Journal of
Environment
(JE)

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CARI Journals

Journal of Environment
ISSN 2789-3863 (Online)
Vol. 3, Issue No. 1, pp 31 - 54, 2023
www.carijournals.org

An Analytical Study of Flora Diversity and Avifauana Distribution and Sustainable Ecotourism Potential of Sakponba Forest Reserve Edo State Nigeria

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Accepted: 15th Mar 2023 Received in Revised Form: 28th March 2023 Published: 6th Apr 2023

Abstract

Purpose: The goal of this study, which was conducted in Nigeria's Sakponba Forest Reserve, was to gather baseline data on the prevalence of bird species and the richness of the state's flora in order to guide future ecotourism planning and management in the area

Methodology: The study area was divided into three compartments, Untouched forest (UDF), Mangrove forest (MGF), and Degraded forest (DGF) made up the study area. The range and richness of bird species in the research area were studied using a line transect approach. 20 transects were distributed at random among the 200 m blocks that made up each of the 60 transect lines, each of which measured 1000 m. The diversity of plant species was calculated using the square approach. Each sampling compartment's 25 by 25 m2 quadrant sample plot is randomly selected, and all trees with a basal area of at least 10 cm and a height of at least one meter are tallied using the algorithm starts count (TEC). 15 plots, each measuring 25 by 25 m2, were created by choosing a random 16 quadrants in each of the five sample containers.

Results: The result of the research study revealed that the area is home to a large range of plants and birds species. In total, the research area contained fifty-five (55) plant species from thirty-seven (37) families and one hundred and seventy-seven (177) bird species from forty-two (42) families. Pycnonotideae has the most species (12), followed by Estrildideae with 11 species, in terms of the family breakdown of the bird species. According to the distribution of bird species, the research area's UDF compartment has a 47% overall proportion, followed by the MGF compartment at 35%, and the DGF compartment with 18%.Pyto-sociological specifications of the tree species in the study area, Ceiba pentandra, a member of the family Bombacaceae, has the highest mean height MT (23) and diameter at breast height DBH (129), while Rhizophora harrisonii, a member of the family Rhizophoraceae, has the highest frequency of occurrence of (15). Family makeup of the plant species in the research region, Fabaceae has the most species with 5, followed by Poaceae with (4).

Unique contribution to Theory, Policy and Practice: Studying bird species in mangrove

forests can provide valuable insights into the ecology and conservation of these important ecosystems, and contribute to our knowledge of biodiversity and ecological relationships in general. The research location is predominantly a transitional zone between rain forest and mangrove forest. This serves as a point of entry for other investigators and promotes bird species preservation

Keywords: *Habitat Type, Diversity, Flora, Bird Species Ecotourism Planning*

INTRODUCTION

In tropical river estuaries and tidal zones, mangroves form a characteristic forest biotope. They have a remarkable capacity for adaptation to the environmental conditions of all kinds of water as well as the infiltration of clean river water. Mangroves are usually referred to by government organizations and businesses who are eager to promote growth as "unhealthy waste-lands" or "useless swamps," and as a result, they are quickly filled with sand to make room for growing metropolitan centers and agricultural regions. As a result of significant mangrove loss and contamination, floating water hyacinth (Eichhornia crassipes), grasses, and weeds now predominate in the tidal marsh. One of tropical Africa's most amazing natural wonders and centers of biodiversity are its salt marshes. (Phillips, et al, 1997).The three Rhizophora species that make up Nigeria's mangroves are R. racemosa, R. Mannequin, and R. harrisonni (Adegbehin, 1993). Tropical deforestation has an impact on the environment and the economy. This is the result of the significant values that have been lost, some of which may be irreversible. Habitat destruction and mangrove loss could be very expensive. According to Barbier (1992), the lost cost or prospective cost of converting Indonesia's primary and secondary forests is in the neighborhood of US$ 625–750 million annually for the bird life in mangroves. This expense is compared to the log rents from the conversion of these woods. In Europe (Acevedo, 2009, Rajpar, and Zakaria, 2010), South America (Acevedo, 2009, Rajpar, and Zakaria, 2010), Africa (Abuodha, 2001, Kairo, 2004), and Australia, critical ecosystem species diversity has been thoroughly investigated (Kutt, 2007). Wetlands provide significant biological roles, but they are suffering catastrophic global harm from overexploitation, much like tropical rainforests (Hartog, 2000, Ellison, 2008). Every region with marshes records losses, and the rates are quickly rising, especially in developing countries, where more than 90% of the mangroves wetlands are found (Duke et al, 2007). The study of bird species richness and variety is crucial because the wetlands forest in Nigeria is threatened by population increase, industrialisation, depletion of resources, and agricultural intensification. The research location is predominantly a transitional zone between rain forest and mangrove forest. This serves as a point of entry for other investigators and promotes bird species preservation.

MATERIALS AND METHOD,

Study Area

The Sakponba Forest Reserve is located at latitude 6004°N and longitude 5032°E in the tropical tropical rainforest region of Nigeria. The object's coordinates are 60°4'N, 5°32'E. The forest reserve is located in the Orhionmwon Local Government Area of Edo State. The Sakponba Forest Reserve is divided into two main areas, Area BC29 and BC32/4, which are separated from one another by the River Jamieson. It has a grid with 175 compartments. There are 75 in BC 32/4 and 101 in BC 29. (Isikhumen, 1998). Less than 30 cm of reddish topsoil with fine sand and loamy texture is present. As the soil lowers the profile at depths more than 30 cm, the texture gets rougher, the Chroma deepens to a brick red color, and subsequently brick red soil is reached (Oguntala 1980). On average, 30 oC of rain falls each year. When it's the driest and wettest, the relative humidity is at least 65% and 100%, respectively (Mengistu, 2007). The lowland rainforest habitat of the Guinea-Congo includes ecosystems of dense forest, secondary forest, and understory layer. The Kapok, Celtis zenkerii, Triplochiton scleroxylon, Antiaris Africana, Pycnathus angolensis, and Alstonia congensis are just a few of the numerous flora that may be found there. The reserve's area is the best illustration of mature secondary forest (Keay, 1989)

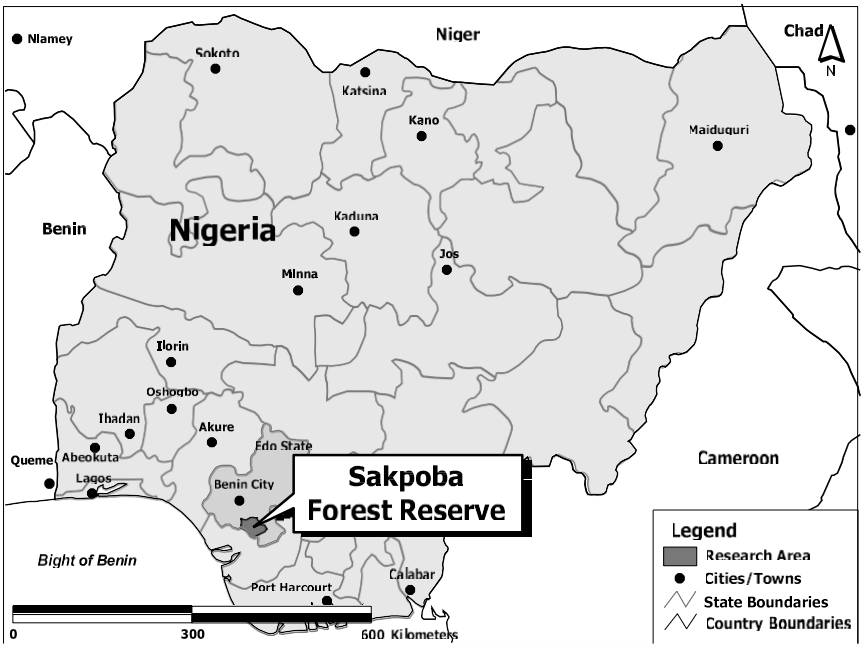


Figure 1, Map of the study area (source: Adewusi, 2004).

Data Collection

Documentation on the variety and spread of bird species in the research location was gathered using the line transects technique (Sutherland, 2009). The site was separated into three areas for the purposes of this investigative process: the mangrove forest (MGF), the undisturbed forest (UDF), and the degraded forest area (DGF). 20 transects were distributed at random among the

200 m blocks that made up each of the 60 transect lines, each of which measured 1000 m. The best times to go on field trips were between 6:00 and 10:00 in the morning and 16:00 and 18:00 in the late afternoon. Three times a week for three months, in both the wet and dry seasons (May, July, and September for the wet season and November, January, and March for the dry season), transect lines were walked. Depending on the topography and the number of bird species observed, lines were walked at a speed of 1.5 km/h on average. All birds observed on the ground, in the foliage, and in the distance were recognized, and the number of each group was noted. Between 10 meters from one another, birds of the same species are counted as a homogeneous entity. A set of 7x50 binoculars was used to identify several bird species. Bird calls were utilized to confirm the presence of crepuscular bird species inside the study sites, and the field reference book of West African birds (Burrow and Demey, 2011) was used to identify the bird species. Birds that were seen but not immediately identified were noted for their physical traits.

Habitat assessment

The number of different plant species was calculated using the quadrant approach (Ogunjiemitie et al., 2005). The complete enumeration technique is used in this technique to count all trees that are at least 1 m tall and have a basal area of at least 10 cm. A 25 by 25 m2 quadrant sample plot is randomly selected from each sampled compartment (TEC). By casting a ballot in each of the five sample blocks three of the 16 quadrants were randomly chosen, culminating in 15 plots that were each 25 by 25 m2 in size. Within each sample quadrant, the essential information was collected. A diameter of less than 10 cm characterizes all plants that are taller than 1 m. total number of trees having a basal area less than 10 cm and a height larger than 1 m. All plant species are listed in full, along with the groupings to which they belong.

Statistical Analysis

Using the data gathered, the Simpson diversity index was used to calculate the diversity of plant and bird species. The result is reported as follows: The diversity index is high. Pi = is the sample's proportion of the ith species, and InPi = is the natural logarithm of the species proportion. Relative population density of the species As stated by Bibby et al. (1992), the relative population density of bird species at different locations and times of year was computed as follows:

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

$$D = n1 + n2 Loge [n1 + n2]$$

$$\pi r2m \, n2$$ Where: D = density

r = radius of the first zone

n1 = number of birds counted within the zone

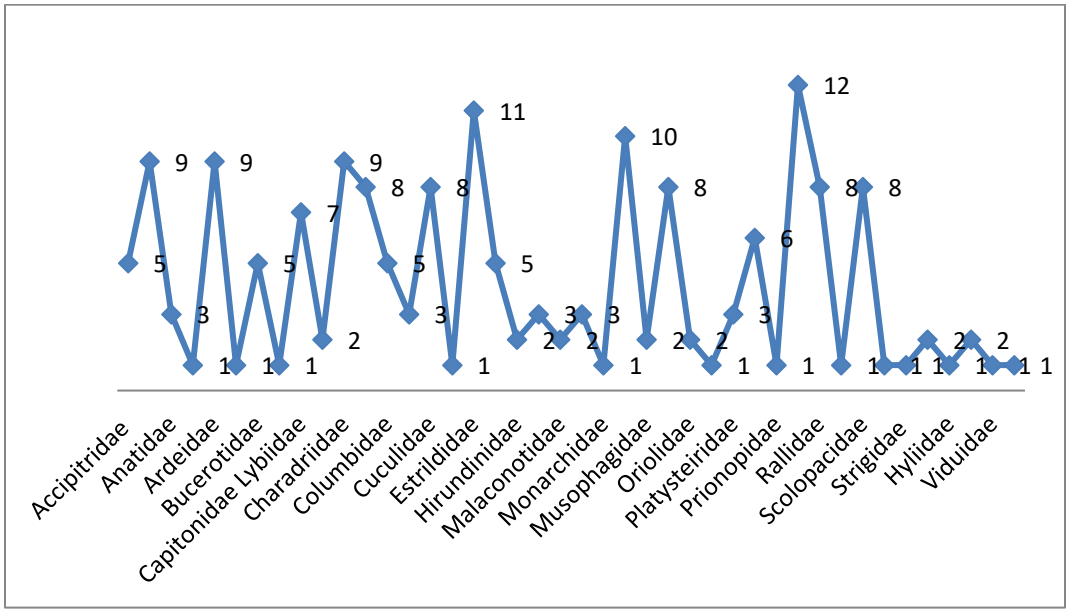
n2 = number of birds counted beyond zone and m = number of the replicate count in such

area.

The data from the field survey were entered into an Excel (version 20) spreadsheet before both descriptive (tables, frequency, and percentage frequency, graph, pie, and bar charts) and analytical statistics were calculated. PAST Model version 3 on a computer was used to investigate bird species diversity, rarefaction, and SHE analysis.

Results

The result of the research study revealed that area was rich in flora and bird diversity. In all a a total of one hundred and seventy seven (177) bird species belonging to forty two (42) families , fifty five (55) plant species belonging to thirty seven (37) families were recorded in the study area. The family composition of the bird species showed that Pycnonotideae has the highest (12) bird species followed Estrildideae with 11 bird species Figure 2. The result of bird species distribution indicates that undisturbed forest compartment has 47% which is the highest in the study area, followed mangrove forest compartment 35% and secondary forest with 18% which is the lowest Figure 3. The result of conservation status of the bird species in the study revealed that 86% were resident bird species with least concern (R/LC), 9% were Palearctic migrants with least concern (P/LC) Figure 4.The Shannon diversity index showed that it was higher in the dry season (5.131) than the wet season (5.01). The Pyto-sociological parameters of tree species in the study area indicates that Ceiba pentandta with belong to the family Bombacaceae has the highest Diameter at breast height DBH (129) and mean height MT (23) while, Rhizophora harrisonii which belong to the family Rhizophoraceae has the highest occurring frequency of (15) Table 2.The family composition of plant species in the study area showed that Fabaceae has highest plant species of (5) which is followed by Poaceae with (4) plant species Figure 6. The result of the diversity index revealed that it was higher in the dry season 3.808 than the wet season 3.58



Journal of Environment
ISSN 2789-3863 (Online)
Vol. 3, Issue No. 1, pp 31 - 54, 2023
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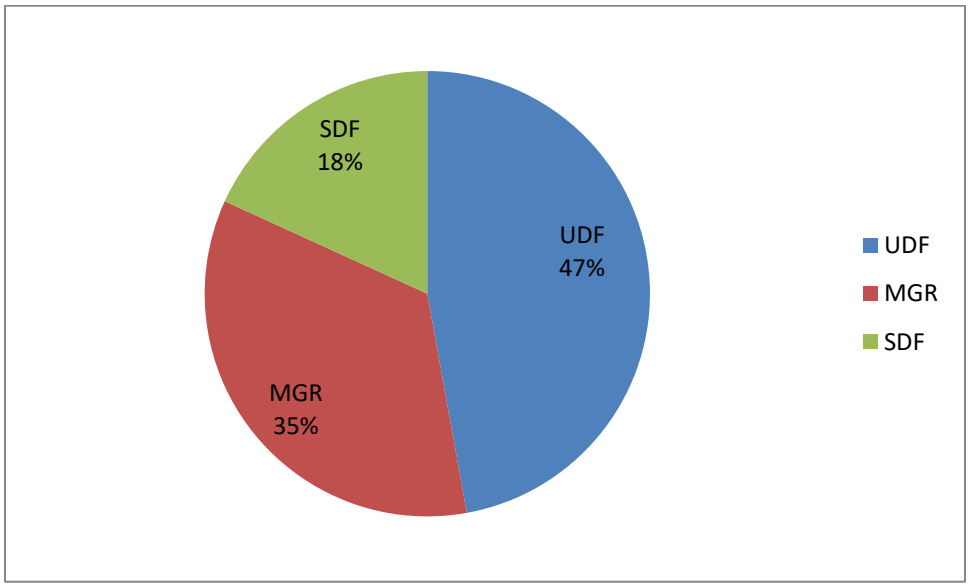

Figure 3, Bird Species in the three compartments in the study area

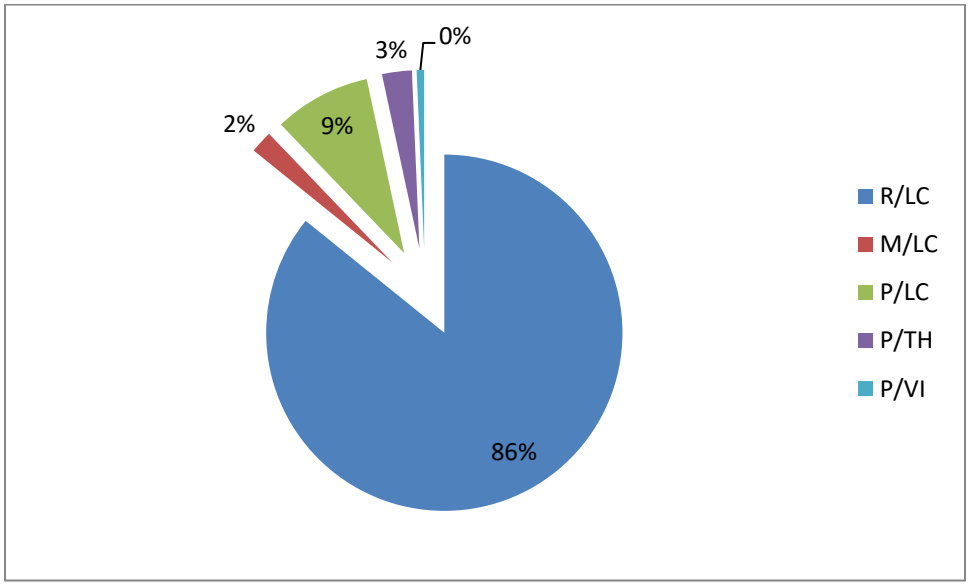

Figure 4, Conservation status of bird species in the study area

Table 1, Diversity index bird species in the study area

Diversity index	Dru season	Lower	Upper	Wet season	Lower	Upper

Taxa_S	174	164	174	153	137	149
Individuals	482	482	482	287	287	287
Dominance_D	0.006	0.007352	0.008187	0.006762	0.008583	0.009943
Shannon_H	5.131	4.941	5.017	5.01	4.765	4.872
Evenness_e^H/S	0.9728	0.8379	0.8822	0.9802	0.8424	0.8889
Brillouin	4.619	4.468	4.525	4.348	4.173	4.244
Menhinick	7.925	7.47	7.925	9.031	8.087	8.795
Margalef	28	26.38	28	26.86	24.03	26.15
Equitability_J	0.9946	0.9655	0.9755	0.996	0.9654	0.9763
Fisher_alpha	97.74	87.6	97.74	133.1	102.8	124.8

Table 2, Pyto-sociological parameters of tree species in the study area

DBH	**MT**	**Frequency**
129	23	15
Ceiba pentandra	Ceiba Pentandra	Rhizophora harrisonii
Bombacaceae	Bombacaceae	Rhizophoraceae

Journal of Environment
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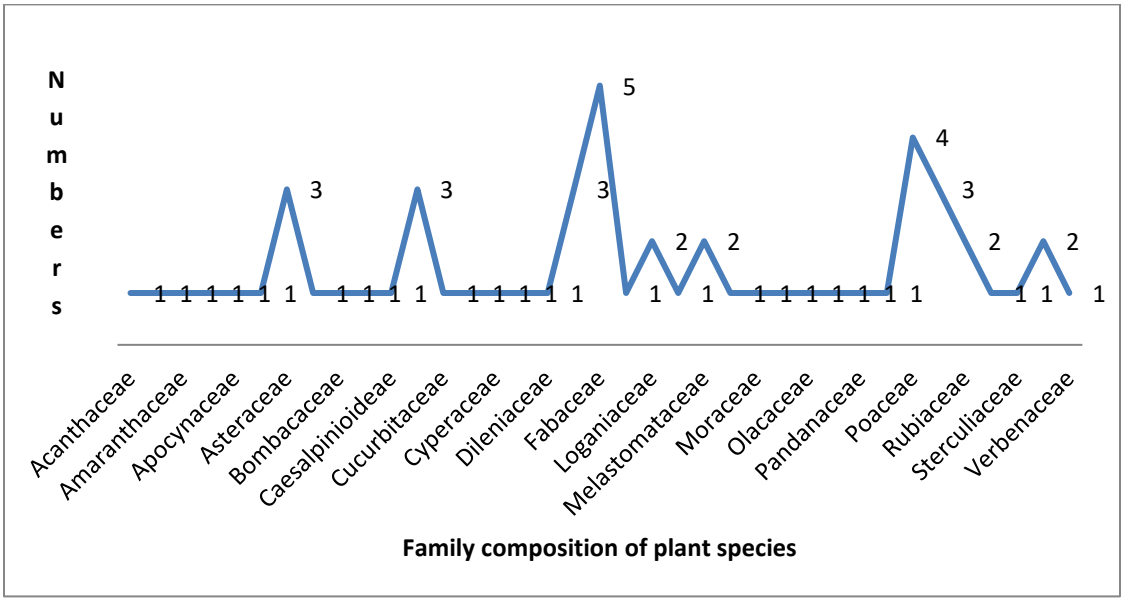

Figure 5, Family composition of plant species in the study area

Table 3, Diversity index of plant species in the study area

Diversity index	Dry season	Lower	Upper	Wet season	Lower	Upper
Taxa_S	55	47	55	44	36	43
Individuals	111	111	111	72	72	72
Dominance_D	0.02719	0.02508	0.03531	0.03665	0.03009	0.04668
Shannon_H	3.808	3.618	3.827	3.58	3.369	3.628
Evenness_e^H/S	0.819	0.7541	0.8644	0.8153	0.7686	0.8939
Brillouin	3.226	3.094	3.248	2.921	2.791	2.969
Menhinick	5.22	4.461	5.22	5.185	4.243	5.068
Margalef	11.47	9.767	11.47	10.05	8.184	9.821
Equitability_J	0.9502	0.928	0.963	0.946	0.9284	0.9696

Fisher_alpha	43.26	30.76	43.26	48.06	28.65	45.01

Discussion

The results of the investigation revealed that the region is home to a large range of plants and bird species . The study area had a total of fifty-five (55) plant species from thirty-seven (37) families and one hundred and seven six (176) bird species from forty-two (42) groups. The findings demonstrate that there is a wide range of bird species in the study area due to the heterogeneity of the categories of natural forests that were looked at. This result is in line with observations made by the authors Roth (1976), He and Legendre (1996), Elmberg et al. (1994), Muoz-Pedreros and Merino (2014), who noted that a larger diversity of ecosystems permits the integration of more species because they meet the requirements of a larger number of species. Similarly, more species may exist in settings with greater diversity since the visible variations in the ecosystem reduce competition. The results clearly show that in relation to the number of bird species, the coastal wetlands segment trails the undisturbed patches section. This demonstrates how human-induced environmental change affects the variety and number of bird species. According to this study, habitat loss, destruction, and degradation pose a severe threat to the richness and diversity of bird species (Birdlife International, 2000). Natural or human-caused attributes may be to liable for this loss of habitat. It is more likely that anthropogenic climate change is to blame for habitat destruction. According to Newton (1988), only human activity has contributed to the 127 to 9672 extinct bird species over the previous 400 years. Gathering firewood, harvesting lumber, farming, drainage marshes, urban sustainability, construction, and industry, among other activities, have all had an impact on diverse habitats (Birdlife International, 2000). More than half of all known species are found in the tropical biome, hence Myers (1996) contends that the loss of this habitat is particularly alarming. These decreases are also connected to agriculture's invasion and the inadequacy of agroforestry systems (Blockhus et al., 1992). The mangrove forest compartment has year-round access to water, making it a year-round habitat for aquatic bird species. We also noticed that the partition had migrant bird species as compared to the vegetative compartments. It has long been understood that moisture is important for mangrove-associated species of wintering domestic birds (Johnson et al., 2006; McKinnon, et al, 2015). This suggests that people's contact with moist ecosystems shields them from the effects of intermittent dryness, which is anticipated to worsen with climate change (Neelin et al., 2006). Duke, et al. (2007)'s discovery that mangroves support a diversity of terrestrial, estuarine, and marine species along the land-sea interface and comprise a variety of unusual ecosystems lends further credence to this. Long, tangled roots of mangroves provide as significant fish breeding areas in addition to serving as vital habitat for many bird species above water. Many aquatic and migrant species use mangroves as ideal nesting and resting grounds, including egrets, herons, and kingfishers. The Charadriidae, Glareolidae, and Scolopacidae

families spend the season in fully developed wet forests with the least amount of disruptions (mangroves and forests encompassing understory forests with 15-20 m tall canopies), which had a higher probability of dwellings and supported a higher species richness than secondary and undisturbed forests. And although density isn't always a great measure of how well an ecosystem is operating, it can be a better sign of the resources that are accessible to wetland and swarming species like plovers, pratincoles, and sandpipers (Van Horne, 1983).

Conclusion and recommendation

According to the research report, the different habitats that varied bird species use have a significant impact on them and have a variety of effects on the abundance and diversity of bird species. The study also showed how important mangrove forests are for presenting both aquatic and terrestrial bird species. Due to the available amount of food, predator protection, and perfect breeding ground, the wetland has the second highest bird species diversity among the three major land use patterns in the study area. Among varied land uses, there are significant differences in species diversity. Bird populations were negatively impacted by habitat loss brought on by increased land development. By giving bird-friendly aesthetics first priority while preserving native tree species in the forest, the diversity of the local avifauna can be conserved. Additionally, the variety of local tree and avian species will grow as a result of this thus has huge ecotourism potential in the state. Since this avifauna in the study region should be safeguarded, it is critical to refrain from strictly enforcing farming practices that may harm it. Supporting initiatives to involve the community and develop income sources is crucial. Career advancement and career from the most deteriorated places ought to go hand in side with this to recover the ecosystem.

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Appendix 1, Checklist, distribution and conservation status of bird species in the study area

Scientific Name	Common Name	UDF	MGR	DGF	CON.status
Aquila africana	Cassin's hawk Eagle	√	×	×	R/LC
Kaupifalco onogrammicus	Lizard Buzzard	×	×	√	R/LC
Hieraaetus wahlbergi	Wahlberg's Eagle	√	√	×	R/LC
Milvus aegyptius	Yellow Bill Kite	×	√	×	M/LC
Polyboroides typus	African Harrier Hawk	√	×	×	R/LC
Ceyx lecontei	African Dwarf Kingfisher	×	√	×	R/LC
Halcyon badia	Chocolate-Backed Kingfisher	×	√	×	R/LC
Halcyon malimbica	Blue-Bresated Kingfisher	×	√	×	R/LC
Halcyon leucocephala	Grey Headed Kingfisher	×	√	×	R/LC
Ispidina picta	African Pigmy Kingfisher	×	√	×	R/LC
Ceryle rudis	Pied Kingfisher	×	√	×	R/LC
Alcedo cristata	Malachite Kingfisher	×	√	×	R/LC
Megaceryle maxima	Giant Kingfisher	×	√	×	R/LC
Halcyon senegalensis	Woodland Kingfisher	×	√	×	R/LC
Dendrocygna viduata	White Faced Whistling Duck	×	√	×	R/LC
Pteronetta hartlaubii	Hartlaub's Duck	×	√	×	R/LC
Sarkidiornis melanotos	Knob Bellied Duck	×	√	×	R/LC
Cypsiurus parvus	African Palm Swift	√	×	×	R/LC

Ardea alba	Great Egret	×	√	×	R/LC
Bubulcus ibis	Cattle Egret	×	√	×	R/LC
Ardeola ralloides	Squacco Heron	×	√	×	R/LC
Lsobrychus minutes	Little Egret	×	√	×	R/LC
Nycticorax nycticorax	Black-Crowned Night Heron	×	√	×	R/LC
Gorsachius leuconotus	White Backed Night Heron	×	√	×	R/LC
Ardea cinerea	Grey Heron	×	√	×	R/LC
Ardea melanocephala	Black Headed Heron	×	√	×	R/LC
Ixobrychus minutus	Little Bittern	×	√	×	R/LC
Anhinga rufa	**African Darter**	×	√	×	R/LC
Apus affinis	African Pied Hornbill	×	×	√	R/LC
Tockus faciatus	African Grey Hornbill	×	×	√	R/LC
Lophoceros nasutus	Black and white Hornbill	√	×	×	R/LC
Bycanistes fistulator	Piping Hornbill	√	×	×	R/LC
Tropicranus alpocristatus	white-Crested Hornbill	√	×	×	R/LC
Horizocerus albocristatus	Blue Cuckoo Shrike	√	×	×	R/LC
Cyanograucalus azureus	Hairy-Breasted Barbet	√	×	×	R/LC
Tricholaema hirsuta	Red-Rumped Tinkeredbird	√	×	×	R/LC
Pogoniulus atroflavus	Naked-Faced Barbet	√	×	×	R/LC
Gymnobucco calvus	Speckled Tinkerbird	√	×	×	R/LC
Pogoniulus scolopaceus	Yellow-Fronted Tinkerbird	√	×	√	R/LC
Pogoniulus chrysoconus	Bristled-Nosed Barbet	√	×	×	R/LC

Gymnobucco peli	Yellow-Throated Tinkerbird	×	×	√	R/LC
Pogoniulus subsulphureus	Standard-Winged Nightjar	×	×	√	R/LC
Caprimulgus nigriscapularis	**Black-Shouldered Nightjar**	×	√	×	R/LC
Caprimulgus longipennis	Three Banded Plover	×	√	×	R/LC
Charadrius tricollaris	Forberaess Plover	×	√	×	P/LC
Charadriusforbesi	kittlitzs Plover	×	√	×	R/LC
Charadrius pecuarious	Common Ring Plover	×	√	×	P/TH
Charadrius hiaticula	Kentish Plover	×	√	×	P/VI
Charadrius alexandrinus	Lesser Black Winged Lapwing	×	√	×	P/LC
Vanellus lugubris	Spur Winged Lapwing	×	√	×	R/LC
Vanallus spinosus	African Wattled Lapwing	×	√	×	R/LC
Vanallus senegallus	Wattled Lapwing	×	√	×	R/LC
Bathmocercus cerviniventris	Black-Head Rufous Warbler	√	×	×	M/LC
Cisticola erythrops	Red-Faced Ccisticola	√	×	×	R/LC
Camaroptera chloronota	Olive-Green Camaroptera	√	×	×	R/LC
Prinia bairdii	Banded Prinia	√	×	×	R/LC
Camaroptera brevicaudata	Grey Backed Camaroptera	√	×	×	R/LC
Prinia subflava	Tawny- Flanked Prinia	×	×	√	R/LC
Apalis jacksoni	Black Throated Apalis	√	×	×	R/LC
Treron calvus	African Green Pigeon	√	×	×	R/LC
Turtur brehmeri	Blue Headed Wood Dove	√	×	×	R/LC

Spilopelia senegalensis	Llaughing Dove	×	×	√	R/LC
Streptopelia semitorquata	Red Eyed Dove	×	×	√	R/LC
Turtur tympanistria	Tambourine Dove	√	×	×	R/LC
urystomus glaucurus	Broad Billed Roller	×	×	√	R/LC
Coracias abyssinicus	Abyssinian Roller	√	×	×	M/LC
Coracias cyanogaster	Blue Bellied Roller	√	×	×	M/LC
Chrysococcyx cupreus	African Emerald Cuckoo	√	×	×	R/LC
Centropus grillii	Black Coucal	√	×	×	R/LC
Cuculus clamosus	Black Cuckoo	√	×	×	R/LC
hrysococcyx caprius	Diederik Cuckoo	√	×	×	R/LC
Cercococcyx mechowi	Dusky Long-Tailed Cuckoo	√	×	×	R/LC
Chrysococcyx klaas	Klaas's cuckoo	×	×	√	R/LC
Centropus senegalensis	Senegal Coucal	×	×	√	R/LC
Ceuthmochares aereus	Yellowwbill	×	×	√	R/LC
Dicrurus adsimilis	Fork-Tailed Drongo	√	×	×	R/LC
Spermestes bicolor	Black-and-White Mannikin	√	×	×	R/LC
Nigrita bicolor	Chestnut-Breasted Negrofinch	√	×	×	R/LC
Nigrita canicapillus	Grey-Headed Negrofinch	√	×	×	R/LC
Nigrita luteifrons	Pale-Fronted Negrofinch	×	×	√	R/LC
Lagonosticta senegala	Red-Billed Firefinch	×	×	√	R/LC
Cryptospiza reichenovii	Red-Faced Crimsonwing	×	×	√	R/LC
Spermophaga ruficapilla	Red-Headed Bluebill	×	×	√	R/LC

Spermophaga haematina	Western Bluebill	√	×	×	R/LC	
Nigrita fusconotus	White-Breasted Nigrita	√	×	×	R/LC	
Parmoptila rubrifrons	Red-Fronted Antpecker	√	×	×	R/LC	
Parmoptila woodhousei	Woodhouse's (Red- Headed) Antpecker		√	×	×	R/LC
Glareola pratincola	Collard Pratincole	×	√	×	P/LC	
Glareola pratincola	Grey Pratincole	×	√	×	P/LC	
Tringa ochropus	Green Sandpiper	×	√	×	P/LC	
Actitis hypoleucos	Common Sandpiper	×	√	×	P/LC	
Tringa erythropus	Spotted Redshank	×	√	×	P/LC	
Cecropis abyssinica	**Lesser striped swallow**	×	√	×	P/LC	
Barn swallow	Hirundo rustica	×	√	×	R/LC	
Cecropis semirufa	Cassin's honeyguide	√	×	×	R/LC	
Prodotiscus insignis	Red-Eyed Puffback	√	×	×	R/LC	
Dryoscopus senegalensis	Lagden's Bush Shrike	√	×	×	R/LC	
Malaconotus lagdeni	Large-Billed Puffback	√	×	×	R/LC	
Dryoscopus sabini	Sabine's Puffback	√	×	×	R/LC	
Dryoscopus sabini	Black Bee-Eater	√	×	×	R/LC	
Merops gularis	Little Bee- Eater	×	×	√	R/LC	
Merops pusillus	White-Throated Bee- Eater	×	×	√	R/LC	
Merops albicollis	Chestnut -Capped Flycatcher	√	×	×	P/LC	
Myiagra castaneigular	African Forest-Flycatcher,	√	×	×	R/LC	
Fraseria ocreata	Blue- Headed Crested	√	×	×	R/LC	

	Flycatcher				
Trochocercus nitens	Blue- Shouldered Robin- Chat	√	×	×	R/LC
Cossypha cyanocampter	Forest Robin	√	×	×	R/LC
Stiphrornis erythrothorax	Forest Scrub Robin	√	×	×	R/LC
Cercotrichas leucosticta	Lowland Akalat	√	×	×	R/LC
Sheppardia cyornithopsis	Pied Flycatcher	√	×	×	P/LC
Ficedula hypoleuca	Sooty Flycatcher	√	×	×	R/LC
Muscicapa infuscata	Guinea Turaco	√	×	×	R/LC
Tauraco persa	Olive-Bellied Sunbird	√	×	×	R/LC
Cinnyris chloropygius	Buff-Throated Sunbird	√	×	×	R/LC
Chalcomitra adelberti	Collard Sunbird	×	×	√	R/LC
Hedydipna collaris	Green-Headed Sunbird	×	×	√	R/LC
Cyanomitra verticalis	Reichenbach1's Sunbird	×	×	√	R/LC
Anabathmis reichenbachii	Splendid Sunbird	×	×	√	R/LC
Sheppardia cyornithopsis	Supberb Sunbird	×	×	√	R/LC
Cinnyris coccinigastrus	Variable Sunbird	×	√	×	R/LC
Cinnyris venustus	Western Black-Headed Oriole	√	×	×	R/LC
Oriolus larvatus	Black-Winged Oriole	√	×	×	R/LC
Oriolus hosii	Forest Wood- Hoopoe	√	×	×	R/LC
Phoeniculus castaneiceps	Chestnut Wattle-Eye	√	×	×	R/LC
Platysteira castanea	African shrike-flycatcher	√	×	×	R/LC
Megabyas flammulatus	Common Wattle-Eye	√	×	×	R/LC

Platysteira cyanea	Red- Headed Malimbe	×	√	×	R/LC
Malimbus rubricollis	Velliot's Black Weaver	×	√	×	R/LC
Ploceus nigerrimus	Red-Vented Malimbe	×	√	×	R/LC
Malimbus scutatus	Yellow Mantted Weaver	×	√	×	R/LC
Ploceus tricolor	Village Weaver	×	×	√	R/LC
Ploceus cuculatus	Blue Billed Malimbe	×	√	×	R/LC
Malimbus ibadanensis	Red Billled Helmet-Strike	√	×	×	R/LC
Prionops caniceps	Ansorge's greenbul	×	√	×	R/LC
Eurillas ansorgei	Red-Tailed Bristlebill	×	√	×	R/LC
Bleda syndactylus	Common Bulbul	×	√	×	R/LC
Pycnonotus barbatus	Green-Tailed Bristlebill	×	√	×	R/LC
Bleda eximius	Honeyguide Greenbul	×	√	×	R/LC
Baeopogon indicator	Icterine Greenbul	×	√	×	R/LC
Phyllastrephus icterinus	Little Greenbul	×	√	×	R/LC
Eurillas virens	Plain Greenbul	√	×	×	R/LC
Eurillas curvirostris	Simple Greenbul	√	×	×	R/LC
Chlorocichla simplex	Red-tailed leaflove	√	×	×	R/LC
Phyllastrephus scandens	Western Nicator	√	×	×	R/LC
Nicator chloris	Yellow Whiskered Greenbull	√	×	×	R/LC
Eurillas latirostris	White Spotted Flutail	×	√	×	R/LC
Sarothrura pulchra	Common Moorhen	×	√	×	R/LC
Gallinula chloropus	Allen's Gallinlule	×	√	×	R/LC

Crecopsis egregia	African Crake	×	√	×	R/LC
apornia flavirostra	Black Crake	×	√	×	R/LC
Himantornis haematopus	Nkulengu Rail	×	√	×	R/LC
Canirallus oculeus	Grey Throated Rail	×	√	×	R/LC
Sarothrura pulchra	White Spotted Flutail	×	√	×	R/LC
Himantopus himantopus	Black-Winged Stilt	×	√	×	R/VU
Tringa nebularia	Common Greenshank	×	√	×	P/LC
Tringa totanus	Redshank	×	√	×	P/LC
Tringa erythropus	Spotted Redshank	×	√	×	P/LC
Tringa ochropus	Green Sandpiper	×	√	×	P/LC
Actitis Hypoleucos	Common Sandpiper	×	√	×	P/TH
Tringa stagnatilis)	**Marsh sandpiper**	×	√	×	P/LC
Numenius americanus	Whimbrel	×	√	×	P/TH
Limosa limosa	Blacĸ-Tailed Godwit	×	√	×	P/LC
Scopus umbretta	Harmmerkop	×	√	×	P/TH
Strix woodfordii	African Wood Owl	√	×	×	R/LC
Poeoptera lugubris	Narrow-Tailed Starling	√	×	×	R/LC
Hylopsar purpureiceps	Purple-Headed Starling	√	×	×	R/LC
Hylopsar purpureiceps	Green Combec	√	×	×	R/LC
Sylvietta virens	Green Hylia	√	×	×	R/LC
Hylia prasina	Grey Longbill	√	×	×	R/LC
Eremomela badiceps	Rufous- Crowned Eremomela	√	×	×	R/LC

Alethe castanea	Fire Crested Alethe	√	×	×	R/LC
Geokichla prince	Grey Ground Thrush	√	×	×	R/LC
Alethe castanea	White-Tailed Alethe	√	×	×	R/LC
Neocossyphus poensis	White-Tailed Ant Thrush	√	×	×	R/LC
Vidua macroura	Pin-Tail Whaydah	×	×	√	R/LC
Zosterops senegalensis	Yellow White Eye	×	×	√	R/LC
		√	×	×	R/LC

UDF-undisturbed forest compartment, MGF-Mangrove forest compartment, DGF- degraded forest compartment. R – Resident bird species, M- Intra Africa migrant, P- Palearctic migrants.

LC-Least concern, TH- threatened species, VI- Vulnerable species

Appendix2, Checklist of plant species in the study area

Name of plants	Family	DBH	MT	Frequency
Acrostichum aureum	Adianthaceae	51	16	9
Anthocleista vogelii	Loganiaceae	45	18	5
Asystasia gangetica	Acanthaceae	66	18	3
Avicennia germinans	Avicenniaceae	41	13	2
Boerhavia diffusa	Nyctaginaceae	35	12	10
Borreria scabra	Rubiaceae	66	15	5
Calophyllum inophyllum	Gutifferae	56	13	2
Ceiba pentandra	Bombacaceae	129	23	1
Conocarpus erectus	Combretaceae	65	17	3
Cyathula prostrata	Amaranthaceae	23	11	2

Dalbergia ecastaphyllum	Papilionoideae	46	14	1
Diodia rubricosa	Rubiaceae	45	12	1
Dissotis rotundifolia	Melastomataceae	67	18	1
Drepanocarpus lunatus	Fabaceae	99	17	2
Echinocloa colona	Poaceae	54	19	2
Eleutheranthera ruderalis	Asteraceae	44	15	3
Gilberiodendron spp	Caesalpinioideae	45	13	2
Grewia venusta	Tiliaceae	88	18	2
Guarea cedrata	Meliaceae	65	19	4
Hannoa klaineana	Simaroubaceae	99	21	4
Hunteria umbellate	Apocynaceae	23	11	5
Lagenaria breviflora	Combretaceae	45	13	3
Laguncularia racemosa	Verbenaceae	56	14	2
Dialium guineense	Fabaceae	14	10	2
Lonchocarpus sericeus	Onagraceae	56	15	2
Ludwigia erecta	Cucurbitaceae	32	17	1
Maesobotrya sp.	Anacardaceae	33	16	2
Alchornea cordifolia	Euphorbiaceae	66	22	7
Afzelia bella	Cyperaceae	78	23	2
Myrianthus arboreus	Moraceae	76	21	2
Millettia arboreus	Fabaceae	45	16	8
Musanga cecropioides	Moraceae	43	18	1

Nephrolepis bisserata	Davalliaceae	55	20	11
Nypa fruticans	Arecaceae	33	13	12
Oplismenus burmannii	Poaceae	45	17	2
Opuntia aciculata	Cactaceae	44	18	2
Ormocarpum verrucosum	Fabaceae	33	16	1
Pandanus candelabum	Pandanaceae	22	12	2
Rhizophora racemosa	Rhizophoraceae	56	19	9
Rhizophora mangle	Rhizophoraceae	34	14	13
Rhizophora harrisonii	Rhizophoraceae	45	12	15
Sacciolepis africana	Poaceae	43	15	3
Sphagneticola trilobata	Asteraceae	21	16	1
Spigelia anthelmia	Loganiaceae	23	11	2
Spilanthes filicaulis	Asteraceae	31	14	2
Sterculia tragacantha	Sterculiaceae	43	17	1
Terminalia catappa	Combretaceae	32	18	3
Tetracera alnifolia	Dileniaceae	44	15	2
Tragus berteronianus	Poaceae	23	10	2
Tristema hirtum	Melastomataceae	23	12	3
Triumfetta cordifolia	Tiliaceae	44	16	2
Uapaca cf. paludosa	Euphorbiaceae	56	18	1
Urena lobata	Malvaceae	76	20	10
Vigna marina	Fabaceae	32	14	2

Ximenia americana	Olacaceae	27	11	1