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Diet selection by goats at Kalemendo, North Darfur, Sudan

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Key words: Plant preference; Bite-count; Rangelands

Abstract

Pressure on rangelands of Sudan has increased in the last few decades due to increase in human population and in animal numbers. The rangelands were also impacted by climate change, desertification, agricultural expansion, mining, and overgrazing. Decreased amounts of rainfall have impoverished the natural rangelands. Goats are capable of grazing on semi-desert regions characterized by low rainfall and scarce grazing plants. It is therefore necessary to know and enhance plant species preferred by goats to properly manage the rangelands. The present study was conducted at Kalemendo, North Darfur State during the rainy season of year 2017 when most plants were flowering. The aim was to investigate plant preference by goats under free grazing conditions. A range site of one km² was selected for the study. The Parker loop method was used to determine botanical composition of herbaceous plants while the point centre quarter method was used to determine density and relative density of trees and shrubs. The bite count technique was used to determine goat diet botanical composition. The herbaceous layer manifested 34 species of which 50.76% were forbs, while grasses constituted 49.24%. The dominant herbaceous plants were *Dactyloctenium aegyptium* (16.08%), *Aristida spp* (13.04%), *Zaleya Pentandra* (9.27%), *Trigonella hamosa* (8.70%), *Echinocloa colona* (6.38%) and *Aerva javonica* (5.36%). Tree and shrub of highest relative density were *Acacia tortils* (67.86%), *Boscia senegalensis* (14.29%), and *Grewia tenax* (3.57%). The diet selected by goats comprised trees/shrubs (42.17%), forbs (36.15%) and grasses (21.68%). Plants most preferred were *Commelina kotschyi*, *Justicia kotschyi*, *Tribulus terrestris*, *Trigonella hamosa*, *Echinocloa colona*, *Permina resinosa*, *Grewia tenax*. and *Acacia mellifera*. It is concluded that rehabilitation of rangelands can best be effected by resort to plant species preferred by goats.

Introduction

1. Animals graze according to nutritional needs; palatability and ease of access. They choose specific plants or parts of plants if not controlled. Goats are characterized by selective grazing mainly based on the exploitation of rangeland resources which are subject to high quantitative and qualitative variations over the year. Fodder trees and shrubs are an integral part of the diet of these animals and constitute the main source of proteins, minerals and vitamins during the dry season (Dicko and Sikena 1991). Preference is defined as the relative consumption of one plant over another by a specific class of animal when given free choice at a particular time and place (Frost and Ruyle 1993). Preference is defined in terms of free choice by an animal. It is essentially behavioral. Relative preference indicates proportional choice among two or more foods (Heady 1964). Goat is the dominant animal in the study area due to ease of raising and adaptation to harsh environmental conditions accompanied by inadequate quality feed. Therefore, this study aimed to identify plants preferred by goats and plant composition of rangeland.

Materials and methods: The Study area is located in the south eastern part of North Darfur State, 19 km from the State capital El Fasher. The site shows arid and semi-arid climate; hot in summer and cold in winter, the mean maximum and minimum temperatures are 34.7°C and 17.7 °C respectively. The average

rainfall ranges between 75-287 mm/year and is characterized by fluctuation from one year to another. The area hosts diverse types of plants (EMS, 2017).

An area of one square kilometer in open rangeland was selected for determination of botanical composition. The density and relative density of trees and shrubs were determined by the point centre quarter method. Botanical composition of the herbaceous layer of the rangeland was measured by the Parker loop method (Parker and Harris 1959). The bite count technique (Van Dyne, 1968) was used to determine the botanical composition of the diet selected by goats. Five goats were selected and observed for three days 09:00 am to 11:30 am, and from 4:00 pm to 6:30 pm. Each goat was observed for a total of 60 minutes/day; the number of bites made by goat on various forage species was recorded. The relative preference index (RPI) was used to classify plants according to their preference and, for herbaceous plants, it is obtained from the relationship: $RPI \% = \text{Species in Diet} (\%) \div \text{Species botanical composition in range} (\%)$. The range plants were classified according to their (RPI) into five forage value categories (NRC 2003) and (Abdelkreim 2012): PP = Preferred Plant (RPI more than 1.25), DP = Desirable Plant (RPI about 0.75 to 1.24), UP = Undesirable Plant (RPI less than 0.75), NCP = Non-consumed plants, and TP= Toxic plants.

Three line transects were selected, each was 300 m long, to measure plant species%, litter%, rock%, bare soil%, and animal pellets% at intervals of one meter using 0.75" loop. The data collected were recorded in a specified sheet. Also, along each of these line transects seven points were taken to measure density and relative density of trees and shrubs by using the point-center quarter method (Cottam and Curtis 1956) cited by David et al. (2004). In this method average distance (AD) for all sample points is calculated as: $AD = \text{summation all distance in all points} \div \text{number of points}$.

Density of all trees/shrubs (D) = area of sample plot \div (AD)².

Density of trees / shrubs spp = number of species \div number of trees in all points \times density of all trees (D).

Relative density = density of species \div all density \times 100.

Results

Table 1 includes plant composition of the rangeland and the botanical composition of the diet selected by goats. Table 2 shows density and relative density of trees and shrubs.

Table (1): Botanical composition of the diet selected by goats at flowering stage during seasons 2017

Scientific name /plant type	% in Rangeland	% in Diet	*RPI	**PC
A. Forbs				
<i>Trigonella hamosa</i>	8.70	11.20	1.29	PP
<i>Commelina kotschyi</i>	1.16	8.24	7.10	PP
<i>Justicia kotschyi</i>	1.89	3.79	2.01	PP
<i>Tribulus terrestris</i>	1.16	2.11	1.82	PP
<i>Alysicarpus vaginalis</i>	4.64	4.32	0.93	DP
<i>Zalya pentandra</i>	9.27	2.03	0.22	UP
<i>Aerva javonica</i>	5.36	0.27	0.05	UP
<i>Mollugo noduavlis</i>	3.63	0.98	0.27	UP
<i>Corchorus olitorius</i>	3.48	0.18	0.05	UP
<i>Portulaca oleracea</i>	1.59	0.00	0.00	NCP
Other forbs	9.88	3.03	-	-
Total Forbs	50.76	36.15		
B. Grasses				
<i>Echinochloa colona</i>	6.38	8.45	1.32	PP
<i>Bracharia deflex</i>	1.16	0.88	0.76	DP

<i>Dactyloctenium aegyptium</i>	16.08	8.47	0.53	UP
<i>Cyperus rotundus</i>	5.22	3.56	0.68	UP
<i>Aristida spp</i>	13.04	0.18	0.01	UP
<i>Eragrostis diplachnoides</i>	3.18	0.10	0.03	UP
<i>Eragrostis tremula</i>	1.73	0.00	0.00	NCP
<i>Zornia diphylla</i>	1.59	0.00	0.00	NCP
other Grass	0.86	0.04	-	-
Total Grass	49.24	21.68		
C.Trees/Shrubs				
<i>Acacia tortils</i>	-	25.91	-	-
<i>Grewia tenax</i>	-	5.29	-	-
<i>Permina resinosa</i>	-	3.68	-	-
<i>Acacia mellifera</i>	-	2.51	-	-
<i>Balanites aegyptiaca</i>	-	2.08	-	-
<i>Acacia Senegal</i>	-	1.41	-	-
Other Trees/Shrubs	-	1.29	-	-
Total Trees/Shrubs	-	42.17		
Total of all plant types	100.00	100.00		

Table (2): Trees/shrubs density and relative density in study area

Scientific name	Tree / shrub density (Plant/km ²)	Trees/shrub relative density (%)
<i>Acacia tortils</i>	247	67.00
<i>Boscia sengalensis</i>	52	14.29
<i>Acacia nilotica</i>	4	1.10
<i>Maerua crassifolia</i>	9	2.47
<i>Leptadenia pyrotechnica</i>	4	1.10
<i>Permina resinosa</i>	9	2.47
<i>Acacia mellifera</i>	9	2.47
<i>Ziziphous spina Christi</i>	4	1.10
<i>Balanites aegyptiaca</i>	9	2.47
<i>Capparis deciduas</i>	4	1.10
<i>Grewia tenax</i>	13	3.57
Total	364	100.00

Discussion: As shown in table (1), goats grazed with high selectivity as appears from range inventory in the study area. It was found that 34 plant species out of 47 detected were selected by goats, the highest class of plants recorded was trees and shrubs (42.17%), followed by forbs (36.15%) and then grasses (21.68%). Based on percentages of browse and herbaceous species in dietary composition, goats have been described as browsers-grazer. This is in variance with the finding of (Sidahmed *et al* .1981) who described goats as browsers according to percentages of browse and herbaceous species in dietary composition. This may be attributed to the diversity of plants where our study was conducted. The plants most preferred were *Commelina kotschyi*, *Justicia kotschyi*, *Tribulus terrestris*, *Trigonella hamosa*, *Echinochloa colona*, *Permina resinosa*, *Grewia tenax* and *Acacia mellifera*. These plants are characterized by soft stems and abundance of leaves and twigs, Morand-Fehr *et al* .(1981) stated that goats select the most nutritive parts of plants such as leaves compared with stems. Some tree, grass and forb species appeared in the diet but not in the botanical composition of the range such as *Acacia senegal* (1.41%).

This may be due to the extensive use of *Acacia senegal* as building materials and the use of their roots in handicraft. Moreover, some plants were found in the range but not in the diet selected by goats such as *Eragrostis tremula*, *Zornia diphylla*, *Protulaca oleracea*, *Boerhavia erecta* and *Boscia senegalensis*. This is consistent with (Adam *et al.* 2012) who reported that *Eragrostis tremula* and *Zornia diphylla* were non consumed by goats in high growth stage. Plants that dominated the range site were *Dactyloctenium aegyptium* (16.08%), *Aristida spp* (13.04%), *Zaleyia Pentandra* (9.27%) and *Trigonella hamosa* (8.70%).

As described in Table (2) it is concluded that trees and shrubs were sparsely distributed in the range site according to mean distance (52.43m) for all points sampled in the plot, (trees density was 364 trees/shrubs /km²). Some trees that formed a high percentage in relative density such as *Acacia tortilis*, *Boscia senegalensis*, and *Grewia tenax* (67.86%, 14.29% and 3.57% respectively) are classified as dominant species in the range site. *Boscia senegalensis* is ecologically the most important species showing good regeneration and high tolerance to fire (IBGR 1984). Factors such as population increase and ensuing anthropogenic activities such as tree felling for use in building, firewood and charcoal, overgrazing, early grazing and drought negatively impacted the range (Mansoor 2015). There is a decline in vegetation cover, especially trees and shrubs. Therefore, care must be taken to change the range management methods to match the sustainability of rangeland resources. Goats selected more trees than forbs or grasses in their diet. It is concluded that rangelands rehabilitation should take into account plants species that are preferred by goats.

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