



## Bird Species and Flora diversity and Sustainable Tourism of Osun-Osogbo Sacred Grove World Heritage site Osun State southwest Nigeria

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### Abstract

The diversity of birds and tree species was studied in Osun- Oshogbo Sacred Groove World Heritage site in southwest Nigeria. A total of 20 transect lines of 500m were randomly laid out and 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 20019. The ecological survey for the floristic study was conducted in March 2019. In this study, a total of 20 study plots of about 25 m × 25m Quadrants (500 sq m) size were established. All woody plants with stems rooted independently within a plot and with a DBH (measured at 1.3 m above ground for all life forms) equal to or greater than 2.5 cm were measured, inventoried, and identified to species level. Multiple stems were measured separately. DBH measurement was taken with a simple tape measure while the height of trees was taken using Haga Altimeter. In all, a total of 125 bird species belonging to 49 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 *Estrildidae* and *Pycnonotidae*, comprising (74 %) of the total species One endemic and one rare weaver bird species were recorded. A total of 741 individual tree species in 174 tree species and 49 families were enumerated. The highest occurring tree species are *Brachystegia Eurycoma* and *Bracchystegia Nigeria* with 36 and 19 tree species respectively. DBH of 466cm was recorded in *Brachystegia Eurycoma*, followed by *Bracchystegia Nigeria* 456 cm in the study area. Also, the highest mean height of 41m was recorded in *Millicia excels* and the highest occurrence of tree species was recorded in *Brachystegia Eurycoma* 39. Shannon diversity was 4.849 in the study area. The result of the family composition indicates that *Sterculiaceae* has the highest tree species 14 followed by *Euphorbiaceae* 13 tree species.



**Keywords:** Birds and tree species, ecological survey, habitat fragmentation and conservation, home range

## Introduction

The increasing disappearance of fauna and flora resources over the years, especially as a result of 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 (Ikemeh, 2009). 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 (Boo,1990). 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). However, South-Western Nigeria is a region of high population densities and intense agricultural land-use areas (Agbelusi, 1994). For this reason, perhaps biodiversity depletion may be occurring at a much higher rate than elsewhere in Nigeria. NEA,(2002) 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 most forest reserves in southwest Nigeria have resulted in the sharp decline of bird species in recent times, avian species are becoming intolerant of pressures on their habitats (Manu, 2000). An assessment of the abundance and diversity of bird species in Oshogbo Groove, therefore, serves as a good indication of the health of the environment.

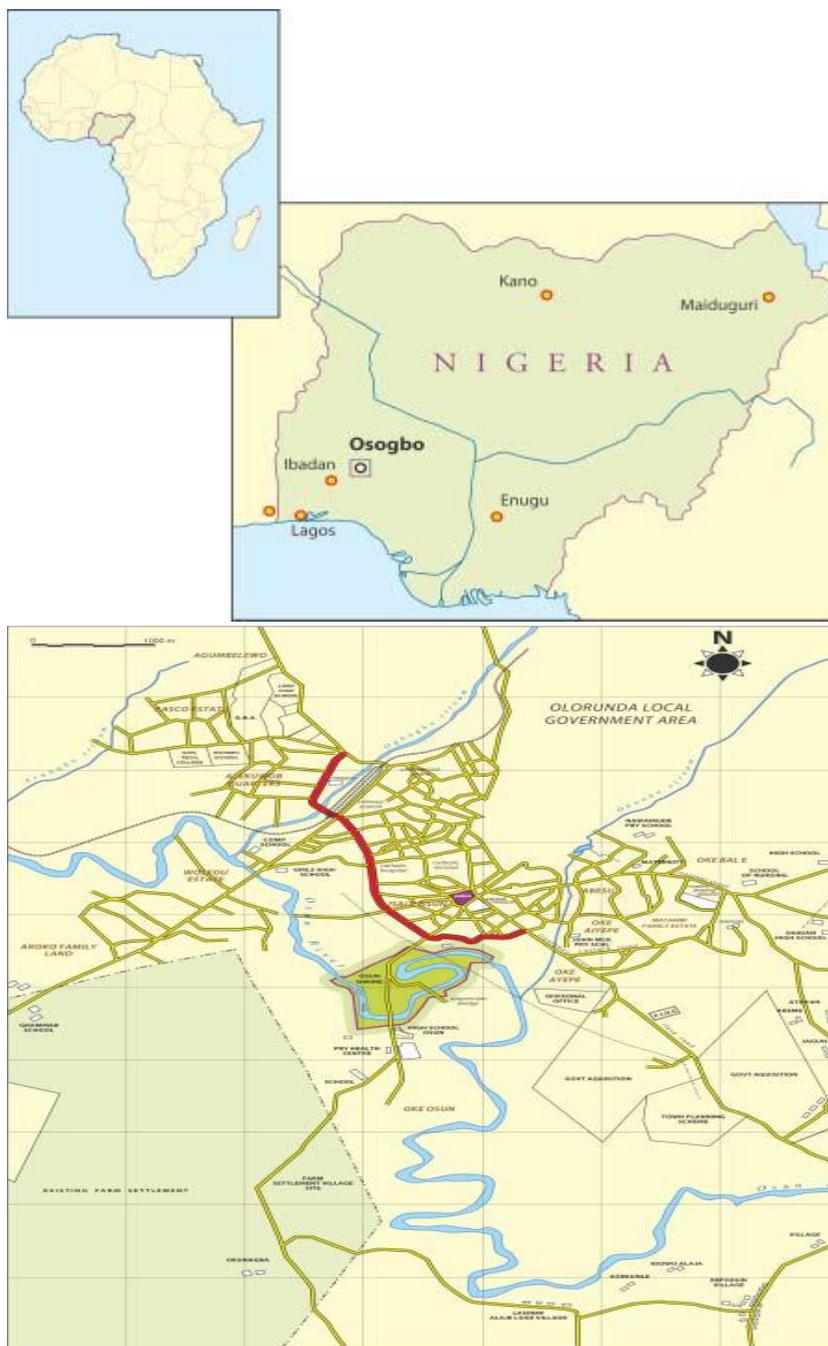
## Material and methods

### Study Area

Osun-Osogbo Sacred Grove is located along the bank of the Osun River in Osogbo Local Government Area of Osun State, South-Western Nigeria (Oseghale, *et al*, 2014)Its geographical coordinates are 7 02 and 08 E. The sacred grove is situated on the margin of the southern forests of Nigeria on a raised parcel that is about 350 meters above sea level. The grove is bounded in the North by Laro and Timehin Grammar Schools, the South by the entrance of Ladoke Akintola University of Technology (LAUTECH) which runs parallel to form a western boundary. In the east, it is bounded by Osun State Agricultural Farm Settlements (NCMM, 2010) Annual rainfall varies between 1600 and 2000 ml, mean annual temperature is 30 °C and the relative humidity is not below 40 % during the dry season and 100 % during the wet season (Mengistu, and Salami, (2007). The study site experiences a bimodal annual rainfall pattern, between April and July and from September to October, separated by a dry season (Isichei, 1995). Vegetation is predominantly rainforest, including wetlands along the rivers and *Panicum maximum* dominated open land. Among the common trees are *Celtis zenkerii*, *Triplochiton scleroxylon*, *Antiaris*



*africana*, *Pycnanthus angolensis* and *Antiaris africana*, *Pycnanthus angolensis* and *Alstonia boonei* (Keay 1989).



**Figure 1:** Map of the Study Area Source: (African World Heritage Sites)

## Data Collection



The line transects method according to (Sutherland, 2009) was used to collect data on bird species diversity, and abundance in the study area. In all 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 program 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 the wet season and November, January, and March for the dry season) of the year. The 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 the reduce daylight effect. Transects were walked at an average speed of 1.5 km 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 of 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 a 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 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 the Shannon diversity index, (Usher, 1991) which is given as:

$$H^i = - \sum P_i \ln P_i$$

Where:  $H^i$  = 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:

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

where:  $D$  = density

$r$  = radius of the first zone

$n_1$  = number of birds counted within zone

$n_2$  = number of birds counted beyond zone and  $m$  = number of replicatecount in such area.

#### Habitat survey

The ecological survey for the floristic study was conducted in March 2019 (Ogunjemite and Oates 2011).

. In this study, a total of 20 study plots of about 25 m × 25m

Quadrats (500 sq m) size were established. All woody plants with stems rooted independently within a plot and with a DBH (measured at 1.3 m above ground for all lifeforms) equal to or greater than 2.5 cm were measured, inventoried, and identified to species level. Multiple



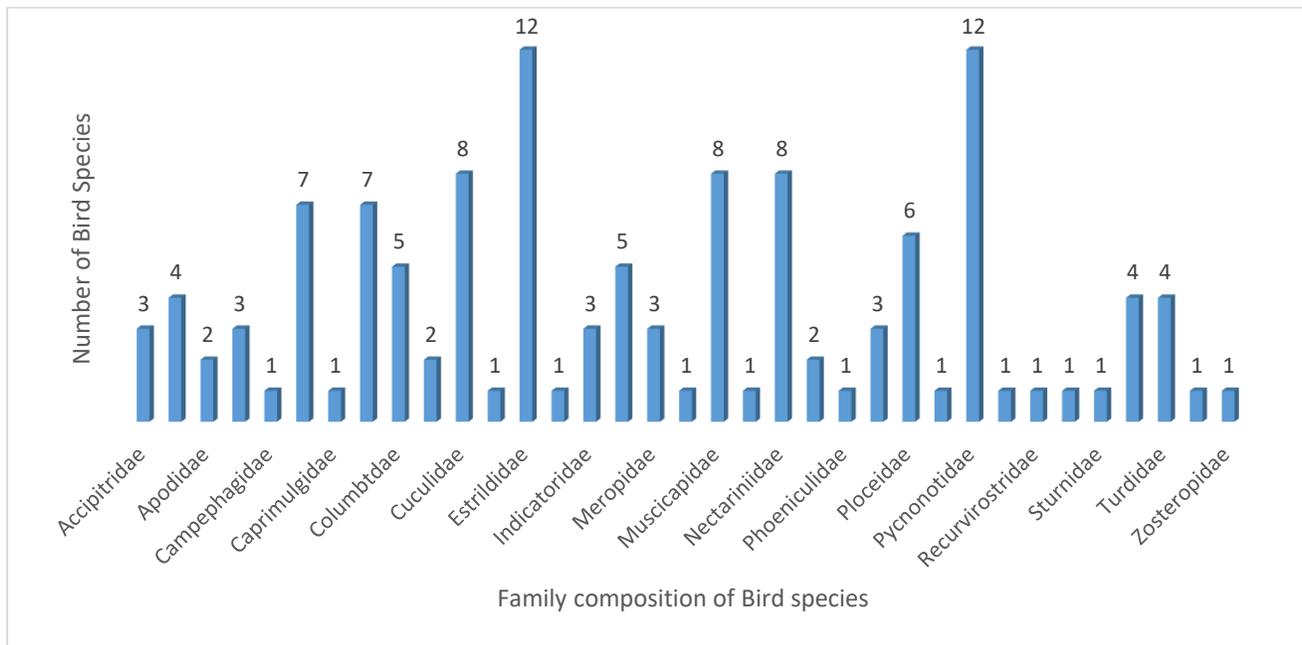
stems were measured separately, but all stems rooting in the same place were counted as one individual. Specimens were collected in April and May 2019. All specimens were sorted to species level and identified by matching them with vouchers identified by specialists or professional botanists. DBH measurement was taken with a simple tape measure while the height of trees was taken using Haga Altimeter.

### Data analysis

Species diversity, floristic composition, and similarity were measured with quantitative and qualitative indices. The frequency of a species for each habitat type is defined as the number of (25x25m) plots in which it is present, and the sum of all frequencies is the total number of plots per site. Species diversity values were expressed in terms of species richness for each habitat type. To quantify and compare floristic composition between habitats, the Pathe st Model was used to analyze the diversity.

### Results

The result obtained from the research study indicates that the study area supports the diversity of birdlife and plant species. A total of 125 bird species belonging to 49 families and 18 orders were enumerated in the study areas. The result of the family composition indicates that Estrildidae and Pycnonotidae have the highest number of bird species of 12 each. One endemic bird species *Malimbus ibadanesis* and one species of weaver *Ploceus tricolor* were encountered during the survey. The understory state has the highest number of bird species in the study area, these bird species that belong to these families are Sylviidae, Cisticolidae, Cuculidae, Estriltidae, and Pycnonodidae. The results of the Shannon\_H diversity showed that it was highest during the dry season (4.659) than the wet season (4.297). A total of 741 individual tree species in 174 tree species and 49 families were enumerated. The highest occurring tree species are *Brachystegia eurycoma* and *Brachystegia nigerica* with 36 and 19 tree species respectively. DBH of 466cm was recorded in *Brachystegia eurycoma*, followed *Brachystegia nigerica* 456 cm in the study area. Also, the highest mean height of 41m was recorded in *Millicia excelsa* and the highest occurrence of tree species was recorded in *Brachystegia eurycoma* 39. Shannon\_H diversity was 4.849 in the study area. The result of the family composition indicates that *sterculiaceae* has the highest tree species 14 followed by *Euphorbaceae* 13 tree species.



**Figure 2:** Bird species family composition in the study area

**Table 1:** Bird species diversity index in study sites

Diversity Index	Dry season	Wet season
Taxa_S	125	100
Individuals	210	175
Dominance_D	0.01229	0.02315
Shannon_H	4.659	4.297
Evenness_e^H/S	0.8439	0.735
Margalef	23.19	19.17
Equitability_J	0.9649	0.9331

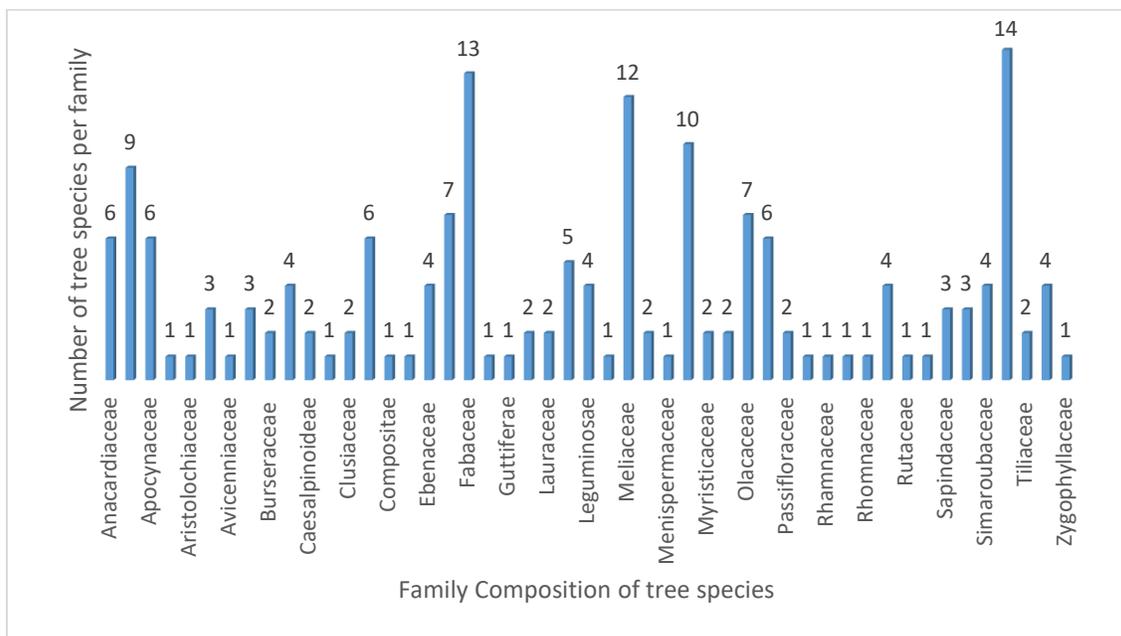


Figure 3: Tree species family composition in the study area

Table 2: Pyto-sociological Parameters of Tree species in the study area

Habitat Type	Number of Tree Species	Number of Individual Tree Species	Highest DBH (cm)	Highest MH (m)	Highest Occurrence	Shannon-Wiener H'
Rain Forest	174	1047	466 <i>Brachystegia nigerica</i>	41 <i>Milicia excelsa</i>	39 <i>Brachystegia nigerica</i>	4.849



## Discussions

The majority of bird species encountered during this study were resident bird species and a few migratory bird species. The 98% of bird species encountered in the study area were forest species which is in agreement with (Elgood et al, 1977) who carried out a bioutsecies survey in South-Western Nigeria. The study area is located in the low land rain forest which offered an even distribution pattern of birds that showed the highest species richness and Shannon diversity in seasons of the year which comprises mixed moist deciduous canopy, that could be due to the presence of a majority of evergreen trees, which provided the sufficient food in the form of flowers and insects (Thiollay, 1998).

The result showed that 125 bird species utilized the study area throughout the research study. This result is consistent with the work of Matlock Jr *et al*, (2003) who reported that forest patches and protected areas in Sao Tome have a high retention of bird species than agricultural landscapes. This is also supported by previous research studies that suggested multi-strata agroforestry systems are being able to accommodate high levels of species richness and abundance for several tropical groups, especially when compared with alternative land use. In the comparison of species diversity between dry and wet seasons, the result indicates diversity was higher in the dry season than in the wet season in the study area. 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 forests support more rare bird species than other habitats. Manu (2007) reported that birds select vegetation variables according to how an individual habitat affects access to food, mates, or its vulnerability to predators.

This study shows that lowland forest in the study areas are the best habitats for the birds as far as the numbers and diversity is concerned. This is in agreement with (Pramod *et al*. (1997) who reported that serious loss of the biodiversity value occurs in the transformation of original landscapes to croplands due to human interference. Karr and Roth, (1971) reported that the more complex the structure or composition of the vegetation, the more likely that habitat will contain more bird species. In this study, tree density, high DBH, presence of the tall emergent trees, trees occurrence, and understory density were important vegetation characteristics responsible for the high bird species richness recorded in the study area. Bird species behavioral pattern was found to play a big role in bird diversity in the conserved area, for example, (Pied Flycatcher, Black-shouldered Puffback, Lagden's Bush-Shrike and Blue Shouldered Robin-Chat, Ibadan malimbe, Yellow Mottled weaver Pipping hornbill, and Black cuckoo were more or less resident in the study area throughout this study and forest edges despite the availability of food resources in the surrounding farmlands (Cody, 1985).

## Conclusions

The presence of some endangered and threatened bird species in the study area is a sign of hope. However, their conservation must be guaranteed and that will only be achieved by the conservation of extensive areas of natural vegetation.

Houses are springing up in the buffer zone in the study area it means a high population and farming intensification is ongoing in the area, the study host a high population of rare bird species of ecotourism value such as *Malinbus ibadanesis*, *Coracias cyanogaster*, *Spizaetus africanus*, *Ceratogymna fistulator*



*Cuculus clamosus* and Yellow Mantled Weaver. The management of these areas should design programs to discourage bush burning, deforestation, and poaching by the local people. The conservation strategy must integrate the physical, economic, social, and cultural conditions of the farmers and local people to come up with innovations and technologies that conserve and sustain biodiversity.

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#### Appendix 1: Checklist of Bird species in the study area

Family	Scientific Name	Common Name
<b>Accipitridae</b>	<i>Spizaetus africanus</i>	Cassin's Hawk eagle
	<i>Kaupifalco monogrammicus</i>	Lizard Buzzard
	<i>Polyboroides typus</i>	African Harrier Hawk
<b>Alcedinidae</b>	<i>Ispidina lecontei</i>	African Dwarf Kingfisher
	<i>Halcyon badia</i>	Chocolate Backed Kingfisher
	<i>Halcyon malimbica</i>	Blue Breasted Kingfisher
	<i>Halcyon senegalensis</i>	Woodland Kingfisher
<b>Apodidae</b>	<i>Cypsiurus parvus</i>	African Palm Swift
	<i>Apus affinis</i>	Little Swift
<b>Bucerotidae</b>	<i>Tockus faciatus</i>	African Pied Hornbill
	<i>Tockus nasutus</i>	African Grey Hornbill
	<i>Ceratogymna fistulator</i>	Pipping Hornbill
<b>Campephagidae</b>	<i>Coracina azurea</i>	Blue Cuckoo Shrike
<b>Capitonidae</b>	<i>Tricholaema hirsuta</i>	Hairy Barbet



	<i>Pogoniulus atroflavus</i>	Red Rumped Tinkeredbird
	<i>Gymnobucco calvus</i>	Naked Faced Barbet
	<i>Pogoniulus scolopaceus</i>	Speckled Tinkerbird
	<i>Pogoniulus chrysoconus</i>	Yellow Fronted Tinkerbird
	<i>Gymnobucco peli</i>	Bristled Nosed Barbet
	<i>Pogoniulus subsulphureus</i>	Yellow-Throated Tinkerbird
<b>Caprimulgidae</b>	<i>Macrodipteryx longipennis</i>	Standard Nightjar
	<i>Caprimulgus nigriscapularis</i>	Black-shouldered Nightjar
<b>Cisticolidae</b>	<i>Bathmoercus cerviniventis</i>	Black Head Rufous Wobbler
	<i>Cisticola erythrops</i>	Red Faced Cisticola
	<i>Camaroptera chloronota</i>	Olive Green Camaroptera
	<i>Prinia bairdii</i>	Banded Prinia
	<i>Camaroptera brachyura</i>	Grey Backed Camaroptera
	<i>Prinia subflava</i>	Tawny- Flanked Prinia
	<i>Apalis jacksoni</i>	Black-throated Apalis
<b>Columbidae</b>	<i>Treron calva</i>	African Green Pigeon
	<i>Turtur brehmeri</i>	Blue-Headed Wood Dove
	<i>Streptopelia senegalensis</i>	Laughing Dove
	<i>Streptopelia semitorquata</i>	Red-Eyed Dove
	<i>Tuertur tympanistria</i>	Tambourine Dove
<b>Coraciidae</b>	<i>Eurystomus glaucurus</i>	Broad Billed Roller
	<i>Coracias cyanogaster</i>	Blue Billed Roller
<b>Cuculidae</b>	<i>Chrysococcyx cupreus</i>	African Emerald Cuckoo
	<i>Centropus grillii</i>	Black Coucal
	<i>Cuculus clamosus</i>	Black Cuckoo
	<i>Chrysococcyx caprius</i>	Diederik Cuckoo
	<i>Cercococcyx mechowi</i>	Dusky Long Tailed Cuckoo
	<i>Chrysococcyx klaas</i>	Klaas Cuckoo
	<i>Centropus senegalensis</i>	Senegal Coucal
	<i>Ceuthmochares aereus</i>	Yellowbill
<b>Dicruridae</b>	<i>Dicrurus adsimillis</i>	Fork Tailed Drongo
<b>Estrildidae</b>	<i>Spermestes bicolor</i>	Black And White Mannikin
	<i>Nigrita bicolor</i>	Chestnut Breasted Negrofinch
	<i>Nigrita canicapilla</i>	Grey Headed Negrofinch
	<i>Nigrita luteifrons</i>	Pale Fronted Negrofinch
	<i>Lagonosticta senegala</i>	Red-Billed Firefinch
	<i>Cryptospiza reichenovii</i>	Red Faced Crimsonwing



	<i>Spermophaga ruficapilla</i>	Red-Headed Bluebill
	<i>Spermophaga haematina</i>	Western Bluebill
	<i>Nigrita fusconota</i>	White Breasted Negrofinch
	<i>Parmoptila rubrifrons</i>	Red Fronted Antpecker
	<i>Parmoptila woodhousei</i>	Woodhouse's Red Headed Antpecker
	<i>Bronze Mannikin</i>	Spermestes cucullatus
<b>Hirundinidae</b>	Rufous Chested Swallow	<i>Cecropis semirufa</i>
<b>Indicatoridae</b>	Cassin's Honeyguide	<i>Prodotiscus insignis</i>
	Black Shouldered Puffback	<i>Dryoscopus senegalensis</i>
	Lagden's Bush Shrike	<i>Malaconotus legdeni</i>
<b>Malaconotidae</b>	Large Billed Puffback	<i>Dryoscopus sabini</i>
	Sabine's Puffback	<i>Dryoscopus angolensis</i>
<b>Meropidae</b>	<i>Merops gularis</i>	Black Bee Eater
	<i>Merops pusillus</i>	Little Bee Eater
	<i>Merops albicollis</i>	White-Throated Bee Eater
<b>Monarchidae</b>	<i>Elminia nigromitrata</i>	Chestnut -Capped Flycatcher
<b>Muscicapidae</b>	<i>Fraseria ocreata</i>	African Forest Flycatcher
	<i>Trochocercus nitens</i>	Blue-Headed Crested Flycatcher
	<i>Cossypha cyanocampter</i>	Blue Shouldered Robin-Chat
	<i>Stiphornis erythrothorax</i>	Forest Robin
	<i>Cercotrichas leucosticta</i>	Forest Scrub Robin
	<i>Sheppardia cyornithopsis</i>	Lowland Akalat
	<i>Ficedula hypoleuca</i>	Pied Flycatcher
	<i>Muscicapa infuscata</i>	Sooty Flycatcher
<b>Musophagidae</b>	<i>Tauraco persa</i>	Green Crested Turaco
<b>Nectariniidae</b>	<i>Fraseria ocreata</i>	Green Crested Turaco
	<i>Trochocercus nitens</i>	Buff Throated Sunbird
	<i>Cossypha cyanocampter</i>	Collard Sunbird
	<i>Stiphornis erythrothorax</i>	Green Sunbird
	<i>Cercotrichas leucosticta</i>	Reichenbach1's Sunbird
	<i>Sheppardia cyornithopsis</i>	Splendid Sunbird
	<i>Ficedula hypoleuca</i>	Superb Sunbird
	<i>Muscicapa infuscata</i>	Variable Sunbird
<b>Oriolidae</b>	<i>Oriolus brachyrhynchus</i>	Western Black-Headed Oriole
	<i>oriolus hosii</i>	Black-Winged Oriole
<b>Phoeniculidae</b>	<i>Phoeniculus castaneiceps</i>	Forest Wood Hoopoe
<b>Platysteiridae</b>	<i>Platysteira castanea</i>	Chestnut Wattle Eye



	<i>Megabyas flammulatus</i>	African Shrike Flycatcher
	<i>Platysteira cyanea</i>	Common Wattle Eye
<b>Ploceidae</b>	<i>Malimbus erythrogaster</i>	Red Headed Malimbe
	<i>Ploceus nigerrimus</i>	Velliot's Weaver
		Red-Vented Malimbe
		Yellow Mantted Weaver
		Village Weaver
		Ibadan Malimbe
<b>Prionopidae</b>	<i>Prionops caniceps</i>	Red Billed Helmet-Strike
<b>Pycnonotidae</b>	<i>Andropadus ansorgei</i>	Anssorges Greenbull
	<i>Bleda syndactyla</i>	Common Bristlebill
	<i>Pycnonotus barbatus</i>	Common Bulbul
	<i>Bleda eximius</i>	Green Tailed Bristlebill
	<i>Baeopogon indicator</i>	Honeyguide Greenbull
	<i>Phyllastrephus icterinus</i>	Icterine Greenbull
	<i>Andropadus virens</i>	Little Greenbull
	<i>Andropadus curvirostris</i>	Plain Greenbull
	<i>Chlorocichla simplex</i>	Simple Greenbull
	<i>Chlorocichla simplex</i>	Simple Leave Love
	<i>Nicator chloris</i>	Western Nicator
	<i>Andropadus latirostris</i>	Yellow Whiskered Greenbull
<b>Rallidae</b>	<i>Sarothrura pulchra</i>	White Spotted Flutail
<b>Recurvirostridae</b>	<i>Himantopus himantopus</i>	Black Winged Stilt
<b>Strigidae</b>	<i>Strix woodfordii</i>	African Wood Owl
<b>Sturnidae</b>	<i>Poeoptera lugubris</i>	Narrow Tailed Starling
	<i>Lamprotornis purpureiceps</i>	Purple Headed Starling
<b>Sylviidae</b>	<i>Sylvietta virens</i>	Green Combec
	<i>Hylia prasina</i>	Green Hylia
	<i>Macrosphenus concolor</i>	Grey Longbill
	<i>Eremomela badiceps</i>	Rufous Crowned Eremomela
<b>Turdidae</b>	<i>Alethe castanea</i>	Fire Tailed Alethe
	<i>Zoothera princei</i>	Grey Ground Thrush
	<i>Alethe diademata</i>	White Tailed Alethe
	<i>Neocossyphus poensis</i>	White Tailed Ant Thrush
<b>Viduidae</b>	<i>Vidua macroura</i>	Pin Tail Whaydah
<b>Zosteropidae</b>	<i>Platysteira concreta</i>	Yellow White Eye



## Appendix 2, Checklist of Tree species in the study area

<b>Name of Tree Species</b>	<b>DBH</b>	<b>MH</b>	<b>Frequency</b>
<i>Adenostemma perrotteii</i>	35	13	7
<i>Adenia lobate</i>	43	17	6
<i>Adenostemma perrotteii</i>	40	19	2
<i>Azalia Africana</i>	233	34	9
<i>Albiza coriaria</i>	188	31	1
<i>Albiza gummifera</i>	199	29	8
<i>Albiza ferruginea</i>	212	32	13
<i>Albiza zygia</i>	246	32	6
<i>Allanblackia floribunda</i>	178	35	4
<i>Alstonia boonei</i>	280	31	4
<i>Alstonia congensis</i>	145	30	6
<i>Altrocarpus heterophylla</i>	47	17	9
<i>Amphimas pterocarpoides</i>	190	29	2
<i>Anarcadium occidentale</i>	57	17	6
<i>Angylocalyx zenkeri</i>	133	28	8
<i>Anona muricata</i>	34	14	6
<i>Anonidium manni</i>	48	18	4
<i>Anopyxis klianiana</i>	67	21	5
<i>Anthoceleista nobilis</i>	76	24	3
<i>Anthothona macrophylla</i>	59	21	4
<i>Antiaris africana</i>	233	35	3
<i>Antiaris welwitschii</i>	222	36	2
<i>Antrocaryon micraster</i>	97	28	5
<i>Aristolochina ningens</i>	111	27	4
<i>Artocarpus attilis</i>	79	27	7
<i>Avicenia germirans</i>	87	30	5
<i>Azadirachta indica</i>	99	24	9
<i>Balanites wilsoniana</i>	43	13	5
<i>Baphia nitida</i>	110	28	7
<i>Bateria fistulosa</i>	57	21	4
<i>Berlinia grandiflora</i>	77	25	8



<i>Berlinia SPP</i>	65	25	3
<i>Bidens pilosa</i>	14	8	3
<i>Blighia sapida</i>	122	27	2
<i>Blighia welwithil</i>	34	12	6
<i>Bombax brevicuspe</i>	133	28	6
<i>Bosqueia angolensis</i>	112	22	6
<i>Brachystegia eurycoma</i>	456	35	36
<i>Brachystegia nigerica</i>	466	39	19
<i>Bridelia ferruginea</i>	375	21	4
<i>Bridelia micrantha</i>	57	24	6
<i>Bryophyllum pinnantum</i>	89	21	9
<i>Canarium schweinfurthii</i>	76	21	7
<i>Carpolobia lutea</i>	64	23	4
<i>Cassia alata</i>	10	8	5
<i>Cassia hrusta</i>	87	24	7
<i>Cathium hispicum</i>	66	21	9
<i>Ceiba pentandra</i>	398	35	8
<i>Celtis aldolfi- friderici</i>	98	23	4
<i>Celtis mildibraedii</i>	56	21	5
<i>Celtis mildibraedii</i>	87	23	6
<i>Celtis zenkeri</i>	111	21	5
<i>Chrysophyllum abidun</i>	231	31	4
<i>Chrysophyllum delevoyi</i>	234	30	4
<i>Chrysopyllum africana</i>	67	21	5
<i>Cissampelos mucronata</i>	41	20	2
<i>Cleistopholis patens</i>	65	21	8
<i>Cola acuminata</i>	110	25	8
<i>Cola ginganta</i>	221	31	8
<i>Cola lateritia</i>	245	31	8
<i>Cola melleni</i>	64	21	5
<i>Combretodendron macrocarpum</i>	131	24	8
<i>Cordia millenii</i>	132	25	5
<i>Crescentia cujete</i>	46	20	12
<i>Cylicodiscus gabunensis</i>	76	26	6
<i>Cymbopogon citratus</i>	99	27	12
<i>Spathodea companulata</i>	132	21	8
<i>Daniella ogea</i>	341	34	4
<i>Deinbollia piñata</i>	88	24	5
<i>Desplatsia subericarpa</i>	42	21	3
<i>Dialium guineense</i>	131	24	9



<i>DIopros nigerica</i>	121	23	6
<i>Diospyros alboflavescens</i>	67	21	7
<i>Diospyros dendo</i>	55	20	9
<i>Diospyros mesipiliformis</i>	62	25	6
<i>Distemonanthus benthamianus</i>	87	26	6
<i>Elaeisis guineesis</i>	110	27	6
<i>Entada Africana</i>	122	28	9
<i>Entandrophragma angolense</i>	351	34	7
<i>Entandrophragma utile</i>	366	38	9
<i>Erythrophleum suaveolens</i>	174	25	6
<i>Fagara macrophylla</i>	95	21	4
<i>Ficus sur</i>	133	27	5
<i>Ficus capensis</i>	121	23	5
<i>Ficus Esasperata</i>	326	34	8
<i>Ficus glumosa</i>	98	25	0
<i>Ficus glumosa</i>	57	21	0
<i>Ficus sur</i>	43	20	3
<i>Ficus thoniigii</i>	54	21	3
<i>Funtumia Africana</i>	136	28	17
<i>Funtumia elastic</i>	90	23	3
<i>Garcinia kola</i>	122	21	3
<i>Gossweilorodendron balsaminiferum</i>	34	14	1
<i>Grewia venusta</i>	43	20	2
<i>Guarea cedrata</i>	79	27	1
<i>Guibourtia sp.</i>	89	23	1
<i>Hallea cilata</i>	38	12	1
<i>Hannoa klaineana</i>	76	23	1
<i>Hevea brasiliensis</i>	85	25	1
<i>Homalium aylmeri</i>	39	11	1
<i>Hunteria umbellate</i>	63	23	2
<i>Hymenostegia afzelii</i>	42	21	2
<i>Icacina trichantha</i>	56	23	1
<i>Irvingia gabonensis</i>	172	28	2
<i>Irvingia grandifolia</i>	129	30	1
<i>Khaya grandifoliola</i>	166	31	3
<i>Khaya ivorensis</i>	34	12	1
<i>Kigelia Africana</i>	199	32	3
<i>Lannea welwitschi</i>	73	23	2
<i>Lonchocarpus griffonianus</i>	72	21	5
<i>Lophira alata</i>	155	29	1



<i>Lovoa trichilioides</i>	111	21	1
<i>Maesobotrya bateri</i>	122	24	2
<i>Maesopsis eminii</i>	26	8	7
<i>Magniferal Indical</i>	67	26	1
<i>Memocylon blakeoides</i>	210	34	8
<i>Milicia excelsa</i>	239	39	3
<i>Milletice cerriceus</i>	56	24	2
<i>monodora myristica</i>	45	21	1
<i>Moringa lucida</i>	56	20	5
<i>Musanga cecropioides</i>	131	21	1
<i>Myrianthus arboreus</i>	133	23	3
<i>Napoleonea vogelii</i>	98	20	2
<i>Nauclea diderrichii</i>	67	22	3
<i>Nesogordonia papaverifera</i>	79	20	5
<i>Newbouldia laevis</i>	73	21	5
<i>Ntrocaryon micraster</i>	84	22	1
<i>Okoubaka aubrevillei</i>	54	21	1
<i>Olox subscorpioidea</i>	59	20	1
<i>Oxytenanthera abyssinica</i>	78	21	2
<i>Pachyelasma tessmannii</i>	53	20	2
<i>Panda oleasa</i>	45	21	3
<i>Pausinystalia macroceras</i>	87	24	2
<i>Pentaclethra macrophylla</i>	99	23	3
<i>Pentaclethra macrophylla</i>	87	26	3
<i>Pentaclethra macrophylla</i>	84	27	1
<i>Pentadesma butyracea</i>	55	21	3
<i>Piptadeniastrum africanum</i>	145	29	1
<i>Polyalthia suaveolens</i>	34	8	2
<i>Polyceratocarpus parviflorus</i>	122	23	1
<i>Psidium guajava</i>	13	5	1
<i>Pterocarpus soyauxii</i>	28	7	3
<i>Pterocarpus osun</i>	117	26	2
<i>Pycanthus angolensis</i>	231	39	1
<i>Rauwolfia vomitoria</i>	98	24	1
<i>Ravolfia traphylla</i>	23	7	2
<i>Ricinodendron heudelotii</i>	32	9	3
<i>Rothmannia hispida</i>	67	24	1
<i>Saacharum officinarum</i>	14	7	1
<i>Scottellia coriacea</i>	54	20	3
<i>Snysepalum dulcificum</i>	13	9	1



<i>Sopondia mombin</i>	63	21	3
<i>Spathodea campanulatu</i>	46	22	1
<i>Staudtia stipitata</i>	76	20	2
<i>Sterculia oblonga</i>	49	21	3
<i>Sterculia tragacantha</i>	54	22	2
<i>Sterculia coriata</i>	34	23	1
<i>Stombosia grandifolia</i>	53	28	1
<i>Strombosia postulate</i>	63	27	3
<i>Tabernaemontana pachysiphen</i>	122	29	1
<i>Terminalia ivorensis</i>	143	29	4
<i>Terminalia superba</i>	167	30	2
<i>Tetracarpidium conophorom</i>	112	21	1
<i>Tetrapleura tetaptera</i>	143	25	2
<i>Tetrorchidium didymostemon</i>	54	23	1
<i>Theobroma cacao</i>	13	7	1
<i>Trama orientalis</i>	25	10	2
<i>Treculia Africana</i>	175	30	2
<i>Trichilia lanata</i>	54	21	1
<i>Trichilia prieuriana</i>	54	21	1
<i>Triplochiton scleroxylon</i>	257	37	4
<i>Triumfetta pentandra</i>	38	21	2
<i>Uvariopsis dioica</i>	11	5	4
<i>Xylopi aethiopica</i>	29	17	1