

## An Assessment of the Herbaceous Species Vegetation of Yankari Game Reserve, Bauchi, Nigeria

<sup>1</sup>M.B. Abdullahi, <sup>2</sup>S.S. Sanusi, <sup>1</sup>S.D. Abdul and <sup>1</sup>F.B.J. Sawa

<sup>1</sup>Biological Sciences Programme, School of Science, Abubakar Tafawa Balewa University, Bauchi, Nigeria

<sup>2</sup>Department of Biological Sciences, Essien Udom Court, University of Maiduguri, Maiduguri, Nigeria

**Abstract:** Herbaceous Species assessment of Yankari Game Reserve Bauchi-Nigeria was carried from July- September, 2003. Quantitative vegetation parameters were recorded using the modified PCQ method. These values were computed to obtain Importance Value Index (IVI) and plant communities were delineated accordingly. Five plant communities were constructed from five habitats (transects) sampled i.e., 1) *Hyperrhenia cyanensis*- *Sateria pumila*- *Ctenium newtoni*; 2) *Digitaria horizontalis* - *Loudetia annua*; 3) *Rynchospora corymbosa* - *Acroceras amplexans* - *Sateria pumila*; 4) *Sateria barbata* - *Hyperrhenia cyanensis* - *Digitaria gayana* and 5) *Echinochloa pyramidalis* - *Urena lobata* - *Ludwigia abyssinica*. The most densely populated species were *Rynchospora corymbosa*, *Hypertherlia cyanensis* and *Digitaria horizontalis* with the highest mean IVI values. The most frequent species *Ctenium newtoni* and *Urena lobata* which is present in three habitats. 14 others were found in two habits and all the rest occurred in a habitat each. A total of 40 plant species belonging to 33 genera and 7 families have been identified. Poaceae (65.0%) is the leading plant family which played a key role in the formation of vegetation of the study area, while Ceasalpinaceae is the family with least members (2.5%).

**Key words:** Importance value index Yankari game reserve • Communities • Species

### INTRODUCTION

The setting aside and management of land as protected areas is a key part of ongoing global efforts to conserve Biological diversity. The amount of land set aside for conservation is an important indicator of progress and the monitoring of this variable provides valuable information to conservation practitioners [1]. This is what is known as ecosystem science and is critical to an understanding of the actual processes within particular ecosystems at various scales [2]. Such an understanding is what permits us to anticipate and mitigate alterations caused by internal or external threats. The idea of stress functions and ecosystems monitoring is a particularly useful one for protected area managers, whose lands are almost always stressed in some way and who can often improve their recovery responses through particular interventions [3-5]. Stress approach to protected area system management leads to a concern for the state of the environment in the protected area.

What are the structural and functional features and characteristics of the protected area and what is their current state? Such an assessment is critical for determining the effects of particular activities on the areas of the protected ecosystem that require more active intervention and protection. Such an approach emphasizes the need for monitoring the protected area to track change as an aid to timely intervention [6]. Many of these approaches can be used to collect and organize information for assessments of protected-area problems and to identify interventions needed for more effective and efficient management [7].

A number of studies have been reported on the vegetation of different zones of the world [8-16]. A few papers have been presented from the YGR [17-27]. But there is no or very little report exist on the herbaceous layer of the vegetation of this area. The present study was carried out to evaluate the herb layer of the study area to bridge the existing literature gap.

## MATERIALS AND METHODS

**Description of the Study Site:** Yankari game reserve lies in the southern part of the Sudan Savanna. It is composed of savanna grassland with well-developed patches of woodland. It is also a region of rolling hills, mostly between 200m and 400m above sea level. It falls within the latitudes 9°50' N and 10° 30' E lying in the south-central area of Bauchi state. The vegetation is composed mainly of combretaceous trees and shrubs, *Azelia*, *Anogeissus* and *Detarium* savanna woodlands. Annual rainfall in the park is between 900mm and 1,000mm. The rainy season is from May to September. Temperatures range between 18°C and 38°C throughout the season. During the dry season, the harmattan wind blows from the Sahara, often bringing dusty skies and night temperatures fall as low as 12 °C. The hottest period falls in March and April, when temperatures can rise above 40°C in the day [28].

The selection of sites was done to satisfy and provide for reasonable sampling of the main floristic types in the area. The number of vegetation types and subtypes identified and sampled for the study follows Green and Amanche [19] and were as follows:

**Habitat I:** Situated on latitudes 09°87'N and longitude 10°39'E, lying along Coulthard way (about a KM east of Ahmadu Bello way), in shrub savanna derived from tree savanna by dying off of most trees which correspond with Transect No. 1.

**Habitat II:** Situated on latitudes 09°46'N, longitude 10°32'E and an altitude of 257ft, lying along Shaaman track, (about 3km west of Kalban hill, near *Azelia* tree savanna junction) which correspond with Transect No. 2.

**Habitat III:** Situated on latitudes 09°88'N, longitude 10°39'E and an altitude of 1410ft, lying about 3km northeast of Wikki camp in combretaceous tree savanna, which correspond with Transect No. 3.

**Habitat IV:** This is situated on latitudes 09°77', longitude 10°53'E and an altitude of 720 ft, about 2.5 km south of Familian Guturu Track in Combretaceous shrub savanna, which correspond with Transect No. 4.

**Habitat V:** Situated on latitudes 09°88'N, longitude 10°34'E and an altitude of 1533ft, lying on Yalo track about 2.5 Km east of Kariyo hill in *Azelia* tree savanna, which correspond with Transect No. 5.

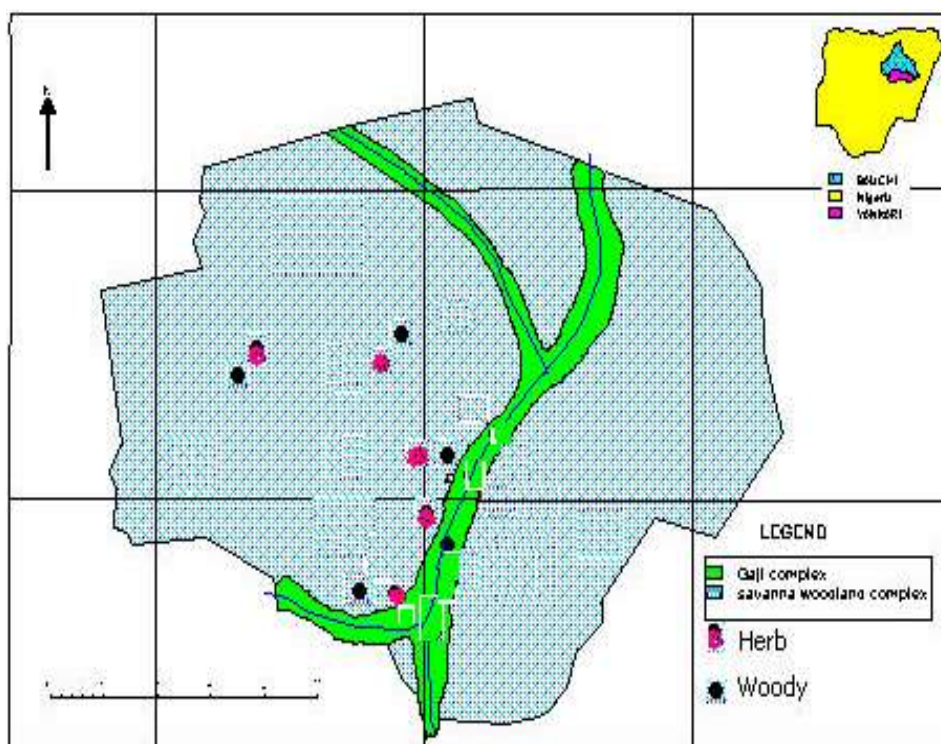


Fig. 1: Map of Yankari Showing the Vegetation study sites

**Study Procedure:** The vegetation study using the PCQ method was undertaken in 2003. 50 sampling points along five Habitats (transects) each were enumerated and recorded. The quantitative account of vegetation such as density and frequency were recorded using plotless sampling technique of Cottam and Curtis [28]. Importance Value Index (IVI) was obtained for each species that was calculated by adding relative density and relative frequency [29]. On the basis of highest IVI, sampled vegetation was delineated into different plant communities based on the three leading dominant species per habitat [29-31]. Species other than the dominants were classified into co-dominants, associates and rare. Plants were identified with the help of floristic literature [32].

## RESULTS

Five plant communities were found in the five distinct habitats (transects) such as 1) *Hyperthelia cyanensis*- *Sateria pumila*- *Ctenium newtoni*; 2) *Digitaria horizontalis* - *Loudetia annua* -; 3) *Rynchospora corymbosa* - *Acroceras amplexans* - *Sateria pumila*; 4) *Sateria barbata* - *Hyperthelia cyanensis* - *Digitaria gayana* and 5) *Echinochloa pyramidalis* - *Urena lobata* - *Ludwigia abyssinica* (Table 1). Twelve species contributed in the

formation of plant communities of the area under study. The most densely populated species were *Rynchospora corymbosa*, *Hyperthelia cyanensis* and *Digitaria horizontalis* with highest mean IVI ranges (Table 1). The most frequent species *Ctenium newtoni* and *Urena lobata* which present in three habitats. 14 others were found in two habits and all the rest occurred in a habitat each. The least important species based on this criterion were *Pennisetum polystachion*, *Fuirena ciliaris* and *Sporobulus pyramidalis*. A total of 40 plant species belonging to 33 genera and 7 families have been identified. Poaceae (65.0%) is the leading plant family which played a key role in the formation of vegetation of the study area, while Ceasalpinniaceae is the family with least members (2.5%).

## DISCUSSION

The highest species richness was recorded from sites III and IV (12 species.) and all other sites have 11 species each. This homogeneous distribution pattern in species composition might be due to degradation of vegetation within the studied habitats. Another reason could be climatic factors which influenced the distribution of species in certain habitats. Similar result of this study has been reported elsewhere. Hussain *et al.* [33] in his studies of the vegetation of Ghalegay hills has recorded and

Table 1: The dominance pattern of herbaceous species in the study area

S/N	Name of the Species	Sites					Importance Value Index	
		1	2	3	4	5	Mean	Max
1	<i>Hyperrhenia cyanensis</i>	19.50			16.50		18.00	19.50
2	<i>Sateria pumila</i>	15.50		14.50			15.00	15.50
3	<i>Ctenium newtoni</i>	14.50			13.00	7.50	11.67	14.50
4	<i>Cyperus exaltatus</i>	14.50					14.50	14.50
5	<i>Chloris pilosa</i>	14.00					14.00	14.00
6	<i>Vetiveria nigriflora</i>	13.50			7.00		10.25	13.50
7	<i>Jardinea congoensis</i>	13.00					13.00	13.00
8	<i>Urena lobata</i>	12.50			12.50	16.00	13.67	16.00
9	<i>Loudetia annua</i>	11.00	16.50				13.75	16.50
10	<i>Axonopus compressus</i>	10.50					10.50	10.50
11	<i>Andropogon ascinioides</i>	3.50			11.50		7.50	11.50
12	<i>Digitaria horizontalis</i>		17.50				17.50	17.50
13	<i>Poligonum salicifolium</i>		14.00	13.50			13.75	14.00
14	<i>Eleusine indica</i>		14.00			5.00	9.50	14.00
15	<i>Brachiaria deflexa</i>		14.00				14.00	14.00
16	<i>Digitaria gayana</i>		14.00		14.00		14.00	14.00
17	<i>Fimbristylis ferruginea</i>		13.00				13.00	13.00
18	<i>Sateria barbata</i>		11.00		18.50		14.75	18.50
19	<i>Heterotis rotundifolia</i>		10.50				10.50	10.50

Table 1: Continued

20	<i>Panicum subalbidum</i>	9.00		9.00	9.00
21	<i>Leersia hexandra</i>	7.50	6.50	7.00	7.50
22	<i>Rynchospora corymbosa</i>		18.50	18.50	18.50
23	<i>Acroceras amplexans</i>		15.50	13.00	14.25
24	<i>Cassia mimosoides</i>		12.50		12.50
25	<i>Echinochloa pyramidalis</i>		12.50	18.50	12.50
26	<i>Rotboellia exaltata</i>		12.00		12.00
27	<i>Poligonum palcrum</i>		11.50		11.50
28	<i>Poligonum lanigerium</i>		10.50		10.50
29	<i>Eragrostis tenella</i>		9.00		9.00
30	<i>Sporobolus pyramidalis</i>		6.50	11.50	6.50
31	<i>Fuirena ciliaris</i>		5.50		5.50
32	<i>Hyparrhenia rufa</i>			10.50	10.50
33	<i>Pycnus lanceolatus</i>			13.50	13.50
34	<i>Cymbopogon giganteus</i>			13.00	13.00
35	<i>Sacciolepis africana</i>		7.00	12.50	9.75
36	<i>Andropogon gayanus</i>			13.50	13.50
37	<i>Ludwigia abyssinica</i>			15.50	15.50
38	<i>Hyparrhenia dissoluta</i>			11.50	11.50
39	<i>Pennisetum polystachion</i>			4.00	4.00
40	<i>Heteropogon contortus</i>			14.50	14.50

Table 2: Association, similarity and correlation between sites for herbaceous species in the study site

Sites	Chi-square	Correlation	ad/bc	Sx	Sr
SiteI/II	2.57898409	-0.253918495	-	37.42102	0.746082
SiteI/III	3.1586804	-0.281010694	-	36.84132	0.718989
SiteI/IV	1.725630691	0.207703556	+	38.27437	1.207704
SiteI/V	1.009105837	-0.158832131	-	38.99089	0.841168
SiteII/III	3.1586804	-0.281010694	-	36.84132	0.718989
SiteII/IV	0.053739364	-0.036653569	-	39.94626	0.963346
SiteII/V	3.1586804	-0.281010694	-	36.84132	0.718989
SiteIII/IV	7.346938776	-0.428571429	-	32.65306	0.571429
SiteIII/V	0.204081633	-0.071428571	-	39.79592	0.928571
SiteIV/V	0.204081633	-0.071428571	-	39.79592	0.928571

reported plant associations of three vegetation zones such as Subtropical semi-evergreen, subtropical chir pine and blue pine temperate zones. Their study supported three communities within three ecological zones of the study area. Likewise, Abdullahi [20] has reported five distinct communities in his study of the Flora of Gaji river Valley of Yankari National Park. In the same vein, Celik *et al.*, [34] have discovered 3 new plant associations in their study of the vegetation of Dilek Peninsula-Great Menderes Delta National Park. Similarly, Ahmad *et al.*, [35] studied vegetation of Soon Valley with particular reference to leguminous plants. The results obtained on various parameters for species importance studied in Chotiri reservoir agree with the work of aforementioned studies. Similar type of studies had also carried out by Kirk-Patrick [36] and AbdulHameed [21]. There was a

weak relationship between sites based on the chi-square statistics. This was in conformity with similar works elsewhere [9, 14, 20, 33] that species distribution in areas with high diversity is always heterogeneous (Table 2). There was only a positive relationship between site 1 and 4 and is not significant ( $P < 0.05$ ) and all other relations were negatively associated and correlated. This depicts site peculiarity based on physical factors which were used in delineating habitats accordingly from the on set of the study.

During the study it has been observed that the grassland vegetation of this area was under enormous biotic pressure from grazing, fire and cutting. These anthropogenic activities appeared to be a continuous threat for native species. It is therefore suggested that: Species with lower IVIs need priority measures for

conservation and those with higher IVIs need monitoring effort in order to maintain their diversity; Use of fire and range grazing need be restricted and should in fact be avoided because of their usefulness for wildlife.

### ACKNOWLEDGEMENT

This work is supported in part by Abubakar Tafawa Balewa University Bauchi, Nigeria. We are also grateful for the Management of Yankari Game reserve and its numerous staff for permission to carry out the research and the field assistance respectively.

### REFERENCES

- Food and Agricultural Organization (FAO), 1997. The state of the world's plant genetic resources for food and agriculture [Online]. Available: [www.fao.org/ag/AGP/AGPS/Pgrfa/pdf/swrfull.pdf](http://www.fao.org/ag/AGP/AGPS/Pgrfa/pdf/swrfull.pdf).
- Colchester, M., 1994. Salvaging nature: indigenous peoples, protected areas and biodiversity conservation. Discussion Paper no 55. Geneva, UNRISD, pp: 16.
- Alcorn, J., 1993. Indigenous peoples and conservation. *Conservation Biology*, 7(2): 424-26.
- Adams, W.M., R. Aveling, D. Brockington, B. Dickson, J. Elliott, J. Hutton, D. Roe, B. Vira and W. Wolmer, 2004. Biodiversity conservation and the eradication of poverty. *Sci.*, 306: 1146-1149.
- Andrew, B., L. Bennun, B. Ten Brink, D. Cooper, I.M. Cote, P. Crane, A. Dobson, N. Dudley, I. Dutton, R.E. Green, R.D. Gregory, J. Harrison, E.T. Kennedy, C. Kremen, N.L. Williams, T.E. Lovejoy, G. Mace, R. May, P. Mayaux, P. Morling, J. Phillips, K. Redford, T.H. Ricketts, J.P. Rodriguez, M. Sanjayan, P.J. Schei, A.S. Van-Jaarsveld and B.A. Walther, 2005. The Convention on Biological Diversity's 2010 target. *Himalayan J. Sci.* Vol 3 Issue 5. 113- 129. Available: [www.sciencemag.org/cgi/content/full/307/5707/212/DC1](http://www.sciencemag.org/cgi/content/full/307/5707/212/DC1).
- GEMS, 1989. Monitoring and Assessment Research Centre. Environmental Data Report, 2nd ed. Oxford, U.K. Basil Blackwell, pp: 77.
- Chape, S., J. Harrison, M. Spalding and I. Lysenko, 2005. Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. *Phil. Trans. R. Soc. B.*, 360: 443-455.
- Shimizu, Y., 1991. Forest types and vegetation zones of Yunnan China. *J. Fac. Sci., Tokyo. Univ. Sec. III. Bot.*, 15: 1-71.
- Kumar, H.D., 1997. Modern concepts of Ecology, 8<sup>th</sup> revised edition; Laser typeset by Rachne Laser set, New Delhi-110008, pp: 478.
- Hussain, F., I. Iqbal and M.J. Durrani, 2000. Vegetation studies on Ghalegay Hills, District Swat, Pakistan. *Pak. J. Pl. Sci.*, 6(1-2): 1-10.
- Bhatti, G.R., M. Shah and R. Qureshi, 2001. Floristic study of arid zone (Desert- Nara Region), Sindh. Final Technical Report, PSF Project, S-SALU/ENVR (45).
- Aparajita, H., G.S. Rawat and A.K. Tiwari, 2002. Population structure of the corridor forest between Rajaji and Corbet National Parks, Uttaranchal, India. *Indian J. For.*, 25: 310-318.
- Banda, T., M.W. Schwartz and T. Caro, 2006. Woody vegetation structure and composition along a rotation gradient in a miombo ecosystem of western Tanzania. *Forest Ecol. mgmt.*, 230: 179-185.
- Kumar, A., B.G. Marcot and A. Saxena, 2006. Tree species diversity and distribution patterns in tropical forests of Garo Hills. *Current Sci.*, 91(10): 11-25.
- Isango, J.A., 2006. Stand Structure and Tree Species Composition of Tanzania Miombo Woodlands: A Case Study from Miombo Woodlands of Community Based Forest Management in Iringa District. *Current Science*, 91(10): 312-340.
- De, A., 2007. Patterns of plant species diversity in the forest corridor of Rajaji- Corbet National Parks, Uttaranchal, India. *Current Science*, 92(1): 90-93.
- Keay, R.W.J., 1962. *Yankari Game Reserve*, Technical Note. No. 17, Department of Forestry Research. Federal Printing Division, Lagos, pp: 12.
- Geerling, C., 1973. The Vegetation of Yankari Game Reserve: Its Utilization and Condition. Bulletin 3. Department of Forestry, University of Ibadan, Nigeria, pp: 136.
- Green, A.A. and M.S. Amanche, 1987. Management Plan for the Yankari Game Reserve, Bauchi State, Nigeria. WWF Project 3632, NCF Technical Report 2, Lagos, pp: 212.
- Abdullahi, M.B., 2001. The Flora of Gaji River Valley, Yankari National Park, Nigeria MSc Thesis, Unpublished, Department of Biological Sciences University of Maiduguri, pp: 78.
- Abdulhamed, A., 2002. Phytosociological Investigation of some sites within and Adjoining Yankari National Park, Bauchi PhD Thesis, Abubakar Tafawa Balewa University, Bauchi, Nigeria, pp: 99.

22. Abdullahi, M.B. and S.S. Sanusi, 2002. A Phytosociological Survey of the Woody Vegetation of the Gaji River Valley, Yankari National Park, Bauchi, Nigeria. *J. Experimental and Appl. Biol.*, 3: 73-76.
23. Abdullahi, M.B., A. Abdulhameed and S.S. Sanusi, 2003. Wildlife Browsing/grazing pressure on the vegetation resource of the Gaji River Valley, Yankari National Park and its implication for management purpose, Bauchi,-Nigeria. *Yankari*, 1: 94-100.
24. Abdullahi, M.B., A. AbdulHameed and A. Abdullahi, 2004. Floristic diversity along the Gaji River Valley, Yankari National Park, Bauchi. 13<sup>th</sup> Annual Conference of the Botanical Society of Nigeria, A.T.B University Bauchi.
25. Abdulhameed, A., S.S. Sanusi and M.B. Abdullahi 2005. The influence of Human activities on the floristic characteristics of woody plants within and outside Yankari National Park, Bauchi State-Nigeria. *Nigerian. J. Botany*, 18: 203-213.
26. Abdullahi, M.B. and S.S. Sanusi, 2006. A Phytosociological Survey of the Herbaceous Vegetation of the Gaji Flood Plains Yankari National Park, Bauchi. *Nigerian J. Botany*, 19(1): 61-67.
27. Abdullahi, M.B., S.S. Sanusi, S.D. Abdul and F.B.J. Sawa, 2008. Floristic Composition of Woody Vegetation and its Affinities in Yankari Game Reserve, Bauchi- Nigeria. *Nig. J. Exp. Appl. Biol.*, 2008. 9, in press.
28. Cottam, G. and J.T. Curtis, 1956. The use of distance measurements in phytosociological sampling. *Ecol.*, 37(3): 451-460.
29. Misra, R., 1968. Ecology work Book. Oxford and IBH Publishing Co. Calcutta, pp: 244.
30. Qadir, S.A., S.Z. Quresh and M.A. Ahmed, 1966. A Phytosociological survey of the Karachi, University Campus. *Vegetatio Acta Geobot.*, 13: 339-362.
31. Qureshi, R. and G.R. Bhatti, 2006. Ethnobotanical Observations of *Achyranthes aspera* Linn. And *Aerva* spp. with Special Reference to the People of Nara Desert. *Hamdard Medicus*, XLIX(1): 43-48.
32. Hutchinson, J. and J.M. Dalziel, 1963. *Flora of West Tropical Africa*, 2nd Edition, Reviewed by Keay, R. W. J. Crown Agent for Overseas Government, UK., pp: 907.
33. Hussain, F., I. Iqbal and M.J. Durrani, 2000. Vegetation studies on Ghalegay Hills, District Swat, Pakistan. *Pak. J. Pl. Sci.*, 6(1-2): 1-10.
34. Celik, A., S. Baslar, A. Guvensen and M. Ozturk, 2003. Role of National Park in Turkey- A case study from Dilek Peninsula-Great Menderes Delta National Park. *Pak. J. Bot.*, 35(5): 641-675.
35. Ahmad, K., M. Hussain, M. Ashraf, M. Luqman, M.Y. Ashraf and Z.I. Khan, 2007. Indigenous vegetation of Soon Valley: At the risk of extinction. *Pak. J. Bot.*, 39(3): 679-690.
36. Kirk-patrick, A.H., 1990. A vegetation survey of heath and moorland in northern Ireland and co. congeal. Dissertation abstract international-B, Science and Engineering, 51(2): 544b.