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THE INFLUENCE OF THREE LANDSCAPE TYPES ON AVIAN SPECIES DIVERSITY AND ABUNDANCE IN FIFTH CHUKKER POLO AND RESORT KADUNA STATE, NIGERIA

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ABSTRACT: There is no any documented scientific data on the utilization landscape by birds in the study area. The goal was to determine the conservation potential of different landscape elements for birds in general. The study was carried out from November 2019 to September 2020. Birds were surveyed at dawn (6:30 – 9:30 hours) and at dusk (15:30 – 18:00 hours), for 80 survey days, twice in a week. The survey was carried out at Farm site, Dam site, and Rocky site within the study area and line transect survey techniques were adapted. A total of nine (9) transects were established and each transect have a total length of 400m, 300m apart. The bird's species diversity index was calculated using Shannon Weiner diversity index. The study revealed a total of One hundred and eight species of birds (108) belonging to forty-eight (48) families and encounter rate of 10,386 individuals were recorded. The distribution of birds' species abundance among the landscape types was significantly different ($f= 3.058, p = 0.0491, df = 2$), but the diversity index was not. The Dam site was recorded with the highest encounter rate of 5361 individuals, highest number of species richness of 95 but lowest diversity index (H') of 3.509 and evenness (E) of 0.771. Secondly, the Rocky site recorded 2679 encounter rate, 62 numbers of species richness with highest diversity index (H') and evenness (E) of 3.912 and 0.948 respectively, while the Farm site had the lowest species abundance and richness of 2346 and 55 respectively with 3.584 and 0.876 diversity index (H') and evenness (E) respectively. Out of 108 identified birds species, 25 species were only restricted in the Dam site, 3 in the Rocky site and 2 species only restricted in the Farm site. In conclusion, the study area is an essential refuge for birds and needs to be conserved.

Keywords: Landscape, bird species, diversity, abundance, encounter rate

1. INTRODUCTION

Birds are found almost everywhere on the earth due to their power of flight, ability to thrive in different ecosystems as well as the ability to feed on different food types; thus an important group in the animal kingdom “Tanko and Chinweuba, 2011”. The ability to observe animals in their natural habitat is fundamental “Bakam *et al.* 2016”. Birdlife International (2000), pointed out that birds serve as pointers to universal biodiversity due to

their ability to inhabit almost every zone of aquatic habitat, terrestrial habitat, tree and mountainous sites. Birds play a very vital ecological role which include; biological tools for education, fruits and seeds dispersal, ecosystem cleaners (e.g scavengers such as vulture), plant pollinators as well as biological control of insects “Bibby *et al.* 2000; Kassahun *et al.* 2019; Tanko and Chinweuba. 2019”. They are also used for environmental health and public awareness.

The hierarchical decision making process of birds is generally believed to be based on habitat selection. This is depending on the ability of an individual to perceive different environmental signal “Hutto 1985; Block and Brennan 1993”. Most avian species are particular about their habitat choice; many factors can influence these activities when it comes to habitat selection “Krisanti *et al.* 2017”. Therefore, any environmental changes may lead to the disappearance of the particular birds species that is utilizing that particular environment “Birdlife International, 2000; Tanko and Chinweuba 2019”. The differences in birds’ requirements have led to specificity on environmental needs “Buckley and Freckleton 2010”.

Birds are extremely receptive to ecosystem changes “Krisanti *et al.* 2017”. This attribute has been relied upon greatly by humans and other organisms as instructive cues to the health of an environment “Agbo *et al.* 2018; Ezealor, 2002”; “Tanko and Chinweuba, 2019”. They are more or less seen to be biological indicators, reflecting the level in which human activities has reduced or increased the quality of an environment and how its multiplier effect is translated on the biodiversity of co-habitants of the same environment “Girma *et al.* 2017; Odewumi *et al.* 2017; Tanko and Chinweuba, 2019”. Mountains and inselbergs are seen as waste lands and as a result, are often neglected in terms of research (Tanko, 2012). But, Tanko (2012) opined that they could serve as either source or sink to the threatened species.

Diversity (variety), composition and distribution of birds vary along the landscape because they are significantly influenced by variety of factors which may include topography, habitat, climate, etc. There is a need to know the bird’s species within our micro- ecological habitats. Birds communities have been studied fairly well both in moderate and tropical forest. But only a very little information is known about bird’s communities’ composition and dynamics. Few studies, especially tropical studies, have concurrently examined how factors at both, landscape levels, and vegetation structure influence patterns of habitat use by birds. Fifth chukker resort is endowed with various landscape and vegetation structure which can be a micro-habitat for many birds with potential for ecotourism. There is no any documented scientific data on the utilization landscape by birds in the study area, which can guide the resorts on what best landscape elements can be implanted to boost both recreational and ecological benefits. The goal was to determine the conservation potential of different landscape elements for birds in general. This work sought to establish the distribution and abundance of the birds found in Fifth chukker and to generate a checklist of these birds. The study can also provide information on how a particular habitat can be maintained in order to conserve other species that benefit from it.

2. MATERIAL AND METHODS

2.1 Description of Study Area

Fifth Chukker Polo and Country Club set within Kangimi Resorts’Katabu, Igabi Local Government Area, Kaduna State, Nigeria. Three thousand picture square hectares. It is characterized by natural setting of animals and different species of trees, recreational lawns of well-trimmed grasses and ornamental shrubs, mangrove, orchard, dam site and rocky site. Many residential building can be seen within close vicinity of the amusement and recreational resort. The different species of trees include; *Azadirachta indica*, *Mangifera indica*, *Butyrospermum parkii*, *Parkia biglobosa*, *Anacardium occidentale*, *Calotropis procera*, *Khaya senegalensis*, *Adansonia digitata* among other. It is situated in The GPS locations of the different study sites are; Farm site (Lat: 10.770597, Long: 7.529642), Rocky site (Lat: 10.708253, Long: 7.573983) and Dam site (Lat: 10.702050, Long: 7.536740) (Figure 1).

2.2 Method of data collection and Study design

A pilot survey was conducted for one month in October 2019, before the actual study in order to gather general information about the accessibility and vegetation cover, through direct observation and interview. The collection of actual data for the study was carried out from November 2019 to September 2020, twice in a week (every Tuesday and Saturday). Birds were surveyed at dawn (6:30 – 9:30 hours) and at dusk (15:30 – 18:00 hours), for 80 survey days in ten (10) months.

The survey was carried out at three different sites within the study area. The line transects survey technique was used “Bibby 2000; Yallop *et al.* 2003”. This census involves an observer moving slowly along the routes and recording all birds detected on either side of the route in the study area. The survey was not conducted in the month of August as rain is at its peak and the tracts became over flooded in the Dam site. Birds perched, in flight, heard or seen with the aid of binoculars (8x42 Olivon), identified with the field guide of the Birds of Western Africa “Borrow and Demey 2014”, were counted and recorded.

A total of nine (9) transects were established along the various terrains available within the study area. Each transect had a total length of 400m, 300m apart to aid data collection and to avoid recounting of the same individual species. The start and end points of each transect was marked using GPS (Garmin® eTrex 10). Three of the landscape types of the study area were

studied: Farm site, Dam site (wetland) and Rocky (mountainous) site with a total of three transects each.

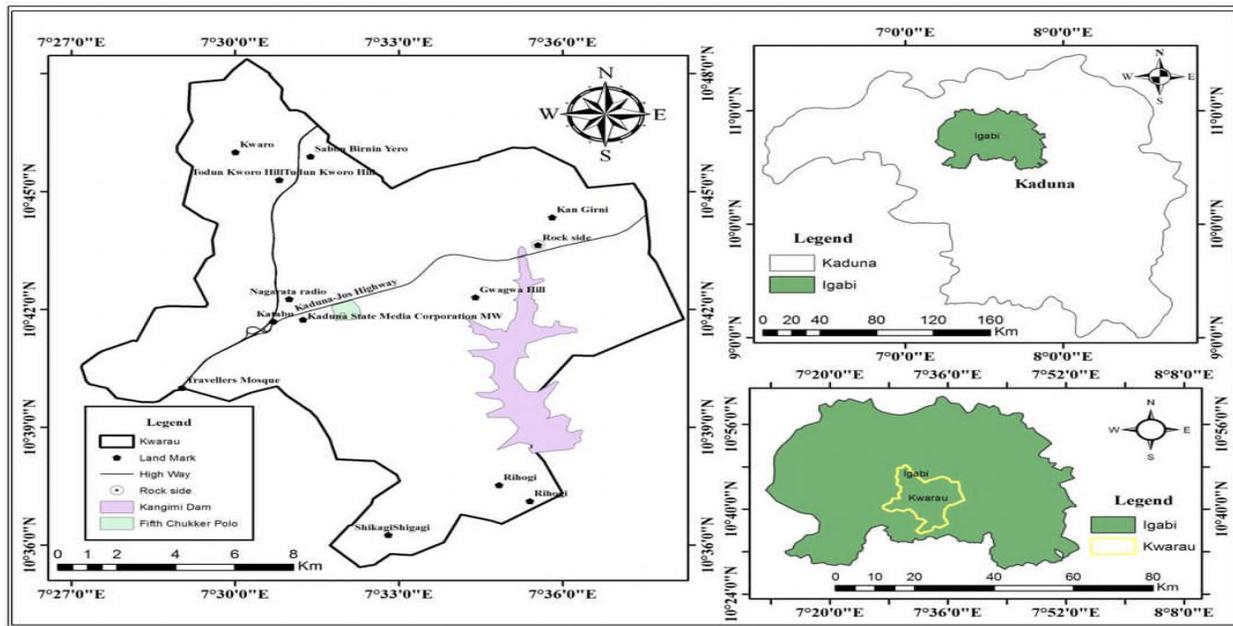


Figure1; Map of Kaduna State showing the Study Sites. (Fifth Chukker Polo)

2.3 Data analysis

During the study period, all data were summarized per habitat type (landscape) in table, using Microsoft excel 2016, and analyzed using Graph pad prism statistical package. Descriptive statistic was used to analyze relative abundance of species and distribution.

The relative abundance was calculated by using equation; Relative abundance (**RA**) (%) = $n/N \times 100$. RA= Relative Abundance, n= number of birds species individual recorded, N= number of birds species individual encounter. The bird's species diversity index was calculated using Shannon Weiner diversity index formula to compare bird's species diversity and abundance between the three (3) landscape types of the study area (i.e., Farm site, Rocky site and Dam site).

$$H' = - \sum_{i=1}^R p_i \ln p_i$$

Where, P_i = Proportion of individual species and R = total number of species of the community (number seen

and heard). Two-way ANOVA was used to determine the significant differences in mean of individual species encountered across the three sites.

3. RESULTS

3.1 Species Richness and Abundance of Birds

The study revealed a total of One hundred and eight species of birds (108) belonging to forty-eight families and encounter rate of 10,386 individuals were recorded. The Ardeidae family had the highest number of species richness of 10, followed by family Alcedinidae with 6 species. The families Cisticolidae and Nectarinidae with 5 species each, while the families Columbidae, Estrildidae and Ploceidae had 4 species each. Six (6) of the forty-eight (48) families had 3 species each, 16 families with 2 species each and the 20 remaining families with one (1) species each. The White-faced Whistling Duck had the highest relative abundance (RA) of 14.079% with 1445 encounter rate out of 10,386 individuals, followed by Stone Partridge with 5.379% of 552 individuals, while the Green-backed Heron had the lowest (RA) of 0.019% (Figure 2).

Table: 1 Fifth Chukker Birds Species Check List and their Relatives Abundance (RA)

Family	Common Name	Scientific Name	RA (%)
Accipitridae	Yellow-billed kite	<i>Milvus aegyptius</i>	0.643
	Black-shouldered Kite	<i>Elanus caeruleus</i>	0.127
Alcedinidae	Pied Kingfisher*	<i>Ceryle rudis</i>	0.731
	Giant Kingfisher*	<i>Megaceryle maxima</i>	0.166
	Grey headed Kingfisher*	<i>Halcyon leucocephala</i>	0.205
	African Pygmy Kingfisher*	<i>Ispidina picta</i>	0.029
	Malachide Kingfisher*	<i>Corythornis cristatus</i>	0.322
	Striped Kingfisher*	<i>Halcyon chelicuti</i>	0.107
Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>	2.972
	Little Egret*	<i>Egretta garzetta</i>	0.409
	Great Egret*	<i>Egretta alba</i>	0.341
	Intermediate Egret*	<i>Ardea intermedia</i>	0.468
	Purple Heron*	<i>Ardea purpurea</i>	0.633
	Grey Heron*	<i>Ardea cinereal</i>	0.058
	Squacco Heron*	<i>Ardeola ralloides</i>	0.565
	Green-backed Heron*	<i>Butarides striata</i>	0.019
	Black-headed Heron*	<i>Ardea melanocephala</i>	0.468
	Anatidae	White-faced whistling* duck	<i>Dendrocygna viduata</i>
Knob-billed Duck*		<i>Sarkidiornis melanotos</i>	0.175
Spur-winged Goose*		<i>Plectropterus gambensis</i>	0.624
Alaudidae	Crested Lark	<i>Galerida cristata</i>	0.668
Bucerotidae	Northern Red-billed Hornbill	<i>Tokus camurus</i>	1.013
	African grey Hornbill	<i>Tokus nasutus</i>	2.280
Columbidae	Red-eyed Dove	<i>Streptopelia semitorquata</i>	1.481
	Vinaceous Dove	<i>Streptopelia vinacea</i>	2.007
	Laughing dove	<i>Streptopelia sensgalensis</i>	0.078
	Speckled pigeon	<i>Columba guinea</i>	0.331
Ciconiidae	Yellow-billed Stork*	<i>Mycteria ibis</i>	0.166
Corvidae	Pied crow	<i>Corvus albus</i>	0.682
	Western Grey Plantain-eater	<i>Crinifer piscator</i>	0.565
Musophagidae	Violet Turaco*	<i>Musophaga violacea</i>	0.039
	Rufous-crowned Roller	<i>Coracias naevius</i>	0.546
Capitonidae	Yellow-fronted tinkerbird	<i>Pogoniulus scolopaceus</i>	0.331
	Yellow-rumped tinkerbird	<i>Pogoniulus subsulphureus</i>	0.409
	Bearded Barbet	<i>Lybius dubius</i>	3.946
Charadriidae	Spur-winged lapwing*	<i>Vanellus spinosus</i>	2.465
	Egyptian Plover*	<i>Pluvianus aegyptius</i>	0.312
	Black-headed Lapwing	<i>Vanellus tectus</i>	1.091
Cuculidae	Senegal Coucal	<i>Centropus senegalensis</i>	2.007
Ardeidae	Great Bittern*	<i>Botaurus stellaris</i>	0.370
Cisticolidae	Red-faced Cisticola*	<i>Cisticola erythrops</i>	0.175
	Singing Cisticola*	<i>Cisticola cantas</i>	0.263
	Croakin Cisticola*	<i>Cisticola natalensis</i>	0.039
	Rock-loving Cisticola+	<i>Cisticola aberrans</i>	0.078
	Senegal Eremomela*	<i>Eremomela pusilla</i>	0.224
Buphagidae	Yellow-billed Oxpecker	<i>Buphagus africanus</i>	0.341
Burhinidae	Senegal thick-knee*	<i>Burhinus senegalensis</i>	0.058
Hirundinidae	White-throated swaiiows	<i>Hirundo albicularis</i>	0.507
Dicruridae	Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	1.627

*= Dam site only, + =Rocky site only, ^ = Farm site only, RA = Relatives abundance

Table 1: continued

Family	Common Name	Scientific Name	RA (%)
Estrildidae	Bronze Mannikin	<i>Spermestes cucullatus</i>	0.146
	Black-and-white mannikin +	<i>Spermestes bicolor</i>	0.253
	Red-billed firefinch	<i>Lagonosticta senegala</i>	1.146
	Red-cheeked cordon-blue	<i>Uraeginthus bengalus</i>	0.507
Falconidae	Common Kestrel	<i>Falco tinnunculus</i>	0.507
	Grey Kestrel	<i>Falco ardosiaceus</i>	0.136
	Fox Kestrel+	<i>Falco alopex</i>	0.526
Jacaniidae	African jacana*	<i>Actophilornis Africana</i>	2.153
Laniidae	Yellow-billed Shrike	<i>Corvinella corvine</i>	3.625
Leiothrichidae	Brown Babbler	<i>Turdoides plebejus</i>	3.946
	Sulphur-breasted Bush shrike	<i>Telophorus sulphureopectus</i>	0.341
Malaconotidae	Yellow-crowned Gonolead	<i>Laniarunus labarous</i>	0.926
Meropidae	Jacobin Cuckoo	<i>Clamator jacobinus</i>	0.068
	Didric Cuckoo	<i>Chrysococcyx caprius</i>	0.127
Motacillidae	Yellow wagtail^	<i>Motacilla flava</i>	0.146
	Yellow-throated long-claw^	<i>Macronyx croceus</i>	0.078
Nectariniidae	Scarlet-chested sunbird	<i>Chalcomitra senegalensis</i>	0.965
	Copper sunbird	<i>Cinnyris cupreus</i>	0.526
	Beautiful sunbird	<i>Cinnyris pulchellus</i>	0.312
	Pygmy sunbird^	<i>Anthodiaeta platara</i>	0.146
	Variable sunbird ^	<i>Cinnyris venustus</i>	0.253
Oriolidae	African Golden Oriole	<i>Oriolus auratus</i>	0.614
Passeridae	Northern grey-headed sparrow	<i>Passer griseus</i>	0.429
Phasianidae	Double-spurred Francolin	<i>Francolinus bicalcaratus</i>	3.264
	Stone partridge+	<i>Ptilopachus petrosus</i>	5.379
Phoeniculidae	Green-wood Hoopoe	<i>Phoeniculus purpureus</i>	1.013
	Black Scimitarbill	<i>Rhinopomastus aterrimus</i>	0.351
Picidae	Fine-spotted woodpecker	<i>Campethera punctuligera</i>	0.253
	Grey Woodpecker	<i>Dendropicus goertae</i>	0.117
Ploceidae	Village weavers	<i>Ploceus melanocephalus</i>	4.414
	Little weaver*	<i>Ploceus cucullatus</i>	2.222
	Northern Red Bishop	<i>Euplectes franciscanus</i>	0.516
	Buffalo weaver	<i>Bubalornis albirostris</i>	0.409
Prinopidae	White Helmet-shrike	<i>Prionops plumatus</i>	0.497
Psittacidae	Senegal Parrot	<i>Poicephalus senegalus</i>	1.403
	Rose-ringed Parakeet	<i>Psittacula krameria</i>	0.224
Pycnonotidae	Common Bulbul	<i>Pycnonotus barbatus</i>	1.705
	Yellow-throated leaflove	<i>Chlorocichla flavicolis</i>	0.224
Phalacrocoracidae	Long-tailed Comorant*	<i>Phalacrocorax africanus</i>	0.273
Recurvirostridae	Black-winged Still*	<i>Himantopus himantopus</i>	0.039
Sturnidae	Purple Glossy Starling	<i>Lamprotornis purpureus</i>	1.345
	Long-tailed Glossy starling	<i>Lamprotornis caudatus</i>	1.345
	Chestnut-bellied starling	<i>Lamprotornis pulcher</i>	0.653
Sylviidae	Sedge Warbler*	<i>Acrocephalus choenobaenus</i>	0.088
	Grey-backed camaroptera	<i>Camaroptera brachyuran</i>	0.769
Threskiornithidae	Hadada Ibis*	<i>Bostrychia hagedash</i>	0.244
Turdidae	African Thrush	<i>Turdus pelios</i>	0.614
Tytonidae	Barn Owl^	<i>Tyto alba</i>	0.069
Viduidae	Village Indigo bird	<i>Vidua chalybeate</i>	1.627
	Black Crake*	<i>Zoornia flavirostra</i>	0.516
	African Crake*	<i>Crex egregia</i>	0.614

*= Dam site only, + =Rocky site only, ^ = Farm site only, RA = Relatives abundance

Table 1: Continued

Family	Common Name	Scientific Name	RA (%)
Anhingidae	African Darter*	<i>Anhinga rufa</i>	0.409
Rallidae	Common Moorhen*	<i>Gallinula chloropus</i>	0.351
	Lesser Moorhen*	<i>Gallinula angulate</i>	0.604
Musciapidae	African paradise flycatcher	<i>Terpsiphone viridis</i>	0.088
	African Palm Swift	<i>Cypsiurus parvus</i>	2.309

*= Dam site only, + =Rocky site only, ^ = Farm site only, RA = Relatives abundance

3.2 Species Diversity (distribution), Richness and Abundance of birds across the Landscape elements

The distribution of birds' species among landscape elements was significantly different ($f= 3.058, p = 0.0491, df = 2$) (Table 3).The Dam site (wetland) was recorded with the highest encounter rate of 5361 individuals, with the highest number of species richness of 95, but lowest diversity index(H') of 3.509 and evenness (E) of 0.771, followed by the Rocky site which recorded 2679 encounter rate,62 number of species richness with highest diversity index (H') and evenness (E) of 3.912 and 0.948 respectively, while the Farm site had the lowest species abundance and richness of 2346 and 55 respectively with 3.584 and 0.876 diversity index (H') and evenness (E) respectively (Table 2).Out of 108 identified birds species, 25 species were only restricted in the Dam site(wetland), 3 in the Rocky site and 2 species only restricted in the Farm site of the study plot.

The distribution of birds' species among landscape types was graphically presented in figure 3.

Table 2: Avian species diversity along the three landscape types

Landscape types	No of species	No of individuals	Diversity index (H)	Evenness (E)
Farm site	55	2346	3.584	0.876
Dam site	95	5361	3.509	0.771
Rocky site	62	2679	3.912	0.948

Table 3: ANOVA Table for Avian Species Abundance along the three Landscape elements

Landscape types	Means	Df	Fcal	P-value
Farm site	21.72	2	3.058	0.0491
Dam site	49.64			
Rocky site	24.81			

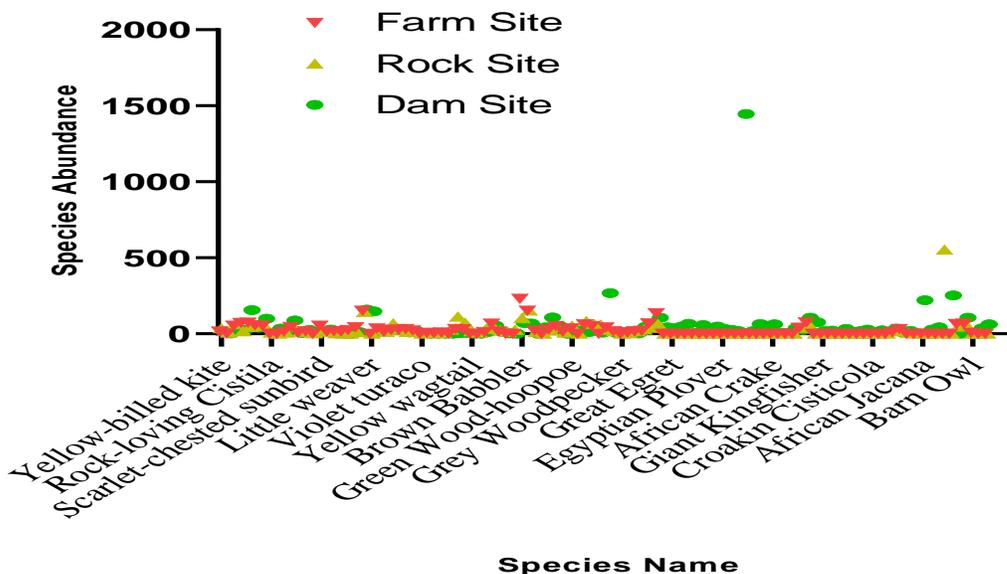


Figure 3: The distribution of birds' species among landscape elements

4. DISCUSSION

A total of 108 species, belonging to 48 families at the encounter rate of 10,386 individuals were recorded during the study period. This is in line with the work of Adong *et al.* (2018), in Kogi State, Nigeria, which reported high number of bird species (108) but less number of families (43). The number of species encountered in this study revealed that the study area is rich in composition of bird species. The high number of birds found in study area, portrays Fifth Chukker as a healthy environment for both plant and animal life since the birds are considered as excellent bio indicators of the health status of an environment “Bibby, 2000”. This could be due to presence of various habitat types found on the three landscape types in the study area “Girma *et al.* 2017”.

The distribution of birds' species among landscape types was significantly different ($f= 3.058, p = 0.0491, df = 2$) (Table 3). The Dam site (wetland) was recorded to have the highest encounter rate and species richness of 5361 and 95 species respectively. Thus, for many bird species in the study plot, Dam site (wetland) was favorable habitat both in the dry and wet season. It could be due to the availability of sufficient water, shelter and variety of food items in form of plants, vertebrates and invertebrates in this habitat for many bird species “Mengesha and Bekele 2008”. It is similar with finding of Kassahun *et al.* (2019), in their work on bird species of Gibe Sheleko National Park, Ethiopia.

During the study period, an essential observation was made, the jacanas, spur-winged lapwing and white-faced whistling duck were observed in both shore and vegetated part of Dam site foraging for food. This is similar with the Lameed (2011) observation, in his work on birds species of Dagona-Waterfowl, Borno State. The majority of wetland birds observed during this study were resident species, migratory and Palearctic species. While Great Bittern (*Botaurus stellaris*) was consider as vagrant.

The Farm site had the lowest species abundance and richness of 2346 and 55 respectively with 3.584 and 0.876 diversity index (H') and evenness (E) respectively. It might be due to habitat modification, scarcity of native tree species, intensive sporting and absence of farming activities. Hence, several studies have shown that birds and other animals are lovers of natural setting of native vegetation than exotic ones “Day,1995”.The altitude effect on bird's species abundance and diversity in mountain ecosystems “Water-house *et al.* 2002” was not observed in this study, probably because the mountain is not high enough to bring about climatic and vegetation variations with altitude, this is similar with the finding of

Tanko and Chinweuba (2019), (birds species composition and abundance of Mount Pati, Lokoja, Kogi State).

5. CONCLUSION

The following conclusions can be drawn from this study

1. The study has provided a baseline data and checklist of Fifth Chukker birds' species. This could stimulate and facilitate future ecological research in the study area.
2. The study area is an essential refuge for birds and need to be conserved. The main illegal activities in the study plot observed during the study period include; grazing, hunting, fishing and logging and this might be of harmful outcome to bird species diversity at long term
3. The study also provided information on the influences of landscapes on avian species (clade) diversity and abundance.
4. For a comprehensive checklist of Fifth Chukker avian species, a study that would encompass encountering of crepuscular and nocturnal species should be conducted.

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