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Avifaunal Diversity of Mini River of Vadodara District of Gujarat

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Abstract

Birds are ecologically very important for any ecosystem and act as bio-indicator of the system. The present study deals with the avifaunal diversity of the Mini River of Vadodara district of Gujarat State. The river passes through both undisturbed and industrial estates. A total of 51 bird species was reported from entire stretch of the river. Most common species of birds reported were Red Wattled Lapwing (*Vanellus indicus*), House Sparrow (*Passer domesticus*), Rock Pigeon (*Columba livia*), Barn Swallow (*Hirundo rustica*), Cattle Egret (*Bubulcus ibis*). The paper highlights the distribution of species along the riverine stretch at different locations and tries to deduce the reason for abundance of species at particular site.

Key-Words: Avifauna, River, Ecosystem

Introduction

India is one of the mega-diversity center haven and about 1303 species of birds, that amount 13% of the total birds of the world (Ali, 2012). Birds are important bio-indicator of any ecosystem. Some bird species are indicator of ecosystem. River is one of the important ecosystems for human being and sustenance of river. Further, the riverine ecosystem plays an important role in the water of reservoir; they support a large variety of vegetation which in turn supports various fauna in and around the river. Expansions cause fragmentation of the natural habitats as well as loss of biodiversity (Marzluff, 2001) due to the destruction and/or modification of habitat that lead to changes in the native flora and fauna. The species richness tends to decline along a gradient of increasing urbanization (Marzluff, 2001; Shochat, 2004; Clergeau *et al.*, 2006) high abundance of birds, tempered by low species richness, particularly of indigenous native species it often exhibited.

Gujarat state with varied ecological regimes provides habitat for 526 bird species (Parasharya *et al.*, 2004). The checklists for birds in and around this city are available (Padate *et al.*, 1998, 2001) and Vadodara city alone recorded 105 bird in 2009 (Rathod, 2009).

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Present work provides baseline data of avifauna of Mini riverine ecosystem of Vadodara city. The rapid increase in urbanization and industrialization has resulted in immense pressure on the lotic ecosystems and associated riparian habitats. The present paper tries to highlight the changes in the system.

Material and Methods

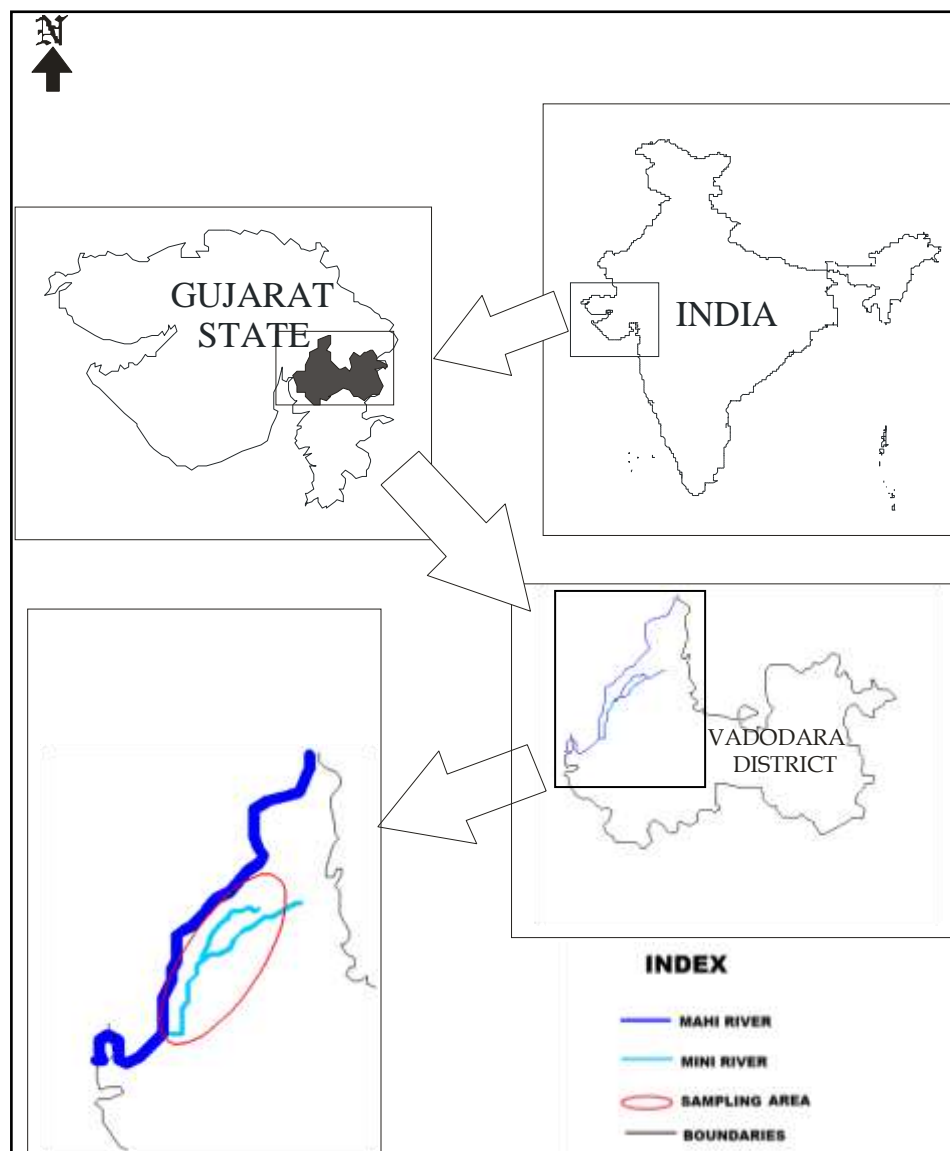
Study area

Mini River originates from Savli and ends in Mahi River after Sindhrot village and joins Mahi River. Nandesari Industrial Estate (NIE) of Gujarat is located on the banks of the Mini River and passes from industrial areas of Ranoli, GSFC (Gujarat State Fertilizer Company) and other major industries. Currently, NIE has 250 small scale industries that produce organic and inorganic chemical compounds, pharmaceuticals, and drugs (Misra, 2002). The region is characterized by the moderate subtropical monsoonal type of climate (Srivastava *et al.*, 2011).

To observe the faunal diversity the whole riverine zone was divided into eight stations. Each area was marked with its location in Google Earth. The study area is divided into two divisions:

- 1) Areas with less human interference includes station 1 and 2. The riverine stretch at station 2 is called as Parvi River. The water is used for washing clothes and drinking purpose.
- 2) Industrial areas includes Station 3 to 8. At Station 3 the river passes through the Manjusar industrial area and at station 5 chemical industries such as dyes, pharmaceuticals, dyes, paints, plastic manufacturing, petrochemicals, pesticides, heavy metals etc. are

present. The water from this point onwards is not used for drinking purpose as the treated and untreated sewage of chemical industries of Nandesari industrial area is discharged into the river.



Methods

The survey was done in the month of January and February 2015 respectively at an interval of 15 days. A total number of 16-18 visits were undertaken during the study period. Birds were observed using binocular and identified following the basis of standard books by Ali (1996) and Grimmett *et al.*, (1999). The birds were counted using transect and point count method "Timed Species Counts" (Rodgers, 1991) was used to see the number of birds recorded in particular time period.

The species richness, diversity indices like Shannon Wiener index and equitability (Krebs, 1985), densities (Rodgers, 1991) were calculated for further analysis. Jaccard's similarity indices between all the study areas are estimated. Finally, the data for each visit was used for statistical analysis with the help of cluster analysis by using various software packages (PAST -03 and Graph-pad Prism-3).

Results and Discussion

A total of 51 species of birds belonging to 35 families and 10 orders was recorded including common and rare species. Among the 51 species of the birds 26 individuals of Passeriformes belonging to 18 families, 7 individuals of Pelecaniformes order belonging to 4 families, 3 individuals of Coraciiformes order belonging to 3 families, 4 individuals of Charadriiformes belonging to 3 families, 3 individuals of Cuculiformes belonging to 1 family, 2 individuals of Anseriformes order belonging to 1 family, 2 individuals of Columbiformes belonging to 1 family, and rest of 4 individuals of Suliformes, Ciconiiformes, Accipitriformes and Psittaciformes belonging to 1 family respectively were recorded.

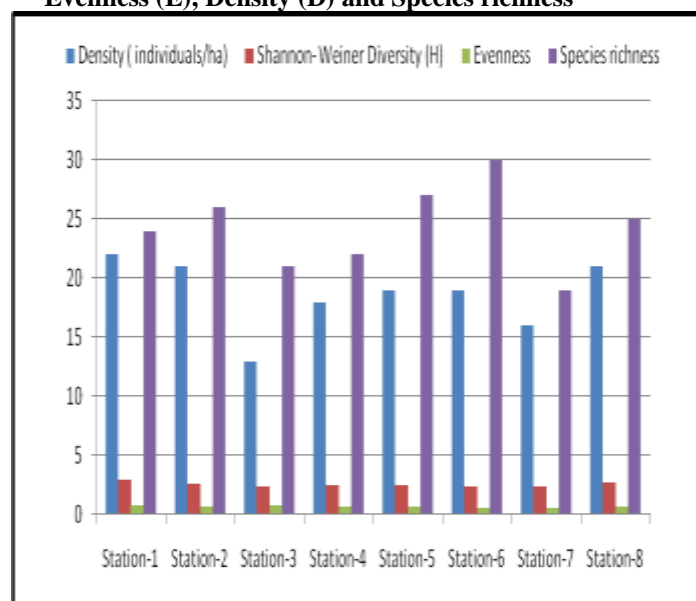
The Species Richness of birds was reported high at station 6 (30) followed by station 5 (27) and station 2 (26) and low at station 7 (19). The difference in the species richness recorded was in relation to good vegetation cover at the former stations. Kumbar and Ghadage (2012) also recorded presence of a good diversity of avifauna attributed to varied vegetation gradients and favourable environmental conditions.

Among all of the species sighted Red Wattled Lapwing (*Vanellus indicus*), House Sparrow (*Passer domesticus*), Rock Pigeon (*Columba livia*), Barn Swallow (*Hirundo rustica*), Cattle Egret (*Bubulcus ibis*), Jungle Babbler (*Turdoides striatus*), Indian Robin (*Saxicoloides fulicatus*), Red Vented Bulbul (*Pycnonotus cafer*), Common Myna (*Acridotheres tristis*), House Crow (*Corvus splendens*), Black Drongo (*Dicrurus macrocercus*) were common at all the stations. Red Wattled Lapwing (*Vanellus indicus*) was the most abundant species followed by Rock Pigeon (*Columba livia*) and House Sparrow (*Passer*

domesticus), Red Wattled Lapwing (*Vanellus indicus*) was the most widespread with its presence in all the stations. This species is classified as Least Concern by IUCN (2014) red List (Birdlife International, 2009) and is a common and widespread wading bird in the Indian sub continent (Sethi *et al.* 2011). This bird usually nests in open country, grazing land, fallow fields and dry beds of village tanks and islets of rivers (Ali and Ripley, 1998).

Species like Yellow Wagtail (*Motacilla flava*) was sighted in February only and possibly due to its migration back to its breeding place. Endangered avifaunal species like Painted Stork (*Mycteria leucocephala*) and Black Headed Ibis (*Threskiornis aethiopica*) was sighted at station 3, 5 and 6 in the month of January and categorised as near threatened by IUCN (2014). The Painted Stork is one of the most abundant Asian storks but decline in population is reported due to anthropogenic factors (IUCN 2014) and its sighting indicates presence of congenial environment for the bird irrespective of human activity. Birds such as White Breasted Kingfisher (*Halcyon smyrnensis*), Lesser Pied Kingfisher (*Ceryle rudis*), Pond Heron (*Ardeola grayii*), Red Wattled Lapwing (*Vanellus indicus*) and Ringed Plover (*Charadrius hiaticula*) was noted at stations 4 and 5, where there is high human activity. Similar high endurance capacity with respect to anthropogenic activities was reported in study carried out along Krishna river basin in Maharashtra (Kumbar and Ghadage 2012).

Figure 1: Station wise differences of birds species with respect to Shannon- Weiner diversity (H), Evenness (E), Density (D) and Species richness



When density (D) of birds was considered, it was reported high at station 1 (22 individuals/ha) followed by station 2 (21 individuals/ha) and station 8 (21 individuals/ha). The lowest bird density was recorded at station 3 (13 individuals/ha) due to high human interference.

Over all the Shanon - Weiner diversity (H') ranged from ≥ 2.928 (at station 1) to ≥ 2.222 (at station 7) (Fig 1). The diversity index lies within the range prescribed for ecological studies, thus indicating high evenness of the community. The study indicates that though the river passes through the industrial area after station 3, yet there is presence of good diversity largely due to presence of vegetation.

When the evenness (E) of species was calculated, the highest evenness was recorded in station 1 (≥ 0.8494), followed by station 3 (≥ 0.8061) and station 4 (≥ 0.7034). The species evenness was more at the stations

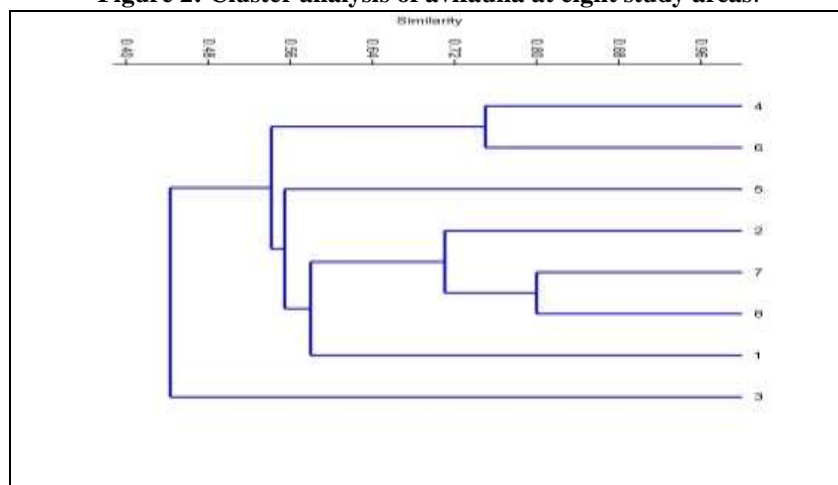
on the upstream location as compared to downstream location. The low human disturbance and good vegetation at upstream stations resulted in high species evenness. Ried and Miller (1989) reported that avifaunal diversity increased when a greater variety of habitats types are present. Similar finding was reported in the present study. At station 1 and 8 the vegetation was good and comprised both the upper strata and lower strata, thereby sustaining good diversity. Studies have demonstrated that a correlation exists between the structural complexity of habitats and species diversity (Hawksworth, Kalin-Arroyo 1995).

Jaccard's Similarity Index was considered to see the similarity between two stations. High degree of similarity was observed between station 6 and station 8 (74%) and between station 7 and station 8 (57%). In both the stations vegetation was dense that provided roosting sites for the birds.

Table 1: Jaccard's Similarity Index of birds

Jaccard's Similarity Index (%)								
0	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Station 1	0	52	41	53	34	35	43	44
Station 2		0	42	41	43	44	55	55
Station 3			0	26	33	24	33	31
Station 4				0	32	49	41	42
Station 5					0	39	44	44
Station 6						0	74	52
Station 7							0	57
Station 8								0

Figure 2: Cluster analysis of avifauna at eight study areas.



Cluster analysis showed that station 7 and 8 are very similar to each other. Both these stations are located within the industrial area, but there is similarity in the vegetation as well and lies close by as well. Station 4 and 6 are also similar with respect to number of species of birds due to vegetation. The community structure of birds at Station 3 is different than other locations. The bird species and their assemblages have proved to be good indicators of environmental quality in many situations (Croonquist and Brooks, 1991; Bryce *et al.* 2002, Frederick *et al.* 2009; Kajtoch, 2014).

“Timed Species Counts” (TSC) was used to see the number of birds recorded in particular time period. Based on TSC count Red Wattled Lapwing (*Vanellus indicus*) was ranked 1, followed by Blue Rock Pigeon (*Columba livia*) and House Sparrow (*Passer*

domesticus). Other species such as Cattle Egret (*Bubulcus ibis*) and Rose Ring Parakeet (*Psittacula krameri*) were also common. Common species like pigeon and lapwing are habituated with the changing habitat were categorised as “Urban Exploiters” (Kark *et al.* (2007), Rathod, 2009). The species seen rarely in the study area include Black Crowned Night Heron (*Nycticorax nycticorax*), Common Hoopoe (*Upupa epops*), Red Collared Dove (*Streptopelia tranquebarica*), Stone Chat (*saxicola torquata*), Brahmini Myna (*Stuenus pagodarum*). Chats and hoopoe are migratory species of birds whereas Brahminy Starling (*Stuenus pagodarum*) is residential species and are not common at study areas Moreover, migratory birds were observed only during winter seasons.

Table 2: Ranking the dataset using Timed Species Counts (TSCs)

Sr. No.	Birds		Visit 1	Visit 2	Total rank score	Mean rank score	Species rank
	Common Name	Scientific Name					
1	Red Wettled Lapwing	<i>Vanellus indicus</i>	74	47	121	60.5	1
2	Rock Pigeon	<i>Columba livia</i>	40	38	78	39	2
3	House Sparrow	<i>Passer domesticus</i>	46	27	73	36.5	3
4	Cattle Egret	<i>Bubulcus ibis</i>	33	15	48	24	4
5	Rose Ring Parakeet	<i>Psittacula krameri</i>	17	27	44	22	5
6	Great Cormorant	<i>Phalacrocorax carbo</i>	40	1	41	20.5	6
7	Green Bee Eater	<i>Merops orientalis</i>	18	21	39	19.5	7
8	Barn Swallow	<i>Hirundo rustica</i>	17	17	34	17	8
9	Jungle Babbler	<i>Turdoides striatus</i>	20	10	30	15	9
10	Black Drongo	<i>Dicrurus macrocercus</i>	18	11	29	14.5	10
11	Black Headed Bunting	<i>Emberiza melanocephala</i>	24	2	26	13	11
12	Common Myna	<i>Acridotheres tristis</i>	19	6	25	12.5	12
13	Wire Tailed Swallow	<i>Hirundo smithii</i>	12	11	23	11.5	13
14	Baybacked Shrike	<i>Lanius collurioides</i>	18	5	23	11.5	13
15	Ashy Crown Sparrow Lark	<i>Eremopterix grisea</i>	16	5	21	10.5	14
16	Red Vented Bulbul	<i>Pycnonotus cafer</i>	14	6	20	10	15
17	Purple Sunbird	<i>Nectarinia asiatica</i>	7	10	17	8.5	16
18	Indian Robin	<i>Saxicoloides fulicatus</i>	10	6	16	8	17
19	Little Egret	<i>Egretta garzetta</i>	11	5	16	8	17

20	Indian Pond Heron	<i>Ardeola grayii</i>	10	1	11	5.5	18
21	Coucal/ Crow Pheasant	<i>Centropus sinensis</i>	6	4	10	5	19
22	Black Kite	<i>Milvus migrans</i>	6	3	9	4.5	20
23	Indian Peafowl	<i>Pavo cristatus</i>	8	1	9	4.5	20
24	White Wagtail	<i>Motacilla alba</i>	7	1	8	4	21
25	Grey Francoline Partridge	<i>Francolinus pondicerianus</i>	7	0	7	3.5	22
26	Ringed Plover	<i>Charadrius Hiaticula</i>	4	3	7	3.5	22
27	House Crow	<i>Corvus splendens</i>	5	2	7	3.5	22
28	Jungle Crow	<i>Corvus macrorhynchos</i>	4	3	7	3.5	22
29	Common Hawk Cuckoo	<i>Cuculus varius</i>	3	3	6	3	23
30	Wood Sandpiper	<i>Tringa glareola</i>	4	1	5	2.5	24
31	Black Winged Stint	<i>Himantopus himantopus</i>	2	3	5	2.5	24
32	Paddy Field Pipit	<i>Anthus rufulus</i>	4	0	4	2	25
33	Baya Weaver Bird	<i>Ploceus philippinus</i>	4	0	4	2	25
34	Lesser Pied Kingfisher	<i>Ceryle rudis</i>	4	0	4	2	25
35	Black Ibis	<i>Pseudibis papillosa</i>	1	3	4	2	25
36	White Breasted Kingfisher	<i>Halcyon smyrnensis</i>	2	2	4	2	25
37	Indian Roller	<i>Coracias benghalensis</i>	3	1	4	2	25
38	Painted Stork	<i>Mycteria leucocephala</i>	3	0	3	1.5	26
39	Indian Koel	<i>Eudynamys scolopaceus</i>	2	1	3	1.5	26
40	Ruddy Shell Duck	<i>Tadorna Ferruginea</i>	1	2	3	1.5	26
41	Black headed Ibis	<i>Threskiornis aesthiopica</i>	2	1	3	1.5	26
42	Eurasian Curlew	<i>Numenius arquata</i>	3	0	3	1.5	26
43	Spotbill Duck	<i>Anas poecilorhyncha</i>	2	1	3	1.5	26
44	Magpie Robin	<i>Copsychus saularis</i>	2	1	3	1.5	26
45	Yellow Wagtail	<i>Motacilla flava</i>	0	3	3	1.5	26
46	Indian Treepie	<i>Dendrocitta</i>	2	1	3	1.5	26

		<i>Vagabunda</i>					
47	Brahminy Starling	<i>Stuenus pagodarum</i>	0	2	2	1	27
48	Hoopoe	<i>upupa epops</i>	2	0	2	1	27
49	Red Collared Dove	<i>Streptopelia tranquebarica</i>	1	1	2	1	27
50	Stone Chat	<i>saxicola torquata</i>	1	1	2	1	27
51	Black Crowned Night Heron	<i>Nycticorax nycticorax</i>	2	0	2	1	27

Conclusion

Density of birds was reported high at station 1 (22 individuals/ha) followed by station 2 (21 individuals/ha) and station 8 (21 individuals/ha). Highest Total species count was recorded for Red Wattled Lapwing (*Vanellus indicus*) with the species rank 1, followed by Blue Rock Pigeon (*Columba livia*) and House Sparrow (*Passer domesticus*). This indicates that these species is widespread in distribution and more adaptive to riverine ecosystem to changing environment and anthropogenic activity. The species evenness was more at the stations on the upstream location as compared to downstream location. The low human disturbance and good vegetation at upstream stations resulted in high species evenness.

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Appendices I : Birds recorded during the field visit at all study areas

Sr. No.	Station		1	2	3	4	5	6	7	8
	Common Name	Scientific Name								
1	Great Cormorant	<i>Phalacrocorax carbo</i>	√	√		√	√	√		
2	Black Crowned Night Heron	<i>Nycticorax nycticorax</i>	√							
3	Painted Stork	<i>Mycteria leucocephala</i>	√			√		√		
4	Baybacked Shrike	<i>Lanius collurio</i>	√	√	√		√		√	√
5	Common Hawk Cuckoo	<i>Cuculus varius</i>	√		√		√			
6	Rose Ring Parakeet	<i>Psittacula krameri</i>	√	√		√	√	√	√	√
7	Red Wattled Lapwing	<i>Vanellus indicus</i>	√	√	√	√	√	√	√	√
8	House Crow	<i>Corvus splendens</i>	√	√	√				√	√
9	Black Drongo	<i>Dicrurus macrocercus</i>	√	√		√	√	√	√	√
10	Little Egret	<i>Egretta garzetta</i>	√	√	√	√		√		
11	Common Hoopoe	<i>Upupa epops</i>	√							
12	Black Headed Bunting	<i>Emberiza melanocephala</i>	√	√	√				√	√
13	Indian Robin	<i>Saxicoloides fulicatus</i>	√	√	√	√		√		√
14	Green Bee Eater	<i>Merops orientalis</i>	√	√	√	√	√	√	√	√
15	Purple Sunbird	<i>Nectarinia asiatica</i>	√	√		√	√	√	√	√
16	Cattle Egret	<i>Bubulcus ibis</i>	√	√	√	√	√	√	√	√
17	Indian Pond Heron	<i>Ardeola grayii</i>	√							
18	Common Myna	<i>Acridotheres tristis</i>	√	√	√	√	√			√
19	Paddy Field Pipit	<i>Anthus rufulus</i>				√				
20	Indian Treepie	<i>Dendrocitta vagabunda</i>			√					
21	Red Vented Bulbul	<i>Pycnonotus cafer</i>	√	√		√	√		√	√
22	Grey Francoline Partridge	<i>Francolinus pondicerianus</i>		√	√					
23	House Sparrow	<i>Passer domesticus</i>	√	√	√	√		√	√	√
24	Baya Weaver Bird	<i>Ploceus philippinus</i>		√			√			
25	Rock Pigeon	<i>Columba livia</i>		√	√	√	√	√	√	√
26	Ringed Plover	<i>Charadrius hiaticula</i>		√				√		√
27	Jungle Babbler	<i>Turdoides striatus</i>	√	√	√		√	√	√	
28	Coucal/ Crow Pheasant	<i>Centropus sinensis</i>		√			√	√	√	
29	Lesser Pied Kingfisher	<i>Ceryle rudis</i>				√				
30	Wood Sandpiper	<i>Tringa glareola</i>	√			√		√		
31	Ashy Crown Sparrow Lark	<i>Eremopterix grisea</i>	√			√				√
32	Indian Peafowl	<i>Pavo cristatus</i>					√			√
33	Black Ibis	<i>Pseudibis papillosa</i>				√	√	√		
34	Red Collared Dove	<i>Streptopelia tranquebarica</i>					√			

35	Indian Koel	<i>Eudynamys scolopaceus</i>			√		√			√
36	Jungle Crow	<i>Corvus macrorhynchos</i>		√			√		√	√
37	Ruddy Shell Duck	<i>Tadorna Ferruginea</i>					√	√		
38	Black Headed Ibis	<i>Threskiornis aesthiopica</i>			√		√	√		
39	Eurasian Curlew	<i>Numenius arquata</i>						√		
40	White Breasted Kingfisher	<i>Halcyon smyrnensis</i>					√	√		
41	Black Winged Stint	<i>Himantopus himantopus</i>				√		√	√	
42	White Wagtail	<i>Motacilla alba</i>		√				√		
43	Spotbill Duck	<i>Anas poecilorhyncha</i>			√			√		
44	Black Kite	<i>Milvus migrans</i>					√	√	√	√
45	Indian Roller	<i>Coracias benghalensis</i>		√						√
46	Stone Chat	<i>saxicola torquata</i>			√					√
47	Wire Tailed Swallow	<i>Hirundo smithii</i>					√			√
48	Magpie Robin	<i>Copsychus saularis</i>				√		√	√	√
49	Barn Swallow	<i>Hirundo rustica</i>	√	√	√	√	√	√	√	√
50	Brahmini Myna	<i>Stuenus pagodarum</i>						√		
51	Yellow Wagtail	<i>Motacilla flava</i>			√		√			
Total			24	26	21	22	27	30	19	25

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