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Assessment of the diversity and abundance of tree species in Afe Babalola University, Ado- Ekiti, Ekiti State, Nigeria

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In this study, an assessment of trees diversity and abundance in the Afe Babalola University Ado Ekiti, Ado Ekiti, Nigeria was carried out. Stratified sampling method was employed. The University was divided into four strata for adequate sampling (Stratum A, B, C, D). The results revealed a total of 816 individual trees of 21 tree species belonging to 16 families. The family Aracaceae has the highest number of species (3 (14%) species), The families of Caesalpiniaceae, Combretaceae, Verbenaceae had 2 species each, while other families (Anacardiaceae, Annonaceae, Apocynaceae, Araucariaceae, Caricaceae, Euphorbiaceae, Malvaceae, Meliaceae, Moraceae, Myrtaceae, Papilonaceae, Pinaceae families) had only one specie each respectively. The family Verbanaceae has the highest number of individual tree flora while Moraceae has the least with 1 tree stand in the study area. *Gmelina arborea* was the most frequently occurring tree species with a total of 472 (58%) individuals while *Ficus benjamina* was the least frequently occurring tree species with only 1 (0.12%) tree individual in the study area. This is suspected to be as a result of their poor establishment, thus special attention needs to be applied both to intensified efforts on planting as well as conserving the available species to avoid their extinction.

Key words: Abundance, tree species, diversity, frequency, planting.

INTRODUCTION

The relevance of trees cannot be overemphasized. There are several uses of trees to man. Trees are determinants of a forest ecosystem as they considerably influence forest microclimate such as (available light, wetness, temperature). In Nigeria, (Raji and Babalola, 2018; Ihenyen et al., 2009; Keay, 1989) reported there are about 560 species of trees. Trees give oxygen, store carbon dioxide hence helps slow the rate of global warming, stabilize the soil and give life to the world's wildlife (Dwyer et al., 1992; Berman et al., 2012; Bratman et al., 2015; Lohr and Pearson-Mims, 2006; Mayer et al., 2009). They also provide man with materials for tools and shelter. They reduce wind speeds and cool the air as they lose moisture and reflect heat upwards from their leaves. It is estimated that trees can reduce the temperature in a city by up to 7ºC (Omoro et al., 2010). Trees also prevent flooding and soil erosion. Trees, apart from forming the major structural and functional basis of

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tropical rainforest also serve the functions of carbon sequestration, watersheds, provide shades and homes to many life forms and above all, act as purifier to the ecosystem Fuwape and Onyekwelu (2011) and (Singh, 2002). A university campus should be promoted as a model environment for sustainable development. Trees in academic institutions located in cities are part of forests resources and the trees can be used as its defining features. The presence of trees defines the landscape by their beauty and, in particular long-lived species, which can endure periodic reproductive features without direct negative demographic consequences (Suratman, 2012; Ashman et al., 2004). A higher number of tree species increases the number of ecologically niches as well as the number of associated species (Agbelade et al., 2016a; Adekunle et al., 2013; Kanowski et al., 2003; Wunderle, 1997).

Planting of trees are deliberately carried out in academic environment for reasons which including aesthetic and other environmental services (Olajuyigbe and Akwarandu 2019; Egunjobi, 1989; Babalola 2010; Martens et al. 2011).

However, trees have undergone different levels of disturbance due to unprecedented increase in human population which have led to cutting of trees for firewood collection, charcoal production, and infrastructural developments (Omoro et al., 2010).

To protect trees from declining, it is essential to examine the current status of species diversity, composition and abundance this will provide guidance for their management and valuable reference for assessment as well as improve knowledge in the identification of ecologically useful species. Therefore, the main objective of this study is to assess tree diversity and abundance in Afe Babalola University, Ado-Ekiti campus with the view to providing baseline information useful to development and conservation of the tree species in the study area. Thus, such information will be useful for tree managers seeking to maximize species diversity and the environmental benefits provided by trees.

MATERIALS AND METHODS

The study was conducted in the campus of Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria. Afe Babalola University is geographically located in Ado-Ekiti (Latitude 7º40'N and Longitude 5º18'E). Ado-Ekiti has two climatic seasons–a rainy season and a dry season, the rainy season lasts for about eight months and the dry season for about four months. The annual rainfall is about 1150mm.

Survey of trees species on campus

A stratified sampling technique was used in this study, the entire Afe Babalola University Campus was divided into four strata and each stratum was further sub divided into sub-strata. All the trees within each of the sub-stratum were counted and identified to species level with their scientific authentication, local and family names with the assistance of the curator in the Herbarium unit of the Department of Plant Science and Biotechnology as well as with the aids of tree identification guide books, including Tropical Tree Crops (Okpeke, 1987), Trees of Nigeria (Keay, 1989), Flora of West Tropical Africa (Hutchinson and Dalziel, 1968) and Useful Plant of West Tropical Africa (Burkill, 1985, 1995, 1997, 1994, 2000). Voucher specimens of the identified trees species were equally prepared and deposited at the herbarium unit. The names of the trees were recorded for all the strata and sub-strata and its number of occurrence were determined. Frequency of occurrence, relative frequency, Shannon-Weiner index, and Simpson diversity index and species evenness was calculated for each stratum, sub-strata and for the entire sampled area.

Data analysis

The data collected during the tree survey were analyzed and calculated using different indices such as Shannon and Wiener, Simpson diversity and species evenness. Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS 20.0).

RESULTS AND DISCUSSION

This study described the taxonomy, diversity, and environmental relevance of tree flora in Afe Babalola University, Ado-Ekiti, Ekiti State. Diverse tree species were identified and collected at this higher institution of learning. Field observation revealed a total of 816 tree flora spread across 21 tree species belonging to 16 families in this study area (Table 1). The results obtained revealed that the abundance and diversity of trees in the academic area of this University were high. This may be attributed to provision of an aesthetic environment and beautification of the landscape for students, staff and other inhabitants of the University. The study revealed that the family Arecaceae has the highest number of 3 (14 %) species (Table 1). These results corroborate the assertion of Ogwu et al. (2016) on the abundance and diversity of trees in University of Benin. This family mainly occur in tropical and subtropical regions, with most genus and species found in Asia, Indonesia, and the Americas.

Also, the predominance of this family may be as a result of its great economic importance. The poor establishment of some trees under the families (Moraceae, Papilonaceae), could be attributed to anthropogenic activities that both endangered, unsettled and negatively target these families. This was supported by the reports of Wardle et al. (2004), who recorded that anthropogenic activities affected the establishment of certain families of trees and placed them at more risk of extinction if not properly and intentionally conserved. Other members of the family in the campus include *Cocos nucifera*, *Acrocomia aculeata*, *Phoenix dactylifera* and *Mauritia flexuosa.*

The Arecaceae family was closely followed by the Verbenaceae and Combretaceae families. These were well known for their economic and medicinal purposes as

Table 1. Demography of trees sampled in ABUAD **(%).**

Families	No. of tree species	Total no. of tree individuals (%)
Anacardiaceae	1	0.61
Annonaceae	1	3.58
Apocynaceae	1	1.36
Araucariaceae	1	2.34
Arecaceae	3	9.00
Caesalpiniaceae	2	1.85
Caricaceae	1	0.37
Combretaceae	2	3.08
Euphorbiaceae	1	4.56
Malvaceae	1	0.99
Meliaceae	1	2.34
Moraceae	1	0.12
Myrtaceae	1	5.30
Papilonaceae	1	0.25
Pinaceae	1	0.62
Verbenaceae	2	63.63
Total	21	100

Table 2. Occurrence of the identified tree species in the study area.

S/N	Botanica Name	Family	Common name	local name
1	*Araucaria cunninghamii (Aiton)*	Araucariaceae	Colonial pine, Queensland pine	Igi Oyinbo
2	*Azadirachta indica (A. Juss.)*	Combretaceae	neem	Dongoyaro
3	*Carica papaya (L.)*	Caricaceae	pawpaw	Ibepe
4	*Cassia fistula (L.)*	Caesalpiniaceae	Golden shower	Igi gbigbe
5	*Cocos nucifera (L.)*	Arecaceae	coconut tree	Igi Àgbọn
6	*Dalbergia latifolia (Roxb).*	Papilionaceae	Indian rose wood	Igi gbigbe
7	*Delonix regia (Hook Raf).*	Caesalpiniaceae	Flame of the forest	Eko omode
8	*Elaeis guinensis (Jacy)*	Arecaceae	african oil Palm	Igi ọ̀pẹ
9	*Eucalyptus Camaldulensis (Dehnh)*	Myrtaceae	river red gum	Igi igbo
10	*Ficus benjamina (L.)*	Moracaceae	weeping fig	Igi ọpọtọ
11	*Gmelina arborea (Roxb).*	Verbenaceace	Bleech wood,goomar teak	Gamhar
12	*Hibiscus rosa (sinensis L.)*	Malvaceae	Chinese hibiscus	Ododoabiscosi
13	*Hura crepitans (L).*	Euphrobiaceae	possum wood, jabillo	Egungun Odo
14	*Mangifera indica (L).*	Anacardiaceae	mango	Mangoro
15	*Morinda lucida (Benth).*	Pinaceae	pinus taxa	Igi pini
16	*Polyalthia longifolla (Lam.)*	Annonaceae	false ashoka/ buddha tree	Igi olopa
17	*Plumeria alba (L.)*	Apocynaceae	dok champa	Fragipani
18	*Roystonea regia (kunth 0. F. Cook)*	Arecaceae	cuban royal palm	Igi ope Oba
19	*Terminalia catappa (L).*	Combretaceae	Country almond	Furutu
20	*Terminalia ivorensis (A Chev).*	Combretaceae	black afara/ivory coast almond	Afara
21	*Tectona grandis (L.F)*	Meliaceae	Teak	Igi opo ina

earlier asserted by Kayode (2008) that *Gmelina arborea* (a member of the Verbenaceae family) was one of the plants used for the construction purposes as well used in the treatment of sexually transmitted diseases in Ekiti State Nigeria. It was equally observed that out of the 21 tree species encountered in the study area, (Table 2 and 3) some were present in all the strata of the campus. For instance, *Hura crepitans*, *Cocos nucifera*, *G. arborea*, and *Tectona grandis* were found in all the strata. The factor responsible for the abundance of these

Table 3. Occurrence of identified tree species in the study area.

S/N	Tree species	Occurrence of tree species / stratum			
		A	B	C	D
1	*Araucaria cunninghamii*	-	+	+	-
2	*Azadirachta indica*	-	+	+	+
3	*Carica papaya*	+	-	+	-
4	*Cassia fistula*	+	-	+	+
5	*Cocos nucifera*	+	+	+	+
6	*Dalbergia latifolia*	+	-	-	-
7	*Delonix regia*	-	+	-	-
8	*Elaeis guinensis*	+	+	+	-
9	*Eucalyptus camaldulensis*	+	-	+	-
10	*Ficus benjamina*	-	+	-	-
11	*Gmelina arborea*	+	+	+	+
12	*Hibiscus rosa*	-	+	+	+
13	*Hura crepitans*	+	+	+	+
14	*Mangifera indica*	+	+	-	-
15	*Morinda lucida*	-	+	-	-
16	*Polyalthia longifolia*	+	+	-	+
17	*Plumeria alba*	-	+	-	-
18	*Roystonea regia*	+	-	+	+
19	*Terminalia catappa*	-	-	+	-
20	*Terminalia ivorensis*	+	-	-	+
21	*Tectona grandis*	+	+	+	+

species might be their perceived economic importance or more probably the ease of establishment.

It was also observed that the *G. arborea* has the highest frequency of occurrence while *C. papaya*, *F. benjamina* have the least. The availability of *G. arborea* in all the divisions of the study area was found to constitute the most frequently encountered tree in the campus of ABUAD, having a total of 472 (58.20%) individual trees (Table 4). One of the suspected reasons for this predominance is the intentional cultivation of the species for its industrial uses. *G. arborea* is economically important in its use in constructions, furniture, carriages, sport, prosthetics and musical instruments.

Similarly, the results of relative frequency, relative diversity and relative abundance of the tree species surveyed in strata A, B, C and D were observed in the Tables 5 to 9 respectively. *G. arborea* has the highest relative frequency in all the four strata with 60.75 in strata A, 36.67 in strata B, 38.10 in strata C, and 60.18 in strata D. This is followed by *E. camaldulensis*, in strata A with 8.35 relative frequencies, *T. grandis* in strata B with 10.67 relative frequencies, *A. cunninghamii* in strata C with 15.24 relative frequencies, and *C. nucifera* in strata D with relative frequency of 8.85. It was also observed that *G. arborea* has the highest relative density in all the four strata, with 72.16 in strata A, 37.00 in strata B, 37.25 in strata C, and 59.41 in strata D. It was followed by *E. camaldulensis* in strata A with a relative density of 8.24, *T. grandis* in strata B with 11.00 relative density, *A. cunninghamii* in strata C with 14.71 relative density and *C. nucifera* in strata D with 9.00 relative density. Similarly, *G. arborea* has the highest relative abundance in all the four strata, with a relative abundance 0.72, 0.37, 0.37, 0.59 in strata A, B, C and D respectively, followed by *E. camaldulensis* with relative abundance of 0.08 in strata A, Tectona grandis with relative abundance of 0.11 in strata B, *A. cunninghamii* with relative abundance of 0.15 in strata C while *C. nucifera* with relative abundance of 0.09 in strata D.

Most of the trees planted in ABUAD were exotic breed, information from the respondents revealed that the residents of the campus could not ascertain the reason for this, however, the planting of exotic breeds forms a trend as reported by Alfred et al. (2014) who found that exotic species flourished and grew more rapidly from the period of emergence to the maturity of the plants. *G. arborea is* an economic plant that was used to construct various furniture works. Also, *G. arborea* tree was used to carve out a lion throne, the last surviving of the eight royal thrones of myañmar, now in the national museum of Yangon Ma (Thanegi, 2017). Amazingly, a few tree species such as *C. papaya*, *F. benjamina* and a few others however had a total count of less than five stands in the whole of the study area, the reason for this is suspected to be their poor establishment, thus special attention needs to be applied both to intensified

Table 4. Frequency of occurrence of the identified tree species in ABUAD campus.

Rank	Tree species	Number of Individual (%)
1.	*Gmelina arborea*	58.20
2.	*Tectona grandis*	5.43
3.	*Eucalyptus camadulensis*	5.30
4.	*Hura crepitans*	4.56
5.	*Polyathia Longifera*	3.08
5.	*Cocos nucifera*	3.08
5.	*Elaesis guinensis*	3.08
8.	*Roystonea regia*	2.84
9.	*Araucaria cunninghamii*	2.34
9.	*Azadirachta indica*	2.34
11.	*Terminalia ivorensis*	2.22
12.	*Flumeria alba*	1.36
13.	*Cassia fistula*	1.11
14.	*Hibiscus rosa*	0.99
15.	*Terminalia catappa*	0.86
16	*Delonix regia*	0.74
17	*Pinus amygdalus*	0.62
18	*Maggifera Indica*	0.62
19	*Carica papaya*	0.37
20	*Dalbergia latifolia*	0.25
21	*Ficus benjamina*	0.12

Table 5. Indices of abundance in strata A (roadside).

Trees	RF	RD	Pi
Gmelina arborea	69.75	72.16	0.72
Eucalyptus camaldulensis	8.35	8.24	0.08
Tectona grandis	5.42	5.15	0.05
Elaeis guinensis	3.16	3.09	0.03
Polyathia longifolia	3.38	3.09	0.03
Cassia fistula	2.03	2.06	0.02
Terminalia ivorensis	2.03	2.06	0.02
Roystonea regia	2.48	2.06	0.02
Hura crepitans	1.35	1.03	0.01
Mangifera indica	0.67	1.03	0.01
Carica papaya	0.45	0.00	0.00
Dalbergia latifolia	0.45	0.00	0.00
Cocos nucifera	0.45	0.00	0.00

Keys: Frequency (F), Relative frequency (RF), Density (D), Relative density (RD), Relative abundance (PI).

efforts on planting as well as conserving the available species to avoid extinction of the species. The study also revealed the poor establishment of some trees under the families (Moraceae, Papilonaceae), this could also be attributed to anthropogenic activities that unsettle and negatively targets these families, this school of thought agrees with Wardle et al. (2004) who also recorded that anthropogenic activities affected the establishment of certain families of trees and placed them at more risk of extinction if not properly and intentionally conserved.

Table 6. Indices of abundance in strata B (car pack).

Trees	RF	RD	Pi
Gmelina arborea	36.67	37.00	0.37
Tectona grandis	10.67	11.00	0.11
Hura crepitans	10.00	10.00	0.10
Polyalthia oliveri Engl.	8.00	8.00	0.08
Plumeria spp.	7.33	7.00	0.07
Cocos nucifera	5.30	5.00	0.05
Azadirachta indica	4.67	5.00	0.05
Elaelis guinensis	5.33	5.00	0.05
Delonix regia	4.00	4.00	0.04
pinus amygdalis	3.33	3.00	0.03
Araucaria cunninghamii	2.00	2.00	0.02
Ficus benjamina	0.67	1.00	0.01
Magnifera indica	1.33	1.00	0.01
Hibiscus rosa	0.67	1.00	0.01

Keys; Frequency (F), Relative frequency (RF), Density (D), Relative density (RD), Relative abundance (PI).

Table 7. Indices of Abundance in Strata C. (Office area).

Trees	RF	RD	Pi
Ginelina arborea	38.10	37.25	0.37
Araucaria cunninghamii	15.24	14.71	0.15
hura crepitans	8.60	8.82	0.09
Restonea regia	7.62	7.84	0.08
Terminalia catappa	6.67	6.90	0.07
Azadirachta indica	5.71	5.88	0.06
Hibiscus rosa	4.76	4.90	0.05
cocos nucifera	4.76	4.90	0.05
Tectona grandis	2.86	2.94	0.03
Elaeis guinensis	2.86	2.94	0.03
Eucalyptus Ccamaldulensis	1.90	1.96	0.02
carica papaya	0.95	0.98	0.01

Keys; Frequency (F), Relative Frequency (RF), Density (D), Relative Density (RD), Relative abundance (PI).

Conclusion

This study found out that most of the trees planted in the University campus were exotic breed. The distribution of trees in the study area could be based on specific needs of the University system as well as its relevance to the resident living on campus (such as noise attenuation, landscaping and beautification, cooling). The relevance of trees is very important as it encourages all the beneficiaries of services of the trees to become involved in preservation and conservation of trees.

However, special attention must be paid to trees that are not easily established such as *F. benjamina* and others to prevent their extinction. The study also revealed the poor establishment of some trees such as *F. benjamina,* and *D. latifolia* under the families (Moracaceae and Papilonaceae respectively) this could be attributed to anthropogenic activities that unsettle and negatively targets these families, this is in accordance with the work of Wardle et al. (2004) who reported that anthropogenic activities affected the establishment of certain families of trees and placed them at more risk of extinction if not properly and intentionally managed and conserved.

Therefore, the tree compositions on Afe Babalola University Campus could be described as relatively available and well diverse. However, there is need to

Table 8. Indices of abundance for strata D.

Trees	RF	RD	Pi
Gmelina arborea	60.18	59.41	0.59
Cocos nucifera	8.85	9.00	0.09
Terminalia ivorensis	7.06	8.00	0.08
Hura crepitans	6.19	6.00	0.06
Azadirachta indica	5.31	5.00	0.05
Roystonea regia	3.54	4.00	0.04
Eucalyptus camaldulensis	3.54	4.00	0.04
Hibiscus rosa	1.76	2.00	0.02
Polyalthia longifolia	1.76	2.00	0.02
Tectona grandis	0.88	1.00	0.01

Keys; Frequency (F),Relative Frequency (RF),Density(D),Relative Density (RD), Relative abundance (PI).

Table 9. Indices of similarities in the occurrence of trees in ABUAD campus.

Strata	Similarity indices				
	IS	Sj	So	Ss_D	Sas
strata A-B	51.85	0.21	0.77	0.41	0.50
Strata A-C	64.00	0.24	0.86	0.46	0.47
Strata A-D	69.57	0.26	0.86	0.46	0.47
Strata B-C	61.54	0.24	0.86	0.46	0.47
Strata B-D	58.33	0.23	0.78	0.41	0.50
Strata C-D	63.64	0.27	0.86	0.46	0.47

Keys: So: Ochio index, SsD: Sorensen dice index, Sas: assymetrical similarities, IS: index of similarity. SJ: jaccard index.

properly and adequately handle and conserve the trees so as to ensure its continuous availability as the need arises.

CONFLICTS OF INTERESTS

The authors have not declared any conflicts of interests.

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