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Species composition, relative abundance and distribution of bird fauna of riverine and wetland habitats of Infranz and Yiganda at southern tip of Lake Tana, Ethiopia

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Abstract: This study was carried out in the southern tip of Lake Tana, Bahir Dar, covering both wet and dry seasons, from August 2006 to March 2007, with the objective to evaluate species composition, relative abundance and distribution of the bird fauna of wetlands and riverine habitat at Infranz, Lake Tana, Ethiopia. Sampling sites were stratified based on the vegetation type and area cover, and transect count technique was employed. A total of 129 bird species consisting of three endemics, two globally threatened, and 21 Palaearctic migrants were identified. The species composition of birds during the wet and dry seasons was not significantly different; but there was a significant difference among the habitats. The Yiganda wetland had the highest species diversity and evenness. The relative abundance score of species during the wet and dry seasons was variable in all the habitats. Expansion of farmlands and irrigation schemes are the main threats to the survival of birds.

Resumen: El estudio fue realizado en el extremo sur del Lago Tana, Bahir Dar, cubriendo tanto la estación seca como la húmeda (agosto de 2006 a marzo de 2007), con el objetivo de evaluar la composición de especies, la abundancia relativa y la distribución de la avifauna de humedales y hábitats ribereños en Infranz, Lago Tana, Etiopía. Los sitios de muestreo fueron estratificados de acuerdo con el tipo de vegetación y la cobertura del área, y se utilizó una técnica de conteo en transectos. Se identificaron en total 29 especies de aves, incluyendo tres endémicas, dos especies amenazada a nivel mundial y 21 inmigrantes Palaeárticos. La composición de especies de aves no difirió significativamente entre las estaciones húmeda y seca, pero sí entre hábitats. En el humedal de Yiganda la diversidad de especies y la equitatividad alcanzaron sus valores máximos. Los valores de abundancia relativa de las especies durante las estaciones seca y húmeda fueron variables en todos los hábitats. La expansión de las tierras agrícolas y los esquemas de irrigación constituyen las principales amenazas para la supervivencia de las aves.

Resumo: Este estudo foi realizado na ponta sudoeste do Lago Tana, Bahir Dar, cobrindo quer as estações húmida e seca, de Agosto 2006 a Março de 2007, com o objectivo de avaliar a composição específica, a abundância relativa e a Distribuição da fauna avícola dos habitats húmidos e ribeirinhos de Infranz, Lago Tana, Etiópia. As técnicas de contagem empregadas basearam-se na estratificação dos locais de amostragem com base no tipo de vegetação, área coberta, e técnica de contagem dos transeptos. Foram identificadas 129 espécies de aves sendo de três endémicas, duas globalmente ameaçadas e 21 migrantes Paleárticas. A composição das espécies durante as estações húmida e seca não eram significativamente diferentes, embora houvesse diferenças significativas entre habitats. A zona húmida de Yiganda apresentou os

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valores mais altos de diversidade específica e de semelhança. O valor de abundância relativa das espécies durante as estações húmida e seca foi variável em todos os habitats. A expansão da terra agricultada e dos esquemas de irrigação são as principais ameaças à sobrevivência das aves.

Key words: Bird distribution, species composition, species diversity, species evenness, wetland habitat.

Introduction

Ethiopia possesses the fifth largest floral composition in tropical Africa (Brenan 1978). As many as 284 species of terrestrial mammals are known to occur in Ethiopia. Among these, 31 (11%) are endemic (Yalden *et al*. 1996). There are about 926 bird species listed for the country, of which 21 are endemic and 19 are globally threatened (Lepage 2006). Nationally, 73 Important Bird Areas (IBAs) have been identified, 30 of these sites comprise wetlands, while the rest are representatives of other ecosystems. Wetlands provide suitable habitats for innumerable organisms including birds. These habitats, however, are declining all over the world. Water resource development is a major cause for this decline. Dams are being constructed by diverting large rivers to produce hydro-electricity, assist navigation and control floods. Such changes have affected estuarine and coastal ecology, and reduced the amount of water reaching flood plain wetlands, affecting their ecology (Kingsford 2000).

Lake Tana basin has a catchment area of 15,000 ha (Nagelkerke 1997). Over 60 rivers and streams flowing from the Simen Mountains to the north, the large central plateau to the east and the gentler sloping land to the west, feed the lake. The water level of the lake rises gradually during the rainy season, after which it slowly falls to reach its minimum level during the dry season (EWNHS 1996). Lake Tana qualifies as an IBA because it possesses globally threatened species such as Wattled Crane (*Bugeranus carunculatus*), Lesser Flamingo (*Phoeniconaias minor*), Rouget's Rail (*Rougetius rougetti*), Pallid Harrier (*Circus macrourus*), and Greater Spotted Eagle (*Aquila clanga*). Recent estimates on the birds of Lake Tana suggested that 43,000 wetland birds are found in the area (Francis & Shimelis Aynalem 2007). There are 214 Palaearctic migrants in Ethiopia and among these, 45 species have been found to over-summer within the boundaries of the country. A large number of these birds have breeding population in Ethiopia (Pol 2006).

The preparation of a list of species is basic to the study of avifauna of a site, because a list indicates species diversity in a general sense (Bibby *et al*. 1992; Bibby 1998). Information is far from complete for most species of birds in different regions. Concentration of threatened avian species is greater in the tropics than elsewhere. Of the 1,029 threatened species, 884 occur in developing countries (Rands 1991). Thus, the burden of conserving threatened species lies on the developing nations, where resources are scarce for effective conservation measures. Apart from their beauty, birds are excellent indicators of water quality. There are two categories of water birds; wetland specialists and generalists. Specialists are those that nest, feed and roost in wetlands. Wetland specialists are wholly dependent on aquatic habitats, and cannot survive in other habitats (Airinatwe 1999). Generalists are those birds that frequently visit wetlands, but are seen in other habitats as well. Cranes, for example, are generally regarded as terrestrial birds, but breed exclusively in wetlands, especially preferring seasonal grass swamps. As a result of wetland habitat loss, the Wattled and Black-crowned Cranes are now under threat (Mengistu Wondafrash 2003).

In Ethiopia, several ecosystems of high biological importance are threatened and there is a need for strong conservation action that should be supported by legislation (Pol 2006). The objective of the present study was to evaluate the species composition, relative abundance and distribution of the bird fauna of the riverine and wetland

habitats of Infranz and Yiganda at the southern tip of Lake Tana, Ethiopia, in order to facilitate the development of a management plan for bird conservation.

Materials and methods

Study area

The wetlands of Infranz and Yiganda, and the riverine habitat of Infranz River, were the specific sites where the present study was conducted (Fig. 1). The area is located in the Amhara National Regional State of Bahir Dar Zone, southern tip of Lake Tana, where the town's geographical location is at about 11°37′ north latitude and 37°25′ east longitude. The southern-most tip of Lake Tana is internationally recognized as Important Bird Area (IBA). The site is one of the water fowl census areas. The wetlands are lowland plains and are regularly inundated with water. Yiganda wetland is located adjacent to Zegie peninsula, whereas Infranz wetland is located towards the southern part of Bahir Dar airport. These areas are not protected and cultivation is carried out when the water level recedes. The vegetation of these areas predominantly comprises species of *Typha* and *Papyrus*. The riverine habitat begins at Infranz wetland habitat towards Lake Tana to the north. It is a permanent river. The vegetation type is a riverine woodland with indigenous trees. The mean annual rainfall is 1651 mm in Yiganda and 927 mm in Infranz wetland areas. The pattern of rainfall distribution is unimodal with a long rainy season between June and September. The minimum and maximum mean temperatures of the study area are 11°C and 28°C in Yiganda, and 13°C and 27°C at Infranz (Shimelis Aynalem 2007).

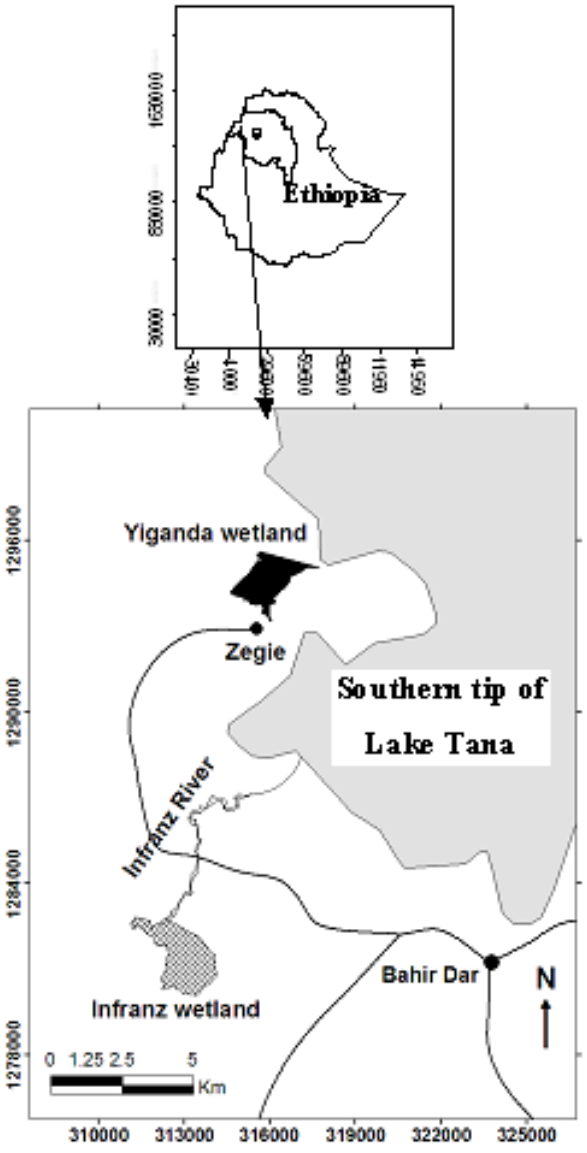

Fig. 1. Map of the study area.

A preliminary survey was conducted during August, 2006. The physical features of the study area were assessed using ground survey. The coordinates of each study site was taken and their boundaries were delineated. The study was conducted from August 2006 to March 2007, covering both wet and dry seasons.

Stratification of the study area and sampling design

The study area was stratified according to habitat type, and the sampling unit within the habitat was determined and assigned on the basis of area coverage and vegetation type. Stratification was made following the methods of Jones (1998) and Krebs (1999). The total area of the riverine habitat and wetlands was 4 and 100 ha of land, respectively. Around 20% of the wetland and 75% of the riverine habitat areas were covered for sampling. A stratified random sampling technique was used for selecting the actual sites for sampling through line transects (Lloyd *et al.* 1998; Sutherland 1996). To avoid repeated counting of birds, routes were reasonably spaced out; in

riverine enclosed habitats by 150-200 m, and in the open wetland habitats by 250-500 m. The speed of walking on the routes depended on the number of birds present and difficulties in recording them. In open wetland habitat, a speed of about 2 km h^{-1} and in riverine habitats 1 km h^{-1} was followed (Bibby *et al*. 1992). To minimize disturbance during the count, a waiting period of 3 to 5 min prior to counting was applied (Hosteler 2001; Sutherland 2000). Counting was accomplished for a fixed period of 3-10 min depending upon how conspicuous the birds were.

Data collection and analysis

Following Jones (1998), data collection commenced about 30 min after dawn and continued to mid-morning. Late afternoon count was also carried out. Data collection was carried out for 5 h a day from 6:30-10:00 a.m. in the morning and from 4:30 to 6:00 p.m. in the afternoon, when the activities of birds were prominent. On average, 20 samples per month were collected. The perpendicular distance from which the bird occurred to the transect line was estimated and then the type and the group number of species were recorded using direct observation. Photographs and videos were taken to justify the species type for those species which were 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. Birds were identified to the species level and their taxonomic groups were properly categorized based on field guides (Alan & Kemp 2001; Alden *et al*. 1995; Sinclair & Ryan 2003; Stevenson & Fanshawe 2002; Urban & Brown 1971; Van Perlo 1995).

Two-way ANOVA was used to analyze the effect of two variables *viz.* season and habitat. The General Linear Model (GLM) procedure of SAS (2000) package was used. Means for variables whose F-values showed a significant difference were compared using the Duncan's Multiple Range Test. Differences were considered statistically significant at 5 and 1% levels. A fixed effect model was used to estimate the effects of season and habitat on the species composition of birds following the formula:

$$Y_{ij} = \mu + \alpha_i + \beta_j + e_{ij}$$

where, Y_{ij} = individual observation, μ = the overall mean of species observed, α = the i^{th} season effect, β = the j^{th} habitat effect and e_{ij} = the error term.

Prior to any analysis, the raw data were log transformed (Fowler & Cohen 1990). Relative abundance of avian species was determined using encounter rates that give crude ordinal scales of abundance (abundant, common, frequent, uncommon and rare) (see Bibby *et al*. 1998). Encounter rate incorporates the effort expended in the analysis of bird survey results; field hours for each observer, and the number of individuals of each species observed. This allows an encounter rate to be calculated for each species by dividing the number of birds recorded by the number of hours spent searching, giving a figure of birds per hour for each species. The abundance categories (the number of individuals per 100 field hours) were: < 0.1, 0.1-2.0, 2.1-10.0, 10.1-40.0 and > 40. For each category, the following abundance score is given: 1 (rare), 2 (uncommon), 3 (frequent), 4 (common), and 5 (abundant), respectively. Therefore, the relative abundance of each bird species was determined on the ordinary scale of rare, uncommon, frequent, common and abundant. For example, if the abundance category is < 0.1, the abundance score will be 1 and the species is considered as rare. Simpson's Index (D) (Simpson 1949), and Shannon-Wiener Index (H´) (Shannon & Weaver 1949) were used to evaluate the bird species diversity. Species evenness (H´/H´max) was also calculated.

Results

A total of 129 species of birds was observed during the two seasons *viz.* wet and dry (Appendix Table 1). Wattled Ibis (*Bostrychia carunculata*) and Black-winged Lovebird (*Agapornis taranta*) are endemic to both Ethiopia and Eritrea. 21 Palaearctic Migrants (PM), one Resident and Palaearctic (R/PM), one Passage Migrant (PassM) and Intra-African Migrant (AM) were recorded during the study period. The remaining (106) bird species were residents. Most of the Palaearctic migrants were observed from November 2006 to February 2007, mostly in the wetland habitats of Infranz and Yiganda where wetland vegetation dominates. Globally threatened species such as Ferruginous Duck (*Aythya nyroca*) and Black-crowned Crane (*Balearica pavonina*) (Near

Threatened), and Wattled Crane (*Bugeranus carunculata*) (Vulnerable) were also recorded.

During the wet and dry seasons, 89 and 103 bird species were recorded, respectively. 63 bird species were common to both seasons, but 26 and 40 species were exclusive to the wet and dry seasons, respectively. The species composition of birds during the wet and dry seasons was not significantly different ($F_{1, 110} = 0.28$, $p > 0.05$), but there was a significant difference among habitats ($F_{2,110} = 3.33$, $p < 0.05$). Season and habitat interaction was, however, not significant ($F_{2, 110} = 0.12$, $p > 0.05$). Duncan's Multiple Range Test showed that mean number of species did not differ significantly between the two wetland habitats (Infranz, mean no. of species = 0.387, n = 44 and Yiganda, mean no. of species = 0.397, n = 26); whereas, that for the riverine habitat (mean no. of species = 0.046, n = 46) was significantly different from the two wetland habitats.

The highest species diversity (D) during the wet season was observed in Yiganda wetland, 0.81, followed by Infranz wetland, 0.50. The riverine habitat had the least species diversity, 0.3. During the dry season, the species diversity at the riverine habitat, Infranz and Yiganda was 0.94, 0.92 and 0.77, respectively. The highest species evenness was registered in the riverine habitat. For the entire season, Yiganda wetland had the highest species diversity and evenness, 0.87 and 0.39, respectively (Table 1).

The relative abundance scores of species during the wet season showed that 21, 19 and 31 species were frequent; 13, 6 and 15 were common; 5, 4, and 2 were abundant at Infranz, Yiganda and in the Riverine habitat, respectively. During the dry season, 28, 18 and 29 species were frequent; 13, 7 and 11 species were common; 6, 6 and 4 were abundant at Infranz and Yiganda wetlands and in the Riverine habitats, respectively. Rare or uncommon species were not registered at both seasons (Table 2). The highest number of species was recorded in the Infranz wetland (57) during the dry season. However, during the wet season, the riverine habitat showed a relatively high number of species (48).

Discussion

The record of 129 species of birds during the

Table 1. Avian species diversity during wet and dry seasons.

Habitat	Season	No. of species	Abundance (no. of individuals)	D	H´	H´/H´max
Infranz	Wet	39	574	0.50	1.56	0.24
	Dry	57	253	0.93	5.53	0.57
	Both	76	827	0.75	2.53	0.38
Yiganda	Wet	29	307	0.81	5.72	0.38
	Dry	44	517	0.77	2.00	0.32
	Both	63	824	0.87	2.59	0.39
Riverine	Wet	47	1261	0.31	1.05	0.27
	Dry	44	240	0.94	3.25	0.86
	Both	74	1501	0.49	1.67	0.23

H´= Shannon-Wiener Index; H´/H´max= Evenness; D= Diversity Index; H´max= ln(S)

Table 2. Number of bird species in different relative abundance categories.

Habitats	Season	Frequent	Common	Abundant
Infranz	Wet	21	13	5
	Dry	28	13	6
Yiganda	Wet	19	6	4
	Dry	18	7	6
Riverine	Wet	31	15	2
	Dry	29	11	4

wet and dry seasons in the limited area shows that the diversity is very high. At the same time, the occurrence of winter birds in the area indicates that the area is important for migratory birds. Most of these were observed from November to February. The globally threatened species, Ferruginous Duck was observed in the wetlands of Infranz during the wet season, whereas, only a pair of Wattled Crane (*B. carunculatus*) was observed during the dry season in Yiganda wetland.

The species composition of birds counted during the wet and dry seasons was not significantly different. The extended time of inundation of the area during the wet and dry seasons could contribute to the insignificant effect of seasons on bird species composition in the studied habitats. Moreover, in the multi-bird species composition study at microgeographic or local scale, the effect of season or the role of climate could be negligible. Bird species also shift their feeding habit between seasons in temperate areas (Ward 1969). This might account for the insignificant effect of seasons on bird species composition.

The species diversity index and evenness of habitats during the entire season revealed that Yiganda wetland had the highest species diversity and evenness. The large size of Yiganda, as compared to the other sites might contribute to the highest bird species diversity and evennes. This is because of the availability of multiple and variety of alternative feed sources for bird; moreover, large area of Yiganda is inaccessable for people contributing to a favourable condition for breeding, feeding and nesting sites. Whereas, Infranz wetland and the riverine habitats are fragmented and exposed to the local people for cultivation and cutting of the vegetation. As a result, birds which depend on these sites for feeding, nesting, hiding and breeding, are affected. In natural habitats where the intervention of humans is less and minimum, the diversity as well as the evennes of species is higher than the fragemented ones where intensive farming is carried out (Rana 2005). Differences in feeding habits and habitats could also increase diversity, evenness and species richness (Smith 1992). The smallest size of the riverine habitat might have contributed to the low evenness and diversity of species both during wet and dry seasons.

The relative abundance of bird species during seasons might be related to the availability of food, habitat condition and breeding season of the species. The distinct seasonality of rainfall and seasonal variation in the abundance of food resources result in seasonal changes in the species abundance of birds (Gaston *et al*. 2000; Karr & Roth 1971). The distribution and abundance of many bird species are determined by the composition of the vegetation that forms a major element of their habitats. As vegetation changes along complex geographical and environmental gradients, a particular bird species may appear, increase or decrease in number, and disappear as the habitat changes (Lee & Rotenberry 2005).

Papyrus vegetation (*Cyperus papyrus*) and *Typha* plants, particularly phragmite beds along the shores of the Lake Tana are important feeding, nesting and breeding sites for wetland birds. Papyrus vegetation is indispensable for wetland birds. People use the matured papyrus reed for local boat construction. The matured plant flower is also used during coffee ceremony to spread on the floor at home. Farmers along the shore of the lake cultivate the area when the water level recedes. Perennial fruit trees and 'chat' (*Catha edulis*) plantation is becoming dominant in the area. At present, the unusually high level of reduction in the size of the lake led many areas under permanent cultivation. Unless appropriate community based conservation measure is taken, the entire habitat will be lost in the near future. Studies conducted in Niger showed that the most important threat for White Storks (*Ciconia ciconia*) was the degradation of wetlands which were ideal habitats for roosting and thermoregulation (Brouwer *et al*. 2003). Human activities threaten the existence of many birds by destroying their habitat or directly affecting their survival and reproductive success (Green & Hirons 1991). The shore of Lake Tana is also being degraded for various purposes. Wide areas of wetlands are being converted for agricultural and urban-industrial-port expansion affecting many bird species (Meyer & Turner 1992). At present, the lake shores are used for permanent cultivation affecting estuarine ecosystem and wetland birds. This leads to a big threat for the survival of species and maintenance of diversity. Similar destruction was also observed in Lake Victoria (Kairu 2001). The planned establishment of hydro-electric power

and irrigation schemes in the area might influence the hydrological cycle of discharge and recharge system of the lake. Kingsford (2000) pointed out that the construction of dams affects the estuarine and coastal ecology; thereby reducing the amount of water reaching flood plain wetlands. Unless environmentally sound operation is carried out, these sites will face similar destruction thereby affecting the diversity of bird species.

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

Bird species	Dry season	Wet season	Both seasons
Abdim's Stork (*Ciconia abdimii*)	+		
Abyssinian Slaty-Flycatcher (*Melaenornis chocolatina*)		+	
African Black Duck (*Anas sparsa*)			+
African Citril (*Serinus citrinelloides*)			+
African Collared-Dove (*Streptopelia roseogrisea*)		+	
African Fish-Eagle (*Haliaeetus vocifer*)			+
African Jacana (*Actophilornis africana*)			+
African Paradise Monarch (*Terpsiphone viridis*)			+
African pygmy-goose (*Nettapus auritus*)			+
African pygmy-Kingfisher (*Ispidina picta*)	+		
African Rook (*Corvus capensis*)	+		
African Spoonbill (*Platalea alba*)	+		
African Water-Rail (*Rallus caerulescens*)			+
African Wattled Lapwing (*Vanellus senegallus*)			+
Allen's Gallinule (*Porphyrio alleni*)	+		
Banded Wattle-eye (*Platysteira cyanea*)			+
Bare-faced Go-away-bird (*Corythaixoides personata*)		+	
Bar-tailed Godwit (*Limosa lapponica*)	+		
Bimaculated lark (*Melanocorypha bimaculata*)		+	
Black Crake (*Amaurornis flavirostris*)			+
Black Kite/ Yellow-billed Kite (*Milvus migrans/parasiticus*)			+
Black-billed Barbet (*Lybius guifsobalito*)			+
Black-billed Wood-dove (*Turtur abyssinicus*)		+	
Black-crowned Crane (*Balearica pavonina*)			+
Black-eared Wheatear (*Oenanthe hispanica*)	+		
Black-headed Heron (*Ardea melanocephala*)			+
Black-headed Lapwing (*Vanellus tectus*)		+	
Black-headed Weaver (*Ploceus melanocephalus*)			+
Black-winged Lovebird (*Agapornis taranta*)			+
Blue-breasted Bee-eater (*Merops variegates*)			+
Blue-headed Coucal (*Centropus monachus*)			+
Bronze Sunbird (*Nectarinia kilimensis*)	+		
Carmine Bee-eater (*Merops nubicus*)	+		
Cattle Egret (*Bubulcus ibis*)			+
Chestnut-backed Sparrow-Lark (*Eremopterix leucotis*)			+
Cinnamon-breasted Rock Bunting (*Emberiza tahapisi*)		+	
Citrine Wagtail (*Motacilla citreola*)		+	
Collared Sunbird (*Anthreptes collaris*)			+
Common Bulbul (*Pycnonotus barbatus*)	+		
Common Chiffchaff (*Phylloscopus collybita*)	+		
Common Fiscal (*Lanius collaris*)			+
Common Moorhen (*Gallinula chloropus*)			+
Common Sandpiper (*Actitis hypoleucos*)			+
Common Snipe (*Gallinago gallinago*)	+		
Common Stonechat (*Saxicola torquata*)	+		
Cut-throat (*Amadina fasciata*)	+		

Contd…

Appendix Table 1. Continued

Bird species	Dry season	Wet season	Both seasons
Double-toothed Barbet (*Lybius bidentatus*)		+	
Eastern Grey Plantian-eater (*Crinifer zonurus*)			+
Egyptian goose (*Alopochen aegyptiacus*)			+
Eurasian Hoopoe (*Upupa epops*)	+		
Eurasian Marsh-Harrier (*Circus aeruginous*)	+		
Ferruginous Duck (*Aythya nyroca*)		+	
Giant Kingfisher (*Megaceryle maximus*)	+		
Glossy Ibis (*Plegadis falcinellus*)	+		
Goliath Heron (*Ardea goliath*)			+
Great Reed-Warbler (*Acrocephalus arundinaceus*)	+		
Greater Blue-eared Glossy- Starling (*Lamprotornis chalbeus*)			+
Great-white Egret (*Egretta alba*)	+		
Green Sandpiper (*Tringa ochropus*)	+		
Greenshank (*Tringa nebularia*)	+		
Grey Heron (*Ardea cinerea*)			+
Grey-backed Fiscal (*Lanius excubitoroides*)	+		
Grey-headed Kingfisher (*Halcyon leucephala*)			+
Grey-headed Sparrow (*Passer griseus*)			+
Hadada (*Bostrychia hagedash*)			+
Hamerkop (*Scopus umbretta*)			+
Helmeted Guineafowl (*Numida meleagris*)	+		
Hemprich's Hornbill (*Tockus hemprichii*)			+
Isabelline Wheatear (*Oenanthe isabellina*)	+		
Isbeline Shrike (*Lanius isabellinus*)	+		
Jameson's Firefinch (*Lagonosticta rhodopareia*)		+	
Laughing Dove (*Streptopelia senegalensis*)			+
Lesser Moorhen (*Gallinula angulata*)	+		
Little Bee-eater (*Merops pusillus*)			+
Little Egret (*Egretta garzetta*)		+	
Little Grebe (*Tachybaptus ruficollis*)	+		
Long-crested Eagle (*Lophaetus occipitalis*)			+
Long-tailed Cormorant (*Phalacrocorax africanus*)			+
Maccoa Duck (*Oxyura maccoa*)		+	
Malachite Kingfisher (*Alcedo cristata*)			+
Marsh Sandpiper (*Tringa stagnatilis*)			+
Namaqua Dove (*Oena capensis*)	+		
Northern Wheatear (*Oenanthe oenanthe*)		+	
Open-billed Stork (*Anastomus lamelligerus*)	+		
Pied Kingfisher (*Ceryle rudis*)			+
Pied Wagtail (*Motacilla alba*)			+
Pin-tailed Whydah (*Vidua macroura*)		+	
Plain-backed Pipit (*Anthus leucophrys*)	+		
Purple Heron (*Ardea purpurea*)			+
Red Bishop (*Euplectes orix*)		+	
Red-billed Firefinch (*Lagonosticta senegala*)			+
Red-billed Oxpecker (*Buphagus erythrorhynchus*)			+
Red-breasted Wheatear (*Oenanthe bottae*)	+		

Contd…

Appendix Table 1. Continued

Bird species	Dry season	Wet season	Both seasons
Red-cheeked Cordonbleu (*Uraeginthus bengalus*)			+
Red-eyed Dove (*Streptopelia semitorquata*)			+
Red-necked Phalarope (*Phalaropus lobatus*)		+	
Red-tailed Wheatear (*Oenanthe xanthoprymna*)	+		
Ruff (*Philomachus pugnax*)			+
Sacred Ibis (*Threskiornis aethiopicus*)			+
Scarlet-chested Sunbird (*Chalcomitra senegalensis*)			+
Sedge Warbler (*Acrocephalus schoenobaenus*)	+		
Silvery-cheeked Hornbill (*Ceratogymna brevis*)			+
Speckled Mousebird (*Colius striatus*)			+
Speckled Pigeon (*Columba guinea*)			+
Spectacled Weaver (*Ploceus ocularis*)			+
Spotted Flycatcher (*Muscicapa striata*)		+	
Spur-winged Goose (*Plectropterus gambensis*)			+
Spur-winged Lapwing (*Vanellus spinosus*)			+
Squacco Heron (*Ardeola ralloides*)			+
Striped Kingfisher (*Halcyon chelicuti*)			+
Stuhlmann's Starling (*Poeoptera stuhlmanni*)		+	
Three-banded Plover (*Charadrius tricollaris*)	+		
Tropical Boubou (*Laniarius aethiopicus*)			+
Variable Sunbird (*Cinnyris venustus*)		+	
Village Indigobird (*Vidua chalybeate*)			+
Violet Wood-hoopoe (*Phoeniculus damarensis*)		+	
Wattled Crane (*Bugeranus carunculatus*)	+		
Wattled Ibis (*Bostrychia carunculata*)	+		
White-backed Duck (*Thalasorrnis leuconotus*)		+	
White-bellied Go-away-bird (*Corythaixoides leucogaster*)		+	
Wire-tailed Swallow (*Hirundo smithii*)		+	
Wood Sandpiper (*Tringa glareola*)	+		
Woodland Kingfisher (*Halcyon senegalensis*)	+		
Yellow Wagtail (*Motacilla flava*)			+
Yellow-billed Egret (*Egretta intermedia*)			+
Yellow-billed Stork (*Mycteria ibis*)	+		
Yellow-crowned Bishop (*Euplectes afer*)		+	
Yellow-fronted Parrot (*Poicephalus flavifrons*)			+
Yellow-mantled Widowbird (*Euplectes macrourus*)		+	