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Frequency and Status of Occurrence of Water-Birds at Anasagar Lake, Ajmer

Rashmi Swroop[1], Dr. Indu Yadav[2]
[1,2]*PhD Scholar and CSIR-Senior Research Fellow, Department of Zoology, SPC Government College, Ajmer*
[2]*Lecturer, Department of Zoology, SPC Government College, Ajmer*

Abstract: ***Anasagar Lake is very important lentic fresh water body of Ajmer which was once the life line of the city. Because of the availability of variety of habitats and varying microclimates throughout the year, a significant number of native bird species and wintering birds can be observed here. The lake is fast losing its capacity of supporting different life forms because of the various anthropogenic activities around the lake; and it calls for regular monitoring of the biodiversity and taking appropriate measures for its conservation. This study was carried out at four different study sites which are near Mansingh Palace, Anasagar Chaupati, Vishram Sthali and Regional College, respectively. Observations were made using 7x35 Nikon CF binoculars, at regular intervals from April 2016 to March 2017. A total of 42 species of water-birds (including wading birds) belonging to 16 families distributed in 9 orders have been recorded along with their habitat characteristics during the period. Most abundant of these belonged to the heron family, Ardeidae. Seasonal Variation in occurrence of water-birds shows that the Lake is an important wintering destination for many taxonomic orders of water-birds. Flamingos, although rare, are both resident and winter visitors and were more frequently sighted during the summers. Frequency of occurrence of birds decreased slightly during monsoon because the foraging sites of birds were flooded. Generally, water-birds are able to employ a wide range of habitats and foraging opportunities and it was observed in the present study too, still, substantial reduction in their numbers indicate the serious deterioration in the quality of this habitat patch. Thus, the paper also discusses, with the status of water-birds, threats pertaining to them and need for their conservation and habitat management, at the lake.***

Keywords: Frequency of Occurrence, Occurrence status, Water-Birds, Anasagar Lake, Ajmer, Seasonal Variation

I. INTRODUCTION

Wetland systems play important roles in the ecosystem. The Anasagar Lake (Latitude 26°47' N& Longitude 74°62' E), situated in the north-west of Ajmer city, was created in the 12th century by building a dam across the river Luni for domestic water supply. The availability of variety of habitats and varying microclimates throughout the year, makes it a suitable foraging as well as nesting habitat for a significant number of water-bird species. Along with the resident species, many migratory birds spend their winters here. The lake is fast losing its capacity of supporting different life forms because of the various anthropogenic activities around the lake.Limnological studies by Ranga (1995) and studies related to primary productivity by Ranga and Koli (2011) exposes that lake has been in eutrophic condition and is highly under pressure of city encroachment and urbanization. Water quality of the lake is deteriorating day by day mainly due to agricultural runoff, industrial effluents and sewage water concerned to the urban population.Anasagar is an important ancient freshwater Lake and it has been an attractive habitat for a variety of resident water-bird species and it is also one of the most important destinations for wintering migratory birds in north western region of India. But it is fast losing its capacity to support varieties of life forms owing to its declining habitat quality. Water-birds (including wading birds) and their natural habitats play a very significant role in ecosystems. A systematic knowledge of their diversity and abundance can help in their conservation and effective habitat management. Literature on the field characteristics, status and distribution and notes on the general ecology of most of the Indian birds are available (Baker, 1922-1931,1932-1935; Whistler and Kinnear, 1930-1937; Ali, 1941, Ali and Ripley, 1983; Grimmett et al., 1999, 2011). Attempts have been made from time to time to study the population of wetland birds. Devarshi (2004) has studied avifauna of Rajasthan state. In Rajasthan, 24 sites are recognized as Important Bird Areas by Islam and Rahmani (2004). The status of lakes of eastern Rajasthan has been discussed by Devarshi (2008).

In spite of the great ecological importance of the Lake, no study related to avifaunal diversity, composition and abundance has been undertaken at this site. Frequency of occurrence is a useful measure to know how many species visit and return at the habitat. It tells about the foraging habitat suitability. Water-birds' preference about returning on a particular foraging site is dependent on their energy budgets. The central aim of this study is to prepare a first-hand record of diversity and status of water-birds at this lake, which can help in future studies related to avifaunal diversity and ecology.

II. MATERIALS AND METHODS

A. *Study Area*

The geographical area under investigation is Anasagar Lake, Ajmer, from which the four study sites were selected for this 12 month study. It is almost 8 miles (13 km) in circumference. The lake's water- spread area varies between 97 and 182 ha, and the depth ranges from 1.9 m to 4.4 m. Its catchment covers 70.6 km^2. Catchment area includes Nagpahar hills and Taragarh hills. Capacity of lake is 2052 million liters (13 feet). The climate of the region is semi-arid with strong seasonality of rainfall. The summer season (April - June) experiences high temperature (max. 44.0°C), while in peak winters (December - January) it goes down very low (min. 5.0°C). More than 80% of 784.0 mm annual precipitation is received from July to September (Sharma et al., 2008).

B. *The four study sites for observations were as follows:*

1) *Site 1:* The first site is situated behind the Mansingh Palace Hotel, Vaishali Nagar. The land at the bank of lake is used for farming. This site remains saturated with water most time of the year and has a lot of emergent vegetation. The site is little far from the urban area because of the farms.
2) *Site 2:* The next site is located near the Anasagar Chaupati (also called Chaupati Garden), Vaishali Nagar and it is relatively closer to the road (called Gaurav path or Anasagar circular road).
3) Site 3: Third site is nearby Vishram Sthali, Pushkar road. A little fishing activity can be observed here. An open drain to the lake is very close to the site.
4) Site 4: The fourth selected study site is in front of Regional Institute of Education, Ajmer (formerly known as Regional college, Ajmer). Fishing activities take place at this site too. A sewage treatment plant and Concrete pavements are near the site. There is little emergent vegetation at this place.

Figure 1: Location of the four study sites at Anasagar Lake, Ajmer

C. Observations

In this study only birds which are directly dependent on Lake for foraging are included. Bird sampling was done at monthly intervals from April 2016 to March 2017. The counts started as early as 6 AM and lasted till 10 AM, so that nocturnal birds could also be sighted. Birds were recorded at their first detection using Nikon 7x35 CF binoculars and Nikon camera (26X zooming capacity). Identification of waterbirds was done using field guides (Ali, 2012; Grimmett *et al.*, 2011). Regular records of waterbirds' occurrence at each visit (by preparing checklists) and their numbers were maintained for further analysis.

D. Data Analysis

The collected data were tabulated, sorted and analysed using the Raunkaier's Law of frequence as suggested by Linsdale (1928) for studying bird populations. The frequency of occurrence (i.e., the probability that an individual of a species occurs in a fragment of determined size area) for each species was calculated. Based on percentage individual frequency of occurrence, species were classified as follows 0-25% as rare (Re), 25-65% as less common (Lc), and 65-100%as common (C) as done by Rajashekara and Venkatesha (2011). Two way ANOVA without replication was used to test the significance of the differences in the frequency of occurrence among different study sites and among different species. Calculations were done using Data Analysis ToolPak of Microsoft Excel 2013.For studying seasonal pattern, four climatological seasons designated by The India Meteorological Department (IMD) were followed. These are Winter, occurring from December to March, Summer or pre-monsoon season, lasting from April to June (April to July in northwestern India), Monsoon or rainy season, lasting from July to September and Post-monsoon or autumn season, lasting from October to November. In Ajmer, October and November are usually cloudless.

III. RESULTS AND DISCUSSION

Total 88 visits were made at the four study sites. Forty two species of waterbirds belonging to 16 families and 6 orders were recorded at the Lake during this 12 month study. Six species were found to be common, 21 were less common and 15 were rare based on their individual percentage of frequencies of occurrence (values depicted in Table 3).Table 1 shows the orders, families, scientific and common name of the recorded waterbird species and their occurring and residing status:

Table 1: Waterbirds found at Anasagar Lake and their occurrence status and residing status

Family	Scientific Name	Common Name	*Occ status	**Residing Status
Anatidae	Anas poecilorhyncha Forster, JR, 1781	Spot billed duck	Lc	R
	Anas crecca Linnaeus, 1758	Common teal	Lc	W
Scolopacidae	Calidris minuta (Leisler, 1812)	Little stint	Re	W
	Calidris pugnax (Linnaeus, 1758)	Ruff (Reeve for female)	Lc	W
	Gallinago gallinago (Linnaeus, 1758)	Common snipe	Re	W
	Calidris temminckii (Leisler, 1812)	Temmnick's stint	Lc	W
	Limnodromus semipalmatus (Blyth 1848)	Asian dowitcher	Re	W
	Tringa ochropus Linnaeus, 1758	Green sandpiper	Lc	W
	Tringa stagnatilis (Bechstein, 1803)	Marsh sandpiper	Lc	W
	Tringa totanus (Linnaeus, 1758)	Common redshank	Re	W
Laridae	Chroicocephalus ridibundus (Linnaeus, 1766)	Black headed gull	Re	W
Sternidae	Sterna aurantia Gray,JE, 1831	Indian river tern	Lc	R
Recurvirostridae	Himantopus himantopus (Linnaeus, 1758)	Black winged stilt	C	R
	Recurvirostra avosetta Linnaeus, 1758	Pied avocet	Lc	W
Charadriidae	Charadrius dubius Scopoli, 1786	Little ringed plover	Lc	RW
	Vanellus indicus (Boddaert, 1783)	Red wattled lapwing	C	R
Podicipedidae	Tachybaptus ruficollis (Pallas, 1764)	Little grebe (Dabchick)	Lc	R
Phalacrocoracidae	Phalacrocorax carbo (Linnaeus, 1758)	Great cormorant	Lc	R

	Phalacrocorax fuscicollis Stephens, 1826	Indian Cormorant	Lc	R
	Microcarbo niger (Vieillot, 1817)	Little cormorant	C	R
Pelicanidae	Pelecanus onocrotalus Linnaeus, 1758	Great white pelican	Lc	RW
Ardeidae	Ardea alba Linnaeus, 1758	Great white egret	C	R
	Ardea cinerea Linnaeus, 1758	Grey heron	Lc	RW
	Ardea pupurea Linnaeus, 1766	Purple heron	Lc	R
	Ardeola grayii (Sykes, 1832)	Indian pond heron	Lc	R
	Bubulcus ibis (Linnaeus, 1758)	Cattle egret	Lc	R
	Egretta garzetta (Linnaeus, 1766)	Little egret	C	R
	Ixobrychus sinensis (Gmelin, 1789)	Yellow bittern	Re	R
	Mesophoyx intermedia (Wagler, 1829)	Intermediate egret	Re	R
	Nycticorax nycticorax (Linnaeus, 1758)	Black crowned night heron	Re	R
Threskiornithidae	Platalea leucorodia Linnaeus, 1758	Eurasian spoonbill	Re	R
	Pseudibis papillosa (Temminck, 1824)	Black ibis (Red naped ibis)	Re	R
	Threskiornis melanocephalus (Latham, 1790)	Black headed ibis	Re	R
Cinconiidae	Mycteria leucocephala (Pennant, 1769)	Painted stork	Lc	R
Phoenicopteridae	Phoenicopterus minor (Geoffroy Saint-Hilaire, E, 1798)	Lesser flamingo	Re	RW
	Phoenicopterus roseus Pallas, 1811	Greater Flamingo	Re	RW
Rallidae	Amaurornis phoenicurus (Pennant, 1769)	White-breasted waterhen	Re	R
	Fulica atra Linnaeus, 1758	Eurasian coot	Lc	R
	Gallinula chloropus (Linnaeus, 1758)	Common moorhen	Lc	R
	Porphyrio porphyrio (Linnaeus, 1758)	Purple swamphen	C	R
Alcedinidae	Alcedo atthis (Linnaeus, 1758)	Common kingfisher	Re	R
Cerilidae	Ceryle rudis (Linnaeus, 1758)	Pied kingfisher	Lc	R

**R = Resident; W= Winter visitor; RW = Resident and Winter visitor (Grimmett et al., 2011) *Based on frequency of occurrence 0–25%= Re (Rare), 25–65% = Lc (Less common), 65–100% = C (Common)

Table 2: Family wise distribution of waterbird species at Anasagar Lake

Order Family	Sum of No. of Species
Anseriformes	2
Anatidae	2
Charadriiformes	14
Charadriidae	2
Laridae	1
Recurvirostridae	2
Scolopacidae	8
Sternidae	1
Cinconiiformes	1
Cinconiidae	1

Coraciiformes	2
Alcedinidae	1
Cerylidae	1
Gruiformes	4
Rallidae	4
Pelicaniformes	13
Ardeidae	9
Pelicanidae	1
Threskiornithidae	3
Phoenicopteriformes	2
Phoenicopteridae	2
Podicipediformes	1
Podicipedae	1
Suliformes	3
Phalacrocoracidae	3
Grand Total	42

Family wise distribution of waterbirds is shown in Table 2, which indicates that most species (9) belonged to the heron family Ardeidae. Fourteen of the 42 species belonged to the order Charadriiformes and 13 belonged to the order Pelicaniformes. This family was previously kept under the order Cinconiformes but recent phylogenomic studies show that herons and ibises (Threskiornithidae) are more closely related to pelicans than storks (Hackett et al., 2008). Family Scolopacidae is also represented by 8 species at Anasagar Lake.At Anasagar lake, waterhen family Rallidae is represented by 4 species, Threskiornithidae and Phalacrocoracidae are by 3 species each; and Anatidae, Recurvirostridae, Charadridae and Phoenicopteridae by 2 species each while Laridae, Sternidae, Podicipedae, , Pelicanidae, Cinconiidae, Alcedinidae, Cerylidae are represented by one species per family. In Table 3, species are arranged in the descending order of their individual percentage frequencies of occurrence of the species (mean for all four sites). Black winged stilt, Red wattled lapwing, Little cormorant, Little egret and Great white egret, show the highest (> 70%) frequencies of occurrence whereas Eurasian spoonbill, Asian dowitcher and Black ibis (Red naped ibis) show the lowest (< 05%) frequencies of occurrence.

Table 3: Species arranged in descending order of their frequencies of occurrence				
Species (Scientific name)	Common name	Individual freq. of occ.	Relative freq. of occ.	Occ. Status
Himantopus himantopus (Linnaeus, 1758)	Black winged stilt	84.09%	5.19%	C
Vanellus indicus (Boddaert, 1783)	Red wattled lapwing	80.68%	4.98%	C
Microcarbo niger (Vieillot, 1817)	Little cormorant	73.86%	4.56%	C
Egretta garzetta (Linnaeus, 1766)	Little egret	73.86%	4.56%	C
Ardea alba Linnaeus, 1758	Great white egret	71.59%	4.41%	C
Porphyrio porphyrio (Linnaeus, 1758)	Purple swamphen	69.32%	4.27%	C
Phalacrocorax carbo (Linnaeus, 1758)	Great cormorant	62.50%	3.85%	Lc
Fulica atra Linnaeus, 1758	Eurasian coot	62.50%	3.85%	Lc
Gallinula chloropus (Linnaeus, 1758)	Common moorhen	62.50%	3.85%	Lc
Anas poecilorhyncha Forster, JR, 1781	Spot billed duck	56.82%	3.50%	Lc
Tachybaptus ruficollis (Pallas, 1764)	Little grebe (Dabchick)	52.27%	3.22%	Lc
Phalacrocorax fuscicollis Stephens, 1826	Indian Cormorant	52.27%	3.22%	Lc

Ardea cinerea Linnaeus, 1758	Grey heron	52.27%	3.22%	Lc
Bubulcus ibis (Linnaeus, 1758)	Cattle egret	50.00%	3.08%	Lc
Tringa stagnatilis (Bechstein, 1803)	Marsh sandpiper	46.59%	2.87%	Lc
Sterna aurantia Gray,JE, 1831	Indian river tern	45.45%	2.80%	Lc
Calidris pugnax (Linnaeus, 1758)	Ruff (Reeve for female)	44.32%	2.73%	Lc
Ardeola grayii (Sykes, 1832)	Indian pond heron	42.05%	2.59%	Lc
Mycteria leucocephala (Pennant, 1769)	Painted stork	39.77%	2.45%	Lc
Pelecanus onocrotalus Linnaeus, 1758	Great white pelican	37.50%	2.31%	Lc
Calidris temminckii (Leisler, 1812)	Temmnick's stint	36.36%	2.24%	Lc
Charadrius dubius Scopoli, 1786	Little ringed plover	35.23%	2.17%	Lc
Tringa ochropus Linnaeus, 1758	Green sandpiper	32.95%	2.03%	Lc
Recurvirostra avosetta Linnaeus, 1758	Pied avocet	29.55%	1.82%	Lc
Ceryle rudis (Linnaeus, 1758)	Pied kingfisher	29.55%	1.82%	Lc
Ardea pupurea Linnaeus, 1766	Purple heron	27.27%	1.68%	Lc
Anas creccaLinnaeus, 1758	Common teal	25.00%	1.54%	Lc
Chroicocephalus ridibundus (Linnaeus, 1766)	Black headed gull	23.86%	1.47%	Re
Phoenicopterus minor (Geoffroy Saint-Hilaire, E, 1798)	Lesser flamingo	23.86%	1.47%	Re
Amaurornis phoenicurus (Pennant, 1769)	White-breasted waterhen	23.86%	1.47%	Re
Tringa totanus (Linnaeus, 1758)	Common redshank	22.73%	1.40%	Re
Nycticorax nycticorax (Linnaeus, 1758)	Black crowned night heron	21.59%	1.33%	Re
Phoenicopterus roseus Pallas, 1811	Greater Flamingo	18.18%	1.12%	Re
Mesophoyx intermedia (Wagler, 1829)	Intermediate egret	17.05%	1.05%	Re
Gallinago gallinago (Linnaeus, 1758)	Common snipe	15.91%	0.98%	Re
Threskiornis melanocephalus (Latham, 1790)	Black headed ibis	15.91%	0.98%	Re
Alcedo atthis (Linnaeus, 1758)	Common kingfisher	14.77%	0.91%	Re
Calidris minuta (Leisler, 1812)	Little stint	7.95%	0.49%	Re
Ixobrychus sinensis (Gmelin, 1789)	Yellow bittern	7.95%	0.49%	Re
Platalea leucorodia Linnaeus, 1758	Eurasian spoonbill	3.41%	0.21%	Re
Limnodromus semipalmatus (Blyth 1848)	Asian dowitcher	2.27%	0.14%	Re
Pseudibis papillosa (Temminck, 1824)	Black ibis (Red naped ibis)	2.27%	0.14%	Re

*Based on frequency of occurrence 0–25%= Re (Rare), 25–65% = Lc (Less common), 65–100% = C (Common)

Two way ANOVA (Analysis of variance) of the individual frequency of occurrence table, yields:

F = 5.136 (between sites, d. f. = 3) > Table value of F= 2.678 (P-value < 0.05)

F= 20.860 (between species, d. f. = 41) >Table value of F= 1.488 (P-value < 0.05)

Hence, the differences in frequencies of occurrence at different sites; and differences in frequencies of occurrence for different species, both are significant.

Such differences can be attributed to the presence of enough emergent vegetation and less anthropogenic disturbance at different sites.

Other than these 42 recorded water related bird species, number of Passeriformes (perching birds) and Galliformes (pheasants) bird species were also frequently sighted at the lake. White throated Kingfisher also known as Tree kingfisher is also a Common species at Anasagar Lake.Table no. 4 shows the seasonal variation in Frequency of occurrence of species belonging to different Taxonomic orders. Except the order Phoenicopteriformes, all other birds were more frequent during winter season. Lesser flamingo visited the lake during the month of July whereas Greater flamingo is rare at the Lake. Cormorants were common throughout the year.

Table 4: Seasonal Variation in Frequency of occurrence of different Orders

Frequency of occurrence	Seasons				Mean
Orders	Summer	Monsoon	Autumn	Winter	
Anseriformes	55.56%	20.45%	40.38%	50.00%	41.60%
Charadriiformes	37.30%	31.49%	26.65%	51.62%	36.77%
Podicipediformes	72.22%	9.09%	38.46%	95.45%	53.81%
Suliformes	50.00%	57.58%	70.51%	69.70%	61.95%
Pelicaniformes	24.79%	36.36%	30.47%	37.41%	32.26%
Cinconiiformes	77.78%	0.00%	19.23%	72.73%	42.44%
Phoenicopteriformes	83.33%	15.91%	0.00%	0.00%	24.81%
Gruiformes	48.61%	32.95%	50.96%	85.23%	54.44%
Coraciiformes	27.78%	0.00%	17.31%	45.45%	22.64%
Mean	53.04%	22.65%	32.66%	56.40%	41.19%

Figures 2 shows the Frequency of occurrence of species during different seasons. Presence of other birds also seemed to affect the preference of some birds to settle at the sites. Seasonal variation in frequency of occurrence of different taxonomic orders suggests that water-birds were more frequent in seasons when water levels, food availability and emergent vegetation were more suitable for them. For instance, members of order cinconiiformes being the shallow water waders, were not sighted during the monsoon season. Kingfishers did not frequent the study site during monsoon which may be associated with lesser prey density due to inflow of water into the lake. Fish scooping Pelicans and Gruiformes members like moorhens showed lesser variations for their foraging techniques allow them to forage in open waters and temporary foraging patches respectively.

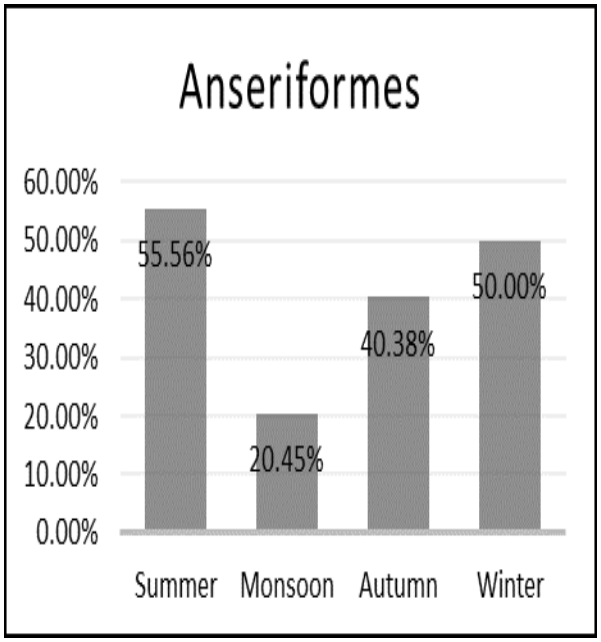


Figure 2.1

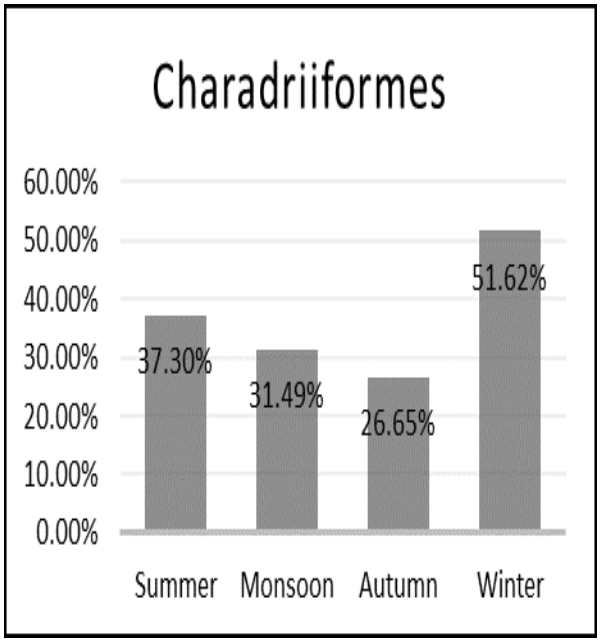


Figure 2.2

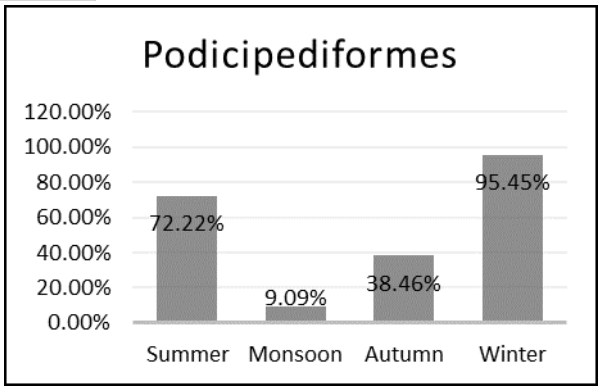
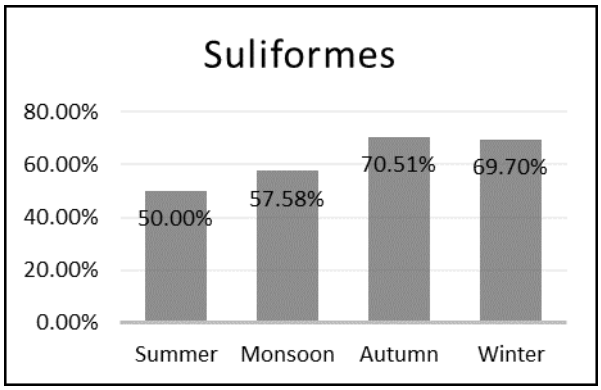


Figure 2.3



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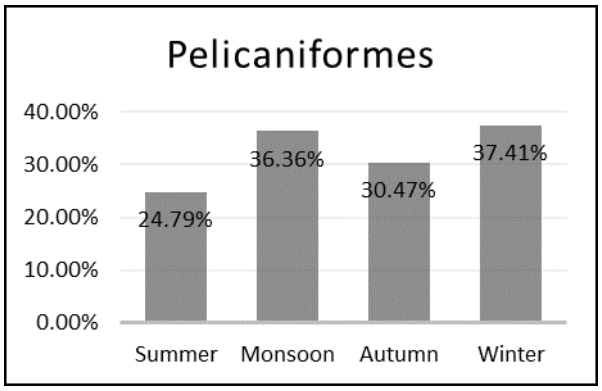

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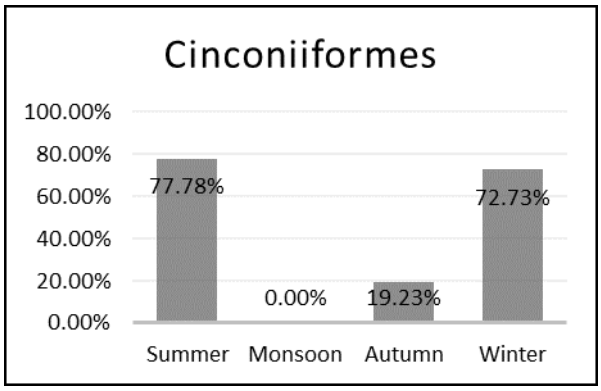

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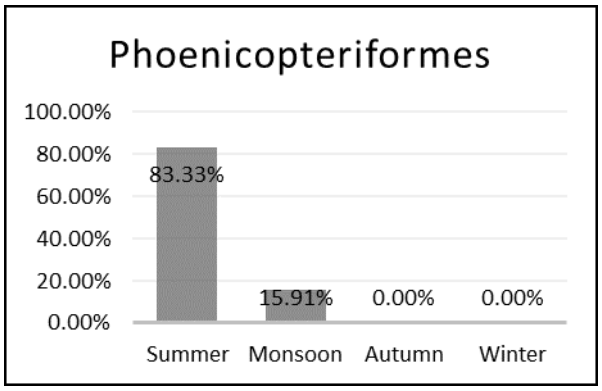

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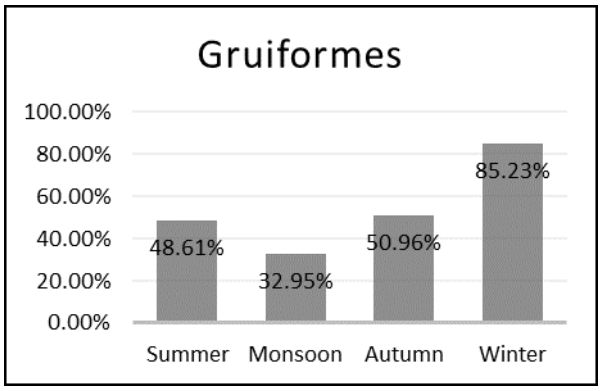

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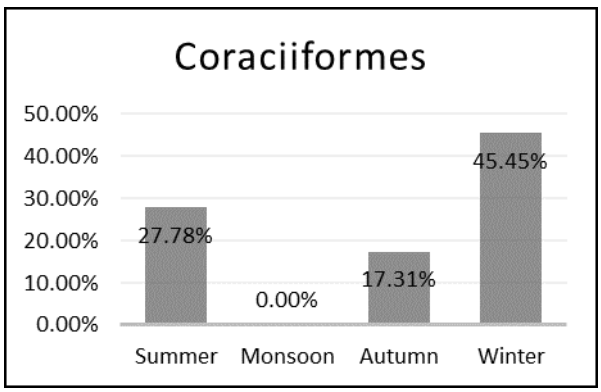

Figure 2.9

Figure 2: Seasonal Variation in Frequency of occurrence of different Orders of water-birds at Anasagar Lake

Figure 3: Purple heron at study site 2 at Anasagar Lake, Ajmer

Figure 4: Lesser flamingos flying over study site 4 at Anasagar Lake, Ajmer

o. of species and abundance of birds were noticed to be decreased slightly when the Lake was full to its maximum capacity and the floodgates had opened. It is because the foraging sites of birds were flooded and the platforms (including emergent vegetation and floating organic material) which wading birds used to stand and forage were submerged. But the abundances recovered gradually once the monsoon was over. In contrast to this, ducks, coots and moorhens remained quite unaffected from the changes in water levels.

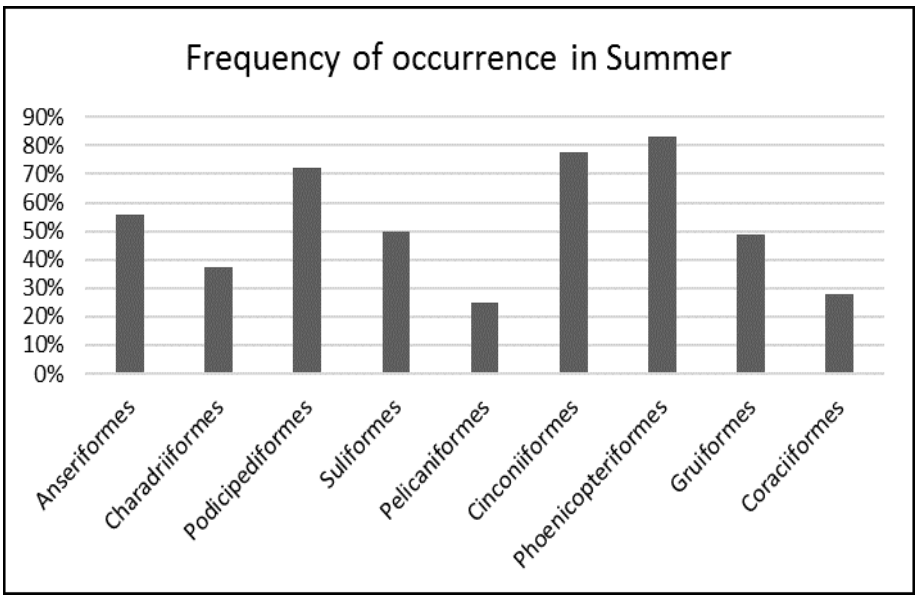

Figure 5.1

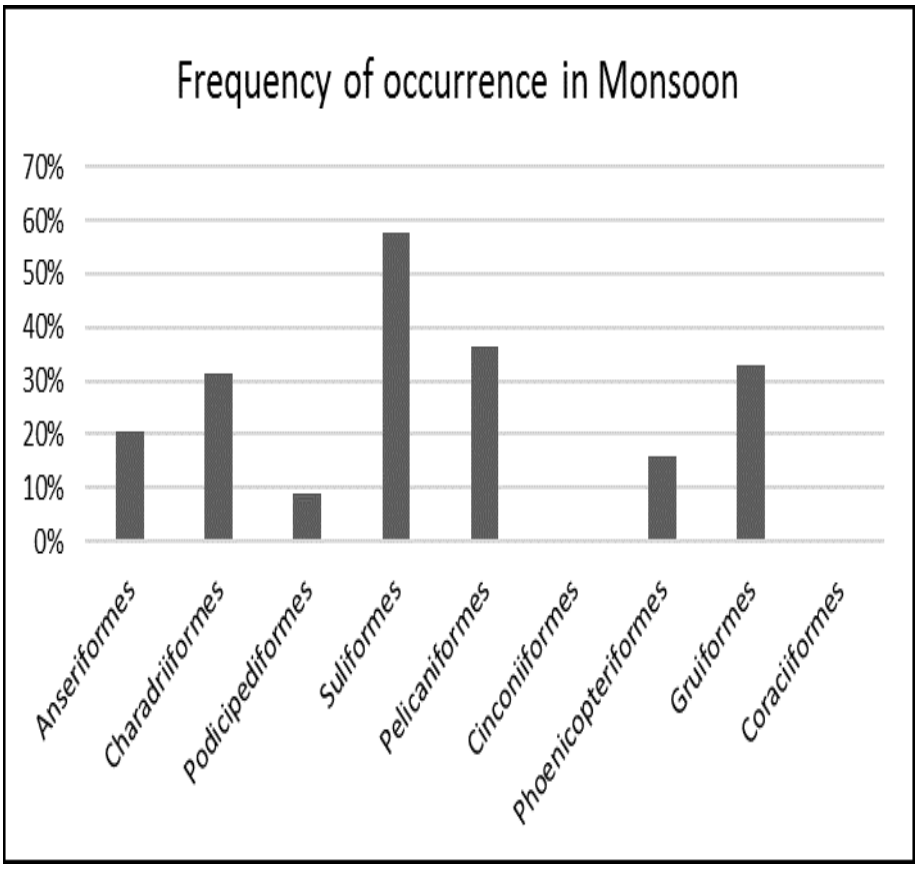

Figure 5.2

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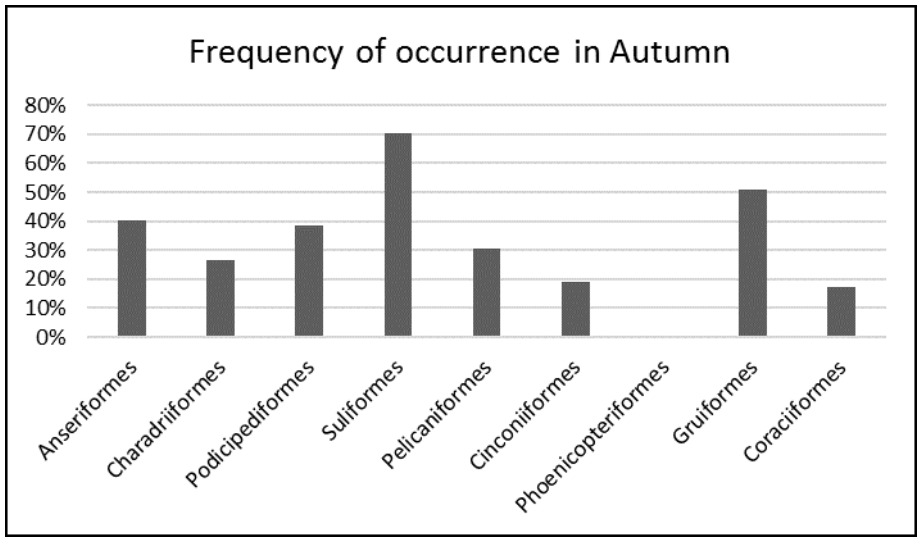

Figure 5.3

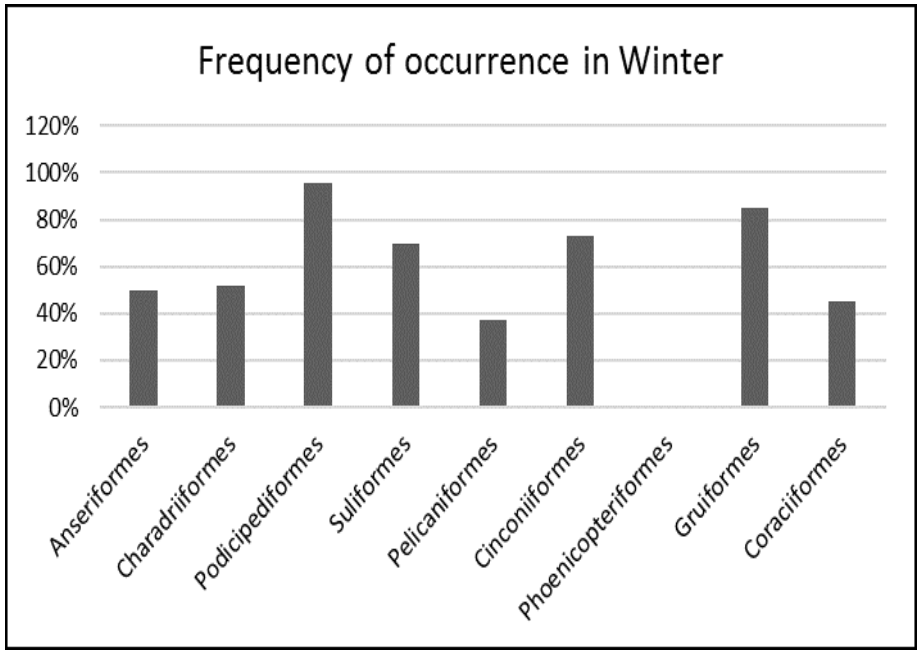

Figure 5.4

Figure 5: Frequency of Occurrence of different Orders per Season

Water-birds of all orders observed during only summer season, although number of individuals or abundance of water-birds were highest during winters.

Throughout the study, waterbirds were found to be foraging near the emergent vegetation and within accessible water depths (based on their bill lengths) but putrefaction of water because of sewage discharge, washing activities, agricultural runoff, permanent construction around the area and human disturbances made it difficult for them to find prey. Emergent vegetation plays very important role in success of foraging by screening the bird.

For conserving the avifaunal diversity and increase the number of migratory birds at the scenic Anasagar Lake, it is necessary to monitor the water quality and encourage the growth of favorable emergent vegetation around the lake. Various foraging and nesting platforms can also be erected to compensate for the unfavourable concrete structures and lack of vegetation. It is very crucial to arrest the unchecked anthropogenic activities and disturbances.

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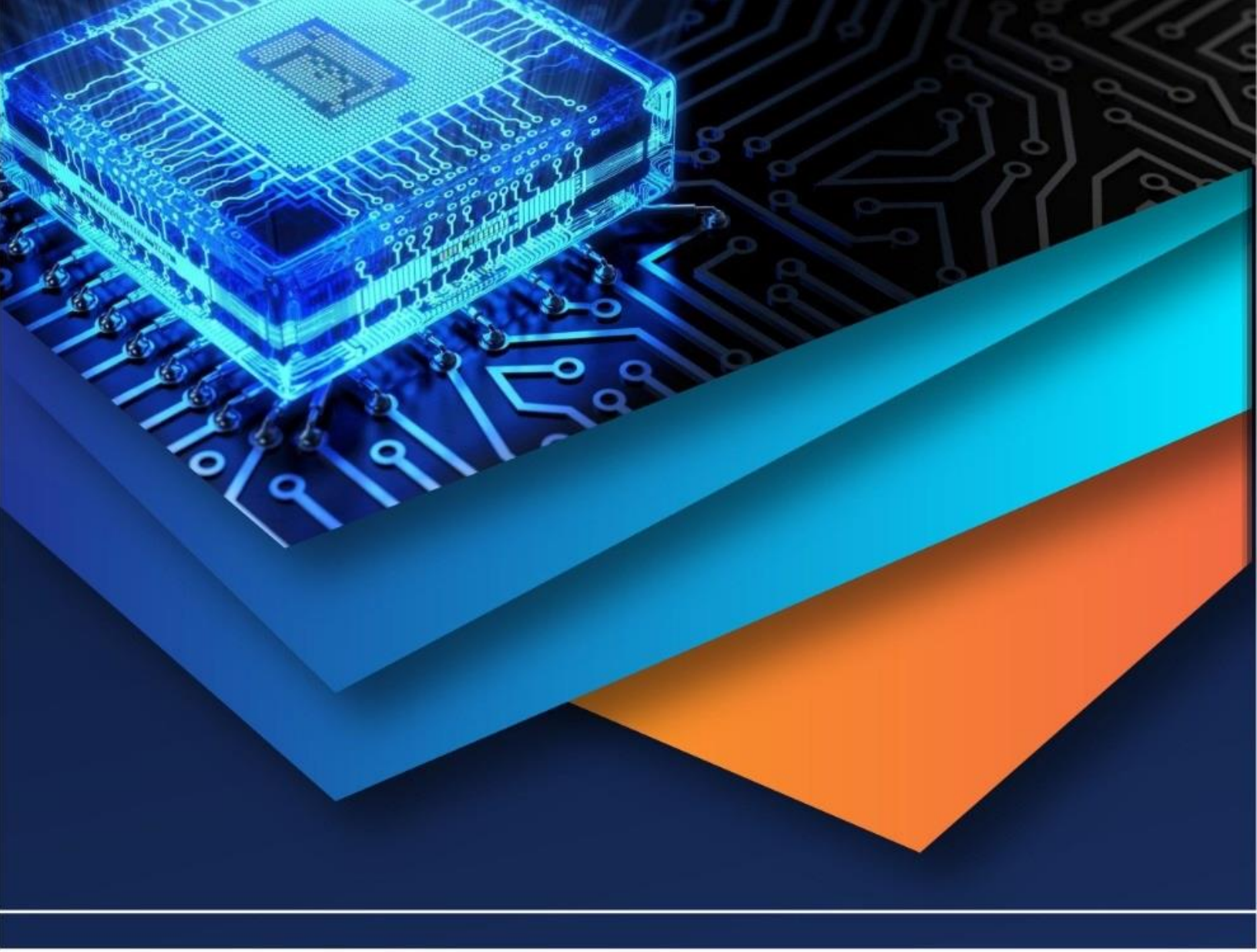

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