

Short Communication

Diversity and abundance of Avifauna species in the riparian zone of Pandam Wildlife Park, Plateau State, Nigeria

Iwar, I.M.¹, Egwumah, P.O.¹ and Ngutor, Levi¹

¹Department of wildlife and range management, Federal University of Agriculture Makurdi Benue State, Nigeria.

(Received: November 07, 2019; Revised: November 29, 2019; Accepted: December 03, 2019)

ABSTRACT

The study investigated the bird species abundance and diversity of the riparian zone of the Pandam Wildlife Park. Two major sites; Terrestrial and Aquatic were surveyed twice a day, in the morning and in the evening. Birds' abundance was determined using the point count method and diversity was determined with the Simpson's diversity index. The result indicated that there was a significant difference in bird species between the terrestrial and the aquatic regions of the riparian area (Terrestrial, 0.89 and Aquatic, 0.80). The vegetative cover of the park was positively correlated to, and had a significant effect on bird species diversity in the park. A total abundance of 620 bird species of 18 families were recorded during the work. 408 species out of the 620 species were observed to be aquatic while 212 birds were observed in the terrestrial region of the zone. The dominant species around the aquatic zone was the *Nettapus auritus* with a frequency of one hundred and thirty one (131) species observed at different time zones. The second most populated aquatic species was the *Ardeola ibis* with ninety one (91) species. The *Actophilornis africana* (Jesus bird) was much and found around the Muye part of the lake due to the vegetation on the water surface. The *Ardea goliath* was the least species found in the area with just two species seen throughout the study period. Species that made the highest contribution to relative abundance included the *Nettapus auritus* (21.13) seconded by the *Ardeola ibis* (14.68) and then the *Actophilornis africana* (7.77) while the least contributions were from the *Ardea goliath* (0.21), *Coracias cyanogaster* (0.31), *Phalacrocorax aristotelis* (0.73) and the *Salpornis salvadori* (0.83). Birds like the *Nettapus auritus*, *Actophilornis africana*, *Milvus migrans* and *Ardeola ibis* were most active at dawn and dusk. This shows these times are the best ones for bird watching. The small Bird diversity index around the riparian region of the park was an indication of the general level of diversity in the park which is not good enough for an IBA, because the park is under serious degradation.

Key words: Avifauna, Abundance, Diversity, Riparian, Wildlife Park

INTRODUCTION

Avifauna is a general name for bird species. Birds are feathered, winged, egg-laying vertebrates. These vertebrates survive in a variety of environments across the globe but mostly forests and wetlands. Birds are social animals that communicate with visual signs, calls and songs (Labe *et al* 2018). They display social behaviors such as cooperative breeding and hunting, flocking and mobbing of predators. Birds live and breed in most terrestrial habitats and on all the seven Continents. As with any natural habitat, wetlands are important in supporting bird species diversity. Nigeria is blessed with many species of birds scattered throughout the different ecological regions (Labe *et al*, 2018). The avifauna of Nigeria include a total of 940 species, of which four are endemic (*Ibadan malimbe*, Jos plateau indigo, Rock firefinch and Anambra waxbill) and five are rare or accidental (species that rarely or accidentally occur in Nigeria).

Diversity is the biological assemblage of species in its entirety, which is the complete representation of all possible measures of biological diversity across space and time (Lasorte and Boecklen, 2005). Species diversity is often measured as an index that incorporates the interplay between species richness (number) and abundance (evenness). This is the combination of number and equitability showing how rare or common a species is in a particular site. Diversity of avifauna acts as one of the most important ecological indicators to evaluate the quality of habitats. Avifaunal diversity has been decreasing due to many anthropogenic activities. Nigeria has a bird list of just over 900 species. Over the last 3 decades, Nigeria has witnessed unprecedented destruction of its natural resource so that less than 3% of the original rainforest cover now remains and large areas of savanna woodland in the north have been converted into farmlands. With a growing population of over 130 million people, the pressures are unlikely to abate so that the future survival of the country's farmland resources is likely to be dependent on the maintenance of its

national parks and the various game and forest reserves throughout the country (African Bird Club, 2013). The poaching pressures throughout Nigeria have led to the demise of many of the larger birds in Nigeria so that Ostrich (*Struthio camelus*) are now restricted to a very small area in the north-east and similarly, Black crowned crane (*Balearica pavonina*) has all but been extirpated in the country. All species of Bustard are now extremely scarce and the big vultures can only be seen with any reliability in the National parks. Grey parrots (*Psittacus erithacus*) once abundant throughout the south are now scarce as a result of the demand for the pet trade. The large forest hornbills are virtually restricted to the forest National parks as a result of the hunting pressures (African Bird Club, 2013). The aim of this study is to survey the population and species diversity of avifauna in riparian area of Pandam lake wildlife park and to determine the species composition and relative abundance of avifauna species in the riparian zone.

MATERIALS AND METHOD

Data collection techniques

Inventory of the abundance of the avifauna species; three sampling plots (100×50) were established on different sides of the lake. The plots were established first in *Guru-bindutse*, the second plot was in the Pandam kwarri part of the lake and lastly the third study was conducted along *Muyi* side of the lake. In each plot, the total number of

birds sighted were counted and recorded. The visible activities of the birds within such areas were identified and recorded too. Other birds were not seen but heard singing, therefore were identified through the sounds heard. Study was also conducted around the forested region of the wildlife park. The overall study was considered aquatic and terrestrial.

Birds that did not occur within the plots but were encountered in the riparian zone were identified and counted since birds are not restricted in movement. All birds were identified to species level mostly with the help of the West African bird guide. Data for the study were collected with the aid of field surveys, personal interviews and administrative records.

Data analysis

Relative abundance

Relative abundance was measured for bird species encountered in each of the sites using the formula below.

$$\text{Species relative abundance} = \frac{\text{Species abundance}}{\text{Total abundance}} \times 100.$$

Measurement of bird species diversity

Bird species diversity was measured in each of the study sites using Simpson's diversity index (Simpson, 1949).

RESULTS

The observations of the present study have been listed in Tables 1-5.

Table 1. Birds of Riparian area of Pandam Wildlife Park

SI/ N	COMMON NAME	SCIENTIFIC NAME	FAMILY	MORNING	EVENING	FREQUENCY
1	Pigmy goose	<i>Nettapus auritus</i>	Anatidae	78	53	131
2	Cattle egret	<i>Ardeola ibis</i>	Ardeidae	52	39	91
3	Lily trotter	<i>Actophilornis Africana</i>	Jacanidae	40	35	75
4	Dabchick	<i>Tachybaptus ruficollis</i>	Podicipedidae	30	14	44
5	Chest-nut backed finch lark	<i>Eremopterix leucotis</i>	Alaudidae	22	18	40
6	Grey hornbill	<i>Ocyrceros birostris</i>	Bucerotidae	18	20	38
7	Common sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae	16	20	36
8	Copper sunbird	<i>Cinnyris cupreus</i>	Nectariniidae	12	18	30
9	Black-kite	<i>Milvus migrans</i>	Accipitridae	15	10	25
10	Barbary shrike	<i>Laniarius barbarous</i>	Laniidae	13	10	23
11	Openbill	<i>Anastomus lamelligerus</i>	Ciconiidae	2	20	22
12	Grey breasted helmet guinea fowl	<i>Numida meleagris</i>	Numididae	9	21	21
13	Amethyst starling	<i>Cinnyricinclus leucogaster</i>	Cinnyricinclus	6	12	18
14	Grey plantain eater	<i>Crinifer zonurus</i>	Musophagidae	4	12	16
15	Olive-backed sunbird	<i>Cinnyris jugularis</i>	Nectariniidae	4	8	12
16	Red shouldered cuckoo shrike	<i>Campephaga phoenicea</i>	Campephagidae	6	4	10
17	Spotted creeper	<i>Salpornis salvadori</i>	Certhiidae	2	6	8
18	Longtailed shag	<i>Phalacrocorax aristotelis</i>	Phalacrocoracidae	5	2	7
19	Blue bellied roller	<i>Coracias cyanogaster</i>	Coraciidae		3	3
20	Goliath heron	<i>Ardea goliath</i>	Ardeidae	1	1	2
TOTAL						620

Table 2. Relative abundance of avifauna in the riparian area of Pandam Wildlife Park

COMMON NAME	SCIENTIFIC NAME	FAMILY	MORNING	EVENING	FRE-QUENCY	RELA-TIVE ABUN-DANCE
Pigmy goose	<i>Nettapus auritus</i>	Anatidae	78	53	131	21.13
Cattle egret	<i>Ardeola ibis</i>	Ardeidae	52	39	91	14.68
Lily trotter	<i>Actophilornis Africana</i>	Jacaniidae	40	35	75	7.77
Dabchick	<i>Tachybaptus ruficollis</i>	Podicipedidae	30	14	44	4.56
Chest-nut backed finch lark	<i>Eremopterix leucotis</i>	Alaudidae	22	18	40	4.15
Grey hornbill	<i>Ocyrceros birostris</i>	Bucerotidae	18	20	38	3.94
Common sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae	16	20	36	3.73
Copper sunbird	<i>Cinnyris cupreus</i>	Nectariniidae	12	18	30	3.11
Black-kite	<i>Milvus migrans</i>	Accipitridae	15	10	25	2.59
Barbary shrike	<i>Laniarius barbarous</i>	Laniidae	13	10	23	2.38
Openbill	<i>Anastomus lamelligerus</i>	Ciconiidae	2	20	22	2.28
Greybreasted helmet guinea fowl	<i>Numida meleagris</i>	Numididae	9	21	21	2.18
Grey plantain eater	<i>Crinifer zonurus</i>	Musophagidae	4	12	16	1.66
Amethyst starling	<i>Cinnyricinclus leucogaster</i>	Cinnyricin-clus	6	12	18	1.87
Olive-backed sunbird	<i>Cinnyris jugularis</i>	Nectariniidae	4	8	12	1.24
Red shouldered cuckoo shrike	<i>Campephaga phoenicea</i>	Campephagi-dae	6	4	10	1.03
Spotted creeper	<i>Salpornis salvadori</i>	Certhiidae	2	6	8	0.83
Longtailed shag	<i>Phalacrocorax aristotelis</i>	Phalacrocoracidae	5	2	7	0.73
Blue bellied roller	<i>Coracias cyanogaster</i>	Coraciidae	–	3	3	0.31
Goliath heron	<i>Ardea goliath</i>	Ardeidae	1	1	2	0.21
TOTAL					620	

(Source, Fieldwork, 2019)

Table 3. Aquatic avifauna species of the riparian zone, Pandam Wildlife Park

S/N	COMMON NAME	SPECIE NAME	FAMILY
1	Pigmy goose	<i>Nettapus auritus</i>	Anatidae
2	Cattle egret	<i>Ardeola ibis</i>	Ardeidae
3	Lily trotter	<i>Actophilornis Africana</i>	Jacaniidae
4	Dachick	<i>Tachybaptus ruficollis</i>	Podicipedidae
5	Common sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae
6	Openbill	<i>Anastomus lamelligerus</i>	Ciconiidae
7	Longtailed shag	<i>Phalacrocorax aristotelis</i>	Phalacrocoracidae
8	Goliath heron	<i>Ardea goliath</i>	Ardeidae

Table 4. Terrestrial avifauna species of the riparian zone, Pandam Wildlife Park

S/N	COMMON NAME	SPECIE NAME	FAMILY
1	Chestnut backed finch lark	<i>Eremopterix leucotris</i>	Alaudidae
2	Copper sunbird	<i>Cinnyris cupreus</i>	Nectariniidae
3	Black-kite	<i>Milvus migrans</i>	Accipitridae
4	Barbary shrike	<i>Laniarius barbarous</i>	Laniidae
5	Grey-breasted helmet guinea fowl	<i>Numida meleagris</i>	Numididae
6	Grey plantain eater	<i>Crinifer zonurus</i>	Musophagidae
7	Amethyst starling	<i>Cinnyrincinclus leucogaster</i>	Cinnyrincinclus
8	Olive backed sunbird	<i>Cinnyris jugularis</i>	Nectariniidae
9	Red-shouldered cuckoo shrike	<i>Campephaga phoenicea</i>	Campephagidae
10	Spotted creeper	<i>Salpornis salvadori</i>	Certhiidae
11	Blue bellied roller	<i>Coracias cyanogaster</i>	Coraciidae
12	Grey hornbill	<i>Ocyrceros birostris</i>	Bucerotidae

Table 5. Diversity of avifauna species of the riparian zone, Pandam Wildlife Park.

S/N	COMMON NAME	SPECIE NAME	FREQUENCY(N)	n(n-1)
1	Chestnut backed finch lark	<i>Eremopterix leucotris</i>	40	1,560
2	Copper sunbird	<i>Cinnyris cupreus</i>	30	870
3	Black-kite	<i>Milvus migrans</i>	25	600
4	Barbary shrike	<i>L. barbarus</i>	23	506
5	Grey-breasted helmet guinea fowl	<i>Numida meleagris</i>	21	420
6	Grey plantain eater	<i>Crinifer zonurus</i>	20	380
7	Amethyst starling	<i>Cinnyrincinclus leucogaster</i>	18	306
8	Olive backed sunbird	<i>Cinnyris jugularis</i>	12	132
9	Red-shouldered cuckoo shrike	<i>Campephaga phoenicea</i>	10	90
10	Spotted creeper	<i>Salpornis salvadori</i>	8	56
11	Blue bellied roller	<i>Coracias cyanogaster</i>	3	3
12	Grey hornbill	<i>Ocyrceros birostris</i>	2	2
TOTAL			212	

Table 6. Abundance of Aquatic avifauna species of the riparian zone, Pandam Wildlife

S/N	COMMON NAME	SPECIE NAME	FREQUENCY(N)	
1	Pigmy goose	<i>Nettapus auritus</i>	131	17,030
2	Cattle egret	<i>Ardeola ibis</i>	91	8,190
3	Lily trotter	<i>Actophilornis africana</i>	75	5,550
4	Dachick	<i>Tachybaptus ruficollis</i>	44	1,892
5	Common sandpiper	<i>Actitis hypoleucos</i>	36	1,260
6	Openbill	<i>Anastomus lamel- ligerus</i>	22	462
7	Longtailed shag	<i>Phalacrocorax aristo- telis</i>	7	42
8	Goliath heron	<i>Ardea goliath</i>	2	2
TOTAL			408	34,428

DISCUSSION

A total of six hundred and twenty (620) bird species of 18 families were recorded during the work. 408 species out of the 620 species were observed to be aquatic in nature, hence were observed around the aquatic (Lake) ecological zone of the park (Table 3). The dominant species around the aquatic zone was the *Nettapus auritus* with a frequency of one hundred and thirty one (131) species observed at different time zones. The second most populated aquatic species was the *Ardeola ibis* with ninety one (91) species. The *Actophilornis africana* (Jesus bird) was much and found around the Muyi part of the lake due to the vegetation on the water surface. The *Ardea goliath* was the least species found in the area with just two species seen throughout the study.

Two hundred and two (212) birds were observed in the terrestrial region of the zone (tab.4). The dominant bird recorded among the trees was the chestnut backed finch-lark (*Eremopterix leucotis*) with Forty (40) species in number. The copper sunbird was the second most populated species with 30 species on record. Counting of birds amongst the woods proved a bit difficult due to the dense vegetative cover and the bird's mobile nature. Species that made the highest contribution to relative abundance (tab.2) include the *Nettapus auritus* (21.13) seconded by the *Ardeola ibis* (14.68) and then the *Actophilornis africana* (7.77) while the least contributions were from the *Ardea goliath* (0.21), *Coracias cyanogaster* (0.31), *Phalacrocorax aristotelis* (0.73) and the *Salpornis salvadori* (0.83).

Not much of the *Ocyrceros birostris* were seen during the study same as the *Coracias cyanogaster* which are solitary in nature. Other birds like the Pied crested cuckoo (*Clamator Jacobinus*) were heard calling among the low woods but not seen due to the nature of the vegetation. Owls (*Tyto alba*) were also heard at night which made counting impossible. Bird diversity and abundance did not vary much between the study sites probably due to even distribution of vegetation variables which gave rise to uniform habitat structures.

From the records, much of the birds found in the park are aquatic in nature. Even the terrestrial birds like the *Milvus migrans* often return to the water for hunting. Many birds like the *Ardeola ibis*, *Ocyrceros birostris*, *Anastomus lamelligerus*, *Ardea goliath*, *Nettapus auritus* etc were found in both areas of the study i.e Terrestrial and Aquatic region. While most birds could fly far away from the riparian region, some like the *Nettapus auritus* and *Actophilornis Africana* were basically found in the riparian zone.

A total of six hundred and twenty (620) birds species belonging to 18 families were found in the riparian sector of the Pandam wildlife Park. Previous research works in the park like that by Audu and Shola (2016), yielded higher compositions compared to this research. It is no surprise as said by Uloko and Yager (2017), that the major vegetation of the park that would have encouraged the activities of birds ranging from breeding, feeding etc is affected over the years through logging, fuel wood collection and burning activities. Also according to

species to exploit landscape transformed by humans, make it possible for them to expand their home ranges as a result they become more widespread and abundant. According to Mangnall and Crowe (2003), annual change in crop type and production also with seasonal crop cycle succession is known to affect avian community structure in the park.

The low abundance and total absence of some birds like the owl (*Tyto alba*) is attributed to their mode of operation at night. For other species like the *Coracias cyanogaster*, it could be attributed to habitat type. The bigger birds like the *Ocyrceros birostris* and *Ardea goliath* were not much and this can be attributed to the rate at which such birds are hunted in the park. The migratory status of some birds might have also been a reason for low abundance both for the aquatic and terrestrial species.

Bird population varied between counting times. Early morning between the time the sun rises and mid-morning were the times of the day when the birds were most active. Some birds like the *Nettapus auritus*, *Actophilornis africana*, *Milvus migrans* and *Ardeola ibis* were most active at dawn and dusk. This shows these times are the best ones for bird watching.

The value of Simpson's index in this study was higher in the terrestrial ecological zone (0.89) when compared to the aquatic ecological zone (0.80). The value near zero is corresponding to highly diverse or heterogeneous ecosystems and the value that tends to one implies a more homogenous ecosystems. The greater level of diversity in the terrestrial region of the part can be related to the fact that there is much food available on land than around the water shores. The neighboring farmlands provide diverse food sources for different species of birds. Most of the birds make their nest among the trees, the aquatic birds inclusive. This could also be another reason for greater diversity among birds in the terrestrial region. The finding of this study is in agreement with the report by Lasorte and Boecklen (2005) that birds abundance and distribution is affected by changes in avian diversity structure. This observation is also not in contrast with the report of Ranchandria (2013) who reported that diversity and species richness of birds is subject to the suitability of their habitats.

In general, the level of diversity is not in any way unconnected with the available ecological requirements of the habitat. Equally, the habitat is rich and diverse in woody plants species, intertwined with epiphytes and climbers that house rich abundance of species of avifauna. This finding is also in agreement with the report by Bideberi 2013), who reported that diversity, distribution and abundance of avifauna species is related to their habitat types.

The occurrence of 620 avifauna species in the riparian zone is a pure indication of the park's rich avifauna diversity. The index values from the study describe high diversity as all the values turned to be closer to one (1). As observed by Uloko and Yager (2018), there was no significant difference between the ecological zones (terrestrial and aquatic) in terms of diversity and abundance. This may be related to closeness between the two

study sites.

All birds were identified but counted only when sighted. Counting by sound was avoided to prevent wrong figures. It will be of great importance to conclude that not all birds seen could be identified and not all birds identified were captured due to bird's very mobile nature.

CONCLUSION

The study focused on the diversity and abundance of avifauna species in the riparian zone of Pandam Wildlife Park, which was divided into two habitat types (Terrestrial and Aquatic). These habitat types were found to be diverse in bird species composition due to the favorable ecological conditions of the area. Many studies have confirmed that for terrestrial communities the numbers of bird species, as well as their diversity are strongly positively correlated with aspects of the structural complexity of vegetation (vegetation variables) (MacArthur 1964; Recher 1969; Karr & Roth 1971). That is, the more complex the structure of composition of the vegetation, the more likely it is that the habitat will contain more bird species. Unfortunately, the Wildlife Park faces a mass disturbance due to urbanization with its accompanying problems such as indiscriminate fire, overgrazing by livestock and majorly deforestation through fuel wood collection and to lesser degree farm expansion. Encroachment of the village into the buffer zone has had an adverse effect on the park overtime. Few years back the government of plateau state permitted the harvest of the famous Madrid tree. This opened the forest to other exploitations resulting to depletion of the of the parks vegetation which is a major aboard for the birds.

The study was no short of challenges. The point count method depends on the researchers' abilities to correctly spot and identify birds in the area. The dense vegetation made bird viewing difficult and hence counting. Noise pollution caused by the surrounding environment, proximity to human settlement, voices and sounds from fishing activities as well as water flowing down its course made observation of birds by ear very challenging.

There was no significant difference in the number of terrestrial and aquatic birds observed during the study. In overall abundance, *Nettapus auritus* had the highest frequency followed by *Ardeola ibis*.

RECOMMENDATIONS

Protection of this reserve and similar types of woodlands on the Jos Plateau will not only preserve what is left of the Jos Plateau vegetation, but will also ensure the persistence of the plateau's biodiversity and further boost tourism for which the State is known.

The Park management and Plateau State Government should intensify efforts towards protecting the Park and its bird species diversity by educating support zone dwellers to plant and manage tree species.

Regular field assessment should be carried out over the years in order to ascertain whether the avian richness and diversity are increasing or decreasing. It is strongly recommended that a relocation of the

dwellers who are now invading the park be effected. Most of the anthropogenic activities affecting wildlife in the park come from the villagers inhabiting the park's buffer zone.

REFERENCES

- African Bird Club(2013). ABC Bulletin 20.2- Tiawo C.O, Omogbemi T, Taiye A.pp 08 209. Retrieved 26th July from <http://www.africanbirdclub.org>
- Akosim C, Kwaga B.T, Ali.A and Mamman G.S (2007). *Flora resources and structue in Pandam wildlife Park*, Plateau State Niegeria. Agric.J.2:740-747
- Akosim, C.(1997). Evaluation of Biodiversity conservation and management in pandam wildlife park, Plateau state, Nigeria. Ph.D thesis, Department of Wildlife and Fisheries Management. University of Ibadan.232pp
- Audu H. and Shola I,(2016). *A survey of abundance and diversity of avain species in Pandam Wildlife Park and surrounding farmland in pandam,Nigeria*. International Journal of Advance Life science 9 (3): 395-400
- Battern L.A (1972). Breeding Bird Species Diversity in Relation to increasing Urbanization. Bird study,19:3,157-166.
- Bibby C.M. Jones and S.Marden (1998). Expedition Field Technique. Follow Science expedition Advisory Centre,28 Jan 2015. Web.07 Aug 2015
- Bideberi G, (2013). Diversity,Distribution and Abundance of Avifuana in respect to Habitat types: A case study of kilakala and Bigwa, Morogoro,Tanzania. Thesis for Master of Science, Sokoine University of Agriculture,Morogoro, Tanzania pp 2
- Birdlife International (2018), State of the World's Bird.Tried Allison and Emma Work. Retrieved 26th July,2019 from <http://www.birdlife.org>
- Blair R.B (1999). *Birds and Buterflies along an Urban gradient: Surrogate taxa for assessing biodiversity?* Ecol.Appl.,9:164-170
- Cade J.T.Digby R.D and Harpercollins,(1982). The Falcons of the World. Retreived 25th July,2019 from <http://www.scholar.google.com>
- Carbo-Ramirez.P and I.Zuria (2011). The value of small urban greenspaces for Birds in a Mexican city. Landscape and Urban Planning 100(3): 213-222
- Clergea p, Mennechez G, Sauvage A and Lemoine A (2001). Human perception and appreciation of birds: A motivation for Wildlife conservation in urban environments of France. In; Avian Ecology in an urbanizing world, pp.69-88, (Marzluff J.M, Brwman R and Donnelly Reds). Kuwer publishers, Norwell, MA.
- Driscoll M, Audubon Editors "Why do birds matter". (March-April 2013). Retrieved on 4-19-2015.
- Ezealor U, (2002). Critical sites for biodiversity conservation in Nigeria, Nigeria conservation Foundation Lagos. 110pp

- Faleyimu O.I, Ijeomah H.M and Agbeja B.O, 2008. Fuelwood Consumption Pattern in Agbowo Community and its Implication on Forest ecosystem. *Obeche* 26(2): 20-26
- Federal Department of Forest (FDF), 1985. National Conservation Strategy for Nigeria. Report. Submitted to Federal Government of Nigeria. pp: 1-75
- Hadley S.J, Hadley A.S and Betts M, 2012. *Acoustic classification of Multiple simultaneous bird species: A multi-instance, multi-label approach*. Journal of Acoustical Society of America, 131:4640-4650
- Gaston A, 1975. Methods for estimating bird populations. *J.Bombay Nat.Hist.soc.*,72:271-283
- Ghazanfar A.S, 1989. Savanna plants of Africa. An illustrated Guide. (1st Edtn). Macmillan publishers LTD. London, pp 1-227
- Ijeoma H.M.and Alarape A.A(2009). Maritals in characteristics of Households in Ecotourism Centers. The case of Rural Tourism Development in Plateau State, Nigeria *Asia-Pacific Journal of Development*. (2): 103-144
- Ijeomah H.M.(2007). Impact of Tourism on perceived poverty Alleviation in Plateau State. PhD Thesis, Department of Wildlife and Fisheries Management, University of Ibadan. 301pp.
- Ijomah J.U and Akosim C, 2000. Elements of Biological Conservation 1st Edition. Trinity Graphics System LTD Jos,pp.1-30
- Johnsgard P.A,(1990). *Hawks, Eagles and Falcons of North America: biology and Natural History*. Smithsonian institution press,1990
- Kwaga B.T, Liya D and Ali A (2017). Avifauna Abundance and Diversity in Jos wildlife Park, Nigeria. *Agricultural science and Technology* 9(3): 234-239
- Kangah-Kessel L, Attuquayefio D, Owusu E and Gbogbo F, (1999). *Bird species Diversity and Abundance in the Abiriw Scared Grove in the Eastern Region of Ghana*. www.ajol.info/index.php/wajae/article/viewFile/45727/29205 Retrieved ons 2nd October, 2016
- Karr J.R and Roth R.R (1971). Vegetation structure and avain diversity in several New world areas. *American Naturalist*,105:423-435
- Lasorte F.A and Boecklen W.D, (2005). Changes in the diversity structure and avifauna assemblages in North America. *Global ecology and Biogeography*. 18,367-378
- LBRB-Lower Benue River Basin, (1982). A feasible Report on the irrigation of Deposit River Basin
- McNaughton J.S and L.L World, (1976). *General Ecology*. (2nd Edition). Holt Rinehart and Wiston Inc. USA. Pp: 1-702
- Mangall M.J and Crowe T.M(2003). *The effects of agriculture on farmland bird assemblage on the Aguthas plain*, Cape, South Africa. *Afri.J of Ecol.*, 41:266-276
- MacArthur J.W (1964). *Environmental factors affecting species diversity*. *American Naturalist*,98:387-397
- Nigerian Environmental Study/Action Team (NEST) (1991). *Threatened Environment: A National Profile*, Nigerian Environment Study/Action Team,Ibadan, 288pp.
- Labe T.E, Iwar I.M and Uloko I.J (2018). *Species Diversity and Avifauna Abundance* in University of Agriculture Makurdi, Benue State, Nigeria. *Forestry Research and Engineering Journal*,2(4): 198-202
- Paul Catling (2011). Effects of invasive alien plants on birds: Some example from North America. Article in *Biodiversity* 6(3). December 2011
- Peter Bethold,(2001). *Bird migration; a general survey*. Oxford University press on Demand 2001.
- Racliffe C.S and Crowe T.M(2001). Habitat utilization and home range size of helmeted Guinea fowl *Numida meleagris* in the Midlands of Kwazulu-Natal province, South Africa. *Biol.Conserv.*,98:333-345
- Ranchandria A.M (2013). *Diversity and richness of bird species in newly formed habitats* of Chandoli National Park in Western Ghats, Maharashtra State, India. *Biodiversity journal*, 4,235-242
- Recher H.F (1969). *Bird species diversity and habitat diversity* in Australia and North America. *American Naturalist* 103: 75-80.
- Robinson W.D, Jeffery D.B Brawn, Scott K.R (2000). *Forest Bird community structure in central Panama : Influence of spacial scale and Biogeography*. *Ecological Monographs* 70(2), 209-235
- Someone A, Araya M.B, Bernal M, E.N. Diebold, K.Grzybowski, Micheals M., Tear J.A, Wallace R.S, and WillisM.J (2002). Oceanographic nd climatic factors influencing breeding and colony attendance patterns of Humboldt Penguins *Speniscus humboldti* in central Chile. *Marinen Ecology Progress series*, 227;43-50
- Uloko J.I and Yager G.O, (2018). *Bird species (Avifauna) Composition and distribution in Pandam wildlife park*, Plateau State, Nigeria. *Asian Journal of Biological Research*, 1(1):12-20
- Uloko J.I and Yager G.O, (2017). *Indegenous Land Tenure System as a Hindrance to the Development of Pandam Wildlife Park*. *Asian Journal of Environment and Ecology*. 5(2) 1-9, ISSN: 2456-690X
- Safra J.E,(1998): *The New Encyclopaedia Britanica*, 15, 18 ed, Chicago, pp.1-112
- Wallace G.E, PhD (2006). Impacts of Federal and Free ranging cats on birds species of conservation concern. *American Bird conservancy*. pp.1-28
- WU J. *Urban Ecology and Sustainability*.The State of the science and Future Directions. "Landscape Urban plan, 2014. Web. 04 Aug.2015