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Abundance, Distribution and Feeding Habit of Western Hartebeest in Borgu Sector of Kainji Lake National Park, Nigeria

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ABSTRACT
The study assessed abundance, distribution and feeding habits of western hartebeest in Borgu Sector of Kainji Lake National Park, Nigeria. Six plant habitats/associations were used for data collection. Six transects of 5km in length were laid in the habitats. Data collected were subjected to King Census model, descriptive statistics and food preference ranking. The results obtained showed 296 individuals recorded with absolute population density of 6.00/km^2 ·Distribution of individuals were 168, 62 and 66 for adults, sub-adults and juveniles with 152 males and 144 females. Habitats distribution of species indicated *Isobelia afzelia* hosting higher animal species (31.41%) while *Burkea africana-Detarium microcarpum* had the lowest (6.76%). For plants parts utilized, grasses, leaves and stems were mostly utilized (15.22%) than tree leaves and seeds (2.17%). Grasses/forbs were preferred (63.64%) than trees and shrubs (36.96%). Abundance and chemical composition/analysis of the preferred forage in the study area is highly recommended.

Keywords: Hartebeest, abundance, distribution, feeding habit, food preference

INTRODUCTION

Western hartebeest is a large high shoulder, deep-chested antelope with long legs, a short neck and a very long, narrow face. The horns are carried on hollow bases or pedicles and show considerable variation from individual to individual and from region to region. Coloration also shows considerable regional variation (Red black in Kalahari, Tan in East Africa, and Golden brown in West Africa) and also individual variation, especially in the *korkay* from Europe. The animal is classified as follows: Kingdom- Animalia, Phylum-chordate, Class- mammalian, Order-Artiodactyla, Family- Bovidae, Genus-*Alcelaphus*, Species- *buselaphus* (IUCN, 2007). Hartebeest are found commonly in all the African grassland and savanna. The short pedicelled more conservative sub species *toro*, *korkay* and *kongoni* live in NE Africa, the Khama in the Kalahari and the Kanki in West Africa have high pedicel and are more advanced (Dunn, 1999). Although regional differences are substantial, hartebeest are consistent everywhere in being grazers that live on boundaries between open grassy plains or glades and parkland, woodland or shrub often on shallow slopes. They go to water regularly but territorial male go without water for quite long periods (Fingesi & Oladebo, 2017). Population estimate of wild animals provide basic information on the success of a particular animal in a given

ecosystem. The knowledge of population helps in habitat assessment for the purpose of management, especially in protected areas like the national parks, game reserves and their equivalents (Kwaga *et al.,* 2017; Adeola *et al.,* 2018). Furthermore, the goal of global mammalian species assessment is to consolidate available information on the systematic distribution, habitat requirement, ecology, life history and conservation status of mammals (Thomas *et al*., 2009). In Nigeria, many wild animal species are becoming extinct as a result of changes in their natural habitats. An environmental organization called Friends of the Earth has identified Nigeria as one of the areas where tropical rain forest is being lost at the rate of over 402,000 hectares per annum. This is a serious threat to our wildlife heritage (Khobe & Kwaga, 2017).

The study on abundance, distribution and feeding habits western hartebeests with respect to different habitat types is important since it will provide an understanding on the wildlife species abundance, diversity and distribution within natural and human occupied habitats (Khobe & Kwaga, 2017). The diets of hartebeest contained low-quality culm material, which could result in dietary stress unless enhanced mastication permitted them to obtain sufficient nutrients to sustain themselves (Spencer, 1995). Roan antelope switched from using grass-leaf regrowth to browse species, especially legumes that produced new leaves and started flowering in March and April when most other browse species were still dormant. The notable decrease of browse (except *Jasminium kerstingii*) in diets of both antelopes when rains returned in June suggested that browse was not a preferred forage but one of necessity and further attested to the classification of species as grass feeders (IUCN, 2000; Ajayi &

Idumah, 2010). Feeding behavior and diet selection in wildlife is driven by the quantity and quality of available food in consonant with the nutritional needs of the animal. For instance, Coyotes are carnivores adapted to eating small animals (mice, voles, etc.) during most part of the year. However, when insects, fruits, and berries are abundant in summer, as much as 80% of a coyote's diet will consist of these food items, (Greg- Smith, 2009). The preference of these diets are probably related to presence of awn spines, hairiness, position of leaves, stickiness texture, but the ultimate determinants of preference is the plant characteristics that stimulates a selective animal response. Presumably, chemical composition is the most important factor in their diet selection. Although western hartebeest are herbivores, they occasionally supplement their diet, and feeding strategies are correlated with body size. Preference may be expressed in terms of proportionate time an animal spends grazing different species, (Fay *et al.,* 2007). There is scanty substantial information on the abundance, distribution and feeding habits/preference on western hartebeest in the Borgu Sector of Kanji Lake National Park, hence the necessity for this study.

MATERIALS AND METHODS

Study Area

Borgu Sector which formed part of Kainji Lake National Park (KLNP) is located between Latitudes 9° 40' 0" N to 10^{o} 20' 0"N and Longitudes 3° 40' 0" E to 4^{o} 20' 0"E in the North West central part of Nigeria between Niger and Kwara States, with a total area of 3,970km^{2} (Figure 1). The Park was established in 1979 by the merger of two former Game Reserves, Borgu Game Reserve and Zurguma Game Reserve. The two sectors had been gazetted in 1962 and 1971 respectively as game reserves by the then Northern Regional Government (Marguba, 2002).

The climate exhibits a wet season which begins around mid-April and ends early November giving about seven months, and a dry season which extends between November and April. The mean annual rainfall is 1100 – 1200mm and the number of rainy days averages about 200 days. The temperature ranges between 18^{0} C and 30^{0}C. The mean temperature during the wet season is about 30^{0}C and drops to about 28^{0}C during the dry season, being affected by the north east harmattan winds. The average relative humidity is 53% but reaches up to 98 % in August through September (Maratayi, 2019). The vegetation is that of Northern Guinea Savanna. However, ecologists recognize five savanna sub types in Borgu Sector of the Park namely the *Diospyros mespiliformis* dry forest, Oli River complex, Riparian Forest/woodland, Isoberlinia Woodland, *Burkea*

africana, *Detarium microcarpum* woodland (Maratayi, 2019). Wild animal species of Borgu Sector of Kainji Lake National Park is typical of those large mammals associated with the guinea savanna of West Africa. Presently, about 13 artiodactyl species, 10 carnivores and 5 primate species represent the large mammals of Borgu Sector of KLNP. There are also 3 reptile species. Common herbivores include the Western Hartebeest (*Alcelaphus buselaphus*,), Senegal kob (*Kobus kob*), Hippopotamus (*Hippopotamus amphibious*) and Oribi (*Ourebia ourebi*), The carnivorous species include Lion (*Panthera leo*), Genet cat (*Genetta tigrina*); and Spotted Hyaena (*Crocuta crocuta*). Olive Baboon (*Papio anubis*) and Patas monkey (*erythrocebus patas*) are the common primate species of the Park while Monitor lizard (*Varanus niloticus*) and Nile crocodile (*Crocodylus niloticus*) are the representative reptiles in the Park (Maratayi, 2019).

Data Collection and Analysis

The study design followed the method described by Fingesi and Oladepo (2017) and adopted by Kwaga *et al.* (2020). Reconnaissance survey of the area was carried out in order to assess the types of vegetation existing in the study area. The preliminary investigation led to the sub- division of the entire study area into various vegetation zones and species associations. Six (6) transects of 5km in length each were laid in the study area, a transect was laid in each habitat type. Bukar Shuaib/ *Isoberlina* mixed woodland**,** Hussaini Mashi/ *Isoberlina tomentosa* woodland**,** Kali/ *Burkea africana, Detarium micocarpum wooded savannah***,** Olusegun Obasanjo/ *Isobelia, Afzelia* mixed woodland, Shehu Shagari/ Riparian forest and Mamudu Lapai/ *Afzelia africana* woodland (Saka *et al.*, 2015). Information on Western hartebeest abundance/population in the study area was determined in March to August, 2019. The King's census technique as described by Anderson *et al*. (2001) and adopted by Akosim *et al.* (2007) for census. This method involved the researcher and his assistant walking along transects and *Alcelaphus buselaphus* sighted on both sides of transects recorded in each case. Equally, the information on species distribution/ structure of the species was determined along the established transects. The number of sighted (adult males, adult females, sub – adult males, sub-adult females, juvenile males and juvenile females) animals were noted and their frequencies obtained following Fingesi and Oladepo (2017) patterns. There were two censuses per day; one in the morning (6:00 am- 11:00 am) and the other in the evening (4:00pm to 6:00 pm). The sighting distance from the observer to the animal was recorded. The perpendicular distance from transect to the animal sighted was also recorded. Habitat/ vegetation type, time of sighting, animal number were recorded following Fingesi and Oladepo (2017. Regarding the feeding pattern of the species, direct observation method as described by Kwaga *et al.* (2017) was adopted. Binoculars were used to observe the Western hartebeest at their feeding sites which was also followed by on the spot inspection of the plants utilized by the animal for the purpose of identification. Preference ranking was done using the frequencies of utilization of the different species and time spent feeding on each preferred species of forage following Saka *et al.* (2015).

The king's census formula was used for the analysis of Western hartebeest population density using DISTANCE Program 7.3 software package. The King's census formula is stated as follows:

$D=\frac{n}{2L\hat{f}}$. Where,

D=the absolute density'

n=Total number of individuals of Western hartebeest encountered.

L= Length of the transect cut and

$\hat{f}$= Average sighting distance (Anderson *et al.*, 2001).

(ii) Calculation of standard error of the mean.

Standard Deviation (X) = $\sqrt{\frac{\sum_{k=1}^{n}(x_k-\mu)^2}{n}}$

Standard Error (S.E) = $\frac{\sigma}{\sqrt{N}}$(Soper, 2015)

S = Standard deviation and σ = Standard error of mean.

Food and feeding habit/ preference ranking

Food preference ranking was determined following Joel (2016). The formula is illustrated as follows:

$P=\frac{x_{i-t}}{y_{l-t}} X \frac{100}{1}$ Where;

P = Preferred food/forage

x_{i-t} = number of times a species was fed on

y_{l-t} = total number of times all the species were fed on.

The values of food preference calculated were ranked according to their order of magnitude (Joel, 2016).

RESULTS

Abundance of Western hartebeest in the Study Area

The result of abundance/absolute estimate of population density of Western hartebeest in the study area Kainji is presented in Table 1. A total of 296 of the specie were detected. The detectability of species was within an effective strip width (ESW) of 60.00m, at a probability of $p = (0 \geq 1.00 \leq 1)$. The result indicated an absolute population density of 1.196 individuals/km^2 and Standard Error of 0.41, while the abundance was 6.00 with a percent coefficient variation of 34.89 and confidence interval of 0.58 - 2.46.

Table 1: Absolute Population Density of Western hartebeest (No/km^2)in the study area.

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95% Percent Confidence Interval	
A(1)	0.1000E+07	0.1701E+15			
f(0)	0.16667E-01	0.34019E-02	20.41	0.99151E-02	0.28016E-01
p	1.0000	0.20412	20.41	0.59491	1.0000
ESW	60.000	12.247	20.41	35.694	100.86
DS	0.23810E-01	0.71143E-02	29.88	0.12405E-01	0.45699E-01
E(S)	50.267	9.0551	18.01	31.752	79.576
D	1.1968	0.41758	34.89	0.58028	2.4684
N	6.0000	2.0934	34.89	3.0000	12.000

Key: (I) = i-th parameter in the estimated probability density function(pdf)
f(0) = 1/u = value of pdf at zero for line transects
p = probability of observing an object in defined area
ESW = for line transects, effective strip width = W*p
D = estimate of density of animals
N = estimate of number of animals in specified area
Source: Field Survey, 2019.

Distribution of Western hartebeest based on habits/Vegetation Associations

The result of distribution of Western hartebeest based on habits/Vegetation associations in the study area is presented in Table 2. Out of a total number of 296 species sighted, 93 were recorded at Olusegun Obasanjo track/*Isoberlina, afzelia* mixed woodland, 49 at Hussaini Mashi track/ *Isoberlina tomentosa* woodland, 39 at Shehu Shagari track/ Riperian vegetation, 39 at Bukar Shuaib track/*Isoberlina* mixed woodland, 20 at Kali track/ *Burkea africana - Detarium micocarpumwooded savanna* and 56 at Mamudu Lapai track/ *Afzelia* africana woodland.

Table 2: Abundance of Western hartebeest according to transects/ vegetation types

S/N	Transect	Vegetation Zone	No. Sighted	Percentage
1	Bukar Shuaib	*Isoberlina* mixed woodland	39	13.18
2	Hussaini Mashi	*Isoberlina tomentosa* woodland	49	16.55
3	Kali	*Burkea africana - Detarium micocarpum* wooded savanna	20	6.76
4	Olusegun Obasanjo	*Isoberlina, afzelia* mixed woodland	93	31.41
5	Shehu Shagari	Riparian forest	39	13.18
6	Mamudu Lapai	*Afzelia Africana*	56	18.92
Total			296	100

Source: Field Survey, 2019.

Age distribution/Structure of Western Hartebeest in the Study Area

The results of age population distribution/ structure of the species in the study area is shown in Table 3. The result indicated a total number of the 296 sighted. Out of these, Adult males were sighted more with a population of 87; Adult female had total number of 81 while Sub adult male and females were 29 and 33 respectively. Male juvenile population stood at 36 while that of the female juvenile was 30.

Table 3: Age Population distribution/ structure of Western hartebeest in the study area.

S/N	Adult	Sub Adult	Juvenile	Total
Male	87	29	36	152
Female	81	33	30	144
Total	168	62	66	296

Source: Field Survey, 2019.

Feeding patterns by Western Hartebeest in the Study Area

The result of the findings in Table 4 shows that out of the 46 times of feeding, 29 was spent feeding on grasses while 17 was spent on browsing. This reveals that the species prefer grazing than browsing and as such, could be categorized more of grazers. *Andropogon gayanus* was the highest frequency of utilization of 7, at 15.22% utilization and the 1st in ranking followed by *Panicum maximum* with frequency of 5, at 10. 90% and 2nd in ranking while *Andropogon tectorium, Hyperrhenia dissolute, Sateria barbata* had frequencies of 4 at 8.70% and 3rd preference ranking. *Pennisetum poystachium, Vitellaria paradoxa, Combretum molle* and *Annona senegalensis* had frequencies of 3 each at 6.52% and 4th in ranking while *Hyperrhenia rufa, Piliosigma thoningii, Gardenia aquala* and *Gardenia sokotoemsis* had frequencies of 2 each at 4.35% and 5th in ranking and *Anogeisius leiorcarpus* with *Afzelia africana* had frequencies of 1 each at 2.17% and 6th in ranking.

Table 4: Species and Plant Parts Fed Upon by Western hartebeest

S/N	Family Name	*Scientific Name*	Common Name	Status	Part Utilized	Frequency of Utilization	Percentage Utilization (%)	Preference Ranking
1	Poaceae	*Andropogon gayanus*	Gamba grass	Grass	Leaves, stem	7	15.22	1
2	Poaceae	*Andropogon tectorium*	Giant blue stem	Grass	Leaves, stem	4	8.70	3
3	Poaceae	*Panicum maximum*	Guinea grass	Grass	Leaves, stem	5	10.90	2
4	Poaceae	*Pennisetum poystachium*	Feathery	Grass	Leaves, stem	3	6.52	4
5	Poaceae	*Hyperrhenia rufa*	Thatching grass	Grass	Leaves, stem	2	4.35	5
6	Poaceae	*Hyperrhenia dissolute*	-	Grass	Leaves, stem	4	8.70	3
7	Poaceae	*Steria barbata*	Bristly foxtail grass	Grass	Leaves, stem	4	8.70	3
8	Caesalniaceae	*Azelia Africana*	Counter wood	Tree	Leaves, seeds	1	2.17	6
9	Caesalniaceae	*Piliostigma thonningii*	Cap stigma	Shrub	Leaves, Pod	2	4.35	5
10	Sapotaceae	*Vitalaria paradoxa*	Shea butter	Tree	Seeds, fruits	3	6.52	4

11	Combretaceae	*Combretum molle*	-	Shrub	Leaves	3	6.52	4
12	Rubiaceae	*Gardenia aquala*	-	Shrub	Leaves	2	4.35	5
13	Rubiaceae	*Gardenia sokotoemsis*	-	Shrub	Leaves, Fruits	2	4.35	5
14	Annonaceae	*Annona senegalensis*	Senegal Annona	Shrub	Fruits	3	6.52	4
15		*Anogeisius leiorcarpus*	-	Tree	Leaves	1	2.17	6
Total						**46**	**100**	

Field Survey, 2019.

Feeding and Food Preference of Western hartebeest in the study area.

The result of feeding and food preference and or plant parts preferred by Western hartebeest is shown in Table 5. Grazing was found to be higher (63.04%) than browsing (36.96%). As regards the type of food/feed preferred by Western hartebeest the in the study area, grasses and forbs were preferred (29) than trees and shrubs (17).

Table 5: Food Preference of Western hartebeest According to Food Class

S/N	Activity	Class of Feed	Frequency	Percentage
1	Browsing	Tree/Shrub	17	36.96
2	Grazing	Grass/Forb	29	63.04
Total		46		100%

Field Survey, 2019.

DISCUSSION

The finding regarding abundance/absolute estimate of population density of Western hartebeest in the study area has been encouraging. Although the finding on the abundance of these species from this study are comparatively lower than that from previous surveys in the study sites, however, this finding, however, is contrary to the result of Fingesi and Oladebo, (2017) which had a density of 21.169 individuals/ km^2. This variation can be attributed to the high influx of cattle grazers as well as armed bandits in the Park which had probably led to migration by the animals.

The finding on the distribution of Western hartebeest based on habits/Vegetation associations in the study area has not come as a surprise given the nature of association of the existing habitats. The finding regarding distribution of the species showed that, species are not evenly distributed across the area. The reason could be that some habitats are rich in forage species than others, thus affecting the distribution of the species under study. The finding partially agrees with that of Fingesi and Oladepo (2017) but in contrast to Saka *et al.* (2015) who had similarbut separate studies on abundance and distribution of Western hartbesest at Kainji Lake and Gashaka Gumti National parks.

Findings on age population distribution/ structure of the species in the study area consists of adult males and females and their juveniles. The findings revealed that adult males were higher than females. The implication is that there is likely going to be little recruitment of offspring's into the next population. The findings of this study agrees with that of Adeola, *et al*. (2018) in a separate study at Old Oyo National Park and also that of Saka *et al.* (2015) who had similar studies of the species at Gashaka Gumti National Park

The findings on feeding patterns by Western hartebeest in the Study Area indicated that grazing was more prominent than browsing. This reveals

that the animal species prefer grazing than browsing and as such, could be categorized more of grazers. *Andropogon gayanus* was the highest in ranking followed by *Panicum maximum*. Others include *Andropogon tectorium, Hyperrhenia dissolute, Sateria barbata* had 3rd preference ranking. *Pennisetum poystachium, Vitellaria paradoxa, Combretum molle* and *Annona senegalensis* are 4th in ranking while *Hyperrhenia rufa, Piliosigma thoningii, Gardenia aquala* and *Gardenia sokotoemsis* were 5th in ranking and *Anogeisius leiorcarpus* with *Afzelia africana* being the 6th.

The findings on the food type and plant parts preferred by Western hartebeest has not changed significantly compared to other studies. Grazing was found to dominate browsing in their feeding patterns. Equally, they are found to feed on leaves and stems of grasses during grazing but fed on leaves, fruits and seeds during browsing. The above observation in this study is in agreement with that of Saka *et al*. (2015) and Kwaga *et al*. (2017) who made similar observation in a related study at Gashaka Gumti National Park and Sumu Wildlife Park in Taraba and Bauchi States respectively regarding feeding ecology of western hartebeest and Giraffes. From the findings of this study, it is suffice to say therefore that western hartebeests are more of grazers than browsers

CONCLUSION

The research focused on the abundance, distribution and feeding habits of western hartebeests in Borgu Sector of Kainji lake National Park, Nigeria. Plant habitats/associations were used for data collection through the establishment of transects. The results obtained indicated a reasonable number of individual species. Their distribution per individuals were adults, sub-adults and juveniles respectively. There were higher number of male than females recorded Frequent feeding were noted on *Andropogon gayanus* and less on *Afzelia africana/Anogeissus leiocarpus*. More of the plant parts were consumed by the animal species through grazing than browsing. Research on the abundance and chemical composition/analysis of the preferred forage species in the study area is highly recommended.

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