

SPECIES COMPOSITION, RELATIVE ABUNDANCE AND HABITAT ASSOCIATION OF THE BIRD FAUNA OF THE MONTANE FOREST OF ZEGIE PENINSULA AND NEARBY ISLANDS, LAKE TANA, ETHIOPIA

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ABSTRACT: The present study was carried out in Zegie Peninsula and Kibran Gebriel and Entos Iyesus Islands of Lake Tana from August 2006 to March 2007. Sampling sites were stratified based on the vegetation type and area cover. Point count technique and chi-square test were employed to see the association of birds with the different vegetation strata. A total of 101 bird species were recorded, out of which 91 were residents (three endemics) and 10 were Palaearctic migrants. The Zegie Peninsula had high species diversity and evenness (0.96 and 0.86, respectively). The relative abundance of birds during the wet and dry seasons was variable. A total of 54 and 68 species were recorded during the wet and dry seasons in the Zegie Peninsula, respectively. The islands possessed 24 species each season. Habitat association of birds within the vegetation strata of Zegie Peninsula during the wet season was: highest at the shore (4.50), followed by gardens (4.00), bushes and shrubs (3.33) and trees (2.17). During the dry season, the highest mean number of birds occurred in the garden vegetation (4.86), followed by trees (3.23), fringe type of vegetation (3.22), and bush and shrub vegetation (2.60). During the wet season, the association of birds with the vegetation stratum was not statistically significant ($p > 0.05$, chi-square = 13, df = 7, n = 32). However, this was significant during the dry season ($p < 0.05$, chi-square = 66.238, df = 9, n = 84). Conservation action to minimize the anthropogenic effect at Zegie should be the order of the day.

Key words/phrases: Avifauna, distribution, habitat association, Zegie Peninsula

INTRODUCTION

Birds have proved to be excellent indicators of biodiversity or productivity as they are easily observed and are relatively well known compared to other animals. Their dispersal in almost every corner of the globe also makes comparative studies simpler (Dash, 1993; WNHS, 1996; Pomeroy and Dranzoa, 1997). Birds are vital for ecological functioning of our environment such as indicators of pollution, seed dispersal, scavenging offal and as predators of insect pests. The distribution and abundance of many bird species are determined by the composition of the vegetation (habitat) (Lee and Rotenberry, 2005). Climate influences habitats and movements of resident and migratory birds. Many species are characteristic of particular habitats or biomes (Stevenson and Fanshawe, 2002). Dry and wet season movement patterns vary a great deal across the region and between years. The activity of birds, especially in more arid areas, is strongly influenced by the presence or

absence of rain (Alertstam, 1982; Stevenson and Fanshawe, 2002).

In Ethiopia, different ecosystems of high biological importance are threatened. Habitat destruction and encroachment of undesirable plant species following flooding and shrinkage of lakes and wetlands are some of the threats to the Ethiopian avifauna (Pol, 2006). Though the country is known for its high biological diversity, studies on the diversity, relative abundance and other ecological aspects of the avian taxa have been little addressed (Urban and Brown, 1971; Ash, 1979; Ash and Gullic, 1989; EWNHS, 1996; Pol, 2006). The Amhara Region of Ethiopia consists of over 75% of the central Ethiopian Highland IBAs (Important Bird Areas). Nineteen highland biome species have so far been recorded from Lake Tana (EWNHS, 1996). The southern tip of Lake Tana is one of the Important Bird Areas of the country. Zegie Peninsula and the nearby islands are areas where remnant indigenous vegetation still occurs. In addition, the area harbours different species of birds some of which are not yet recorded. The

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species composition, distribution, relative abundance and habitat association of the bird fauna of Zegie Peninsula and nearby islands are hardly addressed. Therefore, the present study attempts to fill this gap.

THE STUDY AREA AND METHODS

Forest habitat of the Zegie Peninsula and the two islands of Lake Tana (Kibran Gebriel and Entos Iyesus Monastery) were together considered as Entos-Kibran where the present study was conducted (Fig. 1). This area is located in the Amhara National Regional State of Bahir Dar Zone, southern most tip of Lake Tana ($11^{\circ} 37' N$ latitude and $37^{\circ} 25' E$ longitude).

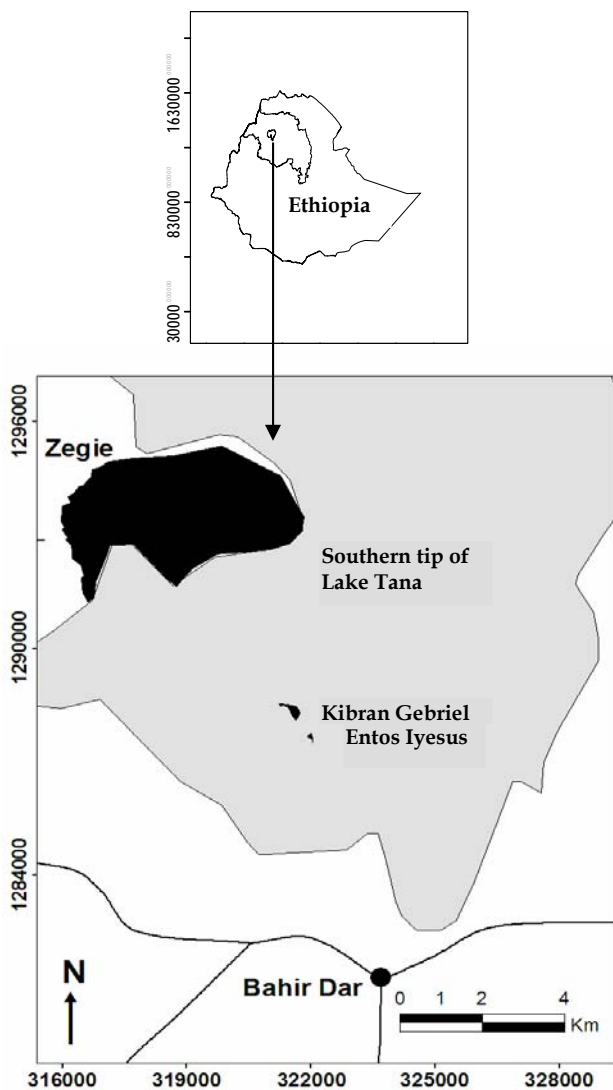


Fig. 1. Location map of the study area.

The Zegie Peninsula has a total area of 1230 ha. The elevation of the area ranges from 1775 to 1985 m asl. The area is covered with patches of indigenous trees. Kibran Gebriel and Entos Iyesus islands are monasteries that possess montane forest types having a total area of 10 ha (Shimelis Aynalem, 2007).

A preliminary survey was conducted during August 2006. The study was conducted from August 2006 to March 2007, covering both wet and dry seasons. The study area was stratified based on the vegetation type. Though the Zegie Peninsula was considered as a montane forest, within the boundary of the Peninsula, different vegetation structures were clearly observed. Three fourth of the total area is surrounded by Lake Tana. As we move away from the lake shore to the centre, the vegetation structure clearly differs. Habitats around the shore of the Lake adjacent to the Peninsula have an elevation of 1775 m. asl. This area is dominated by different vegetation such as *Sizygium guineense* and *Mimusops kummel*. Whereas in the middle of the Peninsula, where the maximum elevation is 1885 m asl at Yiganda Tekle Haymanot Monastery near Ararat Mountain, the density as well as the distribution and type of vegetation varied, dominated by bush and woodland vegetation. In most places inside the Peninsula where more than 8, 000 inhabitants reside, indigenous trees such as *Millettia ferruginea*, *Cordia africana*, *Apodytus dimidiata*, *Rothmannia urcelliformis*, *Celtis africana* and *Ficus vasta* are the dominant ones. Most coffee plantations are grown in the shade of these trees. The open spaces are covered with vegetable, fruit and home gardens. Hence, the sampling unit within the habitat was determined and assigned on the basis of area coverage and vegetation type: bush and shrubs, fringe vegetation, dominant trees, managed or garden areas. Their proportion to the total study area was approximately 20%, 50%, 20% and 10%, respectively. A total of 77 and 102 samples in the Zegie Peninsula, and 17 and 20 in the islands were surveyed during the wet and dry seasons, respectively. The islands are solely devoted for religious purposes with limited inhabitants. The islands are small and are fully covered with indigenous trees including *Podocarpus falcatu*, *Sizygium guineense* and *Mimusops kummel*. The vegetation descriptions of the study area have been carried out by Alemnew Alelign (2001) for the

Zegie Peninsula and Taye Bekele *et al.* (2001) for the Islands.

Stratified sampling technique was made based on the methods of Jones (1998) and Krebs (1999). The sampling blocks were randomly selected and assigned based on the stratification of the study area. Sample areas covered 500 ha and 8 ha in Zegie and Entos-Kibran island, respectively. Based on the habitat type, point count method was employed (Sutherland, 1996; Lloyd *et al.*, 1998). To minimize disturbance during the count, a waiting period of 3 to 5 minutes prior to counting was applied (Sutherland, 2000; Hosteler and Main, 2001). The counting at a specific point was accomplished for a fixed period of stay of 3 to 10 minutes interval depending upon the difficulties of the area and the type of bird species to be identified, not to underestimate or overestimate the population of birds, if the counting time is below three minutes and above 10 minutes, respectively. Personal experience, plumage pattern, size and shapes, colour, songs and calls are important parameters used in the identification of birds.

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 binoculars. The vegetation type/coverage within 100 m radial distance from where the count was carried out was also estimated to see the dominant vegetation types, and to study the association of birds in the type of vegetation they were recorded (feeding, resting or/and breeding). Photographs and videos were taken to justify the species type for those species difficult to identify. The songs and calls record of Chappuis (2000), Rochè (1996), and Hammick (2002) were used to relate with the songs and calls of birds heard during the survey period. Species of birds were identified and their taxonomic groups were properly categorized based on field guides (Urban and Brown, 1971; Alden *et al.*, 1995; Alan and Kemp, 2001; van Perlo, 1995; Stevenson and Fanshawe, 2002).

Data analysis

The data collected were organized in the excel spread sheet for statistical analysis. SPSS (2003)

statistical package was used to employ a chi-square test to see the habitat association of birds in each vegetation stratum of the study areas. Simpson's Index (Simpson, 1949) and Shannon-Weiner Index (Shannon and Weiner, 1949) were used to evaluate the bird species diversity at different habitats for both seasons.

$$H' = - \sum_{i=1}^S P_i \ln P_i \quad D = 1 - \sum_{i=1}^S P_i^2$$

Where,

H' = Shannon-Weiner index

S = the number of species observed

P_i = the proportion of the total sample

\ln = natural logarithm

D = Simpson's Index

Relative abundance of avian species was determined using encounter rates that give crude ordinal scales of abundance (abundant, common, frequent, uncommon and rare) (Bibby *et al.* 1992, 1998).

$$\text{Encounter rate} = \frac{\text{Total number of individual birds observed}}{\text{Period of observation in hour}} \times 100$$

Encounter rate was calculated for each species by dividing the number of birds recorded by the number of hours spent searching, in order to get a figure of birds per hour for each species. The abundance category (the number of individuals per 100 field hr) was: <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).

RESULTS

A total of 101 species of birds belonging to 44 families was observed during the wet and dry seasons (Appendix 1). The Yellow-fronted Parrot (*Poicephalus flavifrons*) is endemic to Ethiopia; whereas, White-cheeked Turaco (*Tauraco leucotis*) and Banded Barbet (*Lybius undatus*) are endemic to Ethiopia and Eritrea. Ninety one resident and 10 Palaearctic migrants were recorded during the study period. During the wet and dry seasons, 78 and 92 bird species were recorded, respectively. Sixty bird species were common for both seasons, but 15 and 26 species were exclusively recorded only during the wet and dry seasons, respectively.

Wet season species diversity index was high in Entos-Kibran island (0.87). But, evenness of species was high in the Zegie Peninsula (0.9). During the dry season, the species diversity and evenness at the Zegie Peninsula and Entos-Kibran island were 0.94 and 0.61; and 0.84 and 0.55, respectively. Zegie Peninsula had the highest species diversity and evenness (0.96 and 0.86, respectively) (Table 1). The relative abundance score of each species during the wet and dry seasons are shown in Table 2 (see appendices 2, 3, 4 and 5 for more detail). During the dry season, the African Finfoot (*Podica senegalensis*) in Entos-Kibran island was categorized as a rare species at local level.

The highest number of species was recorded in the Zegie Peninsula during both seasons. A total of 54 and 68 species were recorded during the wet and dry seasons, respectively. The Entos-Kibran island areas had the least number of species (24 species each) during wet and dry seasons. The

highest mean number of birds was recorded at the shore of the Zegie Peninsula vegetation stratum: fringe vegetation (4.50), followed by gardens (4.00), bushes and shrubs (3.33) and the least mean number of birds was recorded in the dominant tree stratum (2.17) during the wet season. During the dry season, the highest mean number of birds was recorded in the garden vegetation (4.86), followed by dominant trees (3.23), fringe vegetation (3.22) and the least was in the bush and shrub vegetation (2.60) (Table 3). During the wet season, the association of birds with the vegetation strata (bushes and shrubs, dominant trees including fruit trees, fringes and home gardens including horticultural sites) was not statistically significant ($p > 0.05$, chi-square =13, df =7, n= 32). During the dry season, however, the association of birds with the different vegetation strata was statistically significant ($p < 0.05$, chi-square =66.238, df =9, n=84).

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

Study area	Season	No. of species	Individual Abundance	D	H'	H'/H'max
Zegie Peninsula	Wet	52	222	0.59	3.86	0.90
	Dry	68	535	0.94	3.56	0.84
	Both seasons	92	757	0.96	3.87	0.86
Entos-Kibran island	Wet	24	159	0.87	2.49	0.63
	Dry	24	250	0.61	1.69	0.55
	Both seasons	29	409	0.81	2.31	0.69

Note: H' = Shannon-Weiner Index; H'/H'max = Evenness; D = Diversity Index; H'max = ln(S); S = The total number of species.

Table 2. Relative abundance of birds during the wet and dry seasons.

Study area	Season	Number of				
		rare species	uncommon species	frequent species	common species	abundant species
Zegie Peninsula	Wet		25	22	4	-
	Dry		28	24	15	1
Entos-Kibran island	Wet		-	7	11	7
	Dry	1	-	7	9	7

Table 3. Number of species in the different vegetation strata of Zegie Peninsula (mean \pm SE).

Season	Vegetation strata			
	Bush	Trees	Fringes	Gardens
Wet	3.33 \pm .67	2.17 \pm .60	4.50 \pm .50	4.00 \pm 1.78
Dry	2.60 \pm .34	3.23 \pm .36	3.22 \pm .46	4.86 \pm 1.21

An association of birds to a certain type of plant species was observed during the study period. Fruit trees, mainly *C. africana*, *F. vasta* and *F. sycamorus* were observed to support a large number of species such as: greater blue-eared starling, red-winged starling, violet-backed starling, eastern-grey plantain-eater, bare-faced and white-bellied go-away-bird, speckled mousebird, yellow-mantled widowbird, and yellow-fronted thinkerbird; whereas, bronze sunbird, collared sunbird, scarlet-chested sunbird, and variable sunbird were associated with flower bearing trees, shrubs and vegetable gardens. On the fringes or mangrove of Zegie Peninsula, along the shore of the lake, where *S. guineense* and *M. kummel* trees were dominant, the African fish eagle and Kingfishers were associated as a resting site. As these species depended on fish, they require such trees for resting and watching to dive in the water and capture the prey.

DISCUSSION

The highland biome species such as the Yellow-fronted Parrot (*P. flavifrons*), White-cheeked Turaco (*T. leucotis*) and Banded Barbet (*L. undatus*), occurred in substantial numbers. It was based on the abundance score calculated for Zegie peninsula. This was due to the favourable environment of the habitat that supported the species in different ways. Trees particularly, *C. africana* and *F. vasta* are used for nesting, breeding, feeding and sheltering sites for these species. These trees are far from being approached by predators, and human interference; and are also known to produce edible fruits. In addition, the large size of the Peninsula with good vegetation and canopy cover helped to have an ideal habitat for the species. The species diversity index and evenness of the areas during the wet and dry seasons revealed that Zegie Peninsula had more species diversity and evenness than the islands. The outcome of this result coincides with the report of Karr (1976); Janzen (1967) and Smythe (1970) where structurally complex vegetation buffers the influence of seasonality and there is a great stability in resource availability, which allows species to occur as residents throughout the year. The stability of the micro-climate of the Zegie Peninsula compared to the small patch areas of the Islands has contributed to the high species evenness of the area. The small scrap of the islands was difficult to support a large number of birds

and the close location of islands to the Peninsula resulted in the low evenness of the species.

The relative abundance of birds in the study area is 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. The number of uncommon species registered at Zegie Peninsula was high. Those species which have low number of individuals relative to the effort made during the survey compared to others were grouped in the uncommon category. This result can be related to the degradation of habitats that are important for feeding, resting, roosting and breeding. The degradation could be due to vegetation clearing, burning, and habitat modification. Such type of disturbance and degradation of the habitat would reduce the individual population of the species in many ways. Cutting trees and clearing vegetation for coffee plantation and fire wood production to sell to the nearest town were common in the area. Ryan and Owino (2006) suggested that the presence of large number of uncommon species in a certain area could be related to the breeding nature, large home range and niche of the species; besides the degradation of the habitat. In addition, Karr (1976) suggested that the number of individual birds varied independently within the study area. Some species abandon the specified area, decreasing both in the number of species and individuals, while others may have a reduced number but may be present as a few scattered individuals throughout the year. Even species with a relatively stable population will tend to show variation in abundance and occupancy over time (Gaston *et al.*, 2000). For example, the African Finfoot (*P. senegalensis*) at Entos-Kibrán island was rare. The rarity of the African Finfoot is related to the degradation or patchiness of the habitat. According to Wilson and Comet (1996), the absence or rarity of several species appeared to be related to habitat condition. Thiollay (1994) suggested that species that are consistently rare have either large home range or patchily distributed.

The distribution and abundance of many bird species are determined by the composition of the vegetation that comprises a major element of their habitats (Lee and Rotenberry, 2005). In the vegetation strata of Zegie Peninsula, species have shown different associations with the type of vegetation. Along the whole vegetation gradient (slope), most bird species tended to be related with structural variables. Within smaller sub-groups of

sites, some bird species were more associated with a particular plant species: fruit trees, flowering trees, bushes or shrubs (Estades, 1997). The highland biome species, particularly, the yellow fronted parrot, banded barbet, white-cheeked turaco, black-billed and double-toothed barbets and Narina's trogon were highly associated with fruit trees in the Zegie Peninsula, as distinctive plant communities often support quite different bird species (Wilson and Comet, 1996).

It is impossible to apply absolute density to estimate the relative abundance of each species of birds in a multi-species study and a dense vegetation, rather encounter rate is more appropriate. The data provided by the encounter rates do not provide an accurate indication of abundance and are not a substitute for density estimate. In addition, the relative abundance of species has no relation with IUCN species category criteria rather it is useful to know the abundance of the species in a particular area.

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

Species	Wet season	Dry season	All seasons
Abyssinian White-eye (<i>Zosterops abyssinicus</i>)		+	
African Citril (<i>Serinus citrinelloides</i>)			+
African Collared (Rose-Grey) Dove (<i>Streptopelia roseogrisea</i>)	+		
African Cuckoo (<i>Cuculus gularis</i>)	+		
African Darter (<i>Anhinga rufa</i>)		+	
African Finfoot (<i>Podica senegalensis</i>)		+	
African Fish-Eagle (<i>Haliaeetus vocifer</i>)			+
African Harrier-Hawk (<i>Polyboroides typus</i>)			+
African Jacana (<i>Actophilornis africana</i>)		+	
African Little Sparrowhawk (<i>Accipiter minullus</i>)	+		
African Paradise Flycatcher (<i>Terpsiphone viridis</i>)			+
African Pied Wagtail (<i>Motacilla aguimp</i>)			+
African pygmy-Kingfisher (<i>Ispidina picta</i>)		+	
Baglafaecht Weaver (<i>Ploceus baglafaecht</i>)			+
Banded Barbet (<i>Lybius undatus</i>)			+
Bare-faced Go-away-bird (<i>Corythaixoides personatus</i>)	+		
Bearded Woodpecker (<i>Dendropicops namaquus</i>)			+
Black Cap (<i>Sylvia atricapilla</i>)		+	

Species	Wet season	Dry season	All seasons
Black Crane (<i>Amaurornis flavirostris</i>)			+
Black Kite/ Yellow-billed Kite (<i>Milvus migrans /parasiticus</i>)			+
Black-billed Barbet (<i>Lybius guifsobalito</i>)			+
Black-billed Wood-dove (<i>Turtur abyssinicus</i>)		+	
Black-crowned Tchagra (<i>Tchagra senegala</i>)	+		
Black-headed Batis (<i>Batis minor</i>)			+
Black-headed Oriole (<i>Oriolus larvatus</i>)			+
Black-headed Weaver (<i>Ploceus melanocephalus</i>)			+
Blue-breasted Bee-eater (<i>Merops variegates</i>)			+
Blue-headed Coucal (<i>Centropus monachus</i>)			+
Blue-spotted Wood-Dove (<i>Turtur afer</i>)		+	
Brown-throated Wattle-eye (<i>Platysteira cyanea</i>)			+
Bruce's Green-Pigeon (<i>Treeron waalia</i>)	+		
Cattle Egret (<i>Bubulcus ibis</i>)			+
Collared Sunbird (<i>Anthreptes collaris</i>)			+
Common Bulbul (<i>Pycnonotus barbatus</i>)			+
Common Fiscal (<i>Lanius collaris</i>)	+		
Common Sandpiper (<i>Actitis hypoleucos</i>)			+
Common Stonechat (<i>Saxicola torquata</i>)		+	
Copper (Coppery) Sunbird (<i>Cinnyris cupreus</i>)			+
Double-toothed Barbet (<i>Lybius bidentatus</i>)			+
Eastern Grey Plantian-eater (<i>Crinifer zonurus</i>)			+
Egyptian goose (<i>Alopochen aegyptiacus</i>)			+
Eurasian Hoopoe (<i>Upupa epops</i>)			+
European Turtle-Dove (<i>Streptopelia turtur</i>)		+	
Fan-tailed Widowbird (<i>Euplectes axillaries</i>)		+	
Giant Kingfisher (<i>Megaceryle maximus</i>)		+	
Great Reed-Warbler (<i>Acrocephalus arundinaceus</i>)		+	
Greater Blue-eared glossy-Starling (<i>Lamprotornis chalbeus</i>)			+
Great-white Egret (<i>Egretta alba</i>)		+	
Grey Woodpecker (<i>Dendropicos goertae</i>)			+
Grey-backed Camaroptera (<i>Camaroptera brevicaudata</i>)			+
Grey-headed Sparrow (<i>Passer griseus</i>)			+
Hamerkop (<i>Scopus umbretta</i>)			+
Hemprich's Hornbill (<i>Tockus hemprichii</i>)			+
Jameson's Firefinch (<i>Lagonosticta rhodopareia</i>)	+		
Laughing (Palm) Dove (<i>Streptopelia senegalensis</i>)			+
Lemon Dove (<i>Columba larvata</i>)			+
Little Bee-eater (<i>Merops pusillus</i>)			+
Little Egret (<i>Egretta garzetta</i>)		+	
Little Weaver (<i>Ploceus luteolus</i>)	+		
Long-tailed Cormorant (<i>Phalacrocorax africanus</i>)			+
Malachite Kingfisher (<i>Alcedo cristata</i>)			+
Marsh Warbler (<i>Acrocephalus palustris</i>)		+	
Narina's Trogon (<i>Apaloderma narina</i>)		+	
Northern Black Flycatcher (<i>Melaenornis edolioides</i>)			+
Northern Puffback (<i>Dryoscopus gambensis</i>)			+
Nubian Woodpecker (<i>Campethera nubica</i>)	+		
Olivaceous Warbler (<i>Hippolais pallida</i>)		+	
Olive Thrush (<i>Turdus olivaceus</i>)	+		
Open-billed Stork (<i>Anastomus lamelligerus</i>)		+	
Osprey (<i>Pandion haliaetus</i>)		+	

Species	Wet season	Dry season	All seasons
Pied Kingfisher (<i>Ceryle rudis</i>)			+
Pied Wagtail (<i>Motacilla alba</i>)			+
Red-billed Firefinch (<i>Lagonosticta senegala</i>)			+
Red-cheeked Cordonbleu (<i>Uraeginthus bengalus</i>)			+
Red-chested Cuckoo (<i>Cuculus solitarius</i>)	+		
Red-eyed Dove (<i>Streptopelia semitorquata</i>)			+
Red-winged Starling (<i>Onychognathus morio</i>)			+
Rueppell's Robin-Chat (<i>Cossypha semirufa</i>)			+
Sand Martin (Bank Swallow) (<i>Riparia riaipa</i>)			+
Scarlet-chested Sunbird (<i>Chalcomitra senegalensis</i>)			+
Sedge Warbler (<i>Acrocephalus schoenobaenus</i>)		+	
Silvery-cheeked Hornbill (<i>Ceratogymna brevis</i>)			+
Southern Masked Weaver (<i>Ploceus velatus</i>)	+		
Speckled Mousebird (<i>Colius striatus</i>)			+
Speckled Pigeon (<i>Columba guinea</i>)			+
Spectacled Weaver (<i>Ploceus ocularis</i>)			+
Squacco Heron (<i>Ardeola ralloides</i>)			+
Streaky Seed-eater (<i>Serinus striolatus</i>)		+	
Striped Kingfisher (<i>Halcyon chelicuti</i>)			+
Tacazze Sunbird (<i>Nectarina tacazze</i>)		+	
Tropical Boubou (<i>Laniarius aethiopicus</i>)			+
Variable (Yellow-bellied) Sunbird (<i>Cinnyris venustus</i>)	+		
Village Indigobird (<i>Vidua chalybeata</i>)			+
Violet-backed Starling (<i>Cinnyricinclus leucogaster</i>)		+	
White-cheeked Turaco (<i>Tauraco leucotis</i>)			+
White-fronted Black Chat (<i>Myrmecocichla albifrons</i>)	+		
White-headed Vulture (<i>Trigonoceps occipitalis</i>)		+	
White-winged Tern (<i>Chlidonias leucopterus</i>)			+
Yellow-billed Egret (<i>Egretta intermedia</i>)			+
Yellow-fronted Parrot (<i>Poicephalus flavifrons</i>)			+
Yellow-fronted Tinkerbird (<i>Pogoniulus chrysoconus</i>)		+	

Appendix 2. Relative abundance of birds from Zegie Peninsula during the wet season.

Common name	Number of individuals	Abundance score	Relative abundance
Black-headed Oriole	1.0	2	Uncommon
African Collared-Dove	8.0	3	Frequent
African Cuckoo	1.0	2	Uncommon
African Fish-Eagle	1.0	2	Uncommon
African Little Sparrowhawk	2.0	2	Uncommon
African Paradise Flycatcher	7.0	3	Frequent
Baglafaft Weaver	7.0	3	Frequent
Banded Barbet	6.0	3	Frequent
Brown-throated Wattle-eye	1.0	2	Uncommon
Bearded Woodpecker	6.0	3	Frequent
Black-backed Puffback	1.0	2	Uncommon
Black-crowned Tchagra	1.0	2	Uncommon
Blue-headed Coucal	3.0	3	Frequent

Common name	Number of individuals	Abundance score	Relative abundance
Copper Sunbird	1.0	2	Uncommon
Montagu's Harrier	1.0	2	Uncommon
Collared Sunbird	5.0	3	Frequent
Common Bulbul	15.0	4	Common
Common Fiscal	6.0	3	Frequent
Double-toothed Barbet	2.0	2	Uncommon
Eastern Grey Plantain-eater	2.0	2	Uncommon
Giant Kingfisher	3.0	3	Frequent
Grey Woodpecker	3.0	3	Frequent
Grey-headed Sparrow	8.0	3	Frequent
Hamerkop	4.0	3	Frequent
Jameson's Firefinch	12.0	4	Common
Laughing Dove	2.0	2	Uncommon
Lemon Dove	3.0	3	Frequent
Little Bee-eater	23.0	4	Common
Little Weaver	2.0	2	Uncommon
Malachite Kingfisher	2.0	2	Uncommon
Northern Black-Flycatcher	1.0	2	Uncommon
Northern Masked Weaver	1.0	2	Uncommon
Southern Masked Weaver	5.0	3	Frequent
Nubian Woodpecker	1.0	2	Uncommon
Pied Kingfisher	1.0	2	Uncommon
Red-chested Cuckoo	1.0	2	Uncommon
Red-eyed Dove	7.0	3	Frequent
Red-winged Starling	5.0	3	Frequent
Rueppell's Robin-Chat	4.0	3	Frequent
Scarlet-chested Sunbird	1.0	2	Uncommon
Silvery-cheeked Hornbill	4.0	3	Frequent
Speckled Mousebird	3.0	3	Frequent
Speckled Pigeon	6.0	3	Frequent
Spectacled Weaver	2.0	2	Uncommon
Tropical Boubou	10.0	3	Frequent
Village Indigobird	2.0	2	Uncommon
White-cheeked Turaco	1.0	2	Uncommon
White-fronted Black Chat	1.0	2	Uncommon
Yellow-billed Egret	5.0	3	Frequent
Yellow-fronted Parrot	16.0	4	Common

Appendix 3. Relative abundance of birds from Entos-Kibran island during the wet season.

Common Name	Number of individuals	Abundance score	Relative abundance
African Darter	6.7	3	Frequent
African Fish-Eagle	13.3	4	Common
Bruce's Green Pigeon	6.7	3	Frequent
African Harrier Hawk	6.7	3	Frequent
African Paradise Flycatcher	53.3	5	Abundant
African Pied Wagtail	13.3	4	Common
Black Crake	100.0	5	Abundant
Black Kite	153.3	5	Abundant
Black-backed Puffback	6.7	3	Frequent
Black-billed Wood-Dove	13.3	4	Common
Common Bulbul	46.7	5	Abundant
Sand-Martin	13.3	4	Common
White-winged Tern	40.0	4	Common
Eastern Grey Plantian-eater	26.7	4	Common
Egyptian Goose	13.3	4	Common
Eurasian Hoopoe	6.7	3	Frequent
Grey-headed Sparrow	33.3	4	Common
Hamerkop	6.7	3	Frequent
Long-tailed Cormorant	306.7	5	Abundant
Malachite Kingfisher	6.7	3	Frequent
Olive Trush	60.0	5	Abundant
Red-eyed Dove	86.7	5	Abundant
Speckled Pigeon	26.7	4	Common

Appendix 4. Relative abundance of birds from Zegie Peninsula during the dry season.

Common Name	Number of individuals	Abundance score	Relative abundance
Abyssinian White-eye	10	3	Frequent
Black-headed Oriole	2	2	Uncommon
African Citril	12	4	Common
African Darter	2	2	Uncommon
African Fish-Eagle	1	2	Uncommon
African Jacana	2	2	Uncommon
African Paradise Flycatcher	21	4	Common
African Pygmy Kingfisher	1	2	Uncommon
Baglafetch Weaver	2	2	Uncommon
Banded Barbet	8	3	Frequent
Brown-throated Wattle-eye	7	3	Frequent
Beautiful Sunbird	9	3	Frequent
Black Cap	7	3	Frequent
Black Kite	1	2	Uncommon
Black-backed Puffback	11	4	Common
Black-headed Batis	2	2	Uncommon
Black-headed Weaver	1	2	Uncommon
Blue-breasted Bee-Eater	2	2	Uncommon
Blue-headed Coucal	4	3	Frequent

Common Name	Number of individuals	Abundance score	Relative abundance
Blue-throated Bee-eater	13	4	Common
Blue-spotted Wood-Dove	2	2	Uncommon
Cattle Egret	2	2	Uncommon
Collard Sunbird	2	2	Uncommon
Common Bulbul	36	4	Common
Grey-backed Camaroptera	18	4	Common
Sand Martin	100	5	Abundant
Common Stonechat	2	2	Uncommon
Double-toothed Barbet	1	2	Uncommon
Eastern-grey Plantian-eater	23	4	Common
Egyptian Goose	2	2	Uncommon
European Turtle-Dove	4	3	Frequent
Fan-tailed Widowbird	5	3	Frequent
Great White Egret	1	2	Uncommon
Greater Blue-eared Glossy- Starling	5	3	Frequent
Grey Woodpecker	7	3	Frequent
Grey-headed Sparrow	10	3	Frequent
Hamerkop	4	3	Frequent
Hemprich's Hornbill	2	2	Uncommon
Black-headed Batis	2	2	Uncommon
Laughing Dove	13.1	4	Common
Lemon Dove	19	4	Common
Little Bee-eater	1	2	Uncommon
Malachite Kingfisher	1	2	Uncommon
Narina's Trogon	4	3	Frequent
Northern Black Flycatcher	4	3	Frequent
Olivaceous Warbler	6	3	Frequent
Olive Thrush	8	3	Frequent
Marsh Warbler	6	3	Frequent
Open-billed Stork	1	2	Uncommon
Osprey	1	2	Uncommon
Red-billed Firefinch	10	3	Frequent
Red-cheeked Cordonbleu	2	2	Uncommon
Red-eyed Dove	17	4	Common
Red-winged Starling	2	2	Uncommon
Ruppell's Robin-Chat	15	4	Common
Scarlet-chested Sunbird	7	3	Frequent
Silvery-cheeked Hornbill	3	3	Frequent
Speckled Mousebird	8	3	Frequent
Speckled Pigeon	13	4	Common
Spectacled Weaver	2	2	Uncommon
Striped Kingfisher	2	2	Uncommon
Tropical Boubou	13	4	Common
Variable Sunbird	5	3	Frequent
Violet-Backed Starling	13	4	Common
White-cheeked Turaco	4	3	Frequent
White-headed Vulture	1	2	Uncommon
Yellow Fronted Parrot	13	4	Common
Yellow-fronted Thinkerbird	6	3	Frequent