



## DIVERSITY AND ABUNDANCE OF BIRDS OF PREY IN AKURE METROPOLIS, ONDO STATE, NIGERIA

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**ABSTRACT:** The impact of human activities on ecosystems worldwide has led to a biodiversity disaster, including birds. Birds of prey are among the most vulnerable taxa to environmental disturbance, yet their impacts on the environments cannot be undermined. Despite the conservation importance of birds of prey, little is known about the structuring of bird of prey communities in urban regions, especially in Nigeria. Diversity and abundance across five land-use types in Akure metropolis, Ondo State, Nigeria was investigated. We surveyed birds of prey using a systematic sampling along transects for roadside counts. We recorded 849 sightings from 11 species of birds of prey and three families in the study area. Diversity was highest in highways (1.50) and lowest at commercial centres (1.12), while abundance was highest in commercial centres (4.40) and lowest in industrial areas (3.07). The three families include Accipitridae (5 species), Falconidae (5 species) and Corvidae (1 species). The species ranking accumulation curve revealed Pied Crow (*Corvus albus*) as the most abundant with 344 individuals recorded, followed by Yellow-billed Kite (*Milvus migrans*) and Common Kestrel (*Falco tinnunculus*) with 229 and 188 individuals respectively. Some of the species recorded were observed utilizing infrastructures for different purposes. Public awareness must be raised to inform the local populace about the importance of these species to the environment vis-à-vis protecting the man-made structures used by the bird species.

Keywords: Raptors, Transects, Land-use types, Urbanization

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### 1. INTRODUCTION

As the world's natural areas are quickly being changed into urban areas and larger part of the total populace presently live in urban territories, expanding accentuation is being set on conservation within urban communities (Grimm *et al.* 2008; Kowarik 2011). The effects of urbanization on worldwide biodiversity have been broad, prompting the loss of indigenous species, habitat loss and fragmentation, modified biogeochemical cycles and the presentation of novel stressors, for

example, traffic, noise, disease, pollution and introduced predators such as domestic pets (Brearley *et al.* 2012; Goddard *et al.* 2009; Grimm *et al.* 2008; McKinney 2006). The effect of human activities on biological systems worldwide has prompted a biodiversity disaster (Marzluff 2001). As far as its consequences for biotic communities, urbanisation generally leads to a complete rearrangement of assemblages whereby natural habitats and species are replaced with human-dominated landscapes containing novel species compositions and interactions (McDonald *et al.* 2008; Ortega-Alvarez and Macgregor-Fors 2009). In addition, through a procedure

known as biotic homogenisation, urbanization makes a uniform physical condition by supplanting normal biological systems with a built-up environment where urban-tolerant species become widespread, reducing the variety of urban flora and fauna (Crocchi *et al.* 2008; McKinney 2006; Ortega-Alvarez and Macgregor-Fors 2009; van Rensburg *et al.* 2009).

A common tool for monitoring biological integrity is the use of indicator species (Lambeck 1997; Margules and Pressey 2000). Birds are often studied as indicators of ecosystem health, including in an urban context, because their ecology is well-understood, and they respond rapidly to environmental changes (Alberti 2005; Breuste *et al.* 2008). Birds are affected by urbanisation directly through changes in ecosystem processes, habitat, and food supply or indirectly through changes in predation, interspecific competition and diseases (Alberti 2005). The best-studied effects of urbanisation on birds are its effects on species composition, filtering species according to their levels of tolerance to urban disturbance. Some bird taxa such as raptors or birds of prey are appropriate indicators for monitoring changes at an ecosystem scale because they are at the top of food chains, occurring across a broad gradient of anthropogenic disturbance, from pristine wilderness to metropolitan areas, and because individual species are often associated with particular habitat types (Tella *et al.* 1998; Sánchez-Zapata *et al.* 2003; Carrete and Donazar 2005). Moreover, in some biological systems these top predators are tightly associated with high biodiversity values (Sergio *et al.* 2008) such that simulated networks of protected sites constructed on the basis of raptors were more efficient for conserving biodiversity than networks based on lower trophic level species, thus justifying their use as flagship umbrella species (Sergio *et al.* 2006). Nevertheless, the adaptation of some raptors to human-altered environments (Anderson 2001; Panasci and Whitacre 2002) makes their widespread potential as indicators of environmental degradation controversial (Rodríguez-Estrella *et al.* 1998).

Birds of prey or raptors are among the most vulnerable taxa to environmental disturbance (Love and Bird 2000). They are an important tool to focus conservation strategies locally, regionally, and globally. Changes in raptor distribution or abundance can serve as a measure of our impact on landscapes, even in remote areas. Despite threats to biodiversity, birds of prey may find urban landscapes to be suitable to establish residency (Love and Bird 2000). Urban and suburban landscapes provide many raptor species with their two primary

requirements for maintaining successful populations: sufficient food resources and nesting habitat (Love and Bird 2000).

Urban and suburban landscapes may promote a higher diversity of avian species (Marzluff 2005; Estes and Mannan 2003), which are prey for many raptor species. Perhaps more importantly for raptors than species richness, these urban areas may have higher densities of birds and rodents, resulting in a net higher biomass of potential prey items for raptors than may be found within the native habitats of the region. Several raptor species seem to actively seek out urban areas.

Over 25 species are known to live and breed in cities (Love and Bird 2000; Sumasgutner *et al.* 2014), including the Mississippi Kite (*Ictinia mississippiensis*), Merlin (*Falco columbarius*), Cooper's Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Eurasian Kestrel (*Falco tinnunculus*) and Eastern Screech Owl (*Megascops asio*). These species may sometimes be more common in cities than in natural habitats (Mannan and Boal 2004). The most famous example is the Peregrine Falcon (*Falco peregrinus*; Cade and Bird 1990; McKinney 2002), a species that in many regions is best recognised as a metropolitan, city-dwelling raptor. Species such as these tend to thrive in urban areas because they are free from natural predators and persecution and enjoy an abundant supply of food and habitat (Chace and Walsh 2006; Mannan and Boal 2004).

The trend of raptors colonising urban areas is on the rise, with more and more cases being reported, like the Crested Goshawk (*Accipiter trivirgatus*), Crowned Eagle (*Stephanoaetus coronatus*), Northern Goshawk (*Accipiter gentilis*), Eurasian Sparrowhawk (*Accipiter nisus*), and the Black Sparrowhawk (*Accipiter melanoleucus*) (Martin *et al.* 2014). In contrast, many other raptors are vulnerable to the impacts of urbanisation (Mannan and Boal 2004) and are expected to decline (Møller 2011), due to collisions with windows or traffic, electrocution, predation by domestic animals, shortages of suitable prey or habitat, persecution and poisoning (Mannan and Boal 2004). Cities may also pose more subtle physiological risks to raptors, even to those species which appear to do well in urban areas.

The study aims to investigate the diversity and abundance of birds of prey in Akure metropolis across

land-use types to make informed decisions about urban development.

## 2. METHODOLOGY

### 2.1 Study area

#### 2.1.1 Location

Akure, the capital of Ondo State is situated about 430 Km driving distance from Abuja, the capital city of Nigeria. Akure is also the Headquarters of Akure South Local Government Area and one of the fast-growing cities in Nigeria (Adekola *et al.* 2019). It lies on latitude 7.25° N and longitude 5.19° E (Figure 1). The city is located on 396 meters high above sea level. According to 2006 Nigerian Population Census, Akure has a population of 360,268 but the current estimated population is about 495,000 (Oyinloye and Kufoniyi, 2011).

#### 2.1.2 Climate (temperature and rainfall)

High temperatures and high humidity with two distinct seasons characterize the climate of Akure, namely wet and dry seasons. Wet season lasts for about seven months (April to October) and three months of dry season from December to February with intermittent rain showers in March with an annual rainfall of about 1524mm. Annual temperature ranges between 28° C and 31° C with a mean annual relative humidity of about 80% (Oyinloye and Kufoniyi, 2011).

#### 2.1.3 Wetlands

Akure is endowed with wetland resources located at Gbogi, Isikan, Oke Aro, Alagbaka, Isolo/Oke-Ijebu, Ijapo, Odole/Odiolowo, Erekesan, Idi Agbe, Oke Igan and Ayetoro. (Olajuyigbe *et al.* 2015).

### 2.2 Data collection

Field work covered five land-use types, namely: (1) Highways (2) Industrial areas (3) Residential areas (4) Tertiary institutions and (5) Commercial centres. Birds were surveyed through a systematic sampling technique of randomly selected transects along roadsides, following fixed-routes (3-5 km long) and fixed-point (50 × 50 m) observations as used by Adekola *et al.* (2019). This method is widely used for raptors (Seoane *et al.* 2003; Blanco and Montoya 2004). Roadside counts, a method that despite many limitations has been successfully used to examine relative abundances and habitat preferences of raptors in many large and poorly known regions (Sánchez-Zapata *et al.* 2003). The survey was carried out between March and June 2018. The transect count survey was conducted between 8:00h and 10:00h and 16:00h and 18:00h because bird activities have been observed to be at peak at these hours. Surveys were performed only once per time for each road transect to avoid pseudo replication and double counting.

### 2.3 Statistical analysis

Normality test using Shapiro-Wilk test was conducted for normality and frequency distribution of the residuals. Diversity and abundance estimates were used as response variables in general linear models to determine how they varied across different land-use types. Abundance (number of individuals) was estimated as the total number of individuals counted across transects, while diversity was measured by means of the Shannon–Wiener index. Only perched, foraging or displaying birds clearly within the limits of the plot were recorded. Akaike Information Criterion (AIC) was used to select the best model. R statistical software, version 3.4.1 (R Core Team 2014) was used for data analysis as used by Adekola *et al.* (2019).

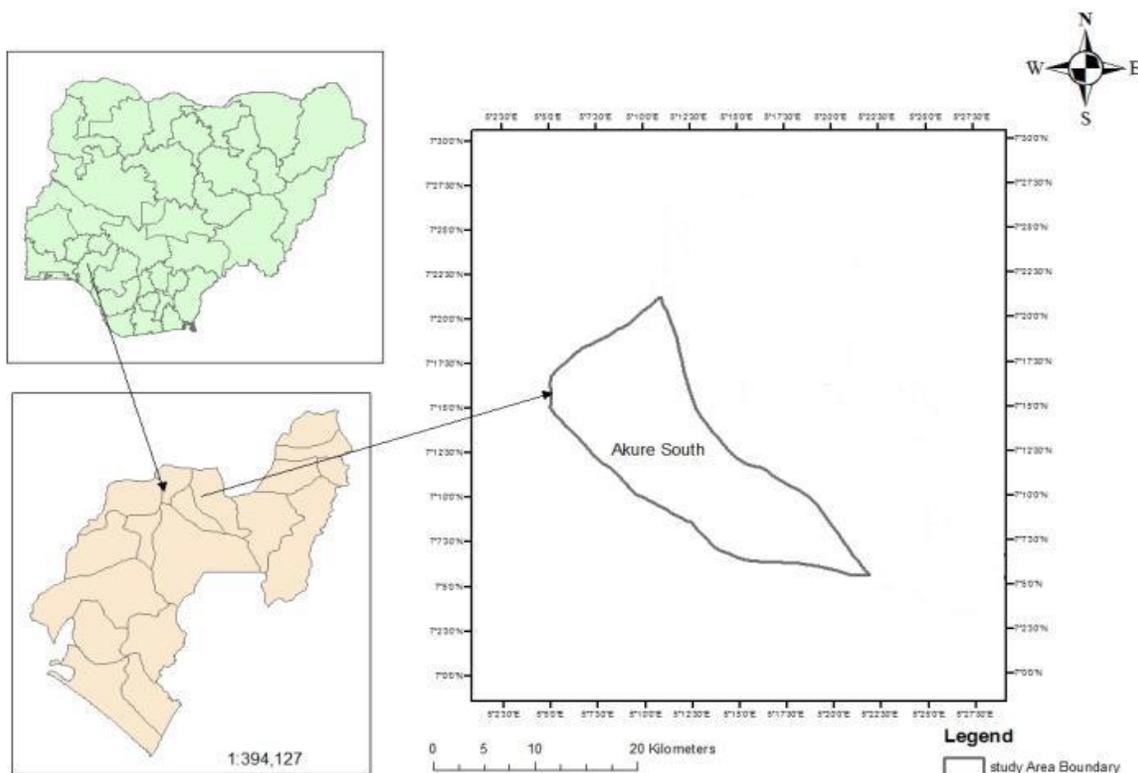


Figure 1: Map of Nigeria showing Ondo State and Akure Metropolis

### 3. RESULTS

#### 3.1 Checklist of Birds of Prey in Akure Metropolis

A total of 849 birds of 11 species belonging to three families were identified and recorded across the five land-use types (Table 1). The three families include Accipitridae (5 species), Falconidae (5 species) and Corvidae (1 species).

#### 3.2 Diversity of Bird of Prey Species in the Land-use Types in Akure

Diversity was highest at Highways (1.50) and lowest at Commercial centres (1.12), while evenness was highest at Commercial centres (0.77) and lowest at Highways (0.50) (Table 2).

Table 1: Checklist of birds of prey recorded in the five land-use types in Akure metropolis, Southwestern, Nigeria

S/N	Family	Common name	Scientific name	IUCN Status
1	Accipitridae	African harrier Hawk	<i>Polyboroides typus</i>	Least Concern
2		Black-shouldered Kite	<i>Elanus axillaris</i>	Least Concern
3		Common Buzzard	<i>Buteo buteo</i>	Least Concern
4		Congo-serpent Eagle	<i>Circaetus spectabilis</i>	Least Concern
5		Lizard Buzzard	<i>Kapifalco monogrammicus</i>	Least Concern
6	Falconidae	Common Kestrel	<i>Falco tinnunculus</i>	Least Concern
7		Grey Kestrel	<i>Falco ardosiaceus</i>	Least Concern
8		Lanner Falcon	<i>Falco biarmicus</i>	Least Concern
9		Lesser Kestrel	<i>Falco naumanni</i>	Least Concern
10		Yellow-billed Kite	<i>Milvus aegyptius</i>	Least Concern
11	Corvidae	Pied Crow	<i>Corvus albus</i>	Least Concern

Table 2: Species Diversity Index (SDI), Evenness, and Equitability of birds of prey across different land-use types in Akure metropolis, Southwestern, Nigeria

S/N	Land-use types	SDI <sup>H</sup>	Evenness <sup>e<sup>H/S</sup></sup>	Equitability <sup>J</sup>
1	Highways	1.50	0.50	0.68
2	Tertiary institutions	1.38	0.66	0.77
3	Industrial areas	1.38	0.57	0.71
4	Residential areas	1.33	0.54	0.69
5	Commercial areas	1.12	0.77	0.8

Table 3: Mean abundance of birds of prey across different land-use types in Akure metropolis, Southwestern, Nigeria

S/N	Land-use types	Mean abundance ± SE
1	Highways	3.55 ± 0.56
2	Tertiary institutions	3.44 ± 0.82
3	Industrial areas	3.07 ± 0.80
4	Residential areas	4.11 ± 0.87
5	Commercial areas	4.40 ± 0.80

Table 4: Species and number of individuals observed across different land-use types in Akure metropolis, Southwestern, Nigeria

S/N	Common name	Abundance	Percentage
1	Pied Crow	344	40.5
2	Yellow-billed Kite	229	27.0
3	Common Kestrel	188	22.2
4	Lizard Buzzard	30	3.5
5	Black-shouldered Kite	25	3.0
6	Common Buzzard	12	1.4
7	Lesser Kestrel	7	0.8
8	African harrier Hawk	7	0.8
9	Grey Kestrel	5	0.6
10	Lanner Falcon	1	0.1
11	Congo serpent Eagle	1	0.1

Table 5: Birds of prey utilizing Infrastructures and Activity across different land-use types in Akure metropolis, Southwestern, Nigeria

S/N	Species Name	Structure Utilized	Activity Observed
1	Pied Crow	Mast	Nesting
		Rooftop	Perching
		Electric pole	Perching
		Billboard	Perching
2	Yellow-billed Kite	Electric pole	Perching
		Billboard	Perching
3	Common Kestrel	Billboard	Perching
		Electric pole	Perching
4	Lizard Buzzard	Rooftop	Perching
5	Black-shouldered Kite	Electric pole	Perching

### 3.3 Abundance of Birds of Prey in Akure

Mean abundance was highest at Commercial centres (4.40) and lowest at Industrial areas (3.07) (Table 3). The species ranking accumulation curve reveals Pied Crow (*Corvus albus*) as the most abundant with 344 individuals recorded, followed by Yellow-billed Kite (*Milvus migrans*) and Common Kestrel (*Falco tinnunculus*) with 229 and 188 individuals recorded respectively (Table 4). Some of the species recorded were observed utilizing man-made structures for different purposes (Table 5).

## 4. DISCUSSION

Forty-six percent (46%) of all tropical birds of prey are threatened by habitat loss (Bildstein *et al.* 1998). Thus, making them hugely adapting to urbanization. Most of the birds of prey recorded were present along highways, probably to take advantage of dead mammals and birds killed by moving vehicles. This is consistent with Marzluff (2001) who stated that distribution of raptors was largely dependent on the availability of food, water and cover. Birds of prey are often used as indicator species owing to their position at the top of the food web and to a number of life history traits (low density or low fecundity) that make them particularly vulnerable to human-induced alterations of their supporting ecosystems (Sergio *et al.* 2006). Their prey species, such as rodents or pigeons, are abundant in urban landscapes, and cities often contain structures that mimic their natural habitats (Mannan and Boal 2004). Studies have shown that raptors are usually the first to go extinct or to be seriously affected in a system after anthropogenic perturbations such as contamination (Duffy 2002), or modification of landscape structure and composition (Chamberlain *et al.* 2000; Carrete *et al.* 2007). Birds of prey have been largely used as indicators of habitat quality (Sánchez-Zapata *et al.* 2003) or biodiversity conservation (Sergio *et al.* 2006).

Roadside surveys have been extensively used to obtain information on the distribution and relative abundance of raptors at several temporal and spatial scales (Fuller and Mosher 1981; Meunier *et al.* 2000), especially in large, poorly known areas where information on the biology and ecology of species is scarce (Bierregaard 1998). Fewer attempts have been made, however, to relate roadside raptor surveys to large-scale habitat transformations (Sánchez-Zapata *et al.* 2003; Seoane *et al.* 2003). The results supported the suitability of this kind of survey to accurately assess abundance of birds

of prey communities in different land-use types. Studies of bird communities have reported different results on the relationship between species richness and diversity and habitat transformation (Hill and Hamer 2004). Some studies argue that these parameters generally decrease with agricultural intensification (Chamberlain *et al.* 2000) and urbanization (Cam *et al.* 2000), whereas others show that both species richness and diversity peaked at moderate levels of development (Anderson 2001).

Signs of breeding activity (nest building, mating, fledglings on nests and young birds begging for food) were seen during the survey which probably revealed adaptability of species to urbanization. This is consistent with the work of Tinajero *et al.* (2017), that reported that birds of prey species richness and diversity decrease with increase in habitat modification by anthropogenic activities. Some of the species have adapted to utilizing man-made structures such as masts, billboards and rooftops for roosting, perching and nesting. For example, concrete buildings resemble the natural cliffs and crags that Peregrine Falcons and kestrels' nest in (McKinney 2002; Sumasgutner *et al.* 2014) Similarly, exotic tree plantations substitute for the natural tropical montane and riparian woodlands which Cooper's Hawks and several other congeners tend to nest in (Mannan and Boal 2004).

## 5. CONCLUSION AND RECOMMENDATIONS

1. Akure is blessed with diverse birds of prey with Pied Crows as the most abundant usually present at highways.
2. Accipitridae and Falconidae were the most abundant families recorded.
3. Bird diversity was highest at highway while abundance was highest at Commercial centres.
4. Birds of prey have undoubtedly adapted to urbanization and thus utilizing infrastructures for their day-to-day activities such as roosting, nesting, breeding etc.
5. Public awareness must 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.

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## APPENDICES



Appendix 1: Black-shouldered Kite (*Elanus axillaris*) perching on an electric pole in Akure metropolis, Southwestern, Nigeria



Appendix 2: Pied Crow (*Corvus albus*) using mast as nesting and roosting site in Akure metropolis, Southwestern, Nigeria



Appendix 3: Common kestrel (*Falco tinnunculus*) perching on a roof top in Akure metropolis, Southwestern, Nigeria