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PALYNOLOGICAL STUDY OF RECENT SURFACE SEDIMENTS FROM COASTAL AREA OF LAGOS, NIGERIA

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ABSTRACT

A palynology study of recent sediments from an 18 cm-core collected from the swamp area in University of Lagos, very close to the Lagos lagoon, was carried out. The recovered palynomorphs included pollen, fern spores, fungal spores and remains, and diatom frustules. Some of the major pollen documented include Arecaceae, Poaceae, *Alchornea cordifolia*, Amaranthaceae/Chenopodiaceae and *Rhizophora*. The recovered palynomorph assemblages revealed the recent vegetation changes in this area, which suggests a dominance of open forest vegetation type. Anthropogenic impact especially farming was a key factor that determined palynomorph diversity and abundance.

Keywords: Lagos, Palynology, Vegetation changes, Human impact, Palaeoenvironment.

INTRODUCTION

Palynology has been a veritable tool in palaeoenvironmental reconstruction especially in documenting history and dynamics of past plant communities (Faegri and Iversen, 1975). On a longer time-scale, palynological proxies can identify broad environmental trends both in terrestrial and aquatic settings and the proxies are mostly drawn from sedimentary deposits such as lakes, marine deposits, peatlands and other wetlands such as marshes and swamps (Jeglum and Rydin, 2006; Smol *et al.*, 2001). It is commonly stated that the present condition of the biosphere is the result of the interaction of ecological and historical factors of the past, and the relative significance of each of these factors in shaping present day world can be evaluated (Qian *et al.*, 2007; Emerson and Gillespie, 2008; Alvarez *et al.*, 2009).

This evaluation can be achieved with the use of palynological tools in addition to other independent records of climate and other aspects of the environment such as, physical and chemical aspects. Palynological investigations during the late Quaternary especially the Holocene, have shown that the vegetation of West Africa had undergone considerable changes (Agwu, 1986; Sowunmi, 2004; Njokuocha, 2012). This is believed to be as a result of climate variability coupled with orbital shifts, which have influenced the development and distribution of vegetation over time (Agwu and Beug, 1982; Jahns, 1996).

Conversely, humans have played a major role in perturbing the environment over the last 5,000 years especially in terms of deforestation (State of The World's Forest, 2012). Few palynological studies of Holocene deposits have been carried out in the coastal environments of Lagos, Nigeria (Orijemie, 2014; Orijemie and Sowunmi, 2014). This study aims at contributing to the existing record of the very recent past vegetation changes through the palynology of a sediment core in the coastal area of Lagos. This is to document the recent changes in plant communities in the coastal area of University of Lagos.

Lagos sits on the coastal area of southwestern part of Nigeria between ~ longitudes 2˚42'E to 3˚ 42'E and latitudes 6˚22'N to 6˚42'N (Figure 1); and is characterized by a humid tropical climate type. The two major seasons are the wet and dry seasons, which occur from April to November and December to March respectively. Annual rainfall in Lagos ranges between 1381.7 mm and 2733.4 mm, and monthly records range between 25 mm and over 400 mm (Ogundele, 2012). Temperature peak ranges between 29 ˚C and 34 ˚C while low temperature ranges between 24 ˚C and 28 ˚C with southwesterly wind and sea breezes prevailing all year round (Ogundele, 2012). University of Lagos is situated in the shoreline of

Lagos lagoon. A mosaic of swamp forest and open vegetation type characterized by *Alchornea cordifolia*, *Ipomoea carica*, Poaceae, Cyperaceae, *Acrosticum aureum, Luffa aegyptica, Commelina africana, Terminalia* spp., *Rhizophora* spp*, Raphia* spp*, Albizia zygia, Syzugium guineensis*, *Mimosa pudica*, *Anthocleista* spp., *Drepanocarpus* sp., *Triumpheta* sp. *Musa* spp. and *Mussaenda polita,* which presently dominate the area.

MATERIALS AND METHODS

The study area (Figure 1) is about 50 m from the brackish lagoon. It falls between longitude 6˚31'3.34" N and latitude 3˚24'4.47" E. An 18 cm deep hole was cored and sediments collected at 2 cm interval, labelled and then subjected to standard palynological treatment, according to Faegri and Iversen (1975). Five grams of each sub-sample was weighed for palynological preparation and treated with HCl, HF and acidified $ZnCl_2$ solutions in order to disintegrate all siliceous and carbonaceous materials. This was followed by acetolysis treatment to remove pollen kit and other cellulosic materials. Two millilitres of glycerine were added to the treated sediment residue for storage and to deduce the volume of the final residue.

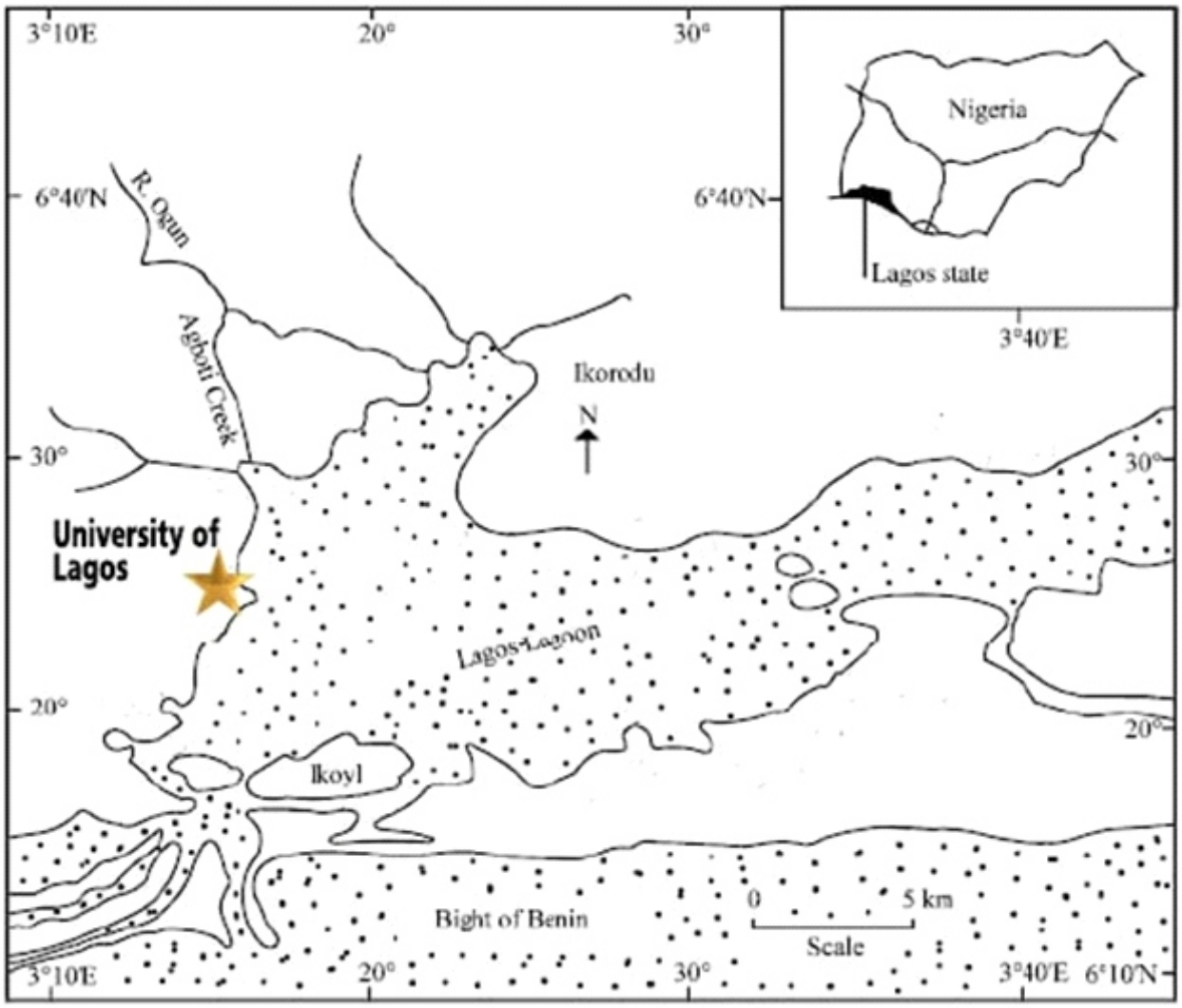

Figure 1: Map of Lagos, showing study site

Pollen slides (2 for each depth) were prepared from the final residue by pipetting 100 µl of the residue onto the slide. Microscopic analysis was carried out with an Olympus Microscope using x40 objective lens and identification of palynomorphs was done using published atlases and albums, which include Sowunmi (1995), Traverse (2007) and Gosling *et al.* (2013), as well as reference materials from the Laboratory of Palaeobotany and Palynology, University of Lagos, Akoka, Lagos Nigeria.

Pollen percentages were calculated using the sum of all pollen grains and fern spores, and pollen diagrams were created using Tilia 2.0.41. Pollen zones were determined by cluster analysis based on similarities in plant assemblages at different depths and pollen taxa were grouped into mangrove savanna, open forest vegetation, fresh water swamp and rain forest. In addition, exaggeration factor of 3 was added to taxa that have very low occurrence for visibility on the pollen diagram.

RESULTS

A total of nine angiosperm taxa, one aquatic taxon, fern and bryophyte spores, fungal spores and hyphae, as well as dicot cuticle and poorly preserved diatoms were recovered from the sediment core (Table 1, figure 2). Based on cluster analysis, four pollen zones A – D were recognized (Figure 3). In pollen zone A (18–14 cm) an open mangrove swamp vegetation composed of Poaceae, Cyperaceae, Amaranthaceae, *Rhizophora* sp., *Acrostichum aureum*, *Nephrolepis undulata*, Arecaceae, *Raphia hookerii,* Pteridophyte spores, Malvaceae, *A. cordifolia, Malus communis* and *Elaeis guineensis* prevailed (Table 1). Representative taxa of pollen zone B (14–8cm) include Poaceae, Amaranthaceae, *Rhizophora* sp., *Nephrolepis undulata*, *Nymphaea lotus*, Arecaceae, Pteridophyte spores, degraded diatoms, *A. cordifolia* and a few Bryophyte spores, which represent an open mangrove vegetation setting. Taxa assemblage recovered from pollen zone C (8–4 cm) include Asteraceae, *A. cordifolia*, *Typha* sp., Poaceae, Cyperaceae, Arecaceae, *Terminalia* sp., *Allophylus africanus, Elaeis guineensis,* Monolete, Trilete and Pteridophyte spores, which represent a mix of mangrove, rainforest and open forest vegetation. From the topmost zone: zone D (4 – 0 cm), the taxa recovered are mix of fresh water, mangrove, rainforest and open vegetation types; they included Poaceae, Cyperaceae, *Rhizophora* sp., *Nephrolepis undulata*, Arecaceae, Pteridophyte spore, *Berlinia grandiflora, Elaeis guineensis, Terminalia* sp. and *A. cordifolia.*

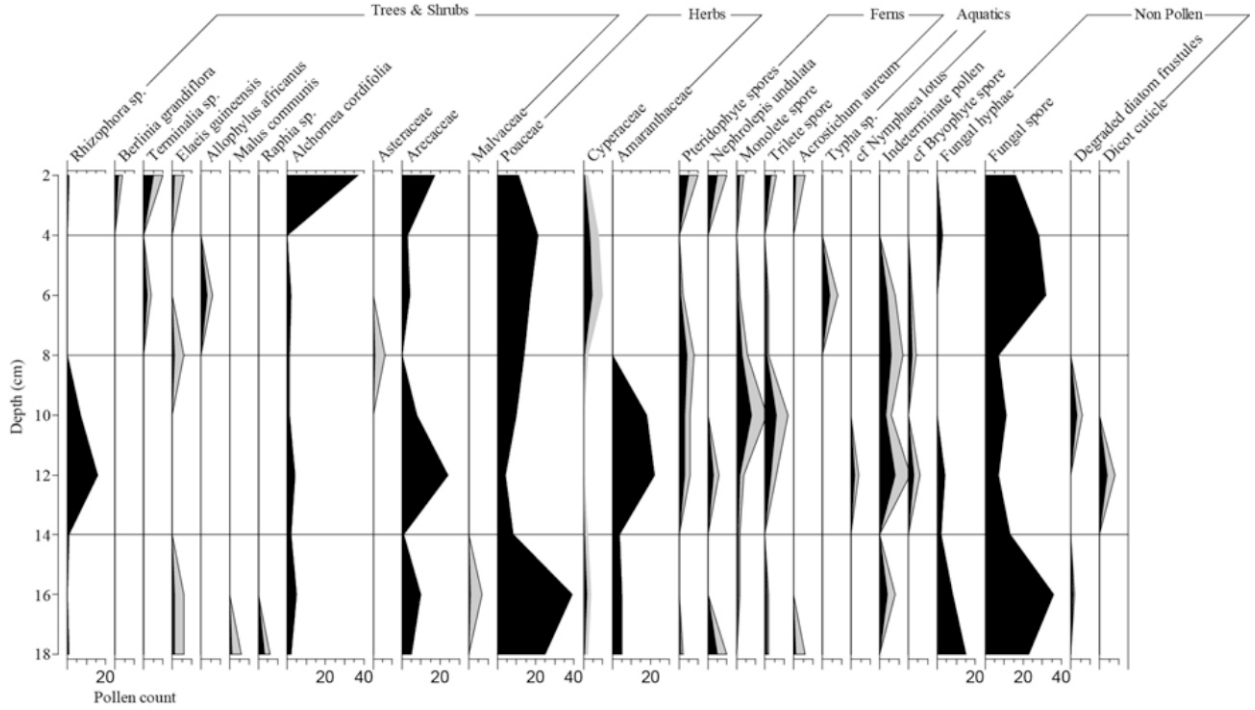

Figure 2: Diagram showing all recovered pollen and non-pollen palynomorphs

Table 1: Distribution of recovered Palynomorphs of studied shallow core

Palynomorphs/Depth (cm)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
Poaceae	11	21	17	14	10	4	8	39	25
Cyperaceae	1	4	5	1	0	0	1	2	1
Amaranthaceae	0	0	0	0	18	22	4	5	5
Rhizophora sp.	1	0	0	0	7	16	1	0	1
Acrostichum aureum	1	0	0	0	0	0	0	0	1
Typha sp.	0	0	4	0	0	0	0	0	0
Nephrolepis undulata	5	0	0	0	0	3	0	0	5
cf *Nympheae lotus*	0	0	0	0	0	2	0	0	0
Arecaceae	17	3	4	0	8	24	1	10	5
Degraded diatom frustules	0	0	0	0	3	0	0	1	0
Raphia hookerii	0	0	0	0	0	0	0	0	3
Monolete spore	2	0	1	3	8	2	1	1	0
Trilete spore	3	0	1	1	6	3	0	1	1
Pteridophyte spores	5	0	1	4	3	3	0	0	1
Malvaceae	0	0	0	0	0	0	0	1	0
Alchornea cordifolia	37	0	2	1	1	4	2	5	2
Asteraceae	0	0	0	1	0	0	0	0	0
Malus communis	0	0	0	0	0	0	0	0	1
Allophylus africanus	0	0	3	0	0	0	0	0	0
Terminalia sp.	5	0	2	0	0	0	0	0	0
Berlinia glandifolia	2	0	0	0	0	0	0	0	0
Elaeis guineensis	1	0	0	1	0	0	0	1	1
Indeterminate pollen	0	0	4	6	3	8	0	4	0
Fungal spore	16	28	32	7	11	7	13	36	23
Fungal hyphae	0	3	0	0	0	4	2	8	15
Dicot cuticle	0	0	0	0	0	4	0	0	0
cf Bryophyte spore	0	0	1	2	0	3	0	0	0
TOTAL	**107**	**59**	**77**	**41**	**78**	**109**	**33**	**114**	**90**

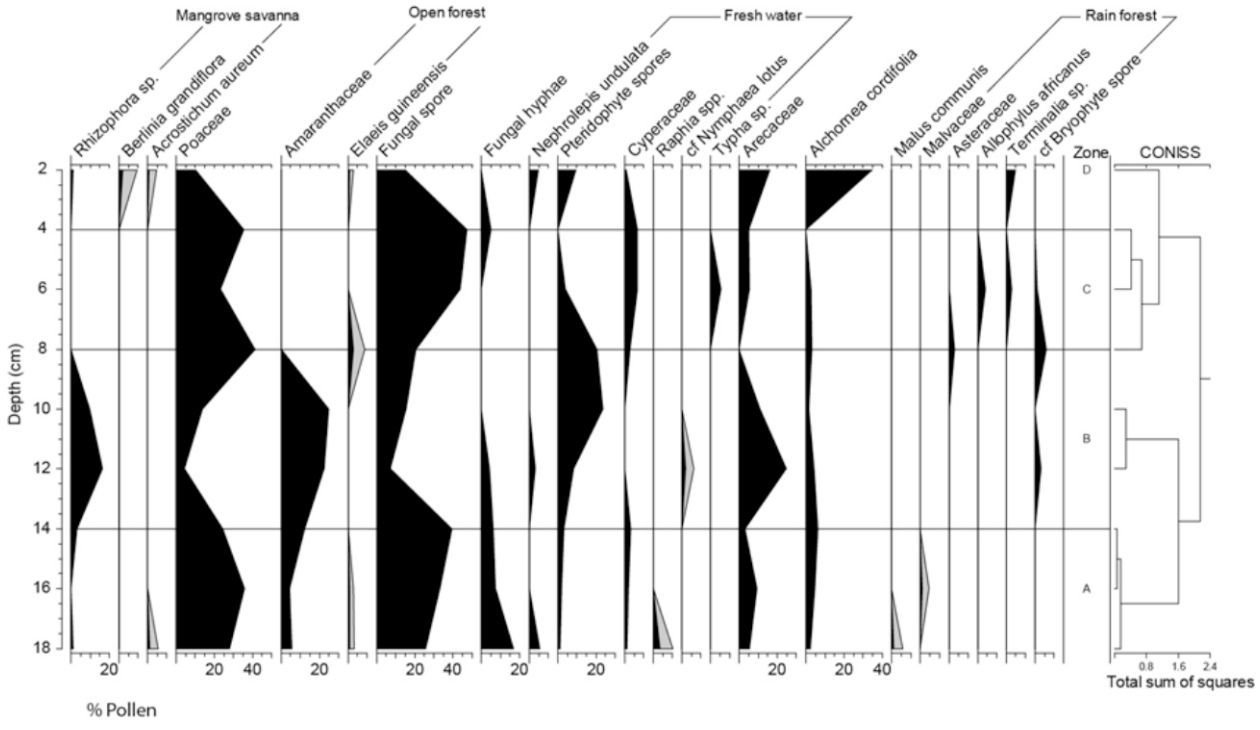

Figure 3: Pollen diagram showing taxa groups with zones based on cluster analysis

Table 2: Percentage sum of pollen and spores

Palynomorph/Depth (cm)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
Poaceae	10.3	35.6	23.3	41.2	13.9	4.1	24.2	35.8	28.1
Cyperaceae	0.9	6.8	6.8	2.9	0.0	0.0	3.0	1.8	1.1
Amaranthaceae	0.0	0.0	0.0	0.0	25.0	22.7	12.1	4.6	5.6
Rhizophora spp.	0.9	0.0	0.0	0.0	9.7	16.5	3.0	0.0	1.1
Acrostichum aureum	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Typha sp.	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0
Nephrolepis undulata	4.7	0.0	0.0	0.0	0.0	3.1	0.0	0.0	5.6
cf *Nymphaea lotus*	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Arecaceae	15.9	5.1	5.5	0.0	11.1	24.7	3.0	9.2	5.6
Raphia spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
Pteridophyte spores	9.3	0.0	4.1	20.6	23.6	8.2	3.0	1.8	1.1
Malvaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Alchornea cordifolia	34.6	0.0	2.7	2.9	1.4	4.1	6.1	4.6	2.2
Asteraceae	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
Malus communis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Allophylus africanus	0.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0
Terminalia sp.	4.7	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0
Berlinia grandiflora	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elaeis guineensis	0.9	0.0	0.0	2.9	0.0	0.0	0.0	0.9	1.1
Fungal spore	15.0	47.5	43.8	20.6	15.3	7.2	39.4	33.0	25.8
Fungal hyphae	0.0	5.1	0.0	0.0	0.0	4.1	6.1	7.3	16.9
cf Bryophyte spore	0.0	0.0	1.4	5.9	0.0	3.1	0.0	0.0	0.0

Table 3: Sum of pollen and spores

Palynomorph/Depth (cm)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
Elaeis guineensis	1	0	0	1	0	0	0	1	1
Berlinia glandifolia	2	0	0	0	0	0	0	0	0
Raphia hookeri	0	0	0	0	0	0	0	0	3
Rhizophora	1	0	0	0	7	16	0	0	1
Arecaceae	17	3	4	0	8	24	1	10	5
Alchornea cordifolia	37	0	2	1	1	4	2	5	2
Amaranthaceae	0	0	0	0	18	22	4	5	5
Poaceae	11	21	17	14	10	4	8	39	25
Cyperaceae	1	4	5	1	0	0	1	2	1
Acrostichum aureus	1	0	0	0	0	0	0	0	1
Trilete spore	3	0	1	1	6	3	0	1	1
Nephrolepis undulata	5	0	0	0	0	3	0	0	5
Pteridophyte spore	5	0	1	4	3	3	0	0	1
cf Bryophyte Spore	0	0	1	2	0	3	0	0	0
cf *Nympheae lotus*	0	0	0	0	0	2	0	0	0
Sum	84	28	31	24	53	84	16	63	51

DISCUSSION AND CONCLUSION

In pollen zone A (18 – 14 cm), the predominance of Poaceae pollen with an average count of 72 pollen, in addition to low recovery of Pteridophyte spores and sparse distribution of *Elaeis guineensis* pollen suggests an open vegetation in this interval (Table 1). pollen zone B (14 – 8 cm) recorded the dominance of Amaranthaceae, *Rhizophora* and Arecaceae pollen with few degraded diatom remains. The low proportions of Poaceae and *A. cordifolia,* and the overall floristic composition may suggest a mangrove vegetation type. In addition, the significant recovery of Amaranthaceae in this zone indicates human farming activities or possibly inundation consequence by marine transgression. The brackish water incursion might have promoted the presence of salt loving Amaranthaceae such as, *Salicornia* (Slenzka *et al*., 2013).

Abundant recovery of Poaceae and Cyperaceae pollen characterized the interval represented by

pollen zone C (8 – 4 cm). However, the occurrence of *Allophylus africanus, Terminalia* sp., and fern spores, although in low proportions, with low recovery of Arecaceae, *A. cordifolia*, *Nephrolepis undulata* and *Nympheae lotus* may indicate a marshy or swampy open grassland vegetation. This vegetation setting is similar to the current vegetation in some adjacent areas to the study site. Following this zone is pollen zone D (4.0 – 0.0cm). The pollen assemblage of this zone include *Terminalia* sp., *Berlinia, Elaeis guineensis*, *A. cordifolia* and Arecaceae. Fern spores particularly *Acrostichum aureum* were recovered in abundance along with fungal spores. *A. cordifolia*, Arecaceae and Poaceae dominated this interval although, Poaceae count decreased to an average of 16, and these taxa form majority of the plants growing in the study area presently (Figure 1).

The close proximity of the study area to the lagoon may have had tremendous impact on the overall vegetation changes, and the study area is mostly wet all year round due to increase in lagoon tide during raining season. This tide also reduces in the dry season, leaving the study area in a marshy/swampy state, and sometimes fairly dry in extreme prolonged dry seasons. Overall, an open swampy vegetation type prevailed in the entire core, which is similar to the surface portion of other Holocene studies that have been carried out in Nigeria in terms of presence of open and swampy vegetation taxa (Sowunmi, 1981; Wang *et al.*, 2008). Anthropogenic activities such as farming, deforestation, construction, burning, and increasing human population are factors, which could possibly have contributed to the open nature of the vegetation. Increased human populations in coastal areas usually result in increased demand for space to erect residential and office buildings, tourist resorts, and recreation areas (Martínez *et al.*, 2004).

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