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THE RELATIVE ABUNDANCE OF FLORASPECIES IN THE TROPICAL RAINFOREST ECOSYSTEM OF BOKI NIGERIA

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Abstract: *This study was conducted with the view to analysing flora species abundance in the tropical rainforest ecosystem of Boki. Despite the spate of indiscriminate logging, this area still remains one of the few ecosystems that have been highly valued for its species diversity. Two forest formations the protected and the unprotected forest were used for the analysis. Six forest enclaves - Kanyang, Borum, Isobendeghe, Okwa I, Okwa II and Okwango were chosen for the study. Transects were laid from the centre of each forest enclave to the heart of the forest. Actual measurement of the quadrat started at a distance of 2km away from each enclave. A quadrat of 100m by 100m was demarcated for flora species identification and enumeration. The relative abundance was computed using the frequency of each species as percentage of the total species in the quadrat. The mean ($\bar{x}$) proportional abundance was computed to determine levels of flora species abundance. This was also complemented with the lognormal curve. Here, the number of flora species was plotted against individual species. The girth of each flora species was determined at breast height of 1.5m. The result of the analysis revealed that very few flora species were of low and high abundance whereas majority were in moderate abundance. Also majority of the trees in the area were in the category of 6-10 metre girth at breast height in the protected forest and 0-5 metre girth at breast height in the unprotected forest.*

Key wards: Species, abundance, frequency, ecosystem, forest.

INTRODUCTION

Abundance of species is an expression of the number of individuals of a species in an area. In otherwards, it is the total number of individuals, or biomass, of a species present in a specified area. The abundance of organisms and how abundance change in time and space are among the most fundamental concerns of ecology, (Moles, M.C, 1999). In most cases, some authors defined ecology as the study of distribution and abundance of organisms. Because of the relative importance of abundance in any given situation, ecologist should understand how to estimate it for a wide variety of organisms. This is borne out of the fact that, ecologist do not measure abundance as an end in itself but as a tool to understand the ecology of populations. Having a firsthand information on how abundant an organism is can help us to understand whether its population is growing, declining or stable over time. As we know generally, population size is one of the characteristics that help ecologists assess a species vulnerability to extinction.

As a matter of fact, researches on abundance of species are popular in the field of macroecology. Environmental researches use studies on the abundance of species to assist build a picture of overall biodiversity in an area, Ugland and White 2007. Scientists refer to the idea of species populations as “relative species abundance” because th2ey are studying species population in a community or habitat relative to other species and other habitats.

Species abundance is applied to mammal species, insects, plants and other creatures. A critical analysis of species abundance and other aspects of biodiversity help scientist to figure out what is going on within a specific ecological environment (William 1964).

In concrete terms, studies on species abundance eventually results in a particular type of species being labelled as an endangered species. In a situation where the population estimates are low enough, the species might be labelled critically. This will invariably generate some specific laws in many nations protecting the remaining population from logging (in the case of plants) and hunting, poaching or even habitat encroachment - as in animals, Brown (1984).

Due to the fact that researches on abundance tend to use small areas as ecological environments, a research of this nature might lead to a local law about protecting a habitat. Most at times, these laws end up affecting local development especially as it has to do with defence of an endangered species in a long run. In the world perspective, species abundance research helps ensure that some of the world's most viable species – both plants and animals exist. Extinction faces a lot of species periodically and most ecologists would say that biodiversity is not thriving relative to its historic levels (Magurrn 2004). More detailed work of species abundance will indicate what is happening to all of the world's plants and animal species and what results that might have for the human community, and the biosphere at large. It is because of this that governments sometimes fund species abundance research and pay premium to what researchers come up with even though it might not have local content. This research is therefore undertaken with the view to determining those flora species that are still available or in relative abundance for human economic pursuance and those that are vulnerable to extinction so that adequate plan of action can be put in place by the government to conserve those endangered species if the future generation must benefit from them.

THE STUDY AREA

Boki lies between latitude 6^0 and 9^0 North of the equator and longitude $8^0 25^1$E and 9^0 21^1E of the Greenwich Meridian. It has a land mass of about 344.952km^2. It is bounded to the north by Obudu and Obanliku, to the south by Ikom to the West by Ogoja and east by Cameroon Republic.

Boki has a typical climate typified with distinct wet and dry season. It has mean temperature range of 25^0c. Humidity is very high (80%) during the rainy season and decreases drastically in the dry season despite the high rate of evapotranspiration in the area. Annual rain fall ranges between 2000mm-3500mm and basically of the convectional type. Rain fall is usually marked by thunderstorm and lightening. The above climatic conditions have interacted to produce a luxuriant vegetation which depicts the area. The low land rain forest covers an extensive area, although much of it has been turned into agricultural fields. This forest exhibits three stratum-the upper, middle and understorey. Many species of plants are found here. They include; Iroko, Mahogany, Obeche, Opepe, Achi and Ebony among others.

Boki is located at the southern end of the Eastern high lands. Elevation range from 150m-700m in Njua, Boje and Nsadop hills. Elevations in the Irruan and Mbe Mountains reach over 1000m. The Plateau surfaces have been dissected to form catchment for such rivers as Afi and Aren. The soils here are composed of sandy clay, sand and sandy loamy. Wetland soils occupy the floodplains of Rivers Afi and Aren.

In the study area, there is existence of both nucleated and isolated farmsteads. Nucleated settlements are found in Okundi, Kakwagom, Katchuan, Ntamante, Okubushuyu, Bonyia, Bawup, and Bansan. Isolated farmsteads are located in Camp 1, 2 and 3 (Borum) Panya Oku, and Kakubong. The major occupation of the people is farming-bush fallow system. It is in a bid to have new farm site yearly that the forest and its rich diversity is destroyed. Fishing is done along major rivers but in a micro scale. Also gathering of forest products occur in the unfarmed land.

METHODOLOGY

The aim of this study was to assess the relative abundance of flora species in the tropical rainforest ecosystem of Boki. Ecosystematically, Boki is divided into two primary formations – the protected and the unprotected forest ecosystems. In order to realise the objective of this study, six forest enclaves were sampled. They include Okwango, Okwa I, Okwa II (protected forest) and Kanyang, Isobendege and Borum (unprotected forest).

A transect was laid from the centre of each of these six forest enclaves to the heart of the forest. Along each transect, a plot measuring 100mx100m was laid consistently and at right angles to the major transect. A total of 18 plots were used for the assessment of species abundance in the area, three from each of the forest enclaves. A distance of 2km was kept apart from the settlement to avoid 'noise in the flora species enumeration

The relative abundance was analysed noting in each quadrate how many individual species are present there and expressing this as a percentage of the total number of species in the quadrate. This is given by

$$Relative\ Abundance = \frac{\text{frequency of a species}}{\text{sum frquency of all species}} \text{ x } \frac{100}{1}$$

The mean ($\bar{x}$) value of the proportional or relative abundance was used to determine the level of abundance. First the relative abundance of each individual flora species was computed and in the end there emerged four classes of proportional abundance values – 0.02, 0.01, 0.003, 0.004 and 0.005. it was from here that the mean value was computed. This is giving by $\sum \frac{x}{n}$ where $\sum$ = summation, x represents the proportional abundance and n is the sample size. The proportional abundance values of species that few within the mean upward were seen to be abundant whereas those species whose values fell below the mean value were seen to be rare. This analysis was further plotted on a lognormal curve according to Preston (1948), to show the exact situation of the species abundance in the study area.

The girth abundance was equally determined in this study. This was done by measuring the size of each flora species at breast height of 1.5m with a girth tape. This was then classed in a 5m interval where all the 91 flora species were categorized.

DATA PRESENTATION AND DISCUSSION OF FINDINGS

As seen in table 1, both the protected and the unprotected forest enclaves in Boki have equal levels of species richness. However, in the protected forest, out of the 91 flora species 6 have proportional abundance value 0.02 each comprising of % of the tree community. 84 flora species have abundance values of 0.01, with each comprising 1% of the tree community. Only one species (*Elais Guinensis*) was seen to have a value of 0.004 as it contributed only 0.4% to the total number of trees in the protected forest of Boki.

On the otherhand; in the unprotected forest. Five flora species were of equal abundance value of 0.02 which means each flora species contributed 2% to the entire forest community structure. 82 species had abundance values of 0.01 with each contributing only 1% of the trees community. Three species had proportional abundance value of 0.03 (0.03%) and one (0.005) thereby contributing only 0.5% of the entire tree community in the study area.

Table 1: Relative Abundance and Girth of Flora Species

s/n	Species	No of individuals in protected forest	Proportional abundance	No of individuals in unprotected forest	Proportional abundance	Girth in protected forest (m)	Girth in unprotected forest (m)
1	*Afzelia*	11	0.01	7	0.01	5.21	2.84
2	*Albizia spp*	10	0.01	6	0.01	6.46	1.96
3	*Alstonia boonei*	7	0.01	6	0.01	6.15	4.92
4	*Altonia congensis*	11	0.01	8	0.01	8.00	3.04
5	*Amphimas pterocarpoides*	13	0.02	9	0.02	9.14	6.00
6	*Aningeria spp*	9	0.01	6	0.01	9.00	5.32
7	*Anipyxis spp*	10	0.01	6	0.01	8.23	5.63
8	*Antiaris toxicaria*	12	0.01	6	0.01	10.15	8.03
9	*Araliopsis spp*	12	0.01	8	0.01	7.42	5.36
10	*Aubrevllea spp*	13	0.02	7	0.01	7.00	5.00
11	*Baillonella toxisperma Mimusop*	7	0.01	3	0.01	8.00	5.00
12	*Berlinia spp*	12	0.01	7	0.01	9.00	6.00
13	*Bombax spp*	9	0.01	6	0.01	7.35	5.24
14	*Borassus spp.*	11	0.01	7	0.01	8.00	5.42
15	*Brachystegia spp.*	9	0.01	6	0.01	8.21	6.00
16	*Cantium schweinfurthii*	9	0.01	8	0.01	7.14	4.10
17	*Canthim spp.*	7	0.01	6	0.01	7.00	5.03
18	*Carapa procera*	10	0.01	7	0.01	8.24	6.21
19	*Funtumia elastica*	10	0.01	7	0.01	6.58	4.28
20	*Celtis*	6	0.01	2	0.003	6.82	4.24
21	*Chrysophyllum spp.*	11	0.01	7	0.01	7.72	5.03
22	*Cleistoholis patens*	9	0.01	7	0.01	8.00	5.84
23	*Coelocaryon preussii*	8	0.01	8	0.01	8.13	2.04
24	*Cola gigantean*	8	0.01	4	0.01	6.58	2.56
25	*Combretodendron spp*	8	0.01	5	0.01	6.00	2.08
26	*Copaitera spp.*	10	0.01	5	0.01	7.51	1.34
27	*Cyloicadiscus gabonensis*	8	0.01	5	0.01	7.00	2.02
28	*Daniellia ogea*	7	0.01	5	0.01	7.30	2.08
29	*Daniellia oliveri*	9	0.01	6	0.01	6.10	1.09
30	*Diospyrous spp.*	7	0.01	3	0.01	6.92	1.82
31	*Distemonanthus*	8	0.01	7	0.01	7.00	2.00
32	*Entandrophragma*	7	0.01	6	0.01	6.14	3.16
33	*Erylopsis spp*	9	0.01	6	0.01	6.00	2.86
34	*Erythrophleum spp.*	9	0.01	6	0.01	8.00	3.18
35	*Fagara spp.*	8	0.01	6	0.01	8.00	6.14
36	*Ficus spp.*	10	0.01	8	0.01	6.22	4.13
37	*Gossweilerodendron spp.*	9	0.01	6	0.01	7.86	2.05
38	*Guarea cedrata*	9	0.01	7	0.01	7.00	4.16
39	*Ceiba pentaidra spp*	8	0.01	7	0.01	12.24	4.24
40	*Guarea thomopsonii*	10	0.01	7	0.01	8.21	5.15
41	*Hallea spp.*	9	0.01	6	0.01	6.24	4.09
42	*Hamnoa spp.*	9	0.01	6	0.01	7.00	4.00
43	*Holoptelea grandis*	8	0.01	5	0.01	7.21	5.00

44	*Homalium spp.*	11	0.01	5	0.01	7.08	5.14
45	*Isoberlinia spp.*	15	0.02	8	0.01	8.16	6.82
46	*Khaya spp.*	12	0.01	9	0.02	7.22	5.21
47	*Klainedoxa gabonesis*	7	0.01	7	0.01	6.8	4.48
48	*Lannea welwitschii*	10	0.01	6	0.01	6.00	4.92
49	*Lophira alata*	8	0.01	5	0.01	7.00	5.85
50	*Lovoa trichilioides*	6	0.01	4	0.01	6.20	4.16
51	*Manea Africana*	11	0.01	8	0.01	7.08	5.21
52	*Manilkara spp.*	8	0.01	6	0.01	6.02	4.00
53	*Musanga cecropoides*	9	0.01	7	0.01	6.00	4.15
54	*Milicia excelsa*	8	0.01	7	0.01	7.23	5.19
55	*Millettia spp.*	13	0.02	4	0.01	8.14	3.00
56	*Nauclea diderrichi*	7	0.01	6	0.01	6.00	4.14
57	*Omphalocarpum spp.*	9	0.01	7	0.01	7.00	5.00
58	*Oxystima spp.*	9	0.01	8	0.01	7.24	5.14
59	*Pando Oleose*	10	0.01	6	0.01	8.00	6.24
60	*Parinari spp.*	8	0.01	6	0.01	7.92	5.81
61	*Parkia spp.*	11	0.02	9	0.01	8.00	6.12
62	*Pausinystalia spp.*	9	0.01	7	0.01	7.14	6.00
63	*Pentaclethra macrophylla*	9	0.01	5	0.01	8.81	3.52
64	*Pericopsis elata (Afrormosia)*	7	0.01	4	0.01	8.00	2.00
65	*Pipetandeniastrum africanum*	10	0.01	9	0.02	7.21	3.00
66	*Paga oleosa*	7	0.01	3	0.005	8.00	2.00
67	*Protomegabaria spp.*	9	0.01	6	0.01	7.00	1.12
68	*Pterocarpus erin*	8	0.01	4	0.01	6.00	1.00
69	*Pterocarpus mildbreadii*	7	0.01	4	0.01	6.00	3.19
70	*Pterocarpus osun*	6	0.01	2	0.003	6.24	3.16
71	*Pterocarpus soyauxii*	5	0.01	3	0.01	6.36	3.00
72	*Pterygota spp.*	8	0.01	5	0.01	7.54	5.28
73	*Pycnanthus angolensis*	9	0.01	6	0.01	8.00	5.74
74	*Ricinodendron heudelotii*	7	0.01	5	0.01	7.84	6.18
75	*Staudia stipitata*	12	0.01	8	0.01	6.80	1.85
76	*Sterculia spp.*	8	0.01	5	0.01	7.00	6.00
77	*Symphonia spp.*	10	0.01	7	0.01	8.00	6.16
78	*Seighemella heckelii*	7	0.01	4	0.01	7.24	6.14
79	*Terminalia ivorensis*	13	0.02	7	0.01	7.36	6.00
80	*Terminalis superba*	11	0.01	8	0.01	8.00	6.00
81	*Tetrapheura tetraptera*	11	0.01	7	0.01	8.00	6.13
82	*Triplochitok scleroxylon*	9	0.01	6	0.01	6.24	4.00
83	*Uopaca spp.*	9	0.01	6	0.01	6.36	4.81
84	*Vitex spp.*	8	0.01	6	0.01	7.00	5.40
85	*Xylopia spp.*	10	0.01	6	0.01	8.00	6.00
86	*Elaeis guinensis*	3	0.004	15	0.02	3.14	1.56
87	*Irvinga gabonensis*	9	0.01	6	0.01	6.00	4.86
88	*Garcina kola*	9	0.01	6	0.01	4.92	3.00
89	*Garcina manii*	6	0.01	3	0.01	1.68	4.26
90	*Capolonio lutea*	7	0.01	3	0.01	0.88	0.16
91	*Cola acuminate*	9	0.01	9	0.02	5.00	2.14

Table 2: Summary of Proportional Abundance of Flora Species

Forest community	**Proportional abundance value and level of abundance**					
	Abundant (0.02)	Abundant (0.01)	Rare (0.003)	Rare (0.004)	Rare (0.005)	No of individual flora species
Protected forest	6	84	-	1	-	820
Unprotected forest	5	82	3	-	1	559

In order to determine the level of abundance, the value of the proportional abundance from the 91 flora species identified in the field was computed. The 91 flora species fell into four categories of relative abundance value – 0.02, 0.01, 0.003, 0.004 and 0.005. The computed mean value was then 0.01. Based on this theoretical scale, any flora species where the value fall between the mean proportional value upward were seen to be abundant. Whereas any value below the mean, that species or group of species were seen to be rare.

From the analysis, it was discovered that in the protected forest, ninety of the flora species were abundant whereas only one was rare (*Elaeis guinensis).* The reason as observed in the field during the course of this study was that this forest was still intact. Exploitation of any form of flora diversity is not guarantee as there exist legislative actions against any form of exploitation. The forest is in its true state as opposed to the unprotected forest where it is seen as "no man's land" in as much as penetration into the forest in concern (Okpiliya, 2004). The case of *Elaeis guinensis* having a very low relative abundant value (rare) in the area may stem from the fact that as local documentary evidence has it that except the palm nuts are disperse by the animals and they grow there, they are not virtually found in primary forest. They are restricted to degraded forest. In otherwords, the presence of *Elaeis guinensis* in any environment is an index of a degradation of the area.

In the unprotected forest, 87 flora species were abundant and four were rare (*pipetandeniatrun africanum, poga oleosa, pterocarpus osun and celtis).* The fact remains that these species that are rare are highly valuable sources of timber in the area. They heavily preyed upon by loggers. This tendency has made these species to be relatively scarce in the area. Infact one of the local residents reported that they now go very far into the forest in search of these flora species.

Generally in the study area, it could be realised that very few species of flora diversity are rare whereas majority are abundant. In this respect, the degree of abundance also matter a lot. That is why the result was further plotted on a lognormal curve according to Preston (1948). The number of individual species was plotted against the number of species. Each interval of the species abundance was twice the preceding one (figure 1a and 1b). These two figures complemented table two but further indicated that all the flora species are moderately abundant as the lognormal curves show. In the strict sense of it, flora species are not highly abundant as indicated in the right tail of the curves. Also few flora species are very rare as the left tail of the normal curves in both figures 1a and 1b show.

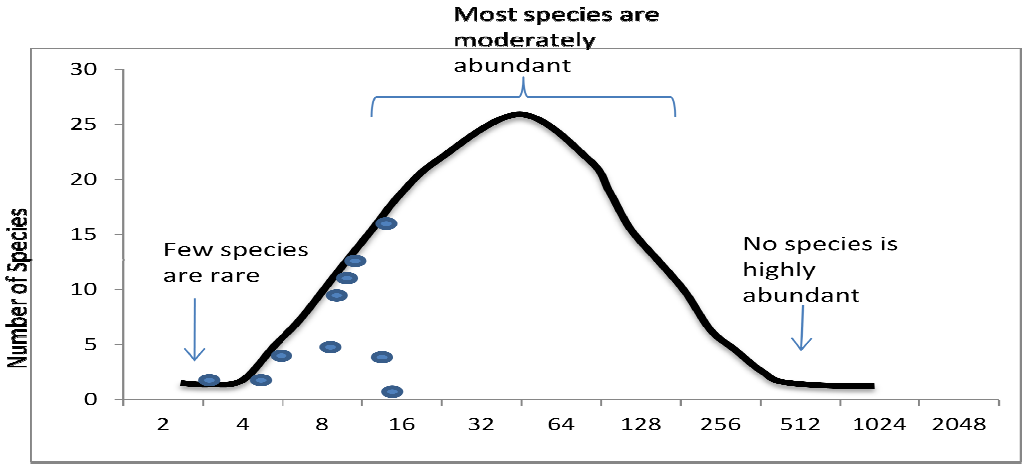

Fig. 1a: Lognormal Distribution of Flora Species in protected forest

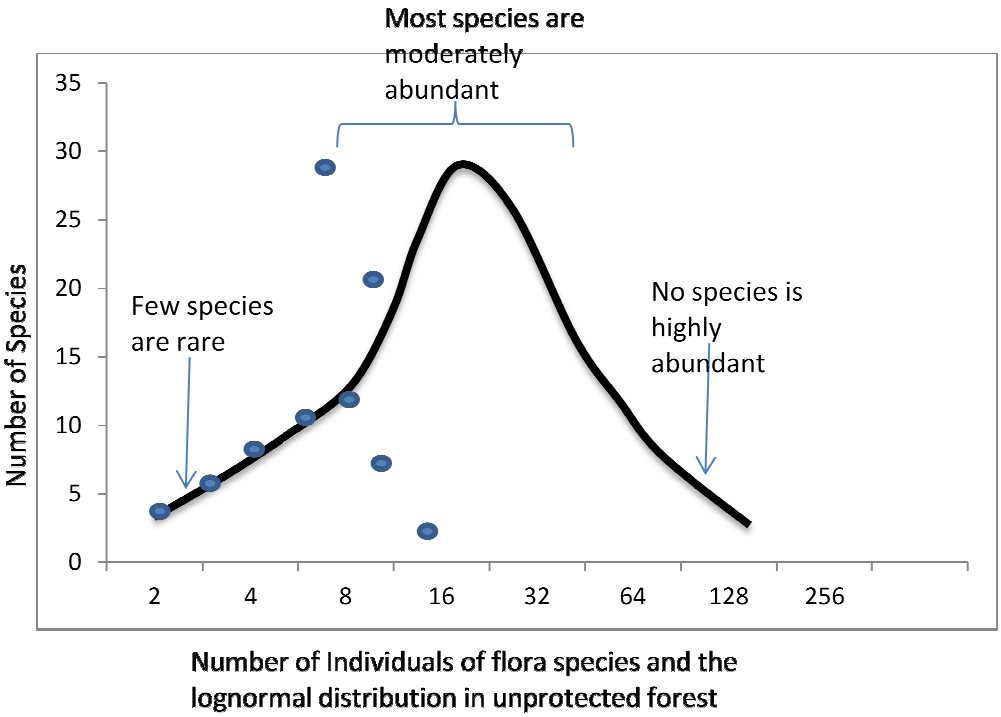

Fig. 1b: Lognormal Distribution of Flora Species in unprotected forest

Density and Girth Abundance

Of the 91 flora species (tree identified and enumerated in both the protected and unprotected forests of Boki, nearly 100% fell under an average of 10m gbh. From the table, it is indicated that both the protected and unprotected forests of Boki exhibited very different densities of flora species between 0-5m gbh and 6-10gbh. I the class size of 0-5m gbh, only eight species (representing 8.8%) were recorded in the protected forest while 83 species representing (91.2%) were in the other size of between 6-10m ghb. On the other hand in the unprotected forest and between 0-5m gbh, all the flora species enumerated in this study fell under this category. There was virtually no flora species in other girth classes. Furthermore, the mean

density and girth abundance for the girth class of 0-5m gbh was found to be 54.4% while that of the class 6-10m gbh was 48.6% lower than the first class. That the above result is not so surprising. Evidences in the field revealed that in the unprotected forest, all the 91 species enumerated fell into the girth class of 0-5m ghb and only 8 in the 6-10m gbh thereby giving a higher mean than the latter class.

It should be understood that the large girth sizes of flora species in the protected than the unprotected forest may be attributed to the fact that most of the species of trees found there have been in existence for years and have continued to increase in sizes. In the Unprotected forest, most of the trees have just regenerated due to anthropogenic activities-essentially logging and bush burning for farming

CONCLUSION

Of all the many facet of the tropical rain forest perhaps the most difficult to grasp and the most threatened by both natural and human factors is the diversity and relative abundance of its species. As rainforest habitats are altered or destroyed in most cases, most tropical flora species become vulnerable to extinction. This study has succeeded in highlighting information on the state of abundance of the identified flora species in the study area so that the government or other conservation agencies can swing into action with the view to protecting the integrity of these species that are of moderate and low abundance which if steps are not taken may face extinction. But the rhetorical here is: “how can this conservation drive be achieved when the rural forest dwellers whose life hinges to a large extent on the forest are not provided with alternative source of livelihood?”. The end result of this scenario is the continuous exploitation of the rich diversity of the forest so as to make ends meet. That is exactly the present state the study area has found itself despite clarion calls for the complete stoppage of exploitation of the rich flora diversity and abundance of the forest

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