

Full Length Research Paper

Assessment of birds of the Arid water bodies in Tigray, Northern Ethiopia

Kiros Welegerima*, Tsegazeabe Hadush Haileslasie, Solomon Kiros, Mokonen Teferi, Kibrom Fitwi and Meheretu Yonas

Department of Biology, Mekelle University, P.O.Box 3179, Mekelle, Ethiopia.

Received 17 February, 2014; Accepted 11 March, 2014

The ornithological role of lake Hashengie and 10 selected reservoirs have been studied from January to February, 2012 in Tigray, Ethiopia. Birds were surveyed using total and Block count methods from suitable vantage points. Bird species diversity, dominance, and vegetation cover were estimated. A total of 22,845 birds of 67 species belonging to 19 families were recorded. Maximum numbers of species were recorded in Lake Hashengie (65) followed by Hzaeti Wedi Cheber (38) and minimum was recorded in Mai Della reservoir (15). Significant difference in bird species were recorded between the two sites which have maximum number of bird species (Mann-Whitney Test: $W = 778.5$, $P = 0.00$). The migratory status of bird species showed that 47 (70 %) were migrants and the rest 20 (29%) were residents. Vulnerable species, Ferruginous duck, *Aythya nyroca*, in Lake Hashengie and globally near threatened species, Rouget's rail *Rougetius rougetii* in Teghane and Ruba Feleg reservoirs were recorded. The highest vegetation cover (65%) was estimated in Tsnkanet. We conclude that the reservoirs and the natural lake intended for irrigation harbor a number of bird species and are an important foraging, breeding, roosting and nesting grounds for the birds.

Key words: Migratory, reservoirs, residential, Hashengie, threatened, vulnerable, Tigray, Ethiopia.

INTRODUCTION

Ethiopia has a large natural and cultural diversity with a gigantic range of climates which result from its topography and latitudinal position. It has a very diverse set of ecosystems ranging from humid forest and extensive wetlands to desert. The great plains of Ethiopia occur atop colossal highland plateaus, cloven into unequal halves by the Great Rift Valley. Many of these mountain ranges reach over 4100 m above sea level, and are home to plentiful endemic species of flora and fauna (Jacobs and Schloeder, 2001). There is a great variation

in altitude ranging from 120 m below sea level in Dalol to 4620 m above sea level in Rass Dashen. The differences in altitude and latitude have resulted in a wide variation in climates (rainfall, humidity, temperature etc) and this improbable diversity of ecology is auxiliary mirrored by the diversity of fauna and flora (Jacobs and Schloeder, 2001; Yalden et al., 1996; Yalden and Lagen, 1992).

According to Institute of Biodiversity Conservation (IBC) (2009) of Ethiopia's 4th Country Report, there are known to be 284 wild mammal, 861 bird, 201 reptile, 63

*Corresponding author. E-mail: lezelalem16@yahoo.com.

amphibian, 188 fish and 1225 arthropod species with about 10, 2, 5, 54, 0.6 and 21% endemism respectively. Several reports site these variations in the topographic features of the country as one of the reasons to its high faunal and floral diversity and endemism (Jacobs and Schloeder, 2001; Yalden et al., 1996). Ethiopia possesses a great diversity of Lakes, rivers and wetland ecosystems. The Ethiopian aquatic ecosystems are found in many areas and include the major rivers and lakes that are of great national and international importance. The country is well known for its richness in its water potential. There are about 30 major lakes, 12 major river basins and over 70 wetlands that are located in different ecological zones of Ethiopia (IBC, 2009). As a result, Ethiopia is a center of biological diversity with ample endemism.

Ethiopia has a diverse number of both terrestrial and aquatic bird species and one of the most significant in Africa and its diverse habitat type definitely contribute for the immensely diverse avifauna. The number of species varies in literature but the most commonly cited number is 861 species of birds (EWNHS, 1996). However, a recently published book on the birds of Ethiopia and Eritrea by Ash and Atkins (2009) minimized to 837 species. Lepage (2013) raises the number to 857. There is no clear estimated number in which the diverse habitat such as National parks, Lakes, Wetlands and Rivers banks are supported to both terrestrial and aquatic birds. Specially, unprotected areas such as reservoirs have never been studied as habitat to feeding, breeding and nesting to water bird diversity in Ethiopia, specifically in Tigray.

Tigray is an arid zone located in Northern Ethiopia. It has only one Natural Lake Hashengie in the southern Ofla Wereda and has many rivers such as Tekezze, Worie, Gba, Tsedya, Gedgeda and Tsalyet. Moreover to this natural lake and rivers, 79 reservoirs have been constructed and continue to construct for the purpose of agricultural irrigation for drought reduction in the region. Farmers intensively use these reservoirs for cultivation of short seasonal crops. The reservoirs are also crucial home for foraging, breeding and nesting of many migratory and residential water birds. A preliminary survey by Tsehaye et al. (2007) established that the reservoirs exhibit a peculiar biodiversity in water birds. Water bird communities represent a potentially useful group of organisms for monitoring changes to freshwater ecosystems. They may be ordered into functional groups representing a combination of diet and habitat use that allow assessment of changes to wetland habitats (Balapure et al., 2013; Kingsford and Porter, 1994). Since water birds frequently show strong dependence on lakes, rivers and proximate wetlands, they are highly sensitive to environmental change and human disturbance.

To our knowledge, the natural Lake Hashengie and the reservoirs are among the least studied water ecosystems with reference to ornithology in the region. There is an

imperative need for collecting relevant information on the diversity of the water bird communities to fill gaps on the overall bird list from this region to the country list. For the most part, a systematic bird species list and information on bird diversity are lacking from both the natural lake and unprotected reservoirs. Bibby et al. (1992) reported that preparation of a list of species is basic to the study of avifauna of a site, because a list indicates species diversity in general sense. Characterizing community species composition and water bird dynamics are also important evaluation indicators that reflect habitat quality (Benjamin et al., 2009; Joseph and Myers, 2005; Paillissona et al., 2002).

Therefore, the study was aimed to assess information on the bird diversity, abundance, screening key species of conservational concern and overall threats in both the natural lake and the selected reservoirs for a better understanding of the habitat suitability for water birds and subsequently for future protection and management of such crucial sites.

MATERIALS AND METHODS

Description of the study area

The study was conducted in seven weredas of Tigray; namely Aynalem, Atsbi Wenberta, Enderta, HintaloWajerat, Kille Belesa, Ofla and Wukro from January to February two times per month in 2012. Water bird survey specially on January and February are appropriate time for estimation of bird diversity and abundance in Ethiopia. Wintering migratory birds are greater than other time in the year. Therefore, our estimation of bird species diversity and abundance both migratory and resident were high. Lake Hashengie (1) from Ofla, Mai Delle (2), Gum Selassa (3) and Mai Gassa I (4) from Hintalo Wajerat, Mai Gassa II (5) and Hizaeti Wedicheber(6) from Enderta, Gereb Beati (7) from Aynalem, Laelay Wukro (8) from Wukro, Teghane (9) and Ruba Feleg(10) from Atsbi Wenberta and Tsinkanet (11) from Kille Belesa were selected (Figure 1).

The natural Lake Hashengie is fed by a number of small streams from the surrounding areas during the rainy season only. There is no river which flow to the lake permanently and no drainage out of it. The bowl rim forms steep cliffs all around, except in the north-east where there is a long basin. East and north east of the lake is surrounded by flat agricultural land and large areas of marshland when water decreases during the dry season. Scatter houses are situated on the foot of the mountains. The valley in the north-east is a vital area which holds up copious domestic animals. Plant coverage was less in comparison to other natural lakes of Ethiopia. However some very small and scattered shrubs and trees, such as *Croton macrostachyus*, *Vernonia amygdalina* and *Buddleja polystachya*, *Acacia abyssinica*, *A. pilispina*, *Ekbergia capensis*, *Juniperus procera* and *Olea europaea cuspidata* were found. Nile *Tilapia Oreochromis niloticus* and introduced carp fishes are also found in the lake.

The other water bodies which were assessed were the reservoirs. All the reservoirs are constructed on suitable agricultural lands for irrigation purpose. People use intensively the water for short term growing crops after seasonal crops are harvested and for domestic animal watering during the dry season. Surroundings of the reservoirs are almost green the whole year. From mid- March and end of April water level decreases in most of the reservoirs. *Garra spp.* and introduced *Tilapia spp.* are found in Laelay Wukro, Tsinkanet while in Mai Gassa I and II, Gum Selassa, Hizaeti Wedi

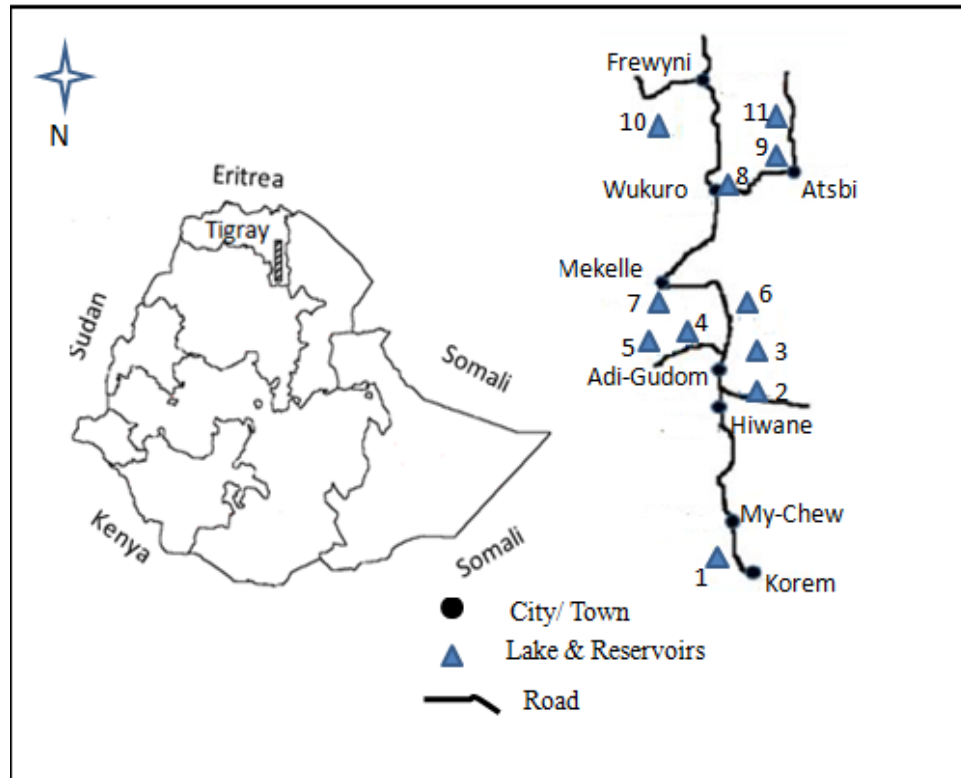


Figure 1. Approximate location of the surveyed lake (1) and reservoirs (2-11) In Tigray, Ethiopia.

Cheber, Gerbe Beati have *Garra spp.* only.

Data collection

Data was collected from one natural Lake Hashengie, previously identified as Important Bird Area (IBA) and 10 reservoirs which are ornithologically poorly studied. For areas with a smaller number of water birds, direct counting was adopted while for areas with a larger assemble of water birds, group-number counting following the method by Ma et al. (2006). In this method, a suitable vantage point was selected and all visible birds were counted. Total count was also used wherever possible, by walking around the proximate wetlands or from specific vantage points to count the birds. If not completely covered, the case of Lake Hashengie the percentage of coverage was marked and Block counts were applied to count the birds. Each site was divided into many sections and each section was counted. During the study, birds which were noticed in the sites were classified according to the migratory status as migratory (M) and resident (R). Some bird species migrate while some of them remain throughout the year. Besides, East African migrant, migrant breeding, migrant wintering and Palearctic migrants were also considered as migrant in the appendix only. Based on the frequency of observation birds were also categorized into Common (Com) for birds seen on 10-11 sites; Occasional (Oc) for birds seen on 7-9 sites, Rare (Ra) for birds seen on 1-6 sites. Birds were systematically counted from morning 6:00 to 10:00 h using Celestron (10 × 50) binocular. Identification of the birds to species level was made using appropriate field guides (Stevenson and Fanshawe, 2002; Sinclair and Ryan, 2003; Redman et al., 2009).

The proportion of vegetation cover was recorded in percentage. Three observers were estimated the surrounding vegetation cover

and average percentage was taken to each reservoir and the natural lake. In addition, some common plant species to all reservoirs are also recorded by using circular line transect around the reservoirs.

Data analysis

The water bird species diversity was determined using Simpson diversity index as described by Akosim et al. (2008). The model is as follows:

$$D = \sum [-P_i \ln P_i]$$

Where, D = Shannon index; P_i is the proportion of the species in the sample. Significant different in bird species between sites which recorded maximum number of bird species was tested using Mann-Whitney Test and tests were set at ($P=0.05$).

RESULTS

Diversity of birds

In the surveyed, one natural lake and ten reservoirs a total of 22, 845 birds of 67 species belonging to 19 families were recorded (Appendix 1). Maximum numbers of species were recorded in Lake Hashengie (65) followed by Hzaeti Wedi Cheber (38) and minimum was recorded in Mai Della reservoir (15) (Figure 2). There is a significant difference in bird species between the two

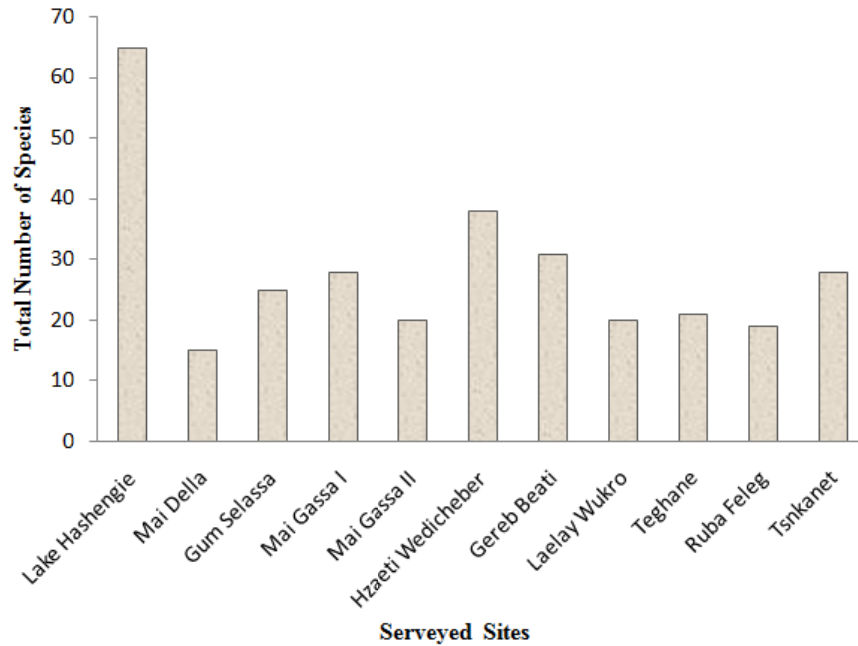


Figure 2. Total number of bird species recorded in each of the study sites in January and February, 2012.

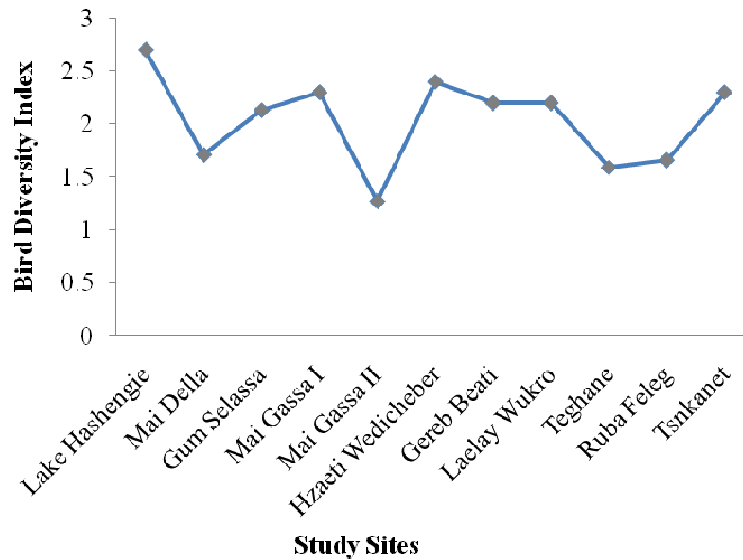


Figure 3. Bird diversity index of the 11 surveyed sites in January-February

sites which recorded maximum number of bird species (Mann-Whitney Test: $W = 778.5$, $P = 0.00$). The maximum number of birds were also recorded in Lake Hashengie (18,000) followed by Hzaeti Wedicheber (876) and Tsnkanet (650). Bird diversity was highest in Lake Hashengie (2.7) followed by Hzaeti Wedicheber (2.4) and lowest was in Mai Gassa II (1.27) (Figure 3). Overall, the highest number of individual birds recorded in the sites

were Egyptian goose, *Alopochen aegyptiacus* (4,580) followed by little greb, *Tachybaptus ruficollis* (2,100) (Appendix 1).

Lake Hashengie holds the highest number of family 18 (except family Otidae) followed by Hzaeti Wedicheber 17 family (except Phalacrocoracidae, Phoenicopteridae and Threskiornithidae) (Figure 4). The least, 11 family were recorded in Mai Della and Gum Selassa. All the

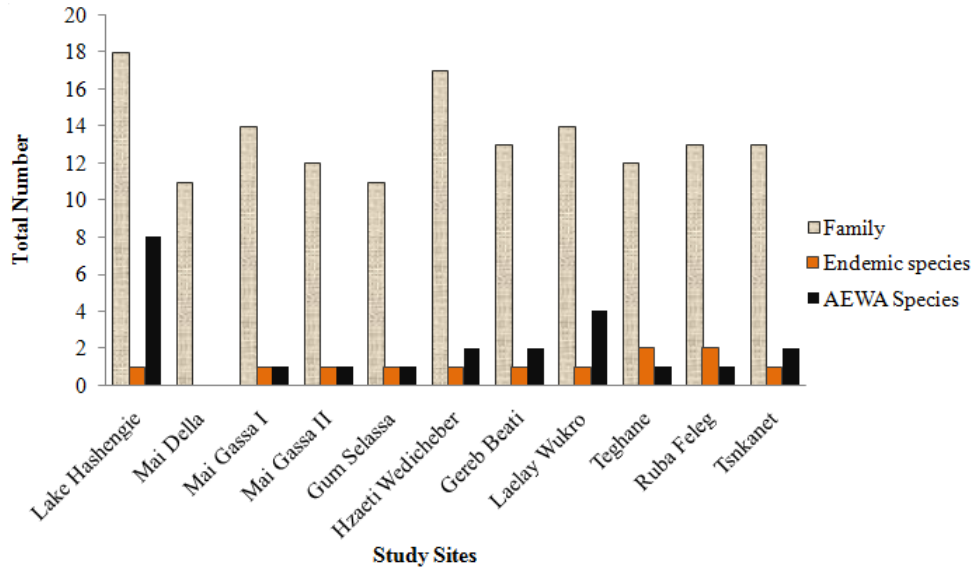


Figure 4. Total number of family, endemic and agreement on the conservation of African-Eurasian Migratory Water birds (AEWA) of bird species recorded in the natural lake and in each Reservoirs of Tigray, Northern Ethiopia.

Table 1. Total number of Species contribution, Resident, Migratory and abundant species in the family of birds recorded in the survey sites.

Family	NS	NRS	NMS	ASF
Anatidae	13	2	11	<i>Alopochen aegyptiacus</i>
Anhingidae	1	-	1	<i>Anhinga rufa</i>
Ardeidae	7	2	5	<i>Bubulcus ibis</i>
Burhinidae	3	3	-	<i>Burhinus senegalensis</i>
Charadriidae	4	1	4	<i>Charadrius tricollaris</i>
Ciconiidae	5	1	4	<i>Charadrius tricollaris</i>
Glareolidae	1	-	1	<i>Glareola pratincola</i>
Motacillidae	1	-	1	<i>Motacilla flava</i>
Otididae	1	1	-	<i>Lissotis melanogaster</i>
Pelecanidae	2	-	2	<i>Pelecanus onocrotalus</i>
Phalacrocoracidae	2	-	2	<i>Microcarbo africanus</i>
Phoenicopteridae	1	1	-	<i>Phoenicopus minor</i>
Podicipedidae	3	-	3	<i>Tachybaptus ruficollis</i>
Rallidae	3	3	-	<i>Fulica cristata</i>
Recurvirostridae	3	1	2	<i>Himantopus himantopus</i>
Scolopacidae	10	-	10	<i>Actitis hypoleucos</i>
Scopidae	1	-	1	<i>Scopus umbretta</i>
Sternidae	2	-	2	<i>Sternula albifrons</i>
Threskiornithidae	4	3	1	<i>Threskiornis aethiopicus</i>
Total	67	18	51	

NS, Number of species; NRS, number of resident species; NMS, number of migratory species; ASF, abundant species in the family.

reservoirs together holds 18 family less than by one from Lake Hashengie. Family Anatidae contributed 13 species, of this 11 are migratory and 2 residents followed by family Scolopacidae 10 species, of this 10 migratory (Table 1).

Six family, Scopidae, Phoenicopteridae, Otididae, Motacillidae, Glareolidae and Anhingidae were represented only by one species. The migratory status of bird species showed that 47 (70%) were migrants and the

Table 2. Species dominance and percentage abundance in each of the study sites in February - January in Tigray.

Site	Species abundance	Percent
Lake Hashengie	<i>Alopochen aegyptiacus</i>	45
Mai Della	<i>Charadrius tricollaris</i>	29
Gum Selassa	<i>Fulica cristata</i>	26
Mai Gassa I	<i>Fulica cristata</i>	36
Mai Gassa II	<i>Egretta garzetta</i>	23
Hzaeti Wedicheber	<i>Fulica cristata</i>	38
Gereb Beati	<i>Alopochen aegyptiacus</i>	25
Laelay Wukro	<i>Egretta garzetta</i>	31
Teghane	<i>Alopochen aegyptiacus</i>	35
Ruba Feleg	<i>Fulica cristata</i>	42
Tsnkanet	<i>Alopochen aegyptiacus</i>	21

rest 20 (29%) were residents. Lake Hashengie 48 species and Hzaeti Wedicheber 30 species had contributed a maximum migratory bird species while the least, 4 species were recorded in Mai Della. Both species, *Alopochen aegyptiacus* and *Fulica cristata* were recorded as abundant species in each of the four different sites. The remaining three sites are dominated by two species (Table 2). The bird species found were categorized into rare 35 (52%), occasional 19 (28%) and common 13 (19%). Three endemic species, *Rougetius rougetii*, *Vanellus melanocephalus* and *Bostrychia carunculata* and eight species, which are listed under the Conservation agreement of African-Eurasian Migratory Water birds (AEWA) were found in the natural lake and the reservoirs (Figure 4).

Status of vegetation

Percentage proportions of the surrounding vegetation cover and anthropogenic activity were recorded. Tsnkanet, Mai Gassa I, Mai Gassa II, showed better plant coverage than the rest of the surveyed lake and reservoirs. Tsnkanet relatively accounted for the highest 65% of the surrounding cover by vegetation. Some aquatic macrophytes including *Cyperus*, *Eleocharis*, *Scirpus*, *Echinochloa*, *Panicum*, *Alisma*, *Nymphaea*, *Typha*, *Paspalidium*, *Potamogeton* were recorded in most of the reservoirs and lake Hashengie.

All surveyed sites were more or less surrounded by agricultural lands and grazing range land except scattered *Acacia* species and other shrubs which grew in the edges. Anthropogenic activities, such as agricultural activity, washing, cattle drink was infrequently observed at Mai Gassa I, Mai Gassa II and Gum Selassa and these sites were far from human settlement. Most surrounding areas of Mai Gassa I and II, Tsnkanet showed diverse vegetation whereas in Laelay Wukro and Teghane the vegetation cover was very less. Below Teghane and

Ruba Feleg a very small wetland created by seepage water was present as home of the globally near threatened species Rouget's rail *Rougetius rougetii*. Mai-Della was the only reservoir without any water and vegetation observed during the study. Lake Hashengie was surrounded by degraded agricultural land with no vegetation coverage and supported a number of grazing animals during the dry season.

Feeding habits and activity

Water birds were found to feed on food available in the wetlands. Feeding partitioning was observed among the bird species during the survey. Egyptian goose *Alopochen aegyptiacus* was found feeding at the water part, open agricultural land and mud reservoirs having no water. Ferruginous duck *Aythya nyroca* and Garganey *Anas querquedula*, little grebe *Tachybaptus ruficollis*, Great crested grebe *Podiceps cristatus*, Great white pelican, *Pelecanus onocrotalus*, Red-knobbed coot *Fulica cristata*, Eurasian coot *Fulica atra* were observed feeding in the pelagic column of water. Common greenshank *Tringa nebularia*, Common sandpiper *Actitis hypoleucos*, Spur-winged goose *Plectropterus gambensis*, Three-banded plover *Charadrius tricollaris*, Wood sandpiper *Tringa glareola*, Senegal thick-knee *Burhinus senegalensis*, African wattled lapwing *Vanellus senegallus* were seen foraging at edge of water. Cattle egret *Bubulcus ibis*, Little egret *Egretta garzetta*, Sacred ibis *Threskiornis aethiopicus*, Rouget's Rail *Rougetius rougetii*, Wattled ibis *Bostrychia carunculata* foraged in the proximate wetlands. Little greb, Red-knobbed coot, Yellow-bill duck, Egyptian goose, Great crested grebe frequently dived into water for feeding. Fighting among water birds was not common during feeding except in Egyptian goose. The most aggressive behavior with noise was shown by Spur winged lapwing towards other birds feeding at the edge of water. Feeding activity was highest in the early morning and late afternoon. During late morning and afternoon sunning in mixed flocks of Great white pelican, Yellow-bill stork and Cattle egrets were common. Egyptian goose and Yellow-bill duck were observed to flock in large number as independent group during sunning. For overnight roosting, most of the water birds aggregated at the edge of the water.

DISCUSSION

Diversity of avian species varied in relation to modified habitats, such as hedgerows, surrounding vegetation composition, wetland structure above and below and anthropogenic effect. Species richness and abundance of birds varied between sites and possibly influenced by altitude and by the type of vegetation (Hailemariam et al., 2013) Lake Hashengie holds the highest number of bird species. We predict that this is the maximum number of

water birds in the lake. Since, large numbers of migratory birds are added to the resident species, this time is the most appropriate time to count migratory birds in Ethiopia. It is the only natural lake covering large area and previously identified as Important Bird Area (EWNHS, 1996). Lake Hashengie may be the first distinction in Ethiopia to Palearctic migrant birds as temporal site after crossing the Palearctic continent. This total bird report in lake Hashengie can approve to the previous total bird estimations by different scholars. Ethiopian Wildlife and Natural History Society (EWNHS) (1996) reported the lake probably holds 20,000 water birds on a regular basis and a total of 17,000+ was recorded in January. We have counted also 56 individuals of the globally vulnerable species of *Aythya nyroca* and endemic species of *Bostrychia carunculata* in the lake. Birds such as, *Vanellus senegallus*, *Vanellus spinosus*, *Mycteria ibis*, *Threskiornis aethiopicus*, *Plectropterus gambensis*, *Aythya fuligula*, *Anas undulata* and *Anas strepera* which are listed under the agreement on the Conservation of African-Eurasian Migratory Water birds were found. Even if such important birds are found in the lake, some species such as the threatened species *Rougetius rougetii* which was reported previously in the lake were absent during our survey. The species predominantly occurs in wetlands and marshy areas (del Hoyo et al. 1996). It has been recorded foraging in open meadows, on bare mud and in shallow waters (Urban et al. 1986; del Hoyo et al. 1996). However, wetlands and marsh lands important habitat for hiding this bird in the surrounding lake is drying by overgrazing of cattle. Czech and Parsons (2002) pointed that natural wetlands continue to decrease in area throughout world. Lake Hashengie, like a number of other Ethiopian lakes such as Lake Tana by Shimelis and Afework (2008) is experiencing serious environmental problems as a result of overgrazing, agricultural encroachment and the unregulated use of agrochemicals. Fishing activity, agricultural expansion in the shoreline and other high anthropogenic disturbance is the current growing impact around the lake. This may be the explanation for the absence of this species during our survey. Even if, we did not able to compare with such previous reports, we can swear this may have clearly effect on the total bird abundance and richness in the lake.

The reservoirs are also home to 62 species of the total 67 species (except *Aythya nyroca*, *Anhinga rufa*, *Anas querquedula*, *Microcarbo africanus* and *Phalacrocorax carbo*). The reservoirs share a number of common birds and important conservational concern of African-Eurasian Migratory Water birds (*Anas undulata*, *Threskiornis aethiopicus*, *Vanellus senegallus* and *Vanellus spinosus*). A Key Ethiopia highland endemic species *Vanellus melanocephalus* and *Rougetius rougetii* are also found in Teghane and Ruba Feleg. This is a highly evident to the reservoirs role in supporting important conservational concern birds in the region.

Most of the migrant species were migrant wintering. Hamerkop *Scopus umbretta*, Abdim's stork *Ciconia abdimii*, Black headed heron *Ardea melanocephala*, Grey headed heron *A. cinerea*, Purple heron *A. purpurea*, Cattle egret *Bubulcus ibis*, Egyptian goose, *Alopochen aegyptiacus*, Little egret *Egretta garzetta*, Sacred ibis *Threskiornis aethiopicus*, Yellow-bill stork *Mycteria ibis* were migrant breeding. The Herons and Abdim's stork commonly breed in Alamata near Lake Hashengie, in Mekelle city near Gereb Beati and in Wukro town near to Laelay Wukro. We have found Egyptian goose with their three chickens and two eggs of other Goose in Tsnkanet. Some birds, for example, Spot-breasted Plover, Blue-winged Goose, Rouget's Rail, White-winged Flufftail, Wattled Crane, Corn Crake, Shoebill, Black-winged Pratincole, Great Snipe, and Lesser Flamingo in general favor, feed and/or breed in wetlands (Mengistu, 2000). We have found also, hedgerows around reservoirs and old plant trees in towns near the reservoirs are good opportunity as breeding site of both migratory and resident species. Report indicated, hedgerows are also serve as a corridor and refuge and play a role in soil conservation and runoff catchments and provide nesting, feeding and wintering sites for birds (Kati and Sekercioglu, 2006; Rappole et al., 2003; Stewart, 2001).

Frequencies of sighting large number of birds were still higher in Lake Hashengie than the reservoirs. This may in terms of area coverage and nature of the lake is better than the reservoirs. Large size as compared to small size might contribute to the highest bird species diversity and evenness. This is because of the availability of multiple and variety of alternative feed sources for bird; moreover, large area is inaccessible for people contributing to a favorable condition for breeding, feeding and nesting sites (Shimelis and Afework, 2008; Smith, 1992). Besides, farmers extensively use water for irrigation and degrade lands for plantation during the dry season. This leads in some of the reservoirs, specifically to late March, water level falls and most of the migratory birds move from the reservoirs lake Hashengie and elsewhere and this may be the possible reason for their less sighting frequency. In 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 (Rana, 2005). Water dependant feeding may have its own impact up on the diet of water birds. *Aythya nyroca* and *Anas querquedula*, *Tachybaptus ruficollis*, *Podiceps nigricollis*, *Anas clypeata*, *Anas undulate* are sighted to feed on significantly deeper water. Various studies reported that water level and the bird abundance are inter-related (Colwell and Taft, 2000). Typical Our result also showed that in Mai Della, which were almost dry during the survey recorded small number of bird species in comparison to the other reservoirs. Considering the negative effect of pesticides, insecticides, herbicides and other chemicals, agricultural practices around the

reservoirs provide alternative food resources to water birds during the dry months such as, *Alopochen aegyptiacus*, *Bostrychia carunculata*, *Threskiornis aethiopicus*, *Plegadis falcinellus*, *Ardea purpurea*, *Egretta garzetta*, *Ardea cinerea*, *Ardea melanocephala*, *Bubulcus ibis*, *Lissotis melanogaster*, *Motacilla flava* and others which prefer near water areas. On the other side, the *Bostrychia carunculata* and *Rougetius rougetii* which are recorded as rare during the survey are completely dependent in wetland and marshland habitats near reservoirs are at high risk to chemicals used in the agriculture. Especially, *Rougetius rougetii* which depend on such kind of habitat for breeding and feeding may become endangered in the near future. del Hoyo et al. (1996) supports that the bird breeds in marshy areas within high altitude montane grasslands and moorlands. Overall, the population of this specie is suspected to be in decline owing to ongoing habitat destruction. Grazing and agricultural fields were used more by *Alopochen aegyptiacus* than other birds. We have observed high number of Egyptian goose which fed in water and on open agricultural land far from water in most of our survey. They are generalist and sometimes difficult to category as terrestrial or aquatic birds since they are dominating the agricultural fields.

Conservational perspectives

Report by Jeffery et al. (2004) large number of breeding populations of palaeartic migrants birds were recorded in Ethiopia. The country also hosts many important resting and feeding areas for birds, including millions of migrates crossing the Sahara Desert (Şekercioğlu, 2012). 47 migratory bird species were recorded including palaeartic species in both the reservoir and the natural lake. However, in Ethiopia, several ecosystems of high biological importance are threatened and there is a need for strong conservation action that should be supported by legislation (Pol, 2006). To our understanding, attempts to conserve faunal diversity specifically avifauna around reservoirs have received little attention. Awareness creation on conservation of bird species and other biodiversity in and around the reservoirs to local people and agricultural experts are decisive. Study by Hailemariam and Tsegazeabe (2013) indicates, establishment of local people awareness on ecological benefits of birds is crucial for conservation activity. Successful conservation of the avian species will depend on community attitude, management of water level, application of chemicals and anthropogenic disturbance around the natural lake and reservoirs. Further similar survey and intensive studies spread over different seasons of the year are needed. This could help in producing other globally interesting birds which are absent in our study for further notice in the conservation of the lake, reservoirs and their proximate flora and fauna.

Conclusion

Overall, the surveyed sites comprised water bird species of resident, migratory, globally threatened and vulnerable bird species. The natural lake, the reservoirs and their proximate wetlands are the only breeding sites to this water bird species in the region. During our observation, most of the reservoirs are relatively suitable for breeding to many birds than the natural lake Hashengie. They can be alternative promising sites to increase bird diversity in such kind of arid regions. But, the sites are still unprotected, undefined and dwindling in area by agricultural expansion and other anthropogenic factors. However, these sites could be additional to the IBA sites to Ethiopia in general and specifically to the region for the future when protection and estimation of the total populations of bird species of the 79 reservoirs is continued.

Conflict of Interests

The author(s) have not declared any conflict of interests.

ACKNOWLEDGEMENT

We thank Mekelle University and College of Natural and computational sciences for financial support and NORAD project for vehicle support. We thank also to responsible authorities in each of the reservoirs who gave us all necessary information.

REFERENCES

- Akosim C, Kwaga BT, Umar B, Mamman GS (2008). The Role of Aquatic Bodies in Avifauna and fish conservation in Pandam Wildlife Park, Pandam, Plateau, Nigeria. *J. Fish. Int.* 3(1):7-11.
- Ash J, Atkins J (2009). Birds of Ethiopia and Eritrea: an atlas of distribution, Christopher Helm, London.
- Balasure S, Dutta S, Vyas V (2013). Physico-chemical factors affecting the distribution of wetland birds of Barna Reservoir in Narmada Basin, Central India. *Int. J. Biodivers. Conserv.* 5(12): 817-825.
- Benjamin M, Vallejo J, Alexander BA, Perry SO (2009). The distribution, abundance and diversity of birds in Manila's last green spaces *Landsc. Urban Plan.* 89:75-85.
- Bibby CJ, Collar NB, Crosby MJ, Heath MF, Imboden C, Jonston TH, Long AJ, Satterfield AJ, Thirgood SJ (1992). Putting Biodiversity on the Map: Priority Areas for Global conservation. Barrington Press, Cambridge.
- Colwell MA, Taft OW (2000). Water bird communities in managed wetlands of varying water depth. *Water Birds* 23:1121-1133.
- Czech HA, Parsons KC (2002). Agricultural wetlands and water birds: A Review. *Water Birds* 25: 56-65.
- Del Hoyo J, Elliott A, Sargatal J (1996). Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.
- EWNHS (1996). Important bird areas of Ethiopia. A First inventory. Ethiopian Wildlife and Natural History Society, Addis Ababa.
- Hailemariam A, Meheretu Y, Tsegazeabe HH (2013). Community composition and abundance of residential birds in selected church forests, Tigray Region, Northern Ethiopia. *Sci. Res. Essays* 8(22):1038-1047.
- Hailemariam A, Tsegazeabe HH (2013). Knowledge and attitude of peasants towards birds in church forests in Tigray region, Northern Ethiopia. *Int. J. Biodivers. Conserv.* 5(8):461-468.

- Institute of Biodiversity Conservation (IBC) (2009). Convention on Biological Diversity (CBD). Ethiopia's 4th Country Report. Addis Ababa, Ethiopia. pp. 1-2.
- Jacobs MJ, Schloeder CA (2001). Impacts of conflict on biodiversity and protected areas in. Ethiopia Washington, D.C.: Biodiversity Support Program. p. 45.
- Jeffery C, Diane M, Debinsi O, Jakubausk S, Aelly K (2004). Beyond species richness, community similarity as a measure of cross taxon congruence for coarse filter conservation. *Conserv. Biol.* 18: 167-173.
- Joseph AB, Myers WL (2005). Associations between avian functional guild response and regional landscape properties for conservation planning. *Ecol. Indic.* 5: 33-48.
- Kati VI, Sekercioglu CH (2006). Diversity, ecological structure and conservation of the land bird community of Dadia reserve, Greece. *Divers. Distrib.* 12:620-629.
- Kingsford RT, Porter JL (1994). Water birds on an Adjacent Freshwater Lake and Salt Lake in Arid Australia. *Biol. Conserv.* 69:219-228.
- Lepage D (2013). Avibase - Bird Checklists of the World, Ethiopia. <http://avibase.bsc-eoc.org/checklist.jsp?region=et&list=clements>
- Ma JH, Liu Y, Lei JY (2006). *Methods for Bird Surveys - A Practical Handbook*. Hong Kong: Bird Watching Society.
- Mengistu W (2000). Wetlands, Birds and Important Bird Areas in Ethiopia. *Proceedings for Awareness Raising on Wetlands of Ethiopia*, Addis Ababa. 13-15.
- Paillissona JM, Reeber S, Mariona L (2002). Bird assemblages as bio-indicators of water regime management and hunting disturbance in natural wet grasslands. *Biol Conserv.* 106:115-127.
- Pol JLV (2006). *A Guide to Endemic Birds of Ethiopia and Eritrea*. 2nd edn. Shama Books, Addis Ababa.
- Rana SVS (2005). *Essentials of Ecology and Environmental Science*. 2nd edn. Prentice-Hall of India Private Ltd., New Delhi.
- Rappole JH, King DI, Diez J (2003). Wintering vs. breeding habitat limitation for an endangered avian migrant. *Ecol. Appl.* 13:735-742.
- Redman N, Stevenson T, Fanshawe J (2009). *Birds of the Horn of Africa: Ethiopia, Eritrea, Djibouti, Somalia, and Socotra* (Princeton Field Guides). Princeton University Press, USA.
- Şekercioglu CH (2012). Promoting community-based bird monitoring in the tropics: Conservation, research, environmental education, capacity-building, and local incomes. *Biol. Conserv.* 151:69-73.
- Shimelis 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. *Trop. Ecol.* 49(2):199-209.
- Sinclair I, Ryan P (2003). *Birds of Africa south of the Sahara*. Princeton University Press, USA
- Smith RL (1992). *Elements of Ecology*. 3rd edn. Harper Collins Publishers Ltd, London.
- Stevenson T, Fanshawe J (2002). *Field guide to the Birds of East African, Kenya, Tanzania, Uganda, Rwanda and Burundi*. London, UK.
- Stewart RE (2001). *Technical Aspects of Wetlands - Wetlands as Bird Habitat*. National Water Summary on Wetland Resources. United States Geological Survey. p. 86.
- Tsehaye A, Tadesse D, Declerck S, Nyssen J, Van der Gucht K, Risch S, Rousseaux S, De Wit J, Afework M, Nigussie H, Abreha G, Poesen J, Deckers J, Vyverman W, De Meester L (2007). *Ecological atlas of reservoirs in Tigray, Northern Ethiopia*. Tigray Livelihood Papers No. 4, VLIR - Mekelle University IUC Programme. p. 80.
- Urban EK, Fry, CH, Keith S (1986). *The birds of Africa vol. II*. Academic Press, London.
- Yalden DW, Lagen MJ (1992). The endemic mammals of Ethiopia. *Mammal Rev.* 22: 115-150.
- Yalden DW, Lagen MJ, Kock D, Hillman JC (1996). *Catalogue of the mammals of Ethiopia and Eritrea. Revised Checklists, Zoogeography and Conservation*. *Trop. Zool.* 9: 3-160.