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Diversity, distribution and species composition of avifauna of the gangetic ecosystem in district Raebareli, Uttar Pradesh, India

Vikas Kumar, Himanshu Mishra, Ashish Kumar*

Department of Zoology, University of Lucknow, Lucknow, Uttar Pradesh, India

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Key words: Diversity, Avifauna, The Ganges, Riverine ecosystem, Raebareli

Abstract

The present study was carried out from July 2015 to June 2016 to assess the diversity, distribution and species composition of birds inhabiting riverine ecosystem. The study was done along the River Ganges, which is the largest river of Uttar Pradesh, flowing through district Raebareli. The presence of birds in the study area was recorded in early morning by a point count method using binoculars and SLR cameras. A total of 38 species of birds were recorded belonging to 10 orders and 19 families. The order Charadriiformes was dominated by 10 species. It accounts for 26.31% of the total birds followed by Palecaniformes which was dominated by 09 species and account for 23.68%. According to extant IUCN Status, most of the species were placed in Least concerned (32), 3 in Near Threatened, and 3 in Vulnerable category.A total of60.5 % were observed to be resident, 34.21% resident migrants and 5.26% were migrants. Maximum species diversity was recorded at Gegaso (1-D= 0.9515 & H'=3.304) and minimum at Dalmau (1-D= 0.9441 & H'= 3.192).Although the study area is resourceful in terms of habitat and food availability yet during the study it was found that various anthropogenic and environmental factors are exerting negative impact on population of birds.

***Corresponding Author:** Ashish Kumar ✉ adellu111@gmail.com

Introduction

Diversity of avifauna is one of the most important ecological indicators to evaluate the quality of habitats, Bhadja and Vaghela (2013). Study of avian diversity is crucial because it reveals information about the nature and kind of habitat occupied by birds,Bibi and Ali (2013). This also gives the demographic status of different birds in a particular ecosystem. Niche specialization of birds and their functional role in food chain can be derived from this study. Birds are ideal bio indicators as they help in pest control, pollination, cleaning the environment as scavenger, Ali and Ripley (1983) and hence, they are used as a useful tool for studying a different variety of environmental problems, Kattan and Frannco (2004). In India approximately 1300 species of birds are found or over13% of the world's bird species, Grimmet *et al*., (1999). 243 species of Water birds are present in India, Kumar *et al*. (2005), almost half of which are migratory. They come to the Indian subcontinent from their breeding grounds. The river birds as indicator of river ecosystem that could convey the importance of the ecological integrity, biological production and conservation value of river system to a large scale, Vaughan, Noble and Ormerod (2007). Study of the river birds, therefore, has the potential to capture information about many elements of riverine landscape and food web. The characteristic feature of riverine ecosystem are water flow is unidirectional, there is a state of continuous physical change, high degree of spatial and temporal heterogeneity at all scales. Riverine ecosystems are highly productive but ecologically fragile, and tend to be degraded and degenerated under the prevailing anthropogenic pressure, Gupta and Singh (2003) and human disturbance such as excessive hunting, Boralee*t al*. (1994), which in turn affect the avian diversity. Study of the abundance and distribution of a range of bird species could be a valuable tool for assessing trends in riverine ecosystem.

The present study was carried out to assess diversity, distribution and species composition of birds inhabiting riverine ecosystem of the river Ganges, which is an excellent example of lotic ecosystem. Sandy banks of river Ganges provides a long stretch of riparian vegetation and habitat for riverine birds. That is why the study area supports a number of birds for their habitat, feeding and mating activity.

Material and methods

Study area

Study was carried out along the River Ganges, flowing through the district Raebareli, Uttar Pradesh, India. Area of the district is 4609 Km^2, and lies between the latitude 25° 49' North and 26° 36' North and longitude 100° 41' East and 81° 34' East. Three sites were selected and named as site A- Gegaso (N-26°,03',26.3",E-080°,54',39.3") site B- Dalmau (N-26°,03',51.6", E-081°,01',38.2") and site C-Unchahar (N-25°,53',23", E-081°,13',08.8").

Census

The study sites were visited regularly at the interval of 15 days, throughout the study period. Bird counting was carried out during early morning from 05.00 am to 09.00 am and from 04.00 pm to 06.00 pm in summer and from 07.00 am to 10.00 am and 03.00 pm to 05.00 pm in winter using binoculars and SLR cameras. The study was based on point count method.

Identification

Identification of birds was done with the help of key reference books, Grewal and Ali (2002), Grimmet *et al*., (2007).

Statistical analysis

Mean and Standard deviation was calculated by using Microsoft excel. Simpson's diversity index (1-D) was used to estimate the biodiversity using the equation: $D = \sum ni\ (ni-1)/\ N\ (N-1)$, Where D = Simpson's Index of Dominance ni = total number of individuals of a particular species N = the total number of individuals of all species (Simpson, 1949). Similarly, Shannon diversity index was determined by $H' = -\sum (Pi)\ (\ln Pi)$, in which Pi = Proportion of total species belonging to i^{th} species. The data collected were analyzed using one way ANOVA followed by Tukey´s test. All the calculations were done with the help of PAST Paleontological Statistics version 3.12.

Result and discussion

Divesrsity & distribution

The present study was designed to enlist riverine bird species, their pattern of distribution and species composition. During the study, a total of 38 species of water birds were recorded which belong to 10 orders and 19 families.

Table 1. Check list of riverine birds in the study area.

S. No.	Common Name	Scientific name	Order	Family	Status	IUCN Status
1	Greylag Goose	*Anseranser* (Linnaeus,1758)	Anseriformes	Anatidae	M	LC
2	BrahminyShelduck	*Tadornaferraginea* (Pallas,1764)	Anseriformes	Anatidae	RM	LC
3	Darter (Snake Birds)	*Anhinga melanogaster* (Pennant,1769)	Charadriiformes	Scolopacidae	RM	LC
4	Black winged Stilt	*Himantopushimantopus* (Linnaeus,1758)	Charadriiformes	Recurvirostridae	R	LC
5	Pied Avocet	*Recurvirostraavosetta* (Linnaeus,1758)	Charadriiformes	Recurvirostridae	RM	LC
6	River Lapwing	*Vanellusduvaucelli* (Lesson,1826)	Charadriiformes	Charadriidae	R	NT
7	Red Wattled Lapwing	*Vanellusindicus* (Boddaert,1783)	Charadriiformes	Charadriidae	R	LC
8	Common Snipe	*Gallinagogallinago* (Linaeus,1758)	Charadriiformes	Scolopacidae	RM	LC
9	Common sand piper	*Actitishypoleucos* (Linnaeus,1758)	Charadriiformes	Scolopacidae	RM	LC
10	Indian Skimmer	*Rynchopsalbicollis* (Swainson,1838)	Charadriiformes	Rynchopidae	RM	VU
11	Common Tern	*Sterna hirundo* (Linnaeus,1758)	Charadriiformes	Sternidae	RM	LC
12	Yellow Wattled Lapwing	*Vanellusmalabaricus* (Boddaert ,1783)	Charadriiformes	Charadriidae	R	LC
13	Painted Stork	*Mycterialeucocephala* (Pennat,1769)	Ciconiiformes	Ciconiidae	RM	NT
14	Asian Open bill Stork	*Anastomasoscitans* (Boddaert,1783)	Ciconiiformes	Ciconiidae	R	LC
15	European White Stork	*Ciconiaciconia* (Linnaeus,1758)	Ciconiiformes	Ciconiidae	M	LC
16	White necked Stork	*Ciconiaepiscopus* (Boddaert,1783)	Ciconiiformes	Ciconiidae	R	VU
17	Lesser Pied Kingfisher	*Cerylerubis* (Linnaeus,1758)	Coraciiformes	Cerylidae	R	LC
18	Small Blue Kingfisher	*Alcedoatthis* (Linnaeus,1758)	Coraciiformes	Alcedinidae	RM	LC
19	White breasted Kingfisher	*Halcyon smyrnesis* (Linnaeus,1758)	Coraciiformes	Halcyonidae	R	LC
20	Saras Crane	*Grusantigone* (Linnaeus,1758)	Gruiformes	Gruidae	R	VU
21	Common Crested Lark	*Galeridacristata* (Linnaeus,1758)	Passeriformes	Alaudidae	R	LC
22	Dusky Crag Martin	*Hirundoconcolor* (Sykes,1832)	Passeriformes	Hirundinidae	R	LC
23	Wire tailed Swallow	*Hirundusmithii* (Leach,1818)	Passeriformes	Hirundinidae	R	LC
24	Bank Myna	*Acridotheresginginianus* (Latham, 1790)	Passeriformes	Sturnidae	R	LC
25	Yellow Wagtail	*Motacillaflava*	Passeriformes	Motacillidae	R	LC

		(Linnaeus,1758)				
26	White Wagtail	*Motacilla alba* (Linnaeus,1758)	Passeriformes	Motacillidae	R	LC
27	Large Egret	*Casmerodiusalbeus* (J.E Gray,1831)	Pelecaniformes	Ardeidae	RM	LC
28	Purple Heron	*Ardaepurpurea* (Linnaeus,1766)	Pelecaniformes	Ardeidae	RM	LC
29	Grey Heron	*Ardaecinerea* (Linnaeus,1758)	Pelecaniformes	Ardeidae	RM	LC
30	Black crowned Night Heron	*Nycticoraxnycticorax* (Linnaeus,1758)	Pelecaniformes	Ardeidae	R	LC
31	Cattle Egret	*Bubulcus ibis* (Linnaeus,1758)	Pelecaniformes	Ardeidae	RM	LC
32	Little Egret	*Egrettagarzetta* (Linnaeus,1766)	Pelecaniformes	Ardeidae	R	LC
33	Black Bittern	*Dupetorflavicollis* (Latham,1790)	Pelecaniformes	Ardeidae	RM	LC
34	Oriental White Ibis	*Threskiornismelanocephalus* (Latham,1790)	Pelecaniformes	Threskiornithidae	R	NT
35	Black Ibis	*Pseudibispapillosa* (Gmelin,1789)	Pelecaniformes	Threskiornithidae	R	LC
36	Little Grebe	*Tachybaptusruficollis* (Pallas,1764)	Podicipediformes	Podicipedidae	R	LC
37	Brown Fish Owl	*Ketapazeylonesis* (Gmelin,1788)	Strigiformes	Strigidae	R	LC
38	Little Cormorant	*Phalacarocoraxniger* (Vieillot,1827)	Suliformes	Phalacarocoacidae	RM	LC

The order Charadriiformes was represented by 10 species and dominated the bird's community of the study area. It accounts for 26.31 % of the total birds followed by Palecaniformes which was dominated by 09 species and account for 23.68%.

The order Passeriformes was dominated by 06 species (15.78%); Ciconiformes by 04 species (10.52%); Coraciformes by 03 species (7.89%); Anseriformes by 2 species (5.2%); Gruiformes, Pelecaniformees, Strigiformes and Suliformes by 1 species (2.63%) each and were fewer in number.

The scientific nomenclature, extant IUCN status and current population status details of avian diversity are given in table1. According to extant IUCN status, out of total 38 species 32 birds were placed in least concerned (LC), 3in Near Threatened (NT) and 3 in Vulnerable (VU) category. Most of the species, (60.52%) were observed to be resident, 34.21 % resident migrants and 5.26 % were migrants as shown in figure 4.

Species evenness, richness and abundance, diversity indices as Shannon-Weiner, Shannon and Weaver (1949) and Simpson index, Simpson (1949) were used to evaluate the avifaunal diversity.

The study revealed that the species richness and evenness was relatively high at Gegaso (0.7161) followed by Unchahar (0.7075) and least at Dalmau (0.6763).

Species composition

Diversity indices are given in table 4 and represented in figure 7 & 8.

Simpson diversity index was used to evaluate minor sample which takes into records both richness and evenness whereas Shannon-Weiner diversity index which specifies the comparative occurrence of many species abundance and relative richness amongst pecies, Whittaker (1977); Barbour *et al.,* (1998).

Table 2. Species abundance, mean & standard deviation of riverine birds in study area.

S. No.	Common Name	Gegaso	Dalmau	Unchahar	Species Abundance	Mean ± S.D.
1	Greylag Goose	6	0	0	6	2 ± 3.46
2	Brahminy Shelduck	7	0	0	7	2.33 ± 4.04
3	Darter or Snake Birds	28	17	15	60	20 ± 7
4	Black Winged Stilt	140	68	90	298	99.33 ± 36.89
5	Pied Avocet	111	45	67	223	74.33 ± 33.6
6	River Lapwing	499	273	158	915	310 ± 173.48
7	Red wattled Lapwing	90	52	60	202	67.33 ± 20.03
8	Common Snipe	92	58	59	209	69.66 ± 19.34
9	Common Sand Piper	80	40	47	167	55.66 ± 21.36
10	Indian Skimmer	41	10	14	65	21.66 ± 16.86
11	Common Tern	121	42	40	203	67.66 ± 46.19
12	Yellow Wattled Lapwing	26	4	7	37	12.33 ± 11.93
13	Painted Stork	64	31	28	123	41 ± 19.97
14	Asian Open bill Stork	125	40	49	214	71.3 ± 46.69
15	European White Stork	67	15	19	101	33.66 ± 28.93
16	White necked Stork	53	12	18	83	27.66 ± 22.14
17	Lesser Pied Kingfisher	88	30	52	170	56.66 ± 29.28
18	Small Blue Kingfisher	52	23	28	82	34.33 ± 15.5
19	White Breasted Kingfisher	140	73	90	303	101 ± 34.82
20	Saras Crane	110	65	82	257	85.66 ± 22.72
21	Common Crested Lark	230	160	221	611	203.66±38.08
22	Dusky Crag Martin	45	35	25	105	35 ± 10
23	Wire tailed Swallow	40	30	15	85	28.3 ± 12.58
24	Bank Myna	270	120	105	495	165 ± 91.24
25	Yellow Wagtail	125	56	60	241	80.33 ± 38.73
26	White Wagtail	170	76	88	334	111.33±51.15
27	Large Egret	77	30	40	147	49 ± 24.75
28	Purple Heron	17	1	3	21	7 ± 8.17
29	Grey Heron	40	8	17	65	21.6 ± 16.5
30	Black crowned Night Heron	57	10	21	88	29.33 ± 24.58
31	Cattle Egret	350	150	260	760	253.33±100.16
32	Little Egret	125	70	100	295	98.33 ± 27.53
33	Black Bittern	44	16	23	83	27.66 ± 14.57
34	Oriental White Ibis	240	75	88	403	134.33±91.74
35	Black Ibis	94	52	63	209	69.66 ± 21.77
36	Little Grebe	95	42	60	197	65.55 ±26.95
37	Brown Fish Owl	20	05	07	32	10.66 ± 8.14
38	Little Cormorant	80	40	57	177	59 ± 20.07

Table 3. Percentage species compostion and species abundance with their order.

S. No.	Abundant order name	Species abundance	Species composition
1.	Charadriiformes	10	26.31
2.	Pelecaniformes	09	23.68
3.	Passeriformes	06	15.78
4.	Ciconiiformes	04	10.52
5.	Coraciiformes	03	7.89
6.	Anseriformes	02	5.2
7.	Gruiformes	01	2.63
8.	Podocipediformes	01	2.63
9.	Strigiformes	01	2.63
10.	Suliformes	01	2.63

Simpson index of diversity (1-D) & Shannon Weiner index of diversity was found to be high at Gegaso (1-D= 0.9515, H= 3.304) and lowest at Dalmau (1-D= 0.9441, H= 3.192). Annual mean and standard deviation of individuals of each species of avifauna is also mentioned in the table 2.

Analysis of variance (ANOVA) was carried out for three different sites of study area which showed a significant difference (P<0.05) across these sampling sites of the river. Analyzed data is given in table 5. Tukey's test shows comparison between mean values of different regions listed in table 6.

Table 4. Diversity index of riverine birds at different sites of study area.

Site	Species Richness	Species Evenness	Species Abundances	Simpson's index (D)	Simpson's index of diversity (1-D)	Shannon diversity index (H')
Gegaso	38	0.7161	4059	0.04845	0.9515	3.304
Dalmau	36	0.6763	1874	0.05593	0.9441	3.192
Unchahar	36	0.7075	2176	0.05116	0.9488	3.238

Table 5. Statistical description of parameters obtained by nonparametric test one way ANOVA.

ANOVA Table	SS	Df	MS	F-Value	P-value
Treatment (between Group)	73781.7	2	36890.9	6.984	0.00139
Treatment (within Group)	586309	111	5282.07		
Total	660091	113			

The banks of river Ganges are rich in flora and fauna, mainly due to, perennial water supply in river ecosystem, which provides nutrients, invertebrate and vertebrate food material in large amount. The wide river banks provide flood plains, seasonal ponds which are rich in plant and animals supporting a variety of birds Donar *et al*., (2012).

Table 6. Tukey's Multiple Comparision test between all group of study area.

Tukey´s Multiple Comparison Test	Mean Diff.	Q	Significant (p<0.05)	Summary	95% Cl of diff.
Column A Vs. Column B	57.50	4.877	YES	**	17.86 to 97.14
Column B Vs. Column C	49.55	4.203	YES	*	9.910 to 89.20
Column B Vs. Column C	-7.947	0.6741	NO	Ns	-47.59 to 31.70

Group A- Gegaso, Group B- Dalmau, Group C- Unchahar.
Value * is significant less than 0.05, **less than 0.01 and *** less than 0.001.

Apart from providing flood plains, banks of river provides mating ground which help in mating and breeding of birds in study area,

Mohan and Gaur (2008).It is important to mention that with the exception of a few species, all the birds are not tied to water and spend most of time in terrestrial habitat.

The study reveals that out of total 10 orders of birds reported during the study, four orders, *viz*. Charadriiformes, Pelecaniformes, Passeriformes and Ciconiformes showed maximum species richness, suggesting they are well adapted to lotic ecosystems. In total, 55.3% birds were found to be resident and remaining 44.7% were resident migratory and migratory. Waders; formed a major chunk of resident migratory birds and, are also the most dominant group of water birds. River lapwing & Common crested lark were the most abundant bird species. Only two species, *viz*. Greylag goose and European White Stork were reported to be migratory and are winter visitors.

Fig. 1.1. GoogleSatelite image of site A- Gegaso.

Figure 1.2. Google Satelite image of site B- Dalmau site.

Figure 1.3. Google Satelite image of site C- Unchahar site.

Simpson index of diversity (1-D) & Shannon Weiner index of diversity was found to be high at Gegaso than other two sites because, there were relatively vast sand banks and Island with rich riparian vegetation, which provides shelter, roosting, feeding and breeding sites to birds.

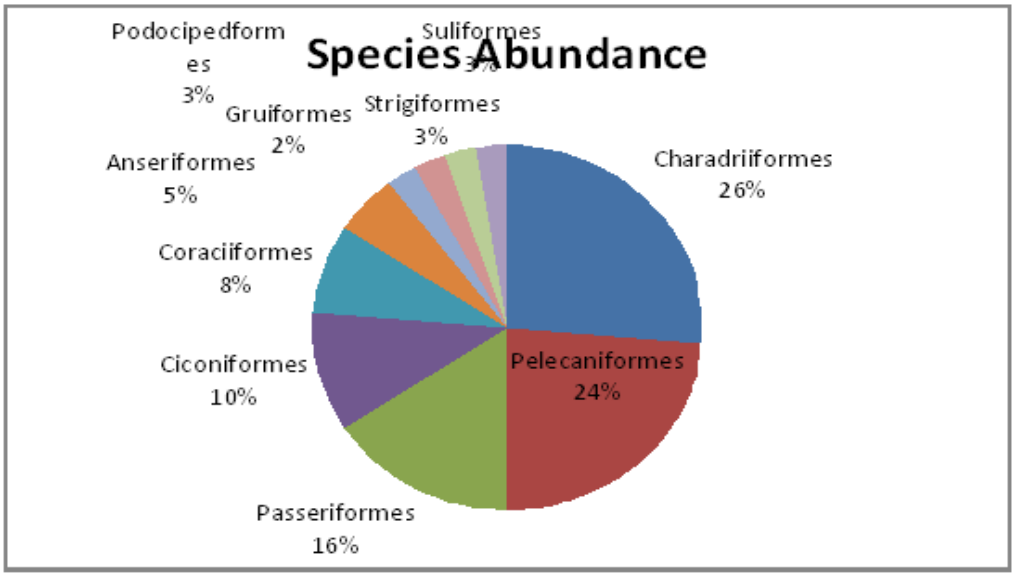

Fig. 2. Species abundance (%) of different birds orders in study area.

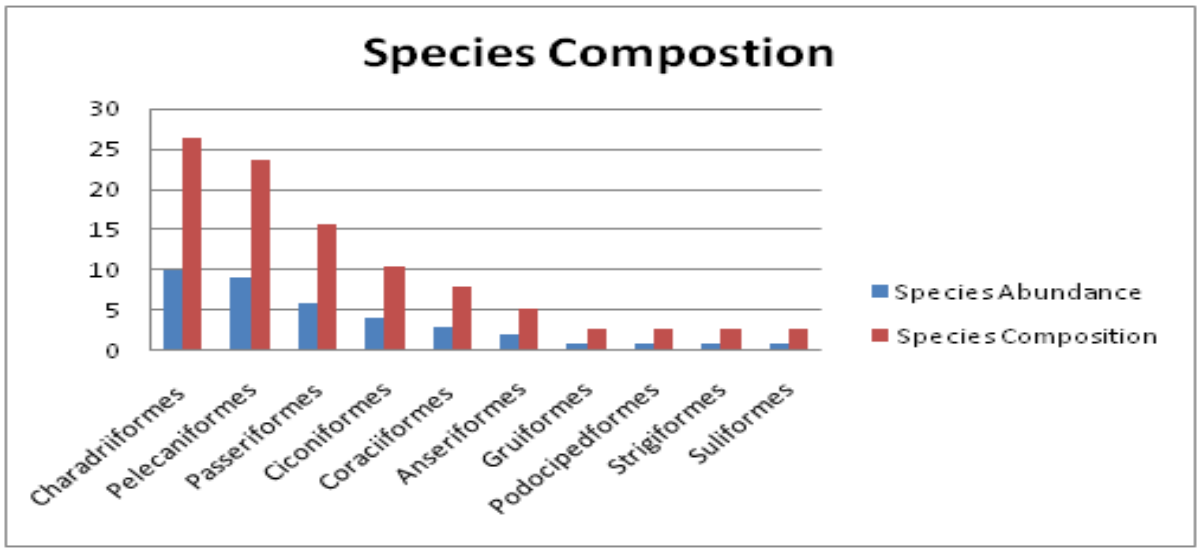

Fig. 3. Species abundance & composition of birds under different orders.

During the study it was found that various anthropogenic and environmental factors are exerting negative impact on population of birds.

Secondary data collected from the local people of the study area suggested that, once, this area used to be heavily populated by migratory birds, but for several years a sharp decline has been observed both in the species number and abundance.

According to local people, the river is receiving less than half of water than what it had previously, which is the major cause of plummeting population of birds. Hunting, too, has corroborated this problem.

We found that pollution, hunting, alterations in physico-chemical properties of water, expansion of crop fields etc. are the major threats to riverine flora and fauna of the study area.

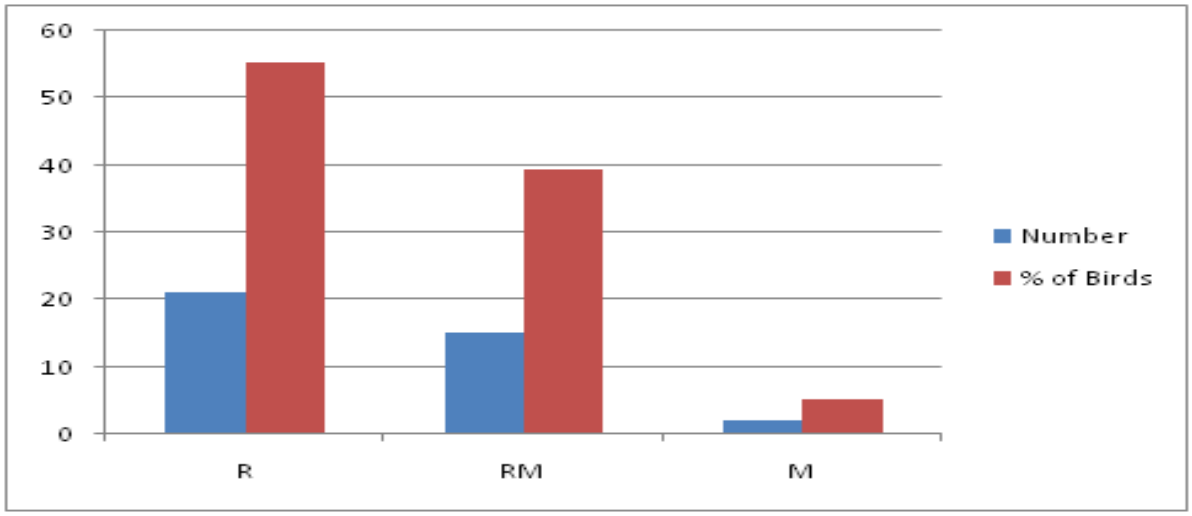

Fig. 4. Status of birds at different sites in study area.

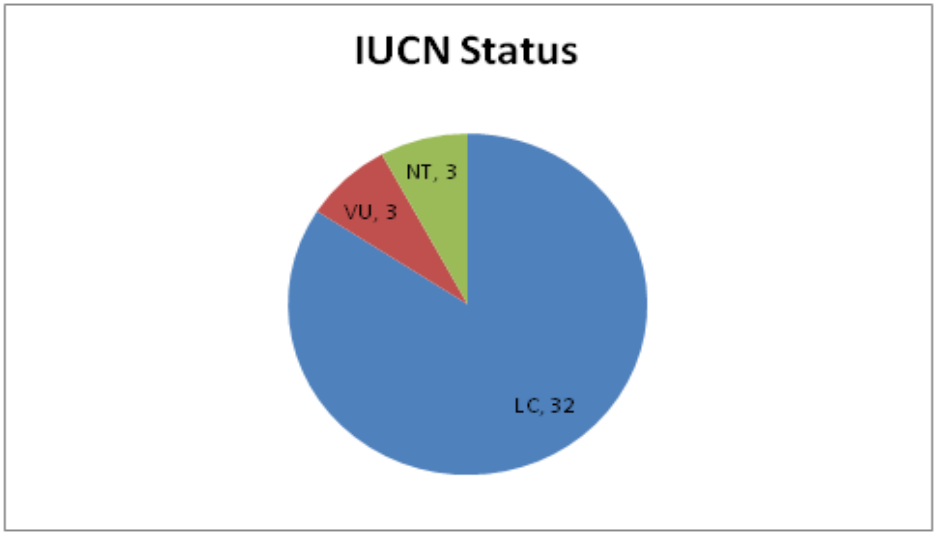

Fig. 5. IUCN Status of birds in study Area.

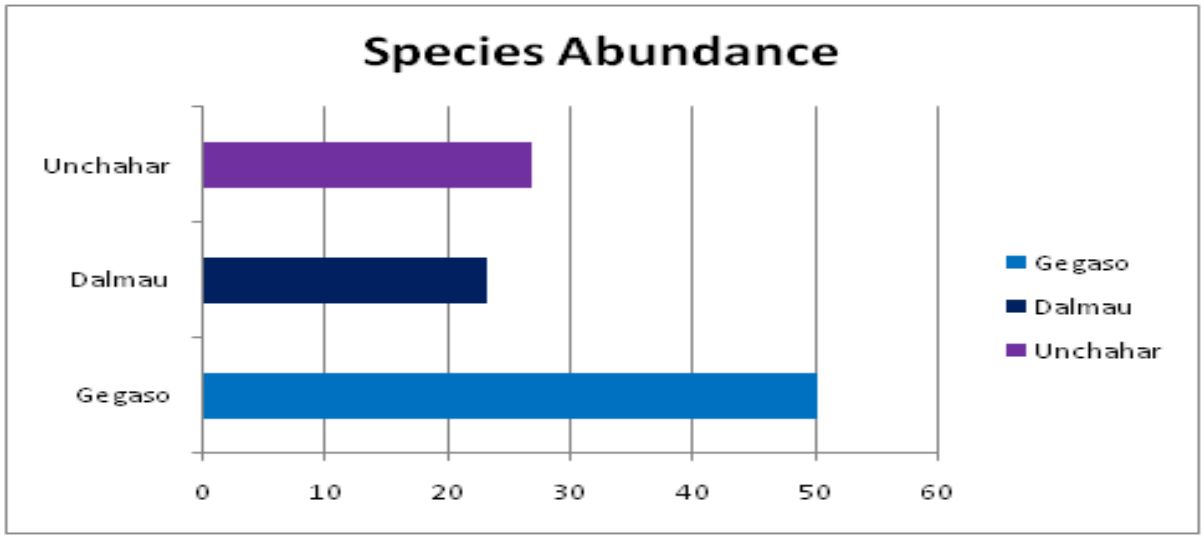

Fig. 6. Diversity of birds (%) at different sites in study area.

Lack of awareness among common masses regarding conservation of nature is also daunting.

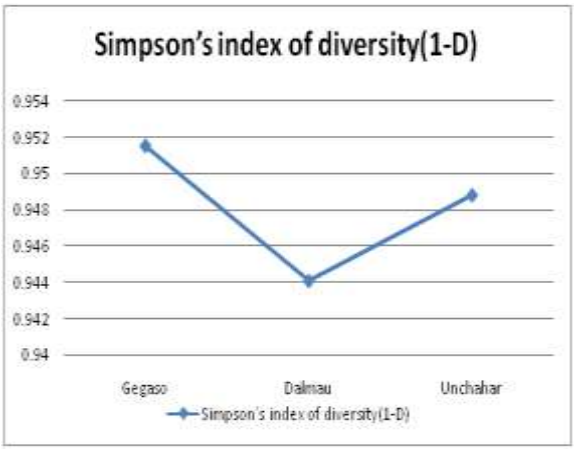

Fig. 7. Simpson's index of diversity at different sites.

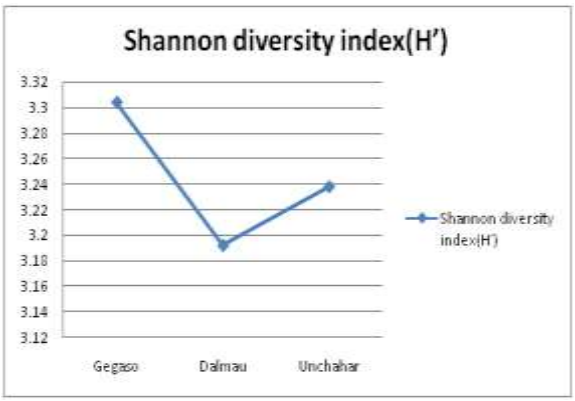

Fig. 8. Shannon diversity index at different sites.

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