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Study on Urban Trees in Ekiti State University, Ado Ekiti, Nigeria: 1. Structure and Composition

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Abstract: *An inventory of tree biodiversity was carried in Ekiti State University, Ado-Ekiti, Nigeria, which is an institution where ecological and economic roles of trees are disseminated. The study involved the use of a stratified sampling technique to carry out a survey of trees species in the University. The campus was divided into four strata - Road side (A), Car parks (B), Office area (C), Student halls/ religion area (D) - and each stratum was further sub-divided into sub-strata. All the trees within each sub-stratum were identified to species level with their scientific, local and family names and they were counted and recorded. The relative frequency, relative density and relative abundance of the identified species were determined. Similarities indices and indices of diversity were determined on the tree species sampled among the strata. The results obtained revealed that a total of 27 tree species, belonging to 17 families were sampled in the campus. The family Caesalpiniaceae has the highest number of species. Some of the identified tree species were found in multiple and dual strata while some occurred in only one stratum. A total of 838 tree individuals were obtained. The most frequently occurring species were T. grandis, G. arborea and P. longifolia with 298, 181 and 149 individuals respectively. The indices of similarities among the strata were low. However Strata A and B as well as A and C appeared to be similar in tree composition. Strategies that would improve and maintain tree composition in the University campus were proposed.*
Keywords: *Urban trees; university; structure; composition*

I. Introduction

Recent initiatives are now focusing on trees and their roles in the maintenance of the quality of the environment. A growing number of literatures, such as Nowak (2006), Yanga, (2005), Escobedo and Nowak (2009), Escobedo (2011), asserted that trees are important component of urban forest. Urban forests include trees and forests located in the cities, ornamental, street and parkland trees, protected forest and green areas. These trees, according to Beckett (2000) and Singh (2002), affect local and regional air quality by removing atmospheric pollutants and chemicals from the vegetation, altering urban micro-climates by lowering temperatures through shading, evapotranspiration, changing wind patterns, modifying boundary layer height and reducing building energy use and consequent emissions from power plants.

Similarly, Kayode (2008), Patel and Patel (2013), Ayo (2013), Ihimikaiye and Tanee (2014) observed that trees constitutes an integral part of human existence as they provide human with raw materials, foods, shelter, clothing, medicine, oral care, fuel wood, wood craft, as well as fodder and forage for livestock. Despite all these important products and services rendered by trees, Ayeni and Kayode (2008) as well as Kayode *et. al.* (2016) asserted that urban forest is poor in the residential areas of Ekiti State, Nigeria. A myriad of reasons were attributed to the poor tree cultivation habit in Ekiti State, Nigeria in previous studies conducted by Kayode and Kadeba (2001), Ayeni and Kayode (2004, 2008), as well as Kayode (2010). Thus a deliberate tree cultivation habit especially in schools, churches, colleges and universities was one of the strategies prescribed to address the apparent dearth of trees in the State.

Consequent on the above, the inventory and assessment of tree biodiversity in different habitats was considered as necessary for the evolvement of long term strategies that will conserve the endangered trees species in the country where tree demography of 560 tree species was enumerated at her independence six decades ago (Ihenyen, 2009). One of such habitat is the Ekiti State University, Ado-Ekiti, Nigeria, a citadel of knowledge where ecological and economic roles of trees are embedded in the knowledge disseminated by the institution. A high expectation that this institution will be rich in tree species of diverse importance abound yet records revealed that there has been no enumeration of trees species in the institution in her 37 years of existence.

The study being reported here is therefore expected to provide basic data on the composition of trees species in the institution, prescribe the appropriate local management strategy for conservation of trees in the University.

II. Materials and Methods

2.1 The Study Area

The study was conducted in Ekiti State University campus, Ado Ekiti, Ekiti State of Nigeria (Obembe and Kayode 2019). It is geographically located on Latitude $7^0$12'N and Longitude $5^0$25' E. The area has two climatic seasons–a rainy season and a dry season, the annual rainfall is about 1150mm. Ekiti State University was established in the year 1982 and it is owned by Ekiti State Government of Nigeria.

2.2 Methods

This study involved the survey of trees species in Ekiti State University, Ado-Ekiti, Nigeria's campus. A stratified sampling technique was used in the study. The University Campus was divided into four strata and each stratum was further sub-divided into sub-strata (Table 1). All the trees within each of the sub-stratum were identified to species level with their scientific, local and family names and counted. Voucher specimen of the identified trees were obtained and taken to the herbarium of the Department of Plant Science and Biotechnology for proper authentication and the specimen deposited. Voucher numbers were assigned to the specimen.

Table 1. Stratification of the Ekiti State University, Ado-Ekiti, Nigeria's campus for tree inventory

S/N	STRATA	SUB- STRATA	
A	Road side	Main gate - Omolayo building	A1
		Roundabout – Faculty of Engineering	A2
		United Bank for Africa – Library	A3
		Former part-time programme Block	A4
		Library – Car park	A5
B	Car park	Faculty of Agriculture	B1
		Faculty of Science	B2
		Faculty of Management Science	B3
		Faculty of Education	B4
		College of Medicine	B5
C	Office area	Omolayo building	C1
		Library	C2
		Health centre	C3
		New senate building	C4

		Sandwich building	C5
D	Student halls/ religion area	New hostel	D1
		Government hostel	D2
		Ajasin hostel	D3
		Catholic church	D4
		Mosque	D5

The following data were determined in each sub- stratum:

(i) Relative frequency (RF) = Frequency of each species/ Total frequency of all species x 100

(ii) Relative density (RD) = Density of each species/ Total density from all species x 100

(iii) Relative abundance of species (pi) = Relative density of species/100

Similarities indices were determined on the tree species sampled among the strata as follows:

(i) Index of similarity (IS), according to Kayode (1990) :
IS = 2Cx100/ (A+B)

(ii) Jaccard index (S_J), according to Gurevitch *et. al.* (2000):
S_J = C/ (A+B+C)

(iii) Ochioi index (S_O), according to Gurevitch *et. al.* (2000):
$S_O = C/ \sqrt{(A + C)} + \sqrt{(B + C)}$

(iv) Sorensen –dice index (S_{SD}), according to Gurevitch *et. al.* (2002):
S_{SD} = 2C/ (A+B+2C)

(v) Asymmetrical similarity (S_{AS}), according to Gurevitch *et. al.* (2002) :
S_{AS} = B/ (B+2C)

Where A is the number of species in first stratum only;
B is the number of species in second stratum only;
C is the number of species common to both strata.

Similarly, the following indices of diversity will be determined as follows:

(i) Simpson index (C), according to Bongers *et. al.*(1988).
$C = \sum pi^2$
Where;
C = Simpson's index
Pi = ni /N
ni = number of individual of species I and
N= total number of all individual

(ii) Shannon - Wiener diversity index (H'), according to Shannon and Wiener
$H' = - \sum pi \ln pi$
Where;
P i= ni/N,
ni = number of individual of one species
N = total number of all individuals
Log = logarithm
H' = Shannon-Wiener diversity index

(iii) Species evenness will also be determined using Shannon's Equitability Index (E), according to Shannon-Wiener

$E = H'/H_M$
Where;
H_M = ln S
S = number of species
H'= Shannon-Wiener index

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III. Results

The results obtained revealed that a total of 27 tree species, belonging to 17 families were sampled in the campus (Table 2). The family Caesalpiniaceae has the highest number of species (6 species). The family Combretaceae has three species, families Anacardiaceae, Moraceae and Verbernaceae, each has two species while other families possess one species each. Table 2 also shows that some of the identified tree species were found in multiple and dual strata while some occurred in only one stratum. For example, while *Carica papaya* and *Gmelina arborea* were found in all the strata used, *Anacardium occidentale, Bauhinia monandra, Delonix regia, Hura crepitan, Polyathia longifolia, Senna grandis, Tectonia grandis* and *Terminalia mantaly* were each found in three of the strata sampled. *Mangifera indica, Pinus caribaea, Roystonea regia* and *Terminalia catappa* were each found in two of the strata while *Auracaria cunningamii, Bauhinia purpurea, Citrus sinensis, Cochlospermum gossypium, Elaeis guineensis, Eucalyptus deglupt*a, *Ficus thonningii, Ficus sur, Holarrhena floribunda, Parkia biglobosa, Peltophorum pterocarpium* and *Terminalia schimperiana,* each occurred in a stratum.

Table 2. Checklist of tree species identified in EKSU Campus, Ado-Ekiti, Nigeria

S/n	Name		Family	Strata of Occurrence*
	Botanical	Common Vernacular		
1	*Anacardium occidentale* L.	Cashew Kaju	Anacardiaceae	A, B, D
2	*Araucaria cunningamii* Aiton ex D. Don	Auracaria Igi Oyinbo	Araucariaceae	C
3	*Bauhinia monandra* (Kurz)	Ochid Tree Igi gbigbe	Caesalpinaceae	A, B, C
4	*Bauhinia purpurea* L	Purple Bauhinia Igi gbigbe	Caesalpinaceae	B
5	*Carica papaya* L	Pawpaw Ibepe	Caricaceae	A, B, C. D
6	*Citrus sinensis* L	Orange Osan	Rutaceae	A
7	*Cochlospermum gossypium* (L)DC	Cotton tree Igba-Owu	Cochlospermaceae	A
8	*Delonix regia* (Hook)	Flame of the Forest Seke	Caesalpiniaceae	A, B, C
9	*Elaeis guineensis* Jacq.	Oil Palm Igi Ope	Arecaceae	A
10	*Eucalyptus deglupt*a	Rainbow Gum Igi Oyinbo	Myrtaceae	B
11	*Ficus thonningii* Blume	Fig Odan	Moraceae	A
12	*Ficus sur* Forssk	Bush Fig Opoto	Moraceae	D
13	*Gmelina arborea* Ruxb	Gmelina Melaina	Verbenaceae	A, B, C, D
14	*Holarrhena floribunda* (G. Don) T. Durand $ Schinz	False Rubber Tree Ako Ire	Apocynaceae	B
15	*Hura crepitan* L	Monkey Egigun odo	Euphorbiaceae	A, B, C
16	*Mangifera indica* L	Mango Mangoro	Anarcardiaceae	A, B
17	*Parkia biglobosa* Jacq	Locust Bean Igi Iru	Mimosaceae	A
18	*Peltophorum pterocarpium* (DC) Backer ex. K. Heyne	Yellow Flame Igi Oyinbo	Caesalpiniaceae	A
19	*Pinus caribaea*	Hunduras Pine Igi Gbigbe	Pinaceae	A, B
20	*Polyathia longifolia* Thwaites	Ashoka Igi Igunnu	Annonaceae	A, B, C
21	*Roystonea regia* (Kunth) O. F. Cook	Royal Palm Ope Oba	Rubiaceae	A, B
22	*Senna grandis* L. f.	Cassia Kassia	Caesalpiniaceae	A, B, C
23	*Senna siamea* (Lam) Irwin & Barneby	Cassia Kassia	Caesalpiniaceae	A, C
24	*Tectonia grandis* L.f.	Teak Tiiki	Verbanaceae	A, B, C
25	*Terminalia catappa* L	Almond Furutu	Combretaceae	B, C

26	*Terminalia mantaly* (H. Pierrer)	Step Tree	Afara Oyinbo	Combretaceae	A, B, C
27	*Terminalia schimperiana*		Udi	Combretaceae	A

The demographic classification of tree species identified in EKSU Campus, Ado-Ekiti, Nigeria was shown in Table 3. A total of 552, 235, 39 and 12 belonging to 21, 17, 12 and 4 families were sampled in Stratum, A, B, C and D respectively. *G. arborea*, *T. grandis* *P. longifolia as well as T. mantaly* and *C. papaya* were the most abundant trees in Stratum, A, B, C and D respectively. These constituted 32%, 64%, 15% (each) and 50% of the trees sampled in Stratum, A, B, C and D respectively. The diversity indices revealed that diversity of trees abounds in the different strata of the study area. Equitability Index values of 0.6051, 2.1085, 0.9101 and 0.7905 were recorded for stratum A, B, C and D respectively.

Table 4 shows the population of each of the 27 identified trees all the strata used in the study area. A total of 838 tree individuals were obtained. The most frequently occurring species (Table 5) revealed that *T. grandis*, *G. arborea* and *P. longifolia* with 298, 181 and 149 individuals respectively, dominated the trees found on the campus.

Table 3. Demographic classification of tree species identified in EKSU Campus, Ado-Ekiti, Nigeria

Description	Strata			
	A	B	C	D
No. of trees observed	552	235	39	12
No. of tree species	21	17	12	4
Most abundant tree species	*G.arborea*	*T. grandis*	*P. longifolia* & *T. mantaly*	*C. papaya*
% of the most abundant species	32%	64%	15% (each)	50%
Relative abundance of the species	0.0032	0.0064	0.0015 (each)	0.0050
Simpson Index / Stratum	0.2249	0.4231	0.202	0.3747
Shannon-Weiner Diversity / Stratum	1.846	1.5226	2.274	1.088
Equitability Index / Stratum	0.6051	2.1085	0.9101	0.7905

Table 4. Population of Identified Trees in different strata of EKSU Campus, Ado-Ekiti, Nigeria

S/n	Tree Species	Strata				Total
		A	B	C	D	
1	*A. occidentale*	2	2	-	4	8
2	*A. cunningamii*	-	-	2	-	2
3	*B. monandra*	8	15	5	-	28
4	*B. purpurea*	-	4	-	-	4
5	*C. papaya*	2	7	1	6	16
6	*C. sinensis*	1	-	-	-	1
7	*C. gossypium*	4	-	-	-	4
8	*D. regia*	18	2	2	-	22
9	*E. guineensis*	1	-	-	-	1
10	*E. deglupta*	-	1	-	-	1
11	*F. thonningii*	1	-	-	-	1
12	*G. arborea*	174	3	3	1	181
13	*H. floribunda*	-	1	-	-	1
14	*H. crepitan*	8	11	4	-	23
15	*M. indica*	1	2	-	-	3

16	*P. biglobosa*	2	-	-	-	2
17	*P. ptericarpium*	3	-	-	-	3
18	*P. caribaea*	6	3	-	-	9
19	*P. longifolia*	125	18	6	-	149
20	*R. regia*	4	10	-	-	14
21	*S. grandis*	1	2	5	-	8
22	*S. siamea*	16	-	2	-	18
23	*T. grandis*	147	150	1	-	298
24	*T. catapa*	-	2	2	-	4
25	*T. mantaly*	9	2	6	-	17
26	*T. schimperiana*	1	-	-	-	1
27	*F. sur*	-	-	-	1	1
Total		552	235	39	12	838

Table 5. Rank order of the 10 most frequently occurring tree species in EKSU Campus, Ado-Ekiti, Nigeria

Rank	Tree species	No. of Individuals
1	*T. grandis*	298
2	*G. arborea*	181
3	*P. longifolia*	149
4	*B. monandra*	28
5	*S. grandis*	26
6	*H. crepitan*	23
7	*D. regia*	22
8	*S. siamea*	18
9	*C. papaya*	18
10	*T. mantaly*	17

The indices of similarities (Table 6) revealed that strata B and C with 69, 0.26, 0.99 and 0.38, IS, $S_{J,}$ S_O and S_{SD} values respectively appeared to be similar in tree composition. Similarly, Strata A and B with IS, $S_{J,}$ S_O and S_{SD} values of 68.4, 0.25, 1.12 and 0.41, and Strata A and C with IS, $S_{J,}$ S_O and S_{SD} values of 23.1, 0.10, 0.38 and 0.19, appeared fairly similarly in tree composition

Table 6. Indices of similarities in the occurrence of tree in EKSU Campus, Ado-Ekiti, Nigeria

Strata	IS	S_J	S_O	S_{SD}	S_{AS}
A-B	68.4	0.25	1.12	0.41	0.40
A-C	60.6	0.23	0.96	0.35	0.46
A-D	23.1	0.10	0.38	0.19	0.74
B-C	69.0	0.26	0.99	0.38	0.46
B-D	27.3	0.12	0.40	0.22	0.74
C-D	21.1	0.11	0.30	0.20	0.81

IV. Discussion

The results from this study revealed that diverse tree species were found in this study area. A number of studies, such as Matsuoka (2010), Wu *et al.* (2014) and Sivarajah *et al.* (2018) asserted that the proportion of tree cover is a significant positive predictor of student performance. The effects of tree cover and species composition were most pronounced in

schools that have high number of trees thus suggesting the importance of urban forestry investments in these schools. Shah,*et al.* (2014) observed that biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. Greater species diversity ensures natural sustainability for all life forms. Biodiversity ensures the health of the ecosystems and enables it to better withstand and recover from a variety of disasters. It also possessed a number of social benefits, such as research, education and monitoring that constituted the major assignment of the universities through the world.

Previous studies also enumerated the advantages offered by urban forest, especially on educational environment. Urban forests moderate air temperature (Cummins and Jackson 2001), mitigate ambient air pollution (Nowak *et al.* 2006), produce human health benefits (Handy *et al.* 2002, Hansmann *et al.* 2007, Hartig *et al.* 2003, Pretty *et al* 2005 and Takano *et. al.* 2002). lower human mortality rates (Villeneuve *et al.* 2012), and generally improve the quality of life of urban inhabitants (Maas *et al.* 2008, Mitchell and Popham 2008). Similarly, human exposure to green space as been found to result in positive feelings, relaxation, stress relief, and restoration of attention-demanding cognitive performance (Taylor *et al.* 2001 Park *et al.* 2011. Pretty *et al* (2005), Takano *et al.* (2002) and Villeneuve *et al.* (2012) have also linked mental health benefits, following exposure to forested areas, with specific physiological responses, including reduced diastolic blood pressure and reduced heart rate.

The results from this study also revealed that the occurrence of the identified tree species were not restricted to a particular stratum. The species were generalists that were not exclusive to a particular stratum. This observation tends to support species occurrence in tropical forest as earlier observed in the study of Mancino *et al.* (2015). However, more trees were planted by road sides and car-parks. While trees were planted in the forlorn stretches of roadside, no tree planting was done in the highway medians. EarthTalk (2016) enumerated the advantages of planting trees by roadside to include enhancement of livability of urban streets, control of noise pollution. Trees reduce the chance of flood and soil erosion; provide reliefs to humans, birds and animals from sun and rain. Wolf (2006) asserted that roadside soils and vegetation capture reasonable proportion of transportation carbon emissions thus constituting valuable "banks" for meeting ambitious carbon sequestration goals. Also, Parsons *et al.* (1998) asserted that drivers seeing natural roadside views show lower levels of stress and frustration compared to those viewing all-built settings.

Tree density around offices and students' halls of residence and religious areas were low. Information received from a key-informant during the study revealed administrators of the study area showed lack a daisical attitude towards tree planting. This observation tends to buttress the previous observations of Oladehinde (2016) and Salbitano *et al.* (2016) that administrators often fail to sufficiently take urban forests as serious issues. Larinde and Oladele (2014), in a study conducted in another University campus in Nigeria, asserted that species composition were scanty in all the student hostels as a result of lack of proper planning, students lacks time to nurse plants, they are unstable, mobile and have no sense of tree ownership while in school.

The study revealed that trees planted in this study were mostly exotic species. Information from key informant revealed that though no reason was attributed to this but the exotic species were observed to establish easily, fast in growth, possess high propagule pressure, and low or intermediate shade tolerance ability thus support the previous assertion of (Dodet and Collet 2012). Oba *et. al.* (2001) also revealed that the exotics tree species possess the potentials to generate revenue. The trees in students' halls of residence and religious areas were dominated by fruit species. Fruit trees provide important nutrients, vitamins and part of family income (Adeboye and Adedayo, 2008). They also have the he capacity to provide the much desired tree cover and other benefits in urban and peri-urban centres. Also natural disasters including wind storms and surface water erosion can be effectively controlled by heavily branched and deep rooted fruit trees (Larinde and Ogunniyan 2011).

V. Conclusion

The tree sampled in the study area is extremely low compared to the massive area presently being occupied by the University. The study therefore is inclined to describe tree composition in the study area as poor, unplanned and non-scientific. Field observation revealed that they were not properly managed. The attitude of the University Management to tree planting and maintenance should change. More trees should be planted on campus especially at strata C and D, that is, near offices, students' halls of residence and religious areas, especially now that the University is transiting from the non-residential institution to a residential institution, trees should be planted adequately at the staff quarters. Larinde and Ogunniyan (2011) enumerated the potential of this initiative in urban forestry. Previous suggestion by Soladoye and Oromakinde (2013) that public enlightenment should be carried out on urban forestry is equally relevant here. The use of indigenous trees in urban forestry should be encouraged as some of them are now endangered. Indigenous trees on campus should be preserved. Botanical Garden should be established and adequately stocked with admixture of indigenous and exotic tree species. Diverse edible fruit trees should be planted in the different strata used in this study. Trees on campus must be properly labeled with the summaries of their values. This will confer respects on the trees from members of the University community for the trees.

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