International Journal of Agriculture, Environment and Bioresearch

Vol. 08, No. 06; 2023

ISSN: 2456-8643

ASSESSMENT OF TREE SPECIES COMPOSITION AND DIVERSITY IN WASAJI FOREST RESERVE TARABA STATE, NIGERIA

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https://doi.org/10.35410/IJAEB.2023.5864

ABSTRACT

The study was conducted in Wasasji Forest Reserve in Taraba State, Nigeria, it assessed tree species composition and diversity. Five transects of 1000m (1km) each were laid in the forest at an interval of 500m apart for the study. Sample plots of 50m x 50m sizes were laid in alternate positions along each transect at interval of 250m were used for data collection. In each sampled plot, tree species from ≥ 10cm diameter were identified and counted. These were used to determined the tree species composition, while their diversity indices were estimated using Shannon-wiener diversity index, margalef's index (species richness index), species evenness, simpson's diversity index and menhinick's diversity index. The results revealed that a total of 48 different tree species comprising of 17 families were recorded in the forest. The family of moraceae had the highest (8) number of species representation in the forest. The most predominant tree species are Funtumia elastica, Tetrapleura tetraptera, Uapaca heudolitii, Ceiba pentandra and Erythrophleum suavolens. The Shannon-wiener index of (3.49), Species richness (7.56), species evenness (0.49), simpson's index ( ), and menhinick's (6.21) were estimated for the forest which are high. The state government should regulate cutting of trees in the forest.

Keywords: Wasaji Forest Reserve, Tree Species, Composition, Diversity, Families.

1. INTRODUCTION

Tropical forests, which are home to around half of the terrestrial plant and animal species, are being destroyed at rates unprecedented in geological history (34,13,15,5). The result is a wave of species extinctions that is leaving our planet both biologically impoverished and ecologically less stable. Since pre-indusrial times, tropical forests have shrunk in area by 35% - 50% (34,6). The degradation of dry forests and habitat loss due to anthropogeniuc activities are among the major causes of decline in biodiversity (21). To meet the increasing demands of rapidly inceasing human population, natural forest resouces are being utilized far beyond their regenerative capacity. This has resulted in decreasing size and quality of natural forests at alarmin rates in Africa and other parts of the world. The effects of disturbances on species diversity is an issue that has engaged ecologist since long (31,26,34,14,25,15).

For the management of both undisturbed and disturbed forest communities, it is very important to understand forest stand structure and composition (4,28). Such an understanding helps the forest managers to assess the potential impacts, the amelioration of effects of disturbance, optimization of productivity and rehabilitation of degraded ecosystems (4). Assessment of floristic composition and structure of forest communities is also useful in identifying important elements of plant diversity, protecting threatened and economic species, and monitoring the forest communities, among others (28). The status of tree populations can be revealed by way of

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ISSN: 2456-8643

size class distribution analysis (19,3). For natural popultions with good and continuous rejuvenation, size class distribution are generally exponentially decaying with many more trees in smaller size classes than in larger ones (8). With certain reservations, a lack of juveniles can, therefore, be an indication of declining populations. On the other hand, size class distribution analysis can indicate trends in species for the nearest future.

Historically, human disturbance has been in existence in dry forests and dates back to early human occupation of forest regions (7). Disturbaces of both natural and human orgin influence forest dynamies and tree diversity at local and regional scales (26,25), and do not only influence diversity, but also post-diaturbance regeneration and dominance of tree species (14), several studies (31, 26, 30,14) have explained the relationship between disturbance and species richness, but the studies that elucidate how disturbances influence stand structure, species composition and regeneration of tree species are very limited (25). Woody species play critical roles in providing goods and services necessary for the well-being of both humans and animals. For instance, they serve as as sources of food, beverages, animal feed,timber/wood used for various purposes, fuel wood, charcoal, medicine, honey, spices, gums, and resins, other non-timber forest/woodland products, tourism,etc. They have also cultural and spiritual asd well as environmental importance.. They play significant roles in carbon sequestration-mitigation of climate change, soil and water conservation, watershed protection, nutrient recycling, nitrogen fixation, amenity and recreation, creation of microclimate, gene conservation, and as habitat and breeding ground for different organisms. Despite this reality, they are severely affected by degradation processes (9). Therfore, there is an urgent need for their restoration, proper management, sustainable utilization and conservation, which, in turn, require a good understanding of their stand structure as well as diversity and status of regeneration of woody species.This study is undertaken to assess tree species composition and diversity in Wasaji Forest Reserve Taraba State, Nigeria.

2. MATERIALS AND METHODS

The research was conducted in Wasaji Forest Reserve. The area lies between latitudes 7^0 43’00’’North and longitudes 10^0 03’ 00’’East. The reserve covers a land area of about 67km^2. The vegetation is marked by forest and tall grass. The topography is made up of undulating plains and raising hills. It is traversed by River Donga and numerous small rivers and streams that serve as tributaries to River Donga. The average temperature is around 32^0 C while the humidity level is average 17 percent

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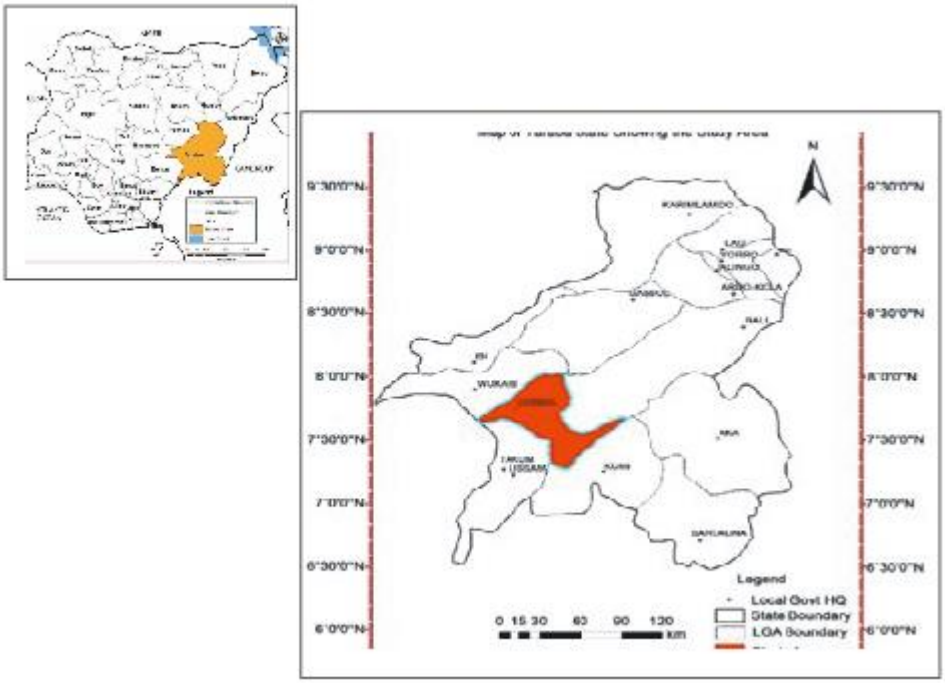

Figure 1: Map of Taraba Showing Donga Local Government Area.

Data Collection

A total of five (5) 1km (1000m) transect lines at intervals of 500m was laid within the forest. Sample plots of 50m x 50m (2,500m^2) were alternatively laid along the transect at an interval of 250m (33). A total land area of 50,000m^2 (5ha) was used for the assessment in the forest. All tree species from ≥ 10 cm diameter were considered for assessment. Data collected were the tree species name, and number from each sampled plot. All the tree species sampled were grouped according to their taxonomical families and the number of tree species obtained were used for diversity classification. The determination of the species diversity was done by using the Shannon-Wiener diversity index (H^1),

Data analysis

The species relative density and relative frequency were calculated and obtained by using equations 1 and 2. Equations 3, 4, 5, 6 and 7 were used to analyzed the species diversity using Shannon-Wiener diversity index which include species evenness, margalef's species richness, Simpson's species diversity and Menhinick's diversity indices. The total number of individual tree species encountered in all the transects were calculated as number per hectare

(a)Species Relative Density (RD): This is refers to the number of individuals of a given species divided by the number of individuals of all species.

RD = $\left[\frac{ni}{N}\right] x\ 100$ ……(1)

Where:

RD = Relative density

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Ni = Number of individual species i
N = Total Number of individual in the entire population
(b)Relative Frequency (RF): was obtained using the formula given by Oduwaiye (20):

$$RF = \frac{\sum Fix100}{Fn} \quad \text{.....(2)}$$

Where:
RF = Relative Frequency
Fi = Number of plot where species was found
Fn = Total Frequency of all Species.
Species diversity index was calculated using Shannon – Wiener diversity index (Equation 3), While Shannon's equitability index (E_H) (equation 4) was adopted for estimating species evenness.
Shannon – Wiener Diversity Index given by price [23] was adopted.

$$H^1 = \sum^{s}_{=1} PiLnPi \quad \text{.....(3)}$$

Where:
H^1 = Shannon diversity index
S = total number of species in the community
Pi = proportion of a species to the total number of plant in the community
Ln = natural logarithm
Species Evenness index in each forest community was determined using Shannon's Equitability (E_H):

$$E_H = \frac{H}{Hmax} = \frac{\sum si=1\ PiLn(Pi)}{\ln(s)} \quad \text{.....(4)}$$

Magalef's Species Richness Index was calculated using the equation below:

$$D = S - \frac{1}{lnN} \quad \text{.....(5)}$$

Where:
D = Margalef's index
S = Number of Species
N = Number of individuals
Simpson's Species Diversity index

$$D = \frac{\sum ni(n-1)}{N(N-1)} \text{ -1} \quad \text{.....(6)}$$

Where:
D = Simpson's index
Ni = number of individual species I
N = total number of all tree species in the entire community
Menhinick's diversity index

$$D_{mn} = \frac{S}{\sqrt{N}} \quad \text{.....(7)}$$

3. RESULTS AND DISCUSSION

A total of 48 different tree species comprising of 17 families were assessed in the study area. The family of Moraceae had the highest (8) number of tree species representation, followed by the family of Melliaceae with 7 species, Caesalpinoidae 5, the families of Mimosoidae and

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Sterculiaceae had 4 species each, Apocynaceae and Papillioidae had 3 species each, Euphobiaceae, Gutteferae, Myristiceae and Rubiaceae had 2 each. The families of Combretaceae, Ebenaceae, Ochnaceae, Sapotaceae and Verbenaceae had 1 species each (Table 1). The families with 1 species representation may be due to their poor establishment or because of anthropogenic activities.This agrees with the work of (32) ,who recorded that anthropogenic activities affected the establishment of certain families of trees and placed them at more risk of extinction if properly and intentionally conserved. The predominant tree species in the reserve include *Funtumia elastica, Tetrapleura tetraptera, Uapaca heudolitii, Berlinia confuse, Ceiba pentandra, Erythrophleum suaveolens,Mammea african , Mansonia altisma,Mytragyna ciliate and Detarium macrocarpa*. Individual tree species with highest number per hectare ($ha^{1)}$ is *Funtumia elastic*a with relative density of 6.9 followed by *Tetrapleura tetraptera* with relative density of 6.5 and *Uapaca heudelotii* with 4.2. Others are *Ceiba pentandra* 3.9, *Erythropleum suavolens* and *Mammea africana* with 3.4 each. However,the result from the study, indicate low tree species population compared to studies conducted by (17, 10,24,12) in Chittagong forests Bangladesh with 62, 64, 92,and 163 respectively and 111 recorded in Amboi Forest Reserve Nigeria by (16), all in the tropical rain forest zones.. Similar studies conducted in Guinea savanna region in Nigeria by (27) showed a total number (42 and 41) of tree species per hectare in Sonkpa and Jabwanje forest reserves respectively which is within the range with the result obtained in this study. This result also commensurate the findings of (18) who recorded 47 tree species in an open and dry woodland in North-Eastern Botswana. This show that the forest reserve still has a reasonable number of representation of diverse tree species.

Table 1:Tree Species Density and Diversity in Wasaji Forest Reserve

S/N	Name of Species	Family	Average tree/ha	RD/ha	PiLnPi
1	Funtumia elastic	Apocynaceae	37	6.91	-0.18
2	Alstonia congensis	Apocynaceae	3	0.49	-0.03
3	Alstonia boonei	Apocynaceae	7	1.23	-0.05
4	Ceiba pentandra	Bombacaceae	21	3.95	-0.13
5	Berlinia confuse	Caesalpiniodae	20	3.70	-0.12
6	Afzelia Africana	Caesalpiniodae	12	2.22	-0.08
7	Erythrophleum suaveolens	Caesalpinioidae	19	3.46	-0.12
8	Detarium macrocarpum	Caesalpinioidae	13	2.47	-0.03
9	Brachystegea eurycoma	Caesalpinioidae	11	1.98	-0.08
10	Terminalia ivorensis	Combretaceae	9	1.73	-0.07
11	Diospyros crassiflora	Ebenaceae	9	1.73	- 0.07
12	Ricinodendron africanum	Euphorbiaceae	13	2.47	- 0.09
13	Uapaca heudelotii	Euphorbiaceae	23	4.20	- 0.13
14	Allablacka floribunda	Guttiferae	5	0.99	- 0.05
15	Mammea Africana	Guttiferae	19	3.46	- 0.12

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16	Khaya senegalensis	Meliaceae	12	2.22	- 0.08
17	Trichilia preuriana	Meliaceae	9	1.73	- 0.07
18	Khaya grandifoliola	Meliaceae	8	1.48	- 0.06
19	Milicia excels	Meliaceae	3	0.49	- 0.03
20	Quarea thompsonii	Meliaceae	1	0.25	- 0.01
21	Carapa procera	Meliaceae	4	0.74	-0.04
22	Khaya ivorensis	Meliaceae	3	0.49	- 0.03
23	Albizia ferruginea	Mimosoidae	5	0.99	- 0.05
24	Tetrapleura tetraptera	Mimosoidae	31	5.68	- 0.16
25	Albizia gumifera	Mimosoidae	1	0.25	- 0.01
26	Piptadeniastrum africanum	Mimosoidae	2	0.50	- 0.02
27	Treculia Africana	Moraceae	4	0.74	- 0.04
28	Ficus mucuso	Moraceae	2	0.50	- 0.02
29	Treculia obovoidea	Moraceae	1	0.25	- 0.01
30	Antiaris welwitschii	Moraceae	3	0.49	- 0.03
31	Bosquia angolensis	Moraceae	7	1.23	- 0.05
32	Antiaris Africana	Moraceae	11	1.98	- 0.08
33	Treculia heudelotii	Moraceae	10	1.85	- 0.06
34	Sacocephalus probeguini	Moraceae	5	0.99	- 0.05
35	Pycnathus angolensi	Myristicaceae	7	1.23	- 0.05
36	Staudtia stipitata	Myristicaceae	6	1.11	- 0.05
37	Lophira alata	Ochnaceae	3	0.49	- 0.03
38	Pterocarpus erinaceus	Papilionoidae	6	1.11	- 0.05
39	Pterocarpus mildbraedii	Papilionoidae	7	1.23	- 0.05
40	Pterocarpus osun	Papilionoidae	1	0.25	- 0.01
41	Mitragyna ciliate	Rubiaceae	13	2.47	- 0.09
42	Nauclea dederrichii	Rubiaceae	4	0.74	- 0.04
43	Mansonia altissima	Sterculiaceae	15	1.98	- 0.08
44	Cola gigantean	Sterculiaceae	8	1.64	- 0.07
45	Pterygota macrocarpa	Sterculiaceae	3	0.49	- 0.03
46	Sterculia oblonga	Sterculiaceae	2	0.50	- 0.02
47	Syncephalum stipulatum	Sapotaceae	3	0.49	- 0.03
48	Vitex grandifolia	Verbenaceae	4	0.74	- 0.04
Total			500	H^1	3.4494

The result of the Shannon-Weiner diversity index (H') for the study area is 3.45 while the species evenness index is 0.49, and the margalef's index is 7.56 (Table 2). This shows that the forest reserve was relatively stable and is able to conserve the diversity of its tree species.

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Research has shown that value less than 1 is characterized as heavily disturbed ecosystem while value above 3 signifies stable environmental condition (29). The Shannon –Wiener diversity index value of 3.45 obtained in this study is quite lower when compared with 3.82 obtained in Afi River forest reserve (1) and diversity index value of 3.49 recorded in Chittagong North Forest Divivsion, Bangladesh (2). This could be as a result of geographical differences between the two locations and sample sizes. Similar studies conducted by (27) in Guinea savanna ecosystem showed lower species diversity which is the result of degration in their study location. The result of the diversity indices for Wasaji forest reserve is an indication that the reserve has lesser anthropogenic disturbances.

The value for E_H also shows that tree species were evenly distributed in the forest reserve. Previous research by (21) shows that tree species diversity and distribution is a reflection of forest degradation but in the case of Wasaji forest reserve the distribution of tree species was relatively okay when compared to that of Shitalpur Forest in Bangladesh. Margalef's index (7.56) shows the species richness for this study which indicate high species richness and comparable with the value obtained by (6) in Kasyoha-kitomi forest

Table 2:The Summary of tree species Diversity Indices in theStudy Area.

No of species	No of families	Shannon-Wiener diversity index (H^1)	Evenness index H/Hmax (E)	Margalef's index (d) species richness
48	17	3.45	0.49	7.56

H' = Shannon – Weinner diversity index, H/Hmax =S pecies eveness, Ds = Simpson's index, S-D/lnM =Margaleff's index

4. CONCLUSION

Wasaji forest Reserve which has an estimate number of trees of 500 trees/ha showed a reasonable rich floral diversity when compared with other savanna forest. *Funtumia elastic*a with relative density of 6.9 followed by *Tetrapleura tetraptera* with relative density of 6.2. and *Uapaca heudelotii* with 4.6. The result of the diversity indices for Wasaji forest reserve is an indication that the reserve has lesser anthropogenic disturbances. The forest has been able to conserve its diversity as indicated from the values obtained from the floristic composition assessme and from the diversity indces. The state governmentnt who is the owner of the reserve need to intensify its management and protective measures that could increase self regeneration of the forest. The state government should also regulate cutting of trees in the forest and bush burning inorder to preserve the diversity of the forest.

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