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Research Article

Assessment of Plant Abundance and Diversity in the Biological Garden, Federal University Lokoja, Adankolo Campus, Kogi State, Nigeria

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Abstract

Plants are used for food, aesthetic purposes, money generating, nutritional supplements, and therapeutic purposes. There is need for taxonomic checking, for giving information on planning and sustainable exploitation, due to the strain that the ever-increasing demand for plant products has placed on the numerous beneficial species. In this study, the diversity and abundance of plant species at the Biological garden of Federal University Lokoja, Adankolo Campus Kogi State, Nigeria was assessed. The University biological garden was divided into two sampling sites for accurate recording of species, line transect of 20m was laid using a rope and a quadrat of size 1mx1m was used to sample plant species in each plot. Systematic sampling method was adopted. Result reveals a total of 21 individual plants of 13 tree species, 4 herbaceous species and 4 shrub species from 17 families were encountered. The dominant families are Fabaceae, Lamiaceae and Malvaceae. Monocotyledonous and dicotyledonous plants account for 29% and 71% of plants available in the sampled sites respectively. Few numbers of plants encountered were exotic while others were native. Angiosperms had 19 representatives (90.48%) while gymnosperms had 2 representatives (9.52 %). Andropogon gayanus was the most abundant plant species. Plants such as Aplectrum hyemale, Ficus carica, Vitellaria paradoxa, Vitex gratifolia had relative density < 1 and as such may be considered threatened within the study area. Weighted Jaccards' Coefficient indices was 0.38, 0.68, 0.50 for trees, herbs and shrub species respectively from both site A and B. Sites A and B are 98% alike when Simpson's diversity index is used to compare diversity levels. The study showed that it is necessary that the garden be given adequate and effective protection from anthropogenic disturbance and unrestricted trespassing. Awareness and orientation on the sustainable uses of plants and importance of botanical gardens and effort should be geared towards sustainable management of fragile species.

Keywords: Anthropogenic Activities; Biodiversity; Plant Assessment; Plant Diversity

Introduction

Plant species serves various purposes which include beautification, income generation, food supplements and medicinal purposes. The ever increasing demand for plant products has brought about intense pressure on the various beneficial species thereby leading to rapid degradation of plants in natural habitats, hence the need for taxonomic checking, for providing information for planning and sustainable utilization [1]. Nigeria's rich biodiversity is influenced by anthropogenic forces and floral diversity has been poorly documented [2]. In the course of millions of years, numerous biotic communities have evolved and established themselves. It is therefore important to know the diversity, similarities and species richness of these communities so as to understand their role in the development of the ecosystem, evolution and in maintenance of stability [3]. An in-depth knowledge of richness, diversity and species composition of plant community is vital for providing information for planning and sustainable utilization [4]. Assessing the status of and trends of plant species diversity population is essential for sustainable, development, strategies and conservation (Aladesanmi *et al*., 2016) [5].

Studies have been carried out on the fauna abundance and diversity of the study site, but the plant diversity and abundance have not been assessed; Hence the need for this study to fill the research and knowledge gap. The study was therefore aimed at assessing the diversity of plant species and its abundance in the Biological garden of Federal University Lokoja, Kogi State.

Materials and Methods

Study area

The Biological garden having a land area of 60mx35m (0.21hectres) located on latitude 7.79 and longitude 6.73 Federal University Lokoja Adankolo campus, Kogi State. Lokoja has a humid tropical climate which is characterized by two distinct seasons; rainy season (April-October) and dry season (November-March). The highest temperature occurs in March and April just before the rainy season. The mean monthly temperature reaches 38^0c in March and drops to 18^0c in December [6].

Method of data collection

The size of the study site was determined using a surveyors' tape and the site was divided into two sampling plots based on the size of garden for accurate recording of species. Systematic sampling method was adopted according to [4]. A line transect of 20m was laid using a rope and a quadrat of size 1mx1m was used to sample plant species in each sample plot at interval. The edge of the garden was dense and the shrubs clustered, hence plant species in this area were not identified. Herbaceous plant species captured within the quadrat were identified, counted and recorded with the help of a plant flora guide (plant net).

Tree species were identified using direct observation. The location data of plant were taken using a Global Positioning System (GPS). Herbarium collections were made and vouchers of plants collected were deposited in the herbarium unit, Federal University Lokoja, Adankolo Campus.

Data analysis

Data collected during the survey were analysed using the following.

Simpson's diversity index (SDI), which is used to measure the total number of different species in a sample and the relative abundance of each species.

$$SDI = \frac{\Sigma n_i (n-1)}{N (N-1)}$$

Where:

SDI= Simpson's diversity index

n = number of individual species

N = number of individual in total population.

Weighted Jaccard's coefficient (x,y): a similarity index used to determine the differences and similarity between two values.

$$(\underline{x}, y) = \frac{\sum_{k=1}^{n} \text{Min } (Xk,Yk)}{\sum_{k=1}^{n} \text{Max } (Xk,Yk)}$$

Where:

X = summation of the minimum of two vector in each dimension.

y = summation of the maximum of two vector in each dimension.

Results

The botanical names, common names, families and habitat of all the plant species encountered in the study sites are presented in Table 1.

Plant species	Common name	Family	Habit	Voucher No
Acalypha indica	Indian acalypha	Euphorbiaceae	Herb	0178
Albizia lebbeck	Woman's tongue	Fabaceae	Tree	0013
Aloe barbadensis miller	Aloe Vera	Liliaceae	Shrub	0187
Andropogon gayanus	Gamba grass	Poaceae	Grass	0180
Aplectrum hyemale	Adam and eve	Orchidaceae	Tree	0183
Azadirachta indica	Neem	Meliaceae	Tree	0132
Calotropis procera	Sodom apple	Apocynaceae	Shrub	0131
Carica papaya	Pawpaw	Caricaceae	Tree	230510
Chromolaena odorata	Siam weed	Asteraceae	Shrub	0117
Combretum africans	Bush willows	Combretaceae	Tree	0185
Daniella oliveri	African balsam tree	Fabaceae	Tree	0188
Ficus carica	Common fig	Moraceae	Tree	0048
Gmelina arborea	White teak	Lamiaceae	Tree	0179

Ipomoea cordatotriloba	Tievine	Convolvulaceae	Herb	0184
Malvastrum ceromadelium	Three lobes	Malvaceae	Shrub	0089
Moringa oleifera	Moringa	Moringaceae	Tree	0006
Passiflora foetida	*Passion flower*	*Passifloraceae*	Shrub	0161
Ployalthia longifolia	Ashoka	Fabaceae	Tree	0182
Steculia setigera	Karaya gum tree	Malvaceae	Tree	0176
Vitellaria paradoxa	Shea tree	Sapotaceae	Tree	0181
Vitex grandifolia	Chaste tree	Lamiaceae	Tree	0186

Table 1: Plant Species Composition of the Biological Garden, Federal University Lokoja.

A total of 21 plant species were recorded from both study sites. The species were dominated by trees.

Figure 1 present a chart distribution showing the growth habit of the total plant species in the study site.

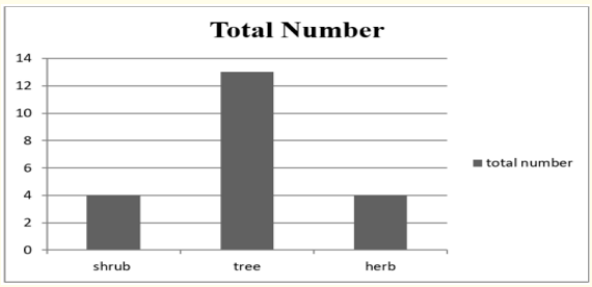

Figure 1: Graph showing growth habit and their total number.

Table 2 presents the families of the plants encountered in the study area and the number of plant species belonging to each family. A total of 17 families were encountered. The *Fabaceae* family was the most abundant family with 3 individual plant species.

The result in Table 3 presents the different groups of the plant flora and their higherplant category. Dicot plant species were more abundant in the study area with a total of 15 individual plant species while monocots were 6. The angiosperm plant types were also more abundant in the study area with a total of 18 individual plant species while gymnosperm plant types were 2.

Family	Species population
Asteraceae	1
Apocynaceae	1
Caricaceae	1
Ombretaceae	1
Convolvulaceae	1
Euphorbiaceae	1
Fabaceae	3
Lamiaceae	2
Liliaceae	1
Malvaceae	2
Meliaceae	1
Moraceae	1
Moringaceae	1
Orchidaceae	1
Passifloraceae	1
Poaceae	1
Sapotaceae	1

Table 2: Relationship between Family and Species Population.

Plant species	Plant Type	Cotyledon
Acalypha indica	Gymnosperm	Dicot
Albizia lebbeck	Gymnosperm	Dicot
Aloe barbadensis miller	Angiosperm	Monocot
Andropogon gayanus	Angiosperm	Monocot
Aplectrum hyemale	Angiosperm	Monocot
Azadirachta indica	Angiosperm	Monocot
Calotropis procera	Angiosperm	Dicot
Carica papaya	Angiosperm	Dicot
Chromolaena odorata	Angiosperm	Dicot
Combretum Africans	Angiosperm	Dicot
Daniella oliveri	Angiosperm	Monocot
Ficus carica	Angiosperm	Dicot
Gmelina arborea	Angiosperm	Dicot
Ipomoea cordatotriloba	Angiosperm	Dicot
Malvastrum ceromadelium	Angiosperm	Dicot
Moringa oleifera	Angiosperm	Dicot
Passiflora foetida	Angiosperm	Dicot
Ployalthia longifolia	Angiosperm	Dicot
Steculia setigera	Angiosperm	Dicot
Vitellaria paradoxa	Angiosperm	Monocot
Vitex grandifolia	Angiosperm	Dicot

Table 3: Plant species based on their higher plant category.

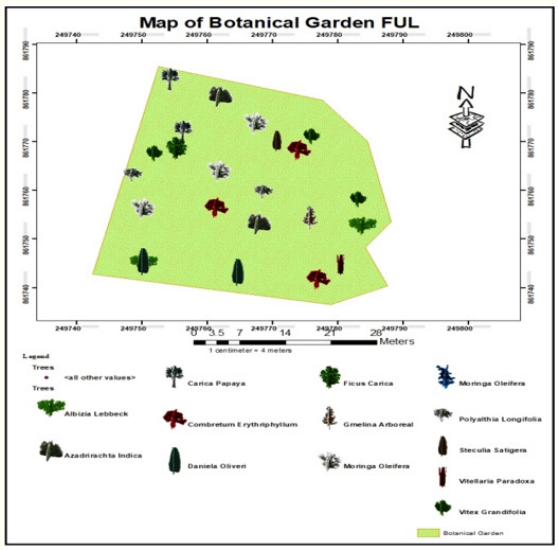

Figure 2: Map of botanical garden showing location of trees.

The results presented in table 4 shows the phytosociological characteristics of plant species in the study sites.

Table 4a represents the computed values of Jaccards' Coefficient for the individual plant species and also the value for general plant species in site A and B. Table 4b represents the comparison of level of diversity between sites A and B using Simpson's Diversity Index (SDI) for comparing their similarities.

The Jaccard Similarity will be 0 if the two sets don't share any values and 1 if the two sets are identical.

The Simpson's coefficient for similarity between sites A and B is 98% which implies that site A is similar to site B.

Discussion

This study has documented the taxonomy, diversity and environmental relevance of plant species in the biological garden of Federal University Lokoja, Adankolo Campus, Kogi State. The botanic garden serve as an educational institute holding documented collections of living plants for the purpose of scientific research, conservation, display and education. Botanical gardens house world class facilities including seed banks, herbaria, greenhouses, nurseries and research laboratories.

Species	Weighted Jaccards' Coefficient
Trees	0.38
Herbs	0.68
Shrubs	0.50
All species	1.56

Table 4a: Weighted Jaccards' Coefficient indices for each site.

Sites	Simpson's Index (100%)	Inference
A and B	98	A is similar to B

Table 4b: Simpson's diversity index for similarities between sites.

The variety of plants, which is a crucial part of green infrastructure, helps to offer baseline information on the richness, composition, and diversity of plant species. Plant provides a wide range of direct and indirect benefits to the ecosystem. Plant vegetation provides food, shelter, medicine and other services to humans; plants are crucial component of the ecological system having productive and recreate functions. Animals depend on green plant for energy and this dependency forms the base of food chain. Plants are the base of food chain and biogeochemical cycling of nutrients between terrestrial and aquatic ecosystem [7]. They also contribute greatly to the health and welfare of everyone who lives and works in the environment.

More so, they provide essential services to the institute and student of the study area. However, the flora of the biological garden of Federal University Lokoja, Kogi State is under threat from infrastructural development and other anthropogenic activities. Similar findings have been reported by [8] on plant communities that have been anthropogenic ally disturbed. As human population continue to grow, land use intensity increases and the negative effects of deforestation are likely to worsen Chazdon [9]. The drastic reduction of species richness occurring in the garden is as a result of climatic changes, continued land development and direct human activities, including trampling and collecting; similar finding was observed by [4] who reported that anthropogenic activities and associated trampling was responsible for the low numbers of plants encountered during the study. Lack of conservation will increase the number of endangered species which after some time could go into extinction. Extinction of plant species should be avoided because we

simply do not know how to create species once it becomes extinct [10]. All the plant species in the study area are terrestrial due to the climatic condition of the study area. These results agree with the work of [11] where mostly terrestrial weeds were found in the study site. The poor establishment of some families could be attributed to anthropogenic activities that endangered this families, the result agrees with the work of [4] who recorded that anthropogenic activities affected the abundance of species and placed them at more risk of extinction if not properly conserved. A total of 21 individual plant species belonging to 17 families were encountered in the study area. The family Fabaceae was reported to be the most abundant family in the study area with a total of 3 individual plants. The families of Meliaceae and Moraceae are less in number which differs from the findings of [12] who reported that the tropical rain forest ecosystem of Southeast Nigeria is dominated by these families. Majority of the species in the study area may be regarded as vulnerable or endangered because their relative densities were less than 1.00. Species richness and diversity of the biological garden federal University Lokoja reveals that the garden has a moderate diversity. However, anthropogenic activities must be discouraged in order to conserve natural resources and provide ecosystem function. If sustainable management measures, such as a significant replanting effort and the creation of a committee to oversee tree maintenance, are not established, these endangered species, may soon disappear from the garden. Overexploitation and replacement of forest ecosystems with human amenities results in the decimation of tree species [13]. The most abundant family recorded is Fabaceae, this is similar to the findings of [14] who also reported the Fabaceae family as the most abundant family in Ehor Forest Reserve, Edo State. This family's dominance may be due to its effective seed dispersal system. The fact that the majority of Fabaceae family members are wind dispersed may explain their extensive prevalence. The biological garden has both indigenous and naturalized exotics plants; trees are scattered and shrubs clustered.

Due to the study area's climatic conditions, dicots were the most frequently encountered individual species, which is similar to the findings of [15]. The lengthy tap roots of dicotyledonous trees are employed to find water deep within the earth during the dry season. The gymnosperm encountered in the study area was *Acalypha indica,* and *Albizia lebbeck* while, Angiosperms were more abundant in the study area with a total of 18 individual plants. Systematic sampling method was adopted which is in line with [4] in the plant sampling in the study area. Results suggest that site B had the highest species richness [15] and less diverse when compared with site A [12]. The Simpson's coefficient for similarity between sites A and B is 98%, which implies that site A is similar to site B.

Conclusion

The richness and diversity of plant species in the biological garden of Federal University Lokoja, Adankolo Campus, Kogi State have been documented. It has been shown that the diverse plant species are necessary component of the institution. The different species including trees, shrubs, and grasses extensively assessed shows that it is necessary that the garden be given adequate and effective protection from anthropogenic disturbance and unrestricted trespassing. Awareness and orientation on the sustainable uses of plants and importance of botanical gardens and effort should be geared towards sustainable management of fragile species.

Bibliography

1. Olujobi O J., *et al*. "Tree Species Diversity of Ikogosi Warm Spring and Arinta Waterfall Watersheds, Nigeria: publication for Sustainable Ecotourism". *Asian Journal of Research in Agriculture and Forestry* (2019).

2. Adeyemi AA., *et al*. "Tree Structural and Species diversity in Okwangwo Forest, Cross River State, Nigeria". *Journal of Research in Forestry, Wildlife and Environment* 7.2 (2015).

3. Haruna H., *et al*. "Quantitative analysis of plant species diversity in Kano zoological garden". *Bayero Journal of Pure and Applied Sciences* 11.1 (2018): 208-213.

4. Olubode OS., *et al*. "Floral diversity in the wetlands of Apete River, Eleyele Lake and Oba Dam in Ibadan, Nigeria: Its implication for biodiversity erosion". *West African Journal of Applied Ecology* 18 (2011): 109-119.

5. Aladesanmi., *et al*. (2016).

6. Ifatimehin., *et al*. (2012).

7. Aigbokhan EI. "Annotated Checklist of Vascular Plants of Southern Nigeria – a quick reference guide to the Vascular Plants of Southern Nigeria: a systematic approach". Uniben Press, Benin City (2014): 346.

8. Jeje AA., *et al*. "Assessment of the Diversity and Abundance of tree species in Afe Babalola University, Ado-ekiti, Ekiti State, Nigeria". *International Journal of Biodiversity and Conservation* 13.3 (2021) 144-151.

9. Chazdon RL. "Tropical Forest Recovery: Legacies of Human Impact and Natural Disturbances". *Prospect. Plant Ecology* 6 (2013): 51-71.

10. Wardle DA., *et al*. "Ecosystem properties and forest decline in contrasting long-term chronosequence". *Science* 305 (2004): 5090513.

11. Osawaru M E., *et al*. "Current status of plant diversity and conservation in Nigeria". *Nigerian Journal of Life Sciences* 3.1 (2013): 168-178.

12. Adekunle VAJ., *et al*. "Rate of Timber production in a tropical rainforest Ecosystem of Southeast Nigeria and its Implication on Sustainable Forest Management". *Journal of Forestry Research* 21 (2010): 225-230.

13. Iroko OA., *et al*. "Impact of Human Activities on the Forest and their Effects on Climate Change". In: Popoola, L. Proceedings of the 32nd Annual Conference of the Forestry Association of Nigeria (FAN) held in Umuahia, Abia State between 20th and 24th October 2008. Pp 208 – 214.

14. Iheyen J., *et al*. "Composition of tree species in Ehor Forest Reserve, Edo State, Nigeria". *Nature and Science* 7.8 (2009): 8-18.

15. Ogwu MC., *et al*. "Diversity and abundance of Tree Species in the University of Benin, Benin City, Nigeria". *Applied Tropical Agriculture* 21 (2016): 46-54.