



Assessment of Tree Diversity and Abundance in Selected Forest Reserves in Osun State, Southwestern Nigeria

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Abstract

Studies have shown that forest has undergone different levels of disturbance due to anthropogenic activities which impacted tree diversity, abundance and species composition. Therefore, this study examined and assessed tree diversity and abundance in five selected forest reserves in Osun State, Nigeria with a view to ascertaining the present species status for mitigation decision. Primary data include measurement of floristic composition and Key Informant Interview (KII) focusing on species inventory. A total of five sampled plots of 10 m × 10 m were demarcated in each five selected forest reserves where total enumeration of tree species within the demarcated plots were identified and classified into families, while parameters like girth (diameter at breast height) and height were measured. The result showed that the maximum height in all the selected forest reserves was 15 m. The highest total number of individual woody tree species was found in Oba Hill Forest Reserve (112). The dominant tree species were exotic species, teak (*Tectonagrandis*) (98 stems) and gmelina (*Gmelinaarborea*) (36 stems) of *verbanaceae* family. Indigenous woody species identified to be highly threatened and at the brinks of extinction include *Terminalia Africana*, *Albiziazygia*, *Miliciaexcelsa*, *Anogeissusleiocarpus* etc. The Shannon-Wiener index (2.499) from Ikeji-Ipeu Forest Reserve was the highest among the five selected Forest Reserves which indicated that this forest was potential biodiversity hotspot. The highest mean basal area of 3.37 m² and highest mean volume of 27.96 m³ both from Oba Hill Forest Reserve showed that matured woody trees were scanty. This study revealed that anthropogenic activities had set in greatly and the forest reserves were poorly managed which had led to the reduction in number of tree diversity. This study therefore, provides baseline information for ecosystem management and control.

Subject Areas

Environmental Sciences

Keywords

Biodiversity Indices, Flora, Forest Structure, Human Activities

1. Introduction

Tropical forests are habitat of numerous species of living things that constitute biodiversity through webs of life [1]. It supports various lifeforms including human beings who dwell in settlements in and around forests [2]. It is a complex ecological system that is dominated by tall growing trees [3] which cover about 30% of the total earth crusts containing about 90% of the world's terrestrial biodiversity [4]. Over the years, forest has been a continuous source of wood, charcoal and land for agricultural purpose which has led to present depletion [5]. In buttressing this view, [6] reported that trees provided many ecosystem services such as species conservation, prevention of soil erosion, and preservation of habitat for plants and animals. However, overexploitation of floristic composition has resulted in the rapid loss of tree diversity which has been recognized as a major environmental and economic threat around the world [7].

It is the home of the world's biodiversity and provides several cultural services and possibilities for recreation activities [8]. The presence of different species ensures ecosystem resilience and the ability to keep living conditions within tolerance levels around an oscillating equilibrium [9].

The twenty-first century is experiencing a dramatic decline in global biological diversity, which is evident in tropical regions [10] while [11] [12] reported that it is due to increasing anthropogenic impacts. Previous studies have shown that trees have undergone different levels of disturbance due to unprecedented increase in anthropogenic activities which had negatively impacted tree diversity, abundance, species composition and indigenous knowledge of tree flora and conservation [13] [14]. It has been established that timber extraction is the principal anthropogenic impact and the main cause of species extinction in terrestrial forest ecosystem [15] [16] [17]. And [18] opined that selective logging has been questioned for its negative effects on both animal and plant diversities. The establishment of Forest Reserves was to preserve biodiversity composition in Southwestern [19].

Meanwhile, Nigeria is endowed with more than 5000 species of plant, 22,090 species of animals and insects, 889 species of birds, and 1489 species of micro-organisms. Out of all these species 0.4% of the plants species are threatened and 8.5% endangered, with 0.14 of the animals and insects threatened and 0.22% endangered [20].

Also between the period of 2000 and 2005, Nigeria has lost about 2048 ha of

forest [21].

Nigeria had suffered setbacks due to the fact that harvested trees were not always replanted as originally planned by the government and that many State governments in Nigeria had virtually abandoned the management of their Forest Reserves, the effect of which is threatened floristic diversity and composition. It was further revealed that the country's forest reserves themselves, including natural and the exotic vegetation have been undergoing increasing threats that arise from anthropogenic activities [22]. Increased biotic activities as a result of increased population and urbanisation are also key factors in overexploitation of natural resources from forests [23].

The rate of national deforestation in Nigeria was 1.8% per annum which was higher than any other countries of the world [24]. A study in Osun State using remote sensing and GIS reported that forests have an average rate of deforestation of 3.1% per annum [25].

From the foregoing, it is evident that sustainable development entails coexistence of both humans and forest biodiversity [14]. Therefore, to protect tree diversity and abundance from declining from our forest, it is essential to examine the current status of species diversity, composition and abundance. This will invariably provide guidance for forest management and will also act as valuable reference for species assessment which will improve our knowledge in identification of ecologically useful ones [26]. A higher number of tree species increases the number of ecological niches as well as the number of associated species [27] [28].

Therefore, information on composition, diversity of tree species and species-rich communities is of primary importance in the planning and implementation of biodiversity conservation efforts [26]. Therefore, this present study assessed and examined tree diversity and abundance in selected forest reserves in Osun State, Nigeria. The specific objectives are: 1) to evaluate tree diversity and abundance in each of the forest reserve in Osun State, Nigeria, 2) to assess the distribution pattern of tree species

2. Materials and Methods

2.1. Study Area

The study was carried out in Osun State located within the tropical rainforest, Southwestern Nigeria within a year (2017 to 2018). The State is located between latitudes 6°40'N and 8°10' North and, between longitudes 4°05'E and 5°02' East. It covers an area of about 8602 square kilometres approximately. It is bounded in the west by Oyo State, in the East by Ondo State, in the North by Kwara State, in the Northeast by Ekiti State and in the South by Ogun State. In view of its location, Osun State is endowed with eleven forest reserves which cover a total area of 91,268 hectares (ha.) (Figure 1). The eleven forest reserves are; Ago-Owu, Ede, Ejigbo, Ife Native Authority, Olla, Ikeji-Ipetu, Ila, Oba Hills, Oni, Osogbo and Shasha forest reserves, out of which only eight are functional. The

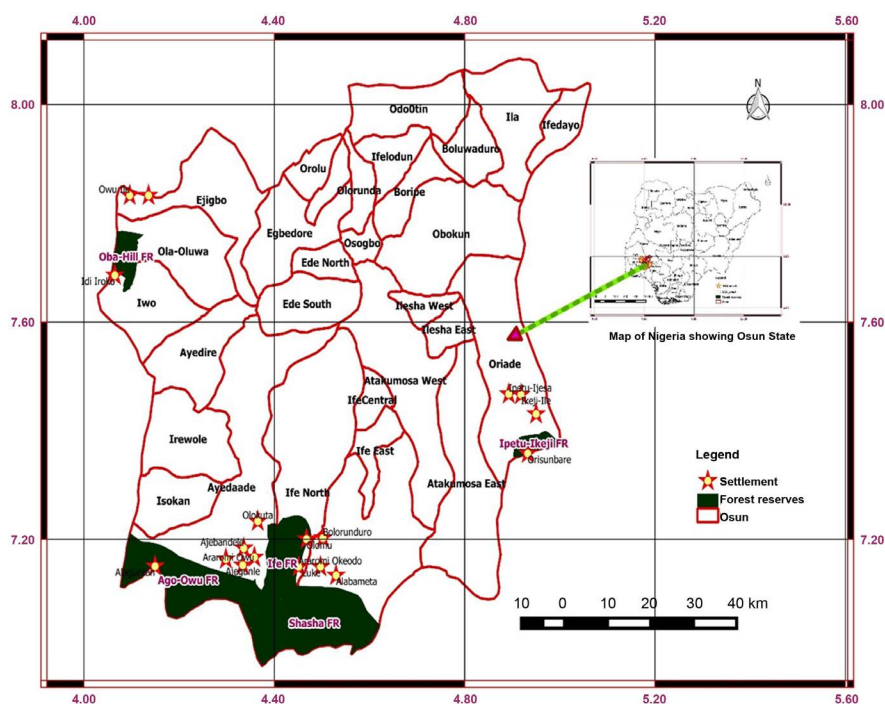


Figure 1. Map of Osun State showing the selected forest reserves.

other three forest reserves namely; Osogbo, Oni and Olla have been usurped for either agricultural purposes or urban expansion. These five forest reserves were selected based on the fact that they have high floristic compositions and are also situated within the lowland rainforest areas of Osun State. The mean annual rainfall is about 1500 mm and mean annual temperature is about 27°C with the annual range of about 3°C . The soils belong to the highly ferruginous tropical red soil associated with basement rocks. Tree species such as *Tectonagrandis*, *Gmelina arborea*, *Albizia zygia*, *Terminalia superba*, *Blihi sapida* and *Milicia excelsa* are dominant in the study area.

2.2. Methods of Data Collection

Field inventory of tree flora was adopted for data collection. Five forest reserves were selected from the eight functional and active forest reserves in the study area based on their high floristic composition and their location at the lowland area of Osun State, Nigeria. They are; Ago-Owu, Oba Hill, Ikeji-Ipetu, Ife native authority and Shasha forest reserves. Five plots of $10\text{ m} \times 10\text{ m}$ each were demarcated for identification and accurate physical measurement (of such variables as, height, girth at dbh, volume and basal area) and recording of different tree species according to Linnaean taxonomy of species classification of 1707 to 1778 [29]. Physical measurement of woody tree girth was measured with the use of girthing tape at the breast height and tree height was measured with Hagar altimeter. All the woody species found in each plot were counted and the family of each species identified. This was done to know the spatial distribution of trees and shrubs and to discover if matured woody species are still in existence. Also,

the status of the species from each forest reserve were documented. The representative samples such as leaves, fruits and bark of trees that could not be identified on the field, were collected and taken to the herbarium for identification.

Global Positioning System (GPS) was used to take the co-ordinates of the sampled plots and questionnaire survey was designed and administered to five forest officials (KII) focusing on species degradation, vegetal composition, rate of reforestation and afforestation.

2.3. Data Analysis

2.3.1. Tree Species Diversity

From each site, the following indices were employed in determining species diversity and richness:

1) Shannon-Weiner index (H), which is the measure of diversity within a site according to Shannon and Wiener (1949) [30]

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

where $P_i = S/N$, S = number of individuals of one species; N = total number of all individuals in the site and \ln = logarithm to base

2) Simpson concentration index

$$\lambda = \sum \left(\frac{n_i}{N_i} \right)^2 \quad (2)$$

2.3.2. Forest Structure Analysis

1) Basal area: the basal area of all trees in the sample plots were calculated using the formula:

$$BA = \frac{\pi D^2}{4} \quad (3)$$

where, BA = Basal area (m^2), D = Diameter at breast height (cm) and π = pie (3.14). The total BA for each plot was obtained by adding all trees BA in the plot.

2) Volume: the volume of each tree was calculated in every plot using the Newton's formula [31]

$$V = (h/6)(A_b + 4A_m + A_t) \quad (4)$$

where, V = Tree volume (m^3), A_b , A_m and A_t = tree cross-sectional area at the base, middle and top of merchantable height, m^2 and tree height (m). Plot volumes were also obtained by adding the volumes of all trees in the entire sampled plot.

3) Relative density (%) of each species was computed using the equation of [32]

$$RD = \left(\frac{n_i}{N} \right) \times 100 \quad (5)$$

where, RD is the relative density of the species; n_i is the number of individuals of species I and N is the total number of all individual trees.

4) Relative dominance (%) of each species was estimated using the formula:

$$RD_o = \frac{(\sum Ba_i \times 100)}{\sum Ba_n} \quad (6)$$

where RD_o is the relative dominance of species; Ba_i is the basal area of all individual trees belonging to a particular species i ; Ba_n is the basal area of stand.

5) Importance Value Index (IVI): This is the sum of RD and RD_o divided by 2 that is $\left(\frac{RD \times RD_o}{2}\right)$ gave importance value index for each species [32] [33]. This was used to express the share of each species in the tree community [34].

3. Results and Discussion

3.1. Woody Tree Species Diversity, Abundance and Tree Growth Variables

Table 1 presents the woody trees diversity indices. A total of 415 individual species with Ikeji-Ipetu FR (20) having the highest family followed by Ago-Owu FR (11) and the forest reserve that had the least family was Ife Native Authority with 3 families. Out of 415 individual species, Oba Hill FR had the highest with (112) individual, Ife Native Authority FR had (104) and Shasha had (100) individual. Ikeji-Ipetu and Ago-Owu FR had (73) and (26) respectively. The tree that had the maximum height (15 m) was from Ikeji-Ipetu FR followed by (12.5 m) from other forest reserves except Oba Hill FR with (12 m). Meanwhile the woody tree that had the highest mean height (10.5 m) was found in Ife Native Authority FR and Ikeji-Ipetu FR (9.9 m), Ago-Owu FR (8.6 m) and Oba Hill FR and Shasha FR with (8.3 m) and (7.5 m) respectively. The woody tree with widest girth (2.8 m) was from Ago-Owu FR and the least wide girth (1.7 m) was from Ife Native Authority FR. This concurred [35] that a tree is said to be a woody plant of erect posture when it has a minimum breast circumference of 7 cm and minimum height of 1.5 m. This implies that the trees in these forest

Table 1. Biodiversity indices and tree growth variables.

	Ago-Owu	Oba Hill	Ikeji-Ipetu	Ife Native	Shasha
Taxa_S	14	12	23	4	9
Individuals	26	112	73	104	100
Family	11	8	20	3	8
Dominance_D	0.1036	0.4214	0.1537	0.8892	0.3314
Simpson_1-D	0.8964	0.6786	0.8993	0.1108	0.6686
Shannon_H	2.471	1.194	2.499	0.2789	1.326
Mean Density	13.2	20.6	15.2	20.8	20.2
Mean height (m)	8.6	8.3	9.9	10.5	7.5
Mean B. Area (m)	2.19	3.37	2.05	0.97	0.96
Mean vol. (m)	19.7	27.96	17.78	8.5	8.95

reserves are woody trees and not shrubs. Ife Native Authority FR had the highest mean density (20.8) and the least mean density (13.2) was found in Ago-Owu FR. This result shows that the woody trees were more concentrated in Ife Native Authority FR than Ago-Owu FR. Oba Hill (3.37 m³) was with highest mean basal area at diameter at breast height (dbh) while Shasha (0.96 m³) (dbh). Also, Oba Hill FR (27.96 m³) has the highest mean volume, followed by Ago-Owu FR (19.7 m³), Ikeji-Ipetu FR (17.78 m³) and Shasha and Ife Native Authority FR had (8.95 and 8.5 m³) respectively. This highest mean volume even from Oba Hill FR was small which implied that woody trees with high girth were not found across the study area. This reflected what was observed during the field study that woody trees found were tiny and undergoing natural regrowth.

3.2. Biodiversity Indices and Tree Growth Value

There are several biodiversity indices such as Shannon Wiener index, Pielou's species evenness index, Margalef and Simpson concentration index which was used [36] in a study in Nigeria, [37] used Shannon Wiener and Jaccard Co-efficient index and [38] used Shannon Wiener index of species evenness and Shannon Maximum diversity index. **Table 1** presents different indices used in this study they are; Dominance_D index, Shannon Wiener index and Simpson concentration index. The dominant species was teak (*Tectonagrandis*) of the Verbanaceae family with Ife Native Authority FR (0.8892) has the highest dominant species followed by Oba Hill FR (0.4214) and Shasha FR (0.3314). Ikeji-Ipetu FR and Ago-Owu had (0.1557) and (0.1036) respectively. This implies that these particular woody species of Verbanaceae family (teak and gmelina) dominated all forest reserves. This was as a result of government effort to establish forest reserves where these two species were planted. Simpson concentration index; as D (dominance) increases, diversity of woody species decreases. The result of Simpson concentration index in Ikeji-Ipetu FR (0.8993) was highest with highest (23) number of species and Ago-Owu (0.8964) followed with (14) different species. The Simpson concentration index for other forest reserves were Oba Hill FR (0.6786) with (12) diverse species, Shasha FR (0.6686) with (9) different species and Ife Native Authority FR (0.1108) with (4) different species. This implies that the dominant woody tree species increases and the diverse woody tree species decreases in these forest reserves. The result from the Simpson concentration index from the five selected forest reserves with value ranged from 0.1108 to 0.8993 which concurred with [39] that, Simpson's index is usually reported as its complement $1 - D$ (or sometimes $1/D$ or $-\ln D$) and D takes on values between zero and one.

The dominant woody species identified during the field survey and the result from Dominance_D and Simpson concentration index shows that *Tectonagrandis* was the most dominant species in all the reserves. The woody species found in all these forest reserves were tiny and not robust because the big and robust woody species have been cut. And some of the indigenous woody species found in the study areas were *Albiziazylgia*, *Terminalia superba*, *Blighiasapida*, *Mili-*

ciaexcelsa except in Ago-Owu forest reserve where the forest land has been used as farm settlement in which cash crops such as *Elaeisguineensis* now dominated the land. This situation in Ago-Owu FR concurred with [40] that forest conversion is causing degradation to forest ecosystem but which appear more profitable than forest conservation because of economic gain. Wahab and Alarape [41] indicated that *Vitellariaparadoxum*, *Anogeissusleocarpus*, *Azeliaafricana*, *Khaya-senegalensis*, *Danielliaoliveri*, *Pterocarpuserinaceus*, *Miliciaexcelsa*, *Isobertinia-doka*, *Gmelinaarborea*, *Elaeisguineensis*, *Irvingiagabonensis* and *Tectonagrandis* were frequently exploited forest species in Oba Hill Forest Reserve.

The family *Verbanaceae* (316) had the total highest number of individual species with (221) species of *Tectonagrandis* and (94) species of *Gmelinaarborea* followed by *Combtrataceae* family with 10 species. (**Appendixes 1-5**).

In this particular study the highest Shannon Wiener index (2.499) was from Ikeji-Ipetu FR followed by Ago-Owu FR (2.471) and Shasha FR (1.326). Oba Hill FR (1.194) and the least (0.2789) was from Ife Native Authority. These results were of lower value to the Shannon Wiener Index obtained on Peninsula of Zegie (3.72) [1] [42] at the Arero Forest (2.67) and [38] in a study in Abuja and Minna were 3.56 and 3.08 respectively. This implies that human interference such as livestock grazing, farming and selective logging were practiced. The implication is that the ecosystem of Ikeji-Ipetu FR had different woody tree species more than all other five selected forests in this study but of lower biodiversity when compared to Arero forest, South Ethiopia and that of Abuja and Minna, Nigeria. This shows that biodiversity was relatively high in Arero forest, Abuja and Minna, Nigeria.

3.3. Species Distribution and Forest Structure

The dominant woody species were *Tectonagrandis* with Ife Native Authority FR (98) having the highest number followed by Oba Hill FR (62) and Shasha FR (45). Ikeji-Ipetu FR (14) and Ago-Owu Forest Reserve (2) with the lowest number of *Tectonagrandis*. The species that followed was *Gmelinaarborea* with Oba Hill FR having the highest total number (36), then Shasha FR (32), Ikeji-Ipetu FR (23) and Ago-Owu FR and Ife Native Authority FR had the least (1) and (2) respectively in the demarcated plots in all the five selected forest reserves (**Appendixes 1-5**). This shows that these two fast growing exotic woody species were specifically planted in all these forest reserves [19] [43] in their various study. But most of these exotic trees had been cleared in Ago-Owu Forest Reserve to pave way for farm settlement meanwhile the most common indigenous woody species still located in some of the demarcated plots in these five forest reserves was *Elaeisguineensis* (Palm fruit). Other indigenous woody species common in the five selected forest reserves were, *Miliciaexcelsa*, *Blighiasapida*, *Momordicafoetida*, *Cordia millenii*, *Celtiszenkeri*, *Triplochiton scleroxylon*, *Terminalia ivorensis*, *Cinnamomum cassia* and some others. These indigenous woody species were initially found in the areas now called forest reserves. The woody species were later cut and exotic woody species (teak and gmelina) were

deliberately introduced and managed by the State Government of Osun. Meanwhile, some of these indigenous woody species were still found either in between or around the exotic woody species plantation without any management activity on them. Most of the exotic woody species still standing in these forest reserves were tiny and some of them were undergoing regeneration. The result of the field sampling shows that woody trees cut were not replanted and that was the reason for tiny and scattered woody trees in the sampling plot of some of the forest reserves like Ago-Owu, Oba Hill, and Ikeji-Ipetu forest reserves. This was supported that degraded forest, and settlement areas which shows an indication of human activities in entire forest reserve [43].

The result also revealed the species Relative Density (RD) which ranged from (0.9% to 94.2%). The species with highest RD was *Tectonagrandis* of the family Verbanaceae. Species Relative Dominance ranged from (0.02% to 3.51%) with species with *Gmelinaarborea* of the family Verbanaceae having the highest RDo. The species Important Value Index (IVI) ranged from (0.4% to 29.7%) with *Tectonagrandis* of the family Verbanaceae. as the highest Important Value Index across the five selected forest reserves. Importance Value Index (IVI) in Ago-Owu FR showed that *Elaeisqueensis* had the highest value of 12.1, followed by *Triplochytton scleroxylon* (3.99), *Albiziazgyia* (3.98), *Milicia excelsa* (3.98) *Funtumiaafricana* (3.97) and *Mansoniaaltissima* had the lowest value of 1.94 (Appendix 3). The case is different in Oba Hill FR as highest values was recorded against *Tectonagrandis* (29.7) and *Gmelinaarborea* and (16.9). *Megaphrynummacriostachyum* had the least value of 0.46 (Appendix 1). Similar to Oba Hill FR is Ikeji –Ipetu FR with *Gmelinaarborea* and *Tectonagrandis* having the highest values of 17.51 and 10.66 respectively (Appendix 2). In Ife Native FRs, *Tectonagrandis* had the highest value of 47.4 while *Afzeliaafricana* had the lowest value of 0.48 (Appendix 5). In Shasha FR, *Tectonagrandis* and *Gmelinaarborea* had the highest values of 23.5 and 16.9 respectively (Appendix 4).

3.4. Forest Official's Report/Key Informant Interview

Forest officials were interviewed to know the species of trees available and management strategies for the continuous supply of these species Therefore, one key informant (forest official) each were interviewed from the five purposively selected forest reserves. The exotic species common to all these forest reserves as mentioned by the forest officials during the Key Informant Interview were teak (*Tectonagrandis*) and gmelina (*Gmelinaarborea*). Table 2 showed indigenous woody species in all the five selected forest reserves that were still available as mentioned by the forest officials during the Key informant interview was; cassia (*Cinnamomom cassia*), Iroko (*Miliciaexcelsa*), Apa (*Afzeliaafricana*), Mansonia (*Mansoniaaltissima*), Isin (*Blighiasapida*), Apa (*Afzeliaafricana*), Araba (*Celbapentandraetrn*), Ayin (*Anogeissusleiocarpus*), Afara (*Terminalia superba*) and so on. Meanwhile, Appendix 6 showed some of these indigenous woody specie that were common to a particular forest reserve, for instance, Ayin (*Anogeissusleiocarpus*), Arere (*Triplochitonscleroxylon*) and Isin (*Blighiasapida*) were com

Table 2. Indigenous woody species common to a particular forest reserve.

Species	Ago-Owu	Ikeji-Ipetu	Oba	Shasha	Ife
<i>Anogeissusleiocarpus</i>			•		
<i>Triplochitonscleroxylon</i>			•		
<i>Azelia Africana</i>					•
<i>Celbapentandraertn</i>	•		•		
<i>Blighiasapida</i>			•		
<i>Milicia excels</i>	•		•		
<i>Iuffa acutangular</i>		•			
<i>Terminalia Africana</i>		•			
<i>Cordia millenii</i>		•			
<i>Mansoniaaltissima</i>				•	•

Source: Author's field work.

monly found in Oba Hill Forest Reserve, *Mansonia* (*Mansoniaaltissima*) was mostly found Ife Native Authority and Shasha Forest Reserves, *Apa* (*Azeliaafricana*) was commonly found in Ife Native Authority, *Iroko* (*Miliciaexcelsa*), *Araba* (*Celbapentandraertn*) was mostly found in Ago-Owu and Oba Forest Reserves. Other indigenous woody species mostly found in Ikeji-Ipetu Forest Reserve were *Oriro* (*Iuffa acutangular*), *Idigbo* (*Terminalia africana*) and *Omo* (*Cordia millenii*). *Idigbo* (*Terminalia africana*) was also commonly found in Shasha Forest Reserve. Some of these species such as *Terminalia Africana*, *Triplochitonscleroxylon* and *Mansoniaaltissima* were said to be endangered and *Celbapentandraertn* and *Milicia excels* were at the brink of extinction. The management strategies mentioned by the officials was natural regeneration.

4. Conclusions and Recommendations

This study engaged in physical measurement of floristic composition of five selected forest reserves in Osun State. The tree girths, tree height and species enumeration were carried out. Key Informant Interview was also part of this study in which both junior and senior forest officials were interviewed. Tree diversity indices such as Shannon Wiener index and Simpson concentration index were used. The result shows that tiny woody species were left in the forest since the tree girth was low. It was discovered during the field survey that portion of the forest reserves has been turned to farm settlement like Ago-Owu forest reserve, Ife Native Authority and Oba Hill forest reserve. Also, the disappearance of woody tree species has caused loss of habitat to animal life and danger to plant life in the forest reserves. The forest reserves are hot spot of biodiversity if they are properly managed. Conservation methods should be encouraged.

Government should embark on regeneration of woody trees and monitor anthropogenic activities in these reserves. Forest management strategies such as selective logging, afforestation and agroforestry that support growth and development of forest reserves should be practiced with intensive monitoring.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix 1: List of Woody Species in Oba Hill Forest Reserve

Local name	Scientific name	Family	F.	MHt (m)	MDbh (cm)	BA (m ²)	Vol (m ³)	RD	RD _o	IVI
Teak	<i>Tectonagrandis</i>	Verbanaceae	63.00	8.90	1.70	0.16	1.36	56.8	2.69	29.7
Gmelina	<i>Gmelinaarborea</i>	Verbanaceae	36.00	9.00	1.30	0.14	1.29	32.4	1.54	16.9
Isin	<i>Blighiasapinda</i>	Sapindaceae	2.00	10.00	2.20	0.39	3.80	1.80	0.08	0.94
Araba	<i>Celbapentandraetrn</i>	Bambacaceae	1.00	12.00	2.60	0.53	6.33	0.90	0.04	0.47
Igba	<i>Parkiabiglobosa</i>	Fabaceae	1.00	12.00	2.10	0.40	4.40	0.90	0.04	0.47
Cassia	<i>Cinnamomum cassia</i>	Caesalpiniodeae	2.00	8.00	1.30	0.30	1.07	1.80	0.06	0.93
Iyeye	<i>Megaphryniummacriostachyum</i>	Anacardiaceae	1.00	5.00	0.80	0.13	0.50	0.90	0.02	0.46
Ako	<i>Brachystegiaeurycoma</i>	Ceasalpinoidea	1.00	7.50	1.20	0.11	0.46	0.90	0.03	0.47
Agbalumo	<i>pondiasmombin</i>		1.00	9.00	1.80	0.42	2.90	0.90	0.05	0.48
Ayin	<i>Anogeissusleiocarpus</i>	Combrataceae	1.00	8.00	1.20	0.39	0.40	0.90	0.05	0.48
Ira	<i>Brideliamicaratha</i>	Phyllanthaceae	1.00	8.50	1.60	0.10	0.70	0.90	0.03	0.47
Cashew	<i>Anacardiumoccidentale</i>	Anacardiaceae	1.00	9.00	2.00	0.32	0.32	0.90	0.06	0.48

Note: MHt means Maximum height, MDbh means Mean Diameter at breast height, BA means Basal Area, Vol means volume, RD means Relative density, RD_o means Relative Dominance and IVI means Important Value Index.

Appendix 2: List of Woody Species in Ikeji-Ipetu Forest Reserve

Local name	Scientific name	Family	F.	MHt (m)	MDbh (cm)	BA (m ²)	Vol (m ³)	RD	RD _o	IVI
Teak	<i>Tectonagrandis</i>	Verbanaceae	14.0	8.40	1.09	0.19	0.99	19.18	2.14	10.66
Gmelina	<i>Gmelinaarborea</i>	Verbanaceae	23.0	8.70	0.84	0.50	5.02	31.51	3.52	17.51
Ayunre	<i>AlbiziazygiaMacbride</i>	Mimozoidae	1.00	12.50	2.66	0.56	6.90	1.37	0.15	0.76
Afara	<i>Terminalia superba</i>	Combretaceae	5.00	9.50	1.22	0.10	1.13	6.85	0.76	3.80
Cassia	<i>Cinnamomum cassia</i>	Caesalpiniodeae	3.00	7.50	1.57	0.23	1.72	4.11	0.45	2.28
Mahogany	<i>Khayasenegalensis</i>	Meliaceae	1.00	7.50	1.80	0.26	1.98	1.37	0.26	0.82
Akoko	<i>Newbouldalaervis</i>	Bignoniaceae	2.00	5.25	0.50	0.28	0.46	2.74	0.29	1.51
Opoto	<i>Ficuscapensis</i>	Moraceae	1.00	3.75	1.50	0.18	0.68	1.37	0.11	0.74
Obobo	<i>Ficusmucoso</i>	Moraceae	1.00	10.00	2.50	0.50	5.02	1.37	0.23	0.80
Ahun	<i>Momordicafoetida</i>	Apocynaceae	1.00	12.50	1.44	0.17	2.08	1.37	0.46	0.90
Iroko	<i>Miliciaexcelsa</i>	Meliaceae	2.00	4.25	1.15	0.15	1.14	2.74	0.35	1.55
Omo	<i>Cordia millenii</i>	Boraginaceae	1.00	8.00	1.40	0.15	1.22	1.37	0.21	0.79
Arere	<i>Triplochitoncleroxylon</i>	Sterculiaceae	1.00	7.80	1.42	0.17	1.30	1.37	0.34	0.86
Oriro	<i>Luffa acutangular</i>		1.00	7.50	1.50	0.18	1.36	1.37	0.27	0.82
Agunmoniye	<i>Gliricidiasepium</i>	Leguminosae	1.00	5.00	1.70	0.23	1.15	1.36	0.13	0.75
Isin	<i>Blighiasapida</i>	Sapindaceae	1.00	7.50	2.67	0.58	4.35	1.37	0.10	0.74
Epin	<i>Ficus exasperate</i>	Euphorbiaceae	5.00	3.50	0.50	0.02	0.08	6.85	0.50	3.67
Ita	<i>Celtiszenkeri</i>	Ulmaceae	1.00	8.00	1.80	0.26	2.11	1.37	0.16	0.76
Pawpaw	<i>Carica papaya</i>	Caricaceae	3.00	2.50	1.10	0.08	0.60	4.10	0.11	2.11
Idigbo	<i>Terminalia ivorensis</i>	Combretaceae	2.00	9.40	1.10	0.10	0.96	2.74	0.20	1.47
Agbalumo	<i>Spondiasmombin</i>		1.00	15.00	1.60	0.20	2.90	1.37	0.19	1.56
Palm Fruit	<i>Elaeisqueineensis</i>	Arecaceae	1.00	7.50	1.00	0.08	0.60	1.35	0.14	0.74
Cashew	<i>Anacardiumoccidentale</i>	Anacardiaceae	1.00	5.00	2.00	0.32	1.61	1.37	0.14	0.76

Appendix 3: List of Woody Tree Species in Ago-Owu Forest Reserve

Local name	Scientific name	Family	F.	MHt (m)	MDbh (cm)	BA (m ²)	Vol (m ³)	RD	RD _o	IVI
Araba	<i>Celbapentandraetrn</i>	Bambacaceae	2.00	10.00	2.94	0.70	2.30	7.70	0.40	2.35
Igba	<i>Parkiabiglobosa</i>	Fabaceae	1.00	8.00	2.20	0.28	1.74	3.80	0.19	1.99
Idigbo	<i>Terminalia ivorensis</i>	Combretaceae	1.00	7.20	1.60	0.19	2.10	3.80	0.10	1.95
Mansonia	<i>Mansoniaaltissima</i>	Sterculiaceae	1.00	6.90	1.40	0.15	2.05	3.80	0.09	1.94
Ako	<i>Brachystegiaeurycoma</i>	Ceasalpinoidea	1.00	6.00	1.30	0.26	2.10	3.80	0.20	2.00
Ire	<i>Funtumia Africana</i>	Apocynaceae	2.00	7.90	2.12	0.34	3.67	7.70	0.23	3.97
Ayunre	<i>Albiziazgyia Macbride</i>	Mimozoidae	2.00	10.00	2.40	0.26	2.60	7.70	0.25	3.98
Arere	<i>Triplochitonscleroxylon</i>	Sterculiaceae	2.00	11.30	3.10	0.82	2.17	7.70	0.29	3.99
Ahun	<i>Momordicafoetida</i>	Apocynaceae	1.00	8.00	2.14	0.36	2.90	3.80	0.24	2.02
Iroko	<i>Miliciaexcelsa</i>	Meliaceae	2.00	9.50	2.44	0.64	0.70	7.70	0.27	3.98
Oro	<i>Irvingiagabonesis</i>	Irvingiaceae	2.00	10.00	2.10	0.44	4.42	7.70	0.24	3.97
Palm Fruit	<i>Elaeisqueeneensis</i>	Arecaceae	6.00	7.50	1.20	0.07	0.40	23.10	1.17	12.10
Teak	<i>Tectonagrandis</i>	Verbanaceae	2.00	8.00	0.90	0.05	0.14	7.70	0.09	3.89
Gmelina	<i>Gmelinaarborea</i>	Verbanaceae	1.00	7.50	0.85	0.05	0.10	3.80	0.10	1.95

Note: MHt means Maximum height, MDbh means Mean Diameter at breast height, BA means Basal Area, Vol means volume, RD means Relative density, RD_o means Relative Dominance and IVI means Important Value Index.

Appendix 4: List of Woody Tree Species in Shasha Forest Reserves

Local Name	Scientific name	Family	F	MHt (m)	MDbh	BA (m ²)	Vol (m ³)	RD	RD _o	IVI
Teak	<i>Tectona grandis</i>	Verbanaceae	45.00	8.01	0.90	0.04	1.37	45.00	2.02	23.50
Gmelina	<i>Gmelinaarborea</i>	Verbanaceae	32.00	10.30	0.69	1.55	0.55	32.00	1.92	16.90
Pine	<i>Pinus spp</i>	Pinaceae	16.00	1.03	1.03	0.06	0.98	16.00	0.98	8.49
Bread Fruit	<i>Artocarpus altilis</i>	Moraceae	1.00	10.00	0.75	0.05	0.45	1.00	0.06	0.53
Cola nut	<i>Cola nitida</i>	Sterculiaceae	1.00	5.00	1.10	0.10	0.50	1.00	0.12	0.56
Palm Fruit	<i>Elaeis guineensis</i>	Arecaceae	2.00	5.00	0.70	0.04	0.19	2.00	0.06	1.03
Idigbo	<i>TerminaliaAicana</i>	Combretaceae	1.00	9.00	1.00	0.90	0.88	1.00	0.13	0.57
Mansonia	<i>Mansonia a issima</i>	Sterculiaceae	1.00	10.00	1.40	0.15	0.99	1.00	0.20	0.60
Cocoa	<i>Theobroma cacao</i>	Malvaceae	1.00	6.00	1.21	0.10	0.85	1.00	0.15	0.58

Note: MHt means Maximum height, MDbh means Mean Diameter at breast height, BA means Basal Area, Vol means volume, RD means Relative density, RD_o means Relative Dominance and IVI means Important Value Index.

Appendix 5: List of Woody Tree Species in Ife Native Authority

Local name	Scientific name	Family	F	MHt (m)	MDbh (cm)	BA (m ²)	Vol (m ³)	RD	RD _o	IVI
Teak	<i>Tectonagrandis</i>	Verbanaceae	98.0	10.90	0.63	0.23	0.28	94.2	0.64	47.4
Gmelina	<i>Gmelinaarborea</i>	Verbanaceae	2.00	7.40	0.40	0.05	0.66	1.90	0.05	0.98
Apa	<i>Azelia Africana</i>	Ceasalpinceae	1.00	12.00	1.70	0.23	2.75	0.96	0.01	0.48
Palm Fruit	<i>Elaeisqueeneensis</i>	Arecaceae	3.00	1.4.0	0.22	0.15	1.14	2.88	0.08	1.48

Note: MHt means Maximum height, MDbh means Mean Diameter at breast height, BA means Basal Area, Vol means volume, RD means Relative density, RD_o means Relative Dominance and IVI means Important Value Index.

Appendix 6: Woody Tree Family Diversity in Five Selected Forest Reserves

Local Name	Family	Ago-Owu	Oba Hill	Ikeji-Ipetu	Ife Native	Sasha	Total
Afara	Combretaceae	-	-	5	-	-	5
Agbalumo	Sapotaceae	-	1	1	-	-	2
Agunmoniye	Leguminosae	-	-	1	-	-	1
Ahun	Apocynaceae	1	-	1	-	-	2
Ako	Ceasalpinoidea	1	1	-	-	-	2
Akoko	Bignoniaceae	-	-	2	-	-	2
Apa	Ceasalpinceae	-	-	-	1	-	1
Araba	Bambacaceae	2	1	-	-	-	3
Arere	Sterculiaceae	2	-	1	-	-	3
Ayin	Combrataceae	-	1	-	-	-	1
Ayunre	Mimozoidae	2	-	1	-	-	3
Bread Fruit	Moraceae	-	-	-	-	1	1
Cashew	Anacardiaceae	-	1	1	-	-	2
Cassia	Lauraceae	-	3	3	-	-	6
Cocoa	Malvaceae	-	-	-	-	1	1
Cola nut	Sterculiaceae	-	-	-	-	1	1
Epin	Euphorbiaceae	-	-	5	-	-	5
Gmelina	Verbanaceae	1	36	23	2	32	94
Idigbo	Combretaceae	1	-	2	-	1	4
Igba	Fabaceae	-	1	-	-	-	1
Ira	Phyllanthaceae	-	1	-	-	-	1
Ire	Apocynaceae	2	-	-	-	-	2
Iroko	Moraceae	2	-	2	-	-	4
Isin	Sapindaceae	-	2	1	-	-	3
Ita	Ulmaceae	1	-	1	-	-	2
Iyeye	Anacardiaceae	-	1	-	-	-	1
Mahogany	Meliaceae	-	-	1	-	-	1
Mansonia	Sterculiaceae	1	-	-	-	1	2
Obobo	Moraceae	-	-	1	-	-	1
Omo	Boriginaceae	-	-	1	-	-	1
Opoto	Moraceae	-	-	1	-	-	1
Oriro	Moraceae	-	-	1	-	-	1
Oro	Irvingiaceae	2	-	-	-	-	2
Palm Fruit	Arecacea	6	-	1	3	2	12
Pawpaw	Caricaceae	-	-	3	-	-	3
Pine	Pinaceae	-	-	-	-	16	16
Teak	Verbanaceae	2	63	14	98	45	221

Source: Author's field work.