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## Diversity of Medium and Large-sized Mammals in Borena-Sayint National Park, South Wollo, Ethiopia

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### Abstract

The study on the diversity of medium and large-sized fauna in Borena-Sayint National Park (BSNP), South Wollo Zone, Ethiopia was conducted from December, 2009 to April, 2010. The study area was divided into Riverine forest, Erica woodland and Open grassland habitats based on topography during the preliminary survey. The altitude of the area ranges from 1900m to 3699m asl. Representative sample sites were taken from each habitat type and surveyed using random linetranssect method. For medium and large mammal survey, indirect methods such as faeces, hairs, spines, pugemarks, sound and carcass were used in addition to the direct observations. Twenty three species of medium to large-sized mammals were identified and recorded from BSNP. Erica woodland contained 20 species and Riverine forest and Open grassland contained 19 and 12 species respectively. Erica woodland had the highest diversity index (2.511) and evenness(0.834), whereas the lowest diversity index (2.315) and evenness(0.786) were recorded in Riverine forest habitat. Simpson similarity index (SI) of medium and large mammal species among three habitats in the study area was 0.407. Major threats of the park identified during the study period were grass collection, livestock grazing and encroachment.

Key words: Borena-Sayint National Park; conservation; diversity; mammals

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## 1. INTRODUCTION

The altitudinal variations within Ethiopia produce a range of climate, which affect every aspect of life in the country; plant and animal distribution and the concentration of people and the types of agriculture, while temperature, rainfall and vegetation play major roles in determining the distribution of fauna including that of endemic mammals[1]. The flora of Ethiopia is very diverse with an estimated number between 6,500 and 7000 species of higher plants, of which 15 percent is endemic.

Ethiopia is also rich in its faunistic diversity. There are 284 species of mammals of which rodents and shrews account for 39.4%[1]. There are 861 species of birds, 201 species of reptiles, 145 species of fresh water fish, 63 species of amphibians and 324 species of butterflies known from Ethiopia. A total of 31 species of endemic mammals are found in Ethiopia. Among these, five are large and the rest are small mammals. The highest level of endemism in the fauna of Ethiopia appears to be related with highlands (above 3000m) in the country[2]. [3] Indicated that mammals are one of the most important components of biodiversity in the world. Functional structures of mammals are determined by the composition of functional traits (feeding type, body mass, activity patterns and gregariousness). Such structures often vary along environmental gradients such as disturbance and resource availability[4]. They range in size from African pigmy mice (*Mus minutoides*) to whales[5].

Large mammals have long been recognized as animals that interact in particularly complex and powerful fashions with their habitat[6]. They are also fundamental elements in many ecosystems. Large carnivores frequently shape the number, distribution, and behavior of prey animals[7; 8]. Large herbivores function as ecological engineers by changing the structure and species composition of the surrounding vegetation[9; 10]. Furthermore, both set of mammals profoundly influence the environment beyond direct species interaction such as through cascading trophic effects[7; 11]. Large mammals perform important ecological functions and are good indicators of the habitat value because they do not typically rely on specific single habitat as many small mammals do[12].

To protect and conserve these diverse and important biological resources such as endemic animals, 12 National Parks, 11 Wildlife Reserves, 3 Sanctuaries, 18 Controlled Hunting Areas and 69 Important Bird Areas have been established as refuge in Ethiopia[13].

Borena-Sayint National Park, the former Denkoro Forest is one of the recently declared National Parks of the country. It has relic biodiversity with significant natural forest and high altitude grassland flora and fauna. It is restricted to a mountain ridge top in highly degraded, eroded and isolated ecosystem in South Wollo Zone of Amhara Regional State in northern Ethiopia and the area has attracted the interest of the National and Regional Government, but with limited biological information. The major objective of this study is therefore, to assess the diversity of medium and large-sized mammalian species in Borena-Sayint National Park and to recommend the conservation measures for fauna distribution of the study area.

## 2. MATERIALS AND METHODS

### 2.1. Geographic location

Borena-Sayint National Park is found in South Wollo Zone (Amhara Regional State) and lies between 10°50'45.4"-10°53'58.3" latitude and 38°40'28.4"-38°54'49" longitude (Fig.1). The park is located in the north eastern part of Ethiopia about 600km by road from Addis Ababa, 205 km from Dessie and 16km from Mekane Selam, the capital of Borena Woreda. The park is situated among three Woredas namely Borena to the south, Sayint to the north and Mehal Sayint (a newly established Woreda) to the east. Borena Woreda on south (with its seven Kebeles) and southwest (with its two Kebeles), Sayint on the north (with one Kebele) and Mehal Sayint on the north (with its two Kebeles) and on the west with one Kebele). Legambo Woreda is located bordering the two Woreda Borena and Sayint. The largest portion of the park is found in Borena Woreda.

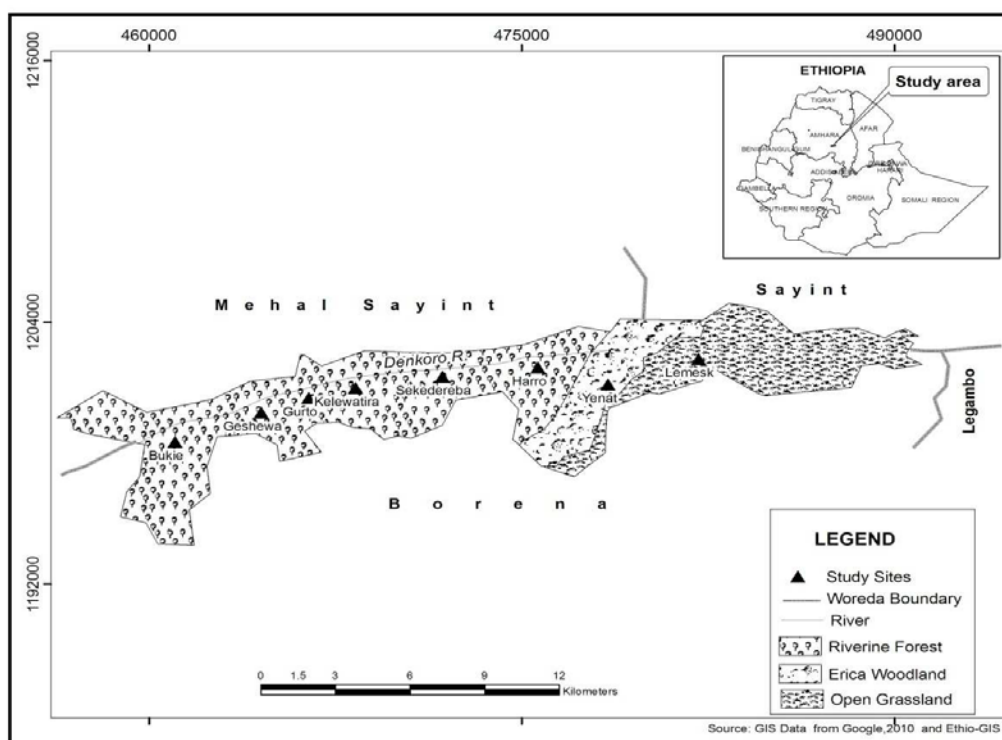


Figure 1. Location map of the study area

### 2.2. Duration of the study

Medium and large-sized faunal survey was conducted from December, 2009 to April, 2010 in BSNP. During this period random transectlines were established randomly and the locations were marked using Global Positioning System (GPS.) Study area was classified in to three major vegetation zones based on vegetation types and altitude. A total of 40 days of fieldwork was done. Other valuable data

such as climate and human population in the study area were gathered from the concerned organizations. Access to the park was on foot.

### 2.3. Study area sub division

Preliminary study was conducted in the first field work. This showed that the study area was heterogeneous in vegetation type and topography and classified in to three Vegetation Zones. These include Vegetation Zone 1/Riverine forest (RF), Vegetation Zone 2/*Erica* woodland (EWL) and Vegetation Zone 3/Open grassland (OGL). Classification of the study area was based on the map of Denkoro Chaka sketched by Park Development and Protection Authority in December, 2006. Each vegetation zone has distinguishing features in vegetation type and topography. Censes zones were established in all three vegetations.

### 2.4. Medium and large-sized mammals' survey

Survey of medium and large mammals in the study area was on foot along a randomly selected transectlines. There were a total of fifteen transect lines, which varied in length from 1.5km to 4km established to observe large mammal species. Transect width ranged from 50m to 400m depending on vegetation cover and topography of the study site. Ten transect lines were established for riverine forest habitat in different study sites. These were three transect lines for Bukie, one foreach Geshewa, Guruto and Kelawatira, two for each Sekedereba and Harro. The remaining two were for *Erica* woodland and three for open grassland.

Two rounds of observations of large mammals were carried out during filed study period from December 15, 2009 to April 11, 2010. When mammals were sighted, the number and GPS location were recorded at each transect line and species identification of large mammals was based on *The kingdom Field Guide to African Mammals* [14] and "*Atibiwochu*"[15].

Observation of medium and large mammals was done early in the morning during 06:00 to 08:00 hr and late in the afternoon during 17:00 to 19:00 hr, when most mammals were active in the study area. Indirect detection indices such as scats, hair samples, tracks, dense or burrows and scratches are very useful when surveying animals such as carnivores that are naturally rare, elusive, found at low densities and difficult to capture repeatedly[16]. Direct observation was using binocular and naked eyes and indirect observation was using indirect evidences.

### 2.5. Data Analysis

Species diversity of medium and large mammals were calculated using the Shannon-Weaver index of diversity,  $H' = -\sum P_i \ln P_i$  where  $P_i$  is the proportion of the  $i^{\text{th}}$  species in the habitat[17].  $H'$  is influenced both by number of species as well as by the evenness with which mammals are distributed with those species. Equal H values may thus be obtained if one habitat contains fewer and evenly distributed species of mammals. The evenness of mammalian species was calculated as  $J = H'/H'_{\text{max}}$  where

$H'_{max} = \ln(s)$  and  $s$  is the number of species. This measure varies between 1 (complete evenness) and 0 (complete unevenness). Chi-square ( $\chi^2$ ) was used to compare differences in abundance of mammal species between habitats and the overall significant difference in abundance of medium and large-sized mammal species in the study area. SPSS computer program was used for Chi-square analysis to test the association of medium and large mammal species and their habitats [18].

Simpson similarity index (SI) was also computed to assess the similarity among and between three habitats with reference to the composition of species.

$$SI = \frac{3C}{I+II+III}$$

Where: SI= Simpson's similarity index,

C= the number of common species to all three habitats

I= the number of species in habitat one

II= the number of species in habitat two

III = the number of species in habitat three

### 3. RESULTS

#### 3.1. Medium and large-sized mammals observed and identified

A total of 23 large and medium sized mammals were observed in BSNP through direct and indirect observations. *Erica* woodland contained 20 species and Riverine forest and open grassland contained 19 and 12 species respectively (Fig. 2).

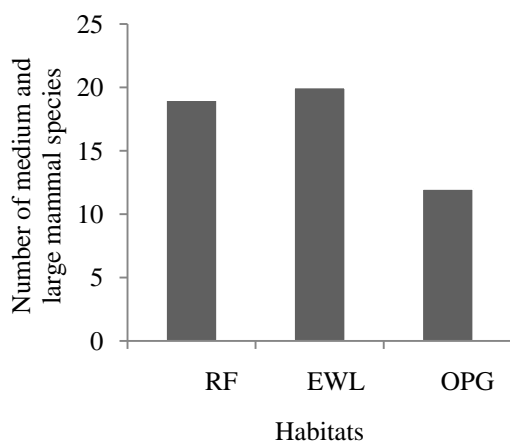


Figure 2. Number of medium and large-sized mammal species in different habitats of the study Area

### 3.2. Diversity indices for medium and large-sized mammals

A total of twenty three medium and large-sized mammals species were identified and recorded. *Erica* woodland was represented by 20 species while riverine forest and open grassland were represented by 19 and 12 species, respectively. Diversity indices ( $H'$ ) and evenness ( $J$ ) of medium and large mammal species along the three habitat types are shown in Table 1. *Erica* woodland had the highest diversity index and evenness, whereas the lowest diversity index and evenness were recorded in open grassland and riverine forest habitat, respectively.

Table 1. Diversity indices ( $H'$ ) and evenness ( $J$ ) of medium and large-sized mammalian species.

Habitat	Number of species	Abundance	$H'$	$J$
Riverine forest	19	285	2.315	0.786
<i>Erica</i> woodland	20	147	2.511	0.834
Open grassland	12	107	2.015	0.811

Simpson similarity index (SI) of medium and large mammal species among three habitats in the study area was 0.407. This indicated that 40.7% of the species were common for all three habitats. Medium and large-sized mammals showed the highest similarity occurrence between the riverine forest and *Erica* woodland, followed by *Erica* woodland and open grassland, whereas the lowest similarity occurrence was between riverine forest and open grassland (Table 2).

Table 2. Similarity in distribution of medium and large-sized mammal species between habitats.

Habitats	Simpson similarity index (SI)
RF vs. EWL	0.694
vs. OPG	0.516
EWL vs. OPG	0.688

The abundance of medium and large mammal species varied between habitats of the study area (Table 3). The overall difference in abundance of medium and large mammal species among three habitats was significant at ( $\chi^2=97$ ,  $df=2$ ,  $p<0.001$ ).

Table 3. Comparison of medium and large-sized mammalian species abundance between habitats.

Habitats	Chi-square ( $\chi^2$ )
RF vs. EWL	44.08**
vs. OPG	80.8**
EWL vs. OPG	6.30*

Where \* = Significance at  $p < 0.05$ ; \*\* =  $p < 0.001$ ;  $df = 1$ .

Habitat association of medium and large-sized mammals of the study area was not significant ( $\chi^2=63.8$ ,  $df=44$ ,  $p>0.05$ ). The mammals use all habitats equally independent of any variables (Table 4).

Table 4. Habitat association of medium and large mammals

	RF	EW	OPG
Chi-Square	9.217	17.174	37.435
df	12	11	9
Asymp. Sig.	.684	.103	.000

N.B: RF= Reverine forest, EW= Erica woodland, OPG= Open grassland

## 4. DISCUSSION

### 4.1. Medium and large-sized mammals' distribution and diversity

The present study area comprised twenty three medium and large-sized mammalian species including the critically endangered Ethiopian wolf (*Canis semensis*) and the very common Gelada baboon (*T.gelada*) which are endemic to Ethiopia.

Distribution and habitat association of large mammals are determined in terms of their water and food requirements. Water and pasture conditions or the combinations of both are the major factors determining the distribution of wildlife populations in their natural habitats[19]. According to [20], habitats in terms of large mammals refer to the vegetation composition, floristic and structural of the area as a product of various factors such as climate, geology and soil. The habitat of the animals is therefore the area where the animal preferably occurs and where all its life necessities are fulfilled. Consequently, medium and large-sized mammal distribution and diversity in the present study area was highly associated with habitat types. Erica woodland has supported the highest number of mammalian species (20), followed by riverine forest having nineteen species from a total of twenty three species. Open grassland habitat has supported twelve medium and large-sized mammalian species. The possible reason for this distribution and diversity of medium and large-sized mammal species might be due to the presence of food and water and stability of the area from disturbances.

The Bushbuck was the most abundant species of family bovidea in the present study area. This species appeared to be more concentrated in the riverine forest, but it was also recorded from *Erica* woodland and never in open grassland habitat. The species was more frequently seen in the center of riverine forest during the day and near to the periphery at night. This might prevent the species from nocturnal predators.

Pairs of klipspringers were seen frequently in the hilly and rocky part of the Park. Common duiker was seen in the *Erica* woodland and open grassland habitats. Its small size helped to obtain cover in small bush and long grasses. Large rock outcrops allow for a suitable temperature (17-25°C) and low humidity for hyraxes to survive[21]. In the present study, direct observation and signs of bush and rock hyrax have been recorded in the Riverine forest and *Erica* woodland habitats more frequently. Hyraxes tend to eat mostly leaves, twigs, fruits, barks and grass.

They are able to eat the bark and twigs because of the design of their gut and their relationships with symbiotic bacteria, which allow them to digest tough fibers[22]. This physiological adaptation made them abundant in the present study area.

Spines and faeces of crest porcupine have been collected throughout the study period from all habitat types of the study area. Therefore, it was relatively common species in BSNP. In addition, hair and faeces of stark's hare, which is a common species in BSNP were collected

*Colobus abyssinicus* is remarkably adapted species, in Ethiopia, and is found at altitudes between approximately 400m and 3300m asl, and occupies a wide variety of habitats ranging through tropical deciduous forest, montane *Juniperus* and *Hagenia* forest and riverine forest. In some areas the species survives in relatively small patches of remnant forest and it is, in general, tolerant of the presence of man[23]. This species was the most dominant primate in the present study area. This high abundance of the species in the study area might correlate with vegetation cover, altitude and availability of water.



The second most dominant of primate species in the study area was gelada baboon. According to Mori[24], gelada baboon occurs in the highlands of

Ethiopia, particularly in northern parts of Rift Valley including Shoa, Gonder, Wollo and Gojjam Provinces and southern parts of Rift Valley in Arsi region. In the present study the species has been observed in all three habitat types with uniform distribution. Geladas are mainly vegetarian, feed upon herbs, grasses (most of the time) and roots but they also seldom eat insect [25]. They were observed eating grasses in BSNP.

*Papio hamadryas* is particularly associated with rocky habitats in desert and semi-desert regions and is now confined to the Arabian Peninsula, northern Somalia, eastern Ethiopia and Red sea hills of Sudan. Although this form is, to considerable extent geographically and ecologically isolated from both *Papio anubis* and *Theropithecus gelada*, there is a limited degree of overlap between the ranges of all three species and such areas of contiguity, hybridization may be anticipated[23]. Likewise, in the present study area *P.hamadryas* range overlap in all three habitats with *T. gelada* but its abundance was decreased from riverine habitat to open grassland habitat. This might show the species preference to semi-desert habitat.

*Chlorocebus aethiops* is widely distributed and often a common species in northern and central Ethiopia, occupying a wide variety of habitats ranging from riverine, tropical deciduous or montane forest to comparatively open *Acacia* woodland. In many areas, this monkey frequents human settlements and feeds extensively on cultivated plants. The species has been recorded near sea level and extends to an altitude of at least 3000m all[23]. In contrast, in this study the species was observed in riverine forest habitat and it is the least abundant of all primates observed in BSNP. This association of species to riverine forest might be due to the

availability of fruit tree species such as *Ficus sur* and *Carissa edulis*. *Panthera pardus* is the most widely distributed of all the wild cats in the world. It is found almost in every kind of habitats ranging from the rain forest to tropics to desert and temperate regions, where food and cover is available[26]. But in the present study area, it was restricted in a certain locality because the local people kill it as this animal preys on domestic animals[27]. This might contribute for the rareness of the species. Signs of spotted hyaena like sound, pug mark and faeces have been recorded in all three habitats of the study area. The sound was heard at night and hunted domestic animals like dogs, sheep and goats

According to [28], Ethiopian wolf (*C. simensis*) occurs in a few mountain ranges of Ethiopian highlands. It occurs in Simien Mountains, Mountain tops of Wollo highland around Abune Yose-ph, Amba Ferit, Donkoro Chacka and other high altitude areas of the Wollo region and in Northern Shoa area of Menz (Guassa). It also occurs in Arsi and Bale mountains of and other high altitude areas[29]. In this study the presence of Ethiopian wolf was confirmed through indirect evidences such as, signs and interviewing the local people. The people who were interviewed in the area had seen wolves rarely, and the species distribution was highly restricted in Afro-alpine parts and never in other parts of the Park.

## **5. CONCLUSION AND RECOMMENDATIONS**

The present study identified and documented mammalian species of BSNP and gave base line information about their presence. The distribution and abundance of mammal species in Park varied because of vegetation types and altitudinal differences. For example, guereza, gelada baboon, sacred baboon and bushbuck were frequently seen in the Park.

The number of large mammal species occurred in the present study area is comparable to other National Parks of the Amhara region such as Alatish National Park. More ever, BSNP has a scenic topographic features and harbored endemic fauna like, gelada baboon, critically endangered Ethiopian wolf and Menilk's bushbuck. So, the park needs strong attention from Federal and regional government to implement proper wildlife management. BSNP is the most threatened park of the country because of its size, shape and location. To conserve the wildlife in the park, threats such as encroachment, livestock grazing, grass cutting, environmental degradation, poaching and deforestation should be minimized.

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