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Assessing Relationship between Abundance and some vegetation attributes of savannah Rangeland at Elsuki area, Sinnar State, Sudan

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Abstract

The current study was conducted at Elsuki area, Sinnar state, Sudan with two consecutive seasons of 2011 and 2012. The study aim of this was assessment of abundance, density, and frequency of vegetation at savannah rangeland in Elsuki area, Sinnar State, Sudan. Five major transects were taken, each transect 3000m length and 10m width, their total area of the study is 150.000m2 which it is about 10% of the total area. Abundance, density, and frequency of vegetation were assessed. In this study the abundance, density and frequency of vegetation were grouped into three categories were high, Middle, and low. The results indicated that the variation in the abundance between the five transects as the result of variable transects. The species of highest composition was *Commelina amplexicaulis* and *Pennistum purpureum* (118.4, 36.5) while species of *Merremia emarginated,* and *Cucumis spp* had middle and lowest percent (8.5, 2) for the seasons 2012 and 2013 respectively. *Commelina amplexcaulis* and *Sporobolus pyramidatus* had a highly density. *Acalypha indica* had a highly frequency percentage shared with *Commelina amplexicaulisin* and *Commelina kotschyi* .The study concluded that unwise utilization and exploitation of the rangelands particularly by man causes range deterioration and serious reduction in range production in both quantity and quality.

Key words: vegetation, Abundance, Density, Frequency, Transects, Savannah, Rangeland

Introduction

Savannah vegetation, particularly in developing countries, is largely exploited through livestock grazing (Scholes and Archer, 1997; Bilotta al., 2007) and the intensity of grazing influences the defoliation rate and sustainability of the ecosystem (Mphinyaneet al., 2008). Most grasses in savannas are fairly tolerant to grazing, but prolonged high grazing intensities will eventually lead to change in species composition (Skarpe, 1992) and reduction in

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grass biomass especially when soil resources are depleted (van Auken, 2009). Bush encroachment is an indicator of environmental degradation (van Vegten, 1984; van Auken, 2009) and is a concern in many parts of Africa and elsewhere in the world (Moleele and Perkins, 1998; Roques et al., 2001; Moleele et al., 2002; Angassa and Oba, 2008a; sankaran, 2009).The general relationships between abundance and distribution developed here eventually should contribute to our understanding of the biogeography, population genetics, and evolution of species as well as the ecological attributes of populations and communities (James, 1984).The spatial configuration of species' abundance has been a topic of discussion in ecology for a century (Gaston 2003). On several occasions, the fact that abundance peaks at the centre of the geographic ranges has been reported and has even been accepted as rule of thumb (Sagarin and Gaines 2002).The aim of this paper is to assess the relationship between Abundance ,density and frequency of vegetation attributes at savannah Rangeland in Elsuki area, Sinnar State, Sudan.

Material and methods

Study Area:

The study was conducted at Elsuki area about 50 km south of Sinnar town at the eastern bank of the Blue Nile under rain fed condition, (Latitude 12º.5′-14º.7′ N and longitude 32º.53′-35º.58′ E). The total area of the state is about 40860 kms². The population is about 1,144,755 distributed within three localities, Sinnar, Dindir, and Singa with the following ratios, 40.2 %, 32.2 %, and 27.6 % respectively. The rangeland represents about 40 % of the total area of the state. This area includes enclosures, valleys, banks of the Blue Nile, Rahad and Dindir rivers in addition to rangelands around mountains and forests. The main pastoral tribes are: Kenana, Lahawein, Nefadia, Arakein, Agalein, Falata, Ambararo, Ruffaa and others, (Abdelaziz, 2010).

Vegetation Measurements:

Five major transects were carried out which were:

Transect 1: North East Abu Teaga(KhourTaweel) from point (N:12.80404 E: 34.22265) to point (N:12.77917 E: 34.22678).

Transect 2: East Um Gorad, from point (N:12.72235 E: 34.17759) to point (N: 12.72832 E: 34.15311).

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Transect 3: North Bonzoga, from point (N: 12.52396 E: 34.16587) to point (N: 12.54356 E: 34.17983).

Transect 4: North West Jabal Abu Kardous, from point (N: 1257799 E: 34.33834) to point (N: 12.59078 E: 34.31731).

Transect 5: North Abu Oshar, from point (N: 12.45194 E: 34.27264) to point (N: 12. 47048 E: 34.26082).

After every 200m within the total length 3km of any transect we used quadrate and belt or line transects to collect data for total plant cover (T.P.C), Bare soil cover (B.S.C), litters of plants (L.P), biomass and state of species growth were recorded.

For all the five transects a total of 75 quadrates were sampled to represent all of the area.

The plant composition was measured along each 100m transect usingloop. The ¾″ inch loop (Parker, 1951) used to measure vegetation every one meter along the 100 meter transects. Hits on species composition, litter, and bare soil were recorded. Resulting information listed on record sheet.

Determination of Abundance (A):

This was determined as follows:

$$A = \frac{\text{Total number of individuals}}{\text{Number of occupied quadrats}}$$

Determination of Density (D):

This is the number of individuals per unit area, and determined as follows:

$$D = \frac{\text{Total number of individuals}}{}$$

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Total number of quadrats

Determination of Frequency (F):

This is calculated as follows:

$$F = \frac{\text{Number of occupied quadrats} \times 100}{\text{Total number of quadrats}}$$

In this study the abundance, density and frequency of vegetation were grouped into three categories were high, Middle, and low. Vegetation group for distinguish between size, dominants, and numbers of vegetation attributes.

Results and discussion

Herbs Abundance:

In season 2011 *Commelina amplexicaulis*had a high abundance in Transect 1and4,while *Pennistumpurpureum,Sporoboluspyramidatus*and *Cassia occidentalis*had a high abundance in Transect 2, 3 and 5 respectively(Table 1).

Middle abundances were recorded for *Merremiaemarginata*in Transect 1 and 5, *Rhynchosia memnonia*in Transect 2 and Transect 4,*Crotalaria senegalensis*in Transect 3 (Table 2). While low abundances were recorded for *Cucumismelo*in Transect 1, *Ipomoea cordofana* in Transect 2,*Helieotroium sudanicum*in Transect 3, *Boerhavia erecta* in line4 and *Cuscutahyalnia* in Transect 5(Table 2).

Inseason 2012 *Justiciapalustris* had a highly abundance in Transect 1, while*Commelinaamplexicaulis, Sporoboluspyramidatus,Commelinakotschyi*and*Cassia occidentalis* had a highly abundance in Transects 2, 3 ,4and 5 respectively(Table 3).

Medium abundances were recorded for *Commelinakotschyi* in Transect 1 and 3 *Cenchrusechinatus* in Transect 2 *Cassia occidentalis* in Transect 4 and *Merremiaemarginata* in Transect 5 (Table 3). While low abundances were recorded for*Indogofirapilosa*in Transect 1,

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Acalypheindica in Transect 2, *Oxygonumatriplicifolium* in line3, *Cenchrusechinatus* in Transect 4 and *Clitoria ternate* in Transect 5.

The change in the abundance between the two seasons in all transects except transect 3 and 5 may be due to both abiological factors, e.g. climate change or herbivory interspecific competition.

Abdelaziz A.A 2010 reported that, the native vegetation is a complex mixture of grasses, herbs and woody species. Dominant annual grasses are: *Echinochloacolona, Cymbopogonnervatus.* The dominant forbs are*: Ipomea spp and Ocimumbacilicum.*

The change in the abundance of a plant species may be due to both abiotic factors, e.g. climate change and biotic factors, e.g. herbivory or interspecific competitionas Van der Valk and Arnold (2011) found.

Table (1): Herbs Abundance for season 2011

Species	**TR1**	**TR 2**	**TR 3**	**TR4**	**TR 5**
	High				
Commelina amplexicaulis	**48.1**	27.6	16	**118.4**	20.5
Pennistum purpureum	1	**36.5**	8.4	0	4
Sporobolus pyramidatus	0	0	**78.1**	1	19.8
Cassia occidentalis	0	6	7.4	2	**35.3**
Mid					
Merremia emarginata	**8.5**	2.1	4	2	**4.2**
Rhynchosia memnonia	4.3	**5.8**	6	**5.4**	3.5
Crotalaria senegalensis	7.1	3.1	**8**	2	5.8
Low					
Cucumis spp	**1**	2	0	0	0
Ipomoea cordofana	0	**1**	0	2	1
Helieotroium sudanicum	1	1.8	**1**	0	0

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Boerhavia erecta	0	0	0	**1**	0
Cuscuta hyalnia	0	0	0	0	**1**

Table (2): Herbs Abundance for season 2012

Species	**TR1**	**TR 2**	**TR 3**	**TR 4**	**TR 5**
	High				
Justicia palustris	**35.9**	9.5	2	11.5	0
Commelina amplexicaulis	19.6	**35.3**	14.3	6.5	11.2
Sporobolus pyramidatus	0	0	**32.3**	0	0
Commelina kotschyi	5	14.3	5.8	**22.8**	6.5
Cassia occidentalis	0	1	2	3.2	**21.3**
Mid					
Commelina kotschyi	**5**	14.3	**5.8**	22.8	6.5
Cenchrus echinatus	1	**8.8**	16	0	4.5
Cassia occidentalis	0	1	2	**3.2**	21.3
Merremia emarginata	4	2	2	0	**2.2**
Low					
Indogofira pilosa	**1**	0	0	1	2
Acalypha indica	0	**2**	1	0	0
Oxygonum atriplicifolium	0	0	**6**	0	0

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Cenchrus echinatus	0	0	0	**1**	0
Clitoria ternate	0	0	0	0	**1**

Herbs Density:

In season 2011*Commelina amplexcaulis* had a highly density percentage in Transects 1, 2 and 4. *Sporobolus pyramidatus* had a highly density percentage in Transect 3, while *Cassia occidentalis* had a highly density percentage in Transect 5 (Table 8).

Medum density percentage was recorded for *Chloris virgate* in Transect 1, *Sorghum arundinaceum* in Transect 2, *Dactyloctenium aegyptium* in Transect 3, *Commelina kotschyi* in Transects 4 and 5, while the lowest density percentage was recorded for *Euphorbia acalyphoides* in Transect1, *Aristolochia bracteolate* in Transect 2, *Thunbergia annua* in Transect 3, *Boerhavia erecta* in Transect 4 and *Cuscuta hyalnia* in Transect 5 (Table 3).

In season 2012 *Justicia palustris* was highly density in Transect 1, while *Commelina amplexcaulis* was highly density in Transects 2 and 5. In Transect 3 *Sporobolus pyramidatus* was highly density, while *Commelina kotschyi* was highly density in Transect 4 (Table 4).

Medium density percentage was recorded for *Srtiga hermothica* in Transect 1, *Cenchrus echinatus* in Transect 2, *Dactyloctenium aegyptium* in Transect 3, *Rhynchosia memnonia* in Transect 4 and *Merremia emarginata* in Transect 5, while the lowest density percentage was recorded for *Ipomoea cordofana* in Transect 1, *Cucumis melo* in Transects 2 and 3, *Cenchrus echinatus* in Transect 4 and *Clitoria ternate* in Transect 5 (Table 4).

Keddy, Paul A. (2001) said that, in many cases (perhaps most) the negative effects upon neighbours arise from competition for light, with larger plants shading smaller plants. In other cases, there may be competition below ground for water, nitrogen, or phosphorus.

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Table (3): Herbs Density for season 2011

Species	TR1	TR 2	TR 3	TR 4	TR 5
	High				
Commelina amplexicaulis	**30.51**	**19.97**	2.62	**69.84**	13.02
Sporobolus pyramidatus	0.00	0.00	**63.96**	0.05	15.71
Cassia occidentalis	0.00	0.48	4.83	0.09	**16.83**
Mid					
Chloris virgate	**7.61**	0.97	1.31	0.00	1.90
Sorghum arundinaceum	4.84	**8.53**	0.00	0.00	0.63
Dactyloctenium aegyptium	0.00	0.00	**5.00**	0.00	2.38
Commelina kotschyi	2.31	6.04	0.25	**11.29**	**8.41**
Low					
Euphorbia acalyphoides	**0.06**	0.00	0.00	0.00	0.00
Aristolochia bracteolate	0.00	**0.08**	0.00	0.00	0.00
Thunbergia annua	0.00	0.24	**0.08**	0.14	1.27
Boerhavia erecta	0.00	0.00	0.00	**0.05**	0.00
Cuscuta hyalnia	0.00	0.00	0.00	0.00	**0.16**

Table (4): Herbs Density for season 2012

Species	TR 1	TR 2	TR 3	TR 4	TR 5
	High				

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Justicia palustris	**46.7**	26.7	6.7	73.3	0
Chloris virgate	33.3	**46.7**	13.3	13.3	13.3
Cassia occidentalis	0	13.3	**60**	33.3	**46.7**
Brachairiae ruciformis	6.7	26.7	6.7	**80**	26.7
Mid					
Cenchruse chinatus	**20**	26.7	6.7	0	13.3
Phyllonthus niruri	0	**13.3**	6.7	0	20
Echinochloa colonum	0	6.7	**13.3**	0	0
Corchorus depressus	0	0	6.7	**20**	0
Cuscuta hyalnia	0	6.7	6.7	0	**13.3**
Low					
Withania somnifra	**6.7**	0	0	0	0
Cyperus rotundus	0	**6.7**	13.3	0	0
Trianthem aportulacastum	0	0	**6.7**	0	0
Cenchruse chinatus	0	0	0	**6.7**	0
Digera muricata	0	0	0	0	**6.7**

Herbs Frequency%:

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In season 2011, *Acalypheindica*had a highly frequency percentage in Transects 1, 2 and 4, sharedwith*Commelinaamplexicaulis*in Transect 2 and with *Commelinakotschyi* in Transects2 and 4 in frequency percentage, where *Sporobolus pyramidatus* had a highly frequency in Transect3 and 5 respectively and shared with *Crotalaria senegalensis, Commelinakotschyi,* in Transect 5 (Table 5).

Medium frequency percentage were recorded for *Chloris virgate* in Transects 1, *Cenchrusechinatus* in Transects 2, *Sesbania Arabica* in Transects 3, *Panicumrepenslinn* in Transects 4 and*Cassia occidentalis* in Transects 5, While *Corchorus depressus*was recorded as lower frequency percentages in all Transects s (Table 4).

In season 2012,*Justiciapalustris*had a high frequency percentage in Transects 1, while*Chloris virgate* had a highlyone in Transects 2, while *Cassia occidentalis* had a highly frequency in Transects 3 and Transects 5. In Transects 4 *Brachairiaeruciformis*had a highly frequency percentage (Table 6).

Medium frequency percentage were recorded for *Cenchrusechinatus*in Transect1, *Phyllonthusniruri* in Transects 2, *Echinochloacolonum* in Transects 3, *Corchorus depressus* in Transects 4 and *Digeramuricata* in Transects 5. *Withaniasomnifra* in Transects 1, *Cyperusrotundus* in Transects 2, *Trianthemaportulacastum* in line3, *Cenchrusechinatus* in line4 and *Digeramuricata* in Transect5 were recorded as lower frequencies percentages (Table 5).

As Odum, 1971 found, many of the plant species that were reported to occur in the area were disappeared from the study area. This is attributed to retrogression and harsh climate condition of the past hundred years or near.

Table (5): Herbs Frequency (F) %for season 2011

Species	TR 1	TR 2	TR 3	TR 4	TR 5

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	High				
Acalypha indica	**93.3**	**60**	6.7	**93.3**	6.7
Commelina amplexicaulis	73.3	**60**	6.7	86.7	26.7
Sporobolus pyramidatus	0	0	**66.7**	6.7	**33.3**
Commelina kotschyi	40	**60**	6.7	**93.3**	**33.3**
Crotalaria senegalensis	53.3	46.7	6.7	33.3	**33.3**
Mid					
Chloris virgate	**40**	13.3	6.7	0	13.3
Cenchrus echinatus	13.3	**26.7**	6.7	0	0
Sesbania Arabica	0	20	**20**	0	0
Panicum repenslinn	20	20	0	**13.3**	0
Cassia occidentalis	0	6.7	53.3	6.7	**20**
Low					
Solanum dubium	**6.7**	0	0	**6.7**	**6.7**
Aristolochia bracteolate	0	**6.7**	0	0	0
Corchorus depressus	**6.7**	**6.7**	**6.7**	0	**6.7**
Euphorbia aegyptiaca	13.3	0	0	**6.7**	0
Cuscuta hyalnia	0	0	0	0	**6.7**

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Table (6): Herbs Frequency (F) % for season 2012

Species	TR 1	TR 2	TR 3	TR 4	TR 5
	High				
Justicia palustris	**46.7**	26.7	6.7	73.3	0
Chloris virgate	33.3	**46.7**	13.3	13.3	13.3
Cassia occidentalis	0	13.3	**60**	33.3	**46.7**
Brachairia eruciformis	6.7	26.7	6.7	**80**	26.7
Mid					
Cenchrus echinatus	**20**	26.7	6.7	0	13.3
Phyllonthusniruri	0	**13.3**	6.7	0	20
Echinochlo acolonum	0	6.7	**13.3**	0	0
Corchorus depressus	0	0	6.7	**20**	0
Cuscuta hyalnia	0	6.7	6.7	0	**13.3**
Low					

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Withania somnifra	**6.7**	0	0	0	0
Cyperus rotundus	0	**6.7**	13.3	0	0
Trianthema portulacastum	0	0	**6.7**	0	0
Cenchrus echinatus	0	0	0	**6.7**	0
Digera muricata	0	0	0	0	**6.7**

Conclusion

Our assessment for abundance of vegetation species on study area is related to some ecological and distribution characteristics. There appears to be a general relationship between abundance and other vegetation attributes in term of density and frequency. The common plants species were *Commelina amplexicaulis, Justicia palustris, Commelina kotschyi* and *Sporobolus pyramidatus*. It was that had variation between transacts. The relationships between abundance, density and frequency of vegetation should contribute to our understanding of the vegetation condition, vegetation interaction, and evolution of species as well as the ecological attributes of populations and communities. It was concluded that vegetation of rangelands in savannah environments contributes to increased productivity and protects the land from degradation. The findings may provide an informed basis for a rangelands management system for pastoralists.

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