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28 June, 2021.

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Dear Dr. Woghiren,

Letter of Acceptance of Manuscript MS: 2820

I am pleased to inform you that your paper titled **"Vegetation Communities and Floristic Diversity of Eleyele and Dandaru Wetlands in Ibadan, Southwest, Nigeria."** By A.I Woghiren and O.S Olubode, has been accepted for publication in the Nigerian Journal of Science (NJS). It is scheduled to appear in Vol. 55 (1), 2021.

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Yours sincerely,

Prof O.E. Fagade FSAN 28/06/2021

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Vegetation Communities and Floristic Diversity of Eleyele and Dandaru Wetlands in Ibadan, Southwest, Nigeria

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Abstract
Wetlands are globally important biodiversity hotspots and are facing rapid loss in floristic diversity and major changes in the functioning of these ecosystems due to various anthropogenic activities. However, wetlands located in large cities in developing nations are often unattended despite major yet often subtle changes in the functioning of the ecosystems. Recognizing this, the study was conducted in two wetland ecosystems, Eleyele and Dandaru wetlands in Ibadan city, southwestern Nigeria, to assess, document and determine the degradation or otherwise of the diversity and stand distribution of herbaceous and wood flora of the wetlands. The study was carried out on the wetlands of Eleyele (Lat, $7^{O}25^{1}48.38''$N, Long, $3^{O}51^{1}45.18''$E; elevation of 200 m ASL) in 2012. Systematic survey was carried out to assess the herbaceous and woody (girth ≥ 10 cm) components of the wetlands following Kent (2012) and Cox (1990) methods. Forty – five plotless sampling points of fifteen 5 m line transects, and twenty–one 10 m ×10 m plots were used for the respective surveys. Species presence and densities were used to compute Relative Importance Values and Diversity Indices following Kent (2012), Hammer *et al*. (2001) and Hill (1994). Topsoil was collected from the top 0 – 15 cm with a soil auger, bulked and analysed following AOAC (1984) methods. The wetland of Dandaru had higher diversity and was in a better floristic and edaphic health than Eleyele Lake wetland. This study recommends that Eleyele Lake wetland should be protected from anthropogenic activities that may lead to the loss of species.

Introduction

Wetlands are unique, productive ecosystems where terrestrial and aquatic habitats meet. Wetlands play a crucial role in maintaining many natural cycles and supporting a wide range of biodiversity. They provide several important services to human society (Fikirte and Mare, 2015). The precise functions and services provided by wetlands depend on their size, type, and location within an urban watershed. Urban wetlands can improve water quality by removing pollutants, and minimizing flood damage by slowing and storing flood-water, and protecting shorelines from erosion by absorbing storm surges. So, globally, wetlands are under heavy pressure. Despite the increasing recognition of the need to conserve wetlands, losses have continued unabated (Xu *et al*., 2019).

A lot of changes frequently occur in an environment over time and several organisms do have the capability to cope with these adjustments which could either be natural or anthropogenic (Thrush *et al*., 2008). When the conditions of organic resources are altered or utilized by man, the whole ecosystem is affected as a result of a fluctuation created in

Keywords: Dandaru wetland, Eleyele Lake, Flora diversity, Ecosystem health, Anthropogenic

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the system. The ecosystem changes over time. In a natural scenario, these kinds of changes do not significantly alter the natural systems, due to the fact that a new, moderately different ecosystem can be created with the natural resources that are presently in place (Galvani *et al*., 2016). These effects are mainly favoured by the continuous increase in the human population.

Increasing human populations and change from subsistence to commercial exploitation of wetland resources continue to exert increasing pressures on limited wetland resources resulting in a decline in services and quality, as well as quantity of products derived from wetlands (Newton *et al*., 2020). In the recent past, industrialization and its related anthropogenic activities have subjected these ecosystems to stress, in some cases leading to alteration and facilitating their ultimate destruction or disappearance (MEA, 2005).

The process of wetland degradation, a common phenomenon occurring in Sub–Saharan African wetlands located in large cities in developing nations, not only results in continuous forest fragmentation but also brings about several physical and biological changes in the ecosystem. Furthermore, water quality and aquatic habitat of both standing and flowing water have been negatively affected, especially in lower watershed areas (Edgar *et al*., 2000). Consequently, there is a loss of biodiversity due to changes in habitat conditions. These remnant fragments provide the last hope for biodiversity conservation.

In the face of a threat by climatic change and ecosystem degradation occasioned as a result of anthropogenic activities, especially in unknown areas of the world, there is a need to understand the ecologies of prime environmental resources in cities (such as Ibadan City) in developing worlds with huge prospects for becoming megacities. Considering the alarming rate of perturbation in the wetlands and the consequential effect on floristic diversity, it becomes paramount to monitor our wetland ecosystem. This paper therefore assesses the abundance, composition and diversity of herbaceous and woody plant species occurring naturally or as an effect of threats occasioned by direct and indirect changes in two of the few remaining forested/wetlands in the densely populated Ibadan metropolis. The baseline data generated could provide an understanding of the effects of human influence on the ecologies of the two sites. This would guide resource managers and users to make informed decisions on how the ecosystem should be conserved.

Materials and Methods

Study area

A floristic survey was carried out on two wetlands in Ibadan, a forest–guinea savanna agroecological transition zone. One of the wetlands was located at Dandaru wetland, (Coordinate`s: $7^{O}24`27.38''N$, $3^{O}54`05.49''E$; Elevation: 219 m above sea level (ASL). The other is the Eleyele Lake wetland located on coordinates: $7^{O}25`48.38''N$, $3^{O}51`45.18''$; Elevation: 200 m ASL. The two wetlands, which were historically connected by vegetation, were at the time of this study separated by houses and urban facilities.

Data collection

A reconnaissance survey involving GIS mapping and ground truthing was conducted on the site to enable familiarization with the actual conditions and situations of the plantation. Flora survey of the wetlands of Eleyele Lake and Dandaru wetland were sampled from November 2011 to May 2012. Herbaceous and woody components of the ecosystems were assessed for composition, abundance, size class determination (of woody flora), relative importance values and stand spatial relationships. The assessment of the herbaceous component was carried out using a systematic sampling procedure. The plotless sampling method of McNeill *et al*. (2010) was employed, where sampling points were systematically located on: one-dimensional transect lines of 5 m length, on a total of 96 transects. In each sampling case, the

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interception length and width were measured. Identification of plant species followed Akobundu and Agyakwa (1998). Species that could not be identified on site were identified in the Department of Forest Resources Management, University of Ibadan, Oyo State, Nigeria.

The floristic survey of woody components followed the use of systematic sampling procedure described in Kent (2012). The sampling plots were marked in the study site by laying plots of 100 square meters dimensions of 50 m intervals. A total of 21 sampling plots were used to assess the woody flora of each ecosystem. The flora for this study was limited to woody plants having ≥10 cm diameter at breast height. Woody plant species composition of each stand was identified following (Keay, 1959), enumerated and recorded. Each plot was divided into 10 m × 10 m basic units for sampling purposes. Within each basic unit, 100 % enumeration of trees was carried out.

DATA ANALYSES

Herbaceous Component Calculations

$$\text{Density} = \frac{\text{Sum (I/W)}}{\text{Total length of all transects}}$$

Where, W = is the maximum width of the organism perpendicular to the transect line

I = is the intercept length

$$\text{Frequency} = \frac{\text{Sum (I/W)}}{\text{Number of individuals of a species}}$$

Number of transects with at least 1 individual of the species

- Relative Density = Density / Total density of all species
- Relative Dominance = Dominance / Total dominance for all species
- Relative Frequency = Frequency / Total frequency of all species
- Relative Importance Value = Relative density + Relative dominance + Relative frequency

All density data collected on the flora of the two wetlands were analyzed following. Relative importance values of species enumerated were computed using relative density and relative frequency as follows:

$$\text{Relative Density} = \frac{\text{Number of individual of species}}{\text{Total number of Individuals}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

$$\text{Relative Importance Value} = \frac{\text{Relative density + Relative frequency}}{2}$$

The data from soil routine analysis of the wetlands were subjected to analysis of variance (ANOVA) following Randomized Complete Block (RCBD) Design ($P<0.5$) (Gomez and Gomez, 1984).

A diversity index of the flora of each wetland was computed using Paleontological Statistics Software (PAST, Version 2.01) of Hammer *et al*, (2001). Diversity indices computed were Taxa, Shannon Weiner Equitability index, Dominance, Simpson`s index and Evenness index as a measure of number of families encountered, randomness of distribution of individuals at each site, prevalence of a species at the expense of other species, species richness and skewedness or otherwise of distribution of species across each site.

The soil samples were collected, bulked, coded and labelled for proper identification, while the water samples were collected as well coded and labelled for proper identification. It was then analysed according to the official methods of analysis described by Association of Official Analytical Chemists (1990).

Results and Discussion

The species composition of the wetlands was rich. A total of 66 herbs in 28 families were encountered using the plotless method for floristic survey of the two study sites in the year 2012. Forty – five herbaceous species belonging to 21 families were encountered at Eleyele Lake (Table 1). The family Poaceae in general had the highest values for the survey parameters than any other family encountered. *Ageratum conyzoides* was the most common

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plant species in the Dandaru wetland, as indicated by its relative importance value (Table 2), while *Sida acuta* was the most common plant species in Eleyele Lake wetland as indicated by its relative importance value (Table 2).

Table 1: Relative Importance Value of different herbaceous species occurring at Eleyele wetland 2012

S/NO	SPECIES	FAMILY	RIV
1.	*Sida acuta* Burm. F.	Malvaceae	9.00
2.	*Chromolaena odorata* (L.) R. M. King & H. Robinson	Asteraceae	7.00
3.	*Amaranthus spinosus* L.	Amaranthaceae	6.00
4.	*Echinochloa obtusifolia* Stapf	Poaceae	6.00
5.	*Mollugo nudicaulis* Lam.	Molluginaceae	6.00
6.	*Panicum maximum* Jacq.	Poaceae	6.00
7.	*Synedrella nodiflora* Gaertn.	Asteraceae	6.00
8.	*Senna occidentalis* L.	Fabaceae	4.00
9.	*Basilicum polystachyon* (L.) Asch.	Labiatae	3.00
10.	*Ficus exasperata* Vahl	Moraceae	3.00
11.	*Momordica charantia* Linn.	Cucurbitaceae	3.00
12.	*Pentodon pentandrus* (Schumach. & Thonn.) Vatke	Rubiaceae	3.00
13.	*Sacciolepis africana* C. E. Hubb. & Snowden	Poaceae	3.00
14.	*Mitracarpus villosus* (Sw.) DC.	Rubiaceae	3.00
15.	*Brillantaisia lamium* (Nees) Benth.	Acanthaceae	2.00
16.	*Ipomoea cairica* (L.) Sweet	Convolvulaceae	2.00
17.	*Kyllinga erecta* Schumach.	Cyperaceae	2.00
18.	*Phyllanthus amarus* Schumach. & Thonn.	Euphorbiaceae	2.00
19.	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	2.00
20.	*Alchornea cordifolia* (Schumach. & Thonn.) Mull. Arg.	Euphorbiaceae	1.00
21.	*Acalypha ciliata* Forssk.	Euphorbiaceae	1.00
22.	*Acroceras zizanioides* (Kunth) Dandy	Poaceae	1.00
23.	*Acroceras amplectens* Stapf	Poaceae	1.00
24.	*Bidens pilosa* L.	Asteraceae	1.00
25.	*Ageratum conyzoides* Linn.	Asteraceae	1.00
26.	*Calopogonium mucunoides* Desv.	Asteraceae	1.00
27.	*Passiflora foetida* L.	Passifloraceae	1.00
28.	*Commelina benghalensis* L.	Commelinaceae	1.00
29.	*Clerodendrum polycephalum* Baker	Ochnaceae	1.00
30.	*Cyperus podocarpus* Boeckeler	Cyperaceae	1.00
31.	*Cynodon dactylon* (L.) Pers.	Poaceae	1.00
32.	*Echinochloa crus-pavonis* (Kunth) Schult.	Poaceae	1.00
33.	*Erigeron floribundus* (Kunth) Sch. Bip.	Asteraceae	1.00
34.	*Euphorbia heterophylla* L.	Euphorbiaceae	1.00
35.	*Ludwigia abyssinica* A. Rich	Onagraceae	1.00
36.	*Ludwigia hyssopifolia* (G. Don) Exell	Onagraceae	1.00
37.	*Ludwigia octovalvis* (Jacq.) Raven	Onagraceae	1.00
38.	*Mariscus cylindristachyus* Steud.	Cyperaceae	1.00
39.	*Mezoneuron benthamianum* Baill.	Fabaceae	1.00
40.	*Spermacoce ruelliae* DC.	Rubiaceae	1.00
41.	*Spermacoce verticillata* L.	Rubiaceae	1.00
42.	*Talinum fruticosum* (L.) Juss.	Portulacaceae	1.00
43.	*Senna obtusifolia* L.	Fabaceae	1.00

RIV = Relative Importance Value

Table 2: Relative Importance Value (RIV) of different herbaceous species occurring at Dandaru wetland 2012

S / NO	SPECIES	FAMILY	RIV
1.	*Ageratum conyzoides* Linn.	Asteraceae	9.42
2.	*Mezoneuron benthamianum* Baill.	Fabaceae	6.52
3.	*Commelina benghalensis* Linn.	Commelinaceae	5.79
4.	*Chromolaena odorata* (L.) R. M. King & H. Robinson	Asteraceae	5.07
5.	*Mariscus cylindristachyus* Steud.	Cyperaceae	4.35
6.	*Spermacoce latifolia* Aubl.	Rubiaceae	4.35
7.	*Sida acuta* Burm. F.	Malvaceae	3.62
8.	*Ficus exasperata* Vahl	Moraceae	3.62
9.	*Panicum maximum* Jacq.	Poaceae	3.62
10.	*Alternanthera sessilis* (L.) R. Br. Ex DC.	Amaranthaceae	2.90
11.	*Alchornea cordifolia* Mull. Arg.	Euphorbiaceae	2.90
12.	*Cyclosorus striatus* (Schum.) Ching.	Thelypteridaceae	2.90
13.	*Launaea cornuta* (Hochst. Ex Oliv. & Hiern) C. Jeffrey	Asteraceae	2.17
14.	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	2.17
15.	*Cynodon dactylon* (L.) Pers.	Poaceae	2.17
16.	*Talinum fruticosum* (L.) Juss.	Portulacaceae	2.17
17.	*Acroceras zizanioides* (Kunth) Dandy	Poaceae	2.17
18.	*Axonopus compressus* (Sw.) P. Beauv.	Poaceae	2.17
19.	*Paspalum conjugatum* Bergius	Poaceae	2.17
20.	*Boerhavia diffusa* L.	Nyctaginaceae	2.17
21.	*Mitracarpus villosus* (Sw.) DC.	Rubiaceae	2.17
22.	*Echinochloa obtusifolia* Stapf	Poaceae	2.17
23.	*Sida urens* L.	Malvaceae	1.45
24.	*Clerodendron polycephalum* Baker	Verbenaceae	1.45
25.	*Momordica charantia* Linn.	Cucurbitaceae	1.45
26.	*Spermacoce verticillata* L.	Rubiaceae	1.45
27.	*Amaranthus viridis* L.	Amaranthaceae	1.45
28.	*Trema guineensis* Schumach. & Thonn.	Ulmaceae	1.45
29.	*Basilicum polystachyon* (L.) Asch.	Labiatae	1.45
30.	*Asystasia gangetica* (L.) T. Anderson.	Acanthaceae	1.45
31.	*Centrosema pubescens* Benth.	Fabaceae	1.45
32.	*Paspalum vaginatum* Sw.	Poaceae	1.45
33.	*Ludwigia abyssinica* A. Rich.	Onagraceae	0.73
34.	*Ludwigia octovalvis* (Jacq.) Raven	Onagraceae	0.73
35.	*Sphenoclea zeylanica* Gaertn.	Sphenocleaceae	0.73
36.	*Calopogonium mucunoides* Desv.	Fabaceae	0.73
37.	*Spigelia anthelmia* L.	Loganiaceae	0.73
38.	*Eragrostis tremula* Steud.	Poaceae	0.73
39.	*Sacciolepis africana* C. E. Hubb. & Snowden.	Poaceae	0.73
40.	*Tridax procumbens* Linn.	Asteraceae	0.73
41	*Oryza longistaminata* A. Chev. & Roehr.	Poaceae	0.73
42	*Sida rhombifolia* L.	Malvaceae	0.73
43.	*Spermacoce ruelliae* DC.	Rubiaceae	0.73
44.	*Peperomia pellucida* (L.) Kunth.	Piperaceae	0.73
45.	*Cyperus haspan* L.	Cyperaceae	0.73

RIV = Relative Importance value

The survey for the diversity of woody floras occurring in the wetlands of Eleyele wetlands (Table 3) and Dandaru (Table 4) in 2012 revealed that Dandaru had a higher alpha diversity for woody vegetation than Eleyele wetlands. Thus, Eleyele ranked first (Table 5)

Table 3: Relative Importance Value of Tree Species Occurring at Eleyele wetland in 2012

S/NO	SPECIES	FAMILY	RIV
1.	*Gmelina arborea* Roxb.	Lamiaceae	36.22
2.	*Tectona grandis* L. f.	Lamiaceae	20.87
3.	Musa spp. L.	Musaceae	14.29
4.	*Gliricidia sepium* (Jacq.) Kunth	Fabaceae	8.81
5.	*Albizia lebbeck* (L.) Benth.	Fabaceae	5.67
6.	*Acacia* spp. Mill.	Fabaceae	4.71
7.	*Carica papaya*	Caricaceae	3.14
8.	*Terminalia catappa* L.	Combretaceae	3.14
9.	*Lophira leucocephala*	Ochnaceae	1.57
10.	*Leucaena leucocephala*	Fabaceae	1.57

RIV = Relative Importance Value

Table 4: Relative Importance Value of Tree Species Occurring at Dandaru wetland in 2012

S/NO	SPECIES	FAMILY	RIV
1.	*Tectona grandis* L. f.	Lamiaceae	20.16
2.	*Gliricidia sepium* (Jacq.) Kunth	Fabaceae	9.22
3.	*Gmelina arborea* Roxb.	Lamiaceae	8.05
4.	*Musa* spp. L.	Musaceae	5.25
5.	*Eucalyptus tereticornis* F. Muell.	Myrtaceae	5.23
6.	*Azadirachta indica* A. Juss.	Meliaceae	5.23
7.	*Milicia excelsa* (Welw.) C. C. Berg.	Moraceae	5.19
8.	*Acacia* spp. Mill.	Fabaceae	4.29
9.	*Triplochiton scleroxylon* K. Schum.	Sterculiaceae	3.78
10.	*Terminalia catappa* L.	Combretaceae	3.59
11.	*Nauclea latifolia* Sm.	Rubiaceae	2.60
12.	*Elaeis guineensis* Jacq.	Arecaceae	2.39
13.	*Albizia lebbeck* (L.) Benth.	Fabaceae	2.37
14.	*Terminalia superba* Engl. & Diels	Combretaceae	2.37
15.	*Terminalia ivorensis* A. Chev.	Combretaceae	2.37
16.	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.	Irvingiaceae	1.43
17.	*Citrus reticulata* Blanco	Rutaceae	1.43
18.	*Citrus sinensis* (L.) Osbeck	Rutaceae	1.43
19.	*Citrus medica* L.	Rutaceae	1.43
20.	*Mangifera indica* L.	Anacardiaceae	1.43
21.	*Cocos nucifera* L.	Arecaceae	1.20
22.	*Dacryodes edulis* (G. Don) H. J. Lam.	Burseraceae	1.20
23.	*Ficus* spp. L.	Moraceae	1.20
24.	*Acacia macrothyrsa* Harms.	Fabaceae	1.20

RIV = Relative Importance Value

Table 5: Diversity indices for herbaceous components of Eleyele wetland

Diversity Indices	Values	Meaning
Taxa (S)	44	Alpha diversity was high
Dominance (D)	0.1032	No prevalence of a particular species
Simpson (1-D)	0.8968	Species richness was high
Shannon (H')	2.802	Equitability was high
Evenness (H'/S)	0.3582	Species were randomly distributed

and Dandaru (Table 6) ranked second in terms of alpha diversity, respectively. However, *Gliricidia sepium*, *Gmelina arborea* and *Milicia excelsa* had the highest density and frequency at Eleyele (Table 7), while *Gmelina arborea*, *Tectona grandis*, *Musa* sp. had the

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highest frequency and density at Dandaru (Table 8)

The diversity of Eleyele wetlands in 2012 is indicated as follows; Number of species (Taxa) was 43, which implies that the alpha diversity

Table 6: Diversity indices for herbaceous components of Dandaru wetland in 2012

Diversity Indices	Values	Meaning
Taxa (S)	47	Alpha diversity was high
Dominance (D)	0.035	No prevalence of a particular species
Simpson (1-D)	0.965	Species richness was high
Shannon (H`)	3.585	Equitability was high
Evenness (H`/S)	0.7671	Species were evenly distributed

Table 7: Diversity indices for tree components of Eleyele Lake in 2012

Diversity Indices	Values	Meaning
Taxa (S)	10	Alpha diversity was low
Dominance (D)	0.3014	No prevalence of a particular species
Simpson (1-D)	0.6986	Species richness was high
Shannon (H`)	1.514	Equitability was low
Evenness (H`/S)	0.4543	Species were not evenly distributed

Table 8: Diversity indices for Tree components of Dandaru wetland in 2012

Diversity Indices	Values	Meaning
Taxa (S)	24	Alpha diversity was high
Dominance (D)	0.1044	No prevalence of a particular species
Simpson (1-D)	0.8956	Species richness was high
Shannon (H`)	2.617	Equitability was high
Evenness (H`/S)	0.5708	Species were evenly distributed

was high, Dominance (D) was 0.1032, which implies that no particular species was prevalent, simpson (1 – D) was 0.8968 which is being interpreted as high species richness, Shannon-wiener indices (H`) was 2.802, which implies that equitability among species was high, and Evenness (H`/S) was 0.3582, this implies that species were randomly distributed (Table 5). For the wetland of Dandaru, results were as follows; Number of species was 45, implying that the alpha diversity was high, Dominance (D) was 0.0350, which means that no particular species was prevalent, Simpson (1-D) was 0.9650, which implies there was high species richness, Shannon-wiener indices (H`) was 3.5850, this implies that the equitability among species was high, Evenness (H`/S) was 0.7671, as this implies that distribution of species were even (Table 6). The survey of Dandaru and Eleyele wetlands in 2012 showed varying degrees of dissimilarities in terms of species composition and structure. This has further laid credence to the fact as stated by Olubode *et al*. (2011) that there is no typical wetland flora. The species composition of the woody plants revealed that the wetlands species, have been seriously reduced and this alteration, if not properly countered could further lead to the loss of species genetic makeup, and may hinder the wetlands from rendering their ecosystem services. The herbaceous species was very consistent with Akobundu and Agyakwa (1998). The decrease in the number of woody species in the wetland of Eleyele in 2012, when compared to the high floristic richness reported by Olubode *et al*. (2011), can be attributed to the various human activities such as illegal felling, unauthorized land encroachment, its open access nature, as well as other activities which have led to erosion of biodiversity, as well as posed serious threat on the lake water body. The confinement and managerial protection of Dandaru wetland may have been responsible for the high floristic richness. Also, differences in edaphic conditions may have been responsible for the variation in species composition. These corroborate with the finding of Ogunyemi (1997) that reported weed flora of southwestern Nigeria relied more on edaphic factors than on climate or crop type. One or a combination of these phenomena was found to occur as the wetlands exhibited flora differences. Also, the prevalence of some notorious invasive plant species in the wetlands poses a threat to biodiversity conservation.

As observed in this study, *Ageratum conyzoides*, *Chromoleana odorata*, *Sida acuta* and *Panicum maximum* were present in both wetlands. In a report by Lowe *et al*., (2000) *Chromoleana odorata* is noted as one of the World`s 100 worst invasive species. Also, according to the ranking of invasive species in West Africa, *Chromoleana odorata*, *Ageratum conyzoides*, *Panicum maximum* and *Sida acuta*

are listed among the most common invasive species (Noba *et al*., 2017) while *Tectona grandis, Gmelina arborea* and *Gliricida sepium* were the predominant woody species for Dandaru and Eleyele wetlands. Trees were not widely considered to be important invasive species until about a decade ago (Richardson and Rejmanek, 2011) when it became obvious that many planted alien trees only became invasive after a long period of time - sometimes exceeding a century. This agrees with the findings carried out by IUCN (2013) which documented the invasive nature of *Tectona grandis, Gmelina arborea, Azadiracta indica* and *Leucaena leucocephala* in some parts of Africa. However, due to the never-ending rise in invasion rates and environmental damages caused by invasive species, colonization theory has lately become a matter of considerable interest to ecologists.

What was observed at the wetlands of Eleyele could be a result of what Olubode *et al*. (2011) referred to as an immediate threat to the continued existence of many rare vascular plant species, which are anthropogenic, with species losses occurring as a result of habitat loss and fragmentation of ecosystem from continued land development, as well as due to direct human activities, including trampling and collecting. The fragmentation as a result of anthropogenic activities leads to the distribution of some flora in spatial areas, which has resulted in the edge effects observed. This agrees with the findings of Lindenmayer and Fischer (2006).

After the Friday, August 26th, 2011 disastrous flood that destroyed lots of property in the Ibadan metropolis, a lot of herbaceous plant species have been encountered on the sediments on the water surface, as these have resulted in the eutrophication of the lakes and reduction in the number of fish caught by fishermen. The water analysis for both lakes also revealed that the lakes are slightly acidic, plus the presence of dissolved and suspended solids in the water. The high prevalence of nitrate in water, which may have arisen from the use of some fertilizers, may also occur from the decomposition of animal and human waste, as was the case in Eleyele, where human faeces could be seen every 10 cm. However, the wetland is continuously perturbed by various human and human–related activities. This is a threat to the stability of wetlands and associated resources. The presence of invasive alien species in large numbers portends grave danger to the continued existence of native floras as this means that the native flora is gradually eroded from the wetlands. The floral erosion if not given adequate remedial actions, would lead to extensive biodiversity erosion because faunas that depend on the eroded floras might as well be lost. This corresponds with the findings of McCauley *et al*. (2015) that the loss of the small wetlands will cause a direct reduction in the linkage among remaining species populations. The environmental variation, according to Hutton *et al*. (2005), perhaps only delays the competitive exclusion of the species, simultaneously weakening the action of factors that promote co–existence.

Poaceae family in general dominated the wetlands in terms of herbaceous plants. This also agrees with the report of Olubode *et al*. (2011) on wetlands in southwestern Nigeria, where their survey also revealed the Poaceae family to be the dominant family of a three-site study with the inclusion of Eleyele wetland. Furthermore, Zhang *et al*., (2014) in research carried out to assess wetland plants in China found Poaceae to be the most dominant family among the top ten families enumerated. The wetland of the Dandaru consisted of woodier and more herbaceous components, while the wetland of Eleyele was sparsely populated with trees (woody component) and herbaceous components, as this can be attributed to their protection status. The wetland of Dandaru is more protected than that of Eleyele, which is highly exposed to anthropogenic activities. The difference observed in species in terms of richness was as a result of their floristic density, in the individual wetlands. This is consistent with the findings of Houlahan *et al*. (2006) who

observed forest cover among other factors as a significant predictor of plant species richness.

The soil analysis conducted on the sites revealed that the soils of the two sites are not the same. The soil of the wetland of Eleyele belongs to the sandy loam textural class, while that of Dandaru belongs to the loamy sand textural class (Table 9). The water analysis conducted on the water of both wetland ecosystems revealed that the pH is slightly acidic (Table 10). The soils of Eleyele wetland had the highest Cation Exchangeable Capacity (CEC), Organic carbon and pH Value, (28.23 ± 11.19; 2.63 ± 0.44 and 4.27 ± 0.14) respectively (Table 9).

Table 9.: Soil chemistry and particle size distribution (n =3 ± S.E) in the rooting layers of plants in the wetlands of Dandaru and Eleyele (2012) in Ibadan

Soil parameters	Dandaru wetland	Eleyele wetland
PH(1N in H_2O)	4.10 ± 0.14	4.27 ± 0.13
Org. Carbon (%)	2.16 ± 0.66	2.63 ± 0.44
CEC ($MolKg^{-1}$)	12.58 ± 1.02	28.23 ± 11.19
Sand (%)	83.00 ± 7.21	80.33 ± 3.33
Silt (%)	13.87 ± 5.78	15.47 ± 3.33
Clay (%)	3.87 ± 1.45	4.20 ± 0.10
Textural Class	Loamy sand	Sandy loam

Table 10: Water Chemistry (n=3 ± S.E) of Dandaru and Eleyele Wetlands in Ibadan (2012)

SITE	Biological Oxygen Demand (BOD) Mg/L	Nitrate (NO_3)	pH
Dandaru wetland	216.83 ± 9.39	11.05 ± 6.38	5.81 ± 0.16
Eleyele wetland	236.87 ± 34.19	17.37 ± 10.14	6.05 ± 0.05
$LSD_{0.05}$	98.41	33.27	0.46

References:

Akonbundu, I.O. and Agyakwa, C.W. 1998. A handbook of West African weeds. IITA, Ibadan, 2nd ed. Ibadan: International Institute of Tropical Agriculture, 521 pp.

AOAC, 1984. Official Methods of Analysis. 14th Edition, Association of Analytical Chemists, Washington DC, 249-252.

AOAC, 1990. Official methods of analysis of the Association of Official Analytical Chemists. vols. 15th ed. Washington, DC.

Cox, G. R. 1990. Laboratory Manual of Ecology, 6th Edition Dubuque, IA: WM. C. Brown publication. 251 pp.

Edgar, G. J., Barret, N. S., Gradden, D. J. and Last, P. R. 2000. The conservation significance of estuaries: a classification of Tasmanian estuaries using ecological, physical and demographic attributes as a case study. *Biological Conservation*, 90: 383-397.

Fikirte, D. T. and Mare, A. D. 2015. Human Development and Wetland Conservation Policy. *International Journal of Environmental Sciences*, Vol. 4(3): 126-138.

Galvani, A. P., Bauch, C. T., Anand, M., Singer, B. H. and Levin, S. A. 2016. Human-environment interactions in population and ecosystem health. *Proceedings of the National Academy of Sciences of the United States of America*, 113 (51) 14502 – 14506.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for agricultural research 2nd edition. John Wiley and Sons, New York.

Hammer, O., Harper, D.A.T and Ryan, P.D. 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontologia Electronica 4(1): 9 pp. http://palaeo-electronica.org/2001_1/past/issue_01.htm

Houlahan, J., Keddy, P. A., Mackay, K. and Findlay, C. S. 2006. The effects of adjacent land use on wetland species richness and community composition. *Wetlands* 26(1): 79-96.

Hutton, J., Adams, W. M. and Murombedzi, J. C. 2005. Back to Barriers? Changing Narratives in Biodiversity Conservation. Forum for Development Studies, 2:341–370.

International Union for Conservation of Nature (IUCN), 2013. Invasive plants affecting protected areas of West Africa. Management for reduction of risk for biodiversity. Ouagadougou, BF: IUCN/PACO. Published by IUCN,

Gland, Switzerland and Ouagadougou, Burkina Faso. ISBN: 978-2-8317-1596-4

Keay, R. W. J. 1959. An outline of Nigeria Vegetation. 3rd Ed. Federal Ministry of Information Printing Division, Lagos.

Kent, M. 2012. Vegetation Description and Data Analysis: A Practical Approach, Wiley-Blackwell. New York.

Lindenmayer, D. B. and Fischer, J. 2006. *Habitat Fragmentation and Landscape Change: An Ecological and Conservation Synthesis* (Island Press, Washington, DC).

Lowe, S. M., Boudjelas, S., De Porter, M. and Browne, M. 2000. 100 of the World's Worst Invasive Species: A Selection from the Global Invasive Species Database. Invasive Species Specialist Group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), University of Auckland, Auckland, New Zealand.

McCauley, L. A., Anteau, M. J., van der Burg, M. P. and Wiltermuth, M. T. 2015. Land use and wetland drainage affect water levels and dynamics of remaining wetlands. Ecosphere 6 (6) 1 – 22.

McNeill, L., Kelly, R. D. and Barnes, D. L. 2010. The use of quadrat and plotless methods in the analysis of tree and shrub components of woodland vegetation. *Proceedings of the Annual Congresses of Grassland Society of Southern Africa*, Vol. 12(1): 109 – 113.

Millennium Ecosystem Assessment (Program). 2005. Ecosystems and human well-being. Washington, D. C: Island Press.

Newton, *et al*. 2020. Anthropogenic, Direct Pressures on Coastal Wetlands. *Frontiers in Ecology and Evolution*, Volume 8: 144.

Noba, K., Bassene, C., Ngom, A., Gueye, M., Camara, A. A., Kane, M., Dieng, B., Rmballo, R., Ba, N., Sane, S., Diop, D., Gueye, M., Konta, I. S., Kane, A., Mbaye, M. S. and Ba, A. T. 2017. Invasive Plants of West Africa: Concepts, Overviews and Sustainable Management. *Advances in Recycling and Waste Management* 2: 121.

Ogunyemi, Sola. 1977. The Distribution of Some Weeds of Arable Crops in South Western Nigeria. *Proceedings of 7th Annual Conference of Weed Science society of Nigeria*, Page 29 – 45.

Olubode, O. S, Awodoyin, R. O. and Ogunyemi, S. 2011. Flora 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, Vol.18.

Richardson, D. M. and Rejmanek, M. 2011. Trees and shrubs as invasive alien species-a global review. *Divers Distribution* 17:788 – 809.

Thrush, S. F., Halliday, J., Hewitt, J. E. and Lohrer, A. M. 2008. The effects of habitat loss, fragmentation, and community homogenization on resilience in estuaries. *Ecological Applications*, 18: 12 – 21.

Xu, T., Wang, B., Yan, D., Wang, K., Li, X., Bi, W., Li, M., Cheng, X. and Liu, Y. 2019. Wetlands of Internation Importance: Status, Threats and Future Protection. *International Journal of Environmental Research and Public Health*, Vol. 16, 1818.

Zhang, Y., Xu, H., Chen, H., Wang, F. and Huai, H. 2014. Diversity of wetland plants used traditionally in China: a literature review. *Journal of Ethnobiology and Ethnomedicine*. 10:72.

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