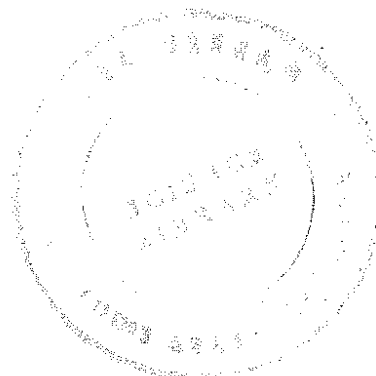


**DIVERSITY, DISTRIBUTION, RELATIVE ABUNDANCE, AND HABITAT
ASSOCIATION OF THE LARGER MAMMALIAN AND AVIAN FAUNA OF
ALATISH, ETHIOPIA.**

**THESIS SUBMITTED TO THE SCHOOL OF GRADGUATE STUDIES, ADDIS
ABAB UNIVERSTY, INPARTIAL FULFILLMENT FOR THE REQUIRMENT
OF THE DEGREE OF MASTER OF SCINCE IN BIOLOGY**

BY GIRMA MENGESHA



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Addis Ababa

ADDIS ABABA UNIVERSITY SCHOOL OF GRADUATE STUDIES

Diversity, Distribution, Relative Abundance and Habitat Association of the Larger Mammalian and Avian Fauna of Alatish, Ethiopia.

**By
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*A Thesis Presented to the School of Graduate Studies of the Addis Ababa
University in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Biology*

Approved by Examining Board:

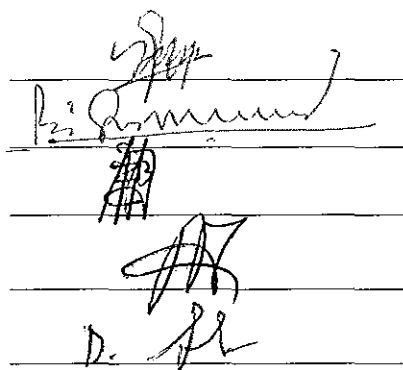
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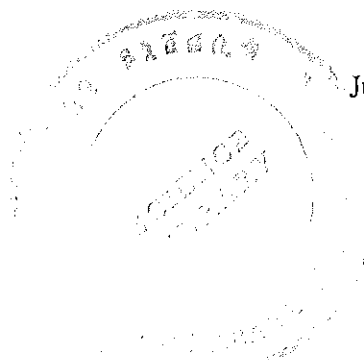
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ABSTRACT

Alatish contains various forms of larger mammalian and avian fauna. The diversity, distribution, relative abundance and habitat association of the larger mammals and birds were investigated during the wet and dry seasons in Alatish.

Based on topographic map, satellite image and preliminary survey, four habitat types were identified in Alatish comprising 37 blocks in 100 km². Eleven blocks were randomly selected based on the type of vegetation. Transect length of 10 km in 0.2 km width were randomly selected to cover 20% of the area. Twenty species of larger mammals and 143 species of birds were recorded. Riverine woodland habitat had the highest large mammalian species diversity both in the wet and dry seasons. The lowest diversity of species was obtained in the woodland habitat. Simpson's Similarity Index was used to analyze the similarity in distribution of larger mammals. Larger mammals showed similarity in their distribution in the four habitat types during the dry season. The relative abundance of large mammals and birds was determined using encounter rates that give ordinal scale. Species diversity of birds was the highest in the woodland habitat followed by bamboo woodland with the highest species evenness in distribution. The wet season survey showed highest species diversity in the wooded grassland habitat owing to the presence of food and water. The dry season survey showed the highest avian species diversity and evenness in the riverine woodland habitat with highest species richness and evenness due to the availability of water. Most of the bird species in Alatish were locally rare as a result of habitat degradation. It is difficult to establish species distribution because of habitat degradation. Availability of food, water and cover was observed to be the major factors determining the diversity of larger mammals and birds.

SPSS analysis showed that there was no significant difference in the use of habitat for larger mammals during the dry season. The dry and wet season data for birds showed high significant difference in the use of habitat implying their preference to certain types of habitat. The woodland habitat showed significance difference and positive association for birds. Habitat destruction by the Nomadic "Falata", and their livestock was severe in Alatish. Poaching and forest fire, also contributed to the destruction of the wildlife habitat. Globally endangered, vulnerable, and rare species such as *Alecephalus buselaphus tora*, *Laxadonta africana* and *Hippotragus equinus* were once abundant in Alatish. However, currently it was difficult to observe them in Alatish easily. Urgent conservation measures with appropriate management plan are needed to conserve the biological diversity and develop the potential wildlife area of Alatish.

1 INTRODUCTION

Ethiopia is endowed with diverse biological resources. According to Hedberg and Edwards (1989) and Stuart et al. (1990), more than 6,500 plants, 277 Mammals, 816 birds, 201 reptiles, 63 amphibians and 150 fishes are known to occur in Ethiopia. These varied biological resources are widely distributed in the different National Regional States of the Federal Democratic Republic of Ethiopia. One of these National Regional States is the Amhara National Regional State (ANRS).

The diversity of biological resources of the ANRS is a reflection of its unique geological history and diverse physical and climatic conditions.

The main geological and topographic features of Ethiopia in general and the ANRS in particular are a contrast between highland and lowland areas. This has great importance with respect to wildlife Conservation (Hillaman 1993; Amhara Region Conservation Strategy (ARCS), 1999).

The ANRS has two major river systems, Abay (Blue Nile), which originates from Lake Tana and flows to the south, and Tekeze, which rises in south Wello and flows to the north. These two rivers with their tributaries provide habitats for many species of fishes, mammals and water birds. As a result, the ANRS has been designated as one of the important bird areas (IBA) of Ethiopia comprising 75% of the central Ethiopian highland endemic bird areas (EWNHS; 1996). The ANRS is also known for its large mammalian fauna.

Unlike most invertebrates and birds that have the ability to exploit large number of ecological niches and become relatively more diverse, large mammals are less diversified. This is due to their larger size and their restriction to certain ecological niches (Vaughan, 1972). Moreover, larger mammals have larger lifespan, have larger body size, need more space to occupy, require more years to reach maturity than smaller ones. Modern mammals are part of the very complex interacting community where many organisms exist together. They are part of the previously more diverse survivors of the larger mammalian community (Kingdon, 1979). The remnant mammalian species are versatile with sufficient ecological plasticity to adapt to changes in their habitat.

The distribution of mammals occurs in two levels namely the geographic distribution of species and the local distribution of individuals. The distribution of a species represents the sum of the many local population and the distribution of a particular species (or group of populations). This is determined by climate, availability of suitable resource, barriers of dispersal and interspecific interaction with those organisms sharing the same area (Vaughan et al., 2000).

On the other hand, home ranges, territories and microhabitats are indicators of the distribution of individuals within an area of convenient habitats. These are governed by access to important resources such as food, living space and availability of mates. Furthermore, the boundaries of species range fluctuate depending on habitat changes, competition, predation, climatic changes, etc. (Smith, 1992). According to Smith (1992), animals are uniformly distributed as a result of some form of intraspecific competition such as territoriality. Some species of mammals use relatively larger ranges for survival and reproduction. Currently, however, the increase in human population has greatly reduced the previous ranges of animals and this has progressively led to the extinction of some of the mammalian and avian fauna. The effect of climate on mammalian and avian distribution is high when seasonal contrasts are violent, water becomes scarce, bush fire scorches wide regions and when the whole region appears to be without green growth that used to support animals (Kingdon, 1971). One of the indicators of richness of an area, in terms of biological resources is an abundance of predator species, which is the sign of ecological richness and diversity (Kingdon, 1977; Prickett, 1983; Sunquist and Sunquist, 1989). This is because each species that sits at the top of the different food chain belonging to different cycles of organic matters insures the existence of other animal communities for every predator. The carnivores depend on herbivores, which in turn depend on vegetation indicating the presence of interdependent groups of species.

Another important factor in mammalian distribution is vegetation. Vegetation is not only used as sources of food for animals, but also provides cover and protects them from harsh environmental conditions such as very high temperature. In spite of its advantage to the existence of living organisms, it is being destroyed continuously due to agricultural expansion, construction, and firewood.

The destruction of vegetation threatens species and leads to changes in ecological balance, loss of genetic diversity and extinction. Some of the species that are threatened

are important species because a number of other species depend for their survival, growth and reproduction. Some species of animals have also become, rare, as their distribution is restricted to certain localities. Those species that are globally threatened are key species for conservation. The number and diversity of species at a given site indicates the importance of habitat and change in the environment (WCMC, 1992; Jermy et al., 1995; Bibby et al., 1998).

Some of the larger mammalian and avian species that occur in the ANRS are threatened with extinction. Some of these species are listed in the IUCN Red Data Book. These include Walia Ibex (*Capra walia*), Ethiopian wolf (*Canis simensis*), Roan antelope (*Hippotragus equinus*), Tora hartebeest (*Alcelaphus buselaphus tora*), African Elephant (*Loxodonta africana*), Abyssinian long claw (*Macromys flavicollis*), Harwood's Francolin (*Francolinus harwoodi*) and wattled ibis (*Bostrychia carunculata*) (Urban, 1980; Murray, 1985; Nowak, 1991; EWNHS, 1996). Furthermore, some of the bird species occurring in ANRS constitute the Ethiopian highland biome restricted assemblage. Such species and their associated habitats warrant conservation so that their genetic diversities can be maintained.

Life on earth is the result of complex interactions between living organisms and the non-living physical environment (Bull, 1978). The loss of one or more species in the interaction breaks the complex interactions that exist in nature and results in loss of biological diversity. To prevent or minimize the loss of biodiversity in the region, conservation of biological resources is essential. Currently, the biodiversity of the ANRS is protected in only one National Park, the Simien Mountain National Park (SMNP). It was established as one of the nine national parks in Ethiopia. This Park has international significance due to its unique biodiversity; its endemic mammalian species including Walia Ibex (*Capra walia*), Ethiopian Wolf (*Canis simensis*) and Gelada baboon (*Theropithecus gelada*). The SMNP is also one of the important bird areas or Ethiopia consisting most of the endemics and some of the globally threatened species. Moreover, the SMNP offers what is probably the most spectacular mountain scenery in Africa. As a result, it has become a major tourist attraction site (Blower, 1969).

The lowland areas of the ANRS are also known to contain various forms of larger mammalian and avian species. One of such lowland areas in the region is Quara Woreda, North Gonder Zone of the ANRS. The southwestern part of Quara Woreda, commonly known as Alatish, is reported to harbour a few important species of

mammals and birds (BOT /RD/LUPT, 1997). However, due to lack of systematic studies in Alatish, the diversity, distribution and relative abundance of the large mammalian and avian fauna was very little known (Kefaylew Sime et al., 1996). Information from local community elders, regional experts and few preliminary surveys carried out in Alatish suggested the presence of large mammals such as Elephants, Buffaloes, Giraffes, Hartebeests, Lions, Leopards, Wild dogs, Rhinoceros, Elands, Roan antelopes and different species of birds and other forms of life.

The vegetation of Alatish area is known to act as a 'Green Guard' due to its function in protecting not only the region but also the whole country against desert expansion from the adjoining Sudan and Sahel region (Crabtree, 1997; ARCS, 1999). Hence, Alatish has a unique ecosystem with its conservation area and rich biodiversity.

Though the local human populations are currently sparsely populated around the proposed Alatish Park, there is an increasing demand to use the area for agricultural activities. One of the big problems in Alatish proposed National Park is the scarcity of water. During the dry season, habitat destruction by the Nigerian nomadic people (Falata) is immense. They use the Park for grazing large number of cattle. They migrate from the Sudan once a year during the dry season. The honey collectors burn the vegetation of the Park. The Gumuz people that live surrounding the northeastern part and the Agwo people that use Alatish to hang beehive are also big threats to the Park. Moreover, the Sudan (Arabs) and the Rubtana tribe from Eritrea use Alatish for grazing large number of sheep, goats and cattle during the dry season. This has resulted in the reduction in the number of wild animals in addition to poaching for trophies, meat and ivory. Logging important tree species that are evergreen, the *Balanites uegyptiaca* ("Lalo"), especially useful during the dry season, and serve as umbrella species, that supports large number of organisms was common in Alatish. The northern region of Alatish is also given to investors that grow oil producing plant sesame. These investors, in addition to using the surrounding large areas of the park for growing of crops, also use the Alatish region for grazing. Some of the local people also use the northern part of Alatish for cultivation. However, the main part of Alatish Park is relatively intact. The pressure from the surrounding area, however, is very great, as Arahs from the Sudan are also known to use the park for grazing and hunting. As a result of such pressure, larger mammals such as elephants, Roan antelope, Tora hartebeest and many avian species have migrated to the nearby Dinder Park and other undisturbed areas of the southern

and eastern Sudan. Although at present, Alatish is being proposed as a National Park, it used to be no one's property since it occurred at the remote part of the region without proper protection.

One of the problems in the conservation of biological diversity is lack of information on the relative importance of the habitat and ecosystem in terms of biological resources (WCMC, 1992). Since the earth's biological diversity and other natural resources provide economic, social, educational, cultural and aesthetic values to mankind, effective conservation Programme for sustainable development should be the order of the day. Due to the shortage of fund, conservationists are unable to assist all species that are under threat. As a result, at present the trend in conservation is to set priority. One way of doing this is identifying biodiversity hotspots based on areas richness as rare, endemic and endangered species and the extent of habitat loss. To qualify an area as hotspot, the degree of threat through habitat loss should be 70% or more of its primary vegetation (Myer et al., 2000). According to Cloudsely-Thompson (1969), the main factors accounting for the distribution and abundance of mammals is related to the nature of vegetation through food and cover it provides, the extent of habitat modification by large-mammals and fire caused by man. Water is another important factor that determines the distribution and abundance of species. Since biodiversity is not uniformly distributed in space and time, biodiversity rich habitats, mega-diversity areas, require more attention for conservation priority. Investigating biological diversity is the central them of ecological, systematic and evolutionary biology. Furthermore, it is absolutely critical to the emerging fields of conservation biology and resource management (Wilson et al., 1996). In order to develop the unique ecosystem and potential wildlife areas of Alatish for its ecological service, biological resource use, other non-consumptive utilization and maintenance of genetic diversity, it was necessary to conduct surveys. Consequently, identifying the diversity, distribution, relative abundance and habitat association of the mammalian and avian fauna is vital to demonstrate the importance of Alatish as a park. This will also serve in the preparation of management plan that would later be established as protected area.

The major aim of the present study is to identify the diversity, distribution, relative abundance and habitat association of the larger mammalian and avian fauna of the proposed Alatish National Park.

2. OBJECTIVES

2.1 General objectives: -

- To generate basic information on the diversity, distribution, relative abundance and habitat association of the larger mammalian and avian fauna of Alatish area.
- To contribute to sustainable development through conservation, management and sustainable utilization of the region's biological resources.

2.2 Specific objectives

The specific objectives are: -

- * To identify the larger mammalian and avian species of the proposed Alatish National Park (APNP)
- * To determine the distribution of larger mammalian and avian species.
- * To determine the relative abundance of the major larger mammalian and avian species.
- * To determine the rare, endemic (if any), endangered species of the larger mammalian and avian fauna of Alatish, and
- * To identify and describe the habitat of the major larger mammalian and avian fauna.

3. THE STUDY AREA

3.1. Location and size

The study area is located in the southwestern part of Quara Woreda, North Gonder Zone of the ANRS, northwest Ethiopia (Fig. 1). It has an area of 2,579.85 km², located at 1048 km northwest of Addis Ababa and 311 km from Gonder town between 11°48' - 12°26' latitude and 35°16'50" - 35°46' longitude. The Altitude of the area varies from 534 to 825 m.a.s.l. Mahadid where Gumz people live is found at the northeastern part of the study area. The Bermel valley separates Alatish from Mahadid and forms the northern boundary. Hayma River (also called Dinder River outside Ethiopia, the Gumuz people live along the river side at the opposite side of Alatish Park) makes the southern boundary. To the west, the Alimatani, and Amdog mountains of the Sudan Republic border the study area. The Omedla village (Kebele in Beneshangul Gumuz) is located at 11.4 km straight-line distance from Alimetani. To the north of Alimatani one finds a place known as Abinune. Zobator and Nigilla mountains form the eastern boundary of Alatish. In this side of the Park, Bambao kebele and its people border the eastern boundary of Alatish (Fig. 2).

3.2. Topography

The proposed park area is relatively flat with an altitude ranging from 534 m.a.s.l. in the plain to 835 m.a.s.l. in the escarpment of the southwest. Some of the small mountains that are sparsely distributed throughout the park area are Xiqua (785 m.a.s.l.) and Barenta (710 m.a.s.l.). There are two major rivers that are sources of water for Alatish wildlife and the area. The centre base is Alatish River that joins with Nigilla at a place called "Megenagna" and the Hyma (also known as Dinder). Alatish River is seasonal, but water can be obtained by digging. However, during the dry season, Hyma or Dinder Rivers are permanent. In addition to the two major rivers, seasonal water is available throughout the park during the wet season, but this drainage dries during the dry season.

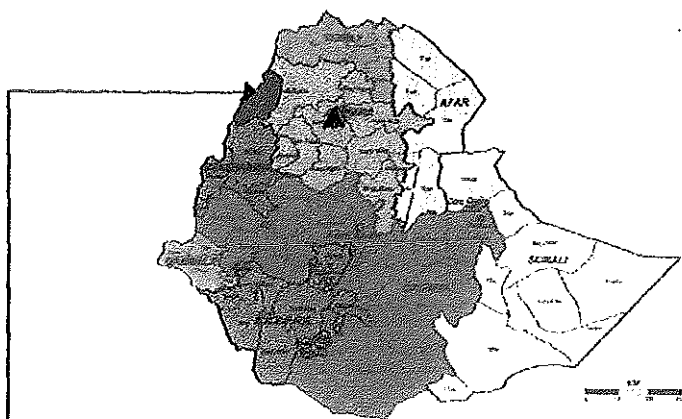


Figure 1. Map of Ethiopia showing the Amhara National State and Alatish Proposed National Park.

- ▲ Amhara Region
- Alatish Proposed National Park area

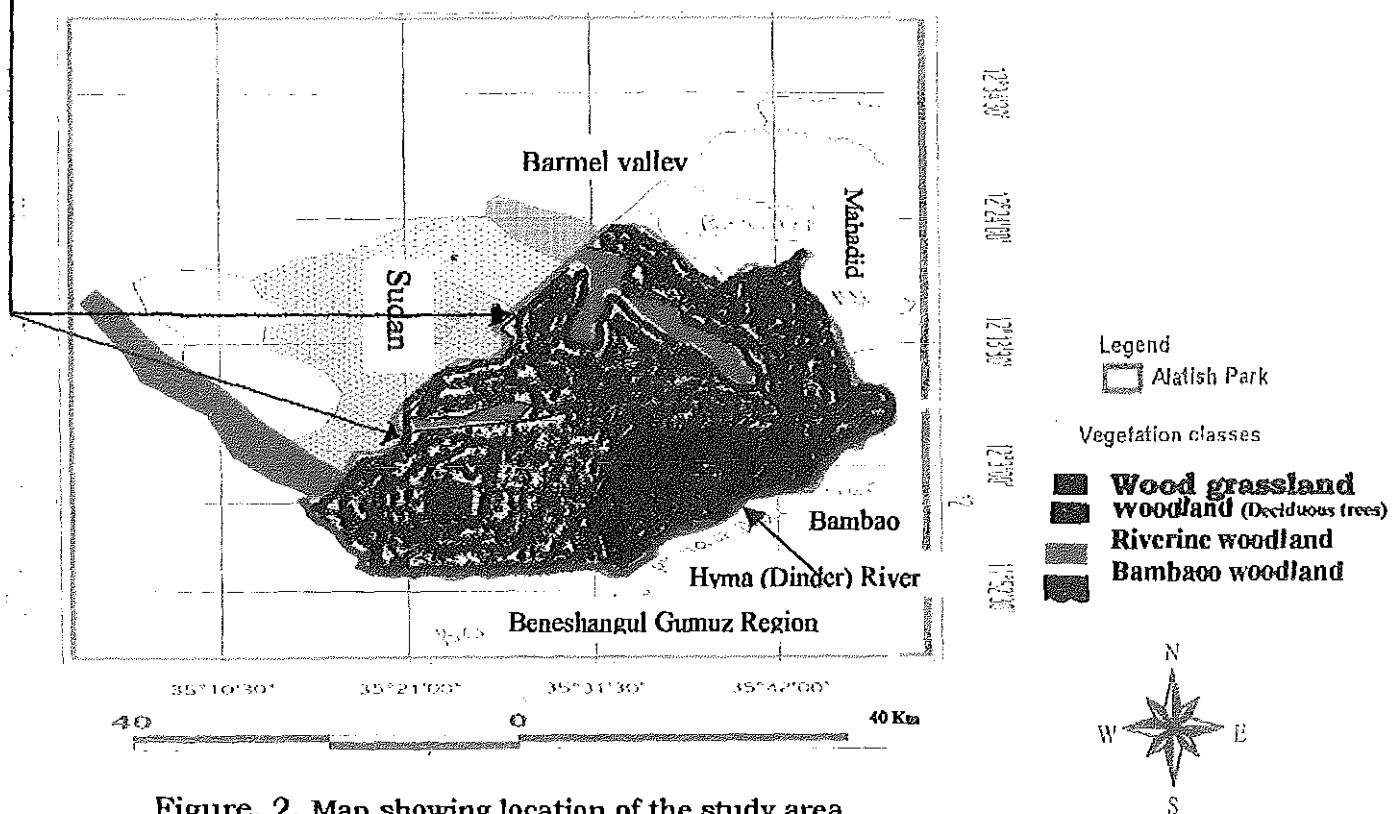


Figure. 2. Map showing location of the study area

3.3. Climate

Although climate is ultimately the most important factor that affects the distribution of animals, its effect is mostly indirect (Cloundselly-Thompson, 1969). However, the direct influence of climate on mammals is clearly observable when the seasonal variation is large, water is scarce, bush-fires scorch and where large area is without sprouting green vegetations that support mammals (Kingdon, 1977). Rainfall and temperature are the two important climatic elements that govern the nature of vegetation. Furthermore, climate plays a vital role in determining the distribution of vegetation and animals. The regional variation in the amount of rainfall in Ethiopia is determined by direct moisture bearing seasonal air current and elevation.

There is no record of climatic data in APNP but the weather record of Metema - Quara Woreda, which is similar to the APNP, is classified as type I rainfall region. This is characterized by one rainy season and one dry season. This region is, therefore, classified as Kola-agro ecological zone (Danil Gemechu, 1977; BOA /RD/LUPT, 1997; AFAP, 1999). There are five rainy months in the area extending from May to September. High concentration of rainfall record is in the Months of July to August. The mean annual rainfall for the past seven years was 941.3 mm and the mean monthly minimum and maximum temperature of the nearby station at Shedi (Metema) are 17.6⁰C. and 37⁰C, respectively (NMA, 2004).

3.4. People and settlement

According to the information from Quara Woreda Administration, the population of Quara reaches 65,285. The increase in population size in the region is reducing the available land resources. At the same time, the re-settlement programme is also going on in the region. This programme involves the shifting of large number of people the crowded area to unoccupied land found at the remote part of the region such as Quara Woreda where Alatish occurs. Moreover, near to Alatish area, arable lands have been allocated to investors, creating pressure on the wildlife resources.

3.5. Land use

Climatic conditions, topography and human settlement are the major factors that affect both the land use and the natural vegetation cover. As the ANRS is one of the early

settlement areas in Ethiopia, it has been subjected to long periods of agricultural activities. About 70% of the livestock exist as an important part of peasant mixed farming system in the highland where 90% of the population live and the remaining 30% of this livestock dwell on the lowland pastoral areas (ARCS, 1999). According to the Metema - Quara Woreda land use study, the area is divided into six-land capability classes based on productivity of land (RU/RD/LUT, 1997). Two of these -land areas are –as are potentially productive and can be suited for wide-range of cropping. According to LU/RD/LUPT (1997), the total area of Quara Woreda is 181345.89 ha, of this 36409.1 ha, is arable land and 35724.94 ha, non-arable land.

The Metema-Quara area as a whole has immense resources. In addition to its use as arable land, incense and gum collection, wildlife and livestock development are also very promising. The natural woodland vegetation cover serves as a suitable habitat for many species of birds and mammals. Quara Woreda, thus, can partly be developed for eco-tourism through the proper management of woodland vegetation and wild animals. The soils of Alatish area consist mostly of shallow soils and sand soils. The hilly areas are relatively not suitable for growing of crops. Thus, it would be good for the development of forest and wild animals.

3.6 Geology

According to BOA /RD/LUPT (1997), the study area is predominantly bounded by sediments including alluvium colluvium (Pleistocene- Holocene) undifferentiated as well as alkaline basalts (Ashangi: group). The earliest and most extensive group of volcanic rocks is trap series, erupted from fissures during the early and middle Tertiary. Ashangi group consists, predominantly alkaline basalts with inter-bedded pyroclastic and rare rhyolites erupted from fissures (BOA /RD/LUPT, 1997). Pleistocene - Holocene undifferentiated continental sediments including alluvium aelian deposit and alluvium are only locally differentiated into lacustrine deposit. The physical and chemical compositions of the soil have an effect on the occurrence and distribution of the vegetation of an area. Many plants are confined only to a certain type of soils (Ricklefs, 1990; Tesfaye Awas, 1997). The distribution of vegetation in turn affects the diversity, distribution and abundance of mammalian and avian fauna. Though the soil in APNP is yet to be studied, the soil of Metema-Quara Woreda that includes APNP consists of eutric vertisols, which is relatively potentially arable land. The woodland vegetation cover is eutric, lithic leptosols that occur extensively on hills, mountains.

broken lands, sloping valleys, and plateaux. Eutric regosoils occur in sloping landforms. Eutric fluvisols occur in valley bottoms and in nearly level alluvial plains (BOA /RD/LUPT, 1997).

3.7. Vegetation

The main factor that determines the distribution and abundance of mammalian and avian species is the nature of vegetation through food and cover it provides (Cloudsley-Thompson, 1969). The interaction of plants and animals had been ignored both by botanists and zoologists until recently (White, 1983). One of the reasons is that animals and habitat association is not perfectly correlated. This may be due to the fact that their range either transgresses the boundaries of vegetation types or when they are confined to one type of vegetation, they occupy only part of it. The natural woody vegetation of the ANRS comprises about 11.6% bush land, 19.9% scrubland, 4.2% woodland, 0.4% high forest and 0.3% h of bamboo forest (Yalden and Lagen, 1992; AFAP, 1999). The surviving stand of natural and semi-natural vegetation of northwestern Ethiopia bordering to the Sudan is the most extensive and it is characterized by various type of woodlands (White, 1983; Jensen et al., 2001). The vegetation in APNP is similar to the Sudanian region. It is mostly undifferentiated Sudainan and Ethiopian woodland type. It covers almost all the western part of the Ethiopian escarpment beginning from Eritrea in the north to Boma plateau, southwest Maji town and penetrates to the Ethiopian highlands. The major tree species of the undifferentiated woodland of Alataish consists of deciduous trees such as *Anogeissus leiocarpus* ("Kerikera"), *Combretum* spp. (Chamida) *Boswellia papyrifera* (Yexanzafe or walia), *Gardenia ternifolia* ("Yekola wanza"), *Lanea fruticosa* ("Fola"), *Pterocarpus lucens* (Charia) *Lonchocarpus laxiflora* ("Hamja"), *Piliostigma thomigi* ("Dwda"), *Terminalia laxiflorous* ("Wanbella") *Acacia seyal* (Grar) *Stereospermum kunthianum* ("Zanazana") *Sterculia setigera* and evergreen tree species such as *Balanites aegyptiaca* ("Lalo"). Most of the vegetation of the sudanian region lies below 1000 m.a.s.l. except some of the areas that support distinct highland species. The grass cover of such lowland areas is usually tall (up to 3 m.) and the dominant grass species of the APNP are *Hyparrhenia* spp, *Sorghum aur* and other *Sorghum* spp and *Pennisetum* spp. Some parts of the Sudanian region vegetation occur especially in the valleys of larger river and on the site of Pleistocene lakes. The most common vegetation is grassland and wooded grassland (White, 1983). The forest in the Sudanian region, like the Sudanian flora in general, is extremely poor. Thus, in the

northern half of the Sudanian region, the riparian forest is semi-deciduous but has frequently been degraded to riverine woodland. Similarly, except for the small amount of swamp woodland and riverine woodland, true forest in APNP is lacking.

The most frequent large trees along the riverside, which was formerly extensive but now remnant are *Diospyros mespiliformis* (Sarken), *Tamarindus indica* ("Kumer"), *Ficus glumosa* ("Warka"), *Ficus sycomorus* ("Shola"), *Acacia sieberana* and in rocky places, *Adina micncephala*. Transitional Sudanian woodland is also found in Alatish Park. These include *Diospyros mespiliformis* and the more conspicuous savanna trees like *Anogeissus leiocarpus*, *Borassus althiopum*, *Combretum molle*, *Kigelia athiopum*, *Piliostigma thonningi*, *Stereospermum kunthianum*, *Terminalia laxiflora*, and *Ziziphus spina christi*. Moreover, according to the draft report of the Management plan for Dinder National Park, broad-leaved tree species such as *Combretum hartmannianum*, *Terminalia browni*, *Boswellia papyrifera* and *Adansonia digitata* are represented in the riverine ecosystem. The draft report further classified the vegetation in the Sudan that includes the vegetation of Dinder National Park has *Acacia seyal* - *Balanites* alternating with grass area and *Anogeissus* - *Combretum hartmannium* savanna woodland zone. Dasmann (1972) classified the vegetation of Dinder National park, which is more or less similar to that of APNP into four categories: - wooded grassland, open grassland, woodland and riverine forest.

The understory of Alatish woodland area is composed of annual grasses (2-3m high). The grasses are intermingled with herbs, consisting of Compositae, Acanthaceae and Convolvulaceae. Sampling a unit of habitat is one approach to population estimates (Southwood and Henderson, 2000) where habitat is sampled together with animals it contains. Based on White (1983), Jensen et al. (2001); Webala et al. (2004), and personal observation during the study periods, the vegetation of the APNP is also generally classified into four: - 1) Riverine woodland since the forest is converted into woodland along the river banks 2) Wooded grassland where the cover of woody plants are between 10-40% of the surface, 3) Woodland where the cover of woody plants is at least 40% of the area, and 4) Bamboo woodland where the area is dominated by lowland bamboo (*Oxytenanthera abyssinica*).

An increase in human population as a result of the re-settlement and allocating of previously virgin lands surrounding Alatish area to investors will greatly increase pressure on the vegetation of APNP. Furthermore, the nomads called "Talatas" who

have used the area for grazing from generation to generation have used the vegetation extensively. The Gumuz and Agaw have also been using the Alatish Park vegetation but their effect was minimal compared to the current usage where, cattle from the local people and investors use the area for pastoral land. Since the type of vegetation in an area is one of the most important factors that determine the kind of species and number of species available in the area, protection of the vegetation is indispensable to maintain the area for wildlife conservation. Therefore, the vegetation of Alatish area should be maintained for its functions such as food, cover, keeping natural balance for the maintenance of larger mammalian and avian fauna of Alatish.

3.8. Livestock

According to the Metama-Quara land use study Quara Woreda has vast area of land for grazing. The incidence of trypanosomiasis that affects livestock is low in this lowland area. Large number of cattle, goats and sheep are kept in and the surrounding APNP. The major livestock raisers are "Falata" who regularly visit the area with thousands of cattle, sheep, goat and some camels and donkeys especially during the dry season. Falatas totally depend on their livestock for their subsistence and use the APNP illegally since they are not Ethiopians. The local people also use APNP for grazing of cattle which they rear for milk, meat and farming purposes.

3.9. Wild animals

According to the ARCS (1999), 50 species of larger mammals and over 450 species of birds have been recorded in the region out of which 4 species of mammals and 20 species of birds are endemic to the region. However, the diversity of mammalian and avian fauna of Alatish area is not known.

4. MATERIALS AND METHODS

4.1. Materials

Materials used during the present study include:- Binocular (8x56 mm), camera, GPS45, GPS12, metre tape, field guides, data sheets, notebooks, rulers, topographic map of 1:250,000, tape recorder, and field tents. Camels were used to travel through APNP. Sesina aircraft was also used for 1 1/2 hours. Structured questionnaires were used to collect data and information concerning impacts of human activities on APNP. Wooden frames were also used to collect plant specimens.

4.2. Methods

4.2.1. Preliminary study

Preliminary study was conducted from August 16 to 26, 2004. During this period all available literatures were reviewed concerning the accessibility, climatic conditions, vegetation, fauna, topography, infrastructure and approximate size of the core areas of wildlife in Alatish.

4.2.2. Selection of the Study Area

Based on the information gathered during the preliminary survey, fieldwork was carried out from 7 October to 14 November 2004 to collect the wet season data. It was impossible to cross the Shnifa River during the wet season. Dry season data collection was carried out from 18 February to 27 April 2005. Following Balakrishnan and Ndhlovu (1991), Bullock (1996), Krebs (1999) and Norton - Griffiths (1978), sampling units (grids) were established in each of the vegetation types. The number of sampling units/grids were determined depending on the size, and the type of vegetation cover in the proposed Park. Based on topographic map of 1:250,000 and satellite image received in 2004, 37 grids were identified. Some of the grids (Blocks) were 10 km x 10 km making a total of 100 km². The remaining grids were at the periphery of the proposed park area and are less than 100 km². A total of 630 km² in 34 transect lines were sampled at random. The 37 grids were first broadly divided into four vegetation types (Grimsdell, 1978) based on the vegetation types in the APNP. The division of vegetation into four types was based on the descriptive memoir (Grimsdel, 1978; White, 1983; Jensen and Friis, 2001) that describes vegetation in northwest Ethiopia as Sudanian vegetation type. Observations made during the study period thus identified

four vegetation types in APNP with minor modification as riverine woodland, wooded grassland, woodland and bamboo woodland to cover 20% of the whole APNP in a total of 11 grids randomly selected.

The areas covered by the four vegetation types are different. Based on the size of the cover of the vegetation types, 20% of the grids were sampled randomly. Then transect lines were laid on the randomly selected grids, again 20% the grids were sampled. The transect lines were chosen at random. The length of each transect line was established at 10 km and the site distance was 200 m on either side of the line transect covering 4 km² of the area (Norton-Griffith, 1978; Western and Grimsdel, 1979; Sutherland 1996; Bibby et al., 1998). During the observation, walking rate was 2.5 km/hour because most of the birds' species may not escape from observation during counting (Bibby et al., 1992, Pomeroy 1992; Sutherland, 1996.)

4.2.3. Data collection

Along the randomly selected transects, the diversity, distribution, relative abundance and habitat association of the larger mammals and birds were studied for 38 days in the wet season and for another 38 days in the dry season. During the observation of larger mammals and bird species, the type of species (diversity), the relative abundance of the different species, their location, and the associated vegetation types including the major tree species were recorded on the data sheet prepared for this purpose. The observation was made with naked eyes and aided by binoculars (8x56mm) and (7x50mm). For identification of mammals, personal experience and field guides (Blower 1969; Haltenorth and Helmut 1977; Kingdon, 1997) were used. In addition Smith and Zim (1956) Spawls et al. (2002) were used in identification of other land vertebrate species. Photographs were also taken for further confirmation. The observed species (mammals, birds and other vertebrates as well as the dominant tree species) were recorded and identified. Specimens of the unidentified plant species were taken to the National Herbarium, Addis Ababa University. Whenever it was possible, age classes and sex structure of the observed larger mammalian species were recorded using the methods of Sinclair and Grimsdel (1982).

Location of observed mammals and birds were determined using GPS 45 and GPS 12 and this was marked on topographic map. The distance of observation was estimated and recorded. The time of observation was morning from 6:00 -10:00 a.m. and in the afternoon from 3:00-1:00 p.m. The exact time of observation was also recorded.

Distance from site and other relevant biological and physical conditions were also recorded on a specially prepared data sheet or field note. Replicates were made on the same transect line twice (Morning & Afternoon).

For the study of birds, similar methods of diversity, distribution and relative abundance were used. Based on the bird type and openness of the habitat, transect width was determined. This was 150-200 m in closed habitat and 250-500 m in open habitats (Bibby et al. 1992; Pomeroy, 1992; Gibbons et al., 1996; Sutherland, 1996). For the identification of birds, Macworth - Pareds et al. (1952; 1955); William and Arlott (1980); Bullock (1996); Perlo (1995); Richards (2000) and other relevant guidebooks were used. Tape-recorder (walkman) was used to record the voice of both birds and mammals. All available indirect observation methods for the identification of mammals and avian fauna such as vocalization, tracks, dropping, carcasses, feeding sign, sign of rubbing, burrows and dens were also used. For pugmark, footprints and hoof marks identification of larger mammals, local guides from the indigenous Gumuz and Amhara people have been very useful. For identification of hoof marks, pugmarks and footprint South African animals spoor guide were used.

4.2.4. Data analysis

The diversity of larger mammals and birds was determined using FORTRAN computer programme (Krebs, 1999; Southwood, 2000). The similarity indices measure was used to identify the degree to which the species and their relative abundance are shared between different communities (Bibby et al., 1998). Simpson's Similarity Index (Simpson, 1949) was used to determine the similarities among the larger mammals, birds and the four habitat types. The relative abundance of the larger mammalian and avian species was determined using encounter rates that give crude ordinal scales of Abundance (Lawen et al., 1996 cited in Bibby et al., 1998). Geo-referenced distribution data were used to map the location of larger mammals and birds. SPSS Computer Programme was used for Chi-square analysis to test the association of animals and their habitats (Fowler and Cohen, 1990).

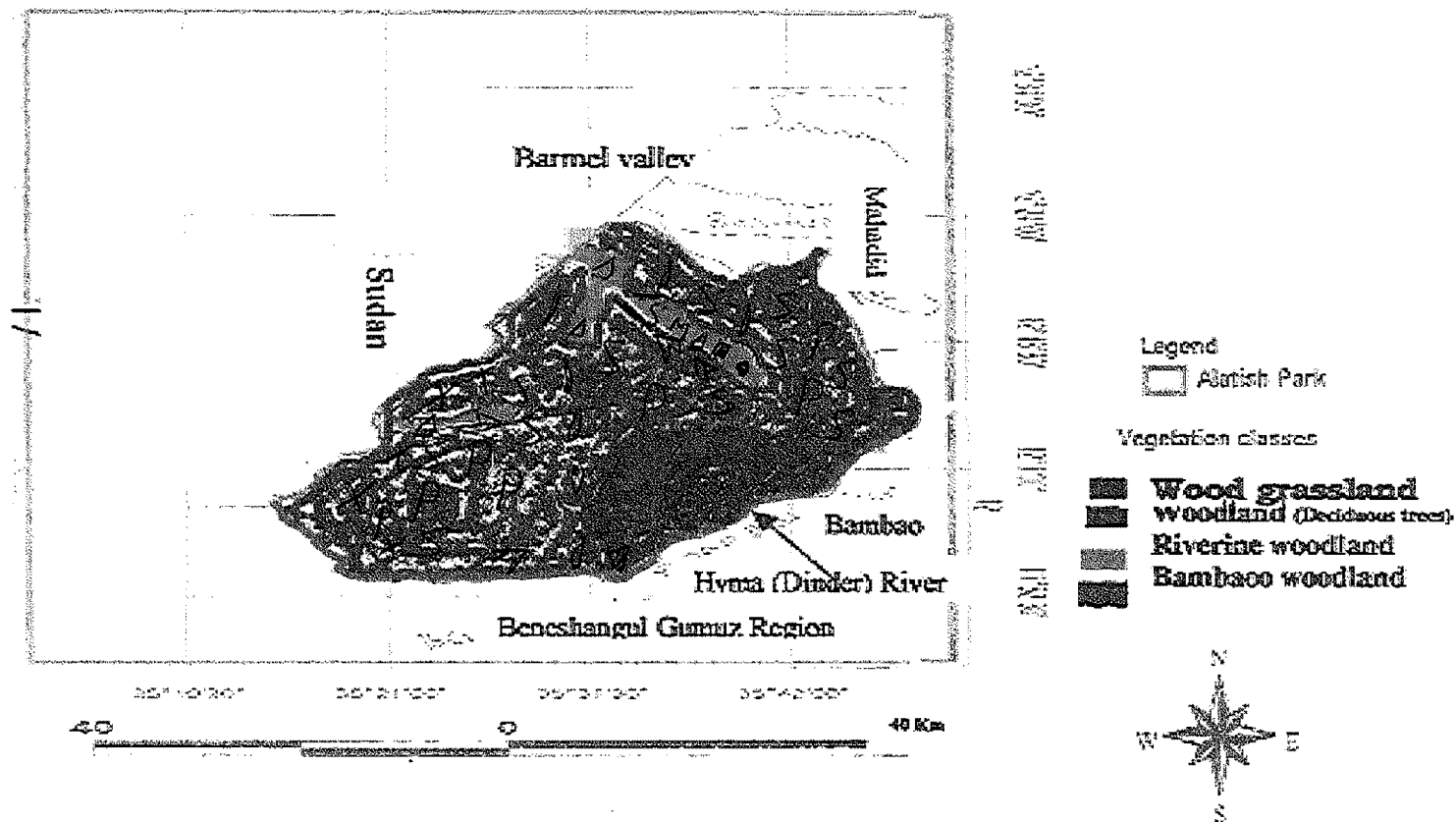


Figure 3. Distributions of larger mammals in Alatish

5. RESULT

5.1. Diversity of larger mammals

Twenty species of larger mammals of ten families were recorded during the present investigation in Alatish (Table 1). Riverine and wooded grassland habitats had the highest species diversity during the wet season (Table 2). The highest large mammalian species richness was obtained in the wooded grassland and woodland habitats. During the dry season, however, the highest larger mammalian species diversity was obtained in the riverine woodland while the lowest species diversity was obtained in the woodland habitat (Table 3). The riverine and bamboo woodland habitats also had the highest even distribution.

Compared to the wet season, the wooded grassland and woodland habitats were less diversified relatively and had less even distribution of the species during the dry season. Unlike in the wet season, woodland habitat had the lowest species diversity, evenness and richness in the dry season.

When the result of both seasons are combined, the riverine and bamboo woodland habitats had the highest species diversity followed by wooded grassland habitat (Table 4). Species evenness was the highest in the riverine and bamboo woodland habitats.

Table 1. Observed large mammalian species of Alatish Proposed National Park

Common name	Scientific Name	Family
Aardvark	<i>Orycteropus afer</i>	Orycteropodidae
African civet	<i>Civettictis civetta</i>	Viverridae
Anubis baboon	<i>Papio anubis</i>	Cercopithecidae
Buffalo	<i>Syncerus caffer</i>	Bovidae
Bushbuck	<i>Tragelaphus scriptus</i>	Bovidae
Elephant	<i>Loxodonta africana</i>	Elephantidae
Greater kudu	<i>Tragelaphus strepsiceros</i>	Bovidae
Grevet Monkey	<i>Cercopithecus aethiop</i>	Cercopithecidae
Grey dicker	<i>Sylvicapra grimmia</i>	Bovidae
Leopard	<i>Panthera pardus</i>	Felidae
Lion	<i>Panthera leo</i>	Felidae

Oribi	<i>Ourebia ourebi</i>	Bovidae
Patas monkey	<i>Enythrocebus patas</i>	Cercopithecidae
Ratel (Honey badger)	<i>Mellivora capensis</i>	Mustelidae
Side striped jackal	<i>Canis adustus</i>	Canidae
Serval cat	<i>Felis serval</i>	Felidae
Spotted hyena	<i>Crocuta crocuta</i>	Hyaenidae
Striped hyena	<i>Hyaena hyaena</i>	Hyaenidae
Vervet monkey	<i>Chlorocebus aethiops pygmaeus</i>	Cercopithecidae
Warthog	<i>Phacochoerus aethiopicus</i>	Suidae

Table 2. Wet season larger mammalian diversity

Habitat types	Number of species	Abundance	H'	H'/H' max.
Riverine woodland	14	1546	3.57	1.00
Wooded grassland	19	8738	2.17	0.82
Woodland	16	3047	1.88	0.71
Bamboo Woodland	9	1317	2.14	0.81

Note: - H=Shannon, Wiener Index of diversity

H/H max = Evenness.

Table 3. Dry season larger mammalian diversity

Habitat types	Number of species	Abundance	H'	H'/H' max.
Riverine woodland	20	2250	2.129	0.711
Wooded grassland	16	3159	1.734	0.625
Woodland	13	2664	1.532	0.597
Bamboo Woodland	10	528	1.968	0.855

Table 4. Diversity of larger mammals during the wet and dry seasons.

Habitats	Number of species	Abundance	H'	H'/H'max
Riverine woodland	20	3014	2.008	0.682
Wooded grassland	19	3075	1.746	0.630
Woodland	16	1964	1.460	0.591
Bamboo Woodland	10	543	2.018	0.841

During the wet season larger mammals showed similarity of occurrence between the wooded grassland and woodland habitats followed by riverine woodland and wooded grassland (Table 5). Where as, the low similarity was indicated in between the wooded grassland and bamboo woodland, riverine woodland and bamboo woodland, woodland and bamboo woodland habitats. The analysis showed similarity for larger mammalian community between the riverine woodland and Wooded grassland habitats and the wooded grassland and woodland habitats in the dry season (Table 6). However, lack of similarity was obtained in between the riverine woodland and bamboo woodland habitats in this season. The present result showed complete similarity in distribution of between the riverine woodland and wooded grassland, riverine woodland and woodland, wooded grassland and woodland habitats. But riverine woodland and bamboo woodland, wooded grassland and womboo woodland showed the low in similarity of distribution (Table 7).

Table 5. Similarity in distribution of larger mammals during the wet season.

	Habitat types			
	Riverine woodland	Wooded grassland	Woodland	Bamboo woodland
Riverine woodland		0.85	0.73	0.69
Wooded Grassland	0.85		0.86	0.57
Woodland	0.73	0.86		0.64
Bamboo woodland	0.69	0.57	0.64	

Table 6. Similarity in distribution of larger mammals during the dry season.

	Habitat types			
	Riverine woodland	Wooded grassland	Woodland	Bamboo woodland
Riverine woodland		0.89	0.79	0.34
Wooded grassland	0.89		0.83	0.62
Woodland	0.79	0.83		0.69
Bamboo woodland	0.34	0.62	0.69	

Table 7. Trends in distribution of larger mammals in all seasons.

	Habitat types			
	Riverine woodland	Wooded grassland	Woodland	Bamboo woodland
Riverine woodland		1.00	1.00	0.73
Wooded grassland	1.00		1.00	0.74
Woodland	1.00	1.00		0.87
Bamboo woodland	0.73	0.74	0.87	

The relative abundance of the 20 larger mammalian species in the present study area revealed that nine were rare species, four were uncommon species, two were common species, one was abundant species and four were frequently (Table 8).

Table 8. Relative abundance of the observed larger mammals in Aliatish.

Species	Number of individuals per 100 field hours	Abundance score	Relative Abundance
<i>Civetticis civetta</i>	0.65	1	Rare
<i>Papio anubis</i>	40.70	4	Common
<i>Orycteropus afer</i>	4.71	2	Uncommon
<i>Syncerus caffer</i>	1.67	1	Rare
<i>Tragelaphus scriptus</i>	8.00	2	Uncommon
<i>Loxodonta africana</i>	1.26	1	Rare
<i>Tragelaphus strepsiceros</i>	2.52	1	Rare
<i>Sylvicapra gramma</i>	3.80	2	Uncommon
<i>Cercopithecus aethiopes</i>	13.81	3	Frequent
<i>Panthera pardus</i>	0.24	1	Rare
<i>Panthera leo</i>	5.52	2	Uncommon
<i>Orebia ourebi</i>	96.03	4	Common
<i>Erythrocebus patas</i>	8.22	3	Frequent
<i>Mellivera capensis</i>	2.60	1	Rare
<i>Crocuta crocuta</i>	6.35	3	Frequent
<i>Felis serval</i>	8.30	3	Frequent
<i>Hyaena hyaena</i>	1.20	1	Rare
<i>Canis adustus</i>	0.56	1	Rare
<i>Chlorocebus a pygrrerthrus</i>	1.77	1	Rare
<i>Phacochoerus aethiopicus</i>	123.00	5	Abundant

Note: - < 3.04 - Rare (1)

3.04 - 6.08 Uncommon (2)

6.38 - 30.43 Frequent (3)

30.7 - 122 Common (4)

Above 122 Abundant (5)

Large mammals were distributed in the different woodland habitats according to their preference to the habitats and this is given in Table 9.

Table 9 Distributions of large mammals in Alatish.

Species	Distribution
<i>Civetticis civetta</i>	South and South west of Alatish
<i>Papio anubis</i>	Along riverine woodland
<i>Orycteropus afer</i>	Along riverine woodland
<i>Syncerus caffer</i>	South of Alatish (Along Hyma River)
<i>Tragelaphus scriptus</i>	Throughout Alatish
<i>Loxodonta africana</i>	North, Center and South of Alatish
<i>Tragelaphus strepsiceros</i>	Throughout Alatish
<i>Sylvicapra gramma</i>	Throughout Alatish
<i>Cercopithecus aethiops</i>	Along riverine woodland
<i>Panthera pardus</i>	Along Riverine woodland (Alatish River)
<i>Panthera leo</i>	Along Riverine woodland (Alatish River)
<i>Orebia ourebi</i>	Throughout Alatish
<i>Erythrocebus patas</i>	South and South west of Alatish
<i>Mellivera capensis</i>	Throughout Alatish
<i>Crocuta crocuta</i>	Throughout Alatish
<i>Felis serval</i>	North of Alatish
<i>Hyaena hyaena</i>	Throughout Alatish
<i>Canis adustus</i>	Eastern AAlatish
<i>Chlorocebus a pygrrerthus</i>	Along riverine woodland
<i>Phacochoerus aethiopicus</i>	Throughout Alatish

Larger mammals such as *Papio anubis*, *Cercopithecus aethiops*, and *Chlorocebus aethiops* were restricted to the riverine woodland (Fig. 4). *Orycteropus afer* was observed making several holes along Alatish River. *Syncerus caffer* was distributed in the southern of Alatish making a migratory route along Hyma River. During the wet season, the species was distributed in the wooded grassland habitat in addition to the riverine woodland. *Loxodonta africana* occurred throughout Alatish in the wet season. However, more number of species was available in the northern wooded grassland than

was dominated by *Entada africana*. This was evidenced from the footprints and faecal droppings (Figs. 5 and 9).

L. africana uses water from the Demier River during the dry season before it dries. Then, it migrates from Xiqua to Omedla in a place called "Sambri" (tall grass). *Phacochoerus aethiopicus* occurs throughout Alatish both in the dry and wet seasons. *Panthera leo* as observed from the pugmark and voice was distributed along Alatish River during the wet season (Fig. 8). It also occurs in the northern part of Alatish. Similar distribution pattern was also observed for *Panthera pardus*. *Civetticivett civetta* was recorded from the south and south west of Alatish. *Tragelaphus scriptus*, *Sylvicapra grimmia*, and *Tragelaphus strepsiceros* were observed throughout the Park during the wet season with more concentration in wooded grassland habitat. *Ourebia ourebi* was observed in the southern and western part of Alatish during the wet season in the open wooded grassland habitat (Fig 5). During the dry season, the distribution was throughout the Park with high concentration in the riverine woodland along Hyma River. *Erythrocebus patas* was recorded in the south and western part of Alatish in both the dry and wet seasons. *Mellivora capensis* was recorded from the south of Alatish but its distribution is throughout the Park as observed from pugmark in the wet season. *Crocuta crocuta*, and *Hyaena hyaena* occurred throughout the Park. *Felis serval* was observed in the northern part of Alatish as evidenced by the pugmark in the wet season.

Wet season large mammalian habitat association showed no significant difference between larger mammals, and their habitat types; $X^2_{54} = 38.9$, $P < 0.05$ (Table 9). This indicated that larger mammals use the whole habitat equally and there is no interaction between the variables. Dry season large mammalian habitat association also indicated no significant difference in habitat association between the different species of mammals, and their habitats $X^2_{57} = 40.7$, $p < 0.05$ (Table 10).

Table 10. Habitat association of large mammals during the wet season.

	Habitat types			
	RWL	WGL	WL	BWL
Chi - square	3.800	4.000	4.700	26.400
df.	13.000	15.000	12.000	7.000
Asym sig.	0.993	0.998	0.967	0.000

Note: - RWL= Riverine woodland BWL= Bamboo woodland

WGL = Wooded grassland

WL = Woodland

df = degree of freedom

Table 11. Habitat association of larger mammals during the dry season.

	Habitat types			
	RWL	WGL	WL	BWL
Chi - square	7.000	7.000	14.200	12.500
d f.	9.000	8.000	8.000	4.000
Asym sing	0.637	0.537	0.077	0.014

5.2. Diversity of birds in Alatish Proposed National Park

One hundred and forty three bird species grouped in 45 families were recorded during the present study in Alatish (Appendix 2). During the wet season, highest species diversity was obtained in wooded grassland and riverine woodland habitat followed by the woodland habitat (Table 12). Species richness was highest in the wooded grassland habitat. However, evenness was the highest in the bamboo woodland. Highest avian species diversity during the dry season was obtained in the riverine woodland habitat (Table 13). Riverine woodland habitat also consisted the highest bird species richness and evenness. The lowest species diversity was obtained in the bamboo woodland habitat. Compared to the wet season, where wooded grassland had the highest avian species diversity, the dry season species diversity became the highest in the riverine woodland followed by wooded grassland habitats. Bird species richness was also highest in the wooded grassland habitats during the wet season. However, bird species richness was the highest in the riverine woodland habitat in the dry season (Tables 13). Woodland habitats had the highest avian species diversity when both seasons were combined (Table 14). But riverine woodland had the highest species richness.

Table 12. Wet season avian faunal diversity

Habitats	Number of species	Abundance	H'	H'/H' max
Riverine woodland	73	5145	3.658	0.853
Wooded grassland	77	9436	3.662	0.843
Woodland	45	4246	3.311	0.870
Bamboo woodland	40	1911	3.562	0.930

Table 13. Dry season avian faunal diversity

Habitats	Number of species	Abundance	H'	H'/Hmax
Riverine woodland	96	10981	3.928	0.940
Wooded grassland	54	12670	2.683	0.859
Woodland	44	10583	2.517	0.652
Bamboo woodland	41	3958	1.652	0.445

Table 14. Avian species diversity of Alatish (both seasons)

Habitat	Number of species	Abundance	H'	H'/Hmax
Riverine Woodland	111	32423	2.257	0.479
Wooded Grassland	80	18811	3.085	0.704
Woodland	64	8742	3.706	0.891
Bamboo Woodland	53	2521	3.652	0.920

Wet season results indicated high similarities in bird community between the riverine woodland and wooded grassland. However, riverine woodland and bamboo woodland habitats showed less similarity in bird community. Wood grassland, woodland habitats and bamboo woodland habitats showed similarity (Table 15).

Generally, the similarity of bird's community in the different habitat was not strong in the season.

Table 15: Similarities in the distribution of birds during the wet season.

	Habitat types			
	Riverine woodland	Wooded grassland	Woodland	Bamboo woodland
Riverine Woodland		0.60	0.49	0.49
Wooded Grassland	0.60		0.57	0.59
Woodland	0.49	0.57		0.59
Bamboo woodland	0.49	0.59	0.59	

During the dry season bird community showed similarity between the wooded grassland and woodland, wooded grassland and Bamboo woodland and between woodland and Bamboo woodland habitats (Table 16). But less similarity is indicated between the riverine woodland, woodland and wooded grassland habitats (Table 16).

Table 16. Dry season similarity in the distribution of birds among the four habitat types.

		Habitat types			
		Riverine woodland	Wooded grassland	Woodland	Bamboo woodland
Riverine woodland			0.64	0.61	0.63
				0.92	
Wooded grassland	0.64				0.82
Woodland	0.61		0.92		0.87
Bamboo woodland	0.63		0.82	0.87	

Avian faunal relative abundance in Alatish revealed that 97 species were rare, 20 species were uncommon, 19 species frequent, 4 common and 3 abundant (Table 17).

Table 17. The relative abundance of 143 bird species of Alatish

Species	Number of individuals per 100 field-hours	Abundance score	Relative abundance
<i>Bucorvus abyssinicus</i>	0.43	1	Rare
<i>Coracias abyssinica</i>	13.70	3	Frequent
<i>Dicrurus adsimilis</i>	3.70	2	Uncommon
<i>Lagonosticta rubricata</i>	6.60	3	Frequent
<i>Vidua paradiseae</i>	0.57	1	Rare
<i>Tockus nasutus</i>	7.08	3	Frequent
<i>Hieraaetus spilogaster</i>	0.65	1	Rare
<i>Upupa epops</i>	3.41	2	Uncommon
<i>Streptopelia decipiens</i>	10.65	3	Frequent
<i>Anastomus lamelligerus</i>	0.41	1	Rare
<i>Ciconia abdimii</i>	0.49	1	Rare
<i>Strix woodfordii</i>	0.04	1	Rare
<i>Terpsiphone viridis</i>	0.58	1	Rare
<i>Motacilla aguimp</i>	0.85	1	Rare
<i>Zosterops abyssinica</i>	0.82	1	Rare
<i>Mirafra cantillans</i>	2.01	1	Rare
<i>Trudus pelios</i>	3.40	2	Uncommon

<i>Haliaeetus vocifer</i>	0.94	1	Rare
<i>Butes rufofuscus</i>	0.29	1	Rare
<i>Tyto alba</i>	0.08	1	Rare
<i>Terathopius ecaudatus</i>	1.40	1	Rare
<i>Ploceus cucullatus</i>	256.00	5	Abundant
<i>Turtur abyssinicus</i>	7.36	3	Frequent
<i>Laniarius erythrogaster</i>	28.00	3	Frequent
<i>Milvus migrans</i>	34.01	4	Common
<i>Lagonosticta vinacea</i>	0.28	1	Rare
<i>Balearica pavonina</i>	0.01	1	Rare
<i>Himantopus himantopus</i>	0.17	1	Rare
<i>Lamprotornis chalcurus</i>	1.40	1	Rare
<i>Ciconia nigra</i>	0.43	1	Rare
<i>Turdus tephronotus</i>	0.43	1	Rare
<i>Uraeginthus cyanocephalus</i>	4.56	2	Uncommon
<i>Petronia dentata</i>	9.37	3	Frequent
<i>Serinus tristriatus</i>	0.426	1	Rare
<i>Lagonosticta rufopicta</i>	0.56	1	Rare
<i>Circaetus cinereus</i>	11.78	3	Frequent
<i>Treron waalia</i>	0.36	1	Rare
<i>Phyllolais pulchella</i>	1.31	1	Rare
<i>Eupectes hordeaceus</i>	0.69	1	Rare
<i>Charadrius asiaticus</i>	0.71	1	Rare
<i>Melanocorypha bimaculata</i>	0.06	1	Rare
<i>Pycononotus barbatus</i>	3.68	2	Uncommon
<i>Turnix sylvatica</i>	0.19	1	Rare
<i>Merops nubicus</i>	2.73	1	Rare
<i>Francolinus clappertoni</i>	9.50	3	Frequent
<i>Calidris ferruginea</i>	0.33	1	Rare
<i>Otus scops</i>	0.11	1	Rare
<i>Vannellus coronatus</i>	1.01	1	Rare
<i>Melierax metabates</i>	0.70	1	Rare

<i>Alopochen aegyptiacus</i>	0.57	1	Rare
<i>Pluvialis aegyptius</i>	1.02	1	Rare
<i>Cercomella familiaris</i>	3.05	2	Uncommon
<i>Turtur chaleospilos</i>	10.87	3	Frequent
<i>Acrocephalus scirpaceus</i>	44.70	4	Common
<i>Clanderrilla brachydactyla</i>	0.10	1	Rare
<i>Micromisus gabar</i>	0.44	1	Rare
<i>Lamprotornis chalybeus</i>	10.48	3	Frequent
<i>Butastur rufipennis</i>	4.33	2	Uncommon
<i>Indicator indicator</i>	4.32	2	Uncommon
<i>Phoeniculus purpureus</i>	2.60	1	Rare
<i>Oxylophus levaillantii</i>	0.66	1	Rare
<i>Egretta alba</i>	0.52	1	Rare
<i>Charadrius leschenaultii</i>	0.66	1	Rare
<i>Ardea cinerea</i>	29.90	3	Frequent
<i>Motacilla cinerea</i>	0.66	1	Rare
<i>Numida meleagris</i>	195.00	5	Abundant
<i>Bostrychia hagedash</i>	1.40	1	Rare
<i>Eupodotis hartlaubii</i>	0.30	1	Rare
<i>Scopus umbretta</i>	4.20	2	Uncommon
<i>Lamprotornis chloropterus</i>	21.00	3	Frequent
<i>Aegypius tracheliotus</i>	1.00	1	Rare
<i>Indicator minor</i>	4.33	2	Uncommon
<i>Merops pusillus</i>	5.10	2	Uncommon
<i>Ploceus luteolus</i>	1.10	1	Rare
<i>Pterocles lichtenstinii</i>	3.00	1	Rare
<i>Merops orientalis</i>	1.10	1	Rare
<i>Charadrius dubius</i>	0.28	1	Rare
<i>Bradypterus haboecala</i>	0.22	1	Rare
<i>Streptopelia senegalensis</i>	4.60	2	Uncommon
<i>Buteo refinus</i>	2.30	1	Rare
<i>Anthus similis</i>	0.24	1	Rare
<i>Lophactes occipitalis</i>	0.84	1	Rare

<i>Leptoptilos crumeniferus</i>	13.50	3	Frequent
<i>Melocichla mentalis</i>	1.80	1	Rare
<i>Corthornis cristata</i>	0.08	1	Rare
<i>Polemaetus bellicosus</i>	0.08	1	Rare
<i>Motacilla clarn</i>	0.08	1	Rare
<i>Onea capensis</i>	10.40	3	Frequent
<i>Luscinia megarhynchos</i>	3.07	2	Uncommon
<i>Campethera nubica</i>	1.70	1	Rare
<i>Lanius nubicus</i>	0.25	1	Rare
<i>Melaenornis edoloides</i>	2.20	1	Rare
<i>Turdus olivaceus</i>	0.11	1	Rare
<i>Cercomela scotocerca</i>	1.34	1	Rare
<i>Pandion haliaetus</i>	0.68	1	Rare
<i>Ceryle rudis</i>	0.70	1	Rare
<i>Bardornis pallidus</i>	0.44	1	Rare
<i>Monticella alba</i>	3.77	2	Uncommon
<i>Anthus leucophrys</i>	0.50	1	Rare
<i>Lamprotornis splendidus</i>	0.50	1	Rare
<i>Glaucidium perlatum</i>	6.54	3	Frequent
<i>Tockus erythrorhynchus</i>	2.22	1	Rare
<i>Cisticola erythorps</i>	0.67	1	Rare
<i>Merops bullocki</i>	0.69	1	Rare
<i>Streptopelia semitorquata</i>	145.00	5	Abundant
<i>Psittacula krameri</i>	4.30	2	Uncommon
<i>Cisticola niombe</i>	0.21	1	Rare
<i>Lamprotornis purpuropterus</i>	34.00	4	Common
<i>Ephippiorhynchus senegalensis</i>	0.16	1	Rare
<i>Francolinus squamatus</i>	4.11	2	Uncommon
<i>Therskiornis aethiopica</i>	0.357	1	Rare
<i>Centropus senegalensis</i>	3.88	2	Uncommon
<i>Burhinus oedienemus</i>	2.02	1	Rare
<i>Ptilopus petrosus</i>	0.74	1	Rare
<i>Vanellus spinosus</i>	7.30	2	Uncommon

<i>Columba guinea</i>	7.21	2	Uncommon
<i>Bubo africanus</i>	0.46	1	Rare
<i>Ammodramus heyi</i>	0.38	1	Rare
<i>Dirurus ludwigi</i>	0.51	1	Rare
<i>Macrodipteryx longipennis</i>	0.31	1	Rare
<i>Aquila rapax</i>	1.22	1	Rare
<i>Anthus trivialis</i>	3.01	2	Rare
<i>Prinia subflava</i>	0.23	1	Rare
<i>Laniarius ferrugineus</i>	0.57	1	Rare
<i>Cisticola nama</i>	3.06	2	Uncommon
<i>Bubo lacteus</i>	0.16	1	Rare
<i>Zosterops senegalensis</i>	0.49	1	Rare
<i>Motacilla flava</i>	0.28	1	Rare
<i>Buphagus africanus</i>	0.28	1	Rare
<i>Euplectes afer</i>	0.19	1	Rare
<i>Burhinus vermiculatus</i>	0.22	1	Rare
<i>Aegyptius occipitalis</i>	0.23	1	Rare
<i>Corythaixoides leucogaster</i>	0.31	1	Rare
<i>Ciconia ciconia</i>	21.30	1	Frequent
<i>Cisticola galactotes</i>	31.50	4	Common
<i>Eurocephalus rueppelli</i>	1.10	1	Rare
<i>Euplectes capensis</i>	0.31	1	Rare
<i>Serinus leucopygius</i>	0.55	1	Rare
<i>Merops albicollis</i>	0.40	1	Rare
<i>Uraeginthus bengalus</i>	17.55	3	Frequent
<i>Merops bullockoides</i>	0.60	1	Rare
<i>Thalassornis leuconotus</i>	0.08	1	Rare
<i>Cisticola judicis</i>	3.68	3	Frequent





Figure 4. Riverine woodland habitat



Figure 5. Wooded grassland habitat



Figure 6. Nests of birds in Bamboo woodland habitat



Figure 7. Woodland habitat affected by fire



Figure 8. Pugmark of *Panthera leo*

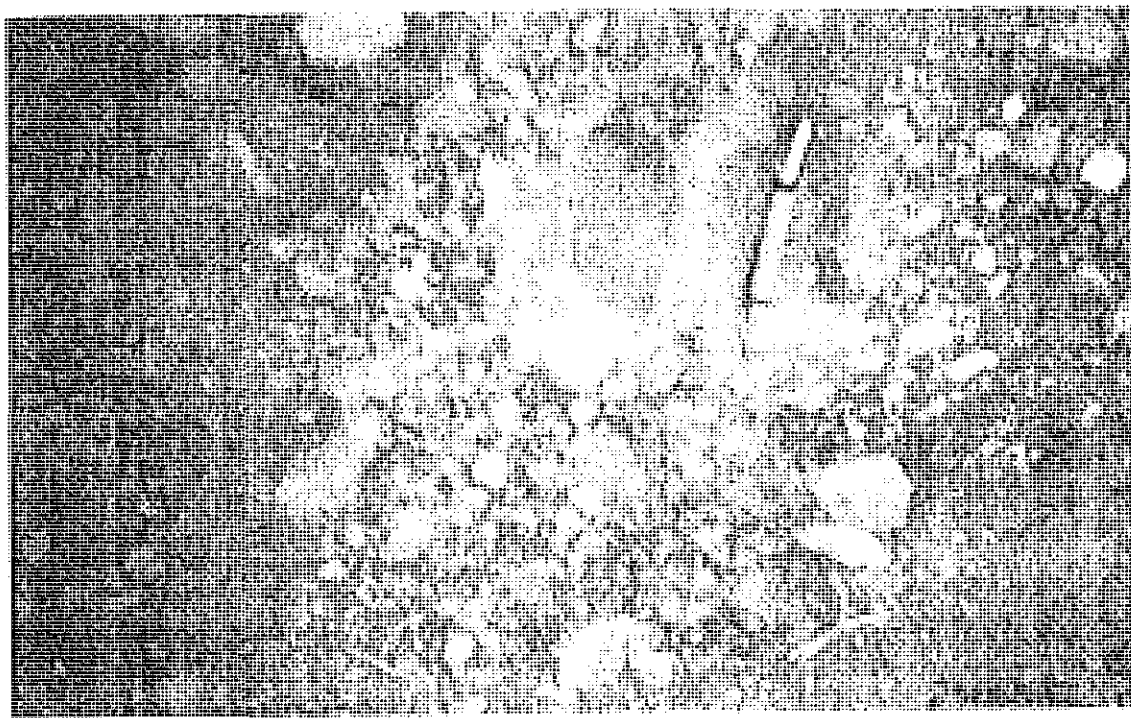


Figure 9. Footprint of *Loxodonta africana*

Birds were distributed in according to their requirements to specific habitat in Alatish (Table18).

Table 18. Distributions of some birds of Alatish.

Common name	Scintific name	Distribution
Abyssinian ground hornbill	<i>Bucorvus Abyssinicus</i>	Center of Alatish (arrund Demir)
Abyssinan roller	<i>Coracias abyssinica</i>	Through out Alatish
African drongo	<i>Dicrusus adsmils</i>	Bush along riverine woodland
African fire finch	<i>Lagnonostieta rubricata</i>	Riverine woodland
Acacia paradise whydha	<i>Vidua paradisaea</i>	Acacia seyal woodland in southwest
African grey hornbill	<i>Tockus nasustus</i>	Wooded grassland and woodland habitat
African Hawk eagle	<i>Hieraaetus spliogaster</i>	Riverine woodland
African hoopoe	<i>Upupa epops</i>	Woodland (south of Alatish)
African morning dove	<i>Sterptopelia decipens</i>	Throughout
African open billed hornbill	<i>Anastomus lamelligerus</i>	Riverine woodland
Abdim's strok	<i>Coconia abdimii</i>	Riverine woodland
African pied wagtial	<i>Motacilla aguimp</i>	Riverine woodland
Abyssinian white eye	<i>Zosterops abyssinica</i>	Riverine woodland
African singing bush lark	<i>Mirafra cantillans</i>	Riverine woodland
African Trush	<i>Trudus pelios</i>	Wooded grassland and Riverine woodland
African fish eagle	<i>Haliaaeetus vicfer</i>	Riverine woodland
Agur Buzzard	<i>Buteo rufofuscus</i>	Wooded grassland
Barn owl	<i>Tyto alba</i>	Woodland
Bateleur	<i>Terthopius eucudatus</i>	Wooded grassland, woodland habitat
Black headed weaver	<i>Ploceus cucullactus</i>	Riverrine woodland (Alatish River)
Black headed gonolek	<i>Laniarius erythrogaster</i>	Bush along Riverine woodland
Black kite	<i>Milvus migrans</i>	Through out Alatish
Black winged stilt	<i>Himantopus himantopus</i>	Alatish River
Black stork	<i>Ciconia niger</i>	Riverine woodland

Black kite	<i>Milvus migrans</i>	Through out Alatish
Black winged stilt	<i>Himantopus himantopus</i>	Alatish River
Black stork	<i>Ciconia niger</i>	Riverine woodland
Bare eyed thrush	<i>Trudus tephronotus</i>	Riverine woodland
Blue capped cordenblue	<i>Uraeginthus cyanocephalus</i>	Wooded grassland
Bush petronia	<i>Petronia dentata</i>	Riverine woodland
Bruce's green piegon	<i>Teron waalia</i>	Woodland
Caspina plover	<i>Charadrius asiaticus</i>	Riverine woodland
Common Bulbul	<i>Pycononotus barbatus</i>	Riverine woodland
Carminc bee eater	<i>Merops nubicus</i>	South of Alatish
Claperton's Francolin	<i>Frncolinus clapertoni</i>	Throughout Alatish
Crulew sand piper	<i>Calidiris ferruginea</i>	Along Hyma River
Egyption plover	<i>Pluvianus aegyptius</i>	Riverine woodland
Emerald spotted wood dove	<i>Turtur chalcospilos</i>	Throughout Alatish
Greater honey guide	<i>Indicator indicator</i>	Throughtout Alatish
Green wood hoopoe	<i>Phoeniculus purpureus</i>	Riverine woodland
Greater white egret	<i>Egeretta alba</i>	Riverine wood land
Greater sand plover	<i>Charadrius leschenalaultii</i>	Riverine woodland
Grey heron	<i>Aredea cinera</i>	Riverine woodland
Grey wagtail	<i>Motaclicca cinerea</i>	Riverine woodland
Helmeted guinea fowl	<i>Numida meleagris</i>	Throughout Alatish
Hadada Ibis	<i>Bostrychia hagedash</i>	Riverine woodland
Lappet faced vulture	<i>Aegypius tracheliotus</i>	Along riverine woodland
Liechtenstein's sand grouse	<i>Pteroles liechtensteinii</i>	Wooded grassland
Marabou stork	<i>Leptptilos crumeniferus</i>	Riverine woodland
Nightangle	<i>Luscinia megarhynchos</i>	Wooded grassland
Nubian wood pecker	<i>Comptthera nubica</i>	Nrth and South of Alatish
Osprey	<i>Pandium haliatus</i>	Woodland
Pied king fisher	<i>Ceryle rudis</i>	Hyma River
Red billed hornbill	<i>Tockus erythrorhynchus</i>	Woodland
Red eyed dove	<i>Streptopelia semitorquata</i>	Through out
Rose -ringed parakeet	<i>Psittacula krameri</i>	Along Riverine woodland in Hyma and Alatish
Tawny eagle	<i>Aquilix rapaxh</i>	Woodland
Tropical Baubou	<i>Laniarius ferrugineus</i>	Centr of Alatish in wooded grassland
Water thicknee	<i>Burhimus vermiculatus</i>	Hyma river
White Bellied Go -away bird	<i>Corythaixoides leucogaster</i>	Along Hyma River

Birds of the family **Bucerotidae** (*Abyssinian ground hornbill*) were recorded in the wooded grassland habitat around Demier at the centre of Alatish (Fig 5.). Birds of the family of **Coraciidae** (*Coracias abyssinica*) were observed in the whole area of Alatish with high concentration in the southern and southwestern part. Species of the family **Dicruridae** were recorded from the bush along the Alatish and Hyma Rivers. Species of the family **Estrilidae** such as *Lagonosticta rubricata*, *Lagonosticta vinacea*, *Lagonosticta rufopicta*, *Uraeginthus cyanocephalus*, and *Uraeginthus bengalus*) were recorded along the riverine woodland. Bird species of family **Bucerotidae** such as *Tockus nasutus*, and *Tockus erythrorhynchus* were distributed throughout Alatish especially in the wooded grassland and woodland habitats.

Vidua paradisaea in the family **Estrilidae** occurred in *Acacia seyal* woodedland in the southwest. Birds of the family **Acciptridae** *Hieraaetus spilogaster*, *Buteo rufofuscus*, *Terathopius ecaudatus*, *Milvus migrans*, *Circus cinereus*, *Melierax metabates*, *Aegypius tracheliofusus*, *Aquilax rapax*, *Aegypius occipitalis* occurred in all the 4 habitats. However species of the family, *Haliaeetus vocifer* was distributed along the riverine woodland habitat. **Upupidae** was distributed in the woodland of southern Alatish along Hyma River. Bird species of the family **Columbidae** (*Streptopelia decipiens*, *Turtur abyssinica*, *streptopelia senegalensis*, *Treron waalia*, *Olea capensis*, *Streptopelia semitorquata*, *Turtur chalcospilos* and *Columba guinea*) were distributed throughout Alatish.

Tockus nasutus, and *Tockus erythrorhynchus* were distributed throughout Alatish especially in the wooded grassland and woodland habitats.

Vidua paradisaea in the family **Estrildidae** occurred in *Acacia seyal* woodedland in the southwest. Birds of the family **Acciptridae** *Hieraetus spilogaster*, *Buteo rufofuscus*, *Terathopius ecaudatus*, *Milvus migrans*, *Circus cinereus*, *Melierax metabates*, *Aegypius trachelioioides*, *Aquila rapax*, *Aegypius occipitalis* occurred in all the 4 habitats. However species of the family, *Haliaeetus vocifer* was distributed along the riverine woodland habitat. **Upupidae** was distributed in the woodland of southern Alatish along Hyma River. Bird species of the family **Columbidae** (*Streptopelia decipiens*, *Turtur abyssinica*, *Streptopelia senegalensis*, *Treron waalia*, *Oena capensis*, *Streptopelia semitorquata*, *Turtur chalcospilos* and *Columba guinea*) were distributed throughout Alatish.



Figure 10. Water birds in Hyma River.

Water birds of the family **Bucerotidae**, (*Anastomus lamelligerus*) **Ciconidae**, (*Ciconia abdimi*, *Ciconia nigra*, *Ephippiorhynchus senegalensis*) were found in the riverine woodland habitat. Where as, *Ciconia ciconia* were found in the southern part of Alatish (Fig 10). Bird species of the family **Strigidae** (*Strix woodfordii*, *Glaucidium perlatus*, *Ootus scops*, *Bubo africanus*, *Bubo lacteus*) occurred in the Riverine and woodland habitats. Species of the family **Muscicapidae** (*Trudus pelios*, *Turdus tephronotus*, *Ceromela familiaris* *Phyllolais pulchella*, *Bradypterus baboecala*, *Melocichla mentalis* *Turdus olivaces*, *Cosspha anamala*, *Lusinia megarhynchos*, *Bradornis pallidus*, *Melaenornis edolioides*, *Cisticola nana*, *Cisticola galactites* and *Cisticola juncidis* generally distributed in the Riverine woodland of tall grass and in wooded grassland habitats.

Birds of the family **Motacillidae** and **Pittidae**: - *Mototacilla aguimp*, *Motacilla clarn*, *Anthus simills*, *Motacilla alba*, *anthus leucopyrs*, *Anthus frivalis*) were also found in the Riverine woodland ecosystem. Species of in the family of **Zosteropidae** such as *Zosterops abyssinica* and *Zustrops senegalensis* were distributed along the riverside in

Alatish. Birds of the family **Alaudidae** such as *Mirafra cantillans* were distributed in Riverine and wooded grassland. *Terathopius ecaudatus* of the family **Accipitridae** occurred in the woodland and wooded grassland area. Bird species of the family **Ploceidae** such as *Ploceas cucullatus* were distributed in the grass along the Riverine woodland habitat. Species of the family **Laniidae**, *Laniarius erthyrogaster* was distributed throughout Alatish with more of its concentration in the bush along the riverside. Species of the family **Gruidae**, **Recurvirostridae**, **Charadriidae**, **Scolopacidae**, **Anatidae** **Glaucolidae**, **Ardeidae**, **Scopidae**, **Aludidae**, **Threskiornithidae**, and **Burhinidae** and **Ardeidae** were distributed in the Rivers of Alatish and Hyma. Species of the family **Sturnidae** were distributed in the riverine woodland of Alatish and Hyma. Birds of the family **Pyronotidae**, **Meropidae**, **Turdidae** were distributed in the riverine woodland and in wooded grassland with sandy area. Family **Phasianidae** was observed to occur throughout the Park with more concentration along the river in Alatish. Family **Phoeniculidae** was also distributed along the river in Alatish.

Species of the family, greenwood hoopoe was observed in the south of Alatish during the wet season but they were observed in the north around Alatish River and Hyma in the south during the dry season. **Indicatoridae** (*Indicator indicator* and *Indicator minor*) were observed throughout the Park area. Species of the family **Pandionidae**, and **Fringillidae** were observed to occur mostly along the riverine woodland. One species of the family **Psittacidae** (*Psittacula krameri*) was observed and recorded from the southern part of Alatish during the wet season but in the dry season, the species was distributed both in the south, central and north of Alatish along Alatish & Hyma Rivers. Species of the family **Cuculidae** was distributed throughout Alatish. Species of the family **Coprimulgidae** was distributed in the woodland of southwest. One of the species of the family **Muscicapidae** was observed to be distributed in the riverine woodland. Species of the family **Picidae** (*Compethera nubica*) was distributed throughout Alatish. Species of the family **Numididae** (*Numida meleagris*) was distributed throughout Alatish proposed Park. One species of the family **Pteroclididae** was found in the wooded grassland habitat and one species of the family **Otididae** was observed in the southwest wooded grassland habitat. The other species of the family

Therskiornithidae was observed to occur along the Riverbed in Hyma, south of Alatish.



Figure 11. Warthog feeding in wood grassland habtiat



Figure 12. The effect of cattle in riverine woodland habitat

Wet season result also indicated high significance difference (Table 19) showing the existence of interaction between the birds and the vegetation type use.

The dry season data $X^2_{73} = 1436.22, P < 0.01$ showed a high significant difference for birds. Highest positive association was obtained in the woodland habitat (Table 20). A strong relationship or interaction between the bird species and habitat use is seen for birds in the woodland and wooded grassland habitats in both the wet and the dry seasons (Tables 19 and 20).

In the wet season, most of the bird species were associated with woodland habitat. In the dry season 22 species were also positively associated with woodland habitat, 21 species with riverine woodland, 23 species with wooded grassland and 7 species with bamboo woodland habitat. High significance difference between the bird species and habitat usage $X^2 2354.5, P < 0.01$ (Table 21) was obtained in all the seasons. The result indicated the preference of birds to certain type of habitats. They showed positive interaction with the woodland and wooded grassland habitats.

Table 19 Habitat associations of birds during the wet season.

	Habitat types			
	RWL	WGL	WL	BWL
Chi - square	259.50	306.19	523.15	179.38
df.	14.00	19.00	13.01	5.00
Asym sig.	0.00	0.00	0.00	0.00

Table 20. Habitat association of birds during the dry season

	Habitat types			
	RWL	WGL	WL	BWL
Chi square	102.04	458.94	6663.92	211.32
df.	21.00	23.01	22.00	7.00
Asym sing	0.00	0.00	0.00	0.00

Table 21. Trends in habitat association of birds in all seasons.

	Habitat type			
	RWL	WGL	WL	BWL
Chi - square	169.07	693.57	990.28	501.54
df.	26.00	30.00	25.00	10.00
Asym sig.	0.00	0.00	0.00	0.00

26 species of fishes in including Catfish and Nile perch and Reptiles such as Egyptian Cobra, Nile crocodile and burrowing asps were also noted in Alatish. Some of the activities of man on mammals and birds in Alatish flying birds and Warthogs feeding in wooded grassland habitat are shown in figures 10, 11, 12, 13 and 14



Figure 13. Pochers and meat of Warthog they killed in Alatish



Figure 14. Water well constructed by Falatas in Alatish River

6. DISCUSSION

6.1 Diversity of large mammals

Ecologists have given emphasis on diversity indices and other measures of community that are ultimately derived from abundance by species and habitat (Conery et al., 1996). Large mammalian species diversity were studied and recorded in Alatish. Highest large mammalian species diversity in riverine and bamboo woodland habitat implied the importance of water for their life as the two habitats are near to Dinder and Alatish Rivers. Furthermore, many factors including climatic changes may contribute to the selection of appropriate habitat that depends on the species physical and behavioral traits (Vaughan et al., 2000). Availability of sufficient food and cover for the larger mammals and openness of habitat in riverine and wooded grassland habitats in the wet season contributed to the increase in species diversity during this season. For herbivores, grass was adequately found; also they were protected from carnivores by the tall grass cover, bush and the woody plant along the riverside. Differences in feeding habits also increased diversity, richness and evenness as stated by Smith (1992).

During the wet season, the woodland habitat has more canopy cover that suppresses the growth of herbaceous and grassy vegetation that support larger mammalian herbivore. As a result, this habitat had lowest large mammalian species diversity, richness and evenness. In the wet season, highest species diversity, evenness and richness was revealed in the wooded grassland habitat owing to openness of this habitat.

Riverine woodland had the highest large mammalian species diversity in the dry season where water could only be found indicating the necessity of water for their life. Therefore, availability of water was the main factor to determine the diversity of the species. This was very important in Alatish because water scarcity is severing. Arabs call "Atish" to mean scarcity of water. Thus, during this season, there was no water available for animals except the water from the sandy riverbed dug by "Falata" in Alatish (Fig 14) and the water in different pools in Hyma. This is why larger mammals concentrate in the riverine woodland habitat during this season. Cover might be another factor but the riverine vegetation had been destroyed by the large number of Falata's cattle, sheep and goats and by forest fire (Fig. 7 and 12). There was also sparse vegetation remained and this supported the few species of larger mammals resulting relatively in higher species diversity. The lowest species diversity of the woodland

habitat during the dry season was due to the effect of fire. In addition, "Falata", the Rubtana tribes and the Arabs with their larger number of domestic animals imposed great pressure on it. This had degraded the wildlife habitat that includes the woodland habitat during the dry season. These accounted to the decrease in diversity of the woodland habitat during this season. Grazers suffer much from food shortage and especially the deficiency of proteins (Sinclair, 1974; 1975; Stanley - Price, 1978; Berry and Louw, 1982; Abaturov et al., 1995). Similarly, food shortage in the dry season reduced diversity and evenness of species in the woodland and wooded grassland habitats.

The extent to which species possessed common habitat was measured using index of similarity (Southwood, 2000). During the wet season larger mammals had similarity in their use of wooded grassland and woodland habitats as these habitats had water. The lack of similarity was obtained in between the riverine woodland and bamboo woodland in the dry season as result of habitat degradation by domestic animals (Fig.12). The bamboo woodland area was used as resting place of domestic animals during the dry season.

The relative abundance and distribution of species manifests their specialization for specific habitat (Ricklefs, 1990). Estimation of relative abundance reflects the comparative sizes of different population with respect to the entire mammalian fauna (Wilson et al., 1996). Furthermore, these estimates are useful to reflect temporal changes in population at different times in the same site. Hillman (1993) and information from local community elders revealed that there were several large mammalian species in Alatish. Rhinoceros, Tora hartebeest, Roan antelope, wild dog, giraffe and other larger mammals were once common in Alatish. However, probably due to the increase in human population in and around Alatish, larger mammalian species might have escaped to the undisturbed area of the south and eastern Sudan. Frequent destruction of the wildlife habitat, particularly by the nomadic people "Falata", coupled with the Rubtana, Arabs, Agaws and the Gumuz have resulted in reduction of biological diversity of the area. Those species of larger mammals that became rare and uncommon were also once abundant but poaching (Fig 13) in addition to habitat destruction has led to the decrease in number. Those species that were classified as 'common' were the ones not required for the purpose of meat, trophies or skin, thus their number remained relatively higher. At the same time, the species classified as abundant

might have developed a better strategy to survive (Kendeigh, 1975; Bergman et al., 2001). One of these is a warthog. They make holes to hide themselves and their young ones from enemies and harsh environmental factors such as temperature. This strategy might have helped them to increase in number.

Some of these mammalian species found in the area are threatened (eg. *Panthera pardus* and *Loxodonta africana* are endangered and *Panthera leo* is rare as classified by IUCN (Kingdon, 1997). Illegal hunting and destruction of their previous ranges and habitats are the major reasons. Alatish was once intact and contained many species of mammals and birds. Recently, however, the rate of habitat destruction has increased as a result of the more and more demand to use the virgin land for growing crops and grazing domestic animals. This has resulted in the absence of some of the previously existing species in the area. Moreover, those species that still remained in Alatish have been greatly reduced in number due to the high pressure resulting from human activities. This has threatened the species of larger mammals in Alatish and made them rare. The uncommon species were, in the past, known to occur in large numbers but poaching and competition for resources such as food, water and living space with domestic animals reduced their number in addition to habitat destruction.

The globally threatened species of larger mammal, *Loxodonta africana*, was currently found in few of the conservation areas in Ethiopia (Blower, 1969; Hillman, 1993). One of these conservation areas is Gambella National Park that is found in the lowland area of Gambella plain in the southwestern Ethiopia. In Ethiopia, *Hippotragus equinus* were known to occur only in the southwestern Ethiopia in Gambella and Wollega provinces (Blower, 1969). *Alcelaphus buselaphus tora* was known to occur in the northwestern Ethiopia, bordering Sudan (Hillman, 1993). These species also occurred and is known to occur in Alatish proposed Nation Park area (Information from indigenous people and personal observation). This showed the richness of Alatish Park area in terms of biological diversity. However, species such as *Alcelaphus buselaphus tora* had not been observed recently. According to Hillman (1993), the drought that had severely hit the northwestern Ethiopia in 1980s deteriorated its number. This species was endangered but the present status is unknown.

Generally, few terrestrial mammals can withstand extreme temperature or other conditions since their environment is not uniform (Vaughan, 2000). Terrestrial environment consists of mosaic of microenvironment. Except for those species that

require certain types of environment such as riverine woodland, other larger mammals were observed throughout the Park during the wet season. The reasons were the availability of food and sufficient vegetation cover to hide them from predators and illegal hunters. Furthermore, domestic animals were not there to compete for food, as was the case in the dry season.

One of the large mammalian species, *Loxodonta africana*, used to frequent different types of habitats including deep forest, open savannah, wet marsh, thorn bush and semi-desert scrub (IUCN, 1984; Nowak, 1991). Similarly, *Loxodonta africana* was distributed throughout the Park area in the wet season as observed from footprint. Moreover, large number of the species was observed in the northern part in the *Entada africana* dominated wooded grassland area. During the dry season, it mostly occurs in the central and southern part where water is adequately available. According to Nowak (1991), food quantity and quality and availability of water are the most important natural factors that determine the spatial distribution of elephants. In line with this, the distribution of *Loxodonta africana* in Alatish area was related to the availability of adequate water and quality food. The species was observed trampling *Entada africana* to feed on its roots. In a place where this tree species dominated footprints were commonly seen. Therefore, availability of quality food in sufficient quantity and sufficient amount of water contributed to the occurrence of mammals in larger number during this season. During the dry season, it mostly occurred in the central and southern part where water is adequately available. The species was known to use water to cool themselves and for metabolic activities. The species mostly occurred in the centre and in the southern part during this season because of the presence of Alatish River and Hyma River that provided them with water. During this season, they make migratory corridor from south to southwestern part to a place of wet tall grass called "Sambri". Though *Loxodonta africana* usually uses parts of woody plants as main sources of food, it also uses grass in the absence of the woody plants. Thus, migration to the "Sambri" was to use the wet grass and to escape from the direct and indirect pressures from human activities.

Phacochoerus aethiopicus is known to occur in Africa south of Sahara (Hiltenorth and Hilmut, 1977 and Nowak, 1991). The species prefers open savanna and lightly forested habitats where it feeds on grass, roots, berries and the bark of young trees. *Phacochoerus* is usually diurnal but in a place where human molestation is high, becomes mostly

nocturnal (Nowak, 1991). In order to rest, rare young and to hide from predators, it uses holes made in nature or dug by aardvark. The species occurred in similar condition in large number in Alatish and is distributed throughout the Park area during both the dry and wet seasons. However, poachers were killing large number of this species for the purpose of meat (Fig 13). Competition for food and water with the domestic animals was also very high.

The relative increase in the number and the distribution of this species in the Park was thus attributed to its nocturnal habits, high reproductive rate and use of holes.

Panthera leo and *Panthera pardus* had lived in wide range of habitats that provide food and cover (Estes, 1991). But, their distribution in Alatish area was restricted to certain localities because the nomads kill them since these animals prey on the domestic animals (Marker et. al, 2003). This has resulted in the reduction of their previous ranges and number in Alatish. Moreover, poachers also kill them for their valuable products such as the skin and fur. This was the reason for the rarity of *Panthera spp.* and other carnivores in Alatish area.

Civettictis civetta was known to occur in both forest and savannah, where tall grass or thickets were sufficient to provide daytime cover (Ewer and Wemmer: 1974). The species occurred in similar habitats in Alatish but restricted to the southern and southwestern part where Dinder Park is near to it. The absence of vegetation cover in the other area of the Park due to habitat destruction had restricted its range to the remote south and southwest of Alatish. Humans also capture them for their masks following the scent left along the animals' path, which also affected their distribution to some extent.

Tragelaphus scriptus, *T. strepsiceros* and *Sylvicapra grimmia* generally occurred throughout Alatish. However, competitions for food with domestic animals and habitat loss also have restricted their range of distribution in Alatish.

Ourebia ourebi is known to occur in savannah region of Africa, south of the Sahara (Nowak, 1991; Shelley, 1989). This species is known to inhabit in areas that are generally open but with sufficient growth of vegetation for protection. They were distributed in similar habitat types in Alatish. Though information from local community elders proved the existence of large number of *Ourebia ourebi* in Alatish area, their number was less than what had been stated.

During the wet season, the tall grass hindered observation of animals from a distance. During the dry season, a few species that were observed were found to be disturbed and

running away all the time. Their habitat was being used by domestic animals. There were Poachers. These had contributed to the reduction in their number and restriction in their distribution to some part of Alatish. During the dry season, they were concentrated in the riverine woodland since other parts of the Park were dry. *Syncerus caffer* was known to occur in most habitats in Africa. The species requires water and as a result move regularly between water and feeding ground (Shelley, 1989). In agreement to this, the species was observed moving from south of Alatish (Hayma River) to the northeast (Alatish River). Though Alatish is a suitable habitat for the species as it consists of grasses and water in some of its parts, the survival of the *Syncerus caffer* was highly affected by poachers. This has limited its population and distribution in Alatish.

The results, obtained showed no difference in the use of the four habitats in the wet season because of the availability of water. It means that the larger mammals used the whole habitat in Alatish. They used the different habitat types during the dry season because their habitats were highly disturbed. They were disturbed due to large number of domestic animals competing for the same area for resources. Otherwise, the species could have been distributed according to their preference to specific types of habitat. The activities of poachers that use automatic weapons (Fig 13) had also threatened and displaced the larger mammalian fauna. Moreover, the destruction of habitat exposes them to their enemies and makes them to wander about. The ever increasing human population has led to habitat degradation that has resulted in many known and countless unknown plant and animal species to extinction and others at risk (Wilson and Peter, 1994).

6.2. Diversity of birds

The bird diversity is an indication of habitat heterogeneity (Pomeroy, 1992). Therefore, the number of species and the number of individuals in an area implies the importance of the area.

The present study recorded 143 species of birds though most of the species were locally rare (Table 17, Appendix 2).

At the time of its establishment, similar lowland National Park in Ethiopia, Gambella National Park, was known to harbour 152 bird species in 5061 km² area (Hillman, 1993). However, the present study recorded 143 species of birds in Alatish proposed National Park in an area of 2,579.85 km². This revealed the presence of more species of birds in Alatish proposed National Park. More species of birds would have been present

in the area if the area is free from habitat modification and destruction. Moreover, some of the bird species were small and inconspicuous and were not easily observed and recorded.

The diversity of bird species in Alatish was due to the presence of diverse food resources. Similar to mammals, most bird species in Alatish were locally rare and uncommon. Species such as *Psittacula krameri*, *Ephippiorhynchus senegalensis*, *Pluvians aegyptius* and *Burhinus oedienemus* are also rare in East Africa (Perlo, 1995). Others such as *Bubo africanus* and *Burhinus vermiculatus* are uncommon in East Africa. Bird species are locally rare and uncommon in Alatish because their habitats are highly degraded by the large number of domestic animals using the area during the dry season.

Wooded grassland and riverine woodland had highest bird species diversity during the wet season as the two habitats provide varieties of food. Furthermore, water is adequately found in the two habitats. The presence of sufficient cover in the wet season also contributed to higher diversity, richness and evenness in the two habitats in this season. Similarly, during the dry season, avian species diversity was the highest in the riverine woodland followed by wooded grassland. This is due to the availability of water only in the riverine woodland ecosystem during this season. The presence of patches that had grass consisting of food for birds in the wooded grassland contributed to the increase in diversity, richness and evenness during the dry season. Each habitat has a specific set of microenvironment that is suitable for a species (Streekumar and Balakrishnan, 2001).

The different species of birds in Alatish were distributed in the different habitat types depending on their habitat requirement. During the wet season, most birds were distributed throughout the Park since disturbance was minimal. However, as a result of fire in the natural habitat that provides breeding environment, food, and cover, most of the bird species leave the area during the dry season. Scarcity of water and food were important factors for birds to change their wet season ranges. Some species (eg. *Psittacula krameri* and *Phoeniculus purpureus*) occurring in the south along Hyma River during the wet season were also found in the centre along Alatish river during the dry season. This is attributed to the availability of adequate food. There are also migratory birds (eg. *Burhinus oedienemus*) visiting the area during the dry season. This is a migration from Europe migrate to Africa to pass the winter season (Urban and Brown, 1971).

- ✓ Vegetation classification based on structural features of habitat is important in the study of birds in open habitats (Bibby et al., 1998). The result of habitat association for birds during the wet and dry seasons reflected the presence of strong interaction between the habitat use and bird species. Bird in general had positive association with bamboo woodland habitat. The reasons were: 1 bamboo woodland habitat supports many species of breeding colonies during the wet season where they use *Oxytenanthera abyssinica* to hang their nest (Fig. 6). 2, the bamboo woodland habitat was available near the wet environment such as Hyma River. Thus, the habitat was suitable for birds to breed, to get water and food. The wet season result also had similar association indicating the birds' requirement of specific habitat types for growth and reproduction.

In line with this, flowering plants support wide variety of birds since they feed on their nectar, berry, fruits and seed (Brooke et al., 1991). During this season, they were distributed among the different habitats because during this season resources occur adequately in the whole habitat. Flowers, fruits, roots and berries were also available to support different species of birds in the four habitats. During the dry season, wooded grassland and woodland habitats showed similarity. The similarity in the community of birds in the wooded grassland and woodland habitats was due to the availability of large quantities of food. Moreover, the two habitats were dry as are far away from water source, relatively undisturbed since water is not available for domestic animals.

- ✓ During the dry season, the whole area of the proposed Alatish Park was burnt but patches remained in places where grass was wet during the burning process. These patchy places had insects and large number of rodents that were used as food. This had contributed to the distribution of more bird species in the different habitats. Moreover, rodents, snakes and other reptiles that provided food for birds were available throughout the woodland areas. Predatory birds look for their prey by resting on larger trees and act as the prey moves. This might be the reason for the positive association of some of the bird species with woodland habitat. The riverine woodland had less association to birds in the dry season because this habitat was extensively used by "Falata's" domestic animals.

7. CONCLUSIONS AND RECOMMENDATIONS

The presence of twenty species of larger mammals and one hundred forty three species of birds revealed the importance of Alatish for wildlife protection.

High species diversity, evenness and richness in the riverine and bamboo woodland habitats implied the importance of these habitats. The two habitats are comparatively moist as they are near to Alatish and Dinder Rivers. This attracted most large mammals and increased their diversity, evenness and richness in the two habitats. Riverine and wooded grassland habitats had highest large mammalian species diversity in the wet season. However, high large mammalian species diversity, evenness and richness were obtained in the Riverine woodland during the dry season. The concentration of larger mammals in this habitat during the dry season implies the necessity of water for their survival, growth and reproduction. Moreover, the wooded grassland habitat consisted of remnant grass and other vegetation that provided food and cover for the larger mammals. However, habitat degradation and poaching have led to the decline in number and highly disturbed their distribution patterns in Alatish particularly during in the dry season. This made it difficult to establish the distribution pattern and habitat association for the larger mammals.

This study, thus suggested the urgent need for conservation measures. Some of the larger mammalian fauna such as *Papio anubis* and *Orycteropus* are generally confined to the riverine woodland habitats. *Syncerus caffer* made migratory route along Hyma River, south of Alatish. If the present disturbance continues, such species will totally disappear from the area in the near future. The study also revealed the preferred habitats and food for the major species such as *Loxodonta africana* in Alatish. Tree species *Entada africana* seemed the most preferred food for *Loxodonta africana*. The wooded grassland habitat that consisted these tree species is the preferred habitat. However, further study is needed to confirm this. During the dry season deficiency of water is noted in the centre and northern Alatish. This has restricted the occurrence of the species in the south of Alatish during this season. This study, thus suggests the need to look for ways of providing water for Alatish wild animals. Alatish also harbours economically important large mammalian fauna such as *Civetticivis civetta*. But *Civetticivis* species was confined to certain parts of Alatish since the pressure from human activities has reduced its previous range. This indicates the high human

influence on the microenvironment of the larger mammals. Species such as *Ourebia ourebi* was known to occur in large number in Alatish. In this study, however, only few individuals were recorded. This is due to the depletion of important resources as a result of the large number of domestic animals. The distribution of birds species occurred in different habitats based on food availability, water and cover requirement. Accordingly, the wooded grassland habitat had highest avian species diversity and richness during the wet season. During the dry season, however, highest avian species diversity was obtained in the riverine woodland habitat. This clearly shows the response of birds to climatic changes. In general, the study identified that most mammalian and avian species are locally rare and uncommon although Alatish is identified as a rich biodiversity area. Direct and indirect evidences and information from local community elders suggested the occurrence of globally rare, endangered and vulnerable larger mammalian and avian fauna in Alatish. The woody vegetation in Alatish area is also known to protect expansion of desert from the adjoining Sudan region. This has revealed the need to establish a conservation area that maintains the biological diversity in Alatish.

Based on the results of the present study, the followings are recommended: -

1. Mammalian species diversity, richness and evenness were the highest in the riverine and bamboo woodland habitats. However the large number of "Falatas", Rubtanas, Arabs and their domestic animals degrades these habitats during the dry season. Therefore, these habitats should be free from such human activities. "Falatas", Rubtanas and Arabs should be evicted from the Alatish proposed park area so as to maintain the mammalian diversity.
2. Most of the mammalian and avian species in Alatish Park area were locally rare and uncommon. This was because the wildlife habitat is highly disturbed due to poaching, logging tree species and the effect of fire. Thus, poaching should be controlled, as there are globally threatened species such as *Loxodonta africana*. Moreover, rare species such as *Hippotragus equinus* and endangered subspecies such as *Alcelaphus buselaphus tora* are known to occasionally use the area, as it was their previous range of occurrence. In order to attract such species and promote their survival. The area should be protected, managed and developed.
3. Investors that use the surrounding arceras of Alatish are creating pressure on the proposed National Park. Moreover, re-settlers of the northern Alitish are also

threatening the proposed Park. Thus; there should be buffer zone. The region should stop re-settling of people around the proposed Park area.

4. This study identified 143 species of birds. This does not mean only 143 species birds exist in Alatish. There may be more bird species particularly smaller, shy and cryptic ones. Further study should be conducted to fill the gap.
5. The diversity of bird species was the highest in the woodland and bamboo woodland threatened habitats.

The wet season result indicated high species diversity in wooded grassland habitat. Where as, riverine woodland had the highest species diversity during the dry season. However, these habitats were destroyed by fire. Eggs and immature birds were observed in the burnt nests. Therefore, the effect of fire should be controlled and there should be a regulatory mechanism to maintain the birds' genetic diversity especially those with globally bird species in Alatish area.

6. Species distribute themselves in areas of suitable climatic conditions when sufficient food for survival and reproduction is available. Habitat degradation has negative impacts. Species also require safe and secured environment so that their young grow and reach maturity. Urgent conservation measure should be taken to stop habitat loss in Alatish proposed Park.
7. Different species of birds show different habitat association. Therefore, the different vegetation types should be protected from being devastated.
8. Scarcity of water was a big problem in the dry season in Alatish. During this season, many of the larger mammals and birds concentrate nearby Hyma and Alatish Rivers. Therefore, water well should be constructed at a certain intervals in Alatish.
9. Alatish is also rich in other vertebrate species such as fish and reptiles. Moreover, plants were not systematically studied in Alatish. Therefore, a multidisciplinary approach is needed to study and fill the gap.
10. Since the Park harbours diversified species of animals and plants; urgent step should be taken to establish the area as a National Park.

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Appendix -1
Some small mammals of Alatish

Scientific name	groups
<i>Arvicanthis dembeensis</i>	Rodents
<i>Arvicanthis niloticus</i>	"
<i>Desmomys harringtoni</i>	"
<i>Mastomys natalensis</i>	"
<i>Mastomys erythroleucus</i>	"
<i>Myomys albipes</i>	"
<i>Acomys cahirinus</i>	"
<i>Acomys cineraceus</i>	"
<i>Acomys wilsoni</i>	"
<i>Tatera robusta</i>	"
<i>Tatera valida</i>	"
<i>Tatera phillipsi</i>	"
<i>Lemniscomys barbarus</i>	"
<i>Mus musculus</i>	"
<i>Mus tenellus</i>	"
<i>Atelerix albiventris</i>	"
<i>Euxenus erythropus</i>	"
<i>Heliosciurus gambianus</i>	"
<i>Xerus rutilus</i>	"
<i>Paraxerus ochraceus</i>	"
<i>Hystrix cristata</i>	"
<i>Crocidura flavescence</i>	insectivore
<i>Crocidura turba</i>	insectivore
<i>Crocidura fumosa</i>	insectivore
<i>Crocidura smithi</i>	insectivore

Common Name	Scientific Name	Family
Little green bee eater	<i>Merops orientalis</i>	Meropidae
Little ringed plover	<i>Charadrius dubius</i>	Charadriidae
Little rush warbler	<i>Bradypterus baboecala</i>	Muscicapidae
Laughing dove	<i>Streptopelia senagalensis</i>	Columbidae
Long legged buzzard	<i>Buteo rufinus</i>	Accipitridae
Long billed pipit	<i>Anthus similis</i>	Motacillidae
Long crested eagle	<i>Laphaetus occipitalis</i>	Accipitridae
Marabou stork	<i>Leptoptilos crumeniferus</i>	Ciconiidae
Moustached warbler	<i>Melocichla mentalis</i>	Muscicapidae
Malachite king fisher	<i>Chrythornis cristata</i>	Alcedinidae
Martial eagle	<i>Polemaetus bellicosus</i>	Accipitridae
Mountain wagtail	<i>Motacilla alba</i>	Motacillidae
Namaqua dove	<i>Olea capensis</i>	Columbidae
Nightangle	<i>Luscinia megarhynchos</i>	Muscicapidae
Nubian wood pecker	<i>Campethera nubica</i>	Picidae

Common Name	Scientific Name	Family
Nubian shrike	<i>Lanius nubicus</i>	Laniidae
Northern black paradiseflycatcher	<i>Melaenornis edolioides</i>	Muscicapidae
Osprey	<i>Pandion haliaetus</i>	Pandionidae
Pied Kingfisher	<i>Ceryle rudis</i>	Alcedinidae
Pallid flycatcher	<i>Bradornis pallidus</i>	
Pied wagtail	<i>Monticola alba</i>	Motacillidae
Plain backed Pipit	<i>Anthus leucophrys</i>	Motacellidae
Pearl spotted wood owl	<i>Glaucidium perlatum</i>	Strigidae
Red billed hornbill	<i>Tockus erythrorhynchus</i>	Bucerotidae
Red faced cist cola	<i>Cisticola erythrops</i>	Muscicapidae
Red throated bee eater	<i>Merops bullocki</i>	Meropidae
Red eyed dove	<i>Streptopelia semitorquata</i>	Colombidae

Common Name	Scientific Name	Family
Rose-ringed parakeet	<i>Psittacula krameri</i>	Psittacidae
Red-pate cist cola	<i>Cisticola njombe</i>	Muscicapidae
Rappel's long tailed staring	<i>Lampratornis purpuropterus</i>	Sturnidae
Saddle - billed stroke	<i>Ephippiorhynchus senegalensis</i>	Ciconiidae
Scally Francolin	<i>Francolinus squamatus</i>	Phasianidae
Sacred Ibis	<i>Threskiornis aethiopica</i>	Threskiornithidae
Senegal coucal	<i>Centropus senegalensis</i>	Cuculidae
Stone curlew	<i>Burhinus oedicephalus</i>	Burhinidae
Stone partridge	<i>Ptilopachus petrosus</i>	Phasianidae
Supper wing lapwing	<i>Vanellus spinosus</i>	Charadriidae
Speckled pigeon	<i>Columba guinea</i>	Columbidae
Spotted eagle owl	<i>Bubo africanus</i>	Strigidae
Splendid starling	<i>Lamprotonis spenata</i>	Sturnidae
Sand partridge	<i>Ammoperdix heyi</i>	Phasianidae
Square tailed drongo	<i>Dicrurus ludwingi</i>	Dicruridae
Standard wing night jar	<i>Macrodipteryx lorigipennis</i>	Coprimulgidae

Common Name	Scientific Name	Family
White-rumped helmet shrike	<i>Eurocephalus rueppelli</i>	Lanidae
West Nile bishop	<i>Euplectes capensis</i>	Ploceidae
White rumped serin	<i>Serinus leucopygius</i>	Fringillidae
White throated bee eater	<i>Merops albicollis</i>	Meropdae
White fronted bee eater	<i>Merops bullockoildes</i>	Meropidae
White backed duck	<i>Thalassornis leuconotus</i>	Anatidae
Red cheeked cordon blue	<i>Uraeginthus bengalus</i>	Eustrildidae
Zetting cisticola	<i>Cisticola juncidis</i>	Musciicapidae

Appendix 3

Plant species of Alatish proposed national park

Scientific name	Family	Local name
<i>Acacia polyacantha</i>	Fabaceae	Grar
<i>Acacia seyal</i>	Fabaceae	Grar
<i>Adansonia digitata</i>	Bombacaceae	Diza
<i>Anogeissus leiocarpa</i>	Combretaceae	Krekra
<i>Acacia nilotica</i>	Fabaceae	Grar
<i>Allophylus macrobotrys</i>	Sapindaceae	Yeqoqi enchet
<i>Balanites aegyptiaca</i>	Balanitaceae	Lafo
<i>Borassus aethiopicum</i>	Burseraceae	Salen enchet
<i>Boswellia papyrifera</i>	Burseraceae	Yexan zaf (walia)
<i>Bridelia scleroneura</i>	Euphorbiaceae	
<i>Cadaba farinosa</i>	Capparidaceae	
<i>Cissus populina</i>	Vitaceae	
<i>Combretum collinum</i>	Combretaceae	chamida
<i>Combretum harotomannianum</i>	Combretaceae	Foroa
<i>Combretum molle</i>	Combretaceae	Abalo
<i>Dichrostachys cinerea</i>	Fabaceae	
<i>Diospyros mespiliformis</i>	Ebenaceae	Sarkin
<i>Echinops longisetus</i>	Asteraceae	
<i>Entada africana</i>	Fabaceae	Duleta
<i>Eragrostis tremula</i>	Poaceae	Yewofsar
<i>Ficus glumosa</i>	Moraceae	Warka
<i>Ficus sycomorus</i>	Moraceae	Shola
<i>Ficus vasta</i>	Moraceae	Warka
<i>Flueggea virosa</i>	Euphorbiaceae	
<i>Gardenia ternifolia</i>	Rubiaceae	Yeqola wanza
<i>Grewia flavescens</i>	Tiliaceae	Lenquxa
<i>Hygrophila auriculata</i>	Acanthaceae	
<i>Hyparrhenia rufa</i>	Poaceae	Sar
<i>Hyperthelia dissoluta</i>	Poaceae	Sar
<i>Kigelia aethiopium</i>	Bignoniaceae	Afxixe

<i>Lannea fruticosa</i>	Anacardiaceae	Fola
<i>Lonchocarpus laxiflorus</i>	Fabaceae	Hamija
<i>Loudetia arundinacea</i>	Poaceae	Sar
<i>Ochna leucophloeos</i>	Ochnaceae	
<i>Oxytheranthra abyssinica</i>	Poaceae	Shemale
<i>Piliostigma thonningii</i>	Fabaceae	Dawda
<i>Pterocarpus lucens</i>	Fabaceae	Charia
<i>Pennistemon schweinfurthii</i>	Poaceae	
<i>Rottboellia cochinchinensis</i>	Poaceae	
<i>Solanum incanum</i>	Solanaceae	Engudiae
<i>Sorghum arundinaceum</i>	Poaceae	Qelo sar
<i>Sterculia africana</i>	Striculiacea	
<i>Stereospermum kunthianum</i>	Bignoniaceae	Zana zana
<i>Sorgum versicolor</i>	Poaceae	Kelo
<i>Tamarindus indica</i>	Fabaceae	Kumer
<i>Terminalia laxiflora</i>	Combretaceae	Wanbella
<i>Vangueria apiculata</i>	Rubiaceae	Dingy asebir
<i>Ximenia americana</i>	Olacaceae	
<i>Ziziphus spina christi</i>	Rhamnaceae	

<i>Lannea fruticosa</i>	Anacardiaceae	Fola
<i>Lonchocarpus laxiflorus</i>	Fabaceae	Hamija
<i>Loudetia arundinacea</i>	Poaceae	Sar
<i>Ochna leucophloeos</i>	Ochnaceae	
<i>Oxythecanthus abyssinica</i>	Poaceae	Shemale
<i>Piliostigma thomningii</i>	Fabaceae	Dawda
<i>Pterocarpus lucens</i>	Fabaceae	Charia
<i>Pennisetum schweinfurthii</i>	Poaceae	
<i>Rotthoellia cochinchinensis</i>	Poaceae	
<i>Solanum incanum</i>	Solanaceae	Engudiae
<i>Sorghum arundinaceum</i>	Poaceae	Qelo sar
<i>Sterculia africana</i>	Striculiaceae	
<i>Stereospermum kunthianum</i>	Bignoniaceae	Zana zana
<i>Sorghum versicolor</i>	Poaceae	Kelo
<i>Tamarindus indica</i>	Fabaceae	Kumer
<i>Terminalia laxiflora</i>	Combretaceae	Wanbella
<i>Vangueria apiculata</i>	Rubiaceae	Dingy asebir
<i>Ximenia americana</i>	Oleaceae	
<i>Ziziphus spina christi</i>	Rhamnaceae	