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## Species List and Diversity of Avifauna Resources of Hadejia-Nguru Wetlands

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## SPECIES LIST AND DIVERSITY OF AVIFAUNA RESOURCES OF HADEJIA-NGURU WETLANDS

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**ABSTRACT:** The circumstantial report that aquatic fauna including aquatic bird populations of Nigeria wetlands are being threatened by anthropogenic activities such as dams, farming, pastoralism and poaching informed this study which aimed at investigating the species lists and diversity of bird resources of Hadejia-Nguru wetlands which consist of Nguru, Dagona and Baturiya sectors. The point count method was used for bird species enumeration. The Shannon Diversity Index and one-way Analysis of Variance were used to analyse the data. The Results obtained indicated 81 species belonging to 32 families were obtained in Nguru sector, 82 species belonging to 30 families in Dagona sector while Baturiya sector has 79 bird species belonging to 30 families' respectively. Shannon Diversity Indices (SDI) ranged from 2.2608 to 3.6288 for bird species. There was no significant difference (At 5% Significance Level) in SDI of bird species within each zone (fringing, intermittently flooded and submerged zones) between the wetland sectors.

**Keywords:** Birds, identification, diversity, checklist, habitat and census

### 1. INTRODUCTION

Biological diversity or biodiversity stands for the variety, variability and abundance of plants, animals and microorganisms as well as the ecosystems and ecological processes to which they belong (Convention on Biological Diversity, 2006). Biological Diversity is usually considered at three levels: genetic, species, and ecosystem diversity. Genetic diversity is the total genetic information contained in the genes of individual organism. Species diversity refers to the variety of living organisms. Ecosystem diversity relates to the enormous diversity of habitat and biotic communities, as well as to the variety of ecological processes within the ecosystems (State of New South Wales (NSW), 2013).

Wetlands are defined as area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, static or flowing, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six (6) meters (Biodiversity Management Bureau 2013). Wetlands incorporate riparian and costal zones adjacent to the wetlands. As a result of these provisions, the coverage of the Convention extends to a wide variety of habitat types, including rivers, shallow coastal waters and even coral reefs, but not deep sea (Stedman and Dhal 2008).

There are two categories of water birds: wetland specialists and generalists. Wetland specialists are those that nest, feed and roost in wetlands. Wetland specialists are wholly dependent on aquatic habitats, and cannot survive in other habitats (Airinatwe, 1999). Generalists

are those birds that frequently visit wetlands, but are seen in other habitats as well. Furthermore, Muhammad and Mohamed (2011) classified wetland birds based on sites as marsh swamp species, open water body species and lotus swamp species.

Birds are the ideal bioindicators and useful models for studying a variety of environmental problems (Elizabeth and Joanna, 2001). Lee and Rotenberry (2005) reported that the dynamics in wetlands are as a result of anthropogenic and natural factors which often results in total disappearance, decrease or increase in number of bird species. Therefore, monitoring of ecological health of wetland ecosystems demand for periodic information on avian species composition and diversity. Bibby *et al.* (1992) reported that the preparation of a list of species is basic to the study of avifauna of a site, because a list indicates species diversity in a general sense.

The Hadejia-Nguru wetlands (HNW) lie on the southern edge of the Sahel savanna in north-eastern Nigeria. The area is a flood-plain complex, comprised of a mixture of seasonally flooded lands and dry uplands. Prior to the droughts of the 1970s, the wetlands covered an area of about 4,125 km<sup>2</sup>, but are now reduced to 3,500 km<sup>2</sup>. The wetlands are extremely important for waterbirds, both for breeding species and for wintering and passage Palearctic waterbirds, while the surrounding areas hold significant numbers of species of the Sahel biome and Sudan-Guinea Savanna biome. The wetlands are extremely important for waterbirds, both for breeding species and for wintering and passage Palearctic waterbirds, while the surrounding areas hold significant numbers of species of the Sahel biome and Sudan-Guinea Savanna biome (BirdLife International, 2001).

Recent studies on Hadejia-Nguru Wetland Birds (Asibor, 2009; Schmidt, 2010) indicated the occurrence of anthropogenic activities in the wetland sites and their environs. This includes the construction of dams for irrigation purposes, farming within the catchment areas, pastoralism and poaching. These activities affect the size of the wetlands and consequently lead to the reduction in birds' roosting sites, the amount of food and cover available. The ultimate result will be the reduction in birds' species composition and diversity. This study therefore, was conducted in view of the need to monitor the species lists and diversity of both residents and Palearctic birds of Hadejia-Nguru Wetlands in order to sustain the socio-economic and tourism potential of the sites.

## 2. MATERIALS AND METHODS

### 2.1. Study Area and Data collection

The study was done in three (3) areas of the Hadejia-Nguru Wetlands, comprising Nguru lake complex, Dagona protected area and Baturiya protected areas, all within the Hadejia-Nguru Wetlands. 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 meters. 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 50m. Each bird was counted once. The results obtained for the period of three years (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)

### 2.2. Data Analysis

Lists of bird of the study area

The species lists of birds of the study area were analyzed using descriptive statistics.

Species diversity of birds of the study area

- i. Species diversity of the avifauna of the study area was analyzed using Shannon Diversity Index (Usher, 1991). The model is stated as follows

$$H^1 = -\sum P_i \ln P_i$$

Where:

$P_i$  is the proportion of the  $i^{\text{th}}$  species in the sample and  $H^1$  is the Shannon index,  $\ln P_i$  is the natural log of the proportion of  $i^{\text{th}}$  species.

- ii. A one-way analysis of variance was used to test if there were significant differences between the Shannon Diversity Indices of bird species between and within zones and sectors. The model is as follows:

$$Y_{ij} = U + T_j + e_{ij}$$

Where,  $Y$  = individual observations

$U$  = General Mean

T<sub>j</sub> = Effect of the jth treatment (Diversity Indices of bird species, woody and herbaceous plant species)

e<sub>ij</sub> = Experimental error

Where means are significantly different, the Least Significant Difference (LSD) was used for means separation.

### 3. RESULTS

#### 3.1. The species List of Avifauna Resources in the Study Area

The species list of bird resources in the study area is presented in Table 1. The result shows that eighty-one

species belonging to thirty families occurred in Nguru wetlands sector. The families with the highest number of species included Anatidae (9), Ardeidae (8), Scolopacidae (8), Charadriidae (6), and Rallidae (5). In Dagona wetland sector, a total of eighty-two bird species belonging to thirty families occurred in the area. Families with the highest number of species included Ardeidae (10), Anatidae (9), Scolopacidae (8), Charadriidae (6), and Rallidae (5). Plate I shows some birds in the sector. Furthermore, in Baturiya sector, seventy-nine bird species were found present, and they belong to thirty families. Families with the highest number of species included Ardeidae (10), Anatidae (9), Charadriidae (6), Scolopacidae (6) and Rallidae (5).

Table 1: Species List of Birds of the Study Area

Family	Species	Nguru	Dagona	Baturiya
Ardeidae	<i>Ardea malanocephala</i>	+	+	+
	<i>Ardea pupurea</i>	+	+	+
	<i>Mesophyx intermedia</i>	+	+	+
	<i>Casmerodius albus</i>	-	+	+
	<i>Egretta gularies</i>	+	+	+
	<i>Egretta garzetta</i>	+	+	+
	<i>Bubulcus ibis</i>	+	+	+
	<i>Scopus umbretta</i>	-	+	+
	<i>Ardeola ralloides</i>	+	+	+
	<i>Nycticorax nycticorax</i>	+	+	+
Ciconiidae	<i>Ciconia abdinii</i>	+	+	+
	<i>Anastomus lamelligerus</i>	+	+	-
Rallidae	<i>Microparra capensis</i>	+	+	+
	<i>Actophilornis africana</i>	+	+	+
	<i>Gallinula chloropus</i>	+	+	+
	<i>Porphyrio alleni</i>	+	+	+
	<i>Caracias abyssinicus</i>	+	+	+
Viduidae	<i>Vidua macroura</i>	+	+	+
Estrildidae	<i>Lagonosticta senegala</i>	+	+	+
	<i>Estrilda melpoda</i>	+	+	+
	<i>Scopus umbretta</i>	+	-	-
Ploceidae	<i>Euplectes franciscanus</i>	+	+	+
Burhinidae	<i>Burhinus capensis</i>	+	+	+
Phasianidae	<i>Francolinus bicalcaratus</i>	+	+	+
Accipitridae	<i>Elanus caeruleus</i>	+	+	+
	<i>Circus aeruginosus</i>	+	+	+
	<i>Circus pygargus</i>	+	+	+
	<i>Milvus mirans</i>	+	+	+
Sagittariidae	<i>Sagittaius serpentarius</i>	+	+	+
	<i>Polyboroides typus</i>	+	+	+
	<i>Haliaeetus vocifer</i>	+	+	+
Ploceidae	<i>Placeus luteolus</i>	+	+	+
	<i>Placeus nigrimentus</i>	+	+	+
	<i>Quelea quelea</i>	+	+	+

Source: Field Data (2011-2013)

Legend: + = Present; - = Absent

Table 1 Cont'd: Species List of Birds of the Study Area

Family	Species	Nguru	Dagona	Baturiya
Nectariniidae	<i>Chalcomitra rubescens</i>	+	+	
Caprimugidae	<i>Caprimulgus inornatus</i>	+	+	+
Cuculidae	<i>Centropus senegalensis</i>	+	+	+
	<i>Clamator glandarius</i>	+	+	+
Columbidae	<i>Streptopelia decipiens</i>	+	+	+
	<i>Columba guinea</i>	+	+	+
	<i>Streptopelia senegalensis</i>	+	+	+
Apodidae	<i>Apus apus</i>	+	+	+
Muscicapidae	<i>Muscicapa pammelaina</i>	-	-	+
	<i>Muscicapa gambage</i>	+	+	+
	<i>Muscicapa pallidus</i>	+	+	-
Corvidae	<i>Corvus albus</i>	+	+	+
Charadriidae	<i>Venellus tectus</i>	+	+	+
	<i>Vannellus spinosus</i>	+	+	+
	<i>Charadrius alexandrines</i>	+	+	+
	<i>Charadrius dublus</i>	+	+	+
	<i>Charadrius pecuarius</i>	+	+	+
	<i>Limosa limosa</i>	+	+	+
Laridae	<i>Larus cirocephalus</i>	+	+	+
Scolopacidae	<i>Calidris alba</i>	+	+	+
	<i>Tringa erythropus</i>	+	+	+
	<i>Philomachus pugnax</i>	+	+	-
	<i>Tringa tetanus</i>	+	+	+
	<i>Tringa nebularia</i>	+	+	+
	<i>Tringa stagnatilis</i>	+	+	+
	<i>Tringa hypoleocus</i>	+	+	-
	<i>Tringa glareola</i>	+	+	+
Sternidae	<i>Chlidonias hybrida</i>	+	+	+
	<i>Gelochenidon nilotica</i>	+	+	+
	<i>Sterna albifrons</i>	+	+	+
Pandionidae	<i>Pandion haliactus</i>	+	+	+
Ardeidae	<i>Butorides striata</i>	+	+	+
Threskiornithidae	<i>Platalea leocorodia</i>	+	+	+
	<i>Bostrychia hagedash</i>	+	+	+
	<i>Plagades falcinellus</i>	+	+	+
Anatidae	<i>Dendrocygna bicolor</i>	+	+	+
	<i>Plectopterus gambensis</i>	+	+	+
	<i>Sarkidiornis melanotus</i>	+	+	+
	<i>Nettapus auritus</i>	+	+	+
	<i>Anas acuta</i>	+	+	+
	<i>Anas querquedula</i>	+	+	+
	<i>Dendrocygna viduata</i>	+	+	+
	<i>Anas clypeata</i>	+	+	+
	<i>Aythya nyroca</i>	+	+	+
Rallidae	<i>Amaurornis flavirosta</i>	+	+	+
	<i>Porphyrio porphyrio</i>	+	+	+
Haematopodidae	<i>Himantopus himantopus</i>	+	+	+
	<i>Recurvirostra avosetta</i>	+	+	+
Alcedinidae	<i>Circus rufus</i>	+	+	+

Source: Field Data (2011-2013)

Legend: + = Present; - = Absent

### 3.2. Shannon Diversity Indices of Bird Species

Tables 2 show the results of Shannon Diversity Indices of bird species according to zones of each sector of the study area. The zones include the fringing, intermittently flooded and the submerged. For bird species, the fringing zones recorded Shannon Diversity Indices of 3.0800, 3.6288 and 3.4486, against Nguru, Dagona and Baturiya sectors respectively. Shannon Diversity Indices of 2.2608, 2.5130 and 2.6071 were recorded for Nguru, Dagona and Baturiya respectively at the intermittently flooded zone. At the submerged zone, the Shannon Diversity Indices were 2.7729, 2.8669 and 2.9019 for Nguru, Dagona and Baturiya sectors respectively. Results of the analysis of variance and mean separation indicated that Shannon Diversity Indices of the within zones, between sectors as well as those between zones and within each sector did not differ significantly (5% Significance Level).

Table 2: Shannon Diversity Indices of Bird Species per Zone of the Wetland Sites

Wetland sector	Zones		
	Fringing	Intermittently flooded	Submerged
Nguru	3.0800 <sup>ns</sup>	2.2608 <sup>ns</sup>	2.7729 <sup>ns</sup>
Dagona	3.6288 <sup>ns</sup>	2.5130 <sup>ns</sup>	2.8669 <sup>ns</sup>
Baturiya	3.4486 <sup>ns</sup>	2.6071 <sup>ns</sup>	2.9019 <sup>ns</sup>

Diversity Indices across the rows and columns are not significantly different at 5% Significance Level  
ns = not significant

## 4. DISCUSSION

### 4.1. The Species Lists and Diversity of Birds of Hadejia-Nguru Wetlands

The results of this study revealed the presence of thirty (30) families of bird species at Hadejia-Nguru wetlands which comprises of three sectors (the Nguru, Dagona and Baturiya sectors). Five (5) families were sighted more on the basis of the number of species that represent them at each sector. The five bird species families include Anatidae, Ardeidae, Scolopacidae, Charadriidae, and Rallidae. In respect of the bird species inventoried per sector, 81 species were encountered at the Nguru wetland; 82 species at Dagona wetland and 79 species in Baturiya wetland area. These findings are higher than those obtained by NCF (2010). The findings indicated the presence of Palaearctic migrants such as (*D. viduata*, *D. bicolor*, *N. auritus*) and Afro-Tropical residents including (*C. abdinii*, *A. acuta* and *M. milvus*) which however constituted the majority of the birds sighted at the sites. The distribution of the bird species sighted according to families agreed with that listed by BirdLife

International. (2013) Furthermore, the 79 to 82 bird species reported in this study are also above the 67 bird species listed by BirdLife International (2001) as the bird species of Nigeria that are purely aquatic. However, Hilton-Taylor *et al.* (2008) observation that Nigerian aquatic birds are dominated by species of herons, water fowl, fish eagle, darters and crakes are in conformity with the findings of this study.

The number of bird species and families recorded in this study, which are higher than those listed in the previous studies (Airinatwe, 1999) suggested the movement of new species of birds of both Palearctic migrants and the Afro-Tropical residents into the study area. This development may not be unconnected with the reduction of human pressure arising from international and local NGOs interventions; and perhaps from relatively favourable environmental conditions, that emerged for some species in the recent years. For example, the recession that occurred as a result of the construction of Kafin-Zaki Dam (Bauchi State) in some places in the wetlands could have encouraged the migration of bird species that are both insectivorous and piscivorous into the wetlands (e.g *E. alba*, *C. abdinii*, *T. glareola* and *S. albifrons*). On the other hand, the great flood which inundated other areas particularly Nguru and Baturiya sectors between 2000 and 2003 could have engineered a favourable ecosystem that provided more woody species, food resources and cover that attracted more species to the study area as reported by World Meteorological Organisation (2010).

### 4.2. Diversity of Birds

Results of the diversity for bird species within the zones of the wetland sectors are the reflections of the importance of the zones to the birds. Overall, the results of the Shannon Diversity Indices for the within and between the zones in all the sectors were relatively high and did not differ significantly (5% Significance Level). However, diversity indices recorded higher values at the fringing zones for all the sectors followed by the submerged zones and lastly the intermittently flooded zones. This finding suggested that the fringing zones could provide all the basic needs of most of the birds, which include nesting sites, food for omnivorous birds and cover. The submerged zones which appeared next in the order of importance could attract high diversity of birds, perhaps because most of the birds inventoried at the submerged zones were piscivorous species (World Meteorological Organisation (2010)). *P. africanus*, *P. capensis*, *Ardea cineria* and *A. purpurea* also depend on the submerged zones for their food all the year round. The instability of the intermittently flooded zone could have accounted for the lower Diversity Indices recorded in the

zone. It therefore, implies from the above account that the fringing and submerged zones require adequate management strategies to guarantee their resilience for higher diversity of birds in the zones.

## 5. CONCLUSION AND RECOMMENDATIONS

Results of species lists of bird species obtained in this study were consistently higher than those of previous findings. However, reports on the species birds found on Nigerian wetlands and according to zones agreed with the findings of this study. Shannon Diversity Indices obtained for bird species further indicated high diversity of these resources in the study area. The widely reported decline in aquatic population may, therefore, be a localised issue as those of Hadejia-Nguru Wetlands have been shown to be at variance with what obtains in other aquatic bodies in Nigeria. The number and density of bird species obtained in this study further indicate the existence of healthy populations of birds in the study area.

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

1. 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.
2. The three tiers of government should ensure through policy instrumentation and enforcement that will prevent the siting of industries that could generate affluence likely to pollute the water bodies.
3. The Local Governments and communities that form part of Hadejia-Nguru Wetlands should have a formal responsibility in the protection of the wetlands.
4. The three sectors of the wetlands should have a common management plan and authority, as opposed to the present status where three different bodies (Nigerian National Park, Yobe State and Jigawa State) take charge of each of the sectors.

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