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Floristic Studies on Herbaceous and Grass Species Growing in the University of Lagos, Nigeria

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Abstract

Rapid loss in flora diversity, changing patterns of vegetation and land use patterns in the University of Lagos Akoka campus has necessitated investigation on the herb and grass species so as to determine their compositions, structures and diversity within the area. Twenty sampling plots of 10m x 10m each were studied in five selected locations using random sampling. The samples were counted and identified using Flora of West Tropical Africa. A total of 75 taxa (herbs = 53 spp and grasses = 22 spp) belonging to 26 families and 64 genera were recorded in the area. Of all the families, Asteraceae and Euphorbiaceae had the highest number of species with seven species of herbaceous plants each. The Simpson index value was highest in locations A and D (0.98), Shannon index value was highest in location A (3.96); while evenness value was highest in location E (0.92). Among the herbs, *Asystasia gangetica* had the highest importance index value (40.22%), while *Panicum maximum* had the highest importance value (34.87%) among the grasses. The results revealed restricted distribution of the species in specific areas probably due to development of infrastructural facilities in the study area. It is recommended that the species with low importance values should be given priorities in terms of conservation policies for future purposes by planting them and protecting their habitats.

Keywords: Conservation; Species composition; UNILAG flora; Urbanization;

Introduction

Nigeria vegetation comprises of three main vegetation types, namely forest (rain forest, fresh water swamp forest and mangrove swamp forest), Savannah (Guinea, Sudan and Sahel savannah) and montane vegetation. These vegetation types are found widely distributed across the geopolitical zones of the country and are greatly influenced by varying climatic conditions (Nodza et al. 2014). The University of Lagos is located in the coastal mangrove area of the south western zone of Nigeria. At inception, four vegetation types existed in the University; viz: fresh water swamp forest near the mainland, salt water (mangrove) swamp, sandy plain on the north, and upland vegetation; with the mangrove covering 50% of the land area. However, Orebamjo and Njoku (1970) reported that rapid urbanization from the 1970s onwards and increase in the student population has fostered the development of several infrastructural facilities in the area leading to clearing of the natural vegetation. Similarly, Nodza et al. (2014) documented

predominantly sandy plain/open vegetation in the area as most of the mangrove vegetation has been cleared for structural development. Consequently, the vegetation of the area largely comprises of exotic trees as well as herbaceous and graminoid species.

Herbaceous plants (forbs) are plants without woody stems above ground (Mongkhonsin et al. 2019); they are broad-leaved flowering plants and are not grass-like (Diggs et al. 1999, Siebert and Dreber 2019), while grasses are graminoids (monocot angiosperms) with narrow leaves growing from the base (Cope and Gray 2009). Herbaceous and graminoid species exhibit cosmopolitan distribution; they could be found in disturbed forest (Mohammed et al. 2015), Savannah (Pokorny et al. 2004, Keddy et al. 2009, Mohammed et al. 2015) and crop land (Gibson 2009). They constitute up to 60% of the plants species diversity in our ecosystem (Clark 2004, Mohammed et al. 2015). Due to their diverse nature, they serve as habitats for a wide array of animals, basis for complex food webs (Smith 2011, Blair et al. 2014, Choy et al. 2015, Andarwulan et al. 2015, Mohammed et al. 2015, Yang et al. 2015) and are involved in the stabilization of topsoil, improving water penetration into soils as well as water holding capacity of the soil (Mashwani et al. 2010, Mohammed et al. 2015, Ford et al. 2016, Gilardelli et al. 2017). Despite these huge ecological prominence and significant proportions to plant biodiversity, they remain understudied and are usually not included in most floristic studies (Batalha and Martins 2002, Linares-Palomino et al. 2008, Moro et al. 2014, Queiroz et al. 2015).

Floristic studies are essential in providing information on plant biodiversity in an ecosystem (Addo-Fordjour et al. 2009, Todou et al. 2017). They are fundamental in drawing the attention of stakeholders to understand the ecosystem services of the biodiversity assemblage and undertake appropriate conservation measures. Although there have been elaborate floristic studies on the woody species of the University of Lagos (Orebamjo and Njoku 1970, Nodza et al. 2014, Ogunyebi et al. 2018), species-rich and widely distributed families of herbaceous species and grasses were not generally mentioned. Apart from the works of Oni and Ndiribe (2019), no other published floristic paper on herbaceous species is available for University of Lagos. Therefore, this study aims to provide information on composition, distribution and diversity of the herbaceous and grass species growing in the University of Lagos as a guide to improve conservation efforts towards ensuring their continual existence.

Materials and Methods

Study area

This study was carried out in the University of Lagos (Akoka campus), Yaba, Lagos, South-western Nigeria. The site was established in 1962, located between 6°30'5.99"N and longitude 3°23'5.99"E and it occupies an area of about 1000acres (Orebamjo and Njoku 1970). University of Lagos is surrounded by four vegetation types; fresh water swamp, mangrove swamp, sandy plain vegetation on the north and east, and the upland vegetation (Orebamjo and Njoku 1970, Nodza et al. 2014). The terrain is undulating with various fresh water channels and creeks passing across at different locations and about 50% of the landmass was dominated by mangrove swamps. This swamp harbours a range of euryhaline communities subjected to the alternating influence of fresh water flood during the wet months (June–October). However, in recent times, the vegetation of this area has been cleared due to anthropogenic human activities, leaving derived forest and open vegetation (Nodza et al. 2014). In the north and east lies the brackish lagoon water which supports a typical terrestrial habitat, and experiences less human disturbance while in the south and west lies the fresh water where the soil is highly rich and supports a rich flora which is highly favoured by the climate type. The experimental study was carried out on plots across these vegetation types due to their richness in grass and herbaceous species as

documented by Orebamjo and Njoku (1970) and Nodza et al. (2014).

Vegetation sampling and sample identification

Twenty (20) plots of 10m x 10m were established in five locations (A, B, C, D and E) in the study area (Figure 1). Within the quadrat, four sub-quadrats of 1m x 1m each were established. These plots were laid out and sampled for herbaceous species and grasses.

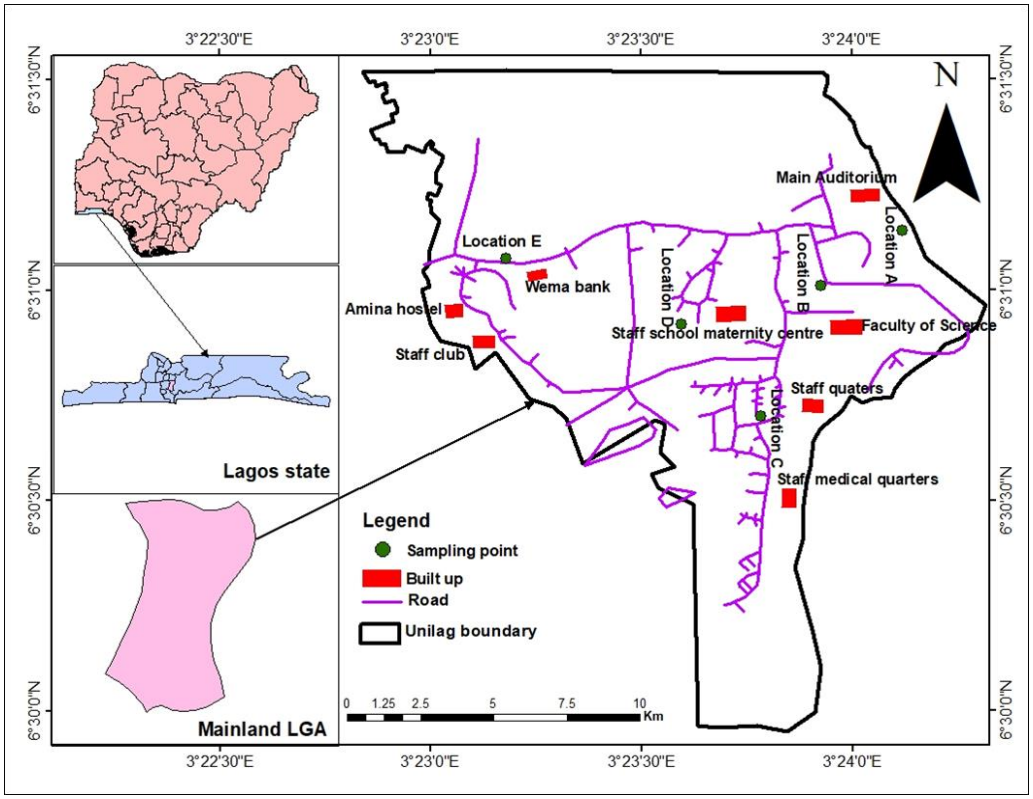

Figure 1: Map of University of Lagos (Akoka) showing study sites; A, B, C, D and E.

Herbs and grasses were inventoried within the 1m x1m sub-quadrat, the number per plot was recorded and vouchers were prepared. All plant specimens encountered were identified to species level on the field using flora of west tropical Africa (Hutchinson and Dalziel 1954) and comparing the collected plant specimens with photographs and illustrations (Akobundu and Agyakwa 1998). Further authentication of the samples was done at the Lagos University Herbarium (LUH) in the Department of Botany University of Lagos. Classification into families was based on APG III (Angiosperm Phylogeny Group 2009) and Ayodele and Yang (2012).

Growth habit: The plants recorded from the study area were classified into growth forms (herb, grass, creeper and climber) following Queiroz et al. *(*2015).

Data analysis: Data obtained on the herbs and grasses within the study area were analyzed using several indices as follows:

Density and frequency of occurrence of the herbs and grasses were determined following Ikyaagba et al. (2015).

a) Density: This expresses the numerical strength of a species. It is given as;

$$\text{Density} = \frac{\text{Total number of individuals of a species in quadrat}}{\text{Total number of quadrats studied}}$$

b) Frequency (%): This expresses the degree of occurrence of individual species in an area. It is given as;

$$\text{Frequency (\%)} = \frac{\text{Number of plots in which a species occurred}}{\text{Total number of plots studied}} \times 100$$

Importance value index: This index was used to determine the overall importance of each species in the study area following Mohammed et al (2015). It involves the summation of relative frequency and relative density.

a) Relative density: This expresses the numerical strength of a species in relation to the total number of individuals of all species studied. It is given as;

$$\text{Relative density} = \frac{\text{Density of individual species}}{\text{Total density of all species}} \times 100$$

b) Relative frequency: This expresses the degree of occurrence of individual species in relation to the total number of individuals species studied. It is given as;

$$\text{Relative frequency} = \frac{\text{Frequency of individual species}}{\text{Total frequency of all species}} \times 100$$

Species richness, diversity and dominance indices: The species richness of herbs and grasses studied was determined by Margalef's index of richness (Magurran 2004). Given as;

a) Margalef's index of richness (D_{mg})

$$\text{Dmg} = \frac{(S-1)}{\text{In N}}$$

Where: S = total number of species, and
N = total number of individual species in a sampling plot.

Species diversity and dominance were evaluated using Shannon's Wiener diversity index (Nodza et al. 2014) and Simpson's index of dominance.

a) Shannon's Wiener diversity index;

$$H' = -\sum_{I=1}^{S} \text{PilnPi}$$

Where: H' = Shannon-Wiener index, S = number of species, P_i = proportion of individual or abundance of i^{th} species expressed as a proportion of the total number of individual of all species, and ln = log base 10.

b) Simpson's index of dominance (D)

$$D = \sum(Pi)2$$

Where; P_i = the proportion of important value of the i^{th} species, and
D = Simpson index of dominance.

Species equitability or evenness index

Species equitability or evenness index was used to calculate how evenly the species were distributed within the study area (Atsbeha et al. 2015).

a) Species equitability or evenness index

$$J = \frac{H'}{H' \max}$$

Where; J = Pielous evenness, H' = Shannon diversity index, and
H' max = In S (number of species).

Results

In the present study, a total of 75 plants species were recorded, of these, 53 species were herbs belonging to 25 families, and 22 species were grasses (Poaceae). The maximum diversity of species was contributed by the family Poaceae (22 spp.), Asteraceae (7 spp.), Euphorbiaceae (7 spp.), Fabaceae (5 spp), followed by Acanthaceae, Convolvulaceae, Portulacaceae and Amaranthaceae (3 species each). Commelinaceae, Cucurbitaceae, Malvaceae and Oxalidaceae had (2) species each, whereas 14 families were monotypic, represented by single species (Table 1). Furthermore, 39% of the plant species encountered were herbs, 32% were grasses, 21% creepers and 8% climbers (Figure 2).

Table 1: Total number of species per family encountered in the study area

S/N	Family	No of species	Species (%)
1	Acanthaceae	3	4.00
2	Aizoaceae	1	1.33
3	Amaranthaceae	3	4.00
4	Asteraceae	7	9.33
5	Cleomaceae	1	1.33
6	Commelinaceae	2	2.67
7	Convolvulaceae	3	4.00
8	Cucurbitaceae	2	2.67
9	Euphorbiaceae	7	9.33
10	Lamiaceae	1	1.33
11	Fabaceae	5	6.67
12	Loganiaceae	1	1.33
13	Malvaceae	2	2.67
14	Melastomataceae	1	1.33
15	Nyctaginaceae	1	1.33
16	Onagraceae	1	1.33
17	Oxalidaceae	2	2.67
18	Passifloraceae	1	1.33
19	Piperaceae	1	1.33
20	Plantaginaceae	1	1.33
21	Poaceae	22	30.33
22	Polygonaceae	1	1.33
23	Portulacaceae	3	4.00
24	Rubiaceae	1	1.33
25	Scrophulariaceae	1	1.33
26	Urticaceae	1	1.33

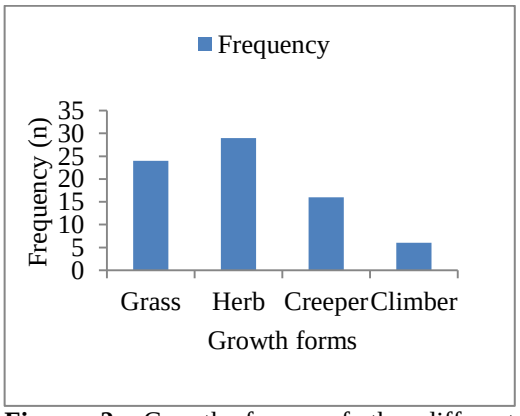

Figure 2: Growth forms of the different species encountered within the University of Lagos, Akoka campus.

The diversity of the plants showed that location A had the highest number of species (58) and highest diversity (Shannon_H'=3.96), while location D was observed as the second largest in terms of species diversity (Shannon_H' = 3.82), however, location B and E had the same number of species (41) and (41), respectively. Locations A and D had the highest species dominance (Table 2).

Table 2: Diversity of grasses and herbaceous plants measured at the study area

	Location A	Location B	Location C	Location D	Location E
No of individuals	114	92	108	110	103
No of species	58	41	50	52	41
No of families	24	21	20	19	11
Shannon_H'	3.96	3.61	3.78	3.82	3.63
Simpson_1-D	0.98	0.97	0.97	0.98	0.97
Evenness e^H/S	0.91	0.90	0.88	0.88	0.92
Margalef, d	12.03	8.85	10.47	10.85	8.63

Although location A had the highest species richness (12.03), locations B, C and E had the same dominance of 0.97 each. However, location E had the highest evenness value of 0.92 and this implies that the distribution of the species was highest at this site. The herbaceous plant with highest relative frequency was *Asystasia gangetica* with 18.17%, revealing that it was the herbaceous plant with most occurrences at each of the study locations and occurred mostly in location B (4.35%) (Table 3).

The grass, *Eleusine indica* had the highest relative frequency (16.26%) and was widely distributed in all the studied plots (Table 3). The lowest relative frequencies were recorded on *Dissotis rotundifolia* (0.88%) and *Momordica charantia* (0.88%). This showed that these two species had the least occurrence

among the 20 plots studied in various locations. This could be as a result of their adaptation to only moist and shady places with loamy soil. *Antigonon leptopus* and *Hewittia malabarica* were climbers found growing close to taller plants including shrubs, while *Antigonon leptopus, Momordica charantia* and *Trianthema* sp. were the least in terms of relative density with values 0.49%, 0.48% and 0.49%, respectively (Table 3). The lowest relative frequencies were recorded for *Acroceras zizanioides* (0.91%), *Digitaria* sp. (0.88%) and *Pennisetum polystachion* (0.91%), while *Axonopus compressus* had highest value (19.56%) in terms of relative density (Table 3).

Asystasia gangetica had the highest importance value index (40.22%) of the herbs in the entire study area, while *Panicum maximum* was the grass species with the highest importance index value (34.87%). The herb species having the least index value (less than 2) included *Antigonon leptopus* (1.42%), *Hewittia malabarica* (1.99) and *Momordica charantia* (1.34%); while grass species having the least index value (less than 2) included *Acroceras zizanioides* (1.97%) and *Pennisetum polystachion* (1.97%) (Table 3).

Table 3: Relative frequency, density and importance value index of non woody herbaceous plants and grasses encountered in the study area

Species	Total relative frequency (%)	Total relative density (%)	Total importance value index (%)
Acalypha frimbriata Schumach&Thonn.	11.50	8.58	19.98
Acroceras zizanioides (Kunth) Dandy.	0.91	1.06	1.97
Ageratum conyzoides L.	1.75	5.01	6.76
Alternanthera sessilis (L.) DC.	16.4	17.3	33.67
Amaranthus hybridus L.	3.75	2.11	5.86
Aneilema sp.	1.81	1.53	3.34
Antigonon leptopus Hook & Arn.	0.93	0.49	1.42
Aspilia africana (Pers.) C.D. Adams.	3.79	2.62	6.41
Asystasia gangetica (L.) T. Anders.	18.2	22.1	40.22
Axonopus compressus (Sw.) P Beauv.	12.1	19.6	31.62
Boerhavia coccinea Mill.	5.6	4.22	9.82
Chloris pilosa Schmach.	6.61	6.45	13.06
Chrysopogon aciculatus (Retz.) Trin.	6.55	6.33	12.88
Cleome rutidosperma DC.	6.80	6.89	13.69
Commelina erecta L.	11.40	11.1	22.54
Croton lobatus L.	5.44	3.99	9.43
Cymbopogon citratus (DC.) Stapf.	1.84	0.98	2.82
Cynodon dactylon (L.) Pers.	9.56	10.8	20.31
Dactyloctenium aegyptium (L.) P. Beauv.	7.36	6.8	14.16
Desmodium scorpiurus (Sw.) Desv.	8.33	6.8	15.13
Desmodium triflorum (L.) DC.	12.5	19.1	31.51
Digitaria sanguinalis (L.) Scop.	3.79	2.71	6.5
Dissotis rotundifolia (Sm.) Triana.	0.88	1.04	1.92
Echinochloa colona (L.) Link.	2.17	1.86	4.03
Eclipta alba (L.) L.	1.97	1.07	3.04
Eleusine indica (L.) Gaertn.	16.3	17.2	33.41
Emilia praetermissa Milne-Redhead.	11.4	9.79	21.17
Eragrostis tenella (L.) P Beauv.	5.48	4.06	9.54
Euphorbia heterophylla L.	3.75	3.17	6.92

Euphorbia hirta L.	5.57	4.83	10.4
Euphorbia hyssopifolia L.	9.60	7.12	15.66
Euphorbia thymifolia L.	12.5	17.1	29.54
Gomphrena celosioides Mart.	14.40	17.7	32.12
Hewittia malabarica (Ls.) Suresh	0.93	1.06	1.99
Indigofera spicata Forssk	4.72	4.23	8.95
Ipomoea carica (L.) Sweet	17.20	17.2	35.44
Ipomoea involucrata Beauv.	10.60	7.71	18.32
Laportea aestuans (L.) Chew.	7.65	7.97	15.62
*Leersia oryzoides (*L.*) Sw.*	2.00	1.08	3.08
Leptocholoa chinensis (L.) Nees.	13.10	12.4	25.46
Lindernia crustaceane (L.)F. Muell.	3.05	3.49	6.54
Ludwigia polycarpa L.	2.00	1.76	3.76
Luffa cylindrical (L.) Roem.	2.02	1.08	3.1
Malvastrum coromandelianum (L.) Garcke.	2.76	2.12	4.88
Mimosa pudica L.	11.30	12.2	23.5
Mimosa quadrivalvisvar. Leptocarpa (DC.) Barneby	5.60	4.18	9.78
Momordica charantia L.	0.88	0.48	1.36
Nelsonia canescens (Lam.) Spreng.	17.20	16.8	34.01
Oldenlandia corymbosa L.	7.70	5.88	13.58
Oxalis corniculata L.	6.44	9	15.44
Oxalis stricta L.	3.69	2.03	5.72
Oplis menusburmanii (Retz.) P Beauv.	2.66	3.55	6.21
Panicum maximum Jacq.	16.20	18.7	34.87
Panicum laxum Sw.	8.75	7.24	15.99
Paspalum conjagatum Berg.	4.60	3.79	8.39
Paspalum scrobiculatum L.	5.69	3.76	9.45
Paspalum vaginatum Sw.	3.05	4.07	7.12
Passiflora foetida L.	3.59	2.6	6.19
Pennisetum polystachion (L.) Schult.	0.91	1.06	1.97
Peperomia pellucida (L.) HB & K	2.68	3.07	5.75
Portulaca oleracea L.	5.76	6.1	11.86
Portulaca quadrifida L.	1.81	2.59	4.4
Phyllanthus amarus Suhum & Thonn.	16.1	15.3	31.42
Ruellia tuberosa L.	1.81	2.58	4.39
Sacciolepis africana C.E. Hubbard & Snowden.	1.09	1.27	2.36
Setaria barbata (Lam.) Kunth	3.05	2.9	5.95
Scoparia dulcis L.	3.92	5.24	9.16
Sida acuta Burm.F	4.61	4.17	8.78
Solenostemon monostachyus (P. Beauv) Briq.	3.63	3.08	6.71
Spigella anthelmia L.	14.5	13.4	27.66
Synedrella nodiflora (L.) Gaertn.	4.83	3.66	8.49
Talinum triangulare (Jacq.) Wild.	4.50	3.65	8.15
Tridax procumbens L.	13.20	16.3	29.49
Trianthema sp. L.	0.93	0.49	1.42
Vernonia cinerea (L.) Lesss	12.40	9.69	22.1

Discussion

Knowledge on species diversity and distribution patterns is important for density evaluation and projection of ecosystem of an area (Saikia et al. 2017). Our study recorded 75 species of non woody herbaceous species and

grasses, which is in contrast to Oni and Ndiribe (2019) who recorded only 47 species within the same study area. The Poaceae was the largest family recorded in the study area with 22 spp; this agrees with Oni and Ndiribe (2019). This could be as a result of their ecological flexibility, resilience to disturbance, long distance seed dispersal and capacity to grow in environments with limited soil moisture (Soreng et al. 2015, Linder et al. 2018). The family Asteraceae and Euphorbiaceae were the largest families of herbs encountered; this is similar to the report of Oni and Ndiribe (2019). Also, our report is consistent with similar studies by Iwara et al. (2014) in Calabar where they recorded Asteraceae and Poaceae as the most dominant family of the herbs studied and Sanyaolu (2015) who recorded large population of Poaceae in disturbed areas within the Lagos state polytechnic Ikorodu campus. The herbs and grasses were unevenly distributed within the study area. Location A, which is around the botanic garden, had the highest number of species and diversity compared to other locations. This could be due to less buildings and human activities within this location. In terms of growth habits, the herbs were the dominant species in most residential areas, whereas the grasses were dominant in non-residential areas. *Asystasia gangetica* was the herbaceous plant with the highest relative frequency in each of the study locations. The higher density and randomized distribution of this species within the study area could be as a result of the species ability to adapt to a wide range of environmental conditions and tolerance to drought, full sun to partial shade, direct exposure to salt spray, and a variety of soils, including alkaline soils. The lowest relative frequencies were recorded for *Dissotis rotundifolia* (0.88%) and *Momordica charantia* (0.88%). This showed that these two species occurred less in all the 20 plots studied. Their clumped distribution could be as a result of their adaptation to moist and shady places with loamy soil. Also, *Antigonon leptopus* and *Hewittia malabarica* were the least in terms of relative frequency and relative density. Their low distribution might have resulted from an adaptation to dry and shady places (Iwara et al. 2014). The grass, *Eleusine indica* had the highest relative frequency (16.26%) in location D and widely distributed in all the studied plots. Its high relative frequency might have resulted from the presence of seeds that could easily be dispersed together with its rapid regeneration as well as the ability to survive well in varying soil types. The lowest relative frequencies were recorded for *Acroceras zizaniodides* (0.91%), *Digitaria* sp. (0.88%) and *Pennisetum polystachion* (0.91%). These grasses had low distribution and each of them was found in location D. *Axonopus compressus* had highest value (19.56%) in terms of relative density. This might have resulted from buried seeds of this species which survived in the soil for longer periods of time (Adkins et al. 2002, Samedani et al. 2013). This species germinates best with sunlight, optimum temperature and moisture; shedding its rhizomes to form large, interconnected stands with extensive root system and providing a rapid growth for the species (Samedani et al. 2013).

The importance value index indicates the extent of dominance of a species in the study area. It is also a measure used to assess the overall significance of a species (Abdullahi 2011). The herb, *Asystasia gangetica* had the highest importance value index (40.22%) in the entire study area while *Panicum maximum* had the highest importance index value (34.87%) of the grass species. The herb species having the least index value (less than 2) included *Antigonon leptopus* (1.42%), *Hewittia malabarica* (1.99%) and *Momordica charantia* (1.34%); while grass species having the least index value (less than 2) included *Acroceras zizanioides* (1.97%) and *Pennisetum polystachion* (1.97%). The lowest importance value indices of these plants might be due to the extensively cleared vegetation through construction of buildings at the study area, since they are better adapted to moist and shady places with high organic matter content. In this study, sand filling for urbanization was observed to be the major threat facing the

herbaceous and grass species growing in the study area. This has consequently led to a decrease in the diversity of herbs and grasses within the study area. This corroborates the report of Orebamjo and Njoku (1970) and Iwara et al. (2014) who affirmed that the population of several indigenous species present in the study area was adversely affected, especially *Ipomoea stolonifera*, *Eragrostis linearis*, *Cyperus tenax*, among others**.**

Conclusion

The study area was predominated by *Asystasia gangetica* and *Panicum maximum*, having highest importance value indices among the herbs and grasses, respectively. *Momordica charantia* was the least dominant among the herbs, while *Acroceras zizanioides* and *Pennisetum polystachion* were the least dominant among the grasses, hence the need to foster the conservation of these plants. This study generated baseline data on the floristic composition of the herbaceous plants and grasses growing on the Akoka Campus of the University of Lagos. This would serve as a guide to the systematists, ethnobotanists, amongst several others researchers who are interested in identifying plants within this area.

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Declaration of Interest

The authors declare no conflict of interest.

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