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Species Obsolute Population Density and Diversity of Water Birds in Wetland Areas of Yankari National Park, Bauchi State, Nigeria

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Abstract: This study was carried out to determine water bird species list, dry season absolute population density and seasonal diversity in the Wetland areas of Yankari National Park. The point count method was used for the inventory of individual species. Diversity was determined using Simpson's diversity index, while student t-test analysis of variance were used to compare water bird species diversity between seasons and sites. The results obtained indicated that a total of 49 water bird species belonging to 11 families occurred in the park. The dry season means density per hectare of water birds in the study area ranged from 43.43±5.12 for *Ardeola ibis* to 0.03±0.25 for *Phalacrorax africana*. There was no significant difference ($p>0.05$) in water birds diversity in Yankari National Park between dry and rainy seasons. Diversity of water birds by sites did not also vary ($p>0.05$). However, more water birds were observed in the dry season than in the rainy season. It is expected that the findings from this study will promote appropriate management strategies for conservation and maximum utilization of water birds in wetland areas of Yankari National Park.

Key words: Species, population density, diversity of water, Yankari National Park, Nigeria

INTRODUCTION

It is certain that human kind lives on this planet by courtesy of plant and animal resources provided by nature. These resources, provide to man, food, water, shelter, drugs and healthy environment. Unfortunately however, the rate at which these resources are diminishing is a point of concern. Yankari National Park supports a variety of life, plants and animals and the intricate ecosystem they help to build. About 52 different species of mammals, 26 species of fish, 17 species of reptiles, 7 species of amphibians and 360 species of birds have been sighted in Yankari National Park (Geerling, 1973; Green, 1987). Only 130 out of the 360 species of birds are resident species while the rest exhibit some form of migration (Dyer and Gartshore, 1975; Green, 1987).

Birds are bio-indicators, they notify us of certain changes occurring in our environment. For example, they have been used extensively as both indicators and predictors of environmental consequences of using Agro-chemicals (Hardy *et al*., 1987). They are among the numerous fauna that may be at risk from the use of Agricultural pesticides (Mineau *et al*., 1990). From economic view point, the arrival of Abdims stork, (*Ciconia abdmiii*) notify the local farmer in the northern Nigeria that the rainy season is approaching. Many bird species are pollinators, sunbird belonging to the family Nectranidae patronizes nectar of most flowering plants and several of them are insectivores that aid in checking insects population explosion that could assume pest status. A typical example of such species include cattle egret (*Bubulcus ibis*). Abdims stork (*Ciconia abdmiii*) and Abysinian rollers (*Crocias abysinica*) (Derek, 1992). Besides, the beauty of birds particularly water birds has made bird watching a very useful way of spending leisure and generating revenue from both local and international tourists.

Gaji river valley serves as the only .major dry season water source of the Yankari National Park (YNP). It offers dry season food and cover to numerous species of wildlife. The river provides important roosting, feeding and nesting sites for large number of bird species, for example cattle egret, (*Ardeola ibis*) Heron, (*Ardeola ralloides*) Ducks, (*Dendrocygna species*) and other species (Green, 1987).

Although the Avifauna of Yankari National Park has been censused and the check-list prepared, the water birds of the park have not been thoroughly studied in terms of their composition, abundance and diversity. The dearth of information on the water birds of Yankari National Park makes the development of management strategies impossible. Hence, the need for this study,

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which has provided a comprehensive list of water birds in Yankari National Park, determined the density of each species of water birds in the wetland areas of the park and the diversity of water birds by sites and seasons in the wetland areas of Yankari National Park.

MATERIALS AND METHODS

Study area: The Yankari National Park is located in southern savanna zone of Bauchi State, Nigeria. It lies within latitude 10° and 30¹E and Longitudes 9° and 50¹N. It covers an area of approximately 2240.10 Km^2 of land and is situated within the districts of Duguri, Gwana and Pali areas (Fig. 1). There is one watershed in the park, that of the Gaji river and its tributaries. The park is like a basin with almost all streams flowing toward the Yashi or Gaji river in the centre. In the south-west of the park, few streams flow into Yuli. Yuli joins the Gaji river eastward. The floor of Gaji river is underlain by shale and clay and at the junction with fine sandstone layer and shale layer beneath. Five large springs have been identified (Wikki, Dimil Gwana, Mawulgo and Tungan Maliki) in the park. All the five springs flow into Gaji river and the basin is open toward the south from where the Gaji river exit the park. The dry season begins in early October and last until April. The wet season starts in May and last through to September with heaviest rainfall generally in August. Mean annual rainfall range from 900-1000 mm. Temperature ranges from 12-36°C in the dry season and 18-33°C in the rainy season (NCF, 1987).

Reconnaissance survey: During the preliminary survey of the study area, 5 permanent wetland sites were delineated based on their size and utilization by water birds and for the purpose of establishing baseline data for future monitoring of water bird populations and diversity. The 5 wetland sites constituted the study sites.

Description of the study sites: The study sites consist of the following:

- Magama, which is about 1 Km south of Wikki Camp, a confluence of Wikki Warm spring and Gaji river.
- Ma'wulgo, is one of the 5 warm spring sites. It is situated at the right bank of the Gaji river, about 9 Km north-east of Wikki.
- Barkono site which is about 6 Km north east of Wikki Camp, adjacent to Marshal Bkurkoo Cave.
- Muazu-Lamido is a confluence of Gaji and Yashin rivers, about 10 km off Wikki camp. The basin opens toward the south from where Gaji river transverse the park.
- Daban-Kuka (the 5th site) is a significant water pond in the upper reaches of Yankari river that retains water throughout the dry season. It is located 15 km north of Wikki Camp.

Study design: Each of the water bird sites was further divided into 5 circular units with 20 m fixed radius. The boundary of each circular unit was marked with permanent features (cluster of bushes on the river banks). Each circular unit constituted a counting station (Fig. 2). To obtain a representative sample, each site was visited 30 times during each season. Rainy season censuses were conducted between May (when the rains started) and July. During this period the wetland areas were still accessible and the grasses were not yet too tall to obstruct viewing. Dry season censuses were conducted from January to March for the same reasons given above. It was the dry season census data only, that was used in calculating the density of water birds in the park. This was done because the abundance, the diversity and the reliability of the census data were higher during the dry season. Besides, bird watching for leisure can only be carried out in the wetland areas during the dry season.

Data collection techniques: Water birds census was carried out in the counting stations using point count method (Bibby *et al.*, 1992). A pair of binocular (25×25 focus apertures), a wrist watch, recording cards and a pencil were used for field observation and recording of census data. Censuses were carried out during the hours of 19:30-22:30 in the morning and 15:30-18:30 in the afternoon from a fixed point. Counts were conducted from above the 4 wheel drive using binocular, five min after the vehicle arrived to allow the disturbed birds settle. Bird species were counted as they occurred at an interval of 3 min from within each circular sample point (Counting station).

Data analysis: The water bird species diversity was determined using Simpson diversity index (Usher, 1992). Species density was determined using-density model. Student t- test and analysis of variance (CRD) were used to compare diversity between seasons and between sites at ($p = 0.05$) based on Wahua's (1999) principles.

RESULTS

The result of water bird species inventory is presented in Table 1. There were 49 species of water birds belonging to 11 families. Birds with the highest number of species were the Ardeidae (13) Charadridae (11) and Ciconoiidae (5).

Table 1: Check list of water birds of yankari national park

Common name	Scientific name	A	B	C	D	E
Ardeidae						
Grey heron	*Ardea cinerea*	x	x	x	x	x
Black herded heron	*Ardea melanocacarphala*	-	x	-	x	-
Goliath heron	*Ardea goliath*	x	x	x	x	x
Purple heron	*Ardea purpurea*	-	x	x	x	x
Green backed heron	*Biutorides striatus*	-	x	-	-	-
Black backed night	*Nyencorax nycticorax heeron*	-	-	x	x	-
Squacco heron	*Ardeola ralloides*	x	x	x	x	x
Little bittern	*Lxobrychus minutus*	x	x	x	x	-
Great white egret	*Eggretta albus*	x	x	x	x	x
Intermediate egret	*Mesophyx intermedia*	x	x	-	-	-
Little egret	*Egretta garzetia*	x	x	x	x	x
Black heron	*Egretta ardestaca*	-	-	-	-	-
Cattle egret	*Ardeola ibis*					
Phalacrocoracidae						
Great cormorant	*Phalacrocorax carbo*	-	x	-	x	-
Long tail cormorant	*Phalacrocorax africana*					
Anatidae						
Fulvous whistling duck	*Dendrucyg na bicolor*	-	-	x	x	x
White face whistling duck	*Dendrocygna viduata*	x	x	x	x	x
Spur winged goose	*Pletropterus gambensis*	-	x	x	x	-
Pigmy goose	*Nettlapus auruitus*	-	x	x	x	x
Knob billed goos	*Sarkidiornis melanota*	-	x	x	x	x
Railidae						
Black crake	*Amauronis flavirostra*	x	x	x	x	x
Moorhen	*Gallinula chloropus*	x	x	x	x	x
Lesser Moorhen	*Gallinula angulata*	x	x	x	x	x
Allen's Gallinule	*Porphyrio alleni*	x	x	x	x	x
Helliornihidae						
Fin foot	Padica selegalensis	-	x	x	-	x
Charadriidae						
Painted snipe	*Rostratula bengalensis*	-	-	-	x	-
Black winged stilt	*Himontopis himantopus*	-	x	-	x	-
Violet tipped courser	*Phinoptilus chalcoptenis*	-	x	-	-	-
Senegal plover	*Veniellus lugubris*	x	x	x	x	x
Senegal wattle plover	*Venellus selegallus*	x	x	x	x	x
Spur winged plover	*Vanallus spinostus*	x	x	x	x	x
Common sand piper	*Tringa glareole*	x	x	x	x	x
Green sand piper	*Tringa achropus*	x	x	-	x	x
Wood sand piper	*Tringa species*	-	-	-	x	-
Unidentified sandpiper	*Tringa species*	-	-	-	x	-
Little stint	*Calidris minuta*	x	x	x	x	x
Ciconidae						
Wooly necked stork	*Ciconica episopus*	-	-	-	-	x
Saddle bill stork	*Ephippiorhynchus senegalensis*	x	x	x	x	x
Black stork	*Ciconia nigra*	-	-	-	x	x
Abdims stork	*Ciconia abdimii*	x	x	-	x	-
Morabour stork	*Leptoptilus crumaniferus*	-	-	-	-	x
Threskiornithidae						
Hadada ibis	*Bostrychia hagedesh*	x	x	x	x	x
Sacred ibis	*Threskiornis acthiopica*	x	x	x	x	x
Glosy ibis	*Plegadis falcinellus*	x	x	x	x	x
Scopidae						
Hammer kop	Scopus umbretta	x	x	x	x	x
Jacanidae						
Lesser Jacana	*Microparia capensis*	x	x	x	x	x
Lily throater	*Actophilormis africana*	x	x	x	x	x
Burhinidae						
Senegal thick knee	*Burhinus senegalensis*	x	x	x	x	x
Spotted thick knee	*Burhinus capensis*	x	x	x	x	x
Key						
Here and in the subsequent tables and interpretations						
Site	Magama	=	A			
Site	Barkono	=	B			
Site	Mawulgo	=	C			
Site	Muazu – Lamido	=	D			
Site	Daban Kuka	=	E			

Table 2: Dry season mean absolute population density of water bird species in five wetland sites of yankari national park

Species		Mean density per hectar
Common name	Scientific name	$\bar{X}$±cl
Grey heron	*Ardea cinerea*	7.5±1.760
Black headed heron	*Ardea melanocephola*	0.74±1.42
Goliath heron	*Ardea goliath*	6.98±3.51
Squacco heron	*Ardea ralloides*	15.85±2.98
Purple heron	*Ardea purpurea*	6.17±3.85
Night heron	*Nycticorex niaticorax*	1.260.550
Great white egret	*Egrtta garmetta*	8.47±1.55
Little egret	*Egretta garzetia*	4.06±2.11
Cattle bittern	*Ardeola ibis*	43.43±5.12
Intermediate egret	*Mesophyc intermedia*	0.12±0.12
Little bittern	*Ixobrychus minutus*	3.71±0.74
Great cormorant	*Phalacrorax africana*	0.03±0.25
Fulvous whistling duck	*Dendrocygna bicolor*	19.12±3.09
White face-whistling duck	*Dendrocygna viduata*	25.09±4.97
Spur winged goose	Pletropterus gambensis	1.71±0.28
Pigmy goose	*Nettlapus aurutus*	1.61±0.41
Knob-bill goose	Sarkidiornis melanota	3.19±1.16
Black crake	Amauronis flavirostra	7.03±5.27
Moorhen	*Gallinula chlorpus*	4.66±3.07
Lesser moorhen	Gallinute angulata	3.19±0.52
Allen's gallinue	Porphyrio alleni	0.88±0.28
Fin foot	Padica senegalensis	2.85±3.15
Black winged stilt	Himontopis himantopus	1.16±0.56
Senegal senegal plover	Veniellus lugubris	25.39±1.37
Wattle plover	Venellus selegallus	28.46±5.13
Spur winged plover	Vanallus spinostus	39.07±3.50
Wooly necked stork	Ciconica episopus	15.42±4.99
Black stork	Ciconica nigra	18.67±4.97
Abdims stork	Ciconica abdimii	11.98±6.95
Saddle bill stork	Ephipporhynchus senegalensis	6.84±2.95
Morabour stork	Leptoptilus cramaniferus	12.67±1.16
Hadada ibis	Bostrychia hagedesh	21.93±6.78
Glosy ibis	Plegadis falcinellus	17.74±2.60
Sacred ibis	Threskiornis acthiopic	2.63±2.21
Hammer kop	Scopus umbretta	12.39±1.37
Wood sandpiper	Tringa species	1.11±0.39
Green sandpiper	Tringa achropus	8.14±2.51
Lesser jecana	Microporia capensis	17.37±2.24
Lily throater	Actophilormis africana	17.66±2.32
Senegal thick knee	Burhinus seneglensis	16.49±0.87
Spotted thick knee	Burhinus capensis	11.42±2.20
Common sand piper	Tringa glareda	10.20±4.21
Little stint	Calidris minuta	6.12±3.93

The pooled result of dry season mean absolute population density of water birds species in five Wetland sites of Yankari National Park is presented in Table 2. The Table shows that bird species with 5 individuals and above per hectare include: Grey heron, Goliath heron, Purple heron, Squacco heron, Great white egret, Cattle egret, Fulvous whistling duck, White face whistling duck, Black crake, Senegal plover, Spur winged plover, Wattle Plover, Wooly necked stork, Saddle-bill stork, Black stork, Abdims stork, Morabour stork, Hadada ibis, Hammer Kop, Lesser jacana, Lily throater, Thick knees, Common sand piper, Green sand paper and Little stink

Table 3 shows the seasonal diversity index of water birds in the study area. The results indicate Simpson's diversity indices of water birds by season as 0.0373 and 0.0386 for dry and Wet seasons respectively for all the sites.

Table 3: Seasonal diversity of water birds in yankari national park

Dry season diversity (Simpson's index)	Wet season diversity (Simpson's index)
0.0373^{NS}	0.0386^{NS}

NS = No Significant difference at p>0.05

Table 4: Diversity by site of water birds in yankari National park

Site	A	B	C	D	E
Simpson' index	0.0588^{NS}	0.0506^{NS}	0.0555^{NS}	0.0441^{NS}	0.0637^{NS}

NS = No Significant difference at p>0.05

Results of Diversity by site of water birds in the study area is shown in Table 4. The Table indicates that Simpson's indices of 5 sites (A, B, C, D and E) were 0.0588, 0.0506, 0.0555, 0.0441 and 0.0637, respectively.

DISCUSSION

The seasonal rivers (Gaji and Yashi) and their tributaries provide the Wetland areas in Yankari National Park. They are significant for the variety and number of wildlife species they contain. Prominent among these wildlife species are the water birds, some are residential while others are migrants.

A total of 49 water bird species is just about 0.06% of the 77.233 species reported by for Nigeria. The difference might be due to variation in size of the Wetlands as the five sites studied in Yankari National Park is an insignificant fraction of the entire Wetland areas of Nigeria. Hence the result agrees with the observation of Usher (1992), that species richness is often affected by the size of the habitat and that diversity is positively correlated with habitat size. Out of the 49 water birds species sighted, 28 bird species had densities of 5 individuals per hectare and above during the dry season. These results make the wetland areas of Yankari National Park important sites for watching and conservation of water birds (Derek, 1992). Since, Simpson's index has a maximum value of 1 in a monoculture and becomes smaller as the community becomes more diversed the diversity indices of the wetland sites [A = 0.0588; B = 0.0506; C = 0.0555; D = 0.044; E = 0.0637] are therefore indicative of fairly high diversity of water birds at the sites and the park at large (Simpson, 1949).

Although there is no significant difference (p>0.05) between the diversity indices of the dry and wet seasons of water birds in the wetland areas, the bird species populations varied to a certain extent. It was observed that more bird species were recorded during dry the season than in the wet season. This result is indicative of the occurrence of migrant birds at the wetland sites during

the dry season. The ecological significance of the wetlands in providing food and breeding grounds for the migrants and residents is thus a major function of Yankari National Park in biodiversity conservation.

The diversity by sites of water birds in the Yankari National Park was not found to be significant ($p<0.05$). This suggests that habitat requirement of the water birds (food, cover, resting, roosting sites and others) are equally available from the study sites. This also indicates that the study sites are equally important for bird watching and conservation of water birds.

CONCLUSION

This study has provided baseline data on species composition, site and seasonal diversity indices as well as dry season density of water birds in the wetland areas of Yankari National Park. The above information will be useful for the preparation of a management plan for bird watchers and for conservation. Furthermore, the species list provided if married with the check-list of species of other Wetland conservation centres in the country, may be useful in updating the country's water bird resources.

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