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Preliminary Distributional Study of Woody Angiosperms of Oba Hills Forest Reserve - an Ignored Vegetation of South-western Nigeria

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ABSTRACT

Assessment of biological diversity has remained an important aspect of species conservation given the challenges brought about by climate change and continuous habitat degradation. In an attempt to update the existing records of Nigeria's floristic inventories therefore, we documented the remaining woody species (trees and shrubs) in Oba Hills Forest Reserve, a disturbed ecosystem of Southwestern Nigeria. Four plots (quadrants) of 25mx25m were randomly laid within the site. All trees and shrubs were assessed and identified as much as possible using taxonomic keys provided in botanical literatures. Individual species in each plot was carefully recorded and subjected to species diversity analysis. A total of 357 individuals were recorded, spreading across 56 species in 25 angiosperm families. The trees were dominant (45) while the shrubs were only 11. The legumes dominated the representative families, contributing 21%. Prominent among the species and across the enumerated area are *Daniella oliveri, Gmelina arborea, Hymenocardia acida, Lophira lanceolata, Vitelaria paradoxa, Tectona grandis,* and *Terminalia avicennioides.* Further observation showed that the ecosystem has been greatly disturbed through plantation establishment and other anthropogenic activities such as farming and animal grazing; and these have reduced the size and species richness of the study area. It thus suggests that the study area needs serious attention if its plant genetic resources are to be restored and protected, in a bid to avoid the complete loss of some identified valuable species therein.

Keywords: Species diversity, legume, flora, conservation, ecosystems

Introduction

The Nigerian rain forests have experienced irreparable destruction resulting from urbanization and general farming activities. Today, many of the previously known forested areas have become derived savanna areas largely due to grazing and logging activities and this scenario has been witnessed in South-Western Nigeria (Agbo-Adediran *et al.,* 2017). It is noteworthy that floristic studies are essential for the provision of information in species diversity and richness (Soladoye *et al.,* 2015; Soladoye and Chukwuma, 2019; Chukwuma *et al*., 2020) and even ecosystem changes which occurs overtime (Soladoye *et al.,* 2011). Floristic studies can also be useful for the management of our forest areas (Addo-Fordjour *et al.,* 2009; Pappoe *et al.,* 2010).

As put by the United Nations Environmental Programme (UNEP, 2007), biodiversity offers essential environmental services upon which life on earth depends; and the tropical forests which is about 7% of the world land area accounts for approximately 55% of the flora and fauna species recorded on earth (Miller, 1990; Watson *et al*., 2000). Olapade and Bakare (1992) had also earlier noted that the existence of plant species in any habitat is important to man and other components of the ecosystem as all plants are valuable for one purpose or the other. It is almost impossible to live without plants, especially as we continue to rely on them for food, improved rural livelihood, household constructions, employment generation and income supplements.

Consequently, land degradation for various agricultural uses has accounted for 55% of habitat loss (Donald, 2004; Green *et al*., 2005), thus, bringing about loss in biodiversity. Isichie (2005) noted that if Nigeria plant resources are properly harnessed, they would ensure food security. Nevertheless, a large number of these species are faced with threat of extinction as pressure on them increases. Such threat also means a threat to the survival of man, especially the rural poor. The present study thus aimed at identifying the trees and shrubs of Oba hills forest reserve, a threatened vegetation in Osun State, Nigeria in an attempt to document the remaining angiosperm records that could serve as baseline information for future regeneration activities and management of the area.

Materials and Methods

Study site

Oba hills forest reserve is located in Osun State, South-western Nigeria and lies between latitudes 7°33'N and 7°47'N; and longitudes 4°2'E and 4°15'E (Figure 1). It covers a 52km^2 hilly terrain with deep gorges and about 12% of the site had been converted to teak plantation (Kormos, 2003). The site is currently composed of savanna and forest species, and occurs in the transitional equatorial climatic zone of West Africa.

Species enumeration

The survey involved repeated visits to the study area for the identification of existing trees species. Specifically, four plots of 25m^2 were randomly laid within the site and individual tree species were carefully enumerated within each plot. The species were identified on the field using taxonomic keys provided in Hutchinson *et al*. (1958-1968) and Keay (1989), while others were taken to the Forest Herbarium Ibadan (FHI) (Holmgren *et al*., 1990) for proper identification. Table 1 gives detailed taxonomic information (name, family and habit) of each species.

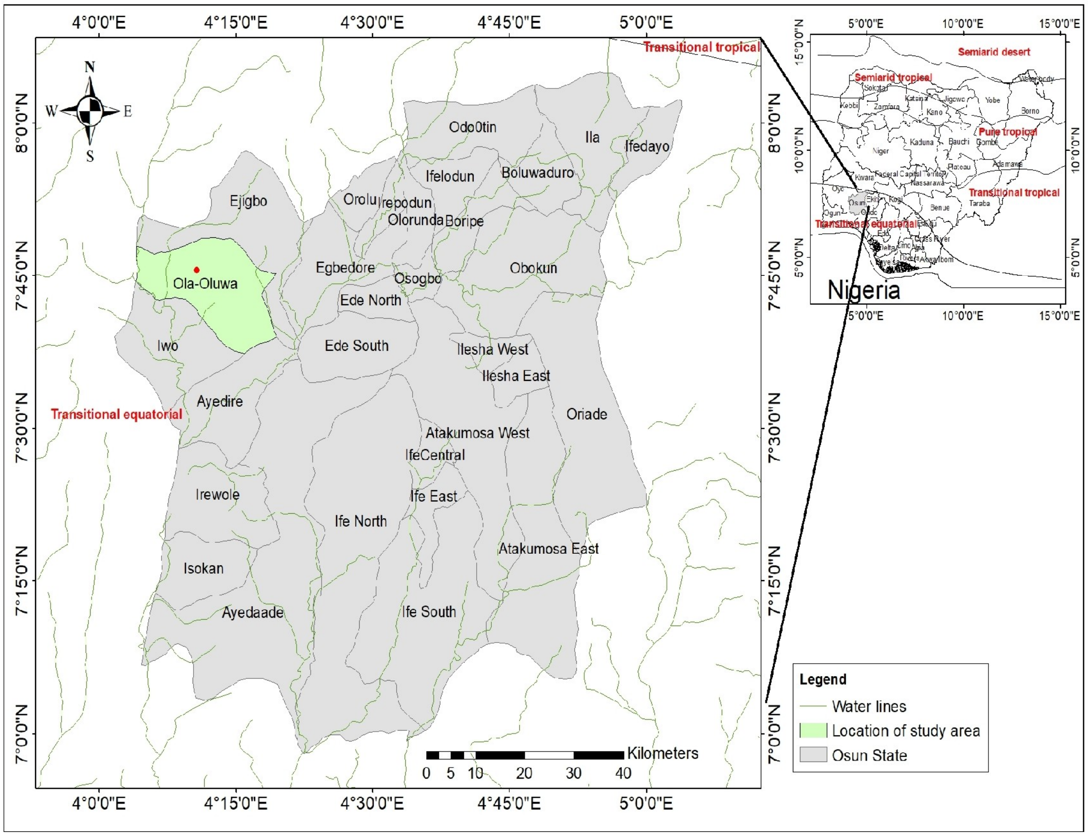

Figure 1. Location map of the study area

Data analysis

The data obtained from the preliminary survey were carefully arranged, and analysed for species abundance and diversity (Dominance, Species richness/Simpson index, Evenness index and Equitability index). Species density and individual Relative Importance Value (RIV) were also computed.

Specifically, species diversity was obtained using diversity indices incorporated in PAleontological STatistics software (PAST 4.02) (Hammer *et al*., 2001), considering the following parameters: abundance, dominance, Simpson Index, Species Richness, Evenness, Equitability Index, and Shannon Wiener as previously described by Kent and Coker (1992), Drews (1993), Olubode *et al*. (2011) and Awodoyin *et al.* (2013).

Multivariate analysis

The multivariate models used involved mathematical expressions of the data that were used to interpret and predict results for decision and policy making.

The data were analysed using the following models

Where: Frequency = 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 the total number of species in the quadrats.

Relative frequency = Frequency of a species × 100

Frequency of other species

Density

Density = Quantitative values of species

Quadrat size /Number of quadrats

Relative density

Relative Density = ni × 100

N

Where ni is the number of individual species

N is the total number of different species in the entire population

Relative Importance Value (RIV)

The Relative Importance Values (RIV) of all the species were determined following Olubode *et al*. (2011), as detailed below:

RIV = Relative Frequency × 100

Relative Density

Results and Discussion

A total of 56 different species of trees and shrubs belonging to 25 families were identified (Table 1). In all, 357 individual stands of these species were recorded from the survey. Dominant among the species are *D. oliveri, G. arborea, H. acida,* and *T. grandis*; with 25, 27, 28 and 30 individual stands respectively. Others include *C. febrifuga, V. paradoxa, L. lanceolata,* and *T. avicennioides* - 12, 13, 14 and 21 individuals respectively while the least represented are *C. pentandra, C. platypterum, M. excelsa,* and *P. thonningii*; all with only 1 individual species across the enumerated plots (Table 2).

On family basis, the species were dominated by the Legumes (Fabaceae) which contributed the highest number of species with a total of 12 species (21%) of the total enumeration. This was followed Combretaceae (5 species; 9%) and Phyllantaceae (4 species; 7%). Others such as Lamiaceae, Malvaceae, Moraceae and Rubiaceae contributed 3 species each (aprox 5.4% each). Five families had 2 species (3.5% each) represented while the remaining thirteen (13) families were represented with only 1 species each; an indication of their importance in ecosystem balancing (Figure 2).

Table 1. Identified trees and shrubs in Oba Hills Forest Reserve

S/No.	Species	Family	Habit
1.	*Afzelia africana* Sm. ex Pers.	Fabaceae	Tree
2.	*Albizia adianthifolia* (Schumach.) W.Wight	Fabaceae	Tree
3.	*Albizia ferruginea* (Guill. & Perr.) Benth.	Fabaceae	Tree
4.	*Albizia zygia* (DC.) J.F.Macbr.	Fabaceae	Tree
5.	*Alchornea cordifolia* (Schumach. & Thonn.) Mull.Arg.	Euphorbiaceae	Shrub
6.	*Annona senegalensis* Pers.	Annonaceae	Shrub
7.	*Anogeissus leiocarpa* (DC.) Guill. & Perr.	Combretaceae	Tree
8.	*Anthocleista djalonensis* A.Chev.	Gentianaceae	Tree
9.	*Anthocleista vogelii* Planch.	Gentianaceae	Tree
10.	*Blighia sapida* K.D.Koenig	Sapindaceae	Tree
11.	*Bombax buonopozense* Beauverd	Malvaceae	Tree

S/No.	Species	Family	Habit
12.	*Bridelia ferruginea* Benth.	Phyllanthaceae	Tree
13.	*Ceiba pentandra* (L.) Gaertn.	Malvaceae	Tree
14.	*Cleistopholis patens* (Benth.) Engl. & Diels	Annonaceae	Tree
15.	*Cussonia barteri* Seem.	Araliaceae	Tree
16.	*Cola gigantea* A.Chev.	Malvaceae	Tree
17.	*Combretum platypterum* (Welw.) Hutch. & Dalziel	Combretaceae	Shrub
18.	*Crossopteryx febrifuga* (Afzel. ex G.Don) Benth.	Rubiaceae	Tree
19.	*Daniellia oliveri* (Rolfe) Hutch. & Dalziel	Fabaceae	Tree
20.	*Elaeis guineensis* Jacq.	Arecaceae	Tree
21.	*Ficus exasperata* Vahl	Moraceae	Tree
22.	*Ficus sur* Forssk.	Moraceae	Tree
23.	*Gardenia aqualla* Stapf & Hutch.	Rubiaceae	Shrub
24.	*Gmelina arborea* Roxb. ex Sm.	Lamiaceae	Tree
25.	*Harungana madagascariensis* Poir.	Hypericaceae	Shrub
26.	*Holarrhena floribunda* (G.Don) T.Durand & Schinz	Apocynaceae	Tree
27.	*Hymenocardia acida* Tul.	Phyllanthaceae	Shrub
28.	*Kigelia africana* (Lam.) Benth.	Bignoniaceae	Tree
29.	*Lannea* A.Rich.	Anacardiaceae	Tree
30.	*Lonchocarpus sericeus* (Poir.) Kunth ex DC.	Fabaceae	Tree
31.	*Lophira lanceolata* Tiegh. ex Keay	Ochnaceae	Tree
32.	*Malacantha alnifolia* (Baker) Pierre	Sapotaceae	Tree
33.	*Margaritaria discoidea* (Baill.) G.L.Webster	Phyllanthaceae	Tree
34.	*Milicia excelsa* (Welw.) C.C.Berg	Moraceae	Tree
35.	*Millettia thonningii* (Schumach. & Thonn.) Baker	Fabaceae	Tree
36.	*Nauclea latifolia* Sm.	Rubiaceae	Shrub
37.	*Newbouldia laevis* (P.Beauv.) Seem.	Bignoniaceae	Tree
38.	*Parinari polyandra* Benth.	Chrysobalanaceae	Tree
39.	*Parkia biglobosa* (Jacq.) R.Br. ex G.Don	Fabaceae	Tree
40.	*Pericopsis laxiflora* (Benth. ex Baker) Meeuwen	Fabaceae	Tree
41.	*Piliostigma thonningii* (Schumach.) Milne-Redh.	Fabaceae	Tree
42.	*Prosopis africana* (Guill. & Perr.) Taub.	Fabaceae	Tree
43.	*Pterocarpus erinaceus* Poir.	Fabaceae	Tree
44.	*Securidaca longepedunculata* Fresen.	Polygalaceae	Shrub
45.	*Securinega virosa* (Roxb. ex Willd.) Baill.	Phyllanthaceae	Shrub
46.	*Spondias mombin* Jacq.	Anacardiaceae	Tree
47.	*Strychnos spinosa* Lam.	Loganiaceae	Shrub
48.	*Syzygium guineense* (Willd.) DC.	Myrtaceae	Tree
49.	*Tectona grandis* L.f.	Lamiaceae	Tree
50.	*Terminalia avicennioides* Guill. & Perr.	Combretaceae	Tree

S/No.	Species	Family	Habit
51.	*Terminalia macroptera* Guill. & Perr.	Combretaceae	Tree
52.	*Terminalia* L.	Combretaceae	Tree
53.	*Vitellaria paradoxa* C.F.Gaertn.	Sapotaceae	Tree
54.	*Vitex doniana* Sweet	Lamiaceae	Tree
55.	*Ximenia americana* L.	Ximeniaceae	Shrub
56.	*Zanthoxylum zanthoxyloides* (Lam.) Zepern. & Timler	Rutaceae	Tree

Diversity indices as revealed in Table 3 showed that, of the total 357 individual species enumerated, Plot 1 had the highest number (150), followed by Plot 3 (102) and Plot 2 (59) while Plot 4 had the least (46). Similarly, Plot 1 and Plot 4 had the highest and least number of species, with 33 and 20 respectively. Dominance index was generally low across the sampled plots, except in Plot 3 where it is somewhat higher. This could be attributed to the presence of certain species such as *D. oliveri*, *G. arborea*, and *H. acida*; which all had considerably high representation.

Further analysis also showed that the Simpson index is generally high across the four plots, while Shannon or diversity index was moderate but slightly highest in Plot 1. Evenness index ranged from moderate in Plot 3 (0.54) to high in Plot 2 and Plot 4 (0.67 each), reflecting equal measure of spread among the species in that sampled plots. The population of trees in each of the enumerated plot is further illustrated in figure 3, while some useful species utilized by the rural dwellers around the study area are listed in table 4. Most of these species are used for traditional medicine, while others are used as sources of food or for furniture construction.

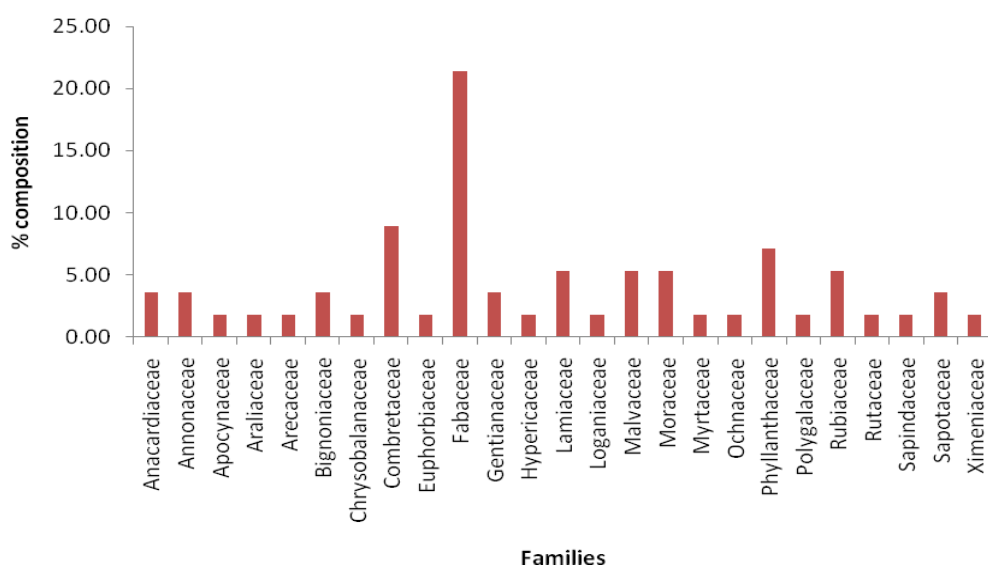

Figure 2. Species distribution across plant families

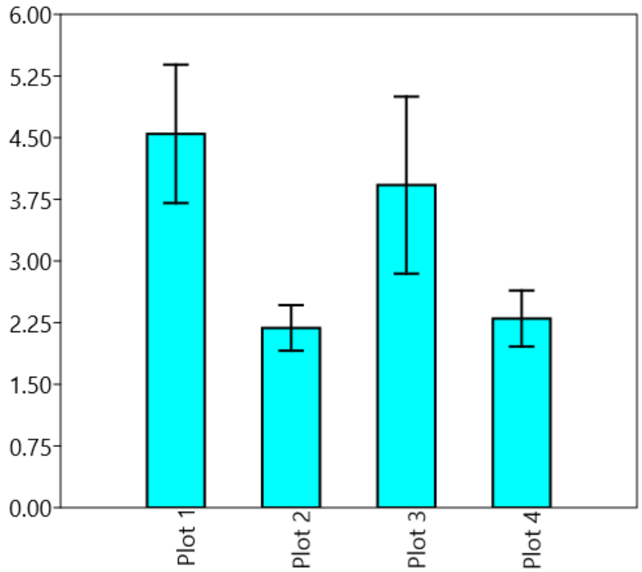

Figure 3. Boxplot of the four study plots

Table 2. Detailed statistics of the species enumerated

No.	Species	Plots				Abund	Freq	Dens	Rel Freq	Rel Dens	RIV
		1	2	3	4						
1.	*A. africana*	6		1	1	8	3	0.003	3.947	2.581	3.264
2.	*A. adianthifolia*	1	1			2	2	0.001	2.632	0.645	1.638
3.	*A. ferruginea*		3			3	1	0.001	1.316	0.968	1.142
4.	*A. zygia*	2	2		1	5	3	0.002	3.947	1.613	2.780
5.	*A. cordifolia*	3	1			4	2	0.002	2.632	1.290	1.961
6.	*A. senegalensis*	5	3		1	9	3	0.004	3.947	2.903	3.425
7.	*A. leiocarpus*	1			2	3	2	0.001	2.632	0.968	1.800
8.	*A. djalonensis*			2	1	3	2	0.001	2.632	0.968	1.800
9.	*A. vogelii*		2			2	1	0.001	1.316	0.645	0.980
10.	*B. sapida*	2	1			3	2	0.001	2.632	0.968	1.800
11.	*B. buonopozense*	1	3			4	2	0.002	2.632	1.290	1.961
12.	*B. ferruginea*	3			1	4	2	0.002	2.632	1.290	1.961
13.	*C. pentandra*		1			1	1	0.000	1.316	0.323	0.819
14.	*C. patens*		2			2	1	0.001	1.316	0.645	0.980
15.	*C. barteri*	1			3	4	2	0.002	2.632	1.290	1.961
16.	*C. gigantea*		3			3	1	0.001	1.316	0.968	1.142

No.	Species	Plots				Abund	Freq	Dens	Rel Freq	Rel Dens	RIV
		1	2	3	4						
17.	*C. platypterum*		1			1	1	0.000	1.316	0.323	0.819
18.	*C. febrifuga*	5		7		12	2	0.005	2.632	3.871	3.251
19.	*D. oliveri*	7	1	13	4	25	4	0.010	5.263	8.065	6.664
20.	*E. guineensis*	1	1			2	2	0.001	2.632	0.645	1.638
21.	*F. exasperata*		2		2	4	2	0.002	2.632	1.290	1.961
22.	*F. sur*	2	2	2		6	3	0.002	3.947	1.935	2.941
23.	*G. aqualla*	3			1	4	2	0.002	2.632	1.290	1.961
24.	*G. arborea*	1		26		27	2	0.011	2.632	8.710	5.671
25.	*H. madagascariensis*				3	3	1	0.001	1.316	0.968	1.142
26.	*H. floribunda*		1	1		2	1	0.001	1.316	0.645	0.980
27.	*H. acida*	16		12		28	2	0.011	2.632	9.032	5.832
28.	*K. africana*	1	1			2	2	0.001	2.632	0.645	1.638
29.	*Lannea sp*	5				5	1	0.002	1.316	1.613	1.464
30.	*L. sericeus*		4		3	7	2	0.003	2.632	2.258	2.445
31.	*L. lanceolata*	11		2	1	14	3	0.006	3.947	4.516	4.232
32.	*M. alnifolia*		3			3	1	0.001	1.316	0.968	1.142
33.	*M. discoidea*	7	3			10	2	0.004	2.632	3.226	2.929
34.	*M. excelsa*		1			1	1	0.000	1.316	0.323	0.819
35.	*M. thonningii*		7			7	1	0.003	1.316	2.258	1.787
36.	*N. latifolia*	5		1	4	10	3	0.004	3.947	3.226	3.587
37.	*N. laevis*	1	5			6	2	0.002	2.632	1.935	2.284
38.	*P. polyandra*	4		5		9	2	0.004	2.632	2.903	2.767
39.	*P. biglobosa*	1	2		1	4	3	0.002	3.947	1.290	2.619
40.	*P. laxiflora*			2		2	1	0.001	1.316	0.645	0.980
41.	*P. thonningii*	1				1	1	0.000	1.316	0.323	0.819
42.	*P. africana*	3		2		5	2	0.002	2.632	1.613	2.122
43.	*P. erinaceus*	3		3		6	2	0.002	2.632	1.935	2.284
44.	*S. longepedunculata*	4		1		5	2	0.002	2.632	1.613	2.122
45.	*S. virosa*		1	2		3	2	0.001	2.632	0.968	1.800
46.	*S. mombin*			2		2	1	0.001	1.316	0.645	0.980
47.	*S. spinosa*			1	3	4	2	0.002	2.632	1.290	1.961
48.	*S. guineense*			3		3	1	0.001	1.316	0.968	1.142
49.	*T. grandis*	22		2	6	30	3	0.012	3.947	9.677	6.812
50.	*T. avicennioides*	14		2	5	21	3	0.008	3.947	6.774	5.361
51.	*T. macroptera*			2		2	1	0.001	1.316	0.645	0.980

No.	Species	Plots				Abund	Freq	Dens	Rel Freq	Rel Dens	RIV
		1	2	3	4						
52.	*Terminalia sp.*			1		1	1	0.000	1.316	0.323	0.819
53.	*V. paradoxa*	6		5	2	13	3	0.005	3.947	4.194	4.070
54.	*V. doniana*			1	1	2	3	0.001	3.947	0.645	2.296
55.	*X. americana*	2				2	2	0.001	2.632	0.645	1.638
56.	*Z. zanthoxyloides*		2	1		3	2	0.001	2.632	0.968	1.800

Keys - Abund – Abundance; Freq- Frequency, Dens – Density; Rel Freq – Relative Frequency; Rel Dens – Relative Density; RIV – Relative Importance Value

Table 3. Diversity Indices of the identified species

	Plot 1	Plot 2	Plot 3	Plot 4
Taxa_S	33	27	26	20
Individuals	150	59	102	46
Dominance_D	0.05727	0.03624	0.1021	0.05024
Simpson_1-D	0.9427	0.9638	0.8979	0.9498
Shannon_H	2.972	2.896	2.561	2.595
Evenness_e^H/S	0.5921	0.6706	0.4979	0.6701
Brillouin	2.772	2.584	2.358	2.304
Menhinick	2.694	3.515	2.574	2.949
Margalef	6.386	6.376	5.405	4.963
Equitability_J	0.8501	0.8788	0.786	0.8664
Fisher_alpha	13.08	19.26	11.27	13.47
Berger-Parker	0.1467	0.1186	0.2549	0.1304
Chao-1	42	33.88	28.55	29

Table 4. Some utilized species within the adjoinng communities of the study area

Species	Uses
Afzelia africana	Fuel wood
Alchornea cordifolia	Medicine
Annona senegalensis	Medicine
Anogeissus leiocarpa	Fuelwood, medicine
Blighia sapida	Food, medicine
Bombax buonopozense	Furniture
Bridelia ferruginea	Medicine
Ceiba pentandra	Furniture
Cola gigantea	Foos
Cussonia barteri	Medicine

Daniellia oliveri	Fuelwood, furniture
Elaeis guineensis	Food
Ficus exasperata	Medicine
Gmelina arborea	Furniture
Lophira lanceolata	Fuelwood
Milicia excelsa	Furniture
Newbouldia laevis	Medicine, traditional events
Parkia biglobosa	Food
Pterocarpus erinaceus	Fuelwood
Securidaca longepedunculata	Medicine
Spondias mombin	Food, medicine
Tectona grandis	Furniture
Terminalia avicennioides	Fuelwood
Vitellaria paradoxa	Food, medicine
Vitex doniana	Food, medicine
Zanthoxylum zanthoxyloides	Medicine

Further observations during the study showed that the study area has been largely degraded through farming and establishment of plantations such as *Gmelina arborea* and *Tectona grandis*, and this corroborates the previous reports by Greengrass (2009) who noted that almost all of the reserve had been converted to plantations and farms, with only two gullies remaining forest-covered. The appreciable number of trees identified also reflects the original composition of the forest, which had over the years become derived savanna vegetation resulting from several anthropogenic activities earlier cited, including farming, logging, and animal grazing amongst others. The continued exploitation of the species especially for fuelwood, is brought about by an increase in the prices of alternative sources of energy. However, previous report by FAO (2007) clearly identified that wood fuel plays significant roles in the day to day lives of the rural populace.

Consequently, it was further observed that species such as *Daniellia oliveri*, *Lophira lanceolata*, *Pericopsis laxiflora* and *Terminalia avicennioides* are some of the preferred species for fuelwood by the community dwellers; and this is similar to the previous observations of Jimoh *et al.* (2009). In general, it is considered that immediate economic benefits exceed those for conservation, as clearly put by Ferraro and Kiss (2002). In practical sense, while the continued dependence on plants for survival is inevitable and arguably unconrollable, we advocate for the establishment of sustainable management strategies to salvage our rich but endangered ecosystems including the present study area. Our position therefore, is not different from the earlier submission of Soladoye *et al.* (2011), who suggested the provision of basic socio-economic amenities such as electricity, schools, good roads, portable water, and hospitals as incentives that could ensure successful conservation of an area.

Conclusion

This study has identified 357 individual stands of 56 species across 25 families, comprising trees and shrubs, in Oba Hills

Forest reserve. Clearly, it has revealed the importance of biodiversity assessment and monitoring, and has no doubt added to the existing records of such studies in South-western Nigeria. With the continued degradation of the study area and over-exploitation of the plant genetic resources therein, a quick intervention by the authorities and implementation of sustainable forest conservation laws is ideal, to avoid an eventual disappearance of species.

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