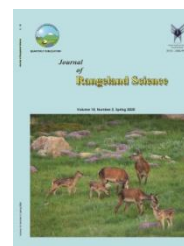Contents available at ISC and SID

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Research and Full Length Article:

Rangeland Plants Preferred by Goats Grazing at Western Jebel Marra Locality, Central Darfur State, Sudan

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Abstract. The study was conducted to determine the plants preference by goats grazing at Central Darfur State, Sudan in 2016. The objective was to identify desirable plants that would assist in range rehabilitation. Five mature female goats were used to determine diet selection using the bite count technique. The total number of bites from each plant species was recorded and the selected diet and preference indices were calculated. It was found that forbs constituted 52.6% of the diet of goats followed by trees and shrubs (43.6%) and then grasses (3.6%). Among the forbs, *Ipomoea sinensis* (Desr.), *Kohautia aspera* and *Haemanthus multiflorus* were the most selected forbs with average values of 7.17%, 5.53% and 4.06%, respectively. *Faidherbia albida*, *Ziziphus spina-christi* and *Albizia amara* were the most selected trees with average values of 18.29%, 7.77% and 7.66%, respectively. The grass species that appeared most in the diet of goats was *Pennisetum pedicellatum* (3.53%). In this study, forbs had higher Relative Preference Indices (RPI) than grasses. The higher values of RPI in forbs as *Abelmoschus esculentus*, *Kohautia aspera*, *Commelina kotschyi*, *Portulaca quadrifida*, *Talinum portulacifolium* and *Setaria acromelaena* were 25.2 7.9, 3.7, 3.68, 3.64 and 3.42, respectively. Plants with higher RPI were suggested for reseeding rehabilitation projects. These findings may be considered as a basis for an informed management system in the study area which will be invaluable in developing sustainable management strategies.
Key words: Bite count, Botanical composition, Relative preference index

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Introduction

Global livestock populations were estimated to be1.43 billion cattle, 1.87 billion sheep and goats, 0.98 billion pigs, and 19.60 billion chickens (Robinson *et al.*, 2014). Sudan has animal resources which reach approximately 106.6 million head with a goat population of 31.2 million head, and Central Darfur State hosts about 2.0 million head (MAR, 2016). This large livestock herd of Sudan depends on natural rangelands and forests for most of their feed requirements which are estimated as 133 million tons of dry matter per year (Fadlalla *et al.,* 2018). However, in many cases, natural rangelands fall short of meeting animal requirements. Several factors affect rangelands productivity and production such as impact of climate change and human activities.

Ground vegetation cover measurements are commonly used for the evaluation of soil protection, watershed health, range land ecological condition and range trend (Holechek *et al*., 2004). Fatur and Fadlalla (2013) found that land cover in two range sites in North Kordofan State, Sudan formed 81.9% and 87.5%, respectively. Comparison of plant combination percent in the study area showed that in the first record duration, maximum plant combination was grasses and forbs (27.27%), shrubs (26.5%) and minimum amount was for annual forbs (2.09%). In the second record period, shrubs (48.45%) and bushy trees (21.64%), and annual forbs (1.45%) formed the plant combination of area (Askarizadeh and Heshmati *et al*., 2011). Browse is an important forage source for goats throughout the year and for sheep during the dry period when herbage is limited (Holechek *et al.*, 2004). At seed setting stage in a protected rangeland site, goat diet contained 4.3% grasses, 51.5% forbs and 44.2% browse (Fatur and Fadlalla, 2013). Also in an open rangeland, plants with the highest Relative Preference Index (RPI) were *Desmodium* pp. (RPI=15.9), *Ipomea eriocarpa* (RPI=15.7) and *Echinochloa colonum* (RPI=5.1); generally, sheep selected more forbs than grasses (Abdelkreim and Fadlalla, 2013). The taken bites by sheep and goats have shown that both of them preferred the composed diet in grazing duration. Although based upon diet selection of sheep in the first and second record period, it has been cleared that perennial forbs were daily the most part of its diet, presence of this vegetation forms in sheep diet selection was not the cause of its preference. Goats, however, have highly preferred forbs in the first record period, but in second stage, they preferred to browse the shrubs and bushy tree (Askarizadeh and Heshmati *et al*., 2011). Annual broad-leaved forbs such as *Launaea mucronata*, shrubs such as *Sphaerocoma aucheri* and perennial grasses such as *Eremopogon foveolatus* are respectively regarded as the palatable plants for a Tali goat (Ashouri *et al*., 2014).

The present study was conducted to determine the plants preferred by goats in Western Jebel Mara locality, Central Darfur State, Sudan. Knowledge of preferred plant species contributes to the selection of desirable plants for range management and rehabilitation.

Materials and Methods
Study area

The study was conducted in Western Jebel Marra Locality, Central Darfur State, Sudan (Fig. 1). The area is located in the north western part of Jebel Marra massive and extends between latitudes 12°57' and 13°00′ ′N and longitudes 24°02' and 24°04′E (DRCO, 2011). Due to the influence of elevation, Jebel Marra weather resembles Mediterranean climate. The annual rainfall in the western slopes ranges from 420 mm/annum at Golol, Murtagello and Nertiti (1000 m.a.s.l) and 1200 mm /annum at the upper altitude (2500-3000 m.a.s.l.). The minimum temperature is ranged from 6°C to10°C (FAO, 1980).
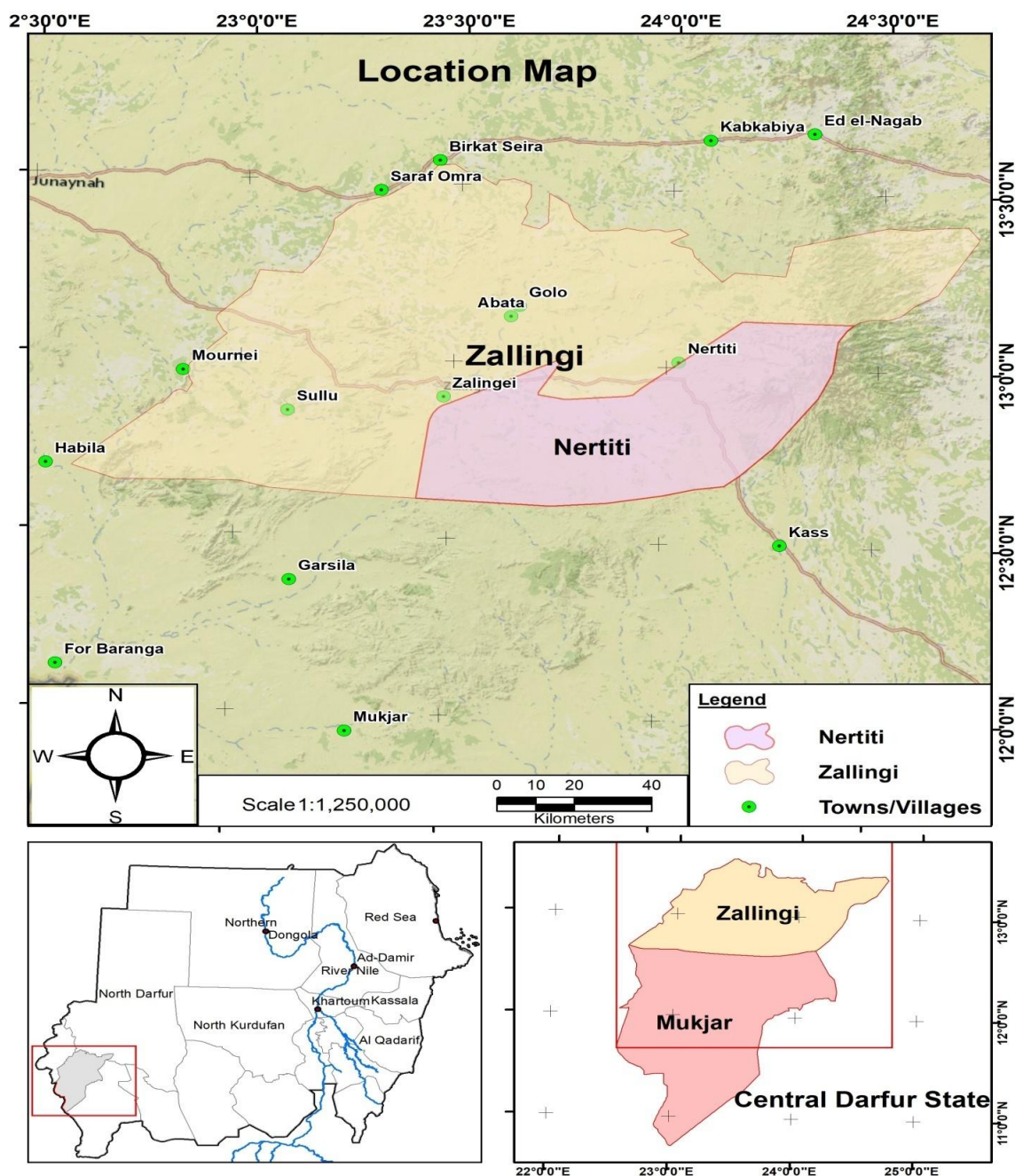
Fig. 1. Central Darfur State Map in Republic of Sudan

Measurement of botanical composition

The loop method (Parker and Harris, 1959) was used to measure botanical composition of the range herbaceous vegetation. Plant composition (%) was calculated as follows:

$$\text{Plant composition \%} = \frac{\text{Total hits of plant}}{\text{Total number of all hits}} \times 100$$

Diet selection by grazing goats

Diet botanical composition was estimated using the bite-count technique (Van Dyne, 1968). The northern side was selected for studying this particular parameter. An area of one km^2 was used to study diet

selection. Five goats were followed by observers for three days and each goat was followed for 25 minutes daily; eventually, all bites counted were recorded for each animal.

Relative preference index (RPI)

RPI was used to classify herbaceous plants according to their preference and it was obtained from the following equation:

$$RPI\% \ \% = \frac{plant\ species\ in\ diet\ (\%)}{plant\ species\ botanical\ composition\ in\ the\ range\ (\%)} \times 100$$

The range plants were classified according to their relative preference index into five forage value categories (NRC, 2003; Abdelkreim and Fadlalla, 2013). In this study, the following indicators were adopted:

PP = Preferred Plant (RPI > 1.25),

DP = Desirable Plant (RPI about 0.70 to 1.0),

UD = Undesirable Plant (RPI < 0.70)

Data analysis

The Statistical analysis was done using Excel software for calculation of the mentioned equations and descriptive statistics. T-Test was used to estimate significance of differences between means of North and South Sites.

Results

Data of ground vegetation cover are presented in Table 1. Significant differences were found in plant cover between the north and south range sites. For the north range site, the plant cover was 83.33% while for the south site, it was 91.22%. These results are in line with Fatur and Fadlalla (2013) who reported that the plant cover in the two range sites formed 81.9% and 87.5%, respectively in North Kordofan State, Sudan. The variations between range sites at Nertiti area in Western Jebel Marra Locality may be due to the topography nature and the north site was rockier than south site. Bare soil, litter and rock results were also shown in Table 1 for both sites. Rocks were significantly higher in the north site compared to the south one (10.11% v 0.22%).

Herbaceous botanical composition for both range sites (north and south) is shown in Table 2. Forbs were considered dominant than grasses at Nertiti area because their compositions were high which reach 82.96 and 78.28 for both sites while grasses compositions were 17.44 and 21.52, respectively. The species with the highest composition were *Spermacoce sp.* (17.1%) and *Corchorus trilocularis* (10.4%) in the north range site while for the south range site, these were *Spermacoce sp.* (15.8%) and *Ipomoea sinensis* (11.2%) (Table 2).

Diet selection by goats according to plant class (forbs, grasses, trees/shrubs) is presented in Table 3. Trees constituted 43.66%, forbs 52.68% and grasses 3.67% of the diet. *Faidherbia albida* is the dominant tree in the diet of goats (18.29%) while *Ipomoea sinensis* is the most selected forb (7.17%) and *Pennisetum pedicellatum* was the most selected grass among grasses (3.53%). This result resamples those achieved by Ashouri *et al.* (2014) who stated that annual broad-leaved forbs such as *Launaea mucronata*, shrubs such as *Sphaerocoma aucheri* and perennial grasses such as *Eremopogon foveolatus* are respectively regarded as the palatable plants for a Tali goat in Iran.

The Relative preference indices of forbs and grasses are presented in Table 4. Only

forbs showed the highest RPI that place them as preferred or desirable plants. The top Relative Preference Indices (RPI) of forbs such as *Abelmoschus esculentus,* *Kohautia aspera*, *Commelina kotschyi*, *Portulaca quadrifida*, *Talinum portulacifolium* and *Setaria acromelaena* were 25.2 7.9, 3.7, 3.68, 3.64 and 3.42.

Table 1. Ground cover percent at Western Jebel Marra Locality

Parameters	Northern site%	Southern site%	Significant differences
Bare soil	5.33	5.67	ns
Litter	1.22	2.89	*
Rock	10.11	0.22	**
Plant	83.33	91.22	*
Total	100%	100%	

Table 2. Botanical composition (%) of herbaceous layer at Western Jebel Marra Locality

Botanical name	Type of plant	Local name	North Site	South Site
Spermacoce sp. DC.	Forb	Mahlab	17.1	15.8
Corchorus trilocularis	Forb	Molokhia	10.4	0.0
Haemanthus multiflorus	Forb	Gesh elfoul	8.0	9.5
Achyranthes aspera	Forb	Abu elrokab	5.2	0.4
Crotalaria saltiana Andr.	Forb	Um tagtaga	5.2	0.6
Senna obtusifolia	Forb	Kawal	4.4	1.0
Xanthium brasilicum vell.	Forb	Rantook	4.4	6.8
Abutilon spp.	Forb	Erig elnar	4.0	0.0
Leucas urticifolia	Forb	Um jallout	3.9	2.1
Ipomoea sinensis (Desr.)	Forb	Hantout	3.2	11.2
Oxygonum atriplicifolium	Forb	lisan elbagar	3.2	8.8
Amaranthus graecizans L.	Forb	Lisan eltiar	2.1	0.0
Crotalaria senegalensis (Pers.)	Forb	Sufera saghira	1.5	1.7
Acanthospermum hispidum	Forb	Horab hawsa	1.3	8.4
Zaleya pentandra	Forb	Rabaa	1.1	0.0
Setaria acromelaena (Hochst)	Forb	Lissagh	0.9	0.1
Portulaca quadrifida L.	Forb	Labab elhimar	0.8	1.5
Talinum portulacifolium	Forb	Einab barry	0.7	0.0
Sida alba	Forb	Um shadida	0.7	0.4
Commelina kotschyi Hassk.	Forb	Ibrig elfaki	0.7	0.9
Kohautia aspera	Forb	Um habiba	0.7	0.5

Euphorbia hirta L.	Forb	Um laban	0.7	0.0
Cucumis dipsaceus Ehrenb.	Forb	Ajur elghazal	0.3	0.1
Allium vineale	Forb	Basal almarfien	0.3	0.0
Boerhavia erecta L.	Forb	Shokal elkhil	0.3	0.0
Polygala erioptera DC.	Forb	Um saboon	0.3	0.0
Abelmoschus esculentus L.	Forb	Bamia barry	0.1	0.2
Farsetia longisiliqua Decne.	Forb	Um adafir	0.1	1.0
Aristolochia bracteolata Lam.	Forb	Um jalajil	0.1	0.0
Indigofera hochstetteri Bak.	Forb	Dahasir sharaya	0.0	0.9
Solanum dubium	Forb	Jibben jibben	0.0	2.2
Sida ovata	Forb	Mokshashat rojal	0.0	0.7
Ocimum basilicum L.	Forb	Raihan	0.0	0.2
Datura stramonium L.	Forb	Sacran	0.0	0.1
Verbascum nubicum	Forb	Saisil	0.0	0.1
Sesbania arabica	Forb	Surieb	0.0	0.2
Cleome gynandra L.	Forb	Tamalika	0.0	1.2
Francoeuria crispa	Forb	Tugur	0.0	1.1
Total forbs			82.96	78.28
Pennisetum pedicellatum	Grass	Um dofofu	8.5	1.1
Digitaria ciliaris (Retz.)	Grass	Shaar elbanat	2.9	2.3
Schoenfeldia gracilis Kunth.	Grass	Danab elnaga	2.7	1.8
Cyperus rotundus L.	Grass	Sieda	1.1	4.6
Brachiaria deflexa	Grass	Um fraw	1.1	0.1
Eragrostis sp. (Koel.)	Grass	Banu	0.7	3.8
Cenchrus ciliaris	Grass	Haskanit naim	0.7	2.6
Chloris virgata Sw.	Grass	Um malih	0.6	0.1
Dactyloctenium aegyptium L.	Grass	Abu asabi	0.4	2.2
Chloris virgata Sw.	Grass	Abu malhi, kormashaib	0.0	2.4
Eragrostis megastachya (Koel.)	Grass	Banu kabir	0.0	0.6
Cynodon dactylon (L.)	Grass	Najila	0.0	0.6
Cymbopogon nervatus	Grass	Nal	0.0	0.4
Total grasses			17.44	21.52
Grand Total			100.4	99.8

Table 3. Diet selection of goats by plant class, Trees, Forbs, and Grasses at Western Jebel Marra Locality

Botanical Name	Type	Local Name	% in Diet
Ipomoea sinensis (Desr.)	Forb	Hantout	7.17
Kohautia aspera	Forb	Um hibayha	5.53
Spermacoce sp. DC.	Forb	Mahlab	4.06
Oxygonum atriplicifolium	Forb	Lisan elbagar	3.81
Haemanthus multiflorus	Forb	Gesh elfoul	3.25
*Setaria acromelaena (*Hochst)	Forb	Lissagh	3.08
Crotalaria senegalensis (Pers.)	Forb	Sufera saghira	3.08
Portulaca quadrifida L.	Forb	Lagab elhimar	2.94
Corchorus trilocularis	Forb	Molokhia	2.62
Commelina kotschyi Hassk.	Forb	Ibrig elfaki	2.59
Abutilon spp.	Forb	Erig elnar	2.8
Talinum portulacifolium	Forb	Einab barry	2.55
Abelmoschus esculentus L.	Forb	Bamia barry	2.52
Achyranthes aspera	Forb	Abu elrokab	1.78
Senna obtusifolia	Forb	Kawal	1.22
Amaranthus graecizans L.	Forb	Lisan eltiar	1.22
Sida alba	Forb	Um shadida	0.74
Leucas urticifolia	Forb	Um jallout	0.70
Acanthospermum hispidum	Forb	Horab hawsa	0.28
Xanthium brasilicum vell.	Forb	Rantook	0.25
Crotalaria saltiana Andr.	Forb	Um tagtaga	0.21
Boerhavia erecta L.	Forb	Shokal elkhil	0.14
Farsetia longisiliqua Decne.	Forb	Um adafir	0.14
Total forbs			52.68
Faidherbia albida	Tree	Haraz	18.29
Ziziphus spina-christi	Tree	Sidir	7.77
Albizia amara.	Tree	Arad	7.66
Acacia nilotica	Tree	Sonot	4.69
Acacia Senegal	Shrub	Hashab	2.48
Grewia tenax.	Shrub	Gidaim	1.50
Calotropis procera	Shrub	Oshar	0.63
Acacia seyal.	Tree	Taleh	0.35
Combretum cordofanum Engler.	Shrub	Habeel	0.18

Diospyros mespiliformis A.DC.	Tree	Joghan	0.07
Ricinus communis	Shrub	Khirwa	0.04
Total trees/shrubs			43.66
Pennisetum pedicellatum	Grass	Um dofofu	3.53
Cenchrus ciliaris	Grass	Haskanit naim	0.07
Digitaria ciliaris (Retz.)	Grass	Shaar elbanat	0.07
Total grasses			3.67
Grand Total			100

Table 4. Relative preference index (RPI) of forbs and grasses selected by goats grazing at Western Jebel Marra Locality

Botanical Name	Type	Local Name	% in Range	% in Diet	RPI	PC
Abelmoschus esculentus L.	Forb	Bamia barry	0.1	2.52	25.2	PP
Kohautia aspera	Forb	Um hibayha	0.7	5.53	7.90	PP
Commelina kotschyi Hassk.	Forb	Ibrig elfaki	0.7	2.59	3.70	PP
Portulaca quadrifida L.	Forb	Lagab elhimar	0.8	2.94	3.68	PP
Talinum portulacifolium	Forb	Einab barry	0.7	2.55	3.64	PP
Setaria acromelaena (Hochst)	Forb	Lissagh	0.9	3.08	3.42	PP
Ipomoea sinensis (Desr.)	Forb	Hantout	3.2	7.17	2.24	PP
Crotalaria senegalensis (Pers.)	Forb	Sufera saghira	1.5	3.08	2.05	PP
Farsetia longisiliqua Decne.	Forb	Um adafir	0.1	0.14	1.40	PP
Oxygonum atriplicifolium	Forb	Lisan elbagar	3.2	3.81	1.19	DP
Sida alba	Forb	Um shadida	0.7	0.74	1.06	DP
Abutilon spp.	Forb	Erig elnar	4	2.80	0.70	DP
Amaranthus graecizans L.	Forb	Lisan eltiar	2.1	1.22	0.58	UP
Boerhavia erecta L.	Forb	Shokal elkhil	0.3	0.14	0.47	UP
Pennisetum pedicellatum	Grass	Um dofofu	8.5	3.53	0.42	UP
Haemanthus multiflorus	Forb	Gesh elfoul	8	3.25	0.41	UP
Achyranthes aspera	Forb	Abu elrokab	5.2	1.78	0.34	UP
Senna obtusifolia	Forb	Kawal	4.4	1.22	0.28	UP
Corchorus trilocularis	Forb	Molokhia	10.4	2.62	0.25	UP
Spermacoce sp. DC.	Forb	Mahlab	17.1	4.06	0.24	UP
Acanthospermum hispidum	Forb	Horab hawsa	1.3	0.28	0.22	UP
Leucas urticifolia	Forb	Um jallout	3.9	0.70	0.18	UP
Cenchrus ciliaris	Grass	Haskanit naim	0.7	0.07	0.10	UP

Xanthium brasilicum Vell.	Forb	Rantook	4.4	0.25	0.06	UP
Crotalaria saltiana Andr.	Forb	Um tagtaga	5.2	0.21	0.04	UP
Digitaria ciliaris (Retz.)	Grass	Shaar elbanat	2.9	0.07	0.02	UP
Cucumis dipsaceus Ehrenb.	Forb	Ajur elghazal	0.3	0.0	0.0	UP
Allium vineale	Forb	Basal almarfien	0.3	0.0	0.0	UP
Zaleya pentandra	Forb	Rabaa	1.1	0.0	0.0	UP
Aristolochia bracteolata Lam.	Forb	Um jalajil	0.1	0.0	0.0	UP
Euphorbia hirta L.	Forb	Um laban	0.7	0.0	0.0	UP
Polygala erioptera DC.	Forb	Um saboon	0.3	0.0	0.0	UP
Dactyloctenium aegyptium L.	Grass	Abu asabi	0.4	0.0	0.0	UP
Eragrostis megastachya (Koel.)	Grass	Banu Abu malih	0.7	0.0	0.0	UP
Schoenfeldia gracilis Kunth.	Grass	Danab elnaga	2.7	0.0	0.0	UP
Cyperus rotundus L.	Grass	Sieda	1.1	0.0	0.0	UP
Brachiaria deflexa	Grass	Um fraw	1.1	0.0	0.0	UP
Chloris virgata Sw.	Grass	Um malih	0.6	0.0	0.0	UP
Total			100.4	56.35		

PC= Plant Classification,
RPI= Relative Preference Index,
PP= Preferred Plant (RPI> 1.25),

Discussion

Botanical compositions (%) of herbaceous layer at Western Jebel Marra Locality for forbs and grasses were 80.62 and 19.48%, respectively. These compositions interpret that the forbs are dominant in rangeland, so this finding is in line with those stated by Askarizadeh and Heshmati *et al*. (2011) who reported that comparison of plant combination percent in the study area has shown that in the first record duration, maximum plant combination was grasses and forbs (27.27%), shrubs (26.5%) and minimum amount was annual forbs (2.09%). In the second record period, the obtained values were for shrubs (48.45%) and bushy trees (21.64%), and annual forbs (1.45%), respectively. On the other hand, the study revealed that the goats selected more forbs (52.68 %) compared to shrubs/trees (43.66%) and grasses (3.67%) (Table 3). These results are in agreement with Fatur and Fadlalla (2013) who reported that at seed setting stage in a protected rangeland site, the diet of goats contained 51.5% forbs, 44.2% browse and 4.3% grasses. Regarding individual species, our findings revealed that *Faidherbia albida*, *Ziziphus spina-christi*, *Albizia amara*, *Ipomoea sinensis Desr, Kohautia aspera* and *Pennisetum pedicellatum* recorded the highest diet selection percent (18.29, 7.77, 7.66, 7.17, 5.53 and 3.53, respectively). This shows that these tree species were favored by goats even more than other individual forb and grass species. These results agree with Holechek *et al*. (2004) who stated that the browse is an important forage source for goats throughout the year and for sheep during the dry period when herbage was limited. Also, it is in line with (Askarizadeh and Heshmati *et al*., 2011) who reported that the taken bites by sheep

and goats have shown that both of them preferred the composed diet in grazing duration. Although based upon diet selection of sheep in the first and second record periods, it has been cleared that perennial forbs were daily the most part of its diet, presence of this vegetation form in sheep diet selection was not the cause of its preference. Goats, however, have highly preferred forbs in the first record period, but in the second stage, they preferred to brows the shrubs and bushy tree. *Abelmoschus esculentus, Kohautia aspera* had the highest RPI showing 25.2 and 7.9, respectively. These results resemble those of Abdelkreim and Fadlalla (2013) who found that in open rangelands, plants with the highest RPI were mainly forbs (*Desmodium* spp. RPI=15.9; *Ipomea eriocarpa* RPI=15.7 and *Echinochloa colonum* RPI=5.1. This reflects that goats preferred forbs more than grasses.

Conclusion

This study concluded that grazing goats preferred forbs more than trees/shrubs and grasses. Trees most selected by goats were *Faidherbia albida*, and *Ziziphus spina-christi.* On the other hand, forbs mostly selected were *Ipomoea sinensis, Kohautia aspera* and *Haemanthus multiflorus,* while the grass most selected was *Pennisetum pedicellatum.* The forbs reported earlier are recommended for rehabilitation programs at Western Jebel Marra Locality, Central Darfur State, Sudan.

Acknowledgment

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گیاهان مرتعی دارای ارجحیت چرا توسط بز در محل جبل مارا غربی، دولت مرکزی دارفو، سودان

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چکیده. این مطالعه در سال ۲۰۱۶ به منظور تعیین اولویت چرای گیاهان توسط بز در دولت مرکزی دارفور، سودان انجام شد. هدف شناسایی گیاهان مطلوب جهت کمک در بازسازی محدوده مراتع بود. از پنج بز ماده بالغ برای تعیین انتخاب رژیم غذایی با استفاده از تکنیک شمارش گاز گرفتن، استفاده شد. تعداد کل گزش‌ها از هر گونه گیاهی ثبت شد و شاخص‌های ترجیحی و رژیم غذایی انتخاب شده محاسبه شد. یافته‌ها نشان داد که فورب‌ها ۵۲/۶٪ و پس از آن درختان و درختچه‌ها ۴۳/۶٪ و سپس گراس‌ها به میزان ۳/۶٪ از رژیم غذایی بزها را تشکیل می‌دهند. در میان فورب‌ها *Ipomoea sinensis، Kohautia aspera* و *Haemanthus multiflorus* به ترتیب بیشترین میزان انتخاب را با میانگین ۷/۱۷٪، ۵/۵۳٪ و ۴/۰۶٪ داشتند. *Faidherbi albida، Ziziphus spina-christi* و *Albizia amara* به ترتیب بیشترین انتخاب را با میانگین ۱۸/۲۹٪، ۷/۷۷٪ و ۷/۶۶٪ در میان درختان داشتند. بیشترین گونه علفی که در رژیم غذایی بزها ظاهر شدند *Pennisetum pedicellatum* (۳/۵۳٪) بود. در این مطالعه فورب‌ها دارای شاخص ترجیحی نسبی بالاتری نسبت به گراس‌ها بودند. مقادیر بالاتر شاخص ترجیحی نسبی(RPI) در فورب‌ها به ترتیب *Abelmoschus esculentus، Kohautia aspera، Commelina kotschyi، Portulaca quadrifida، Talinum portulacifolium* و *Setaria acromelaena* به میزان ۲۵/۲، ۷/۹، ۳/۷، ۳/۶۸، ۳/۶۴ و ۳/۴۳ بود. گیاهان با RPI بالاتر برای مراتع نیاز به اصلاح مجدد پیشنهاد شدند. این یافته‌ها می‌تواند به عنوان مبنایی برای یک سیستم مدیریت آگاه در منطقه مورد مطالعه قرار گیرد که در توسعه راهبردهای مدیریت پایدار ارزشمند خواهد بود.

واژگان کلیدی: شمارش گاز گرفتن، ترکیب گیاه شناسی، شاخص ترجیحی نسبی