SPECIES DIVERSITY OF BIRDS OF PREY IN HADEJIA NGURU WETLANDS, NIGERIA

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ABSTRACT

The study aimed to determine the distribution, diversity and abundance of birds of prey in Hadejia Nguru wetlands Nigeria, carried out in March to August, 2021, with a view to providing information in a bid to establish a baseline for conservation for this group of birds. The Hadejia-Nguru Wetlands (HNWs) is a Ramsar site and an Important Bird Area (IBA) being recognized nationally and internationally as an ecological area for resident, inter-African and Palearctic migrant bird species in sub-Sahara region, Nigeria. Transect line method was used for the bird survey. This involved moving slowly along the transect line and recording all birds seen and detected in and around the transect line. The survey was carried out for a period of six (6) months using transect line method and each site was surveyed twice every month during the study period. Bird observation was carried out twice daily; morning between 6:00 to 10:00 a.m. and evening between 4:00 to 6:30p.m by walking slowly along the transect line. Birds were counted as birds seen and birds inflight were also counted. Richness index (RI) and t-test were used for data analysis. The total number of birds was calculated as the number of birds seen plus the number of birds heard. Transect line survey method detected a total of 1,562 individual birds of prey that belong to twenty four (24) species of 2 families. Accipitridae with 20 species is the richest family in species number and Falconidae with 4 species. Out of the 24 species recorded 16 are resident, 5 Palearctic migrant and 3 intra-African migrant. Four species of global conservation concern were also recorded; the Vulnerable Tawny eagle (Aquila rapax) ,the Near threatened Red-necked falcon (Falco chicquera) and Pallid harrier (Circus macrourus) and the Endangered Martial eagle (Polemaetus bellicosus). Species richness index was highest in Dagona (3.011) and lowest in Baturiya wetland areas (2.308). Public awareness should be raised to inform the local populace about the importance of these species to the environment vis-à-vis protecting the man-made structures used by the bird species.

Keywords: Diversity, wetlands, birds, transect line

INTRODUCTION

Birds are the best known vertebrate group (Lentino, 2003); however, the development of the ornithological knowledge in most African countries is still in its early stages, particularly raptors. Analyses of the status of 557 birds of prey showed that 18% of these birds are threatened with extinction and 52% have declining global populations, making them more threatened than all birds as a whole (BirdLife International, 2019).

The population status and distribution of raptor species can be difficult to estimate because they are often dispersed and/or secretive species that nest in low densities (with large individual area needs), and their population can fluctuate cyclically in relation to prey abundance (Kirk, Hyslop, 1998). This can make raptors studies challenging, and many species remain poorly known around the word (Bildstein *et al*., 1998; Bierregaard, 1998; Watson, 1998). In the recent decades, raptors have become gradually more protected, and several species have becomes significant "flagships" for increasing public interest and support of conservation programs around the world, but their decline often persists, because of pollution, habitat alteration, and fragmentation or direct/indirect human disturbance (Virani, Watson, 1998; Brambilla *et al*., 2004). Their declining numbers and economic relationships warrant additional interest, and studies of total raptor populations are needed as a means by

which we may elucidate their responses to changing pressures and environmental conditions (Smith, Murphy, 1973)

Most species of raptor are conspicuous and they feed on a broad array of invertebrates and vertebrates across all natural and artificial habitats (Thiollay 2006). Today, the dramatic increase in human pressure, deforestation and general decrease in tree cover, overgrazing and erosion, pesticide use, over-hunting and fishing, land degradation and sometimes direct persecution of predators, all impact negatively on raptor population (Thiollay, 2006). For example in West Africa an estimate of the mean abundance index of raptors between protected and unprotected areas has shown a 30 % decline of raptors in protected areas compared with a 67 % decline in unprotected areas (Thiollay 2006, 2007b). In the savannas of West Africa, 40 breeding raptor species and 19 Palaearctic migrant species have been recorded (Borrow and Demey 2001, Thiollay 2007a). Thiollay (2006) observed that little is known about the actual numbers of the various species, and without knowing this it is difficult to determine the real effect of conservation effort.

Studies indicate that raptors are more imperiled than birds in general, with 52% of raptor species in decline and 18% currently classified as threatened with extinction. Whereas across all bird species, 44% are declining and 13% are threatened. Among raptor species listed as Least Concern, 38% are declining, further supporting assertions that the biodiversity crisis should be viewed not only regarding

species extinction, but also population decline (Hughes *et al*., 1997; Ceballos *et a*l., 2017). The global loss of raptors per se is worrying, not just because of their charisma and flagship role (Sergio *et al*., 2008), but also because reduced abundance of raptors can have cascading effects on ecosystem functioning through changes in the numbers and behavior of their prey (Terborgh *et al.,*2001;Şekercioğlu, 2006). Raptor decline may also lead to loss of ecosystem services (Gaston *et al.,* 2018; 'Bryan *et al.*, 2018), sometimes acutely impacting human well-being (Markandya *et al.*,2008). Therefore, population declines, range contractions, and extinctions of raptors demand investigation into their causes and potential conservation interventions.

A survey in Yankari Game Reserve, Bauchi State, Nigeria, revealed a decline in the population of vultures (Tende & Ottosson 2008). However, data on the population status of other raptor species is lacking. In Hadejia Nguru wetlands, birds have been intensively studied but the focus often was on water-related birds, passeriformes and doves (Ringim *et a*l, 2017, Sulaiman *et al*, 2014, Sabo, 2016, Lameed, 2011). Hence, there have been no attempts to describe their population distribution and diversity in detail comparable to those of raptor researchers around the world (Thiollay 1977a, b, 1989, 2007; Piana, Marsden, 2012; Zilio *et al*., 2013). This research aimed at filling this gaps of knowledge by examining the raptor population distribution and diversity in Hadejia Nguru Wetlands, in terms of species richness in order to establish a live data observatory that can help build the local expertise needed to monitor these emblematic species in the future and implement a sound strategy for their effective safeguarding.

MATERIALS AND METHODS

The Hadejia-Nguru Wetlands being an Internationally recognized Ramsar site lie on the southern edge of the Sahel savanna in northeastern Nigeria with coordinates 10o 33.00' East 12o 39.00' North (Figure 1) , an altitude of 152-305 m, and depth of about 1.5- 7 m with a size of about 350, 000 hectares (Birdlife International, 2015). It is a Ramsar site and an Important Bird Area (IBA) being recognized nationally and internationally as an ecological area for resident, inter-African and Palearctic migrant bird species in sub-Sahara region, Nigeria. However, biological invasion due to Typha grass is threatening the rich avifauna of the wetlands in particular water birds. The wetlands a are found in Yobe, Jigawa and Bauchi states, located in the northern part of Nigeria. The catchment area of the wetlands covers an area of about 3,500 km2, which includes two rivers, the Hadejia and the Jama'are, which flow and converge into the Chad Lake. Hadejia-Nguru Wetland (HNW) supports a total of 378 wetland bird species and the highest total numbers of water birds recorded during were 259,769 in 1995; 201,133 in 1996 and 324,510 in 1997 (Birdlife International, 2006). Also the wetland supports at least 250 species of flowering plants, over 136 types of aquatic flora and fauna and more than 103 species of fishes. All these wild plants and animals depend on one another and the flood for survival and so many people depend on them for their livelihood.
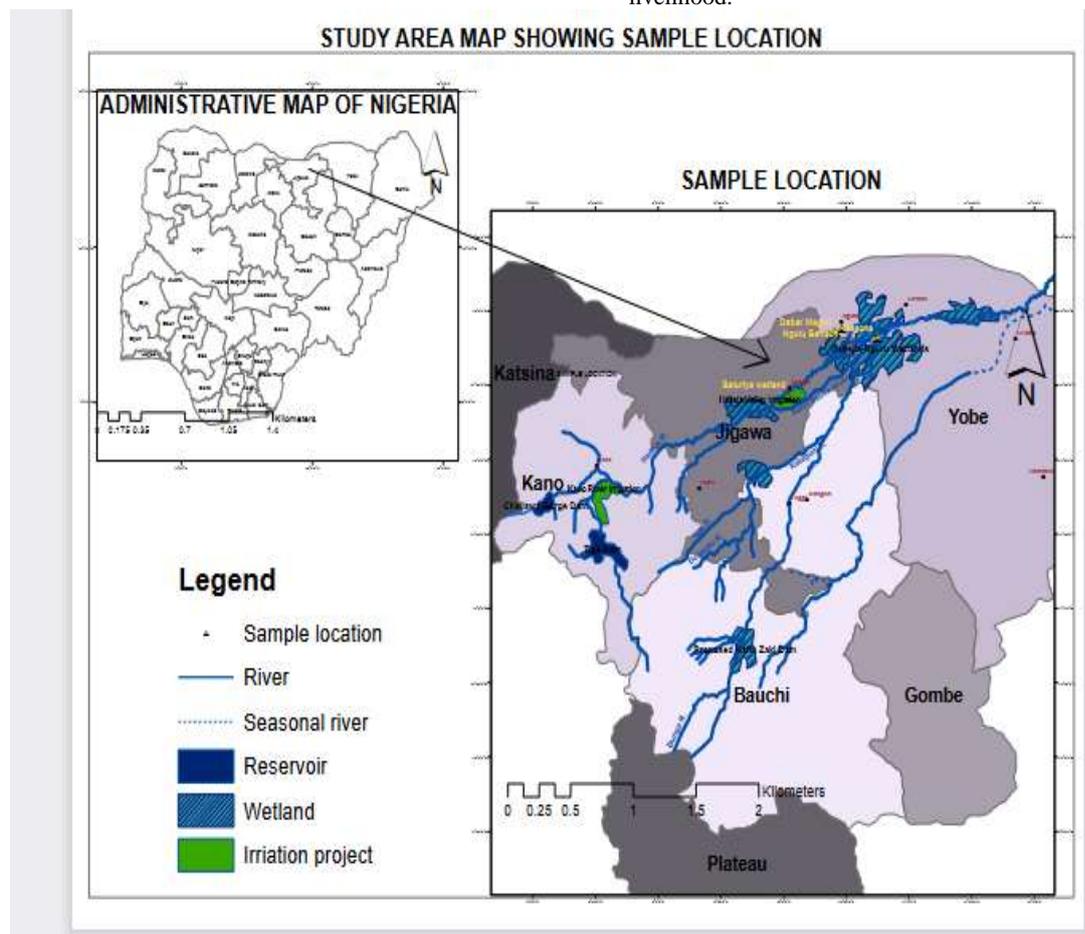

Figure 1: Study Area Map showing Sample Location (Source: Sabo, 2016)

Birds Sampling

Line Transect method was used for the bird survey. This method proved most efficient in terms of data collection per unit effort (Yallop *et al.*, 2003). This census involves an observer moving slowly along the routes and recording all birds detected on either side of the route. A Field survey was carried out in Hadejia Nguru wetlands from March to August, 2021. The census to count raptors was conducted by observations along 5km transect line in each wetland using binoculars, telescopes and field guide to West African Birds by Borrow and Demey, (2014). The observations were conducted by long watches along the transect line. The number of the raptors seen flying around and perching was recorded. The coordinates of each observation point was recorded. Surveys were carried out in the morning around 8am to 10am and in the evening (15h00–18h00) when the temperature was relatively cool and bird's activities are high (Bibby *et al.,* 2000). Garmin 760CSx Global Positioning System (GPS) was used to collect coordinates of the sampling locations.

RESULTS AND DISCUSSIONS

The results presented in table 1 below showed the outcome of transect survey of birds of prey species population distribution in Hadejia-Nguru wetlands from March to August, 2021. Transect line survey method detected a total of 1,562 individual birds of prey that belong to twenty four (24) species of 2 families during this study indicating that the Hadejia-Nguru wetlands area is an important breeding, roosting, and feeding habitat for several raptors (Table 1.).

Accipitridae with 20 species is the richest family in species number and Falconidae with 4 species. This result is in conformity with the findings of Okosodo *et al.*, (2016) who reported accipitridae as the richest family in his studies conducted at South Western Nigeria. It is also in agreement with Kabir (2013) who conducted his research in Bangladash and reported accpitradae as the richest family. In similar vein, this study is in agreement with that of previous report of 3 species of falconidae reported by Lee (2013) in his study on distribution and abundance of raptors in the Korean Penninsula

The most abundant species, Yellow billed kite, black shouldered kite and gabar goshawk comprised 68.5% of all individuals seen in all wetlands in all seasons. This finding is in akin with the study conducted by Adewumi, *et al.*, (2020) who also reported black shouldered kite as one of the abundant specie in Akure metropolis.

Out of the 24 species recorded 16 are resident, 5 Palearctic migrant and 3 intra-African migrant. Four species of global conservation concern were also recorded; the Vulnerable Tawny eagle (*Aquila rapax)* was recorded in both protected and unprotected areas during dry season. The Near threatened Red-necked falcon (*Falco chicquera*) and Pallid harrier (*Circus macrourus*) were also recorded in both protected and unprotected areas in dry and wet seasons in protected and unprotected areas during dry season respectively. The Endangered Martial eagle (*Polemaetus bellicosus*) was seen in dry season in both protected and unprotected areas of Hadejia Nguru Wetlands.

Table 1: Birds of Prey Species in Hadejia Nguru Wetlands

S/No	Local Name	English Name	Scientific Name	Family
1.	Shaho	Red-necked Falcon	*Falco chicquera*	Falconidae
2.	Tayani Goyo	Gabar Goshawk	*Micronisus gabar*	Accipitridae
3.	Karambatta	Common Kestrel	*Falco naumanni*	Falconidae
4.	Shirwa	Yellow billed Kite	*Milvus aegyptius*	Accipitridae
5.	Dan tukuliji	Black Shouldered Kite	*Elanus caeruleus*	Accipitridae
6.	Shirwa	African Swallow Tailed Kite	*Chelictinia riocourii*	Accipitridae
7.	Shirwa	African Marsh Harrier	*Circus ranivorus*	Accipitridae
8.	Farin Shaho	Montagus Harrier	*Circus pygargus*	Accipitridae
9.	Shirwa	Pallid Harrier	*Circus macrourus*	Accipitridae
10.	Shaho/Chi fara	Grasshopper Buzzard	*Butastur rufipennis*	Accipitridae
11.	Duk'i	Wahlbergs Eagle	*Hieraaetus Wahlberg*	Accipitridae
12.	Mekiya/Gagafa	Tawny Eagle	*Aquila rapax*	Accipitridae
13.	Jihirma	Martial Eagle	*Polemaetus bellicosus*	Accipitridae
14.	Farin Komo	Dark Chanting Goshawk	*Melierax metabates*	Accipitridae
15.	Ci Kadangaru	Lizard Buzzard	*Kaupifalco monogrammicus*	Accipitridae
16.	Shaho yar bazara	Bat Hawk	*Macheiramphus alcinus*	Accipitridae
17.	Shaho Madauki	African Goshawk	*Accipiter tachiro*	Accipitridae
18.	Bakin Shaho	Black Kite	*Milvus migrans*	Accipitridae
19.	Surau	Fox Kestrel	*Falco alopex*	Falconidae
20.	Maiwar Shaho	Ovambo Sparrowhawk	*Accipiter ovampensis*	Accipitridae
21.	Surau	Grey Kestrel	*Falco ardosiaceus*	Falconidae
22.	Kwakkore	African Fish Eagle	*Haliaeetus vocifer*	Accipitridae
23.	Jan Shaho	Red-necked Buzzard	*Buteo auguralis*	Accipitridae
24.	Hura Kogo	Western Marsh Harrier	*Circus aeruginosus*	Accipitridae

Source: Field Survey, 2021

The findings of this study suggested more species of birds of prey. This is not in agreement with the Lameed (2011), Ringim *et al.*, (2017) and Odewumi *et al.*, (2020). Lameed (2011) recorded nine (9) birds of prey species in his research on Species diversity and abundance of wild birds in Dagona-Waterfowl Sanctuary. Although his studies was not on birds of prey species but on general birds species diversity. Ringim

et al., (2017) also recorded 8 birds of prey species in his studies on species diversity of migrant birds between protected and unprotected areas of the Hadejia-Nguru wetlands, his research is also on the general bird's species diversity not birds of prey. Odewumi *et al.*, (2020) identified 11 birds of prey species in similar research in Akure metropolis, Ondo State. Sangdon (2013) recorded 16 species

of birds of prey of 2 families in Korean Penusula. Also, this result is not in agreement with Wickramasinghe *et al.*, (2021) who recorded 9 birds of prey species of 2 families (accipitridae and falconidae) in Bolgoda Lake, Sri Lanka in his study on spatial ecology of raptors in an urban wetland. Moreover, the findings of this research is not agreement with Grzegorz (2018) who recorded only 5 birds of prey in the city Wroclaw in Europe during 2002/2010 with the common kestrel and common buzzard as the commonest species, while gabar gashawk, Eurasian sparrowhawk as the rarest species. It is also not in akin with Zillo *et al.*, (2013) recorded a total of 1,890 individuals' birds of prey of 18 species in Southern Brazil, Onoja *et al.*, (2014) recorded 886 individuals of 37 species in Yankari game reserve with the grasshopper buzzard, dark chanting goshawk, African fish eagle, grey kestrel, lizard buzzard and black kite as the commonest species, Okosodo *et al.*, (2016) recorded 39 birds of prey species and owls belonging to 3 families in South western Nigeria with black kite as the commonest species while hooded vulture and tawny eagle have the lowest number of individuals and Tinajero *et al.*, (2017) recorded 332 individuals' birds of prey belonging to 14 species in Scrubland of Northern Central Mexican Dryland environment.

However, the results in agreement with Prakash (1989) who recorded 30 species of birds of prey in Keoladeo National Park, India with 26 species belonging to Accipitridae and 4 to falconidae and Elfari *et al.*, (2020) who recorded 936 individual birds of prey representing 14 species belonging 3 families with accipitridae 9 species as the richest family followed by falconidae (4 species) and pandionidae with only 1 specie. The most abundant species are the black kite, common kestrel and egyptian vulture and Buij & Barbara (2013) who recorded 36 birds of prey belonging to 2 families in lake Chad basin with black kite as the most abundant species.

Also, this is in conformity with the findings of Renzo (2013) who recorded 19 birds of prey species in northwestern Peru. Moreover, Jensen *et al.,* (2005) recorded 28 species of birds of prey in Llanos wetlands, Venezuela.

Birds of Prey Species Richness

A good understanding of the state of communities and ecosystems is vital for devising effective regimes for their conservation (Sutherland 1996, 2000, Gaston 2000, Margules and Pressey 2000, Krebs 2000). This mainly involves an assessment of the state of collective attributes of species in communities and appraising the manner by which environmental changes may affect their future. The commonest approach is an assessment of species richness of

a given community. The species richness of birds of prey within the Hadejia-Nguru wetlands differs between protected and unprotected areas and with seasons. The highest richness index was registered in Dagona wetlands (3.011). Dabar Magini, Nguru Barrack and Baturiya have richness index of 2.683, 2.611 and 2.308 respectively (Table 2). The highest species richness index in the Dagona wetlands of the study area was due to dense vegetation cover of the area (Figure 2) which provides favorite breeding sites, availability of food in microhabitats which favored certain varieties of bird species, cover from predators, and less disturbance compared to other areas. This corroborate with the findings of Sethy *et al.*, (2015) and Takele and Afework (2018) who conducted research in North Orissa University and Choke Mountains, East Gojjam, Ethiopia respectively. Both identified favorite breeding site and availability of food as the main factors influencing birds' higher species diversity index.

The present study shows that Dagona wetlands habitats have dense vegetation cover to serve as a foraging site for a substantial number of bird species. The large size of the area, as compared to the other sites, might contribute to the highest richness and abundance of bird species. As reported by Nabaneeta and Gupta (2010), bird species richness and abundance are influenced by the size of habitat patches, local resource availability and vegetation composition. This is because of the availability of multiple, and varied, alternative feed sources for the birds; moreover, a large area is inaccessible for people contributing to a favorable condition for breeding, feeding and nesting sites (Aynalem and Bekele, 2008). It was also pointed out by Prakash and Manasvini (2013) that a higher abundance of birds in a habitat might be brought by the vegetation composition that forms the main element of their habitat, or it may be influenced by landscape, floral diversity, anthropogenic activities, as well as predation. Various workers have reported significant changes in species richness of avian communities along gradient of vegetation (Krebs 2000) and the effect on raptors is indirect by limiting the availability of their herbivorous prey.

Baturiya wetlands have the lowest species richness index because of sparse vegetation cover consisting mainly of Acacia trees (Figure 2) and is also located on higher altitude. The area is dominated by acacia tree which have smaller leaves and easily shade their leaves, hence does not provide cover to the bird's species. The findings of this research is in agreement with Storch *et al.*, (2003) also Buckley and Freckleton (2010) who reported that, the distribution patterns of bird species normally follows the spatial structure of the environment and habitat requirements of the bird species such as vegetation cover.

Table 2: Species Richness Index in four Study Area

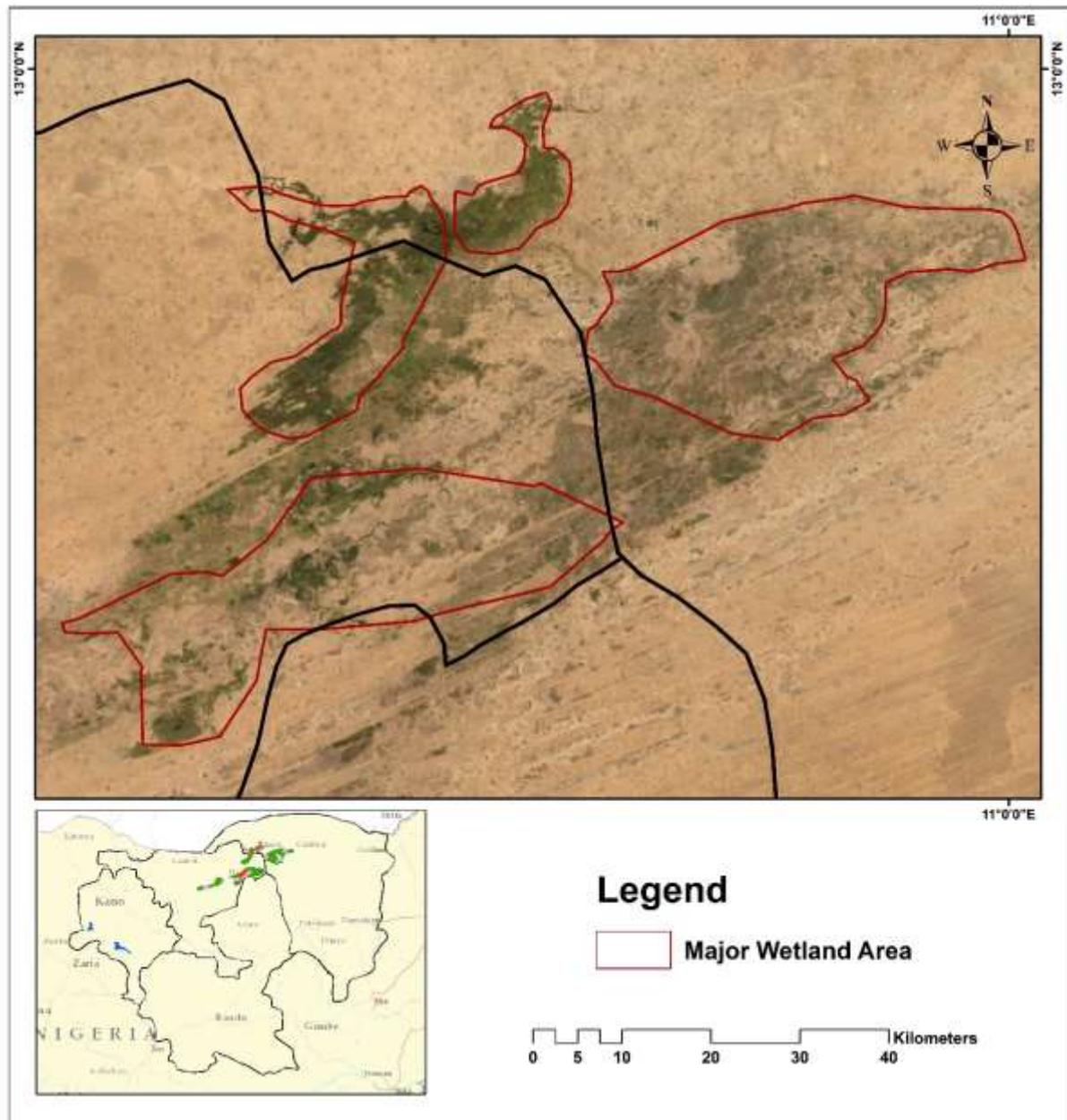| Study Site	Species Richness Index
Baturiya	2.308
Dagona	3.011
Nguru Barrack	2.611
Dabar Magini	2.683

Source: Field Survey, 2021

Figure 2: Vegetation Map of Hadejia-Nguru Wetlands (Source: Sabo, 2016)

We attribute the differences in species richness among wetlands to the environmental heterogeneity. At regional scale of analysis, different biomes would be represented with their own levels of species richness, therefore, the highest levels of species richness occur in highly heterogeneous biomes (Rahbek, 1997). Although, at a larger scale, landscape heterogeneity did not affect species richness of carnivore birds in North America (Carnicer & Dı́az-Delgado 2008).

Rahbek and Graves (2001) found it to be an important predictor of birds' species richness in South America. Environmental heterogeneity has been described as a determinant of species diversity of Neotropical raptor (Jullien & Thiollay 1996; Anderson 2001; Diniz-Filho *et al*., 2002). Since p value (0.000) is less than alpha value (0.05) level of significant, hence there is significant difference in species richness index between the study sites.

Table 3: Seasonal Species Richness Index in the four study sites.

Study Site	Species Richness Index	
	Dry Season	Wet Season
Baturiya	2.693	1.572
Dagona	2.805	1.801
Nguru Barrack	2.702	1.906
Dabar Magini	2.502	2.001

Source: Field Survey, 2021

Table 3 above shows seasonal species richness index in the four study sites. Dagona has the highest species richness index in the dry season (2.805), followed by Nguru barrack (2.702), Baturiya wetlands (2.693) and Dabar Magini has the lowest species richness index in the dry season (2.502).Whereas, Dabar Magini has the highest species richness in the wet season (2.001), followed in descending order by Nguru barrack (1.906), Dagona (1.801) and Baturiya wetlands (1.572).

Mundava *et al*., (2012) identified seasonal weather changes as a factor that influence the ecology of species, hence the birds of prey species abundance. This study at Hadejia-Nguru wetlands recorded higher number of raptors species in dry season (20 species) as compared to the wet season (17 species). However, in terms of abundance, wet season has higher number of relative abundance than the dry season.

Table 4: Species Richness Index during Dry and Wet Seasons

Season	Species Richness Index
Dry	3.066
Wet	2.284

Source: Field Survey, 2021

According to Mehra *et al*., (2017), bird species richness, distribution and abundances are directly or indirectly affected by seasonal variations and rate of anthropogenic activities. Anthropogenic activities such as over grazing and deforestation, which are the main causes of habitat loss, fragmentation, degradation, and climate change can ultimately cause migration and extinction of bird species that are present in that habitat (Gibbs *et al*., 2010).

Since p value (0.008) is less than alpha value (0.05) level of significant, hence there is significant difference in species richness index between dry and wet season

CONCLUSION

The species richness of birds of prey in Hadejia-Nguru wetlands shows there were 24 species of birds of prey belonging to two families during the study period. Out of the 24 species, 16 are resident, 5 Palearctic migrant and 3 intra-African migrant.

The highest number of birds of prey species was recorded in dry season, showing seasonal variation in species richness. Factors such as food availability and foraging ground are responsible. Habitat destruction via logging of trees especially in protected wetlands was the major threat to birds community in Hadejia-Nguru wetlands.

RECOMMENDATIONS

The HNWs harbor many birds of prey species, including globally threatened species. However, in order to maintain the bird community and other biodiversity of the HNWs, the management needs to increase conservation measures that will ensure the protection of the wetlands. This can be done through training and re-training of more forest guards to ensure protection of the wetlands. Public awareness should be raised to inform the local populace about the importance of these species to the environment vis-à-vis protecting the infrastructures used by the birds. More studies on birds of prey species diversity and abundance during migration period (winter season) are needed to provide a complete checklist on the wetlands birds of prey community including Palearctic, resident and the intra African migrant.

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