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RESEARCH ARTICLE

Bird Species Richness and Diversity in Armyworms Infested Maize Plots in Olabel Farms, Southwestern Nigeria

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ABSTRACT

This research examined the Bird Species Richness and Diversity in Armyworms Infested Maize Plots in Olabel Farms, Southwestern Nigeria. **Survey Method:** Point count method was used to collect data on bird species richness and diversity in the study area. In all five counting stations were used and counting bands of the 50 m radius were used for all the stations. One counting station per plot was used for this study. On arrival at the sites, birds were allowed time to settle before recording all the birds seen or heard for a predetermined time usually, 20 minutes. Bird calls were also recorded with a voice recorder and played back later for confirmation. **Results:** A total of 77 bird species belonging to 10 orders and 32 families were encountered in the study area; the order Passeriformes constituted the highest number of bird species in the study area. The family with the largest number of bird species is Accipitridae (n = 7). The composition of bird species obtained in this research revealed that it was not only insectivorous bird species that were encountered in the maize plots but also granivorous and frugivorous bird species that were present on the farm. They probably were feeding on the armyworms as protein supplements. From the results obtained, the relative abundance of the bird species in the study area indicated that Ploceus cucullatus has the highest of relative has abundance (0.0825) while the following bird species have the lowest relative abundance: Egretta intermedia (0.055), Streptopelia semitorquata (0.0325), and Vanellus lugubris (0.03). The Shannon_H diversity index was relatively higher (3.992) during wet season than dry season (3.661) when compared.

Key words: Armyworms infestation, avian species, conservation, diversity, richness

INTRODUCTION

Maize (*Zea mays*) is an important food crop in Nigeria, widely grown in the savanna and forest ecoregions of the country. This crop forms the staple food for most of the population, especially in areas adaptable for their production.[1] Green maize (fresh grains) is eaten roasted or boiled on the cob. They are rich in carbohydrates. In spite of the importance of this cereal as sources of food for human consumption, their production is concentrated in the hands of peasant farmers whose average hectare (ha) is very small, approximately 0.5–1.0 ha per farmer. The technologies are basically traditional farming methods and systems in Nigeria. However, there are few mechanized farms in Southwestern Nigeria.[2] The African armyworm (AAW, *Spodoptera exempta*) also called Okalombo, Kommandowurm, or nut grass armyworm is an African moth. It is a very deleterious pest, capable of destroying entire crops in a matter of weeks. The larvae feed on all types of grasses, early stages of cereal crops (for example, maize, rice, wheat, millet, sorghum), sugarcane, and occasionally in coconut.[3] The armyworm gets its name from its habit of "marching" in large numbers from grasslands into crops. AAW tends to occur at very high densities during the rainy season, especially after periods of prolonged drought. During the long dry season in Eastern

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Africa, population densities are very low. Because outbreaks are never observed during the dry season, it is called the "off-season" by those who monitor AAW. *Exempta* moths live about 10 days.[4]

The female can lay a maximum of about 1000 eggs in her one lifetime. The ivory-colored eggs of the AAW are laid in clusters on leaves. Eggs hatch in 2–5 days. Six larval (caterpillar) instars are completed in 2–3 weeks. Caterpillars occur in two morphologically distinct forms: A "gregarious" form, which is black with yellow stripes, and a solitary form, which is green or brown. The morphological form is determined by density – becoming "gregarious" at higher densities. However, the AAW does not exhibit the true gregarious behavior of locusts. The "gregarious" forms of AAW cause outbreaks. Generally, AAW is not noticed by farmers until the caterpillars are 10 days old and change from green to black.[6] In the last instar, larvae burrow 2–3 cm into the ground to pupate. Adults emerge in 7–10 days.[7] The moths migrate over tens and probably over hundreds, of kilometers between their emergence sites and their oviposition sites.[8] The observation that AAW outbreaks can suddenly occur in areas that were free of the pests for several months has led to the hypothesis that the moths migrate hundreds of kilometer.[4]

In Nigeria, there was a major outbreak of armyworms in Southwestern Nigeria last year; now there is outbreak this year, which destroys the maize farms causing damage of the leaf, resulting in stunted growth of maize plants, yielding too low yield. Thus, this research work examines the bird species encountered in the farm foraging on these worms.

MATERIALS AND METHODS

The study was conducted in Olabel Farms (6° 54'N and 2° 57' E) with an area of 1350 ha. It is a privately owned farm. The farm is located at Ilaro in Yewa South Local Government Area, Southwestern Nigeria, along the Benin-Nigeria border, and the area is poorly studied area in regard to the faunal biodiversity. The farm is divided into plots of different sizes. The rainy season in the area occurs from March till November while the dry season is from December until February. Annual rainfall ranges from 1700 to 2000 mm. The annual mean temperature in the area is 26°C. Soils are predominantly ferruginous tropical, typical of the variety found in intensively weathered areas of basement complex formations in the rainforest zone of Southwestern Nigeria. The soils are well-drained, mature, red, stony, and gravelly in upper parts of the sequence. The texture of topsoil in the area is mainly sandy loam.[5,6] The natural vegetation of the area is tropical rainforest characterized by emergent with multiple canopies and lianas. Some of the most commonly found trees in the area include *Milicia excelsa*, *Afzelia bipindensis*, *Brachystegia* Nigeria, *Lovoa trichilioides*, *Terminalia ivorensis*, *Terminalia superba*, and *Triplochiton scleroxylon*. However, the natural vegetation of the area except for the areas devoted to farmland has now been reduced to secondary regrowth forest thickets and grassland.[7]

Data collection

Data were collected in five plots in the study area for 2 years, and all data were collected in 400 ha maize plots. Point count method[9] was used to collect data on bird species diversity and abundance in the two blocks. Counting bands of the 50 m radius were used for all the stations. The minimum distance between two counting stations was 200 m. All five counting stations were used; one station per a study plot was used. On arrival at the sites, birds were allowed time to settle before recording all the birds seen or heard for a predetermined time (usually, 20 min). Bird calls were also recorded with a voice recorder and played back later for confirmation. Physical features of birds sighted but could not be identified immediately were taken, and field guidebook of West African birds[10] was used to identify the bird species and bird calls was used to confirm the presence of nocturnal bird species within the study sites.

Data were collected for 6 months with 3 months from April to October 2016 when the outbreak of the armyworms was noticed on the farm.

Data analysis

Data collected from the observations were explored with descriptive statistics and analyzed with analysis of variance using the Statistical Package for the Social Sciences (SPSS) version 18 (SPSS, 2008).[11] The computer PAST Model version 3 was used to analyze bird species diversity, generalized linear model, and SHE analysis.

RESULTS

A total of 77 bird species belonging to 10 orders and 32 families were encountered in the study area; the order Passeriformes constituted the highest number bird species in the study area. The family with largest number bird species is Accipitridae (n = 7), while the following families Columbidae, Estrildidae, Nectariniidae, and Pycnonotidae have (n = 5) bird species [Figure 2]. From the results obtained, the relative abundance of the bird species in the study area indicated that *Ploceus cucullatus* has the highest of relative abundance (0.0825) in the study area, while the following bird species has the following relative abundance each *Egretta intermedia* (0.055), *Streptopelia semitorquata* (0.0325), and *Vanellus lugubris* (0.03) Table 1. From the results obtained in the Shannon_H diversity index, it was found out that it was relatively higher in the wet season than dry season 3.661 (Table 2 and 3). The generalized linear model and SHE analysis are shown in Figures 3 and 4. The generated checklist of bird species in shown in Table 4 The results showed that different types of bird species were attracted to the farmland following the outbreak of these armyworms, not only insectivorous bird species were attracted to the study area but other bird species with different feeding habits such as frugivorous, granivorous and bird species that utilizes wetland were also encountered

DISCUSSION

Food availability has been identified as a limiting factor for a number of species on farmland for both adult birds and chicks.[12] Species diversity is often used to make quick assessment and comparison of different habitats.[13] Species richness is, therefore, useful considerations when assessing bird species communities in Olabel Farms in Southwestern Nigeria. The study carried out indicates that the study area supports diverse bird species. The result obtained from the study indicates abundant birdlife in the farmland which

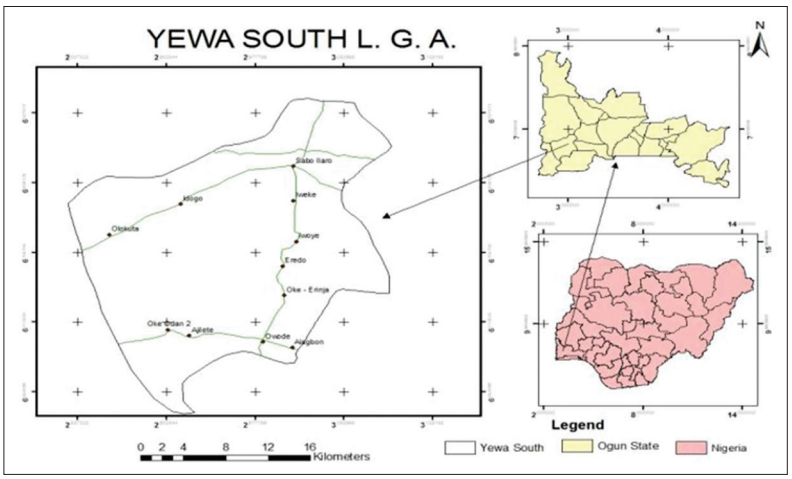

Figure 1: Map of the study area (Source[8])

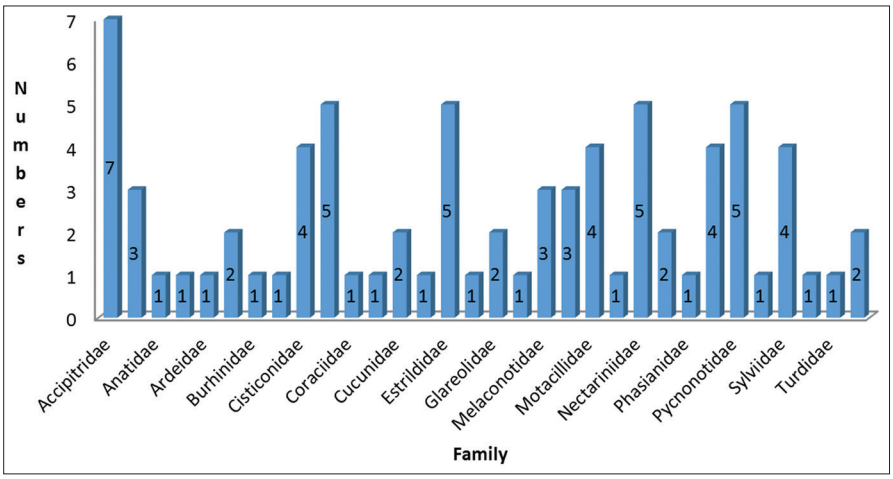

Figure 2: Family composition of bird species in the study area

Table 1: Relative abundance of bird species in the study area

Common name	IND	RA
African Cuckoo Hawk	3	0.0075
African Harrier Hawk	1	0.0025
African Hawk Eagle	4	0.01
Black Shouldered Kite	6	0.015
Yellow Billed Kite	4	0.01
Lizard Buzzard	3	0.0075
Red Necked Buzzard	5	0.0125
Blue Breasted Kingfisher	2	0.005
Malachite Kingfisher	3	0.0075
Senegal Woodland Kingfisher	1	0.0025
Hartlaub's Duck	7	0.0175
African Palm Swift	4	0.01
Intermediate Egret	22	0.055
African Pied Hornbill	1	0.0025
Grey Hornbill	1	0.0025
Senegal Thick-Knee	3	0.0075
Lesser Black-Winged Lapwing	12	0.03
Grey-Backed Camaroptera	2	0.005
Tawny Flanked Prinia	2	0.005
Yellow-Breasted Apalis	6	0.015
Whistling Cisticola	4	0.01
African Green Pigeon	3	0.0075
Blue Spotted Wood Dove	2	0.005
Laughing Dove	3	0.0075
Red Eye Dove	13	0.0325
Vinaceous Dove	1	0.0025
Blue-Bellied Roller	2	0.005
Pied Crow	4	0.01
Black Coucal	7	0.005
Senegal Coucal	4	0.01
Fork-Tailed Drongo	2	0.005
Blue Billed Firefinch	1	0.0025
Bronze Mannikin	2	0.005
Orange-Cheeked Waxbill	3	0.0075
Orange-Winged Pytilia	4	0.01
Red-Billed Firefinch	2	0.005
Common Kestrel	3	0.0075
Collared Pratincole	1	0.0025

(Contd...)

Table 1: (Continued)

Common name	IND	RA
Grey Pratincole	2	0.005
African Jacana	5	0.0125
Black-Crowned Tchagra	4	0.01
Grey-Headed Bushshrike	3	0.0075
Yellow-Crowned Gonolek	2	0.005
Little Bee-Eater	3	0.0075
White-throated Bee-Eater	5	0.0125
Plain-Backed Pipit	3	0.0075
Tree Pipit	2	0.005
Yellow-Throated Longclaw	1	0.0025
Yellow Wagtail	2	0.005
Red-Bellied Paradise Flycatcher	1	0.0023
Whinchat	2	0.005
Amethyst Sunbird	3	0.0075
Collared Sunbird	1	0.0025
Variable Sunbird	2	0.005
Mouse-Brown Sunbird	2	0.005
Splendid Sunbird	1	0.0025
Bush Petronia	2	0.005
Grey-Headed Sparrow	4	0.01
Double-Spurred Francolins	2	0.005
Black-Headed Weaver	1	0.0025
Northern Red Bishop	3	0.0075
Village Weaver	33	0.0825
Yellow-Mantled Widowbird	1	0.0025
Common Bulbul	2	0.02
Simple Leaflove	4	0.01
Swamp Palm Bulbul	2	0.005
Western Nicator	2	0.005
Little Green Bull	3	0.0075
Purple Glossy Starling	1	0.0025
African Moustached Warbler	2	0.005
Garden Warbler	1	0.0025
Green Comec	3	0.0075
Yellow-Bellied Hyliota	2	0.0075
Brown Illadopsis	1	0.025
African Thrush	3	0.0075
Pin-Tailed Whydah	2	0.005
Village Indigobird	5	0.0125

is a disturbed area. The findings to an extent agree with[14,15] (Doris 1994, Okosodo *et al*. 2015) assertion that farmlands and swamp habitats to lesser extent provide habitat for bird species. This also agrees with[16] the study by Cody (1985) who reported that the level of distribution of bird species in a habitat is normally as a result of an occurrence of plant species that support their

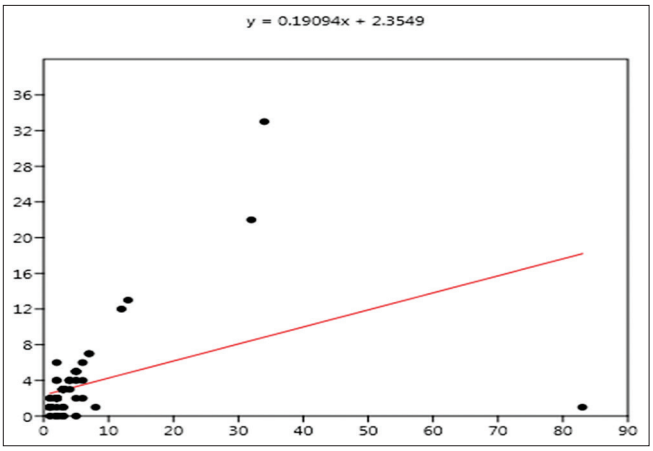

Figure 3: Bird species diversity in the study area (generalized linear model)

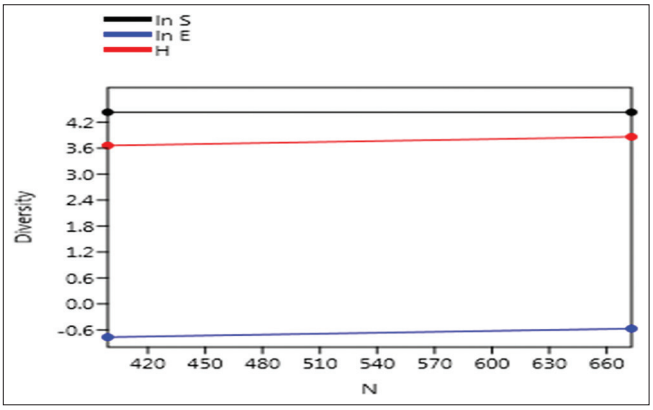

Figure 4: SHE analysis of bird species diversity in the study area

Table 2: Diversity of bird species in the study area during wet season

Diversity index	Maize plots	Lower	Upper
Taxa_S	77	73	77
Individuals	274	274	274
Dominance_D	0.03405	0.0268	0.04214
Shannon_H	3.922	3.772	3.989
Evenness_e^H/S	0.6558	0.5776	0.706
Menhinick	4.652	4.41	4.652
Margalef	13.54	12.83	13.54
Equitability_J	0.9029	0.8732	0.9197
Berger-Parker	0.1204	0.07664	0.146

Table 3: Diversity of bird species in the study area during dry season

Diversity index	Maize plots	Lower	Upper
Taxa_S	84	81	84
Individuals	399	399	399
Dominance_D	0.06423	0.05071	0.0804
Shannon_H	3.661	3.497	3.757
Evenness_e^H/S	0.4629	0.3975	0.5113
Menhinick	4.205	4.055	4.205
Margalef	13.86	13.36	13.86
Equitability_J	0.8262	0.7914	0.8486
Berger-Parker	0.208	0.1679	0.2456

population and to variation in species-specific requirements in the choice of habitat. This is also consistent with the study by Mangnall and Crowe[17] that the distribution of bird species is largely dependent on the availability of food, water, and cover.

The relative abundance of bird species estimates was high in the study area in both seasons of the year. This is consistent with the work of other studies which suggested a high volume availability of preferred food in the Farm.[18] Arable land provides essential foraging opportunities to many European farmland birds.[19-21] Non-crop vegetation in arable fields provides an important source of seeds, but perhaps as importantly, it recruits insects 18. Different groups of bird species seem to respond differently to land analyzed uses. Insectivores are known present marked responses to land use change[23,24] which was for annual agricultural areas were insectivores mean a number of recordings per visit decayed by 50% in relation controls. . The size of the four study areas differs and the cultivated areas were smaller in size than uncultivated areas. This is consistent with[24] the study by Harvey *et al*. (2006), who reported that size of play a major role in determining the number of bird species per km^2 that the larger the size of particular area the smaller the bird species per km^2.

The result of relative abundance obtained is also consistent with the result obtained by Best *et al*.[25] that the extent of change in bird species composition and abundance depends on the specificity of each bird species habitat requirement, in other words, the species tolerance to changes to its environment. Species with the restricted habitat changes pattern are more vulnerable to changes in land use practices than those occupying a wider variety of environment. This agrees with[26] the results obtained by Ratliffe and Crow, 2001, who noted that many bird species have expanded their home ranges because of their ability to exploit landscape transformed by humans and thus have become more widespread and abundant.

During the period of this study, it was observed most bird species encountered in the farm consumed on the z armyworms in maize plots This observation is consistent with[27] the study by Beddington (2010), who reported that bird species besides

Table 4: Checklist of bird species in the study area

Common name	Scientific Name	Order	Family	Status
African Cuckoo Hawk	*Aviceda cuculoides*	Falconiformes	Accipitridae	R
African Harrier Hawk	*Polyboroides typus*	Falconiformes	Accipitridae	R
African Hawk Eagle	*Aquila spilogaster*	Falconiformes	Accipitridae	R
Black Shouldered Kite	*Elanus caeruleus*	Falconiformes	Accipitridae	R
Yellow Billed Kite	*Milvus migrans*	Falconiformes	Accipitridae	R
Lizard Buzzard	*Kaupifalco monogrammicus*	Falconiformes	Accipitridae	R
Red Neck Buzzard	*Buteo auguralis*	Falconiformes	Accipitridae	R
Blue Breasted Kingfisher	*Halcyon malimbica*	Coraciiformes	Alcedinidae	R
Malachite Kingfisher	*Alcedo cristata*	Coraciiformes	Alcedinidae	R
Senegal Woodland Kingfisher	*Halcyon senegalensis*	Coraciiformes	Alcedinidae	R
Hartlaub's Duck	*Pteronetta hartlaubii*	Anseriformes	Anatidae	R
African Palm Swift	*Cypsiurus parvus*	Apodiformes	Apodidae	R
Intermediate Egret	*Egretta intermedia*	Ciconiiformes	Ardeidae	R
African Pied Hornbill	*Tockus fasciatus*	Coraciiformes	Bucerotidae	R
African Grey Hornbill	*Tockus nasutus*	Coraciiformes	Bucerotidae	I
Senegal Thick-Knee	*Burhinus senegalensis*	Charadriiformes	Burhinidae	R
Lesser Black-Winged Lapwing	*Vanellus lugubris*	Charadriiformes	Charadriidae	R
Grey-Backed Camaroptera	*Camaroptera brachyura*	Passeriformes	Cisticonidae	R
Tawny Flanked Prinia	*Prinia subflava*	Passeriformes	Cisticonidae	R
Yellow-Breasted Apalis	*Apalis flavida*	Passeriformes	Cisticonidae	R
Whistling Cisticola	*Cisticola lateralis*	Passeriformes	Cisticonidae	R
African Green Pigeon	*Treron calva*	Columbiformes	Columbidae	R
Blue Spotted Wood Dove	*Turtur brehmeri*	Columbiformes	Columbidae	R
Laughing Dove	*Streptopelia capicola*	Columbiformes	Columbidae	R
Red Eye Dove	*Streptopelia semitorquata*	Columbiformes	Columbidae	R
Vinaceous Dove	*Streptopelia vinacea*	Columbiformes	Columbidae	R
Blue-Bellied Roller	*Coracias cyanogaster*	Coraciiformes	Coraciidae	R
Pied Crow	*Corvus albus*	Passeriformes	Corvidae	R
Black Coucal	*Centropus grillii*	Cuculiformes	Cuculidae	R
Senegal Coucal	*Centropus senegalensis*	Cuculiformes	Cuculidae	R
Fork-Tailed Drongo	*Dicrurus adsimilis*	Passeriformes	Dicruridae	R
Blue Billed Firefinch	*Lagonosticta rubricata*	Passeriformes	Estrildidae	R
Bronze Mannikin	*Spermestes cucullatus*	Passeriformes	Estrildidae	R
Orange-Cheeked Waxbill	*Estrilda melpoda*	Passeriformes	Estrildidae	R
Orange-Winged Pytilia	*Pytilia afra*	Passeriformes	Estrildidae	R
Red-Billed Firefinch	*Lagonosticta senegala*	Passeriformes	Estrildidae	R
Common Kestrel	*Falco tinnunculus*	Falconiformes	Falconidae	R
Collard Pratincole	*Glareola pratincola*	Charadriiformes	Glareolidae	I
Grey Pratincole	*Glareola cinerea*	Charadriiformes	Glareolidae	I
African Jacana	*Actophilornis africanus*	Charadriiformes	Jacanidae	R
Black-Crowned Tchagra	*Tchagra senegala*	Passeriformes	Melanocetidae	R
Grey-Headed Bushshrike	*Malaconotus blanchoti*	Passeriformes	Melanocetidae	R
Yellow-Crowned Gonolek	*Laniarius barbarous*	Passeriformes	Melanocetidae	R
Little Bee-Eater	*Merops pusillus*	Passeriformes	Meropidae	R
White-throated Bee-Eater	*Merops albicollis*	Passeriformes	Meropidae	I
Plain-Backed Pipit	*Anthus leucophrys*	Passeriformes	Motacillidae	I
Tree Pipit	*Anthus trivialis*	Passeriformes	Motacillidae	P
Yellow-Throated Longclaw	*Macronyx croceus*	Passeriformes	Motacillidae	P
Yellow Wagtail	*Motacilla flava*	Passeriformes	Motacillidae	R

(Contd...)

Table 4: (Continued)

Common name	Scientific Name	Order	Family	Status
Red-Bellied Paradise Flycatcher	*Terpsiphone rufiventer*	Passeriformes	Muscicapidae	R
Whinchat	*Saxicola rubetra*	Passeriformes	Muscicapidae	P
Amethyst Sunbird	*Chalcomitra amethystine*	Passeriformes	Nectariniidae	R
Collared Sunbird	*Hedydipna collaris*	Passeriformes	Nectariniidae	R
Variable Sunbird	*Cinnyris venustus*	Passeriformes	Nectariniidae	R
Mouse-Brown Sunbird	*Anthreptes gabonicus*	Passeriformes	Nectariniidae	R
Splendid Sunbird	*Cinnyris coccinigaster*	Passeriformes	Nectariniidae	R
Bush Petronia	*Petronia dentate*	Passeriformes	Passeridae	R
Grey-Headed Sparrow	*Passer griseus*	Passeriformes	Passeridae	R
Double-Spurred Francolins	*Francolinus bicalcaratus*	Galliformes	Phasianidae	R
Black-Headed Weaver	*Ploceus melanocephalus*	Passeriformes	Ploceidae	R
Northern Red Bishop	*Euplectes franciscanus*	Passeriformes	Ploceidae	R
Village Weaver	*Ploceus cucullatus*	Passeriformes	Ploceidae	R
Yellow-Mantled Widowbird	*Ploceus tricolor*	Passeriformes	Ploceidae	R
Common Bulbul	*Pycnonotus barbatus*	Passeriformes	Pycnonotidae	R
Simple Leaflove	*Chlorocichla simplex*	Passeriformes	Pycnonotidae	R
Swamp Palm Bulbul	*Thescelocichla leucopleura*	Passeriformes	Pycnonotidae	R
Western Nicator	*Nicator chloris*	Passeriformes	Pycnonotidae	R
Little Green bull	*Andropadus virens*	Passeriformes	Pycnonotidae	R
Purple Glossy Starling	*Lamprotornis purpureus*	Passeriformes	Sturnidae	R
African Moustached Warbler	*Melocichla mentalis*	Passeriformes	Sylviidae	R
Garden Warbler	*Sylvia borin*	Passeriformes	Sylviidae	R
Green Comec	*Sylvietta virens*	Passeriformes	Sylviidae	R
Yellow-Bellied Hyliota	*Hyliota flavigaster*	Passeriformes	Sylviidae	R
Brown Illadopsis	*Illadopsis fulvescens*	Passeriformes	Timaliidae	R
African Thrush	*Turdus pelios*	Passeriformes	Turdidae	R
Pin-Tailed Whydah	*Vidua macroura*	Passeriformes	Viduidae	R
Village Indigobird	*Vidua chalybeata*	Passeriformes	Viduidae	R

the conservation value, they provide ecosystem services including pest suppression and pollination. They further stated that the value of birds in the suppression of pest insects was once recognized in economic ornithology research, which diminished as pesticides became prevalent, but is now again gaining attention as important. Some savanna bird species were observed in the farm and most of the savanna birds are seed eaters; this suggests that there are a lot of changes in the habitat within the study area. Similarly, in a study of winter wheat fields in Montana,[28] McEwen *et al*. found that two grassland birds, Horned Larks and McCown's Longspurs (*Calcarius mccownii*), had high proportions of cutworms (mostly pale western cutworms, *Agrotis orthogonia*), grasshoppers, and other pest insects in their diets and concluded that bird predation was a positive supplement to other controls.[29] Jones *et al*. (2005) identified bird species in Florida that suppress insect pests on farms as functional insectivores and Jones and Sieving (2006) reported that intercropping sunflower (*Helianthus annuus*) strips increased beneficial birds and insect-foraging time. In apple orchards in the Netherlands,[30] Mols and Visser (2002) found that avian predation of lepidopteran pests significantly increased apple yields by 60% compared to sites where birds were excluded from foraging. They concluded that the small initial cost of erecting nest boxes in apple orchards had value in pest reduction and may result in increased yields. Recent studies in tropical areas have found that birds significantly reduced lepidopteran larvae on coffee plants[31] and lowered coffee's most significant pest (the coffee berry borer, *Hypothenemus hampei*) by 1–21%, resulting in increased quantities of saleable fruit creating an additional US$44–310 per ha depending on annual variation and management intensity.[32]

This is confirmed by the previous study[33] that reported the level of distribution of bird species in a

habitat is normally as a result of an occurrence of plant species that support their population and to variation in species-specific requirements in the choice of habitat. The study, however, revealed the presence of conspicuous relatively less shy and flocking species such as the *Francolinus bicalcaratus*, *Centropus senegalensis*, *Cypsiurus parvus, E. intermedia, Tockus fasciatus*, and *S. semitorquata.* These species were encountered in large numbers in the maize plots and the farm edges. The abundance these bird species may further explain by the presence of more of the visiting species recorded in these farmlands and demonstrate the importance of edge effect and varying floristic composition vegetation types surrounding the farms. This is agreement with the conclusion of Rice *et al*.[34] that species composition of vegetation is important to habitat selection by birds.

CONCLUSION

Bird species diversity was high in farmland than the agroforestry area within the study area which suggests that land use change between the two blocks was responsible for this. The farmland was rich in diverse bird species, some of which have the potential to serve as a biological, environmental indicator, as well as providing study materials for research and education. The distribution of bird species observed in the study area was as a result of available food consumption for the bird species. This implies that availability of food plays a major role in the diversity and abundance of bird species in any habitat.

REFERENCES

1. Adeoti SA. Survey of Disease Incidence and Severity of Cereal Crops in the Northern Savannas. Zaria: Annual Cropping Scheme Report. Cereal Research Programme IAR/Ahmadu Bello University; 1992. p. 45.
2. Amatobi CI, Apeji SA, Oyidi O. Effect of farming practices on populations of two grasshoppers pests, *Kraussaria angulifera* Krauss and *Oedaleus senegalensis* Krauss (*Orthoptera*: *Acrididae*) in northern Nigeria. Trop Pest Manage 1988;34:173-9.
3. Beddington J. Food security: Contributions from science to a new and greener revolution. Philos Trans R Soc B 2010;365:61-71.
4. Bos MM, Steffan-Dewenter I, Tscharntke T. The contribution of cacao agroforests to the conservation of lower canopy and beetle diversity in Indonesia. Biodivers Conserv 200916:2429-44.
5. Best LB, Whitmore RC, Booth GM. Use of cornfields by birds during the breeding season: The importance of edge habitat. Am Midland Nat 1990;123:84-99.
6. Nik B, Ron D. A Guide to the Birds of Western Africa. Princeton: Princeton University Press; 2012.
7. Chamberlain DE, Wilson JD, Fuller RJ. A comparison of bird populations on organic and conventional farm systems in southern Britain. Biol Conserv 2006;88:307-20.
8. Cody ML, editor. An introduction to habitat selection in birds. In Habitat Selection in Birds. London: Academic Press Inc.; 1985. p. 191-248.
9. Harvey CA. Windbreaks enhance seed dispersal into agricultural landscaped in Monteverde, Costa Rica. Ecol Appl 2000;10:155-73.
10. Isichei AO. Omo Biosphere Reserve, Current Status, Utilization of Biological Resources and Sustainable Management (Nigeria). Working Papers of the South-South Cooperation Programme on Environmentally Sound Socio-Economic Development in the Humid Tropics. Paris: UNESCO; 1995.
11. Johnson MD, Levy NJ, Kellermann JL, Robinson DE. Effects of shade and bird exclusion on arthropods and leaf damage on coffee farms in Jamaica's Blue Mountains. Agroforestry Syst 2009;76:139-48.
12. Jones GA, Sieving KE, Jacobson SK. Avian diversity and functional in sectivory on north-central Florida farmlands. Conserv Biol 2005;19:1234-45.
13. Keay RWJ, Onochie CF, Strandfield DP. Trees of Nigeria. A Review Version of Nigerian Trees. Federal Department of Forest research Ibadan: Clarendon Press Oxford University Press; 1989, 1960, 1964. p. 476.
14. Komar O. Ecology and conservation of birds in coffee plantations: A critical review. Bird Conserv Int 2006;16:1-23.
15. MacArthur R H, MacArthur JW. On bird species diversity. Ecology 1999;42:594-8.
16. Manu SA. Effects of Habitat Fragmentation on the Distribution of Forest Birds in South Western Nigeria with Particular Reference to the Ibadan Malimbes and other Malimbes, Ph.D. Thesis. University of Oxford.
17. Mangnall MJ, Crowe TM. The effect of agriculture on farmland bird assemblage on the Agulhas Plain, Western Cape, South Africa. Afr J Ecol 2003;41:266-76.
18. Perfecto I, Vandermeer JH, Bautista GL, Nunez GI, Greenberg R, Bichier P, *et al*. Greater predation in shaded coffee farms: The role of resident neotropical birds. Ecology 2004;85:2677-81.
19. McEwen LC, DeWeese LR, Schladweiler P. Bird predation on cutworms (*Lepidoptera*: *Noctuidae*) in wheat fields and chlorpyrifos effects on brain cholinesterase activity. Environ Entomol 1986;15:147-51.
20. Mols CM, Visser ME. Great tits can reduce caterpillar damage in apple orchards. J Appl Ecol 2002;39:888-99.
21. NAERLS. Recommended Practices for the Production of Maize. Extension Recommended Practices No. 3. Zaria: National Agricultural Extension and Research Liason Services, Ahmadu Bello University; 1982.
22. Ogunlela V. Effects of Different Sowing Dates on Yields of Sorghum in the Guinea Savannah of Nigeria. Dropping Scheme Report. Zaria: Cereal Research

Programme, Institute for Agricultural Research, Ahmadu Bello University; 1985. p. 42.
23. Ratcliffe CS, Crowe TM. The effects of agriculture and the availability of edge habitat on populations of Helmeted Guineafowl Numida meleagris and on the diversity and composition of associated bird assemblages in KwaZulu-Natal province, South Africa. Biodivers Conserv 2001;10:2109-27.
24. Rice RA, Greenberg R. Silvopastoral systems: Ecological and socioeconomic benefits and migratory bird conservation. In: Schroth G, Fonseca GA, Harvey CA, Gascon C, Vasconcelos HL, Izac AM, editors. Agroforestry and Biodiversity Conservation in Tropical Landscapes. Washington, DC, USA: Island Press; 2004.
25. Sieving KE, Willson MF, De Santo TL. Habitat barriers to movement of understory birds in fragmented south-temperate rainforest. Auk 1996;113:944-9.
26. Sutherland WJ. From Individual Behaviour to Population Ecology. Oxford: Oxford University Press; 2009.
27. Teetes GL, Seshu Reddy KW, Leuchner K, House LR. Sorghum Insect Identification Handbook. Hyderabad: International Crops Research Institute for the Semi-Arid Tropics; 2002.
28. Thiollay JM. Long-term dynamics of a tropical savanna bird community. Biodivers Conserv 1995;7:1291-312.
29. Tscharntke T, Klein AM, Kruess A, Steffan-Dewenter I, Thies C. Landscape perspectives on agricultural intensification and biodiversity-ecosystem service management. Ecol Lett 2005;8:857-74.
30. Waltert M, Bobo KS, Sainge NM, Fermon H, Muhlenberg M. From forest to farmland: Habitat effects on Afrotropical forest bird diversity. Ecol Appl 2005;15:1351-66.
31. Werre, (2001). Tropical and subtropical moist broadleaf forests, Western Africa: Southern Nigeria, extending into Benin. Nigerian Lowland Ecoregion, Wild World Report, www.worldwildlife.org.
32. Mols CMM, Visser, ME. Great tits can reduce caterpillar damage in apple orchards. Journal of Applied Ecology. 2002;39:888-99.
33. Perfecto I, Rice RA, Greenberg R, VanderVoort ME. Shade coffee: a disappearing refuge for biodiversity. Bioscience 1996;46:598-608.
34. Rice RA, Greenberg R. Silvopastoral systems: ecological and socioeconomic benefits and migratory bird conservation 2004.