Original Research Article

TREE SPECIES DIVERSITY AND FOREST STRUCTURE OF EDA FOREST RESERVE, EKITI STATE, NIGERIA.

ABSTRACT

Eda Forest Reserves in Ekiti State, Nigeria, was assessed for tree species diversity and forest structure. Systematic line transect sampling technique was adopted for data collection. Two transects, 2000m long and 500m apart were laid in secondary forest and Encroach farmland forest in the reserve. Purposive sampling method was used for data collection in the primary forest patches. Sample plots of 20m x 20m were laid in alternate position along each transect at an interval of 200m. A total of 20 sample plots were laid in each vegetation types. Data collected were analyzed using simple statistical tools such as graphs, grouped bar chart, frequency tables and formulae. The results indicated that, a total of 380, 280 and 137 trees/ha were enumerated in the Primary forest, Secondary forest and Encroach farmland forest comprising 39 species/ha, 38 species/ha and 19 species/ha in each forest types. *Khaya ivorensis* had the highest relative density in the three forest types with 19.74%, 24.53% and 27.74% in Primary, Secondary and Encroach farmland forests respectively. Sterculiaceae, caesalpiniodiae and moraceae are the most species rich families. The mean basal area/ha in the study area was 3.18m^2, 0.36m^2 and 1.68m^2 for primary, secondary and encroach farmland forests. The values of Shannon-Wiener Index (H') are 3.2160, 3.1410 and 2.5120 which is quite high for the forest types. The alpha diversity results show that the forest reserve is a well-stocked tropical rainforest in Nigeria. While, the beta diversity also attested to the heterogeneity structure of the forest. The high species diversity and the relative richness in timber species of the forest reserve correlate relatively with the abundance of each of the species counted in the reserve. However, higher percentage of the lower diameter tree in the forest reserve indicates that the forest reserve has high vigour and recruitment potential.

KEYWORDS: Eda Forest Reserve, floristic composition, heterogeneity, species diversity, forest structure, alpha diversity, beta diversity, tropical forest.

INTRODUCTION

Forests are complex natural resources mostly dominated by trees, whose diversity and sizes varies in different parts of the world. About one third of the earth's land area is covered with forest and nearly 50% of the total forest land is tropical forest (FAO, 2001). The tropical rain forest harbours a great diversity of plants species which represent many life's forms that provide wide variety of food and other useful materials to the people living in and around the forest (White and Edwards, 2000).

The tropical rainforest is a hot, moist biome found near earth's equator. The world's largest tropical rainforest are in southern America, Africa and south-east Asia. Tropical rainforest receive from 600 to 1600mm of precipitation that is fairly evenly distributed throughout the year. The combination of constant warmth and abundant moisture makes the tropical rainforest a suitable environment for many plants, animals and microbes. Tropical rainforest contain the greatest biodiversity in the world, with over 15 million species of plants and animals live within this biome. In other biome, such as the deciduous forest, the decomposition of leaf litter adds nutrient to the soil. But in the tropical rainforest, plants grow so fast, that they rapidly consume the nutrients from the decomposed leaf litter. As a result, most of the nutrients are contained in the trees and other plants rather than in the soil. Most nutrients that are absorbed into the soil are leached out by the abundant rainfall which leaves the soil infertile and acidic. (Mayaux, 2013)

About 39% of Nigeria's forest is typically found in the southern part of the country. High forest reserves are situated mostly in Ogun, Ondo, Ekiti, Cross river and Oyo States. The rain forest in the humid southern part of the country, supply most of Nigeria's timber. while the woodlands of the north are the main source of firewood, wood sculpturing tree species and products such as mortar and pestle and other wood briquetting tree species and products such as charcoal used for domestic energy (F.D.F,2005).

Eda forest reserve is one of the reserves in Ekiti state that is endowed with biodiversity resources. This reserve has suffered degradation and exploitation in the past directly through legal and illegal arbitrary issuance of permits for exploitation. The activities of illegal tree fellers were unprecedented before logging operation ceased on injunction from the government, (EKFD, 2006). However, the closure of the forest reserve did not deter the illegal human activities in the forest which unequivocally aggravated the degradation of the forest. Consequently, the assessment and documentation of species diversity and forest structure becomes imperative before these rare natural resources, becomes history.

MATERIALS AND METHOD

2.1 Study area

The study was carried out in Eda forest reserve in Ekiti state, located in south western part of Nigeria. The reserve covers an area of 9.06km^2 and it is estimated to be 906ha. Eda forest reserve is located in rainforest zone on latitude $7^0$41'3"N and $7^0$73'5"N and longitude $5^0$2'1"E and $5^0$62'0"E and a digital elevation of 526m above sea level. The reserve is bordered in the North by Orin/Ara Ekiti, Eda-ile Ekiti in the West, Omuo Ekiti in the East and in the South by Isinbode Ekiti (Fig. 1). Eda Forest reserve is located in Ekiti East Local Government Area of Ekiti State. It was established purposely for biodiversity conservation and environmental protection. The forest reserve was one of the foremost gazettes in the state. And it was gazetted in 1941 by gazette No. 37, order 1941. The forest reserve was divided administratively into two parts which comprises of the plantation compartment tagged Eda I, which is 3.18 km^2 (318ha) and the Natural Forest tagged Eda II, which covers 5.88km^2 (588ha) in land area. The forest has been well protected from exploitation except some threat from subsistence farmers and few illegal fellers. The reserve is one of the most highly stocked Natural Forest Reserves in Nigeria (EKFD, 2012).

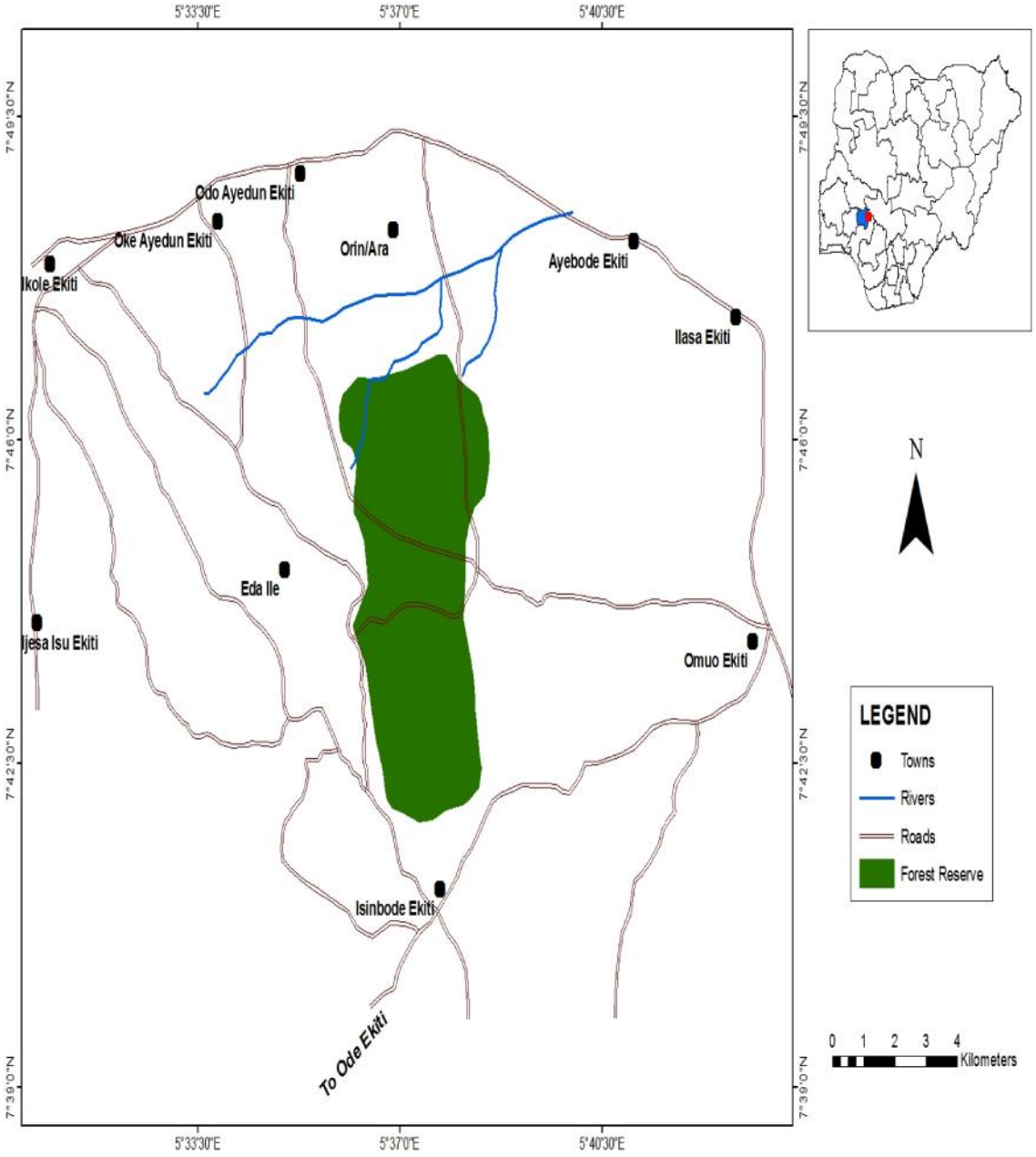

FIGURE 1: MAP OF EKITI STATE SHOWING EDA FOREST RESERVE

2.2 Sampling technique and Data Collection

Data were collected by laying plots using systematic line transect sampling method. Two transects of 2,000m in length and 1m wide with an average distance 617m and 513m apart were laid in the Secondary forest and Encroach farmland areas in the reserve. Variation in distance apart was due to the rough terrain of the area. Due to the uneven nature of the remaining primary forest, purposive sampling technique was adopted for data collection in this vegetation type. Sampled plots of 20m×20m dimension were laid in alternate positions along each transect at an interval of 200m. This

sampling order yielded 20 sample plots per 4000m. This implies that 20 sample plots were laid in each vegetation types. The diagrams of the sampling procedure are shown in figure 2.

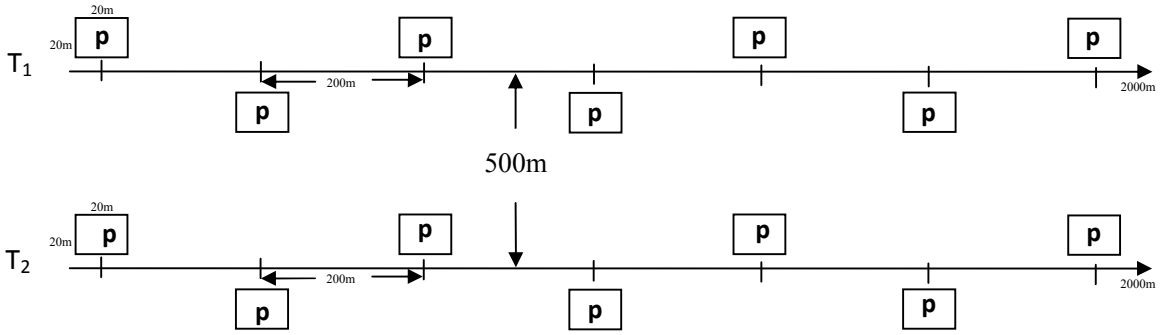

FIGURE 2: Sampling procedure for identification and enumeration in the study area.

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Where: T is transects.

P are plots.

This procedure was used in both secondary forest and encroached farmland areas.

While purposive sampling procedure was adopted in the primary forest types.

2.3 DATA ANALYSIS

The data collected were analyzed using simple statistical tools such as graph, grouped bar chart and frequency tables. Prospective formula were also used to compute the values for density, relative density, level of abundance of the species, dominance species, biodiversity index, relative dominance, species importance value, frequency of the species, Simpson index, Fisher alpha index, Menhinick index, Mergalef's index, Dominance index, Sorensen's index and Shannon Weinner index accordingly.

3.0 RESULTS AND DISCUSSION

3.1 Tree species composition and distribution in the forest reserve

The tree species composition and distribution per hectare for the forest reserve were presented in Table 1. A total of 380 tree individuals comprising of 39 species per hectare were encountered in the Primary forest, while 280 tree individuals comprising of 38 species per hectare were enumerated in the Secondary forest and 137 tree individuals consisting of 19 species per hectare were also identified in Encroached farmland forest respectively.

117 **Table 1: Tree species composition and distribution per hectare in Eda forest reserve.**

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S/N	Species	Family	Primary Forest	Secondary Forest	Encroached Farmland
1	*Afzelia bipindensis* Harms	Caesalpinioideae	---	3	---
2	*Albizia adiantifolia* (Schumach) W. Wight	Mimosoideae	5	3	3
3	*Alstonia congensis* Engl	Apocynaceae	10	---	---
4	*Alstonnia boonei* De wild	Apocynaceae	---	8	3
5	*Aningerea robusta* (A. chev) Aubrev.ϒ Pellegr	Sapotaceae	5	---	5
6	*Antiaris toxicaria* Lesch.	Moraceae	10	10	8
7	*Blighia sapida* K. Konig.	Sapindaceae	---	13	15
8	*Bombax buonopozense* P. Beauv.	Bombacaceae	15	---	3
9	*Brachystegia eurycoma* Harms	Caesalpinioideae	5	---	---
10	*Brachystegia kennedyi* Hoyle	Caesalpinioideae	---	---	3
11	*Bridelia atroviridi* Willd.	Euphorbiaceae	---	3	---
12	*Ceiba pentandra* (L) Gaertn	Bombacaceae	15	8	5
13	*Celtis zenkeri* Engl.	Ulmaceae	10	8	3
14	*Chrysophyllum albidum* Linn	Sapotaceae	5	8	---
15	*Cola gigantea* A. Chev.	Sterculiaceae	---	3	---
16	*Cordea millenii* Baker	Bignoniaceae	5	---	---
17	*Cynometra megalophylla* Harms	Caesalpinioideae	10	---	---
18	*Dalium guinensis* Willd	Caesalpinioideae	5	3	---
19	*Daniella ogea* (Harms) Rolfe ex Holland	Caesalpinioideae	5	---	---
20	*Diospyros mespiliformis* Hoshst	Ebenaceae	5	---	3
21	*Distemona bentamianus* Baill	Caesalpinioideae	5	---	---
22	*Enantia chlorantha* Oliv.	Annonaceae	---	3	---
23	*Entadrophragma angolensis* (Welw) C.DC	Meliaceae	---	5	3

24	*Etandrophragma cylindricum* Sprague	Meliaceae	---	5	---
25	*Erythrophylum suaveolens* (Guill ϒ Perr.) Brenan	Caesalpinioideae	---	3	---
26	*Ficus exaspirata* Vahl	Moraceae	---	8	---
27	*Ficus mucuso* Welw. Ex Ficalho	Moraceae	5	---	---
28	*Funtumia elastic* (preuss) Stapf	Apocynaceae	5	3	---
29	*Gossweilodendron balsamiferum* J.	Caesalpinioideae	---	3	---
30	*Hildergadia baterii* (Mast) Kosterm	Sterculiaceae	5	---	---
31	*Hollarrhena floribunda* (G. Don) Dur ϒ Schinz	Apocynaceae	---	8	---
32	*Khaya ivorensis* A.Chev	Meliaceae	75	65	38
33	*Kigelia africana* (Lam) Benth	Bignoniaceae	5	3	---
34	*Lophira alata* Banks ex.	Ochnaceae	10	---	---
35	*Lovoa trichilioides* Harms	Meliaceae	---	3	---
36	*Mansonia altissima* A. Chev	Sterculiaceae	5	3	---
37	*Melicia excelsa* (Welw) C.C. Berg	Moraceae	25	15	15
38	*Milletia aboensis* (Hook.f) Baker	Papilionoideae	5	---	---
39	*Mitragyna ciliate* Aubrev ϒ Pellegr.	Rubiaceae	---	3	---
40	*Monodora myristica* (Gaertn) Dunal	Annonaceae	---	---	3
41	*Musanga cecropioides* R. Br.	Moraceae	5	8	---
42	*Nesogodonia papaverifera* (A. Chev) R. Capuron	Sterculiaceae	5	3	---
43	*Newbouldia laevis* (P. beauv) Seem	Bignoniaceae	---	3	---
44	*Parinari excelsa* Sabine	Chrysobalanaceae	5	---	---
45	*Pentaclethra macrophyla* Benth	Mimosoideae	---	3	---
46	*Piptadeniastrum africanum* (Hook.F) Brenan	Mimosoideae	5	---	---
47	*Pterocarpus erinaceus* Poir	Papilionoideae	---	3	---
48	*Pterygota macrocarpa* K. Schum	Sterculiaceae	5	---	---
49	*Pycnantus angolensis* (Welw)	Myristicaceae	---	3	3

	Warb				
50	*Recinodendron heudelotii* (Baill) Pierre	Euphorbiaceae	5	8	---
51	*Sterculia rhinopetala* K. Schum	Sterculiaceae	45	25	5
52	*Sterculia tragacantha* Lindi	Sterculiaceae	5	---	---
53	*Strombosia pustulata* Oliv.	Olacaceae	5	---	---
54	*Terminalia ivorensis* A. Chev.	Combretaceae	5	5	3
55	*Terminalia superba* Engl ϒ Diels	Combretaceae	10	---	---
56	*Terocarpus osun* Craib	Papilionoideae	5	3	3
57	*Tetrapleura tetraptera* Taub	Mimosoideae	5	---	---
58	*Triplochyton scleroxylon* K. Schum	Sterculiaceae	10	10	13
59	*Xylopia aethiopica* (Dunal) A. Rich	Annonaceae	---	3	---
60	*Zanthoxylum zanthoxyloides* (Lam) Zepern	Rutaceae	5	3	---
	Total		380	280	137

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3.2 Tree species family distribution per hectare in Eda forest reserve.

The tree species distribution studied on the site revealed that primary forest had the highest number of 39 species followed by secondary forest with 38 species and encroached farmland forest had the least number of 19 species per hectare.

The tree species enumerated in the study area comprises of Twenty-two (22) families as indicated in Table 2. Sterculiaceae family had the highest number of 53 species per hectare, followed by Caesalpinioideae family with 38 species per hectare. While, Sapindaceae family had the least number of 3 species.

Table 2: Tree Family composition and distribution per hectare in Eda forest reserve.

S/N	Family	Primary Forest	Secondary Forest	Encroached Farmland	No of tree species /ha in each family
1	Annonaceae	---	5	3	8
2	Apocynaceae	10	8	3	21
3	Bignoniaceae	10	5	---	15
4	Bombacaceae	10	3	5	18
5	Caesalpinioideae	25	10	3	38
6	Chrysobalanaceae	5	---	---	5
7	Combretaceae	10	3	3	16
8	Ebenaceae	5	---	3	8
9	Euphorbiaceae	5	5	---	10
10	Meliaceae	5	10	5	20
11	Mimosoideae	15	5	3	23
12	Moraceae	20	10	5	35
13	Myristicaceae	---	3	3	6
14	Ochnaceae	5	---	---	5
15	Olacaceae	5	---	---	5
16	Papilionoideae	10	5	3	18
17	Rubiaceae	---	5	---	5
18	Rutaceae	5	---	---	5
19	Sapotaceae	10	5	5	20
20	Sterculiaceae	35	13	5	53

21	Ulmaceae	5	3	3	11
22	Sapindaceae	---	1	2	3
	Total	**195**	**99**	**54**	**348**

3.3 Relative abundance and species diversity of trees species in the forest reserve

3.3.1 Relative abundance of tree species in the study area

The relative abundance analysis of the primary forest tree species revealed that *Khaya ivorensis* had the highest relative density (Rde) of 19.74%, relative dominance (Rdo) of 2.42% and Species Importance Value (SIV) of 22.16%. This was followed by *Sterculia rhinopetala* with relative density of 11.84%, relative dominance of 2.30% and species importance value of 14.14%. While 27 different tree species had the least relative density of 1.32% which includes *Albizia adiantifolia*, *Brachystegia eurycoma*, *Aningeria* robusta, *Cordea millenii* to mention few. *Strombosia pustulata* had the least relative dominance of 0.23%. While, *Recinodendron heudelotii* and *Strombosia pustulata* species had the least species importance value of 1.55%.

3.4 Tree species diversity indices for Eda forest reserve

The diversity for the vegetation types in the forest reserve are indicated as follows. Simpson index revealed that the primary forest was the most diverse in species with 0.9301 than the other two vegetation types with 0.9207 in secondary forest and 0.8774 in encroached farmland forest. The Shannon Wienner index also confirmed that primary forest was more diverse with 3.2160 in species as compared to the secondary forest with 3.1410 and encroached farmland forest with 2.5120. The evenness index also revealed that primary forest contained more species with 0.8778 than the other vegetation types with 0.8635 in secondary forest and 0.8533 in encroached farmland vegetation. Species richness index affirmed that primary forests were more endowed than others with 39 species, followed by secondary forest with 38 species and 19 species from encroached farmland vegetation. The fisher alpha index relayed that, secondary forest was slightly diverse in species than other forest types with 11.8600 which may be due to the rate of regeneration. This was followed by primary forest with 10.8900 and 5.9880 in encroached farmland vegetation.

Table 3: Summary of tree species diversity indices for Eda forest reserve.

Variables	Primary Forest	Secondary Forest	Encroach Farmland
Simpson index (D)	0.9301	0.9270	0.8744
Mergalef's index (d) (species richness)	6.3970	6.5660	3.6590
Evenness index (E)	0.8778	0.8635	0.8533
Menhinck index	2.0010	2.2710	1.6230
Fisher alpha index	10.8900	11.8600	5.9880
Dominance index (C)	0.0699	0.0793	0.1226

3.5 Alpha (α) Diversity OF Tree Species in Eda Forest Reserve

Alpha diversity (AD) is a measure of species richness and evenness was determined for the vegetation of the forest reserves in line with Odum, (1971). The variables used for measuring Alpha diversity were Simpson index, Shannon Wienner index, species evenness, species richness and fisher alpha index. Simpson index revealed that the primary forest was the most diverse in species with 0.9301 than the other two vegetation types with 0.9207 in secondary forest and 0.8774 in encroached farmland forest. The Shannon Wienner index also confirmed that primary forest was more diverse with 3.2160 in species as compared to the secondary forest with 3.1410 and encroached farmland forest with 2.5120. The evenness index also revealed that primary forest contained more species with 0.8778 than the other vegetation types with 0.8635 in secondary forest and 0.8533 in encroached farmland vegetation. Species richness index affirmed that primary forests were more endowed than others with 39 species, followed by secondary forest with 38 species and 19 species from encroached farmland vegetation. The fisher alpha index relayed that, secondary forest was slightly diverse in species than *primary* forest with 11.8600 which may be due to the rate of regeneration. This was followed by primary forest with 10.8900 and 5.9880 in encroached farmland vegetation.

3.6 Beta (β) Diversity of Tree Species in Eda Forest Reserve

Beta diversity is a measure of the extent to which the diversity of two or more spatial units differs (Magurran, 2004). It is generally used to characterize the degree of spatial heterogeneity in diversity

at the landscape scale or to measure the change in diversity along transects of environmental gradients. Dominance index indicated that there was a high dissimilarity of dominance in encroached farmland vegetation with 0.1226 which may be due to high correlation in height and diameter, followed by secondary forest with 0.0793 and 0.0699 in primary forest. The Menhinck index showed some disparities with Secondary forest having the highest, with 2.2710, followed by Primary forest with 2.0010 and least was 1.6230 from encroached farmland vegetation. Sorensen's index showed a conspicuous beta diversity in encroached farmland with 0.2774, while, secondary forest with 0.2321 and the least, primary forest with 0.1974. The community index revealed that, there was diversity in the number of families in both primary and secondary forest having 18 families each and Encroach farmland vegetation had the least number of 15 families.

3.7 Forest structure

The tree species composition and distribution assessed in the forest reserve revealed that primary forest was richer and more diverse than other forest types. The Primary forest was dominated by the big pioneers (light demanders), which are exceptionally tall and provide cover for shade tolerant understorey tree species. It was characterized by the abundance of lianas which entangled the branches and crowns of some vulnerable tree species in the reserve. Some epiphytes and mistletoes were observed on the trunk and branches of the tree species. The Secondary forest comprises of medium size tree, most of which are less than 1m in girth which may be due to exploitation. Tree species in Encroached farmland forest were big, tall and scattered all over the cash crop farms. These few economic tree species might have been retained to provide shade and protection for farm crops. Although, little difference were recorded in the number of species encountered in the Primary forest and Secondary forest. However, slight dissimilarity was observed in the species composition between the Primary forest and Encroached farmland forest. Primary forest had the highest number of 39 species/ha, while Secondary forest had 38 species/ha and Encroached farmland forest had the least number of 19 species/ha as indicated in Tables 1.

Khaya ivorensis A. Chev. (Meliaceae) had the highest number of occurrence (75 stems/ha) (Table 1) and a relative density of 19.74%. Thus, it could be regarded as the most abundant species in the forest reserve. This was closely followed by *Steculia rhinopetala* K. Schum. (Sterculiaceae) with 45 stems/ha and a relative density of 11.84%. The third abundant species was *Millicia excelsa* (Welw) C.C.Berg. with 25 stems/ha and a relative density of 6.58%. *Mansonia altissima* A. Chev. (Sterculiaceae) had the highest mean dbh of 227.80cm. While, the least dbh of 31.00 cm was recorded for *Aningeria robusta* (A. Chev.) Aubrev ϒ Pellegr. in Sapotaceae family. The highest mean height of 53.87m was recorded for *Ceiba pentandra* (L) Gaertn in Bombacaceae family and the least height of 9.2m was counted for *Musanga cecropioides* in Moraceae family respectively. The highest volume per hectare of 936.85m^3 was contributed by *Ceiba pemtandra* (L) Gaertn in Bombacaceae family. This was followed by *Antiaris africana* Lesch with a volume/ha of 616.90 m^3. The least volume/ha of 4.01m^3 was recorded for *Strombosia pustulata* Oliv. in Olacaceae family. However, *Khaya ivorensis* had the highest species importance with an IVI of 22.16 %. This was closely followed by *Ceiba pentandra* with IVI of 17.83%. This species also had the highest relative dominance value of 13.89%, followed by *Antiaris africana with* 10.17% and the least relative dominance value of 0.23% was contributed by *Strombosia pustulata* of Olacaceae family accordingly.

4.0 DISCUSSION

The results of this study revealed that this forest reserve is a repository of many indigenous tropical hardwood tree species in different families. The number of tree species encountered in the sample survey was adopted as a surrogate for the actual species richness in this study (Magnussen *et al.* 2010). The floristic diversity of this forest was slightly lesser than other tropical rainforests in some Asian countries with conservation preference. The species diversity (Alpha diversity) revealed that primary forests were the most diverse with Simpson index of 0.9301 and Shannon index of 3.2160. According to Hawthorne *et al*. (2011), high Shannon index value signifies high species diversity of the forest and the dominance and abundance of few tree species in the reserve. While, the Beta diversity indicated the species similarity indices of the forest reserve as revealed by Sorensen's index in the

forest types identified in the reserve. Primary forest had the Sorensen's index of 0.1974, Secondary forest with 0.2321 and 0.2774 in Encroach farmland forest which are slightly lesser than the values obtained by Ihuma *et al*. (2011) in a Nigerian montane forest. This is evidenced by the 380 trees/ha, 280 trees/ha and 137 trees/ha (797 trees/ha) (dbh ≥ 10 cm) that belongs to 39, 38 and 19 indigenous tree species (96 species/ha) distributed in 22 families in primary, secondary and encroached farmland vegetation types in the forest reserve. Lu *et al.* (2010) obtained a total of 428 stems/ha in 95 species and 38 families in tropical rainforest of Xishuangbana, China. While, Rajkumar and Parthasarathy (2008) encountered a total of 105 species that belong to 32 families in the evergreen forest of Andaman Giant, India. An average stand density of 422 stems/ha was reported for Borneo rainforest by Small *et al.* (2004) and about 544 for a primary forest in Indonesia by Kessler *et al.* (2005). In a Mexican tropical deciduous forest, 347 stems/ha in 148 species distributed among 42 families were reported (Duran *et al*. 2006). Though, the stand density of the forest reserve was lower than the tropical Amazonia forests with 1420 trees/ha and 1720 trees/ha recorded for a tropical forest by Campbell *et al.* (1992). The number of species is also within the range of 62 - 247 species reported for a mature tropical forest in southeast Asia (Losose and Leigh 2004), also higher than 92 species of sub-montane tropical rainforest in Philippines (Hamann *et al.* 1999) and the 81 species of the mature lowland dense forest in Vietnam (Blanc *et al*. 2000). Eda forest reserve has an average number of 380 trees/ha which is higher than the values reported by Adekunle *et al.* (2004) and Jimoh *et al*. (2012) for some tropical forests in Nigeria. The families dominating this forest include the Meliaceae, Sterculiaceae and Moraceae. This report corroborated the works of Adekunle (2006) and Adekunle *et al.* (2010) that the tropical rainforest ecosystem of southwest Nigeria is dominated by these set of tree species and families. In a similar study, Meliaceae, Euphorbiaceae and Moraceae were reported as the families that dominated the tropical rainforest of Doi Inthanon, Thailand (Kanzaki *et al.* 2004), some sites in southeast Asia (Kessler *et al*. 2005), Andaman Giant evergreen forest in India (Rajkumsar and Parthasarathy 2008) and the Xishuangbanna forest in southwest China (Lu *et al.* (2010).

The mean diameters recorded were 78.58cm/ha, 34.60cm/ha and 83.35cm/ha for the forest types in reserve. While, the mean basal area calculated were 3.18m^2/ha, 0.36m^2/ha and 1.68m^2/ha for primary, secondary and encroach farmland forests in the reserve. The mean volumes were 122.44m^3, 13.20m^3 and 53.02m^3 for the forest types in the reserve. While, the mean height recorded were 27.23m, 23.87m and 27.93m for primary, secondary and encroach farmland forest types in the reserve. Some of these values are slightly higher than the values reported by Adekunle *et al.* (2004) and Kumar *et al.* (2002) for some tropical forests of the world. The values are also higher than the values suggested for a well stocked tropical rainforest in Nigeria by Alder and Abayomi (1994). The skewness in dbh distribution is positive because, there are more trees in the lower dbh classes than in upper classes (figure 3). This correlates with the reports of Boubil et al. (2004) and Bobo et al. (2006) for two tropical forests. This implies that, the forest has relatively good regeneration and recruitment potential which are indications of good forest health and vigour.

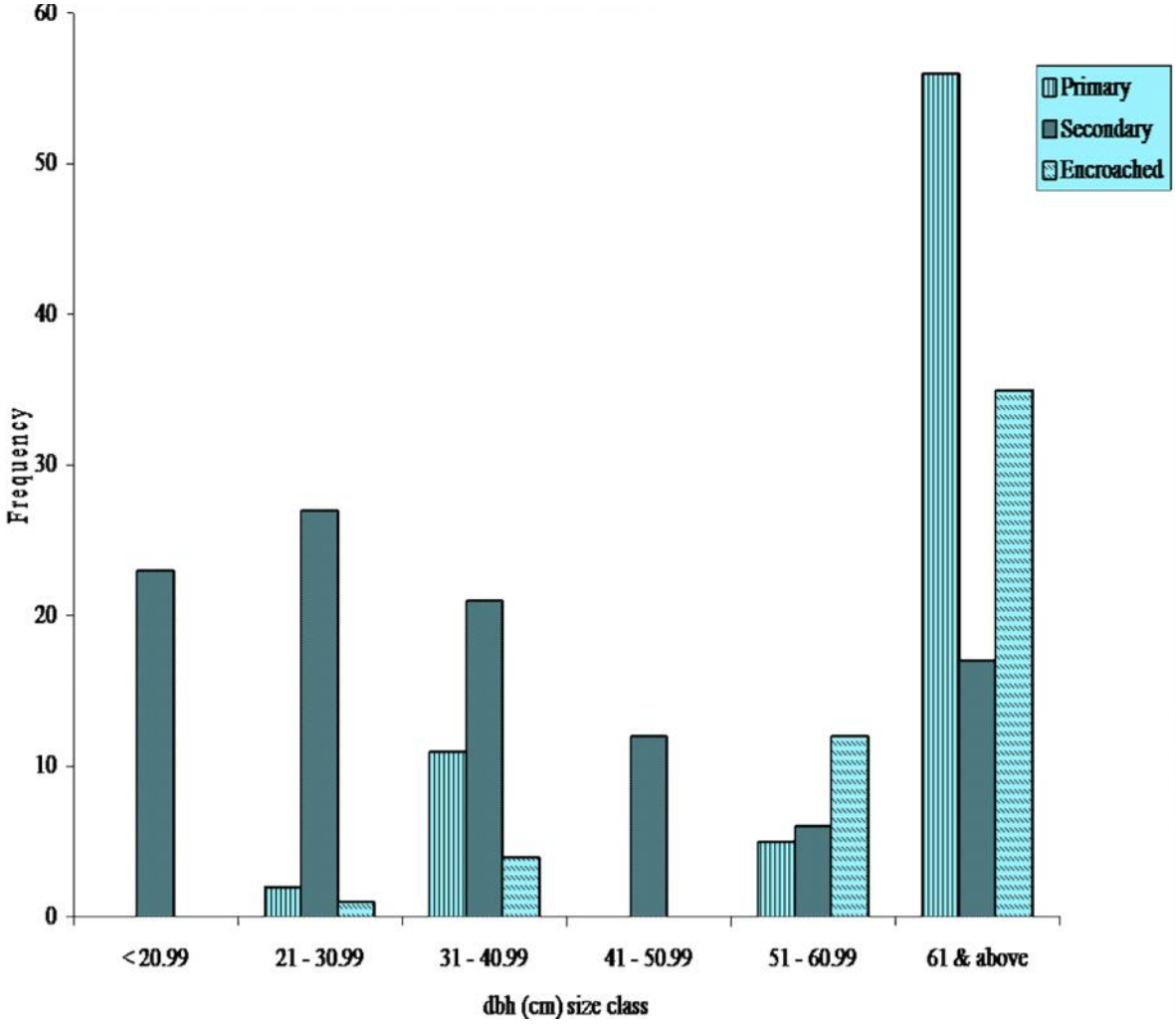

Figure 3: Diameter (Dbh) Distribution pattern of Eda Forest Reserve

Table 4: Summary of Tree growth characteristics for Eda forest reserve

	Primary forest	Secondary forest	Encroached farmland
Mean dbh (cm)	78.58 ± 6.9302	34.61±3.2166	83.35±9.0386
Dominant dbh (cm)	82.00	30.00	140.00
Max. dbh (cm)	209.00	90.00	189.00
Min. dbh (cm	27.00	2.50	27.40
Mean height (m)	27.23 ± 1.9013	23.87±1.5403	27.93±1.5943
Dominant Height (m)	16.70	17.40	28.00
Max. Height (m)	53.87	44.00	39.00
Min. Height (m)	9.20	7.30	15.60
Mean BA/ha (m^2)	3.18±0.5730	0.36±0.0845	1.68±0.3897
Max. BA/ha (m^2)	17.20	2.70	7.13
Min. BA/ha (m^2)	0.29	0.001	0.15
Total Basal Area/ha (m^2)	123.86	13.68	31.87
Mean Volume/ha (m^3)	122.44±29.9292	13.20±4.0597	53.02±14.6674
Max. Vol./ha (m^3)	936.85	136.98	266.56
Min. Vol./ha (m^3)	4.01	0.009	2.65
Total Vol./ha (m^3)	4775.32	501.49	1007.31

5.0 Conclusion

The results of this study revealed the potential of a typical relatively stocked forest reserve in Nigeria. The phytosociological assessment as well as the species diversity and abundance compared favourably with other similar forest ecosystems, including those located in other forest reserves of the world. This forest, therefore, is a potential world heritage site that requires improved conservation, management efforts, and intensive research of all the biodiversity indicators. Conservation efforts should be intensify for these species to prevent them from going into extinction. The results of this work will serve as baseline data that could be helpful in the appraisal of plant resources of the tropical rainforest ecosystem for its effective management. The activities of the rural communities around the forest should be properly monitored by the government agency responsible for the protection and management of the forest reserve. This is to avoid encroachment into the fertile forest gaps created

due to exploitation which may occur as a result of the farmer's quest for more land beyond the buffer zones in the forest reserve.

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