

Status of Tree Diversity in Idah Local Government Area of Kogi State, Nigeria

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ABSTRACT

This paper examined the status of tree diversity in Idah Local Government Area of Kogi State, Nigeria. The data for the study were collected from quadrants laid within five forests which are: forest of the royal dead (Ojaina forest); Inachallo sacred forest; Ubi-egbe forest; forest of the warlords and river bank forest. A total of twenty-one (21) quadrants of 20m x 20m in dimension were used for the assessment. Individual tree species in each of the quadrant were identified, counted, and their diameter at breast height measured. Some of the indices computed are: basal area, species relative frequency, species relative density, species relative dominance, Important Value Index (IVI); Shannon-Wiener diversity index (H'), species evenness and species richness. The results show that *Daniella oliverii*, *Raphia bookeri*, *Elaeis guineensis*, *Khaya senegalensis*, *Parkia biglobosa*, *Vitex doniana*, and *Adansonia digitata* were the most important species with the highest IVI values of 19.54, 18, 14.18, 11.98, 11.94, 11.88 and 9.62, respectively. Based on Shannon-Wiener diversity index, forest of the royal dead (2.93) is most diverse followed by Inachallo sacred forest (2.9), Ubi-egbe forest (2.83), river bank forest (2.7) and forest of the warlords (2.59). The results of species richness show that forest of the royal dead (10.97) is the richest, followed by Inachallo sacred forest (10.34); river bank forest (9.92); Ubi-egbe forest (9.77); and forest of the warlords (8.83). The evenness index shows that individual species in Inachallo sacred forest (2.27) are more evenly distributed, followed by species in forest of the royal dead (2.26), Ubi-egbe forest (2.26), river bank forest (2.19) and forest of the warlords (2.18). An understanding of the current state of the resource is very important in identifying threats to species and ecological communities, and the strategies needed for the preservation of species, habitats and ecosystem functioning.

Key Words: Tree species diversity, species richness, Forest types, conservation, Nigeria

INTRODUCTION

Tree diversity refers to the abundance of different tree species living within a particular area or region. Tree diversity status refers to the state of tree species in a particular area, whereas tree diversity inventory is the systematic collection of data, and evaluation of the state and dynamics of abundance of different tree species. The diversity of trees is fundamental to the total tropical rainforest diversity as trees provide resources and habitat structure for almost other forest species (Cannon et al., 1998). Despite all the efforts at conservation, human activities have caused damages to the natural resources which have resulted in extinction of some indigenous tree species. Shuaibu and Alao (2013) revealed that efforts at large-scale forest plantations establishment, which was done on yearly basis did not yield the desired results. Humans depend on a sustainable and healthy environment, and despite these, they still damage the environment. The rapid deforestation of Nigerian forests for timber, fuelwood, etc has resulted in many of our indigenous tree species being endangered while others are already extinct. John (1997) stated that one of the ways to conserve tropical forests for production of timber without losing other values is to have small undisturbed forest areas preserved within a large matrix of production forest.

The higher the tree diversity of a forest, the more efficient the ecosystem functioning. Hengeveld (1996) stated that species diversity is an important attribute of a natural community that

influences the functioning of an ecosystem. Devastating effects of human activities in forested areas has resulted in loss of tree diversity and therefore reduction in the ecosystem functioning.

Tree diversity declines as population increases and the impacts of the loss of abundance of different tree species can result in loss of economic opportunities and decline in a country's, region's or an area's biological heritage. Onyekwelu and Fuwape (2008) opined that Nigeria's tropical rainforest has been heavily exploited, seriously degraded and fragmented, leaving less than 5% of the country's rainforest ecosystems as undisturbed. The forest estates are valued for their tangible and intangible benefits, which include climate regulation, nutrient recycling, environmental protection, edible fruits, vegetable, herbs, bush meat, timber, watershed protection, etc. High rates of forest clearance for agriculture, urbanization, industries, construction, has resulted into forest degradation, the loss and reduction in tree species diversity which has become difficult to be restored by forest managers. Hubbel et al. (1999) mentioned that disturbances created by these factors determine forest dynamics and tree diversity at the local and regional scales. These disturbances have been considered as an important factor structuring communities.

Tree diversity inventory is important in obtaining information on the status of threatened and endangered trees species. There is no documented information on the status of tree species

diversity within the forest estates in Idah local government area of Kogi state. Therefore, carrying out tree species diversity inventories in the study area will be used to determine the conservation strategies required to protect the forest, regenerate species of interest and to manage the species diversity in sustainable manner. The objective of this study is to examine the current status of tree species diversity in five forests in Idah Local Government Area of Kogi State, Nigeria.

METHODOLOGY

Study Area

The study area is Idah Local Government Area of Kogi State, Nigeria. Idah is a town located on latitude 7°7'12"N and longitude 6°45'42"E with altitude 69m above the sea level. The town is an old river port, which lies on a sandstone cliff on the eastern bank of the River Niger and covers an area of 36 km² with a population of 79,815. Idah is the traditional capital of the Igala people and a major food basket in Kogi State. It has commercial routes on the River Niger, linking Lokoja to the North, Onitsha in Anambra State to the South, and Agenebode in Edo State to the West.

The local populace is engaged in farming and trading of palm produce, rice, yam, maize, cassava, melon, benne-seed, fish, bush meat, and live-stocks. They also produce honey, ogbono seed, locust bean seed, canoes, mortar with pestle, charcoal, cotton weaving, and black soap from indigenous forest trees within the locality. The indigenous forest tree species commonly found in Idah local government area are: *Vitex doniana*, *Irvingia species*, *Adansonia digitata*, *Parkia biglobosa*, *Prosopis gabonensis*, *afzelia Africana*, *Lophira lanceolata*, *Chrysophyllum albidum*, *Vitellaria paradoxa*, *Raphia bookeri*, *Millettia excelsa*, *Khaya senegalensis* and *Daniella oliveri*. The indigenous aquatic and terrestrial wildlife animals found in Idah include: Hippopotamus (*Hippopotamidae*), Crocodile, (*Crocodylus species*), monitor lizard, Turtles, snakes, Duck, Antelopes, Deer, Grass-cutter (*Thryononyx sp*), monkeys, Rabbits, squirrel, rats, Leopard, Elephant (*Laxodontia sp.*), and fishes of different species.

Data Collection

The data for this study were collected from five forests within Idah LGA, which include forest of the Royal Dead (Ojaina forest) (RD); Inachallo Sacred forest (IS); Ubi-egbe Forest (UF); Forest of the Warlords (FW) and the River Bank forest (RB). A total of twenty-one 20m x 20m quadrants (4 quadrants each from IS, UF, FW and RB and 5 quadrants from the RD forests) were used for the assessment. Forest of the Royal Dead (Ojaina forest) (RD); Inachallo Sacred forest (IS) and Ubi-egbe Forest (UF) are preserved sacred forest whereas Forest of the Warlords (FW) and the River Bank forest (RB) are open forests. Individual tree species in each of the quadrants, whose diameter at breast height (dbh) are greater than or equal to 15cm, were identified, counted, and their dbh were measured.

Data Analysis

The data collected were arranged in Microsoft Excel spreadsheet and the routine statistical analysis performed. The following growth and diversity indices were computed from the data: basal area, relative frequency, relative density, relative dominance, important value index, Shannon-Wiener diversity Index (H'), species evenness, and species richness. Below is the formulae used in computing the diversity indices:

$$\text{Frequency} = \frac{\text{Number of quadrates in which species occurs}}{\text{Total number of quadrates}} \times 100 \quad (1)$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100 \quad (2)$$

$$\text{Relative density} = \frac{\text{Number of individuals of the species}}{\text{Total number of individuals of all the species}} \times 100 \quad (3)$$

$$\text{Relative dominance} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all the species}} \times 100 \quad (4)$$

Importance Value Index (IVI) = Relative frequency + Relative density + Relative dominance. Below is the formulae used for qualitative analysis:

$$D = [\sum_{i=1}^n (p_i)^2]^{-1} \quad (5)$$

$$H = -\sum_{i=1}^n (p_i) \times \ln p_i \quad (6)$$

$$E = \frac{1}{\log S} \quad (7)$$

Where H' = Shannon-Wiener Index; ni = number of individuals of a species; N = the total number of individuals; lnPi = the logarithmic proportion of the species; E = evenness, and S = number of species present.

$$\text{Specie richness} = \frac{\text{Total number of tree species-1}}{\text{Log of total number of all the individuals of the tree species}} \quad (8)$$

Dominance (D) = Summation of (Pi)² of all the individual species present.

Results

Five forests, from different locations, which include forest of the royal dead (Ojaina forest); Inachallo sacred forest; Ubi-egbe forest; forest of the warlords and the river bank, were surveyed in this study. A total of twenty-two (22) tree species, 15 families, and 268 individuals were encountered within the study areas. Also, a total of thirteen (13) shrub and herbs species, distributed among eleven (11) families were recorded in the study areas. Based on the results of Important Value Index (IVI) (Table 1), *Daniella oliverii* (19.54) is the most important species in the forest communities assessed, which was followed by *Raphia bookeri* (18.00), *Elaeis guineensis* (14.18), *Khaya senegalensis* (11.98), *Parkia*

biglobosa (11.94), *Vitex doniana* (11.88), *Adansonia digitata* (9.62), etc.

Table 1: Summary of Growth and some Biodiversity indices for tree species identified within the five forest types.

Species	Individual Number	Mean dbh (cm)	Basal Area (m ²)	Relative Density	Relative Dominance	Relative Freq.	IVI
<i>Adansonia digitata</i>	13	63.34	0.32	4.85	0.07	4.72	9.64
<i>Azalia africana</i>	9	51.25	0.21	3.36	0.04	3.15	6.55
<i>Anacardium occidentale</i>	11	47.15	0.17	4.10	0.04	3.15	7.29
<i>Azadirachta indica</i>	13	50.37	0.20	4.85	0.04	4.72	9.62
<i>Ceiba pentandra</i>	8	61.94	0.30	2.99	0.07	3.94	6.99
<i>Chrysophyllum albidum</i>	9	58.69	0.27	3.36	0.06	3.15	6.57
<i>Cola nitida</i>	8	56.51	0.25	2.99	0.05	2.36	5.40
<i>Crescentia cujete</i>	2	47.76	0.18	0.75	0.04	0.79	1.57
<i>Daniella oliverii</i>	27	37.54	0.11	10.07	0.02	9.45	19.54
<i>Elaeis guineensis</i>	19	24.8	0.05	7.09	0.01	7.08	14.18
<i>Irvingia gabonensis</i>	12	55.47	0.24	4.48	0.05	3.94	8.47
<i>Irvingia wombulu</i>	10	51.77	0.21	3.73	0.05	3.15	6.93
<i>Khaya senegalensis</i>	13	50.45	0.20	4.85	0.04	7.08	11.98
<i>Kigelia africana</i>	3	56.14	0.25	1.12	0.05	2.36	3.53
<i>Mangifera indica</i>	10	59.32	0.28	3.73	0.06	3.15	6.94
<i>Milicia excelsa</i>	9	57.21	0.26	3.36	0.06	3.94	7.35
<i>Parkia biglobosa</i>	15	52.1	0.21	5.60	0.05	6.30	11.94
<i>Prosopis gabonensis</i>	11	50.6	0.20	4.10	0.04	3.94	8.08
<i>Raphia hookeri</i>	25	23.04	0.04	9.33	0.01	8.66	18.00
<i>Tamarindus indica</i>	10	49.58	0.19	3.73	0.04	3.94	7.71
<i>Triplochiton scleroxylon</i>	6	53.56	0.23	2.24	0.05	2.36	4.65
<i>Vitellaria paradoxa</i>	8	44.96	0.16	2.99	0.03	3.15	6.17
<i>Vitex doniana</i>	17	37.51	0.11	6.34	0.02	5.51	11.88
Total	268		4.63				200.96

IVI = Importance Value Index.

Table 2 below shows the results of the biodiversity indices computed for the five forests. Shannon-Wiener diversity index ranged from 2.59 to 2.93, with forest of the royal dead being the most diverse ($H^1 = 2.93$), which was followed by Inachallo sacred forest (2.9); Ubi-egbe forest (2.83); the river bank forest (2.7), and forest of the warlords (2.59). The results of species richness show that forest of the royal dead (10.97) is the richest,

followed by Inachallo sacred forest (10.34), river bank forest (9.92), Ubi-egbe forest (9.77) and forest of the warlords (8.83). The species evenness index shows that individual species in Inachallo sacred forest (2.27) are more evenly distributed, followed by species in forest of the royal dead (2.26), Ubi-egbe forest (2.26), river bank forest (2.19), and forest of the warlords (2.18). Table 3 shows the results of threatened, endangered, and vulnerable tree species found in the sacred forests.

Table 2: Summary of the results of Biodiversity indices for the five forest types

The Forests	Shannon-Wiener Index (H)	Species Richness	Evenness Index (%)
Forest of the warlords	2.59	8.83	2.18
River bank forest	2.7	9.92	2.19
Ubi-egbe forest	2.83	9.77	2.26
Inachallo sacred forest	2.9	10.34	2.27
Forest of the royal dead	2.93	10.97	2.26

Table 3 shows the results of threatened, endangered, and vulnerable tree species found in the sacred forests.

Table 3: Threatened, Endangered, Vulnerable Tree species and abundant tree species in all the five forests

Threatened Tree Species	Endangered Tree Species	Vulnerable Tree Species	Abundant Tree Species
		<i>Triplochiton</i>	
<i>Khaya senegalensis</i>	<i>Azalia africana</i>	<i>scleroxylon</i>	<i>Daniella oliverii</i>
<i>Vitellaria paradoxa</i>	<i>Milicia excelsa</i>	<i>Vitex doniana</i>	<i>Elaeis guineensis</i>
<i>Tamarindus indica</i>	<i>Kigelia africana</i>	<i>Irvingia gabonensis</i>	<i>Raphia hookeri</i>
<i>Parkia biglobosa</i>	<i>Ceiba pentandra</i>	<i>Irvingia wombulu</i>	<i>Azadirachta indica</i>
<i>Prosopis gabonensis</i>	<i>Chrysophyllum albidum</i>		<i>Anacardium occidentale</i>
			<i>Mangifera indica</i>

Source: Field Survey, 2014.

DISCUSSION

The quantitative results of inventory of tree diversity carried out in Idah Local Government Area of Kogi State show that the preserved sacred forests is stocked with diversity of indigenous woody plants, which are mainly primary colonizers and the population structure of woody plants appear to be stable in the sacred forests. The qualitative results shows that these sacred forests are diverse, rich in species and the species are uniformly distributed. The preserved sacred forests within the study area are the forest of the royal dead (Ojaina forest); Inachallo sacred forest; and Ubi-egbe forest. The forest of the warlords and the river banks have become open forests since no one goes to war again and Christianity and Islamic religions have eradicated the beliefs in water spirits. The results of Shannon-Wiener diversity index for these forests shows that they contain high species diversities, which is diminishing rapidly due to uncontrolled timber harvest and other anthropogenic activities within the forests. This study has shown that sacred forests could protect tree diversity.



Plate 1: Inachallo Sacred Forest

A sacred forest (Plate 1) is a shelter for deities, cultural ceremonies and traditional religion rituals. They are veritable tools for sustainable biodiversity conservation (Onyekwelu and Olusola, 2014). Sacred forests houses a lot of the threatened and endangered species, which agrees with the findings of Onyekwelu and Olusola (2014), who reported that up 30% of the trees in Osun-Osogbo and Igbo-Oludumare sacred groves in southwestern Nigeria were among the tree species classified as endangered in Nigeria. Lokossou (2010) stated that some

sacred forests are connected with other natural ecosystems and/or protected area through ecological corridors, gallery forests, rivers, and water bodies creating biological connectivity and a spatial /ecological network. Sacred forests are valuable biodiversity reserves with very unique vegetation which are richer in vascular plant and vertebrate species.

The preserved sacred forests (Forests of the Royal Dead; Inachallo sacred forest and Ubi-egbe forest) are probably as old as Idah town itself. They were preserved as burial sites for the kings and other traditional activities. The forests, especially the burial site for the Attahs (the kings of the Igala tribe) symbolized links between the spiritual world of the people and their ancestors. Trees, plants, and animals in this forest are protected and valued for particular occasions and as historic symbols. Due to the traditions associated with the preserved sacred forests, the diversity of tree species found in these forests varies greatly. The forest trees in these forests served as an ancestral symbol of wisdom, authority, custom, and a link between the dead Attahs and the living in the kingdom. For these reasons, the ecosystem and tree species are protected from the sawmillers and other agents of deforestation. According to Ntiamao (1995), sacred grooves in Nigeria protect biodiversity in three ways: by protecting particular animal or plant species; by protecting particular ecosystems or habitats; and by regulating the exploitation of natural resources. It is strictly prohibited to harvest trees within the forests neither is it allowed to hunt animals in the forests. In fact, not even the fishes found inside the stream in one of the forests (Inachallo sacred forest) could be harvested. The plants and trees in all the conserved sacred forests are well preserved and they play a crucial role in traditional healing practices.

CONCLUSION

The sacred forests in the study area play important role in nature conservation and preservation of high biological diversity; threatened and endangered species; that protect freshwater sources, etc. Tree species inventory in the study area has revealed the current status of species within the area, which will go a long way to help the communities within the area to determine the conservation strategies required to protect, regenerate species of interest and to manage the species diversity in sustainable manner. Finally, sacred forests could be important hotspots for high species diversity and thus, should be recognized as an essential part of conservation strategy.

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