


A Preliminary Survey on Diversity and Conservation Status of Medium and Large-Sized Mammals in Weyngus Forest, West Gojjam Zone, Amhara Region, Ethiopia

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Abstract

Mammalian surveys are vital tools for effective managements and conservation strategies. A survey was conducted to investigate the species composition, relative abundance and to determine their major threats in Weyngus Forest, West Gojjam Zone, Amhara Region, Ethiopia. The data were collected from April 2020 to June 2020. Transect method and subjective interviews were used to collect data for the study. A total of 11 species of medium and large sized mammals belonging to six orders and eight families were recorded by direct and indirect evidences. Porcupine (*Hystrix cristata*), Vervet monkey (*Chlorocebus aethiops*), and Colobus monkey (*Colobus guereza*) were among the medium-sized mammals while, Spotted hyena (*Crocuta crocuta*), Bush-buck (*Tragelaphus scriptus*) and Common duiker (*Sylvicapra grimmia*) were among the large-sized mammals recorded in the study area. Vervet monkey has been the most frequently observed species, whereas spotted hyena was observed less often. Simpson's Similarity Index (SI) showed a significant overlap of mammalian species composition between scrubland and natural forest (SI = 0.62). Illegal logging of trees for fuel wood, agricultural land expansion, illegal hunting and land degradation were the main threats of mammals in the study area. Community participation and awareness creation are highly recommended to limit the impact of anthropogenic activities threatening wild-life.

Keywords

Anthropogenic Activity, Mammals' Survey, Relative Abundance, Threats of Mammals

1. Introduction

Mammals are among the most widely distributed organisms in the world and occur from the Antarctic to desert ecosystems [1]. They are the most successful groups of animals next to the arthropods in the globe. This is due to their diversity in size and morphology, physiology, behavioral adaptation, and colonizes diverse habitat types [2]. Total of 5416 number of living species of mammals occurs around the globe. Of these, 2277 (42%) rodents (Rodentia), 1116 (20.6%) bats (Chiroptera), and 428 (7.9%) shrews and allies (Soricomorpha) comprise the largest species [3] [4].

Ethiopia is a home to a wide diversity of flora and fauna due to its' suitable ecological, edaphic and climatic conditions [5] [6]. It has 311 species of mammal fauna, fitting to 144 genera. Of these, 55 mammalian species are endemic to Ethiopia [7]. As a result, the country ranks among the most diverse mammalian faunas in Africa. Mammals provide different purposes such as; economic, cultures and beliefs, educational and scientific values and source of food and income generation like tusks, horns, and ivory [8]. They have also a great role in ecosystem services like in seed dispersal, regulate prey populations, and in nutrient cycling [3].

Due to low reproductive rates, large body size, habitat fragmentation, over-exploitation, and low rate of body growth, low generation time and requirement of large area mammals are facing greater population declines [9] [10]. Among the known species of mammals, 25% are threatened, 11% are endangered, 4% are critically endangered and approximately 2% of the known modern day mammals have gone extinct in the last 400 [11]. Hence, mammalian inventories are key implements to increase conservation policies and mammalian management [12] [13]. There are several previous studies conducted on mammal's diversity, distribution and other ecological aspects mainly targeted in National Parks and Sanctuaries of the country. But research conducted outside those areas like protected forest, agricultural land and other fragmented habitats are very small. Therefore, mammalian inventories in previously unexplored area will contribute to further research and to the amplification of strategies and new measures for the conservation of medium- and large-sized mammals in Weyngus protected forest. The purpose of this study was to articulate medium and large-sized mammals' diversity and to contribute to designing future conservation policies on conservation challenges and biodiversity in Weyngus protected forest, aiming to have knowledge of the mammalian fauna and would provide baseline information on species regarding conservation status in the study area.

2. Materials and Methods

2.1. Description of the Study Area

Weyngus forest is located in Dega Damot District which is one of the fourteen districts of west Gojjam administrative zone of the Amhara region Ethiopia. It is 271 km far from Bahir Dar, the capital city of Amhara Regional state, and 401

km North of Addis Ababa, Ethiopia. The district has three major agro-ecological zones; Dega (75%), Woina Dega (20%) and Kola (5%). The annual rainfall ranges between 900 and 1200 ml [14]. Tigrie Engada is one of the 33 Peasant Association found in the district. All the peoples are followers of the Ethiopian Orthodox Tewahedo Church. Weyngus forest is one of protected forest in Tigrie Engada Peasant Association. It is surrounded by four rural peasant associations namely; Taima abekidan, Gelila, Amija wefchaina and Dingayber Hagere mariyam and is found in the north, south, East and West of the study area respectively (Figure 1).

There are five rivers in the study area, Guacha River flows continuously throughout the year. It is known for use of different wild animals in the forest and livestock's of the surrounding community. The area has more than five large and small caves, especially two of them are well known by the surrounding people. These caves are locally named as a Serval cat cave (in Amharic language named as “የአጎር ዋሻ”) and Cattle cave (in Amharic language named as “የከብት ዋሻ”). Peoples use “Cattle cave” as shelter to their livestock from rain during the wet season. This cave has a competency of holding more than 50 cattle at the same time (Figure 2).

Ekebergia capensis, *Ficus sur*, *Schefflera abyssinica*, *Rosa abyssinica*, *Dovyalis abyssinica*, *Maesa lanceolata*, *Dombeya torrida* and plantations like Eucalyptus species and Bamboo species are the predominantly covering tree species of the area while, *Urera hypselodendron*, *Vernonia amygdalina*, *Laggera tomentosa*, are commonly found herbs species in the area. Bushbuck, Common jackal, Guereza and Vervet monkey are mammalian species commonly found in the area. Different rodent species and avian fauna are also found in this forest. The surrounding people obtain various ecosystem services from the forest, such as foods

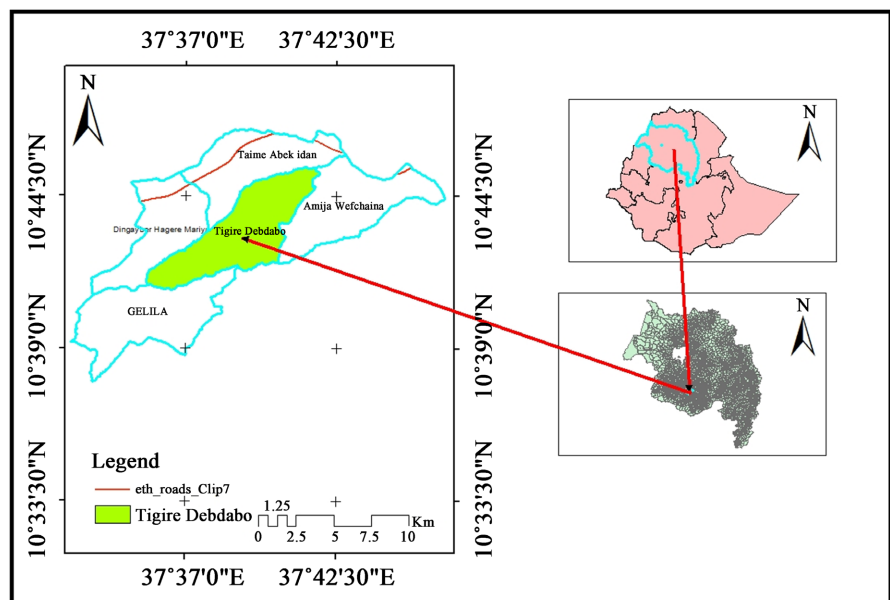


Figure 1. Map of the study area.



Figure 2. Weyngus natural forest (a), water falls of Guacha river found at the left tips of the forest (b), cave used as shelter to livestock from rain during the wet season (c) and rocky and mountainous view of the area (d) (April, 2020; Photo: Anesekegn A.).

(e.g. from *Rosa abyssinica*, *African mulberry* and *Dovyalis abyssinica*); soap (from *Phytolacca dodecandra*) and different home-grown materials (e.g. from *Eucalyptus* spp, bamboo species, *Dombeya torrida*).

2.2. Preliminary Survey

Reconnaissance was made in the first weeks of April 2020 to get basic information on accessibility, vegetation type, and topography of the area. The dominant habitat types were transverse on foot and visual estimation of the area of each habitat type was made.

2.3. Sampling Design

Based on direct observation made during the reconnaissance survey the study area was stratified into four dominant habitat types, these are; natural forest (the forest that grow naturally), human plantations (which are intensively managed stands of trees that have been artificially planted tree species), bar land (the land grasses growing on it but not tree species) and scattered tree (trees distributed or occurring at widely spaced intervals). Different plant species are dominated in each habitat type. The most abundant plant species were identified in the field based on the recorded direct book [15]. This is also supported by familiar peoples living adjuts to the area. Natural forest habitat principally consists of long and large tree species such as *Maytenus senegalensis*, *Geteme Schefflera abyssinica*, *Ekebergia capensis* and *Maesa lanceolata*. Plantation commonly consists of *Eucalyptus* spp and Bamboo species. On the other hand, bare land habitat mainly dominated by different grass species, while the scattered tree habitat largely consist of dispersed plant species of *Dombeya torrida*, *Buddleja polystachya* and *Rosa abyssinica*. A total of eight transect lines (which are fragmented due to the topographic nature of the area) were established to cover the major habitat types. Of these, three in natural forest, two in bar land, two in scattered tree habitat and one in human plantations were laid. These transect lines were placed on the stratified habitat types in a randomly fashion and proportional to the area

of every habitat type as discussed by Varman and Sukumar [16].

2.4. Methods of Data Collection

An investigation on medium and large mammals were conducted from April 2020 to June 2020 using line transect method. Both direct and indirect survey techniques were employed [13] [17]. A survey was conducted in the early morning from 6:00 to 10:00 and late afternoon from 16:00 to 19:00 when the animals are more active [13] [18]. When counting the mammals, one researcher and two field assistance were walking on foot along the pre-established line transect in order to count all the individuals sighted and record indirect evidence of the animal presence in the area. Observation of individual and categories with their respective species was done using unaided eyes and/or binocular (9 × 35 COMPACT WIDE 131M AT 1000M). To minimize disturbance during counting, silent movement followed by 3 to 5 minutes waiting period was allowed. Each encountered species of large and medium sized mammals was identified in the field using Kingdon Field Guide to African Mammals [19]. Mammals weighing between 2 and 7 kg were considered as a medium sized while, weighing above 7 kg were considered as large mammals as applied by Sutherland [20]. The conservation status of medium and large-sized mammals in the study area was addressed through key informant interview and field observation. A total of 18 people (six from each village) were selected for interview based on their long years lived adjacent to the area and their extensive knowledge of the local fauna. Interviews were mainly focused on mammal species existing in the forest and their major threats.

2.5. Data Analysis

Shannon–Wiener diversity index and Shannon-Wiener evenness index [21] was used to analyses species diversity of medium and large-sized mammals and species evenness respectively. Simpson similarity index (SI) was also computed to assess the similarity of mammalian species composition among habitats. The relative abundance of each species was calculated by dividing the number of records of each species by the total number of records of all species in the study area. The abundance of observed mammals were categorized as “common” if they were seen during all of the surveys “uncommon” if they were seen in more than half of the surveys, and “rare” if seen less than half of the surveys period following Legese *et al.* [13]. Interview surveys on the threats of mammals were analysed using SPSS version 20 software, while direct field observations on the threats of mammals were presented descriptively.

3. Results

3.1. Species Composition

Within a total of 126 observations, 11 species of medium and large sized mammals were recorded. Those mammals are belonging to six orders and eight fami-

lies. Seven (63.6%) species were identified by direct sightings; two (18.2%) species were recorded through indications of body parts and vocalization whereas, two (18.2%) species were recorded by evidences obtained from interviewing of local peoples. Order Carnivora had the highest number of species with four species followed by Primates and Artiodactyla with two species each. All the remaining orders were represented by a single species each. At family level, Bovidae, Cercopithecidae, and Canidae had contained two species each; while all the remaining families were represented by a single species each in the study area (Table 1). Spotted hyena and Porcupine were exclusively identified from indirect evidences (scat, spines, footprint and vocalization) but the presence of Serval cat and Bat-eared fox (አፍግ) were guaranteed by villagers. Most (n = 14, 77.8%) of the interviewed peoples claimed that leopard has been an inhabitant of the area before a three years ago, which were illegally hunted. On the other hand, a small number (n = 4, 22.2%) of respondents suggested as they have observed this animals in the area very rarely. But, during our filed survey neither direct nor indirect evidences were observed at all.

3.2. Distributional Patterns and Abundance

The distributional patterns of medium and large sized mammals were varied across the study habitats. High number of species was observed in the natural forest (8 species) whereas; a single species was recorded in bar land habitat. Of the total observed species two (22.2%) species were observed in three of the four habitats, while four (44.5%) species were recorded from two habitat types. On the other hand three (33.3%) species were limited to a single habitat type (Table 2).

Among the 11 species of mammals, Vervet monkey was the dominant mammalian species followed by Guereza, Ethiopian rock hyrax, and Porcupine while,

Table 1. Medium and large sized mammal species composition and their mood of recording in Weyngus forest (key: * = visual, ¥ = vocalization, € = personal communication, £ = scat/spines).

Order	Family	Scientific name	Common name	Local name	Mood of recording
Artiodactyla	Bovidae	<i>Sylvicapra grimmia</i>	Bush duiker	Midako	*
		<i>Tragelaphus scriptus</i>	Bushbuck	Dekula	*
Hyracoidea	Procaviidae	<i>Procavia capensis</i>	Ethiopian Rock Hyrax	Eshekoko	*
Lagomorpha	Leporidae	<i>Lopus starkii</i>	Rabbit	Tenchel	*
Primates	Cercopithecidae	<i>Colobus guereza</i>	Guereza	Gureza	*
		<i>Chlorocebus aethiops</i>	Vervet monkey	Tota	*
Carnivora	Hyeaniadea	<i>Crocuta crocuta</i>	Spotted hyena	Jib	¥, €
	Felidae	<i>Felis Serval</i>	Serval cat	Aner	€
	Canidae	<i>Otocyon megalotis</i>	Bat-eared fox	Afine	€
Rodentia	Hystricidae	<i>Canis aureus</i>	Common jackal	Kebero	*
		<i>Hystrix cristata</i>	Porcupine	Jart	£

Table 2. Medium and large sized mammal species distribution, occurrence and relative frequency observations during the survey period (Key: * their presence is assured by the villagers', - no direct observed).

Scientific name	Occurrence	Habitat types				Total observation	Relative frequency observation
		Natural forest	Human Plantation n	Scattered tree	Bar land		
<i>Sylvicapra grimmia</i>	Rare	6	2	-	-	8	6.3
<i>Tragelaphus scriptus</i>	Rare	3	1	-	-	4	3.1
<i>Procavia capensis</i>	Rare	-	-	12	-	12	9.4
<i>Lopus starkii</i>	Rare	2	1	-	-	3	2.4
<i>Colobus guereza</i>	Common	37	-	-	-	37	29.1
<i>Chlorocebus aethiops</i>	Common	23	16	13	-	52	41
<i>Crocuta crocuta</i>	Rare	2	-	-	-	2	1.6
<i>Felis Serval</i>	*	-	-	-	-	-	-
<i>Otocyon megalotis</i>	*	-	-	-	-	-	-
<i>Canis aureus</i>	Rare	2	1	-	-	3	2.4
<i>Hystrix cristata</i>	Rare	3	1	-	2	6	4.7

Bushbuck, Spotted hyena, and Common jackal were the least common species in the study area. Regarding to the occurrence of mammals based on their frequency of observation through the study interval, Vervet monkey and Guereza were common, while all the remaining observed mammals were rare.

3.3. Species Diversity and Evenness

The highest diversity of mammals was recorded from natural forest habitat ($n = 8$) followed by human plantation ($n = 6$) and scattered tree ($n = 2$) in the area. Nevertheless, only a single species was seen in the bar land habitat, as a result no species diversity here. The Sorensen species similarity index of medium and large sized mammal species was varied between and among habitat.

Medium and large sized mammalian similarity was high between natural forest and human plantation ($SI = 0.857$) followed by bar land and human plantation ($SI = 0.285$), and human plantation and scattered tree ($SI = 0.25$). But, there was no observed mammalian species evenness between scattered tree and bar land ($SI = 0.000$). The species similarity among natural forest, bar land and human plantation ($SI = 0.133$) was slightly smaller than among natural forest, human plantation and scattered tree ($SI = 0.125$).

On the other hand, the highest evenness of the mammalian species was recorded in scattered tree ($E = 0.995$) followed by natural forest ($E = 0.689$) and human plantation ($E = 0.560$). Similarly, the highest Simpson's index (1-D) of mammalian species was recorded from the natural forest habitat (0.682) whereas; no species diversity was recorded in bar land habitat (0.000), where only a single species was observed there. The overall species richness of Weyngus forest

was 11, and Shannon-Wiener Index values were low ($H' = 1.603$) whereas the Simpson's index of diversity showed the highest species diversity (0.736) in the current study area (**Table 3**).

3.4. Major Threats to Mammals of Weyngus Forest

All of the respondents ($n = 18$; 100%) mentioned that illegal hunting was the major threats of medium and large-sized mammals followed by fuel wood ($n = 14$, 77.76%), land degradation (9; 50%), agricultural land expansion ($n = 5$; 27.78%) and grazing ($n = 3$; 16.66%). Statically significant variation was observed among threats in the study area ($\chi^2 = 15.796$, $df = 4$, $p = 0.003$). Furthermore, they stated as cutting forest for fuel wood and fencing are takes place during the night time using hand saw, which prevent peoples from hearing the sound while cutting and they can easily take away. During our field observations, land degradation and different anthropogenic activities such as agricultural land expansion, illegal logging and wood collection for fuel and for construction were reputedly observed (**Figure 3**).

Table 3. Medium and large mammal richness and diversity indices during the survey period.

Variables	Habitats				Overall diversity indices
	Natural forest	Human plantation	Scattered tree	Bar lands	
No. of species	8	6	2	1	11
No. individuals	78	22	25	2	127
SWI (H')	1.433	1.003	0.690	0.000	1.603
H_{max}	2.079	1.791	0.693	0.000	2.397
Simpson's index of diversity (1-D)	0.682	0.477	0.479	0.000	0.736
Evenness	0.689	0.560	0.995	0.000	0.668

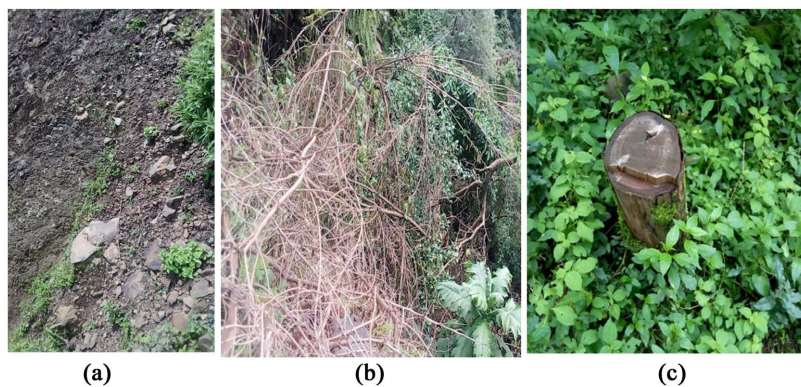


Figure 3. Major threats to mammals of Weyngus forest (land degradation (a), logging for fuel wood (b) and for other infrastructures like, timber (c) (May, 2020; Photo: Belayneh Ayeche)).

4. Discussion

Using direct and indirect evidence, a total of 11 species of medium and large-sized mammals were identified in the current study area. Within a comparable survey period, Legese *et al.* [13] found 12 mammal species in Wabe forest remnants, Gurage zone, Ethiopia. On the other hand, at the Baroye Controlled Hunting Area in Southwestern Ethiopia a large number of animal species (23 species) were discovered [22]. This difference could be owing to the study area's modest size and the survey period's short duration in Weyngus forest. Furthermore, during the study period, agricultural land expansion, illegal logging for fuel wood, overgrazing, and illegal hunting were all regular occurrences. Typically, these have significant negative effects on the fauna of animals. Limited survey length, research area size, and habitat changes caused by diverse anthropogenic pressures all have a major impact on species' existence, abundance and distribution [13] [23] [24].

Similar to other mammalian studies, [3] [23] [25] [26] [27] [28], the current study found that mammals choose one habitat over another based on resource availability and quality. In the current investigation, a great number of species of medium and big mammals were discovered in the natural forest. This is due to the natural forest's lower disturbance rate and greater availability of high-quality food compared to other habitat types. Moreover, Tilahun and Merewa [18], Qufa and Bekele [23], Belete and Melese [27] and Bobo *et al.* [29] reported that high species diversity of mammals was recorded either in woodlands and/or forest habitats.

The most common species seen were vervet monkeys, followed by *Colobus gureza*. The topographic features of the current research area are ideal for primate populations. Primate is the most abundant order in various study areas, according to several studies [3] [13] [28]. Beyond their abundance in varied places, Bobo *et al.* [29] argued those primates' high reproductive success, diversified feeding habits, and more adaptable nature is a factor.

The order Artiodactyla was placed second in terms of distribution and abundance after the order primate. Legese *et al.* [13] reported a similar finding. Nonetheless, this discovery contradicts Geleta and Bekele's [3] and Qufa and Bekele's [23] findings. This difference could be a result of the change in the availability of resource in each study area. *Procavia capensis* thrives in the presence of rocks and caves in the hilly areas of the current study area. Carnivores were few in the research area, both in terms of distribution and number. The existence of unlawful hunting due to large depredations of livestock by carnivores (particularly, Spotted hyena and Bat eared-fox) in and around the research region greatly reduces their number, according to respondents. Their presence could not be easily documented due to human intervention in their nocturnal and cryptic activities, according to Gonfa *et al.* [26].

The order Lagomorpha had the smallest distribution and abundance in the Weyngus forest. In this order, only one species, *Lopus starkii*, was represented. Because *Lopus starkii* is a common crop raider, the respondents decided that it

was hunted. As a result of the struggle, their numbers began to dwindle over time. In and around the Weyngus forest, human-wildlife conflicts are a typical occurrence [29]. Similarly, the order Rodentia has only one species, *Hystrix cristata*. In Wacha protected woodland, Western Ethiopia, Geleta and Bekele [3] stated as order Lagomorpha, Hyracoidea, and Rodentia were each represented by a single species. The natural forest and the human plantation shared the most species similarities. This is most likely owing to the fact that these habitats are located near rivers and mountain ranges, which allows them to hide from potential enemies. The species evenness among the habitats is mostly determined by the proximity of different habitats to one another, differences in sampling attempts, and animal utilization of habitats [13] [29].

Of all, 9 (81.82%) of the species were rare while, 2 (18.18%) were common in the study area. Most mammals are under local threat; especially *Tragelaphus scriptus*. During a field survey, we discovered that this Bovidae was being illegally hunted for meat. The common mammalian risks in the research area included land degradation, agricultural land expansion, illegal logging for fuel wood and illegal hunting. In and around the research area, human-wildlife conflict is claimed to be a common concern [30]. Similar reported as discussed by Tilahun and Merewa [18]. Agreeing to Legese *et al.* [13], the main stresses in Wabe forest fragments are substantial habitat fragmentation, deforestation, expansion of roads and human settlements, and infrastructure expansions such as highways. Other studies, such as Qufa and Bekele [23], Espinosa *et al.* [31], Worku and Girma [32] and Wale *et al.* [33] have documented comparable trends in other study areas in Ethiopia and internationally.

In conclusion, *Tragelaphus scriptus* is the most vulnerable and highly threatened species in the Weyngus protected forest, out of a total of 11 species of medium and large mammals recorded. As a result, additional considerations should be made before it becomes extinct locally. In addition, the research area's shared hazards included land degradation, agricultural land expansion and illegal logging for fuel wood. It is significantly more beneficial to use religion to create community awareness and manage the forest than to rely on the law. Furthermore, the head of the Dega Damot district and the Tigrie Engada Peasant Association should collaborate with the local population to establish a restoration program to secure the survival of mammals in the Weyngus protected forest. We further recommend that more extensive research on mammalian ecology and other related areas be conducted in both wet and dry seasons, since the current study did not.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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