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PLANT DIVERSITY AND COMPOSITION IN PANDAM WILDLIFE PARK, PLATEAU STATE, NIGERIA

[1]Okechalu, A. A., [2]Amonum, J. I. and [2]Agbidye, F. S.
[1]Federal College of Forestry, Jos, Plateau State, Nigeria
[2]Department of Forest Production and Products, Federal University of Agriculture, Makurdi, P.M.B. 2373 Makurdi, Benue State, Nigeria

*Corresponding Author: akpalaj@gmail.com

ABSTRACT

The Pandam wildlife park was surveyed to assess its plants diversity and composition with a view to determining its diversity status and conservation potential. Data were collected from 10 sample plots of 50m x 50m, laid in alternate positions at 250m interval on 2 transects lines of 200m x 200m with a distance of 500m laid between the transects across three vegetation types (savannah woodland, swamp zone and riparian forest). Tree species were identified and Diameter at Breast Height (DBH) of each species was measured. A total of 25,043 of individual plants were identified, distributed in 64 species, 36 genera and 29 families. Trees were 1136 individuals, representing 4.54%, 5602 were herbs (22.4%) and 18266 were saplings (73.05%). The woodland savanna recorded the highest number of species (34) with 49 trees, 58 saplings and 51 shrubs. Fabaceae, Combretaceae and Poaceae were the most dominant families with 25.30%, 9.85% and 8.45% respectively. Anogeissus leiocarpus, Azadirachta indica, Daniellia oliverii, Vitex doniana and Terminalia spp were the dominant tree species encountered. The study revealed that Pandam Wildlife Park had an average species diversity value of between 2.08 (woodland savanna) to 2.65 (swamp forest). The study area had moderate species diversity. Swamp forest area had the highest number (624) of tree stands. The forest trend of the area was a reversed J-shape diameter distribution indicative of healthy recruitment potentials and anthropogenic activities. Therefore, it is recommended that efforts be geared towards the sustainability of fragile species in the Park.

Keyword: Plant diversity, Composition, Conservation Potential, Pandam Wildlife Park

INTRODUCTION

Protected areas in Nigeria harbour most of the remaining interesting biodiversity, but these areas vary in the amount of actual protection occurring on the ground (USAID, 2008). Some wildlife parks including Pandam wildlife parks, have enclave villages, and like all protected areas are closely surrounded by communities that continue to expand their agricultural practices in ever-increasing patches of disturbance. Forest and wildlife parks in the country were originally set up in recognition of the importance of many tree species and the associated flora and fauna around the country (USAID, 2008). Within these areas are many endemic plant species and some that are commercially valuable, like mahogany and other hardwoods. Most of these reserves are now mostly only protected on paper, as they continue to be subjected to official and unofficial unsustainable logging, and

virtually unrestrained firewood and plant collecting.

Floristic analyses are very useful for identifying spatial patterns in plant diversity and composition hence the need for their regular assessment to determine their status (ITTO, 2006). Species richness ensures the maintenance of ecosystem diversity and the continuous sustenance of the services provided by the system. Hence biodiversity assessment has been recognized as a veritable tool guiding biodiversity conservation (Margules and Pressey 2000; Phillips *et al.*, 2003; Royal Society 2003). The savannah forests have been highly degraded thus necessitating the need to work towards their recovery through implementation of research output (ITTO, 2006).

Pandam Wildlife Park is presently undergoing many changes due to anthropogenic activities most especially the conversion of the forest to farmland. There is an urgent need to determine floristic composition of Pandam Wildlife Park. There are few or no scientific works conducted on plant diversity in the Pandam Wildlife Park**.** Therefore, the aim of the study was to identify plants species composition, measure plant species diversity at Pandam by measuring the species richness, evenness and Shannon-Weiner Diversity Index

MATERIALS AND METHODS

Study Area: The study was conducted at Pandam Wildlife Park. It is situated in Plateau State in the guinea savanna ecologic zone of Nigeria. The State land mass covers 53,585 square meters. Plateau State is bounder with Benue, Nasarawa, Kaduna and Bauchi. The Park covers an area of 224 square kilometers (Ijeomah, 2007; Ezealor, 2002). It lies between latitudes $8^0$35' N and $8^0$55' N, and longitudes 8º 00' E and 8º 45' E.

Two rivers, the Dep and the Li, drain the Park, and join before emptying into the River Benue. The land slopes gradually southwards and forms a basin (Pandam Lake) which is a wetland complex of approximately 2 km^2. The vegetation of the Park is typical Sudan-Guinea savanna with gallery forests in riparian areas. The surrounding farmlands have scattered trees and some bush. Crops cultivated include maize, yam, guinea corn, beans and cassava. Grazing also occurs in the farmlands (Dami and Manu, 2008).

Sampling and Data Collection

The major vegetation types were identified in the Wildlife Park. The vegetation types were classified as Savanna woodland (SW), Swamp zone (SZ) and Riparian forest (RF). Stratified Sampling and Systematic Sampling Techniques were adopted to capture the variable vegetation types. The inventory of species was conducted on two transects (sizes 2000 × 2000 m) with a distance of 500m laid between the two transects across the three vegetation types (in savannah woodland, swamp zone and riparian forest). Ten (10) sample plots of (50m x 50m each) in size was laid in alternate positions along each transect at 250m interval in each study site according to Adekunle and Olagoke (2008).

Diameters of trees were measured using diameter tape in cases of large trees; identification of plant samples were carried out using flora field guides (Keay, 1989). Identified tree species were grouped into species and families and presented in tables, charts, percentages, relative frequency, relative density and Important Value Index (IVI). Important value index was calculated for trees by summing relative frequency and relative density values for all species of trees. IVI were used to identify dominant species in the study area.

Floral species identification

Floral species were identified in the field with the assistance of a taxonomist and unidentified sample were collected and

identified at the Herbarium at the Federal College of Forestry Jos.

Measurement of tree variables

Trees were classified using the following categories: seedlings (diameter < 5cm), saplings (diameter: 5 - 9.9 cm) poles ≥ 10 – 19.9cm) and mature trees (DBH > 20cm). The trees were identified, counted and total merchantable height of poles and matured trees were determined using a Spiegel relascope. The diameter at breast height, top and at the middle of matured trees and poles were measured for volume calculation. For shrubs, lianas and herbs smaller sample plots of 5m by 5m and 1m by 1m were laid in the larger plot (following Omeja *et al.*, 2004)

Data Analysis

Tree species classification and diversity indices

All trees were categorized into their families and numbers of species in each family were determined for tree species diversity classification. Frequencies of occurrence were obtained for species abundance/richness. The diversity indices used include: The Important Value Index (IVI) (based on Muller-Dombois and Ellengberg, 1974):

$$IVI = R.D + R.Do. + R.F \quad \ldots\ldots\ldots (1)$$

Where:

IVI = Important Value Index

R.D = r elative density, R.Do =relative dominance and R.F=relative frequency was calculated as follows

$$\textbf{\textit{Species relative density}}\ (\textbf{\textit{RD}}): RD = ni\ x\ 100/\mathrm{N} \quad \ldots\ldots\ldots (2)$$

Where: RD = relative density, n_i = number of individuals of species i and N = total number of individuals in the entire population by taking the stock of individual tree species.

Relative dominance:

$$R.Do = (Bai\ x\ 100)/\Sigma BAn \quad \ldots\ldots\ldots (3)$$

Where:

RDo = relative dominance, BA_i = Basal Area of all individual trees belonging to a particular species i and BA_n= Stand Basal Area.

Relative Frequency (RF):

$$\frac{RF = \sum_{F1} x100}{Fn} \quad \ldots\ldots\ldots (4)$$

Where:

Fi = number of plots where species i will be encountered and F_n = total frequency of all species.

Species richness: Community diversity was obtained using a mathematical formula that takes into account the species richness and abundance of each species in the vegetation. Margalef index was use used to compute Species richness as cited by Spellerberg (1991) and Magurran (2004). The formula of Margalef index is as follows:

$$\mathrm{D} = \frac{S-1}{\ln N} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

H^1 is the Shannon diversity index, S is the total number of species in the community, pi is the proportion of a species to the total number of plants in the community and Ln is the natural logarithm.

Species evenness (E) in each of the vegetation were determined using Shannon's equitability (EH)

$$E = \frac{H^1}{\ln(S)}$$

Where: S is the total number of species in each of the vegetation type.

RESULTS

Flora Species Compositions and Richness in Woodland Savanna Forest of Pandam Wildlife park

A total of 25,043 of plant species were identified (trees, herbs and saplings) distributed in 64 species, 51 genera and 28 families were recorded in Pandam Wildlife Park. Out of this number, 1136 individuals were identified as trees, representing 4.54%, 5602 individuals were identified as herbs (22.4%) and 18266 individuals were recorded as saplings (73.05%).

The result of this finding on floral diversity in Pandam Wildlife Park of Plateau state was assessed and shown on Table 1. Based on the result of this finding, 624 individual tree stands were identified in Swamp forest region, followed by 318 tree stands recorded in Riparian forest while the least number of individual trees stands of 204 was identified in woodland savanna forest in the study area. Number of species was recorded as 34 (woodland savanna), followed by 23 in Riparian forest and 18 species recorded in Swamp forest regions of the study area. The number of tree species families identified was 9, 8 and 6 families each recorded in Swamp, Riparian and Woodland savanna forests respectively, in the study area.

Sapling plants were enumerated, and recorded on individual plants as 6,229, 6066 and 6000 in Swamp, Riparian and Woodland savanna forests respectively. Sapling plants had 29, 21 and 20 number of species recorded in woodland savanna, swamp and riparian forests respectively. Number of families under the sapling life form was 8 in woodland savanna and 1 in riparian forests.

Herbaceous plants were also assessed and based on the result recorded, 2882 individual was obtained under the riparian forest, followed by swamp forest which had 2554 individual herbs while the least number (166) of individual was recorded from woodland savanna forest. Woodland savanna forest had the highest number (11) of herbs species from 7 families, followed by swamp forest which had 8 number of herbs species from 4 families while riparian forest recorded 10 herbs species from 10 families in the study area (Table 1).

Table 1: Flora Diversity in Pandam Wildlife Park, Plateau State

Life forms	Variables	Woodland	Swamp	Riparian
Tree	No. of Individual	204	624	318
	No. of Species	34	18	23
	No. of Families	6	9	8
Sapling	No. of Individual	6,000	6,229	6,066
	No. of Species	29	21	20
	No. of Families	8	-	1
Herbs	No. of Individual	166	2,554	2,882
	No. of Species	11	8	10
	No. of Families	7	4	3

Table 2 shows the result of species occurrence in families across the Vegetation Types in the study area. Based on the result, *Fabaceae* was the most dominant family with 5 species from woodland savanna, 9 from swamp and 4 riparian forests. This was

followed by *Combretaceae* which had 4 tree species from woodland savanna, 2 from swamp and 1 tree species from riparian forest, *Poaceae* had 2 tree species from woodland savanna, 1 from swamp and 3 tree species from riparian forest. The families with the least occurring species of 1 from each were: *Agavaceae, Anacardieceae, Apocynaceae, Arecaceae, Bombacacae, Chrysobalanaceae, Connaraceae, Dioscoreaceae, Gentianaceae, Loganiaceae, Nacardiaceae, Sterculiaceae, Verbenaceae* and *Vitaceae* (Table 2).

Table 2: Families Identified across the Vegetation Types in Pandam Wildlife Park

	Occurrences of Tree Families			
Families	**Woodland Savanna**	**Swamp Forest**	**Riparian Forest**	**Total**
Agavaceae	-	-	1	1
Anacardieceae	1	-	-	1
Annonaceae	2	-	-	2
Apocynaceae	1	-	-	1
Araceae	1	1	1	3
Arecaceae	-	-	1	1
Asteraceae	1	1	-	2
Bignoniaceae	1	-	1	2
Bombacacae	1	-	-	1
Chrysobalanaceae	1	-	-	1
Combretaceae	4	2	1	7
Commelinaceae	-	1	1	2
Connaraceae	1	-	-	1
Dioscoreaceae	1	-	-	1
Fabaceae	5	9	4	18
Gentianaceae	1	-	-	1
Labiatae	1	-	-	1
Loganiaceae	1	-	-	1
Malvaceae	1	1	3	5
Meliaceae	1	1	-	2
Moraceae	1	1	1	3
Nacardiaceae	-	1		1
Poaceae	2	1	3	6
Rubiaceae	-	2	-	2
Sapotaceae	2	1	1	4
Sterculiaceae	1	-	-	1
Verbenaceae	-	1	-	1
Vitaceae	1	-	-	1
Total	**31**	**23**	**17**	**71**

Important Value Index (IVI) of Tree Species across the Vegetation Types in Pandam Wildlife Park

Result on IVI of tree species across the Vegetation Types (woodland savanna, riparian forest and swamp forest) in Pandam Wildlife Park is presented on Tables 3. Based on the result, in woodland forest, eleven (11) tree species had higher IVI, these tree species include: *Daniellia oliveri* (81.93), *Vitellaria paradoxa* (29.60), *Lannea shimperi* (25.63), *Combretum glutinosum* (24.62), *Pterocarpus erinaceus* (23.49), *Anogeissus leiocarpus* (21.44), *Azadirachta indica (15.06), Sterculia setigera* (13.02), *Bombax costatum* (12.95), and *Holarrhena floribunda (10.73)*.

Eight (8) tree species were identified with an IVI values less than 10; these trees were the least dominant tree species and they include: *Ficus sur, Parinari polyandra, Pterocarpus santaloides, Clerodendrum capitatum, Pennisetum purpureum, Annona senegalensis and Grewia mollis* (Table 3).

In Riparian forest 13 tree species that were dominant in the area, these include: *Santiria trimera* (55.96), *Paullinia pinnaga* (18.71), *Synespalum glycyderum* (17.46), *Commelina benghalensis* (14.78), *Nauclea latifolia* (13.85), *Elaeis guineensis* (12.63), *Malacantha alnifolia* (12.5), *Diocorea prochensis* (12.47), *Pterygota bequaetii* (11.91), *Andropogon zectorum* (11.74), *Vitex doniana* (10.93), and *Parkia biglobasa* (10.25). The least dominant tree species were: *Ipomoea involucrate* (1.75), *Terminalia macroptera (*1.78), *Anogeissus leiocarpa* (2.67), *Pandanus cardelabrum* (5.65), *Pterocapus santalinoides* (5.62), *Achomanes welwitschil* (6.46) and *Dialium guineense* (6.63).

The most dominant tree species in the swampy forest were: *Vitex donianna* (27.03), *Parkia biglobasa* (26.39), *Daniellia oliveri* (26.29), *Dialium guineense* (23.13), *Berlinia grandiflora* (20.29), *Terminalia spp* (20.04), *Ficus abutilifolia* (19.52) and *Haematostaphis barteri* (18.50) while the least dominant tree species identified in the study area were: *Tricalysia okelensis* (4.39), *Mitragyna inermis* (6.33), *Albizia zygia* (6.99), *Grewia barteri* (7.38) and *Anogeissus leiocarpus* (8.73).

The most dominant tree species in the study area are*: Anogeissus leucarpus, Azadirachta indica, Daniellia oliveri, Ficus spp, Dialium guineense, Grewia spp, Parkia biglobasa, Lannea shimperi, Vitelleria paradoxa, Terminalia spp, Pterocapus santalinoides, Vitex donianna.* These tree species which occurred in all the three Vegetation Types of the study as indicated on Tables 3.

Table 3: Important Value Index (IVI) of Tree Species across the Vegetation Types in Pandam Wildlife Park

Species	Woodland Area			Riparian Area			Swamp Area			Mean IVI
	RF	RD	IVI	RF	RD	IVI	RF	RD	IVI	
Acacia seyal	-	-	-	-	-	-	3.7	4.3	13.3	11.7
Achanthus montanus	-	-	-	1.2	1.2	5.0	-	-	-	2.5
Achomanes welwitschil	-	-	-	2.5	2.5	6.5	-	-	-	5.0
Albizia zygia	-	-	-	-	-	-	2.8	1.2	7.0	13.3
Andira inermis	-	-	-	2.3	2.3	6.5	-	-	-	6.5
Andropogon zectorum	-	-	-	5.9	5.9	11.7	-	-	-	6.5
Annona senegalensis	1.6	0.6	3.0	-	-	-	-	-	-	3.0
Anogeissus leiocarpus	7.9	5.3	21.4	1.2	1.2	2.7	-	-	-	12.1
Azadirachta indica	6.1	5.0	15.1	-	-	-	7.3	3.7	15.0	15.0
Berlinia grandiflora	-	-	-	-	-	-	6.5	8.4	20.3	6.1
Bombax costatum	6.4	1.9	13.0	-	-	-	-	-	-	13.0
Borassus aethiopium	-	-	-	2.3	2.3	6.1				7.0
Cassia mimosoides	-	-	-	3.7	3.7	9.5	-	-	-	9.5
Clerodendrum capitatum	1.6	1.7	3.8	-	-	-	-	-	-	3.8
Combretum glutinosum	8.2	9.3	24.6	-	-	-	10.1	8.4	26.3	25.5
Commelina benghalensis	-	-	-	7.2	7.2	14.8	-	-	-	14.8
Daniellia oliverii	11.6	37.5	81.9	-	-	-	-	-	-	81.9

Dialium guineense	-	-	-	2.5	2.5	6.6	-	-	-	6.6
Dialium guineense	-	-	-	-	-	-	5.5	9.0	23.1	23.1
Diocorea prochensis	-	-	-	3.7	3.7	12.5	-	-	-	12.5
Elaeis guineensis	-	-	-	5.9	5.9	12.6	-	-	-	12.6
Ficus abutilifolia	-	-	-	-	-	-	5.5	6.8	19.5	19.5
Ficus sur	4.9	1.5	6.8	-	-	-	-	-	-	6.8
Grewia barteri	-	-	-	-	-	-	2.8	1.8	7.4	7.4
Grewia mollis	1.5	0.9	3.8	-	-	-	-	-	-	3.8
Haematostaphis barteri	-	-	-	-	-	-	4.6	8.0	18.5	18.5
Holarrhena floribunda	6.4	1.9	10.7	-	-	-	-	-	-	10.7
Ipomoea involucrate	-	-	-	1.1	1.1	1.8	-	-	-	1.8
Lannea shimperi	8.3	3.9	25.6	2.5	2.5	9.7	-	-	-	17.7
Malacantha alnifolia	-	-	-	5.8	5.8	12.5	-	-	-	12.5
Mitragyna inermis	-	-	-	-	-	-	2.8	1.1	6.3	6.3
Nauclea latifolia	-	-	-	7.0	7.0	19.9	-	-	-	19.9
Pandanus cardelabrum	-	-	-	2.3	2.3	5.7	-	-	-	5.7
Parinari polyandra	4.9	1.5	8.1	-	-	-	-	-	-	8.1
Parkia biglobasa	-	-	-	2.2	2.2	10.3	8.3	8.9	26.4	18.3
Paullinia pinnaga	-	-	-	7.0	7.0	18.7	-	-	-	18.7
Pennisetum purpureum	1.6	0.6	2.6	-	-	-	-	-	-	2.6
Prosopis africana	-	-	-	-	-	-	3.6	7.4	16.9	16.9
Pterocarpus erinaceus	6.8	8.9	23.5	-	-	-	-	-	-	23.5
Pterocarpus santaloides	3.1	1.9	5.6	2.5	2.5	5.6	-	-	-	5.6
Pterygota bequaetii	-	-	-	2.5	2.5	11.9	-	-	-	20.3
Raphia sudanica	-	-	-	2.5	2.5	10.9	-	-	-	11.9
Santiria trimera	-	-	-	10.7	10.7	56.0	-	-	-	10.9
Scleria verrucosa	-	-	-	4.8	4.8	13.4	-	-	-	56.0
Senna alata	-	-	-	-	-	-	5.5	4.7	15.3	15.3
Senna siemia	-	-	-	-	-	-	5.5	2.3	11.5	11.5
Sterculia setigera	6.4	1.9	13.0	-	-	-	-	-	-	13.0
Synespalum glycyderum	-	-	-	4.7	4.7	17.5	-	-	-	17.5
Terminalia macroptera	-	-	-	1.1	1.1	1.8	-	-	-	1.8
Terminalia spp	4.9	1.9	8.0	-	-	-	8.3	5.5	20.0	14.0
Tricalysia okelensis	-	-	-	-	-	-	2.8	0.6	4.4	4.4
Vitelleria paradoxa	8.2	13.8	29.6	-	-	-	3.7	4.0	13.0	21.3
Vitex doniana	-	-	-	4.7	4.7	10.9	8.3	10.5	27.0	19.0

Where: *RF=relative frequency, RD= relative density, IVI= important value index.*

Effect of Vegetation Types on Species Diversity and Distribution in Pandam Wildlife Park

The results of the effect of species diversity across land use pattern on distribution and richness of plants species in the area is presented in Table 4. The tree species had mean diversity ($H^{'}$) of 2.08 (woodland forest), 2.29 (riparian forest) and 2.65 at the swamp forest area with an evenness distribution of 0.78%, 0.83and 0.91, respectively. For plant saplings, mean diversity ($H^{'}$) of 1.57 (woodland forest), 1.89 (riparian forest) and 2.17 at the swamp forest area with an evenness distribution of 0.50%, 0.74 and 0.76, respectively. Herbaceous plants had a mean diversity ($H^{'}$) of 1.68 for woodland savanna, 1.20 at the riparian forest and 1.04 at the swamp forest. For herbaceous plants evenness distribution in the study area, 0.76%, 0.77% and 0.66% were obtained from woodland savanna, riparian forest and swamp forest, respectively.

Table 4: Effect of Vegetation Types on Species Diversity and Distribution in Pandam Wildlife Park

Life forms	Trees			Saplings			Herbs		
	H'	E (%)	D	H'	E (%)	D	H'	E (%)	D
Woodland	2.08	0.78	3.2	1.57	0.5	3.34	1.68	0.77	2.15
Riparian	2.29	0.83	2.95	1.89	0.74	2.18	1.2	0.66	1.13
Swamp	2.65	0.91	2.8	2.17	0.76	2.29	1.04	0.67	0.89

Note: *H' = Species diversity, E = Species evenness, D= Species richness*

Flora diversity across the Vegetation Types in the study area was analyzed using ANOVA and the result is shown on Table 5. Based on the result of ANOVA, diversity of tree species across the Vegetation Types was significantly different (p=0.010) across the Vegetation Types. Mean diversity of 2.65 was recorded at the swamp forest, followed by riparian forest which had 2.29 while woodland savanna was the least diversified forest area with a mean diversity of 2.08.

Sapling and herbaceous plants did not vary significantly (p=0.424 and 0.052) across the Vegetation Types in the study area. The highest mean diversity of sapling plants across the Vegetation Types was obtained as 2.17 (swamp forest), followed by 1.87 (riparian forest) while the least diversified sapling plants of 1.57 was recorded at the woodland savanna forest area. Herbaceous plant species was high at the woodland savanna (1.68), followed by swamp forest (1.31) while the least was recorded at the riparian forest with a mean diversity of 1.20.

Table 5: ANOVA Result on Diversity for Flora Species across the Vegetation Types in Pandam Wildlife Park

Species	Vegetation Types	SD ±Mean
Trees	Woodland Savanna	0.24 ±2.08^{b}
	Riparian Forest	0.08±2.29^{b}
	Swamp Forest	0.08±2.65^{a}
	***P*-value**	**0.010**
Saplings	Woodland Savanna	0.88±1.57^{a}
	Riparian Forest	0.14±1.89^{a}
	Swamp Forest	0.06±2.17^{a}
	***P*-value**	**0.424**
Herbs	Woodland Savanna	0.10±1.68^{a}
	Riparian Forest	0.42±1.20^{ab}
	Swamp Forest	0.36±1.31^{b}
	***P*-value**	**0.052**

Mean followed by the same superscripts in a column are not significantly different from each other.

DISCUSSION

Plant Species Composition and Richness in Pandam Wildlife Park

The result on mean total number of trees stands across the Vegetation Types in the study area implied that, swamp forest area had the highest number of flora (life forms) identified in the study area. This could be as a result of swampy nature of the area which provides adequate required factors (such as abiotic and biotic) for trees growth. Also, it could be due to the nature of the forest i.e. water logging in nature which help to reduce the rate of anthropogenic activities within the forest area. Riparian forest area also had a good number of trees stands identified within the study area. When compared with woodland savanna forest, riparian forest has high density of individual flora than woodland; while woodland vegetation type had highest numbers of flora species and families. The nature of riparian forest (i.e. adjacent or along river bank) could be the reason for the high carry capacity of tree stands than in woodland savanna. This result is in line with the report of Normand *et al*. (2006); Cerón and Reyes (2007) and Nigel *et al.* (2014), they reported that Tree communities in swamps tend to be less diverse at local scales than those in adjacent, well-drained forests.

The results on plant species composition and richness also implied that woodland savanna forest accounted for more than 55% of the total species recorded in the study area. The differences in the family distribution of plant species between the Vegetation Types was evidently due to the level of anthropogenic activities on the Vegetation Types. Woodland savanna forest which faced with more human activities was observed to suffer a higher level of disturbance; yet recorded the highest species abundance but low distribution between the Vegetation Types of the study area.

The result of this finding is in line with the works of Huston and DeAngelis (1994); Sang (2009) and Todaria *et al.* (2010), all recorded a maximum number of species richness in their studies due to intermediate disturbance of the forest types. Moreover, due to the presence of large and permanent water body in the Riparian forest, it has tall and big trees. This conforms to the findings at Buton forest in Indonesia, where large numbers of big and tall trees were found apparently due to abundant supply of groundwater (Summers, 2006).

The total number of plants species recorded in the study area is typical of savanna ecosystem. The species diversity and distribution in the study area, with a record of the highest number of 31 species and lowest with 17 species was considered moderate when compared to that of semi-evergreen forests of Indian Eastern Ghats and Western Ghats. The number of the species recorded in Kolli hills was between 56 and 26 species (Chittibabu and Parthasarathy, 2000), Kalrayan hills had 42-47 species (Kadavul and Parthasarathy, 1999), Shervarayan hills with 33-50 species (Kadavul and Parthasarathy, 1999).

Fabaceae was the most dominant family in the study area with more than 10 species recorded; this was followed closely by the family of Combretaceae with at least 4 species. This conforms to the findings of Moksia *et al.* (2012) who reported that *Combrataceae* and *Fabaceae* were the important families in Kalfou Forest Reserve, Cameroon and Tioga forest in Burkina-Faso respectively which are also in the Savanna region. *Combrataceae* and *Fabaceae* are families known to be native species in most savannah-woodland Mosaics in Africa and are important families in tropical deciduous forests (Ceccon *et al.,* 2002; Zhigila *et al.*, 2015).

The importance value index ranged from 1.75 (riparian forest) to 81.93 (woodland savanna) in the three Vegetation Types of the study area. Woodland savanna forest had the highest values of IVI.

Human impacts were associated more with Woodland savanna forest while high intensity of grazing and browsing specifically occurred in riparian forest. Woodland savanna forest had relatively higher number of tree species in comparison to the other land use type in the study area. Altitude and geographical location could be the major factors in the flora of riparian and swamp vegetation type (Ceccon *et al.*, 2002) but edaphic factors, climatic conditions and the degree of human and livestock disturbances could also be considered responsible for the observed differences (Zhigila *et al.*, 2015).

Anogeissus leiocarpus, Azadirachta indica, Daniellia oliverii, Vitex doniana and *Terminalia spp* were the overall most dominant tree species in the study area, observed in all the three Vegetation Types of the study. Other important tree species like *Vitelleria paradoxa, Lannea shimperi, Combretum glutinosum, Pterocarpus erinaceus, Santiria trimera, Nauclea latifolia, Berlinia grandiflora, Dialium guineense, Parkia biglobasa* had relatively high frequency and high dominance across the Vegetation Types. High importance value index (IVI) of a species indicates its dominance and ecological success, its good power of regeneration and greater ecological amplitude (Curtis and McIntosh, 1950; Cumming, 1990; Cox *et al.,1994*; Abdullahi, 2010; Abba *et al.*,2013). Tree species such as *Ipomoea involucrate, Achomanes welwitschil* and *Pennisetum purpureum* among other tree species were found to have low IVI; this implied that the species require greater conservation efforts.

CONCLUSION

In conclusion, tree species were identified. Fabaceae, Combretaceae and Poaceae were the most dominant families. *Anogeissus leiocarpus, Azadirachta indica, Daniellia oliverii, Vitex doniana* and *Terminalia* spp were the dominant tree species encountered. The study revealed that Pandam Wildlife Park had an average species diversity value of between 2.08 (woodland savanna) to 2.65 (swamp forest). The study area had moderate species diversity. Swamp forest area had the highest number (624) of tree stands. The forest trend of the area was a reversed J-shape diameter distribution indicative of healthy recruitment potentials and anthropogenic activities. Therefore, it is recommended that efforts be geared towards the sustainability of fragile species in the Park.

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