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Full Length Research Paper

Species diversity and abundance of Avifauna in and around Hombolo Wetland in Central Tanzania

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This study assessed the species composition, relative abundance and species diversity of avifauna found in wetland and terrestrial habitats in and around Hombolo Lake. Transect walk, point transect and direct observation methods were deployed for birds' survey. Sampling sites were established following the established transect on the terrestrial area and on the edge around the lake, with an interval of 200 m apart. A total of 67 species, 28 families and 12 orders were identified. Family Ploceidae had the highest number of bird species (nine species) followed by Charadriidae (seven species), Ardeidae and Sturnidae (five species) each and Estrildidae, Nectariniidae and Anatidae (three species) each. Species abundance and diversity varied between the two habitats. Terrestrial habitat had the high species abundance and diversity compared to aquatic habitat. Shannon's diversity index indicated that terrestrial habitat had higher species diversity (H'=3.323) than aquatic habitat (H'=1.938). The study shows that habitat destruction due to anthropogenic activities including expansion of settlements, agriculture and livestock grazing were the main threats to the survival of the birds in and around Hombolo Lake.

Key words: Birds, species, diversity, Hombolo, wetland, Tanzania.

INTRODUCTION

Tanzania has been recognized for its diverse avifauna (Leader-Williams and Tibanyenda, 1996; Zimmerman et al., 1999). This reputation arises from the diversity of species found in the country and the number of endemic species that are restricted to Tanzania (Sritharan and Burgess, 2012). Tanzania Birding Hotspots (2013) reported that about 800 bird species are resident, nearly 200 are regular migrants and 56 species are of global conservation concern of which 21 are endemic to Tanzania. Man-made wetlands in Tanzania are in form of hydropower or water supply lakes. The diverse nature of wetland ecosystems parallels the diversity of avifauna. For example, manmade wetlands have been reported to attract different types of bird species from those in natural wetland ecosystems (Ismail et al., 2012). Such ecosystems are diverse in nature warranting the need to understand their influence on the avifauna populations (Sritharan and Burgess, 2012). The creation of an artificial wetland area is viewed as a valuable measure since it can provide a new habitat for bird communities if all other factors are suitable (Oindo et al., 2001; Zedler, 2003). Moreover, the presence of an artificial wetland habitat has been found to complement its natural counterpart by allowing more species to use different habitats in different conditions (Kloskowki et al., 2009; Lameed, 2011). Wetlands are still being degraded in many parts of the world (Schuyt, 2005). There is a need to assess and monitor birds' populations since their

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numbers, distribution and activities reflect the ecosystem's quality and status (Ismail et al., 2012).

Because of the great variety of wetlands, bird adaptation to and use of wetland environments differs greatly from species to species (Dahl and Johnson, 1991). Birds' use of wetlands during breeding cycles ranges widely. Some birds depend on wetlands almost totally for breeding, nesting, feeding, or shelter during their breeding cycles (Saab, 1999).

About one third of North American bird species use wetlands for food, shelter and breeding (Kroodsma, 1979). Wetland-dependent birds need functional access to a wetland or wetland products during their life cycle, especially during the breeding season (Bellrose and Trudeau, 1988; Dahl and Johnson, 1991). For example, Lake Jipe is an important feeding and nesting site for avifauna. About 48 bird species have been recorded at this site (Baker and Baker, 2002). The shoreline attracts large numbers of migrants, flocks of *Charadrius asiaticus, Riparia riparia, Anthus cervinus* and *Motacilla flava* (Baker and Baker, 2002). As with any natural habitat, wetlands are important in supporting species diversity and have a complex of wetland values (Lameed, 2011). The value of the world's wetlands are increasingly receiving due atten-tion as they contribute to a healthy environment in many ways (Dixon and Wood, 2003).

Wetlands may be seen as natural ecological islands of freshwater habitats surrounded by terrestrial habitats. Wetlands provide food for birds in the form of plants, vertebrates, and invertebrates (Jaikrishna, 2008; Lameed, 2011). Some feeders forage for food in the wetland soils, some find food in the water column, and some feed on the vertebrates and invertebrates that live on submersed and emergent plants. Vegetarian birds eat the fruits, tubers, and leaves of wetland plants (Stewart, 2007). Wetlands are also important as resting sites for migratory birds (Jannert, 2003). Wetlands are among the most productive and fragile ecosystems which deserve special attention due to their biodiversity richness (Barbier et al., 1997; Tiner, 1999; UNEP-MAP RAC/SPA, 2010). Hombolo Lake is among the wetlands which are potential as birds' habitats in Central Tanzania. As an artificial wetland within a generally dry semi-arid landscape, Hombolo Lake may be a repository of different bird species com-pared to natural wetlands. Furthermore, there has been a tremen-dous destruction of avifauna habitats due to increase in human populations around the Lake. This threatens the life of aquatic organisms and seriously affects avifauna which depends on this wetland associated habitat for survival.

Wetlands are very important for avifauna conservation and birds' life can be degraded due to various human activities impacting on wetland ecosystems (Dugan, 1990; Stewart, 2007). Many food resources in wetlands are seasonal and many species, including birds, have sea-sonal fluctuations links to the abundance of these resour-ces (Lameed, 2011) their species richness and diversity. Bird species diversity is therefore a good measure of the value of wetland ecosystems (Dugan, 1990). Bird species diversity and richness are directly correlated with habitat diversity of both biological and structural features (Allen et al., 1999; Sritharan and Burgess, 2012). The greater the variety of habitats regardless of the cause, the more likely is that additional bird species can find suitable habitat (Weller, 1999). The purpose of this paper is to present bird species composition, abundance and species diversity in and around Hombolo Lake in Central Tanzania.

MATERIALS AND METHODS

Description of the study area

This study was carried out in and around Hombolo Lake (Figure 1) which is situated in Dodoma rural district (latitude 05°57′00.0416″S and longitude 35°58′09.0876″E and surface area 15.4 km^2). The Hombolo Lake was constructed in 1957 for irrigation, domestic water supply and to provide water for livestock as well as controlling floods and reduction of problem of water shortage for the people living in Hombolo village, considering that Dodoma is a semi-arid region where the problem of water is significant (Sandstrom, 1995; Mpuli, 2009). The Lake is a water storage basin, with an annual fluctuating water level depending on season. It has a capacity of 32 million m^3 and depth 7 m (Mpuli, 2009).

Climate

Dodoma region receives an average annual rainfall of 550 mm. Rainfall is a unimodal falling mostly from November to April and there is virtually no rainfall from May to October (Sandstrom, 1995). The monthly maximum and minimum temperatures are about 26 and 21°C respectively. The minimum temperature occurs around July while the maximum temperature occurs around February and it starts to rise in August while it gets to its peak in February (Sandstrom, 1995; Rwebugisa, 2008). Hombolo basin is located in the fractured crystalline basement area of Dodoma Region (Nkotagu, 1996).

Field data collection

Data were collected using three methods: transect walk, point transects and direct observations. The most of surveys on the wetland's avifauna were conducted between March and April 2010 using a transect line approach (Bibby et al., 1992) to extensively survey throughout the wetland area so as to assess the avifauna species and abundance. Line Transect method proved most efficient in terms of data collection per unit effort (Yallop et al., 2003). A total of twenty transects were established along the various terrains available within the wetland. Each transect had a total length of 400 m, with 100 m of sub-transects. For each transect, an observer recorded any bird species and numbers in the area with the aid of binoculars. Sampling sites followed the established transect on the terrestrial area and on the edge around the lake, with an interval of 200 m apart. A total of 34 observation sites were established with an interval of 200 m apart. For water birds, observation sites were established at the edge of the lake at an interval of 200 meter from one site to another, whereby twenty three sites were established. In each site, birds' observations were carried out twice daily; morning between 0630 to 1000 h and evening, between 1600 and 1800 h by walking slowly along transects. Birds were counted as bird seen and heard and birds in flight were also recorded.

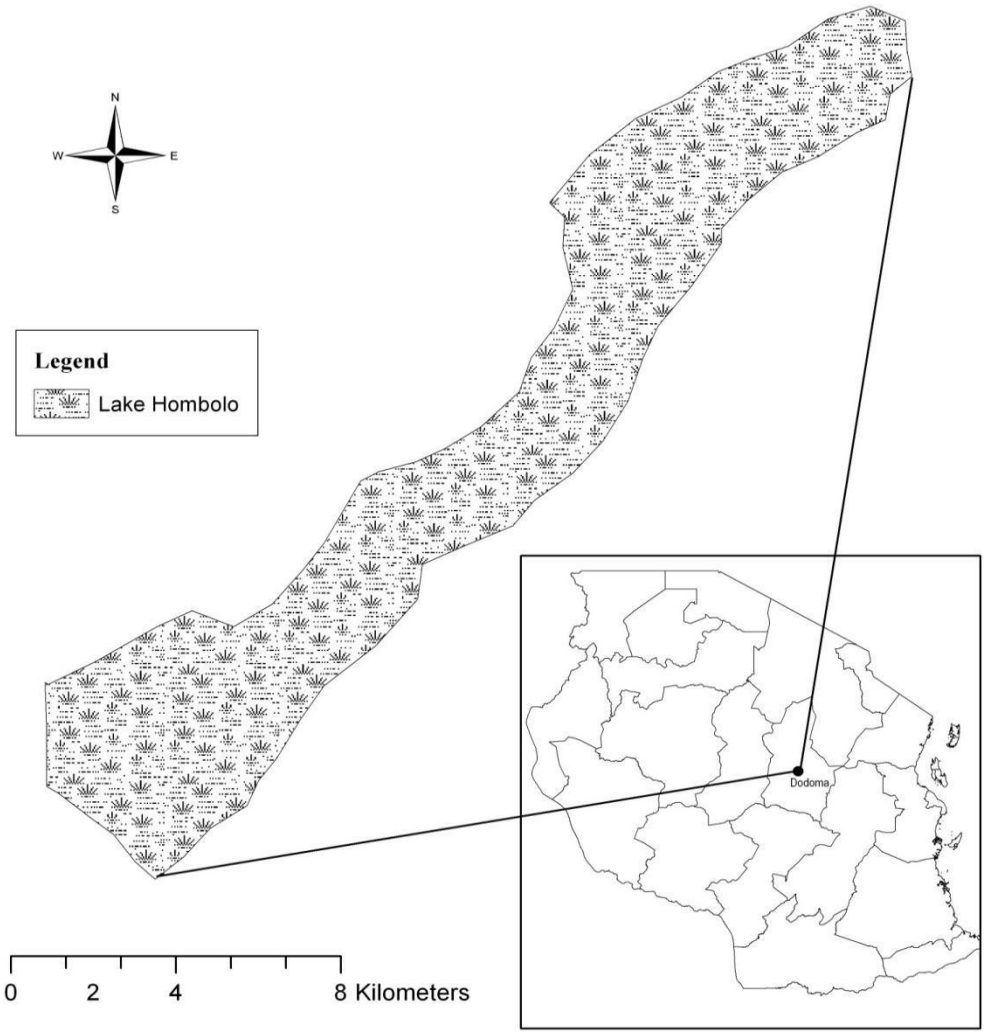

Figure 1. Map showing location of Hombolo Lake in Dodoma, Tanzania.

Data analysis

The relative abundance of a species was obtained by dividing the abundance of a species by the total abundance of all species combined based on the assumption that the frequently seen the species the more abundant it is (Bibby et al., 2000). Birds' diversity was calculated using both Shannon-Weiner and Simpson's diversity indices. Shannon-Weiner diversity Index 'H' was calculated using the formula:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

Where, *Pi* = Proportion of individual species and *R* = total number of species of the community (number seen and heard).

Simpson's diversity Index 'D' was calculated using the formula:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where , n_i = the total number of birds of each individual species and N = the total number of birds of all species. The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

Sørensen similarity index was used to compare the similarity of bird species between terrestrial and aquatic habitats. It measures similarity in species composition (Magurran, 2004) for two sites, A and B, by the Equation:

$$C_S = \frac{2ab}{a+b}$$

Where, *a* is the number of species found in site A; *b* is the number of species in site B and *ab* is the number of species shared by the two sites.

RESULTS AND DISCUSSION

Bird species composition and relative frequency

A total of 637 individuals were observed and recorded in

and around Hombolo Lake (Tables 1 and 2). Family Ploceidae had the highest number of bird species (nine species) followed by Charadriidae (seven species), Ardeidae and Sturnidae (five species) each and Estrildidae, Nectariniidae and Anatidae (three species) each. Family Accipitridae, Coliidae, Emberizidae, Scopidae, Malaconotidae and Meropidae had only one species each. There was greater variation in species composition between terrestrial and aquatic habitats. Terrestrial habitat contributed much in terms of species composition (67%) than aquatic habitat (33%). We observed that ter-restrial habitat had higher number of birds (383 indivi-duals, 61%) than water birds (254 individuals, 39%). However, in overall abundance, Yellow-vented bulbul (*Pycnonotus goiavier*) had the highest relative frequency (8.22%) followed by Yellow-billed egret (*Egretta intermedia*) 6.85%, Little bee-eater (*Merops pusillus*) 4.79%, Speckled Mousebird (*Colius striatus*) and Red-cheeked cordon bleu (*Uraeginthus bengalus*) 3.42% and other 62 species of birds had the lowest relative fre-quency of less that 3%. Higher relative frequency of birds could be contributed by high frequency of occurrences to some of the birds in different sites.

Sixty six (66) individuals of *P. goiavier* were recorded in 12 different sites and its abundance was higher (21.19%) than *E. intermedia* (135 individuals) which occurred in 10 different sites and had abundance of 10.36%. It was observed that Hombolo wetland has attracted many bird species from local to migratory birds to roost, forage and nest in the area. The most of birds observed during this study were resident and migratory species. Lameed (2011) reported that the species that are winter migrants use wetlands for rest and other activities while waiting for the favorable condition of their home range. They invol-ved in activities that afford them opportunity to store enough fats for the journey back to Europe (Lameed, 2011).

Also, higher number of birds in terrestrial habitat may be attributed to the terrestrial habitat having greater resources such as food and nesting sites and a resulting ability to support more birds (Remsen and Parker, 1983; Walwert et al., 2004). It was observed that certain grass species produced seeds which attracted grain-eating birds for example *Quelea quelea* and *Bishops* spp. to inha-biting the area. Trees such as *Ficus spp*., *Psidium guava*, *Azadrachita indica*, *Syzigium spp*, produced fruits, which were preferred food for some birds such as *P. goiavier*, African Paradise flycatcher (*Terpsiphone viridis*) and Speckled Mousebird (*Colius striatus*). Petersen and Westmark (2013) reported that bird species richness and diversity within wetlands were positively correlated with percent cover of trees. Welsh (1987) pointed out that bird abundance and varieties rise with increase in food availability. The higher abundance of birds in terrestrial habitat could also be due to the composition of the vegetation that forms the main element of their habitat (Lee and Rotenberry, 2005; Chapman and Reich, 2007; Salah and Idris, 2013). The lower number of water birds could be attributed to the destruction of the wetland habitats, due to overgrazing, and cultivation. The riverine vegetations near the lake were observed to be heavily overgrazed by cattle which use the areas around the lake as feeding areas and vegetation cleared due to cultiva-tion thus interfering with the area which could be used for nesting, feeding, and breeding sites for wetland birds. A study conducted in Niger by Brouwer et al. (2003) revea-led that the most important threat for White storks (*Ciconia ciconia*) was the degradation of wetlands which were ideal habitats for roosting and thermoregulation. The reduction of bird population may have been contri-buted by degradation of wetlands and the loss of suitable upland habitats that surround wetlands making no value to wetland dependent birds (Bellrose and Trudeau, 1988).

We hypothesized that there was no difference between the terrestrial and wetland habitats in terms of bird spe-cies diversity. However, although there was a difference in numbers of bird species between the terrestrial and wetland habitats when making comparison, the Sorensen's Similarity index was 39% suggesting that both terrestrial and aquatic habitats are different in terms of birds' spe-cies composition. The little observed deviation in species composition could be mainly due to disturbance on wet-land areas (livestock grazing and cultivation around the lake) and seasonal change; the flooded wetland does not favor other species of water birds, which their feeds depend mostly on shallow water.

Bird species diversity

A total 67 species were recorded during the study period comprising of 45 and 22 species of terrestrial birds and water birds respectively. Species richness of different feeding guilds might respond differently to changes in vegetation structure and complexity across tropical ecosystems (Waltert et al., 2005). Shannon's diversity index indicate that terrestrial habitat had higher species diversity (H' = 3.323) than aquatic habitat (H' = 1.938). The overall birds' diversity for both terrestrial and aquatic was 3.447 (Table 3). On the other hand, the Simpson's diversity index for terrestrial birds and water birds were 0.947 and 0.700 respectively. However, the overall Simpson's diversity index for the two habitats was 0.933. This indicates greater variation in species diversity bet-ween the results obtained by using Shannon's and Simpson's diversity indices. This is because Simpson's diversity index takes into consideration relative abun-dance which is not the case for Shannon's diversity index. The higher diversity in terrestrial habitat may be due to high numbers of individuals in some of bird species (15 species had above 10 individuals) compared to water bird species (only 2 species which had indivi-duals above 10 individuals) and diverse vegetation types as microhabitats which favored varieties of bird species.

Vegetation cover has been reported to have a strong

Table 1. Checklist of terrestrial bird species around Hombolo Lake

Order	Family	Scientific name	Common name	Relative frequency (%)	Relative abundance (%)
Apodiformes	Apodidae	*Apus affinis*	Little swift	0.97	1.57
Coliiformes	Coliidae	*Colius striatus*	Speckled Mousebird	4.85	4.96
Columbiformes	Columbidae	*Streptopelia capicola*	Ring-necked Dove	3.88	1.57
Columbiformes	Columbidae	*Treron calvus*	Green pigeon	0.97	0.26
Coraciiformes	Coraciidae	*Coracias caudate*	Lilac breasted roller	2.91	1.57
Coraciiformes	Meropidae	*Merops pusillus*	Little Bee-eater	6.80	4.18
Cuculiformes	Cuculidae	*Centropus superciliosus*	White-browed Coucal	0.97	0.26
Cuculiformes	Cuculidae	*Chrysococcyx caprius*	Didric Cuckoo	0.97	0.26
Falconiformes	Accipitridae	*Milvus migrans*	Black Kite	0.97	0.26
Galliformes	Phasianidae	*Francolinus jacksoni*	Jackson's Francolin	2.91	4.18
Passeriformes	Alaudidae	*Eremopterix leucopareia*	Fischer's sparrow lark	1.94	5.74
Passeriformes	Alaudidae	*Mirafra poecilostern*	Pink-breasted lark	0.97	0.26
Passeriformes	Emberizidae	*Serinus xanthopygius*	Yellow-rumped Seedeater	0.97	1.31
Passeriformes	Estrildidae	*Lonchura Cucullata*	Bronze Mannikn	0.97	0.26
Passeriformes	Estrildidae	*Uraeginthus bengalus*	Red-cheeked cordon-bleu	4.85	4.18
Passeriformes	Estrildidae	*Uraeginthus cyanocephalus*	Blue-capped Cordon-bleu	3.88	1.57
Passeriformes	Fringillidae	*Lagonosticta rubricate*	African fireFinch	1.94	2.87
Passeriformes	Fringillidae	*Lagonosticta senegala*	Red-billed fireFinch	2.91	3.92
Passeriformes	Hirundinidae	*Hirundo griseopyga*	Grey-rumped swallow	0.97	0.52
Passeriformes	Hirundinidae	*Hirundo smithii*	Wire tailed swallow	0.97	0.52
Passeriformes	Laniidae	*Lanius collaris*	Fiscal shrike	1.94	0.78
Passeriformes	Liniidae	*Lanius Cabanisi*	Long-tailed Fiscal	0.97	0.26
Passeriformes	Malaconotidae	*Laniarius Ferrugineus*	Tropical boubou	0.97	0.52
Passeriformes	Muscicapidae	*Trepsiphone viridis*	African Paradise Flycatcher	3.88	3.92
Passeriformes	Nectariniidae	*Cinnyris pulchellus*	Beautiful Sunbird	0.97	1.83
Passeriformes	Nectariniidae	*Nectarinia hunteri*	Hunter's Sunbird	1.94	1.57
Passeriformes	Nectariniidae	*Nectarinia tacazze*	Tacazze Sunbird	3.88	3.13
Passeriformes	Ploceidae	*Anamalospiza imberbis*	Parasitic weaver	1.94	1.57
Passeriformes	Ploceidae	*Euplectes orix*	Red bishop	2.91	2.09
Passeriformes	Ploceidae	*Passer griseus*	Grey -headed Sparrow	2.91	3.66
Passeriformes	Ploceidae	*Ploceus capitalis*	Yellow-backed Weaver	0.97	1.31
Passeriformes	Ploceidae	*Ploceus cucullatus*	Black-headed Weaver	0.97	0.78
Passeriformes	Ploceidae	*Ploceus subaureus*	Golden Weaver	2.91	3.13
Passeriformes	Ploceidae	*Ploceus xanthops*	Holub'sgolden weaver	0.97	1.31
Passeriformes	Ploceidae	*Quelea quelea*	Red- billed quelea	1.94	3.66
Passeriformes	Ploceidae	*Steganura paradisaea*	Pin-tailed whydah	0.97	0.26
Passeriformes	Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented bulbul	11.65	17.23
Passeriformes	Sturnidae	*Cinnyricinclu leucogaster*	Violate backed starling	0.97	0.52
Passeriformes	Sturnidae	*Creatophora cinerea*	Wattled starling	0.97	1.31
Passeriformes	Sturnidae	*Lamprotornis purpuroptera*	Ruppells' Glossy-Starling	1.94	2.61
Passeriformes	Sturnidae	*Lamprotornis spendidus*	Splendid glossy starling	0.97	1.04
Passeriformes	Sturnidae	*Lamprotornis superbus*	Superb starling	0.97	3.13
Passeriformes	Sylviidae	*Acrocephalus rufescens*	Greater swamp warbler	0.97	0.52
Passeriformes	Sylviidae	*Cichladusa guttata*	Spotted Morning warbler	0.97	0.78
Psittaciformes	Psittacidae	*Agapornis personata*	Yellow-collared Lovebird	2.91	2.87

influence on avifauna diversity (Scott Mills et al., 1989; Radford et al., 2005); it was expected that the bird diversity in and around Hombolo Lake would vary following the habitat difference. Overall, the findings of the present study support this prediction. Vegetation variety is among the factor which bird diversity in tropical Africa depends

Table 2. Checklist of water bird species in Hombolo Lake

Order	Family	Scientific name	Common name	Relative frequency (%)	Relative abundance (%)
Anseriformes	Anatidae	*Alopochen aegyptiaca*	Egyptian Goose	2.33	1.18
Anseriformes	Anatidae	*Sarkidiornis melanotos*	Knob-billed Duck	2.33	3.15
Anseriformes	Anatidae	*Dendrocygna viduata*	White-faced Whistling Duck	2.33	0.79
Charadriiformes	Charadriidae	*Vanellus crassirostris*	Long-toed lapwing	2.33	3.94
Charadriiformes	Charadriidae	*Charadrius tricollaris*	Three-banded Plover	2.33	0.79
Charadriiformes	Charadriidae	*Vanellus melanopterus*	Black-winged Plover	2.33	5.91
Charadriiformes	Charadriidae	*Himantopus himantopus*	Black-winged Stilt	2.33	1.57
Charadriiformes	Charadriidae	*Vanellus armatus*	Black smith Plover	2.33	0.79
Charadriiformes	Charadriidae	*Vanellus coronatus*	Crowned Plover	2.33	1.97
Charadriiformes	Charadriidae	*Charadrius pecuarius*	Kittlitz's Plover	2.33	3.54
Ciconiiformes	Ardeidae	*Mesophoyx intermedia*	Yellow-billed Egret	4.65	3.15
Ciconiiformes	Ardeidae	*Egretta garzetta*	Little Egret	4.65	0.79
Ciconiiformes	Ardeidae	*Ardeola ralloides*	Squacco Heron	2.33	0.39
Ciconiiformes	Ardeidae	*Bubulcus ibis*	Cattle Egret	6.98	9.84
Ciconiiformes	Ardeidae	*Egretta alba*	Great White Heron	23.26	53.15
Ciconiiformes	Scopidae	*Scopus umbretta*	Hammerkop	4.65	1.18
Coraciiformes	Alcedinidae	*Alcedo cristata*	Malachite Kingfisher	9.30	1.57
Coraciiformes	Alcedinidae	*Ispidina picta*	Pygmy Kingfisher	2.33	0.39
Coraciiformes	Alcedinidae	*Ceyx erithaca*	Dwarf Kingfisher	2.33	0.39
Coraciiformes	Alcedinidae	*Halcyon senegalensis*	Woodland kingfisher	6.98	1.57
Coraciiformes	Alcedinidae	*Ceryle rudis*	Pied Kingfisher	4.65	0.79
Passeriformes	Motacillidae	*Motacilla aguimp*	African Pied Wagtail	4.65	3.15

Table 3. Bird species composition, richness and diversity.

Parameter	Terrestrial bird	Water bird	Both terrestrial and water bird
Number of individuals	383	254	637
Species richness	45	22	67
Number of families	22	6	28
Proportional by habitat (%)	67	33	100
Shannon's diversity index	3.3	1.9	3.447
Simpson's diversity index	0.947	0.7	0.933

on (Wilson, 1986). Also, the high diversity in terrestrial habitat could be due to high number of few bird species such as *P. goiavier* which accounted for 10% of all individual birds. However, overall, Yellow-billed Egret (*M. intermedia*) had the highest species diversity (H'= 0.329) followed by *P. goiavier* (H'=0.235), Little Egret (*E. garzetta*), (H'=0.127), Fischer's Sparrow Lark (*E. leucopareia*) (H'=0.116) and the Black kite (*M. migrans*), White-browed Coucal (*Centropus superciliosus*), Pink-breasted Lark (*Mirafra poecilosterna*), Green Pigeon (*Treron calvus*), Pin-tailed Whydah (*Vidua macroura*), Didric cuckoo (*Chrysococcyx caprius*), Long-tailed Fiscal (*Lanius cabanisi*), Kittlity's Plover (*Charadrius pecuarius*), Woodland Kingfisher (*Halcyon senegalensis*), Great White Heron (*Ardea alba*) and Pied Kingfisher (*Ceryle rudis*) had the lowest species diversity (*H'*= 0.01).

It was observed that livestock grazing and fishing were the main illegal activities in and around the Hombolo wetland and this might be of detrimental effect to bird species diversity in the long term. The lower number of bird species in the wetland could be due to the flooding of the lake since birds were found only on patches of shallow water where birds were able to get forage. This situation limited some of the bird species which were unable to forage in deep water. Bird species shift their feeding habit between seasons (Ward, 1969). Also, the presence of high number of bird species in terrestrial habitats could be due to the presence of varieties of microhabitats which provide niche for different species of birds. The area had different patches of habitats ranging from grasslands, shrublands, and wooded shrublands and riverine vegetation, thus providing multiple and

Table 4. Birds' species dominance (both terrestrial and water birds).

Order	Family	Scientific name	Common name	Relative abundance (%)
Ciconiiformes	Ardeidae	*Egretta intermedia*	Yellow-billed egret	21.19
Passeriformes	Pycnonotidae	*Pyconotus goiavier*	Yellow- vented bulbul	10.36
Ciconiiformes	Ardeidae	*Egretta garzetta*	Little egret	3.92
Passeriformes	Alaudidae	*Eremopterix leucopareia*	Fischer's sparrow Lark	3.45
Coliiformes	Coliidae	*Colius striatus*	Speckled mouse bird	2.98
Coraciiformes	Meropidae	*Merops pusillus*	Little bee-eater	2.51
Passeriformes	Estrildidae	*Uraeginthus bengalus*	Red- cheeked cordon bleu	2.51
Galliformes	Phasianidae	*Francolinus Jacksoni*	Jackson's Francolin	2.51
Passeriformes	Muscicapidae	*Trepsiphoneviridis*	Paradise Flycatcher	2.35
Passeriformes	Fringillidae	*Lagonosticta senegala*	Red- billed fire Finch	2.35

Table 5. Water birds' species dominance in terms of relative abundance.

Order	Family	Scientific name	Common name	Relative abundance (%)
Ciconiiformes	Ardeidae	*Egretta alba*	Great White Heron	53.15
Ciconiiformes	Ardeidae	*Bubulcus ibis*	Cattle Egret	9.84
Charadriiformes	Charadriidae	*Vanellus melanopterus*	Black-winged Plover	5.91
Charadriiformes	Charadriidae	*Vanellus crassirostris*	Long-toed lapwing	3.94
Charadriiformes	Charadriidae	*Charadrius pecuarius*	Kittlitz's Plover	3.54
Passeriformes	Motacillidae	*Motacilla aguimp*	African Pied Wagtail	3.15
Ciconiiformes	Ardeidae	*Mesophoyx intermedia*	Yellow-billed Egret	3.15
Anseriformes	Anatidae	*Sarkidiornis melanotos*	Knob-billed Duck	3.15
Charadriiformes	Charadriidae	*Vanellus coronatus*	Crowned Plover	1.97
Coraciiformes	Alcedinidae	*Alcedo cristata*	Malachite Kingfisher	1.57

varieties of alternative food and roost for birds.

Bird species dominance

Dominance results when one or several species control the environment and conditions that influence associated species. A total of 67 species were observed and recorded in and around Hombolo Lake covering both, terrestrial and water habitats. The results indicate that overall 10 bird species dominated the area in terms of relative abundance (Table 4). It was revealed that Yellow-billed egret (*E. intermedia*) was the most dominant (21.19%) followed by Yellow-vented bulbul (*P. goiavier*) (10.36%), Little egret (*Egretta garzetta)* (3.92%), Fischer's sparrow Lark (*Eremopterix leucopareia*) (3.45%) while the remaining species of bird had less that 3%. In the wetland habitat, 8 species of bird were recorded to dominate the area (Table 5). The most dominant was Great White Heron (*Egretta alba,* 53.15%), followed by Cattle Egret (*Bubulcus ibis,* 9.84%), Black-winged Plover (*Vanellus melanopterus*, 5.91%) and Long-toed lapwing (*Vanellus crassirostris*, 3.94%).

About ten different bird species were found to dominate the terrestrial habitat in terms of relative abundance (Table 6). Yellow-vented bulbul (*P. goiavier*) was the most dominant bird species (17.23%), followed by Fischer's sparrow Lark (*E. leucopareia,* 5.74%), Speckled Mousebird (*C. striatus,* 4.96%), Little Bee-eater (*M. pusillus),* Jackson's Francolin (*Francolinus jacksoni*) and Red-cheeked cordon-bleu (*U. bengalus*) had 4.18%.

The dominance of these species could be contributed by high encounter rates and the presence favorable habitats around Hombolo Lake. The availability of food makes some birds with a feeding guild of a highly abundant food to dominate the area (Welsh, 1987).

Birds activities in and around Hombolo Lake

Birds were observed to use the Hombolo Lake for various activities. In terrestrial habitats (areas adjacent to the lake), about 154 birds (40%) were observed feeding on fruits mainly *Ficus spp., Psidium guarjava*, *Azadrachita indica* and *Syzigium spp.* About 203 terrestrial birds (53%) were spotted resting in *Acacia* spp and *Eucalyptus* trees. A total of 15 birds (3%) were observed making nests on the Acacia trees, reeds and on shrubs. In water habi-tat, 172 individuals (68%) were observed feeding in the water, catching invertebrates and fish and 88 individuals (35%) resting on the riverine vegetation such as reeds. This indicates that Hombolo Lake is among the wetlands

Table 6. Terrestrial birds' species dominance in terms of relative abundance.

Order	Family	Scientific name	Common name	Relative abundance (%)
Passeriformes	Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented bulbul	17.23
Passeriformes	Alaudidae	*Eremopterix leucopareia*	Fischer's sparrow lark	5.74
Coliiformes	Coliidae	*Colius striatus*	Speckled Mousebird	4.96
Coraciiformes	Meropidae	*Merops pusillus*	Little Bee-eater	4.18
Galliformes	Phasianidae	*Francolinus jacksoni*	Jackson's Francolin	4.18
Passeriformes	Estrildidae	*Uraeginthus bengalus*	Red-cheeked cordon-bleu	4.18
Passeriformes	Fringillidae	*Lagonosticta senegala*	Red-billed fireFinch	3.92
Passeriformes	Muscicapidae	*Trepsiphone viridis*	African Paradise Flycatcher	3.92
Passeriformes	Ploceidae	*Passer griseus*	Grey -headed Sparrow	3.66
Passeriformes	Ploceidae	*Quelea quelea*	Red- billed quelea	3.66

potential for the life of birds. However, it was observed that singing as a behavior to attract the mate (breeding) was the least activity done by birds during surveys and this could be that wet season was not the breeding time.

Conclusion

The study concluded that Hombolo wetland is very important to the bird communities. Family Ploceidae had the highest number of bird species followed by Charadriidae. Family Accipitridae, Coliidae, Emberizidae, Scopidae, Malaconotidae and Meropidae had only one species each. There was greater variation in species composition between terrestrial and aquatic habitats. Terrestrial habitat contributed much in terms of species composition than aquatic habitat. *P. goiavier* had the highest abundance in terms of frequency followed by *M. intermedia*. Higher relative abundance of birds could be contributed by high frequency of occurrences to some of the birds in different sites. *P. goiavier* accounted for 10% of all birds. *M. intermedia* had the highest species diversity followed by *P. goiavier* and *E. garzetta*. The wetland could have more bird spe-cies if intentional measures are taken to manage the area from anthropogenic activities that threaten the life of avifauna. Habitat destruction could have a net negative effect on the population of wetland birds. Thus, if the amount and quality of wetland habitat is substantially reduced, populations of wetland-dependent birds in the area also can be expected to decrease. Further studies to cover dry-season and nocturnal birds to generate a comprehensive list of bird species diversity in and around Hombolo Lake are vital. Land use planning that both protects the wetland and emphasizes bird-friendly landscape design around Hombolo Lake may enhance avian diversity and abundance within the area.

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