

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

**Species composition, Abundance and Activity Pattern of
Birds of Addis Ababa Abattoirs Enterprise**

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Abstract

Studies on species composition and abundance of birds in Addis Ababa Abattoirs Enterprise were carried out from March 2006 to February 2007. The presence of food, scraps and offal, increased the species richness and abundance of birds in the area. In addition to the abundant supply of food, the availability of resting and perching structures has made Addis Ababa Abattoirs Enterprise a favorable area for different species of birds. Point count method was employed to record the relative abundance of individual bird species. The piles of bones although has unpleasant odors, it is a marvelous place for viewing vultures as well as wetland birds. The site supports 21 species of birds, including the endemic species – Wattled Ibis, White-collared Pigeon and Thick-billed Raven. The species composition decreases during wet season due to the departure of migratory birds. From the total species recorded, 57.14% were regular. The most abundant species were Hooded and African White-backed Vultures. The Vultures were usually observed flying over the study area, roosting on the roof of the slaughter house, and also on the ground either being around of feeding. Feeding activity was from 06: 00 – 18:00 h during the dry season. The fresh dumping site is intensively disturbed by human activities and thus affected the normal feeding time of birds. The urbanization level of the area affected bird community in depriving roosting trees. Most of the vultures were observed coming from southwest direction of the study area.

Key words: abundance, composition, dumping site, perching, raptors, roosting, scraps, urbanization, vulture.

1. Introduction

Mankind has been fascinated by birds, observed, used, painted, wrote and sung, kept in captivity, protected and gave them great respect, since the earliest times (Daimond, 1987). They are the most universally celebrated form of animals, found in pictures, photographs, sculptures, words and songs (Clifford *et al.*, 1998). They have been particularly important to the cultural, religious and aesthetic sides of human life from time immemorial. Their prominence in the life of ancient Egypt, for example, is amply attested to in the art and Hieroglyphics of that culture (Houlihan, 1986). Early European art was dominated by religion, and birds were used as religious symbols until the renaissance.

Raptors have martial connotations. Representations of eagles, or eagle feathers were used in military banners or as imperial symbols by peoples as different as Babylonians in the sixth century B.C., the plain Indians of North America, the Aztecs of Montezuma's court, Roman legions, and the present-day Americans (Daimond, 1987).

For centuries, man in the desire to satisfy his needs and improve his life style, has been modifying his environment. Man's exercise to probe into the mysteries of flight by inventing aircraft is one among those endeavors. Because of their great aesthetic and economic value, birds have enjoyed more protection in the past than any other group of animals.

Birds as a source of human food have played a part in human history. Domestic fowls, at present the most abundant bird in the world, were in use in India before 2000 B. C. and have since spread to all parts of the world (Coltherd, 1966). Feathers have been used for many purposes other than ornamentation: as insulation; to stuff mattresses; quills for writing; to trim the flight of arrows and shuttlecocks; and for making artificial flies (Jones, 1985).

People in the modern industrialized societies value birds very highly, for a variety of reasons. They serve as indicators of environmental conditions. The presence of diverse bird populations capable of sustained reproduction is one of the best indications of a healthy environment (Kress, 2000). Birds are often used as a biological model because they are good ecological indicators and they are easily observable (Clergeau *et al.*, 2001).

Birds can also be used as indicators of sites of high biodiversity. Bibby *et al.* (1992) examined the available data for other groups of organisms to compare with bird, and showed that endemism, at least among large vertebrates, is often related to that of birds. In addition to research-based projects, these methods are gaining widespread use among agencies and extension groups to measure baseline patterns of diversity and gauge the effectiveness of management practices (Rosenstock *et al.*, 2002). The presence of rare or endangered species, concentration of species, affiliations of certain species with important ecosystems at a site, and other bird complement have shown parallel significance for other biodiversity (WCMC, 1991 and 1992). However, species richness alone can be a misleading measure of biodiversity, since resistance to disturbances, primary productivity, and adequate functioning

of an ecosystem depend not only on the number of species, but also on other factors, including species abundance, and their levels of interactions from time to time (Magurran, 1988; Cardinale *et al.*, 2000; McCann, 2000; Purvis and Hector, 2000; Tilman, 2000; Loreau *et al.*, 2001).

The value of birds to human society is at present widely recognized and can be extensively traced beyond their immediate products. Wildlife tourism, ranching and sustainable utilization of natural resources are promoted as a source of foreign exchange for developing countries. In many industrialized countries, the revenue from bird watching and related “industries” can be counted in millions of dollars. However, many advantages of birds remain unexplored, for example, their enormous scientific value, which ranges from evolutionary, ecological and behavioral advances to biomedical research, where they are prominent in genetic studies, development of vaccines, and in the discovery and exploitation of retroviruses.

2. Literature Review

2.1 Distribution of birds

Birds are ubiquitous animals that frequent both terrestrial and aquatic ecosystems. The power of flight allows them to move easily between earth and sky, and yet they are also perfectly adapted to every environment that man inhabits. Although birds collectively occupy most of the earth’s surface, most species are found only in particular regions and habitats, whereas others are cosmopolitan.

Geographical distribution of species is a result of the action of both historical and ecological factors in time and space (Vulleumier and Simberloff, 1988). Nearly every one associates penguins with Antarctica, emus with Australia, and hummingbirds for the most part with tropical or sub-tropical regions. Similarly, with respect to habitat, ducks are associated with water, woodpeckers with trees, and field birds with open spaces.

Some species, particularly those of recent origin and those handicapped by lack of mobility, may still be at or near their place of origin, never having succeeded in occupying new regions. Other species, with greater adaptability, better means of dispersal, or a higher reproductive or genetic potential, which creates population pressure and peripheral spreading, have successfully invaded new areas. Some of them, such as the hawks and owls, gulls and terns, swallows and swifts, and many water birds are now virtually world wide (Wallace and Mahan, 1975). Some species extend their range by “island hopping”. A recent example believed to be attributable to this mode of travel is the cattle Egret, which appeared in northern south America in the late 1930’s, presumably from Africa or Europe, and spread rapidly up the coast of North America to Newfoundland and sporadically into the interior, reaching California in 1964 (Crosby, 1972). Ecological changes, such as the development of a more favourable climate in a previously inhospitable region, encourage range expansion. On the other hand, unfavourable climatic change may restrict further spreading.

Birds are by far the best known examples of migrants. Seasonal distribution of birds in any region is affected by their migration patterns. Migratory movement is not a voluntary one,

but is caused by climatic conditions such as food supply and length of daylight (Lincoln *et al.*, 1998). Tropical and sub-tropical countries witness a type of seasonal migration of birds, which is not well known in the northern latitudes. The summer and winter ranges and migrations routes of birds are now fairly well known.

One of the most striking manifestations of the human affinity for birds is man's compulsion to take familiar birds with him to unfamiliar parts of the world. Over 400 bird species have been introduced to at least 100 regions, where they had not reached by themselves (Long, 1981).

Several classifications of regions and zones have been presented, and special habitats have been studied in great detail. Wallace (1876, cited in Wilson 1952), proposed six major Zoogeographical Regions to explain the distribution of faunal groups. Similarity in bird species is easily observed in Palaearctic (Eurasian) and Nearctic (North American) Regions. According to Udvardy (1958), the relationships are as follows: 32 species of Arctic sea birds (86.5 per cent) are common to both sub-regions (Palaearctic and Nearctic), 36 species (75 per cent) of the birds of Tundra are common to both, 28 coniferous forest species (43.8 per cent) occur in both sub-regions, but only seven species (3.1 per cent) of deciduous forest birds are found in both. The biodiversity of bogs is low with very distinctive flora and fauna, and many species can only be found in these ecosystems (Moor, 2002).

The Ethiopian Region includes all of Africa except Northern parts of the Sahara and the extreme north Mediterranean coast. Some features of particular interest of this continent are

the presence of Sahara desert, broad savanna lands (including the veld and scrub thorn) with sharply divided wet and dry seasons, broad equatorial as well as mountain rain forests, and the isolated sub-region of Madagascar, which has a peculiar bird life of its own (Wallace and Mahan, 1975). For more than a hundred years, man has been systematically studying the distribution of birds and the factors that control it. The ranges of many species are still little known. However, for many species of birds, the geographical distribution has been adequately described (Van Tyne and Berger, 1959).

2.2 Diversity of birds

The taxonomy of birds and their distribution are well known and documented. Birds have long been popular with amateurs and professionals and consequently their systematic position and distribution patterns are better known than any other comparable groups of animals, with the possible exception of large mammals (Furness and Greenwood, 1993). According to Ehrlich *et al.* (1994), there are nearly 10,000 known species of modern or recently extinct birds. The living species of birds are grouped into 27 orders and these in turn have been grouped into 155 families (Peterson, 1963). Africa is home to two endemic bird Orders, ten endemic Families (with two more only reaching Madagascar or Arabia) (Sinclair and Ryan, 2003).

As a group, birds are closely associated with forests. Approximately 30% of the world's species of birds are restricted to tropical forests (either for winter or year-round habitat) that they would disappear if all tropical forests were lost (Myers, 1992). Africa is second only to

South America in terms of numbers of bird species, and arguably offers more rewarding birding than other tropical regions. The continent supports more than 2100 of the world's bird species, out of which almost 1400 are endemic species in a diversity of habitats (Sinclair and Ryan, 2003).

Ethiopia has a diverse set of ecosystems ranging from humid forest and extensive wetlands to the desert of the Afar depression. Because of its geographic position, range of altitude, rainfall pattern and soil variability, the country possesses ecological diversity and a huge wealth of biological resource. The geographical location of Ethiopia, particularly the plateau, makes it a bio-geographical island surrounded by expanse of dry lands. This complex topography coupled with environmental heterogeneity offers suitable environments for a wide range of life-forms.

Ethiopia provides habitat for more than 800 species of birds (Urban and Brown, 1971). According to Avibase (2006), out of the 926 bird species listed for the country, 21 are endemic and 19 are globally threatened species. Ethiopia is one of the few countries in the world that possesses a unique and characteristic fauna with a high level of endemism (WCMC, 1991). There are thirteen species restricted to the geographical region of Ethiopian highlands and thus shared by Ethiopia and Eritrea (Vivero Pol, 2001).

About 214 Palearctic migrants have been recorded from Ethiopia, and a large number of these have breeding populations in the country. Although tropical environments are sometimes assumed to be uniform throughout the year, seasonal changes in precipitation are

common. For birds, rainfall regimes and associated environmental changes are of major importance in determining breeding seasons and annual cycles in many regions including Ethiopia (Beals, 1970). Seventy-two species of diurnal raptors occur in Ethiopia, 68 of which are believed to migrate at least in part of their ranges (Brown *et al.*, 1982; Vittery, 1983). Furthermore, the extensive and unique conditions in the highlands of the country have contributed to the presence of the large number of endemic species.

Despite birds being the best-known class of living organisms, there are still substantial gap in our knowledge of the distribution, abundances and densities of species. Every year, more bird species are discovered. A taxonomic revision of the mouse-colored Tapaculo *Syctalopus spelunca* complex was identified as new species and suggested more species are waiting to be described (Dias, 2006). Close comparison of the birds from museum specimens have confirmed as a new species. Observations of new and/or endangered species are costly and time consuming as it requires intensive efforts. One of the 120 species endemic to Madagascar, Sakalava Rail, has only been seen by a handful of ornithologists since its rediscovery in 1995, 30 years after the last previous sighting (Pitches, 2005).

Birds are the most abundant vertebrates next to fish. They are widespread due to their adaptability and the feasibility of movements. Some birds even invade deep water to a depth of up to 200 m (Kress, 2000). The feeding habits of birds afford some striking examples of behavioral adaptability. Every major habitat presents special conditions of life and, usually, peculiar problems of existence for birds living there. Birds occupying a given habitat, as a rule, are adapted to exploit these conditions and to meet these problems, at least sufficiently

well to meet local competition of other species. Dawn (1959) observed, cattle egrets feeding ahead of grazing cattle but becoming inactive when the cattle rested. Sometimes, the egrets become restless and urge resting cattle to carry out more grazing to stir up more food.

The lack of behavioral adaptability of birds is illustrated by specialized feeders accustomed to live on a restricted diet, and apparently unable to change. Some of the most obvious differences among birds are seen in their bill adaptations for feeding. Although special adaptations set limits on the kinds of foods birds can eat, most birds consume a surprising variety of food, frequently switching feeding strategies depending on what foods are available or their nutritional needs for a certain season. Many birds now utilize highway kills or other food supplies formerly not available. By contrast, some other birds are quite resourceful at exploiting new food supplies. The Lammergeier *Gypaetus barbatus* was given the name *Ossifragus* (“bone breaker”) in antiquity because of its habit of dropping bones to get the marrow. Similarly, eagles crack open tortoises by dropping them on rocks. Egyptian vultures *Neophron percnopterus* in East Africa break open Ostrich eggs by throwing stones at them with their bills (Lawick-Goodall and Van, 1967). Smaller, less resistant eggs are picked up and thrown on the ground as well.

2.3 Threat

Professional and amateur workers have collaborated in long-term monitoring of bird populations, together with detailed studies on individual species. The future of birds is seriously threatened by modern way of human life. The demand for more living space for the

rapidly expanding human population and advanced technologies employed to meet these needs are threatening the ecosystems. Each year, the Earth's human population grows and appropriates more natural resources, including land for residential development (Vitousek *et al.*, 1997). Moreover, urban areas are expected to grow substantially in the years to come. By 2030, the percentage of the world's population living in urban areas is projected to increase from the current 49% to approximately 61% (United Nations, 2004).

Though extinction can be the result of natural processes, human impacts have been substantially responsible for the increased rate of extinction in the recent decades (Wilson, 1992). Global biodiversity is being degraded at an alarming rate due to human activities (Skole and Tucker, 1993). In some parts of the Netherlands, songbirds are laying eggs with thin shells and losing many clutches, because acid rains have reduced the abundance of snails, the main source of calcium rich food for the birds (Graveland *et al.*, 1994).

The most comprehensive list, compiled by staff of the World Conservation Monitoring Center, lists 117 bird species that probably have become extinct, at least in the wild, since 1600 (Jenkins, 1992). Twelve per cent of the bird species are threatened with extinction all over the world (Rosser and Mainka, 2000). Also the international law of protecting migratory birds is facing a problem. Migrating birds currently have a poor public image because of widespread media reports claiming responsibility for spreading the lethal H5N1 avian influenza across Asia into Europe and Africa, despite strong evidence to the contrary. These reports have led to irrational persecution of wild birds in places where they are now

perceived as a health risk, with some people even destroying nests to discourage migratory birds from nesting (Patel, 2006).

Any natural or anthropogenic disturbance altering the nature and distribution of plant and animal communities may seriously affect regional biodiversity. Virtually any form of sustained human activity results in some modification of the natural environment. This modification will affect the relative abundances of species and in extreme cases may lead to extinction (Heywood, 1995). Of the three leading causes of species endangerment (urbanization, agriculture, and interactions with non-native species), urbanization ranks highest (Czech and Krausman, 1997; Czech *et al.*, 2000). Urban areas are characterized by high levels of disturbance and environmental modification, which can affect bird populations and community patterns (Rebele, 1994; Blair, 1996). Urban sprawl may occur even faster in developing nations currently rich in biodiversity due to improving socioeconomic conditions (Liu *et al.*, 2003).

According to Donnelly and Marzluff (2004), birds respond to the spatial heterogeneity and distribution of vegetation. Afforestation is one of the main vegetation changes recently observed in peat lands in response to natural and/or anthropogenic disturbances. Large increases in tree cover have been observed in Swedish peatlands over the last 40 years, possibly caused by drainage (Linerholm and Leine, 2004). Afforestation influences the distribution of bird species by changing the vegetation structure of bogs (fewer mosses and shrubs, more trees) and by homogenizing the spatial distribution of plant communities (open patches progressively replaced by forested patches). Previous studies have shown the

importance of both factors for bird distribution (Rotenberry, 1985; Stockwell, 1994; Calme and Desrochers, 2000). For example, during the nesting period, palm warbler is strongly and almost exclusively associated with peatlands, at least in temperate regions where coniferous forests are scarce and mainly restricted to bogs (Wilson *et al.*, 1998; Calme and Desrochers, 1999). Many species traditionally viewed as common are also showing dramatic decline in their numbers in tune with the habitat depletion. Decline in the population of common species indicates the widespread deterioration of their habitats.

Demographic and behavioral considerations are of immediate importance in the formulation of conservation programs, especially in the case of endangered species. Maintenance of genetic variation over short and long terms is paramount in ensuring their viability (Nunney and Campbell, 1993). BirdLife's annual evaluation of the world's bird's shows that the total number of species considered threatened with extinction is more than thousand. Combined with Near-Threatened species, this gives a record 2,005 species at risk more than a fifth of the planet's total of 9,799, and five more than in 2005 (Czeneszkewik, 2006).

In general, human activities have produced similar ecological structures in urban areas even in different biogeographical regions. The response of birds to these environmental changes could lead to the dominance of bird communities by a few very abundant species (Bezzel, 1985). This, in turn, might lead to the general hypothesis that urbanization causes reduced bird communities in urban areas (Jokimaki *et al.*, 1996).

2.4 Avifauna of Ethiopia

The ornithology of Ethiopia is still in its infancy, because of its limited observers and clearly not for lack of birds. According to EWNHS (1996), investigations on avian fauna in Ethiopia are negligible, when compared to other countries in the region. Unlike many of the east African countries, for example, Kenya, Uganda, and Tanzania, despite the existence of rich biodiversity in Ethiopia, detailed studies have not been carried out. Only few researchers have conducted studies on the diversity and ecology of avian species in some parts of Ethiopia (Ash and Gullick, 1989). At present, the threatened bird fauna of Ethiopia are categorized as Critically endangered (2 species), Endangered (5 species including 4 endemics), Vulnerable (12 species) and Near-Threatened (14 species with 2 endemics) (Collar *et al.*, 1994; EWNHS, 1996). To conserve these diverse and important biological resources, nine National Parks, 11 Wildlife Reserves, three Sanctuaries and 18 Controlled Hunting Areas have been established as refugia (Hillman, 1993).

Even though the main concentration of wildlife in Ethiopia appears to be localized in the south and western half of the country, Addis Ababa has quite a diverse flora, which is the home to different species of birds, including a number of endemics. Among the area controlled by Addis Ababa Water and Sewage Authority, Gefersa Reservoir site supports at least 20 highland biome species. Urban (1991) studied Palaearctic and Afro-tropical ducks and geese at Gefersa, over a 6-year period. A preliminary list shows that over 200 species occur within Entoto Natural Park as known from observations and records for Addis Ababa and adjacent areas (Atkins, 1996, cited in EWNHS, 1996).

In the past, ecologists paid little attention to urban ecosystems and focused mainly on pristine ones (Blair, 2004; Collins *et al.*, 2000; Jules, 1997; Marzluff *et al.*, 2001; Vandermeer, 1997). According to Bibby *et al.* (1996), most studies on birds target a particular species or a particular place. The economic usefulness of wildlife can never be the most important rationale behind its conservation. Too many species are likely to lose out as being apparently without economic worth. We do not know how their contribution to our quality of life may one day be measured.

2.5 Raptors

Addis Ababa provides diverse niche by way of garbage dumps, unclean and numerous slaughterhouses, where various birds of prey can find food, shelter and breeding sites. Raptors occur in all habitats except extreme deserts and high-latitude tundra, and from below sea-level to the summits of the Himalayas (del Hoyo *et al.*, 1994). Eagles, falcons, hawks, vultures and owls are birds of prey, which have powerful beaks with a hook on the upper mandible, used to tear flesh from the body of a dead animal. They kill their prey by grasping it with the talons, which in some species may be so long and powerful that the grip of the predator's foot is capable of driving the long hooked claws into or through the prey. Raptors with weak feet as of vultures are compelled to feed on smaller and weaker prey or on carrion. Raptors feed on insects, carrion, and a range of vertebrates, from fish to medium sized mammals.

A generalized bird of prey is known from Eocene deposits, about 55 million years old, in England (Brown and Amadon, 1968). The number of currently recognized raptor species ranges from 285 to more than 310 (Kerlinger, 1989; Sibley and Monroe, 1990; del Hoyo *et al.*, 1994). Diurnal birds of prey comprise about two third of the total species. They find their prey by sight, sometimes assisted by hearing, and kill by speed and agility. The remaining one-third constitutes mainly night hunters. Nocturnal birds locate their prey by hearing, sometimes assisted by sight, and kill by stealth. According to Welty (1975), outstanding among the predominantly carnivorous birds are the diurnal predators (eagles, hawks and falcons), and the nocturnal predators (owls). Owls that hunt chiefly or exclusively by night have specially adapted ears, that enables them to pinpoint a sound so accurately to strike their prey even in pitch darkness. Very acute vision is not necessary, though their eyes are adapted to make the best of poor light; they are designed more to detect movements than to resolve details (Brown, 1971). It has long been recognized that the diurnal birds of prey have remarkable eyesight. The term “eagle-eyed”, denotes unusual keenness of vision, as eagles are exceptional with this power of vision. Most birds have a poor or nonexistent sense of smell, but have keen vision that can resolve details at two to three times the distance achieved by humans (Kress, 2000).

More recently, raptors have suffered indirectly from human activity, particularly from habitat destruction (Newton, 1991). The diurnal raptors living in towns are either scavengers upon human dejects and excreta or are specialists in particular types of prey. Eagles throughout most of the world are in a precarious position. The magnificent monkey-eating eagle *Pithecophaga jefferyi* in the Philippines survives in small numbers on only a few of the

islands. Deforestation and the demand for zoos and trophies have caused its downfall (Gonzales, 1971).

Raptors obviously have an impact on the populations of the animals that they hunt. Much of the antipathy towards birds of prey comes from farmers, who lose many free-ranging chickens to kites and hawks, particularly cooper's hawks and goshawks (Weidensaul, 1996). Overall, populations of 52% of all migratory raptors are threatened by habitat loss, 17% by environment contaminants and 31% by direct persecution (Alerstam, 1990).

Towns are a specialized habitat which only a few species of raptors have adapted to live though those species are sometimes very successful and numerous. But, the ever increasing urban development and deteriorating environmental quality have led to a critical need for reliable information on birds and their habitats. Research on birds in cities worldwide has been steadily accumulating, particularly over the last few decades, and results indicate that as development intensifies, bird communities become increasingly homogenized (McKinney and Lockwood, 1999).

According to Myers and Giller (1988), the effect of habitat structure could be negligible at a macrogeographic scale and the role of climate is more important, whereas the reverse situation could occur at a local scale. The Addis Ababa Abattoirs Enterprise (AAAE) is used as a safe site for many species of predatory birds. Habitat structure is an indication of availability of resources for birds such as foraging sites, nesting and protection from predators. Birds were seen roosting on the roof of the slaughter house, trees and nearby

structures; as well as flying over the slaughter house and on the ground, either loafing or feeding.

The composition of the avifauna of abattoirs is known to be rich. However, no study has been done to describe the types of species and abundance of birds in the area and their response to habitat disturbance and destruction. The role of birds in their ecosystems, and their biology, has been the subject of studies resulting in an ever-increasing body of knowledge in ornithology. Ecological studies in urban areas now seem to be on the rise (Grimm *et al.*, 2001). Thus, the proposed study is intended to add further on the avian fauna in part of a fast developing African capital city, Addis Ababa.

3. Objectives

3.1 General Objective:

- ❖ To study the species composition, abundance and activity pattern of birds in Addis Ababa Abattoirs Enterprise (AAAE).

3.2 Specific Objectives:

- To collect relevant data on the avian species composition in AAAE.
- To estimate the abundance of species.
- To determine the dominant species in relation to the diurnal pattern and seasonality.
- To gather information about the activity pattern of the dominant

species in the study area.

- To determine the flight direction and roosting sites of the dominant species.
- To suggest recommendations for future management strategies.

4. Methods

4.1 The Study Area

The AAAE is located in the Kirkose sub-city, Kebele 08, House number 001. It covers an area of about 38,141 m². The enterprise was built in 1908. The boundaries of the study area are to the north small public entrance, to the west Tenishwa Akaki River, to the south road (to Sarbet), and to the east road (Fig. 1).

In the site, there are piles of bones, dumps of scraps and offal. The unpleasant odor reaches the whole surroundings up to hundreds of meters. This abattoir is the biggest of this type in the city of Addis Ababa. It provides a huge amount of scraps that is reliable food source for all scavenging species of birds throughout the year.

During the establishment period, there were very few settlers around. The original forest cover of the surrounding area was almost completely cleared after the mid of the 20th century. By the 1980s, most of the area was used for settlement, although there are some patches of *Eucalyptus sp.*, *Acacia sp.* and *Olea europaea* trees around. At present, these

neighborhoods surrounding the enterprise have variable human population densities and buildings.

AAAE comprises different rooms. The rooms are sectioned according to the services being provided. Some of the main rooms are: offices, large blocks of slaughter house (with machineries for slaughtering and refining fat), garage, laundry, changing rooms and stores. Besides, the enterprise also possesses partitioned barns, car washing site, a machine made by Girma Alemu to reduce the bad smell of the waste, waste treatment plant, farming plots and heap of bones and waste (scraps) discarded from the slaughter house.

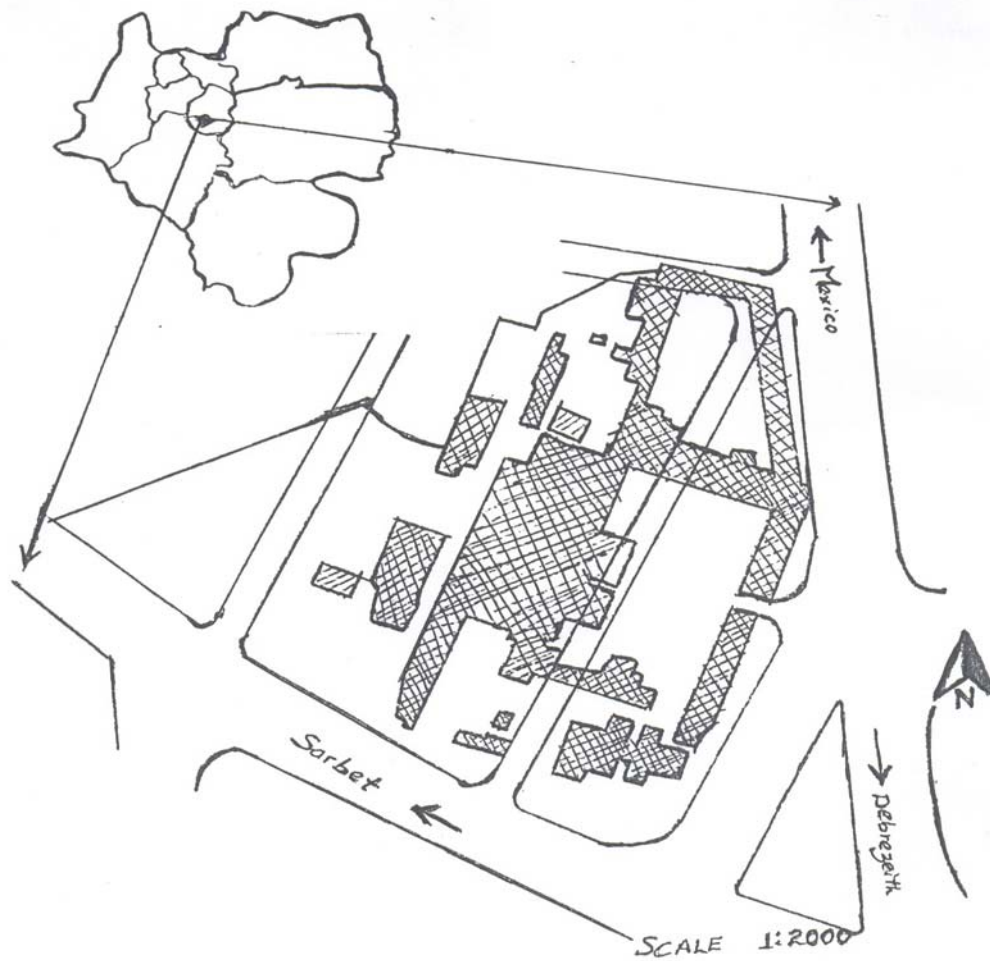


Figure 1. A schematic representation of the study area -Addis Ababa Abattoirs Enterprise.

Source: Land Administration of Addis Ababa (2003).

Figure 1. A schematic representation of the study area -Addis Ababa Abattoirs Enterprise.

Source: Land Administration of Addis Ababa (2003).

Different categories of staff and labourers depend on the abattoirs for their livelihood. At present the enterprise has a total of over 760 workers. The abattoir is the main source of obtaining clean meat for the Addis Ababa population. The number of animals slaughtered annually by the enterprise ranges from 150,000-160,000 heads of cattle and around 50,000 sheep and goats. The estimation of scraps per cattle is 13% while it is 35% for goats and sheep. If the average weight of an ox or cow is about 350 kg, the scraps will be around 45 kg. If the average weight of a sheep or goat is 40 kg, the scraps will be around 14 kg. This will result around 7,052,500 kg of scraps from cattle and 700,000 kg from sheep and goats annually. The site covers a limited area of land over which scavenger birds fly and feed (Fig. 2).

The river is used as a means of effluent discharge from the slaughterhouse providing food for different species of birds. Besides, it is also the major source of water for vegetable garden and horticultural activities in the neighborhood.

The bones accumulated in the abattoirs are being used by private enterprise for the production of organic fertilizer. Due to this, an area has been partially sectioned, which is situated on the north western part, about 30 m away from the gate. There are four gates: the east: the main gate for the workers and vehicles; the north: for animals, vehicles to be washed and to fertilizer manufacturing plant; the south: for animals; and the west: a small gate used by workers for dumping scraps.

The annual rainfall in this area is 1,100 mm. and the mean average temperature is 16⁰C.



Figure 2. Landscape of the dumping site.

Photo: by Hiwot H. (April 09, 2006)

4.2 Data Collection

The study on the composition, abundance and activity pattern of bird species around the study area was carried out from March, 2006 to February, 2007, two days a week for a total of 98 days. For the species to be studied, a card index was prepared, one card for activity pattern and another for the number of species. Birds were observed within a short distance. Observations were made on the species using a binocular (7 x .50) by walking along all parts of the study area, where birds were located. Birds flying over the area were also observed to identify the species. The whole area was surveyed thoroughly. Video recordings and photographic pictures were taken for further confirmation. The bird species were identified and taxonomically classified using Mackworth-Praed and Grant (1952), Urban and Brown (1971), Pain *et al.* (1975), William and Arlott (1992), Perlo (1995) and Avibase (2006). Bird species code follows Campbell (1998).

Birds were categorized into three: resident birds (birds observed during the whole study period), regular birds (birds observed for a considerable part of the year or in different months), and irregular birds (birds observed only once or a few times during the study period) (Karr, 1976). The abundance of birds in and around the enterprise was studied using a modified point count method following Bibby *et al.* (1992) and Pomeroy (1992). Census data were collected twice a day, morning (10 :30 – 11 :30 h) and late afternoon (15 :30 - 16 :30 h). These were the periods where most of the avian species were active in the site. Immature and mature vultures were recorded to determine the proportions. A hand tally counter was employed for counting birds.

Two suitable sites (car washing and scrap dumping sites) were selected to collect data on relative abundance of different species of birds. The two sites were chosen as they were important feeding and roosting places for many species of birds. Birds flying overhead were generally not counted. Bird activity surveys were conducted from dawn to dusk. Observation distance varied from 15-200 m depending on the behavior of the species of birds, and the topography of the area. To record the activity, a behavior category to each observation was assigned as agonistic (threat and appeasement displays), caution (alert postures), foraging (collecting food), body-care (preening and bathing) and roosting (body-care, basking, sleeping and watching). Vultures were tested both as a single scavenger classification and were also separated into groups based on body size and feeding ecology (Kruuk, 1967; Hertel, 1994). By taking sample of roosting sites from Mekanisa, besides looking the direction of flight, the aerial distance and speed of birds (Pennycuick, 1971) was calculated to confirm that the observed vultures flew to the study area.

During the study periods, informal interviews were conducted with the workers of the enterprise and the surrounding community to assess their attitude towards birds; whether they knew about the diversity, abundance, endemic and seasonal variability on the composition of the species; and whether they prohibit or encourage the trapping or killing of birds.

4.3 Data Analyses

For the purpose of analyses, only those species recorded during more than 30% of the study period were included. Abundance was established by calculating the mean species abundance from the census. Descriptive statistics and correlation coefficients were used to compute the diversity, average abundance and relationship of the major bird species.

5. Results

5.1 Species Composition and Abundance

A total of 21 species of birds belonging to four Orders and 10 Families were recorded during the study period (Table 1). Among them, three species, viz., Wattled Ibis, White-collared Pigeon and Thick-billed Raven are endemic to Ethiopia. Yellow billed Kite, Tawny Eagle and Red-rumped Swallow are migratory Palearctic species with resident subspecies in Ethiopia. All the identified birds visit and stay at the study area for the purpose of feeding.

Out of the total bird species of the area, 23.8% belongs to the Family Accipitridae. A list of visitor birds of the different categories is given in Table 2. Based on this category, 19.05% of the recorded birds were residents and 57.14% comprised regular birds. The remaining 23.81% was irregular birds. Four of the resident and six of the regular bird species were dominant in the area. Out of the dominant bird species, 40% are Accipitridae.

Table 1. List of birds recorded from Addis Ababa Abattoirs Enterprise (March – November 2006).

Common Name	Species Code	Scientific Name	Family	Order
Hamerkop	HAME	<i>Scopus umbretta</i>	Scopidae	Ciconiformes
Woolly-necked Stork	WNST	<i>Ciconia episcopus</i>	Ciconiidae	
Marabou Stork	MAST	<i>Leptoptilos crumeniferus</i>		
Sacred Ibis	SAIB	<i>Threskiornis aethiopicus</i>	Threskiornithidae	
Wattled Ibis	WAIB	<i>Bostrychia carunculata</i>		
Yellow billed Kite	YBKI	<i>Milvus migrans</i>	Accipitridae	Falconiformes
Hooded Vulture	HOVU	<i>Necrosyrtes monachus</i>		
African White-backed Vulture	AWBV	<i>Gyps africanus</i>		
Rueppell's Griffon	RUGR	<i>Gyps rueppellii</i>		
Tawny Eagle	TAEA	<i>Aquila rapax</i>		

Table 1. (contd.)

Common Name	Species Code	Scientific Name	Family	Order
Speckled Pigeon	SPPI	<i>Columba guinea</i>	Columbidae	Columbiformes
White-collared Pigeon	WCPI	<i>Columba albitorques</i>		
African Mourning Dove	AMDO	<i>Streptopelia decipiens</i>		
Red-rumped Swallow	RRSW	<i>Cecropis daurica</i>	Hirundinidae	Passeriformes
Yellow Wagtail	YEWA	<i>Motacilla flava</i>	Motacillidae	
Mountain Wagtail	MOWA	<i>Motacilla clara</i>		
Cape Crow	CACR	<i>Corvus capensis</i>	Corvidae	
Pied Crow	PICR	<i>Corvus albus</i>		
Thick-billed Raven	TBRA	<i>Corvus crassirostris</i>		
Greater Blue-eared Glossy-Starling	GBGS	<i>Lamprotornis chalybaeus</i>	Sturnidae	
Red-billed Fire finch	RBFF	<i>Lagonosticta senegala</i>	Estrildidae	

Table 2. Category of birds based on frequency of occurrence.

Resident	Regular	Irregular
Wattled Ibis	Hamerkop	Wooly-necked Stork
Hooded Vulture	Marabou	Tawny Eagle
African White-backed Vulture	Sacred Ibis	White-collared Pigeon
Pied Crow	Yellow billed Kite	Cape Crow
	Rueppell's Griffon	GreaterBlue-eared
	Speckled Pigeon	Glossy-Starling
	African Mourning Dove	
	Red-rumped Swallow	
	Yellow Wagtail	
	Mountain Wagtail	
	Thick-billed Raven	
	Red-billed Fire finch	

Seasonal fluctuations in the number of species were observed during the study period. Initially, 18 species of birds were represented during the dry season. This species composition remained relatively unchanged until the departure of the migrant birds. Among the migratory birds, Hamerkop, Sacred Ibis, Yellow billed Kite and Yellow Wagtail started to leave the study area during late June and early July. During the study period, a juvenile (immature) Tawny Eagle was seen south of the feeding site for the first time on August 6, 2006 afternoon perching on a fence. On September 30, 2006, Woolly-necked Stork entered the study area to feed on the scraps around the effluent. The total number of species reached 16 during the wet season in the study area. White-collared Pigeon was observed on November 4, 2006 at 18 :15 h perching on the roof.

There was no variation in the number of bird species observed in the morning and afternoon, though the occurrences of species vary depending on the season (Fig. 3). During the census period, four species, viz., African White-backed vulture, Hooded vulture, Pied Crow and Wattled Ibis were observed in all the 98 counts. The populations of Hooded and African White-backed vulture were very high in the area, 47.49% and 26.03%, respectively. Similarly, the number of Sacred Ibis recorded in the study area was high (14.70%), but being a local migrant, it appeared in only 78 out of 98 counts. Wattled Ibis (5.46%) ranked fourth in the population size recorded among the 21 species. The raw data are given as Appendix 1. A list of species code corresponding to the sequence is given in Table 1.

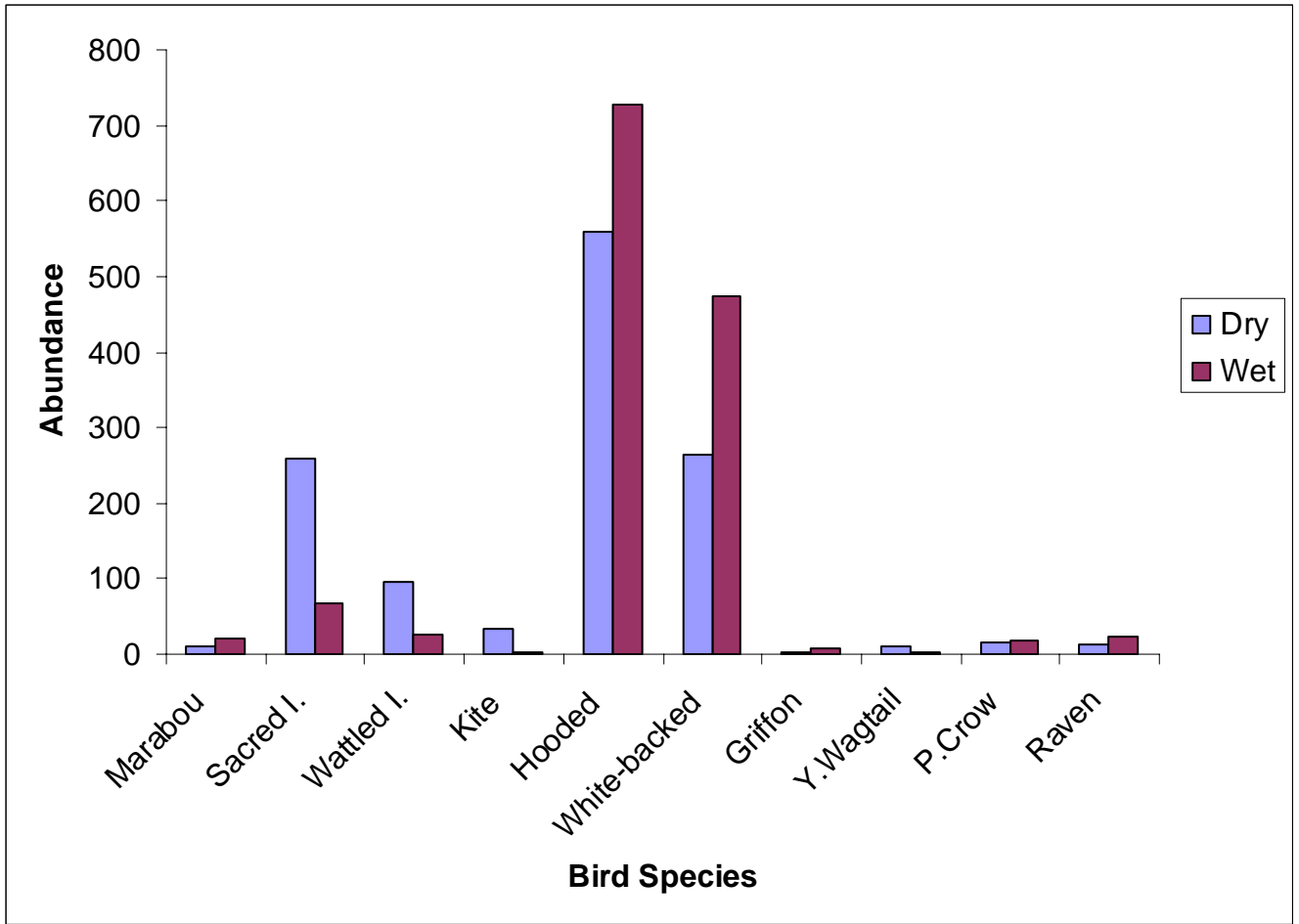


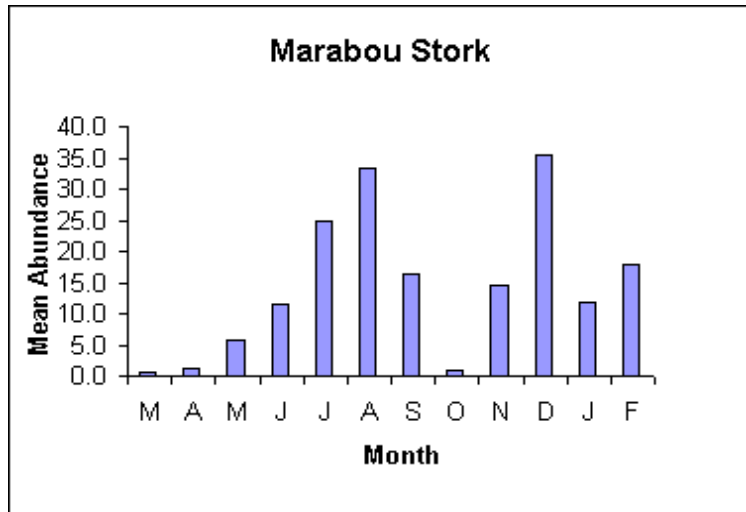
Figure 3. Abundance of dominant bird species in the study area during dry and wet seasons (March, 2006 – February, 2007).

Except for the four migratory birds (Sacred Ibis, Wattled Ibis, Yellow billed Kite and Yellow Wagtail), the abundance of the six species (Marabou Stork, Hooded Vulture, African White-backed Vulture, Rueppell's Griffon, Pied Crow and Thick-billed Raven) was greater during the wet season than during the dry season, i.e., 60.4% and 39.6% respectively.

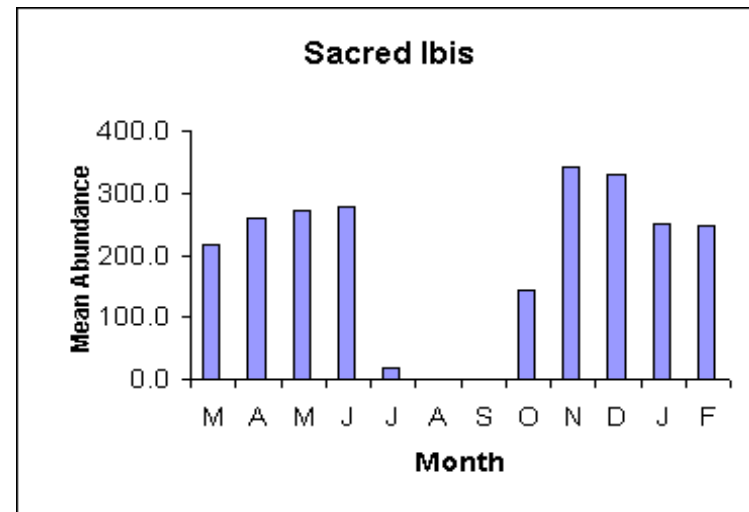
Regarding the African White-backed Vulture, four different colors of plumage were observed during the study period. Despite the continuing availability of food, the number of Hooded and African White-backed vulture declined since early November to February. The number of vultures dwindled extremely at the beginning of January. The number of Griffon recorded at the site does not show consistency. During January and February, there was no record of Griffon in the area. On the other hand, the Pied Crow population was more or less consistent throughout the study period. The monthly abundance of dominant bird species is shown graphically in Figure 4 (A-J).

During the study period, it was not possible to make regular and thorough checks of adult and immature birds. The results obtained in 10 observations (five in wet and five in dry season) for Hooded and African White-backed vultures are presented in Tables 3 and 4. There was fluctuation in the numbers: immature Hooded Vulture during wet and dry seasons between 39.7 – 43.6% and 36.5 – 61.9% respectively, immature African White-backed Vulture during wet and dry seasons between 36.8 – 44.4% and 34.9 – 93.5% respectively. Immature Griffon vulture rarely observed in the study area.

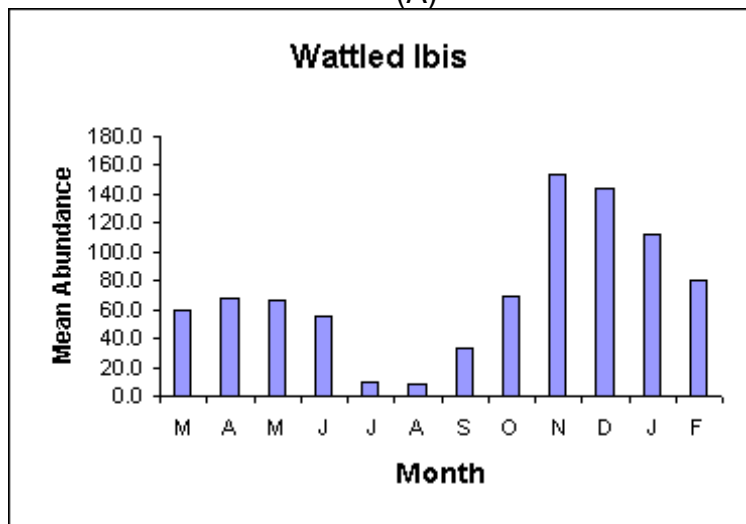
A pronounced decline in the number of Sacred Ibis was seen during the wet season. Similarly the number of Wattled Ibis decreased from mid-June but did not completely disappear from the site. The number of Marabou fluctuated greatly from month to month. The Marabou once abundant in the area began to decline at the beginning of September and virtually disappeared by the third week of September until the last week of October. Again, the number started to increase and fluctuate from the third week of November. From mid-July up to the end of December Thick-billed Raven became more conspicuous. The Yellow Wagtails vanished from the area by mid-July.



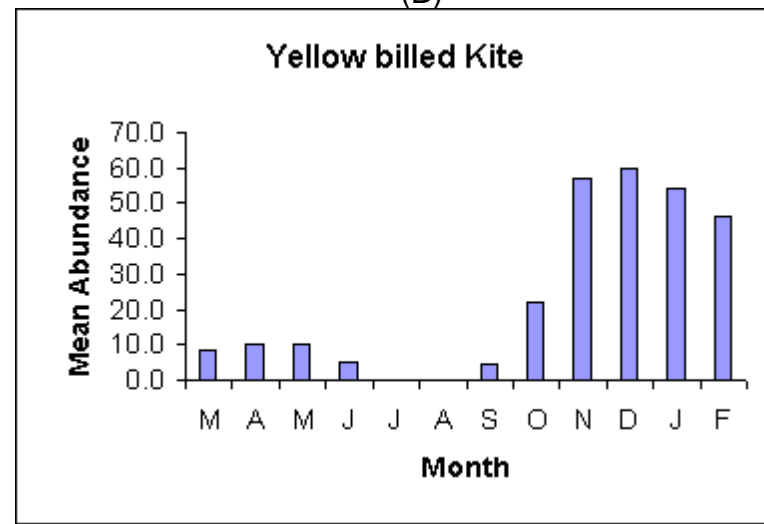
(A)



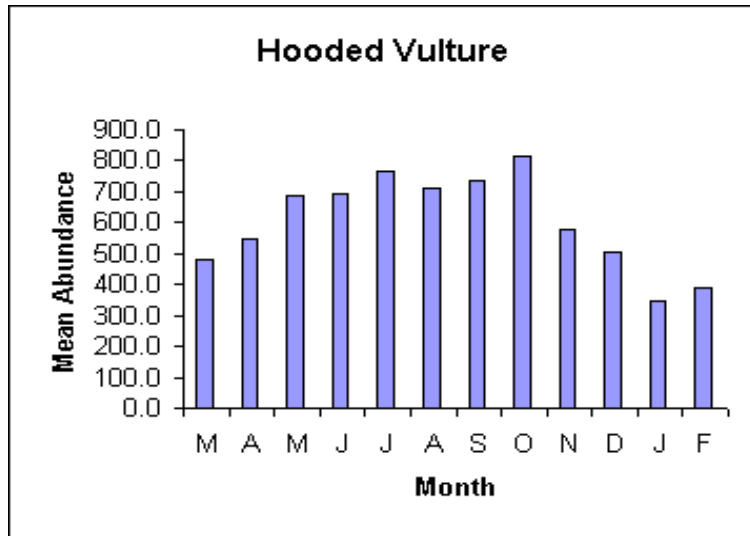
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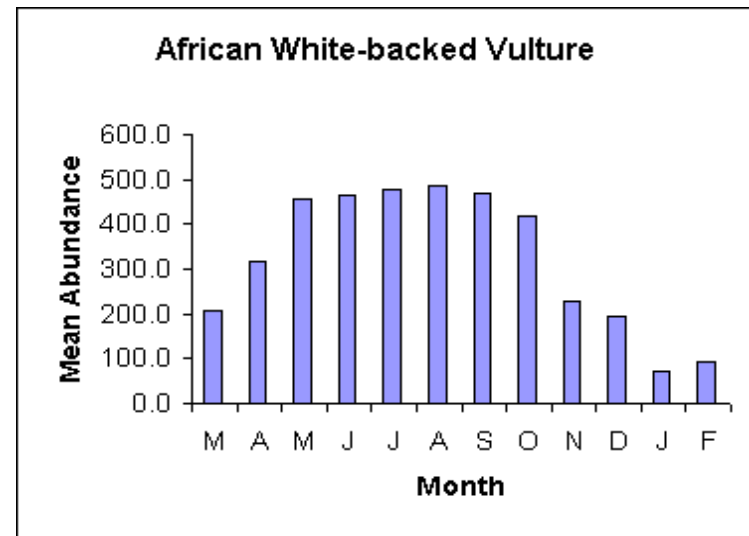
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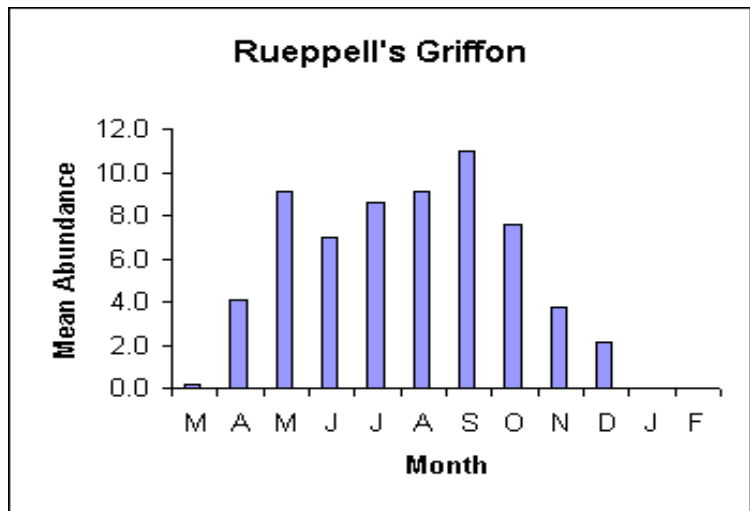
(D)



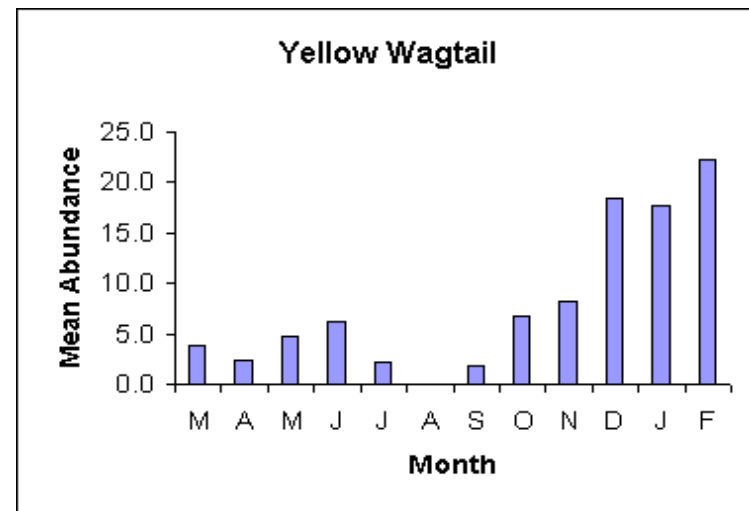
(E)



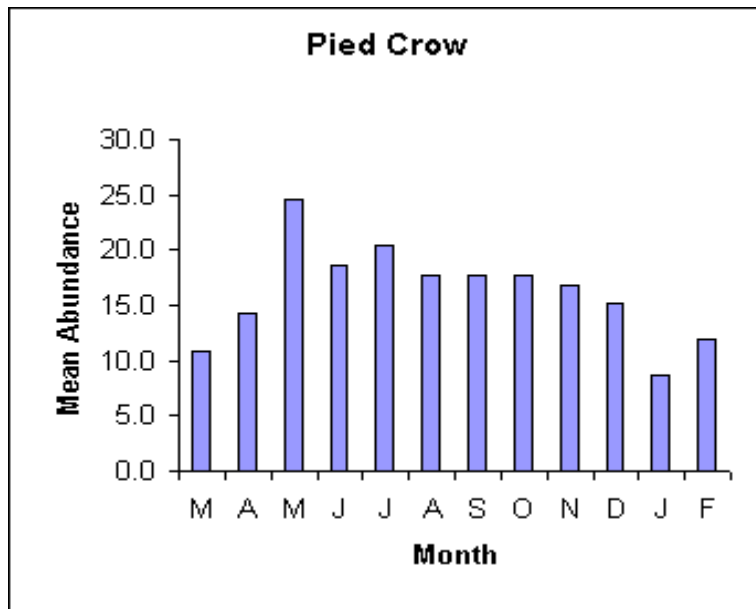
(F)



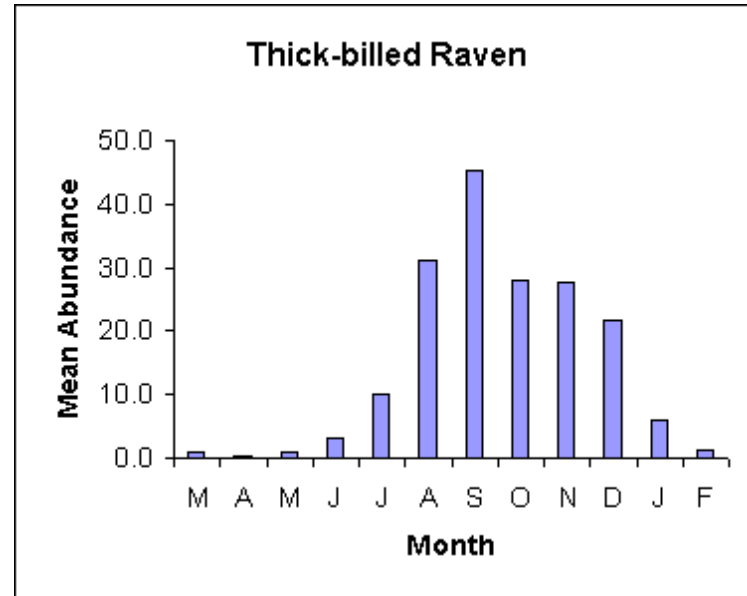
(G)



(H)



(I)



(J)

Figure 4. Monthly abundance of dominant Birds in the study area during 2006/2007(A-J).

Table3. Abundance of adult and immature Hooded Vultures during the wet and dry season.

Season	Date	Adult	Immature	Total
Wet	01/07/2006	477	335	812
	22/07/2006	470	309	779
	12/08/2006	410	315	725
	26/08/2006	430	299	729
	17/09/2006	428	297	725
Dry	29/10/2006	479	275	754
	18/11/2006	231	354	585
	09/12/2006	219	314	533
	23/12/2006	189	307	496
	14/01/2007	176	219	395

Table 4. Abundance of adult and immature African White-backed
Vultures during the wet and dry season.

Season	Date	Adult	Immature	Total
Wet	08/07/2006	313	182	495
	23/07/2006	295	194	489
	19/08/2006	237	189	426
	27/08/2006	297	206	503
	23/09/2006	256	173	429
Dry	28/10/2006	274	147	421
	12/11/2006	49	185	234
	03/12/2006	42	205	247
	17/12/2006	34	181	215
	13/01/2007	3	43	46

In August, Sacred Ibis, Yellow Wagtail and Yellow billed Kite were absent from the study area. Excluding the exceptionally early record – single Kite – observed on 02 September, the migrants began to reappear after mid-September. Yellow Wagtails were seen towards the end of September, and from the last week of November onwards, their number increased. The Yellow billed Kites significantly increased in number from October onwards and became numerous after mid-November (Table 5). They were seldom congregated.

Table 5. Maximum and minimum number of dominant birds recorded during the study period.

Birds	Max.	Date	Min.	Date
Marabou Stork	88	24/12/06	*	
Sacred Ibis	356	10/12/06	*	
Wattled Ibis	167	18/11/06	2	30/07/06
Yellow billed Kite	84	18/11/06	*	
Hooded Vulture	892	22/10/06	221	07/01/07
African White-backed Vulture	516	06/08/06	27	07/01/07
Rueppell's Griffon	22	08/10/06	*	
Yellow Wagtail	33	28/01/07	*	
Pied Crow	33	04/06/06	5	01/04/06, 07, 21/01/07
Thick-billed Raven	67	10/09/06	*	

* Absence.

The monthly abundance of Marabou Stork does not show linear relationship with Wattled Ibis, Hooded and African White-backed Vulture. The same was true between the Thick-billed Raven with Wattled Ibis and Yellow billed Kite (Table 6). The negative linear relationship between the species was 42% and the positive linear relationship was 49%. The deviation of monthly abundance of each species from the mean through the study period was variable (Table 7). There was no occasion on which the study area was totally devoid of bird species.

Table 6. Correlation among dominant bird species in the study area from March 2006 to February 2007.

	Marabou	Sacred	Wattled	Kite	Hooded	White-backed	Griffon	Y.Wagtail	Crow	Raven
Marabou	1.0									
Sacred	-0.3	1.0								
Wattled	0.0	0.8	1.0							
Kite	0.2	0.7	0.9	1.0						
Hooded	0.0	-0.6	-0.6	-0.7	1.0					
White-backed	0.0	-0.6	-0.7	-0.8	0.9	1.0				
Griffon	0.1	-0.6	-0.6	-0.7	0.9	1.0	1.0			
Y.Wagtail	0.2	0.6	0.7	0.9	-0.7	-0.8	-0.7	1.0		
Crow	0.1	-0.3	-0.4	-0.5	0.8	0.8	0.8	-0.5	1.0	
Raven	0.4	-0.5	0.0	0.0	0.5	0.3	0.5	-0.2	0.2	1.0

Table 7. Summarized statistical data of dominant bird species in the study area.

	Marabou	Sacred	Wattled	Kite	Hooded	White-backed	Griffon	Y.Wagtail	Crow	Raven
Mean	14.9	191.4	71.2	22.3	618.7	339.0	5.6	7.3	16.6	15.7
Standard Error	1.61	12.93	4.80	2.45	15.44	15.08	0.53	0.86	0.63	1.62
Standard Deviation	15.98	128.03	47.48	24.27	152.84	149.29	5.21	8.47	6.24	15.99
Range	88	380	165	84	671	489	22	33	28	67
Minimum	0	0	2	0	221	27	0	0	5	0
Maximum	88	380	167	84	892	516	22	33	33	67
Sum	1458	18762	6974	2187	60631	33224	548	712	1623	1541
Count	98	98	98	98	98	98	98	98	98	98
Confidence Level (95.0%)	3.2	25.7	9.5	4.9	30.6	29.9	1.0	1.7	1.3	3.2

5.2 Seasonality and Food availability

The food source for the birds in the study area was fresh and boiled scrap and offal discarded from slaughtered animals. The scraps were dumped twice a day, in the morning, fresh scraps (09 :00 – 10 :30 h) and in the afternoon, boiled hoof (15 :00 – 15 :30 h). The occurrence of offal in the bird's diet was infrequently observed and generally insignificant. The head part, the lower leg parts (fresh and boiled), piece of hides and other scraps constituted the main food source. But, there is competition with human and other mammals (Figure 5). The contribution of mixed fresh pieces of bones, meat and blood in the diet, despite its temporal abundance (3.6%) in the dumping site, is high for Crow, Raven and Marabou, but negligible for vultures. Near the dumping site, 60 – 100 cart of powdered scrap daily piled and mixed with the effluent between 10 :00 h and 10 :30 h. When the discharge was deposited at the edge of the river, different species of birds congregate and feed on it.

Boiled hoof and esophagus part (omasum) was an attractive food of birds. At the time of dumping boiled hoof, birds do not eat because of its hotness. But after an hour, the Wattled Ibis and Yellow billed Kites start feeding from the edge. The next day, in the morning, Vultures concentrate on it.

There were pronounced variations in the number of animals slaughtered from month to month (Table 8), and also between various days within the same month. The highest

number of oxen slaughtered for Christians was 1353 on 05/07/06 and for Muslims it was 95 on 23/09/06.

Table 8. Number of animals slaughtered per month during 2006/2007.

Month	Slaughtered Animals				
	Cattle	Sheep	Goats	Pigs	Total
March	4862	4540	703	91	10196
April	10119	3346	547	98	14110
May	14209	5519	779	125	20632
June	10864	5032	638	84	16618
July	15541	5579	756	73	21949
August	13014	6357	650	101	20122
September	13684	6924	653	119	21380
October	13814	6801	743	104	21462
November	13258	6272	753	105	20388
December	12119	6896	636	106	19757
January	13368	6720	684	107	20879
February	4669	6828	729	112	12338
Total	139521	70814	8271	1225	219831



(a)



(b)



(c)

Figure 5. Competitors of unrelated groups (a) Cat (b) Dog and (c) Man.

Photo: by Hiwot H. (May 07, 2006).

5.3 Activity patterns

Activities recorded throughout the study period were soaring, feeding, threat and appeasement displays, watching, alert postures, flying, roosting, body care, basking and sleeping. But the distinction between these activities was not always clear-cut as they were engaged in two or more activities, simultaneously.

The most significant and attentively observable activity of birds was their feeding habit. Birds start feeding on the dumping site early in the morning from 06 :00 h onwards. They were not seen in the early hours of the morning during the wet season. Vultures stay long waiting for the sun to dry the dew from their feathers. But on several occasions during the dry season, they were observed at the site even before 06 :00 h. The first to arrive at the site was Hooded and the last was Griffon. Most of the birds after reaching the area rather than involving in feeding were perching on the nearby structures for a while. During this time, they stay by preening their feathers and sun-bathing. During the wet season, sun-bathing was more obvious among vultures extending their wings and aligning themselves with the sun for maximum effect (Fig. 6). Only in very few cases, birds were observed feeding during rainy time.

During feeding, mainly four activities, viz., feeding, threat and appeasement displays, watching and alert postures were observed. Those feeding around the effluent, after feeding raise their feathers, shake their bodies and stretch their wings before settling the feather back into place. Then they may return to their feeding site or bask on the roosting

place. Conflict at the feeding site was frequent among Vultures in areas where fresh scraps were disposed. Griffon and African White-backed Vultures display threat and appeasement but Hooded Vultures try to kick with legs like a cock fight. Ibis feeds in groups probing ground regularly. Wagtails rarely fly to the feeding site in group, but after feeding, they usually return to their perching trees in groups. Kites spend long periods in low searching flight, seeking offal. Hamerkops standing in shallow waters at the bank of the river feed on aquatic animals, watching around carefully.

By the time when fresh scraps were dumped at the site (usually between 09 :00 – 10 :30 h), the workers and beneficiaries disturb the birds. Again, during this time, three of the activities (watching, alert postures and flying) were observed. Due to disturbance, they move out first and subsequently invade the area. Thereafter, at every interval of time, an intruder (mainly workers and beneficiaries) disturbs the birds causing a massive stampede. During this occasion, the birds may fly away and habitually perch on convenient places to land on the scraps (Fig. 7) or soar in the sky around the study area. Wattled Ibis makes loud calls in flight. Usually the Sacred Ibis remain on their perch up to 10 :30 h.

During the mid-day, most birds start to leave the feeding site for resting. They roost on the roofs, branches of trees and nearby structures. During the resting time, the Marabou spends many hours standing almost still, never observed sitting on the perch. The time spent for the different diurnal activity patterns and resting were variable.



Figure 6. Sun-bathing of vultures.

Photo: by Hiwot H. (July 16, 2006).



Figure 7. Birds perching on buildings and on walls.

Photo: by Hiwot H. (June 11, 2006).

5.4 Feeding habits

Unless it is rainy or the temperature is low, birds commence feeding at 06 :00 h. This activity continued for a variable length of time. During the dry season, usually from early morning until about 09 :00 h, up to 300 vultures feed on the scraps. The fresh dumping site is intensively disturbed by human activity (Fig. 8). Whenever there is human activity around the scraps, birds keep on perching. But, when the workers and beneficiaries leave the area, the first to land was Hooded vulture. Then half-a-dozen vultures followed by more potential competitors arrive. Finally, new groups of vultures arrive and up to 600 of them could be seen feeding at the area. But, immediately, the fresh dumping site will be under the control of dominant vultures (Fig. 9). There were two peaks of feeding, one between 10 :30 – 12 :00 h and the other between 14 :30 – 16 :30 h.

There was a dominance hierarchy among vultures during feeding. Size affects dominance, that is, both Griffon and African White-backed vulture prevent Hooded vultures from reaching the fresh dumping area. Hooded vultures do not compete with them. This results in the Griffon and African White-backed vultures to be numerically more dominant in the fresh dumping area. Griffon and African White-backed vultures frequently exhibit threat displays when defending the fresh scraps (Fig. 10). In the act of repelling others, there was fighting between the dominants. They make a squealing hissing noise when fighting over a scrap. Particularly, the African White-backed vulture fights with harsh, grating screeches, after bounding attacks. Defense of favourite feeding ground (for example, the freshly dumped scraps) was occasionally observed by the

dominants when less amount of scrap was disposed. In such cases, much time was spent in fighting and only little time was available for feeding.

Until the dominant satiated, others rake away with their bills the old scraps to obtain food (Fig. 11). The African White-backed vultures sometimes pursue the Hooded vulture in the attempt to snatch what they have secured.

When big fleshy offal is identified by any vulture, there will be a squabbling melee of 10-20 dominant vultures among which all manage to get something (Fig. 12). Occasionally when there is competition, vultures try to snatch and swallow bulk fleshy scraps.

After a heavy meal, some of the vultures fly away to a safe perch or roost. Others merely rest on the mounds (Fig. 13). During this time, if there is human movement nearby, the Griffon vultures fly away, but others move or walk sideways.

The Ibis never reached the fresh dumping site in the morning. They search from the old scraps and mainly around the effluent. Their feeding site was towards the road, where the intruders use. So, they were extremely disturbed until all the intruders left the area. A quite different feeding habit was observed in the afternoon, and several places were covered by Ibis and Kites. In the morning, the kites habitually rob birds of the flesh, they have just captured by snatching from the collected scraps. In the afternoon, they feed on the ground. In April and May, the Hooded vulture and Wattled Ibis were observed using their bill to probe into soft ground for insects around the farm yards and bushes.



Figure 8. Human activities around the feeding site.

Photo: by Hiwot H. (June 25, 2006).



Figure 9. Mass of vultures involved in feeding.

Photo: by Hiwot H. (May 21, 2006).



(a)



(b)

Figure 10. Threat and appeasement display (a) when landing and (b) reaping.

Photo: by Hiwot H. (June 18, 2006).



Figure 11. Birds feeding on old scraps.

Photo: by Hiwot H. (June 18, 2006).



Figure 12. The scrambling of dominant vultures.

Photo: by Hiwot H. (July 30, 2006).



Figure 13. Satiated vultures resting on mounds.

Photo: by Hiwot H. (June 04, 2006).

The Thick-billed Ravens collect their food from the fresh dumping site and around the effluent. The Marabou feeds from the old and fresh scraps pieces of meat and worms (insects). They usually swallow the tail part and the male genital organ from the fresh scraps which were not used by other birds. Marabou also snatch food from vultures.

The Wagtails and Red-rumped Swallows feed on worms and flying insects around the old scraps when the day heat is high. This made them to be active for a short time and disappear. The Pied Crows feed largely on the ground and occasionally on trees.

The car washing site is mainly frequented by Hooded vulture and Crows except during the wet season, where rarely one or two African White-backed vultures and Marabous were observed. In the site, the unwanted part from incoming truck was dumped on the open field during washing. As these leftovers were not removed soon, the birds aggregate around the site to scavenge for food. The African Mourning Dove was observed occasionally around this site. Many areas of the enterprise (other than the dumping and car washing sites) were in use by different birds like Red-billed Fire-finches and Speckled Pigeon. The Hamerkop is limited at the end of the effluent joining the river. Relatively, their feeding site is not disturbed at any time.

5.5 Flight direction and Roosting sites

Most of the vultures were observed coming from the southwest direction, where enough roosting trees were located. Trees found inside and surrounding the study area (Fig. 14), at different Orthodox Churches, institutions, and around Mekanisa area were active roosting sites for different species of birds. However, large number of Sacred Ibis came from the southeast direction.

When birds return to their roosting sites, the first to leave the study area was Griffon vulture, at about 16 :30 h then the African White-backed vulture and Marabou disappear from the area. Following them most of the Hooded leave the site. The Sacred Ibis first left the feeding site and perch on the roof. Then starting from 17 :20 h they were observed to fly to their roosting site. There was no consistency in the returning time of Pied Crow and Raven. Wattled Ibis and Kites were the last to depart from the dumping site.

Few Wattled Ibis and Marabou roost on trees inside the study area. They have alternative roosting sites. The Olive tree near the dumping site was used by Wattled Ibis unless Marabou roosts on it. Three to five Pied Crows roost on the roofs of the slaughter house. The Wagtails roost north of the feeding site on trees near the river.

Few Hooded vulture and Ibis were observed roosting on trees in less than 2 km radius from the study area. Vultures roost in groups ranging from 80 to 150.



Figure 14. Vultures within their roosting sites.

Photo: by Hiwot H. (August 13, 2006).

5.6 Responses of Interviews

The following responses were collected during discussions made with the staff members of Addis AAAE and people in the neighborhoods.

- Most of them do not know the advantages of bird species.
- The commonly held expectations were that raptors have a negative effect on domestic hen and pigeon abundance through predation. In their roosting site, there is also a negative attitude due to breaking electricity lines and polluting the area with their faeces.
- The majority commented the diversity of bird species in the past was more than the present time. They witnessed that birds with different colour and size, especially a relatively larger vultures with naked face and neck (“Lappet-faced Vulture”), were common in the dumping site of the abattoir.
- They were unable to recognize the endemic Thick-billed Raven and Wattled Ibis.
- The composition and abundance of birds were greater during the dry season.
- There is a traditional belief among few individuals to keep the African White-backed Vulture in their home to satisfy the guardian spirit.

6. Discussion

6.1 Species Composition and Abundance

The present study area is used by different groups of birds, including wetland birds and Passeriformes. A noticeable characteristic of the bird census in the area was the presence of species that utilized the habitat only as a food source. The availability of food was responsible for the high population of birds in this area. From the total bird species of Addis Ababa as listed by Pain *et al.* (1975), this small habitat comprises about 8%. These birds do not nest in the area.

The feeding site is not a protected area from other animals including humans. The human beneficiaries from the scrap are the major source of disturbance for the normal activities of birds in this area. This phenomenon has greatly affected the species composition and abundance. Disturbance and other extra factors influence urban bird populations and communities (Rebele, 1994; Jokimaki, 1996). Even though human disturbance is high, birds keep on using the area. Among the recorded birds, the least in per cent are resident while the majorities are regular.

Wetland birds of the Order Ciconiforms, which comprised 25% of the bird species in the area, are migratory. Migration greatly alters the bird population by changing both its numbers and composition. Bird species diversity was highest during the dry season. However, seasonal variation in the number of bird species is not related to the availability of food. Birds are able to find suitable food sources in this habitat and consequently one

can find great number of bird species in the area during the wet season. The requirements for bird-life in urban habitats vary from species to species, but most species are limited by availability of food as described by Erz (1966), Hounsome (1979), and Lancaster and Rees (1979).

Seasonal fluctuations in the abundance of individual species were more extreme. For example, the number of Wattled Ibis was decreased dramatically even though they were seen scattered throughout the wet season. During the wet season, some species totally left the area, decreasing both in number of species and individuals. This is related to the findings of Jokimaki *et al.* (2002), different habitat features affected the habitat selection of wintering birds. Some birds, however, are not affected where there is a change in weather on the condition that food is available.

Although the abundance of the population changed from season to season, Vultures remained numerically the dominant birds of the study area. The three species, namely Hooded vulture, African White-backed vulture and Rueppell's Griffon were well represented in the area throughout the study period. The most numerous species are the Hooded and White-backed vulture, though it was surprising to find numerous Sacred Ibis and Wattled Ibis, because Ibis are not strictly meat eating species. The Sacred Ibis were seen in big numbers on the occasions when they are encountered. Although the case for the low number of Griffon is not clear, in most cases, food selection and the possibility of human activities might have been the main factors. Bone fragments, disarticulated by

hyenas and other bone-crushing carnivores are an important part of Griffon vulture diet (Richardson *et al.*, 1986).

The fluctuation in the numbers of adult and immature Hooded and African White-backed vultures was indicative to show that some of the birds were either new visitor or may use other feeding sites. Hooded and African White-backed vulture number did not decline significantly in the area until the first week of November. The decline in the number from November onwards was also confirmed in their roosting sites. The increase in the percentage of immature vulture in the study area during the dry season after November might be related to the breeding season of the adults.

Literature about the African White-backed Vulture different plumages (besides the two: pale brown for adult and dark for immature) is absent. Sometimes, the Hooded vultures tend to be far more numerous than all other species. But during holidays, the number relatively decreases from the usual time. The main reason was people have traditional culture to slaughter animals by forming groups in their surroundings, institutions and enterprises. Due to this, waste and leftovers are disposed in various parts of the city such as sewage channels, on the streets and garbage dumps. The Hooded vultures, therefore, need not visit the study area to locate offal and scraps. Rather, they were observed to remain around the disposals in the city, with relatively fewer Hooded's frequenting the study area. However, information from interview strongly suggests that over the past years, vultures and other species have suffered massive declines in number. This goes in

line with Thiollay (2006), at least several African raptors have declined, but a number of vultures and eagles fail to exist compared to other African raptors.

The cryptic perching behavior of Pied Crow made it difficult to count except the call. Similarly, it arise problem in the feeding site while it is flying here and there. The population of Marabou increased greatly in July and August showing an inverse relationship with that of migratory birds. Marabou disappeared from the area by the mid-September. The disappearance persisted for only four weeks. The Raven population in September was substantially higher than other months. The reason for the increase in number during this month is not found in literatures. But the dispersion of Hooded Vultures in the city might enforce them to feed from the abattoirs. The acrobatic and tireless flight behavior of the Yellow Wagtail makes them difficult to count. However, they were counted when feeding on insects and worms on the ground.

The study area was free of migrant birds during July and August as they migrate to other places where the climate is more favorable. Among the migrants, the Yellow billed Kites were the first to arrive in the study area, during the second half of September. Sacred Ibis and Yellow Wagtails appeared on the last week of September. This being the period with rainfall decreasing and the insect population was increasing.

6.2 Seasonality and Food availability

There is abundance of food in the vicinity of the abattoirs. The major food source for the birds is scraps of slaughtered animals. The number of animals slaughtered fluctuates from time to time. Whether or not and how often the number changed could not be determined. But the range of slaughtered animals per day varied on certain specific occasions, during fasting time and holidays. Large numbers of cattle are slaughtered at different days of the year for celebrating the Orthodox Christian holydays and eve of fasting. The maximum number of animals slaughtered was during the eve of the August Orthodox Christian fast (*Felseta* in Amharic), and the minimum number during the period of major Orthodox Christian fasting season (Lent). Animals were slaughtered in three categories: for Christians, Super markets and Muslims proportionally in number with decreasing order.

The variation in slaughtered numbers at different periods results in a change in the type and amount of scraps to be available for birds. This implies that the number of slaughtered animals has a significant impact on food availability. It can be assumed that as the number of slaughtered animals increases, the amount of scraps disposed also increases. But data on the number of slaughtered animals sometimes may not accurately reflect the amount of food available for birds. Because, additional infected (diseased) parts like liver are discarded and there was exploitation of scraps by human beneficiaries. The omasum which is more seasonal occurs with two major peaks. Peak 1 occurs during the time of holidays, when every body or the majority needs lean meat (clean meat), and peak 2 occurs during the fasting time because of its less demand by the consumers. Both

offal peaks were obvious mostly in the car washing site. However, head parts, lower leg parts, pieces of hides and the male genital organs were available throughout the year. Similarly, udder (breast) was common on the dumping site. Sometimes birds have abundance of food. Those birds associated with the availability of food did not decline significantly in number even during the fasting period. Due to this, birds have long found abattoirs to be satisfying wintering sites, where scraps are readily available (see Fig. 3).

During the fasting period, due to the influx of human beneficiaries, the amount of fresh scrap to be available for birds decreases. During August fasting season, vultures have difficulties in finding enough fresh food. Further, during this wet season, when it is cold, they may not even be able to fly to the dumping site. In vultures, body temperature normally decreases as ambient temperature falls, to save energy (Prinzinger *et al.*, 2002). Rather they stay until the temperature is raised. Special flight adaptations (thermal and slope soaring) save energy during the search for food (Houston, 1974; Obrecht, 1988).

Generally, there are occasions that may lead to a decrease in food supply for birds. This event was apparently due to three reasons: 1) period of fast by the Orthodox Christians, 2) the overexploitation of scraps by human beneficiaries, and 3) continuous manipulation of bones and scraps by bulldozer to aerate (dry) for fertilizer manufacturing. Unless things are changed and if the amount of food decreases in the future, it may affect the composition and abundance of birds in the area. A change in food supply may produce large changes in vulture population size (Parra and Telleria, 2004).

6.3 Activity patterns

Different species of birds were usually seen throughout the day around the study area. There was a strong interaction between the dumping site characteristics, the presence of abundance or competitive species and the composition of bird assemblages. Most species were active at certain times of the day. Their activity and the time spent for different activities varied with the type of weather, length of the day and availability of fresh food. Birds do not wander indiscriminately, but confine their activities within local, measurable areas mainly where fresh scraps were dumped.

Comparatively, the availability of food and the interference of human have more dominance than weather in affecting the activity of birds in the area. However, they prefer sunny and warm days than dull and cold weather. During the dry season, some birds were actively involved in feeding at 06 :00 h. Commonly, five to ten Hooded vultures were seen either on the roof or on the dumping area. The other species arrive at late and the last to visit the area is Griffon, after 10 :30 h. Bahat *et al.* (1998) found that Griffon vultures were able to show a clear dependence of body temperature on ambient temperature.

Most of the species feed in flocks in the study area. Vultures were social in their feeding habits as described by Weidensaul (1996). During feeding, individuals in a flock look in all directions. When they spot a person or any other intruder, they watch suspiciously. In the meantime, if any one of them flew, others follow and the remaining ones will be in

alert. Usually, the first to give signal and fly were Wattled Ibis. When flock is flushed, all arise and call, continuing to do so as they fly away (Urban, 1980). If the intruder does not approach, they continue their usual activities. Otherwise, they abandon the site (Acha *et al.*, 1998). In general, any sign of life or movement will drive them away from their feeding and perching sites.

Although the enterprise authority took some measures to prevent the presence of men (beneficiaries) in the dumping site, they are still observed taking meat from the scraps starting from 09 :00 h. Until the beneficiaries leave the area, numerous short flights are made by birds between the dumping and roosting sites. During this period, few Vultures frequently exchange perches. There were innumerable variations in the skill of individual vultures and in the reactions of their intruders. For example, Griffon and African White-backed vultures when disturbed may desert their feeding sites and fly far away from the study area. But, Hooded vultures perch on the roofs, or stay on the ground near the beneficiaries. If there is human activity around the dumping site, the Sacred Ibis remain in their roost. When the beneficiaries leave the area, in half an hour time, most of the birds aggregate on the feeding site. Due to human interference, birds were sometimes forced to change their normal feeding time. Occasionally, they were observed when feeding actively during the mid-day, especially in relatively undisturbed areas. As Wilson (1990) stated earlier, Pied Crow was not involved in feeding between 12 :30 – 15 :30 h.

The time spent for resting increases from mid-day to early afternoon. Much of a resting time is devoted to caring for their feather, which must be carefully preened to stay in

good condition. This is a common trend to birds, as Weidensaul (1996) stated preening besides smoothening and rejoining the separated barbs also helps to reduce the number of parasites in their feather. During the active feeding time (in the morning), the shortest and longest time spent at any perch were dependent on the type of food and the specific feeding site of the birds. Since the Yellow Wagtail feeds on flying insect their perching time was less than one minute. On the other hand, the feeding site of Sacred Ibis was the road where the human beneficiaries use. So, their perching time was more than two hours. Except Hooded Vultures, all Griffon and most African White-backed Vultures leave the area during the resting time.

When the temperature is low, after mid-day, the resting period diminishes and almost all birds become engaged in feeding activities until dusk. Griffon vulture was absent from the area until 16 :00 h. Unlike most bird species, the upper critical ambient temperature for Griffon vultures is 25°C similar to the Peruvian Penguin (Prinzinger *et al.*, 2002). They are used to feed for a short period of time after 16 :00 h.

Occasionally, threat and appeasement displays occur between birds of the same and/or different species on feeding and roosting sites. In their threat display, Griffon and African White-backed Vultures extend their neck and curve like a bow, the closed bill usually pointed and wing extending as if to attack (see Fig. 10). Actual fights among birds were rare because of the appeasement posture, retreating from a threat and more often there was tolerance. This agrees with the statement of Kress (2000), a bird in an appeasement

posture frequently hunches its shoulders, lowers its beak, and turns away from the threaten bird.

Yellow billed Kites are fearless birds during searching flight and as described by Sinclair and Ryan (2003), often fly swooping down to snatch meat from other birds. They even snatch from the human beneficiaries with agile twists and turns.

The activity patterns of dry and wet seasons show distinct variability. The wet season is the most critical time for many birds. They do not reach early in the morning in the dumping site and even after reaching there; stay perching for hours before getting involved in feeding. Pennycuick (1972) and Houston (1975) have suggested that vultures were dependent on temperature-driven when the heat was high and were therefore less active during the early hours of the day. The reduced food requirements and the ease of satisfying them during the dry season permit the birds to spend longer hours perched quietly in cool area. This is related to the statement of Weathers (1981), the physiological ability to increase body temperature as ambient temperature is raised is well known in birds and save energy expenditure by minimizing the difference between ambient and body temperature. Also ample supply of food (scraps), shortened the periods of feeding.

6.4 Feeding habit

Vultures tended to co-occur with other species and were always the first group to arrive at the feeding site. Since vultures are capable of staying for long periods without feeding as

described by Gracia-Rodriguez *et al.* (1987), even when there is no human disturbance, many vultures can get at the dumping site, but usually there are only a few of those present actively feeding on the scraps.

Most of the time, the neighboring human intruders (beneficiaries) start to come in the fresh dumping site after 08 :30 h to extract meat from the scraps. So, birds fly for a shorter distance and after few minutes land to recommence feeding. When the number of human beneficiaries increases, birds retreat to mounds or roofs or move away and roost for a while. As described by Mark (1998), vultures are actually very shy of humans.

Hooded vulture and Wattled Ibis are the commonest birds frequently seen feeding the powdered scraps deposited around the river bank. Sometimes Yellow billed Kites and African Morning Doves are also included. It is evident that this feeding habit of raptor is clearly different from other published papers, that is, they feed on a broad array of invertebrates and vertebrates in all natural and artificial habitats (Thilloy, 2006). This is presumably because the birds are very well adapted to the area and thus developed unique feature to satisfy their needs.

When the human beneficiaries start leaving the area, it will be safe for birds to feed on the scraps. Most of the time, new comers land at a distance from the feeding site, and then move to join those engaged in feeding. Though, the availability of food is high, Griffon and African White-backed vulture rush at others feeding ground on the fresh scraps, in an attitude of threat display. The competition and conflict between dominants is

for access to fresh scrap. During this time, the Hooded vulture search around the old scraps, otherwise wait for their turn. Hooded vultures are unable to access much material on fresh scraps, instead feeding primarily on old scraps around the dumping site (Petrides, 1959 and Kruuk, 1967). Hooded Vultures supplement scraps with insects and dung. Therefore, they might be less dependent on fresh scraps than the other vultures. Hooded Vulture uses the slender bill to pick at large carcasses after other scavengers have left, or to probe into dung and soft ground for insects (Sinclair and Ryan, 2003). When there is scramble and if the food is big enough to swallow they carry it in claws or bill up to a perching site for consumption. Sometimes, even in the fresh dumping site, the dominant vultures were not aggressive in repelling others. This shows that the dumping site is an undefended area, thus differing from a territory.

As the feeding place of Ibis was variable in the morning and afternoon, they were associated with habitat variables and with the presence of some dominant species. Since the bill of Raven is not adapted to tear off meat from bone, so mostly aggregates around the effluent and occasionally compete for offal with vultures in the fresh dumping site. The huge size of Marabou helped to watch the surrounding easily and snatch food.

The distribution of birds on the dumping site was uniform in the morning, i.e., both the old and fresh scraps were exploited. During the late afternoon, the decrease in the number of vultures gives the chance for other species to concentrate on the fresh dumping area. Usually after 17 :00 h, the area was dominated by Ibis and Kites with very few Hooded vultures. Presumably this is the right time for Ibis and Kites to get enough fresh food.

This group continues feeding until dark. In rare cases one or two African White-backed vultures were observed. Since the habitat is managed habitat, some of the feeding habits were modified. Hence, related articles are not available.

Scavenging from the car washing site can be interpreted as an important adaptation to the availability of food. Pied Crows and Hooded vultures were conditioned to the situation and approach from all directions whenever trucks leave the washing site. This is beneficiary for Pied Crows and Hooded vultures because in the fresh dumping site, they are exposed to very high competition and influence of dominant birds.

6.5 Flight direction and Roosting sites

Birds were observed approaching the study area from different directions. Heavy woodcutting (firewood, charcoal, poles and timber) has turned large tracts of woodlands into shrub lands and buildings in the surroundings. However, trees are still available within the urban matrix, as remnants. These trees provide valuable roosting sites for birds. Some of them were coming from the northeastern direction and the surrounding roosting sites, while the majority was from the southwest direction. The roosting sites were localized on trees, which are far from human activities or secured place such as in institutions, churches, near to hill sides and rivers.

The distance of roosting sites from the study area was variable. Some are localized inside and around the study area. However, birds like Sacred Ibis flies up to 30 km away from

the colonies to feed (Clark and Clark, 1979). Most of the Sacred Ibis roost around Lake Aba Samuel, southeast of the study area. This area might be chosen due to less human disturbance and availability of proper roosting site.

Different species of birds return to the roosting sites at different times. Griffon, Marabou and Sacred Ibis have a fixed time, while others continue feeding if there is no disturbance. Hamerkops sometimes continue their feeding around the river after 18 :00 h and return to roost almost at dark. This is contrary to what Kahl (1967) stated, Hamerkops return 30 – 60 minutes before dark to roost.

7. Conclusion and Recommendations

The AAAE has favorable places for birds to be around and a good access to food and water resources. These factors attract large number of bird species. The present study shows that AAAE supports 21 species of birds belonging to four Orders and ten Families. Of these, three species of birds are endemic to the country. The species abundance decreases during the wet season, when the migratory birds leave the area in search of better environmental conditions.

Among vultures, Hooded were numerically more successful than Griffon and African White-backed Vultures because they rely more constantly on adequate source of food, are less restrictive in their selection of feeding sites and do not escape from the intruders like the others.

The provisioning of food for birds and the activity of humans (beneficiaries and workers) influenced the species composition, abundance and activity of birds occupying the area. The continuous human disturbance on the feeding site and the construction of the enterprise, as of 23/12/06, to shift the car washing site to the southeast have influenced to change the feeding time and reduced the abundance of species.

During the study period, 11 dead and five injured birds were observed at different periods. These were: Hooded Vulture (seven), African White-backed Vulture (two), Marabou (one) and Sacred Ibis (one). Mutilations of toes were observed in the five

individuals of Hooded Vulture. Nothing is known about the reason for these, but, high tension power line had much effect on many species. Two individuals of African White-backed Vultures were observed tied on their leg (one with long electric wire and the other with rope).

The following recommendations are forwarded based on the findings of the present study:

- ❖ African White-backed vultures tend to show four colour variations that are locally consistent, which might need additional research to determine their taxonomic status.
- ❖ Preservation of the study area as a good foraging site for some of the great raptors and wetland birds.
- ❖ Since the availability of scraps and offal might increase the abundance of raptors, further research is likely to uncover the biological interaction of urban avifauna in order to conserve and maintain the ecological balance.
- ❖ The area should be carefully observed over a long period on reproductive potential and behavior of birds that might be helpful to understand the effect of managed habitat on birds.

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Appendix I. Recorded raw Data for 21 species of birds in AAAE.

Date	HAME	WNST	MAST	SAIB	WAIB	BLKI	HOVU	AWBV	RUGR	TAEA	SPPI	WCPI	AMDO	RRSW	YEWA	MOWA	CACR	PICR	TBRA	GBGS	RBFF
11/03/06	1	0	1	217	63	9	461	189	0	0	2	0	0	5	11	0	0	12	0	0	0
12/03/06	0	0	2	211	61	11	478	197	0	0	0	0	3	3	7	0	0	9	2	0	3
18/03/06	0	0	0	208	57	7	497	216	0	0	2	0	0	0	0	2	0	13	1	0	2
19/03/06	0	0	0	215	59	5	482	213	0	0	0	0	1	3	5	4	0	7	0	0	0
25/03/06	1	0	0	226	53	11	491	209	0	0	0	0	0	0	0	2	0	11	0	0	3
26/03/06	0	0	0	218	62	9	464	217	1	0	3	0	0	5	0	0	0	13	2	0	0
01/04/06	0	0	1	220	65	13	479	207	0	0	0	0	0	0	7	0	0	5	0	0	0
02/04/06	0	0	0	231	70	8	502	239	2	0	0	0	3	0	0	0	0	11	0	0	0
08/04/06	1	0	2	246	67	12	513	261	1	0	0	0	0	5	0	0	0	15	0	0	0
09/04/06	0	0	0	263	63	10	520	283	3	0	2	0	2	0	4	0	0	9	1	0	0
15/04/06	0	0	1	274	68	7	537	311	0	0	0	0	0	7	0	0	0	12	0	0	0
16/04/06	1	0	0	276	65	9	556	340	4	0	0	0	1	0	0	0	0	14	3	0	0
22/04/06	2	0	1	281	73	11	567	394	3	0	2	0	0	0	5	0	0	19	0	0	2
23/04/06	0	0	3	257	70	10	540	352	7	0	0	0	1	0	0	0	0	13	0	0	0
29/04/06	4	0	2	269	65	13	679	391	9	0	0	0	0	0	7	0	0	26	0	0	0
30/04/06	3	0	2	272	72	9	568	405	12	0	2	0	0	0	0	0	0	18	0	0	0
06/05/06	3	0	5	257	68	7	665	370	4	0	0	0	0	0	0	0	0	20	0	1	2
07/05/06	5	0	4	268	59	10	708	465	8	0	0	0	0	0	4	0	0	29	0	0	0
13/05/06	0	0	7	263	62	9	681	429	5	0	4	0	1	0	0	0	0	25	0	0	0
14/05/06	6	0	4	279	58	13	763	497	11	0	0	0	0	0	7	0	0	21	0	0	0
20/05/06	8	0	6	258	74	15	694	442	9	0	0	0	0	5	9	0	0	18	1	0	0
21/05/06	5	0	9	288	81	11	613	501	15	0	1	0	0	0	13	0	0	26	2	2	0
27/05/06	0	0	5	276	79	8	629	492	10	0	0	0	3	5	0	0	3	31	2	0	0
28/05/06	7	0	5	279	53	7	758	471	11	0	0	0	0	0	5	0	0	27	3	0	0
03/06/06	8	0	8	297	67	10	622	465	4	0	0	0	0	0	0	0	0	12	5	1	2
04/06/06	0	0	8	281	79	12	647	502	7	0	3	0	0	3	12	0	0	33	2	0	0
10/06/06	5	0	12	290	71	7	752	491	9	0	0	0	0	0	0	0	0	21	1	0	0
11/06/06	5	0	14	276	60	4	615	479	12	0	0	0	0	2	8	0	0	17	3	0	0
17/06/06	0	0	11	283	49	5	792	407	5	0	0	0	0	0	14	0	0	13	3	0	0
18/06/06	0	0	15	271	54	2	703	458	8	0	2	0	2	4	0	0	0	8	2	0	0
24/06/06	2	0	14	269	32	1	735	428	4	0	0	0	0	0	15	0	0	14	5	0	0
25/06/06	3	0	11	251	26	1	659	499	7	0	0	0	0	0	0	0	2	31	3	0	0
01/07/06	1	0	16	77	27	2	812	487	5	0	0	0	0	5	9	0	3	24	1	0	0
02/07/06	0	0	27	63	15	0	790	428	18	0	0	0	0	7	0	0	3	19	4	0	2
08/07/06	0	0	14	21	9	0	713	495	6	0	0	0	0	0	0	0	0	19	6	0	0

Contd...

Date	HAME	WNST	MAST	SAIB	WAIB	BLK	HOVU	AWBV	RUGR	TAEA	SPPI	WCPI	AMDO	RRSW	YEWA	MOWA	CACR	PICR	TBRA	GBGS	RBFF
09/07/06	0	0	19	9	13	0	696	511	4	0	0	0	0	5	2	0	0	27	8	0	0
15/07/06	0	0	24	5	6	0	737	427	2	0	2	0	0	5	0	0	0	18	6	0	0
16/07/06	0	0	32	1	12	0	816	447	13	0	4	0	0	0	6	0	0	12	10	0	0
22/07/06	0	0	24	0	8	0	779	502	5	0	0	0	3	6	5	0	0	16	13	0	0
23/07/06	0	0	28	0	7	0	732	489	12	0	0	0	0	0	0	0	0	22	19	0	0
29/07/06	0	0	31	0	4	0	799	507	7	0	0	0	0	0	0	0	0	28	15	0	2
30/07/06	0	0	33	0	2	0	781	497	14	0	0	0	3	4	0	0	0	19	19	0	0
05/08/06	0	0	28	0	4	0	563	511	6	0	0	0	0	0	0	0	0	6	26	0	0
06/08/06	0	0	26	0	3	0	571	516	15	0	1	0	1	0	0	0	0	15	17	0	0
12/08/06	0	0	38	0	8	0	725	496	11	0	0	0	0	2	0	0	0	17	32	0	0
13/08/06	0	0	29	0	11	0	760	488	13	0	0	0	0	0	0	0	0	22	37	0	0
19/08/06	0	0	38	0	13	0	877	426	4	0	0	0	0	0	0	0	0	19	18	0	0
20/08/06	0	0	25	0	9	0	749	480	11	0	1	0	0	0	0	0	0	26	26	0	0
26/08/06	0	0	39	0	11	0	729	461	7	0	0	0	0	0	0	0	0	16	42	0	0
27/08/06	0	0	43	0	7	0	713	503	6	0	0	0	0	0	0	0	0	21	51	0	0
02/09/06	0	0	36	0	15	1	831	496	4	0	4	0	0	2	0	0	0	25	36	0	2
03/09/06	0	0	31	0	18	0	785	485	9	0	0	0	0	0	0	0	0	17	47	0	0
09/09/06	0	0	25	0	36	0	628	479	11	0	0	0	0	5	0	0	0	15	55	0	0
10/09/06	0	0	28	0	43	0	558	501	18	0	0	0	2	0	0	0	0	8	67	0	0
16/09/06	0	0	14	0	45	1	672	442	10	0	0	0	0	2	0	0	0	27	59	0	0
17/09/06	0	0	12	0	57	3	725	461	19	0	3	0	0	0	0	0	0	19	53	0	0
23/09/06	0	0	0	0	24	11	787	429	7	0	4	0	0	3	0	0	0	13	26	0	0
24/09/06	0	0	1	0	29	12	795	432	16	0	0	0	0	0	4	0	0	15	29	0	0
30/09/06	0	1	0	7	32	11	821	497	5	0	2	0	0	5	12	0	0	21	36	0	0
01/10/06	1	2	0	23	41	16	847	412	7	0	0	0	2	0	15	0	0	19	31	0	2
07/10/06	0	0	3	57	38	21	880	391	4	0	0	0	0	0	0	0	0	17	21	0	0
08/10/06	2	0	0	65	60	20	793	436	22	0	1	0	0	0	17	0	0	23	29	0	0
14/10/06	0	0	0	157	57	24	827	392	2	0	0	0	0	0	11	0	0	18	34	0	0
15/10/06	0	0	0	206	63	18	821	447	8	0	0	0	0	0	0	0	0	15	28	0	0
21/10/06	0	0	0	225	89	25	794	459	1	0	2	0	2	0	8	0	0	13	23	0	0
22/10/06	0	0	0	218	91	22	892	405	6	0	0	0	0	0	0	0	0	21	24	0	0
28/10/06	0	2	2	164	92	27	732	421	7	0	0	0	0	0	10	2	0	16	29	0	0
29/10/06	0	0	2	172	89	24	754	417	11	0	0	0	0	0	0	0	2	18	32	0	2
04/11/06	1	1	2	289	132	28	621	287	3	0	0	0	0	0	14	4	0	15	23	0	2
05/11/06	0	1	7	292	160	39	593	219	9	0	3	0	0	0	3	2	0	23	27	0	0
11/11/06	1	0	0	338	149	41	587	216	3	0	0	0	0	0	7	6	0	21	33	0	0
12/11/06	0	0	4	371	152	53	575	234	5	0	0	2	0	0	6	10	0	16	31	0	2
18/11/06	0	0	26	356	167	84	585	211	5	0	3	0	0	0	4	17	0	17	23	0	2

Contd...

Date	HAME	WNST	MAST	SAIB	WAIB	BLK	HOVU	AWBV	RUGR	TAEA	SPPI	WCPI	AMDO	RRSW	YEWA	MOWA	CACR	PICR	TBRA	GBGS	RBFF
19/11/06	2	0	38	380	159	76	516	207	2	0	0	0	0	0	0	12	0	11	30	0	0
25/11/06	1	0	21	369	162	69	573	215	1	0	0	0	0	0	16	7	0	13	25	0	0
26/11/06	1	0	18	352	151	65	562	221	2	0	0	2	0	0	15	5	0	19	29	0	0
02/12/06	1	0	37	341	148	62	521	235	0	0	3	0	1	0	24	0	0	17	27	0	7
03/12/06	0	0	26	349	156	67	549	247	3	0	2	0	0	0	17	3	0	15	31	0	3
09/12/06	0	0	19	337	139	54	533	239	5	0	0	0	2	0	21	1	0	18	25	0	0
10/12/06	0	0	13	356	145	63	518	196	8	0	2	0	0	0	16	4	0	14	21	0	2
16/12/06	0	0	7	329	136	59	527	163	0	0	0	0	0	0	23	2	0	12	18	0	0
17/12/06	0	0	12	340	153	64	542	215	2	1	0	0	1	0	27	6	0	12	22	0	5
23/12/06	0	0	59	309	127	52	496	201	0	0	0	0	0	0	18	0	0	13	23	0	2
24/12/06	1	0	88	318	132	57	479	184	3	0	0	0	1	0	22	2	0	21	19	0	5
30/12/06	0	0	63	312	149	61	481	163	0	0	0	0	0	0	11	1	0	18	17	0	3
31/12/06	0	0	31	303	152	58	412	117	0	0	2	0	0	0	6	2	0	11	15	0	0
06/01/07	0	0	16	286	127	49	364	98	0	0	0	0	1	0	5	0	0	7	12	0	0
07/01/07	0	0	8	254	109	36	221	27	0	0	2	0	1	0	10	0	0	5	10	0	2
13/01/07	0	0	3	227	102	42	310	46	0	0	0	0	0	0	17	6	0	9	4	0	0
14/01/07	0	0	5	231	98	40	395	52	0	0	0	0	0	0	13	4	0	12	3	0	0
20/01/07	0	0	2	252	136	64	367	59	0	0	0	0	4	0	16	12	0	8	8	0	4
21/01/07	0	0	13	239	125	72	358	107	0	1	0	0	0	0	18	9	0	5	1	0	0
27/01/07	0	0	20	241	94	63	372	102	0	0	0	0	2	0	29	4	0	13	4	0	0
28/01/07	0	0	28	261	101	69	364	93	0	0	0	0	0	0	33	2	0	11	5	0	2
03/02/07	0	0	31	258	93	56	361	74	0	0	2	0	0	0	27	0	0	7	2	0	5
04/02/07	0	0	24	247	78	45	386	89	0	0	0	0	0	0	16	2	2	14	0	0	0
10/02/07	0	0	11	251	72	49	397	96	0	0	0	0	0	0	21	0	3	12	1	0	4
11/02/07	0	0	5	234	77	36	412	118	0	0	0	0	2	0	25	0	0	15	2	0	3

