

Only one vulture was detected during transect surveys in northern Nigeria.

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Abstract

Vulture and raptor populations have declined across West Africa during recent decades due to numerous and widespread anthropogenic threats. To estimate encounter rates of vultures and raptors in northern Nigeria, we conducted a total of 248 km driven transects on 195 km and 53 km of paved and unpaved roads, respectively. We also conducted walked surveys beneath 79 km of power transmission lines to search for dead vultures and raptors; and visited 12 abattoirs, 11 slaughterhouses, and 12 dumpsites to assess the occurrence of vultures and raptors. All fieldwork was done between October and December 2018. Overall, 357 individuals of 23 species were detected, most of which were recorded at low encounter rates. Only one Hooded Vulture *Necrosyrtes monachus* was recorded across all surveys, and no other vulture species were seen. Yellow-billed Kite *Milvus aegyptius*, Grasshopper Buzzard *Butastur rufipennis*, and Black-winged Kite *Elanus caeruleus* had the highest encounter rates of 0.351, 0.262, and 0.189 individuals km⁻¹, respectively. In contrast, the largest raptor species, Booted Eagle *Hieraaetus pennatus*, Short-toed Snake Eagle *Circaetus gallicus*, Beaudouin's Snake-eagle, and Bateleur *Terathopius ecaudatus* had the lowest encounter rate of 0.004 individuals km⁻¹ (one individual each). No dead vultures or raptors were found during the walked surveys beneath power lines. Although historical data about vulture and raptor distribution and abundance in northern Nigeria are limited, our results show an apparent absence of vultures from the wider landscape and a low density of raptors. Support among local stakeholders for the conservation of vultures and raptors should be encouraged through wider dissemination of information about the importance of these birds, as well as stronger deterrents against illegal killing and trade.

Introduction

Over the last four decades, there has been an unprecedented decline in vulture and raptor populations across West Africa owing to human population growth and associated habitat loss, nest disturbance, poisoning, and declining wild ungulate populations (Cuthbert *et al.* 2006, Thiollay 2006, Nikolaus 2011, Ogada *et al.* 2012, Buij *et al.* 2016). Electrocutation and collision with power lines, improvements in slaughterhouse sanitation, as well

as excessive illegal trade, and the use of body parts for traditional beliefs have all also contributed to widespread raptor and vulture population declines in the region (Thiollay 2006, Saidu and Buij 2013). For example, the findings of a study by Buij *et al.* (2016) showed that 73% of vulture and raptor carcasses traded from 12 West African countries between 1992 and 2013 originated in Nigeria. As a result of this decline, all vulture species occurring in West Africa are threatened with extinction following a $\geq 95\%$ decline in their populations

(Ogada *et al.* 2012, 2016, Freitas *et al.* 2020). Similarly, raptor populations have also shown widespread declines across the region (Buij *et al.* 2016).

Although historical data are limited, vultures were thought to formerly be widespread and relatively abundant in northern Nigeria, particularly the Hooded Vulture which was considered the most abundant vulture species in Africa (Mundy *et al.* 1992). According to Mundy *et al.* (1992) in the Sokoto abattoir alone, a single count revealed 300 Hooded Vultures and it was assumed that there were 1000 birds in the area in the 1960s and 1970s. During this period, 279 Hooded Vulture nests were recorded in an area of 40 km² (Mundy *et al.* 1992). Likewise, in Kano, traditional ecological knowledge indicated that sightings of hundreds of

Hooded Vultures were frequent during the 1960s and 1970s before a decline across West Africa became apparent from the 1980s onwards (Thiollay 2006). A photograph of Hooded Vultures by Harrison Forman perched on the roof of houses in Kano in 1961 showed that this bird was once abundant, living closely alongside humans (Figure 1). Although historical data about vulture and raptor populations in northern Nigeria are limited, and recent studies are lacking, these observations are in stark contrast to the current scenario. The illegal trade in vulture and raptor body parts for belief-based use is thought to be one of the primary drivers of population declines in Nigeria and across the region (Ogada *et al.* 2012, Barlow & Fulford 2013, Saidu & Buij 2013, Atuo *et al.* 2015, Buij *et al.* 2016, Owolabi *et al.* 2020, Williams *et al.* 2021).



Figure 1: Hooded vultures perched on the roof of houses in Kano in 1961. Photograph: Harrison Forman.

Recently, the global commitment to vulture conservation has been strengthened by the development of the Multi-Species Action Plan to Conserve African-Eurasian Vultures (Botha *et al.* 2017). Concurrently, in 2017, the “Egyptian Vulture - New LIFE Project” (LIFE16 NAT/BG/000874; www.LifeNeophron.eu), involving institutions and organizations from 14 countries spanning the Balkans, Middle East, and Africa aimed at awareness-raising and education, and reducing the diverse threats affecting the Egyptian Vulture *Neophron percnopterus*, was implemented following the killing of two Egyptian Vultures that were being tracked with GPS transmitters in the vicinity of the Niger-Nigeria border (Arkumarev *et al.* 2018; Kret *et al.* 2018). There are a small number of historical breeding records of the species in northern Nigeria, and there have been recent records of individual birds in the region obtained from tracking data and direct observations (Kret *et al.* 2018, Haroon Mohammed and Abubakar Ringim, pers. obs.). Although the primary motivation for the current study was to assess the occurrence of the Egyptian Vulture, other species of vultures and raptors were also recorded to fill a general gap in knowledge about the current occurrence of vultures and raptors in northern Nigeria.

Methods

Survey areas

Surveys were conducted between October and December 2018 across six states in northern Nigeria: Jigawa, Yobe, Sokoto, Kebbi, Kano, and Zamfara, covering 23 Local Government Areas. These states are within the known range of migratory Egyptian Vultures in Nigeria (Borrow & Demey 2014). All the survey areas were in an environment characterized by Sudan and Guinea Savanna vegetation. In the far northeast and northwest, however, around Yobe and Kebbi states,

the areas are characterized by desert and semi-desert habitats. Rainfall in the region is unimodal, starting from May to September, and a dry season starting from October through April. The average temperature is approximately 30.9°C during the hottest period in May and 22°C (and below) during the coldest period in January (Muhammad *et al.* 2017).

Roads transect and powerline surveys

We conducted a total of 248 km driven transects on 195 km of paved roads and 53 km of unpaved roads to detect live vultures and raptors. Overall, there were 27 different transects that were surveyed once each. Transect lengths ranged from a minimum of 14 km to a maximum of 79 km (Figure 2). Along these transects, some sections of major power transmission lines were surveyed on foot by two people to look for dead birds (total length of powerlines surveyed = 79 km). During powerline surveys, live birds were not recorded and were not included in the reported encounter rates. During driven surveys, birds were identified and counted by two experienced bird observers, an observer, and a recorder. A pair of binoculars and a Field Guide to the Birds of Western Africa (Borrow & Demey 2014) were used to aid bird identification. Where there were uncertainties about species identification, we stopped and spent a few minutes (usually 3-5 minutes) identifying and counting each sighted raptor. Surveys began at 07h00 and finished around 14h00. The vehicle speed was limited to not less than 40 kmh⁻¹ on paved roads and around 40kmh⁻¹ or less on unpaved roads.

All sighted raptors, either perched or in flight along the driven transects were recorded using Survey123 (<https://survey123.arcgis.com>). We calculated the encounter rate for each bird species as the number of individuals recorded divided by the total distance (248 km) surveyed (Murphy *et al.* 2016). The lack of standardized transect methods or repeated surveys are among the limitations of the

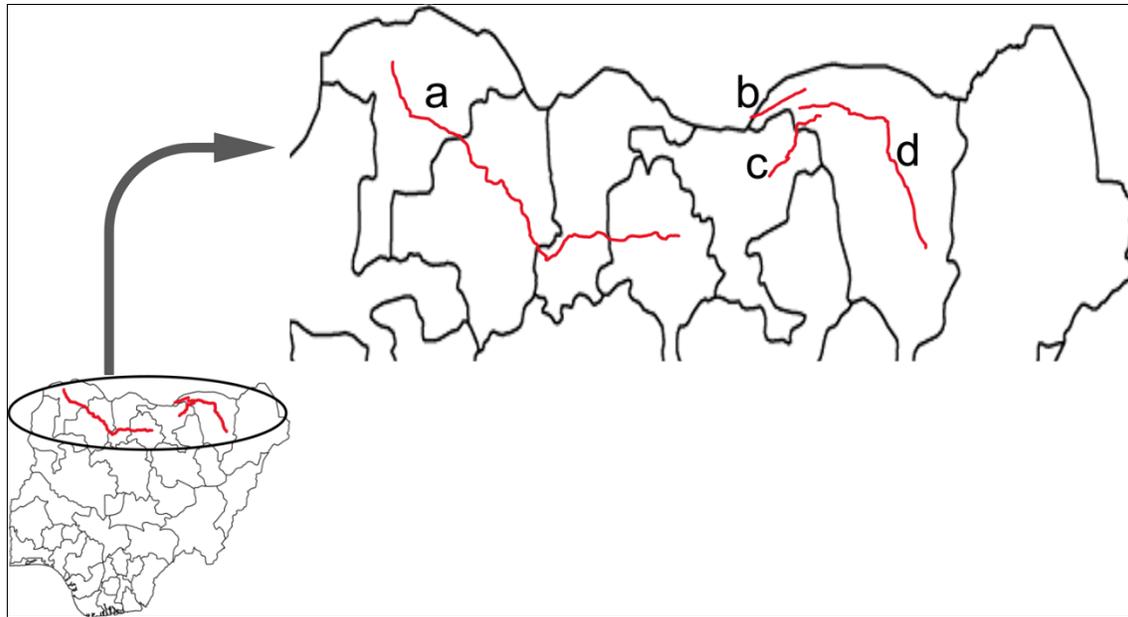


Figure 2: Location of the areas where vultures and raptors were surveyed along road transects and under major transmission lines: a) Kano – Sokoto (70 km); b) Nguru – Machina (45 km); c) Nguru – Hadejia (79 km); d) Nguru – Damaturu (54km) road, in northern Nigeria.

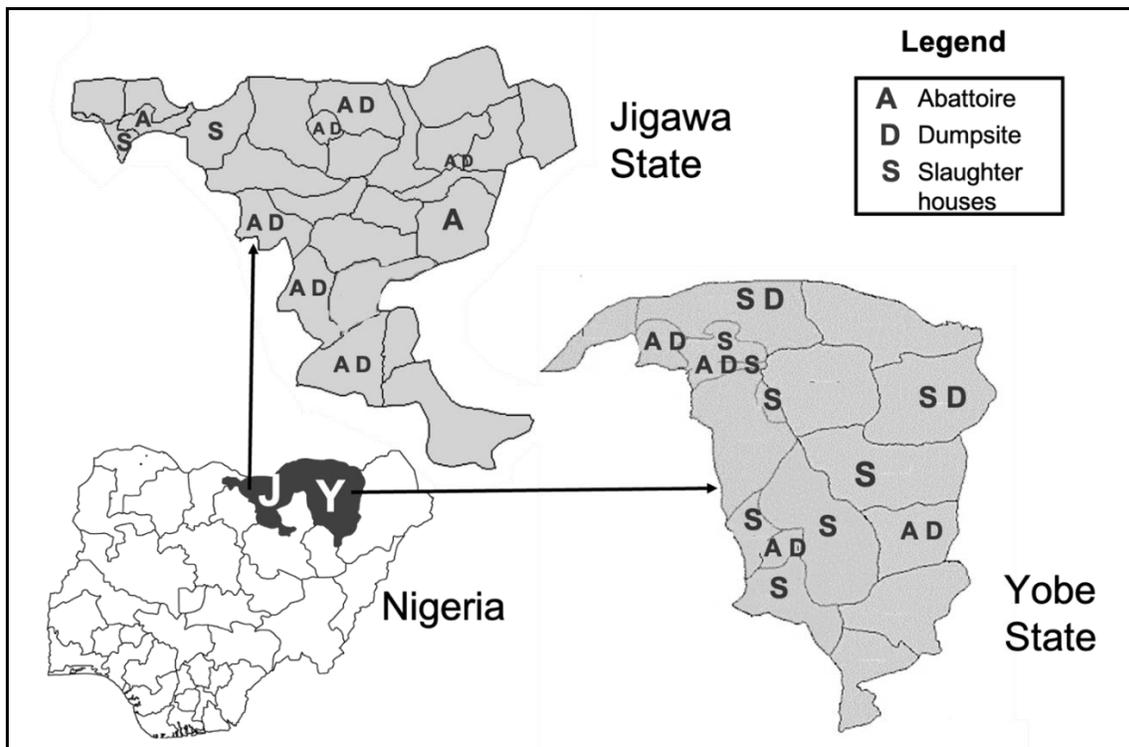


Figure 3: Approximate locations of the selected areas where vultures and other raptors were surveyed at abattoirs, slaughterhouses, and dumpsites in Jigawa and Yobe State in northern Nigeria.

present study, and additional training would improve future surveys.

Abattoir, slaughterhouse and dumpsite surveys

Overall, we visited 12 abattoirs, 11 slaughterhouses, and 12 dumpsites in Jigawa State and Yobe State (Figure 3). In northern Nigeria, abattoirs are large indoor markets where animals are slaughtered, whereas slaughterhouses are small (around 5 x 5 m) areas or buildings where only slaughtering takes place. Abattoirs have specific separate areas such as the veterinary services and places where animals are kept and examined before being sold and slaughtered, but slaughterhouses have none of these. Abattoirs are only found in state capitals (i.e. large cities), whereas slaughterhouses are found in small towns and villages. Dumpsites are areas where trash, garbage, and refuse waste are deposited, which in large cities in Nigeria, for instance, can accumulate in considerable amounts. On arrival at a site, observers located a vantage point with a good view across the area (the number of points depended on the size of the area). Observers waited and recorded the presence and abundance of raptors and vultures. A minimum of two hours was spent surveying at each site.

Results

Overall, 357 individual raptors of 23 species were recorded during the surveys. No Egyptian Vultures were recorded and a sighting of an individual Hooded Vulture at Shuni, Sokoto State, on 19 December 2018 (the sighting is recorded at <https://vmus.adu.org.za/?vm=BirdPix-67315>), was the only record of the species across all surveys. Yellow-billed Kite *Milvus aegyptius* was the most frequently recorded species (87 individuals; 0.35 individuals km⁻¹), followed by Grasshopper Buzzard *Butastur rufipennis* (65 individuals; 0.26 individuals km⁻¹), and Black-winged Kite *Elanus*

caeruleus (47 individuals; 0.19 individuals km⁻¹; Table 1). In contrast, the largest raptor species namely Booted Eagle *Hieraaetus pennatus*, Short-toed Snake Eagle *Circaetus gallicus*, Beaudouin's Snake-eagle *Circaetus beaudouini*, and Bateleur *Terathopius ecaudatus* had the lowest encounter rates, with one individual of each species detected (Table 1).

At abattoir, dumpsite, and slaughterhouses a total of 107 individuals of 12 raptor species were recorded in Jigawa State, and 90 individuals of 16 raptor species were recorded in Yobe State. Species recorded around abattoirs were Common Kestrel *Falco tinnunculus*, Lesser Kestrel *Falco naumanni*, and Western Marsh Harrier *Circus aeruginosus*. No vultures were recorded at any of the abattoirs, slaughterhouses, or dumpsites.

No dead vultures or other raptor species were detected during the powerline surveys. One Abyssinian Roller *Coracias abyssinicus* and one Lesser Blue-eared Starling *Lamprotornis chloropterus* were recorded along the Nguru-Damaturu transect. Communications with Transmission Company of Nigeria (TCN) officials revealed that bird-strikes are usually recorded between September to December around 06h00–10h00 and 16h00–19h00.

Discussion

The surveys conducted during this study detected only a single Hooded Vulture and no Egyptian Vultures. Although the Egyptian Vulture once bred in the region and migratory populations are known to visit northern Nigeria, it appears that the species is now very scarce or absent. However, it is possible that some migratory individuals may visit the study area outside the survey period (October-December) and so they may have been missed. For example, tracked individuals from the Balkan breeding population have been shown to utilize habitats in

Table 1: Vulture and raptor species observed alive during transects (248 km of driven transects), the total number of individuals recorded (count), and their respective encounter rates (i.e. count / total survey distance). No dead vultures or raptors were found during the major transmission powerline surveys, but two non-raptor species were found, which are indicated by asterisks.

Species	Count	Resident / migrant status in survey area	Encounter rate (individuals km ⁻¹)
Hooded vulture <i>Necrosyrtes monachus</i>	1	Resident	0.004
Black Kite <i>Milvus migrans</i>	2	Palaeartic migrant	0.008
Yellow-billed Kite <i>Milvus aegyptius</i>	87	Resident	0.351
Black-winged Kite <i>Elanus caeruleus</i>	47	Resident	0.189
Montagu's Harrier <i>Circus pygargus</i>	8	Palaeartic migrant	0.032
Pallid Harrier <i>Circus macrourus</i>	6	Palaeartic migrant	0.024
Beudouin's Snake-eagle <i>Circaetus beudouini</i>	1	Resident	0.004
Bateleur <i>Terathopius ecaudatus</i>	1	Resident	0.004
Lizard Buzzard <i>Kaupifalco monogrammicus</i>	5	Resident	0.020
Gabar Goshawk <i>Micronisus gabar</i>	9	Resident	0.036
Dark-Chanting Goshawk <i>Melierax metabates</i>	12	Resident	0.048
Shikra <i>Accipiter badius</i>	13	Resident	0.052
Grasshopper Buzzard <i>Butastur rufipennis</i>	65	Intra-African migrant	0.262
Red-necked Buzzard <i>Buteo auguralis</i>	8	Resident	0.032
Booted Eagle <i>Hieraaetus pennatus</i>	1	Resident	0.004
Lesser Kestrel <i>Falco naumanni</i>	18	Resident	0.072
Common Kestrel <i>Falco tinnunculus</i>	36	Resident	0.145
Fox Kestrel <i>Falco alopex</i>	6	Resident	0.024
Red-necked Falcon <i>Falco chicquera</i>	7	Resident	0.028
Grey Kestrel <i>Falco ardosiaceus</i>	11	Resident	0.044
Lanner Falcon <i>Falco biarmicus</i>	10	Resident	0.040
Short-toed snake-eagle <i>Circaetus gallicus</i>	1	Palaeartic migrant	0.004
Western Marsh-harrier <i>Circus aeruginosus</i>	2	Palaeartic migrant	0.008
*Abyssinian Roller <i>Coracias abyssinicus</i>	1	Resident	Found dead beneath power line
*Lesser Blue-eared Starling <i>Lamprotornis chloropterus</i>	1	Resident	Found dead beneath power line

northern Nigeria (Kret *et al.* 2018). However, given the known occurrence of shooting and other threats, even for these few tracked birds, around the Niger-Nigeria border (Kret *et al.* 2018), it is possible that migratory individuals do not survive long enough or in high enough numbers to be detected in Nigeria.

This study showed an almost total absence of vultures and low encounter rates for other raptor species, suggesting a decline in their abundance, most likely due to multiple threats recorded and discussed previously (Saidu & Buij 2013, Freitas *et al.* 2020, Gore *et al.* 2020, Owolabi *et al.* 2020, Williams *et al.* 2021). Nonetheless, some of the encounter rates (e.g., Yellow-billed Kite, Grasshopper Buzzard, and Black-winged Kite) are in fact not particularly low compared to other studies (e.g., Thiollay 2006). It is not surprising that no dead vultures or raptors were found during the power line survey because they occur at low densities in the wider landscape, as well as the likely effect of carcass removal on detection rates (Ponce *et al.* 2010). It is well known that unsafe power lines cause raptor and vulture mortalities and have contributed to population declines (Angelov *et al.* 2013). Since it is well established that the main drivers of vulture declines in West Africa are excessive exploitation and illegal trade for traditional beliefs, poisoning, and other anthropogenic threats (Thiollay 2006, Ogada & Buij 2011, Ogada *et al.* 2012, Di Vittorio *et al.* 2018, Williams *et al.* 2021), these may explain the almost total absence of vultures recorded during this survey.

Like vultures, raptors, particularly the larger species, may utilize extensive ranges, hunting prey

across a range of habitats. Due to anthropogenic threats as highlighted above their low densities can also be negatively affected, including the resident species. Some of the lowest encounter rates, for instance, were for Bateleur and Booted Eagle (encounter rate 0.004 individuals km⁻¹, single individual each). In contrast, a greater number of individuals were recorded for migratory raptor species, such as Pallid Harrier (encounter rate 0.024 individuals km⁻¹, 6 individuals) and Montagu's Harrier (encounter rate 0.032 individuals km⁻¹, 8 individuals) possibly because of their arrival in the region during the survey period.

The findings of this study suggest that vultures are almost entirely absent from the surveyed areas of northern Nigeria. However, due to the limitations of the present surveys (e.g., short survey period and lack of standardized methods for driven transects), coupled with a lack of baseline scientific data about the occurrence and abundance of vultures and raptors in this region, we could not definitively conclude the extent to which vulture and raptor populations have declined. Nevertheless, supported by the results of the focal surveys at slaughterhouses, abattoirs, and dumpsites, vultures are now almost entirely absent from the wider landscape, and other raptor species also only occur at low densities. It is recommended that stakeholders including local hunters, traditional healers, researchers, local chiefs and leaders, conservation scientists and protected area managers, and the public, are all engaged to conserve vultures and raptors in northern Nigeria. Action against illegal killing and illegal trade must be implemented urgently to halt further declines (Buij *et al.* 2016).

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