Journal of Science Research and Reviews
PRINT ISSN: 1595-9074
E-ISSN: 1595-8329
DOI: https://doi.org/10.70882/josrar.2025.v2i3.78
Homepage: https://josrar.esrgngr.org
Original Research Article

Bird Species Richness, Density, Diversity and Trees Composition in Government College Kaduna, Kaduna State, Nigeria

***Agbo, Boniface O. & Abba, Patience Z.**

Department of Biological Sciences, College of Computing, Engineering and Sciences, Faculty of Life Sciences, Kaduna State University (KASU), P.M.B. 2339 Tafawa Balewa Way, Kaduna, Nigeria
*Corresponding Author's email: boniface.agbo@kasu.edu.ng
ORCID iD: https://orcid.org/0009-0002-3496-4257

KEYWORDS
Bird,
Diversity,
Evenness,
Government College Kaduna,
Richness,
Tree.

CITATION
Agbo, B. O., & Abba, P. Z. (2025). Bird Species Richness, Density, Diversity and Trees Composition in Government College Kaduna, Kaduna State, Nigeria. *Journal of Science Research and Reviews*, *2*(3), 32-41. https://doi.org/10.70882/josrar.2025.v2i3.78

ABSTRACT
Man's interaction with the abiotic and biotic world is an integral part of his existence. We examined ecological indices such as richness, diversity and evenness of bird and tree species as bio-indicators of the health of a defunct military camp now Government College Kaduna in Kaduna, Nigeria. Our survey was carried out in the morning with the objective of evaluating bird species distribution and tree composition within the College. Birds sighted, heard and seen in flight within 25m radius from the focal points along the line of transects were counted and identified using Birds of Western Africa field guide. In addition, plotless sampling technique was used in tree survey and identification was aided using the Flora of West Tropical Africa field guide. Data were analyzed in R Statistical Package. We recorded 5,359 and 627 individual birds and trees made up of 32 and 27 species belonging to 23 and 19 families respectively. H'_{bird}, E'_{bird} were not statistically different from H'_{tree}, E'_{tree} at $p>0.05$. The calculated Margalef species richness index $D'_{tree} = 4.04$ while $D'_{bird} = 3.61$, this also was not different statically. Influence of population sizes of sampled organisms on density was significantly different $p=1.23 \times 10^{-4}$. Environmental degradation is not only a critical issue for the birds and plants but could have detrimental impacts on humanity as our future well-being is dependent on maintaining the biodiversity around us.

INTRODUCTION

Birds and trees are biotic components of the environment that perform vital functions in enhancing biodiversity (Agbo *et al*., 2017). As part of the unique roles played in the habitats, population sizes and compositions are sensitive to environmental disturbances (Wilbard and Samora, 2013); thus, making them qualify as good bio-indicators of environmental health (Agbo *et al*., 2018; Krisanti *et al*., 2017)

Africa is evidentially rich in biodiversity, referred to as the collective variety of living things (Audu and Ayuba, 2016). Biotic richness in Africa is partly attributed to its closeness to the equator amidst several factors that make life thrive (Nwaogu *et al*., 2020; BirdLife, 2013). Hence, biodiversity is fundamental to the well-being of humans as it forms the basis upon which essential services intricate to supporting and maintaining life on earth is hinged (BirdLife, 2013). Moreover, the sustainable use of biodiversity offers multiple opportunities for development and improvement of livelihood (BirdLife, 2013).

Despite the relevance, threats to biodiversity are particularly on the increase due to for instance, rapid

urbanization and increasing human activities (Iniunam *et al*., 2025; Aguilera, 2019). The fate of threatened biodiversity is raising concern over the future of the already dwindling diversity in sites surrounded by rural and urban communities (Iniunam *et al*., 2025; Tu *et al*., 2020; Evans *et al*., 2011).

Notably, birds are one of the most common wildlife in urban areas such as schools, residential areas, commercial areas, open spaces in cities. As such, many bird populations are declining from farming, dam construction and general landscape changes exacerbated by urban expansions (Nsor and Obodai, 2014; Evans *et al*., 2009). At local level, the major changes include high rates of land conversion into urban uses and increasing human pressure on biodiversity due to rapid population growth. These are directly or indirectly responsible for driving more species of birds and other taxa closer to extinction (Aguilera, 2019).

Within two decades, the number of birds of global conservation concern on the Nigerian Checklist rose from twenty-six (Ezealor, 2001) to fifty-eight (Agbo, *pers. Obs.*). The International Union for the Conservation of Nature' (IUCN) Red List of Threatened Species, uncovered how thirty-two additional birds rose from least concerned status to high extinction risk category of near threatened to extinct status as a result of threatened habitat and population crises (IUCN, 2017).

Consequently, most studies on birds are concentrated in agricultural landscapes (Ndang'ang'a *et al.*, 2013; Usieta *et al.*, 2013), pristine habitat (Bell, 2006; Raman, 2003; Eniang and Luiselli, 2002) and major city centers (Hensley *et al.*, 2019; Rodrigues *et al.*, 2018) without much attention to school environment. Hence, the purpose of this study was to provide information on the ecological indices such as richness, diversity and evenness of birds and tree species at Government College Kaduna (G.C.K.) in order to establish a baseline for monitoring changes of bird and tree population in the institution.

MATERIALS AND METHODS

Study Area

The study was conducted at Government College Kaduna. The college was established in the 1930's in the defunct colonial military training camp. The new urban setting places the college in Kaduna South Local Government Area. It is located on Longitudes 10° 32' 30" N, 10° 32' 40" N and Latitudes 7° 25' 10" E, 7° 25' 30" E (Figure 1), in a total area of 226,758 m^2 (22.68 hectares). The vegetation is typical of a Savannah characterized by tall grasses, shrubs and trees. Some of the trees found in the area include *Adansonia digitata, Albizia lebbeck, Borassus aethiopum, Parkia biglobosa* and *Khaya senegalensis*. The area has two distinct seasons: wet and dry from April - October and November - March respectively.

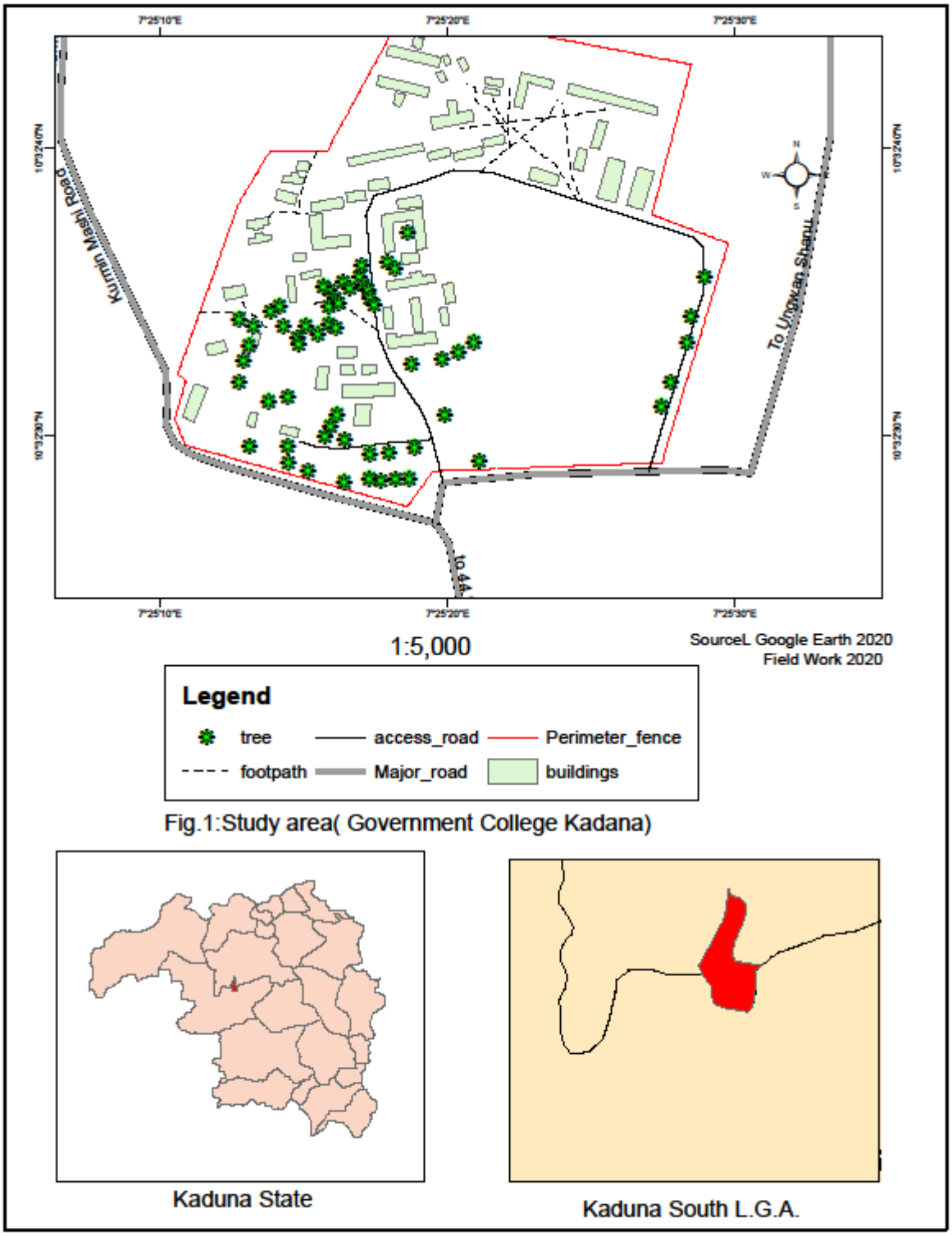

Figure 1: Government College Kaduna (GCK): In set is Kaduna State and Kaduna South Local Government Area

Bird Survey

Line transect method of bird census technique (Bibby *et al*., 2000) was used in this study. The college was stratified into residential area, block of classrooms and open field area. Two transects each were located in the residential area and the block of classes at equal distance of 400m apart, while one transect was located in the open field area. Transects were placed far apart to avoid same bird from being detected on two neighbouring transects (Buckland *et al*., 1993). Transects were placed on vegetated areas in the various strata to avoid interference from pedestrians on pre-existing foot path leading to the residential area, classrooms and school field. The method involved slowly walking a predetermined route at a

consistent pace and recording all birds seen or heard within or on either side of the route within a fixed distance of twenty-five meter radius from the focal points along the stretch of the transects. We were unable to obtain the placement of a second transect in the open field area for lack of space to observe the 400m space before the sixth and next transect. All start and end points of each transect were marked with Garmin 64® Global Positioning System. The field guide to the Birds of Western Africa (Borrow and Demey, 2014) was used in identification of birds that were observed with the help of a pair of 4x42 Olivon binoculars. Birds seen or heard were recorded. Bird surveys were carried out between the hours of 6:30am - 9:30a.m and a total of 36 visits were made to the study area at least three times a week for three calendar months (July to September 2017). Surveys were not conducted in the evenings for logistic purposes amidst several activities staged in the study area after school hours.

Plotless sampling method was used to assess trees diversity and density in the college premises. The technique entails speedy counting of trees without requiring plot boundaries. Tree species were counted and recorded. The field guide to the Flora of West Tropical Africa (Hutchinson *et al*., 1932) was used to identify plants aided by the presence of the Kaduna State University - Department of Biological Science's herbarium curator.

All statistical analysis were conducted in R language and environment for statistical computing (version 3.4.3) and functions implemented in the package *stats* (version 3.2.1) (R Development Core Team 2015). Ecological indices with respect to bird and tree richness, diversity and evenness were quantified using:

Margalef's (1969) index for species richness (*D*') expressed as:

$$D' = (S-1) / \ln(N) \quad (1)$$

Where *S* is the number of species, and *N* is the total number of individuals of the recorded species.

Shannon-Wiener (1963) diversity index (*H*') equation was expressed as:

$$H' = \Sigma\, pi\, (\ln pi) \quad (2)$$

Where, *pi* is the proportion of individual species.

Species evenness was evaluated by Pielou's (1968) evenness index (*E '*) expressed as:

$$E' = H' / H_{max} \quad (3)$$

Where *H '* is the Shannon-Wiener diversity index, H_{max} is the maximum possible diversity, $H_{max} = \ln (S)$, *S* is the number of species in the habitat.

The relative abundance of bird species was determined by the expression formula:

$$\text{Relative abundance (\%)} = n / N \times 100 \quad (4)$$

Where, *n* is the number of individuals of particular recorded bird species and N is the total number of individuals of the recorded species.

Density was determined by the expression formula:

$$\text{Density} = n / \text{Area} \quad (5)$$

Where, *n* is the number of individuals of particular recorded bird species and Area is the size of the college measured in square Meters. One sample t-test was used to determine the difference in the ecological indices of sampled organisms. Bird residency status was determined as described by Dowsett (2018) while Conservation status of both birds and trees were based on the IUCN Red List (2013; 2016).

RESULTS AND DISCUSSION

Bird species abundance, density, IUCN and residency status

We recorded 5,359 individual birds of 32 species in 23 families (Table 1). The findings revealed 73.91% families were represented by single species, 21.74% families were represented by two species while 4.35% families were represented by three species respectively.

Table 1: Descriptive Checklist of the bird species of Government College Kaduna - July-September 2017

S/N	Family	Common/Scientific Name	Relative Abundance	Density (species/m²)	Residency Status	IUCN Status
1	Accipitridae	Black Kite *Milvus migrans*	0.15 [27]	3.53×10^{-5}	AB/PW	LC
2	Apodidae	African Palm Swift *Cypsiurus parvus*	1.10 [17]	2.61×10^{-4}	R	LC
3	Cisticolidae	Senegal Eremomela *Eremomela pusilla*	0.54 [23]	1.28×10^{-4}	RB	LC
4	Columbidae	Laughing Dove *Streptopelia senegalensis*	19.50 [1]	4.61×10^{-3}	RB	LC
5	"	Red-eyed Dove *Streptopelia semitorquata*	5.30 [7]	1.25×10^{-3}	RB	LC
6	"	Vinaceous Dove *Streptopelia vinacea*	1.59 [13]	3.75×10^{-4}	RB	LC
7	Coraciidae	Broad-billed Roller *Eurystomus glaucurus*	0.43 [24]	1.01×10^{-4}	AB	LC
8	Corvidae	Piapiac *Ptilostomus afer*	8.42 [5]	1.99×10^{-3}	RB	LC
9	"	Pied Crow *Corvus albus*	1.06 [18]	2.51×10^{-4}	RB	LC
10	Cuculidae	Senegal Coucal *Centropus senegalensis*	0.58 [22]	1.38×10^{-4}	RB	LC
11	Dicruridae	Fork-tailed Drongo *Dicrurus adsimilis*	0.60 [21]	1.41×10^{-4}	RB	LC
12	Estrildidae	Red-billed Firefinch *Lagonosticta senegala*	4.11 [8]	9.72×10^{-4}	RB	LC
13	"	Red-cheeked Cordon-bleu *Uraeginthus bengalus*	0.67 [19]	1.59×10^{-4}	RB	LC
14	Laniidae	Yellow-billed Shrike *Corvinella corvina*	2.63 [11]	6.22×10^{-4}	RB	LC
15	Leiothrichidae	Brown Babbler *Turdoides plebejus*	1.34 [15]	3.18×10^{-4}	RB	LC

16	Malaconotidae	Yellow-crowned Gonolek *Laniarius barbarus*	0.43 [24]	1.01 x 10^{-4}	R	LC
17	Monarchidae	African Paradise Flycatcher *Terpsiphone viridis*	0.60 [21]	1.41 x 10^{-4}	AB/RB	LC
18	Musophagidae	Western Grey Plantain-eater *Crinifer piscator*	3.71 [9]	8.78 x 10^{-4}	RB	LC
19	Nectariniidae	Pygmy Sunbird *Hedydipna platura*	0.11 [28]	2.65 x 10^{-5}	AB	LC
20	"	Scarlet-chested Sunbird *Chalcomitra senegalensis*	10.79 [2]	2.55 x 10^{-3}	RB	LC
21	Oriolidae	African Golden Oriole *Oriolus auratus*	0.04 [29]	8.82 x 10^{-6}	AB	LC
22	Phoeniculidae	Green Wood-hoopoe *Phoeniculus purpureus*	2.76 [10]	6.53 x 10^{-4}	RB	LC
23	Ploceidae	Northern Red Bishop *Euplectes franciscanus*	0.02 [30]	4.41 x 10^{-6}	RB	LC
24	"	Village Weaver *Ploceus cucullatus*	10.11 [4]	2.39 x 10^{-3}	RB	LC
25	Psittacidae	Rose-ringed Parakeet *Psittacula krameri*	0.26 [26]	6.17 x 10^{-5}	RB	LC
26	"	Senegal Parrot *Poicephalus senegalus*	0.41 [25]	9.70 x 10^{-5}	RB	LC
27	Pycnonotidae	Common Bulbul *Pycnonotus barbatus*	7.05 [6]	1.67 x 10^{-3}	RB	LC
28	Ramphastidae	Bearded Barbet *Pogonornis dubius*	0.63 [20]	1.50 x 10^{-4}	RB	LC
29	Sturnidae	Long-tailed Glossy Starling *Lamprotornis caudatus*	1.18 [16]	2.78 x 10^{-4}	RB	LC
30	"	Purple Glossy Starling *Lamprotornis purpureus*	1.57 [14]	3.70 x 10^{-4}	RB	LC
31	Turdidae	African Thrush *Turdus pelios*	10.51[3]	2.48 x 10^{-3}	RB	LC
32	Viduidae	Village Indigobird *Vidua chalybeata*	1.81[12]	4.28 x 10^{-4}	RB	LC

Descriptions:
Superscript on relative abundance values represents species rank
Residency Status: A = Afrotropical visitor; B = Breeding evidence; P = Palearctic visitor; R = Resident; W=Most winter.
AB = Afrotropical visitor with Breeding evidence
RB = Resident with Breeding evidence
PW = Palearctic visitor present Most winter
Status: International Union for the Conservation of Nature (IUCN) Red List Category of Threatened Species:
LC = Least Concern

Similarly, *Stretopelia senegalensis* ranked first with relative abundance of 19.50 % hence ranked highest while *Euplectus franciscanus* ranked the least with relative abundance of 0.02 % (Figure 2). In terms of density, pattern of occupancy followed a reverse trend as relative abundance with *Euplectus franciscanus* having the highest density of 4.41 × 10^{-6} species/M^2 whereas the *Stretopelia senegalensis* had the least density of 4.61 × 10^{-3} species/M^2 (Table 1).

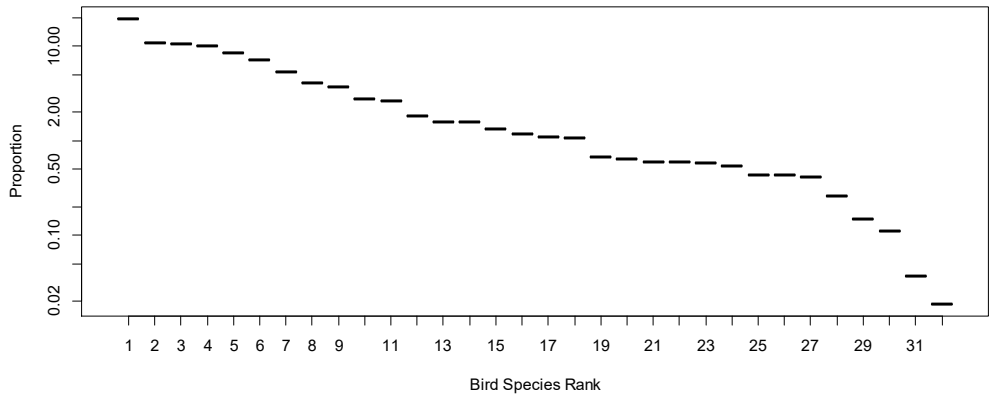

Figure 2: Bird Species Relative Abundance at Government College Kaduna July-September 2017
Key: 1-32 are individual bird species arranged in descending order based on proportion of relative abundance

All the bird species recorded in the study area were in the least concerned category of the International Union for the Conservation of Nature (IUCN) Red list status of threatened species (Table 1). Residency status also revealed 1 uncommon to locally common Palearctic migrant species, 4 Afrotropical visiting and 27 resident bird species in the surveyed area.

Tree density, nativity and IUCN status

A total of 627 individual trees comprising 27species and belonging to 19 families were recorded (Table 2). Eight out of the twenty-seven (29.63%) tree species were of African origin with three having mixed origin. One (3.70%) species was from Madagascar while 66.67% (eighteen) were introduced to Africa.

Table 2: Descriptive checklist of the plant species of Government College Kaduna - July-September 2017

S/N	Scientific/Common Name	Relative Abundance	Density (species/m^2)	Nativity	Family	IUCN Status
1	*Adansonia digitata* Baobab	3.35 [10]	9.26×10^{-5}	Africa/	Malvaceae	NE
2	*Albizia lebbeck* Silk	5.43 [5]	1.50×10^{-4}	Africa/	Fabaceae	NE
3	*Anacardium occidentale* Cashew	0.48 [17]	1.32×10^{-5}	Exotic	Anacardiaceae	NE
4	*Artocarpus heterophyllus* Jack fruits	0.16 [19]	4.41×10^{-6}	Exotic	Moraceae	NE
5	*Azadirachta indica* Neem	5.91 [4]	1.63×10^{-4}	Exotic	Meliaceae	LC
6	*Borassus aethiopum* African fan Palm	0.48 [17]	1.32×10^{-5}	Africa	Fabaceae	NE
7	*Carica papaya* Pawpaw	3.51 [9]	9.70×10^{-5}	Exotic	Caricaceae	NE
8	*Cascabela thevetia* Lucky nut	3.19 [11]	8.82×10^{-5}	Exotic	Apocynaceae	NE
9	*Citrus sp*. Orange	3.67 [8]	1.01×10^{-4}	Exotic	Rutaceae	NE
10	*Delonix regia* Flamboyant	3.19 [11]	8.82×10^{-5}	Madagasca	Fabaceae	LC
11	*Eucalyptus camaldulensis* Red River Gum	0.80 [15]	2.21×10^{-5}	Exotic	Myrtaceae	NE
12	*Ficus sycomorus* Sycamore	0.48 [17]	1.33×10^{-5}	Africa/	Moraceae	NE
13	*Gmelina arborea* Gmelina	5.26 [6]	1.46×10^{-4}	Exotic	Lamiaceae	LC
14	*Khaya senegalensis* African Mahogany	11.64 [2]	3.22×10^{-4}	Africa	Meliaceae	VU
15	*Mangifera indica* Mango	27.59 [1]	7.63×10^{-4}	Exotic	Anacardiaceae	DD
16	*Manilkara zapota* Sapodilla	0.16 [19]	4.41×10^{-6}	Exotic	Sapotaceae	NE
17	*Moringa oleifera* Moringa	3.67 [8]	1.01×10^{-4}	Exotic	Moringaceae	NE
18	*Musa sp*. Banana	2.07 [13]	5.73×10^{-5}	Exotic	Musaceae	NE
19	*Newbouldia laevis* Boundary tree	4.94 [7]	1.38×10^{-4}	Africa	Bignoniaceae	NE
20	*Parkia biglobosa* African Locust bean	3.03 [12]	8.38×10^{-5}	Africa	Fabaceae	NE
21	*Persea americana* Avocardo	1.75 [14]	4.85×10^{-5}	Exotic	Lauraceae	NE
22	*Polyalthia longifolia* Masquerade tree	0.64 [16]	1.76×10^{-5}	Exotic	Annonaceae	NE
23	*Psidium guajava* Guava	0.48 [17]	1.33×10^{-5}	Exotic	Myrtaceae	NE
24	*Sterculia urens* Karaya Gum	6.54 [3]	1.81×10^{-4}	Exotic	Malvaceae	NE
25	*Syzygium cumini* Black plum	0.32 [18]	8.82×10^{-6}	Exotic	Myrtaceae	NE
26	*Terminalia catapa* Tropical Almond	0.48 [17]	1.33×10^{-5}	Africa/	Combretaceae	LC
27	*Vernicia fordii* Tungs	0.80 [15]	2.21×10^{-5}	Exotic	Euphorbiaceae	NE

Descriptions:
Superscript on relative abundance values represents species rank
Nativity: Origin of plant:
Africa/ = Originated from Africa with traces of origin in other continents.
Exotic = None-native to Africa but introduced.
IUCN Status = International Union for the Conservation of Nature (IUCN) Red List Categories of Threatened Species:
DD = Data Deficient; LC = Least Concern; NE = Not Evaluated, VU = Vulnerable

The Red list status of threatened plant species revealed that 77.78% of trees in the study area were yet to be evaluated (NE) under the global IUCN status. One (3.70%) was data deficient (DD), one (3.70%) vulnerable (VU) and four (14.82%) tree species were in the least concern (LC) category (Table 2).

Mangifera indica ranked highest with relative abundance of 27.59 % followed by *Khaya senegalensis* while least ranked among tree species were *Artocarpus heterophyllus* and *Manilkara zapota* each having a relative abundance of 0.16 % (Figure 3).

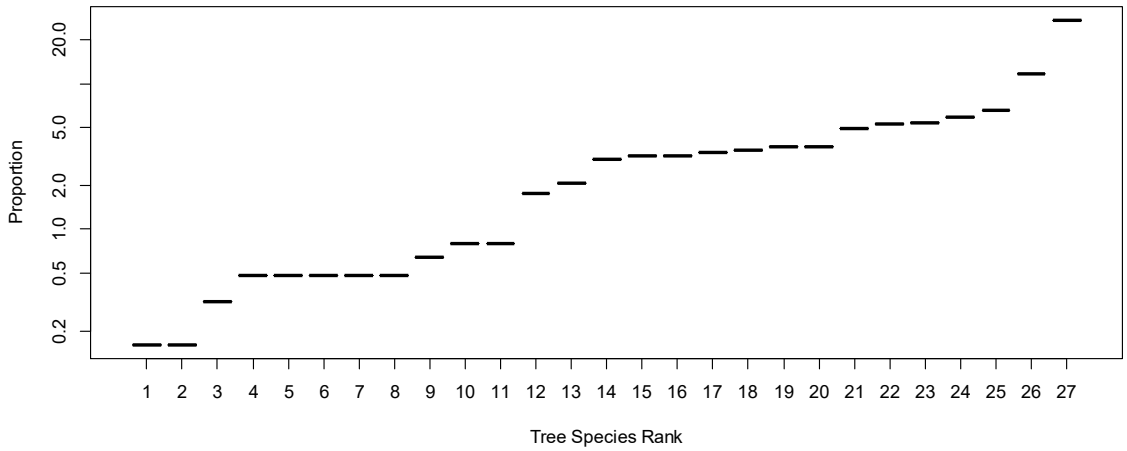

Figure 3: Tree Species Abundance at Government College Kaduna July-September 2017
Key: 1-27 are individual tree species arranged in their ascending ranking order based on proportion of relative abundance

Species richness, diversity and evenness

Collectively, the birds recorded were numerically more than tree species as shown in tables 1 and 2. The calculated Margalef species richness index D'_{tree} = 4.04 was obtained for tree species while D'_{bird} = 3.61 was obtained for bird species, this was not different statically. However, population size of sampled organisms influenced density indicating a significant difference between tree density and bird density (t=4.12, df=58 and p=1.234 ×10^{-4}).

Also, bird species had the highest diversity index H'_{bird} = 2.73 while tree species had a diversity index of H'_{tree} = 2.64, however, tree species had the highest Pielous evenness index E'_{tree} = 0.80 while bird species had E'_{bird} = 0.79. There was no significant difference between bird diversity and tree diversity (p > 0.05*)* as well as Pielous eveness (Table 3). Birds and trees species were ranked based on relative abundance in GCK. The Laughing dove (*Stretopelia senegalensis*) and Mango tree (*Magnifera indica*) ranked first while the Northern-red bishop (*Euplectus franciscanus*), Jack fruit (*Artocarpus heterophyllus*) and Sapodilla (*Manilkara zapota*) trees ranked least amongst the birds and tree species respectively (Figures 2 and 3).

Table 3: Summary statistics of Ecological Indices at Government College Kaduna - July-September 2017

Sampled Organisms	***D '***	***H '***	***E '***
Bird	3.61	2.73	0.79
Tree	4.04	2.64	0.80
	t = 17.82,*df* =1	t = 58.29,*df* =1	t =112.77,*df* =1
	***p* =** 0.98	***p* =** 0.99	***p* =** 0.99
	S	**Relative Abundance**	**Density (species/m^2)**
Bird	32	3.13 ± 0.78	2.36 × 10^{-2}
Tree	27	3.70 ± 1.05	2.77 × 10^{-3}
			t = 4.12, *df* =58
			***p* < 0.05**

Key: *D '* = Margalef's species Richness index, *H '* = Shannon-Wiener Diversity index, *E '* = Pielous Eveness, *S* =Number of species

Discussions

Bird species abundance, richness, density, diversity, IUCN and residency status

The relatively high abundance of bird species recorded in GCK could be attributed to diverse tree species recorded in the study area. The tree species may have provided different foraging and nesting sites for the birds. The success of the trees could likely be attributed to the safe shelter made possible by better protection of the site accredited to the presence of the college (GCK). The number of birds encountered in this study was similar to Afemikhe, (2017) and Agbo *et al.* (2018) bird survey at the Federal College of Forestry Mechanization Afaka, Kaduna State, Nigeria at different times of the day and in

concurrent years. The observed similarity in the compared studies was probably informed by similarity in spatio-temporal characteristics such as temperature and precipitation (Nwaogu *et al*., 2020) in both studied environment.

However, an appreciable difference in the diversity of bird species was recorded between the two sites. This could be due to the level of environmental degradation involved in the areas. On the one hand, the high level of degradation in GCK could be attributed to urban sprawl as the college is almost in the central area of Kaduna metropolis. On the other hand, less degradation in Afaka due to its location on the outskirt of town and the presence of a trial afforestation plantation, this could attract more birds to the area. The reduced number of bird species recorded in GCK corroborates the findings of Evans *et al*., (2011) who opined that increasing urbanization pose major threat to biodiversity across the globe, thereby reducing biodiversity in towns and cities.

Despite the level of environmental perturbations in the study area, the International Union of Conservation of Nature' (IUCN) status of birds in this survey was categorized as least concern (LC). This may be attributed to the resilient abilities of the species to persist irrespective of the severity of environmental degradation on the habitat. Furthermore, the absence of migrating birds in the study area could be due to the time of the study which coincided with none migration season - Palearctic birds are back to supposed breeding grounds. In contrast, intra-African migratory species such as the *Eurystomus glaucurus, Hedydipna platura, Oriolus auratus, Terpsiphone viridis* and the Afrotropical-Palearctic visitor (*Milvus migrans*) were sighted and recorded in this survey. However, their numbers (Figure 2) were not as high as other resident birds with evidences of breeding in the country.

Tree species richness, density diversity, and nativity and IUCN status

Tree composition at GCK, considering the size of the college and its location, can be said to be relatively high. In the study, the entire surroundings of the college were occupied with residential and industrial buildings. Considering the recorded number of tree species, GCK could be environmentally healthy and as such, a safe haven for foraging and nesting birds. However, like any other urban center, gradual degradation of the college environment was observed. Yakubu (2003) reported a significant change in the college environment compared to what it was in the 1930's when it was acquired from the defunct colonial military training camp. The serenity of the site is lost due to the present urban sprawl that has led to the degradation of the environment.

With regards to the trees present in GCK environment, trees of African origin were too few when compared to the exotic ones. There is a need to create awareness and promote indigenous plants in GCK and surroundings. Also, tree planting could be encouraged whereby introducing indigenous plants could help promote bird habitat in the study area, thus conserving biodiversity. Moreover, the most abundant trees *Mangifera indica* was categorized as data deficient (DD). This could be because it is an agricultural plant hence, given little or no attention. The African Mahogany (*Khaya senegalensis*) was in the vulnerable (VU) category. This agrees with Borokini (2014) who reported the species to qualify for this status due to large uncontrolled logging and poorly monitored local exploitation that has led to genetic erosion in Nigeria (Borokini, 2014). On the checklist (Table 2), Flamboyant, Gmelina, Neem and Tropical Almond trees were categorized as Least Concern, this means they were not threatened in the area probably due to the wide spread uses in plantation establishment. Twenty-one (77.78%) tree species in the study area were categorized as yet to be evaluated. This supports the finding of Brummitt *et al*. (2015) report that "the biodiversity of many remote parts of the world remain poorly known and the rate of assessments of extinction risk for individual plant species approximates the rate at which new plant species are described". This revealed that animal records are updated than plants due to domestication of most plants. Never the less, these present a lot of prospects to plant biologists to explore, in the way of research to update the knowledge gap in data base of likely threats on trees.

Birds and trees compositions in GCK

There is no statistical difference between bird and trees species diversity in GCK. The gap in densities may be attributed to the high number of birds encountered. Population size and composition of sampled organisms enable them act as good indicators of the health of an environment. Since birds explore large expanse of GCK, environmental integrity is still intact. The presence of artificial structures (Afrifa *et al*., 2023) other than trees perhaps had contributed to such coverage in the use of the study area. Population sizes and compositions would depreciate when the environment's integrity is ruined. This does not undermine the ability of tree species usage as bio-indicators, but to a large extent are disadvantaged due to their sedentary nature. However, in both organisms of interest, when abundance was correlated against area, there is a strong positive correlations curve as was obtained in concordance with Hubbell (2001). This depicts that, there are more chances of obtaining greater abundance and richness if the study period is extended and the study area is increased.

CONCLUSION

The urban sprawl around the Government College Kaduna was not totally a disadvantage to the thriving of biodiversity

in the area. Birds and trees have the potential of thriving beyond the records obtained in this study. However, the danger faced by avifauna and flora in and around the college as a result of urbanization is not only a critical issue but could have detrimental impact for humanity's future as our well-being is dependent on maintaining the biodiversity around us. It is recommended that further studies be carried out across season for a better understanding of the birds and trees community of this area.

ACKNOWLEDGEMENT
The authors appreciate the management of Government College Kaduna for granting permission to carry out this study within the college compound.

REFERENCES

Afemikhe, B. A. (2018). Survey of bird species abundance and diversity at Federal College of Forestry Mechanization Afaka, Kaduna State. Unpublished undergraduate student project: Department of Biological Science, Kaduna State University.

Afrifa, J. K., Deikumah, J. P. and Monney, K. A. (2023). Comparative use of artificial structures and natural vegetation by birds in a built-up urban area in Ghana. Avian Conservation and Ecology 18(1):6. https://doi.org/10.5751/ACE-02351-180106

Agbo, B. O., Nwaogu, C. J., Bitrus, K. Z., Ottosson, U. and Manu, S. A. (2017). Habitat selection, characteristics and the abundance of *Merops malimbicus* (Rosy Bee-eater) on the River Niger, Nigeria. *Nigerian Journal of Scientific Research* 16(3)*2017; May-June; njsr.abu.edu.ng*

Agbo, B. O., Bakam, H., Andong, F. A., Salihu, M. and Abdulhamid, H. (2018). Dusk and dawn observations of bird abundance and diversity in the Federal College of Forestry Mechanization Afaka, Kaduna Satae. In: *Proceedings of 6th NSCB Biodiversity Conference; Uniuyo 2018*. pp138 – 143.

Aguilera, J. (2019). "The Numbers Are Just Horrendous' Almost 30,000 Species Face Extinction Because of Human Activity." *TIME* (July 18).time.com/5629548/almost-30000-species-face-extinction-new-report/.

Audu, H. and Ayuba, G. M. (2016): Biodiversity conservation in Nigeria: Contemporary challenges for Ecologist. *International Journal of Innovation and Applied Studies,* **18(1)** pp. 331-340.ISSN 2028-9324.

Bell. C. P. (2006). Survey of montane forest avifauna in the Okwango Division of Cross River National Park and adjacent areas on the Obudu Plateau. Report of conservation programmes of the zoological society of London. Pdf 19pp

Bibby, C. J., Burgess, N. D. and Hill, D.A. (2000). *Bird Census Techniques*.**2**nd **ed**. Academic Press, London.

BirdLife International (2013). *State of Africa's birds 2013: Outlook for our changing environment*. Nairobi, Kenya: BirdLife International Africa Partnership, 28p. ISBN 978-0-946888-90-0.

BirdLife International (2016b). The Red List of Threatened Species. IUCN. 2016. Retrieved 14 January 2018.

Borokini, T. I. (2014). A Systematic Compilation of IUCN Red-listed Threatened Plant Spaecies in Nigeria. *International Journal of Environmental Sciences Vol. 3 No.3. 2014. Pp.104-133*

Borrow, N. and Demey, R. (2014). Field Guild to the Birds of Western Africa . *Princeton University,* **151(1):** 19–39. https://doi.org/10.1111/j.1474-919X.2008.00898.x

Brummitt, N. A., Bachman, S. P., Griffiths-Lee, J., Lutz, M., Moat, J. F., Farjon, A., *et al*. (2015). A Baseline Global Assessment for the IUCN Sampled Red List Index for Plants. *PLoS ONE* 10(8): e0135152. https://doi.org/10.1371/journal.pone.0135152

Buckland, S. T., Rexstad, E. A., Marques, T. A. and Oedekoven, C. S.(1993). *Distance Sampling: Methods and Applications*. (Methods in statistical ecology). Springler. https://doi.org/10.1007/978-3-319-19219-2
Dowsett, R. J. (2018). Nigerian Checklist: African Bird Club. Retrieved from https://www.africanbirdclub.org/sites/default/files/15_NigerianList_Dowsett.pdf

Eniang, E.A. and Luiselli, L. (2002). Ikpan wetland rainforest: An area of high biodiversity importance in south-eastern Nigeria. *Revue D Ecologie-la Terre et la Vie* **57,** 19-28.

Evans, K. L., Chamberlain, D. E., Hatchwell, B. J., Gregory, R. D. and Gaston, K. J. (2011). What makes an urban bird? *Global Change Biology,* **17(1):** 32–44. https://doi.org/10.1111/j.1365-2486.2010.02247.x

Evans, K. L., Newson, S. E. and Gaston, K. J. (2009). Habitat influences on urban avian assemblages. *Ibis:The International Journal of Avian Science,* **151(1):** 19–39. https://doi.org/10.1111/j.1474-919X.2008.00898.x

Ezealor, A. U. (2001). Nigeria. In: Important Bird Areas in Africa and Associated Islands: Priority Sites for

Conservation, Fishpool, L.D.C. and Evans, M.I., (eds). Newbury and Cambridge, UK, Pisces Publications and BirdLife International. BirdLife Conservation Series No. 11. pp 673-692.

Hensley, C. B., Trisos, C. H., Warren, P. S., MacFarland, J., Blumenshine, S., Reece, J. and Katti, M. (2019). Effects of Urbanization on Native Bird Species in Three Southwestern US Cities. *Front. Ecol. Evol*. https://doi.org/10.3389/fevo.2019.00071

Hubbell, S. P. (2001). *The Unified Neutral Theory of Biodiversity and Biogeography (MPB-32)*. PRINCENTON; OXFORD: Princeton University Press. https://doi.org/10.2307/j.ctt7rj8w.

Hutchinson, J., Dalziel, J. M., Keay, R. W. J. and Hepper, N. (1932). Flora of West Tropical Africa. Crown Agents for oversees governments and administrations. Millbank, London, S.W.1. https://doi.org/10.1093/oxfordjournals,afraf.a100495

Iniunam, A. I., Tende, T. and Chaskda, A. A. (2025). Assessing the ecological consequences of crude oil spill on bird communities in an Afrotropical landscape. *Journal of Environmental and Sustainability Indicators* 26(2025) 100600; www.sciencedirect.com/journal/environmental-and-sustainability-indicators

IUCN (2013). IUCN Red List of Threatened Species. www.iucnredlist.org . Accessed 12 April 2020

Krisanti, A.A., Choirunnafi, A., Septiana, N.O., Pratama, F.W., Amelia, F., Manjaswari, A., Septiningtyas, P.A., Wati, A.S., Satria, J.Y., Ani, I.L., Wibowo, T. and Sugiyarto (2017). The diversity of diurnal bird species on western slope of Mount Lawu, Java, Indonisia. *Biodiversitas,* 18 (3):1077-1083, https://doi.org/10.13057/biodiv/d180327.

Margalef, R. (1968). *Perspective in Ecological Theory*, University of Chicago Press, Chicago, Ill, USA.

Ndang'ang'a, P. K., Ngorige, J. B. M. and Mwangi, G. (2013). Vegetation composition and structure influences bird species community assemblages in highland agricultural landscape of Nyandarua Kenya. *Ostrich* **(84)3:** 171-179.

Nsor, C. A. and Obodai, E. A. (2014). Environmental determinant influencing seasonal variations of bird diversity and abundance in wetlands, Northern Region (Ghana) *Hindawi* (2014) 548401, http://dx.doi.org/10.1155/2014/548401

Nwaogu, C. J., Cresswell, W and Tieleman, B. I. (2020). Geographical variation in innate immune function does not follow variation in aridity along a tropical environmental gradient. *Nature* **10:**5909. https://doi.org/10.1038/s41598-020-62806-1

Odewumi, O.S., Okosodo, E. F., Talabi, O. (2017). Diversity and Abundance of Avian Species of Owena Multipurpose Dam, Ondo State, Southwest, Nigeria. *J Biodivers Biopros Dev* **(4)163**. https://doi.org/10.4172/2376-0214.1000163.

Pielou, E. C. (1969). *An introduction to Mathematical Ecology,* John Wiley and Sons, New York, NY, USA.

Raman, T. R. S. (2003). Assessment of census techniques for interspecific comparisons of tropical rainforest bird densities: a field evaluation in the Western Ghats, India. *Ibis* **145:** 9-21.

Rodrigues, A. G., Borges-Martins, M. and Zilio, F. (2018). Bird diversity in an urban ecosystem: the role of local habitats in understanding the effect of urbanization. *Zoologia* **(108).** https://doi.org/10.1590/1678-4766e2018017

Shannon, C. E. and Weaver, W. (1963). *The Mathematical Theory of Communication*, The University of Illinois Press, Urbana, Ill, USA.

Usieta, H. O., Manu, S. A. and Ottosson, U. (2013). Farmland conservation in West Africa: How do hedge row characteristics affect bird species richness? *Bird Study* **(60)1:**102-110. https://doi.org/10.1080/00063657.2012.758226

Tu, H. M., Fan, M. W. and Ko, J.C. J. (2020). Different habitat types affect Bird Richness and Evenness. *Nature* **10:1221**, https://doi.org/10.1038/s41598-020-58202-4

Wilbard, A. N. and Samora, M. A. (2013**).** Bird species composition and diversity in habitats with different disturbance histories at Kilombero Wetland, Tanzania **(3)7:**482-488 http://dx.doi.org/10.4236/oje.2013.37056

Yakubu, O. S. (2003). "Nigeria: Government College, Kaduna: Who will turn back the hands of time." *Daily Trust* (November11). https://www.dailytrust.com.ng