Diversity, relative abundance and distribution of avian fauna in three states of East Sudan

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Abstract

The study of avifaunal diversity is an essential ecological tool, which acts as an important indicator to evaluate different habitat condition both qualitatively and quantitatively. Birds are play ecological functions, which include disease regulation, biomass recycling, seed dispersal of fleshy fruits, and pollination. The study was aimed to assess the diversity and distribution of bird species in east Sudan. The result of this finding is valuable data base on area to game orders, area specific management planers, conservationists, ecologists and provides baseline information for different scientific recommendation. Study was conducted in three states; Red Sea, Kassalaa and El Gadarif states in represent eastern States in Sudan. A point transect count aided by binocular was employed to investigate avian species diversity and distribution. Biodiversity indexes were used to calculate the bird species diversity and one way-ANOVA. All together (43) birds species belonging to (11) orders. The highest number of birds observed was Village Weaver (11.7%) belonging to order of Passeriformes. While the orders identified with the highest numbers of different bird species were Accipitriformes (18.6%); and Passeriformes (18.6). The maximum number of birds observed during in states was El Gadarif (45.3%). it concluded that the area has good potential for bird watching tourism that can integrate economic gain with biodiversity conservation. Hence, urgent conservation measures and further detail research is recommended.

Introduction

Biodiversity is defined according to Agyei et al., (2017) Convention on Biological Diversity (CBD) as: “the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems”. Birds live in a variety of ecological niches (Mogaka et al 2019). Research on avifaunal diversity is an important ecological implement, that acts as an essential indicator for measuring different habitat conditions and also play ecological functions, which include biomass recycling, disease regulation, seed dispersal of fleshy fruits, and pollination of the plant (Agyei et al., 2017). Birds are important indicators in biodiversity conservation and for identifying conservation tools (Sethy et al., 2015). Additionally, birds serve as markers of biodiversity and recorders of environmental change, such as the intensity of pollution and its effects on the environment (Sutherland, 2000) Birds are an essential component of the food chain in the natural world, making them excellent indicators of the ecological health of any particular environment (Gill, 1994; Hossain and Baki, 2015; Abie et al., 2019). In many regions of the world, the biodiversity is coming under growing danger. Presently, the IUCN lists 24% of mammals, 27% of reptiles, 20% of amphibians, and 30% of fish species as being globally threatened with extinction and about 12% of the bird species on the earth are actually in danger of going extinct in the next 100 years (Avibase-Bird Checklists of the World, 2005). The bird species in Sudan reported by Mahmoud et al., (2015) as 23 birds species belonging to 14 Families and 9 Orders. The study was aimed to assess the diversity and distribution of bird species in east Sudan. The result of this finding is valuable

database on an area to-game orders, area specific management planners, conservationists, and ecologists and provides baseline information for the different scientific recommendations.

Methodology

Materials And Methods

The study was conducted in three states in eastern Sudan at a different point for each state from 29/10 to 8/11/2017 represented Red Sea, Kassala, and El Gadaref States. The point where purposively selected the place to have water sources. The tools and instruments used in data collection were; binoculars for magnifying, a field guide for species identification, a data-sheet pen or pencil, car for transport

Study Area

Red sea state, in this state where 17 water sources were selected purposively which represent water point in the state and accumulate different bird's species; the following point are namely; Sinkat, Udrose Mountain, Amigla, Ehan, Adalaf, northwest Sinkat, Khor El arab, Amid Mountain, Sasa area, Soterba, Dongunab, Kotaib, Dawit Mountain, Amitia area and south Sinkat.

Kassala state, in Kassala state survey was conducted in Kabary area, Erabab area, Wager area in two Mayas, Delawit north Kassala, and Kasgem El gerba dam which represented main water points in the state, many bird's species were observed see table (3)

El Gdarif state, survey cover El feil forest, Suki Satgaf area, Abu rakham dam, Wad Saleh, Hawata locality, and Gogela two Mayas; representing water point in the state, different type of birds was observed. In this state also observed many birds are died due to impact of pesticide which used in agricultural schemes, according to information from key informant in the area indicates that they birds died by indirect effect of pesticide.

Data analysis and formulas of Bird indices.

Shannon's (H'); Shannon Wiener index was generally used in ecological studies concerned with the number (Vallejo, 2009; Sethy et al., 2015). $H' = -\sum pi * \ln pi$

Where H' is the Shannon-winner index, pi is estimated as ni/N, where ni is the proportion of the total population of the species and $N = -\sum ni$. This uses proportions rather than absolute abundance values to reduce the effects of the order of magnitude difference in bird numbers between species. This index provides a measure of `evenness' in the proportion of each species occurring within squares; $J = \frac{n(n-1)}{N(N-1)}$

Where J' is the Evenness index, H' is Shannon winner index and used formula one and S is species richness (Abie et al., 2019)

Relative abundance (RA) (%) = n/N × 100, where n is the number of individuals of particular species observed and N is the total number of individuals of the species (Abie et al., 2019)

Furthermore, distribution and abundance of species between three states and One-way analysis of variance (ANOVA) was used to test differences between stats sites in species richness and diversity values in the study area (Abie et al., 2019)

Results

43 bird species with various abundances were observed in the study belonging to (11) orders (Fig. 1 and Table 3). The highest number of birds observed in the study period was the Village Weaver (11.7%) belonging to order Passeriformes (Fig. 1 and Table 3). While the orders identified with the highest numbers of different bird species were Accipitriformes, Passeriformes, and Columbidae, (Fig. 1). The maximum number of birds observed during the study period was in El Gadarif state (45.3%) flowed by Red sea (29%), then Kassala (26%) (Fig. 2).

Table (1) one-way ANOVA analysis of Bird species distribution across habitat States

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between States	11597.22	2	5798.612	2.227344	0.112043	3.0681
Within States	328025.3	126	2603.375			
Total	339622.5	128				

Table (2) the species richness the evenness in east Sudan

Variables	Value
Diversity index	3.43
Evenness index	0.05

Table 3
species richness, status and abundance of bird species

S.No	Common name	Scientific name	Order	R	K	G	total	RA
1.	Speckled pigeon	Columba guinea	Columbiformes	6	83	56	145	3.1
2.	Common ringed plover	Charadrius hiaticula	Charadriiforme	3	53	69	125	2.6
3.	White wagtail	Motacilla alba	Passeriformes	88	104	85	277	5.8
4.	Pied king fisher	Ceryle rudis	Coraciiformes	-	13	53	66	1.4
5.	Abyssinian roller	Coracias abyssinicus	Coraciiformes	4	7	12	23	0.5
6.	Black-headed heron	Ardea melanocephala	Pelecaniformes	0	66	132	198	4.2
7.	Grey heron	Ardea Cinerea	Pelecaniformes	0	7	8	15	0.3
8.	Purple heron	Ardea purpurea	Pelecaniformes	0	7	4	11	0.2
9.	Great white egret	Egretta alba	Pelecaniformes	0	8	16	24	0.5
10.	Cattle egret	Bubulcus ibis	Pelecaniformes	0	77	21	98	2.1
11.	Black kite	Milvus migrans	Accipitriformes	53	11	62	126	2.7
12.	Yellow billed kite	Milvus aegyptius	Accipitriformes	43	12	8	63	1.3
13.	Hooded vulture	Necrosyrtes monachus	Accipitriformes	72	15	77	164	3.5
14.	Egyptian vulture	Neophron percnopterus	Accipitriformes	87	8	0	95	2.0
15.	Woodland kingfisher	Halcyon senegalensis	Coraciiformes	0	32	9	41	0.9
16.	Pin-tailed Whydah	Vidua macroura	Coraciiformes	34	4	22	60	1.3
17.	Abyssinian roller	Coracias abyssinicus	Coraciiformes	7	23	66	96	2.0
18.	Little egret	Egretta garzetta	Pelecaniformes	55	8	82	145	3.1

R = Red Sea state, K = Kassala state, G = El Gadarif state, and RA = Relative Abundance

S.No	Common name	Scientific name	Order	R	K	G	total	RA
19.	Yellow billed kite	Milvus aegyptius	Accipitriformes	6	8	12	26	0.5
20.	Black kite	Milvus migrans	Accipitriformes	9	4	8	21	0.4
21.	Beautiful Sunbird	Cinnyris pulchellus	Passeriformes	54	88	102	244	5.1
22.	African fish eagle	Haliaeetus vocifer	Accipitriformes	0	6	2	8	0.2
23.	Common sandpiper	Actitis hypoleucos	Charadriiformes	0	5	12	17	0.4
24.	Green sandpiper	Tringa ochropus	Charadriiformes	6	9	125	140	3.0
25.	Red eyed dove	Streptopelia semitorquata	Columbiformes	23	11	37	71	1.5
26.	Namaqua dove	Oena capensis	Columbiformes	69	34	92	195	4.1
27.	Blue spotted wood dove	Turtur after	Columbiformes	37	34	12	83	1.7
28.	African mourning dove	Streptopelia decipiens	Columbiformes	8	23	122	153	3.2
29.	Egyptian plover	Pluvianus aegytius	Charadriiformes	8	7	3	18	0.4
30.	Hamerkop	scopiae	Pelecaniformes	0	8	4	12	0.3
31.	Tawny eagle	Aquila rapax	Accipitriformes	2	8	2	12	0.3
32.	Nile Valley Sunbird	Hedydipna metallica	Passeriformes	34	65	21	120	2.5
33.	Village Weaver	Ploceus cucullatus	Passeriformes	200	23	332	555	11.7
34.	Northern Red Bishop	Euplectes franciscanus	Passeriformes	0	42	124	166	3.5
35.	Black-crowned Sparrow lark	Eremopterix nigriceps	Passeriformes	88	34	23	145	3.1

R = Red Sea state, K = Kassala state, G = El Gadarif state, and RA = Relative Abundance

S.No	Common name	Scientific name	Order	R	K	G	total	RA
36.	African Palm-swift	Cypsiurus parvus	Apodiformes	125	44	38	207	4.4
37.	Blue-naped Mousebird	Urocolius macrourus	Coliiformes	7	28	8	43	0.9
38.	Lesser Kestrel	Falco naumanni	Falconiformes	5	7	7	19	0.4
39.	African Pied Wagtail	Motacilla aguimp	Passeriformes	223	55	234	512	10.8
40.	Common Bulbul	Pycnonotus barbatus	Passeriformes	6	87	23	116	2.4
41.	Common Hoopoe	Upupa epops	Bucerotiformes	4	0	2	6	0.1
42.	White-throated Bee-eater	Merops albicollis	Coraciiformes	12	42	22	76	1.6
43.	sand partridge	Ammoperdix heyi	Galliformes	7	0	0	7	0.1
Total Observed Birds				**1385**	**1210**	**2149**	**4744**	**100**
R = Red Sea state, K = Kassala state, G = El Gadarif state, and RA = Relative Abundance								

Discussions

During period of survey; 43 different birds species belonging to 11 Orders were observed in three states in eastern Sudan. It could be due to presence of various habitat types such as food, water sources (Hossain and Baki, 2015; Girma et al., 2017; Abie et al., 2019). The identified species; the highest species was observed (18.6%) recorded in two orders Accipitriformes, Passeriformes. Similarly, to the report of Sulieman, (2016). This study revealed that from 43 species of birds observed; 2 species is threatened and according to IUCN.

River Nile is the most important flyway for migratory water birds from, Europe to Africa through the Middle East. Great Rift Valley is the most important migratory and soaring bird away. Which supports a considerable number of habitats for feeding, rusting, or resting sites for birds. Red sea state is the fly was but there less amount of water resources in most areas of the state. The difference in the number of community birds observed during the study period is due to bird migration movement, and feeding habits with some migrating birds arriving in the area for breeding or using the different ecosystem. However, Avifaunal diversity estimation is important biodiversity conservation, monitoring, and for classifying conservation activities besides human activities (Sethy, 2015). Also, the research indicated that the

richness (3.43) and evenness (0.05) this mean that the distribution abundance of birds in eastern Sudan (Red Sea, Kassala, and El Gadarif area) as well as habitat sources such as availability of food, flora and water resources that lead to containing a wide range of different trees and grassland ecosystems supporting a wide range of microhabitats for different species of birds. Additionally, this richness and evenness could be due to seasonal movement of birds; similarly, as recorded by (Sethy, 2015).

The species diversity index fluctuated from state to state and habitat. The highest diversity was shown in El Gadarif state due to availability of water as well as riverine forest, while less in Kassala. Apart from the diversity, the distribution of birds' species among habitat type was showed significantly variation. Bird species recorded the highest, distribution in water sources habitat while in wooded grassland and desert in some areas of Red Sea, and less Kassala state. Previous studies in Sudan have recorded more than 160 species of birds in the Dinder National Park, 24 species in Sunut Forest, 30 species in Tuti Island, and 23 species from the El Ga'ab depression (Salah and Idris, 2013). The comparatively high diversity of birds observed in this study recommends that the habitat of the area is suitable for birds. Nevertheless, increasing anthropogenic activities are a matter of excessive concern when considering the future survival of these species. Sudan has lost a number of wildlife species in the last two decades and this is mostly due to habitat destruction; several varieties of grasses and herbs have disappeared due to overgrazing, and repeated droughts and fires. As reported by Sulieman, et. al, (2016) in the Shendi area, the main threat that affects birds is the destruction of their habitat by tree cutting for agricultural use. In Kassala most of suitable habitat is farmland and lest amount of water viability and similarly, reported by (Sumaila et al., 2020). Also, relevant study indicates that urbanization, industrialization, the threatening of wetlands and the widespread use of pesticides has a threat to birds in wildlife and many wildlife species are endangered because of illegal hunting or over-hunting (Sulieman, et. al, 2016)

Conclusion

The survey was carried out at different ecosystems during the study. 43 bird's species with various abundances were observed in the study belonging to (11) orders. The highest number of birds observed was the Village Weaver (11.72%) belonging to the order Passeriformes and also identified as order with the highest numbers of different birds' species.

Declarations

Conflict of interest

The authors declare that there are no conflicts of interest.

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Authors Contribution

First Author; Data collection, Analysis, and Writing manuscript, second author; Supervisor for field work and third author; analysis and Writing manuscript

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Figures

Figure 1

Percentage of different bird orders observed in three States in east Sudan

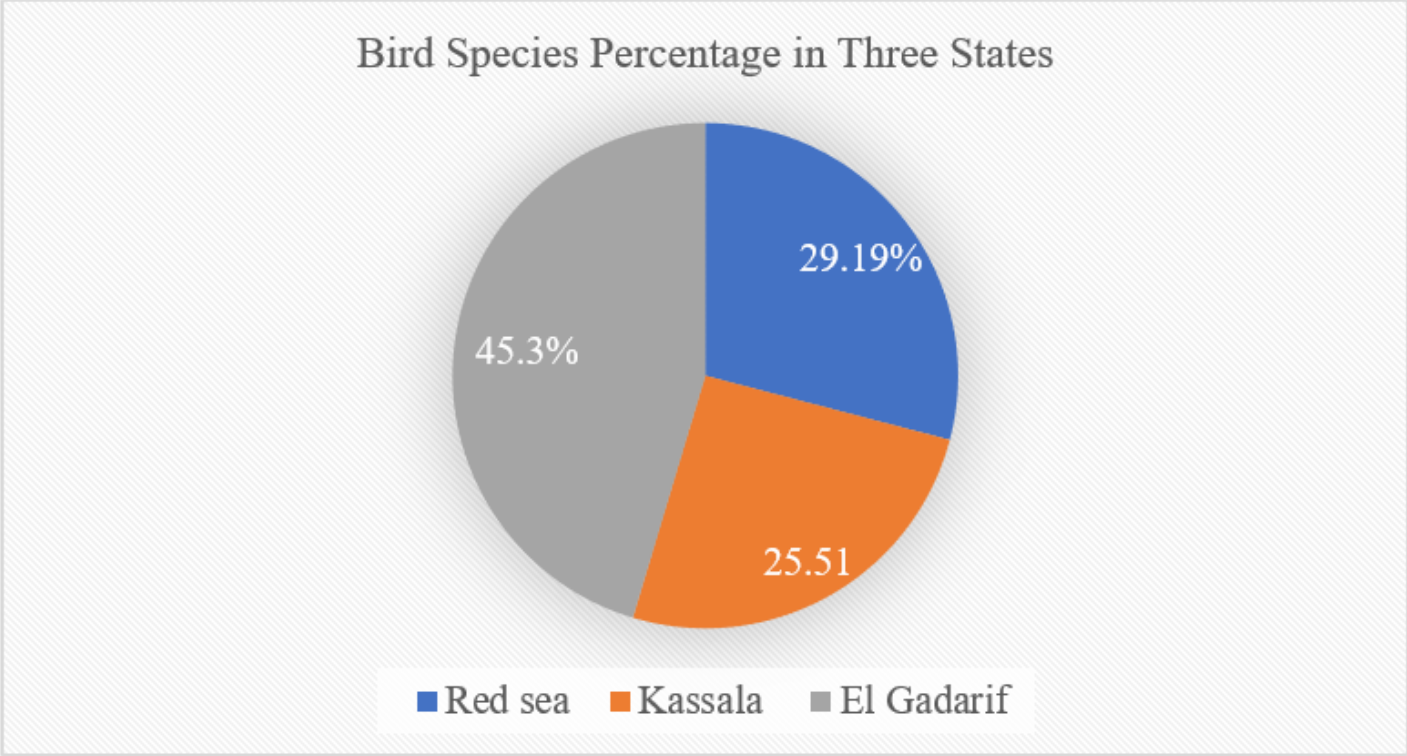

Figure 2

the ratio of species in three States