattle and, to a large extent, sheep. The preference of a grass diet by camels in the dry season adds more pressure to a resource that is already in low supply. This increased demand on the grass resource in the dry season might have a negative effect on cattle production, since they are predominantly grazers.

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