

Assessment of Diversity Indices of Water-Birds in Fresh Water Lake of Ajmer (Rajasthan)



Prakash B.

Associate Professor,
Deptt. of Zoology,
S.P.C. Government College,
Ajmer, Rajasthan

Dutt U.

Teacher Research Fellow,
Deptt. of Zoology,
S.P.C. Government College,
Ajmer, Rajasthan

Abstract

Present study was an approach to document the database of avifaunal diversity (water-birds) having presence occurrence and distribution in and around of Anasagar lake, Ajmer, Rajasthan. Species diversity and dominance of birds were calculated. This study was conducted during April 2017 to March 2018. Overall 44 species of birds belonging to 14 families and 8 orders were recorded during the study period. Diversity Indices i.e. Shannon Index (H') and Simpson Index (D) were also assessed for mathematical measurement of species diversity in a given community. Species richness and species abundance were also observed. The species richness and composition are keen parameters for stability and functioning of an ecosystem and study show Anasagar is diversified study area therefore, there is a strong need of conservation of Anasagar lake and surrounding wetland that is important repositories of avian diversity.

Keywords: Avian-Fauna, Species Diversity, Dominance, Diversity Indices and Conservation

Introduction

Wetland are extremely important areas because they play an important role in our ecosystem. Wetland can be considered as "harbinger" "cradles" and "treasure houses" of all taxonomic groups in floral and faunal diversity. Classification, importance and some major information of wetland has been suggested from time to time Anno (1998); Scott (1989); Maltby (1986); Mahajan *et al.*; (1981); Gopal *et al.* (1980) and Nalawade, *et al.* (2008). The variability in climatic conditions and the changing topography is responsible for the significant ecological diversity encountered within the different wetlands. In India, wetland studies received due attention rather late with pioneering works of Ganapati (1940, 1956), Hussainy (1967), who extensively studied some wetlands and the conservation efforts that are being carried out by Government of India Cook (1985). Conservation of wetland is considered paramount in view of its ecological significance. The main interest in earlier wetland studies was centered on migratory bird conservation and other aquatic life.

Thus the present investigation is an attempt to document the (water birds) avian diversity of one of the most potential microhabitat in central Aravalli foothills Ajmer. The study is focused on proper scientific documentation of the water birds of the area with main emphasis on the Ajmer wetland and nearby areas. The main aim of the study was to measure the bird species diversity at Anasagar lake measuring by the species richness, Simpson index and Shannon-Weiner diversity index. This documentation may help in planning or making proper action plan for conservation of water birds of ecological important species which are facing threats to their survival at the four study sites of study area.

Review of Literature

Most of the birds have specific habitat requirement from season to season. Learning the habitat is one of the foremost steps in studying an organism (Odum, 1971) (Cody, 1984) summarized the available information on habitat selection of birds. Ali (1979) reported that the studies on the ecology as well as ecology of birds in relation to habitats provided valuable data for forest management. Owen and black (1990) published a book on " Waterfowl Ecology "which provided insight into the various aspects of waterfowl like food and feeding ecology of waterfowl, movement and migration, population dynamics, conservation and management, identification of waterfowl and knowing their food and habitat requirement distribution etc. Ecological account of most of the Indian birds was given by

Ali and Ripley (1969) deal with wetland habitat and bird study. However, there is no concise report on the birds of each habitat highlighting their conservation problems.

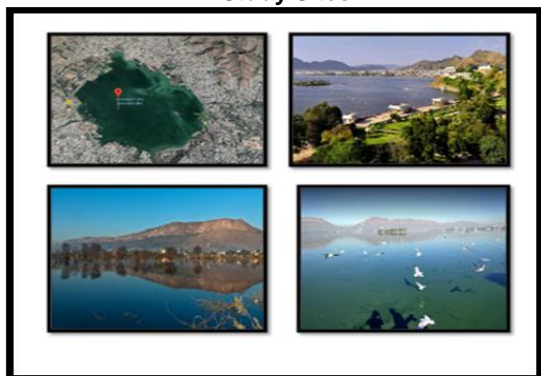
Study Area

Ajmer lies between 26° 58' and 25° 38' North latitude and 73° 52' and 75° 22' East longitude a centrally located city of Rajasthan. Ajmer has a semi arid climate with high temperatures throughout the year.

Anasagar Lake

Anasagar lake a perennial fresh water body has geographical coordinates of 26° 28' North latitude and 74° 38' East longitude with an Altitude of 487.28 meters covering approximately 3864.10 hectare area with the maximum depth (full water level) 3.96 meter to mean depth (full water level) 2.80 meter. The major source of water are Bandi river, rain fall and waste water drain. There are four overflow gates of size 4' X 6' at for inflow and outflow of water. The average annual water level change through precipitation is around 1.00 meter annually. This wetland represents excellent microhabitat for different water birds. (Source: Irrigation department of Ajmer, Rajasthan) . Study area was divided into four sites were selected for detailed studies and to compare the avian fauna distribution in these four sites. Location map of four sites are shown in figure. Site 1: Near Rishi Ghati, Site 2: Near dhobi Ghat, Site 3: Near drain Line and Site 4: Near Agricultural Fields

Study Sites



Material and Methodology

A number of observations regarding waters birds diversity of Anasagar was recorded during one year period. This study was only for the period of January 2017 to March 2018. For the collection of data surveys were deigned during morning and evening hours (7:00 AM to 9:00 AM and 5:00 PM to 7:00 PM) on a fixed date. Study sites were observed by the visual encounter method. Transects were plotted along the periphery of the wetland, observation were started from the start point to the end point to cover all the periphery area of the wetland of interest. Only the avian faunal diversity which encountered in transect were noted and the species outside the transects were left out according to the standard protocols. The stretch of transect was limited to shallow water towards wetland and the range of visibility of opposite side.

To calculate diversity indices, Species richness, Shannon-Weiner (Shannon and Weaver, 1949) and Simpson Index (Simpson, 1949), were used. Shannon diversity is very widely used index for comparing diversity between various habitats (Clarke and Warwick, 2001). A comprehensive study on Anasagar lake of Ajmer was carried out by Mathur *et.al* (2010). Diversity variables and frequency and status of water-birds at Anasagar lake was carried out by Yadav and Swroop (2017) and Swroop and Yadav (2017). It was calculated in order to know the species diversity in different habitat (Hutchison, 1970) (Babi and Ali.2013). based on the abundance of the species by the following formula:

Shannon-Weiner Index (H')

$$H' = - [\sum Pi \ln Pi]$$

Where, H' = diversity Index; Pi = is the proportion of each species in the sample; lnPi = natural logarithm of this proportion.

Simpson Index (D)

$$D = 1 - \{ \sum n(n-1) / N(N-1) \}$$

Where, n= the total number of birds of a particular species; N= the total number of birds of all species birds of all species.

Simpson Diversity Index (D): = 1-D

$$E_{1/D} = (1/D) / S$$

Where, D = Simpson's Index of Diversity and S = Sum of numbers data.

Bird Census: Bird counts were carried out monthly on the sampling site S1.,S2.,S3 and S4 of Anasagar lake. Bird counts were done by two different methods. Actual head counts were made for birds species which were small in number. For fast moving birds or for birds present in large flocks, census was carried out by fixed transect method (Emlen,1971) (Franzreb, 1981). The number of birds visiting the study sites in 15 minutes period was taken as one population count. The average value of 10 such counts represents the population of birds (Bhakta and Banerjee 1995). All the observations were made by the help of Nikon 7 x 35 CF binoculars and Sony camera (34 X Zooming capacity).

Result and Discussion

Identification of Birds

Identification of birds was done initially with the help of experts and using the field guide (Ali, 2012 and Girmmettel *et al.*, 2011) . Table 1 shows the water-bird species observed at the selected four sites at Anasagar Lake, Ajmer during the study period. The classification is based upon the recent phylo-genomic studies (Hackett *et al.*, 2008) . Anasagar is a good diversified and species rich study site in Ajmer district. These days this lake is facing anthropogenic pressure . In total 8 orders belonging to 14 families and 44 species of water-birds were observed from Anasagar wetland . Family Ardeidae was found to be the most dominant family represented by 8 species followed by Anatidae with 7 species and Scolopacidae with 6 species, family Rallidae had 4 species, family Charadriidae and Threskiornithidae had 3 species, family Laridae, Recurvirostridae, Phalacrocoracidae and Pelecanidae had 2 species while 4 families Sternidae, Podicipedae, Ciconiidae and Alcedinidae had only one species.

Table no. 2 shows out of 44 bird species total 26 species (29 %) of water-birds were Resident and 16 species (18 %) of water-birds were Winter Visitors and other 2 species (2%) of water-bird were Resident and Winter Visitor. Out of 44 species of birds 7 species (8 %) were found as Most Common., 13 species (15 %) found as Common., 12 species (14 %) found as Not Common., and 12 species (14 %) found as Rare.

The various diversity indices of water-birds at Anasagar lake shown in table no. 3. The highest value for Shannon-Weiner diversity index was estimated to be (2.4893)., where as Simpson's diversity index value was estimated to be (0.9144). Simpson's evenness of birds species compares the similarity of the population size of each of the species which was estimated to be (0.8342) while species richness (n) was 44. That values indicated the community of the water-birds at Anasagar lake is highly diverse community.

Conclusion

The occurrence and abundance of 44 water-birds species representing 14 families and 8 orders found at Anasagar lake clearly indicate that the lake is a very important wetland habitat for the both resident

and migratory birds species. This habitat must be conserved for both its ecological and aesthetic importance. Water-birds were found to be foraging near the emergent vegetation and within accessible water depths (based on their bill length). Urbanization, deforestation, mining, beautification of lake and other anthropogenic activities are major cause for declining of the population of avian diversity at lake. Construction of permanent pathway and increasing human presence in the area has adversely affected the aquatic avifaunal diversity. Bird-watching may be a popular activity as it increases the awareness about water-birds conservation. For conservation of the (water-bird) avian faunal diversity residential as well as migratory birds at the Anasagar lake it is necessary to monitor the water quality and encourage the growth of favorable habitat around the lake.

Acknowledgement

Authors are very thankful to Principal, Dr. Surendra Kumar Dev S.P.C. Government College Ajmer for his support, proper guidance and encouragement throughout the study period. Our special thanks are to irrigation department of Ajmer, Rajasthan for their help and encouragement.

Table No. - 1: Water-birds found at Anasagar Lake

Family	Zoological Name	Common Name	Urdu / Hindi name	Population	Residing Status
Anatidae	<i>Anas poecilorhyncha</i> (Forster, JR, 1781)	Spot billed-duck	Hanzar Gugral	C	R"
	<i>Anas acuta</i>	Northern Pintail	Seekhpar Sand	R	W
	<i>Anser indicus</i>	Bar-Headed goose	Kaj Hans	NC	W
	<i>Tadorna ferruginea</i>	Ruddy Shelduck	Chakwa Lal	NC	W
	<i>Anas clypeata</i>	Northern Shoveler	Punana Ghirah	C	W
	<i>Anas penelope</i>	Eurasian Wigeon	Peason Chhota Lalsar	R	W
	<i>Anas crecca</i> (Linnaeus, 1758)	Common Teal	Chhoti Murghabi Teal	C	W
Scolopacidae	<i>Philomachus pugnax</i> ((Linnaeus, 1758)	Ruff (Reeve for female)	Gehwala Bagbad	C	R"
	<i>Calidris temminckii</i> (Leisler, 1812)	Temmnick's stint	Chhota Panlawwa	C	W
	<i>Gallinago gallinago</i> (Linnaeus, 1758)	Common Snipe	Chaha	C	W
	<i>Tringa ochropus</i> (Linnaeus 1758)	Green Sandpiper		R	W
	<i>Tringa stagnatilis</i> (Bechstein, 1803)	Marsh Sandpiper		C	W
	<i>Tringa totanus</i> (Linnaeus, 1758)	Common Redshank	Chhota Batan	R	W
Laridae	<i>Larus brunnicephalus</i>	Brown-headed Gull	Dhorma	R	W
	<i>Larus ridibundus</i> (Linnaeus 1766)	Black headed Gull	Dhorma	R	W

Sternidae	<i>Sterna aurantia</i> (Grey, JE. 1831)	Indian River tern	Tehari Ganga Cheel Koorari	NC	R''
Recurvirostridae	<i>Himantopus himantopus</i> (Linnaeus 1758)	Black Winged Stilt	Gaz Paon	MC	R''
	<i>Recurvirostra avosetta</i> (Linnaeus 1758)	Pied Avocet	Kusya Chaha	MC	W
Charadriidae	<i>Charadrius dubius</i> (Scopoli, 1786)	Little Ringed Plover	Merwa Zirrea	R	RW
	<i>Vanellus malabaricus</i>	Yellow Wattled Lapwing	Zirda	NC	R''
	<i>Vanellus indicus</i> (Boddaert, 1783)	Red Wattled lapwing	Tateeri	MC	R''
Podicipedidae	<i>Tachybaptus ruficollis</i> (Pallas, 1764)	Little Grebe (Dabchick)	Dubdubi Pandubi	MC	R''
Phalacrocoracidae	<i>Phalacrocorax niger</i> (Linnaeus, 1758)	Little Cormorant	Chhota Jal Kawwa	NC	R''
	<i>Phalacrocorax carbo</i> (Linnaeus, 1758)	Great Cormorant	Jl Kawwa Pan Kawwa	R	R''
Pelecanidae	<i>Pelecanus onocrotalus</i> (Linnaeus, 1758)	Great white pelican	Hawasil	C	W
	<i>Pelecanus crispus</i>	Dalmatian Pelican		NC	W
Ardeidae	<i>Ardea alba</i> (Linnaeus 1758)	Great White Egret	Bara Malang Bagla	NC	R''
	<i>Ardea cinerea</i> (Linnaeus 1758)	Grey Heron	Nari Sain	R	RW
	<i>Ardea purpurea</i> (Linnaeus 1766)	Purple Heron	Lal Nari	MC	R''
	<i>Ardeola grayii</i> (Sykes 1832)	Indian pond Heron	Broku	MC	R''
	<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret	Badami Bagla Surkhia Bagla	MC	R''
	<i>Egretta garzetta</i> (Linnaeus 1766)	Little Egret	Chhotta Bagla	C	R''
	<i>Egretta intermedia</i> (Wagler, 1829)	Intermediate Egret	Patokha Bagla	NC	R''
<i>Nycticorax nycticorax</i>	Black crowned night Heron		C	R''	
Threskiornithidae	<i>Platalea leucorodia</i> (Linnaeus, 1758)	Eurasian Spoonbill	Chamcha Chamcha Baza	R	R''
	<i>Pseudibis papillosa</i> (Temminck, 1824)	Black ibis (Red naped Ibis)	Kala Baza	R	R''
	<i>Threskiornis melanocephalus</i> (Latham, 1790)	Black headed Ibis	Safed Baza	R	R''

Ciconiidae	<i>Mycteria leucocephala</i> (Pennant, 1769)	Painted Stork	Janghilhok	NC	R''
Rallidae	<i>Amauornis phoenicurus</i> (Pennant, 1769)	White breasted Water-hen	Dawak, Kinati ahak	NC	R''
	<i>Fulica atra</i> (Linnaeus, 1758)	Eurasian Coot	Dasari,asarni, Aari, Khuskul Coot	NC	R''
	<i>Gallinula chloropus</i> (Linnaeus, 1758)	Common moorhen	Jal Murghi Pani Murghi	C	R''
	<i>Porphyrio porphyrio</i> (Linnaeus, 1758)	Purple Swamp-hen	Kalim, Kharim Jalmurgha	NC	R''
Alcedinidae	<i>Halcyon smyrnensis</i> (Linnaeus 1758)	White breasted Kingfisher	Kilkila Neela Machhrala	C	R''
	<i>Ceryle rudis</i> (Linnaeus 1758)	Small Pied Kingfisher	Kilkila	C	R''

**R''= Resident; W= Winter visitor; RW= Resident and winter visitor ; MC= Most Common; C= Common; NC= Not Common and R= Rare
Grimmett et al., 2011**

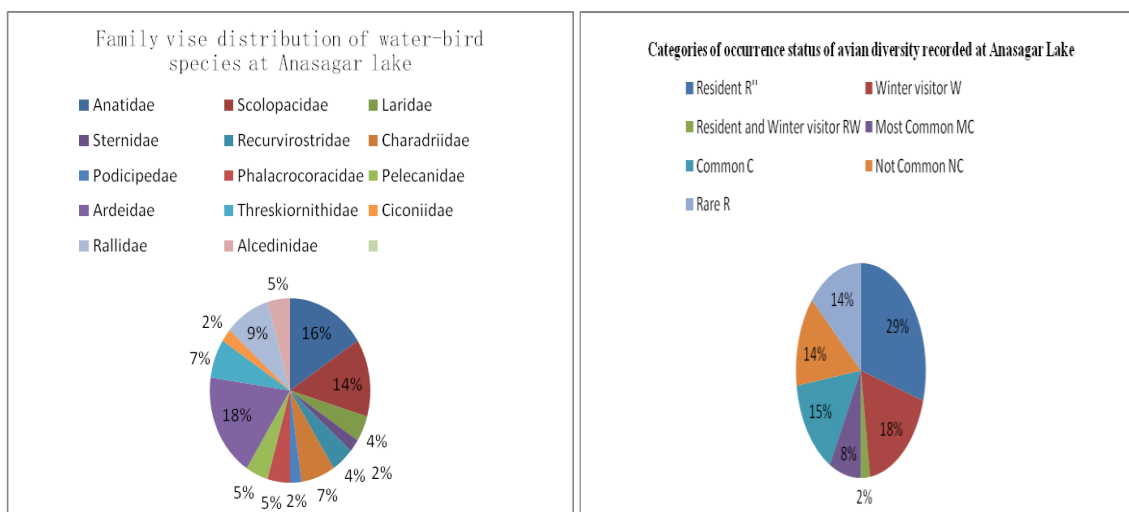


Table No. 2: Categories of occurrence status of avian diversity recorded at Anasagar Lake

S.No.	Status	Abbreviations	Number of Species	Percentages %
1	Resident	R''	26	29%
2	Winter visitor	W	16	18%
3	Resident and Winter visitor	RW	02	2%
4	Most Common	MC	07	8%
5	Common	C	13	15%
6	Not Common	NC	12	14%
7	Rare	R	12	14%

Table No. 3: Diversity Index values of avian diversity recorded at Anasagar Lake

Diversity Index	Result
Shannon Weiner Index (H')	2.4893
Simpson Index (D)	0.0846
Simpson Index of diversity (D)	0.9154
Simpson evenness (E)	0.7883
Species richness (r)	44

Referances

1. Ali, S. (1979): *The book of Indian birds.* Bombay Nature History Society, Bombay.
2. Ali, S. (2012): *The book of Indian birds;* Bombay, Bombay Natural History Society.
3. Ali, S. and Ripley, S.D. (1969): *Handbook of the Birds of India and Pakistan, 2 Vols.,* Oxford University Press, Delhi.
4. Anon, (1998): "Wetland of India" Space Application Center (ISRO) , Ahmadabad , RSAM/SAC/RSAG/MWRD/WLM/TN/02/94, pp. 9.
5. Bibi, F. and Ali, Z. (2013): Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *The journal of animal and plant Science*, 23. (2). pp. 469-474.
6. Clarke, K. R. and Warwick, R. M. (2001). *Changes in marine communities: an approach to statistical analysis and interpretation, 2nd edition, PRIMERE: Plymouth.* pp. 172.
7. Cody, M.L., (ed).(1984): *Habitat selection in birds.* Academic Press, Orlando, Florida, USA.
8. Cook, C.K.K. (1985): Range extensions of aquatic vascular plant species. *J. Aquatic plant management.* 23: pp. 1-16.
9. Emlen, J.T. (1971): Population densities of birds derived from transect counts. *Auk.* 88: pp. 323-342.
10. Franzreb. K. E. (1981). The determination of avian densities using the variable-strip and fixed-width transect surveying methods. In C. J. Ralph and J. M. Scott (eds.). *Estimating the numbers of terrestrial birds.* *Stud. Avian Biol.* 6. pp. 139-145.
11. Ganapati, S.V. (1940): The ecology of a temple tank containing a permanent bloom of *Microcystis aeruginosa* (kuz) Honfr. *J. Bombay Nat. Hist. Soc.* 42(1). pp. 65-77.
12. Ganapati, S.V.(1956): The limnology of two minor irrigation Reservoirs near Madras. I. the Erralupam reservoir hydrobiology. 8 (3-4). pp. 365-438.
13. Gopal, B., Turner, R.E., Wetzel, R.G. and Whingham, F. (1980): *Distribution and Production of Macrophytes in Pichhola lake, Udaipur (India)* Proc. First Int. Wetland Conf., Newelhi, India, pp. 45-54.
14. Grimmet, R., Inskipp, C. and Inskipp, T. (2011): *Birds of the Indian Subcontinent India, Pakistan, Sri Lanka, Nepal, Bhutan, Bangladesh and the Maldives.* Helm Field Guide. Bloomsbury Publishing.
15. Hackett S. J., Kimball, R. T., Reddy, S., Bowie, R.C., Braun, E.L., Braun, M.J., Chojnowski, J.L., Cox, W.A., Han, K.L., Harshman, J., Huddleston, C.J., Marks, B.D., Miglia, K.J., Moore, W.S., Sheldon, F.H., Steadman, W., Witt, C.C. and Yuri, T. (2008): A Phylo-genomic study of birds reveals their evolutionary History. *Science* (5884). pp. 1763-8.
16. Hussainy, S.U. (1967): *Studies on Limnology and primary production of a tropical lake.* *Hydrobiology.* 30. pp. 335-352.
17. Hutchison, K. (1970): A test for comparing diversity based on the Shannon formula. *J. of Theoretical Biology*, 29. pp. 151-154.
18. Mahajan, L., Sharma, S., Sharma, S. P. and Arora, N. K. (1981): Productivity potential of reservoir ecosystem with special reference of Rajasthan. *Acta. Limnol. Indica.* 1. pp. 39-40.
19. Maltby, E. (1986): *Waterlogged Wealth, Way Waste the Worlds Wet Places?* International Institute for environ and development, London and Washington.C
20. 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.
21. Nalawade, P.M., Solunke, K.R., Late, A.M., Patil, C.A. and Mule, M.B. (2008): *Dying lake: A loosing habitat of migratory birds - A case study from Aurangabad city.* Eds. Sengupta, M and Dalwani, R. *Proceedings of Taal 2007: The 12th World Lake Conference:* pp. 1623-1627.
22. Odum, E.P. (1971): Leaching colonization and stabilization during detritus formation: *Mem. Inst. Ital. Indrobiol. Suppl.* 29: 105-127.
23. Owen, M. and Black, J.M.(1990): *Waterfowl Ecology.* Blackie and son Ltd., Glasgow and London.
24. Scott, A. (1989): *Airectory of Asian Wetlands.* IUCN. Gland (Switzerland) and Cambridge U.K.
25. Shannon, C. E. and W. Weaver (1949): *The MathematicalSSSS Theory of Communication.* University of Illinois Press, Urbana, Illinois. pp.144.
26. Simpson, E. H. (1949). *Measurement of diversity.* *Nature*, pp.163: 688.
27. Swarrop, R. and Yadav, I. (2017): *Frequency and Status of Occurrence of Water-Birds at Anasagar Lake, Ajmer.* *Inter.I J. for Res. in Applied Science & Engineering Tech. (IJRASET).* ISSN: 2321-9653; Vol. 5. Issue (10). pp. 1079-1090.
28. Yadav, I. and Swarrop, R. (2017): *Diversity, Abundance and Inter-specific Correlation in Water-Birds at Anasagar Lake, Ajmer.* *International J. Sci. and Res.(IJSR).*, Vol. 6(7). pp. 1306-1317.