BIRD SPECIES ABUNDANCE AND DIVERSITY IN A LOGGED FOREST RESERVE EDO STATE NIGERIA

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ABSTRACT
The abundance and diversity of avian species was studied in Ologbo Concession, Edo state Nigeria. The study area was divided into three compartments based on their different land use types. A total of 60 transect lines were randomly laid out and 20 transect lines per a compartment. The minimum distance between two transect lines was 200m. The number of transect lines was determined by the site size. Data were collected for six months (Dry and Wet seasons) in 20018. Fifty-five (31) bird species were recorded in the Farmland, seventy (70) bird species in the Fallow Area and one hundred and fifteen (115) species encountered in the Undisturbed forest area. In all, a total of 136 bird species belonging to 43 families and 18 orders were recorded in the three study sites, the order Passeriformes had the highest frequency (51 %) of the entire number of birds recorded, while the dominant families were Pycnonotidae, Cuculidae and Estrilidae. One endangered bird species, African Grey Parrot and two rare species of hornbill Black and White casqued Hornbill and Yellow Casqued Hornbill were encountered in the study area. The Shannon diversity index was highest in the undisturbed forest compartment 4.406 than Logged Compartment 3.372 and Farmland Compartment 2.962

Keywords*: Home Range, Agricultural intensification, Avian Species and Habitat fragmentation*.

INTRODUCTION

Many countries in the developing world are experiencing rapid population growth, with associated pressure on natural habitat and their native flora and fauna including avian species (Sodersrom et al., 2003). Habitat loss, destruction, and degradation are the major threat to avian species richness and diversity (Birdlife International, 2000). This loss of habitats can be as a result of human or natural causes. Human activities contribute more to habitat destruction. Newton (2004) acknowledged the fact that, in the last 400 years, human actions alone has eliminated about 127 of approximate 9672 species of modern birds. Activities like firewood collection, logging, agriculture, farming, drainage destruction of wetlands, human settlement, the building of infrastructures and industries among others have altered lots of habitats (Birdlife International, 2000). Marsden et al., 2006 reported that the loss of tropical ecosystem is of concern because the biome contains over half of the world species. Agricultural encroachment and unsustainable silvicultural practices have been implicated for these losses (Wang and Young 2003). Many studies have examined the impact of habitat loss and fragmentation due to agriculture on tropical bird communities (Naidoo, 2004). Relatively few have focused on bird communities in Africa (Mangnall and Crowe, 200). The problem of forest fragmentation is extremely severe in West Africa due to rapid population growth and land-use changes (Manu et al., 2007).

The present study was undertaken to assess the pattern of distribution and diversity of avifauna species abundance and diversity in Ologbo concession Edo state Nigeria. The study bird species in a degraded forest have not be carried in this part of the country. This limited studies in Nigeria confirm that much more research needs to be carried out on tropical rain forest biodiversity and these has great potential to contribute to maintaining the populations of common and rare bird species through the well-informed management. Hence, this research work will provide baseline information that will be of immense important to other researchers in conservation of bird species

MATERIALS AND METHODS
Study area

Ologbo project which is about 7295 ha in area is located N 06^{o} 02' - 06^{o} 08'; E 78^{o} and 05^{o} 30' - 05^{o} 40'and acquired by PRESCO Plc for oil palm plantation development. The project area is made up of 6000 ha formal Ologbo Forest and 1,295 ha of former Obasuyi Concession. The plot has undergone much disturbance from previous clearance for farming. The original vegetation of the environment is typical of the lowland moist rainforest (Keay, 1989). The area is part of the coaster plain of southern Nigeria. The climate is governed by two seasons; the wet season from April to November and the dry season from December to March. The mean annual rainfall is about 2100 mm and temperatures reaches an average of 23-37^{o}C. The present Ologbo concession was part of Ologbo Forest Reserve established under the Benin Native Authority in 1927 (Decker, 2007, Ogunjemite, 2015). The months of July and September and a short relatively dry period in August. December through to February

constitutes the major dry season while January and February are the driest months with each having less than 30 mm rainfall (Ajiboye, 2012). The relative humidity at 15 hours Greenwich Mean Time (GMT) is highest in the maxima months of July and September (81%) and lowest in February (44%). (Ajiboye, 2012). Soils are predominantly ferruginous tropical, typical of the variety found in intensively weathered areas of basement complex formations in the rainforest zone of south-western Nigeria. The soils are well-drained, mature, red, stony and gravely in upper parts of the sequence. The texture of topsoil in the reserves is mainly sandy Oksanen, *et al*, 2013). The natural vegetation of the area is tropical rainforest characterized by emergent with In multiple canopies and lianas. Some of the most commonly found trees in the area include *Melicia excelsa, Afzelia bipindensis, Antiaris africana, Brachystegia nigerica, Lophira alata, Lovoa trichiliodes, Terminalia ivorensis, Terminalia superba,* and *Triplochiton scleroxylon*. However, the natural vegetation of the area except for the areas devoted to forest reserve has now been reduced to secondary regrowth forest thickets and fallow regrowth at varying stages of development or replaced by perennial and annual crops (Ogunsesan*, et al*, 2012).

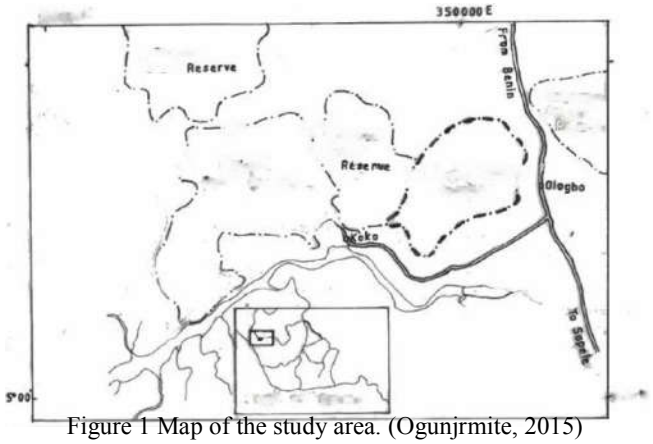

Figure 1 Map of the study area. (Ogunjrmite, 2015)

Data Collection

The study area was divided into three compartments which include the undisturbed forest area, farmland and Secondary forest for the purpose of this study. Line transects method according to (Sutherland, 2009)was used to collect data on bird species diversity, and abundance in the study area. In all an of 60 transect lines were randomly placed measuring 1000 m each transect was divided into 200 m sections with each block having 20 transects randomly placed. The programme GPS 2011 Utility (GPSU, 2012) was used to locate the starting and ending points of transects. Transect lines were walked three times a week for three months in both seasons (May, July and September for wet season and November, January, and March for dry season) of the year.Survey was conducted between 0.600hours and 10.00hours and 1600 hours to 1800 hours, the survey was not conducted beyond 10.00hours in the morning in other to reduce day light effect. Transects were walked at an average speed of 1.5 kilometre per hour, depending on the terrain and the number of bird species recorded. All birds viewed on the ground or in the vegetation, as well as birds that are flying ahead, were identified and the number in the group recorded. Birds of the same species within 10m of each other were counted in the same group. A pair of binoculars with a magnification 7x 50 was used in the identification of bird species. Distance estimates were obtained by using a digital range finder. Physical features of birds sighted but could not be identified immediately were taken and field guide book of West African birds (Burrow and Demey, 2011) was used to identify the bird species and bird calls was used to confirmed the presence of nocturnal bird species within the study sites. Data was collected for six months three months in the dry season (November, February and March) and three months in the wet season (June, August, and September) in 2014

From the data collected, avian species diversity was calculated using Shannon diversity index, (Usher, 1991) which is given as:

$H^i = - \Sigma Pi \, In \, Pi$
Where: $H^i = ^{diversity}$ index
Pi = is the proportion of the ith species in the sample
InPi = is the natural logarithm of the species proportion.

Species Relative Population Density
The relative population density of bird species at various sites and seasons were determined as outlined by Bibby (*et al,* 1992) as follows:

$$D = \frac{n_1 + n_2 \text{Log}_e[n_1 + n_2]}{\pi r^2 m \quad n_2}$$

where: D = density
r = radius of the first zone
n1 = number of birds counted within zone
n2 = number of birds counted beyond zone and m = number of replicatecount in such area.

Habitat analysis

Quadrant method (Ogunjiemitie et al, 2005) was used to determine plant species composition. This method involves a total enumeration count (TEC) of all trees above 1m in height and Basal area of not less than 10cm from $25\times25m^2$ quadrant sample plot which was randomly selected through balloting form each sampling compartments. Three out of the 16 quadrants was randomly selected through balloting in each of the 5 sampling compartments giving 15 plots of a dimension of $25\times25m^2$. The following data was collected within each sampling quadrants. They include:, mean height of 22m and above was considered Tall emergent Tree, 11m to 21m middle layer and 1m to 10m understorey. The classification of the tree species into different strata layers was carried using (Ogunjemite 2015).

i Total enumeration of all trees above 1m height and basal area ≥10cm.
ii Total enumeration of all the trees species (s) and family which they belong.
iii The diameter of all the plants above 1m in the height ≥10cm.

Statistical Analysis
Data obtained from the field survey were entered excel (version 15) spread sheet prior to both descriptive (tables, frequency and percentage frequency, graph, pie and bar charts) and analytical statistics. Variables. Test of homogeneity for the effect of logging and farming on the bird diversity was carried out using PAST Model.

RESULTS

From the result obtained from the research study it indicates that the study area support diversity and abundance of bird life. A total of 143 bird species belonging to 43 families and 18 orders were recorded in the study area. The Unlogged compartment has 47% of bird species which is the highest in the study area, Logged compartment has 31% and farmland has 22% bird species which is the lowest in the study area (Figure 2). A total of 1131 individual bird species were recorded in the study area, Farmland has the highest individual bird species (496) while, Unlogged compartment has the lowest 274 individual bird species in the study area (Figure 3). The result of the family composition indicates that cuculidae has the highest number of bird species, *klass cuckoo and Dusky Long-Tailed and Jacobin Cuckoo* have highest frequency of occurrence during the period of study (Figure 4). The result of the diversity index indicates that it was higher in the unlogged compartment (4.406) than the rest other two compartment than the compartments Logged (3.341) and Farmland 2.962) Table 1. A total of 117 tree species belonging to 34 families were enumerated in the study area, *Ficus exasperata* had the highest DBH, while, *Ceiba pentandra* has the highest mean height. *Alchornea oppositifolia* has the highest frequency of occurrence in the study area (Table 2). The land use impact on the bird species in linear regression is shown in Figure 6. The result of the forest layers obtained shows that understory has the number of tree species (60), the middle layer 37 tree species and Tall emergent layer 11 Figure 7. The result of habitat specialization of bird species in the study area indicates that understory has 64 bird species, wetland 11, Grassland 14, Middle layer 37 and tall emergent 17 bird species Figure 8. Checklist of the bird species in the study area is shown in Table 3

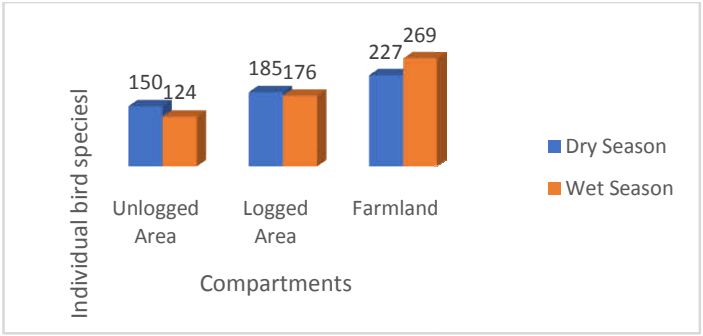

Figure 2 Number of individual bird species in each compartment in the study area

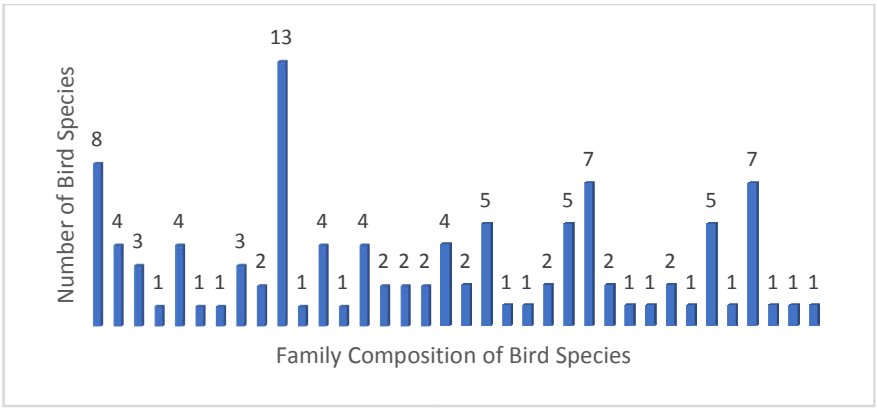

Figure 3 Family composition of bird species in the study area

Table 1 Diversity index of bird species in the study area

Diversity Index	Unlogged	Lower	Upper	Logged	Lower	Upper	Farmlands	Lower	Upper
Taxa_S	92	90	92	46	44	46	22	21	22
Individuals	272	272	272	175	175	175	49	49	49
Dominance_D	0.01349	0.01422	0.01698	0.02609	0.02753	0.03491	0.05789	0.05539	0.08205
Shannon_H	4.406	4.278	4.371	3.732	3.558	3.694	2.962	2.775	2.985
Evenness_e^H/S	0.8905	0.7901	0.8634	0.9075	0.7753	0.8785	0.8787	0.7505	0.9008
Brillouin	3.934	3.826	3.906	3.341	3.192	3.309	2.436	2.286	2.455
Margalef	16.23	15.88	16.23	8.713	8.326	8.713	5.396	5.139	5.396
Equitability_J	0.9744	0.9478	0.9675	0.9747	0.9334	0.966	0.9582	0.9065	0.966
Fisher_alpha	48.9	46.99	48.9	20.33	18.9	20.33	15.35	13.92	15.35
Berger-Parker	0.02574	0.02574	0.04779	0.04571	0.04571	0.08571	0.102	0.08163	0.1837

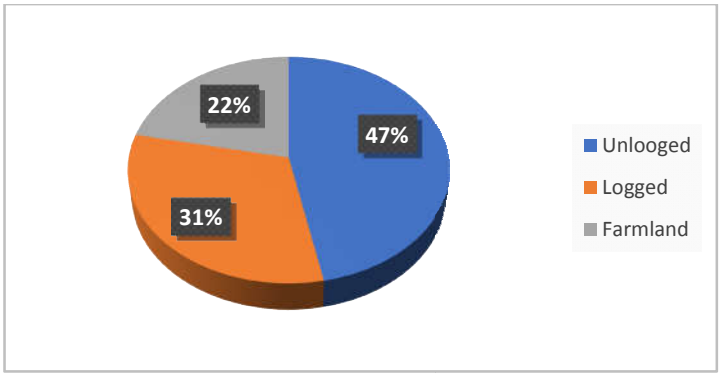

Figure 4 Percentage of bird species in each compartment in the study area

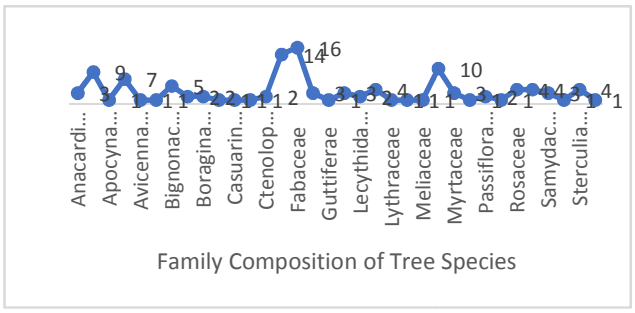

Figure 5 Family composition of tree species in the study area

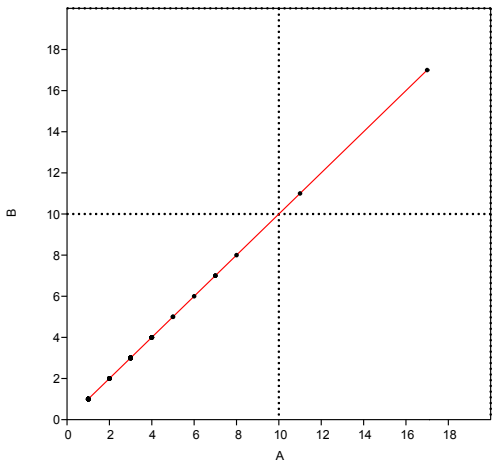

Figure 6 Density of bird species against the habitat variables in the study area

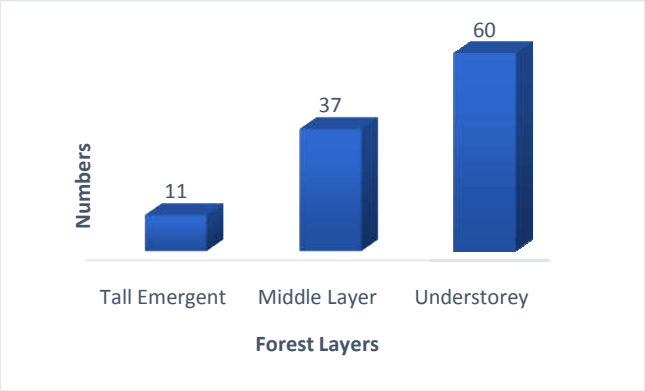

Figure 7 Forest layers classification in the study area

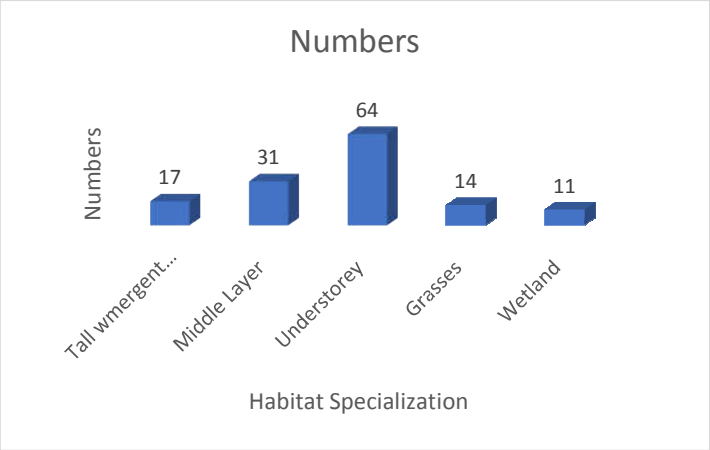

Figure 8 Habitat specialization of bird species in the study area

DISCUSSION

Our study showed that species diversity and richness of bird species in the study area were adversely affected by forest modification and land use. From the result obtained bird species recorded in the undisturbed forest were higher than the rest two compartments Fallow area and the farmland. The observed change in the species richness of several bird groups along the habitat gradient is remarkable because influences farms and deforestation in the study were large compared to the undisturbed area. This is consistent with (Petit and Petit 2003) that understory dwelling rather than canopy or edge-dwelling habit, specialized foraging strategies and restricted geographic range could be responsible for this observation. Waltert et al, (2004) identified general characteristics of forest species sensitive to deforestation and land use, in addition, they suggested that resident birds in contrast to nonbreeding visitors particularly prefer forest habitats. Lindell et al. (2004) reported that resident forest species are often behaviorally inhibited to enter the open agricultural land, functioning as a barrier for dispersal. The Fallow compartment have fewer bird species than the undisturbed forest which is consistent Turner et al. (1997) that secondary forest have a less complex vegetation structure and a lower species richness of larger trees compared to near-primary forest (Turner et al. 1997), which in turn could lead to reduced variability in foraging substrates.

Indeed, the tree diameter distribution and mean high of tree species in the study sites showed that larger trees of certain size classes were reduced in the secondary forest sites compared to a primary forest, and the architecture of secondary forests possibly was more homogeneous than near-primary forest. The relative abundance of avian species in the study area was higher in the farmland than the rest study sites. This agrees with previous work by Kormar (2006) who also reported a high abundance of bird species in cultivated areas, which could be due to food availability. This is also consistent with the result obtained by Best et al, (1990) that the extent of change in bird species composition and abundance depends on the specificity of each bird species habitat requirement, in other words, the species tolerance to changes to its environment. Species with the restricted habitat changes pattern are more vulnerable to changes in land use practices than those occupying a wider variety of environment. From the

result of diversity bird species it was higher in the unlogged Area (4.406) than the rest two other compartments logged Area (3.906) and Farmland (2.962).This result is supported by the previous work were (Kangah- Kesse et al (2008) who surveyed bird diversity in Abiriw sacred grove in Eastern Ghana and used Shannon diversity index recorded a value of 4.46 for the grove a near primary forest and 3.36 for the surrounding cultivated areas. The Undisturbed Area is a primary forest with three strata layers, bird species that utilizes tall emergence trees such the (Black and White Casqued Hornbill and Great Blue Turaco) were encountered and bird species that utilizes under story such as the (Little Greenbull, Common Bulbul, White Tailed Aletheetc.) were also sighted. This is consistent with MacArthur and MacArthur (2001) who reported that diversity increases with the number of layers in the vegetation. Pearson (2001) reported that tropical wet evergreen forest supports more rare bird species than other habitats. Manu (2000) reported that birds select vegetation variables according how an which an individual habitat affects access to food, mates or its vulnerability to predators. This is also in agreement with the report that altering habitats and changing population structure affects avian population. The result also revealed the values for Shannon diversity index, showed that there was no significant difference in bird species diversity between Farmland and Fallow Area, this is expected presumably because of the edge effect in farm land area. This is supported by previous studies, edge effects are described to be remarkably diverse, ranging from changes in species abundance (Manu et al., 2007). Bird species are important indicators of environmental quality and ecological functionality. In this study, we provided data on the response of bird species to certain structural attributes of a natural forest, such as the presence of mature and heterogeneous forest stands (high level of DBH). This study shows that Undisturbed Forest Area which is near primary forest is the best habitats for the bird species as far as the numbers and diversity is concerned. As the most serious loss of the biodiversity value occurs in the transformation of original landscapes to croplands due to human interference (Keith et al 1992). Reduction in habitats quality is thought to be the main underlying causes of the declines in most farmland bird species (Newton 2004)

In the farmlands, we have few trees with (DBH) than 10cm resulting in the decline of bird species diversity. This is supported by previous work of Donald et al, (2006) reported that the conversion of greater areas of land to farming has reduced habitat heterogeneity and led to reductions in species richness and declines in bird species diversity which were once common forest species.

This study indicates that was a positive relationship between bird species recorded and the percentage ground cover. More birds were observed in areas with higher percentage of tree density increased than ground cover as shown in Figure 6. This observation indicated that some rain forest birds used the trees as roosting site. This was observed with some species such as the *Accipiter castanilius,* Dendropico gabonesis, *Psittacus erithacus, Ploceus albinucha, Camaroptera chloronota and Dryoscopus sabini.* These species were found during the survey on the bare ground feeding on the grains, fruits and other vertebrate. This finding is supported. (Huston, 1994) reported that habitat has long been used as a predictor of bird species abundance, and each variety of birds has developed different preferences for habitat. Also agrees with(Cody, 1985) reported that birds select vegetation variables according how an individual habitat affects access to food, mates or its vulnerability to predators.

CONCLUSION

Bird species diversity was higher in the Undisturbed forest Area than Fallow area and Farmland within the study area which suggests that land use change between the three blocks was responsible for this. Settlement camps are springing up in the study area and these people are involved in logging, majorly cutting down commercial timber species such as *Ceiba pentandra*, *Alstonia congensisCola gigantea, Daniella ogea,* Farming intensification is ongoing in the area and compartments are been cleared for the cultivation of Oil palm plantation farms Presco. Government official allocates blocks to timber loggers without proper monitoring, and poaching is ongoing too. However, this may increase extinction risk for many threatened and endangered birds in the area, such as African Grey parrot, Black Casqued Hornbill,, Great Blue Twuracos and Crested Guinea fowl. The management of these areas should design programmes to discourage bush burning, livestock grazing, deforestation and illegal farming in the forest area.

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