

Full Length Research Paper

Check list of Flora and vegetation of an archeological habitat in North Sudan

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Abstract

The study deals with the ecology and taxonomy of the vegetation of the riprain and terrestrial vegetation at old archaeological site (least 5,500 years ago) in Northern Sudan. Selected habitats in the study area (North-Sudan) have been investigated with a focus on diversity of flora, vegetation abundance, and a descriptive taxonomical study including collection, preparation and, identification. During this survey (Between 2007 and 2014) a total of 133 species of plants were identified, belonging to 42 families occupying different habitats. The islands permit the development of the highest number of plant species due to flood, sufficient moisture content and fertile soil. Riparian and arable lands in the study area are significantly rich in plant species, compared with valleys and desert habitats. The most highly represented families were the Poaceae with 17 species followed by the Mimosaceae with 11 species. A distinct zonal distribution of the plant communities was found. The species were exposed to the same geographical conditions, and the environmental conditions in the area with regard to soil type and moisture are suitable for these plants. The most important plant species are either major dominant species, like *Desmostachya bipinnata* and *Rhynchosia minima* or endangered and vulnerable, e.g. *Acacia nilotica* and *Sesbania sesban*, or rare and threatened species and newly recorded for the area such as *Lasiopogon muscoides*.

Key words: Flora, plant diversity, vegetation, abundance, endangered and threatened species.

INTRODUCTION

Sudan is the tenth largest country in Africa and stretches between latitudes 4 and 22 north. It is located in the northern region of the continent, and is surrounded by several other countries on all sides. The study is based on a stretched region of the Nile at archaeological sites in Northern Sudan, with desert environment. There are many microclimates ranging from riparian vegetation and that of the river bank and some islands to bare rocky and sandy desert. The flora of the Sudan has a wide range of ecological habitats, and accordingly different zones were and divided into six agro-ecological zones, whose major plant communities have been described by Harrison and

Jackson (1958) and Wickens (1991) as Deserts, Semi deserts, low rainfall woodland Savannah High rainfall woodland Savannah, Swamps, Highlands and The Red Sea Coast.

Bebawi *et al.*, (1991) studied the vegetation of North Sudan and Sahni (1968) covered the trees of northern and central Sudan from an economical forester point of view.

Very little is known about the ecology and vegetation of the study area. Petit *et al.* (1964) studied the fauna and flora of the area around Wadi Halfa. Halwagy (1961) gave an account on the semi-desert vegetation north of Khartoum, while Halwagy (1963) studied the succession of vegetation of some islands and banks on the Nile near Khartoum and emphasized that the flood will be followed by germination of various seedlings. Ghabbour (1972)

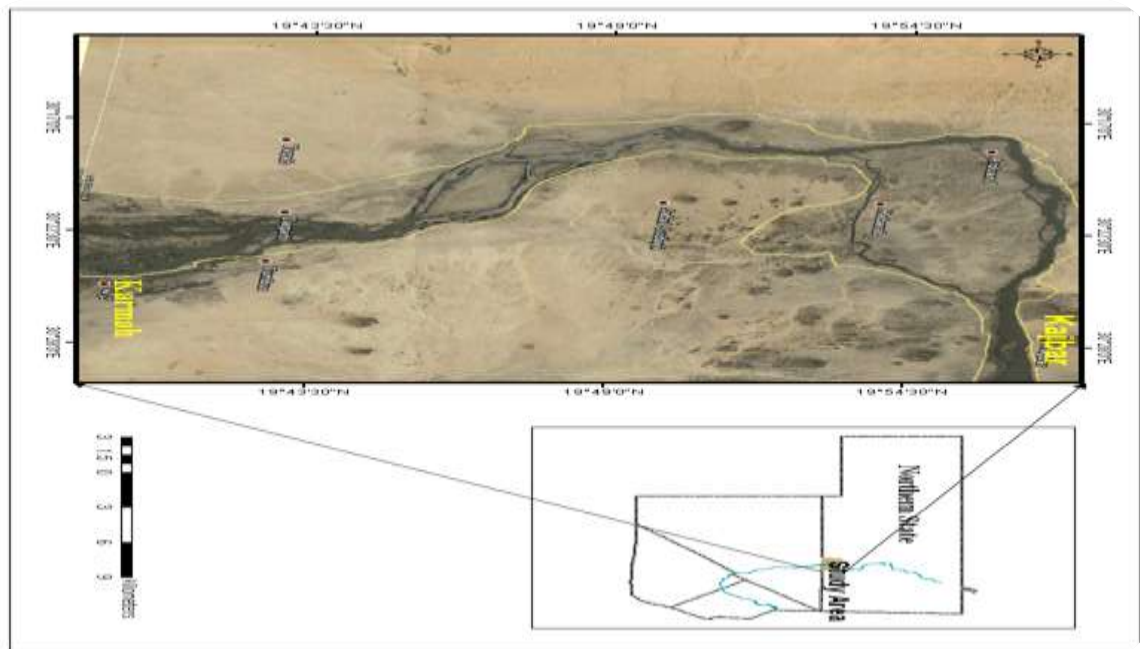


Figure1: Digital image of study area, Northern Sudan (Source: Remote Sensing Authority 2012)

studied the flora of the Nile region at Dongola Research Center (Sudanese Nubia). The literature contains very few floristic records on Lake Nubia before the construction of the lake (Ahti *et al.*, 1973).

The flora along the banks of Lake Nubia and along term changes that have taken place has been reported by Ali (2006; 2004). The northern part of the Sudan has been affected by sahelian drought, so a more or less arid zone has been discussed by Abedal Bari (1985). The degradation of dry lands has a concomitant impact on biodiversity. The broad objective of this study is to document tree, shrub and herbs vegetations species of riparian and terrestrial vegetation islands, semi islands, desert, and arable lands north Sudan, and on archaeological areas, as no previous study was devoted to this particular area, and to conserve the flora of the Sudan before Kajbar Dam.

MATERIALS AND METHOD

The study area

Location

Three sites were chosen for this study within the area of Northern Sudan which is 550 Km north of Khartoum and 50km north of Dongola from Kerma, to Third cataract. It lies at

latitudes 19° 45' 36" N, 19.67, 30.37° and longitudes and 30° 22' 12" E (Fig.1).

The scope of the present research focuses on five main feature in the three sites of the study area:

- a). Some selected islands
- b). Nile banks
- c). Crop- associated plants. (Bourgage Agricultural Scheme)
- d). Desert plane (valley).

Collection and Identification of Plant Components

The collected plant specimens were examined and identified by using the keys given by Anderews (1950, 1952, 1956), Hutchinson and Dziel (1963) Bebawi *et al.*, (1991), Migahid (1996), Ling (2009), Collenette (1999), Cope (1985) and confirmed by information available from specimens deposited at the herbarium of the Botany Department, University of Khartoum, Faculty of Science.

Abundance were recorded by using a modified Braun-Blanquet system ,Forty eight quadrates of 5 x 5m, 1 x 1m were laid along the random transect in khors, desert plane, river banks and in agricultural filed for trees, shrubs and Sub quadrates were used for herbs. This is done on all sites except for islands, where the size of quadrate depends on vegetation type to record abundance of vegetation. Estimates plentifulness of a species of target group according to a predefined scale such as rare, infrequent, abundant, etc, (Kent and Coker, 1992). Field observation of vegetative part of floral has been noted during collection. Synonyme of species were recorded from many references Hutchinson and Dziel (1963). Full species, list

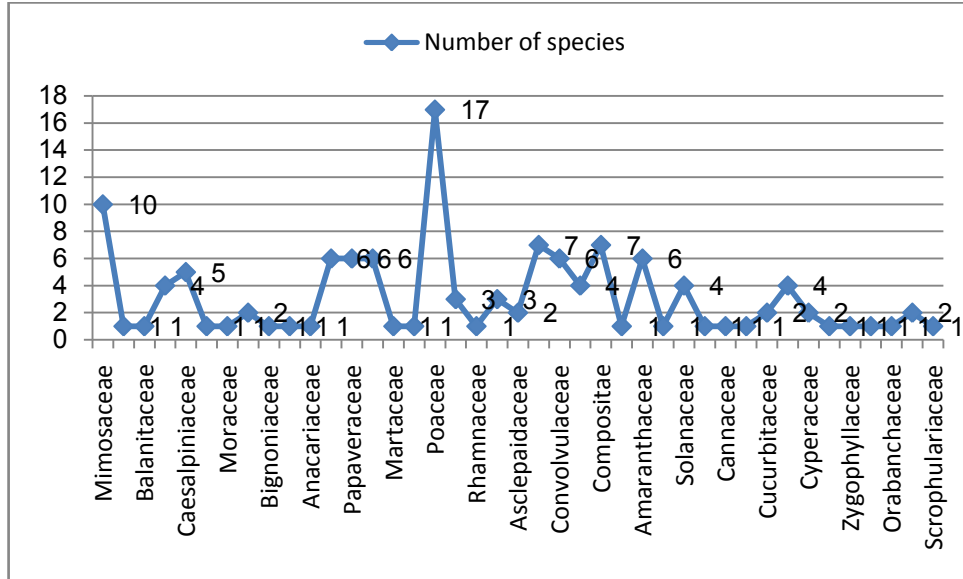


Figure 2: Number of species-families

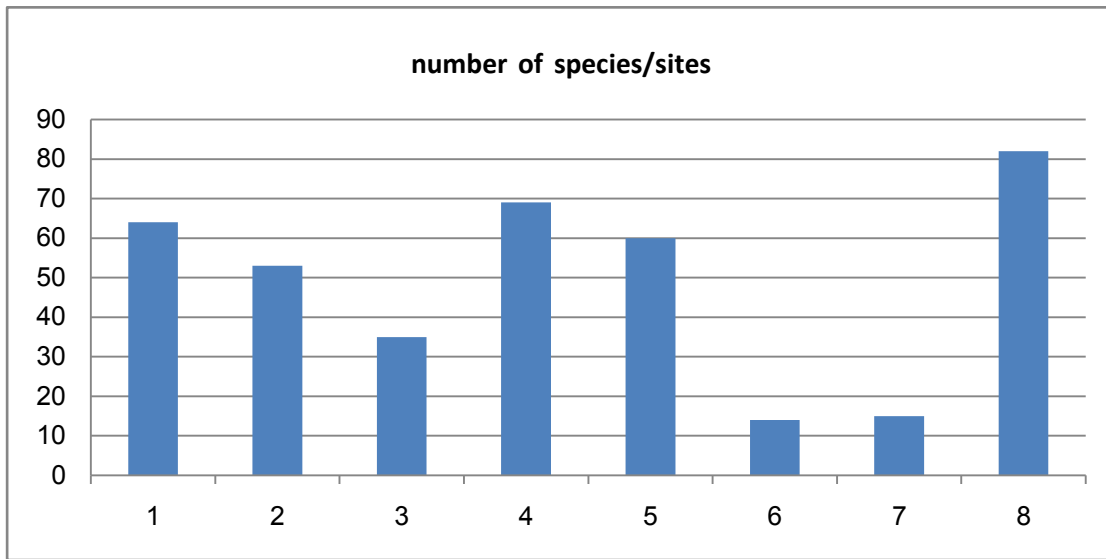


Figure 3: species diversity in the study area 8 sites. (1) some selected islands-simt (frka island (2) Bedin islands-(3)-Abdallah semi islands (4) Kerma (5) Third Catract (Nile bank) –(6) Desert plane (7) Khors (8) Bourgage Agricultural Scheme

and diversity with estimate obtained for various sub-habitats in the study area.

RESULTS AND DISCUSSIONS

Floristic diversity

A total of 133 species, belonging to 42 families were recorded from various sample plots and occupying

different habitat types in the study area. (Table 1) (Figure 2) The most highly represented families were Poaceae (Gramineae) 17 species and Mimocacea 11 species,

Species composition diversity

Species diversity has been given in Table 2, Figure 3. These showed that the species numbers were highest at site 8 (Bourgage scheme) all species were weeds followed by site 4 (Kerma); site 1, site 5 and site 2 were

Table 1. Scale of abundance and diversity of species composition in the sites(1-8)*

	Botanical name	Family	Arabic Name	Life span & form	local name	Sites*								
						1	2	3	4	5	6	7	8	
1	<i>Acacia mellifera</i> (Vahl.)Benth	Mimosaceae	Kiter	T	p		r	-	-	-	-	-	-	R
2	<i>A. nilotica</i> L.Wild.Ex Del	Mimosaceae	Sunt	T	P	Gorta	a	c	a	C	A	-	vr	R
3	<i>A. nubica</i> Benth	Mimosaceae	Loat	T	P		-	r	-	-	-	-	-	-
4	<i>A. sengal</i> (L.) Willd	Mimosaceae	Hashab	T	P	Hashap	r	-	-	-	-	-	-	-
5	<i>A..seyal</i> Del.	Mimosaceae	Taleh	T	P		c	r	r	-	R	-	-	R
6	<i>A.tortlis ssp.tortlis</i> (Forssk) Brenan	Mimosaceae	Syyal	T	P	Taleh	-	o	-		R	-	c	
7	<i>Albizzia lebbeck</i> (Roxb)Bovi	Mimosaceae	Dign-Elbasha	T	P		-	r		R		-		vr
8	<i>Azadirch indica</i> A.Guss	Meliaceae	Neem	T	P	Neem	-	a	r	A	-	-		C
9	<i>Balanites aegyptica</i> (L.)Del.	Balanitaceae	Heglig	T	P	Laloba	-	vr	-	R	-	-	r	R
10	<i>Faidherbia albida</i> (Del.)Chev	Mimosaceae	Haraz	T	P	Haraz	r	r	-	R		-	-	-
11	<i>Bougainvillea spectabilis</i> Wild.	Nyctaginaceae	Gahanamya	T	P		-	r	-	R	-	-	-	-
12	<i>Tamarindus indica</i> L	Caesalpinaceae	Aradeeb	T	P	Areedb	-	-	-	R	-	-	-	R
13	<i>Eucalyptus microtheca</i>	Myrtaceae	Ban	T	P		-	-		R	-	-	-	R
14	<i>benghalensis</i> L. <i>Ficus</i>	Moraceae	labakh	T	P	Labakhka	-	-	-	R		-	-	R
15	<i>Hyphaene thebaica</i> (L.) Martin	Palmae	Dom	T	P	Hambo	-	-	-	o	vr	r	-	C
16	<i>Kigellia Africana</i> (Lam.)Benth.	Bignoniaceae	Umshtur	T	P		-	-	-	R	-	-	-	
17	<i>Loranthus</i> sp.	Loranthaceae	Enaba	T	P	Enaba	c	r	r	R	-	-	-	R
18	<i>Mangifera indica</i> L.	Anacardiaceae	Mango	T	P	Mango	-	r	-		-	-	-	R
19	<i>Maerua crassifolia</i> Forssk.	Capparidaceae	Shager Aldud	sh	pl			c		C		-	-	
20	<i>Parkinsonia aculeate</i>	Caesalpinaceae	Parkinsonia	T	p		-	-	-	C	-	-	-	R
21	<i>Phoenix dactylifera</i> L.	Palmae	Nakheel	T	p	Fanti	c	C	c	C	c	-		C
23	<i>Psidium guajava</i> L.	Mrtaceae	Gwafa	T	p	Gwafa	r	c	-	-	-	-	-	-
24	<i>Sesbania sesban</i> (L.)Merr.	Caesalpinaceae	Sesaban	T- sh	p		c	a	c	A	a	-		R
25	<i>Tamarix nilotica nilotica</i> (Ehrenber)Bunge	Tamaricaceae	Tarfa	T	pl	Moor	a	a	c	-	a			-
26	<i>Tamarix aphylla</i> (L.) Karst.	Tamaricacea	Tarfa	T	P	Gshalgmal	-	-	-	-	-	C		-
27	<i>Capparis dicitdua</i> (forssk.)Edgew	Capparidaceae	Tundub	T	P	Garae	c	-	-	-	r	C		-
28	<i>Nerium oleander</i> L.	Apocynaceae	Ward Hamir	T	P		-	r	-	R	-	-	-	-

Table 1. Continues

29	<i>Prosopis chilensis</i> L.	Mimosaceae	Mesquite	T	P	Pisqute	r	r	-	R	C	-	R
30	<i>Tamarix indica</i> .Willd	Tamaricacea	Tamar hindi	T	P		r	r	-	R	-	-	-
31	<i>Phragmites australis</i> (kav.)exsteud	Poaceae	Boos	sh	p	Boos	-	r	-	-	C	-	-
32	<i>Zizphus spina- chirsti</i> (L.)Desf	Rhamnaceae	Sidr	T	p	Nabagka	r	vr	-	Vr	-	-	r
33	<i>Abutilon pannosum</i> (Forssk.f.)Schlecht.	Malvaceae	Gragdan	sh	p	Gragdan	r	C	r	R	r	-	C
34	<i>Calotropis procera</i> (Ait.) Ait. f.	Asclepiadaaceae	Usher	sh	p	Habdab	C	a	a	A	a	-	a
35	<i>Jatropha glauca</i> Vahl	Euphorbiaceae	Shagrat Alsim	sh	p		r	C	r	R	-	-	C
36	<i>Ipomoea carnea</i> Mart.(Choisy)	Convolvulaceae	Aweer	sh	p		r	C	r	R	r	-	r
37	<i>Leptadinia hetrophylla</i> Forsk	Ascaelepidaceae	Lwais	sh	p		C	a	C	A	r	-	C
38	<i>Maerua oblongifolia</i> forssk.	Capparidceae	Erg elmahaba	sh	p		-	-	-	-	-	R	-
39	<i>Mimosa pigra</i> L.	Mimosaceae	sitElmothtaha	sh	p		C	C		C	C		
40	<i>Pluchea disecoides</i> (L.)Dc.	Compositae	Rihan elgadawel	sh	p	Rihan	r	-	-	-	-	-	C
41	<i>Polygonum glabrum</i> Willd	Polygonaceae	Timshiya	Sh	p	Safsaf	C	C	-	-	R		
42	<i>Ricinus communis</i> L.	Euphorbiaceae	Khirwih	Sh	p	Khirwih	a	C	-	-	C	-	C
43	<i>Achyranthes aspera</i> L.	Amranthaceae	Kashm-elnaseeba	Sh	p		-	-	-	-	R	-	-

Table 2. Flora and abundance of Kerma and Third Cataract Regions North Sudan

	Botinical name	Family	Arabic Name	Life Span & Form	Local Name	Sites*								
						1	2	3	4	5	6	7	8	
44	<i>Aerva javanica</i> (Burm.f)Juss	Amaranthaceae	Gbubish	Sh	P		R	r			r	-	r	C
45	<i>Cassia italica</i> (Mill) Lam	Caesalpiniaceae	Senna	Sh	P	Sana	R	a	C	C	r	-	-	C
46	<i>Cassia senna</i> L.	Caesalpiniaceae	Senna maka	Sh	P	Senna maka	R	a	C	R	r	-	-	C
47	<i>Desmostachya bipinnata</i> (L.)	Poaceae	Halfa	Sh	P	Halfa	A	C	a	A	a	a	C	A
48	<i>Chrizophora plicata</i> (vahl)	Euphorbiaceae	Terob	Sh	P	Terob	R	r	C	-	r	-	-	R
49	<i>Solanum dubium</i> Fresen.	Solanaceae	Gibain	Sh	P	Gibain	-	-	-	-	r	-	-	R
50	<i>Solanum incanum</i> Fresen.	Solanaceae	Gibain	Sh	P	Gibain	-	r	r	R	r	r	r	R
51	<i>Tephrosia apollinea</i> Del.Dc.	Papilionaceae	Amyoga	Sh	P	Amyoga	R	a	-	A	-			A

Table 2. Continues

81	Yunck	<i>Cuscuta campestris</i>	Convolvulaceae	Hamool	he	An		-	-	-	-	-	-	R	
82		<i>Cymbopogon nervatus</i> (Hochst.)Chivv	poaceae	Nal	he	p	Toshe	R	c	a	A	r	-	-	A
83	L.	<i>Cynodon dactylon</i>	Gramineae	Nagiila	he	p	Bunddi	A	a	a	A	a	-	-	A
84	L.	<i>Cyperus sp</i>	Cyperaceae	Seeda	he	p	Seeda	A	c	a	A		-	-	A
85		<i>Cyperus rotundus</i> (L)	Cyperaceae	Seeda	he	p	Seeda	C	a	a	C	a		-	A
86		<i>Dactyloctenium egypticum</i> (L.)Beauv.	Poaceae		he	p	Abuasapie	A	-	-	a	-		-	A
87		<i>Datura stramonium</i> L.	Solanaceae	Sekraran	he	an		-	C	C	-	-	r	-	C
88		<i>D. tatul</i> .Mill.	Solanaceae	Sakraran	he	an	Sakraran	-	-	-	R	-	-	-	R
89	L.	<i>Digitaria asdscendens</i>	Poaceae		he	an		-	-	-	-	r	-	-	R
90	L.	<i>D. velutina</i>	Poaceae	Crabgrass	he	an		-		-	-	-	-		R
91		<i>Echinochloa colonua</i> (L.)Link	Poaceae	Def ra	he	an	Def ra	r	-	-	R	-	-	-	C
92		<i>E. pyramidlis</i>	Poaceae	Def ra	he	an	Def ra	-			R	r	-		
93		<i>Eclipta alba</i> (L.)Hassk.	Asteraceae	Tamr el Khnam	he	an	-	-	o	-	-	-	-	-	-
94	.L	<i>Eragrostis tenella</i>	Poaceae		he	an	Toshe	-	-	-	-	r	-		R
95		<i>E. cilianensis</i> .L	Poaceae		he	an	Toshe	-	-	-	-	-	-		C
96	Mill	<i>Eruca stiva</i>	Cruciferae Brassicaceae	jergeer	he	an	Jergeer	-	-	r	R	-	-		R
97		<i>Euphorbia aegyptic</i> Boiss	Euphorbiacea	Malbina	he	an	Malbina	vr	c	-	C	r	-	-	C
98		<i>E. heterophylla</i> L.	Euphorbiaceae	Malbina	he	an	Malbina	-	r	r	R	r	-	-	-
99		<i>E.hirta</i>	Euphorbiaceae	Malbina	he	an	Malbina	r	c	c	R	r	-		c
100		<i>E. indica</i>	Euphorbiaceae	Malbina	he	an		-		r		C			
101	L.	<i>Fagonia Cretica</i>	Zygophllaceae	Um shok	he	an	Koshe	r		r		r	C	R	c
102	L.	<i>Glinus lotoides</i>	Molluginaceae	Rabaat Elbohar	he	an	Rabaat	c	-	c	-	C	-	-	-
103		<i>Guncellus pygmaeus</i>	Cyperaceae	Kilaywat Elatot	he	an	Toshe	r	-	-	-	r	-	-	-
104		<i>Gynandropsis gynandra</i> (L.)Merr.	Capparidceae		he	an		-	r	-	r	-			r
105		<i>Helotropium egyptica</i>	Capparidceae		he	an		r	r			C	-	-	-
106	Forsk	<i>H. ovaliolium</i>	Capparidceae		he	an		-	-	-	-	-		C	r
107		f.W.Andr <i>H. sudanicum</i>	Capparidceae		he	an		-	-	-	-	-		C	c
108		<i>Sorghum arundinaceum</i> (Dew)Stapf	Poaceae		he	an		-	r	-	-	-	-	-	-
109		<i>Hibscus trionum</i>	Malvaceae		he	an		-			r	-	-	-	-

Table 2. Continues

110	<i>Hibiscus lobatus</i>	Malvaceae		he	an	Sarmontong	-		r	-	-	-	-	
111	<i>Ipomea batatas</i>	Convolvulaceae	bambia	he	an		-	-	r	-	-	-	-	
112	Choisy <i>I. cordofana</i>	Convolvulaceae	Tabar	he	an	Tabar	-	-	-				c	
113	<i>I. pescaprae</i>	Convolvulaceae	Lablab	he	an		r			-	-	-	-	
114	(Desf)Dc. <i>Lasiopogon muscoides</i>	Asteraceae		he	an		-	-	-	-		Vr	-	
115	<i>Zaleya sp</i>	Aizoaceae	Rabaa	he	an		-	r	-	-	r	-	-	
116	<i>Luffa aegyptica</i>	Cucurbitaceae	Luffa	he	an		-	R	-	-	-	-	-	
117	L. <i>Medicago sativa</i>	Papilionaceae	Berseem	he	an	Hadra				r			c	
118	L. <i>Orabanche ramose</i>	Orabanchaceae	Halook	he	an		-	-	-	-	-	-	r	
119	L. <i>Phyllanthus niruri</i>	Euphorbiaceae	Ergana	he	an		r		f		r		r	
120	<i>Physalis angulata</i>	Solanaceae	fruta	he	an		-	-	-	r	-	-	-	
121	<i>Phragmites australis</i>	Poaceae	Boos	he	an		-	c	-	-	-	-	-	
122	<i>Portulaca oleracea</i>	Portulacaceae	Rjla	he	an	Rjla	-	R	R	c	C	r	-	V a
123	<i>P. quadrifida.L</i>	Portulacaceae	Ma-Mleiha	he	an	Tugur	r	-	-	-	C			
124	<i>Pulicaria crispa</i>	Compositae	Tugur	he	an	Ryhan	r	-	-	-	r	-	-	c
125	Linn <i>Punicum repens</i>	Poaceae		he	an		-				r	-	-	c
126)Dc. <i>Rhynchosia minima(L</i>	Papilionaceae	Adan elfar	he	an	Adan elfar	r	a V		c	r	-	-	V a
127	L. <i>Sida alba</i>	Malvacea	Ums hehdid	eh	an		r	C		aV	-	-	-	-
128	<i>Sonchus oleracea Hochst</i>	Compositae	Moleita	he	an	Moleita	r	-	-		r	-	-	r
129	<i>Striga hermonthica(Del)Benth</i>	Scrophulariaceae		he	an		-	-	-	r	-	-	-	c
130	<i>Trinantha portulcastrum L</i>	Aizoaceae(ficoidaceae)	Rabaa	he	an	Rabaa	r	C		r	-	-	-	c
131	<i>Tribulus terrestris L</i>	Zygophyllaceae	Direisa	he	an	Diresal	r	C	r	c	r	r	C	V a
132	<i>Tribulus sp</i>	Zygophyllaceae	Direisa	he	an	Diresal	r	C	r	c	r	r	C	V a
133	Vell. <i>Xanthium bsasilicum</i>	Compositae	Rantouk	he	an		-	-	-	-	-	-	-	r

* plant were arranged according to their habit. He:herb. T:tree, an:annual p:perennial va:very abundant a: abundant c:commom o:ocssinal r:rare vr:very rare a-some selected islands(1) simt(frka island —(2)Bedin islands-(3)-Abdallah semi islands (4)Kerma (5) Third Catract (Nile bank) —(6) Desert plane (7)Khors (8) Bourgage Agricultural Scheme

closely related in terms of species diversity. However it is clear that site 3 occupied an intermediate position with respect to species

diversity. It should be noted that site 6 & 7 gave lower means of species diversity when compared with other sites.

With reference to the species list in the study area and means of ecological parameters of vegetation, that was compared, it was clear that the

study sites were different in their floristic composition. The results showed that the islands permit the development of the highest number of plant species mainly due to seasonal Nile flood, together with sufficient moisture content and fertile soil.

The environmental conditions in the riparian sites were favorable, and highly influenced by the quantum and flow of water in the river channel (Nair, 1994; Harmon *et al.*, Howell *et al.*, 1996 and 1986; Fetherston *et al.*, 1995).

It must be noted that kobodi khor and Tombos (desert), had lower diversity that was related to poor soil moisture and other environmental factors.

CONCLUSIONS

For convenience of description, the vegetation was divided into:

Riverine vegetation (Island, river banks), Vegetation in valleys and khors in the desert and Agricultural land Vegetation

Generally, it may be concluded the result that the riparian and arable lands in study area are significantly rich in flora, compared with khors and desert.

REFERENCE

- Abdel BEM (1985). Recent Changes in the Vegetation of the Sudan Proceeding Seminar on Wildlife Conservation and Management in Sudan, Khartoum Ed. Ernest, D (1991):160-171.
- Ahti T, Hamet-Ahti I, Pettersson, B (1973). Flora of inundated Wadi Halfa reach of the Nile, Sudanese Nubia, with notes on adjacent areas. *Ann. Bot. Fenn.*, 10: 131-162.
- Ali MM (2004). Aquatic and shoreline vegetation of Lake Nubia Sudan *Acta Bot. Croat.*
- Ali MM (2006). Shoreline Vegetation of Lake Nubia Sudan, *Hydrobiologia* 570:101-105.
- Andrews FW (1950). The flowering plants of the Anglo-Egyptian, Sudan (Vol. 1) T. Buncle and Co. Ltd. Arbroath.
- Andrews FW (1952). The flowering plants of the Sudan (Vol.3). T. Buncle and Co. Ltd. Arbroath.
- Andrews FW (1956). The Flowering Plants of the Sudan. Vol. III. Buncle and Co. Arbroath. Scotland, pp 579.
- Bebawi, FF, Neugebohrum I (1991). Review of Plants of Northern Sudan with special reference to their use, *GTZ*. 249p
- Braun AF, Massey RE (1929). *Flora of the Sudan*. Thomas Marby and Co., London.
- Collenette S (1999). *Wild Flowers of Saudi Arabia*. Riyadh: National Commission for Wild Life Conservation and Development.
- Cope T (1985). *A Key to the Grasses of the Arabian Peninsula*. Riyadh: Arab Bureau of Education for the Gulf States.
- Fetherston KL, Naiman J, Bilby RE (1995). Large woody debris, physical process, and riparian forest development in montane river networks of the Pacific Northwest. *Geomorphology* 13: 133-144.
- Ghbbour IS (1972). *Flora of the Nile Region at the Dongola Reach, Sudanese Nubia* PhD, *Rev. zool Bot. Afr.*, LXXXV, 1-2.
- Halwagy R (1961). The vegetation of the Semi-Desert North East of Khartoum, Sudan *Okas*, pp 78-110.
- Halwagy R (1963). Studies on the Succession on Some Islands and Sand Banks in the Nile Near Khartoum, Sudan. *Vegetatio*, 4: 217-234
- Harmon ME, Franklin J F, Swanson FI, Anderson NH (1968). Ecology of Coarse woody debris in temperate ecosystem *Advance in Ecol. Res.*, 5:133-302.
- Harrison MN, Jackson JK (1958). *Ecological classification of Vegetation of the Sudan*. Agricultural Publication Committee Khartoum.
- Hutchinson J, Dalziel JM (1963). *Flora of Tropical West Africa*, Vol.2 (2nd edition). Crown agents for Overseas Governments and Administrations, London.
- Kent M, Coker P (1992). *Vegetation Description and Analysis* Belhaven press London pp.363.
- Kershaw KA (1975). *Quantities and Dynamic Plant Ecology*. 2nd edition Ling H, Kian K, Hoon TC. (2009). *A Guide To Medicinal Plants An Illustrated, Scientific and Medicinal Approach* World Scientific Publishing Co. Pte. Ltd.
- Massey RE (1926). *Sudan Grasses*. Botanical Series Publication. No. 1, Khartoum, Sudan, pp 57.
- Migahid AM (1996). *Flora of Saudi Arabia*, 4th ed., King Saud Univ. Libraries, Riyadh, Saudi Arabia.
- Moore PD, Chapman SP (1986). *Methods in Plant Ecology*. Osney Mead, Oxford pp.589.
- Nair S (1994). *The High Ranges Problems & Potential of a Hill Region in the Southern Western Ghats*, INTACH
- Pettet A, Pettet SJ, Cloudsley-Thompson JL, Idris B EM (1964). Some aspects of the fauna and flora of the district around Wadi Halfa. *Natural History Museum, University of Khartoum, Sudan, Bull.* 2, 1-28.
- Sahni KC (1968). *Important Trees of the Northern Sudan*, Khartoum University press. Khartoum
- Smith J (1949). *Distribution of Trees Species in the Sudan in Relation to Rainfall and Soil Texture*. Ministry of Agric. Sudan Government Bull., No. 4, pp 64.
- Wickens GE (1976). *The Flora of Jebel Marra and its geographical Affinities*. Her Majesty's stationery office, London.
- Wickens GE (1991). *Natural vegetation In: The Agriculture of the Sudan* (ed. G. M. Craig) Oxford University press, Oxford.