



Research Paper

Habitat Effect on Bird Species Diversity and Richness: A case Study of Gili-gili Forest Reserve Edo state Midwestern Nigeria

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Received: 31/01/2021

Revised: 07/02/2021

Accepted: 10/02/2021

Abstract: This study examined habitat effect on bird species in the Gili-gili forest reserve, Edo state, Midwestern Nigeria. The forest reserve was divided into four compartments for this study: undisturbed forest, secondary forest, farmland, and wetland. The crop grown on the farm is as follows, rice, cassava, maize, and yam. Others are cashew, mango, citrus, and oil palm. The point count method was used to collect data on bird species. Counting stations or predefined spots were established in roosting sites, wetland and feeding sites as well as forest edges. Counting bands of 50m radius were used for all the stations. The minimum distance between two counting distances per each study site was 200m. The number of counting stations was determined by the site size and 15 counting stations in each compartment were laid out and used for data collection. In all, 60 counting stations were used. Data were analyzed using the PAST model version 3 to analyze the diversity index. A total of 712 bird encounters were made with one hundred

and twenty (169) bird species belonging to forty-six (48) families and twenty (20) orders were observed in the study area. Undisturbed forest compartment has the highest bird species diversity (78), secondary forest (34), wetland (30) and farmland (27). Farmland compartment has bird species richness (273) followed by secondary forest (149) undisturbed forest (121) and wetland (115). The diversity index indicates it was higher in the dry season 4.996 than the wet season 4.922.

Keywords: *Land use, Crop types, Bird species, Richness and Diversity, and conservation:*

Introduction:

Birds are among the best monitors of environmental changes and have been used to evaluate the environment throughout history as bio-monitors and the changes in their population, behavior patterns, and reproductive ability have most often been used to examine the long term effects of habitat fragmentation. Hence they are the

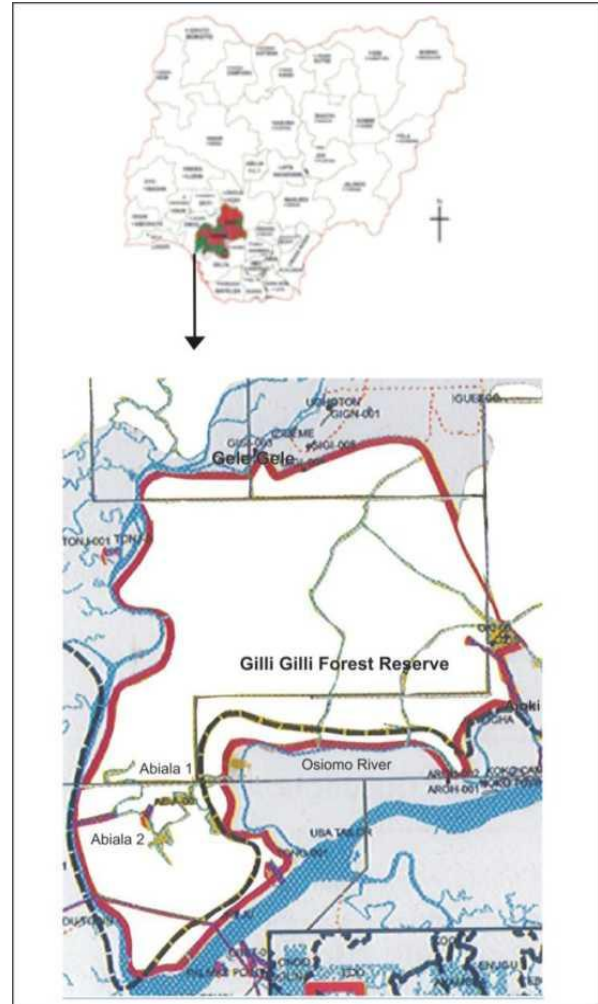
good indicators of the ecological status of any given ecosystem (Castelletta, *et. al.*, 2000). Forests attract much avifauna because of the habitat suitability for most of them. This especially includes the birds that are associated with the vegetation, and for most, the existence of trees is vital to their life cycle. Birds show different levels of interest to various stands depending on the age of the stands. Deforestation in the tropics is one of the major threats to global biodiversity (Dobson *et. al.*, 1997). The relationship between species diversity and its components, richness, and evenness, has been receiving increased attention. Boulinier, *et. al.* (1998) has proposed that changes in diversity may be mediated by changes in one or the other component and that these changes reflect alternative environmental conditions. He suggests that diversity changes with richness in relatively stable, benign environments and varies with evenness under unstable, rigorous conditions. Bird species have not been carried out since it was gazetted in 1935. This paper, therefore, seeks to explore the differences in bird species diversity and composition in the protected and unprotected habitat of Gele-Gele Forest Reserve, Edo State.

Materials and Methods:

Study Area

Gele-gele forest reserve was instituted in 1935. Located on Lat. $5^{\circ} 55'$ & $6^{\circ} 09'N$ and Long. $5^{\circ} 16'$ & $5^{\circ} 27'E$; is located in Ovia North-East Local Government Area of Edo State, Nigeria. The reserve covers an area of 365 Km^2 that ranged from water swamp forest to tropical rain forest. The reserve is drained by rivers Osse and Benue (Aremu, *et. al.*, 2009). The climate of the area is a typical humid tropical rainforest type with an average annual temperature of 27°C . Relative humidity ranging from 60% in the driest months (December-January) to almost 100% during the wettest months (July and

September) (Megistu and Salami, 2007). Rainfall is heavy for about 9 months of the year from March to November with an average annual rainfall of 1778mm to 2286mm, well-distributed within the rainy season.



**Map of the Study Area Source
(Ekeoba, 2015)**

The dry season lasts from December to February. The major soil type is sandy loam; the texture of the soil is responsible for its high permeability and high base-leaching. These conditions, together with the high annual rainfall, induce high soil acidity with soil pH values ranging from 4.30-5.00 (Isichei, 1995). The vegetation type is the Guinea-Congo lowland rainforest including the area of the swamp-forest, high forest, secondary forest and open scrubs (Keay, 1989). The sizeable

number of timber species which include *Kapok*, *Celtiszenkerii*, *Triplochitonscleroxylon* (*Obechie*), *Antiarisaficana*, *Pycnathusangolensis*, and *Alstoniacongensis Halleacilata*, *Lophiraalata*, *Massulariaacumulata*, *Okoubakaaubrevillei*, *Miliciaexcelsa*, *Pipterdeniastriumafricanum*, *Xylopiiaethiopicahas made the reserve an attractive source of timber to logging companies* (Ikhuoria, 1993, Ekeoba, 2015) Other non-timber forest products: fuelwood, chewing sticks, medicinal plants, construction and weaving materials, vegetables, and other food materials are exploited from the reserve.

Data Collection

The study area was divided into four compartments which include the sustenance farm Compartment, Secondary forest compartment, undisturbed forest Compartment and Wetland compartment for this study. Counting stations (Sutherland, 2009) were used to collect data on bird species richness and diversity. Counting stations or predefined spots were established in roosting sites, wetland and feeding sites as well as forest edges. Counting bands of the 50m radius were used for all the stations. The minimum distance between two countings per each study site's stations was 200m. The number of counting stations was determined by the site size. In all, 45 counting stations were used, 15 counting stations in each compartment were laid out. On arrival at the sites, birds were allowed to settle before recording all the birds seen or heard for a predetermined time (20 min). Bird calls were also recorded with a voice recorder and played back later for confirmation. Physical features of birds were sighted but could not be identified immediately when taken, field guidebook of West African birds (Burrow and Demey, 2011) was used to identify the bird species and bird calls

were used to confirm the presence of nocturnal bird species within the study site.

From the data collected, avian species diversity was calculated using Shannon diversity index, which is given as: $H_i =$ diversity index $P_i =$ is the proportion of the i th species in the sample

$\ln P_i =$ 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:

$$H_i = - \sum P_i \ln P_i$$

$$D = n_1 + n_2 \text{Loge} [n_1 + n_2]$$

$$\pi r^2 m n_2$$

Where: $D =$ density

$r =$ radius of the first zone

$n_1 =$ number of birds counted within the zone

$n_2 =$ number of birds counted beyond zone and $m =$ number of the replicate count in such area.

Data obtained from the field survey were entered into Excel (version 15) spreadsheet before both descriptive (tables, frequency, and percentage frequency, graph, pie and bar charts) and analytical statistics. The computer PAST Model version 3 was used to analyze bird species diversity, Rarefaction, and SHE analysis.

Results:

From the result obtained in this research study, it revealed that different land-use types affected the bird species richness and diversity in the study area. A total of 712 bird encounters was made with one hundred and twenty (169) bird species belonging to forty-eight (48) families and sixteen (20) orders were observed in the study area. The result of bird species richness in the study area indicated that the Farmland compartment has the highest (273) bird species richness, followed by secondary forest compartment (149),

Table: 1. Bird species diversity index in the study area

Diversity index	Dry season	Lower	Upper	Wetseason	Lower	Upper
Taxa_S	169	158	168	155	146	155
Individuals	339	339	339	319	319	319
Dominance_D	0.008153	0.008258	0.01061	0.008402	0.008834	0.01098
Shannon_H	4.996	4.842	4.954	4.922	4.767	4.877
Evenness_e^H/S	0.8748	0.7856	0.8546	0.8853	0.7914	0.8571
Brillouin	4.38	4.265	4.351	4.316	4.198	4.282
Menhinick	9.179	8.581	9.125	8.678	8.174	8.678
Margalef	28.84	26.95	28.66	26.71	25.15	26.71
Equitability_J	0.9739	0.9526	0.9692	0.9758	0.9533	0.9693

From the result obtained of the bird species in the four compartments, it is shown that the undisturbed forest compartment has the highest bird species

(78), this is followed by Secondary forest compartment (34), wetland compartment has 30 bird species and farmland compartment (27) Figure,4.

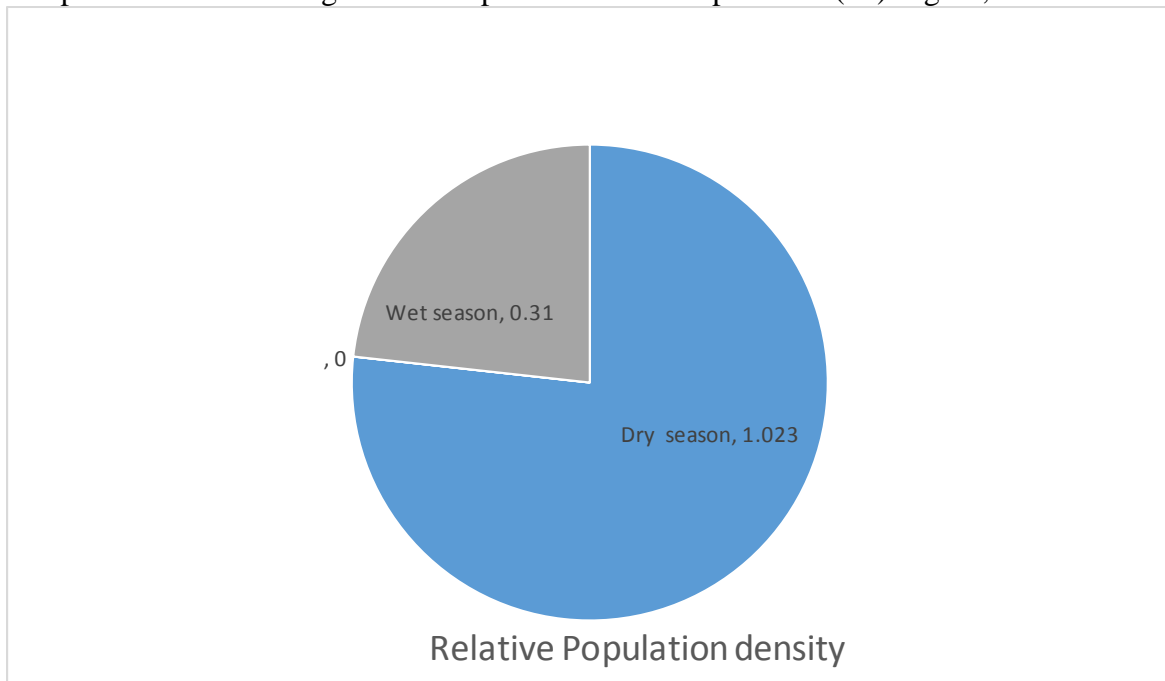


Figure 4. Relative Population Density of Bird Species in the Study area

From the result of the status of bird species enumeration, it was observed that most of the bird species were resident 149,

Palaearctic migrants 12, intra-African migrant 7 and vagrant 1 in the study area Figure 5.

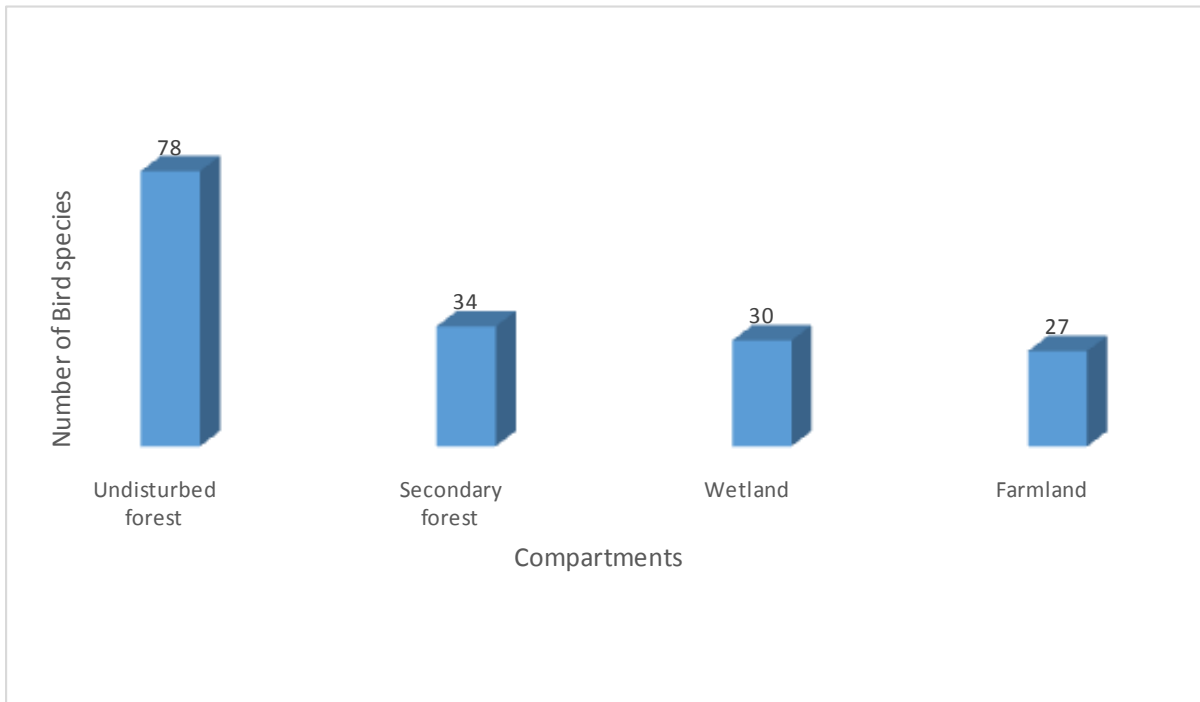


Figure 5: Bird species diversity each compartment

From the obtained most bird species are forest bird species and are resident 149, 12 Palearctic migrants, 7 intra-Africa

migrants, and 1 vagrant Bird species Figure 6.

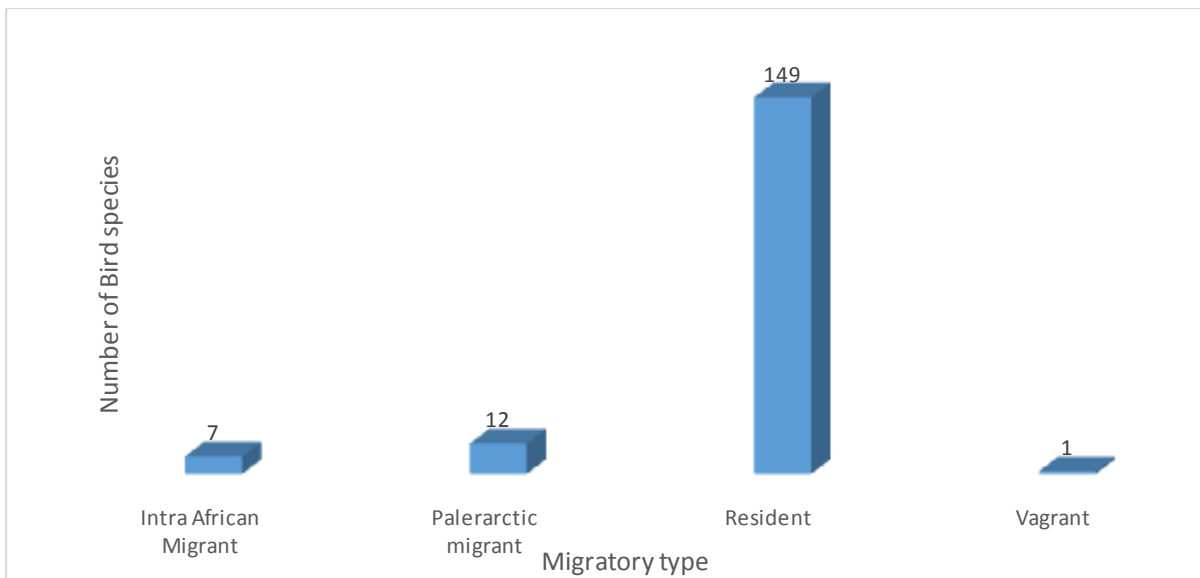


Figure 6 Migratory pattern of Bird species in the study area

Table 2, Checklist of Bird species in the study area

	Scientific names	Common names	Orders
Alcedinidae	<i>Megaceryle maxima</i>	Giant Kingfisher	Coraciiformes
Jacanidae	<i>Actophilornisafricanus</i>	African Jacana	Charadriiformes
Cuculidae	<i>Chrysococcyx cupreus</i>	African Emerald Cuckoo	Cuculiformes
Accipitridae	<i>Haliaeetus vocifer</i>	African Fish Eagle	Accipitriformes
Muscicapidae	<i>Fraseria ocreata</i>	African Forest Flycatcher	Passeriformes
columbidae	<i>Treron calva</i>	African Green Pigeon	Columbiformes
Psittacidae	<i>Psittacus erithacus</i>	African Grey Parrot	Psittaciformes
Accipitridae	<i>Polyboroides typus</i>	African Harrier Hawk	Accipitriformes
Accipitridae	<i>Hieraaetus spilogaster</i>	African Hawk Eagle	Accipitriformes
Falconidae	<i>Falco cuvierii</i>	African Hobby	Falconiformes
Apodidae	<i>Cypsiurus parvus</i>	African Palm Swift	Caprimulgiformes
Bucerotidae	<i>Tockus fasciatus</i>	African Pied Hornbill	Bucerotiformes
Motacillidae	<i>Motacilla alba</i>	African Pied Wagtail	Passeriformes
Pittidae	<i>Pitta angolensis</i>	African Pitta	Passeriformes
Platysteiridae	<i>Megabyas flammulatus</i>	African Shrike Flycatcher	Passeriformes
Strigidae	<i>Strix woodfordii</i>	African Wood Owl	Strigiformes
Rallidae	<i>Porphyrio alleni</i>	Allens Gallinule	Gruiformes
Pycnonotidae	<i>Andropadus ansorgei</i>	Anssorges Greenbull	Passeriformes
Bucerotidae	<i>Tockus hartlaubi</i>	Black Dwarf Hornbill	Coraciformes
Bucerotidae	<i>Ceratogymna subcylindricus</i>	Black And White Casqued Hornbill	Bucerotiformes
Estrildidae	<i>Spermestes bicolor</i>	Black And White Mannikin	Passeriformes
Bucerotidae	<i>Ceratogymna atrata</i>	Black Casqued Hornbill	Bucerotiformes
Cuculidae	<i>Centropus grillii</i>	Black Coucal	Cuculiformes
Rallidae	<i>Amaurornis flavirostris</i>	Black Crake	Gruiformes
Ploceidae	<i>Ploceus nigricollis</i>	Black Neck Weaver	Passeriformes
Malaconotidae	<i>Dryoscopus senegalensis</i>	Black Shouldered Puffback	Passeriformes
Cisticolidae	<i>Apalis jacksoni</i>	Black Throated Apalis	Passeriformes
Oriolidae	<i>Oriolus brachyrhynchus</i>	Black Winged Oriole	Passeriformes
Recurvirostridae	<i>Himantopus himantopus</i>	Black Winged Stilt	Charadriiformes

Ardeidae	<i>Nycticoraxnycticorax</i>	Black-crowned heron	Pelecaniformes
Ardeidae	<i>Ardeamelanocephala</i>	Black-headed Heron	Pelecaniformes
Coraciidae	<i>Coraciascyanogaster</i>	Blue Bellied Roller	Coraciiformes
Ploceidae	<i>Malimbusnitens</i>	Broad Billed Malimbe	Passeriformes
Campephagidae	<i>Coracinaazurea</i>	Blue Cuckoo Shrike	Passeriformes
Muscicapidae	<i>Trochocercusnitens</i>	Blue Headed Crested Flycatcher	Passeriformes
Columbidae	<i>Turturbrehmeri</i>	Blue Headed Wood Dove	Columbiformes
columbidae	<i>Turturafer</i>	Blue Spotted Wood Dove	Columbiformes
Ramphastidae	<i>Gymnobuccopeli</i>	Bristled Nosed Barbet	Piciformes
Coraciidae	<i>Eurystomusglaucus</i>	Broad Billed Roller	Coraciiformes
Estrildidae	<i>Spermestesucullatus</i>	Bronze Mannikin	Passeriformes
Nectariniidae	<i>Chalcomitraadelberti</i>	Buff Throated Sunbird	Passeriformes
Picidae	<i>Campetheranivosa</i>	Buff Throated Woodpecker	Piciformes
Accipitridae	<i>Spizaetusaffricanus</i>	Cassin's Hawk Eagle	Accipitriformes
Apodidae	<i>Neafrapuscassini</i>	Cassin's Spintail	Caprimulgiformes
Estrildidae	<i>Nigrita bicolor</i>	Chestnut Breasted Negrofinch	Passeriformes
Monarchidae	<i>Erythrocercusmccallii</i>	Chestnut -Capped Flycatcher	Passeriformes
Accipitridae	<i>Accipiter castanilius</i>	Chestnut Flanked Sparrowhawk	Accipitriformes
Platysteiridae	<i>Platysteiracastanea</i>	Chestnut Wattle Eye	Passeriformes
Alcedinidae	<i>Halcyon badia</i>	Chocolate Backed Kingfisher	Coraciiformes
Glareolidae	<i>Glareolapratincola</i>	Collard Pratincole	Charadriiformes
Nectariniidae	<i>Hedydipnacollaris</i>	Collard Sunbird	Passeriformes
Pycnonotidae	<i>Pycnonotusbarbatus</i>	Common Bulbul	Passeriformes
Scolopacidae	<i>Tringanebularia</i>	Common Greenshank	Charadriiformes
Rallidae	<i>Gallinulachloropus</i>	Common Moorhen	Gruiformes
Scolopacidae	<i>Tringaerythropus</i>	Common Redshank	Charadriiformes
Scolopacidae	<i>Actitishypoleucos</i>	Common Sandpiper	Charadriiformes
Platysteiridae	<i>Platysteiracyanea</i>	Common Wattle Eye	Passeriformes
Numididae	<i>Gutterapucherani</i>	Crested Guinea Fowl	Galliformes
Ploceidae	<i>Malimbusmalimbicus</i>	Crested Malimbe	Passeriformes
Cuculidae	<i>Chrysococcyxcaprius</i>	Dideric Cuckoo	Cuculiformes

Monarchidae	<i>Elminianigromittrata</i>	Dusky Blue Flycatcher	Passeriformes
Cuculidae	<i>Cercococyxmechowi</i>	Dusky Long Tailed Cuckoo	Cuculiformes
Hirundinidae	<i>Psolidoprocneobscura</i>	Fanti Saw Wing	Passeriformes
Turdidae	<i>Alethecastanea</i>	Fire Tailed Alethe	Passeriformes
Muscicapidae	<i>Stiphorniserythrothorax</i>	Forest Robin	Passeriformes
Muscicapidae	<i>Cercotrichas leucosticte</i>	Forest Scrub Robin	Passeriformes
Phoeniculidae	<i>Phoeniculuscastaneiceps</i>	Forest Wood Hoopoe	Bucerotiformes
Dicruridae	<i>Dicrurusadsimilis</i>	Fork Tailed Drongo	Passeriformes
Strigidae	<i>Bubo poensis</i>	Frasser's Eagle Owl	Strigiformes
Picidae	<i>Dendropicogabonesis</i>	Gabon Woodpecker	Piciformes
Musophagidae	<i>Corythaeolacristata</i>	Great Blue Turaco	Musophagiformes
Ardeidae	<i>Ardea alba</i>	Great Egret	Pelecaniformes
Sylviidae	<i>Sylviattavirens</i>	Green Combec	Passeriformes
Sylviidae	<i>Hylia prasina</i>	Green Hylia	Passeriformes
Scolopacidae	<i>Tringa ochropus</i>	Green Sandpiper	Charadriiformes
Nectariniidae	<i>Anthreptesrectirostris</i>	Green Sunbird	Passeriformes
Pycnonotidae	<i>Bledaeximius</i>	Green Tailed Bristlebill	Passeriformes
Musophagidae	<i>Tauracopersa</i>	Green Turaco	Musophagiformes
Phoeniculidae	<i>Phoeniculuspurpureus</i>	Green Wood Hoopoe	Bucerotiformes
Ardeidae	<i>Butoridesstriata</i>	Green-backed Heron	Pelecaniformes
Turdidae	<i>Zoothera prince</i>	Grey Ground Thrush	Passeriformes
Glareolidae	<i>Glareolacinerea</i>	Grey pratincole	Charadriiformes
Cisticonidae	<i>Cameroptera brachyuran</i>	Grey Backed Cameroptera	Passeriformes
Pycnonotidae	<i>Bledacanicapilla</i>	Grey Headed Bristlebill	Passeriformes
Pycnonotidae	<i>Bledacanicapilla</i>	Grey Headed Bristlebill	Passeriformes
Estrildidae	<i>Nigritacanicapilla</i>	Grey Headed Negrofinch	Passeriformes
Rallidae	<i>Canirallusoculeus</i>	Grey Headed Rail	Gruiformes
Pycnonotidae	<i>Macrosphenusconcolor</i>	Grey Longbill	Passeriformes
Rallidae	<i>Ralluscaeruuslescens</i>	GreyThroated Rail	Gruiformes
Ramphastidae	<i>Tricholaema hirsute</i>	Hairy Barbet	Piciformes
Scopidae	<i>Scopus umbretta</i>	Hamerkop	Charadriiformes
Pycnonotidae	<i>Phyllastrephusicterinus</i>	Icterine Greenbull	Passeriformes

Cuculidae	<i>Chrysococcyxklaas</i>	Klaas Cuckoo	Cuculiformes
Malaconotidae	<i>Malaconotuslegdeni</i>	Lagden's Bush Shrike	Passeriformes
Malaconotidae	<i>Dryoscopussabini</i>	Large Billed Puffback	Passeriformes
Charadriidae	<i>vanelluslugubris</i>	Lesser Black-Winged Lapwing	Charadriiformes
Hirundinidae	<i>Hirundoabyssinica</i>	Lesser Striped Swallow	Passeriformes
Apodidae	<i>Apus affnis</i>	Little Swift	Caprimulgiformes
Meropidae	<i>Meropspusillus</i>	Little Bee Eater	Coraciiformes
Ardeidae	<i>Isobrycusminutus</i>	Little bittern	Pelecaniformes
Accipitridae	<i>Kaupifalcomonogrammicus</i>	Lizard Burzard	Accipitriformes
Accipitridae	<i>Lophaetus occipitalis</i>	Long Crested Eagle	Accipitriformes
Accipitridae	<i>Urotiorchismacrourus</i>	Long Tailed Hawk	Falconiformes
Muscicapidae	<i>Sheppardiacyornithopsis</i>	Lowland Akalat	Passeriformes
Alcedinidae	<i>Alcedocristata</i>	Malachite Kingfisher	Coraciiformes
Scolopacidae	<i>Trigastagnatilis</i>	Marsh Sandpiper	Charadriiformes
Ploceidae	<i>Ploceusalbinucha</i>	Maxwell;S Weaver	Passeriformes
Ramphastidae	<i>Gymnobuccocalvus</i>	Naked Faced Barbet	Piciformes
Trogonidae	<i>Apalodermanarina</i>	Narina's Trogon	Trogoniformes
Sturnidae	<i>Poeopteralugubris</i>	Narrow Tailed Starling	Passeriformes
Rallidae	<i>Sarothrurapulchra</i>	Nkulengu Rail	Gruiformes
Cisticolidae	<i>Camaropterachloronota</i>	Olive- Green Camaroptera	Passeriformes
Cuculidae	<i>Cercococcyxolivinus</i>	Olive- Long Taile d Cuckoo	Cuculiformes
Estrildidae	<i>Nigritaluteifrons</i>	Pale Fronted Negrofinch	Passeriformes
Accipitridae	<i>Gypohieraxangolensis</i>	Palm Nut Vulture	Accipitriformes
Bucerotidae	<i>Ceratogymnafistulator</i>	Pipping Hornbill	Bucerotiformes
Motacillidae	<i>Anthusleucophrys</i>	Plain Backed Pipit	Passeriformes
Pycnonotidae	<i>Andropaduscurvirostris</i>	Plain Greenbull	Passeriformes
Sturnidae	<i>Lamprotornispurpleiceps</i>	Purple Headed Starling	Passeriformes
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphe n	Gruiformes
Bucerotidae	<i>Tockuscamurus</i>	Red Billed Dwarf Hornbill	Bucerotiformes
Estrildidae	<i>Lagonostictasenegala</i>	Red Billed Firefinch	Passeriformes
Prionopidae	<i>Prionopscaniceps</i>	Red Billed Helmet-Strike	Passeriformes
Cuculidae	<i>Cuculussolitaius</i>	Red Chested Cuckoo	Cuculiformes

Columbidae	<i>Streptopelia semitorquata</i>	Red Eyed Dove	Columbiformes
Cisticolidae	<i>Cisticola erythropus</i>	Red Faced Cisticola	Passeriformes
Estrildidae	<i>Cryptospiza reichenovii</i>	Red Faced Crimsonwing	Passeriformes
Ploceidae	<i>Malimbus erythrogaster</i>	Red Headed Malimbe	Passeriformes
Ramphastidae	<i>Pogoniulus atroflavus</i>	Red Rumped Tinkerbird	Piciformes
Pycnonotidae	<i>Pycnonotus cafer</i>	Red Tailed Greenbul	Passeriformes
Ploceidae	<i>Malimbus scutatus</i>	Red Vented Malimbe	Passeriformes
Nectariniidae	<i>Anabathmis reichenbachii</i>	Reichenbach's Sunbird	Passeriformes
Psittacidae	<i>Psittacula krameri</i>	Rose Ringed Parakeet	Psittaciformes
Sylviidae	<i>Eremomela badiceps</i>	Rufous Crowned Eremomela	Passeriformes
Malaconotidae	<i>Dryoscopus angolensis</i>	Sabine's Puffback	Passeriformes
Cuculidae	<i>Centropus senegalensis</i>	Senegal Coucal	Cuculiformes
Strigidae	<i>Bubo shelleyi</i>	Shelley's Eagle Owl	Strigiformes
Dicruridae	<i>Dicrurus atripennis</i>	Shinning Drongo	Passeriformes
Pycnonotidae	<i>Chlorocichla simplex</i>	Simple Greenbul	Passeriformes
Pycnonotidae	<i>Chlorocichla simplex</i>	Simple Leaflove	Passeriformes
Muscicapidae	<i>Muscicapa infusate</i>	Sooty Flycatcher	Passeriformes
Ramphastidae	<i>Pogoniulus scolopaceus</i>	Speckled Tinkerbird	Piciformes
Scolopacidae	<i>Tringa erythropus</i>	Spotted Redshank	Charadriiformes
Charadriidae	<i>Vanellus spinosus</i>	Spur-Winged Lapwing	Charadriiformes
Ardeidae	<i>Ardeolaralloides</i>	Squacco heron	Pelecaniformes
Caprimulgidae	<i>Macrodipteryx longipennis</i>	Standard Nightjar	Caprimulgiformes
columbidae	<i>Turtur tympanistris</i>	Tambourine Dove	Columbiformes
Glareolidae	<i>Cursorius temminckii</i>	Temminck Courser	Charadriiformes
Cuculidae	<i>Pachycoccyx audeberti</i>	Tick Billed Cuckoo	Cuculiformes
Nectariniidae	<i>Cinnyris venustus</i>	Variable Sunbird	Passeriformes
Ramphastidae	<i>Lybius vieilloti</i>	Velliot's Barbet	Piciformes
Ploceidae	<i>Ploceus nigerrimus</i>	Velliot's Weaver	Passeriformes
Accipitridae	<i>Aquila wahlbergi</i>	Wahlberg Eagle	Accipitriformes
Oriolidae	<i>Oriolus brachyrhynchus</i>	Western Black Headed Oriole	Passeriformes
Estrildidae	<i>Spermophaga haematina</i>	Western Blue bill	Passeriformes
Pycnonotidae	<i>Nicator chloris</i>	Western Nicator	Passeriformes

Bucerotidae	<i>Tockusalbocristatus</i>	White Crested Hornbill	Bucerotiformes
Anatidae	<i>Dendrocygnaviduata</i>	White Faced Whistling Duck	
Musophagidae	<i>Alethediademata</i>	White Tailed Alethe	Musophagiformes
Bucerotidae	<i>Ceratogymnaalbotibialis</i>	White Thinghed Hornbill	Bucerotiformes
Meropidae	<i>Meropsalbicollis</i>	White Throated Bee Eater	Coraciiformes
Scolopacidae	<i>Tringaglareola</i>	Wood Sandpiper	Charadriiformes
Estrildidae	<i>Parmoptilawoodhousei</i>	Woodhouse's Antpecker	Passeriformes
Ciconiidae	<i>Ciconiaepiscopus</i>	Woolly-necked Stork	
Cisticonidae	<i>Apalisflavida</i>	Yellow Breasted Apalis	Passeriformes
Bucerotidae	<i>Ceratogymnaelata</i>	Yellow Casqued Hornbill	Bucerotiformes
Ramphastidae	<i>Pogoniuluschrysoconus</i>	Yellow Fronted Tinkerbird	Piciformes
Ramphastidae	<i>Buccanodonduchailui</i>	Yellow Spotted Barbet	Piciformes
Motacillidae	<i>Motacillaflav</i>	Yellow Wagtail	Passeriformes

Discussion:

The bird species richness in this study differed between land uses. The higher bird species richness was observed in the farmland compartment probably due to the food resource availability in this land-use type. Some of the farming activities conducted in this compartment that influence the availability of food for birds from fresh rice, and maize grain to dry rice grain seeds, palm and cocoa fruits which are favored by most bird species. Moreover, the Wetland compartment was made up of bird species that utilize the wetland because there was available food to support them. These findings are consistent with previous studies, which suggested a high volume availability of preferred food in the cultivated areas than the uncultivated areas (Kormar 2006). Farmland provides essential foraging opportunities to many European farmland birds (Bos *et al.*, 2009 and Atkinson *et al.* 2002). Arable land provides essential foraging opportunities to many European farmland birds (Robinson *et al.*, 2001). Non-crop vegetation in arable fields provides an important source of seeds, but

perhaps as importantly, it recruits insects (Marshall *et al.*, 2003). Different groups of bird species seem to respond differently to land analyzed uses. Insectivores are known to present marked responses to land-use change (Walter *et al.*, 2005) which was for annual agricultural areas were insectivores mean a number of recordings per visit decayed by 50% in relation controls. Arable land provides essential foraging opportunities to many European farmland birds (Robinson *et al.*, 2001).

From the result, it was found that the diversity of bird species in home garden land use was the highest in the undisturbed forest compartment. This is due to the presence of varieties of microhabitats that provide a niche for different species of birds. The higher diversity in this compartment use was due to high numbers of individuals in some bird species and diverse vegetation types as microhabitats which favored varieties of bird species. Vegetation cover has been reported to have a strong influence on avifauna diversity (Radford, 2005). Also, vegetation is among the factors which influence bird

diversity in tropical Africa depends on (Sodhi, 2004). Non-crop vegetation in arable fields provides an important source of seeds, but perhaps as importantly, it recruits insects (Marshall *et al.*, 2003). Yet, recent changes in farming practices have reduced the value of arable cropland as a food source. A shift to fall planting (Evans and Green 2007) and increased nitrogen inputs (Billeter *et al.*, 2008) resulted in an increased density of crop vegetation, limiting many species' ability to forage. The increased use of pesticides and shift to fall planting lowers both seed and insect food resources (Boatman *et al.* 2004). Similarly, the loss of winter stubble, resulting from a shift to fall planting, reduced the availability of seeds for granivorous farmland birds (Evans 2003). The introduction of genetically modified crops is engineered to limit weed and insect populations, further impacting avian food resources (Wilson *et al.*, 2009). Including arable fields in conservation efforts is important because the needs of many farmland species are best met by arable fields that in the past provided sufficient food and cover but are now being lost to intensification (Butler and Gillings, 2010). Foraging and nesting opportunities can be improved by providing both spatial and structural vegetative heterogeneity within a field (Morris *et al.*, 2004) such as the incorporation of greater disturbance to produce an abundance of seeds (Wilson *et al.*, 2010).

As observed during the period of this study, fertilizers, herbicides, and pesticides were used in rice and maize plots. The use of these chemicals could be responsible for decrease the diversity of bird species in the Arable Crop Compartment. This finding is consistent with the following authors Arcos *et al.*, (2008), Chamberlain *et al.*, (2006), who reported that increased use of pesticides and fertilizers affects reproduction and mortality both directly

and indirectly. Direct effects occur instantly via failed reproduction or immediate mortality. Indirect effects impact via reduced food supplies. For example, the use of herbicides decreases weed populations and hence also weed seed availability in agricultural areas, reducing food supply in both the short and long term. Weeds also support insects, another important component in the diet of birds. The use of fertilizers benefits the growth of improved crops at the expense of wild plants, resulting in uniform fields with dense crop canopies that are less accessible to farmland birds for use as foraging or breeding habitat.

There is a strong observed correlation between countrywide declines of farmland birds and loss of woody edges (Wilson *et al.* 2009). One-quarter of the risk to farmland birds is attributed to the loss of margins and hedgerows (Butler and Gillings, 2010).

Conclusion and Recommendations:

The study concludes that difference in uses of land has huge influences on bird species diversity. The study revealed further that the wetland is very important to the bird communities. Of the five dominant land uses, the arable zone had the highest abundance bird species this maybe probably as a result of availability food in the compartment. There was a greater variation in species richness between land-use types. Habitat destruction due to the increase in land use imposed a net negative effect on the population of birds. From the study on the richness, and diversity of tree species in relation to land use, it can be concluded that agroforestry compartment land use has the highest diversity. The human disturbance had a significant effect on tree diversity and richness in different land-use type, to maintains the avifauna diversity of the area, land use planning that both protects the native tree species and emphasizes on bird-friendly landscape

design may enhance avian and tree species diversity within the area.

Strict law enforcement on farming practices that will have negative effects on avifauna in the study area should be discouraged. Community education and promotion of alternative income-generating activities should be encouraged and Community education and promotion of alternative income-generating activities should be encouraged.

This should go hand in hand with the restoration of the ecosystem through reforestation in most degraded areas.

Acknowledgement:

The authors are very grateful to the Staff and Management of Edo State Ministry of Agriculture and Natural Resources and especially the Director of Forestry Department for their support during the period of the study

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