International Journal of Ecology and Environmental Sciences 45 (1): 97-106, 2019
ISSN: 2320-5199 (Online)

Species Diversity, Relative Abundance and Distribution of Birds in and Around Lake Hayq Estifanos, South Wollo, Ethiopia

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ABSTRACT

The diversity, relative abundance and distribution of the avian species in and around Lake Hyqe Estifanos were investigated from July 2016 to August 2017 during the wet and dry seasons. The study area was categorized as plantation habitat, modified habitat and water body based on vegetation and habitat type. Data were collected using point transect technique and analyzed using diversity index. Ch-square test was also used to compare species among habitats. A total of 62 species of birds belonging to 12 orders and 29 families were recorded during both dry and wet seasons in the study area. The seasonal variation in abundance of individuals of bird species was significantly different (χ^2= 512.2, df = 1, P < 0.05). During the wet season higher diversity of bird species was observed in the plantation habitat (H = 3.7) but the diversity in the modified habitat (H = 3.4) and water body (H = 2.0) was lower during the same season. During the dry season higher diversity of bird species was observed in the plantation habitat (H = 3.5) but the diversity in the modified habitat (H'= 2.6) and water body (H = 2.1) was lower during the same season. Simpson similarity index (SI) showed 0.76 of bird species among two terrestrial habitats (plantation and modified habitat), but lower similarity (0.09) among the three habitats (plantation, modified habitat and water body). The highest Richness was registered in the plantation habitat (RI = 11.78) and modified habitat (RI = 9.57), but lower in water habitat (RI = 3.65) during the wet season and higher distribution in the plantation habitat (RI = 9.77) and modified habitat (RI = 7.25) and lower in water habitat (RI = 3.64) during the dry season. Livestock grazing, expansion of farmland and settlement contributed to the deterioration in the diversity and abundance of bird species in the area. Thus, serious action is needed to conserve the biological diversity of Lake Hyqe Estifanos.

Key Words: Bird Diversity; Distribution; Habitat Destruction; Lake Hyqe Estifanos; Relative Abundance.

INTRODUCTION

Birds are among the most easily defined and readily recognized categories of endothermic vertebrates, due to the presence of feather, which is unique to them. In addition, the development of forelimbs as wings, mostly for flight; feathered tail that serves for balancing, steering and lifting; toothless horny beak , skeleton , the laying of hard-shelled eggs, a high metabolic rate and a four-chambered hearts showing distinctive adaptations, mainly for flight and bipedal locomotion are physical appearance of birds (Padian and Chiappe 1998). Birds populations used as pointers of overall healthy biodiversity and environmental failure or recovery (Schrag et al. 2009). Any natural or anthropogenic disturbance fluctuating the natural forest and distribution of animal communities may extremely affect regional as well as global biodiversity. Among the different reasons, expansion of agricultural activity, pollution, overgrazing, deforestation and disturbance of breeding habitat are some of them (Aerts et al. 2008). The influence of seasonality fluctuates among the subset of the avian fauna.

Birds are habitat specific and some can occupy more than one habitat type; however because of land

uses changes, most of the birds have been displaced from their original habitats. Environmental heterogeneity in the form of spatial variation in habitat and local climate can affect species distributions. The abundance and distribution of animals are also affected by scale-dependent hierarchical processes that disturb the links between habitat suitability and their numbers (Veech and Crist 2007).

The faunal diversity of Ethiopia is very high. There are 926 bird species are found of these, 21 are endemic and 19 are globally threatened (Avibase 2005). Based on distribution and abundance of bird species Nationally, Ethiopian IBA areas have been grouped into three conservation groups. They are critical (19), urgent (23) and high (31) (Mengistu 2003). In and around Lake Hayq Estifanos is the subject of the present study, is one of such places of conservation concern of the country with very little biological information. It is located in Tehulederi Woreda SouthWollo and the area vegetation cover has been declining due to the development of human and livestock population, expansion of agriculture settlement and pollution. This habitat loss is likely to strictly affect the avifauna and other wild animals live in the area. There are no previous studies on species diversity, relative abundance and distribution of bird in the study area. Therefore, the present study focuses on diversity, distribution and relative abundance of avifauna in and around Lake Hayq Estifanos. The information on the avifauna will help reaching sound decision on matters pertaining to avain conservation of the study area.

STUDY AREA

The study was conducted in and around Lake Hayq, which is located in Northern part of Ethiopia, Amhara Regional State, South Wollo Administrative Zone, and geographically it lies between 11^0 3' to 11^0 18' N latitude and 39^0 41' to 39^0 68' E longitude with an altitude of 2,030 m above sea level (Figure 1) . It is a Crater Lake with surface area, maximum depth and mean depth of 23.2 km^2, 88 m and 37.4 m, respectively and 6.7 km long and 6 km wide (Betel 2010). There is also one big monastery (Hayq Estifanos) which serves as a holly site for Orthodox Christian pilgrims. Moreover, it is one of the tourist sites for eastern part of Amhara Regional State. The total study area is 32 km^2 (Lake and terrestrial part). A small town called Hayq is located at the southern part of the Lake.

The mean annual temperature is 25.9 ^{0}C and rainfall distribution is a bimodal rainfall pattern with a long rainy season between June and September and average annual rainfall of 1211.4 mm (Betel 2010).

There are diverse faunal species of amphibians, reptiles, fishes, birds and small mammals. Plant species like *Juniperus procera* Hochst., *Podocarpus falcatus* Thunb., *Eucalyptus globulus* Labill., *Croton macro-stachyus* Hochst. ex Del., *Ficus vasta* Forssk., *Cordia africana* Lamarck, *Olea africana* Mill, and bamboo. The original forest vegetation consisted of *Olea europaea* subsp.-*cuspidata* Wallich and Don, *Hagenia abyssinica* Willd., *Hypericum revolutum* Vahl, *Acacia abyssinica* Hochst., *Rosa abyssinica* Brown and *Erythrina brucei* Schweinf. .(Tadesse et al. 2013).

METHODS

Water part of the area and terrestrial part of the area classified by using stratified random sampling technique in order to apply point count and line transect methods. In each point count station, a minimum distance of 150–200 m was maintained using GPS to avoid double counting. To minimize disturbance during the count, a waiting period of 3 to 5 minutes prior to counting was applied (Hosteler 2006). Where point count technique was employed, the radial distance from which birds occurred were estimated and the type and group number of the species were observed. Bird species were identified by using their feather shape and colors, beak, eye colors, legs and body size (Wenny et al. 2011). Based on the vegetation structure, the study area was categorized into three habitats. These are plantation habitat, farmland and water body. Point count method was employed for plantation habitat and a line transect method was applied for water bodies and farmland, because the crops are planted along the line making accessibility and easier identification. For this habitat four lines transect for farmland and water part of the study area and two point count method for plantation habitat was used.

Data were collected in December and January for dry season and July and August 2017 wet seasons. Birds were counted with in 10 sampling points and line transects. The same points and line transects were used during both dry and wet seasons in the morning and afternoon. Upon reaching a point and line, 2 to 5 minutes were provided for the birds to settle in case of any disturbances. One 1-km long and 200 m wide transect

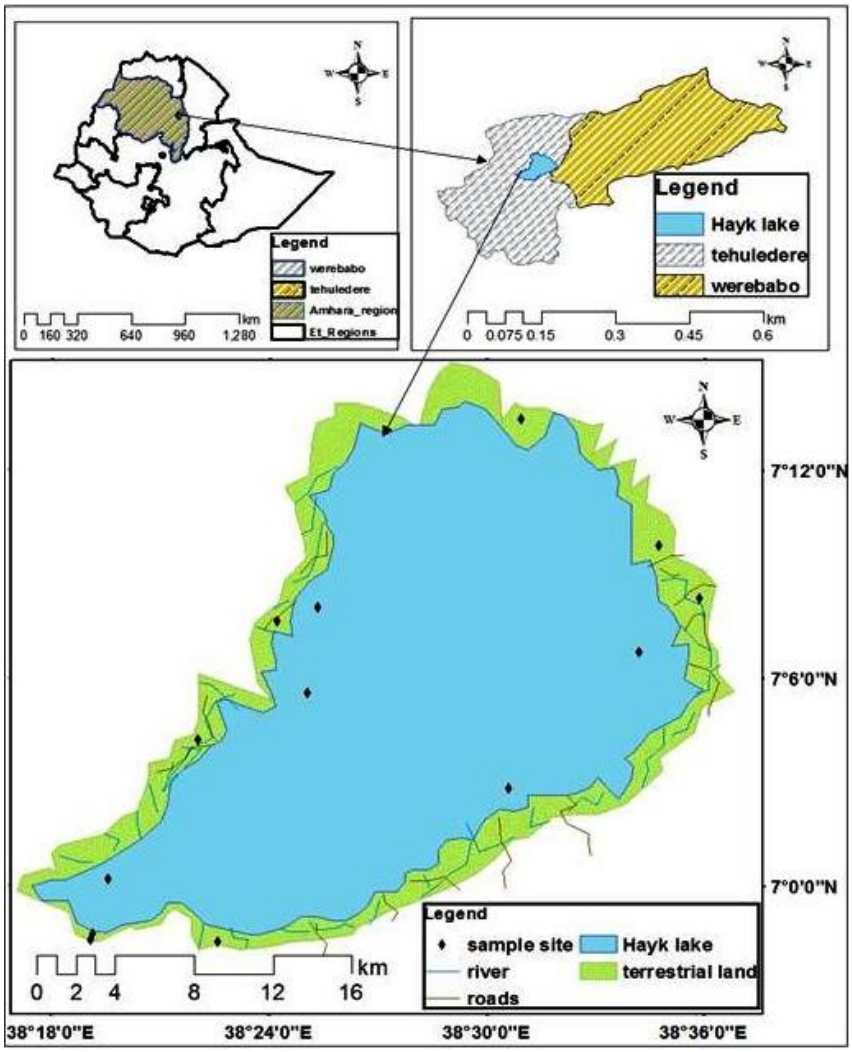

Figure1. Map of the study area and sample site

was laid in each habitat on either side and weekly bird surveys were made for each study. Transect lines were 250–300 m apart from each other to avoid double counting (Hostler and Martin 2006). Point count method were undertaken from a fixed location within the sample unit of radius 20 m with a fixed time interval of 10 minutes was used to count and record all birds observed (Robinson et al. 2000).

The survey was carried out in the absence of rain or heavy fog from 6:30 to 10:00 a.m. in the morning and from 4:30 to 6:00 p.m. in the afternoon. According to Bibby et al. (2000), this census period is appropriate because bird's activities tend to be high at this time. Any factors that disturb the survival of avian species were record through observation. The perpendicular distance from which the bird occurred to the point count was estimated and then the type and the group number of species were recorded using direct observation by using field guide book.

Data Analysis

Data collected during the study period were analyzed using SPSS (version 17.0) statistical program. Chi-square test was used to test the effect of season on relative abundance of birds. The diversity of bird species were calculated by Shannon-Weaver diversity index (H`) (Shannon and Weaver 1949).

The mean and proportion was used to know the composition and abundance of recorded bird species in the study area. Relative abundance of avian species will be determined using encounter rates that give crude

ordinal scales of abundance (abundant, common, frequent, uncommon and rare) (Bibby et al. 1998).

Encounter Rate =

Total Number of Individual Birds Observed x 10

Period of Observation in hours

Species Evenness, which measures the pattern of distribution of the bird populations present in the area, was evaluating using Evenness Index (E; Tramer 1969). Simpson's similarity index (SI) was used to assess the similarity of species between different sites.

RESULTS

Species Composition

A total of 62 species of birds belonging to 12 orders and 29 families were recorded during both dry and wet seasons in the study area. The maximum number of species was recorded for the family Accipitridae (9), followed by Arddeide and Columbidae (6), Ciconiidae, and Syilviidae (5). There were 1 to 4 species in the remaining families. The Order Passeriformes was the most dominant and largest with the highest number of families (20) and the lowest number of speies was identified for the order Podicipediformes, Columbiformes, Cuculiformes, Piciformes Coraciiformes, Gruiformes and Coliiformes. In the study area water part contained (9) species, plantation habitat contained (56) species and modified habitat contained (41) species (Table 1).

Abundance

Relative abundance of birds in the study area during the wet season showed that 12,5% of the species were uncommon, 23.7 % frequent, 15.9 % abundant, 50.5% common and 10.1% rare. During the dry season, 17.5% of the bird species were uncommon, 31.7 % frequent, 46.6 % common, 8.5% abundant and 10.5% rare.

A total of 2203 individuals of bird species were recorded from in and around Lake Hyqe Estifanos area during both seasons. Of these, 36.9 % were observed during the dry season and 1388 (63.0%) individuals were observed during the wet season. Of the recorded bird species, Speckled Pigeon (*Columba guinea*), Red-eyed Dove (*Streptopelia semitolquata*), Yellow Wagtail (*Motacilla flava*), Great Cormorant (*Phalacrocorax carbo*), Lesser Honey guide (*Indicator minor*), African Citril (*Serinus citrinelloides*) and Bruces Green-Pigeon (*Treronwa allia*) was the most abundant individuals during the dry and wet season, but Common Kestrel (*Falco tinnunculus*) was the least abundant species during both seasons. Seasonal variations in abundance of individuals between seasons were observed in the species composition and relative abundance of avian species in the study area. The seasonal variation in abundance of individual of bird species was highly significantly ($\chi^2 = 512.2$, df= 1, $P < 0.05$) differed.

Higher number of species was recorded under order Passeriformes (20), Ciconiformes (8) Falconiformes (7), Pelicaniformes (6), Acciptriformes (6) and Columbiformes (6) but lower number of species was recorded of

Table 1. Bird species composition of Lake Hayq Estifanos

Common name	Scientific Name	Family	Order
African Citril [w]	*Serinus citrinelloides*	Fringilidae	Passeriformes
African Darter	*Anhinga rufa*	Podicipedidae	Pelicaniformes
African Fish Eagle [D]	*Haliaeetus vocifer*	Acciipitridae	Falconiformes
African White backed Vulture	*Gyps africanus*	Acciipitridae	Acciipitriformes
Black-billed wood Dove [DR]	*Turtur abyssinicus*	Columbidae	Columbiformes
Black-crowned Night Heron	*Nycticorax nycticorax*	Ardeidae	Ciconiifores
Black-Eared Wheatear	*Oenanthe hispanica*	Turdidae	Passeriformes
Black Kite [M]	*Milvus migrans*	Acciipitridae	Falconiformes
Black- necked Grebe [R]	*Podiceps cristatus*	Podicipedidae	Podicipediformes
Black –shouldered Kite [MD]	*Elanus caeruleus*	Acciipitridae	Falconiformes
Bruces Green-Pigeon [WR]	*Treron waallia*	Columbidae	Columbiformes
Cape Crow	*Corvus capensis*	Corvidae	Passeriformes

Table 1. (Continued)

Common name	Scientific Name	Family	Order
Cattle Egret [M]	*Bubulcus ibis*	Ardeidae	Ciconiformes
Common Bulbul [W]	*Pycnonotus barbatus*	Pycnonotidae	Passeriformes
Common Kestrel [M]	*Falco tinnunculus*	Falconidae	Falconiformes
Common White throat [M]	*Sylvia communis*	Sylviidae	Passeriformes
Garden Warbler	*Sylvia borin*	Sylviidae	Passeriformes
Great Crested Grebe [R]	*Podiceps cristatus*	Podicipedidae	Podicipediformes
Great Cormorant [WR]	*Phalacrocorax carbo*	Phalacrocorade	Pelicaniformes
Great Spotted cuckoo [D]	*Clamator glandarius*	Cuculidae	Cuculiformes
Green-backed Heron	*Butorides striata*	Ardeidae	Ciconiiformes
Greater Blue-Eared Starling[M]	*Lamprotornis chalybaeus*	Sturnidae	Passeriformes
Greater Blue-eared Glossy-Starling [R]	*Lamprotornis chalybaeus*	Sturnidae	Passeriformes
Greater Honey guide [W]	*Indicator indicator*	Indicatoridae	Piciformes
Grey-Backed Fiscal [MW]	Lanius excubitoroides	Laniidae	Passeriformes
Ground scraper Thrush	Psophocich lalitsitsirupa	Turdidae	Passeriformes
Hamerkop [WR]	*Scopus umbretta*	Scopidae	Pelicaniiformes
Lanner Falcon	*Falco biarmicus*	Falconidae	Falconiformes
Laughing Dove [W]	*Streptopelia senegalensis*	Columbidae	Columbiformes
Lesser Honey guide [R]	*Indicator minor*	Indicatoridae	Piciformes
Lesser striped Swallow	*Hirundo abyssinica*	Hirundanida	Passeriformes
Little Egret [W]	*Egretta garzetta*	Ardeidae	Ciconiiformes
Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	Podicipediforms
Long-crested Eagle [W]	*Lophaetus occipitalis*	Acciipitridae	Falconiformes
Long tailed cormorant [R]	*Phalacrocor axafricanus*	Phalacrocorade	Pelicaniformes
Marabou Stork [R]	*Leptoptilo scrumeniferus*	Ciconiidae	Ciconiiformes
Mountain Wagtail	*Motacilla clara*	Motacillidae	Passeriformes
Olivaceous Warblre	*Hippolais pallida*	Sylviidae	Passeriformes
Osprey	*Pandionh aliaetus*	Pandionidae	Accipitriformes
Pale Prinia	*Prinia somalica*	Cisticolidae	Passeriformes
Peregrine Falcon	*Falco peregrinus*	Falconidae	Falconiformes
Pied Crow [D]	*Corvus albus*	Corvidae	Passeriformes
Pied Kingfisher [R]	*Ceryle rudis*	Alcedinidae	Coraciiformes
Pink-backed Pelican [R]	*Pelecanus onocrofalus*	Podicipedidae	Pelicaniformes
Red-eyed Dove [W]	*Streptopelia semitolquata*	Columbidae	Columbiformes
Red Knobed coot	*Fulica cristata*	Rallidae	Gruiformes
Red-rumped Swallow	*Cecropis daurica*	Hirundinidae	Passeriformes
Ring-necked Dove [W]	*Streptopelia capicola*	Columbidae Columbiformes	Columbiformes
Sacred Ibis [DR]	*Threskiornis aethiopicus*	Threkiomithidae	Pelicaniformes
Speckled Pigeon [RW]	*Columba guinea*	Columbidae	Columbiformes
Speckled Mouse Bird	*Colius striatus*	Coliidae	Coliiformes
Squacco Heron [M]	*Ardeola ralloides*	Ardeidae	Ciconiiformes
Steppe Eagle	*Aquila nipalensis*	Accipitridae	Accipitriformes
Tawny Eagle [W]	*Aquila rapax*	Accipitridae	Accipitriformes
Thick-billed Raven [D]	*Corvus crassirostris*	Corvidae	Passeriformes
Vitelline Masked Weaver	Ploceus velatus	Passeridae	Passeriformes
Wahlberg's Eagle	*Aquila wahlbergi*	Accipitridae	Accipitriformes
White headed Vulture	*Trigonocepus occipitalis*	Accipitridae	Accipitriformes
White Stork [R]	*Ciconia ciconia*	Ciconidae	Ciconiformes
Willow Warbler [M]	*Phylloscopus trochilus*	Sylviidae	Passeriformes
Woolly-necked Stork [R]	*Ciconia episcopus*	Ciconidae	Ciconiformes
Yellow Wagtail [WM]	*Motacilla flava*	Motacilllidae	Passeriformes

Podicipediformes (3), Piciformes (2), Cuculiformes (1), Coraciformes (1), Gruiformes (1) and Coliiformes (1) during wet and dry season (Figure 2).

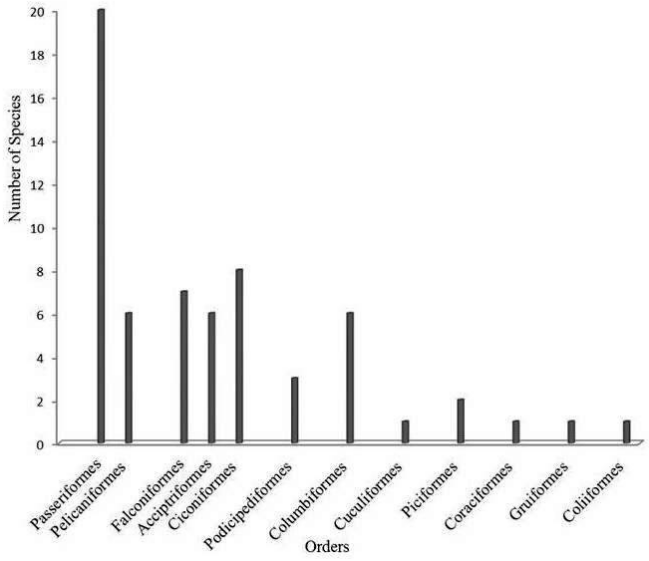

Figure 2. Number of individuals per each order of birds in the study area during the wet and the dry season.

Species Diversity

Diversity index (H') and evenness (E) of bird species varied between the three habitats at different seasons. During the wet season higher diversity of bird species was observed in the plantation habitat (H'= 3.76) but the diversity in the modified habitat (H'= 3.42) and water body (H'= 2.06) was lower with during the same season (Table 2). On the other hand, during the dry season higher diversity of bird species was observed in the plantation habitat (H'= 3.51) but the diversity in the modified habitat (H'= 2.67) and water body (H'= 2.1) was lower with during the same season (Table 3).

Species Evenness

The higher even distribution was registered in the plantation habitat (E=0.99), modified habitat (E=0.96), and water part of the area (E=0.95) and respectively during the wet and higher distribution in the plantation habitat (E=0.98), modified habitat (E =0.84) and water part of the area (E=0.94) and respectively during the dry season (Table 3).

Table 2. Species diversity (H'), Evenness (E) and abundance among their habitats during the wet season

Habitat	Number of species	Abundance	H'	H'max	E (H'/H'max)
Plantation	46	814	3.76	3.82	0.99
Modified	35	455	3.42	3.55	0.97
Water body	9	146	2.06	2.19	0.95

Table 3. Species diversity (H'), Evenness (E) and abundance between habitats during the dry season.

Habitat	Number of species	Abundance	H'	H'max	E (H'/H'max)
Plantation	36	470	3.51	3.58	0.98
Modified	24	225	2.67	3.17	0.84
Water body	9	94	2.1	2.19	0.95

Species Richness

The higher even Richness was registered in the plantation habitat (RI= 11.78), modified habitat (RI = 9.57), and water part of the area (RI= 3.65) and respectively during the wet and higher distribution in the plantation habitat (RI= 9.77), modified habitat (RI= 7.25) and water part of the area (RI= 3.64) and respectively during the dry season (Figure 3).

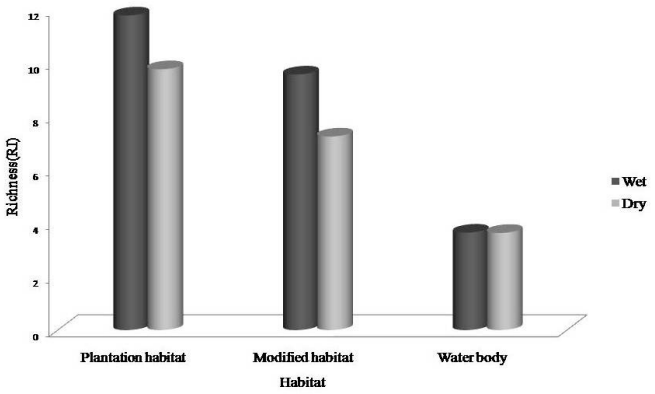

Figure 3. Species Richness during wet and dry season

Species Similarity

Simpson similarity index (SI) bird species between habitats in the study area indicated that (0.76) of the species were common for two terrestrial habitats. (0.09) birds showed similarity occurrence between three habitats (terrestrial and water body) of the study area. Bird species similarity between different habitat types showed variation between seasons. Plantation habitat showed similarity (0.74) during wet and dry season. Modified habitat and water body showed similarity (0.54) and (1) respectively during wet and dry seasons (Table 4).

Plantation and modified habitat (0.59), plantation and water body (0.21) and modified and water body (0.13) showed bird species similarity during the wet season. Plantation and modified habitat had higher species similarity compared to modified and water body which had least during the same season (Table 5).

Plantation and modified habitat (0.41), plantation and water body (0.22) and modified and water body (0.12) showed bird species similarity during the dry season. Plantation and modified habitat had higher similar species compared to modified and water body which had least during the same season (Table 6).

Table 4. Bird species similarity between seasons in the study area

Habitat	Plantation	Modified	Water body
Plantation	0.74	-	-
Modified	_	0.54	_
Water body	-	-	1

Table 5. Bird species similarity between habitats during the wet season

Habitat	Plantation	Modified	Water body
Plantation	-	0.59	0.21
Modified	-	-	0.13

Table 6. Bird species similarity between habitats during the dry season

Habitat	Plantation	Modified	Water body
Plantation	-	0.41	0.22
Modified	-	-	0.12

Table 7. The distribution of families among habitats during wet and dry seasons

Habitat	Wet season	Dry season
Plantation habitat	24	22
Modified habitat	18	17
Water body	5	5

Species Distribution

Seasonal variations were observed in the avian abundance, species richness and distribution of individuals between habitats. Accordingly, the higher number of individual birds (695 individual birds) were recorded from the terrestrial part of the area during the dry season and lower (94 individuals) were recorded water body of the area during the same season and1269 individuals from terrestrial and 146 individuals were recorded from the water part during the wet season. Higher number of species 41 was recorded in the terrestrial part during the dry season and 9 species were recorded from the water part during the same season and 56 was recorded in the terrestrial part during the wet season and 9 species were recorded from the water part during the same season.

During both seasons, the richer number of avian species recorded was in the terrestrial habitats (Dry=41 and Wet=56) and lower number of avian species recorded was from water habitats (Dry=9 and Wet=9), also which was not significantly different (χ^2 =0.37, df = 1, $p > 0.05$). The higher distribution of families was registered in the plantation habitat (24), modified habitat (18), and water part of the area (5) and respectively during the wet and higher distribution of families in the plantation habitat (22), modified habitat (17) and water part of the area (5) and respectively during the dry season (Table 7).

DISCUSSION

A total of 62 species of birds belonging to 12 orders and 29 families were recorded during both dry and wet seasons in the study area. The difference in avian diversity across different sites might be associated with the availability of food, disturbance and predation pressure. But, in terms of species evenness the higher even distribution was registered in plantation habitat modified habitat and water part of the area during both the wet season and the dry season. Plantation habitat is the most significant habitat for birds by supporting around 75% of all bird species while only 45% of all bird species have adapted to humans modified habitats (BirdLife international 2008). This might be due to the ecological stability of the regional ecosystem. The evenness measures of the bird community also showed higher values, due to the fact that species is uniformly represented by individuals. This is explained through habitat heterogeneity. In natural habitats where the intervention of humans is less and minimum, the diversity as well as the evenness of species is higher than the fragmented ones where intensive farming is carried out (Kalkidan and Afework 2011).

The higher diversity in terrestrial habitat may be due to high numbers of individuals compared to water bird species and diverse vegetation types as micro-habitats which favored varieties of bird species (Sethyl et al. 2015). The lower bird species diversity observed in the farmland could be caused by continuing clearing of natural vegetation. Higher vegetation cover support higher diversity of birds. The highest diversity observed in plantation habitat was more likely because of well sufficient vegetation cover than farmland which has been affected by land use changes (Fahring et al. 2010). The highest species diversity indicates a complex community in which a high degree of species interaction is possible opposing to farmland, which implies that few species dominate the habitats. Though modified habitat showed less diversity compared to plantation habitat. On the other hand, the higher evenness in the plantation habitat is supported by continuation of vegetation which reduces the impact of predation to adult birds, young and eggs. The case is different to highly affected habitat like modified one (Campbell and John 2012). In general, complex vegetative habitat had higher diversity when the sampling periods were pooled together. The result is in agreement with many studies which conclude that forest is the main habitat which harbors large bird species diversity (Campbell and John 2012). Therefore, the forest bird species may disappear if degradation will continue to modify the habitat.

Abundance of bird species was observed to change during wet and dry season in three habitat types i.e. plantation, modified and water. Relative abundance of birds in the study area during the wet season showed that most of the species being uncommon (12.5%), common (50.5 %) and during the dry season, 17.5% of the bird species were uncommon, and 46.6% common. According to Sagarin and Gaines (2002) weather had an impact on bird habitats by generating food and cover availability which improve their ability to reproduce and survive hence increasing their abundance. The seasonal variation in abundance of individuals of bird species was significantly different. This was also determined by the presence of resources on which birds depend at different times of the year (Rodriguez- Estrella 2007).

Simpson similarity index (SI) bird species between habitats in the study area indicated that 0.76 of the species were common for two terrestrial habitats. (0.09%) birds showed similarity occurrence between all habitats (terrestrial and water body) of the study area. Higher similarities were seen between plantation and modified habitat but the least similarity observed between terrestrial and water body. The higher species distribution similarities between terrestrial habitats which are spatially closer were expected since these habitat shares some bird species. 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 (Sethy et al. 2015). The studied habitat types recorded 62 bird species which calls attention for conservation.

The higher even Richness was registered in the plantation habitat, but in modified habitat and water part of the area was lower compared to the plantation habitat during the wet and the dry season. According to Gloria Bideberi, (2013) the distribution patterns of bird species normally follow the dimensional structure of the environment and habitat requirement of the bird species. This corresponds with results of this study whereby habitat specificity and generalization were observed. For example Sacred Ibis (*Threskiornis aethiopicus*) Speckled Pigeon (*Columba guinea*) were recorded in all terrestrial habitats.

Abiotic factors affecting species distribution and interspecies interaction as well as the resources that are essential for a species or a group of species have a non-uniform distribution in space (Nabaneeta and Gupta 2010). The highest number of families was observed in

the plantation habitat. This might be due to the high vegetation complexity and floristic composition of the habitats. The least number of families was recorded in the water habitat. Telleria and Santos (1994) pointed out that habitat structure affects the distribution of individual species. Besides, habitat size, foraging modes and floristic composition influence the distribution of the species. This is possibly due to the diversity of vegetation that provided heterogeneous habitat for different avian species. The farmland had also high number of species because of the availability of food. The presence of resources, especially adequate food supply can increase the abundance of bird species at a given area. Birds respond to changes in vegetation composition and structure, which in turn affects their food resources (Kalkidan and Afework 2011). The lowest number of species was observed in water part of the area. This is probably due to the absence of resources and favorability of the weather conditions. Food resources are the most important attractant feature for the birds. This in turn affects bird species that depend on it. Lake Hyqe Estifanos is considered as one of the important bird areas in Ethiopia. Majority of the species are found under the order Passeriformes. In terms of abundance, plantation habitat is more abundant in its bird species as compared to modified habitat. Differences in resource availability between habitats such as breeding sites, nesting materials, cover, food and water restrict some species to certain habitat type while allowing others to be widely distributed. Most of the local communities reduce the quality of in and around Lake Hyqe Estifanos. Hence, the area needs more concern towards the conservation of avifauna resources.

ACKNOWLEDGMENTS

We are grateful to Debre Markos University for allowing us to conduct this study. We are also thankful to Ambasel Woreda for its financial support. First author collected the data, the Second author analysed the data and wrote up the draft. Both authors read and approved the final manuscript.

Conflict of interest

We declare that there is no conflict of interest regarding the publication of this paper.

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Received 18 October 2018
Accepted 17 January 2019