

DENSITY AND DISTRIBUTION PATTERN OF MAJOR BIRD SPECIES IN HADEJIA-NGURU WETLANDS

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ABSTRACT

Indication of decline in aquatic fauna including aquatic bird population in Nigeria wetlands prompted this study. The study aimed at determining the densities and distribution pattern of some bird species in Hadejia-Nguru wetlands. The point count method was used for the enumeration of the birds. The absolute population density model and community similarity coefficient formula were used to analyse the data. The results obtained indicated that the density of the bird species ranged from 2.92birds/ha to 44.43birds/ha at the fringing zones, 4.84birds/ha to 272.65birds/ha at the intermittently flooded zones and 3.60birds/ha to 119.13birds/ha at the submerged zones in the Nguru-Hadejia Wetlands. The distribution pattern shown by the dendrogram indicated the following clusters Dagona and Baturiya intermittently flooded zones cluster; Dagona and Baturiya submerged zones cluster; Nguru, Baturiya and Dagona fringing zones cluster; and Nguru intermittently flooded and Nguru submerge zones cluster. The clusters represent the pattern of bird species distribution in the study area. This implied that zones in the same cluster have similar ecological characteristics.

Key words: Fringing, intermittenment, flood, Distribution, Density, Trends, Species and Wetlands

INTRODUCTION

The status of the population of any wildlife species is a crucial information to wildlife ecologist for the following reasons: i. the information determines the species fitness to its environment; ii. It predicts the species success or failure in the environment; iii. Being renewable resources, its status ought to be monitored to ensure proper utilisation of habitat (Mbaya and Malgwi, 2010). Besides, the continuous attraction of tourists to wildlife resorts had been reported to be a function of population abundance of species (Gawaisa, 2002).

Distribution pattern of wetland birds is based on the three distinct zones of wetlands, which, consists of the fringing, intermittently flooded and submerge zones (Mohammad and Mohammed, 2011) Mohammad and Mohammed (2011) reported that bird species are distributed across three zones of wetlands, which, they described as Mash swamp or Fringing zone, Lotus swamp or intermittently

flooded zone and the open water body or the submerge zones. Akosim (1997) reported that availability of food, nesting or reproductive site and cover determine the distribution of wildlife species across habitat types. Hence, birds' preference to wetland zones is an indication that each zone is distinct from other zones in terms of available food, nesting sites and cover.

The necessity to organize coordinated counts of water birds in all tropical Africa, and evolve a natural network as much as possible had been reported (Anne and Brain, 2011). Although some studies on populations of water birds have been conducted on Hadejia-Nguru wetlands, none was centered on the density and distribution pattern of the birds. This dearth of information on water birds of Hadejia-Nguru wetlands makes the development of conservation strategies for bird species of the sites impossible. This gap in information of water birds of Hadejia-Nguru wetlands prompted this study. The study aimed at determining the densities and distribution

pattern of some bird species in Hadejia-Nguru wetlands.

METHODOLOGY

Assessment of Absolute Population Density of Bird Resources

The method described by Bibby *et al.*, (1992) and Sutherland (1999) were used for bird censuses while birds identification was done using Nik and Ron (2008). Sighting of the birds was done using a binocular. At each zone, counting points were established depending on the total area of the site. At Baturiya, twelve points were made, three in each zone. At Nguru, twelve points were made; three in each zone, and at Dagona, six points were also made, two in each zone. Each point had a radius of 50 metres. The counting stations were adequately spaced to ensure that birds were not counted twice or more. Bird census took place from 06.00 to 11.00 hours and 15.00 to 18.00 hours. On arrival at the counting station, the observers waited for one minute before beginning to count. This was to allow the birds to settle down following expected disturbance by the arrival of the observers. The observers positioned themselves at the counting station and recorded all the birds identified by sight or calls within a specified distance (50m) and beyond the zone. Each bird was counted once. The results obtained for each year (2011, 2012 and 2013) were pooled into:

- i. late dry season (January - March)
- ii. early wet season (April - June)
- iii. late wet season (July - September)
- iv. early dry season (September - December)

Data Analysis

Determination of absolute population density

$$D = \frac{n_1 + n_2}{\pi r^2 m} \log_e \left(\frac{n_1 + n_2}{n_2} \right) \text{ (Bibby et al 1985)}$$

Where:

r = radius of the first zone (the second zone extends from r to infinity)

n_1 = number of birds counted within r

n_2 = number of birds counted beyond r

m = number of replicate points in the set

Distribution pattern of birds of the study area

The distribution pattern of birds of the study area was determined using Community Similarity Coefficient formula stated below:

$$C = \frac{\sum (2m_i)}{\sum (a_i + b_i)} \text{ (McNaughton and Wolf, 1979)}$$

Where: C = Community Similarity Coefficient

a_i = the abundance of species i in community a

b_i = the abundance of species i in community b

m = the minimum value of the species in the community

The matrix Community Similarity Coefficient produced used to construct a dendrogram which shows the pattern of distribution of birds in the study area.

RESULTS

Density and Population of Major Bird Species in Each Wetland Sector

The results of the density and population of major bird species in Nguru (those that were up to one hundred and above in number) is presented in Table 1. At the fringing zone, bird species with densities above 10birds/ha include *Bubulcus ibis* (22.15birds/ha), *Philomachus pugnax* (16.46birds/ha), *T. tetanus* (11.81birds/ha) and *E. gazeta* (10.88 birds/ha) their populations ranged from 313 to 820 birds. The rest of the bird species ranged from 2.92birds/ha to 8.43birds/ha with their populations ranging from 119 birds to 217 birds. At the intermittently flooded zone, *Bubulcus ibis* (14.52 birds/ha), *Tringa tectanus* (15.30 birds/ha), *Tringa erythropus* (15.32 birds/ha), *Dendrocydna viduata* (22.49birds/ha), *Dendrocydna bicolor* (23.54birds/ha), *Philomachus pugnax* (52.71birds/ha), and *Quealea quealea* (110.54birds/ha) had densities above 10.00 birds/ha, with their populations ranging from 251 birds to 3540 birds. Furthermore, at the submerged zone, bird species with densities above 10.00birds/ha included *Bubulcus ibis* (58.64birds/ha), and *Dendrocydna viduata* (84.35birds/ha). Their populations ranged from 324 birds to 2543 birds.

Results of densities and populations of major bird species per zone in Dagona wetland sector is presented in Table 2. Species with

densities above 10.00 birds/ha, at the fringing zone include *Ardea cineria* (11.83), *Streptopelia senegalensis* (11.95birds/ha), *Egretta gazeta* (13.83birds/ha), *Ciconia abdinii* (18.05birds/ha), *Actophilornis africana* (20.39birds/ha), *Ardeola ralloides* (22.52birds/ha), *Tringa tectanus* (22.68birds/ha), and *Bubulcus ibis* (40.58birds/ha). Populations of bird species at the zone ranged from 102 birds to 653 birds. At the intermittently flooded zone of the sector, all but two bird species (*Microparra capensis* 4.84birds/ha and *Ardeola ralloides* 7.99birds/ha) had densities above 10.00birds/ha, with a range of 24.34birds/ha to 272.65birds/ha. Bird species populations in the zone ranged from 210 birds to 5492 birds. At the submerged zone of Dagona sector, 14 of the bird species had their densities ranging from 11.72birds/ha to 97.49birds/ha. Bird species populations ranged from 139 birds to 1383 birds.

Table 3 presents the results of densities and populations of major bird species according to zones in Baturiya wetland sector. Bird species at the fringing zone with the highest densities include *Phalacrocorax africanus* (11.80birds per ha), *Egretta gazeta* (14.53birds per ha), *Actophilornis africana* (21.46birds/ha), *Tringa tectanus* (31.26birds/ha) and *Philomachus pugnax* (44.43birds/ha). Populations of bird species inventoried in the zone ranged from 109 birds to 819 birds. At the intermittently flooded zone of the sector, bird species populations ranged from 209 birds to 4391 birds while those with the highest

densities include *Bubulcus ibis* (10.62birds/ha), *Himantopus himantopus* (11.11birds/ha), *Actophilornis africana* (11.96birds/ha) *Quealea quealea* (14.23birds/ha) *Tringa erythropus* (17.02birds/ha), *Tringa tectanus* (22.26birds/ha), *Dendrocydna viduata* (36.51birds/ha), *Dendrocydna bicolor* (51.49birds/ha) and *Philomachus pugnax* (102.70 birds/ha). Bird species population densities ranged from 5.23birds/ha to 102.70birds/ha. In the submerged zone, *Philomachus pugnax* (50.57birds/ha), *Bubulcus ibis* (61.60birds/ha), *Sarkidiornis melanotus* (62.21birds/ha), *Egretta gazeta* (83.69birds/ha), *Dendrocydna bicolor* (100.53birds/ha) and *Dendrocydna viduata* (119.13birds/ha) had the highest densities. Bird species populations in the zone ranged from 169 birds to 3261 birds.

Distribution Pattern of Bird Species in Hadejia-Nguru Wetlands

Figure 1 presents the dendrogram showing the distribution pattern of bird species in the three wetland sites of Hadejia-Nguru Wetlands. The following clusters can be identify from the dendrogram: (1) Dagona and Baturiya intermittently flooded zones cluster; (2) Dagona and Baturiya submerged zones cluster; (3) Nguru, Baturiya and Dagona fringing zones cluster; and (4) Nguru intermittently flooded and Nguru submerged zones cluster. The clusters represent the pattern of bird species distribution in the study area. Bird species in the zones of each cluster tend to have significant similarities.

Table 1: Density (Birds/ha) and Estimated Population of Major Bird Species Per Zone in Nguru Wetland sites

Bird species	Zone		
	Fringing	Intermittently flooded	Submerged
<i>Egretta garzetta</i>	10.82(313)	—	25.62(845)
<i>Bubulcus ibis</i>	22.15(820)	14.53(478)	58.64(1365)
<i>Ciconia abdinii</i>	6.17(133)	—	—
<i>Actophilornis africana</i>	8.43(217)	5.93(170)	5.56(217)
<i>Carvus albus</i>	2.92(119)	—	—
<i>Tringa tetanus</i>	11.81(312)	15.30(251)	14.65(523)
<i>Philomachus pugnax</i>	16.46(352)	52.71(2135)	21.26(735)
<i>Dendrocydna bicolor</i>	—	23.54(521)	32.46(887)
<i>Dendrocydna viduata</i>	—	22.49(675)	84.35(2543)
<i>Himantopus himantopus</i>	—	6.70(238)	17.14(327)
<i>Vannellus spinosus</i>	—	6.23(236)	17.57(324)
<i>Tringa erythropus</i>	—	15.32(425)	13.20(327)
<i>Quealea quealea</i>	—	110.54(3540)	—
<i>Bostrychia hagedash</i>	—	—	4.62(146)
<i>Plagades falcinellus</i>	—	—	15.03(325)
<i>Plectropterus gambensis</i>	—	—	30.30(1254)
<i>Sarkidiornis melanotus</i>	—	—	43.28(1321)
<i>Anas acuta</i>	—	—	13.06(325)
<i>Anas querquedula</i>	—	—	35.54(431)

Key: Numbers in parenthesis are the population of the bird species, Numbers outside parenthesis are densities of birds per hectare

Table 2: Density (Birds/ha) and Estimated Population of Major Bird Species Per Zone in Dagona Wetland sites

Bird species	Zone		
	Fringing	Intermittently flooded	Submerged
<i>Egretta garzetta</i>	13.83(213)	—	47.26(845)
<i>Bubulcus ibis</i>	40.58(653)	43.54(769)	91.55(1365)
<i>Bostrychia hagedash</i>	—	—	15.02(146)
<i>Actophilornis africana</i>	20.39(254)	31.08(437)	20.84(217)
<i>Dendrocydina bicolor</i>	—	43.47(573)	60.06(653)
<i>Dendrocydina viduata</i>	—	248.61(2531)	97.49(1383)
<i>Plectropterus gambensis</i>	—	—	54.03(786)
<i>Anas acuta</i>	—	—	13.81(241)
<i>Anas querquedula</i>	—	—	11.72(237)
<i>Gallinula chloropus</i>	8.99(148)	—	7.29(139)
<i>Himantopus himantopus</i>	—	45.38(436)	28.30(365)
<i>Vannellus spinosus</i>	—	43.85(769)	30.98(452)
<i>Tringa erythropus</i>	—	61.49(769)	19.21(431)
<i>Tringa tetanus</i>	22.68(429)	26.94(549)	33.60(648)
<i>Philomachus pugnax</i>	—	272.65(5492)	55.12(861)
<i>Quealea quealea</i>	—	27.04(376)	—
<i>Ardea cineria</i>	11.83(238)	56.94(878)	—
<i>Ardea pupurea</i>	—	30.61(534)	—
<i>Ardeola ralloides</i>	22.52(206)	7.99(132)	—
<i>Microparra capensis</i>	—	4.84(143)	—
<i>Sterna albifrons</i>	—	24.34(210)	—
<i>Ciconia abdinii</i>	18.05(233)	—	—
<i>Caracias abyssinicus</i>	7.73(102)	—	—
<i>Porphyrio alleni</i>	6.19(112)	—	—
<i>Placeus nigrimentus</i>	6.41(102)	—	—
<i>Streptopelia senegalensis</i>	11.95(108)	—	—
<i>Columba guinea</i>	9.69(125)	—	—

Key: Numbers in parenthesis are the population of the bird species, Numbers outside parenthesis are densities of birds per hectare

Table 3: Density (Birds/ha) and Estimated Population of Major Bird Species Per Zone in Baturiya Wetland sites

Bird species	Zone		
	Fringing	Intermittently flooded	Submerged
<i>Casmerodius albus</i>	—	—	7.84(210)
<i>Egretta garzetta</i>	14.53(482)	—	83.69(1982)
<i>Bubulcus ibis</i>	—	10.62(673)	61.60(2190)
<i>Ardeola ralloides</i>	8.69(219)	7.98(209)	4.84(169)
<i>Ardea cineria</i>	—	8.55(214)	—
<i>Anastomus lamelligerus</i>	—	—	11.06(241)
<i>Bostrychia hagedash</i>	—	—	3.60(413)
<i>Plagades falcinellus</i>	—	—	11.13(461)
<i>Actophilornis africana</i>	21.46(216)	11.96(329)	16.87(431)
<i>Dendrocydna bicolor</i>	—	51.49(862)	100.53(2180)
<i>Dendrocydna viduata</i>	—	36.51(910)	119.13(3261)
<i>Anas acuta</i>	—	—	23.74(624)
<i>Anas querquedula</i>	—	—	29.75(752)
<i>Himantopus himantopus</i>	—	11.11(451)	9.03(338)
<i>Vannellus spinosus</i>	—	5.91(236)	12.73(372)
<i>Tringa erythropus</i>	—	17.02(742)	10.86(449)
<i>Tringa tetanus</i>	31.26(532)	22.26(642)	22.93(593)
<i>Philomachus pugnax</i>	44.43(819)	102.70(4391)	50.57(1630)
<i>Plectropterus gambensis</i>	—	—	42.41(1752)
<i>Gelochenidon nilotica</i>	—	—	8.35(173)
<i>Sterna albifrons</i>	—	5.23(210)	11.37(326)
<i>Sarkidiornis melanotus</i>	—	—	62.21(1872)
<i>Quealea quealea</i>	—	14.23(430)	—
<i>Ciconia abdinii</i>	6.16(264)	—	—
<i>Phalacrocorax africanus</i>	11.80(216)	—	—
<i>Placeus luteolus</i>	4.14(165)	—	—
<i>Muscicapa gambage</i>	3.74(215)	—	—
<i>Streptopelia senegalensis</i>	4.72(109)	—	—

Key: Numbers in parenthesis are the population of the bird species, Numbers outside parenthesis are densities of birds per hectare.

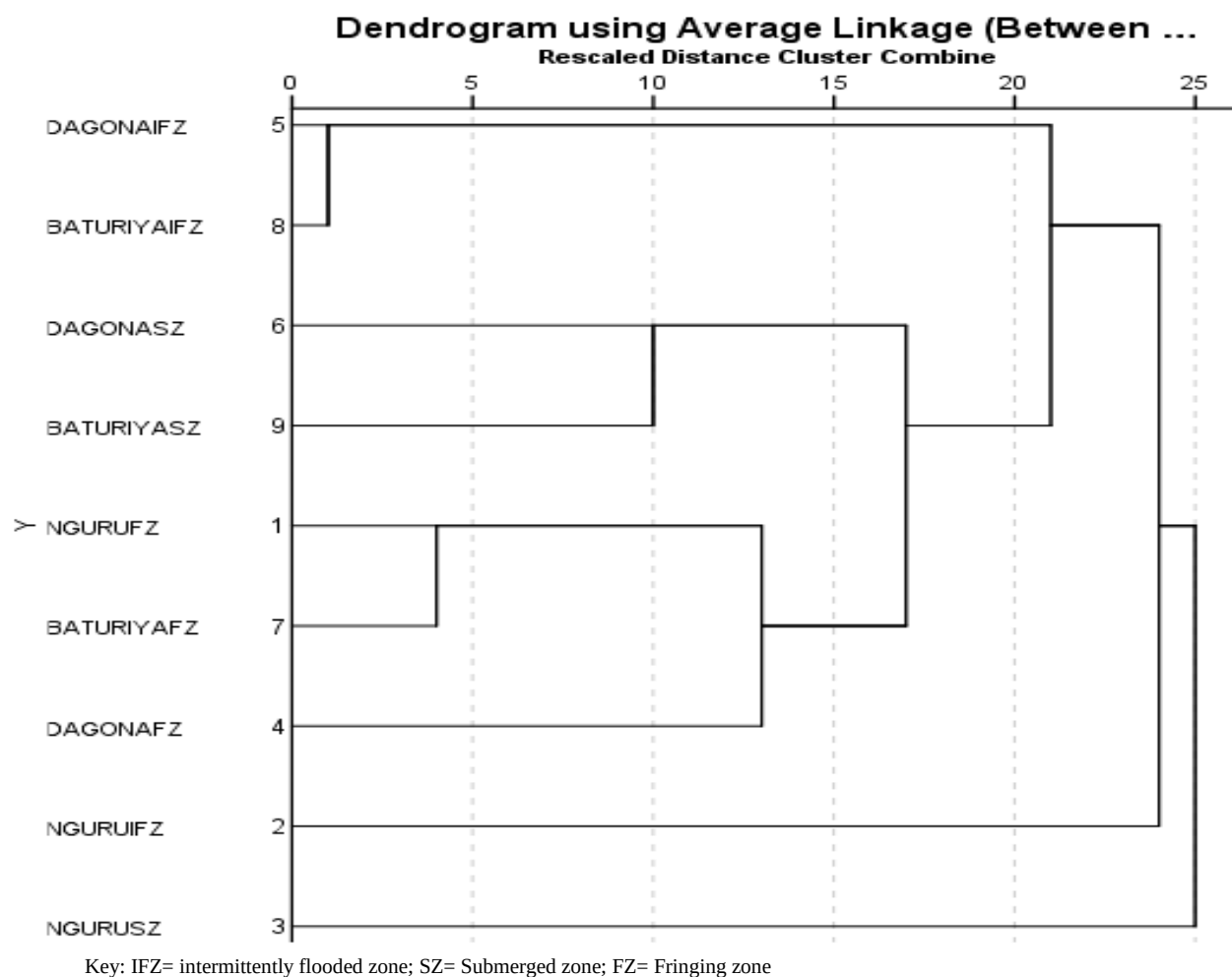


Figure 1: Dendrogram Showing the Distribution Pattern of Avifauna Species in the Three Wetland Sites

DISCUSSION

Density, Distribution Pattern and Trends of Major Birds Species in Hadejia-Nguru Wetlands

Density was determined only for those birds that were more frequently encountered (i.e. those that are up to one hundred and above). There was variation in the densities of birds in the three wetland sectors. However, some bird species were consistent in maintaining densities above 10.00birds/hectare within the zones of each sector (i.e. fringing, intermittently flooded and the submerged zones), and also throughout the three wetland sectors. Densities of 10.00birds/hectare and above were recorded in the fringing zones of at least two wetland sectors for the following bird species: *E. gazeta*, *B. ibis*, *T. Tetanus*, *P. pugnax* and *A. africana*. In the intermittently flooded zones, bird species that recorded densities of 10birds/hectare and above in at least two sectors were *B. ibis*, *T. Tetanus*, *P. pugnax*, *D. bicolor*, *D. viduata*, *H. Himantopus*, *T. Erythropus* and *Q. Quealea*. Bird species with densities of 10birds/hectare in the submerged zones of at least two sectors of the wetland areas include *E. gazeta*, *B. ibis*, *A. africana*, *T. Tetanus*, *P. pugnax*, *D. bicolor*, *P. gambensis*, *S. melanotus*, *A. acuta* and *A. querquedula*. These results agree with McNaughton and Wolf (1979) report that the major ecological principles influencing wild animal density and distribution include food, water and cover. They further observed that animals tend to dominate habitats in which they have a comparative advantage over others in the areas of feeding and competitive interactions. Therefore, the success of each bird species in any of the zones of the wetlands may not be unconnected with the ability of the species to exploit and accumulate as much as possible from common resource pools. Those that have shown to be successful in more than one zone are those that have wider ecological amplitude in terms of adaptation to wider variety of food and habitat types.

Pooled result of bird species numbers showed that the intermittently flooded (37704) zones and submerged (44333) zones recorded higher values than the fringing (15355) zones in the three wetland sectors, with the submerged zones showing the highest value. This is not unexpected as the populations of bird species will naturally be higher where resources

particularly food are more abundant. This observation is similar to the report of McNaughton and Wolf (1979) on population regulatory factors. Overall, a total population of 97392 was recorded for the Hadejia-Nguru Wetlands. When this is compared to 49893 birds recorded by Chad Basin National Park (CBNP), it will be found to be higher. Some factors could have accounted for these observations. They may be factors of human pressure which may be more on CBNP, differences in the availability of required resources and sizes of the two areas. Similar observations and reasons were reported by Egborge (1993)

The dendrogram resulting from the similarity coefficient matrix of bird species of Hadejia-Nguru Wetlands indicated four (4) clusters which include (1) Dagona and Baturiya intermittently flooded zones cluster, (2) Dagon and Baturiya submerged zones cluster, (3) Nguru, Dagona and Baturiya fringing zones cluster and (4) Nguru intermittently flooded and Nguru submerged zones cluster. The result is an indication of the fact that significant number of bird species in the zones of each cluster is similar. The implication is that zones in the same cluster have similar ecological characteristics. Similar observations were made by Akosim (1997) and Shitta (2014) in separate studies at different wetland sites in Nigeria. The information is important for proper guide of tourists interested in bird watching and for research and development of management strategies for adequate conservation of bird species in the study area.

CONCLUSION

The number and density of bird species obtained in this study further indicate the existence of healthy populations of birds in the study area. The distribution pattern of bird species in the study area is an indication of the ecological requirements of the species. This is because species in different zones could occur in the same cluster indicating that they have similar ecological requirements.

RECOMMENDATIONS

In view of the findings of this study the following recommendations are made:

- i. Conservation and management measures currently in place should be

- stepped up to ensure the continuous growth of the bird species diversity in the study area.
- ii. The three tiers of government should ensure through policy instrumentation and enforcement such that industries that will generate affluence likely to pollute the water bodies are not sited close to the Hadejia-Nguru Wetlands to ensure the survival of the birds.
 - iii. The Local Governments and communities that form part of Hadejia-Nguru Wetlands should have a formal responsibility in the protection of the wetlands.
 - iv. The three sectors of the wetlands should have a common management plan and authority, as opposed to the present statue where three different bodies (Nigerian National Park, Yobe State and Jigawa State) take charge of the each of the sectors.
 - v. Creation of awareness on the multiple values, uses and monitoring strategy for conservation of water birds of Hadejia-Nguru wetlands.

REFERENCES

- Anne, E.M. and Brian, J.M., (2011) Biological diversity: frontiers in measurement and assessment. Oxford University Press, Oxford, UK.
- Akosim, C. (1997). Evaluation of Biodiversity Conservation and Management in Pandam Wildlife Park Nigeria. Unpublished PhD Thesis, University of Ibadan. Ibadan Nigeria.
- Bibby C.J., Burgess N. and Hill D.A. (1985). Bird Census Techniques. Academic Press, London. p. 265.
- Bibby, C.J., Collar N.B., Crosby, M.J., Heath, M.F. Imboden, C. Jonston, T.H. Long, A.J. Satterfield, A.J. and Thirgood, S.J. (1992). Putting Biodiversity on the Map: Priority Areas for Global Conservation. Barrington Press, Cambridge.
- Egborge, A.B.M. (1993) Biodiversity of Aquatic Fauna of Nigeria. Natural Resources Conservation Council. Abuja: Pp1-173.
- Gawaisa, S. G (2002) Population Dynamics of Mammals in the Savannah Zones and management programs in Gashaka Gumti National Park, Nigeria. Unpublished master's thesis, Department of Forestry and Wildlife Management Modibbo Adama University of Technology, Yola. Nigeria.
- Mbaya, Y. P. and Malgwi, H. (2010). Species List and Status of Mammals and Birds in Sambisa Game Reserve, Borno State, Nigeria. *Journal of Reserch in Forestry, Wildlife and Environment*. Vol. 2 No. 1 and 2 Pp135-140
- McNaughton, J.S. and Wolf, L.L. (1979) General Ecology. 2nd edition Holt Rinehart and Winston Inc.USA: 1-708.
- Muhammad, N. R. and Mohamed, Z. (2011). Bird Species Abundance and Their Correlationship with Microclimate and Habitat Variables at Natural Wetland Reserve, Peninsular Malaysia. *International Journal of Zoology* Volume 11,2-11,
- Nik, B. and Ron, D. (2008). Field Guide to the Birds of West Africa. Christopher Herlm, London.Pp34-486.
- Sutherland, W.J. (1999). Ecological Census Techniques: A Handbook. Cambridge University Press, London.Pp15-26.