



Evaluation of Wild Birds in the main Campus of Usmanu Danfodiyo University Sokoto, Sokoto State Nigeria

Musa Zara^{1*}, Bunza Mustapha Sani¹, Alarape Abideen Abiodun²

¹Department of Forestry, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Sokoto State, Nigeria.

²Department of Wildlife and Ecotourism Management, University of Ibadan, Ibadan, Nigeria

*Corresponding email: zaramusa61@gmail.com

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Abstract

A re-evaluation study was conducted after eight years of the initial survey to find out the distribution and diversity of avifauna concerning land use types in the main campus of Usmanu Danfodiyo University Sokoto. This was carried out to serve as a follow-up to a survey carried out in 2011 in the study area. Re-evaluation of species diversity is important in conservation as it gives more information on habitat conditions which is necessary for drawing conservation strategies. The study area was stratified into the major land-use types which are Residential, Farmland, Administrative, and Wetland areas. The line transect method was used to collect data on bird abundance and distribution. The Simpson index of diversity (SID) was used to determine species diversity between habitat types whereas the Shannon-Weiner diversity index (H) was used to determine species diversity across the entire area. On the other hand, the Equitability index of Evenness (E_H) was used to determine evenness in the distribution of avifauna across the entire area. A total of 3183 birds belonging to 23 families and 44 species were recorded. Out of these numbers, 1037(32.58%) were recorded in a residential area, a total of 519 birds (16.31%) were recorded in administrative areas, farmland recorded 1556 birds (48.88%), and wetland areas recorded 71 birds (2.23%). The diversity index ranges from 0.45-0.77 with the highest being administrative areas and the lowest being wetland. The Shannon-Weiner diversity index was 2.35 which indicates considerable diversity across the area. Therefore, efforts should be directed towards conserving the habitats and making communities realize the importance of avian species.



Keywords: Avifauna, Conservation, Diversity, re-evaluation

Introduction

Monitoring the avifauna population and their habitat is an essential way to assess the impact of human actions on nature and understand the natural rates of wild birds' changes. A systematic analysis of population trends and habitats is needed to mitigate the decline of biodiversity and document extinction rates. Surveys and monitoring studies permit evaluation of the sources and impacts of potential threats to the birds' population. Birds as described by Nason (1992) are highly specialized flying organisms, and their ability to fly allows them to range widely in search of food and escape predators easily. They occupy many tropic levels in the food chain ranging from consumers to predators. Their occurrences have been helpful as environmental health indicators, plant pollinators, and seed dispersal agents as well as pest controllers (Ramchandra, 2013; Bideberi, 2013). Avifauna is warm-blooded vertebrates in the scheme of biological classification. They belong to the phylum Chordata because of the presence of backbone and to the class Aves for possessing feathers on their bodies (Kwaga *et al.*, 2017). There are approximately 8,700 living species and more than 1,000 extinct species identified from fossil remains (Safra, 1998).

The result from previous research showed that a total of 381 individual birds of 28 different species belonging to 21 families exist in the study area (Abduljalil, 2011). Various ecological factors affect bird species distribution and abundance which are either biotic or abiotic (Kwaga *et al.*, 2017). Given the significance of birds for conservation planning and environmental assessments, there is a need for a better ecological understanding of the role of avian community structure in conservation decision-making. Birds are good environmental indicators because they are easy to count, easily seen in the field, and are quite sensitive to environmental changes. They are regarded as the best-known class of vertebrate animals that occur world wide in nearly all habitats.

However, Usmanu Danfodiyo University, formally known as the University of Sokoto is one of the initial twelve Federal Government-owned Universities in Nigeria established in 1975. It is located in the city of Sokoto, Sokoto State, North-Western Nigeria. Based on the available information in the literature, the main campus is a stronghold for a large number of species of birds but recently the ecosystem of the main campus of the university has been modified, where the habitat has been converted to the building of Faculties, departments, students' hostels, etc for the general wellbeing of staff and students. To prevent further losses and formulate sustainable alternatives to wild bird depletion, there is a need to study the characteristics of the abundance and distribution of birds and other factors that hinder their availability in the study area. But information on the distribution and abundance of avifauna in the main campus of Usmanu Danfodiyo University, Sokoto has not been updated for a decade. Because of this, there is little information on the distribution of avifauna in the study area. Most of the previous studies focused on taking the record on the number of individual species rather than their ecological distribution. In addition to this, the variation in species distribution concerning land use type is of great importance. We often ask questions about why birds are location specific, how they get to a place or why some birds are restricted to a particular habitat, or why birds sighted before are no longer available, we do not always have answers. Hence, this study will



seek answers to some of the questions. An understanding of biological abundance and the underlying causes of depletion has more than just academic interest, but rather a major challenge to ecologists in terms of biodiversity conservation (Kwaga *et al.*, 2017).

As the population of the University community is increasing and this is reflected in the land use system in the study area, hence the conversion of natural habitat to other uses is expected to increase to accommodate the ever-increasing number of staff and students which will have a far-reaching effect on the population of important species of avifauna in the area. Based on this, there is a need to assess avifauna species within say every five years to ascertain their presence as birds are considered good indicators of habitat health and conditions. Knowledge of the ecological distribution of avifauna in the study area is scanty and more work still needs to be done in this aspect of population monitoring. This study will contribute to the existing knowledge and provide updated information on the distribution, abundance, and richness of avifauna in the main campus of Usmanu Danfodiyo University Sokoto which hopefully will boost conservation practices within the area. The main objective of the study is to evaluate wild birds in the main campus of Usmanu Danfodiyo University, Sokoto.

Material and methods

Study Area

The study was conducted at Usmanu Danfodiyo University main campus situated between latitude $13^{\circ}6'0''$ N and $13^{\circ}8' 0''$ N and longitude $5^{\circ}12'0''$ E and $5^{\circ}16'0''$ E in Wamakko Local Government Area of Sokoto, Sokoto State (See Fig. 1). Sokoto State is located in the Sudan Savanna Zone in the extreme North-Western part of Nigeria between longitude $3^{\circ}7'$ E and 6° N'E and latitude $11^{\circ}6'$ N and $13^{\circ}9'$ N (Mamman *et al.*, 2000). The vegetation of Sokoto is typical Sudan Savanna with intensive grass cover interspersed by a few trees and shrubs. The climate is semi-arid, characterized by low rainfall (Nigerian Meteorological Agency, 2017), mean annual rainfall of 659mm, relatively wide, and rapid changes in temperature and humidity. Temperature is generally high. The highest mean monthly temperature is about $40-45^{\circ}\text{C}$ in April while the lowest mean monthly temperature occurs in December/January when the temperature could come down to 15°C .

The following materials were used for conducting the survey;

- i. A pair of binoculars.
- ii. A field guidebook of Birds of West Africa.
- iii. Survey datasheet.
- iv. A sound recorder for recording sounds of birds not sighted on the spot or not easily identified in the field.
- v. Geographic Positioning System (GPS)
- vi. Digital camera
- vii. Safety boot

Census Method

The study area was stratified by land-use types into four different strata so that four land-use types within the main campus of the University were sampled. These include;

1. Farmland areas



2. Wetland areas
3. Residential areas
4. Administrative building areas

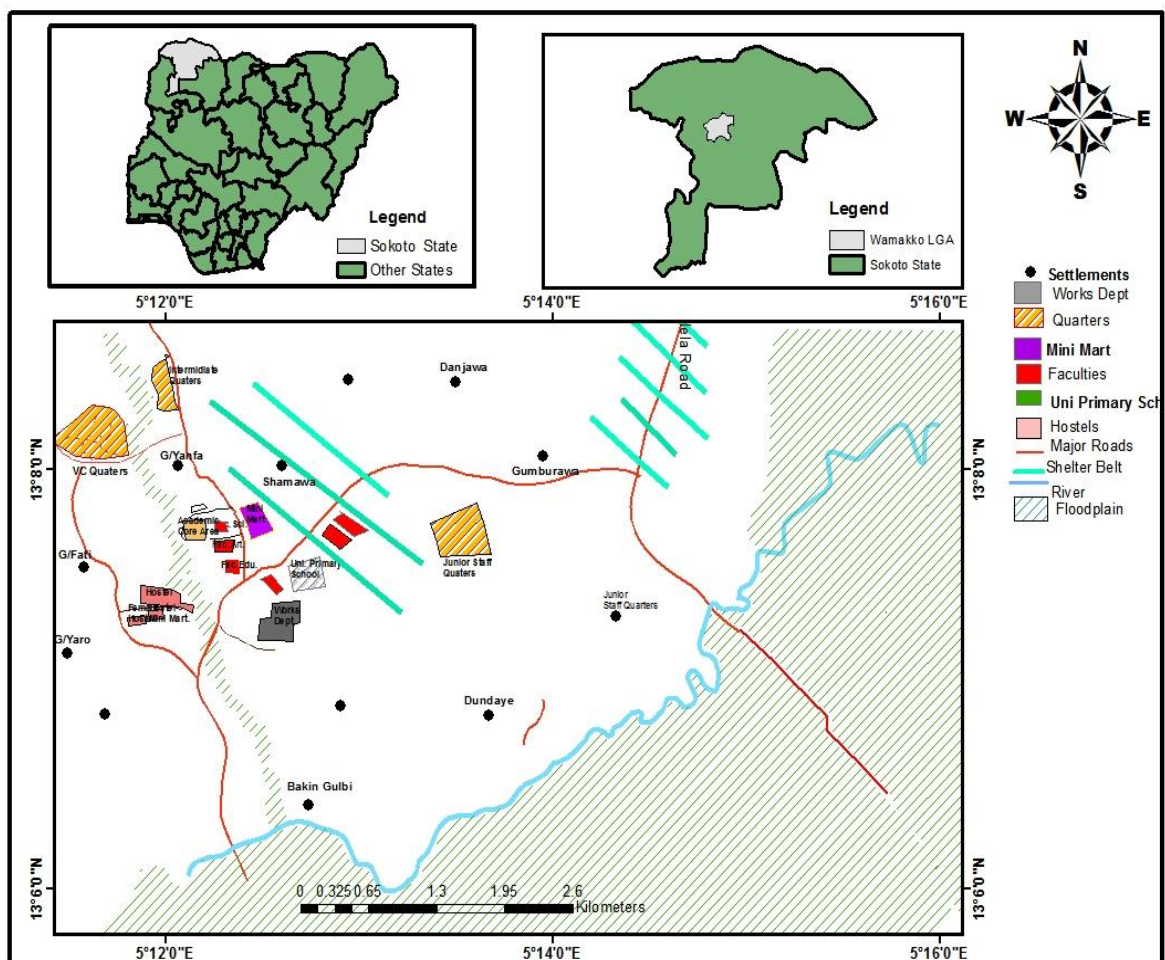


Figure 1: Map of the Study Area (Source: UDUS GIS Lab)

The bird count was conducted using the line transect method (Bunza *et al.*, 2017). This method proved most efficient in terms of data collection per unit effort. Fourteen transects of 300-500m were laid across the study area. Each transect was visited twice, once in the morning (0700-0800hrs) and evening (1700-1800hrs) for two months, and all birds sighted (seen or heard) were identified to species, counted, and recorded in a field notebook. Bird sightings and identification were done with the aid of binoculars and field guides of West African Birds (Borrow and Demey, 2008).

Data Analysis

The data obtained were subjected to descriptive statistics such as frequency distribution and percentages. Simpson diversity index was used to determine species diversity across sites as illustrated below:



$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Where P_i = proportion of the species in the sample (i.e n_i/N)

n = individual of the species in sample N_i

D = Simpson index (maximum value of 1 in a monoculture, and become smaller as the community becomes more diverse (Akosim *et al.*, 2007)

The Equitability index of Evenness was used to determine evenness in the distribution of species across the entire area. Species diversity across the entire area was determined using the Shannon-Weiner diversity index. Shannon-Weiner diversity index takes into account the number of species richness as well as evenness.

$$\text{Shannon index (H)} = \sum - (P_i \times \ln P_i) \text{ ----- (1)}$$

Where:

P_i = the relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individuals in the community $\frac{n_i}{N}$

The value of the index ranges from 0 (low species richness and evenness) to 5.0 (high species richness and evenness)

$$\text{Evenness} = E_H = \frac{H}{\ln(S)}$$

Where,

H_i = Shannon-Weiner index

$\ln(S)$ = natural logarithm of species richness

Relative abundance of the species was determined by placing individual species into categories following Tanko and Ivandstudy011).

<5 = uncommon

6using them

11-20 = frequent

>20 = abundant

Relative frequency RF) for individualspecies off te study area was calculated usingthe formula

$$\text{below;Relative frequency (RF) \%} = \frac{\text{Frequency of a species}}{\text{Total frequency of all specie}} \times 100$$

Results

The results of the study indicated that 3183 individuals belonging to 43 species were recorded. The residential area comes first in terms of species richness, with a total of 25 species, followed by farmland areas with 22 species, while administrative areas have a total of 18 species, and wetland areas hold a total of 8 species. The results further indicated that administrative buildings had the highest value of Simpson diversity index of 0.77, which is the maximum value against farmland area with a value of 0.75, residential area 0.74, and wetland area 0.45. The Shannon-Weiner diversity index obtained (2.35) indicates a considerable level of diversity (not very low and not up to half the maximum value of Simpson diversity index) and the equitability index of evenness (0.29) which indicates low evenness in

Table 1: Checklist of wild birds in the main campus of Usmanu Danfodiyo University Sokoto

Scientific name	Common name	Family	Number	RF (%)
<i>Streptopelia decipiens</i>	African mourning dove	Columbidae	35	1.1
<i>Spilopelia senegalensis</i>	Laughing dove	Columbidae	683	21.5
<i>Bubalornis albirostris</i>	White-billed buffalo weaver	Ploceidae	635	19.9
<i>Quelea quelea</i>	Red billed quelea	Ploceidae	404	12.7
<i>Cecropis semirufa</i>	Rufous chested swallow	Hirundinidae	1	0.0
<i>Coturnix coturnix</i>	Common quail	Phasianidae	2	0.1
<i>Pachycoccyx audeberti</i>	Thick-billed Cuckoo	Cuculidae	2	0.1
<i>Anthus leucophrys</i>	Plain-Backed pipit	Motacillidae	4	0.1
<i>Dicrurus adsimilis</i>	Fork-tailed drongo	Dicruridae	3	0.1
<i>Columba guinea</i>	Speckled pigeon	Columbidae	120	3.8
<i>Dendropicos obsoletus</i>	Brown-backed Woodpecker	Ploceidae	35	1.1
<i>Bubulcus ibis</i>	Cattle egret	Ardeidae	105	3.3
<i>Tockus erythrorhynchus</i>	Red billed hornbil	Bucorvidae	41	1.3
<i>Lamprotornis chalcurus</i>	Bronze tailed glossy starling	Sturnidae	121	3.8
<i>Crinifer piscator</i>	Western grey plantain eater	Musophagidae	39	1.2
<i>Halcyon senegalensis</i>	Woodland kingfisher	Alcedinidae	4	0.1
<i>Passer griseus</i>	Northern grey-headed sparrow	Passeridae	12	0.4
<i>Lamprotornis caudatus</i>	Long-tailed glossy starlings	Sturnidae	33	1.0
<i>Ploceus cucullatus</i>	Village weaver	Ploceidae	30	0.9
<i>Pycnonotus barbatus</i>	Common bulbul	Pycnonotidae	63	2.0
<i>Accipiter melanoleucus</i>	Black sparrow hawk	Accipitridae	1	0.0
<i>Ploceus vitellinus</i>	Vitelline masked weaver	Ploceidae	6	0.2
<i>Ploceus heuglini</i>	Heuglins masked weaver	Ploceidae	56	1.8
<i>Cinnyris pulchellus</i>	Beautiful sunbird	Nectariniidae	60	1.9
<i>Lamprotornis pulcher</i>	Chestnut bellied starling	Sturnidae	597	18.8
<i>Corvus albus</i>	Pied crow	Corvidae	9	0.3
<i>Lagonosticta rara</i>	Black-Billed FireFinch	Estrilidae	1	0.0
<i>Centropus senegalensis</i>	Senegal coucal	Cuculidae	12	0.4
<i>Muscicapa epulata</i>	Little grey flycatcher	Muscicapidae	12	0.4
<i>Accipiter nisus</i>	Eurasian sparrow hawk	Accipitridae	2	0.1
<i>Circus ranivorus</i>	African marsh harrier	Accipitridae	2	0.1
<i>Clamator levaillantii</i>	Levaillants cuckoo	Cuculidae	1	0.0
<i>Corvinella corvina</i>	Yellow-billed shrike	Laniidae	23	0.7
<i>Ardeola ralloides</i>	Squacco heron	Ardeidae	3	0.1
<i>Ardea alba</i>	Great egret	Ardeidae	1	0.0
<i>Ciconia episcopus</i>	Woolly-necked stork	Ciconiidae	9	0.3
<i>Rhinopomastus aterrinus</i>	Blackwood hoopoe	Phoeniculidae	1	0.0
<i>Fraseria cinerascens</i>	White-browed forest flycatcher	Muscicapidae	1	0.0
<i>Lybius dubius</i>	Bearded barbet	Lybiidae	3	0.1
<i>Anomalospiza imberbis</i>	Cuckoo finch	Viduidae	1	0.0
<i>Lagonosticta senegala</i>	Red-billed firefinch	Estrildidae	4	0.1
<i>Ardea intermedia</i>	Intermediate egret	Ardeidae	1	0.0
<i>Ardea cinereal</i>	Grey heron	Ardeidae	4	0.1
<i>Euplectes franciscanus</i>	Northern red bishop	Ploceidae	1	0.0
Total			3183	100.0

Source: (Field survey, 2018)



the distribution of species across the study area. Furthermore, a comparison of the results obtained in the last survey (2011) and the results of this finding was made to ascertain the presence or absence of the species detected in the previous survey (2011) from the results obtained in this study. Species detected in both studies were also identified and recorded in the table (1) below.

Table 2: Simpson index of diversity, Shannon-Weiner diversity index, and equitability index of evenness across the study area.

Variable	SI	SID	Richness	H	E _H
Combined	0.14	0.86	44	2.35	0.29
Residential	0.26	0.74	25		
Administrative	0.22	0.77	18		
Farmland	0.25	0.75	22		
Wetland	0.55	0.45	8		

Source: Field survey, 2018

Table 3: List of birds encountered in the previous survey (AbdulJalil, 2011) and absent in the present survey (2018)

Scientific name	Common name	Family	Total no
<i>Uraeginthus bengalus</i>	Red cheek Corbon bleu	Estrilidae	9
<i>Apus affinis</i>	Little swift	Apodidae	15
<i>Oenanthe leucura</i>	Black wheatear	Muscicapidae	2
<i>Iduna pallida</i>	Eastern olivaceous warbler	Acrocephalidae	2
<i>Numida. Meleagris</i>	Helmeted guinea fowl	Liumididae	6
<i>Circus Pygargus</i>	Montagu's Harrier	Accipitridae	1
<i>Streptopelia roseogrisea</i>	African collard dove	Columbidae	2
<i>Clamator jacobinus</i>	Jacobin Cuckoo	Cuculidae	2
<i>Prinia Subflava</i>	Tawny flanked Prinia	Cisticolidae	8
<i>Mirafa cantillans</i>	Singing Bush Lark	Alaudidae	1
<i>Cercotichas podobe</i>	Black Scrub robin	Muscicapidae	1
<i>Merons apiaster</i>	European bee-eater	Meropidae	1
<i>Streptopelia vinacea</i>	Vinaceous Dove	Columbidae	2

Source: (Field survey, 2011)

Following Tanko and Ivande (2011) relative abundance category, the Rufous chested swallow, Common quail, Thick-billed Cuckoo, Plain-backed Pipit, Woodland kingfisher, Black sparrow hawk, Black-bellied fire finch, Levallants cuckoo, Blackwood hoopoe, Great egret, White-browed forest flycatcher, Bearded Barbet, Cuckoo finch, Grey heron, and Northern red bishop are considered as uncommon because the number recorded for these species was <5. Vitelline masked weaver and pied crow are common because the number recorded for these species was between 6-10. The Northern grey-headed sparrow, Senegal coucal, and Little grey flycatcher are considered as frequent species their number ranged between 11-20. All other species aside from the ones listed above are considered abundant because the number recorded for the species was >20. The low abundance of some species such as the Rufous chested swallow could be a result of habitat alteration in the study area. This is in agreement with the report of Ramchandra (2013) who reported that the diversity and species richness of birds is subject to the suitability of their habitats. The findings of this study are also in conformity with the findings of David *et al.*, (2001) who observed



that habitat type is the most important factor determining species distribution. Moreover, the low number of birds recorded in wetland areas could be a result of anthropogenic activities like fishing by the local communities around the area and this agrees with the findings of Westphal *et al.*, (2006) who reported that human activities have an impact on bird species abundance, distribution, and diversity. The family with the highest number of species is the Ploceidae (1,161 birds), followed by Columbidae (838 birds) and Sturnidae (751 birds).

Table 4: List of birds encountered in this study (2018) but absent in the previous survey (Abduljalil, 2011)

Scientific name	Common name	Family	Total number
<i>Accipiter melanoleucus</i>	Black sparrow hawk	Accipitridae	1
<i>Halcyon senegalensis</i>	Woodland kingfisher	Alcedinidae	4
<i>Ploceus vitellinus</i>	Vitelline masked weaver	Ploceidae	6
<i>Ploceus heuglini</i>	Heuglins masked weaver	Ploceidae	56
<i>Crinifer piscator</i>	Western grey plantain eater	Musophagidae	39
<i>Muscicapa epulata</i>	Little grey flycatcher	Muscicapidae	12
<i>Ardeola ralloides</i>	Squacco heron	Ardeidae	3
<i>Ardea alba</i>	Great egret	Ardeidae	1
<i>Ciconia episcopus</i>	Woolly-necked stork	Ciconiidae	9
<i>Fraseria cinerascens</i>	White-browed forest flycatcher	Muscicapidae	1
<i>Euplectes franciscanus</i>	Northern red bishop	Ploceidae	1
<i>Clamator levaillantii</i>	Levaillants cuckoo	Cuculidae	1
<i>Circus ranivorus</i>	African marsh harrier	Accipitridae	2
<i>Passer griseus</i>	Northern grey-headed sparrow	Passeridae	12
<i>Dendropicos obsoletus</i>	Brown-backed Woodpecker	Ploceidae	35
<i>Cecropis semirufa</i>	Rufous chested swallow	Hirundinidae	1
<i>Coturnix coturnix</i>	Common quail	Phasianidae	2
<i>Lamprotornis chalcurus</i>	Bronze tailed glossy starling	Sturnidae	121
<i>Ardea intermedia</i>	Intermediate egret	Ardeidae	1
<i>Anomalospiza imberbis</i>	Cuckoo finch	Viduidae	1
<i>Lagonosticta senegala</i>	Red-billed firefinch	Estrildidae	4
<i>Lamprotornis pulcher</i>	Chestnut-bellied starling	Sturnidae	597
<i>Anthus leucophrys</i>	Plain-Backed pipit	Motacillidae	4
<i>Pachycoccyx audeberti</i>	Thick-billed Cuckoo	Cuculidae	2
<i>Dicrurus adsimilis</i>	Fork-tailed drongo	Dicruridae	3
<i>Quelea quelea</i>	Red-billed quelea	Ploceidae	404

Source: (Field survey, 2018)

The result of this finding when compared to research conducted by Abduljalil (2011), shows a clear difference in the species present and those absent in both types of research. Species such as Red-cheeked cordon blue, Eastern olivaceous warbler, and little swift were detected in the survey conducted in 2011, and this may not be unconnected with a serious habitat conversion for building and road construction. The previous research (2011) recorded a total of 381 birds belonging to 28 different species while the present research recorded 3183 birds belonging to 44 different species. This indicates that habitat alteration did not have much negative effect on the individual and number of species in the last seven years as more species were detected than sighted in 2011 even though both surveys (2011 and 2018) were conducted the



same season of the year. Humphrey (2004) observed that weather also has impacts on breeding success and food availability. The environment is also described as everything that may influence a species' chance to survive and multiply. The environmental conditions may include the vegetation cover of the different habitats, which may provide the chance of finding one species more abundant in one habitat than the other. Results obtained also showed that more species were recorded during the morning survey than the evening survey. This suggests that birds are more active during morning hours, which agrees with the findings of Tanko and Ivande (2011) who found that activity of most species declines gradually as the morning progresses. High species diversity, richness, abundance, and evenness indexes recorded in the study area were good indications that the area is still much endowed with useful species of birds. This further revealed that the study area provides quality habitat resources such as food, breeding space, and cover for the different species recorded. Based on the results of these findings, the following are recommended:

- 1 The study area would require a biannual survey to detect changes in avian populations.
- 2 The university authority should intensify efforts towards protecting the area and its birds' species diversity since birds are good indicators of habitat conditions.
- 3 Since communities in the main campus of the Usmanu Danfodiyo University lack awareness that birds are an important part of the ecosystem as environmental health indicators, pollinators, and pest controllers, the Department of Forestry and Environment should provide conservation education to the communities so that the contribution of birds in the ecosystem can be realized.

Table 5: List of birds encountered in both surveys (2011 and 2018) in the study area

Scientific name	Common name	Family	Previous no	Present no
<i>Ploceus cacullatus</i>	Village weaver	Ploceidae	59	30
<i>Bubulcus iblis</i>	Cattle egret	Ardeidae	21	105
<i>Lamprolornis Caudatus</i>	Long-tailed glossy sterling	Sturnidae	1	33
<i>Lybius dubius</i>	Beaded barbet	Lybiidae	1	3
<i>Cinnyris pulchellus</i>	Beautiful sunbird	Nectariniidae	2	60
<i>Corvinella corvina</i>	Yellowbilled shrike	Laniidae	8	23
<i>Rhinopomastus aterrinus</i>	Blackwood hoopoe	Phoeniculidae	2	1
<i>Tockus erythrorhynchus</i>	Red billied hornbill	Bucorvidae	33	41
<i>Pycnonotus barbatus</i>	Common bulbul	Pycnonotidae	6	63
<i>Centropus senegalensis</i>	Senegal coucal	Cuculidae	3	12
<i>Streptopelia decipiens</i>	African Morning Dove	Columbidae	74	35
<i>Columba guinea</i>	Speckled pigeon	Columbidae	84	120
<i>Corvus albus</i>	Pied crow	Corvidae	33	9
<i>Spilopelia senegalensis</i>	Laughing dove	Columbidae	163	683
<i>Bubalornis albirostris</i>	White-billed buffalo weaver	Ploceidae	59	30

4 Source: Field survey, (2011 and 2018)

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