ORIGINAL RESEARCH ARTICLE

Avian species abundance and habitat association in Makurdi metropolis, Benue State, Nigeria

Gabriel Ortyom Yager[1], Abideen Abiodun Alarape[2], Adegoke Karounwi Munir Wahab[3], Suurshater Geshi[1]

[1]Department of Wildlife and Range Management, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria.
[2]Department of Wildlife and Ecotourism Management, University of Ibadan, Nigeria
[3]Department of Wildlife and Ecotourism Management, Osun State University, Nigeria

Correspondence Author's email: gbrlyager@gmail.com

ABSTRACT
Appraisal of avian species, especially in urban areas, is paramount to determining the health of the environment. The research focused on the abundance, diversity, and habitat association of avian species within and around the new bridge in Makurdi metropolis, Benue State, Nigeria. The habitats selected were: Abattoir (Ab), Oxbow Lake (Ol), and Farmland (Fl). A line transect length of 100 m was laid (1 at Ab, 2 each at Ol and Fl). The line transect method was used to identify and estimate the abundance and diversity of birds (at 06:00–09:00 hrs and 15:00–18:00 hrs) aided with binoculars for 2 consecutive days weekly in June–November 2021. The Textbook on Birds of West Africa was used for the identification of the species. The dataset was analyzed using descriptive statistics and diversity indices. The result revealed a total number of 23 species (4061 individuals) belonging to 15 families. Five species (41 individuals), 19 species (2,804 individuals), and 8 species (1,216 individuals) were recorded at Abattoir, Oxbowlake, and Farmland, respectively. *Ploceus cucullatus* (55.68%) was the most abundant species, while *Accipitridae* (12.5%) was the dominant family recorded. Variation in density varies across the habitat, with farmland (723.13) being the densest area. The diversity indices indicated that farmland (D: 0.668, H^1: 1.571, and richness (2.267)) had a high value when compared to other habitats. Conservation and management of urban avian species should be encouraged to promote avi-tourism.

Keywords: Bird survey, species abundance, line transect, habitats.

1.0 Introduction

Birds are an essential part of the ecosystem. They are good crop plant pollinators, seed dispersers, and environmental indicators (Bideberi, 2013). Birds belong to the Kingdom "Animalia," Phylum Chordata, and class Aves, and have a worldwide distribution, living in and around oceans, rivers, forests, and mountains (Labe *et al.,* 2018). They are social animals endowed with the ability to communicate through visual signs, calls, and songs. Their

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

melodious songs and calls, social behavioral displays, and bright colours are among the many reasons that attract individuals and groups around the world (scientists, professionals, and naturalists) to research their abundance, diversity, and distribution. Birds are the most easily observed group in the kingdom apart from the large mammals (Kwaga *et al.,* 2017). Thus, they command a high level of tourist attraction in any eco-tourist destination due to their possession of a large number of attractive features.

Birds exhibit beneficial ecological interaction through seed dispersal, soil enrichment, and plant pollination, among others (Birdlife International, 2000). They act as environmental monitors. According to Ramchandra (2013), measuring the diversity of species is paramount to determining their number and existence. The biological assemblage of species within space and time can also be determined (You *et al.,* 2009; Bibi and Ali, 2013). Diversity, therefore, is the biological assemblage of species in its entity, which is a complete representation of biological diversity across space and time (Kwaga *et al.,* 2017). The wide range of differences in their habitat requirements is the cause of specificity in habitat. Habitat perturbations due to human activities have greatly affected avifauna species' abundance and diversity over time. High traffic, through noise pollution, over time has impacted negatively the population abundance and existence of fauna species, especially avifauna (Anderson *et al.,* 2015). The major causes of birds' extinction are habitat loss, over-exploitation, and increased predation (Labe *et al.,* 2018). Doggart *et al*. (2005) reported a decline in avifauna species' abundance and distribution which they linked to human activities. The study aimed to determine the avian species abundance in association with habitats in Makurdi metropolis, Nigeria.

2.0 Materials and methods

2.1 The study area

This study was carried out in Makurdi, Benue State, Nigeria. Makurdi metropolis is the headquarters of Makurdi Local Government Area, located between latitude 7°38'N - 7°50'N and longitude 8°24'E and 8°38'E (Figure 1). It is traversed by the second largest river in the country. The climate of the tropical wet (April to October) and dry (November to March) exists, with an average annual rainfall of 1,173 mm (Ikyaagba *et al*., 2020). The temperature ranges from 28.2°C to 34.1°C (Labe et al., 2018). Urbanization over time has caused a decrease in the major urban trees.

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

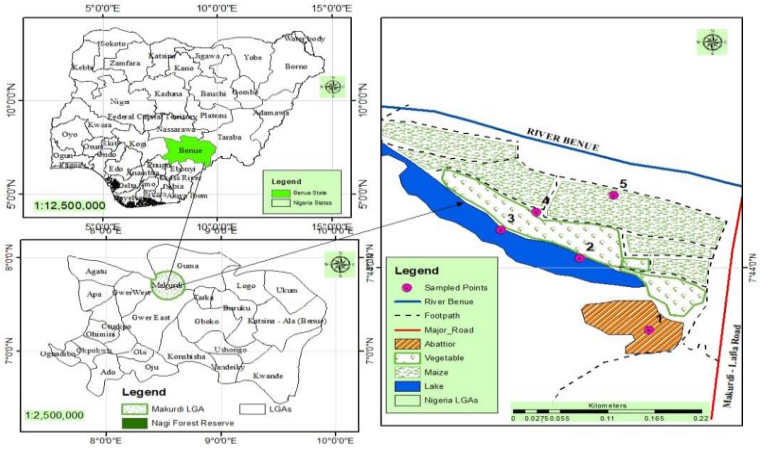

Figure 1. The map of the study area

2.2 Data collection and procedures

The study was carried out at the Wurukum axis of Makurdi specifically at Abattoir, Farmlands and Oxbow Lake located around the new bridge-Wurukum, Makurdi, Benue State. The study covered an area spanning from the new bridge down to the water gauge. The line transect method (length of 200 m each) was used to identify and record avian species within the study area. Five line transects (Abattoir = 1; Farmlands and Oxbow = 2 each) were laid. The survey was carried out between 06:00–09:00 hrs and 15:00–18:00 hrs, aided with binoculars for 2 consecutive days weekly in June–November, 2021. The book Birds of West Africa by Searle *et al*. (1992) was used for identification of the species. A digital camera (Nikon D3200) with an 18mm-55mm lens and a Coolpix (Nikon p510) with a zoom lens were also used for bird capturing.

2.3 Data Analysis

Descriptive statistics and diversity indices such as;

Simpson's Index (λ)- This is actually a measure of dominance and expressed as the reciprocal (DS=1−λ)

$$\lambda = \sum \frac{n_i(n_i-1)}{N(N-1)} \quad (1)$$

Shannon-Wiener Index (H') – The index depends on species richness and evenness.

$$H' = -\sum \left(\frac{n_i}{N} \times ln \frac{n_i}{N}\right) \quad (2)$$

Pilou evenness (J) compares the actual diversity value

$$J = \frac{H'}{H_{max}} \quad (3)$$

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

$$EH = \frac{H'}{\ln S} \quad (4)$$

Margalef's index (MI) – The higher the index the greater the richness

$$MI = \frac{n-1}{lnN} \quad (5)$$

where n_i = number of individuals of each of the i species
N = total number of individuals for the site.

The lake is situated in Nyandarua County, Central Kenya, at 0°09'S latitude and 36°26'E longitude (Fig 1). The temperatures in this area range between 10°C and 28°C. The area receives a bimodal rainfall of 980mm annually between April and June and between October and November (Karuku & Mugo, 2019).

Sediments were sampled from four different locations in Ol'Bolossat, as shown in Fig. 1 below. A Specialty Device, Inc. (SDI) Sediment Sampler Vibe Core and Accessories (Wylie, Texas, USA) were used to collect the samples from the lake depth. The collecting core pipes were sectioned into three levels after collection. The sections were three lake depths; depths of 0-30 cm, depths of 30-60 cm, and depths of 60-90 cm. Each of the three lake depths was considered an independent sample. The collecting pipes were transported to the Jomo Kenyatta University of Agriculture and Technology (JKUAT) laboratory and then were opened to collect the sediments from the different lake depths into separate bags. The plastic bags were zipped. A composite was made by combining sediments from the same lake depth at the four different collection sites. There was a 0–30 cm lake depth composite, a 30–60 cm lake depth composite, and a 60–90 cm lake depth composite.

The wet sediments were air-dried for seven days at the laboratory to prepare them for chemical quality analysis, as shown in Fig 2. After drying, the sediments were ground using a mortar and pestle and sieved using a 2 mm sieve. Sediment samples from the three depths (0–30 cm, 30–60 cm, and 60–90 cm) were then analyzed for the major crop nutrients: nitrogen, phosphorus, and potassium. They were also tested for total organic carbon, E.C., and pH. The analysis was carried out in the JKUAT Department of Horticulture and Food Security soil laboratory.

3.0 Results

3.1 Avian Species composition, distribution, rank abundance and family representation

The results of avian species encountered, their distribution, rank abundance, and family representation are presented in Table 1, Figure 2, and 3. Twenty-three species (4,061 individuals) from 15 families were recorded in the study area. Specifically, five species (41 individuals) were identified and recorded at the abattoir habitat, 19 (2,804 individuals) at the farmland habitat, and 8 (1,216 individuals) at the oxbow lake. The *Ploceus cucullatus* species ranked highest with an abundance of 55.68%, followed by *Porphyrio alleni with an* abundance

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

of 26.84%, and the lowest ranked species was *Milvus migrans with an* abundance value of (0.09%) (Fig. 2). Family representation of avian species indicated that Accipitridae (12.5%) was the most dominant family, while the remaining families had just 1 or 2 species, representing 4.17% and 8.33%, respectively (Fig. 3).

3.2 Avian species density and diversity indices

The results across the three habitats in the study area are presented in Table 2. The result indicates the highest density of occurrence at the farm (723.13), followed by the oxbow lake (262.25), and the least at the abattoir habitat (7.13). The diversity indices obtained indicate that the D-1 = 0.589, = 1.571, and = 2.267 were higher on the farmland compared to the other habitats. On the other hand, the oxbow lake habitat had a higher 0.667.

Table 1. Avian species distribution, abundance and habitat association in Makurdi

Common Name	Scientific Name	Family	Habitats			Total	Species Abd.
			Ab	Fl	Ol		
Black magpie	*Ptilostomus afer*	Corvidae	25	77	0	102	2.51
Common garden bulbul	*Pycnonotus barbatus*	Pycnonotidae	0	55	0	55	1.354
Allen's gallinule	*Porphyrio alleni*	Rallidae	0	1,001	89	1,090	26.84
Village weaver	*Ploceus cucullatus*	Ploceidae	0	1,260	1,001	2,261	55.68
Pied king fisher	*Ceryx rudis*	Alcedinidae	0	26	0	26	0.64
Red eyed dove	*Streptopelia semitorquata*	Columbidae	0	23	0	23	0.57
Rufous cane warbler	*Acrocephalus rufescens*	Parulidae	0	21	0	21	0.52
Little egret	*Egretta garzetta*	Ardeidae	4	10	18	32	0.79
African crake	*Crex egregia*	Rallidae	0	25	10	35	0.86
Senegal thick knee	*Burhinus senegalensis*	Burhinidae	0	18	0	18	0.44
Lesser wood hoopoe	*Phoeniculus aterrimus*	Phoeniculidae	0	40	0	40	0.98
Senegal coucal	*Centropus senegalensis*	Cuculidae	5	20	0	25	0.62
Senegal fire finch	*Lagonosticta senegala*	Estrildidae	0	33	0	33	0.81
Bronze manikin	*Lonchura cucullatus*	Estrildidae	0	59	0	59	1.45
Little ringed plovers	*Charadrius dubius*	Charadriidae	0	0	21	21	0.52
Levaillent's cuckoo	*Clamator lavaillantii*	Cuculidae	0	27	0	27	0.66
Laughing dove	*Streptopelia senegalensis*	Columbidae	3	32	0	35	0.86
Lizzard buzzard	*Kaupifalco monogrammicus*	Accipitrididae	0	28	0	28	0.69
Black kite	*Milvus migrans*	Accipitrididae	4	0	0	4	0.09

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

Ringed plovers	*Charadrius hiaticula*	Charadriidae	0	24	15	39	0.96
Marsh harrier	*Circus aeruginosus*	Accipitrididae	0	0	22	22	0.54
White backed duck	*Aythya nyoroca*	Anatidae	0	0	40	40	0.98
Northern red bishop	*Euplectes orix*	Ploceidae	0	25	0	25	0.62
Total			5(41)	19(2804)	8(1216)	23(4061)	100%

Key: Ab = Abattoir; Fl = Farmland; Ol = Oxbow Lake and Abd = Abundance

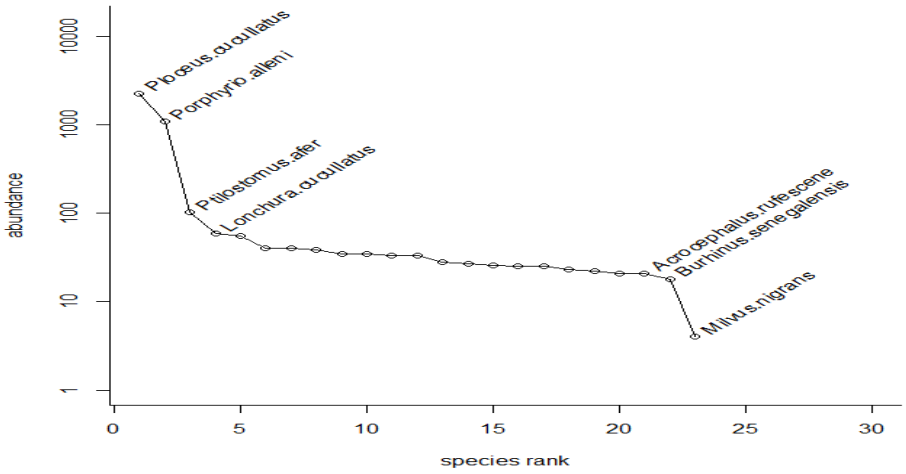

Figure 1. Rank Abundance curve of Avian species in the study area

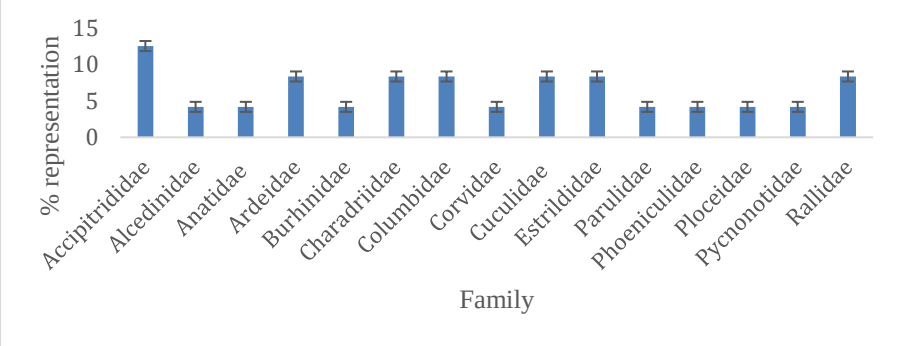

Figure 2. Family representation of Avian species in the study area

Table 2. Density and Diversity indices of Avian species in Makurdi

Habitat	Density	Simpson_1-D	Shannon_H	Evenness_e^H/S	Margalef (Richness)
Ab	7.123	0.589	1.204	0.268	1.077
Fl	723.125	0.667	1.571	0.253	2.267
Ol	262.25	0.315	0.763	0.667	0.986

Key: Ab = Abattoir; Fl = Farmland; Ol = Oxbow Lake

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

4.0 Discussion

Information on avian species' existence within an area is vital due to exploration and destruction of their habitat. It is imperative to understand the habitat supporting animal species, especially birds. The study revealed a clear difference between habitats in terms of abundance and support for bird diversity. Avian species' abundance and diversity vary across habitats. This may have been influenced by various factors such as availability of food, type of land use, proximity to water, and nesting sites that influenced species occurrence. This is in line with the studies of Cletus *et al*. (2016).

The farmland had higher records of avian species compared to other habitats within Makurdi. This agrees with findings by Komar (2009), who linked the species abundance in farmland to food availability. Plaza and Lambertuci (2017) also posited that farms are rich in organic food sources and also harbor different prey species like invertebrates, on which birds usually prey.

The village weaverbird (*Ploceus cucullatus*) was found to be the most dominant bird species in Makurdi, specifically in the farmland. This is in line with the findings of Lahti (2003), who reported high habituation of village weaverbirds within areas close to water sources and agriculture farms. This could also be attributed to the generalist behaviour of the bird species, as recorded by Kassen (2002). The ecological generalist behaviour of birds permits benefits in the physical environs. The population abundance of the village weaverbird could also be linked to less predation because of habitat use characterized by human settlement. This is in line with the findings of Lahti (2003) that village weaverbirds are mostly well known for their affinity to settle around human communities. However, this was a pointer to human-wildlife conflict on agricultural land.

5.0 Conclusion and recommendation

Avian species' abundance varies across the habitat in Makurdi. Their abundance was linked to habitat suitability, though the general diversity was moderate. Avian species are associated more with farmland. The village weaver bird (*Ploceus cucullatus*) was the dominant individual species, especially in the farmland. There is a need to direct efforts towards the conservation and management of urban avian species to promote avi-tourism.

6.0 Acknowledgements

6.1 Declaration of interest

None

7.0 References

Anderson, S.H., Dave, K. and Alastair, W.R. (20015). Birds as pollinators and Dispersers: a case study from New Zealand. *Acta Zoologica Sinica.* 52:112–115.

Bibi, F. and Ali, Z. (2013). Measurement of diversity indices of avian at Taunsa Barrage Wildlife Sanctuary, Pakistan. *The Journal of Animal & Plant Sciences,* 23(2):469–474.

Bideberi, G. (2013). Diversity, *Distribution and Abundance of Avifauna in Habitat Types: a* case of *Kilakala and Bigwa, Morogoro, Tanzania*. Tanzania; Sokoine University of

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9

Agriculture. 2pp.

BirdLife International (2000). Threatened birds of the world. Lynx Edicions and International, Barcelona and Cambridge, UK:Lynx Editions and Birdlife International Journal of Bird conservation International, 11:71-75.

Cletus, A. U., Mathias, S. B. and Johnbless E. O. (2016). Survey of Avian Species Diversity in Bali, Taraba State Nigeria, *International Journal of Research Studies in Zoology* (IJRSZ), 3(1)1-5.

Doggart, N., Lovett, J., Mhoro, B., Kiure, J. and Burgess, N. (2005). Biodiversity surveys in the Forest Reserves of the Uluguru Mountains. Technical paper for The Wildlife Conservation Society of Tanzania and Tanzanian Forest Conservation Group. DSM, Tanzania. pp8 – 18

Ikyaagba E.T, Egwunatum A.E, Ancha P.U, Kongo M. and Origbo, B.U (2020). Awareness of Forestry as a Career among Secondary School Students in Makurdi Metropolis, Benue State, Nigeria. *Journal of Agriculture and ecology Research Internal* 21(6) 21-32.

Kassen, R. (2002). The experimental evolution of specialists, generalists, and the maintenance of diversity.*Journal of Evolutionary Biology*, 15, 173–190. https://doi.org/10.1046/j.1420-9101.2002.00377.x

Komar, O. (2006). Ecology and conservation of birds in coffee plantations: a critical review. Bird Conservation International 16: 1-23.

Kwaga, B. T., Iliya D., Ali A. and Khabe D. (2017). Avifauna Abundance and Diversity in Jos Wildlife Park Nigeria. *Agricultural Science and Technology Journal.* 9(3):234-239.

Labe, T.E., Iwar, I.M. and Uloko, I.J. (2018). Species diversity and abundance of avifauna in the University of Agriculture, Benue State, North Central Nigeria. *Forest Res Eng Int Journal,* 2(4):198–202. DOI: 10.15406/freij.2018.02.00048

Lahti, D. C. (2003). *Ecology and evolution of breeding adaptations in the village weaver Ploceus cucullatus*. University of Michigan.

Plaza, P.I. and Lambertucci, S.A. (2017). How are garbage dumps impacting vertebrate demography, health, and conservation? Glo Ecol Conser 12: 9-20.

Ramchandra, A.M. (2013). Diversity and richness of bird species in newly formed habitats of Chandoli National Park in Western Ghats, Maharashtra State, India. *Biodiversity Journal, 4(1): 235*-242.

Searle, W., Morel, G.J. and Harting, W. (1992). Birds of West. Africa. Willian Collins and Sons Ltd London.

You, M. Vasseur, L., Régnière, J., and Zheng, Y. (2009). The three dimensions of species diversity. *The Open Conservation Biology Journal,* 3:82 –88.

URL: https://ojs.jkuat.ac.ke/index.php/JAGST
ISSN 1561-7645 (online)
doi: 10.4314/jagst.v21i4.9