Original Research Article

Tree Species Composition and Diversity of *Ipinu-Igede* Sacred Forest in Oju Local Government Area of Benue State, Nigeria

Abstract

The role of sacred forest/sacred groves in the conservation of biodiversity is well recognised and documented. Despite the importance of sacred forests in conservation, data of flora species composition and diversity in many sacred forests still remain scanty. The study was conducted to provide baseline data on tree species composition and diversity of Ipinu-Igede sacred forest with a view to promote the role of sacred forest in flora conservation in the area. Systematic sampling technique was adopted for the study. A base line transect of 2km long was established and five (5) other transects 2 km long were laid at regular interval of 500 km apart. On each transect, 4 sampling plots of 50mx50m were established at a regular interval of 500m apart. Within the 50 mx50 m plots, trees with diameter at breast height (DBH)≥10 cm were identified and enumerated. Species Important Value Index (IVI), species richness, species evenness and species diversity were estimated. A total number of 50 tree species in 19 families were recorded. Cola gigantea was the most important tree species with IVI of 14.56, this was followed by Harungana madagascariensis with 13.14 . Caesalpinioideae was the dominant family with 6 species, 48.15% of the families were represented by only one species. The species richness was D=9.436, Species Evenness was E′=0.7668 and species diversity was H=3.646. Thirty percent (30%) of the tree species were in the DBH class of 1-40cm indicating good regeneration status of the sacred forest. Acknowledgement of the traditional practices by scientists and other actors in natural resources conservation will help in promoting forest conservation.

Key words: Biodiversity, Conservation, Regeneration, Flora, Traditional practices

Introduction

The degradation of forest habitats due to anthropogenic activities are considered to be the major causes of decline in the global biodiversity (FAO, 2000, Morris, 2010). In Nigeria, forest resources are continuously under pressure due to the increasing demands of people and their associated industries for water, food, fuel, and income (Oribhabor, 2016). Community and sacred forests are not left out, as pressures due to human activities are gradually creeping into community and sacred forests (Agarwal, 2016). This is happening because the awareness about the value of forest is still limited, as people still regard forests as gifts of nature that should only be exploited without replacement, with erroneous belief that such depleted forests could regenerate naturally (Udofia, 2007).

According to Chandrakanth *et al.* (2004) and Ormsby (2013) sacred forests are disappearing due to cultural change and pressure to use the natural resources that are found in these sacred forests. Despite the pressure, community and sacred forests appear to be the major sources of forest products in many communities because other forests have been completely deforested (Daye and Healey, 2015).

Sacred forests, also called sacred grooves, are places that have cultural or spiritual value for the people who live close to them (Ormsby, 2013). Many communities around the world have reasons behind their protection of sacred grooves. Some of these reasons are based on religious practices (Mgumia and Oba 2003; Onyekwelu and Olusola, 2014;) burial grounds (Okali and Amubode, 1995) and watershed conservation (Asoka *et al.*, 2015, Agarwal, 2016).

In Nigeria, the role of sacred groves in the conservation of biodiversity are well recognized and documented (Okali 1997; Oyelowo, *et al.,* 2012; Udoakpan, *et al.,* 2013; Onyekwelu and Olusola, 2014, Daniel *et al.,* 2015). Studies have demonstrated that, sacred groves possess a great heritage of diverse gene pool of many forest species having socio-religious attachment with a lot of medicinal values (Asokan *et al.,*2015). Sacred groves are considered to be of ecological and genetically important (Agarwal, 2016). They harbour rare, endemic and endangered species of flora and fauna (Asokan *et al.,*2015).

Despite the established values of sacred forests in biodiversity conservation in Nigeria, information on biodiversity of sacred forests is still scanty. This study was conducted in order to provide preliminary information on the tree species composition and diversity in *Ipinu-Igede* sacred forest with a view of promoting forests biodiversity conservation in the area through the use of traditional institution.

Materials and Methods

Study Area

The *Ipinu-Igede* sacred Forest is located in Oju Local Government Area of Benue State within the Southern Guinea Savanna zone covering an area of approximately 3km^2. It lies between Longitude 8^0 25’ 0” and 8^{o}41’67$^{’’}$ E, and Latitude 6^0 51’ 0” and 6^{o}85’0$^{’’}$ N. Characterized by two distinct seasons; wet and dry season. The wet season occur between April to October, and dry season between November to March. Mean annual rainfall is between 1200mm and 1500mm. Mean annual temperature is 30^{o}c. Relative humidity is between 60% and 80% wet but decreases in the early months of dry season (Jimoh *et al*., 2009).

Ipinu-Igede is an ancestral heritage site for the Igede people of Benue State stretching through three communities; *Oyinyi, Andibilla and Uchenyim*. It is the location where the ancestral fathers of *Igede* land first settled when they migrated to Benue and the sacred forest contains relicts of traditional worship practices.

Sampling design

The survey team was made up of a plant taxonomist from the Department of Forest Production and Products, University of Agriculture, Makurdi and two experienced local guides who were knowledgeable in the local identification of tree species.

A base line was established 200 m from the edge of the forest and the five (5)subsequent transects of 2km long were systematically positioned parallel to the first as described by Buckland *et al.* (1993) using compass and GPS at regular interval of 500m apart. This was to cover a larger proportion of the forest. On each of the transect, 4 sample plots of 50m x 50m were systematically laid at intervals of 500m. Within the 50 x 50 m plots, trees with diameter at breast height (DBH) ≥ 10 cm were enumerated (Turyahabwe and Tweheyo, 2010, Ikyaagba *et al.,* 2016). Diameters of trees were measured using a diameter tape. Where there were cases of irregular features such as buttresses, diameters were taken above those features (Turyahabwe and Tweheyo, 2010). Each of the tree encountered was assigned a class based on DBH. The identification of plants samples was carried out using flora Field guides (Keay, 1989; Arbonnier, 2004, Agishi 2010). This was in conjunction with the taxonomist that was engaged for the identification of the trees on the field. Some of the trees were identified through their local names with the aid of local guides, after which such names were compared with the names found in Agishi (2010) which have the Igede and the scientific names.

DATA ANALYSIS

Tree species classification

All plant species encountered were classified into families. Floristic composition in the study area was estimated using Importance Value Index (IVI), species richness, species diversity and species evenness.

Importance Value Index (IVI) was calculated for all species by summing relative frequency and relative density values for all the tree species. IVI was used to identify dominant tree species in the study area (Maingi and Marsh, 2006; Adam *et al.,* 2007).

Frequency

$$\text{Frequency} = \frac{\text{Number of plots in which species occur}}{\text{Total number of plots sampled}}$$

Relative frequency

The degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$\text{Relative Frequency} = \frac{\text{Species frequency of individual species}}{\text{Total of frequency values for all species}} \times 100$$

Density

$$\text{Density} = \frac{\text{Number of individual species}}{\text{Area sampled}}$$

Relative density

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species and can be calculated as:

$$\textbf{Relative Density} = \frac{\text{Species density of individual species}}{\text{Total density for all species}} \times 100$$

Importance Value Index (IVI) = relative frequency+ relative density

Floristic composition in the sacred forest was estimated using diversity indices such as species richness, species evenness and species diversity. Species richness was computed using Margalef (1951) as expressed by Spellerberg (1991) and Magurran (2004) as follows:

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

Where, D = species richness index (Margalef index), S = number of species and N = the total number of individuals.

Species diversity was estimated using Shannon- wiener diversity index as expressed by Spellerberg (1991) and Magurran (2004).

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

Where H′ = species diversity index, pi = the proportion of individuals or the abundance of the i^{th} species expressed as a proportion of the total abundance. The use of natural log is usual because this gives information in binary digits.

Species evenness was estimated using Pielou’s evenness (equitability) index (Pielou, 1975) used by Turyahabwe and Tweheyo (2010) as follows:

$$J' = \frac{H'(observed)}{H_{max}}$$

J′ = Pielou’s evenness index. Where H′ (observed) / H_{max}, where H_{max} is the maximum possible diversity, which would be achieved if all species were equally abundant (=Log S)

RESULTS

Tree species composition

A total number of 50 tree species in 27 families were recorded in all (Table 1). The most occurring tree species in *Ipinu-Igede* sacred forest were *Cola gigantea* with Relative Frequency (RF) of 5.67% and Relative Density (RD) of 8.89%, This was followed by *Harungana* *madagascariensis* with Relative Frequency (RF) of 4.26% and Relative Density (RD) of 8.89%, this was also followed closely by *Rauvolfia vomitoria* with Relative Frequency (RF) of 4.96% and Relative Density (RD) of 5.56%, *Elaeis guinensis* with Relative Frequency (RF) of 4.96%, and Relative Density (RD) of 4.44%. (Table1).

On Important Value Index which provides knowledge on important species of the plant community; *Cola gigantea* was the most dominant species with IVI value of 14.56, followed by *Harungana madagascariensis*, *Rauvolfia vomitoria* and *Elaeis guinensis* with IVI values of 13.14, 10.52, 9.41 respectively(Table1).

Table 1: Tree species composition showing the family, species, RF, RD, IVI of Ipinu-Igede Sacred Forest.

S/N	Species	**Family**	**RF**	**RD**	**IVI**
1	*Afzelia africana* Pers.	Caesalpinioideae	2.84	2.78	5.61
2	*Albezia zygia* (DC) J.F. Macbr.	Mimosaceae	1.42	1.11	2.53
3	*Alchornea cordifolia* (Schmach & Thonn.) Mull.Arg	Euphorbiaceae	2.13	1.68	3.79
4	*Allophylus africanus* P.Beauv.	Sapindaceae	1.42	1.67	3.09
5	*Alstonia boonei* De Wild	Apocynaceae	3.55	2.78	6.32
6	*Anogeissus leiocarpus(DC) Guill. & Perr.*	Combretaceae	2.13	1.67	3.8
7	*Anthoclesta djalonesis* A.Chev.	Gentianaceae	0.71	1.11	1.82
8	*Antiaris toxicaria* (Rumph ex Pers.)	Moraceae	2.13	1.67	3.79
9	*Aubrevillea kerstingii (*Harms) Pellegr	Mimosaceae	1.42	1.67	3.09
10	*Baphia nitida Lodd*	Papilionoideae	2.13	2.22	4.35
11	*Barteria fistulosa* Mast.	Passifloraceae	2.13	2.22	4.35
12	*Berlinia grandiflora*(Vahl) Hutch. & Dalziel	Caesalpinioideae	1.42	1.11	2.53
13	*Bombax costatum* Pellegr. & Vuille	Bombaceae	2.13	1.67	3.79
14	*Canarium schweinfurthii* Engl.	Burseraceae	1.42	1.11	2.53
15	*Ceiba pentandra* (L) Gaertn	Bombacaceae	2.13	1.67	3.79
16	*Celtis Zenkeri* Engl.	Ulmaceae	0.71	1.11	1.82
17	*Chrysophyllum albidum G. Don*	Sapotaceae	2.84	2.22	5.06
18	*Cola argentea* Mast	Sterculiaceae	5.67	8.89	14.56
19	*Daniellia oliveri* (Rolfe) Hutch. & Dalziel	Caesalpinioideae	1.42	1.67	3.09
20	*Dialium guineense* Willd.	Caesalpinioideae	0.71	0.56	1.26
21	*Diospyros mespiliformis* Hochst ex D. AC	Ebanaceae	1.42	1.11	2.53
22	*Elaeis guineensis* Jacq.	Arecaceae	4.96	4.44	9.41
23	*Erythrophelum suaveolens* (Gull.& Perr.) Brenan	Caesalpinioideae	1.42	1.11	2.53

24	*Ficus exasperata* Vahl.	Moraceae	3.55	2.78	6.32
25	*Garcinia livingstonei* T. Anders	Guttiferae	2.13	1.67	3.79
26	*Harungana madagascariensis* Lam. er Poir	Guttiferae	4.26	8.89	13.14
27	*Holarrhena floribunda* (G.Don) T. Durand & Schinz.	Apocynaceae	1.42	1.11	2.53
28	*Irvingia gabonensis* (Aubry-Lecomte) Baill	Irvingiaceae	2.13	2.22	4.35
29	*Isoberlinia doka* Craib & Stapf.	Caesalpinioideae	0.71	1.11	1.82
30	*Khaya grandifoliola* C.DC	Meliaceae	3.55	3.33	6.89
31	*Khaya senegalensis* (Desr.) A. Juss.	Meliaceae	2.84	3.33	6.17
32	*Kigelia africana* (Lam) Benth	Bignoniaceae	0.71	0.56	1.26
33	*Lonchocarpus laxiflorus* Guill. & Perr	Leguminosae	1.42	1.67	3.09
34	*Mangifera indica* Linn.	Anacardiaceae	0.71	0.56	1.26
35	*Milicia excelsa* (Welw.) C.C. Berg	Moraceae	1.42	1.11	2.53
36	*Morinda lucida* Benth	Rubiaceae	2.84	2.76	5.61
37	*Mussanga cecropioides* F. Br.	Cecropiaceae	0.72	0.56	1.26
38	*Napoleona Vogelii* Hook. & Planch	Lecythidaceae	0.71	0.56	1.26
39	*Newbouldia laevis* (P. Beauv.) Seemann exBureau	Bignoniaceae	0.71	0.56	1.26
40	*Pachystela pobeguiniana* Pierre ex Lecomte	Sapotaceae	2.13	1.67	3.79
41	*Parkia bicolor* A. Chev	Mimosaceae	0.71	1.11	1.82
42	*Pterocarpus erinaceus* Lam	Papilionoideae	2.84	1.67	4.51
43	*Pterocarpus santalinoides* DC	Papilionioceae	2.13	1.67	3.79
44	*Rauvolfia vomitoria* Afzel.	Apocynaceae	4.96	5.56	10.52
45	*Rothmannia hispida* (K. Schum) Fagerlind	Rubiaceae	0.71	1.11	1.82
46	*Spondias mombin* Linn.	Anacardiaceae	2.84	2.78	5.61
47	*Syzygium guineense* (Willd.) DC	Myrtaceae	2.13	1.67	3.79
48	*Terminalia superba* Engl.&Diels	Combretaceae	1.42	1.11	2.53
49	*Uapaca togoensis* Pax	Euphorbiaceae	1.42	1.67	3.09
50	*Vitex doniana* Sweet	Verbanaceae	0.71	0.56	1.26

RF= Relative Frequency, RD= Relative Density, IVI= Important Value Index

Family composition

A total of 25 families were recorded in the study area. The result shows that Caesalpinioideae was the dominant family with six (6) tree species representing (12%) of the species recorded. This was followed by Apocynaceae, Meliaceae, Mimosaceae, Papilionioceae Sapindaceae with three (3) tree species representing (6%) of the species recorded. Thirteen (13) (48.15%) families recorded in the study area were represented by one (1) tree species. Also 8 (29.63%) of the families were represented by 2 species each, while 6(22.22) families were represented by 3 and above tree species (Fig.1).

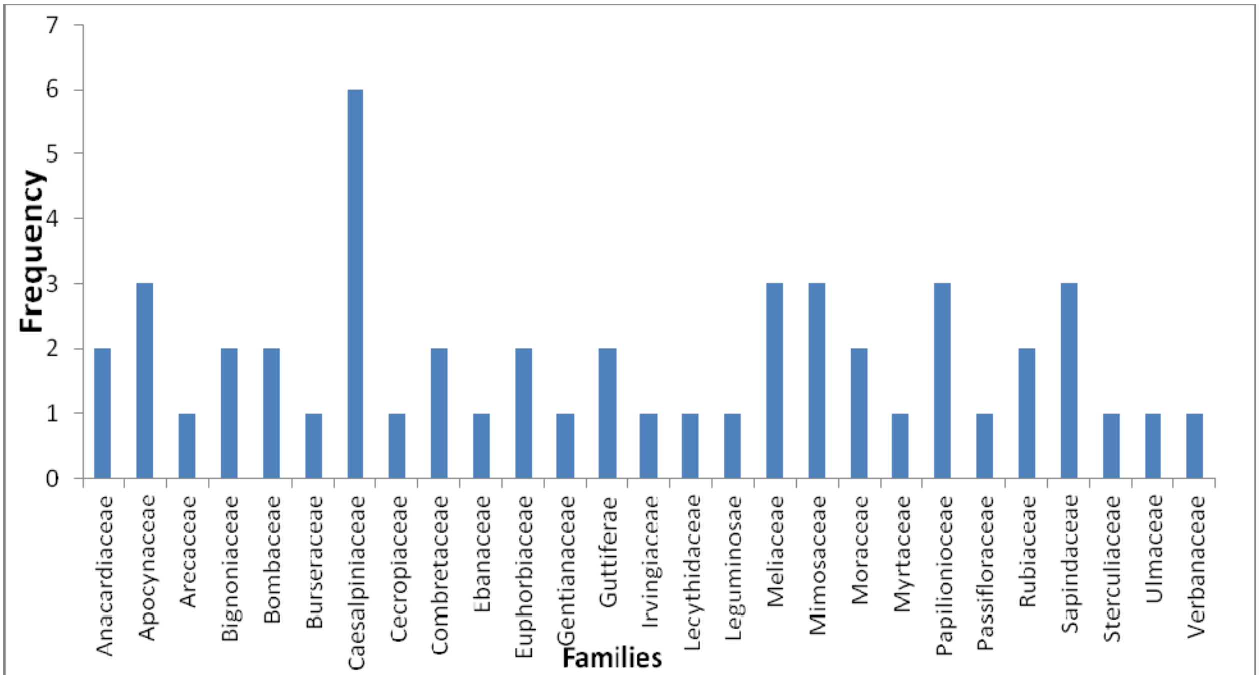

Fig. 1. Family Composition of Tree species in the *Ipinu-igede* Sacred Groove

Species Diversity, Richness and Evenness Indices

A total of 50 species with 180 individual stands were recorded, The species richness for the *Ipinu-Igede* sacred forest was D= 9.436, species evenness J′= 0.7668 and Shannon-weiner's Diversity index stood at H'=3.646 (Table 2).

Table 2: Species Diversity, Richness and Evenness Indices

Variables	**Indices**
Number of tree Species	50
Individuals	180
Shannon-weiner's index_H	3.646
Species Evenness (J′)	0.7668
Species Richness (D)	9.436

Diameter at Breast Height Class of the Species

The Diameter at Breast Height (DBH) class distribution indicated that 30% of the tree species were in DBH class of 1-40cm, 23% of the tree species were in the DBH class of 41-80cm. while 10 % of trees species in the study area were in DBH class of 161cm and above (Fig.2).

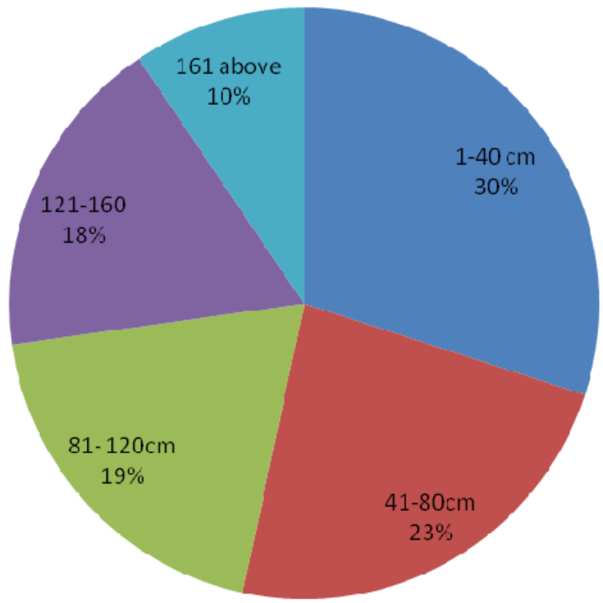

Fig.2 DBH Class distribution in *Ipinu- Igede*

DISCUSSION:

Tree species composition

The number of tree species recorded in the *Ipinu-Igede* Sacred Forest was a demonstration of the value of sacred forest in forest biodiversity conservation. It also confirmed the diverse nature of sacred forest and it is an important conservation site (Asokan *et al.,* 2015, Agarwal. 2016). The number of tree species recorded in this study was within the range of tree species composition recorded in Osun-Osogbo sacred grove with 61 tree species (Onyekwelu *et al.,* 2014). It was similar to 52 tree species recorded in Igbara-Oke sacred grove in Nigeria by

Oyelowo *et al.* (2012). The number was higher than what was obtainable in *Ayan Nsit* sacred forest in Nigeria (Udofia *et al.,* 2014). It was also higher than the number recorded by Daniel *et al.* (2015) in some selected sacred forests in Nigeria in which the highest number of tree species recorded was 38 species. At international level it was higher than 38 tree species recorded in Ilangudipatti Ayyanar sacred grove in India (Thandavamoorthy, 2017).

This result when compared to other studies implies that species composition in *Ipinu-Igede* Sacred Forest is diverse in tree species, considering the location of the study area which is located in the savanna. Also coupled with the fact that it has an inherent link with the host community who depend highly on the forest for timber, fuel wood, and other wood products for their livelihood which can easily result in the depletion of the tree species. Most of the tree species recorded in the study area were also recorded in other sacred forests in Nigeria (Onyekwelu, *et al.,* 2014, Udofia *et al.,* 2014, Daniel *et al.,* 2015). A good number of them are of high economic value, such species included; *Ceiba pentandra, Elaeis guinensis, Irvingia gabonensis, Khaya grandifoliola, Milicia excelsa, Terminalia superba, Pterocarpus spp,* and many others. The high number of tree species recorded in this study agreed with the other previous studies which concluded that sacred forest of West Africa act as vital refuge for forest biodiversity (Bosart, *et al.,* 2006, Kokou *et al.,* 2008, Onyekwelu, *et al.,* 2014, Udofia *et al.,* 2014, Lynch *et al.,*2018).

4.5.2 Family composition

The domination of *Caesalpinioideae,* agreed with the records of Richard (1996) and Schmitt (1996) that Caesalpinioideae is the most dominant tree family in West Africa with 115 tree species. Study by Jimoh *et al.* (2009) recorded *Caesalpinioideae* as the most abundant family. Other families with fair representation in the study area were *Apocynaceae, Meliaceae, Mimosaceae, , Papilionioceae and Sapindaceae.* Similar experience was recorded by Oyelowo *et al.,* (2012), Onyekwelu *et al.,* (2014), Daniel *et al.* (2015). The representation of good number of the families by only one or two tree species is similar to other studies in the

Savanna area of West Africa (Attua and Pabi, 2013, Ikyaagba, *et al.,* 2015, Wakawa *et al.,* 2017,). However, this is an indication of the fragile nature of the savanna ecosystem, which requires attention to avoid extinction of some of these families.

4.5.3 Diversity indices:

Diversity index is the measure of variety of species in an area. According to Sax (2002) and Daniel *et al.* (2015) an area with diversity index > 1 is considered to be rich in species, while an area with diversity index < 1 is considered to be less diverse. The result shows good species richness 9.436 and good species diversity 3.646; this is an indication that *Ipinu-Igede* Sacred Forest was rich in tree species. This result is higher than 2.05 and 1.11 recorded by Udofia *et al.* (2014) in Ayan Nsit, its species diversity value was also higher than 3. 54 and 2.35 recorded by Onyekwelu *et al.* (2014) in Osun Osogbo and Igbo-Olodumare sacred groves. The Evenness index of this study was higher than the values of 0.66 and 0.44 recorded by Onyekwelu *et al.* (2014) in Osun Osogbo and Igbo-Olodumare sacred groves. This was indication of fair representation of individual stand across species.

In Tanzania, species richness in sacred groves was greater than in state forest reserves (Mgumia and Oba 2003). In Benin, Alohou *et al.* (2017) also recorded higher Species richness in Sacred forest compared to a forest reserve. This was an indication that some sacred forests are better than natural forests in terms of species richness, species diversity index and seedling regeneration potential. The evidence that sacred groves contain high species diversity and richness may support the consideration of conservationists for promoting sacred groves for in-situ biodiversity conservation.

The horizontal and of the forest as revealed by the diameter and height distribution shows a forest whose population structure is expanding, ensuring its stability. The high number of tree species within the DBH class of 1-40cm could be an indication of good regeneration status of

Ipinu-Igede sacred forest. Similar experience was recorded by Oyelowo *et al.* (2012) in Igbara-Oke in Nigeria, Onyekwelu *et al.* (2014) also reported a similar experience in Odun-Osogbo sacred grove. Another reason for most of the species in the lower DBH class could be that there is an increase in the disturbance of the forest from human activities, despite restrictions. As suggested by some authors Colding and Folke (2001), Kobina and Kofi (2009) Jimoh *et al.,* (2012) the success of traditional systems of resource conservation relies heavily on the presence of a homogenous ethnic or cultural community sharing similar values and experiences. This is usually based on a strong shared belief in the spiritual world and its pervasive influence on people's lives. The presence of other tribes in the area could be another reason for the disturbance of *Ipinu- Igede* sacred forest. Similar experience was reported by Jimoh *et al.,* (2012) among Ejagham tribe in Cross River state of Nigeria. In some instances members of the community may consider traditional practices as being evil due to influence of new religion and westernization (Kobina and Kofi 2009, Onyekwelu *et al.,* 2014, Amonum *et al.,* 2017). In Ghana Saj *et al*. (2006) reported a case where a Church encouraged her members to hunt monkey which is regarded as a taboo among the people. In Nigeria, Anoliefo *et al.* (2003) and Akindele (2010) reported that, many local people in Nigeria have embraced Christianity and hence shun traditional religion and its taboos. Some of these reasons stated above are responsible for degradation of sacred forest all over world, (Chandrakanth *et al.*, 2004, Sarfo-Mensah *et al.* 2010, Ormsby and Bhagwat, 2010). This calls for strong enforcement of laws guiding this sacred forest by the communities where they are located.

Conclusion

Sacred Forests are generally established to meet traditional needs of the people. Sacred forest usually promote conservation of biodiversity. The result of this study has contributed to the body of studies which demonstrates that sacred forest can contribute immensely to the conservation of forest biodiversity. The study revealed that *Ipinu- Igede sacred forest* still harbour many flora and fauna species. It is believed that the community maintained the Sacred forest in order to preserve their culture and tradition. Acknowledgement of the traditional practices by scientists and other actors in natural resources conservation will help in promoting forest conservation.

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