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Habitat Structure of Bird Communities in Forests of the Wetlands in Ekiti State, Nigeria

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Abstract

The potential of wetland habitats to the management of birds is grossly unknown in many areas across Nigeria. Many wetland forest communities support valuable pools of biodiversity and genetic resources thereby making them important sites for conservation and scientific interest. This study, assessed the habitat structure of bird communities in the forests of three wetlands namely, Egbe, Ero, and Ogbese in Ekiti State, Southwest Nigeria using standard methods. Diversity indices between the wetland forest vegetation types were assessed. The result shows that 87 species of plants in 28 families were found in the three wetland forests. 83 species in 27 families at Egbe, 85 species in 28 families at Ero and 74 species in 27 families at Ogbese. The plant families with the largest number of species were Euphorbiaceae (20), Annonaceae (12), Caesalphiniodeae (8) and 72 species (82.75%) common to the wetland forests. The highest floristic similarity index was found between Egbe and Ogbese wetland vegetations but the diversity of plants differed significantly among the wetland forest vegetations. Egbe and Ero wetland forests showed higher species richness (47, 42) and diversity indices (3.18, 3.16) respectively. The occurrence of fair flora species richness and diversity indicates that the wetland vegetations are still within tolerable ecological level such that an effective management scheme to maintain the ecological qualities is developed in order to conserve the wetlands and its forest types from further degradation and engender flora regeneration.

Keywords: Diversity, floristic, wetland, habitat.

Introduction

The potential of wetland habitats to the management of birds is grossly unexplored in many areas across Nigeria. Many wetland forest communities support highly valuable pools of biodiversity and genetic resources, thereby making them important sites in terms of conservation and scientific interest. However, a major problem confronting bird species conservation is the increasing rate of unsustainable development that has become a threat to the bio-wealth and even causing species extinction (Khan, 2000).

In recent years, concern has increased over the continuous degradation of the world's wetland forests which are known to sustain life and perform useful functions in the maintenance of ecological balance. In Nigeria, the large-scale destruction and mismanagement of the wetland forest ecosystems have taken place. Human activities have caused shifts in wetland- dependent bird populations since the beginning of the 20th century. It is apparent that there have been many changes in the distribution and diversity of wetland forest birds because as the natural wetland forest habitats are altered, their ability to sustain bird populations' decreases more so since each species of wetland-dependent bird has a unique and complex set of needs which the wetland forest habitats provide.

However, as the numbers and areas of wetlands forest decline, so will the number of wetland forest-dependent birds. In Nigeria, extensive wetland forest losses have displaced birds from large areas and continued wetland forest losses probably will cause continued losses of wetland forest birds (Ogunyemi, 2012). The recent recognition of the values of wetland forests and the effects of their losses has provided incentives to their maintenance and restoration.

The floristic composition in vegetation has been used to describe the habitat of many bird species and it is indicative of the potentials in terms of site selection for conservation purposes. The structure of vegetation has been described as a function of three components: vertical stratification, the spatial distribution of the individual plants and the abundance of each species (Kersaw, 1973). These factors strongly influence the associated community of fauna, especially arboreal animals (Bright and Morris, 1990). Most studies on vegetation are centered on pristine habitats that have not experienced disturbance over a long period and give the pictures of natural systems and serve as basis for detecting changes that help in conservation programs. The effective management of bird species requires the understanding of the functioning of natural vegetation systems which provide detailed qualitative base-line data needed for monitoring the changes and which will lead to efficient and effective management of the bird resources. One aspect of relevance to the understanding of the functioning of natural vegetation systems is the knowledge of species composition, distribution, diversity and evenness. Thus an understanding of the habitat requirements, distribution of natural environment and abundance are critical to birds' management.

Every management programme or management oriented study would profit from a detailed study of the habitat requirements. The foregoing on the importance of vegetation to birds and those habitat parameters provide the basis for rating the relative abilities of the habitat to support birds' population, necessitated studies on the habitats of bird communities in the wetland forests of Ekiti State, Nigeria. The study involved an assessment of the flora composition, diversity and abundance in the selected wetland forests and the knowledge of the floristic conditions of the forests would be is useful in the management of the birds' habitats.

Materials and Methods

Study sites

The study was carried out in three selected wetlands of Ekiti State, Nigeria. The state lies within the tropics and located between $4^{0}45^{1}$ to $5^{0}45^{1}$ E and Latitude $7^{0}15^{1}$ to 8^{0} 15^{1} N. The climate is tropical with average temperature of 25^{0}C all year round and high relative humidity. The state is characterized by high rainfall and there are two distinct seasons: the wet season (March– mid November) with a break in August and the dry season (mid-November to the end of March).The rainfall in the wetland forests in generally above 1,200 mm annually.

The three (3) study sites were selected from the five (5) prominent wetland forests in Ekiti State. Site A, Egbe wetland forest region (Site A) has from 86.3 km (length) to 55.8 km (width) and is characterized by shrubs, fall trees (30-40 m) with a dense canopy. The wetland forest exhibits a marked seasonality: heavy rains alternating with dry months. Site B, Ero wetland forest (Site B) ranges from 110.6 km (Length) to 59.1 km (width) and is characterized by high frequency of fairly tall trees (20-30 m) with a moderately dense canopy.

Site C is the Ogbese wetland forest (Site C) ranges from 73.6 km (length) to 54.2 km (width) has fewer tall trees (25-35m) with a dense canopy.

Data Collection

In each wetland forest, five sample plots 20 m^2 spaced 200 m apart were measured and randomly laid as described by Ogunjemite *et al.,* (2005) .The vegetation surroundings were examined for the number of individual tree species present greater than 30cm girth at breast height, and the number of shrub and climber species. The identification of tree, shrub and climber species was obtained through the knowledge of local botanists (using vernacular species names and features such as colour of the tree bark and leaves). For plant species that were difficult to identify in the field, taxa were coded according to the respective wetland forests, pressed and brought to the Plant Taxonomist at the Herbarium of Ekiti State University for identification to the species level following the comparison method with herbarium specimens and using the published volumes of the flora of West Africa. (Hutchinson and Dalziel 1954-1972).

Vegetation Analysis

At each plot, the species and individuals (abundance) were counted. The abundance of plant species was determined as the number of plant species per wetland forest area. Floristic composition, diversity and distribution of the plant species were determined using the following: species richness, diversity indices, Shannon-Wiener index, Sorenson's index and species evenness (E), Shannon-Wiener diversity index (H) was used to compare the diversity in species composition of the three wetland forest vegetation types. The floristic or similarity between the three wetland forest vegetation types was calculated using Sorenson index which compares the species composition. Species evenness was calculated using Shannon's equitability.

The relative abundance of plant species within each wetland forest types (equitability or evenness) was calculated as $E=H^1/LnS$ (Magurran, 1988), where S is the number of plant species and H^1 the Shannon-Wiener index of diversity.

Statistical Analysis

Statistical significance of diversity indices between the wetland forest vegetation types was assessed using one-way Analysis of Variance (ANOVA) procedure with LSD post hoc-tests.

Results

Tree Plant Species Composition, diversity and Floristic Similarity

The three wetland forests are permanent in nature with varying sizes and water levels at different seasons. The number of plant species recorded in the studied wetland forest was 87 (Table 1); 83 species in 27 families found in Egbe wetland forest; 85 species belonging to 28 families recorded in Ero wetland forest while Ogbese wetland forest had 74 species in twenty-seven 27 families. The highest number of species was recorded in Ero wetland in which 100% of the families featured while 86% featured in Egbe and Ogbese wetland forests. The plant families with the largest number of species composition (N) were Euphorbiaceae (N=20), Annonaceae (N=12) and Caesalphiniodeae(N=8)while Chrysobalanaceae, Sterculiaceae, Flacourtiaceae, and Combretaceae had N=7,6, and5 respectively.

Table 1: Frequency of occurrence of individual plant species in Ekiti wetland forests

S/N	Tree Species	Family	Egbe	Ero	Ogbese
1.	*Enantia Chlorentha*	Annonaceae	3	1	4
2.	*Cleistopholis patens*	Annonaceae	2	1	5
3.	*Xylopia rubescens*	Annonaceae	2	2	0
4.	*Xylopa aethiopica*	Annonaceae	3	3	1
5.	*Monodora tenuifolia*	Annonaceae	4	3	5
6.	*Raphia Lookeri*	Palmae	4	2	0
7.	*Moringa oleifera*	Moringaceae	5	6	8
8.	*Campylospermum flavum*	Ochnaceae	0	1	2
9.	*Lophira alata*	Ochnaceae	2	1	1
10.	*Terminalia superba*	Combretaceae	2	1	4
11.	*Terminalia Ivorensis*	Combretaceae	1	1	0
12.	*Anogeissus leiocarpa*	Combretaceae	42	29	17
13.	*Elaeis guinensis*	Palmae	7	4	5
14.	*Musanga cecropioides*	Moraceae	2	2	3
15.	*Garcinia kola*	Guttiferae	5	3	6
16.	*Ganunia mannii*	Guttiferae	2	2	7
17.	*Greavia mollis*	Tiliaceae	3	1	0
18.	*Glyphaea brevis*	Tiliaceae	2	3	5
19.	*Mansonia altissima*	Sterculiaceae	5	5	3
20.	*Pterygota macrocarpa*	Sterculiaceae	2	2	5
21.	*Cola millenii*	Sterculiaceae	4	2	5
22.	*Cola hispida*	Sterculiaceae	7	8	5
23.	*Cola laurifolia*	Sterculiaceae	8	14	21
24.	*Cola acuminate*	Sterculiaceae	3	3	3

25.	*Macaranga barteri*	Euphorbiaceae	0	1	0
26.	*Bridelia feruginea*	Euphorbiaceae	3	3	5
27.	*Alchornea cordifolia*	Euphorbiaceae	4	2	5
28.	*Macaranga hurifolia*	Euphorbiaceae	2	0	5
29.	*Alchornea laxiflora*	Euphorbiaceae	6	0	4
30.	*Bridelia coriacea*	Euphorbiaceae	3	1	2
31.	*Bridelia ferruginea*	Euphorbiaceae	7	8	9
32.	*Bridelia atroviridis*	Euphorbiaceae	5	8	9
33.	*Uapaca guineesis*	Euphorbiaceae	6	11	2
34.	*Uapaca togoensis*	Euphorbiaceae	5	7	6
35.	*Drypetes gilgiana*	Euphorbiaceae	3	4	0
36.	*Drypetes principum*	Euphorbiaceae	3	3	7
37.	*Drypetes gossweileri*	Euphorbiaceae	6	6	5
38.	*Sterculia rhinopetale*	Sterculiaceae	7	6	5
39.	*Alstonia congensis*	Apocynaceae	11	10	0
40.	*Alstonia boonei*	Apocynaceae	2	2	4
41.	*Gmelina arborea*	Lamiaceae	9	8	10
42.	*Afzelia Africana*	Caesalphiniodeae	10	8	14
43.	*Daniellia ogea*	Caesalphiniodeae	3	4	3
44.	*Daniellia oblonga*	Caesalphiniodeae	5	2	1
45.	*Detarium senegalense*	Caesalphiniodeae	9	10	7
46.	*Brachystegia eurycoma*	Caesalphiniodeae	3	5	2
47.	*Brachystegia nigerica*	Caesalphiniodeae	3	3	0
48.	*Afzelia bipindensis*	Caesalphiniodeae	0	1	1
49.	*Detarium macrocarpum*	Caesalphiniodeae	5	3	6
50.	*Cassia sieberiana*	Caesalphiniodeae	3	2	5
51.	*Pentaclethra macrophylla*	Mimosoideae	5	4	0
52.	*Albizia zygia*	Mimosoideae	1	2	2
53.	*Tetrapleura tetraptera*	Mimosoideae	1	1	2
54.	*Parkia biglobosa*	Mimosoideae	7	3	5
55.	*Parkia bicolor*	Mimosoideae	3	2	4
56.	*Leucaena leucocephala*	Mimosoideae	29	18	33
57.	*Baphia nitida*	Papilionoideae	10	11	9
58.	*Treculia africana*	Moraceae	5	4	4
59.	*Pterocarpus osun*	Papilionoideae	2	4	5
60.	*Gliricidia sepium*	Papilionoideae	25	17	12
61.	*Millettia thonningii*	Papilionoideae	39	32	28
62.	*Ficus capensis*	Moraceae	17	12	9
63.	*Ficus goliath*	Moraceae	2	1	0
64.	*Milicia escesa*	Moraceae	5	2	2
65.	*Chrysophyllum albidum*	Sapoteaceae	22	20	7
66.	*Burkea africana*	Caesalphiniodeae	2	3	1
67.	*Cieba pentandra*	Bombaceaceae	10	19	21
68.	*Dacryoodes edulis*	Burseraceae	7	7	9
69.	*Khaya ivorensis*	Meliaceae	1	1	1
70.	*Khaya senegalensis*	Meliaceae	6	9	7
71.	*Khaya gransifoliola*	Meliaceae	1	5	8
72.	*Deinbollia maxima*	Meliaceae	12	18	11
73.	*Blighia sapida*	Sapindeceae	11	8	5
74.	*Allophyllus africanas*	Sapindaceae	1	1	0
75.	*Lecaniodiscus cupanioides*	Sapindaceae	2	2	3
76.	*Deinbollia pinnata*	Sapindaceae	16	12	14
77.	*Spondias mombin*	Anacardiaceae	4	11	9
	Climbers				
78.	*Gnetum africanam*	Gnetaceae	5	4	3
79.	*Eremospatha macrocarpa*	Arecaceae	7	5	2

80.	*Gongronema latifolium*	Apocynaceae	3	6	4
81.	*Laccosperma secundiflora*	Arecaceae	6	1	3
82.	*Momordica augustisepala*	Cucurbitaceae	0	2	0
	Shrubs				
83.	*Aframomum melegueta*	Zingiberaceae	6	5	8
84.	*Lasianthera africanum*	Stemonuraceae	5	5	2
85.	*Aframomum iranburyi*	Zingiberaceae	4	1	0
86.	*Heinsia crinata*	Rubiaceae	3	1	2
87.	*Carpolobia lutea*	Polygalaceae	5	3	6

A comparison among the wetlands showed that 27 families were common to the three wetlands forest. The lowest value of diversity was recorded in the Ogbese wetland forest which also showed the lowest values of species richness, species per area and individual per area (Table 2).

Table 2

Species richness, Shannon's diversity index, equitability, species/area ratio, abundance and individuals / area and evenness of the selected wetlands in Ekiti State.

Variables	Egbe wetland	Ero wetland	Ogbese wetland
Species richness	47	42	30
Shannon's index	3.16^{b}	3.18^{a}	2.96^{c}
Equitability	0.82	0.85	0.87
Species/area ratio	2.35	2.10	1.50
Abundance*	434	366	241
Individuals/area	21.70	18.30	12.05
Evenness	0.50	0.57	0.65

Values with the different superscripts in the same row indicate significant differences among wetland forest vegetation types. (ANOVA, $P < 0.05$).

*Number of individual per 20 m^2.

Based on the Shannon-Wiener index, the Ero wetland forest was the most diverse (3.18) which was significantly different from Egbe wetland forest (3.16) and Ogbese wetland forest (2.96).

The evenness analysis shows that flora species composition in Ogbese wetland fores wast most evenly distributed with value 0.65 followed by Ero wetland forest (0.57) while Egbe wetland forest had the least even distribution (0.50).

Life Forms

Table 3 shows that the most abundant life form in the wetland forests was woody tree species (N=74, 85.10%) followed by climber species (N=5, 5.75%) and shrubs (N=5, 5.75%). The frequency of occurrence of woody tree species was higher in Ero wetland forest and Egbe wetland forest than in Ogbese wetland forest type (Table 3).

Table 3: Number of plant species according to life form

	Egbe wetland forest vegetation	%tage	Ero wetland forest vegetation	%tage	Ogbese wetland forest vegetation	%tage
Trees	74	89.2	75	88.24	66	89.2
Shrubs	5	6.00	5	5.88	4	5.40
Climbers	4	4.80	5	5.88	4	5.40

Table 4: Floristic similarities in the studied wetland forest vegetation

	Egbe wetland forest vegetation	Ero wetland forest vegetation	Ogbese wetland forest vegetation
Egbe wetland forest vegetation	-		
Ero wetland forest vegetation	3.70	-	
Ogbese wetland forest vegetation	10.56	10.42	-

Egbe wetland forest had the highest density of trees (21.70 25m^{-2}) followed by Ero wetland forest (18.30 25m^{-2}) and Ogbese wetland (12.05 25m^{-2}). The most dominant tree species in terms of density in Egbe wetland forest vegetation was *Anogeissus leiocarpa* (1.68 25m^{-2}). *Millettia thonningii* (1.28 25m^{-2}) in Ero wetland forest vegetation and *Leucaena leucocephala* in Ogbese wetland forest. In Egbe wetland forest, *Terminalia spp.* and other six (6) species had the lowest frequency (1 stand125m^{-2}); *Enantia chlorentha* and 16 other species in Ero wetland forest (1 stand 125m^{-2}) and *Xylopia aethiopica* and four (4) other species in Ogbese wetland forest. (1 stand125m^{-2}). The similarity index revealed that the highest value of floristic similarity was found between Egbe and Ogbese wetland forests (Table 4). Also Ero and Ogbese wetland forests showed relatively high floristic similarity.

Discussion

The results of this study attest to the variation in floristic composition across the studied wetland sites. This suggests that the plant species composition and the flora diversity could be the key factors that would determine the distribution of bird species in the sites. Woody tree species constituted 88.51% of the flora composition and varied considerably between the three wetland forests at 85, 83, and 74 125m^{-2} in Ero, Egbe and Ogbese wetland forests respectively. This variation is due to differences in soil composition, anthropogenic disturbance of the forest in addition to seasonal flooding of the sites (Ogunyemi and Olujobi, 2010). Besides, other factors including interspecific interactions, habitat modification, seed bank, availability of resources, disturbance levels together with stochastic dispersal limitation have influence on the vegetation composition in forests (Conell, 1989; Dalling *et. al;* 2002). The most important plant families are Euphorbiaceae, Caesalpiniodeae, Mimosoideae, Annonaceae Sterculiaceae. The plant species within the family Euphorbiaceae (*Uapaca guineensis, Uapaca togoensis, Macaranga hurifolia, Bridelia ferruginea, Drypetes gilgiana and Alchornea laxiflora)* provide roosting, nesting and escape cover for bird species inhabiting the sites. The families Caesalpiniodeae and Mimosoideae produce seeds and attract insects which constitute reasonable proportion of the diets of nectivores, granivores and insectivorous bird species inhabiting the sites. The community structure of bird trophic guilds revealed significant mean abundance of insectivores and granivores in Egbe and Ero wetland forests (Ogunyemi, 2012).

A total of 27 families (96.43%) of plants are ubiquous to the three wetland forest vegetation types. The family distribution of flora species shows significant variations, which attested to by the frequency of occurrence of some species dominant in the habitats. The dominance of some flora species families plays vital roles to the existence of bird species at the study sites.

The results further show that the frequency of occurrence and the commonness of some flora species in birds' habitats may play a significant role in avifauna distribution in the area. Rice (1983) reported that the species composition of vegetation is important to habitat selection by birds and that frequency of occurrence of the major tree species is an important aspect of the birds' community habitat selection.

It has been asserted that information on compositional similarity between different vegetation types could be employed as basis for the formulation of management plan aimed at habitat manipulation and improvement (Ferrier, 2002; Steinitz *et al.,* 2005). The measurement of habitat parameters provides the basis for rating the relative abilities of the habitat to support birds. The result of this study is, therefore, of management importance to the population of wetland forest vegetation birds in Ekiti State.

The similarity index expresses low similarity (3.70) of flora species composition between Egbe and Ero wetland forests which is a reflection of the differences in flora species composition. However, the highest similarity index was recorded between

Egbe and Ogbese wetlands (10.56) while Ero wetland forest and Ogbese wetland forest (10.42) ranked next. These results suggest that the relief of the wetland forests, nature of soils, and level of disturbance and succession ages of forest could be considered as determinant factors modulating the floristic composition and the abundance of species in the wetlands vegetation. Chandrashekara and Ramakrishna (1993) reported that the level of disturbance and succession ages of forest have pronounced effects on flora species composition.

The Shannon-Wiener indices are close to that obtained for of the habitat of Old Oyo National Park, Nigeria (Ogunjemite *et. al;* 2013). The flora diversity of 3.18, 3.16, and 2.96 for Ero followed by Egbe and Ogbese wetland forests respectively which could be related to more of secondary regrowth compared to Ero wetland forest vegetation types. Terborgh (1973) argued that most habitat and geographic variation in plant species richness may simply be due to the relative size and extent of particular habitats and environments. A low diversity in an environment may have more to do with the biogeographic rarity of such environment resulting in low equilibrium species richness. The species evenness was highest in Ogbese (0.50) which is a clear evidence that the floristic composition i.e the flora species of the vegetation type have even frequency of occurrence in their distribution which compliment the assertion of Kent and Coker (1992) that the higher the value of evenness, the more even the species in their distribution.

Conclusion

Ekiti State wetland forests have high ornithological and overall biodiversity values and deserve conservation attention. This study provides information on the floristic composition of bird species communities in the wetland forest vegetation types in the State. The study revealed that Ero and Egbe wetland forests are more diverse in flora composition than Ogbese wetland forest but the flora species richness in the three wetland forest types indicated sparse population probably due to variation in soil composition and level of disturbance.

Floristic compositions are valuable indicators of environmental qualities. The occurrence of fair flora species richness and diversity indicate that the wetland vegetation types are still within tolerable ecological level. Therefore, it is very important to develop an effective management scheme to maintain the ecological qualities. Presently there is a high level of habitat disturbance and if a substantial part of the bird community of wetlands forest vegetation is to be preserved, efforts should be made to conserve the wetlands and its forest types from further degradation which will invariably give room for flora regeneration.

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