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ASSESSMENT OF THE ABUNDANCE AND DISTRIBUTION OF WESTERN HARTEBEEST (*Alcelaphus buselaphus*) IN SOUTHERN SECTOR OF GASHAKA GUMTI PARK, NIGERIA

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ABSTRACT

This study assessed the distribution and abundance of Western hartebeest (Alcelaphus buselaphus) in Gashaka Gumti National Park. Information on the abundance and distribution of Western hartebeest as well as their problems were examined. Stratified sampling procedure was adopted, in which three (3) line transects of 1 km length were laid at interval in each of the study area. The result revealed that Western hartebeest abound in each of the habitat, with a total population of 508 animals with a density of 1.92/km^2. The ANOVA result shows no significant difference among the zones in terms animals composition and distribution of the studied species ($P > 0.05$). The present population structure of Western hartebeest is heavily a promising future in the park. It was observed that poaching, loss of habitat and cattle disturbance are the major environmental challenges threatening their survival. New strategy of anti-poaching patrols and public enlightenment should be adopted and recommended in order to address the environmental factors militating against the survival of Western hartebeest.

Keywords: Distribution, Assessment, Abundance**,** Western hartebeest, Anti-poaching

INTRODUCTION

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 tropical rain forest wildlife heritage (NEST, 1991).

Today, wildlife is under pressure everywhere and the major and current threats to wildlife loss and the most dangerous of all causes, is that of habitat destruction. According to Oates and Anadu (1982), in every minute over 20 hectares of the world's rain forest are destroyed and, if the devastation continues at this rate, most of the forest will become waste land by the year 2015. Conservation is the management of human use of the biosphere so that it may yield the greatest sustainable benefit to the present generations while maintaining the potentials to meet the needs and aspirations of future generations (Ayodele *et al*., 1999). The modern concept of conservation, which is the wise maintenance and utilization of the earth resources is no more than the combination of these two ancient principles; the need to plan resources management on the basis of accurate inventory; and the need to take protective measures to ensure that resources do not become exhausted (IUCN, 1986). Bolen and Robinson (1999) emphasized the human component, defining wildlife management as the application of ecological knowledge to populations of vertebrate animals and their plant and animal associates in a manner that strikes a balance between the needs of these populations and the need of the people. Several approaches can be used to manage wildlife including preservation, conservation, and management (Anderson, 1999; Anderson *et al*., 2002).

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 (45-83cm) 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 Ethiopia. According to Kingdon (1997), the weight measurement of male and female varies: The female weight ranges between118-185kg, while that of male is between 125-218kg male.

In an effort to protect global biodiversity and encourage the study, restoration, and sound management of endangered species, the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Conservation Monitoring Centre (WCMC) maintain a global list of endangered and vulnerable animal species called the Red List which assesses the status of, and threats to, animal species worldwide. Also to add to this and other biodiversity databases, non-governmental organizations such as Conservation International and World Wildlife Fund conduct periodic rapid assessments of wildlife species (Noss, 2007).

According to Wakirwa (1998) there is increased pressure particularly from farmers to eliminate wild animals such as Western hartebeest despite the government's warnings and efforts to preserve the species. In Gashaka Gumti National Park the present population number of Western hartebeest is not certain and the population dynamics and sex ratios are unknown. Also their behaviour and general ecology present a matter of speculations. The lack of information on the general ecology of Western hartebeest in the study area makes their conservation and management very difficult, there is therefore, the need to study the distribution and abundance so as to provide part of the information that will help in taking more accurate management decision on the species in the conservation area.

Human encroachment into the wildlife habitat for illegal activities such as poaching has been contributing to the reduction in the population of western hartebeest. The solution therefore is embracing preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment. These will go a long way checking the rate of environment deterioration and loss of wildlife habitat, and also enable government to plan for the general management of the species in order to boost game meat and sustainable utilization of the resource.

The assessment of wild animal population such as Western hartebeest is essential in order to measure progress and plan for future conservation action. It is necessary to determine whether the utilization of the animal resources is truly sustainable or not. The study on the abundance and distribution of western hartebeest in Gashaka Gumti National Park will help us to know the area or habitat type, the species richness in the park. This will help in determining the consequences of poaching, food shortage and disease outbreak, so as to facilitate proper western hartebeest conservation in the park. The study aims to assess the abundance and distribution of western hartebeest in Gashaka Gumti National Park, Nigeria.

METHODOLOGY

Study Area

Gashaka Gumti National Park is the largest and most diverse park in Nigeria, covering an area of approximately 6,671sq. km, and is split between Adamawa and Taraba States. It's located in the Northeast of Nigeria between latitudes $6^{0}55'$ and $8^{0}05'$N, and between longitudes $11^{0}11'$ and $12^{0}13'$E with the Federal Republic of Cameroon as its eastern border (Figure 1). The park's name is derived from two of the region's oldest and most historic settlements: Gashaka village in Taraba State, and Gumti village in Adamawa State. Gashaka Gumti National Park was created (along with other seven national parks) by Decree No. 36 of August, 1991, and repealed by Decree N0. 46 of 1999 (now Act) by the merging of Gashaka Game reserve with Gumti Game Reserve (Magurba, 2002).

The pattern of climatic zones in the study area is distorted by the influence exerted by highland areas that are located throughout the region and beyond (Pepeh and Nicholas, 2002). This results in increased rainfall on the crests and western flanks of these mountain ranges and low rain shadow to the east. Annual rainfall within the park ranges from 1200mm in the north to 3000mm in the southern region. Wet season is normally experienced from April to November, and dry season from December to

March. In December period, there is always a low temperature at night time, and ranges from 10-15^{0}C, while, in March and April, the temperature is as high as 40^0-43^{0}C in the daytime. Temperature can be much cooler at higher altitudes and during the harmattan period that occurs from November to March (Pepeh and Nicholas, 2002).The region can be divided into two major physiographic provinces. The plains of the Benue valley which lie to the west and north of the region, predominantly below 300m above sea level and the Adamawa Highlands situated to the south and East of the park. Thus, the southern sector is predominantly mountainous, with Nigeria's highest peak, Chappal Waddi, lying on border with Cameroon at 2,442m above sea level. The northern park area is made up of rolling hill up to 900 m above sea level (GGNP, 1998).There are three basic soil types in the Park: soils derived from basement complex rocks; soils derived from volcanic rocks and those that are derived from alluvial origin in river valleys (GGNP, 1998). The topographically induced rainfall regime or pattern closely correlates with the vegetation type of the region. Bawden and Tuley (1966) identified four main vegetation zones: Lowland Rainforest, Montane Rainforest, Montane Forest, Grassland and Savanna Woodland. (Figure 2.)

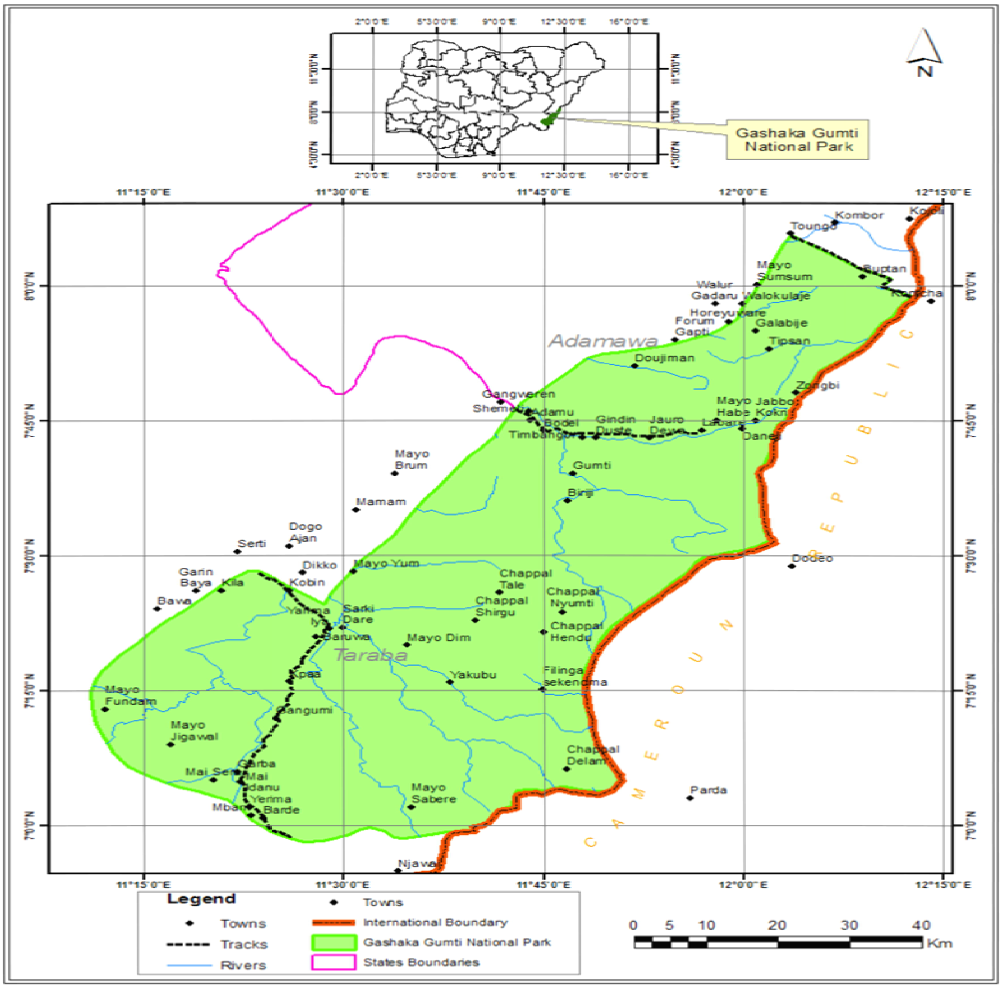

Figure 1: Map of Gashaka Gumti National Park showing the study sites. Source: (GGNP Management Plan, 1998).

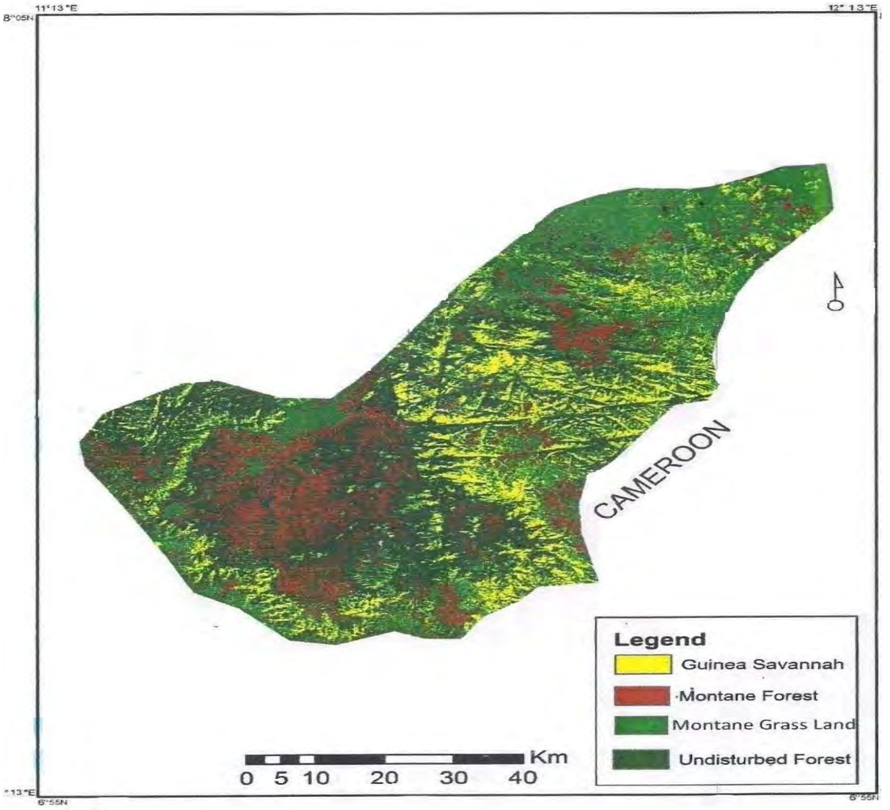

Figure 2: Vegetation Map of GashakaGumti National Park.
Source: Nigeria Sat –X National Space Research and Development Agency (NARSDA, 2013)

Study Design and Data Collection Techniques

The study was carried out in the Southern sector of the park. Three (3) lines transect of 5 km distance long each were randomly laid in selected locations in the southern sector of the park as follow:

i. Transect 1 – Mayo Kpa'a – Mayo Bam
ii. Transect 2 – Maidanu Road – Mashayin Zafi
iii. Transact 3 – Beacon 655 – Confluence of Mayo Kam and Mayo Jarandi

In addition, fifty (50) copies of questionnaires were also administered to the five (5) ranges of the southern sector of the park to solicit information about the park.

Western hartebeest inventory

Direct method of census was used. Line transects were established using a stratified random sampling procedures (Plumtre and Reynolds, 1994). The transects were walked at approximately 2.5km per hour,5 days in the month from March to May, counting all groups of western hartebeest sighted along the transect. The distance from the transect line to the centre of the groups was estimated, and the number of the animal sighted in the group was recorded (Plumtre and Reynolds, 1994; White, 1994). Also, additional information were collected on the sex of species, number of individuals sighted, sighting distance and the species activities when first sighted.

Data Analysis

The population density of *A.buselaphus* was estimated, using the program DISTANCE 5.0 (Thomas *et al*., 2006).

Half normal key model (Equation 1 and 2) as discussed by Buckland *et al,*. (2001) and Thomas *et al.* (2009) were used to calculate the abundance of Western Hartebeest in the study area. The model is of the form:

Half-normal key K(y) = exp(-y**2/(2* A(1)**2)) ------ (1)

Half-normal key (K(y) = (y**2/(2* A(1)**2)) ---------- (2)

Model evaluation The half-normal key model was used to evaluate the density and abundance of the western hartebeest in the study area. Model with a lower value of Akaike Information Criteria (AIC) was selected as the best equation. In addition, one-way analysis of variance was used to test variation between species distribution and the vegetation zones (Equation 3).

$$Y_{ijk}= \mu + T_I + \sum_{ij} \text{ -------------------- } (3)$$

Where:

Y_{ijk} = Total sum of observations.

μ = General mean

T_j = effect of j treatment

$\sum_{ij}$ = the error associated with the experiment

RESULTS

Assessment of Abundance of Western Hartebeest in the Study Area

The findings from this study indicated that there are 127 Western hartebeest sighted in the sampled area (1000 km^2). Out of this 127 Western hartebeest sighted, 95(74.80%) were adults and the remaining 32(28.2%) were young animals. Therefore, the extrapolation of the sighted hartebeest with the total land mass of the Southern sector of park gave a total population of 508Western hartebeest. The estimation of animal abundance and density shows that, the Effective Strip Width (ESW) was 52.174m i.e. to both left and right side of the transect. The density of the *A. buselaphus* in the study area was estimated as 1.92 per km^2, with a standard error of 0.40, while, the abundance was 13.00 with a standard error of 2.74 (Table 1).

Table 1: Estimation of Animal Density and Abundance

Parameter	Point estimate	Standard error
A(1)	60.92	43.94
F(0)	0.19	0.40
P	0.86	0.18
ESW	52.78	10.98
D	1.92	0.40
N	13.00	2.74

Source: Field Survey 2014

where:

A(I) = i^{th} parameter in the estimated probability density function(pdf)

F(0) = Value of pdf at zero for line transects

P = probability of observing an object in defined area

ESW = Effective Strip Width (for line transects) = W*p

D = Density of animals

N = Number of animals in specified area

Detection FCT/Global/ Plot

The result of the Quantile-quantile (Qq) plots of half normal model, fitted to the line transect data, shows that the model fit was less satisfactory, indicating no clear evidence of rounding in the observation at the beginning of the observation (less than 0.6). This indicates evidence of too few detection of animals close to the transect line, which was relative to what could have been expected under the half normal model. Also, the histogram (Figure 3) shows the frequency distribution of the observed animals, with the red line indicating the best fit function. The sighted animals very close to the transect (Figure 4) are low in population, and increases with increase in distance (at highest distance of 40m), while, fewer animals were observed as the distance increases up to 60m.

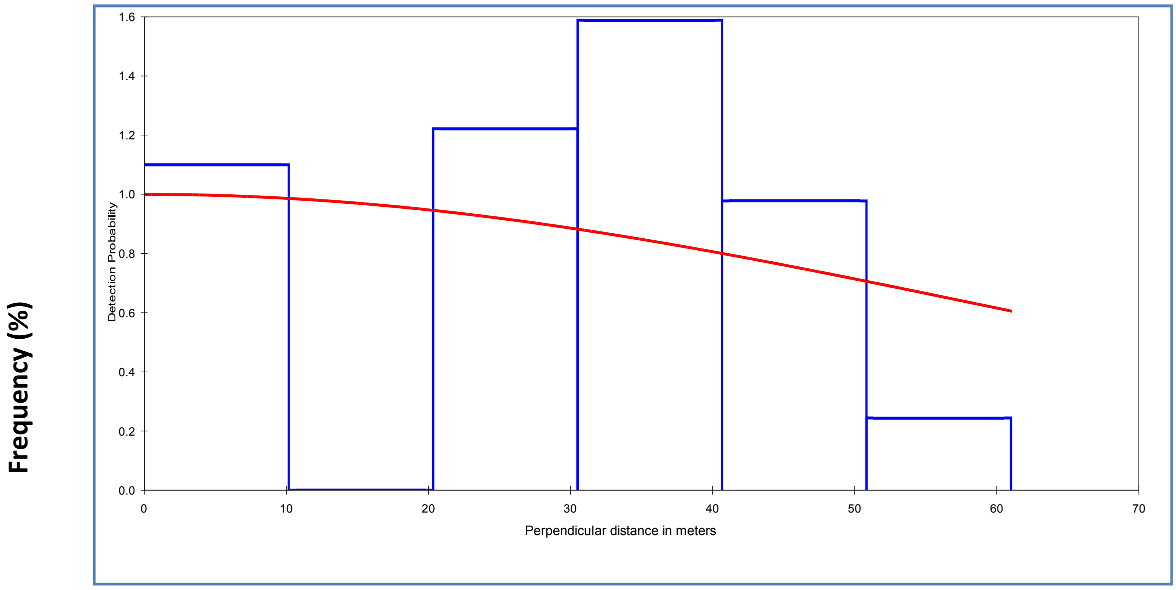

Figure 3: Histogram showing the frequency distribution of Western hartebeest

The result of analysis of variance (ANOVA) (Table 2) shows that, there is no significant difference in the distribution of hartebeest among the transects. This indicated that the animals are widely and evenly distributed in the park.

Table 2: ANOVA for the Transect/Zones

Source of Variation	Sum of Square	Degree of freedom	Mean square	F Calc.	P Value	F Crit.
Transect	12.9047	2	6.4523	0.7188	0.4936	3.2381$^{n.s}$
Error	350.0714	39				
Total	362.9762					

n.s = Not significant

Environmental Challenges

Out of the 50 copies of the questionnaire administered, 37 respondents (74%) attributing poaching to be the biggest environmental challenge threatening the survival of Western hartebeest. Also 8 (16%) and 5 (10%) respondents attributed loss of habitat and disturbance by cattle as others environmental factors respectively (Appendix 1: Table 3).

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Figure 4: Number of Animals Sighted along the Transects.

Table 3: Environmental Factors Affecting Western Hartebeest

S/No	Factor	No. of respondent	Percentage (%)
1	Poaching	37	74
2	Loss of habitat	8	16
3	Disturbance by cattle	5	10

DISCUSSION

The result from this study indicate that the population density (d) of Western hartebeest is 1.92km^2 with an abundance (n) of 13.00 and effective strip width (ESW) of 50.174m. This result shows an increase in the population of the W. hartebeest as against that reported by Gawaisa, (2006); Akinyemi and Kayode, (2011) that the population density (d) of Western hartebeest was1.7 ± 0.4 km^2 and 0.07km^2 in GGNP and old Oyo National park respectively. The increase in the population density of the species implies that the awareness on wildlife conservation by the Government is yielding a positive result, as these has help in reduction in number of poachers and hunters terrorising the park.

The findings from this study as indicated in Figure 6 shows the quantile fits known as quantile-quantile (Q-Q) plot corresponding to fits of a half normal line transact data. In this result the model fit seems less satisfactory indicating that there is no clear evidence of rounding at the beginning of the observation (0.0-0.6) and in addition, the result shows evidence of too few detection (shown as dashed line, which represents the average number of detection per area) close to the transect line, relative to what would be expected under the half-normal model as presented by Buckland *et al.* (2001) which stated that in the plot of the fit of a detection function model to the data if they follow the same distribution, then a plot of the quantiles of the first variable against the quantile should follow a straight line (dash line and solid line). But here the fitted cumulative distribution function (cdf) is shifted systematically above zero than the empirical distribution function (edf). These suggest that proper care should be taken whenever distance data is being collected, and all record and calculation should be close to accurate. Animals should be sighted and recorded quickly before they started running away and ensure that distances are measured without errors. The method also require that a large number of transects are used and that the location of these is random and independent of the animal location. All these will help to arrive at good fit (Buckland *et al*. 1993).

The study also revealed that frequency of the observation was very low close to the transact and increase with increased in distance up to at 40m beyond which it records fewer and fewer observation to reach the maximum at the distance of60m. Beyond 60m the pattern of observation was not so clear; this may due to visibility bias caused by visual impediments and observer error. Hence, Buckland*et al.* (2001), suggested that truncating with caution at 60m that is about 5% of the observations is often reasonable, so as to give good fit. The highest number of hartebeest was recorded along Mai Idanu road to Mashayin Zafi. However the result of the analysis of variance (ANOVA) indicated there is no any significant difference among the transect, thus, the Western hartebeest are widely and evenly distributed in the park.

Despite the fact that the population of Western hartebeest is relatively modest, western hartebeest are still being faced with some environmental challenges. Hartebeest have reduced markedly in number across their range, as their distribution has been increasingly fragmented, as a result of poaching for meat and expansion of settlement and livestock (IUCN, 2001). As it has already occurred most of the rest of the species former range, are currently decreasing because of poaching as it is occurring in the study area. The population is likely to become fragmented until they are confined to areas where there is effective control of poaching and encroachment by livestock and settlement. In spite of the various anti-poaching patrol techniques employed in order to curb the menace of poaching in the National Park, the prevalence of poaching activities was very conspicuous during this study, as poacher's camps and foot prints were found at certain part of the park. Gawaisa (2006) recorded also an evidence of poaching activities in the park and these activities include foot prints of poachers, poacher's camps and gun shots. Influx of cattle into the park is also a problem of concern to the survival of hartebeest. The incursion of cattle into the park in the dry season and of recent raining season has forced the animals to hide in secluded areas and also emigrate from the park. Gawaisa (2002) pointed out that each dry season, large numbers of livestock from other parts of the country are attracted to the park for pasture and water and this influx has caused the migration of some animals as a result of disturbance. Deforestation around the park results in habitat fragmentation which in turn results in animals migrating, dying or being killed, Gawaisa (2006). During the study, it was observed that many areas that used to be the buffer zone (land adjacent to the park) has been cleared thereby reducing the home range and habitat of some animals

CONCLUSION

The family *Acelaphinae* in which the western hartebeest *A.buselaphus* belongs is on the present global conservation focus. The increase in pressure, particularly from hunters to eliminate wild animal, such as western hartebeest, despite the government's warning and efforts on conservation of wildlife species. Therefore, there is a need for more knowledge on its abundance and the problem facing the species in protected areas. The proper conservation and management of the species, it's habitat, ecology and abundance is necessary for its sustainability in the protected areas such as Gashaka Gumti National Park.

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