



Research Paper

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

Okosodo, E. F. and Sarada Prasad Mohapatra

Department of Leisure and Tourism Management, The Federal Polytechnic Ilaro, PMB 50, Ilaro Ogun State Nigeria.

Department of Botany, Narasingha Choudhury Autonomous college, Jaipur, Odisha, India.

Corresponding author: francis.okosodo@federalpolyilaro.edu.ng,
bot.ncacjajpur@gmail.com

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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).

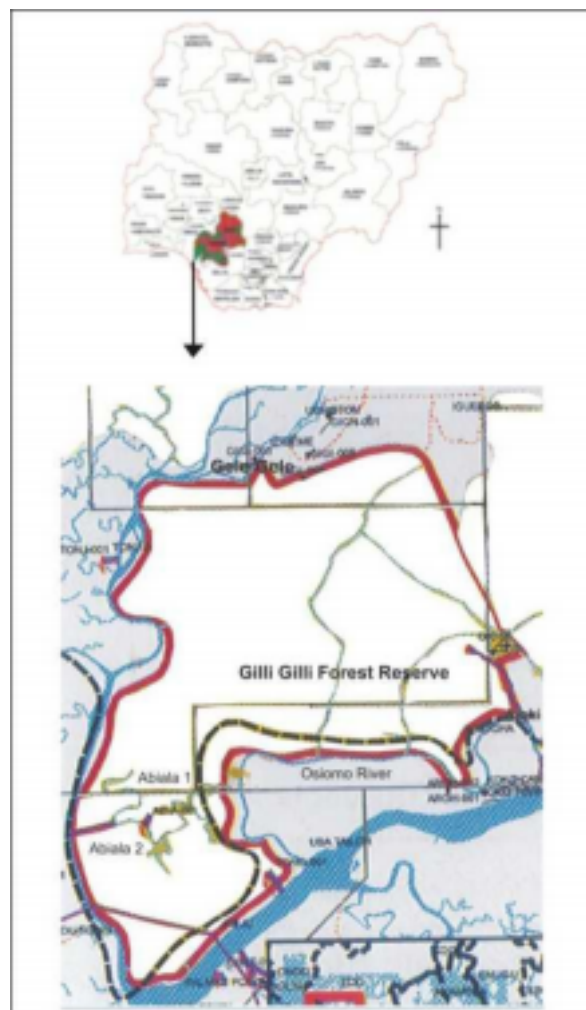
The relationship between species diversity and its components, richness, and evenness, has been receiving increased attention. Boulinier, *et. al.* (1998) has proposed that changes in diversity may be mediated by changes in one or the other component and that these changes reflect alternative environmental 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. $5^{\circ}55'1''$ & $6^{\circ}09'0''$ N and Long. $5^{\circ}16'1''$ & $5^{\circ}27'1''$ E; is located in Ovia North-East Local Government Area of Edo State, Nigeria. The reserve covers an area of 365 Km² 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

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:

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

$$D = n_1 + n_2 \text{Loge} \left[\frac{n_1 + n_2}{\pi r^2 m} \right]$$

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),

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undisturbed forest compartment (121) and wetland compartment (115) Figure, 2.

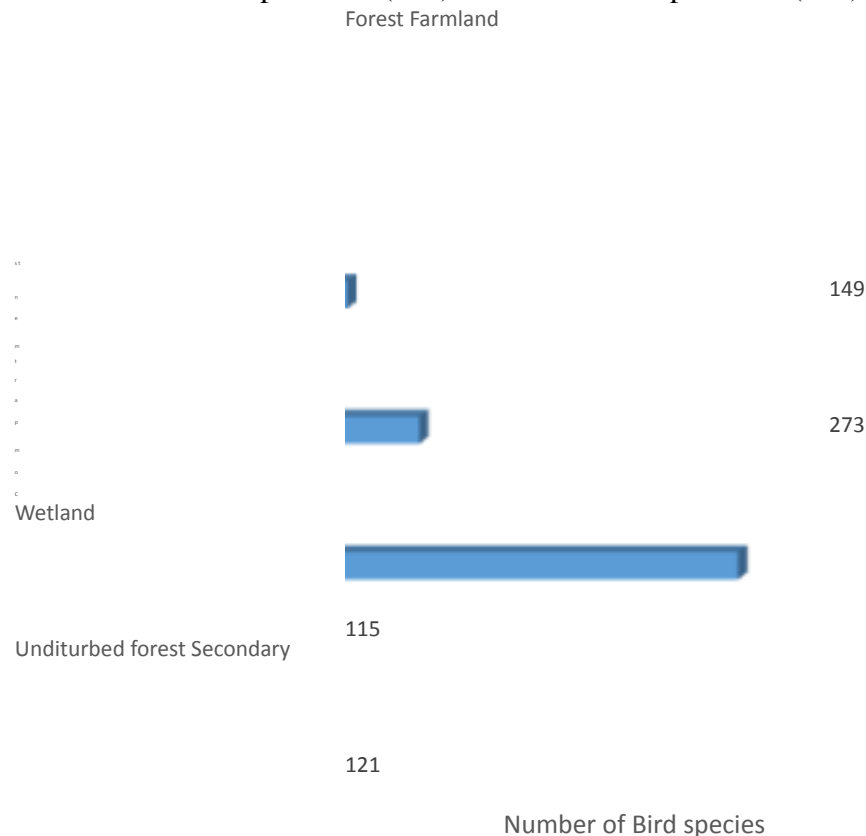


Figure 2, Number of individual Bird species in each compartment

The result of the bird species composition in the study area indicates that the family Pycnonotidae has the highest number of

Accipitridae (10) bird species Figure, 3.

bird species (12), this is followed by

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7

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1
3
2
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Family Composition of Bird Species

Figure 3: Family composition of Bird species in the study area

The relative population density in the study area shown that it was higher in the dry season (1.031) than the wet season (0.031). The result of the Shannon

diversity index indicates that it was higher in the dry season 4.996 than the wet season (4.922) Table, 1.

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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
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

compartment (34), wetland compartment has 30 bird species and farmland compartment (27) Figure 4.

Wet season, 0.31
, 0 Dry season, 1.023
(78), this is followed by Secondary forest

Relative Population density

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.

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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

Figure 6.

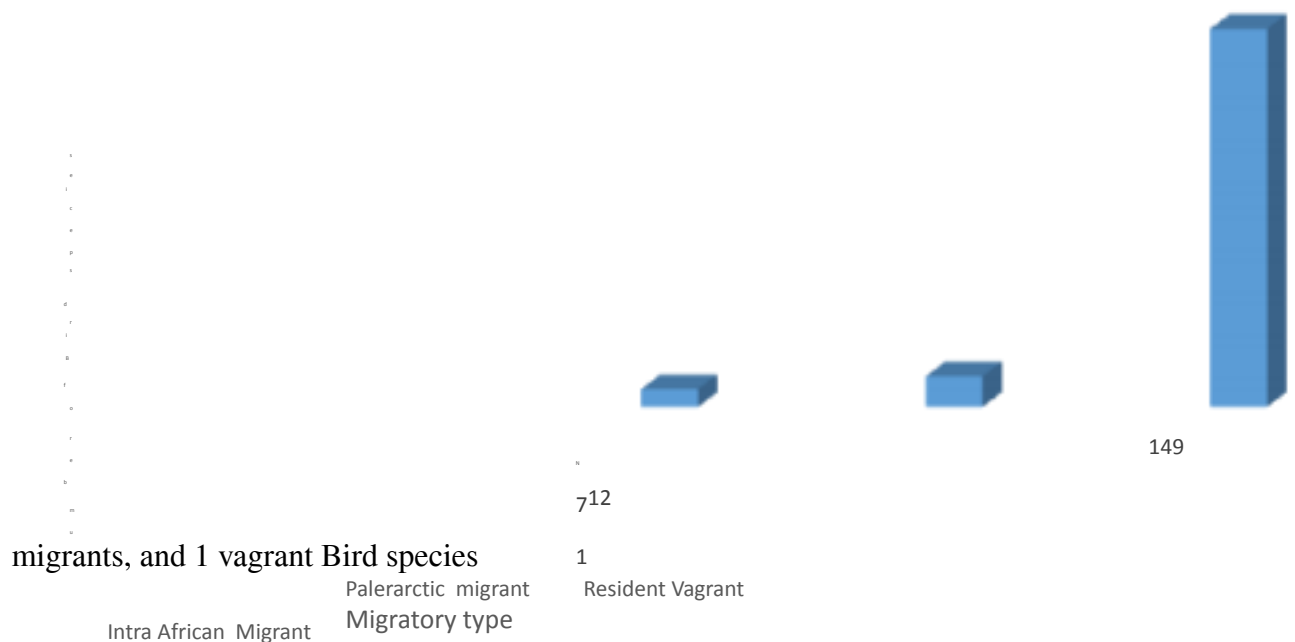


Figure 6 Migratory pattern of Bird species in the study area

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Table 2, Checklist of Bird species in the study area

Scientific names Common names Orders

Alcedinidae *Megaceryle maxima* Giant Kingfisher Coraciiformes

Jacaniidae *Actophilornis africanus* African Jacana

Charadriiformes

Cuculidae *Chrysococcyx cupreus* African Emerald Cuckoo Cuculiformes Accipitridae

Haliaeetus vocifer African Fish Eagle Accipitriformes Muscicapidae *Fraseria ocreata* African

Forest Flycatcher Passeriformes columbidae *Treron calva* African Green Pigeon Columbiformes

Psittacidae *Psittacus erithacus* African Grey Parrot Psittaciformes Accipitridae *Polyboroides typus*

African Harrier Hawk Accipitriformes Accipitridae *Hieraaetus spilogaster* African Hawk Eagle

Accipitriformes

Falconidae

Falco cuvierii African Hobby

Falconiformes

Apodidae *Cypsiurus parvus* African Palm Swift Caprimulgiformes Bucerotidae *Tockus fasciatus*

African Pied Hornbill Bucerotiformes Motacillidae *Motacilla alba* African Pied Wagtail

Passeriformes Pittidae *Pitta angolensis* African Pitta Passeriformes Platysteiridae

Megabyas flammulatus African Shrike Flycatcher Passeriformes Strigidae *Strix woodfordii* African

Wood Owl Strigiformes

Rallidae *Porphyrio alleni* Allens Gallinule

Gruiformes

Pycnonotidae *Andropadus ansorgei* Ansorges Greenbull Passeriformes Bucerotidae

Tockus hartlaubi Black Dwarf Hornbill Coraciiformes Bucerotidae

Ceratogymna subcylindrica Black And White Casqued Hornbill Bucerotiformes

Estrildidae *Spermestes bicolor* Black And White Mannikin Passeriformes Bucerotidae

Ceratogymna atrata Black Casqued Hornbill Bucerotiformes Cuculidae *Centropus grillii* Black

Coucal Cuculiformes

Rallidae *Amaurornis flavirostris* Black Crake

Gruiformes

Ploceidae *Ploceus nigricollis* Black Neck Weaver Passeriformes Malaconotidae

Dryoscopus senegalensis Black Shouldered Puffback Passeriformes Cisticolidae *Apalis jacksoni*

Black Throated Apalis Passeriformes Oriolidae *Oriolus brachyrhynchus* Black Winged Oriole

Passeriformes Recurvirostridae *Himantopus himantopus* Black Winged Stilt Charadriiformes

Ardeidae *Nycticorax nycticorax* Black-crowned heron Pelecaniformes Ardeidae
Ardeamelanoleuca Black-headed Heron Pelecaniformes Coraciidae *Coracias cyanogaster* Blue
 Bellied Roller Coraciiformes Ploceidae *Malimbus nitens* Broad Billed Malimbe Passeriformes
 Campephagidae *Coracina azurea* Blue Cuckoo Shrike Passeriformes Muscicapidae
Trochocercus nitens Blue Headed Crested Flycatcher Passeriformes
 Columbidae *Turtur brehmeri* Blue Headed Wood Dove Columbiformes columbidae *Turtur afer* Blue
 Spotted Wood Dove Columbiformes Ramphastidae *Gymnobuccopelia* Bristled Nosed Barbet
 Piciformes Coraciidae *Eurystomus glaucurus* Broad Billed Roller Coraciiformes Estrildidae
Spermestes cucullatus Bronze Mannikin Passeriformes Nectariniidae *Chalcomitra adelberti* Buff
 Throated Sunbird Passeriformes Picidae *Campethera nivosus* Buff Throated Woodpecker Piciformes
 Accipitridae *Spizaetus africanus* Cassin's Hawk Eagle Accipitriformes Apodidae *Neafrapus cassini*
 Cassin's Spintail Caprimulgiformes Estrildidae *Nigrita bicolor* Chestnut Breasted Negrofinch
 Passeriformes Monarchidae *Erythrocercus mccallii* Chestnut -Capped Flycatcher Passeriformes
 Accipitridae *Accipiter castaneus* Chestnut Flanked Sparrowhawk Accipitriformes Platysteiridae
Platysteira castanea Chestnut Wattle Eye Passeriformes Alcedinidae *Halcyon badia* Chocolate
 Backed Kingfisher Coraciiformes Glareolidae *Glareola pratincola* Collared Pratincole Charadriiformes
 Nectariniidae *Hedydipna collaris* Collared Sunbird Passeriformes Pycnonotidae *Pycnonotus barbatus*
 Common Bulbul Passeriformes
 Scolopacidae *Tringanebularia* Common Greenshank
 Rallidae *Gallinula chloropus* Common Moorhen

Gruiformes

Charadriiformes

Scolopacidae *Tringa erythropus* Common Redshank Charadriiformes Scolopacidae
Actitis hypoleucos Common Sandpiper Charadriiformes Platysteiridae *Platysteira cyanea* Common
 Wattle Eye Passeriformes Numididae *Gutterapucherani* Crested Guinea Fowl Galliformes Ploceidae
Malimbus malimbicus Crested Malimbe Passeriformes Cuculidae *Chrysococcyx caprius* Dideric
 Cuckoo Cuculiformes

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Monarchidae *Elminia gromittrata* Dusky Blue Flycatcher Passeriformes Cuculidae
Cercococcyx mechowii Dusky Long Tailed Cuckoo Cuculiformes Hirundinidae
Psaliidoprocne obscura Fantail Saw Wing Passeriformes Turdidae *Alethe castanea* Fire Tailed Alethe

Passeriformes Muscicapidae *Stiphorniserythrothorax* Forest Robin Passeriformes Muscicapidae
Cercotrichas leucosticte Forest Scrub Robin Passeriformes Phoeniculidae *Phoeniculuscastaneiceps*
 Forest Wood Hoopoe Bucerotiformes
 Dicruridae *Dicrurusadsimilis* Fork Tailed Drongo Passeriformes Strigidae *Bubo poensis* Frasser's
 Eagle Owl Strigiformes Picidae *Dendropicogabonesis* Gabon Woodpecker Piciformes Musophagidae
Corythaeolacristata Great Blue Turaco Musophagiformes Ardeidae *Ardea alba* Great Egret
 Pelecaniformes Sylviidae *Sylviettavirens* Green Combec Passeriformes Sylviidae *Hyliaprasina* Green
 Hylia Passeriformes Scolopacidae *Tringa ochropus* Green Sandpiper Charadriiformes Nectariniidae
Anthreptesrectirostris Green Sunbird Passeriformes Pycnonotidae *Bledaeximius* Green Tailed
 Bristlebill Passeriformes Musophagidae *Tauracopersa* Green Turaco Musophagiformes

Phoeniculidae

Phoeniculuspurpureus Green Wood Hoopoe
 Bucerotiformes

Ardeidae *Butoridesstriata* Green-backed Heron Pelecaniformes Turdidae *Zoothera prince* Grey
 Ground Thrush Passeriformes
 Glareolidae *Glareolacinerea* Grey pratincole

Charadriiformes

Cisticionidae *Camaroptera brachyuran* Grey Backed *Camaroptera* Passeriformes Pycnonotidae
Bledacanicapilla Grey Headed Bristlebill Passeriformes Pycnonotidae *Bledacanicapilla* Grey
 Headed Bristlebill Passeriformes Estrildidae *Nigritacanicapilla* Grey Headed Negrofinch
 Passeriformes Rallidae *Canirallusoculeus* Grey Headed Rail Gruiformes
 Pycnonotidae *Macrosphenusconcolor* Grey Longbill Passeriformes Rallidae *Ralluscaeruuslescens*
 GreyThroated Rail Gruiformes Ramphastidae *Tricholaema hirsute* Hairy Barbet Piciformes
 Scopidae *Scopus umbretta* Hamerkop Charadriiformes Pycnonotidae *Phyllastrephusicterinus*
 IcterineGreenbull Passeriformes

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Cuculidae *Chrysococcyxklaas* Klaas Cuckoo Cuculiformes Malaconotidae *Malaconotuslegdeni*
 Lagden's Bush Shrike Passeriformes Malaconotidae *Dryoscopusabini* Large Billed Puffback
 Passeriformes Charadriidae *vanelluslugubris* Lesser Black-Winged Lapwing Charadriiformes
 Hirundinidae *Hirundoabyssinica* Lesser Striped Swallow Passeriformes Apodidae *Apus affnis* Little
 Swift Caprimulgiformes Meropidae *Meropsusillus* Little Bee Eater Coraciiformes Ardeidae
Isobrycusminutus Little bittern Pelecaniformes Accipitridae *Kaupifalcomonogrammicus* Lizard

Burzard Accipitriformes Accipitridae *Lophaetus occipitalis* Long Crested Eagle Accipitriformes
 Accipitridae *Urotriorchismacrourus* Long Tailed Hawk Falconiformes Muscipidae
Sheppardiacyornithopsis Lowland Akalat Passeriformes Alcedinidae Alcedocristata Malachite
 Kingfisher Coraciiformes Scolopacidae *Trigastagnatilis* Marsh Sandpiper Charadriiformes Ploceidae
Ploceusalbinucha Maxwell;S Weaver Passeriformes Ramphastidae *Gymnobuccocalvus* Naked Faced
 Barbet Piciformes Trogonidae *Apalodermanarina* Narina's Trogon Trogoniformes Sturnidae
Poeopteralugubris Narow Tailed Starling Passeriformes Rallidae *Sarothrurapulchra* Nkulengu Rail
 Gruiformes Cisticolidae *Camaroptera chloronota* Olive- Green Camaroptera Passeriformes Cuculidae
Cercococcyxolivinus Olive- Long Tailed Cuckoo Cuculiformes Estrildidae *Nigritaluteifrons* Pale
 Fronted Negrofinch Passeriformes Accipitridae *Gypohieraxangolensis* Palm Nut Vulture
 Accipitriformes Bucerotidae *Ceratogymnafistulator* Pipping Hornbill Bucerotiformes Motacillidae
Anthusleucophrys Plain Backed Pipit Passeriformes Pycnonotidae *Andropaduscurvirostris* Plain
 Greenbull Passeriformes Sturnidae *Lamprotornispurpleiceps* Purple Headed Starling Passeriformes
 Rallidae *Porphyrio porphyrio* Purple Swampen Gruiformes Bucerotidae *Tockuscamurus* Red Billed
 Dwarf Hornbill Bucerotiformes Estrildidae *Lagonostictasenegala* Red Billed Firefinch Passeriformes
 Prionopidae *Prionopscaniceps* Red Billed Helmet-Strike Passeriformes Cuculidae *Cuculussolitaius*
 Red Chested Cuckoo Cuculiformes

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Columbidae Streptopeliasemitorquata Red Eyed Dove Columbiformes Cisticolidae
Cisticolaerythrops Red Faced Cisticola Passeriformes Estrildidae *Cryptospizareichenovii* Red
 Faced Crimsonwing Passeriformes Ploceidae *Malimbuserythrogaster* Red Headed Malimbe
 Passeriformes Ramphastidae *Pogoniulusatroflavus* Red RumpedTinkerbird Piciformes
 Pycnonotidae *Pycnonotuscafer* Red Tailed Greenbull Passeriformes Ploceidae *Malimbusscutatus*
 Red Vented Malimbe Passeriformes Nectariniidae *Anabathmisreichenbachii* Reichenbach1's
 Sunbird Passeriformes Psittacidae *Psittaculakrameri* Rose Ringed Parakeet Psittaciformes
 Sylviidae *Eremomelabadiceps* Rufous Crowned Eremomela Passeriformes Malaconotidae
Dryoscopusangolensis Sabine's Puffback Passeriformes Cuculidae *Centropussenegalensis* Senegal
 Coucal Cuculiformes Strigidae *Bubo shelleyi* Shelley's Eagle Owl Strigiformes Dicruridae
Dicrurusatripennis Shinning Drongo Passeriformes Pycnonotidae *Chlorocichla simplex* Simple
 Greenbull Passeriformes Pycnonotidae *Chlorocichla simplex* Simple Leaflove Passeriformes
 Muscipidae *Muscicapa infusate* Sooty Flycatcher Passeriformes Ramphastidae
Pogoniulusscolopaceus Speckled Tinkerbird Piciformes

Scolopacidae *Tringa erythropus* Spotted Redshank

Charadriiformes

Charadriidae *Vanellus spinosus* Spur-Winged Lapwing Charadriiformes Ardeidae *Ardeola alaroides* Squacco heron Pelecaniformes Caprimulgidae *Macrodipteryx longipennis* Standard Nightjar Caprimulgiformes columbidae *Turtur tympanistria* Tambourine Dove Columbiformes Glareolidae *Cursorius temminckii* Temminck Courser Charadriiformes Cuculidae *Pachycoccyx audeberti* Tick Billed Cuckoo Cuculiformes Nectariniidae *Cinnyris venustus* Variable Sunbird Passeriformes Ramphastidae *Lybius vieilloti* Velliot's Barbet Piciformes Ploceidae *Ploceus nigerrimus* Velliot's Weaver Passeriformes Accipitridae *Aquila wahlbergi* Wahlberg Eagle Accipitridae *Oriolus brachyrhynchus* Western Black Headed Oriole Passeriformes Estrildidae *Spermophaga haematina* Western Bluebill Passeriformes Pycnonotidae *Nicator chloris* Western Nicator Passeriformes

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Bucerotidae *Tockus albocristatus* White Crested Hornbill Bucerotiformes Anatidae *Dendrocygna viduata* White Faced Whistling Duck Musophagidae *Alethe diademata* White Tailed Alethe Musophagiformes Bucerotidae *Ceratogymna albotibialis* White Thighed Hornbill Bucerotiformes Meropidae *Merops albicollis* White Throated Bee Eater Coraciiformes Scolopacidae *Tringalareola* Wood Sandpiper Charadriiformes Estrildidae *Parmoptila woodhousei* Woodhouse's Antpecker Passeriformes Ciconiidae *Ciconia episcopus* Woolly-necked Stork Cisticolidae *Apalis flava* Yellow Breasted Apalis Passeriformes Bucerotidae *Ceratogymna elata* Yellow Casqued Hornbill Bucerotiformes Ramphastidae *Pogoniulus chrysoceros* Yellow Fronted Tinkerbird Piciformes Ramphastidae *Buccanodon chaillui* Yellow Spotted Barbet Piciformes Motacillidae *Motacilla flav* 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

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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

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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 is most degraded areas.

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