Population Status, Feeding Behaviour and Habitat Preference of Helmeted Guinea Fowl (*Numida meleagris*) in Surrounding Vegetation of Cross River University Technology, Nigeria

Comment [C1]: The authors should verify the words limit that can be used in the Title of the AJRIZ journal.

ABSTRACT

The population status, feeding behaviour and habitat preference of the helmeted guinea fowl (*Numida meleagris*) ~~was~~ were investigated in this research. The period of carrying out the research comprised from ~~within ten months, j~~January to o~~O~~ctober~~,~~ of 2021. The line transect method was used to collect data on the population status of the species. The quadrate vegetation sampling method was used to investigate the preferred habitat. Data generated from the research were analyzed using descriptive statistics, while results were compared using chi-square test (X^2). The average number of *Numida meleagris* in the study area was 434 and 293 during the wet and dry seasons, respectively. The most important daytime activities of ~~helmeted guinea fowl~~the species were feeding, resting, scanning and running. The observed population ~~of the guinea fowl~~ differ significantly across sectors during the wet and dry seasons ($-X^2$ = 8.00, p = 0.03). The relationship between allocated time to each activity and time of the day was greatly significant (t = 4.04, p = .001). The number of individuals was 3.0±4.0 and 5.0±0.2 individuals/km^2 during the dry and wet seasons, respectively. The importance value index (IVI) for *Gmelina arborea, Tectona grandis* and *Elaeis guineensis were* 24.41, 20.39, and 18.17, representing the dominant plant species in the study area. Human disturbance was responsible for loss of habitat, nesting and foraging sites. Protection of the habitat against exploitation will reduce poaching habitat destruction, and restore its nesting sites, thereby increasing its population.

Comment [C2]: The abstract should highlight the main findings of the research.

Keywords: Population, helmeted guinea fowl, feeding behaviour, habitat.

Comment [C3]: It is highly recommended to do not use same words as used in the manuscript title.

1. INTRODUCTION

The helmeted guinea fowl (*Numida meleagris*) is a bird species of the *Numididae* family. They are terrestrial birds capable of strong flight, but prefer to run often than fly. The species are highly polygamous and form breeding pairs [1~~16~~].

They~~ species~~ eat mostly grubs, roots, tubers, small reptiles, crawling insects, and occasionally vegetables and fruits. The species is found in many African countries such as Senegal, Gambia, Guinea, Sierra Leone, Mali, Burkina Faso, Ghana, and Nigeria, as well as in sub-tropical and tropical Savannahs, grasslands, and shrub land [26].

Though the species is classified by the ~~i~~international U~~u~~nion for ~~the~~ C~~c~~onservation of N~~n~~ature ~~and~~ (IUCN) ~~natural resources~~ [39] as least concerned (LC), because of their abundance and extensive range.~~,~~. The increase ~~increasing~~of the human population, conversion of land for agriculture, burning and environmental degradation have resulted to the decline in the population of the species. The helmeted guinea fowl is also found within the vegetation area in Obubra campus of Cross River University of Technology (CRUTECH), located in Nigeria. This supposedly protected area ~~is not protected as such, as the area~~ is exposed to anthropogenic activities by the locals.

Though the species is wide spread and sparingly distributed in areas where it occurs, the current status of its population, feeding behaviour and habitat preference, as well as its management problems as it relate to human interference are still poorly reported [1~~34~~]. This is necessary to prevent the decimation of the species population, emigration to other unsafe areas, and possible extermination. For effective conservation strategies to be adopted, understanding the status of the population as well as the habitat preference of the helmeted guinea fowl is desirable.

Birds generally are good indicators of the quality and health of ecosystems. The helmeted guinea fowl is an important component of the ecosystem. The demand for agricultural land couple with visible anthropogenic activities like hunting of animal for bush meat, decimation of habitats for

Formatted: Justified

Comment [C4]: Insert References list numbers as it appears in the order the text.

This reference should be the first [1].

Do it to all the references used in the manuscript text.

Additionally, redo the references list.

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

agricultural and other land development purposes, as well as its use as fuel wood is alarming [45]. These constitutes the major factors threatening the survival of the helmeted guinea fowl within its range, thereby mounting pressure on the species population and its habitat. There is ~~yet~~ no study on any species of guinea fowl in the study area yet, but its population in other parts of Africa, Asia and Europe is reported to be declining [67].~~-~~

This study can provide useful information for effective planning, monitoring and evaluation, while guiding experts on which conservation measures to adopt. This information can reduce emigration of species to unsafe areas, maintain a balance in its population, if not increase it numbers, and ensure the protection of the species and its habitat.

Therefore, this study aims~~is therefore designed to~~ estimate the population density, feeding behaviour, and habitat preference ofthe helmeted guinea fowl in the Obubra campus (Nigeria)~~study area~~. ~~Birds generally are good indicators of the quality and health of ecosystems. The helmeted guinea fowl is an important component of the ecosystem. The demand for agricultural land couple with visible anthropogenic activities like hunting of animal for bush meat, decimation of habitats for agricultural and other land development purposes, as well as its use as fuel wood is alarming [4]. These constitutes the major factors threatening the survival of the helmeted guinea fowl within its range, thereby mounting pressure on the species populationand its habitat. There is yet no study on any species of guinea fowl in the study area, but its population in other parts of Africa, Asia and Europe is reported to be declining [7]. This study can provide useful information for effective planning, monitoring and evaluation, while guiding experts on which conservation measures to adopt. This can reduce emigration of species to unsafe areas, maintain a balance in its population if not increase it numbers, and ensure the protection of the species and its habitat.~~

2. MATERIALS AND METHODS

2.1. Study a~~A~~rea

The study was conducted in the surrounding vegetation of Obubra campus, ~~of~~ Cross River University of Technology, Nigeria. The area comprehends 1115km^2 [11], and ~~lies~~is located

Formatted: Highlight

Formatted: Highlight

Comment [C5]: The methodology needs to be improved. Describe better the methods.
Insert more bibliographic references.

Formatted: Justified

Formatted: Font: Not Bold

Formatted: Justified

Formatted: Font: 12 pt, Not Bold

between latitude 5°9' 45'' and 6°9' 15'' North of the equator andlongitude 8°9' 12'' East. ~~The total land area of Obubra is 1115km^2 [11].~~ The climate is characterized by distinct wet and dry seasons, with an annual rainfall distribution of between 2500mm to 3000mm, and an annual temperature ranging from ~~of~~ 25 ~~–~~to 27°9 ~~c~~C [1].

2.2. Sampling techniques and experimental procedure

Preliminary survey was conducted to determine the potential location of the species in the study area using the~~.~~ ~~The~~ line transect method ~~was used for survey~~. This method involves walking and recording species on both sides of a predetermined route. In transect distance estimation is perpendicular to the line transect, rather than the distance from the bird to the observer following the method proposed by Hosteler & Main [8]. The area was divided into four (4) sectors; Northern (N), Western (W), Eastern (E) and Southern (S) ~~sectors.~~

Three (3) transects each measuring 3km and 10m in width ~~will be~~were laid in upland agricultural field (UAF), lowland swamp field (LSF) and secondary forested area (SFA) in each of the sectors respectively. Each transect (1.5km) in a 10,000km^2 area was walked simultaneous with trained assistants for sixty minutes to avoid double counting.

Data was collected periodically, between morning (6:30am), afternoon and evening (6:30pm), being three months each in the rainy season and dry season. The species abundance was recorded using the visual and call method (REFERENCE). Silent movement followed by five minutes waiting was allowed before the commencement of the survey to avoid habitat disturbance [8]. The materials used include binoculars, field note books, pencils, biros, stopwatches, identification guides, data recording sheets, protective clothing, and measuring tape.

2.3. Estimating population

Data was collected consecutively for three days every month for ten (10) months, between morning

Formatted: Highlight

Formatted: Highlight

Formatted: Justified

Formatted: Highlight

Comment [C6]: Suggestion: Insert a figure showing the transects design used in the experiment.

Comment [C7]: The transects division followed some previously used method/standard? Please provide this information and cite the bibliographic reference.

Comment [C8]: Insert a bibliographic reference confirming the use of the mentioned method.

Comment [C9]: This “waiting time” followed some previously used method/standard? Please provide this information and cite the bibliographic reference.

Formatted: Highlight

Formatted: Justified

Formatted: Font: 11 pt, Not Bold

(6:30am), afternoon and evening (6:30pm). The direct method, involving the transect method and indirect methods, approaching calls and visual observation, ~~was~~ were employed in population estimation. ~~The direct method is the transect method while the indirect method involves calls and visual observation.~~ The population density was determined using the formula (equation 1) proposed by Asokan et al. [2].

D = N / 2 x L x W ~~$D = \sum \frac{n}{\quad} .2LW$~~ (Equation 1)

Where: D = estimated density of the species; ~~L = total transect; Nn~~ = number of the species detected; L = total transect; W = width of transect, ~~D = estimateddensity of the species [2].~~

2.4. Feeding behaviour

Time spent and activity carried out during foraging, time of day, length and site of perching, preening, resting, and flying will be recorded using field observations approaching the methodology proposed by Shimelis and Afework [15]. The focal sampling method was used repeatedly to watch and follow the species for ten minutes, early in the morning and late in the evening. Additionally~~Also,~~ type of food items consumed were recorded.

2.5. Habitat preference

Major plant species were collected and identified using the quadrate method as described by 14. Schemnitz [14], and with the ~~help~~ support of a plant taxonomist. Three quadrates measuring 10m x 10m for the secondary forested area, 4m x 4m for upland agriculture field and 2m x 2m for lowland swam field were used [12]. Relative density (RD), relative frequency (RF) and relative dominance (RDO) for plants was determined by the equations 2, 3, and 4, respectively.

Relative density (RD) = Density of a species / total density of all species * 100 (Equation 2)

Relative frequency (RF) = Frequency of a species / total frequency of all species * 100 (Equation 3)

Relative dominance (RDO) = Dominance of a species / total dominance of all species * 100 (Equation 4)

2.6. Data a~~A~~nalysis

Formatted: Highlight

Formatted: Justified

Formatted: Highlight

Formatted: Justified

Formatted: Font: Not Bold

Formatted: Highlight

Formatted: Highlight

Comment [C10]: How? Which method? Followed some previous research?

Insert complementary information/ equations.

Formatted: Font: 10 pt

Formatted: Centered

Formatted: Font: 10 pt

Formatted: Centered

Formatted: Justified, Indent: First line: 0.49"

Formatted: Justified

Formatted: Font: Not Bold

The one-way Aanalysis of Vvariance test (one-way ANOVA) was used to analysis analyze and interpret the data from different habitats, and population, while the Chi square (X^2) and t-test using was used for comparison of population densities across sectors, seasons and habitats at a 95% significant level α = .05. The importance value index (IVI) for three species in each transect was calculated using the equation 5 [5].

IVI = RD+ RF+ RDO (Equation 5)

Where: IVI: importance value index; RD = relative density (RD); relative frequency (RF); relative dominance (RDO).

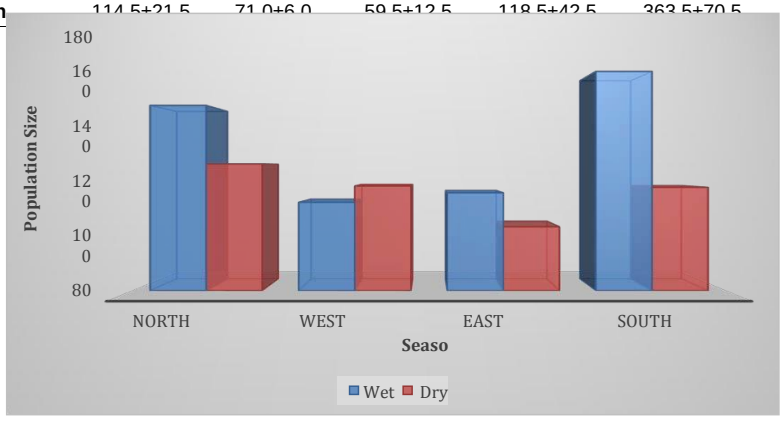
3. RESULTS

3.1. Population size of helmeted guinea fowl in the study area

For the wet and dry seasons, a total of 364 helmeted guinea fowls were recorded. The Eastern sector had the least number of birds, while the highest number was recorded in the Southern sector, followed by the Northern sector (Table 1). The total number of guinea fowls in the study area was significantly different (X^2 = 8.00, p = .03) in both the wet and dry seasons (Figure 1).

Table 1. Population density (n) of helmeted guinea fowl in the different sectors of the Obubra campus of Cross River University of Technology, Nigeria.

	Sector				
Season	Northern	Western	Eastern	Southern	**Total**
Wet	136	65	72	161	434
Dry	93	77	47	76	293
Mean	114.5±21.5	71.0±6.0	59.5±12.5	118.5±42.5	363.5±70.5



Formatted: Font: Not Bold
Formatted: Font: Not Bold
Formatted: Font: Not Italic, Superscript
Formatted: Font: Not Italic, Highlight
Formatted: Font: Not Bold
Formatted: Justified
Formatted: Font: (Default) Arial, Not Italic
Formatted: Font: Not Italic, Superscript
Formatted: Font: (Default) Arial, Not Italic
Formatted: Font: Not Bold, Not Italic
Formatted: Font: (Default) Arial, Not Italic
Formatted: Font: (Default) Arial
Comment [C11]: I recommend to redo the figure. Insert the X and Y titles in the software program to avoid formation errors. The figure should follow the AJRIZ journal format.
Formatted: Justified, Indent: Left: 0.49", Right: 1.15", Space Before: 0.05 pt, Tab stops: 6.6", Left
Comment [C12]: The table and figure titles should be auto explicative.

The titles should be irmproved.

Figure 1: Population ~~Seasonal comparison~~ of *Numida meleagris* comparison with wet and dry season and location of transects in the Obubra campus of Cross River University of Technology, Nigeria.~~the study area~~.

3.2. Feeding/behaviour pattern of helmeted guinea fowl in the study area

The species ~~was found to be feeding~~ feeds mostly on insects, worms, and fresh grasses especially during the wet season. During wet and dry seasons ~~T~~the activities observed ~~in both seasons~~ were flying, resting, scanning, feeding, and running, with feeding being the most important activity ~~in both seasons~~ (Figure 2). There~~y~~ was a significant difference in the feeding and ~~behavioural~~behavioral pattern of the helmeted guinea fowls in both seasons ($t = 4.04$, $p = .001$) (Table 2).

Table 2. Time spent on different activities according to time of day.

Activity	Time of day (% of hours)					
	6:30-9:30	9:30-12:30	12:30-3:30	3:30-6:30	$\chi^2 = 4043$	P = 0.001
Flying	7	6	3	12		
Resting	9	8	61	7		
Scanning	8	14	22	10		
Feeding	68	65	6	66		
Running	8	7	8	5		

Source: Field Survey (, 2021).

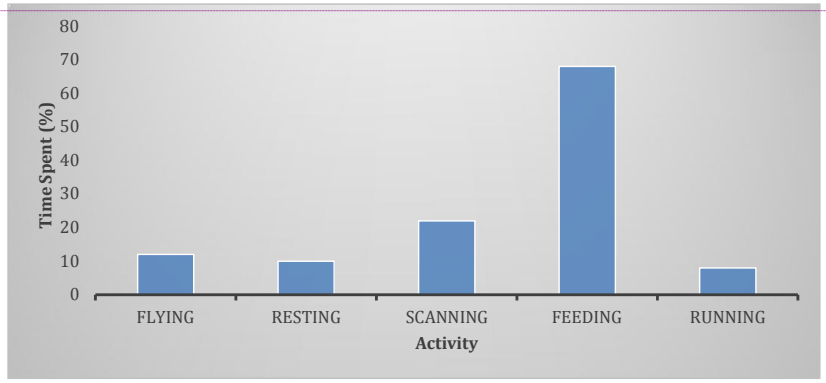


Figure 2: Percentage seasonal activity pattern of *Numida meleagris* in the study area.

Table 3 and 4 should be cited in a text before appears. Include a paragraph approaching the

Formatted
Comment [C13]: The table and figure
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted Table
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted Table
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Comment [C14]: Redo the Table and
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted

information.

3.2. Habitat preference/plant species composition of helmeted guinea fowl in the study area.

The observed helmeted guinea fowls showed preference for upland agricultural field than lowland swamp field and the secondary forested area during the wet season than the dry season (Table 3). Gmelina, teak and oil palm were the most dominant plant species observed, across habitats during the study (Table 4).

Table 3. Seasonal variation in number ofo. of individuals of helmeted guinea fowl in the different habitats [...]. ~~UAF=Upland agricultural field, LSF=Lowland swamp field, SFA= Secondary forested area, SE=Standard Error.~~

Habitat type	Season		
	Wet	Dry	Mean±SE
UAF	243	176	209.5±33.5
LSF	168	98	133.0±35.0
SFA	23	19	21.0±2.0

Where: UAF=uUpland agricultural field;, LSF=lLowland swamp field,; SFA= sSecondary forested area;, SE=sStandard eError. Source: Field Survey (2021). Significant relationship existed between seasons and across habitats (X^2= 12.00, p = 0.02).

Table 4. Plant species in the three selected habitats in the study area.

Family	Species	RD	RF	RDo	IVI
Combretaceae	*Terminalia ivorensis*	5.3	5.3	0.03	10.63
Combretaceae	*T. superba*	5.3	2.6	0.01	7.91
Makvaceae	*Tripochiton scleroxylon*	5.3	4.3	0.02	9.62
Moraceae	*Milicia excelsa*	5.3	3.9	0.02	9.22
Moraceae	*Treculia africana*	5.3	0.7	0.00	6.00
Sterculaceae	*Cola nitida*	5.3	2.9	0.02	8.22
Sterculaceae	*C. gigantean*	5.3	4.9	0.03	10.23
Anacardiaceae	*Magnifera indica*	5.3	3.6	0.02	8.92
Lamiaceae	*Gmelina arborea*	5.3	19.0	0.11	24.41
Lamiaceae	*Tectona grandis*	5.3	15.0	0.09	20.39
Arecaceae	*Elaeis guineensis*	5.3	12.8	0.07	18.17
Fabaceae	*Tetrapleura tetraptere*	5.3	1.9	0.01	7.21
Fabaceae	*Parkia biglobosa*	5.3	2.3	0.00	7.60
Fabaceae	*Afzelia african*	5.3	0.9	0.00	6.20

Comment [C17]: Complement title.
Comment [C18]: Rewrite this pargraph.
Comment [C19]: Complement the table
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Comment [C20]: Complement the table
Formatted
Formatted Table
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted
Formatted

Leguminosae	*Pterocarpus mildbraedii*	5.3	3.9	0.02	9.22
Leguminosae	*P. osun*	5.3	6.9	0.04	12.24
Burseraceae	*Dacryodes edulis*	5.3	1.9	0.01	7.21
Irvingiaceae	*Irvingia gabonensis*	5.3	5.2	0.03	10.53
Rutaceae	*Citrus sinensis*	5.3	2.6	0.01	7.91
Total	**19**	**100.7**	**100.6**	**0.54**	**201.84**

Where: D=Density, F=frequency, RF=Relative Frequency, RDO=Relative dominance, IVI=Importance Value Index. Expected results are for D/10m^2, D/4m^2, D/2m^{2}Source: Field Survey (2021).

Formatted: Centered
Formatted: Centered
Formatted: Centered
Formatted: Centered
Formatted: Centered
Formatted: Centered

~~**3.2. Habitat preference/plant species composition of helmeted guinea fowl in the study area**~~

~~The helmeted guinea fowls observed showed preference for upland agricultural field, than lowland swamp field and the secondary forested area during the wet season than the dry season (Table 3).~~

4. DISCUSSION

The study showed ~~though~~ that the species was generally abundant in the study area, the number of helmeted guinea fowls observed showed variations across sectors with the southern sector having the highest population, closely followed by the northern sector.

The high population recorded in this sectors may have been due to the availability of food and water in the area as stated by [13]. The highest density of ~~guinea fowl~~the species was recorded during wet season, between the months of j~~J~~une and s~~S~~eptember. During this period, there is abundant food and breeding activities of bird species as ~~asserted~~ described by Sutherland, ~~(~~2000~~)~~ [ ]. However, the low densities recorded in eastern and western sectors was majorly due to habitat disturbance, crop cultivation, subsistence hunting and predation [2].

The helmeted guinea fowl feeds largely on invertebrates such as centipedes, ants, termites, spiders, beetles, slugs, snails and worms, most of which are usually in abundant during the wet season. The upland agricultural field was most preferred by the species during both seasons, followed by the lowland swamp field. This ~~was~~ fact can be related ~~due~~ to the availability of different species of invertebrates for consumption by the species [17].

The species also utilizes swamp areas for drinking water during evening hours, and for rest when the weather is extremely hot [18].

Low numbers of the species ~~was~~were observed in the secondary forested area. The helmeted guinea fowl usually prefers open space for feeding, shelter, escape from predators and mating. Nevertheless~~However~~, the selectivity preference of this species was greatly dependent on varied environmental and anthropogenic factors within the surrounding vegetation of the study area as emphasized by [7].

The presence of *Gmelina arborea*, *Tectona grandis* and *Elaeis guineensis* as the dominant plant species in the study area is an indication that the area is highly disturbed (REFERENCES). ~~.~~ This is because this ~~plant~~ species are exotic and mostly found areas that are highly degraded (REFERENCES). The disappearance of the helmeted guinea fowl habitat was as a result of

Formatted: Font: Not Italic, Highlight

Formatted: Font: Not Italic, Highlight

Formatted: Font: Not Italic, Highlight

Formatted: Font: Not Italic, Highlight

Formatted: Font: Not Italic, Highlight

Formatted: Font: 10 pt, Not Bold, Not Italic

Comment [C21]: Needs to be improved with bibliographic references.

Formatted: Font: Not Italic, Highlight

persistent agricultural activities, local poaching and habitat changes resulting from annual bush burning, erosion and other anthropogenic activities.

5. CONCLUSION

The helmeted guinea fowl population is adversely affected by both anthropogenic and environmental factors. The species population is under threat of man's interference in the form agricultural activities and hunting of the species for meat. The protection of the species habitat through demarcation and fencing can ensure the protection of the species and increase its population as well.

Comment [C22]: The conclusions are approached in the Introduction of the manuscript, but not correspond with the achieved results.

The item should be rewrite in order to answer the objectives, using the most representative data/numbers achieved in this study.

REFERENCES

Comment [C23]: The authors should redo the item following the correct sequence obeying the order that appears in the manuscript.

The authors should improve the references in order to approach the journal template format.

1. Adinya, I B., Enya, V.E, and Kuye, O.O. 2007. Structure of Ofatura goat market, Obubra Local Government Area of Cross River State, Nigeria. *Global Journal of Agricultural Sciences*. 6(1):55-59. Ajol (UK): http://www.inasp.info\ajol.

2. Asokan, S., Ali, A. M. S., Manikannan, R., Nithiyanandam, G. T. 2010. Population densities and diurnal activity pattern of the Indian Roller *Coracias benghalensis* (Aves. Coraciiformes) in Nagapattinam District. Tamil Nadu, *Indian Journal of Threatened Taxa*, **2**(10): 1165-1191.

3. Birdlife International .2016. *Francolinus albogulans*. The I U C N Red list of threatened species.

4. Brown, J. D., Robinson, S. K., Thompson, F. R. 2001. The role of disturbance in the ecology and conservation of birds. *Annual Reviews in Ecological Systems*, **32**: 252-276.

5. Coroi, M., Skeffingtonb .M. S., Gillera, P., Smitha, C., Gomalye, M., O'donovan, G. (2004). Vegetation diversity and stand structure in streamside forests in the South of Ireland. *Forest Ecology and Management***202**:39-57.

6. Crowe, T. M. 2000. Limitation of populations in the helmeted guinea fowl. *South African Journal of Wildlife Resources*, **8**:117-126.

7. Heidari N., Arbabi T., Noori G., & Shahriari A. 2009. Distribution, Population and Ecology of Black Francolin *Francolinus francolinus bogdanovi* in Sistan Plain, in relation to plant coverage and drought. *Podoces 4***(1)**: 28-36.

8. Hosteler, M. E., Main, M. B. 2001. Florida monitoring program. Transect and point count method for surveying birds. University of Florida, Florida.

9. International Union for the Conservation of Nature. 2006. Red List of Threatened species. Retrieved on 11th May. Database entry includes justification for why this species is of least concern. *Trends in Ecology and Evolution,* **21** (2):71-76

10. Lars S., Killian M., Dan Z. 2010. Collins Bird Guide, 2nd edition. Harper Collins publishers Ltd, Trento, Italy Pp 1-98

11. Ogwa, J.O.N. 2007. A handbook on Obubra: A comprehensive presentation of Obubra L.G.A of Cross River State from 1900 to 2007. Enugu: life gate publications.

12. Penningto, D.N., Blair, R.B. 2011. Habitat selection of breeding riparian birds in an urban environment: untangling the relative importance of biophysical element and spatial scale. *Diversity and distribution* **17**: 506-518

13. Sajid M., Tariq M, Muhammad R., Irfan Z., Muhammad S, N. 2010. A comparative study on the population and habitats of the Grey Prancolin (francolins pondicerianus) and the Black Francolin *Francolinus francolinus* in lehri Natine Park Dunjab, Pakistan. *Podoces*, **5**(1): 42-53.

14. Schemnitz D. S. 1980. Wildlife management techniques manuals. Wildlife Society, U.S.A, Washington, pp. 147.

15. Shimelis, A., and Afework .B. 2009. Species compositions, relative abundance and aabitat association of the bird fauna of the montane forest of Zegie peninsula and nearby Island, Lake Tana, Ethiopia. SINET: *Ethiopia Journal of Science*, **32**(1):45-56.

16. Tariku H., Schimelis A., Dereje Y. 2019. Activity pattern, flocking behaviour and habitat preference of yellow fronted Parrot (*Poicephalus flavifrons*) in Zegie forest, southern shore ofLlake Tana, Ethiopia. *International Journal of Advanced Research and Publications*, **3**(1):29-46.

17. Tewodros K., and Afework B. 2013. Population status, feeding ecology and activity pattern of helmeted guinea fowl (Numida Meleagris) in Abijata-shalla Lakes National Park. *African Journal of Environmental Science and Technology*, **7**(1):49-55.

18. Whittingham, M. J., Evans, K. L. 2004. The effect of habitat structure on predation risk of bird in agriculture landscapes. *Ibis*, **146** (2):210-220