Vol. 11(6), pp. 175-182, June 2019
DOI: 10.5897/IJBC2018.1260
Article Number: 21035C461001
ISSN 2141-243X

http://www.academicjournals.org/IJBC

ACADEMIC JOURNALS
expand your knowledge

International Journal of Biodiversity and Conservation

Full Length Research Paper

Species' composition and relative abundance of Lakeshore bird species around Lake Hawassa, Ethiopia

Serekebirhan Takele[1*] and Genet Endale[2]

[1]Department of Biology, College of Natural Sciences, Arba Minch University, Arba Minch, Ethiopia.
[2]Addis Ketema Preparatory School, Hawassa, Ethiopia.

Received 24 December, 2018; Accepted 18 April, 2019

Ecological investigation of species diversity and relative abundance of birds was conducted from January to September 2017 at the shoreline of Lake Hawassa, SNNPR, Ethiopia. Three habitats namely- Tikurwuha wetland, Human settlement and Farmland were identified for the study. A total of 60 bird species under 14 orders and 37 families were identified. In general, 2720 individuals of 81 species of birds were recorded during the wet season and 1557 individuals of 49 species during the dry season. During wet season, Tikurwuha wetland habitat had the highest diversity (H'=3.469) whereas the lowest diversity was recorded in farmland (H'=2.864). Analogously, during dry season the highest and the lowest diversity were recorded in Tikurwuha wetland habitat (H'=2.845) and farmland habitat (H'=2.584), respectively. The overall seasonal species' composition and relative abundance between dry and wet seasons were statistically significant (P < 0.05). In spite of the fact that the lake supports good number of birds' populations, anthropogenic activities going on near the lakeshore such as farm land and human settlement expansions are shrinking available habitats to birds through altering the vegetation composition and structure that ultimately affects birds' abundance and survival. Accordingly, since the existence of lakeshore bird species is based on the lake ecosystem, anthropogenic pressure such as farming activities and human settlement very close to the lake should be banned.

Key words: Birds, relative abundance, species composition, species diversity.

INTRODUCTION

Ethiopia is a country endowed with great natural and cultural diversity. It covers an extraordinary number of the world's broad ecological zones with a high plateau and a central mountain range divided by Great Rift Valley. The country contains remarkable altitudinal range from the Danakil depressions in the Afar 100 masl (meter above sea level) to the mountain top of Ras Dashen in the north 4,620 masl. The diverse ecosystems endowed Ethiopia with a diverse biological wealth of flora, fauna, and microbes. Protected areas in the country comprise 21 National Parks, two Wildlife Sanctuaries, three Wildlife Reserves, 20 Controlled Hunting Areas, six Community Conservation Areas, two Wildlife Rescue Centers, two Community Managed Ecotourism and Hunting Areas, six Open Hunting Areas, three Commercial Ranches, two Botanical Gardens and Herbariums, four Biosphere

*Corresponding author. E-mail: Serekebirhan.takele@amu.edu.et.

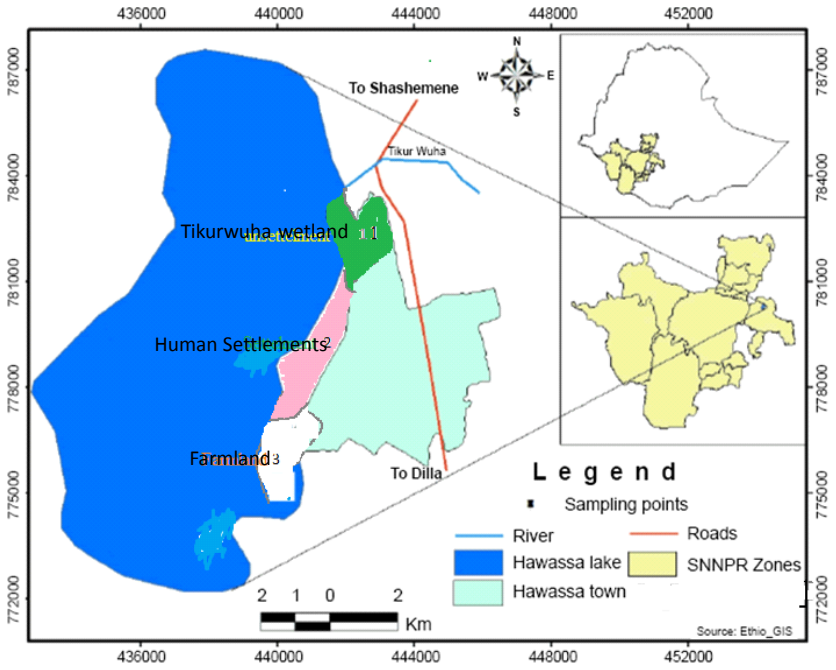

Figure 1. Map of the study area.

Reserves, 80 National Forest Priority Areas and three Municipal Parks (Weldemariam, 2016).

The country harbors 926 species of birds of which 639 are residents and 224 are regular seasonal migrants, including 176 from the Palearctic and 48 inter-African (Lepage, 2016). It is also indicated that 24 species are endemic to Ethiopia whereas additional 13 are shared only with Eritrea. So far in the country, 73 hotspots have been identified as Important Bird Areas (IBAs). Of these, 30 sites (41%) comprise wetlands, while the rest are representatives of other types of ecosystems. Nationally, Ethiopian IBA sites have been grouped into three conservation categories based on distribution and abundance as Critical (19), Urgent (23) and High (31) (Mengistu, 2003).Despite the rich bird assemblages in Ethiopia, due to enormous habitat degradation, fragmentation and loss, survival of many bird species including the endemic and globally threatened ones are endangered (Lepage, 2016). Particularly, expansion of agriculture, livestock encroachment and deforestation by the ever increasing human population has been often mentioned as the major causes of birds' habitat degradation, fragmentation and loss in the country ultimately affecting their survival (Girma et al., 2011).

The lakeshore birds are among the most popular and interesting of birds. They are small to medium size characterized by slender, probing bills and longish legs (Laurent et al., 2012). Shorebirds come in many shapes and sizes, but all of them share certain characteristics, both physically and behaviorally. Nearly all shorebirds have a distinct preference for wet habitats and shorelines, both on coasts as well as along inland waterways, marshes or general riparian habitats most shorebirds are carnivorous and eat a range of insects, mollusks, crustaceans and worms. Physically, these birds have round heads; longer legs and very useful bills (Melissa, 2017).

Lake Hawassa is one of the most productive and aesthetically attractive rift valley lakes in Ethiopia with many ecosystem services. It is one of the eight rift valley lakes in the country and is among the first row of the places where people choose to have an outdoor recreation. The lake hosts diverse wildlife particularly avian fauna. However, although many former studies on the hydrology, water chemistry, fish diversity and other related researches on the lake have been carried out, ecological studies on lakeshore birds are not yet researched. Therefore, the study aimed at gathering primary information on the species composition and relative abundance of lakeshore birds around Lake Hawassa.

MATERIALS AND METHODS

Description of the study area

Lake Hawassa is located in the Southern Nations Nationalities and Peoples Regional State (SNNPR) about 275km south of Addis Ababa with the geographical coordinates of 7°3'N latitude and 38°28'E longitude (Figure 1). It is the smallest of all the Ethiopian rift valley lakes having a total surface area of 95 km^2 and a total

drainage area of 1, 371.6 km^2. Its mean depth is 11 m with maximum depth of 22 m. The lake is found at 1,686 masl which is about 16 km long and 8 km wide with an estimated water volume of 1.3 billion m^3 (Zinabu, 2010). The average monthly maximum and minimum temperature of the study area is recorded in March (30.3°C) and December (10.0°C), respectively. Furthermore, the highest and lowest average rainfall records occur in September (233.8 mm) and December (0.2 mm), respectively (NMSA, 2016).

Lake Hawassa contains four main watersheds namely; the Ungauged sub catchment around the lake draining onto the surface of the lake, the Tikurwuha sub watershed draining through the Tikurwuha river, the Wondokosha and the Muleti closed sub watersheds (Yemane, 2004). The Lake is one of the freshwater shallow lakes found in the central Ethiopian Rift Valley. The sum totalities of aquatic and terrestrial habitats adjoining the lake facilitate the rich diversity of flora and fauna compared to other Ethiopian Rift valley lakes. Scores of species with sundry forms of flora, fauna and micro-organisms make the lake extremely rich in biodiversity (Sairam, 2014). The lake is among one of the biggest bird sanctuaries in the rift valley and homeland for several hundred species of water birds, including local and palaearctic migrants with large population of Marabou storks. Further, the lake is a major source of income through eco-tourism while the inhabitants depend on the lake for fishing and recreation (Sairam, 2014).

Preliminary survey

A reconnaissance survey was carried out for a week to be well acquainted with the study area. The area was divided into sampling strata and units that cover the whole area based on habitat type following Buckland et al. (2001). Three different habitat types found near the lakeshore were selected namely; tikurwuha wetland, human settlement and farmland.

Sampling design

Point count method (Manley et al., 2006; Lambert et al*.,* 2009) was used to study abundance and composition of birds in the study area. Data were recorded by distributing points in the given habitat and selecting points from the distributed points on a random basis. (Geographical positioning System (GPS) was used to locate the geographical points for the bird counting stations. Accordingly, 10, 12 and 8 counting stations were used for tikurwuha wetland, human settlement and farmland, respectively. One counting station on each habitat was laid for 300 m length with a fixed width of 100 m (50 m on either side) and two times a month bird survey was made for each habitat. Numbers, types and locations of birds were recorded during a fixed amount of time at each point. Counting stations were marked using a conspicuous colored polyteen sheet at each station. The radius of point counting stations was set at bands based on the birds' delectability test during reconnaissance survey (Norvell et al., 2003; Rosenstock et al*.*, 2002).

Data collection and analysis

Data collection methods

Data collection was carried out from January 2017 to September, 2017. Hence both dry (January to May) and wet (June to September) seasons were considered (Amare, 2005). Bird identifications and counting of individuals were conducted by direct observation aided with binoculars. Observations were made by standing in the middle of the point transect and observing 360° round quietly and gently up to a distance of 50 m radius. Each point transect was 100 m far away from road side to avoid edge effect and 300 m far away from each other to avoid double counting of the same individual of a species following (Shimeles and Afework, 2008). Observation time of 5 to 15 min was used for the count depending upon how conspicuous the birds were. To minimize disturbance during the count, a waiting period of 3 to 5 min prior to counting was applied (Sutherland and Green, 2000). In each observation, bird species were identified and numbers of individual observed within the 50 m radius were recorded on data sheet prepared for this purpose. Data collection was carried out early in the morning from 06:00 to 10:00am and in the late afternoon from 04:00 to 06-30 pm when the activity of birds becomes prominent (Tsigereda, 2011). Identification and categorization of birds to their respective taxonomic groups' done following field guide books (Sinclair and Ryan, 2003; Redman et al*.*, 2009).

Data analysis

Analysis of the data was made using different diversity indices and encounter rates to estimate relative abundances. The species diversity of the area for each month was given in terms of Shannon-Weaver diversity Index. Shannon-Weaver diversity Index is calculated as:

$$H' = \sum_{i=1} (pi)(\ln pi) \quad (1)$$

where, i is the proportion of the species relative to the total number of species (pi) multiplied by the natural logarithm of this proportion (ln pi) (Gaines et al., 1999). For estimating the relative abundance of birds in the study area, encounter rate was used to give a crude ordinal scale of abundance following Bibby et al*.* (1998):

$$Encounter\ Rate\ (ER) = \frac{\text{Nuumber of birds recorded}}{Number\ of\ hours\ spent\ searching} X10 \quad (2)$$

Hence, the abundance categories: < 0.1, 0.1-2.0, 2.1-10.0, 10.1-40.0 and > 40 were used. For each category, the following abundance score was given: 1(rare), 2 (uncommon), 3 (frequent), 4 (common), and 5 (abundant), respectively. Therefore, the relative abundance of each bird species was determined on the ordinary scale of rare, uncommon, frequent, common and abundant. Furthermore, by using SPSS (Version.22) software, Chi- square test was employed to determine the effects of season and habitat types on bird's relative abundance and distribution.

RESULTS AND DISCUSSION

Species composition

In the present study a total of 60 bird species belonging to 14 orders and 37 families were identified. Order Passeriformes was represented by the highest number of species (35%). Such higher representation of passerines or perching birds is common as Order Passeriformes is the largest and most diverse order of birds, comprising over half of the world's known bird species (Sibley and Monroe, 1990). On the other hand, the lowest number of species was recorded under Coliformes, Columbiforms, Cuculiform, Acciptriforms and Gruiform orders with one

species each. Most of the birds in the study area were observed throughout the study period. Out of the total species recorded in the study area, two species (3.3%) were endemic to Ethiopia, three(5%) species were endemic to Ethiopia and Eritrea, 18 (30%) palertic migrant and 26 (43.3%) resident and the rest species were partially migrant (Table 1).

The present study revealed that lake Hawassa provides important habitat that supports large number of bird species including the two endemic species- Banded Barbet (*Lybius undatus*) and Thick billed raven (*Corvus crassirostris*) as well as other three species-Black winged love bird (*(Agapornis taranta*), Ethiopian Oriole (*Oriolus monacha*) and Wattled Ibis (*Bostrychia carunculata*) which are both endemic to Ethiopia and Eritrea. In addition, the occurrence of winter birds in a significant number (n=18) is an indication that the area is important site for migratory birds too. In a similar study that has been carried out at the southern tip of Lake Tana, 21 species of migratory birds were recorded (Shimeles and Afework, 2008).

Species composition of birds in different seasons was also computed for study sites. In general, during wet season the diversity of bird species in all habitat types was high. During this season, Tikurwuha wetland habitat had the highest diversity (H'=3.469) whereas the lowest diversity was recorded in farmland (H'=2.864). Moreover, the highest evenness record (H'/Hmax=0.9493) was from human settlement habitat whereas the lowest was in Tikurwuha wetland habitat (H'/Hmax=0.9176). On the other hand, during dry season the highest and the lowest diversity were recorded in Tikurwuha wetland habitat (H'=2.845) and farmland habitat (H'=2.584), respectively. The species evenness during this season H'/Hmax was 0.9529, 0.9054 and 0.9463 for human settlement, tikurwuha wetland and farmland habitats, respectively (Table 2). The overall seasonal species composition between dry and wet seasons was statistically significant ($P<0.05$).

Species diversity is the species richness in an area with consideration for species abundance. Richness is an indicator of the relative wealth of species. A combined measure of abundance and richness is however a crucial source of information in determining conservation priorities (Geofrey et al., 2013). The measure of species diversity in the area can be affected by several factors. The sampling method used (Pomeroy, 1992), the size of the study area (Bibby et al*.,* 1998) and habitat heterogeneity (Pomeroy, 1992). Detection probability should also be taken into account because each species in a given habitat has its own probability of being detected, which is usually less than 100% (Shiferaw, 2008). In general, in all habitat types of the present study, bird species diversity during wet season was high due to high species richness and/or evenness.

A total of 60 species of birds belonging to 37 families have been recorded during the present study. Such record of the bird species showed that diversity is very high in the study area. Presumably, this is due to the availability of multiple and variety of alternative food resource and favorable climatic condition for nesting and breeding. According to Borgesio (2004) lakeshore habitats provide ample food resources such as fish, frogs, worms and insects to many bird species. Furthermore, De Filippo (2003) concurs with this idea by pointing out that birds require water as essential component of nutrition and medium for other activities. Among the three habitat types in the present study, relatively the highest species diversity was recorded in Tikurwuha wetland habitat. This is due to the fact that as compared to other habitats, anthropogenic activity in this habitat is very limited which in turn provides good food availability. Smith (1992) described that food resources are one of the key factors to determine species diversity in the particular area. Similar observation has been reported from a study conducted in LakeTana, Yiganda wetland (Shimeles and Afework, 2008). Moreover, high diversity generally indicates more complex and healthier communities since a greater variety of species are allowed for more species interactions hence, greater system stability. On the other hand, in the farmland habitat relatively less bird diversity was observed. This is due `to the fact that the area is covered with vegetables such as onion, cabbages, spinach and carrot and also maize is cultivated. These cash crops are cultivated twice a year in the study area by irrigation of water from the lake. Therefore, birds do not get adequate place for nesting and breeding. According to Meyer and Turner (1992), the conversion of wetlands for agriculture and urban industrial ports affect the nesting and breeding sites of many bird species. The use of irrigation from the lake is steadily increasing not only along the shore line of the lake but also in many of the natural drainage basins that used to recharge the wetland and eventually end up in the lake. In Ethiopia it has been revealed that expansion of agriculture altered the habitats of birds negatively impacting their abundance and distribution (Girma et al*.,* 2011; Pennington and Blair, 2011).

Relative abundance

The relative abundance during the dry season was uncommon (6.6%), frequent (31.6%), common (41.6%) and abundant (20%). On the other hand, during wet season the abundance score was uncommon (8.3%), frequent (30%), common (43.3%) and abundant (18.3%). Rare species were not registered at both seasons (Figure 2). The occurrence of birds at different abundance score was also recorded in all study habitats during both dry and wet seasons. In general, the 'common' abundance category was predominant as compared to other categories irrespective of habitat types and season (Table 3).

Common bird species were very abundant in the study

Table 1. Bird species recorded in the study area.

Order	Common name	Scientific name	Family
	Thick billed Raven♣	*Corvus crassirostris*	Corvidae
	Rufousscrub♥	Cercotrichas galactotes	Muscicapidae
	Ruppell's Robin chat	*Cossypha semirufa*	Muscicapidae
	Red winged warbler♥	Acrocephalusbaeticatus	Acrocephalidae
	Red billed Ox pecker •	*Buphaguserythrorhynchus*	Buphagidae
	Parrot billed Sparrow	Passer gongonensis	Passeridae
	Northen Masked Weaver •	*Ploceus taeniopterus*	Ploceidae
	Bronze Mannikil•	*Lonchura cucullata*	Estrildidae
	Beautiful Sunbird •	*Nectarinia pulchella*	Nectariniidae
Passeriformes	Barred Warbler •	*Sylvia nisoria*	Sylviidae
	African Citril♥	*Serinuscitrinelloides*	Fringillidae
	Collared Sunbird•	*Anthreptescollaris*	Nectariniidae
	Common bulbol•	*Pycnonotusbarbatus*	Pycnonotidae
	Ethiopian Oriole♠	*Oriolus monacha*	Oriolidae
	Fork-tailedDrongo•	*Dicrurusadsimilis*	Dicruridae
	Lesser masked Weaver •	Ploceusintermedius	Ploeceida
	Lesser whitethroat♥	Bucorvusabyssinicus	Sylviidae
	Gardenwarbler♥	*Sylviaborin*	Sylviidae
	Golden Breasted Starling	Lamprotornisregius	Sturnida
	Little Weaver •	*Ploceusluteolus*	Ploeceida
	PygmySunbird •	Hedydipnaplatura	Nectariniidae
	Cattle Egreat♥	*Egrettaalba*	Ardeidae
	Grey Heron♥	*Ardeacinerea*	Ardeidae
	Great Whitepelican•	*Pelecanusonocrotalus*	Pelecanidae
	Hadada Ibis•	*Bostrychiahagedash*	Threskiornithidae
Pelecaniformes	Hamer Kop •	*Scopusumbretta*	Scopidae
	Royal Spoon •	*Plataleaalba*	Threskiornithidae
	Sacred Ibis •	*Threskiornisaethiopicus*	Threskiornithidae
	WattledIbis ♣	*Bostrychiacarunculata*	Threskiornithidae
	African Black Duck	Anassparsa	Anatidae
	Egyptian Goose♥	*Alopochen aegyptiaca*	Anatidae
	Fulvouswhistling Duck•	*Dendrocygnabicolor*	Anatidae
Anseriform	White backed Duck♥	*Thalassornisleuconotus*	Anatidae
	Whitefaced whistling Duck♥	*Dendrocygnaviduata*	Anatidae
	Blue Winged Goose	Cyanochencyanoptera	Anatidae
Columbiforms	Bruce's green pigeon•	*Treronwaalia*	Columbidae
Charadriiformes	African Jackana♥	*Actophilornis africanus*	Jacanidae
	Black-tailed Godwt Green	*Limosalimosa*	Scolopacidae
	Blacked Eremomela	Eremomelacanescens	Cisticolidae
	GreyheadedGull •	*Chroicocephaluscirrocephalus*	Laridae
	Whiskered Tern♥	*Chlidoniashibridus*	Laridae
Coraciiforms	African Hoopoe♥	*Upupaepops*	Upupidae
	Grey headed kingfisher ♥	*Halcyonleucocephala*	Alcedinidae
	Malchites kingfisher •	*Alcedocristata*	Alcedinidae
	PiedKingfisher •	*Cerylerudis*	Alcedinidae
	Silver Checked Hornbil•	*Bycanistesbrevis*	Bucerotidae
	Giant Kingfisher	Megaceryle maxima	Alcedinidae
Piciforms	Greater Honey guide •	*Indicatorindicator*	Indicatoridae
	Banded barbet ♣	*Lybiusundatus*	Lybiidae

Table 1. Contd

Accipitriforms	African Fish eagle♥	Haliaeetusvocifer	Accipitridae
Suliformes	Reed Cormorant •	Microcarboafricanus	Phalacrocoracidae
	Great Carmorat♥	*Phalacrocoraxcarbo*	Phalacrocoracidae
	White breasted Cormorat	Phalacrocorax africanus	Phalacrocoracidae
Psittaciforms	Black winged Love bird♠	*Agapornistaranta*	Psittaculidae
	Baglafecht Weaver	*Ploceusbaglafecht*	Ploeceida
Coliformes	Speckled Mousebird•	*Coliusstriatus*	Coliidae
Ciconiform	Marabou Strock•	*Leptoptiloscrumenifer*	Ciconiidae
	Saddle-billed Stork♥	Ephippiorhynchussenegalensis	Ciconiidae
Gruiform	Reed Knobed Coot ♥	*Fulicacristata*	Heliornithidae
Cuculiforms	Blue-headed Coucal	Centropusmonachus	Cuculidae

♥:Palerctic migrants,♣: Endemic,♠:Endemic to Ethiopia and Eretria •:Resident Un marked species are partially migrant.

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

No. of habitat	Abundance (season)	Species	individuals	D	H'	H'/H 'max
Tikurwuha wetland	Dry	19	627	0.9371	2.845	0.9054
	Wet	35	1309	0.9668	3.469	0.9176
Human settlement	Dry	16	633	0.9323	2.724	0.9529
	Wet	27	872	0.9589	3.244	0.9493
Farmland	Dry	14	297	0.9207	2.584	0.9463
	Wet	19	539	0.9389	2.864	0.923

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

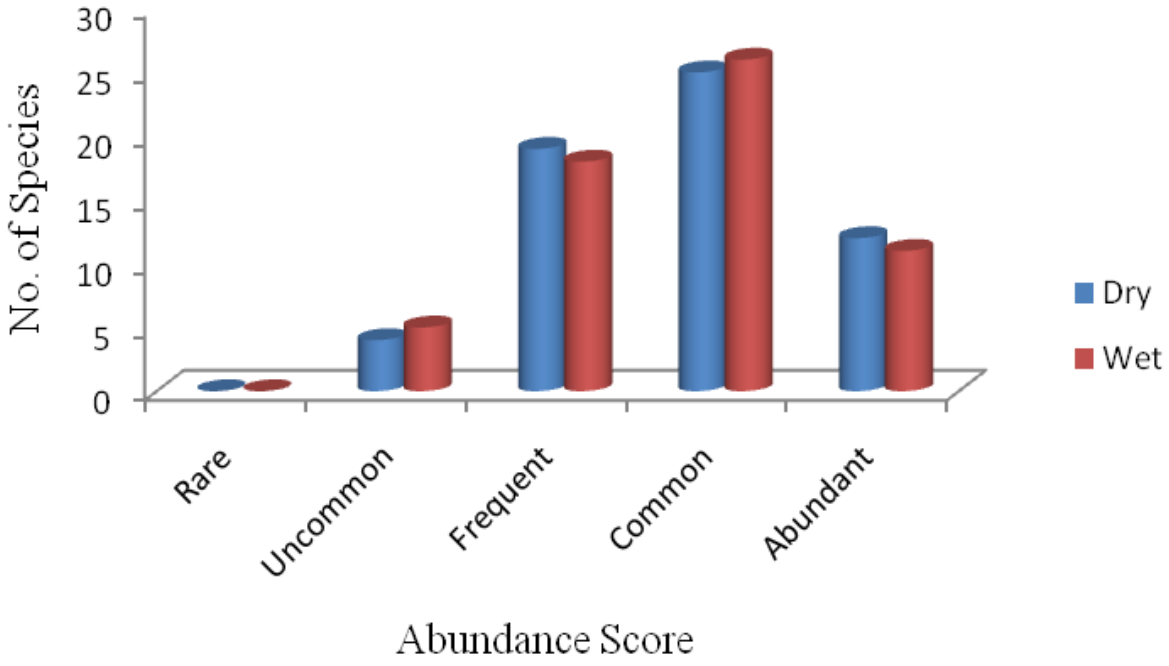

Figure 2. Abundance score of bird species in the study area during dry and wet season.

Table 3. Number of bird species in different relative abundance categories.

Habitat	Season	Uncommon	Frequent	Common	Abundant
Tikurwuha wetland	Dry	3	9	10	4
	Wet	3	10	13	5
Human settlement	Dry	1	7	9	5
	Wet	1	6	10	4
Farmland	Dry	-	3	6	3
	Wet	1	2	3	2

area due to the favorability of the area to satisfy their nutritional requirements during both seasons. These birds were observed foraging on food and water resources available around the lake. For instance, marabou stroke, Sacred Ibis, African Jacana and Hammer Kop were recorded in large number around fish market areas along the lakeshore of the study area. In human settlement areas where there are cafeterias, hotels and boating service delivery sites, White pelicans, Marabou stroke, Baglafecht weaver, Sacred Ibis, Royal spoon and Egyptian Goose were frequently observed foraging on leftover foods. The surrounding area of the lake is covered with dense strands of emergent, submerged and floating aquatic vegetation. Its surface and bottom provide lush habitats for a diverse variety of animal life and extends into swamps, creating an even greater diversity of inter-connected aquatic niches. This habitat diversity supported the floral and faunal richness of the ecosystem and rendered it a key feeding station for migratory birds.

The fishing activity in the lake affects many shore living birds; on the other hand around fish markets the head and internal parts of fish that are discarded during fish harvesting provide food for many bird species. In the present study, Marabou Stork, Great White Pelican, African Sacred Ibis, Little Egret, and Thick billed Raven species were frequently observed feeding on scraps of fish dumped by fishermen. Presumably, these birds forgo their natural pattern of foraging. Marabou storks and pelicans, in particular, were seen flying and crowed among AmoraGedel and Tikurwuhalake shore areas during the periods when fish scraps are dumped.

In the present study, relative abundance of bird species between seasons was significantly varied ($P < 0.05$). A total of 2720 individuals of 81 species of birds were observed during the wet season and 1557 individuals of 49 species during the dry season in the three types of habitats (Table 2). This could be due to the availability of food resources, habitat condition, breeding season and as well as the migratory behavior of the species. In a similar fashion Gaston and Blackburn (2000) explained that distinct seasonality of rainfall and seasonal variation in the abundance of food resource resulted in seasonal changes in the abundance of birds. Moreover, the temporal decoupling between food resource and bird number, variable climate harshness in different regions or the inability of individuals to reach isolated areas affect migratory bird population(Telleria et al., 2009).

In general, the lake shores are important feeding, and breeding sites for birds. Farmers along the shore of the lake cultivate the area when the water level recedes. Fruit trees such as mango and papaya and vegetables are becoming dominant in the study area. At present, the unusually high level of reduction in the size of the lake led many areas under permanent cultivation. Obviously, this could diminish bird's habitat unless appropriate community based conservation measures are taken.

Conclusion

The study area is home for varieties of lakeshore bird species. Among these some are globally threatened species as well as endemic birds of Ethiopia. A total of 60 bird species were recorded in three different habitats. High diversity of bird species was recorded in Tikurwuha wetland area whereas low diversity in farmland area. Both species composition and relative abundance of birds varied between seasons. The availability of food resources, habitat condition, breeding season, migratory behavior and the like might contribute to such variation. Most of the birds in the study area are common in the three habitats. In general, the 'common' abundance category was predominant as compared to other categories irrespective of habitat types and season.

Presently, although the lake supports good number of birds populations, anthropogenic activities going on near the lakeshore such as farm land and human settlement expansions are shrinking available habitats to birds through altering the vegetation composition and structure that ultimately affects birds' abundance and survival. Moreover, the leftover foods dumped from hotels, resorts and cafeterias surrounding the lakeshore affect the natural feeding habit and /or foraging behavior of birds as observed in Marabou Stork, Great White Pelican, African Sacred Ibis, Little Egret, and Thick billed Raven, in the

present study.

Recommendations

Based on the result of the study the following recommendations are forwarded:

(i) As the existence of lakeshore bird species is based on the lake ecosystem, anthropogenic pressure such as farming activities and human settlement very near the lake should be banned.
(ii) Concerned authorities should give due concern to lakeshore bird species since these birds can be good sources for ecotourism.
(iii) To have complete ecological information about lakeshore bird species in the study area, additional ecological studies *viz*. feeding behavior, activity pattern, and reproductive behavior and so on should be studied in the future.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGMENTS

The authors are grateful to regional office of culture and tourism for providing us valuable information about the study area. Furthermore, we are very thankful to Arba Minch University for covering all financial expenses during the study.

REFERENCES

Amare L (2005). Site action plan for the conservation and sustainable use of the lake Hawassa. Biodiversity: Addis Ababa.
Bibby C, Jones M, Marsden S (1998). Bird Surveys:Expedition Field Techniques. The Expedition Advisory Center Royal Geographic Society, London, 139pp.
Borgesio M (2004). Agricultural intensification and the collapse of Europe's farmland bird populations. Proceedings of the Royal Society B: Biological Sciences 268:25-29.
Buckland ST, Anderson DR, Burnham KP, Lake JL, Borchers DL (2001). Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press, Oxford, 377pp.
Geofrey E, Soka PK, Munishi T, Mgina BT (2013). Species diversity and abundance of Avifauna in and around Hombolo Wetland in Central Tanzania. International Journal of Biodiversity and Conservation. 5(11):782-790
Gaines WL, Harrod RJ, Lehmkuhl JF (1999). Monitoring Biodiversity: Quantification and interpretation. USDA Forest Service. Pacific North-west Research Station. General Technical Report, PNW-GTR-443.
Gaston KJ, Blackburn TM (2000*).* Pattern and Process in Macro ecology. Blackwell Science Ltd. 371pp.
Girma M, Yosef M, Afework B (2011*).* A comparison of terrestrial bird community structure in the undisturbed and disturbed areas of the AbijataShalla lakes national park, Ethiopia. International Journal of Biodiversity and Conservation 3(9):389-404.
Lambert JD, Hodgman TP, Laurent EJ, Brewer GL, lliff MJ, Dettmers R(2009). The Northeast Bird Monitoring Handbook. American Bird Conservancy Virginia. 225pp.
Laurent EJ, Bart J, Giocomo J, Harding S, Koch K, Moore-Barnhill L, Mordecai R, Sachs E, Wilson T (2012). A Field Guide to Southeast Bird Monitoring Programs and Protocols, Southeast Partners in Flight. Available at: http://SEmonitoringguide.sepif.org
Lepage D (2016). Avibase-Bird Checklists of the World-Ethiopia Bird life International. Available at: http://avibase.bsc-eoc.org/checklist.jsp?region=ET.
Manley PN, Van Horne B, Roth JK, Zielinski WJ, McKenzie MM, Weller TJ, Weckerly FW, Vojta C (2006). Multiple species inventory and monitoring technical guide. General Technical Report, Washington DC, 2-5.
Melissa M (2017). General shore bird types and common characteristics*:* Available at: http://www.thespruce.com/types-of-shorebirds-387309
Mengistu W (2003) .Wetland birds and important bird areas in Ethiopia. MSc. Thesis, Louisiana State University.
Meyer WB, Turner BL (1992). Human population growth and global land use/cover change. Annual Review of Ecology, Evolution, and Systematics 23:39-61.
NMSA (National Meteorology Agency) (2016). Annual Report, Hawassa.
Norvell RE, Howe FP, Parrish JR (2003). A seven-year comparison of relative abundance and distance-sampling methods. Auk 120:1013-1028.
Pennington DN, Blair RB (2011). Habitat selection of breeding riparian birds in an urban environment: Untangling the relative importance of biophysical element and spatial scale. Divers and Distribution 17:506-518.
Pomeroy D (1992). Counting Birds. A guide to assessing numbers, biomass and diversity of Afro- tropical birds. African Wildlife Foundation. Nairobi.
Redman N, Stevenson T, Fanshawe J (2009). Birds of the Horn of Africa. Princeton University Press, Princeton.
Rosenstock SS, Anderson DR, Giesen KM, Leukering T, Carter MF (2002). Land bird counting techniques: Current Practices and an alternative. Auk 119:46-53.
Sairam P (2014).Species Diversity of Lake Hawassa, Ethiopia. International Journal of Science 3(11):1-8.
Shiferaw A (2008). Species Diversity, Distribution, Habitat Association, Relative Abundance and Similarity of Bird and Mammals Species in Kore Conservation area, Southern Ethiopia. M.Sc Thesis submitted to Addis Ababa University, Ethiopia.
Shimeles A, Afework B (2008*).* Species composition, relative abundance and distribution of bird fauna of riverine and wetland habitats of Infranz and Yiganda at southern tip of Lake Tana, Ethiopia. Tropical Ecology 49:199-209.
Sibley CG, Monroe BL (1990). Distribution and taxonomy of birds of the wor*ld*. New Haven, USA: Yale University Press.
Sinclair I, Ryan P (2003). Birds of Africa: South of the Sahar*.* Princeton University Press, Princeton 760 pp.
Smith RL (1992). Elements of Ecology. 3rd ed. Harper Collins Publishers Ltd, London.
Sutherland WJ, Green RE (2000). Habitat assessment. In: Bird Ecology and Conservation: A Handbook of Techniques*,* 2nd ed., Oxford University Press Inc., New York. 405pp.
Telleria JL, Ramirez A, Galarza A, Carbonell R, Perez- Tris J, Santos T (2009). Do migratory pathways affect the regional abundance of wintering birds? A test in Northern Spain. Journal of Biogeography 36:220-229.
Tsigereda D (2011). Species diversity and Abundance of birds of Addis Ababa Bole international Airport. M.Sc. Thesis submitted to Addis Ababa University, Ethiopia.
Weldemariam T (2016). Bird Species Composition and Diversity in Wetlands of Awi zone and Wombera hotspot areas Northwestern, Ethiopia.
Yemane G (2004) Assessment of Water Balance of Lake Hawassa Catchment. Msc Thesis, ITC: Enshede the Netherlands.
Zinabu G (2010).The Limnology of Lake Hawassa. Proceedings of the National Symposium of Lake Hawassa, Department of Biology, Hawassa University, Hawassa*.*