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COLLEGE OF AGRICULTURE AND NATURAL RESOURCE

DEPARTMENT WILDLIFE AND ECOTOURISM MANAGEMENT

LARGE MAMMALS DIVERSITY AND THREATS IN BORENA SAYINT WEREHIMENONATIONAL PARK NOTHERN PART OF ETHIOPIA



SENIOR RESEARCH SUBMITTED TO DEPARTMENT OF WILDLIFE AND ECOTOURISM MANAGEMENT, COLLEGE OF AGRICULTURE AND NATURAL RESOURCE, WOLKITE UNIVERSITY FOR THE PARTIAL FULFILLMENT OF THE COMPLETION OF BSc DEGREE IN WILDLIFE AND ECOTOURISM MANAGEMENT

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List of Acronyms and Abbreviations

BSWNP……. Borena Sayint Werehimeno National Nark

ENMSA…… Ethiopian National Metrological Service Agency

CEQA……California Environmental Quality Act

HWC…….. Human Wildlife Conflict

IUCN…… International Union for Conservation of Nature

NGO……...Non-Governmental Organization

Masl……..Meter above sea level

Spp…… species

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ABSTRACT

Ethiopia is one of the African countries with high (320) mammalian species that distributed throughout the country, particularly the protected areas like Borena Sayint Werehimeno National park. The aim of the study was to identify large mammal's diversity and threats in BSWNP. The Data for This Study Was Collected Questionnaires, Key Informant Interview, Field Observation and Secondary Sources. 50 respondents' was selected purposefully based on their extensive knowledge, experience, local elders, scout and involvement with in the study area. The data was analyzed by using descriptive statistics. The study was conducted by stratifying the habitat types of the study area as Riverine forest, Erica wood land and open grass habitat based on land cover features. Across the stratified habitats type riverine forest 14, Erica wood land 10 and open grass land 8 species and Simpson similarity index (SI) of large mammal species among three habitats are 31.25 % of the species were common for all three habitats and endemic large mammal such as gelada baboon, Menelik bushbuck and Ethiopian wolf. Most of mammals of the park were critically endangered, vulnerable and list concern species. Threats of large mammals in the park are both human and natural forces. Mitigation measurements of threats of large mammals are creating awareness about the importance of potential tourism resources found in the park for community and giving a proper training to all stockholders, proper implementation of formulate rules and regulation, to promote and conservation practice development works on the park.

Key word: Mammal, Diversity and Treat

1. INTRODUCTION

1.1. Background of the study

Mammals are sub phylum of vertebrata, air-breathing animals whose females are characterized by the possession of mammary glands, while both males and females are characterized by sweat glands, hair, three middle ear bones used in hearing brain. The large mammalian fauna of Africa is subject a series concern to many interest groups, because Africa contains the great community of large size mammals in the world. Information on large size mammal's distribution and abundance is very important of understanding their significance as ecological driving force and their development for tourism purpose. Large sized mammals are found in most forest and savannah regions of Africa and it is utmost important to protect them for the role they play in the ecosystem and beauty of nature (Tefera, shoshani and yirmed, 2008).

Ethiopia is one of the endemicity centers of the world countries owing to its geographic position and topography characteristics by high mountains and deep valleys resulting in a home to many large sized mammalian species indigenous to Africa savanna. Additionally, Ethiopia is among the world leader in terms of richness and endemism of mammalian species. The country endowed with high large size mammalian species and faunal biodiversity that provides different benefits such as medicinal, social, cultural, aesthetic, conservational, bio-indicators and economic. Monitoring large mammal's species distributions also provides important data to evaluate whether favorable conservation status has been achieved and supports the legal obligation towards species protection and conservation (Bekele and Yalden, 2013).Inventory of the mammal's species in Ethiopia indicates that there are above 320 species and sub species of mammals. Among this are such as gelada baboon, Walia ibex, and wild ass etc. Amara regional state particularly the south Wollo zones is an area of biodiversity and are mark able potential of large sized mammals. The zones are the area where Borena Sayint Werehimeno national park (BSWNP) is located. BSWNP is newly established park in Ethiopia found in the Amare region which supports some variety of wild life resources. Among this preliminary large mammals species inventory of the park such as gelada baboon, Menelik bushbuck, Ethiopian wolf and some are found.

Threats of large mammals in BSWNP are agricultural expansion, poaching (illegal hunting), illegal settlement and encroachment, livestock grazing, and drought. Purpose of this study will be for the fulfillment the gap, that there was lack of scientific research about large mammal and threats in BSNP (Yirmed andAfework, 2000).

1.2. Statement of the Problem

Mammals are important in terms of economic, medicine, recreational, food, scientifically and conservational. Nonetheless, understanding of large mammal and threats is surprisingly patchy, particularly for the large developing countries including Ethiopia. BSWNP possesses a unique and charismatic fauna and flora with high level of large size mammal species. Conservation and management of large mammals and the rest wildlife and their habitat of the park is poor as result of scattered investigation, low promotion of the park, high anthropogenic activities, lack of awareness and negative perception of local communities towards mammals and the park, low inventory and environmental impact assessment and environmental auditing on mammals community of the park. Furthermore; the large mammals' population and the in provisions of the park were not fully documented and assessed because of infant stage of the establishment park, Therefore, imperative to assess the large mammals and their threats in BSWNP.

1.3. Significance of the study

The result of the study mainly gives attention large mammal's diversity and their threats in BSWNP. Therefore; the finding of the study will document the current population status of large mammals and their threats in BSWNP. Additionally, the finding of the study will survey as baseline for future researcher, wildlife manager, Non-Governmental Organization (NGOs) and give technical assistance for different experts in the area of conservation. Furthermore; the study will create awareness and attitudinal change to local communities towards the large mammals and the park.

1.4. Objectives

1.4.1. General Objective

- The overall objective of the study was to identify the large mammals diversity and threats in Borena Sayint Werehimeno National Park

1.4.2. Specific objectives

- To identify large mammals population in Borena Sayint Werehimeno National Park
- To investigate the potential threats of large mammal population in the study area

1.5. Research question

- What are the current states of large BSWNP?
- What are the threats of large mammals in the study area?
- What are the possible solutions of this threat?

1.6. Scope and Limitations of the Study

In Ethiopia, there are many national parks but this study was basically focused on BSWNP. The study was large mammals diversity and their threats with specially focus on BSWNP. This study was faced different challenges. It includes lack of enough source of information, lack of budget and full material, Lack of sufficient time to conduct the research, some respondents was not concentrate attention for the answer was the main limitation of the study.

1.7. Organization of the study

The study was having five chapter and many others sub topic under each chapter. The first chapter deal about background and justification, statements of problem, objectives of study, research question, significance of the study and scope and limitation. The second chapter is presented about the review of literature. The third chapter describes methodology, description of the study area, sample size, research design and data analysis. The fourth chapter concerned about the result and discussion of the study and the fifth chapter focus on the conclusions and recommendation.

2. LITERATURE REVIEW

2.1. Mammal Diversity

Currently, the term mammal includes all living animals that are not domesticated that produce milk, which has mammary gland and found in the wild. Mammal diversity refers to the variety of all living mammals from the little Etruscan shrew or bumblebee bat to Blue whale (tone) that differ at the genetic, species and ecosystem levels throughout the world. Ethiopia is among the world leader in species richness and endemism of mammalian. The country endowed with high large sized mammalian species. The species richness, endemicity and rarity across geographic area were essential to give attention for conserving mammal diversity (Young, 2012). Inventory of the wildlife potential of Ethiopia indicates that there are above 320 species and sub-species of mammals. The most common mammals of the country are African elephant *(Loxodontaafauna*), leopard (*Pantherapardus)*, African wild ass (*Equssafricanus*), lion (*Pantheraleo*), hyena (*Crocatacrocata*), anubis baboon (*Papio anubis*), gelada baboon (*Theropithecus gelada*), Mountain Nyala (*Traglaphus buxtoni*), WaliaIbex (*Cabraibawalia*), Semen fox (*Canissimiensis*), caracal (*Felis caracal*) and greater kudu (*Tragelaphusstrepsiceros*). Of which are 39 endemics to country such as mountain Nyala, Wali ibex, gelada baboon, Ethiopian wolf and wild ass. The Amara regional state particularly the northern zone is an area of biodiversity and a remarkable potential of large seized mammals. The zone is the area where BSWNP is located. It is a newly established park, which supports a great variety of mammal's species (Tefera, shoshani and yirmed, 2008).

2.2. Large mammals in Ethiopian

Ethiopia has one of the most diverse mammalian faunas in Africa and the great attractions of its wildlife heritage. The large mammals are mainly concentrated in the south and southwest border and adjacent area of the country (Yalden, 1992).

Furthermore, the Great Rift Valley and mountain massifs are also homes for many endemic mammals. Ethiopia as "Home of the Unique Seven" which refers to seven distinctive and large endemic mammals found only in Ethiopia. Those seven large mammals are; the Ethiopian wolf (*Canissimensis*), Mountain nyala (*Tragelaphusnbuxtoni*), Walia ibex (*Capra walle*), Menelik bush buck, Swayne's hartebeest (*Alcelaphusbuselaphusswaynei*), Gelada baboon (*Theropithecus gelada*) and Bale monkey (*Chlorocebusdjamdjamensis*). These large mammals are diversified in

different parts of Ethiopian national park. Some of these are: - The Ethiopian wolf **(***Canissimensis***): -** is confined to a very few areas of the country. Although rare in the Simien Mountains themselves, it is much more frequently seen in the Bale National Park. It lives exclusively on the high mountain plateau (Yirmed, 2004). Sometimes called the Ethiopian wolf or Abyssinian wolf, it is large by fox standards with long legs. The Gelada baboon (*Theropithecus gelada*) is found in great numbers in similar mountainous areas to the Simien fox. It is particularly recognizable by the heart-shaped red skin on its chest and its lion-like mane. It is particularly numerous in the Simien Mountains. Global warming is having a dire effect on its habitat and it is fast disappearing. The Walia ibex (*Capra walie***)** is the rarest of the endemic animals in Ethiopia (Tedla, 1995). Its principle area is in the Simien Mountains where it can only be seen on very steep areas of high mountains. It has magnificent heavily ridged horns that sweep back over its shoulders. The Menelik bushbuck (*Traglaphus scriptus Meneliki)* is plentiful in the Bale and Simien mountains and is found in forest and bush at high altitude. The males are dark, the females brown/red. The horns are a twisted closed spiral. The mountain nyala *(Tragelaphusnbuxtoni)* is found in the various mountainous areas east of the Rift Valley such as the Bale National Park and the Kuni-Muktar sanctuary. It prefers the high moorlands. It is, more accurately, a kudu and is recognizable by its elegant lyre-shaped horns. The Swaynes hartebeest **(***Alcelaphusbuselaphusswaynei***)** is very rare and prefers open plains and woodland. It can be found in the Awash and Niche sar National parks. This animal has suffered much from being hunted during the period of the Derg when protection was poor (Manspeizer, and Delellegn, 1992).

2.2.1. Large mammals in Borena Sayint Werehimeno National park

BSWNP was designated as a regional forest priority area and lastly due to its biodiversity importance, the regional government has Decided it to be a Park With The Name Of Borena-Sayint Werehimeno National Park (BSWNP) with proclamation number 68/2009 (Dereje Yazezew, 2009).The Park is a home of different mammals, amphibians and birds, more than 30 mammals and over 77 different birds have been identified. More than 10 large mammals, such as Ethiopian wolf or key Kebero (*Canissimensis*), Gelada baboon (*Theropithecus gelada*), Starks Hare (*Lepus starckii*) leopard (*Panthera pardus),* and Menelik bushbuck (*Traglaphus Scriptus Meneliki)* are found in the park (Marker, *et al*., 2003).

2.3. Threat of large Mammals in Ethiopia

The major threats of large Mammals in Ethiopia are agricultural expansion, poaching (illegal hunting), illegal settlement and encroachment, livestock grazing, fire wood and charcoal production, military activities (shooting), and drought (Kumsa, 2006). Some of the major threats are the following,

2.3.1. Habitat loss

Habitat loss was the greatest, most serious of all threats to mammals. Habitat loss due to the expansion of human activities, including urbanization and the increase in cultivated land surfaces, was identified as a main threat to all mammal species described in the IUCN Red List (IUCN, 1995).

2.3.2. Agricultural Expansion

Agriculture and other development activities had led to an overall decline of mammals. Agricultural practices also influence terrestrial and aquatic mammal diversity within and around agricultural fields (Naughton-Treves, 1997). Fertilizers, pest control chemicals, tillage and even crop rotation had an impact on the biodiversity of agricultural ecosystems. Due to increasing human and livestock population was a common experience in protected areas of most Ethiopia. Such a conversion of natural vegetation covers to other use types such as farmlands, grazing lands, human settlements and urban center has shown for the cause of loss of mammals, deforestation and land degradation ((Bishaw, 2001)

2.3.3. Invasive species

Invasive species can affect landscapes and the provision of ecosystem service. While many are decrease have identified the diverse of biodiversity loss, they have not considered or modeled the interactions between drivers (Ngwenocc, Mwasims and Kairu, 2009).Invasive species, overgrazing and land degradation were common problems in Ethiopia. The introduction of non-native species and genetic stock was a major threat to mammal diversity. There were thousands of new and foreign genes introduced with trees, shrubs, herbs, microbes, and higher and lower animals each year. Many of these new species survive and adapt, after many years of adaptation, become invasive. In the park a number of animal and plant species were reported as endangered, threatened or critically endangered. It has failed to protect the species.

2.3.4. Human-Wildlife Conflicts of Large mammals

Naturally, organisms live together in an ecosystem for a long period of time. Then, through time, it shows high degree of intrinsic stability and resilience to climate and other environmental factors in the given ecosystem (Treves *et al*, 2003). However, when humans entered these systems, the natural phenomena become disturbed. One of the effects of human activities was introduction of exotic species. Most of the introduced species cannot develop an adaptive coexistence with the native species. In addition, in many cases, the introduced species are not capable of resisting predators, disease and other factors that occur in the environment (Messmer, 2000).

Habitats were forced to decrease their number and invade the marginal habitats but those species that were able to adapt a changing ecology and survive in agricultural system become involved in a direct competition with humans (Deresse, 2003).

2.3.5. Unsustainable Utilization

Unsustainable utilization (over grazing/browsing, harvesting and hunting) of mammal was one of the major threats to large mammals and ecosystem services. Farmers found within the lake watershed were pumping water unsustainably to irrigate. This eventually resulted in the disappearance of the lake affecting the livelihood of the people that have been dependent on the lake (Brook, 2011).

2.4. Threat of large mammals in BSWNP

The major threats of large mammals in BSWNP are agricultural expansion, grass collection, livestock grazing, human settlement, deforestation, poaching, habitat fragmentation and encroachment of invasive species. Moreover, all large mammals were susceptible to hunting; high rate of occurrence was recorded for Gelada baboon (Papio Anubis). The different infrastructure construction in both compounds is causing different impacts. As the area is rich in large mammals and other species and threatened by different factors to reverse the situation, urgent conservation action is highly recommended (Yihune, Bekele, and Tefera, 2008)

2.5. Mitigations Measurement of Treats of Large Mammals

Mitigation is often defined as a means to make something less harsh, harmful, severe, or painful. The term mitigation and its various applications have become more specified in the

environmental arena. A formal mitigation process was developed in the enforcement of the California Environmental Quality Act (CEQA), passed in 1970 (Ashenafi and Leader, 2005). The CEQA defines mitigation as follows: Avoiding the impact altogether by not taking a certain action or parts of an action, Minimizing impact by limiting the degree or magnitude of the action and its implementation, Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment, Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action and Compensating for the impact by replacing or providing substitute resources or environments.

3. METHODOLOGY

3.1 Description of the Study Area

Borena Sayint Werehimeno National Park is found in South Wollo Zone (Amara Regional State) and lies between 10°50‟45.4”-10°53‟58.3” latitude and 38°40‟28.4”-38°54‟49” longitude. The Park is located in the north eastern part of Ethiopia about 600km by road from Addis Ababa, 200km from Dese and 18km from Mekane Selam, the capital of Borena Woreda and area covers 4325 km^2. The park was established in 2001 E.C administered by ANRS. The park is situated among three Woreda namely Borena to the south, Sayint to the north and Mohali Sayint (a newly established Woreda) to the east, Borena Woreda on south (with its seven Keble's) and southwest (with its two Keble's), Sayint on the north (with one Kebele) and Mehal Sayint on the north (with its two Keble's) and on the west with one Kebele). Leg ambo Woreda is located bordering the two Woreda Borena and Sayint. The largest portion of the Park is found in Borena Woreda (Abate Ayalew, Tamrat Bekele and Sebsebe Demissew, 2006).

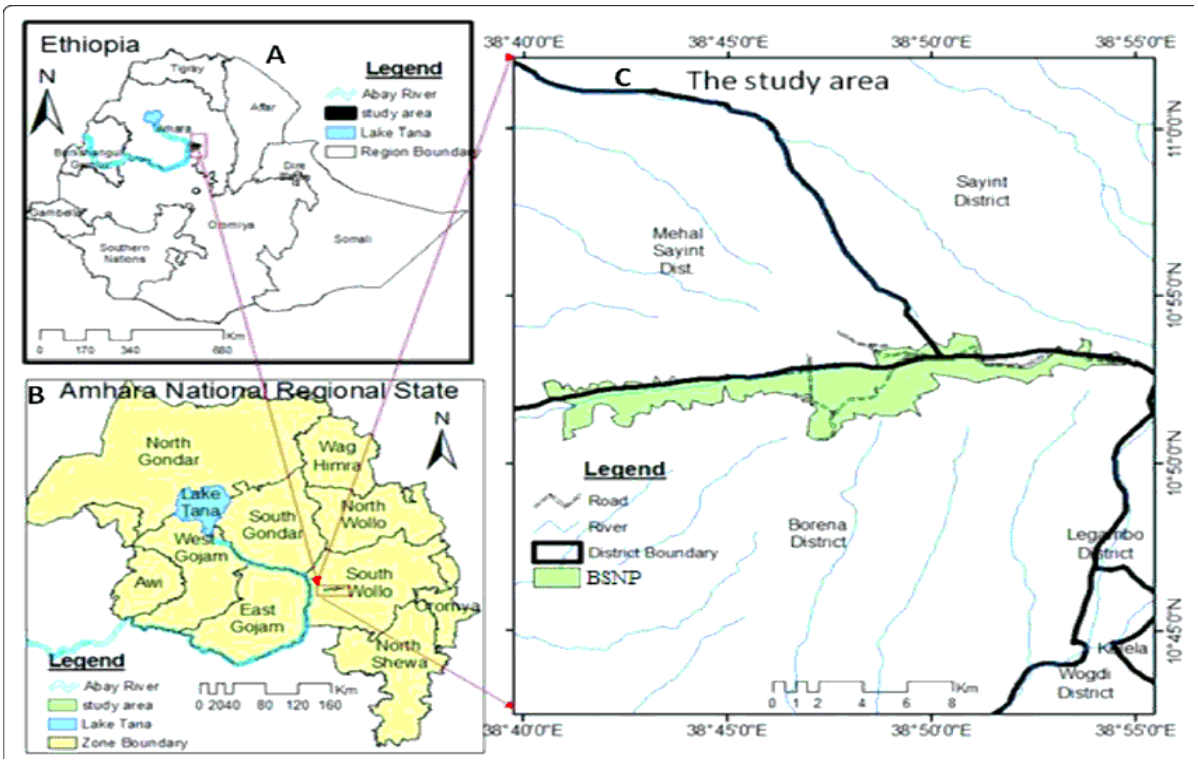


Figure 1 Map of the Study Area (Source BSWNP Office, 2019)

3.1.1. Climate

Rainfall and temperature data were recorded in Mekane Selam meteorological station, 18 km away from the study area. This station is the closest of all other stations that record rainfall and temperature and has altitude and weather conditions close to the study area and awide range of attitude and there embraces three climatic zone such as dega, woina dega and wurch (ENMSA, 2009).

3.1.2. Temperature

A seventeen years mean monthly maximum and minimum temperature of the area were summarized and showed that the mean monthly maximum temperature ranges between 17.8^{o}C (August) and 24.4^{o}C (March); whereas the mean monthly minimum temperature varies between 9.5^{o}C (November) and 11.8^{o}C

3.1.3. Topography

The Park has different topographical features ranging from low land to highland mountains. The altitude ranges between 1900m to 3699 masl. The park is generally characterized by rough topography with mountains, deep incised valleys, escarpments and plateaus. South Wollo is in most parts covered by volcanic rocks mainly basalt of tertiary age (Anonymous, 1998). According to the land area of Donkoro forest (now Borena-Sayint Werehimeno National Park) was 80km^2. Currently it covers only an area of only 43km^2, which makes it the smallest Park among the National Parks of Ethiopia.

3.1.4. Demography

Population pressure is the major threat of the development of the Park. There is high number of population in three bordering Woreda of the Park. According to Federal Republic of Ethiopia Central Statistical Agency the population of Borena, Sayint and Leg ambo Woreda was 158,920, 144, 937 and164, 964, respectively Three Woreda.

3.1.5. Fauna

BSWNP is a central high land area that is reach in biodiversity. It harbors various species of wild animals including mammals, birds, invertebrates, and amphibians. There are about 23 large and medium mammals, 77 bird species and rodents are concentrated in the national park. The larger

endemic mammals found in the park are Ethiopian Wolf, Menelik bushbuck, Gelada baboon, Strakes hare. Abyssinian Genet (*Genetaabyssinica*) has been recorded as endemic species for the ark. But, it is not listed as endemic species of in any achieves and documents, other endemic small mammals, such as Stenocephalomice*gresiecauda*and *Croudirabeilayi*are known from the afro alpine vegetation. In addition, one or more endemic bats or *chiroptera spp.* .Is or are believed to occur in the area as there are many species in the various caves.

3.1.6. Flora

One of the most attractive features of Ethiopia is the diversity of this vegetation. Various parts of the country with varied topography, altitude and rain fall distribution have resulted in unique vegetation formation. The abundance and distribution of mammals depend up on the nature, structure and density of vegetation. BSWNP represents rich biodiversity with higher number of endemic species and attractive bio physical features. Even though the park is small in size, it has higher species diversity due to the characteristics of the most evergreen forest. The study area, in general encompasses three vegetation zones, Afro alpine belt, sub afro alpine belt, afro Montana forest belt. BSNP contains real representative of high land biodiversity in the country. The lower forest is dominated by *podocarpusfalcatus*/ Ethiopian endemic Soft wood/ with juniper and Oleo with increasing as we go higher (BSWNP Leaflet). The upper forest is dominated by Repanea, Dombeya and Hagenia (Indigenous tree) moving in to the lower stratum of *Erica arboreal* and *Hypericumreveltum*near forest edge at 3000 m a.s.l (BSWNP leaflet). Above the forest edge there is a high altitude grass land dominated by *festucagelibertina* /Gausses/ with scattered Giant lobelia (*Loeliarhynopetalum)* and red hot pokers (Kniphofiafolisa). / BSWNP leaflet.

3.2 Methodology

3.2.1 Sample design and Sampling Technique

For this specific study, the target group was selected Borena district purposively. Which is adjacent frequently or closely related to Borena Saint Werehimeno National Park. Purposive sampling technique was employed to select the sample Keble's namely (Anferfra and Chirochorkos,) from the selected districts based on the presence of the threats of large mammals. Kebele means the smallest governmental administrative unit of the district in the study area. 50 respondents' was selected purposefully by considering the level interaction their extensive knowledge, experience, local elders, scout and involvement with in the study area and

dependency on the national park. We have perceived to be aware of detailed points raised during the survey and to select local communities from near to Borena Saint Werehimeno National Park.

3.3. Methods of data collection

Different type of data was collected for this study through the use of various ways of data collection for the achievement of the objectives of the study from different sources. This study was used both primary and secondary data sources. The primary data was collected from interview, field observation, questionnaires. The secondary data was collected from statistical report of official documents, books and from different journals of related literature.

A. Questionnaire

The study area was based on sample Keble household cross sectional survey pre-test structure questioner organizing in logical order of presentation. Using generated qualitative and quantitative data pertaining to demographic characteristics, aspects of participation, park resource use and dependence questionnaires

B. Key informant interview

This data collection method was used to collect necessary data from experts of park office that are working in BSWNP, park scout and local people living in and around the national park. Interview was prepared specially for all staff members by preparing interview questions about asses' large mammals' diversity and threats in the park. Interviewers who purposefully selected from in the park which were made from them the researcher prepare another interview question with check lists.

C. Filed observation

The study area was conduct by the researcher using digital photo camera, binocular and naked eye in order to substantiate the data, document analyses was also conducted. Document (reports and minus from Borena Sayint Werehimeno national park was analyze.

D. survey of large mammals

Survey of large mammals in the study area was on foot along randomly selected transecting lines. There were a total of four transect lines, which varied in length from 2 km to 4 km established to observe large mammal species. Transect width ranged from 50 m to 400 m depending on vegetation cover and topography of the study site. Two transect lines were

established for riverine forest habitat in different study sites, these are Bukie and Harro. The remaining two transect lines were for Erica woodland and open grassland. Observation of large mammals was done early in the morning during 02:00 to 06:00 hr. most large mammals were active in the study area. Indirect method such as scats, hair samples, tracks and, dense or burrows are very use full when surveying animals such as carnivores that are naturally rare, elusive, found at low densities and difficult to capture repeatedly. Direct Observation was using binocular and naked eyes and indirect observation was using indirect evidences.

3.4. Data Analysis

Analysis of the data was Species diversity large mammals were calculated using the Shannon-Weaver index of diversity, $H= - \sum Pi \ lnPi$ where Pi is the proportion of the i^{th} species in the habitat (Shannon and Weaver, 1949). H is influenced both by number of species as well species. Equal H values may thus be obtained if one habitat contains fewer and evenly distributed species of mammals. The evenness of mammalian species was calculated as J= H/H max where H max= ln (s) and s = the number of species.

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

SI= 3C/I+II+III

Where: SI= Simpsons similarity index,

C= the number of common species to all three habitats

I= the number of species in habitat one

II= the number of species in habitat two

III = the number of species in habitat three

4. RESULT AND DISCUSSION

4.1. Demographic characteristics of respondents

According to the demographic characteristics of respondents the studies have been mentioned in table 1.Below. We are including different category such as: sex, age and education status. According to sex category (70 %) of male and (30 %) Female were participated. According to education status Certificate (30%), Diploma (32%), Read and Write (12%) and Bachelor degree (16%) Master and above (10%) were higher than Diploma. According to age category 18-25 were (36%), 26-33 were (40 %), 34-41 (14%), 42-49(10%) and > 50 were (6 %) identified.

Table 1: Distribution of respondent demographic characteristic (n=50)

Demographic character	Category	No of respondents	Percent (%)
Sex	Male	35	70
	Female	15	30
Total		50	100%
Age	18-25	15	36
	26-33	20	40
	34-41	7	14
	42-49	5	10
	>50	3	6
Total		50	100%
Educational status	Certificate	15	30
	Diploma	16	32
	Read And Write	6	12
	Bachelor degree	8	16
	Master and above	5	10
Total		50	100%

4.2 Economic Activities of Respondents

The respondents said that the source of income were from agricultural product, honey bee farming and livestock keeping. According to the respondents, 80% of the respondents was depends up on agricultural product, 10% of the respondents was depends up on honey bee farming and 10% of the respondents was depend up on livestock keeping, this was the major activity of the local communities for the sources of income generation. Because of the condition

of the place was important for agricultural products, honey bee and livestock keeping. Livestock keeping is the activity of the local communities live around the park that sheep, goats and cattle were highly produced from these species such as, milk, meat, skin production and used for trade in to different places that generate income for the local community.

4.3. Large mammals in BSWNP

According to the respondents revealed that around 17 species of large mammals were identified in Borena Sayint Werehimeno national park. From this gelada baboon and Menelik bushbuck are the most dominate and highly distributed large mammal species in the park.

Table 2: List of large mammals in BSWNP, Northern Highland

No	Species name	local name	scientific name	Family
1	Menelik bushbuck	Dikulla	*Tragelaphus scriptus Menilik*	*Bovidae*
2	Klipspringer	Sessa	*Oreotagus oreotagus*	*Bovidae*
3	Common duiker		*Sylvicapra grimmia*	*Bovidae*
4	Spotted hyena	Jib	*Corcuta corcuta*	*Haaenidae*
5	Columbus Gureza	Gureza	*Colobus abyssinicus*	*Bovidae*
6	Stark hare	Tinchel	*Lepus starckii*	*House stark*
7	Common bushbuck	Tera Dikulla	*Traglaphus scriptus scriptus*	*Poiygonaceae*
8	Lion	Anbesa	*Panther leo*	*Felidae*
9	Gelada baboon		*Theropithecus gelada*	*Cerecopithecidae*
10	Sacred baboon		*Papio hamadryas*	*Cerecopithecidae*
11	Vervet monkey		*Chlorocepus aethiops*	*Cerecopithecidae*
12	Honey badger	Araji	*Mellivora capensis*	*Mustelidae*
13	Leopard	Nebir	*Panthera pardus*	*Felidae*
14	Ethiopian Wolfe	Red fox	*Cain's simensis*	*Canidae*
15	African Wolf		*Cainsaurous lupaster*	*Canidae*
16	Common jackal	Fox	*Cain's aureus*	*Canidae*
17	Anubis baboon	Monkey	*Papio Anubis*	*Hominidae*

4.4. Large Mammal Diversity and Distribution in BSWNP

A total of 17 large sized mammal species were identified and recorded. *Erica* woodland contains 10 species while riverine forest and open grassland were represented by 14 and 9 species, respectively. Diversity indices (H) and evenness (J) of large mammal species along the three habitat types (Table 3, 4 and 5). *Erica* woodland H =**1.894** and **J**=**0.872**, open grassland has H =**1.812 and J**= **0.871 and** Riverine forest H=**1.848** where **J**= **0.700** had the species diversity index and evenness respectively**.** Therefore from the three habitats, Erica woodland has higher species diversity and species evenly distributed than open grassland and Riverine forest. And also Riverine forest has higher species diversity and the species are unevenly distributed compared to open grassland.

Table **3** Diversity index of large mammals' species in Riverine forest

Riverine forest	No of spp.	Pi	Ln pi	Pi ln pi
Menelik bushbuck	10	0.047	-3.057	-0.143
Klipspringer	2	0.009	-4.710	-0.042
Common duiker	2	0.009	-4.710	-0.042
Spotted hyena	5	0.023	-3.772	-0.086
Columbus Gureza	45	0.212	-1.551	-0.328
Stark hare	8	0.037	-3.296	-0.122
Common bushbuck	12	0.056	-2.882	-0.162
Lion	1	0.004	-5.525	-0.022
Sacred baboon	34	0.160	-1.832	-0.293
Gelada baboon	22	0.103	-2.273	-0.234
Vervet monkey	20	0.094	-2.364	-0.222
Anubis baboon	45	0.212	-1.551	0.328
Honey badger	2	0.009	-4.710	-0.042
Leopard	4	0.019	-3.963	-0.075
Total	212			1.848

Table 4 diversity index of large mammal's species in Erica wood land

Erica woodland	No of spp.	Pi	In pi	Pi In pi
Menelik bushbuck	5	0.038	-3.270	0.124
klipspringer	7	0.053	-2.937	-0.155
Common ducker	11	0.084	-2.476	-0.207
Spotted hyena	6	0.046	-3.079	-0.141
Columbus Gureza	25	0.192	-1.650	-0.316
Common bushbuck	14	0.107	-2.234	-0.240

Sacred baboon	20	0.153	-1.877	-0.287
Common jackal	2	0.015	-4.199	-0.062
Gelada baboon	35	0.269	-1.313	-0.353
Stark hare	5	0.038	-3.270	-0.124
Total	130			1.894

Table 5 Diversity index of large mammal species in open grass land

Open grass land	No of spp.	Pi	In pi	Pi In pi
Klipspringer	15	0.15	-1.898	-0.284
Common duiker	10	0.1	-2.302	-0.230
Spotted hyena	5	0.05	-2.995	-0.150
Ethiopian Wolf	3	0.03	-3.506	-0.105
Anubis baboon	15	0.15	-1.897	-0.284
Sacred baboon	20	0.2	-1.609	-0.321
Gelada baboon	30	0.3	-1.203	-0.360
African wolf	2	0.02	-3.912	-0.078
Total	100			1.812

Table 6; Diversity indices (H) and evenness (J) of large sized mammal species.

Habitat	number of SPP	Abundance	H	J
Riverine forest	14	212	1.848	0.720
Erica woodland	10	130	2.009	0.872
Open grassland	8	100	1.802	0.871

Simpson similarity index (SI) of large mammal species among three habitats in the study area was 0.3125. This indicated that 31.25 % of the species were common for all three habitats (shows in Table 7). Large sized mammals are the highest similarity occurrence between the *Erica* woodland, and open grassland followed by riverine forest and whereas the lowest similarity occurrence between riverine forest and open grassland.

Table: - 7 Simpson Similarity index (SI) for large sized mammals among three habitats.

Species in Habitat I	Species in habitat II	Species in habitat III	Species common to habitat I, II and III	Similarity index SI=2C/I+II+III
Menelik bushbuck	common Jackal	Ethiopian wolf	Starks hare	
Gelada baboon	Menelik bush buck	Klipspringer	spotted hyena	
Common ducker	Klipspringer	Common ducker	Gelada baboon	
spotted hyena,	spotted hyena,	Starks hare	Common ducker	
Starks hare	Common bushbuck	Scared baboon	Scared baboon	
Common bushbuck	Scared baboon	Gelada baboon		
Vervet monkey	Common ducker	African wolf		
Klipspringer	Gelada baboon	spotted hyena		
honey badger	Starks hare			
Scared baboon	Garza			
Leopard,	Common Jackal			
Gureza				
Lion				
S=14	S=10	S=8	S=5	**Si=0.3125**

Distribution and habitat association of large mammals are determined in terms of their water and food requirements. Large-sized mammal diversity in the present study area was highly associated with habitat types. The possible reason for this distribution and diversity of large-sized mammal species might be due to the presence of food and water and stability of the area from disturbances.

The Bushbuck was one of the large mammal's species of family Bovidae in the present study area. This species appeared to be more concentrated in the riverine forest, but it was also

recorded from Erica woodland and never in open grassland habitat. The species was more frequently seen in the center of riverine forest during the day and near to the periphery at night. This might prevent the species from nocturnal predators.

Klipspringers were seen frequently in the hilly and rocky part of the Park. Common duiker was seen in the Erica woodland and open grassland habitats. Gelada baboon was primate species in the study area. According to (Mori, and Belay, 1990), gelada baboon occurs in the highlands of Ethiopia, particularly in northern parts of Rift Valley including Shewa, Gondar, Wollo and Gojam and southern parts of Rift Valley in Arsi region. In the present study the species has been observed in all three habitat types. Geladas are mainly vegetarian, feed upon herbs, grass (most of the time) and roots but they also seldom eat insect (Last, 1982). They were observed eating grasses in BSWNP.

According to (Sillero-Zubiri, and Gottelli, 1995) Ethiopian wolf (C. simensis) occurs in a few mountain ranges of Ethiopian highlands. It occurs in Simien Mountains, Mountain tops of Wollo highland around Abune Yoseph, AmbaFerit, Donkoro Chaka and other high altitude areas of the Amara region and in Northern Shewa area of Menz (Guassa). It also occurs in Arsi and Bale mountains of and other high altitude areas (Marino, 2003). In this study the presence of Ethiopian wolf was confirmed through indirect evidences such as, signs and interviewing the local people. The local people who were interviewed in the area had seen Ethiopian wolves rarely, and the species distribution was highly restricted in open grassland parts of the Park.

4.5. Conservation status of large mammals in BSWNP

Conservation status of large mammals in the study area where CR=critical endangered, VU =vulnerable LC =list concern. Where Ethiopian wolf and lion are critical endangered, leopard are vulnerable and the other species are list concern.

Table 8: Conservation status of large mammals in BSWNP

Status	Mammals	Respondents	Percent (%)
CR	Ethiopian wolf	30	60
CR	Lion	20	40
LC	African wolf	1	2
VU	Leopard	2	4
LC	Gelada baboon	4	8
LC	Menelik bushbuck	4	8
LC	Vervet monkey	3	6
LC	Common ducker	2	4
LC	Honey Berger	4	8
LC	Stark hare	5	10
LC	Klipspringer	3	6
LC	Common bushbuck	4	8
LC	Common jackal	4	10
LC	Anubis baboon		8
LC	Spotted hyena	4	8
LC	Columbus Gureza	3	6
LC	Scared baboon	2	4

Recently species diversity of mammals of BSWNP was decreased their population number. This was because of different cause such as habitat loss, poaching, deforestation, agricultural practice and conflict between mammals and local communities in the park. Because of these factors mammals were extinct and lost. Current population status of large mammals in the park is increasing, due to the conservation of mammals and governmental agency attended the park. According to the respondents this situation was occurred because of the park regulated by the government that provides rule and regulation to conserve the national park and wild mammals of the park. Government helps to the local communities to conserve the National park by reduced deforestation, prohibit poaching, and prohibit agricultural practice, resettlement and count up Scout, Create Awareness, and Equal Benefit Sharing of the Local Community, Manager and wildlife expert. Although current population status of most large mammals are increase, in some parts of the park the population status few large mammal was decreased. Ethiopian Wolf was one of these decreased their numbers in the park. For the poor Ethiopian Wolf number in the park was associated with different problems. Some of the Problems were Mostly or Specifically Lack of Food, Disease and death of Ethiopian wolf due to Unknown Reasons.

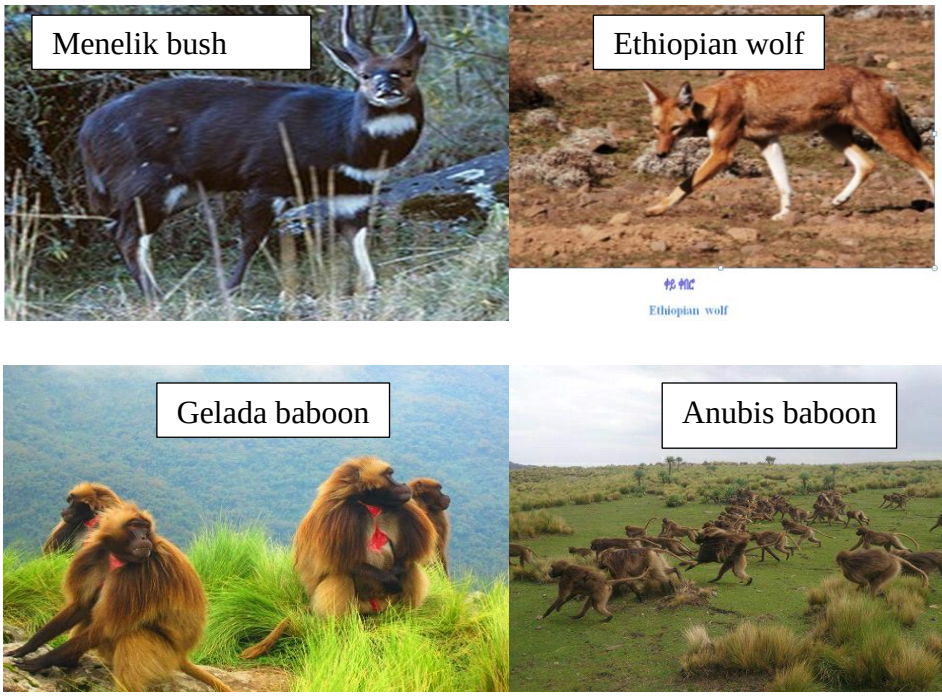


Figure 2:-The common large mammal in the study area (source, BSWNP, 2019)

4.6. Treats of Large Mammals in Borena Sayint Werehimeno National Park

As shown in the below graph 1 and 2, some of the major threats of large mammals in BSWNP are human and natural forces. Human activities such as agricultural practice, deforestation, grazing, Grass collection, poaching and Conflict and Natural force such as disease, prey predator relationship, flooding. The causes of HWC are Prohibit land grazing, human property damage, crop damage. According to the respondents human activity was the major threats of large mammals in the park.

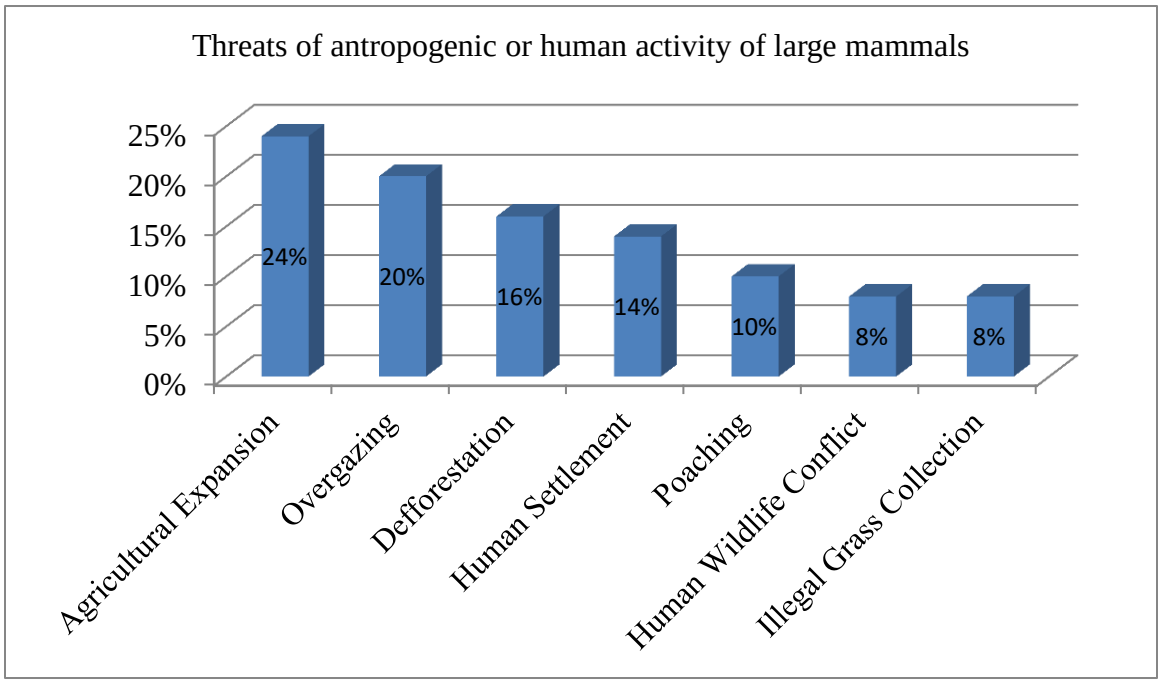
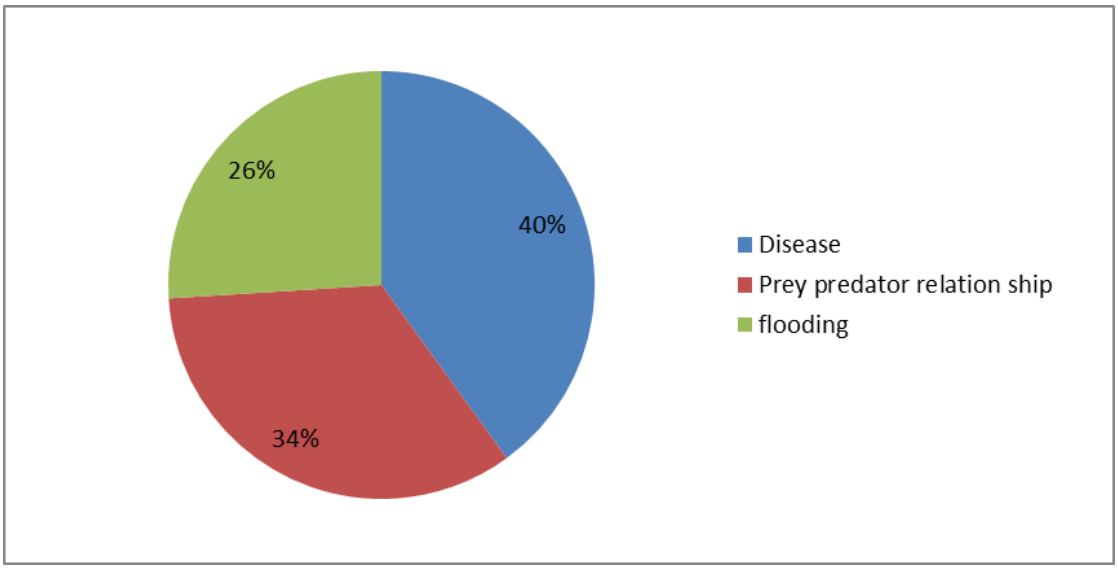


Figure 3:- Threats of anthropogenic or human activity of the park



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Figure 4:- Natural factors influencing the national park

4.6.1. Deforestation

According to the respondent 16% deforestation is the major threat large of mammals in BSWNP. This threat was mainly caused by human activity for fire wood collection, house hold and charcoal production, farming land and road construction and for feeding of sheep and goats. Local communities were cutting of trees for expansion of farm land, house hold, fire wood collection and livestock grazing send fire for the purpose of charcoal production, and land farm. Due to high level of deforestation in BSWNP, large mammals of this park were reduced.

4.6.2. Agricultural Expansion and human settlement

According to the respondents during data collection was agricultural expansion (24%), and human settlement (14%) was another major threat of large mammals in Borena Sayint Werehimeno National Park; recently there was agricultural practice inside the park conflict was raised between wild mammals and human. Agriculture practice also influence terrestrial and aquatic mammal diversity with in and around agriculture fields. Fertilizers, pest control chemicals, tillage, even crop rotations had impact of the biodiversity of agriculture ecosystem. Agriculture and other development activity had led to an on overall decline of large mammals



Figure 5:- Agricultural expansion and human settlement (photo by Zenebu, 2019))

4.6.3. Human Wild Conflict

Human wild life conflict is the negative interaction between human and wild animals. Human wild life Conflicts are affected particularly large sized mammals. Due to this conflict where mostly either critical endangered or declined rapidly. One of major cause for HWC was increasing human population adjacent to the park According to the respondents 8%, conflict was occurred. Wild mammal damaged crop production and livestock. When the wild animal is damage the crops of the local community conflict becomes emerge between the two groups.

4.6.4. Over Grazing

Borena Sayint Werehimeno national parks are lack of natural buffer zone According to the respondents 20%, Grazing was another major threat of large mammals in the park, due to this local communities were farming and livestock production are the main activities, were over grazing and livestock keeping inside the park the number of large mammals were lost by the scarcity of resource and habitat degradation occurred.



Figure 6:- over grazing by livestock (source BSWNP Office, 2019)

4.6.5. Illegal Grass collection

BSWNP is part of the afro alpine center of plant diversity. With high levels of endemism the high land part of the park have been dominated by *festuca gilbertiana* (commonly name called guassa) and giant lobelia. Guassa is a thin- leaved species. . According to the respondents 8 % is one of the serious threats of large mammals in the Park. The local people cut grass to feed their cattle, sell in the market and thatching houses. This might cause scarcity of grass for herbivores and disturb the natural behavior of wildlife in the Park.



Figure 7:- Illegal grass collection (Source BSWNP Office, 2019)

4.6.6. Disease

According to the respondents 40% disease was another threat of in the park caused by natural force, for examples Ethiopian wolf was affected by rabbi's virus due to the contamination between the affected domestic dogs. When the domestic dog and Ethiopian wolf directly contaminate to each other than the disease directly transmit from the infected domestic dog to Ethiopian wolf, results for the reduction or extinction of the mammals.

4.6.7. Poaching

According to the respondents 10% poaching was another threat of large mammals of the park. Local communities were hunting of mammals for food. Due to poaching inside the park a number of large mammals were reduced.

4.6.8. Prey predator relationship

According to the respondents 34% Prey predator relationship was caused by natural force affected large mammals, like; Menelik bush buck affected by leopard, klipspringer affected by gelada baboon and leopard.



Figure 8:- prey predator (source BSWNP Office, 2019)

4.7. Mitigation Measurement of Treats of Large Mammals in the study area

According to the respondents acquired information from open ended question some mention are the following to solve the above problems: Creating awareness about the importance of potential tourism resources found in the park for community and giving a proper training to all stockholders, to reduce illegal grass collection, over grazing ,cutting tree, to minimize agricultural practice, resettlement of the local community, reduce deforestation, by formulate rules and regulation for performed local communities, to recognize, promote and conservation practice development works are performed in the park, to increase and facilitate work of ecotourism development activity and also Creates qualified person and management strategy.

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Borena Sayint Werehimeno national park is one of the national parks of Ethiopia found in south Wollo zone in northern part of Amara region. This study was conduct large mammal's diversity and threats in the park. The total of 17 large mammal species was identified by questioner, field observation, interview and secondary sources. The Diversity (H) and evenness (J) of large mammal species along the three habitat types are *Erica* woodland the highest diversity index and evenness, whereas open grassland has higher species evenness and lower species diversity index than Riverine forest. The Current population status of large mammals in the park is increased, due to the conservation of mammals and governmental agency attended the park. Large Mammals of the park were endemic such as gelada baboon, Menelik bushbuck and Ethiopian wolf. Most of large mammals in the park were critically endangered, list concern and vulnerable species. Ethiopian wolf was one of the Critically Endangered of large mammal species found in the park, this was because of high level of disease and lack of food. Major threats of mammals of the park were deforestation, grazing, poaching, prey predator relationship, human settlement, agricultural practice and human wild conflict. From the result majority of respondent said that agricultural expansion(24%) has been the most threat and illegal grass collection and HWC(8%) are also the least threats for large mammals in BSNP. The mitigation measurement of treat of mammals are creating awareness about the importance of potential tourism resources found in the park for community and giving a proper training to all stockholders.

5.2. Recommendation

Based on the finding of the present study the following points are recommended:

- The federal and regional government should pay attention to the park in the enhancement of local prosperity,
- To generates supplementary income and expands job opportunities as well as acting as a tool for the conservation of the natural environment.
- The local administration urgently should reallocate farmers that had legal arable land inside the park.
- Wildlife management authorities should encourage ensuring that protected areas with mammals receive adequate patrolling.
- Improve the extension services and training in awareness creation and knowledge development of the local community on the importance of mammal conservation, and the participation of local people in design, planning, implementation and evaluation should be encouraged.
- To calm down the major threats of mammal species (habitat disturbance and) involving a wide range of activities that is impossible for the management authority to carry out all conservation related functions by itself, there should be delegation of some duties and broad participation and cooperation from a spectrum of institutions.
- To ensure laws, coordination is required with the police, and perhaps with the military authorities as well as with the local government.

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7. APPENDIX
WOLKITE UNIVERSITY

COLLEGE OF AGRICULTURE AND NATURAL RESOURCE

DEPARTMENT OF WILDLIFE AND ECOTOURISM MANAGEMENT

Quaternary of culture and tourism office employees of Borena Sayint National Park

Dear Respondents

The main objective of this questionnaire is to collect information about "assessment of large mammal and treats of Borena Sayint Werehimeno National Park partial fulfillment for the BA (bachelor of art) degree in Wildlife and Ecotourism management at Wolkite University. The researcher will like to thanks in advance for all your cooperation and participation.

General Instruction

- No need of writing your name
- Use (√)Mark in the box of your choice for closed questions
- Write your answer for open question on the space provided.

Appendix I: Demographic characteristics

- Name of village (Keble's) _____

- Sex male female
- Household type: Male headed female headed
- Age 18-25 26-33 34-41 42-49 50 and above
- Educational level: certificate college diploma Read and write only bachelor degree master and above

- Marital status: married single divorced widowed

. Religion: Orthodox Christian Protestant Muslim other

- Occupational status

Governmental employee

Business men Farmer Others

Appendix II list Interview and questionnaires information

1, what is the current status of large mammals in the park?

2. What are the major threats of large mammals of the park?

A. Natural forces B. Human activities C. both

3. Based on question no 2 if your answer is Natural forces, what are these

4. Based on question no 2 if your answer is Human activities, what are these?

A, Deforestation C, Agricultural practice

B, over grazing D, other

5. What is the level of the threats of large mammals of the park?

A, Increase B, Decrease C, none

6. How many large mammals are found in BSNP?

A, 4 B, 5 C, 15 D, above 15

7. What types of large mammal is found?

A. Endemic B. Endangered

C. Critically endangered D. Threatened

E. Both

8. What is the level of large mammals?

A. Increase B, Decrease

C. If increase how?

D. If decrease how?

9. Is there gelada baboon in the national park?

A. Yes B. No

10. Based on question no 9 if your answer is yes how many?

A, 100 B, 50 C, 150 D. above 150

11. What is the major cause of human wild life conflict in BSWNP?

12. What are your livelihood activities?

A. Crop production B. Livestock keeping

C. Farming and livestock keeping D. Trade

E. Other (mention)