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Evaluation of Dry Season Diversity and Stocking Rate of Guyaku Grazing Reserve, Adamawa State- Nigeria.

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Target audience: Extension agents, forage agronomist, ruminant nutritionist

Abstract

An evaluation of dry season diversity and stocking rate of Guyaku Grazing Reserve in Gombi Adamawa State Nigeria was conducted from November to Marchss. Dry season diversity of herbaceous and woody plant species was determined using the Shannon Diversity Index Model. Stocking rate was estimated using the ratio of 60% of forage yield to animal requirement for a given period. Results showed that the reserve comprises of diverse herbaceous and woody plant spices with Shannon Diversity Index value of 2 200 and 3 129 for the herbaceous and woody plant species respectively. The mean yield of forage was 1 085 kg DM/ha and the estimated stocking rate was 0.5/TLU/ha/210 days. It was recommended that the range should not be stocked with more than 0.5/TLU/ha/ 210 days around the periods of November to May and controlled grazing plan for the reserve be abided by so as to improve cattle production in the region. Fodder bank development and fodder bank conservation are also highly recommended.

Keywords: Diversity, Grazing reserve, stocking rate

Description of the Problem

Forages have always provided the base upon which ruminant nutrition is built. Ruminants can utilize a wide range of feed resources but the bulk of their feed comes from forages hence they are primarily considered as forage consumers. In the tropics the natural pasture which supply the bulk of ruminants' feed becomes dry and of low nutritive value during the dry season leading to a marked decrease in voluntary intake and digestibility (1). Apart from that, the feeds in the region do not only become low in quality but the intensity of grazing noted may lead to the disappearance of species or suspension of growth (2); or the loss of herbaceous vegetation cover may be due to long dry season, overgrazing and bush fire (3) . Data on parameters such as diversity of woody and herbaceous plant species, herbage yield and stocking rate which serve as indices of the state of

health and vigor of a range in relation to its productive potentials (4) is lacking in Guyaku range. The absence of these data particularly those of forage diversity and yield disposes the range to overstocking and consequently to degradation due to overgrazing, destruction of grass roots as well as soil pulverization and compaction (5). This situation leads to the colonization of the range by undesirable species. Besides, lack of information on dry season forage availability and yield makes it impossible to determine the appropriate supplemental feed for balanced ration during the dry season. Hence, this study evaluated forage yvailability, diversity, yield and stocking rate of Guyaku grazing reserve.

Materials and Methods

The study area was Guyaku Government Grazing Reserve situated in Gombi Local Government Area of Adamawa State, Nigeria. The reserve lies between latitude 10^0 and $30^{'}$ North of the Equator and between longitude 12^0 and $30^{'}$E of the Green which Meridian (6). The vegetation of the reserve is Guinea Savannah. The temperature in the area ranges from 26.1^0C to 27.8^0C with minimum temperature of 18^0C and maximum temperature of 45^0C (7). The relative humidity is low (20-35%) and can go up to 80% around April to September. The annual rainfall ranges from 622.3mm to 1324.7mm with an average rainfall of 102.7mm (8). The reserve has a non-leached tropical and alluvia soil. Its agricultural potential is low (8). The terrain of the reserve is undulating with an altitude of 400-500m above sea levels; however some hills can reach up to 750m (6).

Study Design

The survey was carried out from November to December, 2013. This was done for the purpose of identifying and delineating major range sites (11). The study area was delineated into five blocks (A, B, C, D &E) which served as the range sites using natural futures such as reserve boundary, footpaths and streams. In each of the five blocks, a transect was established using the method of (12). Prismatic compass was used for determining the straight lines along transects of 2kms length. Natural features such as big trees and rocks were used for demarcating the transects along which sampling points were established. In addition, a one hectare plot was established in each of the five blocks (A, B,C, D and E) .

Data Collection Techniques

For the purpose of determination of herbaceous and wood species checklist and diversity indexes a total count of each species of woody plants(trees and shrubs) was made from the one hectare plot in each site and the average number for each species from the five plots was determined . The same procedure was used to obtain the average number of herbaceous plant species from $1m^2$ quadrats laid at random points along the transects

Herbage yield Determination.

Dry season herbage yield was

determined following Kallah (13) method. It involved cutting desirable herbage from within 1m2 quadrats randomly located along the established transects in the range sites (A, B, C, D and E). Cutting height varied from ground level to about 10cm above ground level. The cut samples were weighed immediately to obtain fresh weight and then put in sample bags for subsequent drying and weighing to a constant weight in order to obtain dry matter yield. The mean yield in gms for each range site was obtained by summing up the weights obtained from the quadrats along each transect. This was divided by the number of quadrats employed along the transect. The yield for the entire study area was extrapolated from the overall means of samples. Forage yield was converted from gm/m^2 to kg/ha.

Data Analysis

(1) Determination of Herbaceous and woody plant species diversity indexes

Assessment of species diversity of herbaceous and woody plant species was carried out using Shannon Diversity Index (11). The mathematical formula is stated bellow:

$$H' = - \sum_i^s pi \, In \, pi$$

Where

H' = Shannon Diversity Index

Pi = Fraction of Entire Population of species

S = No. of Species Encountered

In = Natural Logarithm

(ii) Determination of Stocking Rate

A determination of dry season stocking rate was conducted according to (15). A feed requirement of a matured zebu cow weighing 250kg which was estimated to consume 6.0kg dry matter per day was used. The amount of forage produced per hectare was reduced by 40% due to forage lost to wildlife, insects, animals' trampling and contamination, requirement for soil protection and the usual error associated with small plot (16). The assessment of stocking rate was conducted using the following;

1. Area of grazing reserve in (Ha); Total forage yield in (Kg), Useable forage (60% of total forage yield in kg); Animal requirement (6.0 kg for Zebu cow of 250kg weight); and grazing period. Therefore,

   Stocking Rate =

   $$\frac{\text{yield of useable forage/ha}}{\text{Total feed requirement by TLU for the period}}$$

   Where:

   TLU = Tropical livestock Unit

Table 1 Species diversity of herbaceous plants

S/No	Scientific name	No. of species	Pi	Inpi	-(pi in pi)
1	*Eragrostis tremula*	107	0.01	-4.61	0.046
2	*Dactyclotenium aegyptium*	246	0.03	-3.51	0.105
3	*Chloris pilosa*	228	0.02	-3.91	0.078
4	*Digitaria gayana*	100	0.01	-4.61	0.046
5	*Bracharia deflexa*	100	0.01	-4.61	0.046
6	*Pennisetum pedicellatum*	794	0.08	-2.53	0.202
7	*Loudatia simplex*	2909	0.31	-1.17	0.363
8	*Setaria pladefusca*	723	0.08	-2.53	0.202
9	*Aristida stipeides*	948	0.10	-230	0.230
10	*Ctenium newteni*	215	0.02	-3.91	0.078
11	*Hyperthelia dissolute*	1125	0.12	-2.12	0.254
12	*Cymbopogon giganteus*	281	0.03	-3.51	0.105
13	*Cyprus escolentus*	210	0.02	-3.91	0.078
14	*Stylosanthes mucronata*	121	0.01	-4.61	0.046
15	*Tephrosia bracteulata*	641	0.07	-2.66	0.186
16	*Crotolaria retusa*	100	0.01	-461	0.046
17	*Cassia tora*	101	0.01	-4.61	0.046
18	*Acanthuspermum hispidium*	100	0.01	-4.61	0.046
19	*Urena lobata*	100	0.01	-4.61	0.046
20	*Waltheria indica*	100	0.01	-4.61	0.046
21	*Borreria radiate*	100	0.01	-4.61	0.046

Total No. of species encountered ***= 9517***

(Source, field survey, 2013) *H=2.200*

Results and Discussion

The result of the checklist of herbaceous plant species indicated that they belonged to seven (7) families made up of twenty one (14) individual species some of which were present in all the five range sites (Tables 1and 2). The results showed that *Loudatia simplex* and *Hyperthelia dissoluta* had the highest species diversity indices of 0.363 and 0.254 respectively while *Aristida stipeides* had diversity index of 0.230 . The diversity index of 0.202 was recorded for *Pennisetum pedicellatum* and *Setaria pladefusca*. others were *Tephrosia bacteulata , Cymbopogon giganteus* and *Borreria radiate* with 0.105 each. The species *Chloris pilosa* and *Cyperus escolentus* had 0.078 diversity index each. The least diversity index of 0.046 was recorded for the following species *: Eragrostis tremula , Digitaria gayana , Bracharia deflexa*, *Stylosanthes mucronta , Urena Lobata and walteria indica*. Shannon Diversity Index for herbaceous plant species in the study area was 2.200.

Table 2 Species diversity of woody plants

S/No	Scientific name	No. of species	Pi	Inpi	-(pi in pi)
1	*Combretum fragrans*	86	0.09	-2.41	0.217
2	*Combretum glutinosum*	50	0.05	-2.99	0.149
3	*Anogeissus leiocarpus*	52	0.06	-2.81	0.169
4	*Butyrospermum paradoxon*	14	0.01	-4.61	0.046
5	*Annona senegalensis*	106	0.11	-2.21	0.243
6	*Piliostigma thonningi*	78	0.08	-2.51	0.202
7	*Uvaria chamae*	93	0.10	-2.30	0.230
8	*Terminalia lexiflora*	16	0.02	-3.91	0.078
9	*Terminalia avicennioides*	17	0.01	-4.61	0.046
10	*Combretum lacardii*	11	0.01	-4.61	0.046
11	*Ziziphus mauritiana*	10	0.01	-461	0.046
12	*Bridelia ferruginea*	10	0.01	-4.61	0.046
13	*Daniellia oliveri*	10	0.01	-4.61	0.046
14	*Tamarindus indica*	15	0.01	-4.61	0.046
15	*Carissa edulis*	10	0.01	-4.61	0.046
16	*Hymenocardia acida*	11	0.01	-4.61	0.046
17	*Daturium macrocapum*	37	0.01	-4.61	0.046
18	*Parinary curatilifola*	10	0.01	-4.61	0.046
19	*Combretum mole*	12	0.01	-4.61	0.046
20	*Balanies aegyptiaica*	59	0.06	-2.81	0.169
21	*Faidherbia albida*	40	0.04	-3.22	0.129
22	*Pseudocedrella kostchyi*	10	0.01	-4.61	0.046
23	*Diospyros mespiliformis*	10	0.01	-4.61	0.046
24	*Isobalimia tormentosa*	12	0.01	-4.61	0.046
25	*Gardenia erubscens*	10	0.01	-461	0.046
26	*Adamsonia digitata*	10	0.01	-4.61	0.046
27	*Parkia clappertoniana*	10	0.01	-4.61	0.046
28	*Stroychnus spinosa*	11	0.01	-4.61	0.046
29	*Kigelia Africana*	10	0.01	-4.61	0.046
30	*Afromosia laxiflora*	10	0.01	-4.61	0.046
31	*Xemenia Americana*	11	0.01	-4.61	0.046
32	*Ficus piatyphylla*	10	0.01	-4.61	0.046
33	*Vitex domiana*	10	0.01	-4.61	0.046
34	*Khaya senegalensis*	11	0.01	-4.61	0.046
35	*Commiphora africana*	10	0.01	-4.61	0.046
36	*Ficus sycomorus*	11	0.01	-4.61	0.046
37	*Ficus polita*	11	0.01	-4.61	0.046
38	*Hymenocardia acida*	10	0.01	-4.61	0.046
39	*Afzelia africana*	11	0.01	-4.61	0.046
40	*Pterocarpus erinaceus*	10	0.01	-4.61	0.046

Total No. of indivivuals encountered =944
(Source, field Survey, 2013) *H=2.200*

Results of woody plant species also indicated that *Annona senegalensis*, *Uvaria chamae and Combretum fragrans* had the highest species diversity indices of 0.242, 0.230 and 0.217, respectively. The diversity index of 0.202 was determined for *Piliostigma thonningii* while *Anogeisus*

leicarpus and *Balanite aegyptica* had diversity index of 0.169 each.

Similarly, *Detarium macocarpum* and *Faidherbia albida* had diversity index of 0.129 each. Also, *Terminalia laxiflora* and *Tamarindus indica* had diversity index of 0.078 each. The least diversity index of 0.046 was recorded for *Terminalia aviecenides, Combretum lacardii,Ziziphus acardii , Ziziphus Mauritania, Bridellia ferruginea, Daniellia oliveri, Carisa edulis, Hymenocardia acida and Parinary curatilifola.* The results are indicative of relatively equal and high diversity of plant species at both herbaceous and woody layers. Furthermore, when the species richness of herbaceous plants (14) obtained in this study is compared to that of Highveld of Swaziland where sixteen species were used(17), which was considered the highest among four(4) rangelands, it could be confirmed that the herbaceous plant species diversity in Guyaku grazing reserve is high. High diversity of species is an indication of resilient and stable ecosystem. The result of high diversity in resisting extreme disturbance such as fire and drought was reported by (13). They further observed that significant relationships exist between patterns of species richness and degree of stability. The result therefore, suggests that management and conservation measures such as reseeding and replanting, control of pest and diseases, prescribe burning, control of woody plants, grazing control and fertilization. This will eliminate factors that affect the health of rangeland ecosystem and influence upward trend. The high diversity values of herbaceous and woody plant species could have enabled the ruminant animals in the reserve meet their forage preference need according to (12). Also (12), reported a high vegetation diversity in a study in Highveld of Swaziland and opined that management practices such as reduction of livestock numbers, reseeding and rangeland rehabilitation programmers should be initiated to address the problem of communal grazing areas.

Table 3. *H*erbage Yield in the Study Area (g/m^2 quadrat)

Quadrat No.	A	B	C	D	E
1	50	124	136	160	50
2	140	157	191	85	60
3	120	153	95	103	65
4	245	185	60	68	0
5	190	142	128	92	56
6	50	160	120	170	125
7	95	95	150	115	60
8	122	143	95	0	65
9	100	0	88	115	60
10	225	160	0	160	95
Sub-totals	**1337**	**1319**	**1063**	**1068**	**636**
Means	**133.7**	**131.9**	**106.3**	**106.8**	**63.6**

Overall total = 5423 Overall means = 108,5gms Yield =1085kg/ha

(Sources field Survey, 2013)

The animals started depending on the woody browse plants from around November when the study started, but towards the middle of February most of the woody plants have shed off their leaves leaving the animals to scavenge on patches of grass roughages. This finding tallies with the report of (14) that animals depend on such low quality forage during the late dry season.

The forage yield from the study area though conducted during the dry season was 1085kg/Dm/ha which falls within the range of 1000-3500kg/Dm/h reported by (4), (9) and (15) for the Guinean Savannah Zone. The 9ha/TLU/day reported by (9) and the 11ha/TLU/day reported by (16) were above the estimated stocking rate of 0.5/TLU/ha/day or 2ha/TLU/day obtained from this study. The result obtained is also at variance with the 1/ha/TLU/day reported by (15) who conducted the research from August to October in the same reserve, when the yield of the forage species was expected to be high. Overall, the findings revealed a lower forage yield in the dry season with resultant lower stocking rate. The findings therefore suggest that adequate planning should be put in place for supplementary feeding of livestock during the dry season

Table 4. pasture indices and dry season stocking rate of Guyaku grazing reserve

S/N	Parametres	
1	Forage yield (kg/ha	1085
2	Area of grazing reserve (ha)	18125-3000=15,125(ha)
3	Total forage yield of grazing reserve (kg/DM)	16,410,625
4	Usable forage (60% of forage yield (kg/DM))	9,846,375
5	Animal requirement (Zebu cattle of 250kg live weight per day	6.0
6	Grazing period	210 days
7	Stocking rate of grazing reserve	(0.5TLU/ha/210 days

(Source field Survey, 2013)

Conclusion and Applications

The study showed that:

1. The diversity indices for both the herbaceous and woody plant species studied showed high Shannon Diversity Index values of 2,200 and 3,129, respectively.
2. The stocking rate of the reserve was 0.5/TLU/day or 2ha/TLU/day for the dry season (I,e from November 2013 to March 2014.
3. The low yield which resulted in low stocking rate is not unexpected as most of the forage plants reached their wilting point between December and March and fall off as litter, which are then trampled upon or grazed by wild animals.
4. The reserve should not be stocked with more than 0.5/TLU/day during the dry season i.e. from November to May.

5. Adequate supplementary feeding should be made available if the dry season stocking rate determined from this study is to be exceeded.

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