

# Population Distribution, Density and Diversity of Aquatic Avifauna at Different Lakes in and Around Mysore, Karnataka, India

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**Abstract:** The aquatic avifauna plays a crucial role in maintaining the intricate balance between biotic and abiotic components in various water habitats. Several bird species exclusively depend on seasonal or perennial water bodies for their normal survival and help keep the healthy status of water habitats in and around urban ecosystem. In this regard, present investigation was conducted systematically at five Lakes in and around Mysore during 2019-2020 by following standard methods. Total 33 aquatic bird species, which belong to 16 families of 10 orders in class Aves, were recorded. The distribution, population density and percent occurrence of aquatic avifauna indicated considerable variation. However, analysis of variance of aquatic avifauna found at different Lakes didn't show significant variation ( $F=1.010$ ;  $P<0.05$ ) but, the diversity indices indicated considerable difference between the Lakes in and around Mysore. The dominance ('D') index of aquatic avifauna was ranged between 0.112 and 0.331, the Shannon diversity ('H') index ranged between 1.860 and 2.515 and the Fisher alpha value ranged between 3.247 and 4.424 at different Lakes. Moreover, Simpson 'J' (Equitability) index of aquatic avifauna was 0.669 to 0.887, suggesting unevenness between the Lakes. Further, the Sorenson's ( $\beta$  diversity) index value of aquatic avifauna was minimum 0.424 to maximum 0.800 and indicated considerable variation existed between the Lakes. The reason for this variation in species composition and variance needs to be attended critically to understand the prevailed conditions of these Lakes. However, Lakes are vital components of urban ecosystem; acts like lungs of local environment and their preservation help conserve aquatic avifaunal diversity amidst urban ecosystem. At this juncture, periodic assessment of local avifaunal diversity would help understand the existing constraints if any, faced by the avifauna and their water habitats. It requires in depth investigations and results of such observations are published elsewhere.

**Keywords:** Aquatic avifauna, Diversity, Lakes, Urban Environment, Mysore.

## I. INTRODUCTION

Birds are amazing creatures on this planet earth represent diverse group of vertebrates, found in various types of ecosystems to lead normal survival (Jordan and Verma, 2000). However, few bird species require aquatic habitats to attend various activities during their survival. Inland aquatic habitats include freshwater ponds, pools, lakes, rivers, marshy areas and wetlands (Kumar *et al.*, 2005; Basavarajappa, 2006) have provided suitable habitat for local and migratory aquatic avifauna. However, inland aquatic habitats are prone to various anthropogenic activities such as clearance, conversion and degradation, encroachment and sewage pollution, hunting for food, wild birds trade etc (Lakshmi *et al.*, 2020). All these activities have pushed several inland lakes/ponds to endangered state in recent years (Sathish *et al.*, 2020). Since, avifauna of India represents 64% global avian diversity. Among them, many bird species are depended on inland water habitats viz., ponds, lakes, rivers which are located at/nearby villages/town/urban/metropolitan centers. Nearby these centers, management and maintenance of healthy pollution free environment amidst inland aquatic habitats is a challenging task and becomes a puzzle to the local administration. Unless if there are no scientific investigations on such inland aquatic habitats pertain to the biotic and abiotic components, status of animals in general and avifauna in particular perhaps, it would be difficult to the local administration to undertake suitable measures to restore such aquatic habitats. Therefore, to help solve prevailed problematic issues, convention on wetlands established under Article 8 at Ramsar, Iran in 1971 (Anonymous, 2020) to preserve local aquatic habitats and their biodiversity. On this line, many aquatic biologists are doing investigations to collect scientific information on water habitats and their species composition.

Several bird species are directly or indirectly depend on various inland water bodies such as pools, ponds, lakes, reservoirs for their survival and hence they are called 'aquatic avifauna'. Aquatic avifauna is a part of different food chains and food webs at different trophic levels (Grimmett *et al.*, 2011), become inseparable elements of inland water habitats at/nearby village/town/urban environment (Lakshmi *et al.*, 2020; Sathish *et al.*, 2020). Hence, several authors

have made periodic investigations and published reports on aquatic avifauna, water habitats at/nearby the village/town/city/metropolitan areas outside India (Rajpar and Zakaria, 2010; Lameed, 2011; Donatelli *et al.*, 2013; Klemetsen and Knudsen, 2013; Shao *et al.*, 2014; Henkanthgedara and Amarasinghe, 2015; Odewumi *et al.*, 2017; Dauda *et al.*, 2017; Wijesundara *et al.*, 2017). In India, Kumar and Gupta (2009), Hussain *et al.* (2012), Bhadja and Vaghela (2013), Kanaujia *et al.* (2013), Teneson and Ravichandran (2015), Cross *et al.* (2015), Puri and Virani (2016), Wanjari and Washim (2016) and Bora *et al.* (2017), have reported avifauna in different aquatic ecosystems at Kerala, Kurukshetra, Gujarat, Maharashtra Jammu and Kashmir states. In Karnataka, Basavarajappa (2006, 2007 and 2009), Bhat *et al.* (2009), Rajashekar and Venkatesh (2010), Donar *et al.* (2012), Dayananda (2014), Konkali and Ganesh (2014), Manjunath and Joshi (2014), Patil and Ganesh (2014), Rubina and Ganesh (2016), Satish *et al.* (2020) have studied the avifaunal diversity at Davangere, Udapi, Bangalore, Gulbarga, Shimogga, Dharwad, Bellary, Belagavi and Chamarajanagar Districts in Karnataka.

However, in Mysore District, Guruprasad (1997), Ravikumar *et al.* (1999), Mahesha and Balasubramanian (2010), Saphagirish *et al.* (2015), Hanieh and Mokshapathy (2016), Upadhyaya and Chandrakala (2016), Adarsh and Manasa, (2019), Shivaprakash *et al.* (2019), Shruthi and Basavarajappa (2016) have recorded aquatic avifauna at various inland water habitats in and around Mysore. Mysore experiences salubrious climate around the year (Kamath, 2001) due to its pleasant ecological conditions (Table I). The prevailed congenial conditions have created suitable habitat for many resident, local migrant and migratory bird species at different Lakes amidst Mysore (Lakshmi *et al.*, 2020). Few bird species are migrating from faraway places and visiting these Lakes during different seasons. Published reports on aquatic avifaunal density and diversity are meager. Mysore is the second most populous city in Karnataka after Bangalore, considered as one of the fast growing cities in Karnataka (Anonymous, 2011). The intensive developmental activities in and around the Mysore city has created pressure on water habitats located in and around Mysore. However, reports on aquatic avifauna population density, distribution and diversity at Lakes located in and around Mysore needs to be updated periodically about its avifaunal composition to understand the current status (Gibbs, 1993). Hence, the present investigation was undertaken to reveal the aquatic avifaunal diversity.

## II. METHODS AND MATERIALS

**Study area:** Mysore is one of the heritage cities in India, geographically located between 12° 18' 26" north latitude and 76° 38' 59" east longitude with an altitude of 763 meters above msl, amidst south-western part of Karnataka (Kamath, 2001). Physiographic features of study sites along with the ecological conditions of Mysore city are shown in Table I.

**Methodology:** Present investigation was conducted for six months i.e., from September, 2019 to March, 2020. Aquatic birds were recorded by following random sampling method as per Basavarajappa (2006). Five aquatic ecosystems viz., Bogadi Lake, Dalavai Lake, Karanji Lake, Kukkarahalli Lake and Lingambudi Lake were selected in and around Mysore city and visited these Lakes twice a week. Aquatic avifauna was observed during 0900 to 1200 and 1500 to 1800 hours on the earmarked variable width line transect (VWLT) using Olympus Binocular with 10x50 DPS I with 10x magnification and photographed with the help of Nikon Coolpix 1340, 20.2 mega pixels point shoot camera as per Burnham *et al.* (1980). Morphological features of water birds like body size, color, shape, beak size and shape, color of shank, phalanges etc. Recorded birds were identified using Indian Birds App and field guides published by Ali (1996), Ali and Ripley (1983 and 1987), Sonobe and Usui (1993), Woodcock (1980) and Manakkadan and Pittie (2001).

**Statistical analysis:** Population density, percent occurrence, analysis of variance (ANOVA) was used as per Saha (2009). The aquatic avifaunal diversity was calculated by using PAST version 2.10. The  $H'$  diversity of aquatic birds was calculated by using Shannon Diversity Index ( $H'$ ) that combines the number of species within different lakes with the relative abundance of each species as per Magurran (2004). Shannon Diversity Index ( $H'$ ):  $H' = -\sum (p_i \ln p_i)$ , where,  $p_i$  is the proportion of the  $i^{\text{th}}$  species in the total sample and  $\ln p_i$  is the natural log of  $p_i$ . Moreover, the species richness in the community and their evenness in abundance are the two parameters that define 'H'. The evenness of species within a lake was calculated by using Pielou's Evenness Index ( $J'$ ) to identify the variation within the community among the species. Pielou's Evenness Index:  $J' = H'/\ln S$ , where, S is the number of species present in the site and  $H'$  is the diversity index.

## III. RESULTS

**Distribution:** Aquatic avifauna recorded at different Lakes in and around Mysore is shown in Table II. Total 33 species were recorded which belongs to 10 orders and 16 families. The common and scientific names of aquatic birds found at different Lakes of Mysore are given in Tables II and IV. Further, order, family and their representation in different Lakes of Mysore is depicted in Tables III and IV. Among the orders, Pelicaniformes were more predominant (33.4%) and represented by 11 species which were found in three families (Tables II, III and IV). It was followed by

Charadriiformes, Gruiformes, Anseriiformes and Suliformes respectively with 18.2 (6 species), 12.1 (4 species) and 9.1% each (3 species each) (Tables II and IV). However, Apodiformes, Ciconiiformes, Passeriformes and Podicipediformes were represented by 3% each (one species each). Further, details of different families and their percent representation are given in Tables III and IV. Surprisingly, Ardeidae family members were high (21.2%) with seven species, it was followed by Rallidae family members (12.2%) with four species. The Anatidae and Threskiornithidae family members were represented by 9.1% with three species each. Moreover, Alcedinidae, Charadriidae, Phalacrocorcidae and Scolopacidae family members were 6.1% each with two species each. However, Anhingidae, Apodidae, Ciconiidae, Jacanidae, Motacillidae, Pelicanidae and Recurvirostridae family members' representation was 3% each with only one species each at different Lakes of Mysore (Tables II, III and IV).

**Population Density:** Altogether, 8767 aquatic avifauna were observed during the present study. The population density of aquatic avifauna is given in Table II. Among the aquatic avifauna, painted stork population density was high (1,544), it was followed by northern Shoveler and little grebe respectively 1,333 and 972 occurred at different Lakes of Mysore (Table II). Moreover, spot-billed duck, cattle egret, red-wattle lapwing and purple moorhen population density was good and it was 606, 549, 497 at different Lakes. However, 12 aquatic bird species population density was moderate compared to other species and it was >200. Remaining 14 bird species population density was fair and it was >100 in these Lakes (Table III).

**Per cent occurrence:** Percent occurrence of 33 aquatic avifauna recorded at different Lakes of Mysore is given in Table III. The Kukkarahalli Lake has hosted highest (44.4%) aquatic birds and it was followed by Lingambudi Lake (27.2%), Dalavai Lake (17.5%) and Karanji Lake (10.4%). However, aquatic birds were very less (>1%) at Bhogadi Lake (Table V). Among the aquatic birds, painted stork population was high (17.6%), it was followed by northern Shoveler and little grebe respectively 15.2 and 11.1% occurred at different Lakes of Mysore (Table III). Moreover, spot-billed duck, cattle egret, red-wattle lapwing and purple moorhen population was good and it was < 5% at different Lakes. However, 12 aquatic avifauna percent occurrence was moderate compared to other species and it was in between 1 to 5%. Remaining 14 bird species occurrence was fair and it was > 1% in these Lakes (Tables III and V).

**Analysis of variance:** Table V shows the aquatic bird's population density in different lakes at Mysore. Total 41 birds were recorded in Bogadi Lake, 1534 birds were recorded in Dalavai Lake, 912 birds were found in Karanji Lake. The Kukkarahalli Lake and Lingambudi Lake hosted 3896 and 2384 birds respectively. However, the analysis of variance of aquatic avifauna species composition between these Lakes didn't indicated significant variation ( $F=1.010$ ;  $P>0.05$ ) (Table V).

**Diversity index:** Table VI shows the aquatic bird's species diversity index at different Lakes of Mysore. The aquatic birds dominance index ('D') was high (0.331) in Lingambudi Lake and it was followed by Dalavai Lake (0.255). However, Bogadi Lake, Karanji Lake and Kukkarahalli Lakes have indicated aquatic birds dominance >0.2 (Table VI). Further, the diversity indices like Shannon Index ('H') and Sorenson's Index (B) diversity) were calculated as diversity indices, which incorporated both species richness and abundance into a single value. The Shannon index 'H' value ranged between 1.860 and 2.515 and Fisher alpha value ranged between 3.247 and 4.287 and suggested a variation between the indices. Moreover, Simpson and Shannon 'J' (Equitability) indices revealed that the distribution of majority of aquatic avifauna within the five Lakes was 0.66 to 0.88 and 0.57 to 0.92 suggesting unevenness between these five Lakes (Table VI). Further, the Sorenson's (Beta diversity) index values indicated considerable variation between the five Lakes with the values ranging between 0.466 and 0.800, however, few aquatic bird species overlapped between the lakes considerably (Table VII).

#### **IV. DISCUSSION**

Aquatic avifauna offers diversified habitat conditions due to their amphibious habits. They show unique behavior due their different foraging, roosting, resting, nesting and breeding sites to have safe survival (Jordan and Verma, 2000). During the present investigation, altogether 8,767 avifauna was recorded, which belong to 33 species from 10 orders and 16 families in the class Aves. It showed the avifaunal diversity prevailed at different Lakes in and around Mysore. Further, aquatic avifauna distribution, density, species composition and percent occurrence were uneven between Bogadi, Dalavai, Karanji, Kukkarahalli and Lingambudi Lakes. Thus, aquatic avifauna lives at diversified water ecosystems to access conditions prevailed at the vicinity of aquatic ecosystems (Jordan and Verma, 2000). Among 10 orders; Pelicaniformes were more common represented by 11 species. Few species belong to Charadriiformes, Gruiformes, Anseriiformes, Suliformes, Apodiformes, Ciconiiformes, Passeriformes and Podicipediformes were living at these Lakes with different population density. Surprisingly, Ardeidae family members were very high (21.2%) with seven species in most of the Lakes compared to other species. The Rallidae, Anatidae, Threskiornithidae, Alcedinidae, Charadriidae, Phalacrocorcidae, Scolopacidae, Anhingidae, Apodidae, Ciconiidae, Jacanidae, Motacillidae, Pelicanidae

and Recurvirostridae family members were living with specific population density at different Lakes in and Mysore. Similar type of observations was reported by Rajashekara and Venkatesha (2011), Harisha (2016), Rubina *et al.* (2016) and Shruthi and Basavarajappa (2016). Moreover, total, 8767 aquatic avifauna was observed at five Lakes. Total four species namely: painted stork, northern shoveler, little grebe, spot-billed duck, cattle egret, red-wattle lapwing and purple moorhen population density was very good compared to remaining species. Accordingly, their percent occurrence at these lakes was varied considerably. Overall, the Kukkarahalli Lake has hosted highest (44.4%) aquatic avifauna compared to Lingambudi Lake (27.2%), Dalavai Lake (17.5%) and Karanji Lake (10.4%). However, Bhogadi Lake had >1% aquatic avifauna. However, analysis of variance of aquatic avifaunal composition didn't indicate significant variation between these Lakes.

The Kukkarahalli Lake is located amidst Manasagangotri campus and managed by University of Mysore and the Lake is encircled by good vegetation along with the fencing. Good protective measures are taken to manage the Lake habitat except little disturbance due to walking path established around the periphery of Lake water. Moreover, prevailed good vegetation (Lakshmi *et al.*, 2020) has provided suitable roosting, resting and nesting sites for many bird species including Pelicaniformes. Whereas, Karanji Lake and Lingambudi Lake are maintained and managed by Zoo Authority of Karnataka and Forest Department respectively in Mysore. However, source of water is not same in these Lakes along with different vegetation conditions. Both the Lakes are kept open for recreation purpose for public besides there is a walking path established around the periphery of the Lakes. However, Dalavai Lake is located at the outskirts of Mysore city, receives sewage from residential areas. However, Bogadi Lake was totally devoid of water and completely eutrophicated during the present study. Perhaps, all these varied conditions amidst these five Lakes might have attracted different bird species and hence the variation in population distribution, percent occurrence and diversity of aquatic avifauna (Chace and Walsh, 2006; Uttangi, 2001; Barkear and Kadadevar, 2017).

Further, the 'H' indices (1.860 and 2.515) and Fisher alpha values (3.247 and 4.287) indicated the presence of normal aquatic bird's diversity with little evenness between the five Lakes. This was supported by Simpson and Shannon 'J' (Equitability) indices, which revealed unevenness between the Bogadi, Dalavai, Karanji, Kukkarahalli and Lingambudi Lakes by showing the 'J' value 0.669 to 0.887 and 0.577 to 0.929. Further, Sorenson's index ( $\beta$  diversity) has suggested a little variation between these Lakes. Since, Sorenson's index is a useful statistical tool to measure the similarities or dissimilarities of variety and abundance of species between the habitats (Basavarajappa *et al.*, 2018) and thus displayed the diversity value ranging between 0.4666 and 0.8000. The Sorenson's index wasn't zero, but it differed to different Lakes and indicated the overlapping of few aquatic bird species between these Lakes considerably. Our observations corroborate the description of Maguran (2004) in  $\beta$  diversity. Hence, present study provided an insight about the diversity of aquatic bird's species at Lakes in and around Mysore. Thus, our observations are on par with the observations of Hussain *et al.* (2012), Birasal (2010), Rajashekara and Venkatesha (2011), Rubina *et al.* (2016), (Mohan and Gaur, 2008), (Kumar and Gupta, 2009), (Bhat *et al.*, 2009), (Ravikumar, 2011), (Rajashekara and Venkatesha, 2011), (Kanaujia *et al.*, 2013), (Teneson and Ravichandran, 2015), (Wanjari and Washim, 2016), (Harisha, 2016), (Shruthi and Basavarajappa, 2016). Thus, aquatic avifaunal population distribution, density, percent occurrence and diversity is not similar, it varies considerably due to the prevalence of specific physical, biological and ecological conditions (Lameed, 2011; Donatelli *et al.*, 2013; Geoffrey *et al.*, 2013; Shao *et al.*, 2014; Shruthi and Basavarajappa, 2016; Dauda *et al.*, 2017; Odewumi *et al.*, 2017; Wijesundara *et al.*, 2017). Thus, aquatic avifauna has direct relationship with inland water habitats (e.g. Lakes) and their presence reveals the prevalence of suitable conditions which suits the normal survival diversified bird species.

## V. CONCLUSION

Total 33 aquatic avifaunal species were recorded from five lakes located in and around Mysore. Bird species represented 16 families and 10 orders and their representation varied considerably. However, few species were common in their appearance at all Lakes in this region and it was evidenced in the Simpson 'J' (Equitability) and Shannon 'H' indices of evenness for all aquatic avifauna encountered. Further, the Shannon diversity index was 1.860 and 2.515 with 3.247 and 4.287 Fisher alpha value. The Simpson 'J' (Equitability) index was 0.666 to 0.88 and 0.57 to 0.92 between the Lakes. The Sorenson's index was 0.466 and 0.800. Aquatic avifauna plays a pivotal role and get involved in various food chains and food web amidst Lake Ecosystems. They require suitable life supporting conditions for their safe survival. Therefore, water habitats in and around urban areas must be protected to preserve existing local biodiversity. Moreover, water habitats act as lungs of urban ecosystem, their preservation could help provide good environment and recreation to urban population. Therefore, this type of investigations should be made periodically to record the avifaunal diversity that could help collect scientific information to formulate and suggest suitable mitigation measures to preserve water habitats amidst urban areas.

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Table I. Few details of different Lakes of Mysore

Sl. No.	Lake	Geographical Location	Water Catchment Area	Annual Ecological Conditions in Mysore
1.	Bogadhi	12° 31' 69" N. latitude, 76° 59' 83" E. longitude	NA	Mean min. Temperature: 19°C. Mean max. Temperature: 31°C.
2.	Dalvai	12° 15' N. latitude 76° 39' E. longitude	NA	Average Temperature: 24.4°C. Mean min. Relative Humidity: 65%
3.	Karanji	12° 18' 10" N. latitude 76° 40' 25" E. longitude	55 hectares	Mean max. Relative Humidity: 90% Annual Rainfall: 800mm
4.	Kukkarahalli	12.30° N. latitude	4.5 sq. km	No. of rainy days: 53

		78.63°E. longitude		Elevation: 600-900 mm MSL. Vegetation: Wet to dry deciduous Type.
5.	Lingambudi	12° 16' 9.74" N. latitude 76° 36' 43.12" E. longitude 730 m above the sea level	45 sq. km	

(Source: Kamath, 2001 and Google earth.com) Note: NA: Data not available.  
MSL: Mean Sea Level.

Table II. Systematic position and population density of aquatic avifauna at different Lakes of Mysore (N=56)

Sl. No.	Order	Sl. No	Family	Sl. No.	Common Name	Scientific Name		
1	Anseriformes	1	Anatidae	1.	Lesser Whistling Duck	<i>Dendrocygna javanica</i>		
				2.	Northern Shoveler	<i>Spatula clypeata</i>		
				3.	Spot - billed Duck	<i>Anas poecilorhyncta</i>		
2	Apodiformes	2	Apodidae	4.	Asian-Palm Swift	<i>Apus apus</i>		
3	Charadriiformes	3	Charadriidae	5.	Red - wattle Lapwing	<i>Vanellus indicus</i>		
				6.	Yellow - wattle Lapwing	<i>Vanellus malabaricus</i>		
				4	Jacanidae	7.	Bronze - winged Jacana	<i>Metopidius indicus</i>
				5	Recurvirostridae	8.	Black-winged Stilt	<i>Himantopus himantopus</i>
6	Scolopacidae	6	Scolopacidae	9.	Common Sandpiper	<i>Actitis hypoleucos</i>		
				10.	Wood Sandpiper	<i>Tringa Glareola</i>		
4	Ciconiiformes	7	Ciconiidae	11.	Painted Stork	<i>Mycteria leucocephala</i>		
5	Coraciiformes	8	Alcedinidae	12.	Common Kingfisher	<i>Alcedo atthis</i>		
				13.	White - throated Kingfisher	<i>Halcyon smyrnensis</i>		
6	Gruiformes	9	Rallidae	14.	Common Coot	<i>Fulica atra</i>		
				15.	Common Moorhen	<i>Gallinula chloropus</i>		
				16.	Purple Moorhen	<i>Porphyrio porphyrio</i>		
				17.	White Breasted Water Hen	<i>Amaurornis phoenicurus</i>		
7	Passeriformes	10	Motacillidae	18.	White browed Wagtail	<i>Motacilla maderaspatensis</i>		
8	Pelicaniformes	11	Ardeidae	19.	Black Crowned night -Heron	<i>Nycticorax nycticorax</i>		
				20.	Cattle Egret	<i>Bubulcus ibis</i>		
				21.	Great Egret	<i>Ardea alba</i>		
				22.	Grey Heron	<i>Ardea cinerea</i>		
				23.	Little Egret	<i>Egretta garzetta</i>		
				24.	Pond Heron	<i>Ardeola grayii</i>		
				25.	Purple Heron	<i>Ardea purpurea</i>		
				12	Pelicanidae	26.	Spot - billed Pelican	<i>Pelecanus philippensis</i>
				13	Threskiornithidae	27.	Black - headed Ibis	<i>Threskiornis melanocephalus</i>
						28.	Glossy Ibis	<i>Plegadis falcinellus</i>
29.	Red- napped Ibis	<i>Pseudibis papillosa</i>						
9	Podicipediformes	14	Podicipedidae	30.	Little Grebe	<i>Tachybaptus ruficollis</i>		
10	Suliformes	15	Phalacrocoracidae	31.	Great Cormorant	<i>Phalacrocorax carbo</i>		
				32.	Little Cormorant	<i>Microcarbo niger</i>		
				16	Anhingidae	33.	Oriental Darter	<i>Anhinga melanogaster</i>

Table III. Systematic position and population density of aquatic avifauna recorded at different Lakes in Mysore (N=56)

Sl.No.	Common Name	Lake	Population Density	% Occurrence
1.	Lesser whistling Duck	KL	22	0.3
2.	Northern Shoveler	LL	1333	15.2
3.	Spot - billed Duck	KKL & LL	606	6.9
4.	Asian-palm Swift	DL, KL, KKL & LL	144	1.6
5.	Red - wattle Lapwing	DL, KL, KKL & LL	497	5.7
6.	Yellow - wattle Lapwing	KKL & LL	118	1.4
7.	Bronze - winged Jacana	DL, KL & KKL	109	1.3
8.	Black-winged Stilt	KKL & LL	168	1.9
9.	Common Sandpiper	DL, KKL & LL	98	1.1
10.	Wood Sandpiper	DL, KKL & LL	60	0.6

11.	Painted Stork	KL, KKL & LL	1544	17.6
12.	Common Kingfisher	BL, DL & KKL	40	0.4
13.	White - throated Kingfisher	All	67	0.7
14.	Common Coot	DL, KL & LL	240	2.8
15.	Common Moorhen	KL & KKL	23	0.3
16.	Purple Moorhen	DL, KL, KKL & LL	661	7.5
17.	White - breasted water Hen	KL & KKL	11	0.1
18.	White browed Wagtail	BL, KL, KKL & LL	19	0.3
19.	Black Crowned night-Heron	KL & KKL	39	0.4
20.	Cattle Egret	All	549	6.0
21.	Great Egret	BL, DL, KKL & LL	58	0.7
22.	Grey Heron	BL, KL & KKL	114	1.5
23.	Little Egret	All	84	0.7
24.	Pond Heron	All	351	4.1
25.	Purple Heron	BL, KL, KKL & LL	73	0.9
26.	Spot - billed Pelican	KKL & LL	182	2.0
27.	Black - headed Ibis	BL, DL, KKL & LL	67	0.8
28.	Glossy Ibis	DL, KL, KKL & LL	126	1.6
29.	Red- napped Ibis	DL, KL, KKL & LL	188	2.1
30.	Little Grebe	DL, KL, KKL & LL	972	11.1
31.	Great Cormorant	DL, KL, KKL & LL	134	1.5
32.	Little Cormorant	DL, KL, KKL & LL	56	0.7
33.	Oriental Darter	KKL	14	0.2
Total			8767	100.0

Note: BL: Bogadi Lake; DL: Dalavi Lake; KL: Karanji Lake; KKL: Kukkarahalli Lake; LL: Lingambudi Lake. Data is based on Table II.

Table IV. Order and family of aquatic avifauna found at different Lakes of Mysore (N=56)

Sl. No.	Order	% occurrence	Name of Lake	Sl.No	Family	% occurrence
1.	Anseriformes	9.1	KL, KKL, LL	1.	Anatidae	9.1
2	Apodiformes	3.0	DL, KL, KKL & LL	2	Apodidae	3.0
3.	Charadriiformes	18.2	DL, KL, KKL & LL	3.	Charadriidae	6.1
			DL, KL & KKL	4.	Jacaniidae	3.0
			KKL & LL	5.	Recurvirostridae	3.0
			DL, KL, KKL & LL	6.	Scolopacidae	6.1
4.	Ciconiiformes	3.0	KL, KKL & LL	7.	Ciconiidae	3.0
5.	Coraciiformes	6.1	All	8.	Alcedinidae	6.1
6.	Gruiformes	12.1	All	9.	Rallidae	12.2
7.	Passeriformes	3.0	BL, KL, KKL & LL	10.	Motacillidae	3.0
8.	Pelicaniformes	33.4	All	11.	Ardeidae	21.2
			KKL & LL	12.	Pelicanidae	3.0
			All	13.	Threskiornithidae	9.1
9.	Podicipediformes	3.0	DL, KL, KKL & LL	14.	Podicipedidae	3.0
10.	Suliformes	9.1	DL, KL, KKL & LL	15.	Phalacrocoracidae	6.1
			KKL	16.	Anhingidae	3.0
Total		100.0	-	Total		100.0

Note: Data is based on Table II. BL: Bogadi Lake; DL: Dalavi Lake; KL: Karanji Lake; KKL: Kukkarahalli Lake and LL: Lingambudi Lake.

Table V. Analysis of variance of aquatic avifauna recorded at different Lakes of Mysore (N=56)

Sl. No.	Name of Bird	Bhogadi Lake	Dalavai Lake	Karanji Lake	Kukkarahalli Lake	Lingambodi Lake
1.	Lesser Whistling Duck	-	-	22	-	-
2.	Northern Shoveler	-	-	-	-	1333
3.	Spot - billed Duck	-	98	141	246	121



4.	Swift	-	12	20	50	62
5.	Red - wattle Lapwing	-	36	57	182	222
6.	Yellow - wattle Lap wing	-	-	-	16	102
7.	Bronze - winged Jacana	-	53	22	34	-
8.	Black - winged Stilt	-	-	-	141	27
9.	Common Sandpiper	-	10	-	8	80
10.	Wood Sandpiper	-	19	-	12	29
11.	Painted Stork	-	-	12	1522	10
12.	Common Kingfisher	3	12	-	25	-
13.	White - throated Kingfisher	3	9	9	27	19
14.	Common Coot	-	65	126	-	49
15.	Common Moorhen	-	-	16	7	-
16.	Purple Moorhen	-	57	81	468	55
17.	White Breasted Water Hen	-	-	2	9	-
18.	Wagtail	1	-	5	10	3
19.	Black crowned night Heron	-	-	21	18	-
20.	Cattle Egret	8	298	7	204	32
21.	Great Egret	3	2	-	8	45
22.	Grey Heron	7	-	57	50	-
23.	Little Egret	4	18	5	39	18
24.	Pond Heron	5	79	57	150	60
25.	Purple Heron	1	-	27	38	7
26.	Spot - billed Pelican	-	-	-	179	3
27.	Black - headed Ibis	6	19	-	38	4
28.	Glossy Ibis	-	22	16	84	4
29.	Red- napped Ibis	-	11	4	161	12
30.	Little Grebe	-	694	195	14	69
31.	Great Cormorant	-	9	5	118	2
32.	Little Cormorant	-	11	5	24	16
33.	Oriental Darter	-	-	-	14	-
Total		41	1534	912	3896	2384
% Occurrence		0.5	17.5	10.4	44.3	27.2
'F' value		1.010*				

Note: \*Value is not significant.

Table VI. Aquatic avifauna diversity index in different Lakes of Mysore (N=56)

Sl. No.	Diversity Index	Lakes in and around Mysore				
		Bogadi	Dalavai	Karanji	Kukkarahalli	Lingmbudi
1.	Dominance_D	0.130	0.255	0.112	0.184	0.331
1.	Shannon 'H'	2.141	1.937	2.515	2.361	1.860
2.	Simpson 1_D	0.868	0.744	0.887	0.815	0.669
3.	Equitability_J	0.929	0.646	0.802	0.694	0.577
4.	Fisher_alpha	4.214	3.247	4.287	4.424	3.895

Note: Data is based on Table V.

Table VII. Beta diversity indices of aquatic avifauna at different Lakes of Mysore (N=56)

Sl.No.	Lake	Bogadi	Dalavi	Karanji	Kukkarahalli	Lingmbudi
1.	Bogadi	-	-	-	-	-
2.	Dalavai	0.4666	-	-	-	-
3.	Karanji	0.4242	0.6976	-	-	-
4.	Kukkarahalli	0.5000	0.7600	0.7924	-	-
5.	Lingmbudi	0.4571	0.8000	0.7083	0.4727	-

Note: Data is based on Table V.