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SPECIES COMPOSITION, RELATIVE ABUNDANCE AND DISTRIBUTION OF THE AVIAN FAUNA OF ENTOTO NATURAL PARK AND ESCARPMENT, ADDIS ABABA

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ABSTRACT: A study on avian species composition, relative abundance, diversity and distribution at Entoto Natural Park and escarpment was carried out during July 2009 - March 2010. The study area was stratified based on vegetation composition. Four habitat types: forest (rehabilitation and nursery areas), farmland, church compound (St. Mary's and St. Raguel Churches) and eucalyptus plantation were considered. Point count method was employed for forest habitat and eucalyptus plantation, line-transect method for farmland and total count method was used for the church compound. T-test and ANOVA were applied for analysis of the effect of season and habitats on abundance of species. As a result, 124 avian species belonging to 14 orders and 44 families were identified in the study area during the wet (July, 2009 to October, 2009) and dry season (December, 2009 to March, 2010) surveys. The average temperature and rainfall for wet and dry seasons were 7.5°C and 315 mm and 20.5°C and 9 mm, respectively. During the dry season, highest avian diversity was observed in the farmland habitat (H'=3.73), followed by the forest (H'=2.92), whereas during the wet season, highest avian diversity was observed in the forest habitat (H'=3.98), followed by church compound (H'=3.25). Highest number of species was recorded on farmland and forest habitats during the dry and wet seasons. Simpson's Similarity Index showed the highest species similarity between forest and farmland during both wet and dry seasons. There was no significant difference between seasons and habitats in the abundance of birds in these habitats. However, wet season had an effect on the avian abundance in eucalyptus plantation ($t=2.952$, $P<0.05$). Eucalyptus plantation, soil erosion, deforestation, habitat fragmentation, settlement and land degradation were the main threats for the distribution of birds in the present study area.

Keywords/phrases: Bird diversity, Entoto Natural Park, Species similarity

INTRODUCTION

Ethiopia has diverse sets of ecosystems, ranging from humid forest and extensive wetlands to deserts, such as Afar depression, supporting a wide variety of life forms (Hillman, 1993; EWNHS, 1996; Viveropol, 2001). The high and rugged mountains, deep gorges and vast rolling plains of the country show its topographic diversity (Yalden, 1983). The altitudinal difference, with the peak at Ras Dashen (4620 m asl) and 116 m below sea level in the Afar depression, is the main reason that made Ethiopia one of the very few countries rich in biodiversity (Hillman, 1993; EWNHS, 1996).

Wide ranges of altitudes in Ethiopia have given the country a variety of ecologically distinct areas with three climatic zones (tropical, subtropical and temperate zones) that led to the diversification of endemic species (EWNHS, 1996). Topographic variability and temperature are identified as important predictors of avian species richness (Karr, 1976; 1980; Davies *et al.*, 2007).

There are over 1850 species of birds in Africa, of these 926 are found in Ethiopia. Among the avian species that occur in Ethiopia, 16 are endemic (Redman *et al.*, 2009). Including the endemics, 665 species are residents, 30 are migratory breeding in the Palaearctic region and 69 are mainly African (south of the Sahara desert) or tropical species which also occur in the Palaearctic region. There are 199 Palaearctic winter visitors in Ethiopia, including 21 passage migrants. Of these, 169 are only visitors with no resident forms. There are 47 species, which migrate within the African continent, with few

Palaearctic migrant forms (Urban and Brown, 1971).

In terms of the avian fauna, Ethiopia is one of the most significant countries in the mainland Africa (World Conservation Monitoring Centre (WCMC, 1991; 1995). Since Ethiopia contains a wide variety of habitats, including high mountains, grasslands, deserts and lowlands, the distribution of bird species in the country is quite complex (Urban, 1980). Most of the the birds that are found in Ethiopia are not investigated.

One of the important bird areas (IBAs) in Ethiopia is Entoto Natural Park and escarpment, which borders Addis Ababa and Oromiya regions (BLI, 2009). Entoto area and its surroundings have high elevation with a diverse flora and fauna. The area is mostly covered with eucalyptus plantation, grazing area and cultivations of barley. Over the years, the diversity in this area has been affected as a result of various natural and anthropogenic threats. This increases the threat for avian species from time to time. The present study is, therefore, aimed at understanding the current species composition, diversity, relative abundance and distribution of birds at Entoto Natural Park and escarpment.

THE STUDY AREA AND METHODS

The study area

Entoto Natural Park and escarpment is located between latitudes 9°04′N - 9°06′N and longitudes 38°44′E - 38°49′E (Fig. 1), and covers an area of 1300 ha on the southeast facing slopes of Mt. Entoto, between the northern limit of the city of Addis Ababa and the track along the mountain ridge. The topographic feature of the study area is composed of rolling terrain with average elevation of 2800 m asl, which ranges from 2500 to 3100 m asl (SWARDO, 2007). The foothills of the Entoto mountain range has a similar geologic makeup with that of the top of the mountain and consists of volcanic rocks, reddish rhyolite, trachytes, ignimbrites, tuffs, welded tuffs and black obsidian (SWARDO, 2007). The natural vegetation is Afro-montane forest. Where drainage is impeded, there occurs woodland with open meadows. The original forest vegetation consisted of *Juniperous excelsa* with groves of *Olea europaea* subsp.-*cuspidata,* scattered *Hagenia abyssinica, Hyericum revolutum, Podocarpus falcatus, Ficus* spp., *Acacia abyssinica, Rosa abyssinica* and *Erythrina brucei*. This has been modified as a result of anthropogenic activities. At present, most of the area is covered with *Eucalyptus globulus* plantation as substitute for firewood.

Methods

A preliminary survey of birds in and around the Entoto Natural Park and escarpment was carried out at the beginning of July 2009 to gather basic information about the area. The actual study was carried out from July 2009 to March 2010 encompassing both wet and dry seasons. Random sample sites, representing each habitat type, were selected based on stratified random sampling method. Based on the vegetation structure, the study area was categorized into four habitats. These are forest habitat (rehabilitated and nursery area), farmland, eucalyptus plantation and church compounds (Entoto Mariam and Entoto Saint Raguel churches). Point count method was employed for forest habitat and eucalyptus plantation since the two habitats cover large area. Besides, the habitats are too dense to cover the whole area. A line transect method was applied for farmland because the crops are planted along the line making accessibility and identification easier. Total count method was used for church compounds because the sizes of the churches are small and easily manageable to have the whole count (Lack, 1966).

Point count method was undertaken from a fixed location within the sample unit of radius 15 to 20 m with a fixed time interval consisting of 5–10 minutes. To minimize disturbance during counts, a waiting period of 3–5 minutes prior to counting was applied. Where point count technique was employed, the radial distance from which birds occurred was estimated and the type and group number of the species were observed using binoculars. Large number of point count locations (> 20) was identified from each study plot. There were 9 grids in forest and eucalyptus plantations. In each block, 35 point count stations were identified. In each point count station, a minimum distance of 150–200 m was maintained using GPS to avoid double counting (Sutherland, 1996).

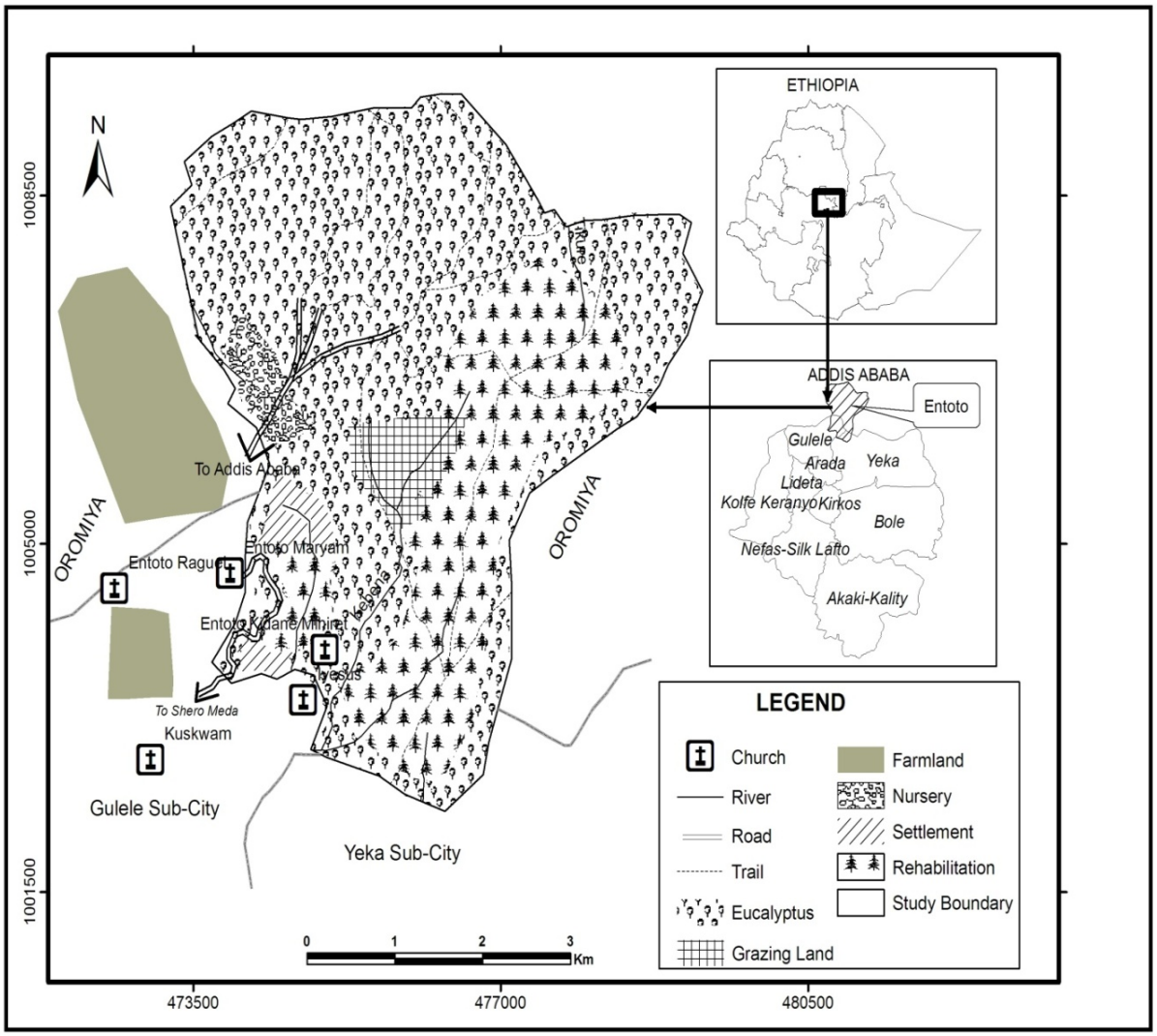

Fig. 1. Location map of the study area with different habitats.

In the farmland, six grids, each with 1 km^2 area were sampled. In each grid, four transect lines, each with a length of 1 km, were located. Birds heard and observed within 25 m on either side of the transect line were recorded. Transect lines within a grid were 250–300 m apart from each other to avoid double counting (Bibby *et al.*, 1992/1998; Hostler and Martin, 2006). The compounds of the two churches are about 1 km apart.

Data were taken for five days per week depending on the weather conditions and time of the day when bird species were active. Data were collected early in the morning (06:30–10:00 h) and late in the afternoon (15:30–18.00 h).

For identification of species, plumage pattern, size, shape, colour, songs and calls were considered as important parameters (Afework Bekele and Shimelis Aynalem, 2009). Binoculars as well as naked eyes were used for observation. Field data sheets were used to record the observations. Photographs were taken to confirm the identification of some of the species. Avian calls were recorded whenever possible using a tape recorder. The taxonomic groups of birds were categorized based on field guides (Williams and Peterson, 1963; Urban and Brown, 1971; Van Perlo, 1995; Williams and Arlott, 1996; Stevenson and Fanashawe, 2002; Sinclair and Ryan, 2003, Redman *et al.*, 2009).

Data analysis

Data obtained during the survey were analyzed using SPSS (2006) statistical package.

One way analysis of variance (ANOVA) was employed to see the effect of habitat composition on abundance of birds in a given season. Chi-square test was used to evaluate the habitat preference in each study site. Avian diversity of each habitat was analyzed using Shannon-Wiener diversity Index (H') (Shannon and Wiener, 1949). Simpson's Index (D) (Simpson, 1949) and relative abundance were determined following Bibby *et al*. (1998).

Encounter rate was calculated for each species by dividing the number of hours spent searching. Abundance category (the number of individuals per 100 field hour) was: < 0.1, 0.1–2.0, 2.1–10.0, 10.1–40.0 and 40+. Abundance score was given as 1 (Rare), 2 (Uncommon), 3 (Frequent), 4 (Common) and 5 (Abundant).

RESULTS

124 species of birds belonging to 14 orders and 44 families were identified in the study area. Among them, five were endemic to Ethiopia while 11 were shared between Ethiopia and Eritrea. The highest number of species was recorded for the family Turdidae (11), followed by Accipitridae (8) and Nectariidae (6). There were 1–5 species in the remaining families. The Order Passeriformes was the most dominant and largest with the highest number of families (18) and species (62). Four species were Intra-African migrants, 13 were Palearctic migrants and 81 were residents. Among the 124 avian species, 11 and 33 were recorded exclusively during the dry and wet seasons, respectively (Table 1).

Table 1. Bird species observed at Entoto Natural Park and escarpment (♠ Endemic, ☼ Endemic to Ethiopia and Eritrea, ♥ Palearctic Migrant, ♦ Intra-African Migrant, D = Dry season, W = Wet season, unmarked species are resident birds).

Family	Common Name	Scientific Name
Accipitridae	Augur Buzzard	*Buteo augur*
	Lizard Buzzard	*Kaupifalco monogrammicus*
	African Harrier Hawk	*Polyboroidees typus*
	Crowned Eagle D	*Strephanoaetus coronatus*
	African fish eagle D	*Haliacetus vocifer*
	Black Kite♦	*Milvus migrans*
	White-headed Vulture D	*Necrosyrets monachus*
	Red-Thighed Sparrow hawk	*Accepiter erythropus*
Alaudidae	Rufous-naped Lark	*Mirafa Africana*
	Thelka Lark	*Galenarida thelka*
	Crested Lark	*Galerida cristata*
	Obbia Lark	*Spizocorys obbiensis*
Anatadae	Blue-winged goose☼	*Cyanochen cyanoptera*
	Egyptian goose	*Alopochen aegyptica*
Apodidae	African palm Swift	*Cypsiurus parvus*
	Nyaza Swift	*Apus niansae*
	Alpine Swift	*Apus melba*
	Common swift♥	*Apus apus*
	White-rumped Swift	*Apus caffer*
Capitonidae	Banded barbet ☼ W	*Lybius undatus*
	Black-billed Barbet W	*Lybius guifsobalito*
Caprimulgidae	Mountain Nightjar	*Caprimulgus poliocephalus*
Charadritidae	White Fronted Sand Plover	*Charadrius marginatus*
	Spot-breasted plover	*Vanellus melanocephalus*
Ciconiidae	Yellow-billed strok D	*Mycteria ibis*
Cisticolidae	Singing Cisticola D	*Turdus olivaceus*
	Stout Cisticola	*Cisticola galactotes*
Coliidae	Speckled Mouse bird	*Colius stiatus*
Columbidae	Dusky Turtle Dove	*Streptopelia turtus*
	Red-eyed Dove	*Streptopelia lugens*
	Speckled Pigeon	*Columba guinea*
	White-collared Pigeon☼	*Columba albitorques*

Table 1. (Contd).

Family	Common Name	Scientific Name
Corvidae	Thick Billed Raven☼	*Corvus crassirostris*
	Pied Crow	*Corvus capensis*
	Fan-tailed Raven	*Corvus rhipidurus*
Cuculidae	Jacobin Cukoo ♦W	*Camator jacobinus*
Estrididae	Red-winged Pytiiia	*Pytilia phoenicoptera*
	Yellow-bielled Waxbill	*Estrida paludicola*
	Red-rumped Waxbill	*Estrida charmosyna*
	Red-billed firefinch	*Lagonossticta senegala*
Fringillidae	Yellow Fronted Canary	*Serinus mozambicus*
	Brown-rumped Seed eater W	*Serinus tristraitus*
	Streaky Seedeater	*Serinus striolatus*
	Black-headed Siskin♠	*Serinus nigriceps*
	African Citril	*Serinus citrinelloides*
Hirunidindae	Wire-tailed swallow	*Hirundo smithi*
	Rock martin W	*Hirundo fuligula*
	Blue swallow W	*Hirundo atrocaerulea*
	Common house martin♥ W	*Delichon urbicum*
	Ethiopian Swallow W	*Hirundo aethiopica*
Indicatoridae	Greater Honey Guide	*Indicator indicator*
	Lesser Honey Guide	*Indicator minor*
	Wahlberg's honey bird	*Prodotiscus regulus*
Laniidae	Common Fiscal	*Lanius collaris*
Laridae	Slender-billed Gull♥	*Larus genei*
Meropidae	Blue-breasted Bee-eater	*Merops variegates*
	Little Bee-eater	*Merops pusillus*
Monarchidae	African paradise flycatcher	*Terpsiphone viridis*
Montacillidae	Abyssinian Long Claw♠	*Macronyx flavicollis*
	Yellow wagtail♥	*Motacilla flava*
Muscicapidae	Abyssinian flycatcher☼	*Melaenoris chocaltina*
	Semi-collared flycatcher♥ D	*Ficedula semitorquata*
Musophagidae	Princeruspoli's Turaco	*Turaco ruspolii*
	White-cheeked Turaco	*Turaco leucotis*
Nectariniidae	Olive Sunbird	*Nectarinia olivacea*
	Tacazze Sunbird	*Nectarinia tacazze*
	Variable Sunbird	*Cinnyris vanuatu*
	Bronze Sunbird	*Nectarinia kilimensis*
	Collared Sunbird	*Anthreptes collaris*
	Scarlet-chested Sunbird	*Chalcomaitra senegalensis*
Oriolidae	African Black headed oriole	*Oriolus larvatus*
	African golden oriole♦	*Oriolus auratus*
	Ethiopian oriole☼	*Oriolus monacha*
	Blck headed forest oriole	*Oriolus monacha*
Pandionidae	Osprey ♥W	*Pandion haliaetus*
Paridae	White-backed black tit ☼D	*Parus leuconotus*
	Dusky tit D	*Parus funeruse*
Passeridae	Chestnet Sparrow W	*Passer eminibey*
	Swainson's Sparrow W	*Passer swainsonii*
Phasianidae	Moorland Francolin W	*Francolinus psilolaemus*
	Erckel's Francolin☼	*Francolinus erckelii*
	Common Quail♥	*Coturnix coturnix*
Phoeniculidae	Abyssinian Scimitarbil	*Rhinopomadtus minor*
	Violet-wood-hoopoe	*Phoeniculus damarensis*
Picidae	Abyssinian woodpecker♠ W	*Dendropicus abyssinicus*
Ploceidae	Spectacled weaver	*Ploceus ocularis*
	Rupell's weaver	*Ploceus galbula*
	Baglafech weaver	*Ploceus baglafecht*
	Yellow-mantled widowbird W	*Euplects macrourus*
	Fan-tailed widowbird W	*Euplects axillaris*

Table 1. (Contd).

Family	Common Name	Scientific Name
Psittacidae	Rose ringed parakeet	*Psittacula krameri*
	Red headed love bird☼	*Agapornis pullarius*
	Yellow-fronted parrot♠ D	*Poicephalus flavifrns*
	Black winged love bird	*Agapornis taranta*
Pycnonotidae	Northern Brownbul D	*Phyllastrephus strepitans*
	Common Bulbul W	*Mptacilla clara*
	Slender billed Greenbul♥	*Andropadus gracilirostris*
Ramizidae	Mouse colored penduline tit	*Anthscopus musculus*
Sternidae	Black tern ♥W	*Chlidonias niger*
Sturnidae	Sharpe's Starling W	*Cinnyricinclus femoralis*
	Common Starling W	*Sturnus vuldaris*
	Chestnet winged Starling W	*Onychognathu swalleri*
Sylvidae	Willow warbler ♥W	*Phylloscopus strochilus*
	Brown warbler W	*Sylvia borin*
	Brown woodland warbler W	*Phylloscopus umbrovirens*
	Wood warbler ♥W	*Phylloscopus sibilatri*
Threskiornithidae	Wattled Ibis☼	*Bostrychia carunculata*
	Hadada Ibis	*Bostrychia hadegash*
	Sacred Ibis ♦W	*Threskiornis aethiopicus*
Timaliidae	Abyssinian cat bird♠	*Parophasma galinieri*
	African hill barbbler	*Pseudoalcippe abyssinica*
Trogonidae	Narina Trogon W	*Apoloderma naria*
Turdidae	Olive Thrush	*Turdus philomelas*
	Abyssinian Ground Thrush	*Zoothera piaggiae*
	Mountain Thrush W	*Turdus abyssinicus*
	Blue-rock Thrush ♥W	*Monticola solitaries*
	Spoted palm Thrush W	*Cichladusa guttata*
	Groundscraper Thrush	*Psoohocichla litsipsirupa*
	Rupell's Robin Chat	*Cossypha semirufa*
	White crowned Robin Chat W	*Cossypha albicapilla*
	Moorland chat	*Cercomela sordida*
	White-winged cliff-chat ☼W	*Myrmecocichi semirufa*
	Pied Wheater ♥W	*Cossypha semirufa*
Zosteropidae	Montane White EyeD	*Zosterops poliogaster*

Variations in the number of bird species was observed among the four habitats. During the dry season, farmland had 46 and eucalyptus plantation had only 17 species. During the wet season, forest habitat possessed 56 species and eucalyptus plantation had 27 species (Table 2). During the dry season, highest avian diversity was observed in the farmland (H'=3.73), followed by the forest (H'=2.92) and church compounds (H'=2.86). The least diversity of avian species during the dry season was observed in the eucalyptus plantation (H'=2.74). The highest and lowest even distribution were observed in the farmland and eucalyptus plantation (E=0.97) and forest (E=0.80), respectively. During the wet season, highest avian diversity was observed in the forest (H'=3.98) followed by church areas (H'=3.25). The least diversity of avian species during the wet season was observed in the farmland (H'=2.82). The highest and the lowest even distribution during wet season were observed in the forest (E=0.99) and farmland (E=0.75), respectively.

Relative abundance of bird fauna among the four different habitats during wet and dry seasons indicated that 150 (52.4%) of the species were frequent, 32 (11.2%) were common, 26 (9.1%) were abundant, 74 (25.9%) were uncommon and 4 (1.4%) were rare (Table 3). During both dry and wet seasons, forest ($t=0.137$, $P> 0.05$), farmland ($t=-0.70$, $P>0.05$) and church compound ($t=0.662$, $P>0.05$) did not show significant difference in the abundance of avian species. However, wet season had an effect on avian abundance in eucalyptus plantation ($t=2.952$, $P < 0.05$) (Table 4).

Table 2. Bird species abundance, diversity and evenness during the wet (July, 2009-October, 2009) and dry (December 2009-March, 2010) seasons.

Habitat	Season	No. of species	Abundance	D	H′	E
Forest	Wet	56	2723	0.97	3.98	0.99
	Dry	39	2623	0.92	2.92	0.80
	Both	56	3913	0.97	3.96	0.98
Farmland	Wet	42	2718	0.95	2.82	0.75
	Dry	46	2305	0.96	3.73	0.97
	Both	46	3719	0.96	3.68	0.96
Church	Wet	34	1782	0.95	3.25	0.92
	Dry	25	2147	0.93	2.86	0.89
	Both	53	3292	0.97	3.91	0.98
Eucalyptus	Wet	27	406	0.96	3.2	0.97
	Dry	17	233	o.93	2.74	0.97
	Both	35	1141	o.97	3.59	1

D′=Simpson Diversity; H′= Shannon-Wiener diversity Index; E = Evenness.

Table 3. Relative abundance of species of birds during the wet and dry seasons.

		Rank				
Habitat	Season	Rare	Uncommon	Frequent	Common	Abundant
Forest	Dry	-	18	18	3	-
	Wet	-	22	30	1	3
Farmland	Dry	2	8	28	7	1
	Wet	-	2	20	11	9
Church	Dry	1	4	14	4	2
	Wet	-	6	18	4	6
Eucalyptus	Dry	1	6	8	2	-
	Wet	-	8	14	-	5

Table 4. Log-transformed abundance values of birds in different habitats during dry and wet season (Mean ± SE).

Habitat	Season	No. of Grids	M ± SE	Effect
Forest	Dry	9	291.4 ± 12	T = 0.137, P > 0.05
	Wet	9	302.6 ± 5.5	
Farmland	Dry	6	384.1 ± 6.61	T = -0.70, P > 0.05
	Wet	6	453.0 ± 10.6	
Church	Dry	2	1073.0 ± 13.5	T = 0.662, P > 0.05
	Wet	2	891 ±7.8	
Eucalyptus	Dry	9	25.9 ± 1.64	T = 2.952, P < 0.05
	Wet	9	45.5 ± 1.34	

T stands for a pair-wise t-test which is a statistical instrument to see the variations of abundance of birds between two variables (seasons); P is statistically significant/not significant effect of seasons on habitats.

Based on the family groups, birds showed variation in the distribution among the four habitat types. Columbidae, Estrildidae, Ploceidae and Turididae were the most abundant families in the present study area. The highest number of families was observed in the church compound followed by forest. The least number of families was recorded in the farmland habitat.

DISCUSSION

The distribution of birds within the four habitat types varied among each other at family level. The highest number of families was observed in the church compound followed by the forest habitat. This might be due to the high vegetation complexity and floristic composition of the habitats. The least number of families was recorded in the farmland. Telleria and Santos (1994) pointed out that habitat structure affects the distribution of individual species. Besides, habitat size (Willis, 1979), foraging modes (Marone, 1991) and floristic composition (Wiens and Rotenberry, 1981) have influence in the distribution of the species.

The highest number of avian species was observed in the forest habitat. This is probably due to the diversity of vegetation that provided heterogeneous habitat for different avian species. The farmland had also high number of species because of the availability of food. The presence of resources, especially adequate food supply can increase the abundance of bird species at a given area. Chace and Walsh (2006) indicated that birds respond to changes in vegetation composition and structure, which in turn affects their food resources. Areas outside the Entoto Park can potentially provide suitable habitats, resource and food. In contrast, the lowest number of species was observed in eucalyptus plantation. This is probably due to the allelopatic effect of the eucalyptus. This in turn affects bird species that depend on it. MacArthur and MacArthur (1961) have stated that the decline in the quality of habitat results in the loss of habitat leading to a decline in the resident avian fauna.

The second highest number of individuals was recorded in the farmland habitat during both seasons. This is due to the adaptability of birds to live in human-modified habitats, where food is available. The openness of the sites, compared to natural habitats with relatively dense vegetation cover, might have also contributed for easy identification of the species. Sisay Hailu (2008) also in his study indicated that, as open areas are easily accessible for locating birds. There was a significant variation in the number of avian species between seasons. In the study area, there is a predictable seasonal change in temperature and rainfall. During the wet season, the productivity and yield of habitats increases and in response to these, the species richness increases. Oindo *et al.* (2001), and McPherson and Jetz (2007) stated that in a predictable seasonally changing environment, different species may be suited to conditions at different times of the year. Hence, more species might be expected to exist in areas where seasonality has more effect.

During both seasons, the highest avian diversity was observed in the forest habitat followed by church areas. This is probably due to the presence of high vegetation structure and volume that support high avian diversity. As the number of vegetation layer increases, the number of available niches for birds also increases and so does the diversity of avian species. This is due to the different feeding habit of birds at each tree level leading to niche separation (MacArthur, 1964). The least diversity of avian species was observed in the eucalyptus plantation. In the case of the church area, the vegetation is free from anthropogenic effect and the vegetation structure is complex supporting diverse species composition.

The relative abundance of birds in the forest habitat showed large number of bird species grouped as uncommon. This might be due to the vegetation complexity and inconspicuousness of small birds. Thinh (2006) pointed out that each avian species in a given habitat such as forest has its own probability of being detected, which is usually less than 100%. Pomery and Dranzoa (1997) explained that many forest species are difficult to detect, especially those of understory. Besides, in eucalyptus plantation, only two avian species were grouped as common. This might be due to the impact of eucalyptus on the ecosystem like drying out of the surrounding habitat and the inhibitory effect of it minimizing the chance of other plants to grow. As a result, the availability of food resource declines. This has effect on the number of birds that depend on such habitats.

CONCLUSIONS

During both seasons, the highest species richness and individuals of birds species recorded in forest habitats. The Species diversity and species evenness was also high in the forest and farmland during wet and dry seasons, respectively. These show that both habitats are important for birds by providing the necessary

requirements like food, water and nesting and breeding sites. The seasonal variation in number of individual species and their distribution in the study area are also directly related to the types of habitats.

Entoto Natural Park and Escarpment has different mammals besides to birds. Thus, it can serve as important centre of biodiversity and tourist attraction. However the area has a long history of eucalyptus plantation, settlement, deforestation and erosion. *Eucalyptus* species have been introduced for satisfying the growing demand of wood for fuel, construction material and to reduce the pressure on the remaining natural vegetation. *Eucalyptus* trees demand large quantities of water, and areas that were previously seasonally wet and supporting a distinctive flora and fauna has now dried up. This leads to scarcity of water.

Removal of timber, twigs and leaves, which is used for fuel and grazing land for the livestock leads to erosion. Most who enter the biomass fuel business are poor and vulnerable members of the society such as women household heads, landless farmers, widowed/divorced poor women and orphaned children lacking other opportunities to secure their livelihood, are highly depend on forests for income generation. The deforestation of watersheds has resulted in loss of genetic resources, flooding and wood scarcity. Illegal settlements in the parks enable the people to have free access to entry and collect fuel wood.

Therefore, protection of the area is mandatory for wildlife conservation especially for birds to enrich their diversity, abundance and to maintain the natural ecological balance of the area.

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REFERENCES

1. Afework Bekele and Shimelis Aynalem (2009). Species composition, relative abundance and habitat association of the bird fauna of the montane forest of Zegie Peninsula and nearby Islands, Lake Tana, Ethiopia. *SINET: Ethiop. J. Sci*. **32:**45–56.
2. Bibby, C.J., Burgess, N.D. and Hill, D. (1992). *Bird Census Techniques*. Academic Press, London, 241 pp.
3. Bibby, C.J., Johnes, M. and Marsden, S. (1998). *Expedition Field Techniques: Bird Surveys*. The Expedition Advisory Centre Royal Geographic Society, London, 134 pp.
4. BLI (2009). *Important Bird Area Fact Sheet*: Entoto Natural Park and escarpment, Ethiopia. Downloaded from Data Zone at http://www.BirdLife.org on 5/2/2010.
5. Chace, J.F. and Walsh, J.J. (2006). Urban effects on native avifauna: A review. *Landscape urb. Plan*. **74**:46–69.
6. Davies, R.G., Orme, C.D., Storch, D., Olson, V.A., Thomas, G.H., Ross, S.G., Ding, J., Rasmussen, P.C., Bennett, P.M., Owens, I.P., Blackburn, J.M. and Gaston, K. J. (2007). Topography, energy and the global distribution of bird species richness. *Proc. Roy. Soc. B*. **274**:1189–1197.
7. Ethiopian Wildlife and Natural History Society (EWNHS) (1996). *Important Bird Areas of Ethiopia: A First Inventory*. Ethiopian Wildlife and Natural History Society, Addis Ababa, 300 pp.
8. Hillman, J.C. (1993). *Ethiopia: Compendium of Wildlife Conservation Information*, Vol. 1. Ethiopian Wildlife Conservation Organization, Addis Ababa, 454 pp.
9. Hostler, M.E. and Martin, M.B. (2006). *Florida Monitoring Program: Transect Method for Surveying Birds*. University of Florida press, Florida, 37 pp.
10. Karr, J. (1976). Seasonality, resource availability and community diversity in tropical bird communities. *Am. Nat*. **110**:973–994.
11. Karr, J. (1980). Geographical variations in the avifauna of tropical forest undergrowth. *Auk* **97**:23–298.
12. Lack, D. (1966). *Population Studies of Birds*. London, Claredon Press, Oxford, 213 pp.
13. MacArthur, R. and MacArthur, J. (1961). On bird species diversity. *Ecology* **42**:594–598.
14. MacArthur, R.H. (1964). Environmental factors affecting bird species diversity. *Am. Nat*. **98**:387–397.
15. Marone, L. (1991). Habitat features affecting bird spatial distribution in the montane desert of Argentina. *Austr. J. Ecol*. **1**:77–86.
16. McPherson, M.J. and Jetz, W. (2007). Type and spatial structure of distribution data and the perceived determinants of geographical gradients in ecology: the species richness of African birds. *Global Ecol. Biogeogr*. **16**:657–667.

17. Oindo, B.O., De By, R.A. and Skidmore, A.K. (2001). Environmental factors influencing bird species in Kenya. *Afr. J. Ecol*. **39**:295–302.
18. Pomery, D. and Dranzoa, C. (1997). Method of studying the distribution, diversity and abundance of birds in East Africa: some qualitative approaches. *Afr. J. Ecol*. **35**:110–123.
19. Redman, N., Stevenson. T. and Fanashawe. J. (2009). *Birds of the Horn of Africa*. Princeton University Press, Princeton and Oxford, 496 pp.
20. Shannon, C.E. and Wiener, N. (1949). *The Mathematical Theory of Communication*. The University of Illinois press, Urbana, 117 pp.
21. Simpson, E.H. (1949). Measurement of diversity. *Nature* **163:**688**.**
22. Sinclair, I. and Ryan, P. (2003). *Birds of Africa South of the Sahara: Field Guides.* Princeton University Press, Princeton, 759 pp.
23. Sisay Hailu (2008). Species composition, distribution, relative abundance and habitat association of Avifauna of Wof Washa National Forestry Priority Area, Ethiopia. M.Sc Thesis (unpublished), Addis Ababa University, 76pp.
24. SPSS (2006). Statistical Package for Social Sciences (SPSS), Version 15 application guide. SPSS Inc, Chicago.
25. Stevenson, T. and Fanashawe, J. (2002). *Birds of East Africa: Field Guide.* Christopher Helm Black Publishers, Ltd., London, 602 pp.
26. SWARDO (2007). Sululta Woreda Agriculture and Rural Development Office (SWARDO) Environmental management plan of Sululta Woreda., Unpublished document, Chancho, 274 pp.
27. Sutherland, W.J. (1996). *Ecological Census Techniques: A Hand book*. Cambridge University Press, Cambridge, 336 pp.
28. Telleria, J.L. and Santos, T. (1994). Factors involved in the distribution of forest birds in Iberian Peninsula. *Bird Study* **41**:161–169.
29. Thinh, V.T. (2006). Bird species richness and diversity in desert scrub. *Ecology* **5**:121–125.
30. Urban, E.K. (1980). *Ethiopia's Endemic Birds.* Ethiopian Tourism Commission, Addis Ababa, 30pp.
31. Urban, E.K and Brown, L.H. (1971). *A checklist of Birds of Ethiopia*. Haile Sellasie I University Press, Addis Ababa, 143 pp.
32. Van Perlo, B. (1995). *Birds of Eastern Africa*, *Collins Illustrated Checklist*. Harper Collins Publishers, London, 301pp.
33. Viveropol, J.L. (2001). *A Guide to Endemic Birds of Ethiopia and Eritrea*. Shama Books, Addis Ababa, 80 pp.
34. WCMC (1991). *Biodiversity Guide to Ethiopia*. World Conservation Monitoring Centre, Cambridge, 75 pp.
35. WCMC (1995). *Endangered Birds*. World Conservation Monitoring Centre, Chicago, 60 pp.
36. Wiens, J.A. and Rotenberry, J.J. (1981). Habitat association and community structure of birds in shrub-steppe environment. *Ecol. Monogr*. **51**:21–42.
37. Williams, G. and Arlott, N. (1996). *Field Guide to Birds of East Africa*. Harper Collins Publishers, Hong Kong, 416 pp.
38. Williams, J.G. and Peterson, T.G. (1963). *A Field Guide to the Birds of East and Central Africa*. Collins Clear-Type Press, London, 289 pp.
39. Willis, E.O. (1979). The composition of avian communities in reminiscent woodlots in southern Brazil. *Auk* **90**:62–77.
40. Yalden, D.W. (1983). The extent of high ground in Ethiopia compared to the rest of Africa. *SINET: Ethiop. J. Sci*. **6**:35–39.