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Population Status and Habitat Association of Waterbuck (*Kobus Ellipsiprymnus Ellipsiprymnus* Ogilby, 1833) in Maze National Park, South Western Ethiopia

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Abstract

The population status and habitat association of the waterbuck (*Kobus ellipsiprymnus ellipsiprymnus*) were studied in Maze National Park (MzNP) during the wet and dry seasons in the year 2018–2019. The study aimed to investigate the population status, distribution and habitat association of waterbuck in the Park. Eight representative transects were randomly laid down across the main four habitat types; four for the savannah grasslands with scattered trees, two for the riverine forest, and one for the open grassland and one for the bushland habitat. Counts were carried out in around 20% of the total area of the Park. The estimated mean population size of waterbuck in the Park was 527±47 individuals. Male to female sex ratio was 1.00:1.36. Sub-adults (55.70%) were the dominant population followed by adults and calves. A herd size was larger during the wet season, while smaller in the dry season with the mean group size of 16.8±3.16 and 9.4±1, respectively. The larger groups were observed in the riverine forest between 1–2 km distances from the permanent water source. Availability of water, abundance of food, vegetation cover, and topographic features for predator avoidance were the major factors influencing the distribution of waterbucks in the study area. Therefore, the Park management and other concerned bodies should give more attention on the access of water and forage by digging artificial water hole and controlled burning of the grassland area of the Park.

Keywords: Distribution, Population structure, Sex ratio

Introduction

The waterbuck (*Kobus ellipsiprymnus ellipsiprymnus* Ogilby, 1833) is one of the six species of the Genus *Kobus* in the family *Bovidae* (Estes, 1991). It is a large antelope adapted to moist savannah ecosystems. It is usually found close to permanent sources of water; such as rivers and lakes, and lives in sub-Saharan African countries; such as South Africa, Ethiopia, South Sudan, and Senegal, and inhabits from tropical rainforest to the desert habitats. In Ethiopia, it occurs

west of the Great Rift Valley in association with the rivers, lakes, and wetlands. It is not seen in arid and high altitudinal areas (Kingdon, 1997). Mainly it prefers open habitats with a short to medium ward height vegetation for grazing as a grazer of leafy vegetation. The most distinctive feature of the animal is the large white circle which runs around their rump. Males have long rippled horns sweeping gently upwards and forwards in a shallow arc (Kingdon, 1997).

In the past, the waterbucks inhabited in most of the sub-Saharan Africa countries, however today the range of their distribution is reduced and fragmented (Sinclair, 1977). In Ethiopia, they are found in Omo, Mago, and Gambella (EWCA, 2010), Alatish (Grima Mengesha and Afework Bekele, 2008), and Chebera Churchura (Adane Tsegaye *et al*., 2015) National Parks. However, due to lack of research and information on the waterbucks, the population size is not properly known in many of those areas. Therefore, studies on the population status and habitat association of waterbuck in the Ethiopian protected areas especially in the MzNP, in which the ecology of many mammalian species are little known, are very much required. Therefore, this study was intended to investigate population status, and habitat association of waterbuck in the Maze National Park, south Ethiopia, and to suggest possible recommendations based on the findings.

Materials and Methods

The study area

Maze National Park is located in Gamo zone, South Nations Nationalities and Peoples Region (SNNPR), 473 km southwest of Addis Ababa, the capital city of Ethiopia. Formerly the national park was set as controlled hunting area, then transformed to the wildlife reserve area and finally established as a national park in 2005. It is one of the wildlife conservation areas known for its good population of the critically endangered endemic Swayne's Hartebeests, covers an area of 202 km^2 (Befekadu Refera and Afework Bekele, 2006). The name of the Park 'Maze' is derived after the largest river that crosses the Park. The main rivers, which are tributaries to the river Maze are Lemase, Domba and Zage Rivers.

Meteorological data (1997-2005) obtained from Morka station which is located 2.5 km away from the Park, shows the highest average annual temperature of the area *i.e.*, 32.88°C, while the lowest being 17.5 °C. On the other hand, the average annual precipitation varied between 2,841.6 and 3,299.8 mm. December, January, February and March are the hottest months, while June, July and August are the coldest months in the area (Siraj Mohammed *et al*, 2017).

Methods

Duration of the study

A preliminary observation was carried out in August 2018. A detailed study was carried out from January to March, 2019 and from June to August, 2019 for the dry and wet seasons, respectively. Quantitative data was obtained on the population size, structure, herd size, distribution, and habitat association of waterbuck during both seasons.

Sampling design

The study area was stratified based on the main vegetation types in the study area. These included Savannah grassland with scattered trees, bush land, Woodland and Riverine forest. Based on the major selected habitat types, a total of eight transects were randomly sampled. The number of transects in each habitats varied depending on the visibility (Norton-Griffiths, 1978; Ndhlovu and Balakrishnan, 1991). Thus, survey was conducted using subsidiary tracks guided by GPS and compass in each randomly selected habitat along the selected transects. The length of transects varied from 1.5 to 5 km and width 500 to 1000m. Consecutive transects were at a distance of 1.0–1.5 km. Transect lines were delineated by poles and/or natural signs. The proportional area of each sampling block in the survey zones, the number and total length of transects and the areas sampled are given below (Table 1).

Table 1. The number of potential and actual transects in the study area

Habitat type	Area coverage (km^2)	Number of potential transects	Number of sampled transects	Length of each transect (km)	Width of each transect (km)	Coverage (%)
Savannah grassland with scattered trees	128	21	4	5	1	19.04
Riverine forest	34.5	9	2	5	0.5	22.22
Open grass land	17	7	1	4	0.5	14.28
Bush land	22.5	3	1	4	0.5	33.33
Total	202	40	8	18	2.5	20.0

Population estimate

Transect counts were carried out from 06:00 to 10:00 hrs. in the morning and 16:00 to 18:00 hrs. in the late afternoon, when the animals were active and visibility was good. Transects were surveyed twice a day with the help of two trained and experienced scouts during wet and dry seasons at an average speed of 1.5km/hr to maximize the probability of seeing all individuals on both sides of the transects (Norton-Griffiths, 1978). Silent detection method was followed to minimize disturbances (Wilson *et al.,* 1996).

Under the normal conditions, waterbuck could be successfully identified from a distance of up to 150 m, and when the conditions were ideal, it could be seen up to 300 m. Repeated counting of the same herd were avoided using recognizable features or unusual features such as herd size, group composition and distinct individuals with deformities on horn, tail and ear (Wilson *et al.,* 1996). Thus, all herds were individually recognized. The mean number of individuals observed per transect were pooled together, and extrapolated to estimate the population for the whole study area. Population densities were estimated using the population estimate divided by the size of the study area (Wilson *et al*., 1996). Therefore, quantitative data were collected during both seasons on the population size, structure and habitat association.

Population structure

Each individual counted was grouped into its respective sex and age (adult, sub adult, and juveniles) classes. Body size, pelage, external genitalia, shape and size of horn, and mammary glands were considered to identify their sex and age categories (Sinclair and Grimsdell, 1978; Ndhlovu and Balakrishnan, 1991).

Herd size

The location of each herd was plotted on the map of the study area. Individuals with in 50m distance were considered as a member of the same herd (Borkowski and Furubayashi, 1998).

Habitat association

The average size of herds observed in different habitat types during the wet and dry seasons were recorded in a data collection sheet to compare the distribution of the waterbuck following the methods of Larson *et al.* (1978) and Norton-Griffiths (1978).

Data analysis

All data collected were computed using SPSS version 20 software program (α = 95% level of significance, p<0.05), descriptive statics and Ms-excel.

Total population in each habitat was estimated following Norton-Griffith (1978) formula.

$$N = \frac{n}{n1} \text{ x total area of that habitat}$$

Where, N = total number of population in each habitat

n = number of animal in total area surveyed

n1 = total area surveyed in km^2

A difference between age and sex, groups and population size across seasons in each habitat type was tested using the Chi-square test.

The preference of habitat types between seasons were analysed by Chi-square test.

Results

Population estimate

The mean numbers of waterbucks recorded during the wet and dry seasons were 114.8 ± 18.8 and 96 ± 18.8, respectively. The average population density estimated was 2.6 ± 0.24 km^2. Population estimates for MzNP during wet and dry seasons were 574± 47 and 480 ± 47 individuals, respectively, with a mean of 527 ± 47 (Table 2). The variation in the population size between dry and wet seasons was insignificant ($\chi 2 = 7.7$, df = 1, P>0.05).

Table 2. Population estimate of waterbuck in Maze National Park (Mean ± SE)

Season	Individual observed ± SE	Density/km2 ± SE	Estimate ± SE
Wet	114.8 ± 18.8	2.84± 0.24	574 ± 47
Dry	96 ± 18.8	2.37± 0.24	480± 47
Mean	105.4 ± 18.8	2.6 ± 0.24	527 ± 47

Age and sex structure

Of the total individuals estimated during the study, females and males constituted 286.5 ± 12.48 and 230.5 ± 10.52 mean number of individuals, respectively. The mean male to female sex ratio was 1.00:1.36 in which the majority of waterbucks were females. The mean ratio of sub-adult

male to sub-adult female was 1:1.35 (Table 3 and 4). Some of the individuals' sex was not identified.

Table 3. Age and sex structure of waterbuck during the wet and dry season (Mean ± SE)

Age/Sex	Season						Percentage
	Wet		Dry		Mean		
	Observed	Estimated	Observed	Estimated	Observed	Estimated	
Adult male	25.6±4.2	131±10.72	15.7±3.07	80±7.83	20.65±3.65	105.5±25.5	19.59
Adult female	26.9±4.25	135±11.05	20.8±4.07	100±9.79	23.85±4.25	117.5±17.5	22.62
Sub-adult male	24.7±4.04	126±10.31	23.8 ± 4.66	124±12.4	24.25±4.32	125±1.0	23.01
Sub-adult female	33.9±5.55	170±13.91	32.9 ± 6.44	168±16.45	33.4±5.95	169±1.0	31.68
Juvenile/ unidentified sex	3.7 ± 0.6	12±0.98	2.8±0.54	8±0.78	3.25±0.58	10±2.0	3.10
Total	114.8±18.8	574 ± 47	96 ± 18.8	480 ± 47	105.4 ± 18.8	527± 47	100.00

Table 4. Observed Sex and Age ratio of waterbuck during wet and dry seasons

Season	Age and sex ratio			
	AM:AF	SAM:SAF	SAF:AF	SAM:AM
Wet	1:1.03	1:1.25	1:0.79	1:1.04
Dry	1:1.35	1:1.35	1:0.59	1:0.60
Mean	1:1.19	1:1.39	1:1.69	1:1.32

AM=adult male, AF=adult female, SAM=sub-adult male, SAF=sub-adult female

Herd size

A total of 34±8.73 and 51±8.73 herds were estimated during wet and dry seasons, respectively. The range of the group size of the waterbuck in the study area was ranged from 2 to 27 individuals, and the mean group size was 16.8±3.16 and 9.4±1 during wet and dry seasons respectively. During the study period (from months of March, April and May), it was observed that large number of animals congregated in groups. While, during the months of December, January and February, they split up into smaller groups. The largest groups of individuals were observed in the riverine forest, and the smallest were observed in the woodland habitat. There was a marked difference in the mean herd size of the individuals between the wet and dry seasons (χ^2 = 41.813, df =1, P<0.05) (Table 5).

Table 5**.** Herd size of Waterbuck during the wet and dry seasons in MzNP

Season	Total number of individual ± SE		Mean Herd number		Range of herd Size	Mean herd Size
	Observed	Estimated	Observed	Estimated		
Wet	114.8 ± 18.8	574 ± 47	6.8 ± 3.4	34 ± 8.73	2-27	16.8±3.16
Dry	96 ± 18.8	480 ± 47	10.2± 3.4	51± 8.73	2-12	9.4±1
Mean	105.4 ± 18.8	527 ± 47	8.5 ± 3.4	42 ±8.73	19	13.1

Habitat association

The maximum average numbers of waterbuck were recorded in the riverine forest habitat (N=53.75 ± 9.7) which is the most preferred habitat type for the individuals, whereas it was minimally recorded in the open grass land (N=21 ± 3.71). Hence, the riverine forest was the highly utilized habitat (63.8%) in the dry season, while open grassland (13.7%) was the least utilized. In the wet season, riverine forest (40%) and Savannah grassland with scattered trees (39.8%) were almost equally utilized. However, waterbucks did not spend much time in open grassland habitat in both seasons comparing to the other two habitats. The number of waterbucks observed in the different habitat types were significantly different ($\chi 2 = 85.5$, $P < 0.05$) (Table 6).

Table 6. Habitat association of Waterbuck in MzNP (Mean ± SE)

	habitat				Habitat type				
Season	Savannah grassland with scattered trees		Riverine forest		Open grass land		Bush land		Total estimated
	Observed	Estimated	Observed	Estimated	Observed	Estimated	Observed	Estimated	
Wet	37.0 ± 6.06	212.0 ± 17.36	51.8 ± 8.48	238.0 ± 19.49	26.0 ± 4.28	124.0 ± 10.15	-	-	574±47
Dry	24.3 ± 4.76	107.0 ± 10.48	55.7 ± 10.91	301.0 ± 29.47	16.0 ± 3.13	64.0 ± 6.27	-	-	480±47
Mean	30.65 ± SE	159.5 ± SE	53.75 ± SE	269.5 ± SE	21 ± SE	94 ± SE	-	-	527 ±47

Mow = Mean observed waterbuck population, Esw = Estimated waterbuck population

Discussion

The study shows that the average number of waterbuck was decreased during the dry season as compared to the wet season. This might be due to lack of enough food during the wet season as compared to the dry season, or else the individuals may hide themselves inside the forest in the dry season which makes the visibility of the animals difficult. Similar results were reported by Aramde Fetene *et al*. (2011), and Wubie Bayie and Mesele Yihune (2018), even though; the latter two researchers did their studies on bushbuck at Wof-washa forest and Sekele Mariam forest, respectively. Similarly, when the availability of resources becomes low, Menelik‟s bushbucks travel into another area in order to get sufficient food resources in Wof-Washa Forest, North Shoa, Ethiopia (Brnesh Hailemariam *et al*., 2015). In the wet season, the waterbuck populations showed increment relatively in the open grassland and savannah grassland with scattered tree habitats. This might be due to the availability of palatable grass resources in those habitats. Wirtz and Petra (1988) noted that, at Nakuru National Park, with increasing rainfall, waterbuck moves from the open shrub land area to the open grassland, while with decreasing rainfall, it moves from the open grassland to the open shrub land area in order to get food resources. The other reason for the increasing population in the wet season might be their peak breeding time in the season. The maximum number of Juveniles was recorded during the wet season. This might also be due to the availability of quality foods during the wet season. Okello *et al*. (2015) also state that a relatively large number of young individuals were seen during the rainy season. But according to Adane Tsegaye *et al*. (2015), a peak number of calves were observed during the dry season in Chebera Churchura National Park, and it is a good period for counting waterbuck.

Sex and age structures of a population at any given time are indicators of the status of the population as well as vital for evaluating the viability of a species (Wilson *et al*., 1996). The proportion of females was higher than males depicting a healthy and increasing waterbuck population in the study area. However, proportion of calves was relatively lower than the other age groups during the wet season. This might be attributed to difficulty of counting calves in the dense vegetation cover during the wet season and the vulnerability of the young to predators during this season (Spinage, 1982).

Increased mortality of male waterbucks due to predation also attributes to the variation in the sex ratio. Male waterbucks leave the natal herd, distribute in less favorable habitats, and suffer an increased predation pressure compared to the females of the same age class which stay in the natal

herd (Spinage, 1982). While nursery herds are free to seek the best grazing areas in their home range, and bachelor herds remain at peripheral areas. Tomlinson (1980) also revealed that, bachelor groups are forced to occupy marginal areas in order to avoid conflicts with the territorial males.

Waterbucks showed significant variation in their habitat preferences during both seasons as large numbers of herd sizes were recorded during the wet season. Changes in the herd size are closely associated with the availability of edible grasses and sometimes due to the reproductive behavior of the animals. This is supported by the findings of Jarman and Jarman (1973) in which waterbucks made a large group of mixed male, female, and young during the breeding period, and herd size varied due to the reproductive behavior and environmental disturbances. The Juveniles were consistently less than adults and sub-adults within the group and they were observed frequently during the wet season than the dry season.

Conclusion

The present study gives baseline information on the population status and habitat association of waterbuck in the Maze National Park for future studies on the other ecological aspects of the same animal.

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