VOL. 3, NO. 4, April 2013 ISSN 2225-7217
ARPN Journal of Science and Technology

http://www.ejournalofscience.org

Ecological Survey of Plant Species Producing Valuable Forest Products in Two Sacred Forest in South Eastern Nigeria

[1] Udoakpan U.I, [2] Nelson, I. U, [3] Jacob, D.E.,
[1,3] Forestry and Wildlife Department, University of Uyo, Nigeria
[2] Biodiversity Preservation Center, Uyo, Nigeria
[1] ubongudoakpan@gmail.com , [2] immanelcin@yahoo.com , [3] daniellajacob1@ymail.com

ABSTRACT

Two tropical forest fragments namely Ikot Efre Etak and Asanting community forests in Akwa Ibom State, Nigeria were assessed for the population and diversity index of plants producing valuable forest products. Appropriate ecological model were used to obtain the plant population density, Abundance/Richness index, diversity index similarity index. A total of 69 plant species comprising 41 species of trees, 13 shrub, 8 herbs, 4 climbers and 3 palms were encountered in the study areas. Apart from Canarium schweinfurthii (Linn.) and Mimusops heckelii (Linn.) with density of 11and 16 individual/ha respectively, all other tree species had a density of less than 10 individual/ha. Bambusia vulgaris (Schrad. Ex Wend.) had the highest shrub population density of 31 individual/ha, and in the herb category, Costus afar (Ker-Gawl.) and Hippocratea africana (Willd.) had the highest density of 53 and 11 individual/ha. Furthermore, the result also shows that Ancistrophyllum secondiflorum (P. Beauv and Wendl.) had the highest population density of 23 individual/ha in the palm category. The Sorensen's similar indexes for the two sites were Tree (41.46%), Shrubs (46.15%), Herbs (37.5%), Climber (50%) and Palm (33.33%). The study implied that The forest have extensively been degraded as a result of unsustainable exploitation. This has affected the plant population in the area. Community dependence on forest resource for their livelihood has drastically reduce the population of both flora and fauna species in the forest. Enrichment planting should be carried out for ecological restoration of the degraded area.

Keyword: *Tropical forest, Forest products, Population density, Nigeria*

1. INTRODUCTION

A forest is a natural resource of multiple values, oftentimes, estimated from the stand point of population density or standing volume of timber tree species present, while ignoring the more valuable non-timber species (Udo et al., 2009). The Nigerian forest is predominantly a rainforest occupying only 9.7% (95, 372km^2) of the country's land area of 983, 213km^2 (Onyekwelu et al., 2005). The tropical rainforest is the most biologically diverse terrestrial ecosystem on earth. It is also a complex community whose framework is provided by trees of many sizes, form and species. Trees are often the most conspicuous plant life form in a tropical rain forest. Upon the framework of these trees and within the microclimate of the canopy of the trees, grow a wide range of other kinds of plants such as epiphytes, strangling plants, climbers, parasitic and saprophytes. Unfortunately, only a fragment of the country's tropical rainforest (21% of the rainforest ecosystem and 2% of the country's land mass) has been constituted into forest reserves (Udo et al., 2009).

Nigeria has one of the highest rates of forest loss (3.3 percent) in the world (mongabey.com). Since 1990, the country has lost some 6.1 million hectares or 35.7 percent of its forest covers. Worse, Nigeria's most biodiverse ecosystems—its old-growth forests—are disappearing at an even faster rate. between 1990 and 2005, the country lost a staggering 79 percent of these forests and since 2000 Nigeria has been losing an average of 11 percent of its primary forests per year—double the rate of the 1990s (mongabey.com). These figures give Nigeria the dubious distinction of having the highest deforestation rate of natural forest on the planet, consequently our pristine ecosystems have been significantly altered (Turner, 2001) with severe consequences on biodiversity, soil and climate (Udofia et al., 2011).

The need to conserve our remaining areas of tropical rainforest cannot be over emphasized given the high rate of forest destruction, degradation and fragmentation threatening the survival of both fauna and flora species in the country. As efforts are geared towards preventing the utter destruction of our ecosystem and ensuring the conservation of our rich biodiversity, adequate quantitative and qualitative ecological data of the flora and fauna species is imperative. Such data is needed for effective and realistic conservation strategies. The required ecological data include species composition, abundance of each species, stem diameter distribution and abundance of regeneration of each species. This study was therefore carried out to assess the diversity and population densities of plants producing economically valuable forest products so as to provide a basis for formulating strategies for sustainable management of the forest and other similar forest tracts.

2. METHODOLOGY

2.1 Study Area

The study was carried out in two sacred forests (Ikot Efre Itak (IEI), Uyo Local Government Area and Asanting (ASN), Ibiono Ibom Local Government Area) in Akwa Ibom State located in southeastern part of Nigeria. Ikot Efre Itak is located between latitudes 40° 30` - 5° 30` N and longitudes 70° 31` - 80° 20" E covering an area of approximate 29.57km$^2$ hectare (IWADO, 2000). Asanting sacred forest is located between latitudes 5° 00` - 6° 21`N and longitudes 8° 20` - 80° 80 E covering a land area of

27.76km^2. The mean annual rainfall of the state is between 2400mm and 3000mm. The mean minimum and maximum temperature are 260C and 30.5oC respectively while the mean relative humidity of the area is about 83%. The forest is growing on silt loam soil (onlinenigeria.com).

2.2 Sampling Method And Design

Three 200m transects were laid randomly at 20 meters away from and perpendicular to the access route into each of the two sacred forest. The plant species within 20 meters away from both sides of each transect which produce valuable non- timber products were enumerated. It therefore summed up to an area of 18, 000 m^2 (1.8ha) assessed in each of the two sacred forest.

2.3 Data Processing And Analysis

The enumerated plant species were classified into five life-forms of Trees, Palms, Shrubs, Climbers and Herbs. The data were collected during dry and rainy seasons between years 2011 and 2012.The mean population density per hectare of each species was determined from its population in the 1.8 ha area assessed.

The Diversity Index of the plant species was determined using Shannon Weiner index (H1) as described Magurran (1988).

$$\text{Diversity Index (H1)} = \sum Pi \ln Pi \quad (1)$$

Where: Pi = Ni/N, Ni – Total number of individuals of species I, N – Total number of individuals o all species.

Species Richness was also calculated using Margalef Index (d) as described by Aremu (2010)

$$\text{Species Index (d)} = S\text{-}1/\ln N \quad (2)$$

Where: S – Total number of Species, N – Total number of individuals of all species.

The Species evenness was calculated using Pielon Index (E) as described by Aremu (2010)

$$\text{Pielon Index (E)} = H1/\ln S \quad (3)$$

Where: H1 – Diversity Index, S - Total number of Species

$$F_k = \sum Y_i/n \times 100 \quad (4)$$

Where: F_k – frequency, Y_i – incidence of species k in site I, n – number of species sampled
*In = Natural log

The Beta diversity/similarity for the two study areas were determined using Sorensen's index as described by Olajide et al (2008). Sorensen's index (SI) is expressed as:

$$SI = [\ a / a + b + c\ ] \times 100 \quad (5)$$

Where a = Number of species present in both sites under consideration, b - Number of species present in site 1 but absent in site 2, c - Number of species present in site 2 but absent in site 1

3. RESULTS

A total of 59 plant species belonging to 46 families were identified in IEI sacred forest. The distribution of the plant species indicated 33 species of trees belonging to 21 families, 12 species of shrub belonging to 12 families, 7 species of herbs belonging to 7 families, 4 species of climbers belonging to 4 families and 3 species of palms belonging to 2 families while a total of 38 plant species belonging to 29 families were identified in ASN sacred forest. The distribution showed 24 species of trees belonging to 17 families, 7 shrub species belonging to 7 families, 4 herbs belonging to 3 families, 2 climbers belonging to 2 families and 1 palm tree belonging to the family of Arecaceae (Table 1, 2, 3, 4 and 5).

3.1 Tree Species Population Density, Diversity Index, Richness And Evenness

In table 1, the result showed that the family of Sapotaceae, Fabaceae and Leguminosae had the highest number of 4 plant species each followed by Anarcardiaceae, Moraceae and Malvaceae with 2 plant species each in IEI sacred forest and Mimusops heckelii (Linn.) had the highest population density of 16 individuals/ha, followed by Canarium schweinfurthii (Linn.), Dracaena sp. (Linn.), Combretodendron macrocarpum (P. Beauv.) and Antrocaryon klaineanum (Pierre.) with density of 12, 7, 6 and 6 individual/ha respectively while other tree species varied between 2 and 1 individual/ha respectively.

In ASN sacred forest, Fabaceae and Leguminosae had the highest number of 4 plant species each followed by Sterculiaceae with 2 plant species. Canarium schweinfurthii (Linn.) had the highest population density of 11 individuals/ha, followed by, Brachystegia eurycoma, Baphia nitida (Lodd.), Aningeria robusta (A. Chev.), Albizia zygia and Oncoba spinosa with density of 8, 8, 7, 6 and 6 individual/ha and other tree species also varied between 4 and 1 individual/ha respectively. The tree Species diversity index, Richness and species Evenness of tree species in IEI was -1.3207, 16.2950, -0.8697 respectively while ASN was -1.1767, 11.9850, -0.8526 respectively and the similarity index between the two sites is 41.46%.

3.2 Shrub Species Population Density, Diversity Index, Richness And Evenness

The result in Table 2 indicates that Bambusia vulgaris (Scrad. Ex Wend.) had the highest shrub population density of 31 individuals/ha followed by Glyphaea brevis (Spreng.), Harungana madasgarensis (Lamb. Ex Poir.), Coelocaryon preussii (Warb,), Maesobotrya dusenii (Pax.) with 4/ha and Garcinia mannii

(Linn.), Homalium letestui (Jacq.) with 3 individuals/ha respectively while the shrub species with the least frequency had a population density of 1 individual/ha in IEI. In ASN, Bambusia vulgaris (Schrad. Ex Wend) also had the highest shrub population density of 31 individuals/ha followed by Coelocaryon preussii (Warb.), Garcinia mannii (Linn.), and Chromolaena odorata (L.) King & H. Rob with 3 individuals/ha respectively while Glyphaea brevis (Spreng.), Maesobotrya dusenii (Pax.) and Newbouldla laevis (Seeman ex Bureau.) had the least population density of 2 individual/ha respectively. The Species diversity index, Richness and Species Evenness of shrubs in IEI was -0.7840, Richness 6.4745, Evenness -0.7265 respectively while ASN had -0.5250, 3.6085 and -0.6212 respectively and the similarity index between the two sites is 46.15%.

3.3 Herb Species Population Density, Diversity Index, Richness And Evenness

In the herb category, the result in Table 3 shows that Costus afar (Ker-Gawl.) and had the highest density of 53 individual/ha and 11 individuals/ha respectively while the other five other herb species enumerated had a population density of less than 10 individual/ha in IEI. The herb population density of ASN showed that Costus afar (Ker-Gawl.) and Hippocratea africana (Willd.) had the highest density of 23 individual/ha and 9 individuals/ha respectively while the other two herb species enumerated, Combretum zenkeri (Engl. & Diels) and Combretum micranthum (G. Don.) had a population density of 2 and 1 individual/ha respectively. The Species diversity index, Richness and Evenness of herb species in IEI sacred forest was -0.4625, Richness 3.2519, and species Evenness -0.5473 respectively ASN had -0.3867, 1.9429, -0.6423 respectively and the similarity index between the two sites is 37.5%.

3.4 Climber Species Population Density, Diversity Index, Richness And Evenness

The result in Table 4 also indicated that Cissus quadrangularis (Linn.) had the highest population density of 17 individual/ha, Gnetum africanum (Welw.) 3 individual/ha and Piper guineensis (Schum and Thonn.) 2 individual/ha while Dioscorea bulbifera (Linn.) had the least population density of 1 individual/ha in IEI. The result in ASN also indicated that only two climber species belonging to the family of Vitaceae and Solanaceae were observed and enumerated in the study area. Cissus quadrangularis (Linn.) had the highest population density of 14 individual/ha, followed by Dioscorea bulbifera (Linn.) with a population density of 13 individual/ha. The Species diversity index, Richness and Evenness of climber in IEI sacred forest was -0.4957, Richness 2.6931, and species Evenness -0.8233 respectively and in ASN -0.2024, 1.6254, -0.6724 respectively and the similarity index between the two sites is 50%.

3.5 Palm Species Population Density, Diversity Index, Richness And Evenness

In IEI sacred forest, Ancistrophyllum secondiflorum (P.Beauv and Wenldl.) had the highest palm population density of 23 individual/ha and Elaeis guineensis (Jacq.) 12 individual/ha while Raphia hookeri (Mann and Wendl.) had the least population density of 2/ha (Table 5). The only palm species observed and enumerated in ASN was Elaeis guineensis (Jacq.) belonging to the family of Arecaceae with a population density of 8 individual/ha. The Species diversity index, Richness and Evenness of palms in IEI sacred forest was -0.4957, Richness 2.6931, and species Evenness -0.8233 respectively and in ASN -0.2024, 1.6254, -0.6724 respectively and the similarity index between the two sites is 33.33%.

4. DISCUSSION

The existence and population density of a plant species in a tract of a rainforest is a function of the availability of its seeds or propagules and the existence of favorable micro-climate for the seed germination and growth (Olajide et al., 2008). Furthermore, the abundance and rarity of a plant species, especially those of great economic value, is a function of the intensity and pattern of exploitation which the forest is generally subjected to (Udo et al., 2009). Consequently, the identification of 41/ha tree species in the two sites showed that the two community forest is very under stocked in tree diversity. Accordingly, a forest is considered rich in tree species if a hundred different species are found in a single hectare (Nwoboshi, 1982; Pathasrathy and Karthikeyan, 1997 and Onyekwelu et al., 2005). Etigale (2010) encountered 385 trees/ha belonging to 70 tree species, 73 genera and 28 families in a rain forest reserve in Cross River State, Nigeria. Also, Ogbonnaya (2002) found 319 trees/ha belonging to 109 species, 85 genera and 37 families. Adekunle et al. (2002) recorded 365 trees/ha which belonged to 31 species and 15 families in Omo Forest Reserve and Abayomi (2001) encountered 179 trees/ha belonging to 68 families and 59 genea in three rainforest in Cross River State, Nigeria. This finding therefore agrees with the observation of Udo et al. (2009) and Nath et al. (2005) that higher population of trees are usually observed in an undisturbed tropical rainforest when compared with those of the disturbed tropical rainforest in Nigeria and Northeast India.

Most of the plants species in the study areas were observed to be less than 10 individuals per hectare except for Canarium schweinfurthii (Linn.), Bambusia vulgaris (Schrad. Ex Wend), Costus afar (Ker-Gawl.), Mimusops heckelii (Linn.) and Cissus quadrangularis (Linn.) with a population of 11, 31, 23, 16 and 14 individual per hectare respectively indicating that the plant species are rare and endangered species (Udo et al., 2009; Olajide et al., 2008). According to Pathasrathy and Karthikeyan (1997), tree species with less than 10 stands per/ha are considered as a rare or endangered species. The less than 10 individual tree species/ha of the majority of the tree species may be attributed to the intense and selective logging of the two forest for good quality hard wood for timber and other industrial uses in the areas. The study also revealed that the high density of Canarium schweinfurthii (Linn.) and Mimusops heckelii (Linn.) in the study area can be

attributed to the less exploitation of the tree species which is considered of a lesser wood quality for construction purposes by the people.

However, the high population of tree species, diversity index, Richness and Species evenness and lower similarity index between the two sites over other life forms encountered in the study area can be attributed to the favorable micro-climate and the initial ban on the exploitation of trees in the area for timber as a result of the consecration of the area as a sacred forest.

The fewer population of shrub, herbs, climbers and palms in the forest fragments may also be attributed to the unfavorable micro-climate and paucity of viable seeds to sustain regeneration. Furthermore, the shading of the sunlight and the allelopathic nature of some tree plant species must have made it difficult for the herbs and climbers to thrive in the area. The high presence of Cissus quadrangularis (Linn.) in the study area could be attributed to it being of lesser economic value to other climber species and it was observed to be of much older stock from any other climbers in the study area.

Furthermore, all the plant species identified and enumerated in the study area were observed to be of economic importance to the people of the community as they either produce timber or NTFP's such as edible fruits and seeds of which the people depended for food, oil, poles, leafy vegetable and traditional medicine which are usually sold in the rural and urban areas by the people who trade in them as their means of livelihood (Udo and Udofia, 2006; Udo et al., 2009; Olajide et al., 2008).

5. CONCLUSION AND RECOMMENDATION

Human activities including unsustainable resources exploitation in Asanting and Ikot Efre Itak communities has greatly depleted the resources base of the community forest. The study indicates that majority of the plant life forms in the study area are either scares or endangered. However, tree species had the highest population density in the study area followed by the herb species while the climber species had the least population density. The population of individual species of climbers, herbs and shrubs in the study area has greatly been depleted as a result of unsustainable exploitation of the plant form.

It is therefore recommended that measures to foster partnership between the community and other stakeholders in natural resources conservation in the areas should be encouraged to ensure sustainable natural resources management in the areas. Furthermore, public enlightenment on the need for sustainable natural resources exploitation should be intensified in the area to raise the level of awareness of the locals; also there is need for the provision of alternative means of livelihood for the local populace to reduce their rate of dependence on the available resources of the forest. Finally, afforestation and re-afforestation programs should be timely carried out to rehabilitate the degraded ecosystem.

REFERENCES

[1] Abayomi, J.O. (2001). A Timber resources assessment of some natural forest sample plots in Cross River State, Nigeria. In: Popoola, L., Abu, J.E. and Oni, P.I. (Eds.) Forestry and National Development. Proceedings of the 27th Annual Conference of the Forest Association of Nigeria, Abuja, pp. 17-26.

[2] Adekunle, V.A.J., Akindele, S.O. and Fuwape, J.A. (2002). Impacts of over exploitation on biodiversity, yield and sustainable use of tropical rainforest ecosystem: A case study of Omo Forest Reserve, Southwestern Nigeia. In: Abu, J.E., Oni, P.I. and Popoola, L. (Eds.) Forestry and challenges of sustainable Livelihood. Proceedings of the 28th Annual Conference of the Forest Association of Nigeria, Akure, pp. 252-263.

[3] Aremu, T.O. (2010). The Diversity and distribution of mammals in Nigeria. In: Ijeomah, H.N. and A.A. Aiyeloja (eds). Practical issues in forest and wildlife resources management in Nigeria. Green Canopy Consultant, Choba, Port Harcourt, Nigeria. pp 552-581

[4] Etigale, E.B. (2010). Trees species diversity, abundance and regeneration potential in Ukpom River Forest Reserve, Cross River State, Nigeria. Unpublished M.Sc. Dissertation, University of Uyo, Uyo, Nigeria, pp 49-84.

[5] IWADU (2000). Ibiono Ibom Welfare and Development Union (IWADU) Hand book, 2000.

[6] Longman, K.A. and Jenik, J. (1992). Tropical forests and its environment. ELBS/Longman Publishers, 374pp.

[7] Magurran, A. E. (1988). Ecological Diversity and its measurement. First Edition. Chapman and Hill Publication, London, 384p.

[8] Mongabey.org. Nigeria. Accessed 11th January, 2012.

[9] Nath, O.C., A. Arunachalam, M.I. Khan, K. Arunachalam and A.R. Barhuiya (2005). Vegetation analysis and tree population structure of tropical wet evergreen forest in Namdapha National Park, Northeast India. Biodiversity and Conservation 14: 2109-2136.

[10] Nwoboshi, L.C. (1982). Tropical silviculture: Principles and techniques. Ibadan University Press, Ibadan, Nigeria. 333pp.

[11] Olajide, O., Udo, E.S. and D.O. Out (2008). Diversity and population of timber tree species producing valueable non-timber products in two tropical ainforest in Cross River State, Nigeria. Journal of Agriculture and Social Science 4(2): 65-68.

[12] onlinenigeria.com (2011). Akwa Ibom State. www.onlinenigeria.com/Akwa+Ibom. Accessed August 28, 2011.

[13] Onyekwelu, J.C., Adekunle, A.J. and Adeduntan, S.A. (2005). Does tropical rainforest ecosystem possess the ability to recover from severe degradation? In: Popoola, L., Mfon, P. and

[14] Oni, P.I. (eds.) Sustainable forest management in Nigeria: Lessons and Prospects. Proceedings of the 30th Annual Conference of the Forest Association of Nigeria, Kaduna, pp. 145-163.

[15] Ogar, D. A. (2009). Fundamentals of Forestry and Wildlife Management in Nigeria. Unical Printing Press. 122p.

[16] Parthasarathy, N. and Karthikeyan, R. (1997). Biodiversity and population density of woody species in a tropical evergreen forest in Courtalhem Reserve Forest, Western Ghats, India. Tropical Ecology 38: 297-306.

[17] Turner, I.M. (2001). The Ecology of trees in the tropical rainforest, p. 298. Cambridge University Press, Cambridge, UK.

[18] Udo, E.S. and S.I. Udofia (2006). Marketing of Chrysophyllumalbidum (Linn) fruits within the produce market in Uyo, Akwa Ibom State of Nigeria. Global J. Pure Appl. Sci., 12: 307-313.

[19] Udo, E.S., O. Olajide and E.A. Udoh (2009). Life-form classification and density of plants producing economically valuable non-timber products in Ukpom Community Forest, Akwa Ibom State, Nigeria. Nigerian Journal of Botany, Vol. 22(1): 147-154

[20] Udofia, S.I., D.E. Jacob, P.W. Owoh and N.S. Samuel (2011). Steming environmental degradation: The afforestation approach. Nigerian Journal of Agriculture, Food and Environment 7(1): 22-27

Table 1: Tree species producing valuable forest products in the study area

Tree species	Family	Ikot Efre Itak		Asanting	
		Population Frequency (%)	$P_i \log P_i$	Population Frequency (%)	$P_i \log P_i$
Albizia zygia (DC.) Macbr.	Fabaceae	-	-	6(7.23)	-0.0845
Alstonia boonii (De Wild.)	Apocynaceae	2(2.17)	-0.0361	-	-
Anacardium occidentalis (Linn.)	Anacardiaceae	1(1.09)	-0.0214	-	-
Anchomanes difformis (BIume.)	Araceae	1(1.09)	-0.0214	2(2.41)	-0.039
Aningeria robusta (A. Chev.)	Sapotaceae	1(1.09)	-0.0214	7(8.43)	-0.0906
Anthonotha macrophylla (P. Beauv.)	Fabaceae	1(1.09)	-0.0214	1(1.21)	-0.0232
Antrocaryon klaineanum (Pierre)	Anacardiaceae	6(6.52)	-0.0773	-	-
Autranella congolensis (De Wild.)	Sapotaceae	2(2.17)	-0.0361	-	-
Baphia nitida (Lodd.)	Fabaceae	1(1.09)	-0.0214	8(9.64)	-0.0979
Berlinia grandiflora (Vahl) Hutch. & Dalziel	Leguminosae	-	-	1(1.21)	-0.0232
Bombax buonopozense (P. Beauv.)	Malvaceae	1(1.09)	-0.0214	-	-
Brachystegia eurycoma (Harms)	Caesalpinioideae	-	-	8(9.64)	-0.0521
Canarium schweinfurthii (Linn.)	Burseracea	12(13.04)	-0.1154	11(13.25)	-0.1163
Ceiba pentandra (L. Gaertn.)	Malvaceae	1(1.09)	-0.0214	3(3.61)	-0.0521
Coelocaryon botryoides (Vermoesen)	Myristicaceae	-	-	3(3.61)	-0.0521
Cola acuminate (P. Beauv.)	Malvaceae	1(1.09)	-0.0214	-	-
Cola argentea Schott and (Endl.)	Sterculiaceae	3(3.26)	-0.0485	2(2.41)	-0.039
Cola lepidota (K.Schum)	Sterculiaceae	-	-	2(2.41)	-0.039
Combretodendron macrocarpum (P. Beauv.)	Lecythidaceae	6(6.52)	-0.0773	-	-
Coula edulis (Baill.)	Olacaceae	1(1.09)	-0.0214	1(1.21)	-0.0232
Daniella ogea (Harms. Rolfe ex Holland)	Fabaceae	1(1.09)	-0.0214	1(1.21)	-0.0232

Diospyros mespiliformis (Linn.)	Ebenaceae	1(1.09)	-0.0214	-	-
Distemonanthus benthamianus (Benth.)	Leguminosae	2(2.17)	-0.0361	-	-
Dracaena sp. (Linn.)	Agavaceae	7(7.61)	-0.0851	1(1.21)	-0.0232
Erythrina senegalensis (Linn.)	Leguminosae	4(4.34)	-0.0591	4(4.82)	-0.0635
Ficus exasperate (Linn.)	Moraceae	1(1.09)	-0.0214	2(2.41)	-0.039
Garcinia kola (Heckel)	Clusiaceae	1(1.09)	-0.0214	1(1.21)	-0.0232
Irvingia gabonensis (Hook. f.)	Irvingiaceae	2(2.17)	-0.0361	1(1.21)	-0.0232
Khaya grandifollala (C. DC.)	Meliaceae	1(1.09)	-0.0214		
Lonchocarpus spp (Donn. Sm.) Benth.	Leguminosae	-	-	4(4.82)	-0.0635
Milicia excels (Benth and Hook)	Moraceae	1(1.09)	-0.0214	-	-
Mimusops heckelii (Linn.)	Sapotaceae	16(17.39)	-0.1321	-	-
Musanga cercopoides (R. B)r	Urticaceae	3(3.26)	-0.0485	1(1.21)	-0.0232
Omphalocarpum elatum (P. Beauv.)	Sapotaceae	1(1.09)	-0.0214	-	-
Oncoba spinosa (Forssk)	Flacourtiaceae	-	-	6(7.23)	-0.0845
Oxystigma mannii (Baill.)	Leguminosae	1(1.09)	-0.0214		
Pentaclethra macrophylla Benth.	Leguminosae	2(2.17)	-0.0361	2(2.41)	-0.039
Pterocarpus mildbraedii (Jacq.)	Fabaceae	3(3.26)	-0.0485	-	-
Tetrapleura tetraptera Benth.	Mimosaceae	2(2.17)	-0.0361	-	-
Uapaca esculenta (Crantz)	Euphorbiaceae			2(2.41)	-0.039
Xylopia aethiopica (Dunal)	Annonaceae	3(3.26)	-0.0485	-	-
Total		**92(100)**	**-1.3207**	**83(100)**	**-1.1767**

Tree species diversity indices -1.3207, Richness 16.2950, Evenness -0.8697 (Ikot Efre Itak)
Tree species diversity indices -1.1767, Richness 11.9850, Evenness -0.8526 (Asanting)
Sorensen's similarity index = 41.46%

Table 2: Shrub species producing valuable forest products in the study area

Tree species	Family	Ikot Efre Itak		Asanting	
		Population Frequency (%)	$P_i \log P_i$	Population Frequency (%)	$P_i \log P_i$
Bambusia vulgaris (Schrad. Ex Wend)	Poaceae	31(52.5)	-0.1461	31(67.39)	-0.1155
Coelocaryon preussii (Warb.)	Myristicaceae	4(6.76)	-0.0808	3(6.52)	-0.0773
Chromolaena odorata (L.) King & H. Rob	Asteraceae	-	-	3(6.52)	-0.0773
Crotalaria retusa (Linn.)	Fabaceae	1(1.69)	-0.0334	-	-
Cylicodiscus gabonensis (Harms.)	Leguminosae	2(3.38)	-0.0497	-	-
Garcinia mannii (Linn.)	Clusiaceae	3(5.07)	-0.0657	3(6.52)	-0.0773
Glyphaea brevis (Spreng.)	Tiliaceae	4(6.76)	-0.0808	2(4.35)	-0.0592
Harungana madasgarensis (Lam. Ex Poir.)	Hypericaceae	4(6.76)	-0.0808	-	-
Homalium letestui (Jacq.)	Flacourtiaceae	3(5.07)	-0.0657	-	-
Maesobotrya dusenii (Pax.)	Phyllanthaceae	4(6.76)	-0.0808	2(4.35)	-0.0592
Newbouldla laevis (Seeman ex Bureau.)	Bignoniaceae	1(1.69)	-0.0334	2(4.35)	-0.0592
Sacoglottis gabonensis (Baill.)	Humiriaceae	1(1.69)	-0.0334	-	-
Uvaria chamae (P. Beauv.)	Annonaceae	1(1.69)	-0.0334	-	-
Total		**59(100)**	**-0.7840**	**46(100)**	**-0.5250**

Tree species diversity indices -0.7840, Richness 6.4745, Evenness -0.7265 (Ikot Efre Itak)
Tree species diversity indices -0.5250, Richness 3.6085, Evenness -0.6212 (Asanting)
Sorensen's similarity index = 46.15%

Table 3: Herb species producing valuable forest products in the study areas

Tree species	Family	Ikot Efre Itak		Asanting	
		Population Frequency (%)	$P_i \log P_i$	Population Frequency (%)	$P_i \log P_i$
Costus afar (Ker-Gawl.)	Zingeberaceae	53(75.72)	-0.0915	23(65.710	-0.1198
Hippocratea africana (Willd.)	Celastraceae	11(15.72)	-0.1273	9(25.71)	-0.1517
Thevetia peruviana (Juss.)	Apocynaceae	4(5.72)	-0.0733	-	-
Carpolobia lutea (G. Don)	polygalaceae	3(4.29)	-0.0587	-	-
Combretum micranthum (G. Don.)	Combretaceae	1(1.43)	-0.0264	1(2.86)	-0.0441
Combretum zenkeri (Engl. & Diels)	Combretaceae	-	-	2(5.72)	-0.0711
Crinum jagus (Thomps.)	Amaryllidaceae	1(1.43)	-0.0264	-	-
Gongronema latifolium (Benth.)	Asclepiadaceae	3(4.29)	-0.0587	-	-
Total		**70(100)**	**-0.4625**	**35(100)**	**-0.3867**

Shrub species diversity indices -0.4625, Richness 3.2519, Evenness -0.5 (Ikot Efre Itak)
Shrub species diversity indices -0.3867, Richness 1.9429, Evenness -0.6423 (Asanting)
Sorensen's similarity index = 37.50%

Table 4: Climber species producing valuable forest products in the study areas

Tree species	Family	Ikot Efre Itak		Asanting	
		Population Frequency (%)	$P_i \log P_i$	Population Frequency (%)	$P_i \log P_i$
Piper guineensis (Schum and Thonn.)	Piperaceae	2(15.38)	-0.1236	-	-
Gnetum africanum (Welw.)	Gnetaceae	3(23.08)	-0.1468	-	-
Cissus quadrangularis (Linn.)	Vitaceae	7(53.85)	-0.1445	14(82.35)	-0.0695
Dioscorea bulbifera (Linn.)	Solanaceae	1(7.69)	-0.0808	3(17.65)	-0.1329
Total		**13(100)**	**-0.4957**	**17(100)**	**-0.2024**

Climber species diversity indices -0.4957, Richness 2.6931, Evenness -0.8233 (Ikot Efre Itak)
Climber species diversity indices -0.2024, Richness 0.8127, Evenness -0.6724 (Asanting)
Sorensen's similarity index = 50.00%

Table 5: Palm species producing valuable forest products in the study areas

Tree species	Family	Ikot Efre Itak		Asanting	
		Population Frequency (%)	$P_i \log P_i$	Population Frequency (%)	$P_i \log P_i$
Elaeis guineensis (Jacq.)	Arecaceae	9(26.47)	-0.1521	2(100)	0
Ancistrophyllum secondiflorum (P. Beauv and Wendl.)	Arecaceae	23(67.65)	-0.1139	-	-
Raphia hookeri (Mann and Wendl.)	Palmae	2(5.88)	-0.0733	-	-
Total		**34(100)**	**-0.3393**	**2(100)**	**0**

Climber species diversity indices -0.3393, Richness 1.3059, Evenness -0.7111(Ikot Efre Itak)
Climber species diversity indices = 0, Richness = 0, Evenness = 0 (Asanting)
Sorensen's similarity index = 33.33%