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Species Diversity, Distribution, Relative Abundance and Habitat Association of the Avian Fauna of Modified Habitat of Bahir Dar and Debre Mariam Island, Lake Tana, Ethiopia

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ABSTRACT

The study was carried out along the southern shore of Bahir Dar gulf (Lake Tana) and Debre Mariam Island from August 2006 to March 2007, covering both wet and dry seasons. Sampling sites were stratified based on the vegetation type and area cover. Point count technique was employed. A total of 154 bird species consisting of three endemic, two globally threatened, and 33 Palaearctic migrants were identified. The species diversity index and evenness of habitats during the entire season of the study periods revealed that Debre Mariam Island had the highest species diversity and evenness, 0.94 and 0.88, respectively. The relative abundance score of each species was variable. The number of species recorded in the modified habitat of Bahir Dar during the wet and dry seasons was 74 and 107; and in Debre Mariam Island 28 and 33, respectively. The mean number of species in the wetland vegetation stratum was (7.50), followed by papyrus bed (5.67), garden (5.57), trees and woodlands (5.00), and fruit trees (4.00). Chi-square test for the wet season showed that the association of birds with the vegetation stratum was not statistically significant ($P>0.05$, chi-square $=5.846$, df $=8$, $n=26$). But, during the dry season, it was significant ($p< 0.01$, chi-square $=33$, df $=11$, $n=51$). Deforestation, cultivation and pollution were the main threats for the survival of bird fauna in the area.

Key Words: Diversity indices, Distribution, Habitat Association, Relative Abundance, Species Evenness.

INTRODUCTION

Currently there are 29 orders, 201 families, 2073 genera and 10,010 species of the class Aves (Lepage 2006). Birds are grouped into a number of categories based on the regularity with which they occur such as resident species, summer visitors, winter visitors, transit passengers and rare vagrants (Spencer 1963). Climate radically influences habitats and local movements of resident and migratory birds. Many species are characteristic of particular habitats or biomes (Stevenson and Fanshawe 2002). Resident and migrant bird distribution is strongly influenced by equatorial seasons (Alertstam 1982, Stevenson and Fanshawe 2002).

Ethiopia's unique topography, past geological history and wide range of climate has made the country rich in biodiversity (Shibru Tedla 1995, Leykun Abune 2000). There are about 926 bird species listed for the country, of which 21 are endemic and 19 are globally threatened species (Lepage 2006). Lake Tana basin has a catchment area of 15,000 ha (Nagelkerke 1997). The area qualifies as an Important Bird Area (IBA) because it possesses the globally threatened species such as Wattled Crane, Lesser Flamingo, Rouget's Rail, Pallid Harrier, and Greater Spotted Eagle (EWNHS 1996). The population of water birds around Lake Tana is likely to exceed 40,000 seasonally (Francis and Shimelis Aynalem 2007). In the same area, 19 highland biome species have so far been recorded, including the Abyssinian Long-eared Owl, White-backed Black Tit, White-throated Seedeater and Banded Barbet (EWNHS 1996).

Birds have proved to be excellent indicators of biodiversity or productivity and are vital for ecological

functioning of our environment such as indicators of pollution, seed dispersal, scavenging offal and as predators of numerous insect and other pests (Dash 1993, Pomeroy and Dranzoa 1997). Apart from their beauty, birds are excellent indicators of water quality (Airinatwe 1999). Wetlands provide suitable habitats for innumerable organisms including birds. The presence or absence of shelter may influence whether birds will inhabit a wetland or a nearby upland area. Water resource development is a major cause for the decline of wetlands throughout the world (Kingsford 2000).

The distribution and abundance of many bird species are determined by the composition of the vegetation that comprises a major element of their habitat (Lee and Rotenberry 2005). The number of rare and endemic species and the diversity of the species present at the site can be used as indicator of the importance of different sites or habitats for bird conservation (Bibby et al. 1992, Bibby 1998).

In Ethiopia, 204 bird species are wetland-dependant. Although, many of these birds are known taxonomically, much of their ecology remains uninvestigated. The aim of the present study is to evaluate the species diversity, distribution, relative abundance and habitat association of the avian fauna of the modified habitat of Bahir Dar and Debre Mariam Island, Lake Tana, Ethiopia.

THE STUDY AREA

The modified habitats of Bahir Dar gulf (Lake Tana) and Debre Mariam Island were the specific sites where the present study was conducted (Figure 1). The area is located in the Amhara National Regional State of Bahir Dar zone, southern most tip of Lake Tana, whose geographical location is $11^0$37' north latitude and $37^0$25' east longitude. The topographic feature of the modified habitat of Bahir Dar is plain, outcrop rocks with marshy area; whereas, Debre Mariam, which is the nearest of all islands to Bahir Dar is situated at the outlet of the Blue Nile River. It is regularly inundated. Both areas are characterized by a mixture of bushy woodland and wetlands. The area receives a mean annual rainfall of 1490 mm. The pattern of rainfall distribution shows mono-modal with a long rainy season between June and September. The minimum and maximum mean temperature of the study area was 13^0C and 27^0C.

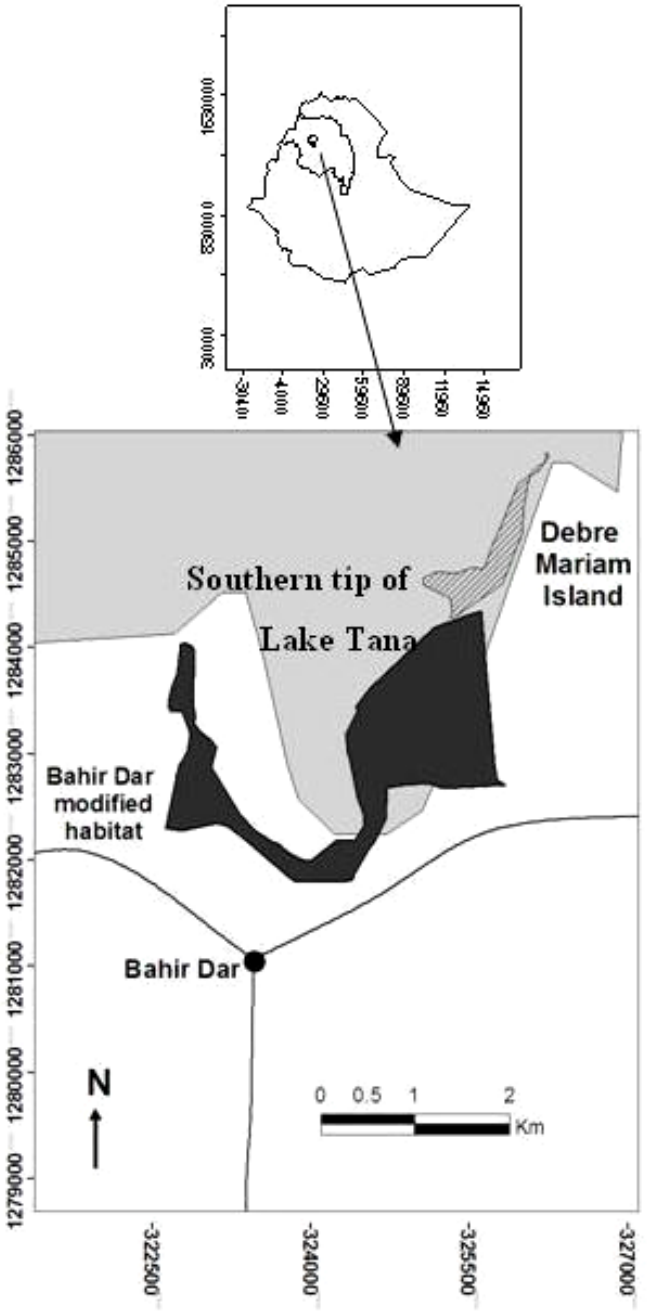

Figure 1. Map of the study area

METHODS

The duration of the present study was from August, 2006 to March, 2007, covering both wet and dry seasons. Specimens were collected to determine the dominant plant species in each vegetation type. The collected plant specimens were pressed and taken to the

National Herbarium of Addis Ababa University for further classification. The study area was stratified based on the habitat type. The sampling unit within the habitat was determined and assigned on the basis of area coverage and vegetation type. The vegetation structure of the study sites is variable consisting of marshy and short grasses; fruit trees and flowers most of which are fig trees; garden vegetation stratum (vegetable garden, ornamental gardens, and recreation areas); mixed type of vegetation (grassland, woodland and trees) and papyrus bed. Stratification was carried out based on the methods of Jones (1998) and Krebs (1999). Sampling blocks were made based on the area coverage and type of vegetation. From the total area of 400 and 76 ha of land, 160 and 45 ha of sample areas were covered for Bahir Dar and Debre Mariam Island, respectively.

Based on the habitat type, point count method was employed (Southerland 1996, Lloyd et al. 1998). To avoid repeated counting of birds, routes were reasonably spaced out. Point count method was applied on either side of a circle at 25 m radius in the forest and 50 m in open bushland habitat. Each individual bird was counted once on a sampling point. Flying in and flying out birds during counting period was not considered. To minimize the disturbance during the count, a waiting period of 3 to 5 minutes prior to counting was applied (Southerland 2000, Hosteler 2001). The count was accomplished for a fixed period of 3-10 minutes depending upon how conspicuous the birds are. Following Jones (1998), data collection began about 30 minutes after dawn and continued to mid-morning, when bird activity declined. Late afternoon count was also carried out. Where point count technique is employed, the radial distance from which the bird occurred was estimated and then the type and the group number of species were recorded using direct observation. Birds seen on the specified band length were recorded. The vegetation type/coverage within 100 m radial distance from where the count was carried out was also estimated to see the association of birds. Photographs and videos were taken to justify the species type for those species difficult to identify. Some inconspicuous bird species were also identified based on their calls. The song and call records of Chappuis (2000), Rochè (1996) and Hammick (2002) were used to relate with the songs and calls of birds heard during the survey period. Bird species were identified and their taxonomic groups were properly categorized based on field guides (Urban and Brown 1971, Van Perlo 1995, Alden et al. 1995, Alan and Kemp 2001, Stevenson and Fanshawe 2002, Sinclair and Ryan, 2003). Simpson's Index and Shannon-Weiner Index were used to evaluate the bird species diversity. Relative abundance of avian species was determined using encounter rates that give crude ordinal scales of abundance Chi-square test was used to see the habitat association of birds in each vegetation stratum of the study areas.

RESULTS

A total of 154 species belonging to 53 families was observed during wet and dry seasons (Table 1). Wattled Ibis (*Bostrychia carunculata*), Black-winged Lovebird (*Agapornis taranta*) and White-cheeked Turaco (*Tauraco leucotis*) were registered as endemic to both Ethiopia and Eritrea. Thirty three Palaearctic migrants (PM) were recorded during the study period. The remaining 123 bird species were residents. Black-crowned Crane (*Balearica pavonina*) (Near Threatened); Lappet-faced Vulture (*Torgos tracheliotus*) (Vulnerable) were recorded as globally threatened species.

The habitats possessed both common and unique species. During the wet and dry seasons, 87 and 134 bird species were recorded, respectively. Sixty seven bird species were common for both seasons, but 20 and 67 species were exclusively recorded only during the wet and dry seasons, respectively. Wet season species diversity index of habitats shows that the highest species diversity was observed in Debre Mariam Island. But, evenness of the species was 0.90, and 0.89, in Bahir Dar and Debre Mariam Island, respectively. During the dry season, the species diversity at Debre-Mariam and Bahir Dar was 0.94 and 0.92, respectively (Table 2).

The relative abundance score of each species during the wet season was 30 and 18 species frequent; 15 and 7 common; 6 and 3 abundant at Bahir Dar and Debre Mariam Island, respectively. Only 21 species of birds were uncommon for Bahir Dar. During the dry season, 45 and 23 species were frequent; 18 and 9 species were common; 7 and 1 were abundant for Bahir Dar and Debre Mariam Island, respectively. However, in the modified habitat of Bahir Dar, 33 uncommon species were registered, and only one species was categorized as rare species (Table 3). The highest number of species (74 and 107 species during the wet and dry seasons, respectively) was recorded in the modified habitat (Figure 2). Debre Mariam Island had the least number of species in the area with 28 and 33 species each during wet and dry seasons, respectively.

Table 1. Bird species recorded during wet and dry seasons.

Common name	Scientific name
African Black Duck[(d)]	*Anas sparsa*
African Black-headed Oriole[(d)]	*Oriolus larvatus*
African Citril	*Serinus citrinelloides*
African Darter	*Anhinga rufa*
African Fish-Eagle	*Haliaeetus vocifer*
African Jacana[(d)]	*Actophilornis africana*
African Paradise Monarch	*Terpsiphone viridis*
African Pied Wagtail [(w)]	*Motacilla aguimp*
African pygmy-goose	*Nettapus auritus*
African Wattled Lapwing	*Vanellus senegallus*
African Wattled Lapwing[(d)]	*Vanellus senegallus*
Baglafecht Weaver [(w)]	*Ploceus baglafecht*
Banded Wattle-eye[(d)]	*Platysteira cyanea*
Bearded Woodpecker[(d)]	*Dendropicos namaquus*
Black Crake	*Amaurornis flavirostris*
Black Kite/ Yellow-billed Kite	*Milvus migrans/parasiticus*
Black-billed Barbet	*Lybius guifsobalito*
Black-billed Wood-dove [(w)]	*Turtur abyssinicus*
Black-billed Wood-hoopoe[(d)]	*Phoeniculus somaliensis*
Black-crowned Crane	*Balearica pavonina*
Black-crowned Tchagra [(w)]	*Tchagra senegala*
Black-eared Wheatear [(d)]	*Oenanthe hispanica*
Black-headed Batis	*Batis minor*
Black-headed Heron	*Ardea melanocephala*
Black-headed Weaver [(w)]	*Ploceus melanocephalus*
Black-winged Lovebird	*Agapornis taranta*
Blue-breasted Bee-eater[(d)]	*Merops variegates*
Blue-headed Coucal[(d)]	*Centropus monachus*
Booted Eagle [(d)]	*Aquila pennatus*
Bronze Mannikin [(w)]	*Spermestes cucullatus*
Bronze Sunbird	*Nectarinia kilimensis*
Brubru [(d)]	*Nilaus afer*
Bruce's Green-Pigeon [(w)]	*Treron waalia*
Carmine Bee-eater [(d)]	*Merops nubicus*
Cattle Egret[(d)]	*Bubulcus ibis*
Collared Sunbird [(w)]	*Anthreptes collaris*
Common Black-headed Gull [(d)]	*Larus ridibundus*
Common Bulbul	*Pycnonotus barbatus*
Common Camaroptera [(w)]	*Camaroptera brachyuran*
Common Chiffchaff [(d)]	*Phylloscopus collybita*
Common Fiscal	*Lanius collaris*
Common Moorhen	*Gallinula chloropus*
Common Sand Martin[(d)]	*Riparia riaipa*
Common Sandpiper	*Actitis hypoleucos*
Common Stilt [(d)]	*Himantopus himantopus*
Coqui Francolin [(d)]	*Francolinus coqui*
Crested Malimbe [(w)]	*Malimbus malimbicus*
Cut-throat	*Amadina fasciata*
Double-toothed Barbet[(d)]	*Lybius bidentatus*
Eastern Grey Plantain-eater	*Crinifer zonurus*
Egyptian goose	*Alopochen aegyptiacus*
Eurasian Hoopoe	*Upupa epops*
Eurasian Marsh-Harrier [(d)]	*Circus aeruginous*
Eurasian Redstart [(d)]	*Phoenicurus phoenicurus*
Gadwall [(w)]	*Anas strepera*
Garganey [(d)]	*Anas querquedula*
Giant Kingfisher	*Megaceryle maximus*
Goliath Heron	*Ardea goliath*
Great Black-headed Gull [(d)]	*Larus ichthyaetus*
Great Cormorant[(d)]	*Phalacrocorax carbo*
Great Reed-Warbler [(d)]	*Acrocephalus arundinaceus*
Great White Pelican	*Pelecanus onocrotalus*
Greater Blue-eared Glossy-Starling	*Lamprotornis chalbeus*
Great-white Egret[(d)]	*Egretta alba*
Green Sandpiper[(d)]	*Tringa ochropus*
Greenshank [(d)]	*Tringa nebularia*
Grey Heron[(d)]	*Ardea cinerea*
Grey Woodpecker	*Dendropicos goertae*
Grey-backed Fiscal [(d)]	*Lanius excubitoroides*
Grey-headed Kingfisher	*Halcyon leucephala*
Grey-headed Sparrow	*Passer griseus*
Groundscraper Thrush [(d)]	*Psophocichla litsipsirupa*
Hadada	*Bostrychia hagedash*
Hamerkop [(w)]	*Scopus umbretta*
Isbeline Shrike	*Lanius isabellinus*
Jameson's Firefinch [(w)]	*Lagonosticta rhodopareia*
Knob-billed Duck [(d)]	*Sarkidiornis melanotos*
Lappet-faced Vulture [(w)]	*Torgos tracheliotus*
Laughing Dove	*Streptopelia senegalensis*
Lesser Black-backed Gull[(d)]	*Larus fuscus*
Lesser Grey Shrike [(d)]	*Lanius minor*
Lesser Moorhen [(d)]	*Gallinula angulata*
Lesser Striped-Swallow[(d)]	*Cecropis abyssinica*
Little Bee-eater	*Merops pusillus*
Little Egret	*Egretta garzetta*
Little Grebe [(d)]	*Tachybaptus ruficollis*
Little Stint [(d)]	*Calidris minuta*
Little Tern [(d)]	*Sterna albifrons*
Long-crested Eagle	*Lophaetus occipitalis*
Long-tailed Cormorant	*Phalacrocorax africanus*
Malachite Kingfisher	*Alcedo cristata*
Marsh Sandpiper	*Tringa stagnatilis*
Marsh Warbler [(d)]	*Acrocephalus palustris*
Mosque Swallow [(d)]	*Cecropis senegalensis*
Namaqua Dove [(d)]	*Oena capensis*
Northern Black Flycatcher	*Melaenornis edolioides*
Northern Puffback	*Dryoscopus gambensis*
Northern Sylvietta [(d)]	*Sylvietta brachyura*
Northern Wheatear [(w)]	*Oenanthe oenanthe*
Olivaceous Warbler [(d)]	*Hippolais pallida*
Olive Thrush [(w)]	*Turdus olivaceus*

Common name	Scientific name
Open-billed Stork [(d)]	*Anastomus lamelligerus*
Osprey [(d)]	*Pandion haliaetus*
Pale Prinia [(d)]	*Prinia somalica*
Pied Crow [(d)]	*Corvus albus*
Pied Flycatcher [(w)]	*Ficedula hypoleuca*
Pied Kingfisher	*Ceryle rudis*
Pied Wagtail	*Motacilla alba*
Plain-backed Pipit [(d)]	*Anthus leucophrys*
Purple Heron	*Ardea purpurea*
Red-backed Shrike [(w)]	*Lanius collurio*
Red-billed Firefinch	*Lagonosticta senegala*
Red-cheeked Cordonbleu[(d)]	*Uraeginthus bengalus*
Red-cheeked Cordonbleu[(d)]	*Uraeginthus bengalus*
Red-eyed Dove	*Streptopelia semitorquata*
Red-knobbed Coot [(d)]	*Fulica cristata*
Red-necked Phalarope [(w)]	*Phalaropus lobatus*
Red-tailed Wheatear [(d)]	*Oenanthe xanthoprymna*
Rueppell's Robin-Chat	*Cossypha semirufa*
Ruff[(d)]	*Philomachus pugnax*
Sacred Ibis	*Threskiornis aethiopicus*
Saddle-billed Stork [(d)]	*Ephippiorhynchus senegalensis*
Scarlet-chested Sunbird	*Chalcomitra senegalensis*
Sedge Warbler [(d)]	*Acrocephalus schoenobaenus*
Senegal Thick-knee [(d)]	*Burhinus senegalensis*
Silvery-cheeked Hornbill [(w)]	*Ceratogymna brevis*
Southern Pochard [(w)]	*Netta erythrophthalma*
Speckled Mousebird	*Colius striatus*
Speckled Pigeon	*Columba guinea*
Spectacled Weaver[(d)]	*Ploceus ocularis*
Spotted Eagle-Owl [(d)]	*Bubo africanus*
Spur-winged Goose	*Plectropterus gambensis*
Spur-winged Lapwing[(d)]	*Vanellus spinosus*
Squacco Heron	*Ardeola ralloides*
Straited Heron [(d)]	*Butorides striata*
Streaky Seedeater	*Serinus striolatus*
Striped Kingfisher	*Halcyon chelicuti*
Tambourine Dove	*Turtur tympanistria*
Three-banded Plover [(d)]	*Charadrius tricollaris*
Tropical Boubou	*Laniarius aethiopicus*
Variable Sunbird[(w)]	*Cinnyris venustus*
Violet-backed Starling [(d)]	*Cinnyricinclus leucogaster*
Wattled Ibis [(d)]	*Bostrychia carunculata*
White Tern [(d)]	*Sterna repressa*
White-cheeked Turaco	*Tauraco leucotis*
White-headed Vulture [(d)]	*Trigonoceps occipitalis*
Wire-tailed Swallow [(w)]	*Hirundo smithii*
Wood Sandpiper [(d)]	*Tringa glareola*
Yellow Wagtail	*Motacilla flava*
Yellow-billed Egret[(d)]	*Egretta intermedia*
Yellow-crowned Bishop [(w)]	*Euplectes afer*
Yellow-fronted Tinkerbird [(d)]	*Pogoniulus chrysoconus*
Yellow-mantled Widowbird [(w)]	*Euplectes macrourus*
Zebra Waxbill [(w)]	*Sporaeginthus subflavus*

[d] = birds observed only during the dry season,
[w] = birds observed only during the wet season)

Table 2. Avian species diversity during wet and dry seasons.

Habitat Type	Season	No. of species	Abundance	D	H´	H´/H´max
Bahir Dar	Wet	73	1767	0.59	3.86	0.90
	Dry	103	986	0.92	3.41	0.74
	Both seasons	137	2753	0.82	3.02	0.614
Debre Mariam	Wet	28	88	0.93	2.97	0.89
	Dry	35	101	0.94	4.42	1.24
	Both seasons	36	189	0.94	3.16	0.882

H´= Shannon-Wiener Index; H´/H´max= Evenness; D= Diversity Index; H'max= $\ln(S_i)$

In the modified habitat, during the wet season, the highest mean number of birds occurred in the wetland habitats (7.50), followed by the papyrus bed (5.67), garden (5.57), trees and woodlands (5.00). The least number of bird species was observed on fruit trees (4.00). During the dry season, the highest number of birds occurred in the wetland vegetation with mean of 7.00, followed by garden (5.00), trees and woodlands

Table 3. Relative abundance of bird species during wet and dry seasons

Habitats	Season	Rare	Uncommon	Frequent	Common	Abundant
Bahir Dar	Wet	-	21	30	15	6
	Dry	1	33	45	18	7
Debre Mariam	Wet	-	-	18	7	3
	Dry	-	-	23	9	3

Table 4. Number of species in the vegetation strata of modified habitats (mean±SE).

Season	Vegetation stratum				
	Fruit trees and flowers	Garden	Trees, woodland and grassland	Papyrus bed	Wetland
Wet	4.00 ± 0.71	5.57 ± 0.72	5.00 ± 0.93	5.67 ± 1.33	7.5 ± 0.29
Dry	2.50 ± 0.76	5.00 ± 1.53	3.86 ± 0.69	2.88 ± 0.52	7.0 ± 1.53

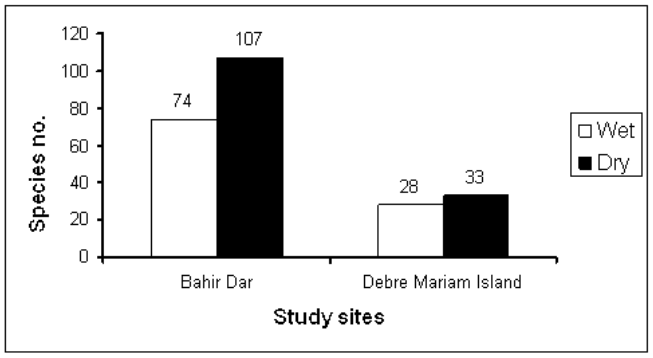

Figure 2. Distribution of bird species during wet and dry seasons

(3.86) and the least was on fruit trees and flower stratum (4.00) (Table 4). Chi-square test for the wet season showed that the association of birds with the vegetation stratum was not statistically significant ($P>0.05$, chi-square $=5.846$, df $=8$, n$=26$). Whereas, during the dry season, the type of species was significantly associated with the vegetation types ($p<0.01$, chi-square $=33$, df $=11$, n$=51$). Intense degradation on the wetland area is observed.

DISCUSSION

A total of 154 species of birds was observed during wet and dry seasons. The occurrence of high number of species in the limited area shows the high diversity and importance of the sites. Among the globally threatened species, the Black-crowned Crane and Lappet-faced Vulture were observed in high numbers. Most of the Palaearctic migrants were observed from November to February where wetland vegetation dominated. Debre Mariam Island had the highest species diversity and evenness. This might be related to the nature of the habitat that a structurally complex vegetation type buffers the effect of seasonality (Janzen 1967, Smythe 1970). The modification of the physical environment for various purposes could result in greater stability in resource availability and thereby allowing more species to occur as residents throughout the year (MacArthur and MacArthur 1961).

The differences in relative abundance of birds recorded in the study area might be related to the availability of food, habitat condition and breeding season of the species. According to Karr and Roth (1971), the distinct seasonality of rainfall and seasonal variation in the abundance of food resources result in

seasonal changes in the abundance of birds. Uncommon species may be related to the breeding nature, large home range and niche of the species; besides the degradation of the habitat (Ryan and Owino 2006). Even, species with relatively stable population will tend to show variation in abundance and occupancy over time (Gaston et al. 2000). According to Wilson and Comet (1996), the absence or rarity of several species appeared to be related to habitat condition. For example, habitat constraints limited the distribution and population density of Redwing Francolin (*Linus levaillantii*) in the highland grasslands of Mpumalanga Province, South Africa. Quality and quality of the habitat in terms of food abundance, diversity and cover are important factors that influenced the distribution of Redwing Francolin (Jansen et al. 2001). This report coincides with the result of the present study that the rarity of the Coqui Francolin (*F. coqui*) in woody grassland vegetation stratum might be due to habitat destruction and the human pressure on *Francolin* species in the unprotected areas. Thiollay (1994) suggested that species that are consistently rare have either large home range rather evenly spaced or they are patchily distributed. However, the obvious factor that explains their localization is difficult to identify.

The distribution and abundance of many bird species are determined by the composition of the vegetation consisting of a major element of their habitats. As vegetation changes along complex geographical and environmental gradients, a particular bird species may appear, increase in abundance, decrease or disappear as habitats become variable (Lee and Rotenberry 2005). In the vegetation strata of the modified habitats, species have shown different associations with the type of vegetation. Along the whole vegetation gradient, most bird species tend to be related with structural variables. Within smaller sub-groups of sites, some bird species were more associated with a particular plant species (Estades 1997). The association of birds with the habitats was found to be significant during the dry season. The availability of food resources during the dry season might account for this. Black-winged Lovebird and White-cheeked Turaco were highly associated with fruit trees. This information is also supported by Wilson and Comet (1996) because distinctive plant communities often support quite different bird species. Mainly *Ficus vasta* and *Ficus sycomorus* fruit trees were observed to support Greater Blue-eared Glossy Starlings, Violet-backed starling, Eastern-grey Plantain-eater, Speckled Mousebird, Yellow-mantled Widowbird and Yellow-fronted Thinkerbird, whereas Collared Sunbird, Scarlet-chested Sunbird and Bronze Sunbird were associated with flower bearing trees and some shrubs.

Wetland specialists and generalists were confined to papyrus bed vegetation and wetlands. Papyrus specialists occurred in areas that had tall, dense and least disturbed papyrus stands. Papyrus clearance and degradation witnessed around Lake Victoria in recent years have affected the availability of suitable habitat conditions for nesting and feeding birds particularly, Carruthers's cisticola, White-winged Warbler and Papyrus Gonolek (Rayan and Owino 2006). In the wetland vegetation stratum of the modified habitat of Bahir Dar, where the papyrus vegetation dominates, wetland specialists like Sedge Warbler, Great Reed Warbler, Black Crake and Common Moorhen, Squacco heron, Little Grebe and the African Water-Rail were associated with this type of vegetation.

Human activities threaten the existence of many bird species by damaging or destroying their habitat or directly affecting their survival and reproductive success (Green and Hirons 1991). The shore of Bahir Dar gulf, Lake Tana is being degraded for different purposes. The overwhelming size of wetland conversion is undertaken for agricultural purposes and urban-industrial-port expansion affecting many bird species (Meyer and Turner 1992). Siltation and extensive macrophytes around the lake would affect the ecosystem of the avian wetland generalists and specialists. Birds like kingfishers, gulls, and terns, which feed on fish, and other birds where their breeding and nesting sites depend entirely on the habitat would be greatly affected. Pollution like solid waste and effluents from Bahir Dar town and agrochemicals and pesticides are washed to the lake by run off. Similar problem was observed in Lake Victoria (Kairu 2001). Though the effects of these pollutants were not properly evaluated, it will have a big impact on the lake ecosystem.

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