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Implications of management practices on the physiognomic features of the vegetation at the Kainji Lake National Park, Nigeria

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Abstract

Implications of management on the physiognomic features of vegetation at Kainji Lake National Park (KLNP) was carried out between December 2013 and July 2014. This is a popular tourist destination and its physical state is thus of concern. Information on percentage species composition, canopy cover, girth sizes, crown volume, life form, wildlife population and ground cover by vegetation types was obtained by point –centre-quarter and point-intercept-techniques. Park workers were interviewed on the type of vegetation management adopted for the Park. Areas commonly subjected to burning were marked in each vegetation type. Vegetation types identified were- *Terminalia macroptera* tree savanna (Tm), *Isoberlinia tomentosa* woodland (It) and *Burkea/Detarium* woodland (B/D).Percentage bare ground for *Terminalia macroptera* vegetation (1.3%) was significantly ($p<0.01$) lower than the 6.9% for *Isoberlinia tomentosa* vegetation and 9.5% for B/D vegetation. However, the values obtained for tree canopy in the Terminalia macroptera and B/D vegetation was lower than 77.2% obtained in *Isoberlinia tomentosa* woodland. Annual grass which constituted 9.1% of the *Isoberlinia tomentosa* vegetation shows no significant ($p<0.05$) difference with a value of 10.1% in *Terminalia macroptera* vegetation while the values for perennial grass were not different ($p>0.05$) between two vegetation types. Percentage litter and woody plants were not significantly ($p>0.05$) different between the vegetation types. Burning generally improved canopy cover and life forms.

Key words: vegetation types, fire, management practices, protected area

Introduction

The study area for this article was Kainji National Park which is a national park in Niger State and Kwara State, Nigeria. It was established in 1978 and it covers an area of about 5340.82 km² in totality. Fire is an important traditional tool in tropical land management. Fire is widely used in tropical land conversion and regrowth removal (Malingreau and Tucker 1988, Eva and Lambin 2000, Aragão *et al*. 2008) because it is an economically attractive management tool to farmers lacking access to machinery or fertilizer and pesticides (Pyne 2001). Consequently, fire management helps support 300 million of the world's forest-based poor (Brady 1996). Fire use and management throughout the tropics is diverse and context dependent. Burning benefits plant growth primarily because of changes in the physical rather than the chemical environment (Bond and van Wilgen, 1996). Direct effects stimulate seeds to germinate and indirect effects provide a more favourable environment for germination to occur (Senthilkumar et al., 1998). Direct effects following burning are generally to do with the exposure of seeds to high temperatures or plant derived smoke that have scarifying effects on seeds (Bebawi and Campbell, 2002). Fire creates opportunities for enhanced plant reproduction through increased flowering, seed dispersal and by removing plant covers thereby reducing competition from established plants (Pandey, 1988).

Rangeland deterioration will continue to occur unless remedial measures are taken. The challenge is to integrate the conservation, preventative and remedial action and ongoing management of rangelands to protect biological diversity and maintain the ecological processes which provide the productive capacity of its natural resources. Intensive rangeland improvement methods such as fertilization, replacement and reinforcement, rapidly increase production by 100% within 1 to 3 years, but these are expensive and difficult to implement (Trollope, 1999). Although prescribed burning and grazing intensity rangeland management tools have comparatively low potential increases in forage production and plant species diversity potential benefits, they are not labor intensive and are widely applied cost-effective approaches that can be used to reverse or decelerate rangeland deterioration (Fuhlendorf and Eagle 2004; Mapiye et. al., 2006).

Prescribed burning (or controlled burning) is the use of fire under specific conditions to achieve desired goals (Trollope, 1999). It has the potential to manipulate rangeland vegetation to favour optimum forage and animal productivity (Trollope and Trollope, 1996). Nigeria is blessed with rich and unique array of ecosystems and a great variation in natural resources. These have evolved a diversity of fauna and flora supporting more than 1,340 species of animals, among which are 274 mammals, 860 birds and about 4,600 species of plant (FORMECU, 1996). This ranks Nigeria as one of the richest countries of Africa in terms of biodiversity (FMoE, 2001). However, wildlife conservation and management have been facing many social and ecological problems in Nigeria.

Several authors have identified some of the factors affecting biodiversity conservation in Nigeria, including land clearing for agriculture and uncontrolled logging, gathering of firewood (Asibey and Child, 1990); overgrazing and deforestation; indiscriminate or ill-planned bush burning; high population rate and illegal hunting for bush meat (Akinyemi and Oduntan, 2004) and shape of the landscape, drainage, vegetation and soil types (Ayodele and Lameed, 1999).

Materials and Methods

Study area

Kainji Lake National Park was established in 1979 by the merger of the two former Game Reserves – Borgu Game Reserve (located in Niger and Kwara State) and Zugurma Game Reserve (located in Niger State), the two sections had been gazetted in 1962 and 1971 respectively as Game Reserves by the then Northern Regional Government. It was the first National Park and the second largest of all the eight National Parks in Nigeria. It is located between latitude 9^0 $4^0$1 and 10^0 $3^0$1N and longitude 3^0 $3^0$1 and 5^0 $5^0$1E and has a total landmass of 5,370.82km2. It has a savanna climate. Night temperature can be as low as 7^0C near Oli River. The drainage system in the two sectors of Kainji Lake National Park is maintained by the Oli, Menai and Doro Rivers (Borgu sector) and Manyara and Nuwa Zurugi Rivers (Zurguma sector). The mean annual rainfall varies from 1100mm in the eastern part to 1150mm in the western part. The trend surface analysis of the mean annual rainfall in Borgu sector indicates a decrease in rainfall from the south to the north and increasing rainfall toward the west and east (Milligan, 1979).

The park officials were interviewed on the type of vegetation management being carried out and the consequences of such management on the population ecology of wild animals.

Reconnaissance survey

In December 2014, a reconnaissance survey was carried out in order to identify the vegetation types of the park as described by Geerling (1976). Areas subjected to early burning within vegetation types were marked for easy identification.

Wildlife Populations

Eighteen ground counts of wild animals were made in each vegetation type, between January and March, 2014. For the censuses, a four wheeled drive and 8x30 pairs of binoculars for ground counts were used. Vehicle moved at 20km.p.h and animals were counted to the right and left of the transect length. Sighting and perpendicular distances for each animals encountered were determined in order to arrive at effective transect width. Morning counts (9 for each vegetation) commenced at 08:00hrs while that for evening was 16:00 hours.

Vegetation Analysis

Vegetation analysis was carried out during the month of June and July 1987 when all the burnt areas had fully grown into grasses. The point centered quarter method of plotless sampling described by Cottam and Curtis (1956) was used for vegetation analysis (physiognomic features and site indices) in three vegetation types: *Terminalia macroptera* tree savanna, *Burkea* / *Detarium* Savanna woodland and *Isoberlinia tomentosa* wood land. The stations were approximately randomized by pacing distances and casting rod to locate the centre point approximately randomized by pacing distances and casting rod to locate the centre point. At each sampling point, four quarters were established using a cross.

The individual plant nearest the point in each quarter was located and their distances from the sampling point were measured and recorded. Physiognomic features assessed include percentage canopy cover, list and percentage of the common dominant plant species composition, percentage frequency as the occurrence of a species at a sampling point, trunk diameter at breast height (circumference ÷ 3.14) and crown volume. Ground cover and canopy cover were further estimated by the point-intercept technique. This involved the use of a point frame made from wood 1 metre high and 1 metre long. Ten wire pins of the same length as the legs of the frame were slid through holes set 10cm apart. A sample point was determined by lowering a pin until its tip first contacted a plant or bare ground.

The height of trees or woody plants was estimated by pacing distances and angular measurements technique described by Muellar –Dumbois and Elienberg (1974). Each of these indices was determined within the burnt site, marked earlier.

Data Analysis

From the raw data, the parameters to be evaluated were calculated using the following formulae:

a) Density: The density of each species was calculated as

$$\frac{\text{(total number of the species)}}{80} \times \text{(number of trees in } 100m^2\text{)}$$

$$\text{Relative Density} = \frac{\text{number of individual species}}{\text{Total number of individuals}} \times 10$$

b) Dominance: For each tree species, the Basal Area was calculated from the formula

$$\text{Basal Area} = \frac{C^2}{4\pi}$$

Where C – circumference (girth) with the assumption that it is the point at which the girth measured is circular.

The mean basal area of the species was obtained.
Dominance was therefore calculated as (mean basal area) x (number of trees in $100m^2$)

Relative Dominance as:

$$= \frac{\text{(Dominance of a species)}}{\text{Dominance of all species}} \times 100$$

c) Frequency:

$$\frac{\text{(the number of points with species)}}{20} \times 100$$

Relative Frequency as:

$$\frac{\text{(Frequency of a species)}}{\text{Sum frequency of all species}} \times 100$$

d) Importance Value (I.V)

(Relative Density) + (Relative Dominance) + (Relative Frequency)

e) Crown Volume: This was calculated with the formulae $4/3\pi r^3$ for spherical shaped crowns and $2/3\pi r^3$ for hemisphere shaped trees.

f) Ground and canopy cover: For each index, this was calculated as:

$$\frac{\text{(total number of hits for the index)}}{200} \times 100$$

Statistical Analysis

The Student's t-test for test of significance between two means of independent samples was used.

Results

Interview on Management Practices at KLNP

Results emanating for the interview with KLNP staff on vegetation management indicate that habitat improvement programs: transplanting, seeding, pruning, slashing and thinning have never been carried out in the Park, rather the vegetation is subjected to annual burning in order to facilitate visibility for game viewing, reduce fuel load emanating from the annual grasses and forbs, and provide early flush of grasses for wild animal feeding during the dry month of December to April. The burning regimes are carried out as follows:

i) Early burning, from November of a year to February of the following year, for those parts of the Park where most of the grasses have dried out.
ii) Late burning, from March to May, for any other fuel that was left unburnt after the early burning.

For effective implementation of this technique as contained in the management plan document for the Park, the Borgu sector of the Park is divided into six blocks, and burning is carried out rotationally.

The early burning reduces tall grasses, and induces early flush of perennial grass. The early flush is reported to attract grazers in large numbers to these areas. On the other hands, early burning limits the movement and distribution of animal herds like the elephant which are reported to restrict their activities only to the unburnt areas. Late burning enhances the establishment of perennial grass species such that perennial grass growth is abundant during the rains and the animals are distributed almost evenly in the Park.

Table 1 shows the relative density, relative frequency and relative dominance of tree species in three vegetation types at KLNP. *Butyrospermum paradoxum, Detarium microcarpum* and *combretum* species were present in each of the vegetation types sampled. In addition, *Terminalia macroptera, Piliostigma thonningii, Pseudocedrela kotschyi, Daniellia oliveri* and *Naudea latifolia* were encountered in the *Terminalia macroptera* vegetation. Species composition in the *Isoberlinia tomentosa* and *Burkea* / *Detarium* (B/D) woodland was similar except for *Annona senegalensis* and *Maytenus senegalensis* recorded for only *Burkea*/ *Detarium* woodland.

A relative density of 34.2% obtained for *Detarium microcarpum* in B/D was significantly ($p<0.01$) higher than either the 14.8% or 0.6% obtained in the *Isoberlinia tomentosa* and *Terminalia macroptera* vegetation, respectively. The difference in relative density of *Butyrospermum paradoxum* between the vegetation types was significant ($p<0.01$) and similar to the trend obtained for *Detarium microcarpum* while relative density for *Combretum* sp (9.2%) in the *Terminalia macroptera* was higher than the relative density (5.5%) for *Isoberlinia tomentosa* and 4.2% for B/D vegetation. There was a tendency for the density of common tree species to be higher in the B/D than in the *Isoberlinia tomentosa* vegetation. This higher value was significant ($p<0.01$) for *Burkea africana*.

Data on relative dominance shows that *Terminalia macroptera, Isoberlinia tomentosa* and B/D constituted 59.3%, 42.3% and 38.1% of total tree species in the respective vegetation types. The relative frequency of tree species in the *Terminalia macroptera* tree savanna ranged between 54.3% for *Terminalia macroptera* and 0.6% for *Detarium microcarpum*. In the *Isoberlinia tomentosa* woodland, *Isoberlinia tomentosa* ranked highest with a relative frequency of 32.0%, Gardenia sp (5.7%) and *Butyrospermum paradoxum* with 5.0%. Relative frequency in the B/D savanna ranged between 0.5% for *Annona senegalensis* and 19.5% for *Terminalia sp*.

Table 1: Relative density, Relative frequency and Relative dominance of tree species in three vegetation types at KLNP

	Relative density			Relative frequency			Relative dominance		
	Tm	It	B/D	Tm	It	B/D	Tm	It	B/D
Terminalia macroptera	72.0	-	-	54.3	-	-	59.3	-	-
Combretum sp.	9.2	5.5	4.2	18.7	8.1	12.2	13.7	4.2	2.9
Piliostigma thonningii	6.9	-	11.6	6.5	-	8.3	4.6	-	9.0
Pseudocedrela kotschyi	5.4	-	-	8.2	-	-	4.0	-	-
Daniellia oliveri	2.2	-	3.2	3.2	6.3	-	7.2	-	1.6
Naudea latifolia	3.8	-	-	1.4	-	5.6	5.2	0.5	-
Butyrospermum paradoxum	0.5	9.2	6.4	3.6	5.0	8.5	0.8	16.0	17.2
Detarium microcarpum	-	14.8	34.2	0.6	14.2	19.1	0.5	2.8	15.1
Burkea Africana	-	19.4	25.5	-	10.4	14.5	-	9.0	23.0
Terminalia sp.	-	4.6	8.9	-	4.9	19.5	-	3.1	7.4
Gardenia sp.	-	6.2	3.3	-	5.7	7.8	-	1.8	3.0
Annona senegalensis	-	-	0.6	-	0.3	0.5	-	2.0	0.9
Crossopteryx febrifuga	-	8.0	0.5	-	12.0	2.0	-	5.2	7.2
Maytenus senegalensis	-	-	0.9	-	-	0.9	-	-	4.4
Isoberlinia tomentosa	-	29.9	-	-	32.0	-	-	42.3	-
Others	-	2.4	1.0	3.5	1.1	1.1	4.7	13.1	8.3

Legend
Tm - *Terminalia macroptera* tree savanna
It – *Isoberlinia tomentosa*
B/D – *Burkea/ Detarium* savanna woodland

Table 2 shows percentage canopy, ground cover life forms of herbs in three vegetation types at KLNP. Percentage bare ground for *Terminalia macroptera* vegetation (1.3%) was significantly ($p<0.01$) lower than the 6.9% for *Isoberlinia tomentosa* vegetation and 9.5% for B/D vegetation between where there were no significant ($p<0.05$) difference. However, the similar ($p>0.05$) values for tree canopy in the *Terminalia macroptera* and B/D vegetation was lower than 77.2% obtained in the *Isoberlinia tomentosa* woodland. Annual grass which constituted 9.1% of the *Isoberlinia tomentosa* vegetation shows no significant ($p<0.05$) difference with a value of 10.1% in the *Terminalia macroptera* vegetation while the values for perennial grass were not different ($p>0.05$) between two vegetation types. Percentage litter and woody plants were not significantly ($p>0.05$) different between the vegetation types.

Table 2: Percentage canopy cover, ground cover and life forms of herbs in three vegetation types at KLNP

Cover	Vegetation types			
	Tm	It	B/D	mean
Bare ground	1.3	6.9	9.5	5.9
Litter	4.9	4.0	5.2	4.7
Perennial grass	51.2	45.9	43.1	46.7
Annual grass	10.0	9.1	8.2	9.1
Forbs	12.2	15.2	14.8	14.1
Woody plants	20.4	18.9	19.2	19.5
Total	100.0	100.0	100.0	100.0
Tree canopy	56.4	77.2	41.2	58.3

The percentage girth size distribution of tree species in the three vegetation types is shown in table 3. In each of the vegetation types, girth sizes of most tree species did not exceed 100cm. Only 32.2% of *Terminalia macroptera* vegetation, 14.0% of *Isoberlinia tomentosa* and 14.5% B/D vegetation occurred under girth rate below 50cm. Although the 36.1% of *Terminalia macroptera* vegetation and 12.2% of the *Isoberlinia tomentosa* vegetation in the 50-100cm girth size range were not widely different from the corresponding values for those with girth size below 50cm, the 4.6% of B/D in 50-100cm range was significantly ($p<0.01$) lower than the value of 14.5% for girth size below 50cm.

A comparative analysis of species common to the three vegetation types shows that *Combretum* sp. with girth size less than 50cm was least common in the B/D (2.9%) and most common in the *Terminalia macroptera* (6.8%). *Butyrospermum paradoxum* in the B/D vegetation constituted 4.6% of trees with girth size in the 50-100cm range, a significantly ($p>0.01$) higher value than 1.8% obtained in each of *Terminalia macroptera* and *Isoberlinia tomentosa* vegetation.

Table 3: Percentage girth size distribution of tree species in the three vegetation types at KLNP

Species	50cm			50-100cm			100cm		
	Tm	It	B/D	Tm	It	B/D	Tm	It	B/D
Terminalia macroptera	32.2	-	-	36.1	-	-	7.8	-	-
Combretum sp.	6.8	4.5	2.9	2.0	2.3	-	2.9	1.0	-
Piliostigma thonningii	5.9	-	10.0	-	-	-	-	-	-
Psedocedrela kotechyi	-	-	-	3.5	-	-	-	-	-
Daniellia oliveri	12.1	-	-	3.2	-	1.1	2.8	-	-
Nauclea latifolia	1.0	2.4	-	1.8	-	-	-	-	-
Butyrospermum paradoxum	1.3	-	-	2.3	1.4	4.6	4.0	1.8	5.6
Detarium microcarpum	1.8	8.0	14.5	-	2.8	2.0	-	-	-
Burkea Africana	-	6.3	12.0	-	2.0	4.7	-	-	6.2
Terminalia sp.	-	1.5	10.9	7.2	2.9	-	-	2.0	1.0
Gardenia sp.	-	4.8	11.9	-	3.3	-	-	1.5	-
Annona senegalensis	-	-	2.8	-	-	-	-	-	2.1
Crossopteryx febrifuga	-	6.5	-	-	1.0	1.2	1.5	2.6	-
Maytenus senegalensis	-	-	4.0	-	-	-	-	-	-
Isoberlinia tomentosa	-	14.0	2.0	-	12.2	1.8	-	9.3	1.5
Others	3.0	-	-	1.0	1.9	-	-	-	-
Total	64.1	48.0	71.0	57.1	29.8	15.4	19.0	18.2	16.4

Table 4 shows the crown volume and average height of tree species in the three vegetation types at KLNP. Among the common tree species, *Combretum* sp. appeared to be the shortest in all vegetation types with a height of 5.8m, 6.8m and 7.2m in *Terminalia microptera* tree savanna, B/D and *Isoberlinia tomentosa* woodland respectively. *Butyrospermum paradoxum* was tallest (15.4m) in *Terminalia macroptera* and shortest (10.5m) in the B/D while *Detarium microcarpum* essentially maintained a height of 13.4±1.0m in the three vegetation types.

Height essentially ranged between 4.5m for *Piliostigma thonningii* and 15.4m for *Butyrospermum paradoxum* in the *Terminalia macroptera* vegetation. In the *Isoberlinia tomentosa* vegetation, *Ptilostigma thonningii* was also the shortest (5.4m) tree species while *Detarium microcarpum* was the tallest (14.4m). Each of *Maytenus senegalensis* and Gardenia sp. had the lowest height of 4.5m while Terminalia sp. was the tallest (15.2m) in the B/D woodland.

Table 4 Crown volume and average height of tree species in three vegetation types at KLNP

Species	Height (m)			Crown Volume (cm^3)		
	Tm	It	B/D	Tm	It	B/D
Terminalia macroptera	8.5	-	-	23350.0	-	-
Combretum sp.	5.8	7.2	6.8	20652.4	10028.2	836.6
Piliostigma thonningii	4.5	5.4	-	5615.9	-	2926.9
Psedocedrela kotechyi	6.2		-	9826.6	-	-
Daniellia oliveri	10.5	-	-	21715.7	-	-
Nauclea latifolia	6.8	-	-	5280.3	-	-
Butyrospermum paradoxum	15.4	12.6	10.5	2446.2	9020.9	19235.0
Detarium microcarpum	12.4	14.4	13.4	1095.5	13049.5	5444.8
Burkea Africana	-	12.6	12.6	-	46502.4	27033.4
Terminalia sp.	-	10.2	15.2	-	6808.8	4418.7
Gardenia sp.	-	5.8	4.5	-	6975.0	874.6
Annona senegalensis	-	-	7.2	-	-	10.3
Crossopteryx febrifuga	-	6.4	5.3	-	29339.5	3714.5
Maytenus senegalensis	-	-	4.5	-	-	-
Isoberlinia tomentosa	-	12.4	-	-	346409.1	-
Others	8.1	12.0	-	5306.6	6457.2	-

Table 5 shows the distribution of large animal population in relation to vegetation types at KLNP. This table shows that *Burkea* is associated with hartebeest, bushbuck, oribi and cob as well as buffalo. *Detarium* is associated with buffalo and kob. *Afzelia* is associated with oribi, warthog and red duiker. *Isoberlinia* is associated with hartebeest, roan antelope and warthog; *Afzelia* is associated with duikers.

No animal was sighted in *Terminalia*. The baboons were distributed in all the vegetation types except Olli complex. Bushbuck was not sighted in the other vegetation types viz*: Isoberlinia, Acacia*, the fringing forest and Olli complex. Oribi was also selective in habitat association. Hippopotamus was sighted only in the hippo pool. No elephant and lion were sighted throughout the period of the census.

Table 5: Distribution of large mammal population in relation to vegetation types at KLNP

Species	Population (n/35km^2) of wild animals by vegetation types								
	B	**D**	**A**	**I**	**As**	**Av**	**Ff**	**Oc**	**Total**
Baboon	900	500	1407	-	800	900	899	-	5401
Bushbuck	250	300	150	-	-	-	-	-	200
Waterbucks	200	98	-	-	-	-	-	102	400
Duiker	100	80	250	87	75	30	100	133	855
Oribi	350	200	100	-	-	-	200	100	1350
Western hartebeest	350	200	50	500	250	100	150	800	2400
Kob	2500	3600	300	-	100	2500	800	1000	10800
Roan antelopes	305	327	-	1384	38	92	105	-	2296
Warthog	350	-	325	30	-	-	100	-	805
Hippopotamus	-	-	-	-	-	-	-	35	35
Buffalo	631	758	-	-	400	553	-	-	2343
Green monkey	100	200	134	-	91	50	40	60	675
Elephant	-	-	-	-	-	-	-	-	-
Lion	-	-	-	3	-	5	-	-	8
Patas monkey	58	70	34	-	3	5	8	-	128

Legend
B- *Burkea* , D- *Detarium*, A- *Afzelia*, I- *Isoberlinia,* As- *Acacia* savannah,
Av- *Acacia* variant, Ff – Fringing forest, Oc – Olli complex

Discussion

In this study, it has been ascertained that the only vegetation management practice at KLNP is burning. The reasons why other management practices such as transplanting, direct seeding, rejuvenation, release, mechanical and technical thinning are not embarked upon, might not be divorced from the quality of the habitat which is naturally maintained for most part of the year. The advantages of burning enumerated in the work of (Bebawi and Campbell, 2000. Pandey, 1988) stated that savanna trees sprout well before the grasses and often long before the beginning of rains. If the vegetation is subjected to late burning alone, the cover will be removed almost totally. Also, effective control of woody growth depends on the frequency of burning and the intensity of each fire which depends on the amount of fuel available after grazing. Also, the immediate result of early burning is provision of flush for dry season grazing.

The introduction of tree species non-typical of this region of the savanna was not noticed. All the tree species in each vegetation type are typical fire tolerant savanna species. In terms of relative frequency, the tree species after which the vegetation types were named ranked highest suggesting that fire failed to alter species composition, frequency and dominance.

There is improvement in the percentage plant cover. Most of the bare ground observed during the study, especially in *Isoberlinia tomentosa* woodland and *Terminalia macroptera* tree savanna was under tree canopies. The relative high percentage of bare ground in the *Burkea/Detarium* woodland tends to support that this vegetation type should be protected from fire. The high percentage of perennial grass cover is an indication that there is adequate availability of high quality forage for grazers while the relative low percentage of woody plants is an indication that regenerating stumps and seedlings are killed by fire annually. This is in agreement with the work of Obot et. al. (1982).

Trollope, (1999) has shown that cover is of great ecological importance because apart from provision of shelter and protection, it also gives a good measure of plant biomass. The high percentage canopy cover in *Isoberlinia tomentosa* woodland as well as its large crown volume shows that adequate shelter and protection is given wildlife species in this vegetation type. Despite the fact that biomass production has not been monitored for this study, it can be contingent from the good plant cover that there is likely to be high biomass production in the park. Moreover, the amount and characteristics of the plant biomass are of direct importance to the animals associated with the vegetation, because the plant biomass provides their shelter and food. The vegetation at KLNP has not only been managed towards achieving this goal but the goal is achieved as indicated by the results.

The higher percentage of trees in the lower (50-100cm) girth size range is an indication that the vegetation is still developing towards a climax, and observation similar to that of Obot et.al ascertained that fire retards the natural development of vegetation towards a forest or woodland type climax and may hold it more or less permanently in a tree savanna stage. Since there is a more or less uniform treatment of the vegetation types to the burning regimes, the highest percentage of trees in the girth size range of 50-100cm obtained from the *Isoberlinia tomentosa* woodland could be due to some other factors and not fire alone. The likely factors are topography, soil type, water availability and degree of utilization of this habitat by wildlife. Olli River is the principal source of perennial water in the park.

The species which were encountered along the river were kob, baboon, duikers and waterbucks. In the savanna vegetation, species encountered the most were hartebeest, roan antelopes and oribi. Therefore, animals such as roan antelopes and baboons which browse extensively are less dependent on water. The absence of the elephant form the park is not clear. Probable reasons for their absence could be either due to the absence of adequate cover in the dry season or due to noise disturbance by the Nigerian Air force planes which are flown across the park almost daily. The absence of wild animal species in the *Terminalia macroptera* vegetation could be due to inadequate forage for dry season grazing. The wildlife /vegetation association suggests that warthog, roan antelope and baboon tend to select the woodland habitat.

Tourism value of KLNP

Kainji Lake National Park (KLNP) was the primary National Park established among the eight that are presently in Nigeria.

> "As a matter of fact, it said to be one of the jewels of Nigeria inland and containing a number of flora and fauna resources of the country. With temperature ranges

> between 10oc and 30oc and an average relative humidity of 53%,the Park houses a lot of wildlife like: elephants, lions, buffaloes, antelope, hunting dogs, hippos, patas, monkey, lion, python, Nile crocodile. There are also leopard, hyena, kob, cobra, green snake, bush buck, tilapia, mountain reedbuck, red flanked duiker, oribi, grimms duiker, warthog, mongoose, stone partridge, snake head, hadada ibis, Bee eaters, electric cat fish clawless otters, hartebeest, turtles, manatees, roan goanna, baboons, antelopes, kobs, ape, Ducker, crocodile and countless others. In addition, approximately 180 species of birds have been recorded to be housed by the park. And they include secretary bird, ground hornbill, jugglers, oriole warbler, great white pelicans and other rare pale arctic migrants. The Climate exhibits wet and dry seasons from April to November and November to April respectively. The mean annual rainfall is 1100 to 1200mm for about 200 days. It is, however, important to note that at Kainji Lake National Park, you can enjoy wilds-experience, conservation-education-lectures, easy housing and restaurant, boating on the lake; including a tour of Hydropower station, tour of cultural places, fishing, sightseeing, camping facilities, indoor games and movies cabled from the satellite network. And for the record, there are two rivers in the park namely, Oli Menei, Doro and Manyara Rivers" (Pulse.ng, 2018).

The national park encompasses a landmass of about 5,340 kilometers and is separated into three main regions made up of two game reserves and a Lake viz.: the Borgu Game Reserve, the Zugurma Game Reserve, and the Kainji Lake. There is also a Wildlife Museum worth a visit.

Conclusion

The tree species composition at KLNP depicts a typical savanna ecosystem with fire tolerant species. The influence of fire, as a management practice on the physiognomy of the vegetation has been shown by the slow recruitment of tree species into the higher girth size range which for a wildlife habitat is satisfactory. This is because the indices - crown volume and canopy cover had shown that there is adequate cover, shelter and shade for wild animals. The low percentage of bare ground in each of the vegetation types compared with the other indices - annual grass cover, perennial grass, forbs and woody plants cover means that the life forms of herbs in this habitat is not only adapted to annual fires but has also maintained sufficient ground cover in order to check erosion as well. Wild animals in the park are associated with vegetation types based on their food and water requirements viz: while the western hartebeest, roan antelope and oribi prefer the woodland, the kob, waterbuck and duiker prefer riverine areas.

Therefore, it is important to monitor this habitat from time to time to check deterioration and ensure that it is corrected in order to meet the requirement of these various species of wildlife. As at present, however, the present structure and composition of the vegetation at KLNP does not demand for another management practice apart from burning.

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