

BIOMASS, PRODUCTIVITY AND UTILIZATION OF RANGE PLANTS OUTSIDE WILDLIFE CONSERVATION AREAS IN BAUCHI STATE, NIGERIA

E. INAH¹ AND F.S. APANTAKU²

1. Forestry & Wildlife Management Department, University of Agriculture, P.M.B. 2240
Abeokuta, NIGERIA

2 Department of Mathematical Sciences, University of Agriculture, P.M.B 2240
Abeokuta, NIGERIA

Received 19 September, 1998; Accepted 19 April, 1999

ABSTRACT

The biomass, productivity and utilization of the herb stratum was assessed in range-lands outside wildlife conservation areas in Alkali, Gombe*. Toro and Misau Local Government Areas of Bauchi State with Yankari National Park (YNP) as control. These parameters were investigated during dry and wet seasons between April 1988 and November 1990. The analysis of variance technique was employed in analysing the design, while the randomised block design was used in the analysis of the data. In all the sites the biomass was higher in wet than dry season with values ranging from 250 - 831 g/m² and 105 - 706 g/m² respectively. The effect of sites was significant on productivity at 0.05 level of significance. The significance of the data on wild fauna production and on the wildlife resources conservation is discussed.

Key words: Biomass, Productivity, utilization, range plants; wildlife conservation areas, game reserve, National parks.

INTRODUCTION

Nigeria is rich in biodiversity of plant and animal life forms which are found distributed over a wide range of climatic and vegetational zones extending from the coastal and marine forms through extensively rich tropical forests, wetlands, rivers and lakes, hills, plateau and mountains, guinea, sudan and sahel savannas to arid and semi-arid lands.

Over the years, thousands of wild plant and animal life forms have been lost to both human activities and natural phenomena. The encroaching desert and receding shores of Nigeria are very familiar environmental problems. The once extensive virgin rain forests of southern Nigeria is now represented only by

the area enclosed within the Cross River National Park.

Due to loss of food sources and suitable habitats arising from human activities (especially indiscriminate bush burning, clearing for farming and ambitious socio-economic projects and poaching), some species of wild animals that were numerous in several parts of Nigeria including Bauchi State have become very rare or feared to be extinct (Hall, 1976).

However, for some decades now, serious efforts are being made to minimise the biodiversity loss and to sensitize the world government to the need for conserving the genetic resources. These include the Stockholm Declaration of the United Nations Conference on the Environment (1972); the report of the World Commission on Environment and Development (WCED) in the 1987 and recently in Agenda 21 of the 1992 United Nations Conference on Environment and Development (UNCED), signed by most countries including Nigeria. Each of the 40 chapters of this agenda adopted in Rio de Janeiro, especially chapters 10 and 15, touches on the various aspects of biodiversity conservation, factors affecting it, how to access and study it and the means to achieve its conservation (Ene-Obong, 1996).

Indicators of the federal Government of Nigeria's awareness of the need to conserve biodiversity for improved wildlife productivity include the Decree No. 33 of 1987 establishing the National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan; the Nigeria's National Parks Decree No. 36 of 1991 establishing the National park Board to run the six national wildlife parks in the country, and the establishment of the Federal Environmental Protection Agency (FEPA) to encourage environmentally friendly practices in the country in order to conserve biodiversity. These plans are splendid but the problem is in the execution which is being hindered by poor staffing and

* Gombe is now in Gombe State.

TABLE 1: RAINFALL DATA IN THE STUDY SITES FROM 1988 TO 1990

Study site	Part of	Total mean annual rainfall (mm)	Length of wet season (days)	Date rains Start	Date rains end
Alkaleri	South	882	150 - 160	26 April - 1 May	11 - 20 Oct.
Gombe	East	875	130 - 150	18 - 26 April	8 - 19 Oct.
Toro	West	1094	165 - 175	22 April - 1 May	21 Oct - 8 Nov.
Yankari	South East	968	150 - 160	26 April - 1 May	11 - 20 Oct.
Misau	North	800	110 - 130	11 - 12 May	22 Sept - 10 Oct.

Source: Inah (1991)

dwindling funding of these parastatals. Apart from these constraints, it has been observed that during part of the dry season, some wild fauna species move out of the protected areas especially in the semi-arid regions (including Bauchi State) in search of food, water and more suitable habitats (Inah and Amubode, 1994). It is believed that about 90% of Nigeria's wild fauna species are found outside conservation areas often in range lands.

Despite the exemplary role of Bauchi State in contemporary wildlife conservation and management in Nigeria (Inah, 1991), there is still a dearth of information on the productivity of range plants being utilized by both the domestic livestock and wild fauna species outside conservation areas in the state. This study was, therefore, undertaken to assess the biomass, productivity and utilization of the herb-stratum range plants in order to evaluate their implications on wild fauna production and on wildlife resources conservation/management outside the protected areas.

MATERIALS AND METHODS

The Study Area

Bauchi State lies within latitudes $9^{\circ} 00' - 13^{\circ} 00'$ North and longitudes $8^{\circ} 42' - 11^{\circ}$ East, in North Eastern Nigeria, largely in the (Guinea and Sudan) savanna zone (Keay, 1959; Kowal and Knabe, 1972).

The abundance of wildlife in the state is instrumental to the creation of Lame-Bura Game Reserve and Yankari National Park there. Such animals are well-documented by several authors (Collier, 1934; Hall 1976; Afoiayan and

Amubode, 1985; Happold, 1987).

The animals include elephants, buffalo, roan antelope, water buck, bush buck and western harbeest. Others include warthog, lion, duiker, and several species of birds, baboon and monkey. The vegetation in the study sites was classified by keay (1959) into Sudan savanna characterized by shrubbed grassland (in Gombe and Misau), wooded shrubland (Alkaleri) and shrubbed woodland (Toro and Yankari).

The total mean annual rainfall (Table 1) decreased from a range of 900 - 1100 mm in the South (Alkaleri, Toro and Yankari) to about 800mm or less in the northern parts of Bauchi State (Misau). However, the value for Gombe is about 875mm. The start of rains extends from 22nd April - 1st May in the South to 11 - 12th May in Misau and the north (Table 1). The inverse situation marks the end of rains (wet season) which varies from 22nd September - 10th October in the north to 10 to 20th October in the south (e.g. Alkaleri and Yankari).

Methodology

The biomass and productivity of the herb stratum was studied between April 1988 and November 1990 by the Clip-and-Weight Method (Shrimal and Vyas, 1975; Jones 1979) in fallow (range) lands outside conservation areas, during wet and dry seasons in each of Alkaleri, Gombe, Toro and Misau Local Government Areas of Bauchi State using the upland part of Yankari National Park as control.

The investigation was conducted in grazed/browsed and ungrazed/unbrowsed areas that is within unfenced and fenced $1m^2$.

BIOMASS PRODUCTIVITY AND UTILIZATION OF RANGE PLANTS IN BAUCHI STATE

TABLE 2: BIOMASS, PRODUCTIVITY AND UTILIZATION OF PLANTS IN THE STUDY SITES

Season	Study site	Biomass(g/m ²)	Productivity(g/m ² /28 days)	Utilization (g/m ² /28days)
Wet	Alkalari	306	139	165
	Gombe	250	202	48
	Toro	289	211	78
	Misau	466	354	112
	Yankari	831	642	189
Dry	Alkalari	171	98	67
	Gombe	105	83	22
	Toro	252	198	54
	Misau	279	213	66
	Yankari	706	613	93

plots respectively. A 1m² quadrant was randomly established in each study site and all the herbaceous plants within it were clipped at 1cm from the ground and weighed during each sampling. This was repeated 20 times at 10m interval along a 200m transect in each site at 28 days interval between April 1988 and November 1990. After recording the wet weight of the clippings, 1000g sample was taken and oven-dried in the laboratory at 60°C (Jones, 1979). It was re-weighed at 24 hour intervals until constant weight occurred. The dry matter was then used to estimate the biomass on dry matter basis (Shrimal and Vyas 1975; Madgwick, 1979).

In case of fodder productivity, ten 1m² plots were fenced in each study site and their herbaceous cover were initially clipped at 1 cm from the ground at 28 days interval (between April 1988 and November, 1990), thereafter the herbaceous cover in these plots were re-clipped and weighed. Productivity on dry matter basis was determined by drying the representative fodder samples from each plot subsequently extrapolating the data obtained.

Fodder utilization was assessed using twenty 1m² plots established in the open range-land

in each study site. Ten of these plots were fenced and the other ten unfenced. Herbaceous cover in both the fenced and unfenced plots was clipped at the start of experiment and subsequently at 28 days interval. The biomass in fenced plots less biomass in the unfenced plots was the quantity of vegetation utilized by the herbivores. The data were analysed using the randomized block design. The analysis of variance (ANOVA) technique was the tool used in analysing the design.

RESULTS

Table 2 shows the biomass, productivity and utilization of food plants in the study sites. The ANOVA and effects of season and sites on biomass, productivity and utilization of the herbaceous plants are shown in Table 3. The data indicate that the effects of season (i.e wet and dry) and of sites were significant on each parameter at 0.05 level of significance. In all the sites, the biomass was higher in wet season than dry season with values ranging from 250g/m² in Gombe to 831g/m² in YNP and 105g/m² in Alkalari to 706g/m² in YNP respectively (Table 2). The effect of season was significant on the herbage productivity and the effect of sites

was also significant on productivity at 0.05 level of significance (Table 3). Similar productivity value in both seasons was recorded in YNP and Toro, unlike in Gombe where the dry season productivity 83g/m²/28 days was about 41% of that for wet season (202g/m²/28 days). The effect of season and site were both significant on the herbage utilization by herbivores. Values range from 48 - 189g/m²/28 days in wet season and 22 - 93g/m²/28 days for dry season.

DISCUSSION

The seasonal variation in the standing crop with higher biomass in the wet than dry season in all

(14.04 - 76.44 g/m²/28 days in June and September respectively).

Generally, the low herbage productivity in range-lands outside the conservation areas has several implications on fauna productivity and environmental resources conservation:

These include:

- (1) There is loss/reduced vegetation cover and herbaceous food resources for some wild fauna species in the area.
- (2) The productivity of the wild fauna species may decrease due to prolonged walk in search of food, sometimes covering several kilometers which exposes them to poachers, predators and adverse climate. For example, increased sweating and drooling during exposure to high

TABLE 3: ANOVA AND EFFECTS OF SEASON AND SITES ON PLANT BIOMASS, PRODUCTIVITY AND UTILIZATION (X = 5%)

Source/Factor of Variation	D	Biomass	Productivity	Utilization
	d.f	SS 445912.0 MS 111478	SS 342693.60 MS 85673.40	SS 12188.00 MS 3047.00
Sites	4	F 0073.80	F 51.913	F 7.18
Season	1	SS 39564.10 MS 39564.10 F 26.19	SS 11764.90 MS 11764.90 F 7.13	SS 6051.60 MS 6051.60 F 14.25
Error	4	SS 6042.40 MS 151.60 F 0	SS 6601.60 MS 1650.40 F 0	SS 1698.40 MS 424.60 F 0
Total	9	491518.50	311060.10	19938.00
Effect of Season		Significant	Significant	Significant
Effect of sites		Significant	Significant	Significant

the sites was probably partly a function of soil characteristics variations, water availability during the rains (Jones, 1979) and vegetation protection. The mean annual rainfall of about 900mm and 1000mm in Alkalari and Yankari perhaps contributed greatly to the high biomass observed. Vegetation conservation is best in Yankari National Park. The significantly high biomass and productivity in YNP may be due to improved canopy and herbaceous coverage arising from strict protection (Inah, 1991). The vegetal productivity obtained in YNP during this study was similar to that of Shrimai and Vyas (1975) in the grassland part of Udaipur, India

ambient temperature could lead to loss of nutrients by the animal (Williamson and Payne, 1978).

- (3) Inadequate vegetation cover could result in increased exposure of soil surface leading to increased soil erosion, desertification and environmental degradation.

Indicators of these problems in the study sites include frequent windstorm ladden with sand, frequent sheet and gully soil erosions especially in Gombe and Ningi, low annual rainfall as well as late commencement of rains and early stoppage (Table 1). Inah (1993) noted that some streams and rivers in the critically desertified zones dry

BIOMASS PRODUCTIVITY AND UTILIZATION OF RANGE PLANTS IN BAUCHI STATE

up in the dry season resulting in increased suffering of rural dwellers and low productivity of both domestic and wild fauna species.

CONCLUSION AND RECOMMENDATIONS

The biomass, productivity and utilization of range plants were generally lower in each of the other study sites than in YNP. This development should be checked and reversed, otherwise the present environmental degradation and loss of wildlife habitats (due to desertification, climatic changes, human activities and other factors) in the study sites may worsen thus increasing the suffering of rural dwellers and hindering wildlife productivity and conservation.

Environmental conservation education should be stepped up (using English and local languages) especially on the disadvantages of uncontrolled bush burning and indiscriminate cutting of vegetation. Also, rural dwellers should be encouraged to embrace both the taungya farming system and community tree plantation establishment for economic benefits and to check environmental resources damage. These measures may enable the native pastures and degraded range-lands to recover and improve.

REFERENCES

- AFOLAYAN, T.A. and AMUBODE, F. O. (1985): Stock assessment of larger mammals in Nigerian wooded savanna and its management implications. *Forest Ecol. And Management* 13: 257 - 263.
- COLLIER, F.S. (1934): The preservation of the fauna of Nigeria. *Nigerian Field* 4: 3 - 13, 51 - 62.
- ENE-OBONG, E.E. (1996): Bio-conservation and sustainable food production. *Proceedings of 5th Annual Scientific Conference of the Nigerian Society for Biological Conservation, Umudike*, 6 - 10 October, 1996 5 - 8.
- HALL, P. (1976): Priorities for Wildlife Conservation in North Eastern Nigeria. *Nigerian. Field*, 41: 99 - 112.
- HAPPOLD, D.C.D. (1987): *The Mammals of Nigeria*. Clarendon Press, Oxford, 384p.
- INAH, E.I. (1991): *Biological Values and Conservation of Wildlife Resources Outside game Reserves in Bauchi States, Nigeria*. Unpublished, Ph.D. Thesis, University of Ibadan 425p.
- INAH, E.I. (1993): Impacts of bush burning on desertification in Bauchi State, Nigeria: *Proceedings of the International Workshop on Natural and Man-made Hazards in Africa*. 30th January - 4th February, 1993 at Ikenga Hotel, Awka, Anambra State, pp 113 - 118.
- INAH, E.I. and AMUBODE, F.O. (1994): The effects of plants usage on tree height and canopy in Bauchi State, Nigeria. *Journal Trop. Forest Res.* 9 & 10: 20 - 28.
- JONES, G. (1979): *Topics in applied geography: Vegetation Productivity*. Longman, London, 100p.
- KEAY, R.W.J. (1959): *An Outline of Nigerian Vegetation*. 3rd Edn. Government Printer, Lagos. 35p.
- KOWAL, J. and D. KNABE (1972): *An agroclimatological atlas of the Northern States of Nigeria*. Ahmadu Bello University Press, Zaria, pp 94 - 99.
- MADGWICK, H.A.I. (1979): Biomass and Productivity Models for Forest Canopies. In: Reinchle, D.E. (ed). *Analysis of Temperature Forest Ecosystems*. Chapman and Hall, London. pp 47 - 54.
- SHRIMAL, R.L. and VYAS, L.N. (1975): *Net Production in Grassland at Udaipur, India*. *Ecol. Studies II Tropical Ecological Systems, Trends in Terrestrial and Aquatic Research* (eds) F.B. Golle and E. Medina, Springer Verlag, New York. pp 265 - 271.
- WILLIAMSON, G. and W.J.A. PAYNE (1978): 3rd Edn. *An Introduction to Animal husbandry in the Tropics*. Longman Group Ltd., London, 755p.