

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES



**SPECIES COMPOSITION AND DIVERSITY OF AVIAN
FAUNA OF BEHERETSIGIE, CENTRAL AND FERENCYE
RECREATIONAL PARKS IN ADDIS ABABA, ETHIOPIA**

BY

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DEDICATION

This study is dedicated to my beloved mother Mrs, Tsedale Endale for her affectionate love and persistent pray that I become successful in pursuit of my academic ambitions.

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ABSTRACT

An ecological study on birds in urban habitats was carried out from August 2006 to March 2007 in Beheretsigie, Central and Ferencye Recreational Parks of Addis Ababa, covering both the wet and dry seasons. Total count method was used to obtain data on species composition, diversity and abundance of the avian communities. A total of 47173 individuals of 102 species belonging to 39 families were recorded. The relative abundance of bird species was determined using encounter rates that give crude ordinal scale. The result showed that most of the species were common. Seasonal fluctuation in the abundance of bird species was observed during the study period. Shannon-Wiener and Simpson Similarity Index were used to analyze the diversity and similarity of bird species of the study sites. The species diversity was the highest in Behertsigie ($H' = 3.753$) and the least in Ferencye ($H' = 3.230$) Recreational Parks during both seasons. There were significant differences in the number of species identified in each site during the study period ($\chi^2 = 17.636$, $df = 2$, $p < 0.05$). However, seasonally, at each site, there was no significant difference in the species number. The highest species similarity was obtained between Ferencye and Central Recreational Parks during wet (0.67) and dry (0.73) seasons. The highest percentage similarity between seasons within each park was obtained in Ferencye Recreational Parks (93.3%). The result of the present study has shown that urban recreational parks are rich in avifauna. Long-term studies and assessment of the avian communities on the sites is recommended.

Key words: Birds, recreational parks, species richness, species diversity, species similarity.

1. INTRODUCTION

Ethiopia is host to a variety of life forms. This diversity is the result of the wide range of ecological habitats available to this nation. Ethiopia's boundary encompasses the major part of eastern African highland massif. On the northern and western boundaries lie the foothills of the main massif. The Great Rift Valley cuts diagonally across the country from the Red Sea to Kenya creating a vast depression (Brown *et al.*, 1982; Yalden, 1983). These lowland areas have isolated the highlands resulting in great variation of altitude from 116 m below sea level to 4620 m asl (Ethiopian Mapping Authority, 1988; Hillman, 1993). Rainfall also varied widely in amount and distribution. These factors strongly influenced Ethiopia's extraordinary range of terrestrial and aquatic ecosystems and contributed to the high rate of endemism and genetic diversity. Ethiopia is thus recognized as one of the globally rich biodiversity nations and deserves conservation priority and attention locally, regionally and globally (EWNHS, 1996).

Myers *et al.* (2000) listed 25 global hotspots of the world and stressed the importance of Ethiopian highlands to feature an exceptionally high plant endemism and threat as well, but are not sufficiently documented to meet the hotspot criteria. Since then the number of such hotspots identified has been increased to 34 including the Ethiopian highlands (Conservation International, 2007). It is estimated that between 6500 and 7000 species of higher plants occur in Ethiopia. Of these, 15% is endemic (WCMC, 1992). Ethiopia has been recognized as one of the 12 Vavilov centres of crop diversity (w.w.w.telecom.net. IBCR, 2006). Ethiopia is also the fifth largest floral country in tropical Africa (Brenan, 1978). The country is also rich in its faunistic diversity. Ethiopia harbours 284 species of mammals, of which 31 (11%) are endemic (Yalden *et al.*, 1996; Viveropol, 2001). There are also 201 species of reptiles, 150 species of fresh water fishes, 324 butterfly species and 63 species of amphibians in Ethiopia (Hillman, 1993). Regarding the avifauna, Ethiopia is one of Africa's birding hotspots possessing 925 species (Avi-base, 2005). Of these, 21 species are endemic and 19 are globally threatened species. Most of the endemic birds are widely distributed, chiefly on the south and western highland plateaux (Urban, 1980).

The birds of Ethiopia are from four biome-restricted assemblages: the afro-tropical highland biomes, which form large parts of the central area with 49 species of birds including seven endemic, the Somali-Massai biome, the richest in species, 98 species are recorded of which 6 are endemic, the Sudan-Guinea savannah biome which occupies much of the western part of the country with 16 species and the Sahel biome in a small area of far north with eight bird species (Fishpool and Evans, 2001; Yilma Dellelegn and Mengestu Wondafrash, 2002).

Birds are major indicators of the state of a given environment because they are highly sensitive to habitat changes. Important Birds Area Site (IBAs) inventories have been completed for East Africa (EWNHS, 1996; Bennun and Njoroge, 1999). In total, 228 IBAs have been identified. A remarkable 69 Important Bird Areas (IBAs) were defined by the Ethiopian Wildlife and Natural History Society as part of the Important Bird Areas in Africa and associated islands. Since the publication of EWNHS (1996), the number of IBAs has increased to 73 (Brooks, *et al.*, 2001).

Over the years, the diversity is being affected due to various natural and anthropogenic threats. Inadequate attention has been given to the conservation and sustainable use of birds. Knowledge of wildlife composition and their distribution in the country are very essential. However, except 9 National Parks, 3 Wildlife Sanctuaries, 8 Wildlife Reserves and 18 Controlled Hunting Areas (Hillman, 1993), where limited information is available on the fauna, there is minimal information about the areas outside these designated areas. The unprotected areas can also hold large number of biota.

Addis Ababa, the capital city of Ethiopia, is founded in 1886. The city covers about 540 km² of which 18.2 km² is rural. It is located at the very heart of the country. It encompasses coordinates from 9° 2'N to 38° 42'E. The city lies at the foot of the 3,000 m high Entoto Mountain (Ethiopian Mapping Authority, 1988). Despite its proximity to the equator, Addis Ababa enjoys a mild, afro-alpine and warm temperate climate. The lowest and the highest annual average temperatures range between 9.9° and 24.6°C. It is the third

highest capital city in the world ranging from 2,200 to over 3,000 m on the top of the Entoto Mountain (EWNHS, 1996).

Addis Ababa and its surroundings have a diverse flora, which is home to different species of birds, including a number of endemics. The main types of habitats found in and around Addis Ababa are buildings, gardens, church grooves, gullies, cliffs, streams, open areas, marshy valley, Eucalypts plantations and recreational parks (EWNHS, 1996). According to Sanitation Beautification and Parks Sector Development Programme (SBPSDP) (2004), 405 hectares of land is reserved for Parks development but only 137.2 ha (33.9%) has been so far developed. In Addis Ababa, there are 11 public (government) recreational Parks. These Parks have aesthetical value for the city. City parks are suitable for the survival of birds but are not well documented. The present study is, therefore, to gather information on the status of avifauna in three of the Recreational Parks in Addis Ababa (Beheretsigie, Central and Ferencye).

2. LITERATURE REVIEW

An avifauna is a set of bird species living in a particular geographical area. Avifauna reflect the history of a region, because they are the result of millions of years of evolution, adaptive radiation, dispersal, invasion and extinction (Heywood and Watson, 1995). Birds are well-defined group of animals. They show considerable variation in relation to the demand imposed by their varied habitats and ways of life. These variations include overall size, shape, size of the bill, leg, egg, flying ability and longevity (Welty, 1975; Perrins, 1990). Birds are homogenous in basic body plan and biology. They are the most homogeneous and most easily recognized class of animals (Wallace, 1963; Wallace and Mahan, 1975).

One of the greatest difficulties in the classification of birds is that their structure is very uniform. They are classified by their external forms. Recently, DNA structure and biochemical methods have been employed to reassess certain relationships. McFarland *et al* (1979) and Wilson (1952) mention approximately 9000 different species of birds. Ornithologists estimate the number to be in order of 100 billion. Currently the class Aves includes 29 orders, 201 families, 2073 genera and 10,010 species (Bird classification, 2007).

The fossil record of birds is not extensive. The light hollow bones of birds are not likely to survive as fossils. However, unusually well preserved fossil birds are contributing more to understand the evolution of birds. Scientific evidence indicates that birds are derived from reptiles. The exact departure of birds from early reptiles is not clear from the fossil record (Gill, 1990; Kurochkin, 1995). Understanding the bird evolution is constantly changing as more fossils are excavated. They were once established as a new group of vertebrates because of the diversity in both form and function. Most of the birds that we recognize today had appeared 35 million years ago (Johnstone, 1983; Faaborg,

1988; Chatterjee, 1995). Since then, birds have radiated over the earth displaying wide range of size, form, color, habits and habitats. They are cosmopolitan in distribution living in every continent, all seas and almost all islands (Perrins, 1990). The power of flight allows birds to move easily from one habitat to the other. They are also adapted to every environment that man inhabits.

Each species has its own ecological preference. It is largely a product of the interaction between existing ecological conditions and the species evolutionary history (Bibby *et al.*, 1992; Heywood and Watson, 1995). However, many species share broadly similar distribution patterns. Areas with varied topography and climatic conditions support more species than uniform ones. Terrestrial bird diversity increases from the poles towards the equator. Habitat complexity is greater in the tropics. It provides opportunity for ecological specialization of species. Competition, predation and parasitism are more intense in the tropics permitting more species to coexist using diverse resources (Begon, *et al.*, 1996; Stattersfield, *et al.*, 1998).

The distribution of a species is determined by climate, availability of suitable resources, barriers of dispersal and interspecific interaction with those organisms sharing the same area (Vaughan *et al.*, 2000). On the other hand, home range, territories and microhabitats are indicators of the distribution of individuals within an area of convenient habitats. These are governed by access to important resources. Furthermore, the range of species fluctuates depending on habitat change, competition, predation and climatic change (Smith, 1992).

Some species have limited ranges because of narrow habitat or food requirement. Small geographical range is associated with habitat specialization. Species occupying disturbed or strongly seasonal habitat types may also have large area of distribution. Body size and abundance also affect range size. Large species usually occur at lower densities than small species if their range is very small (Brooke and Birkhead, 1991; Stattersfield *et al.*, 1998).

Impacts of human activities may influence the distribution of birds. The range may become restricted through local extermination or by destruction of its habitat. Humans may also extend the range of a species either by deliberately introducing birds selectively to new areas or accidentally by creating suitable conditions where none existed before (Perrins, 1990).

Birds can exploit seasonal feeding and nesting opportunities. They respond to annual changes, which influence habitat and food availability by using a different set of habitats at different seasons or years. The migratory movement in response to seasonal climatic changes can result in short or long distances (Klaassen, 1996). According to Mackworth-Praed and Grant (1952), in Africa, three kinds of migration can be recognized. Complete migration includes those species which visit Africa during the non-breeding (winter) season from Europe and Asia and normally absent during the remainder of the year, trans-equatorial migration includes those few species, which inhabit drier or humid areas for breeding and in so doing cross the equator and local migration includes those species, which move about following the food supply within Africa.

For birds, rainfall regimes and associated environmental changes are of major importance in determining breeding seasons and annual cycles (Beals, 1970). MacArthur (1964) recognized that birds have short breeding seasons at high latitudes and longer breeding seasons at low latitudes. The seasonality of climatic variables must impose a long-term seasonal pattern on primary production and in turn there is a restricted period of the year during which most birds breed. Birds generally produce young when and where there is ample food (Wyndham, 1986). Bird species that face seasonal irregularity in the availability of food resources shift to feeding on other resources or move to another area where the preferred food resource is available. Where there is no seasonal irregularity in food availability and other factors are held constant, a species can maintain itself throughout the year (Karr, 1976). Karr (1976) stated that complex vegetation structure buffer the effect of seasonality resulting in great stability of resource availability and allows more species to occur.

Birds have been popular with naturalists, amateurs and professionals and are better known than any other comparable group of animals with possible exception of the larger mammals (Pomeroy and Dranzoa, 1997). The abundance and diversity of birds reveal the conditions and impact of destruction or modification of habitats (Jarvis, 1993). The presence of rare or endangered species, concentration of species, affiliations of certain species with important ecosystems at a site have shown parallel significance for biodiversity (WCMC, 1992). Birds are among the most sensitive and valuable indicators of the health of our natural environment. They are an attractive choice as bio-indicators. They have long been used as a source of material for the chemical analysis of environmental pollutants (Diamond and Filion, 1987).

Birds are the single major taxon most commonly used to set conservation priorities because they are widespread, diverse, easily surveyed, taxonomically well known and have a broad popular appeal (Bibby *et al.*, 1992; Brooks *et al.*, 2001). There is a good overlap in endemism between birds and other taxa. Saving the restricted range for birds will therefore help the long-term survival of other threatened fauna and flora (Yilma Dellelegn and Mengistu Wondafrash, 2002). Birds form good flagship species for conservation, education, advocacy and raising public awareness (Furness and Greenwood, 1993).

Birds are important for ecosystem processes in which they play key roles, such as pollination, seed dispersal, scavenging offal and as predatory of herbivorous insects and pests (Sigel *et al.*, 2006). Birds also act as carriers of diseases of man and other animals, temporary host of disease vectors and spread some plant diseases and parasites through their feet and beaks. Quelea species at times do great damage to human food supplies (Pomeroy, 1992).

Wildlife also occur outside forest areas. For example, urban wildlife forms are well recognized. Urban environments are also being recognized as special ecosystems. A great deal of ecological work has been done on urban birds (Clergeau, *et al.*, 1998). Population ecology, community dynamics and habitat relationship of these diverse and mobile

groups are well understood in natural and in urban habitats. It is important to focus on the impact of urbanization on avian species and community. Cities are enormously complex. It includes a built environment and anthropogenic alteration to the biotic and abiotic environment. Urban areas are spatially heterogeneous (Bowman and Marzluff, 2001). As cities grow and expand, the urban environment replaces and modifies a large portion of the natural habitat. This habitat loss results in some of the highest rates of local extinction of a range of native fauna, including avian assemblage (Parsons *et al.*, 2006).

Urbanization affects diversity of birds (Blair, 1996). In urban ecosystem, bird species richness is affected by both the abundance and diversity of vegetation and by habitat heterogeneity (Lancaster and Rees, 1979; Natuhara and Imai, 1996). Local features (site level) are more important than regional features (landscape level) in structuring urban bird communities (Clergeau, *et al.*, 1998). Site-specific actions such as shrubs and tree planting, water restoration and increasing vegetation diversity can change bird diversity in towns. Modification of habitats has produced similar ecological structures in urban areas even in different geographical regions. The response of birds to the environmental changes could lead to the dominance of bird communities by a few very abundant species. Thus, urbanization might lead to uniform bird communities in urban areas (Beissingers and Osborne, 1982; Bezzel, 1985; Thompson *et al.*, 1993; Jokimäki *et al.*, 1996; Marzluff, 2001; Jokimäki *et al.*, 2002). This result agrees with the view of Blondel *et al.* (1984) that similar kinds of habitat, independently of the geographical location, have similar animal communities. The more humans manipulate the environment, the more similar the bird communities become (Blair, 2001).

Increase in bird abundance in urban environment is due to higher resource abundance in cities and species interactions (Emelen, 1974; Bolger, 2001; Mennechez and Clergeau, 2001), a decrease in predation pressure (Marzluff, 2001) and nest predation (Major *et al.*, 1996; Jokimäki and Huhta, 2000). In addition to natural food, urban birds obtain food from feeders, exotic vegetation and human refuse (Schochat, *et al.*, 2004).

Urban birds forage primarily on the ground, and secondarily in the canopy (Beissinger and Osborne, 1982). Urban lawns have higher net productivity and food utilization by birds. Species that forage on lawns are assured by repeatedly finding suitable food items (Falk, 1976). Because of the increased visibility afforded by lawns, the probability of detecting and escaping predators increases. In addition, ground birds use less energy walking than flying birds in other strata (Kendeigh, 1972). Thus, ground-gathering species dominate urban bird communities.

Bird species diversity theoretically increases with habitat diversity (MacArthur and MacArthur, 1961). However, the volume of foliage is less in the towns for all layers and is a critical resource that limits food density and diversity, nest placement and predator avoidance and escape. Hooper *et al.* (1975) indicated the influence of vegetation cover, particularly shrubs and canopy layers, on the diversity of birds in urban areas. The type of vegetation cover also influences avian communities. Ornamental trees, often fruit bearers, provide different source of food for omnivorous and seed-eating birds (Beissinger and Osborne, 1982). Urban bird communities are composed mostly of omnivorous species that are adapted to human behaviour and to various human by-products. Other species (seedeaters, insectivores and frugivores) join the omnivores due to the availability of other resources (Clergeau *et al.*, 1998).

Surrounding habitat features may affect bird community structures and bird diversity in urban areas (Jokimäki, 1999). However, Erz (1966) and Clergeau *et al.* (2001) suggested that bird species do not colonize newly urbanized areas from the surrounding countrysides, but immigrate from already urbanized populations. Urban bird communities are composed of species not common in the surrounding landscapes (Clergeau *et al.*, 1998). This implies that local features are more important than surrounding landscapes. An urban habitat is an ecosystem with its own biological processes and unique species composition. However, more ecological studies are needed to address the issue properly. A better understanding of this modified and evolving ecosystem contributes to a better management of increasing bird- people conflicts and assists in improving the quality of urban life (Clergeau *et al.*, 1998). The inevitable loss of natural habitat following

urbanization could have a major impact on biodiversity. Green areas, gardens and recreational Parks are the main contributors to urban biodiversity in developed nations (Chamberlain, *et al.*, 2004). These areas constitute a very important habitat to cities. The Recreational Parks in Addis Ababa are used as refugia for many species of birds. Habitat structure is an indication of availability of resources for birds such as foraging sites, nesting and protection from predators. Thus, the proposed study is intended to add further on the avian fauna in a fast developing capital city, Addis Ababa.

3. OBJECTIVES

3.1. General objective

To generate basic information on the species composition, diversity and relative abundance of the avian fauna of Beheretsigie, Central and Ferencye Recreational Parks in Addis Ababa.

3.2. Specific objectives

- To study the species composition of avian fauna of the study areas,
- To assess the relative abundance of the bird species in the study areas,
- To identify the possible factors that regulate the richness of avian fauna in the study sites,
- To assess the diversity of bird species in the study sites, and
- To determine the impact of season on the population size of avian in urban areas

4. THE STUDY AREA AND METHODS

4.1. The Study Areas

Addis Ababa is the capital city as well as the political and cultural centre of Ethiopia. It is also the official diplomatic capital of the United Nations Economic Commission for Africa (ECA). Moreover, it houses the Headquarters of the African Union (AU) since 1963. The Addis Ababa city was founded in 1886 having 50,000 inhabitants, mostly of military and their families (Addis Ababa city council, 2007). In 2004, the population of the city was estimated to be around 3 million (ORAAMP, 2002). The area of the city is approximately 54000 ha. The built up area covers 35,826 ha with a gross population density of 55.5 persons per ha (LDA, 2004).

There are 11 major functional and formal recreational parks with the total area of 110 ha in Addis Ababa. At present, social services are given in the recreational areas such as wedding ceremony, supply of flowers and tree seedlings.

The present study sites comprised of three (Beheretsigie, Central and Ferencye Recreational Parks) recreational parks. These sites were selected as representatives of the typical form of urban recreational areas. All these sites were developed more than 30 years ago. Selection was made depending on the age, vegetation cover, size and location of the recreational parks. Beheretsigie, Central and Ferencye Recreational Parks represent urban parks in the city with natural, exotic wooded plantation and areas of wetland.

4.1.1. Location

The altitude of the city varies from 2,200 to over 3,000 m asl. The topography is high in the north and west, relatively flat in the southwest and southeast and bisected by deep gorges and rivers crossing the city from north to south (ORAAMP, 2002). Beheretsigie covers an area of 110,000 m². It encompasses coordinates from 08° 57.10'N to 38° 44.37'E with an altitude of 2198 m (Fig. 1). Ferencye covers an area of 54,000 m². It

encompasses coordinates from $09^{\circ} 02.92'N$ to $38^{\circ} 46.52'E$ at an altitude of 2483 m (Fig. 2). The Central Park covers an area of $80,000 \text{ m}^2$. It lies between $09^{\circ} 00.02'N$ and $38^{\circ} 46.35'E$, at an altitude of 2343 m (Fig. 3).

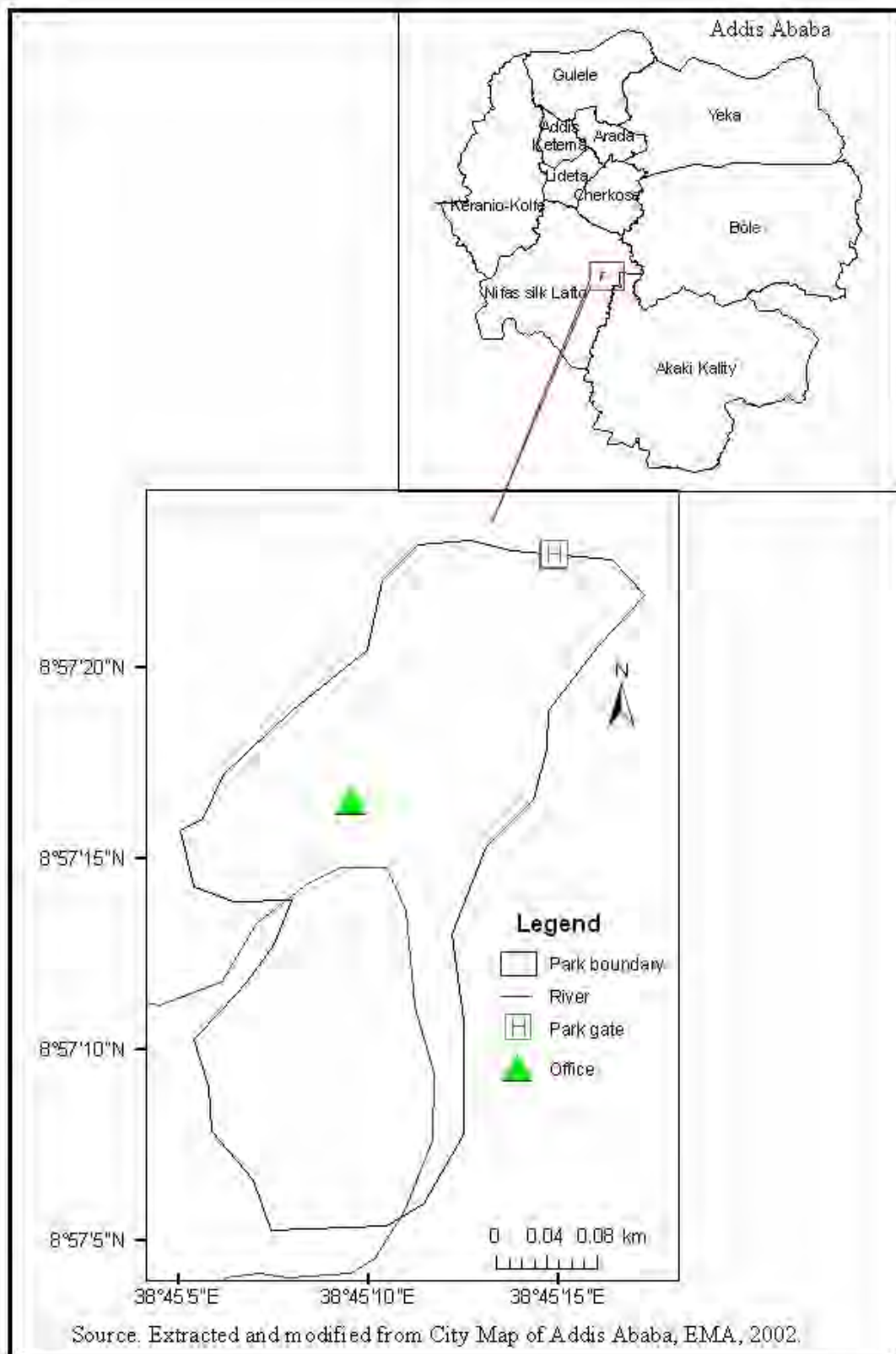


Figure 1. Map of the study area - Beheretsigie Recreational Park.

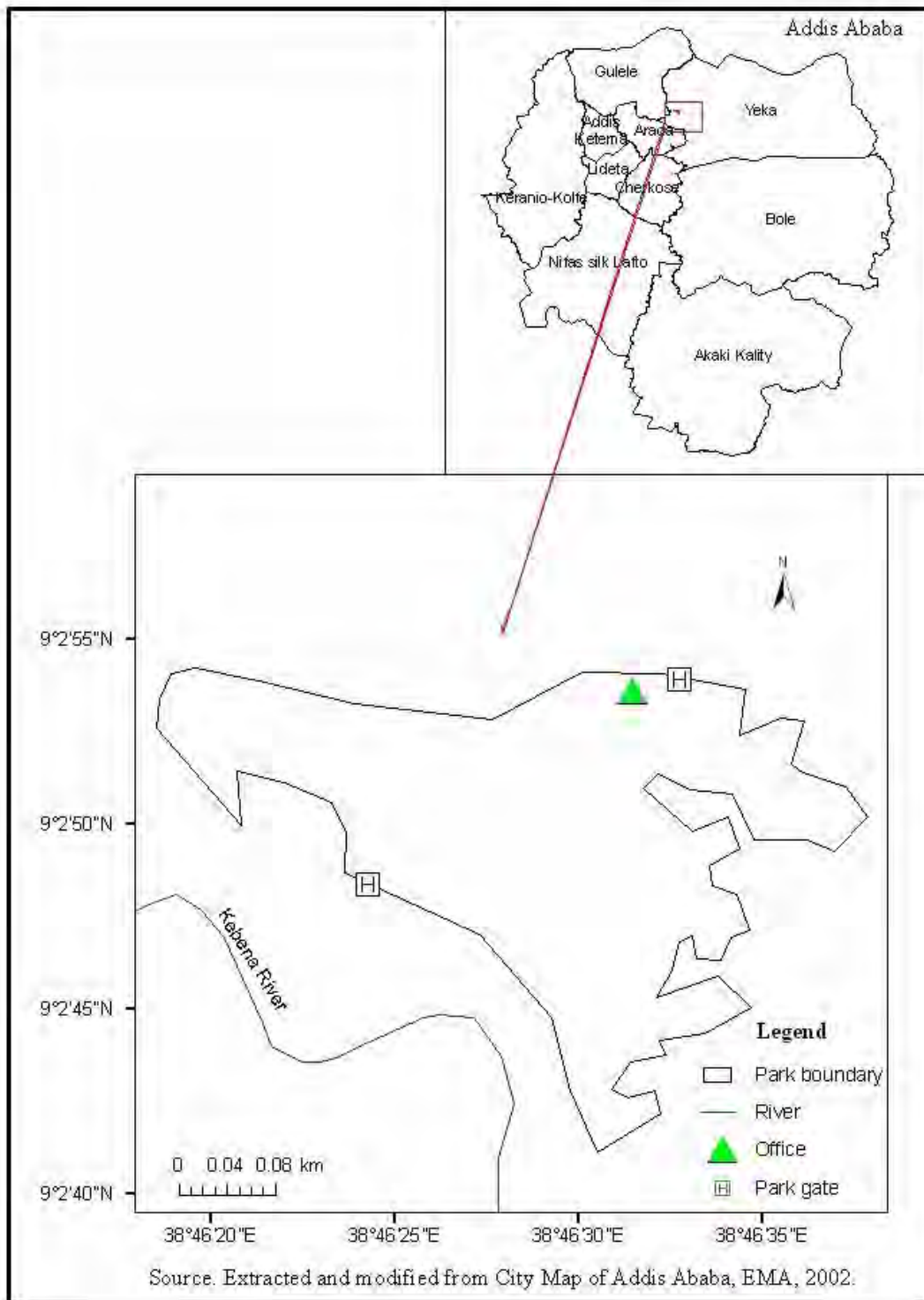


Figure 2. Map of the study area - Ferencye Recreational Park.

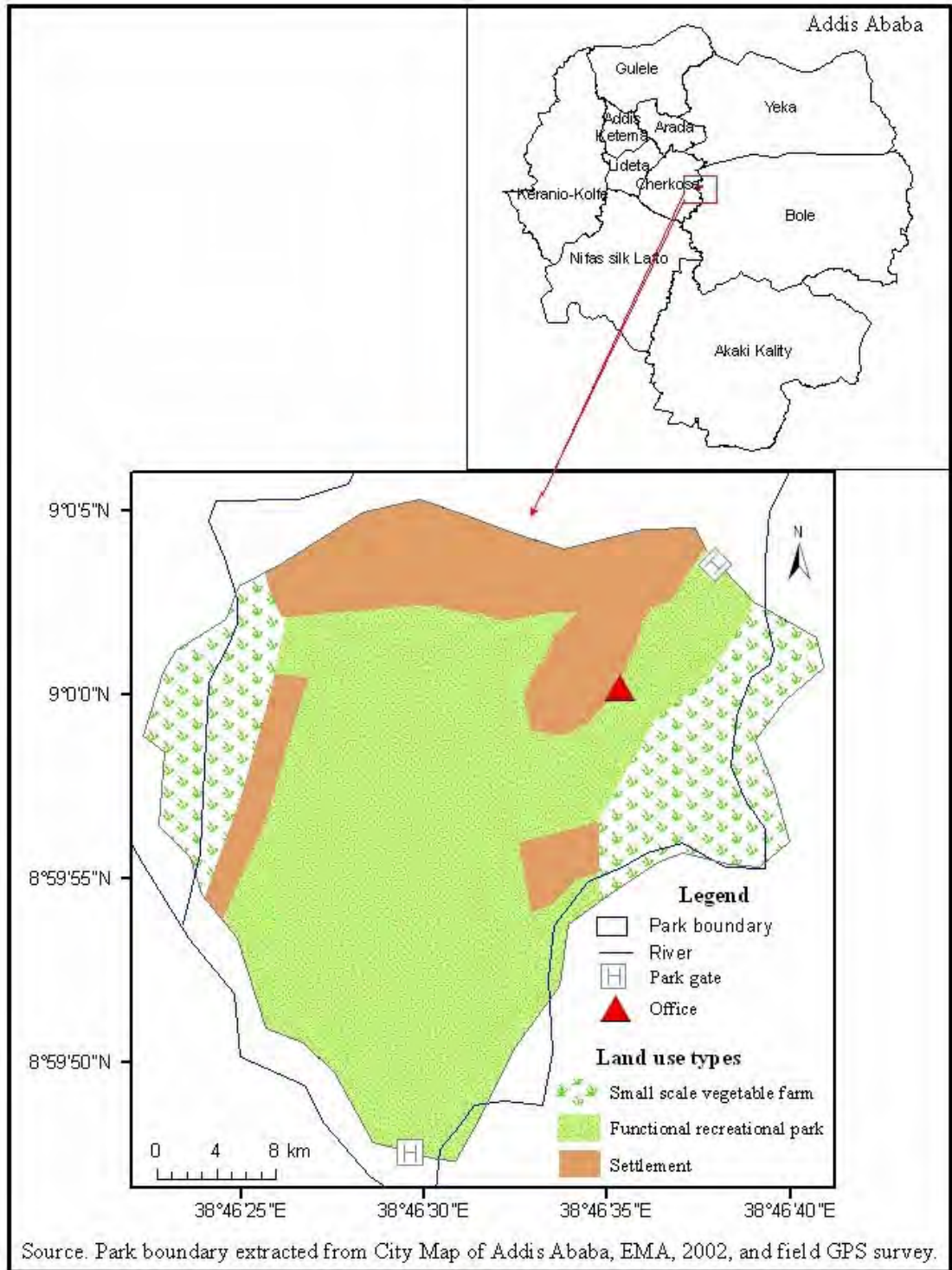


Figure 3. Map of the study area - Central Recreational Park

4.1.2. Climate

Addis Ababa is characterized by distinct seasons that are locally known as Bega, Belg and Kiremet. The average minimum temperature ranges between 9.09°C and 12.32°C and the average maximum temperature ranges between 21.3°C and 25.9°C (Fig. 4).

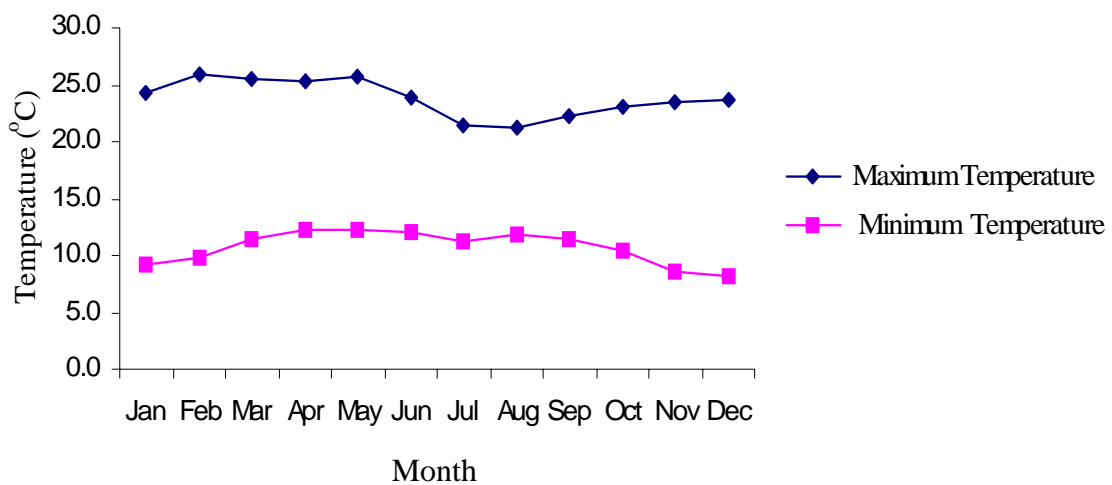


Figure 4. Monthly average maximum and minimum temperature of Addis Ababa during 1997 – 2006. Source: National Meteorological Service Agency (2006).

Addis Ababa has a bimodal rainfall distribution, with two rainy seasons separated by a short dry period. The mean monthly rainfall data of the last 10 years (1997 –2006) of the area shows that it gets low rainfall between March-May and high rainfall between July – September. The average monthly rainfall distribution varies between 9.29 – 290.42 mm (Fig. 5).

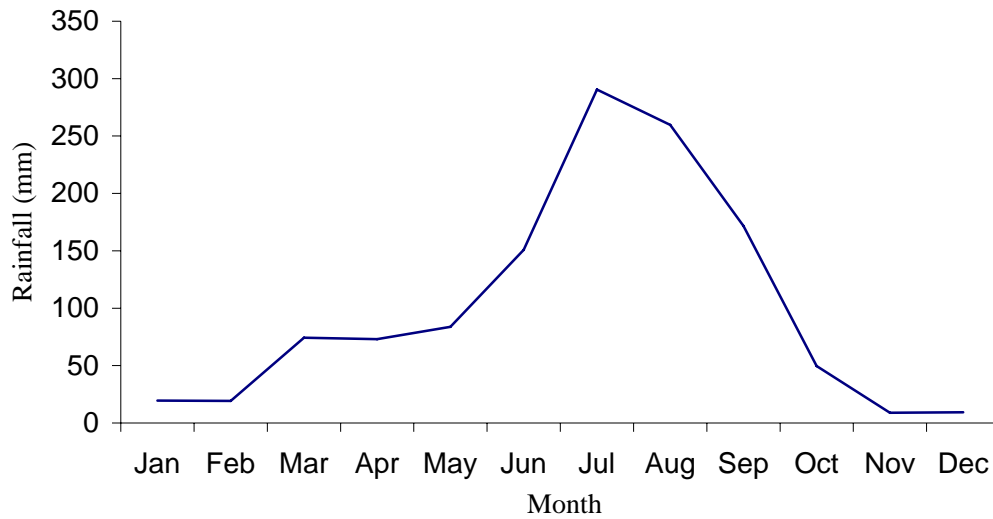


Figure 5. Monthly average rainfall of Addis Ababa during 1997-2006.

Source: National Meteorological Service Agency (2006).

4.1.3. Vegetation

The original natural vegetation of Addis Ababa was dry evergreen montane forest and woodland (Tamrat Bekele, 1994). Consequently, the areas under natural vegetation have dwindled as a result of anthropogenic activities. In Addis Ababa, the natural vegetation had been replaced by built up habitat, cultivation and wooded plantation, mostly Eucalypts.

The structure of the city vegetation varies. It has a habitat with lawns, ornamental vegetation, gardens, recreational city parks as well as fragments of original forest vegetation. Recreational city parks are dominated by wooded plantation of both indigenous and exotic plant species.

Beheretsigie Recreational Park is characterized by mixed and scattered vegetation type composed of large trees, herbs, bushes and grass. Riparian vegetation also occurs along the River Akaki that crosses one of the study areas (Plate 1A-D). The dominant species are *Podocarpus falcatus*, *Vernonia amygdalia*, *Phoenix reclinata*, *Olea europaea*, *Acacia*

abyssinica, *Hagenia abyssinica*, *Juniperus procera*, *Calistemos cirtinus*, *Jacaranda mimosipholia*, *Gravilia robusta* and *Pennisetum* spp.

In Central Recreational Park, open lawns mixed with garden areas, patches of Eucalypts vegetation and a cleared area that is replaced by concrete characterize the habitat (Plate 2 A-D). The dominant plant species is Eucalypts (*Eucalyptus globulus*, *Eucalyptus citriodora* and *Eucalyptus saligna*).

Ferencye Recreational Park has an even distribution of the dominant trees, almost no understory of bushes or shrubs and less developed grass cover (Plate 3A-D). The dominant species are *Olea europaea*, *Juniperus procera* and *Podocarpus falcatus*.

4.2 Methods

4.2.1. Data collection

The study on the species composition and diversity of avifauna in the study sites were carried out from August to November 2006 for the wet season and from January to March 2007 for the dry season. Bird species were recorded on the weekly basis from early morning (06:00 – 10:00 h) and late afternoon (15:00 – 18:00 h), when most of the species were active.

As these study sites are small in size, census was carried out by total count method (Jones, 1998; Krebs, 1999; Sutherland, 2000; Rosenstock *et al.*, 2002; Urfi *et al.*, 2005). Total count census was performed in a defined area and collected information on species composition and diversity. During the census period every individual observed and identified were recorded. Birds flying overhead were included, if they were specifically associated with the habitat.

During the study period, the observer could move anywhere within the park for the identification of the species of birds. The observer moved through all parts of the area, concentrating on places where birds actively were greatest. No constant route was

followed. The route varied so that over a series of counts the area was covered thoroughly.

The data recorded for each site were date, start and end time, bird species and abundance. Abundance was established by calculating the mean species abundance from the census. Birds were visually detected with unaided eye and for clear identification binocular was used. Individuals observed during the study period were identified to the species level using field guide books Mackworth-Praed and Grants (1952; 1955), Urban and Brown (1971), Pain *et al.* (1975), Williams and Arlott (1980), Van Perlo (1995) and Avibase checklist of the World-Ethiopia (2005).

4.2.2. Data Analysis

Shannon-Wiener index was used to estimate bird species diversity. The similarity indices was used to measure the degree to which the species are shared between different communities (Bibby *et al.*, 1998). Simpson's similarity index was used to determine the similarities in between parks and seasons. Crude ordinal scale of abundance was used to determine the relative abundance of birds using encounter rates. SPSS version 13.0 software program and Chi-square tests were used to assess the species diversity between seasons and recreational parks. Excel computer program was also used to analyze data and draw graphs.

5. RESULTS

During wet and dry seasons, 47173 individuals of birds, representing 102 species, belonging to 17 orders and 39 families were recorded (Table 1).

Table 1. Bird species observed in Beheretsigie, Central and Ferencye Recreational city Parks during both seasons during the study period.

Family	Common Name	Scientific Name
Scopidae	Hammerkop ● ◆	<u>Scopus umbrella</u>
Scopidae	Hadada Ibis ● ◆	<i>Scopus umbretta</i>
Threskiornithidae	Wattled Ibis ♥	<i>Bostrychia hagedash</i>
Threskiornithidae	Egyptian Goose ♥	<i>Bostrychia carunculata</i>
Anatidae	African Black Duck ◆ ♥	<i>Alopochen aegyptiaca</i>
Anatidae	Black-shouldered Kite ♥	<i>Anas sparsa</i>
Accipitridae	Black Kite* ♥	<i>Elanus caeruleus</i>
Accipitridae	African Fish-Eagle♥	<i>Milvus migrans</i>
Accipitridae	Hooded Vulture ♠ ♣	<i>Haliaeetus vocifer</i>
Accipitridae	White-backed Vulture ♣	<i>Necrosyrtes monachus</i>
Accipitridae	Lappet-faced Vulture ♠ ♣	<i>Gyps africanus</i>
Accipitridae	White-headed Vulture ▲ ♥	<i>Torgos tracheliotus</i>
Accipitridae	African Harrier-Hawk ♠ ◆	<i>Trigonoceps occipitalis</i>
Accipitridae	Lizard Buzzard ● ▲	<i>Polyboroides typus</i>
Accipitridae	Augur Buzzard ♥	<i>Kaupifalco monogrammicus</i>
Accipitridae	Tawny Eagle* ♥	<i>Buteo augur</i>
Accipitridae	Long-crested Eagle ● ◆	<i>Aquila rapax</i>
Accipitridae	Erckel's Francolin ◆♥	<i>Lophaetus occipitalis</i>
Phasianidae	Rouget's Rail ♥	<i>Francolinus erckelii</i>
Rallidae	Common Moorhen ◆♥	<i>Rougetius rougetii</i>
Rallidae	Common Sandpiper ◆♥	<i>Gallinula chloropus</i>

Contd'

Scolopacidae	Green Sandpiper ♦ ♥	<i>Actitis hypoleucos</i>
Scolopacidae	Wood Sandpiper ♥	<i>Tringa ochropus</i>
Scolopacidae	Speckled Pigeon* ♥	<i>Tringa glareola</i>
Columbidae	White-collared Pigeon ▲ ♥	<i>Columba guinea</i>
Columbidae	Dusky Turtle-Dove* ♥	<i>Columba albitorques</i>
Columbidae	Red-eyed Dove* ♥	<i>Streptopelia lugens</i>
Columbidae	Black-winged Lovebird* ♥	<i>Streptopelia semitorquata</i>
Psittacidae	Levaillant's Cuckoo●♦	<i>Agapornis taranta</i>
Cuculidae	Klaas' Cuckoo●♦	<i>Clamator levaillantii</i>
Cuculidae	African Wood-Owl ● ▲	<i>Chrysococcyx klaas</i>
Strigidae	Speckled Mousebird* ♥	<i>Strix woodfordii</i>
Coliidae	Little Bee-eater ♥	<i>Colius striatus</i>
Meropidae	Blue-breasted Bee-eater ♥	<i>Merops pusillus</i>
Meropidae	European Bee-eater ♠ ♣	<i>Merops variegatus</i>
Meropidae	Eurasian Hoopoe ♠ ♦	<i>Merops apiaster</i>
Upupidae	Banded Barbet ♦♥	<i>Upupa epops</i>
Capitonidae	Eurasian Wryneck●♦	<i>Lybius undatus</i>
Picidae	Rufous-necked Wryneck●♦	<i>Jynx torquilla</i>
Picidae	Abyssinian Woodpecker ♠ ♣	<i>Jynx ruficollis</i>
Picidae	Cardinal Woodpecker ●♦	<i>Dendropicos abyssinicus</i>
Picidae	Gray Woodpecker* ♥	<i>Dendropicos fuscescens</i>
Picidae	Red-rumped Swallow*	<i>Dendropicos goertae</i>
Hirundinidae	Tree Pipit ● ♣	<i>Cecropis daurica</i>
Motacillidae	African Pied Wagtail ♥	<i>Anthus trivialis</i>
Motacillidae	Yellow Wagtail ♥	<i>Motacilla aguimp</i>
Motacillidae	Gray Wagtail●♦	<i>Motacilla flava</i>
Motacillidae	Mountain Wagtail●♦	<i>Motacilla cinerea</i>
Motacillidae	Common Bulbul* ♥	<i>Motacilla clara</i>
Pycnonotidae	Groundscraper Thrush ♦ ♥	<i>Pycnonotus barbatus</i>
Turdidae	Olive Thrush●♦	<i>Psophocichla litsipsirupa</i>

Contd'

Turdidae	Singing Cisticola ♠ ♦	<i>Turdus olivaceus</i>
Cisticolidae	Winding Cisticola ♦ ♥	<i>Cisticola cantans</i>
Cisticolidae	Stout Cisticola ♥	<i>Cisticola galactotes</i>
Cisticolidae	Pectoral-patch Cisticola ♦ ♥	<i>Cisticola robustus</i>
Cisticolidae	Tawny-flanked Prinia* ♥	<i>Cisticola brunnescens</i>
Cisticolidae	Green-backed Camaroptera	<i>Prinia subflava</i>
Cisticolidae	Yellow-bellied Eremomela ♠ ♦	<i>Camaroptera brachyura</i>
Sylviidae	Willow Warbler ♦ ♥	<i>Eremomela icteropygialis</i>
Sylviidae	Common Chiffchaff ♦ ♥	<i>Phylloscopus trochilus</i>
Sylviidae	Wood Warbler ● ♦ ♥	<i>Phylloscopus collybita</i>
Sylviidae	Garden Warbler ♦ ♥	<i>Phylloscopus sibilatrix</i>
Sylviidae	Brown Warbler* ♥	<i>Sylvia borin</i>
Sylviidae	Abyssinian Slaty-Flycatcher* ♥	<i>Parisoma lugens</i>
Muscicapidae	African Dusky Flycatcher ♣ ♥	<i>Melaenornis chocolatinus</i>
Muscicapidae	Rueppell's Robin-Chat*♥	<i>Muscicapa adusta</i>
Muscicapidae	Pied Wheatear● ♣	<i>Cossypha semirufa</i>
Muscicapidae	White-winged Cliff-Chat ● ♦	<i>Oenanthe pleschanka</i>
Muscicapidae	Black-headed Batis ♦ ♥	<i>Thamnolaea semirufa</i>
Platysteiridae	African Paradise-Flycatcher* ♥	<i>Batis minor</i>
Monarchidae	Abyssinian Catbird ▲ ♥	<i>Terpsiphone viridis</i>
Timaliidae	White-backed Black-Tit* ♥	<i>Parophasma galinieri</i>
Paridae	Spotted Creeper ● ▲	<i>Melaniparus leuconotus</i>
Certhiidae	Tacazze Sunbird* ♥	<i>Salpornis spilonotus</i>
Nectariniidae	Variable Sunbird* ♥	<i>Nectarinia tacazze</i>
Nectariniidae	African Yellow White-eye♥	<i>Cinnyris venustus</i>
Zosteropidae	Montane White-eye* ♥	<i>Zosterops senegalensis</i>
Zosteropidae	Common Fiscal ● ♦	<i>Zosterops poliogastrus</i>
Laniidae	Northern Puffback ● ♦	<i>Lanius collaris</i>
Malaconotidae	Tropical Boubou ♥	<i>Dryoscopus gambensis</i>
Malaconotidae	Cape Crow● ♣	<i>Laniarius aethiopicus</i>

Contd'

Corvidae	Pied Crow ♥	<i>Corvus capensis</i>
Corvidae	Thick-billed Raven ♣ ♥	<i>Corvus albus</i>
	Greater Blue-eared Glossy-	
Corvidae	Starling ● ♦	<i>Corvus crassirostris</i>
Sturnidae	Red-billed Oxpecker* ♥	<i>Lamprotornis chalybaeus</i>
Sturnidae	Gray-headed Sparrow* ♥	<i>Buphagus erythrorhynchus</i>
Passeridae	Swainson's Sparrow* ♥	<i>Passer griseus</i>
Passeridae	Baglafaecht Weaver* ♥	<i>Passer swainsonii</i>
Ploceidae	Spectacled Weaver* ♥	<i>Ploceus baglafaecht</i>
Ploceidae	Speke's Weaver ● ♦	<i>Ploceus ocularis</i>
Ploceidae	Black-headed Weaver ● ♦	<i>Ploceus spekei</i>
Ploceidae	Yellow-bellied Waxbill ▲ ♥	<i>Ploceus melanocephalus</i>
Estrildidae	Red-cheeked Cordon bleu* ♥	<i>Coccygia quartinia</i>
Estrildidae	Red-billed Firefinch* ♥	<i>Uraeginthus bengalus</i>
Estrildidae	Bronze Mannikin* ♥	<i>Lagonosticta senegala</i>
Estrildidae	Village Indigobird	<i>Spermestes cucullatus</i>
Viduidae	Yellow-crowned Canary ● ♦	<i>Vidua chalybeata</i>
Fringillidae	Abyssinian Siskin ● ♦	<i>Serinus flavivertex</i>
Fringillidae	African Citril ● ♦	<i>Serinus nigriceps</i>
Fringillidae	Yellow-fronted Canary ● ♦	<i>Serinus citrinelloides</i>
Fringillidae	Streaky Seed eater* ♥	<i>Serinus mozambicus</i>
Fringillidae	Brown-rumped Seed eater* ♥	<i>Serinus striolatus</i>

* Species observed in parks.

♦ Species observed only in Beheretsigie Park.

● Species observed during the wet season. ♣ Species observed only in Central Park.

♠ Species observed during the dry season. ▲ Species observed only in Ferencye Park.

♥ Species observed during both seasons.

Out of the recorded species in the three recreational parks, three were endemic to Ethiopia and nine species of birds were shared between Ethiopia and Eritrea (Table 2). Black-winged Lovebird, Abyssinian slaty-flycatcher and white-backed black-tit were

observed throughout the recreational parks while Wattled ibis and Rouget's rail were distributed in Beheretsigie and Central Recreational Parks. Abyssinian siskin, Banded barbet and White-winged cliff-chat were seen only in Beheretsigie, Thick-billed raven and Abyssinian woodpecker occurred only in Central and Abyssinian catbird and white-collared pigeon were only seen in Ferencye Recreational Parks. Among the recorded species, 63 were residents, 15 were Palaearctic migrants with resident subspecies in Ethiopia, and two species were African migrants. 28 and eight species of birds were observed exclusively during the wet and dry seasons, respectively. The Family Accipitridae was represented by 12 species. Families Sylviidae, Cisticolidae and Fringillidae were represented by six species each and the rest of the Families identified in the recreational parks ranged between one and five. From the identified families, 22 were from the Order Passeriformes.

Table 2. Endemic birds observed in the recreational parks in Addis Ababa.

No	Endemic	Endemic to Ethiopia and Eritrea
1	Abyssinia catbird	Abyssinian slaty flycatcher
2	Abyssinian woodpecker	Black winged lovebird
3	Abyssinian siskin	Banded barbet
4		Rouget's rail
5		Thick-billed raven
6		Wattled ibis
7		White-baked black tit
8		White collared pigeon
9		White winged cliff chat

During the wet season, a total of 94 species was recorded in the recreational parks. There were only 71 bird species during the dry season. The difference in this overall number of species between the two seasons was not statistically significant ($\chi^2 = 3.206$, $df = 1$, $p = .073$). The highest number of species recorded was in Beheretsigie Recreational Park during both the wet and dry seasons. A total of 80 and 58 species were observed in this study site during wet and dry seasons, respectively. In all study sites, the number of

observed bird species decreased during dry season compared to wet season. Species richness in the three sites ranged from 39 to 80 species during wet season and from 36 to 58 during dry season. Species richness was highest in Beheretsigie (84 species), followed by Central (52 species) and Ferencye (40 species). There was a difference in species richness among Beheretsigie (22), Central (4 species) and Ferencye (3 species) recreational parks between wet and dry seasons (Fig. 6). The difference in species richness between seasons was not statistically significant at Beheretsigie, ($\chi^2 = 3.507$, $df = 1$, $p = .061$), Central, ($\chi^2 = 0.178$, $df = 1$, $p = .673$), and Ferencye, ($\chi^2 = 0.120$, $df = 1$, $p = .729$). Seasons did not have significant effect on the species number.

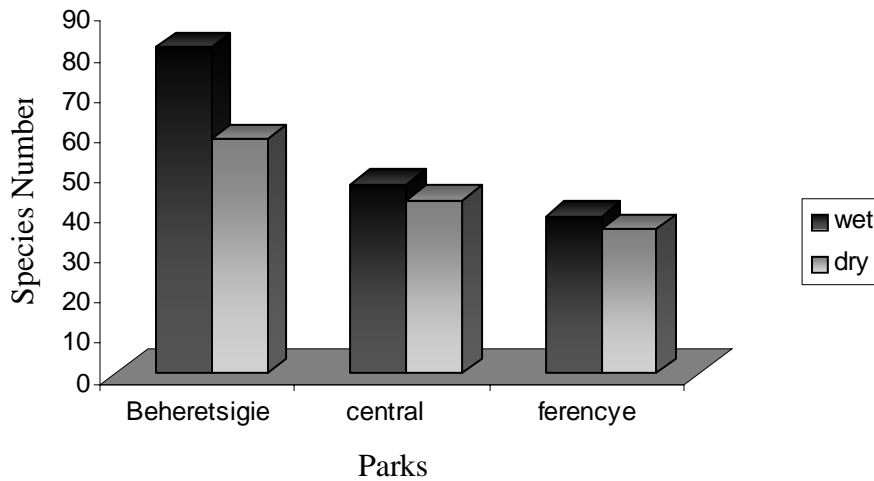


Figure 6. Species richness of birds in Recreational Parks during the wet and dry seasons.

Species diversity of birds was highest in Beheretsigie ($H' = 3.766$) and least in Ferencye ($H' = 3.150$) recreational parks during the wet season. Species were least evenly distributed in Ferencye and Beheretsigie Recreational Parks during the wet season (Table 3).

Table 3. Wet season bird species diversity in the Recreational Parks.

Park	Species richness	Abundance	H'	H'/Hmax
Beheretsigie	80	12,584	3.766	0.860
Central	47	6,157	3.340	0.868
Ferencye	39	7,271	3.150	0.860

During the dry season, diversity of species was found highest in Beheretsigie ($H' = 3.541$) and lowest was in Ferencye ($H' = 3.236$) Recreational Parks. The highest level of evenness was also in Ferencye during the dry season (Table 4).

Table 4. Dry season bird species diversity in the Recreational Parks.

Park	Species richness	Abundance	H'	H'/Hmax
Beheretsigie	58	9,479	3.541	0.873
Central	43	5,572	3.333	0.887
Ferencye	36	6,110	3.236	0.904

The highest species diversity was obtained in Beheretsigie when the two seasons were combined. Species of birds were more evenly distributed in Ferencye than in Beheretsigie and Central Recreational Parks (Table 5).

Table 5. Diversity of birds during both dry and wet seasons.

Park	Species richness	Abundance	H'	H'/Hmax
Beheretsigie	84	22063	3.753	0.848
Central	52	11729	3.378	0.855
Ferencye	40	13381	3.230	0.876

In terms of species richness and diversity, Beheretsigie, Central and Ferencye Recreational Parks were similar during the dry ($r = .988$) season than the wet ($r = .954$) season (Fig. 7). Correlation was significant at the level of 0.01 ($p = .000$).

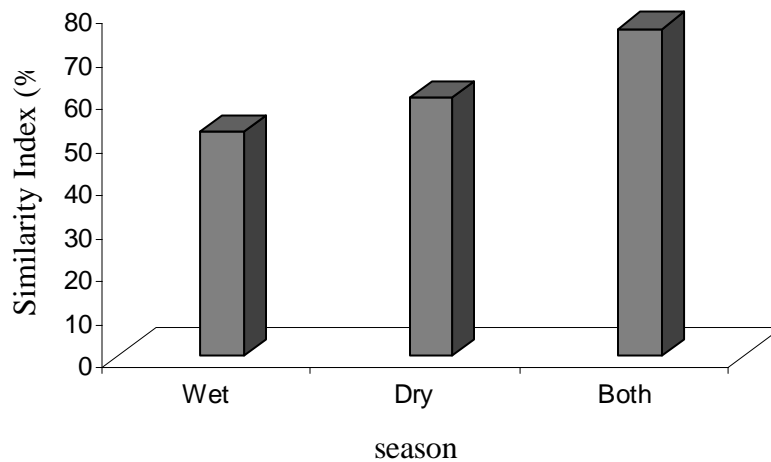


Figure 7. Species diversity similarity among recreational parks during wet and dry Seasons.

Bird communities showed high similarity between the Central and Ferencye Recreational Parks during the dry season. The result also revealed less similarity between Beheretsigie and Ferencye Parks. Values for bird species similarity between Recreational Parks ranged from 0.64 to 0.73 during the dry season (Table 6).

Table 6. Species similarity among the Recreational Parks during the dry season.

Park	Beheretsigie	Central	Ferencye
Beheretsigie		0.69	0.64
Central	0.69		0.73
Ferencye	0.64	0.73	

During the wet season, species similarity between Central and Ferencye Recreational Parks was high. However, Beheretsigie and Ferencye Recreational Parks showed less similarity in bird species (Table 7).

Table 7. Species similarity among the Recreational Parks during the wet season.

Park	Beheretsigie	Central	Ferencye
Beheretsigie		0.63	0.52
Central	0.63		0.67
Ferencye	0.52	0.67	

There was a statistically significant difference in the similarity of bird species between parks during the dry and wet seasons. The maximum similar value was obtained between Central and Ferencye during the dry (0.73) and wet (0.67) seasons, whereas the minimum was between Beheretsigie and Ferencye Recreational Parks with a value of 0.52 and 0.64 during the wet and the dry seasons, respectively.

High value of seasonal bird species similarity was observed in the three recreational parks. But, Ferencye showed the highest similarity. Thirty-five species (93.33%) of the total bird species (40) were common in both seasons in this Recreational Park. The

minimal value (78.26%) of similarity was observed in Beheretsigie Recreational Park (Table 8).

Table 8: Species similarity based on seasons.

Park	Similarity	% similarity between seasons
Beheretsigie	54	78.26
Central	38	84.44
Ferencye	35	93.33

Species abundance in all the three Recreational Parks was higher during the wet season. A total of 26,012 and 21,161 individuals were recorded in the study sites during the wet and dry seasons, respectively. Seasonal fluctuation in the abundance of birds was observed during the study period. This was statistically significant at the level of 0.01 (Beheretsigie, $\chi^2 = 436.977$, $df = 1$, $p = .000$, Central, $\chi^2 = 13.530$, $df = 1$, $p = .000$, and Ferencye, $\chi^2 = 84.915$, $df = 1$, $p = .000$) (Fig. 8).

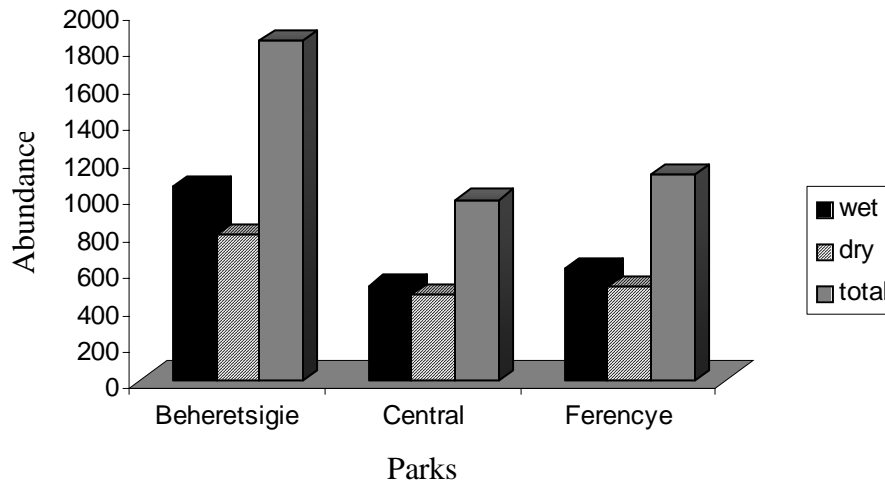


Figure 8. Abundance of birds in the study sites.

The relative abundance of species of birds in recreational parks ranged from 0.17 to 191.67 per 100-field hrs during the wet season. During the dry season, it ranged between 0.84 to 125.56 per 100-field hrs. In Beheretsigie, during the wet season, Speckled mouse had the highest number of individuals. Long-crested eagle and Levillant’s cuckoo were with the least number of individuals. During the dry season, Speckled mouse had the largest number of individuals and Black-headed batis was the least. In Central Park, during the wet season, Brown-rumped seedeater had the highest number of individuals, whereas Yellow wagtail was the least. Common bulbul was the highest and White-backed vulture was the least during the dry season. At Ferencye Park, Black-winged lovebird had the highest abundance and African wood owl was the least during the wet season. Brown-rumped seedeater had the highest and White-headed vulture had the least number of individuals during the dry season (Appendix 2). Relative abundance of the bird fauna among the three recreational parks indicated that 93 species (30.7%) were locally common, 86 species (28.4%) frequent, 56 species (18.5%) rare, 48 species (15.8%) uncommon and 20 species (6.6%) abundant (Table 9, Fig. 9).

Table 9: Relative abundance of bird species in the three recreational parks during wet and dry seasons.

Park	Beheretsigie		Central		Ferencye		Total
	Wet	Dry	Wet	Dry	Wet	Dry	
Abundant	6	3	1	-	6	4	20
Common	17	17	18	16	11	14	93
Frequent	31	15	8	11	11	10	86
Uncommon	14	16	5	6	3	4	48
Rare	12	7	15	10	8	4	56
Total	80	58	47	43	39	36	303

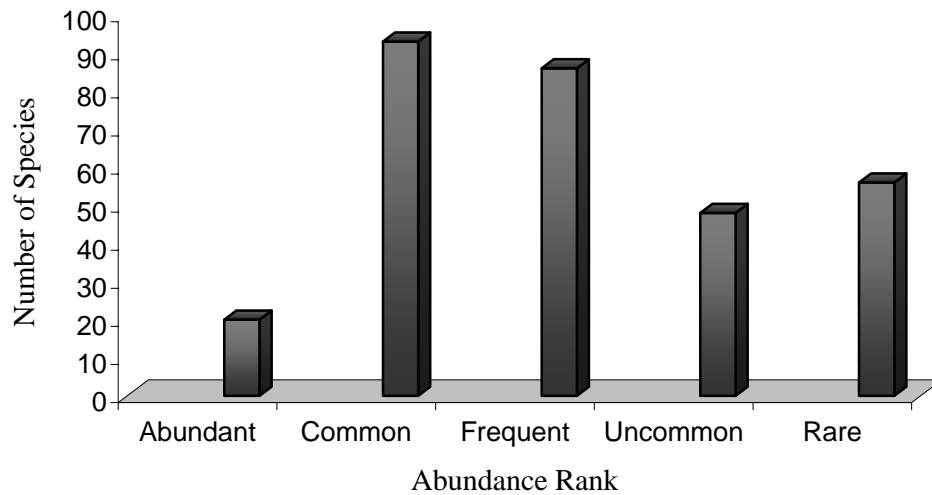


Figure 9. Abundance rank of bird species in the study sites during both seasons.

The most abundant bird species recorded during both seasons make up 49.9% of the total population recorded in the study areas. Brown-rumped seedeater (*Serinus tristriatus*), Common bulbul (*Pycnonotus barbatus*), Red-billed oxpecker (*Buphagus erythrorhynchus*), speckled mousebird (*Colus striatus*), Streaky seedeater (*Serinus striolatus*), Tacazze sunbird (*Nectarinia tacazze*), Bronze manikin (*Spermestes cucullatus*), Black-winged lovebird (*Agapornis taranta*), Montane white-eye (*Zosterops poliogastrus*) and Rueppell's robin-chat (*Cossypha semirufa baglafecht*) were most numerous and widely spread. These were also the most common birds in gardens, streets trees, green and residential areas.

6. DISCUSSION

Urban Parks are considerably rich in bird species diversity and richness than other urban habitats (Jokimäki and Suhonen, 1993). However, many studies showed that change of natural habitats into urbanized areas have reduced the space for survival of birds and resulted in decline of their richness and diversity (Emelen, 1974; Beissienger and Osborne, 1982; Marzluff, 2001). Even though, changes in habitat characteristics can influence the richness and diversity of birds, present study sites had 42.5% of the total bird species of Addis Ababa as listed by Pain *et al* (1975). The results of the present investigation also show that these three recreational parks are rich in avifauna. A total of 102 species of birds were recorded during the study period. The study recorded 22 highland biome species of which Abyssinian woodpecker, Abyssinian catbird and Abyssinian siskin, are endemics. These species were also recorded within the city and the surrounding areas such as Entoto Natural Park and escarpment (EWNHS, 1996). Entoto Natural Park and escarpment is one of the important bird areas of the country. The similarity with Entoto Natural Park and escarpment is due to its nearness of geographical location, climatic conditions and the presence of indigenous and exotic plantation in the two areas.

High number of species was recorded in the study sites. This might be due to the adaptable nature of birds to live in human habitats. The openness of the sites compared to natural habitats with relatively dense vegetation cover might have also contributed to easy identification of the species.

The presence of ample resources, especially having an adequate food supply can increase the abundance of bird species at a given area. Chace and Walsh (2006) indicated that birds respond to change in vegetation composition and structure, which in turn affects their food resources. Managed areas tend to increase plant species richness or increase in total vegetation cover, leading to the presence of diverse avifauna. Areas outside recreational parks can potentially provide suitable habitats, resources and food for example Addis Ababa Abattoirs enterprise (Hiwot Hibiste, 2007) for moving in and out

of the recreational parks. Bird species richness of a recreational park may be influenced by land-use within the park and areas surrounding it. So, local features and the surroundings of the parks including, man-made structures such as buildings, utility poles, farms and gardens can be important for increasing habitat diversity, which can also influence the avian species richness of the study sites (Plate 4A and B).

Edge effects impact recreational parks because the park edge to area ratio increases. This may increase plant community (shrubs and herbs). It may be more suitable for birds by providing more food due to increased light levels. The increased plant productivity provides high density of fruits, flowers and invertebrates. The high edge to interior ratio also leads to the impact of surrounding areas. It helps birds to adapt to anthropogenic resources. The study by Hohtola (1978) showed that edge heterogeneity increased bird species diversity. Moderate levels of modification can favour the increase in distribution of many species, mostly due to edge effect resulting from increased heterogeneity (Karr 1976).

In recreational parks, the avifauna was protected from human-induced activities during the early morning and evening periods of greatest avian activities because these areas were open only for eight hours, a day. At the same time, during the wet season, human activities were low.

High number of species was observed in Beheretsigie Recreational Park both during wet and dry seasons. Beheretsigie contained a high number of large trees, a variety of tree species having different strata and mixed tree species that can influence bird communities. These provide varieties of food and nest sites compared with Central and Ferencye Recreational Parks. These structurally more diverse and rich vegetation are likely to account for the higher species richness than the other two sites. It is clearly known that richness and diversity increases with the size of a given recreational park because relative to smaller areas, large areas contain more diverse plant community associated with more structural diversity resulting in greater number of resources and higher niche availability. This is supported by Donnelly and Marzluff (2004) and Antos

et al. (2006) that size had significant effect in the richness and composition of bird species. Gaveriski (1976) and Davidar *et al.* (2001) stressed the effect of size and habitat to be important determinants of species richness and diversity. Many studies also have confirmed that the number of bird species and diversity are strongly related with the structural complexity of vegetation (Recher, 1969; Karr and Roth, 1971). In addition to the effect of vegetation structure, the dominant tree species may play an important role in determining the richness of the bird communities. The importance of dominant tree species to avian community structure, although contrary to MacArthur and MacArthur (1961), is supported by the findings of Rotenberry and Wiens (1980). In addition to the dominant tree species, vegetation composition and related vegetation structures could have increased the number of bird species and diversity of the study sites.

Statistically insignificant differences in species richness were observed between wet and dry seasons in the study sites. The availability of water, better management and protection of the area may be able to stabilize resource availability and help birds to occur in the sites throughout the seasons. Species also are well adapted to seasonal shifts in food availability and consumption. For example, omnivorous birds increase fruit intake when this resource is more abundant (Karr, 1976; Borghesio and Laiola, 2004). In addition, bird species that occur in recreational parks are able to forage from the surrounding areas as well. Other than the natural food, birds obtain food from ornamental trees, other fruit bearing exotic vegetation and human activities in areas surrounding the parks (residential and small scale farming areas). Thus, the surrounding habitat features may influence bird species richness and diversity in the recreational parks. Similarly, Rivard *et al.* (2000) showed that parks are not isolated areas, species move in and out and areas outside parks can potentially provide suitable resources.

There was a high bird species similarity among the sites in both seasons. The highest was between Ferencye and Central Recreational Parks during the wet and dry seasons. This is probably due to anthropogenic effect, which results in similar habitat patterns. This goes in line with the finding of Bezzel (1985) that human activities have produced similar ecological structures in urban areas. Another reason for the similarity of species composition between sites may be that species are adapted to life in town and these

common bird species are mainly the same in all sites (Jokimäki *et al*, 1996). In addition, the nearness of the sites is an important source of similarity. Patchy areas that are close to one another allow better breeding and dispersal opportunities. Morand (2000) showed that two areas may share the same number of species not because they are similar in area and/or in diversity, but because they are geographically close which allows individuals to move easily from one island to the other.

Relative abundance reflects the comparative size of different population with respect to the entire avifauna of a site. These estimates are useful to reflect temporal changes in population at different times in the same sites. Seasonal fluctuation in the abundance of individual species was observed in the recreational parks. In all the three-study sites, abundance of birds decreased during the dry season. The requirements for birds in urban habitats vary from species to species, but most species are limited by availability of resources as described by Erz (1966) and Lancaster and Rees (1979). Park usage and maintenance changes the resources that occur in the sites. These changes are facilitated by anthropogenic disturbances in the sites. Clearing, removing, simplifying ground cover and trimming the different layers of vegetation reduce the foliage volume. Removal of litters, logs and dead trees reduce the ground nesting cover, cavity nest resources and diverse insects that many birds depend upon. This is the major reason for the variation of bird abundance between seasons in the study sites. This was in agreement with Marzluff and Ewing (2001) in that dense, variable ground and shrub cover, and diverse vegetation structure provide high diversity of habitats for more nesting, feeding and hiding spots. When these key resources are removed, it affects abundance and richness of birds in the area. In general, in proportion to the volume of vegetation, plants provide nest sites and favourable perching sites. The number of birds in a site is dependent on factors associated with the amount of food, so indirectly on the vegetation present. These factors are the resources on which birds depend on it.

The parks are subjected to high level of human use especially during the dry season. Such use leads to disturbances of birds during reproductive and feeding activities. Overall, it appears that direct disturbance such as walking or playing on or off walking lane can affect all but a few tolerant species. This disturbance level contributes to the decrease in

individual bird species. Blumstein *et al.* (2005) have supported the idea. As the number of human using the park increases, birds move away from the area. They spent less time in it. Human disturbances can reduce food consumption by birds foraging within the park. Thus, disturbance might reduce fitness. Although the abundance of species number changed from season to season, the most common species remained the dominant birds of the study sites because they are capable of exploiting resources from edges and human-built environments (Mills *et al.*, 1989; Blair, 1996).

In the present study, the role of habitat association was not considered because normally the study sites are small, modified, similar in respect to the management status and general habitat structure. In addition, their location were so near to each other increasing the movement of birds between the sites. Even though human disturbance is high, birds keep on using the area. Additional long term study should be conducted to find what factors influence the richness and diversity of birds in urban recreational parks.

7. CONCLUSION AND RECOMMENDATIONS

The present study shows that Beheretsigie, Central and Ferencye Recreational Parks support 102 species belonging to 39 families. Among these, three are restricted to the country, nine are shared with Eritrea and sixty-three are residents. High species richness, diversity and similarity were observed in the recreational parks. Composition and structure of vegetation, park size, availability of resources and human-induced activities may all influence the diversity of birds that inhabit these study sites. No ecological study was carried out prior to the present study and it was not possible to compare composition, abundance and diversity of bird species in the study sites.

Recreational parks can be ideal refuges for birds. There is a need to discover ways to modify and diversify recreational parks to harbour varieties of species so as to enhance the value of such habitats. The role of parks should be to provide more recreation space for humans, while providing habitat for native plants and birds at the same time. It is therefore, recommended that:

- ❖ To understand well the response of birds to continuous human-induced land-use changes in recreational parks and the surrounding areas, there is a need for long-term studies linking birds with different aspects of land-use changes.
- ❖ Few bird species that are yet identified and recorded can occur in and around these areas. Seasonal and continuous assessment will further reveal more species in the Recreational Parks.
- ❖ As the availability of resources might increase the abundance of bird species, further research is likely to uncover the biological interactions of urban avifauna in order to conserve and maintain the ecological balance.

- ❖ Localized revegetation effort, such as planting native species may be a useful method for maintaining avian richness and diversity in these areas. Even though these areas can not be further extended, conserving natural landscapes in Addis Ababa with diverse vegetation will be important to create suitable habitats for birds.

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9. APPENDICES

Appendix 1. Recreational Parks in Addis Ababa (Government).

Name of Park	Location
Beheretsigie	Saris
Genet	Aqaqi Kaliti
Hamele 19	Gulele
Sheger	Gulele
Yeka	Shola
Ferencye	French Embassy
Gola	Gola Micheal
Afencho Ber	Afencho Ber
Anbesa Gebi	Sedest Killo
Central	At the back of Ourael
Kolfe	Kolfe

Appendix 2: Relative abundance of bird species from the three recreational parks.

a) Beheretsigie: during the wet season

Species	Individual per 100 field hrs	Abundance Score	Rank
Abyssinian Siskin	5.84	2	Uncommon
Abyssinian Slaty-Flycatcher	18.50	3	Frequent
African Black Duck	8.17	3	Frequent
African Citril	5.34	2	Uncommon
African Fish-Eagle	2.84	1	Rare
African Paradise-Flycatcher	29.17	3	Frequent
African Pied Wagtail	6.34	3	Frequent
African Yellow White-eye	17.50	3	Frequent
Baglafecht Weaver	59.50	4	Common
Banded Barbet	4.84	2	Uncommon
Black Kite	9.50	3	Frequent
Black-headed Batis	1.34	1	Rare
Black-headed Weaver	6.34	3	Frequent
Black-shouldered Kite	4.34	2	Uncommon
Black-winged Lovebird	42.00	4	Common
Blue-breasted Bee-eater	9.00	3	Frequent
Bronze Mannikin	43.00	4	Common
Brown Warbler	37.67	4	Common
Brown-rumped Seedeater	122.00	5	Abundant
Cardinal Woodpecker	3.34	2	Uncommon
Common Bulbul	122.17	5	Abundant
Common Chiffchaff	20.84	3	Frequent
Common Fiscal	6.00	2	Uncommon
Common Moorhen	3.17	2	Uncommon
Common Sandpiper	22.17	3	Frequent

Dusky Turtle-Dove	31.84	4	Common
Egyptian Goose	10.67	3	Frequent
Erckel's Francolin	2.84	1	Rare
Eurasian Wryneck	4.17	2	Uncommon
Garden Warbler	2.50	1	Rare
Gray Wagtail	12.17	3	Frequent
Gray Woodpecker	19.17	3	Frequent
Gray-headed Sparrow	34.50	4	Common
Greater Blue-eared Glossy-Starling	26.67	3	Frequent
Green Sandpiper	21.67	3	Frequent
Green-backed Camaroptera	44.84	4	Common
Groundscraper Thrush	12.84	3	Frequent
Hadada Ibis	9.67	3	Frequent
Hammerkop	0.50	1	Rare
Klaas' Cuckoo	0.67	1	Rare
Levaillant's Cuckoo	0.17	1	Rare
Little Bee-eater	26.50	3	Frequent
Long-crested Eagle	0.17	1	Rare
Montane White-eye	47.00	4	Common
Mountain Wagtail	25.67	3	Frequent
Northern Puffback	1.67	1	Rare
Olive Thrush	26.00	3	Frequent
Pectoral-patch Cisticola	1.50	1	Rare
Pied Crow	8.17	3	Frequent
Red-billed Firefinch	42.84	4	Common
Red-billed Oxpecker	125.00	5	Abundant
Red-cheeked Cordon bleu	23.50	3	Frequent
Red-eyed Dove	36.00	4	Common
Rouget's Rail	48.50	4	Common
Rueppell's Robin-Chat	79.50	4	Common

Rufous-necked Wryneck	3.34	2	Uncommon
Speckled Mousebird	144.34	5	Abundant
Speckled Pigeon	10.67	3	Frequent
Spectacled Weaver	10.17	3	Frequent
Speke's Weaver	4.17	2	Uncommon
Stout Cisticola	5.84	2	Uncommon
Streaky Seedeater	122.34	5	Abundant
Swainson's Sparrow	60.34	4	Common
Tacazze Sunbird	126.67	5	Abundant
Tawny Eagle	6.84	3	Frequent
Tawny-flanked Prinia	33.50	4	Common
Tropical Boubou	20.84	3	Frequent
Variable Sunbird	40.17	4	Common
Village Indigobird	5.00	2	Uncommon
Wattled Ibis	47.00	4	Common
White-backed Black-Tit	9.34	3	Frequent
White-winged Cliff-Chat	2.50	1	Rare
Willow Warbler	16.67	3	Frequent
Winding Cisticola	4.17	2	Uncommon
Wood Sandpiper	7.17	3	Frequent
Wood Warbler	3.84	2	Uncommon
Yellow Wagtail	23.50	3	Frequent
Yellow-bellied Eremomela	1.50	1	Rare
Yellow-crowned Canary	8.67	3	Frequent
Yellow-fronted Canary	41.17	4	Common

b) Beheretsigie: during the dry season

Species	Individual per 100	Abundance	
	field hrs	Score	Rank
Abyssinian Slaty-Flycatcher	16.50	3	Frequent
African Black Duck	9.67	3	Frequent
African Fish-Eagle	3.00	1	Rare
African Harrier-Hawk	2.84	1	Rare
African Paradise-Flycatcher	20.67	3	Frequent
Baglafecht Weaver	56.84	4	Common
Banded Barbet	5.34	2	Uncommon
Black Kite	28.34	3	Frequent
Black-headed Batis	1.34	1	Rare
Black-shouldered Kite	9.67	3	Frequent
Black-winged Lovebird	29.17	3	Frequent
Blue-breasted Bee-eater	13.84	3	Frequent
Bronze Mannikin	122.50	5	Abundant
Brown Warbler	19.84	3	Frequent
Brown-rumped Seedeater	125.34	5	Abundant
Common Bulbul	64.67	4	Common
Common Chiffchaff	6.00	2	Uncommon
Common Moorhen	2.34	1	Rare
Common Sandpiper	6.00	2	Uncommon
Dusky Turtle-Dove	32.00	4	Common
Egyptian Goose	27.00	3	Frequent
Erckel's Francolin	3.00	1	Rare
Garden Warbler	4.84	2	Uncommon
Gray Woodpecker	5.84	2	Uncommon
Gray-headed Sparrow	31.17	4	Common
Green Sandpiper	4.84	2	Uncommon

Groundscraper Thrush	5.67	2	Uncommon
Hoopoe	2.84	1	Rare
Little Bee-eater	40.67	4	Common
Montane White-eye	59.84	4	Common
Pectoral-patch Cisticola	5.67	2	Uncommon
Pied Crow	8.50	3	Frequent
Red rumped swallow	12.67	3	Frequent
Red-billed Firefinch	39.17	4	Common
Red-billed Oxpecker	72.50	4	Common
Red-cheeked Cordon bleu	25.17	3	Frequent
Red-eyed Dove	73.67	4	Common
Rouget's Rail	32.67	4	Common
Rueppell's Robin-Chat	48.50	4	Common
Singing Cisticola	5.00	2	Uncommon
Speckled Mousebird	130.00	5	Abundant
Speckled Pigeon	5.84	2	Uncommon
Spectacled Weaver	11.00	3	Frequent
Stout Cisticola	5.17	2	Uncommon
Streaky Seedeater	64.50	4	Common
Swainson's Sparrow	45.50	4	Common
Tacazze Sunbird	37.17	4	Common
Tawny Eagle	5.34	2	Uncommon
Tawny-flanked Prinia	49.17	4	Common
Tropical Boubou	30.17	3	Frequent
Variable Sunbird	45.17	4	Common
Wattled Ibis	31.17	4	Common
White-backed Black-Tit	5.84	2	Uncommon
Willow Warbler	5.17	2	Uncommon
Winding Cisticola	5.50	2	Uncommon
Wood Warbler	5.84	2	Uncommon

Yellow Wagtail	9.67	3	Frequent
Yellow-bellied Eremomela	2.67	1	Rare

c) Central: during the wet season

Species	Individual per 100	Abundance	
	field hrs	Score	Rank
Abyssinian Slaty-Flycatcher	25.42	3	Frequent
African Dusky Flycatcher	5.84	2	Uncommon
African Fish-Eagle	2.71	1	Rare
African Paradise-Flycatcher	23.96	3	Frequent
Augur Buzzard	2.50	1	Rare
Baglafecht Weaver	74.80	4	Common
Black Kite	17.92	3	Frequent
Black-winged Lovebird	48.75	4	Common
Blue-breasted Bee-eater	2.92	1	Rare
Bronze Mannikin	50.21	4	Common
Brown Warbler	38.13	4	Common
Brown-rumped Seedeater	126.67	5	Abundant
Cape Crow	2.50	1	Rare
Common Bulbul	46.25	4	Common
Dusky Turtle-Dove	45.63	4	Common
Egyptian Goose	2.71	1	Rare
Gray Woodpecker	2.30	1	Rare
Gray-headed Sparrow	25.00	3	Frequent
Green-backed Camaroptera	2.71	1	Rare
Little Bee-eater	34.80	4	Common
Montane White-eye	49.38	4	Common
Pied Crow	38.13	4	Common
Pied Wheatear	2.09	1	Rare

Red-billed Firefinch	37.09	4	Common
Red-billed Oxpecker	89.80	4	Common
Red-cheeked Cordon bleu	16.67	3	Frequent
Red-eyed Dove	32.09	4	Common
Rouget's Rail	5.84	2	Uncommon
Rueppell's Robin-Chat	42.92	4	Common
Speckled Mousebird	66.67	4	Common
Speckled Pigeon	12.50	3	Frequent
Spectacled Weaver	5.21	2	Uncommon
Stout Cisticola	2.30	1	Rare
Streaky Seedeater	68.96	4	Common
Swainson's Sparrow	77.50	4	Common
Tacazze Sunbird	39.59	4	Common
Tawny Eagle	5.84	2	Uncommon
Tawny-flanked Prinia	44.59	4	Common
Thick-billed Raven	25.84	3	Frequent
Tree Pipit	2.30	1	Rare
Tropical Boubou	2.92	1	Rare
Variable Sunbird	21.25	3	Frequent
Village Indigobird	2.30	1	Rare
Wattled Ibis	3.13	2	Uncommon
White-backed Black-Tit	2.09	1	Rare
White-backed Vulture	2.71	1	Rare

d) Central: during the dry season

Species	Individual per	Abundance	
	100 field hrs	Score	Rank
Abyssinian Slaty-Flycatcher	21.67	3	Frequent
Abyssinian Woodpecker	2.30	1	Rare
African Dusky Flycatcher	11.88	3	Frequent
African Fish-Eagle	2.30	1	Rare
African Paradise-Flycatcher	27.30	3	Frequent
Augur Buzzard	1.46	1	Rare
Baglafecht Weaver	60.42	4	Common
Black Kite	21.25	3	Frequent
Black-winged Lovebird	28.13	3	Frequent
Blue-breasted Bee-eater	30.00	3	Frequent
Bronze Mannikin	61.67	4	Common
Brown Warbler	22.71	3	Frequent
Brown-rumped Seedeater	72.50	4	Common
Common Bulbul	81.46	4	Common
Dusky Turtle-Dove	26.05	3	Frequent
Egyptian Goose	2.92	1	Rare
European Bee-eater	2.30	1	Rare
Gray Woodpecker	2.50	1	Rare
Gray-headed Sparrow	27.30	3	Frequent
Hooded Vulture	1.25	1	Rare
Lappet-faced Vulture	1.88	1	Rare
Montane White-eye	46.67	4	Common
Pied Crow	39.80	4	Common
Red-billed Firefinch	43.34	4	Common
Red-billed Oxpecker	62.71	4	Common
Red-cheeked Cordon bleu	11.46	3	Frequent
Red-eyed Dove	38.34	4	Common

Red-rumped Swallow	7.71	3	Frequent
Rouget's Rail	5.84	2	Uncommon
Rueppell's Robin-Chat	48.75	4	Common
Speckled Mousebird	58.96	4	Common
Speckled Pigeon	5.21	2	Uncommon
Spectacled Weaver	2.71	1	Rare
Streaky Seedeater	68.75	4	Common
Swainson's Sparrow	56.67	4	Common
Tacazze Sunbird	35.21	4	Common
Tawny Eagle	5.84	2	Uncommon
Tawny-flanked Prinia	60.63	4	Common
Thick-billed Raven	5.63	2	Uncommon
Variable Sunbird	36.46	4	Common
Wattled Ibis	4.17	2	Uncommon
White-backed Black-Tit	6.05	2	Uncommon
White-backed Vulture	0.84	1	Rare

e) Ferencye: during the wet season

Species	Individual per	Abundance	
	100 field hrs	Score	Rank
Abyssinian Catbird	5.00	2	Uncommon
Abyssinian Slaty-Flycatcher	28.62	3	Frequent
African Paradise-Flycatcher	29.17	3	Frequent
African Wood-Owl	0.28	1	Rare
African Yellow White-eye	18.34	3	Frequent
Augur Buzzard	2.50	1	Rare
Baglafecht Weaver	72.78	4	Common
Black Kite	20.28	3	Frequent
Black-shouldered Kite	1.39	1	Rare

Black-winged Lovebird	191.67	5	Abundant
Bronze Mannikin	67.50	4	Common
Brown Warbler	30.28	3	Frequent
Brown-rumped Seedeater	122.23	5	Abundant
Common Bulbul	170.84	5	Abundant
Dusky Turtle-Dove	56.12	4	Common
Gray Woodpecker	5.56	2	Uncommon
Gray-headed Sparrow	56.39	4	Common
Little Bee-eater	25.28	3	Frequent
Lizard Buzzard	2.78	1	Rare
Montane White-eye	115.28	4	Common
Red-billed Firefinch	80.84	4	Common
Red-billed Oxpecker	155.56	5	Abundant
Red-cheeked Cordon bleu	29.45	3	Frequent
Red-eyed Dove	74.17	4	Common
Rueppell's Robin-Chat	131.95	5	Abundant
Speckled Mousebird	23.62	3	Frequent
Speckled Pigeon	14.73	3	Frequent
Spectacled Weaver	12.50	3	Frequent
Spotted Creeper	0.28	1	Rare
Streaky Seedeater	127.78	5	Abundant
Swainson's Sparrow	114.17	4	Common
Tacazze Sunbird	81.12	4	Common
Tawny Eagle	2.23	1	Rare
Tawny-flanked Prinia	60.84	4	Common
Variable Sunbird	50.56	4	Common
White-backed Black-Tit	28.06	3	Frequent
White-collared Pigeon	5.84	2	Uncommon
White-headed Vulture	1.95	1	Rare
Yellow-bellied Waxbill	1.95	1	Rare

f) Ferencye: during the dry season

Species	Individual per	abundance	
	100 field hrs	Score	Rank
Abyssinian Catbird	5.00	2	Uncommon
Abyssinian Slaty-Flycatcher	47.50	4	Common
African Paradise-Flycatcher	52.78	4	Common
African Yellow White-eye	17.50	3	Frequent
Augur Buzzard	2.78	1	Rare
Baglafecht Weaver	81.67	4	Common
Black Kite	28.62	3	Frequent
Black-shouldered Kite	26.39	3	Frequent
Black-winged Lovebird	72.50	4	Common
Bronze Mannikin	62.23	4	Common
Brown Warbler	63.34	4	Common
Brown-rumped Seedeater	125.56	5	Abundant
Common Bulbul	123.89	5	Abundant
Dusky Turtle-Dove	28.06	3	Frequent
Gray Woodpecker	5.28	2	Uncommon
Gray-headed Sparrow	50.56	4	Common
Montane White-eye	122.50	5	Abundant
Red-billed Firefinch	55.00	4	Common
Red-billed Oxpecker	122.50	5	Abundant
Red-cheeked Cordon bleu	24.17	3	Frequent
Red-eyed Dove	30.28	3	Frequent
Red-rumped Swallow	12.23	3	Frequent
Rueppell's Robin-Chat	66.39	4	Common
Speckled Mousebird	25.28	3	Frequent
Speckled Pigeon	28.06	3	Frequent
Spectacled Weaver	4.17	2	Uncommon

Streaky Seedeater	103.62	4	Common
Swainson's Sparrow	101.39	4	Common
Tacazze Sunbird	57.78	4	Common
Tawny Eagle	2.78	1	Rare
Tawny-flanked Prinia	58.34	4	Common
Variable Sunbird	48.89	4	Common
White-backed Black-Tit	30.00	3	Frequent
White-collared Pigeon	5.56	2	Uncommon
White-headed Vulture	2.23	1	Rare

Appendix 3. Plant species identified during the study period

Family	Scientific Name	Local Name
Arecaceae	<i>Phoenix reclinata</i>	Zembaba
Apocynaceae	<i>Nerium oleander</i>	Oleander
Asteraceae	<i>Vernonia amygdalia</i>	Grawa
Bignoniaceae	<i>Spathodea campanulata</i>	Jacaranda
	<i>Jacaranda mimosipholia</i>	
Boraginaceae	<i>Cordia africana</i>	Wanza
Cupressaceae	<i>Juniperus procera</i>	Tid
	<i>Cupressus lusitanica</i>	
Dracaenaceae	<i>Dracaena steudneri</i>	
Euphorbiaceae	<i>Croton macrostachyus</i>	Besana
	<i>Euphorbia abyssinica</i>	Kulqual
	<i>Ricinus communis</i>	Gulo
Fabaceae	<i>Acacia abyssinica</i>	Gerar
	<i>Millettia ferruginea</i>	Birbera
	<i>Erythrina brucei</i>	Korch
Flacortiaceae	<i>Dovyalis abyssinica</i>	Koshim
Moraceae	<i>Ficus sur</i>	Shola
Myrtaceae	<i>Calistemon citrinus</i>	Bottle brush
		Yeshit
	<i>Eucalyptus citriodora</i>	baharzaf
	<i>Eucalyptus globulus</i>	baharzaf
	<i>Eucalyptus saligna</i>	Key baharzaf
Oleaceae	<i>Olea africana</i>	Weira
Pinaceae	<i>Pinus patula</i>	
Poaceae	<i>Arundo donax</i>	Shembeko

Podocarpaceae	<i>Podocarpus falcatus</i>	Zigba
Proteaceae	<i>Gravilia robusta</i>	
Rosaceae	<i>Hagenia abyssinica</i>	Koso
	<i>Prunus africana</i>	Tikur inchet
	<i>Rosa abyssinica</i>	Kega
Sapindaceae	<i>Allophylus abyssinicus</i>	Embus



Plate 1A.



Plate 1B.



Plate 1C.



Plate 1D.

Plate 1. Beheretsigie Recreational Park during the study period.
Photo: Elizabeth Girma



Plate 2A.



Plate 2B



Plate 2C.



Plate 2D

Plate 2. Central Recreational Park during the study period.
Photo: Elizabeth Girma



Plate 3A.



Plate 3B.



Plate 3C



Plate 3D

Plate 3. Ferencye Recreational Park during the study period.
Photo: Elizabeth Girma



Plate 4A



Plate 4B.
Plate 4. Surrounding features of the study sites.
Photo: Elizabeth Girma