Study on vegetation diversity at savannah Rangeland in Elsuki area, Sinnar State, Sudan

Part -1 (Environmental Science)
Chapter-II
May/Vol.1.0/Issue-I

Abstract: This study was conducted in at Elsuki area, Sinnar State, Sudan with the objective of studying the vegetation diversity at savannah rangeland in the 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. Vegetation diversity indices was assessed and calculated. In this study diversity indices of vegetation was grouped into three categories were high, Middle, and low. The results indicated that the variation in the diversity indices between the five transects as the result of variable transects. The species of highest diversity indices were Phyllonthus niruri and Cucumis melo while species of Acnthespermum hispidum, and Sporobolus pyramidatus had middle and lowest percent for the seasons 2012 and 2013 respectively. Acacia mellifra and Sporobolus pyramidatus had a highly shrubs diversity indices. 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: Diversity Indices, Herbaceous, Tree, Shrub, Transects, Savannah.

ISSN CODE : 2456-1045 (Online)
(ICV-Env. Sc/Impact Value): 1.62
(GIF) Impact Factor : 1.002

Journal Code : ARJMD/EVS/V-1.0/I-1/May-2016
website : www.journalresearchijf.com
Received : 20.03.2016
Accepted : 12.04.2016
Date of Publication :31.05.2016
Page: 10-13

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Introduction

The rangelands are often heavily grazed to allow the herbaceous vegetation diversity to recover (e.g., Aronson et al 1993; Asefa et al 2003; Mengistu et al 2005; Abebe et al 2006). The potential impact of global biodiversity loss due to climate change had accelerated the efforts to investigate the relationship between diversity and ecosystem properties and processes such as productivity, nutrient cycling, and resilience to disturbance (Walker 1995; Chapin et al. 1998; Peterson et al. 1998; Lavorel 1999; Loreau et al. 2001). Changes in range quality in terms of loss of vegetation diversity and cover have continued to attract research in the African communal rangelands (Vetter et al. 2006).The current study aims to investigate vegetation diversity 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, (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).

Sampling: Five major transects were taken, each of 3000m length, 10m width for trees and shrubs, for herbs one quadrate taken each 200m within a total area of 150.000m2. Sampling precision was obtained by long narrow rectangles crossing contour lines, according to Barmann (1953).

Diversity Indices: When ecologists talk of high diversity, they often mean a community containing a large number of different species. However, Anne E. Magurran (1988) states that most methods for measuring diversity actually consist of true components (species richness and relative abundance). The index used for measuring diversity is the index of Simpson's (1949). It is calculated as follows:

$$SiD = \frac{N(N-1)}{\sum n(n-1)}$$

Where:

SiD = Simpson's Index of diversity.

N = Total number of individuals.

n = Number of individuals of each species.

Σ = Sum of.

Results and Discussion

Herbaceous Diversity Indices (SiD): In table 1, depending on the index of Simpson's, in season 2011 Phyllonthus niruri had a highly diversity in Transect 1, while Cucumis melo in Transect 2. In Transect 3 Acnthespermum hispidum was a highly diversity, while Merremia emarginata was a highly diversity in Transect 4. In l Transect 5 Tribuluster restris was a highly diversity.

Medium diversity was recorded for Cucumis melo in Transect 1, Thunbergia annua in Transect 2 and 4, Commelina kotschyi in Transect 3 and Justicia palustris in Transect 5. The lowest diversity was recorded for Commelina amplexicaulis in Transects1, 2, and 4. In Transect 3 Sporobolus pyramidatus was recorded lower diversity, where Cassia occidentalis had a lower one in Transect 5 (Table 1).

Table (1): Herbaceous Diversity Indices (SiD) for season 2011

Species	TR 1	TR 2	TR 3	TR 4	TR 5
High					
Phyllonthus niruri	**1502511**	128443.5	0	0	0
Cucumis melo	250418.	**770661**	0	0	0
Acnthespermum hispidum	0	8468.802	**744810**	404985	0
Merremia emarginata	351.22	5666.63	26600.3	**2429910**	943.5
Tribuluster restris	0	0	1601.74	0	**198135**
Mid					
Cucumis melo	**250418.**	770661	0	0	0
Thunbergia annua	0	**256887**	0	**809970**	7076.25
Commelina kotschyi	1926.29	277.72	**248270**	78.69	143.79
Justiciapalustris	33.73	35.46	8184.73	2690.93	**66045**
Low					
Commelina amplexicaulis	**10.76**	**25.16**	1501.63	**2.05**	59.66
Sporobolus pyramidatus	0	0	**2.45**	0	40.84
Cassia occidentalis	0	51377.4	435.31	2429910	**35.60**

In season 2012 Sida alba was highly diversity in Transect 1, while Phyllanthus madraspatensis in Transect 2 was very diverted. Phyllonthus niruri was a highly diversity in Transect 3, while Acnthespermum hispidum was a highly diversity in Transect 4. In Transect 5 Rhynchosia memnonia was a highly diversity (Table 2).Medium diversity was recorded for Cenchruse chinatus in Transect 1, Rottobeolla cochinchinensis in Transect 2, Cymbopogon nervatus in Transect 3, Ipomoea cordofana in Transect 4 and Chloris virgate in Transect 5. Justiciapalustris was recorded lowest diversity in Transects1 and 4. In Transect 2 Commelina amplexicaulis was recorded lower diversity, Sporobolus pyramidatus in Transect 3, Cassia occidentalis had a lower one in Transect 5 (Table 2).

Table (2): Herbaceous Diversity Indices (SiD) for season 2012

Species	TR 1	TR 2	TR 3	TR 4	TR 5
High					
Sida alba	**179700**	5550.12	26838	0	0
Phyllanthus madraspatensis	0	**155403**	0	3103.47	0
Phyllonthus niruri	0	51801	**161028**	0	11501
Acnthespermum hispidum	59900	7400.14	161028	**139656**	11501
Rhynchosia memnonia	3993.33	1707.73	4473	604.57	**69006**
Mid					
Cenchruse chinatus	**59900**	261.18	1341.9	0	1916.83
Rottobeolla cochinchinensis	6417.86	**51801**	0	0	0
Cymbopogon nervatus	0	0	**53676**	552	1254.66
Ipomoea cordofana	0	0	0	**46552**	69006
Chloris virgate	1711.43	478.16	16102.8	912.78	**23002**
Low					
Justicia palustris	**5.73**	221.07	161028	**17.73**	0
Commelina amplexicaulis	37.81	**27.93**	178.33	1790.46	44.81
Sporobolus pyramidatus	0	0	**4.86**	0	0
Cassia occidentalis	0	155403	1052.47	1163.8	**6.26**

Vander Valk and Arnold (2011) found that, the diversity of plant life is an essential underpinning of most of our terrestrial ecosystems. In season 2011 Combretum hartimanniam, Acacia mellifra, and Capparis decidua were highly shrubs in term of diversity indices.Medium diversity indices was recorded for Acacia mellifra. Acacia oreofota was recorded lowest diversity indices, (Table 3).

Table (3): Shrubs Diversity Indices (SiD) for season 2011

Species	TR 1		TR 2		TR 3		TR 4		TR 5	
	NO.	SiD	NO.	SiD	NO.	SiD	NO.	SiD	NO.	SiD
Acacia oreofota	345	1.18	411	1.32	401	1.07	47	9.13	552	1.01
Acacia mellifra	25	232.50	51	87.55	2	85491.00	45	9.97	2	154290.00
Combretum	4	11625.17	1	0.00	0.00	0.00	47	9.13	1	0.00
Capparis decidua	0.00	0.00	2	111628.00	7	4071.00	0.00	0.00	1	0.00
Cadaba forinosa	0.00	0.00	8	3986.71	0.00	0.00	1	0.00	0.00	0.00
Grewia texrinax	0.00	0.00	0.00	0.00	4	14248.50	0.00	0.00	0.00	0.00
Calotropis procera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aerva jovanica	0.00	0.00	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00

Result in (Table 4) showed Shrubs Diversity Indices (SiD) for season 2012. Sterospermum kunthiamum, Capparis decidua and Acacia mellifra, were highly shrub diversity indices respectively .Medium diversity indices was recorded for Acacia mellifra. Acacia oreofota was recorded lowest diversity indices. Acacia mellifra. Acacia oreofota were recorded medium and lower diversity indices for the two seasons 2011 and 2012.

Table (4): Shrubs Diversity Indices (SiD) for season 2012

Species	TR 1		TR 2		TR 3		TR 4		TR 5	
	NO.	SiD	NO.	SiD	NO.	SiD	NO.	SiD	NO.	SiD
Acacia oreofota	24.00	1.91	247.00	1.21	502.00	1.11	55.00	6.84	210.00	1.06
Acacia mellifra	7.00	25.14	23.00	145.68	15.00	1325.03	70.00	4.20	0.00	0.00
Combretum aculeatum	0.00	0.00	0.00	0.00	0.00	0.00	18.00	66.36	0.00	0.00
Capparis decidua	2.00	528.00	1.00	0.00	4.00	23188.00	0.00	0.00	0.00	0.00
Cadaba forinosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grewia texrinax	0.00	0.00	1.00	0.00	6.00	9275.20	0.00	0.00	0.00	0.00
Calotropis procera	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
Aerva jovanica	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sterospermum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	1548.00
Acacia oreofota	24.00	1.91	247.00	1.21	502.00	1.11	55.00	6.84	210.00	1.06

Result in (Table 5) shown trees diversity indices (SiD) for season 201I. Dichrostachys glumerata Acacia seyal, and Blaanites aegyptica were highly diversity indices. Medium diversity indices was recorded for Combretum aculeatum. Acacia oreofota was recorded lowest diversity indices.

Table (5): Trees Diversity Indices (SiD) for season 2011

In season 2012 Ziziphus spina chiristi , Acacia seyal, and Acacia Senegal were highly tree diversity indices. Medium diversity indices were recorded for Balanites aegyptica. Hyphaene thebaica was recorded lowest diversity indices for trees (Table 6).

Table (6): Trees Diversity Indices (SiD) for season 2012

Species	TR 1		TR 2		TR 3		TR 4		TR 5	
	NO.	SiD	NO.	SiD	NO.	SiD	NO.	SiD	NO.	SiD
Acacia seyal	117	1.43	12	423.73	2	3655.00	166	32.29	0.00	0.00
Ziziphus spina chiristi	9	270.28	12	423.73	0.00	0.00	16	3685.58	1	0.00
Acacia Senegal	11	176.91	12	423.73	10	81.22	639	2.17	0.00	0.00
Dichrostachys	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balanites aegyptica	3	3243.33	14	307.32	65	1.76	110	73.77	123	1.15
Acacia nilotica	0.00	0.00	187	1.61	5	365.50	0.00	0.00	0.00	0.00
Sterculia setigera	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00	0.00
Acacia polyacontha	0.00	0.00	0.00	0.00	0.00	0.00	2	442270.00	4	1441.00
Adansonia digitata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anogeissus leiocarpus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hyphaene thebaica	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00	0.00
Acacia fistula	0.00	0.00	0.00	0.00	0.00	0.00	4	73711.67	4	1441.00
Delbergia melanoxylon	0.00	0.00	0.00	0.00	0.00	0.00	3	147423.33	0.00	0.00

Conclusion

The present study investigated vegetation diversity at savannah Rangeland. The finding reveals that Herbaceous, shrubs, and tress increased in term of diversity indices. The highest plant diversity indices were Phyllonthus niruri ,Phyllanthus madraspatensis , Acacia mellifra , Balanites aegyptica and Acacia seyal. It was concluded that vegetation of rangelands in savannah environments contributes to increased diversity and protects the land from degradation. The findings may provide an informed basis for a rangelands management system for pastoralists.

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