ECOLOGICAL SURVEY OF AVIFAUNAL RESOURCES IN UNIVERSITY OF PORT HARCOURT, NIGERIA

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Abstract

A survey of the avifaunal resources was conducted in the three campuses (Choba, Abuja, and Delta) of the University of Port Harcourt, Nigeria to ascertain their bird species composition, abundance, diversity, and affinity for different tree species. Bird census was carried out on twelve focal trees in each of the three campuses for a period of six months. Shannon-Wiener (H) and Simpson (1 − D) diversity indices were used to measure the diversity of bird species in each of the campuses, while similarity in bird species between campuses was ascertained using Sorensen's similarity index (SI). Paleontological Statistics (PAST) software was used to obtain a hierarchical classification of the tree species in each campus based on the similarity of bird species sighted on them. A total of 5277 birds belonging to 8 species were encountered in Choba Campus; 3937 belonging to 7 species in Abuja Campus; and 3034 belonging to 8 species in Delta Campus. Choba Campus had the highest bird diversity (H = 0.6623; Simpson 1 − D = 0.3370), followed by Abuja Campus (H = 0.4415; Simpson 1 − D = 0.2217), and Delta Campus (H = 0.1656; Simpson 1 − D = 0.05804). Similarity in bird species composition was highest between Abuja Campus and Delta Campus (SI = 93%) and least between Choba Campus and Delta Campus (SI = 63%). Ploceus cucullatus was the most abundant bird species in the three campuses. In Abuja Campus, Cocus nucifera, Polyalthia longifolia and Terminalia catappa were ecologically the most distant tree species with respect to bird species composition; in Delta Campus, Cocus nucifera, Pinus caribaea, and Polyalthia longifolia, were the most ecologically distant; while Hura crepitans and Polyalthia longifolia were the most ecologically distant in Choba Park. Further investigation is required to ascertain why bird species in the various campuses showed no affinity for Cocus nucifera and Polyalthia longifolia.

Key words: *University of Port Harcourt, avifauna, abundance, diversity, tree-bird interaction*

Introduction

Birds are useful indicators of global biodiversity partly because they have dispersed into, and diversified in almost all terrestrial regions, altitudes and habitats (BirdLife International, 2000). They are always the group chosen as a gauge of the effects of a given land management regime because of their utility as a visible, charismatic, easily recognized and well known and studied group (Mac Nally *et al*., 2004).

Birds are valued for a variety of reasons. They serve as indicators of environmental conditions and are also key species for education and awareness (Bibby *et al*., 2000). This may be because of their high mobility, which makes it easy for them to move from one unsuitable environment to a more suitable one.

The presence of diverse bird populations capable of sustainable reproduction is one of the best indications of a healthy environment (Kress, 2000). Birds are often used as a biological model because they are good ecological indicators and they are easily observable (Clergeau *et al*., 2001). The presence of carcass would always attract members of the vulture family while the prevalence of fruits and flowers would always attract nectar and seed eaters.

Birds can also be used as indicators of sites of high biodiversity and species richness (Chase *et al*., 2000; Vielliard, 2000; Mikusinski *et al*., 2001; Sauberer *et al*., 2004; Thomson *et al*., 2007). This method is gaining widespread use as a strategy to measure baseline patterns of diversity, and gauge the effectiveness of

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management practices (Rosenstock *et al*., 2002). The presence of rare or endangered species, concentration of species, affiliations of certain species with important ecosystems at a site, and other bird complement have shown parallel significance for other biodiversity (WCMC, 1992).

The protection of birds can lead to the protection of other biodiversity (including mammals, reptiles and invertebrates), because conserving bird species involves conserving their habitat and other organisms that are associated with that habitat.

Diversity of avifauna is one of the most important ecological indicators to evaluate the quality of habitats. Presently wildlife species including avifauna are in crisis all over the world. The case of Niger Delta environment is more critical due to regular environmental pollution and fragile nature of the ecosystem.

Avifauna diversity has been decreasing due to the destruction of natural habitats and human disturbances. Wanton destruction of natural habitats by felling nesting trees and foraging plants for commercial use of woods and lands are the main factors responsible for decreases in avian foraging habitat and their nesting sites as well as their abundance and diversity. Consequent upon these challenges, there has been a growing concern towards sustainability of avifaunal resources. The absence of reliable record on the diversity of bird species in the University of Port Harcourt implies that extinction of some bird species could hardly be detected as there is no baseline information to make reference to in the University.

This study therefore was conducted to provide baseline information on the avifaunal resources of the University of Port Harcourt. It evaluated the species composition, abundance, and diversity of the avifauna in three campuses of the University of Port Harcourt; and also examined bird species' affinity for various tree species.

Methodology
Study Area
The study was conducted at the University of Port Harcourt, Choba. It is located on latitude

4^0 53' 14"N through 4^0 54' 42"N and longitude 6^0 54' 00"E through 6^0 55' 50"E. The University has three campuses namely: Abuja, Delta and Choba. The three campuses are separated by road networks, although, Abuja and Delta Campuses are closer to each other in terms of distance. Figure 1 is the map of University of Port Harcourt showing the three campuses and their landmarks.

Methodology
Hundred percent enumeration of trees having a minimum dbh (diameter at breast height) of 7cm and a minimum height of 5m in the built-up areas of the three campuses was conducted. Twelve focal trees were selected systematically in each of the three campuses to cover all the tree species encountered and to ensure that a minimum distance of 100 metres was maintained between focal trees. The rationale for maintaining this minimum distance was to ensure that birds counted for a particular focal tree are not counted for another during a particular survey. The focal trees were visited for bird census four times (days) in a week – between the hours of 6.00a.m. and 9.00a.m. for the first two days, and between the hours 3.30 p.m. and 6.30p.m for the remaining two days. Data were collected for a period of six months - March to August, 2012. During each survey the bird species sighted on the focal trees in each campus were identified to species level, and the number of individuals counted and recorded. Identification of bird species was done with the aid of Borrow and Demey (2001; 2004).
Data Analysis
Relative abundance
Relative abundance was measured for both tree and bird species encountered in each of the campuses using the formula below.

Species relative abundance =

Species abundance x 100

   Total abundance
Measurement of bird species diversity
Bird species diversity was measured in each of the campuses using both Simpson diversity index (Simpson, 1949) and Shannon-Wiener diversity index (Odum, 1971).
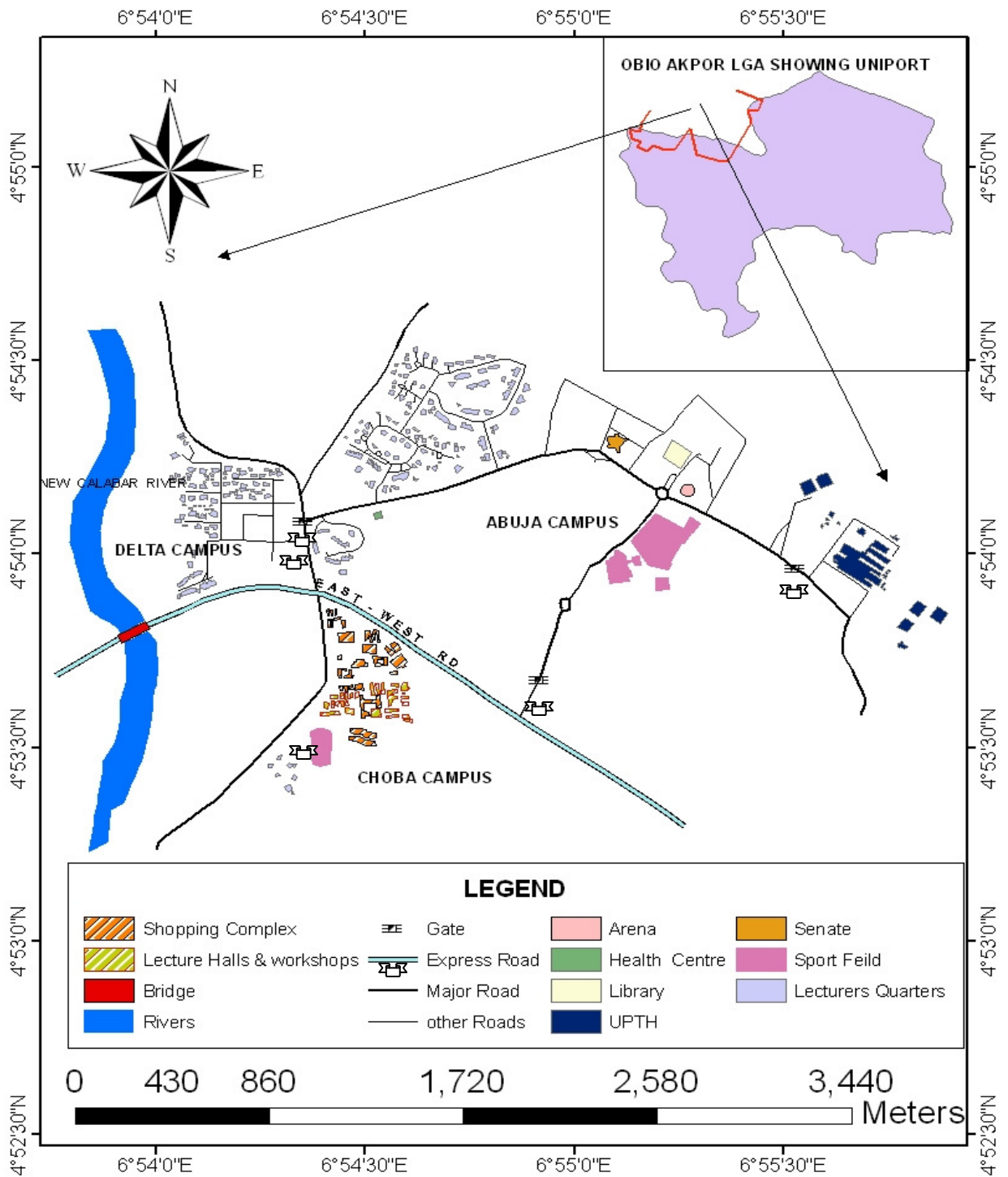
Figure 1 Map of University of Port Harcourt
Source: Department of Geography and Environmental Management, University of Port Harcourt.

Simpson diversity index is expressed as:

$$D = \frac{\sum\limits_{i=1}^{q} ni(ni-1)}{N(N-1)}$$

Where: N = total number of individuals encountered

ni = number of individuals of ith bird species enumerated for i=1……q

q = number of different bird species enumerated.

Shannon-Wiener diversity index is expressed as:

$$H = -\sum_{i=1}^{s} pi \log pi$$

Where: pi = the proportion of individuals in the ith bird species

s = the total number of bird species

Measurement of similarity in bird species between campuses

Sorensen similarity index was used to measure the extent of similarity in bird species composition between campuses. In this study, Sorensen's similarity index was computed after Margurran (2004) using the formula below.

Sorensen's similarity index =2a / 2a + b + c

Where: a = number of species common to both campuses

b = number of species present in Campus 1 but absent in Campus 2

c = number of species present in Campus 2 but absent in Campus 1

Cluster Analysis

Cluster analysis was done to obtain a hierarchical classification of tree species in each of the campuses based on the bird species sighted on them such that tree species with similar bird species are grouped together while the ones with dissimilar bird species are grouped separately. In this study, Cluster analysis was performed using the Paleontological Statistics (PAST) software.

Results

Tree species composition in the three campuses

The tree species encountered in the three campuses and their populations are shown in

Table 1. The numbers of tree species observed in Abuja campus, Delta campus and Choba campus were 10, 11 and 12 respectively, with Abuja campus having the highest population of trees (264), followed by Delta campus (72), while Choba campus had the least population (64).

The distribution of tree species among families in the three campuses is shown in Figure 2. Combretaceae had the highest number of species in Choba and Delta campuses while the families – Fabaceae, Arecaceae, and Anarcadiaceae, had the highest number of species in Abuja campus. Sorensen's similarity indices for the three campuses based on their tree species composition is shown in Table 2. The highest similarity in tree species was observed between Choba campus & Delta campus (87%), followed by Delta campus & Abuja campus (48%), and Choba campus & Abuja campus (45%).

Bird Species Composition in the three Campuses

Bird species found in the three campuses are shown in Tables 3, 4 and 5 for Abuja campus, Delta campus and Choba campus respectively. In Abuja campus *Ploceus cucullatus* had the highest relative abundance (87.55%) while *Bubulcus ibis* (0.03%) had the least relative abundance (Table 3). In Delta campus, *Ploceus cucullatus* also had the highest relative abundance (97.03%) while *Bubulcus ibis* and *Tockus fasciatus* had the least relative abundance (0.03% each; Table 4). In Choba campus, *Ploceus cucullatus* (79.78%) and *Vidua interjecta* (0.04%) had the highest and least relative abundance respectively (Table 5).

Figure 3 shows the distribution of bird species among families in the three campuses. The family pioceidae had the highest number of species in Choba campus. Species belonging to the families – Accipitridae and Viduidae, were found only in Choba campus while those of the families – Ardeidae and Bucerotidae, were absent in Choba campus. The family – Turdidae, was represented by one species found only in Delta campus.

Table 1 Checklist of tree species in the three campuses and their populations

| S/No. | Species | Population in built-up areas | | |
		Abuja	Delta	Choba
1.	*Azadirachta indica*	140	0	0
2.	*Spondias cytherea*	3	0	0
3.	*Elaeis guineensis*	40	0	0
4.	*Delonix regia*	4	0	8
5.	*Hura crepitans*	7	3	2
6.	*Terminalia catappa*	15	4	12
7.	*Mangifera indica*	10	2	3
8.	*Senna augustifolia*	5	0	0
9.	*Polyalthia longifolia*	25	3	4
10.	*Cocus nucifera*	15	6	0
11.	*Casuarina equisetifolia*	0	21	7
12.	*Eucalyptus camaldulensis*	0	3	7
13.	*Terminalia ivorensis*	0	18	6
14.	*Gmelina arborea*	0	2	8
15.	*Pinus caribaea*	0	4	1
16.	*Terminalia mantaly*	0	0	1
17.	*Senna spp.*	0	6	5
	Total	264	72	64
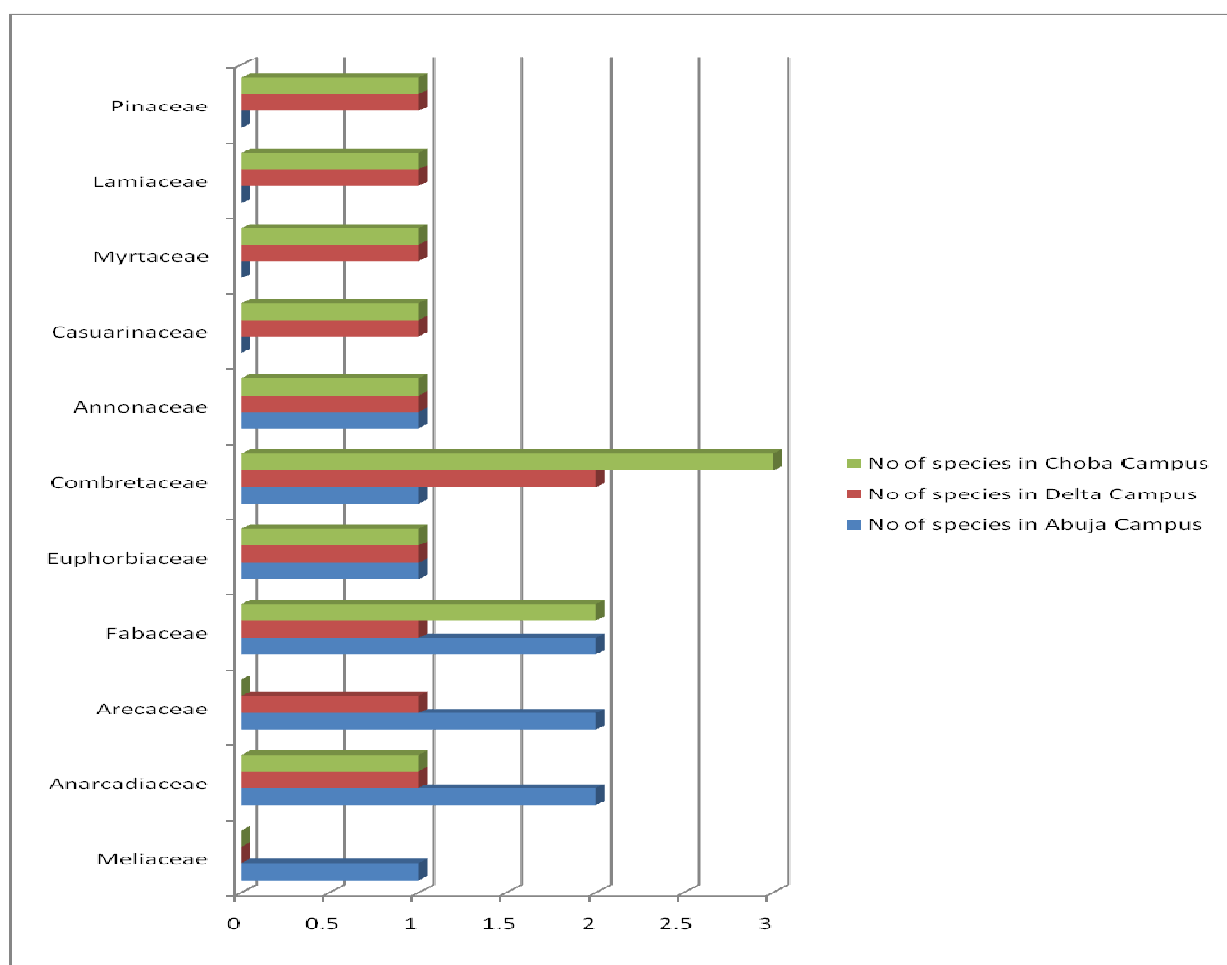
Figure 2 Distribution of tree species among families in the three campuses

Table 2 Sorensen's similarity indices for the three campuses based on their tree species composition

	Abuja	Delta	Choba
Abuja	*	0.4762	0.4545
Delta		*	0.8696
Choba			*

Table 3 Abundance of bird species at Abuja Campus

S/N	Scientific name	Common name	Abundance	Relative abundance (%)
1.	*Passer griseus*	Grey-headed sparrow	423	10.74
2.	*Ploceus cucullatus*	Village weaver	3447	87.55
3.	*Lanius collaris*	Common fiscal	6	0.15
4.	*Streptopelia capicola*	Ring-necked dove	46	1.17
5.	*Bubulcus ibis*	Cattle egret	1	0.03
6.	*Tockus fasciatus*	African pied hornbill	12	0.31
7.	*Corvus albus*	Pied crow	2	0.05
	Total		3937	100

Table 4 Abundance of bird species at Delta Campus

S/N	Scientific name	Common name	Abundance	Relative abundance (%)
1.	*Ploceus cucullatus*	Village weaver	2944	97.03
2.	*Passer griseus*	Grey-headed sparrow	21	0.69
3.	*Lanius collaris*	Common fiscal	6	0.2
4.	*Corvus albus*	Pied crow	57	1.88
5.	*Bubulcus ibis*	Cattle egret	1	0.03
6.	*Tockus fasciatus*	African pied hornbill	1	0.03
7.	*Tordus torquatus*	Ring ouzel	2	0.07
8.	*Streptopelia capicola*	Ring-necked dove	2	0.07
	Total		3034	100

Table 5 Abundance of bird species at Choba Campus

| S/N	Scientific name	Common name	Abundance	Relative abundance (%)
1.	*Corvus albus*	Pied crow	852	16.15
2.	*Streptopelia capicola*	Ring-necked dove	6	0.11
3.	*Passer griseus*	Grey-headed sparrow	72	1.36
4.	*Ploceus luteolus*	Little weaver	19	0.36
5.	*Ploceus cucullatus*	Village weaver	4210	79.78
6.	*Necrosyrtes monachus*	Hooded vulture	76	1.44
7.	*Lanius collaris*	Common fiscal	40	0.76
8.	*Vidua interjecta*	Exclamatory paradise whydah	2	0.04
	Total		5277	100
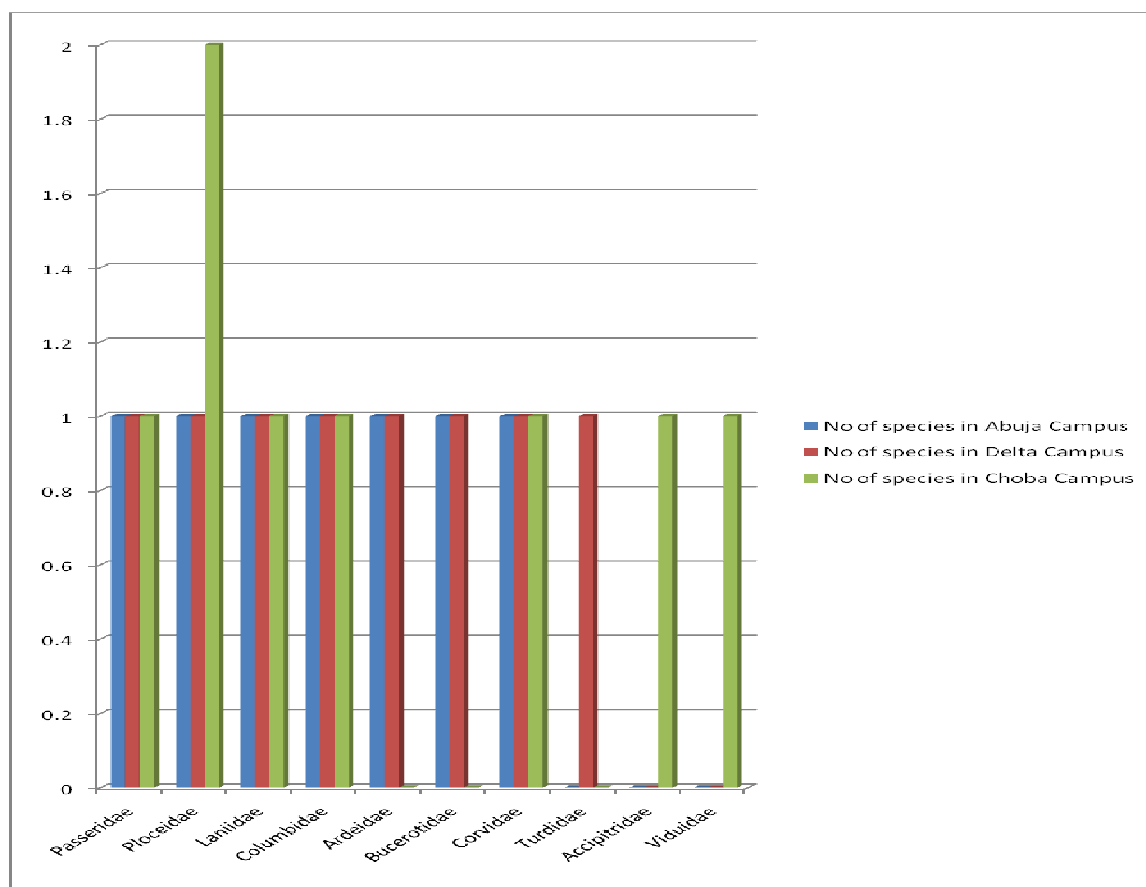
Figure 3 Distribution of bird species among families at the three campuses

Diversity and level of similarity in bird species composition for the three campuses

The diversity indices for the three campuses are shown in Table 6. Choba Campus had the highest bird diversity, followed by Abuja Campus, and Delta Campus. Similarity in bird species composition between campuses is shown in Table 7. Abuja campus and Delta campus had the highest similarity while Choba Campus and Delta Campus had the least similarity.

Tree - Bird Species Interaction

The bird species sighted on different tree species and their populations are presented in Tables 8, 9, and 10 for Abuja campus, Delta campus, and Choba campus respectively. The cluster classification of the tree species based on the similarity of bird species sighted on them are shown in Figures 4, 5, and 6 for Abuja campus, Delta campus, and Choba campus respectively. At Abuja campus, the highest number of birds was sighted on *Mangifera indica* while no birds were sighted on *Terminalia catappa, Polyalthia longifolia*, and *Cocus nucifera* (Table 8). *Delonix regia* and *Azadirachta indica* were ecologically the closest with regards to the bird species sighted on them (Figure 4). At Delta campus, the highest bird population was observed for *Casuarina equisetifolia*, while no bird species were sighted on *Polyalthia longifolia*, *Cocus nucifera*, and *Pinus caribaea* (Table 9). The least ecological distance with respect to the bird species sighted in Delta campus was observed between *Eucalyptus cameldulensis* and *Hura crepitans* (Figure 5). At Choba campus, *Terminalia catappa* harboured the highest bird population while no birds were sighted on *Hura crepitans* (Table 10). The least ecological distance in terms bird species sighted on trees at Choba campus was observed between *Terminalia catappa* and *Mangifera indica* on one hand, and *Eucalyptus cameldulensis* and *Gmelina arborea*, on the other hand (Figure 6).

Table 6 Diversity indices for bird species in the three campuses

	Abuja	Delta	Choba
Number of species	7	8	8
Individuals	3937	3034	5277
Shannon H	0.4415	0.1656	0.6623
Simpson 1- D	0.2217	0.05804	0.3370

Table 7 Sorensen's similarity indices for the three campuses based on their bird species composition

	Abuja	Delta	Choba
Abuja	*	0.9333	0.6667
Delta		*	0.6250
Choba			*

Table 8 Bird species sighted on different focal tree species at Abuja Campus

S/No.	Species	AZIN	SPCY	ELGU	DERE	HUCR	TECA	MAIN	SEAU	POLO	CONU	TOTAL
1.	*Bubulcus ibis*	0	0	1	0	0	0	0	0	0	0	1
2.	*Corvus albus*	0	0	0	0	0	0	0	2	0	0	2
3.	*Lanius collaris*	2	0	0	2	0	0	0	2	0	0	6
4.	*Passer griseus*	173	25	14	4	7	0	0	200	0	0	423
5.	*Ploceus cucullatus*	24	0	192	66	0	0	3165	0	0	0	3447
6.	*Streptopelia capicola*	1	0	0	1	44	0	0	0	0	0	46
7.	*Tockus fasciatus*	0	0	2	0	1	0	0	9	0	0	12
	TOTAL	200	25	209	73	52	0	3165	213	0	0	3937

AZIN = *Azadirachta indica*; SPCY = *Spondias cytherea*; ELGU = *Elaeis guineensis*; DERE = *Delonix regia*; HUCR = *Hura crepitans*; TECA = *Terminalia catappa*; MAIN = *Mangifera indica*; SEAU = *Senna augustifolia*; POLO = *Polyalthia longifolia*; CONU = *Cocos nicifera*

Table 9 Bird species sighted on different focal tree species at Delta Campus

S/No	Species	MAIN	TECA	CAEQ	SESP	EUCA	TEIV	GMAR	POLO	PICA	CONU	HUCR	TOTAL
1.	*Bubulcus ibis*	0	0	1	0	0	0	0	0	0	0	0	1
2.	*Corvus albus*	0	0	23	0	0	0	34	0	0	0	0	57
3.	*Lanius collaris*	0	2	1	3	0	0	0	0	0	0	0	6
4.	*Passer griseus*	1	1	2	2	0	14	1	0	0	0	0	21
5.	*Ploceus cucullatus*	21	0	2869	0	11	0	38	0	0	0	5	2944
6.	*Streptopelia capicola*	0	0	0	0	0	0	2	0	0	0	0	2
7.	*Tockus fasciatus*	0	0	1	0	0	0	0	0	0	0	0	1
8.	*Tordus torquatus*	0	0	0	2	0	0	0	0	0	0	0	2
	TOTAL	22	3	2897	7	11	14	75	0	0	0	5	3034

MAIN = *Mangifera indica*; TECA = *Terminalia catappa*; CAEQ = *Casuarina equisetifolia*; SESP = *Senna sp.*; EUCA = *Eucalyptus camaldulensis*; TEIV = *Terminalia ivorensis*; GMAR = *Gmelina arborea*; POLO = *Polyalthia longifolia*; PICA = *Pinus caribaea*; CONU = *Cocus nucifera*; HUCR = *Hura crepitans.*

Table 10 Bird species sighted on different focal tree species at Choba Campus

S/No	Species	HUCR	SESP	PICA	TECA	TEIV	POLO	EUCA	GMAR	DERE	MAIN	TEMA	CAEQ	TOTAL
1.	*Corvus albus*	0	28	0	0	8	0	701	45	1	0	0	69	852
2.	*Lanius collaris*	0	0	0	0	0	0	0	0	37	0	3	0	40
3.	*Necrosyrtes monachus*	0	0	0	0	76	0	0	0	0	0	0	0	76
4.	*Passer griseus*	0	0	22	0	14	0	0	0	1	0	9	26	72
5.	*Ploceus cucullatus*	0	0	0	3091	0	0	0	0	0	1119	0	0	4210
6.	*Ploceus lateolus*	0	0	19	0	0	0	0	0	0	0	0	0	19
7.	*Streptopelia capicola*	0	5	0	0	0	0	0	0	0	0	0	1	6
8.	*Vidua interjecta*	0	0	0	0	0	0	0	0	0	0	0	2	2
	TOTAL	0	33	41	3091	98	0	701	45	39	1119	12	98	5277

HUCR = *Hura crepitans*; SESP = *Senna sp.*; PICA = *Pinus caribaea*; TECA = *Terminalia catappa*; TEIV = *Terminalia ivorensis*; POLO = *Polyalthia longifolia*; EUCA = *Eucalyptus camaldulensis*; GMAR = *Gmelina arborea*; DERE = *Delonix regia*; MAIN = *Mangifera indica*; TEMA = *Terminalia mantaly*; CAEQ = *Casuarina equisetifolia.*
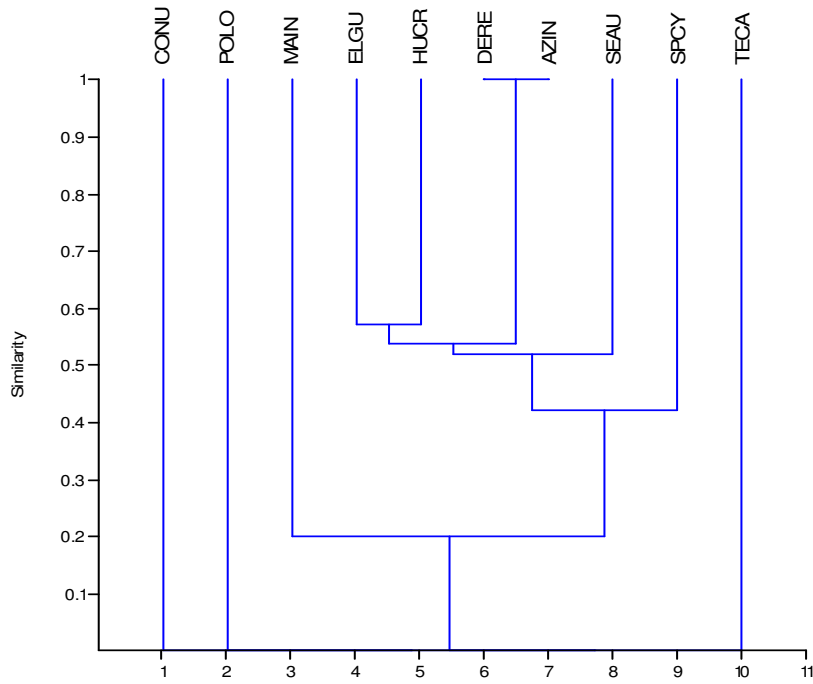
Figure 4 Cluster dendogram classification of tree species in Abuja Campus based on the bird species sighted on them
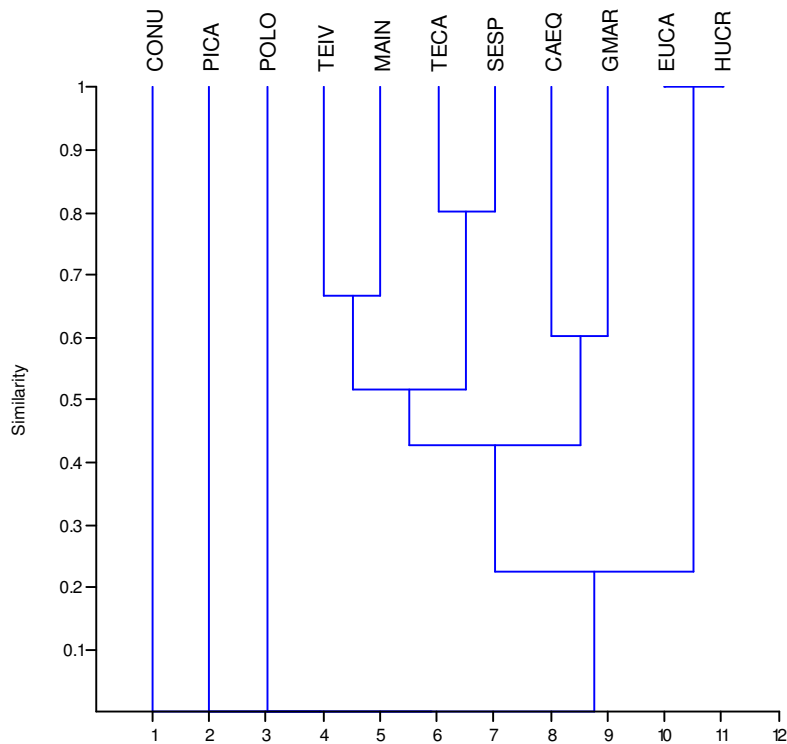

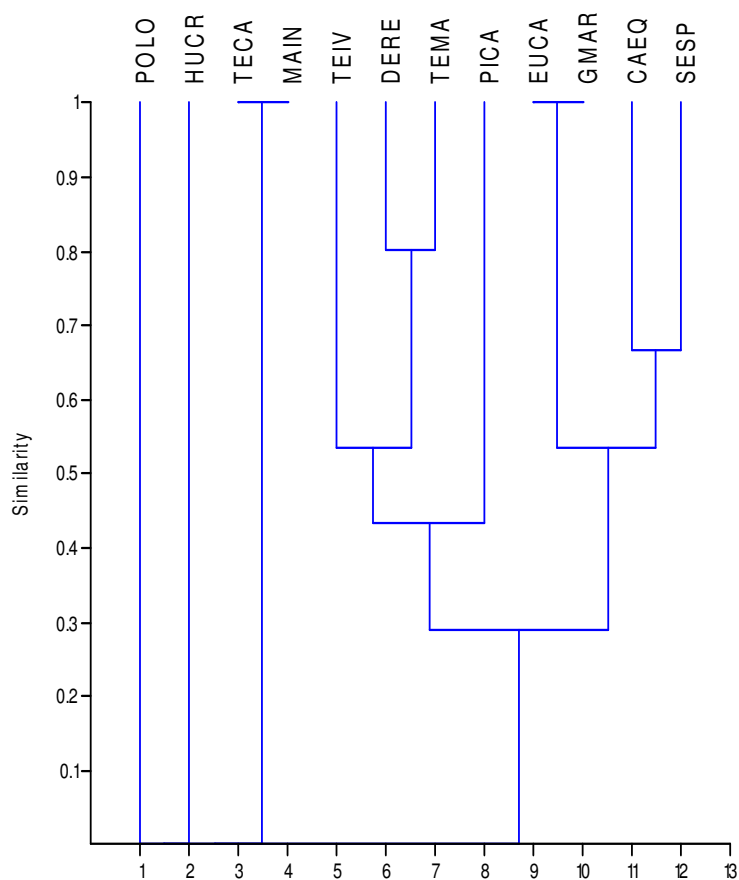Figure 5 Cluster dendogram classification of tree species in Delta Campus based on the bird species sighted on them

Figure 6 Cluster dendogram classification of tree species in Choba Campus based on the bird species sighted on them

Discussion

Abuja campus had the highest number of trees compared to the Delta campus and Choba campus. Abuja campus is larger in terms of landmass and more spacious. Abuja campus was also planned to have more permanent structures such as churches, mosque and staff quarters than both Delta and Choba campuses. It was therefore designed to have more avenue trees. The number of trees in Delta campus is more than that of Choba campus, and this can be ascribed to the fact that the Vice Chancellor's lodge and the staff club (a place for relaxation) are located in Delta campus. It also used to harbour the administrative headquarters of the University. It was perceived that the high caliber of staff that would occupy such administrative offices in Delta campus would appreciate the value of urban forestry. This agrees with Aju and Popoola (2011) that

trees in residential areas and gardens enhance self-esteem.

Choba campus, despite its relatively lesser landmass and noisy nature recorded the highest number of birds because of its closeness to the residential areas of Choba community. Most birds migrating from Ozuoba and nearby areas have no closer open space with trees to nest and feed apart from Choba campus. This differs with the situation in Abuja and Delta campuses that are closer to rural areas, where there are several tree species for flying birds to perch on, and rest. Similar abundant species of birds have been observed on many tall tree species (especially *Terminalia* species) in Isaac Boro Park, an open space in Port Harcourt, Rivers State. Tall tree species especially *Terminalia* species serve as nesting places for birds particularly vultures and kites.

Although, Abuja campus had the highest tree population, bird species diversity was highest in Choba campus. Bird species diversity in the campuses seems to have been influenced more by tree species richness than tree density. Higher tree species richness in Choba campus would have enhanced variability of habitats and food sources to encourage bird species diversity than in Abuja campus where 53% of the total tree population belongs to only one tree species – *Azadirachta indica*. One possible explanation for a positive relationship between food plant and animal species richness is that a greater number of plant species could potentially provide more niches for the coexistence of animal species -'niche assembly hypothesis' (Hutchinson, 1959). However, the lowest bird species diversity in Delta campus is attributable to the very high dominance of *Ploceus cucullatus* which accounted for over 97% of the total bird population in the campus. High dominance of a particular species relative to others impacts negatively on the diversity of biotic communities.

Similarity in bird species composition did not follow the same pattern with similarity in tree species composition between campuses. Similarity in tree species was highest between Choba campus and Delta campus while similarity in bird species was highest between Delta campus and Abuja campus. Choba campus and Delta campus were established before the Abuja campus, and the more recent nature of the latter may have informed some appreciable level of change in the choice of tree species planted in it. This probably explains why the similarity in tree species between Abuja campus and either Choba campus or Delta campus was below 50%. However, the highest similarity in bird species composition between Abuja campus and Delta campus is quite understandable because of the proximity of the two campuses to each other and the natural environment, than Choba campus which is now completely in an urban setting and separated from the other two campuses by the popular East-West road. Generally, similarity in bird species between the campuses was higher than tree species similarity. Higher similarity in bird species can be attributed to the mobile and migratory nature of birds as opposed to the immobile and static nature of trees. Ihuma *et al.* (2011) have also reported higher similarity in frugivorous species than tree species in fragmented habitats of a Nigerian montane forest ecosystem.

Elaeis guineensis, Delonix regia, Senna augustifolia, and *Azadirachta indica* had the highest number of bird species (i.e. bird species richness) in Abuja campus, while *Casuarina equisetifolia* had the highest bird species richness in both Choba campus and Delta campus.

Ploceus cucullatus (Village weavers) were the only bird species sighted on *Mangifera indica* in Abuja campus. With a total number of 3,447 of *Ploceus cucullatus* sighted in Abuja campus, approximately 92% of them were sighted on *Mangifera indica*. The few times Village weavers were sighted on *Elaeis guineensis*, were when they were either feeding on insects or collecting foliage from it to build their nests on *Mangifera indica*.

In Choba campus, about 82% of *Corvus albus* sighted was on *Eucalyptus camaldulensis*, but not a single bird of the species *Corvus albus*, was sighted on the *Eucalyptus camaldulensis* in Delta campus. This also agrees partly with Holmes and Robinson (1981) and Holmes and Schultz (1988).

Hooded vultures (*Necrosyrtes monachus*) were sighted only in Choba campus on *Terminalia ivorensis*. Although this tree species is also common in Delta campus, none of the species (Hooded vultures) was sighted on them in Delta campus. This cannot be unconnected with the fact that most of the *Terminalia ivorensis* in Choba campus are tall (Over 10 meters) and their branching form makes them choice sites for nesting carnivorous birds. Most carnivorous birds nest in branches of tall trees where their eggs will be safe. The branching form of *Terminalia* species provides good anchorage for the large nest of carnivorous birds. Using these trees as nesting sites, they forage within their home range and carry the preys they caught to the tall trees where they relax and feed on them undisturbed.

Consequently, the variations in bird's affinity to different tree species could be attributed to the interaction between foraging style and foliage structure as well as the

abundance of preferred prey. This agrees with the findings of Holmes and Robinson (1981) and Holmes and Schultz (1988).

Conclusion

Four tree species - *Hura crepitans, Terminalia catappa, Mangifera indica* and *Polyalthia longifolia,* were found to be common to the three campuses. Two tree species - *Cocos nucifera,* and *Polyalthia longifolia* , had no record of bird association during the research period. Further research would help ascertain the reasons for this.

Five bird species - *Passer griseus, Ploceus cucullatus, Lanius collaris, Streptopelia capicola* and *Corvus albus,* were common to the three campuses. However, *Ploceus cucullatus* was the most abundant bird species in the three campuses.

The study showed that bird species diversity was generally low in the three campuses though, higher in Choba campus than the other two campuses.

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