

# Birds in semi-natural wetlands of arid landscape- a study on their diversity in Kachchh region of Gujarat, India

Prapti J. Gohil<sup>1</sup> and Arun Kumar Roy Mahato<sup>2</sup>

<sup>1</sup>*Shree Ramkrishna Institute of Computer Education and Applied Sciences, Surat 394 221, Gujarat, India*

<sup>2</sup>*Gujarat Institute of Desert Ecology, Mundra Road, Bhuj, Kachchh 370 001, Gujarat, India*

(Received 23 May, 2020; accepted 4 July, 2020)

## ABSTRACT

Kachchh district of Gujarat despite falling into arid region is rich in presence of wetlands and dependent avifauna. Apart from the popularly known larger wetlands like Rann of Kachchh and Chharidhandh, other manmade water bodies in rural and urban areas of the region supports and enrich biodiversity which are poorly documented. The present study was carried out in the month of January and March, 2017 to analyse avian diversity of three selected lesser known semi-natural wetlands located within 25 km radius of Bhuj city of Kachchh district. A total of 64 species of birds belonging to 32 families and 11 orders were recorded includes 19 terrestrial bird and 45 water birds. The species dominance was highest of *Fulica atra* and *Microcarbo niger* among the recorded species. The analysis revealed that the bird species richness in these wetlands were 25, 49 and 16 with species diversity 2.29, 2.79 and 2.56 respectively. The results conclusively indicated the importance of studying and long term monitoring of such wetlands are vital for conservation of rich diversity of birds.

*Key words: Avi-fauna, Species, Wetland bird, Arid land, Kachchh*

## Introduction

Dry and sub-humid lands, including arid and semi-arid regions, grasslands, savannahs, and Mediterranean landscapes, encompass approximately 47% of the Earth's terrestrial area (CBD, 2019). Wetland areas in dry and sub-humid lands, for instance, are often of crucial importance in supporting migratory bird species (CBD, 2007). Wetlands are particularly important for waterbirds (Rajpar and Zakaria, 2013), which depend on them for finding food and breeding grounds. The degradation of wetlands can have significant conservation implications extending beyond the local scale when degradation affects

migratory birds, which rely on wetlands for suitable habitat during the migration (Webb *et al.*, 2010). Wetlands in particular have suffered great human pressure during the last decades and many of them have been destroyed.

Human establishments are often associated with the destruction of natural habitats but also with creation of new ones that could be beneficial for birds. Semi-natural wetlands are distinct ecosystems serve as a balancing reservoir for sustaining native flora and fauna (Surana *et al.*, 2007). Artificial aquatic habitats created by man, are nowadays become important alternative habitats for wild birds (Ma *et al.*, 2004). Small lentic wetlands, whether natural,

mixed or artificial, are important for the maintenance of local and regional bird diversity (Murillo Pacheco *et al.*, 2017). Geiosa *et al.* (2018) found that while on average natural wetlands have more species and support higher abundances, certain artificial wetlands have the potential to support similarly diverse communities.

Kachchh is one among the arid district of India expand in 45652 sq. km, entails 67.94% of the state wetland area (SAC, 2011). There are as many as 231 major and minor reservoirs built to cater to the irrigational and drinking water needs of the region. Though, the small man-made wetlands are considered a refuge for biodiversity, but the importance of such manmade lentic wetlands for the maintenance of bird diversity in human dominated landscapes is not wellknown in this arid landscape. Wetland bird of western parts of Kachchh was studied by Gajera *et al.* (2011) while wetland birds of some water bodies in drier parts of Kachchh studied by Koladiya *et al.* (2013). Several water bodies have been developed by local communities in this dryland for the purposes of irrigation and drinking water for livestock are also serving as a habitat for many water birds and water dependent birds in course of time. These semi-natural water bodies are now vital for many wildlife notably avi-fauna. Though, these small

water bodies serving as a feeding and breeding ground for many bird species, majority of the studies on this drier region are focussed mainly on large wetlands. Thus, the study was conducted to assess the status and diversity of avi-fauna on three selected semi-natural water bodies of Kachchh.

## Materials and Methods

**Study Area:** The semi-natural/man-made wetlands are located in the Kachchh district of Gujarat, India. The area falls under the arid bio-geographic zone of the country. After a pilot survey around the city of Bhuj, three wetlands were selected for assessment of diversity of birds in these wetlands (Figure 1). The wetlands were selected based habitat type, location, human interference, vegetation cover etc. The wetlands include; Ishwarsagar lake (Site-1) ( $23^{\circ}11'30.63''N$ ,  $69^{\circ}26'57.07''E$ ) located in Vandhay village on Bhuj-Naliya highway at distance of 24.2 km from Bhuj which is spread in 8 ha area, Devisar lake (Site-2) ( $23^{\circ}23'14.55''N$ ,  $69^{\circ}41'55.04''E$ ) is located 18.8 km from Bhuj near Rudramata dam right beside state highway 45 and spread in 26 ha area, and Vandh lake (Site-3) ( $23^{\circ}11'27.95''N$ ,  $69^{\circ}35'27.29''E$ ) located near Vandh village at a distance of 10.1 km from Bhuj along Bhuj-Mandvi highway spread in 14



Fig. 1. Locations of Study Sites in Kachchh district of Gujarat

ha area.

### Survey Method

Each of the three study sites was visited weekly in the winter months of January to February, 2017 to survey the avian diversity of these sites. Observations were made during 7:00 – 10:30 hour in morning and 16:00 – 18:00 hour in evening with the aid of 10 x 50 Bushnell binoculars and camera. Birds were counted based on point count method (Bibby *et al.* 2000) from different vantage points at each wetland based on good visibility. The field survey data were noted on an ornithological data sheet that includes species, number of individuals, activity, field characteristics and threats along with other minor details. Birds were identified using field guides Grimmett *et al.* (2011) and Ali (2002). All the recorded species were categorized according to their migratory status as resident (R), resident-migrant (RM) and migrant (M) (Koladiya *et al.*, 2013). The feeding status of the birds was divided into six following groups: grainivore (G), herbivore (H,) insectivore (I), carnivore (C), piscivore (P) and omnivore (O) (Ali and Ripley 1983). The threatened status of each recorded species was tabulated as per the Red list category of IUCN, 2018 and Indian Wildlife (Protection) Act, 1972.

### Data Analysis

Bird population analysis was conducted applying calculations of the dominance index by species diversity index by Shannon and Weaver (1949), and species richness index of Marglef (1963) using PAST (version 1.0) Statistical Software.

Species Dominance (Dom.) =  $(n_i/N) \times 100$  [ $n_i$ : the number of individuals in the  $i$  species,  $N$ : the total number of individuals]

Species diversity ( $H'$ ) =  $-\sum (n_i/N) \times \ln (n_i/N)$  [ $n_i$ : the number of individuals in the  $i$  species,  $N$ : the number of individuals in a given area]

Species richness ( $D_a$ ) =  $(s-1)/\ln (N)$  [ $s$ : the total number of species,  $N$ : the total number of detected individuals]

The data on other aspect of status and diversity were statistically analysed using MS-Excel.

## Results

### Status of Avi-fauna

Altogether, a total of 64 species of birds were re-

corded during the study from the selected wetland which is belonging to 50 genera, 32 families and 11 orders. Among the recorded birds, 19 species were terrestrial belonging to 16 genera, 14 families and 7 orders while rest of 45 species were water birds belonging to 34 genera, 18 families and 6 orders. Among the recorded species falling under 51 genera, 44 of them were monotypic, whereas 7 genera were polytypic with two or more than two species observed. The highest number of species (7 species) was recorded under the genus *Anas*. Among the three wetlands, highest number of species recorded from Site-2, followed by Site-3 and least number of species recorded from Site-1 (Figure 2). The recorded bird species were belonging to 12 orders in which Ciconiiformes was the largest order with 26 species, followed by Passeriformes with 11 species while, six orders with only one species each. Similarly, among the recorded 32 families of birds, 11 families represented by two or more than two species and rest of 21 families were represented by one species each. Among the recorded species, 29 species were resident, 25 species were resident-migrant and rest of 10 species were of migratory birds (Table 1). Classification of the trophic guilds of recorded species, maximum number of species were omnivore (21 species) followed by insectivore (17 species), piscivore (10 species) and rest of the species were herbivore, grainivore and carnivore (Figure 3).

On analysis of the recorded birds, 11 species (3 terrestrial and 8 waterbird) were common to all the three sites. While on assessing the abundance status, Site 2 recorded highest number of common (15) and uncommon (28) species while rare bird species were recorded highest in Site 3 (Table 2). As per the Red list of threatened species of IUCN (2019), 5 species out of 64 recorded species were listed under Near

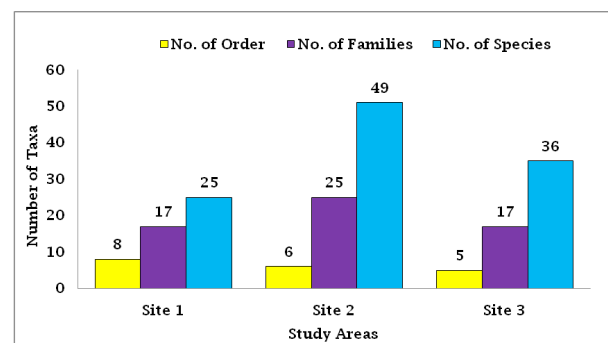
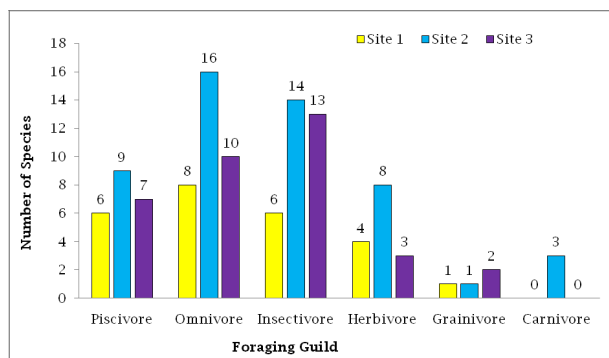


Fig. 2. Avi-faunal diversity recorded from the selected semi-natural wetlands of Kachchh

**Table 1.** Site-wise migratory status of recorded birds

Migratory Status	No. of Species			Total
	Site-1	Site-2	Site-3	
Resident	11	20	17	29
Migratory	4	9	5	10
Resident Migratory	10	20	14	25
Total	25	49	36	64



**Fig. 3.** Distribution of avifauna according to foraging guild

Threatened (NT) category which includes; *Anhinga melanogaster*, *Mycteria leucocephala*, *Sterna aurantia*, *Limosa limosa* and *Threskiornis melanocephalus* and rest of the species are Least concern species. As per Indian Wildlife (Protection) Act, 1972; all the recorded species are listed in Schedule IV category except *Pandion haliaetus* and *Platalea leucorodia* are categorised as Schedule I species.

**Species diversity and Distribution**

Analysis of the population data of each species recorded from the selected wetlands showed significant difference in their population among the wetlands ( $F=8.957, P<0.001$ ). Among the recorded bird species, dominance was recorded highest of *Fulica altra* (11.42), followed by *Microcarbo niger* (10.60), *Anas Penelope* (8.21) while lowest dominance (0.05) recorded of *Vanellus leucurus*, *Tringa glareola* and *Lanius isabellinus* (Table 3). The Shannon-Weiner diversity index ( $H'$ ) was recorded highest in Site-2

**Table 2.** Abundance status of Avifauna in different study sites

Study Area	No. of Species		
	Common	Uncommon	Rare
Site-1	11	9	5
Site-2	15	26	8
Site-3	12	10	14

( $H'=2.79$ ), followed by Site-3 ( $H'=2.56$ ) and lowest in Site-1 ( $H'=2.29$ ) which revealed that the species was medium to moderate in these wetlands (Table 4). Similarly, the Margalef’s species richness index was recorded moderate in all wetlands with highest richness in Site-2 (5.52), followed by Site-3 (4.21) and lowest in Site-1 (3.47). Opposite to species diversity and richness, the species evenness was recorded highest in site-1 and lowest in site-2. Among the selected wetland, species composition and population of bird significantly differ among sites. Similarly, among broad categories of birds, water bird species and resident migrant species were significantly differing among wetlands (Table 5).

**Discussion**

Biodiversity in different ecosystems of various climatic conditions are surviving with specific adaptation strategies. In dry and sub-humid lands, biodiversity is well adapted to the harsh climatic conditions characterize by inconsistent or erratic rainfall patterns, and with high temperatures. With the loss or degradation of many natural wetlands in arid areas of Kachchh region, manmade semi-natural wetlands support many species of avi-fauna to survive on the extreme climatic condition of this region. Isolated wetlands, supported by groundwater, provide a critical resource for humans and wildlife in arid regions around the world (Minckley *et al.*, 2013). Ma *et al.* (2004) concluded that natural wetlands are better habitats for water birds than artificial wetlands, while the artificial ones are also suitable habitats for water birds in winter. Though, the conservation value of natural wetlands is higher, artificial wetlands have the potential to play a complimentary role in the conservation of bird communities (Geiosa *et al.*, 2018). Desert wetlands have been overlooked in conservation priority assessments because quantitative measures of alpha biodiversity rank these environments in the lower quartiles (Cavieres *et al.*, 2002). Wetland of this region, whether, natural or manmade, facing several natural as well as anthropogenic challenges from ongoing climate change, desertification, infra-structure development, intensive agriculture, etc. The The present study found that size of the semi-natural/manmade wetland is one of the important factors for species richness and diversity. The bigger size wetland support rich diversity of bird compared to smaller one. The species diversity index



**Table 3.** Status of bird species recorded from selected wetlands and their dominance

S. No.	Scientific Name	Bird Species	Individuals recorded				Dom.
			Site-1	Site-2	Site-3	Total	
1	<i>Actitis hypoleucos</i>	Common Sandpiper	0	26	26	52	2.35
2	<i>Alcedo atthis</i>	Common Kingfisher	4	2	3	9	0.41
3	<i>Amaurornis phoenicurus</i>	White-breasted Waterhen	2	0	0	2	0.09
4	<i>Anas acuta</i>	Northern Pintail	0	58	0	58	2.62
5	<i>Anas clypeata</i>	Northern shoveler	0	0	30	30	1.35
6	<i>Anas crecca</i>	Common Teal	0	51	36	87	3.93
7	<i>Anas penelope</i>	Eurasian Wigeon	0	182	0	182	8.21
8	<i>Anas platyrhynchos</i>	Mallard	0	2	0	2	0.09
9	<i>Anas poecilorhyncha</i>	Indian Spot-billed Duck	0	72	12	84	3.79
10	<i>Anas strepera</i>	Gadwall	0	178	0	178	8.03
11	<i>Anhinga melanogaster</i>	Darter	9	25	1	35	1.58
12	<i>Ardea alba</i>	Great Egret	2	11	5	18	0.81
13	<i>Ardea cinerea</i>	Grey Heron	0	5	0	5	0.23
14	<i>Ardea purpurea</i>	Purple Heron	4	3	0	7	0.32
15	<i>Ardeola grayii</i>	Indian Pond Heron	0	4	6	10	0.45
16	<i>Ceryle rudis</i>	Pied Kingfisher	11	7	0	18	0.81
17	<i>Charadrius dubius</i>	Little Ringed Plover	0	6	7	13	0.59
18	<i>Cinnyris asiaticus</i>	Purple Moorhen	6	21	0	27	1.22
19	<i>Corvus splendens</i>	House Crow	5	8	5	18	0.81
20	<i>Dendrocygna bicolor</i>	Lesser Whistling-duck	15	0	0	15	0.68
21	<i>Dicrurus macrocercus</i>	Black Drongo	4	7	2	13	0.59
22	<i>Egretta garzetta</i>	Little Egret	0	3	5	8	0.36
23	<i>Eudynamis scolopacea</i>	Asian Koel	3	0	0	3	0.14
24	<i>Fulica atra</i>	Eurasian Coot	0	253	0	253	11.42
25	<i>Gallinula chloropus</i>	Common Moorhen	22	3	0	25	1.13
26	<i>Gelochelidon nilotica</i>	Gull-billed Tern	0	4	0	4	0.18
27	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	6	5	5	16	0.72
28	<i>Himantopus himantopus</i>	Black-winged Stilt	0	54	53	107	4.83
29	<i>Hirundo rustica</i>	Barn Swallow	0	3	5	8	0.36
30	<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana	0	5	0	5	0.23
31	<i>Lanius isabellinus</i>	Isabelline Shrike	0	1	0	1	0.05
32	<i>Limosa limosa</i>	Black-tailed Godwit	0	6	2	8	0.36
33	<i>Merops orientalis</i>	Green Bee-eater	0	7	9	16	0.72
34	<i>Microcarbo niger</i>	Little Cormorants	50	175	10	235	10.60
35	<i>Motacilla alba</i>	White Wagtail	0	1	1	2	0.09
36	<i>Motacilla flava</i>	Yellow Wagtail	0	3	5	8	0.36
37	<i>Motacilla maderaspatensis</i>	White-browed Wagtail	0	1	3	4	0.18
38	<i>Mycteria leucocephala</i>	Painted Stork	0	4	0	4	0.18
39	<i>Nettapus coromandelianus</i>	Cotton Pygmy Goose	14	0	0	14	0.63
40	<i>Pandion haliaetus</i>	Osprey	0	2	0	2	0.09
41	<i>Pelecanus onocrotalus</i>	Great White Pelican	0	6	1	7	0.32
42	<i>Phalacrocorax carbo</i>	Great Cormorant	0	23	0	23	1.04
43	<i>Phoenicopterus ruber</i>	Greater Flamingo	0	20	0	20	0.90
44	<i>Platalea leucorodia</i>	Eurasian Spoonbill	0	14	11	25	1.13
45	<i>Plegadis falcinellus</i>	Glossy Ibis	0	7	3	10	0.45
46	<i>Porphyrio porphyrio</i>	Purple Sunbird	6	1	1	8	0.36
47	<i>Pseudibis papillosa</i>	Red-naped Ibis	0	5	5	10	0.45
48	<i>Psittacula krameri</i>	Rose-ringed Parakeet	2	0	0	2	0.09
49	<i>Pycnonotus cafer</i>	Red-vented Bulbul	17	0	0	17	0.77
50	<i>Pycnonotus leucotis</i>	White-eared Bulbul	28	15	0	43	1.94
51	<i>Sarkidiornis melanotos</i>	Knob-billed Duck	0	90	0	90	4.06
52	<i>Saxicoloides fulicata</i>	Indian Robin	7	0	13	20	0.90

**Table 3.** Continued ...

S. No.	Scientific Name	Bird Species	Individuals recorded				Dom.
			Site-1	Site-2	Site-3	Total	
52	<i>Saxicoloides fulicata</i>	Indian Robin	7	0	13	20	0.90
53	<i>Spilopelia chinensis</i>	Spotted Dove	0	0	3	3	0.14
54	<i>Sterna aurantia</i>	River Tern	3	3	7	13	0.59
55	<i>Sterna hirundo</i>	Common Tern	0	0	6	6	0.27
56	<i>Stigmatopelia chinensis</i>	Laughing Dove	10	0	0	10	0.45
57	<i>Streptopelia decaocto</i>	Eurasian collared Dove	0	11	2	13	0.59
58	<i>Tachybaptus ruficollis</i>	Little Grebe	21	55	28	104	4.69
59	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	0	0	5	5	0.23
60	<i>Tringa glareola</i>	Wood Sandpiper	0	1	0	1	0.05
61	<i>Tringa ochropus</i>	Green Sandpiper	0	0	3	3	0.14
62	<i>Upupa epops</i>	Common Hoopoe	1	0	0	1	0.05
63	<i>Vanellus indicus</i>	Red-wattled Lapwing	36	98	61	195	8.80
64	<i>Vanellus leucurus</i>	White-tailed Lapwing	0	0	1	1	0.05
		Number of Order	8	6	5	11	
		Number of family	17	25	17	32	
		Number of species	25	49	36	64	
		Number of Individuals	288	1547	381	2216	
		Species Diversity	2.39	2.79	2.56	2.58	
		Species richness	3.47	5.52	4.21	4.4	

**Table 4.** Species Diversity of wetland avifauna in selected study sites

Species Diversity	Site-1	Site-2	Site-3	Overall
Taxa (S)	23	49	36	64
Individuals	288	1547	381	2216
Species Dominance (D)	0.11	0.08	0.10	0.09
Shannon Diversity Index (H)	2.39	2.79	2.56	2.58
Species Evenness ( $e^H/S$ )	0.77	0.51	0.72	0.66
Margalef Species Richness	3.47	5.52	4.21	4.40

**Table 5.** Distribution of birds in selected wetlands

Variables	Category	No. of species	F	P-value	F crit
Habitat	Terrestrial bird	19	1.099	0.341	3.168
	Waterbird	45	7.271	0.001"	3.065
Migratory Status	Resident bird	29	2.562	0.083	3.105
	Resident Migrant	25	4.631	0.013"	3.124
	Migratory bird	10	1.312	0.286	3.354
Wetland sites	All birds	64	8.296	0.0003"	3.044

(H': 2.58) and richness index (4.4) recorded in the present study is in spite of their comparably small size, the rich diversity of avi-fauna during winter season is highlighting the importance of these semi-natural wetlands in arid region.

Dry and sub-humid lands include many fragile wetland ecosystems which require prime conservation priority now-a-day to halt irreparable loss of biological diversity. Loss and degradation of natural wetlands is a global phenomenon which poses

serious threats dependent biodiversity and threatened wildlife. The degradation of natural wetlands has significant effects on the ecosystem functionalities and services they provide to sustain biodiversity survive on those services. In such condition, small to large size of manmade wetland supports dependent wildlife specifically the birds to cope up with the ongoing natural and anthropogenic pressure in the area. The results of the present study also suggest that the semi-natural/manmade

wetland support rich avi-faunal diversity and are important site for the conservation of bird in arid landscape.

### Acknowledgements

We would like to thank the Dr. V. Vijaykumar, Director, Gujarat Institute of Desert Ecology, Bhuj for providing the opportunity and facility. We also appreciate the help and supports received from Dr. Nikunj Gajera and Dr. Jayesh Bhatt of Gujarat Institute of Desert Ecology.

### References

- Ali, S. and Ripley, S.D. 1983. A Pictorial Guide to the birds of the Indian Subcontinent, Bombay Natural History Society, Oxford University Press, Bombay.
- Ali, S. 2002. *The Book of Indian Birds*, Oxford University Press, New Delhi.
- Bibby, C.J., Hill, D.A., Burgess, N.D. and Mustoe, S. 2000. *Bird Census techniques*. Academic Press, London.
- CBD. 2007. What is Dry and Sub-humid Lands Biodiversity? Available at: <https://www.cbd.int/drylands/what.shtml> {Date accessed: 23 April 2020}
- CBD. 2019. Living in harmony with nature. Available at: <https://www.cbd.int/undb/media/factsheets/undb-factsheet-drylands-en.pdf> {Date accessed: 23 April 2020}
- Gajera, N.B., Mahato, A.K.R. and Vijay Kumar, V. 2012. Wetland birds of arid region-a study on their diversity and distribution pattern in Kachchh. *Columban Journal of Life Science*. 13 (1&2) : 47-51.
- Giosa, E., Mammides, C. and Zotos, S. 2018. The importance of artificial wetlands for birds: A case study from Cyprus. *PLoS ONE*. 13(5): e0197286. <https://doi.org/10.1371/journal.pone.0197286>
- Grimmett, R., Inskipp, C. and Inskipp, T. 2011. *Birds of the Indian Subcontinent*, Oxford University Press, Delhi.
- Koladiya, M.H., Mahato, A.K.R., Shah, J.P. and Vijaykumar, V. 2013. Avifauna of "Pena Thathh": A Lesser known Wetland in Banni Grassland of Kachchh district, Gujarat, India. *International Journal on Research in BioScience*. 2 (1): 59-65.
- Ma, Z., Li, B., Zhao, B., Jing, K., Tang, S. and Chen, J. 2004. Are artificial wetlands good alternatives to natural wetlands for waterbirds? – A case study on Chongming Island, China. *Biodiversity & Conservation*. 13 (2): 333–350.
- Minckley, T.A., Turner, D.S. and Weinstein, S.R. 2013. The relevance of wetland conservation in arid regions: A re-examination of vanishing communities in the American Southwest. *Journal of Arid Environments*. 88 : 213-221.
- Murillo Pacheco, J., López Iborra, G.M., Escobar, F., Fernando Bonilla Rojas, W. and Verdú José, R. 2017. The value of small, natural and manmade wetlands for bird diversity in the east Colombian Piedmont. *Aquatic Conservation*. 28 (1): 87-97
- Rajpar, M.N. and Zakaria, M. 2013. Assessing an Artificial Wetland in Putrajaya, Malaysia, as an Alternate Habitat for Waterbirds. *Waterbirds*. 36 : 482–493.
- Space Applications Centre (SAC). 2011. National Wetland Atlas. SAC, Indian Space Research Organisation, Ahmedabad.
- Surana, R., Subba, B.R. and Limbu, K.P. 2007. Avian diversity during rehabilitation stage of Chimdi Lake, Sunsari, Nepal. *Our Nature*. 5 (1): 75-80.
- Webb, E.B., Smith, L.M., Vrtiska, M.P. and Lagrange, T.G. 2010. Effects of Local and Landscape variables on wetland bird habitat use during migration through the Rainwater Basin. *The Journal of Wildlife Management*. 74 : 109–119.