academicJournals

Vol. 8(22), pp. 1038-1047, 11 June, 2013
DOI 10.5897/SRE2013.5367
ISSN 1992-2248 ©2013 Academic Journals
http://www.academicjournals.org/SRE

Scientific Research and Essays

Full Length Research Paper

Community composition and abundance of residential birds in selected church forests, Tigray Region, Northern Ethiopia

Hailemariam Areaya[1,2]*, Meheretu Yonas[2] and Tsegazeabe Hadush Haileselasie[3]

[1]Department of Biology, Axum University, Ethiopia.
[2]Department of Biology, Mekelle University, P. O. Box 231, Mekelle, Ethiopia.
[3]KU Leuven, Department of Biology, P. O. Box 231, Lueven, Belgium.

Accepted 21 May, 2013

Birds are among the best known parts of the earth's biodiversity. This study was conducted in three selected church forests located in different agroclimate zones (Kola, Weyna Dega and Dega) in Tigray region, Northern Ethiopia to investigate the community composition and abundance of residential birds. Data collection was carried out between November 2011 and March 2012 for a period of five months, two days in a month for each study site for a total of 30 days. Line transects and point count techniques were employed. Observation on birds was taken twice a day (in the early morning from 06:00 to 09:30 h and late in the afternoon from 16:30 to 18:30 h for a total of six hours in a day. A total of 65 bird species were recorded. Of the recorded bird species, 5 were endemic to Ethiopia. Diversity and community similarity of birds were calculated using the Shannon–Weiner diversity index and Sorenson's similarity index respectively. The mean bird species diversity was highest in Giorgis Church forest (H'=3.42) and lowest in Michael Church forest (H'=2.42). A significant difference in diversity of birds between Giorgis and Michael church forests (t=7.707, n=5, p<0.05), Giorgis and Endakidanemeheret Church forests (t=3.492, n=5, p<0.05) was observed while no significant difference was observed in diversity of birds between Michael and Endakidanemeheret Church forests (t=-0.361, n=5, p=0.737). More bird species evenness (1.08) was observed in Giorgis Church forest and low in Endakidanemeheret Church forest (0.88). The bird community similarity of the three church forests were very small (Css=0.11).

Key words: Abundance, birds, church forests, Dega, diversity, kola, plants, species richness, Weyna Dega.

INTRODUCTION

There are over 1850 bird species in Africa of which Ethiopia has about 926 with 23 endemic and 19 globally threatened species (Lepage, 2006). The country has about 665 resident bird species (Girma et al., 2011). About 73 important bird areas (IBAs) are identified within the country (Shimelis and Bekele, 2008; Ethiopian Wildlife and Natural History Society (EWNHS), 1996) helps to conserve the biodiversity of the continent and enhance economic growth through tourism and associated activities. Of the 73 IBAs, four are found in the Tigray region. The most common birds in the country belong to the family Passeriformes (Girma et al., 2011).

Ethiopia possesses the fifth largest floral composition in tropical Africa (Shimelis and Bekele, 2008). Ecological diversity and climatic variation of the country to a large extent are explained by its highly variable

*Corresponding author: E-mail: hilinatsegazeabe@yahoo.co.uk.

topography, altitude ranging from 125 m below sea level (m b.s.l.) in the Dallol Depression to 4,620 m above sea level (m a.s.l.) at Ras Dashen (Yilma and Geheb, 2003). Changes in composition of bird species are correlated with vegetation structure, topography and related physical and biological features varying along altitudinal gradients (Mallet-Rodrigues et al., 2010). Birds are among the best known parts of the earth's biodiversity, but quantified knowledge is far from complete for most species and this leads to an obstacle in conservation of birds (Aerts et al., 2008; Mason et al., 2005).

The study of birds in Ethiopia is still in its infancy, clearly because of lack of trained professionals but not for lack of birds. According to Ethiopian Wildlife and Natural History Society (EWNHS, 1996), investigations on bird fauna in Ethiopia are negligible, when compared to other neighbouring African countries, that is, Kenya, Uganda, and Tanzania. Even baseline information is lacking for Ethiopian avifauna; little knowledge from important bird areas (IBAs) indicates the existence of rich diversity of the wildlife in general and avifauna in particular (Ash and Gullic, 1989).

The Ethiopian Orthodox Church has long history of planting, protecting and preserving trees around churches (Colwell, 2010). It is forbidden by the religion for anyone to cut the trees around churches as a result of which old aged indigenous trees which have been totally removed from many places in the country (forest/wild) are still standing. This in turn results in the formation of patchy forests around the churches (Feoli, 1996, cited in Leul et al., 2010). Owing to this the Ethiopian Orthodox Church forests have attracted the attention of biologists since they are acting as biodiversity "hot spots". Several animal species including birds and mammals, in addition to plants, inhabit these patchy habitats. The patchy habitats are attracting several animals from areas where sever deforestation and land degradations have occurred (Sharma et al., 1999).

Birds play a vital role in floral biology and pollination of plants; about half of the plants concerned are clearly adapted to bird pollination as well as indicates environmental health and they have been considered as indicator species of inhabited areas (Colwell, 2010; Clout and Hay, 1989; Rajashekara and Venkatesha, 2011).

Bird watching as a new area of tourism is now greatly developing and generating significant economic benefit in several countries (Pienkowski, 1992). Countries which are benefiting from bird watching sectors are those who have documented necessary information on their ornithological studies and prepared field guides; they know the locations or distributions of the birds and their abundance which helps them to analyze the impact of direct and indirect effects of tourism on biodiversity (Palacio–Nunez et al., 2007). Recently several attempts have been made to increase awareness, more studies on wildlife by the government of Ethiopia gives attention to biodiversity (EPA, 1997) but not as compare to the church forest birds for conservation and tourism implications in Ethiopia.

Recent studies (Shimelis and Afework, 2008; Aert et al., 2008) have been conducted on forest birds in Ethiopia but not in church forest birds. Although the main purpose of the churches is to serve as places of worship, burials and meditating religious festivals, they also provide valuable and secured habitats for plants and animals (Alemayehu et al., 2005). Church compounds are the monasteries of trees and other biodiversity resources where one can animate trees escaped from being destroyed forever under the shelter of the church value and esteem. Many indigenous trees and shrubs, which in some places were destroyed completely over the last century, are still found standing in the compounds of remote rural churches (Taye et al., 1998).

Recent studies by Alemayehu et al. (2005) in North Gondar showed that churches have been places of refuge for many indigenous plants in the semiarid highlands of Ethiopia. However, bird species residing in these forest patches is rarely investigated. Forests in churches are sanctuaries for different organisms ranging from microbes to large animals including birds. Studies on the diversity of plants have been conducted by Taye et al. (1998) in eight churches of south Gonder, Northern Ethiopia; however, very little is known about the bird community composition and abundance in those church forests of semiarid high lands of the Tigray region. This study, therefore, is aimed at investigating the community composition and abundance of residential birds in Endakidanemeheret, Michael and Giorgis Church forests located in different agroclimate zones of the Tigray region, Northern Ethiopia.

MATERIALS AND METHODS

Study area

The study was conducted in three church forests of the Tigray region, namely: Endakidanemeheret Church forest (in Abergelle, Central Zone) (13°28'02"N, 39°10'33"E, 1600 m a.s.l.), Michael Church forest (in Hagereselam, South Eastern Zone) (11°18'12"N, 14°11'25"E, 2100 m a.s.l.) and Giorgis Church forest (in Korem, Southern Zone) (13°08'07"N, 23°20'23" E, 2600 m a.s.l.) (Figure 1). Each of the church forests was intended to represent three different altitudinal ranges, lowland, mid-altitude and high-altitude. Purposive selection of these church forests was made based on information obtained from reconnaissance survey as there was no previous research conducted in the region in this regard.

Endakidanemeheret Church forest has an area of approximately 22500 m^2 with red soil. The type of forest in this church is characterized by sparse forest trees including shrubs. A dominant tree in this church forest is *Euphorbia tirucalli*. The main rainy season runs from June to September but there is a considerable variation from year to year. The average annual rainfall in this church forest is 580 mm. The maximum and minimum average temperature is 26.72 and 19.1°C respectively (National Meteorological Agency, 2012). This church forest is surrounded by agricultural fields.

Michael Church forest has an area of approximately 75000 m^2

Figure 1. Map of Ethiopia (top right) and Tigray (Lower left) with the study sites (Source: Google map).

with black clay soil. The type of forest in this church is characterized by sparse forest trees including shrubs. A dominant tree in this church forest is *Euphorbia abyssinica*. The main rainy season runs from June to September but there is a considerable variation from year to year. The average annual rainfall in this church forest is 762 mm. The maximum and minimum average temperature is 17.16 and 7.42°C respectively (National Meteorological Agency, 2012). This church forest is surrounded by agricultural fields in the west, east and north directions but forest of it is south wards.

Giorgis Church forest has an area of approximately 75000 m^2 with black soil. The type of forest in this church is characterized by highly dense forest trees including shrubs. A dominant tree in this church forest is *Juniperus procera*. The main rainy season runs from June to September but there is a considerable variation from year to year. The average annual rainfall in this church forest is 889 mm. The maximum and minimum average temperature is 18.26 and 3.64°C respectively (National Meteorological Agency, 2012). This church forest is surrounded by agricultural fields in the west and forest of south, north and east directions. Within these agricultural fields there is a waste disposal site.

Data collection

In each of the study area, data were collected from November 2011 to March 2012 for two consecutive days every month of five months for a total of 30 days. For survey of bird species richness, diversity and abundance in the church forests, a line transects and point count method was used (Ethiopian Wildlife and Natural History Society, 1996; Redman et al., 2009).

A total of eight transect lines (containing sixteen point counts) were laid in the three church forests. The length of transects was approximately 300 m in Giorgis Church forest (Korem) and Michael (Hagereselam) Church forests each and 200 m in Endakida-nemeheret (Abergelle) Church forest. The variation among the number of transect lines was because of the difference in the size (area) of the church forests. The other line transects were encircled within it at an approximately equal distance from each other, as 50, 100 and 150 m towards the main church (where main prayer is held). Point count technique, where observation is made from a fixed location within a fixed time interval (approximately 5 to 10 min) was used to identify and enumerate the birds. To minimize disturbance during enumeration, a waiting period of 3 to 5 min prior to counting was applied.

The line transect was permanently marked with water proof white paint in each church forest for use throughout the study period. All birds observed or heard in the transect area were identified and recorded to species level. Data were collected following the marked permanent transects, for a period of two consecutive days in a month, early in the morning from 06: 00 to 09:30 h and late in the afternoon from 16:30 to 18:30 h replicating the same transects with exact times dependent on practical considerations of walking between sites. However, every effort was made to ensure that sample times were generally equivalent between sites. For identification of bird species, 8×40 wide field binocular and colored field guides (Terry and John, 2002) were used. Occasionally photographs were taken to count and identify the birds that were not easily identified in the field.

Data analysis

Species richness and abundance of birds in each study sites were estimated by using SPSS software package version 16. Species

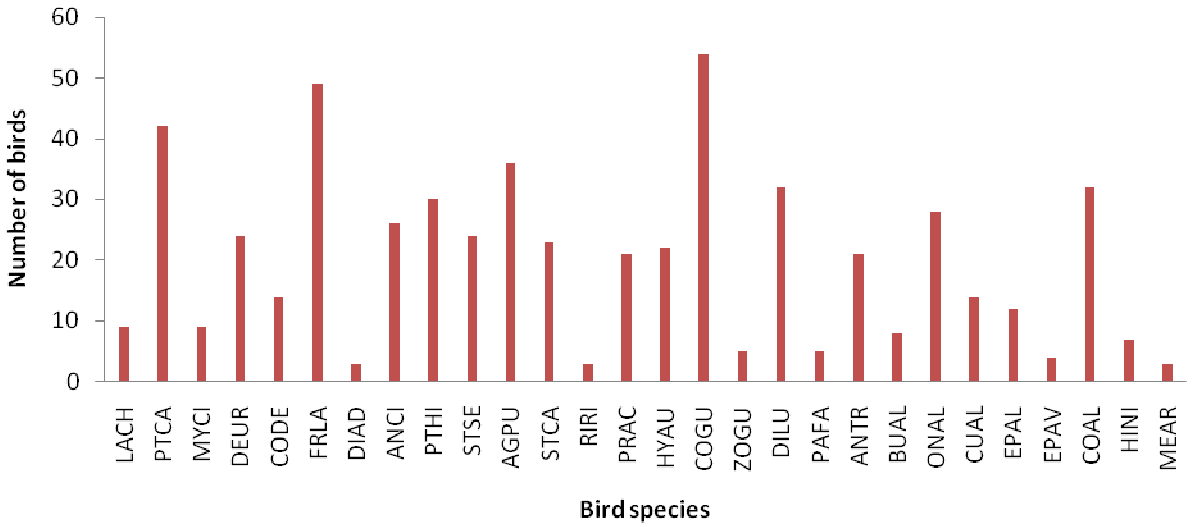

Figure 2. Total bird species abundance of Endakidanemeheret church forest, November 2011 -March 2012. *LACH = Lamprotornis chalcurus, PTCA = Pternistis castaneicollis, MYCI = Myrmecocichla cinnamomeiventris, DEUR = Delichon urbicum, CODE = Columba delegorguei, FRLA = Francolinus lathami, DIAD = Dicsruru adsimilis, ANCI = Anthus cinnamomeus, PTHI = Pternistis hildebrandti, STSE = Stigmatopelia senegalensis, AGPU = Agapornis pullarius, STCA = Streptopelia capicola, RIRI = Riparia riparia, PRAC = protornis acuticaudus, HYAU = Hyliota australis, COGU = Columba guinea, ZOGU = Zoothera guttata, DILU = Dicrurus ludwigii, PAFA = Parus fasciiventer, ANTR = Anthus trivialis, BUAL = Bubalornis albirostris, ONAL = Onychognathus albirostris, CUAL = Columba albitorques, EPAL= Epthianura albifrons, EPAV= Epthianura avbifrons, COAL= Columba albinucha, HINI = Hirundo nigrita and MEAR = Melaenornis ardesiacus.*

richness and abundance were expressed as the number of species and the total number of individual of a species within each church forest respectively. The community structure of bird species (species diversity) was described in terms of Shannon-Wiener diversity Index [H' = -∑ (pi*lnpi)] and species evenness is H' = H'/ lnS (Kathleen et al., 2005). T-test was used to compare the mean bird species diversity of the three church forests.

The community similarity of bird species of the church forests was assessed using Sorensen's coefficient which is, S = 3C/ A+B+C (Jeffery et al., 2004). P-values of less than 0.05 were considered to be statistically significant. Birds observed for 25% and more of the study period were considered as residential birds (Karr, 1986) and only those birds were considered for analysis. Bird species observed once in one of the sites were considered as accidental visitors and removed from analysis.

RESULTS

Bird community composition and abundance

Endakidanemeheret Church forest (Abergelle)

A total of 560 individual birds belonging to 28 species, 13 families and 4 orders were recorded from this church forest. The most abundant species was speckled pigeon (*Columba guinea*) (10%) and less abundant species were Fork tailed drongo (*Dicsruru adsimilis*) (1%), Sand martin (*Riparia riparia*) (1%) and Yellow eyed black flycatcher (*Melaenornis ardesiacus*) (1%) (Figure 2).

Two (7%) of the total species recorded were found to be endemic to Ethiopia, namely: White collared pigeon (*Columba albitorques*) and White billed starling (*Onychognathus albirostri*). Among the 4 orders recorded, Passeriformes was represented by the highest number of species (16 species) and Galliforms and Psittaciformes were represented by three species each (Table 1). The highest number of species (86%) was recorded in November and lowest (43%) in February (Figure 3).

The Shannon-Weiner diversity index indicated that, more species diversity (H' = 2.89) was in December and less (H' = 2.05) in November (Figure 4).

Michael Church forest (Hagereselam)

A total of 600 individual birds belonging to 22 species 13 families and 6 orders were recorded from this church forest (Table 1). The most abundant species (14%) was Speckled pigeon (*Columba guinea*) and less abundant species (1%) were Palm nut vulture (*Gypohierax angolensis*), Eastern honey bird (*Pernis orientalis*) and Tree pipit (*Anthus trivialis*) (Figure 5).

Three (0.5%) of the total species recorded were endemic to Ethiopia, namely: Ruppell's chat (*Myrmecocichla melaena*), White collared pigeon (*C. albitorques*) and White billed starling (*O. albirostri*).

Among the 6 orders recorded, Passeriformes was represented by the highest species (14 species) and

Table 1. List of bird species recorded from the three study sites (Endakidanemeheret (Abergelle), Michael (Hagereselam) and Giorgis (Korem) church forests, November 2011 - March 2012.

S/No.	Common name	Scientific name	Family	Order	Church forests		
					E/k/meheret	Michael	Giorgis
1	Afeb pigeon	*Columba unicincta*	Columbidae	Columbiformes	X	X	✓
2	African green pigeon	*Treron calvus*	Columbidae	Columbiformes	X	✓	✓
3	African pied wagtail	*Motacilla aguimp*	Motacillidae	Passeriformes	X	✓	✓
4	African scopes owl	*Otus senegalensis*	Strigidae	Strigiformes	X	X	✓
5	African white backed vulture	*Gyps africanus.*	Accipitridae	Accipitriformes	X	X	✓
6	Blue headed bee eater	*Merops muelleri muelleri*	Meropidae	Coraciiformes	X	✓	X
7	Bronze tailed starling	*Lamprotornis chalcurus*	Sturnidae	Passeriformes	✓	✓	X
8	Cassin's honey bird	*Prodotiscus insignis*	Indicatoridae	Piciformes	X	X	✓
9	Chest nut napped francolin	*Pternistis castaneicollis*	Phasianidae	Galliformes	✓	X	X
10	Clapperton's francolin	*Pternistis clappertoni*	Phasianidae	Galliformes	X	X	✓
11	Cliff chat	*Myrmecocichla cinnantris*	Muscicapidae	Passeriformes	✓	X	X
12	Common house martin	*Delichon urbicum*	Hirundinidae	Passeriformes	✓	X	X
13	Common white throat	*Sylvia communis*	Sylviidae	Passeriformes	X	✓	✓
14	Dark caped yellow warbler	*Chloropeta natalensis*	Sylviidae	Passeriformes	X	X	✓
15	Eastern bronze napped pigeon	*Columba delegorguei*	Columbidae	Columbiformes	✓	X	X
16	Eastern green tinker bird	*Pogoniulus simplex*	Lybiidae	Piciformes	X	✓	X
17	Eastern honey bird	*Pernis orientalis*	Meliphagidae	Piciformes	X	✓	✓
18	Forest francolin	*Francolinus lathami*	Phasianidae	Galliformes	✓	✓	✓
19	Fork tailed drongo	*Dicsruru adsimilis*	Dicruridae	Passeriformes	✓	X	X
20	Grass land pipit	*Anthus cinnamomeus*	Motacillidae	Passeriformes	✓	X	X
21	Greater blue earned starling	*Lamprotornis chalybaeus*	Sturnidae	Passeriformes	X	X	✓
22	Grey apalis	*Apalis cinerea*	Cisticolidae	Passeriformes	X	✓	✓
23	Hildebrandits francolin	*Pternistis hildebrandti*	Phasianidae	Galliformes	✓	X	X
24	Honey guide green bull	*Baeopogon indicator*	Pycnonotidae	Passeriformes	X	✓	X
25	Laughing dove	*Stigmatopelia senegalensis*	Columbidae	Columbiformes	✓	X	X
26	Marsh sand piper	*Tringa stagnatilis*	Scolopacidae	Charadriiformes	X	X	✓
27	Mouse-colored pendulin tit	*Anthoscopus musculus*	Remizidae	Passeriformes	X	X	✓
28	Northern anteater chat	*Myrmecocichla aethiops*	Muscicapidae	Passeriformes	X	X	✓
29	Palm nut vulture	*Gypohierax angolensis*	Accipitridae	Falconiformes	X	X	✓
30	Red checked cordon-bleu	*Uraeginthus bengalus*	Estrildidae	Passeriformes	X	✓	X
31	Red headed love bird	*Agapornis pullarius*	Psittacidae	Psittaciformes	✓	X	X
32	Ring naked dove	*Streptopelia capicola*	Columbidae	Columbiformes	✓	X	✓
33	Ruppell's griffon vulture	*Gyps rueppellii*	Accipitridae	Falconiformes	X	X	✓
34	Ruppell's chat	*Myrmecocichla melaena**	Muscicapidae	Passeriformes	X	✓	✓
35	Sand martin	*Riparia riparia*	Hirundinidae	Passeriformes	✓	X	X
36	Scaly francolin	*Francolinus squamatus*	Phasianidae	Galliformes	X	✓	✓
37	Sharp tailed starling	*protornis acuticaudus*	Sturnidae	Passeriformes	✓	✓	X
38	Short earned owl	*Asio flammeus*	Strigidae	Strigiformes	X	X	✓
39	Simple green bull	*Chlorocichla simplex*	Pycnonotidae	Passeriformes	X	X	✓
40	Sooty chat	*Myrmecocichla nigra*	Muscicapidae	Passeriformes	X	✓	X
41	Southern hyliota	*Hyliota australis*	Sylviidae	Passeriformes	✓	X	X
42	Speckled pigeon	*Columba guinea*	Columbidae	Columbiformes	✓	✓	✓
43	Spotted eagle owl	*Bubo africanus*	Strigidae	Strigiformes	X	X	✓
44	Spotted ground thrush	*Zoothera guttata*	Sturnidae	Passeriformes	✓	X	X
45	Square tailed drongo	*Dicrurus ludwigii*	Dicruridae	Passeriformes	✓	X	X
46	Stresemann's bush-crow	*Zavattarioris stressemanni**	Corvidae	Passeriformes	X	X	✓
47	Stripe breasted tit	*Parus fasciiventer*	Paridae	Passeriformes	✓	X	X
48	Thick-billed raven	*Corvus crassirostris**	Corvidae	Passeriformes	X	X	✓
49	Tree pipit	*Anthus trivialis*	Motacillidae	Passeriformes	✓	✓	X
50	Tropical boubou	*Laniarius aethiopicus*	Malaconotidae	Passeriformes	X	X	✓

Table 1. Contd.

51	Velvet mantled drongo	*Dicrurus modestus*	Muscicapidae	Passeriformes	X	✓	X
52	Walberg's honey bird	*Prodotiscus regulus*	Indicatoridae	Piciformes	X	X	✓
53	White billed buffalo weaver	*Bubalornis albirostris*	Ploceidae	Psittaciformes	✓	X	X
54	white billed starling	*Onychognathus albirostris**	Sturnidae	Passeriformes	✓	✓	✓
55	White breasted negro finch	*Nigrita fusconotus*	Estrildidae	Passeriformes	X	✓	X
56	White collared pigeon	*Columba albitorques**	Columbidae	Columbiformes	✓	✓	✓
57	White faced scopes owl	*Otus senegalensis*	Strigidae	Strigiformes	X	X	✓
58	White fronted black chat	*Epthianura albifrons*	Muscicapidae	Passeriformes	✓	X	X
59	White fronted chat	*Epthianura albifrons*	Muscicapidae	Passeriformes	✓	X	X
60	White headed black chat	*Myrmecocicha amotti*	Muscicapidae	Passeriformes	X	X	✓
61	White headed vulture	*Trigonoceps occipitalis*	Accipitridae	Falconiformes	X	X	✓
62	white napped pigeon	*Columba albinucha*	Columbidae	Columbiformes	✓	X	✓
63	White throated blue swallow	*Hirundo Nigrita*	Hirundinidae	Psittaciformes	✓	X	X
64	Wood house's ant pecker	*Parmoptila woodhouse*	Estrildidae	Passeriformes	X	✓	X
65	Yellow eyed black flycatcher	*Melaenornis ardesiacus*	Muscicapidae	Passeriformes	✓	X	X

E/k/meheret = Endakidanemeheret, * = endemic species, X =absence of species, and ✓ = presence of species in the study site.

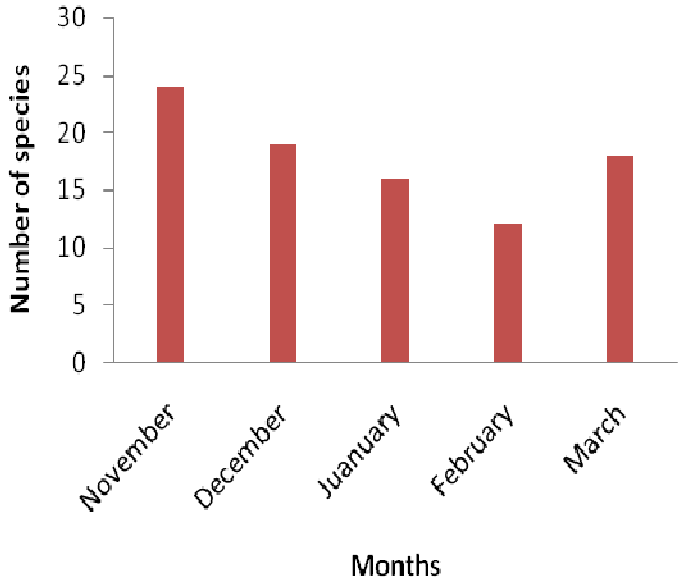

Figure 3. Monthly number of bird species recorded in Endakidanemeheret Church forest, November 2011 to March 2012.

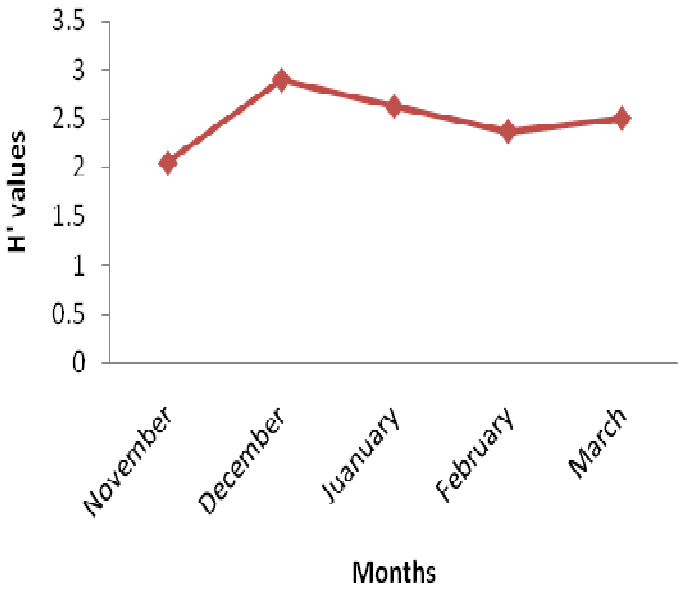

Figure 4. Monthly Shannon-Wiener diversity index (H') values of Endakidanemeheret Church forest, November 2011 to March 2012.

Coraciiform and Falconiforms were represented by one species each (Table 1). The highest number of species (77%) was recorded in November and the least (41%) was recorded in March (Figure 6).

The Shannon-Weiner diversity index indicated that, more species diversity (H' = 2.59) was in January and the least (H' = 2.12) in March (Figure 7).

There was no significant difference in bird diversity between church forest and Endakidanemeheret Church forests (t = -0.361, df = 4, p = 0.737).

Giorgis Church forest (Korem)

A total of 1516 individual birds belonging to 35 species 16 families and 8 orders were recorded from this church forest (Table 1). The most abundant species (7.7%) was African white backed vulture (*Gyps africanus*) and the less abundant species (0.2%) was Northern anteater chat (*Myrmecocichla aethiops*) (Figure 8).

Five (14%) of the total species recorded were found to be endemic to Ethiopia, namely: Ruppell's chat (*M. melaena*), Stresemann's bush crow (*Zavattarioris*

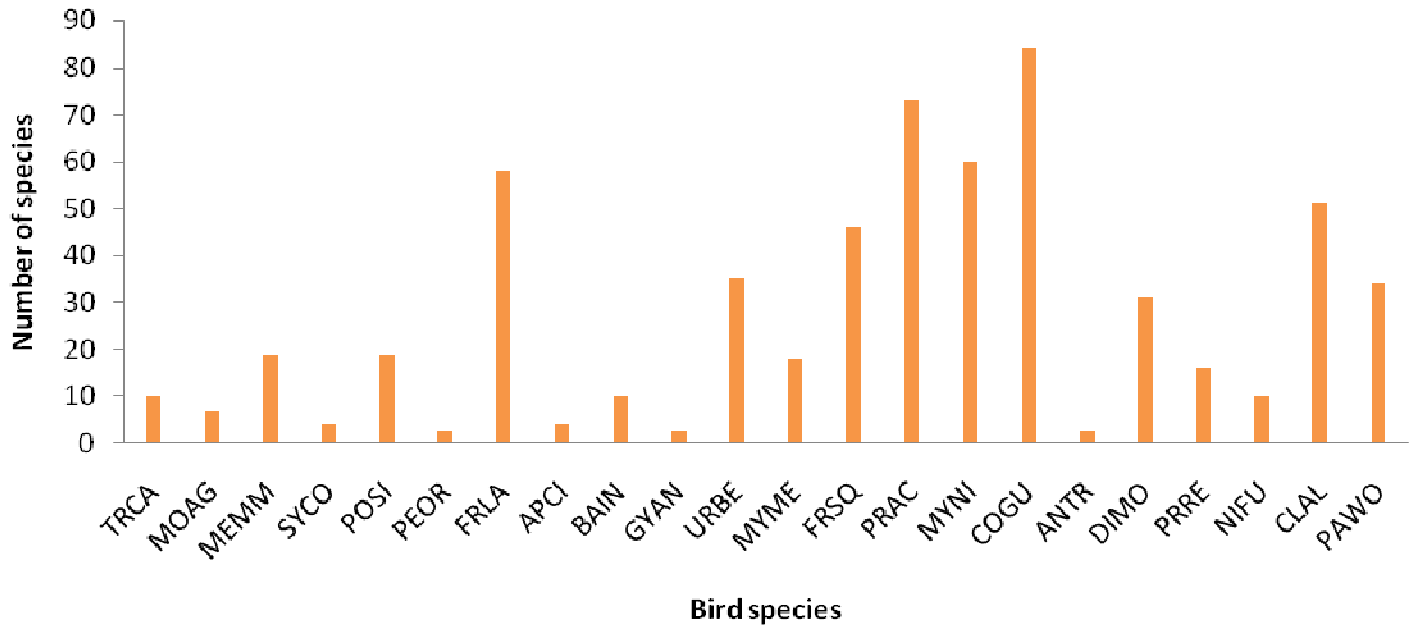

Figure 5. Total bird species abundance of Michael Church forest, Hagereselam, November 2011 - March 2012. *TRCA = Treron calvus, MOAG = Motacilla aguimp, MEMM = Merops muelleri muelleri, SYCO = Sylvia communis, POSI = Pogoniulus simplex, PEOR = Pernis orientalis, FRLA = Francolinus lathami, APCI = Apalis cinerea, BAIN = Baeopogon indicator, GYAN = Gypohierax angolensis, URBE = Uraeginthus bengalus, MYME = Myrmecocichla melaena, FRSQ = Francolinus squamatus, PRAC = protornis acuticaudus, MYNI = Myrmecocichla nigra, COGU = Columba guinea, ANTR = Anthus trivialis, DIMO = Dicrurus modestus, PRRE = Prodotiscus regulus, NIFU = Nigrita fusconotus, CLAL = Columba albitorques and PAWO = Parmoptila woodhouse.*

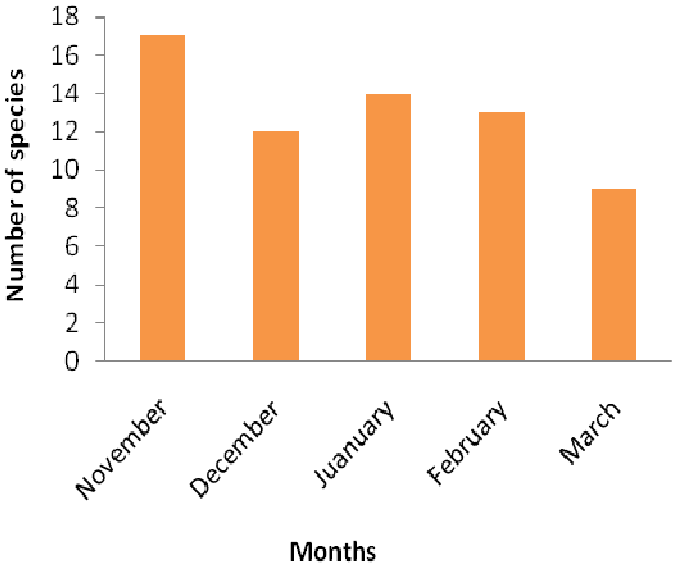

Figure 6. Monthly number of bird species recorded in Michael church forest, Hagereselam, November 2011 - March 2012.

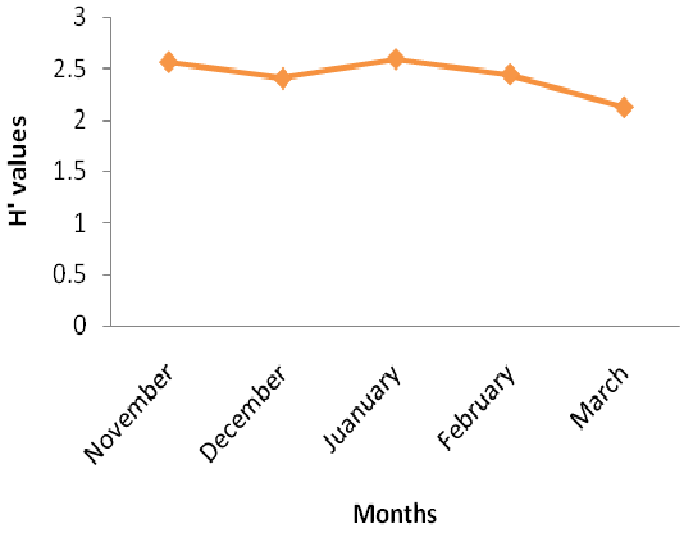

Figure 7. Monthly Shannon-Wiener diversity index (H') values of Michael Church forest, November 2011 to March 2012.

stressemanni), Thick billed raven (*Corvus crassirostris*), White collared pigeon (*C. albitorques*) and White billed starling (*O. albirostri*).

Among the 8 orders recorded, Passeriformes was represented by the highest species (14 species) and Accipitriformes and Charadriiforms were represented by one species each (Table1). The highest number of species (83%) was recorded in November and the least (54%) in February (Figure 9).

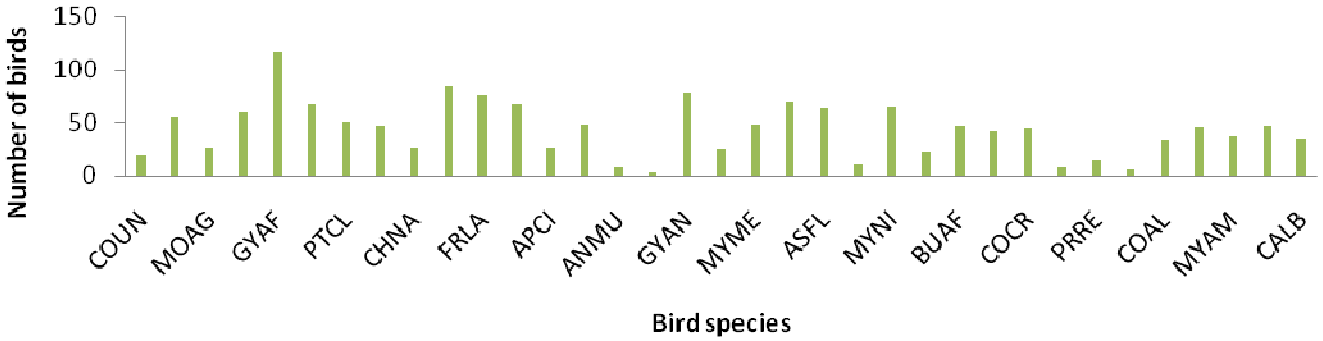

Figure 8. Total bird species abundance of Giorgis Church forest, November 2011 to March 2012. *COUN = Columba unicincta, TRCA = Treron calvus, MOAG = Motacilla aguimp, OTSE = Otus senegalensis, GYAF = Gyps africanus, PRIN = Prodotiscus insignis, PTCL = Pternistis clappertoni, SYCO = Sylvia communis, CHNA = Chloropeta natalensis, PEOR = Pernis orientalis, FRLA = Francolinus lathami, LACH = Lamprotornis chalybaeus, APCI = Apalis cinerea, TRST = Tringa stagnatilis, ANMU = Anthoscopus musculus, MYAE = Myrmecocichla aethiops, GYAN = Gypohierax angolensis, GYRU = Gyps rueppellii, MYME = Myrmecocichla melaena, FRSQ = Francolinus squamatus, ASFL = Asio flammeus, CHSI = Chlorocichla simplex, MYNI = Myrmecocichla nigra, COGU = Columba guinea, BUAF = Bubo africanus, ZAST = Zavattarioris stressemanni, COCR = Corvus crassirostris, LAAE = Laniarius aethiopicus, PRRE = Prodotiscus regulus, ONAL = Onychognathus albirostris, COAL = Columba albitorques, OTSE = Otus senegalensis, MYAM = Myrmecocicha amotti, TROC = Trigonoceps occipitalis and CALB = Columba albinucha.*

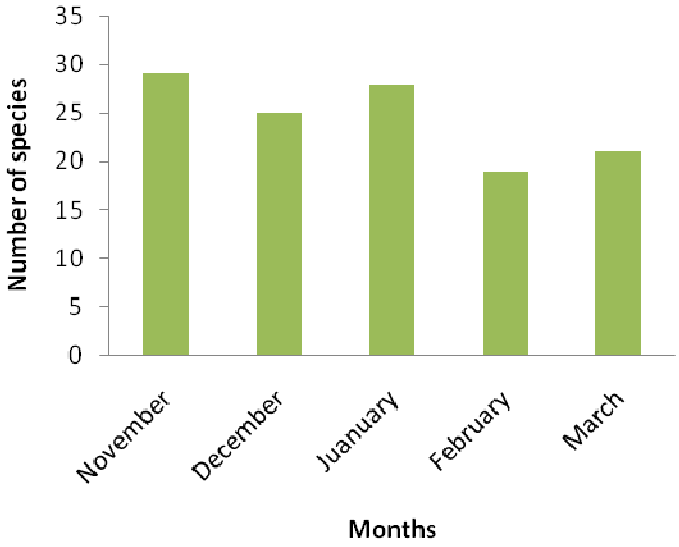

Figure 9. Monthly number of bird species recorded in Giorgis Church forest, November 2011 to March 2012.

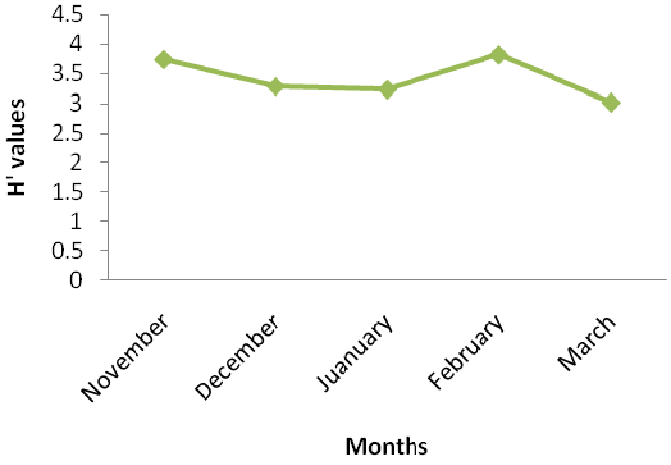

Figure 10. Monthly Shannon-Wiener diversity index (H') values of Giorgis Church forest, November 2011 to March 2012.

The Shannon-Weiner diversity index indicated that, more species diversity (H' = 3.82) was in February and the least (H' = 3.01) in March months (Figure 10).

There was significant difference in bird diversity of between this church forest with Michael Church forest ($t = 7.707$; $df = 4$; $p<0.05$) and with Endakidanemeheret Church forests ($t = 3.492$; $df = 4$; $p<0.05$).

The evenness values of the bird community of Endakidanemeheret, Michael and Giorgis Church forests is, E = 0.88, 0.96 and 1.1 respectively and their community similarity is 0.11.

DISCUSSION

Bird community composition and abundance

A total of 65 bird species (28 from Endakidanemeheret Church forest, 22 from Michael Church forest and 35 from Giorgis Church forest) were recorded. The species richness and abundance of birds varied between the three church forests possibly influenced by the variations in altitude and the type of vegetation. Of the total species, 4 species were common to the three church forests, 11 species were common to Giorgis and Michael Church forests, 6 species to Giorgis and Endakidanemeheret Church forests and 7 species were common to Michael

and Endakidanemeheret Church forests. 31% of the recoded total species (3% of endemic species) were in agreement with the previous findings of forest birds by Aerts et al. (2008) in Ethiopia and 3% with Simons et al. (2006) in United States.

Giorgis Church forest is diverse in plant composition and there is a forest in its eastern zone in addition to its own diverse plants compared to the other two church forests. This could be the reason for the presence of the more species richness and abundance of birds in the church forest.

The most abundant species from the three church forests was African white backed vulture (*G. africanus*) recorded from Giorgis church forest. This could be due to the presence of suitable plants for nesting and the presence of waste disposal site acting as feeding site near the church forest. The availability of food is responsible for higher species richness and abundance of birds in this church forest especially for African white backed vulture (*G. africanus*). This is in agreement with the findings of Hiwot Hibste (2007) that deals with the species composition, abundance and activity pattern of birds of Addis Ababa Abattoirs Enterprise. Although the abundance of birds changed from months to months, African white backed vulture (*G. africanus*) remained numerically the most abundant species throughout the study period in church forest. The second most abundant species was Eastern honey bird (*Pernis orientalis*). This could be because of the presence of a lot of honey bees in the very old *J. procera* trees which are very important food source of this species.

Species belonging to Passeriformes were the most abundant in the present study areas as reported by Girma et al. (2011) which compared terrestrial bird community structure in the undisturbed and disturbed areas of the Abijata Shalla Lakes National Park, Ethiopia.

Larger forest patches supported more bird species than smaller ones as reported by Suarez-Rubio and Tomlinson (2009) of forest birds in India. This is consistent with the present finding that the higher in plant composition supports the greater bird species (Giorgis Church forest). Giorgis Church forest, as expected due to the altitude and plant composition difference from the two forest churches, had more birds compared to the rest two church forests. Variation in Altitudinal distribution of birds by Mallet-Rodrigues et al. (2010) in a mountainous region in south-eastern Brazil observed that more bird species were recorded from the low altitudes compared to the mid and high altitude. This is not consistent with the current finding in which variations of the agroclimate of the study sites makes a difference in bird species richness and abundance.

The overall community similarity of the three church forests were very low (CC= 0.11). This indicates that bird community composition of the three church forests were strongly dissimilar. The highest species evenness (1.08) was observed in Giorgis Church forest compared to the other two church forests. This could be due to the presence of better food availability in the church forest. Less mean species evenness (0.88) was observed in Endakidanemeheret Church forest, which indicates there is an unbalanced distribution of the number of individuals among different species. This unevenness in bird species richness can be partly attributed to differences in the habitat type and quality (Marie et al., 2008).

No significant difference in diversity of bird species between Michael and Endakidanemeheret Church forests and a significant difference in diversity of bird species between Giorgis Church forest with Michael Church forest and with Endakidanemeheret Church forests could be due to the less food/fruit/ availabilities of these church forests compared to the third (Giorgis church forest). The less food availability probably could lead to less richness and abundance of species (Parrini et al., 2008).

CONCLUSIONS AND RECOMMENDATIONS

The Ethiopia Orthodox Tewahido Church forests are favourable places for birds to inhabit and a good access for food resources. The present study showed that the three church forests support more number of bird species belonging to different families and orders. Therefore, urgent conservation measure of the wildlife habitat management may help to conserve bird species of the church forests.

ACKNOWLEDGEMENTS

The study was sponsored by Mekelle University, Department of Biology. Special thanks go to Mrs. Kidan Gebrekiros, Mr. Getachew Mulualem, Eleni Areaya and Kiros Welegerima which made many useful comments that greatly improved the manuscript.

REFERENCES

Aerts R, Lerouge F, November E, Lens L, Hermy M, Muys B (2008). Land rehabilitation and the conservation of birds in a degraded Afromontane landscape in northern Ethiopia. Biodivers. Conserv. 17:53-69.

Alemayehu W, Demel T, Powell N (2005). Church forests in North Gondar Administrative Zone, northern Ethiopia. Forest Trees Livelihoods 15:49-74.

Ash JS, Gullic TM (1989). The present situation regarding endemic breeding birds of Ethiopia. Scopus 13:90-96.

Colwell M (2010). The Church in the forest. Conservation in Ethiopia. 18:2.

Environmental Protection Authority (EPA) (1997). The Conservation Strategy of Ethiopia. Action Plan for the Federal Policy on Environment. 7:4-9.

Ethiopian Wildlife and Natural History Society (1996). Important Bird Areas of Ethiopia: A First Inventory. Ethiopian Wildlife and Natural History Society, Addis Ababa, pp. 55-60.

Federal Democratic Republic of Ethiopia, National Metrological Agency (2012). Mekelle Branch, Tigray.

Girma M, Yosef M, Afework B (2011). A comparison of terrestrial bird

community structure in the undisturbed and disturbed areas of the Abijata Shalla Lakes national park, Ethiopia. Int. J. Biodivers. Conserv. 3:389-404.
Hiwot H (2007). Species composition, Abundance and Activity Pattern of Birds of Addis Ababa Abattoirs Enterprise, pp. 28-37.
Karr JR (1986). Seasonality resource availability and community diversity in tropical bird communities. Am. Nat. 110:937-974.
Kathleen A, Nolan K, Callahan JE (2005). The Shannon-Weiner Species Diversity Index. Beachcomber Biol. 27:334-338.
Lepage D (2006). Avibase-Bird Checklists of the World- Ethiopia. http://www.bsc- eoc.org. Accessed on 30/01/2012.
Leul K, Tamrat B, Sileshi N (2010). Vegetation Composition in Hugumbirda-Gratkhassu National Forest Priority Area, South Tigray. Momena Ethiop. J. Sci. 2:27-48.
Mallet-Rodrigues F, Parrini R., Pimentel SL, Bessa R. (2010). Altitudinal distribution of birds in a mountainous region in southeastern Brazil. Zologia 27:503-522.
Marie L, Paguntalan J, Godfrey JP (2008). Significant records of birds in forests on Cebu island, central Philippines. Fork tail 24:48-56.
Mason NW, Mouillot D, Lee WG, Wilson JB (2005). Functional richness, functional evenness and functional divergence: The primary components of functional diversity. Oikos 111:112-118.
Palacio–Nunez J, Verdu R. J, Galante E, Jimenez–Garcia D, Olmos–Oropeza,G (2007). Birds and fish as bioindicators of tourist disturbance in springs in semi–arid regions in Mexico: A basis for management. Anim. Biodivers. Conserv. 3:29-41.
Parrini R., Pacheco JF, Haefeli L (2008). Observation of the aves alimentando dos fruits of Melastomataceae (*Miconia sellowiana*) of Floresta Atlântica Alto-Montana do Parque Nacional the Serra dos orgaos e do Parque Nacional do Itatiaia, regiao Sudeste do Brasil. Atualidades Ornitologicas 146:4-7.
Pienkowski WM (1992). The impact of tourism on coastal breeding waders in western and southern Europe: An overview Pienkowski. Impact Tourism Coast. Breed. Waders 68:92-96.
Rajashekara S, Venkatesha GM (2011). Community composition of aquatic birds in lakes of Bangalore, India. J. Environ. Biol. 32:77-83.
Redman CJ, Johnes M, Marsden S (2009). Expedition Field Techniques: Bird Surveys. Expedition Advisory Center Royal Geogr. Soc. 1:134-137.
Sharma S, Rikhari HC, Palni LM (1999). Conservation of natural resources through religion: A case study from Central Himalaya. Soc. Nat. Res. 12:599-612.
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 LakeTana, Ethiopia. Trop. Ecol. 49:199-209.
Simons RT, Shriner AS, Farnsworth LG (2006). Comparison of breeding bird and vegetation communities in primary and secondary forests of Great Smoky Mountains National Park. Biol. Conserv. 129:302-311.
Suarez-Rubio M, Tomlinson RJ (2009). Landscape and patch-level factors influence bird communities in an urbanized tropical island. Biol. Conserv. 142:1311-1321.
Taye T, Kumulachew Y, Getachew B, Sisay Z (1998). Forest Biodiversity Conservation: Perspectives of the Ethiopian Orthodox Tewahido Church. Institute of Biodiversity Conservation and Research, Addis Ababa Ethiopia, pp. 23-43.
Terry S, John F (2002). Field guide to the birds of east Africa Kenya, Tanzania, Uganda, Rwanda, Burundi.
Yilma A, Geheb K (2003). Wetlands of Ethiopia. Proceedings of a seminar on the resources and status of Ethiopia's wetlands 1:5-9.