



Research Article

Population Distribution of Birds of Prey 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. Raptor decline may also lead to loss of ecosystem services, sometimes acutely impacting human well-being. Therefore, the population distribution of birds of prey demands an investigation for potential conservation interventions. The study, which was conducted between March and August of 2021, sought to map the distribution of birds of prey in Hadejia Nguru wetlands, Nigeria, to provide baseline data for their conservation. 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 the 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 or heard. The total number of birds was calculated as the number of birds seen plus the number of birds heard. The results showed 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. 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.

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INTRODUCTION

Birds in their diversity constitute part of the natural environment and play functional roles such as agents of pollination and seed dispersal, sources of the food chain and agents in breaking seed dormancy. Otieno (2009) reported that birds are highly specialized flying machines, and their ability to fly allows them to cover a wide range of areas in search of food and evades predators easily. Estimates of bird abundance are widely used in bird conservation. For example, they allow us to measure changes in population size (Gregory *et al.*, 2003) and assess whether isolated populations are workable (Frank *et al.*, 2005). Information on the population sizes of individual species can also be used to set priorities, allowing conservation efforts to be focused on those species in need of attention (Mijeje, 2009). Birds usually select foraging habitats based on the availability of their main prey items and understanding habitat preferences provides critical information for species conservation (Okosodo *et al.*, 2016).

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 are scavengers like vultures and condors that feed on carrion as their main food source.

The contemporary dramatic increase in human pressure, deforestation and a general decrease in tree cover, overgrazing and erosion, pesticide use, over-hunting and fishing, and sometimes direct persecution of predators, all impact negatively on the raptor population (Thiollay, 2006). For example, in the West

African region, an estimate of the mean abundance index of raptors between protected and unprotected areas has shown a 30 % decline in protected areas compared with a 67 % decline in unprotected areas (Thiollay, 2007b).

The population status and distribution of raptor species can be difficult to estimate because they are often dispersed and secretive species that nest in low densities (with large individual area needs), and their population can fluctuate cyclically with prey abundance (Kirk, 1998). This can make raptors studies challenging, and many species remain poorly known around the world (Watson, 1998). In recent decades, raptors have become gradually more protected, and several species have become 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 (Brambilla *et al.*, 2004). Their declining population 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 (Zilio *et al.*, 2013).

Studies indicate (BirdLife International (2005, 2015 & 2018)) that raptors are more imperilled than other 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 (Ceballos *et al.*, 2017). The global loss of raptors per se is worrying, not just because of their charisma and flagship role in the ecosystem (Sergio *et al.*, 2008), but also

because the reduced abundance of raptors can have cascading effects on ecosystem functioning through regime changes in the numbers and behaviour of their prey (Şekercioğlu, 2006). Raptor decline may also lead to loss of ecosystem services (Gaston *et al.*, 2018), sometimes acutely impacting human well-being. Therefore, population declines, range contractions, and extinctions of raptors demand an investigation into their causes and potential conservation interventions.

In Hadejia Nguru wetlands, birds have been intensively studied but the focus often was on water-related birds, Passeriformes and doves (Ringim *et al.*, 2017, Sulaiman *et al.*, 2014a, Sabo, 2016; Lameed, 2011). Hence, there have been no attempts to describe their population distribution and diversity in detail compared to those of raptor researchers around the world. This research aimed at filling this gap of knowledge by examining the raptor population distribution and diversity in Hadejia Nguru Wetlands.

The ecosystem is an important site for biodiversity, especially migratory water birds from the Palearctic regions. For example, at one time, the floodplain supports over 423,000 birds of 68 species, including significant numbers of Ferruginous Duck (*Aythya nyroca*), Spur-winged Goose (*Plectropterus gambensis*), Black-tailed Godwit (*Limosa limosa*), and Ruff (*Philomachus pugnax*) (Birdlife international, 2010). Other wildlife species found include species of gazelle (*Gazella sp.*), duiker (*Cephalophus sp.*), jackal (*Canis sp*) and hyena (*Crocuta crocuta*) (Ogunkoya and Dami, 2007). In total, there are about 378 bird species listed for the wetland, 103 fish species, 250 species of flowering plants and more than 136 species of aquatic flora and fauna (Oduntan *et al.*, 2010).

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 the sub-Saharan region, Nigeria. The Hadejia-Nguru Wetlands are extensive floodplains created by the Hadejia and Jama'are rivers to form the Komodugu-Yobe River which drains into Lake Chad. The HNWs lie on the southern edge of the Sahel savanna in northeastern Nigeria, the wetlands covered an area of about 350, 000 ha and an altitude of 152-305 m (Birdlife international, 2015). The ecosystem comprises permanent ponds and seasonally flooded pools connected by a network of channels. Three broad types of vegetation occur in HNWs. There is a scrub savanna, which consists of upland farmland areas and Acacia woodlands. The second includes the 'tudu' (raised areas) which are never inundated with tree species of *Acacia spp*, *Ziziphus spp.*, *Balanites aegyptiaca*, *Tamarindus indica* and *Adansonia digitata*, while common grasses include *Cenchrus biflorus*, *Andropogon spp.* and *Vetiveria nigriflora*. In addition, there are pockets of riparian forests and woodlands, known as 'kurmi' comprising species of *Khaya senegalensis*, *Mitragyna inermis* and *Diospyros mespiliformis*. In some parts, the 'kurmi' has been replaced with orchards of Mango *Mangifera indica* and Guava *Psidium guajava* (Ezealor, 2001). The third vegetation type consists of the seasonally flooded marshes in which the tree *acacia nilotica* is common while Dum palms (*Hyphaene thebaica*) grow

on small raised islands (Ezealor, 2001). Aquatic grasses include *Echinochloa* and *Oryza spp.* while in drier parts *Dactyloctenium aegyptium*, *Setaria*

spp. and *Cyperus spp.* occur and extensive vegetation of *Typha domingensis* along the shore of the wetland

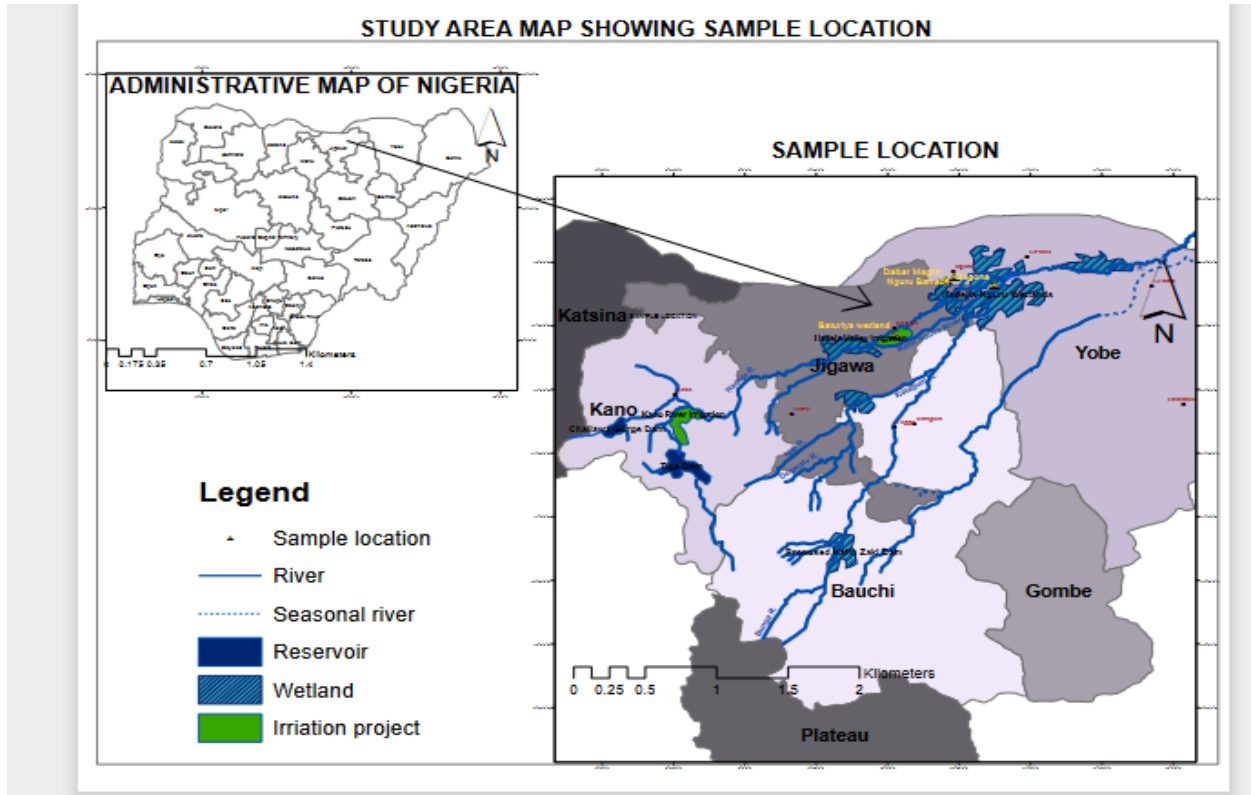


Figure 1: Map of study Area showing Sample Location

Birds Sampling

The 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 Baturiyya (12^o429478'E, 10^o049868'E), Dagona birds' sanctuary (12^o819608'E, 10^o725485'N), Nguru Barrack (12^o875450'E, 10^o996691'N) and Dabar Magini (12^o855667'E, 10^o405581'N). The census to count raptors was conducted by observations along a 5km transect line in each wetland using binoculars and a 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 raptors seen flying around and perching was recorded. The coordinates of each observation point were recorded. Surveys were carried out in the morning around 8 am to 10 am and in the evening (15h00–18h00) when the temperature was relatively cool and bird activities are high (Bibby *et al.*, 2000). Garmin 760CSx Global Positioning System (GPS) was used to collect the coordinates of the sampling locations

**RESULTS AND DISCUSSIONS
POPULATION DISTRIBUTION OF BIRDS OF PREY**

The results presented in table 1 below showed the outcome of the transect survey of birds of prey species population distribution in Hadejia-

Nguru wetlands from March to August 2021. The 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 conforms to the findings of Okosodo *et al.* (2016) who reported that Accipitridae was the richest family in studies conducted at South Western Nigeria. It is also in agreement with Kabir (2013) who conducted his research in Bangladesh and reported Accipitridae as the richest family. It is also in agreement with the previous report of 3 species of Falconidae reported by Lee (2013) in his study on the distribution and abundance of raptors in the Korean peninsula

The most abundant species, Yellow-billed kite, black-shouldered kite and gabar goshawk comprised 68.5% (Table 1) of all individuals seen in all wetlands in all seasons. This finding is similar to the study conducted by Odewumi, *et al.* (2020) who also reported black-shouldered kites as one of the abundant species in the Akure metropolis.

Out of the 24 species recorded 16 are residents, 5 Palearctic migrants and 3 intra-African migrants Table 2. Four species of global conservation concern were also recorded; the Vulnerable Tawny eagle (*Aquila rapax*) was recorded in both protected and unprotected areas during the 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 the dry season in both protected and unprotected areas of Hadejia Nguru Wetlands.

The findings of this study suggested more species of birds of prey. This is not in agreement with 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, as his studies were not on birds of prey species but general bird species diversity. Ringim *et al.* (2017) also recorded 8 birds of prey species in their studies on species diversity of migrant birds between protected and unprotected areas of the Hadejia-Nguru wetlands, as his research is also on the general bird species diversity not birds of prey. Odewumi *et al.* (2020) identified 11 birds of prey species in similar research in the Akure metropolis, Ondo State. Lee (2013) recorded 16 species of birds of prey of 2 families in the Korean Peninsula, which disagrees 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 the spatial ecology of raptors in an urban wetland.

Table 1: Birds of Prey Species in Hadejia Nguru Wetlands

S/No.	English Name	Scientific Name	Family	Rel. Abundance (%)
1.	Red-necked Falcon	<i>Falco chicquera</i>	Falconidae	1.088
2.	Gabar Goshawk	<i>Micronisus gabar</i>	Accipitridae	12.804
3.	Common Kestrel	<i>Falco naumanni</i>	Falconidae	0.128
4.	Yellow billed Kite	<i>Milvus aegyptius</i>	Accipitridae	42.382
5.	Black Shouldered Kite	<i>Elanus caeruleus</i>	Accipitridae	13.316
6.	African Swallow-Tailed Kite	<i>Chelictinia riocourii</i>	Accipitridae	5.058
7.	African Marsh Harrier	<i>Circus ranivorus</i>	Accipitridae	5.954
8.	Montagus Harrier	<i>Circus pygargus</i>	Accipitridae	0.832
9.	Pallid Harrier	<i>Circus macrourus</i>	Accipitridae	1.280
10.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	Accipitridae	2.945
11.	Wahlbergs Eagle	<i>Hieraaetus Wahlberg</i>	Accipitridae	0.192
12.	Tawny Eagle	<i>Aquila rapax</i>	Accipitridae	0.320
13.	Martial Eagle	<i>Polemaetus bellicosus</i>	Accipitridae	1.024
14.	Dark Chanting Goshawk	<i>Melierax metabates</i>	Accipitridae	4.225
15.	Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	Accipitridae	1.280
16.	Bat Hawk	<i>Macheiramphus alcinus</i>	Accipitridae	0.960
17.	African Goshawk	<i>Accipiter tachiro</i>	Accipitridae	1.216
18.	Black Kite	<i>Milvus migrans</i>	Accipitridae	0.384
19.	Fox Kestrel	<i>Falco alopex</i>	Falconidae	0.896
20.	Ovambo Sparrowhawk	<i>Accipiter ovampensis</i>	Accipitridae	0.640
21.	Grey Kestrel	<i>Falco ardosiaceus</i>	Falconidae	1.280
22.	African Fish Eagle	<i>Haliaeetus vocifer</i>	Accipitridae	1.023
23.	Red-necked Buzzard	<i>Buteo auguralis</i>	Accipitridae	0.384
24.	Western Marsh Harrier	<i>Circus aeruginosus</i>	Accipitridae	0.512

Source: Field Survey, 2021

Moreover, the findings of this research disagree with Grzegorz (2018) who recorded only 5 birds of prey in the city of Wroclaw in Europe from 2002 to 2010 with the common kestrel and common buzzard as the commonest species, while gabar goshawk, Eurasian sparrowhawk as the rarest species. It is also not similar to Zillo *et al.* (2013) who recorded a total of 1,890 individuals of birds of prey of 18 species in Southern Brazil, Onoja *et al.*, (2014) recorded 886 individuals of 37 species in the 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 Southwestern Nigeria with the 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.

The present results agree 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 Buij & Barbara (2013) recorded 36

birds of prey belonging to 2 families in the lake Chad basin with the black kite as the most abundant species, which in conformity with the findings of Renzo (2013) who recorded 19 birds of prey species in northwestern Peru and Jensen *et al.* (2005) recorded 28 species of birds of prey in Llanos wetlands, Venezuela.

Table 2: Migratory and Conservation Status of birds of prey species

S/No.	Common Name	Conservation Status	Migratory Status
1.	Red-necked Falcon	NT	R
2.	Gabar Goshawk	LC	R
3.	Common Kestrel	LC	PM
4.	Yellow billed Kite	LC	IAM
5.	Black Shouldered Kite	LC	R
6.	African Swallow-Tailed Kite	LC	IAM
7.	African Marsh Harrier	LC	R
8.	Montagus Harrier	LC	PM
9.	Pallid Harrier	NT	PM
10.	Grasshopper Buzzard	LC	IAM
11.	Wahlbergs Eagle	LC	R
12.	Tawny Eagle	VU	R
13.	Martial Eagle	EN	R
14.	Dark Chanting Goshawk	LC	R
15.	Lizard Buzzard	LC	R
16.	Bat Hawk	LC	R
17.	African Goshawk	LC	R
18.	Black Kite	LC	PM
19.	Fox Kestrel	LC	R
20.	Ovambo Sparrow Hawk	LC	R
21.	Grey Kestrel	LC	R
22.	African Fish Eagle	LC	R
23.	Red-necked Buzzard	LC	R
24.	Western Marsh Harrier	LC	PM

Source: Field Survey, 2021

Key: LC – Least Concern, VU – Vulnerable, EN – Endangered, NT – Near Threatened, R- Resident, PM – Palearctic Migrant, IAM – Intra African Migrant

A total of twenty -four different birds of prey species were identified in the study area with varying degrees of conservation status. Among the categories, *Red-necked Falcon (NT)* *Pallid Harries (NT)*, *Tawny Eagle and Martial Eagle (EN)* were the most affected by human activities in the area. There are several factors which may likely be responsible for their

decline which include: Habitat loss, poaching and illegal trade (Buij *et al.*, 2015). These pressures may be enough to increase extinction risk significantly, especially in the case of species that are already vulnerable. Habitat loss is by far one of the major factors responsible for the decline of these birds of prey species, caused by deforestation, over-grazing and

overfishing. However, poaching and the illegal trade of birds or parts of birds of prey contributed immensely to their decline. One of the main cause's declines in the population of Africa's largest and most recognizable birds of prey is the use of their body parts in traditional medicine which agrees with (Buij *et al.*, 2015). Threatened species that are particularly targeted by traditional medicine dealers in the study area are (e.g., *black kite*, *Red-necked Falcon*, *Pallid Harries*, *Tawny Eagle* and *Martial Eagle*). These birds' species will experience more significant declines in population numbers as selective hunting persists.

Population Distribution of Birds of Prey in Baturiya Wetlands

Table 3 shows the number of birds of prey species recorded in the Baturiya wetland during the study. Baturiya Wetland is a protected area. A good example of a natural wetland of the Sudano-Sahelian biogeographical region comprises ponds and seasonally flooded land that is replenished by the annual flooding of the Kafin Hausa River. It supports a great diversity of flora and fauna and is particularly important for its water birds. A wide range of resident and migratory water birds depend on this wetland - the Yellow-billed stork, Knob-billed goose, African Grey Hornbill, etc.

Table 3: Diversity of Birds of prey population in Dry and Rainy season in Baturiya Wetland protected Area

S/No.	Common Name	Scientific Name	No. of Individuals
1.	Gabar Goshawk	<i>Micronisus gabar</i>	41
2.	Black Shouldered Kite	<i>Elanus caeruleus</i>	51
3.	Black Kite	<i>Milvus migrans</i>	3
4.	African Marsh Harrier	<i>Circus ranivorus</i>	29
5.	Dark Chanting Goshawk	<i>Melierax metabates</i>	15
6.	Pallid Harrier	<i>Circus macrourus</i>	7
7.	African Swallow-Tailed Kite	<i>Chelictinia riocourii</i>	38
8.	Martial Eagle	<i>Polemaetus bellicosus</i>	4
9.	Grey Kestrel	<i>Falco ardosiaceus</i>	9
10.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	14
11.	Yellow Billed Kite	<i>Milvus aegyptius</i>	204
12.	Ovambo Sparrow Hawk	<i>Accipiter ovampensis</i>	9
13.	Montagus Harrier	<i>Circus pygargus</i>	2
14.	Red-necked Falcon	<i>Falco chicquera</i>	3
15.	Western Marsh Harrier	<i>Circus aeruginosus</i>	2
	TOTAL		431

Source: Field Survey, 2021

In this protected wetland, a total of 431 individual birds of prey that belong to 15 species of two families were recorded both during the dry and wet seasons (Table 3). During the dry season, 14 birds of prey species of 125 individuals were detected, whereas in the wet season 306 individuals of 10 species were recorded. Hence, the number of species is higher in the dry season, whereas species abundance is higher in the wet season.

Avian species are known to select different habitats because of seasonal changes throughout the year or their annual cycle (Brandt & Cresswell, 2008; Santangeli & Cardillo, 2012). In tropical regions, non-passerine species are observed selecting different habitats during the dry and rainy seasons (Brandt & Cresswell, 2008). Often, non-passerine species select habitats with a larger home range during the dry season as

opposed to the rainy season (Brandt & Cresswell, 2008), because there are fewer available food and water resources during the dry season (Brandt & Cresswell, 2008). Similar patterns of habitat selection were observed during non-passerine species' non-breeding (dry) and breeding (wet) seasons (Santangeli & Cardillo, 2012). It is important to understand how seasonal changes such as dry and wet seasons influence non-passerine habitat use and selection to understand how ambient environmental factors affect avian species distribution and abundance. Of the 15 species, 8 are Resident, 3 intra-African migrants and 4 Palearctic migrants. This study recorded a higher number of birds of prey species than the previous research (Adeiza and Hadiza, 2020). Adeiza *et al.* (2020) recorded 7 species of birds of prey in the same location and at the same time (March-August), with a focus on birds on general bird species diversity in the area. This variation could be attributed to the focus of the

study, the method of data collection and the area coverage within the wetland.

Dagona wildlife sanctuary is located within the Bade-Nguru wetland sector. Dagona Waterfowl Sanctuary is significant by the internationally assisted conservation effort to protect the Palearctic migrant birds. It is open Sudan/scrub Sahelian vegetation, though a small part of the wetland is covered with water all year-round yielding support for water birds and other wildlife found in that area

Population Distribution of Birds of Prey in Dagona Wetlands

In the Dagona wetland which is also a protected area, 550 individuals of birds of prey of 20 different species were recorded (Table 4) during the wet and dry seasons. In the dry season, 103 birds of prey belonging to 14 species were observed, while in the wet season 447 birds of prey of 12 species were recorded.

Table 4: Birds of prey Species in Dagona (both dry and wet seasons)

S/No.	Common Name	Scientific Name	No. of Individuals
1.	Pallid Harrier	<i>Circus macrourus</i>	7
2.	Gabar Goshawk	<i>Micronisus gabar</i>	53
3.	Black Shouldered Kite	<i>Elanus caeruleus</i>	64
4.	Black Kite	<i>Milvus migrans</i>	3
5.	Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	9
6.	African Marsh Harrier	<i>Circus ranivorus</i>	23
7.	Dark Chanting Goshawk	<i>Melierax metabates</i>	18
8.	Yellow Billed Kite	<i>Milvus aegyptius</i>	299
9.	African Swallow Tailed Kite	<i>Chelictinia riocourii</i>	6
10.	Tawny Eagle	<i>Aquila rapax</i>	2
11.	Ovambo Sparrow Hawk	<i>Accipiter ovampensis</i>	2
12.	Red-necked Falcon	<i>Falco chicquera</i>	6
13.	Martial Eagle	<i>Polemaetus bellicosus</i>	8
14.	Montagus Harrier	<i>Circus pygargus</i>	5
15.	Fox Kestrel	<i>Falco alopex</i>	14
16.	African Fish Eagle	<i>Haliaeetus vocifer</i>	8
17.	African Goshawk	<i>Accipiter tachiro</i>	5
18.	Grey Kestrel	<i>Falco ardosiaceus</i>	2
19.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	10
20.	Western Marsh Harrier	<i>Circus aeruginosus</i>	6
TOTAL			550

Source: Field Survey, 2021

This research recorded a higher number of birds of prey than Lameed (2011) and Ringim *et*

al. (2017). Lameed (2011) recorded (9) birds of prey species in his research on Species diversity

and abundance of wild birds in Dagona-Waterfowl Sanctuary, on general bird species diversity. Ringim *et al.* (2017) also recorded 8 birds of prey species in their studies on species diversity of migrant birds between protected and unprotected areas of the Hadejia-Nguru wetlands, on the general bird's species diversity not birds of prey. Out of the 20 birds of prey species recorded in this area, 13 are residents, 4 are Palearctic visitors and 3 intra-African migrants (Borrow & Demey, 2014). Also, 2 species are near threatened (Pallid Harrier and Red-necked Falcon), 1 vulnerable (Tawny Eagle), 1 endangered (Martial Eagle) and 13 least concern (IUCN Red List, 2016), all these were recorded in the dry season.

Population Distribution of Birds of Prey in Nguru Barrack Wetlands

In the Nguru barrack/Gashua wetland, 16 birds of prey species of 313 individuals were recorded (Table 5). Only two (2) species are of

global conservation concern (The red-necked falcon which is classified by IUCN as near threatened and the Tawny eagle as vulnerable specie), the remaining 14 species were classified as least concern. Fourteen (14) species of 125 individuals were recorded in the dry season, while in the wet season 190 birds of prey population of eleven (11) species were detected. The two (2) Palearctic visitors seen in the Nguru barrack wetland were recorded during the dry season, (2) out of 3 intra-African migrants were recorded in both the dry and wet season and 1 intra-African migrant was recorded in the wet season only. Out of the 16 species detected in the wetland, nine (9) species were recorded in both dry and rainy seasons, and five (5) species (Red-necked falcon, Common Kestrel, Montagu's Harrier, Wahlberg's eagle and Tawny eagle) were seen only in the dry season, while two (2) species (Fox kestrel and Grasshopper buzzard) were recorded only during the wet season.

Table 5: Birds of prey Species diversity in Nguru Barrack Wetland (both dry and wet Seasons)

S/No.	Common Name	Scientific Name	No. of Individuals
1.	Red-necked Falcon	<i>Falco chicquera</i>	2
2.	Gabar Goshawk	<i>Micronisus gabar</i>	57
3.	Common Kestrel	<i>Falco naumanni</i>	1
4.	Yellow Billed Kite	<i>Milvus aegyptius</i>	82
5.	Black Shouldered Kite	<i>Elanus caeruleus</i>	53
6.	African Swallow Tailed Kite	<i>Chelictinia riocourii</i>	19
7.	African Marsh Harrier	<i>Circus ranivorus</i>	19
8.	Montagus Harrier	<i>Circus pygargus</i>	1
9.	Wahlbergs Eagle	<i>Hieraaetus Wahlberg</i>	3
10.	Tawny Eagle	<i>Aquila rapax</i>	3
11.	Dark Chanting Goshawk	<i>Melierax metabates</i>	11
12.	Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	11
13.	Bat Hawk	<i>Macheiramphus alcinus</i>	12
14.	Red-necked Buzzard	<i>Buteo auguralis</i>	18
15.	Fox Kestrel	<i>Falco alopex</i>	6
16.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	15
	TOTAL		313

Source: Field Survey, 2021

Population Distribution of Birds of Prey in Dabar Magini Wetlands

In the Dabar Magini/Margadu wetland, 16 birds of prey species of 268 individuals were recorded (Table 6). Out of the 16 species observed, 3 are of global conservation concern (The Threatened Pallid Harrier, Red-necked falcon and the Endangered Martial eagle). The remaining 13 species were classified as least concern by IUNC Red List (2016).

During the dry season, 13 species of 121 individuals were detected while in the wet season 11 species of 148 individuals were

observed. Three Palearctic migrants were recorded during the dry season (Pallid harrier, Common kestrel and Montagus harrier). Also, 3 Intra-African migrants were seen in both dry and wet seasons. Of the 16 species recorded in Dabar Magini/Margadu wetlands, 7 were seen in both dry and wet seasons, 5 species in the dry season only (Pallid harrier, Common kestrel, Martial eagle, Montagu's harrier and Red-necked falcon) and 3 species recorded in wet season only (African Fish eagle, Grey kestrel and bat hawk).

Table 6: Birds of prey Species Diversity in Dabar Magini Wetland (both dry and wet seasons)

S/No.	Common Name	Scientific Name	No. of Individuals
1.	Black Shouldered Kite	<i>Elanus caeruleus</i>	40
2.	Pallid Harrier	<i>Circus macrourus</i>	6
3.	African Marsh Harrier	<i>Circus ranivorus</i>	14
4.	Gabar Goshawk	<i>Micronisus gabar</i>	49
5.	Common Kestrel	<i>Falco naumanni</i>	1
6.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	7
7.	Yellow Billed Kite	<i>Milvus aegyptius</i>	77
8.	African Swallow Tailed Kite	<i>Chelictinia riocourii</i>	16
9.	Martial Eagle	<i>Polemaetus bellicosus</i>	4
10.	Red-necked Falcon	<i>Falco chicquera</i>	4
11.	Montagus Harrier	<i>Circus pygargus</i>	4
12.	Dark Chanting Goshawk	<i>Melierax metabates</i>	20
13.	African Goshawk	<i>Accipiter tachiro</i>	14
14.	Bat Hawk	<i>Macheiramphus alcinus</i>	3
15.	Grey Kestrel	<i>Falco ardosiaceus</i>	3
16.	African Fish Eagle	<i>Haliaeetus vocifer</i>	6
	TOTAL		268

Source: Field Survey, 2021

The results of the survey revealed that unprotected areas (Nguru/Barrack and Dabar Magini Wetlands) have the highest number of birds of prey species (21 species) (Table 7) as compared to protected areas (Baturiya and Dagona Wetlands) with 20 species of birds of prey species (Table 8). The differences in the number of birds of prey species in the area may

be due to the changes in land use and forest heterogeneity which brings about variation in the availability of food, predation and risk which is supported by Margnall & Crowe (2013) which stated that the distribution of bird species is largely on the availability of food, water and cover.

Table 7: Birds of Prey Species in Unprotected Area (UPAs)

S/No.	Common Name	Scientific Name	No. of Individuals
1.	Red-necked Falcon	<i>Falco chicquera</i>	18
2.	Gabar Goshawk	<i>Micronisus gabar</i>	108
3.	Common Kestrel	<i>Falco naumanni</i>	2
4.	Yellow Billed Kite	<i>Milvus aegyptius</i>	159
5.	Black Shouldered Kite	<i>Elanus caeruleus</i>	93
6.	African Swallow Tailed Kite	<i>Chelictinia riocourii</i>	35
7.	African Marsh Harrier	<i>Circus ranivorus</i>	33
8.	Montagus Harrier	<i>Circus pygargus</i>	6
9.	Pallid Harrier	<i>Circus macrourus</i>	6
10.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	22
11.	Wahlbergs Eagle	<i>Hieraaetus Wahlberg</i>	3
12.	Tawny Eagle	<i>Aquila rapax</i>	3
13.	Martial Eagle	<i>Polemaetus bellicosus</i>	4
14.	Dark Chanting Goshawk	<i>Melierax metabates</i>	31
15.	Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	11
16.	Bat Hawk	<i>Macheiramphus alcinus</i>	15
17.	African Goshawk	<i>Accipiter tachiro</i>	14
18.	Fox Kestrel	<i>Falco alopex</i>	6
19.	Grey Kestrel	<i>Falco ardosiaceus</i>	3
20.	African Fish Eagle	<i>Haliaeetus vocifer</i>	6
21.	Red-necked Buzzard	<i>Buteo auguralis</i>	6
	TOTAL		584

Source: Field Survey, 2021

The unprotected wetlands are being utilized for rice and vegetable cultivation which attract insects, rodents and smaller birds (Red-billed quelea birds), which can serve as a source of food for the smaller and medium size birds of prey. Most birds of prey species frequent open wetlands, and they forage mainly on the ground for insects, millipedes, centipedes, spiders, snails, earthworms and seeds.

The study is supported by the findings of Mzendah *et al.* (2015), in Southern Gonarezhou National Park which determine the bird species diversity across a gradient of land use revealed that species diversity was higher in Manjinji Pan (unprotected area) than either the degraded Manyanda Pan or cultivated lands. This may be due to land use types like agriculture and woodland status in three different study areas. However, these findings are not in agreement with a study done by

Child *et al.* (2009), who reported that protected area landscapes were serving as important reservoirs of functionally important populations while agricultural landscapes, (unprotected) facilitate the presence of species that link aquatic and terrestrial systems.

The results from the study revealed that insectivorous birds had a higher number in unprotected wetlands than in protected wetlands. The unprotected area supported different species of insects that feed on nectar and other parts of the plants. This contributed to a higher number of insectivorous birds in the habitat. The reasons for observing more insectivorous birds in the unprotected wetland habitat were probably because some bird species favour disturbed sites. The results supported the prior expectation of another researcher who investigated those insectivorous birds showed a decline in species

richness from protected to unprotected wetland habitats (Walter *et al.*, 2005). The result from this study did not support the observation by Sydeman *et al.* (2001) who observed that agricultural practices in Europe have affected farmland bird populations negatively, both during summer and winter. Therefore, according to this study, one can conclude that insectivores favour cultivated or unprotected areas (Kissling *et al.*, 2012) and may be attributed to food availability from crops and insects.

Similarly, the findings of this research are not in agreement with a study done by Herremans, (1998) in Botswana who reported that birds of prey were more frequently reported from protected than unprotected land. However, the results did not support the observation by Child *et al.* (2009) who observed that raptors and scavengers display the most consisted losses in unprotected areas while nutrient dispersers and grazers tend to increase in protected areas.

Table 8: Birds of Prey Species in Protected area (PAs)

S/No.	Common Name	Scientific Name	No. of Individual
1.	Pallid Harrier	<i>Circus macrourus</i>	14
2.	Gabar Goshawk	<i>Micronisus gabar</i>	94
3.	Black Shouldered Kite	<i>Elanus caeruleus</i>	115
4.	Black Kite	<i>Milvus migrans</i>	6
5.	Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	9
6.	African Marsh Harrier	<i>Circus ranivorus</i>	52
7.	Dark Chanting Goshawk	<i>Melierax metabates</i>	35
8.	Yellow Billed Kite	<i>Milvus aegyptius</i>	503
9.	African Swallow-Tailed Kite	<i>Chelictinia riocourii</i>	44
10.	Martial Eagle	<i>Polemaetus bellicosus</i>	12
11.	Grey Kestrel	<i>Falco ardosiaceus</i>	11
12.	Grasshopper Buzzard	<i>Butastur rufipennis</i>	24
13.	Montagu Harrier	<i>Circus pygargus</i>	7
14.	Red-necked Falcon	<i>Falco chicquera</i>	9
15.	Tawny Eagle	<i>Aquila rapax</i>	2
16.	Ovambo Sparrow Hawk	<i>Accipiter ovampensis</i>	10
17.	Fox Kestrel	<i>Falco alopex</i>	14
18.	African Fish Eagle	<i>Haliaeetus vocifer</i>	10
19.	African Goshawk	<i>Accipiter tachiro</i>	5
20.	Western Marsh Harrier	<i>Circus aeruginosus</i>	8
	TOTAL		984

Source: Field Survey, 2021

Occurrence of birds of prey like a Black kite (*Milvus migrans*), Ovambo sparrow hawk (*Accipiter ovampensis*) and Western marsh harrier (*Circus aeruginosus*) was seen in protected areas. Among the 24 species of birds of prey, the Pallid harrier (*Circus macrourus*), Gabar goshawk (*Micronisus gabar*), Black-shouldered kite (*Elanus caeruleus*), Yellow-billed kite (*Milvus aegyptius*), Lizard buzzard

(*Kaupifalco monogrammicus*), African swallow-tailed kite (*Chelictinia riocourii*), Martial eagle (*Polemaetus bellicosus*), African marsh harrier (*Circus ranivorus*), Grey kestrel (*Falco ardosiaceus*), Grasshopper buzzard (*Butastur rufipennis*), Montagu's harrier (*Circus pygargus*), Red-necked falcon (*Falco chicquera*), Tawny eagle (*Aquila rapax*), Fox kestrel (*Falco alopex*), African fish eagle

(*Haliaeetus vocifer*), African goshawk (*Accipiter tachiro*) and Dark chanting goshawk (*Melierax metabates*) were common in all PAs and UPAs. Birds of prey like the Common kestrel (*Falco naumann*), Wahlbergs eagle (*Hieraaetus Wahlberg*), Bat hawk (*Macheiramphus alcinus*) and Red-necked buzzard (*Buteo auguralis*) are seen only in unprotected areas.

The findings of this research are supported by Thiollay (2007a) who stated that most large birds of prey species were generally found only in protected areas. Conversely, the abundance of most of the smaller species was not different between protected and cultivated areas, and three species were more abundant in cultivated areas.

Black kite is only seen in protected wetlands (Dagona) during the survey, this shows that the bird occurs in the area in low numbers. However, this species has declined to the extent, of not being seen outside protected areas. The species recorded are mostly medium size raptors (Black kite, Fox kestrel, Grasshopper buzzard and Dark chanting Goshawk).

Among the larger birds of prey recorded in the unprotected areas were the martial eagle, tawny eagle and Wahlberg's eagle (seen once). Larger birds of prey species may not find the unprotected areas conducive because of inadequate food supply and nest sites due to the degraded nature of the habitat. The largest bird of prey species encountered in the unprotected area was the Red-necked buzzard. Most of the raptor's species in unprotected areas were medium size species that can survive on small prey like insects, scorpions and rodents.

CONCLUSION

This survey shows that the Hadejia-Nguru wetlands still retained a considerable number of birds of prey species and raptors that normally occur in West Africa. 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 comprising of the dry and rainy seasons, out of the 24 species, 16 are resident, 5 Palearctic migrants and 3 intra-African migrants. The highest number of birds of prey species was recorded in the 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 the bird community in the Hadejia-Nguru wetlands.

RECOMMENDATIONS

The HNWs harbour many birds of prey species, including globally threatened species. However, to maintain the bird community and another biodiversity of the HNWs, the management needs to increase conservation measures that will ensure enforcement and the protection of the rich diversity of wetlands. This can be done through training and re-training of more forest guards to ensure the protection of the wetlands. Public awareness by informing the local populace about the importance of these species to the environment vis-à-vis protecting the infrastructures used by the birds should be conducted periodically.

More studies on birds of prey species diversity and abundance during the 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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