Original Research Article

ABUNDANCE AND DIVERSITY OF BIRDS IN THE OGBESE FOREST RESERVE, EKITI STATE, NIGERIA

Abstract

A study was carried out to evaluate the species composition and relative abundance of bird species of the natural and plantation forest of Ogbese Forest Rserve, Ekiti State .The study was conducted from April, 2010 to February, 2011 covering both wet and dry seasons. Sample sites were stratified based on the vegetation types and transect count techniques was employed for the evaluation. A total of 52 bird species consisting of 47 resident and 5 immigrant species was recorded. The species composition of birds during the wet and dry seasons was not significantly different. The natural forest vegetation had the highest species diversity and evenness. The relative abundance score of species during the Wet and dry seasons was variable in both habitats. The result of this study has shown that the natural and plantation vegetation types of Ogbese Forest Reserve, Ekiti State. The heterogeneity of flora species in the natural forest compared to the plantation forest might be responsible for the variation**.** The management of birds in the reserve should take cognizance of the vegetation types for effective conservation of bird species which are resident in the reserve.

Key words: Vegetation, Diversity, Abundance, Immigrants, Birds

Introduction

Avifauna is a general name for bird species. Birds are feathered, winged, egg–laying vertebrates. They belong to the Kingdom “Animalia,” Phylum Chordata and class Aves. They have a worldwide distribution, living in and around oceans, rivers, forest and mountains. They are the most noticeable group in the animal kingdom (Zedler, 2003). Birds are used as a

tool for environmental monitoring. Birds are good biological indicators. They are good indicators of the general state of our biodiversity (Labe et al., 2018). Without birds reducing the population of these insects, imagine the population of these insect pests that would consume our blood, destroy agricultural crops and forest trees (Lameed, 2011; Ezealor, 2001).

Ogbese Forest Reserve, Ekiti State, Nigeria is an artificial planted forest of the former Ondo State Forestry Department. The forest reserve covers a land mass of 72 km^2 consisting of 27km^2 as forest, 16 km^2 savanna, 14 km^2 fresh water swamp forest and 10 km^2 as disturbed land. The plantation site of the reserve is 5 km^2 comprising of 4 km^2 of *Tectona grandis* and 1 km^2 of *Gmelina arborea*. The forest vegetation of the reserve constitutes 37.5% of the total land mass with pre-dominant tree species: *Enantia cholarentha, Cleistophohs patens, Barteria nigritana, Cola acuminata, Parinari congesis, Milicia excelsa, lckaya senegalensis, Albizia zygia, Terminalia superba and* herbaceous species. The deciduous tree species provide the nesting sites for bird species inhabiting the area. The River Ogbese flows through the major part of the reserve and has pronounced impact on the vegetation. Annual rainfall varies from 1250 mm to 1400 mm, mean temperature varies from 21^0C to 25^0C and humidity is 75%. Anderson et al. (2006) maintained that when distinct ecosystems such as forests and wetlands are destroyed, the ecological roles of birds often disappear with them. Habitat loss, over exploitation and increased predators are the causes of decline in population. Extinction of bird species is predicted to continue in the near future, if avian extinction is left unabated.

The taxonomic studies of tree species in Ogbese Forest Reserve, Ekiti State Nigeria, has been described in few studies focusing on its diversity as well as its conservation, but relevant information is completely lacking on the avifauna diversity of this reserve. The objectives of the study were to identify the diversity of avifauna species inhabiting the varying vegetation

types in Ogbese Forest Reserve in Ekiti State might be important for awareness towards biological conservation of birds in the area.

Materials and Methods

Study Area

The study was carried out in Ogbese Forest Reserve, Ekiti State, Nigeria. The reserve is located within the tropics and lies between latitude 50^0 32' and 40^0 27' North and longitude 70^0 50' and 90^0 28' East. The prevailing climate is tropical with an average temperature of 25^0C all year round and high relative humidity. The rainy season has an average of 240 days with mean annual rainfall of 1250 to 1400 mm. The pattern of rainfall distribution is bimodal with a long rainy season between April and mid- November with a peak in September while the dry season stretches from mid- November to the end of March. The total land mass of the reserve is about 72.52km^2 out of which 27 km^2 is of pure forest stand, 16 km^2 is savannah, 14 km^2 is swamp forest and 10.52 km^2 is a disturbed land. The plantation site of the reserve is 5 km^2 comprising 4 km^2 of *Tectona grandis* and 1 km^2 *Gmelina arborea*.

Birds Assessment

A preliminary survey was conducted in April, 2010, for familiarization with the bird community and habitat types. The coordinates of the site were taken and the plots delineated. The study was conducted from April, 2010 to February, 2011, covering both wet and dry seasons. A survey of abundance and diversity of avifauna species of the Ogbese Forest Reserve, Ekiti State was conducted from twenty (20) plots distributed in 72.52 km^2 area using transect count method as described by Burnham *et al.* (1980). The stratified random sampling technique (Thakur *et al;* 2003) was adopted for studying the birds of the area, which involved dividing the sites into different strata based on vegetation types. The relative value of each vegetation type for attracting different bird species was determined by the establishment of 0.5 km long transect in each of the four (4) plots located in each of the identified two

vegetation types. Birds were observed by walking along the transects for three consecutive days in a month for the duration of twelve months. Data collection commenced about 30 minutes after dawn and was carried out for five hours at 6:30 – 10:00 and 16:30 – 18:00 daily that correspond to periods of prominent bird activities (Jones,1998).In order to avoid repeated counting of birds, transects were reasonably spaced at least 200 m apart. A record was made of all the types and group number of bird species through direct observation with binoculars (Olympus 10 x 42) and identified to the species level and taxonomic groups categorized based on Field Guides to Birds of Western Africa (Borrow and Demey, 2004) and Field Guides to Birds of Africa (Mackworth – Praed and Grant, 1970). Other materials used were Compass equipped with a sighting mirror and Global Positioning System (GPS).

Data Analysis

The cumulative list of bird species recorded in each of the five forest types of Ogbese forest reserve was used as a basic measure of avian richness. The relative abundance of avian species was determined using encounter rate that gives crude ordinal scales of abundance: abundant, common, common uncommon and rare (Bibby *et al;* 1998). The encounter rate incorporates the field hours of observation and the number of individuals of each species observed. This allows the encounter rate to be calculated for each species by dividing the number of birds recorded by the number of hours spent searching, giving a figure of birds per hour for each species. The abundance categories ≤ 1.0, (rare) 1.1 – 2.0, (uncommon) 2.1 – 10.0, (fairly common) 10.1 – 40.0 (common) and >40 birds. Diversity was calculated using both Shannon-Weiner and Simpson's diversity indices. Shannon – Weiner diversity index 'H' was calculated using formula:

$H' = - \sum pi \, In \, Pi$

where, Pi = proportion of individual species and R = total – number of species of observed

Simpson's diversity index 'D' was calculated using the formula:

$$D = \frac{\sum ni\,(ni - 1)}{N\,(N - 1)}$$

Where ni = total number of birds of each individual – species and N = the total number of birds of all species. The value D ranges between 0 and 1 with this – index, 1 represents infinite diversity and 0, no diversity. One way analysis of variance (ANOVA) was used for analyze the variation in birds composition between the vegetation types with the General Linear Model (GLM) procedure of SAS (2000) package.

Differences were considered statistically significant at 5% level. The data were further subjected to detailed analysis to determine species richness index, species evenness index, Sorensen index of similarity, Margalef diversity index, and Simpson's index (Margalef 1968).

Results

Fifty-two (52) bird species belonging to eleven (11) Orders and twenty two (22) families were recorded during the two seasons viz wet and dry in the five vegetation types of Ogbese Forest Reserve out of which forty (40) were non- passerine and ten (10) were passerine species (Table 1). The natural forest vegetation type contains the highest number of bird species than the plantation vegetation type in both seasons. The higher numbers of birds: 49 and 47 were recorded in the natural forest vegetation in both the wet and dry seasons respectively out of which 45 bird species were residents and 7 species were migratory. Also 36 and 37 bird species were obtained in the plantation vegetation in both seasons out of which 33 were residents and 7 species were migratory, (Table 2 and 3). Most of the migratory bird species were observed from November, 2010 to February, 2011 in both the natural and plantation forest vegetation. The Order Passeriformes constituted the predominant group, representing 27.3% of families (n=6) and 20% of species (n=10). The families with the largest number of species were Ardeidae (n=6), Accipitridae (n=5) and Columbidae (n=5).

129 The bird species were distributed within the natural forest and plantation ecosystems in
130 Ogbese Forest Reserve.

131 In each season, 49 bird species were recorded and (47) bird species were common to
132 both seasons while 2 and 3 species were exclusive to the wet and dry seasons respectively.
133 Also 12 bird species were exclusive inhabitants of the natural forest while no exclusive
134 species was recorded in the plantation forest (Table 3). The species composition of birds
135 during the wet and dry seasons was not significantly different (P>0.05) but there was a
136 significant difference among the two major vegetation types ((P>0.05).

137 The highest species diversity during the wet season was observed in natural forest
138 vegetation (3.63) while the plantation vegetation had a lower species diversity (3.39). During
139 the dry season, the species diversity in the natural forest vegetation and plantation vegetation
140 was 3.67 and 3.34 respectively. The higher species evenness was registered in the natural
141 forest vegetation in both the wet and dry seasons (Table 2).

142 **Table 1. Avian Distribution of Natural and Artificial forests of Ogbese Forest Reserve,**
143 **Ekiti State.**
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S/N	SPECIES SCIENTIFIC NAME	ORDER	FAMILY
1.	Little Egret *Egretta gazetta*	Ciconiiformes	Ardeidae
2.	Cattle Egret *Bubulcus ibis*	Ciconiiformes	Ardeidae
3.	Great Egret *Ardea alba*	Ciconiiformes	Ardeidae
4.	Goliath Heron *Ardea goliath*	Ciconiiformes	Ardeidae
5.	Grey Heron *Ardea cinerea*	Ciconiiformes	Ardeidae
6.	Dwarf Bittern *Ixobrychus sturmii*	Ciconiiformes	Ardeidae
7.	Wooly – necked Stork *Ciconia episcopus*	Ciconiiformes	Ciconiidae
8.	Yellow – billed Stork *Mycteria ibis*	Ciconiiformes	Ciconiidae
9.	African Black kite *Milvus migrans*	Falconiformes	Accipitridae
10.	African harrier hawk *Polyboroides typus*	Falconiformes	Accipitridae
11.	Lizard Buzzard *Katpifalco monogrammicus*	Falconiformes	Accipitridae
12.	Shikra *Accipiter badius*	Falconiformes	Accipitridae
13.	Grasshopper buzzard *Buteo butco*	Falconiformes	Accipitridae
14.	Lesser kestrel *Falco naumanni*	Falconiformes	Falconidae
15.	Scaly francolin *Francolinus squamatus*	Galliformes	Phasianidae
16.	Double spurred francolin *francolinus bicalcaratus*	Galliformes	Phasianidae
17.	Forest – francolin *Francolinus lathami*	Galliformes	Phasianidae
18.	Crested Guineafowl *Guttera pucherani*	Galliformes	Numididae
19.	Common sandpiper *Actitus hypoleucos*	Charadriformes	Scolopacidae
20.	Chestnut – bellied Sandgrouse *Pterocles exustus*	Pterocliformes	Pteroclidae
21.	Lemon dove *Columba larvata*	Columbiformes	Columbidae
22.	Laughing Dove *Streptopelia senegalensis*	Columbiformes	Columbidae
23.	African Green Pigeon *Treron calva*	Columbiformes	Columbidae
24.	Tambourine dove *Turtur tympanistria*	Columbiformes	Columbidae
25.	Mourning collared Dove *Streptopelia decipiens*	Columbiformes	Columbidae
26.	Senegal coucal *Centropus senegalensis*	Cuculiformes	Cuculidae

27.	Common cuckoo *Cuculus canorus*	Cuculiformes	Cuculidae
28.	African cuckoo *Cucolus gularis*	Cuculiformes	Cuculidae
29.	Black coucal *Centropus grillii*	Cuculiformes	Cuculidae
30.	Little swift *Apus affinis*	Apodiformes	Apodidae
31.	Common swift *Apus apus*	Apodiformes	Apodidae
32.	African palm-swift *Cypsiurus parvus*	Apodiformes	Apodidae
33.	African pygmy – king fisher *Ispidina picta*	Coraciiformes	Alcedinidae
34.	Dwarf kingfisher *Ispidina lecontei*	Coraciiformes	Alcedinidae
35.	African Grey hornbill *Tockus nasutus*	Coraciiformes	Alcedinidae
36.	Black casqued hornbill *Ceratogymna atrata*	Coraciiformes	Bucerotidae
37.	African pied hornbill *Tockus fasciatus*	Coraciiformes	Bucerotidae
38.	Lesser honey guide *Indicator minor*	Piciformes	Indicatoridae
39.	Spotted Honey guide *Indicator maculatus*	Piciformes	Indicatoridae
40.	Fire-bellied wood pecker *Dendropicos Pyrrhogaster*	Piciformes	Picidae
41.	Black – headed weaver *Ploceus cucullatus*	Passeriformes	Ploceidae
42.	Slender-billed weaver *Ploceus pelzelni*	Passeriformes	Ploceidae
43.	Grey wood pecker *Dendropicous goetae*	Piciformes	Picidae
44.	Mosque swallow *Cecropis daurica*	Passeriformes	Hirundinidae
45.	African pied wagtail *Motacilla aguimp*	Passeriformes	Motacillidae
46.	Ethiopian swallow *Hirundo aethiopita*	Passeriformes	Laniidae
47.	Pied crow *Corvus albus*	Passeriformes	Corvidae
48.	Little bee eater *Merops pusillus*	Coraciiformes	Meropidae
49.	Olive – bellied sunbird *Nectarinia chloropygius*	Passeriformes	Nectariniidae
50.	Superb sunbird *Nectarinia superba*	Passeriformes	Nectariniidae
51.	Olive sunbird *Nectarinia olivacea*	Passeriformes	Nectariniidae
52.	Pin tailed whydah *Vidua chalbeata*	Passeriformes	Ploceidae

Table 2: Avian Species Diversity during Wet and Dry Seasons.

Vegetation	Season	No of species	Abundance (No of Individuals)	D	H	H /Hmax
Natural forest	Wet	49	234	0.96	3.63	0.83
	Dry	47	597	0.97	3.67	0.84
Plantation	Both	52	831			
	Wet	36	240	0.96	3.39	0.77
	Dry	37	135	0.95	3.34	0.76
	Both	40	375			

H^1 – Shannon–Wiener Index, D = Diversity Index, H^1/H^1max = Evenness H^1max = In(s).

Table 3. Status of bird species in the natural and plantation forest of Ogbese Forest Reserve

FT	NR	NI	TS	NEBS	NWEBS	NDEBS
Natural Forest	45	07	52	12	02	03
Plantation Forest	33	07	40	0	-	-

FT= Forest types, NR= Number of residents, NI=Number of immigrants, TS=Total Species, NEBS= Number of Exclusive bird species, NWEBS= Number of Wet season Exclusive bird species, NDEBS= Number of Dry season Exclusive bird species

Table 4: Number of bird species in different relative abundance categories.

Vegetation	Season	Frequent	Common	Uncommon	Rare	Abundance
Natural	Wet	06	05	07	23	04
	Dry	10	05	03	12	05
Plantation	Wet	02	01	04	10	01
	Dry	03	02	04	10	04

Discussion

The record of fifty two (52) bird species observed during wet and dry seasons in the limited area shows that the diversity is very high (Table 5 & 6). The occurrence of high number of resident bird species in the area indicates that the area could provide the necessary requirements for resident bird species.

The species composition of birds counted during the wet and dry seasons of the study was not significantly different. The extended time of inundation of the area during the wet and dry seasons could contribute to the insignificant effect of seasons on bird species composition in the study areas. Ward (1969) asserted that bird species shift their feeding habit between seasons in temperate habitats and this may likely be responsible for the insignificant effect of seasons on bird species composition in the present study.

Table 5. Total number of bird species observed during the wet and dry seasons in natural forest.

S/N	SPECIES SCIENTIFIC NAME	WET	DRY
1.	Little Egret *Egretta gazetta*	22	19
2.	Cattle Egret *Bubulcus ibis*	34	36
3.	Great Egret *Ardea alba*	14	12
4.	Goliath Heron *Ardea goliath*	09	07
5.	Grey Heron *Ardea Cinerea*	-	04
6.	Dwarf Bittern *Ixobrychus sturmii*	06	07
7.	Wooly – necked stor *Ciconia episcopus*	04	-
8.	Yellow – billed stor *Myeteria ibis*	12	10

9.	African black kite *Milvus migrans*	-	44
10.	African hafier hawk *Polyboroides typus*	05	08
11.	Lizard Buzzard *Katpifalco monogrammicus*	06	06
12.	Shikra *Accipiten badius*	06	05
13.	Grasshopper buzzard *Buteo butco*	07	-
14.	Lesser kestrel falco naumanni	07	06
15.	Scaly francolin francolinus squamatus	28	30
16.	Double spurred francolin *francolinus bicalcaratus*	05	07
17.	Forest – francolin francolinus lathami	24	19
18.	Crested Guineafowl *Guttera pucherani*	20	22
19.	Common sandpiper *Actitus hypoleucos*	07	-
20.	Chestnut – bellied sandgrouse *pterocles exustus*	-	10
21.	Lemon dove *Columba larvata*	11	17
22.	Laughing Dove *Streptopelia enegalensis*	16	14
23.	African Green Pigeon *Treron Calva*	06	08
24.	Tambourine dove *Turtur tympanistria*	08	13
25.	Mourning collared Dove *Streptopelia decipiens*	13	11
26.	Senegal coucal *centropus enegalensis*	08	08
27.	Common cuckoo Cuculus canorus	10	12
28.	African cuckoo *Cuculus gularis*	13	09
29.	Black coucal *Centropus grillii*	07	05
30.	Little swift *Apus affinis*	16	10
31.	Common swift *Apus apus*	06	05
32.	African palm-swift *Cypsiurus parus*	20	24
33.	African pygimy – king fisher *Ispidina picta*	10	05
34.	Dwarf kingfisher *Ispidina lecontei*	14	17
35.	African Grey hornbill *Tockus nasutus*	05	07
36.	Black casqued hornbill *Ceratogymna atrata*	09	06
37.	African pied hornbill *Tockus fasciatus*	10	12
38.	Lesser honey guide *Indicator minor*	05	07
39.	Spotted Honey guide *Indicator maculates*	08	10
40.	Fire-bellied wood pecker *Dendropicas Pyrrhogaster*	09	12

41.	Black – headed weaver *Ploceus cucullatus*	23	22
42.	Slender-billed weaver Ploceus pelzelni	81	21
43.	Grey wood pecker Dendropicous goetae	09	08
44.	Mosque swallow Cecropis daurica	19	17
45.	African pied wagtail *Motacilla aguimp*	10	12
46.	Ethiopian swallow Hirundo aethiopita	07	-
47.	Pied crow (Corvus albus)	20	21
48.	Little bee eater (Merops pusillus)	11	08
49.	Olive – bellied sunbird (Nectarinia chloropygius)	8	10
50.	Superb sunbird (Nectarinia superba)	08	06
51.	Olive sunbird (Nectarinia olivacea)	08	07
52.	Pin failed why dah (Vidua chalbeata)	10	-

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Table 6. Total number of bird species observed during the wet and dry seasons in plantation forest

S/N	SPECIES SCIENTIFIC NAME	WET	DRY
1.	Little Egret *Egretta gazetta*	25	17
2.	Cattle Egret *Bubulcus ibis*	27	28
3.	Great Egret *Ardea alba*	15	14
4.	Grey Heron *Ardea Cinerea*	-	08
5.	Dwarf Bittern *Ixobrychus sturmii*	07	05
6.	Woolly – Necked stock *Ciconia episcopus*	02	04
7.	Yellow – billed stock *Myeteria ibis*	03	03
8.	African black kite *Milvus migrans*	-	67
9.	Lizard Buzzard *Katpifalco monogrammicus*	06	05
10.	Shikra *Accipiten badius*	05	04
11.	Grasshopper buzzard *Buteo butco*	05	-
12.	Lesser kestrel falco naumanni	06	08
13.	Scaly francolin francolinus squamatus	32	35
14.	Common sandpiper *Actitus hypoleucos*	05	04
15.	Chestnut – bellied sandgrouse *pterocles exustus*	-	05
16.	Lemon dove *Columba larvata*	11	10
17.	Laughing Dove *Streptopelia senegalensis*	13	15
18.	African Green Pigeon *Treron Calva*	12	15
19.	Tambourine dove *Turtur tympanistria*	9	08
20.	Mourning collared Dove *Streptopelia decipiens*	14	16
21.	Senegal coucal *centropus senegalensis*	10	08
22.	Common cuckoo Cuculus canorus	07	08
23.	African cuckoo *Cuculus canorus*	07	06
24.	Little swift *Apus affinis*	24	21
25.	Common swift	14	15
26.	African pygimy – king fisher *Ispidina picta*	09	11
27.	Dwarf kingfisher *Ispidina lecontei*	10	11
28.	African Grey hornbill *Tockus nasutus*	07	07
29.	African pied hornbill *Tockus fasciatus*	09	08

30.	Spotted Honey guide *Indicator maculates*	12	11
31.	Fire-bellied wood pecker *Dendropicas Pyrrhogaster*	05	07
32.	Black – headed weaver *Ploceus cucullatus*	23	30
33.	Slender-billed weaver Ploceus pelzelni	36	21
34.	African pied wagtail *Motacilla aguimp*	12	10
35.	Ethiopian swallow Hirundo aethiopita	12	-
36.	Pied crow (Corvus albus)	16	17
37.	Olive – bellied sunbird (Nectarinia chloropygius)	-	12
38.	Superb sunbird (Nectarinia superba)	07	07
39.	Olive sunbird (Nectarinia olivacea)	08	07
40.	Pin tailed why dah (Vidua chalbeata)	11	-

The species diversity index and evenness of both the natural forest and forest plantation during the entire season revealed that the natural forest vegetation had the higher species diversity and evenness. The species diversity of flora in the natural forest compared to the plantation forest might play a determinative role in the higher diversity and evenness recorded. This may be as a result of the presence of multiple and variety of alternative feed sources for birds. In addition, natural forest vegetation community which has been for reasonable number of years without disturbance is more diverse and comprises of various plant species and life forms which provide better food, cover, breeding and nesting sites could have contributed to high species diversity and evenness in the natural forest vegetation (Labe et al., 2018). On the other hand, plantation forests are in some areas fragmented, exposed to agroforestry practices and tree species exploitation. In view of this, birds which inhabit this habitat are affected. Rana (2005) was of the opinion that pristine natural habitats properly preserved from human interference are of higher diversity and evenness of species than the fragmented areas where anthropological activities takes place. Variations that exist in feeding habits and habitats might also contribute towards the increment of diversity,

evenness and species richness (Smith, 1992). In the university of agriculture, Benue state, north central Nigeria (Labe et al., 2018), it was reported that a total of 978 birds comprising of both terrestrial and aquatic birds were recorded in the morning hours. While 988 birds comprising of both terrestrial and aquatic birds were recorded in the morning. Ardeola ibis was the most abundant species (21.55%), followed by Streptopelia decipiens (13.73%).

The unregulated anthropogenic disturbances impact negatively on the plantation forest habitats and this might have been responsible for low evenness and species diversity experienced in the plantation forest vegetation types during both the wet and dry seasons. The relative abundance of individual bird species during the seasons might be dictated by the availability of food, habitat physiognomy and breeding season of the species. Lee and Rotenberry (2005) asserted that the distribution and abundance of many bird species are influenced by the composition and structure of the vegetation community that serves as cover to bird species. As vegetation structure changes, a particular bird species may subsist. Human activities which are more pronounced in the plantation forest of Ogbese Forest Reserve might be responsible for the lower number of bird species recorded in the vegetation types during both dry and wet seasons of the study year. Human activities threaten the existence of many birds by altering the vegetation structure of their habitats and thereby impeding their reproductive success (Green and Hirons 1991). The intensive timber logging activities and agroforestry practices in the plantation forest are major factors that affect bird species richness.

Conclusion

The result of this study has shown that the natural and plantation vegetation types of Ogbese Forest Reserve, Ekiti State considered in this study are not similar in bird species diversity, evenness and abundance. The occurrence of high number of resident bird species in the area indicates that the area could provide the necessary requirements for resident bird

species. The heterogeneity of flora species in the natural forest compared to the plantation forest might be responsible for the variation**.** There was no significant variation in species composition and population density between terrestrial and aquatic bird species. The species composition of birds counted during the wet and dry seasons of the study was not significantly different. The management of birds in the reserve should take cognizance of the vegetation types for effective conservation of bird species which are resident in the reserve. Flora species richness favors higher diversity and abundance of bird life and management measures that aim at increasing flora composition might help in the maintenance of healthy bird population is a major factor that might affects bird species richness.

ETHICAL ISSUE: NA

CONSENT: NA

REFERENCES

Bibby, C; M. Jones and S.|Marsden. (1998). Expedition Field Techniques: Bird surveys. Expedition Advisory Centre. Royal Geographical Society London.

Borrow, N. and R. Demey (2004). Birds of Western Africa, C. Black Publishers Ltd., 37 Soho Square, London WSD 3 AZ.

Burnham, K.P., D.R. Anderson and J.L. Laake (1981). Line transect estimation of bird population density using a fourier series. In: Estimating the number of Terrestrial Birds. (eds) C.J. Ralph and M.J.ScoH. studies in Avian Biology No 6. Cooperorniothological society.

Jones, M. (1998). Study design Pp. 15 – 34. In: C. Bibby, M. Jones and S. Marseden (eds). Expendition Field Techniques, Bird surveys. Royal Geographical society with the Institute of British Geographer, London.

Lee P.Y. and J.T. Rotenberry (2005). Relationships between bird species and tree species assemblages in forested habitats of eastern North America J. of Biogeogr. 32: 1139-1150.

Mackworth – Praed, C.W. and C.H.B. Grant (1970): The Birds of the West Central and Western of Africa. Vols 1 and II, Longmans, Green and Company, London, New y and Western of Africa. Vols 1 and II, Longmans, Green and Company, London, New York.

Margalef R. (1968):Perspectives in Ecological Theory. University of Chicago Press,Chicago, IL, P. 111.

Rana, S.V.S. (2005). Essentials of Ecology and Environmental science. 2nd (eds.) Prentice-Hall of India Private Ltd;. New Delhi.

SAS (2000): SAS user's Guide. Statistical Analysis System (SAS) Institute, Inc, Cary, North-Carolina, U.S.A.

Shannon, C.E. & W. Weaver (1949): The mathematical theory of communication. University of Illinois press, Urban, Illinois.

Simpson E. H. (1949): Measurement of diversity. Nature 163: 688.

Smith, R.L. (1992). Elements of Ecology.3rd (eds.) Harper Collins Publishers Ltd; London.

Thakur, M.L.R. Paliwal, P.C. Tak and V.C. Maltu (2003). Birds of Balh valley, distric mandi, Himachal Pradesh, India. Annuals of Forestry 11(1): 113 – 126.

Ward, P. (1969). The annual cycle of the Yellow-vented Bulbul, Pycnonotus goiavier, in a humid equatorial environment. Journal of Zoology 157:25-45.

Labe TE, Iwar IM, Uloko IJ. Species diversity and abundance of avifauna in the university of agriculture, Benue state, north central Nigeria. Forest Res Eng Int J. 2018;2(4):198–202. DOI: 10.15406/freij.2018.02.00048

Zedler JB. Wetlands at your service: reducing impacts of agriculture at the watershed scale. Frontiers in Ecology and the Environment. 2003;1(2):65–72.

Lameed GA. Species diversity and abundance of wild birds in Dagona water fowl sanctuary, Borno State, Nigeria. African Journal of Environmental Science and Technology. 2011;5(10):855–866.

Ezealor AU. Important Bird Areas in Africa and Associated Islands: Priority sites for Conservation Series. UK: Pisces Publications; 2001. p. 673–682.

Anderson SH, Dave K, Alastair WR, et al. Birds as pollinators and Dispersers: a case study from New Zealand. Acta Zoologica Sinica. 2006;52:112–115.