Preliminary Assessment of Bird Species Diversity in Chukwuemeka Odumegwu Ojukwu University, Igbariam, Nigeria

Ukpeli, G. A.[1,2], Chukwu, O.,[1] Ibe, A. E.[1], Ezenwenyi, J. U.[1], Okafor T. T.[3], Adeyemi, M. A.[1], and Ezenwankwo, S. O.[1]*

[1]*Department of Forestry and Wildlife, Nnamdi Azikiwe University, Awka, Nigeria*
[2]*A.P Leventis Ornithological Institute, Jos, Nigeria*
[3]*Landscape Ecology and Nature Conservation, University of Greifswald, Germany*

KEYWORDS

Bird,
Distribution,
Diversity,
Ecological management
Ornithology
University,

*CORRESPONDING AUTHOR

onye20042000@yahoo.com,
+2348032633835

ABSTRACT

Birds are excellent bio indicators of health of biodiversity. Urbanization has been identified as one of the causes for bird decline. This study aimed at assessing bird diversity and distribution within Chukwuemeka Odumegwu University (COOU), Igbariam campus, Anambra State, Nigeria with a view to providing baseline information for ecological management. The study area was stratified into forested and open spaces; hence, 5 plots of 100 m × 100 m size were systematically laid in each stratum. Bird activities were recorded from line transects with stating points systematically determined in each plot for one (1) month. Birds were identified to species level. The species compositions were analyzed using Shannon Wiener (H') diversity and Pielou's richness (E) indices. A total of 1984 birds distributed in birds consisting of 73 species distributed among 28 families were recorded COOU. Cisticolidae and Estrildidae were the most dominate family. Streptopelia semitorquata (Red-eyed dove) had the highest Relative density (RD) of 13.58% in the open space and 21.30% in the forested habitats. The result showed that COOU had H' and E had values of 3.20 and 0.461 for the forested area and 3.18 and 0.463 for the open area, respectively. The study concluded that COOU Igbariam campus has high bird species diversity. Furthermore, the design of programmes that encourage nature conservation were recommended.

INTRODUCTION

Birds are feathered, winged, egg–laying vertebrates which are often termed as avifauna. Birds belong to the Kingdom "Animalia," Phylum "Chordata" and Class "Aves", they have a worldwide distribution, living in and around rural and urban, forested and residential areas and are the most noticeable group in the animal kingdom (Zedler, 2003). The bright colours, distinct songs and calls, and showy displays of birds add fun to human life. Birds live and breed in most terrestrial habitats and on all countries including Nigeria which have diverse bird species of birds in all its ecological regions (Labe *et al*., 2018).

The increased disappearance of avifauna species over the years especially as a result of the anthropogenic activities is a great challenge to conservation. The United Nations (UN) estimates 55% of the world's population lives in urban areas, with the proportion expected to increase to 68% by 2050 (UN, 2918). Increase in world's population is positively correlated with deforestation (Carr, 2004), leading to loss of biodiversity. In Nigeria, the destruction of natural habitats continues rapidly, resulting in the depletion of the country's bird biodiversity and distribution (Oladeji *et al*., 2012).

Diverse urban forests can also function as wildlife habitats for a wide range of organisms especially wild birds (Jaman *et al*., 2021). University campuses are among urban structures that usually have more trees and can provide various ecosystem services (Wang *et al*., 2021).Various campuses in higher institutions represent a fundamental component of biodiversity in many parts of the world (Hernandez *et al*., 2018). Irrespective of the fact that institutional campuses have been linked to positive health and well-being (Holt *et al*., 2019), and they are primarily designed to provide a picturesque environment for learning and leisure, these campuses have the capacity to support high avifauna diversity due to their vegetation complexity (Carb´o-Ramírez *et al*., 2010; Lessi *et al*., 2016). High institutional campuses have been reported to serve as important habitats with the capacity to host a wide variety of fauna and flora (Colding and Barthel, 2017). For example, the Pune City University Campus, in the Western Indian state of Maharashtra, even though covers about 5% of the city's total landmass, is said to harbor half of the city's birds, butterfly and plant species. Surprisingly, a quarter of these taxa were found nowhere else order than the university campus (Kulkarni *et al*., 2001).

Successful conservation requires the urban habitat matrix to provide enough resources and connectivity for local species, in addition to habitat preservation (Shoffner *et al*., 2018). Thus, acting to alter urban vegetation communities can positively impact bird species diversity and how the birds are distributed in the area (Threlfall *et al*., 2016). While birds are seemingly ubiquitous throughout Nigeria, their ecologies in the urban ecosystems remain poorly understood. Thus, this study assessed bird diversity and distribution within Chukwuemeka Odumegwu Ojukwu University, Igbariam campus, Nigeria.

MATERIAL AND METHOD

Study area

The study was conducted in Chukwuemeka Odumegwu University (COOU) Igbariam Campus Anambra State, Nigeria. The University covers an area of about 714 hectares and located between longitude 6.94869° to 6.98174° E and latitude 6.27321° to 6.31003° N (Fig. 1) on elevation of 76 m above sea level. The climate is dominated with distinct dry and wet seasons with a temperature range of 24 – 36°C and annual rainfall of 1520-2020 mm. The vegetation in this area is half cleared dominated by farmlands with a wide expanse of palm tree (*Elaeis guineensis*) plantation. It has a table to gentle sloppy terrain with streams some of which dries up at the peak of dry season (Ibeh and Nworji, 2022).

Instrument Used

The Vortex 8×42 Binoculars was used for sighting of the birds from a distance, features such as feather shape and colors, beak, eye colors, legs and body size, and bird in flight were used to identify individual bird species and confirmed using HELM Field Guide (Birds of Western Africa by Borrow and Demey, 2014). A Sound recorder from mobile device was used to record the birds heard, this was later sent to an Ornithologist Expert for a second verification to reduce errors. Birdlasser mobile application was used to note the birds seen and heard, which formulate the data into a CSV file. For safety, a pair of Safety Boots, Rain coat, Water-proof back pack and Forestry overall was used. To map out transects, Global Positioning System (GPS) Map was used to measure the distance of transects and to take coordinates of the area which the study was carried out, Cutlass, Distance tape to measure the area.

Data Collection and Analysis

The areas inside the campus were stratified into forested and open spaces (Bibby *et. al.*, 2000; Sutherland, 2006) depending on the activity and position of birds (Bibby *et. al*., 2000), a systematic selection was used to select five (5) plots of 100 m × 100 m for the forested areas (PLT 1 – 5) and also for the open areas (PLT 6 – 10), which gave a total of ten (10) plots. To ensure the independence of each plots, were laid 50 m apart from each other from 7h30 to 11h00 (Morning) and from 3h00 to 6h30 (Evening). All the selected plots were shuffled into all the designated time of the day to ensure no bird relating to time was missed out.

Within each plot, line transects were laid, starting points each line transects were systematically selected for each day to eliminate some areas being left out and five (5) plots data was collected morning and evening for five (5) days in a week, for four (4) weeks. The time ration was also systematically spread out to each transect. This is to ensure bird activities were properly collected with respect to time.

The data collected for this project was subjected to descriptive and correlation analysis. Shannon – wiener's diversity (Shannon and Weaver, 1949) and Pielou's evenness (Adekunle *et al.*, 2013) indices were also computed. The mathematical expressions are as:

$$H' = -\sum_{i=1}^{s} P_i \ln P_i \qquad (Equation\ 1)$$

$$E = \frac{H'}{H_{max}} = \frac{\sum_{i=1}^{s} P_i \ln P_i}{\ln (s)} \qquad (Equation\ 2)$$

Where,

H= Shannon-Weiner index
Pi= Relative abundance (RD) of the ith species,
S = the total number of species in the community
ln= natural log
i= 1, 2, . . ., n.

This analysis was implemented using Microsoft Excel 2010.

RESULTS

This study enumerated a total of 1984 birds consisting of 73 species distributed among 28 families. The family Cisticolidae and Estrildidae were the most dominate family of the bird population in this study area with the largest number of bird species representing 10.00% each of the total number of bird species in the population (Table 1). The bird species with the highest frequency was *Streptopelia semitorquata* (Red-eyed dove) with Relative density (RD) of13.58% in the open and 21.30% in the forested habitats. This was followed by *Lonchura cucullata* (Bronze Mannikin) with RD= 11.19% in the forested habitat and *Milvusa egyptius* (Yellow-billed Kite) with RD= 6.63% in the open habitat.

Bird species diversity and evenness in COOU are presented in Table 2. Shannon-Weiner index of diversity (H') and Pielou's evenness index (E) had a value of 3.20 and 0.461 respectively for the forested area, 3.18 and 0.463 respectively for the open area, and 3.19 and 0.46 respectively for the study area (pooled data) (Table 2).

Table 1: Distribution of bird species and frequency within each bird family in the study area

FAMILY	RD	SPECIES	SN	OPEN			SN	FORESTED		
				Scientific Name	F	RD %		Scientific Name	F	RD %
Accipitridae	7.14	African Goshawk	*1*	*Accipiter tachiro*	2	0.21				
		Black-winged Kite	*2*	*Elanus caeruleus*	2	0.21				
		Lizard Buzzard	*3*	*Kaupifalco monogrammicus*	5	0.52	*1*	*Kaupifalco monogrammicus*	6	0.59
		Yellow-billed Kite	4	*Milvus aegyptius*	64	6.63	*2*	*Milvus aegyptius*	53	5.20
		African Harrier-Hawk					*3*	*Polyboroides typus*	7	0.69
Alcedinidae	1.43	Woodland Kingfisher	*5*	*Halcyon senegalensis*	11	1.14	4	*Halcyon senegalensis*	10	0.98
Apodidae	1.43	African Palm Swift	*6*	*Cypsiurus parvus*	1	0.10	*5*	*Cypsiurus parvus*	8	0.79
Ardeidae	4.29	Black-headed Heron	*7*	*Ardea melanocephala*	35	3.63	*6*	*Ardea melanocephala*	3	0.29
		Little Egret	*9*	*Egretta garzetta*	43	4.46	*7*	*Egretta garzetta*	57	5.59
		Western Cattle Egret	*10*	*Bubulcus ibis*	26	2.69	*8*	*Bubulcus ibis*	50	4.91
Bucerotidae	2.86	African Grey Hornbill	*11*	*Lophoceros nasutus*	19	1.97	*9*	*Lophoceros nasutus*	13	1.28

		African Pied Hornbill	*12*	*Lophoceros fasciatus*	5	0.52				
Burhinidae	1.43	Senegal Thick-knee	*13*	*Burhinus senegalensis*	2	0.21				
Cisticolidae	10.00	Croaking Cisticola	*14*	*Cisticola natalensis*	3	0.31	*10*	*Cisticola natalensis*	1	0.10
		Grey-backed Camaroptera	*15*	*Camaroptera brevicaudata*	2	0.21	*11*	*Camaroptera brevicaudata*	3	0.29
		Short-winged Cisticola					*12*	*Cisticola brachypterus*	1	0.10
		Singing Cisticola					*13*	*Cisticola cantans*	7	0.69
		Red-faced Cisticola	*16*	*Cisticola erythrops*	13	1.35	*14*	*Cisticola erythrops*	29	2.85
		Tawny-flanked Prinia	*17*	*Prinia subflava*	6	0.62	*15*	*Prinia subflava*	9	0.88
		Winding Cisticola	*18*	*Cisticola marginatus*	10	1.04	*16*	*Cisticola marginatus*	2	0.20
Columbidae	7.14	Blue-spotted Wood Dove	*19*	*Turtur afer*	20	2.08	*17*	*Turtur afer*	19	1.87
		Laughing Dove	*20*	*Spilopelia senegalensis*	36	3.73	*18*	*Spilopelia senegalensis*	15	1.47
		Red-eyed Dove	*21*	*Streptopelia semitorquata*	131	13.58	*19*	*Streptopelia semitorquata*	217	21.30
		Tambourine Dove	*22*	*Turtur tympanistria*	1	0.10				
		Vinaceous Dove	*23*	*Streptopelia vinacea*	2	0.21	*20*	*Streptopelia vinacea*	22	2.16
Coraciidae	1.43	Blue-bellied Roller					*21*	*Coracias cyanogaster*	11	1.08
Corvidae	1.43	Pied Crow	*24*	*Corvus albus*	45	4.66	*22*	*Corvus albus*	18	1.77
Cuculidae	5.71	Jacobin Cuckoo	*25*	*Clamator jacobinus*	1	0.10	*23*	*Clamator jacobinus*	1	0.10
		Senegal Coucal	*26*	*Centropus senegalensis*	13	1.35	*24*	*Centropus senegalensis*	13	1.28
		Diederik Cuckoo					*25*	*Chrysococcyx caprius*	1	0.10
		Klaas's Cuckoo					*26*	*Chrysococcyx klaas*	2	0.20
Estrildidae	10.0	Bar-breasted Firefinch	*27*	*Lagonosticta rufopicta*	2	0.21	*27*	*Lagonosticta rufopicta*	7	0.69
		Black-and-white Mannikin	*28*	*Lonchura bicolor*	1	0.10	*28*	*Lonchura bicolor*	34	
		Black-bellied Firefinch					*29*	*Lagonosticta rara*	2	0.20
		Bronze Mannikin	*29*	*Lonchura cucullata*	55	5.70	*30*	*Lonchura cucullata*	114	11.19
		Grey-headed Nigrita	*30*	*Nigrita canicapillus*	1	0.10	*31*	*Nigrita canicapillus*	2	0.20
		Orange-cheeked Waxbill	*31*	*Estrilda melpoda*	6	0.62	*32*	*Estrilda melpoda*	2	0.20
		Red-billed Firefinch	*32*	*Lagonosticta senegala*	4	0.41	*33*	*Lagonosticta senegala*	9	0.88
Falconidae	2.86	African Hobby					*34*	*Falco cuvierii*	1	0.10
		Common Kestrel	*33*	*Falco tinnunculus*	8	0.83	*35*	*Falco tinnunculus*	2	0.20
Fringillidae	1.43	Yellow-fronted Canary					*36*	*Crithagra mozambica*	15	1.47

Hirundinidae	1.43	Ethiopian Swallow	*34*	*Hirundo aethiopica*	1	0.10				
Malaconotidae	1.43	Black-crowned Tchagra	*35*	*Tchagra senegalus*	3	0.31	*37*	*Tchagra senegalus*	11	1.08
Meropidae	1.43	White-throated Bee-eater	*36*	*Merops albicollis*	24	2.49				
Motacillidae	1.43	Yellow-throated Longclaw	*37*	*Macronyx croceus*	5	0.52	*38*	*Macronyx croceus*	5	0.49
Musophagidae	1.43	Western Plantain-eater	*38*	*Crinifer piscator*	17	1.76	*39*	*Crinifer piscator*	17	1.67
Nectariniidae	5.71	Copper Sunbird	*39*	*Cinnyris cupreus*	7	0.73	*40*	*Cinnyris cupreus*	28	
		Olive Sunbird	*40*	*Cyanomitra olivacea*	1	0.10	*41*	*Cyanomitra olivacea*	1	0.10
		Splendid Sunbird					*42*	*Cinnyris coccinigastrus*	21	2.06
		Variable Sunbird	*41*	*Cinnyris venustus*	16	1.66	43	*Cinnyris venustus*	27	2.65
Passeridae	2.86	Bush Petronia					*44*	*Gymnoris dentata*	3	0.29
		Northern Grey-headed Sparrow	42	*Passer griseus*	149	15.44	*45*	*Passer griseus*	33	3.24
Phasianidae	4.29	Common Quail					*46*	*Coturnix coturnix*	1	0.10
		Double-spurred Francolin	*43*	*Pternistis bicalcaratus*	13	1.35	*47*	*Pternistis bicalcaratus*	16	1.57
		Helmeted Guineafowl	*44*	*Numida meleagris*	1	0.10				
Platysteiridae	1.43	Brown-throated Wattle-eye	*45*	*Platysteira cyanea*	10	1.04	*48*	*Platysteira cyanea*	7	0.69
Ploceidae	8.57	Black-necked Weaver	*46*	*Ploceus nigricollis*	15	1.55	*49*	*Ploceus nigricollis*	15	1.47
		Chestnut-crowned Sparrow-Weaver	*47*	*Plocepasser superciliosus*	5	0.52				
		Heuglin's Masked Weaver	*48*	*Ploceus heuglini*	15	1.55				
		Northern Red Bishop	*49*	*Euplectes franciscanus*	13	1.35				
		Vieillot's Black Weaver					*50*	*Ploceus nigerrimus*	11	1.08
		Yellow-mantled Widowbird	*50*	*Euplectes macroura*	67	6.94				
Pycnonotidae	5.71	Common Bulbul	*51*	*Pycnonotus barbatus*	22	2.28	*51*	*Pycnonotus barbatus*	43	4.22
		Red-tailed Leaflove	*52*	*Phyllastrephus scandens*	3	0.31	*52*	*Phyllastrephus scandens*	3	0.29
		Simple Greenbul	*53*	*Chlorocichla simplex*	2	0.21				
		Yellow-whiskered Greenbul					*53*	*Eurillas latirostris*	1	0.10
Scopidae	1.43	Hamerkop					*54*	*Scopus umbretta*	1	0.10
Turdidae	1.43	African Thrush					*55*	*Turdus pelios*	4	0.39
Viduidae	2.86	Pin-tailed Whydah	*54*	*Vidua macroura*	1	0.10	*56*	*Vidua macroura*	4	0.39
		Village Indigobird					*57*	*Vidua chalybeata*	1	0.10
SUMMARY	**100**			***H'*=3.18**	**965**	**100**		***H'*=3.20**	**1019**	**100**

DISCUSSION

This study shows the diversity and distribution of birds in COOU Igbariam campus. In the Campus, the families: Cisticolidae andEstrildidae were the most dominate family in the study area. This result was similar to Nsor*et al.* (2018) the most diverse avian family in the Federal College of Education (Technical) Gombe, Nigeria was the Estrildidae family. This was not similar to Ogunyemi (2020) who reported that Nectarinidae, Columbidae and Pycnontidae as the most dominant families of birds in Ekiti State University, Ado - Ekiti, Nigeria. This was also in disagreement with Eveso *et al.* (2022) that reported Ploceidae as the most dominant family in Federal University Gashua, North-East Nigeria; the differences might be as a result of the difference in the ecology of the study areas.

Streptopelia semitorquata (Red-eyed Dove) and *Lonchura cucullata*(Bronze Mannikin) were the dominant bird species in the study area. From the study, it is evident that the open and forested strata in the Campus share similar and dissimilar bird species and the frequency of each species are almost the same number. The Shannon's diversity index of COOU had a value of 3.20 and 3.18 respectively for the Forested and Open Area, this indicates a fairly higher diversity in the Forested strata (H>3.0). This result agrees with Magurran (2004) who stated that a low H' value generally suggests a study area with few species and a few dominant species, while a high H' value suggests considerably more dominant species. These values were greater than 2.85 Ekiti State University, Ado- Ekiti (Ogunyemi, 2020) and less than 4.218 for Covenant University Ota (Okosodo *et al.*, 2016) both in Southwestern Nigeria. Pielou's evenness for the bird species in the open strata of 0.461 was also slightly higher than that of the open strata with a 0.002 difference. This also implies that the species in Open strata are more evenly distributed than the forested strata, though the forested strata have more diversity. The active disturbance of the open area might have also a contributed factor, due to the fact that the area is characterized with active farms, roads side, classrooms and construction sites. Farming activities such as Rice and Cassava farming are very popular on the campus, including cattle grazing.

The disparities in bird species diversity and abundance among the various land use types may be due to variations in land use and forest heterogeneity, which affect food, cover, predation danger, and microclimatic fluctuation (Okosodo *et al.*, 2016).

CONCLUSION

This study shows the diversity and distribution of birds in the Chukwuemeka Odumegu Ojukwu University, Igbariam campus, Nigeria. Bird species diversity was higher in the forest area than open area within the campus. *Streptopelia semitorquata* (Red-eyed Dove) and *Lonchura cucullata* (Bronze Mannikin) were the dominant bird species and Cisticolidae and Estrildidae were the most dominate families in the study area. The University management should design programmes to encourage nature conservation.

ACKNOLEDGEMENT

Authors acknowledge IDEA WILD for donating a pair of Vortex 8×42 Binoculars through the equipment grant to support this study. We also acknowledge the A.P Leventis Ornithological Research Institute (APLORI) and Nigerian Bird Arlas Project (NiBAP) for training and technical support throughout the project. Furthermore, we thank the management of the COOU for allowing us to carry out data collection in the campus.

REFERENCES

Adekunle, V.A.J., Adewole, O.O. and Akindele, S.O. (2013). Tree species diversity and structure of a Nigeria. *Tropical Ecology* 54(3):275-289.

Bibby, C.J., Burgess, N.D., Hill, D.A., (2000). *Bird Census Techniques*, 2nd edition. London, *UK*.

Borrow, N. and Demey R., 2024. *Helm Field Guides: Bird of Western Africa*. Christopher HELM London, an imprint of Bloomsbury Publishing Plc.

Carb´o-Ramírez, P., Zuria, I. (2011). The value of small urban greenspaces for birds in a Mexican city. *Landsc. Urban Plan.* 100, 213–222. https://doi.org/10.1016/j. landurbplan.2010.12.008.

Carr, D. L. (2004). Proximate Population Factors and Deforestation in Tropical Agricultural Frontiers. Population and Environment, 25(6), 585 .https://doi.org/10.1023/B:POEN.0000039066.05666.8d

Colding, J., Barthel, S., (2017). The role of university campuses in reconnecting humans to the biosphere. *Sustainability (Switzerland)* 9 (12), 2349.https://doi.org/10.3390/su9122349

Eveso, J.O. Wakawa, L.D. Richard, R. (2022). Diversity and abundance of avifauna species in Federal University, Gashua, northeast Nigeria. *Journal of Research in Forestry, Wildlife and Environment*, 14 (1): 98-109.

Hernandez, J.G.V., Pallagst, K. and Hammer, P. (2018). Urban Green Spaces as a component of a ecosystem functions, services, users, community involvement, initiatives and actions", *International journal of environmental sciences and natural resources. 8(1): 555730. https://doi.org/10.19080/ijesnr.2018.08555730*

Holt, E.W., Lombard, Q.K., Best, N., Smiley-Smith, S., Quinn, J.E. (2019). Active and Passive Use of Green Space, Health, and Well-Being amongst University Students.*Int J Environ Res Public Health*. 16(3):424. https://doi.org/10.3390/ijerph16030424

Ibeh, K. G. and Nworji, M. J. (2022). Checklist of Ethno-Medico-Botanical Trees in Igbariam Campus of Chukwuemeka Odumegwu Ojukwu University (COOU), Anambra State, Nigeria. *International Journal of Research and Scientific Innovation* (IJRSI) 9 (3): 8-15.

Jaman,M. F., Sarker, A. R., Alam, M., Rahman, M.,Rabbe, F., Rana, A. S., Shome, A. R.and Hossain, S. (2021). Species diversity, distribution and habitat utilization of urban wildlife in a megacity of Bangladesh.*Biodiversity Journal*. 12. 635-653. https://doi.org/10.31396/Biodiv.Jour.2021.12.3.635.653.

Kulkarni, M., Dighe, S., Sawant, A., Oswal, P., Sahasrabuddhe, K.P.A., (2001). Institutions: Biodiversity Hotspots in Urban Areas. Tropical Ecosystems: Structure, Diversity and Human Welfare. Oxford and IBH, New Dehli, India, pp. 693–695.

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 EngInt J.* 2(4):198–202. https://doi.org/10.15406/freij.2018.02.00048

Lessi, B.F., Pires, J.S.R., Batisteli, A.F., Fors, I.M.G., (2016). Vegetation, urbanization, and bird richness in a Brazilian periurban area.*Ornitol.Neotrop.*27, 203–210.

Magurran, A.E. 2004. *Measuring Biological Diversity.*Blackwell Publishing, Boston

Nsor, C.A, ;Aliyu, B, Zhigla, D., Dauda, E and Cleophas, B. A. (2018). Making the best of a Human modified Habitat; an assessment of Avian Distribution and Diversity in Federal College of Education (Technical) Gombe, Gombe State- Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, 3(4): 1527 -1535.

Ogunyemi, O.O. (2020). Plant- Species Preference by Birds in Ekiti State University, Ado - Ekiti, Nigeria.*Journal of Ecology and Natural Resources*, 4(6): 000215.

Okosodo, E.F. Orimaye, J.O. Obasogie, F.O. (2016), Avifauna Species Diversity of Covenant University Otta South Western Nigeria.*Greener Journal of Agricultural Sciences* 6 (1), 17-27.

Oladeji, S.O., Agbelusi, A.E. and Trevelyan, R. (2012). Anthropogenic activities threatening the management of the ecotourism resources in old Oyo national park, Nigeria. *Ethopian journal of environmental studies and management* 5: 100-111.

Shannon, C. E., and Weaver, W. (1949): *The Mathematical theory of communication*. Urbana, University Illinois Press, Urbana.

Shoffner A, Wilson AM, Tang W, Gagné S.A. (2018). The relative effects of forest amount, forest configuration, and urban matrix quality on forest breeding birds. *Sci Rep.* 8(1):17140. https://doi.org/10.1038/s41598-018-35276-9.

Sutherland, W.J., (2006). *Ecological Census Techniques: A Handbook.* Cambridge university press.

Threlfall, C. G., Williams N.S.G, Hahs, A.K. and Livesley S.J. (2016). Approaches to urban vegetation management and the impacts on urban bird and bat assemblages. *Landscape and urban planning*, 153: 28–39.

UN, (2018). United Nation Revision of the World Urbanization Prospects is published by the Population Division of the United Nations Department of Economic and Social Affairs (UN DESA). URL: https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html Accessed on 18/02/2024

Wang, X.,Wang, Y., Qu, X., Huang, B., Li, Z., Sun, J., Wei, X., Yang, X. (2021). Urban trees in university campus: structure, function, and ecological values. *Environmental Science and Pollution Research,(33):*45183-45198.https://doi.org/10.1007/s11356-021-13841-6

Zedler, J.B. (2003).Wetlands at your service: reducing impacts of agriculture at the watershed scale. Frontiers in ecology and the environment. 1(2):65–72.