



E-ISSN: 2320-7078

P-ISSN: 2349-6800

www.entomoljournal.com

JEZS 2020; 8(2): 1232-1243

© 2020 JEZS

Received: 16-01-2020

Accepted: 20-02-2020

Aditya Parihar

Department of life science,
Hemchandracharya North
Gujarat University, Patan,
Gujarat, India

Parin Dal

Animal Ecology and
Conservation Biology Research
Laboratory, Department of
Biosciences, UGC-Center of
Advance Studies, Saurashtra
University, Rajkot, Gujarat,
India

Yogesh Khandla

Animal Ecology and
Conservation Biology Research
Laboratory, Department of
Biosciences, UGC-Center of
Advance Studies, Saurashtra
University, Rajkot, Gujarat,
India

Dharmik Parmar

Sankalchand Patel College of
Engineering, Visnagar, Gujarat,
India

Vishal Parihar

SS Vidhyasankul, Kuchavada,
Pathavada, Gujarat, India.

Hiteshkumar Parmar

Animal Ecology and
Conservation Biology Research
Laboratory, Department of
Biosciences, UGC-Center of
Advance Studies, Saurashtra
University, Rajkot, Gujarat,
India

Corresponding Author:**Hiteshkumar Parmar**

Animal Ecology and
Conservation Biology Research
Laboratory, Department of
Biosciences, UGC-Center of
Advance Studies, Saurashtra
University, Rajkot, Gujarat,
India

Checklist of avifauna from some selected sites of Visnagar city, Mehshana, North Gujarat

**Aditya Parihar, Parin Dal, Yogesh Khandla, Dharmik Parmar, Vishal
Parihar and Hiteshkumar Parmar**

Abstract

Birds play a very important role in the food web and food chain of the ecosystem. Data records were encompassed by visual encounter survey method at random with a total of 98 days of samplings by four man-hours. A total of 96 species of birds from 40 families and 86 genera were recorded from selected sites. Among all the sites, maximum number of genera, species, Simpson's diversity index, Simpson's reciprocal index and Shannon wiener's species diversity were higher in the Pindariya lake site. 05 species were Nearly Threatened and single species Asian Woollyneck (*Ciconia episcopus*) was Venerable (IUCN, 2019). It is apparent that urban and rural areas of Visnagar city maintain avifaunal diversity and sustain the ecosystem services derived from them.

Keywords: Avifauna, checklist, conservation status, urban and rural sites, Visnagar city

Introduction

Birds play a very important role in the ecosystems such as predators, pollinators, scavengers, seed dispersals, seed predators and ecosystem engineers by behaviorally and those that arise via bird products [1]. Globally there is a total of 9672 species of birds in the world have been reported [2]. A total of 1932 species and 113 families species recorded from Southeast Asia listed [3] and 1263 species from 23 orders, 107 families and 492 genera listed from India [4]. From the Gujarat state Parasharya listed 526 species and 76 families [5]; Ganpule listed 574 species of birds from the various localities of the state [6]. From the Mehshana district, a total of 229 species of birds were listed by online database "bog" (<http://birdsofgujarat.co.in/>). From the Visnagar city and vicinity, there are some ornithologists studied breeding activities of some urban birds [7, 8, 9, 10, 11]. The avifaunal diversity was studied and recorded 103 species of birds from the urban area [12]. Thereafter no such records of the avifaunal studies have found in this area. So, the current study dealt with a checklist and systematics updates of avifauna, site-wise comparison, site-wise diversity indices, conservation status and photographic documentation of all the recorded birds from the study area.

Material and Methods**Location and study period**

Visnagar is a taluka place of Mehshana district, which is about more than 700 years old. It is situated between 23° 42' N and 71° 34' E above 127 MSL. It is surrounded by wetland and agricultural land ecosystems and there is no forest area and a large river. The experiment was conducted from the year of July-2015 to December-2018 in two urban sites (Arvindnagar, M. N. College) and three rural sites (Dediya Lake, Pindariya Lake, Singhoda Lake) of Visnagar city (Fig. 1) and characteristics of the sites are also shown in Table 1.

Material used and survey methodology

The study sites have visited an average of 1 to 3 days in a month by four man-hours. A total of 98 days of samplings were randomly done by a visual encounter survey method (Table. 2). For the data collection and field survey, binocular (Celestron Up-close 12x50 and Celestron Up-close G2 10x25), DSLR (Canon 700D, Nikon D5300) cameras and Point and shoot (Sony cyber-shot, Canon HX 530HS) cameras were used to photography and observed the birds accurately. For identification of avian species, taxonomic books such as [13, 14, 15, 6] and online versions of the birds database Birdlife International (www.birdlife.org) and Birds of Gujarat.

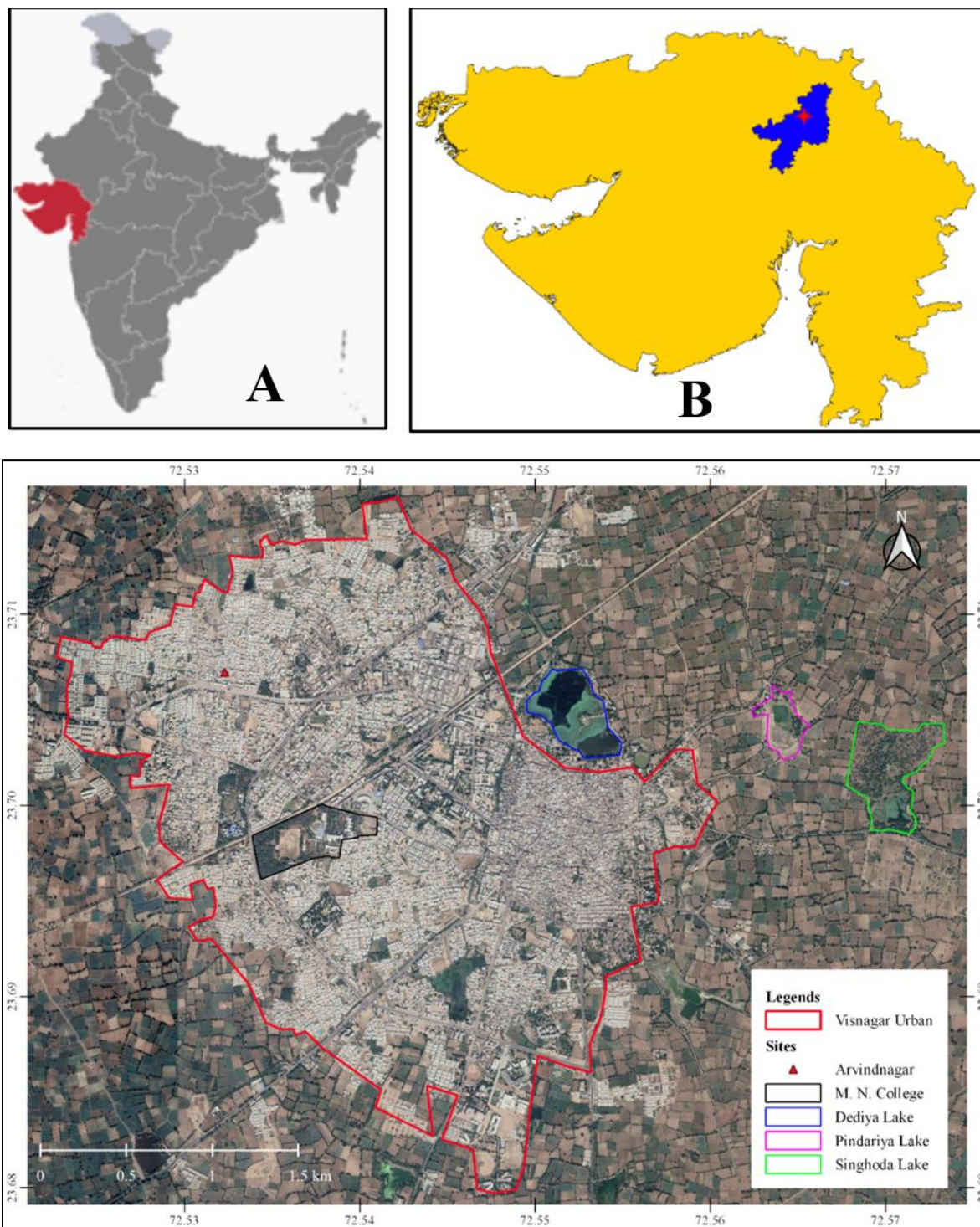


Fig 1: A. Location of Gujarat in India. B. Location of Mehshana in Gujarat. C. Location of Visnagar city and study area.

Data analysis

Checklist and systematics of the recorded avifauna from Visnagar city with references to five selected sites from two different zones (urban and rural) up to the genus and species level (Table 3). Site-wise familial diversity indices and

overall diversity indices were calculated (Table 4) in the PAST^[16]. Site-wise comparisons based on the presence-absence similarity of recorded avifauna by group average link from the study area (index of Bray-Curtis) by using BioDiversity Professional version 2.0 developed^[17] in Fig. 2.

Table 1: Site characteristics and GPS location of the study area.

Code	Site name	Coordinates (N, E)	Zone / site characteristics	Area (m ²)
S1	Arvindnagar	23.706770, 72.532188	Urban, residential area	303
S2	Pindariya Lake	23.7045926, 72.5626582	Rural, very less human encouragement activities	71700
S3	Dediya Lake	23.7048405, 72.5499826	Rural, close to human residential area	166830
S4	M. N. College	23.6990657, 72.5368621	Urban, multi-structural habitat complex	169346
S5	Singhoda Lake	23.701352, 72.5722674	Rural, protected areas	224095

Table 2: Summary of visits during study period.

Year	Months												Total
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2015	0	0	0	0	0	6	7	3	5	3	3	3	27
2016	4	0	3	2	0	5	5	4	3	3	4	2	35
2017	4	1	4	4	2	2	2	0	0	0	0	0	19
2018	2	2	3	1	1	3	2	2	0	0	0	1	17
Total	10	3	10	7	3	10	15	13	6	8	7	6	98

Results and Discussion

A total of 96 species of birds from 40 families and 86 genera were recorded from the five selected sites. Among them, a maximum number of genus and species were recorded from the Ardeidae family. Among all the sites, the Pindariya Lake was the maximum number of genera (78) and species (86) were recorded followed by Singhoda Lake (60 genera, 68

species), Dediya Lake (61 genera, 67 species), M. N. College (36 genera, 37 species) and Arvindnagar site (24 genera, 26 species) in Table 3.

Overall, avifaunal diversity reveals that the maximum number of the family (40) and species (86) recorded from the Pindariya lake site. Simpson's diversity index (1-D), Simpson's reciprocal index (1/D) and Shannon wiener's species diversity (H') were higher in the Pindariya lake site (1-D = 0.963, 1/D = 26.8, H' = 3.5) among all the sites. Pielou's evenness (0.894) were found significantly higher in the Arvindnagar site among all the sites. Margalef's richness was recorded maximum and similar (8.8) in the Pindariya lake and Singhoda lake site (Table 4). Pindariya lake site is located between the urban and rural of the Visnagar city so that it plays a very important role as a bridge between the urban and rural zones for the bird dispersals.

Table 3: Checklist of avifauna recorded in study area.

	Species name	Scientific name	Site					MS
			S1	S2	S3	S4	S5	
Family: Accipitridae								
1.	Black Kite	<i>Milvus migrans</i> ^{LC **}	-	-	+	+	+	B
2.	Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i> ^{LC **}	+	+	+	-	+	B
3.	Shikra	<i>Accipiter badius</i> ^{LC **}	+	+	+	+	+	B
Family: Aegithinidae								
4.	Common Iora	<i>Aegithina tiphia</i> ^{LC}	-	-	-	-	+	B
Family: Alcedinidae								
5.	Common Kingfisher	<i>Alcedo atthis</i> ^{LC}	-	+	+	-	-	B
6.	Pied Kingfisher	<i>Ceryle rudis</i> ^{LC}	-	+	+	-	+	B
7.	White-throated Kingfisher	<i>Halcyon smyrnensis</i> ^{LC}	+	+	+	-	+	O
Family: Anatidae								
8.	Knob-billed Duck	<i>Sarkidiornis melanotos</i> ^{LC}	-	+	+	-	+	B
9.	Cotton Pygmy-goose	<i>Nettapus coromandelianus</i> ^{LC}	-	+	+	-	-	E
10.	Indian Spot-billed Duck	<i>Anas poecilorhyncha</i> ^{LC}	-	+	+	-	+	B
11.	Lesser Whistling-duck	<i>Dendrocygna javanica</i> ^{LC}	-	+	+	-	+	B
12.	Northern Shoveler	<i>Anas clypeata</i> ^{LC}	-	+	+	-	+	P
13.	Ruddy Shelduck	<i>Tadorna ferruginea</i> ^{LC}	-	+	-	-	-	H
Family: Anhingidae								
14.	Oriental Darter	<i>Anhinga melanogaster</i> ^{NT}	-	+	+	-	-	K
Family: Ardeidae								
15.	Black-crowned Night-heron	<i>Nycticorax nycticorax</i> ^{LC}	-	+	-	-	-	B
16.	Cattle Egret	<i>Bubulcus ibis</i> ^{LC}	-	+	+	+	+	B
17.	Great White Egret	<i>Ardea alba</i> ^{LC}	-	+	+	-	+	B
18.	Grey Heron	<i>Ardea cinerea</i> ^{LC}	-	+	+	-	+	D
19.	Indian Pond-heron	<i>Ardeola grayii</i> ^{LC}	-	+	+	-	+	B
20.	Intermediate Egret	<i>Ardea intermedia</i> ^{LC}	-	+	+	-	+	B
21.	Little Egret	<i>Egretta garzetta</i> ^{LC}	-	+	+	-	+	B
22.	Purple Heron	<i>Ardea purpure</i> ^{LC}	-	+	+	-	+	B
Family: Bucerotidae								
23.	Indian Grey Hornbill	<i>Ocyrceros birostris</i> ^{LC}	-	+	-	+	+	M
Family: Burhinidae								
24.	Eurasian Thick-knee	<i>Burhinus oediconemus</i> ^{LC}	-	+	+	+	+	B
Family: Charadriidae								
25.	Little Ringed Plover	<i>Charadrius dubius</i> ^{LC}	-	+	-	-	+	B
26.	Red-wattled lapwing	<i>Vanellus indicus</i> ^{LC}	-	+	+	+	+	O
27.	Yellow-Wattled Lapwing	<i>Vanellus vanellus</i> ^{LC}	-	-	-	-	+	N

Table 3: Continue....

	Species name	Scientific name	Site					MS
			S1	S2	S3	S4	S5	
Family: Ciconiidae								
1.	Asian Woollyneck	<i>Ciconia episcopus</i> ^{VU}	-	+	-	-	-	E
2.	Asian Openbill	<i>Anastomus oscitans</i> ^{LC}	-	+	+	-	-	B
3.	Painted Stork	<i>Mycteria leucocephala</i> ^{LC}	-	+	+	-	+	L
Family: Cisticolidae								
4.	Ashy Prinia	<i>Prinia socialis</i> ^{LC}	-	+	+	+	+	B

5.	Common Tailorbird	<i>Orthotomus sutorius</i> ^{LC}	+	+	+	+	+	B
Family: Columbidae								
6.	Eurasian Collared-dove	<i>Streptopelia decaocto</i> ^{LC}	+	+	+	+	+	B
7.	Laughing Dove	<i>Spilopelia senegalensis</i> ^{LC}	+	+	+	+	+	B
8.	Red Collared Dove	<i>Streptopelia tranquebarica</i> ^{LC}	+	+	+	-	+	B
9.	Common Pigeon ^{##}	<i>Columba livia</i>	+	+	+	+	+	-
10.	Yellow-footed Green-pigeon	<i>Treron phoenicoptera</i> ^{LC}	-	+	-	+	-	O
Family: Coraciidae								
11.	Indian Roller	<i>Coracias benghalensis</i> ^{LC}	-	-	-	+	+	F
Family: Corvidae								
12.	House Crow	<i>Corvus splendens</i> ^{LC}	+	+	-	+	-	B
13.	Indian Jungle Crow	<i>Corvus macrorhynchos</i>	-	+	-	-	-	-
14.	Rufous Treepie	<i>Dendrocitta vagabunda</i> ^{LC}	+	+	+	+	+	O
Family: Cuculidae								
15.	Asian Koel	<i>Eudynamis scolopaceus</i> ^{LC}	+	+	+	+	+	-
16.	Common Hawk-cuckoo	<i>Hierococyx varius</i> ^{LC}	-	+	-	-	-	B
17.	Greater Coucal	<i>Centropus sinensis</i> ^{LC}	+	+	+	+	+	B
18.	Jacobin Cuckoo	<i>Clamator jacobinus</i> ^{LC}	-	+	-	-	-	B
Family: Dicruridae								
19.	Black Drongo	<i>Dicrurus macrocercus</i> ^{LC}	+	+	+	+	+	G
Family: Estrildidae								
20.	Indian Silverbill	<i>Euodice malabarica</i> ^{LC}	+	+	+	-	+	B
Family: Hirundinidae								
21.	Red-rumped Swallow	<i>Cecropis daurica</i> ^{LC}	-	+	+	-	-	A
22.	Wire-tailed Swallow	<i>Hirundo smithii</i> ^{LC}	-	+	+	-	-	O
Family: Jacanidae								
23.	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i> ^{LC}	-	+	+	-	-	B
Family: Laniidae								
24.	Long-tailed Shrike	<i>Lanius schach</i> ^{LC}	-	+	-	-	+	B
Family: Laridae								
25.	Heuglin's gull	<i>Larus fuscus</i> ^{LC}	-	+	-	-	-	I
26.	River Tern	<i>Sterna aurantia</i> ^{NT}	-	+	-	-	-	B

Table 3: Continue...

	Species name	Scientific name	Site					MS
			S1	S2	S3	S4	S5	
Family: Leiotrichidae								
1.	Jungle babbler	<i>Turdoides striata</i> ^{LC}	+	+	+	+	+	B
2.	Lrge grey babbler	<i>Turdoides malcolmi</i> ^{LC}	-	+	+	-	+	O
Family: Megalaimidae								
3.	Coppersmith Barbet	<i>Psilopogon haemacephalus</i> ^{LC}	-	+	+	+	+	B
Family: Meropidae								
4.	Green Bee-eater	<i>Merops orientalis</i> ^{LC}	+	+	+	+	+	B
Family: Motacillidae								
5.	White Wagtail	<i>Motacilla alba</i> ^{LC}	-	+	+	-	+	I
Family: Muscipidae								
6.	Indian Robin	<i>Saxicoloides fulicatus</i> ^{LC}	+	+	+	+	+	B
7.	Oriental Magpie-robin	<i>Copsychus saularis</i> ^{LC}	+	+	+	+	+	B
8.	Pied Bushchat	<i>Saxicola caprata</i> ^{LC}	-	-	-	-	+	I
Family: Nectariniidae								
9.	Purple Sunbird	<i>Cinnyris asiaticus</i> ^{LC}	+	+	+	+	+	B
Family: Passeridae								
10.	Chestnut-shouldered Bush-sparrow	<i>Gymnoris xanthocollis</i> ^{LC}	-	+	-	-	-	B
11.	House Sparrow	<i>Passer domesticus</i> ^{LC}	+	+	+	+	+	B
Family: Pelecanidae								
12.	Great White Pelican	<i>Pelecanus onocrotalus</i> ^{LC}	-	+	-	-	+	I
Family: Phalacrocoracidae								
13.	Great Cormorant	<i>Phalacrocorax carbo</i> ^{LC}	-	+	+	-	-	J
14.	Little Cormorant	<i>Microcarbo niger</i> ^{LC}	-	+	+	-	-	J
Family: Phasianidae								
15.	Grey Francolin	<i>Francolinus pondicerianus</i> ^{LC}	-	+	+	-	+	B
16.	Indian Peafowl [#]	<i>Pavo cristatus</i> ^{LC***}	-	+	+	+	+	B
Family: Phoenicopteridae								
17.	Lesser Flamingo	<i>Phoeniconaias minor</i> ^{NT**}	-	+	-	-	+	B
Family: Picidae								
18.	Lesser Golden-back	<i>Dinopium benghalense</i> ^{LC}	-	-	-	+	+	B
19.	Yellow-crowned Woodpecker	<i>Leiopicus mahrattensis</i> ^{LC}	-	-	-	-	+	B

Family: Podicipedidae								
20.	Little Grebe	<i>Tachybaptus ruficollis</i> ^{LC}	-	+	+	-	+	B
Family: Psittacidae								
21.	Rose-ringed Parakeet	<i>Psittacula krameri</i> ^{LC}	+	+	+	+	+	O
Family: Pycnonotidae								
22.	Red-vented Bulbul	<i>Pycnonotus cafer</i> ^{LC}	+	+	+	+	+	O

Table 3: Continue...

	Species name	Scientific name	Site					MS
			S1	S2	S3	S4	S5	
Family: Pycnonotidae								
1.	White-eared Bulbul	<i>Pycnonotus leucotis</i> ^{LC}	-	+	-	-	-	B
Family: Rallidae								
2.	Common Coot	<i>Fulica atra</i> ^{LC}	-	+	+	-	-	B
3.	Common Moorhen	<i>Gallinula chloropus</i> ^{LC}	-	+	+	-	-	B
4.	Purple Swamp-hen	<i>Porphyrio porphyrio</i> ^{LC}	-	-	+	-	-	B
5.	White-breasted Water-hen	<i>Amaurornis phoenicurus</i> ^{LC}	-	+	+	-	+	B
Family: Recurvirostridae								
6	Black-winged stilt	<i>Himantopus himantopus</i> ^{LC}	-	+	+	-	+	I
7	Pied avocet	<i>Recurvirostra avosetta</i> ^{LC}	-	+	-	-	-	I
Family: Scolopacidae								
8	Black-tailed Godwit	<i>Limosa limosa</i> ^{NT}	-	+	+	-	+	I
9.	Common Redshank	<i>Tringa totanus</i> ^{LC}	-	-	-	-	+	I
10	Marsh Sandpiper	<i>Tringa stagnatilis</i> ^{LC}	-	+	-	-	-	I
11	Pintail Snipe	<i>Gallinago stenura</i> ^{LC}	-	-	-	-	+	I
12	Temminck's Stint	<i>Calidris temminckii</i> ^{LC}	-	+	-	-	-	I
Family: Strigidae								
13	Spotted Owlet	<i>Athene brama</i> ^{LC**}	+	+	+	+	+	B
Family: Sturnidae								
14	Common Myna	<i>Acridotheres tristis</i> ^{LC}	+	+	+	+	+	B
15	Bank Myna	<i>Acridotheres ginginianus</i> ^{LC}	-	+	+	+	+	O
16	Brahminy Starling	<i>Sturnia pagodarum</i> ^{LC}	+	+	+	+	+	O
17	Rosy starling	<i>Pastor roseus</i> ^{LC}	-	+	-	+	+	P
Family: Threskiornithidae								
18	Black Headed Ibis	<i>Threskiornis melanocephalus</i> ^{NT}	-	+	+	+	+	B
19	Eurasian Spoonbill [#]	<i>Platalea leucorodia</i> ^{LC**}	-	+	+	-	+	C
20.	Red-napped Ibis	<i>Pseudibis papillosa</i> ^{LC}	-	+	+	+	-	B
Family: Upupidae								
21	Common Hoopoe	<i>Upupa epops</i> ^{LC}	+	+	+	+	+	I
Total number of species			26	86	67	37	68	

Abbreviation: S1-Arvindnagar, S2-Pindariya Lake, S3-Dediya Lake, S4- M. N. College, S5-Singhoda Lake; (^{LC}) Least concern, (^{NT}) Nearly threatened, (^{VU}) Venerable; (^{**}) Appendix. II, (^{***}) Appendix. III, ([#]) Schedule Category I, (^{##}) Schedule Category IV; MS-Migratory status; A-Common Monsoon migrant, B-Common resident, C-Common resident and local migrant, D-Common resident and winter visitor, E-

Common to uncommon resident, F-Common to uncommon resident and local migrant, G-Common to uncommon resident and migrant, H-Common to uncommon winter visitor, I-Common winter visitor, J-Fairly common resident, K-Uncommon resident, L-Uncommon to locally common resident, M-Uncommon to rare resident, N-Vagrant. Winter, O-Very common resident, P-Very common winter visitor.

Table 4: Site-wise comparison of familial diversity indices.

Diversity Indices	Sites					Total
	S1	S2	S3	S4	S5	
Family	18	40	35	25	38	43
Total no. of Taxa (S)	26	86	67	37	68	96
Dominance (D)	0.0710	0.0373	0.0430	0.0533	0.0398	0.0347
Simpson's diversity index (1-D)	0.929	0.963	0.957	0.947	0.960	0.965
Simpson's reciprocal index (1/D)	14.1	26.8	23.3	18.8	25.1	28.8
Shannon wiener's species diversity (H')	2.8	3.5	3.4	3.1	3.4	3.6
Pielou's (1966) evenness (e ^H /S)	0.894	0.820	0.817	0.876	0.819	0.812
Margalef's (1959) richness d=(S-1)/ log N	5.2	8.8	8.1	6.6	8.8	9.2

Site-wise comparisons based on the presence-absence similarity of the sites were divided into the main two clusters approximate at 56% faunistic similarity and clearly distinguished by the urban and rural sites. The first cluster was further divided into two groups (Dediya Lake, Pindariya

Lake and Singhoda lake site) at 78% faunistic similarity. Dediya Lake and Pindariya Lake have the highest faunistic similarity (85%) among all the five sites. The second group was divided into M. N. College and Arvindnagar site at approximately 69% faunistic similarity (Fig. 2).

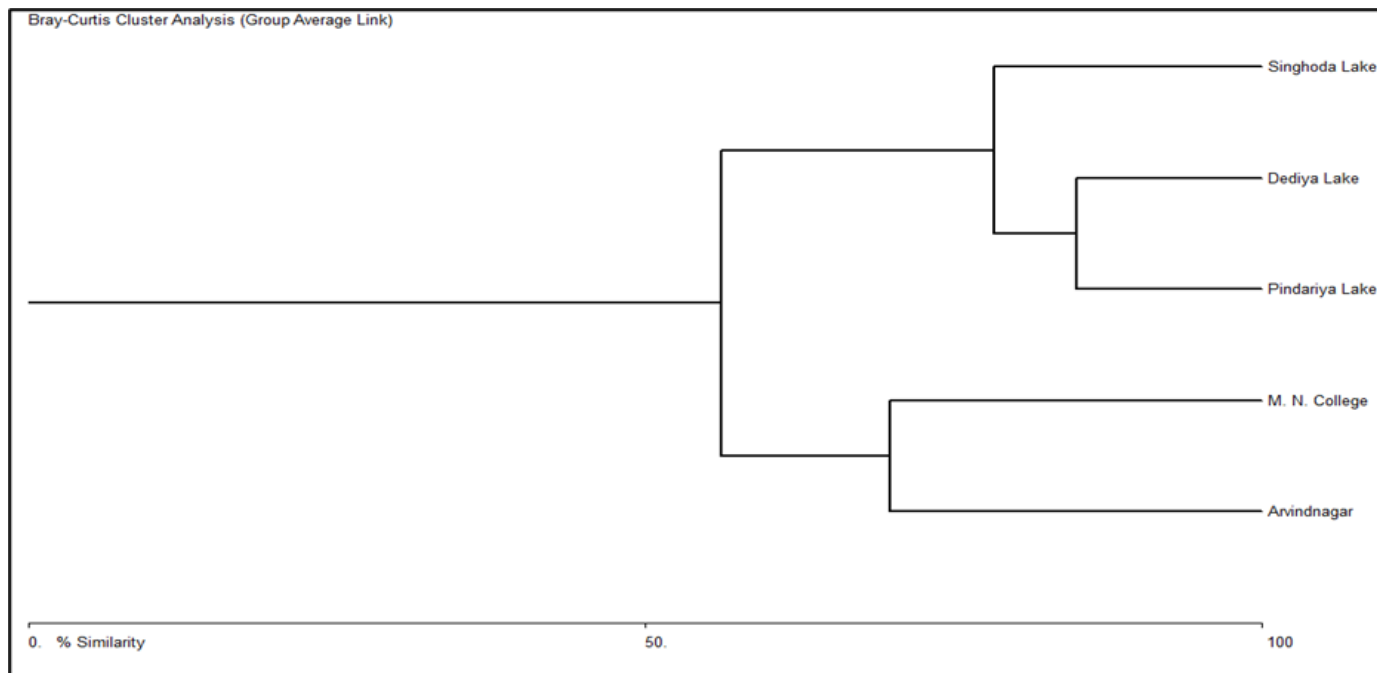


Fig 2: Site-wise comparisons based on presence-absence similarity of recorded avifauna from study area (index of Bray-Curtis).

International Union for Conservation of Nature ^[18] of the avifaunal community reveals that a total of 87 species of birds were Least concern (LC) category, 05 species were Nearly Threatened (NT) category and only single species Asian Woollyneck (*Ciconia episcopus*) was Venerable (VU) category (Table 3). A total of 06 species of birds were from Appendix II and only single species Indian Peafowl (*Pavo cristatus*) from Appendix III ^[19]. From the study area, only three species recorded from the Wildlife Protection Act (WPA), 1972 among them two species were in the schedule I

category and other single species was in the schedule IV category ^[20].

As per migratory status was given by Ganpule ^[6] a total of 60% species were from the Common resident (58 species) followed by the Common winter visitor (13%, 12 species), Very common resident (10%, 10 species), Common to uncommon resident, Fairly common resident and Very common winter visitor (2%, 2 species) and remaining only single species (1%) were reordered during the study period (Table 3, Fig. 3).

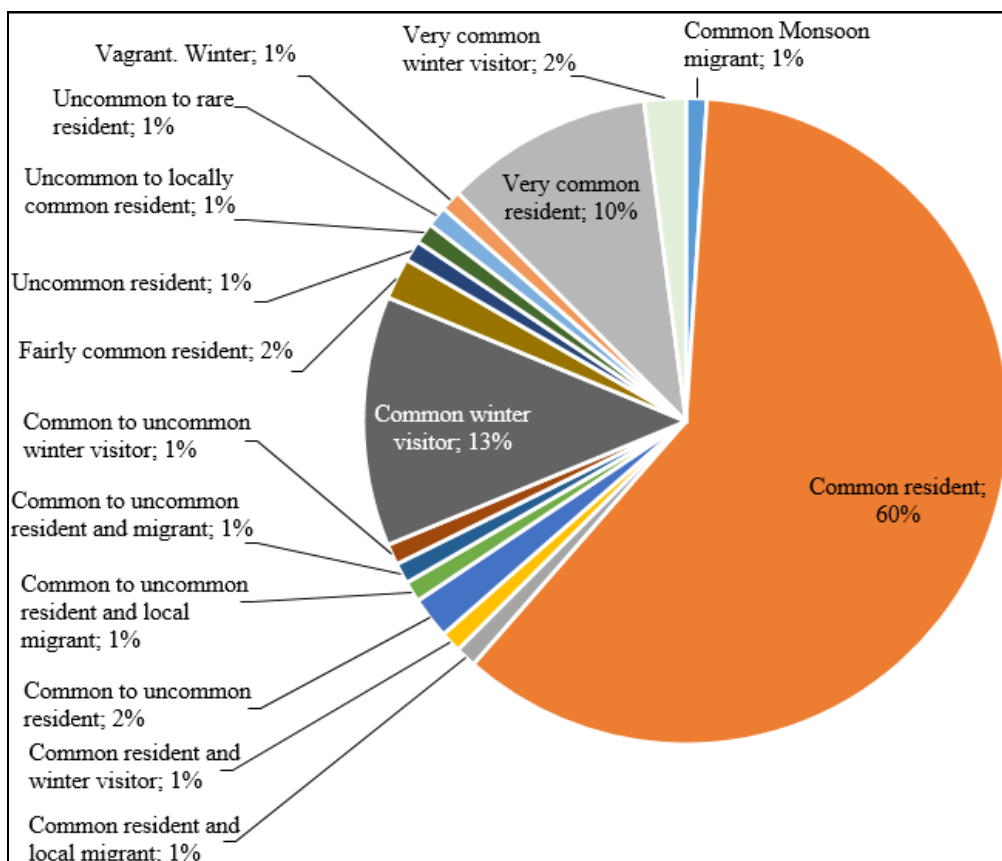


Fig 3: Migratory status or recorded avifauna.

Most of the Common resident species were recorded from Pindariya lake (52 species) followed by the Dediya lake (46 species), Singhoda lake (44 species), M. N. College (25 species) and Arvindnagar (18 species). Most of the Common winter visitor bird species were found from the Pindariya Lake (09 species) followed by the Singhoda lake (08 species), Dediya lake (04 species) and only single species Common Hoopoe (*Upupa epops*) recorded from the Arvindnagar and M. N. College sites.

Maximum Very common resident species were noted from the Pindariya lake (10 species) followed by the Dediya lake (9 species), Singhoda lake (08 species), M. N. college (07 species) and Arvindnagar (05 species) (Table 3). Two

Common to uncommon resident species Cotton Pygmy-goose (*Nettapus coromandelianus*) and Asian Woollyneck (*Ciconia episcopus*) were recorded from the Pindariya and Dediya Lake. Two Fairly common resident species Great Cormorant (*Phalacrocorax carbo*) and Little Cormorant (*Microcarbo niger*) were recorded from the Pindariya and Dediya Lake. Very common winter visitor species Northern Shoveler (*Anas clypeata*) was found from the Pindariya Lake, Dediya Lake, Singhoda Lake and Rosy starling (*Pastor roseus*) was recorded from the M. N. College, Pindariya Lake and Singhoda Lake (Table 3). All the recorded avifauna were documented in Plate 1 to 5.



Plate 1: Recorded avifauna from the study area.

1. Black Kite, 2. Oriental Honey-buzzard, 3. Shikra, 4. Common Iora, 5. Common Kingfisher, 6. Pied Kingfisher, 7. White-throated Kingfisher, 8. Knob-billed Duck, 10. Indian Spot-billed Duck, 11. Lesser Whistling-duck, 12. Northern Shoveler, 13. Ruddy Shelduck, 14. Oriental Darter, 15. Black-crowned Night-heron, 16. Cattle Egret, 17. Great White Egret, 18. Grey Heron, 19. Indian Pond-heron.

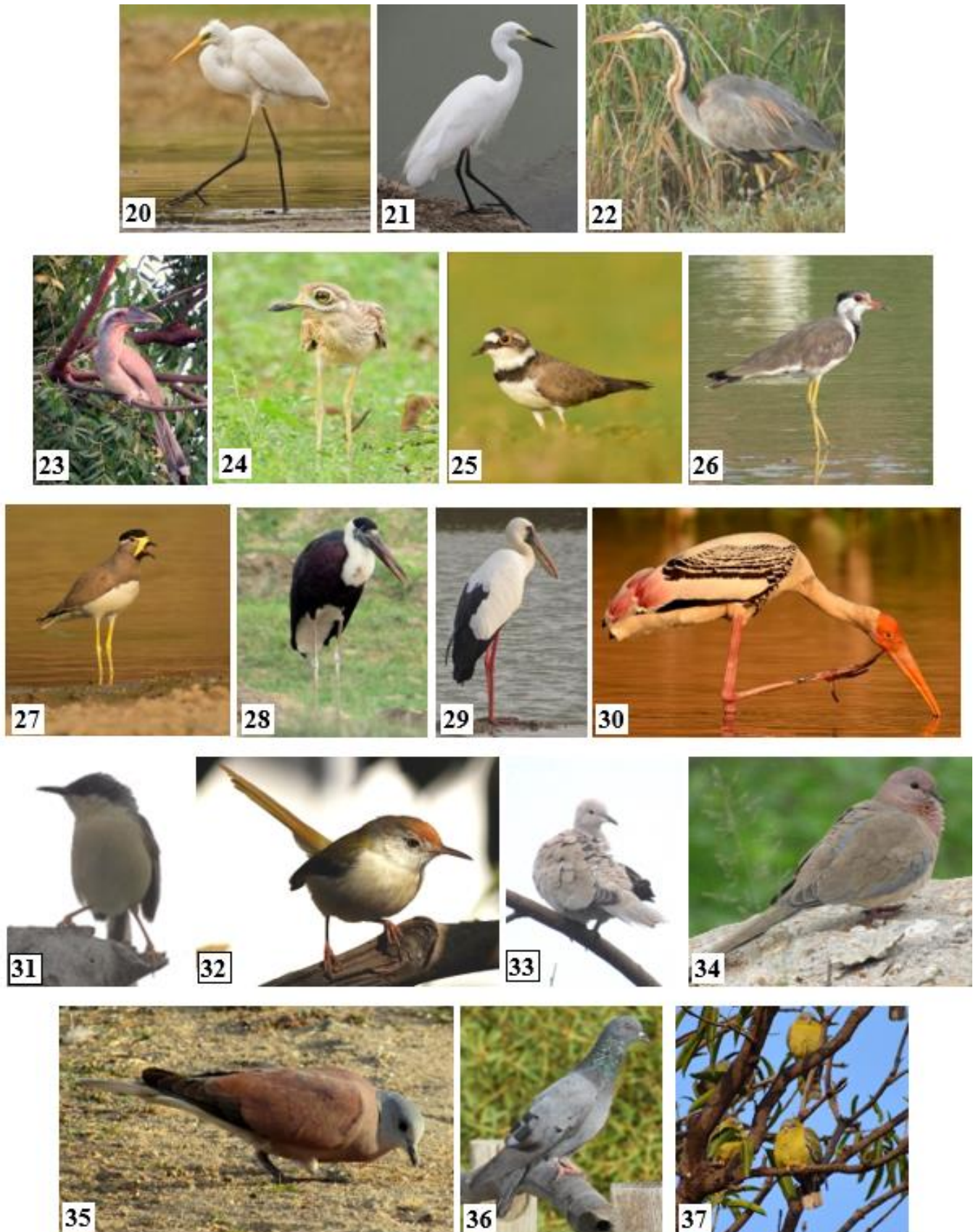


Plate 2: Recorded avifauna from the study area.

20. Intermediate Egret, 21. Little Egret, 22. Purple Heron, 23. Indian Grey Hornbill, 24. Eurasian Thick-knee, 25. Little Ringed Plover, 26. Red-wattled lapwing, 27. Yellow-Wattled Lapwing, 28. Asian Woollyneck, 29. Asian Openbill, 30. Painted Stork, 31. Ashy Prinia, 32. Common Tailorbird, 33. Eurasian Collared-dove, 34. Laughing Dove, 35. Red Collared Dove, 36. Common Pigeon, 37. Yellow-footed Green-pigeon.

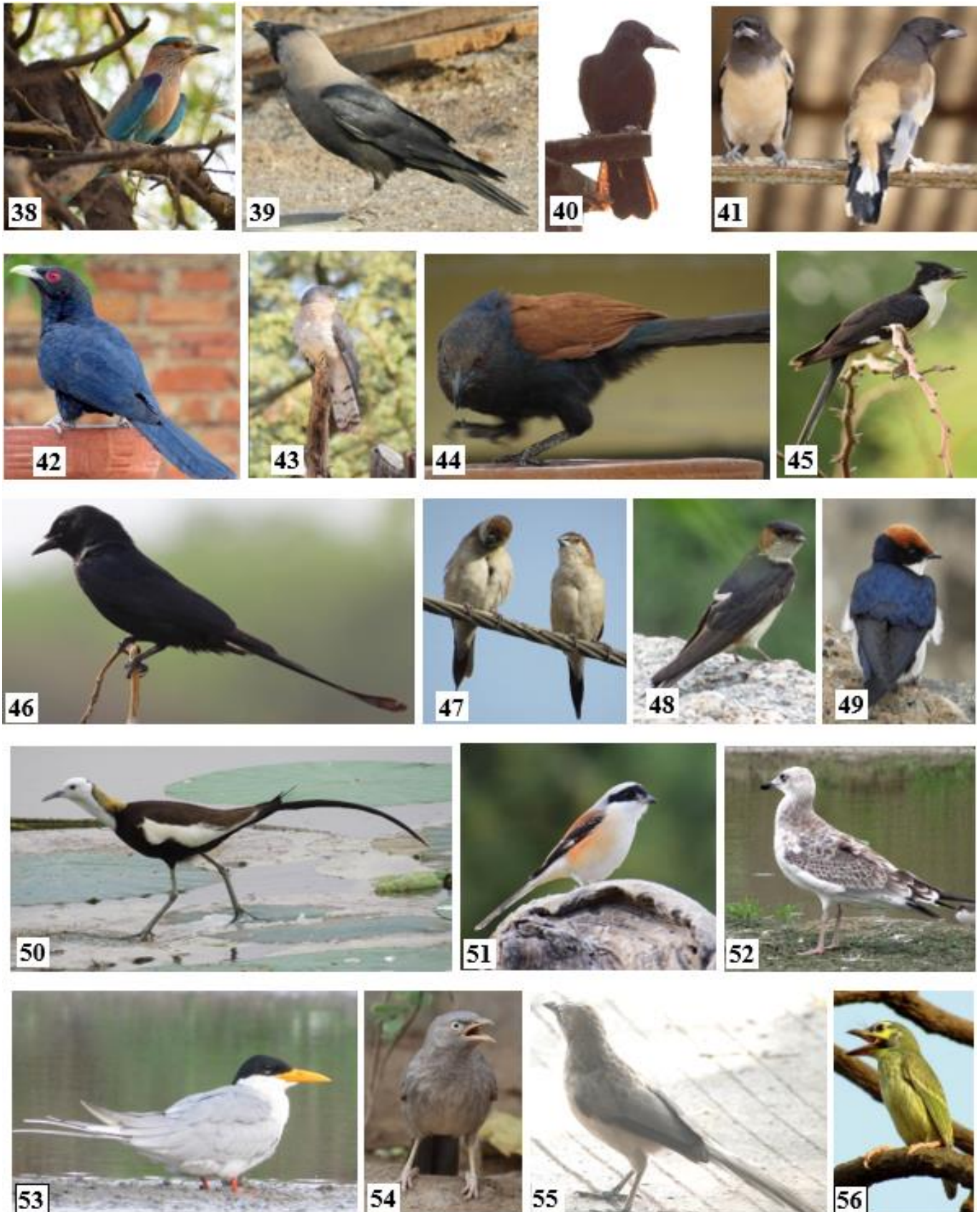


Plate 3: Recorded avifauna from the study area.

38. Indian Roller, 39. House Crow, 40. Indian Jungle Crow, 41. Rufous Treepie, 42. Asian Koel, 43. Common Hawk-cuckoo, 44. Greater Coucal, 45. Jacobin Cuckoo, 46. Black Drongo, 47. Indian Silverbill, 48. Red-rumped Swallow, 49. Wire-tailed Swallow, 50. Pheasant-tailed Jacana, 51. Long-tailed Shrike, 52. Heuglin's gull, 53. River Tern, 54. Jungle babbler, 55. Large grey babbler, 56. Coppersmith Barbet.

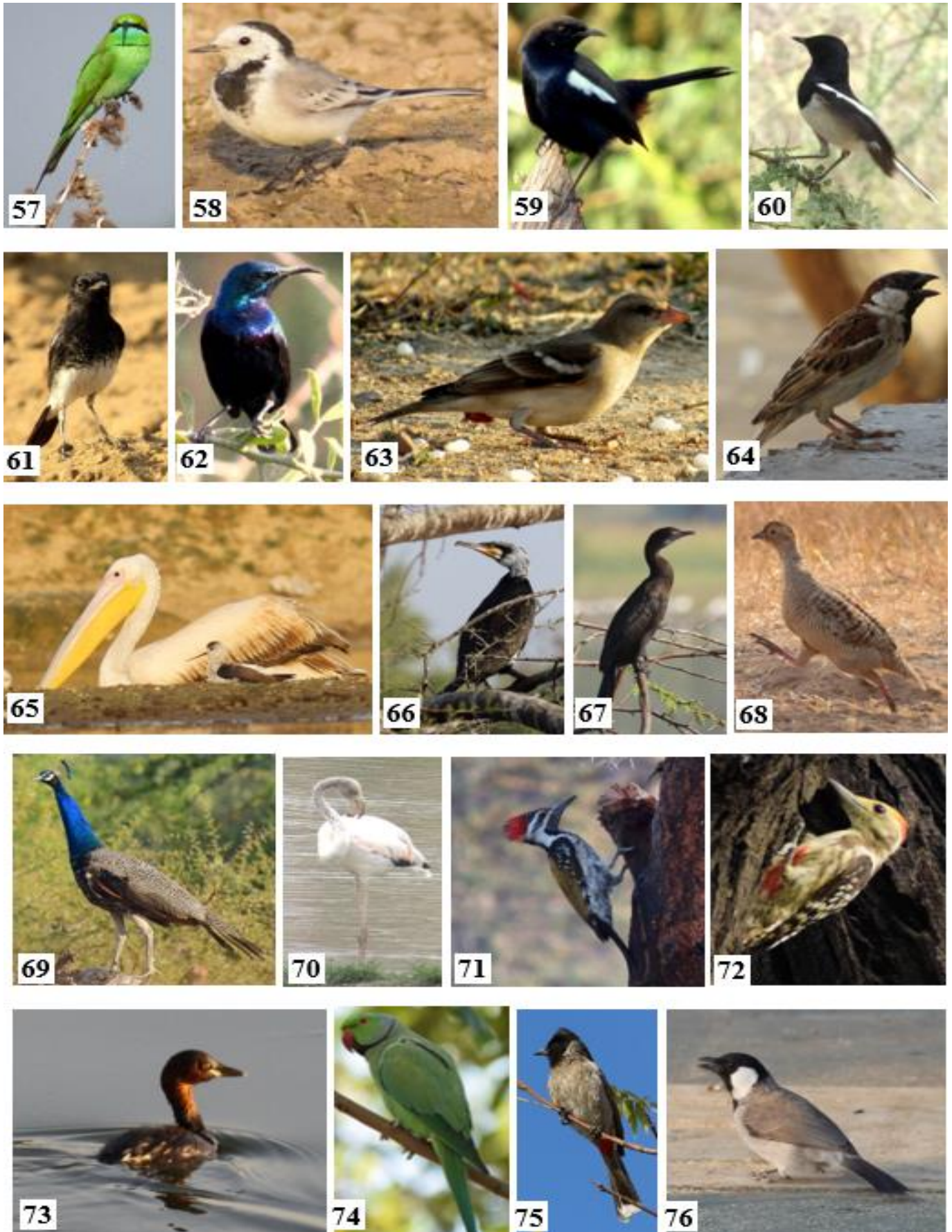


Plate 4: Recorded avifauna from the study area

57. Green Bee-eater, 58. White Wagtail, 59. Indian Robin, 60. Oriental Magpie-robin, 61. Pied Bushchat, 62. Purple Sunbird, 63. Chestnut-shouldered Bush-sparrow, 64. House Sparrow, 65. Great White Pelican, 65. Great Cormorant, 66. Little Cormorant, 67. Grey Francolin, 68. Indian Peafowl, 70. Lesser Flamingo, 71. Lesser Golden-back, 72. Yellow-crowned Woodpecker, 73. Little Grebe, 74. Rose-ringed Parakeet, 75. Red-vented Bulbul, 76. White-eared Bulbul.

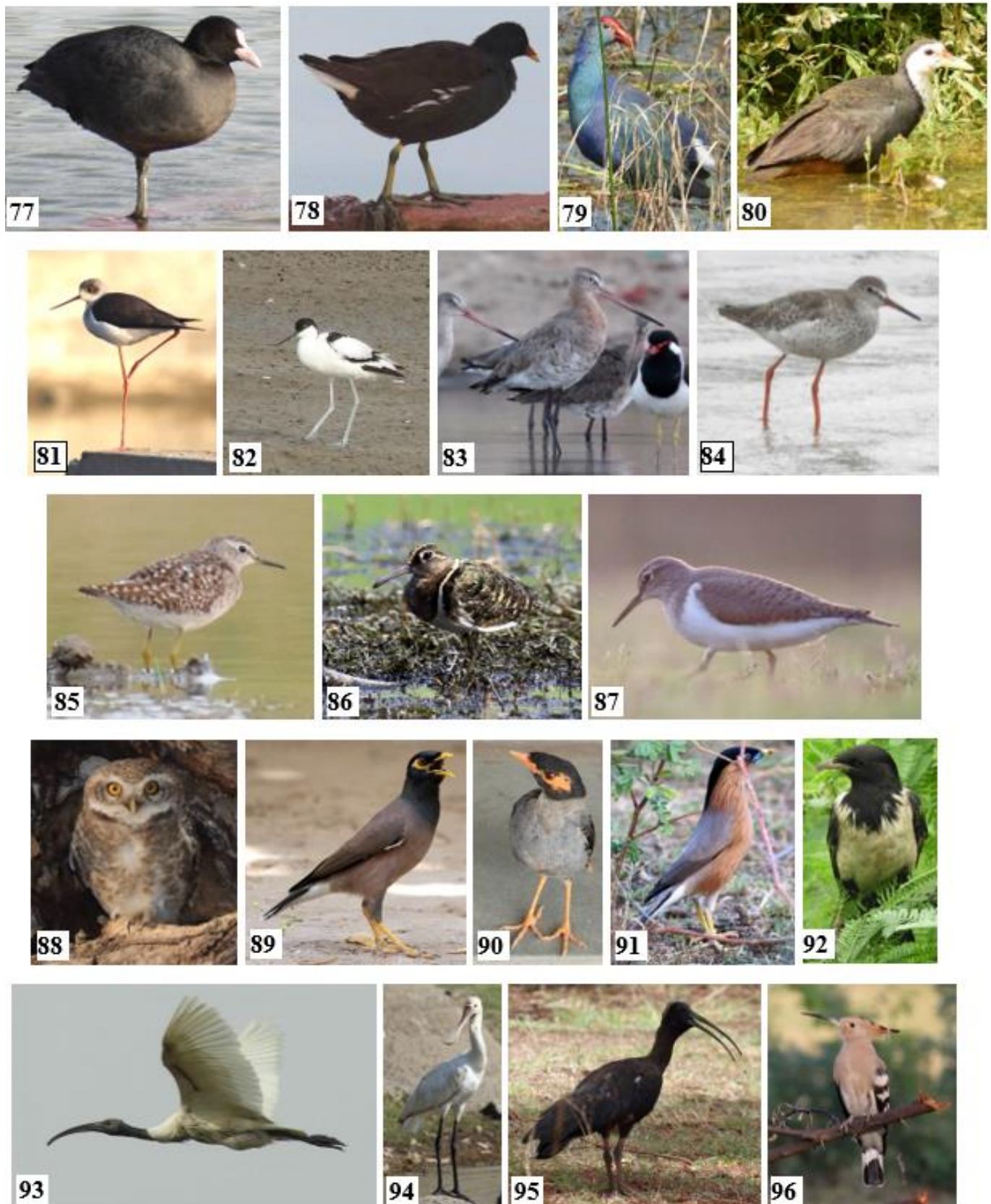


Plate 5: Recorded avifauna from the study area.

77. Common Coot, 78. Common Moorhen, 79. Purple Swamp-hen, 80. White-breasted Water-hen, 81. Black-winged stilt, 82. Pied avocet, 83. Black-tailed Godwit, 84. Common Redshank, 85. Marsh Sandpiper, 86. Pintail Snipe, 87. Temminck's Stint, 88. Spotted Owlet, 89. Common Myna, 90. Bank Myna, 91. Brahminy Starling, 92. Rosy starling, 93. Black Headed Ibis, 94. Eurasian Spoonbill, 95. Red-napped Ibis, 96. Common Hoopoe.

Conclusion

Increased urbanization typically leads to an increase in avian

biomass but a reduction in richness^[21] and also supports our findings that rural sites (i.e. Dediya Lake, Pindariya lake site

and Singhoda Lake) were very important for avian species migration, food and reproduction purposes. It also supports that urban and rural sites avian diversity and richness show significantly higher during the study period. Present data records have a higher significant species diversity than were done in the past studies on the river community^[22] and water reservoirs^[23].

Diverse wetland complexes are the greatest value in providing habitat for local and migratory bird species. Along these, we found that sighting and nesting of Indian Grey Hornbill (*Ocyrceros birostris*) from the Pindariya Lake and Dediya lake site. So, we conclude that data records from the Visnagar rural sites are very important to conserve the avifaunal community and suggest that take an action from the Visnagar Municipality to conserve these water bodies and control the anthropological activities there which affect the diversity of birds.

Acknowledgement

Authors are thankful to Mr. Dolatsang Vala, Mr. Parikshit Dhaduk, and Mr. Devansh Makwana for help in identification of bird species. Appreciations to anonymous reviewer for comments and suggestion to improve manuscript.

References

- Whelan CJ, Wenny DG, Marquis RJ. Ecosystem services provided by birds. *Annals of the New York academy of sciences*. 2008; 1134(1):25-60.
- Sibley CG, Monroe BL. *Distribution and Taxonomy of Birds of the World*. Yale University Press, 1990, 1-1111.
- Praveen J, Jayapal R, Inskipp T, Warakagoda D, Thompson PM, Anderson RC, Carr P, *et al*. Checklist of the birds of South Asia (v5.0), 2019. Website: http://www.indianbirds.in/wp-content/uploads/2019/12/south_asia_checklist_v5_0.xlsx [Date of publication: 16 December 2019].
- Praveen J, Jayapal R, Pittie A. A checklist of the birds of India. *Indian Birds*. 2016; 11(5-6):113-172.
- Parasharya BM, Borad CK, Rank DN. A Checklist of the Birds of Gujarat. *Bird Conservation Society, Gujarat*, 2004, 1-26.
- Ganpule P. The birds of Gujarat: Status and distribution. *Flamingo*. 2016; 8(3-12):2-40.
- Vyas BM. Breeding seasons and nest site selection of some selected urban birds of Visnagar city area and its vicinity. *Asian Journal of Animal Science*. 2009a; 4(1):88-90.
- Vyas BM. Breeding activities of some urban birds. *Asian Journal of Animal Science*. 2009c; 4(2):182-185.
- Joshi RP, Acharya CA, Senma RC. First record on breeding chronology of little cormorant, *Phalacrocorax niger* in Visnagar, north Gujarat. *Asian Journal of Animal Science*. 2010; 5(1):17-19.
- Senma RC, Acharya CA. Nest and nest contents of near threatened Black Headed Ibis (*Thriakiornis melanocephalus*). *Asian Journal of Animal Science*. 2009; 4(2):146-148.
- Patel MG. Breeding cycle of selected wetland birds from Visnagar, Gujarat, *International Journal of Pure science and Agriculture*. 2016, 181-184.
- Vyas BM. A case study: Habitat selection of urban birds. *Asian Journal of Animal Science*. 2009b; 4(1):123-125.
- Ali S, Ripley SD. *Hand book of the Birds of India and Pakistan*. Compact edition, Oxford University Press, Oxford. 1983, 1-737.
- Ali S. *The Book of Indian Birds*, Bombay Natural History Society, Oxford University, Press, Revised 13th edition. 2012, 1-326.
- Grimmett, R, Inskipp, C, Inskipp T. *Helm field guides: Birds of the Indian Subcontinent* second edition. Oxford University Press, India, 2013, 1-506.
- Hammer Ø, Harper DA, Ryan PD. PAST paleontological statistics software package for education and data analysis. *Palaeontologia electronica*. 2001; 4(1):1-9.
- McAleece N, Gage JDG, Lambhead PJD, Paterson GLJ. *BioDiversity Professional statistics analysis software*. Version 2. Jointly developed by the Scottish Association for Marine Science and the Natural History Museum London, 1997. <https://www.sams.ac.uk/science/outputs/>.
- International Union for Conservation of Nature, *Red List of Threatened Species*. Version (2019-2). [Accessed 11th October, 2019].
- Convention on International Trade in Endangered Species. *Checklist of CITES Species*. [Accessed 11th October, 2019] Available: <http://checklist.cites.org/#/en>.
- Wildlife Protection Act. *Schedule Species Database of India*; 1972. Available: www.wiienviis.nic.in [Accessed 11th October, 2019].
- Chace JF, Walsh JJ. Urban effects on native avifauna: a review. *Landscape and urban planning*. 2006; 74(1):46-69.
- Dal P, Vaghela AK. Preliminary survey of avifaunal diversity around Shetrunji River, Dhari, India. *Journal of Biology and Earth sciences*. 2015; 5(1):19-24.
- Vala DS, Trivedi VM. Status of aquatic birds at aji-1 water reservoir, Rajkot, Gujarat, India. *Journal of Global Biosciences*. 2018; 7(2):5375-5384.