

*Original*

## **The Flora and Fauna in Eastern Nile Locality at Khartoum State**

Reem A. Hamid\*<sup>1</sup>, Alawia A. Elawad<sup>2</sup> and Elfatih E. Mahgoub<sup>2</sup>

<sup>1</sup>Wildlife Research Centre, Animal Wealth Research Co-corporation, Khartoum, Sudan.

<sup>2</sup>Faculty of Science and Technology, Al-Neelain University, Khartoum, Sudan.

<sup>2</sup>College of Animal Production Science and Technology, Sudan University of Science and Technology, Khartoum, Sudan.

**\*Corresponding author E-mail address:** reemasah01@yahoo.com

Received: 31 Jan. 2024

Accepted: 27 Feb. 2024,

---

### **Abstract:**

The present study is the pioneer that document the biodiversity of the Eastern Nile Locality, Khartoum State, Sudan including five range enclosures. The main objective of the present study is to document the natural vegetation status and floristic, faunal composition in five rangeland enclosures namely Abozaid (15° 46' 928", 32°88'549") Wadtbar (15° 42' 846",33°06'552"), Elhedabab (15° 42' 893", 33°002' 36"), Salamat Wad Niel (15° 652' 680", 33°25' 928") and Seyal Elfaki Saad (15° 54' 976", 33°20' 724") in Eastern Nile Locality, Khartoum State, and to provide a recent species list. The quantitative assessment of the flora in the five enclosures was determined by measurement of density, abundance, frequency, relative density, relative abundance, relative frequency and importance value index. On each of the five enclosures 9 plots were selected and the measurements were taken for 3 consecutive years. Nineteen plants were encountered during the survey. The results revealed that the herbaceous cover is dominated by *Aristida adscensionis* in four of the five studied enclosures while in Elhedabab enclosure *Schoenefeldia gracilis* is the most dominant species.

Standard collection and identification methods were used for both plants and animals. During the study period, a total of 33 plant species, representing 27 genera from 14 families, in 11 orders were recorded. Poaceae had the highest contribution; followed by Fabaceae and Zygophyllaceae. The flora comprises a variety of life-forms; most are

ISSN: 2948-300X (print) 2948-3018 (Online)

theophytes. The majority of the plant species have important ethnobotanical uses. From the collected plant 24 species are fodders grazed or browsed by wild animals and domestic livestock and 24 species are used for medicinal purposes. Almost all plant parts are economically used. The wild faunal survey results indicated the presence of 16 species two of which are reptiles, belonging to 1 order falling within 2 families. The avifauna consisted of nine species, falling in seven families within 4 orders. While the observed mammals were 5 species, falling in 5 families. Owing to the results produced by the present study, which represents the base for further ecological studies, there is an urgent need for monitoring and conserving the biodiversity in the Eastern Nile Locality.

**Key words:** Flora, Fauna, Biodiversity, Life forms, Economic uses.

## **Introduction**

The U.N. Convention on Biological Diversity (CBD) (2020) defines Biodiversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part”. According to Karmebäck *et al.*, (2015) and Wairore *et al.*, (2015) establishment of enclosures as a management tool that leads to agricultural diversification and ensure food security. Using of enclosures in the African drylands is becoming an effective management tool (Greiner, 2016 and Lovschal *et al.*, 2017).

More than 80 percent of Sudan consists of arid or semiarid areas. IPCC (2014) projected that the Horn of Africa will be among the regions to be most negatively affected by climate change.

The Eastern Nile Locality lies in the semi-desert ecological zone which is characterized by low and erratic rainfall (Harrison and Jackson, 1958).

Vegetation cover of this zone comprises annual and perennial grasses, forbs, shrubs and trees.

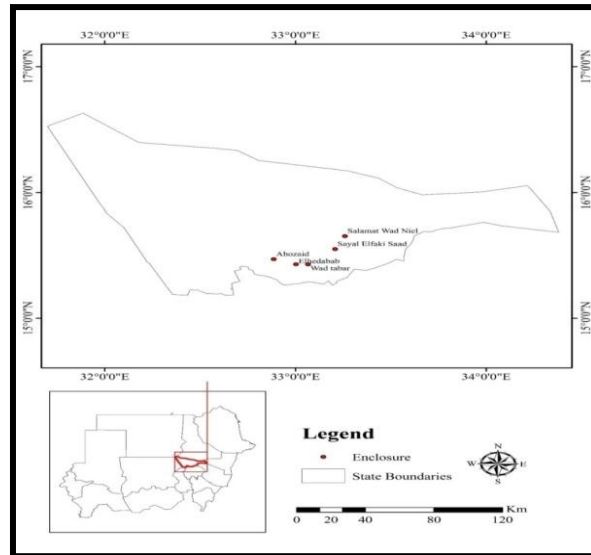
The floral composition of the Eastern Nile Locality has not been recently investigated. A general survey of the vegetation of Khartoum province had been represented by Obeid and Mahmoud (1969) and Mahmoud and Obeid (1971). Recently Abdalla and El Ghazali (2010) studied the flora of Khartoum Nile banks; Hamad *et al.* (2020) reported the Flora of Tutti Island and Mahmoud *et al.*, (2022) study the flora of Um Dom Island.

No previous attempts have been carried out to document the wildlife species inhabiting this area.

## **MATERIAL AND METHODS:**

### **The Study area:**

The Eastern Nile Locality is in the Eastern part of Khartoum State, 45 Kilometers north eastern Khartoum. The studied area is located between 15°42' 846" - 15° 652' 680" N and 33° 25' 928" - 32°88' 549" E. Five range enclosures has been established in this locality namely: Abozaid, Wadtabar, Elhedabab, Salmat Wad Niel and Seyal Elfaki Saad (Map 1).



**Map 1:** Study area

### **Specimen collection and identification:**

The collection procedure followed Bean (2016). Specimens were identified using the available literature (Andrews, 1950, 1952 and 1956; El Amin, 1990 and Braun *et al.*, 1991). Recent literature was consulted for current plant names (World Flora Online (WFO)). The list of families covered in this study was arranged according to the Angiosperm System of Classification of Flowering Plants (APG IV, 2016) while subfamilies, genera, and species were arranged alphabetically within the families. The identified specimens were confirmed with authenticated herbarium specimens in the Royal Botanical Garden Herbarium Kew, the United Kingdom (<http://apps.kew.org/herbact/navigator>.

*ed.*) and secondary resources including books and proceedings. Vernacular names given were compiled from local people and available literature. Ethnobotanical uses given were compiled from local people or retrieved from online bibliographic databases like Web of Science and Google Scholar, Useful Tropical Plants and PROTA4U Homepage, and secondary resources including books and proceedings; 13 use citations were recorded including 6 economic use categories and 7 used part categories. Due to its compelling simplicity, the life-form classification system of Raunkiær *et al.*, (1934) was used.

The survey for wildlife was carried out by direct observations of the individuals and indirect method by signs observation, tracks and foot prints

during the day and spotlight counts survey during the night to indicate the probability of occupancy (Cromsigt *et al.*, 2009, MacKenzie, *et al.*, 2006 and Kéry, *et al.*, 2016). Capturing of small mammals and reptiles was carried out with cage traps. Spotlight CP 7150 with a power of 550,000 watts' halogen was used during the night survey and direct observation was used during the day. These were identified using Curlis *et al.* (2020), Leenders (2019) and Farallo *et al.* (2010), As for birds' direct observation method and Bisley Deluxe 10 X 50 binocular were used. Identification was carried out using Wenny *et al.* (2011) method.

**Results and discussion:**

The floral results are presented in Table 1 which includes a list of collected taxa and their life forms, economic uses and the parts used from each. A total of 33 plant species, belonging to 27 genera included within 14 families falling in 11 orders were recorded from the study area. The results include a varying range of species within different families. Poaceae is the largest family represented by 9 species; followed by Fabaceae 8 species. Zygophyllaceae is represented by 3 species and each of Malvaceae and Euphorbiaceae 2

species. Acanthaceae, Aizoaceae, Apocynaceae, Asteraceae, Cucurbitaceae, Cyperaceae, Orbanchaceae, Solanaceae and Rubiaceae are monophyletic (Fig.1). This result can be considered as normal in a semi-desert environment. The families Poaceae and Fabaceae are usually widely distributed in any floristic study. Occurrence of Poaceae can be attributed to their economic uses, wide variety, ecological range of tolerance and to their efficient seed dispersal capability (Collentte, 1999 and Marjan and Manohar, 2014).

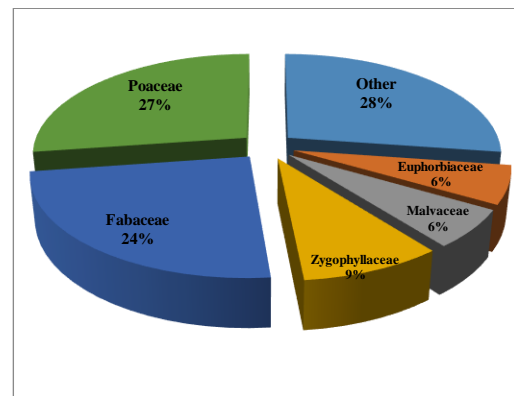


Fig (1): % of plant species within families

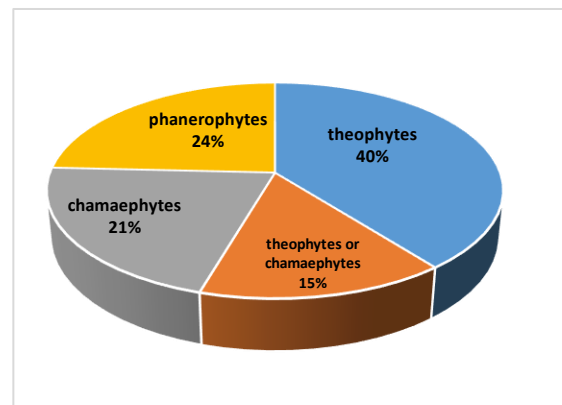
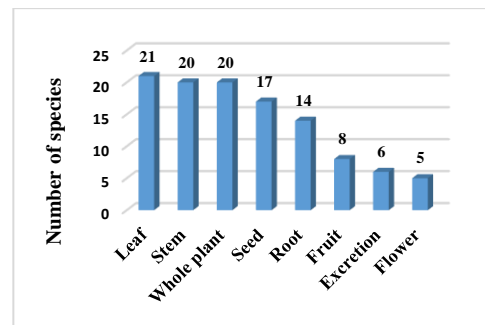
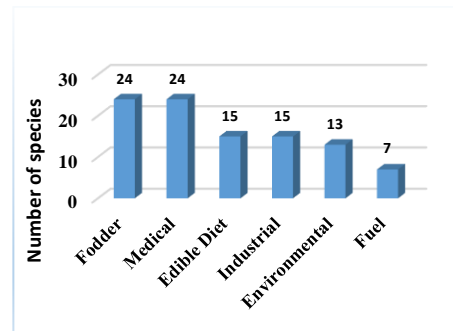


Fig (2): % of life forms within plant species.

The most common annual grasses are *Aristida adscensionis* and *Schoenefeldia gracilis*. The common forbs are *Corchorus depressus* and *Fagonia indica*, while the common shrubs and trees were *Acacia tortilis* subsp. *spirocarpa*, *A. ehrenbergiana* and *A. mellifera*; these findings agree with (Harrison and Jackson 1958).

The flora comprises different life-forms (Fig. 2); most are theophytes (40%). All plant species have important economic uses (Fig. 3a). The study area is considered as a natural range for the livestock. Twenty-four species are fodder plants, most are grazed and some are browsed by animals during the dry season. Seeds of *Blepharis ciliaris* (Fig. 4) a widely distributed fodder plant in most North African countries are brought to the locality during the broadcast program of the executive Range and Pasture Administration, Khartoum. Large trees, shrubs and grasses are utilized for building materials. Some plants are used for medicinal purposes; others are edible as human food, while *Striga hermonthica* parasitized the cultivated areas. All plant parts are being used; the use of

leaves was predominant followed by stem, whole plant, seeds, root, fruits, excretions and flowers (Fig. 3b).



**Fig (3): (a) Economic uses  
(b) used parts of collected taxa**

The faunal survey resulted in identification of 16 species (Table 2). The results revealed the presence of two species of reptiles belonging to 2 families within 1 order. The finding of this study was in agreement with (Corkill, 1935) who reported that *Rhagerhis moilensis* have been secured from Western, Northern and Khartoum States. Jawad (2021) stated the warm and dry climate is a suitable habitat for reptiles and he reported that *Stenodactylus sthenodactylus* inhabits semi desert regions.

The avian fauna results revealed the presence of nine species of birds' species falling into 7 families within 4 orders, seven of which are recorded in Sudan (Nikolaus, 1987). *Turdoides fulva* is resident and common with breeding records in Sudan. *Corvus rhipidurus* is residential and a local migrant; it inhabits local rocky hills and mountains. *Corvus albus* is a resident and a local migrant. *Streptopelia roseogrisea* is resident and common, reported to breed in Sudan. *Oena capensis* it is very common, local and African migrant species. *Cursorius cursor* is a rare palaeartic migrant. *Ptilopsis leucotis* (Fig. 5) breeds in Sudan and prefers dry acacia savanna and open woodland. *Eremopterix verticalis* and *Lanius meridionalis* were not reported by Nikolaus (1987). Also, the result is compatible with Del Hoyo *et al.* (2007) who mentioned that Passeriformes inhabits a wide diversity

of habitats. *Corvus albus* was recorded in Jabel El Dayer National Park, North Kordofan State (Ibrahim *et al.*, 2021).

From the 224 species and sub-species of mammals other than bats reported by Setzer (1965) in the Sudan the survey revealed the presence of five species within 5 families in 3 orders. *Vulpes pallida* (Fig. 6) **encountered in this survey** inhabits sandy and stony deserts and semi-desert areas, Saharan-Sahel in northern Africa; it may also occur near human habitation and cultivated fields where food is more available than natural habitat Sillero-Zubiri *et al.*, (2016). *Jaculus jaculus* is endemic to North Africa, northeastern Africa, the Arabian Peninsula, and southwestern Asia it inhabits arid environments desert and semi desert areas (Ben-Faleh *et al.*, 2010 and Boratyński *et al.*, 2014).



Fig (4): *Blepharis ciliaris pallida*

Fig (5): *Ptilopsis leucotis*

Fig (6): *Vulpes*

**Table (1): Floral Composition of the Eastern Nile Locality, Sudan.**

Taxa	Life form	Uses						Used part								
		F d	E	M	F u	I	E n	W	R	S t	L	F l	F	S e	E x	
<b>I. Monocots</b>																
1/ <b>Poales</b>																
<b>i Cyperaceae</b>																
1. <i>Cyperus rotundus</i> L.	Ch	+	+	+		+		+	+	+	+					
<b>ii Poaceae</b>																
subf.: Aristidoideae																
2. <i>Aristida adscensionis</i> L.	Th/ Ch	+					+	+	+	+	+					
subf.: Chloridoideae																
3. <i>Dactyloctenium aegyptium</i> (L.) Willd.	Th	+	+	+				+		+	+				+	
4. <i>Eragrostis cilianensis</i> (All.) Janch.	Th	+	+	+		+	+	+	+	+	+				+	
5. <i>E. tremula</i> Hochst. Ex Steud.	Th/ Ch	+	+			+		+		+	+				+	
6. <i>Schoenefeldia gracilis</i> Kunth.	Ch Th	+				+		+		+	+					
subf.: Panicoideae																
7. <i>Brachiaria deflexa</i> (Schumach.) C. E. Hubb. ex Robyns	Th Th	+	+					+		+	+				+	
8. <i>Cenchrus biflorus</i> Roxb.	Th/ Ch	+		+			+	+	+	+	+				+	
9. <i>C. ciliaris</i> L.	Ch	+	+		+	+	+	+	+	+	+				+	
10. <i>Panicum turgidum</i> Forssk.	Ch															
<b>II. Eudicots/Superrosids/Rosids/Fabids</b>																
2/ <b>Zygophyllales</b> Link																
<b>iii Zygophyllaceae R.Br.Subf. Tribuloideae</b>																
11. <i>Balanites aegyptiaca</i> (L.) Delile	Ph Th	+	+	+	+	+	+	+	+	+	+				+	+
12. <i>Tribulus terrestris</i> L.			+	+						+					+	+
subf.: Zygophylloideae																
13. <i>Fagonia indica</i> Burm. f.	Th/C h	+		+						+	+	+				







**Table (2): Fauna of Eastern Nile Locality**

Animal	Order	Family	Scientific Name	Common Name
<b>Reptiles</b>	Squamata	Colubridae	<i>Rhagerhis moilensis</i> Reuss	False cobra
		Gekkonidae	<i>Stenodactylus</i> <i>Sthenodactylus</i> Lichtenstein.	Elegant gecko
<b>Birds</b>	Charadriiformes	Glareolidae	<i>Cursorius cursor</i> Latham.	Cream-coloured courser
	Columbiformes	Columbidae	<i>Streptopelia roseogrisea</i> Sundevall.	African collared (Rose-Grey) Dove
			<i>Oena capensis</i> Linnaeus	Namaqua Dove
	Passeriformes	Alaudidae	<i>Eremopterix verticalis</i> Smith.	Grey backed sparrow lark
		Corvidae	<i>Corvus albus</i> Statius Muller	Pied Crow
			<i>C. rhipidurus</i> Hartert	Fan- Tailed Raven
		Laniidae	<i>Lanius meridionalis</i> Temminck	Southern grey shrike
Timaliidae	<i>Turdoides fulva</i> Desfontaines	Fulvous babbler		
Strigiformes	Strigidae	<i>Ptilopsis leucotis</i> Temminck	Northern white-faced scops- owl	
<b>Mammals</b>	Carnivora	Canidae	<i>Vulpes pallida</i> <b>Cretzschmar</b>	Sand fox
		Felidae	<i>Felis</i> sp.	Wild cat
	<b>Lagomorpha</b>	Leporidae	<i>Lepus</i> sp.	Hare
	Rodentia	Dipodidae	<i>Jaculus Jaculus</i> Linnaeus	Desert Jerboas
		Gerbillinae	<i>Gerbillus</i> sp.	Jerbel

**Conclusion:**

Most of the plant species of the study area have important economic uses. The area is considered as an important source for animal wellbeing, 22 species are fodder plants; most herbaceous are grazed and woody plants are browsed by animals during the dry season. Large trees and shrubs are utilized for timber.

Some plants are used for medicinal purposes; others are edible as human food; while *Striga hermonthica* parasitized the cultivated areas.

The herbaceous cover is dominated by *Aristida adscensionis* which spread in all enclosures except in Elhedabab which is dominated by *Schoenefeldia gracilis* followed by *Aristida*

*adscensionis*. *Acacia tortilis* subsp. *spirocarpa* is the only woody plant present in all enclosures except Wad Tbar.

Thirty-three plant species were recorded from the study area. Poaceae was the largest family; followed by Fabaceae and Zygophyllaceae. Most of the plant species of the study area have important economic uses. Twenty-two species are fodder plants. The faunal survey of the area resulted in the identification of 16 species; two of which are reptiles, 9 birds and 5 Mammals.

#### **Recommendations:**

1. Establishment of more range enclosures. Broadcasting of palatable species like *Belpharis ciliaris* and *Panicum turgidum* should be continued to improve range condition.
2. Establishment of fire lines should be continued to control wild fires.
3. Comprehensive survey of wildlife resources in rangeland should be conducted seasonally.

#### **Authors' contribution statement:**

Reem collected the plant and animal data; Reem and Alawia identified and classified the collected plant species

and wrote the text; Reem and Elfatih collected the data identified and classified the encountered animal species.

#### **Acknowledgement**

We are grateful to Utaz. Mohammed Fadl-Almola, Hussien Suliman, Rania Ahmed, Khalda Suliman and Fereeda Hamdan who participated in the field survey. Special thanks to Omda of Sharg Alneel Abdel-Alla Alsedige and his family for hospitality.

#### **References:**

1. Abdalla, W. and El Ghazali, G. E, B. (2010) The Flora of Nile Banks in Khartoum State, a Check List with Emphasis on Trees and Shrubs. *Sudan Silva*, 14(1): 35-48 ISSN:0562-5122.
2. Andrews, F.W. (1950). The flowering plants of the Angl-Egyptian Sudan, Vol. 1, Arbroath, UK: Buncle & Co. Ltd. Arbroath. Scotland.
3. Andrews, F.W. (1952). The flowering plants of the Angl-Egyptian Sudan, Vol., 2 Arbroath, UK: Buncle & Co. Ltd. Arbroath. Scotland.
4. Andrews, F.W. (1956). The flowering plants of the Sudan,

- Vol. 3 Arbroath, UK: Buncle & Co. Ltd. Arbroath. Scotland.
5. APG IV (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181(1): 1-20. <https://doi.org/10.1111/boj.12385>
  6. Bean T. (2016). Collection and preserving plant specimens, a manual. 2nd edition. Department of Science, Information Technology and Innovation, Queensland Herbarium, Brisbane.
  7. Ben Faleh, A.; Cosson, J.F.; Tatar, C.; Ben Othmen, A.; Said, K.; Granjon, L. (2010). Are there two cryptic species of the lesser jerboa *Jaculus jaculus* (Rodentia: Dipodidae) in Tunisia? Evidence from molecular, morphometric, and cytogenetic data. *Biol. J. Linn. Soc.*, 99, 673-686.
  8. Boratyński, Z.; Brito, J.C.; Campos, J.C.; Karala, M.; Mappes, T. (2014). Large spatial scale of the phenotype-environment color matching in two cryptic species of African desert jerboas (*Dipodidae: Jaculus*). *PLOS ONE* 9(4) e94342: 1-9.
  9. Braun, M., Burgstaller H., Hamdoun, A. M. and Walter, H. (1991). Common weeds of Central Sudan. GTZ. Eschborn.
  10. Collente, S. (1999). Wild Flowers of Saudi Arabia. National Commission for Wildlife Conservation and Development, Riyadh.
  11. Corkill, N.L. (1935). Notes on Sudan snakes: a guide to the species represented in the collection in the Natural History Museum, Khartoum. Sudan.
  12. Cromsigt, J.P.G.M., van Rensburg, S.J., Etienne, R.S., Olf, H. (2009) Monitoring large herbivore diversity at different scales: comparing direct and indirect methods. *Biodiversity and Conservation* 18: 1219-1231.
  13. Curlis, J. D., Fisher, E. C., Muhic, W. K., Moy, J., Garro-Cruz, M., & Joaquín Montero-Ramírez, J. (2020). A survey of

- the reptiles and amphibians at the University of Georgia Costa Rica field station in San Luis de Monteverde, Costa Rica. *CheckList*, 16(6), 1433-1456. <https://doi.org/10.15560/16.6.1433>.
14. Del Hoyo, J., Elliott, A., Christie, D., (2007). *Handbook of the Birds of the World*. Vol. 12. 552.
  15. El Amin, H.M. (1990). *Trees and shrubs of the Sudan*. Ithaca press. Exeter. London.
  16. Farallo, V.R., Brown, D.J. and Forstner, M.R.J. (2010) An improved funnel trap for drift-fence surveys. *The Southwestern Naturalist* 55 (3): 457–460.
  17. Greiner, C. (2016). Land-use change, territorial restructuring, and economies of anticipation in dryland Kenya. *Journal of Eastern African Studies*, 10, 530–547.
  18. Hamad, M. S., Ali, Fatima S. M., Mohammed, Safia A. A. and Kordofani, Maha (2020). Checklist of the Flora of Tutti Island, Khartoum Province, Sudan. *Journal of Agriculture and Ecology Research International* 21(4): 27-40; Article no. JAERI.55797 ISSN: 2394-1073.
  19. Harrison, M. N. and J. K. Jackson. (1958). *Ecological classification of the vegetation of the Sudan*. Agricultural Publication Committee, Khartoum.
  20. Ibrahim, A. H., Rahom, M. A. O., Allam, T. and Eltahir, M. E. S. (2021). Assessment of Existing Palearctic Migrant Birds in Jabel El Dayer National Park, North Kordofan State, Sudan, 3(1): 46-63, 2021; Article no. AJRRA.38.
  21. IPCC (2014). *Climate Change 2014: Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y.]
  22. Jawad, L.A. (2021). *Tigris and Euphrates Rivers: Their Environment from Headwaters to Mouth*, Aquatic Ecology Series 11.
  23. Karmeback, V.N., Wairore, J.N., Jirstrom, M., & Nyberg, G. (2015). Assessing gender roles in a changing landscape: Diversified agro-pastoralism in

- drylands of West Pokot, Kenya. Pastoralism: Research, Policy and Practice, 5.  
doi:10.1186/s13570-015-0039-4.
24. Kéry, M. and Royle, J. A. (2016). Applied Hierarchical Modeling in Ecology Vol. 1 (Academic Press, Cambridge,
25. Leenders T (2019) Reptiles of Costa Rica: a field guide. Cornell University Press, Ithaca, New York, USA.
26. Lovschal, M., Bocher, P.K., Pilgaard, J., Amoke, I., Odingo, A., Thuo, A., & Svenning, J.C. (2017). Fencing bodes a rapid collapse of the unique Greater Mara ecosystem. Scientific Reports, 7, 41450.
27. MacKenzie, D. I. *et al.*, (2006). Occupancy Estimation and Modeling: Inferring Patterns and Dynamics of Species Occurrences (Academic Press, Cambridge.
28. Mahmoud, A. and Obeid, M. (1971). Ecological Studies in the Vegetation of the Sudan: I. General Features of the Vegetation of Khartoum Province. *Vegetatio*, Vol. 23, 3/4 (Aug. 26,): 153-176, Published By: Springer
29. Mahmoud N, Elhakeem, M. S. Abdallah A. H. and Kordofani M. (2022). Study about an Inventory of Flora in Um Dom Island (Khartoum State), Sudan. *Current Topics in Agricultural Sciences* Vol. 8: 135-146, DOI: 10.9734/bpi/ctas/v8/15752D.
30. Marjan, J. and Manohar, M. (2014). Distribution of Poaceae, Chenopodiaceae, Papaveraceae and Fumariaceae Plant Families in Fars, Iran an application of GIS in Plant Systematic and Conservation. *Life Science Journal*; 11(6).
31. Nikolaus, G. 1987. Distribution Atlas of Sudan's Birds with Notes on Habitat and Status. Bonner Monographien Nr. 25, Bonn.
32. Obeid, M. and Mahmoud, A. (1971). Ecological Studies in the Vegetation of the Sudan: I. General Features of the Vegetation of Khartoum Province. *Vegetatio* Vol. 23, No. 3/4: 153-176.

33. Raunkiær, C. C (1934). The life forms of plants and statistical plant geography: Oxford, UK: Clarendon Press.
34. Setzer, H. W. (1956). Mammal of Anglo-Egyptian Sudan. Pro. U.S. Nat. Hist. Mus. 106:447-587.
35. Sillero-Zubiri, C., Rostro-Garcia, S. and Burruss, D. (2016). Spatial organization of the pale fox in the Termit Massif of east Niger. American Society of Mammologists.
36. U.N. Convention on Biological Diversity (CBD) (2020). In LANDSCAPE NEWS: Biodiversity 101: Why it matters and how to protect it.
37. Wairore, J.N., Mureithi, S.M., Wasonga, O.V., & Nyberg, G. (2015). Benefits derived from rehabilitating a degraded semi-arid rangeland in private enclosures in West Pokot County, Kenya. *Land Degradation & Development*, 27, 532–541.
38. Wenny, D.G., DeVault, T.L., Johnson, M.D., Kelly, D., Sekercioglu, C.H., Tomback, D.F. and Whelan, C.J. (2011). The need to quantify ecosystem services provided by birds. *Auk* 128:1-14.

#### Electronic Sites:

- <http://apps.kew.org/herbact/navigator.ed>. Kew Herbarium Catalog.
- PROTA (2017). PROTA4U Web database. Grubben GJH, Denton OA, eds. Wageningen, Netherlands: Plant Resources of Tropical Africa. <http://www.prota4u.org/search.asp>
- Useful [Tropical Plants](http://tropical.thefern.info). <http://tropical.thefern.info>. Last update 30.7.2021
- World Flora Online (WFO) Accessed at <http://www.worldfloraonline.org>