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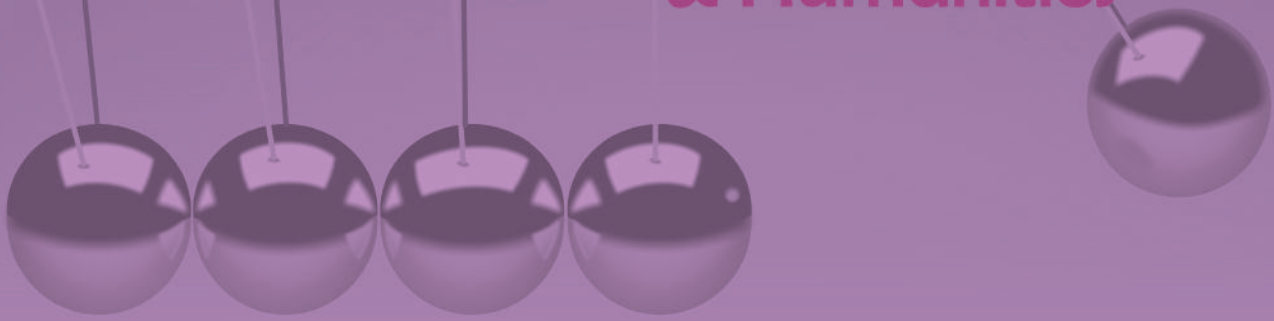

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Secondary Dynamics of the Okomu Forest, Edo State, Nigeria

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Abstract

The global environment has, over the years, come under intense pressure from population explosion and activities associated with urbanisation and industrialisation. In Nigeria, evidence of this is characterised by the need for land for several purposes ranging from industrial, residential to agricultural, amongst others. Consequent on these disturbances the integrity and sustainability of our forests have been greatly compromised. Consistent information on protected forests in Nigeria, for the purpose of efficient monitoring and management, are however limited. The Okomu forest, in spite of its status as a national park, is under intense pressure from the surrounding communities and towns. Information on the level and impact in the Okomu forest is limited. This study therefore adopted the ecosystem approach, in examining the dynamics and present level of degradation occurring within the Okomu forest. Height, girth, crown diameter and density measurements were taken from ten quadrats of 20m by 20m in the disturbed and the undisturbed zones of the forest and a comparison carried out. The student t test, at the 0.05 significance level, revealed no significant difference between both zones in the height (t 110 = 0.139) and the girth (t 110 = 0.912). The crown diameter was however discovered to be significantly different in both zones (t 110 = 3.33). The tree numbers for both zones were seen to occur majorly in the earlier age classes ranging from 20m – 40m, with an exception occurring in the >80m class, confirming the trend of increasing degradation. Location specific and eco-friendly sustainable strategies should be adopted to ensure efficient management of the Okomu forest national park.

Introduction

Forests in Africa, especially west and central Africa, store up to 120 tonnes/Ha of carbon being the some of the highest in the world (Naazia & Xiaoxue, 2016). This role ensures the sustainability of the global ecosystem and the survival of man. The inherent potentials of forests which form the crown of the plant kingdom as a resource cannot therefore be overemphasized. Forests, generally provide a number of goods and services ranging from fuel wood, food, and medicine to a range of associated activities for the people within the vicinity and beyond. In addition, forests also carryout several services which positively impact the natural environment and ensure the efficient running of the ecosystem, such as soil fertility preservation, preservation of water resources etc. (FAO, 2002). Intense pressure however arising from population increase and urbanisation have had significant impact on vegetation integrity and stability. Corroborating this, FAO (2001) noted that about 80% of the populace are dependent on forests for fuel wood. FAO (2002) attributed the dismal state of the forests in the rural areas to high poverty level, in connection with relatively consistently rising population. In urban areas, the dependence, though similar is more of an indirect nature. It is however, known that the remaining available tracts of forests usually occur in close proximity with rural areas.

The impact of disturbances, arising from anthropogenic pressure disrupts the delicate balance of the climax forest resulting in a chain reaction of changes, thereby altering its original character. Several authors have noted that some of these changes are characterised by species composition , structure amongst others (Oke & Oyedare, 2008; Phil-Eze & Aratoke, 2017). Consequently, the attempt by the degraded forests to return to their original state after any form of disturbance culminates in the emergence of secondary forests. Secondary forests are an essential and important link in the succession process, with focus on the restoration and attainment of ecological integrity. Chokkalingam and DeJong (2011, pg 19) defined secondary forests are "forests regenerating largely through natural processes after significant human and/or natural disturbance of the original forest vegetation at a single point in time or over an extended period, and displaying a major difference in forest structure and/or canopy species composition, with respect to nearby primary forest on similar sites". In spite of the noticeable differences observed in both the typical tropical and secondary forests, they both possess similar abilities to perform certain fundamental roles. Notable of these include climate modification and regulation of the global carbon cycle, amongst others Schroeder *et al* (2010), Ademoh *et al*, (2017), Liu *et a*l. (2005), Maness *et al.* (2012), O'Halloran *et al*. (2012). It therefore follows that the management options for the typical forest would be generally similar, with variations limited to specifics. Schroeder (2010) however noted that information concerning the extent of degradation and other basic characteristics such as species composition and forest structure are inadequate.

Several interventions, in response to the issue of degradation of forests have emerged over time. Notable of which has been the adoption of conservation policies and laws characterised by the setting up of protected areas. A Protected Area, according to the International Union for Conservation of Nature (IUCN), is defined as areas of land or sea "dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, managed through legal or other effective means" IUCN (2008) Onojeghuo and Onojeghuo (pg 500, 2015a). A case in point in the adoption of this strategy in southern Nigeria has been the establishment of the Okomu National Park, in Edo state. The Okomu National park, was established as a forest reserve in 1912 by the British colonial government. The initial purpose for its designation was for timber exploitation. The Okomu forest is generally referred to as the Plateau Forest of Okomu. The Okomu forest is rich in biodiversity and is characterised by a relatively high level of endemism. It is heterogeneous, being comprised of the rainforest, lacustrine, riparian and fresh water ecosystems (Ekeoba & Ohuoemose, 2020). Its establishment as a National Park status, was instituted within the core of the forest due to intense pressure arising from high rates of exploitation and rapid population increase emanating from the margins Onojeghuo and Onojeghuo (pg 500,2015a). The annual rates of deforestation within the Okomu forest for the period of 1987 -2011 are observed to be higher than that outside the reserve, owing to intensified agricultural activities, bush burning, amongst others (Anadu, et al. 1988; Eguavoen, 2007; Osehobo, 2013). Lee and Oates (1999) however, asserted that much of the Okomu forest is actually composed of mature secondary forest, evidenced by the presence of charcoal and pottery, at a significant depth in the soil profile. This can be attributed to the activities of previous human occupation. The consistently increasing impact of anthropogenic activities in the Okomu forest cannot therefore be overemphasized.

Vital information on the structure and distribution of protected areas within the Niger Delta (being majorly regenerating secondary forests) is largely inadequate Onojeghuo & Onojeghuo (pp 486, 2015b). The need therefore for the capture of baseline data for the purpose of conservation, monitoring and management is imperative. In the light of the aforementioned, it becomes pertinent to assess the status of the Okomu forest, presently, for the purpose of efficient monitoring on the level of regeneration or degradation. More insight on the nature and extent of maturity of the (present day) old mature secondary forest as well as the extent of recovery of the disturbed areas needs to be assessed. It becomes necessary to assess the character across the forest, for the purpose of assessing the varying growth levels, based on the varying impact of anthropogenic activities. This is for the purpose of determining the influential factors involved in the process of growth and succession. This study, therefore examines the structural characteristics and species composition of both the disturbed and relatively undisturbed zones of the secondary forests of Okomu. This is with the aim of obtaining a proper comprehension of the dynamics of the matured secondary forest as well as the determination of its succession level

Description of Study Area

Okomu forest (Fig. 1) is characterized by a mosaic of swamp forest, high forest, secondary forest and open scrub. It is one of the major tracts of lowland tropical rainforest left standing in Nigeria. It is, however undergoing extreme pressure emanating from anthropogenic sources owing to encroachment from surrounding settlements. Further corroborating this, Amusa, Omonu, Olabode, and Newton, (2017) noted that about fifty thousand people in 45 villages live in and around the park. It is therefore continuously threatened by large scale illegal logging, the expansion of large rubber and oil palm plantations nearby, as well as incursions by a growing human population involved in farming and hunting.

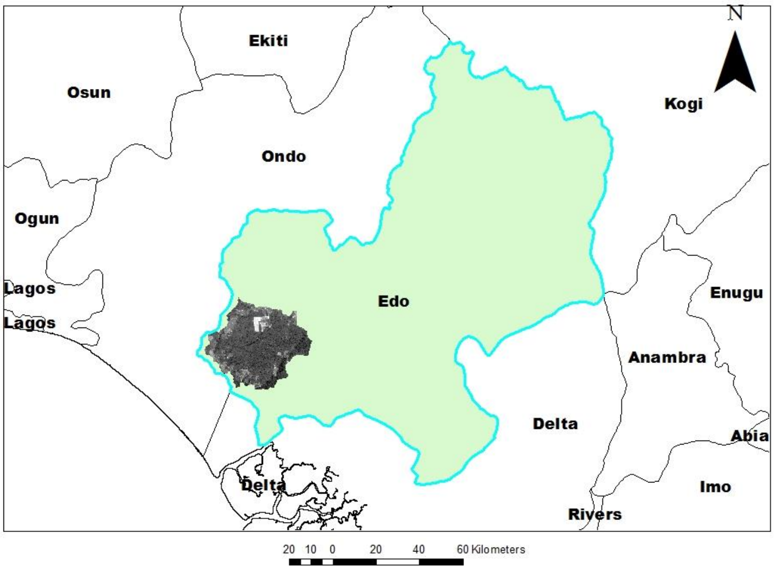

Fig. 1: Map of the Okomu forest reserve in Edo State

Source: Oladejo (2015)

Materials and Methods

The Okomu National Park, located in Ovia South – West local government area of Edo state, has an area of about 1083 km^2 and is about 75km west of Benin City, Nigeria (Fig. 1). It is home to a number of endangered species (plant and animal) as well as the African mahogany family (*Meliaceae*). Stratified sampling was adopted whereby the study area was categorised into disturbed and undisturbed zones. Measurements were taken from ten quadrats within each zone, of 20m by 20m quadrats, totalling twenty quadrats in all. The following measurements were obtained from within each quadrat viz: height, girth, crown diameter, density and species composition. The student t test was used to analyze the significant difference in the height, girth and crown diameter of the disturbed and undisturbed portions of the Okomu forest, at the 0.05 significance level.

Result of Findings

The tree species encountered include; *Albizia ferruginea, Albizia adiantifolia, Albizia lebbeck, Alstonia congensis, Achyranthes aspera, Acacia ataxacantha, Ageratum conyzoides, Acalypta ciliate, Afzelia Africana, Aspilla africana, Cyperus difformis, Cnetis ferruginea, Cyathula prostrata, Dracaena manii, Elaeis guineensis, Entandrophragma angolense, Funtumiaelastica, Guarea cedrata, Garcinia kola, Ipomea involucrata, Irvingia gabonensis, Khaya grandifololia, Khaya ivorensis, Monodora myristica, Mucuna pruriens, Ocimum gratissimum, Rauwolfia vomitoria, Spondias mombin, Terminalia ivorensis, Urena lobata, Xylopia aethiopica*

The mean structural values of height, diameter at breast height (dbh) and crown diameter of all the quadrats sampled are shown in Table 1. These values show the general character and nature of the trees in both zones of the forest.

Table 1: Mean structural values for the disturbed and undisturbed zones of Okomu forest

	Mean Height (m)	Mean DBH(m)	Mean Girth (m)	Mean Crown diameter(m)
Disturbed	54.8	0.87	2.7	3.0
Undisturbed	54.3	0.90	2.8	4.1

Source: Fieldwork (2015)

The values of the crown diameter, dbh and girth were seen to be slightly higher in the undisturbed than the disturbed, while the reverse is the case for the height, being slightly lower in the undisturbed.

The student t test for significant difference at the 0.05 significance level of the various structural indicators in both zones is seen in Tables 2, 3 and 4.

Table 2: Student t test result on the tree height in the disturbed and the undisturbed zones of Okomu forest.

		F	Sig	T	Df	Sig. (2 tailed)	Mean Difference	Std Error Difference	Lower	95% Confidence Interval of the Difference
Height	Equal variances assumed	.002	.966	.139	110	.890	.503	3.624	-6.678	7.684
	Equal variances not assumed			.138	77.101	.890	.503	3.634	-6.733	7.739

Table 3: Student t test result on girths in the disturbed and undisturbed zones of Okomu forest

		F	Sig	T	Df	Sig. (2 tailed)	Mean Difference	Std Error Difference	Lower	95% Confidence Interval of the Difference
Girth	Equal variances assumed	5.398	.022	-.912	110	.364	-.102	.112	-.324	.120
	Equal variances not assumed			-.996	98.379	.321	-.102	.102	-.305	.101

Table 4: Student t test result on crown cover in the disturbed and undisturbed zones of Okomu forest

		F	Sig	T	Df	Sig. (2 tailed)	Mean Difference	Std Error Difference	Lower	95% Confidence Interval of the Difference
Cover	Equal variances assumed	9.113	.003	3.330	110	.001	.890	.267	.360	1.419
	Equal variances not assumed			3.627	97.756	.000	.890	.245	.403	1.377

The student t test showed no significant difference in the height and dbh of the disturbed and undisturbed. The test values for the height are $t_{110} = 0.138$, $p > 0.05$ and $t_{110} = 0.912$, $p > 0.05$, for the dbh (Tables 2 & 3). The tree crown diameter is however seen to be an exception, being significantly different in both zones, having a test value of $t_{97.756} = 3.627$, $p > 0.05$).

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The relationship of the height classes with varying tree numbers, dbh and crown diameter are seen in Figs 2, 3 & 4.

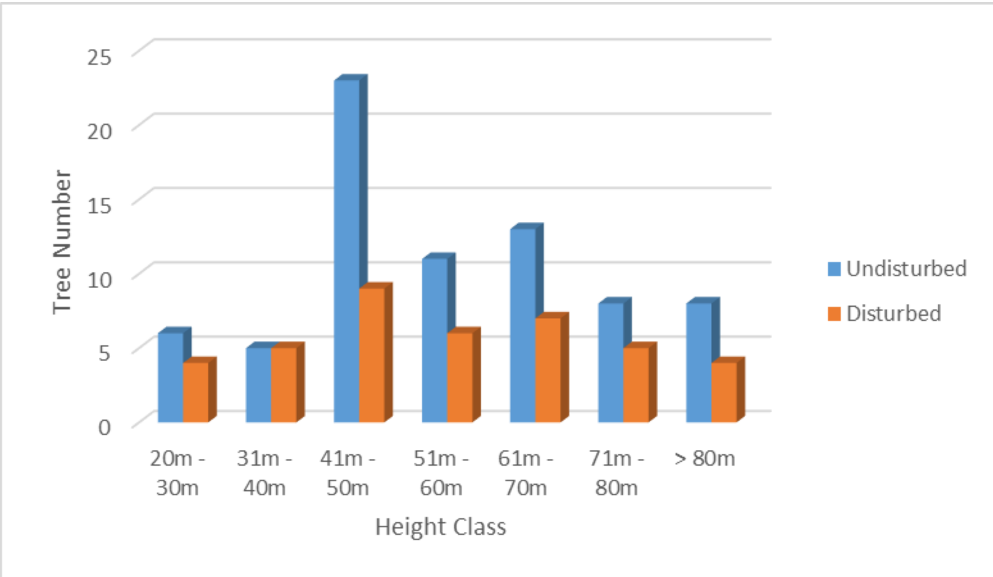

Fig 2: Bar chart showing tree number for the different height classes in the disturbed and undisturbed zones of the Okomu forest

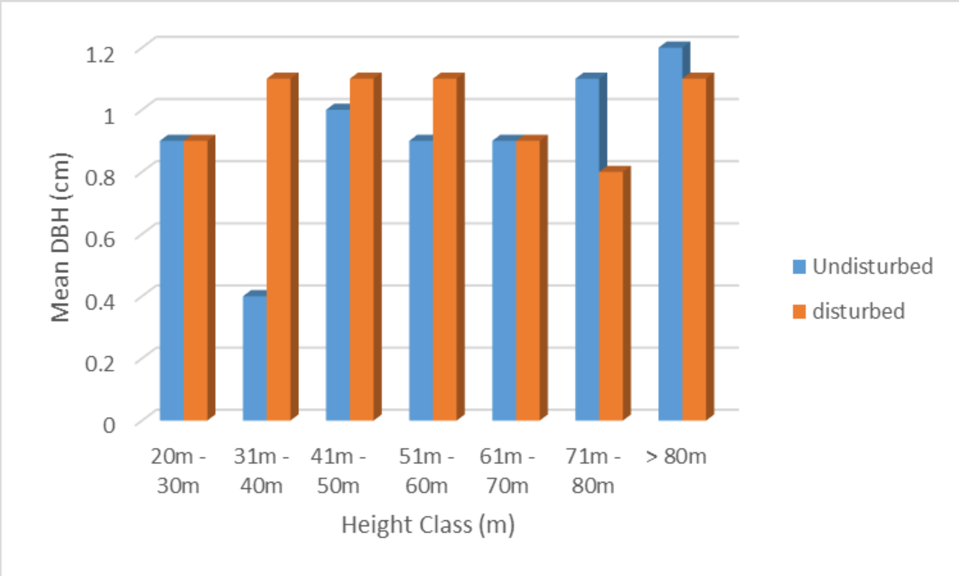

Fig 3: Mean DBH for the different height classes in the undisturbed and disturbed zones of the Okomu forest.

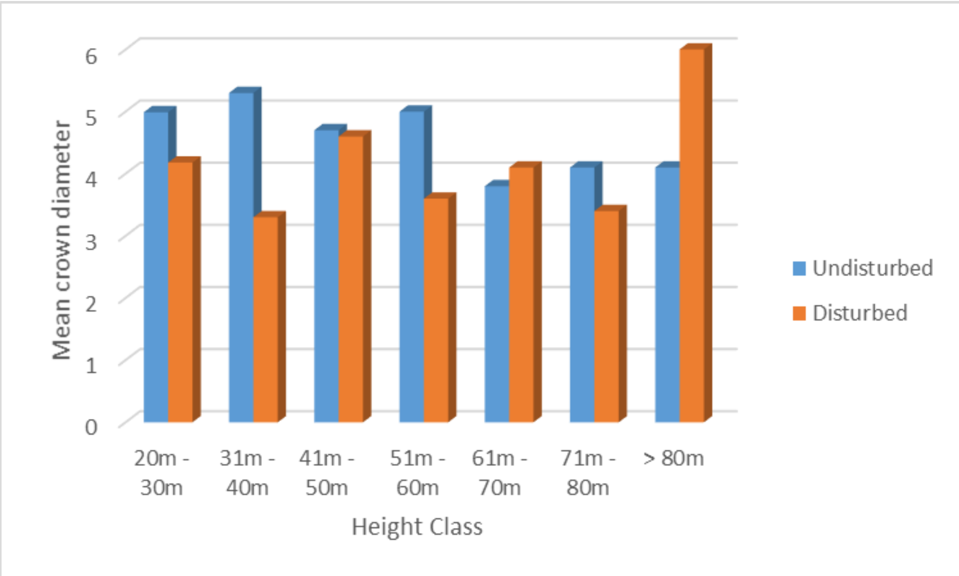

Fig 4: Mean crown diameter for the different height classes in the disturbed and undisturbed zones of the Okomu forest

The tree number is seen to be higher in all the height classes in the undisturbed zone, with the exception of the 31m – 40m height class. The tree number in this class is even for both zones suggesting the occurrence of selective harvesting in the undisturbed zone within this class. The growth pattern of trees in both zones is seen to be similar. In Fig 3, the dbh for the trees in the 31m -40m height class, in the undisturbed zone, is seen to be much higher than that of the trees in the disturbed zone. In the lower height class of 21m – 30m, the dbh is similar in both zones. The dbh in the 31m- 60m and the > 80m height classes are seen to be even with a decline occurring in the 61m – 80m height classes, in the disturbed zone. In the undisturbed zone, however, none of the dbh in all the height classes is seen to surpass those of their counterparts in the disturbed zone, with the exception of the 71m - >80m height classes. This further suggests that the size of the individual trees is not influenced by the availability of space as is the case in the disturbed zone but by the intrinsic properties of the species in question. The crown diameter in the undisturbed zone is seen to reduce gradually in the 71m- >80m height classes. The crown diameter is higher in the undisturbed zone in all the classes, with the contrary occurring in the >80m class. This suggests that there is an absence of emergents, further confirming the secondary status of the Okomu forest.

Discussion of Results

The similarity in the character of the disturbed and undisturbed zone, in terms of height and Diameter at Breast Height (dbh), could be an indication of the fact that the relatively undisturbed area is gradually being influenced by the pressure emanating from the disturbed zone. Degradation is therefore prevalent owing to easier access occasioned by the proximity of the disturbed to the undisturbed zones. The lowest tree numbers in the disturbed zone, is observed in the 20m – 30m and >80m. In the undisturbed zone however, the lowest tree number occurred in the 31 – 40m. The lowest tree numbers for both zones, comprise majorly of relatively younger trees, implying that the population of older trees exceeds that for younger trees. This suggests therefore, a reduction in the potential for the replacement of outgoing tree species over time, culminating in degradation (Fig 2). Selective harvesting is likely to be more prevalent in the 31m - 40m height class, even though also apparent in the preceding class. This trend seems to be a major factor influencing low tree numbers observed in the initial classes. The least exploited height class in the undisturbed zone is that of the 41m-50m.

The dbh for the height classes of 31m- 40m in the disturbed zone were significantly higher than their counterparts in the undisturbed zone. This situation could be due to selective harvesting and a number of other unknown factors which may be location specific such as underlying soil, faunal activities or microclimatic setting etc. The dbh of the trees in the 31m-60m height class is also higher in the disturbed zone than that of the undisturbed. The trend in the disturbed zone is unusual as expected, with a rise from the 21m-30m class to the 31m-40m class, where it remains consistent and then reduces in the higher classes, with the exception of the > 80m class. The situation is not much different in the undisturbed with an inconsistent rise and fall, which is followed by a gradual rise in the higher classes of 71- >80m class. The observed uneven nature across the height class, as against a gradual rise across the height classes (indicative of the natural matured tropical rainforest) signifies growth retardation. This is a further indication of the vulnerable state of the Okomu forest. The generally higher dbh in the 31m-60m of the disturbed zone could be attributed to the lower competition for soil nutrients as a result of the fewer tree in the undisturbed.

The highest crown diameter occurring in the disturbed zone as against the undisturbed zones, in the > 80m height class, is likely to be an indication of more space and fewer trees competing for the available resources. The pattern in both zones is however irregular, indicating influence of other factors. The implication of the crown diameters in the undisturbed zone being significantly higher, establishes the prevalence of ongoing degradation and a subsequent stall in the succession process.

Conclusion

The status of the Okomu forest as a secondary forest is not in doubt owing to its uneven structural nature, as against that of the natural forest which is structured in layers. A confirmation of the prevalence of degradation is depicted by the occurrence of fewer number of younger trees relative to older trees in both the disturbed and undisturbed zone. The implication of this is the reduction in the potential for the replacement of outgoing tree species over time. Selective harvesting was identified as a likely factor affecting all dbh classes, except for those between 31-60m dbh class. Both forest zones had no significant structural variations, implying the prevalence of factors of degradation occurring all across the forest. This is evidence of the break down and lack of enforcement of the conservation laws already in place. The potential therefore for the progression of succession in the Okomu forest is almost completely eroded. This delicate imbalance and trend of degradation already established portends a bleak future, for the sustainability of the fauna, flora and consequently the indigenous people within and around the area.

Recommendations

In view of the aforementioned, the following are recommended:

1. Further studies should be geared towards the adoption of strategies and interventions, as well as the implementation of already existing environmental laws.
2. Selective harvesting can be tackled by the provision of cost effective and alternatives to fuel wood.
3. Further research, which should be multidisciplinary in approach, is encouraged for the purpose of identifying location specific and environmental friendly strategies to ensure the boosting of forest recovery

References

Ademoh, F.O., Muoghalu, J.I., & Onwumere, B. (2017). Temporal pattern of tree community dynamics in a secondary forest in south western Nigeria, 29 years after a ground fire. *Global Ecology and Conservation*, 9, 148-170.

Amusa, T. O, Omonu, C., Olabode, E., & Newton, N. J. (2017). Population, status and distribution of forest elephants in Okomu national park, Omo forest reserve, south western Nigeria. J*ournal of research in forestry, wild life and environment*, 9 (2), 44-56

Anadu, P., Elamah, P. & Oates, J. F. (1988). The bushmeat trade in southwestern Nigeria: a case study', *Human Ecology*, 16: 199-208.

Chokkalingam, U. & De Jong, W. (2001). Secondary forest: A working definition and typology. *International Forestry Review* 3(1): 19–26.

Ekeoba, I. M., & Okuomose, S. I. (2020). Okomu plateau forest and associated wetlands in Southern Nigeria: status, threats and significance. *International journal of Hydrology*. 4 (1):31-40.

Eguavoen, E. O. (2007). Modelling land cover change in Edo and Delta states, Nigeria, Department of Geography, University of Leicester. Leicester. United Kingdom.

Food and Agricultural Organisation (FAO) (2002). Tropical Secondary Forest Management in Africa. Workshop on Workshop on Tropical Secondary Forest Management in Africa. Reality and perspectives, In collaboration with ICRAF and CIFOR, FAO/EC LNV/GTZ, Nairobi, Kenya, 9-13 December 2002

Food and Agricultural Organisation. (2001). State of the World's Forests. Food and Agriculture Organisation of the United Nations. Rome.

International Union for the Conservation of Nature (IUCN) (2008). Guidelines for Applying Protected Area Management Categories; IUCN: Fontainebleau, France.

Lee, J. T., & Oates, J. F (1999). New data on the history of the plateau forest of Okomu, Southern Nigeria: An insight into how human disturbance has shaped the African rain forest. *Global ecology and Biogeography*. 8.:355- 361.

Liu, H.P., Randerson, J.T., Lindfors J., & Chapin, F.S. (2005). Changes in the surface energy budget after fire in boreal ecosystems of interior Alaska: an annual perspective. *J. Geophys. Res.: Atmos.,* 110 (13) : 1-12

Maness H., Kushner P.J., & Fung, I. (2012). Summertime climate response to mountain pine beetle disturbance in British Columbia. *Nat. Geosci*. 6:65-70

Naazia, E., & Xiaoxue, W. (2016). Why Africa's forests are important — for its people, for China, and the world. An infographic presentation for the China-Africa Forest Governance Learning Platform. International Institute for environment and development. https://www.jstor.org/stable/resrep02703 Accessed: 26-05-2020

Oke, S.O., & Oyedare, P.F. (2008). Effects of Logging Activities on the Floristics and Structure of the Vegetation in Isokan Area of Southwestern Nigeria. *Journal of Plant Sciences,* 3:157-167.

Oladejo, S.O. (2015). Land Use/Land Cover and Biodiversity status of Okomu Forest Reserve. 10.13140/RG.2.1.3563.1441. https://www. researchgate.net.

O'Halloran T.L., Law B.E., & Goulden, M.L. (2012) Radiative forcing of natural forest disturbances. *Global Change Biol*., 1: 555-565

Onojeghuo, A.O., & Onojeghuo, A.R (2015a). Protected area in the Niger Delta using Multi-temporal remote sensing. *Environment,* 2: 500-520

Onojeghuo, A.O., & Onojeghuo, A.R (2015b). Mapping forest transition trends in Okomu reserve using Landsat and UK-DMC-2 satellite data. *South African Journal of Geomatics.* 4 (4) : 486-501

O'Halloran, T.L., Law, B.E. & Goulden, M.L. (2012). Radiative forcing of natural forest disturbances. *Global Change Biol*., 1: 555-565

Osehobo, V. (2013). Nature under threat, Otedo News Update, http://ihuanedo.ning.com/m/group/discussion?id=2971192%3ATopic%3A90943

Phil-Eze, P.O., & Aratoke, G.A. (2017). Evaluation of contemporary status of indigenous biodiversity conservation measures in Nigeria: Lessons from Idemili North LGA of Anambra State. *Journal of Geography, Meteorology and Environment.* 2 (1) : 20-29

Schroeder, J.-M., Oke, D.O., Onyekwelu, J.C., & Yirdaw, E. (2010). Secondary forests in West Africa: a challenge and opportunity for management, *IUFRO World Series* Vol.25, International Union of Forest Research Organizations (IUFRO).