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Seasonal Changes in Vegetation Cover of Elsuki area, Sinnar State, Sudan

Abdelfadeel Khalafallah Abuelgasim[1], Tamador A Algam[2]
[1, 2] Faculty of Natural Resources and Environmental Studies, Sinnar University, Sudan. Faculty of Agricultural technology @ fish science, Alneelain University, Khartoum, Sudan

Abstract
Two consecutive seasons of 2011- 2012 and 2012- 2013 were studied at Elsuki area, Sinnar State, Sudan to assess the seasonal changes of the vegetation cover, using five major transects each one 3000m length and 10m width, of total area 150.000m^2. 75 quadrates and 5 pellets transect were used to assess changes in the flora of the area. The results showed that there were sixty-four species decreased by 70.3% while they increased by 26.6% and normal percentage of 3.13%. Main decrease species was *Commelina amplexicaul* is (30.08%), where main increase was *Srtiga hermothica* (0.75%). Fifteen tree species were recorded, decreased by 53.3% while they increased by 40% and normal percentage of 6.7%. Main decrease species was *Acacia seyal var seyal* (8.83%), where main increase species was *Acacia senegal* (17.39%). Nine shrub species were recorded decreased by 66.7% while they increased by 22.2% and normal percentage of 11.1%. Main decreases species was *Acacia oerfota* (36.65%), where main increase was *Stereospermum kunthianum* (0.31). Increasing or decreasing in vegetation cover maybe attributed to seasonal climate changes, human activities or grazing process, so it's to be recommended more investigations to record these changes to conserve Elsuki vegetation cover.

Keywords: Decrease, increase, Elsuki, Sinnar, Sudan

Introduction
World Research Institution Annual Report 1995 recorded 3112 flowering plants in Sudan. 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) [17, 3, 10, 6, 7]. 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) [16]. Most grasses in savannhas are fairly tolerant to grazing, but prolonged high grazing intensities will eventually lead to change in species composition (Skarpe, 1992) [13] and reduction in grass biomass especially when soil resources are depleted (Van Auken, 2009) [14]. Micro environmental factors vary with seasonal changes which affect the growth stage (seedling, sapling and young trees) of plant communities that maintain population structure of any forest (Khumbongmayun *et al* 2006) [15]. Thus, it becomes an important issue to understand the species diversity, population structure and regeneration status of any forest communities for the maintenance of both natural and control (protected) forest. Therefore, information on the regeneration status of plant is important to determine the potential of an area for biodiversity conservation and sustainability (Edwin-Wosu N. L. and E. A. B. Edu 2013) [4]. Bush encroachment is an indicator of environmental degradation (Van Vegten, 1984; Van Auken, 2009) [15, 14] 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, 2008; Sankaran, 2009) [8, 11, 9, 1, 12]. The aim of this study is to assess the changes of vegetation cover in the study area.

Materials and methods
Five major transects were taken at Elsuki area (N: 12.80404 E: 34.26082).The average annual rainfall in the study area since 2000 to 2012 varies from 695 mm to 413 mm (Table1), each transect of 3000m length, 10m width for trees and shrubs, where for herbs 75 quadrates were taken each one of 1$\times$1m within a total area of 150.000m^2 to assess the changes in vegetation cover in the study area. Sampling precision was obtained by long narrow rectangles crossing contour lines, according to Barmann (1953) [2].

$$\text{Individual change \%} = \frac{Individual\ change}{\Sigma\ changes} \times changes\%$$

Table 1: Temperature, relative humidity and rain fall at Sinnar state, Sudan during the period from 2000-2012.

Year	Min / temp	Max / temp	R.H	Rainfall
2000	19-5	34-2	67%	544.4 mm
2001	20-7	35-5	65%	326.4
2002	19-8	35-9	49%	341

2003	20-3	37-8	50%	504.5
2004	20-3	37-3	47%	224
2005	20-7	37-7	49%	191.5
2006	20-1	36-9	50%	437.2
2007	20-0	36-4	53%	742.4
2008	20-2	36-6	53%	384.4
2009	20-5	37-5	53%	309
2010	22-3	38-3	48%	327.3
2011	20-5	36-6	54%	535
2012	21-1	35-4	50%	413

***Source*:** Metrological station Khartoum (2013).

Results and Discussions

Herb attributes

Seasonal changes of herb species in Elsuki is presented in table 2: sixty-four species are recorded in the two seasons. Generally, species richness decreased by 70.3% while it increased by 26.6% and normal percentage of 3.13% during the season 2011 – 2012 to 2012 – 2013.

Decreasers

Main decreases during the two seasons were *Commelina amplexicaulis* (30.08%), *Eragrostis diplochnoides* (8.86%), *Acalyphe indica* (3.70%), *Commelina kotschyi* (2.37%), *Sorghum arundinaceum* (2.26%) and *Justicia palustris* (2.15%) consequently, based on the highest value of change (Table 2). This may be attributed to change in rainfall between The two seasons.

Increasers

Species indicating high percentage of increase in the two seasons were *Srtiga hermothica* (0.75%), *Cymbopogon nervatus* (0.37%), *Corchorous fasicularis* (0.27%), *Cucumis melo* (0.24%), *Cuscuta hyalnia* (0.24%), *Pennisetum purpureum* (0.23%), *Digera* and *Choloris parbata* ver. *Meccana* with respective values of (0.20%) Table2. Low rain fed may be accord to increase some species affected by flooding like *Cucumis melo* and *Corchorous fasicularis* because these species were unpalatable

Normal

Two species were not changes during the two seasons which were *Soncuchus cornutes* and *Withania somnifra* (Table2).

Table 2: Seasonal changes of herbs species in Esuki area, Sinnar State. Sudan

No.	Species	2011-2012	2012-213	Individual change	Individual change %	Pattern
1.	*Srtiga hermothica* (Del.) Benth.	27	80	53	0.75	Increases
2.	*Cymbopogon nervatus* (Hochst.) chiov.	11	37	26	0.37	
3.	*Corchorousfasicularis*	5	24	19	0.27	
4.	*Cucumis melo* L.	6	23	17	0.24	
5.	*Cuscuta hyalnia* Roth	1	18	17	0.24	
6.	*Pennisetum purpureum* Schumach.	120	136	16	0.23	
7.	*Digera alternifolia* (L.) Mart.	12	26	14	0.20	
8.	*Choloris parbata* ver. Meccana Ash. et. Schweinf	0	14	14	0.20	
9.	*Ipomoea aquatic* Forsk.	7	20	13	0.18	
10.	*Echinochloa colona* (L.) link	11	24	13	0.18	
11.	*Cassia occidentalis*	173	185	12	0.17	
12.	*Sesbania Arabica* Steud.. & Hochst.	9	18	9	0.13	
13.	*Sida alba* (L.)	6	14	8	0.11	
14.	*Phyllanthus niruri* L.	7	9	2	0.03	
15.	*Ipomoea cordofana* Choisy.	4	6	2	0.03	
16.	*Euphorbia aegyptiaca* Bioss	5	6	1	0.01	
17.	*Clitoria ternate*	0	1	1	0.01	
No.	**Species**	**2011-2012**	**2012-213**	**Individual change**	**Individual change %**	**Pattern**
18.	*Soncuchus cornutes*	4	4	0	0.00	Normal
19.	*Withania somnifra*	1	1	0	0.00	
20.	*Euphorbia acalyphoides* Hochst. ex Bioss	1	0	-1	-0.01	Decreases
21.	*Aristolochia bracteolate*	1	0	-1	-0.01	
22.	*Boerhaviaerecta*	1	0	-1	-0.01	
23.	*Ipomoea sinensis* (Desr.) Coisy.	21	18	-3	-0.04	
24.	*Solanum dubium* Fresen.	4	0	-4	-0.06	
25.	*Cenchrus echinatus*	6	1	-5	-0.07	
26.	*Sesbania pachycarpa* DC.	7	0	-7	-0.10	
27.	*Vernonia amygdatina*	15	7	-8	-0.11	
28.	*Aeschynomeneindica*	9	0	-9	-0.13	

29.	*Oxygonum atriplicifolium* (Meisn.) Martelli	18	6	-12	-0.17	
30.	*Thunbergia annua* ex Nees.	15	3	-12	-0.17	
31.	*Eriochloa nobica* (Stude.) Hack. And stapf. Ex thell.	16	4	-12	-0.17	
32.	*Corchorus depressus* (L.) Christens	19	6	-13	-0.18	
33.	*Dactyloctenium aegyptium* (L.) Beauv.	76	62	-14	-0.20	
34.	*Trianthema portulacastum* L.	16	2	-14	-0.20	
35.	*Penisetum pedicellatum* (Trin)	16	1	-15	-0.21	
36.	*Dinebra retroflexa* (Vahl.) Panz	33	17	-16	-0.23	
37.	*Helieotropium sudanicum* F.W. Ander	16	0	-16	-0.23	
38.	*Acnthespermum hispidum*	27	10	-17	-0.24	
39.	*Physalis angulate* L.	23	3	-20	-0.28	
40.	*Panicum repenslinn* L.	21	0	-21	-0.30	
41.	*Indigofera oblongifolia* Forsk.	27	5	-22	-0.31	
42.	*Abelmoschus esculentus* (L.) Moench	40	16	-24	-0.34	
43.	*Brachairiae ruciformis*	143	117	-26	-0.37	
44.	*Tribuluster restris* L.	33	6	-27	-0.38	
45.	*Echinochloa pyramidalis* (Lam)	34	6	-28	-0.40	
46.	*Desmodium dichotomum* (Klein) DC.	63	31	-32	-0.46	
47.	*Indogofira pilosa* Poir.	37	4	-33	-0.47	
48.	*Eragrostis megastechya* (Koel.) Link	54	16	-38	-0.54	
49.	*Rhynchosia memnonia* (Del.) Cooke.	96	57	-39	-0.55	
50.	*Phyllanthus madraspatensis* L.	58	12	-46	-0.65	
51.	*Cenchrus echinatus*	122	63	-59	-0.84	
52.	*Ocimum basilicum* L.	119	49	-70	-1.00	

No.	Species	2011-2012	2012-213	Individual change	Individual change %	Pattern
53	*Rottobeolla cochinchinensis*	82	11	-71	-1.01	Decreases
54	*Digera muricata* (L.) Aschers.	74	1	-73	-1.04	
55	*Cyperus rotundus* L.	84	10	-74	-1.05	
56	*Crotalaria senegalensis* (Pers.) Bacle ex DC	126	41	-85	-1.21	
57	*Merremia emarginata* (Burm.f.) Hallierf	141	47	-94	-1.34	
58	*Choloris virgate* Sw.	172	67	-105	-1.49	
59	*Justicia palustris* (Hochst.) T. Anders.	568	417	-151	-2.15	
60	*Sorghum arundinaceum* (Dew.) stapf	194	35	-159	-2.26	
61	*Commelina kotschyi* Hassk	420	253	-167	-2.37	
62	*Acalypheindica*	263	3	-260	-3.70	
63	*Eragrostis diplochnoides*	881	258	-623	-8.86	
64	*Commelina amplexicaulis* Hassk	2431	316	-2115	-30.08	
	Total	7032	2627	-4405		
	Change%				-62.64	

Tree attributes:

Seasonal changes of tree species in Elsuki is presented in Table 3: fifteen species are recorded in the two seasons. Generally, species richness decreased by 53.3% while it increased by 40% and normal percentage of 6.7% during the season 2011 – 2012 to 2012 – 2013.

Decreasers

Main decreasers during the two seasons were *Acacia seyal var seyal* (8.83%), *Ziziphus spina chiristi* (8.03%), *Dichrostachys cinerea* (4.45%) and *Cephalucroton cordofanus* (2.85%) consequently, based on the highest value of change (Table3). *Acacia seyal* is desired species for charcoal industries, where other species may decrease of human activities like extension of rain fed agriculture.

Increasers

Species indicating high percentage of increase in the two seasons were *Acacia senegal* (17.39%),*Acacia nilotica* (4.51%) and *Balanites aegyptica* (3.98%) consequently, Table 3. Since *Acacia Senegal* is an economic tree, the increasing of it is accepted, while *Acacia nilotica* is common species and high adapted for this area, where *Balanites aegyptica* is protected by national forest corporation laws which affected in its increase properly.

Normal

One species is not changes during the two seasons which is *Sterculia setigera* (Table 3).

Table 3: Seasonal changes of tree species in Esuki area, Sinnar State, Sudan.

No.	Species	2011-2012	2012-213	Individual change	Individual change %	Pattern
1.	*Acacia senegal* (L.) Willd.	410	672	262	17.39	Increases
2.	*Acacia nilotica* (L.) Wild. Ex Del	124	192	68	4.51	
3.	*Balanites aegyptica*	255	315	60	3.98	

4.	*Acacia seyal var fistula*	0	8	8	0.53	
5.	*Delbergia melanoxylon*	0	3	3	0.20	
6.	*Hyphaene thebaica* (L.) Mart.	0	1	1	0.07	
7.	*Sterculia setigera* Del	1	1	0	0.00	Normal
8.	*Adansonia digitata*	1	0	-1	-0.07	Decreases
9.	*Anogeissus leiocarpus*	1	0	-1	-0.07	
10.	*Acacia polyacontha*	8	6	-2	-0.13	
11.	*Combretum hatmannianum* Schweinf.	8	3	-5	-0.33	
12	*Cephalucroton cordofanus*	43	0	-43	-2.85	
13.	*Dichrostachys cinerea* (L.) whiee & Arn	67	0	-67	-4.45	
14.	*Ziziphus spina chiristi* (L.) Desf.	159	38	-121	-8.03	
15.	*Acacia seyal var seyal* Del.	430	297	-133	-8.83	
	Total	1507	1536	29		
	Change%				1.92	

Shrub attributes

Seasonal changes of shrub species in Esuki is presented in Table 4: nine species are recorded in the two seasons. Generally, species richness decreased by 66.7% while it increased by 22.2% and normal percentage of 11.1% during the season 2011 – 2012 to 2012 – 2013.

Decreases

Main decreases during the two seasons were *Acacia oerfota* (36.65%), *Combretum aculeatum* (1.79%) and *Acacia mellifra* (0.51) consequently, based on the highest value of change (Table 4).

Increasers

Species indicating high percentage of increase in the two seasons were *Stereospermum kunthianum* and *Grewia tenax* with respective values of (0.31) and (0.15) consequently (Table 4). Bush encroachment is an indicator of environmental degradation (Van Vegten, 1984; Van Auken, 2009) [15, 14]

Normal

One species is not changed during the two seasons which is *Calotropis procera* (Table 4).

Table 4: Seasonal changes of shrubs species in Esuki area, Sinnar State, Sudan.

No.	Species	2011-2012	2012-213	Individual change	Individual change %	Pattern
1.	*Stereospermum kunthianum* Cham.	0	6	6	0.31	Increases
2.	*Grewia tenax* (Forisk) Fiori.	4	7	3	0.15	
3.	*Calotropis procera*	1	1	0	0.00	Normal
4.	*Aerva jovanica*	1	0	-1	-0.05	Decreases
5.	*Capparis decidua*	10	7	-3	-0.15	
6.	*Cadaba forinosa*	9	0	-9	-0.46	
7.	*Acacia mellifra* (Val.) Benth	125	115	-10	-0.51	
8.	*Combretum aculeatum*	53	18	-35	-1.79	
9.	*Acacia oerfota*	1756	1038	-718	-36.65	
	Total	1959	1192	-767		
	Change%				-39.15	

Conclusion and Recommendations

It is to be concluded that seasonal changes are affected in Elsuki vegetation cover of it three levels negatively, which appear in percentages of species decreases. These changes may be attributed to seasonal climate changes or human activities. That is not all what's happened, but there were significant percentage of increase in a very important species all of the vegetation covers. So, it's to be recommended that more investigations were needed to record these changes to take a right step about conserving Elsuki vegetation cover.

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