Assessment of raptor species relative abundance in Hadejia Nguru Wetlands, Nigeria

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Abstract

Birds of prey are some of the most threatened vertebrate taxa, and in the last three decades many species have experienced severe population declines or faced extinction. The global loss of raptors per se is worrying, not just because of their charisma and flagship role, but also because reduced abundance of raptors can have cascading effects on ecosystem functioning. Raptor decline may also lead to loss of ecosystem services, sometimes acutely impacting human well-being. Therefore, population distribution, diversity and abundance of birds of prey demand investigation for potential conservation interventions. The study aimed to determine the abundance of birds of prey in Hadejia-Nguru wetlands, 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. Transect line method was used for the bird survey. This involved moving slowly along the transect line and recording all birds seen in and around the transect line. The survey was carried out for a period of six (6) months 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 3pm to 6p.m. A pair of binoculars with magnification 7X50 was used for identification of birds visually alongside with field guide "Birds of West Africa" for identification of birds. Relative abundance and t-test were used for data analysis. The total number of birds was calculated as the number of birds seen. 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 and Falconidae with 4 species. 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. 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*). 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.

1.0 Introduction

Birds of prey, or raptors, include species of bird that primarily hunt and feed on vertebrates that are large relative to the hunter. Additionally, they have keen eyesight for detecting food at a distance or during flight, strong feet equipped with talons for grasping or killing prey, and powerful, curved beaks for tearing flesh. The term *raptor* is derived from the Latin word

rapio, meaning to seize or take by force. In addition to hunting live prey, most also eat carrion, at least occasionally, and vultures and condors eat carrion as their main food source (Britannica, 2022).

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, 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; 2007).

Globally, human-caused environmental impacts, such as habitat loss, have seriously impacted raptor species. Human activities are responsible for the catastrophic decline and extinction of thousands of animal and plant species throughout the world, and this loss is occurring at unprecedented rates (Ceballos *et al*., 2020). Raptors are some of the most threatened vertebrate taxa, and in the last three decades many species have experienced severe population declines or faced extinction (McClure, 2018; Buechley *et al.,* 2019). This threat is primarily the result of habitat loss and fragmentation, pollution, human–wildlife conflicts, and global climate alterations (Donázar *et al*., 2016).

Quantifying the species abundance of birds communities has gained increasing importance in environmental impact assessment especially in conservation planning and ecological research (Bibby *et al*., 2000). Species inventories not only help in understanding species losses but alsohelp determine the characteristics of species that are vulnerable to habitat perturbations (Koh *et al*., 2004).

Abundance of bird species is largely influenced by the spatiotemporal distribution of some key environmental resources (McCain, 2009). As a result, various studies elsewhere in the world attempted to study factors that affect bird abundance and distribution at spatial and temporal scales (Mengesha *et al.,* 2010). Seasonality plays a major role in determining the abundance and distribution of birds. Seasonality affects food and cover availability of bird population, which in turn affects breeding success and ultimately survival of the bird species (Mengesha *et al.,* 2010). The seasonal variation in the amount of rainfall and temperature and spatial and temporal microhabitat conditions are known to affect the availability of various food items for birds (Mengesha *et al.,* 2011). Based on species sensitivity to the type of habitat, these could alter the diversity, abundance, and distribution of birds in an area.

2.0 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 10° 33.00' East 12° 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 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 km^2, 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 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 (Birdlife international, 2006).

2.1 Birds Sampling

Line Transect method that proved to be most efficient in terms of data collection per unit effort was applied (Yallop *et al*., 2003). The 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 four locations within Hadejia-Nguru wetlands from March to August, 2021. The locations were Baturiya (12^{0}429478'E, 10^{0}049868'E), Dagona birds sanctuary (12^{0}819608'E, 10^{0}725485'N), Nguru Barrack (12^{0}875450'E, 10^{0}996691'N) and Dabar Magini (12^{0}855667'E, 10^{0}405581'N). The census to count raptors was conducted by observations along 5km transect line in each wetland using binocular 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 3am to 6pm 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.
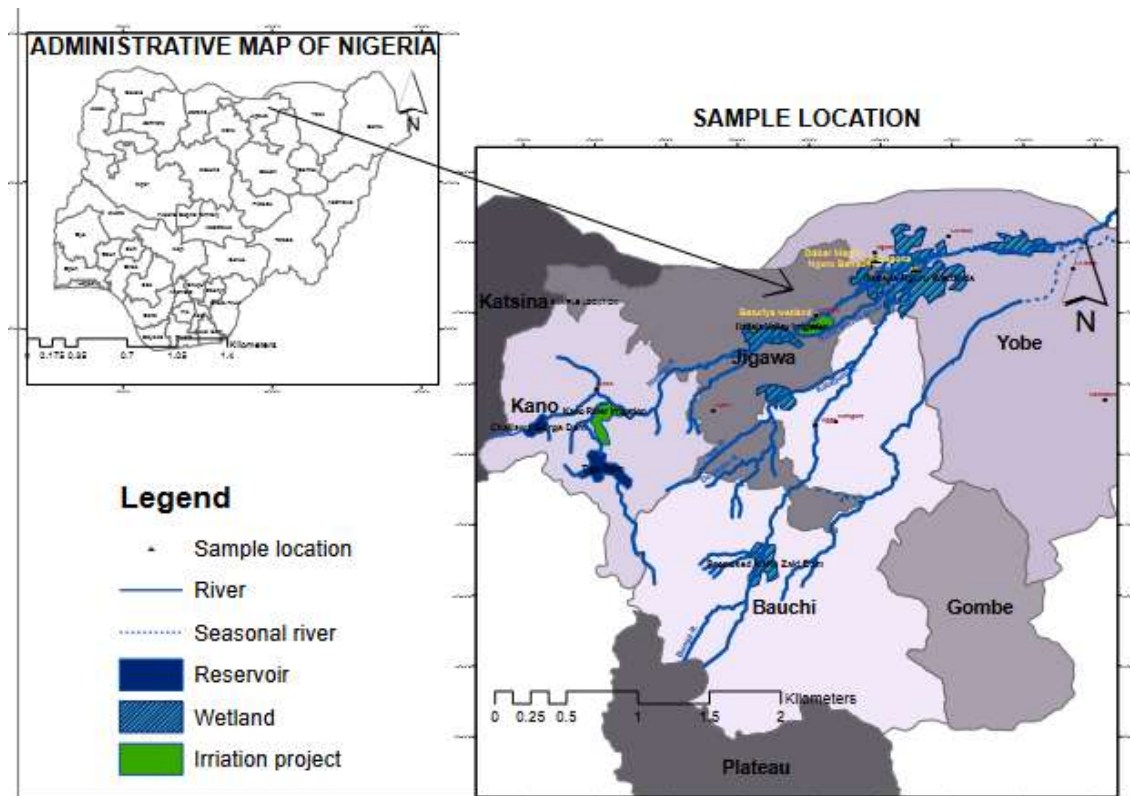

Figure 1: Study area map showing sample location

3.0 Results and discussions

The results presented 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 in Hadejia-Nguru wetlands, Nigeria.

3.1 Relative abundance of birds of prey in Baturiya Wetlands

In Baturiya wetlands, a total of 431 birds of prey species were observed, that is (27.6% of all detections) were recorded. The birds belong to 15 species and 2 families. Three species, yellow billed kite (*Milvus aegyptius*) (47.3%), black shouldered kite (*Elanus caeruleus*) (11.8%) and Gabar goshawk (*Micronisus gabar*) (9.5%) showed the highest relative abundance. The higher abundance of these birds in wetlands could be due to the composition of the main elements of their habitats (availability of food, water, breeding sites).The findings of this study is supported by Esther *et al*., (2018) who reported similar trends of yellow billed kite abundance in Akure, Nigeria. The high relative abundance of yellow billed kite, black shouldered kite and Gabar goshawk may not be unconnected with availability of food, water, breeding

sites which are supported by various authors. Khobe and Kwaga (2017) in their studies on birds' species of Jos Wildlife Park, Nigeria reported that the level of distribution of bird species in a habitat is normally as a result of an occurrence of plant species that support their population and to variation in species specification requirements in the choice of habitat. This finding is also in agreement with Kwaga *et al*. (2017) that the distribution of birds' species is largely dependent on the availability of food, water and cover. In contrast to my findings of higher relative abundance of birds of prey, Takele and Afework (2018) recorded Wattled Ibis (*B. carunculata*). Slender billed starling (*O. tenuirostris*), Alpine chat (*P. sordida*), Waller's starling *(Onychognathus walleri)*, and White collared pigeon *(Columba albitorques)* as the species with higher relative abundance in his studies on species composition, relative abundance and distribution of bird species in Choke Mountains, East Gojjam, Ethiopia. In similar vein, Demeke *et al*. (2019) in his studies on diversity and relative abundance of birds in Loka Abaya National Park, Sidama Zone, Southern Ethiopia, identified Hooded Vulture, Rüppell's Griffon and White backed Vulture as birds of prey with higher relative abundance.

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On the contrary, five birds of prey species, Martial eagle (*Polemaetus bellicosus*) (0.7%), black kite (*Milvus migrans*) (0.7%), red-necked falcon (*Falco chicquera*) (0.7%), Montagus harrier (*Circus pygargus*) (0.5%) and Western marsh harrier (*Circus aeruginosus*) (0.4%) showed the least relative abundance in the wetland reserve (Table 1). This connected to human activities that dramatically modified ecosystems. As a results birds of prey are affected through variety of mechanisms that results in negative effects on their fitness and survival and consequently on population size, distribution and abundance.

This finding is in agreement with Arjunamar and Daniel (2017) who reported large declines in the reporting rates of Martial Eagles, Montagus harrier

and red-necked falcon across South Africa. Declines in large raptors, including eagle species, have been recorded in other areas of Africa (Thiollay, 2006; Virani *et al.*, 2011). For Martial Eagles, Thiollay (2006) reported the complete disappearance of Martial Eagles in Burkina Faso, Mali and Niger outside of protected areas, over a 30-year period, and a 50% decline within protected areas. However, there has been very little comprehensive national analysis of abundance changes for any raptor species in Africa (Krüger *et al.*, 2014). The findings from the analysis by Thiollay (2006), together with other information at a more local scale from elsewhere in Africa, have resulted in the Martial Eagle being up listed to 'Vulnerable' (BirdLife International, 2018).

Table 1: Birds of prey diversity in Baturiya Wetland

Common Name	Scientific Name	No. of Individuals	Relative Abundance (%)
Gabar Goshawk	*Micronisus gabar*	41	9.513
Black Shouldered Kite	*Elanus caeruleus*	51	11.833
Black Kite	*Milvus migrans*	3	0.696
African Marsh Harrier	*Circus ranivorus*	29	6.729
Dark Chanting Goshawk	*Melierax metabates*	15	3.480
Pallid Harrier	*Circus macrourus*	7	1.624
African Swallow Tailed Kite	*Chelictinia riocourii*	38	8.817
Martial Eagle	*Polemaetus bellicosus*	4	0.928
Grey Kestrel	*Falco ardosiaceus*	9	2.088
Grasshopper Buzzard	*Butastur rufipennis*	14	3.248
Yellow Billed Kite	*Milvus aegyptius*	204	47.332
Ovambo Sparrow Hawk	*Accipiter ovampensis*	9	2.088
Montagus Harrier	*Circus pygargus*	2	0.464
Red-necked Falcon	*Falco chicquera*	3	0.696
Western Marsh Harrier	*Circus aeruginosus*	2	0.464
TOTAL		431	

3.2 Relative abundance of birds of prey in Dagona Wetlands

Dagona wetlands hold a total of 550 individual birds of prey (35.2% of all detections) during the study period. They belong to 20 species of two families. The results indicated that, yellow billed kite (*Milvus aegyptius)* (54.4%), black shouldered kite (*Elanus caeruleus*) (11.6%) and gabar goshawk (*Micronisus gabar*) (9.6%) were the dominant birds of prey in the wetlands. In contrast, western marsh harrier (*Circus aeruginosus*) (1%), African goshawk (*Accipiter tachiro)* (0.9%), Montagus harrier (*Circus pygargus*) (0.9%), Ovambo Sparrow hawk (*Accipiter ovampensis*) (0.4%), Tawny eagle (*Aquila rapax*) (0.4%) and Grey kestrel (*Falco ardosiaceus*) (0.4%) were the rarest raptor species recorded in the area (Table 2). The higher relative abundance of yellow billed kite in the study area is connected to its migration pattern. It leaves southern hemisphere

around March – April to northern hemisphere at the beginning of rainy season.

The large size of the wetland, as compared to the other sites, might contribute to the highest richness and abundance of bird species. As reported by Nabaneeta and Gupta (2010) in their study on avian community analysis in fragmented landscapes of Cachar District, Assam that, 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 Manasvini (2013) in their research on urban avifaunal diversity in southern Ridge of Delhi, 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

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by landscape, floral diversity, anthropogenic activities, as well as predation.

The findings of this study is in agreement with Rodriguez *et al.* (2015) who recorded 25 birds of prey species with grey kestrel and lanner falcon as rare species in eastern Guinea-Bissau, Nigeria.

Abundance of bird species is largely influenced by the distribution of some key environmental resources (McCain, 2009). As a result, various studies elsewhere in the world attempted to study factors that affect bird abundance and distribution at spatial and temporal scales (Peterson *et al.*, 2011). Seasonality plays a major role in determining the abundance and distribution of birds. Seasonality affects food and cover availability of bird population, which in turn affects breeding success and ultimately survival of the bird species (Fuller, 2010).

The seasonal variation in the amount of rainfall, temperature and temporal microhabitat conditions are known to affect the availability of various food items for birds (Peterson *et al.*, 2011). Based on species sensitivity to the type of habitat, these could alter the diversity, abundance, and distribution of birds in an area. Particularly, it has been revealed that processes acting in breeding and wintering grounds determine both the patterns of habitat occupancy and seasonal abundance in migratory bird species (Newman, 2000). Tropical and subtropical countries witness a certain type of seasonal migration of birds, which is not well known in the northern latitudes (Fuller, 2010).

A worrying sign is that only two eagle's species were observed in Dagona wetlands during the study. Eagles require much larger areas of pristine primary forest compared with most other species and there have been past concerns that many reserves and even national parks are simply too small to support and ensure the long-term survival of some eagle species. Dagona National Reserve is one of the largest protected areas in Northern Nigeria spanning over two thousand square kilometres, therefore is unlikely to be the case (Bodmer, *et al*, 2008).

Table 2: Birds of prey species in Dagona

Common Name	Scientific Name	No. of Individuals	Relative Abundance (%)
Pallid Harrier	*Circus macrourus*	7	1.273
Gabar Goshawk	*Micronisus gabar*	53	9.636
Black Shouldered Kite	*Elanus caeruleus*	64	11.636
Black Kite	*Milvus migrans*	3	0.545
Lizard Buzzard	*Kaupifalco monogrammicus*	9	1.636
African Marsh Harrier	*Circus ranivorus*	23	4.182
Dark Chanting Goshawk	*Melierax metabates*	18	3.273
Yellow Billed Kite	*Milvus aegyptius*	299	54.364
African Swallow Tailed Kite	*Chelictinia riocourii*	6	1.091
Tawny Eagle	*Aquila rapax*	2	0.364
Ovambo Sparrow Hawk	*Accipiter ovampensis*	2	0.364
Red-necked Falcon	*Falco chicquera*	6	1.091
Martial Eagle	*Polemaetus bellicosus*	8	1.455
Montagus Harrier	*Circus pygargus*	5	0.909
Fox Kestrel	*Falco alopex*	14	2.545
African Fish Eagle	*Haliaeetus vocifer*	8	1.455
African Goshawk	*Accipiter tachiro*	5	0.909
Grey Kestrel	*Falco ardosiaceus*	2	0.364
Grasshopper Buzzard	*Butastur rufipennis*	10	1.818
Western Marsh Harrier	*Circus aeruginosus*	6	1.091
TOTAL		550	

3.3 Relative abundance of birds of prey in Nguru Barrack Wetlands

A total of 313 raptor species observation (20% of all detections) were recorded in Nguru barrack area. The birds belong to 15 species and two families. Yellow billed kite (*Milvus aegyptius*) (26.2%), Gabar goshawk (*Micronisus gabar*) (18.2%) and Black shouldered kite (*Elanus caeruleus*) (16.9%) were the three most abundant birds of prey species in the Nguru barrack wetlands. Whereas, Walhbergs eagle (*Hieraaetus Wahlberg*) (0.9%), Tawny eagle (*Aquila rapax*) (0.9%), Red-necked falcon (*Falco chicquera*) (0.6%), Common kestrel (*Falco naumanni*) (0.3%) and Montagus harrier (*Circus pygargus*) (0.3%) were the least common in Nguru barrack area (Table 3).

3.4 Relative abundance of birds of prey in Dabar Magini Wetlands

In this wetlands, 268 individual birds of prey species (17.2% of all detections) that belongs to 16 species and two families were observed. Species of yellow billed kite (28.7%), Gabar goshawk (18.3%) and Black shouldered kite (14.9%) have the highest relative abundance in the area. While, Common kestrel (0.4%) seen once, Bat hawk (1.1%), Grey kestrel (1.1%), Martial eagle (1.5%), Red-necked falcon (1.5%) and Montagus harrier (1.5%) were the rarest in the area (Table 4).

Table 3: Birds of prey species diversity in Nguru Barrack Wetland

Common Name	Scientific Name	No. of Individuals	Relative Abundance (%)
Red-necked Falcon	*Falco chicquera*	2	0.639
Gabar Goshawk	*Micronisus gabar*	57	18.211
Common Kestrel	*Falco naumanni*	1	0.319
Yellow Billed Kite	*Milvus aegyptius*	82	26.198
Black Shouldered Kite	*Elanus caeruleus*	53	16.933
African Swallow Tailed Kite	*Chelictinia riocourii*	19	6.070
African Marsh Harrier	*Circus ranivorus*	19	6.070
Montagus Harrier	*Circus pygargus*	1	0.319
Wahlbergs Eagle	*Hieraaetus Wahlberg*	3	0.958
Tawny Eagle	*Aquila rapax*	3	0.958
Dark Chanting Goshawk	*Melierax metabates*	11	3.514
Lizard Buzzard	*Kaupifalco monogrammicus*	11	3.514
Bat Hawk	*Macheiramphus alcinus*	12	3.834
Red-necked Buzzard	*Buteo auguralis*	18	5.751
Fox Kestrel	*Falco alopex*	6	1.917
Grasshopper Buzzard	*Butastur rufipennis*	15	4.792
TOTAL		313	

Table 4: Birds of prey species diversity in Dabar Magin Wetland

Common Name	Scientific Name	No. of Individuals	Relative Abundance (%)
Black Shouldered Kite	*Elanus caeruleus*	40	14.925
Pallid Harrier	*Circus macrourus*	6	2.239
African Marsh Harrier	*Circus ranivorus*	14	5.224
Gabar Goshawk	*Micronisus gabar*	49	18.284
Common Kestrel	*Falco naumanni*	1	0.373
Grasshopper Buzzard	*Butastur rufipennis*	7	2.612
Yellow Billed Kite	*Milvus aegyptius*	77	28.731
African Swallow Tailed Kite	*Chelictinia riocourii*	16	5,970
Martial Eagle	*Polemaetus bellicosus*	4	1.493
Red-necked Falcon	*Falco chicquera*	4	1.493
Montagus Harrier	*Circus pygargus*	4	1.493
Dark Chanting Goshawk	*Melierax metabates*	20	7.463
African Goshawk	*Accipiter tachiro*	14	5.224
Bat Hawk	*Macheiramphus alcinus*	3	1.119
Grey Kestrel	*Falco ardosiaceus*	3	1.119
African Fish Eagle	*Haliaeetus vocifer*	6	2.239
TOTAL		268	

3.5 Relative abundance of birds of prey in Hadejia-Nguru Wetlands

In Hadejia-Nguru wetlands, a total of 1,562 individual raptors of 24 species belonging to 2 families were recorded. Three species, yellow billed kite (*Milvus aegyptius*) (42.4%), Black shouldered kite (*Elanus caeruleus*) (13.4%) and Gabar goshawk (*Micronisus gabar*) (12.8%) were the most dominant species in the wetlands. In contrast, Bat hawk (*Macheiramphus alcinus*) (0.9%), Montagus harrier (*Circus pygargus*) (0.8%), Grey kestrel (*Falco ardosiaceus*) (0.8%), Ovambo Sparrow hawk (*Accipiter ovampensis*) (0.6%), Western marsh harrier (*Circus aeruginosus*) (0.5%), Black kite (*Milvus migrans*) (0.4%), Red-necked buzzard (*Buteo auguralis*) (0.4%), Tawny eagle (*Aquila rapax*) (0.3%), Walhbergs eagle

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(*Hieraaetus Wahlberg*) (0.2%) and Common kestrel (*Falco naumanni*) (0.1%) were the rarest birds of prey species in the Hadejia-Nguru wetlands (Table 5). Yellow billed kite and black shouldered kite species were also found to be the most dominant species in other wetland habitats as reported by Zakaria *et al.,* (2009) in Peninsular (Malaysia), Odewumi *et al.,* (2017) in Ondo State (Nigeria), as well as Sunday and Olumide (2018) in Oyo State, Nigeria. The findings of this study is not in conformity with Chiatante and

Panuccio (2021) who recorded, 168 raptors of 10 species in Armenia with the Black kite been the most abundant species, followed by the Common Kestrel and the Western Marsh Harrier. Furthermore, the prevalence of these species is probably due to the availability of aquatic insects and other suspended macro-invertebrates that serve as the diet of many bird species.

Table 5: Birds of prey species in Hadejia Nguru Wetlands

Common Name	Scientific Name	No. of individuals	Relative Abundance (%)
Red-necked Falcon	*Falco chicquera*	17	1.088
Gabar Goshawk	*Micronisus gabar*	200	12.804
Common Kestrel	*Falco naumanni*	2	0.128
Yellow billed Kite	*Milvus aegyptius*	662	42.382
Black Shouldered Kite	*Elanus caeruleus*	208	13.316
African Swallow Tailed Kite	*Chelictinia riocourii*	79	5.058
African Marsh Harrier	*Circus ranivorus*	93	5.954
Montagus Harrier	*Circus pygargus*	13	0.832
Pallid Harrier	*Circus macrourus*	20	1.280
Grasshopper Buzzard	*Butastur rufipennis*	46	2.945
Wahlbergs Eagle	*Hieraaetus Wahlberg*	3	0.192
Tawny Eagle	*Aquila rapax*	5	0.320
Martial Eagle	*Polemaetus bellicosus*	16	1.024
Dark Chanting Goshawk	*Melierax metabates*	66	4.225
Lizard Buzzard	*Kaupifalco monogrammicus*	20	1.280
Bat Hawk	*Macheiramphus alcinus*	15	0.960
African Goshawk	*Accipiter tachiro*	19	1.216
Black Kite	*Milvus migrans*	6	0.384
Fox Kestrel	*Falco alopex*	14	0.896
Ovambo Sparrowhawk	*Accipiter ovampensis*	10	0.640
Grey Kestrel	*Falco ardosiaceus*	20	1.280
African Fish Eagle	*Haliaeetus vocifer*	16	1.023
Red-necked Buzzard	*Buteo auguralis*	6	0.384
Western Marsh Harrier	*Circus aeruginosus*	8	0.512
TOTAL		1,562	

3.6 Relative abundance of birds of prey in Hadejia-Nguru Wetlands during dry season

In the dry season of 2021 (March – May), 491 individual birds of prey (31.4% of all birds of prey detected) belonging to 20 species of two families were detected. The three most abundant species are the Black shouldered kite (*Elanus caeruleus*) (21.6%), Gabar goshawk (*Micronisus gabar*) (18.1%) and Yellow billed kite (*Milvus aegyptius*) (16.1%).

The eight rarest species during dry season are the, Black kite (*Milvus migrans*) (1.2%), Bat hawk (*Macheiramphus alcinus*) (1.2%), Tawny eagle (*Aquila rapax*) (1%), Ovambo sparrow hawk (*Accipiter ovampensis*) (1%), Walhbergs eagle (*Hieraaetus Wahlberg*) (0.6%), Grasshopper buzzard (*Butastur rufipennis*) (0.6%), Common kestrel (*Falco naumanni*) (0.4%) and Grey kestrel (*Falco ardosiaceus*) (0.2%) (Table 6). The low relative

abundance of eagles, falcons and hawks in the study area is in agreement with Thiollay (2006) who reported similar in his study of raptors in West Africa.

3.7 Relative abundance of birds of prey in Hadejia-Nguru Wetlands during wet season

During wet season, total birds of prey of 1,103 individuals (70.6% of all detections) that belong to 17 species of two families were recorded in the wetlands. Three species, yellow billed kite (*Milvus aegyptius*) (52.9%), Black shouldered kite (*Elanus caeruleus*) (11%) and Gabar goshawk (*Micronisus gabar*) (10%) have the highest relative abundance in the wetlands during wet season. While ten species, Fox kestrel (1.8%), African fish eagle (*Haliaeetus vocifer*) (1.5%), Lizard buzzard (*Kaupifalco monogrammicus*) (1.4%), Grey kestrel (*Falco ardosiaceus*) (1.2%), African goshawk (*Accipiter tachiro*) (0.9%), Bat hawk (*Macheiramphus alcinus*) (0.8%), Western marsh

harrier (*Circus aeruginosus*) (0.7%), Red-necked buzzard (*Buteo auguralis*) (0.5%) and Ovambo sparrow hawk (*Accipiter ovampensis*) (0.5%) have the least relative abundance in the wetland during wet season (Table 7).

Highest number of individual bird species (20) was observed during the dry season because of the scanty leave in the bush and most trees had wiltered their leaves, while the lower (17) was observed during the wet season, high observed individuals birds in dry season can be due to visibility, scanty vegetation and high rate of wilting coefficient in trees. Despite the fact that some species like Yellow-billed kite (*Milvus*

migrans parasitus) migrated before rainy season, higher species abundance (501) was observed in rainy season while lower abundance (296) was observed during the dry season. Higher abundance during the wet season can be due to presence of food, and breeding season.

The dominance of these species could be attributed to the presence of favorable habitats around Hadejia-Nguru wetlands. The availability of food makes some birds with a feeding guild of a highly abundant food to dominate the area (Welsh, 1987).

Table 6: Birds of prey species in Hadejia Nguru Wetlands during dry season

Common Name	Scientific Name	No. of individuals	Relative Abundance (%)
Red-necked Falcon	*Falco chicquera*	21	4.277
Gabar Goshawk	*Micronisus gabar*	89	18.126
Common Kestrel	*Falco naumanni*	2	0.407
Yellow Billed Kite	*Milvus aegyptius*	79	16.089
Black Shouldered Kite	*Elanus caeruleus*	106	21.589
African Swallow Tailed Kite	*Chelictinia riocourii*	52	10.591
African Marsh Harrier	*Circus ranivorus*	31	6.314
Montagus Harrier	*Circus pygargus*	13	2.648
Pallid Harrier	*Circus macrourus*	20	4.073
Grasshopper Buzzard	*Butastur rufipennis*	3	0.611
Wahlbergs Eagle	*Hieraaetus Wahlberg*	3	0.611
Tawny Eagle	*Aquila rapax*	5	1.018
Martial Eagle	*Polemaetus bellicosus*	16	3.259
Dark Chanting Goshawk	*Melierax metabates*	19	3.870
Lizard Buzzard	*Kaupifalco monogrammicus*	5	1.018
Bat Hawk	*Macheiramphus alcinus*	6	1.222
African Goshawk	*Accipiter tachiro*	9	1.833
Black Kite	*Milvus migrans*	6	1.222
Grey Kestrel	*Falco alopex*	1	0.204
Ovambo Sparrow	*Accipiter ovampensis*	5	1.018
TOTAL		491	

Table 7: Birds of prey species in Hadejia Nguru Wetlands during wet season

Common Species Name	Scientific Name	No. of individuals	Relative Abundance (%)
Gabar Goshawk	*Micronisus gabar*	111	10.063
Fox Kestrel	*Falco alopex*	20	1.813
Yellow Billed Kite	*Milvus aegyptius*	583	52.856
Lizard Buzzard	*Kaupifalco monogrammicus*	15	1.359
Grasshopper Buzzard	*Butastur rufipennis*	43	3.898
African Marsh Harrier	*Circus ranivorus*	62	5.621
Black Shouldered Kite	*Elanus caeruleus*	122	11.061
African Goshawk	*Accipiter tachiro*	10	0.907
Bat Hawk	*Macheiramphus alcinus*	9	0.816
Dark Chanting Goshawk	*Melierax metabates*	47	4.261
African Swallow Tailed Kite	*Chelictinia riocourii*	27	2.448
Red-necked Falcon	*Falco chicquera*	6	0.544
Grey Kestrel	*Falco ardosiaceus*	13	1.179
African Fish Eagle	*Haliaeetus vocifer*	16	1.451
Red-necked Buzzard	*Buteo auguralis*	6	0.544
Ovambo Sparrow	*Accipiter ovampensis*	5	0.453
Western Marsh Harrier	*Circus aeruginosus*	8	0.725
TOTAL		1,103	

Yellow billed kite has the highest abundance in all the wetlands and seasons because is one of the most common birds of prey on the African continent and arguably the most visible. It is common intra African breeding migrant. This species is an intra-African migrant, moving northward in Nigeria during the rainy season (Cresswell *et al*., 2009). The relative abundance of yellow billed kite during dry season is 16.089% whereas during wet season it stands a yellow billed kite (*Milvus aegyptius*) (52.9%). Our counts may therefore have been affected by this migration, as the beginning of our data collection starts during dry season and through the onset of the rains. The yellow-billed kite can be distinctly identified with an all yellow beak. It is an all brown bird often with a lighter grey-brown head. The all yellow beak is the bird's most telltale feature, and makes it easy to identify in the field. Yellow-billed kites can be found almost anywhere, and is sometimes more common to see outside of protected areas than within because there is less competition from other raptors. There is no threat to this species and is classified by IUCN as least concern.

This species is extremely opportunistic in its feeding habits, and the diet includes small vertebrates, insects (including winged termites), carrion, offal and dead or dying fish. These kites may pirate prey from other birds' species, feed on road kills and village dumps and attend bushfires and grassland fires, sometimes in large congregation. They spend much of their time in low searching, taking prey in flight or from the ground (Birdlife, 2018). We counted larger numbers of yellow billed kite at roosts than at foraging sites, a trend observed by other studies (Pomeroy, 1975; Ssemmanda and Pomeroy, 2010; Kibuule, 2016), and may be related to the fact that these birds congregate in large numbers to roost but feed in widely dispersed areas (Ssemmanda and Pomeroy, 2010).

4.0 Conclusions

This survey shows that, the Hadejia-Nguru wetlands still retained a considerable number of birds of prey species that normally occur in West Africa. Relative abundance of birds in the study area showed that most of the species were abundant with yellow billed kite, black shouldered kite and gabar goshawk having the highest relative abundance in almost all the study sites and seasons. Whereas, on the contrary, birds of prey species like, martial eagle, black kite, red-necked

falcon, montagus harrier, and western marsh harrier showed the least relative abundance in the wetlands.

5.0 Recommendations

The Hadeji Nguru Wetlands (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.

Declarations

Ethics approval and consent to participate
Not Applicable
Consent for publication
All authors have read and consented to the submission of the manuscript.
Availability of data and material
Not Applicable.
Competing interests
All authors declare no competing interests.
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