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Avian Diversity and Feeding Guilds within Lekki Conservation Centre, Lagos State, Nigeria

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Abstract: ***The diversity and the feeding guilds of birds in Lekki Conservation Centre was carried out over a period of six months (May-October) with a view to providing information on the complexity of ecosystem structure and updated information on each type of habitat in the Centre. The sampled area covered both the forest area and grassland region of the study site. The Line Transect method was used. A total of 89 bird species belonging to 34 families were recorded during the study covering an area of about 70 hectares. The species diversity was measured by Shannon's diversity index which was based on the number of species for Transect A, Transect B and Forest was 3.242, 3.146 and 2.704 respectively while the species evenness measured based on the number of species for Transect A, Transect B and Forest was 0.3763, 0.347 and 0.4152 respectively The result of the study concluded that birds' species in the grassland region were more diverse than the forest area while the birds' in the Forest area was evenly distributed than birds in the grassland. The avian feeding guild concluded that insectivores birds were widely distributed in the sampled area.***

Keywords: Ecosystem Structure, Feeding Guilds, Diversity, Evenness, Conservation Centre

1. Introduction

Habitat suitability promote the population of wildlife while loss of habitat threatens wildlife population which can eventually lead to their extinction. Deforestation causes changes in avian feeding guilds because of alterations in the structure of the food web Harris and Pimm (2004). Birds are some of the most prominent species of the Earth's biodiversity and being sensitive to environmental changes they act as key indicators for assessing the status of ecosystem health (Taper *et al*., 1995; Olechnowski 2009). They are also tolerant of habitat change, and show a wide range of feeding guilds Johns (1991). The study of avian feeding guilds is important for understanding the complexity of ecosystem structure and for providing updated information on each type of habitat in the ecosystem Azman *et al*., 2011. From definition, it is a group of species that have similar feeding or foraging habits Hutto (1985).

In Lagos, the human demands for food, raw materials and residential areas have produced a great loss of natural vegetation. Assessing the bird diversity of a habitat over time and space is one of the key issues for avian community ecologists. Richness, abundance and community composition are often used by ecologists to understand the diversity of species in their natural occurrence Magurran (2004). Quite a number of researchers documented the response that avian diversity shows to different vegetation composition structure MacArthur and MacArthur (1961), and have also demonstrated that avian diversity increases with an enhanced level of vegetation Wiens (1969).

This study aims to investigate the avian diversity and their feeding guilds in Lekki Conservation Centre, (LCC).

2. Materials and Method

Study Area

The study was carried out in the Lekki Conservation Centre, Lekki, which lies on Latitude 6°26'30.0"N and Longitude 3°32'08.0"E. According to Köppen-Geiger climate classification, Lagos state has a tropical climate with summers much rainier than the winters. The average temperature is 27.0 °C. The average annual rainfall is 1693 mm and least amount of rainfall occurs in December with an average of 21 mm BBC (2011). The sampled area covered both forest area and grassland region. The forest area had a mangrove terrain, swamp and secondary re-growth while the grassland is dominated majorly with grasses, sparse distribution of trees and shrubs. The animals commonly found in the region include cane rats (grass cutters) wild rabbits, duikers, wild dogs, monkeys, birds and snakes.

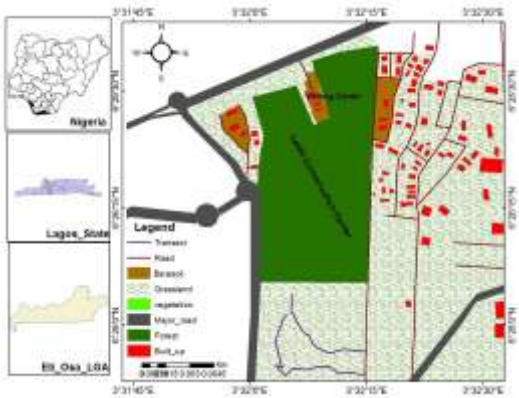

Figure 1: Map of Lekki Conservation Centre

Bird Survey

A preliminary survey was done by walking in a straight line as possible through the study area Walsh and White (1999) with an experienced wild life officer as a guide. The bird population was recorded using the Line transect method. Two transect lines (Transect A and Transect B) were established along the grassland region of the sampled area which were 420 m and 620 m respectively while the 2 km trail broad walk and the 400 m long canopy walk way was used to sample the forest area. Along the transect lines, point was marked at every 20m apart which made transect A to have 21 points and transect B to have 31 points. Transect were walked as quietly as possible between the hours of (06:50-10:30) am and (03:50-6:00) pm when birds were

notably most active and therefore easier to detect Butyls and Mwangi (1994) which also helped to avoid sighting birds directly against the sun which might introduce bias in terms of correct identification. Birds was observed by the use of binoculars (Panorama: 10 x 50mm), picture of birds was captured by the use of Canon 30 D (18-200mm)

During the transect walk, the observer recorded data on the sightings of bird species, number of individuals sighted and perpendicular distance from the line at which the species was sighted. Only those observations lying within 50m of either side of the transect line were recorded. Observed species were identified and recorded on data sheet prepared for the purpose. Photographs of the birds was taken and identified to species level with standard identification keys prepared by Borrow and Demey (2004) and Serle and Morel (1977). The experience of conservation experts was also used in the identification of some birds. Each species was assigned to a feeding guild according to Wells (1999, 2007).

Palaeonotological Statistical software (PAST) and Microsoft Excel was used to analyze the diversity and evenness of birds in the sampled area.

3. Results

During the course of observation seventeen (17) orders, thirty-four (34) families, eighty-nine (89) species of birds were observed and recorded at the study area.

Table 1: The List of Birds Identified in the Sampled Area

S/N	*Order*	*Family*	*Common Name*	*Species*
1	Accipitriformes	Accipitridae	Black-shouldered Kite,	*Elanus caeruleus*
2	Accipitriformes	Accipitridae	Black Kite,	*Milvus migrans*
3	Accipitriformes	Accipitridae	Red Kite	*Milvus milvus*
4	Accipitriformes	Accipitridae	Palm-nut Vulture	*Gypohierax anglolensis*
5	Accipitriformes	Accipitridae	African Harrier Hawk	*Polyboroides typus*
6	Accipitriformes	Accipitridae(Pandionidae)	Osprey	*Pandion haliaetus*
7	Apodiformes	Apodidae	African Palm Swift	*Cypsiurus parvus*
8	Apodiformes	Apodidae	Mottled Spinetail	*Telacanthura ussheri*
9	Bucerotiformes	Bucerotidae	African Pied Hornbill,	*Tockus fasciatus*
10	Bucerotiformes	Bucerotidae	Piping Hornbill,	*Bycanistes fistulator*
11	Bucerotiformes	Bucerotidae	White-crested Hornbill	*Tropicranus albocristatus*
12	Caprimulgiformes	Caprimulgidae	Long-tailed Night Jar,	*Caprimulgus climacurus*
13	Charadriiformes	Charadriidae.	Spur-winged Lapwing	*Vanellus spinosus*
14	Charadriiformes	Jacanidae	African Jacana	*Actophilornis africanus*
15	Charadriiformes	Motacillidae	Plain-backed Pipit,	*Anthus leucophrys*
16	Ciconiiformes	Ardeidae	White-faced Whistling-duck	*Dendrocygna viduata*
17	Ciconiiformes	Ardeidae	Green-backed heron	*Butorides striata*
18	Ciconiiformes	Ardeidae	Squacco Heron (Juvenile),	*Ardeola ralloides*
19	Ciconiiformes	Ardeidae	Cattle Egret,	*Bubulcus ibis*
20	Ciconiiformes	Ardeidae	Great Egret	*Ardea alba*
21	Ciconiiformes	Ardeidae	Black-crowned Night Heron	*Nycticorax nycticorax*
22	Columbiformes	Columbidae	Laughing Dove,	*Streptopelia senegalensis*
23	Columbiformes	Columbidae	Red-Eyed Dove,	*Streptopelia semitorquata*
24	Columbiformes	Columbidae	Blue-spotted Wood Dove,	*Turtur afer*
25	Columbiformes	Columbidae	Tamborine Dove,	*Turtur tympanistria*
26	Coraciiformes	Alcedinidae	Blue-breasted Kingfisher,	*Halcyon malimbica*
27	Coraciiformes	Alcedinidae	Grey-headed Kingfisher	*Halcyon leucocephala*
28	Coraciiformes	Alcedinidae	Pied Kingfisher,	*Ceryle rudis*
29	Coraciiformes	Alcedinidae	Shining-blue Kingfisher	*Alcedo quadribrachys*
30	Coraciiformes	Coraciidae	Broad-billed Roller	*Eurystomus glaucurus*
31	Coraciiformes	Meropidae	White-throated Bee-eater,	*Merops albicollis*
32	Coraciiformes	Meropidae	Little Bee-eater,	*Merops pusillus*
33	Cuculiformes	Cuculidae	Senegal Coucal	*Centropus senegalensis*
34	Cuculiformes	Cuculidae	Yellow bill	*Ceuthmochares aereus*
35	Falconiformes	Falconidae	Common Kestrel,	*Falco tinnunculus*
36	Falconiformes	Falconidae	Grey kestrel	*Falco ardosiaceus*
37	Gruiformes	Rallidae	White-spotted Flufftail	*Sarothrura pulchra*
38	Musophagiformes	Musophagidae	Yellow-billed Turaco,	*Tauraco macrorhynchus*
39	Musophagiformes	Musophagidae	Western Grey Plantain-eater	*Crinifer piscator*
40	Passeriformes	Alaudidae	Flappet Lark,	*Mirafra rufocinnamomea*
41	Passeriformes	Cisticolidae	Grey backed Camaroptera	*Camoroptera brachyura*
42	Passeriformes	Cisticolidae	Zitting Cisticola	*Cisticola juncidis*
43	Passeriformes	Cisticolidae	Winding Cisticola	*Cisticola galactotes*
44	Passeriformes	Corvidae	Pied Crow,	*Corvus albus*
45	Passeriformes	Estrildidae	Bronze Mannikin,	*Spermestes cucullata*
46	Passeriformes	Estrildidae	Black-and-white Mannikin	*Spermestes bicolor*
47	Passeriformes	Estrildidae	Bar-breasted Firefinch	*Lagonosticta rufopicta*
48	Passeriformes	Estrildidae	Grey-Headed(-Crowned) Negrofinch	*Nigrita canicapillus*

49	Passeriformes	Estrildidae	Chestnut-breasted negrofinch,	*Nigrita bicolor*
50	Passeriformes	Estrildidae	Orange-cheeked Waxbill	*Estrilda melpoda*
51	Passeriformes	Hirundinidae	Barn Swallow	*Hirundo rustica*
52	Passeriformes	Hirundinidae	Ethiopian Swallow	*Hirundo aethiopica*
53	Passeriformes	Motacillidae	Yellow Wagtail	*Motacilla aguimp*
54	Passeriformes	Muscicapidae	Spotted Flycatcher	*Muscicapa striata*
55	Passeriformes	Nectariniidae	Variable Sunbird,	*Cinnyris minullus*
56	Passeriformes	Nectariniidae	Green-headed Sunbird	*Cyanomitra verticalis*
57	Passeriformes	Nectariniidae	Carmelite Sunbird	*Chalcomitra fuliginosa*
58	Passeriformes	Nectariniidae	Copper Sunbird	*Cinnyris cupreus*
59	Passeriformes	Nectariniidae	Splendid Sunbird	*Cinnyris coccinigastrus*
60	Passeriformes	Nectariniidae	Collared Sunbird,	*Hedydipna collaris*
61	Passeriformes	Nectariniidae	Olive-bellied Sunbird	*Cinnyris chloropyguis*
62	Passeriformes	Nectariniidae	Olive Sunbird,	*Cyanomitra olivaceus*
63	Passeriformes	Nectariniidae	Reichenbach's Sunbird,	*Anabathims reichenbachii*
64	Passeriformes	Nectariniidae	Buff-throated sunbird,	*Chalcomitra adelberti*
65	Passeriformes	Passeridae	Northern grey-headed Sparrow,	*Passer griseus*
66	Passeriformes	Ploceidae	Vieillot's Black Weaver,	*Ploceus nigerrimus*
67	Passeriformes	Ploceidae	Orange Weaver,	*Ploceus aurantius*
68	Passeriformes	Ploceidae	Black-necked Weaver,	*Ploceus nigricollis*
69	Passeriformes	Ploceidae	Red-vented Malimbe	*Malimbus scutatus*
70	Passeriformes	Ploceidae	Village Weaver	*Ploceus cucullatus*
71	Passeriformes	Pycnonotidae	Common Bulbul,	*Pycnontus barbatus*
72	Passeriformes	Pycnonotidae	Swamp Palm bulbul,	*Thescelocichla leucopleura*
73	Passeriformes	Pycnonotidae	Little Greenbul	*Andropadus virens*
74	Passeriformes	Pycnonotidae	Simple Leaflove	*Chlorocichla simplex*
75	Passeriformes	Sturnidae	Splendid Glossy Starling,	*Lamprotornis splendidus*
76	Passeriformes	Sylviidae	Willow Warbler	
77	Passeriformes	Sylviidae	Garden Warbler	*Sylvia borin*
78	Passeriformes	Sylviidae	Green Hylia	*Hylia prasina*
79	Passeriformes	Turdidae	African Thrush,	*Turdus pelios*
80	Passeriformes	Viduidae	Pin-tailed Whyday,	*Vidua macroura*
81	Passeriformes	Viduidae	Pale-winged Indigobird,	*Vidua wilsoni*
82	Passeriformes	Zosteropidae	Yellow White-eye,	*Zosterops senegalensis*
83	Pelecaniformes	Phalacrocoracidae	Long-tailed Comorant	*Phalacrocorax africanus*
84	Piciformes	Capitonitidae	Double-toothed Barbet,	*Lybius bidentatus*
85	Piciformes	Capitonitidae	Yellow-throated Tinkerbird,	*Pogoniulus subsulphureus*
86	Piciformes	Capitonitidae	Yellow-rumped Tinkerbird,	*Pogoniulus bilineatus*
87	Piciformes	Capitonitidae	Speckled Tinkerbird	*Pogoniulus scolopaceus*
88	Psittaciformes	Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*
89	Strigiformes	Tytonidae	Barn Owl	*Tyto alba*

Table 2: The Total Number of Birds Based on the Number of Species in Reference to Shannon and evenness of Distribution

0	A	B	FOREST
Taxa_S	68	67	36
Individuals	3877	3322	463
Shannon_H	3.242	3.146	2.704
Evenness_e^H/S	0.3763	0.347	0.4152

As shown in Table 2, Location A had higher value of evenness with 0.3763 compared to that of location B with 0.347 which implied that bird species in this location were more evenly distributed than birds in the location B. In addition, Shannon index in location A was found to be 3.242 which was higher than location B with Shannon index of 3.146. This showed that Location A was more diverse in species than location B while Thirty-Six (36) species of birds were identified from the forest section which were more evenly distributed than the other locations but the birds were less diverse with Shannon index of 2.704.

Table 2.1: The Total Number of Birds Based on the Number of Families in Reference to Shannon, Eveness and Menhinick.

0	A	B	FOREST
Taxa_S	29	30	19
Individuals	3877	3322	463
Shannon_H	2.496	2.54	2.237
Evenness_e^H/S	0.4184	0.4226	0.4931

As shown in Table 2.1, Twenty-Nine (29) families of birds were sampled along transect A, thirty (30) families of birds were sampled along transect B and Nineteen (19) families of birds were sampled in the forest area. Although forest had the lowest number of families, it had the highest value of evenness with 0.4931 compared to Transects A and B. Locations A and B had Shannon index of 2.496 and 2.54 which showed them to be more diverse.

Table 3: Vegetation Composition Identified during the Sampled Period

Plant Species	Transect A	Transect B	Forest
Anacardium occidentale	+	+	-
Chrysobalnus icaco	+	+	-
Elaesis guineensis	+	+	+
Khaya invorensis	+	_	-
Napolonia vogeli	+	+	-
Nauclea latifolia	+	+	-
Parkia bicolor	+	+	-
Spondias mobin	+	+	-
Syzygium owariense	+	+	-
Tetracera alnifolia	+	+	-
Vitex doniana	+	+	-
Pterocarpus santolinoides	-	-	+
Raphia hookeri,	-	-	+
Triplisium madagascriensis	-	-	+
Ficus platyphylla	-	-	+
Alstonia boonei	-	-	+
Andropogon gayanus	+	+	-
Anadelphia afzeliana.	+	+	-

+means Present; - means Absents.

Table 3 shows some of the major vegetation's that dominated the sampled area. *Elaesis guineensis*, was found in the three habitat while major grasses in the grassland region were *Andropogon gayanus* and *Anadelphia afzeliana*.

Table 4: Feeding Guilds of Birds according to their Families

Families	Feeding Guilds	Transect A	Transect B	Forest
Accipitridae	Carnivores	+	+	+
Alaudidae	Insectivore+Seed Eater	+	+	-
Alcedinidae	Insectivore and Frugivores	+	+	+
Apodidae	Insectivores	+	+	+
Ardeidae	Carnivores+Insectivores	+	+	+
Bucerotidae	Ominivores	+	+	+
Capitonitidae	Insectivores and Fruigivores	+	+	+
Caprimulgidae	Insectivores	-	+	-
Cisticolidae	Insectivores	-	+	+
Charadriidae.	Insectivores	+	+	-
Columbidae	Frugivores+Seed-eater	+	+	+
Coraciidae	Insectivores	+	-	-
Corvidae	Insectivores and Fruigivores	+	+	+
Cuculidae	Insectivores and Fruigivores	+	+	-
Estrildidae	Grainvores and Seed eater	+	+	-
Falconidae	Scavengers	+	+	+
Hirundinidae	Insectivores	+	+	-
Meropidae	Insectivores	+	+	+
Motacillidae	Insectivores	+	+	-
Muscicapidae	Insectivores	-	-	+
Musophagidae	Frugivores	+	+	+
Nectariniidae	Insectivores and Nectivores	+	+	+
Passeridae	Insectivore+Seed eater	+	+	-
Phalacro coracidae	Carnivores	+	+	-
Ploceidae	Insectivores + Seed-eater	+	+	+
Psittacidae	Frugivores+seed-eater	+	-	-
Pycnonotidae	Frugivores and ominivores	+	+	+
Rallidae	Frugivores	-	-	+
Sturnidae	Ominivores	+	+	+
Sylviidae	Insectivores	+	+	+
Turdidae	Ominivores	+	+	-
Tytonidae	Carnivores	-	+	-
Viduidae	Insectivores and Fruigivores	+	+	-
Zosteropidae	Insectivores and Nectivores	+	+	-

+ means Present; '- means Absent.

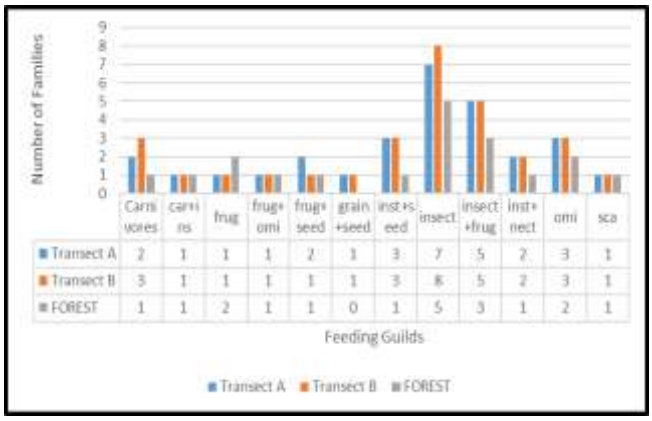

Figure 2: The Feeding Guild of the Bird Species Sighted at the Study Area

Twelve (12) types of feeding guild were identified in the sampled area among all the thirty-four (34) families that were represented in the sampled area. Carnivores, Carnivores+Insectivores, Frugivores, Frugivores+ Ominivores, Frugivores+ Seed-eaters, Granivores + Seed-eaters Insectivores + Seed-eaters, Insectivores, Insectivores+ Frugivores, Insectivores+Nectivores, Ominivores and Scavengers.

Figure 2 shows that Transect B had the highest number of insectivorous birds followed by Transect A. Forest region had the least number of birds. The Scanvengers, Carnivores+Insectivores had one family of birds in the three habitat.

4. Discussion

The present study produced a reliable estimate of birds through direct observations on line transects that were repeatedly walked for over a considerable period of time Kumara (2012). The Centre had a rich variety of strata and guilds owing to its topography and different habitats like the grassland area, swamp forest, presence of ponds which enhanced the diversity of birds.

Vegetation Complexity is clearly associated with the structure of the avian community Wilson (1974). Sixty-Eight (68) bird species recorded in the grassland region along Transect A in the study area during the period of study was found to be higher in evenness, more diverse and richer than Transect B in the same region. This could be due to the positive influence of the vegetation physiogonomy. Although, higher number of bird species was recorded along Transect A over other sampling points in the study area (i.e. Transect B and forest area region), however, Evenness index showed that birds were more evenly distributed in forest area but were less diverse. This could be due to less disturbance of their habitat which was also in agreement with the findings of Germaine *et al.,* (1998) and Sekercigoulu and Sodhi (2007), Wu *et al.,* (2009) and Mengesha *et al.,* (2011) stated that bird species in grassland were more diverse than birds in forest area while the birds in forest area were evenly distributed.

Food availability and habitat suitability had been reported to have influence on the bird species relative abundance and distributions Mengesha and Bekele (2008). The abundance of bird's species recorded in grassland over forest reserve area in the study area was observed to be influenced by the presence of diverse vegetation structures such as *Chrysobalnus icaco* tree which attracted a lot of birds due to the presence of fruits and insects that the bird species fed on. Likewise, where *Syzygium owariense* was located in the grassland region attracted a lot of weaver birds to the flowering bud of the tree while the presence of *Raphia sp.* might have led to the presence of Palm-nut Vulture in the region. Although a negligible difference was observed between the number of families recorded in transect A and Transect B during the period of study, however, the tendency for Transect B to be more diverse based on the distribution of families might be due to habitat suitability for the Barn Owl that used the gazebos along the transect B as their shelter.

The inter-relationship among various species of birds in an environment could either be symbiotic, mutualistic or parasitic while several other birds observed interacts in the course of food According to FONA (2014) the Black Kite is a bird of prey and more so a scavenger although sometimes it hunts and captures live rodents and reptiles while the Pied Crow are more of a scavenger which are mostly seen on the ground and sometimes hovering in the sky. This might have led to their roosting together in search of food as observed in the grassland section of the Lekki Conservation Centre. The study of the avian feeding guilds was important for understanding the complexity of ecosystem structure and for providing updated information on each type of habitat in the ecosystem as reported by Azman *et al.*, (2011). From definition, it is a group of species that have similar feeding or foraging habits Hutto (1985). The insectivorous birds tend to have highest population in relation to the families of bird represented in the study area for the three locations (Transect A with 7 families; Transect B with 8 families while Forest has 5 families). In line with this, Abrams and Griffiths (1981) suggested that the distribution of bird species was determined ultimately by prey type and availability, and movements associated with breeding regimes. Availability of insects in the sampled area might have led to the abundance of the birds that fed on them. It was also noticed that some of the birds that feed on insects tended to move out in a very high numbers immediately after rain or when it rained early in the morning before the sampling period especially White-throated Bee-eater.

Conclusively, the avaliabilty of food, reduction in predation risk and vegetation structure played major influence on the occurrence and distribution of birds in Lekki Conservation Centre where they were subjected to fewer disturbances.

5. Recommendations

An increase in human settlements will impact negatively on avian species. A more eco-friendly urbanization is essential to curb more negative human interferences in any areas. Further research on appropriate conservation mechanisms and management techniques with ultimate conservation goal of changing urban enviromnet into species rich ecosystem are required.

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