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SUCCESSIONAL STATUS, REGENERATION AND RECRUITMENT POTENTIAL OF SACRED GROVES IN SOUTH WEST NIGERIA

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Abstract
The global species extinction rate is increasing, reaching about 1,000 times or more than the natural rate due to forest conversions. Recently, ecologists, conservationists and government have adopted various conservation methods. One of the methods that have gained attention in the recent time is the traditional methods of protecting and managing biodiversity, prominent among is sacred groves. Since management systems of sacred groves are likely to have contrasting effects on the regeneration and recruitment capability of pioneer and non-pioneer species, different impacts on adult tree species diversity are likely. However, no known study has tested this hypothesis. In this study, four sacred groves (Osun-Osogbo, Igbo-Olodumare, Idanre Hill and Ogun-Onire) were purposively selected. In each sacred grove, two line transects of 1000 m each, separated from each other by a distance of at least 1000 m were used in laying temporary sample plots. Four temporary sample plots of 40m × 20m were laid at alternate sides of the transect at 250m interval. Within each sample plot, all living trees with DBH ≥ 10 cm were identified and their DBH measured. For tree saplings enumeration, 10m × 10m sub-plot was laid at the middle of each 40 m x 20 m sample plot. All saplings with DBH >1.0 cm but < 10 cm were identified and their dbh measured. A 5 m × 5 m quadrant was laid within the 10 m × 10 m sub-plots to identify seedling species and record their frequencies. Results show that some tree species were found to exist only in some sacred groves. Also, some tree species that were not found in protected forests existed in sacred groves. The presence of these unique tree species contributes to the welfare and stability of the local environment as well as indicates the potential of sacred groves for conservation of important tree species. High regeneration and succession in the sacred groves investigated in this study were partly attributed to taboos, cultural and traditional methods. Adoption of these methods is therefore recommended for use in different forest reserves in South West Nigeria.

Keywords: *Sacred grove, succession, recruitment and regeneration potential*

Introduction

Biodiversity is essential for the wellbeing of the ecosystem but the escalating extinction crisis shows that the diversity of nature can no longer support the current pressure that humanity exerts on the forest (Shushma et al., 2015). High density and diversity of species in rainforests have attracted incessant disturbance of forest ecosystem (Onyekwelu et al., 2008). Species extinction rate is increasing, reaching up to 1,000 times or more than the natural rate because of habitat destruction, land conversion for agriculture and development, climate change, pollution and the spread of invasive species (Shushma et al., 2015).

Recently, ecologists, conservationists and government have adopted and recommended various conservation methods. One of the methods that have gained attention is the use of traditional practices in protecting and managing biodiversity, among which sacred grove is the prominent (Daye and Healey, 2015). In Nigeria, sacred groves have been observed to play a vital role in biodiversity conservation (Onyekwelu and Olusola, 2014). Though sacred groves are habitations for both rare and endemic species, there are still reports of anthropogenic activities ravaging the ecosystem (Khan et al., 2008).

Due to present challenges confronting forest conservation in Nigeria, researchers have made concerted efforts to assess the status of different forest types in Nigeria, using criteria such as tree species diversity, growth and yield, species richness, species abundance, etc (Onyekwelu et al., 2008, Adekunle et al, 2013; Onyekwelu and Olusola, 2014). Although studies have been carried out describing tree species diversity, population structure and regeneration status in different tropical rainforests (Adekunle, 2006; Onyekwelu et al 2008; Adekunle et al, 2013), limited studies (Onyekwelu and Olusola 2014) have assessed tree species diversity in sacred groves in Nigeria. Also, no known study has assessed the regeneration and recruitment potentials of sacred groves in Nigeria.

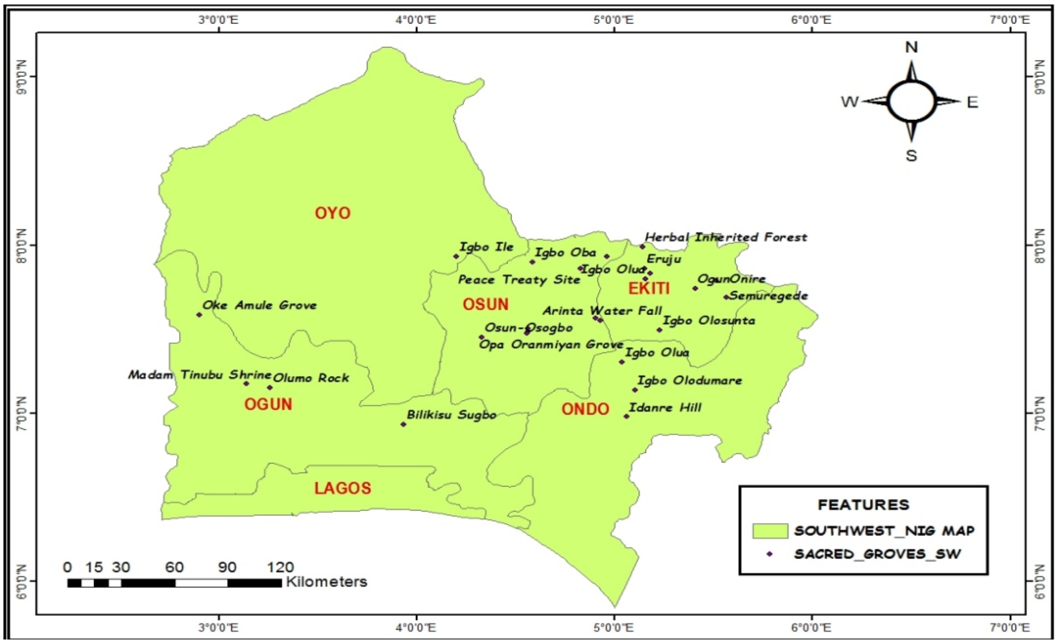
Sacred groves have been reported to harbour several commercially important and highly valuable tree species, hence their sustainability is key to the continued existence of mankind (Onyekwelu and Olusola, 2014). But today, they are confronted with the task of finding suitable strategies to enhance regeneration and recruitment (Rahman, 2019). Regeneration in natural forest is a biological process which involves asexual and sexual reproduction, dispersal and establishment (Barness, 1997) while successful regeneration and vigorous height growth lead to recruitment. In silviculture, recruitment is a process by which trees move from one size class to another (Helms,1998) or by which young trees overgrown certain threshold value of height or diameter (Lexerod and Eid, 2005).

Greene et al. (1999) listed the factors that could influence the density and composition of seedlings in forest ecosystem to include: site conditions, seed rain and banks, light conditions, competition, intra and inter species relations. Klopcic et al. (2012) opined that bregeneration patterns are often streamlined with distinctive types such as early and late successional tree species. The early successional species (pioneer species) are usually abundant during establishment phase but have relatively low survival rate whereas the late successsional species (non-pioneer species) have moderate and periodic establishment with higher survival rate (kimmins, 2004). According to Bazzaz (1991), regeneration of pioneer tree species can be initiated by human disturbance, while, in contrast, removal of the forest canopy can hamper regeneration of non-pioneer species.

Management of sacred groves are likely to have contrasting effects on the regeneration and recruitment capability of pioneer and non-pioneer species, thus different impacts on adult tree species diversity are likely. However, no studies have tested this hypothesis. Testing this hypothesis will be of importance to forest conservationists. Information from this investigation will provide information on the capacity of sacred groves to contribute to biodiversity conservation, especially regeneration and recruitment.

Methodology

The study was carried out in Southwestern Nigeria made up of Ogun, Oyo, Osun, Ekiti, and Ondo States. The area lies between longitude 2^0 $31^'$ and 6^0 $00^'$ East and Latitude 6^0 $21^'$ and 8^0 $37^'$N with a total land area of 77,818 km^2 (Agboola, 1979). A high percentage of the region lie within the tropical rainforest zone of Nigeria with distinct dry and rainy seasons. Annual rainfall ranges between 1000 mm and 2500 mm) while mean temperature varies between 21- 34ºC. Rainfalls occur within the months of April to October while the dry season lasts from November to March) (Faleyimu et al., 2013). Soils are predominantly ferruginous tropical, typical of the variety found in intensively weathered areas of basement complex formations in the rainforest zone of south-western Nigeria (Onyekwelu et al., 2008).



. 1: Map of South- West Nigeria with Sacred Groves

Method of Data Collection

Out of the mapped sacred groves in south western Nigeria (Figure 1), four (Osun-Osogbo, Igbo-Olodumare, Idanre Hills and Ogun-Onire) were purposefully selected to cover as much of the region as possible. In each sacred grove, two-line transects of 1000 m each in length, separated by a distance of at least 1000 m from each other was laid approximately at the middle of each site. Temporary sample plots of 40m × 20m was laid on alternate sides along each transect at every 250m interval, giving 4 plots per transect, 8 plots per sacred grove and 32 plots for this study. Within each sample plot, all living trees with DBH ≥ 10 cm were identified and their DBH measured. For tree sapling enumeration, 10m × 10m sub-plot was laid at the middle of each 40 m x 20 m plot. All saplings with DBH >1.0 cm but < 10 cm was identified and their dbh measured. A 5 m × 5 m quadrant was laid within the 10 m × 10 m sub-plot to identify seedling species, whose frequencies were recorded.

Data Analysis

The following biodiversity indices were computed:

(i) Species diversity index was calculated using the Shannon-Weiner diversity index (eqn. 1; Kent and Coker, 1992):

$$H^{'} = -\sum_{i=1}^{S} p_i \ln(p_i) \qquad (1)$$

Where: H' = Shannon-Weiner diversity index , S = Total number of species in the community ,
P_i = roportion of S made up of the i^{th} species, ln = natural logarithm

(iv) Shannon's maximum diversity index was calculated using eqn, 2:

$H_{max} = \ln(S)$ …………………………..…………………. (2)

Where: H_{max} = Shannon's maximum diversity

(v) Species evenness in each community was determined using Shannon's equitability (E_H)(eqn. 3):

$$E_H = \frac{H^{'}}{H_{Max}} = \frac{\sum_{i=1}^{S} P_i \ln(P_i)}{\ln(S)} \qquad (3)$$

(vi) Mangalef's index was calculated using the eq n. 4:

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

Where

S = number of species

N = number of individual

(vii) Simpson's index (eqn. 5)

$$D = 1 - \sum\left(\frac{n_i}{N}\right)^2 \qquad (5)$$

Where

n_i = number of individual of species i

N = total number of all tree species in the entire community

Results

Number of tree families in the overstory and understory layers of the various sacred groves varied from 19 to 29 and 15 to 25, respectively (Table 1). There were 32 to 58 tree species at overstory layer and 39 to 78 at the understory. Shannon-Wiener diversity index ranged from 1.8 to 3.46 at the overstory layer of the sacred groves and 2.65 to 3.55 at the understory (sapling) layer. The range of tree density at the overstory was 309 to 417 ha^{-1}, which was much lower than the 775 to 1445 ha^{-1} at the understory layer (Table 1).

The successional status of the sacred groves was studied using the 5 dominant species. Except Dialum guinensis and Funtumia elastic that were not found at the seedling stage, other species in Osun Osogbo sacred grove occurred at all three stages (i.e. seedling, sapling and over-story)(Figure 2), indicating that the species in the grove had good succession. In Igbo-Olodumare sacred grove, four of the five dominant tree species occurred at the three stages (Figure 3). Succession was fair at Idanre Hills sacred grove with two of the dominant species absent at the seedling stage (Figure 4) Figure 5 presented a picture of poor succession at Ogun-Onire grove with four of the dominant species absent at the seeding (3) and sapling (1) stages.

In this study, species recruitment was defined as those species that were present at the seedling stage and absent at sapling and overstory stages. Figure 6 revealed that Ogun-Onire sacred grove had the highest recruitment potential, followed by Osun Osogbo sacred grove Both Igbo-Olodumare and Idanre Hills sacred grove displayed low recruitment potential.

Tree species that occurred at only a site was regarded as unique to that site and denoted with "+". Tree species common to at least two sacred groves were denoted with "o" and those that were not found at a sacred grove are presented as "-" . Brachystegia eurycoma, Angylocalyx oligophyllus, Brachystegia nigerica, Gliricidia sepium, Rothmannia whitfieldii were unique to Osun-Osogbo sacred grove. Hildegardia barteri, Mansonia altissima, Amphiman pterocarpoides, Cleistopholis patens, Cordia millenii, Euphorbia lateriflora, Ficus cycomorus, Irvingia smithii, Piptadeniastrum africanum and Zanthoxylum zanthozaloides were unique to Igbo-Olodumare (Table 2). Entandrophragma cylindricum and Lovoa trichilioides were unique to Idanre Hills and Ogun-Onire sacred groves, respectively. Other unique species associated with each sacred grove are presented in Table 2.

Tree species endemic in the sacred groves in Southwestern Nigeria are presented in Table 3. For example, Amphimas pterocarpoides, Euphobia lateriflora, Ficus sycomorus and Hildegardia barterii were among the tree species found only in Igbo-Olodumare. Angylocarlyx oligophyllus, Hanoa cleiniana and Rothmannia whitfieldii were found only in Osun-Osogbo sacred grove. Anopyxis klaineana, Anthonotha macrophylla, canarium schweinfurthii, Celtis philipensis, Draceana arborea and Drypetes gossweileri were tree species found only in Ogun-Onire sacred grove. In Idanre Hills, Holarrhena floribunda, Monodora tenufolia and Pterocarpus mildbreadii were the endemic tree species.

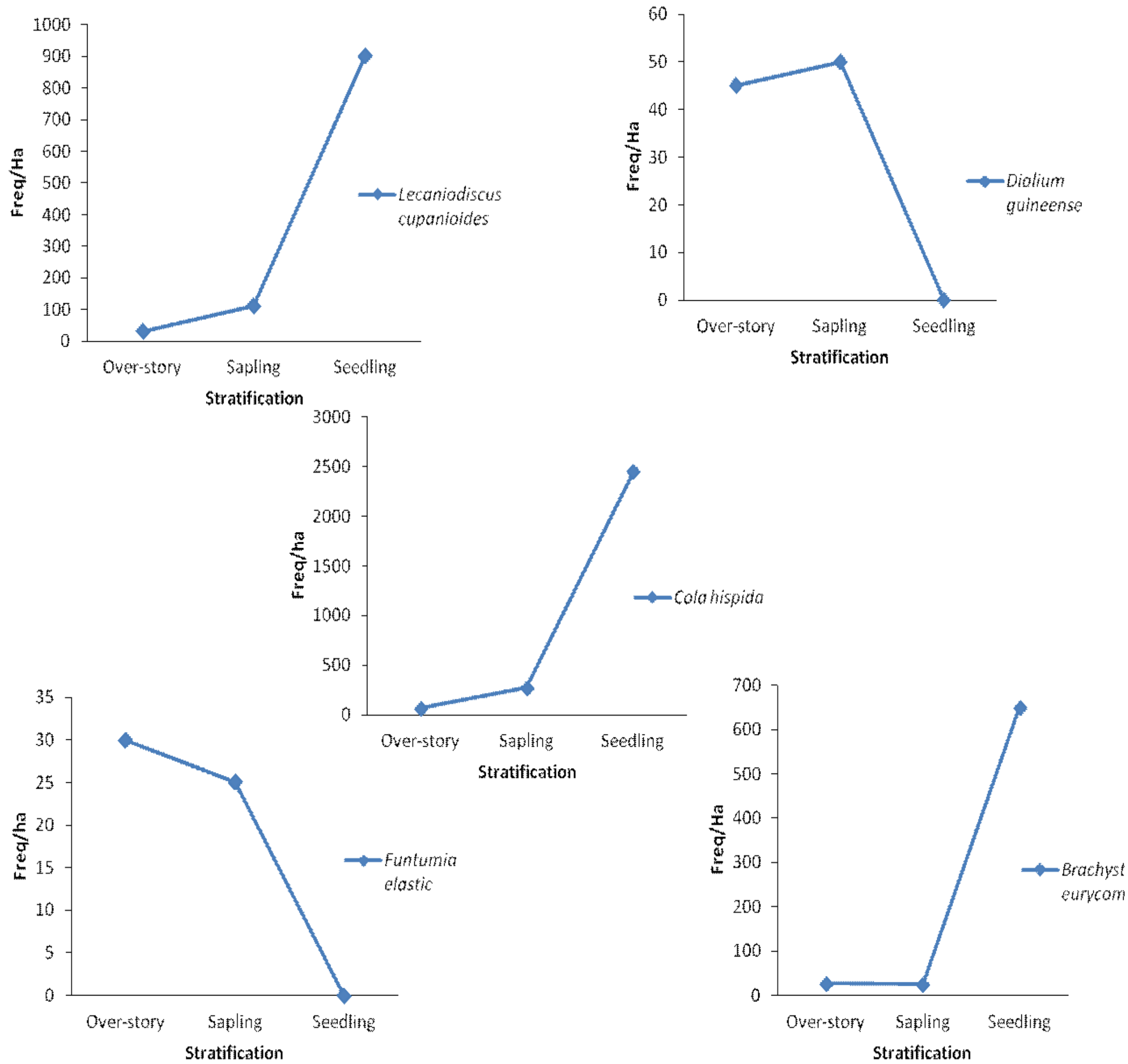


Figure 2: Successional status of five (5) most dominant species in the Osun Osogbosacred grove

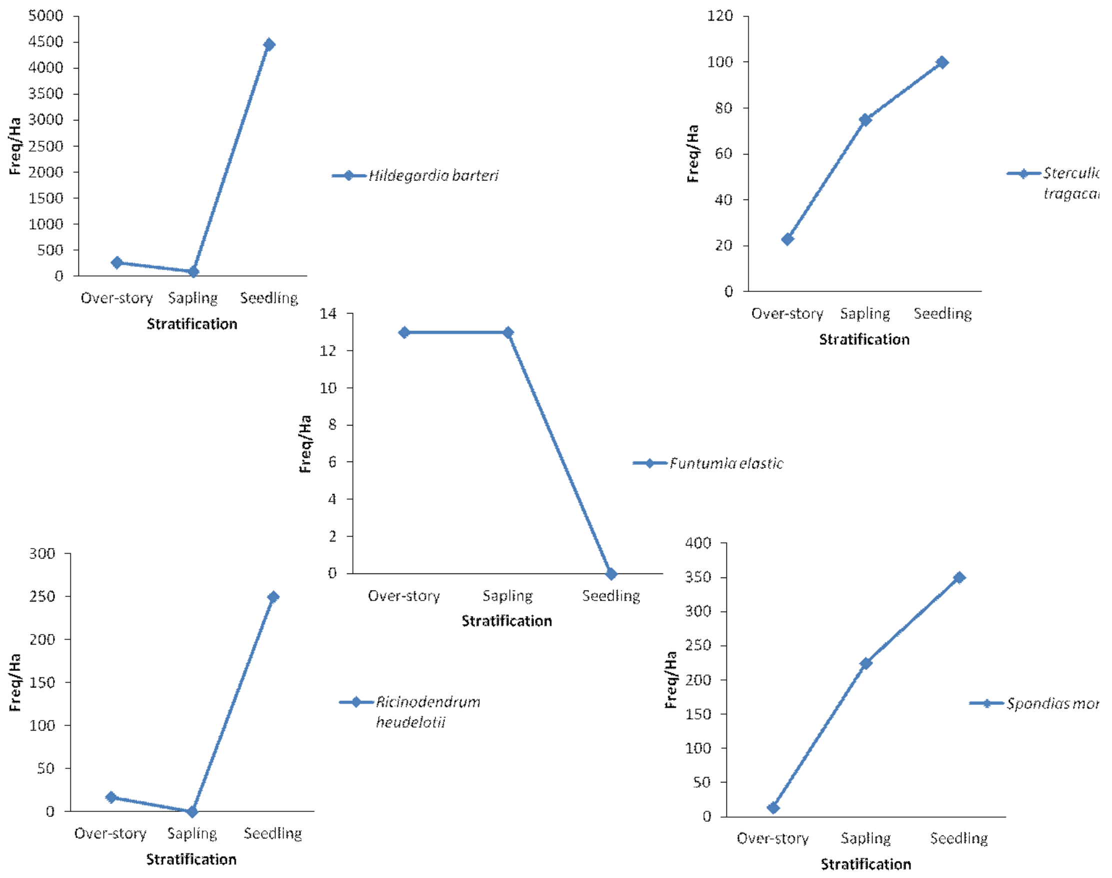


Figure 3: Successional status of five (5) most dominant species in Igbo-Olodumare sacred grove

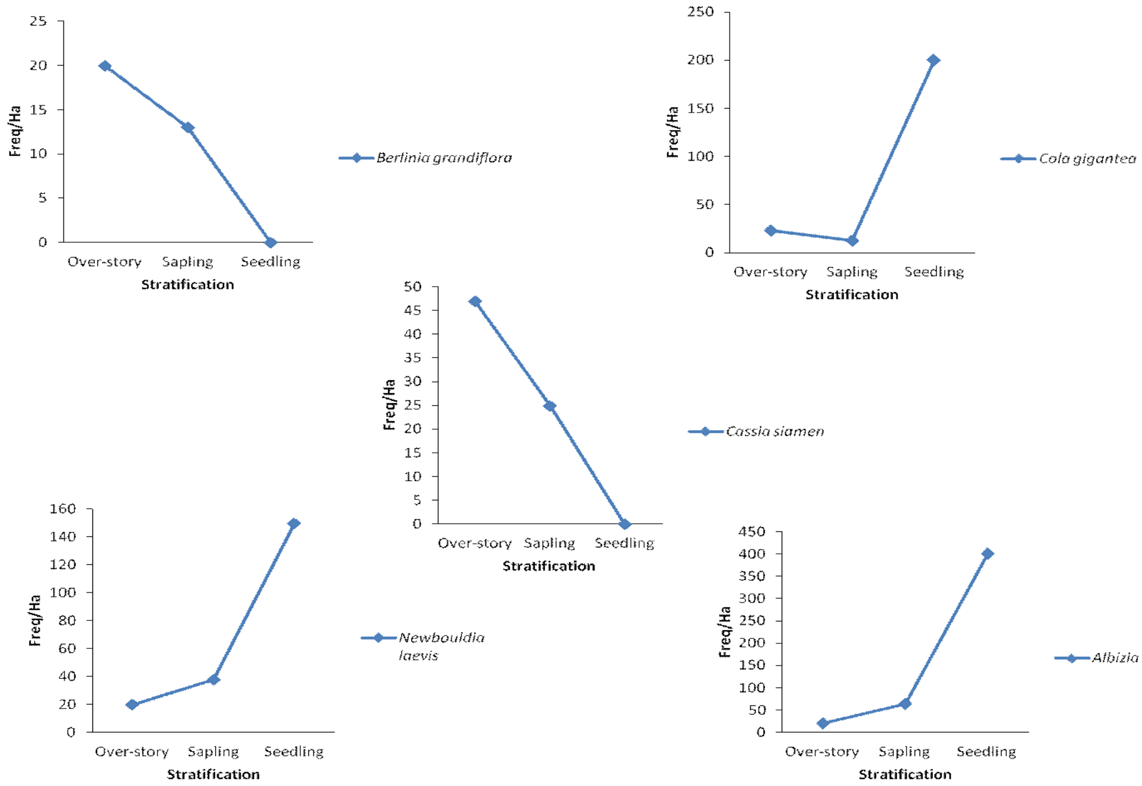


Figure 4: Successional status of five (5) most dominant species in Idanre Hill sacred grove

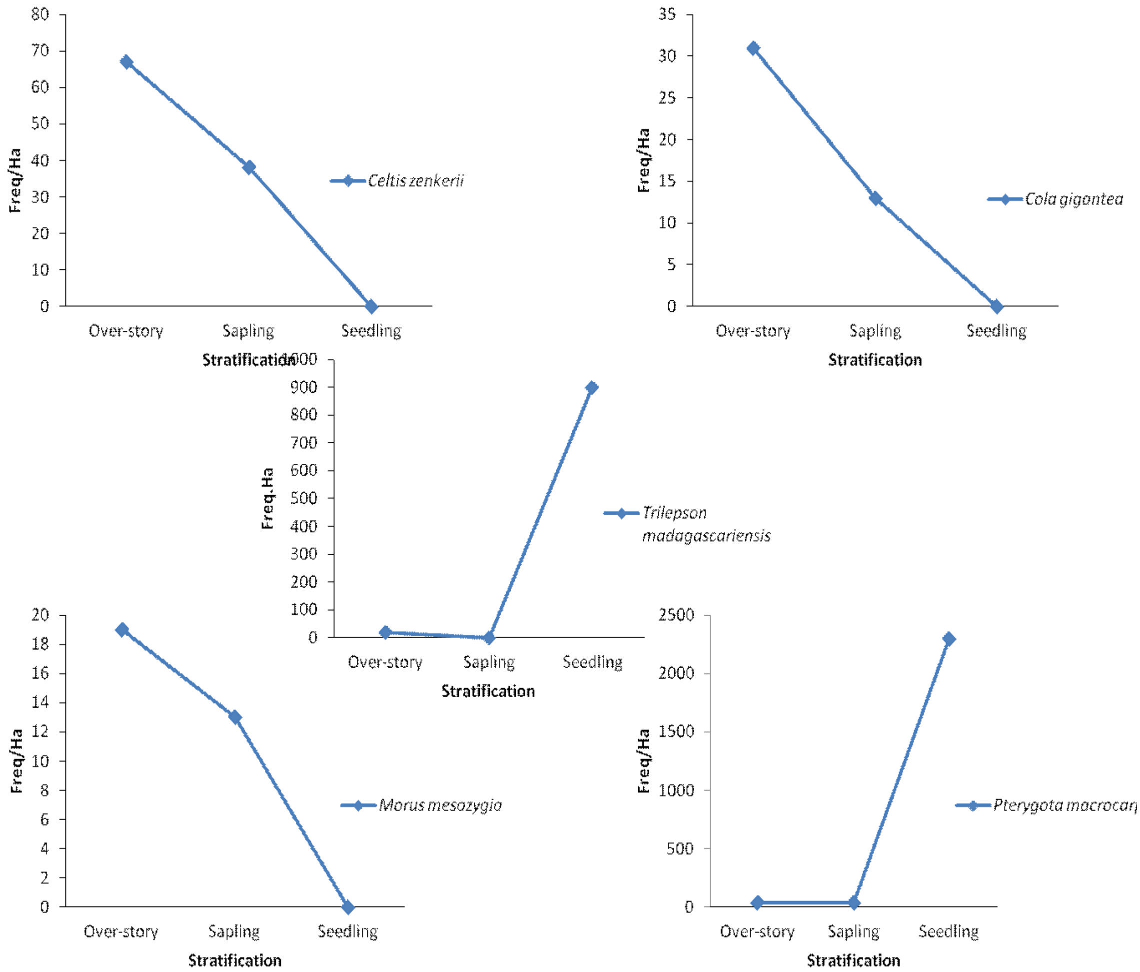


Figure 5: Successional status of five (5) most dominant species in Ogun Onire sacred grove

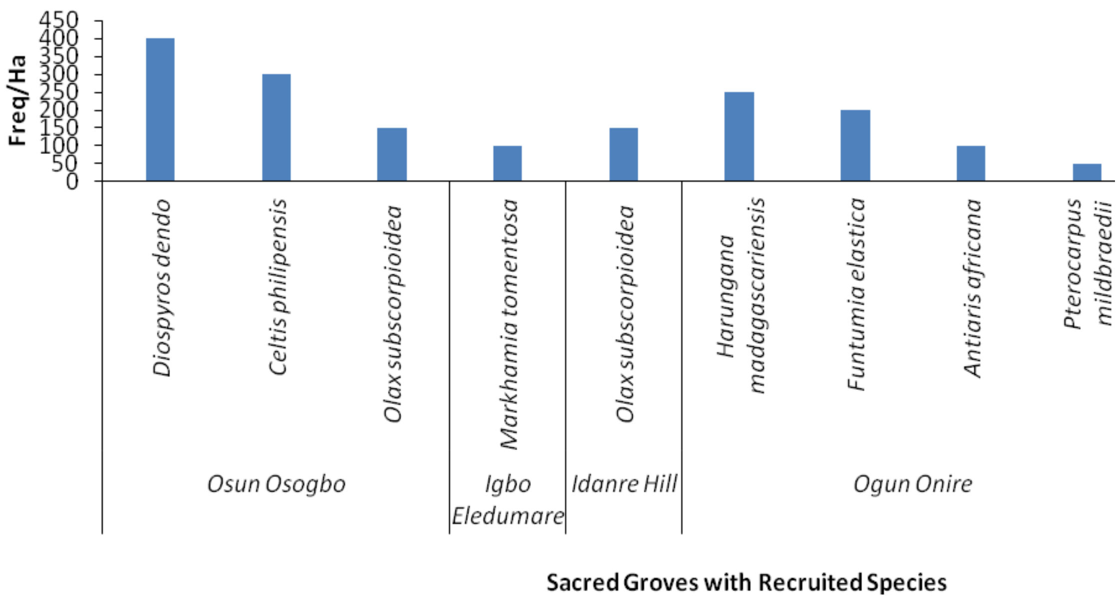


Figure 6: Recruitment potential of sacred groves in SW Nigeria

Table 1: Summary of the Diversity Indices

Diversity indices	Osun-Osogbo	Igbo-Olodumare	Idanre Hills	Ogun-Onire
	Overstory Layer			
Number of Species	46	32	43	58
Number of Families	27	19	26	29
Number of Trees Ha^{-1}	417	408	309	408
Shannon-Wiener diversity Index	3.19	1.8	3.25	3.46
Shannon-Wiener species Evenness	0.84	0.52	0.86	0.85
Simpson Concentration	0.07	0.4	0.06	0.05
Species Richness (margalef index)	8.05	5.57	7.94	10.24
	Understory Layer			
Number of Species	55	39	73	78
Number of Families	17	15	20	25
Number of Under-story Ha^{-1}	775	835	1445	903
Shannon-Wiener diversity Index	3.55	2.65	3.26	3.51
Shannon-Wiener species Evenness	0.63	0.36	0.36	0.43
Simpson Concentration	0.96	0.90	0.92	0.95
Species Richness (margalef index)	8.12	5.65	9.90	11.31

Table 2: Unique Tree Species in the Study Area

S/N	Name of Species	Osun Osogbo	Igbo	IdanreHill	OgunOonire
1	*Afzelia africana*	-	−	−	+
2	*Albizia ferruginea*	o	o	o	o
3	*Albizia lebbeck*	o	−	−	o
4	*Albizia zygia*	o	−	o	o
5	*Alchornea laxiflora*	−	−	−	+
6	*Alchornia cordifolia*	−	−	+	−
7	*Alstonia boonei*	−	−	o	o
8	*Amphiman pterocarpoides*	−	+	−	−
9	*Angylocalyx oligophyllus*	+	−	−	−
10	*Anopyxis klaineana*	−	−	−	+
11	*Anthocleista djalonensis*	−	−	+	−
12	*Anthonotha macrophylla*	−	−	−	+
13	*Antiaris africana*	o	−	o	−
14	*Baphia nitida*	o	−	o	−
15	*Berlinia grandiflora*	−	−	o	o
16	*Blighia sapida*	o	o	o	o
17	*Bombas buonopozense*	−	−	−	+
18	*Brachystegia eurycoma*	+	−	−	−
19	*Brachystegia kennedyi*	−	−	−	+
20	*Brachystegia nigerica*	o	o	−	−

21	*Canarium schweinfurthii*	–	–	–	+
22	*Cassia siamen*	–	–	+	–
23	*Ceiba pentandra*	o	o	o	o
24	*Celtis mildbraedii*	o	o	–	o
25	*Celtis philippensis*	–	–	–	+
26	*Celtis zenkerii*	o	o	–	o
27	*Chrysophyllum albidum*	–	–	o	o
28	*Cleistopholis patens*	–	+	–	–
29	*Cola acuminate*	–	–	–	+
30	*Cola gigantean*	–	–	o	o
31	*Cola hispida*	o	o	o	o
32	*Cola millenii*	o	o	–	o
33	*Cordia millenii*	–	+	–	–
34	*Dialium guineense*	o	–	o	–
35	*Diospyros dendo*	–	o	o	o
36	*Diospyros mobutensis*	o	–	–	o
37	*Discoglypremna caloneura*	+	–	–	–
38	*Distemonanthus benthamianus*	o	–	o	–
39	*Dracaena arborea*	–	–	–	+
40	*Dracaena marginata*	o	–	o	–
41	*Drypetes gossweileri*	–	–	–	+
42	*Drypetes oblongifolia*	+	–	–	–
43	*Entandrophragma angolense*	–	–	–	+
44	*Entandrophragma cylindricum*	–	–	+	–
45	*Ficus sycomorus*	–	+	–	–
46	*Ficus exasperate*	–	o	o	o
47	*Ficus mucoso*	o	–	o	o
48	*Funtumia elastic*	o	o	o	o
49	*Gliricidia sepium*	+	–	–	–
50	*Gmelina arborea*	+	–	–	–
51	*Hanoa cleniana*	+	–	–	–
52	*Hildegardia barteri*	–	+	–	–
53	*Holarrhena floribunda*	–	–	+	–
54	*Hunteria Umbellata*	–	–	–	+
55	*Irvingia smithii*	–	+	–	–
56	*Ixora guinensis*	+	–	–	–
57	*Khaya grandifoliola*	–	o	o	o
58	*Lannea welwitschii(Hiern)*	–	–	–	+
59	*Lecaniodiscus cupanioides*	o	o	–	o
60	*Lovoa trichilioides*	–	–	–	+
61	*Malachanta alnifolia*	–	–	–	+
62	*Mallotus oppositifolius*	–	–	–	+
63	*Manilkara obovata*	o	–	o	–
64	*Mansonia altissima*	–	+	–	–
65	*Margaritaria discoidea*	o	o	o	o
66	*Massularia acuminate*	+	–	–	–
67	*Melachanta alnifolia*	+	–	–	–
68	*Milicia excels*	–	o	o	o
69	*Milletia thonningii*	o	–	o	o
70	*Monodora myristica*	o	–	o	–

71	*Monodora tenuifolia*	–	–	–	+
72	*Morinda lucida*	–	–	+	–
73	*Morus mesozygia*	–	–	o	o
74	*Myrianthus arboreus*	–	–	–	+
75	*Napoleonaea imperialis*	+	–	–	–
76	*Newbouldia laevis*	o	–	o	–
77	*Piptadeniastrum africanum*	–	+	–	–
78	*Pterocarpus mildbraedii*	–	–	+	–
79	*Pterygota macrocarpa*	–	o	o	o
80	*pycnanthus angolensis*	–	–	–	+
81	*Rauvolfia vomitoria*	–	–	+	–
82	*Ricinodendrum heudelotii*	o	o	–	o
83	*Rothmannia longiflora*	o	o	–	–
84	*Rothmannia whitfieldii*	+	–	–	–
85	*Spathodea campanulata*	o	–	–	o
86	*Spondias mombin*	–	o	o	–
87	*Spondias pinnata*	o	–	o	o
88	*Sterculia oblonga*	o	o	o	o
89	*Sterculia rhinopetala*	–	–	–	+
90	*Sterculia tragacantha*	–	o	o	–
91	*Strombosia fasae*	+	–	–	–
92	*Strombosia pustulata*	–	–	–	+
93	*Tabernaemontana Coronaria*	+	–	–	–
94	*Terminalia superb*	–	–	o	o
95	*Tetrapleura tetraptera*	–	–	–	+
96	*Trema orientalis*	–	–	+	–
97	*Trichilia monadelpha*	o	–	o	–
98	*Trichilia welwitschii*	o	o	o	o
99	*Trilepson madagascariensis*	o	–	–	o
100	*Triplochiton scleroxylon*	o	–	–	o
101	*Voacanga africana*	–	–	–	+
102	*Zanthoxylum zanthozaloides*	–	+	–	–

Note: + a unique species, o species common to sites and – species not found in the site.

		Sacred Groves				Protected Areas	
S/N	Name of Species	Osun Osogbo	Igbo	Idanre Hill	Ogun Oonire	Queen's Plot, Akure Forest Reserve (Lawal and Adekunle, 2013)	Omo Biosphere Reserve (Salami and Akinyele, 2018)
1	*Amphimas pterocarpoides*		+	-	-	-	-
2	*Angylocalyx oligophyllus*	+	-	-	-	-	-
3	*Anopyxis klaineana*	-	-	-	+	-	-
4	*Anthonotha macrophylla*	-	-	-	+	-	-
5	*Canarium schweinfurthii*	-	-	-	+	-	-
6	*Celtis philippensis*	-	-	-	+	-	-
7	*Dracaena arborea*	-	-	-	+	-	-
8	*Drypetes gossweileri*	-	-	-	+	-	-
9	*Euphorbia lateriflora*	-	+	-	-	-	-
10	*Ficus sycomorus*	-	+	-	-	-	-
11	*Hanoa cleniana*	+	-	-	-	-	-
12	*Hildegardia barteri*	-	+	-	-	-	-
13	*Holarrhena floribunda*	-	-	+	-	-	-
14	*Irvingia smithii*	-	+	-	-	-	-
15	*Lannea welwitschii(Hiern)*	-	-	-	+	-	-
16	*Lovoa trichilioides*	-	-	-	+	-	-
17	*Malachanta alnifolia*	-	-	-	+	-	-
18	*Massularia acuminate*	+	-	-	-	-	-
19	*Monodora tenuifolia*	-	-	-	+	-	-
20	*Morinda lucida*	-	-	+	-	-	-
21	*Piptadeniastrum africanum*	-	+	-	-	-	-
22	*Pterocarpus mildbraedii*	-	-	+	-	-	-
23	*Rothmannia whitfieldii*	+	-	-	-	-	-
24	*Tetrapleura tetraptera*	-	-	-	+	-	-
25	*Voacanga africana*	-	-	-	+	-	-

Discussion

Species diversity index is a measure of the variety of species in an area. Ogun-Onire sacred grove had the highest overstory species diversity index (3.46) while Igbo-Olodumare had the lowest. Except at Igbo-Olodumare, the Shannon–Weiner diversity index at the understory was similar to that of the overstory in other sacred groves. Generally, the diversity indices reported for sacred groves in this study were higher than the 2.82 for a Strict Nature Reserve in Akure forest reserve, Nigeria (Lawal and Adekunle, 2013). The diversity indices for Osun-Osogbo and Igbo-Olodumare groves in this study were comparable to those of Onyekwelu and Olusola (2014) for same sacred groves. However, our evenness indices were higher than the 0.66 and 0.44 recorded by Onyekwelu et al. (2014) for Osun Osogbo and Igbo-Olodumare sacred groves. Ikyaagba et al. (2019) reported higher number of species in Osun-Osogbo grove than the values recorded in this study for three of the sacred groves, except Ogun-Onire, which could be attributed to differences in the sampling intensity. For example, Ikyaagba et al. (2019) used larger (50m x 50m) and more (20) sample plots. The sacred groves in our study had higher number of understory species compared to what was published by Onyekwelu and Olusola (2014). These high number of species, especially at the understory, is a clear demonstration of important contribution to forest biodiversity conservation.

Currently, forest reserves in Nigeria are faced with lots of challenges. Illegal logging and clearance of forests for agriculture had negatively impacted the population of valuable tree species. For example, Olayinka et al. (2018) reported that Eda forest reserve has undergone various degrees of degradation from both illegal and legal loggers. This has led to reduction in tree species richness, the forest reserve is now dominated by few tree species. Degradation of Nigerian forests has also been reported by other researchers (Aruofor, 2001; Onyekwelu et al., 2008; Onyekwelu and Olusola, 2014). In addition, species regeneration was negatively affected by forest degradation. Therefore, forestry professionals are confronted with the task of finding the best approach to enhance regeneration of valuable tree species. In recent times, sacred groves are being considered as viable alternatives to state managed forests.

The high number of tree species at the understory layer of the sacred groves is an indication of healthy recruitment and by extension, healthy regeneration in this ecosystem. Our results revealed that the understory layer of the sacred groves had between 39 and 78 tree species against the 32 to 58 tree species at overstory layer. Another indication of good regeneration in sacred groves is the much higher density in the understory layer compared to the overstory. Except for few tree species, the number of seedlings was higher than that of sapling and overstory species in all sacred groves. The few species without representation at the seedling stage were encountered at the sapling and overstory stages. This is an indication that sacred groves has good recruitment and regeneration potentials. Ballabha et al. (2013) opined that regeneration is considered good if the number of seedlings > number saplings > number of overstory trees; fair if the number of seedlings > number saplings ≤ number of overstory trees; poor if the species were present only in a sapling stage and no seedlings were observed; and not regenerating if only adult trees of a particular species was present.

Conservation and maintenance of biodiversity in natural forest ecosystem can only be guaranteed through regeneration (Rahman et al., 2011). The high regeneration recorded for most species in each sacred grove, especially Ogun-Onire, could be attributed to the level of access restrictions imposed by their chief priests. For instance, nobody dared entered Ogun-Onire sacred grove without the permission of the chief priest. This is because most tree species in the grove are believed to be inhabited by the gods. To guarantee safe entry, these gods will be appeased through sacrifice. Also, there are taboos and myths that are feared by the people, which limits or prevents their entrance into the groves. With these restrictions, anthropogenic activities that could destroy seedlings are reduced thereby enhancing the regeneration and succession potentials of the groves. One major threat to forests ecosystem is limited tree regeneration; which creates opportunity for agricultural expansion (Rudel, 2013). The high recruitments recorded in the sacred groves could be attributed to disposal by birds and other animals that bring new seeds or fruits to the grove. In addition, the high recruitments could be attributed to disposal worshippers, visitors and tourists to the groves.

Sacred groves could serve as a reservoir for preserving unique tree species. In this study, some tree species were discovered to exist only in some sacred groves. For instance, Hildegardia barteri was endemic in Igbo-Olodumare, Entandrophragma cylindricum and Lovoa trichilioides were unique to Idanre Hills and Ogun-Onire sacred groves, respectively. Also, some tree species that were not found in protected forests (e.g. Queen's plot, Akure forest reserve, and Queen's plot, Omo forest reserve, Nigeria) existed in sacred groves. The presence of these unique tree species directly or directly contributes to the welfare and stability of the local environment. The prevalence of these unique species clearly indicates the potential of sacred groves for conservation of important tree species. Sacred groves have been reported to be reservoir of endangered species. Onyekwelu and Olusola (2014) reported that about 32% of the species encountered in Osun-Osogbo and Igbo-Olodumare sacred groves have been classified as endangered by FORMECU (1998).

Conclusion and Recommendation

Sacred groves could harbour high regeneration and promote conservation of tree species, especially in forest understory layer. Osun-Osogbo, Idanre Hills, Igbo-Olodumare and Ogun-Onire sacred groves harboured some unique and important tree species. High regeneration and successional status maintained in all the sacred groves in this study were achieved using taboos, cultural and traditional methods. These methods could be incorporated in managing forest reserves in Southwestern Nigeria.

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