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Research Article

A Study of Derived Savanna environment through airborne palynomorphs, Anyigba, Kogi State, Nigeria.

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Abstract: A study of airborne palynomorphs of Derived Savanna environment, Nigeria during the dry season (October-December) and wet season (April-June) in 2012, revealed the presence of great diversity of palynomorphs consisting of pollen grains, fungal spores, algal cysts, diatoms, dinoflagellate cysts and spores of pteridophytes (ferns). In addition to pollen grains and spores, other minute plant parts such as trichomes, charred/ burnt epidermis of leaves, cells and tissues were also airborne. A total of 20027 palynomorphs consisting of 8574 pollen grains, 6679 fungal spores, 213 diatoms, 51 dinoflagellate cysts, 167 pteridophyte spores, 2930 burnt plant epidermis/ trichomes and 1413 charred poaceae cuticle were encountered. The trapped pollen grains of plants were representatives of the major phytoecological zones (Forest, Savanna, Human impact/ Introduced) of the catchment area. The major pollen and spores contributors include those of Poaceae, *Elaeis guineensis* Jacq, *Lannea acida*A.Rich, *Nauclea latifolia*S.M., *Syzygium guineense*, *Daniellia oliveri*, *Alchornea cordifolia*Sw, *Berlinia grandifolia*, *Albizzia zygia*, *Commiphora africana*, *Botryodiplodia*, *Curvularia*, *Pithomyces*, and *Syncephalastrum*. All these are characteristic species of the Forest- Savanna ecozone. The presence of pollen record of *Corylus avellana*, *Encephalartos* species and *Ecbolium* speciesis a valid evidence of long distance transport. The excessive increase in the relative abundance of burnt plant parts is an indication of annual bush fire and residual precipitation associated with the vegetation of the study area. The presence of burnt plant parts and fungal spores in the atmosphere affirms the great influence of anthropogenic activities on the local vegetation. Analysis of variance for the various phytoecological indicator species shows that there was no statistical significant difference ($P>0.05$) between the pollen recorded for the various indicator species. Indicators of Savanna species were the highest pollen contributors. Results confirmed the vegetation of the study area to be Derived Savanna despite high level of anthropogenic activities. This study could be used to monitor the frequency and intensity of indiscriminate bush fire and other anthropogenic activities in the surrounding savanna vegetation and provide adequate restoration and conservation measures for safety health and environmental sustainability.
Keywords: Derived Savanna, Airborne Palynomorphs, Anyigba environment, Nigeria

INTRODUCTION

The study of vegetation and the way in which it has been altered and developed in the course of time indicates past changes that have occurred in our terrestrial environment. Variations in climate and in the intensity of human activity in historic and prehistoric times have made their mark upon vegetation, and the plants themselves have left a record of these changes in the form of vast quantities of pollen grains which have survived in contemporary sediments[1].

The use of spores in environmental studies is primarily in its application to the study of vegetational history. Conclusion about climate and human disturbances could be deduced from such analysis and these are termed secondary deductions [2]. Facts gathered from such analysis could be useful to climatologists and oil explorationists among others [3]. Aeropalynology is the scientific study of biological particles such as pollen, fungal spores, dust mites, insect debris and organic dust present in the air [4].

The widely dispersed pollen and spores provide a broad picture of the surrounding vegetation of the areas in which they are produced. Some factors that aid in the dispersal are the size, shape and density of the pollen and spores, the position of the parent plants (that produce them) in the vegetation and the prevailing climatic conditions [5].

The discipline of aeropalynology is devoted to the study of pollen, which can be used both for biostratigraphy and to gain information about the abundance and variety of plant life; which can itself provide important information about palaeoclimates.

The quantity and quality of palynomorphs, especially pollen grains and spores in the air at any given time depend largely on the plant and fungi producing them, the abundance of the plant communities, the nature of palynomorphs, the flowering or season of reproduction and the meteorological factors such as rainfall, humidity, temperature, wind speed and wind direction [5].

Airborne pollen and spores are indicators of the vegetation of a region [6] and are related to the

palynomorphs produced in the immediate surroundings of the study location and catchment area. It is possible to study the quantitative abundance of atmospheric pollen content (APC). These airborne particles can be trapped with specially designed equipment.

Vegetation is an assemblage of synusia existing together in a particular location that may be characterized by its component species or by combination of structural and functional characters, which characterize the appearance or the physiognomy of the vegetation. This vegetation, though zoned into belts that correspond to the rainfall zones, is still controlled by edaphic, climatic and geomorphological factors [7].

Derived Savannais a vegetation type which is characterized by the presence of fire tolerant and fire sensitive trees with appreciable occurrence of grasses and is co-inhabited by forest and savanna species[8].

The study is aimed at investigating the airborne palynomorphs (pollen, spores, charred epidermis, diatoms, dinoflagellate cysts, algae) of the Derived Savanna (Anyigba). An attempt will be made to interprete the distribution pattern of the prevalent climatic factors. The trapped pollen and spores will be compared with the vegetation of the catchment region.

The Derived Savanna constitutes the study area for the project and the sampling point is Anyigba, Dekina LGA which is a university sub-urban town located in the Eastern Senatorial District of Kogi State, Nigeria. Anyigba lies approximately between latitude $7^{0}30^{1}$N and longitude $7^{0}15^{1}$E. It is surrounded by smaller towns, villages and homesteads, whose inhabitants in numerous ways have left their impact on the environment.

Present climate

Anyigba, Dekina Local Government Area of Kogi State, Nigeria is endowed with a hot and humid climate. The climate is characterized by the seasonal alternation of the Tropical Continental (TC) and Tropical Maritime (TM) air masses and all year round high temperatures with an annual range of 24.1˚-31.2˚C. Associated with the Tropical continental air mass is the North-East Trade wind (Harmattan), which is prevalent at the beginning (November-January) of the dry season. The South West monsoon wind is associated with the Tropical maritime air mass during the rainy season.

Anyigba (Derived Savanna) environment experiences a fairly distinct rainy season (April‘3.7mm’ – October ‘4.3mm’) and sometimes very little residual precipitation or occasional rainfall in November (1.2mm). Some months of the year (December- March) are completely devoid of rainfall. Similar finding has been reported by Hooghiemstra and Agwu [9] that the determinant climatic factor is the seasonal distribution of rainfall. The inter-tropical Discontinuity (Inter-Tropical Convergence Zone) is of paramount importance in the distribution of rainfall and pollen rain in West Africa. Wind speed for the study environment is high with a range of 3.6- 4.7Km/hr. Wind speed is critical in the removal of pollen from the anthers of both wind and insect pollinated plants.

MATERIALS AND METHODS

Eight locations were selected within Anyigba, Dekina Local Government Area of Kogi State, Nigeria as sampling sites. These sites were chosen for safety and security, logistic reasons and convenience of environmental analysis. At each site, a pollen trap (Modified Tauber Sampler) was buried in the ground in such a way that the collar was about 4cm above the ground level [10]. Prior to this, a mixture of glycerol (65ml), formalin (30ml) and phenol (5ml) was poured into each of the trap. The positions of the traps at various locations were recorded using a Global Position System (GPS). The solutions in the trap prevented the palynomorphs from drying up, kill insects and also prevented the decay of dead organisms. The trap was left to stand throughout the duration of the study period. At the end of every two weeks of each month, solution collection was done and the traps thoroughly washed with water to prevent any contamination and are then recharged with the above mentioned chemical solution. This procedure was repeated bi-monthly from April-December(covering both the dry season sampling and the rainy seasons) for one year.

The periodic one year palynomorphs collectedwith the pollen samplers were recovered through centrifugation at 2000 r.p.m (revolution per minute) for 5 minutes and supernatant decanted each time. The precipitates were washed twice with distilled water and recovered through centrifugation. The sediments were treated with glacial acetic acid to remove water before acetolysis.Acetolysis mixture was freshly prepared in a ratio of 9:1 from acetic anhydride and concentrated sulphuric acid. Acetolysis was carried out by boiling the palynomorphs in a water bath at 100^{0}C [2, 11]. The mixture was placed in water–bath at 100˚C for 5 minutes, stirred and then centrifuged for 5 minutes and supernatant decanted. The recovered precipitates were washed with glacial acetic acid, and finally washed twice with distilled water, centrifuged each time and decanted. The recovered palynomorphs were stored in a plastic vials in glycerin and ethanol solution (2:1).

One drop of thoroughly shaken palynomorphs suspension was mounted on microscope slide and covered with an 18×18mm cover slip. The mount was sealed off with colourless nail varnish to prevent drying up of the palynomorphs. The prepared slide was then examined microscopically with Olympus microscope at x400 magnification for counting and Leica microscope at x1000 magnification for detailed morphological studies. Palynomorphs identification, counting and classification was done with the help of reference

descriptions and photomicrographs from Agwu and Akanbi [11]; Bonnefille and Riollet [12]; Barnett and Hunter [13], Sowunmi [14], Zillinsky [15] and prepared slides of pollen samples in the Palynological Research Unit; Department of Biological Sciences, Kogi State University, Anyigba.

RESULTS

A total of 8574 pollen grains comprising of forty- six (46) pollen types belonging to twenty-nine (29) plant families; 213 diatoms (fresh water species of the *Cerataulina sp*.); 51 dinoflagellate cysts; 6679 fungal spores; 167 fern spores with a slight increase from April (23) to October (51); 2930 burnt plant epidermis/ trichomes and 1413 charred poaceae cuticle. Common among fungal spores identified include those of *Alternaria, Botryodiplodia, Cerastosporium, Curvularia, Exosporium, Gliomastix, Helminthosporium, Neurospora, Nigrospora, Pithomyces, Stemphylium, Syncephalastrum, Teliospore,* and *Tetraploa*.

The plant debris recorded were mostly trichomes and epidermal tissue mostly of grasses and some xylem vessel element. A reduction in relative abundance of Charred Poaceae Cuticles from April (61) to October (9) depicts the decrease unavailable dry leaves especially after bush fire. (Table 1).

Table 1. Airborne palynomorphs trapped during the study period

Palynomorpha/ Months	APR.	MAY	JUN.	OCT.	NOV.	DEC.	TOTAL	MEAN
Pollen grains	1192	2548	1387	593	1442	1412	8574	1429
Diatoms	52	99	21	-	17	24	213	35.5
Dinoflagellate cysts	21	11	5	-	2	12	51	8.5
Burnt plant parts	324	172	106	21	181	2126	2930	488.33
Charred Poaceae Cuticle	61	11	19	9	52	1261	1413	235.5
Fungal spores	1046	1113	1268	1020	685	1547	6679	1113.16
Pteridophyte (fern) spores	23	32	47	51	14	-	167	27.83
TOTAL TRAPPED PARTICLES	2719	3986	2853	1694	2393	6382	20027	3337.83

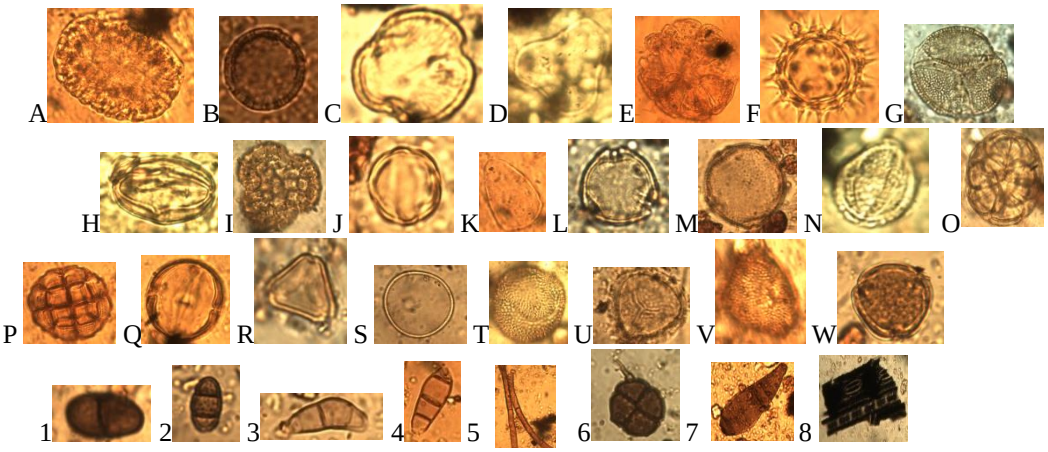

Fig. 1: A- *Ecbolium sp.*; **B-***Amaranthaceae/ Chenopodiaceae*; **C-** *Lannea acida*; **D-***Elaeis guineensis*; **E-** *Rauvolfia vomitoria*; **F-** *Asteraceae*; **G-** *Newbouldia laevis*; **H-***Senna sp.*; **I-** *Delonix sp.*; **J-** *Combretaceae/ Melastomataceae*; **K-** *Cyperaceae*; **L-** *Alchornea cordifolia*; **M-** *Hymenocardia acida*; **N-** *Phyllanthus sp.*; **O-** *Adenanthera pavonina*; **P-** *Albizzia zygia*;**Q-***Trichilia prieureana*; **R-** *Syzygium guineense*; **S-** *Poaceae*; **T-** *Talinum triangulare*; **U-** *Pteris sp.*; **V-** *Morelia senegalensis*; **W-** *Solanum melongena*;
1-*Botryodiplodia*; **2-***Pithomyces*; **3-***Curvularia*; **4-***Syncephalastrum*; **5-**Fungal hyphae; **6-***Dictyoarthrinium*; **7-** *Dinoflagellate* cysts; **8-**Burnt plant parts.

DISCUSSION

Analysis of fossil pollen is the most important approach to reconstruction of past flora, vegetation and environment [16].

The increase in fresh water diatom frustules in the aerospora of Anyigba environment is an indication of increasing dryness and the arrival of long distance transported materials from Northeast (NE) trade wind otherwise known as Harmattan. In environmental analysis, diatoms are useful palaeoecological indicators and have distinct ecological tolerance, and they provide a substantial amount of autecological information.

Their rich occurrences and diversity could therefore be linked with the Condensed Sections and associated Maximum Flooding Surfaces (MFS) which occur in River Niger, Lokoja and its environment

during the period of the study. Hooghiemstra and Agwu [9] reported similar finding and opined that din flagellates are marine phytoplanktons associated with transgressive and high stand regimes.

The high degree of fungal spore occurrence in the atmosphere could be further associated with the large traits of maize farms as well as infected plants in and around Anyigba environment. It is evident to say that several allergic reactions of the eyes resulting in symptoms such as sneezing, runny/ itchy nose as well as itchy and watering eyes prevalent in Anyigba environment is as a result of the abundance and prevalence of different species of these aerospora.

During the dry season in Anyigba environment, most ferns and fern- like plants (*Pteris sp., Selaginella and Lycopodium*) die back and survive the inclement period through perennating rhizomes. The relatively low number of fern spores in the dry season could be attributed to a virtual absence of sporulation of ferns in the dry season.

The occurrence and excessive increase in their relative abundance of burnt plant parts in the airborne spectra of the study environment is an indication of annual bush fire and residual precipitation associated with the vegetation of the study area. The presence of burnt plant epidermis/ trichomes in the atmosphere of the study environment affirms the great influence of anthropogenic activities on the local vegetation.

During domestic and wild fire incidences, charred plant particles from grasses, shrubs, and trees wafted into the atmosphere. They serve as indicator of bush fire and they can be used in monitoring the intensity and frequency of bush fires. Findings agree favourably with the report of Agwu [5] who demonstrated the application of 'Charred Graminae Cuticle' as a key identification of late Cenozoic climate changes in the Niger Delta. The relative abundance of charred poaceae cuticles could also be attributed to annual bush fires that herald the onset of farming, activities of cattle herdsmen that want to stimulate fresh grass re-growth as well as people that engage in hunting expedition to flush out wild animals. Similar findings have been reported by Agwu *et al*., [17].

Anthropogenic activities and natural events have resulted in varying floral composition of the vegetation in different parts of the study area. Certain areas, particularly gallery forests and windward sides of highland, are populated by forest species while the open areas and senile soils are dominated by savanna species. Other places are more or less shared by both equally.

The vegetation of the study area is essentially a Derived Savanna, where Forest and Savanna species co-exist side by side with relics of Forest vegetation disappearing to be succeeded by fire-hardy species of Savanna. Disappearance of Forest species is brought about by a combination of factors, including annual bush-burning, excessive lumbering, excessive firewood gathering, excessive grazing by livestock and shifting cultivation. As a result of these factors, the vegetation of the study area has become impoverished with several economic species at the verge of extinction [18].

CONCLUSION

The pollen rain over the Derived Savanna in Nigeria reflects the vegetation of the catchment region. This study still confirmed that the vegetation of Anyigba environment is a Derived Savanna type despite high level of anthropogenic activities on the ecosystem. High level of anthropogenic activities on the environment such as the massive and incessant deforestation (felling of trees) for building of residential lodges is a serious threat to the biosphere; has resulted in widespread loss of biodiversity and germplasm. The annual bush fire and burning of fossil fuel as a result of rapid urbanization has resulted in the unusual increase in the atmospheric heat balance whose implication is the excessive sensible heat experienced in the study environment recently. Long term effects could result in climatic change.

The abundance of charred plant particles and smoke as a result of indiscriminate bush fire has not only pollute the environment but has increased the concentration of greenhouse gases (carbon (iv) oxide, carbon monoxide, chlorofluorocarbon (CFCs), etc.) emitted into the atmosphere whose long term effects could result in global warming.

REFERENCES

1. Roberts N; The Holocene: an environmental history. Basil- Blackwell. New York. 1998; 361.
2. Erdtman G; Handbook of Palynology. An introduction to the study of Pollen grains and Spores. Hafnar Publishing Company, New York. 1969 ; 486.
3. Moore PD, Webb JA; An illustrated guide to pollen analysis. Hodder and Stoughton, Kent-London. 1983;191.
4. Hyde HA; Atmospheric pollen and spores in relation to Allergy1. Clin. Aller, 1972; 2:153-179.
5. Agwu COC; A Study of Niger Delta Environment through air-born palynomorphs, Port-Harcourt, Nigeria. Palaeoecology of Africa, 2001; 27:191-205.
6. Agwu COC; Modern pollen rain in Nsukka: An indicator of the vegetation of Nsukka Plateau. Wurzburger Geogr. Arb., 1997; 92:97-115.
7. White F; The vegetation of Africa. Paris: UNESCO, 1983; 356.
8. Usman SS; Nigerian Vegetation. Maxson Press, Makurdi. 2004; 24.

9. Hoogghiemstra H, Agwu COC; Distribution of palynomorphs in marine sediments: A record for seasonal wind patterns over NW Africa and adjacent Atlantic. Geologische Rundschau, 1986;75(1):81-95.
10. Tauber H; Investigations of aerial pollen transport in a forested area. Dansk Botanisk Arkiv, 1977; 32(1):1-121.
11. Agwu COC, Akanbi TO; A palynological study of honey from four vegetation zones of Nigeria. Pollen et Spores, 1985; 27:335-348.
12. Bonnefille R, Riollet G; Pollen des savanna d'Afrique orientale. Paris: CNRS, 1980; 140.
13. Barnett HL, Hunter B; Illustrated Genera of Imperfect Fungi. Fourth Edition. APS Press, Minnesota, USA. 1998; 218.
14. Sowunmi MA; Pollen Grains of Nigerian Plants. Grana, 1995;34:120-141.
15. Zillinska FJ; Common Diseases of Small Grain Cereals. A Guide to Identification. American Phytopathological Society, Minnesota, USA. 1983;126.
16. Faegri K, Iversen J; Textbook of Pollen Analysis. John Wiley and Sons. New York. 1989; 487.
17. Agwu COC, Njokuocha RC, Mezue O; The study of airborne pollen and spores circulating at 'head level' in Nsukka environment. Bio-Research, 2004; 2(2):7-14.
18. Usman SS; Some Endangered Plant Species in Igalaland. A paper presented at Igala Pofessor's Forum, Kogi State University, Anyibga. 2012; 8.