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HABITAT EFFECTS ON AVIAN SPECIES ABUNDANCE AND DIVERSITY IN IDANRE FOREST RESERVE SOUTH WESTERN NIGERIA

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ABSTRACT: Habitat effect on the Abundance and Diversity of avian species was studied in Idanre Forest Reserve, South West Nigeria. The study area was divided into three compartments based on their different land use types. A total of 30 transect lines were randomly laid out and 10 transect lines per a compartment. The minimum distance between two transect lines was 200 m. The number of transect lines was determined by the site size. Data were collected for six month (Dry and Wet seasons) in 20014. Fifty five (55) 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 Bucerotidae and Pycnonotidae, comprising (7.4%) of the total species One endangered bird species, African Grey Parrot and 10 species Hornbills were encountered in the study area.
Key words: Home range; Agricultural intensification; Avian species; Habitat fragmentation.

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INTRODUCTION

The increasing disappearance of fauna and flora resources over the years especially as a result of the anthropogenic activities is a great challenge that conservation authorities are facing worldwide. Tropical forests are under threat from large scale forest clearance, mineral extraction and industrialization. For example in Nigeria alone, 184 animal and plant species, as well as valuable natural spaces, including old growth forests and wetlands, are known to be at risk [1]. Furthermore, each year, around 20.4 million hectares (50.4 million acres) of tropical forest are being destroyed or seriously damaged in areas such as Amazonia, Central America, Malaysia, Indonesia, and Borneo [2]. Nigerian rainforests have not been spared from these quantum destructions. In Nigeria at present the destruction of natural habitats continues rapidly, resulting in the depletion of the country's biodiversity [3]. However South Western Nigeria is the region of high population densities and intense agricultural land-use area [4]. For this reason, perhaps biodiversity depletion may be occurring at much higher rate than elsewhere in Nigeria [5].

Reported that increased export demands for primates and birds for research and trade in timber and non-timber species are indirect causes of biodiversity loss in various parts of the country. Agricultural intensification, logging and poaching within and around Idanre Foest Reserve have resulted to sharp decline of bird species. In recent times, avian species are becoming intolerant of pressures on their habitats [6]. An assessment of the abundance and diversity of bird species in Idanre Forest Reserve, therefore, serve as a good indication of the health of the environment.

MATERIALS AND METHODS

Study area

Idanre forest reserve has a total land area of 527.1 km^2, although official compartment maps estimate an area of 540.45 km^2 with coordinates of 6°51′28″N 5°06′20″E [7,1]. The forests are a lowland rainforest at altitudes ranging mostly between 10-400 metres above sea level. Within the Idanre reserve there are inselbergs and hilly forests spread across the entire area. However, average altitude for the forest is only about 177 m. The area has mean annual temperature is between 25°C-26°C while generally the minimum temperature is 19°C and the maximum temperature is 33°C. Annual precipitation is between 1200mm – 2200mm. The typical vegetation of the area is mixed deciduous forest [7,8]. The forests falls within the Nigerian lowland forest ecoregion that extends from the eastern margin of the Dahomey Gap in Benin to the Niger River in the west [9] and situated within the Congolian subdivision of the Guinea – Congolian belt [10,8]. Where intact natural forest vegetation still persist, some relatively dominant plant species include *Mansonia altissimas, Nesogordonia papaverifera, Pterygota spp., Sterculia spp., Triplochiton scleroxylon, Antiaris africana, Ficus spp., Milicia excelsa, Brachystegia spp., Cylicodiscus gabunensis, Gossweilerodendron balsamiferum, Piptadeniastrum africanum* [9,11]. However, land cover and original forest vegetation has long been modified by various forms of human activities particularly logging and farming. An equally large area has become fallow dominated by the invasive weed Chromolaena odorata suggesting recent clearing and in some cases the vegetation has regenerated gradually into secondary regrowth and some patches of isolated undisturbed forest in the hilly areas. Original forest cover of the reserve is lost and replaced by secondary forest; secondary bush, plantain plantations cocoa plantations and other form of agricultural/crop land.

Data Collection

The study area was divided into three compartments which include the undisturbed forest area, farmland and Fallow Area for the purpose of this study. Line transects method according to Ref. [12] was used to collect data on bird species diversity, and abundance in the study area. In all a of 30 transect lines were randomly placed measuring 1000 m each transect was divided into 200 m sections with each block having 10 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 0600 hours and 10.00 hours and 1600 hours to 1800 hours, 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 one 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 7 × 50 was used in identification of bird species. Distance estimates were obtained by using a digital range finder. The side of the transect that the bird was recorded was also noted in order to calculate the distance from the transect for groups made up separately recorded individuals which may have been on different sides of the transect. If birds were in a tight group or recordings were to be made, the distance to the centre of the group was taken. Physical features of birds sighted but could not be identified immediately were taken and field guide book of West African birds [13] 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, which is given as:

$Hi = - \Sigma Pi \ In \ Pi$

Where: Hi = 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:

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

Where: D = density
r = radius of the first zone
n_1 = number of birds counted within zone
n_2 = number of birds counted beyond zone and m = number of replicate count in such area.

Habitat analysis

Quadrant method [14] 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 10 cm from 25 × 25m^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 × 25m^2. The following data was collected within each sampling quadrants. They include:, mean height of 22 m and above was considered Tall Emergent Tree, 11 m to 21 m Middle layer and 1 m to 10 m Understorey. The classification of the tree species into different strata layers was carried using Longman and Jennik.

i Total enumeration of all trees above 1 m height and basal area ≥ 10 cm.
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 ≥ 10 cm.

Statistical Analysis

Data obtained from the field survey were entered into 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 farming on the bird diversity was carried out using one way ANOVA.

RESULTS

A total of 136 bird species belonging to 43 families and 18 orders were recorded in the study area. The Order Passeriformes had the highest frequency (51 %) of the entire number of birds encountered, while the dominant family are Bucerotidae and Pycnonotidae, comprising (7.4 %) of the total species (Figure 1). The record of the bird species in the three land use type revealed that the Undisturbed Forest has a total of 115 bird species belonging to 36 families and 16 orders, Fallow Land has 70 bird species belonging to 27 families and 12 orders while, the Farmland has 55 bird species belonging to 29 families and 12 orders as shown in Table 1. The result of the relative abundance of bird species in the study area revealed that Farmland has 0.26 and 0.22 for both seasons of the year, Fallow Area has 0.19 and 0.12 and Disturbed Area has 0.17 and 0.21. From the result obtained on the bird species diversity index Undisturbed Area had the highest diversity index in both seasons of 4.64 while Fallow area has 4.02 and Farmland 3.75 (Table 2-4).

A total of 56 individual tree species in 16 taxa and 11 families were enumerated in the Farmland, the highest occurring tree species is *Ficus* Sur with 3 individuals sampled. The highest DBH of 101cm was recorded in *Ficus exasperata* and the highest mean height of 31m was recorded in *Ficus exasperate*. 96 individual tree species in 28 taxa and 17 families were enumerated in the Fallow Area, the highest occurring tree species is *Ficus exasperata* with 4 individuals sampled. The highest DBH of 145cm was recorded in *Trculia Africana* .Also the highest mean height of 28m was recorded in *Ficus exasperata.*

Table 1: Bird Species Composition in the Study Area

Location	Species	Family	Order
Farmland	55	29	12
Fallow Area	70	27	12
Undisturbed Forest Area	115	36	16

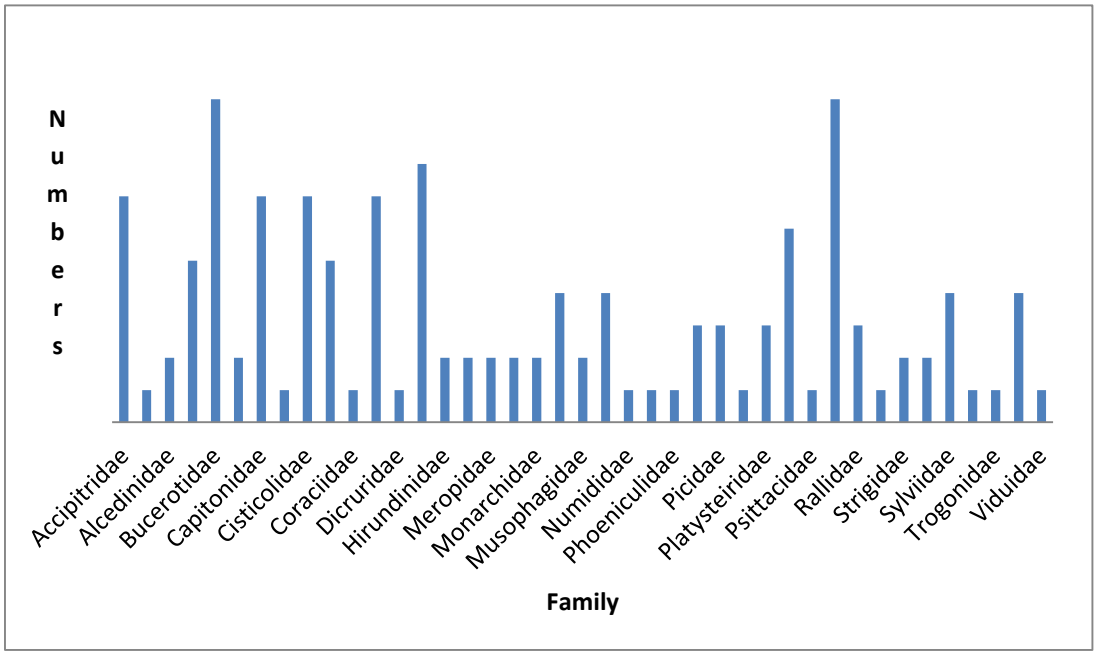

Figure 1: Family Composition of bird species in the Study Area

A total of 253 individual tree species in 67 taxa and 32 families were enumerated in the Undisturbed Area, the highest occurring tree species is *Musanga cecropidiodes* with 14 individuals sampled, the highest DBH of 462 cm was recorded in *Ceiba pentandra* and the highest mean height of 34 m was recorded in *Ceiba pentandra* Figure 2-5 revealed the tree species per each layer in the three different compartments. The Undisturbed area has more tall emergent trees than the rest compartments and most of the left over species in the fallow Area and Farm Land are fruit trees and trees of no economic importance.

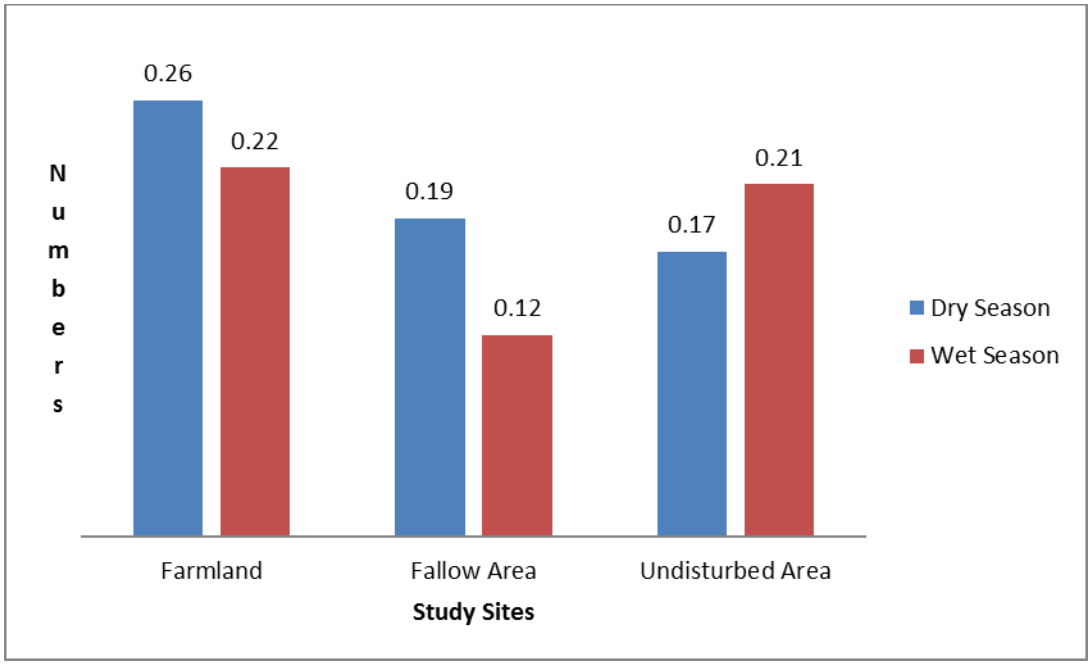

Figure 2: Relative Abundance of Bird Species in the Study Area

Table 2: Diversity index of bird Species in the Study Area

Plots	Birds Mean freq.	Taxa	Individual	Shannon	Dominance	Evenness	Mangalef
FL	4.71±0.56 [a]	56	264	3.75	0.04	0.76	9.86
FA	3.44±0.32 [b]	70	241	4.02	0.02	0.80	12.58
UP	2.10±0.08 [c]	115	242	4.64	0.10	0.93	20.77

Table 3: Checklist of Bid Species in the Study Area

Family	Scintific Name	Common Name
Accipitridae	*Polyboroides typus*	African Harrier Hawk
	Aviceda cuculoides	African Cuckoo Hawk
	Gypohierax angolensis	Palm -Nut Vulture
	Spizaetus africanus	Cassin's Hawk Eagle
	Kaupifalco monogrammicus	Lizard Burzard
	Lophaetus occipitalis	Long Crested Eagle
	Urotriorchis macrourus	Long Tailed Hawk
Anatidae	*Dendrocygna viduta*	White Faced Whistling Duck
Alcedinidae	*Ispidina lecontei*	African Dwarf Kingfisher
	Halcyon badia	Chocolate Backed Kingfisher
Apodidae	*Cypsiurus parvus*	African Palm Swift
	Apus batesi	Bates Swift
	Telacanthura melanopygia	Black Spinetail
	Neafrapus cassini	Cassin's Spinetail
	Rhaphidura sabini	Sabines's Spinetail
Bucerotidae	*Ocyceros griseus*	African Dwarf Hornbill
	Tockus nasutus	Africa Grey Hornbill
	Tockus fasciatus	African Pied Hornbill
	Ceratogymna subcylindricus	Black And White Casqued Hornbill
	Ceratogymna atrata	Black Casqued Hornbill
	Tockus hartlaubi	Blck Dwarf Hornbill
	Ceratogymna fistulator	Pipping Hornbill
	Tockus camurus	Red Billd Dwarf Hornbill
	Ceratogymna albotibialis	White Thinghed Hornbill
	Ceratogymna elata	Yellow Casqued Hornbill
Campephagidae	*Coracina azurea*	Blue Cuckoo Shrike
	Coracina pectoralis	Western Wattle Cuckoo Strike
Capitonidae	*Gymnobucco peli*	Bristle-Nosed Barbet
	Tricholaema hirsuta	Hairy Barbet
	Pogoniulus atroflavus	Red Rumped Tinkerbird
	Gymnobucco calvus	Naked Faced Barbet
	Pogoniulus chrysoconus	Yellow Fronted Tinkerbird
	Pogoniulus bilineatus	Yellow Rumped Tinkerbird
	Pogoniulus subsulphureus	Yellow Throated Tinkerbird

Table-3 cont...

Caprimulgidae	*Macrodipteryx longipennis*	Standard Winged Nightjar
Cisticolidae	*Prinia bairdii*	Banded Prinnia
	Apalis flavida	Yellow Breasted Apalis
	Apalis jacksoni	Black Throated Apalis
	Cisticola erythrops	Red Faced Cisticola
	Camaroptera chloronota	Olive Green Camaroptera
	Prinia subflava	Twany Flanked Prinnia
	Camaroptera superciliaris	Grey Backed Cammaroptera
Columbidae	*Treron calva*	African Green Pigeon
	Stre[topelia semitorqata	Red Eyed Dove
	Turtur afer	Blue Spoted Wood Dove
	Streptopelia senegalensis	Laughing Dove
	Turtur brehmeri	Blue Headed Wood Dove
Coraciidae	*Eurystomus glaucurus*	Broad Billed Roller
Cuculidae	*Chrysococcyx cupreus*	African Emerald Cuckoo
	Cuculus clamosus	Black Cuckoo
	Chrysococcyx caprius	Dideric Cuckoo
	Cercococcyx mechowi	Dusky Long Tailed Cuckoo
	Chrysococcyx klaas	Klaas Cuckoo
	Centropus senegalensis	Senegal Coucal
	Ceuthmochares aereus	Yellowwbill
Dicruridae	*Dicrurus adsimillis*	Fork Tailed Drongo
Estrildidae	*Spermestes bicolor*	Black And White Mannikin
	Nigrita bicolor	Chestnut Breasted Negrofinchh
	Spermestes cucullatus	Bronze Maannikin
	Nigrita canicapilla	Grey Headed Negrofinch
	Nigrita luteifrons	Pale Fronted Negrofinch
	Spermophaga haematina	Western Bluebill
	Parmoptila rubrifrons	Red Fronted Antpecker
	Parmoptila woodhousei	Woodhouse's Red Headed Antpecker
Hirundinidae	*Psalidoprocne obscura*	Fanti Saw Wing
	Cecropis semirufa	Rufous Chested Swallow
Indicatoridae	*Prodotiscus insignis*	Cassin's Honeyguide
	Indicator minor	Lesser Honeyguide
	Malaconotus legdeni	Lagden's Bush Shrike
Meropidae	*Merops pusillus*	Little Bee Eater
	Merops albicollis	White Throated Bee Eater
Motacillidae	*Motacilla flav*	Yellow Wagtail
	Motacilla aguimp	African Pied Wagtail
Monarchidae	*Erythrocercus mccallii*	Chestnut -Capped Flycatcher
	Elminia nigromittrata	Dusky Blue Flycatcher

Table-3 cont...

Muscicapidae	*Fraseria ocreata*	African Forest Flycatcher
	Stiphrornis erythrothorax	Forest Robin
	Cercotrichas leucosticta	Forest Scrub Robin
	Sheppardia cyornithopsis	Lowland Akalat
Musophagidae	*Corythaeola cristata*	Great Blue Turaco
	Tauraco persa	Green Crested Turaco
Nectariniidae	*Chalcomitra adelberti*	Buff Throated Sunbird
	Hedydipna collaris	Collard Sunbird
	Cinnyris coccinigaster	Splendid Sunbird
	Cinnyris venustus	Variable Sunbird
Numididae	*Guttera pucherani*	Crested Guinea Fowl
Oriolidae	*oriolus hosii*	Black Winged Oriole
Phoeniculidae	*Phoeniculus castaneiceps*	Forest Wood Hoopoe
Phsianidae	*Francolinus lathami*	Latam's Forest Francolins
	Ptiopachus petrosus	Stone Partridge
	Francolinus bicalcaratus	Double Spurred Francolin
Picidae	*Campethera caroli*	Brown -Eared Woodpecker
	Campethera nivosa	Buff Throated Woodpecker
	Dendropicos pyrrhogaster	Fire-Bellied Woodpecker
Pittidae	*Pitta angolensis*	African Pitta
Platysteiridae	*Platysteira castanea*	Chestnut Wattle Eye
	Platysteira cyanea	Common Wattle Eye
	Platysteira concreta	
Ploceidae	*Ploceus melanocephalus*	Black Headed Weaver
	Ploceus cucullatus	Village Weaver
	Malimbus scutalus	Red Vented Malimbe
	Ploceus nigricollis	Black Neck Weaver
	Malimbus erythrogaster	Red Headed Malimbe
	Ploceus tricolor	Yellow Mantled Weaver
Psittacidae	*Psittacus erithacus*	Grey Parrot
Pycnonotidae	*Andropadus ansorgei*	Anssorges Greenbull
	Bleda syndactyla	Common Bristlebill
	Pycnonotus barbatus	Common Bulbul
	Bleda eximius	Green Tailed Bristlebill
	Bleda canicapilla	Grey Headed Bristlebill
	Phyllastrephus icterinus	Icterine Greenbull
	Andropadus virens	Little Greenbull
	Chlorocichla simplex	Simple Greenbull
	Chlorocichla simplex	Simple Leave Love
	Nicator chloris	Western Nicator
Rallidae	*Canirallus oculeus*	Grey Throated Rail
	Crex egregia	African Crake
	Himantornis haematopus	Nkulengu Rail
	Sarothrura pulchra	White Spotted Flutail

Table-3 cont...

Recurvirostridae	*Himantopus himantopus*	Black Winged Stilt
Strigidae	*Strix woodfordii*	African Wood Owl
	Bubo shelleyi	Shelley's Eagle Owl
Sturnidae	*Poeoptera lugubris*	Narrow Tailed Starling
	Lamprotornis purpureiceps	Purple Headed Starling
Sylviidae	*Sylvietta virens*	Green Combec
	Hylia prasina	Green Hylia
	Macrosphenus concolor	Grey Longbill
	Eremomela badiceps	Rufous Crowned Eremomela
Timaliidae	*Illadopsis cleaveri*	Black- Capped Illadopsis
Trogonidae	*Apaloderma narina*	Narina's Trogon
Turdidae	*Alethe castanea*	Fire Tailed Alethe
	Zoothera princei	Grey Ground Thrush
	Alethe diademata	White Tailed Alethe
	Neocossyphus poensis	White Tailed Ant Thrush
Viduidae	*Vidua macroura*	Pin Tail Whaydah

Table 4: Pyto-sociological Parameters of Tree Species in the Four Study Area

Location	Individual Tree Species	Taxas	Family	Family Highest Occurrence	Tree Species Highest occurrence	Highest DBH (cm)	Mean Height (m)
Farm Land	56	16	11	Leguminosae 4	*Ficus* Sur 3	*Ficus* exexaperata 101	*Ficus* Sur 27
Fallow Area	96	28	17	Moracea 2	*Ficus* exasperate 4	Treculia African 145	*Ficus* exasperata 28
Undisturbed Forest	253	67	32	Meliaceae and Moraceae 6	Musanga cecropidiodes 14	*Ceiba pentandra* 462	*Ceiba pentandra* 34

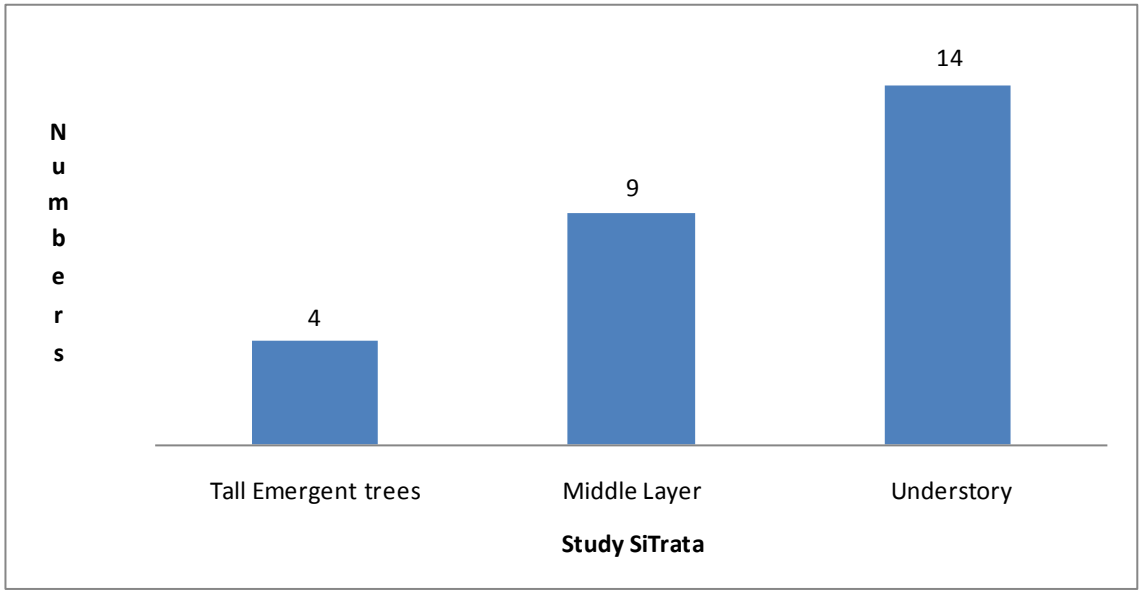

Figure 3: Number of Tree Species in each Strata layer in the Fallow area Study Site

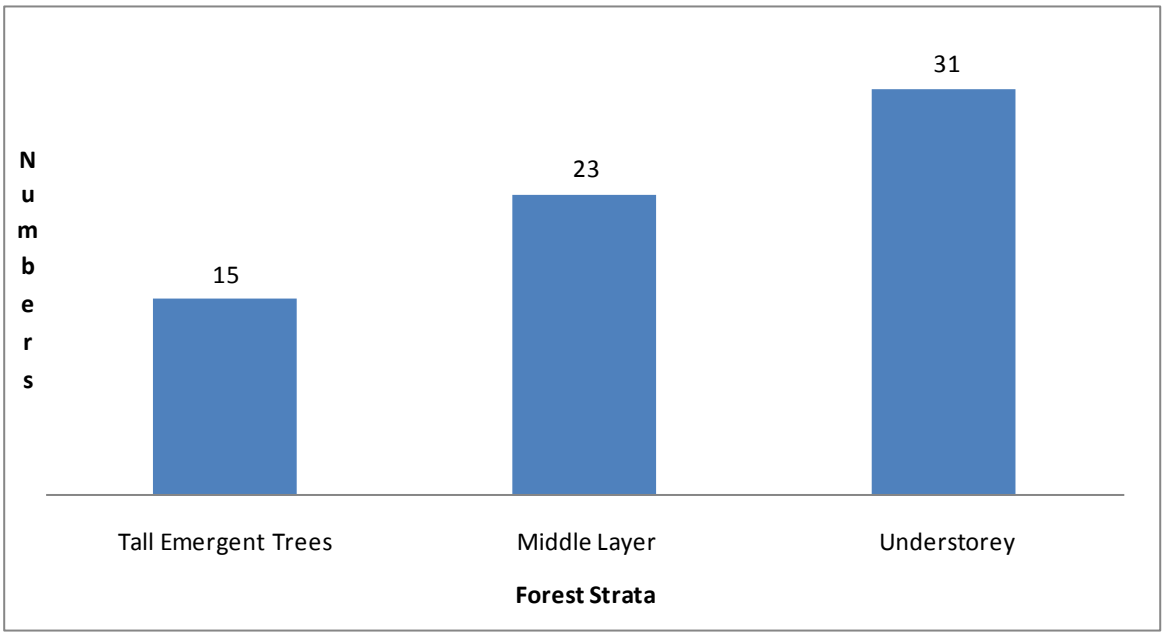

Figure 4: Number of Tree Species in each Strata layer in the Undisturbed Area study Site

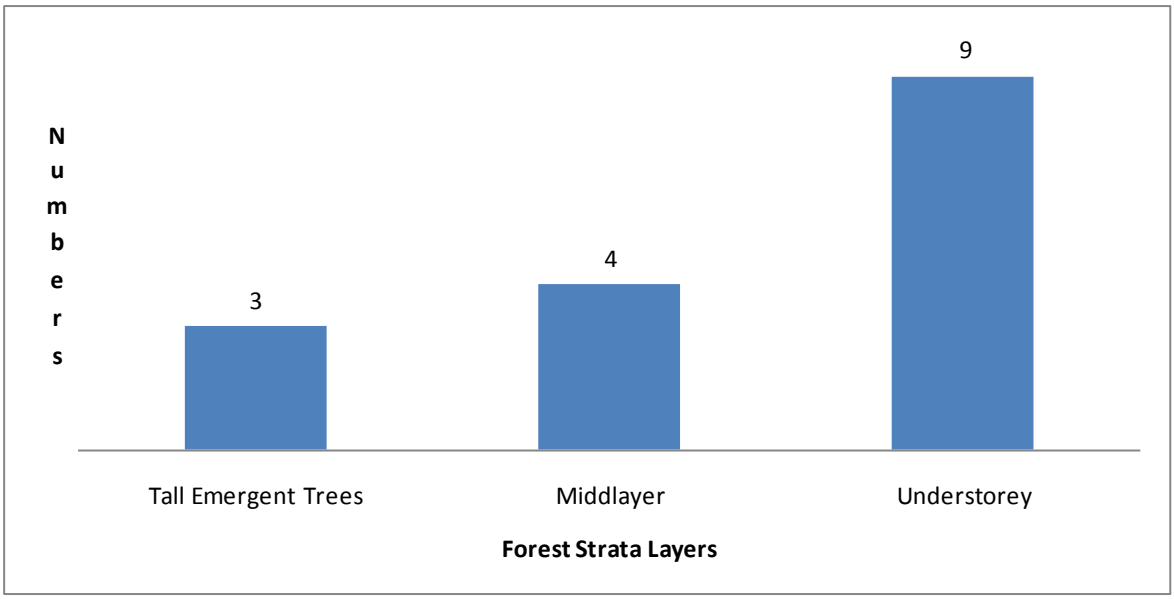

Figure 5: Number of Tree Species in each Strata layer in the farmland study Site

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 in size compared to the undisturbed area. This is consistent with [15,16] that understory dwelling rather than canopy or edge-dwelling habit, specialized foraging strategies and restricted geographic range could be responsible for this observation. In [17,18] 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. In [19,20] reported that resident forest species are often behaviorally inhibited to enter open agricultural land, functioning as a barrier for dispersal. The Fallow have less bird species than the undisturbed forest which is consistent [21,22] that secondary forest have a less complex vegetation structure and a lower species richness of larger trees compared to near-primary forest [21,22] 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 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 [23] who also reported 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*, [24] 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 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 Undisturbed Area (4.64) than the rest two other compartments Fallow Area (4.65) and Farmland (3.65).This result is supported by the previous work were [25] 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 [26] who reported that diversity increases with the number of layers in the vegetation. In [27] reported that tropical wet evergreen forest support more rare bird species than other habitats. In [28] reported that birds select vegetation variables according to the manner by 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 [29,28]. 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 birds 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 [30]. Reduction in habitats quality is thought to be the main underlying causes of the declines in most farmland bird species [31].

In the farmlands we have few trees and less (DBH) resulting in the decline of bird species abundance and richness. This is supported by previous work of [32,33] who 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 which were once common forest species.

CONCLUSION AND RECOMMENDATION

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. Large settlement camps are springing up within the study area and these people are involved in logging, majorly cutting down commercial timber species such as *Ceiba pentandra, Alstonia congensis Cola gigantea, Daniella ogea*, Farming intensification is ongoing in the area and compartments are been cleaved for the cultivation of cocoa and plantain farms. Government official allocate blocks to timber logers without proper monitoring, and poaching is ongoing too. Deforestation and settlements by the local people should be discouraged Sustainable harvest of tree species in this area should be properly managed so that avian habitats can be supported. Land conversion for agricultural purposes is very high in this region, since most of the communities are agrarian. 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.

As a result of urban settlement catching up with the study area from all directions it is like an Island in trouble. This is the reason the management of this Forest Reserve should seek assistance from other conservation agencies that should come up with technical assistance that will further impact on the management of the forest block within the study area.

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