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EVALUATION OF BIRD'S SPECIES DIVERSITY IN BODEL FOREST OF GASHAKA GUMTI NATIONAL PARK, NIGERIA

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ABSTRACT: The study evaluated the bird's species diversity in Bodel forest reserve of Gashaka Gumti National Park (GGNP). The persistent decline in birds' species population and their diversity posed a great challenge to its conservation, hence the need for the study in the location. Systematic sampling method was employed, in which three (3) transects of 1 km in length were laid at an interval of 200 m apart in the study site. Species of bird sighted along the transect were observed and recorded. Two diversity indices, Shannon-Weiner's and Simpson were used to evaluate the bird's species diversity. The species evenness was determined using evenness equation E = H'/Ln(S). Likewise, means, standard deviation and Coefficient of variation was estimated. The results on bird's species distribution revealed a total of 788 birds, belonging to 73 species and 26 families in the study area. Lunchura cucullata had the highest frequency of 82 birds (10.4%), followed by Ploceus cuculatus with 50 birds (6.3%), while the least frequency of 1(0.1%) was recorded for Eliminilongi cauda. The two diversity indices revealed that bird species in Bodel forest reserve of Gashaka Gumti National Park are highly diverse. Simpson's index gave a value of 0.97, while Shannon-Weinner's index gave a value of 3.79 of species diversity in the reserve. T-test conducted shows that the two indices were significant in measuring bird's species diversity, but, Shannon-Weiner's index is mostly preferred due to its lower mean standard error (0.005). The study concludes that Bodel Forest reserve of Gashaka Gumti National Park is capable of sustaining a large population of bird species, if human interference is curtailed. Since birds occupy many tropic levels in a food chain, their occurrence should be protected and conserved as they are of helpful in environmental health indicator, pollinators, seed dispersal and as agent of pest control.

Keywords: Species diversity, Population, Indices, Protected, Distribution

INTRODUCTION

Bird's species are undergoing rapid declines, understanding the factors driving these declines is hindered by missing information about migratory connectivity and the lack of data to quantify environmental processes across the annual cycle (Rushing *et al.*, 2016). Habitat loss and climate change have been attributed to the declines in wood thrush breeding abundance (Runge *et al*., 2005). For example, high-abundance core breeding populations appear to be more limited by habitat loss, whereas low-abundance, peripheral populations appear to be limited by climate-driven seasonal interactions. Apart from this, there are other mechanisms and factors such as predation, intra- and inter-specific interactions, competition for food, environmental and spatial factors may affect their distribution and permanence. (Püttker *et al.*, 2015). Understanding the processes that contribute to the distribution and diversity of birds species is still a challenge in ecological studies.

The rapid increase in human population has diversely affected diversity around the globe (Blom *et al*., 2004). The negative effects of this increase include pollution, climate change, deforestation, habitat loss, and invasion of exotic species (Scanes, 2018).

Birds are good environment indicators and help to identify priority areas for conservation (Galgani *et.al*, 2010). Metrics such as species currently inhabiting any specific area, their historic distribution records, and the levels of threat to the species aid in protection efforts (Myers *et al.*, 2000). These threats are leading species toward extinction (Altaf, 2016). Thus, the project was designed determine the diversity and distribution of birds in different habitats.

Birds are organisms with high dispersal ability, that participate in many biological interactions and are usually highly faithful to specific habitats (Van Houtan *et al*,2012; Santos, 2004). In addition, birds make up the most diverse group of terrestrial vertebrates, comprising species that are excellent environmental indicators that respond quickly to subtle changes in the environment (Peter, 2002). Thus, understanding the biotic and abiotic mechanisms that affect the distribution of bird species may play a key role in the discussion of the processes that

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contribute to the establishment and diversity of species. The Climate, particularly the dry and rainy seasons clearly affects the abundance of food resources, where rainy seasons have greater environmental complexity and higher supply and availability of resources (Develey and Peres, 2000). Climate is a key environmental variable for the occurrence and abundance of birds in the landscape, in both time and/or space (Van Houtan *et al.*, 2012; Lees *et al.*, 2014). Also, variables such as humidity, solar radiation and air temperature affect the metabolic rate of avian species, producing different levels of physiological responses (Porter and Gates, 1969), thus influencing the egg hatching rates in birds, where high temperatures associated with low humidity ranges can lead to reduced reproductive success (Boleli and Quiiroz, 2012). Birds help in the stability of an ecosystem by dispersing seeds and pollination of plants.

The changes in climatic conditions also puts many bird species at risk of extinction, even those currently considered safe (Birds life, (2004). With a global mean surface temperature increase of 1-2 ºC above pre-industrial levels, many unique and threatened ecological systems will be at risk and numerous species will face extinction (Noble *et al*., 2005). Precipitation, along with temperature, is also especially likely to influence the behaviour of migratory birds. It is expected to affect their decision to depart for migration indirectly by acting on food availability and birds' consequent ability to build up energy reserves. Drought in critical stopover areas for migratory birds affects their ability to refuel on water and prey before crossing barriers such as deserts (Mazumder, 2014). The focus of this study is to evaluate the status of the birds species and their diversity in Bodel forest reserve of Gashaka Gumti National Park for conservation purpose.

MATERIALS AND METHODS

Study Area

Gashaka Gumti National Park is the largest and most diverse park in Nigeria, covering an area of approximately 6,671sq. Km, and is split between Adamawa and Taraba States. It's located in the Northeast of Nigeria between latitudes 6^{O} 55' and 8^{O} 05'N, and between longitudes $11^{O}11'$ and $12^{O}13'$E, with the Federal Republic of Cameroon on the eastern border (Figure 1). The park's name was derived from two of the region's oldest and most historic settlements: Gashaka village in Taraba State, and Gumti village in Adamawa State. Gashaka Gumti National Park was created (along with other seven national parks) by Decree No. 36 of August, 1991, and repealed by Decree N0. 46 of 1999 (now Act) by the merging of Gashaka Game reserve with Gumti Game Reserve (Marguba, 2002). The pattern of climatic zones in the study area is distorted by the influence exerted by highland areas that are located throughout the region and beyond (Pepeh and Nicholas, 2002). This results in increased rainfall on the crests and western flanks of these mountain ranges and low rain shadow to the east. Annual rainfall within the park ranges from 1200mm in the north to 3000mm in the southern region. Wet season is normally experienced from April to November, and dry season from December to March. In December period, there is always a low temperature at night time, and ranges from 10-15 ºC, while, in March and April, temperature is as high as 400 per daytime. Temperature can be much cooler at higher altitudes and during the harmattan period that occurs from November to March (Pepeh and Nicholas, (2002). The region can be divided into two major physiographic provinces. The plains of the Benue valley which lie to and north of the region, predominantly 300m above sea level and the Adamawa Highlands situated to the south and East of the park (Adebayo and Zemba, 2020)

Method of Data Collection

The data for this study were collected from September to December 2021.Systematic sampling technique was adopted for data collection. Three (3) lines transect T1, T2 and T3 of one (1) km in length was laid at an interval of 200 m across the study site. All species of bird sighted along each transect with the aid of binoculars and naked eyes were identified and recorded. Two to three minutes of keen observation was usually done on a line transects which allowed the birds acclimate to the presence of human. Also, physical features like the colour of the head, colour of the neck, colour of the wings and colour of the tail were also observed. The counts were done as early as 6.00 am, because birds are warm blooded and are active almost all the time. Each line transects was visited for five (5) times during period of the study. Information on climatic factors of the study area was collected, and this was used for predicting the population of the bird species in the study area.

Data Analysis

Descriptive and inferential statistics such as frequency and tables were used for the data analyses.

Estimation of Diversity Indices and Equitability

Diversity Index was estimated using Shannon diversity index (H') (Equation 1) and Simpson's diversity index (Equation 2), while, species equitability (evenness) (Equation 3) was estimated using Pielou's measure of species evenness.

1. $H' = -\sum P_i Ln P_i$ Equation (1)
2. $D = 1 - \left[\frac{n(n-1)}{N(N-1)}\right]$ Equation (2)
3. $E = H'/Ln(S)$ Equation (3)

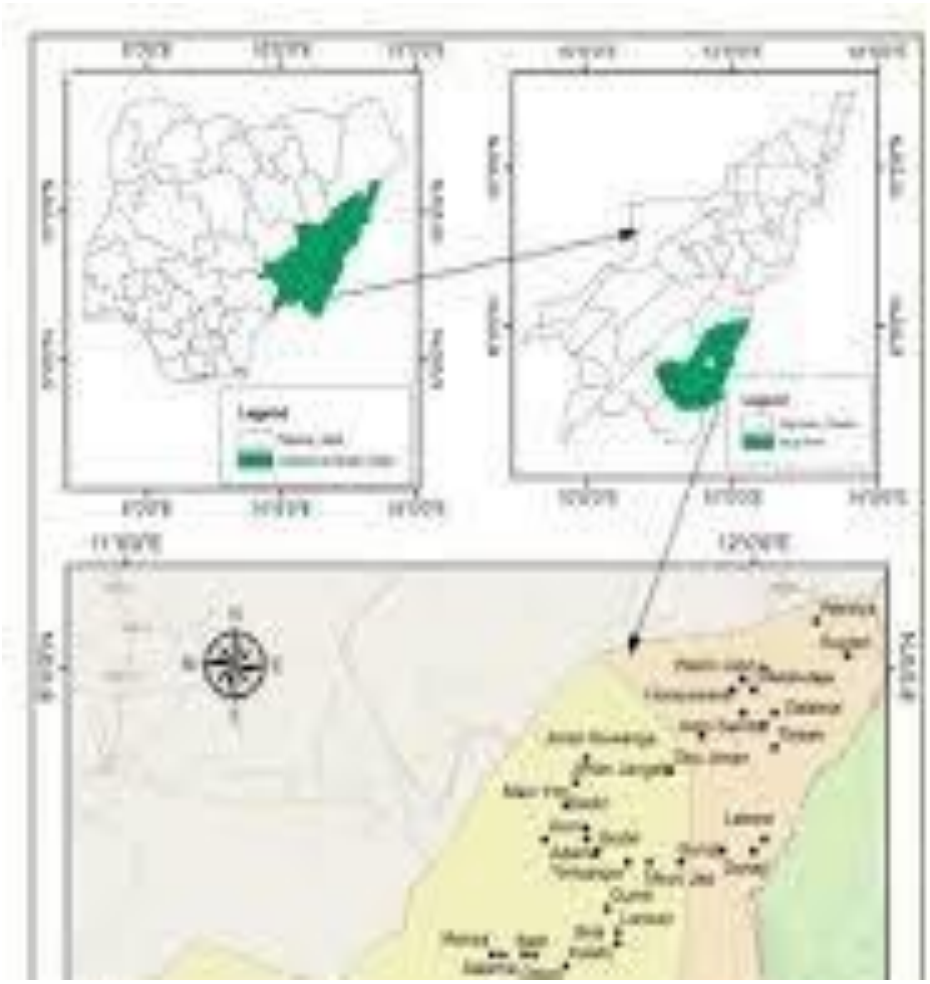

Fig 1: Map of Gashaka Gumti National Park Showing the Study Area
Source: (Warren, 2004)

Comparison of the Species Diversity Indices

Student t-test (Eqn. 4) was used to compare the significant effect of the two diversity indices on the bird's population, and is of the form:

$$t = \frac{\overline{sh} - \overline{sm}}{\sqrt{Sp(h,sh,sm\left(\frac{1}{nsh} + \frac{1}{nsm}\right)}}$$ Equation (4)

Where;
t = student t-test
$\overline{sh}$ = mean of number of Shannon
$\overline{sm}$= mean of number of Simpson's

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Sp = pooled variance
nsm, nsh = number of observation

RESULTS AND DISCUSSION

Birds Species Distribution in Bodel Forest of Gashaka Gumti National Park

A total of 788 birds, belonging to 73 species and 26 families were identified in the study area. All the birds species enumerated were subjected to six different class intervals of 10 (Appendix I). Out of the 788 birds sighted, almost 33.6% birds fell into 11- 20 class interval, this was followed by class 1- 10 with 24.6% birds species, while the least birds species was (8.8%) and felled into class interval greater than 50. (Table 1). The estimated mean and standard deviation of the bird species in Bodel forest reserve of GGNP was estimated as 75.5 and 23.08 respectively, while the coefficient of variation was 30.5% (Table 1). The result of the study revealed that *Lunchura cucullata species* had the highest frequency of 82 birds (10.41%), which was followed by *Ploceus cuculatus* with a frequency of 50 birds (6.35%), while the least frequency of 1(0.13%) was recorded for *Eliminilongi cauda* (Table 2). The rank abundance curve (Figure 2) plotted revealed a decline in number of birds species from lower class to a higher class, this indicates that there was no evenness in birds species distribution in Bodel forest of Gashaka Gumti National Park. The number of bird's species and family sighted in Bodel forest is higher than that reported by Issa, (2019) in his study, in which 33 birds' species belonging to 24 families were recorded. This indicated that Bodel forest is highly diverse in terms of bird's species diversity than that of Sharkia Governorate in Egypt.

Table 1: Frequency Class Distribution of Birds specie in GGNP

Class interval	Frequency	No. of species per class	Mean	Standard Deviation	Coefficient of Variation (%)
1 – 10	194 (24.6)	46			
11 – 20	265 (33.6)	19			
21 – 30	69 (8.8)	3			
31 – 40	80 (10.2)	2	75.50	23.08	30.51
41 – 50	98 (12.4)	2			
>□50	82 (10.4)	1			
Total	788(100)	73			

Value in parenthesis is in percentage (%)

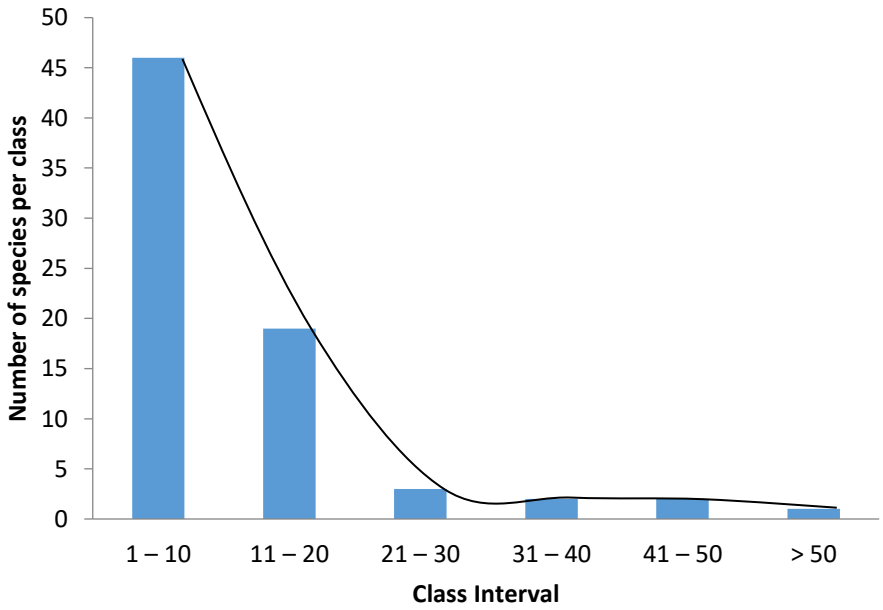

Figure 2: Rank abundance curve for Bird's species in Gashaka Gumti National Park

Table 2: Distribution of Birds Species in Bodel Forest, Gashaka Gumti National Park

S/No.	Species	Frequency	Percentage (%)
1	*Acrocephalus rufescens*	3	0.380711
2	*Agapornus pullarius*	11	1.395939
3	*Antichromus minutes*	5	0.634518
4	*Apalis nigriceps*	7	0.888325
5	*Apus horus*	20	2.538071
6	*Arthreptes rectirostris*	14	1.77665
7	*Ati capilla*	8	1.015228
8	*Baeopogon indicator*	2	0.253807
9	*Bubulus ibis*	3	0.380711
10	*Buteo buteo*	2	0.253807
11	*Centropus senegalensis*	3	0.380711
12	*Chalcomitra rubessers*	23	2.918782
13	*Cinnyris cupreus*	11	1.395939
14	*Cinnyris minullus*	17	2.15736
15	*Cinnyris venustus*	14	1.77665
16	*Circus cyaneus*	3	0.380711
17	*Cocracias abyssinicus*	7	0.888325
18	*Corvinella corvina*	5	0.634518
19	*Crinifer zonurus*	21	2.664975
20	*Cypsiurus parvus*	2	0.253807
21	*Delichon urbica*	3	0.380711
22	*Dicrurus adsimilis*	5	0.634518
23	*Egrets ardesiaca*	2	0.253807
24	*Egretta alba*	40	5.076142
25	*Elanus caerules*	11	1.395939
26	*Eliminilongi cauda*	1	0.126904
27	*Elminia albventris*	4	0.507614
28	*Estrilda melpoda*	12	1.522843
29	*Euplectes hartlaubi*	4	0.507614
30	*Euplectes macrourus*	11	1.395939
31	*Ficedula albiventris*	3	0.380711
32	*Francolinus squamatus*	2	0.253807
33	*Gypohierax angolenisis*	11	1.395939
34	*Halycyon senegalensis*	4	0.507614
35	*Hedydipna platura*	11	1.395939
36	*Indicator indicator*	3	0.380711
37	*Kaupifalco monogrammicus*	5	0.634518
38	*Lagonosticta senegala*	5	0.634518
39	*Lamprotornis choloropterus*	4	0.507614
40	*Lamprotornis purpures*	2	0.253807
41	*Laniarus aethiopicus*	2	0.253807
42	*Laniarus poensis*	4	0.507614
43	*Lanius minor*	3	0.380711
44	*Logonisticta rufopicta*	7	0.888325
45	*Lunchura cucullata*	82	10.40609
46	*Malimbus erythrogaster*	3	0.380711
47	*Malimbus malimbicus*	8	1.015228
48	*Malimbus rubricollis*	3	0.380711
49	*Megacerlye maxima*	10	1.269036
50	*Melaenornis edolioides*	3	0.380711
51	*Milvus migrans*	8	1.015228
52	*Muscicapa adusta*	2	0.253807
53	*Musophaga rossae*	3	0.380711
54	*Numida melagris*	8	1.015228
55	*Oxylophus jacobinus*	25	3.172589
56	*Phoeniculus purpureus*	2	0.253807
57	*Phyllastreplus poenensis*	10	1.269036
58	*Ploceus cuculatus*	50	6.345178
59	*Ploceus luteolus*	20	2.538071

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60	*Poicephalus senegalus*	5	0.634518
61	*Prodotiscus regulus*	11	1.395939
62	*Psalidoprocne nitens*	8	1.015228
63	*Pseudochelidon eurystomina*	40	5.076142
64	*Pycnontus barbatus*	48	6.091371
65	*Sagittarius serpentarius*	3	0.380711
66	*Stephanoaetus coronatus*	2	0.253807
67	*Streptopelia decipens*	3	0.380711
68	*Streptopelia semitorquata*	17	2.15736
69	*Streptopelia senegulensis*	11	1.395939
70	*Streptopelia vinacea*	20	2.538071
71	*Sylvia borin*	11	1.395939
72	*Treron calva*	15	1.903553
73	*Uraeginhus bengalus*	17	2.15736
Total		**788**	**100**

Birds Species Richness, Diversity, and Evenness in Bodel Forest Reserve, GGNP

The Shannon-Weiner's and Simpson's indices result (Appendix II) shows a high population distribution of bird's species in the study area. This indicates that the savannah woodlands of GGNP is very rich in plant species and this is due to the availability of favourable climatic conditions, which attracted the diverse numbers of bird species inhabiting the ecosystems

In term of bird's species diversity in the study area, Shannon Weinner and Simpson indices gave a high value of 3.79 and 0.97 respectively, while, the value of the evenness of bird's species (Figure 4) gave a value of 1.79. This indicated that availability of good habitat and favourable climatic condition enhanced the bird's species diversity. This result is in accordance with Bibby *et al.* (2000) who also reported that good breeding sites, prevalence of variety of plant species promoted high diversity of bird's species in their study.

One of the most important factors observed in Bodel forest was the moderate levels of disturbances and the presence of arboretum, which influenced high population of some families of bird species like Estrildidae, Nectarinidae, and Ploceidaein the area. This may be due to the availability of different plant species, precisely fruits, seeds, leaves, grasses, and some insects and maggots in the arboretum, which also serves as a suitable feeding, nesting and breeding habitats for the migratory birds. This result is in line with Ezealor (2001), who reported almost 910 species of birds in a family of 90 in his study. Also, this study agrees with the findings of David and Parmelee (2013) in their study of the diversity of bird species and conservation carried out in two wetlands of Upper Benue River Basin (UBRB) in Adamawa State, Nigeria in which 53 and 55 bird families with 163 and 160 species were recorded in Kiri and Gyawana Lake respectively.

Comparison of Shannon-Weinner's and Simpson Diversity Indices

Presented in Table 3 is the t-test result for comparing the Shannon-Weiner's and Simpson index as a measure of bird's species diversity in Bodel Forest Reserve of GGNP. The result revealed that Shannon-Weinner index had a means of 0.051and standard deviation of 0.043 respectively, while, Simpson's had a mean and standard of value 281.04 and 882.19 respectively. This indicated that Simpson is the best index to use when considering species diversity due to its higher mean value and standard deviation. Also, the t-test conducted further shows a high positive correlation coefficient (0.82) between the two indices compared. The significant relationship ($p <$ 0.005) between the two indices indicated that both can be used to measure species diversity, although, Simpson's gives the best result.

Table 3: T-test for comparing Birds Species Diversity

Diversity Indices	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**	**Correlation**	**Sig.**
Shannon-Weiner's	0.051	73	0.043	0.0051	0.822	0.0003
Simpson	281.04	73	882.189	103.252		

CONCLUSION

The study has shown that Bodel Forest reserve of Gashaka Gumti National Park is capable of sustaining a large population of bird species, if human interference can be curtailed. The two indices compared for the assessment of bird's species diversity are good in measuring diversity in the study area, but Shannon-Weinner index is most prefer due to lower value of mean standard error as compared to Simpson's index. Since bird's are integral part of the ecosystem that occupy many tropic levels in a food chain ranging from producers to consumers, there occurrence should be protected and conserve as they are of helpful in environmental health indicator, pollinators, seed dispersal and as an agent of pest control.

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Appendix I: Distribution of Birds Species In Bodel Forest Reserve of GGNP

S/No.	I	II	III	IV	V	VI
1	*Eliminilongi cauda*	*Agapornus pullarius*	*Crinifer zonurus*	*Egretta alba*	*Pycnontus barbatus*	*Lunchura cucullata*
2	*Baeopogon indicator*	*Cinnyris cupreus*	*Chalcomitra rubessers*	*Pseudochelidon eurystomina*	*Ploceus cuculatus*	
3	*Buteo buteo*	*Elanus caerules*	*Oxylophus jacobinus*			
4	*Cypsiurus parvus*	*Euplectes macrourus*				
5	*Egrets ardesiaca*	*Gypohierax angolenisis*				
6	*Francolinus squamatus*	*Hedydipna platura*				
7	*Lamprotornis purpures*	*Prodotiscus regulus*				
8	*Laniarus aethiopicus*	*Streptopelia senegulensis*				
9	*Muscicapa adusta*	*Sylvia borin*				
10	*Phoeniculus purpureus*	*Estrilda melpoda*				
11	*Stephanoaetus coronatus*	*Arthreptes rectirostris*				
12	*Acrocephalus rufescens*	*Cinnyris venustus*				
13	*Bubulus ibis*	*Treron calva*				
14	*Centropus senegalensis*	*Cinnyris minullus*				
15	*Circus cyaneus*	*Streptopelia semitorquata*				
16	*Delichon urbica*	*Uraeginhus bengalus*				
17	*Ficedula albiventris*	*Apus horus*				
18	*Indicator indicator*	*Ploceus luteolus*				
19	*Lanius minor*	*Streptopelia vinacea*				
20	*Malimbus erythrogaster*					
21	*Malimbus rubricollis*					
22	*Melaenornis edolioides*					
23	*Musophaga rossae*					
24	*Sagittarius serpentarius*					

25	*Streptopelia decipens*
26	*Elminia albventris*
27	*Euplectes hartlaubi*
28	*Halycyon senegalensis*
29	*Lamprotornis choloropterus*
30	*Laniarus poensis*
31	*Antichromus minutes*
32	*Corvinella corvina*
33	*Dicrurus adsimilis*
34	*Kaupifalco monogrammicus*
35	*Lagonosticta senegala*
36	*Poicephalus senegalus*
37	*Apalis nigriceps*
38	*Cocracias abyssinicus*
39	*Logonisticta rufopicta*
40	*Ati capilla*
41	*Malimbus malimbicus*
42	*Milvus migrans*
43	*Numida melagris*
44	*Psalidoprocne nitens*
45	*Megacerlye maxima*
46	*Phyllastreplus poenensis*

Appendix II Species Frequency, Simpson's and Shannon-Weiner's Diversity Indices

S/No.	Species	Frequency	Pi	Lnpi	Shannon-Weiner's	Simpson's
1	*Acrocephalus rufescens*	3	0.003807	-5.57089	0.021209	6
2	*Agapornus pullarius*	11	0.013959	-4.2716	0.059629	110
3	*Antichromus minutes*	5	0.006345	-5.06006	0.032107	20
4	*Apalis nigriceps*	7	0.008883	-4.72359	0.041961	42
5	*Apus horus*	20	0.025381	-3.67377	0.093243	380
6	*Arthreptes rectirostris*	14	0.017766	-4.03044	0.071607	182
7	*Ati capilla*	8	0.010152	-4.59006	0.0466	56
8	*Baeopogon indicator*	2	0.002538	-5.97635	0.015168	2
9	*Bubulus ibis*	3	0.003807	-5.57089	0.021209	6
10	*Buteo buteo*	2	0.002538	-5.97635	0.015168	2
11	*Centropus senegalensis*	3	0.003807	-5.57089	0.021209	6
12	*Chalcomitra rubessers*	23	0.029188	-3.534	0.10315	506
13	*Cinnyris cupreus*	11	0.013959	-4.2716	0.059629	110
14	*Cinnyris minullus*	17	0.021574	-3.83628	0.082762	272
15	*Cinnyris venustus*	14	0.017766	-4.03044	0.071607	182
16	*Circus cyaneus*	3	0.003807	-5.57089	0.021209	6
17	*Cocracias abyssinicus*	7	0.008883	-4.72359	0.041961	42
18	*Corvinella corvina*	5	0.006345	-5.06006	0.032107	20
19	*Crinifer zonurus*	21	0.02665	-3.62498	0.096605	420
20	*Cypsiurus parvus*	2	0.002538	-5.97635	0.015168	2

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21	*Delichon urbica*	3	0.003807	-5.57089	0.021209	6
22	*Dicrurus adsimilis*	5	0.006345	-5.06006	0.032107	20
23	*Egrets ardesiaca*	2	0.002538	-5.97635	0.015168	2
24	*Egretta alba*	40	0.050761	-2.98062	0.1513	1560
25	*Elanus caerules*	11	0.013959	-4.2716	0.059629	110
26	*Eliminilongi cauda*	1	0.001269	-6.6695	0.008464	0
27	*Elminia albventris*	4	0.005076	-5.2832	0.026818	12
28	*Estrilda melpoda*	12	0.015228	-4.18459	0.063725	132
29	*Euplectes hartlaubi*	4	0.005076	-5.2832	0.026818	12
30	*Euplectes macrourus*	11	0.013959	-4.2716	0.059629	110
31	*Ficedula albiventris*	3	0.003807	-5.57089	0.021209	6
32	*Francolinus squamatus*	2	0.002538	-5.97635	0.015168	2
33	*Gypohierax angolenisis*	11	0.013959	-4.2716	0.059629	110
34	*Halycyon senegalensis*	4	0.005076	-5.2832	0.026818	12
35	*Hedydipna platura*	11	0.013959	-4.2716	0.059629	110
36	*Indicator indicator*	3	0.003807	-5.57089	0.021209	6
37	*Kaupifalco monogrammicus*	5	0.006345	-5.06006	0.032107	20
38	*Lagonosticta senegala*	5	0.006345	-5.06006	0.032107	20
39	*Lamprotornis choloropterus*	4	0.005076	-5.2832	0.026818	12
40	*Lamprotornis purpures*	2	0.002538	-5.97635	0.015168	2
41	*Laniarus aethiopicus*	2	0.002538	-5.97635	0.015168	2
42	*Laniarus poensis*	4	0.005076	-5.2832	0.026818	12
43	*Lanius minor*	3	0.003807	-5.57089	0.021209	6
44	*Logonisticta rufopicta*	7	0.008883	-4.72359	0.041961	42
45	*Lunchura cucullata*	82	0.104061	-2.26278	0.235467	6642
46	*Malimbus erythrogaster*	3	0.003807	-5.57089	0.021209	6
47	*Malimbus malimbicus*	8	0.010152	-4.59006	0.0466	56
48	*Malimbus rubricollis*	3	0.003807	-5.57089	0.021209	6
49	*Megacerlye maxima*	10	0.01269	-4.36691	0.055418	90
50	*Melaenornis edolioides*	3	0.003807	-5.57089	0.021209	6
51	*Milvus migrans*	8	0.010152	-4.59006	0.0466	56
52	*Muscicapa adusta*	2	0.002538	-5.97635	0.015168	2
53	*Musophaga rossae*	3	0.003807	-5.57089	0.021209	6
54	*Numida melagris*	8	0.010152	-4.59006	0.0466	56
55	*Oxylophus jacobinus*	25	0.031726	-3.45062	0.109474	600
56	*Phoeniculus purpureus*	2	0.002538	-5.97635	0.015168	2
57	*Phyllastreplus poenensis*	10	0.01269	-4.36691	0.055418	90
58	*Ploceus cuculatus*	50	0.063452	-2.75748	0.174967	2450
59	*Ploceus luteolus*	20	0.025381	-3.67377	0.093243	380
60	*Poicephalus senegalus*	5	0.006345	-5.06006	0.032107	20
61	*Prodotiscus regulus*	11	0.013959	-4.2716	0.059629	110
62	*Psalidoprocne nitens*	8	0.010152	-4.59006	0.0466	56
63	*Pseudochelidon eurystomina*	40	0.050761	-2.98062	0.1513	1560
64	*Pycnontus barbatus*	48	0.060914	-2.7983	0.170455	2256
65	*Sagittarius serpentarius*	3	0.003807	-5.57089	0.021209	6
66	*Stephanoaetus coronatus*	2	0.002538	-5.97635	0.015168	2
67	*Streptopelia decipens*	3	0.003807	-5.57089	0.021209	6
68	*Streptopelia semitorquata*	17	0.021574	-3.83628	0.082762	272
69	*Streptopelia senegulensis*	11	0.013959	-4.2716	0.059629	110
70	*Streptopelia vinacea*	20	0.025381	-3.67377	0.093243	380
71	*Sylvia borin*	11	0.013959	-4.2716	0.059629	110
72	*Treron calva*	15	0.019036	-3.96145	0.075408	210
73	*Uraeginhus bengalus*	17	0.021574	-3.83628	0.082762	272
	TOTAL	788	3.793263			20516
			H = 3.79			D = 0.96

H = Shannon-Weiner Index; D = Simpson's Index