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Research Article

STUDIES ON AVIAN DIVERSITY IN ANGEREB FOREST AND ADJACENT FARM LAND WITH REFERENCE TO RAINY AND POST RAINY SEASONS, NORTHWESTERN ETHIOPIA

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ABSTRACT

The current study was conducted in Angereb forest and adjacent farm land during rainy and post rainy seasons of the year 2011. Information was gathered by using line transect method on occurrence of species and number of individuals with the objectives of estimating the density, diversity, richness and abundance of species. A total of 89 avian species were recorded from 37 families belongs to 11 orders in the study area. Among them one species is endemic to Ethiopia (*Macronyx flavicollis*) and four species are shared with Eretria (*Bostrychia carunculata, Columba albitorques, Agapornis taranta, Corvus crassirostris*). The present results showed variation in avian density, diversity, richness and abundance among the sites across seasons. The overall (invariable of seasons) calculations show the maximum records for all the parameters except similarity index from the forest habitat. The rainy seasonal calculations reveal that the maximum of all the parameters were recorded from the forest habitat and the minimum from the farmland habitat. Except the density and abundance remaining parameters were highest in forest habitat for post rainy season. The overall diversity and richness had shown strong relationship with each other and in relation to seasonal species richness, the significant variation was found only in forest habitat ($p=0.016$).

Keywords: Abundance, Angereb forest, Avian diversity, Richness, Seasons.

INTRODUCTION

Ethiopia is one of the most prominent countries in Africa, in terms of its avifauna. The country's diverse habitat types contribute for the tremendously diverse avifauna, over 926 species are recorded from Ethiopia of which 21 species are endemic to Ethiopia, 14 other bird species are shared with Eretria and 19 are globally threatened (Lepage, 2006). Forests, wetlands and reverine systems are sites for wintering or passage migrant birds in Ethiopia (EWNHS, 1996). According to the report made by Ash (1981), there are 214 Palarctic migrant bird species occurring in Ethiopia. Of these total, 45 species have been found to over summer within the boundaries of the country. A large number of these birds have breeding populations in Ethiopia (Pol, 2006). At present, 69 Important Bird Areas covering at least 47,757 km², equivalent to 4.3% of the land area of the country, which are also important for large number of other taxa, are identified by the Ethiopian Wildlife and Natural History Society and Birdlife International (EWNHS, 1996; Birdlife International, 2007) following scientifically defensible quantitative criteria. These include the already existing protected areas and many other additional sites.

The class Aves contains more species distributed over nearly the entire earth than other class of vertebrates (Harrison and Smith, 1993). About 9930 species of birds exist worldwide, belonging to 204 families (George, 2010). More than 50 percent of the extant avian species belong to the order Passeriformes (Avibase, 2010). Birds are an important forest resource because of their ecological role and recreational values (Scott and Gottfried, 1983) an important aspect of the ecology of the birds pertains to factors that influence their number

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and richness *i.e*. their diversity. Diversity, an old and popular concept in ecology (Zahl, 1977) was the most highly valued criterion used for the assessment of conservation potential and ecological value (Tubbs and Blackwood, 1971; Tans, 1974; Gehlbach, 1975; Margules and Usher, 1981; Baskin, 1994). It is major aspect of conservation (Kershaw et *al*., 1995) and was also frequently used to judge the success of conservation efforts (Hall and Willig, 1994).

The temporal and spatial patterns of bird abundance within an ecosystem in terms of both numbers of individuals and species indicate the highly seasonal nature of food resources (Tilahun *et al*., 2001; Mengesha and Bekele, 2008). Change in structure and compositional diversity of native vegetation would alter composition of bird community (Fleishman *et al*., 1990; Leito *et al*., 2006; Acevedo and Aide, 2008).

In Ethiopia, many researchers have carried out different studies on avian diversity; distribution and abundance in different ecosystems particularly emphasize on National parks and protected areas. However, few investigators put their efforts in northern part of Ethiopia. Afework and Shimelis (2008) showed species composition, relative abundance and distribution of bird fauna of riverine and wetland habitats of Infranz and Yiganda at southern tip of Lake Tana, Ethiopia. However, there is no an evidence of study which had been conducted before within the present study area. Thus, this study was conducted with the objective of providing basic information about the distribution, abundance and diversity of avian species in this study area.

MATERIALS AND METHODS

The current study was conducted in Angereb forest and adjacent Farm land, which is located between latitude and longitude of 12°36′N and 37°28′E with an average elevation of 2162 m.a.s.l. A preliminary survey was conducted during May, 2011 to familiar with the study area and to select habitats to be used for the survey. In this survey, an overall view of the avian fauna and topographical features of the area was assessed. The Line transect method (Burnham *et al*., 1980) was employed for data collection. One transect on each habitat were laid for one kilometer length with a fixed width of 200 meters (100 meters on either side) and weekly bird surveys were made for each study site. Field data collection was carried out from June to August 2011 for rainy season and from October to December 2011 for post rainy season. According to Bibby *et al*., 2000, data collection was carried out in the early morning from 6:30 am to 10:00 am in which avian are active and frequently detected. The counting was avoided during rainy and cloudy days because such types of climatic conditions significantly affect the activities of birds. Most birds were identified by direct observation with the aid of binocular and Collins field guide Birds of East Africa (Williams and Arlott, 1996).

Data Analysis

The density (D) is an expression of the numerical strength of a community in an area at a particular time was calculated in each of the sites for comparison. The Shannon's index (H') was chosen for the diversity calculation. This method was selected because it provides an account for both abundance and evenness (Magurran, 1988). It also does not disproportionately favour some species over the others as it counts all species according to their frequencies (Lou, 2006). Other parameters such as Species Richness (S), Abundance Distribution (AD), Species Evenness (H'E), Richness Index (RI) and Simpson's Similarity Index (SI) also were derived.

The density (D) is defined by following formula:

D = Number of individuals in a community / Area sampled (1)

The community structure of avian species of each habitat was described in terms of Shannon-Wiener diversity Index (H') (Shannon and Wiener, 1949). Shannon-Wiener diversity Index is calculated as

Shannon's index, (H') is defined by:

$$H' = \sum_{i=1}^{s} (pi)\,(\log_{10} pi) \qquad (2)$$

where, *i* is the proportion of the species relative to the total number of species (*p*i) multiplied by the natural logarithm of this proportion (ln *p*i) and the final product multiplied by -1. The Shannon's index ranges typically from 1.5 to 3.5 and rarely reaches 4.5 (Gaines *et al*., 1999).

Species richness (S) is defined by:

$$S = \sum n \qquad (3)$$

where, *n* is number of species in a community.

Abundance Distribution (AD) is defined by:

$$AD = \sum n \quad (4)$$

where, *n* is number of individuals encountered from different species in a community.

Species evenness is often assessed by Shannon's equitability index (H'E) which is calculated by:

$$H'E = H'/ H_{max} \quad (5)$$

where, H_{max} is defined as ln (S) H'E values ranges from 0 to 1, in which 1 indicates complete evenness.

R**ichness index** (RI) of each species was determined using the formula:

$$RI = S-1/lnI \quad (6)$$

Where, S = Number of species in each habitat, ln = Natural logarithm, I= Number of species in each habitat

Simpson's similarity index (SI) was used to assess the similarity of species between two different sites by using the formula:

$$SI = 2C/A+B \quad (7)$$

Where, SI = Simpson's similarity index;
A = Number of species that occur in a site A;
B = Number of species that occur in a site B;
C = Number of common species that occur in a site A and B

Analysis of variance using one way ANOVA by SPSS 16 for windows was applied to separate the means.

RESULTS

A total of 89 avian species were recorded from 37 families belongs to 11 orders in which one species is endemic to Ethiopia (*Macronyx flavicollis*) and four species are shared with Eretria (*Bostrychia carunculata, Columba albitorques, Agapornis taranta, Corvus crassirostris*) and six species were endangered under IUCN red list category. Among the total number 78 species were recorded from forest habitat and 65 species from farm land habitat and 54 of them were seen commonly in both the habitats. A maximum of 58 species belongs to the order Passeriformes, followed by the orders Coraciformes and Columbiformes (6 species each) and the minimum of one species each from four orders namely Anseriformes, Colliformes, Pssittaciiformes and Trogoniformes were recorded during this study period (Table 1).

The avian community characteristics such as Density (D), Diversity (H'), Species Richness (S), Abundance Distribution (AD), Evenness (H'E), Richness Index (RI) and Similarity Index (SI) were calculated for the comparison of habitats with reference to overall (invariable of seasons) and seasonal variations. The overall calculations show the maximum records for all the parameters except similarity index from the forest habitat (Table 2).

The rainy seasonal calculations reveals that the maximum of all the parameters were recorded from the forest habitat and the minimum from the farmland habitat (Table 3)

The calculations for post rainy season vary among the habitats. Except the density and abundance remaining parameters were highest in forest habitat (Table 4).

Table 1. Occurrence and status of avian species recorded during the study period.

S. No.	Scientific Name and Status	Family	Order	Occurrence	
				Forest	Farmland
1	*Ardea melanocephala*	Ardeidae	Ciconiformes	-	+
2	*Bostrychia hagedash*	Threskiornithidae	,,	-	+
3	*Threskiornis aethiopicus*	,,	,,	-	+
4	*Bostrychia carunculata*[1]	,,	,,	+	+
5	*Merops pusillus*	Meropidae	Coraciformes	+	+
6	*Phoeniculus somaliensis*	Phoeniculidae	,,	+	-
7	*Upupa epops*	Upupidae	,,	-	+
8	*Tockus alboterminatus*	Bucerotidae	,,	+	+

9	*Tockus hemprichii*	,,	,,	+	+
10	*Coracias abyssinica*	Coraciidae	,,	+	-
11	*Alopochen aegyptiacus*	Anatidae	Anseriformes	-	+
12	*Milvus migrans*	Accipitridae	Accipitriformes	+	+
13	*Aquila rapax*	,,	,,	+	+
14	*Gypaetus barbatus*	,,	,,	+	+
15	*Buteo rufofuscus*	,,	,,	+	+
16	*Lophaetus occipitalis*	,,	,,	+	-
17	*Columba guinea*	Columbidae	Columbiformes	+	+
18	*Columba albitorques*[1]	,,	,,	+	+
19	*Streptopelia senegalensis*	,,	,,	+	+
20	*Streptopelia decipiens*	,,	,,	+	+
21	*Streptopelia lugens*	,,	,,	+	+
22	*Streptopelia semitorquata*	,,	,,	+	+
23	*Colius striatus*	Coliidae	Colliformes	+	+
24	*Bubo africanus*	Strigidae	Strigiformes	+	-
25	*Bubo lacteus*	,,	,,	+	+
26	*Centropus senegalensis*	Cuculidae	Cuculiformes	+	-
27	*Chrysococcyx caprius*	,,	,,	+	-
28	*Chrysococcyx klaas*	,,	,,	+	-
29	*Corythaixoides leucogaster*	Musophagidae	,,	+	+
30	*Agapornis taranta*[1]	Psittacidae	Pissitaciiformes	+	-
31	*Apaloderma narina*	Trogonidae	Trogoniformes	+	-
32	*Anthus cinnamomeus*[2]	Motacillidae	Passeriformes	+	-
33	*Macronyx flavicollis*[1,2]	,,	,,	+	-
34	*Hirundo daurica*	Hirundinidae	,,	+	-
35	*Psalidoprocne albiceps*	,,	,,	+	-
36	*Cecropsis senegalensis*	,,	,,	+	-
37	*Hirundo aethiopica*	,,	,,	+	-
38	*Hirundo senegalensis*	,,	,,	+	-
39	*Emberiza tahapisi*	Emberizidae	,,	+	-
40	*Pycnonotus barbatus*	Campephagidae	,,	+	+
41	*Tardus abyssinicus*[2]	Turdidae	,,	+	+
42	*Cossypha caffra*	,,	,,	+	+
43	*Thamnolaea semirufa*	,,	,,	+	+
44	*Monticola rufocinereus*	,,	,,	+	+
45	*Psophocichla litsitsirupa*	,,	,,	+	+
46	*Galerida theklae*	,,	,,	-	+
47	*Myrmecocichla melaena*	,,	,,	+	-
48	*Terspsiphone viridis*	Muscicapidae	,,	+	+
49	*Prinia subflava*	,,	,,	+	+
50	*Nectarinia tacazze*	Nectariniidae	,,	+	+
51	*Nectarinia pulchella*	,,	,,	+	+
52	*Chalcomitra senegalensis*[2]	,,	,,	+	+
53	*Cinnyris venustus*[2]	,,	,,	+	+
54	*Lamprotornis chalybaeus*	Sturnidae	,,	+	+
55	*Onychognathus morio*	,,	,,	+	+
56	*Lamprotornis corruscus*	,,	,,	+	+
57	*Serinus tristriatus*	Fringillidae	,,	+	+
58	*Serinus citrinelloides*	,,	,,	+	+
59	*Serinus striolatus*	,,	,,	+	+

60	*Oriolus larvatus*	Oriolidae	,,	+	-
61	*Spermestes cucullata*[2]	Estrildidae	,,	+	+
62	*Passer swainsonii*	Ploceidae	,,	+	+
63	*Uraeginthus bengalus*	,,	,,	+	+
64	*Lagonosticta senegala*	,,	,,	+	+
65	*Vidua chalybeate*	,,	,,	+	+
66	*Amadina fasciata*	,,	,,	+	-
67	*Ploceus velatus*	Passeridae	,,	+	+
68	*Euplectes macroura*	,,	,,	+	+
69	*Euplectes ardens*	,,	,,	+	+
70	*Euplectes macrourus*	,,	,,	+	+
71	*Ploceus beglafecht*	,,	,,	+	+
72	*Euplectes franciscanus*	,,	,,	-	+
73	*Euplectes hordeaceus*	,,	,,	-	+
74	*Vidua macroura*	Iduidae	,,	+	+
75	*Corvus albus*	Corvidae	,,	+	+
76	*Corvus crassirostris*[1]	,,	,,	+	+
77	*Corvus rhipidurus*	,,	,,	+	+
78	*Corvus capensis*	,,	,,	-	+
79	*Lanius excubitoroides*	Laniidae	,,	+	+
80	*Lanius collaris*	,,	,,	+	+
81	*Laniarius aethiopicus*	,,	,,	+	+
82	*Buphagus erythrorhynchus*	Buphagidae	,,	+	+
83	*Oenanthe oenanthe*	Alaudidae	,,	-	+
84	*Oenanthe isabellina*	,,	,,	-	+
85	*Oenanthe lugubris*	,,	,,	+	+
86	*Tchagra senegalus*	Malconidae	,,	+	-
87	*Cisticola galactotes*	Cisticollidae	,,	+	-
88	*Turdoides leucopygius*	Timilidae	,,	+	-
89	*Turdoides rubiginosus*	,,	,,	+	-

Note: [1] = Endemic to Ethiopia and Eretria (EWNHS, 1996); [2] = Endangered (IUCN, 2013); + = Presence of Species; - = Absence of Species.

Table 2. Overall avian community characteristics.

Habitat	D/km^2	H’	S	AD	H’E	RI	SI
Forest	463.13	3.87	78	2223	0.88	17.67	0.64
Farmland	443.33	3.62	65	2128	0.85	15.33	0.76

Table 3. Rainy seasonal avian community characteristics.

Habitat	D/km^2	H’	S	AD	H’E	RI
Forest	471.25	4.05	74	1131	0.94	16.96
Farmland	425.00	3.67	57	1020	0.91	13.85

Table 4. Post rainy seasonal avian community characteristics.

Habitat	D/km^2	H’	S	AD	H’E	RI
Forest	455.00	3.68	61	1092	0.90	14.60
Farmland	461.66	3.57	54	1108	0.89	13.29

DISCUSSION

A total of 89 species of birds were recorded from the study area, this indicates that the area is rich in avian diversity. Majority of the bird species (58 species) belongs to the order Passeriformes. This result is in agreement with Kalkidan (2010) findings. In her findings, among 124 species, 62 belong to the order Passeriformes. The report of Avibase (2010) also supports the result. According to the report of Avibase (2010), more than 50 percent of the existing avian species belongs to Passeriformes. The highest density, diversity, richness, abundance were recorded from the forest habitat like with the result of Dereje (2006). The high density, diversity, richness abundance of birds in forest habitat may be associated with the presence of sufficient amount of food, and availability of nesting materials. In addition, it can also be due to the diversity of vegetation that provides heterogeneous habitat for different avian species.

CONCLUSION

The Angereb forest is a patchy remenant of Afromontane forest, which is considered as one of the important bird areas in Ethiopia. The study has indicated that the study area is supporting many species of birds. Majority of the species are found under the order Passeriformes. In terms of abundance, the forest habitat is more abundant in its bird species as compared to farm land habitat. Hence, the forest habitat needs more concern towards the conservation measures in relation to avifauna of the area. Majority of the species of birds are common to both seasons indicating that they are not migratory. In order to extract exhaustive information, additional detailed study of long duration on the diversity and other ecological aspects of the bird should be conducted.

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