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Research Article

Diversity, Abundance, and Distribution of Avian species in Bayero University Main Campus, Kano State, Nigeria

***Lawal, F. O.[1] and Yakubu, S. A.[2]**

[1]Department of Forestry and Wildlife Management, Bayero University, Kano, Nigeria
[2]Department of Wildlife and Ecotourism, University of Ibadan, Oyo State, Nigeria
****Corresponding Author's email*: folawal.fwm@buk.edu.ng; Phone: +2348059990351, +2349134744621**

ABSTRACT
The study used point count method to collect data on diversity, abundance, and distribution of avian species in Bayero University Main Campus based on different vegetation types, including agricultural, residential, and degraded savannah habitats. A total of 886 individual birds of 61 bird species belonging to 35 families and 16 orders were identified in this study. The 307 individuals recorded in agricultural habitat, consisting of 17 families, while 278 individuals were recorded in residential habitat, consisting of 12 families, and 301 individuals were recorded in degraded savannah habitat, consisting of 21 families. The counting bands of the 50m radius were used for all the stations. The distance between the two counting stations was 500m. The counting was observed in the morning (06:00 to 08:00) and evening (05:00 to 07:00). The study revealed that there was no significant difference between habitats and the bird feeding guild. The Kruskal-Wallis test was applied to test the difference in bird abundance between habitat types, revealing that the number of birds in the agricultural and degraded habitats differed significantly from the residential habitat as $p < 0.05$ ($H= 3578$, $p= 0.0001$). Whereas Shannon-Wiener diversity index (H) used to determine species diversity index was 3.413, evenness of 0.927 and richness of 8.840. The finding revealed that the diversity of birds between the three habitats was not significant ($F=0.098$, $df=2$ and $P=0.943$ at $\alpha=0.05$). There was no significant difference in diversity between the agricultural, residential and degraded savannah bird composition.

Keywords: Bird survey; Genetic diversity; Habitat fragmentation; Point count method; Urban Ecology

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INTRODUCTION

Birds (class Aves) are best known group of organisms due to their wide spread distribution diversity and their performance in human culture and science. They have been extensively studied and admired for their unique behaviours songs and ecological roles (Sekercioglu, 2006). With over 10,000 recognized species worldwide inhabiting nearly every ecosystem on the biosphere. Birds exhibit remarkable diversity in morphology, behaviour, and habitat preferences (Gill, 2020). They are characterized by unique morphological adaptations such as feathers, hollow bones and high metabolic rates which facilitate flight in most species (Jarvis *et al.,* 2014). Ecologically, bird contribute to ecosystem stability through seed dispersal, pollination, pest control, population check and nutrient cycling (Yakubu, 2024). Furthermore, birds serve as bio-indicators, reflecting changes in environmental conditions such as habitat degradation and climate change (Chace & Walsh, 2006). Birds' population are affected majorly by anthropogenic activities including deforestation, habitat fragmentation, pollution, and climate change (BirdLife international, 2021).

Today, many bird species face population declines due to threats includes hunting, introduction alien species, and illegal wildlife trade, pushing several keystones avian species to the brink of extinction (Ceballos *et al.,* 2017). As a result, avian conservation has become a critical area of research interest, with scientists employing ecological, behavioural and genetic studies to understand population dynamics and inform conservation strategies (Frankham *et al.,* 2017).

Nigeria hosts a rich avian diversity, with approximately 940 recorded species (BirdLife International, 2024). Among these, 8 species are classified as Critically Endangered, 14 as Endangered, 22 as Vulnarable, 38 as Near Threatened, 858 as Less Concern, and five as Data Deficient (BirdLife International, 2024). Nigeria accounts for approximately 9.4% of global bird diversity, highlighting its significance for avain conservation (Birdfact, 2024).

The study on diversity, abundance and distribution of birds with respect of different habitats types is important since it will provide a better understanding on the bird diversity, abundance, and distribution within natural, cultivated and human occupied habitats, also to create more awareness on the positive impacts birds have on the environment, serve as a leverage for other researchers to work more on birds in related to the habitat and seasons present in Nigeria and some close related country with likely same habitat. Finally, enhance a platform for promoting avitourism in the country.

MATERIALS AND METHODS

Study Area

Bayero University (Main campus) is located in Danbare within Kumbotso Local Government area, Kano state, Nigeria. It is located on the latitude 11.96°N and longitude 8.43°E. The campus spans approximately 1,458 hectares (ha) with built-up area covering about 352ha. The campus comprises of diverse trees and shrubs species characteristic of the Sudan savanna vegetation ecosystem, the dominant trees species are *Azadirachta indica* (Neem) and *Eucalyptus camaldulensis* (River red gum). The Main campus can be designated as a suburban, as it integrates built-up areas with natural and semi-natural vegetation. Additionally, areas located farther from faculty buildings and staff residences experience minimal anthropogenic disturbances, preserving native vegetation and local biodiversity.

Materials

The materials utilized for this study are;

Field Guide: Birds of West Africa Book (Borrow and Demey, 2002

Optical Equipment: Nikon 10×42 binoculars for bird identification and observation.

Navigation Device: Garmin GPS for recording geographical coordinates

Audio Equipment: Tape recorder for capturing bird calls and vocalizations

Data Recording Tools: Recording sheets and pens for field data documentation.

Survey Methods

Point count method was used in the collection of data (Burgess *et al*., 2000). The survey was conducted from September 1st 2023 to February 29th 2024, from 06.00am to 08.00am (morning section) and 05.00pm to 07.00pm (evening section) twice weekly. The study randomly stratified the survey area to 15 sites, the site separated by a minimum distance of 500m to ensure that each site was independent. Within each site, 5-point count plots station were separated by 100m to reduce the chance of double counting individuals (Filloy *et al*., 2019). Bird heard (call) and seen in the radius of 50m from the count station were noted for 10minutes. The birds were identified using Nikon 10×42 binoculars and the Birds of West Africa Field Guide Book (Grimmett *et al*., 2016). The unknown birds were later identified using photographs taken during field work. The 15 sites distributed among the following; Agricultural, Residential and Degraded Savanna habitat types across the study area and to evenly cover all locations within the campus (New campus).

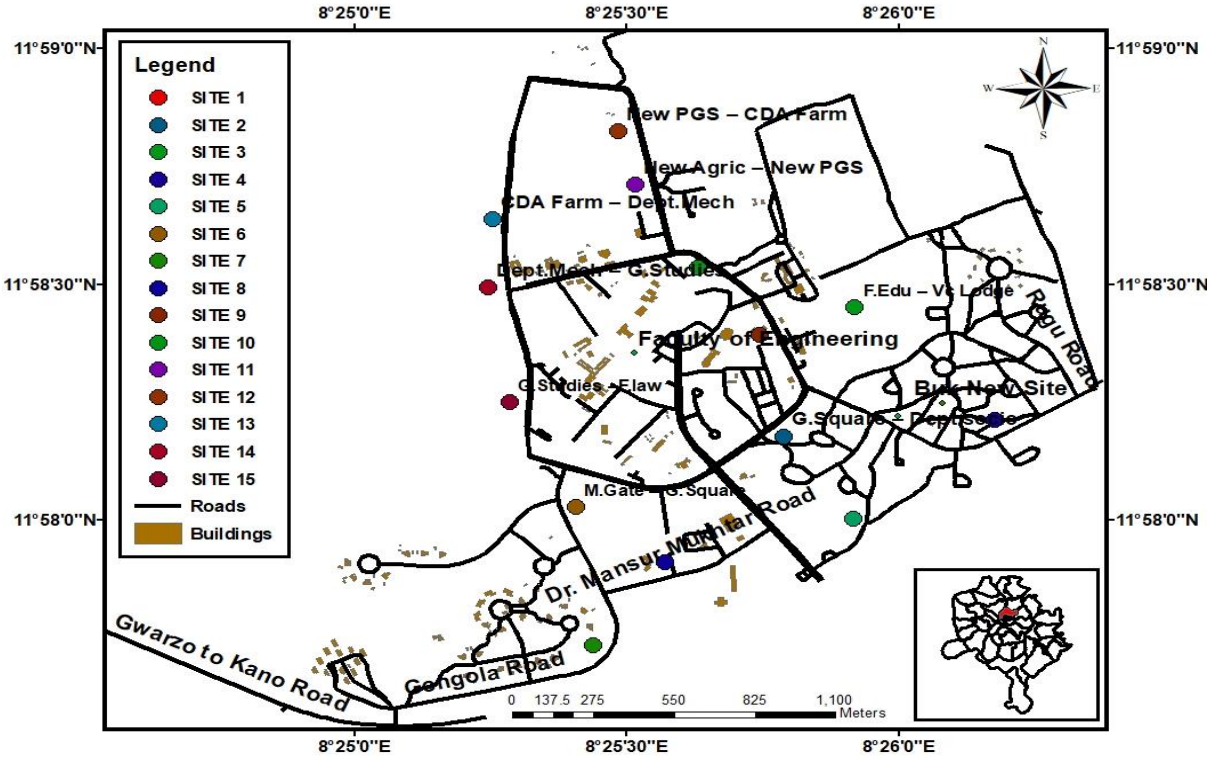

Figure 1: Map of Bayero University Kano, new campus showing the survey fifteen sites

Data Analysis

The data collected was analysed using descriptive statistics as in simple frequency counts and percentages. Shannon Weiner and Simpson index was adopted to evaluate the bird species diversity, evenness, richness and abundance. The family name, common name, and scientific name, were given based on the field guide to the birds of western Africa (Borrow and Demey, 2014) while feeding guild was according to handbook for the birds of world Alive (HBW, 2019) and (Borrow and Demey, 2014).

RESULTS

Birds species in the study area

A total of 886 individual birds, 61 bird species belonging to 35 families and 16 orders were identified in the study arae, which included 59 resident species, and 2 migrants. Six families had the highest number of species; Columbidae with five species, the Falconidae with four species, Accipitridae, Cuculidae Nectarinnidae, and Sturnidae with three species in each family.

Table 1: Checklist of Avian Species in Bayero University New Campus. (√ Yes, - No.)

S/N	Family	Common Name	Scientific Name	Heard	Sight	Time	Guild
1	Accipitridae	Yellow billed kite	*Milvus aegyptius*	–	√	Both	Carnivore
2	Accipitridae	Black kite	*Milvus migrans*	–	√	Both	Carnivore
3	Accipitridae	Oriental honey buzzard	*Pernis ptilorhynchus*	–	√	Both	Carnivore
4	Alcedinidae	Grey headed kingfisher	*Halcyon leucocephala*	–	√	Evening	Omnivore
5	Apodidae	Little swift	*Apus affinis*	–	√	Morning	Insectivore
6	Apodidae	African palm swift	*Cypsiurus parvus*	–	√	Both	Insectivore
7	Ardeidae	Cattle egret	*Bubulcus ibis*	–	√	Evening	Insectivore
8	Aegithalidae	Black eared Bushtit	*Tuidus pelios*	–	√	morning	Granivore
9	Bucerotidae	Southern yellow hornbill	*Tockus leucomelas*	–	√	Both	Frugivore
10	Bucerotidae	Northern red hornbill	*Tockus erythrorhynhus*	–	√	Both	Frugivore
11	Charadriidae	Spur winged lapwing	*Vanellus spinosus*	√	–	Both	Insectivore
12	Charadriidae	Black headed lapwing	*Vanellus melanopterus*	–	√	Both	Insectivore
13	Cisticolidae	Desert cisticola	*Cisticola aridulus*	–	√	morning	Insectivore
14	Cisticolidae	Zitting cisticola	*Cisticola juncidis*	–	√	morning	Insectivore
15	Columbidae	Laughing dove	*Spilopelia senegalensis*	√	√	Both	Granivore
16	Columbidae	African mourning dove	*Zenaida macrouna*	√	√	morning	Granivore
17	Columbidae	African collard dove	*Stretopelia decaoto*	√	√	Both	Granivore
18	Columbidae	Rock pigeon dove	*Columba livia*	–	√	Both	Granivore
19	Columbidae	Black-billed wood dove	*Turtur abyssinicus*	–	√	Both	Granivore
20	Coraciidae	Abyssinian roller	*Coracias abyssinicus*	–	√	Evening	Insectivore
21	Corvidae	Pied crow	*Corvus albus*	√	–	Evening	Omnivore
22	Corvidae	Piapiac	*Ptilostomus afer*	–	√	Evening	Omnivore
23	Cuculidae	Senegal coucal	*Centropus senegalensis*	–	√	Both	Carnivore
24	Cuculidae	Common hawk cuckoo	*Hierococcyx varius*	–	√	Both	Insectivore
25	Cuculidae	Jacobin cuckoo	*Clamator jacobinus*	–	√	Both	Carnivore
26	Emberizidae	Lark bunting	*Calamospiza melanocorys*	–	√	Morning	Granivore
27	Falconidae	Grey kestrel	*Falco ardosiaceus*	–	√	Both	Carnivore
28	Falconidae	Fox kestrel	*Falco alopex*	–	√	Both	Carnivore
29	Falconidae	Common kestrel	*Falco innunculus*	–	√	Both	Carnivore
30	Falconidae	Red necked falcon	*Falco chicqera*	–	√	Both	Carnivore
31	Hirundinidae	Dusky crag martin	*Ptyonoprogne concolor*	–	√	Both	Insectivore
32	Malaconotidae	Yellow crowned Gonelek	*Laniarius barbarus*	–	√	Both	Insectivore

Table 2: Checklist of Avian Species in Bayero University New Campus. (√ Yes, - No.)

S/N	Family	Common Name	*Scientific Name*	Heard	Sight	Time	Guild
33	Musophagidae	Western plantain eater	*Crinifer piscator*	–	√	Both	Frugivore
34	Nectarinnidae	Pygmy sunbird	*Anthodiaeta platura*	–	√	Morning	Nectarivore
35	Nectarinnidae	Beautiful sunbird	*Cinnyris pulchellus*	–	√	Both	Nectarivore
36	Nectarinnidae	Variable sunbird	*Cinnyris venustus*	√	–	Morning	Nectarivore
37	Phasianidae	Double spurred francolin	*Pternistis bicalcaratus*	–	√	Morning	Omnivore
38	Phoeniculidae	Green wood hoopoe	*Phoeniculus purpureus*	–	√	Both	Insectivore
39	Picidae	Spotted woodpecker	*Campethera punctuligera*	√	–	Both	Insectivore
40	Picidae	Grey woodpecker	*Mesopicos goertae*	–	√	Both	Insectivore
41	Oriolidae	African golden oriele	*Oriolus auratus*	–	√	Both	Frugivore
42	Passeridae	Grey headed sparrow	*Passer griseus*	–	√	Both	Frugivore
43	Ploceidae	Northern red bishop	*Euplectes franciscanus*	–	√	Both	Insectivore
44	Ploceidae	Village weaver	*Ploceus cucullatus*	–	√	Both	Granivore
45	Ploceidae	Black headed weaver	*Ploceus melanocephalus*	–	√	Both	Granivore
46	Psittacidae	Senegal parrot	*Poicephalus senegalus*	–	√	Evening	Frugivore
47	Psittaculidae	Rose ringed parakeet	*Psittacula krameri*	–	√	Both	Frugivore
48	Pyconotidae	Common bulbul	*Pycnonotus barbatus*	–	√	Both	Frugivore
49	Ramphastidae	Bearded barbet	*Pogonornis dubius*	–	√	Both	Frugivore
50	Strigidae	Greyish eagle owl	*Bubo cinerascens*	√	–	Evening	Carnivore
51	Strigidae	Pearl-spotted Owlet	*Glaucidium perlatum*	–	√	Evening	Carnivore
52	Sturnidae	Long tailed glossy starling	*Lamprotornis caudatus*	–	√	Both	Omnivore
53	Sturnidae	Blue eared starling	*Lamprotornis chalybaeus*	–	√	Both	Omnivore
54	Sturnidae	Purple glossy starling	*Lamprotornis purpureus*	–	√	Both	Omnivore
55	Timaliidae	Brown babbler	*Turdoides plebejus*	–	√	Both	Insectivore
56	Turdidae	African thrush	*Turdus pelios*	–	√	Both	Omnivore
57	Turdidae	Eurasian blackbird	*Turdus merula*	–	√	Both	Granivore
58	Tyrannidae	Scissor tailed flycatcher	*Tyrannus forticatus*	–	√	morning	Insectivore
59	Upupidae	Hoopoe	*Upupa epops*	–	√	Both	Insectivore
60	Viduidae	Village indigo bird	*Vidua chalybeate*	√	√	Both	Granivore
61	Viduidae	Pin-tailed Whydah	*Vidua macroura*	–	√	Both	Granivore

Field work, 2024

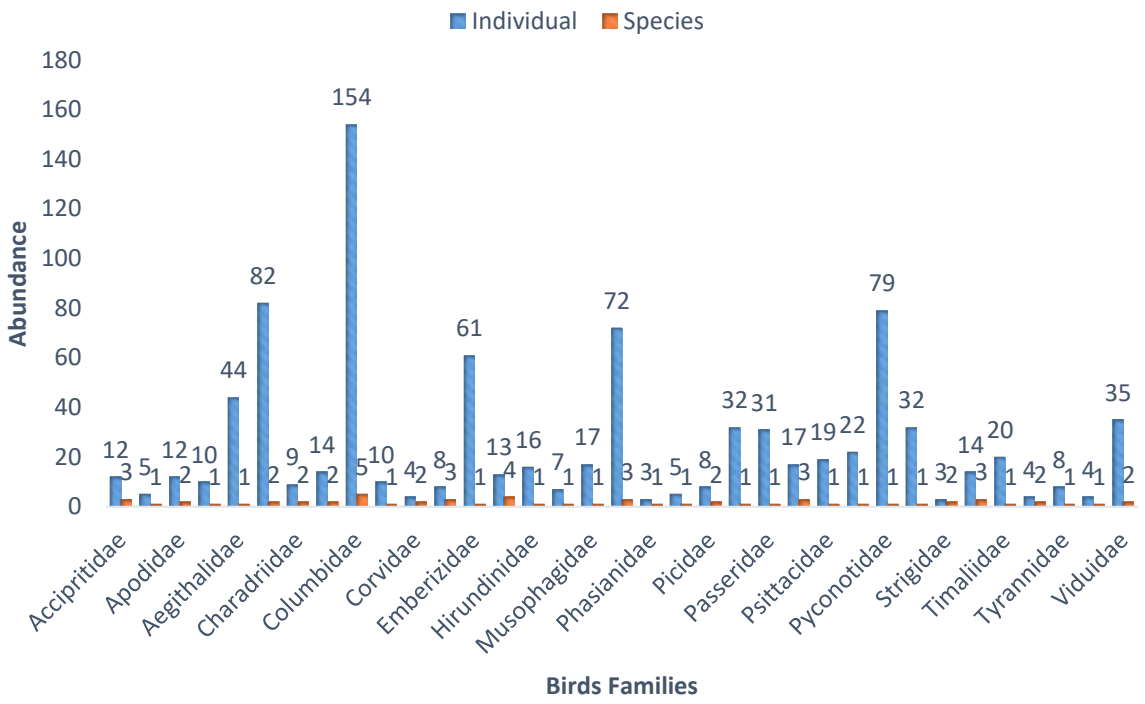

Figure 2. Relative abundance of birds' families found in the study area

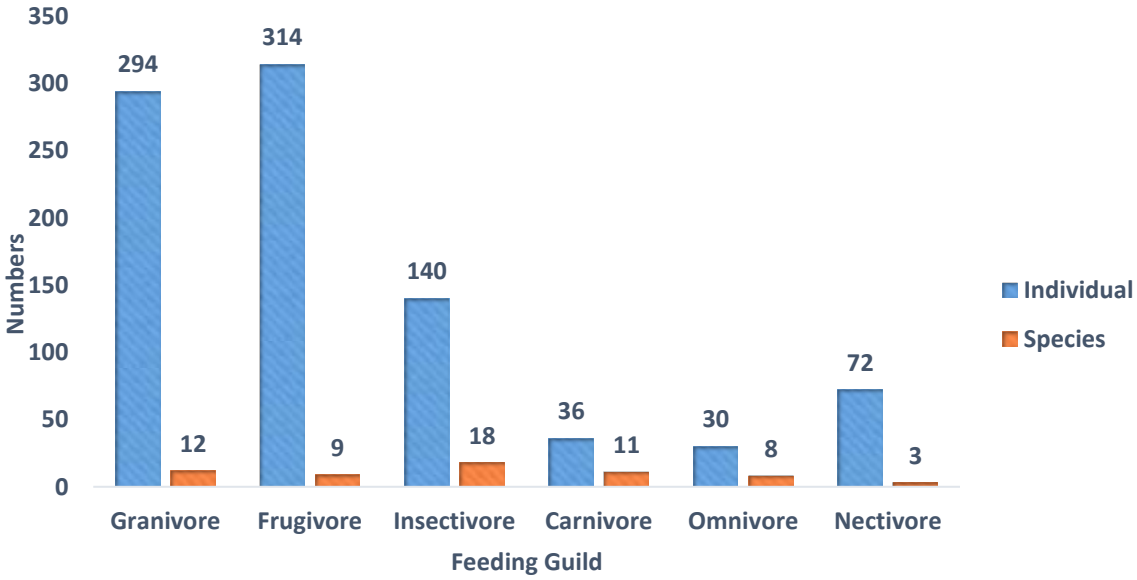

Figure 3: Feeding Guild in the Study Area

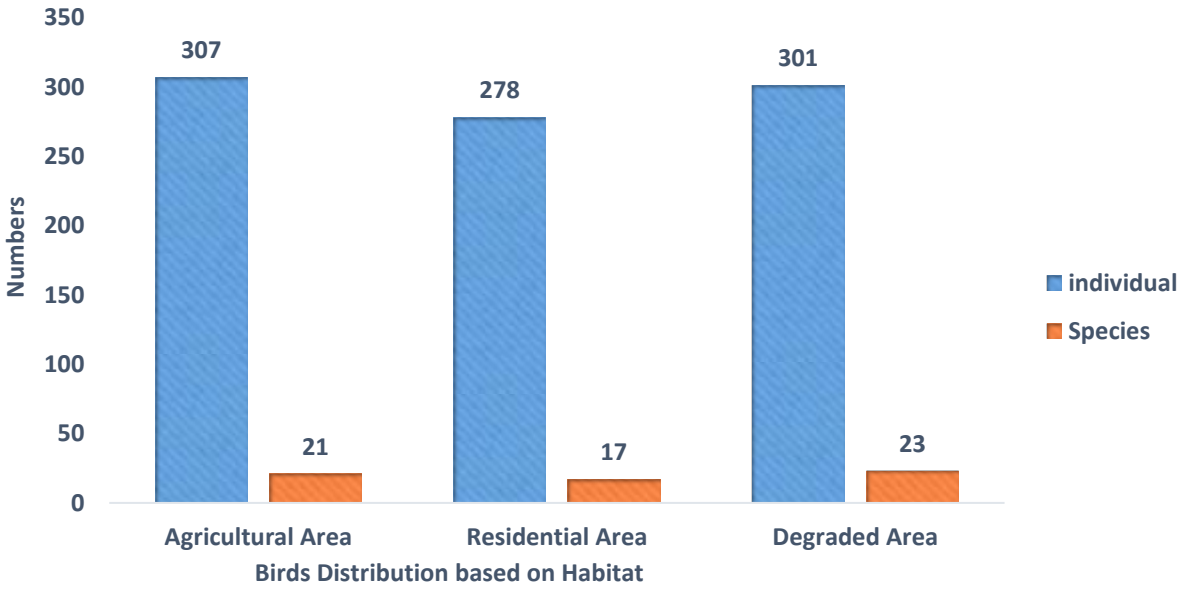

Figure 4: **Distribution of birds based on the Habitat**

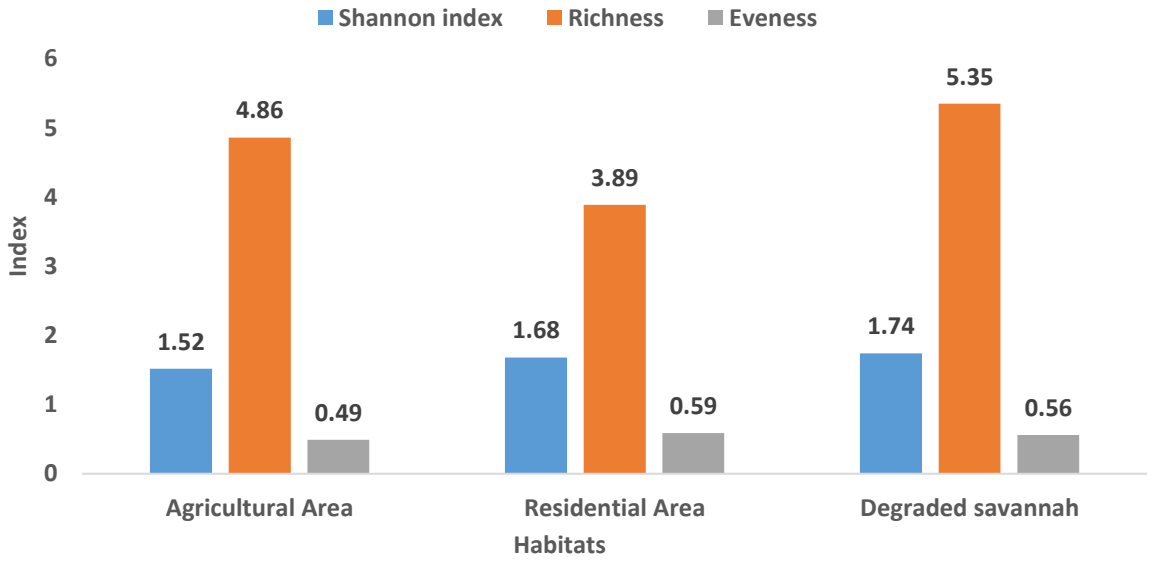

Figure 5: The species diversity, richness, and evenness of birds at the sites

DISCUSSION

A previous study was conducted in Bayero university, Kano new campus (Magaji and Rabiu, 2019). They reported 99 bird species belonging to 47 families, which included 84 resident species, 11 Palearctic migrants and four intra-African migrants. Seven families had the highest number of species then Accpitridae, Ardeidae, Columbidae, Estrididae, Falconidae, and Sturnidae with five species in each family. Difference in the recorded bird species might arise from disparity in the study period this study lasted for six months' dry season alone in contrast to their study which lasted for a whole year extending both wet and dry seasons.

This research work categories bird species based on their feeding guild, 18 species were insectivores, followed by Granivores (12 species), and then carnivores (11 species) while Frugivores has (9 species) and omnivores has (8 species). Insectivores were reported to be the most common bird species in some urban setting in Nigeria (Odewumi *et al*., 2015; Abdul-hadi and Rabiu, 2018). Furthermore, Larger species study identified are ground foragers that feed on available food materials in open spaces with the campus, among which include long-tailed glossy starling (*Lamprotornis caudatus*), Laughing dove (*Streptopelia senegalensis*), Black-billed wood dove (*Turtur abyssinicus*) and Eurasian blackbird (*Turdus merula*).

The study revealed that the Bayero university main campus supports a diversity of bird species. The result obtained from the survey site indicates abundance birdlife in both agricultural, residential and degraded savannah habitats. However, there were differences in the bird species encountered in all the habitats. The differences in bird species diversity and abundance in the different land use types may be due to land use changes and forest heterogeneity which bring about variation in the availability of food, cover, predation risk and micro-climate variation which is supported by many authors. Cody (1985) reported the level of distribution of bird species in a habitat is normally as a result of an occurrence of plant species that supported their population and to variation in species-specific requirements in the choice of habitat**.** This also reported by Mangnall and Crowe, (2003) that the distribution of bird species is largely dependent on the availability of food, water, and cover. The number of bird species recorded in the in residential habitat was lower than the two other habitats, and this suggests that human disturbance in terms human pollution intensification alters the bird species richness (Pearson, 1977). Herkert (2009) reported that the loss of habitat to urbanization reduces the quality of the remaining vegetation thus affect the population of avian species in the area. The relative abundance of avian species in agricultural area was higher than residential, and degraded savannah. This agrees with previous work by Komar (2006) who also reported a high abundance of bird species in cultivated areas, which could be due to food availability.

This study recorded the higher number of insectivore bird species than other feeding guild classification. Insectivores species were reported to be the most common bird species in some urban area in Nigeria (Odewumi *et al*., 2015; Abdul-hadi and Rabiu, 2018). Furthermore, quite a number of these species are ground foragers that feed on available food materials in open spaces within the campus, among which include Long tailed glossy starling (*Lamprotornis caudatus*), Laughing dove (*Streptopelia senagalensis*), Black-billed wood dove (*Turtur abysinicus*), and Eurasian blackbird (*Turdus merula*). Despite the averment that bird species richness and diversity decrease with rising urbanization along an urban-rural gradient (Vandewalle *et al*., 2010). The families of Columbidae, Pycnonotidae and Bucerodidae recorded a higher number of species in the both residential and agricultural area. Example, laughing dove (*Spilopelia senegalensis)* belonging to Columbidae is the most abundant species in the study area due to the abundance of their food (seed-eating birds). The Common Bulbul *(Pycnonotus barbatus*) belonging to Pycnonodidae are also among the abundant species and are mostly found on farmlands due to the availability of food (seeds) (Agyel-Ohemeng *et al*., 2019).

The Shannon-Weiner diversity index of bird species surveyed at Agricultural area was 1.52, richness 4.86 and evenness of 0.49, while in the Residential Area, Shannon index was 1.68, Richness 3.89 and evenness of 0.59 and in the degraded savannah, Shannon index was 1.74, richness 5.35 and evenness of 0.56 (Figure 4) the diversity index in degraded savannah was higher than of residential, and farmland area. This is because of the availability of multiple and variety of alternative food source for the birds. Residential, and farmland area is exposed to people for cultivation, building construction, noise pollution, and cutting of the trees, and this cause birds depending on these sites for feeding, nesting and breeding being affected in diversity. In natural habitats where the intervention of humans is less minimum, the diversity, richness, and as well as evenness of bird species is higher than the fragmented ones where intensive farming is carried out (sekercioglu, 2002). Differences on feeding habits and habitats could also increase diversity, evenness and species richness. The higher diversity recorded in degraded savannah was more likely because of well sufficient vegetation cover than in residential and farmland which has been affected by land use changes (Giannechini, 1993).

Though farmland showed less diversity, higher dominance was due to persistence of native and generalist species like a large number of African Thrush (*Turdus pelios*) cattle egret (*Bubulcus ibis*), Common Bulbul (*Pycnonotus barbatus*), Village Weaver (*Ploceus cucullatus*). (Chace, 2006; Rodriguesz, 2007). On the other hand, the higher evenness in the residential area is supported by presence of tall trees which reduces the impact of predation to adult birds, young and eggs. This study agreed with many survey work which concluded that forested area is the main habitat which harbors large bird species diversity (Askins, 2012). As the vegetation cover changes along environmental gradients, certain bird species may appear, increase or decrease in number and disappear as the habitat change (MacArthur, 1962)

CONCLUSION

Avian species diversity was higher in the area with less anthropogenic activities, i.e. degraded savannah, and farmland than the residential area, the higher diversity suggests higher ecological stability compared to human disturbed habitat, yet degraded savannah and farmlands are imperative part of the ecosystem that harbour large numbers

of birds compare to disturbed area. The study provided information about the diversity and structure of bird communities in different habitat in Bayero University main campus and result suggests that differences in resource availability between habitat such as breeding sites, nesting materials, cover, food and water restrict some species to certain habitat type while allowing others to be widely distributed, the study also concluded that any human activity that alter the habitat structure impact birds abundance, diversity and their distribution.

To improve bird diversity in Urban settlement gardening and tree planting should be encouraged. This will enhance bird species diversity such that human settlement will no longer be viewed as a lost habitat for wildlife, but rather a habitat that with proper management, has the potential to support diverse bird communities.

The university lack awareness that birds are important part of ecosystem as environtal health indicator, pollinators and pest controller, the department of Forestry and Wildlife Management, Environment management and Biology department in the university community should work together to foster the conservation awareness.

It is also recommended that the University management should take into account the remnant vegetation during construction and landscaping activities to avoid altering the foraging and breeding habitats of many bird species

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