



Comparative study of avifaunal diversity and density of Bannigola, Ankasamudra and Magadi Wet land areas of North Karnataka, India

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Abstract

In the hitherto study three Wetlands have been selected to study the diversity and density of avifauna because all the three study areas are away from each other and exhibit dissimilarity in their habitat structure. Ankasamudra study area occupies first place in accommodating 173 species under 62 families of 20 orders followed by Bannigola back waters area of T.B. Dam with 141 species, 59 families, 21 orders where as another study area Magadi lake recorded 100 species, 45 families, and 19 orders. It clearly indicates that the study area Ankasamudra harbored highly diversified and denser avian population due to food, water and vast space for roosting and nesting by having hundreds of *Acacia* trees in it, rather than the remaining two study areas. Hence Ankasamudra is emerged as a most promising destiny for both resident and migrant avian species.

Keywords: avifauna, species, diversity, nesting, roosting, study area

Introduction

Wetland is a land area that is saturated with water either permanently or seasonally whether natural or artificial, temporary or permanent with static or slightly flowing fresh water, brackish water or salt water (Ramsar convention, 1971). Wetlands are treasure of living community (Hosetti, 2002) ^[2] and birds also inhabit these wetlands for feeding, breeding, nesting or roosting (Paramesh kumar and Gupta, 2013) ^[1] hence named as wetland birds, which comprises bird groups like water fowls and waders. In addition, several other bird groups like kingfishers, passerines, raptors are also ecologically dependent on wetlands and are considered as wetland dependent and associated avifauna (Kumar *et al.*, 2005) ^[3].

Gandiva *et al.*, (2013) ^[4] opined that complex characteristics like water chemistry, aquatic vegetation, invertebrate fauna and physical features of wetlands and habitat structure are significantly influence birds species diversity. Wetlands are providing food and shelter at least for 20% of threatened bird species in the Asiatic region which is far more than 10% of the globally threatened birds (Kumar *et al.*, 2005) ^[3]. Aves are considered as biological indicators of environmental quality in various management programmes (Morrison *et al.*, 1986 and Jerjins 1988). Monitoring of wetland birds provides valuable information on the ecological health and status of wetlands and can be a vital tool for developing awareness regarding the conservation value of the wetlands. The importance of local landscapes for conservation of avifauna can only be understood by knowing the structure of the bird community of that region (Kattan and Franco, 2004) ^[5].

Fraser and Keddy (2005) opined that although wetlands are one of the most productive ecosystems and are most severely affected habitats next to tropical forests, they are being neglected in densely populated country like India. In the last century, over 50% of the wetlands in the world have been lost and the remaining wetlands degraded to different degree because of the adverse influence of human activities (Bird life international, 2003). Hence in this context the present study was undertaken to assess the factors which influence avifauna in wetland habitats.

Materials and methods

Observation and photography of the wetland birds at the study area was done by using Olympus binoculars (Olympus 10x50 DPSI, Field 6.50) and (Canon EoS 6001), DSLR Camera. Birds were classified into orders and families by referring to "Birds of Indian Subcontinent" by R. Grimmett, Carol Inskipp and Tim Inskipp (2011). In the present study survey of birds conducted from April 2015 to March 2016, April 2016 to March 2017 and April 2017 to March 2018 for three consecutive years (Weakly one visit to one study area and from 6AM to 11AM and 4PM to 6PM).

Study areas

Three wetlands were selected for present study due to dissimilarity in habitat structure, water resource, food availability, place for roosting and breeding for birds.

1. Bannigola backwaters of T.B. dam

Bannigola is a village in Hagaribommanahalli Taluk in Ballari District of Karnataka State, India. It is located 101km towards west from Ballari, (15°10'43.02 N Latitude and 076°06'23.3 E Longitude). Tunga Bhadra dam

lake), 5 families with 6 species in Bannigola backwater and Magadi lake registered 4 families and 4 species. Order Ciconiformes: 2 families with 9 species (Ankasamudra lake), 2 families with 7 species (Bannigola backwater) and 2 families with 8 species in Magadi lake.

Order Accipitriformes includes 2 families with 11 species (Ankasamudra lake), 2 families with 7 species in Bannigola backwater and one family with 6 species in Magadi lake. The remaining orders constituted with one or two families with one or two species each in all the three study areas.

The present study also showed that the family Sturnidae (48.577%), Ciconidae (23.86%), Ardeidae (6.22%) and Plocidae (3.31%) were highly dominating in the Ankasamudra lake during winter season. Consecutive places were occupied by the family Anatidae (2.18%), Threskiornithidae (2.59%), Scolopacidae (1.370%), Motacillidae (1.356%), Alaudidae (0.52%) and Cisticolidae (0.233%) and the remaining families constitute 0.01% to 1.0% each of the total family wise frequency of occurrence in Ankasamudra lake.

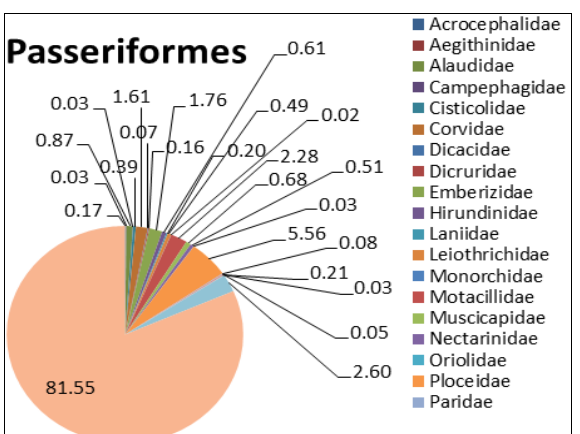
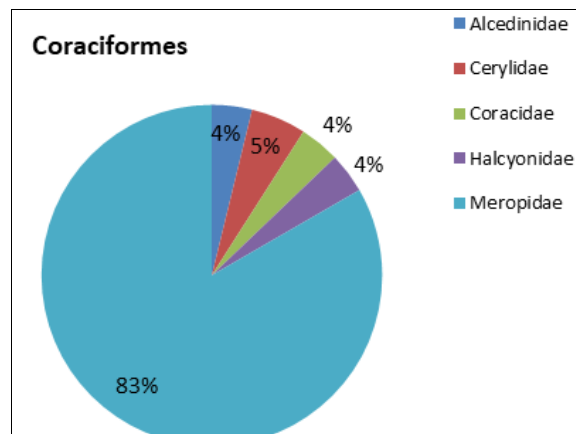
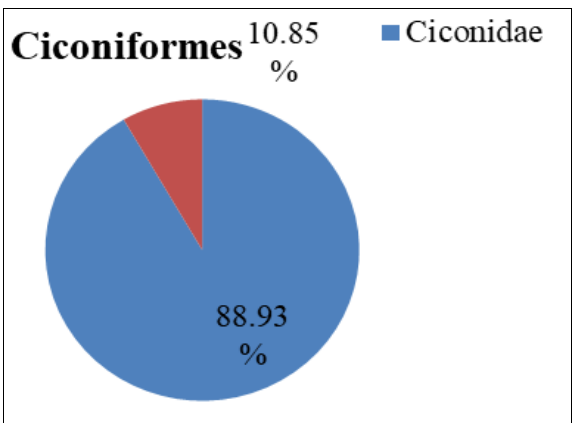
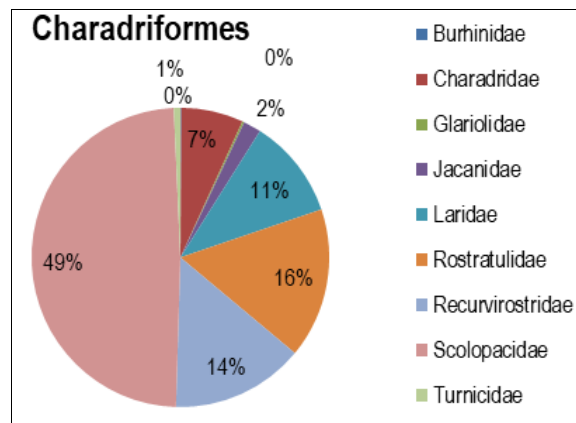
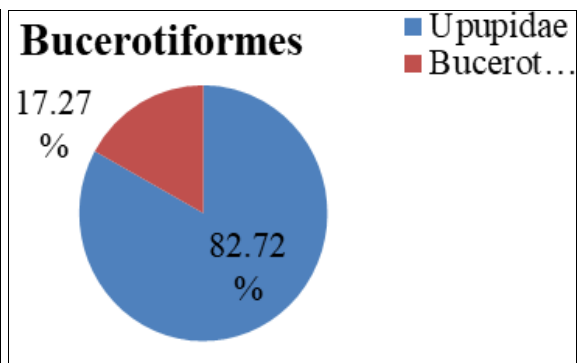
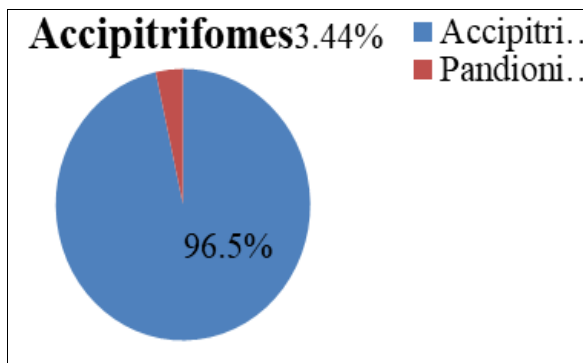
In Bannigola backwater, family Anatidae (19.73%), Phoenicopteridae (18.32%), Plocidae (9.674%), Phalacrocoracidae (7.27%), Motacillidae (6.88%), Emberizidae (6.63%), Hirundinidae (5.68%) and Scolopacidae (5.326%) were prominently dominated the wetland. Next it is Glariolidae (4.374%) and Recurvirostridae (2.125%) and remaining families contributed 1.1% to 2% each of total family wise frequency of occurrence.

In Madagi lake, family Anatidae (74.048%) is highly dominating especially by Bar headed geese (4000-6000 number in every winter season) and further places occupied by Gruidae (2.29%), Cisticolidae (2.17%), Leiothrichidae (2.73%), Ardeidae (1.79%), Passeridae (1.53%), Alaudidae (1.13%) and Charadriidae (1.02%). The remaining families were constituted 0.5 to 1% each family wise frequency of occurrence.

Table 1: Comparison of family wise percentage of three study areas (based on the density of the avifauna).

Sl. No	Family	Ankasamudra	Bannigola	Magadi
1.	Accipitridae	0.084	0.146	0.32
2.	Acrocephalidae	0.1	0.034	0.5
3.	Aegithinidae	0.016	0.054	-
4.	Alaudidae	0.518	0.159	1.13
5.	Alcedinidae	0.016	0.12	0.22
6.	Anatidae	2.177	19.73	74.04
7.	Anhingidae	0.012	0.05	-
8.	Apodidae	0.294	0.105	1.1
9.	Ardeidae	6.207	1.288	1.79
10.	Bucerotidae	0.019	0.032	0.05
11.	Burhinidae	0.003	0.026	-
12.	Campephagidae	0.019	0.026	-
13.	Caprimulgidae	0.011	0.045	-
14.	Cerylidae	0.022	0.034	0.05
15.	Charadriidae	0.189	0.682	1.02
16.	Ciconidae	21.218	0.624	0.34
17.	Cisticolidae	0.233	0.306	2.17
18.	Columbidae	0.18	-	0.77
19.	Coraciidae	0.016	0.052	-
20.	Corvidae	0.956	0.075	0.71
21.	Cuculidae	0.214	0.241	0.11
22.	Dicacidae	0.044	0.03	-
23.	Dicruridae	0.098	0.233	0.38
24.	Emberizidae	1.045	6.63	-
25.	Falconidae	0.016	0.013	0.09
26.	Glariolidae	0.006	4.374	-
27.	Gruidae	-	-	2.29
28.	Halcyonidae	0.016	0.099	0.18
30.	Hirundinidae	0.365	5.681	0.18
31.	Jacaniidae	0.054	-	-
32.	Lanidae	0.118	0.405	0.15
33.	Laridae	0.303	1.214	0.12
34.	Leiothrichidae	0.292	0.553	2.73
35.	Megalaimidae	0.01	0.047	0.08
36.	Meropidae	0.35	0.969	0.66
37.	Monorchidae	0.009	-	0.2
38.	Motacillidae	1.356	6.888	0.35
39.	Muscicapidae	0.406	0.163	0.18
40.	Nectarinidae	0.304	0.237	0.18
41.	Oriolidae	0.015	0.056	-
42.	Pandionidae	0.003	0.022	-
43.	Paridae	0.048	0.049	0.06
44.	Passeridae	1.548	-	1.53

45.	Pelecanidae	0.19	0.22	-
46.	Phalacrocoracidae	3.894	7.27	0.37
47.	Phasianidae	0.197	0.766	0.3
48.	Phoenicopteridae	-	18.32	0.16
49.	Phylloscopidae	0.031	0.078	-
50.	Picidae	0.047	0.101	-
51.	Ploceidae	3.302	9.674	0.63
52.	Podicipedidae	0.121	0.078	0.5
53.	Psittaculidae	0.13	0.702	0.36
54.	Pteroclididae	0.041	0.284	-
55.	Pycnonotidae	0.122	0.316	0.24
56.	Rallidae	0.235	0.205	1.64
57.	Recurvirostridae	0.405	2.125	0.14
58.	Rostratulidae	0.455	-	-
59.	Scolopacidae	1.368	5.326	0.4
60.	Strigidae	0.031	0.065	0.05
61.	Sturnidae	48.467	0.861	0.69
62.	Sylviidae	0.019	0.269	-
63.	Threskiornithidae	2.59	1.038	0.51
64.	Turnicidae	0.02	0.349	-
65.	Upupidae	0.091	0.028	0.2



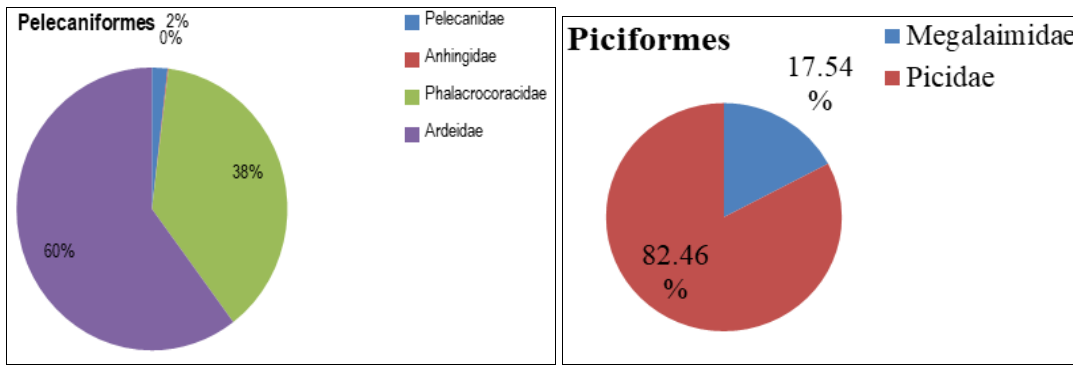


Fig 2: Percentage composition of birds at Family level (1-8) of Ankasamudra

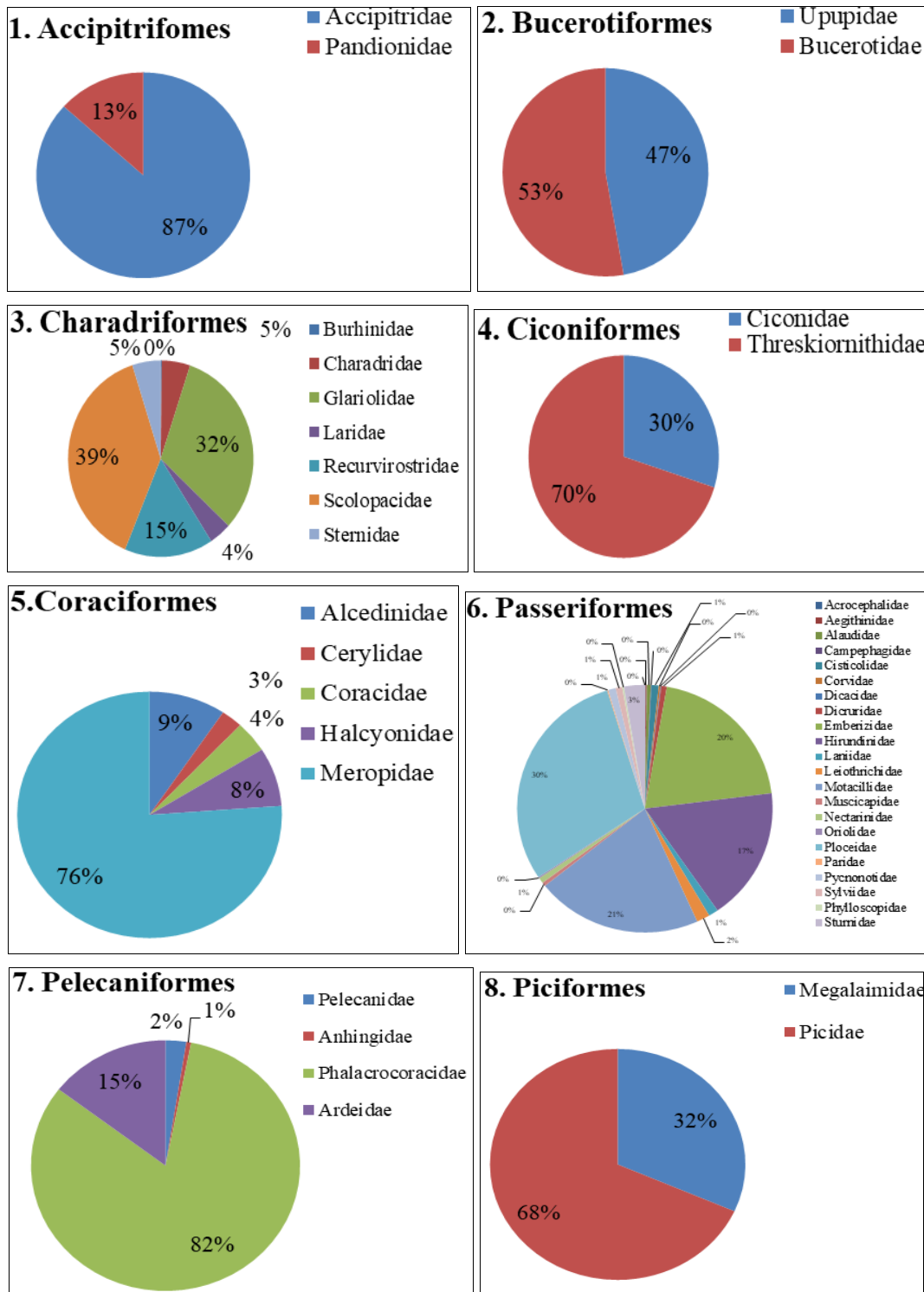


Fig 3: Percentage composition of birds at Family level (1-8) of Bannigola back water

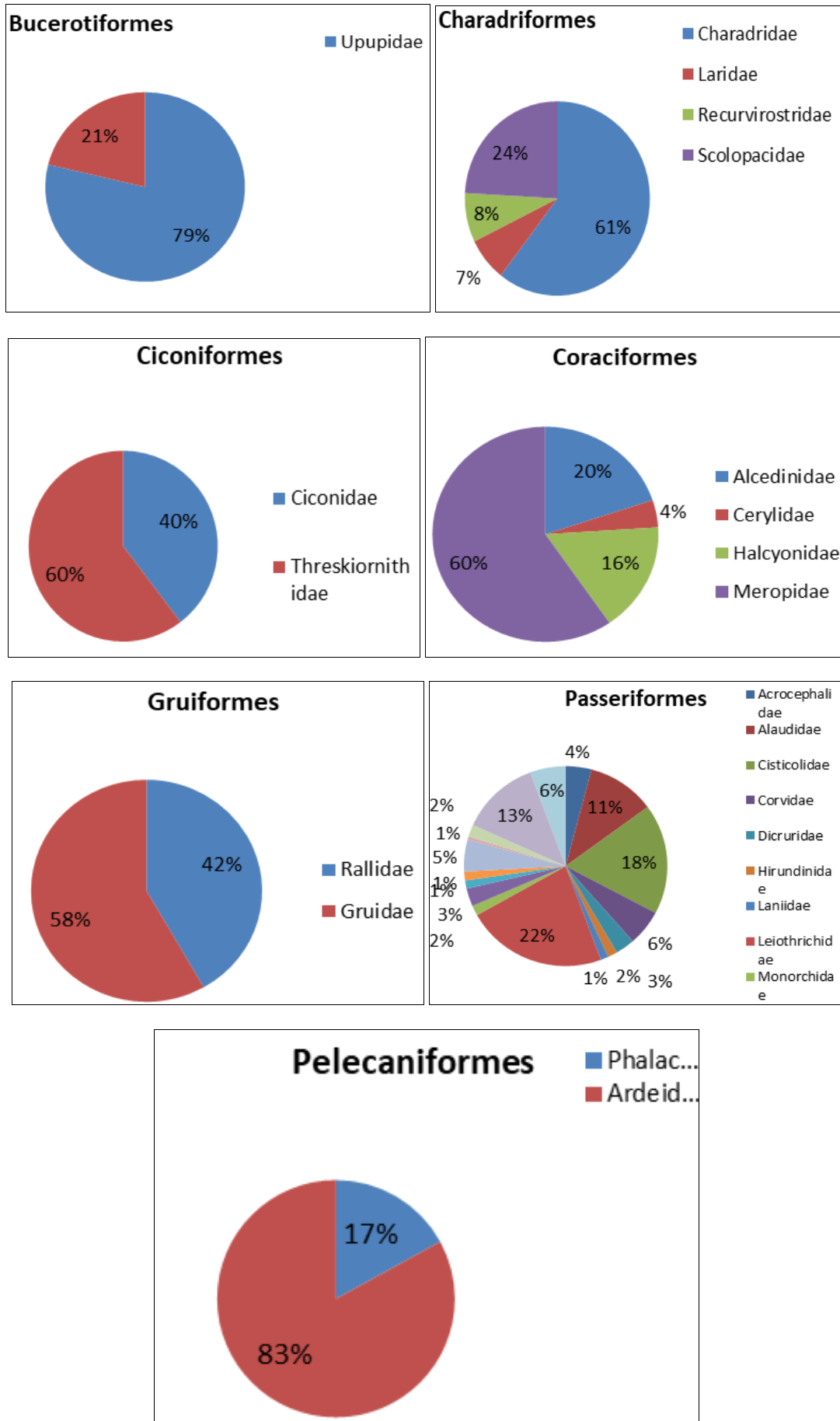


Fig 4: Percentage composition of birds at Family level (1-7) of Magadi Lake

The order Passeriformes (59.431%) and followed by Ciconiformes (23.86%), Charadriiformes (2.803%), Anseriformes (2.177%) and the remaining orders with one or two families each with one or two species respectively.(Table 2, Fig 5).

The order Passeriformes showed highest diversity (32.78 %) followed by Anseriformes (19.73%), Phoenicopteriformes (18.32 %), Charadriiformes (13.75%), Pelecaniformes (8.83%), Ciconiformes (2.084 %) and Accipitriformes (0.168%) and the rest of the orders comprise 1 to 3 families each in the study area respectively(Table-2, Fig-5).

The order Anseriformes showed highest diversity (74.04 %) followed by Passeriformes (12.14%), Gruiformes (3.93 %), Pelicaniformes (2.15%) and the rest of the orders comprise 1to3 families each in the study area respectively (Table-2, Fig-5).

Table 2: Comparison of order wise percentage of three study areas (based on the density of the Avifauna).

Sl. No	Order	Ankasamudra	Bannigola	Magadi
1	Accipitriformes	0.087	0.168	0.32
2	Anseriformes	2.177	19.73	74.04
3	Apodiformes	0.294	0.105	1.1
4	Bucerotiformes	0.11	0.06	0.25
5	Caprimulgiformes	0.011	0.045	
6	Charadriiformes	2.803	13.75	1.68
7	Ciconiformes	23.86	2.084	0.85
8	Coraciiformes	0.42	1.273	1.12
9	Cuculiformes	0.214	0.241	0.11
10	Columbiformes	0.18	0.241	0.77
11	Falconiformes	0.016	0.013	0.09
12	Galliformes	0.197	0.766	0.3
13	Gruiformes	0.235	0.205	3.93
14	Passeriformes	59.431	32.78	12.14
15	Pelecaniformes	10.303	8.835	2.15
16	Piciformes	0.057	0.148	0.08
17	Psittaciformes	0.13	0.702	0.36
18	Pteroclidiformes	0.041	0.284	
19	Podicipediformes	0.121	0.078	0.5
20	Strigiformes	0.031	0.065	0.05
21	Phoenicopteriformes		18.32	0.16

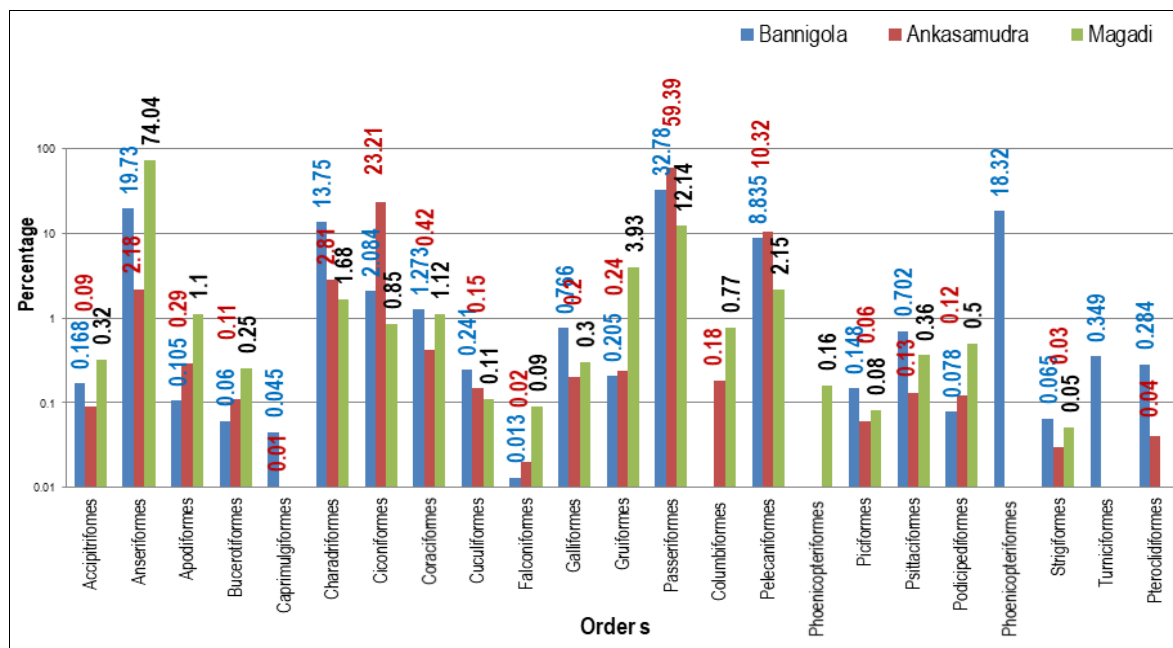


Fig 5: Comparative analysis of Order percentage composition of Avifauna in study area

In the present study, it is confirmed that the Bannigola backwater recorded 67.37% of resident birds, 22.69% of migratory birds, 4.96% of seasonal and only one species of passage migrant- Greater flamingo. Whereas Ankasamudra lake constituted 75.72% resident, 20.23% migratory, 3.46% seasonal and 0.57% summer visitor birds. Finally Magadi lake comprises 64% resident birds, 31% of migratory and 5% seasonal visitors (Table-3).

Table 3: Percentage comparison of birds visiting three study areas.

Study area	Resident Birds	Migratory Birds	Passage Migrant	Summer Visitor	Seasonal Visitor
Bannigola Backwater	67.37%	22.69%	One Species	-	4.96%
Ankasamudra Lake	75.72%	20.23%	-	0.57%	3.46%
Magadi Lake	64%	31%	-	-	5%

Correlations between the water birds and wetland species may be mere reflection of some critical habitat features, often correlated with food bases (Terborg, 1985). Stable decreasing or increasing avifauna species in wetland study areas in accordance with stable decreasing or increasing status of their major threats, food bases, which might indicate a positive relationship with these variables (Adeshkumar and Amita Kanaujia, 2017) ^[7]. Stapanian *et al.*, (2004) ^[8] evaluated the avian species richness in wetlands using certain criteria on which factor affecting habitat heterogeneity and species richness. Rainfall, wetland area, wetland depth and major water bird food bases have been suggested as the limiting factors to decide abundance and diversity of avifauna in wetlands (Bartodziej and Wey mouth, 1995) ^[9].

Dey (2015) ^[26] worked on the comparative study of avifauna diversity and abundance on the areas of Ox Bow lakes and Mothijheel Murshidabad, West Bengal stated that the intense anthropogenic pressure surrounding the wetlands and agricultural practices influenced the characteristics of the habitat and his results revealed that the wetland birds provide vital information on the ecological health and the status of wetlands. In the hitherto study all the three study areas have registered noticeable abundance and diversity of avifauna indicating that these wetlands are not much affected by the anthropogenic activities and which is supported by the data that least concern (LC) occupied highest percentage (n=132, 93.61%) and near threatened (NT) (n=8, 5.67%) and vulnerable (VU) known only 0.70% (n=1) in Bannigola backwater.

Whereas Ankasamudra reported 95.37% of least concern (LC) (n=165), near threatened (NT) 3.46% (n=6), vulnerable (VU) 0.57% (n=1) and endangered species 0.57% (n=1). In Magadi lake least concern (LC) species constituted 94%, near threatened (NT-5%) and vulnerable (VU) species 1%.

Near threatened birds like Black tailed Godwit, River tern, Painted stork, Black headed Ibis were commonly noticed in all the three study areas, vulnerable species namely woolly necked stork was sighted in all the three study areas. Another near threatened bird Red necked Falcon sighted in Ankasamudra and Magadi lakes, whereas, Pallied Harrier and Eurassian Curlew recorded in Bannigola backwater only. Endangered species like Curlew Sandpiper, Great thick knee and Adjutant stork are sighted only in Ankasamudra lake. Spot billed pelican and oriental Darter were recorded both in Bannigola and Ankasamudra lakes. Among these study areas Ankasamudra lake registered maximum number of near threatened (n=9) birds followed by Bannigola and Magadi lakes.

In all the three wetland areas family Anatidae emerged as the largest family with more numbers of aquatic birds whereas other families also exhibit significant number of species. Although species richness varied predictably with latitude and other environmental gradients (Hawkins *et al.*, 2003; Hillebrand, 2004), the mechanisms responsible for geographic patterns in biodiversity are poorly understood (Mittelbach *et al.*, 2007; Currie *et al.*, 2004) ^[11]. Classic niche- based hypothesis argued that local species richness is related to the variety of available resources including escape space from enemies (Ricklefs, 1975; Ricklefs, 2009) ^[12, 13] which were partitioned among species to reduce interspecific competition and there by allowed co-existence (Macarthur, 1972; Schoever, 1974; Tilman, 1982; Chase and Leibold, 2003) ^[14, 15, 17]. Due to non-availability of sufficient space in Magadi lake, species abundance and diversity is less when compared to other two study areas. As far as number of species concerned no significant difference was found during each season when they cited in same geographical zones (Jagruti and Padate, 2008) ^[16]. Since Bannigola back water and Ankasamudra lakes are located in same geographical area they depicted similarities in diversity and distribution of avifauna.

The Statistical analysis of diversity, density, frequency, IUCN status, WPA status and shanon-weiner and Simpson diversity indices revealed Ankasamudra lake is more significant ($H^1=3.843$; $D=0.732702$) and followed by Bannigola back waters ($H^1=3.296$; $D=0.4936$) and Magadi lake ($H^1=3.296$; $D=0.471833$) in respect of diversity of avifauna (Table-4). It is also represented by flow chart as follows; Diversity of Ankasamudra lake > Bannigola back water > Magadi lake. Adeshkumar and Amita Kanauji (2017) opined that Shannon-Weiner diversity index and Simpson's index have no significant difference among different samples and Whittaker (1977) ^[27] stated that the Shannon-Weiner and Simpson diversity indices are directly associated with abundance and relative richness amongst species. High value of both diversity indices indicated the conducive environmental conditions of wetlands (Patil, 2017) ^[18] and similar observations were made in irrigation reservoir of Savli taluk of district Vadodara by Rathod and Padate (2008) ^[16]. Collecting data on habitat utilization pattern was water birds inhabiting the lake wetland may be a vital issue for successful conservation activity and design action plans (Ali Elafri *et al.*, 2017) ^[19] particular habitats have different importance for different species. Besides typical attractive habitats like stubble to wintering birds may help in forage in the habitats that occur in a traditional forming land scape. Agri-environmental program should strive to preserve traditional agriculture areas which support a high variety of habitats (Zbigniew Kasprzy Kwoski and Artur Golawski, 2012) ^[20]. Similarly type of ecology can be seen in and around the study areas, thus they attract more number of species, this supports the hitherto research as well.

Table 4: Comparative Analysis of Shannon and Simpson diversity indices of the three study areas

Study area	Total no. of individuals (Avg. for 3 years)	$H' = -\sum P_i \ln p_i$	$D = 1 \frac{\sum n(n-1)}{N(N-1)}$
Bannigola Backwater	17848.66	3.452	0.94
Ankasamudra Lake	33976.6	3.843	0.732702
Magadi Lake	4364.67	3.296	0.471833

Unfortunately wetlands are generally regarded as wastelands, breeding grounds for mosquitos and from the view point of administrators and land developers, they are thought to be fit only for land reclamation. Due to these reasons a number of wetland birds of India are under severe threat and require urgent protection (Hosetti and Venkateshwaralu, 2001; Hosetti, 2002) [21]. Onolragchoa Ganold (2017) studied globally threatened birds and opined that investigations on birds is not sufficient and required continues monitoring. Gombobathar and Monks, 2011) [24] studied threatened birds of Mongolia (Regional Red list series) (Bird life international data zone, 2017) and concluded that habitat loss, human settlement, tourism or recreation were the major threats to birds. Patrick Barkham (2008) [25] discussed on the threats to birds and stated that agricultural expansion, intensification, logging were the major threats to decline of avian species. Hence conservation of wetlands and avifauna needs prevention of interference of human beings.

Conclusion

The present study revealed that these wetlands located in arid zone are attracting migratory birds from within the country and from other countries as well due to availability of sufficient food in the wetlands and surrounding irrigated lands. It is realized that during the study Ankasamudra lake showed maximum diversity and density of avifauna which is attributed to all the essential factors like food, water and more importantly roosting place by existing well grown *Acacia* tress in the entire lake catchment but the remaining two study areas attracted relatively low density and diversity of avifauna because place for roosting and breeding was the limitation in them.

The present study also confirmed that wetlands are not waste lands; they are home lands and breeding sites of avifauna. Thus conservation of wetlands is an urgent need for the day to invite the winged guests to these abodes of biodiversity in the dry lands of North Karnataka, India.

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