

BIODIVERSITY PATTERNS OF TREE SPECIES IN AND AROUND SEASONAL POOLS (MAYAS): A CASE STUDY FROM EASTERN SUDAN

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Abstract: This study was conducted during the dry season (February to May 2016) in Dinder National Park to assess the density, relative density, frequency, and abundance of tree species across five Mayas: Abdel Ghani, Musa, Ras Amir, Ein-Elshamis, and Gererrisa. Using the transect line sampling method, data on tree populations were collected and analyzed. The results showed variation in tree abundance and density per square kilometer among the Mayas. The most abundant and dominant tree species identified were *Acacia seyal*, *Ziziphus* spp., *Combretum* spp., *Balanites aegyptiaca*, and *Acacia polyantha*. Among these, *Acacia seyal* covered the largest area and was the most widespread species in the park. To manage the proliferation of *Acacia seyal*, the study suggests controlled cutting and sale in local markets and nearby villages, which could reduce the need for people to enter the park, thus aiding in conservation efforts.

Keywords: Transect sampling, tree density, relative density, abundance

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INTRODUCTION

The vegetation is sparse in the desert zones of the Sudan and various species of *Acacia* occur in the regions near the Nile valleys. Large forested areas are found in the central Sudan, especially in the river valleys. Among the most common trees are (hashab) *Acacia Senegal*, (talih) – *Acacia seyal*, (heglig) – *Balanite aegyptiaca* and several

species of *Acacia mellifera*. Other varieties of timber trees are found in White Nile basin (Kanno, 2004). The vegetation which includes forest and pastures is the most important element in Dinder National Park (Kanno, 2004). Without vegetation almost no life exists in the park. It is the main source of food for almost all wildlife species of the park and it prevents soil erosion. Vegetation decomposition increases soil fertility and compaction. Therefore, any deterioration in the vegetation means instability in the park ecosystem (Kanno, 2004). *Acacia seyal*, *Combretum hartmannianum* and *Balanite aegyptiaca* formed the woodland with tall grass including sorghum species. The reverie forest is characterized by *Hyphaena thebachia*, *Acacia seibriana*, *Tamarindus indica* and *dalbergiame lanoxylon*. Harrison and Jackson (1958) gave a general classification of Sudan vegetation in which Dinder area is included in the *Acacia seyal* - *Balanite* savanna alternating with grass area zone, and *Anogeissus* – *combretum hartmannianum* savanna woodland zone. The description given by Desman (1972) differs from the rest, in that Desman has classified the vegetation of Dinder National Park into four categories, wooded grassland, open grassland, wooded land and riverine forest. Hakim et al. (1978) and Abdel Hameed (1983) recognized three types of ecosystem *Acacia seyal* – *Balanites* woodland, riverine ecosystem and the mayas (wetland ecosystem). Dinder is mainly and extensively made of savanna grassland, woodland and rain river forest with and a few hills and high land located along and near the Ethiopian border. The park has all the three ecosystems, each with its own plant and animal communities.

Dinner National Park is large area with high diversity of topographic, ecological zones which make the ground survey so difficult to cover the whole park. The vegetation cover in the Park is characteristically important because it relates to the wildlife management which provides the animals with food, water, shelter and cover. The aim of this study was to identify the trees species and their distribution, densities, relative densities, frequency and abundance in the park.

MATERIALS AND METHODS

Study area

Dinder National Park was established in 1935. It is the most important Wildlife reserve in southeast Sudan. The park is located in the north eastern Blue Nile state towards the Ethiopian border between latitudes (11 to 13°N) and longitudes (35 to 13°E) and about 550 km south east Khartoum. It situated between two seasonal rivers Dinder and Rahad. Dinder National Park covers about (100,446.8 Km²). The climatic conditions of the park in general can be summarized as cool and dry in winter and wet and warm in summer (Hashim, 1987).

Table 1. Densities, relative densities, frequency and abundance of trees in north and west direction of Abdel Ghani Maya in Dinder National Park.

Tree species	Transects									
	North					West				
	No of Trees	Density per km	Relative density	Frequency	Abundance	No of Trees	Density per km	Relative density	Frequency	Abundance
Acacia Seyal	46	7324.8	0.0722	0.65	7324.8	32	5095.5	0.0312	0.5	5095.5
Acacia nilotica	69	10987.2	0.108	0.15	10987.2	18	2866.2	0.0176	0.1	2866.2

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Acacia Polycantha	123	19585.1	0.094	0.6	19585.1	425	67675.1	0.4157	0.7	67675
Acacia Sieberiana	0	0	0	0	0	0	0	0	0	0
Balaniteaegyptia	38	6050.1	0.0596	0.6	6050.1	53	8439.4	0.0518	0.6	8439.4
ZizphusSpp	0	0	0	0	0	13	2070.0	0.0127	0.1	2070.0
CombertumSp	18	159.2	1.569	0.05	159.2	5	0	0	0	0
Cratevaadanso	1	2866.2	0.028	0.4	2866.2	0	796.1	4.890	0.1	
Gardinaspp`	0	0	0	0	0	0	0	0	0	0
Total	295	101432.6				546	162796.9			

Methods

The study was conducted in Dinder National Park during the dry season from February to May 2016. The vegetation data were collected along two randomly placed (in different directions) 1 km long transects at each of the five Mayas.

The starting point of transects was taken from the edge of the Maya along to the woodland. Along each transect a circular plots of each 10 meters radius were established (totaling to 20

$$\text{Abundance} = \frac{\text{Number of individuals}}{\text{Number of plots in which species occur}}$$

plots) and the tree species inside the circle were identified, counted and recorded in all the 20 plots. The area of each plot was calculated according to the formula $A = \pi r^2$ then multiplied by 20 to determine the total area surveyed along the transect (1km).

The summation individual number of stems of each tree species was computed. Then, the density, the relative density, frequency, and abundance of each tree species were calculated.

The data was calculated according to formula:

$$\text{Density} = \frac{\text{Total number of individual}}{\text{Area sampled}}$$

$$\text{Relative density} = \frac{\text{Density of a given species}}{\text{Total density of all species}} \times 100$$

$$\text{Frequency} = \frac{\text{Number of plots species occur}}{\text{Total number of plots}} \times 100$$

RESULTS AND DISCUSSION

The dominant tree species in Abdel Ghani Maya was Acacia polycantha, with density of (19585.1) per km² followed by Acacia nilotica (10987.2), Balanities aegyptiaca (6050.1) Acacia seyal (7324.8) and Combertum spp (2866.2). Zizyphus spinachristi and gardenia spp were not observed. Acacia seyal showed the highest densities along the transect laid out in northern direction than the one in western direction and this may be attributed to the availability of baboon (Papio anubis) in that area who contributed significantly in distribution of these trees.

Acacia nilotica showed higher density in northern direction and this may be attributed to the availability of water in that area (Table 1).

The number of tree species were higher in western direction than in north of the Musa Maya. The dominant trees species were *Acacia seyal* with the density of 99044.5 per km² followed by *Zizphus spp*, *Acacia nilotica*, *Balanit* *eaegyptiaca* and *Combertum spp* (Table 2).

Table 2. Densities, relative density, frequency, and abundance of trees in north and west direction of Musa Maya in Dinder National Park.

Tree species	Transects									
	North					West				
	No of Trees	Density per km	Relative density	Frequency	Abundance	No of Trees	Density per km	Relative density	Frequency	Abundance
<i>Acacia Seyal</i>	90	14331.2	0.3405	0.7	14331.2	622	99044.5	0.78182	1.8	99044.5
<i>Acacia nilotica</i>	0	0	0	0	0	15	2388.5	0.1209	0.15	2388.5
<i>Acacia Polycantha</i>	12	1910.9	0.05479	0.15	1910.9	2	318.4	0.01612	0.18	318.4
<i>Acacia Sieberiana</i>	0	0	0	0	0	5	796.1	0.0403	0.15	796.17
<i>Balaniteaegytiaca</i>	16	2547.8	0.07305	0.4	2547.8	22	3503.1	0.1774	0.5	3503.1
<i>ZizphusSpp</i>	8	1273.9	0.03652	0.15	1273.9	47	7484.0	0.3790	0.4	7484.07
<i>CombertumSpp</i>	20	3980.9	0.1141	0.1	3980.9	0	159.2	0.0628	0.05	159.2
<i>Cratevaadansonina</i>	25	3184.8	0.0913	0.35	3184.8	1	0	0	0	0
<i>Gardinaspp`</i>	0	0	0	0	0	0	0	0	0	0
Total	264	34872.8				124	19744.8			

In Ras- Amir Maya the dominant tree species Combertum spp. In general we found that the are Acacia seyal with the density of 21974.5 per densities of tree species in northern direction is km² followed by Zizphus spp, Crateva greater than that in the western direction and this adonensonia, Balanitie aegyptiaca and may be attributed to the dryness of that part (Table 3).

In southern side of Ein- Elshmis Maya the number of tree species in the south is greater than that of the northern one. The dominant tree species **Table 4**. Densities, relative densities, frequency and abundance of trees in north and south direction of Ein- Elshamis Maya in Dinder National Park.

Tree species	Transects									
	North					South				
	No of Tree s	Densi ty per km	Relati ve densit y	Frequen cy	Abundan ce	No of Tree s	Densi ty per km	Relati ve densit y	Frequen cy	Abundan ce
Acacia Seyal	150	23885.3	0.5136	0.85	23885.3	45	212	33757.9	0.670	1
Acacia nilotica	0	0	0	0	0	0	0	0	0	0
Acacia Polycantha	63	10031.8	0.2157	0.85	10031.8	20	15	2388.5	0.047	0.25
Acacia Sieberiana	0	0	0	0	0	0	0	0	0	0
Balaniteaegyptiac a	2	318.4	6.847	0.1	318.4	86	58	9235.6	0.183	0.6
ZizphusSpp	3	477.7	0.0102	0.5	477.7	27	72	11464.9	0.227	0.4
CombertumSpp	74	0	0	0	0	42	0	0	0	0
Cratevaadansoni a	0	11783.4	0.253	0.8	11783.4	0	24	3821.6	0.075	0.55
Gardinaspp`	0	0	0	0	0	0	0	0	0	0
Total	292	46496.6				220	381			

Table 5. Densities, relative densities, frequency and abundance of trees in northern and southern direction of Grerrisa Maya in Dinder National Park.

Tree species	Transects									
	South					West				
	No of Tree s	Densi ty per km	Relati ve densit y	Frequen cy	Abundan ce	No of Tree s	Densi ty per km	Relati ve densit y	Frequen cy	Abundan ce
Acacia Seyal	57	9076.4	0.2896	0.75	9076.4	85	13535.0	0.338	0.75	13535.0
Acacia nilotica	2	318.4	0.0101	0.1	318.4	10	1592.3	0.0398	0.05	1592.3

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Acacia	45	7165.6	0.2286		7165.6	2	318.4	7.966	0.1	318.4
Polycantha										
Acacia	1	129.2	4.1226	0.05	129.2	0	0	0	0	0
Sieberiana										
Balaniteaegytiac	7	1114.7	0.0355	0.15	1114.7	20	3184.8	0.0796	0.05	3184.8
a										
ZizphusSpp	9	1433.1	0.0457	0.15	1433.1	101	16082.8	0.402	0.35	16082.8
CombertumSpp	61	2070.0	0.0660	0.15	2070.0	32	0	0	0	0
Cratevaadanson	13	9713.3	0.3099	0.76	9713.3	0	5095.5	0.127	0.5	5095.5
ia										
Gardinaspp`	2	318.4	0.0101	0.1	318.4	1	159.2	25350.3	0.05	159.2
Total	197	31339.1				251	39968			

in Ein –Elshamis Maya were Acacia seyal with the Gardenia spp showed fewer densities in Gererrisa with the density of 16082.8 per km² followed by density of 33757.9 per km² followed by Maya and the number of trees in western direction Acacia seyal, Acacia polycantha, Combertum spp Combertumspp, Zizphuaspp, Acacia polycantha is higher than the southern one. The dominant and Balanite aegyptiaca (Table 5).

And Balanite aegyptiaca (Table 4). Tree species in Gererrisa Maya were Zizphus spp The general dominant tree species was Acacia

seyal in all area searched and this is in line with the findings of (Desman, 1972). Acacia seyal and Balanite aegyptiaca association changes into Anogeissus leiocarous and Combretum spp (Hakim and Nimir, 1983).

The recent study revealed that in burnt areas almost

90%of the regenerated growth is of Acacia seyal which is more resistant to fire than the other two dominant` species, Balanite aegyptiaca and Combretum hartmannianum and this agreed with the findings of Abdel Hameed et al (1999)

Form the above discussion the expansion of these dominant tree species at the account of open grass land has a negative impact on wildlife species that prefer open grass land as their habitat.

Conclusion

The densities of the tree species in the five Mayas are different. The highest densities were observed in Abdel Ghani Maya followed by Musa, Ein-Elshamis, Ras-Amir and Gererrisa. Acaia seyal showed the highest densities in comparison with other tree species. Acacia seyal covers larger area in Dinder National Park and also one of the common and dominant tree species.

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