Direct Research Journal of Agriculture and Food Science
Vol. 11(2) Pp. 18-24, February 2023
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS08263419
Article Number DRJAFS08263419

https://directresearchpublisher.org/drjafs/

Original paper

Assessment of Species Diversity and Relative Abundance of Raptors in North Western Region of Nigeria

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Received 9 December 2022; Accepted 23 January 2023; Published 2 February 2023

ABSTRACT: The purpose of this study was to find out the diversity, distribution and abundance of raptor species in North Western Region of Nigeria. The study was conducted between September, 2022 and January 2023. Road transect line method was used to collect data on bird diversity, abundance and distribution 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. Birds were counted as birds seen and birds in-flight were also counted. The species relative abundance index was used to find the relative abundance in the region, whereas Shannon-Wiener diversity index (H') was used to determine species diversity. A total of thirty two (32) species of 3 families were recorded including species of global conservation concern during this study, indicating that the North western region of Nigeria is an important breeding, roosting, and feeding habitat for several raptor species. The findings from this study provide evidence that the areas can serve as a refuge for birds. Therefore, conservation efforts should as well be directed towards making communities view human occupied areas as a habitat for birds, and not as a lost habitat.

Keywords: Abundance, raptors, road transect, bird

INTRODUCTION

The raptors are excellent bio-indicators of environmental health and widely preferred for monitoring of wildlife and conservation programs (Mac Nally *et al.*. 2004, Chambers, 2008). Since raptors are located at the top of the food chains, their population fluctuations provide good information for natural ecosystems (Herremans-Tonnoey, 2000). Hence important information on natural ecosystems could be obtained by monitoring raptor species. Most of the raptors are seriously threatened in Europe (Birdlife, 2004), Asia, Middle East and Africa (Cramp 1998, Ferguson-Lees and Christie, 2001, Mebs and Schmidt, 2006). It is essential therefore to determine the status and distribution of this group in different countries and regions. Quantifying the species abundance of bird's communities has gained increasing Importance in environmental impact assessment especially in conservation planning and ecological research (Bibby *et al.,* 2000). Species inventories not only help in understanding species losses but also help determine the characteristics of species that are vulnerable to habitat perturbations (Koh *et al.,* 2004). The species richness is simply the total number of species within a habitat or community. Species richness is the most commonly used measure of diversity because it is a straight forward measure and it is intuitive. The main problem with using species richness is that it does not provide any information on how well each of the species is represented in the sampled area. Species diversity is a measure of both the number of species (species richness) and the relative contribution of each of these

species to the total number of individuals in a community (evenness) (Stiling, 2002). Diversity has been referred to as the quantitative measure that reflects how many different species are in existence in a data set. A variety of objective measures have been created in order to measure of diversity. The basic idea is to obtain a quantitative estimate of biological variability that can be used to compare biological entities, composed of direct components, in space or time (Albert, 2012). Monitoring of species is therefore important in determining conservation actions if set plans to be effective in achieving population objectives that for increasing populations to reach target levels. Assessment of birds' species richness and abundance of an area makes it possible for any organization to plan for future conservation and sustainable utilization of avifauna resources (Bird Life International, 2008).

MATERIALS AND METHODS

Study area

North Western Nigeria is composed of three distinct geographic entities: Sokoto-Rima Basin, the Kano Region and the North Central Highlands (Udo, 1970). Northwest zone of Nigeria is located between Latitudes 9^{o} 021N and 13^{o}581N and Longitudes 3^{o} 081E and 10^{o}151E (Fig.1). Of the Nigeria's total area of 923,768 km^{2}, north western region occupies a total of 226, 662 km^{2}. Northwest zone of Nigeria shares borders with Niger Republic in the northern part, Benin and Niger Republic in the Western part, Niger State and FCT to the south, and Yobe, Bauchi and Plateau States to the East. It covers seven states namely: Jigawa, Kano, Katsina, Zamfara, Sokoto, Kebbi and Kaduna.

The climate of Northwest zone of Nigeria is the tropical wet-and-dry type (Koppen's Aw climate). The wet season starts from April through October with a peak in August, while the dry season extends from November of one calendar-year to April of the next (Abaje *et al.,* 2012). The annual average rainfall varies from about1, 733 mm at the extreme southern part of the zone to about 600 mm at the extreme northern part (Abaje *et al.,* 2016) (Figure 1). The rainfall intensity is very high between the months of July and August (ranging from 60 mm hour-1to 99 mm hour-1) (Oladipo, 1993). The pattern of rainfall in this region is highly variable in spatial and temporal dimensions with an inter-annual variability of between 15 and 20% (Abaje, 2016).

The climate is dominated by the influence of the relative warm and moist tropical maritime (mT) air mass, which originates from the Atlantic Ocean associated with Southwest winds in Nigeria; and the relatively cool, dry and stable tropical continental (cT) air mass that originates from the Sahara Desert and is associated with the dry, cool and dusty Northeast Trades known as the Harmattan (Abaje *et al*., 2015). These two air masses (mT and cT) meet along a slanting surface called the Intertropical Discontinuity (ITD). The movement of the ITD northwards across northern part of this zone in August (around latitude 21 to 22^{o}N) marks the height of the rainy season in the whole zone while its movement to the southernmost part around January/February (approximately at 6^{o}N) marks the peak of the dry season in the zone (Abaje *et al*., 2017). The movement of the ITD is very irregular, varying according to the season from 20 to 5.60 of latitude per month, and the southward retreat of the ITD is faster than its northward advance. While the northward advance is at the rate of about 160 km per month, that of the southward retreat is at about 320 km per month (Ayoade, 2005). This accounts for the rather gentle onset of the rainy season in the zone and its rather abrupt end (Abaje, 2016). The highest average air temperature normally occurs during the hot season (March to May) while the lowest average air temperature occurs during the cold season (December to February) (Abaje *et al.,* 2017).

The vegetation type of north-western Nigeria is of the West African type which follows the pattern of rainfall distribution. The north-western Nigeria falls within Sudan Savannah zone of Nigeria, distinguished by large expanse of grasslands with widely spaced trees of varying heights and diversity. The Sudan savannah belt is found dominating the Sokoto Plains across to the Chad Basin, covering over a quarter of the country's land area. It is found in places with rainfall of about 600 - 1000 mm and 4 - 6 months of dry season. The vegetation is made up of grasses 1-2 m high and often stunted trees. Some of the most frequent trees in this environment are *Hyphaene thebaica*, *Parkia biglobosa, Adansonia digitata, Fadherbia albida, Tamarindus indica*, *Borassus aethiopum, Prosopis africana, Balanite aegyptiaca, Acacia nilotica* and exotic species such as *Azadirachta indica, Eucalyptus camaldulensis and Cassia siammea*.

Survey design

The survey within the north-western Nigeria was carried out for fifteen weeks from 01 September to 31 December 2022. This period coincided with the cessation of the rainy season, with insignificant rainfall during the period of the survey. Twelve line-transects (Bibby *et al*., 2000) of an average length of 60 km were used to count raptors. A total distance of 7,064 km was covered during this transect survey. Transects were chosen to cover four states (Jigawa, Kano, Katsina and Sokoto States). The coordinates of the start and end of each transect were recorded. Surveys were carried out in the morning (6h30 13h00) and evening (15h00–18h00) because bird

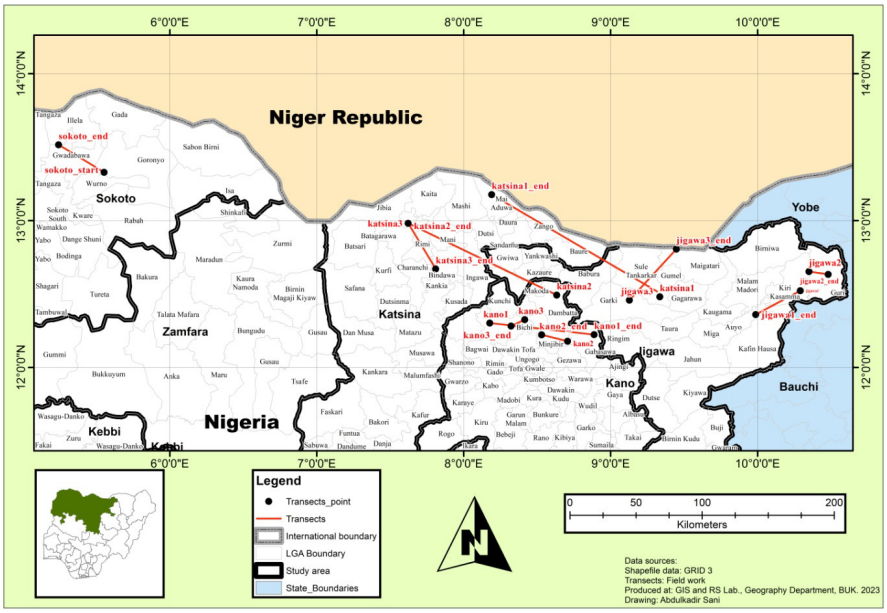

Figure 1: Map of study area showing transect line.

activities have been observed to be at peak at these hours. Counts were made by two non-driving observers from a car moving at an average speed between 20 and 30 km/h (Fuller and Mosher 1981). All raptors flying, perched and heard were identified, counted and their locations recorded using a Garmin 760CSx global positioning system (GPS) receiver. Using binoculars and a telescope, the surroundings were scanned for any raptors seen perched or flying. Efforts were made to avoid double counts of birds observed by noting the direction in which the last counted individual disappeared from sight and the flock size. All raptors seen perched or flying or heard were identified and recorded. Surveys were carried out between 10h00 and 14h00, and all transects were visited once every month for four months.

Data analyses

Data collected was explored for parametric assumptions to find whether it is normally distributed or not. Shannon wiener diversity will be used to compute species diversity. Shannon-Wiener Index is defined and given by the following function:

$H=\sum[(pi)\times ln(pi)]$

Where

- *Pi*= proportion of total sample represented by species *i*. Divide no. of individuals of species i by total number of samples.
- *ln(pi)* = Natural log of *Pi*

The relative abundance of the bird species will be determined by using expression:

$$\text{Relative abundance } (\%) = \frac{n}{N} \times 100$$

Where, n is the numbers of individuals of particular recorded species and N is the total number of individuals of recorded species.

RESULTS AND DISCUSSION

The results presented in (Table 1) below showed the outcome of transect survey of raptors species diversity in North western region of Nigeria. Transect line survey method detected a total of 1,099 individual birds of prey that belong to thirty two (32) species of 3 families during this study indicating that the North western region of Nigeria is an important breeding, roosting, and feeding habitat for several raptors (Table 1). The study revealed that raptors distributed throughout the region are influenced by food availability and habitat. In the present study, 32 species of Raptors were identified belonging to 3 families from the North western region of Nigeria. 24 species are considered as common, 6 occasional, 5 winter visitor and 7 as rare species of raptors were reported in Rajaji National Park (Das et al., 2011). Out of 32 species, family Accipitridae has 24 species i.e. 75%,

Table 1: Raptors species in north western region of Nigeria.

S/No.	Common Name	Scientific Name	Family
1.	Gabar Goshawk	*Micronisus gabar*	*Accipitridae*
2.	Yellow Billed Kite	*Milvus aegyptius*	*Accipitridae*
3.	Black Winged Kite	*Elanus caeruleus*	*Accipitridae*
4.	African Swallow Tailed Kite	*Chelictinia riocourii*	*Accipitridae*
5.	African Goshawk	*Accipiter tachiro*	*Accipitridae*
6.	Long Crested Eagle	*Lophaetus occipitalis*	*Accipitridae*
7.	Red Necked Buzzard	*Buteo auguralis*	*Accipitridae*
8.	Lizard Buzzard	*Kaupifalco monogrammicus*	*Accipitridae*
9.	Bat Hawk	*Macheiramphus alcinus*	*Accipitridae*
10.	Red Necked Falcon	*Falco chicquera*	*Falconidae*
11.	African Marsh Harrier	*Circus ranivorus*	*Accipitridae*
12.	Black Sparrow Hawk	*Accipiter melanoleucus*	*Accipitridae*
13.	Ovambo Sparrow Hawk	*Accipiter ovampensis*	*Accipitridae*
14.	Western Marsh Harrier	*Circus aeruginosus*	*Accipitridae*
15.	Shikra	*Accipiter badius*	*Accipitridae*
16.	Dark Chanting Goshawk	*Melierax metabates*	*Accipitridae*
17.	Black Kite	*Milvus migrans*	*Accipitridae*
18.	Grey Kestrel	*Falco ardosiaceus*	*Falconidae*
19.	Lanner Falcon	*Falco biarmicus*	*Falconidae*
20.	Lesser Kestrel	*Falco naumanni*	*Falconidae*
21.	Common Kestrel	*Falco naumanni*	*Falconidae*
22.	Wahlbergs Eagle	*Hieraaetus Wahlberg*	*Accipitridae*
23.	Pallid Harrier	*Circus macrourus*	*Accipitridae*
24.	African Harrier Hawk	*Polyboroides typus*	*Accipitridae*
25.	Barn Owl	*Tyto alba*	*Tytonidae*
26.	Grasshopper Buzzard	*Butastur rufipennis*	*Accipitridae*
27.	Montagus Harrier	*Circus pygargus*	*Accipitridae*
28.	Tawny Eagle	*Aquila rapax*	*Accipitridae*
29.	Martial Eagle	*Polemaetus bellicosus*	*Accipitridae*
30.	Fox Kestrel	*Falco alopex*	*Falconidae*
31.	African Fish Eagle	*Haliaeetus vocifer*	*Accipitridae*
32.	Red-footed Falcon	*Falco vespertinus*	*Falconidae*

Source: Field Survey, 2022

Falconidae has 7 species i.e 22% and Tytonidae has 1 specie i.e. 3% of raptors (Table 1). According to IUCN status 27 species were Least Concern (LC), 3 species were Near Threatened (NT), 1 specie was Endangered (EN) and 1 specie was Vulnerable (V) (Table 2).

A similar result with species of Endangered, vulnerable category, Near Threatened and Least Concerned species has been previously reported from Hadejia-Nguru wetlands, Nigeria (Sabo and Mohammed, 2022). A variety of threats like sporadic fire, cattle grazing, mining and illegal Non Timber Forest Product collection by local communities affecting the safe nesting, roosting sites and prey base and eventually the population size. Protection of breeding, roosting, and feeding areas to aid in raptor conservation, as well as awareness and education programs for people who contribute to raptor conservation. Identification is one key to understanding the biology of a species, it might then be possible to develop conservation strategies to ensure the future of the raptors. Disturbances, habitat loss and decrease in food availability present serious threats for the raptors in the studied region.

Accipitridae with 24 species is the richest family in species number and Falconidae with 7 species. This result is in conformity with the findings of Sabo and Mohammed (2022) and Okosodo *et al*., (2016) who reported accipitridae as the richest family in their studies conducted at Hadejia-Nguru wetlands and South Western Nigeria respectively.

It is also in agreement with Kabir (2013) who conducted his research in Bangladash and reported accipitradae as the richest family. Also, this study recorded higher number of falconidae family than that of previous report of 3 species of falconidae reported by Lee (2013) in his study on distribution and abundance of raptors in the Korean peninsula.

Table 2: Migratory and conservation status of raptor species.

S/No.	Common Name	Conservation Status	Migratory Status
1.	Gabar Goshawk	LC	Resident
2.	Yellow Billed Kite	LC	Resident
3.	Black Winged Kite	LC	Resident
4.	African Swallow Tailed Kite	LC	*Intra- African Migrant*
5.	African Goshawk	LC	Resident
6.	Long Crested Eagle	LC	Resident
7.	Red Necked Buzzard	LC	Resident
8.	Lizard Buzzard	LC	Resident
9.	Bat Hawk	LC	Resident
10.	Red Necked Falcon	NT	Resident
11.	African Marsh Harrier	LC	Resident
12.	Black Sparrow Hawk	LC	Resident
13.	Ovambo Sparrow Hawk	LC	Resident
14.	Western Marsh Harrier	LC	Palearctic visitor
15.	Shikra	LC	Resident
16.	Dark Chanting Goshawk	LC	Resident
17.	Black Kite	LC	Palearctic visitor
18.	Grey Kestrel	LC	Resident
19.	Lanner Falcon	LC	Resident
20.	Lesser Kestrel	LC	Palearctic visitor
21.	Common Kestrel	LC	Palearctic visitor
22.	Wahlbergs Eagle	LC	Resident
23.	Pallid Harrier	NT	Palearctic visitor
24.	African Harrier Hawk	LC	*Resident*
25.	Barn Owl	LC	*Resident*
26.	Grasshopper Buzzard	LC	Intra-African Migrant
27.	Montagus Harrier	LC	Palearctic visitor
28.	Tawny Eagle	VU	*Resident*
29.	Martial Eagle	EN	*Resident*
30.	Fox Kestrel	LC	*Resident*
31.	African Fish Eagle	LC	*Resident*
32.	Red-footed Falcon	NT	*Resident*

Source: Field Survey, 2022
Key: LC – Least Concern, VU – Vulnerable, EN – Endangered, NT – Near Threatened

Table 3: Birds of prey relative abundance in the study Area.

S/No.	Bird Species	Observations	Relative Abundance %
1.	Gabar Goshawk	315	28.7
2.	Yellow Billed Kite	114	10.4
3.	Black Winged Kite	182	16.6
4.	African Swallow Tailed Kite	40	3.64
5.	African Goshawk	36	3.28
6.	Long Crested Eagle	10	0.91
7.	Red Necked Buzzard	14	1.27
8.	Lizard Buzzard	17	1.55
9.	Bat Hawk	12	1.09
10.	Red Necked Falcon	11	1.00
11.	African Marsh Harrier	19	1.73
12.	Black Sparrow Hawk	5	0.45
13.	Ovambo Sparrow Hawk	10	0.91
14.	Western Marsh Harrier	21	1.91
15.	Shikra	17	1.55
16.	Dark Chanting Goshawk	28	2.55
17.	Black Kite	5	0.45
18.	Grey Kestrel	46	4.19
19.	Lanner Falcon	5	0.45

20.	Lesser Kestrel	19	1.73
21.	Common Kestrel	44	4.00
22.	Wahlbergs Eagle	14	1.27
23.	Pallid Harrier	12	1.09
24.	African Harrier Hawk	16	1.46
25.	Barn Owl	1	0.09
26.	Grasshopper Buzzard	21	1.91
27.	Montagus Harrier	8	0.73
28.	Tawny Eagle	10	0.91
29.	Martial Eagle	6	0.55
30.	Fox Kestrel	13	1.18
31.	African Fish Eagle	29	2.64
32.	Red-footed Falcon	15	1.36
33.		1,099	

Source: Field Survey, 2022

Relative abundance of birds of prey in North Western Region of Nigeria

In North western region of Nigeria, a total of 1,099 individual raptors of 32 species belonging to 3 families were recorded. Three species, Gabar goshawk (*Micronisus gabar*) (28.7%), Black Winged Kite (*Elanus caeruleus)* (16.6%) and yellow billed kite (*Milvus aegyptius*) (10/4%) were the most dominant species in the region. In contrast, Barn owl (*Tyto alba*) (0.09%), Black Sparrow Hawk (*Accipiter melanoleucus)*, Lanner Falcon (*Falco biarmicus*) and Black Kite (*Milvus migrans*) have a relative abundance of (0.45%), Martial eagle (*Polemaetus bellicosus*) (0.55%), Montagus harrier (*Circus pygargus*) (0.73%), Tawny eagle (*Aquila rapax*) (0.91%), Ovambo Sparrow hawk (*Accipiter ovampensis*) (0.91%) and Long crested eagle (0.91%) were the rarest birds of prey species in the region (Table 3). Gabar Goshawk, Yellow billed kite and black shouldered kite species were also found to be the most dominant species as reported by Zakaria *et al.,* (2009) in Peninsular (Malaysia), Odewumi *et al.,* (2017) in Ondo State (Nigeria), as well as Olumide and Sunday (2018) in Oyo State, Nigeria. The findings of this study is not in conformity with Chiatante and Panuccio (2021) who recorded, 168 raptors of 10 species in Armenia with the Black kite been the most abundant species, followed by the Common Kestrel and the Western Marsh Harrier. Furthermore, the prevalence of these species is probably due to the availability of aquatic insects and other suspended macro-invertebrates that serve as the diet of many bird species.

Conclusion

The species richness of birds of prey in North Western part of Nigeria shows there were 32 species of birds of prey belonging to three families during the study period. Out of 32 species, family Accipitridae has 24 species i.e. 75%, Falconidae has 7 species i.e 22% and Tytonidae has 1 specie i.e. 3% of raptors (Table 1). According to IUCN status 27 species were Least Concern (LC), 3 species were Near Threatened (NT), 1 specie was Endangered (EN) and 1 specie was Vulnerable (V). 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 birds community in the region.

Recommendation

This survey shows that the North Western region of Nigeria retains a considerable number of raptor species that normally occur in West Africa. Therefore, it is recommended that efforts should be made to enlighten the surrounding communities on the need to stop the persecution of raptors. However an additional study on the feeding habits, nesting and breeding patterns of the raptors will enhance the fauna. A raptor monitoring programme also needs to be put in place to detect changes in the region. Raptor conservationists should remember early advice from Rosalie Edge—"The time to protect a species is while it is still common."

Acknowledgement

The authors wishe to express gratitude to the Tertiary Education Trust Fund (TetFund) for funding the staff training and development intervention program in Nigeria. I also want to appreciate the management of Binyaminu Usman Polytechnic Hadejia, Jigawa State, Nigeria. I must also thank the authors whose publications are useful in our research.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or of this

article

REFERENCES

Abaje, I. B., Sawa, B.A., Iguisi, E.O. and Ibrahim, A.A. (2015). Assessment of Rural Communities' Adaptive Capacity to Climate Change in Kaduna State, Nigeria. *Journal of Environment and Earth Science*, 5 (20), 14-23.

Abaje, I.B. (2016). Assessment of Rural Communities' Perceptions, Vulnerability and Adaptation Strategies to Climate Change in Kaduna State, Nigeria.Unpublished PhD Thesis, Department of Geography, Ahmadu Bello University, Zaria, Nigeria.

Abaje, I.B., Abashiya, M., Onu, V. and Masugari, D.Y. (2017).Climate Change Impact and Adaptation Framework for Rural Communities in Northern Nigeria.*Jorind,* 15 (2), 142-150.

Abaje, I.B., Ati, O.F. and Iguisi, E.O. (2012).Changing Climatic Scenario and Strategies for Drought Adaptation and Mitigation in the Sudano–Sahelian Ecological Zone of Nigeria. Publication of the Association of Nigerian Geographers (ANG) and the Department of Geography, Usman Danfodio University, Sokoto.99-121.

Abaje, I.B., Sawa, B.A., Iguisi, E.O. and Ibrahim, A.A. (2016).Impacts of Climate Change and Adaptation Strategies in Rural Communities of Kaduna State, Nigeria. *Ethiopian Journal of Environmental Studies and Management,* 9 (1): 97 – 108.

Albert, O.H. (2012). Measurement of Species Diversity in Developing Nations. *Journal of Applied Ecology*. Blackwell Publishing. Oxford, U.K. Pp 22-29.

Ayoade, J.O. (2005). Introduction to Agroclimatology (2nd ed.). Ibadan: University Press Plc.

Bibby, C. J., Burgess, N., Mustoe, S.H. and Hill, D.A. (2000). Bird Census Techniques. London Academic Press.

Birdlife International (2008). Bird Life's online World Bird Database: The Site for Bird . Version 2.1. Cambridge, UK: Birdlife International.

BirdLife International (2004). Birds in the European Union: A Status Assessment. Bird Life International, Wageningen, The Netherlands, 160.

Chambers, S.A. (2008). Birds as Environmental Indicators: Review of Literature. Parks Victoria Technical Series No. 55. Parks Victoria, Melbourne, 48

Chiatante, G. and Panuccio, M. (2021). Environmental factors affecting the wintering raptor community in Armenia, Southern Caucasus. *Community Ecology* https://doi.org/10.1007/s42974-021-00038-7

Cramp, S. (1998). The Complete Birds of the Western Palearctic. Oxford University Press. CD ROMs.

Das, S.K., Dashrahe, A., Marathe, S., Kundu, N. and Kesharwani, R. (2011). Status of Raptors with Special Reference to Vultures in and Around Rajaji National Park, India, *World Journal of Zoology*; 6 (4), 350-356

Ferguson-Lees, J. and Christie, D.A. (2001). Raptors of the World. Christopher Helm, London, 320

Fuller, M.R. and Mosher, J.A. (1981). Methods of Detecting and Counting Raptors: A Review. *Stud Avian Biol* 6:235—24.

Herremans, M. and Herremans-Tonnoeyr, D. (2000). Land use and the Conservation Status of Raptors in Botswana. *Biological Conservation* 94: 31–41. DOI: 1 0.1 01 6/S0006- 3207(99)001 66-4

Kabir, A. (2013). Abundance and Distribution of the Raptors in Bangladesh, *Global Journal of Poultry Farming and Vaccination*, pp. 007-010.

Koh, L. P., Sodhi, N. S. and Brook, B. W, (2004). Prediction Extinction Proneness of Tropical Butterflies. *Conservation Biology, 18, 1571—1578*

Lee, S. (2013). Distribution and Abundance of Wintering Raptors in the Korean Peninsula, *J. Ecol. Environ*. 36(4): 211-216.

Mac Nally, R., Ellis, Mand and Barret, G. (2004). Avian Biodiversity Monitoring in Australian Rangelands. *Austral Ecology* 29: 93–99. DOI: 1 0.1111 /j.1 442-9993.2004.01 352.x.

Mebs, T. and Schmidt, D. (2006). Die Greifvögel Europas, Nordafrikas und Vorderasiens Biologie, Kennzeichen, Bestände. Franckh-Kosmos Verlags Stuttgart, 495.

Odewumi, O.S., Adekola, O.E. and Aladesiun, O.A. (2020). Diversity and Abundance of Birds of Prey in Akure Metropolis, Ondo State, Nigeria, *Journal of Forest Science and Environment* . 5(2020): 1 – 10.

Okosodo, E.F., Orimaye, J. O. and Odewumi, O.S. (2016).Diversity and Abundance of Birds of Prey and Owls in Four Selected Areas in South Western Nigeria.*International Journal of Environment, Agriculture and Biotechnology (IJEAB) Vol-1, Issue -2, ISSN: 2456-1878.*

Oladipo, E.O (1993). Some Aspects of the Spatial Characteristics of Drought in Northern Nigeria. Natural Hazards, Netherlands. 8:171-188.

Olumide, A.M. and Sunday, O.O. (2018). Avian Conservation In Man-Made Wetland: A Case Study Of Asejire And Eleyele Dams, Oyo State, *Nigeria. Journal of Sustainable Development in Africa*, 2018; 20(2), 17-32.

Sabo, B.B., Mohammed, S., and Danladi, S.I. (2022). Assessment of Raptor Species Relative Abundance in Hadejia Nguru Wetlands, Nigeria. *Gadau J Pure Alli Sci, 1(2): 189-199. https://doi.org/10.54117/gjpas.v1i2.37*

Stiling, P. (2002). Ecology Theories and. Applications 4th edition Prentice Hall of India private Ltd New Delhi l000lpg 300

Udo, R.K. (1970).Geographical Regions of Nigeria. London: Heinemann

Zakaria, M., Rajpar, M.N. and. Sajap, S.A. (2009). Species Diversity and Feeding Guilds of Birds in Paya Indah Wetland Reserve, Peninsular Malaysia. *Intl. J. Zoological Res*., 5 (3): 86–100.