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E: ISSN NO.: 2349-980X **Shrinkhla Ek Shodhparak Vaicharik Patrika**

Seasonal Variation of Avian Diversity of Anasagar Lake Ajmer: A Case Study from Central Aravalli Foothill Ranges

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Abstract

The importance of birds is demarcated on the basis of their habitat diversity, great productivity, and distinctive avifauna. Recent studies have shown the positive correlation between bird diversity and wetland habitat therefore the birds' diversity can be one of the good bio-indicators of particular wetland.The present study was carried out to identify the seasonal variation of avifauna of Anasagar lake Ajmer which is very important lentic fresh water body of Ajmer.Observation suggested that total 96 species belonging to 42 families and 15 orders were found in the study area. Out of 96 species 26 are winter migratory,10 are summer migratory and 60 are resident.

Keywords: Central Aravalli, Avian Diversity, Seasonal Variation, Presence-Absence.

Introduction

Wetlands are defined as 'transitional zones between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water'.Wetlands contribute to an environmental health in many ways. Wetlands performs a large variety of valuable functions such as recycle nutrients, purify water, attenuate floods, maintain stream flow etc. Wetlands are often described as "Kidneys of the landscape"(Mitsch & Gosselink 1986).

Wetlands and water bodies are important repositories of aquatic biodiversity or biodiversity dependent on them. Birds are dependent on the habitat functioning in specific ways, the population trends of birds can tell us about how well the ecosystem functions.One of the most useful things that birds can indicate is overall habitat quality. The damages in such excellent system of water holding because of urbanization or other factors typically causes water quality to worsen. In addition, wetlands are important feeding and breeding areas for wildlife and provide a stopping place and refuge for water birds and wetland dependent birds. As with any natural habitat, wetlands are important in supportings pecies diversity and have a complex of wetland values.

Wetlands cover atleast 6% of the Earth and have become a focal issue for conservation due to the ecosystem services they provide. Aquatic biodiversity is dependent on hydro-logic regime; geological conditions and efforts are being made to conserve the biodiversity found in wetlands, streams and rivers.The first step in conservation of biodiversity is to assess the diversity of natural resources present and identify those, which are important and most irreplaceable (Groombridge&Jenkins 1998).

Countless species of birds, mammals, reptiles, amphibians, fish and invertebrate species depend on water and wetland vegetation for their survival (Mitsch and Gosselink, 2000).Each habitat or microhabitat has its own meritorious characteristics with regards to avifauna composition (Manhaes and Loures-Ribeiro, 2005).The native vegetation having crucial role in species diversity and occurrence it even alter the composition of bird community (Fleishman *et al.,* 1990; Letio*et al.,* 2006; Acevedo and Aide, 2008).

Birds are considered as one of the best bio-indicators. Their presence in specific habitat shows the importance of that habitat in ecological prospective for that particular area (Harney and Bhute, 2014).

Objectives of the Study

Aims of present study are to prepare a comprehensive database of bird species having occurrence at Anasagar Lake, along with their

seasonal variations at the study area. That may help to plan conservation and sustainable development strategies as Ajmer city is under the 'Smart City' developmental programme of Government of India.

Review of Literature

A total of 1340 species of the birds were documented from the Indian subcontinent that comprises nearly 13% of species of total species of the world (Ali & Ripley, 1987; Manakadan & Pittie 2001). Out of these 1340 species nearly about 510 documented from the state of Rajasthan (Grimmettet al, 1999). Sharma et al (2012) documented the avian fauna of Sharawan Sagar wetland situated nearby the Anasagar Lake and reported 90 species of birds. Lawaniya et al (2013) reported the avian diversity their distribution from certain wetlands of Kota, Rajasthan. Sharma et al (2013) reported first photographic records of greater painted snipe from the water bodies of Ajmer district, central Aravalli. Swaroop and Yadav (2017) identified 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 studied period at Anasagar Lake, Ajmer. Yadav and Swaroop (2017)made documentation about diversity abundance and inter-specific correlation in water birds at Anasagar Lake. Meena et al. (2018) suggested that total 53 species of birds belong to 16 families were found in Kekri, a small city of Ajmer district of Rajasthan state. Dutt and Prakash (2018) reported the greater flamingo from the Anasagar Lake one more previous sighting of flamingos around Ajmer was reported by Choudhary, (2007). Prakash and Dutt (2018) reported an annotated checklist of 58 species of birds and water-associated bird's diversity in two Anasagar Lake and Foysagar Lake of Ajmer from March 2017 to February 2018. Upadhyay et.al (2019) observed total of 56 species belonging to 34 families from December 2017 to December 2018 in Sophia Girls College Campus, Ajmer.

Methodology

Survey Methods

The field surveys were conducted during the October 2017 to March 2019 for the observation of birds mainly for presence and absence of the birds and seasonal variations.

Identification Tools

Birds were subsequently observed using "The book of Indian birds" by Salim Ali, "Birds of Indian subcontinent" by Carol Inskipp, Richard Grimmett and Tim Inskipp,"A pictorial field guide to birds of India" by Bikram Grewal.

Frequency Percentage

The percentage of frequency for each species was calculated simply by dividing the numbers of days on which the species was observed by the total number of observation days multiplied by 100.

Relative Diversity Index (RDi)

The relative diversity (RDi) of families was calculated (Torre-Cuadros et al., 2007).

$$\mathrm{RDi} = \frac{Number\ of\ bird\ species\ in\ a\ family}{Total\ number\ of\ Species} \mathrm{X}\ 100$$

Sorenson Index

To assess the association of species between two study sites, Sorensen's index of similarity (Sorenson 1948) was calculated.

$$C_S = 2j/(a+b)$$

Where

j = number of species common to both sites;
a = number of species at site A;
b = number of species at site B;

Jaccard Index

To assess the association of species between two study sites, Jaccard index of similarity was calculated.

$$C_j = j/(a+b-j)$$

Where

j = number of species common to both sites;
a = number of species at site A;
b = number of species at site B;

Profile of Study Area

Ajmer is centrally located in the state of Rajasthan between $25^0$28' North longitude and $73^0$22' East latitude.Total area of Ajmer city is 241.56 sq. km. The city has desert zone on the one hand and humid zone on the other, thus having zone of confluence. The climate is sub tropical and is characterized broadly into 3 season viz. Summer (March to June), Monsoon (July to September) and Winter (November to February). The temperature ranges from 14^0C to 40^0C, the minimum being in the winters and maximum in summers.

The lake was constructed by Chouhan King Arnoraj or Anaji (about 1135-1150A.D.), the grandfather of Emperor Prithviraj Chouhan. When it was constructed, the circumference was of 60 miles. But now the circumference is of 8 miles when it is full. Its capacity is 72.48ef. Water spread is 11377m.sq.ft; the depth now is 16ft. Its catchment area has been reduced since it was in 1891 A.D.

The catchments of Anasagar Lake are Nagpahar hills, Taragarh hills (hillocks of Central Aravalli Mountain Ranges) and a part of Ajmer city. The total catchment contributing to the lake inflow is about 71 sq. km.Interrupted catchment area is 28.46 sq. km. and free catchment area is 42.11 sq. km. In the west after the Nagpahar hills, the Great Indian Desert starts.The rocky hills in the catchment area are the lime Bearing rocks, agglomerate start and sandy clay.Mathur el al., (2010) assessed the various physico-chemical properties of Anasagar lake and mentioned about its water pollution levels. In the present study, the stretch of Anasagar was divided into four sampling sites for the observation.

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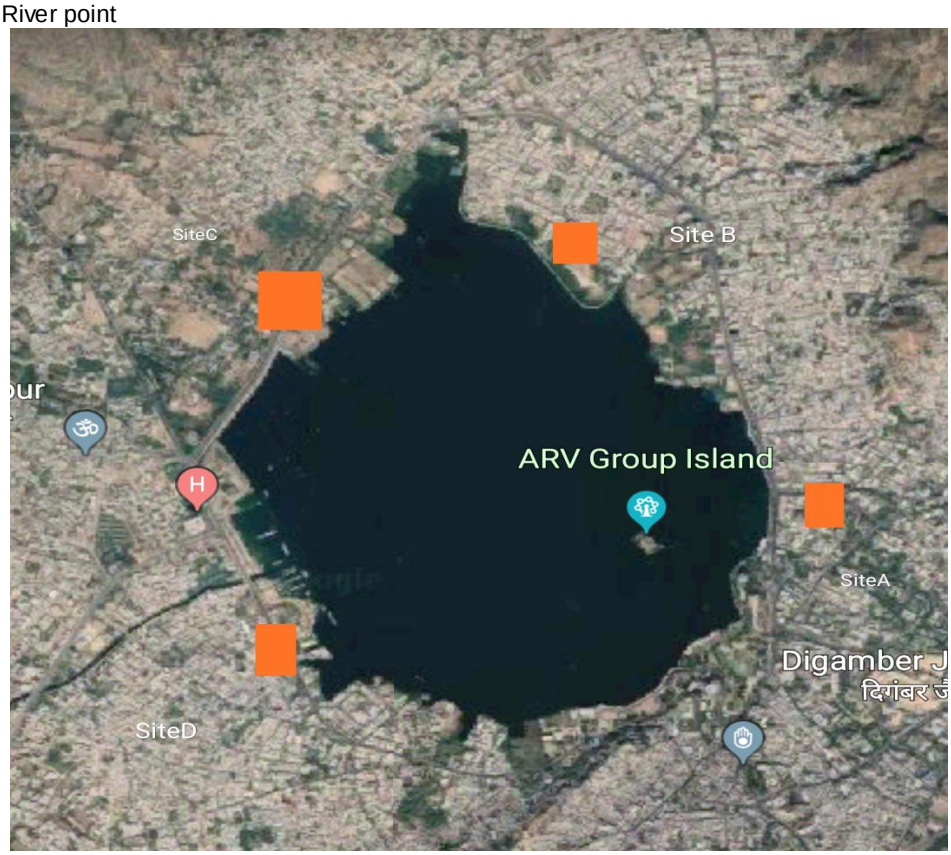
Figure 1: Study area map.Site A: Chaupati**; Site B:** SagarVihar Pathway**; Site C:** Regional Institute Chaupati**; Site D:** Badi River point



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Observation and Results

Table 1: Study Sites wise Presence Absence of Avian Species

S.No.	Order	Family	Common Name	Scientific Name	Site A	Site B	Site C	Site D	IUCN Status
1	Anseriformes	Anatidae	Bar-headed Goose	*Anser indicus*	1	1	1	1	LC
2	Anseriformes	Anatidae	Ruddy Shelduck	*Tadorna ferruginea*	0	0	1	1	LC
3	Anseriformes	Anatidae	Northern Shoveler	*Spatula clypeata*	1	1	1	1	LC
4	Anseriformes	Anatidae	Indian Spot-billed Duck	*Anas poecilorhyncha*	1	1	1	1	LC
5	Anseriformes	Anatidae	Common Teal	*Anas crecca*	1	0	1	1	LC
6	Anseriformes	Anatidae	Mallard	*Anas platyrhynchos*	0	0	0	1	LC
7	Anseriformes	Anatidae	Northern Pintail	*Anas acuta*	1	1	0	0	LC
8	Galliformes	Phasianidae	Indian Peafowl	*Pavo cristatus*	0	1	0	1	LC
9	Phoenicopteriformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	1	1	1	1	LC
10	Columbiformes	Columbidae	Rock Pigeon	*Columba livia*	1	1	1	1	LC
11	Columbiformes	Columbidae	Eurasian Collared Dove	*Streptopelia decaocto*	1	1	1	1	LC
12	Columbiformes	Columbidae	Spotted Dove	*Streptopelia chinensis*	1	1	1	1	LC
13	Columbiformes	Columbidae	Laughing Dove	*Streptopelia senegalensis*	0	1	1	0	LC
14	Columbiformes	Columbidae	Yellow -footed green pigeon	*Treron phoenicoptera*	0	1	0	0	LC
15	Cuculiformes	Cuculidae	Greater Coucal	*Centropus sinensis*	1	1	1	1	LC
16	Cuculiformes	Cuculidae	Asian Koel	*Eudynamys scolopaceus*	1	1	1	1	LC
17	Gruiformes	Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*	0	1	0	0	LC
18	Gruiformes	Rallidae	Purple Swamphen	*Porphyrio porphyrio*	0	1	1	0	LC
19	Gruiformes	Rallidae	Common Moorhen	*Gallinula chloropus*	0	1	1	1	LC
20	Gruiformes	Rallidae	Common Coot	*Fulica atra*	0	1	1	1	LC
21	Pelecaniformes	Ciconiidae	Painted Stork	*Mycterial eucocephala*	0	1	1	1	NT
22	Pelecaniformes	Ciconiidae	Asian Openbill	*Anas tomusoscitans*	1	1	1	1	LC
23	Pelecaniformes	Ciconiidae	Black-crowned Night Heron	*Nycticorax nycticorax*	1	1	0	1	LC
24	Pelecaniformes	Ciconiidae	Indian Pond Heron	*Ardeola grayii*	1	1	1	1	LC
25	Pelecaniformes	Ciconiidae	Cattle Egret	*Bubulcus ibis*	1	1	1	1	LC

26	Pelecaniformes	Ciconiidae	Grey Heron	*Ardea cinerea*	0	1	0	1	LC
27	Pelecaniformes	Ciconiidae	Purple Heron	*Ardea purpurea*	0	1	1	1	LC
28	Pelecaniformes	Ciconiidae	Great Egret	*Ardea alba*	1	1	1	1	LC
29	Pelecaniformes	Ciconiidae	Intermediate Egret	*Ardea intermedia*	1	1	1	1	LC
30	Pelecaniformes	Ciconiidae	Little Egret	*Egretta garzetta*	0	1	0	0	LC
31	Pelecaniformes	Threskiornithidae	Glossy Ibis	*Plegadis falcinellus*	0	1	1	1	LC
32	Pelecaniformes	Threskiornithidae	Red naped ibis	*Pseudibis papillosa*	1	0	1	1	LC
33	Pelecaniformes	Phalacrocoracidae	Little Cormorant	*Microcarbo niger*	1	1	1	1	LC
34	Pelecaniformes	Phalacrocoracidae	Great Cormorant	*Phalacrocorax carbo*	1	0	1	1	LC
35	Pelecaniformes	Pelecanidae	Great White Pelican	*Pelecanus onocrotalus*	1	1	1	1	LC
36	Pelecaniformes	Pelecanidae	Dalmatian Pelican	*Pelecanus crispus*	1	1	1	1	NT
37	Charadriiformes	Recurvirostridae	Pied Avocet	*Recurvirostra avosetta*	1	1	1	1	LC
38	Charadriiformes	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	1	1	1	1	LC
39	Charadriiformes	Charadriidae	Little Ringed Plover	*Charadrius dubius*	0	1	1	1	LC
40	Charadriiformes	Charadriidae	Kentish Plover	*Charadriusa lexandrinus*	0	1	1	1	LC
41	Charadriiformes	Charadriidae	Yellow-wattled Lapwing	*Vanellusmalabaricus*	0	0	1	1	LC
42	Charadriiformes	Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	1	1	1	1	LC
43	Charadriiformes	Scolopacidae	Black-tailed Godwit	*Limosal imosa*	1	1	1	1	NT
44	Charadriiformes	Scolopacidae	Ruff	*Calidris pugnax*	0	1	1	0	LC
45	Charadriiformes	Scolopacidae	Little Stint	*Calidris minuta*	0	1	0	0	LC
46	Charadriiformes	Scolopacidae	Common Snipe	*Gallinago gallinago*	0	1	1	0	LC
47	Charadriiformes	Scolopacidae	Common Sandpiper	*Actitishy poleucos*	0	1	1	0	LC
48	Charadriiformes	Scolopacidae	Wood Sandpiper	*Tringa glareola*	0	1	0	0	LC
49	Charadriiformes	Laridae	Pallas's Gull	*Ichthyaetusicht hyaetus*	1	0	1	1	LC
50	Charadriiformes	Laridae	Gull-billed Tern	*Gelochelidon nilotica*	1	1	1	1	LC
51	Charadriiformes	Laridae	River Tern	*Sterna aurantia*	1	1	1	1	NT
52	Charadriiformes	Laridae	Black bellied tern	*Sterna aucticauda*	1	0	1	1	EN
53	Accipitriformes	Accipitridae	Black Shoulder Kite	*Elanus caeruleus*	1	1	1	1	LC
54	Accipitriformes	Accipitridae	Shikra	*Accipiter badius*	1	1	0	1	LC

55	Accipitriformes	Accipitridae	Black Kite	*Milvus migrans*	1	1	1	1	LC
56	Strigiformes	Strigidae	Spotted Owlet	*Athene brama*	1	0	0	1	LC
57	Bucerotiformes	Upupidae	Common Hoopoe	*Upupa epops*	1	1	1	1	LC
58	Piciformes	Ramphastidae	Coppersmith Barbet	*Psilopogonhaema cephalus*	1	1	0	0	LC
59	Coraciiformes	Meropidae	Green Bee-eater	*Merops orientalis*	1	1	1	1	LC
60	Coraciiformes	Meropidae	Blue cheek bee-eater	*Merops persicus*	0	1	0	0	LC
61	Coraciiformes	Coraciidae	Indian Roller	*Coracias benghalensis*	1	1	1	1	LC
62	Coraciiformes	Alcedinidae	Pied Kingfisher	*Ceryle rudis*	1	1	1	1	LC
63	Coraciiformes	Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis*	1	1	1	1	LC
64	Psittaciformes	Psittaculidae	Rose-ringed Parakeet	*Psittacula krameri*	1	1	1	1	LC
65	Passeriformes	Vangidae	Common Woodshrike	*Tephrodornis pondicerianus*	0	1	1	0	LC
66	Passeriformes	Dicruridae	Black Drongo	*Dicrurus macrocercus*	1	1	1	1	LC
67	Passeriformes	Rhipiduridae	White-browed Fantail	*Rhipidura aureola*	1	1	1	1	LC
68	Passeriformes	Laniidae	Long-tailed Shrike	*Lanius schach*	1	1	1	1	LC
69	Passeriformes	Corvidae	RufousTreepie	*Dendrocitta vagabunda*	0	1	1	0	LC
70	Passeriformes	Corvidae	House Crow	Corvus splendens	1	1	1	1	LC
71	Passeriformes	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus*	1	1	1	1	LC
72	Passeriformes	Ploceidae	Baya Weaver	*Ploceus philippinus*	0	1	1	1	LC
73	Passeriformes	Estrildidae	Indian Silverbill	*Euodice malabarica*	1	1	1	1	LC
74	Passeriformes	Passeridae	House Sparrow	*Passer domesticus*	1	1	1	1	LC
75	Passeriformes	Motacillidae	White-browed Wagtail	*Motacillama deraspatensis*	1	1	1	1	LC
76	Passeriformes	Motacillidae	Citrine Wagtail	*Motacilla citreola*	1	0	0	1	LC
77	Passeriformes	Cisticolidae	Ashy Prinia	*Prinia socialis*	1	1	1	1	LC
78	Passeriformes	Hirundinidae	Wire-tailed Swallow	*Hirundo smithii*	1	1	1	1	LC
79	Passeriformes	Hirundinidae	Dusky Crag Martin	*Ptyonoprogneconcolor*	1	1	1	1	LC
80	Passeriformes	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	1	1	1	1	LC
81	Passeriformes	Phylloscopidae	Common Chiffchaff	*Phylloscopus collybita*	0	1	1	1	LC
82	Passeriformes	Leiothrichidae	Large Grey Babbler	*Argya malcolmi*	0	1	1	1	LC

83	Passeriformes	Sturnidae	Rosy Starling	*Pastor roseus*	1	1	1	1	LC
84	Passeriformes	Sturnidae	Asian Pied Starling	*Gracupica contra*	1	1	1	1	LC
85	Passeriformes	Sturnidae	Brahminy Starling	*Sturnia pagodarum*	1	1	1	1	LC
86	Passeriformes	Sturnidae	Common Myna	*Acridotheres tristis*	1	1	1	1	LC
87	Passeriformes	Sturnidae	Bank Myna	*Acridotheres ginginianus*	1	1	1	1	LC
88	Passeriformes	Muscicapidae	Indian robin	*Saxicoloides fulicatus*	1	1	1	1	LC
89	Passeriformes	Muscicapidae	Oriental Magpie Robin	*Copsychus saularis*	1	1	1	1	LC
90	Passeriformes	Muscicapidae	Black Redstart	*Phoenicuruso chruros*	1	1	0	0	LC
91	Passeriformes	Muscicapidae	Brown Rock Chat	*Oenanthe fusca*	1	1	1	1	LC
92	Passeriformes	Muscicapidae	Desert Wheatear	*Oenanthe deserti*	0	1	0	0	LC
93	Passeriformes	Muscicapidae	Siberian Stonechat	*Saxicola maurus*	1	1	0	0	LC
94	Passeriformes	Cisticolidae	Jungle prinia	*Prinia sylvatica*	0	1	1	1	LC
95	Passeriformes	Motacillidae	Pied wagtail	*Motacilla alba*	1	1	1	1	LC
96	Passeriformes	Oriolidae	Indian oriole	*Oriolus kundoo*	0	1	1	0	LC
					65	86	78	77	

Table Legends:
Site A: Chaupati**; Site B:** SagarVihar Pathway**; Site C:** Regional Institute Chaupati**; Site D:** Badi River point
'**0**' indicates the absence of species and '**1**' indicates the presence of species
LC: Least Concern; **NT**: Near Threatened; **VU**: Vulnerable; **EN**: Endangered

Table 2: Seasonal Variation of Avian Species of Anasagr Lake

S.No.	Name	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Frequency%	Migratory Status
1	Bar-headed Goose	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	33.3	WM
2	Ruddy Shelduck	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	22.22	WM
3	Northern Shoveler	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	61.11	WM
4	Indian Spot-billed Duck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
5	Common Teal	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
6	Mallard	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	16.66	WM
7	Northern Pintail	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	44.44	WM
8	Indian Peafowl	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R

9	Little Grebe	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	44.44	WM
10	Rock Pigeon	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
11	Eurasian Collared Dove	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
12	Spotted Dove	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
13	Laughing Dove	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
14	Yellow -footed green pigeon	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
15	Greater Coucal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
16	Asian Koel	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	50	WM
17	White-breasted Waterhen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
18	Purple Swamphen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
19	Common Moorhen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
20	Common Coot	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
21	Painted Stork	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	50	WM
22	Asian Openbill	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	50	WM
23	Black-crowned Night Heron	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
24	Indian Pond Heron	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
25	Cattle Egret	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
26	Grey Heron	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
27	Purple Heron	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
28	Great Egret	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
29	Intermediate Egret	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
30	Little Egret	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
31	Glossy Ibis	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
32	Little Cormorant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
33	Great Cormorant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
34	Great White Pelican	0	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	61.11	WM
35	Dalmatian Pelican	0	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	61.11	WM
36	Red naped ibis	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
37	Pied Avocet	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM

38	Black-winged Stilt	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	33.33	SM
39	Little Ringed Plover	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	11.11	SM
40	Kentish Plover	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
41	Yellow-wattled Lapwing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
42	Red-wattled Lapwing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
43	Black-tailed Godwit	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
44	Ruff	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
45	Little Stint	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	83.33	WM
46	Common Snipe	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	50	WM
47	Common Sandpiper	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM
48	Wood Sandpiper	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
49	Pallas's Gull	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
50	Gull-billed Tern	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
51	River Tern	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	50	WM
52	Black bellied tern	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
53	Black Shoulder Kite	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
54	Shikra	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
55	Black Kite	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
56	Spotted Owlet	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
57	Common Hoopoe	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
58	Coppersmith Barbet	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	55.55	WM
59	Green Bee-eater	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	88.88	WM
60	Blue cheek bee-eater	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	83.33	WM
61	Indian Roller	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
62	Pied Kingfisher	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
63	White-throated Kingfisher	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
64	Rose-ringed Parakeet	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
65	Common Woodshrike	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
66	Black Drongo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
67	White-browed Fantail	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
68	Long-tailed Shrike	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM
69	RufousTreepie	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
70	House Crow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
71	Purple Sunbird	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R

72	Baya Weaver	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
73	Indian Silverbill	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
74	House Sparrow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
75	White-browed Wagtail	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
76	Citrine Wagtail	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM
77	Ashy Prinia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
78	Wire-tailed Swallow	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM
79	Dusky Crag Martin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
80	Red-vented Bulbul	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
81	Common Chiffchaff	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM
82	Large Grey Babbler	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
83	Rosy Starling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
84	Asian Pied Starling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
85	Brahminy Starling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
86	Common Myna	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
87	Bank Myna	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
88	Indian robin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
89	Oriental Magpie Robin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
90	Black Redstart	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM
91	Brown Rock Chat	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
92	Desert Wheatear	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	27.77	SM
93	Siberian Stonechat	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
94	Jungle prinia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
95	Pied wagtail	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	R
96	Indian oriole	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	44.44	SM

Table Legends:
'**0**' indicates the absence of species and '**1**' indicates the presence of species
R: Resident; **WM**: Winter Migrant; **SM**: Summer Migrant

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Figure 1: Graphical Representation of Family wise Relative Diversity Index (RDi)

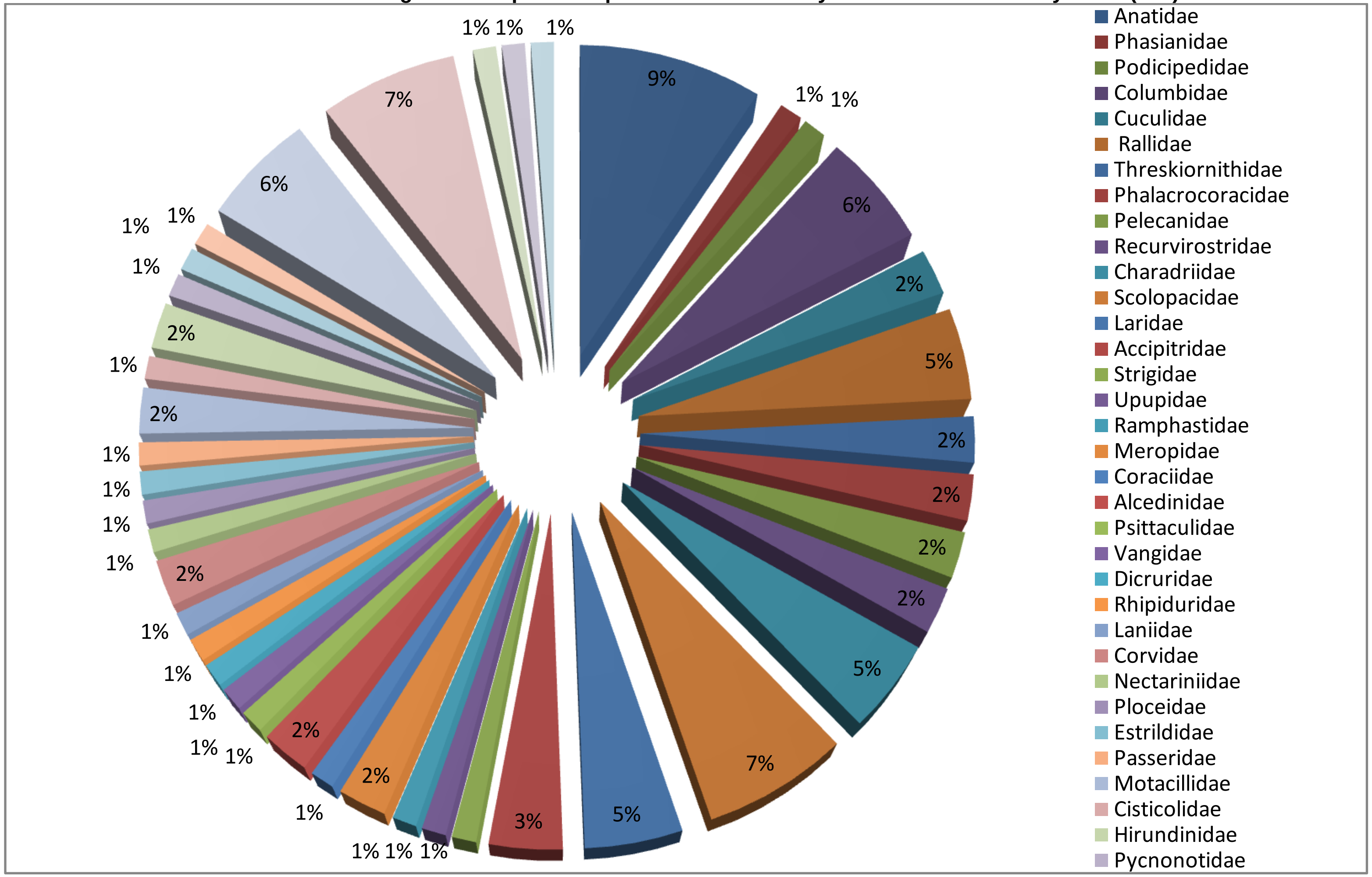

Table 3: Family wise Relative Diversity Index (RDi) of observed Avian Species of Anasagar Lake

S.No.	Family	No. of Species	Rdi
1	Anatidae	8	8.33
2	Phasianidae	1	1.04
3	Podicipedidae	1	1.04
4	Columbidae	5	5.2
5	Cuculidae	2	2.08
6	Rallidae	4	4.16
7	Threskiornithidae	2	2.08
8	Phalacrocoracidae	2	2.08
9	Pelecanidae	2	2.08
10	Recurvirostridae	2	2.08
11	Charadriidae	4	4.16
12	Scolopacidae	6	6.25
13	Laridae	4	4.16
14	Accipitridae	3	3.12
15	Strigidae	1	1.04
16	Upupidae	1	1.04
17	Ramphastidae	1	1.04
18	Meropidae	2	2.08
19	Coraciidae	1	1.04
20	Alcedinidae	2	2.08
21	Psittaculidae	1	1.04
22	Vangidae	1	1.04
23	Dicruridae	1	1.04
24	Rhipiduridae	1	1.04
25	Laniidae	1	1.04
26	Corvidae	2	2.08
27	Nectariniidae	1	1.04
28	Ploceidae	1	1.04
29	Estrildidae	1	1.04
30	Passeridae	1	1.04
31	Motacillidae	2	2.08
32	Cisticolidae	1	1.04
33	Hirundinidae	2	2.08
34	Pycnonotidae	1	1.04
35	Phylloscopidae	1	1.04
36	Leiothrichidae	1	1.04
37	Sturnidae	5	5.2
38	Muscicapidae	6	6.25
39	Cisticolidae	1	1.04
40	Motacillidae	1	1.04
41	Oriolidae	1	1.04

Table 4: Jaccard and Sorenson Index Values of Avian Species at Four study sites of Anasagr Lake (Site A: Chaupati; Site B: Sagar Vihar Pathway; Site C: Regional Institute Chaupati; Site D: Badi River point)

		Sorenson Index			
	Sites Under Observation	**Site A:** Chaupati	**Site B:** SagarVihar Pathway	**Site C:** Regional Institute Chaupati	**Site D:** Badi River point
Jaccard Index	**Site A:** Chaupati	-	**0.768**	**0.797**	**0.859**
	Site B: SagarVihar Pathway	**0.623**	-	**0.866**	**0.822**
	Site C: Regional Institute Chaupati	**0.671**	**0.763**	-	**0.903**
	Site D: Badi River point	**0.753**	**0.698**	**0.824**	-

Conclusion

A total of 96 species of birds belonging to 42 families and 15 orders were recorded during the study period. However on site first (Chaupati) a total of 65 species belonging to 34 families and 13 orders, on site second (SagarVihar Pathway) a total of 86 species belonging to 41 families and 14 orders, on site third (Regional Institute Chaupati) a total of 78 species belonging to 39 families and 14 orders, on site fourth (Badi River point)a total of 77 species belonging to 39 families and 15 order are recorded respectively. Out of these 96 species 26 are winter migratory, 10 are summer migratory and 60 are resident to the study area. Out of 96 species 62 are most common, 13 are common, 19 are not common, 2 are rarely sighted. The diversity available at study are showed the significant dissimilarity as the dissimilarity indices (Sorenson and Jaccard) was calculated among all the study sites. Maximum dissimilarity among study site A (Chaupati) and B (Sagar Vihar Pathway) was observed as 0.768 and 0.623 by Sorenson and Jaccard index respectively. While in contrast the maximum similarity among study site C (Regional Institute Chaupati) and D (Badi River point) was observed as 0.903 and 0.824 by Sorenson and Jaccard index respectively.

Recommendations

From an ecological perspective, wetlands are valuable as they are among world's most productive ecosystems and host a large amount of biological diversity. As cities around the world experience an increase in growth, the need to expand sustainably, operate efficiently and maintain a high quality of life for residents becomes even greater. As Ajmer city is recently considered under the smart city development programme and several developmental projects are in pipeline hence the presented data base may be useful for the policy makers and developers for the sustainable approach of development.

References

Acevedo, M.A. and Aide, T.M. (2008): Bird community dynamics and habitat associations in Karst, Mangrove and Pterocarpus forest fragment in an urban zone. Caribbean Journal Science 44: 402–416.

Ali, S. & S.D. Ripley (1987). Compact Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan, and Sri Lanka. Oxford University Press, Delhi, India, 737pp.

Choudhary, N. (2007). Environmental Analysis of Anasagar Wetland Using Remote Sensing and GIS. Ph.D. Thesis M.D.S.U. Ajmer, Rajasthan. pp. 136.

Dutt, U. and Prakash, B. (2018): Re-Sighting of Greater Flamingos (Phoenicopterusroseus) at Anasagar Lake, Ajmer, Rajasthan, India. Int. J. ShrinkhlaEkShodhparakVaicharikPatrika. ISSN NO.: 2321-290X. Vol. 3(6). pp.64-66.

Fleishman, E., N. McDonald, R., McNally, D., Murphy, J., Waters, T., Floyd, J. Fowler and L. Cohen (1990): Practical Statistics for Field Biology. John Wiley and Sons, New York.

Grimmett, R., C. Inskipp& T. Inskipp (1999). Pocket Guide to the Birds of the Indian Subcontinent. Oxford University Press, New Delhi. 384pp

Groombridge, B. & M. Jenkin. 1998. Freshwater Biodiversity: A Preliminary Global Assessment, WCMC. Biodiversity Series No.8, World Conservation Press.

Harney, N.V. and K.B. Bhute (2014): Diversity of avifauna in and around Chalbardi (Rai) lake near Bhadrawati, district Chandrapur (M.S.), India. Journal of Global Biosciences. 3(2): 399-405.

Lawaniya, N. K. ; Sharma , D. D and Sharma ,V. (2013): Occurrence and Distribution of Avianfauna from certain wetlands of Hadauti plateau, Kota, Rajasthan. Int. Jou. of Environmental and Animal Conservation; Vol. 2(1). pp. 8-21.

Leito, A., J. Truu, E. Roosaluste, K. Seep and I. Podier (2006): Long term dynamics of breeding birds in broad-leaved deciduous forest on Hanckasti Island in the west-estonian archipelago. Ornis. Fennica 83: 124–130.

Manakkadan, R. and Pittie A. (2001): Standardized Common and Scientific Names of the Birds of the Indian Subcontinent. Buceros 6 (1): 1-37.

Manhães, M.A. and A. Loures-Ribeiro (2005): Spatial distribution and diversity of bird community in an urban area of southeast Brazil. Brazilian Archives of Biology and Technology 48(2): 285–294.

Mathur, P., Patan, S., Sharma, K., Nair, N. and Shobhawat, A. (2010): Assessment of physico-chemical properties of Anasagar lake of Ajmer (India). J.Environ. Res. And develop. Vol. 4(3). pp. 780-787.

Meena, D., Yadav, D., Sharma, V., Senapati, T. and Kachhawa, JBS (2018): Current Status of fresh water Avifaunal Diversity of Tehsil Kekri and nearby area of Ajmer District, Rajasthan India. Int. J. for Res. in App. Sci. & Eng. Tech. Vol. 6(1).

Mitsch, W.I. & I.G. Gosselink. 1986. Wetlands. Van Nostrand Reinhold, New York

Prakash, B. and Dutt, U. (2018). Assessment of Diversity Indices of Water-Birds in Fresh Water Lake of Ajmer (Rajasthan). Int. J. ShrinkhlaEkShodhparakVaicharikPatrika. ISSN NO.: 2321-290X. Vol. 5(10). pp.22-27.

Sharma, V., Kumawat, K.R., Meena, D., Yadav, D., Kumar, A., Kumawat, K.N. and Sharma, K.K. (2013): Sighting of Greater Painted Snipe Rostratulabenghalensis at wetland of central Aravalli foothills, Ajmer, Rajasthan. ISSN 2319-1104.Jou. on New Bio. Reports. Vol. 2(2). pp. 99-102.

Sharma, V., Kumawat, K.R., Yadav, D., Kumar, A., Meena, D., Kumawat, K.N. and Sharma, K.K. (2012): Avian fauna of ShrawanSagar (Wetland near central Aravalli foothills): Distribution, current statusand recent threats. Int. Jou. Of Envi. &Ani. Cons. Vol. 1(2). pp. 16-24.

Sorensen, T. (1948): A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of the vegetation on Danish commons. Kongelige Danske Videnskabernes Selskab 5: 1–34

Swarrop, R. and Yadav, I. (2017): Frequency and Status of Occurrence of Water-Birds at Anasagar Lake, Ajmer. Inter. J. for Res. in Applied Science & Engineering Tech. (IJRASET). ISSN: 2321- 9653; Vol. 5. Issue (10). pp. 1079- 1090.

Upadhyay, M., Vyas, R. and Sharma V. (2019): Avifauana of Sophia Girls' College Campus, Ajmer, Rajasthan. Int. J. Shrinkhla Ek Shodhparak Vaicharik Patrika. Vol. 6(6): 74-80.

Yadav, I. and Swroop, R. (2017): Diversity, Abundance and Inter-specific Correlation in Water-birds at Anasagar Lake, Ajmer. Int. Jon. Sci. and Res. (IJSR), Vol. 6(7). pp. 1306-1317.