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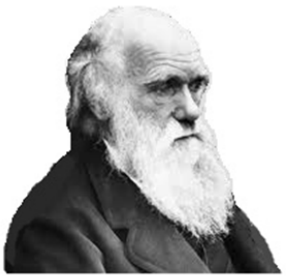

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Distribution and relative density of trees species in Kainji Lake National Park, Nigeria

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ABSTRACT

The importance of trees in the environment cannot be overemphasized. This present study, therefore, deals with the distribution and relative density of trees species in Kainji Lake National Park. Data were collected using plot sampling techniques. Therein, a 50 by 50 m^2 plot was randomly laid. Within each sample plot, data on all trees ≥ 10 cm in diameter at breast height were enumerated. The data were analyzed using descriptive statistics. The result shows that different types of plants species were enumerated in the selected plots. This included six families of trees: Fabiaceae, Caesalpiniaceae, Rubiaceae, Maliaceae, Annonaceae, and Mimosaceae. The percentage score of tree species in the four plots reveals that *Afzelia africana* recorded the highest with a total number of 60 species, followed by *Detarium macrocarpium* with 47 species, while *Anogeissus leiocarpus* and *Azadirachta indica* recorded 31 and 17 species, respectively. *Gardenia aqualla* was the least species recorded. The density and relative density of *Afzelia africana* recorded the highest, with 1.2 ha and 26.9%, followed by *Detarium microcarpiuum* with 0.94 ha and 21.1%, respectively, while *Gardenia aqualla* was the least with 0.02 ha and 0.4%. In terms of mean height, *Daniela oliveri* recorded the highest, with 28.1 m, followed by *Afzelia africana* with 21.8%, while *Azadirachta indica* was the least with 5.8%. The mean DBH of *Entada africana* and Anogeissus leiocarpus recorded was 28.7 cm and 28.1 cm, while *Prosopis africana* and *Accacia gournmaensis* recorded 14.0 and 13.4, respectively, which were the least. The Types of wild animal species that are associated with the tree species include Baboon, Kob, Grim duiker, Francolin, Patas monkey, etc. Relative abundance of the animal species shows that *Papio anubis* recorded the highest, with 40.5 individuals, while *Erythrocebus patas* recorded the least, with 2.5 individuals.

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***Keywords*:** Distribution, relative density, trees, species, Kainji Lake National Park

1. INTRODUCTION

Trees as part of vegetation resources play an integral part in human and economic development of any nation, for the simple reason that economic trees are crucial for meeting the majority of rural energy needs, they (trees) provide many basic needs for life, such as medicine, food, fodder, timber, environmental protection and sustainability, etc. Based on this, therefore, it could be concluded that trees touch almost all aspects of life (Rabi'u and Murtala, 2013).

Forest provides habitat for organisms that make up earth biodiversity, many small animals use trees as shelter and protection from predators. The natural forest ecosystems have economic benefits potentials to the nation. The environment, according to Agbogidi and Ofuoku (2007), is the closest neighbor of man. Man depends directly and indirectly on the environment for almost everything relating to growth and survival on the planet earth. Among the major biotic components of the environment are forests and other vegetation and the wise management of the environment depends on a better understanding of their components. Given the dynamic nature of the global ecosystem, environment changes, driven by man-made and natural cause is inevitable. Economic activities and the rate of population growth have increased to a point where the effect of humanity on the environment can no longer be ignored (Aimufia, 2002).

The importance of forest to mankind cannot be overemphasized. Agbogidi and Eshegbeyi (2008) noted that forests and forest products play vital roles in human life from the cradle to the grave. Aimufia (2002) emphasized that the cot on which the baby lies at birth, the buildings and furniture he uses, at the various levels of his education, his endeavours in industry and agriculture, the accommodation and furniture he acquires as a worker/ entrepreneur, his diet and health sustaining systems, the armchair, he relaxes on his old age, and the coffin or casket in which he returns to Mother earth, are forest dependent. Keay *et al*. (1989) and Abu and Adebisi (2002) stated that the traditional uses of forests are basically for subsistence, income, environmental and social/ culture.

Aliyu (2006) stated that reasonable numbers of trees are threatened by habitat loss, following heightened deforestation. Although there is a great incompatibility between urbanizations/ industrializations, the agriculture and conservation developmental activities should be environmentally friendly to allow for a sustained productivity (Agbogidi and Okonta, 2009).

Critically, over 50 million people in Africa depend on trees for a multitude of economic, social and environmental services and disruption or degradation of these services have a number of detrimental impacts upon communities livelihoods (Anderson *et al*., 1999). Arnold (1998) interestingly points out that once deforestation of trees occur, it increases the area for potential grazing practices which can further degrade the land.

Allen and Breshears (1998) exemplify that wood resources levels are affected by vegetation changes and shortened fallow periods. A number of researchers have highlighted that similar regions have experienced decreases in the length of fallow periods and therefore a resultant decrease in soil fertility which affect ecosystem compositions (FAO, 2001).

If trees are not managed properly, the tree canopy cover can become dense, blocking out light so that no other plants can grow beneath them. This can lead to decreased diversity of economic trees with many rarer plants species. The high rate of exploitation and gross miss use of natural resources have led to a large scale reduction in the number of wildlife species in Nigeria. Sufficient data, regarding the ecological surveys of economics trees in our reserve areas, are yet to be established, the reason therefore prompted this study.

2. METHODOLOGY

2. 1. Study Area

Kainji Lake National Park is located in The North West central part of the country between latitude 9°45'N and 10°23'N and longitude 3°40'E and 5°47'E (**Fig. 1**). It is made up of two sectors, Borgu and Zugurma. Borgu sector is situated in Borgu and Kaima/Baruten Local Government Area of Niger and Kwara state, respectively, while Zugurma sector is situated in Mashegu Local Government of Niger state. It covers a total land area of 5,340.82 m^2. The major features of the climate of the park is that it is divided into wet and dry seasons and the variability is from year to year. The wet season extends from May to November, while the dry season extends from December to April.

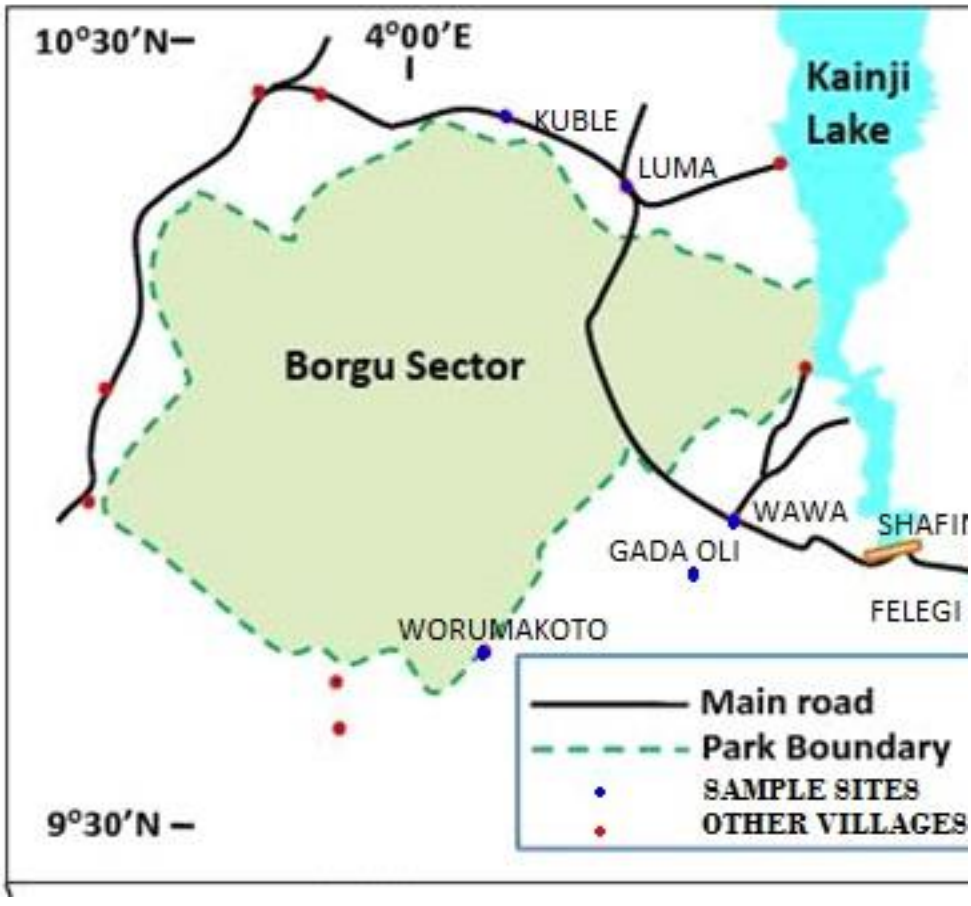

Fig. 1. Map of The Study Area
Source: Ayeni, 2017

The mean annual rainfall of the sector varies from 1,100 mm in the trends surface analyses of the mean annual rainfall in the sector by Milligan 1979, indicated a decrease in rain from the south to the north, an increase rainfall towards the west and east, and generally low condition in the central and northern region, which stretches from the north through the central regions, to the south. Temperature of the park shows a distinct pattern of temperature. It is high in the dry season, just before the rain and lower during the wet season, it picks up again towards the end of the wet season and later drops to the lowest value in December and January, during the harmattan. The highest temperatures are recorded between April and May and between July and August, there is also a marked variation between the Maritan temperature during the dry light hours, with morning temperature greater than afternoon temperature. Absolute temperature may be more extreme than average values, as during the harmattan, temperature may be more extreme than average values as during the harmattan, temperature as low as 10 °C may occur in the Oli valley, while diurnal temperature during this period may exceed 30 °C.

The relative humidity appears to increase gradually from value at the beginning of the day season to a peak during the wet season, and in general the relative humidity follows an opposite pattern to that of the temperature. Wind is both the incidence and duration of the wet season, and considering the year as a whole, the northern winds predominate over southern winds in the sector of the park. There is also a distinct season trend, with the dry dusty, Northern winds prevailing during the beginning of the dry season, that is November to February, while the moist southern winds prevail throughout the wet season.

2. 2. Methods of data collection

A reconnaissance survey was carried out in the study area prior to the detailed study to identify areas where the site plots will be mapped out. Plot sampling techniques were used, a 50 by 50 m^2 plot was randomly laid. Within each sample plot, data on all trees ≥ 10 cm in diameter at breast height were enumerated. The data obtained were entered into data sheet in the field. The data were analysed using descriptive statistics in the form of tables, charts, and frequency distribution.

3. RESULTS

Table 1 shows different types of plants species that were enumerated in the selected plots, six families of trees were enumerated which include fabiaceae, caesalpiniaceae, rubiaceae, maliaceae, annonaceae, and mimosaceae. The percentage score of tree species in the four selected plots was revealed in **Table 2**, in which *Afzelia africana* recorded the highest with a total number of 60, followed by *Detarium macrocarpium* with 47, while *Anogeissus leiocarpus* and *Azadirachta indica* recorded 31 and 17, respectively. *Gardenia aqualla* is the least species recorded. **Table 3** shows the tree density, relative density, height mean, and mean DBH of the trees in the study area, the density and relative density of *Afzelia africana* recorded the highest with 1.2 ha and 26.9%, followed by *Detarium microcarpiuum* with 0.94 ha and 21.1%, respectively, and *Gardenia aqualla* was the least with (0.02 ha and 0.4%). In terms of height mean, *Daniela oliveri* recorded the highest with 28.1 m, followed by *Afzelia africana* with 21.8%, and *Azadirachta indica* as the least, with 5.8%. The mean DBH of *Entada africana* and Anogeissus leiocarpus recorded to be 28.7 cm and 28.1 cm, while *Prosopis Africana* and *Accacia gournmaensis* recorded 14.0 and 13.4, respectively, which are the least.

Table 1. Types of plants species in the study area

s/n	Scientific name	Family name	Plot 1	Plot 2	Plot 3	Plot 4
1	*Parkia biglobosa*	Fabiaceae	++	++	++	--
2	*Entada Africana*	Caesalpiniaceae	++	--	--	++
3	*Gardenia aqualla*	Rubiaceae	--	--	--	+
4	*Azadirachta indica*	Maliaceae	++	++	++	++
5	*Terminalia nigrican*	Rubiaceae	++	--	--	--
6	*Daniela oliveri*		++	--	++	--
7	*Prosopis africana*		++	++	++	++
8	*Afzelia africana*	ceasalpiniaceae	++`	++	--	++
9	*Ficus thonnigii*		--	--	++	++
10	*Anogeissus leiocarpus*	annonaceae	--	++	--	++
11	*Accacia gournmaensis*	Mimosaceae/fabacea e	--	+ +	++	--
12	*Morinda lucida*	Rubiaceae	++	++	++	++
13	*Piliostigma thonnigii*	caesalpinioideae	++	++	++	++
14	*Detarium microcarpum*	Caesalpiniaceae	++	++	++	++
15	*Vitellaria paradoxa*		--	++	++	++

++ Present, -- Absent

Table 2. Percentage Score of Tree Species in the four Selected Plots of Kainji Lake National Park (Borgu Sector)

s/n	Scientific name	Family name	Plot 1	Plot 2	Plot 3	Plot 4	Total
			F(%)	F(%)	F(%)	F(%)	
1	*Parkia biglobosa*	Fabiaceae	5(62.5)	2(25.5)	1(12.5)	0(0)	8
2	*Entada Africana*	caesalpiniaceae	7(87.5)	0(0)	0(0)	1(12.5)	8

3	*Gardenia aqualla*	Rubiaceae	0(0)	0(0)	0(0)	1(100)	1
4	*Azadirachta indica*	Maliaceae	11(64.7)	3(17.6)	2(11.8)	1(5.9)	17
5	*Terminalia nigrican*	Rubiaceae	2(100)	0(0)	0(0)	0(0)	2
6	*Daniela oliveri*		2(33.3)	0(0)	4(66.7)	0(0)	6
7	*Prosopis Africana*		1(25.0)	1(25.0)	1(25.0)	1(25.0)	4
8	*Afzelia Africana*	ceasalpiniaceae	42(70.0)	15(25.0)	0(0)	3(15.0)	60
9	*Ficus thonnigii*		0(0)	0(0)	2(66.7)	1(33.3)	3
10	*Anogeissus leiocarpus*	Annonaceae	0(0)	2(6.5)	0(0)	29(93.5)	31
11	*Accacia gournmaensis*	Mimosaceae/ fabaceae	0(0)	14(93.3)	1(6.7)	0(0)	15
12	*Morinda lucida*	Rubiaceae	2(33.3)	1(16.7)	1(16.7)	2(33.3)	6
13	*Piliostigma thonnigii*	caesalpinioideae	1(25.0)	1(25.0)	1(25.0)	1(25.0)	4
14	*Detarium microcarpum*	Caesalpiniaceae	14(29.8)	9(19.1)	22(46.8)	2(4.3)	47
15	*Vitellaria paradoxa*		0(0)	3(27.3)	5(45.5)	3(27.3)	11
Total			**87**	**51**	**40**	**45**	**223**

Table 3. Tree Density, Relative Density, Height Mean, and Mean D.B.H.

s/n	Scientific name	Total Number of Species	Density (ha)	Relative Density (%)	Height Mean (m)	Mean DBH (cm)
1	*Parkia biglobosa*	8	0.13	3.6	7.2	17.8
2	*Entada Africana*	8	0.13	3.6	9.5	28.7
3	*Gardenia aqualla*	1	0.02	0.4	6.0	19.02
4	*Azadirachta indica*	17	0.36	7.6	5.8	33.2
5	*Terminalia nigrican*	2	0.04	0.9	18.3	22.0
6	*Daniela oliveri*	6	0.12	2.7	28.1	68.6
7	*Prosopis Africana*	4	0.08	1.8	17.0	14.0
8	*Afzelia Africana*	60	1.2	26.9	21.8	39.2

9	*Ficus thonnigii*	3	0.06	1.3	14.2	17.9
10	*Anogeissus leiocarpus*	31	0.61	13.9	12.1	28.1
11	*Accacia gournmaensis*	15	0.3	6.7	4.2	13.4
12	*Morinda lucida*	6	0.12	2.7	8.9	22.7
13	*Piliostigma thonnigii*	4	0.08	1.8	9.8	23.1
14	*Detarium microcarpum*	47	0.94	21.1	6.6	26.0
15	*Vitellaria paradoxa*	11	0.22	4.9	19.7	31.2
Total		**223**		**99.99**		

Table 4. Types of Wild Animal Species that are found in the Study Area

Common Name	Scientific Name	Plot1	Plot2	Plot3	Plot4
Baboon	*Papio Anubis*	++	++	++	++
Kob	*Kobus kob*	++	−−	−−	++
Grim Duiker	*Sylvicapra grimmia*	−−	−−	−−	++
Francolin	*Francolinus bicalcarabus*	++	−	−	−−
Stone Partridge	*Ptilopachus petrosus*	−−	++	++	−−
Guinea Fowl	*Guttera edouardi*	++	++	++	−−
Grouund Hornbill	*Bucorvus abyssinicus*	−−	++	−−	−−
Patas Monkey	*Erythrocebus patas*	++	−−	−−	−−

++ Present, −− Absent

Table 5. Relative abundance of Wild Animal Species in the Four Selected Plots of KLNP

Common Name	Scientific Name	Plot 1	Plot 2	Plot 3	Plot 4	Total Number	Relative Abundance
Baboon	*Papio anubis*	8	6	11	7	32	40.5
Kob	*Kobus kob*	7	0	0	3	10	12.7

Grim Duiker	*Sylvicapra grimmia*	0	0	0	3	3	3.8
Francolin	*Francolinus bicalcarabus*	13	0	0	0	13	16.5
Stone Partridge	*Ptilopachus petrosus*	0	4	8	0	12	15.2
Guinea Fowl	*Guttera edouardi*	2	1	3	0	6	7.6
Ground Hornbill	*Bucorvus abyssinicus*	0	1	0	0	1	1.3
Patas Monkey	*Erythrocebus patas*	2	0	0	0	2	2.5
Total		**32**	**12**	**22**	**13**	**79**	**100.0**

Types of wild animal species that are associated with the tree species are recorded in **Table 4**, which includes Baboon, Kob, Grim duiker, Francolin, Patas monkey, etc. Relative abundance of the animal species is shown in **Table 5**, *Papio anubis* recorded the highest with 40.5, while *Erythrocebus patas* recorded the least with 2.5.

4. DISCUSSION

The analysis of trees diversity indices shows that the tree are not evenly distributed in the study area, although the result indicated that Plot 1 was more diverse and rich. This could be attributed to the fact that the plot lies along the major river (River Oli) thus retaining water for a longer period. However, Plot 2 was more even in terms of species distribution. This could be attributed to varying levels of exploitation within the park. Like many primary forests/reserves in the tropical region of the world, the original vegetation of the study area has been extensively modified (Jimoh *et al*., 2009). One of the most factors known to influence the use of land and other natural resources wildlife reserve is human population growth and their activities (Coomes *et al.*, 2000). Hence, the fair result obtained for tree species richness and diversity in the area may have been influenced by degradation of the vegetation through a human impact. Ahmed (2013) equally observed that habitat loss/degradation is responsible for biodiversity loss and ultimate extinction of species. This result is in accordance with Johnson and Marcellinus (2015), who reported that areas that are interfered with by human exploitation usually have these components disturbed and the balance disrupted. The effects of the disturbance vary in severity, depending on how much of the natural environment is still preserved in the process of resources exploitation and development. Generally *Afzelia africana* had the highest value for both, frequency, density, and relative density and had been one of the most dominant species in the Park. While *Gardenia aqualla* is the least amongst trees enumerated. A total of seventy nine animal species within the class mammalian and Aves were recorded. This research study was able to establish that despite the increasing anthropogenic activities threatening the park, the park still has a potential to support conservation activities, such as game viewing, wilderness experience, medical plant tours, and bird watching. This support the finding of Agbelusi (1995)

that the potential and resources of the Park are many and varied from flora to fauna, to water resources that are adequate and can conveniently support research work and ecotourism activities. It could be deduced that there was a presence of large mammals such, as Roan antelope. Presence of avian species, such as Francolin, Grey hornbill, etc., were observed during the field observation. Some of these fauna resources are listed among the species of wildlife associated with wildlife tourism, drawing public attention and are more regularly observed by the ecotourism (Ayeni, 2007).

5. CONCLUSION AND RECOMMENDATION

A total number of 223 trees were enumerated, belonging to 6 families in the study area. The families of *Rubiaceae* and C*aesalpiniceae* were the most highly represented, each with two or more species. All others had only one species each. *Afzelia africana* recorded the highest frequency, relative density, density, and mean DBH, while *Gardenia aqualla* recorded the least. It was demonstrated in the study that the park has exceptional rich biodiversity and are home to populations of trees and wild animals, all threatened by the loss of forest. The areas are under constant bush burning. This change has impacted the forest ability to withstand the effect of climate change and these excessive bush burning if the impacted is not checked will result to the loss of many more trees that serve as home for wild animals.

Recommendations

- Indiscriminate cutting of large trees and shrubs, in and around the park, should be stopped so as to allow plants growth
- Uncontrolled bush burning should be stopped
- There should be a forum to stop the local communities from entering the park to hunt and to carry out other illegal activities.

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