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Distribution and Conservation Status of Plants' species in the Botanical Garden and Arboretum domiciled in University of Uyo, Nigeria.

[1]Ezekiel, A. G., [1]Umoh, O. T., [2]Mbong, E. O*., [1]Ntukidem, A. U. and [1]William, R. A.

[1]Department of Botany and Ecological Studies,
University of Uyo, Akwa Ibom State.

[2]Department of Environmental Biology,
Heritage Polytechnic, Eket,
Akwa Ibom State

Email: mbongemem@yahoo.com

Abstract

This research assessed the plant species composition, distribution and International Union for the Conservation of Nature (IUCN) conservation status of plants in University of Uyo botanical garden and arboretum using systematic sampling technique. The species were sampled in 10 x 10 m quadrats spaced at least regular intervals of 20 m from each quadrat. Thirty-one and thirty-eight species were encountered in the arboretum and botanic garden respectively. In terms of the frequency, Chromolaena odorata and Nauclea diderichii had the highest values (75%), while Acanthus montanus, Anthocleista djalonensis, Anthonotha macrophylla, Baphia nitida, Barteria nigritiana, Carpolobia lutea, Ceiba pentandra, Cnestis ferruginea, Entandrophragma utile, Hura crepitans, Lonchocarpus griffoneonus, Rauvolfia vomitoria, Senna siamea, Tamarindus indica, Tectona grandis and Treculia africana had the least frequency (25% each). For the density, Nauclea diderichii had the value of 250±15.30 st/ha. In the botanic garden, Ageratum houstonianum, Alchornea cordifolia, Chromolaena ordorata and Croton hirtus had the highest frequency (100%) while Allamanda cathartica, Asystasia gangetica, Bambusa vulgaris, Caladium bicolor, Centrosema virginianum, Cnestis ferruginea, Culcasia scandens, Cyathula prostrata, Desmodium scorpiurus, Emilia sonchifolia, Heliconia psittacorum, Ipomea involucrata, Lagenaria sphaerica, Mimosa pudica, Nephrolepis bisserata, Panicum sp., Pentaclethra macrophylla, Plumeria rubra, Polyalthia longifolia, Pteridium aquilinum, Scoparia dulcis, Senna siamea, Sesamum radiatum and Sida acuta had the least frequency (33.33%). The vegetation of both sites indicated variation in composition of trees, shrubs, herbs, climbers and ferns. These heterogeneities may be a pointer to their varying adaptation levels and differential responses of plant species to pedological and anthropogenic influences.

Keywords: Arboretum, Botanical garden, Plant species, conservation status and density.

INTRODUCTION

There are different definitions about botanic gardens. According to Kuzenanov and Sizykh (2006), botanic gardens are innovative institutions that can help local people in many ways via the introduction of new economically valuable plant species, a creation of friendly and secure environment and improvement and beautification of settlement, a city greening, a restoration and a repatriation of rare plants, the "horticultural therapy", a continuous

*Author for Correspondence

education and public awareness and so on etc. The world first university botany garden was created in Padua in 1545, which makes the Botanical garden of Padua the oldest surviving example of this type of cultural property (Var, 2013). Botanical gardens are living plant museums where a combination of herbaceous and woody plants can be observed and endangered plant species are protected and promoted and with the help of research on plants, visitors can be trained directly or indirectly and recreational activities are offered for the public (Var, 2013, Okon, *et al.*, 2021). Botanical gardens are a special category of garden distinctive for their scientific basis, inspiration planting, commitment to the plant conservation and involvement in environment education (Oldfields, 2013). Botanical gardens are uniquely positioned to help address the issues relevant to restoring ecosystems. Botanical garden can broadly be called a living repository or refugia of plants arranged and maintained on some scientific basis and where the collections are usually labelled or marked for identification (Okon, *et al.*, 2021).

The botanical gardens conservation international, BGCI (2021) defines a botanical garden as any "institution holding documented collections of living plants for the purpose of scientific research, conservation, display and education (Jackson *et al.,* 2000). They provide knowledge and expertise in plant taxonomy, horticulture, biodiversity inventory, conservation biology, restoration ecology and ethno-botany which are key element for achieving successful restoration. Botanical gardens also collectively serve as a global repository for documented plants maintained in living genetic individual of plants maintained in living collection or seed banks (Corllet, 2016). BGCI (2021) opined that botanical garden brings the understanding necessary to ensure that restoration leads to adequate taxonomic diversity and incorporates appropriate genetic provenance by utilizing knowledge gained from these collections and combined with landscape knowledge from field surveys and ecological research.

An arboretum refers to a botanical collection composed exclusively of trees, a place where many varieties of trees are grown for research, educational and ornamental purposes. More commonly, a modern arboretum is a botanical garden containing living collections of woody plants and is intended at least in part for scientific study (Paul, Charles and Stephen, 2011, Mbong, *et al.*, 2020a). They are focused on beauty, education, research and the opportunity to observe and admire nature (Okon, *et al.,* 2021).

Vegetation strongly affects soil characteristics, including soil volume, chemistry, and texture, which feed-back to affect various vegetation characteristics, including productivity, structure, and floristic composition (Brant *et al.,* 2006). Products of vegetation including tissues of both the aboveground litter and below-ground root detritus are the main sources of soil organic matter (SOM), which influences physicochemical characteristics of soils such as the pH, water-holding capacity (WHC), texture, and nutrient availability (Ogbemudia and Mbong, 2013 and Mbong *et al.,* 2020b). This research was aimed at authentication of the current status of phytodiversity within the University of Uyo botanical garden and arboretum. This will serve as information that can be used in proper management of botanic garden and arboretum.

MATERIALS AND METHODS

Study Area

This study was carried out in the arboretum of the Department of Forestry and Natural Environmental Management and Botanical garden of Department of Botany and Ecological Studies, University of Uyo. The arboretum lies within the Annex campus between latitudes 4°35′ and 5°35′N and longitudes 7°35′ and 8°25′E while the botanical garden lies within the

main campus of the University between latitudes 5°37′ and 5º42′N and longitudes 7º96′ and 7°99′E beside Botany Department on the other side of the University's main drive.

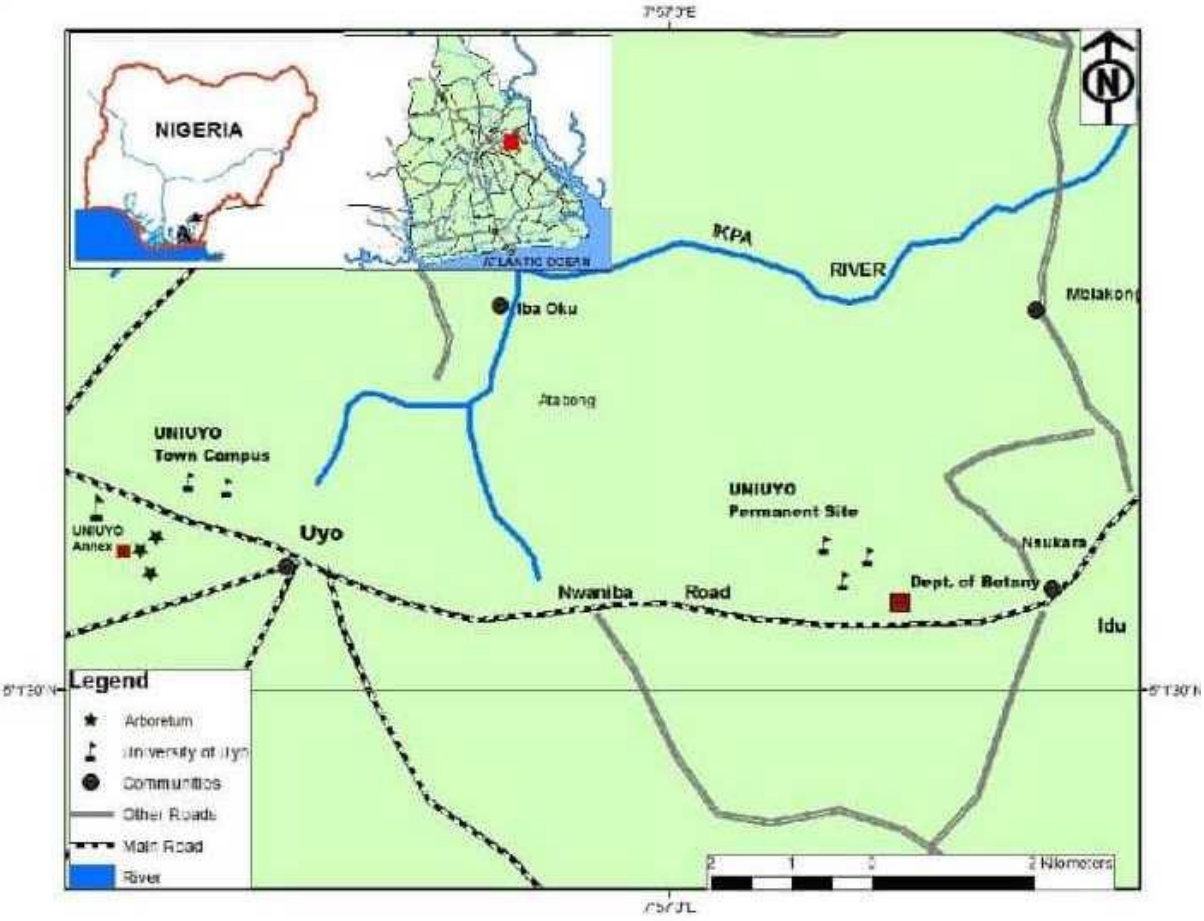

Fig. 1 Map of Study Area

Vegetation and Soil Sampling

Vegetation was sampled using 10 x 10 m quadrats for each vegetation unit. In each quadrat, plants were identified to species level and their frequency and density were obtained by enumeration. Unknown plant species were collected for identification and confirmation from voucher specimens in Botany and Ecological Studies Departmental Herbarium. Conservation status of each plant was enumerated using IUCN (2021) and Natureserve databases (2020).

Statistical Analysis

Frequency and growth forms (habit) distribution of plant encountered in terms of trees, shrubs, herbs, ferns and climbers in the two locations are presented using descriptive statistics in form of tables, percentages and bar chat according to the methods of Mbong, *et. al.* (2020c) and Bassey, *et al.,* 2023).

RESULTS

Floristic composition of the arboretum

The floristic composition of the arboretum is presented in Table 1. A total of thirty one species were encountered. In terms of the frequency, *Chromolaena ordorata* and *Nauclea diderichii* had

the highest values of 75% respectively, while *Acanthus montanus*, *Anthocleista djalonensis*, *Anthonatha macrophylla*, *Baphia nitida*, *Barteria nigritiana*, *Carpolobia lutea*, *Ceiba pentandra*, *Cnestis ferruginea*, *Entandrophragma utile*, *Hura crepitans*, *Lonchocarpus griffneonus*, *Rauvolfia vomitoria*, *Senna siamea*, *Tamarindus indica*, *Tectona grandis* and *Treculia africana* had the least frequency value of 25 % each. For the density, *Nauclea diderichii* had the value of 250±15.30 st/ha while *Anthocleista djalonensis* (33.33±1.30 st/ha), *Anthonotha macrophylla* (33.33±1.06 st/ha), *Baphia nitida* (33.33±1.00 st/ha), *Barteria nigritiana* (33.33±0.98 st/ha), *Carpolobia lutea* (33.33±1.11 st/ha), *Ceiba pentandra* (33.33±0.96 st/ha), *Cnestis ferruginea* (33.33±1.02 st/ha), *Entandrophragma utile* (33.33±0.85 st/ha), *Hura crepitans* (33.33±0.79 st/ha), *Lonchocarpus griffneonus* (33.33±1.02 st/ha), *Rauvolfia vomitoria* (33.33±1.00 st/ha), *Senna siamea* (33.33±1.34 st/ha) and *Tamarindus indica* (33.33±0.85 st/ha) were also recorded.

The floristic composition of the botanic garden is presented in Table 2 *Ageratum houstonianum*, *Alchornea cordifolia*, *Chromolaena ordorata* and *Croton hirtus* had the highest frequency of 100% respectively, while *Allamanda cathartica*, *Asystasia gangetica*, *Bambusa vulgaris*, *Caladium bicolor*, *Centrosema virginianum*, *Cnestis ferruginea*, *Culcasia scandens*, *Cyathula prostrata*, *Desmodium scorpiurus*, *Emilia sonchifolia*, *Heliconia psittacorum*, *Ipomea involucrata*, *Lagenaria sphaerica*, *Mimosa pudica*, *Nephrolepis bisserata, Panicum* sp., *Pentaclethra macrophylla*, *Plumeria rubra, Polyalthia longifolia, Pteridium aquilinum*, *Scoparia dulcis*, *Senna siamea*, *Sesamum radiatum* and *Sida acuta* had the least frequency value of 33.33%. For density, *Croton hirtus* had the highest density value of 300±12.36 st/ha while *Lagenaria sphaerica* (1.00±0.0006 st/ha), *Senna siamea* (1.00±0.004 st/ha), *Emilia sonchifolia* (1.00±0.005 st/ha), *Polyalthia longifolia* (1.00±0.009 st/ha) and *Plumeria rubra* (1.00±0.04 st/ha) had the least density values. Figure 1 and 2 shows the distribution of species by families and growth forms respectively. The family with the highest taxa distribution was Fabaceae (6) in both Arboretum and botanic garden. Also, there were more shrubs, herbs and climbers in the botanic garden while there were more tree species in the arboretum comparing both vegetation forms (Figure 3 and 4)

Table 1: Floristic composition of the arboretum

Plant species	Family	Habit	Frequency (%)	IUCN Status
Acanthus montanus (Nees) T. Anderson	Acanthaceae	Herb	25	LC
Alchornea cordifolia Mull. Arg.	Euphorbiaceae	Shrub	50	LC
Anchomanes difformis (Bl.) Engl	Araceae	Herb	50	LC
Anthocleista djalonensis A.Chev.	Loganiaceae	Tree	25	LC
Anthonotha macrophylla P. Beauv.	Fabaceae	Shrub	25	LC
Bambusa vulgaris Schrad. Ex J.C. Wendl.	Poaceae	shrub	50	NE
Baphia nitida Lodd.	Fabaceae	Tree	25	LC
Barteria nigritiana Hook. f.	Passifloraceae	Tree	25	LC
Brachystegia eurycoma Harms	Fabaceae	Tree	50	LC
Caladium bicolor (Aiton) Vent.	Arecaceae	Herb	50	NE
Carpolobia lutea G. Don	Polygalaceae	Shrub	25	LC
Ceiba pentandra (L.) Gaertn.	Malvaceae	Tree	25	LC
Chromolaena ordorata (L.) R.M.King & H.Rob.	Asteraceae	Shrub	75	NE
Chrsophyllum albidum G.Don	Sapotaceae	Tree	50	NE
Cnestis ferruginea Vahl ex DC.	Connaraceae	Shrub	25	NE
Cola argentea Mast.	Sterculiaceae	Shrub	50	NT
Costus afer Ker-Gawl.	Costaceae	Herb	50	NE
Entandrophragma utile Dawe & Sprague	Meliaceae	Tree	25	NE
Gmelina arborea Roxb.	Lamiaceae	Tree	50	LC
Gongronema latifolia (Benth.) (GL)	Apocynaceae	Climber	50	NE
Hura crepitans L.	Euphorbiaceae	Tree	25	NE
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.	Irvingiaceae	Tree	50	NT
Lonchocarpus griffneonus	Fabaceae	Tree	25	NE
Nauclea diderichii (De Wild. & T. Durand) Merrill	Rubiaceae	Tree	75	NE
Palisota hirsuta (Thunb.) K. Schum.	Commelinaceae	Herb	50	LC
Rauvolfia vomitoria Afzel.	Apocynaceae	Shrub	25	LC
Senna siamea (Lam.) Irwin et Barneby	Fabaceae	Tree	25	LC
Syngonium angustatum	Araceae	Herb	50	NE
Tamarindus indica L.	Fabaceae	Tree	25	LC
Tectona grandis L.f.	Lamiaceae	Tree	25	EN
Treculia africana Decne.	Moraceae	Tree	50	LC

Key: LC- Least concerned;NE- Not Evaluated;EN-Endangered;NT-Near Threatened

Table 2: Floristic composition of the botanic garden

Plant species	Family	Habit	Frequency (%)	IUCN status
Ageratum houstonianum Mill.	Asteraceae	Herb	100	NE
Alchornea cordifolia Mull.Arg.	Euphorbiaceae	Shrub	50	LC
Allamanda cathartica L.	Apocynaceae	Shrub	33.33	NE
Aspilia africana (Pers.) C.D. Adams	Asteraceae	Herb	66.66	NE
Asystasia gangetica (L.) T. Anderson	Acanthaceae	Herb	33.33	NE
Bambusa vulgaris Schrad. Ex J.C. Wendl.	Poaceae	Shrub	33.33	NE
Caladium bicolor (Aiton) Vent.	Arecaceae	Herb	33.33	NE
Centrosema virginianum (L.) Benth.	Fabaceae	Herb	33.33	NE
Chromolaena ordorata (L.) R.M.King & H.Rob.	Asteraceae	Shrub	100	NE
Cnestis ferruginea Vahlex DC.	Connaraceae	Shrub	33.33	NE
Combretum zenkeri Engl. & Diels	Combretaceae	Shrub	66.66	LC
Crotolaria sphaerocarpa Perr. ex DC.	Fabaceae	Herb	66.66	NE
Croton hirtus L. Herit	Euphorbiaceae	Herb	100	NE
Culcasia scandens P. Beauv	Araceae	Climber	33.33	LC
Cyathula prostrata (L.) Blume	Amaranthaceae	Herb	33.33	NE
Desmodium scorpiurus (SW.) Desv.	Fabaceae	Shrub	33.33	NE
Elaeis guineensis J. Gaertn	Arecaceae	Tree	66.66	LC
Emilia sonchifolia (L.) DC.	Asteraceae	Herb	33.33	NE
Gloriosa superba L.	Colchicaceae	Herb	66.66	LC
Glyphea brevis (Spreng.) Monarch	Tiliaceae	Shrub	66.66	NE
Harungana madagascariensis Lam. expoir	Hypericaceae	Tree	66.66	NE
Heliconia psittacorum L.F.	Heliconiaceae	Herb	33.33	NE
Ipomea involucrata P. Beauv.	Convulvulaceae	Herb	33.33	NE
Lagenaria sphaerica (Sond.) Naudin	Cucurbitaceae	Herb	33.33	NE
Mimosa pudica L.	Fabaceae	Shrub	33.33	LC
Nephrolepis bisserata (SW.) Schott	Nephrolepidaceae	Fern	33.33	NE
Panicum sp. L.	Poaceae	Herb	33.33	-
Pentaclethra macrophylla Benth	Fabaceae	Tree	33.33	LC
Plumeria rubra L.	Apocynaceae	Tree	33.33	LC
Polyalthia longifolia (Sonn.) Thwaites	Annonaceae	Tree	33.33	NE
Pteridium aquilinum (L.) Kuhn	Dennstaedtiaceae	Fern	33.33	LC
Rauvolfia vomitoria Afzel	Apocynaceae	Shrub	66.66	LC
Scoparia dulcis Linn	Scrophulariaceae	Herb	33.33	NE
Senna siamea (Lam.) Irwin et Barneby	Fabaceae	Tree	33.33	LC
Sesamum radiatum Schumach & Thornn	Pedaliaceae	Herb	33.33	NE
Sida acuta Bunn. F.	Malvaceae	Shrub	33.33	NE
Triumfetta rhomboidea Jacq	Malvaceae Tiltaceae	Shrub	66.66	NE
Uvaria chamae P. Beauv.	Annonaceae	Shrub	66.66	LC

Key: LC- Least concerned;NE- Not Evaluated;EN-Endangered;NT-Near Threatened

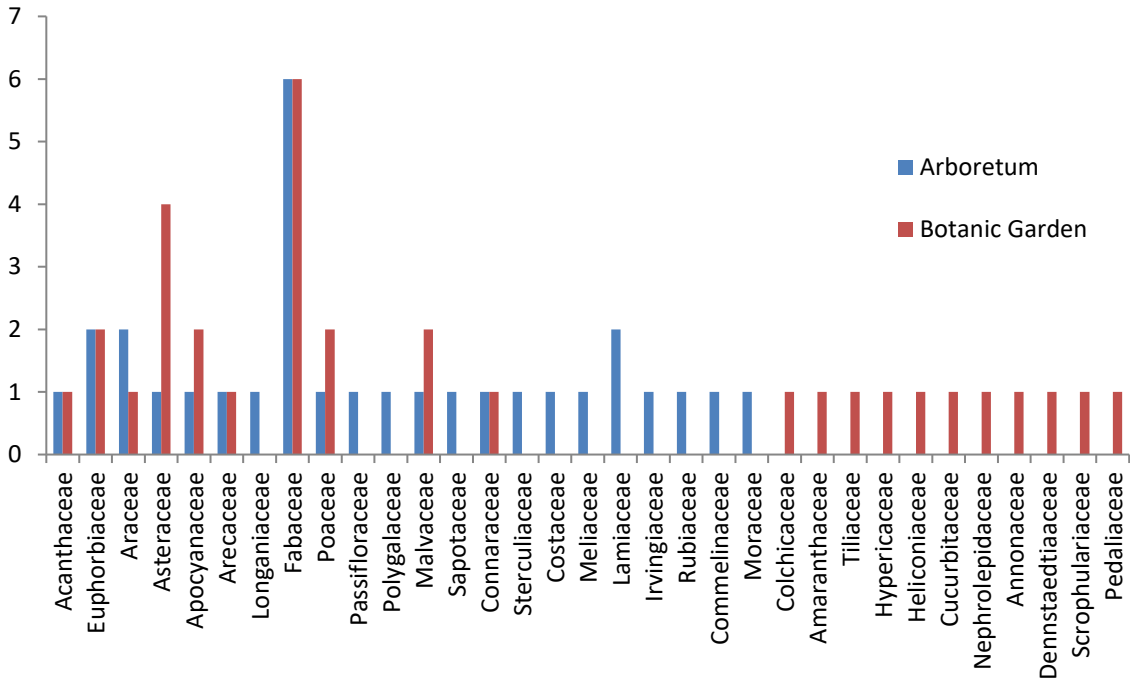

Figure 1: Species distribution by Families in study sites

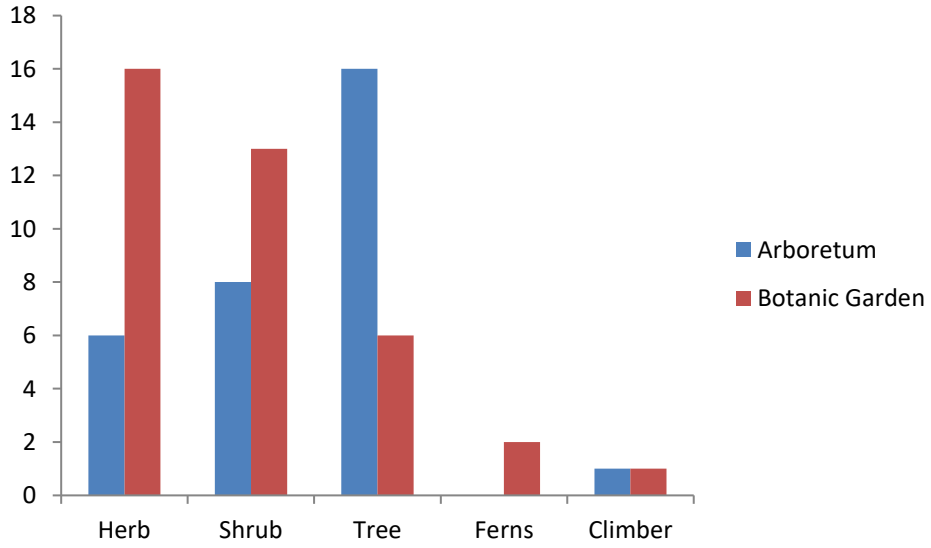

Figure 2: Species distribution by growth forms in study sites

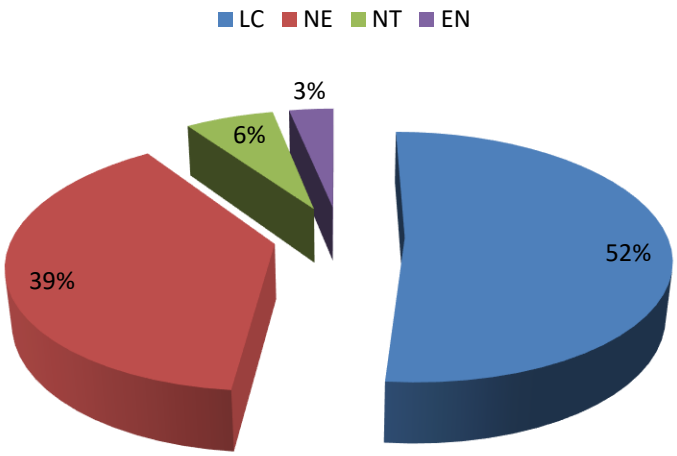

Figure 3: Species composition by conservation status in the arboretum

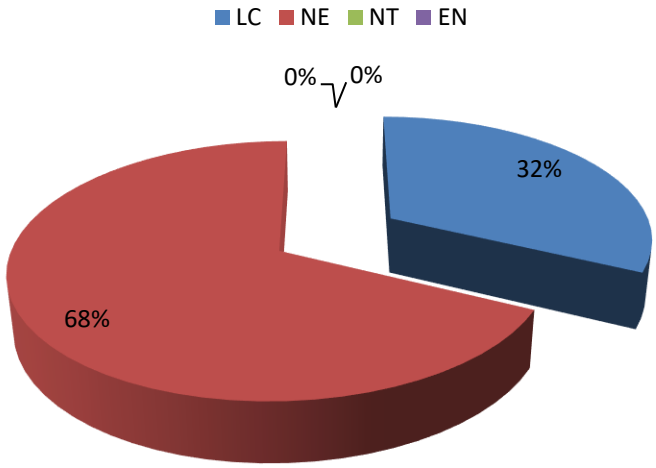

Figure 4: Species composition by conservation status in the botanical Garden

DISCUSSION

The vegetation characteristics of the two study sites showed discernible heterogeneities and variations in abundance and composition of species. These heterogeneities may be a pointer to their varying adaptation levels and differential responses of plant species to pedological factors (Mbong, *et al.,* 2020a). This also corroborates with the findings of Ogbemudia and Mbong, (2013). This scholar maintained that the germination of seed and establishment of plants depend on environmental conditions in the immediate vicinity of the seed or seedling. Plant species with high frequency and density values in the study sites may highlight their inherent abilities to adapt and cope with the predominant environmental conditions. It may also suggest that the pedological conditions were suitable and favourable for their massive establishments and proliferations. Safe sites or favourable microsites might have also contributed to the high frequency and density values of species. Titus and Del Moral (1999),

Ogbemudia *et al.,* (2014) and Anwana *et al.,* (2018) affirmed this in their various studies. According to these authors, spatial safe sites distribution often determines where seedling establishment occurs and influences strongly the successional and colonization patterns in species. They further added that seed germination and seedling establishment patterns can be affected greatly by microsite conditions. Nonetheless, the effective reproductive strategies as well as the high potential of regeneration of these species may have also contributed to their frequency and density values. This synchronizes with the findings of Santamaria, (2002) that efficient dispersal abilities and effective reproductive strategies are among the factors that can give rise to dominance and rarity of species in different ecosystems. The low frequency and density values of species in the two study sites are not unrelated to their inabilities to adapt fully to pedological and environmental conditions which are vital for their establishments (Ezekiel, *et. al.* 2023). Kabir *et al*., (2010) added that the exploitation of species selectively may result in slow regeneration potentials, low frequency and density.

The closeness in values with regards to the frequency of species in the may pinpoint high competition for environmental resources such as nutrients, water, light and space. In this regard, species with the ability to withstand and compete strongly with other species for the aforementioned environmental resources will have high frequencies while the unable ones will have low frequency values. This agrees with the findings of Ogbemudia and Mbong (2013) that competition for environmental resources such as nutrients; water and light have great tendencies to affect the pattern of growth and density of species that are incapable of outweighing other competitors. Specifically, the IUCN conservation status of species indicates that most of the species found in the garden are either not yet evaluated and some others belonged to the least concern categorization. Specifically, in the botanic garden, no plants encountered belonged to the group near threatened (NT) or endangered (EN). Also, as observed, there were more trees in the arboretum compared to the botanical garden while there were more herbs and shrubs in the botanical garden when compared to the arboretum. This variation clearly indicates that the botanical garden is still in its primary stage of development and conservation. The family Fabaceae and Euphorbiaceae were consistently present in both the botanical garden and arboretum and so recorded the highest number of taxa across both sites. This is consistent with the findings of Sikolia and Omomdi (2017) and Okon *et al.,* (2021) who reported higher abundance of the plant species from the families Euphorbiaceae and Fabaceae in the University Botanical garden in Maseno and Akwa Ibom State University botanical garden respectively. Concurrently, Nodza *et al.,* (2014) also reported high frequency of plants from the family Fabaceae growing on Akoka Campus of University of Lagos. Also, the findings of this research confirm the previous reports of Mbong *et al.,* (2020b) who noted the presence of high quality timber species in the same arboretum. The retension of these species over time underscores the fact that the arboretum could serve as a reserve for conservation of threatened endemic timber species in this locality. Notably, taxa scores in terms of herbs diversity and richness in this study indicates that the botanic garden may serve as rich reservoir for common medicinal plants for the host community. The high abundance of species belonging to specific families as observed in this study in both sites may be attributed to their economic values and uses within the study area (Ogbemudia *et al*., 2014).

CONCLUSION

This study successfully documented plants' species found in University of Uyo botanical garden and arboretum. Variations in the plant species composition of the two assemblages under study are obvious. The vegetation characteristics of the two locations showed discernible heterogeneities and variations in abundance and composition of species. More tree

species were encountered in the arboretum than in the botanic garden while more herbs and shrubs occurred in the botanical garden compared to the arboretum.

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