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Preliminary assessment of tree species diversity in Afi Mountain Wildlife Sanctuary, Southern Nigeria

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ABSTRACT

Appraisal of flora species which form an integral part of animal ecology, in wildlife based protected areas is necessary before any meaningful conservation work can commence. This informed the study on the preliminary assessment of tree species diversity in Afi Mountain Wildlife Sanctuary (AMWS) and its adjoining communal forest, a biodiversity hotspot in Nigeria. The Point Centre Quarter Method (PCQM) was employed for the study while the Shannon-Weiner Diversity Index (*H*) and student *t* test were used to analyse data generated. The study revealed a total of 102 tree species in 35 families and 74 tree species in 31 families for the protected (sanctuary) and communal forests respectively. *Afzelia bipidensis* (RD = 5.00) and *Ceiba pentandra* (RD = 7.50) were the abundant species in the protected and communal forests respectively. Forty-nine (49) and twenty-seven (27) tree species were recorded as threatened in the protected and communal forests respectively. The Shannon-Weiner Diversity Indices obtained for the sanctuary (H_1 = 4.3459) and communal forest (H_2 = 4.0250) are not significantly different ($p > 0.05$). The dominance of *Ceiba pentandra* and presence of *Harungana madagascariensis*, and *Musanga cecropioides* in the communal forest indicated a characteristic of a secondary forest occasioned by anthropogenic impacts.
Keywords: Assessment; tree species; diversity indices; sanctuary; communal forest.

INTRODUCTION

The Afi Mountain Wildlife Sanctuary (AMWS) was established to protect a significant portion of the Afi River Forest Reserve in Cross River State, Nigeria, which has suffered severe anthropogenic impacts for decades. This became necessary in view of the fact that the sanctuary is a biodiversity hotspot characterized by species diversity and endemism (Conservation International, 2005). The area has suffered from activities of illegal logging operators thereby threatening important flora and fauna species (Agbor, 2003). Thus there is need to appraise the composition of tree species using diversity indices to ascertain the present status of tree species which form an integral part of wild animal habitat of the sanctuary.

It is quiet obvious that data generated from the study will promote effective conservation of biodiversity within the sanctuary and adjoining communal forest. The objective of the study is therefore to quantify tree species composition and abundance using diversity indices in Afi Mountain Wildlife Sanctuary and its adjoining communal forests.

MATERIALS AND METHODS

AREA OF STUDY: The area of study is Afi Mountain Wildlife Sanctuary (AMWS) and its adjoining communal forests. The Sanctuary is situated within the mountainous and relatively rugged rainforest block in the border region of South-Eastern Nigeria and South-West Cameroon, an area recognized as one of Africa's biodiversity hotspots (Conservation International, 2005). The sanctuary which is located within the Afi River Forest Reserve in Boki Local Government Area of Cross River State, Nigeria, lies approximately between latitude 6^o 15' and 6^o 25' North and between longitude 8^o 55' and 9^o 15' East. Following renewed international attention in the late 1980s, the creation of a wildlife sanctuary at Afi Mountains for the conservation of the endemic Cross River Gorilla and other wildlife species was recommended. Thus in May 2000, the Cross River State Government gazetted the Afi Mountain Wildlife

Sanctuary covering approximately 104km^2 (Wikipedia, 2012)

The Afi Mountain Wildlife Sanctuary falls within the tropical high forest vegetation zone. The entire area falls within a broad annual rain fall zone of 3,000 mm - 3,800 mm but, with a variation increasing from lowland to uphill (Agbor, 2003). Rainy season starts around late March / early April to September with a break in August. The dry season starts from October and ends in March. The mean monthly maximum temperature ranges from 22.2^{o}C to 27.4^{o}C (Edet, 2010).

Notable endemic and endangered species of wildlife include the Cross River gorilla (*Gorilla gorilla diehli*), Nigeria chimpanzee (*Pan troglodytes vellorosus*) and drill (*Mandrillus leucophaeus*). Other known wildlife species which are protected by the Endangered Species Decree 11 of 1985 include the red-eared guenon (*Cercopithecus erythrotis*), mona guenon (*Cercopithecus mona*) and red river hog (*Potamochoerus porcus*). Presently, the sanctuary habours the world's largest roosting site for migrating European barn swallows (*Hirundo rustica*), and also an important nesting site for the rare bare-necked rock fowl (*Picarthertes oreas*) (Edet, 2010).

MATERIALS USED FOR THE STUDY

The materials used for the study include measuring tapes (50m), point centre quadrant, twine, ranging Poles, machetes and flagging tapes.

METHODOLOGY: The Point Centre Quarter Method (PCQM) as described by Bryant *et al.* (2005) was employed to assess tree species composition in Afi Mountain Wildlife Sanctuary and its adjoining communal forest in December, 2011

Fifteen (15) transects of 1km (1000m) each in length were cut in each of the survey area (i.e. the sanctuary and communal forest). Out of the fifteen (15) transects, five (5) were randomly selected in each survey area. This gave a total of 5km (5000m) length of transects in each survey area. A communal forest belonging to Katabang (an adjoining community to AMWS) was selected for this study. Transects were pegged at 100 metres interval and the point centre quadrant dropped systematically at this point. This gave a total of 50 sampling points with a record of 200 trees per sampled area. Only trees of 1m and above in height nearest to the sampling point in each quarter of the quadrant were enumerated and recorded.

DATA ANALYSES

Data obtained from tree species composition was analysed to obtain relative density (%) and relative abundance.

Relative density of species (RD) = $\frac{Number\ of\ individual\ species}{Total\ number\ of\ trees}\ x100$

Relative abundance of species (*Pi*) = $\frac{Relative\ density\ of\ species}{100}$

The various species were scored according to their relative densities (RD); i.e. abundant (RD ≥ 5.00), frequent (4.00 ≤ RD ≤ 4.99), occasional (3.00 ≤ RD ≤ 3.99), rare (1.00 ≤ RD ≤ 2.99) and threatened / endangered (0.00 < RD ≤ 1.00)

Data obtained from relative abundance was used to compute the Shannon - Wiener's Diversity Index (*H*) as described by Stirn (1981) for the protected and unprotected (communal) forests of the area. Shannon-Wiener's Diversity Index in given by the equation

$$H = -\sum_{i=1}^{s} Pi\ lnPi$$

Where *H* = Shannon-Wiener's Diversity Index, P_i = Relative abundance of the ith species, lnP_i = Natural logarithm of the corresponding relative abundance (P_i) of the species. The values of Shannon - Wiener Index obtained from the two locations were compared using the student *t* test as described by Jayaraman (1999). The *t* test is given by the equation:

$$t = \frac{|\ H_1 - H_2\ |}{\sqrt{Var\ (H_1) + Var(H_2)}}$$

with v degrees of freedom as:

$$v = \frac{[Var(H_1) + Var(H_2)]^2}{[Var(H_1)]^2/_{N_1} + [Var(H_2)]^2/_{N_2}}$$

where

$$Var\ (H) = \frac{\sum Pi(lnPi)^2 - (\sum Pi\ lnPi)^2}{N} + \frac{S-1}{2N^2}$$

H_1 = Shannon – Wiener Index value obtained for the protected forest, H_2 = Shannon – Wiener Index value obtained for the communal forest, *Var (H)* = Variance in diversity for each location, S = Number of species present per location, N = Number of trees counted per location.

RESULTS

Table 1: Indices of Tree species composition in protected forest of AMWS

Family	Species	RD	P_i	lnP_i	P_i ($ln\ P_i$)	$(lnPi)^2$	$Pi(lnPi)^2$
Annacardiaceae	*Antrocaryon klaineanum*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annacardiaceae	*Antrocaryon micaster*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annacardiaceae	*Sorindeia mildbraedii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annacardiaceae	*Spondias mombin*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Anisophyliaceae	*Poga oleosa*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annonaceae	*Monodora myristica*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annonaceae	*Xylopia Africana*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Annonaceae	*Xylopia staudtia*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Apocynaceae	*Alstonia boonei*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Apocynaceae	*Alstonia congensis*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Apocynaceae	*Funtumia elastic*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Apocynaceae	*Rauvolfia vomitoria*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Apocynaceae	*Pleiocarpa talbotii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Bignoniaceae	*Newbouldia laevis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Bombacaceae	*Ceiba pentandra*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Bombaceae	*Bombax buonopozense*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Buseraceae	*Canarium schweinfurthii*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Buseraceae	*Dacryodes edulis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Connaraceae	*Cnetis ferruginea*	0.50	0.050	-5.2983	-0.0265	28.0720	0.1404
Combretaceae	*Terminalia ivorensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Combretaceae	*Terminalia superb*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Ebenaceae	*Diospyros heudelotii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Ebenaceae	*Diospyros melocarpa*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Ebenaceae	*Diospyros zenkerii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceaea	*Alchornia laxiflora*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceaea	*Anthonota fragrance*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceaea	*Cyrtogonne argentia*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceaea	*Grosseria vignei*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceaea	*Maesobotrya dusenii*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Euphorbiaceaea	*Maesobotrya staudtii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceaea	*Rhicinodendron heudelotii*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Euphorbiaceaea	*Uapaca acuminate*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Flacourtiaceae	*Compostylus ovalis*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Flacourtiaceae	*Ophiobostyrs zenkerii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Guttiferae	*Garcinia kola*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Guttiferae	*Garcinia manni*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Guttiferae	*Harungana madagascariensis*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Guttiferae	*Mammea africanum*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Irvingiaceae	*Irvingia gabonensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Irvingiaceae	*Irvingia wombulu*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Afzelia bipidensis*	5.00	0.050	-2.9957	-0.1498	8.9742	0.4487
Leguminosae	*Albizia ferruginea*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Leguminosae	*Albizia lebbeck*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Albizia zygia*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Leguminosae	*Angylocalyx oligophyllus*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Brachystegia eurycoma*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Leguminosae	*Daniella ogea*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Leguminosae	*Dialum guineense*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Leguminosae	*Parkia bicolor*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Leguminosae	*Pentaclethra macrophylla*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Leguminosae	*Piptandeniastrum africanum*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646

Leguminosae	*Pterocarpus erinaceous*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Leguminosae	*Pterocarpus mildbraedii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Pterocarpus osun*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Pterocarpus soyauxii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Tetrapleura tetraptera*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Leguminosae	*Zenkerella citran*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Loganiaceae	*Anthocleista djalonensis*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Entandrophragma angolense*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Entandrophragma cylindricum*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Meliaceae	*Guarea glomerulata*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Khaya grandifolia*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Meliaceae	*Khaya ivorensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Meliaceae	*Lovoa trichiloides*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Melicea excels*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Meliaceae	*Melicea zygia*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Mimosaceae	*Newtonia duparquetiana*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Moraceae	*Anthodeista vogelii*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Moraceae	*Musanga cercropioides*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Moraceae	*Myriathus arboreus*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Moraceae	*Treculia Africana*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Myristicaceae	*Pycnanthus angolensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Myristicaceae	*Pycnanthus microcephalus*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Ochnaceae	*Lophira alata*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Palmae	*Elaeis guineensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Papilionaceae	*Baphia nitida*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Polygalaceae	*Carpolobia alba*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Polygalaceae	*Carpolobia lutea*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Polygonaceae	*Antiaris Africana*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Rubiaceae	*Didymosalpinx parviflora*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rubiaceae	*Heinsia crinata*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Rubiaceae	*Hymenodictyon biafranum*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rubiaceae	*Massularia acuminate*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rubiaceae	*Mytragyna stipulosa*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Rubiaceae	*Nauclea diderrichi*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Rosaceae	*Parinari chrysophylla*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rutaceae	*Tectea afzeli*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rutaceae	*Zanthoxylum xanthoxyloides*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Sapindaceae	*Blighia sapida*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Sapindaceae	*Placodiscus tubiniatus*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sapotaceae	*Bailonella toxisperma*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sapotaceae	*Chrysophylum albidum*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Sterculiaceae	*Cola gigantean*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sterculiaceae	*Cola lepidota*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Sterculiaceae	*Cola millenii*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Sterculiaceae	*Cola pachycarpa*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sterculiaceae	*Leptobychia pallid*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sterculiaceae	*Sterculia tragacantha*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Sterculiaceae	*Triplochiton scleroxylon*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Styraceae	*Afrostyrax lepidophyllus*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Tiliaceae	*Deplatsia dewevrei*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Verbenaceae	*Vitex doniana*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404

Table 2: Indices of Tree species composition in communal forests adjoining AMWS

Family	Species	RD	P_i	lnP_i	P_i (ln P_i)	$(lnPi)^2$	$Pi(lnPi)^2$
Annacardiaceae	*Spondias mombin*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Anisophylleceae	*Poga oleosa*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annonaceae	*Enanthia chlorantha*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Annonaceae	*Monodora myristica*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Annonaceae	*Xylopia Africana*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Annonaceae	*Xylopia staudtia*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Apocynaceae	*Alstonia boonei*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Apocynaceae	*Alstonia congensis*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Apocynaceae	*Funtumia elastica*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Apocynaceae	*Rauvolfia vomotora*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Bombacaceae	*Ceiba pentandra*	7.50	0.075	-2.5903	-0.1943	6.7097	0.5032
Bombaceae	*Bombax buonopozense*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Bignoniaceae	*Newbouldia leavis*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Buseraceae	*Dacryodes edulis*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Combretaceae	*Terminalia ivorensis*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Combretaceae	*Terminalia superb*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Ebenaceae	*Diospyros heudelotii*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Ebenaceae	*Diospyros melocarpa*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Euphorbiaceae	*Maesobotrya dusenii*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Euphorbiaceae	*Rhicinodendron heudelotii*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Euphorbiaceae	*Uapaca acuminate*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Guttiferae	*Garcinia kola*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Guttiferae	*Harungana madagascariensis*	4.50	0.045	-3.1011	-0.1395	9.6168	0.4328
Guttiferae	*Mammea Africana*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Icacinaceae	*Lasianthera Africana*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Irvingiaceae	*Irvingia gabonensis*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Irvingiaceae	*Irvingia wombulu*	0.50	0.005	-5.2983	-0.0261	28.0720	0.1404
Leguminosae	*Afzelia Africana*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Leguminosae	*Afzelia bipidensis*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Leguminosae	*Abizia ferruginea*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Albizia zygia*	4.50	0.045	-3.1011	-0.1395	9.6168	0.4328
Leguminosae	*Angylocarlyx oligophyllus*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Brachystegia eurycoma*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Leguminosae	*Daniella ogea*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Dialum guineense*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Leguminosae	*Parkia bicolor*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Leguminosae	*Pentaclethra macrophylla*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Leguminosae	*Pterocarpus erinaceous*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Leguminosae	*Tetrapleura tetraptera*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Meliaceae	*Entandrophragma cylindricum*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Guarea glomerulata*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Khaya grandifolia*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Khaya ivorensis*	0.05	0.005	-5.2983	-0.0265	28.0720	0.1404
Meliaceae	*Lovoa trichiloides*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Meliaceae	*Melicia excela*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Moracea	*Ficus exasperate*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Moracea	*Ficus umbelatum*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Moracea	*Musanga cercropioides*	4.00	0.040	-3.2189	-0.1288	10.3613	0.4145
Moracea	*Myrianthus arboreus*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Moracea	*Treculia Africana*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Myristicaceae	*Pycnanthus angolensis*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Ochnaceaea	*Lophira alata*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121

Palmae	*Elaeis guineensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Papilionaceae	*Baphia nitida*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Piperaceae	*Nauclea diderrichii*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Polygalaceae	*Carpolobia alba*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Polygalaceae	*Carpolobia lutea*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Polygonaceae	*Antiaris Africana*	4.00	0.040	-3.2189	-0.1288	10.3613	0.4145
Rubiaceae	*Heinsia crinata*	2.50	0.025	-3.6889	-0.0922	13.6080	0.3402
Rubiaceae	*Massularia acuminate*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Rubiaceae	*Mytragyna ciliate*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rubiaceae	*Mitragyna stipulosa*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Rutaceae	*Zanthoxylum xanthoxyloides*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sapindaceae	*Blighia sapida*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Sapotaceae	*Baillonella toxisperma*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Sapotaceae	*Chrysophyllum albidum*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Sterculiaceae	*Cola acuminate*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sterculiaceae	*Cola gigangtea*	2.00	0.020	-3.9120	-0.0782	15.3037	0.3061
Sterculiaceae	*Cola lepidota*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Sterculiaceae	*Cola nitida*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sterculiaceae	*Sterculia tragacantha*	0.50	0.005	-5.2983	-0.0265	28.0720	0.1404
Sterculiaceae	*Triplochiton scleroxylon*	1.50	0.015	-4.1997	-0.0630	17.6375	0.2646
Ulmaceae	*Trema guineensis*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121
Verbanaceae	*Vitex doniana*	1.00	0.010	-4.6052	-0.0461	21.2079	0.2121

H_1 = 4.3459; $Var(H_1)$ = 11.8661; H_2 = 4.0250; $Var(H_2)$ = 7.7945; $N_I = N_2 = 200$; $v(d\ f) = 384$; $t_{cal} = 0.0724$; $t_{tab(0.05)} = 1.96$

DISCUSSION

The result shows that the diversity indices for the sanctuary (H_1 = 4.3459) and communal forest (H_2 = 4.0250) are not significantly different ($p > 0.05$) from each other. One hundred and two (102) tree species in 35 families were encountered in the sanctuary with *Afzelia bipidensis* (RD = 5.00) as the only abundant species (Table 1). There was no record of frequent and occasional species while rare and threatened / endangered species were represented by fifty-two (52) and forty-nine (49) tree species respectively. In the communal forests, seventy-four (74) tree species were encountered in thirty-one (31) families (Table 2). *Ceiba pentandra* (RD = 7.50) was the only abundant species in the communal forest while frequent species were represented by *Harungana madagascariensis* (RD = 4.50), *Albizia zygia* (RD = 4.50), *Musanga cercropioides* (RD = 4.00) and *Antiaris africana* (RD = 4.00) as shown in Table 2. Occasional species in the communal forests were absent. Rare species were represented by forty- two (42) tree species while threatened species were made up of twenty-seven (27) tree species. The dominance of *Ceiba pentandra* followed by *Harungana madagascariensis*, *Albizia zygia* and *Musanga cecropioides* as frequent species, indicated that the communal forests possessed some characteristics of secondary forest, possibly as a result of anthropogenic impacts occasioned by bush burning and agriculture. These are species which are common in a degraded forest as reported by Etukudo *et al*, (1994). Over-exploitation and utter conversion of forest ecosystems results in the decimation of tree species (Iroko *et al.*2008). The above analysis shows that there was likelihood of more tree extraction for timber and other uses in the communal forests than the protected area (sanctuary). Owing to this demand, some of these species become rare and threatened. The disappearance of many economically valued tree species across Nigeria is a well known phenomenon (Agbogidi, 2011; Adekunle and Akinlembola,, 2008; Sale *et al.,* 2008; Oni *et al.*, 2010). If forests are indiscriminately depleted, the various uses and roles associated with them would be lost.

CONCLUSION AND RECOMMENDATION: Different levels of disturbance have different effects on tree diversity in the study sites. Thus if the goal of management is to preserve biodiversity in the area, there is need to understand how diversity is impacted by different management strategies.

Reliable information on the status and trends of forest resources helps give decision makers the prospective necessary for orienting forestry policies and programs. Thus forest composition assessment of Afi Mountain Wildlife Sanctuary will serve as a valuable

tool that will enable conservators and managers of the sanctuary to quantify tree diversity as well as providing information on numerical structure of species in the area of study.

The Cross River State Forestry Commission, which is saddled with the responsibility of managing the resources of the sanctuary, should design programmes that will create more awareness on the part of the people to see the need to protect flora and fauna species from being threatened. Domestication of indigenous tree species should be advocated both for poverty alleviation in the communal lands of the area, and for a balance to be maintained in the ecosystem (Jimoh and Haruna, 2007; Olufemi and Akinlosufu, 2006). Cultivation of edible and medicinal species in the communal forests should be encouraged by government and other stakeholders of Afi Mountain Wildlife Sanctuary and environs. This would reduce the rate of encroachment into the sanctuary for plant species exploitation for economic and medicinal reasons. Above all, more studies should be carried out to ascertain the level of disturbance and how this affects flora and fauna composition, distribution and abundance in Afi Mountain Wildlife Sanctuary and environs.

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