

SPECIES COMPOSITION AND STRUCTURE OF *ISOBERLINIA* WOODLAND OF SHIKA, ZARIA NIGERIA.

ABSTRACT

Shika, zaria(lat.11⁰12¹) vegetation previously described as *Isoberlinia* woodland was studied in order to review the effect of human activities on the woodland. The vegetation plots were farming section and a rested plot of minimum anthropogenic impacts (here called disturbed and undisturbed plot respectively).The diversity and biomass of woody and herbaceous species were determined. Additionally, basal area and volume of woody species were also determined. A total of 72 species belonging to 36 families were identified.Shannon-weiner diversity showed that the farmed plot with 2.441 and equitability of 0.733 had higher diversity than the undisturbed (2.331 and 0.685). These two plots were 66% similar in vegetal composition. There was low total basal area covered in either plot,0.4348 undisturbed and 0.0473 farmed. The total wood volume was also low at 9.53m³ for the undisturbed and 0.685m³ for the farmed plot. The woody biomass for the undisturbed was 0.015ton/ha for the undisturbed and 0.001 ton/ha for the farmed plot.The totalherbaceous biomass for the undisturbed plot was 70.7ton/ha and 49.7ton/ha for the disturbed plot. The soils were characteristically alfisols and much degraded reflecting degrees of vegetalexploitation. The low woody volume and biomass though disturbing but not withstanding had high *Isoberlina* component hence,the woodland can still and better be called degraded *Isoberlinia* woodland.

Keyword: species composition, woodland,*Isoberlinia*,soil type

INTRODUCTION

Worldwide, mankind is facing the negative repercussions of global change (Walker *et al.* 1999, IPCC 2000). A major consequence of global environmental change is an increasing shortage of natural resources, especially the threat to biodiversity (Thomas *et al.* 2004). The vegetation of any area is inadvertently tampered with by human. At certain level such uses could become detrimental to a sustainable vegetation cover. (Jones,1979). The genus *Isoberlinia* is a woody caesalpinoideae in the family fabaceae(legume family) of five species native to tropical Africa,two species are predominant in Nigeria's guinea savanna*I. doka*,and *I. tomentosa*(Jackson, 1970).The trees of the Nigeria guinea are on the average,little more than 7-2m tall and also have a less compact special arrangement than the Miomba woodland with which they have similar characteristics (White,1983).Shikaisoberlina woodlands are used for cropping and livestock grazing(F.A.O. 2001). Subsistence farmers also collect fuel wood from these which may have added effect on degradation of the indigenous woodlands. FAO, 2001also advocated

for more detailed and standardized data on biomass and structure of vegetation units, in order to parameterize global and regional vegetation maps. Studies linking species composition to environmental parameters are sparse for West Africa savanna systems (Hahn, 1996), such knowledge is however required in order to expand the understanding of ecosystem processes. This study assessed the impact of farming activities on the composition and structure of *Isobberlinia* woodlands.

MATERIALS AND METHODS

Study Area

The study was carried out in Shika, Zaria, Nigeria. Shika is geographically located between latitude 11° to 12°N and longitude 7° to 33°E at an altitude of 640M above sea level (Akpaet *al.*, 2002). Shika is located about 20km along the Zaria -Sokoto road in Kaduna state, North Central, Nigeria. It has three distinct climatic seasons. These are the cold dry season (November – February), the hot dry season (March- May) and the wet season (June – October). The total annual rainfall ranges from 617 to 1365mm with a 50-year average of 1041mm. Most of the rains fall between July and September (Akpaet *al.*, 2002). Area extent of study was approximately 15 hectares of range land under different management strategies. The management types included farmed sections, grazing lots and rested plots (i.e. ungrazed and unfarmed) with minimum anthropogenic impact. The study was conducted from June to September, 2006.

VEGETATION SAMPLING

A strategy of simple random sampling was used as the vegetation appeared on inspection to be homogeneous in structure and flourishes. The sampling unit was a plot of 30 m x 30 m (900m²). Two plots were sampled for each of the woodland.

IDENTIFICATION OF SPECIES

Species were identified on the field from recognition while critical species were determined by comparing with types and use of flora in the herbarium unit of Biological sciences Department, Ahmadu Bello University, Zaria, Nigeria.

PARAMETERS EVALUATED ON VEGETATION

HEIGHT AND DIAMETER

With each 30 m x 30 m plot, the height and dbh of all individual trees was measured in order to characterize tree structure of the plot.

CALCULATION OF TREE COVER AND VOLUME

For each tree individual in 30 m x 30 m plot, the basal area was calculated using πr^2 (m²) and volume was calculated using $\pi r^2 h$ where $\pi=22/7$, r=radius, h=height of trees were measured.

The species composition of the plots was described using Importance Value Index. (VanAndel, 2001).

The following parameters were measured:

1. Relative dominance = (total basal area for a species/total basal area of all species) x 100.
 2. Relative density = (number of individuals of a species/total number of individuals) x 100.
 3. Relative frequency = (frequency of a species/sum of all frequencies) x 100.
 4. The importance value index (IVI) = relative dominance + relative density + relative frequency.
- In general the relative dominance, relative frequency, and relative density vary in the range 0 – 100%, so the species and importance value indices (IVI) vary between 0 and 300%.

WOODY BIOMASS

Woody biomass was calculated after schongart (2003) as stated in orthman (2005) given the equation below:

$$\text{Woody biomass} = \frac{\text{height(m)}}{2} \times \frac{\text{dbh(m}^2\text{)}}{2} \times \pi \times \text{wooddensity(t/m}^3\text{)}$$

Wood density define as the over-drymass per unit of green volume (tons/m³) for tropical tree species were given by Brown (1997).Data on wood density were not available for all sampled tree species. Brown (1997) gives wood densities for many Africa tree species within the range of

0.5-0.79 (tm-3) taking into account only those in the studied area, a mean value of 0.65 (tm-3) was calculated.

Sampling of herb layer data

Species composition

Vegetation surveys were conducted in the 5 m x 5 m (25m²) plot in each of woodland. The species were identified and their numbers determined in the 1 m x 1 m quadrants.

Herbaceous Biomass

The herbs in the 1m x 1m quadrant were harvested with sickle for above ground biomass determination .The harvested herbs were weighed as grass and forbs separately. Harvesting was done in September at the peak period of flowering grass species. Samples were oven dried to constant weight. Dry matter yield was calculated using the formular below:

$$\text{Percentage dry matter (\%Dm)} = \frac{\text{sub sample of dried matter weight} \times 100}{\text{sub sample of fresh weight}}$$

$$\text{Dry matter yield} = \frac{\%Dm \times \text{fresh weight}}{100} (\text{g/m}^2)$$

DATA ANALYSIS

Vegetation data were analysed using the mathematical index of Shannon –wieners (1968) as stated in Tiseer and Smith (2004). The Shannon Diversity Index and equitability was computed as $(H' = \sum P_i \cdot \ln P_i)$ where $P_i = n_i/N$.

H' is the index of diversity,

Pi is the importance value of a species as a proportion of all species.

ni' is number of individual species.

N' is total number of individual species.

Equitability $J = H / \ln N$.

112 Microsoft Excel 2007 package was used for data analysis.

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114 **RESULTS**

115 A total number of 72 species were recorded in 36 families. The families represented by the
116 greatest number of species were Fabaceae (12 species), Combretaceae (7 species), Poaceae (7
117 species), 39 species were trees and shrubs while 33 herbaceous species were recorded. The
118 predominant woody species was *Isobberliniadoka* with 307 species in the undisturbed plot and 224
119 species in the disturbed plot. The dominant herbaceous species was *Seteriabarbata* with 300
120 species in the undisturbed plot and *Fadogiapobeguinew* with 501 species in the disturbed plot. A
121 single stands of *Entadaafricana*, *Strychnos spinosa* has the highest height of 5.5m and 4.5m
122 respectively. While *Isobberliniadoka* has the height of 2.5m in the undisturbed plots. In the
123 disturbed plot all height measurement was less than 2.5m. In undisturbed plot *Lennaeshimperi*
124 contributed the highest girth of 40cm as seen in Table 1b.

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126 In table 3 below, the textural class of the soil in the farmed plot is loam with 45% sand, 34% silt
127 and 21% clay. The physicochemical parameters shows average low organic matter in the farmed
128 plot which had correspondingly high Nitrogen content of 0.53g/kg^{-1} , other macro elements were
129 low except for Magnesium (0.78cm/kg). The undisturbed plot was texturally sandy loam with
130 49% sand, 34% silt and 21% clay. The organic carbon at 0.97g/kg^{-1} was low. The nitrogen
131 content of the soil at 0.53g/kg^{-1} was high. Other element were low except again for magnesium
132 at 0.63cmg/kg^{-1} in all cases the sodium content 1.8cm was low which removes any fears of
133 solidification. The available phosphorous was low either in the undisturbed or the plot.

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138 **Table 1a: Plants diversity for undisturbed and disturbed isoberlinia Woodland.**

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S/no	Species	Families	Undisturbed		Disturbed	
			woody	Herb	woody	Herb
1	<i>Isoberliniadora</i>	Fabaceae (c)	307		224	
2	<i>Adenodolichospaniculatus</i>	Fabaceae (p)				159
3	<i>Khayasenegalensis</i>	Meliaceae	-		8	
4	<i>Butyrospermumparadoxum</i>	Sapotaceae	18		23	
5	<i>Vitexdoniana</i>	Verbenaceae	6		1	
6	<i>Securidacalolongependiculatus</i>	Polygalaceae	20		35	
7	<i>Afxelia Africana</i>	Fabaceae (c)	-		10	
8	<i>Entada Africana</i>	Bignoniaceae	10		26	
9	<i>Stereospermumkunthiana</i>	Fabaceae (m)	-		6	
10	<i>Detariummicrocarpum</i>	Fabaceae (c)				
11	<i>Cusoniabarberia</i>	Areliaceae				
12	<i>Annonasenegalensis</i>	Annonaceae	11		16	
13	<i>Pilostigmathonnigii</i>	Fabaceae (c)	17		48	
14	<i>Azadirachtaindica</i>	Meliaceae	-		-	
15	<i>Dicrostachyscineria</i>	Fabaceae (m)	122		38	
16	<i>Brideliaferruginea</i>	Pherbiaceae	9		1	
17	<i>Lennaeshimperi</i>	Anacardiaceae	8		10	
18	<i>Terminaliaavvicinoides</i>	Combretaceae	1		8	
19	<i>Fadogiapobeguini</i>	Rubiaceae		16		501
20	<i>Ximenia Americana</i>	Olaceae	-		3	
21	<i>Maeruaacrasifolia</i>	Capparidaceae	-		2	
22	<i>Cissuscornifolia</i>	Vitaceae		4		2
23	<i>Vernoniaakotschiana</i>	Asteraceae				
24	<i>Cochlospermumtintorum</i>	Cochlospermaceae		38		23
25	<i>Phyllanthusmuellerianus</i>	Euphorbaceae	-		1	
26	<i>Gardenia Aquila</i>	Rubiaceae	6		2	
27	<i>Guierasenegalensis</i>	Combretaceae	2		3	
28	<i>Swartziamadagascariensis</i>	Fabaceae (c)				
29	<i>Lippiamultiflora</i>	Verbenaceae		196		72
30	<i>Strychnosspinosa</i>	Loganiaceae	15		12	
31	<i>Astrosolenmarcrozhia</i>	Thymelaceae				69
32	<i>Costusafer</i>	Zingiberaceae				102
33	<i>Andropogongayana</i>	Poaceae		80		80
34	<i>Stylochitonhypogaea</i>	Araceae		36		23
35	<i>Seteriapallidifusca</i>	Poaceae		47		12
36	<i>Xyrisp</i>	Xyridaceae		14		36
37	<i>heckhloesp</i>	Poaceae		130		60
38	<i>Secteria barbata</i>	Poaceae				
39	<i>Aspilia Africana</i>	Asteraceae		25		189
40	<i>Eragosticatroviens</i>	Poaceae		35		21
41	<i>Hypharrheniarufe</i>	Poaceae		52		
42	<i>Gutenbergiapolustris</i>	Asteraceae		3		74
43	<i>Stylochitonhypogaea</i>	Araceae		36		23
44	<i>Cyperusmichellus</i>	Cyperaceae		120		4
45	<i>Paspalum arbriculare</i>	Poaceae				25
46	<i>Heeria insignis</i>	Anacardiaceae		6		
47	<i>Aselepiasgurassavica</i>	Asclepiadaceae				5
48	<i>Waltheria indica</i>	Sterculiaceae		27		58
49	<i>Crotolarialanchnosuma</i>	Fabaceae (p)				1
50	<i>Latanacamara</i>	Verbenaceae				6
51	<i>Afromosaxiflora</i>	Fabaceae (c)				
52	<i>Gmelinaaborea</i>	Verbenaceae			1	
53	<i>Terminaliamollis</i>	Combretaceae	22		6	
54	<i>Pavettacorymbosa</i>	Rubiceae	2		4	
55	<i>Ochnaafzellii</i>	Ochnaceae	102			
56	<i>Combretum lamprocarpum</i>	Combretaceae				
57	<i>Ficusthonningii</i>	Moraceae	3			
58	<i>Sechiumidule</i>	Cucurbitaceae	145			
59	<i>Scorpariaduleis</i>	Scrophalariaceae		4		
60	<i>Tephrosiapedicellata</i>	Fabaceae (p)		60		
61	<i>Stylosanthesauretta</i>	Fabaceae (p)				

62	<i>Ipomea aquatic</i>	Convolvulaceae		32			
63	<i>Ekebegiasenegalensis</i>	Meliaceae	1				
64	<i>Diospyrusspiliformes</i>	Ebenaceae					
65	<i>Psorepermumsenegalensis</i>	Hypericaceae					
66	<i>Asperagus Africana</i>	Liliaceae					
67	<i>Hymencandiaacida</i>	Euphorbiaceae	2		48		
68	<i>Maranthespolyandra</i>	Rosaceae		8			
69	<i>Terminalialanceolatum</i>	Combreteceae			10		
70	<i>Danielia Oliveri</i>	Fabaceae (c)	1				
71	<i>Securinegavirosa</i>	Euphorbiaceae	38				
72	<i>Taccainvocluclrata</i>	Taccaceae				4	
total			941	611	1622	1546	

Table 1b: Summary of species composition and structural characteristics for each Woodland type.

Diversity measure	Undisturbed		Disturbed	
	Woody	Herb	Woody	Herb
No of family	18	17	15	15
No of species	30	25	28	25
Average dbh(m)	0.1±0.5		0.02±0.06	
Mean height(m)	2.24±1.4		0.7±0.05	
Basal area (m ²)	0.43		0.05	
Volume(m ³)	9.53		0.68	
Biomass(tons)	0.54	70.7(g/m2)	0.02	49.7(g/m2)
Shannon index	2.33	2.63	2.44	2.68
Equitability	0.69	0.82	0.73	0.83

Table 2: The five most abundant woody species in each Woodland type according to decreasing order of the species importance value index (IVI).

Species	Undisturbed IVI(%)/200		Disturbed IVI(%)/200		147
	Woody	Herb	Woody	Herb	
<i>Isobertliniadoka</i>	39.9		42.3		
<i>Sechiumidule</i>	15.4				
<i>Dichrostachyscineria</i>	13.1		6.5		
<i>Ochnaafzeli</i>	12.9				
<i>Detariummicrocarpum</i>	8.0				
<i>Otherwoody species</i>	110.7				
<i>Securidacalongependiculata</i>			29.1		
<i>Pilostigmahonnigie</i>			9.8		
<i>Hymencardiaocida</i>			7.8		
<i>Other woody species</i>			104.5		
<i>Seteriababarta</i>		19.9			
<i>Stylosanthesqurretta</i>		17.4			
<i>Lippiamultiflora</i>		12.8			
<i>Heckloeasp</i>		8.4			
<i>Cyperusmichellus</i>		7.7			
<i>Others herbs</i>		133.8			
<i>Fadogiapobeguini</i>				32.4	
<i>Cochlospermuntinctorium</i>				14.6	
<i>Aspiliaafricana</i>				12.0	
<i>Adenodolicuspeniculatus</i>				6.6	
<i>Other herbs</i>				122.2	

149 Table 3: PHYSICO CHEMICAL PARAMETERS OF SOIL IN THE INVESTIGATED
150 PLOTS.

Woodland type	Texture class	%o.c g/kg ⁻¹	N g/kg ⁻¹	P ppm	Ca cm/kg ⁻¹	Mg cm/kg ⁻¹	K cm/kg ⁻¹	Na cm/kg-1
Undisturbed	Sandy loam	0.97	0.53	0.79	1.00	0.60	0.12	1.8
Disturbed.	Loamy	0.75	0.53	0.63	1.7	0.78	0.19	1.65

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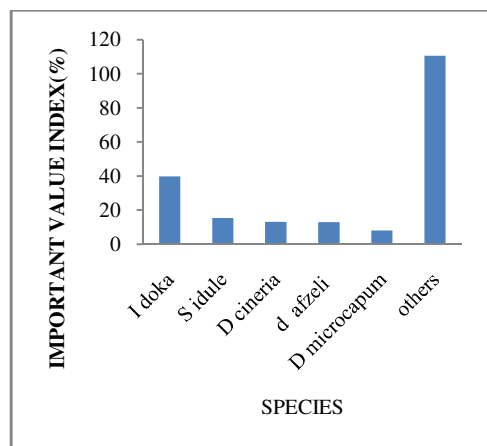


Fig1; Important dominants woody species in the undisturbed woodland

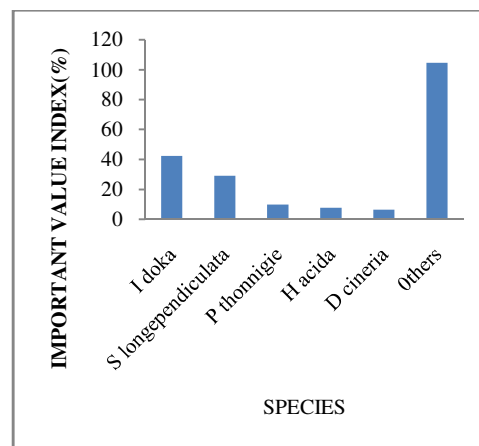


Fig2; Important dominants woody species in the disturbed woodland

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157 DISCUSSIONS

158 There is variation in the species composition and structures of the disturbed and undisturbed

159 plots in the woody and herbaceous layer. The composition is similar to that described by

160 Kershaw, (1968) in the central border Nigeria *Isobertliniasp* being the most dominant and

161 numerous giving a monospecific picture of the woodlands gives reason why it was called

162 *Isobertlinia* woodlands by Jackson(1980).

163 Due to the less ability of *Isobertliniasp* to regenerate after over exploitation for fuel wood or

164 clearing of the woodland during farming, other competitive species such

165 as *Adenodolichospenniculatus* *Detariummicrocarpum*, *Daniellaoliver*,

166 *Vitexdoniana*, *Annonasenegalensis* etc come into the woodland. The diversity of plant in all plots

167 was high. However this was higher in the farming plots, this may be due to the resilient nature of

168 most savanna plants which have a phyophytic behavior and regenerate from buds on their below

ground parts. The consequence is that cutting during farm clearing operation serve to multiply regenerating stocks. This proves a case of disturbance induced diversity (Hansson, 2000). The maximum population of species of 39 in the plots is also appreciable given the area sampled. The consequence is that diversity at the level of this interference is not too adversely affected. An earlier report of sample size much larger than 900 square meters yield a total of 42 plant species (Ubom and Isichei, 1998). The plots were also of 66% similar meaning that subsistence farming did not account for gross disappearance of species in this case.

Isobertlini adoka, though dominant in numerical value had awfully low basal area plant has of late been highly exploited for fuel to the extent that yearly Regrowth are even harvested. Indeed these appear to be a high skew to biomass in all plots in favour of grass and forbs. While figure for this are alarmingly high, the biomass estimate for wood are very low. The implication are that, the vegetal conditions typified by this plots can no longer supply wood either for rough construction or timber, there is a progressive turning of the woodlands of shika into open ranges which favour grassing more than any other form of land use. The high herbaceous biomass cannotes high danger of annual fires which can exacerbate the degradation of the range. *Isobertliniasp* has been recorded as an endangered species by (Famuyide et al., 2004). The ridiculously low volume figure indicate the wanton exploitation which is not pursued with conservation, indicates that no regard is given to sustainability and perpetuity. As poverty increase and population increase, the range will no longer cope with the demand for fuel wood and farm land. This may reach a catastrophe that can result to ecosystem collapse (FAO, 1990).

The soil presented mixed parameters which indicate at best progression on the part of degradation. Some normal situation were noted such as PH at 5.8-6.0 range for the soil. The low

sodium entails that no immediate solidification problems are envisage with soils. The low phosphorus level is characteristics of alfisol of the guinea savanna (Adeayel, 1989). The low organic matter and relatively high Nitrogen could suggest that rapid mineralization occurs in the soils. Perhaps the soil nitrogen level is not commensurate the rapid organic carbon loss.

The low organic matter carbon status could also be due to lack of replenishment of soils with organic matter as crop residues are used as fuels. The rapid removal of trees can also be another factor in the low soil organic Carbon. This loss of fertility in either the undisturbed or the farmed plots can note a situation where plants regeneration and production will be painfully slow and low. With unabated use of such lands perhaps with fertilizer practices, the consequences would be degradation. This may aggravate the already poor vegetal state and escalate/set stage for desertification (Sivakumaret *al.*, 1992)

CONCLUSIONS

This study revealed that deforestation problem in Shika, zaria has attained a critical level which can no longer be ignored. Any forms of anthropogenic activity detrimental to biodiversity need to be checked against background of sustainability. The prevailing trends of exploitation certainly connote danger in the not too distance future given emerging trends of desertification, drought and global warming. Therefore proper vegetation management should be adopted in order to maintain a balance ecosystem and a sustainable resources base for the benefit of the present and future generations. Since the wood density calculated for tropical trees were few in Africa, further studies on the determination of wood density of Nigeria tree species should be carried out. Studies linking vegetation to environmental parameter should be carried out in details for better understanding of vegetation

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