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Research Article

Diversity, relative abundance and distribution of avifauna in Gambella Town, Southwest Ethiopia

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ABSTRACT

Urban areas are considered as important bird areas due to the availability of considerable food and roosting sites, particularly in dump and abattoirs, wetland and woodland. The objective of this study was to determine diversity, distribution and relative abundance of bird species in and around Gambella town, South West Ethiopia. Data were collected using line transect techniques point count in the wetland, and total count techniques in the abattoir and dump site from 7:00−10:00 A.M. in the morning and 4:00−6:00 P.M. in the afternoon for two consecutive days in each week and each in four study sites. Shannon-Wiener diversity, evenness indices and Simpson's similarity indices, were used to analyses of diversity, evenness and community similarity of the species respectively. One-way ANOVA and Pair wise t-test statistical tests were used for data analysis. During this study, a total of 6623 individuals belonging to 66 species, 31 families and 13 orders were identified. Among the 31 identified families Ardeidae was numerically the dominant family represented with 11 species, while Coraciides, Columbidae, Turdides and Monarchidae were the least dominant families represented with 1 species each. At species level hooded vulture was the most abundant bird species. ANOVA result revealed birds abundance was significantly ($p<0.05$) varies among the four sites. There is no significant difference in the abundance of birds between dry and wet season (t- test, $p=>0.05$).Wetland site was found to be with relatively higher value of species diversity (H'=3.18) than other three site. Most birds had locally scored uncommon, frequent in the ordinal scale and a few species with rare ranks in both seasons. The occurrence of such species indicates there is a need of wildlife conservation prioritization in those sits.

Key words: Avifaunal, Diversity, Gambella, Relative abundance, Passeriformes, Point count

INTRODUCTION

Urbanization refers to all environmental changes caused by urban development and is a global phenomenon that affects both animals and plants (Western, 2001). The consequence of urbanization is natural and semi natural habitats are replaced by the built environment, roads and other infrastructure (Marzluff *et al*., 2008). Urban birds usually have access to multiple food sources because of the various human activities and supplementary foods, primarily from bird feeders (Coogan *et al*., (2017). Similarly Oro *et al*. (2013), stated that food subsidies derived from waste dumping sites are a potential food sources for different species of organisms including birds.

Ethiopia is an important regional center for biological diversity due to its wide ranges of altitude, variability in habitat, climate, geographic position, rainfall pattern and soil variability (Zemede, 2001). These make Ethiopia have about more than 2970 species of animals and 7,000 of higher plant species with 12% endemism, among the fauna 320 are mammals with 36 endemism, 1,249 arthropods with 23 endemism, 200 fish with 40 endemism, 202 reptiles with 17 endemism and 73 amphibians with 30 endemism (EBI, 2015). In addition, around the world approximately 10,000 different species of birds (class Aves), among these 2355 species in Africa, with 245 of them being globally with extinction, while Ethiopia has a rich avifauna which is about 40% of Africa and 24 of which are endemic and 19 of which are globally threatened (Weldemariam, 2016). Although, around 73 hotspots has been listed as important bird areas in Ethiopia, 30 of which comprise wetlands, 30 existing protected areas, while the rest are representatives of other ecosystems (Mengistu, 2003). Birds are currently the most successful of all terrestrial vertebrates, with 28 orders and 166 families (WCMC, 1992 ;).

Avian diversity is often used as one of the most important indicators of ecological functioning and process i.e. bio indicator of pollution, are agent's nutrient recycling and plant gene flow through seed dispersal and pollination and regulate population of harmful insects and other pests (Sekercioglu, 2006). Urban areas are used as feeding sites for many wildlife species such as invertebrates, and various birds particularly opportunistic for scavengers. It helps to improve survival rate and body condition, enhance reproductive performance, reduces cost of feeding time, to minimize risk of migration, predation and extinctions particularly for endangered species (Meles and Bogale, 2018). However, the reduction of food availability in sites may also have a negative impact such as shifting in feeding behaviors and other costs (Duhem *et al*., 2003).

In most African countries, including Ethiopia, avian study, conservation and protection efforts are

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mainly focused on protected areas such as national parks. But, exploration and conservation of birds in urban areas are neglected (Sodhi, 2002). Several literatures shown that, avian diversity has declined in Africa in recent decades, mainly through loss and fragmentation of foraging habitats and nesting sites due to deforestation, agricultural expansion and urbanization (White *et al.,* 2005). Urbanization ranks first among the three primary drivers of species extinction (Czech *et al*., 2000). Due to greater number of human population inhabits in and around urban areas, which accounts more than 50% of the global human populations (UN, 2007). This urban expansion is still occurring at an alarming rate, particularly in the developing nations of Africa, Asia, and Latin America, which includes Ethiopia (Starke, 2007).

The Gambella region is one of the important bird areas (EWNHS, 1996). Gambella town also has natural and human-made habitats for birds that offer them diverse food items, nesting and roosting sites, shelter, and other facilities. Although, there is avifaunal resource potential, like wetland, woodland and scavenger birds etc. However, no study has been conducted before about diversity, abundance and distribution of avifaunal in the study area. In order to conserve and monitor bird species, it is necessary to understand population dynamics, identify causes of change patterns where they occur, identify species at risk, and provide a quantitative measure of diversity (Tsegaye, 2019). The present study attempts to document the diversity, distribution and relative abundance of avifaunal in and around Gambella town to provide current information on birds.

General objective

- The main objective of this study is to investigate diversity, distribution and relative abundance of Avian Fauna in Gambella Town.

Specific objectives

The specific objectives of this study were to

- Assess the species composition and distribution of Avifauna in the study area.
- Estimate the relative abundance of bird species in the study site.
- Compare abundance and diversity of bird species between seasons and habitat.

MATERIALS AND METHODS

The study was being conducted from dry season 2021 to wet season,2022 in Gambella town. Gambella Town is located in the South-western part of Ethiopia about 777 km away from Addis Ababa, the capital city of Ethiopia. It has been situated in the lowlands of Baro Akobo River Basin between latitudes 6^0 22' to 8^0 37' North and longitudes 33^0 10' to 35^0 50' East. The region borders with Benishangul Gumuz and Oromiya region to the North; Southern Nations, Nationalities and People's Regional State (SNNPRS) and the Sudan Republic to the South (Selemon and Alemken, 2019). The town is founded on the banks of the Baro River. There are two distinctive seasons on the Gambella plains: the wet (May to October) and dry (November to April). July and August are the wettest months while December, January and February are the driest ones.

The annual rainfall amount ranges from 900mm-2200mm (Wondachew & Muchie, 2017). The mean annual temperature of the District ranges from 27 ^{0}C to 40 ^{0}C, with an elevation in the range of 450 to 1,000 meters above sea level.

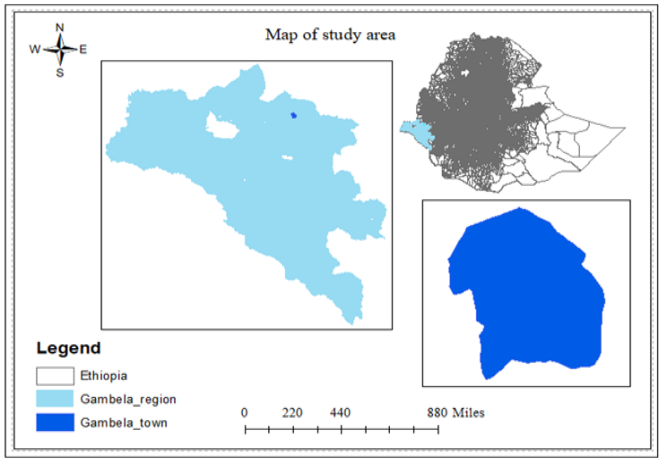

Figure 1. Map of the study area (Source: Ethio- region, Arc GIS Version 3.8 Software)

Conceptual Frame work

Conceptual framework was developed to assess the species composition and relative abundance in the study area. The conceptual frame work depicts the relationship between the independent and the dependent variables. Currently ANOVA has been proven to be the best to assess abundance of individual among four study sites and Pair Wise T test were used for seasonal variation of abundance of species and their individuals. This idea generates an assumption that have a relationship with species composition, abundance, diversity and evenness. To see the relationship between species composition, abundance, diversity and evenness dimensions it is better to use the method of Hiwot & Afework, 2007.

In the study area there is variation of species and individual in four study sites and in two seasons then a conclusion could be drawn that season has a significant difference with species and individual abundance. To know about the impact of the individual species and their abundance were used by using direct observation and interview of the local people.

In this study, non-probability sampling was employed. Purposive/ judgment type of non-probability sampling was used for selecting the study site and probability sampling was used.

Sampling design

Cross-sectional survey was conducted and stratified into wetlands, woodland, abattoir and dump site. Data were collected using point count techniques for woodland site, In these site a total of four lines transects approximately 1.5 km length were established from different direction of the town.

Using the transect count method, birds were counted by walking at slow and uniform pace throughout the whole transect. The speed of walking on the routes was determined by the number of birds present and the extent of difficulties in recording them (Tsegay, 2020). In abattoir and dump site the data collection method where used total count method, due to small size area. Where as in wet land site the data collection where used in point count methods and point transects were established in wetland site. In this method observations were made by standing in the middle of the point transect and observing 360° round quietly and gently up to a distance of 30 m radius (Tsegay *et al*.,2019).

All birds seen and heard within this 30 m radius were recorded. Each point transect was 100 m far away from road side to avoid edge effect and was at least and was at least 150 m far away from each other to avoid double counting of the same individual of a species following the methods of (Aynalem and Bekele, 2008). To minimize disturbance during the count, a waiting period of 3 to 5 min prior to counting were applied (Weldemariam *et al*., 2016).

Data collection

Two sessions of data collection were carried out for both wet and dry seasons. Gambella has two season only i.e. dry(summer) and wet(rainy season). Actual data collection of the study on the diversity, relative abundance and distribution of bird species in the study area where carried out from dry season, 2021 to wet season,2022. Bird identifications and counting of individuals were conducted by direct observations aided with binoculars (8×42). The data were collected in two days per a week was used to record bird species in wet and dry seasons. Data were collected early in the morning from 7:00 to 10:00 A.M. and in the late afternoon from 4:00 to 6:00 P.M., for a total of five hours in a day) when the activity of birds is prominent following (Aynalem & Bekele, 2008).

Observation at each point transect lasted for 15 min and field guides of east African was used for identification of the birds (Perlo, 1995). The following characteristics were applied to identify the bird species. External morphology, (Color, size, beak, leg and tail) song, calls and habitat type (Wenny *et al*., 2011). Birds flying over the area were also observed to identify the species. Finally, birds' checklist was prepared on the basis of their scientific names, common names and International Union for Conservation of Nature (IUCN) status. The numbers, types and locations of birds was recorded during a fixed amount of time at each point. All observed bird species was recorded with a prepared datasheet.

Method of data analysis

Data was entered into Microsoft excel 2010 and analysis using Statistical Package for the Social Sciences (SPSS) version 20. Variations of birds and seasons with habitat types were analyzed using pair wise T test and One-way analysis of variance (ANOVA). Mean for variables whose values showed significance differences were compared using LSD Multiple Comparison Test. The species diversity of each habitat in the two seasons was analyzed using Shannon diversity Index (Shannon and Wiener, 1949). Species evenness was evaluated using Shannon-Wiener evenness Index (E) (Southwood and Henderson, 2000). Simpson's similarity index (Simpson, 1949) was used to assess the similarity of species between two different habitat types. The relative abundance of avian species was determined using encounter rates that give crude ordinal scales of abundance as abundant, common, frequent, uncommon and rare (Bibby et al., 1998). Abundance categories 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 given1 (rare), 2 (uncommon), 3 (frequent), 4 (common) and 5 (abundant) (Bibby *et al*., 2000).

RESULTS

Species composition

A total of 66 avian species belonging to 13 orders and 31 families was identified in the study area. In wet and dry seasons 55 and 46 bird species were recorded, respectively. From those, 34 species were common to both seasons. Whereas, 11 species of birds was recorded only during the dry season and 21 species was recorded during the wet season (Appendix -Table 2). The highest number of species was recorded for the family Ardeidae with 11 species, which accounts for 22.4% of the identified species followed by the Accipitridae (9 species). The rest of the families ranged from one to four species (Appendix, 1). Among the recorded bird species, the order Passeriformes was numerically the dominant order, represented by the highest number of families (14) and 25 species, which accounts for 38.8% of the identified species. Cuculiformes, Falconiformes and Suliformes were the least dominant orders represented with 1 species (Figure 2)

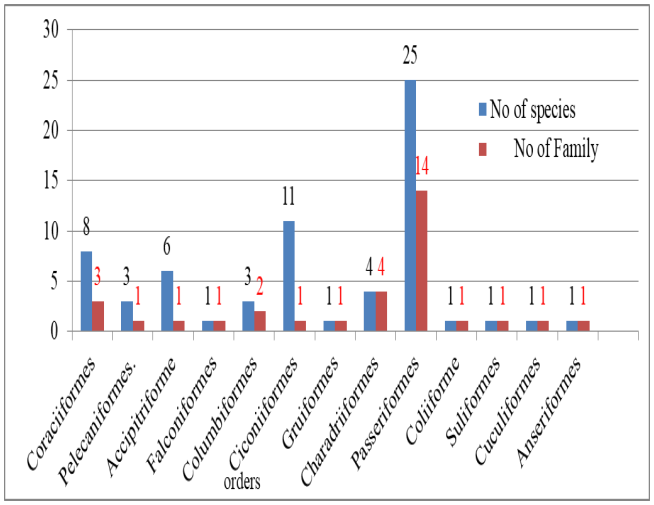

Figure 2. Compositions of different orders and family of birds of the study area.

Abundance and Distribution of bird species on different sites

Bird species' abundance varied among sites. The highest abundance was recorded in wetland (2455), followed by woodland (2407), abattoir (1188) and the least abundance was recorded in dump sites (573 during both season. The number of individuals observed varied between sites, it was significant (DF = 3, F = 2.933, p = 0.038 <0.05 (Table, 2). This indicates that the difference in habitat had a significant effect on the abundance of individual species.

In wetland site 44.44% of bird species, 34.35% of bird species from woodland site, 11.10% of bird species were from abattoir site and 10.10% of bird species were distributed from dump sites were identified in both Seasons (Figure, 3).

Relative abundance of species

From the total of 46 bird species were identified in dry season, 32 species and 14 species are uncommon and frequent respectively. Whereas during wet seasons 55 bird species were identified, from these 34, 17 and 4 species are grouped under uncommon, frequent and rare respectively(Table 1) . However, there is no common and abundant species in the study area. As a result, the majority of the species had low population sizes; as consequence, they were locally grouped under uncommon species, frequent and rare.

Table 1. Relative Abundance of Species

Common name	Scientific name	Order	Family	IUCN red list category	Movement pattern
Swallow tailed bee-eaters	*Merops hirundineus*	Coraciiformes	Meropidae	Least concern	Resident
Madagascar bee-eaters	*Merops superciliosus*			Least concern	Resident
Southern Carmine bee- eaters	*Merops nubicoides*			Least concern	Seasonal migrate
African pigmy king fisher	*Ispidina picta*		Alcédinidés	Least concern	Seasonal migrate
Hadada Ibis	*Bostrychia hagedash*	Ciconiiformes		Least concern	Resident
Egyptian vulture	*Neophron percnopter-us*	Falconiformes		Endangered	Seasonal migrate
Pied king fisher	*Ceryle rudis*			Least concern	Resident
Grey headed king-fisher	*Halcyon leucocephala*			Least concern	Seasonal migrate
Abyssinian roller	*Coracias abyssinicus*		Coraciidés	Least concern	Seasonal migrate
African sacred ibis	*Threskiornis aethiopi-cus*		Threskiior-nithidae	Least concern	Seasonal migrate
African fish eagle	*Haliaeetus vocifer*	Accipitriforme	Accipitridae	Least concern	Resident
Glossy ibis	*Plegadis falcinellus*			Least concern	Seasonal migrate
Saddle-billed Stork	*Ephippiorhynchus senegalensis*		Ciconiida	Least concern	Seasonal migrate
Cattle Egret	*Bubulcus ibis*		Ardeidae	Least concern	Seasonal migrate
Great egret	*Ardea alba*			Least concern	Seasonal migrate
Yellow billed stork	*Mycteria ibis*			Least concern	Seasonal migrate
Abdim ' s stork	*Ciconia abdimii*			Least concern	Seasonal migrate
Africa open bill stork	*Anastomus lamel-ligerus*			Least concern	Seasonal migrate
Black headed heron	*Ardea melanocephala*			Least concern	Seasonal migrate
Marabou stork	*Leptoptilos crumenifer*			Least concern	Resident
Woolly-necked stork	*Ciconia episcopus*			Least concern	Resident
Goliath heron	*Ardea goliath*	Pelecaniformes		Least concern	Seasonal migrate
Squacco heron	*Ardeola ralloides*			Least concern	Seasonal migrate
Grey heron	*Ardea cinerea*			Least concern	Seasonal migrate
African mourning dove	*Streptopelia decipiens*	Columbiformes	Columbidae	Least concern	Resident
Speckled pigeons	*Columba guinea*			Least concern	Resident
Bruce's green pi-geon	*Treron waalia*			Least concern	Resident
Black crowned crane	*Balearica pavonina*	Gruiforme	Gruidae	Vulnerable	Resident
Little Curlew	*Numenius minutus*	Charadrii-formes	Scolopacidae	Least concern	Seasonal Migrate

Spur- winged Lap-wing	*Vanellus spinosus*		Charadriidae	Least concern	Seasonal migrate
Spotted Thick- knee	*Burinus capensis*		Burhinidae	Least concern	Resident
African jacana	*Actophilornis africanus*		Jacanidae,	Least concern	Resident
Zanzibar red bishop	*Euplectes nigroventris*	Passeriformes	Ploceidae	Least concern	Resident
North-ern Red Bishop	*Euplectes franciscanus*			Least concern	Resident
Red headed-Malimbe	*Malimbus rubiccollis*			Least concern	
Grey – capped social weaver	Pseudonigrita arnaudi			Least concern	Resident

Effects of season on abundance in each sites

In seasonal variation, the individual abundance of species in both dry and wet seasons, dump ($t = -2.412$, $P<0.05$), abattoir ($t = -2.461$, $P<0.05$), wetland ($t = 3.757$, $P<0.05$), and woodland ($t = -2.418$, $P<0.05$) had significant effects on the abundance of avian species between seasons. However, in the overall sites of dry and wet seasons, there was insignificant effect on the abundance of avian species ($t = -0.199$, $P > 0, 05$) (Table 2).

Species richness, diversity and evenness

Variation in the number of bird species was observed among the four sites and between seasons in the same site. The highest number of species was recorded from wetland during dry (37) seasons followed by woodland with 31species during wet season. During both seasons, the highest number of bird species was recorded from wetland (41) followed by woodland (34) (table 3).

In both seasons, the bird species diversity in each of the four site types varied from 2.03 to 3.18. The highest bird species diversity was recorded in wetland site with 3.18. Abattoir site was recorded as the lowest bird species diversity, with 2.03 (Table, 3). The species evenness (SE) in each of the four site types varied from 0.85 to 0.91. The most evenly distributed in terms of birds was calculated as the dump site, with a 0.91.Wetland were recorded as the lowest in species evenness, with 0.85 (Table 3).
Where, (J') =Evenness index and (H') =Shannon diversity

Species similarity

During the wet season, more species similarity was seen between species of dump and abattoir sites (SI = 0.5). While the least similarity was observed between woodland and dump sites (SI = 0.06), during the dry season, the highest similarity was observed between the dump and abattoir sites (SI = 0.5), and the lowest species similarity was seen between woodland and abattoir sites (SI = 0.064) (Table, 4).

Table 2. Abundance values of bird species in four sites during dry and wet season (Mean ± SE)

Habitat	Season	M ±SE	t-value	P-value
Wetland	Dry	44.39±6.987	3.757	.001
	Wet	17.45±5.352		
Woodland	Dry	33.29±5.795	-2.418	.022
	Wet	43.87±6.179		
Abattoir	Dry	38.22±8.806	-2.461	.039
	Wet	93.78±24.250		
Dump	Dry	22.88±6.026	-2.412	.047
	Wet	48.75±6.997		
Overall	Dry	53.33±10.188	-1.199	.236
	Wet	69.71±9.466		

Table 3. Bird species diversity, evenness in the four study site during wet and dry season

Habitat	Season	No Species	No of individual	Diversity (H')	Evenness (J)	Both season	
						(H)	(J)
Wetland	Dry	37	1941	3.12	0.86		
	Wet	17	514	2.04	0.72	3.18	0.85
Woodland	Dry	23	849	2.84	0.89		
	Wet	31	1558	3.13	0.91	3.16	0.89
Abattoir	Dry	9	379	1.85	0.91		
	Wet	8	809	1.99	0.89	2.03	0.86
Dump	Dry	6	173	1.72	0.96		
	Wet	8	400	2.00	0.95	2.18	0.91

Where, (J') =Evenness index and (H') =Shannon diversity

Table 4. Species similarity of birds among the four site types during wet and dry seasons

Habitats	Season	Simpson's Similarity Index(SI)			
Site type		Wet land	Wood land	Abattoir	Dump
Wetland	Dry	-	0.3	0.30	0.24
	Wet	-	0.3	0.22	0.22
	Both	-	0.32	0.2	0.26
Wood-land	Dry	-	-	0.12	0.06
	Wet	-	-	0.064	0.12
	Both	-	-	0.08	0.13
Dump	Dry	-	-	-	0.5
	Wet	-	-	-	0.5
	Both	-	-	-	0.35
Abattoir	Dry	-	-	-	
	Wet	-	-	-	
	Both	-	-	-	

DISCUSSION

In this study, a total of 66 species of birds were identified. In comparison to another equivalent urban area in the country, like Wolkite Town, which has 30 avian species (Tsegaye *et al*., 2019); Gambella Town is relatively rich in its avifauna. This is probably due to a difference in resource availability, the size of the area, and the close proximity of Gambella town to the Baro River and wetland. Similarly due to varieties of habitats that comprise the terrestrial and aquatic vegetation's, the number of bird species is more diverse (Gibru *et al*., 2019). Whereas, it is lower than the report of Gibru and Mengesha, (2019) (103 species) Avifauna in Lake Hawassa and Adjoining Areas, Southern Ethiopia, Kalkidan and Afework, (2011)(124 species) Entoto Natural Park and Escarpment, Addis Ababa and (Ayalew *et al*., 2015) (118) Sheko District, Southwest Ethiopia. This is consistent with Mulualem *et al*. 2016; Hiwot and Afework, 2007; variation in species composition may be related with availability of food presented, the degree of threats and disturbances found in the area, as well as other ecological needs surrounding the area. Similarly, it might be associated with geographical variations and extreme climatic factors (Takele and Afework, 2018). Among the recorded bird species, the order Passeriformes was numerically the dominant order, represented by the highest number of families (15) and species (25) of the identified species. This result agrees with the findings of Alemayehu *et al*. (2020) Avian Distribution and Abundance in the Case of Mettu District, Southwest Ethiopia, Weldemariam *et al*. (2016c) Avifauna Diversity in Kafa Biosphere Reserve in Southwest Ethiopia, and Seyoum *et al*. (2018) Wabe fragmented forests around Gubre subcity and Wolkite town, Southwestern Ethiopia. They reported among the 65, 42 and 50 species identified, respectively, 47%, 47.6% and 44%of the species are belonged to the order Passeriformes.

Based on the family groups, birds showed variation in the distribution among the four sites. The highest number of families was observed in the wetland habitat. This might be due to large size of the area and it surrounded by grassland and large trees, making these areas ideal for feeding and resting various bird species. The least number of families was recorded in the abattoirs (Table 1). This might be due to the presence of homogenous food items in the area, because of these mostly scavengers' species are present. On the other hand, egret, vulture, ibis and Marabou stork are high distribution in the wet land, abattoir and dump site, because of, the availability of food items that feed these species present in both sites, like scraps of fish dumped by fishermen, dumped from hotels, and non-edible parts of the abattoir. The distribution bird species may be influenced by habitat size and quality, bird foraging modes and floristic composition (Girma *et al*., 2017).

According to the rate of occurrence during the study period, the majority of bird fauna during dry and wet seasons locally was uncommon, frequent, and rare. Because of low number of individuals relative to the effort made during the survey, this might be due to suitability of habitat type, resource availability, and degree of disturbance in the area. Similarly; Shimelis & Afework, (2009); Ayalew *et al*. (2015), they stated that the presence of a large number of uncommon species in a certain area could be related to the breeding nature, large home range, and niche of species. Similarly finding on Tsigereda (2011), in Bole International Airport;, Ethiopia, who reported that most of the species of bird were found to be uncommon.

The abundance of individual scores varied among sites in this study ($p<0.05$). Wetland sites had a higher abundance of individual species than other sites. This could be due to the presence of varied alternative food sources for a variety of certain bird species and less anthropogenic disturbance. In line with Tsegay *et al*. (2019), reported that the variation in abundance of bird species between habitats is determined by food availability, breeding sites, suitable cover and nesting sites, the adaptation or tolerance level of the species. The difference in number of species, and number of individuals among the different habitat types could be associated with differences in habitat characteristics and feeding habits of birds (Laurent *et al.,* 2007).

There was a significant difference in abundance among habitats ($F = 2.933$, $p< 0.05$). However, the overall bird count of the dry and wet seasons had no significant difference in the abundance of avian species ($p > 0.05$). According to Tsegaye *et al*. (2016); Moges *et al*. (2018) and Demeke *et al*. (2019), reported variations in species composition recorded during the wet and dry seasons were not significantly different, but there was a significant difference among habitats. However in contradict with Takele and Endale (2019), Lakeshore bird species around Lake Hawassa, Ethiopia, reported that relative abundance of bird species between seasons was significantly varied ($P < 0.05$).

Diversity of woodland sites was highest during the wet season than dry season. This might increase vegetation composition and vegetation layer, meaning that, there was an improvement in the quality of nesting sites and the amount of food available. Seasonal changes cause seasonal variation in the availability of food and water resources. According to Chace *et al*. (2006) reported, birds shift between habitat types based on their needs and the availability of food and cover. This

a) Wetland site in dry season

b) Wetland site in wet

c) Dump site

d) Abattoir site

e) Black Crone Crane

f) Marabou Stork

Figure 2. Site Photographs (a, b, c, d, e, f) taken during study period

is in line with Nega and Afework, (2008), Dembia plain wetland, Lake Tana during the wet season, and the Angara habitat, harboring different species because of the presence of flowers, grass, the availability of a variety of food sources, cover for birds and dense trees. Similarly, Demeke *et al*. (2019) bird diversity and relative abundance in Loka Abaya National Park, Sidama Zone, Southern, Ethiopia, reported that the decline in the diversity of birds in wooded grassland during the dry season compared to the wet season might be due to the decrease in vegetation productivity, reduction of food availability, and sometimes low quality of nesting sites for birds.

The diversity of birds in abattoir and dump sites was decreases more during the dry season than during the wet season. This might be due to low available dumped food and carcass available for scavenger birds, as a result of fasting period of orthodox Christians in the study period Hiwot and Afework (2007), birds of Addis Ababa Abattoirs Enterprise, reported during the fasting period diversity of bird was decreased.

Diversity of birds in wetlands increased during the dry season rather than the wet season. This could be related to the availability of moisture, immigration and food resources, like small fish, tadpoles, frogs, insect and larvae, whereas, in summer season, the water content of the wetland is too high; it will be difficult to feed these resources. In line with Demeke *et al*. (2019) diversity and relative abundance of birds in Loka Abaya National Park, Southern Ethiopia, reported, diversity of birds increased in wetland areas during the dry season.

During both seasons, the wetland site was more diverse than the other three sites. This may be due to the large size of the area and the diverse of habitats in surrounding, such as large trees (Fruit trees like mango) and grass land. This agrees with Aynalem & Bekele (2008), Birds of the riverine and wetland habitats of Infranz and Yiganda at the southern tip of Lake Tana, Ethiopia, reported, the large size of Yiganda, as compared to the other sites might contribute to the highest bird species diversity.

The species evenness (SE) was higher in the dump sites. This might be due to bird species that more or less equally harvest the available resources and similar behaviors to resist disturbance. In contrast, wetland site have the lowest species evenness. This may be due

to the dominance by a few bird species, as a result of different suitability of species for nesting and feeding. This could be due to differences in resource competition, breeding behavior and feeding behaviors among the various bird species in each habitat (Tsegaye, 2020).

There is a high degree of Sorensen's similarity between dump and abattoir sites. This might be due to the similarity in foraging opportunities, their geographical proximity, and similar extent of disturbances. Habitat types that are close to one another can share the same number of species (Demeke *et al*., 2019). In addition, the adjacent occurrence of the two habitat types could be an important source of similarity (Ziyad and Mustefa, 2019). The woodland and dump habitats have low community Sorensen similarity. This might be due to the difference in the resources and breeding area requirements among the bird species. The lowest avian similarity could probably be due to the difference in foraging adaption and the response of birds to anthropogenic disturbance in each habitat (Tsegaye, 2020).

CONCLUSION

In the face of the relatively small area coverage, the avifaunal species composition and the population size of each bird species in Gambella town were rich, due to favorable places for birds as, a good access to food and water resources. The seasonal variation in number of individual species and their distribution in the study area are also directly related to the types of site and availability of food. The African sacred ibis (*Threskiornis aethiopicus)*, hooded vulture(*Necrosyrtes monachus)* and Marabou stork (*Leptoptilos crumenifer)* were the most dominant species because of less restrictive in their selection of feeding sites and the ability to resist anthropogenic impacts. The diverse bird community in the study area was attributable to the presence of easily accessible water resources, availability of different food resource, nesting of natural and man-made environment for different bird species. Many bird species migrate between different habitats, thereby optimizing the availability of food sources and breeding habitats. The abattoirs sites are located near to the road, no standard organization of dump and expansion of urbanization in wetland site are factors of bird species. As a result of the areas being urban and having a high bird composition, so bird watching ecotourism should be encouraged in the area. Therefore, there should be a need for protecting and to conserve the biodiversity of the area including the avifauna.

RECOMMENDATION

Additional ecological studies, such as feeding behavior, breeding and activity patterns, particularly on abattoirs, dump site, and wetland areas, should be conducted in the future to obtain complete ecological information about bird species in the study area.

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