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POPULATION DENSITY AND DISTRIBUTION OF COMMON LARGE HERBIVORES ALONG TOURIST ROADS IN GONAREZHOU NATIONAL PARK, SOUTHEAST ZIMBABWE

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ABSTRACT

The aim of this study was to establish the population density and distribution of common large herbivores along tourist roads in northern and central Gonarezhou National Park, Zimbabwe. Distance sampling method was used to collect data for density and distribution of common large herbivores in April 2012. Seven transects (tourist roads) with a total of 176 km were surveyed, i.e., four transects in northern Gonarezhou and three in central Gonarezhou. A total of 17 large herbivore species were recorded. The distribution of the large herbivore species varied among transects in northern and central Gonarezhou. Larger herbivore species were more distributed in northern Gonarezhou compared to central Gonarezhou. However, there were no significant differences in the densities of common large herbivores between the two study strata in Gonarezhou (Mann-Whitney *U* test, all $P > 0.05$). We recommend the fencing of park sections where there is high human-wildlife-livestock interactions as this will help to reduce illegal hunting of animals and forage competition among wildlife and livestock, thus expanding the spatial distribution of large herbivores in Gonarezhou National Park.

Keywords: Distance Sampling, Conservation, Protected Area, Human-wildlife-livestock interactions

1. INTRODUCTION

Savannas are characterized by high herbivore diversity that is heterogeneously distributed in space and time (du Toit and Cumming, 1999; Olff *et al*., 2002; Cromsigt *et al*., 2009). The high faunal diversity and herbivore biomass in savannas are directly linked to the high spatial heterogeneity of these ecosystems, apparently through ungulate habitat specificity that varies with body size (du Toit and Cumming, 1999; Hopcraft *et al*., 2012). Counting mammals by either direct observations or indirect (nest and faecal) surveys produces density and distribution estimates which are vital for decisions regarding the degree of protection afforded to a species, the size and management of protected areas (Thomas, 1991; Gaidet-Drapier *et al*., 2006; Dunham, 2012).

Recent studies in Gonarezhou National Park, Zimbabwe suggest that there has been noticeable habitat modification from fires, herbivores and past human activities, leading to the decline of canopy woodlands and herbaceous plant cover in some habitats

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(e.g., Gandiwa & Kativu, 2009). Changes in the structure and composition of some woodlands can result in the loss of prefered habitats of some wildlife species hence affecting their density and distribution (Gandiwa, 2013). Most communal areas in south-eastern Zimbabwe are associated with human population increase which leads to encroachments into wildlife areas, and increased dependency on natural resources for livelihood, which often results in habitat loss and degradation, thus influencing wildlife abundances and their distribution (Gandiwa *et al*., 2011, 2013). Livestock grazing inside Gonarezhou and illegal hunting has led to habitat deterioration and displacement of wild herbivores (Gandiwa *et al*. 2011, 2013). Therefore, the aim of this study was to estimate the population density and distribution of common large herbivores along tourist roads in northern and central Gonarezhou National Park.

2. MATERIALS AND METHODS

2.1 STUDY AREA

This study was carried out in the northern and central Gonarezhou National Park (Fig. 1). Gonarezhou covers an area of about 5,053 km². Altitude varies between 165 and 575 metres above sea level. Three seasons can be recognized in the study area: hot and wet (November to April), cool and dry (May to August) and hot and dry (September to October). Average maximum and minimum temperatures are 29 ºC and 19 ºC respectively based on the data recorded in 2011. Average rainfall for 2011 was 579 mm. Three major perennial rivers pass through Gonarezhou National Park, which are Save, Runde and Mwenezi.

The major vegetation type is mopane (*Colophospermum mopane*) woodland, which covers approximately 40% of the park, other vegetation types such as Acacia wood-

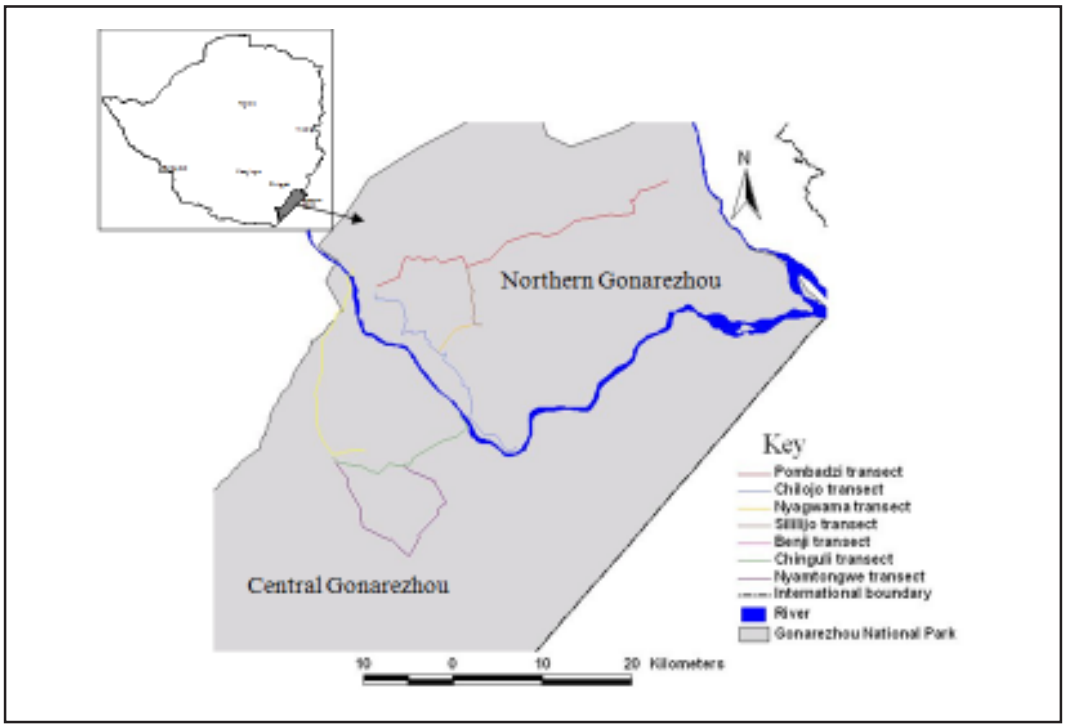

Fig. 1: Location and outline of road transects surveyed in northern and central Gonarezhou National Park, Zimbabwe.

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land, Combretum woodland, Brachystegia glaucesens, *Androstachys johnsonii* and *Spirostachys africana* do occur. There is a wide variety of large herbivore species in the Gonarezhou National Park and these include African elephant (*Loxodonta africana*), hippopotamus (*Hippopotamus amphibius*), buffalo (*Syncerus caffer*), giraffe (*Giraffa camelopardalis*), plains zebra (*Equus quagga*), waterbuck (*Kobus ellipsiprymnus*), roan antelope (*Hippotragus equinus*), sable (*Hippotragus niger*) and wildebeest (*Connochaetes taurinus*). The park has a number of large carnivores such as African lion (*Panthera leo*) and spotted hyena (*Crocuta crocuta*).

2.2 DATA COLLECTION

Distance sampling method was used to collect data for animal densities and distribution (Buckland *et al.,* 1993; Durant *et al*., 2011). Distance sampling is a method used to estimate the density of a population based on the distance of the observer to the animal (Buckland *et al.,* 1993). Large mammalian herbivores have been defined as having an adult mass of e" 10kg (Nowak, 1991). Olff *et al.,* (2002) further defined large mammals as animals having a body weight of > 2kg. For this study large herbivore is defined as having a weight e" 5kg. Surveys were conducted to gather data on animal abundances and distribution along tourist roads in two sections of Gonarezhou, namely northern and central divided by the Runde River. Seven transects (or tourist roads) were sampled, four in northern Gonarezhou: Pombadzi, Chilojo, Nyagwama and Sililijo and three in central Gonarezhou: Benji, Chinguli and Nyamutongwe. A total of 176 km was covered during the survey. The roads selected were distributed so as to cover as much of the park as possible. Counts were conducted by three observers, one recorder and one driver, beginning between 7:00 and 9:00 am in the morning and 2:00 and 5:00 pm in the afternoon in April 2012. The vehicle moved at between 30 and 40 km per hour. For each sighting, the position was marked using a Garmin 60 Geographic Position System (GPS) unit, species, number of animals, angle of sighting and sighting distance.

2.3 DATA ANALYSIS

Animal densities were calculated by dividing the number of animal sighted for each species in each transect by the mean sighting distance, transect length and transect width (sum of left and right side of the transect). Mann-Whitney *U* test was used to establish whether densities of these species differed between the northern and southern Gonarezhou using STATISTICA version 6 for Windows (Stat Soft, 2001). Geographical Information System Arc View 3.2 software for Windows was used in the analysis of animal distribution.

3. RESULTS

3.1 Population densities of common large herbivores

Seventeen animal species were recorded in this present study. Highest densities of common duikers (*Sylvicapra grimmia*) were sighted in Benji transect (Table 1). Highest densities of impala (*Aepyceros melampus*), warthog (*Phacochoerus aethiopicus*), waterbuck *(Kobus ellipsiprymnus*) and wildebeest (*Connochaetes taurinus*) were sighted in Chinguli transect. Elephant and nyala (*Tragelaphus angasii*) were sighted in high densities in Chilojo transect and grysbok (*Raphicerus melanotis*) in Sililijo transect. Baboon (*Papio ursinus*), monkey (*Cercopithecus aethiops*) and bushbuck (*Tragelaphus scriptus*) were only sighted in Chilojo transect. Reedbuck (*Redunca arundinum*) were only sighted in Pombadzi transect and klipspringer (*Oreotragus oreotragus*) in Sililijo transect. Overall, there were no significant differences in the densities of animals sighted between the northern and central Gonarezhou (Mann-Whitney *U* test, all $P > 0.05$).

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Table 1: Densities of all the sighted animals in the seven transects in Gonarezhou National Park, Zimbabwe.

Common name	Scientific name	Animal density (per km²)						
		Pombadzi	Chilojo	Nyagwama	Sililijo	Benji	Chinguli	Nyamutongwe
Browsers								
Kudu	*Tragelaphus strepsiceros*	7.90	5.56	1.77	0.39	0.38	1.86	0.00
Common duiker	*Sylvicapra grimmia*	0.96	0.00	0.72	0.00	0.76	0.63	0.00
Grysbok	*Raphicerus melanotis*	0.23	0.00	1.18	3.40	0.00	0.00	0.00
Klipspringer	*Oreotragus oreotragus*	0.00	0.00	0.00	0.58	0.00	0.00	0.00
Steenbok	*Raphicerus campestris*	0.07	0.00	0.00	0.00	0.38	0.00	0.30
Bushbuck	*Tragelaphus scriptus*	0.00	0.10	0.00	0.00	0.00	0.00	0.00
Grazers								
Warthog	*Phacochoerus aethiopicus*	0.11	0.38	0.00	0.00	0.57	0.93	0.00
Waterbuck	*Kobus ellipsiprymnus*	0.00	3.42	0.00	0.00	1.14	6.86	0.00
Zebra	*Equus quagga*	0.53	0.39	0.00	3.40	0.00	0.00	0.00
Wildebeest	*Connochaetes taurinus*	0.57	0.71	0.00	0.00	0.00	31.25	0.00
Reedbuck	*Redunca arundinum*	0.13	0.00	0.00	0.00	0.00	0.00	
Hippopotamus	*Hippopotamus amphibious*	0.00	0.00	0.00	0.00	2.28	0.00	0.00
Mixed feeders								
Elephant	*Loxodonta Africana*	0.36	3.98	0.00	0.19	2.58	1.56	0.61
Impala	*Aepyceros melampus*	17.95	32.32	48.76	7.48	36.38	175.31	0.00
Nyala Omnivores	*Tragelaphus angasii*	0.11	0.96	0.00	0.00	0.00	0.00	0.00
Vervet Monkey	*Cercopithecus aethiops*	0.00	1.55	0.00	0.00	0.00	0.00	0.00
Chacma Baboon	*Papio ursinus*	0.00	1.33	0.00	0.00	0.00	0.00	0.00

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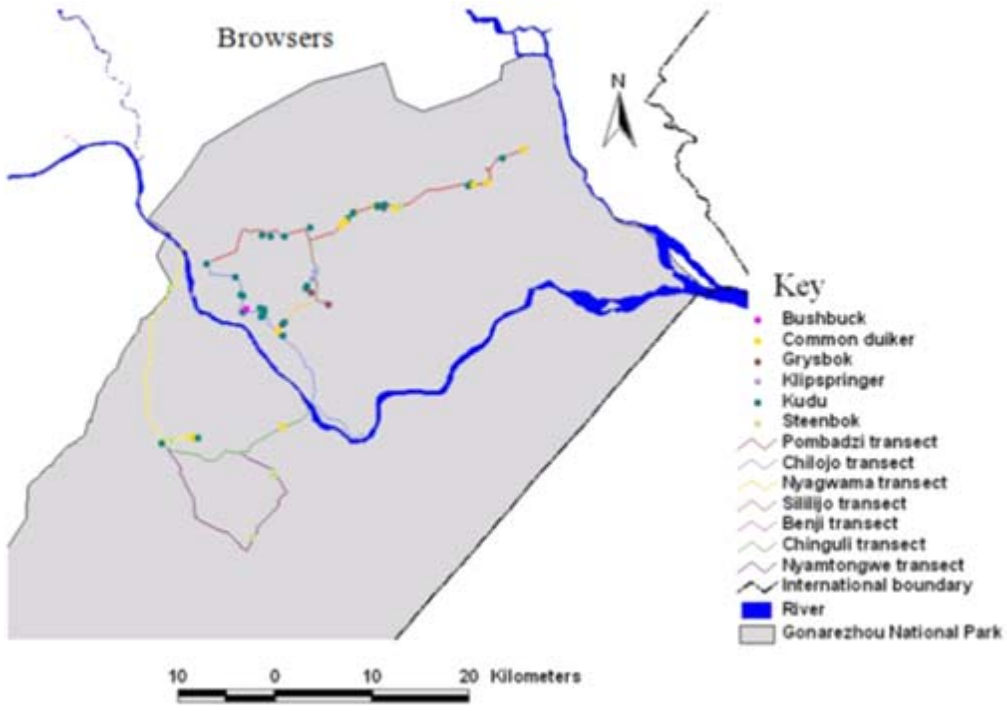
3.2 Distribution of common large herbivores in northern and central Gonarezhou

Most of the animal species were sighted in the northern Gonarezhou (16 animal species) than central Gonarezhou (9 animal species). Accordingly, most of the grazers, browsers and mixed feeders were sighted in northern Gonarezhou than central Gonarezhou (Figure 2). However, omnivoreswere only sighted in northern Gonarezhou.



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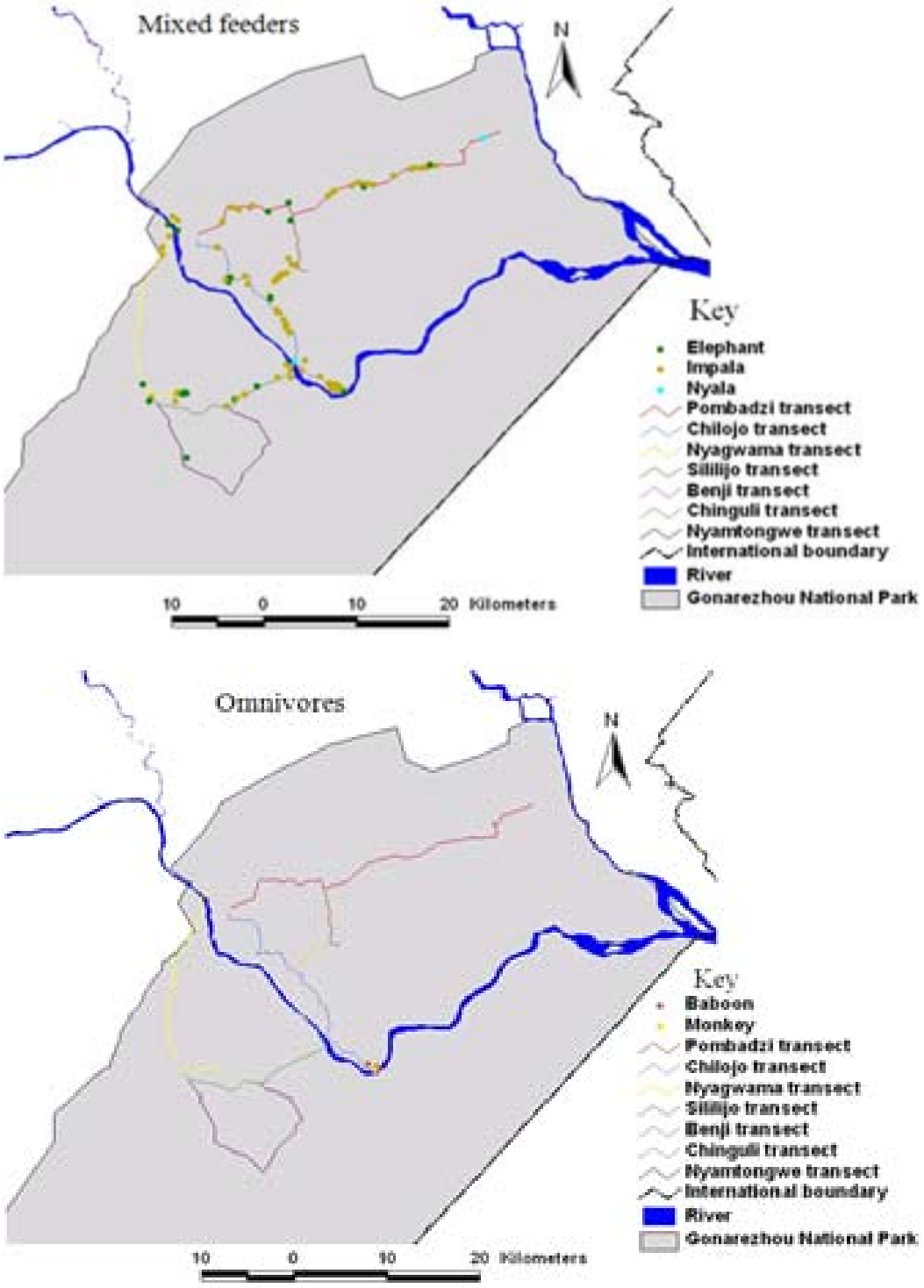

FIG. 2: **DISTRIBUTION OF COMMON LARGE HERBIVORES IN NORTHERN AND CENTRAL GONAREZHOU NATIONAL PARK, ZIMBABWE.**

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4. DISCUSSION

Our results showed that there were no significant differences in the densities of large herbivores between central and northern Gonarezhou. Our results suggest that there is little habitat variation between the central and northern Gonarezhou, hence the recorded similar distribution and animal densities. However, in terms of animal species, northern Gonarezhou had a higher species richness compared to central Gonarezhou. These recorded differences may have been influenced by a number of factors. First, the influence of surface water, in the Runde River, since some of the transects in northern Gonarezhou were close to a major perennial river, thus altering animal concentrations near water source. In semi-arid ecosystems, the location of water sources has been identified as an important factor influencing the distribution patterns of large herbivores (Western, 1975; Owen-Smith, 1996; Ogutu *et al*., 2010).

This study was conducted almost a year after the completion of a control fence in the northern Gonarezhou. We therefore, speculate that fencing of the northern boundary of Gonarezhou might have led to a reduction of illegal entry by local people in northern Gonarezhou thus leading to a decline in illegal hunting, livestock encroachments and uncontrolled fires in northern Gonarezhou, resulting in a high concentration of animal species and their abundances. Previous studies in Gonarezhou have shown that antelopes are the prime target for illegal hunting (e.g., Gandiwa *et al*., 2013). However, in central Gonarezhou, the boundary with the local community was not fenced at the time of this study, thus illegal human activities inside the park may have negatively influenced the abundance and diversity of species occurring in this section of the park. Our findings of generally low animal densities and species richness in central Gonarezhou lend support of the conservation theory that suggests that many species should live in lower densities at the periphery of protected areas or areas prone to disturbance compared with the core areas or highly protected areas (Kiffner *et al*., 2013).

Some species of large herbivores were not sighted during the present study transect surveys, but they do occur in the Gonarezhou ecosystem, for example, giraffe, buffalo, sable and roan antelope. This may be due to the fact that some of the survey transects did not pass through preferred habitats utilized by these species. Moreover, it has been reported that large herbivores avoid human infrastructure and also that increased human activity may affect large herbivore behaviour in multiple scales (Leblond *et al*., 2013).

We recognise that other factors, e.g., differences in habitats, human activities, dust impacts, natural predation and fires, that may influence animal densities and distribution have not been considered in this study. For example, a recent study in Gonarezhou has shown that grass cover is a powerful determinant of large herbivore distribution and density (Gandiwa, 2013). Future studies in Gonarezhou should focus on investigating the relative importance of specific environmental determinants in influencing large herbivore distribution and abundance.

5. CONCLUSION

This study has shown that there were no significant differences in the densities of large herbivores in northern and central Gonarezhou. More herbivore species were distributed in northern Gonarezhou compared to central Gonarezhou. Fencing of the northern boundary of Gonarezhou may have reduced illegal entry of people in this area, poaching incidents, uncontrolled fires and livestock grazing (Gandiwa *et al*. 2011, 2013) resulting in more animal species being distributed in this area. Our study findings have implications for tourism activities in Gonarezhou, particularly wildlife viewing opportunities using game drives. Therefore, fencing areas of the park boundary where

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there is high human-wildlife-livestock interactions will help to reduce illegal hunting of animals and forage competition among wildlife and livestock.

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