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Species composition and relative abundance of medium and large mammals in Mengaza communal forest, East Gojjam, Ethiopia

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Studies on the species composition, relative abundance and distribution of medium and large mammals were carried out from August 2015 to July 2016 in Mengaza communal forest. Data were collected using line transect technique. A total of twelve species of medium and large mammals were identified and recorded in the study area. Rock hyrax (*Procavia capensis*), porcupine (*Hystrix cristata*), honey badger (*Mellivera capensis*), vervet monkey (*Chlorocebus aethiops*), Abyssinian hare (*Lepus habessinicus*), black backed jackal (*Canis mesomelas*), klipspringer (*Oreotragus oreotragus*), olive baboon (*Papio anubis*), were among the medium mammals but Spotted hyena (*Crocuta crocuta*), aardvark (*Oryctropus afer*), bohor reed buck (*Redunca redunca*) and common duiker (*Sylvicapra grimmia*) were among the large mammals identified in the study area. Olive baboon (32.7%) was the most abundant species during dry and wet seasons. Mammalian species composition between the two habitats (natural forest and plantation) was not significant (X^2 = 0.47, df =1, P > 0.05). However, there was seasonal variation in the abundance of individuals of medium and large mammals (X^2 = 3.89, df = 1, P < 0.05). The area is facing severe degradation due to human population pressure. Therefore, there should be proper conservation of the forest to sustain the wildlife species living there.

Key words: Abundance, distribution, medium and large mammals, Mengaza Communal Forest, plantation species composition.

INTRODUCTION

Mammals are diversified both structurally as well as functionally (Yonas and Fikresilasie, 2015). Class Mammalia is composed of 5,487 species and more than 1150 species of mammals are found in Africa (Borges et al., 2014). East Africa is rich in mammalian fauna are the (Zerihun et al., 2012a). Topographic diversity and climate most significant predictors of mammalian species diversity (Melaku, 2011) in which heterogeneous habitats

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support different species of mammals (Vaughan et al. 2000).

Ethiopia is one of the African countries known for highest mammal species richness (Zerihun et al., 2012b), and possesses more than 320 mammals, of these, 36 are endemic to the country (Alemneh, 2015a, b; Rabira et al., 2015). The highest level of endemicity is credited to the large extent of highlands (Yalden and Largen, 1992). More than 60% of the mammal species in Ethiopia are medium and large- size (Dereje et al., 2015). Most populations of medium and large mammals are severely depleted in the country including protected areas (Rabira et al., 2015). It is due to growth of human population, habitat loss, fragmentation, weak management of the protected areas and deforestation (USAID, 2008).

Knowledge on local fauna is essential for future conservation strategies and provide basic information for more complex ecological and biogeographical studies (Botelho et al., 2012), and which is the first step for conservation action (Botelho et al., 2012; Fornitano et al., 2015). Investigations on mammalian diversity, abundance and habitats provided information of the status of populations for appropriate conservation actions (Galetti et al., 2009; Rabira et al., 2015; Yosef, 2015). Hence, lack of survey may hinder preparation of appropriate management plan in the protected areas (Fornitano et al., 2015). The fauna of Ethiopia is not well investigated (Dawit and Afework, 2008; Alemneh 2015 b; Dereje et al., 2015). There is little quantitative information about how the tropical forest mammals change (Ahumada et al., 2011).

Most of the diversity and population ecology of medium and large mammals are targeted on National Parks and sanctuaries of the country (Mohamed and Afework, 2014), but outside of the protected areas records and conservation status of the different species of mammals are poorly known (Rabira et al., 2015). There are about 48 protected areas (National Parks, Wildlife Reserves, Sanctuaries, and Controlled Hunting Areas) in the country (Young, 2010). These protected areas cover roughly 16.4 % of the countries land area (Melaku, 2011; Alemneh, 2015 b).

So more should be done and surveys on the protected and potential areas should be carried out. Assessments on the diversity and abundance of wildlife resources is an important components of conservation programs (Fornitano et al., 2015; Yosef, 2015), that it can locate areas of high diversity of mammals and help managers understand effects of habitat loss and habitat fragmentation (Dawd and Solomon, 2013).

There was no study on diversity and abundance of the mammalian species in the study area conducted yet. Therefore, the present study focuses on species composition, relative abundance and distribution of medium and large mammals in Mengaza Communal Forest, East Gojjam. Comparison of medium and large sized mammals between habitats and seasons were assessed.

MATERIALS AND METHODS

Mengaza Communal Forest is found in Dejen woreda, East Gojjam zone in the northwestern part of Ethiopia. According to Derba Medroc (2008), the study area is located between 10°12'0" to 10°14'30" N and 38° 6'30" to 38°8'0^{o} E at about 238 km north of Addis Ababa. The total area coverage of the study area is 265 ha of which 187 ha is covered with natural forest, which is called Mengaza and 78 ha is covered with plantation (modified area), which is known as Amarie (Figure 1). The altitude of the natural forest area ranges from 2331 to 2381 m a.s.l. and the plantation altitude ranges between 2408 to 2459 m a.s.l. The study area was protected by local community members since 1980s (Derba Medroc, 2008).

Before the actual data collection pilot survey was conducted in August 2015. During this period, information like types of vegetation, topography and others were collected. Data were collected using line transect method (Verman and Sukumar, 1995). A total of six transect lines were systematically established in both natural forest (Acacia woodland) and plantation in which among the, transects four of them were from natural forest and the remaining two from plantation. The location of each transect was marked by global positioning system (GPS). The length of transects ranged from 0.8 to 1.05 km depending on the topography of the habitat and the distance between each transect was 1 to 2 km to avoid double counting (Figure 1).

Both direct and indirect techniques were employed in the field. Surveys in the sampled areas were performed twice a day, early in the morning (6:00 to 8:00) and late in the afternoon (16:00 to 19:00) when most mammals were more active in the study area (Meseret and Solomon, 2014; Dereje et al., 2015). Care was taken by the observer not to disturb the animals (Dawd and Solomon, 2013). During data collection, an observer walks on foot along each transect and directly count all the individuals sighted with their respective species using unaided eyes and binocular.

Transects were covered from opposite ends in order to minimize bias (Yosef, 2015). Information like species, the number of individuals, location, habitat type, sex and age were recorded (Campose et al., 2013). Field identification of mammalian species was carried out using mammal's field guild of Blower (1969) and Gelderen (2015). Mammals in the study area were categorized in to medium (those between 2 and 7 kg) and large (those over 7 kg body mass) mammals (Dereje, 2015). In addition to direct observation of live animal indirect evidence was also used to collect data. Indirect evidence is very useful when surveying animals such as carnivores that are naturally rare, elusive, found at low densities and difficult to capture repeatedly. So the presence of medium and large mammals were also been precisely indicated using indirect evidences, using sounds, spines, burrows and faecal droppings (Campos et al., 2013; Borges et al., 2014; Dereje et al., 2015). The collected data were tabulated and analyzed with appropriate statistical methods. Shannon-Wiener diversity Index (H'):

$$(H' = -\sum (Pi \ln Pi)$$

Where *H'* is Shannon index of diversity, *Pi* is the proportion of individuals of species in a sample and ln = Natural logarithm was used to compute diversity of medium and large mammals in the study area (Shannon and Wiener, 1949).The evenness of mammalian species was calculated as:

$$E = H'/ H' max$$

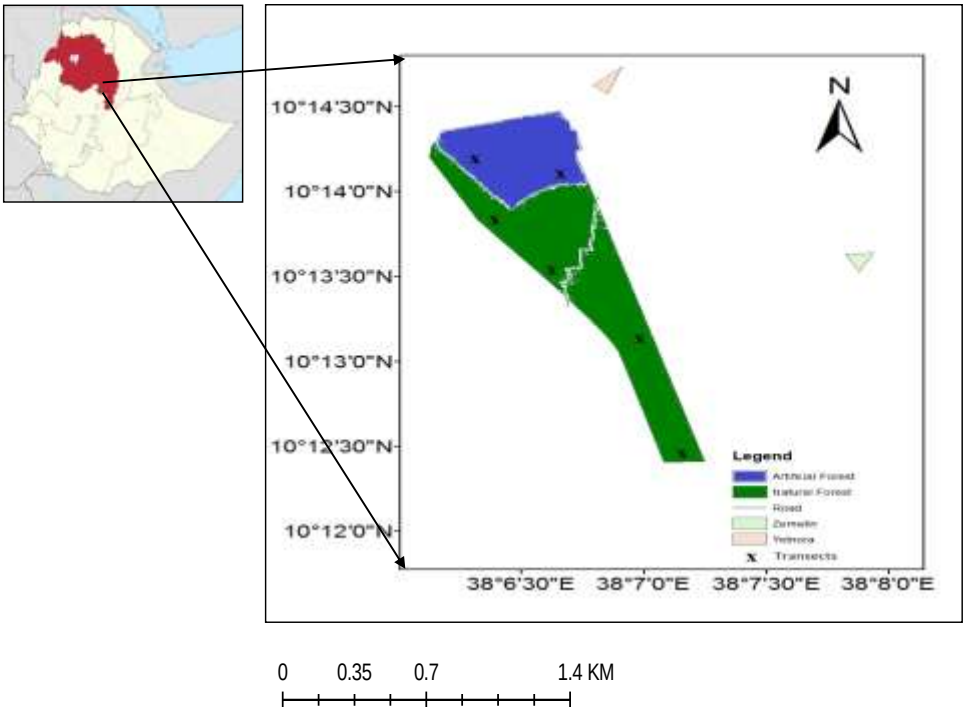

Figure 1. Map of the study area.

Where H' is observed index of diversity and H' max=ln(S); S = the number of species in each habitat; ln = Natural logarithm was computed to determine the number of individuals of the mammalian species between habitats and seasons as used by Dereje et al. (2015). The relative abundance of each species (observed medium and large mammals) in the two habitat types were computed using the formula;

$$\text{Abundance} = \frac{\text{total number of individual of a species}}{\text{total number of individuals species in the sampled habitat}} \times 100$$

as used by Botelho et al. (2012) and Rabira et al. (2015).

Chi-square test was used to compare the seasonal variations in species composition and abundance of individuals between habitats. Simpson similarity index (SI) was also computed to assess the similarity between the two habitats with reference to the composition of species.

$$SI = 2C/ I+II$$

Where: SI = Simpson's similarity index; C = the number of common species to all two habitats; I = the number of species in habitat one (natural forest) and II = the number of species in habitat two (plantation forest)

RESULTS

A total of 12 medium and large mammal species under 11 families were identified in both of the study area during the dry and the wet seasons. The species include Aardvark (*Orycteropus afer*), Abyssinian hare (*Lepus habyssinicous*), Rock hyrax (*Procavia capensis*), Common duiker (*Sylvicapra grimmia*), Bohor reed buck (*Redunka redunka*), klipspringer (*Oreotrgus oreotragus*), Spotted hyena (*Crocuta crocuta*), Black backed jackal (*Canis mesomelas*), Honey badger (*Mellivora capensis*), Porcupine (*Hystrix cristata*), Vervet monkey (*Chlorocebus aethiops*) and Olive baboon (*Papio anubis*). Species composition in the natural forest was higher, than in the plantation. In the study area the natural forest contained 11 mammal species and the plantation area contained eight species. The variation was not significant (χ^2 = 0.47, df =1, P > 0.05).

A total of 315 individuals of medium and large mammals were recorded from Mengaza communal forest area during both seasons in which of the recorded mammalian species, Olive baboon (*P. anubis*) was the most (32.7%) abundant species followed by vervet monkey (*C. aethiops)* (18.7%) during both seasons, but Aardvark (*O. afer)* was the least abundant species during both seasons (Table 1). There was significant seasonal variation in abundance of medium and large mammals (χ^2 = 3. 89, df= 1, P < 0.05). Majority (55.6%) of the species was observed during the dry season and the remaining 140 (44.4%) individuals were observed during the wet season. *P. anubis* was the largest species during both the dry (32%) and the wet (33.6%) seasons (Table 2).

There was significant variation in abundance between

Table 1. Number of individual species, and their relative abundance of medium and large mammals identified in the study area.

Family	Common name	Scientific name	No. of individuals	Relative abundance (%)
Oryctropodidae	Aardvark	*Orycteropus afer*	4	1.3
Leporidae	Abyssinian hare	*Lepus habyssinicous*	16	5.1
Procaviidae	Rock hyrax	*Procavia capensis*	30	9.5
Bovidae	Common duiker	*Sylvicapra grimmia*	19	6.0
Reduncinae	Bohor reed buck	*Redunka redunka*	29	9.2
Bovidae	Klipspringer	*Oreotrgus oreotragus*	15	4.8
Hyaenidae	Spotted hyena	*Crocuta crocuta*	5	1.6
Canidae	Black backed jackal	*Canis mesomelas*	9	2.8
Mustelidae	Honey badger	*Mellivora capensis*	11	3.5
Hystricidae	Porcupine	*Hystrix cristata*	15	4.8
Cercopithea	Vervet monkey	*Chlorocebus aethiops*	59	18.7
Cercopithecidae	Olive baboon	*Papio anubis*	103	32.7
Total			315	100

Table 2. Seasonal variation in abundance of medium and large mammalian species in the study area.

Species	Total number of individuals and their percentage	
	Dry (%)	Wet (%)
Oryctropus afer	2(1.1)	2(1.4)
Lepus habessinicus	9(5.1)	7(5)
Procavia capensis	17(9.7)	13(9.3)
Sylvicapra grimmia	11(6.3)	8(5.7)
Redunca redunca	19(10.9)	10(7.1)
Oreotragus oreotragus	8(4.6)	7(5)
Crocuta crocuta	3(1.7)	2(1.4)
Canis mesomelas	5(2.9)	4(2.9)
Mellivera capensis	6(3.4)	5(3.6)
Hystrix cristata	7(4)	8(5.7)
Chlorocebus aethiops	32(18.3)	27(19.3)
Papio anubis	56(32)	47(33.6)
Total	175(100)	140(100)

natural forest and plantation habitats (χ^2 = 90.670, df = 1, P < 0.05). High number (135) of individual mammals was recorded in natural forest habitat in which 40 individuals were recorded from the plantation during the dry season also, 107 individuals in natural forest and 33 individuals were recorded from the plantation during the wet season.

Diversity index (H') and evenness (E) of medium and large mammals varied between the two habitats at different seasons. During the dry season higher diversity of medium and large mammalian species was observed in the natural forest (H' = 3.17) but the diversity in the plantation was lower (H' = 2.17) during the same season. The higher and lower even distribution was registered in the natural forest (E =1.32) and plantation forest (E = 1.11), respectively. Higher number of species (11) was recorded in the acacia woodland during the dry season and seven species were recorded from the plantation during the same season, but which was not significant at (χ^2 = 0.889, df = 1, P > 0.05) (Table 3).

During the wet season higher diversity of medium and large mammalian species was also observed in natural forest (H' = 3.089) and the diversity was lower in the plantation (H'=1.653). The higher and lower even distribution was recorded in the natural forest (E =1.40) and plantation (E=0.79), respectively during the same season. The species richness was higher (9) in the natural forest during the wet season (Table 4). There was no significant difference (χ^2 = 0.059, df = 1, P > 0.05) in

Table 3. Species diversity between habitats during the dry season.

Habitat type	No. of species	Abundance	SWI (H')	H'max	H'/H'max (E)
Natural forest	11	135	3.17	2.39	1.32
Plantation	7	40	2.17	1.95	1.11

Table 4. Species diversity between natural forest and plantation during the wet season.

Habitat type	Number of species	Abundance	SWI(H')	H'max	H'/H'max(E)
Natural forest	9	107	3.089	2.197	1.40
Plantation	8	33	1.653	2.079	0.79

Table 5. Species similarity between the acacia forest and the plantation.

Mammals in Natural forest (I)	Mammals in plantation (II)	Common species of habitat I and II	Similarity Index SI = 2C/I+II
Canis mesomelas	*Canis mesomelas*	*Canis mesomelas*	
Chlorocebus aethiops	*Crocuta crocuta*	*Crocuta crocuta*	
Crocuta crocuta	*Hystrix cristata*	*Hystrix cristata*	
Hystrix cristata	*Lepus habessinicus*	*Lepus habessinicus*	
Lepus habessinicus	*Mellivera capensis*	*Mellivera capensis*	
Mellivera capensis	*Sylvicapra grimmia*	*Oryctropus afer*	
Oreotragus oreotragus	*Redunca reduca*	*Sylvicapra grimmia*	
Oryctropus afer	*Oryctropus afer*		
Papio anubis			
Procavia capensis			
Sylvicapra grimmia			
∑S=11	∑S=8	∑S=7	SI=0.74

mammalian species diversity during the wet and dry seasons in the study area (Table 4). Simpson similarity index (SI) of medium and large mammal species between the two habitats in the study area was 0.74. This indicated that 74% of the species were common for all two habitats (Table 5).

About 66.7% (n = 8) of the species were diurnal, it included vervet monkey (*C. aethiops),* Abyssinian hare (*L. habessinicus),* klipspringer *(O. oreotragus),* Olive baboon (*P. anubis),* Rock hyrax (*P. capensis),* Bohors reed buck *(R. reduca),* Common duiker (*S. grimmia)* and Black backed jackal *(C. mesomelas).* But about 33.3% (n = 4) of the species were nocturnal these were *C. crocuta, H. cristata, M. capensis, O. afer.* The variation in activity pattern was not statistically significant (χ^2 = 1.33, df =1, P > 0.05).

DISCUSSION

A total of 12 species of medium and large sized wild mammals were identified in Mengaza communal forest. Similarly Zerihun et al. (2012a) recorded 18 species of medium and large sized mammals in and around Wondo Genet Forest patch, southern Ethiopia, on the other hand, Zerihun et al. (2012b) also recorded 19 species of large mammals. In Borena-Sayint National Park, south Wollo, Ethiopia, Meseret and Solomon (2014) recorded 23 medium and large mammals. Mengaza Communal Forest was not as rich in mammalian species diversity, the reason might be due to disturbance and low quality of habitat in the forest area, because guarding is not strengthened by communal law.

Food availability and other factors such as climate,

geology and soil determined the distribution of wildlife populations in their natural habitats (Meseret and Solomon, 2014). According to the present study, medium and large sized mammals showed variation in composition between the two habitats and between seasons. Higher diversity of mammalian species was recorded in the natural forest habitats during both seasons. This is probably due to the presence of high vegetation diversity.

Similarly, earlier studies in different parts of Ethiopia revealed that mammalian species diversity is often high in areas where there are sufficient food resources and volume of habitat and available water sources (Dawud and Solomon, 2013). On the other hand, less diversity of mammalian species in plantation habitats during both seasons was probably related to the presence of more anthropogenic impact than the natural forest. The natural forest is relatively far from human settlements so that human impact was minimal.

The ecological preference and evolutionary adaptation of mammalian species play a role in their occurrence and abundance in different habitat types (Dawd and Solomon, 2013; Rabira et al., 2015). Studies noted the correlation of mammalian distribution and their habitat associations mainly with better availability of resources and protection. Higher even distribution was observed in the natural forest during both dry and wet seasons and lower even distribution was recorded in the plantation during both dry and wet seasons.

The possible explanations for this could be due to high number of livestock and pack animals were grazing near to the plantation area. Similar study in Kaka fragments has discovered the highest value of even distribution of mammals in the natural forest habitats in both seasons (Zerihun et al., 2012a). Higher number of medium and large mammalian species was recorded in the natural forest habitats and also recorded during the dry season than the wet season. Hence, their abundance significantly varied between habitats and between seasons as it was recorded by Zerihun et al. (2012b) and Dereje et al. (2015). Olive baboon (*P. anubis*) was highly abundant compared to other species recorded in the study area. Olive baboon is known to be widely distributed in Africa in a wide variety of habitats (Kingdon, 2013) and this might be due to their feeding behavior and high reproductive success.

Although the area is protected by the community, some people were seen to intrude the area repeatedly due to loosen communal law and inactiveness of Governmental bodies. Hence, due to farming activity high number of livestock and people involved around the area. Human activities like collection of fire wood, cutting grass and other activities are often affecting the study area which in turn affects wildlife in the area. Therefore, supporting Mengaza communal forest from governmental offices could greatly increase its effectiveness in biological conservation. Hence, there should be an immediate conservation management action to enhance the diversity and abundance of medium and large mammalian fauna in the study area. About 66.7 % of the species were diurnal. This might be due to human disturbance which mostly happened in daytime, so human disturbance should be a main disturbance factor to the activity of diurnal wildlife in the study area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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