PRINT ISSN 1119-8362
Electronic ISSN 2659-1502

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

J. Appl. Sci. Environ. Manage.
Vol. 26 (12) 2095-2099 December 2022

Assessment of Tree Species Diversity, Family Composition and Diameter Size Class of Tree Species in Igbo-Olua Sacred Groove, Ondo State, Nigeria

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ABSTRACT: This study was carried out to assess the tree species diversity, family composition and diameter size distribution of the tree species in Igbo-Olua sacred groove, Ondo state, Nigeria using appropriate standard techniques. A total of 34 tree species distributed in 23 families were recorded. Sterculiaceae family (66) had the highest number of individual stem per ha while Moraceae family had the highest number in terms of tree species per hectare (7). The distribution of the diameter structure is typical of the natural forest type with high number of tree species in the smaller size classes or interval (12.5) and the number of tree species decreases with increasing size class or interval. Diversity measures obtained included Shannon-Weiner index (3.09), Evenness (0.64) and Margalef index (6.36). Awakening the consciousness of people towards the protection of sacred groves has practical implications on their survival. Hence government and other allied institutions should gear efforts towards grove conservation.

DOI: **https://dx.doi.org/10.4314/jasem.v26i12.25**

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Cite this paper as: AINA-ODUNTAN, O. A; ONILUDE, Q. A, OSUNDUN, S. O; ONADEJI, O. M; AFOLABI, O. S; ADEDOYIN, O. D. (2022). Assessment of Tree Species Diversity, Family Composition and Diameter Size Class of Tree Species in Igbo-Olua Sacred Groove, Ondo State, Nigeria. *J. Appl. Sci. Environ. Manage.* 26 (12) 2095-2099

Dates: Received: 05 November 2022; Revised: 05 December 2022; Accepted: 24 December 2022; Published: 31st December 2022

Keywords: Diameter size class; family distribution; sacred grove; tree diversity assessment

Sacred groove is one of the prominent methods of in-situ conservation of biodiversity in Nigeria and in particular, the world in general. Other common methods in Nigeria include Biosphere Reserves, Game Reserves, Regeneration Plots and Permanent Sample Plots. Sacred grooves are created to protect representative samples of natural ecosystems for preservation of biodiversity and ecological processes, scientific study, environmental monitoring, education and the maintenance of genetic resources in a dynamic and evolutionary state (Isichei 1995). Also, patches of vegetation protected on the basis of religious faith are referred to as sacred groves. In some societies of Africa, America, Asia, Australia and Europe had long been preserving sections of the natural environment as sacred groves to Gods and Goddesses (Gadgil and Vartak, 1975; Khiewtam and Ramakrishnan, 1989; Hughes, 1994; Ramakrishnan, 1996). The role of natural sacred sites, particularly sacred groves, is attracting increasing interest in conservation organizations such as UNESCO, the WWF and has significant relevance for the implementation of the Conservation of Biological Diversity which stresses more on the use of traditional wisdom and practices for conservation and sustainable use of biological diversity. However, sacred forests have remained resilient to extensive deforestation and land use changes in Nigeria and the world over (Bhagwat et al.,

2005). The sacred groves have played an important role in conserving the forest and its constituent biodiversity elements since ancient times. In recent years with the erosion of religious faith and encroachments of these sacred groves, there is a growing concern if the groves indeed can offer a refugium to the rare, endangered and endemic species (Kushalappa and Bhagwat, 2001). Forests have been fulfilling the human needs from time immemorial. Sacred grooves are an example for positive human intervention in conserving forests (Accavva, 2002). The ownership of the sacred groves is with the state government and managed jointly with the local communities. The contributions of local communities toward the managements of sacred grooves are mainly in terms of providing protection and tree enrichment. This has contributed immensely in maintaining health and growth of scared grooves and is instrumental in providing many non-tangible benefits such as biodiversity conservation, aesthetic and recreational services (Bhagwat *et al*., 2005). However, in many part of Nigeria, sacred groves are very rich in biological diversity. Previous studies have shown that sacred grooves still stand out distinctly as relicts of each particular ecosystem (Alabi, 1992). Several case studies of the definition of sacred grooves have been highlighted and results of several studies in Nigeria have also shown that sacred grooves are richer in floristic composition (Okali and Amubode, 1995; Alabi, 1992; Oyelowo *et al*. 2018). Traditional religion and cultural practices thus contributed greatly to restricting and controlling the utilization of the resources of these very representative land areas (Godson, 1998). Assessment of quantitative information on family composition, abundance and diameter size distribution of tree species in the sacred groove is of key significance to understand the form and structure of a forest community and also for planning and implementation of conservation strategy of the community i.e sacred groove (Grime 1979; Chabot and Mooney, 1985). Reliable data on regeneration trends are required for successful management and conservation of the tree species (Vitousek and hooper, 1993). Therefore, the present study was carried out to assess the tree species diversity, family composition and diameter size distribution of the tree species in Igbo-Olua sacred groove, Igbara-Oke, Ondo state, Nigeria.

MATERIALS AND METHODS

Study Area: The study area is located at Igbara Oke area in Ifedore Local Government Area of Ondo state, Southwestern Nigeria. The study site is on Lat. 7°24' 0" and Long. 5° 3' 0". There is a distinct dry and rainy seasons. Its annual average rainfall and temperature is 1489mm and 26.5ºC respectively (Oyelowo, *et al*., 2018). The Igbo-olua sacred groove stands as a major cultural site for many of the festivals that do take place in the area. Some of the festivals include: Yam festival (OdunIjesu), *Ijobi* festival and *Ikedi* festival where cow is killed ones in three years for the rituals (Oyelowo, *et al*., 2018). The importance of this forest to the community has been established in praising each other *"OluaUgbara a gbeketera o"* meaning "the god (Olua) of Igbara will bless all" (Oyelowo, *et al*., 2018). It has become a custom to perform rituals before tree assessment in the sacred grove.

Data Analysis

Basal Area Estimation: The Basal Area (BA) of individual trees sampled will be estimated using the formula in equation given by Husch *et al, 2003.*

$$BA = \frac{\pi d^2}{4} \quad \ldots\ldots\ldots\ldots 1$$

Where: BA = Basal area (m^2); D = dbh (cm); Π = 3.142 (constant)

Ecological diversity assessment: Paleontological Statistics (PAST) software was used extensively for the diversity analysis as suggested by Magurran, (2004). The Shannon-Wiener diversity index (H'), Species Evenness (E') and Margalef's index (d) were all calculated to determine the tree species diversity.

Shannon-Wiener Diversity Index (H'): The Shannon-Wiener diversity index is the most widely used index in community ecology. The values of Shannon-Wiener diversity index is usually found to fall between 1.5 and 3.5 and only rarely surpasses 4.5 (Magurran, 2004). It is given by

$$H' = -\sum_{i=1}^{s} PiLnPi \quad \ldots\ldots\ldots\ldots 2$$

Where; H' is the Shannon-Wiener diversity index; S is the total number of species in the community; pi is the proportion of *S* made up of the *i*th species; Ln is natural logarithm.

Pielou's Species Evenness Index (E): The ratio of the observed diversity (H) to the maximum diversity (H_{max}) is taken as a measure of evenness (E).

$$E = \frac{\sum_{i=1}^{S} P_i Ln P_i}{ln\,(S)} \qquad 3$$

Where S is the total number of species. E is constrained between 0 and 1.0 with 1.0 representing a situation in which all species are equally abundant.

Margalef's Index (d): Margalef's index (d) was used to calculate the species richness. The Margalef's index (d) is independent of sample size. It is based on the relationship between total number of species (S) and total number of individuals (N). Margalef's index is given by:

$$d = \frac{S-1}{\ln(N)} \qquad 4$$

Where S is the total number of species; N is the total number of individuals and lnis the natural logarithm ($\log_e$).

RESULT AND DISCUSSION

Tree species diversity and abundance: Forests contain the greatest diversity in terms of species, genetic material and ecological processes of all ecosystems. Forest community plays a central role in the functioning of the biosphere, as they are the origin of many cultivated plants and animals (EU 2008). Sacred groves are one of the in situ methods of conservation that are used strictly to protect rare habitat types and tree species from being disturbed through man's activities. Diversity indices provide important information about the rarity and commonness of species in a community. The ability to quantify diversity in this way is an important tool for biologists trying to understand community structure. The tree species diversity in Igbo-Olua sacred grove showed the total number of individual/ha recorded to be 180, while the total of 34 tree species/ha were identified (table 1). The tree diversity obtained for this study was presented in table 1. The high values of the diversity indices obtained reveal that the sacred grove is very high in tree species diversity and abundance. The Shannon-Wiener index (3.09) and Evenness (0.64) were very high, indicating that the sacred grove is a potential biodiversity hotspot. Although, these indices do not compared favourably with several protected areas that are biodiversity hotspots in the south western Nigeria as reported by Adekunle, (2006), Adekunle *et a*l., (2013). However, the Shannon-Weiner index value obtained in this study falls within the range of 2.94 - 3.96 that was obtained by Rao *et al*. (2011) for sacred groves in south eastern, ghats, India. Also, falls within the range of Shanon-Weiner index values (2.69 – 3.33) obtained by Duran *et al*., (2006).The results of this study revealed that sacred grove is a repository of indigenous tropical hardwood tree species in different families. In terms of relative abundance, the most occurring individual tree species was *Cola gigantea* with 35 individual stems /ha. It was followed by *Triplochiton scleroxylon* with 13 individual tree stems/ha. Others of significant occurrence in order of abundance were *Celtiszenkeri* (11), *Hildegardia barteri* (11), *Entandrophragma angolense* (8), *Albizia zygia* (8), *Myrianthus arborea* (8), *Leuconadiscu scopanoides* (8), *Sterculia triagacantha* (8), *Khaya grandifololia* (7) etc. Low abundance individual tree species identified in the groove included *Newbouldia leavis (*1), *Terminalia ivorensis* (1), *Trichilia monadelpha (2), Antiaris African* (2), *Sterculia rhinopetala* (3).

Table 1: Tree diversity and growth components of tree species in Igbo-olua sacred groove

Diversity and Growth components	Values
Individual stem/ ha	180
Tree species/ha	34
Shanon-weiner index (H')	3.09
Pielou's Species Eveness index (E')	0.64
Margalef's index (d)	6.36
Total Dbh (cm)	1054.66
Mean Dbh (cm)	31.01
Mean Basal area (m^2)	1900.25
Total basal area (m^2)	64608.56

Family distribution and composition: Individual tree species family distribution of the Igbo-olua sacred grove was presented in figure 2. Sterculiaceae family had the highest number of occurrence of 66 individual tree stem/ha (figure 2), followed by the Moraceae family with 29 individual tree stem/ha.

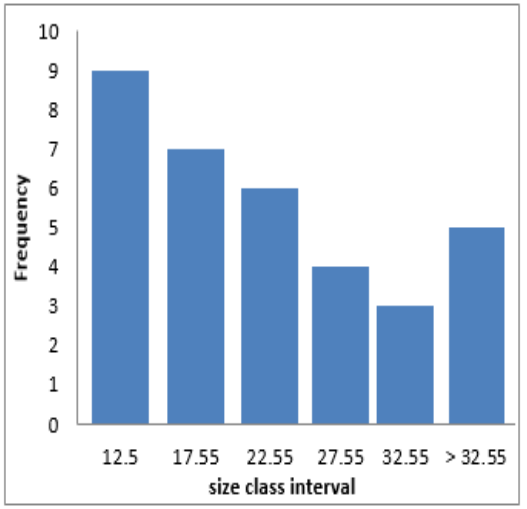

Fig 1: Diameter size class of tree species in Igbo-olua sacred grove, Ondo state

This was followed by Meliaceae and Ulmacaee families with individual tree stem/ha of 18 and 14 respectively (figure 2). However, Moraceae family was the most abundant family with highest number tree species (7), followed by Sterculiaceae (6) (figure 3).This study corroborated with the report of Oyelowo et al., (2012) as the same number of tree species were obtained for Moraceae and Sterculiaceae families. This shows that there is minimal level of or no anthropogenic activities going on in the sacred grove.

This might be due to security level put in place in the grove by the community. However, method of seed dispersal has been identified as mechanism that plays a strong role in the preponderance of occurrence of species in family with high diversity (Ogunleye *et al*., (2004); Soladoye *et al*., (2005).

Diameter size class: The result of the diameter class size for the Igbo-olua sacred grove was presented in figure 1. The distribution of the diameter is typical or similar to the natural forest type with high number of tree species in the smaller size classes or interval (12.5) and the number of tree species decreases with increasing size class or interval as shown in figure 1. The highest frequency was observed in the class interval of 12.5 while the least frequency was observed in class interval 32.55 (figure 1). As typical of mature natural forest, the number of stems was inversely proportional to diameter sizes, (Fig. 1), indication of a healthy recruitment of the individuals in the sacred grove. However, the shape of this forest community in the grove is of inverted J- shape, similar to that found in the tropical forest (Oduwaiye *et al*., 1998; Oyelowo *et al*., 2018).

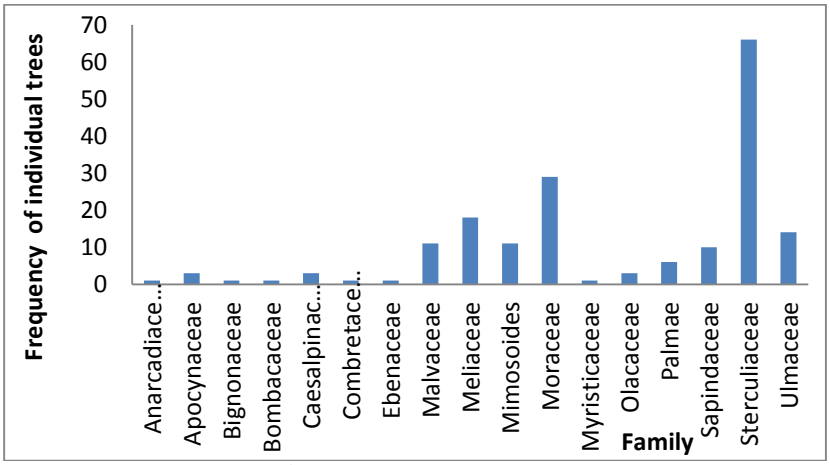

Fig 2: Family distribution of tree species by individual trees in Igbo-olua sacred grove

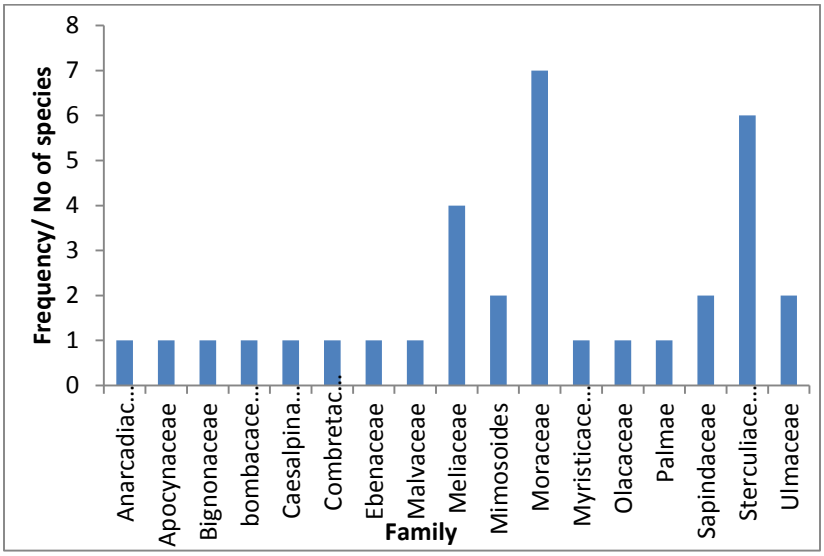

Fig 3: Family composition and distribution of tree species in Igbo-olua sacred grove

Conclusion: It is evident that the grooves are functionally diverse, although lesser in diversity when compare with other diversity of south-western forest community. This helps to facilitate efficient utilization of resources and in turn sustaining a balanced interaction between the environment and the biological entities of the sacred grooves. Baseline information for formulating conservation and management strategies of the present sacred forest is highlighted. Thus, a systematic management plan is required for the conservation of flora and sustainable use of available resources.

REFERENCES

Accavva M (2002): Preservation of Devrakadu in Kodagu district–A resource economic study. India: ICAR; 2002. p. 1–5.

Adekunle, V. A. J. 2006. Conservation of tree species diversity in tropical rainforest ecosystem of southwest Nigeria. *J. Tropical Forest Sci.* 18: 91-101.

Adekunle, V.A.J; Olagoke, A.O and Akindele, S. O (2013): Tree species diversity and structure of a Nigerian strict nature reserve. *Trop. Ecol.* 54(3): 275-289.

Alabi, K.A (1992): Traditional forest conservation in practice: A case study of Ikire-Ile in Ola–Oluwa Local Government. M.Sc. Degree Dissertation, Department of Forest Resources Management, University of Ibadan, Ibadan.

Bhagwat S.A; Kushalappa C.G and Williams P.H (2005): A landscape approach to biodiversity conservation of sacred groves in the Western Ghats of India. *Conservation Biol.* 19(6):1853–1862.

Chabot B. F and Mooney H. A (1985): Physiological Ecology of North American communities. USA: Chapman and Hall; 1985. p. 1–15.

Gadgil M and Vartak V.D (1975): Sacred groves of India-A plea for continued conservation. Journal of the Bombay, *Natural History Society*. 72(2):314-320.

Godson, C.V. (1998): Some perspectives of traditional African knowledge in biodiversity conservation. In: Traditional knowledge and Modern Concept. *Proceedings of third UNESCO MAB Regional Seminar* on BRAAF. Pp. 43-54.

Grime J. P (1979): *Plant strategies and vegetation process*. UK: John Wiley; 1979. Hughes T.P (1994): Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Sci.* 265(5178):1547-1551.

Isichei, A. O. (1995): Omo biosphere reserve, current status, utilisation of biological resources and sustainable management (Nigeria). UNESCO South-South cooperation programme working paper No. 11.

Khiewtam R.S Ramakrishnan P.S (1989): Socio-cultural studies at the sacred groves at Cherrapunji and adjoining areas of North-Eastern India. Man in India. 1989; 69:64-71.

Magurran, A. E. 2004. *Measuring Biological Diversity*. Blackwell, Oxford. UK.

Oduwaiye E. A., Oyeloye B and Oguntala A. B. (1998): Species Diversity and Potentiality for Forest Regeneration in Okomu Permanent Sample Plot: Forestry and Challenges of Sustainable Livelihood, Proceedings of the 28th Annual Conference of the Forestry Association of Nigeria, Akure, Ondo State, Nigeria, 2002, 4-8 November. pp 264-272.

Ogunleye , A.J. Adeola , A.O., Ojo , L.O. and Aduradola, A.M (2004): Impact of farming activities on vegetation in Olokemeji forest reserve, Nigeria. *Global Nest: the Int. J.* 6 (2). 131-140

Okali, D.U.U. and Amubode, F.O. (1995): Resources conservation in Oboto, Nigeria. In: Towards Common Ground – Gender and Natural Resources Management in Africa. Pp. 27-47.

Oyelowo, O. J., Aduradola, A. M., Ekpo, E. N. And Ine, I. E. (2012): Floristic composition of a Sacred groove in Igbara-Oke, Ondo State, Nigeria. *J. Forestry Res. Manage. 9 83-92, 0189-8418.*

Ramakrishnan P.S (1996): Conserving the sacred: From species to landscapes. Nature and Resources.UNESCO.1996; 32: 11-19.

Rao, B.R.P; Babu, M.V.S; Reddy; M.S; Reddy, A.M; Rao, V.S; Sunitha, S. and Ganeshaiah, N.K (2011). Sacred groves in Southern Eastern Ghats, India: Are they better managed than forest reserves? *Tropical Ecology* 52: 79-90.

Soladoye M.O; Sonibare M.A; Nadi A.O and Alabi D.A. (2005). Indigenous Angiosperm Biodiversity of OlabisiOnabanjo University Permanent site. *African J. Biotechnol. 4 (5):554-562.*

Vitousek P. M and Hooper D. U (1993): Biological diversity and terrestrial ecosystem Biogeochemistry. In: Shulze ED & Mooney HA, editors. *Biodiversity and ecosystem functioning*. Germany: Springer–Verlag; 1993. p. 3–14.