Journal of Research in Forestry, Wildlife & Environment Vol. 16(2) June, 2024
E-mail: *jrfwe2019@gmail.com; jfewr@yahoo.com*
http://www.ajol.info/index.php/jrfwe

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ISBN: 2141 – 1778
Ibrahim et al., 2024

AVIFAUNA SPECIES RICHNESS AND ABUNDANCE IN RELATION TO HABITAT FEATURES IN SELECTED AREAS OF GUINEA SAVANNA ZONE, NIGERIA

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ABSTRACT

This study was aimed to assess the avifaunal species richness and abundance in relation to habitat features in Guinea Savanna Zone of Nigeria. Point count method was employed to record bird species in four stratified habitats – forest, woodland, grassland and riverside, while Quadrats were used to record plant species and habitat features. Grassland habitat had the highest plant species abundance while forest had the highest species richness. Among all the habitat features, only tree density showed a positive association with the bird species abundance, richness and diversity because trees serve as the main niches for most bird species. However, water cover was the only feature that showed significant positive correlation with bird abundance because most colonial species converge at such habitat for the abundant food, water, nesting materials and breeding. In conclusion, the assessment of the vegetation composition and structure of the Guinea Savanna Zone of Nigeria has revealed the impacts of habitat disturbance on the avifaunal diversity, and indices of climate change have been recorded.

Keywords: Birds, Diversity, Habitat types, Plant species, Guinea Savanna

Correct Citation of this Publication

Ibrahim, A. B., Ndams, I. S., Gadzama, I. M. K., Tanko, D., Mathew, D. A., Wada, Y. and Chercaoui, S. I. (2024). Avifauna species richness and abundance in relation to habitat features in selected areas of Guinea Savanna Zone, Nigeria. *Journal of Research in Forestry, Wildlife & Environment*, 16(1): 103 – 110.

INTRODUCTION

Avian species constitute the commonest fauna of all habitat types and they are responsive to changes in our environment (Birdlife International, 2018). The Class Aves is of ecological importance in their habitats; they serve as bio-indicators of healthy ecosystems, birds of prey (raptors) eat up carcasses, thereby cleaning the environment (Egwumah *et al*., 2017). Birds such as sunbirds are also important in plant pollination, which aids crossbreeding of flowering plants and therefore, keep our forests healthy through their dispersal roles (Birds.com, 2023). Forest is the most significant habitat of birds, it supports 77% of all bird species while only 50% of bird species have adapted to human modified habitats (World Bird Database, 2016). Nigeria is blessed with many species of birds scattered throughout the different ecological regions (Labe *et al*., 2018).

Population density and species diversity of birds differ, increasing or decreasing according to habitat type and richness (Muhammad *et al*., 2019, Birds.com, 2023). Birds select habitats that fit their requirements for successful reproduction and survival, although some generalist species may utilize several habitat types (Rodríguez-

Estrella, 2007). Differences in requirement among bird species have caused specificity on habitat requirement (Buckley and Freckleton, 2010). In a larger number of habitats, plant communities determine the physical structure of the environment, and therefore, have a considerable influence on the distributions, abundance and diversity of birds and interactions of other animal species. For example, for bird species diversity in forests, Tewes *et al*. (2004) revealed that the physical structure of a plant community, how the foliage is distributed vertically, may be more important than the actual composition of plant species.

Deforestation for clearance of new farms and settlements are the major causes of habitat loss occurring throughout the tropics (Yanda and Munishi, 2007). As a result, comprehensive information on bird abundance, diversity and distribution that covers the entire landscape from settlement areas, farmlands to the natural forests are inadequate. The study of faunal diversity, abundance and distribution are essential ecological tools, which acts as an important indicator to evaluate different habitats both qualitatively and quantitatively. It also fulfills many ecological functions, which include disease regulation, biomass recycling, seed dispersal of fleshy fruits and pollination (Iwajomo *et al*., 2018). It therefore aimed to assess relationship among qualitative habitat (niche) features, species richness and abundance of birds in the habitat types in Guinea Savanna Zone of Nigeria.

MATERIALS AND METHODS

Description of the Study Area

The study area covered selected parts of Guinea Savanna (GS) ecological zone of Nigeria on Latitude 7°42'55.29"N - 11° 5'55.62"N and Longitude 4°0′44.05″E – 8°43′53.40″E. Almost half of the territory of Nigeria is occupied by a moist, so-called Guinean high-grass savanna. Precipitation per year here is 1000-1400mm on the average. The plots of these savannas border the banks of the rivers with gallery forests. The grass reaches a great height, in which not only a man, but also a large animal can hide. Among the savanna vegetation in Nigeria, various types of so-called elephant grass predominate. The ecological zone is known with two seasons; dry season (November – February) and wet season (March – October). The Northern Guinea Savanna, Zaria and parts of Kainji in Kaduna and Nger States respectively are covered with grasses with scattered trees and shrubs dominate the vegetation while trees are shorter and thorny and are fewer in numbers than in the Southern Guinea Savanna (parts of Kogi and Kwara States) (Makinwa, 2017, Kupika *et al*., 2017).

Study design

The study was conducted in purposively selected areas of the Guinea Savanna vegetation, Nigeria, considering especially forests, woodlands and rivers/lakes around Important Bird Areas (IBAs), including protected reserves within the region as shown in Figure 1. Random sampling method was employed to select four permanent counting points of 30m radius with a distance of at least 100m apart (Jankowski *et al*., 2009) using Geographical Information System (GIS). Each of the four habitat types had four points in four sites of the study area, making a total of 64 sampling points. The Point Count Method was adopted, and the most suitable for the uneven terrain and dense undergrowth in which detection of birds using other techniques may be difficult. In each habitat type, a site was examined using quadrat of varying dimensions for grasses, shrubs and trees to record habitat features such as vegetation cover and density (Fiala *et al*., 2006).

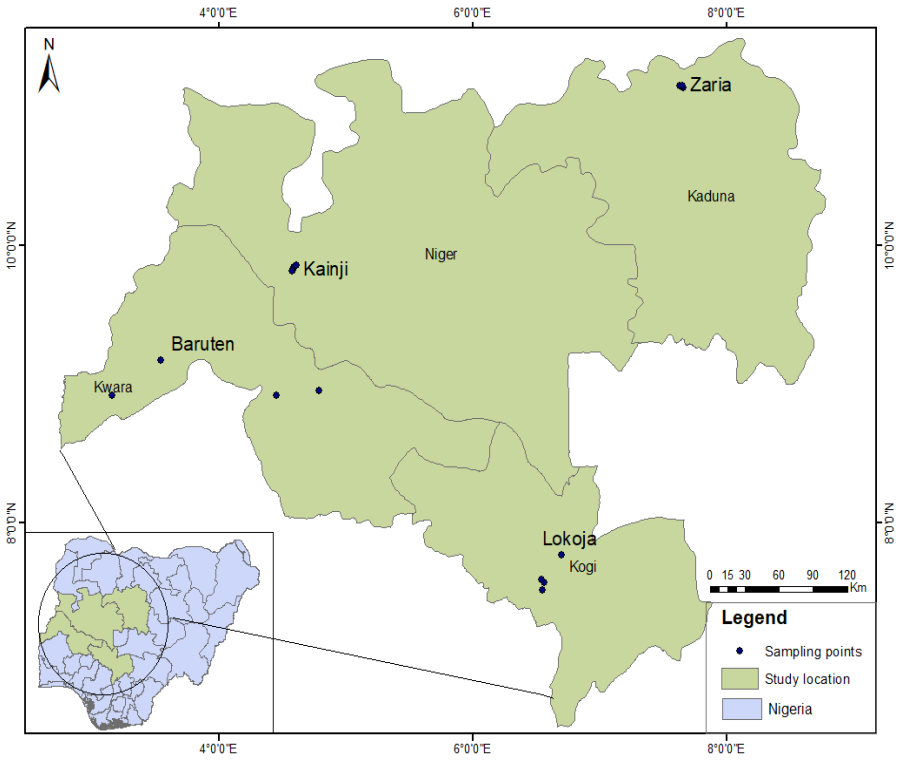

Figure 1: Map of sampling sites and points in Guinea Savanna Zone of Nigeria
Source: ArcGIS 10.8 Version

Data collection

Determination of bird species composition and abundance

Birds were counted in each sampling point. Here, upon reaching a point, 2-5 minutes was provided for the birds to settle in case of any disturbance (Bryan *et al*., 1984). Ten minutes was used to count and record all birds observed or heard within 30 m radius (Terborgh *et al*., 1990; Robinson *et al*., 2000)

The recording of birds was conducted from 6:30–10:30 in the morning and from 16:00-18:00 in the evening of the same day, as this is the period when most birds are active (Bryan *et al*., 1984). Observation of birds were done using digital camera binoculars 12 × 32 m (Model: 1080P) and Date, bird species, number, habitat type, were recorded and coordinates were taken using a hand-held GPS (Model N9 GARMIN eTrex Legend) personal navigator. Birds were identified to the species level based on Field Guides of Borrow and Demey (2013). The abundance of each species of bird was recorded and the mean abundance was determined for each.

Determination of qualitative habitat features

Plant species density and cover were recorded from nested sampling points using Quadrat of 1m × 1m for grasses and forbs, 5m × 5m for shrubs and 10m × 10m for trees; and compared with bird abundance in all habitat types (Fiala *et al*., 2006).

Data Analyses

Bird and plant species diversities, richness and evenness were determined using Shannon-Weiner diversity Index in the PAST program. One-way Analysis of Variance (ANOVA) was used to compare mean abundance of bird and plant species. Spearman correlation analysis was used to determine relationships between habitat features and bird species richness, abundance and diversity. Values of $P \leq 0.05$ was considered statistically significant using R-Statistics package for Windows version 4.1.2 (2022).

RESULTS

Analysis of variance (ANOVA) results showed that the mean abundance of bird species ranged from 28.1 ± 8.93 on grassland to 54.5 .0 ± 38.7 at

riverside, and significantly varied across habitat types (F (3) = 5.2651, *P* = 0.006, Figure 2) with riverside and grassland having the highest and least mean abundance, respectively. Species richness ranged from 54 on grassland to 86 in forest. The difference between any two habitats was statistically significant (GLM: Chisq = 10.182, df = 3, *P* = 0.017). However, the difference was only through a pairwise comparison, between forest and grassland (*P* = 0.03); and grassland and woodland (*P* = 0.04) (Figure 3). The mean abundance of plant species on habitats ranged from 32 ±16 at riverside to 59 ± 40 on grassland (Figure 4) while plant species richness did not differ significantly across habitats (Figure 5).

Meanwhile, habitat features that influenced bird species abundance were measured and the results showed both positive and negative correlations across the habitat types. Grass cover showed negative correlation with the trio of bird abundance, richness and diversity while tree cover showed positive correlation with bird species richness and diversity (Table 1). Although tree cover was only marginally significant at *P* = 0.08 while water cover was the only significant feature at *P* = 0.05. It was only tree density that showed a positive correlation with all the variables – bird abundance, richness and diversity.

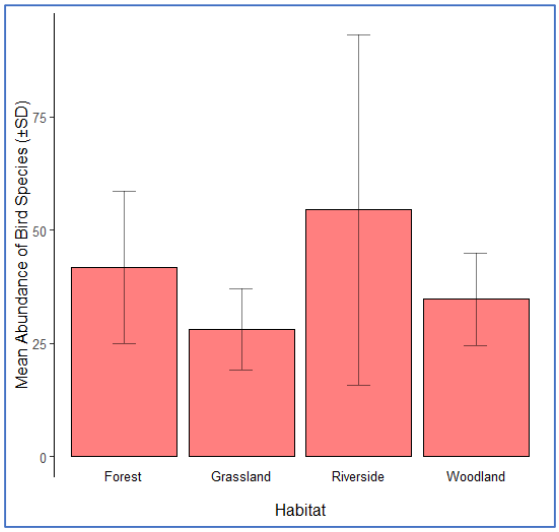

Figure 2: Mean abundance of bird species across habitat types in the study area ANOVA: F (3) = 5.2651, *P* = 0.006

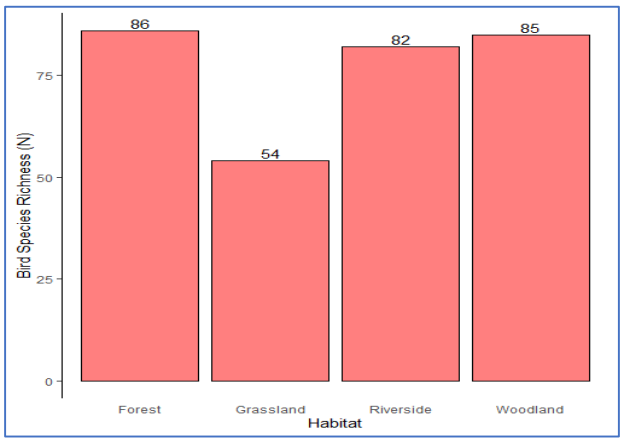

Figure 3: Species richness of birds across habitats in the study area **(GLM: Chisq = 10.182, df = 3, *P* = 0.017)**

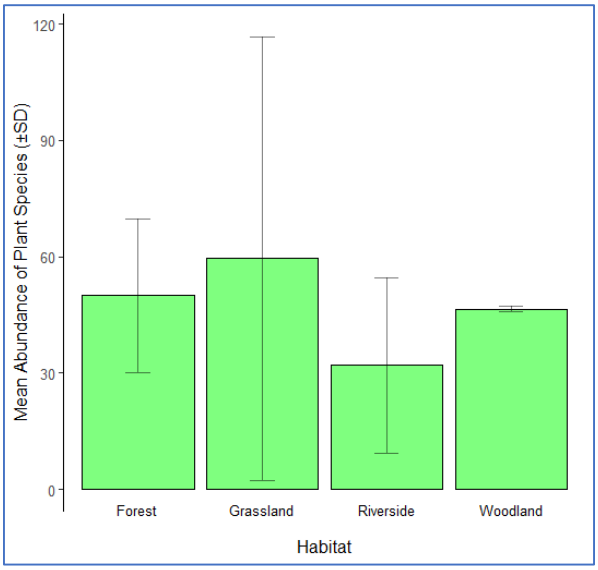

Figure 4: Mean abundance of plant species across habitat types in the study area (GLM: Chisq. 65.669 df = 3, *P* <0.0001)

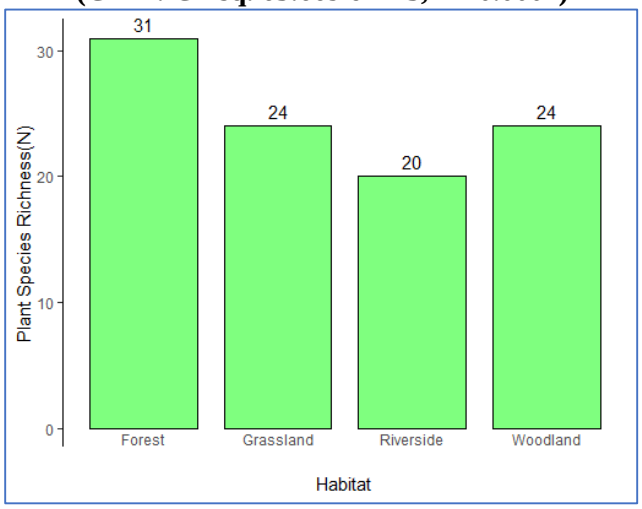

Figure 5: Plant species richness across all habitats in the study area (GLM: Chisq = 2.48, df = 3, *P* = 0.47)

Table 1: Spearman correlation coefficient between bird abundance, richness and diversity with habitat features in all habitats of the study area

Habitat features	Abundance	Diversity	Richness
Grass cover	-0.35	-0.29	-0.38
Shrub cover	-0.28	0.32	0.11
Tree cover	-0.07	0.45	0.35
Water cover	0.51*	-0.26	-0.01
Grass density	-0.15	0.08	0.07
Shrub density	-0.09	0.27	0.18
Tree density	0.01	0.16	0.2

NB: * = Significant at P = 0.05

DISCUSSION

The high species richness in this study could be attributed to its geographical significance, land characteristics and number of tree diversity, grasses and water bodies which make the habitats structurally complex. This is in line with the studies of Lawton (1999) and that of Gaston (2000) which stated that theoretical and empirical evidence have also proved over time that species richness is highly influenced by complex landscape. Sinha *et al*. (2019) explained that riverine landscapes are well suited to studies of this type of analysis because bird distribution and environmental variations are both relatively easy to quantify, just as Ward *et al*. (2002) and Vaughan *et al*. (2007) submitted that riverine environments host a large number of bird species.

Meanwhile, the forest habitat recorded the highest species richness and only next to riverside in abundance due to comparatively more trees with close canopy. The presence of trees with understory vegetation in this area provided food resources, breeding habitat and cover for the birds. Again, this habitat has a suitable nesting environment for several bird species. Okosodo and Okosodo (2020) reported high number of bird species and abundance in a study of diversity and abundance of bird species in Okomu National Park, Nigeria.

The savanna nature of the study area reflected that grassland habitat had the highest abundance of plants. This is as a result of the open vegetation with high sunlight competing with the shrubs and trees for photosynthesis. This agrees with the report of Miller (2000) who submitted that most of the grasslands of the world are situated in semiarid region and they may have some common habitat characterizations of humid and arid, typical of the savanna environment. Goudie (1993) and Shochat *et al*. (2010) also put forward that succession occurs because altered environmental conditions favour certain species, which therefore can compete more successfully for nutrients, light, space and many other factors. As a result, populations of well-adapted species have replaced earlier ones that are now less well equipped to compete in the altered conditions. This is also in agreement with this result where succession led to high abundance of grasses.

The abundance of birds was found to be influenced by the habitat features in this study. This might not be unrelated with the fact that tree cover and density are basic requirements that provide food and nesting materials for almost all bird species. Bird abundance had strong positive correlation with tree cover and tree density in all habitats. This is consistent with the work of Shochat *et al*. (2010) who argued that trees contribute to the complexity of the habitat which influences the survival of birds. The same positive correlation was also reported by Pearman (2002) and Naido (2004). The negative relationship observed between bird abundance and tree percentage cover as well as tree density in the forest was because of the closed canopy which deprives some colonial birds from flying around and again space competition is another reason. This agrees with the submission of McWethy *et al*. (2009) that bird abundance tends to decrease with tree canopy closure in the well-developed forest. Meanwhile, the combined analysis of habitat features with the trio of bird abundance, richness and diversity resulted to a negative correlation with grass cover because most species of birds in their numbers do not nest or forage on grassland. This contrasts with the report of Murray *et al*. (2008) who found that the number of grassland birds tend to increase with grass cover and density. However, shrub cover and tree cover recorded positive relationship with bird species richness and diversity because both shrubs and trees provide more fruits, seeds and nesting materials for majority of the species. Shrub cover and tree cover also provide shade and hiding places for the diverse species against predators, although only tree cover showed marginal significance indicating that it had more influence over shrub cover. This finding is in line with Shochat *et al*. (2010) and Chapman and Reich (2007) who argued that trees contribute to the complexity of the habitat and increase with shrubs cover respectively influence bird's survival in the forest and woodland.

Water cover was the only feature that showed significant positive correlation with bird abundance because most colonial species converge at such habitats for the abundant food, water, nesting materials and breeding. Riverine

areas serve as corridors for the migration of many bird species in large numbers from one landscape to the other. This finding agrees with Bos *et al*. (2009) who reported that riverine areas host high bird abundance because of the availability of food, water and nesting materials.

Among all the habitat features in the combined analysis of the habitat, only tree density showed a positive association with the bird species abundance, richness and diversity because trees serve as the main niches for most bird species. This is a further proof that trees provide more food, nesting materials and microenvironment for majority of bird abundance, species richness and the diversity.

CONCLUSIONS AND RECOMMENDATIONS

The habitat features influenced avifauna abundance and distribution in all the habitats with both positive and negative correlations but only water cover had a significant positive correlation (r = 0.51) with bird's abundance. Periodic monitoring and assessment of vegetation composition and structure should be practiced and used as a tool to identify and understand threatened habitats and impacts of disturbance on avifaunal diversity.

Acknowledgements

We are grateful to Nigeria Bird Atlas Project (NiBAP) for sponsoring some of the trips to the sampling locations and also, the mini-grant from Senator Sadiq Suleiman Umar Foundation**.** We are also grateful to Mr. Ahmed Olalekan Akande and his team for spending a great deal of time during the sampling at Kainji Lake National Park despite the insecurity challenges.

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