

Species diversity and Abundance of Mammals (Medium and Large sized) in Yotyey/Yewezera Community Forest, Gurage Zone, Southern Ethiopia

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Abstract

Abstract The availability of accurate data on forest resources is an essential requirement for species documentation, community identification, and planning within the context of sustainable use of the forest. A survey of mammalian species was conducted in Yotyey/Yewezera Forest southern Ethiopia to assess their diversity and abundance in the area. Transect method was used to collect data for the study. Data was collected from the established line transect in each habitat from February 2019 to April 2019. A total of 553 individuals of 10 medium and large sized mammalian species distributed in to five orders and six families were recorded. *Chlorocebus aethiops* (42.9%) was the most abundant mammalian species followed by *Colobus guereza* (22.2%). *Leptus starcki* (1.6%), *Traglyphus scriptus* (2.9%), *Crocota crocuta* (3.3%) were the less abundant species. The highest diversity of mammals was recorded from open grassland ($H' = 2.082$; Simpson's index of diversity (1-D) = 0.8626) and the less was from human plantations area ($H' = 1.044$; Simpson's index of diversity (1-D) = 0.6311). Though, Yotyey/Yewezera community forest is with high potential of conserving biodiversity, it is not free from anthropogenic factors that threatened the biological components of it. Therefore, awareness should be created for the local people about the effects of forest destruction on the wildlife and start biodiversity conservation program in the area. Key words: Abundance, diversity, mammals, Yotyey/Yewezera forest, Southern Ethiopia

Introduction

Ethiopian is characterized by a wide range of edaphic and climate conditions. This creates diverse ecosystems which have their own distinctive climatic conditions, and supports different plant and animals species including various bird species depending up on their habitat requirements (Desalegn and Subramanian, 2015; Tesfahunegny *et al.* , 2016; Girma *et al.* , 2017). Ethiopia is known as the home of 7,000 of higher plant species with 840 (12%) of them are endemics (Tefahunegny, 2016). The country also possess 2970 described animals species, among them, 320 are mammals with 36 endemics, 926 birds with 24 endemics, 1,249 arthropods with 11 endemics, 200 fish with 40 endemics, 202 reptiles with 17 endemics and 73 amphibians with 30 endemics (Seyoum *et al.* , 2018). This biological diversity coupled with high number of endemics is associated with unique geological history, diverse climatic and physical conditions and topographical variation of the country (Mengesha and Bekele, 2008; Getahun, 2018).

Mammal inventories are tremendously vital to improve our understanding of their geographical distribution (Melo *et al.* , 2012). The ecological relevance of mammals, shortage of ecological data and increased human threats make the matter very essential and necessary to evaluate their current conservation status (Wuver and Attuquayefio, 2006). The absence and rarity of these mammals in a given ecosystem have severe consequences in the structure, composition and diversity of forests (Geleta and Bekele, 2016). Hence, surveys of mammalian diversity, abundance and habitat conditions of a particular ecosystem is the first step for conservation action and provide information to establish appropriate conservation strategies (Atnafu and Yihune, 2018).

Mammals of Ethiopia are under progressive studies, but the diversity and conservation status of mammalian species outside protected areas are poorly known. (Gonfa *et al.* , 2015). The under estimated faunal records of the country are only from the protected areas, where they are relatively well preserved (Young, 2012). However, records and conservation status are still poorly known outside these areas (Bekele and Yalden, 2014). The survival of wildlife species outside the protected areas is at high risk (Bekele and Yalden, 2014). Therefore, study of mammals in unprotected areas is equally important even more because of the huge anthropogenic pressures they absorb from their surrounding environments.

Because of anthropogenic impacts, the range of natural ecosystem of the country continually is collapsing (Yosef *et al.* , 2010). The country had experienced substantial deforestation, soil degradation and an increase in the area of bare land over the years. The need for fuel wood, arable land and grazing areas have been indicated as the main causes of forest degradation; frequently leading to loss of forest cover and biodiversity, erosion, desertification and reduced water resources (Ensermu and Teshome, 2008). This calls for the need to generate relevant information in order to contribute to the conservation, management and sustainable utilization of these forest resources in particular and the biodiversity in general. Knowledge of faunal diversity records, their abundance is basic for status determination and to propose appropriate conservation measure. Most studies conducted so far in the current study area did not attempt to assess the faunal diversity. Therefore, limited information is available on faunal composition and diversity of mammalian species in Yotyet/Yewezera Forest. Furthermore, the forest is under severe anthropogenic impacts. Hence, there is a need for data that would contribute to the conservation and sustainable use of this forest. Thus, species documentation, community identification and description of this forest are important. Faunal exploration is an important component of the study in a given protected area. It helps in understanding the potential of the area in composition and diversity of animals as well as to carryout conservation action for the future. Therefore, the current study is initiated to provide primary information about mammalian species composition, species diversity of Yotyet/Yewezera Forest.

Methods

Study area description

The area of this study, Yotyet/Yewezera Community forest, is located in southern portion of Central Ethiopia in Eza Wereda, Gurage Zone of SNNPR. The Yotyet/Yewezera forest is specifically found in West Gurageland, which proper part of the Shewan Plateaus, Central Highlands of Ethiopia. West Gurageland refers to highland portion of the so called 'Gurageland', part of Gurage Zone (an administrative unit), which is politically made part of the SNNPR. The Gurage Zone consists of two major physiographic regions: East Gurageland, which is situated in the western rim of Central Rift Valley of Ethiopia, and Western Gurageland which consists of highland section and is proper southern part of the Shewan Plateaus, Central part of Ethiopia. The forest area is located between 8° 7' 32" to 8° 8' 8" north latitude and 38° 4' 38" to 38° 5' 40" east longitude. It is found 209 km. and 50 km. away from Addis Ababa to the south (following Addis Ababa to Wolkite route) and Wolkite, seat of Gurage Zone administration respectively. Genemar and Girar villages bound it in the north, Yegeremuje (Atirfo Debrework Kidus Giyorgis Church) in the south, Nereshe in the west, and Yeshemya in the east respectively. The climate of Yotyet/Yewezera forest may be considered cool and it may be conventionally further identified as temperate (dega) climatic region for it occurs in an elevation zone ranging from 2504 to 2808 meters a.m.s.l.

Yotyet/Yewezera community forest (with an area of about 76.08 hectare) is one of the residual (remaining) forests and the largest in the West Gurageland. It is protected surprisingly in similar cases with other protected community forests of the wereda. Ten other community managed forests in the wereda include Koter Gedra, Genemar, Abangiya-Megecha, Geche, Wabe, Geme, Amba, Shashat-Yeganetiye, Genet Mariam, and Yame (Belay *et al.* , 2019). There were open forest areas in the forest before the 1980's, which were covered by grassland and bushland, and used by grazing and browsing domestic animals of surrounding five villages namely Nereshe, Genemar, Girar, Yeshemya and Yegeremuje (Atirfo Debrework Kidus Giyorgis). Many of the forest species of Yotyet/Yewezera are predominantly composed of *Juniperus*, *Podocarpus* , Bamboo Ebony, and Hagenia. The forest is luxuriant in its species composition and scenic attraction. The

area is also known for its high concentration of eucalyptus woodlots. The forest is the source of various wild animals and wild edible plants. It is also the source of River Koshkoshe, which is the tributary of Megecha which finally joins River Wenke, which is one of the main tributaries of River Gibe on the left side.

The majority of population of the study area earns its livelihood mainly from rain fed mixed farming. The cool and hospitable climatic condition of the region enabled the area to host a good soil type, which in turn created favorable conditions for crop cultivation. The most important food crops cultivated in the area include enset, wheat, barley, potato, beans, peas and other food crops. The land use pattern consists of settlements and footpaths, enset plantation, horticulture, cropland, grassland (including grazing land), eucalyptus woodlots, bushland and forestland. The land use and linear settlement pattern and housing construction give an inspiring and attractive scene to the landscape. Settlements are situated on both sides of ridges that are running from northeast to south and or southwest, facing each other and separated by an avenue referred to as jefure.

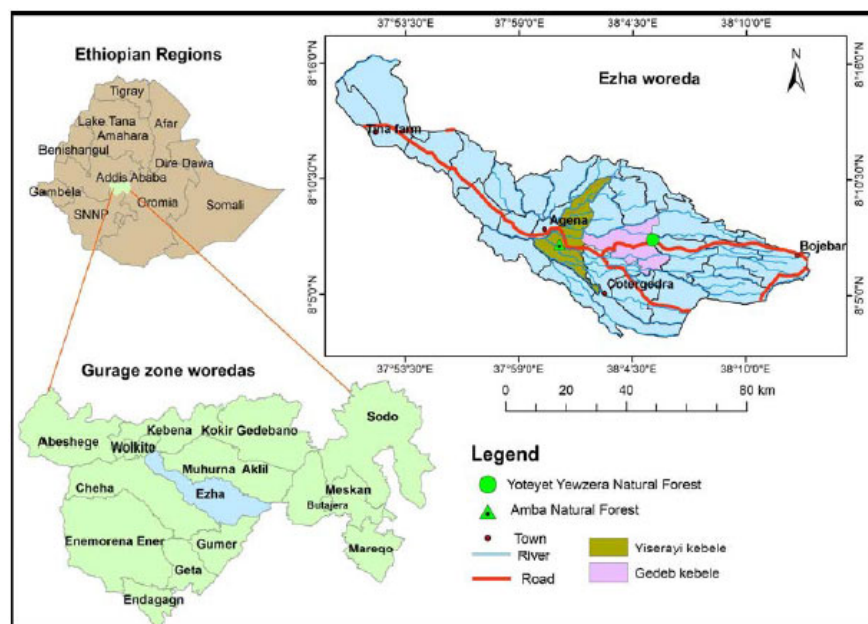


Figure 1: Map of the study area

Sampling design

Preliminary surveys was conducted in an effort of observing the overall landscape to stratify the habitat for line transects segments and explore the accessibility and habitat characteristics of the study sites. The study area was heterogeneous in vegetation type and topography and classified in to three Vegetation Zones; human plantation, open grassland and natural forest. The total number, length and width of line transects were determined based on habitat type or topography of the sites and size of the area (Porrás *et al.* , 2016). As a result, a total of 33 transect lines (4 from human plantation, 12 from open grassland and 17 from natural forest) were systematically established representing each habitat and used to estimate abundance and distribution of mammalian species. Transect length of 1.5km and width of 250m (in human plantation), transect length of 2km and width of 200m (in open grassland) and transect length of 2.5km and width of 50m (in natural forest) were taken.

Data collection method

Data was collected from the established line transect in each habitat from March 2019 to April 2019. Transect surveys was made walking slowly along the long axis of the study site treks, and all individuals and species of

mammals observed was recorded. The count was made for a period of 10 to 15 minutes within the counting station. Survey was conducted every two weeks twice a day (in the early morning 07:00-10:00hr and 4:00-6:00hr in the late afternoon)) (Aynalem & Bekele, 2008), when activities of mammals more prominent. Focal samples were observed at random, and the observed activities were recorded during the interval periods. When mammals were sighted, the number and GPS location were recorded at each transect line and species identification of large mammals. Direct and indirect observations of mammalian fauna were conducted along randomly selected transects. Direct observation was made with the aid of binoculars and naked eyes. The identification was also further confirmed through standard mammalian field guides (Yirga, 2008). Fecal dropping/scats, tracks, burrows, scratches were used as indirect evidences. Indirect evidences are very useful when surveying animals that are naturally rare, elusive, found at low densities and difficult to capture repeatedly (Dirzo *et al.*., 2009).

Data analysis

All statistics related to the types of data was carried out on statistical package for social sciences (SPSS) 20.0 software. The number of individual mammals recorded from transect laid in similar habitat types were pulled together for analysis purpose. Shannon-Wiever diversity index (H'), and Simpson's diversity Index (1-D) was used to determine the diversity of species in each habitat in the study areas. Species evenness was determined using Shannon-Weiner evenness index formulas: $E = H' / H_{max}$, Where, H' = Shannon-Weiner diversity index, $H_{max} = \ln S$, is natural logarithm of total number of species in each habitat. Simpson's similarity Index ($SI = 2C / I + II$ Where, C = number of common species to the habitats, I = the number of species in habitat one and II = the number of species in habitat two) was used to look the similarity between study habitats with reference to composition of species. The relative abundance index (RAI) of species was calculated by dividing the number of records of each species by the total number of records of all species.

Results

Species composition

During the current study, a total of 553 individuals of 10 medium and large sized mammalian species distributed in to five orders and six families were recorded. Order Artiodactyla was represented by largest number of families (two) and species (five). More mammalian species was recorded for the family Bovidae (three species) followed by Cercopithecidae (Two species), and Suidae (two species). Hyeniadea, Leporidae and Hystricidae were the least represented families in the study area (Table 1).

Table 1: Species composition of mammals in Yotyet/Yewezera, 2019

Order	Family	Scientific name	Common name	Local name	ID	Evidence
Artiodactyla	Bovidae	<i>Redunca redunca</i>	Bohor reedbuck	Dikula	Visual	<i>Sylvicapra grimmia</i> Common duiker Midako Visual

Species distribution and relative abundance

The distributional pattern of mammals in the current study area varied across the study habitats. About 90% of the species were observed in both open grassland (9 species) and natural forest (9 species) and least species in human plantation (3 species). However, it was not statistically significant ($\chi^2 = 3.000$, $df = 2$, $p = 0.223$). The overall difference in abundance of medium and large mammal species among three habitats was not statistically significant ($\chi^2 = 6.000$, $df = 2$, $p = 0.199$). But, Natural forest harbored more mammalian records (424) followed by open grassland (114) and the least was in human plantation (15). Certain species were also limited to specific habitat type. For instance, *Colobus guereza* and *Leptus starcki* were only recorded from natural forest and open grassland respectively. Among the 10 recorded species of

mammals, *Chlorocebus aethiops* (42.9%) was the most abundant mammalian species followed by *Colobus guereza* (22.2%). *Leptus starcki* (1.6%), *Traglaphus scriptus* (2.9%), *Crocota crocuta* (3.3%) were the least abundant species (Table 2).

Table 2: Species distribution and Relative abundance of mammals in Yotyet/Yewezera, 2019

Scientific name	
Common name	
Habitat Types	
Plantation Open	
Natural	
grassland forest	RAI
<i>Redunca</i>	3.8 3.4 2.9 3.3
<i>redunca</i> Bohor	9.4 6.3 1.6 22.2
reedbuck - 8	42.9 4.2
13 <i>Sylvicapra</i>	
<i>grimmia</i>	
Common	
duiker - 12 7	
<i>Traglaphus</i>	
<i>scriptus</i> Bush	
buck - 11 5	
<i>Crocota</i>	
<i>crocuta</i>	
Spotted hyena	
- 5 13	
<i>Phacochoerus</i>	
<i>aethiopicus</i>	
Warthog 7 23	
22 <i>Pontamo-</i>	
<i>choreus</i>	
<i>larvatus</i> Bush	
pig 3 17 15	
<i>Lepus starcki</i>	
Stark's hare -	
9 - <i>Colobus</i>	
<i>guereza</i>	
Guereza - -	
123	
<i>Chlorocebus</i>	
<i>aethiops</i>	
Vervet monkey	
- 22 215 <i>Hytrix</i>	
<i>cristata</i>	
Porcupine 5 7	
11	

Species diversity and evenness

The highest diversity of mammals was recorded from open grassland ($H' = 2.082$; Simpson's index of diversity (1-D) = 0.8626) and the less was from human plantations area ($H' = 1.044$; Simpson's index of diversity (1-D) = 0.6311). Likewise, mammals were more evenly distributed in open grassland ($E = 0.950$) (Table 3).

Table 3: Species diversity and evenness of mammals in Yoty-et/Yewezera, 2019

Habitat type	No. of species	No. of individuals	H'	Hmax	E	SID (1-D)
Human plantation	3	15	1.044	1.099	0.950	0.6311
Open grassland	9	114	2.082	2.197	0.950	0.8626
Natural forest	9	424	1.404	2.197	0.950	0.8626

Species similarity index

Simpson Similarity Index value showed a considerable overlap of species between open grassland and natural forest habitats ($SI = 0.88$). The similarity was lower in between open grassland and plantation ($SI = 0.5$) as well as between Plantation and natural forest ($SI = 0.5$).

Major threats to mammals of Yotyet/Yewezera forest

Field observations have showed that human activities such as illegal logging of trees for fuel wood, extraction of construction materials, grazing by livestock, human encroachment, were putting an enormous strain on the diversity and abundance of mammals in the study area. Anecdotal interview survey of the local people on their knowledge and attitudes towards the wildlife, their habitat conservation and threats to the study habitat were employed to six individuals available in the study area during the study period. The study participants were Gedebe kebele officer (2), Eza woreda environmental protection office (2) and landowners (2) in the study area. All of them were males and had knowledge of the animals living in the area. They also showed positive attitudes for the conservation of the area. The study participants, showed interest to participate in the conservation of the area. Currently, the forest is given to one of the local church named Atirfo Giorgis to be conserved.

Discussion

During the current study period, a total of 10 species were identified. This result is comparable to the report of Kabeta *et al.*, (2019) from Wabe fragmented forest, Atnafu & Yihune (2018) from communal forest of northern Ethiopia and Geleta & Bekele (2016) from Wacha protected forest in the western Ethiopia. But, the mammalian species diversity recorded in the current study area is very low compared to other protection areas found across the country (Meseret and Solomon, 2014; Gonfa *et al.*, 2015; Negari *et al.*, 2015). The low mammalian species diversity of the present study area might be associated with a limited survey period, variation in the size of the study areas, and severe habitat loss and fragmentation by various anthropogenic pressures.

Vervet monkey (*Chlorocebus aethiops*) and guereza (*Colobus guereza*) were the most abundant mammals identified in the current study area. Similar result was also reported by several studies conducted in different parts of Ethiopia (Gonfa *et al.*, 2015; Geleta and Bekele, 2016). This high abundance of these primates may be also associated with the wide distributional range of the species (Bobo *et al.*, 2014) and their more adaptive nature to different habitats (Gonfa *et al.*, 2015). In addition, this is may be due to the high reproductive successes, diversified foraging behavior and high tolerance level of primates to human disturbances (Bobo *et al.*, 2014).

The overall difference in abundance of medium and large mammal species among three habitats was not statistically significant. But, natural forest harbored more mammalian records (424), followed by Open grassland (114) and the least was in Human plantation (15). 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. Several mammalian studies, revealed that there is a tendency of mammals to favor one habitat over the other following the change in the abundance and quality of resources (Yimer and Yirga, 2013; Atnafu and Yihune, 2015; Gonfa *et al.* , 2015; Negeri *et al.* , 2015; Geleta and Bekele, 2016). Similar studies conducted in different part of the world showed that mammalian distribution and their habitat association correlated mainly with better availability of water, foraging opportunity and protection (Mekonnen *et al.* , 2011; Yaba *et al.* , 2011). For instance, in the current study, Vervet monkey (*C. aethiopsis*) was mostly seen at the edge of the forest closer to the river forests and at the center of the natural forest. Similar result is reported by Meseret & Solomon, (2014). The presence of this species at the edge of the riverine forest might be associated with a system of feeding on crops from shorter distance and easier sheltering when back off. According to the finding of Fetene *et al.* , (2011) and Geleta & Bekele, (2016) guereza (*C. guereza*) largely selected riverine and large trees, but was totally absent in the scrublands. Particularly, they dwelled the top canopy of *Juniperus*, *Podocarpus* (the dominant tree) and Bamboo tree of natural forest. This could be probably due to relatively surplus fruits and leaves and better protection provided by those tall tree species. According to Gonfa *et al.* , (2015), this is riverine habitats and large trees are inaccessible to humans. In addition, since, the forest habitat is relatively less disturbed, it might have also contributed a refuge for the shy behavior of Guereza.

The low diversity and abundance of mammals in human plantation area suggests that mammals prefer relatively less human disturbed areas. This might be due to the small proportion of sampling, and the dominance of homogenous plant species, Eucalyptus species that provide low foraging and protection opportunity for large mammals (Gonfa *et al.* , 2015; Negeri *et al.* , 2015; Geleta and Bekele, 2016). According to Matias *et al.* , (2011), there is positive correlation between habitat heterogeneity and animal species diversity. Furthermore, habitat homogeneity was reported for lower diversity (Mekonnen *et al.* , 2011).

Though, Yotyet/Yewezera community forest is given to Atrifo Kidus Giorgis church to be conserved, it is not free from the anthropogenic activities pressure. Human activities such as illegal logging of trees for fuel wood, extraction of construction materials, grazing by livestock, human encroachment, were recorded during Field observations. These human activities may alter this natural environment. Anthropogenic activities affect the interactions, distribution and diversity of species through habitat loss and modifications (Torres *et al.* , 2016). Deforestation and habitat loss threaten mammals by decreasing area, connectivity, and fragment size, and increasing edge effects and number of fragments of the natural landscapes (Bernardo and Melo, 2013). Livestock were also seen in certain part of the habitats competing for food with mammalian species particularly. Other studies (Gonfa *et al.* , 2015; Kabeta *et al.* , 2019) also report the adverse effects of livestock on wildlife. If these threats continue, there might be no more chance to see the present floras and faunas of the study area. Recently, numerous anthropogenic factors have promoted habitat loss and fragmentation, and the decline and losses of global mammalian biodiversity (Bernardo and Melo, 2013; Geleta and Bekele, 2016). Change in vegetation community structure due to human activities could be altering the availability and quality of food, shelter and water. This might be lead to alter the diversity, abundance and distribution of population of a particular habitats or it may lead to additional problems such as risk of predation or cost of migration for searching food (Mengesha *et al.* , 2011). Habitat disturbance has also a negative impact for forest specialist species as they do not have any alternative foraging or breeding sites (Asefa *et al.* , 2017). According to Asefa *et al.* , (2015) allowing large and repetitive livestock population in to unprotected area will also lead to los of grassland specialist species.

Conclusion

Yotyet/Yewezera community forest possesses unique habitat with high potential of conserving biodiversity. The forest contains diversities of habitat suitable for variety of flora and associated faunal diversity. Local people showed good attitudes for mammals and their conservation. This could be used as an opportunity and

asset for the conservation of this ecosystem and its wildlife resources. An immediate conservation measures should be in place to retain these mammals with further detailed study, e.g. an alternative work opportunity should be created for fuel wood exploiters and charcoal producers to reduce the pressure from the habitat. Beside this, awareness should be created for the local people on the effects of forest destruction on the wildlife. Furthermore, thorough inventory for faunal diversity involving seasonal based and all vertebrate, and strengthen the forest management will ensure the sustainability of ecosystem supporting the rich biodiversity components.

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Conflict of interest

The authors declare that there is no competing interest in conflicts.

Author contributions

Ashenafi Teklemariam, Belete Tilahun, Demelash Sime, and Zemedkun Siraj proposed the proposal, and designed the study data collection. All authors designed the survey method and conducted fieldwork. Ashenafi Teklemariam analysis, and revised the whole document. Belete Tilahun, Demelash Sime, and Zemedkun Siraj edit the manuscript and revised the final version of the main document for submission for potential review. All authors contributed to the writing of the manuscript and approved the submitted version.

Data availability statement

All data used in this study are archived in the Dryad data repository (Available here: DOI: <https://doi.org/10.5061/dryad.pnvx0k6ks>).

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