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A CHECKLIST OF TREE SPECIES IN THE BIOLOGICAL GARDEN OF OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

Dada[1], C.M. and Folorunso[2], A.E.
[1]Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria
[2]Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria

Correspondence: dadacaleb8@gmail.com

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ABSTRACT

A study was conducted to investigate the depletion of tree species and inventory in the Biological Garden of Obafemi Awolowo University (OAU), Ile-Ife. The study was aimed at creating a checklist of tree species in the study area. Data collection was done by dividing the study area into five sampling plots selected at random. The results indicated the presence of 72 tree species belonging to 23 families, with a total of 460 individual trees. The most common tree species found were *Albizia zygia* (DC.) J.F. Macbr and *Alstonia boonei*. The Fabaceae family had the highest percentage composition of 20.8%, making it the dominant family. The study showed a significant difference between the current and a previous survey, with the average composition of the current survey being 4.75 ± 8.30 and the previous one being 10.15 ± 16.53. This survey has provided an overview of the tree species growing in the Biological Garden of OAU, Ile-Ife. The flora richness of the identified trees are also reported in this study. The species richness of trees in the study area can be improved by controlling the indiscriminate felling of trees and other anthropogenic activities that can result in the depletion of the vegetation.

Key words: Checklist; biological garden; tree; vegetation
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INTRODUCTION

A tree is a perennial plant with an elongated stem, or trunk, supporting branches and leaves in most species. In some usages, the definition of a tree may be narrower, including only woody plants with secondary growth, (Crowther *et al*., 2015). Trees have been in existence for 370 million years. It is estimated that there are just over 3 trillion mature trees in the world, majority of which are angiosperms. There are about 1000 species of gymnosperms (The Plant List, 2010).

Many tree species are a source of medicine, especially in traditional medicine and are useful in the treatment of various diseases (Bako *et al*., 2005). They have been an indispensable source of both preventive and curative medicinal preparations for human beings (Dery *et al.,* 1999). Nigeria's vegetation is one of the most endowed in Africa, as almost all the vegetation types that exist in other African countries are widely distributed in different geopolitical zones of the country. This is favoured by variations in climate and geographic features. Nigeria harbours about 7,895 species of plant, making it one of the richest countries in the continent in terms of biodiversity (Pelemo *et al*., 2011; Adeyemi and Ogundipe, 2012). However, these habitats are under threat from advancing civilisation and other unsustainable human activities. The attitude of the populace towards conservation is relatively poor, thereby resulting in the loss of genetic resources at all levels. The rate of deforestation in the country is estimated at 3.5% per year, translating to a loss of 350,000–400,000 ha of forest land per year. The entire Nigeria's forest land area is now about 10%, which is well below FAO's recommended national minimum of 25%. If proper measures are not taken, it may render the threatened species extinct (Pelemo *et al.,* 2011).

Plants are continually gaining recognition, thereby increasing the number of plants used by man both locally and internationally. However, as the demand for plants increases, the rate of depletion of tree species in the Biological Garden of Obafemi Awolowo University is becoming alarming. There is no up-to-date information about the availability of plant species within the Garden including their exact locations and the morphological characteristics used for their identification. This creates confusion and makes research cumbersome for plant users. There is, therefore, the need for a checklist of plants in the Garden.

MATERIALS AND METHODS

Study Area

The study was based on an intensive field survey that was conducted within 20.5 hectares of secondary forest in the Obafemi Awolowo University Biological Garden, Ile-Ife, Nigeria (Figure 1). The Garden is made up of a total of 51 acres of land out of 13,000 acres of land owned by the University. Five sampling plots of 25 m × 25 m in size were designated plots 1, 2, 3, 4 and 5 between latitudes 7°31.33′ N – 7° 31.45′ N and longitudes 4° 31.42′ E. These were randomly sampled within the Garden.

Field Survey and Data Collection

The tree species encountered within the five sampling plots were identified, classified and named using the taxonomists in the Department. Morphological characteristics were used as a means of identification. The tree species were boldly numbered using white paint and plastic labels bearing their family, generic and specific names, which were fixed on the trees. The individual trees were counted and classified into families, genera and species.

Specimens of trees that could not be identified were collected for processing and identification in the Herbarium. The assessment of native versus introduced status was based on the information provided by the literature sources (Hutchinson and Dalziel, 1954; Keay *et al.*, 1964a; Keay, 1989b). Voucher specimens of all the plants were collected and deposited at the Obafemi Awolowo University Herbarium (IFE). The tree species compositions of these plots were established by listing all the species encountered in each plot and summing up to get the total number of plant species for each plot. The Shannon & Wiener Diversity Index, which accounts for species richness and how the species are distributed, was derived from the formula;

$H^1 = -\sum Pi \ln(Pi)$

Where:

H_1 is the Shannon-Weiner diversity index

$Pi=\frac{ni}{N}$

Pi = Relative abundance of each species (I)

N is the total number of individuals of all species

i is the number of individuals of a species.

To estimate the convergence of species during succession, the similarity in species composition in each plot was compared using the Sørensen index of similarity (SIS). The comparison done by the measurement of the similarity and dissimilarity between sampling plot pairs was based on the presence or absence of species of interest in each study plot. Values near 1 indicate nearly identical community composition between the pair of plots and values near 0 indicate that communities have very little compositional overlap between the plot pairs. The Sørensen similarity index was calculated as:

$$Q_s = 2C / A + B$$

Where,

C = Number of species common to the plots

A = Total number of species in plot A

B = Total number of species in plot B

The evenness of distribution of species was calculated using Pielou's evenness index, J.

$J = \frac{H1}{in\ (S)}$

Where: J is the Pielou's evenness index

H^1 is the Shannon-Weiner diversity index

S is the total number of species in each plot. The estimation of the density, diversity and evenness indices all accounted for unequal plot sizes.

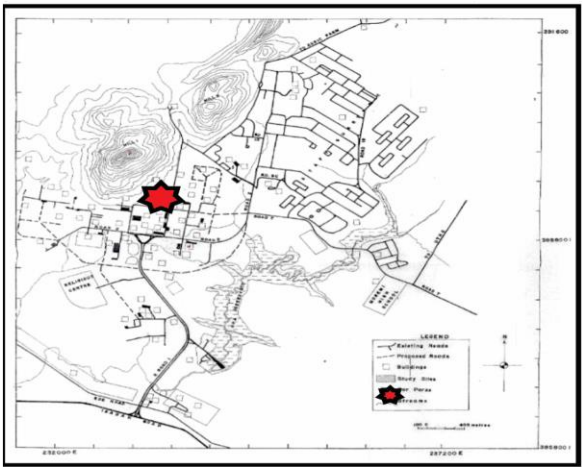


Figure 1: Map of Obafemi Awolowo University, Ile-Ife, showing the study area

RESULTS AND DISCUSSION

The total number of individual tree species encountered was 460, distributed in 23 families. Plot 1 had the highest number of individuals (145) while plot 2 had 107 individuals and plot 4 had the least number of 52 individuals. The most common species in these plots were *Albizia zygia* (DC.) J.F. Macbr, *Alstonia boonei* De Wild**.,** *Bosqueia angolensis* Ficalho, *Celtis zenkeri* Engl., *Elaeis guineensis* Jacq., *Ficus mucuso* Welw, *Funtumia elastica* (Preuss) Stapf., *Myrianthus arboreus* P. Beauv., *Newbouldia laevis* (P. Beauv.) Seem. Ex Bureau., *Pycnanthus angolensis* (Welw.) Warb, *Spondias mombin* L., and *Sterculia tragacantha* Lindl.

Table 1: Abundance of individuals of each of the species encountered in the five plots

Plot	Number of tree species per plot	Abundance per plot	Mean ± SD
1	44	145	3.44±3.01
2	38	107	3.00±4.25
3	29	81	2.82±3.26
4	26	52	2.08±1.41
5	25	75	3.24±3.76

SD: Standard Deviation

Table 2 shows species distribution across the families with the Fabaceae having the highest percentage composition of 20.8%. Also, other families that are common in this Garden are Malvaceae and Moraceae which have a percentage composition of 12.5%.

Table 2: Relative Species contribution in the study plots

S/N	Family	No of Species	% Composition
1.	Anarcadiaceae	3	4.2
2.	Annonaceae	1	1.4
3.	Apocynaceae	7	9.7
4.	Arecaceae	1	1.4
5.	Bignoniaceae	5	6.9
6.	Burseraceae	1	1.4
7.	Caricaceae	1	1.4
8.	Combretaceae	1	1.4
9.	Dilleniaceae	1	1.4
10.	Dracenaceae	1	1.4
11.	Euphorbiaceae	3	4.2
12.	Fabaceae	15	20.8
13.	Lauraceae	1	1.4
14.	Loganiaceae	1	1.4
15.	Malvacea	9	12.5
16.	Meliaceae	2	2.8
17.	Moraceae	9	12.5
18.	Myristicaceae	1	1.4
19.	Rubiaceae	2	2.8
20.	Sapindaceae	3	4.2
21.	Sapotaceae	1	1.4
22.	Simaroubaceae	1	1.4
23.	Ulmaceae	2	2.8
		72	**100%**

Table 3: List of tree species and their families in different plots in the area Studied

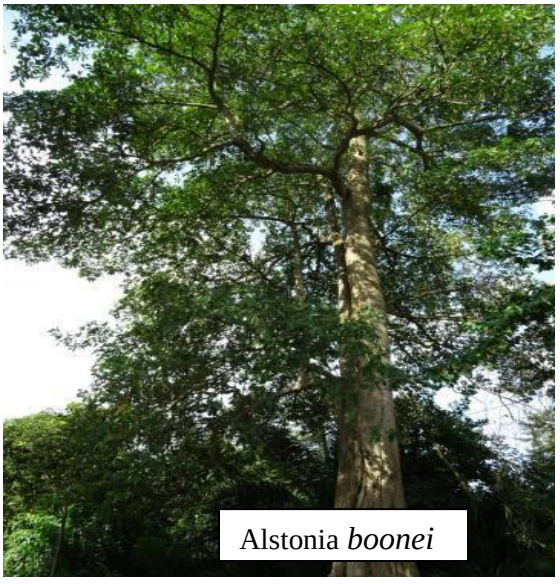
S/N	Name of the tree	Family	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
			No of individuals per plot				
1.	*Afzelia africana* Sm.ex Pers.	Fabaceae	1	0	0	0	0
2.	*Albizia coriaria* Welw.	Fabaceae	0	0	1	0	0
3.	*Albizia ferruginea* (Guill. & Perr.) Benth	Fabaceae	2	0	0	0	0
4.	*Albizia glabberima* (Schum. & Thenn.) Benth	Fabaceae	0	0	0	2	0
5.	*Albizia adiantifolia* (Schum.) W.F. Weight	Fabaceae	1	0	0	0	0
6.	*Albizia verugata*	Fabaceae	1	0	0	2	0
7.	*Albizia zygia* (DC.) J.F. Macbr	Fabaceae	2	4	1	3	3
8.	*Alstonia boonei* De Wild.	Apocynaceae	0	5	5	1	1
9.	*Amphimas pterocarpoides* Harms	Fabaceae	1	0	0	0	0
10.	*Anacardium occidentale* De Wild.	Anarcadiaceae	0	2	3	0	0
11.	*Anthocleista vogelii* Planch.	Loganiaceae	0	0	0	0	1
12.	*Antiaris africana* Engl.	Moraceae	1	3	0	0	
13.	*Baphia nitida* Lodd.	Fabaceae	0	1	0	0	0
14.	*Bauhinia monandra* Kurz	Fabaceae	12	0	0	0	0
15.	*Blighia sapida* Koenig	Sapindaceae	5	0	2	1	1
16.	*Blighia unijugata* Baker	Sapindaceae	1	2	0	0	0
17.	*Bombax buonopozence* P. Beauv.	Malvaceae	0	0	0	4	0

18.	*Bombax costatum* Pellegr. & Vuillet	Malvaceae	0	1	0	0	0
19.	*Bosqueia angolensis* Ficalho	Moraceae	10	0	12	1	5
20.	*Canarium schweinfurthii* Engl	Burseraceae	0	0	1	0	0
21.	*Canthium vulgare* (K.Schum.) Bullock	Rubiaceae	1	0	0	0	1
22.	*Carica papaya* L.	Caricaceae	2	3	0	0	1
23.	*Cassia siamea* (Lam.) H.S. Irwin & Barneby	Fabaceae	0	3	0	0	0
24.	*Ceiba pentandra* (L.) Gaertn	Malvaceae	1	0	0	0	0
25.	*Celtis philippensis* Blanco	Ulmaceae	0	1	0	0	3
26.	*Celtis zenkeri* Engl.	Ulmaceae	6	2	10	5	3
27.	*Chrysophyllum albidium* G. Don	Sapotaceae	1	1	3	0	0
28.	*Cola acuminata (*P. Beauv.) Schotl & Endl.	Malvaceae	5	0	1	0	0
29.	*Cola millenii* K. Schum.	Malvaceae	0	0	1	0	0
30.	*Cola nitida* (Vent). Schett & Endl.	Malvaceae	5	1	1	1	0
31.	*Crescentia cujete* Linn.	Bignoniaceae	2	0	0	0	0
32.	*Dillenia indica* Linn.	Dilleniaceae	0	0	1	0	0
33.	*Dracaena fragrans* (Willd.) Link	Dracenaceae	0	0	1	0	0
34.	*Elaeis guineensis* Jacq.	Arecaceae	4	1	3	1	1
35.	*Entada africana* Gull. & Perr.	Mimosaceae	0	2	0	0	0

36.	*Eriocoelum macrocarpum* Gill ex Engl.	Apocynaceae	0	1	3	0	0
37.	*Ficus exasperata* Vahl	Moraceae	4	2	0	6	0
38.	*Ficus mucuso* Welw	Moraceae	0	5	3	2	2
39.	*Ficus capensis* Thumb.	Moraceae	1	0	0	0	0
40.	*Funtumia elastica* (Preuss) Stapf.	Apocynaceae	3	27	13	2	19
41.	*Hannoa klaineana* Pierre & Engl.	Simaroubaceae	6	0	0	0	1
42.	*Holarrhena floribunda* (G. Don) T. Durand & Schinz	Apocynaceae	9	5	0	0	2
43.	*Khaya senegalensis*	Meliaceae	1	0	0	0	0
44.	*Lecaniodiscus cupanoides* Planch. Ex Benth	Sapindaceae	4	4	0	0	7
45.	*Mangifera indica* L.	Anacadiaceae	0	4	0	2	0
46.	*Manihot glaziovii* Mull. Arg.	Euphorbiaceae	0	0	0	1	2
47.	*Margaritaria discoidea* (Bail.) Webster	EuphorPoaceae	1	0	0	0	0
48.	*Markhamia tomentosa* (Benth.) K. Schum. ex. Engl.	Bignoniaceae	5	0	0	0	0
49.	*Milicia excelsa* (Welw.) C.Berg	Moraceae	2	0	1	1	1
50.	*Millettia thonningii* (Schum. & Thonn.) Bak.	Moraceae	0	0	5	0	1
51.	*Monodora tenuifolia* Benth.	Annonaceae	0	1	0	0	0
52.	*Morinda lucida Benth*.	Rubiaceae	2	0	0	1	0
53.	*Morus mesozygia* Stapf	Moraceae	1	0	0	0	0
54.	*Myrianthus arboreus* P. Beauv.	Moraceae	9	5	0	1	2
55.	*Newbouldia laevis* (P. Beauv.) Seem. Ex Bureau.	Bignoniaceae	11	2	1	2	2

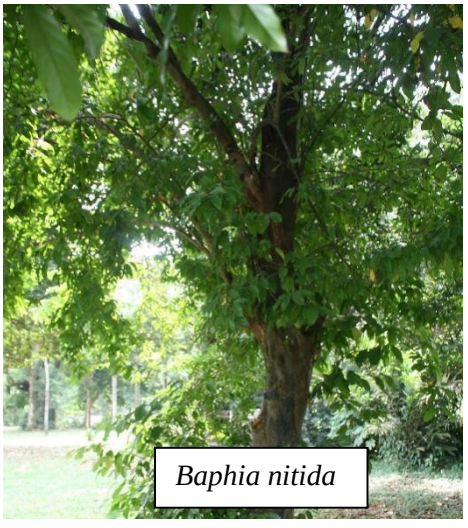
56.	*Persea americana* Mill	Lauraceae	0	1	0	0	0
57.	*Piptedeniastrum africanum* (Hook. f.) Brenan	Fabaceae	0	0	1	0	0
58.	*Pterocarpus mildbraedii* Harms	Fabaceae	0	1	0	0	0
59.	*Pycnanthus angolensis* (Welw.) Warb	Myristicaceae	4	1	1	4	4
60.	*Rauvolfia vomitoria* Afzel.	Apocynaceae	1	0	0	0	0
61.	*Ricinodendron heudelotii* Baill.) Pierre ex Pax	Euphorbaceae	0	1	0	1	7
62.	*Rothmania longiflora* Salisb.	Apocynaceae	0	0	1	0	0
63.	*Spathodea campanulata* P.Beauv.	Bignoniacease	2	1	0	0	0
64.	*Spondias mombin* L.	Anacardiaceae	1	2	2	2	0
65.	*Sterculia tragacantha* Lindl.	Malvaceae	2	3	-	1	3
66.	*Stereospermum acuminatisimum* (L. F.) Dc.	Bignoniaceae	1	0	0	0	0
67.	*Terminalia superba* Engl.et Diels	Combretaceae	0	1	1	1	1
68.	*Tetrapleura tetraptera* (Schum. & Thonn.) Taub.	Fabaceae	0	0	1	0	0
69.	*Theobroma cacao* L.	Malvaceae	0	1	2	0	0
70.	*Trichilia heudelotii* Planch. ex Oliv.	Meliacaee	6	3	0	1	0
71.	*Triplochiton scleroxylon* K.Schum	Malvaceae	0	1	0	2	0
72.	*Voacanga africana* Stapf	Apocynaceae	6	3	0	1	0
	Total		145	81	52	52	75

Albizia zygia



Alstonia *boonei*

Afzelia africana



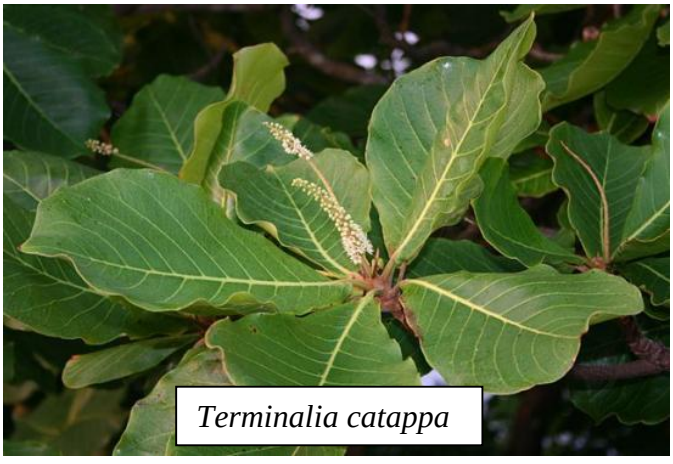
Baphia nitida

Bombax buonopozence

Cassia siamea

Ceiba pentandra

Celtis zenkeri



igure 2: *In situ* images of some of the tree species in the study area

Table 4: Result of independent t-test comparing the average species composition between previous and current population

Study	Mean	Std Deviation	t –value	p-value
Previous (1991)	10.15	16.53	1.976	0.05
Current (2019)	4.69	8.28		

Table 5: Sorenson Index of Similarity and Diversity of five plots in the Biological Garden of Obafemi Awolowo University Estate

PLOT	1	2	3	4	5
1	-				
2	0.49	-			
3	0.27	0.44	-		
4	0.46	0.59	0.50	-	
5	0.52	0.54	0.47	0.60	-

Figure 2: Photograph showing mute and mock courts built in part of the Biological Garden

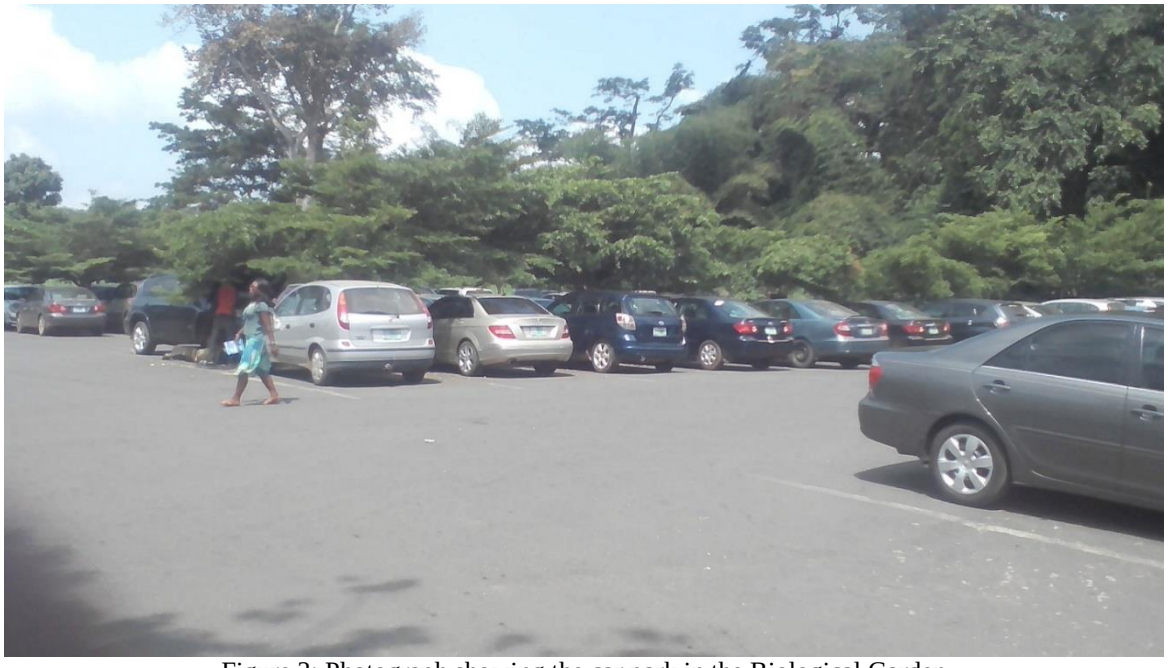


Figure 3: Photograph showing the car park in the Biological Garden

The result of the species richness recorded in this study showed that the rate of degradation of the tree species within the Biological Garden of Obafemi Awolowo University, Ile-Ife was alarming and if necessary precautions are not taken, this may lead to the extinction of many economic trees and some plant species with high medicinal value. There was a drastic reduction in the number of tree species in the garden when compared with the previous survey. During the last survey, a total number of 990 individual tree species was reported but only 451 individual tree species were recorded in the present study. This shows a drastic reduction in the number of individual tree species. Low species diversity recorded in some of the sampling sites is an indication that the vegetation is extremely threatened due to human activities. Factors affecting biodiversity conservation in Nigeria include the clearing of land for farming, logging and deforestation (Durugbo *et al.,* 2012). In this study, the destruction of habitat for housing or for construction was the major difficulty observed during the study. The continuous removal of the tree species for infrastructure facilities has brought about a remarkable reduction in some genera such as *Albizia, Antiaris, Cola, Ficus*, *Newbouldia,* etc. The increased abundance of *Bosqueia angolensis, Canthium vulgare, Cassia siamea, Celtis zenkeri, Lecaniodiscus cupaniodes, Myrianthus arboreus and Sterculia tragacantha* could be due to their recruitment strategies. Thus, ecological processes such as seed dispersal and recruitment of these plant species are of great interest to understanding evolutionary strategies that facilitate their persistence in these habitats (Clarke *et al*., 2001).

The results also showed that plot 1 in the study area had the highest species richness and was more diverse when compared with the other plots. Species richness is used in comparing between different habitats (Wiens, 1989), which agreed with that of Alamu and Agbeja (2011) that there was a high rate of deforestation due to anthropogenic activities in Nigeria and other developing countries in the world. The checklist of tree species reported in this study was envisaged to give a summary of the tree species growing in the study area. (Nodza *et al*. (2014) reported that a checklist of tree species is an attempt to give an overview of tree species in their study area and also to provide the rate of genetic depletion of the floral species. According to Raji and Babalola (2018), a frequent checklist of tree species of a particular geographical location will help to know their abundance and their distribution. Nodza *et al*. (2014) also observed that the degradation of the vegetation in their study areas resulted from the construction of infrastructural facilities and lecture theaters. Recently, an increase in the population of

staff and students who are using vehicles has prompted the construction of a car park. This resulted in continuous degradation of the vegetation in the studied area and has put the existence of the tree species in this area in a state of danger. Olowokudejo (1987) noted that the high rate of deforestation could make some plants to become extinct if proper measures were not taken. Iroko *et al*. (2009) reported that over-exploitation and replacement of vegetation with human basic infrastructural facilities have destroyed tree species. The most abundant family of tree species encountered in this study was the family Fabaceae with a percentage composition of 20.8%. Similarly, Iheyen *et al.* (2009) reported that the family Fabaceae had the highest percentage of composition in Ehor Forest Reserve, Edo State. He suggestion that this could be due to their seed dispersal mechanism. Most of the legumes dispersed their seed by wind. This may be why there are many large trees of economic importance in the Garden.

CONCLUSION

The checklist of the tree species encountered in the study area has provided an overview of the tree species growing in Obafemi Awolowo University. The floral richness between the current study and the previous survey has also been reported. However, decrease in the species richness can be prevented by controlling the indiscriminate felling of trees and other means of vegetation degradation.

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