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DENSITY, DISTRIBUTION AND FEEDING STRATEGIES OF ROAN ANTELOPE (*HIPPOTRAGUS EQUINUS*) IN BORGU SECTOR OF KAINJI LAKE NATIONAL PARK, NIGERIA

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Abstract

The study examined the density, distribution, food and biomass of *Hippotragus equinus* in the Borgu sector of Kainji Lake National Park. Six 4 km × 4 km transects were constructed in the six identified vegetation communities in the Park. The transects were traversed twice a month for 12 months. Estimates were based on direct censusing techniques only. The results showed that a total of 26 groups of *H. equinus*, representing 308 individuals, were sighted in the Borgu sector of the Park. Riparian forest and woodland habitat harbour the highest population of nine groups of *H. equinus*. Sub-adult females constituted the highest *H. equinus* population structure in dry and wet seasons, with 29. 7 and 25.4 per cent of the population, respectively. *Hippotragus equinus* biomass in the park ranged between 5.8 and 60.1 kg km^{-2}, and population counts varied significantly ($P < 0.05$) between dry and wet seasons and between each habitat in the Park. Fourteen plant species are used for food by *H. equinus* in the Park, including *Andropogon gayanus, A. schirensis, A. tectorum, Hyparrhenia rufa, H. dissoluta, H. diplandra* and *H. cyanescens*. Their percentage crude protein and fat ranged between 4.8 and 8.8, and between 4.7 and 18.9, respectively. Measures to sustain the existing population of *H. equinus* in the Park are also discussed.

Résumé

AREMU, O. T.: *Densité, distribution et less stratégies d'alimentation d'antilope rouanne* (Hippotragus equinus) *au secteur Borgu du Parc National du Lac Kainji, au Nigeria.* Cette étude examinait la densité, la distribution, l'aliment et la biomasse de *Hippotragus equinus* au secteur Borgu du Parc National du Lac Kainji. Six 4 km × 4 km des section - transversales étaient construites dans les six communautés de végétation identifiées dans le parc. Ces sections transversales étaient traversées deux fois par mois pour 12 mois. Les estimations étaient basées sur les techniques de recensement direct seulement. Les résultats révélaient qu'une totalité de 26 groupes de *H. equinus* représentant 308 individus étaient apercevue au secteur Borgu du parc. La forêt riveraine et l'habitat de la zone boisée hébergent la population la plus élevée de 9 groupes de *H. equinus*. Les femelles subadultes constituaient la structure de population la plus élevée de *H. equinus* dans les saisons sèche et humide respectivement avec 29.7 et 25.4 pour cent de la population. La biomasse de *H. equinus* dans le parc variait entre 5.8 et 60.1 kg km^{-2} et la population comptable variait considérablement ($P < 0.05$) entre les saisons sèche et humide et entre chaque habitat dans le parc. Quatorze espèces de plante sont utilisées comme pâture par *H. equinus* dans le parc, y compris *Andropogon gayanus, A. schirensis, A. tectorum, Hyparrhenia rufa, H. dissoluta, H. diplandra*, et *H. cyanescens*. Leur pourcentage de protéine brute et de l'huile variait respectivement entre 4.8 - 8.8 et entre 4.7 - 18.9. Des mesures pour soutenir la population existante de *Hippotragus equinus* dans le parc sont également discutées.

Introduction

Kainji Lake National Park has diverse faunal resources which include 65 species of mammals, 420 species of birds, 34 species of reptiles, nine species of amphibians, and 50 species of fish (Ita, 1993; Park News, 1993). However, the Park's potential in game viewing and eco-tourism are often not realized due to illegal game poaching, habitat destruction, illegal grazing, and unregulated bush burning (Ayeni, 1980).

Enabor (1991) reported that several countries, including Nigeria, are exploiting their natural resources at levels that far exceed their sustainable productive capacity, due to pressure for income and economic development, and that such countries face the risk of total loss of income and, thus, a veritable source of wealth. David (1991) noted that greater understanding of ecological processes is essential if the earth's natural resources are to be conserved and sustained. Despite the importance of biodiversity to human beings, they have willingly or inadvertently caused a rare destruction of the ecosystem. Nsikan (1998) states that one of the most disturbing features of the ecosystem is the near extermination of species through unfriendly environmental activities of humans. These activities include destruction of habitats, unsustainable agricultural practices, over-exploitation of biological resources, industrialization, bush burning and poaching.

The World Tourism Organization (WTO, 1996) reported that wildlife-based tourism accounts for at least 6 per cent of the World Gross Domestic Product (WGDP) and employs 127 million people, and that by the year 2006, tourism will represent 11.5 per cent of the WGDP at US$ 7.1 trillion, employing some 385 million people.

Roan antelopes *(Hippotragus equinus)* are found in the northern and southern savanna (Estes, 1990). The weight of adult males varies between 242 and 300 kg while shoulder height ranges between 145 and 216 cm. Colouration is pale-gray to rufous, and nostrils are white. They are sedentary in small herds but they aggregate occasionally. They are grazers but may browse occasionally. Under favourable conditions, (apparently) throughout its range, *H. equinus* reproduces every 12 months, mating within a few weeks of calving. Gestation period is 270-287 days. Its natural enemies include lions *(Panthera lea)* and leopard *(Pantera pardus)* (Estes, 1990).

The objectives of the study were to determine the relative abundance, distribution, feeding strategies, and biomass of *H. equinus*. The study was also intended to recommend conservation strategies for the existing population of *H. equinus* in the Park.

Experimental

Study area

The Kainji Lake National Park (9°40^1 - 10° 30^1 N; 3° 30^1 - 5° 50^1 E) has a total land area of 5,340.83 km^2 with Borgu sector comprising 3,970.83 km^2 (74.3 %) and Zugurma sector covering 1,370 km^2 (25.7 %). The vegetation of the Borgu sector has been described as northern savanna (Keay, 1989). According to Afolayan (1978), the six main vegetation communities in the Borgu sector are (i) *Burkea africana/Detarium microcarpum* woodland savanna, (ii) *Diospyros mespliformis* dry forest, (iii) Riparian forest and woodland, (iv) *Terminalia macroptera* tree savanna, (v) *Isobelinia tomentosa* woodland, and (vi) *Isobelinia doka* savanna woodland. The Oli river flows from the Republic of Benin through Borgu sector into the Niger river. In the dry season, the river breaks into pools, which hold water throughout the year and serve as the only source of water for the wild animals. Long-term average annual rainfall is between 900 and 1,100 mm. The Park has diverse faunal resources including *Papio anubis, Kobus kob, Hippopotamus amphibius, Syncerus caffer, Panthera leo, Panthera pardus,* and *Hippotragus equinus.* Floral resources in the Park include *Burkea africana, Terminalia avicennoides, Diospyros mespliformis, Anogeissus leiocarpus, Entanda africana,* and *Vitex doniana* (Ayeni, Afolayan & Ajayi, 1982).

Survey techniques

Six 4 km × 4 km transects were laid in the six identified vegetation communities with a total effective study area of 96 km^2. Each transect was left untouched for 4 days after construction before data collection to reduce human disturbance and to allow wild animals to return to their initial home range. Each transect was traversed twice a month for 12 months in both dry and wet seasons, from 7.00 a. m. to 1.00 p. m. and from 4.00 p.m. to 7.00 p. m. (local time), with an average walking speed of 2.5 km h^{-1}. Periods of walking were interspersed with periods of rest and quiet to increase the possibility of detecting animals that might hide or flee upon the approach or movement of the observers.

The individuals were counted conservatively by including only individuals seen. Binoculars (Zeiss Dialyt 10 × 40) were used to observe and detect the presence of *H. equinus*. Animals sighted were identified as outlined and described by Jean & Pierre (1990). Information collected on any individual *H. equinus* sighted included date and time sighted, habitat, sex, sighting distance and population structure such as numbers of adult males and females, sub-adult males and females, and juveniles. Four basic assumptions were made as recommended by Burnham (1980), Seber (1982) and Dunn (1993) as follows: (i) animals are seen before they flee, (ii) no animal is counted twice, (iii) sighting of *H. equinus* does not depend on sighting other animal species, and (iv) all animals are distributed at random with respect to the transect.

Hippotragus equinus biomass was estimated as follows: individual km^{-2} × adult height (kg individual^{-1} × 0.75) = kg km^{-2} (Dunn, 1993). Mean adult weight of 240 kg was used as recommended by Estes (1990). All data collected were subjected to oneway analysis of variance (ANOVA) at $P<0.05$ significant level (Stelle & Torrie, 1980). Plant species eaten by *H. equinus* were collected and pressed and later compared with standard (certified) prepared herbarium at the Forestry Research Institute of Nigeria (FRIN), Ibadan, Nigeria, for plant identification (Soladoye, 1996). Plant proximate composition was determined by Weende's analysis through the Kjeldahl procedure (AOAC, 1990). Body size, shape and appearance of horns, presence of male genital organs and udders were used to determine *H. equinus* sex (population structure) such as adult males and females, sub-adult males and females, and juveniles (Dunn, 1993).

Results

The results showed that riparian forest and woodland habitat harbour the highest population of *H. equinus* in dry and wet seasons with a total of 154 individuals, followed by *Burkea africana/ Detarium microcarpum* habitat with a total of 38 individuals. *Isobelinia doka* savanna woodland recorded the least total population of *H. equinus* with 12 individuals. Also, the mean group size ranged between 6 and 18. A total of 182 and 126 *H. equinus* were sighted in dry and wet seasons, respectively, in all the six vegetation communities in the Park (Table 1). Sub-adult females constituted the highest percentage of *H. equinus* population in the Park, ranging between 25.4 and 29.7 per cent, followed by adult females, which ranged between 23.8 and 25.3 per cent. Adult males recorded the least, ranging between 10.4 and 11.9 per cent of the population (Table 2).

The highest *H. equinus* biomass was recorded in riparian forest and woodland habitat (60.1 ± 5.6 kg km^{-2}), followed by *Diospyros mespliformis* dry forest habitat with 25.4 ± 4.9 kg km^{-2}. The least biomass of 5.8 ± 2.2 kg km^{-2} was recorded in both *Terminalia macroptera* tree savanna and *Isobelinia doka* savanna woodland habitats (Table 3). The 14 plant species used for food by *H. equinus* included *A. gayanus, A. schirensis, A. tectorum, H. rufa, H. dissoluta, H. diplandra, H. cyanescens, Panicum maximum,* and *Cymhopogon giganteus* (Table 4). Their percentage crude protein ranged between 5.7 and 8.8, while percentage fat ranged between 5.1 and 6.4, and percentage crude fibre ranged between 24.9 and 30.4 (Table 5).

Discussion

The highest population of 15 groups of *H. equinus* was sighted in the dry season, with the wet season recording 11 groups (Table 1). This might be because visibilities were usually improved during the dry season when most thickets were opened up and animals trekked long distances in search of forage and water. These results support an earlier report (Onadeko, Shotuyo & Meduna, 1998) that seasons affect distributions of wild animals. Also, riparian forest and woodland habitat harbours the highest population of *H. equinus* in dry and wet seasons in the Park. This may be due to the availability of water from Oli river throughout the year, especially during the dry season when other sources in the Park have dried up. In addition, the habitat provides cover, breeding space and food for the wildlife species, a result consistent with that of Aremu, Elekhizor & Obasogie (2001).

The least abundance and distribution of *H. equinus* in *Terminalia macroptera* tree savanna and *Isobelinia doka* savanna woodland habitats in dry and wet seasons (a total of four groups) could be attributed to these habitats being in the upland area of the park, where sources of water and desirable plant species for food are limited. This supported the view of Afolayan (1978) that habitat qualities influence distribution and abundance of wild animals in a conservation area. The highest *H. equinus* biomass recorded in the riparian forest and woodland habitat (60.1 kg km^{-2}) could be due to the high abundance of *H. equinus* in the habitat. Although the relative abundance of *H. equinus* recorded in the Park in the dry and wet seasons (0.16 ± 0.09 and 0.13 ± 0.04 group km^{-2}) could be regarded as fairly low considering the size of the Borgu sector of the Park (3,970 km^{-2}), this may be attributed to high poaching activities and habitat destruction through indiscriminate burning of vegetation as observed in the Park. Population counts vary significantly ($P < 0.05$) between the dry and wet seasons, and between each habitat, which means

TABLE 1

Relative abundance and distribution of H. equinus *in dry and wet seasons in Borgu sector of the Park*

	Dry season				*Wet season*			
Habitat	*GS*	*I*	*MGS*	*CI*	*GS*	*I*	*MGS*	*CI*
Ba/Dm/w	2	20	10 ± 1.71	2.4-3.5	2	18	9 ± 1.5	3.7-5.8
Dmdf	3	36	12 ± 1.74	1.8-2.1	2	20	10 ± 1.4	1.8 -3.4
Rfw	5	90	18 ± 1.83	4.2-4.9	4	64	16 ± 1.07	2.4 -3.8
Tmts	1	14	14 ± 1.28	2.7-3.2	1	12	12 ± 1.53	3.2-5.4
Itw	2	16	8 ± 0.78	0.9-2.1	1	6	6 ± 1.63	1.8-3.2
Idsw	1	6	6 ± 0.92	3.7-4.2	1	6	6 ± 1.84	2.7-3.6
Total	14	184			11	126		

Dry season relative abundance 0.16 ± 0.09 group km^{-2}

Wet season relative abundance 0.13 ± 0.04 group km^{-2}

Ba/Dm/w – *Burkea africana* / *Detarium microcarpum* woodland savanna, Dmdf – *Diospyros mespliformis* dry forest, Rfw – riparian forest and woodland, Tmts – *Terminalia macroptera* tree savanna, Itw – *Isobelinia tomentosa* woodland, Idsw – *Isobelinia doka* savanna woodland, GS – group sighted, I – individuals, MGS – mean group size, CI – confidence interval.

TABLE 2
Population structure of H. equinus *in dry and wet seasons in Borgu sector of the Park*

	Dry season						*Wet season*					
Habitat	*AM*	*AF*	*SAM*	*SAF*	*J*	*n*	*AM*	*AF*	*SAM*	*SAF*	*J*	*n*
Ba/Dm/w	3	6	2	5	4	20	2	5	2	4	5	18
Dmdf	4	8	5	10	9	36	2	6	3	4	5	20
Rfw	7	21	13	31	18	90	7	14	8	17	18	64
Tmts	2	4	1	3	4	14	2	3	1	4	2	12
Itw	2	5	2	3	4	16	1	1	1	2	1	6
Idsw	1	2	0	2	1	6	1	1	1	1	2	6
Total	19	46	23	54	40	182	15	30	16	32	33	126
Mean	3.17	7.67	3.83	9.0	6.67	30.33	2.5	5.0	2.67	5.33	5.5	21.0
Percentage	10.4	25.3	12.6	29.7	21.98		11.9	23.8	12.7	25.4	26.2	

AM – adult males, AF – adult females, SAM – sub-adult males, SAF – sub-adult females, J – juveniles, n – number sampled, Ba/Dm/w – *Burkea africana / Detarium microcarpum* woodland savanna, Dmdf – *Diospyros mespliformis* dry forest, Rfw – riparian forest and woodland, Tmts - *Terminalia macroptera* tree savanna, Itw – *Isobelinia tomentosa* woodland, Idsw - *Isobelinia doka* savanna woodland.

TABLE 3
H. equinus *biomass in Borgu sector of the Park*

Habitat	*Biomass (kg km^{-2})*
Ba/Dm/w	19.5 ± 4.94
Dmdf	25.4 ± 4.90
Rfw	60.1 ± 5.87
Tmts	9.8 ± 2.38
Itw	7.8 ± 3.66
Idsw	5.8 ± 2.15

Ba/Dm/w – *Burkea africana / Detarium microcarpum* woodland savanna, Dmdf – *Diospyros mespliformis* dry forest, Rfw – riparian forest and woodland, Tmts – *Terminalia macroptera* tree savanna, Itw – *Isobelinia tomentosa* woodland, Idsw– *Isobelinia doka* savanna woodland.

that habitat quality determines distribution and abundance of wildlife species.

Andropogon and *Hyparrhenia* grass species recorded the highest percentage use when compared to other plant species. This could be attributed to the grass species being very abundant in the Park, containing high percentages of crude protein and fat (ranging between 5.7 and 8.8, and 5.1 and 6.4, respectively), making them to be preferred by *H. equinus*. This supported an earlier report by Agbelusi & Alokan (1993) that wild animals usually preferred plants with high percentage crude protein and fat.

Conclusion

The remaining population of *H. equinus* in the Park needs to be adequately protected and conserved so that the species will not be totally eradicated. The population of *H. equinus* could

TABLE 4
Plant species eaten by H. equinus *in Borgu sector of Kainji Lake National Park*

Plant species	*Part (%) utilization*
Andropogon gayanus	YL (5.5 %), ML (3.8 %)
Andropogon schirensis	YL (6.5 %), ML (3.5 %)
Andropogon tectorum	YL (7.4 %), ML (3.7 %)
Hyparrhenia rufa	YL (5.2 %), ML (3.4 %)
Hyparrhenia dissoluta	YL (5.0 %), ML (3.1 %)
Hyparrhenia diplandra	YL (3.8 %), ML (3.0 %)
Hyparrhenia cyanescens	YL (4.1 %), ML (3.5 %)
Panicum maximum	YL (3.8 %), ML (3.2 %)
Braciliaria brachylopha	YL (3.8 %), ML (3.0 %)
Cymbopogon giganteus	YL (3.1 %), ML (2.8 %)
Echinocloa obtusiflora	YL (3.2 %), ML (2.9 %)
Bekeropsis uniseta	YL (3.7 %), ML (3.1 %)
Burkea africana	YL (1.1 %), ML (2.8 %)
Vitalaria paradoxum	F (2 %)

YL – young leaves, ML – mature leaves, F – fruits

TABLE 5
Proximate composition of plant species eaten by H. equinus *in Borgu sector of Kainji Lake National Park*

Plant species	*% CP*	*% Fat*	*% CF*	*% Ash*	*% NFE*
Andropogon gayanus	8.7	6.4	25.1	8.7	51.1
Andropogon schirensis	8.5	6.2	28.2	9.4	47.7
Andropogon tectorum	7.9	6.0	30.0	10.1	46.0
Hyparrhenia rufa	6.7	5.8	32.4	11.1	44.0
Hyparrhenia dissoluta	6.1	5.7	24.9	10.7	52.6
Hyparrhenia diplandra	5.7	6.1	2.9.4	13.1	45.7
Hyparrhenia cyanescens	8.8	6.2	24.9	10.0	50.1
Panicum maximum	6.4	5.7	28.8	12.4	46.7
Braciliaria brachylopha	6.0	5.1	27.6	8.4	52.9
Cymbopogon giganteus	5.0	5.4	30.1	13.1	45.5
Echinocloa obtusiflora	5.7	5.9	25.7	12.7	50.6
Bekeropsis uniseta	5.2	4.7	26.2	14.2	47.9
Burkea africana	6.0	4.8	22.8	18.7	47.1
Vitalaria paradoxum	4.8	18.9	22.7	8.8	44.8

% CP – percentage crude protein, % CF – percentage crude fibre, % NFE – percentage nitrogen-free extract.

then build up to sustain the effective breeding population size soon. *Hippotragus equinus* identified territories need to be improved by providing more desirable plant species for food. Also, poaching activities should be controlled without delay. Habitat destruction through indiscriminate burning of vegetation and illegal grazing should be controlled to improve the level of existing *H. equinus* population in the Park.

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