

Diversity, Distribution and Relative Abundance of Avian Fauna in and Around Zengo Forest, East Gojjam, Ethiopia

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ABSTRACT

Species composition, relative abundance and distribution of avian fauna in and around Zengo Forest was studied during September 2014 to March 2015. Data were collected using point count and line transect method during the wet and dry seasons. A total of 42 avian species belong to 22 families were identified in the study area during the wet and dry season. Highest number of species was recorded on farmland and forest habitats during the dry and wet seasons, respectively. The lowest value of avian fauna species similarity among vegetation types during both seasons had a value of 0.15, and the highest was observed between forest and farmland of 0.37. There was no significant difference among habitats ($F_{3, 1879} = 1.70, P > 0.05$). However season had an effect on avian fauna abundance in woodland habitat ($\chi^2 = 0.09, P < 0.05$). The present study revealed that Zengo Forest supports diversity of avian fauna species in different types of habitats. The importance of different habitats for avian species is providing the essential supplies such as food, water and nesting. Habitat destruction, deforestation, habitat fragmentation were the main threats for avian in the study area. Therefore, awareness creation and active community participation are essential for conserving the habitats and avian fauna of the area.

Key Words: Avian Fauna; Species Diversity; Zengo Forest.

INTRODUCTION

Ethiopia has diverse set of ecosystems, ranging from humid forest and extensive wetlands to deserts, at Afar depression, supporting a broad diversity of surviving forms (Viveropol 2001). The high mountains, gorges and enormous undulating plains of the country show its topographic variety (Yalden 1983). Ecological diversity and climatic variation of the country to a large extent are explained by its highly variable topography (Abebe and Geheb 2003).

Ethiopia has to 861 birds species of which 16 are endemic (Redman et al. 2009). And 19 bird species are globally susceptible (Avibase 2005). The country has about 665 species of residents, 30 are migratory breeding in the Palearctic region, and 69 are mainly African, which means south of the Sahara Desert (Moller 2012). Thus, the country is one of the most considerable areas

the mainland of Africa (WCMC 1995). The distribution of avian fauna in the country is moderately complex. Birds have provided to be admirable indicators of biodiversity and efficiency because they are easily seen and are relatively well known as compared to other animals. Birds are therefore, used to indicate how well a habitat functions (Donald et al. 2010).

Avian fauna species are more numerous than other vertebrates animals distributed on the earth. More than 50% of the existing species of avian fauna belongs to the family Passeriformes (Girma et al. 2011). In Ethiopia, different ecosystems of biological significance are threatened and need strong conservation action. The threats result in the expansion of seasonal cultivation, and the negative attitude of people in some areas towards birds. Thus, the number and quality of forest habitats are reduced and the population of different ecosystem dependent birds decreasing (Robert 2003). Therefore, the

present study focuses on diversity, distribution and abundance of avian fauna species in and around Zengo Forest, East Gojjam, Ethiopia.

MATERIALS AND METHODS

Study Area

Zengo Forest is located in East Gojjam Zone, which is 8 km away north-west of Amanuel town with an altitude ranging from 2250 m to 3000 m above sea level (average 2058 m). It lies between 10° 25' 6" to 10° 24' 9" N latitude and 37° 32' 7" to 37° 33' 9" E longitude. It has an area of 455 ha (Figure 1). Zengo Forest has different diversified flora and fauna. Topographically, the study area is made up of rolling terrain and contains both the highland and lowland of the basin and the landscape composed little plateau.

The dominant vegetation in this area is characterized by forest trees including *Ficus species*, *Albizia gummifera*, *Brucea antidysenterica*, *Cissampelos mucronata*, *Rumex abyssinicus*, *Acacia bussei*, *Buddleja polystachya*, *Carissa edulis*, *Dombeya torrid*, *Embelia schimperi*, *Rosa abyssinica*, *Rubus apetalus*. There are also other trees and climbers present in the forest. Agricultural lands are largely confined in the upland area with forest accessibility restricted to the steepest and the most inaccessible slop surrounding the reserve (Machakel Woreda Agriculture and Rural Development Office 2012).

METHODS

Before the actual data collection, pilot survey was conducted in and around Zengo forest in September 2014. The study area was stratified based on vegetation type. Sampling units along with different kinds of habitats were selected on the basis of stratified random

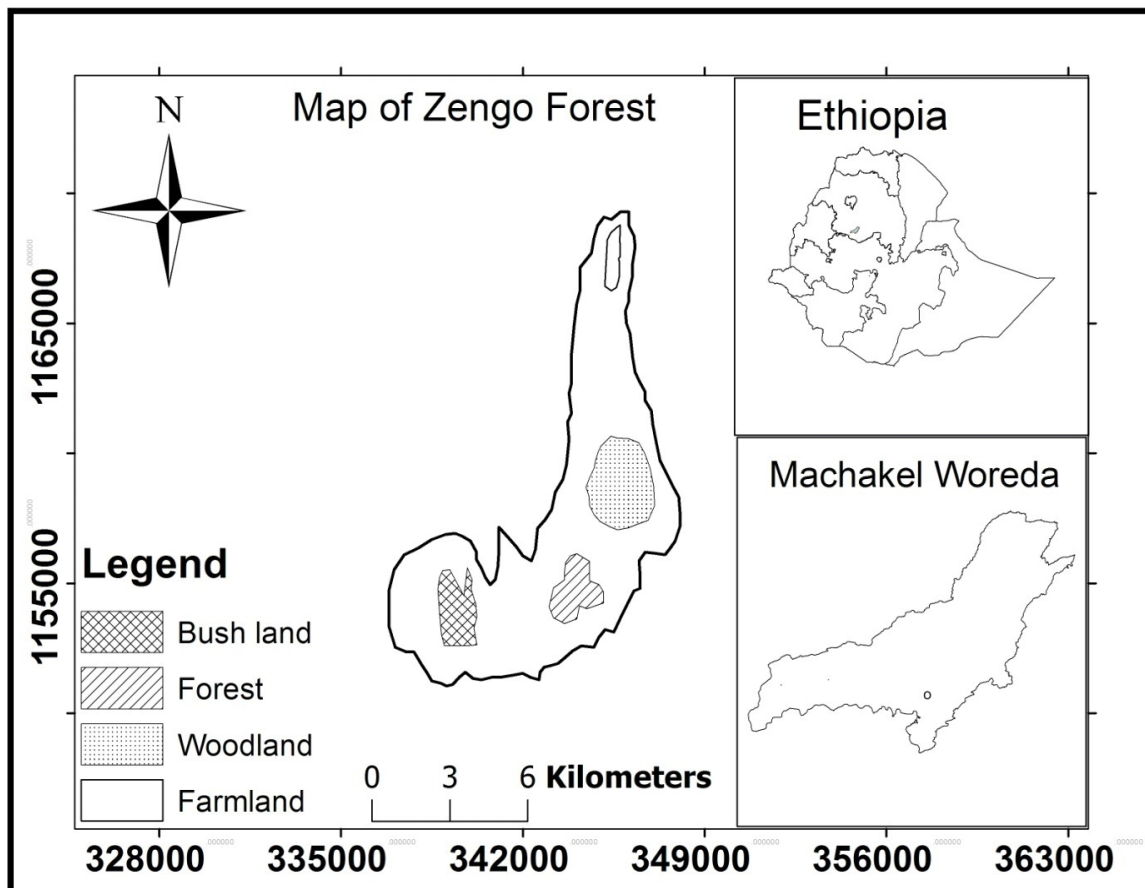


Figure 1. Map of the study area - the Zengo Forest

sampling techniques. The technique involved dividing the study area with grids on a map then using random coordinates to locate the sampling sites within each grid squares following Bibby et al. (1998). Sample blocks were randomly selected.

Bird Counting

Point count method was employed for both forest and bushland habitat because the two habitats were dense to cover the whole area. On the other hand, line transect method was applied for both farmland and woodland because in farmland, crops were planted along the line, so that it was easy for identifying bird species however, woodland plantations were characterized by sparse forest trees. Point count method was applied from a fixed location within the sample unit of radius 15 to 20 m for 5 to 10 minutes (Lloyd et al. 1998; Rosenstock et al. 2002).

During counting, a waiting period of 3 to 5 minutes was applied to minimize disturbance. Where point count technique is employed, the radial distance from the avian species was predictable and the type or group numbers of species were recorded using binoculars. A total of 20 point count sites were identified in both forest and bushland. In each point count site, a minimum distance of 150-200 m was employed using GPS to avoid double counting (Sutherland 1996). In the farmland and woodland a total of three grids were used for carryout counting. In each grid, there were 3 transect lines. Transect lines within a grid were 250-300 m apart from each other to avoid double counting (Hostler and Martin 2006). Data were collected in morning (6:30 a. m. to 10:00 a. m.) and late afternoon (4:30 p.m. to 6:00 p.m.) when birds are active (Bibby et al. 1998), during wet and dry seasons (Centerbury et al. 2000). Bird species identification carried out using birds field guide (Stevenson and Fanashawe 2002).

Data were analyzed using SPSS software version 20 statistical package. One-way ANOVA was used to see the effect of different variables on the ecology of avian species. Furthermore, Chi-square test was also used to test the habitat preference of birds in the area. The relative abundance of avian species was determined using encounter rates that give the basic ordinal scales of abundance as abundant, common, frequent, uncommon and rare (Bibby et al. 1998).

Data Analyses

Shannon-Wiener diversity Index (H') was calculated for each habitat (Kathleen et al. 2005). Simpson's index of diversity (D') was also used to evaluate the relative abundance of avian species in each habitat type during both wet and dry seasons. Encounter rate i.e., the total number of individual birds observed per hour of observation, was calculated for each species by dividing the number of birds observed by the hours spent searching them. The abundance categories (the number of individuals per 100 field hours) were: < 0.1, 0.1-2.0, 2.1-10.0, 10.1-40.0 and >40. For each category, the following abundance score was given: 1 (Rare), 2 (Uncommon), 3 (Frequent), 4 (Common) and 5 (Abundant), respectively (Lawton 2000).

RESULTS

Species Composition

A total of 42 avian species belong to 22 different families were identified during wet and dry season in the study area. Of these 17 species during wet season and 12 species during dry season however, 13 species were residents. The highest number of species was recorded for the family Sylviidae and Turdidae that contained 5 species each Accipitridae contained 4 species, Sturnidae and Columbidae contained 3 species and the rest of the families ranged between 1 and 2. During the wet season, 30 bird species were observed. The species recorded during the dry season were less than wet seasons. Therefore the numbers of species observed during the wet and dry seasons recorded among habitat were not significantly different ($\chi^2 = 0.88$, $df = 3$, $P > 0.05$). A cumulative total of 25 avian fauna species observed during the dry season (Table 1).

Relative Abundance

There was significant difference among the habitat in the relative abundance of avian species during the wet season ($\chi^2 = 49.4$, $df = 3$, $P < 0.05$). The relative abundance score of avian species during the wet season showed that 11 species were common and frequent at forest and bushland respectively. Furthermore, 10 species were common and frequent, at farmland and bushland habitat. In woodland, 9 species were frequent whereas in farmland there were 3 frequent species.

Table 1. List of bird species recorded in Zengo Forest (§= Intra-African Migrant, W= wet season, D= dry season, unmarked species are resident).

Family	Common name	Scientific name
Laniidae	Tropical boubou ^w	<i>Laniarius ferrugineus</i> (Gmelin, 1788)
Sylviidae	Tawny flanked prinia ^w	<i>Prinia subflava</i> (Gmelin, 1789)
	Banded tit-warbler ^w	<i>Parisomia boehmi</i> (Reichenow, 1882)
	Brown woodland warbler ^D	<i>Phylloscopus umbrovirens</i> (Rüppell, 1840)
	Black breasted apalis ^w	<i>Apalis flavida</i> (Strckland, 1852)
	Black headed apalis	<i>Apalis melanocephala</i> (Fischer and Reichenow, 1884)
Sturnidae	Magpie starling ^D	<i>Speculipastor bicolor</i> (Reichenow, 1879)
	Red billed oxpecker ^D	<i>Buphagus erythorhynchus</i> (Stanley, 1814)
	Yellow billed oxpecker ^{§ w}	<i>Buphagus africanus</i> (Linnaeus, 1766)
Capitonidae	Red fronted tinker bird ^{§ w}	<i>Pogoniulus pusillus</i> (Dumont, 1816)
	Spotted flanked barbet ^D	<i>Tricholaema lacrymosa</i> (Cabanis 1878)
Pecidae	Cardinal wood pecker ^w	<i>Dendro picosfuscescens</i> (Vieillot, 1818)
Bucerotidae	Yellow billed horn bill	<i>Tockus flavirostris</i> (Rüppell, 1835)
Alaudidae	Northern white tailed lark ^w	<i>Mirafra albicanda</i> (Reichenow, 1891)
Estrildidae	Peters twin spot ^w	<i>Hypargos niveoguttatus</i> (Peters, 1868)
Paridae	Mouse coloured penduline tit ^{§ w}	<i>Remiz musculus</i> (Cabanis, 1851)
	African pendulin tit	<i>Remiz caroli</i> (Sharpe, 1871)
Columbidae	Ring-necked dove	<i>Streptopelipa caicola</i> (Sundevall, 1857)
	Red- eyed dove	<i>Streptopelia lugens</i> (Rüppell, 1837)
	Speckled pigeon	<i>Columba guinea</i> (Linnaeus, 1758)
Motacillidae	Richards pipit ^w	<i>Anthus novaeseelandia</i> (Gmelin, 1789)
Pycnonotidae	Necator ^D	<i>Nicator chloris</i> (Valenciennes, 1826)
Accipitridae	Black shouldered kit	<i>Elanus caeruleus</i> (Desfontaines, 1789)
	Hooded vulture ^D	<i>Necrosyrtes monachus</i> (Temminck, 1823)
	Red-thigted sparrow hawk ^D	<i>Accipiter erythropus</i> (Hartlaub, 1855)
	Lizard buzzard	<i>Kaupifalco monogrammics</i> (Temminck, 1824)
Turdidae	African thrush ^w	<i>Turdus pelios</i> (Bonaparte, 1850)
	Brown chested alethe ^{§ w}	<i>Alethe poliocephala</i> (Bonaparte, 1850)
	Ruppelis robin chat ^w	<i>Cossypha semirufa</i> (Rüppell, 1840)
	White browed robin chat	<i>Cossypha heuglini</i> (Hartlaub, 1866)
	Olive thrush	<i>Turdus olivaceus</i> (Linnaeus, 1766)
Muscicapidae	Paradise fly catcher ^D	<i>Terpsiphone viridis</i> (Muller, 1776)
Nectariniidae	Snow headed robin chat ^D	<i>Cossypha niveicapilla</i> (Lafresnave, 1838)
	Pygmy longed-tailed sunbird ^D	<i>Anthreptes platura</i> (Vieillot, 1819)
Psittacidae	Red fronted parrot ^D	<i>Poicephalus gulielmi</i> (Jardine, 1849)
Fringillidae	Little green sunbird ^w	<i>Nectarinia seimundi</i> (Ogilvie-Grant, 1908)
	Streaky seed eater ^w	<i>Serinus striolatus</i> (Rüppell, 1840)
Indicatoridae	Lesser honey guide	<i>Indicator minor</i> (Stephens, 1815)
Phasiaridae	Scaly francolin ^D	<i>Francolinus squamatus</i> (Cassin, 1857)
Corvidae	Pied crow	<i>Corvus albus</i> (Müller, 1776)
	Cape rook	<i>Corvus capensis</i> (Lichtensten, 1823)
Turdoididae	Hill babbler ^{§ w}	<i>Alccipe abyssinica</i> (Rüppell, 1840)

Table 2. Relative abundance of avian species during the wet season using encounter rates.

Habitat	Rare	Uncommon	Common	Frequent
Forest	-	1	11	10
Farmland	-	1	10	3
Bush land	1	4	2	11
Woodland	1	1	5	9

There was no significant different among habitat in the relative abundance of avian species during the dry season= 123.3, df = 3, P> 0.05) however, there was significant difference between the two seasons ($F_{1,112} = 22.5, P < 0.05$). During the dry season most common avian were recorded in the farmland 16, whereas in bushland 7 and woodland 3 species were uncommon and frequent, respectively (Table 3).

Table 3. Relative abundance of avian species during dry season using encounter rates

Habitat	Rare	Uncommon	Common	Frequent
Forest	-	1	6	4
Farmland	-	1	16	1
Bush land	1	-	2	7
Woodland	-	3	1	3

There was no significant difference among habitats in the number of species diversity = 24. 3, df = 3, P>0.05). The relative abundance of the avian fauna among the four habitats during both wet and dry seasons showed that 41.38% species were frequent, 45.68% were common, 10.34% were uncommon and 2.58% were rare. The highest species diversity during the wet season was recorded in forest ($H' = 3.66$) followed by woodland ($H'=3.49$). Bushland habitat had the least species diversity ($H' = 3. 27$). The highest and the least even distribution was registered in forest ($E = 0.99$) and bushland ($E = 0.90$), respectively (Table 4). The highest numbers of avian species (22) were recorded in the forest.

Table 4. Avian species diversity during the wet season.

Habitat	No. of species	No. of individuals	H'	H'max	E	D'
Forest	22	356	3.66	3.71	0.99	0.97
Farm land	14	313	3.32	3.64	0.91	0.98
Bush land	18	184	3.27	3.61	0.90	0.98
Wood land	16	181	3.49	3.71	0.94	0.97

Species Diversity

There was insignificant difference in the number of avian species among habitats $^2 = 41.2, df = 3, P > 0.05$). There were also significant differences between seasons ($F_{1,114} = 12. 77, P < 0.05$). The highest species diversity during the dry season was recorded in farmland ($H' = 3.66$) followed by the bushland ($H' = 3.54$) and forest habitat ($H' = 3.22$). The least diversity of species was recorded in the woodland area ($H' = 3.24$). The highest even distribution of avian species was recorded in farmland and bushland ($E = 1.00$) whereas, the least even distribution had registered in forest habitat ($E = 0.90$) (Table 5). The highest number of avian specie was observed in the farmland 18 during the dry season.

Table 5. Avian species diversity during dry season.

Habitat	Number of species	Number of individuals	H'	H'max	E	D'
Forest	11	309	3.22	3.56	0.90	0.97
Farm land	18	219	3.66	3.47	1.00	0.96
Bush land	10	202	3.54	3.47	1.00	0.96
Wood land	7	173	3.24	3.53	0.92	0.96

DISCUSSION

Species composition and abundance of avian species were varied in different habitat within the study area. Avian species in the study area was distributed differently among habitats structure because change in the habitat characteristics influences the richness and avian diversity. The relative abundance of avian species during wet and dry seasons might be related to the availability of food, habitat condition and breeding

season of the species. Similarly, Schroth et al. (2004) stated that the distinct seasonality of rainfall and seasonal variation in the availability of food resources ends or result in seasonal changes in the species abundance of bird species. The existence of sufficient resource, especially ample food supply can boost the abundance of avian species at a given area. The avian species respond to changes in vegetation composition and structure, which in turn affects their food resources (Chace and Walsh 2006). The lowest number of species was observed in woodland due to less vegetation structure in the given area during dry season. As ecosystem stability depends on the species richness and composition, therefore, a decline in bird's diversity where lead to successive changes in properties of natural environment. Ecosystem management, however, needs to improve understanding of the consequences of decline in avian diversity (Serkioglu 2006).

The highest numbers of individuals were recorded in the forest and farmland during wet season and in the forest and bushland during dry season. The openness of the habitat compared to natural habitats with fairly dense vegetation cover might have also contributed for easy identification of the avian fauna species. Similarly, Sisay Hailu (2008) stated that open areas make easy sighting of avian fauna clear for identification and classification as well as counting. The noticeable character of the bird's survey in the area was the occurrence of species that utilize the habitat as a food resource. The accessibility of food was responsible for the high population of birds in varied habitat type (Lawton 2000). The breeding and feeding site of avian fauna is not a protected from human and other animals. The human beneficiaries from different activities are the major source of disturbance for the normal activities of birds in the study area. Therefore, this condition has greatly affected the species composition of avian fauna. Disturbance and other extra factors influence bird's population (Lepczyk et al. 2004). The lowest avian species similarity was between bushland and farmland during the dry season, while between bushland and woodland during the wet season due to the differences in feeding adaptation of avian in each habitat. Species diversity increases with the complexity of habitat. This diversity considered both the richness and evenness of species. Evenness is a measure of the relative abundance of different species making up the richness of an area. This evenness is an important component of diversity indices (Turchi et al. 1995; Leinster and Cobbold 2012) and expresses even distribution of the individuals among different species. The relative abundance of avian species in the forest

habitat during wet season showed that high numbers of avian species were grouped as frequent. This might be related to the availability of food, habitat condition, breeding season of the species and vegetation complexity. According to Think (2006) each avian species in a given habitat for instance, forest has its own probability of being detected. Besides in woodland habitat, five avian species were grouped as common. The distribution of avian fauna species within four habitats varied among each other at the family level. The highest numbers of families were observed in the bushland habitat, followed by forest. This might be due to higher vegetation complexity and floristic composition of the habitats. Least number of families were recorded in the farmland. This could be due to the spars vegetation density and small size. Similarly, Lee and Rotenberry (2005) pointed out that habitat structure affects distribution of individual species; habitat range, foraging modes and floristic composition having an influence in the distribution of avian.

The importance of different habitats for avian species is providing the essential supplies such as food, water and nesting. The seasonal variation in the number of individual of avian species and their distribution in the study area are directly related to the types of habitats. The current threats of the study area are poaching, cultivation and grazing have negative impact on the diversity and abundance of avian fauna and on the biodiversity, as well as ecosystem of the area. For the stability and proper functioning of the ecosystem, species richness and composition occupies a prominent place. There is an urgent need, to safeguard avian fauna species diversity in the area by protecting natural habitat of the protected area. Removal of timber, twigs and leaves used for fuel is causing severe to land degradation. Humans extensively collect firewood from the area. However, protection of the area is compulsory for avian fauna and other wildlife species in order to have enough breeding sites, and to maintain the natural ecological balance of the area. Therefore, to conserve the study area and its surroundings, the Woreda Agriculture and Rural Development Office should implement effective forest management and delineate the Zengo Forest. Furthermore, there should be rehabilitation program in the area through afforestation and community based conservation.

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