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Growth characteristics and diversity of urban tree species in selected areas of Uyo Metropolis, Akwa Ibom State, Nigeria

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ABSTRACT

This study investigated the growth characteristic and diversity of urban tree species in selected areas (educational, commercial and residential areas) of Uyo metropolis, Akwa Ibom State, Nigeria. The quantitative data collected on growth parameters (dbh, basal area and volume) were analyzed and ecological indices such as Shannon-Wiener diversity index, evenness and species similarity index were employed to determine the diversity of the study areas. The results showed that educational area has the highest level of growth parameters in terms of number of families (29), number of species (63), as compared to commercial and residential areas with 16 and 30, and 24 and 54 respectively. The highest density per hectare of tree species was found in residential area. Species diversity index, species richness and species evenness were in the order educational area > residential area > commercial area, thus indicating that the indices are dependent on some silvicultural conditions of the area. The educational area has the highest diversity (63), followed by residential area (54) and commercial area (30). The result of Sorensen's species similarity index between the three study strata revealed the sequence 66.10, 65.17 and 56.80 between commercial and residential areas, educational and commercial areas, educational and residential areas respectively; signifying that species in commercial and residential are more similar than any other area combination. On the other hand, the results of the test of significance among means of growth characteristics (mean dbh, mean basal area and mean volume,) using ANOVA and LSD indicated no significance differences among the study areas (P> 0.05); thus supporting the sameness in the diversity of the study areas.

Keywords: growth characteristics, species diversity index, species richness, species evenness.

INTRODUCTION

Trees significantly affect the existence of millions of city dwellers by its tremendous capacity to reduce air pollution level and satisfying provision of shade and cool environment. Urban trees play an important role in ecology of human habitats in many ways. They filter air, water and sunlight; provide shelter to animals and recreational area for people. They moderate local climate, slow down wind and storm water, shade homes and business centers to conserve energy. They are critical in cooling the urban heat island effect; thus, potentially reducing the number of unhealthful ozone days that plague major cities in peak summer months.

Many authors have submitted to the validity of the concept of urban forestry as encompassing the planning, design, establishment and management of trees and forest stands with amenities values situated in or near urban areas (COST E12, 1997; Nilsson and Randrup 1997; Miller; Helms 1998). Importantly, European Co-operation in the field of Science and Technology (COST) established an action programme- COST Action E12 "Urban Forest and Trees" in 1997 with overall goal to improve the knowledge base needed for the planning, design and establishment

and management of urban forests and trees(COST E 12,1997). Noteworthy domain of this action programme include critical management of urban forests and urban trees using scientific and computer-based inventory techniques for sustainable urban uses (Konijninenijk *et.al.*,2000).

However, the idea behind this laudable has not be sustained and never has it been introduced in Nigeria despite vast forest trees occupation in Nigerian ecosystems. The impact of increasing population and intense rural-urban migrations with unregulated exploitation of forests and timber have contributed immensely to alarming rate of forest degradation in Nigeria; which consequently has impacted negatively on urban forestry and its potential in Nigeria.

Obviously, urban forests management is very nascent in Nigeria following little or no quantitative information about the status of urban forests and trees. Consequently, there is a growing need and interest in quantifying urban forests and trees habitat characteristics such as forest structure, floristic composition with species diversity and richness indices in different urban areas (Mcpherson, 1996; Johnston, 1997; Johnston and Rushton, 1999). This study investigates the growth characteristics and diversity of selected urban trees in Uyo metropolis , Akwa Ibom, Nigeria.

MATERIALS AND METHODS

Study area

The study was conducted in Uyo metropolis; the capital city of Akwa Ibom State, Nigeria. It is located in the coastal south-southern part of the country lying between latitudes $4^{o}32^{\square}$ and $5^{o}33^{\square}$N and longitudes $7^{o}25^{\square}$ and $8^{o}25^{\square}$E. The map below shows the Uyo metropolis and the study areas used in this study. The topography of the study area is mostly that of coastal plain sediments with predominant flat landscape. This makes room for natural deposits of mosaic of marine, deltaic, estuarine, lagoonal and fluviol acustine material. Some parts of the city are undulating while some areas are valleys, marshes, ravines and swamps due to its proximity to Atlantic Ocean. The climate of the area favours cultivation and extraction of agricultural and forest products such as palm, rubber, cocoa, cassava, rice, yam, plantain, banana, maize and general timber produce. Its vegetation type is typical of evergreen rain forest and mangrove.

Data collection and analyses

Quantitative data on growth characteristics of standing urban tree species were collected from the selected areas. Growth variables such as species density, tree height and diameter at breast height (dbh), basal area and volume were measured and estimated from the sampled areas. Moreover, the data from the quantitative measurement was subjected to ecological analysis using indices such as species relative density, relative dominance, species diversity, evenness and species similarity, with each index given as;

(i) Species relative density (RD %)

RD = (ni/N) x 100…….. equation 1

Where ni = number of individual of specie
N = total number of all trees in the study area

(ii) Species relative dominance (RD_o %)

$$\mathbf{RD_o} = \frac{(\sum B_{ai} x\ 100)}{\sum B_{an}} \quad \textbf{……equation 2}$$

Where B_{ai} = basal area of individual tree belonging to species i
B_{an} = stand basal area

(iii) *Species diversity was computed using Shannon – Wiener diversity index (Kent and* Coker 1992)

$$\mathbf{H'} = -\sum_{i=1}^{s} P_i \ln(P_i) \quad \textbf{…….equation 3}$$

H' = Species diversity index
S = Total number of species in the study area
P_i= Proportion of S made up of the ith species
$\ln = natural\ logarithm$

(iv) *Species evenness in each category was determined using Shannon's equitability index* (E_H)

$$\mathbf{E_{(H)}} = \frac{H^I}{H_{max}} = \frac{\sum_{i=1}^{s} P_i\, ln(P_i)}{ln(S)} \quad \textbf{.....equation 4}$$

H_{max} = ln (s) = Shannon Maximum diversity Index

(v) Sorensen's similarity index between the three sample areas were estimated using the formula

$$\mathbf{SI} = \left[\frac{2C}{a+b}\right]\mathbf{100} \quad \textbf{.....equation 5}$$

SI = Similarity index
C = number of species in strata a and b
a, b = number of species at strata a and b

(vi) Volume estimation
The volume of individual tree sampled from the study areas were estimated using Huber's formula; given as

$$\mathbf{V = A_{dbh} X\ H} \quad \textbf{.....equation 6}$$

Where A_{dbh} = basal area at dbh
H = Total height

(vii) Basal area estimate was computed from

$$\mathbf{g} = \frac{\pi D^2}{4} \quad \textbf{.....equation 7}$$

Where, g = Basal area
D= dbh
$\pi = 3.142\ (constant)$

(viii) Test of Significance Analysis
Test of significance for volume, DBH, basal area, among the sampled areas were carried out using randomized complete block design (RCBD) whereas, the means were separated using fisher's least square difference (LSD). Randomized Complete Block Design (RCBD) statistical model as given by (Adesoye, 2004) is:

$$\mathbf{Yij = \mu + bi + tj + eij} \quad \textbf{.....equation 8}$$

where yij = individual observation
μ = population mean
bi = block effect
tj = treatment effect
eij = Random error

While the fisher's least square difference

$$LSD = t\frac{\alpha}{2} df\ x \sqrt{\frac{2MSE}{r}} \quad \text{.....equation 9}$$

where α = 0.05 (level of significance)
df = Degree Of freedom
MSE= Mean Square Error

RESULTS AND DISCUSSION

Table1: Summary of results for growth parameters of urban tree species in the study areas

Study Area	Density/ha	Number of families	No of species	Mean dbh (cm)	Mean basal area(m^2)	Mean volume(m^3)
Commercial area	236.67	15	30	27.19[a]	712.00[a]	4544.42[a]
Residential area	39.95	24	54	26.98[a]	698.37[a]	4576.91[a]
Educational area	34.87	29	63	29.51[a]	755.45[a]	5532.06[a]

Source: Field Survey, 2011.

The estimate of growth parameters per hectare is summarized in Table 1 with Educational area having the highest number of species, mean dbh, basal area and volume. For the density per hectare, commercial area is more densed than others due to the small size of its area compared to that of the residential and educational areas. The estimates of growth parameters as reported in this result showed significantly high mean values in dbh, basal area and volume in educational area. In comparing growth parameters between commercial and residential areas, the former shows higher mean values in dbh and basal area than the later while the later shows a higher mean value only on volume.

The result of the test of significance of the urban tree growth characteristics sampled, showed no significant difference (P>0.05) between the three study areas. This may be because people have come to realize the importance of trees in their environments and agrees to allow trees survive around them for ecological balance, management and sustainability. The study of Mohammad (2008), justified the need to carefully plan and manage the urban forest to serve today and tomorrow, and the importance trees being present in an area has to do with its growth parameters, which constitutes the density that influences the climate.

Table 2: Summary of results of ecological indices for urban tree species in the study areas

Study Area	Number of families	No of species	H'	H_{max}	E_H	D
Commercial area	16	30	74.88	3.40	22.02	71.48
Residential area	24	54	42.62	3.99	10.68	38.63
Educational area	29	63	340.67	4.14	82.23	336.53

Source: Field Survey, 2011.

H' = Shannon-Wiener's diversity index; H_{max} = Shannon's maximum diversity index; E_H = Shannon's equitability index (species evenness); D = difference between the diversity index (H') and its maximum value (H_{max}); SI = Sorensen's species similarity index between the three study areas.

Table 3: Sorensen's species similarity index for the study area

	Commercial area	Educational area	Residential area
Commercial area	*	65.17	66.10
Educational area	65.17	*	56.80
Residential area	66.00	56.80	*

Source: Field Survey, 2011.

The summary of ecological variations of urban trees between the study areas (commercial area, residential area and educational institution) is shown in Table 2. The table summarizes the study areas in terms of number of families, number of species, Shannon- wiener's diversity index, Shannon's maximum diversity index, Shannon's equitability index, difference between diversity indices and Sorensen's species similarity index between the three study strata. Educational area has the highest values for number of families and species at 29 and 63, followed by residential area at 24 and 54 and lastly, the commercial area at 15 and 30 respectively. For the Shannon wiener's diversity index, the highest value was found in commercial area with 74.88, while residential and educational areas show lesser values at 42.62 and 46.41 respectively. In the result of Shannon's maximum diversity index, educational area has the highest

value at 4.14 while residential and commercial areas had 3.99 and 3.40 respectively. The results for Shannon's equitability index and the difference between the diversity index and its maximum show that educational area has the highest values at 82.23 and 336.53 respectively followed by commercial area at 22.02 and 71.48 respectively and lastly, the residential area at 10.68 and 38.63 respectively. The result of Sorensen's species similarity index between the three study strata as shown in Table 3 shows the sequence 66.10, 65.17 and 56.80 between Commercial and Residential areas, Educational and Commercial areas, Educational and Residential areas respectively; indicating that species in Commercial and Residential are more similar than any other area combination. The study of Onyekwelu *et. al.*, 2008 agrees with this study where his Shannon-wiener's diversity (H') and Shannon's maximum diversity follow the order Queen's forest > Oluwa forest > Elephant forest of Nigeria.

Isabelle *et al*., (1998) reported also on the significance of the evaluation of the ecological variations among species that helps to make reasonable decisions in a bid to know the appropriate silvicultural treatment to apply to urban forest tree species as a management strategy. Ecological variations between places help in quantifying the urban forests and its ecological services with best fit management plan for each place (Zipperer and Carreiro, 2008).

Table 4: Species richness in commercial area

Family	Species	Number of species	Dbh(cm)		RD(%)	RD_o (%)	IV (%)
			Mean	max.			
Leguminosae	*Acacia auriculiformis*	14	31.17	34.69	46.67	5.36	26.01
Euphorbiaceae	*Acalypha fimbriata*	40	0	0	133.33	0	66.67
Meliaceae	*Azadirachta indica*	19	29.70	32.78	63.33	6.61	34.97
Poaceae	*Bambusa vulgaris*	12	0	0	40	0	20
Casuarinaceae	*Casuarina equisetifolia*	29	32.98	38.51	96.67	13.03	54.85
Palmae	*Cocos nucifera*	11	32.69	38.35	36.67	2.55	19.61
Euphorbiaceae	*Croton zambesicus*	9	19.10	23.23	30	1.42	15.71
Cycadaceae	*Cycas revolute*	7	0	0	23.33	0	11.67
Leguminosae	*Delonix regia*	22	33.33	38.19	73.33	9.25	41.23
Verbenaceae	*Duranta repens*	140	0	0	466.67	0	233.33
Rubiaceae	*Ixora laxiflora*	15	0	0	50	0	25
Cecropiaceae	*Ficus benjamina*	12	29.49	39.15	40	0	20
Cecropiaceae	*Ficus carica*	10	29.24	31.19	33.33	2.44	17.89
Verbenaceae	*Gmelina arborea*	4	27.53	31.19	13.33	1.20	7.27
Malvaceae	*Abelmoschus esculentus*	150	0	0	500	0	250
Euphorbiaceae	*Hura cripitans*	18	36.52	38.83	60	9.45	34.72
Bignoiaceae	*Jacaranda mimosifolia*	6	29.48	31.35	20	2.05	11.02
Palmae	*Laccosperma secundiflorum*	22	40.28	51.88	73.33	14.52	43.93
Leguminosae	*Leucaena leucocephala*	6	23.05	24.19	20	1.25	10.63
Anacardiaceae	*Mangifera indica*	10	45.58	47.42	33.33	8.16	20.75
Cecropiaceae	*Musanga cecropioides*	2	27.53	28.33	6.67	0.60	3.63
Rubiaceae	*Mussiaenda philippica*	3	0	0	10	0	5
Leguminosae	*Pilostigma thonnigii*	15	27.66	31.51	50	4.65	27.33
Pinaceae	*Pinus caribea*	18	30.25	34.56	60	6.57	33.28
Heliconiaceae	*Heliconia* spp.	8	0	0	26.67	0	13.33
Annonaceae	*Polyalthia longiflora*	29	0	0	96.67	0	48.33
Leguminosae	*Senna siamea*	15	23.03	28.49	50	3.16	26.58
Combretaceae	*Terminalia catappa*	4	31.41	31.83	13.33	1.55	7.44
Combretaceae	*Terminalia superba*	6	34.51	35.96	20	0.46	10
	Togolis ficus	54	0	0	180	0	90

Source: Field Survey, 2011.

Table 5: Species richness in residential area

Family	Species	Number of species	Dbh(cm)		RD(%)	RD_o (%)	IV (%)
			Mean	Max.			
Leguminosae	*Acacia auriculiformis*	3	23.23	24.19	5.56	0.54	3.05
Euphorbiaceae	*Acalypha fimbriata*	35	0	0	64.81	0	32.41
Leguminosae	*Albizia lebbeck*	3	38.34	38.51	5.56	1.47	3.51
Leguminosae	*Albizia zygia*	2	31.29	31.38	3.70	0.65	2.18
Anarcadiaceae	*Anacardium occidentale*	7	27.88	29.60	12.96	1.82	7.39
Annonaceae	*Annona muricata*	3	24.24	24.82	5.56	0.59	3.07
Lecythidaceae	*Napoleona imperialis*	6	26.54	28.33	11.11	1.41	6.26
Meliaceae	*Azadirachta indica*	21	32.37	35.58	38.89	7.36	23.13
Leguminosae	*Baphia nitida*	2	11.78	12.41	3.70	0.09	1.90
Casuarinaceae	*Casuarina equisetifolia*	12	36.90	38.83	22.22	5.45	13.84

Sapotaceae	*Chrysophyllum albidum*	3	38.93	39.78	5.56	1.52	3.54
Rutaceae	*Citrus paradise*	1	18.78	18.78	1.85	0.12	0.98
Rutaceae	*Citrus reticulate*	2	19.57	20.05	3.70	0.26	1.98
Palmae	*Cocos nucifera*	9	28.43	31.51	16.67	2.45	9.56
Sterculiaceae	*Cola accuminata*	7	27.14	37.24	12.96	1.79	7.37
Sterculiaceae	*Cola parchycarpa*	5	21.13	25.14	9.26	0.76	5.01
Olacaceae	*Coula edulis*	2	44.88	45.51	3.70	1.34	2.52
Bignoniaceae	*Crescentia cujete*	3	24.19	30.24	5.56	0.60	3.08
Euphorbiaceae	*Croton zambesicus*	10	27.53	31.19	18.52	2.55	10.54
Burseraceae	*Dacryodes edulis*	5	29.50	31.83	9.26	1.46	5.36
Caesalpinaceae	*Dalium guinensis*	3	19.63	20.69	5.56	0.39	2.97
Leguminosae	*Delonix regia*	16	29.75	31.35	29.63	4.73	17.18
Annonaceae	*Dennettia tripetala*	3	23.55	23.87	5.56	0.55	3.06
Verbenaceae	*Duranta repens*	200	0	0	370.37	0	185.19
Lecythidaceae	*Eucalyptus camaldulensis*	7	37.35	37.71	12.96	3.25	8.11
Moraceae (Cecropiaceae)	*Ficus carica*	8	29.79	41.69	14.81	2.43	8.62
Leguminosae	*Gliricidia sepium*	3	16.66	17.19	5.56	0.28	2.92
Rubiaceae	*Hensia crinata*	9	9.37	10.82	16.67	0.27	8.47
Euphobiaceae	*Hura cripitans*	16	29.71	31.35	29.63	4.719	17.17
Irvingiaceae	*Irvingia gabonensis*	3	31.99	32.46	5.56	1.02	3.29
Rubiaceae	*Ixora hybrid*	100	0	0	185.19	0	92.59
Bignoiaceae	*Jacaranda mimosifolia*	5	26.99	28.01	9.26	1.21	5.24
Palmae	*Laccosperma secundiflorum*	16	42.14	47.74	29.63	9.20	19.41
Leguminosae	*Leucaena leucocephala*	3	29.75	31.51	5.56	0.89	3.22
Anacardiaceae	*Mangifera indica*	10	37.08	39.78	18.52	4.62	11.57
Cecropiaceae	*Musanga cecropioides*	5	31.26	35.01	9.26	1.64	5.45
Rubiaceae	*Musiaenda philippica*	8	0	0	14.81	0	7.41
Leguminosae	*Pentaclethra macrophylla*	2	44.32	44.56	3.70	1.31	2.51
Lauraceae	*Persea Americana*	6	28.66	29.41	11.11	1.64	6.38
Pinaceae	*Pinus caribea*	16	31.88	36.76	29.63	5.45	17.54
Annonaceae	*Polyalthia longiflora*	25	0	0	46.30	0	23.15
Myrtaceae	*Psidium guajava*	7	11.28	13.02	12.97	0.30	6.63
Palmae	*Raphia hookerii*	11	24.10	28.33	20.37	2.14	11.26
Humiriaceae	*Sacoglottis gabonensis*	3	31.30	31.83	5.56	0.98	3.27
Leguminosae	*Senna siamea*	12	35.43	37.24	22.22	5.03	13.62
Anacaediaceae	*Spondias cytherea*	5	46.34	47.42	9.26	3.58	6.42
Anacardiaceae	*Spondias mombin*	4	14.52	15.60	7.41	0.28	3.85
Sterculiaceae	*Sterculia tragacantha*	3	30.18	30.08	5.56	0.91	3.23
Caesalpinaceae	*Tamarindus indica*	2	37.64	38.19	3.70	0.94	2.32
Combretaceae	*Terminalia catappa*	10	38.27	39.72	18.52	4.88	11.70
Combretaceae	*Terminalia* spp.	5	33.29	34.37	9.26	1.85	5.55
Combretaceae	*Terminalia superba*	7	37.34	37.87	12.96	3.25	8.11
Cupressaceae	*Thuja standishii*	15	0	0	27.78	0	13.89
	Togolis ficus	150	0	0	277.78	0	138.89

Source: Field Survey, 2011.

Table 6: Species richness in educational institution

Family	Species	Number of species	Dbh(cm)		RD(%)	RD_o (%)	IV (%)
			Mean	Max.			
Leguminosae	*Acasia auriculiformis*	15	31.40	37.87	23.81	3.30	13.55
Leguminosae	*Adenanthera pavonina*	4	18.18	18.78	6.35	0.29	3.32
Leguminosae	*Albezia ferruginea*	8	21.51	22.47	6.35	0.81	3.58
Leguminosae	*Albezia lebbeck*	10	33.98	35.65	15.87	2.53	9.20
Apocynaceae	*Alstonia boonei*	1	30.24	30.24	1.59	0.20	0.89
Anacardiaceae	*Anacardium occidentale*	4	22.75	23.55	6.35	0.45	3.40
Annonaceae	*Annona muricata*	3	24.08	25.14	4.76	0.38	2.57
Meliaceae	*Azadirachta indica*	10	30.97	36.66	15.87	2.29	9.08
Poaceae	*Bambusa vulgaris*	15	0	0	23.81	0	11.90
Bombacaceae	*Bombax custatum*	1	42.65	42.65	1.59	0.40	0.99
Leguminosae	*Brachystegia nigerica*	3	30.98	31.83	4.76	0.63	2.70
Pinaceae	*Calithris intratropica*	7	36.95	37.56	11.11	2.09	6.60
Leguminosae	*Cassia augustifoliola*	5	31.80	31.89	7.94	1.11	4.52
Caesalpinaceae	*Cassia fistula*	4	22.47	24.19	6.35	0.44	3.40
Casuarinaceae	*Casuarina equisetifolia*	10	31.84	32.15	15.87	2.22	9.05
Sapotaceae	*Chrysophyllum albidum*	4	32.26	32.94	6.35	0.91	3.63
Annonaceae	*Cleistopholis patens*	3	32.46	32.46	4.76	0.69	2.73
Sterculiaceae	*Cola accuminata*	3	29.76	35.65	4.76	0.60	2.68
Sterculiaceae	*Cola parchycarpa*	1	12.41	12.41	1.59	0.03	0.81

Bignoniaceae	*Crescentia cujete*	1	22.92	22.92	1.59	0.11	0.85
Euphorbiaceae	*Croton zambesicus*	9	22.11	24.82	14.29	0.97	7.63
Caesalpinoceae	*Dacryodes edulis*	4	26.58	31.19	6.35	1.24	3.80
Leguminosae	*Delonix regia*	30	23.92	27.05	47.62	2.02	24.82
Annonaceae	*Dennetia tripetala*	1	31.19	31.19	1.59	0.21	0.90
Verbenaceae	*Duranta repens*	250	0	0	396.83	0	198.41
Lecythidaceae	*Eucalyptus camaldulensis*	21	34.92	37.94	33.33	5.73	19.53
Cecropiaceae	*Ficus benjamina*	22	29.14	34.53	34.92	4.14	19.53
Cecropiaceae	*Ficus exasperate*	11	19.73	21.64	17.46	0.94	9.20
Verbenaceae	*Gmelina arborea*	7	25.87	27.53	11.11	1.03	6.07
Hypericaceae	*Harungana madagascariensis*	5	10.49	12.09	7.94	0.12	4.03
Euphorbiaceae	*Hura cripitans*	21	26.71	28.33	33.33	3.29	18.31
Irvingiaceae	*Irvingia gabonensis*	2	40.47	41.15	3.17	0.72	1.95
Rubiaceae	*Ixora hybrid*	180	0	0	285.71	0	142.86
Bignoiaceae	*Jacaranda mimosifolia*	8	26.10	27.69	12.70	1.09	6.89
Meliaceae	*Khaya senegalensis*	12	36.38	39.15	19.05	3.48	11.27
Palmae	*Laccosperma secundiflorum*	16	44.06	44.88	25.40	6.80	16.10
Leguminosae	*Leucaena leucocephala*	8	26.62	28.49	12.70	1.24	6.97
Anacardiaceae	*Mangifera indica*	4	19.65	20.37	6.35	0.35	3.34
Moraceae (Cecropiaceae)	*Melicia excelsa*	2	45.04	46.15	3.17	0.89	2.03
Cecropiaceae	*Musanga cecropioides*	6	32.84	34.69	9.52	1.65	5.59
Sapotaceae	*Omphalocarpum procerum*	1	32.78	32.78	1.59	0.24	0.91
Annonaceae	*Pachypodanthium staudtii*	2	31.59	31.99	3.17	0.44	1.81
Leguminosae	*Parkia biglobosa*	5	26.10	28.64	7.94	0.78	4.36
Leguminosae	*Pentaclethra macrophylla*	4	43.99	45.64	6.35	1.70	4.02
Lauraceae	*Persea Americana*	3	23.66	24.82	4.76	0.37	2.57
Pinaceae	*Pinus caribea*	23	30.03	38.51	36.51	4.75	20.63
Leguminosae	*Piptadeniastrum africanum*	6	23.38	24.51	9.52	0.72	5.12
Annonaceae	*Polyalthia longiflora*	33	0	0	52.38	0	26.19
Myrtaceae	*Psidium guajava*	6	21.45	21.64	9.52	0.60	5.06
Leguminosae	*Pterocarpus mildbraedii*	4	21.07	24.82	6.35	0.39	3.37
Leguminosae	*Pterocarpus soyauxi*	4	40.66	41.37	6.35	1.45	3.70
Palmae	*Raphia hookerii*	5	20.58	21.64	7.94	0.46	4.20
Poaceae	*Saccharum officinale*	24	0	0	38.10	0	19.05
Leguminosae	*Senna simea*	24	25.90	28.64	38.10	3.56	20.83
Anacardiaceae	*Spondias cytherea*	9	38.60	39.78	14.29	2.94	8.61
Anacardiaceae	*Spondias mombin*	4	33.97	27.69	6.35	0.60	3.47
Guttiferae	*Symphonia globululifera*	1	40.74	40.74	1.59	0.36	0.98
Verbenaceae	*Tectona grandis*	55	39.86	41.37	87.30	19.14	53.22
Combretaceae	*Terminalia catapa*	12	32.88	35.33	19.05	2.84	10.95
Combretaceae	*Terminalia superba*	6	32.31	32.46	9.52	1.37	5.45
Cupressaceae	*Thuja standishii*	50	0	0	79.36	0	39.68
Sapotaceae	*Tieghemella heckelii*	2	0	0	3.17	0.98	2.08
	Togolis ficus	30	0	0	47.62	0	23.81
Moraceae (Cecropiaceae)	*Treculia Africana*	3	32.25	32.78	4.76	0.68	2.72
	Plumera alba	1	31.83	31.83	1.59	0.22	0.90

Source: Field Survey, 2011.

Information about species richness among the study areas are shown in Tables 4 - 6 with each table belonging to commercial, residential and educational areas respectively. A total of sixteen (16) families and thirty (30) species of both trees and shrubs were identified in commercial area with *Duranta repens* having the highest relative density (RD) and relative dominance (RD_o) while *Mussiaenda philippica* has the lowest relative dominance (RD_o) value (Table 4). The result of important value (IV) of species within this stratum indicated the same trend with *Duranta repens* having the highest (233.33%) and *Mussiaenda philippica*, the lowest (5%) (Table 4).

There are twenty-four families and fifty-four species of both trees and shrubs identified in the residential area of the study area with *Duranta repens* having the highest relative density (RD) of 370.37%, highest relative dominance (RD_o) recorded for *Laccosperma secundiflorum* with value of 9.20% while *Baphia nitida* has the lowest dominance (RD_o) at 0.09%.The result for the important value (IV) of species within this stratum showed the same trend of *Duranta repens* having the highest value (185.19%) and *Baphia nitida* the lowest (1.90%) (Table 5).

Table 6 shows the result of the species richness in the educational area where a total of twenty-nine families and sixty-three species of both trees and shrubs were identified with *Duranta repens* still taking the lead in the relative density (RD) with value 396.83%, *Tectona grandis* shows the highest relative dominance (RD_o) with value 19.14% and lastly, *Duranta repens* the highest important value of 198.41% (Table 6). This observation was in agreement

with the study of Onyekwelu *et al*, (2008), when he recorded ecological variations among families of three species found in Queen's, Oluwa and Elephant forests respectively of Southwestern Nigeria.

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