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Phytodiversity Assessment of Ramsar Site in Niger Delta, Nigeria

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Abstract:- The study presents findings on the species composition, frequency of occurrence, species abundance and species diversity of two Ramsar wetlands (Orashi and Oguta) in Nigeria during rainy and dry seasons. A systematic sampling approach using the line-transect method with dimensions of 150 m×50 m was employed for the investigation. The result reveals that Orashi had a higher species composition than Oguta for both seasons, with most of the species being evenly distributed across the ecosystem. A total of 47 species belonging to 26 families were recorded with Orashi having higher species composition than Oguta. Thirty-nine (39) species were recorded during rainy season at Oguta which increased to forty-one (41) during dry season and 42 species were recorded at Orashi for the two seasons. However, more than 70% of the plant species at Oguta during the rainy season had the same frequency of occurrence as that of the dry season. The study also found that certain plant species were more abundant during the dry season at both wetlands than the rainy seasons. *Panicum maximum* was the most abundant species across all seasons and sites. The family with the largest important value index was *Poaceae, Asteraceae,* and *Phyllanthaceae*. Species richness was lowest at Orashi during the rainy season and highest at Oguta during the dry season. Evenness of species was highest at Orashi in the dry season, with low disparity between the number of individuals within each species. The study concludes that seasonality plays a significant role in species composition and that monitoring phytodiversity is crucial in assessing the health and stability of wetlands, especially given the potential impact of anthropogenic activities such as artisanal refining and sewage discharge.

Keyword:- *Wetland, Species richness, Species evenness, phytodiversity, Anthropogenic activities, ramsar,*

I. INTRODUCTION

Wetlands are among the most productive and diverse ecosystems on the planet, and they provide a wide range of functions and values that are critical for human well-being and the health of the environment (Clarkson et al., 2013). Wetlands play a vital role in regulating the Earth's climate and weather patterns, filtering and purifying water, controlling floods and erosion, and supporting a diverse range of plant and animal species (Jisha&Puthur, 2021). They are also important cultural and recreational sites that provide opportunities for tourism and education (Aazami&Shanazi, 2020).

Despite their importance, wetlands are under threat from a range of human activities, including land-use change, agricultural expansion, urbanization and pollution (Dar et al., 2020). These activities are causing the degradation and loss of wetland ecosystems, which has significant implications for the health and well-being of people and the environment (Adekola& Mitchell, 2011). Wetland loss and degradation can lead to reduced water quality, increased flood risk, reduced fish stocks, and loss of biodiversity and ecosystem services (Asunbo&Tanee, 2022).

One of the most significant global efforts to conserve wetlands is the Ramsar Convention on Wetlands, an international treaty that aims to conserve and sustainably use wetlands around the world (Ramsar Convention, 2021). The Ramsar Convention recognizes wetlands of international importance, also known as Ramsar sites, and provides a framework for their conservation and management. Ramsar sites are designated based on a set of criteria that consider the ecological, social and cultural values of wetlands (Ramsar Convention, 2021).

Nigeria has made significant progress in identifying and conserving Ramsar wetlands, with eleven Ramsar sites covering a total area of 1076,730 hectares (Nwaogu et al., 2021). Three of these Ramsar sites are located in the Niger Delta, a region known for its rich biodiversity and unique wetland ecosystems (Okonkwo et al., 2015). The Apoi Creek Forest, Upper Orashi Forest, and Lake Oguta are all Ramsar sites that support a diverse range of plant and animal species, including many that are rare and endangered (Nwankwoala&Okujagu, 2014).

To ensure the long-term conservation and management of Ramsar wetlands in the Niger Delta, it is important to conduct phytodiversity assessments that can provide valuable insights into the current status of plant diversity in the area and help guide future conservation efforts. The present study aims to identify the plant species present, their distribution and abundance. The findings of this study will be critical for developing effective conservation strategies and promoting sustainable management practices that can protect the unique wetland ecosystems of the Niger Delta.

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II. MATERIALS AND METHOD

A. Site Description

This research was done in the Niger Delta region of Nigeria, specifically in two Ramser wetlands of international importance: (Oguta Lake and Upper Orashi Forest), located in Imo and Rivers States, respectively.

Orashi is a river situated between Longitude 6º45´36”E and Latitude 5º45’58.57” and is a part of the lower Niger River basin (Fig.1a). It is a tributary of Oguta Lake in southeastern Nigeria, as noted by Mmom et al. (2013) and Mbajiorgu, et al. (2003). Fishing and palm oil production is the major activities in the site of study.

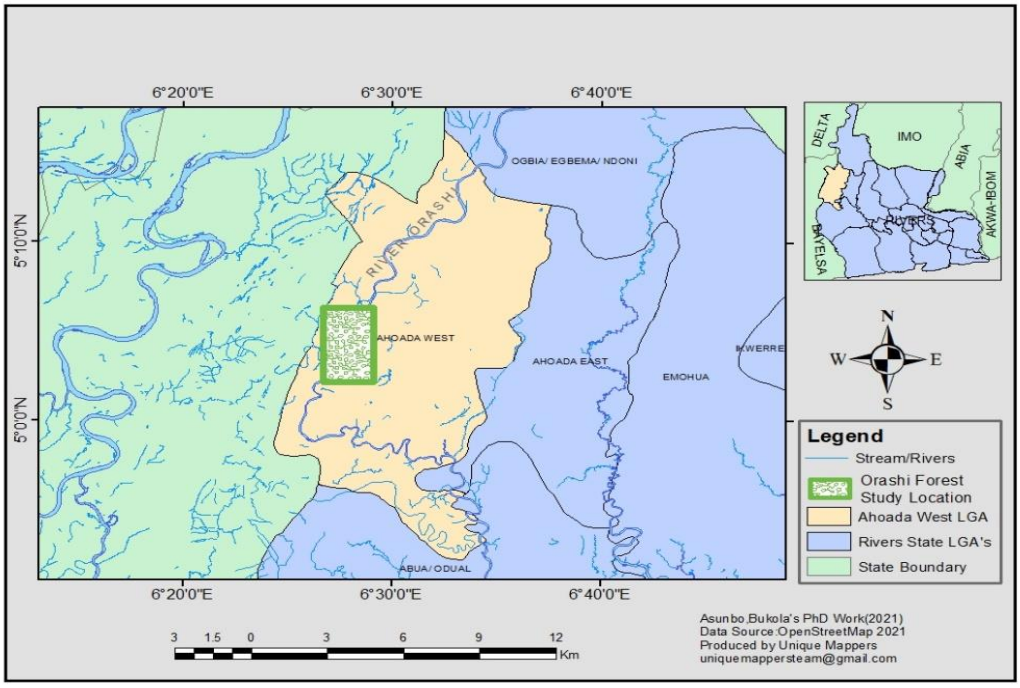

Fig. 1a: Map of the Study Area, Orashi Forest, Ahoada West LGA, Rivers State.

Oguta Lake is located between Latitude 5º42’25”N and Longitude 6º47’28”E in Imo State, is a lean 'finger lake' formed by the damming of the lower Njaba River with alluvium, and it is the largest natural lake in the State (Fig. 1b). The lake is situated in Oguta, approximately 50 kilometres (30 mi) from the junction of the Ndoni and Orashi River (Chuku, 2005). The major activities ongoing at these sites of study is farming, fishing, transportation of goods using ferries and speed boat.

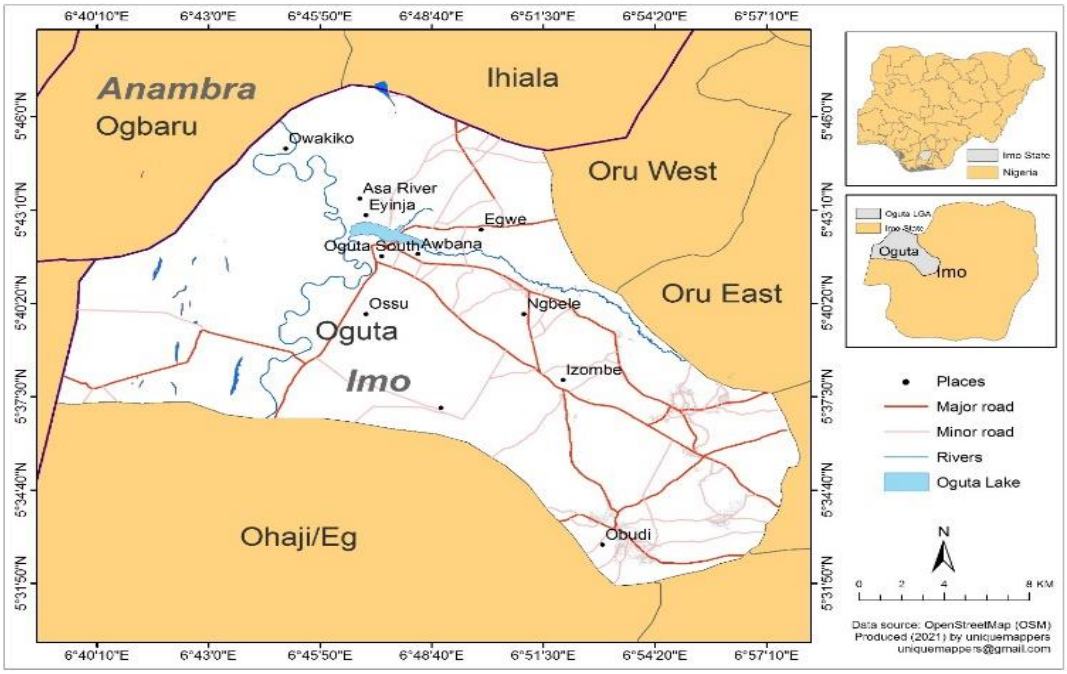

Fig. 1b: Map of the Study Area, Oguta Lake, Oguta LGA, Imo State

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B. Sampling techniques and Phytodiversity Assessment

The study was done in 2021 at two seasons - the dry season (February) and the rainy season (September). Two sampling stations, located more than 15000 m apart, were identified at each RAMSAR site - Oguta lake and Upper Orashi Forest. A systematic sampling approach using the line-transect method with dimensions of 150 m x 50 m was employed for each sampling stations. Within each sampling station, three sub-sampling units were created at 50 m intervals, each measuring 50 m×50 m. In total, there were 12 sampling plots of 6 sampling unit for each of Orashi and Oguta. Data collection involving, identification and recording of plant species within each sampling plot were done. Species that could not be identified on site were preserved and identified with the use of reliable literature references such as Etukudo (2003) and Aigbokhan (2014). After species composition determination, other parameters such as species frequency, relative frequency, species abundance, relative abundance, species density, relative density, Importance Value Index (IVI) and species diversity indices were calculated using the appropriate formulae used by Gbaa*et al.* (2022). The results of the analysis were then presented in tabular form.

III. RESULTS

Table 1 shows the species composition for the rainy and dry seasons for the two Ramsar wetlands. A total of forty seven (47) species belonging to twenty-six (26) families was recorded with Orashi having higher species composition when compared to Oguta. Thirty-nine (39) species were recorded during rainy season at Oguta which increased to forty-one (41) during dry season and 42 species were recorded at Orashi for the two seasons.

Table 1: Species composition Orachi and Oguta

S/N	Species	Family	Habit	Common Name	Oguta		Orashi	
					Rainy	Dry	Rainy	Dry
1	*Bambusa vulgaris* Schrad. ex J.C.Wendl.	Poaceae	Tree	Bamboo	24	24	26	26
2	*Ageratum conyzoides*L.	Asteraceae	Herb	Goat weed	332	141	238	118
3	*Talinum triangulare*	Talinaceae	Herb	Waterleaf	140	42	61	73
4	*Telfairia occidentalis*	Cucurbitaceae	Climber	Fruited pumkin	109	49	43	77
5	*Xanthosoma sagittifolia* (L.) Schott	Aracea	Herb	Arroweaf	57	28	37	11
6	*Manihot esculentum*Crantz.	Euphorbiaceae	Shrub	Cassava	0	104	153	0
7	*Elaeisguineensis*Jacq.	Arecaceae	Tree	Palm Tree	7	7	18	18
8	*Alchornea cordifolia* Müll.Arg.	Euphorbiaceae	Tree	Christmas bush	0	0	34	20
9	*Panicum maximum* Jacq.	Poaceae	Herb	Guinea grass	358	161	97	46
10	*Dioscoreabulbifera*L.	Dioscoreaceae	Climber	Aerea yam	0	40	0	0
11	*Calamus rotang* L.	Arecaceae	Shrub	Rattan	0	0	12	12
12	*Raphia hookeri*G.Mann&H.Wendl.	Arecaceae	Tree	Raphia palm	21	21	0	0
13	*Raphia vinifera* P.Beauv.	Arecaceae	Tree	Raphia palm	24	24	0	0
14	*Tectona grandis* L.f.	Lamiaceae	Tree	Teak	0	0	9	9
15	*Musa paradisiaca* L.	Musaceae	Tree	Banana	2	2	0	0
16	*Thalia geniculata*L.	Marantaceae	Herb	Bent aligator	0	0	58	23
17	*Setaria pumila*(Poir.) Roem. &Schult.	Poaceae	Herb	Cattail grass	0	0	199	72
18	*Urena lobata* L.	Malvaceae	Shrub	Caesarweed	100	59	250	130
19	*Wissadula rostrata* (Schumach.) Hook. f.	Malvaceae	Herb		44	44	86	64
20	*Sida acuta* Burm.f.	Malvaceae	Herb	wireweed	84	38	43	19
21	*Sida cordifolia* L.	Malvaceae	Herb	Flannel weed	66	33	25	9
22	*Alstoniaboonei*De Wild.	Apocynaceae	Tree	Cheese wood	10	10	4	4
23	*Musangacecropioides*R.Br. &Tedlie	Urticaceae	Tree	Umbrella tree	6	6	9	9
24	*Pentaclethra macrophylla*Benth.	Fabaceae	Tree	Oil bean tree	5	5	11	11
25	*Lophiraalata* Banks ex Gaertn	Ochnaceae	Tree	red ironwood	5	5	1	1
26	*Chromolaenaodorrata*(L.) R. King & H. Robinson).	Asteraceae	Shrub	Sian weed	84	28	68	40
27	*Miliciaexcelsa* (Welw.) C.C. Berg	Moraceae	Tree	Iroko	3	3	3	3
28	*Costusafer*Ker-Gawl	Costuceae	Shrub	Bush cain	39	39	67	67
29	*Diplaziumsammatii*(Kuhn.) C.Chr.	Athyraceae	Herb	Diplazium fern	102	61	133	57
30	*Ipomoea aquatica*Forssk.	Convolvulaceae	Climber	Water spinach	85	35	93	47
31	*Ipomea ivolicrata*P.Beauv.	Convolvulaceae	Climber	Frog'sgourd	82	52	116	48
32	*Ageratum houstonianum* Mill.	Asteraceae	Herb	Blueweed	199	72	190	98
33	*Aspiliaafricana* (Pers.) C.D.Adams	Asteraceae	Herb	Sun flower	39	19	57	33
34	*Newbouldialaevis*(P.Beauv.) Seem. ex Bureau	Bignoniaceae	Tree	Boundary plant	3	3	6	6
35	*Phyllanthus amarus*Schumach. &Thonn.	Phyllanthaceae	Herb	Gale of wind	242	77	271	210
36	*Senna alata* (L.) Roxb.	Fabaceae	Shrub	Candle bush	22	18	32	61
37	*Senna hirsuta*(L.) H.S.Irwin&Barneby	Fabaceae	Shrub	Hairy senna	20	11	32	20
38	*Senna obtusifolia* (L.) H.S.Irwin&Barneby	Fabaceae	Shrub	Chinese senna	22	12	30	13
39	*Mangifera indica* L.	Anacardiaceae	Tree	Mango	1	1	6	6
40	*Dacryodes edulis* H.J. Lam	Burseraceae	Tree	African pear	1	1	1	1
41	*Psidium guajava* L.	Myrtaceae	Tree	Guava	2	2	0	0
42	*Calopogoniummucunoides*Desv.	Fabaceae	Climber	Wild groun nut	7	7	14	14

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43	*Pueraria phaseoloides* (Roxb.) Benth.	Fabaceae	Climber	Puero	14	14	30	15
44	*Andropogon tectorum*Schumach. &Thonn.	Poaceae	Herb	Horse grass	69	22	59	28
45	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	Herb	Braken fern	6	6	20	12
46	*Naucleadiderrichii*(De Wild. &T.Durand) Merr.	Rubiaceae	Tree	Bilinga	0	0	1	1
47	*Cenchrus purpureus* (Schumach.) Morrone	Poaceae	Herb	Elephant grass	133	19	0	95

Analysis of species frequency and relative frequency of occurrence at Oguta and Orachi are presented in Table 2 for dry and rainy seasons. It was observed that species at Orashi are more evenly distributed across the ecosystem for the two seasons than that of Oguta. Above 70% of plant species at Oguta during the rainy season have the same frequency of occurrence with that of the dry season. Species like *Ageratum conyzoides, Xanthosoma sagittifolia, Manihot esculentum, Panicum maximum, Raphia vinifera, Urena lobata, Wissadula rostrata, Sida acuta, Sida cordifolia, Musangacecropioides, Cistus afer, Diplaziumsammatii, Ipomoea aquatica, Ipomoea ivolicrata, Ageratum houstonianum, Phallathusamarus*and *Pueraria phaseoloides* have the highest and same relative frequency of occurrence.

Table 2: Species frequency and relative frequency of occurrence at Oguta and Orachi

S/N	Species	Family	Habit	Oguta				Orashi			
				Rainy		Dry		Rainy		Dry	
				F (%)	RF (%)	F (%)	RF (%)	F (%)	RF (%)	F (%)	RF (%)
1	*Bambusa vulgaris* Schrad. ex J.C.Wendl.	Poaceae	Tree	66.67	2.083	66.67	2.15	100	2.8037	100	2.83
2	*Ageratum conyzoides*L.	Asteraceae	Herb	100	3.125	100	3.23	100	2.8037	100	2.83
3	*Talinum triangulare*	Talinaceae	Herb	100	3.125	66.67	2.15	100	2.8037	100	2.83
4	*Telfairia occidentalis*	Cucurbitaceae	Climber	100	3.125	66.67	2.15	100	2.8037	100	2.83
5	*Xanthosoma sagittifolia* (L.) Schott	Aracea	Herb	100	3.125	100	3.23	100	2.8037	100	2.83
6	*Manihot esculentum*Crantz.	Euphorbiaceae	Shrub	0	0	100	3.23	100	2.8037	0	0
7	*Elaeisguineensis*Jacq.	Arecaceae	Tree	100	3.125	100	3.23	100	2.8037	100	2.83
8	*Alchornea cordifolia* Müll.Arg.	Euphorbiaceae	Tree	0	0	0	0	66.67	1.8691	100	2.83
9	*Panicum maximum* Jacq.	Poaceae	Herb	100	3.125	100	3.23	100	2.8037	66.67	1.887
10	*Dioscoreabulbifera*L.	Dioscoreaceae	Climber	0	0	66.67	2.15	0	0	0	0
11	*Calamus rotang* L.	Arecaceae	Shrub	0	0	0	0	66.67	1.8691	66.67	1.887
12	*Raphia hookeri*G.Mann&H.Wendl.	Arecaceae	Tree	100	3.125	100	3.23	0	0	0	0
13	*Raphia vinifera* P.Beauv.	Arecaceae	Tree	100	3.125	100	3.23	0	0	0	0
14	*Tectona grandis* L.f.	Lamiaceae	Tree	0	0	0	0	66.67	1.8691	66.67	1.887
15	*Musa paradisiaca* L.	Musaceae	Tree	33.33	1.042	33.33	1.08	0	0	0	0
16	*Thalia geniculata*L.	Marantaceae	Herb	0	0	0	0	100	2.8037	100	2.83
17	*Setaria pumila* (Poir.) Roem. &Schult.	Poaceae	Herb	0	0	0	0	100	2.8037	100	2.83
18	*Urena lobata* L.	Malvaceae	Shrub	100	3.125	100	3.23	100	2.8037	100	2.83
19	*Wissadula rostrata* (Schumach.) Hook. f.	Malvaceae	Herb	100	3.125	100	3.23	100	2.8037	100	2.83
20	*Sida acuta* Burm.f.	Malvaceae	Herb	100	3.125	100	3.23	100	2.8037	100	2.83
21	*Sida cordifolia* L.	Malvaceae	Herb	100	3.125	100	3.23	66.67	1.8691	66.67	1.887
22	*Alstoniaboonei*De Wild.	Apocynaceae	Tree	66.67	2.083	66.67	2.15	66.67	1.8691	66.67	1.887
23	*Musangacecropioides*R.Br. &Tedlie	Urticaceae	Tree	100	3.125	100	3.23	66.67	1.8691	66.67	1.887
24	*Pentaclethra macrophylla*Benth.	Fabaceae	Tree	66.67	2.083	66.67	2.15	0	0	100	2.83
25	*Lophiraalata* Banks ex Gaertn	Ochnaceae	Tree	66.67	2.083	66.67	2.15	100	2.8037	33.33	0.943
26	*Chromolaenaodorrata*(L.) R. King & H. Robinson).	Asteraceae	Shrub	100	3.125	100	3.23	100	2.8037	100	2.83
27	*Miliciaexcelsa* (Welw.) C.C. Berg	Moraceae	Tree	66.67	2.083	33.33	1.08	66.67	1.8691	66.67	1.887
28	*Costusafer*Ker-Gawl	Costuceae	Shrub	100	3.125	100	3.23	100	2.8037	100	2.83
29	*Diplaziumsammatii*(Kuhn.) C.Chr.	Athyraceae	Herb	100	3.125	100	3.23	100	2.8037	66.67	1.887
30	*Ipomoea aquatica*Forssk.	Convolvulaceae	Climber	100	3.125	100	3.23	100	2.8037	100	2.83
31	*Ipomea ivolicrata*P.Beauv.	Convolvulaceae	Climber	100	3.125	100	3.23	100	2.8037	100	2.83
32	*Ageratum houstonianum* Mill.	Asteraceae	Herb	100	3.125	100	3.23	100	2.8037	100	2.83
33	*Aspiliaafricana* (Pers.) C.D.Adams	Asteraceae	Herb	100	3.125	33.33	1.08	100	2.8037	100	2.83
34	*Newbouldialaevis*(P.Beauv.) Seem. ex Bureau	Bignoniaceae	Tree	66.67	2.083	66.67	2.15	100	2.8037	100	2.83
35	*Phyllanthus amarus*Schumach. &Thonn.	Phyllanthaceae	Herb	100	3.125	100	3.23	100	2.8037	100	2.83
36	*Senna alata* (L.) Roxb.	Fabaceae	Shrub	66.67	2.083	33.33	1.08	100	2.8037	100	2.83
37	*Senna hirsuta*(L.)	Fabaceae	Shrub	66.67	2.083	66.67	2.15	100	2.8037	66.67	1.887

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	H.S.Irwin&Barneby										
38	*Senna obtusifolia* (L.) H.S.Irwin&Barneby	Fabaceae	Shrub	66.67	2.083	66.67	2.15	100	2.8037	100	2.83
39	*Mangifera indica* L.	Anacardiaceae	Tree	33.33	1.042	33.33	1.08	66.67	1.8691	66.67	1.887
40	*Dacryodes edulis* H.J. Lam	Burseraceae	Tree	33.33	1.042	33.33	1.08	33.33	0.9346	33.33	0.943
41	*Psidium guajava* L.	Myrtaceae	Tree	66.67	2.083	66.67	2.15	0	0	0	0
42	*Calopogoniummucunoides*Desv.	Fabaceae	Climber	66.67	2.083	66.67	2.15	100	2.8037	100	2.83
43	*Pueraria phaseoloides* (Roxb.) Benth.	Fabaceae	Climber	100	3.125	100	3.23	100	2.8037	100	2.83
44	*Andropogon tectorum*Schumach. &Thonn.	Poaceae	Herb	100	3.125	33.33	1.08	100	2.8037	100	2.83
45	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	Herb	66.67	2.083	66.67	2.15	66.67	1.8691	66.67	1.887
46	*Naucleadiderrichii*(De Wild. &T.Durand) Merr.	Rubiaceae	Tree	0	0	0	0	33.33	0.9346	33.33	0.943
47	*Cenchrus purpureus* (Schumach.) Morrone	Poaceae	Herb	100	2.803	100	3	0	0	100	2.83

Table 3 shows species abundance and relative species abundance for rainy and dry seasons in Oguta and Orachi, respectively. Overall, species abundances of Oguta and Orashi increased during the rainy season. In addition, *Panicum maximum* and *Phyllanthus amarus* were found to be the most abundant species at Oguta and Orashi for the two seasons, respectively. The relative species abundance were low at the studied sites.

Table 3: Species abundances relative species abundance for rainy and dry seasons in Oguta and Orachi

S/N	Species	Family	Habit	Oguta				Orashi			
				Rainy		Dry		Rainy		Dry	
				A (m^{-2})	RA (%)	A (m^{-2})	RA (%)	A (m^{-2})	RA (%)	A (m^{-2})	RA (%)
1	*Bambusa vulgaris* Schrad. ex J.C.Wendl.	Poaceae	Tree	12	1.435	12	2.3	8.667	0.964	8.67	1.51
2	*Ageratum conyzoides*L.	Asteraceae	Herb	111	13.23	47	9	79.33	8.825	39.3	6.83
3	*Talinum triangulare*	Talinaceae	Herb	47	5.581	21	4.02	20.33	2.262	24.3	4.23
4	*Telfairia occidentalis*	Cucurbitaceae	Climber	36	4.345	25	4.69	14.33	1.594	25.7	4.46
5	*Xanthosoma sagittifolia* (L.) Schott	Aracea	Herb	19	2.272	9.3	1.79	12.33	1.372	3.67	0.64
6	*Manihot esculentum*Crantz.	Euphorbiaceae	Shrub	0	0	35	6.64	51	5.673	0	0
7	*Elaeisguineensis*Jacq.	Arecaceae	Tree	2.3	0.279	2.3	0.45	6	0.667	6	1.04
8	*Alchornea cordifolia* Müll.Arg.	Euphorbiaceae	Tree	0	0	0	0	17	1.891	6.67	1.16
9	*Panicum maximum* Jacq.	Poaceae	Herb	119	14.27	54	10.3	32.33	3.597	23	4
10	*Dioscoreabulbifera*L.	Dioscoreaceae	Climber	0	0	20	3.83	0	0	0	0
11	*Calamus rotang* L.	Arecaceae	Shrub	0	0	0	0	6	0.667	6	1.04
12	*Raphia hookeri*G.Mann&H.Wendl.	Arecaceae	Tree	7	0.837	7	1.34	0	0	0	0
13	*Raphia vinifera* P.Beauv.	Arecaceae	Tree	8	0.957	8	1.53	0	0	0	0
14	*Tectona grandis* L.f.	Lamiaceae	Tree	0	0	0	0	4.5	0.501	4.5	0.78
15	*Musa paradisiaca* L.	Musaceae	Tree	2	0.239	2	0.38	0	0	0	0
16	*Thalia geniculata*L.	Marantaceae	Herb	0	0	0	0	19.33	2.151	7.67	1.33
17	*Setaria pumila* (Poir.) Roem. &Schult.	Poaceae	Herb	0	0	0	0	66.33	7.379	24	4.17
18	*Urena lobata* L.	Malvaceae	Shrub	33	3.986	20	3.77	83.33	9.27	43.3	7.53
19	*Wissadula rostrata* (Schumach.) Hook. f.	Malvaceae	Herb	15	1.754	15	2.81	28.67	3.189	21.3	3.71
20	*Sida acuta* Burm.f.	Malvaceae	Herb	28	3.348	13	2.43	14.33	1.594	6.33	1.1
21	*Sida cordifolia* L.	Malvaceae	Herb	22	2.631	11	2.11	12.5	1.39	4.5	0.78
22	*Alstoniaboonei*De Wild.	Apocynaceae	Tree	5	0.598	5	0.96	2	0.222	2	0.35
23	*Musangacecropioides*R.Br. &Tedlie	Urticaceae	Tree	2	0.239	2	0.38	4.5	0.501	4.5	0.78
24	*Pentaclethra macrophylla*Benth.	Fabaceae	Tree	2.5	0.299	2.5	0.48	0	0	3.67	0.64
25	*Lophiraalata* Banks ex Gaertn	Ochnaceae	Tree	2.5	0.299	2.5	0.48	0.333	0.037	1	0.17
26	*Chromolaenaodorrata*(L.) R. King & H. Robinson).	Asteraceae	Shrub	28	3.348	9.3	1.79	22.67	2.521	13.3	2.32
27	*Miliciaexcelsa* (Welw.) C.C. Berg	Moraceae	Tree	1.5	0.179	3	0.57	1.5	0.167	1.5	0.26
28	*Costusafer*Ker-Gawl	Costuceae	Shrub	13	1.555	13	2.49	22.33	2.484	22.3	3.88
29	*Diplaziumsammatii*(Kuhn.) C.Chr.	Athyraceae	Herb	34	4.066	20	3.9	44.33	4.931	28.5	4.95

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30	*Ipomoea aquatica*Forssk.	Convolvulaceae	Climber	28	3.388	12	2.23	31	3.448	15.7	2.72
31	*Ipomea ivolicrata*P.Beauv.	Convolvulaceae	Climber	27	3.269	17	3.32	38.67	4.301	16	2.78
32	*Ageratum houstonianum* Mill.	Asteraceae	Herb	66	7.933	24	4.6	63.33	7.045	32.7	5.68
33	*Aspiliaafricana* (Pers.) C.D.Adams	Asteraceae	Herb	13	1.555	19	3.64	19	2.113	11	1.91
34	*Newbouldialaevis*(P.Beauv.) Seem. ex Bureau	Bignoniaceae	Tree	1.5	0.179	1.5	0.29	2	0.222	2	0.35
35	*Phyllanthus amarus*Schumach. &Thonn.	Phyllanthaceae	Herb	81	9.647	26	4.92	90.33	10.05	70	12.2
36	*Senna alata* (L.) Roxb.	Fabaceae	Shrub	11	1.315	18	3.45	10.67	1.187	20.3	3.53
37	*Senna hirsuta*(L.) H.S.Irwin&Barneby	Fabaceae	Shrub	10	1.196	5.5	1.05	10.67	1.187	10	1.74
38	*Senna obtusifolia* (L.) H.S.Irwin&Barneby	Fabaceae	Shrub	11	1.315	6	1.15	10	1.112	4.33	0.75
39	*Mangifera indica* L.	Anacardiaceae	Tree	1	0.12	1	0.19	3	0.334	3	0.52
40	*Dacryodes edulis* H.J. Lam	Burseraceae	Tree	1	0.12	1	0.19	1	0.111	1	0.17
41	*Psidium guajava* L.	Myrtaceae	Tree	1	0.12	1	0.19	0	0	0	0
42	*Calopogoniummucunoides*Desv.	Fabaceae	Climber	3.5	0.419	3.5	0.67	4.667	0.519	4.67	0.81
43	*Pueraria phaseoloides* (Roxb.) Benth.	Fabaceae	Climber	4.7	0.558	4.7	0.89	10	1.112	5	0.87
44	*Andropogon tectorum*Schumach. &Thonn.	Poaceae	Herb	23	2.751	22	4.21	19.67	2.188	9.33	1.62
45	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	Herb	3	0.359	3	0.57	10	1.112	6	1.04
46	*Naucleadiderrichii*(De Wild. &T.Durand) Merr.	Rubiaceae	Tree	0	0	0	0	1	0.111	1	0.17
47	*Cenchrus purpureus* (Schumach.) Morrone	Poaceae	Herb	44.3	4.942	6.33	1.18	0	0	31.7	5.5

Presented in Table 4 is the result for species density and relative species density for Oguta and Orashi during rainy and dry seasons. Oguta wetland showed species with the highest density when compared with Orashi across the two seasons. However, at Orashi, the species with highest density (in order of decreasing density) were *Phyllanthus amarus, Urena lobata, Ageratum conyzoides, Setaria pumila* and *Ageratum conyzoides*,. Out of the forty-two (42) species observed at Orashi, only *Ageratum conyzoides, Urena lobata*, and *Ageratum houstonianum* were observed to have a relative density greater than 5% for both rainy and dry seasons. In Oguta wetland, *Ageratum conyzoides, Panicum maximum, Ageratum houstonianum* and *Phallathusamarus* were also found to have relative density greater than 5% for the two seasons.

Table 4: Species density and relative species density for Oguta and Orashi

S /N	Species	Family	Habit	Oguta				Orashi			
				Rainy		Dry		Rainy		Dry	
				D (m^{-2})	RD (%)	D (m^{-2})	RD (%)	D (m^{-2})	RD (%)	D (m^{-2})	RD (%)
1	*Bambusa vulgaris* Schrad. ex J.C.Wendl.	Poaceae	Tree	8	0.985	8	1.81	8.667	0.984	8.67	1.6
2	*Ageratum conyzoides*L.	Asteraceae	Herb	110.67	13.63	47	10.6	79.33	9.005	39.3	7.26
3	*Talinum triangulare*	Talinaceae	Herb	46.667	5.747	14	3.17	20.33	2.308	24.3	4.49
4	*Telfairia occidentalis*	Cucurbitaceae	Climber	36.333	4.475	16.3	3.7	14.33	1.627	25.7	4.74
5	*Xanthosoma sagittifolia* (L.) Schott	Aracea	Herb	19	2.34	9.33	2.11	12.33	1.4	3.67	0.68
6	*Manihot esculentum*Crantz.	Euphorbiaceae	Shrub	0	0	34.7	7.84	51	5.789	0	0
7	*ElaeisguineensisJacq.*	Arecaceae	Tree	2.3333	0.287	2.33	0.53	6	0.681	6	1.11
8	*Alchornea cordifolia* Müll.Arg.	Euphorbiaceae	Tree	0	0	0	0	11.33	1.286	6.67	1.23
9	*Panicum maximum* Jacq.	Poaceae	Herb	119.33	14.7	53.7	12.1	32.33	3.67	15.3	2.83
10	*Dioscoreabulbifera*L.	Dioscoreaceae	Climber	0	0	13.3	3.02	0	0	0	0
11	*Calamus rotang* L.	Arecaceae	Shrub	0	0	0	0	4	0.454	4	0.74
12	*Raphia hookeri*G.Mann&H.Wendl.	Arecaceae	Tree	7	0.862	7	1.58	0	0	0	0
13	*Raphia vinifera* P.Beauv.	Arecaceae	Tree	8	0.985	8	1.81	0	0	0	0
14	*Tectona grandis* L.f.	Lamiaceae	Tree	0	0	0	0	3	0.341	3	0.55
15	*Musa paradisiaca* L.	Musaceae	Tree	0.6667	0.082	0.67	0.15	0	0	0	0
16	*Thalia geniculata*L.	Marantaceae	Herb	0	0	0	0	19.33	2.194	7.67	1.41
17	*Setaria pumila* (Poir.) Roem. &Schult.	Poaceae	Herb	0	0	0	0	66.33	7.529	24	4.43
18	*Urena lobata* L.	Malvaceae	Shrub	33.333	4.105	19.7	4.45	83.33	9.459	43.3	8
19	*Wissadula rostrata* (Schumach.) Hook. f.	Malvaceae	Herb	14.667	1.806	14.7	3.32	28.67	3.254	21.3	3.94

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20	*Sida acuta* Burm.f.	Malvaceae	Herb	28	3.448	12.7	2.87	14.33	1.627	6.33	1.17
21	*Sida cordifolia* L.	Malvaceae	Herb	22	2.709	11	2.49	8.333	0.946	3	0.55
22	*Alstoniaboonei*De Wild.	Apocynaceae	Tree	3.3333	0.411	3.33	0.75	1.333	0.151	1.33	0.25
23	*Musangacecropioides*R.Br. &Tedlie	Urticaceae	Tree	2	0.246	2	0.45	3	0.341	3	0.55
24	*Pentaclethra macrophylla*Benth.	Fabaceae	Tree	1.6667	0.205	1.67	0.38	3.667	0.416	3.67	0.68
25	*Lophiraalata* Banks ex Gaertn	Ochnaceae	Tree	1.6667	0.205	1.67	0.38	0.333	0.038	0.33	0.06
26	*Chromolaenaodorrata*(L.) R. King & H. Robinson).	Asteraceae	Shrub	28	3.448	9.33	2.11	22.67	2.573	13.3	2.46
27	*Miliciaexcelsa* (Welw.) C.C. Berg	Moraceae	Tree	1	0.123	1	0.23	1	0.114	1	0.18
28	*Costusafer*Ker-Gawl	Costuceae	Shrub	13	1.601	13	2.94	22.33	2.535	22.3	4.12
29	*Diplaziumsammatii*(Kuhn.) C.Chr.	Athyraceae	Herb	34	4.187	20.3	4.6	44.33	5.032	19	3.51
30	*Ipomoea aquatica*Forssk.	Convolvulaceae	Climber	28.333	3.489	11.7	2.64	31	3.519	15.7	2.89
31	*Ipomea ivolicrata*P.Beauv.	Convolvulaceae	Climber	27.333	3.366	17.3	3.92	38.67	4.389	16	2.95
32	*Ageratum houstonianum* Mill.	Asteraceae	Herb	66.333	8.169	24	5.43	63.33	7.189	32.7	6.03
33	*Aspiliaafricana* (Pers.) C.D.Adams	Asteraceae	Herb	13	1.601	6.33	1.43	19	2.157	11	2.03
34	*Newbouldialaevis*(P.Beauv.) Seem. ex Bureau	Bignoniaceae	Tree	1	0.123	1	0.23	2	0.227	2	0.37
35	*Phyllanthus amarus*Schumach. &Thonn.	Phyllanthaceae	Herb	80.667	9.934	25.7	5.81	90.33	10.25	70	12.9
36	*Senna alata* (L.) Roxb.	Fabaceae	Shrub	7.3333	0.903	6	1.36	10.67	1.211	20.3	3.75
37	*Senna hirsuta*(L.) H.S.Irwin&Barneby	Fabaceae	Shrub	6.6667	0.821	3.67	0.83	10.67	1.211	6.67	1.23
38	*Senna obtusifolia* (L.) H.S.Irwin&Barneby	Fabaceae	Shrub	7.3333	0.903	4	0.9	10	1.135	4.33	0.8
39	*Mangifera indica* L.	Anacardiaceae	Tree	0.3333	0.041	0.33	0.08	2	0.227	2	0.37
40	*Dacryodes edulis* H.J. Lam	Burseraceae	Tree	0.3333	0.041	0.33	0.08	0.333	0.038	0.33	0.06
41	*Psidium guajava* L.	Myrtaceae	Tree	0.6667	0.082	0.67	0.15	0	0	0	0
42	*Calopogoniummucunoides*Desv.	Fabaceae	Climber	2.3333	0.287	2.33	0.53	4.667	0.53	4.67	0.86
43	*Pueraria phaseoloides* (Roxb.) Benth.	Fabaceae	Climber	4.6667	0.575	4.67	1.06	10	1.135	5	0.92
44	*Andropogon tectorum*Schumach. &Thonn.	Poaceae	Herb	23	2.833	7.33	1.66	19.67	2.232	9.33	1.72
45	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	Herb	2	0.246	2	0.45	6.667	0.757	4	0.74
46	*Naucleadiderrichii*(De Wild. &T.Durand) Merr.	Rubiaceae	Tree	0	0	0	0	0.333	0.038	0.33	0.06
47	*Cenchrus purpureus* (Schumach.) Morrone	Poaceae	Herb	44.333	5.247	6.33	1.36	0	0	31.7	5.84

At Oguta, *Panicum maximum* has the highest important value index of 32.09 followed by *Ageratum conyzoides* with 29.99 important value index. These high values were recorded during rainy season. *Phallathusamarus* and *Ageratum conyzoides* with important value index of 27.9 and 20.63 respectively were observed to have the maximum important value index at Orashi. However, the high value of *Phallathusamarus* recorded at Orashi were observed during rainy season, although dry season value was also high but decrease in value was recorded. For *Ageratum conyzoides* the high important value index was observed during dry season (Table 5).

Table 5: Important value index for Oguta and Orashi for the two seasons

				Oguta		Orashi	
S/N	**Species**	**Family**	**Habit**	**Rainy**	**Dry**	**Rainy**	**Dry**
1	*Bambusa vulgaris* Schrad. ex J.C.Wendl.	Poaceae	Tree	4.504	6.3	4.751	5.94
2	*Ageratum conyzoides*L.	Asteraceae	Herb	29.99	23	20.63	16.9
3	*Talinum triangulare*	Talinaceae	Herb	14.45	9.3	7.373	11.5
4	*Telfairia occidentalis*	cucurbitaceae	Climber	11.94	11	6.025	12
5	*Xanthosoma sagittifolia* (L.) Schott	Aracea	Herb	7.737	7.1	5.576	4.14
6	*Manihot esculentum*Crantz.	Euphorbiaceae	Shrub	0	18	14.27	0
7	*Elaeisguineensis*Jacq.	Arecaceae	Tree	3.691	4.2	4.152	4.98
8	*Alchornea cordifolia* Müll Arg.	Euphorbiaceae	Tree	0	0	5.047	5.22
9	*Panicum maximum* Jacq.	Poaceae	Herb	32.09	26	10.07	8.71
10	*Dioscoreabulbifera*L.	Dioscoreaceae	Climber	0	9	0	0
11	*Calamus rotang* L.	Arecaceae	Shrub	0	0	2.991	3.67
12	*Raphia hookeri*G.Mann&H.Wendl.	Arecaceae	Tree	4.824	6.2	0	0
13	*Raphia vinifera* P.Beauv.	Arecaceae	Tree	5.067	6.6	0	0
14	*Tectona grandis* L.f.	Lamiaceae	Tree	0	0	2.71	3.22
15	*Musa paradisiaca* L.	Musaceae	Tree	1.363	1.6	0	0

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16	*Thalia geniculata*L.	Marantaceae	Herb	0	0	7.149	5.58
17	*Setaria pumila*(Poir.) Roem. &Schult.	Poaceae	Herb	0	0	17.71	11.4
18	*Urena lobata* L.	Malvaceae	Shrub	11.22	11	21.53	18.4
19	*Wissadula rostrata* (Schumach.) Hook. f.	Malvaceae	Herb	6.685	9.4	9.246	10.5
20	*Sida acuta* Burm.f.	Malvaceae	Herb	9.922	8.5	6.025	5.1
21	*Sida cordifolia* L.	Malvaceae	Herb	8.465	7.8	4.205	3.22
22	*Alstoniaboonei*De Wild.	Apocynaceae	Tree	3.092	3.9	2.243	2.48
23	*Musangacecropioides*R.Br. &Tedlie	Urticaceae	Tree	3.61	4.1	2.71	3.22
24	*Pentaclethra macrophylla*Benth.	Fabaceae	Tree	2.588	3	0.416	4.14
25	*Lophiraalata* Banks ex Gaertn	Ochnaceae	Tree	2.588	3	2.879	1.18
26	*Chromolaenaodorrata*(L.) R. King & H. Robinson).	Asteraceae	Shrub	9.922	7.1	7.898	7.61
27	*Miliciaexcelsa* (Welw.) C.C. Berg	Moraceae	Tree	2.386	1.9	2.15	2.33
28	*Costusafer*Ker-Gawl	Costuceae	Shrub	6.281	8.7	7.823	10.8
29	*Diplaziumsammatii*(Kuhn.) C.Chr.	Athyraceae	Herb	11.38	12	12.77	10.3
30	*Ipomoea aquatica*Forssk.	Convolvulaceae	Climber	10	8.1	9.771	8.44
31	*Ipomea ivolicrata*P.Beauv.	Convolvulaceae	Climber	9.76	10	11.49	8.56
32	*Ageratum houstonianum* Mill.	Asteraceae	Herb	19.23	13	17.04	14.5
33	*Aspiliaafricana* (Pers.) C.D.Adams	Asteraceae	Herb	6.281	6.1	7.074	6.77
34	*Newbouldialaevis*(P.Beauv.) Seem. ex Bureau	Bignoniaceae	Tree	2.386	2.7	3.253	3.55
35	*Phyllanthus amarus*Schumach. &Thonn.	Phyllanthaceae	Herb	22.71	14	23.11	27.9
36	*Senna alata* (L.) Roxb.	Fabaceae	Shrub	4.302	5.9	5.201	10.1
37	*Senna hirsuta*(L.) H.S.Irwin&Barneby	Fabaceae	Shrub	4.1	4	5.201	4.85
38	*Senna obtusifolia* (L.) H.S.Irwin&Barneby	Fabaceae	Shrub	4.302	4.2	5.051	4.38
39	*Mangifera indica* L.	Anacardiaceae	Tree	1.202	1.3	2.43	2.78
40	*Dacryodes edulis* H.J. Lam	Burseraceae	Tree	1.202	1.3	1.084	1.18
41	*Psidium guajava* L.	Myrtaceae	Tree	2.285	2.5	0	0
42	*Calopogoniummucunoides*Desv.	Fabaceae	Climber	2.789	3.3	3.853	4.5
43	*Pueraria phaseoloides* (Roxb.) Benth.	Fabaceae	Climber	4.258	5.2	5.051	4.62
44	*Andropogon tectorum*Schumach. &Thonn.	Poaceae	Herb	8.708	6.9	7.224	6.17
45	*Pteridium aquilinum*(L.) Kuhn	Dennstaedtiaceae	Herb	2.688	3.2	3.738	3.67
46	*Naucleadiderrichii*(De Wild. &T.Durand) Merr.	Rubiaceae	Tree	0	0	1.084	1.18
47	*Cenchrus purpureus* (Schumach.) Morrone	Poaceae	Herb	12.992	5.54	0	14.2

The species richness, evenness and diversity for the sites of study for the two seasons is presented in Table 6. Based on the recorded value for species richness, Orashi rainy season shows the lowest richness value followed by Oguta rainy season value. However, the highest value was recorded during dry season at Oguta. The lowest Species evenness was observed at Oguta rainy season with the value of 0.768. Furthermore, maximum diversities of species were observed during the dry season at the two sites of study.

Table 6: Species richness, evenness and diversity of Oguta and Orashi

Parameter	**Oguta**		**Orashi**	
	Rainy	**Dry**	**Rainy**	**Dry**
Species Richness	5.771	6.259	5.711	6.221
Species Evenness	0.768	0.836	0.829	0.838
Species Diversity	2.941	3.200	3.173	3.226

IV. DISCUSSION

Phytodiversity, or plant diversity, refers to the range and variability of plants in an ecosystem and the level of phytodiversity in a given location depends on the climatic conditions of that ecosystem (Scherrer &Körner, 2011). Phytodiversity tends to cluster in hotspots and increases over time, but can be slowed by deforestation, pollution, and other factors (Lang et al., 2019). This diversity is vital in sustaining life through evolutionary, ecological, and cultural processes (Cabral et al., 2019). However, rapid environmental changes have resulted in mass extinctions (Kaiho et al., 2016). To monitor the health and stability of wetlands, especially when faced with natural and human-induced disturbances, phytodiversity assessment is a useful tool (Li et al., 2014).

Considering the two sites of study (Oguta and Orashi), seasonality was observed to play a significant role in species composition for each of the study sites. This observation was in agreement with the report of Asunbo and Tanee(2022) and also with Adeonipekun et al. (2019), where they concluded that seasons have an essential role to play in the species composition of an ecosystem.

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Accordingly, the most abundant plant species common to the study sites include *Ageratum conyzoides, Panicum maximum, Phyllanthus amarus, Ageratum houstonianum, Urena lobata, Talinum triangulare, and Diplaziumsammatii*. These species are herbs with the exception of *Urena lobata*. The observation corroborates with the findings of Moges et al. (2017), who stated that wetlands are mostly dominated by herbs.

Oguta had a higher species density than Orashi. The lower species density observed at Orashi may be due to the various anthropogenic activities ongoing at and near the study site. These activities include sewage discharge into the water body and artisanal refining near the site of study. A similar observation was made by Yabrade and Tanee (2016); where they reported a decline in species density and abundance in a mangrove ecosystem due to artisanal refining. Artisanal refineries can have catastrophic impacts on biodiversity found in an ecosystem. Phytotoxins introduced into the environment due to these activities can reduce photosynthetic processes that occur in flora, as well as reducing the regeneration of plants (Asimie&Omokhua, 2013).

The families with the largest important value index were Poaceae, Asteraceae, and Phyllanthaceae. These families were among the plant species that were reported by NDDC (2005) to be prevalent in Niger Delta wetlands of Nigeria. However, the species family at Orashi was lower than those of Oguta. This could be due to large-scale disturbance and the impact of mechanical erosion dominant at Orashi; this could have affected the hydrological features. This observation corroborates with the report of Aisuebeogun et al. (2014) and Igu and Marchant (2018). Furthermore, the evenness of species was observed to be highest at Orashi in the dry season, followed by Oguta in the same dry season. There was a low disparity between the number of individuals within each species for Orashi, which resulted in the insignificant variations observed within the season. Contrary to Orashi, Oguta had definite differences when Oguta was compared within season. Ahiarakwem et al., 2012 explained that Oguta been an area that is located in a natural depression where deep flooding and sedimentation were prominent can experience decrease in species eveness during rainy season. This observation is also in line with the report of Genrich, (2017) where he stated that long periods of standing water can affect vegetation evenness.

Tonkin, et al. (2017) and Khan et al. (2013) concluded that the ability of an ecosystem to support different flora assemblages at different periods of the year is a function of seasons and the ecological condition of the system. Consistent with this, is seen in the observation made when the species diversity of each of the study site was compared within and across seasons. Species diversity of Oguta varied when it was compared to that of Orashi, however, higher species diversity was observed during dry season for the two sites. Anthropogenic activities can have a severe impact on biodiversity. The results of this study provide important insights into the phytodiversity of wetlands in Nigeria and highlight the need for conservation efforts to protect these valuable ecosystems.

V. CONCLUSION

In conclusion, phytodiversity is crucial for the sustainability of life and is affected by various factors, including seasonality and human activities. The study of the wetlands in Oguta and Orashi highlights the impact of anthropogenic activities on plant diversity in ecosystems. The lower species density observed at Orashi is attributed to the various anthropogenic activities ongoing at and near the study site. These activities include sewage discharge into the water body and artisanal refining near the site of study. The family with the largest important value index were *poaceae, asteraceae* and *phyllanthaceae*. These families were among the plant species that were reported to be prevalent in Niger Delta wetlands of Nigeria. The results also showed that seasonality played a significant role in species composition for each of the study sites. Species richness was lowest at Orashi study site during rainy season and highest at Oguta during dry season. Evenness of species was observed to be highest at Orashi in dry season followed by Oguta in the same dry season.

The study highlights the importance of monitoring the health and stability of wetlands, especially when faced with natural and human-induced disturbances. It also emphasizes the need for conservation efforts to preserve plant diversity in ecosystems. It is essential to create awareness among people about the importance of plant diversity and the impact of human activities on ecosystems. Governments and organizations should implement policies that promote sustainable land use practices and discourage activities that can lead to the destruction of ecosystems. Finally, it is vital to continue to study the dynamics of ecosystems to understand the complex relationships between species and their environment, which will help us to develop strategies for conserving plant diversity and promoting sustainable development

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