

Waste as a Resource for Avifauna: Review and Survey of the Avifaunal Composition in and around Waste Dumping Sites and Sewage Water Collection Sites (India)

Satya Prakash Mehra*, Sarita Mehra, Mohib Uddin, Vikas Verma, Hrishika Sharma, Tehlu Singh, Gurpreet Kaur, Tasso Rimung and Himmat Ram Kumhar

Rajputana Society of Natural History, Village Ramnagar, PO Malah, Bharatpur, Rajasthan, India

Abstract

Urbanization has led to the challenge of waste disposal. The dumping sites are affecting the natural habitats in and around urban areas. The most eye catching group of animals, the birds had used these modified habitats. The reconnaissance surveys were conducted for eleven sites of the seven municipal areas Rajasthan and Punjab states of India to assess the avifaunal composition. The observations of bird species using modified habitats in form of solid and liquid (effluent/ sewage) waste sites were assessed. The dumping site at Mount Abu (Sirohi, Rajasthan) was no more in existence. Since authors were involved in studies since last two decades, therefore, past records were also included for such sites.

It was observed that such sites of waste collection (solid and liquid) were harboring 100 species of birds with three additional species in past, accounting 103 bird species belonging to 37 families in 11 orders. Terrestrial species accounted 53 whereas wetland bird species were 37 species and 11 species were wetland dependent. Around 58 species were resident, 18 migrants and 27 species resident with local movements. Thirteen species of global interest were recorded from the sites. Three of these species were under critically endangered and were the past records. Two endangered species, one vulnerable species and seven near threatened species were recorded from the investigation sites. Sites of Udaipur and Bharatpur were having the maximum diversity of birds.

Besides scavenger and raptors species, egrets and passerines were of common occurrence. It was observed that the sites were mainly used for the feeding purposes and if the surrounding habitats were used for the other life cycle processes by the birds. The dumping sites with the organic (biodegradable and animal) wastes could be prepared and further modified as per the nature's rule to develop the birding sites for the species of global interest. The animal waste management through reviving bio-disposal mechanism through scavenger birds could be ideal model for revenue generation through birding.

Keywords: Human; Nature; Environment

Introduction

Importance of the theme

Twenty-first century can be characterized by tremendous growth of urban areas along with associated process of globalization and unification of urban environments. Despite of the fact that cities occupy just 2% of the Earth's surface, their inhabitants use 75% of the planet's natural resources [1,2]. Due to changes in the habitats and the direct human disturbances, the urban development processes affect avifauna by various means, which might be positive or negative [3]. However, some bird species can thrive in human-modified landscapes, if the habitats retain ecologically important features [1,2,4]. There are ample of studies on relation of the landscapes with the abundance of animal populations especially where the anthropogenic activities are affecting the natural characteristics of the habitats [2,5-7] and owing to the home ranges this is the case particularly for birds [4]. The birds are the most eye catching group of animals among all at any site or habitats whether wild or modified [8].

India is facing a challenge of the ever increasing urban population due to lack of available services and resources resulting into the heap of garbage dump and sewer waste water [9]. The unpleasant odor of the decomposing wastes infuses everywhere. However, the garbage dumping and the waste water sites are being used by diverse species of invertebrates and vertebrates [10,11]. The surveys were undertaken by the authors to assess the avifaunal species of such sites from selected urban lands of Rajasthan and Punjab. The paper enlisted the species of birds recorded from investigation sites.

Materials and Methods

Study area

Seven urban areas from two states of India, four from Rajasthan and three from Punjab were surveyed by the authors with the prime objective to assess the avifaunal composition of all the sites of dumping grounds as well as waste water collection irrespective of their status identified by the respective municipal bodies. The selection of urban areas was based on the authors working areas. The urban spaces included municipal areas of Udaipur, Mount Abu, Bharatpur and Kota from Rajasthan and Nawanshahr (Shaheed Bhagat Singh Nagar), Moga and Ludhiana from Punjab (Figure 1). Six of them are district headquarters whereas Mount Abu falls in Sirohi District of Rajasthan.

Seven urban areas had eleven sites under two broad types of habitats – seven terrestrial habitats in form of dumping grounds (T)

*Corresponding author: Mehra SP, Rajputana's Shakuntalam, Village Ramnagar, PO Malah, Bharatpur 321001 Rajasthan, India, Tel: +91 9414165690; E-mail: drspmehra@yahoo.com

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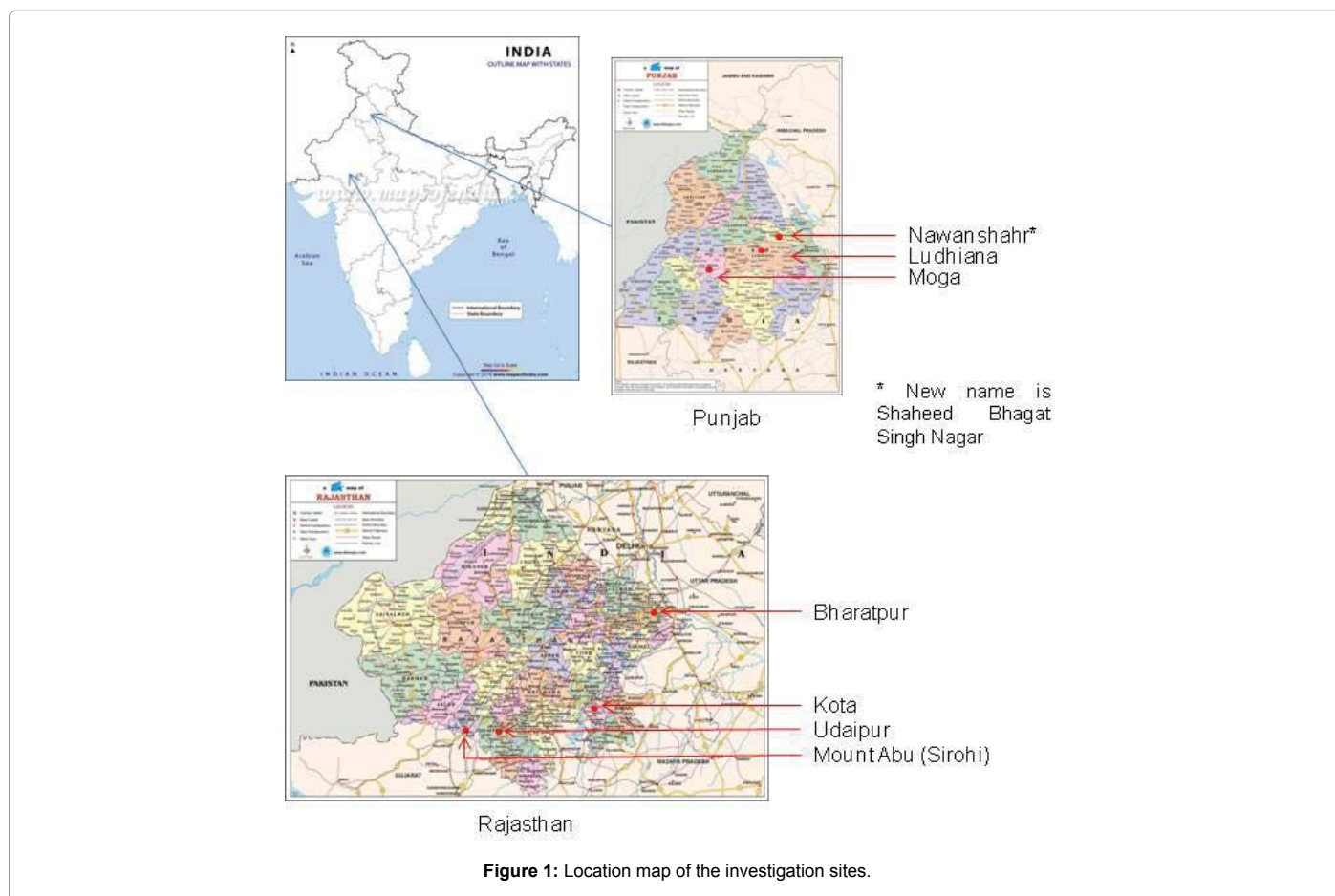


Figure 1: Location map of the investigation sites.

and four aquatic habitats in form of waste water collection ponds or effluent/ sewage treatment plant (A). The habitats as per the sites are given in Table 1.

Methodology

Over all, eleven sites of seven urban areas were visited by the authors in different seasons over the year (Jan 2016 - Jan 2017).

The surveys and scientific samplings of the investigation area were started from 1999 onwards from Udaipur, 2002 onwards from Mount Abu, 2007 onwards from Bharatpur and 2014 onwards from rest of the sites. The present observations includes records from all the sites for the year 2016 but include past observations also to enlist all the bird species which show their presence on waste disposal sites. Direct sighting records at the site and identification of the species were done during the observations.

The terrestrial habitat sites are symbolized by “T” and aquatic habitat sites are symbolized by “A” in the present observations. The symbol T or A is having serial number for each site of observations (Table 1).

Out of the eleven sites, Mount Abu site (T3) is not in existence due to shifting of the dumping ground from Mount Abu to foothills at Abu Road. Therefore, past records from the Chimney site (T3) of Mount Abu were undertaken by authors. Nomenclature is used as per Manakadan and Pittie [12]. Habitat wise checklist is prepared as per Kumar et al. [13].

Observations and Results

Species richness and status

Around 103 bird species belonging to 37 families in 11 orders were recorded from the study area (Tables 2 and 3). Based on the reviews and past observations of the states of Rajasthan and Punjab in general, the status of the species in the investigation area shows that 58 species (ca 56%) are residents, 18 species are migrants and rest 27 resident species have local migratory nature. Specifically, there are slight differences in the status of the species at local levels due to local movements as per the climatic changes. From the present investigation and recent time period maximum 86 bird species were recorded from sites of Udaipur followed by 75 from Bharatpur sites. Three species in each case was enlisted from the past records. The observations of Chimney Dumping Ground (Mt Abu) are based on past records [11].

Species richness and habitat

The investigated area has diversity of the habitat. Broadly bird species were categorized on the basis of the use of two major habitats, namely terrestrial and aquatic (Table 3). Of the total 103 species, 53 were terrestrial species, 37 wetland species and 13 wetland dependent species.

Globally important species

As according to the IUCN Red List, three vulture species, namely

Sr. No.	Urban Area with waste disposal site/s	Site/s of observations	Code Used	Major Type of Habitat
Rajasthan				
1	Bharatpur	Dumping site near NH 11	T1	Terrestrial
2		Scattered ponds and <i>nallahs</i> (drains)	A1	Aquatic
3	Kota	Garbage Dumping Ground	T2	Terrestrial
4		Thermal Ash Pond	A2	Aquatic
5	Mt Abu	Chimney Site	T3	Terrestrial
6	Udaipur	Baleecha Dumping Site	T4	Terrestrial
7		Tetardi Dumping Site	T5	Terrestrial
8		Ahar <i>nallah</i> (drain)	A3	Aquatic
Punjab				
9	Moga	Garbage Dumping Ground	T6	Terrestrial
10	Nawanshahr (Shaheed Bhagat Singh Nagar)	Garbage Dumping Ground	T7	Terrestrial
11	Ludhiana	Budha <i>nallah</i> (drain)	A4	Aquatic

Table 1: Habitats as per the sites.

Sr. No.	Common Name	Scientific Name	Habitat	Observations from the Urban Areas							
				Bharatpur	Kota	Mt Abu*	Udaipur	Moga	SBSN	Ludhiana	
1	Grebes	Podicipedidae									
1	Little Grebe (5)	<i>Tachybaptus ruficollis</i> (Pallas, 1764)	W	x	x	x°	x	x	x	x	x
2	Cormorants/ Shags	Phalacrocoracidae									
2	Little Cormorant (28)	<i>Phalacrocorax niger</i> (Vieillot, 1817)	W	x	0	0	x	0	0	0	0
3	Herons, Egrets and Bitterns	Ardeidae									
3	Little Egret (49)	<i>Egretta garzetta</i> (Linnaeus, 1766)	W	x	x	x°	x	x	x	x	x
4	Large Egret or Great Egret (45-46)	<i>Casmerodius albus</i> (Linnaeus, 1758)	W	x	0	x°	x	0	0	0	x
5	Median Egret or Intermediate Egret (47, 48)	<i>Mesophoyx intermedia</i> (Wagler, 1829)	W	x	x	x°	x	0	0	0	x
6	Cattle Egret (44)	<i>Bubulcus ibis</i> (Linnaeus, 1758)	W	x	x	x°	x	x	x	x	x
7	Indian Pond-Heron (42-42a)	<i>Ardeola grayii</i> (Sykes, 1832)	W	x	x	x°	x	x	x	x	x
8	Little Green Heron or Little Heron (38-41)	<i>Butorides striatus</i> (Linnaeus, 1758)	W	x	0	0	x	0	0	0	0
9	Black-crowned Night-Heron (52)	<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	W	x	0	0	x	0	0	0	0
4	Storks	Ciconiidae									
10	Painted Stork (60)	<i>Mycteria leucocephala</i> (Pennant, 1769)	W	x	0	0	x	0	0	0	0
11	Asian Openbill-Stork or Asian Openbill (61)	<i>Anastomus oscitans</i> (Boddaert, 1783)	W	x	0	0	x	0	0	0	0
5	Ibises and Spoonbills	Threskiornithidae									
12	Glossy Ibis (71)	<i>Plegadis falcinellus</i> (Linnaeus, 1766)	W	x	x	x°	x	0	0	0	0
13	Oriental White Ibis or Black-headed Ibis (69)	<i>Threskiornis melanocephalus</i> (Latham, 1790)	W	x	x	0	x	0	0	0	0
14	Black Ibis (70)	<i>Pseudibis papillosa</i> (Temminck, 1824)	W	x	x	x°	x	0	0	0	0
6	Geese and Ducks	Anatidae									
15	Lesser Whistling-Duck (88)	<i>Dendrocygna javanica</i> (Horsfield, 1821)	W	x	x	0	x	0	0	0	0
16	Brahminy Shelduck or Ruddy Shelduck (90)	<i>Tadorna ferruginea</i> (Pallas, 1764)	W	x	0	0	x	0	0	0	0
17	Comb Duck (115)	<i>Sarkidiornis melanotos</i> (Pennant, 1769)	W	x	0	0	x	0	0	0	0
18	Northern Shoveller (105)	<i>Anas clypeata</i> Linnaeus, 1758	W	x	0	0	x	0	0	0	0
7	Hawks, Eagles, Buzzards, Old World Vultures, Kites, Harriers	Accipitridae									

19	Black-shouldered Kite (124)	<i>Elanus caeruleus</i> (Desfontaines, 1789)	T	x	x	x ^o	x	x	x	x
20	Black Kite (132-134)	<i>Milvus migrans</i> (Boddaert, 1783)	T	x	x	x ^o	x	x	x	x
21	Brahminy Kite (135)	<i>Haliastur indus</i> (Boddaert, 1783)	WD	x	0	0	x	0	0	0
22	Egyptian Vulture (186-187)	<i>Neophron percnopterus</i> (Linnaeus, 1758)	T	x	0	x ^o	x	0	0	0
23	Indian White-backed Vulture or White-rumped Vulture (185)	<i>Gyps bengalensis</i> (Gmelin, 1788)	T	x ^o	0	0	x ^o	0	0	0
24	Long-billed Vulture (182)	<i>Gyps indicus</i> (Scopoli, 1786)	T	x ^o	0	0	x ^o	0	0	0
25	Red-headed Vulture (178)	<i>Sarcogyps calvus</i> (Scopoli, 1786)	T	x ^o	0	0	x ^o	0	0	0
26	Western Marsh-Harrier or Eurasian Marsh Harrier (193)	<i>Circus aeruginosus</i> (Linnaeus, 1758)	WD	x	0	0	x	0	0	0
27	Shikra (137-140)	<i>Accipiter badius</i> (Gmelin, 1788)	T	x	x	x ^o	x	x	x	x
28	Steppe Eagle (169)	<i>Aquila nipalensis</i> Hodgson, 1833	WD	0	0	0	x	0	0	0
29	Eastern Imperial Eagle (167)	<i>Aquila heliaca</i> Savigny, 1809	WD	0	0	0	x	0	0	0
8	Osprey	Pandionidae								
30	Osprey (203)	<i>Pandion haliaetus</i> (Linnaeus, 1758)	WD	0	0	0	x	0	0	0
9	Falcons	Falconidae								
31	Lesser Kestrel (221)	<i>Falco naumanni</i> Fleischer, 1818	T	0	0	x ^o	0	0	0	0
32	Common Kestrel (222-224)	<i>Falco tinnunculus</i> Linnaeus, 1758	T	0	0	x ^o	x	0	0	0
33	Red-headed Falcon or Red-necked Falcon (219)	<i>Falco chicquera</i> Daudin, 1800	T	0	0	x ^o	0	0	0	0
34	Laggar or Laggar Falcon (208)	<i>Falco jugger</i> J.E. Gray, 1834	T	0	0	x ^o	0	0	0	0
35	Peregrine Falcon (209-211)	<i>Falco peregrinus</i> Tunstall, 1771	WD	x	0	0	0	0	0	0
10	Pheasants, Partridges, Quails	Phasianidae								
36	Grey Francolin (244-246)	<i>Francolinus pondicerianus</i> (Gmelin, 1789)	T	x	0	x ^o	x	0	0	0
37	Rain Quail (252)	<i>Coturnix coromandelica</i> (Gmelin, 1789)	T	0	0	x ^o	0	0	0	0
38	Jungle Bush-Quail (255-258)	<i>Perdica asiatica</i> (Latham, 1790)	T	0	0	x ^o	x	0	0	0
39	Rock Bush-Quail (259-261)	<i>Perdica argoondah</i> (Sykes, 1832)	T	0	0	x ^o	x	0	0	0
40	Grey Junglefowl (301)	<i>Gallus sonneratii</i> Temminck, 1813	T	0	0	x ^o	0	0	0	0
41	Indian Peafowl (311)	<i>Pavo cristatus</i> Linnaeus, 1758	T	x	x	x ^o	x	x	x	x
11	Rails, Crakes, Moorhens, Coots	Rallidae								
42	White-breasted Waterhen (343-345)	<i>Amauromis phoenicurus</i> (Pennant, 1769)	W	x	x	x ^o	x	0	0	x
43	Purple Moorhen or Purple Swamphen (348-349)	<i>Porphyrio porphyrio</i> (Linnaeus, 1758)	W	x	x	x ^o	x	0	0	x
44	Common Moorhen (347-347a)	<i>Gallinula chloropus</i> (Linnaeus, 1758)	W	x	x	x ^o	x	0	0	x
45	Common Coot (350)	<i>Fulica atra</i> Linnaeus, 1758	W	x	x	x ^o	x	0	0	x
12	Jacanas	Jacanidae								
46	Pheasant-tailed Jacana (358)	<i>Hydrophasianus chirurgus</i> (Scopoli, 1786)	W	x	x	x ^o	x	0	0	0
47	Bronze-winged Jacana (359)	<i>Metopidius indicus</i> (Latham, 1790)	W	x	x	x ^o	x	0	0	0
13	Painted-Snipes	Rostratulidae								
48	Greater Painted-Snipe (429)	<i>Rostratula benghalensis</i> (Linnaeus, 1758)	W	x	0	x ^o	x	0	0	0
14	Plovers, Lapwings	Charadriidae								
49	Little Ringed Plover (379-380)	<i>Charadrius dubius</i> Scopoli, 1786	W	x	x	x ^o	x	0	0	0
50	Red-wattled Lapwing (366-368)	<i>Vanellus indicus</i> (Boddaert, 1783)	W	x	x	x ^o	x	x	x	x
15	Sandpipers, Stints, Snipes, Godwits and Curlews	Scolopacidae								
51	Common Snipe (409)	<i>Gallinago gallinago</i> (Linnaeus, 1758)	W	0	0	0	x	0	0	0
52	Black-tailed Godwit (389-390)	<i>Limosa limosa</i> (Linnaeus, 1758)	W	x	x	0	x	0	0	0
53	Common Redshank (393, 394)	<i>Tringa totanus</i> (Linnaeus, 1758)	W	x	x	0	x	0	0	0
54	Wood Sandpiper (398)	<i>Tringa glareola</i> Linnaeus, 1758	W	x	0	0	x	0	0	0
55	Common Sandpiper (401)	<i>Actitis hypoleucos</i> Linnaeus, 1758	W	x	0	0	x	0	0	0
56	Little Stint (416)	<i>Calidris minuta</i> (Leisler, 1812)	W	x	0	0	x	0	0	0

57	Ruff (426)	<i>Philomachus pugnax</i> (Linnaeus, 1758)	W	x	0	0	x	0	0	0
16	Avocets and Stilts	Recurvirostridae								
58	Black-winged Stilt (430-431)	<i>Himantopus himantopus</i> (Linnaeus, 1758)	W	x	0	0	x	0	0	x
17	Stone-Curlew and Stone-Plovers/Thick-knees	Burhinidae								
59	Stone-Curlew or Eurasian Thick-knee (435-436)	<i>Burhinus oedichnemus</i> (Linnaeus, 1758)	T	x	0	0	x	0	0	0
60	Great Stone-Plover or Great Thick-knee (437)	<i>Esacus recurvirostris</i> (Cuvier, 1829)	W	0	0	0	x	0	0	0
18	Gulls, Terns	Laridae								
61	River Tern (463)	<i>Sterna aurantia</i> J.E. Gray, 1831	W	x	0	0	x	0	0	0
19	Pigeons and Doves	Columbidae								
62	Blue Rock Pigeon (516-517)	<i>Columba livia</i> Gmelin, 1789	T	x	x	x ^o	x	x	x	0
63	Little Brown Dove or Laughing Dove (541)	<i>Streptopelia senegalensis</i> (Linnaeus, 1766)	T	x	x	x ^o	x	x	x	0
64	Red Collared-Dove (535-536)	<i>Streptopelia tranquebarica</i> (Hermann, 1804)	T	x	x	x ^o	x	x	x	0
65	Eurasian Collared-Dove (534)	<i>Streptopelia decaocto</i> (Frisvaldszky, 1838)	T	x	x	x ^o	x	x	x	0
20	Parakeets	Psittacidae								
66	Rose-ringed Parakeet (549-550)	<i>Psittacula krameri</i> (Scopoli, 1769)	T	x	x	x ^o	x	0	0	0
21	Cuckoos, Malkohas and Coucals	Cuculidae								
67	Greater Coucal (600-602)	<i>Centropus sinensis</i> (Stephens, 1815)	T	x	x	x ^o	x	0	0	0
22	Owls	Strigidae								
68	Spotted Owlet (650-652)	<i>Athene brama</i> (Temminck, 1821)	T	0	0	x ^o	x	0	0	0
23	Kingfishers	Alcedinidae								
69	Small Blue Kingfisher or Common Kingfisher (722-724)	<i>Alcedo atthis</i> (Linnaeus, 1758)	WD	x	0	0	x	0	0	0
70	White-breasted Kingfisher or White-throated Kingfisher (735-738)	<i>Halcyon smyrnensis</i> (Linnaeus, 1758)	WD	x	x	x ^o	x	x	x	x
24	Bee-eaters	Meropidae								
71	Small Bee-eater (749-752)	<i>Merops orientalis</i> Latham, 1801	T	x	x	x ^o	x	x	x	0
25	Rollers	Coraciidae								
72	Indian Roller (755-757)	<i>Coracias benghalensis</i> (Linnaeus, 1758)	T	x	0	x ^o	x	0	0	0
26	Hoopoes	Upupidae								
73	Common Hoopoe (763-766)	<i>Upupa epops</i> Linnaeus, 1758	T	x	x	x ^o	x	0	0	0
27	Swallows and Martins	Hirundinidae								
74	Dusky Crag-Martin (914)	<i>Hirundo concolor</i> Sykes, 1833	T	x	0	x ^o	x	0	0	0
75	Wire-tailed Swallow (921)	<i>Hirundo smithii</i> Leach, 1818	WD	x	x	x ^o	x	0	0	0
76	Red-rumped Swallow (923-928)	<i>Hirundo daurica</i> Linnaeus, 1771	WD	x	0	x ^o	x	0	0	0
28	Wagtails and Pipits	Motacillidae								
77	White Wagtail (1885-1890)	<i>Motacilla alba</i> Linnaeus, 1758	WD	x	0	x ^o	x	0	0	0
78	Large Pied Wagtail or White-browed Wagtail (1891)	<i>Motacilla maderaspatensis</i> Gmelin, 1789	WD	x	x	x ^o	x	0	0	0
79	Grey Wagtail (1884)	<i>Motacilla cinerea</i> Tunstall, 1771	WD	x	0	x ^o	x	0	0	0
29	Bulbuls	Pycnonotidae								
80	White-eared Bulbul (1123-1124)	<i>Pycnonotus leucotis</i> (Gould, 1836)	T	0	x	0	0	0	0	0
81	Red-vented Bulbul (1126-1132)	<i>Pycnonotus cafer</i> (Linnaeus, 1766)	T	x	x	x ^o	x	x	x	0
30	Shrikes	Laniidae								
82	Rufous-tailed Shrike (942-943)	<i>Lanius isabellinus</i> Hemprich and Ehrenberg, 1833	T	0	0	x ^o	0	0	0	0
83	Brown Shrike (949-950a)	<i>Lanius cristatus</i> Linnaeus, 1758	T	0	0	x ^o	0	0	0	0
84	Bay-backed Shrike (939-940)	<i>Lanius vittatus</i> Valenciennes, 1826	T	0	0	x ^o	x	0	0	0
85	Rufous-backed Shrike or Long-tailed Shrike (946-948)	<i>Lanius schach</i> Linnaeus, 1758	T	0	0	x ^o	0	0	0	0

86	Southern Grey Shrike (933-935)	<i>Lanius meridionalis</i> Temminck, 1820	T	0	0	x ^o	x	0	0	0
31	Thrushes, Robins, Wheaters	Turdinae								
87	Oriental Magpie-Robin (1661-1664)	<i>Copsychus saularis</i> (Linnaeus, 1758)	T	x	x	x ^o	x	0	0	0
88	Indian Robin (1717-1721)	<i>Saxicoloides fulicata</i> (Linnaeus, 1776)	T	x	x	x ^o	x	x	x	0
89	Black Redstart (1671-1672)	<i>Phoenicurus ochruros</i> (Gmelin, 1774)	T	x	0	x ^o	x	0	0	0
90	Indian Chat (1692)	<i>Cercomela fusca</i> (Blyth, 1851)	T	x	x	x ^o	x	x	x	0
32	Babblers	Timaliinae								
91	Rufous-bellied Babbler or Tawny-bellied Babbler (1219-1223)	<i>Dumetia hyperythra</i> (Franklin, 1831)	T	0	0	x ^o	0	0	0	0
92	Large Grey Babbler (1258)	<i>Turdoides malcolmi</i> (Sykes, 1832)	T	x	0	x ^o	x	0	0	0
93	Jungle Babbler (1261-1265)	<i>Turdoides striatus</i> (Dumont, 1823)	T	x	0	x ^o	x	0	0	0
33	Munias (Estrildid Finches)	Estrildidae								
94	White-throated Munia or Indian Silverbill (1966)	<i>Lonchura malabarica</i> (Linnaeus, 1758)	T	0	0	x ^o	0	0	0	0
34	Sparrows	Passerinae								
95	House Sparrow (1938-1939a)	<i>Passer domesticus</i> (Linnaeus, 1758)	T	x	x	x ^o	x	0	x	0
96	Yellow-throated Sparrow or Chestnut-shouldered Petronia (1948-1949)	<i>Petronia xanthocollis</i> (Burton, 1838)	T	0	0	x ^o	0	0	0	0
35	Starlings and Mynas	Sturnidae								
97	Brahminy Starling (994)	<i>Sturnus pagodarum</i> (Gmelin, 1789)	T	0	0	0	x	0	0	0
98	Asian Pied Starling (1002-1004)	<i>Sturnus contra</i> Linnaeus, 1758	T	x	x	x ^o	x	x	x	0
99	Common Myna (1006-1007)	<i>Acridotheres tristis</i> (Linnaeus, 1766)	T	x	x	x ^o	x	x	x	0
100	Bank Myna (1008)	<i>Acridotheres ginginianus</i> (Latham, 1790)	T	x	x	x ^o	x	x	x	0
36	Drongos	Dicruridae								
101	Black Drongo (962-964)	<i>Dicrurus macrocercus</i> Vieillot, 1817	T	x	x	x ^o	x	0	0	0
37	Crows, Treepies	Corvidae								
102	House Crow (1048-1051)	<i>Corvus splendens</i> Vieillot, 1817	T	x	x	x ^o	x	x	x	0
103	Jungle Crow or Large-billed Crow (1054-1057)	<i>Corvus macrorhynchos</i> Wagler, 1827	T	0	0	x ^o	0	0	0	0
	TOTAL			78	45	70	89	22	23	17
<p>Note: x = present records, 0 = no records, x^o = past records Mount Abu* = observations are based on past records (225-256): Numbers within brackets after the common names are the numbers given to species in Ripley's (1982) Synopsis, which was also followed in Ali and Ripley's Handbook T = Terrestrial, W = Wetland, WD = Wetland Dependent R: Resident; RM: Resident with Local Movement; M: Migrant</p>										

Table 2: Checklist of species as per the urban areas.

Indian White-backed Vulture (*Gyps bengalensis*), Long-billed Vulture (*G. indicus*) and Red-headed Vulture (*Sarcogyps calvus*) are the Critically Endangered species, so as the records from the investigation sites. None of the three were sited during the recent year of observations but had the past records from two areas of Udaipur and Bharatpur (Figure 1).

As per the second category of threat i.e., Endangered, two species viz. Egyptian Vulture (*Neophron percnopterus*) and Steppe Eagle (*Aquila nipalensis*) were recorded from sites of dumping sites of Bharatpur (Near NH 11 adjoining Keoladeo National Park)) and Udaipur (*Baleecha*). Eastern Imperial Eagle (*Aquila heliaca*) enlisted in vulnerable category of threatened species were recorded from site of Udaipur (*Baleecha*). Seven NT (Near Threatened) species, Painted Stork (*Mycteria leucocephala*), Black-headed Ibis (*Threskiornis melanocephalus*), Great Thick Knee (*Esacus recurvirostris*), Black-tailed Godwit (*Limosa lapponica*), River Tern (*Sterna aurantia*), Red-headed Falcon (*Falco chicquera*), Lagggar Falcon (*F. jugger*) were enlisted in the

Table 2. Out of these five species were recorded from different sites in the investigation period whereas two (*Falco* sp.) were past records. Thus, dumping (solid and liquid wastes) sites of Udaipur (*Baleecha* and Ahar Nallah) harbored eight species of global interest whereas sites of Bharatpur were visited by four near threatened species.

Activities and behavior

The dumping ground was the site with a great variety of food giving space to several micro and macro fauna and flora. These resulted into the food for the bird species. The most common activity observed for the birds was feeding. In raptors, the common feature was single presence except when the animal carcass was part of disposal wastes. The egrets and passerine species were mostly observed in groups. Same was the case with the aquatic species, which were observed in small flocks with different numbers depending on the area of the sewage or effluent waste water collection sites. The stretches in form of nallah

Sr. No.	Orders	Family	Number of Species			
			Terrestrial	Wetland	Wetland Dependent	No. of Species in Study Area
1	Galliformes	Phasianidae	6	0	0	6
2	Anseriformes	Anatidae	0	4	0	4
3	Upupiformes	Upupidae	1	0	0	1
4	Coraciiformes	Alcedinidae	2	0	2	4
		Meropidae Coraciidae				
5	Cuculiformes	Cuculidae	1	0	0	1
6	Strigiformes	Strigidae	1	0	0	1
7	Columbiformes	Columbidae	4	0	0	4
8	Psittaciformes	Psittacidae	1	0	0	1
9	Gruiformes	Raliidae	0	4	0	4
10	Ciconiiformes	Podicipedidae	12	29	6	47
		Phalacrocoracidae				
		Ardeidae				
		Ciconiidae				
		Threskiornithidae				
		Accipitridae				
		Pandionidae				
		Falconidae				
		Jacaniidae				
		Rostratulidae				
		Charadriidae				
		Scolopacidae				
		Recurvirostridae				
Burhinidae						
Laridae						
11	Passeriformes	Hirundinidae	25	0	5	30
		Motacillidae				
		Pycnonotidae Laniidae				
		Turdinae				
		Timaliinae				
		Estrilidae Passerinae Sturnidae				
		Dicruridae				
		Corvidae				
10 Orders		37 Families	53	37	13	103

Table 3: Order, family and species as per the habitats.

used to had flocks of waders due to its shallow nature. The waterhen species (white-breasted waterhens, swamphens and moorhens) were the species found nesting within or near the waste water sites. Egrets and passerine birds were found nesting only when there was enough vegetation around waste dumping sites. The stretches of Ahar nallah were the observed sites for nesting along with those at Bharatpur. Thus, it was concluded that in presence of the natural resources and habitats, these human modified habitats could be one of the places attracting birds and could be used for birding.

Discussion

The avifaunal species richness is directly or indirectly affected by the environmental characteristics especially in the areas with the high rate of anthropogenic activities [14]. Surman [15] listed several factors of disturbances reflecting ecological and behavioral characteristics in birds. It is important to assess the micro habitats available to birds at

a smaller spatial scale. As per the studies of Anon [16] anthropogenic factors are among the critically important factors in mapping the micro-habitat site in terms of avifaunal sensitivity and ultimately informing the mitigation requirements. In the present investigation, it was observed that the study area harbors ninety percent of the avifauna in their habitats [1,2,8,17,18]. The species richness was greatly affected in the sites of disturbances [1,2,8,17,18]. The waste disposal sites (both solid and liquid) are exclusively observed under the present investigation. Tuljapurkar and Bhagwat [10] observed that the concentration of garbage at one place by civic authorities in towns and mega cities provides an ample supply of food to diverse species including birds. As expected the number of species was not up to the higher side as compared to the other sites low disturbances. Despite of the fact that the conditions were not favorable for the birds, the waste sites harbored substantial number of species. Since the present investigation was a short period investigation of a year and need long-term monitoring to

recommend the sites as a useful resource for avifauna but it observed that the species which are resistant enough to the deteriorating environment use these sites for their life cycle processes. The life cycle processes are mainly food in terms of organic wastes [19,20]. This showed that the sites were not the primary choice of the observed species. If they get the better option, they might shift. Due to limited studies, such interpretations need justifiable study time period to conclude (Supplementary Figures 1-3).

Conclusion

The dumping sites were mostly considered to be useful for a certain professionals of the community dealing with waste as wealth. But these sites could be of great utility for the raptorial species “Vulture Cafeteria” of global interest. The only need is to check and balance. The animal wastes and the biodegradable wastes could be used as a food resource for different species. Further, with the development of green belt around the dumping sites, one could attract the diversity of birds. Thus, these sites could be of great revenue generation for the local municipal bodies.

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