A COMPARATIVE STUDY OF SPECIES DIVERSITY OF MIGRANT BIRDS BETWEEN PROTECTED AND UNPROTECTED AREAS OF THE HADEJIA-NGURU WETLANDS, NIGERIA

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ABSTRACT

Among the most complex and fascinating behaviour in birds is their long, non-stop migration. Despite Hadejia-Nguru Wetlands (Ramsar site) being an important wintering ground for migratory birds, little is known about the diversity while density is completely lacking. This study assessed the status of migratory birds in the wetland's Protected Areas (PAs) and Unprotected Areas (UPAs). A total of 99 census points spaced 400 m apart with radius of 100 m were surveyed from 14 wetlands (48 point count stations in the PAs and 51 in the UPAs). A total of 54 migrant bird species belonging to 13 orders and 25 families were recorded. Of the 54 species, 20 were Intra-African migrants and 34 Palearctic winters including two globally threatened species; the European Turtle Dove Streptopelia turtur *and Pallid Harrier* Circus macrourus*. Results showed that Protected wetlands had significantly higher species diversity (H' = 1.39) than Unprotected ones (H' = 1.28) (p = 0.0064), however, there was no significant difference in the density of birds between the two areas (p = 0.9246). The two areas were similar in species composition by 81%. Both Palearctic and Intra-Africa migrant birds were recorded in the wetland, thus revealing the importance of the Hadejia-Nguru as wintering sites for migratory birds. The Nigerian government has obligation to protect these migratory birds because it is a signatory to several international treaties aimed at conserving these birds.*

Key words: *Circus macrourus*, Hadejia-Nguru Wetlands, Threats to migratory birds, Palearctic and Intra-Africa Migrant birds, *Streptopelia turtur*

INTRODUCTION

Birds migration is the predictable seasonal movement from a breeding ground to a distant wintering ground, and back again within a year (Chan 2001). Among the most fascinating behaviour in birds migration is the long, nonstop flights of an11000 Km as observed in Bar-tailed godwits *Limosalapponica* over inhospitable habitats (e.g. oceans, mountains, etc.) from Alaska to New Zealand (Gill 2005). According to Vickery et al. (2014) about 126 bird species are identified as Afrotropical-palearctic migrants with estimated number of individuals ranging from 2.1 to 5 billion. Annually, these birds migrate from Eurasia to Africa in search for favourable weather and food (Berthold 2001). In similar way, many bird species migrate within the African continent, such as from West Africa to Southern Africa (Hockey2000). During this exodus, birds rely on stopover sites to rest and refuel. These stopovers vary in duration and frequency based on certain factors, such as weather, food availability, and threats including hunting, shooting, and trapping (Mehlman et al. 2005). Due to these long-distance movements across countries, several initiatives have been put in place to safeguard migratory birds. These include the

Ramsar Convention on Wetlands, 1971, Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979, and the Agreement on the Conservation of African- Eurasian Migratory Waterbirds (AEWA 1999).

In Africa, migratory bird species can generally be divided into two categories, the Palearctic migrants and the intra-African migrants (Borrow and Demey 2014). The Palearctic migrant species breed in Europe, North Africa, and part of Asia, and spend their wintering season in tropical Africa, whereas Intra-African migrants breed in one part of Africa and spend the post-breeding season in a different location or appear partially in another part within Africa. In Nigeria, about 249 bird species are migratory, 148 being waterbirds (Birdlife International 2016a). Within the country lies a Ramsar site and an Important Bird Area, the Hadejia-Nguru Wetlands (HNWs). This wetland is considered as one of the most important ornithological site in Nigeria, and West Africa by providing wintering ground for migratory birds (Birdlife International 2013). The HNWs consist of four Protected Areas (PAs): Adiani Forest Reserve, Baturiya Game Reserve, Chad Basin National Park, and Nguru Lake and Marma Channel (Birdlife International 2016b), in addition to the several unprotected wetlands (UPAs). The Nigerian government has put in place some laws including the National Park Service Act (1999/2006), Endangered Species Act (2000), Environmental Protection Law (1988/1989), Forestry Law (1938)and Wild Animal Law (1963) to protect wildlife with many found within the wetland areas (Kankara 2013). According to these laws, all forms of anthropogenic activities are allowed outside the PAs, but strictly forbidden in the PAs, except in the Ramsar designated wetlands and game reserves were human activities are allowed in a sustainable manner.

Worldwide migratory birds have suffered population declines and range constriction due to increase in anthropogenic pressures (Wilcove and Wikelski 2008). Growing evidence links this to agricultural expansion (Inouye *et al*. 2000, Murphy 2003). For example, migratory farmland birds such as Yellow Wagtail *Motacilla flava* and the vulnerable European Turtle Dove *Streptopelia turtur* population have been reported to decline over the last three decades (Ockendon*et al*. 2012, Gilroy *et al*. 2016). Other studies have attributed the decline of migratory birds to habitat degradation and wetland reclamation (Zwarts*et al*. 2009, Kirby *et al*. 2008). For instance, about 37% and 43% of intertidal wetlands in China and South Korea, respectively, have been reclaimed as a result of developmental activities (Kirby *et al*. 2008). In Europe, freshwater diversion has caused 90% loss of the breeding habitat of Aquatic Warbler *Acrocephalus paludicola* since 1960 due to changes in water regimes (Vickery *et al*. 2014). Recently, global climate change has emerged as new threat to migratory bird species (Inouye *et al*. 2000, Both *et al*. 2009). In Europe, for example, the migration pattern of birds that winters southern part of the Sahara has advanced by an average of 2.5 days over the last four decades presumably fastening to cross the Sahel prior to dry period. On the contrary, migrants wintering north of the Sahara have delayed autumn passage by 3.4 days on average over the same period (Birdlife International 2004).

Furthermore, hunting, and poisoning especially on wintering ground and stopovers are among the multiple threats which the migratory birds are facing (Kirby *et al.* 2008). According to Zwarts *et al*. (2009), in the Inner Niger Delta (Senegal) alone, the number of wintering Ruffs *Philomachus pugnax* killed in the last two decades varied from an estimated 10% to 60% of the population. Pesticide and

rodenticides application, and Acacia woodland clearance for agriculture have significantly affected the threatened *S. turtur* and Pallid Harrier *Circus macrourus* (Birdlife International 2016a). In Zimbabwe, *C. macrourus* has vanished as a result of habitat loss and the use of pesticides (Cherry 1997).

The HNWs have undergone tremendous change since the drought experienced in the 1970s. These factors combined with hunting, fishing, grazing, and extensive farming in the HNWs have been noted to seriously affect the wetland bird community (Olofin 1993, Cresswell, 2012, Blench 2013) including migratory birds because the HNWs serves as a wintering and stopover site for many bird species in the Sahel (Vickery et al. 2014). Most available studies in HNWs focus on resident species. Some studies analysed the foraging guild of *P. Pugnax* (Ezealor and Giles 1997), efforts and problems of water birds conservation (Akinsolaet al. 2000), human-bird conflict (Oduntanet al. 2010), bird diversity associated with certain plant communities (Lameed 2011, Sulaimanet al. 2014) and effect of wetland type and size on bird diversity (Sulaimanet al. 2015). Despite the significant importance of HNWs to both resident and migratory birds, little attention is given to how the wetlands support an array of diverse migratory birds during the northern winter. This study aimed at comparing the migrant bird communities in HNWs with reference to their protection status in the protected and unprotected wetlands. More recent, little is known about the wetland bird community due to Boko Haram insurgency in the North-eastern Nigeria which made the wetland areas difficult to access.

MATERIALS AND METHODS

Study area

The Hadejia-Nguru Ramsar site is located in northeast, Nigeria (Latitude $12^{o}15'$ N and $13^{o}00$N and longitudes $10^{0}00'$ E and $11^{o}00'$ E, Figure 1). The wetland lies between an altitude of 152 and 305 m above sea level, and has a depth of about 1.5- 7.0 m (Abubakar and Abubakar 2013, Birdlife International 2016b). Two distinct climates exist in the wetland; wet season from May-September and dry season from October-April. Rainfall is between 500- 600 mm, whereas temperature ranges from 12°C during cold season to about 40°C during hot season (Ogunkoya and Dami 2007). The wetlands cover an area of about 350 000 hectares. The HNWs is a Ramsar site and an Important Bird Area (Birdlife International 2016b). There are four protected wetlands and several unprotected ones in the HNWs (Birdlife International 2016b).The main vegetation in both PAs and UPAs are scrub savanna and *Acacia* woodlands, with seasonally flooded areas of marsh with trees of Doum palm *Hyphaene thebaica* and farmland areas in UPAs. However, some plants have invaded part of the wetland PAs; Hippo grass *Vossia cuspidata* in Oxbow Lake and Maram, Southern cattail *Typha domingensis* along the Nguru Lake and Marma Channel.

Methods

Birds survey was conducted in fourteen wetlands (7 in PAs, and other seven in the UPAs) post-rainy season from October to December, 2015. A total of 48 point count stations were surveyed in PAs and 51 from UPAs once each month using point count as described by Bibby (2000). Visits were made in the morning from 6:00 to 10:00 h and from 16:00 to 18:00 h in the evening when birds were more active. Each point count station was surveyed thrice during the study period and the average number of all birds recorded taken for all the point stations. Number of point count stations surveyed was determined by the size of particular wetland, this is because the intensity of sampling needs to be proportional to size of the sampled area.

Point count stations were spaced 400 m apart. Observation of birds was carried out with Braun Binoculars 16 x 10 m. A total of 57.6 ha were surveyed in PAs and 61.2 ha in the UPAs.

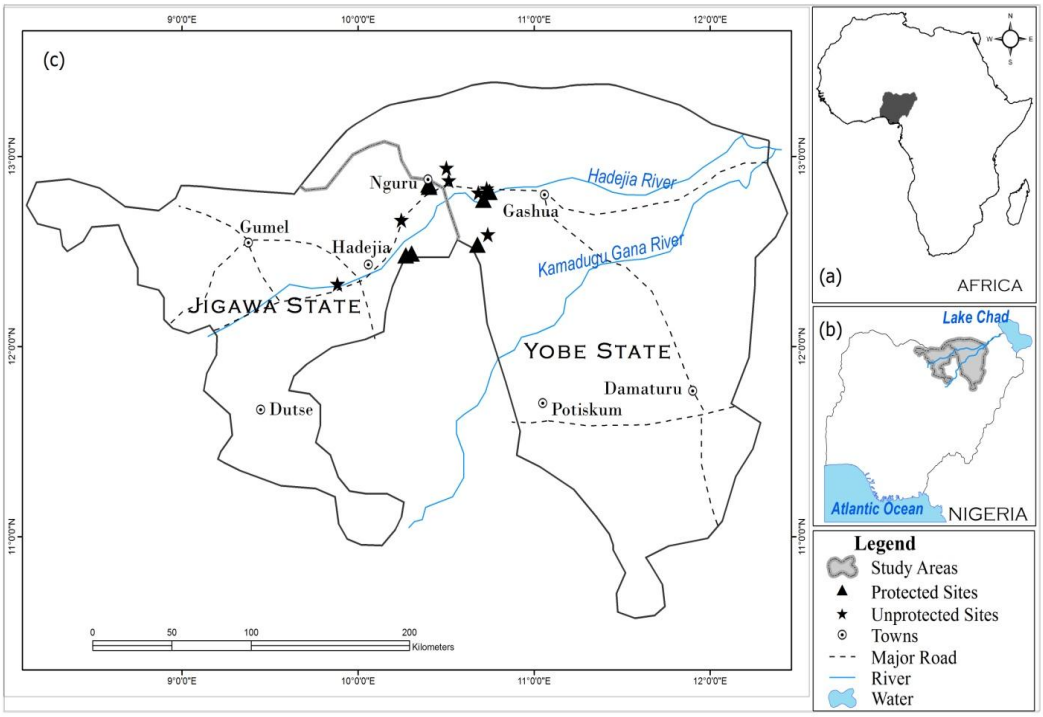

Figure 1: Map of the HNWs showing the location of the 14 sampling sites in PAs and UPAs

Data analyses

Data collected were explored for parametric assumptions and found normally distributed (Kolmogorov Smirnov, p>0.05). Paleontological Statistics software (PAST version 2.17, Hammer *et al.* 2001) was used to compute species diversity using Shannon-Weiner diversity indices. Special *t*- test was used to compare species diversity between PAs and UPAs. Species richness (S) was interpreted as the number of bird species recorded in PAs and UPAs. Chi-square (χ^2) was used to test the difference in species richness between PAs and UPAs. SØrensen's similarity index (Cs) was used to measure species similarity between PAs and UPAs according to Magurran (2004), given by the formula below;

$$Cs = \frac{2j}{a+b}$$

Where *Cs* is the SØrensen's index of similarity, *a* is the number of species in the PAs, *b* is the number of species in the UPAs, and *j* is the number of species common to both areas.

Birds identification was done using field guide to the birds of Western Africa by Borrow and Demey (2014). Migratory status of all birds recorded is categorized as Palearctic winter or Intra-African migrant

according to Borrow and Demey (2014) and Dowsettet al. (2016), common name, scientific name, and IUCN status are also given. Means of birds abundance is presented as Mean ±SD. Population density (PD) of bird species was determined according to Sutherland (1996), using the formula below;

$$PD = \frac{\text{Number of individuals of a bird species}}{\text{Area of wetland (in hectares)}}$$

RESULTS

A total of 54 migrant bird species belonging to 25 families, 13 orders were recorded. Overall, 20 species were Intra-African migrants and 34 Palearctic winters (Table 1). Two species of global conservation concern were also recorded, the Vulnerable European Turtle Dove *Streptopelia turtur* were recorded only from single count in December and the Near Threatened Pallid Harrier *Circus macrourus* recorded in all the three months. The former was recorded at Maram PAs (28 individuals), and *C. macrourus* from both areas, three individuals from the PAs) and in the UPAs five individuals were recorded. PAs had higher species diversity (*H'* = 1.39) than UPAs (*H'* = 1.28) (t = 2.72, df = 15397, *p* = 0.0064). The two areas were similar in species composition by 81% (CCs = 0.81) reflecting a very high similarity (Ratliff 1993). This very high similarity indicates that the species diversity is fairly similar across the landscape. This high similarity is supported by the insignificant difference in the species richness between PAs (S = 46) and UPAs (S = 45) (χ^2 = 0.0110, df = 1, *p* = 0.9165). In terms of birds population density, there was no significant difference between UPAs (47 individuals/ha) and PAs (43 individuals/ha) (t = -0.0948, df = 1, *p* = 0.9246).

The most abundant species in both PAs and UPAs were Garganey *Spatula querquedula* (PAs; 5209±2284; UPAs; 6103±2024) and Red-billed Quelea *Quelea quelea* (PAs; 595±256, no. of samples = 3; and UPAs; 759±745, no. of samples=3). As for the IUCN conservation status categories (IUCN Red List 2015), out of the 54 bird species recorded, 23 were Least Concern (population trend decreasing), 15 Least Concern (population level stable), 9 Least Concern (population level increasing), 4 Least Concern (population status not assessed) and 3 Least Concern (population status unknown) (Table 1).

Table 1: Checklist of migratory bird species recorded in PAs and UPAs of the HNWs during the study period (October- December, 2015).

Family	Species name	Common name	IUCN status	Migratory status
Anatidae	*Spatula querquedula*	Garganey	↓	PW
	Sarkidiornis melanotos	Knob-billed Duck	↓	IA
Bucerotidae	*Lophoceros nasutus*	African Grey Hornbill	-	IA
Upupidae	*Upupaepops*	Hoopoe	↓	PW
Apodidae	*Apusapus*	Common Swift	-	PW
Caprimulgidae	*Caprimulgus longipennis*	Standard-winged Nightjar	-	IA
Ciconiidae	*Ciconia abdimii*	Abdim's Stork	↓	IA
	Anastomus lamelligerus	African Openbill	↓	IA

Family	**Species name**	**Common name**	**IUCN status**	**Migratory status**
	Ciconia ciconia	White Stork	↑	PW
Cuculidae	*Clamator glandarius*	Great Spotted Cuckoo	-	PW
Accipitridae	*Chelictinia riocourii*	African Swallow-tailed Kite	↓	IA
	Milvus migrans	Black Kite	*	PW
	Circus macrourus	Pallid Harrier	NT/-	PW
	Circus aeruginosus	Western Marsh Harrier	+	PW
	Circus pygargus	Montagu's Harrier	↓	PW
	Accipiter badius	Shikra	-	IA
	Milvus migrants parasitus	Yellow-billed Kite	**	IA
Pandionidae	*Pandion haliaetus*	Osprey	↑+	PW
Columbidae	*Streptopelia turtur*	European Turtle Dove	VU/↓	PW
Alcedinidae	*Ispidina picta*	African Pygmy-kingfisher	-	IA /BV
	Halcyon leucocephala	Grey-headed Kingfisher	-	IA/BV
Laridae	*Gelochelidon nilotica*	Gull-billed Tern	↓	PW
	Larus cirrocephalus	Grey-headed Gull	-	PW
	Chlidonias hybrida	Whiskered Tern	-	PW
Scolopacidae	*Tringa glareola*	Wood Sandpiper	-	PW
	Gallinago Gallinago	Common Snipe	↓	PW
	Tring aochropus	Green Sandpiper	-	PW
	Actitis hypoleucos	Common Sandpiper	↓	PW
	Calidris minuta	Little Stint	↓	PW
	Calidris pugnax	Ruff	↓	PW
	Tring aerythropus	Spotted Redshank	-	PW
Rallidae	*Gallinu laangulata*	Lesser Moorhen	*	IA
	Gallinu lachloropus	Common Moorhen	-	PW
	Porphyrio alleni	Allen's Gallinule	↓	IA
Hirundinidae	*Riparia riparia*	Common Sand Martin	↓	PW
	Hirundo aethiopica	Ethiopian Swallow	↑	IA
	Cecropis domicella	West African Swallow	**	IA
Sylviidae	*Sylvia communis*	Common Whitethroat	↑	PW
	Acrocephalus scirpaceus	European Reed Warbler	-	PW
	Acrocephalus schoenobaenus	Sedge Warbler	-	PW
	Acrocephalus baeticatus	African Reed Warbler	**	IA
Nectariniidae	*Nectarinia pulchella*	Beautiful Sunbird	↑	IA
Ploceidae	*Quelea quelea*	Red-billed Quelea	↑	IA

Family	Species name	Common name	IUCN status	Migratory status
Muscicapidae	*Oenanthe oenanthe*	Northern Wheatear	↓	PW
Laniidae	*Lanius senator*	Woodchat Shrike	↓	PW
Motacillidae	*Motacilla flava*	Yellow Wagtail	↓	PW
Passeridae	*Passer leteus*	Sudan Golden Sparrow	**	IA
Ardeidae	*Ardea cinerea*	Grey Heron	*	PW
	Egretta garzetta	Little Egret	↑	IA
	Ixobrychus minutus	Little Bittern	↓	PW
	Ardea purpurea	Purple Heron	↓	PW
	Ardeola ralloides	Squacco Heron	↓	PW
Ptercolidae	*Pterocles quadricinctus*	Four-banded Sandgrouse	↑	IA
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	↓	PW

Key: PW (Palearctic winter), IA (Intra-African), BV (Breeding Visitor), VU (Vulnerable), NT (Near Threatened), Least Concern/population trend increasing (↑), Least Concern/population trend decreasing (↓), Least Concern/population trend stable (-), Least Concern/population trend unknown (*), Unassessed (**).

Table 2: Density of migratory bird species in PAs and UPAs of the HNWs recorded during the study period (October- December, 2015).

Common name	PAs, mean±SD	Density/ ha	UPAs, mean±SD	Density/ ha
African Grey Hornbill	10±5	0.18	11±3	0.18
Abdim's stork	40.0	0.69	3.0	0.05
African Openbill	100±5	0.18	10	0.16
African Swallow-tailed kite	-	-	2±1	0.04
African Pygmy Kingfisher	6.0	0.10	2±1	0.03
African Reed Warbler	5.0	0.08	6.0	0.09
Allen's Gallinule	33.0	0.57	5±1	0.08
Black Kite	7±4	0.12	7±3	0.12
Beautiful Sunbird	43±20	0.74	9±1	0.14
Common Moorhen	26.0	0.45	18±8	0.23
Common Sand Martin	15.0	0.26	30.0	0.49
Common Snipe	-	-	5.0	0.08
Common Swift	2.0	0.03	-	-
Common Whitethroat	-	-	4±4	0.07
Common Sandpiper	4.0	0.07	2±1	0.02
Ethiopian Swallow	35±28	0.61	2±0	0.03
European Reed Warbler	6.0	0.10	8±2	0.12
European Turtle Dove	28.0	0.49	-	-
Four-banded Sandgrouse	4.0	0.07	63±12	1.03
Garganey	5209±2284	90.44	6102±2024	99.72
Gull-billed Tern	20±13	0.35	2±2	0.04

Common name	PAs, mean±SD	Density/ ha	UPAs, mean±SD	Density/ ha
Glossy Ibis	31±20	0.53	39±19	0.63
Great Spotted Cuckoo	-	-	4.0	0.06
Grey Heron	10±6	0.16	18±10	0.29
Green Sandpiper	29±5	0.50	79±31	1.23
Grey-headed Gull	4.0	0.07	-	-
Grey-headed Kingfisher	4±1	0.07	-	-
Hoopoe	1±1	0.02	1.0	0.02
Knob-billed Duck	198±51	3.44	106±79	1.73
Little Bittern	3.0	0.05	-	-
Little Egret	16±7	0.27	21±8	0.34
Little Stint	-	-	38.0	0.62
Lesser Moorhen	10.0	0.17	7.0	0.11
Montagu's Harrier	2±0	0.03	-	-
Northern Wheatear	2±2	0.04	7±3	0.10
Osprey	1.0	0.02	-	-
Pallid Harrier	3±2	0.05	5±3	0.08
Purple Heron	42±9	0.73	23±8	0.38
Ruff	6±1	0.07	71±46	1.16
Red-billed Quelea	594±256	10.32	759±745	12.40
Sedge Warbler	48±41	0.82	14±0.3	0.22
Sudan Golden Sparrow	42±7	0.73	21±7	0.34
Shikra	2.0	0.03	-	-
Spotted Redshank	5.0	0.09	63±28	1.03
Squacco Heron	150±70	2.60	63±22	1.03
Standard winged-nightjar	2.0	0.03	-	-
Wood Sandpiper	379±53	6.59	653±444	10.66
Woodchat Shrike	-	-	5±2	0.06
Western Marsh Harrier	8±2	0.14	13±5	0.22
West African Swallow	-	-	2.0	0.03
White Stork	-	-	11	0.18
Whiskered Tern	7.0	0.12	3.0	0.05
Yellow-billed Kite	1.0	0.02	1±0.6	0.02
Yellow Wagtail	289±135	5.02	333±86	5.44

In this study, raptor species particularly Black kite, Pallid Harrier and Western Marsh Harrier were observed frequently in open wetlands areas ideal for taking prey. The European Reed Warbler and African Reed Warbler which depend on wetland areas dominated by emergent plant vegetation were recorded in *Typha domingensis* vegetation along the shores of Nguru Lake and Marma Channel. Also, Egret species; Grey heron *Ardea cinerea*, Purple heron *Ardea purperea* and Little egret *Egretta garzetta* were observed mostly in wetland habitats covered with Hippo grass *Vossia cuspidata.*

DISCUSSION

PAs had higher diversity than UPAs. This concurs with other findings elsewhere (Williams et al. 1996, Evans et al. 2006, Franco et al. 2007). In this study, the higher diversity in PAs could be attributed to dense

vegetation which serves as refuge, food source, and can provide suitable microhabitats for many bird species (Weller 1999), in addition to high protection from the human influence in the PAs than in the UPAs. Although, there was high diversity in the PAs, species similarity between PAs and UPAs was very high indicating that both areas provided suitable conditions for migratory bird species in HNWs. Higher bird density in PAs was due to less human activities such as fishing, grazing, and farming (Burton et al. 2002), hence, high density of bird species can occur per unit area unlike in the UPAs (Martin and Possingham 2005). The higher number of birds recorded in the UPAs was a result of few species such as Garganey, Green Sandpiper, Ruff, Spotted Redshank and Wood Sandpiper that dominated the area, as compared to PAs.

This study recorded a higher number of migratory bird species than previous studies (Lameed 2011, Sulaimanet al. 2014) in HNWs. Lameed (2011) recorded 17 species palearctic winters and 4 intra-African migrants from three wetland sites, Gastu, Maram and Oxbow Lake in Dagona Waterfowl Sanctuary. This variation may be due to small area and the influence of different seasons that was sampled within the HNWs unlike the present study that covered 14 wetland sites. In a similar way, Sulaimanet al. (2014) reported 18 Palearctic winters and 8 intra-African migrants within the HNWs 70 point count stations as compared to 99 point count stations in the present study. This indicates that increased sampling effort in this study might have been the reason for the high records. This study recorded eight more bird species including African Reed Warbler, African Swallow-tailed Kite, Common Sand Martin, Common Whitethroat, European Turtle Dove, Gull-billed Tern, Grey-headed Gull, Northern Wheatear and Woodchat Shrike which were not recorded in the other studies. Conversely, seven species reported by Lameed (2011), and Sulaimanet al. (2014) were not recorded in the present study, Northern Shoveler *Anas clypeata*, Melodious Warbler *Hippolais polyglotta*, Marabou Stork *Leptoptilos crumeniferus*, Common Kestrel *Falco tinnunculus*, Common Tern *Sterna hirundo*, Kittlit'z Plover *Charadrius pecurius* and Marsh Sandpiper *Tringa stagnatilis*. Variation in birds detectability could be from differences among observers, habitats surveyed, and the behaviour of some species (Bibby 2000, Somershoeet al. 2006).

At the moment, migratory birds are in danger of extinction than ever in the human history due to impact of anthropogenic activities (Birdlife International 2004, 2013). The two globally threatened species sighted in this study are threatened by anthropogenic disturbances, such as clearance of scrub, and acacia woodland areas for agriculture, pesticide and rodenticides application, as well as hunting (Browne and Aebischer 2005, Birdlife International 2016c). These activities combined with global climate change may further accelerate the threats facing these species (Both *et al*. 2009).Twenty eight individuals of *S. turtur* were recorded in the PAs in Maram wetland area dominated by *Acacia nilotica* and *A.seyal* during the December count. According to Aebischer and Browne (2005) *S. turtur* arrived at its wintering ground in West Africa between mid August and late October. In addition, although, *S. turtur* is listed in the checklist of the birds of Nigeria, this was the first recording in HNWs. The species was observed feeding and roosting with African mourning dove *Senegalensis decipiens*, contrary, to Morel and Morel (1988) who reported that the species usually associates with Vinaceous dove *S. vinacea.* In the HNWs, *S. turtur*, like elsewhere in the world, is threatened by anthropogenic activities (Browne and Aebischer 2005), and its population status and extent of threats is

unknown. Only fewer studies have attempted to study the species on its wintering ground (Morel 1985, 1987).

In the United Kingdom, *S. turtur* is protected by national legislation under the wildlife and countryside Act 1981 and Schedule 1 of the Wildlife order (1985), but in Nigeria apart from being one of the species protected under the international conservation of migratory species of which Nigeria is a signatory, no national protection status has been granted to the species. During this study, *C. macrourus* were recorded throughout the survey period anticipating that the species arrived earlier than *S. turtur*. Possibly because migratory birds can arrive early or late on their wintering ground depending on certain factors, such as weather conditions and food availability particularly along stopover sites (Mehlmanet al. 2005, Berthold 2001). However, in the HNWs, the ecology and habitat use by *C. macrourus* has not been examined by any study as investigated elsewhere in Mediterranean (Panuccio and Agostini 2006), Kazakhstan (Terraubeet al. 2009), and India (Verma 2005, Narwade*et al*. 2013). For conservation purposes, *C. macrourus* is listed in the Red Data books of Belarus, Ukraine, Russia and Turkey (Birdlife International 2016c). In India, the species is listed under Indian Wild Life Protection Act, 1972 (Mukundarao 2014) whereas in Nigeria, the protection status has not been offered to *C. macrourus*.

CONCLUSION AND RECOMMENDATIONS

The findings of this study revealed that both PAs and UPAs serve as a refuge for intra-African and Palearctic winters in HNWs. Thus management of these habitats can help conserve the migratory bird species. The study has provided an inventory of migratory bird species, as well as their densities in HNWs, which serves as a baseline data for further studies. In general the Hadejia-Nguru Wetlands are important sites for Palearctic and intra-African migrant bird species including some globally threatened species. Moreover, information on the ecology of migratory birds especially the threatened ones in relation to habitat use and threats in HNWs is still scant. The Nigerian government has obligation to protect these migratory birds because it is a signatory to several international conventions aimed at conserving these birds. Future studies are recommended on the birds' distribution particularly on the threatened species.

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