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# Impact of Seasonal Changes on Avifauna Diversity in Nguru Wetland, Yobe State, Nigeria

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

The research on impact of seasonal changes on avifauna diversity in Nguru Lake of Hadejia-Nguru Wetland was carried out in two different seasons for the period of six 6 months, from April to June (dry season) and July to September (wet season). The aim was to evaluate the impact of seasonal changes on avifauna diversity and the species richness in the study area. A reconnaissance survey was carried out to select study sites and sampling points. Five (5) different points were selected which comprises of Madauka, Kayayyashi, Farin Ruwa, Badum and Guzan respectively and Point count census techniques were adopted. In each counting station, bird observation was carried out twice daily; morning between 6:00 am and 10:00 am and evening between 4:00 pm and 6:00 pm. Data compilation was done using Microsoft Excel and were analysed using statistical software Past

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326b. Bird diversity was calculated using Shanon-Weiner diversity index. The findings of this research showed that the majority of birds identified were Resident species (12,225 individual birds), Migratory species (8,186 individual birds) and Palearctic Migrants (10,876 individual) species in the study area. Dominant bird species in Nguru lake were Philomachus pugnax, Actophilornis africanus and Phalacrocorax africanus. A total of 5,538 individual birds' was identified (Dry Season) in Nguru lake '' belonging to 21 families in which Ardeidae family had the highest (7) species of bird. Shannon Diversity Index' has 2.55 in dry season, while in Wet Season' has 3.40. This indicated that there was relatively equal and high diversity of bird species in Wet Season in the study area and has the total species richness of 6,711. Overgrazing and other anthropogenic activities which affect the population diversity of avifauna species serve as major threats to the continued existence of Wetlands. Typha grass also remained pressing problem which create microhabitats reducing critical habitat for feeding, nesting and roosting habitat for birds, as well as hampers the smooth flow of water used by many water bird species. In view of the findings of this study, effective monitoring and strategies for conservation to restore the population of bird species, provide public enlightenment of the people around the wetland and management of Hadejia-Nguru Wetland promptly advice the significant importance of the wetland in serving as home for resident and migratory birdspecies.

*Keywords: Impact; seasonal; changes; avifauna; diversity; reconnaissance; survey; sampling.*

## 1. INTRODUCTION

Avifauna is a general name for bird species. Birds are feathered, winged, egg–laying vertebrates. They belong to the Kingdom "Animalia," Phylum "Chordata" and Class "Aves". They have a worldwide distribution, living in and around oceans, rivers, forests and mountains. They are the most noticeable group in the animal kingdom. Their bright colours, distinct songs and calls, and showy displays add fun to human life. Many people derive great pleasure from watching birds and listening to their beautiful songs. Birds are social animals that communicate with visual signs, calls and songs. They display social behaviours 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. Nigeria is blessed with many species of birds scattered throughout the different ecological regions. As with any natural habitat, wetlands are important in supporting bird species diversity. Wetlands provide food for birds in the form of plants, vertebrates, and invertebrates. Some birds forage for food in the wetland soils, while some find food in the water column and others feed on the vertebrates and invertebrates that live on submerged and emergent plants [1].

Studies on bird diversity by Burgess et al. [2], Doggart et al. [3], Frontier- Tanzania [4], and Yanda and Munishi (2007) in the Uluguru area were confined to the forest emphasis in the general negative effects of forest conversion to human dominated habitats. Nevertheless, human dominated and agricultural habitats vary a lot and therefore the effect on birds can be very different [5]. Responses of birds to habitat changes differ depending on their strategies, some lifestyles benefit from habitat change, while for others it is a principal threat [5]. Birds arevery visible and integral part of the ecosystem that occupy many trophic levels in a food chain ranging from consumers to predators. Their occurrences have been helpful as environmental health indicator, plant pollinators and seed dispersal as well as pest controller [6,7]. This research work identified avifauna species and determine its diversity in the study area.

## 2. MATERIALS AND METHOD

### 2.1 Study Area

This research was carried out at Hadejia-Nguru Wetlands (HNWs) located in the Sahelian Zone of Nigeria at a point where River Hadejia and flow through a fossil dune field before converging and draining into Lake Chad. It lies between latitude 12013'N to 12055'N and longitude 10015'E to 11030'E [8], covering three Nigerian states namely; Bauchi, Jigawa and Yobe (Fig. 1). The Hadejia-Nguru Wetlands named after two major towns (Hadejia and Nguru) are extensive floodplain wetlands in the dry lands of northern Nigeria which are surrounded by many villages. It supports a wide range of biodiversity and livelihood activities [8].

The wetlands extend for approximately 120 km from west to east within Jigawa State and for a

further 60-70km down-stream in adjacent Yobe State [9]. In width, the wetlands range from 10km to more than 50 km from north to south, with approximately 8000km2 of floodplain. The extent of the floodplain varies considerably from year to year depending on rainfall and complex interactions of river flow, dam releases, flood regimes and topography [10].

## 2.2 Research Design

A reconnaissance survey was carried out with the aid of topographic map andpersonnel assistant to select study sites and sampling points in the field after obtaining permission from the authorities of Nguru Wetland. The survey was carried out at study area and five (5) points were been selected namely; Madauka, Kayayyashi, Farin Ruwa, Badum and Guzan lakes respectively. The survey was carried out for the period of six (6) months (three months for dry season and three months for wet season. Birds' observation was carried out once in a month. Birds were counted as birds seen and heard around the area and birds in flight were also be counted within 100 meters radius to aid data collection. A pair of binoculars with magnification 988,000m Model 750 was used for birds viewing alongside with field guide book "Birds of Western Africa" by Borrow and Demey [11] for identification of birds [12]. A Komery Digital Camera 24MP was also used for taking photographs of birds.

## 2.3 Method of Data Collection

Point count census techniques as outlined by Bibby et al. [13] and Ralph et al. [14] were adapted to count the birds for the study. Five (5) different points was selected randomly from each study sites, namely; Madauka, Kayayyashi, Farin Ruwa, Badum and Guzan.

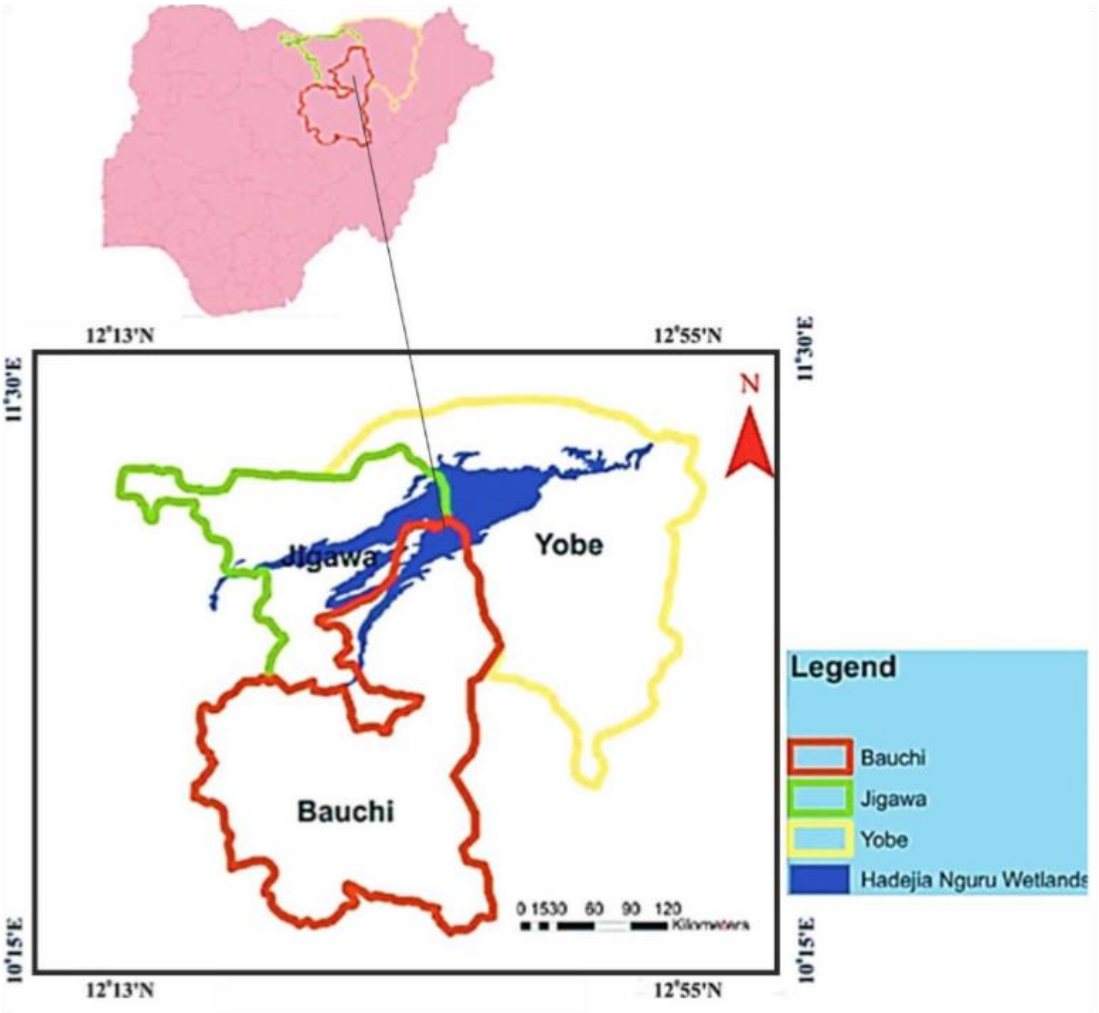


**Fig. 1. Map of Nigeria Showing the Study Area. Source: [8]**

In each counting station, bird observation was carried out twice daily; morning between 6:00am and 10:00am and evening between 4:00pm and 6:00pm. On arrival at each counting station, the observers stayed for five (5) minutes before beginning to count. This was to enable the birds to settle down following disturbance by the arrival of the observers. The observers at each counting point recorded the entire birds encountered for a period of ten (10) minutes with the aid of binoculars alongside with field guide book "Birds of Western Africa" by Borrow and Demey [11]. Data forms were structured for ease of recording all the information.

### 2.4 Data Analysis

Compilation and analysis of data was done using Microsoft Excel (2013 version). Data were analysed using statistical software Past 326b.

i. Table was used to present the types of avifauna species identified in the study areafor rainy season and dry season according to Lammeed [15].
ii. Avifauna species diversity was calculated using Shannon-Weiner diversity index, H:

$$H = - \sum_{i=1}^{S} Pi \, 1n \, Pi$$

Where:

H = Shannon-Weiner Diversity Index
S = Total number of species of the community (number seen and heard).
Pi = Proportion of each or individual (1th) species in the Sample.
1nPi = Natural Logarithm of the species proportion. (Lammeed, 2011).

## 3. RESULTS

### 3.1 Avifauna Species Identified in Nguru Wetland (NGW) in Dry Season

The result of the avifauna species identified in 'NGW' for the 1st, 2nd and 3rd visits are presented in Table 1. The table showed that 2,148 bird species were identified in the first visit, 1,658 bird species were identified in the second visit and 1,732 species were identified in the third visit (Total = 5,538) belonging to 21 different families in dry season in the study area. The families of Bucerotidae, Coraciidae, Cuculidae, Motacillidae, Phalacrocoracidae, Ploceidae, Psittacidae, Pyconotidae, Recurvirostridae, Scolopacidae, Sternidae, Sturnidae and Viduidae contained 1 species each, families of Accipitridae, Alcedinidae, Charadriidae and Jacanidae contained 2 species each, family of Anatidae contained 3 species, while families of Columbidae and Rallidae contained 4 species and Ardeidae contained the highest number of 7 species in the study area.

### 3.2 Avifauna Species Identified in Nguru Wetland (NGW) in Wet Season

The result of the avifauna species identified in the study area for the 1st, 2nd and 3rd visits are presented in Table 2. The table shows that 690, 281 and 202 bird species (Total = 1,173) were identified in the first, second and third visits respectively during rainy season, different families in the study area. The families of Bucerotidae, Coraciidae, Cucilidae, Motacillidae, Phalacrocoracidae, Ploceidae, Psittacidae, Pyconotidae, Recurvirostridae, Scolopacidae, Sternidae, Sturnidae and Viduidae contained a single bird species each, meanwhile the families of Accipitridae, Alcedinidae, Charadriidae and Jacanidae contained 4 bird species each where only Anatidae family contained 3 species of birds, the families of Columbidae and Rallidae contained 4 bird species while Ardeidae contained 7 different bird species in the study area during wet season.

### 3.3 Avifauna Species Diversity in the Research Area

The result of avifauna species diversity of Nguru Wetland during dry season is shown in Table 3. The result indicated that the Shannon Diversity Index was 2.548 for total individual species in the study area with Philomacus pugnax (0.34258) having the highest diversity and Egrettaintermedia (0.00156) being the lowest diversity.

The result of avifauna species diversity of Nguru Wetland, Wet Season is shown in Table 4. The result indicated that Shannon Diversity Index was 3.40307 for total individual species in the study area with Actophilonis africanus (0.2136) having the highest diversity while Circus ranivorus (0.01087), Egretta intermedia and Nettapus auritus (0.01527) respectively having the lowest diversity.

**Table 1. Avifauna Species Identified in the Study Area (Nguru Wetland) for Dry Season**

| S/N | Family | Scientific Name | Common Name | Frequency | | | Total |
|---|---|---|---|---|---|---|---|
| | | | | 1st Visit | 2nd Visit | 3rd Visit | |
| 1. | Accipitridae | *Circus ranivorus* | African Marsh Harrier | 3 | 2 | 1 | 6 |
| | " " | *Milvus aegyptius* | Yellow billed Kite | 4 | 2 | 10 | 16 |
| 2. | Alcedinidae | *Halcyon leucocephala* | Grey-headed Kingfisher | 3 | - | 2 | 5 |
| | " " | *Ceryle rudis* | Pied Kingfisher | 1 | 6 | 19 | 26 |
| 3. | Anatidae | *Nettapus auritus* | African Pygmy Geese | - | - | 84 | 84 |
| " | " | *Dendrocygna bicolor* | Fulvous Whistling Duck | 9 | 7 | 8 | 24 |
| " | " | *Dendrocygna viduata* | White Face Whistling Duck | 558 | 26 | 117 | 701 |
| 4. | Ardeidae | *Egretta ardesiaca* | Black Heron | 3 | 28 | 23 | 54 |
| " | " | *Bubulcus ibis* | Cattle Egret | 24 | 22 | 12 | 58 |
| " | " | *Ardea cinerea* | Grey Heron | 14 | 19 | 12 | 45 |
| " | " | *Egretta intermedia* | Intermediate Egret | 1 | - | - | 1 |
| " | " | *Egretta garzetta* | Little Egret | 10 | 17 | 33 | 60 |
| " | " | *Ardea purpurea* | Purple Heron | 8 | 19 | 17 | 44 |
| " | " | *Ardeola ralloides* | Squacco Heron | 128 | 88 | 65 | 281 |
| 5. | Bucerotidae | *Tockus erythrorhynchus* | Red-billed Hornbill | - | 2 | - | 2 |
| 6. | Charadriidae | *Vanellus tectus* | Black-headed Lapwing | 9 | 11 | - | 20 |
| | " " | *Vanellus spinosus* | Spur-winged Lapwing | - | 15 | 69 | 84 |
| 7. | Columbidae | *Streptopelia decipiens* | African Mourning Dove | 18 | 24 | 25 | 67 |
| | " " | *Streptopelia senegalensis* | Laughing Dove | 15 | 14 | 7 | 36 |
| | " " | *Columba guinea* | Speckled Pigeon | 34 | 18 | 27 | 79 |
| | " " | *Streptopelia vinacea* | Vinaceous Dove | 22 | 34 | 32 | 88 |
| 8. | Coraciidae | *Coracias abyssinica* | Abyssinian Roller | 3 | - | 2 | 5 |
| 9. | Cuculidae | *Centropus senegalensis* | Senegal Coucal | 2 | 5 | 4 | 11 |
| 10. | Jacanidae | *Actophilornis africanus* | African Jacana | 245 | 184 | 475 | 904 |
| | " " | *Microparra capensis* | Lesser Jacana | 14 | 22 | 114 | 150 |
| 11. | Motacillidae | *Motacilla flava* | Yellow Wagtail | 141 | 94 | 10 | 245 |
| 12. | Phalacrocoracidae | *Phalacrocorax africanus* | Longtail/Reed Cormorant | 227 | 109 | 383 | 719 |
| 13. | Ploceidae | *Ploceus cucullatus* | Village Weaver | 10 | - | 40 | 60 |
| 14. | Psittacidae | *Psittacula krameri* | Rose-ringed Parakeet | - | 7 | - | 7 |
| 15. | Pyconotidae | *Pycnonotus barbatus* | Common Bulbul | 4 | - | 8 | 12 |
| 16. | Rallidae | *Amaurornis flavirostris* | Black Crake | 9 | 4 | 16 | 29 |

| S/N | Family | Scientific Name | Common Name | Frequency | | | Total |
|---|---|---|---|---|---|---|---|
| | | | | 1st Visit | 2nd Visit | 3rd Visit | |
| | " " | *Gallinula chloropus* | Common Moorhen | 32 | 45 | 78 | 155 |
| | " " | *Gallinula angulate* | Lesser Moorhen | - | - | 10 | 10 |
| | " " | *Porphyrio madagascariensis* | Purple Swamphen | 6 | 4 | 19 | 29 |
| 17. | Recurvirostridae | *Himantopus himantopus* | Black-winged Stilt | - | 8 | - | 8 |
| 18. | Scolopacidae | *Philomachus pugnax* | Ruff | 550 | 770 | 10 | 1330 |
| 19. | Sternidae | *Sterna nilotica* | Gull-billed Tern | 36 | 50 | - | 86 |
| 20. | Sturnidae | *Lamprotornis caudatus* | Longtail Glossy Starling | - | 2 | - | 2 |
| 21. | Viduidae | *Vidua chalybeate* | Village Indigo | 5 | - | - | 5 |
| Total Number of Species Per Location | | | | 2,148 | 1,658 | 1,732 | 5,538 |

*Source: Field Survey, 2024*

**Table 2. Avifauna Species Identified in the Study Area (Nguru Wetland) for Wet Season**

| S/N | Family | Scientific Name | Common Name | Frequency | | | Total |
|---|---|---|---|---|---|---|---|
| | | | | 1st Visit | 2nd Visit | 3rd Visit | |
| 1. | Accipitridae | *Circus ranivorus* | African Marsh Harrier | 1 | 1 | - | 2 |
| | " " | *Milvus aegyptius* | Yellow billed Kite | 8 | 6 | 2 | 16 |
| 2. | Alcedinidae | *Halcyon leucocephala* | Grey-headed Kingfisher | 7 | 1 | - | 8 |
| | " " | *Ceryle rudis* | Pied Kingfisher | 24 | 11 | 7 | 42 |
| 3. | Anatidae | *Nettapus auritus* | African Pygmy Geese | 3 | - | - | 3 |
| " | " | *Dendrocygna bicolor* | Fulvous Whistling Duck | 10 | - | - | 10 |
| " | " | *Dendrocygna viduata* | White Face Whistling Duck | 23 | - | - | 23 |
| 4. | Ardeidae | *Egretta ardesiaca* | Black Heron | 34 | 17 | 10 | 61 |
| " | " | *Bubulcus ibis* | Cattle Egret | 36 | 9 | 6 | 51 |
| " | " | *Ardea cinerea* | Grey Heron | 34 | 12 | 9 | 55 |
| " | " | *Egretta intermedia* | Intermediate Egret | 3 | - | - | 3 |
| " | " | *Egretta garzetta* | Little Egret | 24 | - | - | 24 |
| " | " | *Ardea purpurea* | Purple Heron | 13 | 8 | 7 | 28 |
| " | " | *Ardeola ralloides* | Squacco Heron | 32 | 12 | 7 | 51 |
| 5. | Bucerotidae | *Tockus erythrorhynchus* | Red-billed Hornbill | 9 | 5 | 5 | 19 |
| 6. | Charadriidae | *Vanellus tectus* | Black-headed Lapwing | 25 | 14 | 10 | 49 |
| | " " | *Vanellus spinosus* | Spur-winged Lapwing | 14 | 7 | 4 | 25 |
| 7. | Columbidae | *Streptopelia decipiens* | African Mourning Dove | 16 | 12 | 9 | 37 |

| S/N | Family | Scientific Name | Common Name | Frequency | | | Total |
|---|---|---|---|---|---|---|---|
| | | | | 1st Visit | 2nd Visit | 3rd Visit | |
| | " " | *Streptopelia senegalensis* | Laughing Dove | 20 | 11 | 11 | 42 |
| | " " | *Columba guinea* | Speckled Pigeon | 41 | 20 | 11 | 72 |
| | " " | *Streptopelia vinacea* | Vinaceous Dove | 28 | 15 | 10 | 53 |
| 8. | Coraciidae | *Coracias abyssinica* | Abyssinian Roller | 15 | 4 | 2 | 21 |
| 9. | Cuculidae | *Centropus senegalensis* | Senegal Coucal | 8 | 7 | 7 | 22 |
| 10. | Jacanidae | *Actophilornis africanus* | African Jacana | 67 | 24 | 12 | 103 |
| | " " | *Microparra capensis* | Lesser Jacana | 32 | 20 | 11 | 63 |
| 11. | Motacillidae | *Motacilla flava* | Yellow Wagtail | 9 | - | - | 9 |
| 12. | Phalacrocoracidae | *Phalacrocorax africanus* | Longtail/Reed Cormorant | 28 | 12 | 11 | 51 |
| 13. | Ploceidae | *Ploceus cucullatus* | Village Weaver | 13 | 4 | 4 | 21 |
| 14. | Psittacidae | *Psittacula krameri* | Rose-ringed Parakeet | 7 | 4 | 3 | 14 |
| 15. | Pyconotidae | *Pycnonotus barbatus* | Common Bulbul | 21 | 12 | 12 | 45 |
| 16. | Rallidae | *Amaurornis flavirostris* | Black Crake | 13 | 8 | 8 | 29 |
| | " " | *Gallinula chloropus* | Common Moorhen | 5 | 4 | 8 | 17 |
| | " " | *Gallinula angulata* | Lesser Moorhen | 11 | 5 | 4 | 20 |
| | " " | *Porphyrio madagascariensis* | Purple Swamphen | 4 | 2 | 2 | 8 |
| 17. | Recurvirostridae | *Himantopus himantopus* | Black-winged Stilt | 4 | - | - | 4 |
| 18. | Scolopacidae | *Philomachus pugnax* | Ruff | 18 | - | - | 18 |
| 19. | Sternidae | *Sterna nilotica* | Gull-billed Tern | 9 | 6 | 4 | 19 |
| 20. | Sturnidae | *Lamprotornis caudatus* | Longtail Glossy Starling | 16 | 3 | 1 | 20 |
| 21. | Viduidae | *Vidua chalybeata* | Village Indigo | 5 | 5 | 5 | 15 |
| Total Number of Species Per Location | | | | 690 | 281 | 202 | 1,173 |

*Source: Field Survey, 2024*

**Table 3. Avifauna Species Diversity in the Study Area (Nguru Wetland) for Dry Season**

| S/N | Species | Frequency | Pi | lnPi | PilnPi |
|---|---|---|---|---|---|
| 1. | *Actophilornis africanus* | 904 | 0.163236 | 1.81256 | 0.29587 |
| 2. | *Amaurornis flavirostris* | 29 | 0.005237 | 5.25209 | 0.0275 |
| 3. | *Ardea cinerea* | 45 | 0.008126 | 4.81273 | 0.03911 |
| 4. | *Ardea purpurea* | 44 | 0.007945 | 4.8352 | 0.03842 |
| 5. | *Ardeola ralloides* | 281 | 0.05074 | 2.98103 | 0.15126 |
| 6. | *Bubulcus ibis* | 58 | 0.010473 | 4.55895 | 0.04775 |
| 7. | *Centropus senegalensis* | 11 | 0.001986 | 6.22149 | 0.01236 |
| 8. | *Ceryle rudis* | 26 | 0.004695 | 5.36129 | 0.02517 |
| 9. | *Circus ranivorus* | 6 | 0.001083 | 6.82763 | 0.0074 |
| 10. | *Columba guinea* | 79 | 0.014265 | 4.24994 | 0.06063 |
| 11. | *Coracias abyssinica* | 5 | 0.000903 | 7.00995 | 0.00633 |
| 12. | *Dendrocygna bicolor* | 24 | 0.004334 | 5.44133 | 0.02358 |
| 13. | *Dendrocygna viduata* | 701 | 0.12658 | 2.06688 | 0.26163 |
| 14. | *Egretta ardesiaca* | 54 | 0.009751 | 4.6304 | 0.04515 |
| 15. | *Egretta garzetta* | 60 | 0.010834 | 4.52504 | 0.04903 |
| 16. | *Egretta intermedia* | 1 | 0.000181 | 8.61939 | 0.00156 |
| 17. | *Gallinula angulata* | 10 | 0.001806 | 6.3168 | 0.01141 |
| 18. | *Gallinula chloropus* | 155 | 0.027988 | 3.57596 | 0.10009 |
| 19. | *Halcyon leucocephala* | 5 | 0.000903 | 7.00995 | 0.00633 |
| 20. | *Himantopus himantopus* | 8 | 0.001445 | 6.53995 | 0.00945 |
| 21. | *Lamprotornis caudatus* | 2 | 0.000361 | 7.92624 | 0.00286 |
| 22. | *Microparra capensis* | 150 | 0.027086 | 3.60875 | 0.09775 |
| 23. | *Milvus aegyptius* | 16 | 0.002889 | 5.8468 | 0.01689 |
| 24. | *Motacilla flava* | 245 | 0.04424 | 3.11813 | 0.13795 |
| 25. | *Nettapus auritus* | 84 | 0.015168 | 4.18857 | 0.06353 |
| 26. | *Phalacrocorax africanus* | 719 | 0.12983 | 2.04153 | 0.26505 |
| 27. | *Philomachus pugnax* | 1330 | 0.240159 | 1.42645 | 0.34258 |
| 28. | *Ploceus cucullatus* | 50 | 0.009029 | 4.70737 | 0.0425 |
| 29. | *Porphyrio madagascariensis* | 29 | 0.005237 | 5.25209 | 0.0275 |
| 30. | *Psittacula krameri* | 7 | 0.001264 | 6.67348 | 0.00844 |
| 31. | *Pycnonotus barbatus* | 12 | 0.002167 | 6.13448 | 0.01329 |
| 32. | *Sterna nilotica* | 86 | 0.015529 | 4.16504 | 0.06468 |
| 33. | *Streptopelia decipiens* | 67 | 0.012098 | 4.4147 | 0.05341 |
| 34. | *Streptopelia senegalensis* | 36 | 0.006501 | 5.03587 | 0.03274 |
| 35. | *Streptopelia vinacea* | 88 | 0.01589 | 4.14205 | 0.06582 |
| 36. | *Tockus erythrorhynchus* | 2 | 0.000361 | 7.92624 | 0.00286 |
| 37. | *Vanellus spinosus* | 84 | 0.015168 | 4.18857 | 0.06353 |
| 38. | *Vanellus tectus* | 20 | 0.003611 | 5.62366 | 0.02031 |
| 39. | *Vidua chalybeata* | 5 | 0.000903 | 7.00995 | 0.00633 |
| Total | | 5,538 | 1 | | 2.548 |

*Source: Field Survey, 2024*

**Table 4. Avifauna Species Diversity in the Study Area (Nguru Wetland) for Wet Season**

| S/ N | Species | Frequency | Pi | lnPi | PilnPi |
|---|---|---|---|---|---|
| 1. | *Actophilornis africanus* | 103 | 0.087809 | 2.43259 | 0.2136 |
| 2. | *Amaurornis flavirostris* | 29 | 0.024723 | 3.70002 | 0.09148 |
| 3. | *Ardea cinerea* | 55 | 0.046888 | 3.05999 | 0.14348 |
| 4. | *Ardea purpurea* | 28 | 0.02387 | 3.73512 | 0.08916 |
| 5. | *Ardeola ralloides* | 51 | 0.043478 | 3.13549 | 0.13633 |
| 6. | *Bubulcus ibis* | 51 | 0.043478 | 3.13549 | 0.13633 |
| 7. | *Centropus senegalensis* | 22 | 0.018755 | 3.97628 | 0.07458 |
| 8. | *Ceryle rudis* | 42 | 0.035806 | 3.32965 | 0.11922 |
| 9. | *Circus ranivorus* | 2 | 0.001705 | 6.37417 | 0.01087 |

| S/ N | Species | Frequency | Pi | lnPi | PilnPi |
|---|---|---|---|---|---|
| 10. | *Columba guinea* | 72 | 0.061381 | 2.79065 | 0.17129 |
| 11. | *Coracias abyssinica* | 21 | 0.017903 | 4.0228 | 0.07202 |
| 12. | *Dendrocygna bicolor* | 10 | 0.008525 | 4.76473 | 0.04062 |
| 13. | *Dendrocygna viduata* | 23 | 0.019608 | 3.93183 | 0.07709 |
| 14. | *Egretta ardesiaca* | 61 | 0.052003 | 2.95645 | 0.15375 |
| 15. | *Egretta garzetta* | 24 | 0.02046 | 3.88927 | 0.07958 |
| 16. | *Egretta intermedia* | 3 | 0.002558 | 5.96871 | 0.01527 |
| 17. | *Gallinula angulata* | 20 | 0.01705 | 4.07159 | 0.06942 |
| 18. | *Gallinula chloropus* | 17 | 0.014493 | 4.23411 | 0.06136 |
| 19. | *Halcyon leucocephala* | 8 | 0.00682 | 4.98788 | 0.03402 |
| 20. | *Himantopus himantopus* | 4 | 0.00341 | 5.68103 | 0.01937 |
| 21. | *Lamprotornis caudatus* | 20 | 0.01705 | 4.07159 | 0.06942 |
| 22. | *Microparra capensis* | 63 | 0.053708 | 2.92419 | 0.15705 |
| 23. | *Milvus aegyptius* | 16 | 0.01364 | 4.29473 | 0.05858 |
| 24. | *Motacilla flava* | 9 | 0.007673 | 4.8701 | 0.03737 |
| 25. | *Nettapus auritus* | 3 | 0.002558 | 5.96871 | 0.01527 |
| 26. | *Phalacrocorax africanus* | 51 | 0.043478 | 3.13549 | 0.13633 |
| 27. | *Philomachus pugnax* | 18 | 0.015345 | 4.17695 | 0.0641 |
| 28. | *Ploceus cucullatus* | 21 | 0.017903 | 4.0228 | 0.07202 |
| 29. | *Porphyrio madagascariensis* | 8 | 0.00682 | 4.98788 | 0.03402 |
| 30. | *Psittacula krameri* | 14 | 0.011935 | 4.42826 | 0.05285 |
| 31. | *Pycnonotus barbatus* | 45 | 0.038363 | 3.26066 | 0.12509 |
| 32. | *Sterna nilotica* | 19 | 0.016198 | 4.12288 | 0.06678 |
| 33. | *Streptopelia decipiens* | 37 | 0.031543 | 3.4564 | 0.10903 |
| 34. | *Streptopelia senegalensis* | 42 | 0.035806 | 3.32965 | 0.11922 |
| 35. | *Streptopelia vinacea* | 53 | 0.045183 | 3.09703 | 0.13993 |
| 36. | *Tockus erythrorhynchus* | 19 | 0.016198 | 4.12288 | 0.06678 |
| 37. | *Vanellus spinosus* | 25 | 0.021313 | 3.84844 | 0.08202 |
| 38. | *Vanellus tectus* | 49 | 0.041773 | 3.1755 | 0.13265 |
| 39. | *Vidua chalybeata* | 15 | 0.012788 | 4.35927 | 0.05575 |
| | Total | 3.40307 | 1,173 | 1 | |

*Source: Field Survey, 2024*

**Table 5. Shannon-Weiner Indices for Avifauna Species Diversity in the Study Area (Nguru Wetland)**

| Indices | Dry Season | Wet Season |
|---|---|---|
| Taxa_S | 39 | 39 |
| Individuals | 5538 | 1173 |
| Dominance_DM | 0.1253 | 0.03948 |
| Simpson | 0.8747 | 0.9605 |
| Shannon_H | 2.548 | 3.403 |
| Evenness_e^H/S | 0.3277 | 0.7707 |
| Equitability_J | 0.6955 | 0.9289 |

*Source: Field Survey, 2024*

## 4. DISCUSSION

The finding of this study shows that the majority of bird species identified during the research were Resident (12,225), Migratory (8,186) and Palearctic Migrant (10,876) species in the study area. Some of the resident species recorded include, African Jacana, Longtail/Reed Cormorant, African Mourning Dove, Vinaceous Dove, Pied Kingfisher, Common Moorhen; Migratory birds include, Yellow Wagtail, African Marsh Harrier, Intermediate Egret, Red-billed Hornbill, Garganey; and the Palearctic migrant bird species were White-faced Whistling Duck, Squacco Heron, Fulvous Whistling Duck, Yellow Billed Kite and Green Sandpiper. According to Osunsina et al. [16] the majority of birds observed during the study were resident species,

migratory and Palearctic migrant species. Similar observation was made by Sabo, [17]. This shows that bird species found are either residents, intra-migrants, Vagrant and Palearctic Migrant. Also Lameed, [15] in his study, showed that the majority of wetland birds observed were Resident, Migratory and Palearctic species. The finding of this study could be established that the most dominant bird species in Nguru Lake were Philomachus pugnax (1,330), Actophilornis africanus (904), Phalacrocorax africanus (719), Columba guinea (79).

The findings of the study on diversity of avifauna species in Nguru Wetlandshows that the Shannon Diversity Index for the area was 2.55 in Dry Season, while that of Wet Season the area has 3.40. The results are indicative of relative high diversity of bird species in the Wet Season. This finding strongly agrees with the statement of Bibi and Ali [18] who clearly stated that the values of Shannon-Weiner Diversity Index usually falls between 1.5 and 3.5, only rarely it surpasses 4.5. This relative equal and high diversity of bird species at Nguru Lake is an indication of quantitative measure that reflects how many different species are in existence in the sites. This result supports Mengesha and Bekele [19] who reported that the avian diversity is an indication of habitat heterogeneity and the number of species and individuals in an area implies the importance of the area. Each habitat has a specific set of microenvironment that is suitable for the species.

## 5. CONCLUSION

This study was conducted to investigate the status and diversity of Avifauna species in the study area, the information on the occurrence of birds every month obtained was used for seasonality analysis. However, species identified in dry season was higher compared to the wet season, due to the presence of migrants and Palearctic migrant avifauna species in the study area (dry season) in which this study coincided with the period of their migration in the area. Species diversity attained concentrated in the area, it could be due to the availability, abundance of food in the area.

## 6. RECOMMENDATIONS

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

i. Effective monitoring and strategies for conservation to restore the declining population of bird species.
ii. Provide public enlightenment of the people around the wetland on values of Nguru Wetlands.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

We hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Labe LT, Iwar II, Uloko IJ. Species diversity and abundance of avifauna in the University of Agriculture, Benue State, North Central Nigeria. For Res Eng Int J. 2018;2(4):198-202. doi:10.15406/freij.2018.02.00048.
2. Burgess ND, Doggart N, Lovett J. The Uluguru Mountains of Eastern Tanzania: the effect of forest loss on biodiversity. Oryx. 2002;36:140-152.
3. Doggart N, Lovett J, Mhoro B, Kiure J, Burgess N. Biodiversity surveys in the forest reserves of the Uluguru Mountains. DSM: Technical paper for The Wildlife Conservation Society of Tanzania and Tanzanian Forest Conservation Group. 2005;8-18.
4. Frontier-Tanzania. Uluguru component biodiversity survey 2005 (Volume III): Uluguru North Forest Reserve. Bracebridge F, Fanning H, Howell R, Rubio A, St. John A, editors. Dar Es-salaam: Society for Environmental Exploration and the University of Dares Salaam; CARE-Tanzania, Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF); 2005. p. 1-78.

5. Tworek S. Different bird strategies and their responses to habitat changes in an agricultural landscape. Ecol Res. 2002;17:339-359.
6. Hadley SJK, Hadley AS, Betts M. Acoustic classification of multiple simultaneous bird species: A multi-instance multi-label approach. J Acoust Soc Am. 2012;131(6) :4640-4650.
7. Ramchandra AM. Diversity and richness of bird species in newly formed habitats of Chandoli National Park in Western Ghats, Maharashtra State, India. Biodivers J. 2013;4(1):235-242.
8. Ayeni AO, Ogunsesan AA, Adekola OA. Provisioning ecosystem services provided by the Hadejia-Nguru wetlands, Nigeria: current status and future priorities. J Sci Africa. 2019;5:2276-2468.
DOI: 10.1016/j.sciaf.2019.e00124.
9. Caro R, De-frutos H, Kltwan A. Typha charcoal in Senegal: changing a national threat into durable wealth. Cambridge: Massachusetts Institute of Technology; 2011.
10. Bourn D. Review of remote sensing options for environmental monitoring of the Hadejia-Nguru wetlands, Nigeria. Oxford: Environmental Research Group Oxford Limited; 2003.
11. Borrow N, Demey R. Field guide to the birds of Western Africa. Princeton: Princeton University Press; 2014.
12. Ramsar Convention Bureau. Background papers on wetland values and functions. Gland, Switzerland: Ramsar Convention Bureau; 2000.
Available:http://www.ramsar.org/info/values
13. Bibby CJ, Burgess ND, Hill D. Birds census techniques. 2nd ed. London: Academic Press; 1992. p. 24-41.
14. Ralph CJ, Geupel GR, Pyle P, Martin TE, Desante DF. Handbook of field methods for monitoring landbirds. United States Department of Agriculture; 1993. Gen Tech Rep PSW-GTR-144.
15. Lameed GA. Species diversity and abundance of wild birds in Dagona Waterfowl Sanctuary, Borno State, Nigeria. Afr J Environ Sci Technol. 2011;5(10):855-866.
16. Osunsina IOO, Ogialekhe P, Adebayo OA, Yisau MA. Bird species diversity and abundance in Borgu sector of Kainji Lake National Park, Nigeria. Niger J Wildlife Manag. 2018;2(2):41-50.
17. Sabo BB. Checklist of bird species at the Hadejia-Nguru wetlands, Nigeria. Glob Adv Res J Agric Sci. 2016;5(11):402-412.
18. Mengesha G, Bekele A. Diversity and relative abundance of birds of Alatish National Park, North Gondar, Ethiopia. Int J Ecol Environ Sci. 2008;34(2):215-222.
19. Bibi F, Ali Z. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. J Anim Plant Sci. 2013;23(2):469-474.



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