PRINT ISSN 1119-8362
Electronic ISSN 1119-8362

Full-text Available Online at
https://www.ajol.info/index.php/jasem
http://ww.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 24 (11) 1861-1865 November 2020

Floristic Structure of Fire Experimental Plots of Olokemeji Forest Reserve, Ogun State, Nigeria

TAIWO, DM; OLATIDOYE, OR; JEMINIWA, OR; OYEBOLA, TO; OMONU, C

Forestry Research Institute of Nigeria, P.M.B. 5054, Ibadan, Nigeria
**Corresponding Author Email: taidamar20@gmail.com; Tel: +2348167754312*

ABSTRACT: Total enumeration of tree species was carried out fire experimental plot of Olokemeji forest reserve for relative importance value (RIV) mean heights, mean diameter at breast height and mean basal area. Three investigative plot (Plot A, B and C) were established. Plot A which represents Early Burn is burnt annually during the dry season while Plot B was burnt annually during the rainy season when the trees are still wet and Plot C serves as the protected area. *Gmelina arborea* had the highest relative importance value (28.31), this is followed by *Dalbergia sissoo* which had RIV of 10.94. Plot C recorded the highest frequency of trees with the highest tree heights, this is closely followed by Plot A and Plot B being the plot with the lowest mean height. Plot C has the highest mean diameter at breast height (DBH) of trees and it is followed by Plot B and Plot A with very close mean DBH. The highest mean basal area was also recorded in Plot C, the highest total basal area and tree volume was also recorded at Plot C as 32.2 m^2 ha^{-1} and 188.8 m^3. The size distribution of tree species depicts that Plot C has been protected just as expected.

DOI: https://dx.doi.org/10.4314/jasem.v24i11.3

Dates: Received: 22 September 2020; Revised: 29 October 2020; Accepted: 04 November 2020

Keywords: Forest, Structure, Flora, Dynamics, Fire

The floristic structure of a forest depicts the dynamics of its biological diversity. Burning has an impact on the structure of the forest. Prescribed burning is carried out in fire experimental plots for the purpose of fire tracing. This process helps to determine the response of the forest to forest fires and in addition, plants which are fire tolerant are discovered. Fire experimental plots have three investigative plots named as Plot A where early burning takes place, Plot C where late burning is carried out and Plot C which serves as the control plot and is protected over time. In addition to natural causes of ignition, prescribed burning was one of the management tools commonly used by man in the forest (Lloret and Marí 2001; Naveh, 1975). Fire thus acted as a fundamental factor on ecosystem functioning and as a major ecological driver of vegetation changes (Attiwill, 1994; Moreno and Oechel, 1994; Lavorel *et al*., 1998), by modeling landscapes (Gillson, 2009) and contributing to maintain habitat heterogeneity and biological diversity (Blondel *et al*., 2010; Moreira *et al*., 2001). Given the very strong effect of fire on vegetation, plant distribution and ecosystem function could likely be more heavily affected by the on-going modifications in fire regime consequent to global changes than by the direct effect of climate changes (Pausas and Fernández-Muñoz, 2012). Moreover, the combined impact of these fire regime changes and enlarged environmental limitations for post-fire tree recruitment could deeply affect the species composition of Mediterranean forests (Lloret *et al*., 2004, 2009; Peñuelas and Filella, 2001). Natural fires cannot be controlled but anthropogenic fires can be subjected to control. Such controlled fires canbe used as a forest management technique. Prescribed burning has also been used to reduce potentially hazardous natural fuels and remove accumulated dead plant materials. The fire investigation plots at Olokemeji Forest Reserve, Nigeria were set up by Forestry Research Institute of Nigeria in 1929 to monitor the number of trees on each plot when fire is introduced at different times during the dry season and to be able to recommend appropriate time of burning of fields for shifting cultivators and to monitor the effects of prescribed periodic burning on long term vegetation development (Akinsoji and Sowemimo, 2005). The plots were clear-felled in 1929 and left to grow naturally and the prescribed burning was applied annually. Charter and Keay (1960) observed that late burn promoted the development of Savanna vegetation on Plot A while early dry season burn was changing the vegetation to forest type but at a rate slower than Plot C (the fire- protected plot). Forest dynamics can be enumerated through the understanding of its floristic composition, relative importance value of species, diameter class distribution, tree basal area and volume. The manipulation of stand basal area to

**Corresponding Author Email: taidamar20@gmail.com; Tel: +2348167754312*

achieve forest management goals can be as important as the use of prescribed fire or other vegetation treatments. The manipulation of stand basal area to achieve forest management goals can be as important as the use of prescribed fire or other vegetation treatments (Chen *et al*., 2007). The fire experimental plot of Olokemeji has gone through series of human interference since its establishment, most especially the prescribed burning as well as other anthropogenic impacts, hence, the purpose of this study is to evaluate the structure of the forest in order to understand the dynamics of the fire experimental plot.

MATERIALS AND METHODS

Study Site: Olokemeji forest reserve occupies a total land area of 58.88 km^2 .The reserve, which was established in 1899 is the second forest reserve in Nigeria. The forest reserve is situated between latitude 70" 25^0 N 30^0 to 70" 39^0 N and Longitude 30" 32^0E to 30" 44^0E. The site lies approximately 32km west of Ibadan, and 35km north-east of Abeokuta.

Olokemeji fire experimental plot was established in the year 1929 for the purpose of fire tracing. Three plots were established within the fire experimental plot and were named as Plot A (Early burn), Plot B (Late burn) and Plot C (Protected). The fire investigation plots are bordered by plantations of *Gmelina arborea, Dalbergia sisso* and *Senna siamea*. The physical features, climate and vegetation of the reserve have been described by Hopkins (1972).

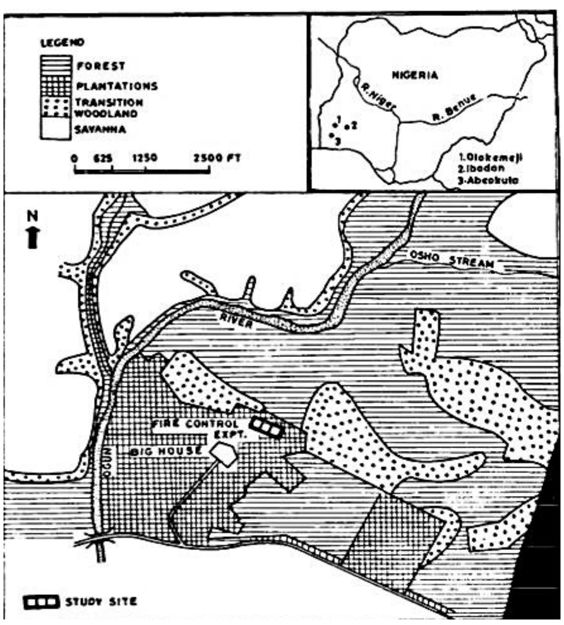

Fig 1: Map of Olokemeji Fire Experimental Plot, Ogun State, Nigeria (Source: Aderopo Akinsoji, 2013)

Sampling technique: Total tree standswith diameter at breast height (DBH) greater than or equal to 10 cm girth were enumerated for this study. Tree Species Identification: The botanical names of every stands encountered in each plot was recorded. Each tree was recorded fully in the field with extra effort made not to omit any eligible tree in a plot, this is to reduce the possibilities of any species omitted within the plot.

Data Analysis: The Relative Importance Values (RIV) of all species were determined following Olubode *et al*., 2011. It was computed as:

$$\text{RIV} = \frac{\text{Relative Frequency}}{\text{Relative Density}} \times 100$$

Where: Frequency: It is the number of occurrence of a species in a set of quadrats or area;
Relative Frequency = It is a relative value of occurrence of a species in a set of quadrats to total species in the quadrats.

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

Density is the quantity of individual species to abundance of species per unit area.

$$\text{Density} = \frac{\text{Quantitative values of species}}{\text{Quadrat size}}$$

Relative density was obtained using the formula;

$$\text{Relative Density} = \frac{ni}{N} \times 100$$

Where <u>ni</u> is the number of individual species; N is the total number of different species in the entire population Basal area

Basal area (m^2 ha^{-1}) = $\frac{\pi d^2}{40000}$ (Onyekachi and Johnson, 2018)

Where π is 3.142 and d' is the diameter at breast height (cm)

The total basal area for each of the sample plots was then obtained by summing the basal area of all trees in the plot while mean basal area for the plots was determined by dividing the total basal area by the number of trees in the sample plot.

Tree Volume

Volume = $0.42 \times H \times B$ (Chen *et al*., 2005)

Where 0.42 is a constant: H = individual tree heights (m): B = Individual tree basal area

RESULTS AND DISCUSSION

Species Composition and Relative Importance Value of Tree species in Fire Experimental Plot of Olokemeji Forest Reserve: Out of the sixteen species of trees enumerated, nine families were found. The family with the highest species recorded was Fabaceae, this is followed by family Combretaceae and Sapotaceae. Other families found among the species enumerated are; Rutaceae, Malvaceae, Anarcadiaceae and Meliaceae. *Gmelina arborea* has the highest relative density, relative frequency and relative importance value in the fire experimental plot of Olokemeji, this is closely followed by *Dalberga sisso* and *Manikawa obuwata.* Tree species with the lowest relative important value are *Albizia lebbeck, Maganitaria discadea, Ovaria charea* and *Zanthoxyllum.*

Table 1: Distribution of Tree Species in Investigative Plots of Olokemeji Fire Experimental Plot

Species	Plot A	Plot B	Plot C	Family	Relative Density	Relative Frequency	Relative Importance Value
Pterocarpus erinaceus Poir	1	0	1	Fabaceae	1.2	7.69	4.45
Albizia lebbeck (L.) Benth	1	0	0	Fabaceae	0.6	3.85	2.22
Maganitaria discadea	0	1	0		0.6	3.85	2.22
Zanthoxyllum Franch&Sav			1	Rutaceae	0.6	3.85	2.22
Lannea egregia Engl. & K. Krause	2			Anarcadiaceae	1.2	3.85	2.52
Vitellaria paradoxa C.F. Gaertn.			2	Sapotaceae	1.2	3.85	2.53
Parkia biglobosa (Jacq.) R.Br. Ex G.Don			3	Fabaceae	1.8	3.85	2.83
Afzelia Africana Persoon			5	Fabaceae	3.01	3.85	3.43
*Hildegardia barteri(*Mast.) Kosterm			7	Malvaceae	4.22	3.85	4.03
Acacia spania Pedley		3	2	Fabaceae	3.01	7.69	5.35
Pseudocedrela kotschyi Harms	4		1	Meliaceae	3.01	7.69	5.35
Terminalia superba Engl. &Diels	1		4	Combretaceae	3.01	7.69	5.35
Anogeissus leiocarpus (DC.) Guill. &Perr.	1	3	3	Combretaceae	4.22	11.54	7.88
Manilkara obovata (Sab. & G Don)			26	Sapotaceae	15.66	3.85	9.75
Dalbergia sissoo DC.	12	5	1	Fabaceae	10.84	11.54	11.19
Gmelina arborea Roxb.exSm	25	43	8	Lamiaceae	45.78	11.54	28.66

Mean Height Mean Diameter at breast height and Mean Basal Area Of Fire Experimental Plots of Olokemeji, Forest Reserve: Out of the three investigation plots in the fire experimental, Plot C has the highest mean height at 13.11 m, this is followed by Plot A at 12.32 m and Plot B has the lowest mean height at 11.69 m. Plot C has the highest mean diameter at breast height at 71.32 cm, this is followed by Plot B at 51.91 cm which is closely followed by Plot A 50.52 cm. Plot C has the highest mean basal area at 0.4m^2 ha^{-1}, followed by Plot B which has 0.21 m^2 ha^{-1} and Plot A has 0.2 m^2 ha^{-1} mean basal area.

Basal Area and Volume of Tree Stands in the Fire Experimental Plot of Olokemeji Forest Reserve, Ogun State, Nigeria: The total basal area of each plots examined at the fire experimental plot revealed that Plot A had the least which is 11.2 m^2 ha^{-1}, this is closely followed by Plot B which has 13.68 m^2 ha^{-1} and Plot C having the largest basal area at 32.2 m^2 ha^{-1}.The total tree volume followed a similar order with Plot C having the largest tree volume at 188.8 m^3 ha^{-1}, Plot B has 74.43 m^3 ha^{-1}and Plot A has the least total tree volume at 55.84 m^3 ha^{-1} The fire experimental plot of Olokemeji forest reserve comprise of diverse tree species, sixteen species of trees belonging to eight families, with family Fabaceae being the largest amongst all.

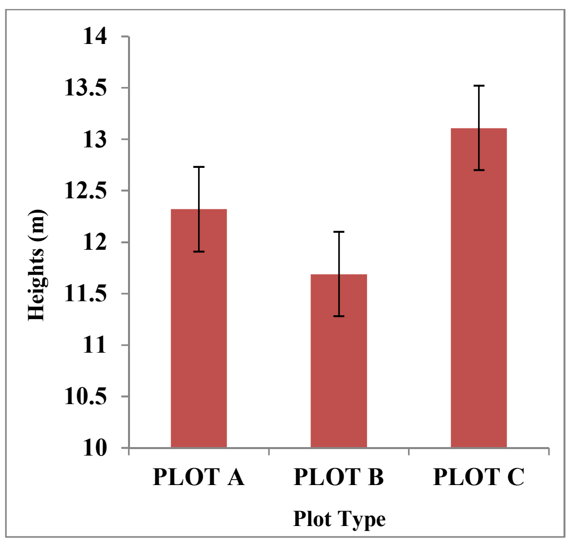

Fig 1: Mean Height of Trees in the Fire Experimental Plot of Olokemeji Forest Reserve

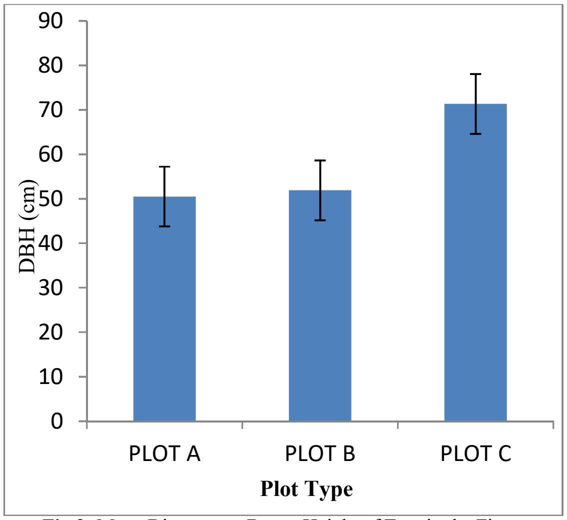

Fig 2: Mean Diameter at Breast Height of Tree in the Fire Experimental Plot of Olokemeji Forest Reserve

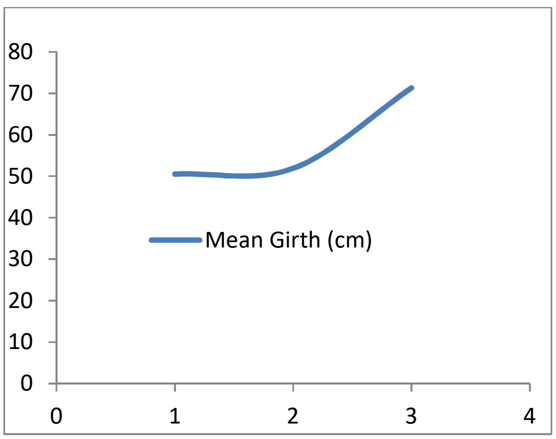

Fig 3: Diameter at Breast Height Distribution in Fire Experimental Plot of Olokemeji Forest Reserve

Fig 4: Mean Basal Area of Trees in the Fire Experimental Plot of Olokemeji Forest Reserve

The abundance of *Gmelina arborea, Dalbergia sissoo* and *Manilkara obovata* could be as a result of being fire resistance and the investigative plot being surrounded by *Gmelina arborea* and *Dalbergia sissoo* plantations, this reflected in the relative importance values of the species where *Gmelina arborea*, *Dalbergia sissoo*, *Manilkara obovata*, *Anogeissus leiocarpus* and *Terminalia superba* have the highest indices.

Table 2: Tree Basal Area and Tree Volume of Investigative Plots of Olokemeji Fire Experimental Plot

Plots	Total Basal Area (m^2 ha^{-1})	Total Volume (m^3 ha^{-1})
PLOT A	11.2	55.84
PLOT B	13.68	74.43
PLOT C	32.2	188.8
Total	**57.08**	**319.07**

Most of the species found on the plots are fire resistant plants, this is in agreement with the findings of Akinsoji (2013). Plot B which represents late burning has the lowest mean height (11.69 m) among the three divisions. Plot A which represents early burning has a mean height (12.32 m) which is lower than the average height of trees expected to be found in a tropical forest. Plot C has the highest mean height at 13.11m which is also lower than the height of trees expected in a tropical rainforest. This could be attributed to the regeneration and regrowth of the tree species after a major loss of the forest (Ogunwale, 2015). The horizontal and vertical structures of the forest as revealed by the mean diameter at breast height and mean height show a forest that is growing, ensuring it's stability. The highest mean diameter at breast height was found in the protected plot, Plot C at 71.32 cm, this is followed by Plot B at 51.91 cm which is closely followed by Plot A 50.52 cm, this reveals the occurrence of matured trees in the plots with DBH greater than 40 cm. This is also in agreement with the findings of Akinsoji (2013). In addition, the diameter distribution curve, which depicted a reverse J-shape indicate an healthy and stable ecological structure and population. Plot C has the highest mean basal area at 0.4 m^2 ha^{-1}, followed by Plot B which has 0.21 m^2 ha^{-1} and Plot A has 0.2 m^2 ha^{-1} mean basal area. The total basal area for the three plots followed the same order of increase with Plot C having the highest total basal area at 32.2 m^2 ha^{-1}, Plot B has 13.68 m^2 ha^{-1} while Plot A had the lowest total basal area at 11.2 m^2 ha^{-1}. The total volume of tree stands in each plots followed a similar order with Plot C having the highest tree volume at 188 m^3 ha^{-1}, this is followed by Plot B with 74.43 m^3 ha^{-1} and Plot A with the least tree volume of 55.84 m^3 ha^{-1}. These revealed that Plot C has actually been protected just as expected and it is almost attaining the status of a mature forest, Plot A is gradually becoming a savannah forest as a result of the annual early burning and Plot B has changed into a transitional woodland, this is in agreement with the findings of Akinsoji (2013) and Addo-Fordjour *et al.,* 2009; Anning *et al*., 2009.

Conclusion: The floristic structure of Olokemeji fire experimental plot has proofed without doubt that prescribed burning can serve as a management tool for maintaining stability in the forest ecosystem, however, the fire experimental plot needs to be further protected to prevent the loss of the tree stands which could invariably hinder the plots from serving their individual purposes.

REFER ENCES

Addo-Fordjour, P; Obeng, S; Anning, A; Addo, M. (2009). Floristic composition, structure and natural regeneration in a moist semi-deciduous forest following anthropogenic disturbances and plant invasion. *Inter. J. Biodiv. Conserve.*1 (2):21-37.

Akinsoji A. (2013). Vegetation Development Dynamics of Fire Experimental Plots at Olokemeji Forest Reserve, Nigeria. *J. Bio. Agric. Healthcare.* 3, (16) 128-133

Akinsoji, A; Elizabeth S. (2005). Effects of prescribed burning on bacterial and fungal communities of top soil in Olokemeji Forest Reserve, Nigeria. *The Ekologia* 3(2): 13-19

Anning, A; Akyeampong, S; Addo-Fordjour, P; Anti, K; Kwarteng, A; Tettey, Y. (2009). Floristic composition and vegetation structure of the KNUST Botanic Garden, Kumasi, Ghana. *J. Sci. Tech.* 28 (3); 103-122.

Attiwill P. M. (1994). The disturbance of forest eco-systems. The ecological basis for conservative management. *Forest. Ecol. Manage.* 63: 247-300

Blondel J; Aronson J; Bodiou J.Y; Boeuf G. (2010). The Mediterranean region. Biological diversity in space and time. Oxford University Press, New York, USA.Pp54

Charter J. R; Keay R. W. J. (1960). Assessment of the Olokemeji fire-control experiment (Investigation 254) twenty eight years after institution. Nigerian For. Inf. Bull. (New series) 3: Fed. Govt. Printer, Lagos.

Chen Q; Gong P; Baldocchi D; Tian Y. Q. (2007). Estimating basal area and stem volume for individual trees from lidar data. *Photogramm Eng Remote Sens.* 73: 1355-1365.

Hopkins S. B. (1972). The Olokemeji Forest Reserve II. The local history of the reserve, *The Nigerian Field* 34: 171

Lavorel S; Canadell J; Rambal S; Terradas J. (1998). Mediterranean terrestrial ecosystems: research priorities on global change effects. Global Ecology and Biogeography *Letters* 7**:** 157-166

Lloret F; Marí G. (2001). A comparison of medio- eval and the current fire regimes in managed pine forests of Catalonia (NE Spain). *Forest Eco- logy and Manage.* 141: 155-163

Lloret F; Peñuelas J; Estiarte M. (2004). Experimental evidence of reduced diversity of seedlings due to climate modification in a Mediterranean-type community. *Global Change Biology* **10**: 248-258

Lloret F; Peñuelas J; Prieto P; Llorens L; Estiarte M. (2009). Plant community changes induced by experimental climate change: seedling and adult species composition. *Perspect. Plant Ecol.* 11. 53-63

Moreira F; Ferreira P. G; Rego F. C; Bunting S. (2001). Landscape changes and breeding bird assemblages in north-western Portugal: the role of fire. *Landscape Ecol.* 16: 175-187

Moreno J. M.; Oechel W. C. (1994). The role of fire in Mediterranean type ecosystems. Springer- Verlag, Berlin, Germany.*Fire*.34: 112-120

Naveh Z. (1975). The evolutionary significance of fire in the Mediterranean region. *Vegetation* **29**: 199-208

Ogunwale A. O. (2015). Deforestation and Greening the Nigerian Environment. *International conference on African Development Issues*. (CU-ICADI).Pp217.

Olubode, O. S; Awodoyin R. O; and Ogunyemi S. (2011). Floral diversity in the wetlands of Apete River, Eleyele Lake and Oba Dam in Ibadan, Nigeria: Its implication for Biodiversity Erosion. *West Afr. J. Appl. Ecol.* 18: 109-119.

Onyekachi C; Johnson S. A. (2018). Basal Area-Stump Diameter Models for Tectona grandis Linn. F. stands in Omo Forest Reserve, Nigeria. *J. Forest. Environ. Sci*. 34. (2). 119-125

Pausas J. G; Fernández-Muñoz S. (2012). Fire regime changes in the Western Mediterranean Basin: from fuel-limited to drought-driven fire regime. *Climatic Change* 110 (1-2): 215-226

Peñuelas J; Filella I. (2001). Phenology: responses to a warming world. *Sci.* 294 (5543): 793-795