2019-09-23

ASSESSMENT ON DIVERSITY, ABUNDANCE AND DISTRIBUTION OF MEDIUM AND LARGE SIZE MAMMALS IN GUNA MOUNTAINS COMMUNITY CONSERVATION AREA. COMMUNITY CONSERVATION AREA, SOUTH GONDAR, ETHIOPIA.

Dereje, Chukala

BAHIR DAR UNIVERSITY

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

GRADUATE PROGRAM

ASSESSMENT ON DIVERSITY, ABUNDANCE AND DISTRIBUTION OF MEDIUM AND LARGE-SIZE MAMMALS IN GUNA MOUNTAINS COMMUNITY CONSERVATION AREA, SOUTH GONDAR, ETHIOPIA.

M.Sc. Thesis

By

Dereje Chukala

June 2019

Bahir Dar, Ethiopia

BAHIR DAR UNIVERSITY

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

GRADUATE PROGRAM

ASSESSMENT ON DIVERSITY, ABUNDANCE AND DISTRIBUTION OF MEDIUM AND LARGE SIZE MAMMALS IN GUNA MOUNTAINS COMMUNITY CONSERVATION AREA. COMMUNITY CONSERVATION AREA, SOUTH GONDAR, ETHIOPIA.

M.Sc. Thesis

By

Dereje Chukala

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCES (M.Sc.) IN WILDLIFE CONSERVATION AND ECOTOURISM MANAGEMENT.

Major Advisor: Dr. Mezgebu Ashagrie

Co-advisor: Dr. Girma Eshete

June 2019

Bahir Dar, Ethiopia

THESIS APPROVAL SHEET

As a member of the board of examiners of, the Masters of Sciences (M.Sc.) thesis open defense examination we have read and evaluated this thesis prepared by Dereje Chukala entitled "**Assessment on Diversity, Abundance and Distribution of Medium and Large-Size Mammals in Guna Mountains Community Conservation Area South Gondar, Ethiopia"**. We here by certify that; the thesis is accepted for fulfilling the requirements for the award of the degree of Master Sciences (M.Sc.) in Wildlife Conservation and Ecotourism Management.

Board of Examiners

_____	_____	_____
Name of External Examiner	Signature	Date
_____	_____	_____
Name of Internal Examiner	Signature	Date
_____	_____	_____
Name of Chairman	Signature	Date

DECLARATION

This is to certify that this thesis entitled "**Assessment on Diversity, Abundance and Distribution of Medium and Large-size Mammals in Guna Mountains Community Conservation Area, South Gondar, Ethiopia."** submitted in partial fulfillment of the requirements for the award of the degree of Master of Science, **in Wildlife Conservation and Ecotourism Management,** to the graduate Programme of College of Agriculture and Environmental Sciences, Bahir Dar University, by Mr. Dereje Chukala (Id. No. BDU1018656PR is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for the award of any degree or diploma to the best of our knowledge and belief.

Name of the Student _____Signature _____ Date_____

Name of the Supervisor _____Signature _____ Date_____

Name of Co-advisor _____Signature _____ Date _____

ACKNOWLEDGMENTS

I would like to thank my supervisor Dr. Mezgebu Ashagrie and co-advisor Dr. Girma Eshete for their generous assistance, encouragement and valuable comments on the content and depth of the thesis throughout the study. My special thanks goes to Dr. Mezgebu Ashagrie for giving me an opportunity to work at Guna Mountains Community Conservation Area and providing with all necessary field materials and facilities. I would also like to thank him for his training on basic ecological data collection methods when I was in the field. Generally it could not be possible to complete this work without his holistic support. I would also like to thank Bahir Dar University for funding my thesis research project.

I am grateful to Amhara National Regional State, South Gondar Zone Guna Mountains Community Conservation Area Office, and Guna Mountains Community Conservation Area Community, and Mr. Desalegn Mequanent scout of GMCCA. I thank Dr. Eshetu Moges, Mr. Adamu Yemir Dr. Minwylet Mingist and Mr. Gashaw Mesafint for their material and moral contribution. I appreciate my friend, Awoke Yenealem for his support in the field, I am thankful to my grandfather for his everlasting help and encouragement.

ACRONYMS

BCTPD	Bureau of Culture, Tourism and Parks Development
EWCP	Ethiopian Wildlife Conservation Programme
ORDA	Organization for Rehabilitation and Development in Amhara
m.a.s.l	meter above sea level
EWCA	Ethiopian Wildlife Conservation Authority
EWNHS	Ethiopian Wildlife and Natural History Society
GMCCA	Guna Mountains Community Conservation Area
IUCN	International Union for Conservation of Nature
IBAs	Important Bird Areas
USAID	United States Agency for International Development
SPSS	Statistical Package for Social Sciences

ABSTRACT

Guna Mountains Community Conservation Area is found in South Gondar. It was formally established as a community conservation area in 2016. The concern of this study is to estimate the diversity, abundance, and distribution of medium and large-size mammalian in different habitat types of Guna Mountains Community Conservation Area. The study area was divided into four habitats (Guassa grassland, Plantation, open grassland with scattered *Lobelia* and *Helichrysum*, and *Erica* moorland) based on vegetation type during a preliminary survey. Representatives sample sites were taken from each habitat types and surveyed using the line transect method. Overall 25 transect lines (8 transect lines on Guassa grassland, 5 transect lines on Plantation, 5 transect lines on Erica moorland, and 7 transect lines on Open grassland with scattered *Lobelia* and *Helichrysum*) were laid systematically in all habitats to study and collect data on mammalian species diversity, abundance, and distribution. The study was conducted from December 2018 to May 2019. Data collected from the study area was coded, entered and analyzed by using SPSS version 22 and Microsoft Excel. Species diversity was calculated by Shannon diversity index. Distribution of species among different habitat types was analyzed by chi square association test. A total of 13 medium and large-size mammalian species those belong to 8 families and 6 orders were recorded in the study area. The higher number of species were recorded in Plantation (5 species) followed by Guassa grassland, (4 species) whereas the lower number of specie was recorded in open grassland with scattered *Lobelia* and *Helichrysum* (2 species). Relative abundance of different species was statistically significantly different (χ^2=1197.276, df=12, p = 0.001). The diversity index was higher in Plantation (0.94), whereas lower diversity index was recorded in open grassland with scattered *Lobelia* and *Helichrysum* (0.13). Results revealed that statistically significantly difference in mammalian distributions in different habitat types (χ^2 =1167.33, df =36, p = 0.001). Rock hyrax (*P. capensis*) was the most abundant (42.2%) species followed by *T. gelada* (32.85%). Whereas *Canis aureus* was the least abundant (0.5%) species. Currently, the area was suffering from different human activities mostly from agriculture and settlement expansion and cattle grazing. Administrative units and all other concerned bodies shall cooperate to limit the impact of anthropogenic activities threatening the wildlife in the area.

Keywords/phrases: Abundance; Community Conservation Area; Distribution; Diversity; Guna Mountain; Large and Medium-Size Mammals

TABLE OF CONTENTS

LIST OF TABLES

LISTOF FIGURES

LIST OF APPENDICES

CHAPTER 1 INTRODUCTION

1.1. Background of the Study

Ethiopia is one of the world's rich biodiversity countries among the world leaders in terms of species diversity and it deserves attention regionally and globally (Lavrenchenko and Afework Bekle, 2017). Ethiopia has 4 biomes (Afro Tropical Highland, Somali-Masai, Sudan-Guinean Savannah and Sahelian Transition); vegetation based 10 broad ecosystems, 32 agro-ecological zones, 69 Important Bird Areas (IBAs) and 2 hotspots (Horn of Africa Hotspots and Eastern Afromontane Hotspot) with several biodiversity centers, ecological communities and sub agro-ecologies (Young, 2012). The main part of the Eastern Afromontane biodiversity hotspot is made up of the three ancient mountain massifs including the Ethiopian Highlands. They also host 680 species of birds among which 31 are endemic to both Ethiopia and Eretria. Moreover, more than 320 of the nearly 200 mammals found in Ethiopian highlands are found nowhere else (Conservation International, 2012).

Mammals are diversified both structurally as well as functionally (Yonas Terefe and Fikresilasie Samuel, 2015). Class Mammalian is composed of 5,487 species and more than 1150 species of mammals are found in Africa (Borges *et al*., 2014). Topographic diversity and climate condition are the most significant predictors of mammalian species diversity (Melaku Teferra, 2011). Ethiopia is one of the African countries known for highest mammal species richness and possesses more than 320 mammals, of these, 55 are endemic to the country (Lavrenchenko and Afework Bekle, 2017). The three mountain ranges Bale, Arsi, and Simien together account 60% of the total afro alpine and sub afro alpine ecosystems in the country (Girma Mengesha, 2012). The highest level of endemicity is credited to the large extent of highlands (Yalden and Largen, 1992). Among this Amhara Region has about 637 species of birds (12 are endemic), 50 species of mammals (17 are endemic) and variety of fish, reptiles, amphibians and a large number of plant species which require detail studies to quantify (Abeje Kassie, *et al*., 2018). The region has 5 legally declared parks,16 priority forest reserves, 3 community conservation area, Abune Yosef, Menze Guassa and Guna Mountain community conservation area, 3 water basins (Abay, Tekeze and Awash) and 58 major rivers and 5 lakes including the largest highland lake Tana) (Abraham Marye, 2010.).

These protected areas cover roughly 16.4 % of the countries land area (Melaku Teferra, 2011; Alemneh Amare, 2015). Most populations of medium and large-Size mammals are severely depleted in the country including protected areas (Rabira Gonfa *et al*., 2015). It is due to the 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 biogeographically studies (Botelho *et al*., 2012), and which is the first step for conservation and monitoring action (Botelho *et al*., 2012; Fornitano *et al*., 2015). Investigations on mammalian diversity, abundance, and distribution provided information of the status of populations for appropriate conservation and monitoring actions (Rabira Gonfa *et al*., 2015). Hence, the lack of a survey may hinder the preparation of an appropriate management plan in the protected areas (Fornitano *et al*., 2015). Most of the diversity and population ecology of medium and large-size mammals are targeted on national parks and sanctuaries of the country Mohammed Ersado and Afework Bekele, (2014), but outside of the protected areas records and conservation status of the different species of mammals are poorly known (Rabira Gonfa *et al*., 2015). therefore, because of these wildlife resources, Ethiopia has established different protected areas including, national parks, wildlife reserves, priority forests, biosphere reserves, and community conservation areas to protect its wildlife. So more assessments on the diversity, abundance, and distribution of wildlife resources is an important component of conservation and monitoring programs (Fornitano *et al*., 2015), that it can locate areas of high diversity of mammals and help managers understand the effects of habitat loss and habitat fragmentation (Dawud Yimer and Solomon Yirga, 2013). Conservation of Ethiopia's diversity of species and ecosystems is vital to ensure sustainable growth, to mitigate the effects of anthropogenic activity on wildlife and to avoid the collapse of life support systems.

Unless Ethiopia rapidly enhances the protection of its biodiversity, the combination of the effects of climate change due to different human activity and unsustainable development will cause an environmental disaster that will assuredly result in increased levels of the extinction of wildlife and poverty. The most terrestrial ecosystem of Ethiopia is directly or indirectly affected by human activity. The distribution of species and biodiversity is determined by a large number of a biotic and biotic factors, of which only a few are well-established form a given species (Araujo and Guisan 2006; Elith and Leathwick, 2009).

Animals in protected areas or conservation may be exposed to stress due to anthropogenic activity including unwanted ecotourism activity, an agricultural activity which is near to the protected area, people's settlements' (Stephens *et al*., 2001). For example, nature-based tourism has significant risk related to negative impacts on wildlife. Tourists seek to watch rare or spectacular species often during sensitive times such as breeding or nesting periods (Knight, 2009).

1.2. Statement of the Problem

In Ethiopia, there are many designated protected areas of land including national parks, wildlife reserves, priority forests, biosphere reserves, and community conservation areas (Young, 2010). These protected areas do not only act as biodiversity 'banks', but they also provide important ecosystem service and centers for traditional ecological knowledge (EWCA, 2014). Ethiopia's protected areas are increasingly degraded (Zelealem Tefera and Leader, 2005). The land is being converted for subsistence and commercial agriculture, the forest is used for fuel wood and construction; protected grasslands are used for livestock grazing (Sillero and Stwizer, 2004). Even if Ethiopia is center of endemic fauna and flora species, population estimation, and monitoring have not been properly done. However, conceptually population estimation of those wildlife forms an integral part in the process of well conservation action. The loss of forests and other protected land resources are underpinned by a growing human population, unsustainable natural resource management, and poor enforcement of existing legislation, and very low public awareness (Kugonza *et al*., 2009).

Mammals are the most influenced biodiversity when the protected area is degraded. As habitat gets fragmented, the boundary for the interaction between humans and wildlife is increasing. As a result of habitat fragmentation and subsequent edge effect, wildlife diversity and distribution become too low. Consequently, it leads to greater reduction or extinction as wildlife lacks to fulfill their nutritional, ecological and behavioral needs. According to investigation made Ethiopian Wildlife and Natural History Society (EWNHS (1996). Among different potential nature conservation sites of the country Guna Mountain Community Conservation Area suffering from conservation threatening factors. Mostly from agricultural activity and livestock grazing that are dramatically change the mountains/ecosystems. Due to this diversity and distribution of wildlife in the mountains and its surrounding areas are expected to be too low and their population structure is very biased. Even if the area had general management plan and reports but, regarding to wildlife diversity, distribution, abundance, conservation, and monitoring aspect there is no detail scientific paper done in Guna Mountains Community Conservation Area. Because of this problem and research gap wildlife is reduced or migrates from the area. Therefore, the concern of this study is to identify species composition/estimate the diversity, abundance, and distribution of both medium and large-size mammalian in different habitat types of Guna Mountains Community Conservation Area.

The outcome of this study will be valuable document for decision making, policy development, for monitoring and conservation of wildlife and effective management of the area. In addition, the results from this investigation assist the different monitoring program of this conservation area and project partners to draft a sustainable and locally adapted action for the development of future intervention and also a basis for other researchers.

1.3. Objectives of the Study

1.3.1. General Objective

- The general objective of the study was to assess the diversity, abundance, and distribution of medium and large-size mammals in Guna Mountains Community Conservation Area.

1.3.2. Specific objectives

- To assess the distribution of medium and large-size mammals in different habitat types of Guna Mountains Community Conservation Area.
- To estimate the abundance of medium and large-size mammalian species in Guna Mountains Community Conservation Area.
- To estimate the diversity of medium and large-size mammalian species in the area.

1.4. Research Questions

1 Do different species of medium and large-size mammals in Guna Mountains Community Conservation Area evenly distributed in different habitat types?

2 Do the different species of mammals' proportional in their abundance? Which species is locally the most abundant and which species is rare in the Guna Mountains Community Conservation Area?

3 How much Guna Mountains Community Conservation Area is diverse in mammal species? Which habitat type supported diverse mammal species?

CHAPTER 2 LITRATURE REVIEW

2.1. Taxonomic Diversity of Mammals in Ethiopia

Ethiopia is one of the world's rich biodiversity countries among the world leaders in terms of species diversity and it deserves attention regionally and globally (Lavrenchenko and Afework Bekle, 2017). However, wildlife has a very diverse set of ecosystems ranging from the humid population in Ethiopia has diminished over the past forest and extensive wetlands to the desert. The countries have diverse habitat types definitely contribute for the tremendously diverse mammals; there are more than 320 mammal species in Ethiopia, of which five are critically endangered, eight are endangered, twenty seven are vulnerable, and twelve are near threatened (IUCN, 2001).

Ethiopia does contain, within the national parks one of the world largest concentration of large mammals. But a complete inventory does not exist and endemism is not well documented. Ethiopian mammals, fauna consists of 320 and 55 of them are endemic to the country (Lavrenchenko and Afework Bekle, 2017). The country also consists more than 861 species of birds (19 are endemic), 201 species of reptiles (16 are endemic), 63 species of amphians (28 are endemic) and 150 species of fish (40 are endemic) (Wilson and Reeder, 2005).

Mammals are diversified both structurally as well as functionally (Yonas Terefe and Fikresilasie Samuel, 2015). More than 60% of the mammal species in Ethiopia are the medium and large size (Dereje Yazezew and Alemneh Amare 2015). Among this Amhara Region has about 637 species of birds (12 are endemic), 50 species of mammals (17are endemic) and variety of fish, reptiles, amphibians and a large number of plant species which require detail studies to quantify. Class mammalian is composed of 5,487 species and more than 1150 species of mammals are found in Africa (Borges *et al*., 2014). Topographic diversity and climate condition are the most significant predictors of mammalian species diversity (Melaku Teferra, 2011). Mammals are an extra ordinary group, showing an amazing diversity of species, forms, ecologies, physiologies, life histories and behave viruses.

The greatest numbers of extant species (99%) are in the subclass Theria which consists of 5136 eutherian mammal species (i.e. .placental species such as rodents, bats, carnivores, primates, cows, whales and elephants), and a smaller proportion (346 species) of metatherian species (i.e. marsupial mammals such as kangaroos and opossums). The number of mammal taxa recorded for Ethiopia has increased significantly (Lavrenchko and Afework Bekle, 2017). Order Pholidota ,family Manidae ,four new genera (Manis, Myoncteris ,Uranomys ,Aethomyus) and ten species (*Myonycteristor quata*, *Hipposideros abae*, *Pipistrellus aero*, *Pipistrellus annulus* ,*Neoromicia zuluensis* , *Manistem minckii*, *Aethomys hindeis* ,*Uranomys ruddi* ,*Mastomysery throleucus* ,and *Crocidur aluna*) were detected for the first time within the boundaries of Ethiopia (Lavrenchenko, 2010; Kruskop ,2016).

2.2. Distribution of mammal species in Ethiopia

The altitudinal variations within Ethiopia produce a range of climate, which affects every aspect of life in the country; 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 (Lavrenchenko and Afework Bekle, 2017). The distribution of species and biodiversity is determined by a large number of abiotic and biotic factors, of which usually only a few are well established for any given species (Araujo and Guisan, 2006; Elith and Leathwick, 2009). Large body size species with extended home ranges, or those with limited dispersal ability will be affected more negatively by habitat fragmentation compared to highly mobile species which are able to persist as meta populations in fragmented landscapes (Purvis *et al*., 2000). Similarly, species with high reproductive rates are more likely to persist under high hunting pressure than species with extended inter-birth intervals and lower number of offspring (Fa and Brown, 2009). Mammals are a highly versatile group that includes some of the world's fastest runners, deepest divers, and most agile fliers, having colonized most of the Earth's habitats. The distribution of species is determined by climate, availability of suitable resources barrier of dispersal and interspecific interaction with those organisms sharing the same area. The distribution of species represents the sum of many local populations and the distribution of a particular species or group of populations.

Structurally complex habitats may provide more niches and diverse ways of exploiting environmental resources and thus increase species diversity. In most habitats, plant communities determine the physical structure of the environment and therefore have a considerable influence on the distribution and interactions of the animal. Large carnivores frequently shape the number, distribution, and behavior of prey animals. Large herbivores function as ecological engineers by changing the structure and species composition of the surrounding vegetation. The destruction, fragmentation, and loss of much habitat type of wild mammals are occurred because of the increase in human population (Manhaes and Ribeiro, 2005). Many forest areas have changed to urbanization, agricultural activities and pasture land and also to bare land.

Therefore human activities have a great impact on mammal's abundance, distribution and diversity (Westphal *et al*., 2006). For example the reduction in abundance and loss of many species is due to human interferences having been seen in the tropics (Cordeiro, 2005). This agricultural activity is constraining even more of the afroalpine habitats and the species endemic in these habitats. So, crop raiding by the wildlife is expected to happen because the ranging and foraging sites of different wildlife for example gelada baboon, serval, spotted hyena and porcupine site are already occupied by farm land (ORDA,2013). Agricultural expansion near the tip of mount Guna in Ellet Dibana and Dat Kebele, Misrak Estie Woreda was highly affecting the area. In this aspect the farmers compromise the habitat of gelada baboon and the quality of the environment in general. Grasslands cover 41% of Earth's land surface and provide livelihoods for nearly 800 million people, as well as forage for livestock, wildlife habitat, valuable ecosystem services, and locations for recreation and tourism (Zhang 2006; Stromberg *et al*., 2013). The decline of productivity and ecological function of grassland ecosystems due to human activity or natural processes, is recognized ecological and environmental problem worldwide and can have far-reaching implications including changes to local hydrology, dust storms, commodity scarcity, and the societal consequences of displaced populations (Feng *et al*., 2009).

Overgrazing is one of the primary contributors to grassland degradations around the world, through a reduction in vegetation cover, degradation of topsoil, causing soil compaction as a result of trampling, reduction in soil infiltration rates, and enhancement of the susceptibility of soils to erosion (Shuhong Wu. *et al*., 2014).

Mammals are preferred the habitat that is fit their requirements for success of reproduction, food availability, and shelter. The morphological and physiological adaptation of the animals is restricted to feed on specific food items except for some mammals' species. Therefore habitat type is restricting the distribution and diversity of the mammals (Macleam, 1970). The complexity, cover, and density of forest are the most important factors in mammals' habitat selection. Since habitat feature is provided, food, shelter to escape themselves from a predator (Whittingham and Evans, 2004). While the heterogeneity of habitat features can play a great role in the determination of species abundance and their occurrence the specific habitat types (Pennington and Blair, 2001).

The destruction or removal of the forest for different purposes decreases the distribution of wild mammals and or isolation of the entire habitat which is exposed to fragmentation. This fragmentation of habitat will expose the species to different dangers' like predators (Schlossberg and King, 2008). Altitude affects the distribution of the mammals in the mountain setting (Hobson *et al*., 2003). The elevation of the mountain creates the microclimate which determines the temperature, soil characteristics and vegetation type of the given environment (Waterhouse *et al*., 2002). Due to this, it affects the distribution of mammals directly or indirectly by limiting the resources availability in the ecosystem. Lower altitude has more species diversity and distribution than the higher altitude. While some species are restricted to a certain area and few of them will occur throughout the altitudes (Jankowski *et al*., 2009).

2.3. Conservation Status and Threats of Mammals

Wildlife conservation is accused for marginalizing people, denying people access to traditional and legitimate rights, property damage, and risk to human life through attack by wild animals and disease transmission. Status of protected areas in Ethiopia is reported to be relatively poor (Jacobs and Schroeder, 1993) and severely damaged during or after the civil war that brought the current government to power. Despite good framework for natural resource management, the implementation on the ground in Ethiopia was affected by limited participation of stakeholders. The eastern Ethiopia protected areas are place where several IUCN Red lists of threatened species such as (Elephants, Gravy zebra, wild ass and others mammals) are conserved. However, currently these protected areas and their wildlife resources are facing a number of threatening factors.

Invasive species, overgrazing, illegal hunting and land degradation are common problems in (Babile Elephant Sanctuary, Yangudi-Rasa, Omo, and Awash and Nechisar National Parks (Young, 2012)).

It has been facing a great challenge in protecting the continuous decline of both faunal and floral of these areas (Solomon Belay and Aklilu Amsalu, 2014). Ecological threat monitoring refers to the systematic method of collecting information about some ecological variable or threat to the environment (EWCA, 2014).

The protected areas (PA) of eastern Ethiopia (Awash National Park, Aledeghi Wildlife Reserve, Yangudi-Rasa national park, Sororotergem or Kuni-Muktar Mountain Nyala sanctuary and Babile elephant sanctuary) are not ecologically analyzed in a way that leads to address the threat factors along their relative severity in advance. The effectiveness of wild animal conservation efforts is highly depending on careful identification of wild animal threatening factors existing in the protected areas. Moreover, wildlife management and species recovery plans will highly depend on measuring of the protected area susceptibility index to the threat factors (Kiringe and Okello, 2007). However, the current trend of local natural resource conservation authorities' lacks proactive measures and they are poorly taking part in the intervention of avoiding severe threats facing protected areas.

2.3.1. Human wildlife conflict

Human-wildlife conflict is fast becoming a serious threat to the survival of many common and endangered species in the world (Gereta and Roskaft, 2010). The future of wildlife and protected areas is still a big question to many scientists due to the increase in conflicts, normally the result of human population increasing the land demand for different livelihood activities (Mesele Yihune *et al*., 2009). For example in Africa alone the rate of population increase is between 2.0% - 3.1% per annum (Gereta and Roskaft, 2010). Mutandwa, and Gadzirayi (2007) argues that, despite the contribution realized from wildlife sector, a number of problems make wildlife a concern, especially to the socio-economic status of the communities bordering wildlife-protected areas. These problems include conflicts with other land uses, poaching, wildlife habitat loss, environmental pollution, global warming and introduction of exotic species. The failure of wildlife to compete effectively with other land uses in sustaining the livelihood of the adjacent communities exacerbates these problems.

As a result, local people look at wildlife as a liability rather than an economic and social status advantage, thus making wildlife conservation efforts to be perceived a contradiction to the socio-economic endeavors of local communities (Barrow, 2001).

2.3.2. Crop cultivation

Crop cultivation provides a major source of wellbeing for afro-alpine and sub-afro-alpine massifs community (ORDA, 2013). It provides employment and means of subsistence for their wellbeing. Most of the afro-alpine and sub-afro-alpine ecosystem/wildlife of Ethiopia is affected by crop cultivation. The overwhelming expansions of farm land on Guna massifs have also dramatic implication for the loss of biodiversity. Currently, crop land has taken the Mount Guna up to 3700m a.s.l. which is dramatically change the ecosystem structure and wildlife diversity and distribution (ORDA, 2013).

2.3.3. Land use patterns

Most of afro-alpine and sub-afro-alpine of Ethiopian ecosystem are affected by land use pattern and human settlement (Girma Eshete *et al*., 2015). Land use changes and degradation of natural resources, particularly vegetation and soils, are increasing at alarming rate in the highlands of Ethiopia Abate Ayalew (2006) stated that the broken and rugged nature of topography together with adverse inference of humans on the environment has brought about severe soil erosion in South Wollo Zone. Human activities especially need for firewood and cultivation in this Moore lands in the zone is speeding up the process of soil erosion. The negative impact of land use on biodiversity, climate, water, soil, and air, in particular, and on ecosystem services in general, has been recognized as one of the greatest environmental concerns for human populations today ((World Resources Institute (WRI, 2001)).

The ecological consequence of land use on a wide range of habitats has a direct influence on the diversity and distribution of mammals' species (Kool, 1993).The Land use and covers of the Mount Guna as a whole, it is easy to observe how intensive exploitation of farm plots utilizes the natural ecosystem of the area(ORDA,2013). Non-coherent decisions, weak land use policies and unstable government organization structure have led to the transformation of natural habitats to other land use (Gelet, 2010).

2.3.4. Issues of boundary/Lack of clear boundary

The boundary of a given national park is important to prepare its management plan and to put down possible conservation strategies of its area and it is also important to improve its management (Council of Ministers Regulations No. 163/2008). However, lack of a well-defined and mutually agreed upon border is among the challenges that affect the conservation and management of national parks in Ethiopia. Guna Mountains Community Conservation Area is also hasn't clear/defined boundary because of this, the wildlife found in the mountains faces to different human activities.

2.3.5. Lack of coordination

Stakeholders are people who are affected either negatively or positively or those who can affect the outcome of a proposed intervention (Karl, 2000). Stakeholders can be classified as primary stakeholders and secondary stakeholders based on their interest (direct or indirect) (FAO, 1998). Primary stakeholders are those who have a direct interest in the resource; either because they depend on it for their livelihoods or they directly involved in its exploitation; and the best examples are the local community and park management (Karl, 2000). Whereas, secondary stakeholders are those who have indirect interest in management and conservation of natural resources and /or depend at least partially on wealth or business generated by the resource and intermediaries in the process of delivering aid to the primary stakeholders; and the best examples are local government, cooperatives and higher education institutions (FAO, 1998 ; Karl, 2000). According to Temesgen Gashaw, (2015) setting up of different objectives (including a difference in prioritizing objectives) and lack of mutual respect are some of the causes which may result in lack of coordination among stakeholders.

CHAPTER 3 MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. Location and topography

The Guna Mountains Community Conservation Area with a total area of 4615 hectare which is located between 38°10’19.59’’to 38°16’34.63’’N latitude and 11˚39’48.09’’ to 11°45’31.61’’E longitude in south Gondar zone (Figure 1) at a distance of 20 km from Debre Tabor town in the south eastern direction and at a distance of 30 km from Nefas mewcha town in the western direction (ORDA, 2013). Moreover, the area is found along Woldiya Woreta Asphalt road, in 129 km from Bahir Dar and 699 km from Addis Ababa. Currently, a new gravel road from Gassay to Wegeda (Simada Woreda) and Mekane Eyesu (Misrak Estie Woreda) that pass Mount Guna is being under construction. The elevation of the area varies from 3200m at the base to 4116m at the peak of the mountain. The area is bounded within three woredas: - Farta in the northern and western directions, Lay Gaint in the southern and south eastern directions and Estie in the western and south western directions.

The study area shares common borders with 11 Kebele’s, out of which a three are re from Farta woreda (Soras, Moksh, and Agra), four are from Lay gaint woreda (Titira, Akabit, Guna beyemider and Guna Gedeba) and four from Misrak Estie woreda. However, the six Keble’s from the two woredas (Farta and Lay gaint) have a significant influence on the resources utilization of the area. The Afroalpine and Sub-afroalpine ecosystems are well known as the source of many rivers that drain to the south western (Eastern Estie), Tekeze river and Lake Tana. The elevation of the Guna Mountains Community Conservation Area ranges from 3,200 to 4,116 m.a.s.l. and its total area is about 4,615 hectare.

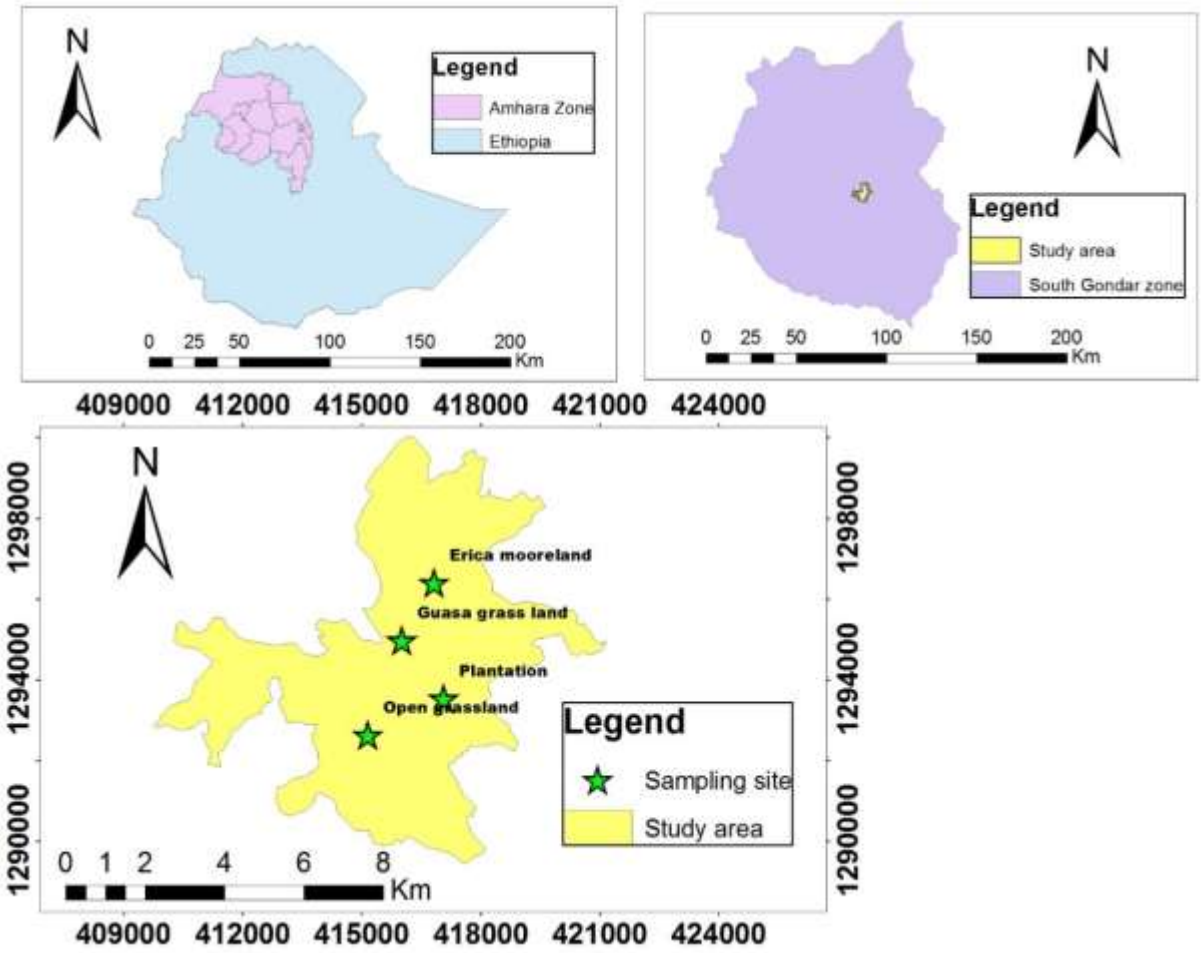

Figure 1 Location map of the study area

3.1.2. Climate data

Rainfall and temperature data were taken in the Gassy Meteorological Station. This station is the closest of all other stations that record rainfall and temperature and has altitude close to the study area. These data were taken from the West Amhara National Regional State Meteorology Service Agency (from the years, 2008 up to 2018).

3.1.2.1. Temperature

A ten years mean monthly maximum and minimum temperature of the area were summarized and showed that, the mean monthly maximum temperature ranges between 23ºc April and 24.ºc February and March whereas the mean monthly minimum temperature varies between 4ºc (November and October) and 5ºc (December)(Figure 2).

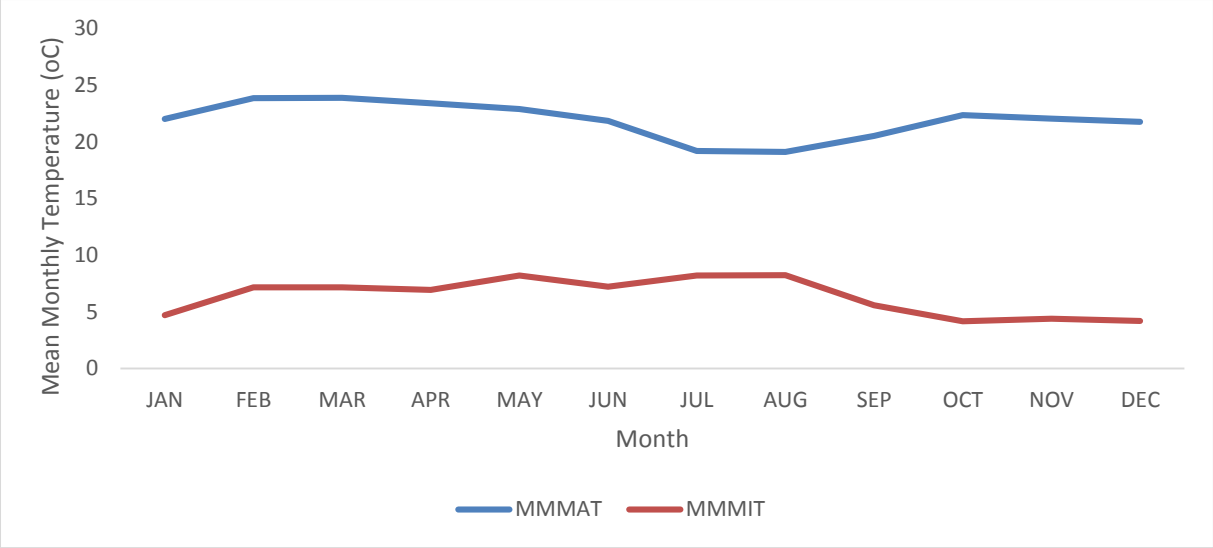

Figure 2 Mean monthly maximum and minimum temperatures of the study area from 2008 to 2018

Source:-West Amhara National Regional State Meteorology Service Agency 2008-2018

3.1.2.2. Rainfall

According to ten years rainfall summarized data, the area has a unimodal rainfall distribution, characterized by a prolonged wet season from March to September (long rain), locally known as “Kiremt”. The mean monthly rainfall of the area varies between 9 mm (January) and 346mm (July) (Figure 3).

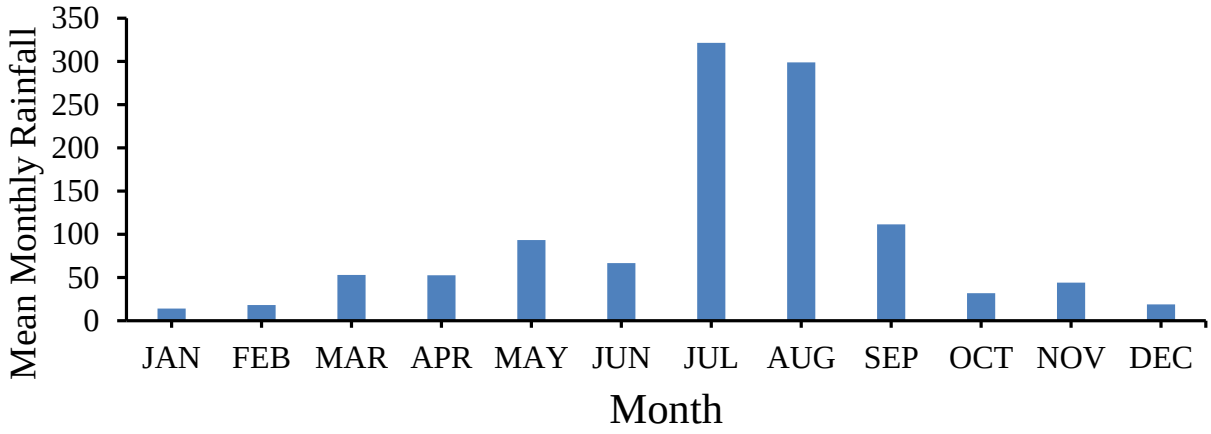

Figure 3 Mean monthly rainfall of the study area from 2008 to 2018

Source:-West Amhara National Regional State Meteorology Service Agency (2008-2018)

3.1.3. Fauna

The combination of altitudinal variation and isolation of the area has given rise to a number of rare and endemic species and a high level of diversity. This high endemicity and diversity justify the inclusion of Guna Mountains Conservation Area in conservation biodiversity hotspot. Diversity of mammals and bird species with high endemicity are expected in the area. According to information on Guna Mountains Community Conservation Area general management plan 2016 the Guna Mountains Community Conservation Area development endeavor would safeguard habitats for 30 higher and small mammals, and 139 Bird species. Moreover, the management plan has given conservation priority to Gelada baboon. This species among Ethiopian mammals are highly specialized to grasslands and cliffs at high elevations on the plateaus (>2350m) (Wilson and Reder, 2005).

3.1.4. Hydrology status

Guna Mountains Community Conservation Area is not only source of biodiversity and livelihoods but it is also important as water catchments from which more than 41rivers and numerous streams emerge and join to two basins Abay and Tekeze basins) and Tana sub basin (ORDA,2013). Rivers and streams emerged from Mount Guna escarpment that forms the major part of these basins are: Ribb, Gumara, Beshelo, Wanqa, Gedeba, and Zoga.

Gumara is one of the main rivers on the east side flowing to Lake Tana. It drains Mountain Guna and drops its load in the low land to the mouth of Lake Tana in the southeastern direction. The Lake Tana is fed by four large perennial rivers (Ribb, Gumera, Megach and Gilgel Abay rivers). Gumara and Ribb together account 42.9% of the total runoff to Lake Tana sub-basin. They flow all year round due to the continuous source of the groundwater of the highlands of Guna Mountains Community Conservation Area where 18.2% of the mean annual rainfall goes to groundwater (ORDA, 2013).

3.2 Methods

3.2.1 Reconnaissance survey

A preliminary study was conducted in the first phase of field work for three days. In this survey it was observed that the study area was heterogeneous in vegetation cover with four habitat types. The habitat types include Guassa grassland, Open grassland with scattered *Lobelia* and *Helichrysum*, Plantation, and *Erica* moorland (Fig 4). In the general survey information about

the study area characteristics like vegetation type, and an overview of the distribution of mammals were taken. The survey was also used for selecting the sample site for the data collection on the diversity, abundance and distribution of mammals. Mammalian sampling sites were selected and marked in all habitat types.

During the preliminary survey upon arrival at each site, local people were informally asked the species of medium and large-size mammals which were found and where they were more distributed in the area. A short time of training was taken to observe, count and identify medium and large size mammals. The training was focused on how to observe and identify the mammals in to their taxonomic group. These groups of mammals were identified based on their taxonomic features like coat color, pattern and body size. Medium-size mammals were defined as mammals with a weight between 2-7 kg, whereas large-size mammals were defined as mammals with weight more than 7kg (Emmons and Feer, 1997). Check list of these groups of mammals of the GMCCA was developed from local people key informant interviews and previously compiled document (ORDA, 2013).

Figure 4. Sample site selected for collect data at four habitat types. (Photo was taken by Dereje, in 2019)

3.2.2 Sampling design and data collection

Survey of medium and large-size mammals was conducted through stratified systematic sampling method (Greenwood and Robinson, 2006). A total of 25 transect lines with a length of 1km each were established to observe both medium and large-size mammal species. The sampled area represents 20% of the study area. The transect lines were laid in this study with sampling distribution of 7 transect lines on open grassland with scattered *Lobelia* and *Helichrysum*, 5 transect lines on Plantation , 5 transect lines on *Erica* moorland, and 8 transect lines on Guassa grassland. To avoid double counting, the start and end points of transect lines

were clearly identified and marked before and after the survey. Moreover, observation of both medium and large-size mammals in adjacent transect lines were counted in short time interval.

Transect width ranged from 200m to 400m depending on vegetation cover of the study site. In Guassa grassland and Open grassland with scattered *Lobelia* and *Helichrysum* habitat types transect lines were laid 400 m apart from each other, since the habitats are open with good visibility. But, in the *Erica* moorland and Plantation habitats transect lines were laid 200m apart from each other (Zerihun Girma *et al*., 2012). Four rounds of observations of both medium and large-Size mammals were carried out during the field study period from December, 2018, to May, 2019 with a total of 36 days.

Surveys of medium and large-size mammals were done in the morning from 6:00 to 11:30 am and late in the afternoon from 3:30 to 6:30 pm. In these sampling periods, most diurnal mammals were active and easier for observing them in the study area.

Direct observation using 15x70 Sky master binocular and naked eyes was employed for identifying and recording both medium and large-size mammals (Fig 5).

Moreover, picture and video of the mammals were taken for further confirmation of the identification when simple identification was not possible during the survey.

Figure 5. Way of recording the mammals in the sample site area during the field survey

3.3 Materials used during field Survey

Materials used during this survey were Sky master binoculars15x70, Sony digital camera 20x, Garmin 72 GPS and the Kingdon African Mammals Field Guide. Binoculars was used to observe mammals those were difficult to be identified with the necked eye and which were far apart from survey route. The GPS was used to mark the location where the animals were observed, and Sony digital camera 20x was used to take pictures and for video recording of

mammals that support for clear identification; the Kingdon African Mammals field guide (Kingdon, 2003) was used for identification of the mammals.

3.4 Method of data Analysis

The data collected from the area were analyzed using different indices and statistical tests. Species diversity and richness of medium and large-size mammals at the different habitat types were estimated using the Shannon- Wiener index of diversity (Weiner, 1949).

$H' = -\sum P_i \ln P_i$ ……..……1

Where:

H'= Shannon-Weiner diversity Index,

P_i= the proportion of sampled species or abundances of the i^{th} species expressed as proportion out of total sample

ln = natural logarism

Evenness of species distribution (J) = H'/Hmax,…….....2

Where, H'= Shannon-Weiner diversity Index and Hmax =lnS where S equals the number of species (Weiner, 1949).

Simpson similarity index (SI) was also computed to assess the similarity between four habitats (Krebs, 1999).

SI=4C/I+II+III+IV…….3

Where: SI= Simpson's similarity index,

C= the number of common species to all four 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

IV= the number of species in habitat four

The relative abundance index of species (RAI) was calculated by dividing the number of individuals recorded on each species by the total number of individuals recorded on all species.

Chi-square (χ^2) association test was used for analysis of distribution pattern of mammals among the four habitat types (Open grassland with scattered *Lobelia* and *Helichrysum*, *Erica* moorland, Plantation, and Guassa grassland). Chi-square (χ^2) goodness of fit was used for comparison of relative abundance of the different medium and large-size of mammal species in the study are (Flower and Coher, 1990). These statistical tests were employed by using SPSS version 20 and Microsoft Excel. All statistical tests applied were done at 5% level of significance.

CHAPTER 4 RESULT AND DISCUSION

4.1 Results

4.1.1 Diversity of medium and large-size mammals

In the current study, a total of 13 medium and large-size mammal species under 6 order and 8 families were identified. The species include Rock Hyrax (*Procavia capensis*), Common Duiker (*Sylvicapard grimmia*), Spotted Hyena (*Crocuta crocuta*), Black-backed Jackal (*Canis mesomelas*), Side Striped Jackal (*Canis adustus*), African golden wolf (*Canis aureus*), Serval (*Leptailurus serval*), Dwarf Mongoose (*Heloga leparvula*), Grivet Monkey (*Chlorocepus aethiops*), Klipspringer (*Oreotragus oreotragus*),Caracal (*Caracal caracal*), Porcupine (*Hystrix cristata*), and Gelada baboon (*Theropithecus gelada*) (Table1). Order Rodentia was represented by one species (*Hystrix cristata*).

Among the total species recorded higher (84.6 %) species diversity were observed on large-size mammals whereas the rest (15.4%) mammals were categorized in to medium-size mammals (Table 1). Related to their feeding behavior the species diversity of carnivore (53.85%) was nearly proportional to non-carnivore (46.15%). At family level, Canidae were the diverse family with 23.07 % of the total species composition followed by Felidae, Bovidae and Cercopithecidae families (15.38%). While, Herpestinidae, Hystricidae, Hyaenidae and Procaviidae were the least represented families (7.69 %) in the study area.

Table 1.Taxonomic diversity of medium and large-size mammals' identified from Guna Mountains Community Conservation Area.

Common Name	Scientific Name	Order	Family	Body size
Rock hyrax	*Procavia capensis*	Hyracoidea	Procaviidae	Medium
Grivet monkey	*Chlorocebus aethiops*	Primate	Cercopithecidae	Large
Gelada baboon	*Theropithecus gelada*	Primate	Cercopithecidae	Large
African golden wolf	*Canis aureus*	Carnivora	Canidae	Large
Serval	*Leptailurus serval*	Carnivora	Felidae	Large
Side striped Jackal	*Canis adustus*	Carnivora	Canidae	Large
Black back Jackal	*Canis mesomelas*	Carnivora	Canidae	Large
Common duiker	*Sylvicapard grimmia*	Artiodectyla	Bovidae	Large
Klipspringer	*Oreotragus oreotragus*	Ayracoidea	Bovidae	Large
Spotted hyena	*Crocuta crocuta*	Carnivora	Hyaenidae	Large
Caracal	*Caracal caracal*	Carnivora	Felidae	Large

Porcupine	*Hystrix cristata*	Rodential	Hystricidae	Large
Dwarf Mongoose	*Helogale undulata*	Carnivora	Herpestnidae	Medium

Plantation habitat had the highest diversity index (H'=0.94) compared to the other three habitat types of Guna Mountains Community Conservation Area (i.e.; Guassa grassland, Open grassland with scattered *Lobelia* and *Helichrysum*, and *Erica* moorland. Whereas the lowest diversity index (H'=0.13), was obtained in open grassland with scattered *Lobelia* and *Helichrysum* habitat type. The species evenness was also high in Plantation (J= 0.67) and low in Guassa grassland (J=0.39) (Table 2).

Table 2.Number of species, Diversity index and Evenness of both medium and large-Size mammals identified in Guna Mountains Community Conservation Area.

Habitat Types	No of spp	H'	H'max	H'/H'max
Guassa grassland	4	0.54	1.37	0.39
Erica moorland	3	0.54	1.17	0.46
Plantation	5	0.94	1.39	0.67
OGLwith scd *Lobelia* and *Helichrysum*	2	0.13	0.19	0.55

4.1.2. Relative abundance of medium and large-size mammals

A total of 415 individuals of medium and large-size mammals were recorded from Guna Mountains Community Conservation Area during the present study. Apart the recorded mammalian species, Rock Hyrax (*Procavia capensis*) was the most abundant (42.2%) species followed by Gelada baboon (*Theropithecus gelada*) (32.85%). Whereas Black-backed jackal (*Canis mesomelas*) was the least abundant (0.5%) species in the study area during the present study (figure 8). Overall the relative abundance of different species was statistically significantly different (χ^2=1197.276, df=12, p = 0.001) (Appendix 4). Related to their body size, majority of the mammal recorded during this study were large-size mammmals (56.63%) Whereas the rest (43.36%) were grouped under medium-size mammals of the study area. At a higher taxonomic hierarchy level order primates was the most abundant order (42.89 %) followed by Hyracoidea (42.19%) whereas, Artiodectyla and Hyracoidea shared the same value (0.72 %) and they were the least abundant orders observed in Guna Mountains Community Conservation Area during the present study.

At family level, Cercopithecidae was the abundant families (42.89 %) followed by Procaviidae (42.27%). Whereas family Herpestinae and Hystricidae were the least (1.2%) families in the study area. Related to their feeding behavior the non-carnivore species were the most abundant (87.71%) than the carnivore (12.29%) in the area during the present study. Among the carnivore species recorded from the study area African golden wolf (*Canis aureus*) was relatively abundant (3.6%) whereas Black backed Jackal was the least abundant (0.5%) species (Figure 7).

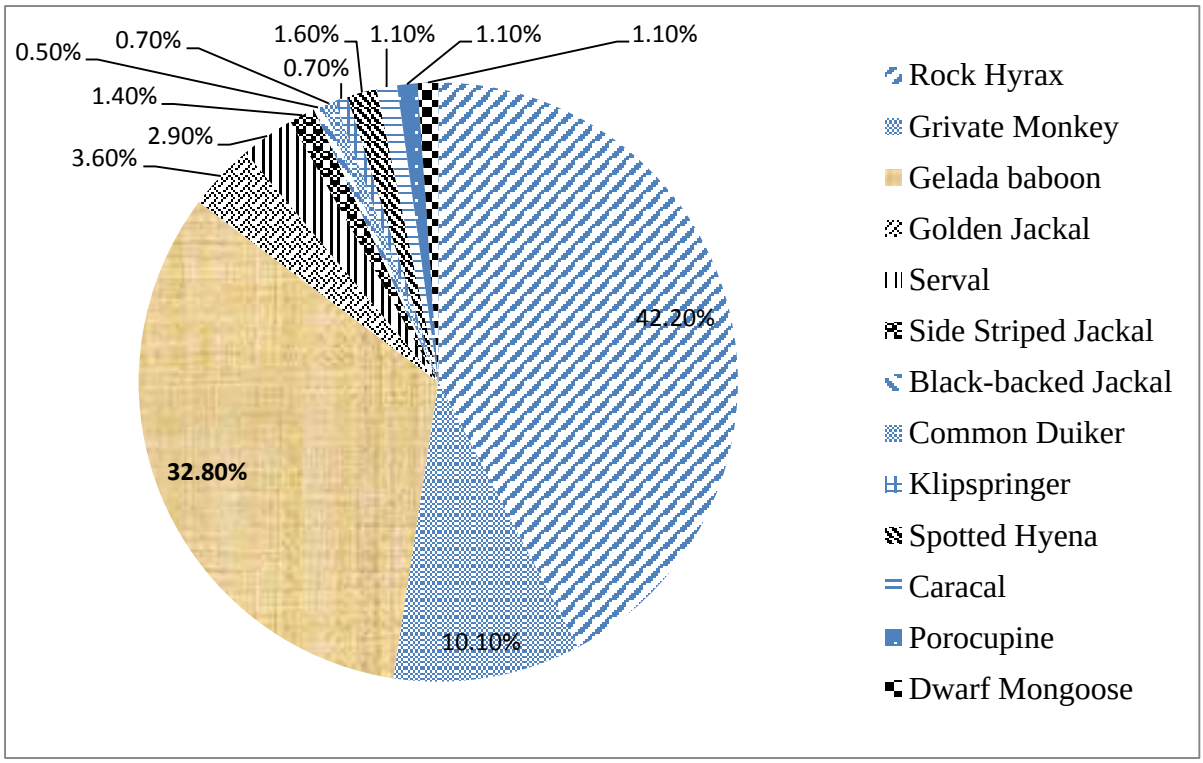

Figure 6. Relative abundance of medium and large-size mammals identified in the study area.

4.1.3. Distribution of medium and large-size mammals

The distributional pattern of mammals in the current study area varied across the study habitats. Distribution of mammalian species of this study showed statistically significant variation among different habitat types (χ^2 =1167.33, df =36, p = 0.001) (Appendix 2). The distributions of different mammal species were habitat specific. Specifically, Rock hyrax (*Procavia capensis*), and caracal (*Caracal caracal*) were only recorded from Open grassland with scattered *Lobelia* and *Helichrysum* habitat types of Guna Mountains Community Conservation Area during the current study.

Similarly, porcupine (*Hystrix cristata*) and spotted hyena (*Crocuta crocuta)* were observed in *Erica* moorland habitats only. Grivet monkey (*Chlorocebus aethiops*), Klipspringer (*Oreotragus oreotragus*), Common duiker (*Sylvicapard grimmia*) and Dwarf Mongoose (*Heloga leparvula*) were also observed only in Plantation habitats of Guna Mountains Community Conservation Area. African golden wolf (*Canis aureus*), Side striped Jackal (*Canis adustus*) and Black backed Jackal (*Canis mesomelas*) were recorded in Guassa grassland; whereas Gelada baboon was observed in Guassa grassland with cliffy area (Appendix 1).

Table 3. Shows that distribution pattern of Canidae Species.

Name of species		Habitat the species are observed				
		EML	GGL	OGLSLM	WL	Total
Black-backed Jackal	Count	0	2	0	0	2
	Expected Count	0.1	0.8	0.9	0.3	2
	% within Name of Species	0.00%	100.00%	0.00%	0.00%	100.00%
	% within Habitat the Species are observed	0.00%	1.30%	0.00%	0.00%	0.50%
African Golden wolf	Count	0	15	0	0	15
	Expected Count	0.7	5.7	6.5	2.1	15
	% within Name of Species	0.00%	100.00%	0.00%	0.00%	100.0%
	% within Habitat the Species are observed	0.00%	9.40%	0.00%	0.00%	3.60%
Side Striped Jackal	Count	0	6	0	0	6
	Expected Count	0.3	2.3	2.6	0.8	6
	% within Name of Species	0.00%	100.0%	0.00%	0.00%	100.00%

	% within Habitat the Species are observed	0.00 %	3.80 %	0.00%	0.00 %	1.40%

Table 4. Shows the distribution patterns of Bovidae species.

Name of species		Habitat the species are observed				Total
		EML	GGL	OGLS	WL	
Common Duiker	Count	0	0	0	3	3
	Expected Count	0.1	1.1	1.3	0.4	3
	% within Name of Species	0.00 %	0.00 %	0.00 %	100.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	0.00 %	0.00 %	5.30%	0.70%
Klipspringer	Count	0	0	0	3	3
	Expected Count	0.1	1.1	1.3	0.4	3
	% within Name of Species	0.00 %	0.00 %	0.00%	100.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	0.00 %	0.00%	5.30%	0.70%

Table 5. Shows the distribution patterns of Felidae species.

Name of species		Habitat the species are observed				Total
		EML	GGL	OGLSH	WL	
Serval	Count	8	0	0	4	12
	Expected Count	0.5	4.6	5.2	1.6	12

	% within Name of Species	66.70 %	0.00 %	0.00%	33.30 %	100.00 %
	% within Habitat the Species are observed	42.10 %	0.00 %	0.00%	7.00%	2.90%
Caracal	Count	0	0	5	0	5
	Expected Count	0.2	1.9	2.2	0.7	5
	% within Name of Species	0.00 %	0.00 %	100.00 %	0.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	0.00 %	2.80%	0.00 %	1.20%

Table 6. Shows the distribution patterns of Herpestnidae.

Name of species		Habitat the species are observed				
		EML	GGL	OGLSH	WL	Total
Dwarf Mongoose	Count	0	0	0	5	5
	Expected Count	0.2	1.9	2.2	0.7	5
	% within Name of Species	0.00 %	0.00 %	0.00 %	100.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	0.00 %	0.00 %	8.80%	1.20%

Table 7. Shows the distribution patterns of Cercopithecidae.

Name of species	Habitat the species are observed				
	EML	GGL	OGLSH	WL	Total

Gelada baboon	Count	0	136	0	0	136
	Expected Count	6.2	52.1	59	18.7	136
	% within Name of Species	0.00 %	100.00 %	0.00 %	0.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	85.50 %	0.00 %	0.00 %	32.80 %
Grivet Monkey	Count	0	0	0	42	42
	Expected Count	1.9	16.1	18.2	5.8	42
	% within Name of Species	0.00 %	0.00 %	0.00%	100.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	0.00 %	0.00%	73.70 %	10.10 %

Table 8. Shows the distribution patterns of Procaviidae

Name of species		Habitat the species are observed				
		EML	GGL	OGSLH	WL	Total
Rock Hyrax	Count	0	0	175	0	175
	Expected Count	8	67	75.9	24	175
	% within Name of Species	0.00 %	0.00 %	100.00 %	0.00 %	100.00 %
	% within Habitat the Species are observed	0.00 %	0.00 %	97.20 %	0.00 %	42.20 %

Table 9. Shows the distribution patterns of Hystridae.

	Habitat the species are observed

Name of species		EML	GGL	OGLSH	WL	Total
Porcupine	Count	5	0	0	0	5
	Expected Count	0.2	1.9	2.2	0.7	5
	% within Name of Species	100.00 %	0.00 %	0.00 %	0.00 %	100.00 %
	% within Habitat the Species are observed	26.30%	0.00 %	0.00 %	0.00 %	1.20%

Table 10. Shows the distribution patterns of Hyaenidae.

Name of species		Habitat the species are observed				
		EML	GGL	OGSLH	WL	Total
Spotted Hyena	Count	6	0	0	0	6
	Expected Count	0.3	2.3	2.6	0.8	6
	% within Name of Species	100.00 %	0.00 %	0.00 %	0.00 %	100.00 %
	% within Habitat the Species are observed	31.60 %	0.00 %	0.00 %	0.00 %	1.40%

Even though the species distribution were analyzed by using chi-square test it also estimated at habitat level by using Simpson similarity index. Based on this, Simpson similarity index (SI) of medium and large-size mammal species among the selected four habitats in the study area was dissimilar. This indicated that 100% of the species were independently leave in their own habitats. Whereas in Plantation and *Erica* moorland the similarity index was observed. This showed that 25% of the species were common for Plantation and *Erica* moorland habitats.

Large-size mammals showed similarity occurrence between the Plantation and *Erica* moorland whereas the medium size mammal haven't common species at all habitat types (Table 3).

Table 11.Simpsons' similarity index (SI) for medium and large-size mammal mammals caught among the four habitats.

Habitat types	Simpson Similarity index (SI)
PLvs.EMLvs.GGLvs. OGLwSL&H	0
PL vs.EML	0.25

N.B:- PL= Plantation, EML= Erica moorland, GGL= Guassa grassland, OGLSLH=Open grass with scattered *Lobelia* and *Helichrysum*.

4.2. Discussion

The present study found a total of 13 species of medium and large-size mammalian. The species richness of medium and large-size mammals identified during the present study was lower than other afro alpine and sub afro alpine ecosystems like Borena Saint National park, Choke Mountain, Abune-Yosef and Menz-Guassa community conservation. A similar study in Borena-Saint National Park Meseret Chane and Solomon Yirga, (2014) recorded 23 species of medium and large-size mammals, United Nations Development Programme, (2012) recorded 16 medium and large-Size mammalian species in Menz-Guassa Community Conservation Area. Saavedra *et al*., (2009) identified 24 medium and large-size mammalian species in Abune Yosef and Abeje Kassie *et al*. (2018) recorded 20 medium and large-size mammals in Choke Mountain. Among Saavedra *et al*., (2009) identified mammalian species in Abune Yosef; Gelada baboon, Klipspringer, Caracal, Common duiker, African golden wolf, Rocky hyrax, Side striped jackal, Grivet monkey and spotted hyena were also observed in the Guna Mountains Community Conservation Area during the current study. Whereas Rock hyrax, Porcupine, Gelada baboon, Klipspringer, Common duiker, Caracal, Spotted hyena, African golden wolf, and Black backed jackal were the common species recorded/identified in Guna Mountains Community Conservation Area during the present stud and in Boren Sayint National Parks in 2014 by Meseret Chane and Solomon Yirga.

According to this investigation, among the four afro alpine and subafro alpine ecosystems almost around seven mammalian species were common for them (African golden wolf, Spotted hyena, Caracal, Common duiker, Klipspringer, Gelada baboon and Rock hyrax).
Earlier the Bureau of Culture, Tourism and Parks Development (2013) reported that Guna Mountains Community Conservation Area had high mammal diversity. Moreover, this report recorded three endemic medium and large-size mammals in 2013. But during the present study species diversity of mammals was lower with only one endemic of mammals species compared to the checklist of the report. The reason for lower diversity of mammal species diversity during the present study might be due to high level of disturbance, habitat loss and lack of food availability for animals in the area.

Habitat feature and other factors such as settlements and agricultural expansions and overgrazing determined the diversity of wildlife populations in their natural habitats (Link *et al*., 2010). Guna Mountains Community Conservation Area; like other afro alpine mountains of Ethiopia, was the home of Ethiopian wolf which is endemic to Ethiopia (BCTPD, 2013). But, the species was reported being locally extinct in Guna Mountains Community Conservation Area earlier (Marino and Sillero-Zubiri, 2013).This might be due to habitat loss, low food availability and other related factors. During the present study higher diversity of mammal species was recorded in Plantation, Guassa grassland and, *Erica* moorland habitat types of Guna Mountains Community Conservation Area respectively. This is probably due to the presence of high vegetation diversity, food availability and low level of disturbance. Similarly, earlier studies in different parts of Ethiopian afro-alpine and sub-afro alpine ecosystem revealed that mammalian species diversity is often high in areas where there are sufficient food resources and low level of human disturbance and overgrazing and available water sources (Tsegaye Gadisa *et al*., 2015).

On the other hand, the least diversity of mammal species was recorded in open grassland with scattered *Lobelia* and *Helichrysum* habitat type. This might be due to the presence of more anthropogenic impact/activities like grazing competition of domestic animals with wild animals which can result low food availability, high disturbance level and low vegetation cover for escaping from predation or being hunted than in Guassa grassland, Plantation and *Erica* moorland habitat types. Changes in habitat and landscape characteristics due to land-use change can have also a significant effect on species diversity (Andrade and Aide, 2010).

Among the recorded mammalian species during the present study only one species (*Leptailurus serval*) was distributed at two habitats of the study area. While the rest twelve mammalian species were observed only at a single habitats. This might be due to the feeding behaviors of the animals, habitat fragmentation and loss, human disturbance, habitat cover and resource availability (water and food).

The ecological preference and evolutionary adaptation of mammalian species play a great role in their occurrence and abundance in different habitat types (Rabira Gonfa *et al*., 2015). The rock hyrax (*Procavia capensis*) was the most abundant species (42.2%) than the other 12 species recorded in this study. This species appeared to be more common in open grassland with scattered *Lobelia* and *Helichrysum*, but never recorded in Guassa grassland, *Erica* moorland, and Plantation habitat types. Similarly Rock hyrax was observed in the area of open grassland with scattered *Lobelia* and *Helichrysum* habitat type.

This helps the species to escape from predators. Moreover, large rock outcrops allow for a suitable temperature (17-25℃) and low humidity for hyraxes to survive (Grizemek, 2004). They are able to eat the bark and twigs, leaves and fruits because the design of their gut and their relationships with symbiotic bacteria, which allow them to digest tough fibers (Rubsamen *et al.,* 2004). Due to this feeding association the species was recorded at open grassland with scattered *Lobelia* and *Helichrysum* habitat more frequently during the field surveys. A similar study conducted in Borena Saint National Park in 2014 Guereza (*Colobus abyssinicus)* was the most abundant (22.34%) among the rest 22 Mammalian species recorded.

The second abundant species was Gelada baboon (32.8%). Gelada was observed in grassland with cliffy habitat type on aggregated group ranging from single one male group to bands. Similar to this investigation Gelada baboon was also the second abundant (16%) species in Borena Sayint National Park during a research conducted by Meseret Chane and Solomon Yirga in 2014). The third abundant species in the study area was Grivet monkey with relative abundance of (10.1%). Apart from the three most abundant species mentioned above, Bovid and Canide species were also recorded in relatively lower abundance. Both Klipspringer and Common duiker were low in relative abundance (0.7%). The least abundant species recorded from Guna Mountains Community Conservation Area during this investigation was Black backed Jackal (*Canis aureus*) (0.5%). This might be due to habitat loss, high level of disturbance, low resource availability and other related factors.

The Guna Mountains Community Conservation Area comprised 13 medium and large-size mammalian species including the very common Gelada baboon (*T. gelada*) which are endemic to Ethiopia. During the field survey Gelada baboon (*Theropithecus gelada)* was observed in group (i.e. one male with several female). This flagship species among the Ethiopian mammals are highly specialized to grassland and cliffs at elevation on mountain greater than 2350m (BCTPD, 2013). Similar to this report during the present field surveys the species was observed at elevation between 3216m up to 4116m of the mountain. They have a very restricted distribution in the central and North highlands of the Ethiopian plateau with estimated population number of 600,000 individuals (Saavedra *et al*., 2009). The species is classified as near threatened (IUCN, 2003).

Large mammals are experiencing high population decline due to habitat fragmentation, over exploitation and requirement of large cover (Cardillo *et al*., 2005). Similarly during the research field survey the most affected mammals was large-size animals when compared to medium and small mammals of the area. According to the observation during the field survey, the main and immidate threats of the species was the local people near to the mountains. During the field survey Gelada baboon was recorded from three localities: at 'Jib washa' between Dibana and Dat kebeles in Easter Esite woreda, 44 individuals were recorded, 81 Gelada baboons were observed at 'Molalie Gede' in Mokish kebeles, Farta woreda. Whereas the rest 11 individuals were recorded at Guna Gedeba.

The distribution pattern of Grivet monkey (*Chlorocebus aethiops*) was restricted in Plantation at higher (3273m) altitude. This distribution patterns of the species might be, due to habitat loss and fragmentation in an area. Even if their distribution was restricted in particular area, their number was high relative to some other mammals of the area recorded during this study. Grivet monkey was also observed in acacia Plantation at altitude of 2200m in Abune Yosef. Similarly the study conducted on distribution and habitat association of Grivet monkeys in eastern and central Eretria the species was recorded at altitude of more than 2500m from open Plantation habitat types (Dielmar *et al*., 2002). This association of species to open Plantation might be due to the availability of fruit tree species in the area.

African golden wolf, Side striped Jackal and Black-backed Jackal were observed in Guassa grassland habitat type during the late afternoon. This association of species to Guassa grassland habitat type might be due to easy searching and catching success rate their prey. Hence Canids feed on small mammals like rodents and grazing animals. Among the other 12 species, 12 individuals of Serval *(Leptailurus serval)* was distributed in two habitats (Plantation and *Erica* moorland) of Guna Mountains Community Conservation Area during the present study. Among the twelve Servals recorded in this study eight of them were observed in *Erica* moorland whereas four of them were observed at Plantation habitat types.

Therefore, serval was a relatively common species in *Erica* moorland habitats of Guna Mountains Community Conservation Area. This might be associated to the feeding behaviors hence, Servals preferred habitat like tall grassland, Plantation, moist area, often associated with wetlands. This preference results in a patchy and localized distribution (Reeder, 2005). The bulk of Servals diet constitutes rodents, birds, frogs, insects, small reptiles and fishes are also taken to complement their diet (Reeder, 2005). In addition, porcupine and spotted hyena, were recorded in *Erica* moorland habitat type at elevation of 3732m of the Mountains. According to the current study, the distributions of these two species were low relative to most of the species found in the area. African golden wolf was observed in Guassa grassland habitat between altitudes of 3200 up to 3926m. But African golden Wolf was observed in a hilly dry acacia Plantation area at 2200m in Abune Yosef.

Klipspringers and Common duiker were observed in Plantation habitat type between elevations of 3274 to 3357m. Similarly the Klipspringer and Common duiker were observed across a wide ecological range and between altitudes of 3000 up to 3900m in Abune Yosef. According to the local people's information these two species were found in *Erica* moorland before two years ago. But now because of habitat loss and fragmentation the species were not observed in *Erica* moorland habitat types of the study area. During this field study observation these two species were courses of conflict with the local people. They were raiding crop such as potato. Due to this human-wildlife conflict and associated disturbance on the species it was very difficult to count and estimate their population status in the study area. Caracal was observed directly in Guna Mountains Community Conservation Area at elevation between 3325 up to 3664m during the current study. However, this mammalian species was observed indirectly at elevation between 2100 up to 2500m in Abune Yosef.

Spotted hyena was observed directly at elevation of 3465m during the current but this species was recorded through indirect method in Abune Yosef. Side striped jackal was observed in Guassa grassland habitat type of Guna Mountains Community Conservation Area between 3264 and 3926m in this study. Similarly the species was recorded in the open, plain and moderately grazed mosaic of grass between 3,550 and 3,900 m of height in Abune Yosef. Rock hyrax was fund at elevation up to 4200m in habitat with rocky crevices allowing it to escape from predators (George *et al*., 2007).

Similarly during the present study Rock hyrax (*Procavia capensis*) was recorded from mixed habitat types (rock, grassland, scattered *Lobelia* and *Helichrysum)*at elevation up to 3974 m. Hyraxes typically live in groups of 10 to 80 (George *et al*., 2007). Similar to these during the researcher field survey hyraxes were observed in open grassland with scattered *Lobelia* and *Helichrysum)* with high distribution pattern at specific/particular area. Bovidae species were observed in two or more pair in the study area. Whereas the other identified mammalian species from Guna Mountains Community Conservation Area such as; spotted hyena, caracal, porcupine and others were observed when they moved solitarily.

CHAPTER 5 CONCLUSION AND RECOMMENDTOINS

5.1. Conclusion

The diversity of medium and large mammal species recorded from Guna Mountains Community Conservation Area was lower compared to the other afro-alpine and subafro-alpine protected areas. Some of the mammal species commonly found in afro-alpine and subafro-alpine ecosystems were not observed in Guna Mountains Community Conservation Area. Moreover, compare to other protected areas having similar habitat types, the number of endemic mammals in Guna Mountains Community Conservation Area is lower. It is only the *T. gelada* being endemic medium and large mammals of the area. These lower diversity and endemism are potentially related to significant conservation threats associated with land-use pattern of the area known by expansion of crop cultivation and livestock grazing.
The diversity, distribution, and abundance of mammalian species in the area varied because of vegetation types, level of disturbance, food and water availability and altitudinal differences.

Even though, the Guna Mountains Community Conservation Area has been threatened due to different human practices such as: agricultural and settlement expansion, livestock grazing, grass cutting and collection still habitat types of the Guna Mountains Community Conservation Area were the home for different fauna biodiversity. The combination of the effects of climate change due to different human activity and unsustainable development will cause an environmental disaster that will assuredly result in increased levels of the extinction of wildlife.

Knowledge on local fauna is essential for future conservation strategies and provide basic information for detail ecological and biological studies on mammals of the area. The result of this study will serve as a cue for further study on the biodiversity of the area and conservation activities to be implemented in the future. To minimize the impact of anthropogenic activities on wildlife of the study area, community awareness and participation, enforcement of existing law and rehabilitating the degraded area play a great role for sustainability of wildlife in the study area.

5.2. Recommendations

Guna Mountains Community Conservation Area is one of the potential afro-alpine and subafro-alpine ecosystem conservation areas of Ethiopia with endemic fauna and flora. Before conservation initiative which was initiated by the regional government to develop it as community conservation area in 2016, Guna was communal grazing land. It had a risk to be like most highly modified highland environment. Even though expansion of farmlands and grazing pressure have been threatening conservation of the areas, the conservation initiatives in developing management plan and managing efforts observed in the area have to be appreciated and supported. Therefore, to ensure the long-term sustainable conservation of fauna, flora, and the afro-alpine and subafro-alpine habitats of the area, the following ideas are recommended to mitigate conservation threats and enhancing management effectiveness of the protected area.

- The National and Regional government should introduce appropriate conservation and livelihood development strategies and Police to conserve the wildlife of the area by controlling further local extinction of species.
- Involvement of various stakeholders through developing conservation strategy design, implementation and monitoring as well as supporting livelihood of local peoples are essential to ensure conservation of this critical ecosystem.
- Government-local people partnership shall be established to develop sustainable natural resource management strategies those should also ensure benefits of local people and minimize conservation versus livelihood conflict. Thus, demarcations made as natural buffer zone and core conservation zone can be effective to minimize the human-wildlife conflict and exploration of the wildlife of the area unsustainably.
- Further and long-term, as well as more and integrated research, should be done on the impact of wildlife in the area.
- In order to minimize the degradation of the area and mitigate conservation threats, improving the local people's livelihood through technologically supported agricultural practices like beekeeping and planning to ensure the benefits of local people from the resources conserved should be given priority. So that illegal activities such as firewood collection, settlement and agricultural expansions near to the mountains by the local community can be controlled.

REFERENCES

Abate Ayalew. 2006. Conservation challenges of Gibe Sheleko National Park, South western Ethiopia. National Resources. 6:286-289.

Abeje Kassie, Mengistu Wale and Weldemariam Tesfahunegny. 2018. Assessment of the wildlife and ecosystem status of Choke Mountain, North Western Ethiopia. *Biological Diversity and Conservation.*11 (1): 125-132.

Abraham Marye. 2010. Socioeconomic Situation, Tourism Potential and Biodiversity study report for Mount Guna Proposed Community Conservation Area.

Andrade M. and Aide M. 2010. Effects of habitat and landscape characteristics on medium and large mammal species richness and composition in northern Uruguay. 27:909–917.

Araujo M. and Guisan A. 2006. Challenges for species distribution modeling. *Journal of Biogeography* 33:1677–1688.

Balakrishinan M. and Easa P. 2004. Habitat preference of large mammals in the Parambikulam Wildlife Sanctuary. Karala, India. *Biological Conservation*. 37:191-200.

Barrow. 2001. Indigenous and Traditional Peoples and Protected Areas: Principles, Guidelines, and Case Studies. Switzerland.

Borges H., Calouro M., Botelho A. and Silveira M. 2014. Diversity and habitat preferenc of medium and large-Size mammals in an urban forest fragment of southwestern Amazon, 104(2):168-174.

Botelho A., Calouro M., Borges H. and Chaves W. 2012. Large and medium mammals of the Humaita Forest Reserve, southwestern Amazonia, state of Acre, Brazil 8(6):1190-1195.

Cardillo M., Mace G., Jones E., and Purvis, A. 2005. *Multiple Causes of High Extinction Risk in Large Mammal Species Science* pp. 1-7.

Conservation International. 2012. United Nations List of Protected Areas. IUCN, DC, USA.

Cordeiro J. 2005. Does forest fragmentation impact mixed-species foraging wildlife Species Flocks in Tanzania forest. Arush Tanzania, 157-165.

Dawd Yimer and Solomon Yirga. 2013. Mammals of the Mazie National Park, Southern Ethiopia. *Ethiopian Journal of Sciences*, 36(1):55-61.

Dereje Yazezew and Alemneh Amare. 2015. The Diversity, Distribution, and Relative abundance of Medium and Large-Size Mammals in Baroy Controlled Hunting. Area Illubabor Zone, Southwest Ethiopia: *International Journal of Molecular Evolution of Biodiversity*.5 (4):1-9.

Dielmar Zinner, Fernando Pelaez and Frank Torkler. 2002**.** Distribution and habitat of grivet monkeys (*Cercopithecus aethiops aethiops*) in eastern and central Eritrea. *African Journal of Ecology.*

Emmons L. And Feer H. 1997. Neotropical Rainforest Mammals a Field Guide. The University of Chicago.

Ethiopian Wildlife Conservation Authority. 2014. First Enhancing our Heritage Assessment at Simien Mountains. Ethiopia National Park (SMNP), WHS.

Ethiopian Wildlife and Natural History Society. 1996. Important Bird Areas of Ethiopia. A first inventory. Ethiopian Wildlife and Natural History Society. December 1996, Addis Ababa.

Fa J. and Brown D. 2009. Impacts of hunting on mammals in African tropical moist Forests: a review and synthesis 39:231–264.

Food and Agriculture Organization of the United Nations. 1998. Integrated Coastal Area Management.

Feng Y., Liu T., Tokola H. and Wang X. 2009. Assessment of grassland Degradation in Guinean County, Qinghai Province, China, Land Degradation and Development 20:55–68.

Flower and L. Coher. O. 1990. Practical Statistics for Field Biology. Chi Chester: Johno Wiley and Sons.

Formisano L., Angeli T., Theodore R., Olifiers N. and Cassia B. 2015. Medium to large- Size mammals of the Augusto Ruschi Biological reserve, Sao Paulo state Brazil, 232-243.

Gelet. 2010. The mammals of the isolated Harenna Forest southern Ethiopia: Structure and history of the fauna. 46: 223–231.

Gete Zeleke and Huns Hurni. 2001. Implications of land use and land cover dynamics for Mountain resource degradation in the Northwestern Ethiopian highlands. Mountain 21: 184-191.

George A., Lee C., Stephen H. and Joseph F. 2007. Mammalogy; Adaption, Diversity and Ecology. P: 376.

Gereta E. and Roskaft J. 2010. Conservation of Natural Resources, some Africa and Asia Examples. Tapir Academic Trondheim, Norway. P: 34.

Girma Eshete, Girmay Tsegaye, Hans Bauer and Zelealem Tefera. 2015. Community Resource Uses and Ethiopian Wolf Conservation in Mount Abune Yosef. Environmental Management 56:684–694.

Girma Mengesha. 2012. Alpine grassland degradation index and its response to recent climate variability in Northern Tibet, China. Quaternary International 226:143–150.

Girma Mengesha and Rebira Gonfa. 2012. Large mammals and mountain encroachments On Mount Kaka and Hunkolo Fragments, Southeast Ethiopia. *Asian Journal of Applied Sciences.* 5: 279-289.

Grizemek. B. 2004. *Animal Life Encyclopedia*. Detroit: Thomas/Gale P: 1-190.

Hobson K., Wassenaar L., Mil B., Lovette I., Dingle C. and Smith T. 2003. Stable isotopes as indicators of altitudinal distributions and movements in an Ecuadorean

International Union for Conservation of Nature. 2001. The IUCN Red List of Threatened Species: Mammals of Ethiopia.

International Union for Conservation of Nature. 2001. Economic Values of Protected Areas: Guidelines for Protected Area Managers. IUCN, Gland, Switzerland and Cambridge, UK. Pp: 12-52.

Jacobs M. and Schroeder C. 1993. Awash National Park Management Plan: 1993-1997. EWCO, Addis Ababa.

Jankowski J., Ciecka A., Meyer N. and Rabenold K. 2009. Beta diversity along Environmental gradient: implications of habitat specialization in tropical montane landscapes. *Journal of Animal Ecology* 78:315-327.

Jeremy J., Greenwood D. and Robbert A. 2006. Principles of Sampling. Second Edition Edited by William J. Sutherland. P: 11–86.

Karl M. 2000. Monitoring and evaluating stakeholder's participation in agriculture and rural development.

Kingdon J. 2003. The Kingdon Field Guide to African Mammals. Christopher Helm A and C Black Publishers London, P: 475.

Kiringe and Okello. 2007. Threats and their relative severity to wildlife protected areas of Kenya. *Applied ecology and environmental research*, 5 (2): 49-62.

Knight J. 2009. Wildlife Responses to Recreationists. In Wildlife and Recreationists: Coexistence through Management and Research. Washington, DC.

Kool K. 1993. The diet and feeding behavior of the siliver leaf monkey (*Trachypithecus Auratu sondaicus*) in Indonosia. *International Journal* of *Primatoologyl*. 14: 667- 700.

Krebs. J. 1999. Ecological methodology 2nd edition Addison welsey Educational publishers, Inc., California. P: 620.

Kruskop. 2016. Diversity and Conservation of Ethiopian mammals *Ethiopian Journal of Biological Sciences.*

Kugonza A., Buyinza M. and Byakagba P. 2009. Linking local communities' livelihoods and Forest Conservation in Masindi district, Northwestern Uganda, Kampala. Resources. *Journal of Applied Sciences*. 4:10-16.

Lavrenchenko 2010. Diversity and Conservation of Ethiopian mammals *Ethiopian Journal of Biological Sciences.*

Lavrenchenko and Afework Bekle. 2017. Diversity and Conservation of Ethiopian Mammals Ethiopian *Journal of Biological Sciences*.

Leader Williams. Zelealem Tefera. 2005. Indigenous common property resource Management in the Central Highlands of Ethiopia. Human Ecology 33: 539–563.

Leathcwick 2009. Challenges for species distribution modeling. *Journal of Biogeography* 33:1677–1688.

Lin k A., Luna L. And Alfonos F. 2010. Initial effects of fragmentation on the density of three Geotropically Primate species in two low land forest of Colombia. Endangered species, 13:41-50.

MacLean L. 1970. An analysis of the fauna of the southern Kalahari Gemsbok National Park. Zoological Africana 5:249–273.

Manhaes M. and Ribeiro A. 2005. Spatial Distribution and Diversity of mammal. The community in an Urban Area of Southeast Brazil. *International Journal* 48 (2): 285- 294.

Marino J. and Sillero-Zubiri C. 2013. Canis simensis. The IUCN Red List of Threatened Species 2013:e.T3748A10051312.http://dx.doi.org/10.2305/IUCN.UK.20111.RLTS.T3748A100J51312.

Melaku Teferra. 2011. Wildlife in Ethiopia: Endemic large Mammals. *World Journal of Zoology*. 6(2):108-116.

Meseret Chane and Solomon Yirga. 2014. Diversity of Medium and Large-Size Mammals in Borena-Sayint National Park, South Wollo, Ethiopia.

Mesele Yihune, Afework Bekele and Zelealem Tefera. 2009. Human-gelada baboon conflict in and around the Simien Mountains National Park, Ethiopia. *African Journal of Ecology*. 47:276–282.

Mutandwa J. and Gadzirayi W. 2007. Persistence of large mammal faunas as indicators of global human impacts. *Journal of Mammalogy* 88: 1363-1380.

Organization for Rehabilitation and Development in Amhara ORDA. 2013. Socioeconomic Situation, Tourism Potential and Biodiversity study report for Mount Guna Proposed Community Conservation Area.

Pennington D. and Blair R. 2011. Habitat selection of breeding mammals in an urban environment: Untangling the relative importance of biophysical element and spatial scale. Diversity and Distribution of mammas. 17:506 – 518.

Purvis A., Gittleman J., Cowlishaw G. and Mace M .2000. Predicting extinction risk in Declining species. Proceedings of the Royal Society of London. Series Biology Sciences 267:1947–1952.

Rabira Gonfa, Gadisa Tsegaye and Tadesse Habitamu. 2015. The diversity, abundance and Habitat association of medium and large-Size mammals of DatiWolel National Park, Western Ethiopia, International *Journal of Wildlife Conservation*. 7(2):112-118.

Reeder D. 2005. Mammal species of the world. A taxonomic and geographic reference. 1488- 4674.

Rubsamen K., Hume D. and Engelhard W. 2004. Physiology of the rock hyrax. Comparative Biochemical Physiology 72A, 271 - 277.

Saavedra D. 2009. The Abune Yosef Massif. Birds and Mammals of a hidden jewel of Ethiopia.

Sillero C. and Stwizer D. 2004. Management of Wild Canids in Human- Dominated Landscape People and Wildlife Initiative. Wildlife Conservation Research Oxford University.

Solomon Belay, Aklilu Amsalu and Eyuallem Abebe. 2014. Land Use and Land Cover Changes in Awash National Park, Ethiopia: Impact of Decentralization on the Use and Management of Resources. *Open Journal of Ecology*, 4, 950-960.

Stephens P., Sillero C. and Leader N. 2001. Impact of Livestock and settlement on the Large Mammalian wildlife of Bale Mountains National Park, Southern Ethiopia. Biological Conservation.100, 307-322.

Shuhong Wu., Meng Yong and Zhang Zhi. 2014. Influences of continuous grazing and livestock exclusion on soil properties in a degraded sandy grassland, Inner Mongolia, northern China. Catena59:267–278.

Temesgen Gashaw. 2015. Threats of Bale Mountains National Park and solutions, Ethiopia. *Journal of Physical factors*.

United States Agency for International Development. 2008. Ethiopia Biodiversity and Tropical Forests 118/119 Assessment Biodiversity Analysis and Technical Support for USAID/ Africa USAID/ Ethiopia Programming.

United Nations Development Programme. 2012. *Guassa-Menz Community Conservation Area, Ethiopia*. Equator Initiative Case Study Series. New York, p: 56.

Waterhouse F., Mather M. And Seip D. 2002. Distribution and abundance of mammals relative to elevate on and biogeoclimatic zones in coastal old growth Forests in southern British Columbia *Journal of Ecosystems and Management*.

Wemmer C., Kunz T. Lundie H., Jenkins G. and Shea W. J. 1996. Mammalian sign. In Measuring and Monitoring Biological Diversity: Standard Methods for Mammals, PP:48-92.

Weiner N. 1949. The Mathematical Theory of Communication. University of Illinois. P: 117.

Westphal I., Steffan D. and Tscharntke T. 2006. Bumblebees' experience Landscapes at different spatial scales: possible implications for coexistence of mammals.

Whittingham M. and Evans K. 2004. The effects of habitat structure on predation Risk of Wildlife in agricultural landscapes. 146(2):210–220.

World Resources Institute. 2001. People and Ecosystems: The Frying Web of Life; WRI: Washington.

Yalden D. and Largen M. 1992. The endemic mammals of Ethiopia. Mammal Review 22:115-150.

Yonas Terefe and Fikresilasie Samuel. 2015. Species Composition and Abundance of mammals in Yarer Mountain Forest Area, Central Ethiopia. American. *Journal of Biology of Sciences*. 3(3):87-92.

Young J. 2010. Ethiopian protected areas. A 'Snapshot'. A reference guide for future Strategic and project fund, EWCA, Addis Ababa.

Zelealem Tefera. 2005. Indigenous common property resource Management in the Central Highlands of Ethiopia. Human Ecology, 33: 539–563.

Zerihun Girma, Yosef Mamo and Mateos Ersado. 2012. Species Composition, Distribution And Relative Abundance of Large Mammals in and Around Wondo Genet Forest Patch Southern Ethiopia. *Research Journal of Forestry,* 11: 1-12.

Zhang J. 2006. Grassland degradation and strategies: a case from Shanxi Province, China. Rangelands 28:37–43.

LIST OF APPENDICES

Appendices 1. Shows the distribution of medium and large-size mammals in different habitat types.

Name of species		Habitat the species are observed				Total
		EML	GGL	OGLSLM	WL	
Black-backed Jackal	Count	0	2	0	0	2
	Expected Count	0.1	0.8	0.9	0.3	2
	% within Name of Species	0.00%	100.0%	0.00%	0.00%	100.0%
	% within Habitat the Species are observed	0.00%	1.30%	0.00%	0.00%	0.50%
Caracal	Count	0	0	5	0	5
	Expected Count	0.2	1.9	2.2	0.7	5
	% within Name of Species	0.00%	0.00%	100.00%	0.00%	100.0%
	% within Habitat the Species are observed	0.00%	0.00%	2.80%	0.00%	1.20%
Common Duiker	Count	0	0	0	3	3
	Expected Count	0.1	1.1	1.3	0.4	3
	% within Name of Species	0.00%	0.00%	0.00%	100.0%	100.0%
	% within Habitat the Species are observed	0.00%	0.00%	0.00%	5.30%	0.70%
Dwarf Mongoose	Count	0	0	0	5	5
	Expected Count	0.2	1.9	2.2	0.7	5
	% within Name of Species	0.00%	0.00%	0.00%	100.0%	100.0%

	% within Habitat the Species are observed	0.00 %	0.00 %	0.00%	8.80 %	1.20 %
Gelada baboon	Count	0	136	0	0	136
	Expected Count	6.2	52.1	59	18.7	136
	% within Name of Species	0.00 %	100.0 0%	0.00%	0.00 %	100.0 0%
	% within Habitat the Species are observed	0.00 %	85.50 %	0.00%	0.00 %	32.80 %
African Golden wolf	Count	0	15	0	0	15
	Expected Count	0.7	5.7	6.5	2.1	15
	% within Name of Species	0.00 %	100.0 0%	0.00%	0.00 %	100.0 0%
	% within Habitat the Species are observed	0.00 %	9.40 %	0.00%	0.00 %	3.60 %
Grivet Monkey	Count	0	0	0	42	42
	Expected Count	1.9	16.1	18.2	5.8	42
	% within Name of Species	0.00 %	0.00 %	0.00%	100.0 0%	100.0 0%
	% within Habitat the Species are observed	0.00 %	0.00 %	0.00%	73.70 %	10.10 %
Klipspringer	Count	0	0	0	3	3
	Expected Count	0.1	1.1	1.3	0.4	3
	% within Name of Species	0.00 %	0.00 %	0.00%	100.0 0%	100.0 0%
	% within Habitat the Species are observed	0.00 %	0.00 %	0.00%	5.30 %	0.70 %
Porcupine	Count	5	0	0	0	5
	Expected Count	0.2	1.9	2.2	0.7	5
	% within Name of Species	100.0 0%	0.00 %	0.00%	0.00 %	100.0 0%

	% within Habitat the Species are observed	26.30 %	0.00 %	0.00%	0.00 %	1.20 %
Rock Hyrax	Count	0	0	175	0	175
	Expected Count	8	67	75.9	24	175
	% within Name of Species	0.00 %	0.00 %	100.00 %	0.00 %	100.0 0%
	% within Habitat the Species are observed	0.00 %	0.00 %	97.20 %	0.00 %	42.20 %
Serval	Count	8	0	0	4	12
	Expected Count	0.5	4.6	5.2	1.6	12
	% within Name of Species	66.70 %	0.00 %	0.00%	33.30 %	100.0 0%
	% within Habitat the Species are observed	42.10 %	0.00 %	0.00%	7.00 %	2.90 %
Side Striped Jackal	Count	0	6	0	0	6
	Expected Count	0.3	2.3	2.6	0.8	6
	% within Name of Species	0.00 %	100.0 0%	0.00%	0.00 %	100.0 0%
	% within Habitat the Species are observed	0.00 %	3.80 %	0.00%	0.00 %	1.40 %
Spotted Hyena	Count	6	0	0	0	6
	Expected Count	0.3	2.3	2.6	0.8	6
	% within Name of Species	100.0 0%	0.00 %	0.00%	0.00 %	100.0 0%
	% within Habitat the Species are observed	31.60 %	0.00 %	0.00%	0.00 %	1.40 %
Total	Count	19	159	180	57	415
	Expected Count	19	159	180	57	415
	% within Name of Species	4.60 %	38.30 %	43.40 %	13.70 %	100.0 0%

% within Habitat the Species are observed	100.0%	100.0%	100.00%	100.0%	100.0%

Appendices 2. Test statistics for species distribution in different habitats

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1167.339[a]	36	.001
Likelihood Ratio	934.022	36	.000
N of Valid Cases	415		

Appendices 3. Chi-Square test for frequency of each individuals in different habitat types.

	Observed N	Expected N	Residual
1	175	32.1	142.9
2	42	32.1	10.9
3	136	32.1	104.9
4	15	32.1	-17.1
5	12	32.1	-20.1
6	6	32.1	-26.1
7	2	32.1	-30.1
8	3	32.1	-29.1
9	3	32.1	-29.1
10	5	32.1	-27.1
11	5	32.1	-27.1
12	5	32.1	-27.1
13	6	32.1	-26.1
Total	415		

Appendices 4. Test Statistics of frequency for individuals' specie in different habitat types.

	frequency
Chi-Square	1197.276[a]
df	12
Asymp. Sig.	.001

Appendices 5. Example of medium and large-Size mammals recorded from Guna Mountains Community Conservation Area. Community Conservation Area.

Leptailurus serval)

Procavia capensis

Sylvicapard grimmia

Hystrix cristata

Theropithecus gelada

Canis adustus

BIOGRAPHICAL SKETCH

The author was born in March 23, 1994 at 12 Keble, Bishoftu town, East shewa, Ethiopia. He attended his elementary school (1-8) at Tute elementary school and his secondary (9-10) at Chefe Donsa secondary school and preparatory (11-12) at Bishoftu general higher education preparatory school. Then he joined Bahir Dar University College of agriculture and environmental sciences in 2014 in Fisheries, wetlands, and wildlife managements department and he was graduated in June 28, 2016. Then the author joined the school of graduated studies of Bahir Dar University College of agriculture and environmental sciences regular program in 2018 to study his Masters of sciences degree in wildlife conservation and ecotourism managements.