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Phytosociological study of Abubakar Tafawa Balewa University (ATBU), Gubi Campus, Bauchi

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ABSTRACT

Phytosociological study of Gubi Campus of the Abubakar Tafawa Balewa University (ATBU) Bauchi was conducted, using the Point Center Quarter method (PCQ). The study area *has a total land area of 48 km^2;* the study area was divided into four (4) sites. *And from each site 20 quadrants measuring 100x100m were selected as representatives of the whole study area. Each of the quadrants was divided into five subunits (20x20m) from the right angles and the center. In each of the subunits (20x20m), 10 sampling point were randomly established and phytosociological data were recorded. Plant (tree) species composition, density, frequency, coverage and importance value indices (I.V.I) were determined. The community of the study area was established by the dominant species and designated as Anogeissus-Parkia-Sclerocarya woodland. Two families were found to be leading in terms of species representations, they are Combretaceae and Mimosaceae. Anogeissus leiocarpus and scelerocarya birea, has the highest numerical strength. Shannon Wiener's index indicates the vegetation is reasonably diverse. Jaccard index showed similarity between site 3 and 4, there was generally dissimilarity between the other sites. Vegetation in Gubi Campus was observed to be under threat from anthropogenic activities. There is thus the need for University authority to device measures to conserve the vegetation.*

INTRODUCTION

Plant formations are the largest and most complex units of vegetation and represent the level at which most world map are compiled. The distribution of these complex units are generally determined by climate and influenced by soil conditions. Differences in soil properties produced by the interaction of climate, topography and vegetation over time have a profound effect on parent material, biological system and plant communities that they support. The physical and chemical characteristics of a soil are determined by the additions and losses from leaching, seepage and erosion coupled with transfers and transformation within the soil, resulting in the gradual development of different soil types (Archibold, 1995). Plant community alongside other biotic components and the abiotic environment make up an ecosystem in which interactions of organisms and their environmental factors take place through flow of energy and cycling of materials. The first requirement for analyzing plant communities, therefore, is to analyze the ecosystem with the list of species present, community structure and dynamics have been the focus of much present ecological research (Diamond and Case, 1985). Phytosociological studies are important for two basic reason, namely mapping and ecological purpose (Causton, 1988).

A central goal of plant ecology is to understand the factors controlling local distribution of plant species and thus composition of plant communities (Barton 1993). Species distribution reflects the effects of several factors at different scales. Climate, topography and soil are thought to exert influences on plant distribution (Ricklefs 1990;

Ringrose *et al.*, 2003), though many authors have found that landscape or physiographic factors play an important role in plant community organization (O'Brien, 1993; McAuliffe, 1994). Others have demonstrated that soil characteristics are the most important factors in plant community organization (Bornkamm and Kehl, 1990; El-Bana *et al*., 2002). Serious concerns about environmental degradation resulting from intensive forms of land use that exceed the ecological carrying capacity have widely been reported (Mzezewa, 2009). Reversal of such negative trends is quite difficult because not only ecological but also social, economical and political issues are involved. Rather than try to consider all these issues in an integrated manner right away, it is advisable to first analyses the problems from disciplinary standpoints and then combine these into a comprehensive evaluation.

The sustainable management of natural resources is a key issue for survival of life on earth. In this effort, conservation of biodiversity has been put up at the highest priority through the Convention of Biological Diversity (CBD). It is realized that the threats and vulnerability to the species/ecosystem are greatest in recent times mainly due to over exploitation of biological resources. However, natural hazards due to their adverse impacts, also contribute to the loss of biodiversity. A protected Area (PA) network has been established to conserve the gene pool in *in situ* conservation structure. Since biodiversity represents the very foundation of human existence, therefore, most of the countries in the world are committed to biodiversity conservation and are taking inventories of their biodiversity, making attempts to conserve these resources, and also monitoring conservation efforts. It is therefore, a challenge to the scientific community to offer help to the biodiversity managers based on scientific facts. Issues like population growth, change in land use, deforestation, forest fragmentation, habitat loss etc. are of major concern. Certain categories of species are especially vulnerable to habitat reduction and fragmentation. The total amount of open space decreases, and individual patches diminish and become more isolated from each other. This trend is considered one of the major causes of species extinction today (Noss, 1991). *In situ* conservation of biodiversity through protected area network has been successful to a large extent, thereby allowing species to throw a myriad of varieties and land races in the gene pool evolved and adapted to changing environmental conditions. Biodiversity is an attribute of an area and specifically refers to the variety within and among living organisms (Porwal and Singh, 2009), it can be measured in term of genetic diversity, identity and number of different types of species, assemblages of species, biotic communities, biotic processes, the amount (e.g. abundance, biomass, cover, rate etc.) and structure of each.

The world is facing increase pressure on its natural resource environments due to loss of productive topsoil and deforestation. The present environmental problem is largely result of the interactions between people, natural resources and technology Benneh *et al*., (1996). In developing countries the economics value of natural resources such as forest has been shown to be the major course of deforestation. About 1.5 billion living in developing countries rely on forest wood for cooking and heating (Tucker, 1999). Thus thousands of hectares are lost due to lack of trees as a result felling many species of plants or genetic resource on which life depends is lost. To rectify this is to try to find better way of managing natural resources for sustainable development, secondly is to study the ecosystem through general biodiversity research, and examining the extent of depletion of plants in the ecosystem with a view to proffering a sustainable management of the genetic resources.

The diverse edaphic and physiographic feature of the Abubakar Tafawa Balewa University Gubi Campus is associated with its rich vegetation diversity. Construction work is still going on; infrastructures are replacing the natural vegetation, though many open and green areas still support several plant communities. Anthropogenic activities are largely responsible for deterioration of plant cover leading to desertification especially in the semi arid and arid regions (AbdulHameed *et al.*, 2005). Felling of trees in Abubakar Tafawa Balewa University, Bauchi Gubi Campus to make way for construction and agricultural land is becoming a serious menace and could, in the long run, change not only the physiognomy but the floristic composition of the University campus.

Phytosociology has been used as a tool in studying the vegetation over long period to show stages of development and changes in physiognomy (Sharma, 1993). The knowledge of species composition in an area can be directed at protecting and preserving the plants for scientific, economic and aesthetic purposes (AbdulHameed *et al*,. 2001; AbdulLahi and Sanusi 2006; AbdulHameed and Sharma 2008). Factors responsible for the distribution of plant species have been studied and reported by Nwadiningwe and Onyekwelu (2006),

MATERIALS AND METHODS

Gubi Campus of the Abubakar Tafawa Balewa University, Bauchi is located 25 kilometer away from Bauchi metropolis, is sited in Gubi village of Ganjuwa local Government of Bauchi state Nigeria, it has a total land area of 48 km^2 (Fig 1). It is within Savanna zone at latitude 10^o 45'N and longitude $9.^o$ 82'E with an annual average rain fall of 250mm occurring mainly during the months of June to September, August is the wettest month with 335mm of rainfall.

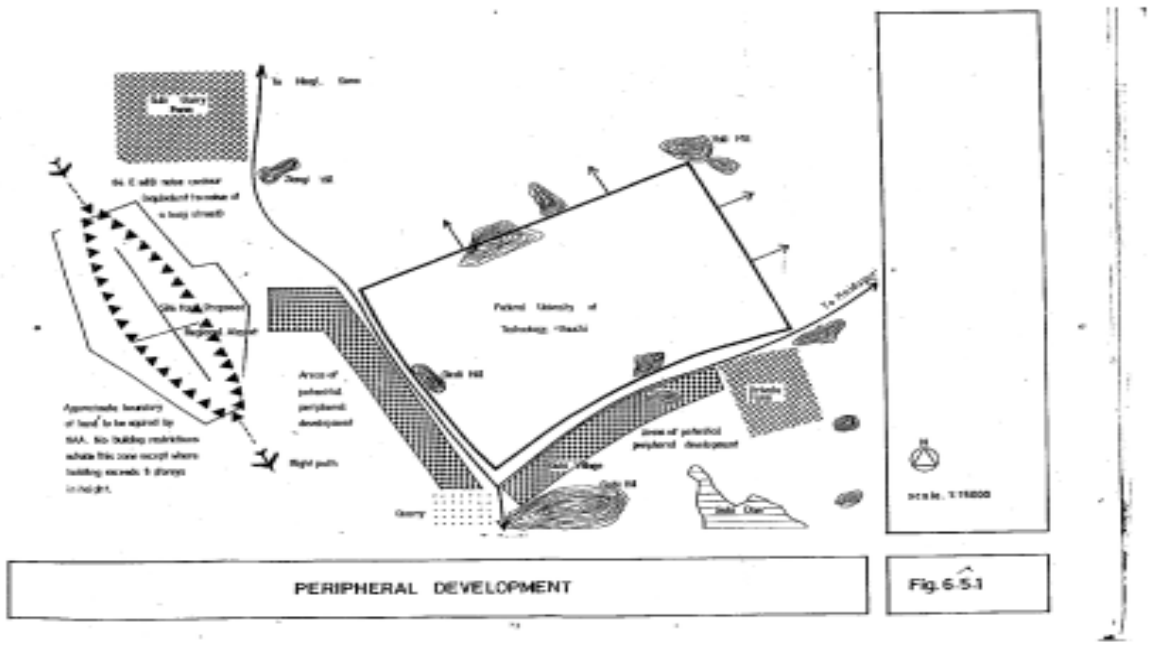

FIG. 1, Map of the Gubi Campus of Abubakar Tafawa Balewa University, Bauchi

Point Center Quarter (PCQ) was used for this study of Abubakar Tafawa Balewa University Bauchi Gubi Campus (Curtis and Cutam, 1956).The study area was divided into four sites. And from each site 20 quadrants measuring 100x100m were selected as representatives of the whole study area. Each of the quadrants was divided into five subunits (20x20m) from the right angles and the center. These subunits were systematically sampled for all trees. In each of the subunits (20x20m) 10 sampling point were randomly established and phytosociological data were recorded. In every quarter the nearest tree to the sampling point was identified and counted and the quarter number recorded. The distance from the sampling point to the tree, and the diameter at breast height were measured.

The vegetation data were quantitatively analyzed for basal area, relative density, relative frequency and relative cover (Phillips, 1959, Curtis and Mckintosh, 1951). The importance value index (IVI) for the tree species was determined as the sum of the relative frequency, relative density and relative cover (Cottam and Curtis, 1956).

The Shannon Wiener's diversity index was used to measure the species diversity in the various sites. This was used to compute both abundance (Shannon's H) and the evenness of the species present (Shannon's equitability E_H) Shannon's diversity index was calculated from the formula.

Diversity H^-

$$\sum_{I=1}^{S} Pi\ InPi$$

Species Pi was calculated and then multiplied by the natural logarithm of the proportion (InPi). The resulting product was summed across species and multiplied by -1.

Shannon's equitability or evenness was computed thus

Equitabilty J or $E_H = H = H$

H max Ins

RESULTS

A total of 28 species of phanerophytes belonging to 15 families were recorded in this study (Table 1). Combretaceae is the family represented by the highest number of species with *site 2* having the highest individual species. This is followed by Mimosaceae, Bursaraceae Steculianaceae, Sapotaceae and Verbenaceae were the families' represented with least number of species. *Anogeisus leicarpus* had the highest member of 101 individuals, followed by *Combretum glutinosum* and *Sclerocarya birrea* which had 34 and 31 individuals respectively. *Nauclea latifolia, Pakia biglobosa, Terminalia glaucescens* and *Vitellaria paradoxa* were recorded less than 4 individuals.

TABLE 1: Tree and their Families, Occurrence, Frequency, Density, Coverage and IVI at ATBU Bauchi Gubi Campus

S/N	SPECIES	FAMILY	OCCURRENCE	FREQUENCY (%)	DENSITY (ha^{-1})	COVERAGE(cm^2)	IVI
1	*Lannea acida*	Anacardiaceae	2	7.5	39.5	37.8	14.29
2	*Sclerocarya birrea*	Anacardiaceae	31	78.8	232.5	72.43	99.75
3	*Commiphora africana.*	Bursaraceae	5	10	16.3	S4.07	6.34
4	*Piliostigma reticulatum*	Caesalpiniaceae	17	6.3	9.25	3.44	5.86
5	*Termarindus indica*	Caesalpiniaceae	3	20	36	1.58	14.1
6	*Anogeissus leiocarpus*	Combretaceae	101	10	25.5	1.52	6.62
7	*Combretum glutinosum.*	Combretaceae	34	35	71.5	6.99	24.96
8	*Combretum reticulatum.*	Combretaceae	26	28.8	75.5	6.38	24.45
9	*Ptelcopsis suberosa*	Combretaceae	2	10	15	0.2	7.11
10	*Terminalia glaucescens.*	Combretaceae	2	23.3	69.5	4.42	20.75
11	*Diospyros mispiliformis.*	Ebenaceae	10	11.7	30	1.79	10.51
12	*Prosopis africana*	Fabaceaea	5	10	10	0.14	4.79
13	*Parkia biglobosa*	Fabaceae	3	20	34	0.2	10.58
14	*Azanza garckeana.*	Malvaceae	5	15	32	6.73	7.97
15	*Khaya senegalensis.*	Meliaceae	8	13.3	24	58.22	15.82
16	*Albizia chevalieri*	Mimosaceae	6	10	21	1.11	5.31
17	*Acacia polyacantha.*	Mimosaceae	8	7.5	13	0.55	4.91
18	*Dichrostachys cineria*	Mimosaceae	1	12.5	22	0.71	7.31
19	*Acacia hockii*	Mimosoideae	9	7.5	14	50.13	40.78
20	*Ficus sycomorus.*	Moraceae	4	16.3	35.8	1.58	11.94
21	*Ficus glumosa*	Moraceae	3	5	8.5	0.14	3.01
22	*Detarium microcarpum .*	Papilionaceae	15	7.5	19.5	4.2	10.37
23	*Crossopteryx febrifuga.*	Rubiaceae	2	45	93.7	28.9	26.93
24	*Nauclea latifolia*	Rubiaceae	3	15	32	10.46	12.83
25	*Ziziphus mauritiana.*	Rhamnaceae	3	7.5	13	0.2	4.9
26	*Sterculia setigera.*	Sterculiaceae	3	7.5	13	0.19	4.3
27	*Vitellaria paradoxa.*	Sapotaceae	1	5	17	1.1	3.01
28	*Vitex doniana.*	Verbenaceae	3	15	32	10.68	15.31

Table 1; show the mean frequency of the four sites of Gubi campus. *Anogeisus leiocarpus (78*.8%) was the most frequent of species; this is followed by *Sclerocarya birrea* (45.0%) and then, *Combretum reticulatum* (35.0%), *Combretum glutinosum* and *Detarium microcarpum* recorded mean frequency (2.8.8%) and *(*22.3%) respectively. *Accacia hockii, Nauclea latifolia, Parkia biglobosa, Sterculia setigera, Terminalia glaucescens, Vitellaria paradoxa* recorded mean frequency value of (7.5%) each. The least mean frequency value was recorded for *Azanza garekeana* (6.3%).

The density and coverage values and their means are shown in tables1, respectively. *Anogeissus leiocarpus* recorded remarkably high mean density value (223.5ha^{-1}). This is the highest density in the study area. *Sclerocarya birrea* followed with (93.7ha^{-1}), *Combretum glutinosum* and *Combretum reticulatum* (71.5ha^{-1}) with densities of 75.5ha^{-1} and 71.5ha^{-1} respectively. *Terminalia glausescens* and *Nauclea latifolia* recorded mean density of (13.0 ha^{-1}). Tree with least mean density was Ptelcopsis suberosa (8.5 ha^{-1})

The highest mean coverage values were recorded for *Anogeissus leiocarpus* (72.43cm^2). Trees with appreciably higher values were *Khaya senegalensis* (58.22cm^2), *Parkia biglobosa* (50.13cm^2), and *Sclerocarya birrea* (28.90cm^2). The rest of the trees had very low coverage, with coverage less than 1.0 cm^2 recorded for *Crossopteryx*

febrifuga, *Ficus cycomorus*, *Nauclea latifolia*, *Prosopis africana*, *Ptelcopsis suberosa*, *Terminalia glaucescens*, *Vitex doniana*, and *Dichrostachys cineria*.

The Importance Value Indices (IVI) of tree species is shown in Table 1. The plant species which recorded highest Importance value Index formed the basis for naming the community. These are *Anogeiossus leiocapus* (99.75), *Parkia biglobosa* (40.78) and *Scelerocarya birrea* (26.93). Some species had relative high importance values they are *Combretum reticillatum* (24.96), *Combretum glutinosum* (24.45) and *Detarium microcarpum* (20.75). The species with least IVI value was recorded for *Piliostigma reticulatum*, *Vitellaria paradaxa* (3.01),

Appendix 2, 3, 4 and 5 reveal values for Shannon and Wiener (1963) Diversity index (H). For the study *sites* of Gubi Campus of Abubakar Tafawa Balewa University, Bauchi: *Site 1* had H= 2.2, site 2, H=2.5, site 3, H=2.3 and site 4 H= 2.2. While those for (EH) were *Site 1* had 0.43, *Site 2* had 0.69, *Site 3*, had 0.58 and *Site 4* had 0.59. The values for diversity and evenness were considerably higher in site 2.

DISCUSSION

Density values reveal the numerically strongest plant species Misra (1968). This is however depends on the luxuriance and adaptation of the vegetation in the community. *Anogeissus leiocarpus* and *Combretum glutinosum* were found to record the highest density value. This could be as a result of plant ability to thrive very well in savannah habitat; the sandy loam nature of the soil in the habitat could also be contributory factor to this predominance. The numerical weakest tree species was *Ptelcopsis suberosa* having the least density due to the anthropogenic activities.

Basal cover gives an indication of wood that are harvested for economic purpose in an area Misra (1968) *Anogeissus leiocarpus* and *Sclerocarya birrea* recorded the highest basal cover in the study area, this could be attributed to highest population and circumference values for species, *Ficus sycomorus* and *Pteleopsis suberosa* had least basal cover values, this could be due to effect of the anthropogenic activities within the study area.

The tree species with higher frequency were *Anogeissus leiocarpus*, *Sclerocarya birrea* and *Combretum glutinosum* species with higher population had comparatively higher frequency this could suggest human interference through selective utilization and conservation of such species (Ahn, 1970) and couple with the ecological adaptability of the tree species.

The species having the highest Importance Value Index (IVI) were considered as the leading dominant of the community which is considered responsible for naming the community while other vegetation recorded in the area could be grouped as co-dominants, associates or rare plant species depending on their IVI status (Arshad *et al*., 2002). Based on this however, the community in Gubi Campus of Abubakar Tafawa Balewa University, Bauchi was *Anogeisus-Parkia-Sclerocarya* these are the most ecologically successful tree species. This could be attributed to their wide ecological amplitude. The co-dominant species were *Combretum-Combretum-Detarium.* Combretaceae, Mimosaceae were found to be the dominant families representing a major portion of the four *sites* of the Gubi campus. This could be associated with a wider range of growth, adaptability and distribution of various members of these families in the campus. The result was not unexpected in this ecological zone. AbdulHameed (2005) has reported Combretaceae as one of commonest families within a similar ecosystem. This is an indication of the adaptability in terms of tolerance and survivability and dispersal of members of this family. Similar reports were shown by Ogunniran and Muogholu (2007).

The diversity of habitats and or species remains one of the most frequent cited criteria in conservation assessment. Based on the values recorded in this study (2.2–2.5), the habitat could be regarded as having reasonably diverse vegetation.

CONCLUSION

From the findings of this research the following conclusion could be made, Gubi campus of the Abubakar Tafawa Balewa University, Bauchi, was reasonably diverse in phanerophytes, though numerical strength of most species is threatened. Despite the restriction of cutting trees for fuel and medicinal purposes, clearing of land for both agriculture and construction by the University authority is still ongoing.

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