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Journal of Threatened Taxa

Building evidence for conservation globally

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

COMMUNICATION

CONSERVATION STATUS, FEEDING GUILDS, AND DIVERSITY OF BIRDS IN DAROJI SLOTH BEAR SANCTUARY, KARNATAKA, INDIA

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26 June 2021 | Vol. 13 | No. 7 | Pages: 18738–18751

DOI: [10.11609/jott.6855.13.7.18738-18751](https://doi.org/10.11609/jott.6855.13.7.18738-18751)



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Conservation status, feeding guilds, and diversity of birds in Daroji Sloth Bear Sanctuary, Karnataka, India

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Abstract: The present study was carried out to investigate the importance of habitat quality for the diversity, distribution, and abundance of avifauna in Daroji Sloth Bear Sanctuary, Ballari District from February 2015 to January 2016. A total number of 189 species of birds, belonging to 62 families and 18 orders were recorded during the survey. A family-wise analysis showed that the families Accipitridae (12 species), followed by Muscicapidae (11 species), Ardeidae & Alaudidae (8 species each), and Cuculidae (7 species) dominated the avifauna of the region. The residential status of birds revealed that 74% (140 species) were resident, 23% (44 species) were winter, 2% (3 species) were summer and 1% (2 species) was passage migrant's species. The study resulted in the recording of five globally Near Threatened category, viz, Painted Stork, Black-headed Ibis, Oriental Darter, River Tern, and Pallid Harrier; and two Vulnerable species, viz, Yellow-throated Bulbul and Woolly-necked Stork. The feeding guild analysis revealed that the insectivorous guild has the most number of recorded avian species (33%, 63 species), followed by carnivorous (31%, 58 species) and least by nectarivorous (1%, 2 species). This study provides baseline data for monitoring the avifauna in the sanctuary and demonstrates the importance of the area in bird conservation. The study also highlights the negative impact of anthropogenic activities as the main cause for the loss of diversity of both birds and their habitat and the urgent need to conserve this biodiversity-rich area with long-term monitoring programs.

Keywords: Avifaunal diversity, Ballari District, feeding guild, relative abundance, southern Deccan Plateau, threatened fauna, Yellow-throated Bulbul.

Editor: H. Byju, Coimbatore, Tamil Nadu, India.

Date of publication: 26 June 2021 (online & print)

Citation: Harisha, M.N., K.S.A. Samad & B.B. Hosetti (2021). Conservation status, feeding guilds, and diversity of birds in Daroji Sloth Bear Sanctuary, Karnataka, India. *Journal of Threatened Taxa* 13(7): 18738–18751. <https://doi.org/10.11609/jott.6855.13.7.18738-18751>

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Funding: None.

Competing interests: The authors declare no competing interests.

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Author contributions: MNH involved in the design of the research, data collection, analysis and write up of the manuscript. ABS participated in survey, data collection and identification as well as write up of the manuscript. BBH contributed in supervision of data collection and manuscript preparation.

Acknowledgements: We are extremely grateful to all faculty members of the Department of Applied Zoology and Wildlife Management, for their support. We are grateful to the Ballari Department for granting permission to conduct the study in the Daroji Sloth Bear Sanctuary and for their gracious hospitality during the study period.





INTRODUCTION

Birds are good indicators of the ecological status of any ecosystem (Bilgrami 1995). Ecologically; birds are of tremendous importance because of their key roles as pollinators and agents of seed dispersal (Nason 1992; Bibi & Ali 2013). Changes in their population, behavior patterns, and reproductive ability have been used mostly to examine the long-term effects of habitat fragmentation (Harisha & Hosetti 2009). Given the significance of birds for conservation planning and environmental assessments, there is a need for a better ecological understanding of the role of bird diversity patterns and community structure in conservation decision-making (Kati & Sekercioglu 2006).

Forests attract a significant number of birds because they provide suitable habitats for most birds, especially those birds associated with vegetation, and for most, the existence of trees is a vital component of their life cycle. The birds' level of interest in various forests depends on the age of the stand. The composition of bird species is highly related to the vegetation structure of forests (Robertson & Hackwell 1995). The habitat type and structural complexity influence species diversity and the inter-relationship between vegetation and avian population (MacArthur & MacArthur 1961).

Approximately, 9,990 bird species are recorded on our planet and the Indian subcontinent is home to 1,263 bird species (Praveen et al. 2016a), constituting about 12% of the world avifauna. Of these, approximately 531 species of birds have been reported from Karnataka. Due to geographical variation, the Deccan Plateau region of India possesses great diversity in agricultural as well as wild floral and faunal diversity. Therefore, understanding the diversity and structure of bird communities is essential to delineate the importance of regional or local landscapes for avian conservation (Kattan & Franco 2004).

Very few avifaunal works have been done in Daroji Sloth Bear Sanctuary (DSBS). Previously, Neginhal et al. (2003) reported 90 species of birds. Later, Harisha (2013) recorded 135 bird species belonging to 43 families under 16 orders from 2009 to 2012. Except for these earlier reports, no detailed long-term studies have been made on the biodiversity of birds in the study area. In this context, the present study was undertaken to highlight the status, composition, feeding guilds, and diversity of birds of DSBS, Ballari District, Karnataka.

MATERIALS AND METHODS

Study Area

Daraji Sloth Bear Sanctuary is located between Hospet and Sandur Taluk of Ballari District of Karnataka and is spread over 82.72 km² (Figure 1). It is about 50 km from Ballari and about 15 km from the World Heritage Site Hampi. In October 1994, the Government of Karnataka declared 5587.30 ha of the Bilikallu Forest Reserve as Daroji Sloth Bear Sanctuary. After 15 years, in October 2009, the government added 2685.50 ha of the Bukkasagara Forest Reserve to the sanctuary. This resulted in the overall area increasing from 5587.3 ha to 8272.8 ha. It lies between 15.269°N and 76.571°E with an average elevation of 521 m, temperature of 20–46°C & annual rainfall of 450–500 mm. It is a strewn hillock that stretches between Daroji of Sandur Taluk and Ramasagar of Hospet taluk in Ballari District (Image 1, 2). The sanctuary has rich floral and faunal diversity. The flora of this sanctuary is primarily dry deciduous scrub and southern thorn forests. The typical species of scrub jungle, *Grewia damine* is found to be the most abundant species of the plant followed by *Senegalia catechu* and *Albizia amara* in the habitat. It has a very stable population of Sloth Bears and they reside in the numerous caves found in the hillocks within the sanctuary. Leopards, monitor lizards, mongoose, pangolins, and Star Tortoises are some of the other animals that abound in the sanctuary.

Sampling method

A study on avifaunal diversity was carried out from February 2015 to January 2016. The line transect method was used, as the habitat of the study area was of open type (Sutherland et al. 2005). Six line transects were set up, which were approximately 500m in length and 20–30 meters in width. The transect line was walked at a constant pace for approximately 30 minutes. Twelve field visits (1 visit per month) were conducted observing the status and diversity of birds. The field surveys were conducted in the morning (0600–1000 h) and the evening (1600–1900 h), depending on the season when birds were most active. Birds were observed using the Olympus binoculars (10x50), and were identified with the help of field guides (Ali & Ripley 1983; Grimmett et al. 2011) and were given standardized common and scientific names (Praveen et al. 2016b). The residential status of the birds was worked out and birds are grouped under different categories like resident, summer, passage, and winter migrants or visitors depending on their timing and duration of occurrence (Grimmett et

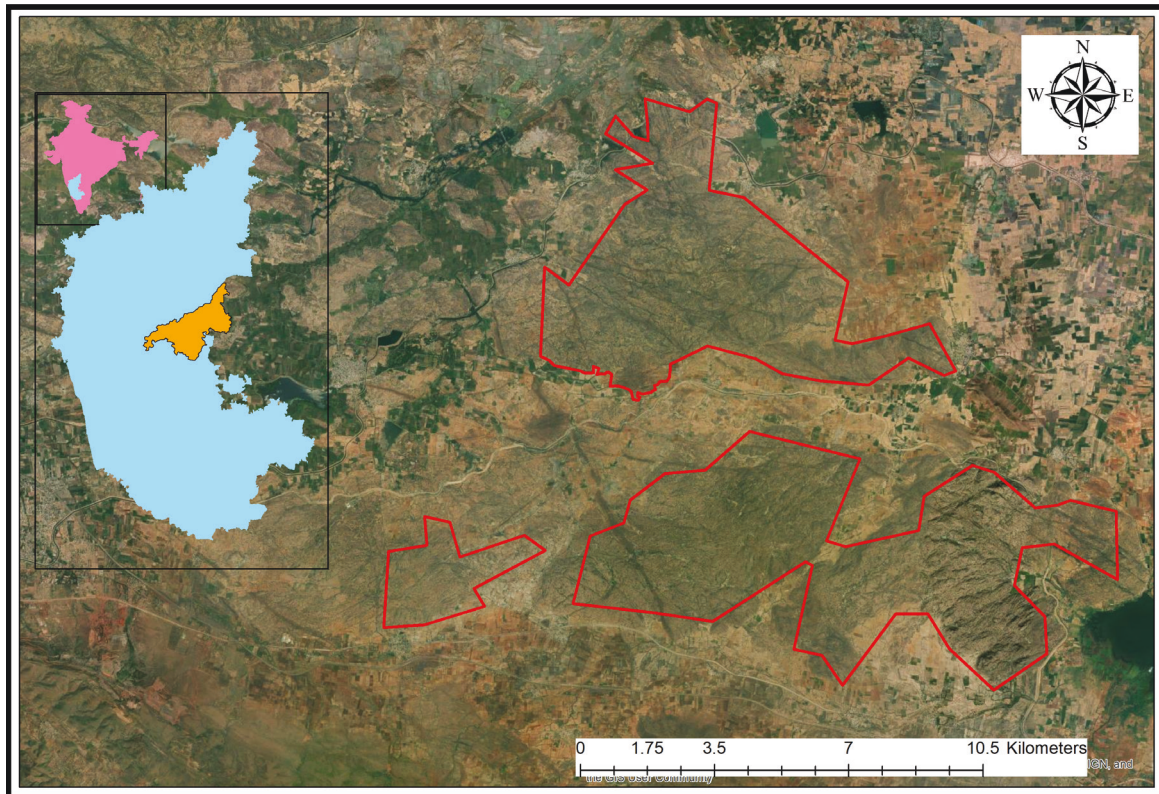


Figure 1. Daroji Sloth Bear Sanctuary, Ballari District, Karnataka.



Image 1. Study area during dry seasons. © M.N. Harisha



Image 2. Study area during wet seasons. © M.N. Harisha

al. 2011). The International Union for the Conservation of Nature (IUCN) Red List status was additionally used to compare the local status with the global status. During the surveys, other information or threats to bird conservation were noted. The data recorded in each survey were kept separate, and later analyzed for relative abundance based on the frequency of bird sightings and are categorized, as very common (Vc) sighted >10 times; common (Co) sighted 7–9 times; uncommon (Uc) sighted 3–6 times; rare (Ra) sighted 1–2 times (MacKinnon & Phillipps 1993). Feeding guilds were classified based

on direct observations and available literature (Ali & Ripley 1987). The relative diversity (RDI) of families was calculated adopting the following formula (Torre-Cuadros et al. 2007):

$$RDI = \frac{\text{Number of bird species in a family}}{\text{Total number of species}} \times 100$$



RESULTS AND DISCUSSION

Avian diversity

A total of 189 species of birds belonging to 62 families under 18 orders were recorded from DSBS. Nonpasserine birds dominated the diversity with 98 species (52%) compared to passerine birds (91 species, 48%) (Table1). The present investigation revealed that out of 62 families, Accipitridae dominated the study area with maximum number of species and RDI value, i.e., 12 species (RDI= 6.45%), followed by Muscicapidae with 11 species (RDI= 5.91%), Ardeidae and Alaudidae with 8 species (RDI= 4.30%) each, Cuculidae with seven species (RDI= 3.76%), Phasianidae, Scolopacidae, Cisticolidae with six species (RDI= 3.23%) each, Anatidae, Columbidae, Motacillidae, Hirundinidae, Sturnidae, Rallidae with five species (RDI= 2.69%) each, Laniidae, Estrildidae, Pycnonotidae, Leiothrichidae with four species (RDI= 2.15%) each, Ciconiidae, Phalacrocoracidae, Charadriidae, Strigidae, Picidae, Alcedinidae, Corvidae, Emberizidae, Acrocephalidae, Phylloscopidae with three species (RDI= 1.61%) each, Pteroclididae, Apodidae, Threskiornithidae, Jacanidae, Meropidae, Falconidae, Psittaculidae, Campephagidae, Dicuridae, Dicaeidae, Nectariniidae, Ploceidae, Passeridae, Sylviidae with two species (RDI=1.08%), Podicipitidae, Caprimulgidae, Anhingidae, Burhinidae, Recurvirostridae, Turnicidae, Laridae, Tytonidae, Bucerotidae, Upupidae, Ramphastidae, Coraciidae, Pittidae, Oriolidae, Vangidae, Aegithinidae, Monarchidae, Paridae, Zosteropidae, Timaliidae with one species (RDI= 0.54) each respectively (Table 2). A similar pattern of dominance of Accipitridae was observed by different authors from different protected areas in India, i.e., from Araku Valley of Ananthagiri Hills of the Eastern Ghats in Visakhapatnam, Andhra Pradesh (Kumar et al. 2010), a scrub forest of Sri Lankamalleswara Wildlife Sanctuary, Andhra Pradesh (Mali et al. 2017), Tamhini Wildlife Sanctuary, the northern Western Ghats, Maharashtra (Vinayak & Mali 2018), and Bhimbandh Wildlife Sanctuary, Bihar (Khan & Pant 2017).

Avian community structure as per residential status and relative abundance

The analysis of data on the residential status revealed that out of 189 species, 140 (74%) were resident, 44 (23%) winter, 3 (2%) summer, and 2 (1%) passage migrants respectively (Figure 2). The occurrence of a significant number of winter migrant species can be attributed partly to the study area being on the Central Asian Flyway and serving as a wintering and stopover site for migratory birds that breed in the Palearctic region

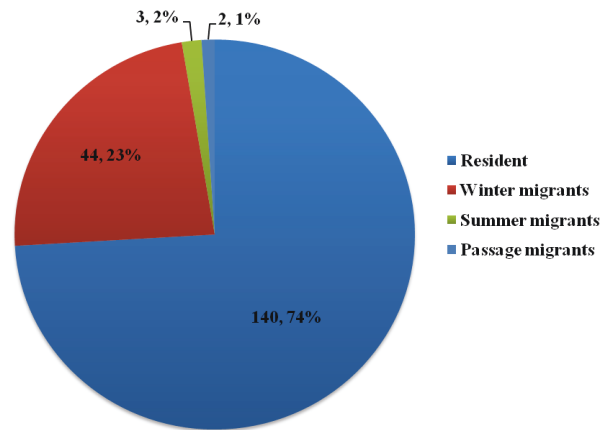


Figure 2. Residential status (%) of birds at Daroji Sloth Bear Sanctuary.

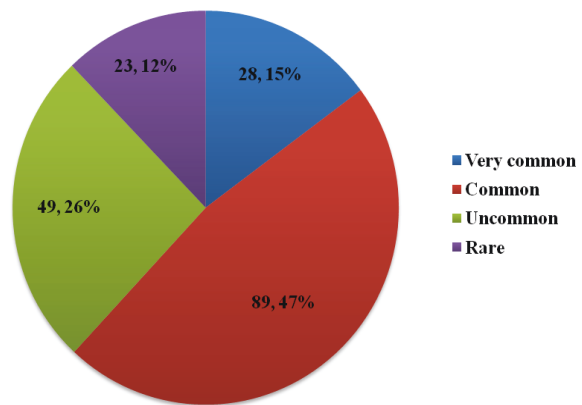


Figure 3. Relative abundance (%) of birds at Daroji Sloth Bear Sanctuary.

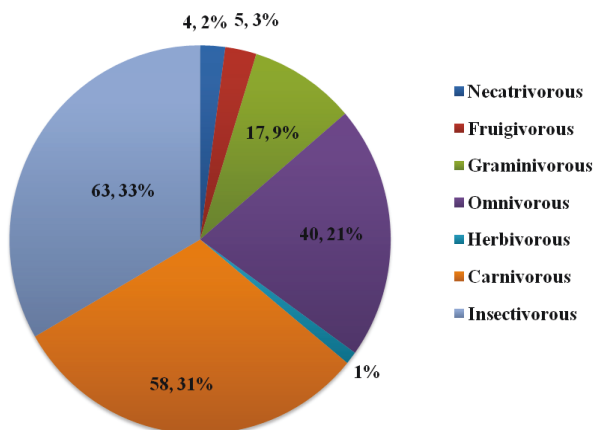


Figure 4. Feeding guilds (%) of birds at Daroji Sloth Bear Sanctuary.

(Kumar et al. 2016). The spatio-temporal distribution and relative abundance of avifauna in any given habitat are determined based on the quality and quantity of food available as the major factor (Wiens 1989; Ma et

Table 1. Systematic list and status of Birds in Daroji Sloth Bear Sanctuary, Karnataka.

	Common name	Scientific name	Feeding guilds	Residential status	Relative abundance	IUCN	WPA
	Order: Anseriformes						
	Family: Anatidae						
1	Lesser Whistling Duck	<i>Dendrocygna javanica</i> Horsfield, 1821	O	R	Co	LC	Sch. IV
2	Garganey	<i>Spatula querquedula</i> Linnaeus, 1758	H	Wm	Ra	LC	Sch. IV
3	Northern Shoveler	<i>Spatula clypeata</i> Linnaeus, 1758	C	Wm	Ra	LC	Sch. IV
4	Indian Spot-billed Duck	<i>Anas poecilorhyncha</i> J.R. Forster, 1781	H	R	Co	LC	Sch. IV
5	Northern Pintail	<i>Anas acuta</i> Linnaeus, 1758	C	Wm	Ra	LC	Sch. IV
	Order: Galliformes						
	Family: Phasianidae						
6	Rain Quail	<i>Coturnix coromandelica</i> J.F. Gmelin, 1789	G	R	Co	LC	Sch. IV
7	Jungle Bush Quail	<i>Perdica asiatica</i> Latham, 1790	G	R	Vc	LC	Sch. IV
8	Rock Bush Quail	<i>Perdica argoindah</i> Sykes, 1832	G	R	Vc	LC	Sch. IV
9	Grey Francolin	<i>Francolinus pondicerianus</i> J.F. Gmelin, 1789	G	R	Vc	LC	Sch. IV
10	Painted Spurfowl	<i>Galloperdix lunulata</i> Valenciennes, 1825	O	R	Vc	LC	Sch. IV
11	Indian Peafowl	<i>Pavo cristatus</i> Linnaeus, 1758	O	R	Vc	LC	Sch. I
	Order: Phoenicopteriformes						
	Family: Podicipitidae						
12	Little Grebe	<i>Tachybaptus ruficollis</i> Pallas, 1764	C	R	Co	LC	Sch. IV
	Order: Columbiformes						
	Family: Columbidae						
13	Rock Pigeon	<i>Columba livia</i> J.F. Gmelin, 1789	G	R	Vc	LC	Sch. IV
14	Spotted Dove	<i>Streptopelia chinensis</i> Scopoli, 1786	G	R	Vc	LC	Sch. IV
15	Eurasian Collared Dove	<i>Streptopelia decaocto</i> Frivaldszky, 1838	G	R	Vc	LC	Sch. IV
16	Laughing Dove	<i>Streptopelia senegalensis</i> Linnaeus, 1766	G	R	Vc	LC	Sch. IV
17	Red Collared Dove	<i>Streptopelia tranquebarica</i> Hermann, 1804	G	R	Co	LC	Sch. IV
	Order: Pteroclidiformes						
	Family: Pteroclididae						
18	Chestnut-bellied Sandgrouse	<i>Pterocles exustus</i> Temminck, 1825	G	R	Co	LC	Sch. IV
19	Painted Sandgrouse	<i>Pterocles indicus</i> J.F. Gmelin, 1789	G	R	Co	LC	Sch. IV
	Order: Caprimulgiformes						
	Family: Caprimulgidae						
20	Indian Nightjar	<i>Caprimulgus asiaticus</i> Latham, 1790	I	R	UC	LC	Sch. IV
	Family: Apodidae						
21	Indian House Swift	<i>Apus affinis</i> J.E. Gray, 1830	I	R	VC	LC	Sch. IV
22	Asian Palm Swift	<i>Cypsiurus balasiensis</i> J.E. Gray, 1829	I	R	Co	LC	Sch. IV
	Order: Cuculiformes						
	Family: Cuculidae						
23	Asian Koel	<i>Eudynamis scolopacea</i> Linnaeus, 1758	F	R	Co	LC	Sch. IV
24	Greater Coucal	<i>Centropus sinensis</i> Stephens, 1815	O	R	Co	LC	Sch. IV
25	Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i> Jerdon, 1840	O	R	Co	LC	Sch. IV
26	Common Hawk Cuckoo	<i>Hierococcyx varius</i> Vahl, 1797	I	R	Co	LC	Sch. IV
27	Sirkeer Malkoha	<i>Taccocua leschenaultia</i> Lesson, 1830	I	R	Uc	LC	Sch. IV
28	Crested Pied Cuckoo	<i>Clamator jacobinus</i> Boddaert, 1783	I	Sm	Uc	LC	Sch. IV
29	Grey-bellied Cuckoo	<i>Cacomantis passerinus</i> Vahl, 1797	I	R	Uc	LC	Sch. IV



	Common name	Scientific name	Feeding guilds	Residential status	Relative abundance	IUCN	WPA
	Order: Gruiformes						
	Family: Rallidae						
30	Common Coot	<i>Fulica atra</i> Linnaeus, 1758	O	R	Co	LC	Sch. IV
31	White-breasted Waterhen	<i>Amaurornis phoenicurus</i> Pennant, 1769	O	R	Co	LC	Sch. IV
32	Slaty-breasted Rail	<i>Lewinia striata</i> Linnaeus, 1766	O	R	Uc	LC	Sch. IV
33	Brown Crake	<i>Zapornia akool</i> Sykes, 1832	O	R	Co	LC	Sch. IV
34	Purple Swamphen	<i>Porphyrio porphyrio</i> Linnaeus, 1758	O	R	Co	LC	Sch. IV
	Order: Pelecaniformes						
	Family: Ciconiidae						
35	Painted Stork	<i>Mycteria leucocephala</i> Pennant, 1769	C	R	Ra	NT	Sch. IV
36	Woolly-necked Stork	<i>Ciconia episcopus</i> Boddaert, 1783	C	R	Co	VU	Sch. IV
37	Asian Openbill	<i>Anastomus oscitans</i> Boddaert, 1783	C	R	Co	LC	Sch. IV
	Family: Ardeidae						
38	Little Egret	<i>Egretta garzetta</i> Linnaeus, 1766	C	R	Vc	LC	Sch. IV
39	Intermediate Egret	<i>Ardea intermedia</i> Wagler, 1829	C	R	Co	LC	Sch. IV
40	Cattle Egret	<i>Bubulcus ibis</i> Linnaeus, 1758	C	R	Vc	LC	Sch. IV
41	Great Egret	<i>Ardea alba</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
42	Indian Pond Heron	<i>Ardeola grayii</i> Sykes, 1832	C	R	Vc	LC	Sch. IV
43	Striated Heron	<i>Butorides striata</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
44	Grey Heron	<i>Ardea cinerea</i> Linnaeus, 1758	C	Pm	Co	LC	Sch. IV
45	Purple Heron	<i>Ardea purpurea</i> Linnaeus, 1766	C	R	Co	LC	Sch. IV
	Family: Threskiornithidae						
46	Black-headed Ibis	<i>Threskiornis melanocephalus</i> Latham, 1790	C	R	Co	NT	Sch. IV
47	Indian Black Ibis	<i>Pseudibis papillosa</i> Temminck, 1824	C	R	Co	LC	Sch. IV
	Family: Phalacrocoracidae						
48	Little Cormorant	<i>Microcarbo niger</i> Vieillot, 1817	C	R	Co	LC	Sch. IV
49	Indian Cormorant	<i>Phalacrocorax fuscicollis</i> Stephens, 1826	C	R	Co	LC	Sch. IV
50	Great Cormorant	<i>Phalacrocorax carbo</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
	Family: Anhingidae						
51	Oriental Darter	<i>Anhinga melanogaster</i> Pennant, 1769	C	R	Co	NT	Sch. IV
	Order: Charadriiformes						
	Family: Burhinidae						
52	Indian Thick-knee	<i>Burhinus oediconemus</i> Linnaeus, 1758	C	R	Uc	LC	Sch. IV
	Family: Charadriidae						
53	Yellow-wattled Lapwing	<i>Vanellus malabaricus</i> Boddaert, 1783	C	R	Uc	LC	Sch. IV
54	Red-wattled Lapwing	<i>Vanellus indicus</i> Boddaert, 1783	C	R	Co	LC	Sch. IV
55	Little Ringed Plover	<i>Charadrius dubius</i> Scopoli, 1786	C	Wm	Uc	LC	Sch. IV
	Family: Recurvirostridae						
56	Black-winged Stilt	<i>Himantopus himantopus</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. IV
	Family: Jacanidae						
57	Bronze-winged Jacana	<i>Metopidius indicus</i> Latham, 1790	C	R	Co	LC	Sch. IV
58	Pheasant-tailed jacana	<i>Hydrophasianus chirurgus</i> Scopoli, 1786	C	R	Co	LC	Sch. IV
	Family: Scolopacidae						
59	Little Stint	<i>Calidris minuta</i> Leisler, 1812	C	Wm	Uc	LC	Sch. IV
60	Wood Sandpiper	<i>Tringa glareola</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. IV
61	Common Snipe	<i>Gallinago gallinago</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. IV

	Common name	Scientific name	Feeding guilds	Residential status	Relative abundance	IUCN	WPA
62	Common Sandpiper	<i>Actitis hypoleucos</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. IV
63	Marsh Sandpiper	<i>Tringa stagnatilis</i> Bechstein, 1803	C	Wm	Uc	LC	Sch. IV
64	Green Sandpiper	<i>Tringa ochropus</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. IV
	Family: Turnicidae						
65	Barred Buttonquail	<i>Turnix suscitator</i> J.F. Gmelin, 1789	C	R	Co	LC	Sch. IV
	Family: Laridae						
66	River Tern	<i>Sterna aurantia</i> J.E. Gray, 1831	C	R	Co	NT	Sch. IV
	Order: Accipitriformes						
	Family: Accipitridae						
67	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i> Temminck, 1821	C	R	Uc	LC	Sch. I
68	Black-winged Kite	<i>Elanus caeruleus</i> Desfontaines, 1789	C	R	Co	LC	Sch. I
69	Short-toed Snake Eagle	<i>Circaetus gallicus</i> J.F. Gmelin, 1788	C	R	Uc	LC	Sch. I
70	Shikra	<i>Accipiter badius</i> J.F. Gmelin, 1788	C	R	Co	LC	Sch. I
71	Black Eagle	<i>Ictinaetus malaiensis</i> Temminck, 1822	C	R	Uc	LC	Sch. I
72	Booted Eagle	<i>Hieraetus pennatus</i> J.F. Gmelin, 1788	C	Wm	Uc	LC	Sch. I
73	Bonelli's Eagle	<i>Aquila fasciata</i> Vieillot, 1822	C	R	Co	LC	Sch. I
74	Pallid Harrier	<i>Circus macrourus</i> S.G. Gmelin, 1770	C	Wm	Ra	NT	Sch. I
75	Western Marsh Harrier	<i>Circus aeruginosus</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. I
76	Montagu's Harrier	<i>Circus pygargus</i> Linnaeus, 1758	C	Wm	Ra	LC	Sch. I
77	Black Kite	<i>Milvus migrans</i> Boddaert, 1783	C	R	Co	LC	Sch. I
78	Brahminy Kite	<i>Haliastur Indus</i> Boddaert, 1783	C	R	Co	LC	Sch. I
	Order: Strigiformes						
	Family: Tytonidae						
79	Barn Owl	<i>Tyto alba</i> Scopoli, 1769	C	R	Co	LC	Sch. IV
	Family: Strigidae						
80	Indian Eagle Owl	<i>Bubo bengalensis</i> Franklin, 1831	C	R	Co	LC	Sch. IV
81	Brown Fish Owl	<i>Ketupa zeylonensis</i> J.F. Gmelin, 1788	C	R	Co	LC	Sch. IV
82	Spotted Owlet	<i>Athene brama</i> Temminck, 1821	C	R	Co	LC	Sch. IV
	Order: Bucerotiformes						
	Family: Bucerotidae						
83	Indian Grey Hornbill	<i>Ocyrceros birostris</i> Scopoli, 1786	F	R	Uc	LC	Sch. I
	Family: Upupidae						
84	Common Hoopoe	<i>Upupa epops</i> Linnaeus, 1758	I	R	Co	LC	Sch. IV
	Order: Piciformes						
	Family: Picidae						
85	Eurasian Wryneck	<i>Jynx torquilla</i> Linnaeus, 1758	I	Wm	Ra	LC	Sch. IV
86	Yellow-crowned Woodpecker	<i>Dendrocopos mahrattensis</i> Latham, 1801	I	R	Co	LC	Sch. IV
87	Lesser Golden-backed Woodpecker	<i>Dinopium benghalense</i> Linnaeus, 1758	I	R	Co	LC	Sch. IV
	Family: Ramphastidae						
88	Coppersmith Barbet	<i>Psilopogon haemacephalus</i> Muller, 1776	F	R	Co	LC	Sch. IV
	Order: Coraciiformes						
	Family: Meropidae						
89	Green Bee-eater	<i>Merops orientalis</i> Latham, 1801	I	R	Vc	LC	Sch. IV
90	Blue-tailed Bee-eater	<i>Merops philippinus</i> Linnaeus, 1767	I	Wm	Uc	LC	Sch. IV
	Family: Coraciidae						
91	Indian Roller	<i>Coracias benghalensis</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV



	Common name	Scientific name	Feeding guilds	Residential status	Relative abundance	IUCN	WPA
	Family: Alcedinidae						
92	Common Kingfisher	<i>Alcedo atthis</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
93	White-throated Kingfisher	<i>Halcyon smyrnensis</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
94	Pied Kingfisher	<i>Ceryle rudis</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
	Order: Falconiformes						
	Family: Falconidae						
95	Common Kestrel	<i>Falco tinnunculus</i> Linnaeus, 1758	C	Wm	Uc	LC	Sch. IV
96	Peregrine Falcon	<i>Falco peregrinus</i> Tunstall, 1771	C	Wm	Uc	LC	Sch. I
	Order: Psittaciformes						
	Family: Psittaculidae						
97	Rose-ringed Parakeet	<i>Psittacula krameri</i> Scopoli, 1769	F	R	Vc	LC	Sch. IV
98	Plum-headed Parakeet	<i>Psittacula cyanocephala</i> Linnaeus, 1766	F	R	Uc	LC	Sch. IV
	Order: Passeriformes						
	Family: Pittidae						
99	Indian Pitta	<i>Pitta brachyuran</i> Linnaeus, 1766	I	Sm	Ra	LC	Sch. IV
	Family: Campephagidae						
100	Black-headed Cuckooshrike	<i>Lalage melanoptera</i> Ruppell, 1839	I	R	Uc	LC	Sch. IV
101	Small Minivet	<i>Pericrocotus cinnamomeus</i> Linnaeus, 1766	I	R	Uc	LC	Sch. IV
	Family: Oriolidae						
102	Indian Golden Oriole	<i>Oriolus kundoo</i> Sykes, 1832	O	Sm	Co	LC	Sch. IV
	Family: Vangidae						
103	Common Woodshrike	<i>Tephrodornis pondicerianus</i> J.F. Gmelin, 1789	I	R	Co	LC	Sch. IV
	Family: Aegithinidae						
104	Common Iora	<i>Aegithina tiphia</i> Linnaeus, 1758	I	R	Co	LC	Sch. IV
	Family: Dicruridae						
105	Black Drongo	<i>Dicrurus macrocerus</i> Vieillot, 1817	O	R	Co	LC	Sch. IV
106	White-bellied Drongo	<i>Dicrurus caeruleus</i> Linnaeus, 1758	O	R	Uc	LC	Sch. IV
107	Ashy Drongo	<i>Dicrurus leucophaeus</i> Vieillot, 1817	O	Wm	Uc	LC	Sch. IV
	Family: Laniidae						
108	Brown Shrike	<i>Lanius cristatus</i> Linnaeus, 1758	I	Wm	Uc	LC	Sch. IV
109	Long-tailed Shrike	<i>Lanius schach</i> Linnaeus, 1758	I	R	Co	LC	Sch. IV
110	Bay-backed Shrike	<i>Lanius vitta</i> Valenciennes, 1826	I	R	Co	LC	Sch. IV
111	Southern Grey Shrike	<i>Lanius excubitor</i> Linnaeus, 1758	C	R	Co	LC	Sch. IV
	Family: Corvidae						
112	Rufous Treepie	<i>Dendrocitta vagabunda</i> Latham, 1790	O	R	Co	LC	Sch. IV
113	House Crow	<i>Corvus splendens</i> Vieillot, 1817	O	R	Co	LC	Sch. IV
114	Jungle Crow	<i>Corvus macrorhynchos</i> Wagler, 1827	O	R	Co	LC	Sch. IV
	Family: Monarchidae						
115	Indian Paradise Flycatcher	<i>Terpsiphone paradise</i> Linnaeus, 1758	I	R	Co	LC	Sch. IV
	Family: Dicaeidae						
116	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i> Latham, 1790	N	R	Co	LC	Sch. IV
117	Thick-billed Flowerpecker	<i>Dicaeum agile</i> Tickell, 1833	N	R	Co	LC	Sch. IV
	Family: Nectariniidae						
118	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i> Linnaeus, 1766	N	R	Vc	LC	Sch. IV
119	Purple Sunbird	<i>Cinnyris asiaticus</i> Latham, 1790	N	R	Vc	LC	Sch. IV

	Common name	Scientific name	Feeding guilds	Residential status	Relative abundance	IUCN	WPA
	Family: Ploceidae						
120	Baya Weaver	<i>Ploceus philippinus</i> Linnaeus, 1766	G	R	Vc	LC	Sch. IV
121	Streaked Weaver	<i>Ploceus manyar</i> Horsfield, 1821	G	R	Uc	LC	Sch. IV
	Family: Estrildidae						
122	Red Avadavat	<i>Amandava amandava</i> Linnaeus, 1758	G	R	Uc	LC	Sch. IV
123	Indian Silverbill	<i>Euodice malabarica</i> Linnaeus, 1758	G	R	Vc	LC	Sch. IV
124	Black-headed Munia	<i>Lonchura Malacca</i> Linnaeus, 1766	G	R	Co	LC	Sch. IV
125	Scaly-breasted Munia	<i>Lonchura punctulata</i> Linnaeus, 1758	G	R	Vc	LC	Sch. IV
	Family: Passeridae						
126	House Sparrow	<i>Passer domesticus</i> Linnaeus, 1758	O	R	Vc	LC	Sch. IV
127	Yellow-throated Sparrow	<i>Gymnoris xanthocolis</i> E. Burton, 1838	O	R	Uc	LC	Sch. IV
	Family: Motacillidae						
128	White-browed Wagtail	<i>Motacilla maderaspatensis</i> J.F. Gmelin, 1789	I	R	Co	LC	Sch. IV
129	Western Yellow Wagtail	<i>Motacilla flava</i> Linnaeus, 1758	I	Wm	Uc	LC	Sch. IV
130	Grey Wagtail	<i>Motacilla cinerea</i> Tunstall, 1771	I	Wm	Uc	LC	Sch. IV
131	White Wagtail	<i>Motacilla alba</i> Linnaeus, 1758	I	Wm	Uc	LC	Sch. IV
132	Paddyfield Pipit	<i>Anthus rufulus</i> Vieillot, 1818	I	R	Uc	LC	Sch. IV
	Family: Emberizidae						
133	Red-headed Bunting	<i>Granativora bruniceps</i> von Brandt, 1841	I	Wm	Ra	LC	Sch. IV
134	Black-headed Bunting	<i>Granativora melanocephala</i> Scopoli, 1769	I	Wm	Ra	LC	Sch. IV
135	Grey-necked Bunting	<i>Emberiza buchanani</i> Blyth, 1845	I	Wm	Ra	LC	Sch. IV
	Family: Paridae						
136	Cinereous (Great) Tit	<i>Parus cinereus</i> Vieillot, 1818	I	R	Co	LC	Sch. IV
	Family: Alaudidae						
137	Ashy-crowned Sparrow Lark	<i>Eremopterix grisea</i> Scopoli, 1786	I	R	Vc	LC	Sch. IV
138	Singing Bushlark	<i>Mirafra cantillans</i> Blyth, 1845	O	R	Co	LC	Sch. IV
139	Sykes's Lark	<i>Galerida deva</i> Sykes, 1832	O	R	Co	LC	Sch. IV
140	Crested Lark	<i>Galerida cristata</i> Linnaeus, 1758	O	R	Co	LC	Sch. IV
141	Jerdon's Bushlark	<i>Mirafra affinis</i> Blyth, 1845	O	R	Co	LC	Sch. IV
142	Oriental Skylark	<i>Alauda gulgula</i> Franklin, 1831	O	Wm	Uc	LC	Sch. IV
143	Indian Bushlark	<i>Mirafra erythroptera</i> Blyth, 1845	O	R	Co	LC	Sch. IV
144	Rufous-tailed Finch Lark	<i>Ammomanes phoenicura</i> Franklin, 1831	O	R	Co	LC	Sch. IV
	Family: Cisticolidae						
145	Zitting Cisticola	<i>Cisticola juncidis</i> Rafinesque, 1810	I	R	Uc	LC	Sch. IV
146	Grey-breasted Prinia	<i>Prinia hodgsonii</i> Blyth, 1844	I	R	Co	LC	Sch. IV
147	Ashy Prinia	<i>Prinia socialis</i> Sykes, 1832	I	R	Co	LC	Sch. IV
148	Plain Prinia	<i>Prinia inornata</i> Sykes, 1832	I	R	Co	LC	Sch. IV
149	Jungle Prinia	<i>Prinia sylvatica</i> Jerdon, 1840	I	R	Co	LC	Sch. IV
150	Common Tailorbird	<i>Orthotomus sutorius</i> Pennant, 1769	I	R	Co	LC	Sch. IV
	Family: Acrocephalidae						
151	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i> Blyth, 1849	I	Wm	Ra	LC	Sch. IV
152	Clamorous Reed Warbler	<i>Acrocephalus stentoreus</i> Hemprich & Ehrenberg, 1833	I	R	Ra	LC	Sch. IV
153	Booted Warbler	<i>Iduna caligata</i> M.H.C. Lichtenstein, 1823	I	Wm	Ra	LC	Sch. IV
	Family: Hirundinidae						
154	Dusky Crag Martin	<i>Ptyonoprogne concolor</i> Sykes, 1832	I	R	Vc	LC	Sch. IV



	Common name	Scientific name	Feeding guilds	Residential status	Relative abundance	IUCN	WPA
155	Barn Swallow	<i>Hirundo rustica</i> Linnaeus, 1758	I	Wm	Ra	LC	Sch. IV
156	Wire-tailed Swallow	<i>Hirundo smithii</i> Leach, 1818	I	R	Co	LC	Sch. IV
157	Red-rumped Swallow	<i>Cecropis daurica</i> Laxmann, 1769	I	R	Ra	LC	Sch. IV
158	Streak-throated Swallow	<i>Petrochelidon fluvicola</i> Blyth, 1855	I	R	Ra	LC	Sch. IV
	Family: Pycnonotidae						
159	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i> Linnaeus, 1758	O	R	Vc	LC	Sch. IV
160	Red-vented Bulbul	<i>Pycnonotus cafer</i> Linnaeus, 1766	O	R	Vc	LC	Sch. IV
161	White-browed Bulbul	<i>Pycnonotus luteolus</i> Lesson, 1841	O	R	Co	LC	Sch. IV
162	Yellow-throated Bulbul	<i>Pycnonotus xantholaemus</i> Jerdon, 1845	O	R	Uc	VU	Sch. IV
	Family: Phylloscopidae						
163	Greenish Leaf Warbler	<i>Seicercus trochiloides</i> Sundevall, 1837	I	Wm	Ra	LC	Sch. IV
164	Tickell's leaf warbler	<i>Phylloscopus affinis</i> Tickell, 1833	I	Wm	Ra	LC	Sch. IV
165	Green Leaf Warbler	<i>Seicercus nitidus</i> Blyth, 1843	I	Pm	Ra	LC	Sch. IV
	Family: Sylviidae						
166	Yellow-eyed Babbler	<i>Chrysomma sinense</i> J.F. Gmelin, 1789	I	R	Co	LC	Sch. IV
167	Hume's (Lesser) Whitethroat	<i>Curruca curruca</i> Linnaeus, 1758	I	Wm	Ra	LC	Sch. IV
	Family Zosteropidae						
168	Oriental White-eye	<i>Zosterops palpebrosus</i> Temminck, 1824	I	R	Uc	LC	Sch. IV
	Family: Timaliidae						
169	Tawny-bellied babbler	<i>Dumetia hyperythra</i> Franklin, 1831	O	R	Uc	LC	Sch. IV
	Family: Leiothrichidae						
170	Common Babbler	<i>Argya caudata</i> Dumont, 1823	O	R	Co	LC	Sch. IV
171	Jungle Babbler	<i>Turdoides striata</i> Dumont, 1823	O	R	Vc	LC	Sch. IV
172	Large Grey Babbler	<i>Argya malcolmi</i> Sykes, 1832	O	R	Vc	LC	Sch. IV
173	Yellow-billed Babbler	<i>Turdoides affinis</i> Jerdon, 1845	O	R	Vc	LC	Sch. IV
	Family: Sturnidae						
174	Chestnut-tailed Starling	<i>Sturnia malabarica</i> J.F. Gmelin, 1789	O	Wm	Uc	LC	Sch. IV
175	Brahminy Starling	<i>Sturnia pagodarum</i> J.F. Gmelin, 1789	O	R	Co	LC	Sch. IV
176	Common Myna	<i>Acridotheres tristis</i> Linnaeus, 1766	O	R	Co	LC	Sch. IV
177	Jungle Myna	<i>Acridotheres fuscus</i> Wagler, 1827	O	R	Co	LC	Sch. IV
178	Rosy Starling	<i>Pastor roseus</i> Linnaeus, 1758	O	Wm	Uc	LC	Sch. IV
	Family: Muscicapidae						
179	Bluethroat	<i>Luscinia svecica</i> Linnaeus, 1758	I	Wm	Ra	LC	Sch. IV
180	Indian Robin	<i>Saxicoloides fulvatus</i> Linnaeus, 1766	I	R	Co	LC	Sch. IV
181	Oriental Magpie Robin	<i>Copsychus saularis</i> Linnaeus, 1758	I	R	Co	LC	Sch. IV
182	Asian Brown Flycatcher	<i>Muscicapa dauurica</i> Pallas, 1811	I	Wm	Ra	LC	Sch. IV
183	Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i> Blyth, 1843	I	R	Co	LC	Sch. IV
184	Verditer Flycatcher	<i>Eumyias thalassinus</i> Swainson, 1838	I	Wm	Uc	LC	Sch. IV
185	Red-breasted Flycatcher	<i>Ficedula parva</i> Bechstein, 1792	I	Wm	Uc	LC	Sch. IV
186	Black Redstart	<i>Phoenicurus ochruros</i> S.G. Gmelin, 1774	I	Wm	Uc	LC	Sch. IV
187	Blue Rock Thrush	<i>Monticola solitarius</i> Linnaeus, 1758	I	Wm	Uc	LC	Sch. IV
188	Pied Bushchat	<i>Saxicola caprata</i> Linnaeus, 1766	I	R	Co	LC	Sch. IV
189	Siberian Stonechat	<i>Saxicola maurus</i> Pallas, 1773	I	Wm	Uc	LC	Sch. IV

IUCN Red List categories: LC—Least Concern | NT—Near Threatened | VU—Vulnerable | WPA Schedules (I, II, III, IV) as per Indian Wildlife (Protection) Act, 1972 | Residential Status: R—Resident | Wm—Winter migrant | Sm—Summer migrant | Pm—Passage migrant | Feeding guilds: I—Insectivorous | C—Carnivorous | H—Herbivorous | O—Omnivorous | G—Granivorous | F—Frugivorous | N—Nectarivorous | Relative Abundance: Co—Common | Uc—Uncommon | Vc—Very common | Ra—Rare.

Table 2. Relative diversity index (RDI) of various avian families at Daroji Sloth Bear Sanctuary, Karnataka.

	Family	No. of species	RDI
1	Accipitridae	12	6.45
	Muscicapidae	11	5.91
2	Ardeidae	8	4.30
	Alaudidae		
3	Cuculidae	7	3.76
4	Phasianidae	6	3.23
	Scolopacidae		
	Cisticolidae		
5	Anatidae	5	2.69
	Columbidae		
	Motacillidae		
	Hirundinidae		
	Sturnidae		
Rallidae			
6	Laniidae	4	2.15
	Estrildidae		
	Pycnonotidae		
	Leiothrichidae		
7	Ciconiidae	3	1.61
	Phalacrocoracidae		
	Charadriidae		
	Strigidae		
	Picidae		
	Alcedinidae		
	Corvidae		
	Emberizidae		
	Acrocephalidae		
	Phylloscopidae		
8	Pteroclididae	2	1.08
	Apodidae		
	Threskiornithidae		
	Jacaniidae		
	Meropidae		
	Falconidae		
	Psittaculidae		
	Campephagidae		
	Dicruridae		
	Dicaeidae		
	Nectariniidae		
	Ploceidae		
	Passeridae		
Sylviidae			
9	Podicipitidae	1	0.54
	Caprimulgidae		
	Anhingidae		
	Burhinidae		
	Recurvirostridae		
	Turnicidae		
	Laridae		
	Tytonidae		
	Bucerotidae		
	Upupidae		
	Ramphastidae		
	Coraciidae		
	Pittidae		
	Oriolidae		
	Vangidae		
	Aegithinidae		
	Monarchidae		
Paridae			
Zosteropidae			
Timaliidae			

al. 2010; Jha 2013). The analysis of relative abundance based on the frequency of sightings indicated that 89 species were common, 49 were uncommon, 28 were

very common and 23 were rare species, which accounts for 47%, 26%, 15%, and 12% of the frequency of distribution in the study area (Figure 3).

Avian community structure as per habitat

From the earlier studies undertaken elsewhere, it is evident that variation in vegetation structure influences species distribution (MacArthur et al., 1962; Karr & Roth, 1971; Pearman 2002) within a habitat. Of the 189 species recorded, 139 species were associated with terrestrial habitat and 50 species were wetland-associated, which account for 74% and 26% of total bird species recorded (Table 1). Wetland characteristics like size, water depth, quality of water, trophic structure, and presence of suitable roosting and nursery sites influence the abundance and diversity of birds (Wiens 1989; Mukherjee et al. 2002; Ma et al. 2010). During the present study, wetland birds such as ducks, herons, egrets, cormorants, grebes, storks, jacanas, and kingfishers, which were observed to feed on aquatic organisms (fish, amphibians, invertebrates, etc.) at different water depths available in the wetlands and adjoining agriculture fields and marshy area.

Feeding guild structure

The diversity of avifauna in the study area may be due to the presence of a wide spectrum of food niches. The different species of birds occupying a particular feeding guild and space have evolved specialized foraging strategies to explore and obtain food resources efficiently and thus to reduce competition among diverse species (Nudds & Bowlby 1984; Jose & Zacharias 2003). An analysis of the feeding guilds of these birds revealed that 33% (63 species) were insectivorous and 31% (58 species) were carnivorous, 21% (40 species) were omnivorous, 9% (17 species) were granivorous, 3% (5 species) were frugivorous, 2% (4 species) were nectarivorous and 1% (2 species) were herbivorous respectively (Figure 3). Due to their specialized diet and low availability of preferable food resources, the nectarivores and piscivores are traditionally less represented (Wiens 1989). Occurrence of a significant number of insectivorous bird communities indicates that the area consists rich insect diversity as well as less disturbance in the form of forest fire consequences (Gregory et al. 2001) and also play a major role as important bio-control agents of insect pest of agriculture, horticulture, and forest ecosystem (Mahabal 2005; Thakur et al. 2010).

Among the 21 species of birds of prey recorded from the study area, 17 species were diurnal raptors like Oriental Honey Buzzard *Pernis ptilorhynchus*, Black-



Images 3, 4 & 5 Anthropogenic activities in Daroji Sloth Bear Sanctuary. © K.S. Abdul Samad

winged Kite *Elanus caeruleus*, Short-toed Snake Eagle *Circaetus gallicus*, Shikra *Accipiter badius*, Black Eagle *Ictinaetus malaiensis*, Booted Eagle *Hieraaetus pennatus*, Bonelli's Eagle *Aquila fasciata*, Pallid Harrier *Circus macrourus*, Western Marsh Harrier *Circus aeruginosus*, Montagu's Harrier *Circus pygargus*, Black Kite *Milvus migrans*, Brahminy Kite *Haliastur indus*, Common Kestrel *Falco tinnunculus*, and Peregrine Falcon *Falco peregrines* and the other four were nocturnal raptors like Barn Owl *Tyto alba*, Indian Eagle Owl *Bubo bengalensis*, Brown Fish Owl *Ketupa zeylonensis*, and Spotted Owlet *Athene brama*. The presence of carnivorous species in the study area, which is primarily influenced by the availability of

food sources, however, indicates the abundance of their prey. Prey bases such as small birds, lizards, snakes, rats, are among the food sources for carnivores in the area. The study area also supports four species of nectarivorous birds which include, Thick-billed Flowerpecker *Dicaeum agile*, Pale-billed Flowerpecker *Dicaeum erythrorhynchos*, Purple-rumped Sunbird *Leptocoma zeylonica*, and Purple Sunbird *Cinnyris asiaticus* have been regularly seen from the area.

Conservation status of avian fauna

To understand the importance of a site it is necessary to examine the significance in terms of the presence and abundance of species (Bruford 2002). DSBS supports 15 (8%) species of birds included in Schedule I, and 174 (92%) species included in Schedule IV of the Wildlife Protection Act (WPA, 1972). As per IUCN red list, Daroji supports, two globally Vulnerable (VU) species—Yellow-throated Bulbul *Pycnonotus xantholaemus* & Woolly-necked Stork *Ciconia episcopus*—five Near Threatened (NT) species—Painted Stork *Mycteria leucocephala*, Black-headed Ibis *Threskiornis melanocephalus*, Oriental Darter *Anhinga melanogaster*, River Tern *Sterna aurantia*, & Pallid Harrier *Circus macrourus* (IUCN, 2010)—and remaining 180 species are under Least Concern (LC) (Table 1).

It is evident from earlier studies that the landscape with diverse habitats provides opportunities for diverse avian fauna assemblages (Karr & Roth 1971). The study area has been selected as an important bird area in India (IBA), as it maintains a significant thriving population of a globally threatened and vulnerable species, i.e., Yellow-throated Bulbul with its fragmented population is restricted to the southern Deccan Plateau of India (Birdlife International 2001). Earlier recorded sighting (Allen 1908) of 20 pairs was in June 1901 in the Ballari District. Kottur (2014) observed this species around Matanga Hill in Hampi, Daroji Sloth Bear Sanctuary, and Sannapura Forest in the Koppal District. This species has been considered as Vulnerable because of threats caused due to degradation of its scrub forest habitats by various anthropogenic activities such as total clearance of vegetation, excessive wood-cutting, cattle-grazing and the quarrying of hillocks, etc (Subramanya et al. 1993, 1995; Stattersfield et al. 1998).

Daraji Sloth Bear Sanctuary lies in an important biogeographic zone, i.e., Deccan Peninsula with its amazingly diverse vegetation structure and environments not only attracts a variety of resident as well as migratory bird species but also influence their diversity and distribution within the habitat (MacArthur et al. 1962; Karr & Roth 1971; Pearman 2002). Anthropogenic disturbances on

forest structure and function are well on record (Bhat & Murali 2001; Chandrashekara et al. 2006) and indicated a negative influence of the anthropogenic intervention on overall bird diversity (Image 3–5). The present study also revealed that the avifauna and their habitat was under threats due to intensive anthropogenic activities, highlighted earlier along with those other disturbances like habitat alternations, construction of roads, firewood collection, and poaching in the forest areas that impacted the environment adversely which intern disturbing many threatened and migratory bird species. Hence, documentation of the bird community and identification of potential threats are the primary concerns of conservation at present.

The data recorded in the present study provides valuable information about the diversity of avifauna of Daroji Sloth Bear Sanctuary, as a baseline data for future EIA studies, and helping in formulating future conservation strategies to improve the forest habitats, which will attract the number of the resident bird as well as migratory species. Further, more long-term scientific studies and monitoring along with local participation needed to understand the ecological status, seasonal wise abundance, and diversity, and conservation of birds in this particular area.

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

June 2021 | Vol. 13 | No. 7 | Pages: 18679–18958

Date of Publication: 26 June 2021 (Online & Print)

DOI: 10.11609/jott.2021.13.7.18679-18958

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