A STUDY ON MAMMALIAN DIVERSITY OF ABAYA-HAMASSA NATURAL VEGETATION, SOUTHERN REGION, ETHIOPIA

A Thesis submitted to the School of Graduate Studies
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In Partial Fulfillment of the requirement for the Degree of Master of science in
Dry land Biodiversity

By

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Abstract

A study on mammals was carried out from November 2003 to May 2004 in Abaya-Hamassa Natural Vegetation Area. A total of 33 (thirty three) species of mammals were observed. Of these, 25 were medium to large- sized mammals, 5 small rodents, 2 bat species and 1 shrew. Photographs of some large mammals and measurements and photographs of rodents were taken. For large mammals both direct and indirect observation methods were employed and all evidences were recorded including direct observation, footprints, feces, bones and horns. To capture small rodents two types of traps were set in different habitat types. The captured animals were weighed.

The study established that the main threats to the mammals of the area are habitat destruction and overgrazing. With increasing human pressure in the study area, human Wildlife interactions are becoming more common and dangerous to the wildlife.

Key words: Mammals, vegetation, Hamassa and Abaya

1. Introduction and Literature review

Ethiopia is characterized by wide range of ecological, edaphic and climatic conditions that account for the wide diversity of its biological resources both in terms of floral and faunal wealth (Alemu Berhanu, 1976; Yalden, 1983; Houerou, 1986; Shibru Tedla, 1995).

Houerou (1986) pointed out that Ethiopia is certainly one of the most interesting countries ecologists can dream of, and the most interesting in Africa from this point of view. It is an extraordinarily diversified country in terms of its ecological conditions in its habitats, flora and fauna. Ethiopia is a land of natural contrasts, from the tops of the rugged Simien Mountains, which is 4600m a.s.l. to the depth of the Danakil depression at 120 meters below sea level, one of the lowest dry land points on earth.

Although Ethiopia may not match some other African countries in display of animal abundance, given its isolation and former contacts with both Africa and Eurasia, it has an interesting and diverse fauna (Parker, 1988).

The topological features of Ethiopia range in altitude between 120 m below sea level to over 4600m a.s.l. The extensive highland plateaux, with an altitude of over 2500m a.s.l. Covers 40% of the country. The great African rift valley runs from north to south bisecting the plateaux and in connection with the lowlands, surrounding the country this feature isolates and separates the plateaux from other parts of the continent. The varied topography, the Rift valley and the surrounding lowlands have given the country a wide spectrum of habitats and a large number of endemic plants and animals.

Yalden (1983) pointed out that the Ethiopian highlands comprise more than 50% of the African high ground. This very large area of high land may be a major reason why so many endemic animals and plants are found in Ethiopia. Out of these 28 endemic mammals, 17 are high altitude moorland or grassland species, whose altitudinal ranges are confined to above 1900 to 2000m (e.g. *Theropithecus gelada*, *Canis simensis*). Of the

23 avian endemics 10 are high altitude moorland or grassland birds (e.g. *Bostrychia carunculata, Columba albitorques*). However, many of these regions remain relatively unexplored partly due to inaccessibility.

Lowland areas of Ethiopia are characterized by semi-arid climate. The semi arid zone gets 400 to 600mm of annual rainfall, and the elevation varies from 1000 to 1500m. The lowland regions of Ethiopia are inhabited by interesting varieties of mammals and birds (Erickson, 1982). These areas are rich in species composition, but they are un-explored partly because of malaria and trypanosomiasis.

Different people have attempted to describe the mammals of Ethiopia. (Largen et al., 1974; Yalden, and Largen, 1992; Yalden, et al., 1976, 1977, 1980, 1984, 1986,1996; Hillman, 1993a; Dippennar, 1980; Dieterln and Rupp, 1978; and Straeten and Verheyen, 1979). They have made considerable contributions towards the understanding of the mammals of Ethiopia.

In his study of Ethiopian mammals, Hillman (1993b) showed that there are 277 (two hundred and seventy seven) mammalian species of which 31 (thirty one) mammals are endemic. At present most of these species are restricted within the limits of conservation areas due to the continued human population pressure and habitat degradation. In an effort to conserve these natural resources, Ethiopia has established 38 conservation areas that include nine national parks (out of which, only two, the Awash National Park and Semien Mountain National are gazetted), three sanctuaries, eight wildlife reserves and eighteen controlled hunting areas. However, all these conservation areas are under constant threat of human activities, such as settlements, human incursion, livestock grazing, timber extraction and fuel wood collection (Hurni and Ludi, 2000).

There is no absolute certainty as to how many different species there are, particularly in the case of small mammals like the bats, shrews and rodents. Taxonomists are constantly

revising and assessing the scientific status of many mammals with the development of more sophisticated methods of establishing genetic diversity.

Vaughan et al., (2000), indicated that these are exciting times for those interested in the study of mammals since the first edition of mammal species of the world was published in 1982. Since then, nearly 500 new mammal species have been described, as the result of recent explorations in remote parts of the world and taxonomic revisions of problematic groups. Next to birds, mammals are the group of animals whose diversity has been most intensively studied. Most species of extant mammals have already been described but 10 to 12 new species continue to be named each year (Corbet and Hill, 1991).

Corbet and Hill (1991) showed that in some groups of mammals, for example, the ungulates and carnivores, it is unlikely that many completely new species await discovery and our delimitation of known species is unlikely to change much. Amongst the small mammals the situation is very different. Several completely new species, mainly bats and rodents are discovered each year.

Mammals are the most familiar groups among vertebrates. They are also the most varied and adaptable animals, which survive in the broadest range of habitats from oceans to the poles and from deserts to forests. Within this variety, mammals share some fundamental characteristics: They are homoeothermic, give birth to living young (except monotremes), feed their young with milk produced in the mammary glands and most of them have a covering of hair on their body (Juliet and Don, 2002).

The definition of mammals is widely accepted, but the taxonomic relationships among mammals are disputed and differ among different workers. This can be a source of difficulty as accurate taxonomic relationships are important for comparisons to explain the adaptations of animals and evolution. The taxonomy of mammals has been based mainly on morphological and karyological data.

Mammals with their highly developed nervous system and numerous ingenious adaptations, occupy almost every environment on earth that supports life. This is partly due to the mammalian features of endothermy, which enables them to be active under wide environmental conditions. Hickman et al. (1995) pointed out that although not a large group, the class Mammalia is overall the most biologically differentiated group in the animal kingdom. Many potentialities that dwell more or less latently in other vertebrates are highly developed in mammals. Mammals are exceedingly diverse in size, shape, form and function. They range in size from the recently discovered kitti's hog-nosed bat, weighing only 1.5g, to the whales, some of which exceed 100 tons (Juliet and Don, 2002).

The size range of mammals is unsurpassed by all other animal groups. The largest mammal is the blue whale, which is not only the biggest creature alive today, but also the largest animals ever to have lived on the earth. It is more than 70 million times heavier than the smallest mammals, such as the Hog-nosed bat and pygmy shrew, which are smaller than a human thumb. Between these two extremes are mammals of almost every imaginable size and shape, including mice that are smaller than some insects. Otters and dolphins that can out swim fish, fruit bats with wingspans greater than those of most birds, and massive buffaloes with horns longer than adult human arms (Juliet and Don, 2002).

Terrestrial mammals range in body mass from less than 2g for the Etruscan pig- nosed bat and pygmy shrews, to more than 5 tons for the African elephant.

Like all living things, mammals have evolved over long periods of time. According to Juliet and Don (2000), about 4475 or so mammal species alive today are only a small proportion of all the mammals that have lived on earth. The peak of mammalian evolution, the "golden age of mammals" occurred in the Miocene 25 million years ago. Although, the Pliocene ages still had a rich mammalian fauna, it never again reached such spectacular proportions (Vaughan, et al., 2000)

The earliest mammals of the late Triassic were small mouse or shrew- sized animals with enlarged cranium, jaws redesigned for a shearing action, and a new type of dentition in which the teeth are replaced only once. This contrasts with the primitive amniotes pattern of continual tooth replacement throughout life. The earliest mammals were almost certainly endothermic, although their body temperature would have been rather lower than modern mammals (Hickman, et al., 1995).

Despite their remarkable success, mammals are much less diverse than most other animal and vertebrate taxa. This is probably attributable to their far greater individual size, to the high-energy requirements of endothermic condition, and thus to the inability of mammals to exploit great number of restricted ecological niches.

Simpson (1945) classified 26 orders of placental mammals, ten of which are extinct. The most numerous are the rodents with 1702 species followed by the bats with 925 species (Nowak, 1994). The species richness of some orders of small mammals is far greater than for the larger better-known species. For example the Artiodactyla (225spp.), Carnivora (249 spp.), and primates (356 spp.)(Juliet and Don, 2002).

Among global mammals, approximately 25% or some 1,100 occur in the African continent (Chris and Tilde, 1997). Africa is noted for its diversity and abundance of large mammalian herbivores (Kutilek, 1979). It comes as a surprise to many people that there are so many species of small mammals on the African continent. Rodents represent one of the widely distributed and successful groups of vertebrates. Their evolutionary success can be easily seen from their species number that accounts for more than 40% of mammalian species. This success is attributed to their higher reproductive potential and young age in evolutionary terms, about 26 to 38 million years (MacDonald, 1984).
Bats (order Chiroptera) are among the most diverse and geographically dispersed living mammals. They form the largest mammalian aggregations known and may be the most abundant as measured by number of individuals. Only the rodents (order Rodentia) have more number of species than bats (Nowak, R.M. 1994).

Vegetation provides food, shelter and cover to mammals. The structure and composition of vegetation, therefore, determines the distribution, abundance, and diversity of mammals. In other words, the diversity and demographic conditions of mammals are reflections of habitat variables. In general, the more diverse the habitat is, the more diverse the mammalian fauna would be (Rogers and Gorman, 1994).

According to IUCN (1980), humans have long been interested in our fellow mammals, and have long exploited them. Wild mammals and most other organisms are under greater pressure than ever from humans in all parts of the world. In many less developed areas inhabitants hunt year round: either they are primarily hunters who depend on mammals for much of their food or they hunt to supplement their limited food supplies. The long term exploitation of mammals by humans has a devastating impact.

Vaughan, et al (2000), indicated that mammals face numerous threats to their continued existence including habitat degradation and destruction, over exploitation, loss of genetic diversity, endangerment and extinction. Expanding human settlements, illegal hunting and habitat destruction have combined to put pressure on mammalian communities, especially in under-protected areas (Estes, 1991; Caro, 1999a,b; Corti, et al., 2002).

The main problem confronting not only mammals but also all of the earth's biodiversity is clear and obvious everywhere. It is human over population (Ehrlich and Wilson 1991). The present global human population is about 6 billion people. If growth continues at the present rate the population could reach 10 billion to 17 billion in the next hundred years (Bongaarts, 1998). The demand of our growing population for some basic resources such as shelter, water, fuel and food would consume the remaining large tracts of natural habitats. The pace of wildlife habitat destruction and species extinction has increased worldwide. During the last 400 years nearly 500 described animal species, mostly vertebrates have become extinct (WCMC, 1992). The natural distribution of many of the large African mammals have been altered considerably by recent human activities, including farming, warring, hunting and of course poaching (Anton and Turner, 2004)

The population of large mammals is continuously declining in number due to the shrinkage of their natural habitats (Fryxell and Sinclair, 1988). The advent of changes to man's land use systems and to natural human population growth have meant that all parts of the highlands, and many parts of the lowlands which are the last relicts could disappear soon.

Wildlife conservation programs have attracted more attention in the near past (IUCN, 1980). People in the developed countries are far more interested in trying to save some attractive living creatures from extinction than in conservation of soil, water or vegetation. These aspects are all inter-related and it is obvious that wildlife conservation is intimately tied up with the conservation of the inanimate resources. There are various reasons for conserving wildlife other than the desire for controlled hunting. The best reason is that all species of animal life including reptiles, birds, fishes, and amphibians besides the large mammals which most people think only as animals, have a right to live, as well as man (Brown, 1973).

The real and proper reason for conserving wildlife is that no species of animals living on earth with us should be caused to die out through our own carelessness, neglect or cruelty. Humanity's record in conserving natural resources of any kind is extremely poor, and wildlife is no exception (IUCN, 1995).

Although the variation in the topography of Ethiopia has resulted in the diversification of the wildlife (WCMC, 1992), problems facing the Ethiopian wildlife conservation today are enormous.

The economic and ecological significance of mammals is far-reaching. Some mammals cause damage to agricultural crops, pasture, forestry, nursery and household furniture. Some others are involved in disease transmission and destruction. Big games are of great significance especially in tourist attraction, and therefore the national economy. Some mammals serve as human food sources in many parts of the world.

In terms of size and the capacity to earn revenue large mammals are important. Small mammals are not as important as the large, better known mammals in this respect. However, the sheer number of species, and the large population of some of these species, deserves some measure of recognition. Small mammals are particularly important because of their multiple functional roles in the ecosystem. They have many beneficial interactions with plants such as seed dispersal, seed germination and pollination of flowers. They modify local environments by their burrowing activities, and form food of many predators. Some species are reservoir hosts for microorganisms, which cause diseases in humans and domestic animals, and others are pests in agriculture and stored products. Bats are of value as predators of insects. Humans utilize some species of rodents as food. Thus, small mammals have roles in most ecological systems and in all habitats and many of their activities impinge on other animals including humans (Happold, 1995).

Ethiopia is well endowed with wild animal species. A few inventories exist with respect to mammals. However, our knowledge of these groups is far from complete.

The purpose of the present study is, therefore, to identify, and to collect base line data of mammalian species of the Abaya–Hamassa natural vegetation area and to add information about mammals of Ethiopia.

1.1. General objective

To identify and document the mammalian species of the study area

1.2. Specific objectives

- To compile mammalian species and publish the findings in order to share with institutions concerned
- To assess the potential of the area for future research
- To provide baseline information for future park establishment plan to the regional government.

1.3. Research Questions

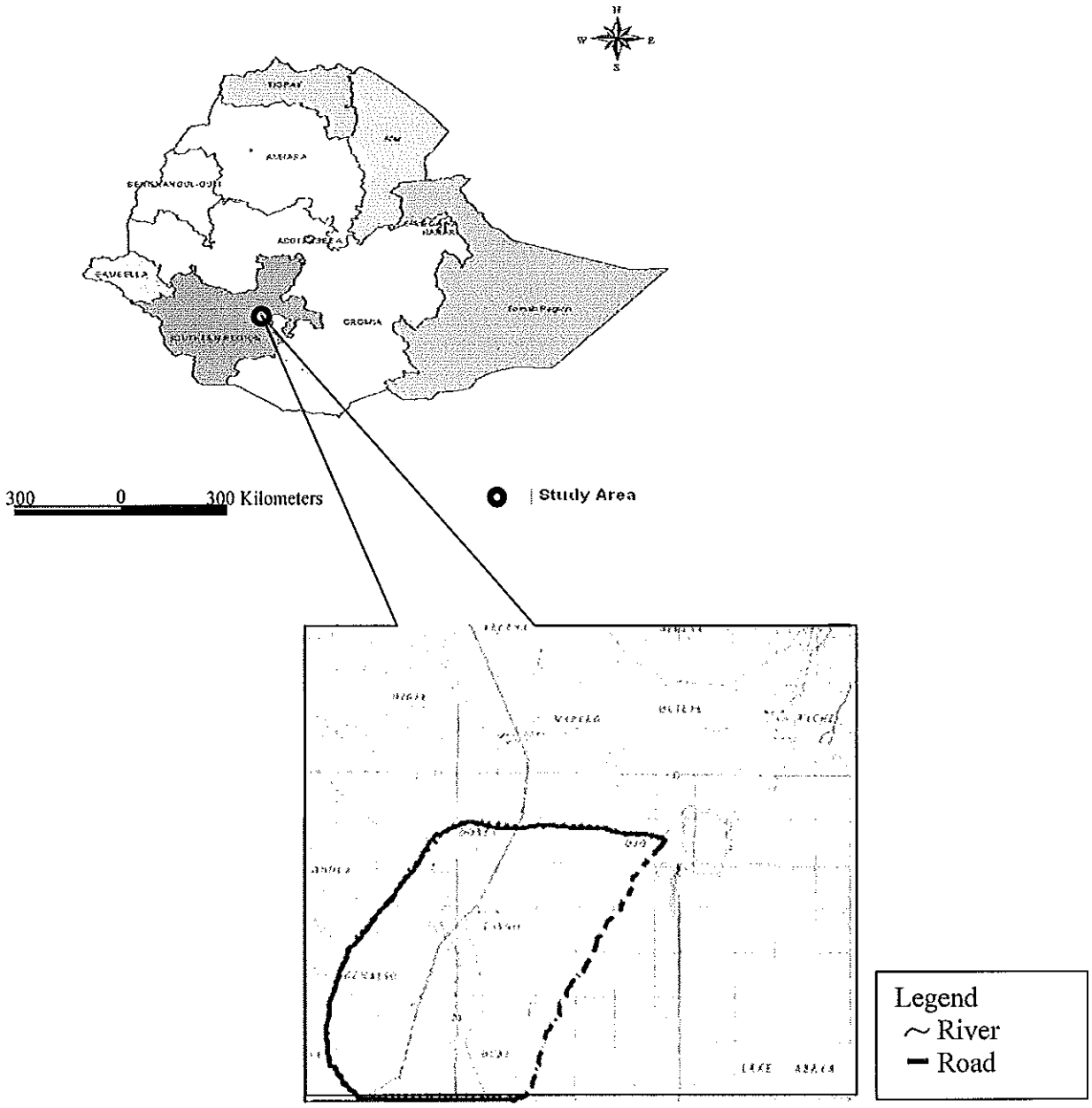
1. What kinds of mammals are there in Lake Abaya-Hamassa area?
2. Which species of mammals are more frequently seen in the study area?
3. Are there rare species?
4. Are there new species? Or species, which are not recorded previously in the catalogue of Ethiopian mammals?

2. Materials and Methods

2.1.1. Description of the study area

The study area, Abaya-Hamassa Natural Vegetation, is situated in southwestern Ethiopia, at the western edge of Rift Valley (Fig 1). It lies between latitude N 6^0 27' 404-6^0 37'368' and longitude E 37^0 44.042' - E37^0 52.169'. The elevation of the study area ranges from 1184 to 1410m a.s.l. The topography of the study area is rugged and ranged from the steep slope at the escarpment of the Rift Valley to nearly flat surface around the coastal strip of Lake Abaya.

Map of Ethiopia and the study



2.1.1.1. Climate

The study area occurs in the semi-arid or "Qolla" zone, a zone, which has been defined as those areas, which receive an annual rainfall of 400 to 700mm. According to Daniel Gamachu (1977), this limited amount of annual rainfall of "Qolla" is a result of being located within a low-pressure convergence zone more commonly referred to as the Inter-Tropical Convergence Zone (ITCZ), which has both temporal and spatial variability in rainfall, humidity and temperature.

The study area is located in between the basins of Hamassa and northwestern part of Lake Abaya for which only scanty information is available on the rainfall and temperature. As a result, I summarized data on weather collected at the nearby Mirab Abaya, Ber Ber station, which is at similar altitude and undoubtedly experiences similar weather, although rainfall data may differ as a result of localized storms.

2.1.1.2. Rainfall

According to (NMSA, 2003), the rainy season varies with latitudes. The main dry season is from October to February, the main rainy season occurs between April and June (Fig 2). Within the region belonging to Hamassa water shades, there is a gradual decrease in annual rainfall from northwestern part of Lake Abaya and western regions, down to the Rift lowlands. According to Raunet (1978), the present study area receives 897.3mm of average annual rainfall. The amount of rainfall decreases to about 500mm.

Monthly Rainfall in Gammo Gofa Zone (Mirab Abaya Ber Ber Station) Recorded Monthly (between 1997and 2003)

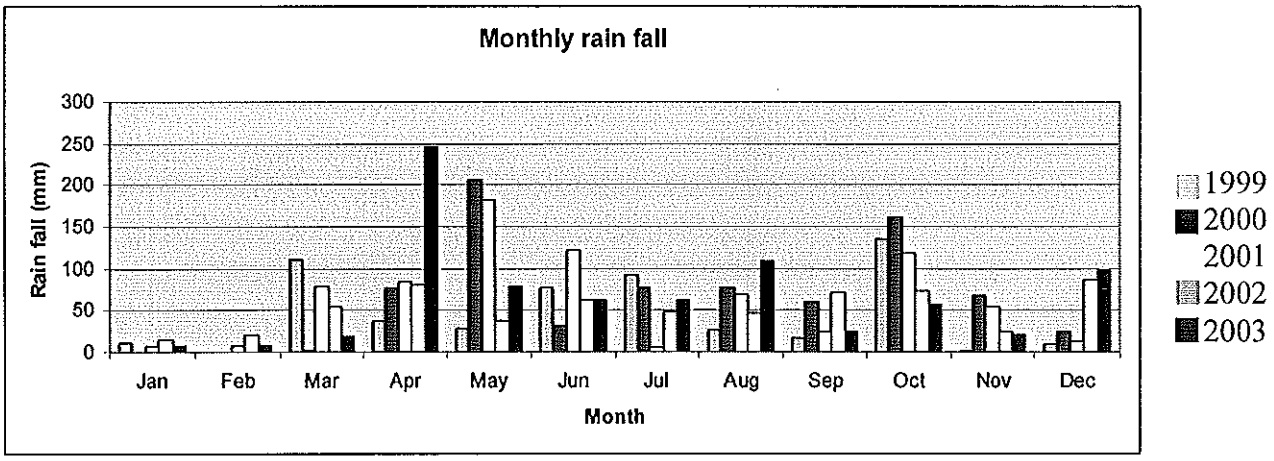


Figure 2. Monthly Rain fall

2.1.1.3. Temperature

The mean monthly temperature minima ranged between 16.9°- 19.7°c and that of the maxima ranged between 27.3°-34.4°c. The lowest average temperature record of a month was in July (16.9°c) and the highest average temperature record of a month was in March (34.4°c). (Fig. 3).

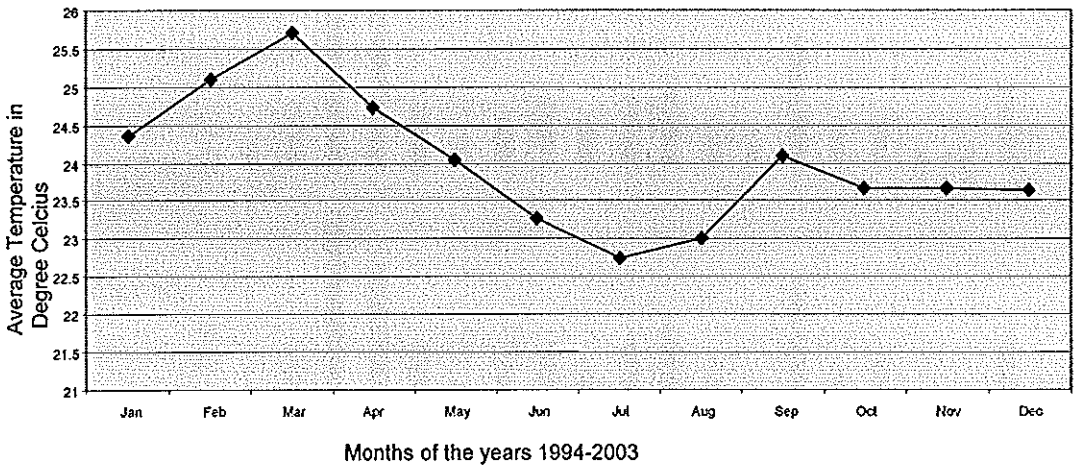


Figure 3. Average temperature

Source: National Meteorological Services Agency

2.1.2. Demography

Surveys in 2000 and 2001, estimated the number of people living in and around the study are to be 1529 and 1673, respectively. Subsequent sociological studies suggest a dramatic increase of people living within and around the study area (CSA, 2003).

2.1.2.1 Land Use

Land use practices within the Abaya-Hamassa Natural vegetation fall into three categories. Agriculture, animal husbandry and "other"- a category that concerns the harvest of natural resources such as charcoal, sand, and wood

2.1.2.2 Agriculture

In recent years, rain-fed agriculture, in the region has increased (Fig 4). The total area under cultivation to date is 900 ha. Currently the Hamassa River is the most important source for irrigation.

The most common types of grain growing in the area are maize and sorghum. Cotton and varieties of fruits are common in the area.

Figure 4 Farming practice in the study area.

2.1.2.3. Animal

The Sidama and Guji are the principal livestock owners and managers of the area. According to EASE, (2002), it was estimated that between these two groups, there are 4460 livestock in the area. To varying degrees, most of them are dependent upon the natural forage found on Abaya-Hamesa natural vegetation either seasonally or permanently. They have a permanent homestead and base at which the older members of the community remain throughout the year. They move in response to seasonal changes in the quality of grazing and the tsetse fly challenge. Their housing varies in complexity and usually depends on the time they anticipate spending at one particular grazing area. The traveling unit normally consists of a common herd owned by close male relatives. The women purchase grains in local markets and other basic needs from the proceeds of selling milk and dairy products. Other livestock owners include Wolaita and Gamo people. They take their livestock out of compounds during the day and graze them on the rangelands (Fig 5.). In addition, they offer them supplementary feed in the form of cut grass and occasionally grains.

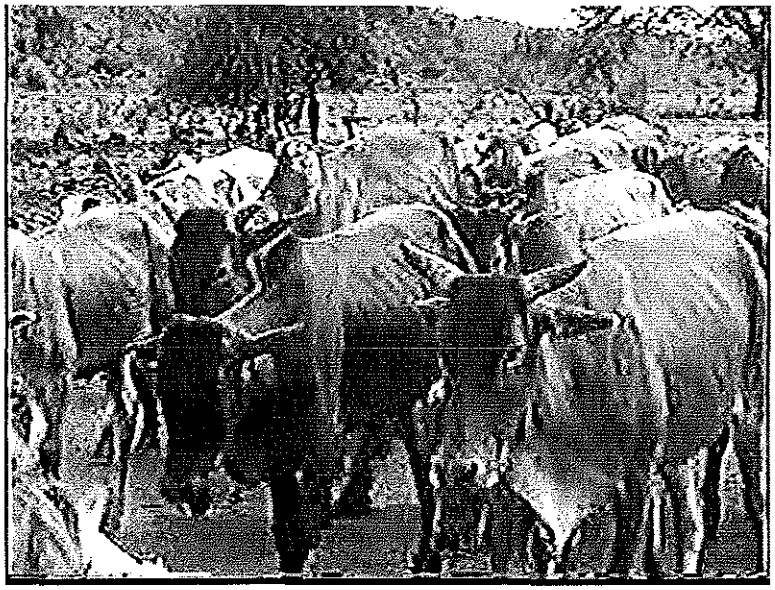


Figure 5 Some of the livestock in the study area

2.1.2.4.Other

Other natural resources, which are currently being harvested in the area, include fuel-wood, charcoal, building materials such as wood, sand and basalt gravel. These are mostly used locally, either for private and commercial enterprises. In the past, any motivated entrepreneur freely harvests all, but now the situation has changed.

2.1.3. Wildlife

2.1.3.1. Birds

There are 70 species of birds recorded in the Abaya-Hamassa natural vegetation area (Appendix 1). The bird fauna of the present study area is believed to be richer than the one indicated by available record (Personal observation) (Figure 6).

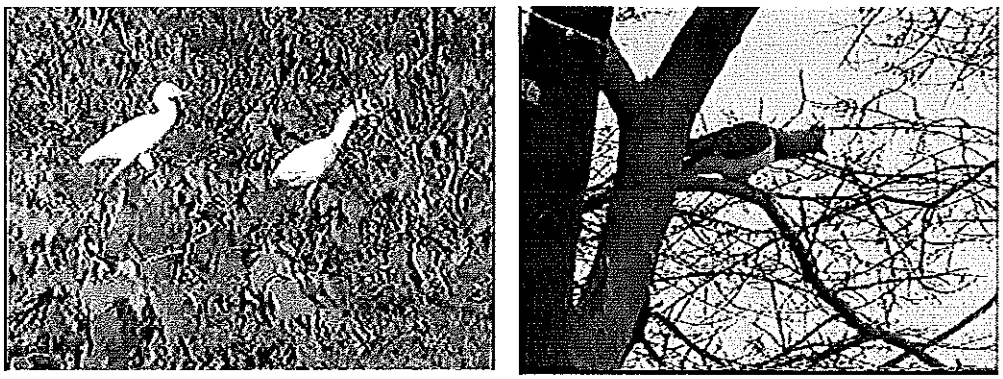


Figure 6 Some birds of the study area.

2.1.3.2 Other Fauna

The reptilian fauna of the area is rich owing to the suitable climate. Some species of reptiles are recorded (Appendix 2). Crocodiles are very common in Hamassa River and Lake Abaya. Varieties of snake species exist in the study area. The most common in the area include Black-necked cobra, puff Adder, Green Night Adder and a variety of woodland snakes (personal observation). Tiger fish, catfish, telapia and giant Nile perch are found in Lake Abaya. There are amphibians and many invertebrates awaiting identification.

2.1.4. Vegetation

There are 277 species of plants recorded in the study area (Appendix 3). (Eyasu Chama, unpubl.). Intensive groundwork has been done to check the vegetation communities and species composition. The vegetation types of the area are described using a physiognomic classification basically recommended by East African Range Committee (Pratt and Gwynne, 1977). English names were used to describe these community types. Based on this four vegetation types were identified: - scrubland, riverine forest, Woodland and thicket.

2.1.4.1 Scrubland

Almost 75 percent of the area is scrubland. *Acacia nilotica, A. tortils, Balanites aegyptica, Croton zambesicus, Commiphora schimperi, Acalypha fruticosa, Euphorbia schimperiana, Grewia bicolor, G. villosa, Hyparhenia rufa, Heteropogon contortus, pennisetum cladestimum and Sporobolus pyramidalis* constitue the scrubland vegetation.

2.1.4.2 Riverine forest

In this habitat, the land covered by closed stands of trees of one or more storeys, with an interlaced upper canopy rising to 7 - 40m or more in height. Herbs and shrubs dominate the ground cover. In the study area, this type of forest is limited to major river courses, where the water table is very high through out the year. The species found in the tree layer are: *Baphia abyssinica, Diospyros abyssinica, Ficus exasperata, F. Sycomorus, Euphorbia tirucalli, Boswellia rivae, Syzygium guinees, Terminalia brownii, Tamarindus indica, Papea* capensis, and *Olea hochstteteri.*

The representative shrub species in the riverine forest form dense cover of 15 to 20 m height. Common shrub species are *Carissa spinarum, Rhus natalensis, Ziziphus mucronata, Ximenia americana, Telclea nobili, Flaveria trinevia Grewia tenax, G.*

tembensis and *Dodonea angustifolia.* The vegetation cover of the herbaceous layer is different from place to place. Dominant herbaceous species are: *Barleria eranthemoides, Chenopodium ambrosioides, Cucumis propheratom, Chloris gayana, Cymbogon excvatus, Cynodon dactylon, Echinochloa colonus, Enteropogon macrostachyus, Commelina diffuse, a*and *Cyperus articulatus (*Figure 7).

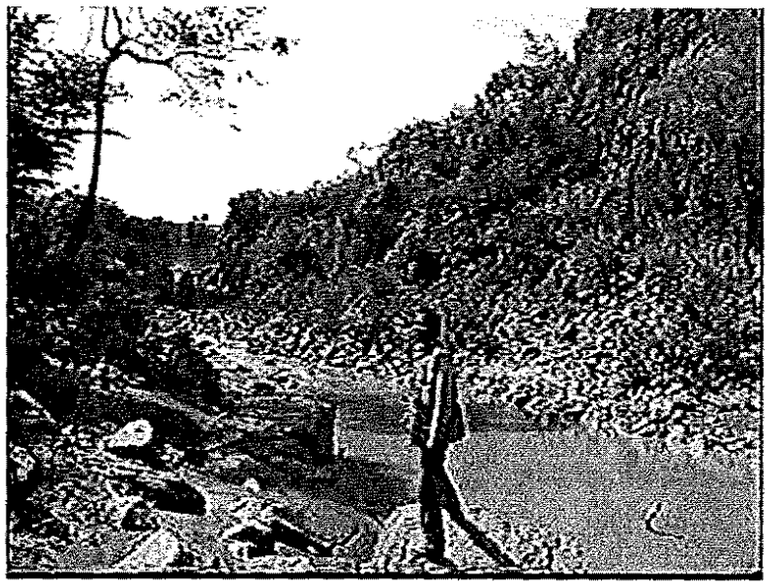


Figure 7 Riverine Forest around Hamassa River.

2.1.4.3. Woodland

The representative tree species of these vegetation types include *Combretum molle, Commiphora bruceae, C. habessinica, Boswellia rivae, Acacia tortilis,*and *A. senegal, Olea Africana.* The dominant shrubs in this type of vegetation are *Rhus natalensis, Maerua angdensis, Dichrostachys cinerea, Dodonea angustifolia, Teclea nobili, Leucas glabrata, Ocimum urticifolium, Piliostigma thonningii, A. brevispica,, A. hockii* and *Acokanthero schimperi.*

The Herbaceous layer is composed of 70 - 90% grasses and herbs of *Amaranthus caudatus, Asparagus africanus, Cardus leptacanthurs, commelina benghalensis, Digitaria gramineas, Elevsine indica, Eragrostic apera panicum reptens,*and *Saccharom spontaneum.*

2.1.4.4. Thicket

The Thicket is an extreme form of bush land where the woody plants form closed stands through which man or the larger ungulates can pass only with extreme difficulties. In the area, this type of vegetation is limited to shores of Lake Abaya. This vegetation type is composed of dense thicket of *Baphia abysbinica, Ficus exasperata, F vasta, F. thonningii Flacourtia indica, Maytanus arbutifolia, Ricinus communis,*and *Steganotaenia araliacea.* Other common species of plants are: *Canthium setiflorum, Capparis tomentosa, Crotolaria axillaris, Endostemon tereticaulis, Cyathula orthacantha, Gardenia ternifolia, Mystroxylon aethiopicum, Hydrophila schulli, Sorghum aroundinaceum, Hibscus panduriformis, Justicia cufodontii, J. flava,*and *Cyperus articulatus.*

2.1.5. Geology and Soil

The formation of protorift took place towards the end of Oligocene. The appearance of the Lake Abaya inside the protorift is presumed to be in Lower Miocene times (Raunet, 1987).

It is to be noted that the presence of important fluvio-lacustrine deposits as well as younger volcanic products most considerably decrease the actual vertical displacement of many faults in this area. All the faults within the studied area look extremely young as shown by some faults, which have affected recent, rhyolitic flows as well as recent basaltic scoria, cones and flows (Desta Horecha, 1990). The surveyed area is exclusively made up of volcanic products associated with recent fluvio-lacustrine sediments. Rhyolites are the oldest outcropping rocks within the study area (Gezahegne Yirgu, 1980).

The area has black cotton soil (vertisols), which forms wide and deep cracks during the dry season which is very sticky with poor drainage surface and little aeration in the wet season. The soil types on escarpments are of volcanic or metamorphic origin. The volcanic origin is shallow to moderately deep, well drained, exceedingly stony and reddish brown soil.

2.1.5.1 Hydrogeology

Water sources are fairly abundant in the study area. Rising from the Soddo highlands, the Hamassa river drains the eastern part of the area and flows southwest into Lake Abaya. The Hamassa river provides habitats for a variety of wildlife, notably crocodiles, fish and reptiles. The local people around the area use this river for irrigation. A group of springs flow into Hamassa river bed some 1/2km downstream from the main bridge along the Soddo-Arbaminch road. In the study area, there are a number of hot springs and associated deposits. These have been well described in the UNDP geothermal work (UNDP, 1973). In the dry season, when Hamassa River decreases in volume and stops flowing, the hot springs provide water for domestic and wildlife consumption.

Lake Abaya is the largest of the Rift Valley lakes with an area of 1,160km^2. Mountains, which make the scenery spectacularly beautiful and located at 1300m a.s.l, surround this lake (Fig. 8). According to Desta Horecha (1990) the colour of the lake is red due to the colloidal suspended ferric oxide particles, which are introduced by most of the rivers that

drain into the lake. The Bilate River particularly, which crosses areas of red soil in Wolaita and Kambata regions, is the largest river entering Lake Abaya. A great deal of study has been done which has made the Rift Valley in general, and the area around Lake Abaya in particular, more interesting from the geothermal aspect (UNDP, 1973).

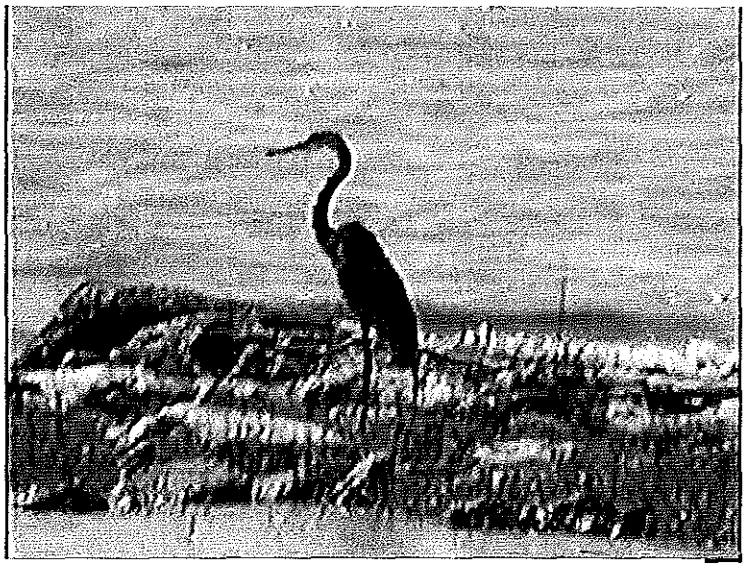


Figure 8: African darter on the shore of Lake Abaya

2.2. Small Mammal Trapping

The definition of small mammals is rather arbitrary. Happold (1984), in his articles on small mammals of the Sahara used a body mass of up to 3kg for small mammals. International Biological programme (IBP) Small Mammals working group decided that mammals weighing up to 5 kg are to be classified as small (Bouliere, 1965). The small mammals expected in the area include rodents, shrews and bats. Being usually secretive, nocturnal, and mobile rodents are seldom seen even when present in a given area in great number (Williams, 1993). Therefore, trapping is the most employed method in studying them. Many species enter traps readily (Sutherland, 1996).

Four line-transects (each 285m long) were established to capture rodents. To capture small rodents, two types of traps were set in the different habitat types. (Scrubland,

riverine forest, woodland, and bush land). Each line had 20 Sherman live traps. The distance between traps was 15m. The number of traps occasionally varied according to circumstances. Trapping was conducted from 14 November 2003 to 19 May 2004. Total number of trap nights utilized during the survey period was 300.

In addition to these four trap lines, 20 break-back traps were placed, wherever possible across the rodents' burrows runways or places where rodents were thought likely to move, to make full survey of the area.

Each trap was baited with peanut butter. Bait replenishing was done as necessary. Traps were camouflaged with hay and other plants of the area as found, mainly to avoid excess heat during the day and to camouflage. This was also found important in preventing people from being attracted by shiny and glittering objects from afar. Flagging tapes marked trap locations. Traps were checked twice a day, early in the morning (06-0 7:00hr) and late in the afternoon (around 18.00h). The two checks were necessary to identify nocturnal and diurnal species. Further, it minimizes mortalities and trap stress. The location of trapping sites was changed every week to cover different vegetation zones, and also to cover as much area as possible in each vegetation zone.

Standard morphometric measurements such as body length; tail length and weight were taken. The captured animals were weighed (using spring balance, accurate to the nearest gram). Some catches were preserved in formalin and are being kept in the collections of the Zoological Natural History Museum, Addis Ababa University, Ethiopia. Others were skinned and mounted.

Species identification was carried out using distinguishing characters listed in Yalden, et al. (1976), Kingdon, (1974) and Nowak (1991). Specimens available at the Zoological Natural History Museum, Biology Department, AAU, were also used for accurate identification, where voucher specimens prepared during this study are lodged. Some of the identification was done at the plant protection department of Ministry of Agriculture.

2.3. Large Mammal survey

Surveys were conducted from vehicle and on foot using existing roads in the study area. Line transect methods were used to observe large mammalian species. Three rounds of observations of large mammals were made between November and May, 2004 in the area of study from a vehicle driven through existing roads, and surveys conducted on foot. Dry season was found to be the best for observation and movement from place to place by vehicle and on foot. Most of the animals were observed by naked eye and sometimes aided by binoculars (8x4).

2.3.1 Vehicle Monitoring/survey

A total of five transects each with varying length were set in the study area. To locate mammals, a total of 2040 km distance was covered in three weeks interval between January and May, 2004. Foot walks accompanied each vehicle monitoring.

Direct observation and the use of binoculars (8x40) were employed to identify and count the mammalian species along the existing roads. Surveys involved two or more observers inside a vehicle starting soon after dawn or before dusk when animal activity was at its peak

During vehicle monitoring, when an animal was sighted, the vehicle was stopped and its species sex, location and habitat type were recorded. The location was recorded from a global positioning system (GPS). Survey routes were essentially confined to existing roads in the area.

2.3.2. On-Foot survey

As it was not always possible to traverse dense bush or broken terrain and sloppy rocks with vehicle, foot survey was the only alternative. The majority of surveys were conducted on foot together with local guides. During the study period, three long and several short distance walks through woods were made using the internal traces in the study area. Both direct and indirect observation methods were employed. All evidences of large mammals is recorded, including direct observation, footprints, feces, bone, horns, quills and resting or sleeping sites on the ground. Some people argue that the study of indirect evidence is the most practical procedure for assessing the presence of large mammals Rabinowitz, (1993a). Merz (1986) have used indirect methods of observation to estimate the mammalian species diversity.

Because large wide ranging mammal species often focus their activities along waterways, particularly early in the morning and at noon, occasional and irregular observation was made along waterways. Only Presence data were collected in this study.

3. Results

A total of 33 (Thirty three) species of mammals were observed in the study area (Table.1). Photographs of some large mammals, as well as measurements and photographs of small rodents taken while alive or still fresh. Five species of small rodents were trapped and identified from the study area. Distribution of small mammals along vegetation types and number of individuals caught are shown in (Table 2). Twenty-five large mammalian species were recorded (Table 3). Anubis baboon followed by vervet monkey and common bushbucks were the most frequently observed mammalian species. Distribution of mammals in each habitat type is shown in (Table 4). The best time to observe some diurnal mammals is shown in Table 5.

3.1 Mammalian species identified

Table 1: Mammalian species identified in Abaya-Hamassa natural vegetation area

No	Common name	Scientific name
I	Artiodactyla	
1	Greater Kudu	*Tragelaphus strepsiceros*
2	Lesser Kudu	*Tragelaphus imberbis*
3	Common Bushbuck	*Tragelaphus scriptus*
4	Grey duiker	*Sylvicapra grimmia*
5	White bellied duiker	*Cephalophus leucogaster*
6	Common warthog	*Phacochoerus africanus*
7	Guenther's long snouted dikdik	*Rhynchotragus guentheri*
8	Hippopotamus	*Hippopotamus amphibious*
II	Primates	
9	Anubis Baboon	*Papio anubis*
10	Vervet Monkey	*Cercopithecus aethiopus*
11	Abyssinian black and white colobus	*Colobus guereza*
III	Carnivora	

12	Lion	*Panthera leo*
13	Serval	*Felis serval*
14	Spotted hyena	*Crocuta crocuta*
15	Black-backed jackal	*Canis Mesomelas*
16	Civet	*Viverra civetta*
17	Large spotted genet	*Genetta tigrina*
18	White tailed Mongoose	*Ichneumia albicauda*
19	Egyptian Mongoose	*Herpestes ichneumon*
20	Ansorge's Cusimanse	*Crossarchus ansorgei*
IV	Rodentia	
21	Crested porcupine	*Hystrix cristata*
22	Striped ground squirrel	*Xerus erythropus*
23	Grass Rat	*Arvicanthis dembeensis*
24	House Rat	*Rattus rattus*
25	White footed Rat	*Praomys albipes*
26	Multimammate rat	*Mastomys natalensis*
27	Spiny mouse	*Acomys cahirinus*
V	Insectivora	
28	Shrew	*Crocidura bottegi*
VI	Lagomorpha	
29	Abyssinian Hare	*Lepus habessinicus*
VII	Tublidentata	
30	Aardvark	*Orycteropus afer (pallas)*
VIII	Hyracoidea	
31	Rock Hyrax	*Procavia capensis*
IX	Chiroptera	
32	Lesser Mouse tailed Bat	*Rhinopoma hardwickii*
33	Dark winged lesser house Bat	*Scotoecus hirundo*

Most of the scientific names used here are based on those used in the catalogue of the mammals of Ethiopia, Vol 1-6 (Yalden, et al., 1986).

3.2. Small Mammals Caught

Small mammal trapping was opportunistic as the main aim was to trap maximum number of species rather than to produce statistically robust measures of trapping success. As such, seven species were trapped and identified. Captures (by traps) allowed me to confirm the presence of spiny mice (*Acomys cahirinus*), house rat (*Rattus rattus)* grass rat (*Arvicanthis dembeensis)* multimammate rat (*Mastomys natalensis)* white-footed rat (*praomys albipes*), and shrew (*Crocidura bottegi*).

3.2.1 *Acomys cahirinus*

Measurement:

Head-body length (HB)	: 10cm
Tail length (TL)	: 6-7cm
Body weight (BW)	: 27- 49gm
Habit	nocturnal

This species was widely distributed in the area in nearly all types of habitats (Table 5). Although this species was widely distributed in all types of habitats, they were more abundant in rocky woodland. They live in burrows from where they normally emerge at night to forage.

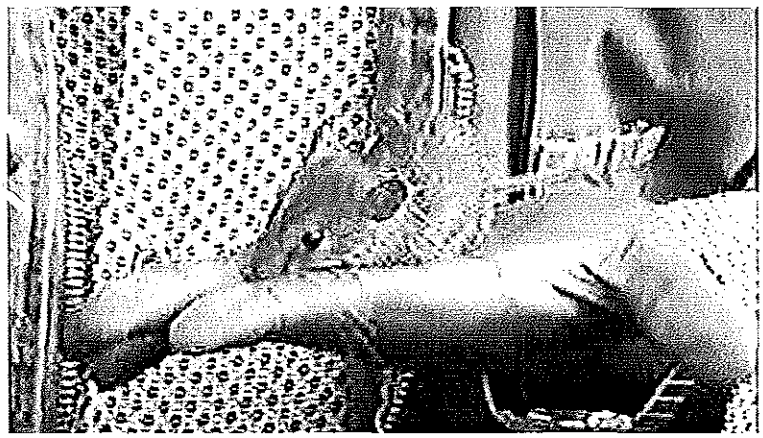


Figure 9 *A. cahirinus trapped in the study area*

3.2.2 *Arvicanthis dembeensis*

Measurement:

Body weight (BW): 90 -120g

Head-body length (HB): 14 - 16 cm

Tail length: (TL): 11 - 12 cm

Habit: Diurnal

Next to *A. cahirinus*, *A. dembeensis* is the most frequently trapped species in the study area (Table 2). (Fig. 10).

Fig. 10: Tail part of *A. dembeensis* was trapped by break-back trap

3.2.3 *Mastomys natalensis*

Measurement:

Head-body length (HB): 12 cm

Tail length (TL): 10cm

Body weight (BW): 86gm

Habit nocturnal

This species was more common in bush land than the other habitat types in the area of study.

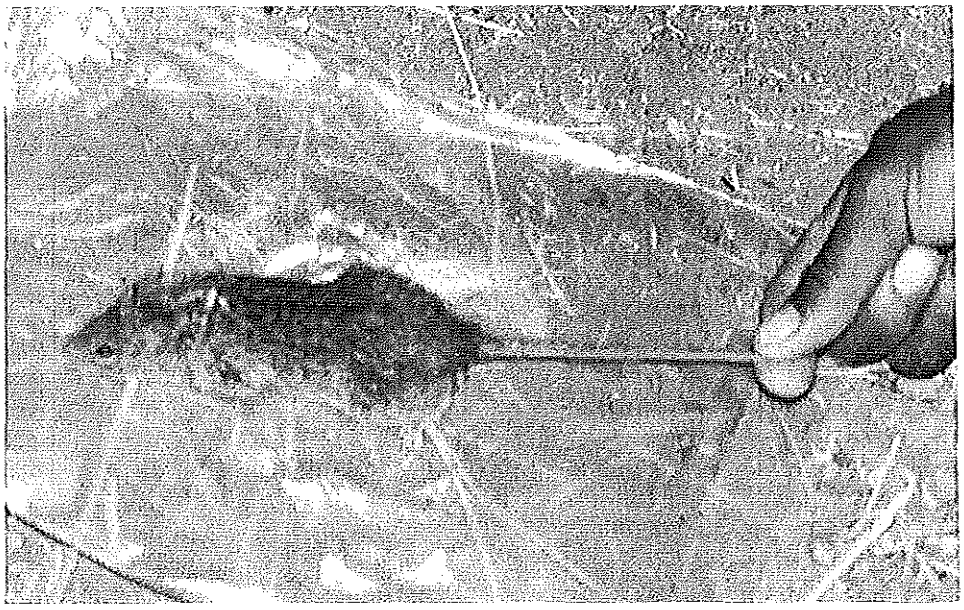


Figure 11: Dorsal view of *M.natalensis*

3.2.4 *Praomys albipes*

Measurement:

Head-body length (HB): 9cm

Tail - length (TL): 13cm

Body weight (BW: 37 gm

Habit nocturnal

This species was highly confined to the riverine forest along the Hamassa River. (Fig. 12).

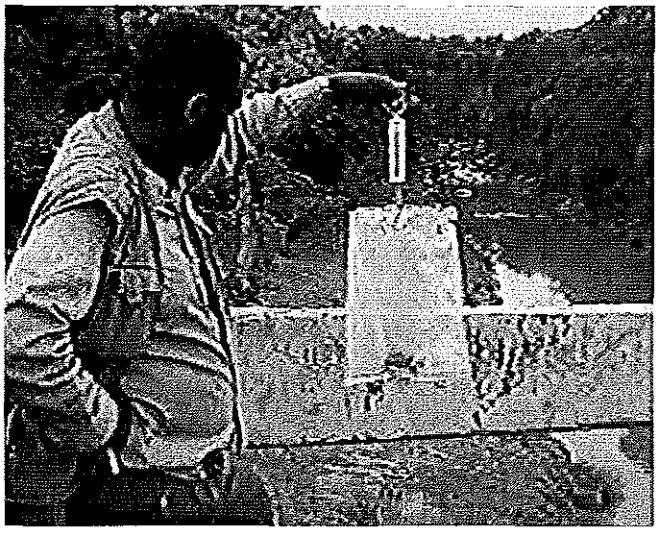


Figure 12: The investigator weighing one of the rodents trapped using a spring balance.

3.2.5 *Rattus rattus,* House rat

Measurement:

Head-body length (HB): 16cm

Tail - length (TL): 19cm

Body weight (BW): 130gm

Habit nocturnal or diurnal

Traps set in human residential area caught about five individuals of house rat, *Rattus rattus*. This rat was not found in captures collected from natural vegetation.

3.2.6 *Crocidura bottegi*

Two individuals were collected from an area in the farmland. Its darker venter and dark hind feet identify this small species. Previously this species was recorded near Lake

Abaya (Yalden et al., 1976). The captured specimens were collected and preserved in formalin.

Table 2. Small mammal species totals in different habitats

Species	Habitat type				
	SL (1288m a.s.l.)	WL (1268m a.s.l.)	RF (1400m a.s.l.)	Bushland (1282m a.s.l.)	Total
Acomys cahirinus Number caught	4	45	8	22	79
Arvicanthis dembeensis Number caught	10	8	-	25	43
Mastomys natalensis Number caught	-	6	5	13	24
Praomys albipes Number caught	-	-	6	-	6
Total	14	59	19	60	152

SL = scrubland WL (Woodland), RF = (riverine forest) BS (Bush land or thicket)

3.3 Large Mammals Observed

Table 3. Large mammals encountered in the study area (footprints, faeces, quills or direct sightings)

Species	**Sightings**	**Method of identification**	**Recorded number of individuals**	
			Min	**Max**
Greater Kudu *Trangelaphus strepsiceres*	10	Visual/horns	1	5
Lesser kudu Tragelaphus imberbis	3	Visual	1	2
Common bushbuck *Tragelophus scriptus sylvatieus*	21	Visual/horns	1	3
Gunther's long snouted dikdik *Rhuynchotragus guentheri*	17	Visual/faeces	1	5
Grey duiker *Syivicapra grimmia*	1	Visual	1	
White bellied duiker *Cephalophus leucogaster*	1	Visual	1	2
Common warthog *phacochoerus africanus*	3	Visual/faces	1	3
Hippopotamus *Hippopotamus amphibious*	6	Footprints/dung	-	

Anubis baboon *Papio anubis*	13	Visual	4	50
Vervet monkey *Chlorocebus aethiops*	5	Visual	6	20
Abyssinian black and white colobus *Colobus guereza*	6	Visual	2	10
Lion *Panthera leo*	3	Footprints	1	
Serval Felis serval	1	Visual	1	
Spotted hyaena *Crocuta crocuta*	2	Visual/faeces	1	2
Black-backed jackal *Canis mesomelas*	3	Visual	1	2
Civet *Viverra civetta*	1	Visual/KV	1	
Large spotted genet *Genetta tigrina*	1	Visual/KP	1	
White tailed mongoose *Ichneumia albicauda*	3	Visual/KV	1	
Egyptian mongoose Herpestes *ichneumon*	2	Visual	2	5
Ansorge's cusimanse *Crossarchus ansorgei*	1	Faeces	-	-
Crested porcupine *Hystrix cristata*	3	Quills		-

Striped ground squirrel *Xerus erythropus*	3	Visual	1	2
Abyssinian hare *Lepus habessineus*	1	Visual	1	-
Aardvark *Orycteropus afer (pallas)*	2	Diggings/faeces	-	
Rock hyrax *Procavia capensis*	5	Visual	3	10

KV: killed by vehicle, KP: killed by predators

Direct observations allow precise identification of diurnal mammals. The following species were observed. Greater kudu, common bushbuck, duikers, Dikdik, lesser kudu, warthog, baboons, vervet monkey, Colobus, hares and blacked backed jackal, hyena and serval. The direct observation during the study period was mostly made in the morning and afternoon. Only short observations were possible in all occasions, and mostly 1 to 2 minutes, because bushes and thickets become obstacles to continue tracking of animals. The Animals were shy and escape into nearby bushes when they noticed the human approaches in most cases. Their tracks, diggings, faeces, feeding sites, bones, horns and quills encountered helped to know the presence of many mammals. Lion, spotted hyenas, Ansorge's cusimanse, crested porcupine and Aardvark were among the indirectly observed mammals.

Table 4: Large mammals supported in different habitats

	HABITATS			
Species	Bush Land	Scrub land	Riverine	Wood land
Aardvark	Present	Absent	Absent	Absent
Bushbuck	Present	Present	Present	Present
Baboon	Present	Present	Present	Present
Greater kudu	Present	Absent	Present	Present
Lesser Kudu	Present	Absent	Present	Absent
Hyena	Present	Absent	Absent	Absent
Black-backed jackal	Present	Absent	Absent	Present
Civet	Present	Absent	Absent	Present
Warthog	Present	Absent	Absent	Present
Lion	Present	Absent	Absent	Absent
Dikdik	Present	Present	Absent	Absent
Porcupine	Present	Present	Absent	Present
Colobus	Present	Absent	Present	Absent
Egyptian mongoose	Present	Present	Absent	Absent
white tailed mongoose	Present	Absent	Absent	Absent
Serval	Present	Absent	Present	Absent
White bellied duiker	Present	Absent	Absent	Absent
Striped ground squirrel	Absent	Present	Absent	Absent
Ansorge's cusimanse	Absent	Absent	Present	Absent
Hyrax	Absent	Absent	Present	Absent
Hare	Absent	Absent	Absent	Present
Grey duiker	Absent	Absent	Absent	Present
Vervet monkey	Absent	Absent	Present	Absent

Three primate species, Baboon, Vervet monkey and the Abyssinian Colobus were found in the study area. They occurred in riverine forest and dense bushes particularly along the Hamassa River bank and lakeshores.

Baboons

Baboons were common and frequently seen in all habitats throughout the area. However they were less frequent in open scrub, which seemed only to be visited by bands of over 40. They were more numerous around Hamassa River where there were many more fruits in figs. Most footprints were observed around Hamassa River. Their activity continued throughout the day although they were often very noisy at night and in the morning. Their food items included *Diospyros abyssinica* fruit, and other *Diospyros* sp. fruit that had fallen to the ground, *Balanites aegyptica* fruit and ripe figs *Ficus sycomorus*. Around Hamassa River, I found many sites with broken trees where baboons had been displaying. The animals drag branches or small trees up and down the forest to impress others. Most females had babies on their back in dry season.

Vervet

A few groups were seen in all bushes and especially forest habitats. They seemed less common around lakeshores than Hamassa River regions. The vervets were seen eating ripe, *Zizipus macronata* berries, ripe figs *Ficus sycomorus*,and *Diospyra abyssinica* fruits. Differently aged groups were seen along the bank of the river. Troops of this species and colobus were observed foraging in the same trees.

COLOBUS

This species was best observed by its loud early morning calls. Four groups were observed along Hamassa River to descend to the ground and move to the next tree. These colobus seemed markedly shyer than the other monkey species.

HERBIVORES

The extensive riverine forest and bush land in the study area support herbivore populations. There were eight herbivore species observed in the study area. The most common were bushbuck, Greater kudu and Dikdik. These animals were scattered over their suitable habitats in mainly thickets and woodland. During the dry season they concentrated around Hamassa River and shores of Lake Abaya and to lesser extent in the central part of the open scrubland. In the rainy season the distribution of mammals in the open scrubland decreases. Sometimes no animal was seen.

BUSHBUCK

Bushbucks were found to be common everywhere. They were the most numerous antelope species in the region. Either two or three individuals or an adult individual alone were seen frequently. They drink water in the Hamassa River.

They inhabit the watercourse of the riverine forest where they obtain shelter in the dense vegetation and along escarpment, and eat the foliage of the shrubs, herbs and small amount of grass. They were prone to flee at the slightest disturbance in this habitat. This reaction of the animals was observed many times during the survey period. An old horn of bushbuck was collected.

GREATER KUDU

Around the Hamassa river sporadic sightings of up to five small groups (maximum size six, singles frequent) showed the species to be secretive and local, but not scarce. Small

groups were seen feeding near Hamassa river and in the central part of the study area, early in the morning and late in the afternoon. Female adult greater kudus were observed with their young. Greater kudu shelter in bush land in the heat of the dry season. They move out to the open scrubland in the wet season (Fig. 13).

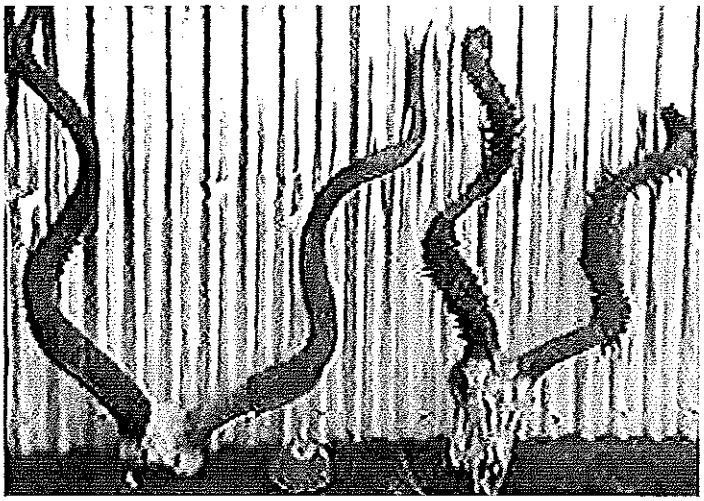


Fig. 13: Horn of greater kudu collected from the study area

DIK DIK

Dik diks were frequently encountered throughout bush land in the late afternoon and early in the morning (up to 2 per day), but unrecorded in the riverine forest and in the woodland habitats. Most of the observation was in pairs (Fig. 14). Their pea sized old and fresh pellet piles were observed during the study period. They were predominantly diurnal. These animals could often be approached within 2m provided that the observer was silent.

Figure 14: Dik diks observed in the bush land habitat

HIPPOPOTAMUS

Fresh and old faeces and footprints of hippopotamus were encountered frequently when traveling along shores of Lake Abaya. Tracks were mostly of small groups.

CARNIVORA

Nine species of carnivores were recorded during the study period. The most common and wide spread being spotted hyena (*Crocuta crocuta*). Droppings of hyenas and Ansorge's cusimanse were observed and collected. Hyenas were heard at nights around Hamassa River. During the survey period, only two were seen. Black backed jackals were seen in the northwestern and central part of the study area.

LION

Foot prints of lion were observed for three consecutive days in the morning survey in the bush land. During the survey, its resting place was observed. All tracks were of individual animals. There were no signs of a pride. In addition, very distant roars were heard occasionally from western corner of Lake Abaya. Fair numbers are known to exist in the Hamassa river valleys and the surrounding long grasses and thick vegetation.

SERVAL

Serval is one of the rarest carnivores in the study area. It is only once that this species was seen during the survey period (Fig 15).

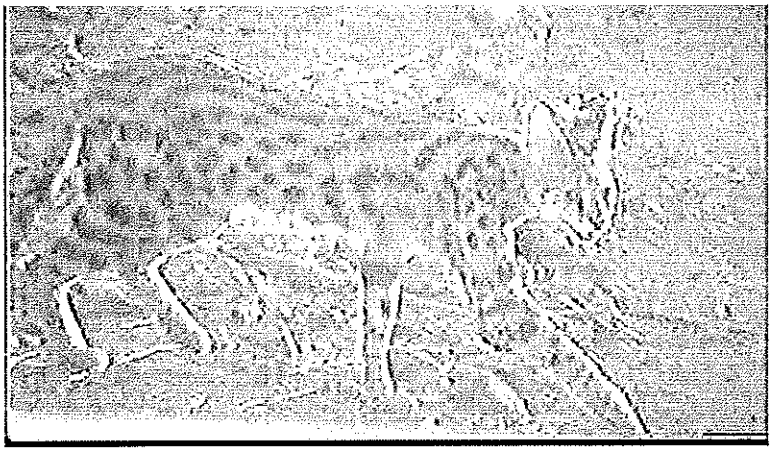


Figure 15: Serval observed while crossing the road

CIVET

This species was never seen alive in the study area. But an adult civet killed by vehicle on the main road to Arbaminch was observed (Fig.16).

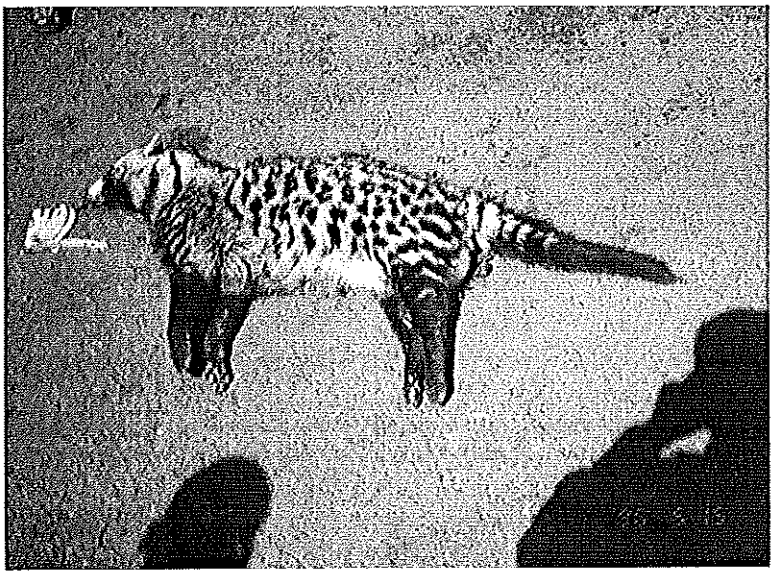


Figure 16:African Civet killed by vehicle on the road

LARGE SPOTTED GENET

One large spotted genet, which was killed in the bush land, was observed. The tail part was collected (Fig 17).

Figure 17: Large spotted genet killed by predator

WHITE TAILED MONGOOSE

Along the main road (Addis Ababa to Arbaminch) four differently sized white-tailed mongooses were sighted killed at different spots.

EGYPTIAN MONGOOSE

A small Group of Egyptian mongoose were seen twice during the survey in the central part, near Tuba and when crossing roads.

AARDVARK

Footprints and characteristic diggings of aardvark were found on several areas of the bush land. Old droppings were collected from certain localities.

BLACK BACKED JACKALS

Black backed jackals were seen in the northwestern and central part of the study area.

Table 5: Best time to find some diurnal mammals

Species	Best time to see them
Greater kudu	Early morning and late afternoon
Lesser kudu	Early morning to river for water
Dik-dik	Most active 0800-1000 & from 1700-1830
Warthog	Most active early morning and evening
Bushbuck	Most commonly seen in the early morning in the mid day coming to water and late afternoon along ridges
Colobus Monkeys	Mornings and mid day and afternoons of trees along Hamassa River on the branches
Abyssinian Hare	Mornings and evenings during the dry season
Baboon	At down, near dusk, mid day
Duiker	Early morning and late afternoon
Rock hyrax	Most active 09:00-10:00
Vervet monkey	Early morning along reverine forests
Striped ground squirrel	Mornings and late afternoons

4: Discussion

4.1 Small Mammals

The presence and distribution of rodents in different habitat types of the study area was obtained by trapping.

Different habitats had wide ranging capture success rates. Variations in species number were obvious between habitats. The woodland and bush land habitats had the maximum number of species recorded during the trapping period. Woodland and thickets have a good vegetation cover dominated by different trees, shrubs and grasses. The greater number of individuals and species of small rodents in these habitats is the result of better provision of food and cover of the Acacia bushes and the thickets, which had very thick and spreading branches, covering the ground like umbrella. The ground was covered with dense grasses, which provided good nesting sites and hiding places.

Low catch records was observed in scrubland. The site was a rather exposed area with regard to both aerial and ground cover, and was hardly favored by rodents. Its poor cover may have made it quite exposed and unfavorable for rodent colonization.

A. cahirinus was widely spread and the most abundant rodent species in the study area. It was found in nearly all vegetation types surveyed. It is characterized by having spiny fur and small body size. The spiny fur makes members of the genus *Acomys* quite unmistakable (Yalden, et al., 1976). All individuals caught here were grey in pelage. All were clean white below (Fig. 9). Several individuals had damaged tail. According to Carleton (1984), this species can shed their tails at the 5^{th} caudal vertebrae. Unlike lizards, once lost they cannot regenerate the tail. *A. cahirinus* has first been recorded from southeastern corner of Lake Abaya, where the present study was conducted (Rhoads, 1896).This species, like other members is most characteristic of arid, lowland regions and is often in Acacia scrub, in association with other species.

A. dembeensis was found mostly in the bush land. It is the most exposed diurnal rodent in the study area around road. This species is similar in size to *A. abyssinicus* but differs in usually lacking a mid-dorsal stripe (Yalden, et al., 1976). *A. dembeensis* is considered to be essentially a lowland species with most recording lying between sea level and 2000m a.s.l. although there are a few from higher altitudes such as kotaber at 2650m a.s.l. Yalden, et al. (1976). Previously this species was recorded from Mirab Abaya and southwestern corner of Lake Abaya (Dorst, 1972; Yalden, et al., 1976.

A. dembeensis keeps on watching long creasted eagle from afar, whether they were flying or are perched on top of nearby acacia trees. The rats never leave the entrance of their burrows as long as the bird is around. Long creasted eagle could take even trapped *A. dembeensis.* Black- kite (*Milvus migrans*) is also the most common avian predator frequently seen taking live rodents and could be an important predator, especially where the cover is thin. Various snakes were frequently seen around traps with rats.

Multimmate rat (*M.natalensis*) might be present in low numbers in a particular area. The species was obtained close to cultivated land. *M. natalensis* and *A. dembeensis* were frequenting herbaceous and bushy patches. *M. natalensis* is less associated with natural vegetation than is *Praomys albipes* Yalden, et al. (1976) showed that this species is very widespread in Ethiopia, especially in the Rift valley. *M. natalensis* has been recorded in Ethiopia from 500 to 2900m but seems to be comparatively scarce above 2500m. At lower altitudes, it is not noticeably a dry country form but tends to be associated with river valleys and lakesides, where it is often an inhabitant of cultivated land.
M. natalensis is similar in size to *P. albipes*, but differs in having a distinctly shorter tail and pure white hind feet, lacking the dark metatarsal mark of albipes (Yalden, et al., 1976). This species has an altitudinal range, which considerably overlaps that of *P. albipes.* In this study, this situation is not observed. *M. natalensis* is less common than *Acomys cahirinus* and *Arvicantis dembeensis* in the study site.

P. albipes in the study site is highly restricted, as it was captured from riverine forests only. My data do not support the conclusion by Timmins and Duckworth (1992), that it is

dominant species of lowland and has wide distribution. This species can be distinguished from *M. natalensis* by its long tail. Because of its pure and white hind feet the species is known as white-footed rat. This is the common rat of the Ethiopian plateaux at altitudes of about 1500 - 3300m a.s.l. This species has previously been collected from Mirab Abaya, which is located on the western part of the present study area Dorst, (1972). That was the only reliable record from lower altitudes. In the present study, it is only found in the riverine forest parts of the area

Rattus rattus was captured from peasants' residential places while feeding on stored grain. It is notorious in destroying a wide range of food, cloth and other items. This rat was not found in captures collected from traps placed in different vegetation types. There was no other species of wild rodent that was captured from the spots where the black rat was caught. This species differs from the native *praomys* by its harshest fur. *Rattus* rattus is best distinguished from *R. norvegicus* by its longer tail. Beadles and Ingersol (1968), cited in Yalden, et al., (1976) showed that *R. rattus* was previously recorded from Damota valley, which is located on the northern part of the present study area.

The rodent fauna of the Abaya- Hamassa natural vegetation area form the prey base to many avian predators. Rodents in general are highly vulnerable to predators, particularly birds as observed in the study area. They cannot afford an extended stay in exposed habitats, as the birds will pick them up; consequently their survival is highly dependent on the presence of shelter. In addition, well-covered habitat, provide them with good nesting sites. There were no data regarding mammalian predators. No poaching was observed in the study area. Two species of bats were captured by hand around houses. In addition, one shrew was recorded.

4.2 Large mammal distribution and abundance

Abaya-Hamassa area has never been noted for its populations of large mammals. In this study, ground based survey of large mammal population disclosed the presence a few species. Constraints of accessibility to different parts of the study area means that in practice the surveys are biased in various ways. Spatial bias exists in that the central and peripheral parts of the area are the most intensively surveyed. This is associated with the road network. There are also observation biases caused by the varying visibility in different vegetation types at different period of the survey.

On-foot surveys are the only alternative for recording animals away from the main roads and gathering indirect information about the mammals. But on-foot surveys are reducing relative opportunity to observe animals. The mammals were less frequently observed in southeastern and northern part of the study area. This is most likely due to a high level of human activities.

Unfortunately, large mammal abundance was lower than the expected since the area is close to Nechi-Sar National Park. But it is difficult to discuss the population trend of mammals in the study area, since there has not been any study made before.
Three species of primates were observed in relatively large numbers. Greater kudus warthogs and hippopotamus were the largest artiodactyls found. There were also medium sized ungulates such as common bushbuck, duikers, lesser kudus and dikdiks. Large carnivores including lion and spotted hyenas are well represented in the study area. Smaller species comprise black-backed jackals, large spotted genet, serval, Egyptian mongoose, white tailed mongoose and stripped ground squirrel. According to my observations, white tailed mongoose is one of the most common of small carnivore species. In their study of natural conditions and regional features of the mammalian fauna in Ethiopia, Sokolov et al., (1997), showed that this species are widely distributed in Ethiopia. Some of these carnivores are rare.

The relative abundance of mammals is naturally associated with preference towards a given habitat. This depends on what the habitat provides in terms of food, breeding sites, shelter and free space. However, tolerance for these needs is different among different groups of animals. Small mammals, for example, give priority to cover than food. Usually they avoid predators by hiding or else, if spotted there is little chance to escape. On the other hand, large mammals emphasize on the importance of food in their habitat. Most of them run to avoid predators rather than hide. They can use any standing tree or some behavioral strategies to avoid sun during the very hot hours of the day.

Generally, the vegetation communities are of scrubland, riverine forest, woodland and thickets. It was observed that large numbers of mammals are found in the areas with open grassland habitat. This shows diurnal large ungulates prefer open grassland, less disturbed and with tall trees for refuges near the open grassland. Bush lands seem important for most species, scrub land least and the riverine forest and woodland have an intermediate number of species. The concentration of animals on bush land/thicket may be attributed to the availability of grasses, and water from the Hamassa river, which crosses the study area. All commonly encountered species were frequent in single habitat. Some species of mammals had narrow habitat choice.

The most threatened of the study area habitats is unquestionably the scrubland, which is being rapidly cleared for firewood and charcoal. After it is depleted, the pressure will probably move onto the riverine forest and bush lands unless a solution is found to this pressing problem.

During the dry season, the grass in most parts of the study area is dry and unpalatable. The herbivores thus tend to concentrate around the points where grazing is adequate. As a result, they shift to the woodland and riverine forest in Hamassa valley, as these areas provide excellent shade and other food items. Due to their high water requirements, animals including greater kudu, lesser kudu and bushbuck spend dry season in the vicinity of permanent water as vegetation actively grows in the area during the dry season. During the rainy season, food is abundant everywhere. As a result, the animals are well dispersed in the study area during this period. However, more mammals were

observed during the dry season than wet season. The longer vegetation cover in the wet season made observation difficult. Due to the more open nature of vegetation in the dry season as well as the concentration of the animals in limited areas the visibility of mammals from a distance is made possible.

The general daily pattern of mammals was characterized by morning and late afternoon activity with a period of rest in the middle of the day. Usually, around the middle of the day diurnal mammals remain resting or lying down under tree shades to escape the intense heat of the day.

4.2.1. Major Threats to large Mammals

Wild large mammal populations throughout Ethiopia have undergone a serious decline in numbers mainly due to habitat destruction and competition from livestock.

4.2.2. Habitat Destruction

Habitat destruction or alteration of the ecosystem as a result of unscientific agricultural practices and forest exploitation. Wildlife habitat destruction is not only manifested by expanding and shifting cultivation, but also by deliberate deforestation for firewood, building, and charcoal.

In the present study area, exploitation of forests for building, firewood and charcoal, is generally wasteful and destructive. Firewood collection, cutting wood for charcoal and building, and overgrazing have impact on the survival of wild animals in the area that use the habitat for shelter and food. The number of livestock in the area was greater than any time of the past (Personal communication). High livestock population has damaged the area, especially at the central part of the study area.

Permanently settled farmer's associations and scattered temporary pastoralists were there in the study area. The people around the study area depend heavily on wood collected locally for their fuel and construction needs. The forests along Hamassa River are being cleared. Most charcoal makers were 'immigrants' to the area. They are selling charcoal for drivers coming from Arba-Minch to Soddo and Addis Ababa to provide or supplement their income. With increasing human pressure in and around the study area, human-wildlife interactions are becoming more dangerous to the wildlife.

4.2.3 Wildlife-Livestock Interactions

The pace of wildlife habitat destruction and species extinction has increased worldwide. During the last 400 years nearly 500 described animal species mostly vertebrates have become extinct (WCMC, 1992). The populations of large mammals are continuously declining in numbers due to the shrinkage of their natural habitats (Fryxell and Sinclair, 1988).

Competition for resources such as grazing area and water is another major concern of pastoralists especially where the aim is to maximize returns from livestock in terms of protein production, and herd size. Wild animals are seen as direct competitors for resources.

Conservationists argue that livestock tends to displace wildlife from grazing areas and convert habitat into less productive and less biologically diverse states. Boyd et al., (1999) deny this: Livestock and wildlife exploit different (but overlapping) ecological niches in time and space and have evolved different physiological and behavioral strategies to reduce competition. The present study area is less productive for rain-fed agriculture and wildlife is arguably better adapted to semi-arid conditions than livestock, which is more dependent on water and susceptible to trypanosomiasis.

Although human population is low in the study area, there are large herds of cattle and some parts appear to be overgrazed. In general, however, the pressure from cattle is

nowhere near as great as around the northern part of Lake Abaya. The wild ungulates probably suffer from disturbance by man and domestic stock rather than from direct competition for grazing.

Wild mammals cannot carry their normal daily activities or rear their young in the presence of constant human disturbance. Under such circumstances, animals are forced to shift to alternate areas, decreasing the effective size of the area in which they can live.

4.3 Does Abaya-Hamassa Area deserve protection?

A. Benefits to the local community

Protected areas can benefit local communities in many ways (IUCN/UNEP, 1986b),

1. Promotion of Tourism

The potential for tourism is the most important economic argument for conserving Abaya-Hamassa area (Fig 18). The reddish brown colored Abaya Lake and relatively diverse wildlife are the main features to attract tourists.

Ethiopia has enormous potential for wildlife tourism and the studied area could be the first to benefit as it already has a good road, is closer to both Soddo and Arba-Minch towns, and has relatively rich and varied wildlife resources.

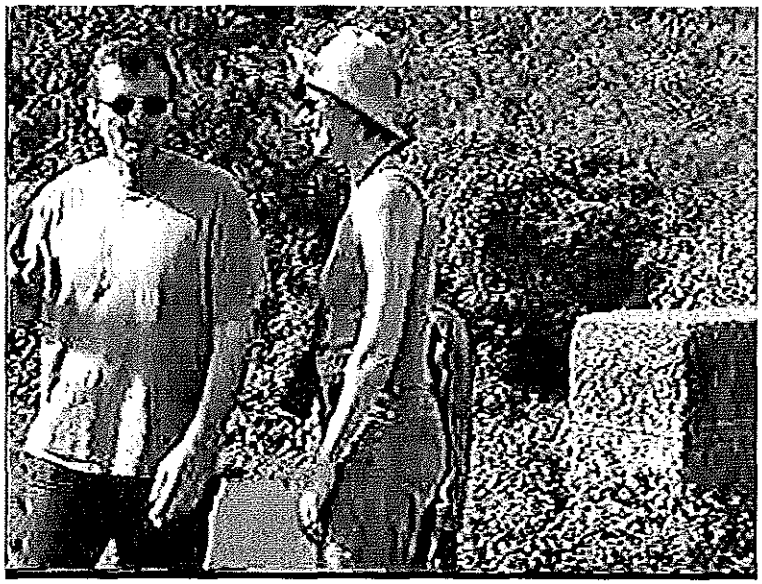


Figure 18: Some of visitors to the study area

2. Creation of employment opportunities

Development of Abaya –Hamassa area as tourist attraction would create jobs for individuals in the area. In addition, development of tourism in the area does help the growth of the areas nearby.

3. Provision of education facilities

Lake Abaya area is a valuable site for School classes, Institutes and University students to gain practical experience in the field of biology, geology and geography. This area is an ideal site for research on the best use of dry land environment.

B. Protection of wildlife

Ethiopia began its wildlife conservation programme in 1965, with the establishment of a chartered wildlife conservation organization now part of the Ministry of Agriculture. Hamassa River Valley, Lake Abaya shores, Ridges and Thickets contain large communities of fauna and flora. Around 70 species of birds, 25 large and 8 species of small mammals were recoded by this survey in the area. Many of these would be lost to the region if the habitat destruction continues.

5. Conclusions and Recommendation

The mammalian fauna in the studied area are documented to provide baseline information to which future conservation efforts can refer. The data generated by this study provide essential baseline information on the species present. Here I documented types of mammals in different vegetation types of the study area. This is the first ecological research ever conducted in the Abaya-Hamassa area.

Although numbers of mammalian species are not great, the area contains important populations of small rodents, herbivores and carnivores species of large mammals such as common bushbuck, greater kudu, lesser kudu, lion and hyena.

Visitors to Abaya Lake region can be reasonably sure of seeing primates, ungulates and some carnivores. Many of the mammals in the study area were found in certain vegetation types more often than on others. For example, hippopotamus was found near the waters; duickers, bushbuck and greater kudus in the woods. This finding confirms the well-established knowledge about preference of African ungulates (Estes, 1991). Findings from this study suggest that most mammals are concentrated in the bush land. There were no obvious movements of mammals to open areas in the wet season while some mammals made minor movements between scrubland and wooded habitats during the course of the day.

In the study area, livestock may compete with wildlife for both water and forage. Although pressure by domestic animals and humans are increasingly rapid, the many wild mammalian species still live in the area. The future of the mammals of the region would be assured if habitat destruction and overgrazing could be brought under proper control.

Most of the land in question is quite unsuitable for agriculture and it should not be difficult to convince local authorities that conservation of wildlife in this case is the wisest form of land use in the area.

Recommendations

The present study provides baseline information about mammals of Abaya-Hamassa area. Public enlightenment programme should be carried out to increase the awareness of the people so that they stop their illegal activities and work in conjunction with zonal and wereda authorities.

Every effort should be made to manage pastoralists living within the proposed area and grazing the domestic animals within the area should be prohibited.

The involvement of rural people in taking joint responsibilities for sustainable management of wildlife and other natural resources in their vicinities or close to which they live and to share in the direct and in-direct benefits of its management.

The track, which departs from main road and to Abaya Lake, will have to be improved and other tracks or roads must be built. Judging from the abundance of wildlife and the beautiful scenery of the area, I recommend that Abaya-Hamassa area be declared as a game reserve or as a wildlife reserve.

In addition, the following studies should be carried out to properly manage the animal and plant life of the area.

a. Habitat utilization of large ungulates
b. The population status of duickers
c. The population dynamics of small rodents, especially that of *A. cahirinus*

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Appendix 1.

Lists of Bird identified during the study period

No	Common names	Species name
1	Ring necked Dove	*Streptopelia capicola*
2	Red-eyed Dove	*Streptopelia semitorquata*
3	Namaqua Dove	*Oena Capensis*
4	Speckled pigeon	*Colomba guinea*
5	Superb starling	*spreo superbus*
6	Bule-eared Glossy starling	*Lamprotornis chalybavs*
7	Red-wing starling	*Onychognathos morio*
8	Red Cheeked cordon Bleu	*Uraeginthus bengalus*
9	Pied Crown	*Corvus albus*
10	Dwarf Raven	*Corvus edithae*
11	Speckled Mousebird	*Colius striatos*
12	African Hoope	*Upopa epops africanus*
13	White-Browned coucal	*Centropus soperciliosus*
14	Grey Hornbill	*Tockus nasutus*
15	Von Der Deckenis Hornill	*Tockus deveni*
16	Yellow-Billed Hornbill	*Tockus flavirostris*
17	Hemprich's Hornbill	*Tockus hemprichii*
18	Abyssinian Ground Hornbill	*Bicorovos abyssinicus*
19	Drongo	*Dicrurus adsimilis*
20	Yellow-Billed oxpecker	*Buphagus africanus*
21	Crested Francolin	*Francolinus Sephaena*
22	Hildebrandt's Francolin	*Francolinus icterorhynchus*
23	Helmeted Guineafowl	*Nomida meleagris*
24	Egyptian Goose	*Alopochen algyptiaca*
25	African fish eagle	*Haliaeetos vocifer*
26	Long crested eagle	*Lophaetus occipitalis*
27	Black kite	*Milvos migrans*
28	Black-breasted glossy starling	*Lamprotornis purpureus*
29	Goliath Heron	*Ardea cinerea*
30	Hamerkop	*Scopus umbretta*
31	Cattle egret	*Ardecla ibis*
32	Great white egret	*Egretta alba*
33	Dwarf Bittern	*Ardeirallus sturmii*
34	Giant kingfisher	*Ceryle maxima*
35	Rufous crowned Roller	*Coracias naevia*
36	Abyssinian Roller	*Coraciaws Abyssinia*
37	Brown parrot	*Poicephalus meyeri*
38	Orange-Bellied parrot	*Poicephalus rufiventris*
39	Chestnut-Bellied sandgrouse	*Pterocles exostus*

No	Common names	Species name
40	Curly-crested Helmet Shrike	*Prionops cristata*
41	White-crowned shrike	*Eurocephalus roppelli*
42	White-browed sparrow weaver	*Plocepasser mahali*
43	White-Bellied go away-bind	*Corythaixoides leucogaster*
44	Spur-winged plover	*Vanellus spinosus*
45	Crowned plover	*Vanellus coronatus*
46	Saddle bill stork	*Ephippiar hynchus senegalensis*
47	Glossy Ibis	*Plegadis falcinellus*
48	Yellow-Billed stork	*Ibis ibis*
49	Hadada Ibis	*Hagedashia hagedash*
50	Blue-breasted kingfisher	*Halecyon malimbicus*
51	Africa pied wagtail	*Motacilla aguimp*
52	Bateleur	*Terathopius ecaudatus*
53	Bearded woodpecker	*Thripias namaquus*
54	Paradise flycatcher	*Terpsiphone viridis*
55	Yellow necked spurfowl	*Francolinus leucoscepus*
56	Harlequ in Quail	*Contunrnix delegorguei*
57	Carmine bee-eater	*Merops nubicus*
58	African Scimitarbill	*Phoeniculus cyanonelas*
59	Red-billed Hornbill	*Tockrs erythrochynchus*
60	Standard winged nightjar	*Macrodipteryx vexillarius*
61	Red-fronted Tinker bird	*Pogoniulus leucomystax*
62	Buff-spotted woodpecker	*Campethera nivosa*
63	Scarlet-tufted malachite sunbird	*Nectarinia Johnstoni*
64	Blue capped cordon-bleu	*Uraeginthus cyanocephalus*
65	Masked Weaver	*Ploceus intermedius*
66	Vitelline Masked weaver	*Ploceus velatus*
67	White-Headed buffalo weaver	*Dinemellia dinemelli*
68	Grey Heron	*Ardea cinera*
69	Wattled plover	*Vanellus Senegallus*
70	Nubian Vulture	*Torgos tracheliouts*

Appendix 2. **List of reptiles**

Common name	Scientific name
1.Nile crocodile	*Crocodilus niloticus*
2.Monitor lizard	*Varanus niloticus*
3.Tortoise	*Terrapene Carolina*
4.Puffadder	*Bitis arietans*
5.Spitting cobra	*Naja nigricollis*
6.python	*Python sebae*

Appendix 3

Vegetation Date Collected from Abaya-Hamassa-Southern Ethiopia, Wolayta

No	Scientific Name	Family	Habit	Vernacular Name
1	*Abrus Precatorius L.*	Fabaceae	Woody climber	
2	*Abutilon bidentatum (Hochst) A. Rich*	Malvaceae	Woody herb	
3	*A. figarianum Webb.*	Malvaceae	Herb	Arikyaa
4	*A. graveolens (Roxb.ex Hernem) Wight & Arn*	Malvaceae	Herb	
5	*Acacia brevispica Harms.*	Febaceae	Shrub/tree	Worxxafiya
6	*A dolichocephala Harms.*	Fabaceae	Shrub/tree	
7	*A. drepanolobium Harms. ex Sj*stedt*	Fabaceae	Shrub/small tree	
8	*A. hockii Del. Willd*	Fabaceae	Shrub/tree	Mulishaqiyaa
9	*A. mellifera (Cahl.) Both.*	Fabaceae	Shrub/tree	
10	*A.nilotica (L.) Willd ex Del.*	Fabaceae	Tree	Guugnttaa.
11	*A. senegal (L.) Willd.*	Fabaceae	Tree	Wangayyiya.
12	*A.Seyal Del.*	Febaceae	Tree	Puleesaa
13	*A. tortilis (Forssl) Hayne*	Fabaceae	Tree	Xorqqaa
14	*Acalypha ciliata Forssk*	Euphorbiaceae	Shrub	
15	*A.fruticosa Forssk*	Euphorbiaceae	Shrub	Shatinttaa
16	*A.racemosa Baill*	Euphorbiaceae	Herb/shrub	
17	*Acokanthera schimperi (A.DC.) Schweinf.*	Apocynaceae	Shrub/tree	Yiishnchaa
18	*Actinopteris semiflabellata Pic - Serm*	Actinopteridaceae	Herb	
19	*Agratum conyzoides L.*	Asteraceae	Herb	Zee'isaa
20	*Allophylus rubifolius (A. Rich) Engl.*	Sapindaceae	Shrub	
21	*Aloe gibertii Sebsebe & Brandham*	Aloaceae	Succulent shrub	Godare'uuttaa
22	**Alternanthera pungens Kunth**	Amaranthaceae	Herb	
23	*Amaranthus caudatus L.*	Amaranthaceae	Herb	Gaggabisaa
24	*A. graecizans L.*	Amaranthaceae	Herb	
25	*A. spinosus L.*	Amaranthaceae	Bushy herb	Paracumadhdhiya a
26	*A.viridis L.*	Amaranthaceae	Herb	
27	*Ampelocissus bombycica (Bak) Planch*	Vitaceae	Climber	
28	*Annonia Senegalenisis Pers.*	Annonaceae	Tree	
29	*Asparagus africanus Lam.*	Asparagaceae	Herb	
30	*A. falcatus L.*	Asparagaceae	Shrub	
31	*A. flagellaris (Kunth) Baker*	Asparagaceae	Shrub	
32	*A. racemosus Willd.*	Asparagaceae	Shrub	
33	*Asystasia ammophila Ensermu*	Acanthaceae	Herb	

No	Scientific Name	Family	Habit	Vernacular Name
34	*Balanites aegyptica (L.) Del.*	Balanitaceae	Shrub/tree	
35	*B. rotudifolia (Ven Tieghm) Blatter*	Balanitaceae	Shrub/tree	Doomayiyaa
36	*Baphia abyssinica Brummitt.*	Fabaceae	Tree	Gibbuwaa
37	*Barleria eranthemoides R. Br. ex C.B. Clarke*	Acanthaceae	Spiny shrub	
38	*B. parviflora R.Br. ex T. Anders*	Acanthaceae	Shrub	
39	*B.ventricosa Hochst, ex Nees*	Acanthaceae	Shrub	
40	*B. quadrispina Lindau*	Acanthaceae	Shrub	
41	*Bidens pilosa L.*	Asteraceae	Herb	Qaracochaa
42	*Blepharis moderaspatensis (L.) Roth*	Acanthaceae	Perennial herb	
43	*Boerhavia erecta L.*	Nyctaginaceae	Herb	
44	*Boswellia rivae Engl.*	Burseraceae	Tree	Woshilechcha
45	*Botheriochloa insculpta (Hochst. ex A. Rich) A. Comus.*	Poaceae	Herb	
46	*Brachiaria eruciformis (J. Smith) Griseb*	Poaceae	Annual	
47	*Bridelia micrantha (Hochst) Baill*	Euphorbianceae	Shrub	
48	*Cadaba farinosa Forssk.*	Capparidaceae	Shrub	Deeshshafila
49	*Calpurnia aurea (Ait.) Benth*	Fabaceae	Shrub/small tree	Maylluwa
50	*C. pseudosetiflorum Bridson*	Rubiaceae	Shrub	
51	*C.setiflorum Hiern*	Rubiaceae	Shrub	Shenderaa
52	*Capparis fascicularis DC.*	Capparidaceae	Shrub	Uguuggiyaa
53	*C.tomentosa Lam.*	Capparidaceae	Shrub	
54	*Cardia monoica Roxb.*	Boragnaceae	Tree	Eeraa
55	*Cardiospermum halicacabum L.*	Sapindaceae	Annual climber	
56	*Carduus leptacanthus fresen*	Asteraceae	Herb	
57	*Carissa spinarum L.*	Apocynaceae	Climber/shrub	Laadiyaa
58	**Centella asiatica (L.) Urban**	Apiaceae	Creeping herb	
59	*Chamaecrista mimosoides (L.)Greene*	Fabaceae	Shrub	
60	*Chenopodium ambrosi*ides L.*	Chenopodiaceae	Herb	
61	*C. opulifolium Scharader ex Koach and Ziz.*	Chenopodiaceae	Herb	
62	*C.Schimperianum Schult*	Chenopodiaceae	Shrub	
63	*Chloris gayana Kunth*	Poaceae	Grass	
64	*Chlorophytum zavattarii (Cufod) Nordal*	Anthericaceae	Herb	
65	*Cirsium vulgare (Sav) Ten*	Asteraceae	Herb	
66	*Cissus petiolata Hook.f.*	vitaceae	Climber/scrambler	
67	*C.quardrangularis L.*	Vitaceae	Succulent climber herb	
68	*C.rotundifolia (Forssk,)Vahl.*	Vitaceae	Climber	
69	*Cleome gynandra L.*	Capparidaceae	Herb	Gemeeduwaa
70	*Clitoria ternatea L.*	Fabaceae	Annual or	

No	Scientific Name	Family	Habit	Vernacular Name
			short lived perennial	
71	*Combretum collinum ssp. binderanum Fresen.*	Combretaceae	Tree	Qarcciituwa
72	*C.molle R.Br. ex G. don.*	Combretaceae	Tree	Sobbuwaa
73	*Commelina benghalensis L.*	Commelinacea	Herb	
74	*C.diffusa Burm.f.*	Commelinaceae	Herb	Dale'ishaa
75	C.erecta L.	Commelinaceae	Herb	Dale'ishaa
76	C.petersii Hassk	Commelinaceae	Herb	Dale'ishaa
77	Commiphora africana (A.Rich) Engl.	Burseraceae	Tree	Anisaa
78	*C.braceae Chiov.*	Burseraceae	Tree	Anisaa
79	*Commiphora habessinica (Derg) Engl.*	Burseraceae	Tree	Anisaa
80	*Commiphora Schimperi (Berg) Engle*	Burseraceae	Tree	Anisaa
81	*Corchorus olitorius L.*	Tiliaceae	Herb	Mulikkayiyaa
82	*Crossandra nilotica Oliv.*	Acanthaceae	Shrub	
83	*Coincana L.*	Fabaceaee	Annual or short lived perennial	
84	*C.omcama L.*	Fabaceae	Shrub	
85	*C. laburnifolia L.*	Fabaceae	Shrub	
86	*C. pallida Ait*	Fabaceae	Herb/shrub	
87	*C. oyenostachya Benth.*	Favaceae	Annual/Perennial	
88	**C.spinosa Hochst. Ex Benth**	Favaceae	Annual/Perennial	
89	*Croton zambesicus Muell. Arg.*	Euphorbiaceae	Shrub/tree	Baallibadiya
90	*Cucumis prophetarum L.*	Cueurbitaceae	Herb	
91	*Cyathula cylindruca Moq*	Amaranthaceae	Shrub	
92	*C.orthacantha (Aschers.) Schinz*	Amaranthaceae	Shrub	
93	*Cymbopogon excavatus (Hochst) Stapf.*	Poaceae	Grass	
94	*Cynanchum altiscundens K.Schum*	Asclepiadaceae	Climber/herb	
95	*Cylndon dactylon (L.) Pers*	Poaceae	Perennial	Suraa
96	*Cyperus alopecuroides Rottb.*	Cyperaceae		
97	*C.articulatus L.*	Cyperaceae	Annual herb	Bedaariyaa
98	*C.assimilis Stewd.*	Cyperaceae	Annual	
99	*C.distans L.f.*	Cyperaceae	Annual herb	
100	*C. dubius Roth. Ssp. Marocephalus (C.B.Clarke) Lye*	Cyperuceae	Annual herb	
101	*C.fischerianus A. Rich*	Cyperaceae	Perennial	
102	*C. haspon L.*	Cyperaceae	Herb	
103	*C.nutans Vahl.*	Cyperaceae	Annual herb	Ceeccaa
104	*C. rotundus L.*	Cyperaceae	Herb	Xettaa
105	*Cyphostemma adenocaule (Steudy A. Rich)*	Vitaceae	Climber/scra	

No	Scientific Name	Family	Habit	Vernacular Name
	Descoings ex Wild & Drummond		mbler	
106	*Datura stramonium L.*	Solanaceae	Herb	Machchaara
107	*Desnidium repandum (Vahl.) Dc.*	Fabaceae	Climber	
108	*Dicrocephala chrysanthemifolia (Bl.) DC.*	Asteraceae	Shrub/herb	
109	*Dichrostachys cinerea (L.) Wight & Am.*	Fabaceae	Shrub/small Tree	Gargaruwaa
110	*Digitaria velutina (Forssk)P. Beav.*	Poaceae	Grass	
111	*E.haploclada (Stapf) Stapf.*	Poaceae	Perennial	
112	*E.Pyamidalis (Lam.) Hitche & Chase*	Poaceae	Perennial	
113	*Ehreita cymosa Thohn*	Boraginaceae	Tree	
114	*Elaeodendron Buchananii (Loes) Loes*	Celastraceae	Shrub/tree	
115	*Eleusine indica (L.)Gaertn.*	Poaceae	Annual	Axiixiyaa
116	*Endostemon tereticaulis (Poir.) M. Ashby*	Lamiaceae	Shrub	
117	Enteropogon macrostachyus (Hochst.ex A. Rich) Benth	Poaceae	Grass	
118	*Eragrostis aspera (Jaq) Nees*	Poaceae	Annual herb	
119	E.cilianensis (All.) Vign. Ex Janchen	Poaceae	Annual herb	
120	*Erianthemum dregei (Eckl. And zeyl.) Tieghem.*	Loranthaceae	Parasitic shrub	Bawiyaa
121	*Eriochloa fatmensis (Hochst & Steud.) Clayton.*	Poaceae	Grass	
122	*Eriasema psoraleoides (Lam.) G. Don*	Febaceae	Shrub	
123	*Erythrina abyssinica Lam. Ex DC.*	Fabaceae	Tree	Bortuw
124	*Euclea divinorum Hiern*	Ebenaceae	Shrub/small tree	Megara
125	*Euphorbia kibwezensis Pax*	Euphorbiaceae	Tree	Akkirsa
126	*E. polyacantha Boiss*	Euphorbiaceae	Shrub	
127	*E. schimperiana Scheele*	Euphorbiaceae	Sub shrubby	Tontoloshiya
128	*E. tirucalli L.*	Euphorbiaceae	Tree	Maaxxuwaa
129	*Ficus exasperata Vahl.*	Moraceae	Tree	Wolaa
130	*F. ingens (Miq.) Miq*	Moraceae	Tree	
131	*F. sycomorus L.*	Moraceae	Tree	
132	*F. thonningii Blume*	Moraceae	Tree	
133	*F. vasta forssk*	Moraceae	Tree	
134	**Fimbristylis bisumbellata (Forssk.) Bub**	Cyperaceae	Annual	
135	*Flacourtia indica (Burm.f.) Merr*	Flacourtiaceae	Shrub/tree	Haglaa
136	*Flaveria trinervia (Spreng) C. Mohr*	Asteraceae	Shrub	
137	*Flueggea virosa (Lilld,) Voigt*	Euphorblaceae	Shrub/small tree	
138	*Galinsoga parviflora Cav.*	Asteraceae	Herb	Biziddiya
139	*Gardenia ternifolia Schum, & Thonn*	Rubiaceae	Shrub	
140	*Glycine wightii (Wight & Arm.) Verdc. Ssp*	Fabaceae	Climber herb	

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	wightii			
141	*Gomphocarpus fruicosus (L.) Ait. f.*	Asclepiadaceae	Shrubby herb	
142	*G. integer (N.E. Br.) Bullock*	Asclepiadaceae	Herb	
143	*G. [urpurascens A. Rich*	Asclepiadaceae	Herb	
144	*Gomphrena celosioides Mart.*	Amaranthaceae	Herb	
145	*Grewia bicolor Juss*	Tiliaceae	Shrub/tree	Xawayyiyaa
146	*G. Erythraea Schweinf.*	Tiliaceae	Shrub	
147	*G. ferruginea Hochst. Ex A. Rich.*	Tiliaceae	Shrub	
148	*G.flavescens Juss*	Tiliaceae	Climbing Shrub	
149	*G.tembensis fresen*	Tiliaceae	Shrub	
150	*G.tenax (Forssk) Fiori*	Tiliaceae	Shrub	
151	*G. trichocarpa Hochst. Ex A. Rich*	Tiliaceae	Shrub\ tree	
152	*G.vekytuba (Forssk) Vahl.*	Tiliaceae	Shrub/Small tree	Allagashiyaa
153	*G.villosa Willd*	Tiliaceae	Shrub	Worqpuuttuwaa
154	*Guizotia gillettii*	Asteraceae	Herb	
155	*G. scabra (Vis.) Chiov.*	Asteraceae	Herb	Adel'eciishshaa
156	*Harrisonia abyssinic Oliv.*	Simaroubaceae	Shrub	Kanakasilettaa
157	*Helichrysum schimperi (Sch. B.p.ex A. Rich) Moeser*	Asteraceae	Herb	
158	*Heteropogon contortus (L.) Roem & Schult*	Poaceae	Perennial	Albbuwaa
159	*Hibiscus aponeurus Sprague and Hutch*	Malvaceae	Herb/shrub	
160	*H.cannabinas L.*	Malvaceae	Herb	
161	*H.dongolensis Del.*	Malvaceae	Herb/shrub	
162	*H.panduriformis Brum. F.*	Malvaceae	Herb	
163	*H.pyconostemon Hochr.*	Malvaceae	Herb	
164	*Hippocratea africana (Willd) Loes*	Celastraceae	Shrub	
165	*Hoslundia oppossita vahl.*	Lamiaceae	Shrub	
166	*Hygrophila schulli (Hamilt.) M.R. Almeid & S.M. Almeida.*	Acanthaceae	Herb	Para'aguntaa
167	*Hyparhenia rufa (Nees) Stapf.*	Poaceae	Annual/perennial	Mattosiyaa
168	*Indigofera schimperi Jaub & Spach*	Fabaceae	Shrubby perennial	Dandrettaa
169	*I. spicata Forssk.*	Fabaceae	Shrub	
170	*Ischaemum afrum (J.F.Gmel.) Dandy*	Ooaceae	Grass	
171	*Jasminum floribundum R.Br. ex Fresen*	Oleaceae	Woody climber	
172	*J. grandiflorum ssp floribundum L. (R. Br. Ex Fresen) P.S. Green*	Oleaceae	Climber/shrub	
173	*Justicia cufodontii (Fiori) Ensermu*	Acanthaceae	Herb	
174	*J. flava (Cahl) Vahl.*	Acanthaceae	Herb	

No	Scientific Name	Family	Habit	Vernacular Name
175	*J. ladonoides Lam.*	Acanthaceae	Annual herb	
176	*Kalanchoe glaucescens Britten*	Crassulaceae	Perennial herb	
177	*K. lanceolata (Forssk) Pers*	Crassulaceae	Herb	
178	*K.marmorata Bak.*	Crassulaceae	Perennial sub shrub	
179	*Kleinia squarrosa cufod.*	Asteraceae	Climber	
180	*Lecaniodiscus fraxinifolius Bak*	Sapindaceae	Tree	Olonchuwaa
181	*Lactuca inermis Forssk.*	Asteraceae	Herb	
182	*Laggera crispata (Cahl) Hepper & Wood.*	Asteraceae	Herb	Geleshshotambu waa
183	*L. pterodonta (DC.) Oliv.*	**Asteraceae**	Herb	
184	*Leptochloa rupestris C.E. Hubb*	**Poaceae**	Herb/grass	
185	*Leucas glabrata (Cahl) Sm. In Rees.*	**Lamiaceae**	Shrub	
186	*Leucas martinicencis (Jacq) R.Br.*	**Lamiaceae**	Herb	Haregaabbula
187	*Ludwigia stolonifera (Fuill, & Perr) Raven*	**Onagraceae**	Herb	
188	*Lycopersicon (L.) Karst. esculentum*	**Solanaceae**	Herb	Pugguwaa
189	*Maerua angolensis DC.*	**Capparidaceae**	Shrub/tree	Ambilettaa
190	*M. triphylla A. Rich.*	**Capparidaceae**	Shrub/tree	Tambuwaa
191	*Mariscus macropus (Böck.) C.B. Clarke.*	**Cyperaceae**	Herb	
192	*Maytanus undata (Thunb.) Blakelock*	**Cekastraceae**	Shrub	
193	*M. arbutifolia (A. rich.) Wilezek*	**Cekastraceae**	Shrub/tree	
194	*Meineckia phyllonthoides Baill.*	**Euphorbiaceae**	Woody based herb/shrub	
195	*Melanthera abyssinica (Sch. Bip. Ex. A Rich.) Benth & Hook. F.*	**Asteraceae**	Herb	
196	*Mollugo nudicandis Lam*	**Molluginaceae**	Herb	
197	*Momordica friesiorum (Harms) C. Jeffrey*	**Cucurbitaceae**	Herb	
198	*M. pterocarpa H. ex A. Rich*	**Cucurbitaceae**	Climber herb	
199	*M. sessilifolia Cong.*	**Cueurbitaceae**	Herb	
200	*Monanthotaxis parvifolia (Oliv.) Verde.*	**Annonaceae**	Climber	
201	*Mystroxylon aethipicum (Thnb) Loes.*	**Celastraceae**	Shrub	
202	*Pchna inermis (Forssk) Schweinf, ex Penzing*	**Ochnaceae**	Shrub	
203	*Ocimum canum Sims*	**Lamiaceae**	Herb	Zitiituwaa
204	*O. urticifolium Roth*	**Lamiaceae**	Shrub	Gulluwaa
205	*Olea europaea L.*	**Oleaceae**	Tree	Wogaraa
206	*O.hochstetteri Bak.*	**Olacaceae**	Shrub/tree	Haattamaaxxuwa
207	*Oncoba spinosa Forssk.*	**Flacourtiaceae**	Shrub	
208	*Oncocalyx schimperi (A. Rich.) M. Gilbert*	**Lobranthaceae**	Parasitic shrub	Bawiyaa
209	*Opuntia ficus-indica (L.) Miller*	**Cactaceae**	Shrub/small tree	
210	*Osyris quadriparitita decn.*	**Santalaceae**	Shrub	Malixaanuwaa
211	*Oxygonum sinuatum (Mesin.) Dmmer*	**Polygonaceae**	Herb	Qum'aqum'uwaa

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212	*Ozoroa insignis Del.*	**Anacardiaceae**	Shrub/tree	
213	*O.pulcherrima (Schweinf.) R. & A. Fermandes*	**Anacrdiaceae**	Shrub/tree	Dachchiyaa
214	*Panicum maximum Jacq.*	**Poaceae**	Perennial	
215	*P.porphyrrhizos steud.*	**Poaceae**	Grass	
216	*P.repens L.*	**Poaceae**	Perennial	Garbaatiyaa
217	*Pappea capensis Eckl. & Zeyh.*	**Sapindaceae**	Tree	Ceecilliyaa
218	*Paspalum scrobiculatum L.*	**Poaceae**	Perennial	
219	*Pavetta gardeniifolia A. Rich.*	**Rubiaceae**	Shrub	
220	*Pavonia melhanioides Thulin*	**Malvaceae**	Perennial herb	
221	*P. propinqua Garcke*	**Malvaceae**	Shrub	
222	*Pellaea calomelanos (Sw.) Link*	**Pteridaceae**	Herb	
223	*Pennisetum clandestinum Chiov.*	**Poaceae**	Annual	gorxaa
224	*P. ramosum (Hochst) Schweinf*	**Poaceae**	Annual	
225	*P. trachyphyllum Pilg.*	**Poaceae**	Grass	
226	*Pentarrhinum insipidum E. Mey.*	**Asclepiadaceae**	Climber	
227	*Peristrophe paniculata (Forssk.) Brummitt*	**Acanthaceae**	Herb	
228	*Perotis patens Gand.*	**Poaceae**	Grass	
229	*Persicaria senegalensis (Meisn) Sojak*	**Polygonaceae**	Herb	
230	*Phyllanthus ovalifolius Forssk.*	**Euphorbiaceae**	Climber/shrub	
231	*P. sepialis Muell Arg*	**Euphorbiaceae**	Shrub	
232	*Piliostigma thonningii (Schumach.) Milne-Redh*	**Fabaceae**	Rarely shrub/tree	Qalqalluwa
233	*Plectranthus cylindraceus Hochst. ex Benth*	**Lamiaceae**	Herb	
234	*P. longipes Baker*	**Lamiaceae**	Herb	
235	*Plumbago zeylanica L.*	**Plumbaginaceae**	Herb	
236	*Polygonum plebeium R.Br.*	**Polygonaceae**	Herb	
237	*P. Senegalense Meisn.*	**Portulacaceae**	Herb	
238	*Portulaca oleracea L.*	**Portulacaceae**	Herb	
239		**Mavaceae**	Shrubby herb	Wusaawusuwaa
240	*Sida urens L.*	**Malvaceae**	Herb	
241	*Solanum glabratum Dunael*	**Solanaceae**	Shrub	
242	*S. incanum L.*	**Solanaceae**	Shrub	Buluwaa
243	*S.lanzae F. Lebrum and Stork*	**Solanaceae**	Shrub	Puxaa
244	*Sorghum arundinaceum (Desv.) Stapf.*	**Poaceae**	Annual	Eceremaldduuaa
245	*Sphaeranthus teetzii Oliv. & Hiern*	**Asteraceae**	Herb	Wobaxaa
246	*S. ukambensis Vatke & Hoffin*	**Asteraceae**	Herb	Geleshshotambuwa a
247	*Sporobolus consimilis Fresen.*	**Poaceae**	Annual herb	
248	*S. festivus Hochst. ex A. Rich.*	**Poaceae**	Grass	
249	*S. oplados (Trin.) Nees*	**Poaceae**	Grass	
250	*S. pyamidalis P. Beauv.*	**Poaceae**	Grass	
251	*Steganotaenia araliacea Hochst. ex A. Rich*	**Apiaceae**	Tree	Cirraaruwaa
252	*Strychnos mitis S. Moore.*	**Loganiaceae**	Tree	

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253	*Stylosanthes fruitcosa (Retz.) Alston*	**Fabaceae**	Herb	Kindiichuwaa
254	*Syzgium guineense (Wild) DC.*	**Myrataceae**	Tree	Ochchaa
255	*Tagetes minuta L.*	**Asteraceae**	Herb	Wontiqammaa
256	*Tamarindus indica L.*	**Fabaceae**	Tree	Koryaa
257	*Teclea nobilis Del.*	**Rutaceae**	Shrub	Laallaa
258	*Terminalia brownii Fresen*	**Combretaceae**	Tree	
259	*themeda triandra Forssk.*	**Poaceae**	Perennial	
260	*Tragia plukenetii A. Radcl-Smith*	**Euphorbiaceae**	Herb	Tintalashuwaa
261	*Tribulus terrestris L.*	**Zygophyllaceae**	Herb	
262	*Tricalysia niamniamensis Heirn*	**Rubiaceae**	Shrub	Woratukkiyaa
263	*Trichodesma zeylanicum (L.) r. Br.*	**Boragnaceae**	Herb	
264	*Triumfetta marcrophylla K. Schum.*	**Tiliaceae**	Shrub	
265	*T. rhomboidea Jacq.*	**Tiliaceae**	Herb	
266	*Vangueria apiculata K. Schum.*	**Rubiaceae**	Tree	
267	*Vernonia adoensis Sch. Bip. ex Walp.*	**Asteraceae**	Shrub	Kanahamakkaa
268	*Wissadula rostrata (Schummach & thonn.) Hook. f.*	**Malvaceae**	Perennial herb	
269	*Xanthium spinosum L.*	**Asteraceae**	Herb	
270	*X. strumarium L.*	**Asteraceae**	Herb	Dorsaqarccochaa
271	*Ximenia americana L.*	**Olacaceae**	Shrub/tree	Asittiyaa
272	*X. caffra Sond*	**Oleaceae**	Shrub	
273	*Zanthoxylum charybeum Engl.*	**Rutaceae**	Shrub	Atayiifiya
274	*Zaleya pentadra (L.) Jeffrey.*	**Aizoaceae**	Herb	
275	*Ziziphus manuritiana Lam.*	**Rhaminaceae**	Shrub/tree	Gaammogaadiyaa
276	*Z. mucronata Wild*	**Rhaminaceae**	Shrub/tree	Sesilettaa
277	*Z. spina christi (L.) Desf.*	**rhamnaceae**	Shrub	Gaammogaadiya