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DIVERSITY AND RELATIVE ABUNDACE OF BIRD SPECIES OF SHEKO DISTRICT, BENCH MAJI ZONE, SOUTHWEST ETHIOPIA

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ABSTRACT

This study was conducted to assess the diversity and relative abundance of bird species in Sheko district, Bench Maji Zone, southwest Ethiopia. The study covered thee habitat types: forest, human settlement and farmland. Sampling sites were assigned based on the area cover of the habitat types. Point count method in the forest and line transects method in human settlement and farmlands were used to collect data. A total of 118 avian species belonging to 41 families and 13 orders were identified throughout the study period. In the wet season, the highest species diversity was recorded in human settlement (H'=3.63) followed by the forest (H'=3.51). During the dry season, avian diversity was the highest in forest (H'=3.39) followed by farmland (H'=3.35). The species composition of birds among the three habitats showed significant variation, but there was no significant difference between seasons. High species similarity was seen between human settlement and farmland (SI=0.55) followed by forest and human settlement (SI=0.48) and the lowest species similarity was observed between farmland and Forest (SI=0.43). Long term ecological study and awareness creation about the values of birds to the local community were recommended.

INTRODUCTION

Ethiopia harbors more than half (926 species) of bird species recorded in Africa (Aynalem and Bekele, 2008). Among these, 21 species are endemic and 19 species are globally threatened (Redman *et al.,* 2009) of which two species are critically endangered, five species endangered, and12 species vulnerable (Collar *et al*., 1994; EWNHS, 1996). Nationally, 73 IBAs sites are identified which are represented by three conservation categories: 19 critical sites, 23, urgent sites and 31 highly sited areas (Mengistu, 2003). Out of the IBAs in the country, wetlands comprise 41% (30 sites) while the rest are represented by other habitat types (Aynalem and Bekele, 2008). Many areas of the Afromontane forests and critical areas of birds in Africa, including Ethiopia are subjected to severe ecological degradation and deterioration due to human induced impacts (Timberlake, 1985; EFAP, 1989). Humans have threatened the existence of birds by destroying their habitat for various purposes (Green and Hirons, 1991). In Southern Nations, Nationalities and People's Regional State of Ethiopia, over 50% of the high forest present in 1990, mostly found in the south-west highlands, is expected to be destroyed by 2020 if the present trends of human induced impacts continue (WBISPP, 2009). Sheko forest, one of the subjects of the present study, is the center of origin for wild form of *Coffea Arabica* in Ethiopia. The forest is characterized by complex and diverse landscape which emphasizes its botanical uniqueness and conservation value (Senbeta *et al*., 2007). Sheko is area where activities of traditional production systems like crop production, animal husbandry and garden coffee production are practiced (Woldemariam, 2003).The main driver of land use change in the district is population growth, both due to natural increase and through immigration and resettlement (Schmitt, 2008). Such changes in forest structure and composition are known to negatively affect forest birds and the role of birds in the ecosystem services (Thiollay, 1997, 1999). So far, many studies have been conducted on the East African (mainly Kenya, Uganda and Tanzania) avian ecology, but, very few studies were carried out on the diversity and other ecological aspects of birds in some parts of Ethiopia (Ash and Gullick, 1989). Thus, the ecology of birds is little known in most parts of Ethiopia. Sheko district is one of the places with conservation concern in the country but with little ecological information on avian

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fauna. Hence we hypothesized that habitats with less human disturbance will be with high diversity of birds. Therefore the present study was conducted to document the diversity and relative abundance of bird species in Sheko district, Bench Maji Zone, southwest Ethiopia.

MATERIALS AND METHODS

Study area and climate

Sheko district is located in Bench Maji Zone, Southern Nations and Nationalities People National Regional State, Ethiopia. The district lies between the coordinates of 6^0 58' N and 35^0 45'E and altitudinal range of 900 m to1850 m a s l (Figure 1). The rainfall distribution in the area is unimodal (one long rainy season between April and September) with a mean annual rainfall of 1850.55 mm. The mean monthly maximum temperature ranges from 27.8 to 33.37 ^{0}C and the mean monthly minimum temperature ranges from11.68 to22.01^{o}C.

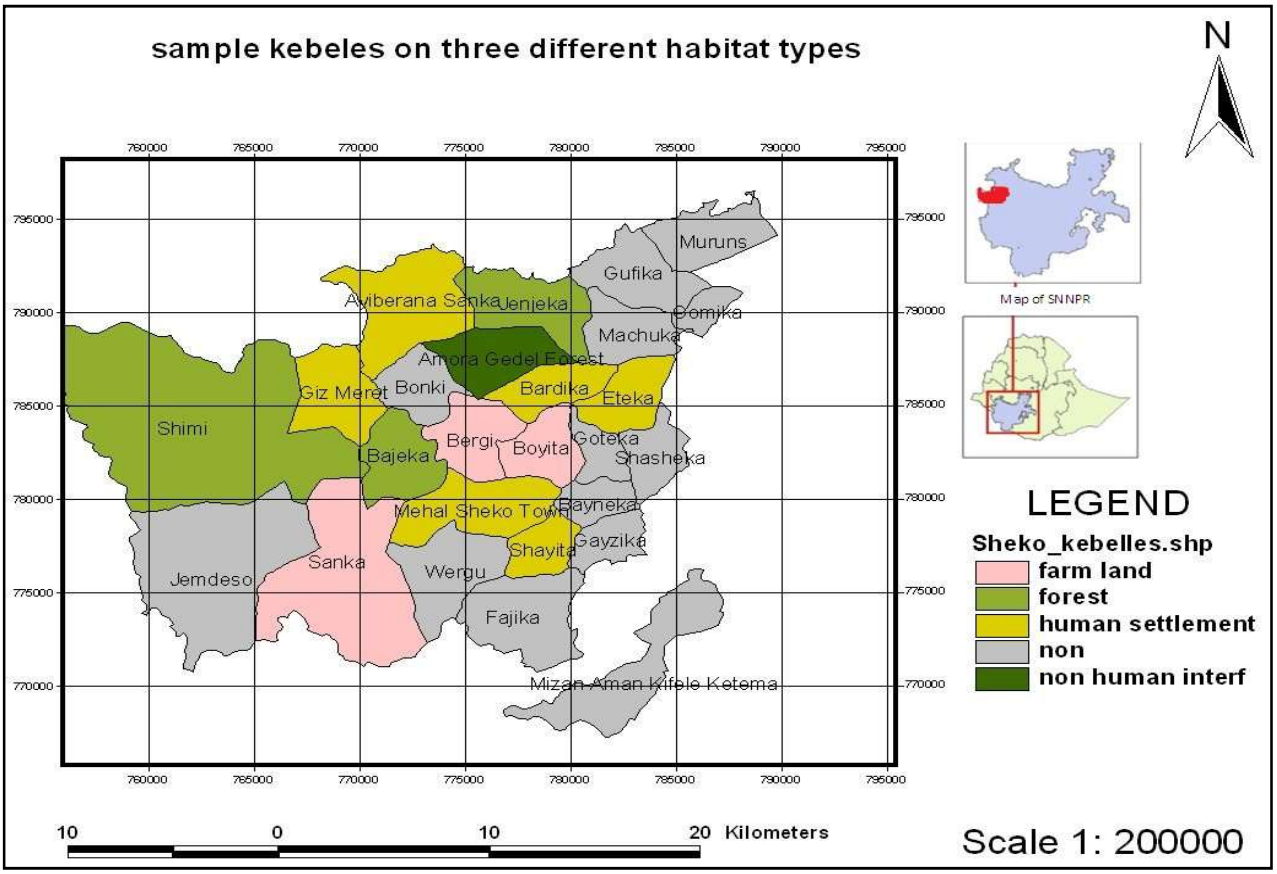

Figure 1. Map of the study area with different habitat

Methods

Three habitat types: forest, farmland and human settlement area were assessed in the present study. Sampling sites were randomly established from each habitat type to make results representatives of the whole study area (Sutherland, 1996; Bibby *et al.*, 1998). Data collection was carried out from June, 2012 to February, 2013 to cover both wet and dry seasons. In the forest, data was collected using point transect technique. Three study plots (each 1.25km^2) one from each of the three zones of the forest (intensively managed, lightly managed and agro forestry) were established. In each study plot, at least 16 point count locations, each located apart at a minimum distance of 150-200 m were assigned (Sutherland, 1996).The count was performed from a fixed location within the sample unit of radius 25 m within 10 minutes. To minimize disturbance during count, a waiting period of 3 to 5 minutes were applied prior to counting. In farmland and human settlements, the method of line transect was used to record birds (Bibby *et al*., 1998; Hostler and Martin, 2006). A total of 30 and 18 study plots, each 1km x 1km, were established in human settlement and farmland respectively. In each plot, four transect lines with a length of 1km and widths of 50 m were located. We were moving at speed of 1km/hr along transect lines while recoding birds (Bibby *et al*., 2000). Data was collected from 6:30-10:00 a.m. in the morning and 3:30 - 6:00 p.m. in the afternoon when the activities of birds are prominent. Species identification was done using bird field guide book (Lan and Petert, 2003).

In addition, photographs were also taken to further confirm the identification of some species (Peterson, 1963).Fly-overs are included in species composition, but not considered in diversity and relative abundance analysis. Shannon-Wiener diversity Index (H') (H'=-$\sum$ (PilnPi, Where Pi = Proportion of the ith species) (Shannon and Wiener, 1949) was used to compare the diversity of bird species among the different habitats. Shannon-Wiener evenness Index (E) (E=H'/ H max; where max = Ln S and S is the total number of species (S) in each site) (South wood and Henderson, 2000) was used to

compare species evenness among habitats. Prior to any analysis, the raw data was Log transformed (Fowler & Cohen 1990). Simpson's similarity index (SI = 2 C/A+ B; Where A = Number of species that occur in site A, B = Number of species that occur in site B and C = Number of common species that occur in site A and B) was used to assess the similarity between different habitats with reference to the composition of bird species. The relative Abundance of bird species was determined using encounter rates (Lowen *et al.*, 1996). Encounter rate for each species was calculated by dividing the number of birds recorded by 100 field hours. For the five abundance categories, < 0.1, 0.1-2.0, 2.1-10.0, 10.1-40.0 and > 40, the following five abundance scores 1(rare), 2 (uncommon), 3 (frequent), 4 (common), and 5 (abundant), were given respectively. One-way ANOVA were employed to see the effects of different variables on the ecology of birds at 0.05 level of significance.

RESULTS

Species Composition

In the present study, 118 avian species belonging to 41 families were identified from all study sites. Of the recorded species, Thick-Billed Raven (*Corvus crassirostris*) and Wattled Ibis (*Bostrychia carunculata*) are near-endemic species. Two families, family Accipitridae and Ploceidae were represented by eight species each and family, Hirundinidae was represented by 11 species. Twenty seven families were represented by two to seven species. The remaining 11 families were represented only by a single species. Among 118 bird species recorded, 103 and 82 species were recorded during wet and dry seasons, respectively and 67species were common to both seasons. But, 36 and 15 species were exclusive to the wet and dry seasons respectively.

Species diversity and evenness indices

Variations were observed in species diversity among the different habitats during the wet and dry seasons. The human settlement supported the highest diversity of birds (H'=3.63) during the wet season and the forest supported the highest diversity (H'= 3.39) during the dry season. The least diversity of birds (H'=3.39) was recorded in the farmland during wet season and human settlement (H'=3.28) during the dry season (Table 1). The highest evenness (E= 0.90) was recorded in the forest during the dry season and human settlement (E= 0.88) during the wet season (Table 1).

Relative abundance

During the wet season, 30, 34 and 25 species were frequent in forest, human settlement and farmland respectively. While 22, 19 and 14 species were frequent in forest, human settlement respectively during the dry season. In the forest and human settlement, 16 species of birds were common during both dry and wet seasons. Only one species in the forest and farmland and two species in human settlement were abundant (Table 2)

Species Similarity indices

Species similarity was high between bird species of human settlement and farmland in both seasons (SI=0.6 dry, SI=0.57 wet). The lowest species similarity was recorded for species of forest and farmland (SI=0.42) during the dry season and forest and human settlement (SI=0.403) during the wet season (Table 3).For both wet and dry seasons combined, high species similarity was seen between species of human settlement and farmland (SI=0.55) and the lowest species similarity was observed between farmland and forest (SI=0.43) (Table 3)

Table 1. Bird species diversity (H') and evenness (E) in different habitat types in Sheko district

Habitat	Seasons	No. of species	Abundance (No. individuals)	H'	H'max	E
Forest	Wet	56	2860	3.51	4.03	0.87
	Dry	44	2452	3.39	3.78	0.90
Human settlement	Wet	63	3090	3.63	4.14	0.88
	Dry	47	2823	3.28	3.85	0.85
Farmland	Wet	53	2598	3.39	3.97	0.85
	Dry	46	2681	3.35	3.83	0.88
Forest	Dry and wet seasons combined	70	3700	4.05	4.25	0.95
Human settlement		76	3670	3.79	4.33	0.88
Farmland		66	3704	3.65	4.19	0.87

Table 2. Number of bird species in different relative abundance categories in Sheko district

Habitat	Season	frequent	Uncommon	Common	Abundant
Forest	wet	30	9	16	1
	dry	22	6	16	-
Human settlement	wet	34	11	16	2
	Dry	19	11	16	1
Farm land	Wet	25	13	14	1
	Dry	14	11	20	1

Table 3. Species similarity of bird species between different habitat types in Sheko district

Habitat	Number of species		Common species							
			Human settlement				Farmland			
	Wet	Dry	No. of species		SI		No. species		SI	
			Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Forest	56	44	24	21	0.403	0.46	22	19	0.404	0.42
Human settlement	63	47	-	-	-	-	33	28	0.57	0.60
Farmland	53	46	-	-	-	-	-	-	-	-

DISCUSSION

Differences in habitat characteristics and feeding habits of bird species are responsible for variation in diversity of bird species among different habitats (Smith, 1992). The reason for high diversity of bird species around human settlement during the wet season could be the presence of various species of fruiting trees most of which bear fruits during the wet season. On the other hand the significant variation observed in the number of species among the three habitats might be due to variation in habitat heterogeneity. The homogenous vegetation in the farmland coupled with its disturbance during harvest might be the reason for its low diversity of bird species. On the other hand, the heterogeneous vegetation and vegetation strata in the forest could have provided several niches for birds making the forest the habitat with high diversity of birds. The importance of the availability of vegetation strata for the number of bird species is also supported by several studies. For example, Cueto and Casenava (1999) reported positive correlation between bird species richness and the availability of vegetation strata. Chace and Walsh (2006) indicated that birds respond to changes in vegetation composition and structure, which in turn affects their food resources.

The difference in relative abundance of birds recorded at the present study areas might be due to the availability of food, habitat condition and breeding nature of the species. The distinct seasonality of rainfall and seasonal variation in the abundance of food resource result in seasonal changes in species abundance of birds (Karr and Roth, 1971; Gaston *et al*., 2000). The relative abundance of bird species in the study areas was grouped as uncommon, common, frequent and abundant. The uncommon species may be related to the breeding nature, large home range and niche of the species. In addition, degradation of the habitat might be a reason for the species to be uncommon (Ryan and Owino, 2006). The farmlands are exposed to the local people for cultivation and cutting of the vegetation as compared to others habitats, which have negative impact on bird population those depend on this habitat. This idea is in agreement with MacArthur (1961) that indicated, the decline in the quality of habitat resulted in the loss of habitat leading to a decline in the resident avian fauna.

The species composition of birds counted during the wet and dry seasons was not statistically different ($p > 0.05$). This result agrees with the work of Bekele and Shimelis (2009) in which their finding at micro geographic or local scale showed that the effect of season or the role of climate was negligible. The small value of diversity (H'=3.65) and evenness (E=0.87) in the farmland of this study is similar with Rana (2005), who reported that in natural habitats where the intervention of humans is less and minimum, the diversity as well as the evenness of species is higher than the fragmented ones where intensive farming is carried out. 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 leading to niche separation (MacArthur, 1964). Study carried out by Erdelen (1984) also showed that bird species diversity is significantly correlated with the vegetation structure. From the observation of this study, the reason could be due to cultivation of farmland, removal of plants and some crops at germination stages. Consequently shortage of food, structural change that happens in the farmland enforced birds to migrate to nearby habitats. As indicated by Smith (1992) difference in feeding habits and habitats could result in different diversity, evenness and species richness. The distribution of avian within three habitats varied at family level. The highest numbers of families (30) were observed in the forest area followed by human settlement (26). This might be due to higher vegetational complexity in the forest than human settlement. This finding is in line with MacArthur (1972) who reported that the complexity of vegetation structure for avian can provide stable source of food, nesting and cover from predator. As pointed by Tellaria and Santos (1994), the habitat structure affects distribution of individual species of birds. Besides, habitat size (Willis, 1979), foraging modes (Marone, 1991) and floristic composition (Wiens and Rotenberry, 1981) have influence in the distribution of Avian. Least number of families (22) was recorded in the farmland. This could be due to the less vegetation complexity in this site. This finding in line with Dawit (2009), who reported that avian species richness and distribution is influenced by vegetation structure, which is the principal determinant factor of avian species richness.

The study showed that both, the diversity (H'=3.65) and evenness (E=0.87) have small value in the farmland compared to the other habitat types. This finding is in line with Rana (2005), who reported that in natural habitats where the intervention of humans is less and minimum, the diversity as well as the evenness of species is higher than the fragmented ones where intensive farming is carried out. As the number of vegetation layer increases, the number of available niches for avian also increases and so does the diversity of avian species. This is due to the different feeding habit of avian leading to niche separation (MacArthur, 1964). The diversity of bird species is significantly correlated with the vegetation structure (Erdelen, 1984). Structural change in the vegetation of farmland as a result of removal of plants might have forced avian to migrate to nearby habitats.

The study also revealed variation in the abundance of avian species in the three different habitats. The highest number of individuals was recorded in the human settlement followed by forest habitat in both seasons. This might be due to the presence of different types of fruit trees grown by the residents which could be alternative food sources for birds that feed on fruits and seeds. Moris (1992) reported that the direction and magnitude of differences in bird community following habitat alteration is related primarily to species-specific adjustment to the structure and floristic characteristic of the habitat. Provision of awareness creation, at all levels about benefits of the forest to the local community and detailed study of long duration on the diversity and other ecological aspects of forest bird species were recommended.

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