

# Birds of the south-western Deccan Plateau region of Maharashtra, India, with special reference to the Great Indian Bustard *Ardeotis nigriceps*

Sujit S. Narwade & Asad R. Rahmani

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Sujit S. Narwade, Project Scientist, Bombay Natural History Society, Hornbill House, Shaheed Bhagat Singh Road, Mumbai 400001, Maharashtra, India.

E-mail: [s.narwade@bnhs.org](mailto:s.narwade@bnhs.org). [Corresponding author]

Asad Rahmani, Member of the Governing Council and Former Director, Bombay Natural History Society, Hornbill House, Shaheed Bhagat Singh Road, Mumbai 400001, Maharashtra, India. E-mail: [rahmani.asad@gmail.com](mailto:rahmani.asad@gmail.com).

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## Abstract

In the Great Indian Bustard Sanctuary, Solapur, Maharashtra, and its surrounding Deccan Plateau landscape, we documented the status of 282 species of birds (254 by us, and 27 through an eBird checklist review); including fourteen Threatened, with special emphasis on the Great Indian Bustard *Ardeotis nigriceps*, and eight Near-Threatened categories of the IUCN Red List of Threatened Species (IUCN 2020). The status of eight grassland obligatory species of Least Concern (IUCN 2020), such as larks (Alaudidae), Indian Courser *Cursorius coromandelicus*, and Chestnut-bellied Sandgrouse *Pterocles exustus* are also discussed. Seasonal variation in bird richness at various habitats, encounter rate per hour for each species, and flock size of selected species have been provided. To understand deeper aspects about encounter rate and flock size in lark species, data were pulled out separately from the transect data. A one square kilometer patch of grassland was selected at Nannaj-Mardi (adjacent to the Great Indian Bustard Sanctuary) for a breeding survey of larks. Out of 254 bird species documented, 143 were residents, 22 locally migratory, 84 long distance migrants, four resident-local migratory, and one resident-migratory. A note on roosting sites of 23 species of birds on trees, as well as six ground roosting species is given separately. Locations of existing, and upcoming, industrial developments have been overlaid on Great Indian Bustard distribution location data as well as on 14 selected grasslands of more than 300 ha each, to understand the threats to the birds and the habitat.

## Introduction

Pioneering studies documented the avifauna of this region in the nineteenth century (e.g., Sykes 1832; Jerdon 1839; Burgess 1854, 1855; and Fairbank 1876). Davidson & Wenden (1878) listed 361 species during an expedition to Pune, Satara, Sangli, Ahmednagar, and Solapur districts—areas we cover in our study. Butler (1881) listed 452 species during his intensive survey in the Ahmednagar, Pune, Solapur, and part of Satara districts (his 'Deccan and South Mahratta Country').

Nearly half a century later Ali & Whistler (1934) conducted ornithological surveys in erstwhile Hyderabad State, up to the Marathwada region of present-day Maharashtra, including parts of Osmanabad District. Mahabab's (1989) bird list from Solapur District came five decades subsequently, detailing bird sightings in the administrative units called Taluka in the local language. While studying Great Indian Bustards, Rahmani (1989) listed 115 species from Nannaj and surrounds, Solapur District. Bharucha & Gogte (1990) studied the avian profile of a human-modified aquatic ecosystem in the backwaters of the Ujani Dam, and recorded the colonial nesting of water birds. Prasad (2004) compiled an annotated checklist of 532 bird species found in western Maharashtra, which included the present study area. More recent works from our study area include that of Narwade & Fartade (2010) who addressed threats to the ground nesting birds around Osmanabad, and of Hippargi *et al.* (2012) who restricted themselves to a one square kilometre patch of unprotected grassland on the south of Solapur city.

The decrease in the population of large ground birds, such as the Critically Endangered (hereinafter, CR) Great Indian Bustard *Ardeotis nigriceps*, and the Endangered (hereinafter, EN) Lesser Florican *Sypheotides indicus*, due to habitat degradation and hunting was noted at the turn of the twentieth century (Rahmani 2002).

Most of the earlier studies comprised rapid expeditions in the Deccan Plateau, or focused only on the Great Indian Bustard in a small pocket of the core area of the Nannaj-Mardi Great Indian Bustard Sanctuary, and lacked quantitative data. Due to insufficient data on the status and distribution of birds, and given the rapidity of change in this landscape, it is becoming difficult to implement effective management and conservation initiatives. Our attempt at a more holistic approach tries to fill this gap for the south-western part of the Deccan Plateau region of Maharashtra.

## Study area

We covered all representative habitats of the districts of Osmanabad, Solapur, Satara, and Pune (non-hilly parts). An intensive study was conducted in the Great Indian Bustard Sanctuary, Solapur, and its surrounding ~ 50 km radius (Talukas of North Solapur, South Solapur, Mohol, Barshi, and Mangalvedha), while other parts of the districts, with similar representative habitats, were covered opportunistically (17.00°N–19.00°N, 74.00°E–77.00°E; 400–600 m asl). These included areas from the Talukas of Osmanabad, Washi, Lohara, and Tuljapur in Osmanabad District; Baramati, and Indapur in Pune District;

Mahsawad and Man in Satara District; and Ahmedpur in Latur District (Fig. 1). This region is classified under 6B Central Region of Deccan Peninsula by Rodgers & Panwar (1988), and the forest type represents Southern Tropical Thorn Scrub (6A/CI) (Champion & Seth 1968), but includes patches of the tropical dry deciduous forest also.

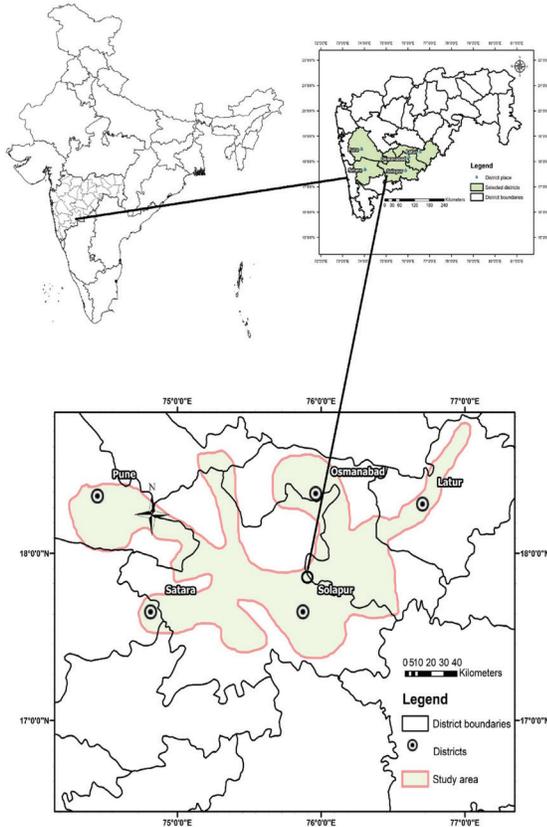


Fig. 1. Study area (intensive study area ~ 50 km radius of Great Indian Bustard Sanctuary, Nannaj, Solapur, and extensive study area as shown above)

1. Climate
2. The climate of the study area is tropical, with hot summers (28–48°C) and cool winters (13–27°C), with the average rainfall being 488 mm (450–600 mm) during 1900–2000 (Pathak & Gagrani 2006). During our study, with the exception

of 2010 when rainfall was comparatively high (800 mm), the area faced semi-drought conditions in 2012 (400 mm) and 2014 (<400 mm). Scarcity of fodder, during drought years, forced farmers to hold their cattle in government-run stalls and feeding sites called '*chara chavnis*' in Marathi. Out of 11 Talukas of Solapur District hereinafter, Mangalvedha and Sangola, in the western region, are particularly more drought prone, and received very low rainfall (~ 400 mm).

## Methods

Our study was conducted from January 2010 to December 2018, with an initial phase of area exploration during 2010–2012, intensive field surveys during 2013–2015, and follow up studies during 2016–2018. The study sites were fixed based on literature review, feedback received from local birdwatchers, and fine-tuned after initial field visits. We customized surveys (Table 1) for (a) common and widely distributed birds in open areas, (b) wetland birds, (c) Great Indian Bustard, (d) other globally threatened species, (e) breeding bird surveys (of Least Concern) grassland obligatory species, and (f) roost site counts of flocking species. For studies of crepuscular, nocturnal, and highly localized species as well as those most detectable in the non-breeding season, we visited the area outside transect duration. We divided the year into three seasons—monsoon (June–September), winter (October–February), and summer (March–May)—to record seasonal variation in the population of birds.

- A. Open area species:** Based on our knowledge of the area, and Google Earth map images, we laid ten transects each, in grassland, agricultural areas, and patches of dry deciduous forests within a 15 km radius of Nannaj-Mardi (17.79°N, 75.87°E). Transects (1,000 m x 50 m) were positioned randomly, and visited at least once each season (Bibby *et al.* 2000; Strindberg & Buckland 2004), amounting to an effort of 90 h (Table 1). An observer and a field assistant conducted the surveys in transects spread across the landscape (see Fig. 5) at fixed times of the day: 0600–1000 h and 1600–1830 h during 2013–2015. The average time they took per transect was 20 min. Their counts have been used to analyse the species encounter rate per hour (Appendix 1), as well as box plot for understanding the flock size (Figs. 2, 3). For every transect walked, we counted the number of individuals of all species, and calculated the mean encounter rate in terms of the number of individuals per transect of observation, in each season, and not all

**Table 1.** Details of the customised field surveys

Sr. No.	Type of survey	Number of sites	Season/months/year	Habitat types covered	Total field hours
A	Open area (transects)	10	3 seasons in 3 years (2013–2015)	3 (Grassland, agriculture, plantations)	90
B	Wetland birds	3	12 monthly surveys	Wetland	18
C	Great Indian Bustard survey	Landscape	3 seasons per year during 2010–2017	Grassland and croplands	1,152 (multiple observers)
D	Globally threatened species	Landscape	Entire study period	Grassland, agriculture, plantations, wetlands	Data extracted from all types of surveys done
E	Breeding bird survey of Least Concern grassland obligatory species	Fortnightly (12 in six months)	February to September 2015	1 sq km area of Nannaj-Mardi	12
F	Roosting sites	37 (23 tree roosts and 14 ground roosts)	2 visits (September 2014–October 2015)	Roosting sites	74

seasons pooled together (see Shahabuddin et al. 2017). We did not calculate the encounter rate for nocturnal species and opportunistic sighting records, which were noted while travelling from one place to another and not included in the systematic surveys as provided in table number 1. We used 'Biodiversity-Pro' software (McAleece et al. 1997) to plot a rarefaction curve showing spatial and seasonal variation in species richness of birds in the study area. We created the rarefaction curve by randomly re-sampling the pool of N samples, multiple times, and then plotting the average number of species found in each habitat sample for a season. Box plots were prepared for comparing the flock sizes among a group/cluster of birds. The number of birds detected in various group sizes are arranged in separate columns and considered as a flock/cluster/group.

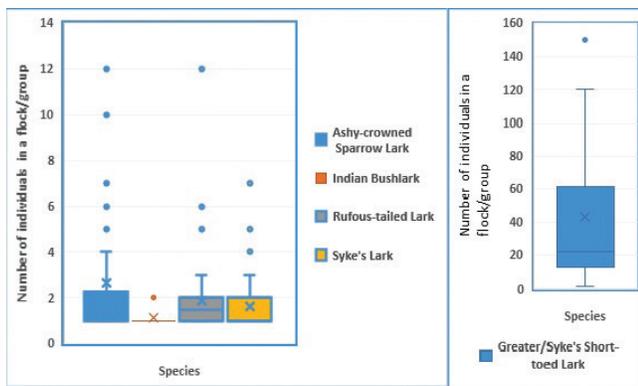


Fig. 2. Box plots showing flock size of the lark species found in study area. Graph for Greater/Syke's Short-toed Lark (n=19) given separately as large flock size influences the visual interpretation of other species.

**Note** - Box plot splits data into quartiles: the body of boxplot consists of first (Q1) and third (Q3) quartiles, vertical line within the box is median indicates usual flock size of the species and outliers are the occasional congregations seen. Two horizontal lines are called whiskers, one goes from Q1 to smallest non-outlier in data set and other goes from Q3 to largest outlier. Open circles are outliers.

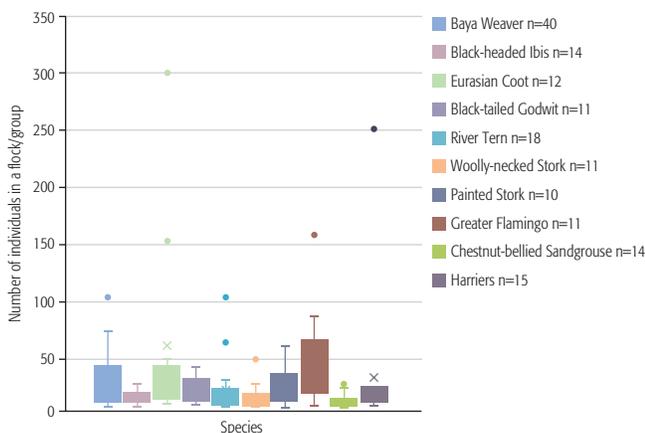


Fig. 3. Box plots showing flock size of the bird species

**B. Wetland birds:** Counts were carried out at three wetlands: a small wetland of about 150 ha in Masla, Tuljapur Taluka, Osmanabad District; Hotgi, a medium-sized wetland (c.300

ha, South Solapur Taluka, Solapur District; and a large-sized wetland (c.500 ha) in Hipparga, North Solapur Taluka, Solapur District (Fig. 2). These three wetlands were visited monthly between September 2013 and October 2014, and all the birds exclusively observed on water reservoirs were counted and, hence, the encounter rate for them is calculated using point count hours (Bayani & Dandekar 2017). Visits to the wetlands were made between 1600 h and 1630 h each time to keep uniformity in data collection, amounting to 18 h of effort (Table 1). When the small and medium wetlands were dry in summer, we also visited other adjoining wetlands to check the presence of birds in the study area (data not included here). Monthly variation in bird count at different size of wetlands plotted using bar graphs (Fig. 4).

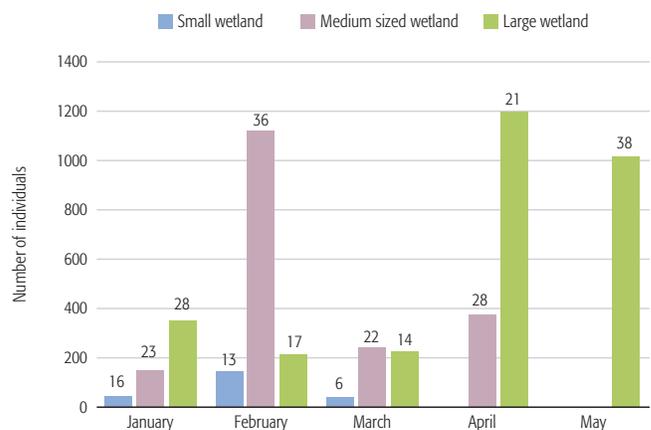


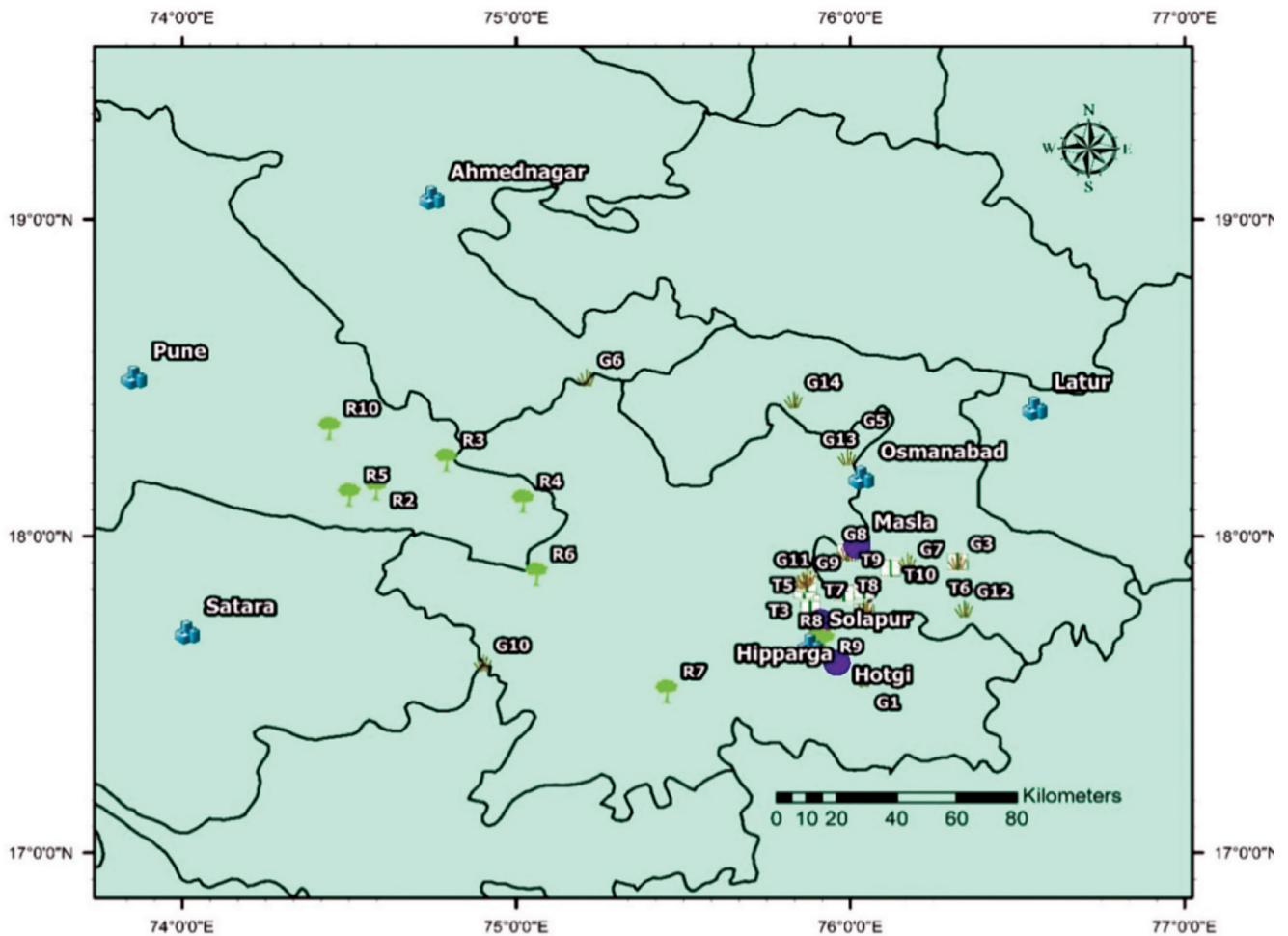
Fig. 4. Monthly variation in bird count at different size of wetlands in study area in 2013 (On top of column, number of species has been mentioned)

**C. Great Indian Bustard:** Specific survey areas were identified, using historical sighting data (Rahmani et al. 2014). Great Indian Bustard is known to move a lot and can be seen up to 50–100 km from its breeding site. Therefore, to avoid duplicate counts, the maximum number of birds counted in a single day was considered as the estimated population count of the study area (Fig. 1), following the method used by Rahmani (1989). With the help of local NGOs and six volunteers, we conducted three seasonal surveys annually, at landscape level, to understand the seasonal variation in the Great Indian Bustard count in our study area (Fig. 7).

**D. Other Threatened and Near Threatened birds:** Data has been pooled from transects and point counts for flock/group size analysis.

**E. Other grassland obligatory species:** To understand more details of the encounter rate and flock size in lark species, the data were pulled out separately from the transect data (Buckland et al. 2008), and has been plotted by line graph (Fig. 2). One square kilometer of grassland was selected at Nannaj-Mardi (adjacent to Great Indian Bustard Sanctuary) for researching upon breeding birds. Numbers of nests of particular species were counted during March to October 2013 to know fluctuation in the number of nests. We visited the above-mentioned site fortnightly.

**F. Roosting birds:** Initially we conducted opportunistic surveys at multiple sites, and identified communal roosts with the help of local volunteers (Table 5). Birds were located by



### Legends

-  District place
-  Roosting sites
-  Wetlands
-  Grasslands
-  Transects
-  District boundaries

Fig. 5. Map showing study sites such as grasslands, wetlands, transects laid, roosting sites covered across the landscape

**Wetlands:** Hipparga (large), Hotgi (medium) and Masla (small)

**Grasslands:** **Osmanabad District:** G3=Dahivadi-Kati, Taluka Tuljapur; G4=Devkuruli-Katgaon, Taluka Tuljapur; G8=Masla-Pangardarwadi grassland, Taluka Tuljapur; G11=Savargao-Kemwadi, Taluka Tuljapur; G12=Vadacha Tanda, Naldurga, Taluka Tuljapur; G13=Yedshi, Taluka Osmanabad; G14=Yermala, Taluka Kalamb. **Satara District:** G7=Karkhel, Taluka Mhaswad; G10=Rajewadi, Taluka Mhaswad. **Solapur District:** G1=Achegaon-Auj, Taluka South Solapur; G2=Boramani-Dhotri, Taluka South Solapur; G5=Jathar Bablyat, Taluka Mangalvedha; G6=Kamone-Khadki, Taluka Karmala; G9=Nannaj-Vadala-Mardi grassland, Taluka North Solapur.

**Tree roosting sites:** **Pune District:** R2=Baramati, Taluka Baramati; R3=Bhadalwadi, Taluka Indapur; R4=Indapur town, Taluka Indapur; R5=Malegaon Budruk, Taluka Baramati. **Solapur District:** R1=Balives area, Solapur District Town; R6=Malinagar; R7=Mangalvedha town, Taluka Mangalvedha; R8=Near Hotel Vikram Palace; R9=Police Headquarter, Solapur city; R10=Rupa Bhavani temple.

**Transect locations:** **Osmanabad District:** T6=Dahivadi-Kati, Taluka Tuljapur; T9=Masla-Pangardarwadi grassland, Taluka Tuljapur; T10=Kasai, Taluka Tuljapur. **Solapur District:** T1=Akolekati-Mardi road, Taluka North Solapur; T2=Gangewadi, Taluka South Solapur (boundary place); T3=Plantations, Behind Rest House Nannaj, Taluka North Solapur; T4=Boramani-Dhotri, Taluka South Solapur; T5=Courser hill area, Nannaj, Taluka North Solapur; T7=Karamba, Taluka North Solapur; T8=Kasegao-Gangewadi, Taluka South Solapur;

following flight lines, especially in the evenings, and direct observations while walking along roads, alongside wetlands, in villages, and grassland patches. A Global Positioning System (GPS) device was used to record accurate geographical coordinates of all observations. The numbers

of birds arriving at roosts, in the evening, were counted till it became dark. This was done once a month, by one observer, from September 2013 to October 2014. It was difficult to get exact numbers and therefore, estimates have been provided as baseline data for further research.

**G. Data from other sources:** We also referred to the earlier records of the birds reported from intensive study area of Great Indian Bustard Sanctuary, Nannaj, Solapur and 50 km radius. Check lists (Hipparga Lake, Hiraj, and Yamai Lake in Pandharpur Taluka of District Solapur; and Tata Institute of Social Science Tuljapur, Gangewadi, and Katgao lakes of District Osmanabad) uploaded on eBird ([www.eBird.org](http://www.eBird.org); up to March 2020 in the revised manuscript) were referred to capture the overall bird species diversity in our study area during our study period. This list, along with the cited literature, showed us the species that we did not record during our study and details provided along with the citations (Appendix 2).

## Results and discussion

We documented 254 bird species and summarised their status in Table 2 (for more details please see Appendix 1). Twenty-seven species, which were recorded by other observers on eBird, are listed separately.

### Seasonal variation in the population of birds in different habitats

The species richness, in grasslands, was highest in the monsoon as compared to the other two seasons (Fig. 6). In the monsoons, the Baya Weaver *Ploceus philippinus*, Indian Courser *Cursorius coromandelicus*, larks (Alaudidae), and francolins (*Francolinus* spp.) were seen frequently as they nested in the study area. The Indian Courser was seen congregating at its breeding grounds in undisturbed grassland, and sometimes up to 70 individuals were seen together. During summer, the overall encounter rate of all birds was low, while species richness in the agriculture areas was high in winters as compared to the other two seasons (Fig. 6). Here we would like to give an example of seasonal variation in the count of the Baya Weaver. The Baya Weaver was encountered in flocks of 40–200 birds during transects, and in the hundreds at roost sites (for example nearly ~ 8,000 birds were seen in a forest patch at Ramling, Osmanabad District). We also noted passage migrants. For example, the Indian Paradise-flycatcher *Terpsiphone paradisi* was recorded in some forested areas mainly during September–October and March–April.

### Wetland birds

During summer very few birds were present on small and medium-sized wetlands as compared to the larger waterbodies (Fig. 2). In the monsoons, species such as storks (Ciconiidae), herons (Ardeidae), and egrets were seen spreading throughout

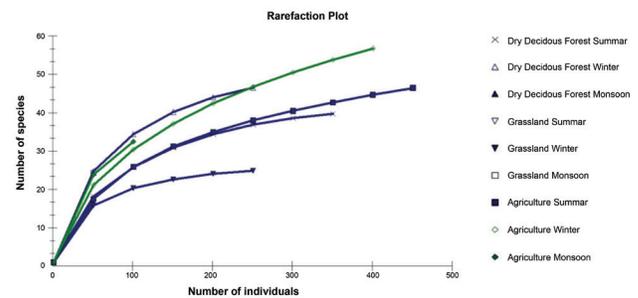


Fig. 6. Rarefaction curve showing spatial and seasonal variation in species richness in study area

the study area. Migratory Black Stork and White Stork were seen occasionally in the study area. Large flocks of passerines, such as larks and weavers, used the edges of these waterbodies in summers. In winter, ducks and geese (Anatidae) were recorded feeding in adjoining croplands in the early mornings and resting during daytime at the waterbodies. We noted a sudden increase in the populations of Eurasian Coot *Fulica atra* and cormorants (*Phalacrocorax* spp.) in the monsoons. Usually 50–100 coots were sighted in the wetlands, but a sighting of more than 1,000 coots in winter (Fig. 4) indicated local movements, although this needs further studies. Ground-nesting colonial water birds such as pratincoles and plovers were seen on the edges of the waterbodies during summer and pre-monsoon seasons. Greater Flamingo *Phoenicopterus roseus* was reported as rare previously in the study area (Deccan Plateau), but flocks of 50–60 birds were commonly seen at almost all major wetlands, with a maximum of over 150 birds during April–May one site (at Hipparga lake) (Fig. 4).

### Critically Endangered

**Great Indian Bustard** One can judge how wide-ranging and abundant the Great Indian Bustard was in the Deccan, in days gone by, from notes in *The Oriental Sports Magazine*, wherein it was mentioned that Robert Mansfield, a British officer, killed 961 bustards in Ahmednagar District during 1809–1829 (Burton 1920). The Great Indian Bustard was recorded from various parts of Maharashtra such as, Nagpur, Vardha, Yawatmal, and Chandrapur districts of the Vidarbha region (Rego 1983; Garde 1993; Pimplapure 2001; Kasambe et al. 2007; Thosar et al. 2007); Vajapur Taluka of Aurangabad District, Mukhed- and Udgir Talukas of Nanded District, and Parbhani by (Ali & Whistler 1939, 1940; Ahmednagar (Dangre 1966; Kurhade & Jagtap 1998); and Pune (Nalavade 1992). The population of the Great Indian Bustard in the Great Indian Bustard Sanctuary was 50–60

**Table 2.** Summary of resident and migratory birds in study area

Sr. No.	Migratory/Resident status	Number of species	Criteria
1	Resident (R)	143	Breeds and seen most of the time in study area
2	Locally Migratory (LM)	22	Birds seen in study area most of the time and breeding in neighbouring areas of few km away
3	Long distance migrants (M)	84	Seen only in specific season and not breeding in study area
4	Breeding visitors (BV)	4	Birds breed in study area and not seen regularly during rest of the period
5	Resident-migratory (RM)	1	Part of the bird population breeds in study area while large number of migratory populations seen along with the resident population, in winter

birds in the 1980s (Kulkarni 1981; Rahmani & Manakadan 1990; Kumar et al. 1997), and c.30–40 during 2000–2006 (Rahmani & Kalra 2005). This population declined to 13 in 2010, five birds in 2015, and then a single bird was seen in 2016 (Fig. 7) in the Great Indian Bustard Sanctuary, Maharashtra (366.73 sq. km in the districts of Solapur and Ahmednagar). During 1980–1990, after its initial success, bustard conservation failed in many areas because of poor habitat management in protected areas, by the forest department, and the change in land use in non-protected areas (Ali et al. 1984; Rahmani 1989; Rahmani et al. 2014). Extensive infrastructure developments, such as heavy-duty overhead wires, roads, industries, and canals completely changed the habitat on a landscape level (Fig. 8). For example, during our study an adult male Great Indian Bustard collided with a power line in the Nannaj area in September 2015 (Bhagwat Mhaske from Great Indian Bustard Sanctuary, Nannaj, *verbally*, September 2015). A female bustard, with a leg injury (probably due to collision with a power line), was brought to the forest department in February 2012. She was treated and kept in a cage for one-and-a-half months, but died in March 2012 (Source: Pune Wildlife Division).

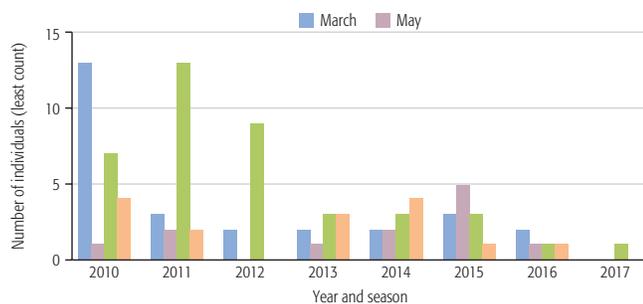


Fig. 7. Graph showing year wise decline in Great Indian Bustard in Great Indian Bustard Sanctuary, Maharashtra

**Great Indian Bustard Locations:** GIB1=Boramani, Taluka South Solapur, District Solapur; GIB2=Courseer hill area, Nannaj, Taluka North Solapur, District Solapur; GIB3=Dahivadi-Kati, Taluka Tuljapur, District Osmanabad; GIB4=Gangewadi, Taluka South Solapur, District Solapur; GIB5=Devkuruli-Katgao, Taluka Tuljapur, District Osmanabad; GIB6=Karamba, Taluka North Solapur, District Solapur; GIB7=Kasegao-Gangewadi, Taluka South Solapur, District Solapur; GIB8=Katgao, Taluka Tuljapur, District Osmanabad; GIB9=Kemwadi, Taluka Tuljapur, District Osmanabad; GIB10=Masla-Pangardarwadi, Taluka Tuljapur, District Osmanabad; GIB11=Nannaj, Taluka North Solapur, District Solapur; GIB12=Plantations, Behind Rest House Nannaj, Taluka North Solapur, District Solapur; GIB13=Savargao-Kemwadi, Taluka Tuljapur, District Osmanabad; GIB14=Akolekati-Mardi road, Taluka North Solapur, District Solapur; GIB15=Shelgao, Taluka Barshi, District Solapur; GIB16=Raleras=Dhamangao Taluka Barshi, District Solapur; GIB17=Lohara, Taluka Lohara, District Osmanabad; GIB18=Osmanabad, Taluka Osmanabad, District Osmanabad

**Existing and proposed industrial developments:** 1=Chincholi MIDC; 2= Pump house; 3=Cement Godown; 4=Proposed Domestic airport; 5=Katara Spinning mill; 6=Balajji Amines Chemical factory; 7=Stone quarries and stone crushers; 8=Solar power plant; 9=poultry industry; 10=Educational and industrial hub; 11=Textile Industry; 12=Siddheshwar sugar factory; 13=NTPC thermal power plant; 14=Zuari and Penna cement plant; 15=Jai Hind Sugar Factory; 16=Birla Cement Factory; 17=City expansion twin Solapur; 18=proposed wind mills at Devkuruli, Taluka Tuljapur, District Osmanabad (proposed); 19=proposed wind mills at Naldurga, Taluka Tuljapur, District Osmanabad (proposed); 20=Solar power plant, at Naldurga, Taluka Tuljapur, District Osmanabad; 21=proposed wind mills at Lohara, District Osmanabad (proposed); 22=GIB Sanctuary, Nannaj-Mardi, District Solapur; 23= Maharashtra Industrial Development Corporation; 24=Wind mills at Yermala; District Osmanabad.

### Threatened and Near Threatened species

We present detailed account on 15 IUCN Red List species that are in need of immediate protection. Grassland obligatory species that are categorized globally as of Least Concern, but are facing threats of habitat destruction, are discussed separately.

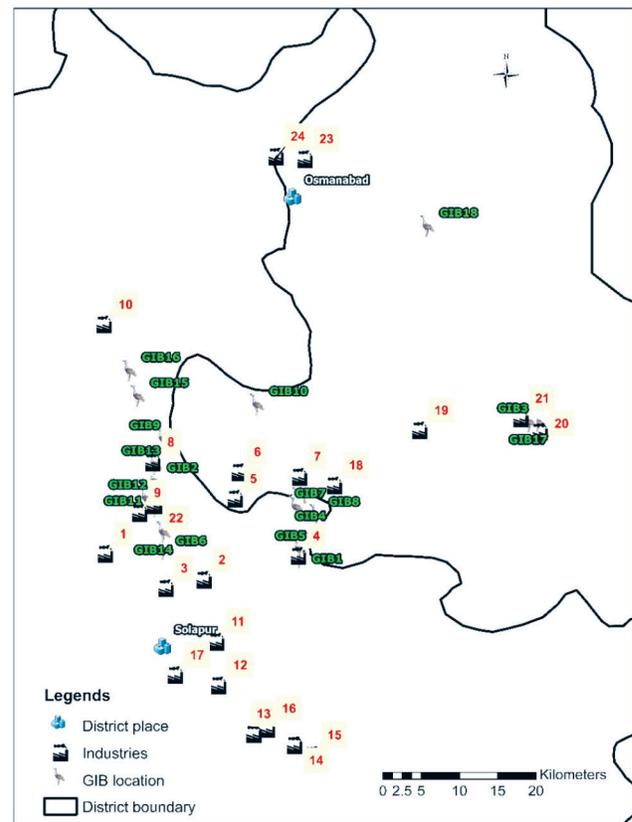


Fig. 8. Great Indian Bustard (GIB) distribution in study area and existing as well as upcoming industrial development

### Endangered species

**Lesser Florican *Syphotides indicus*** The Lesser Florican was occasionally seen in the Nannaj area in 1980s (Rahmani 1989). The last record of this species in the Nannaj area was in 2006 at Karmala of Solapur District (Rahmani et al. 2014). There were two instances of rescue and release of this bird from the study area: one on 19 September 2017 from Bhigwan village, Pune District (Swapnil Jared, *pers. comm.* 2017), and other on 25 November 2017 from a ground near the police headquarters, Solapur city (Mukund Shete, *pers. comm.* 2017).

**Egyptian Vulture *Neophron percnopterus*** A single juvenile Egyptian Vulture was sighted at Achegaon village, Solapur District in January 2012, along with two adult birds at a carcass-dump at Kanabas, southern Solapur. It was historically reported from Solapur, and part of Satara in the Deccan plateau (Davidson & Wenden 1878; Burgess 1854) when it was common in the whole state, but has now become rare (Rahmani et al. 2014).

### Vulnerable species

**Woolly-necked Stork *Ciconia episcopus*** We observed this bird usually in groups of two to three individuals foraging in agriculture areas, shallow wetlands, and even grasslands during monsoon, while in winter, groups of 15–20 birds were seen, and occasionally up to 40 (Fig. 4).

**Indian Spotted Eagle *Clanga hastata*** One at Kanabas in December 2012; one at Terna Lake near Thodsarwadi village

of Osmanabad in November 2013, and one at Katgaon Lake, Tuljapur, Osmanabad in December 2014. While two birds were observed perched on power lines running in between croplands and catching the Black-headed Bunting *Emberiza melanocephala*, in February 2012 at Nannaj.

**Greater Spotted Eagle *Clanga clanga*** Two or three individuals were seen visiting Hipparga Lake during winter across the study period, 2011 to 2017.

**Indian Skimmer *Rynchops albicollis*** One bird was reported (Rahmani et al. 2014) in the winter of 2012 from the backwaters of Kurnur Dam of Akkalkot Taluka, Solapur District (Shivanand Hiremath, *pers. comm.* 2012). Burgess (1855) found four or five nests and young ones in Bheema River, probably near Ahmednagar. Butler (1881) also sighted a couple of birds on the Bheema.

### Near Threatened species

**Lesser Adjutant *Leptoptilos javanicus*** Reported near Degaon village, Mangalvedha Road, Solapur, on 09 January 2015 (Vanjari & Vanjari 2015); but rare in the state, with very few reports from south-western Maharashtra (Rahmani et al. 2014).

**Painted Stork *Mycteria leucocephala*** Flocks of up to 1,000–1,200 birds were sometimes observed (Fig. 5) on large water reservoirs during summer, when a majority of lesser wetlands dried up. We observed its colonial nesting at seven sites Pingali, Man Taluka; Kurawali Lake, Phaltan Taluka Satara District; Bhadalwadi in Ujani backwaters, Indapur Taluka, Pune District; Donaj Lake, Mangalvedha Taluka; Kasegao Lake, South Solapur Taluka, Solapur District; Katgao Lake, Tuljapur Taluka, as well as

Terna Lake in Osmanabad District. According to Rahmani et al. (2014) these birds are usually found in flocks of 30–40 in all major wetlands of Maharashtra.

**Black-headed Ibis *Threskiornis melanocephalus*** Seen at almost all major wetlands, in flocks of 10–20 birds, increasing to 50 birds at times (Fig. 3). Around 250 were seen at Bhadalwadi village area in the Ujani backwater of Pune District, and breeding colonies were recorded at Indapur and Solapur towns. Naik (1990) had earlier recorded a breeding colony in Indapur. Bharucha & Gogte (1990) reported its breeding season as March–June, in the Ujani backwaters. Burgess (1854) had reported this species in this area from before the dam was constructed.

**Pallid Harrier *Circus macrourus*** We observed mixed roosts of three harrier species: Montagu's Harrier *C. pygargus*, Pied Harrier *C. melanoleucos*, and Pallid Harrier, but could not count the species separately at their roost. Around 400 harriers were counted at 14 roosting sites (Table 3), and one of the largest roosts at the Great Indian Bustard Sanctuary, Nannaj, had about 250 individuals (Fig. 3). Earlier also, harriers were seen roosting in large numbers in the Nannaj bustard area of Solapur (Rahmani 1989; Kasambe & Mhaske 2011). Earlier, the Pied Harrier was rare, while Hen- and Marsh Harriers were much more common (Rahmani 1989). Davidson & Wenden (1878) considered harriers common in the Deccan and reported their arrival as early as September, and their departure by April.

**Indian River Tern *Sterna aurantia*** We observed them in flocks of up to 20 birds, at almost all waterbodies, and with a summer congregation of about 1,000–1,200 individuals at two drying

**Table 3.** List of ground roosting species and sites in Solapur- and Osmanabad Districts

No.	Species	Area/site	District	High count	Season
	Harriers ( <i>Circus</i> spp., mixed species roosting)	Achegaon-Auj, Taluka South Solapur	SO	15	W
		Nilegao, Taluka South Solapur,	SO	25	W
		Boramani, South Solapur Taluka	SO	20	W
		Devkuruli-Gangewadi, Taluka South Solapur	SO	8	W
		Masla-Pangardarwadi, Taluka Tuljapur	OS	12	W
		Kasai, Taluka Tuljapur	OS	35	W
		Nannaj-Vadala-Mardi, Taluka North Solapur	SO	250	W
		Vadacha tanda-haldara tanda, Taluka Tuljapur	OS	20	W
	Lesser Sand Plover <i>Charadrius mongolus</i>	Katgao Lake, Taluka Tuljapur	OS	15	W
		Itkal-Dhangarwadi lake, Taluka Tuljapur	OS	30	W
	Oriental Pratincole <i>Glareola maldivarum</i>	Hipparga, Taluka North Solapur	SO	70	S
		Hotgi lake, Taluka South Solapur	SO	50	S
	Small Pratincole <i>Glareola lactea</i>	Hotgi lake, Taluka South Solapur	SO	150	S
	Greater/Sykes's Short-toed Lark <i>Calandrella brachydactyla/dukhunensis</i>	Boramani, Taluka South Solapur	SO	400	W
		Masla-Pangardarwadi, Taluka Tuljapur	OS	300	W
		Wadacha Tanda, Naldurga, Taluka Tuljapur	OS	2,000	W
		Nannaj, Taluka North Solapur	SO	300	W
	Sykes's Lark <i>Galerida deva</i>	Nannaj, Taluka North Solapur	SO	200	W

Legend: OS=Osmanabad, PU=Pune, SO=Solapur; S=Summer, W=Winter.

wetlands of Hipparga and Hotgi. We also observed colonies on islands in the Bhima River (Fig. 3), near Kalashi and Kumbhargao villages. This bird was also reported breeding earlier by Bradbeer (1987), Bharucha & Gogte (1990), and Bharucha et al. (1988), at Lonavla, Pune District, and by Unnithan & Unnithan (2003) in March–April from the Bhima River, Ujani Dam area.

**Red-headed Falcon *Falco chicquera*** We observed them in the Nannaj bustard area, usually during July–August (monsoon), and counted 11 individuals in a day-long survey in August 2010 at Nannaj and adjoining areas. In August 2014, we observed only three individuals in the same area. Nesting birds were seen at three locations, one each at Bhat Nimgao village near Akluj, Hipparga Lake area, and, near Nanduri village of Tuljapur, Osmanabad District. The species was previously reported from Ahmednagar (Burgess 1854); Solapur (Davidson & Wenden 1878; Barnes 1888); Pune (Purandare 1989); Pandharpur, Mangalvedha, Mohol, Barshi, and Akkalkot Taluka of Solapur District (Mahabal 1989); Ujani area (Bharucha & Gogte 1990).

**Great Thick-knee *Esacus recurvirostris*** Single birds, or pairs were especially seen during summer when water level in wetlands was low at Masla, Tuljapur Taluka, Osmanabad; Hotgi Lake, South Solapur Taluka, Solapur; and Hipparga Lake, North Solapur Taluka, Solapur. During the rest of the year their sightings were rare and difficult. It was reported to breed near the Bhima River, Ahmednagar in March (Burgess 1855), while Davidson & Wenden (1876) recorded it in Solapur and Satara districts. In recent years, it was recorded from Pune (Ingalkhalikar & Gole 1987; Bradbeer 1987; Purandare 1989; Mahabal & Lamba 1987).

**Black-tailed Godwit *Limosa limosa*** We recorded them at almost all major wetlands, normally in flocks of 20–40 birds (Fig. 4). In Maharashtra, it was earlier reported from many sites in Vidarbha, Marathwada, and along the western coast (Prasad 2004; Rahmani et al. 2014).

**Note** - Other species that were recorded historically in Deccan (Davidson & Wenden 1878; Mahabal 1989), and listed by Prasad (2004), such as the White-rumped Vulture *Gyps bengalensis* (Critically Endangered), Sociable Lapwing *Vanellus gregarius* (Critically Endangered), Greater Adjutant *Leptoptilos dubius* (Endangered), and Black-necked Stork *Ephippiorhynchus asiaticus* (Near Threatened) have not been seen during our study.

### Status of obligate grassland birds

There is little information available about larks and other ground nesting birds (Fig. 3). The Ashy-crowned Sparrow-lark *Eremopterix griseus* breeds in summer, and at the onset of the monsoons, parents were seen feeding juveniles. They mainly forage in grassland areas, especially in the monsoon and in winters, but in summers, before breeding, these birds were observed along the edges of the waterbodies in groups of 10–30 individuals. The

Rufous-tailed Lark *Ammomanes phoenicura* breeds from late summer up to the October, and the Sykes's Lark *Galerida deva*, one of the most widespread, breeds during the monsoon. The Indian Bush Lark *Mirafra erythroptera* was seen breeding soon after the onset of monsoon until the arrival of winter (Table 4). It predominantly uses grasslands and often perches at the height of 2 to 3 m, on bushes in open areas. Greater/Sykes's Short-toed Lark *Calandrella brachydactyla/dukhunensis* is migratory and is usually seen in large flocks of hundreds of birds.

The Chestnut-bellied Sandgrouse *Pterocles exustus* is usually seen in coveys of 10–15 individuals, and occasionally in congregations of about 60 birds, especially at breeding grounds (Fig. 3). No large congregations of this species were seen in the Nannaj area after year 2011. The Indian Courser *Cursorius coromandelicus* is widely distributed, but breeds mainly in undisturbed grasslands. Due to plantation work carried out under the Drought Prone Area Programme, many grassland patches have become unsuitable for ground nesting birds. We observed 70 nests of the Indian Courser in an area termed 'Courser Hill', behind the Forest Rest House in Nannaj in August 2010. Thereafter, we saw a decline of nests at that site: from 40 in 2011, 22 in 2012, 4 in 2013, and 12 in 2014. Similar decreased has been reported by Manjpara & Gadhvi (2010) in Abdasa Taluka, Kachchh, when intensive agricultural and plantation activities took place in the natural grasslands.

### Communal roosting of birds

We noted communal roosts of birds, at different places in the study area in winters, summers. Two types of roosts were recorded:

**Tree roosts:** Tree roosts were mainly on *Acacia* sp., *Ficus* sp., *Bombax ceiba*, tamarind *Tamarindus indica*, mango *Mangifera indica*, and neem *Azadiracta indica*. Twenty-three species of birds were seen roosting on trees in our study area. Some notable large mixed species roosting sites were in Bhadalwadi, Taluka Indapur, District Pune, where c.10,000 Little Cormorant *Microcarbo niger*, 600 Painted Stork *Mycteria leucocephala*, and 2,000 Common Myna *Acridotheres tristis* were counted. More than 10,000 Baya Weaver were seen roosting at Ramling Yedshi, Osmanabad District, in winter. A large roost of around 100,000 Rosy Starling *Pastor roseus* was seen at Baramati, District Pune, and of more than 40,000 at Donaj, Mangalvedha, District Solapur. More than 1,000 Rose-ringed Parakeet were seen roosting on mixed species of trees at Malinagar, District Solapur (Table 5).

**Ground roosts:** Bustards, harriers, coursers, and larks roosted on the ground in grasslands and fallow fields. Bustards roost on the ground in relatively open areas (Rahmani 1989). Some wetland birds, such as pratincoles and sand plovers were also found roosting on ground on edges of wetlands. Mixed species roosts of harriers were seen at eight sites, with a highest count of

**Table 4.** Comparative account of breeding in lark species in Solapur, based on data collected in year 2013

Heading	Ashy-crowned Sparrow Lark	Rufous-tailed Lark	Syke's lark	Indian Bushlark
Breeding season	March–September	May–September	June–October	June–October
Number of nests observed in sq km area of undisturbed grassland in Nannaj–Mardi area	15	7	13	02

**Table 5.** List of tree roosting birds and sites in study area

S. No.	Species	Name of area	District	High Count	Season
1.	Little Cormorant <i>Microcarboniger</i>	Bhadalwadi, Taluka Indapur	PU	10000	W, S
2.	Indian Shag <i>Phalacrocorax fuscicollis</i>	Malinagar	SO	90	Year round
3.	Cattle Egret <i>Bubulcus ibis</i>	Sangavi, Taluka Baramati	PU	300	S
		Nira, Taluka Indapur	PU	500	S
		Malegaon, Taluka Baramati	PU	400	S
		Nannaj, Taluka North Solapur	SO	600	W, S
		Nimgao, Malshiras	SO	400	W
		Mangalvedha	SO	800	S
		Solapur town (Rupa Bhavani temple area)	SO	400	R
4.	Grey Heron <i>Ardea cinerea</i>	Bhadalwadi, Taluka Indapur	PU	90	W, S
5.	Pond Heron <i>Ardeola grayii</i>	Mangalvedha	SO	40	S
6.	Little Egret <i>Egretta garzetta</i>	Nimgao, Malshiras	SO	50	W
		Mangalvedha	SO	40	S
		Solapur town (Rupa Bhavani temple area)	SO	50	R
7.	Black-crowned Night Heron <i>Nycticorax nycticorax</i>	Bhadalwadi, Indapur Taluka	PU	15	R
		Nimgao, Malshiras	SO	35	R
8.	Painted Stork <i>Mycteria leucocephala</i>	Bhadalwadi, Indapur Taluka,	PU	600	W, S
		Indapur town	PU	600	W, S
9.	Black-headed Ibis <i>Threskiornis melanocephalus</i>	Bhadalwadi, Taluka Indapur	PU	34	W, S
		Solapur town (Rupa Bhavani temple area)	SO	75	R
10.	Red-naped Ibis <i>Pseudibis papillosa</i>	Mangalvedha	SO	34	S
11.	Brahminy Kite <i>Haliastur Indus</i>	Plantation, Hotgi lake	SO	23	W
12.	Black Kite <i>Milvus migrans</i>	Smruti Udyan, Solapur	SO	60	S
		Baramati town	PU	300	W, S
13.	Rose-ringed Parakeet <i>Psittacula krameri</i>	Malinagar	SO	3,000	W, S
		Mangalvedha	SO	500	S
		Solapur town (Rupa Bhavani temple area)	SO	200	R
		Near Hotel Vikram palace, Solapur town	SO	70	W, S
14.	Red-vented Bulbul <i>Pycnonotus cafer</i>	Nimgao, Malshiras	SO	70	W
15.	Green Bee-eater <i>Merops orientalis</i>	Plantations, Behind Rest House Nannaj	SO	400	W
		Akolekati-Mardi road, Great Indian Bustard Sanctuary area	SO	300	W
		Shiradhon, Tuljapur	SO	70	W
16.	Black-headed Bunting <i>Emberiza melanocephala</i>	Rupa Bhavani temple, Solapur town	SO	500	W
17.	Red-headed Bunting <i>Emberiza bruniceps</i>	Achegao-Auj, South Solapur	SO	400	W
		Mangalvedha	SO	300	W
18.	House Sparrow <i>Passer domesticus</i>	Karamba	SO	500	W
		Old abandoned house, Balives area, Solapur city	SO	400	W
		Kasegao-Gangewadi, Taluka South Solapur	SO	300	W
19.	Baya Weaver <i>Ploceus philippinus</i>	RamlingYedshi, Taluka Osmanabad	OS	10,000	S
20.	Common Myna <i>Acridotheres tristis</i>	Bhadalwadi, Taluka Indapur	PU	2,000	W, S
		Nimgao, Malshiras	SO	50	W
		Mangalvedha, District	SO	65	S
		Solapur town (Rupa Bhavani temple area)	SO	60	R
		Hanuman Nagar, Solapur town	SO	400	W, S
21.	Rosy Starling <i>Pastor roseus</i>	Malinagar, Malshiras	SO	3,000	W, S
		Nimgao, Malshiras	SO	5,000	W
		Donaj, Mangalvedha	SO	40,000	W, S
		Solapur town (Rupa Bhavani temple area)	SO	10,000	R
		Near Hotel Vikram palace, Solapur	SO	1000	W, S
		Baramati	PU	1,00,000	W, S
22.	Brahminy Myna <i>Sturnia pagodarum</i>	Mangalvedha	SO	100	W, S
23.	House Crow <i>Corvus splendens</i>	Mangalvedha	SO	250	S
		Smriti Udyan, Solapur	SO	40	S
		Near Hotel Vikram palace, Solapur town	SO	150	W, S
		Solapur (Rupa Bhavani temple area)	SO	40	R

Legend: OS=Osmanabad, PU=Pune, SAT=Satara, SO=Solapur; R=Regular, S=Summer, W=Winter

250 birds at of Nannaj-Mardi and lowest, of eight, at Devkuruli-Gangewadi, South Solapur, District Solapur. We also found a large roost of more than 2,000 Greater/Sykes's Short-toed Larks at Wadacha Tanda, Naldurga, District Osmanabad (Table 3).

### Conservation challenges for birds and their habitats

We focused our attention on mapping conservation challenges of grassland species around the core area of the Great Indian Bustard Sanctuary. We surveyed 14 grassland patches of more than 300 ha as a basis for compiling information on current land use and upcoming development projects on each area, development proposed, and projects in progress (Fig. 8). The extent of existing and, on-going developments, and proposed industries indicates great pressure on the remaining grassland habitat (Fig. 8). We saw that except for two protected areas of the Great Indian Bustard Sanctuary, and three non-protected areas, some form of development is proposed on all grassland patches (Fig. 8). Below we list our concerns regarding the survival of grasslands in the study areas.

1. In South Solapur, apart from an existing grinding unit of Grasim Cement, two new cement plants became operational from year 2017 (#14 and 16, Fig. 8). These include mining, transport of limestone, and cement bags (#3, Fig. 8). Grinding and mixing of additives for different cement grades will also have an impact on biodiversity due to the spreading of dust and other cement particles.
2. The Solapur Supercritical Thermal Power Plant was proposed at Fatatewadi village of South Solapur (#13, Fig. 8) in 2010. The Power Plant is operational now and drawing water from the Ujani Reservoir, which is 150 km away. A network of high-tension wires surrounds it. Fly ash and bottom ash, which are released during operations, will negatively impact existing avifauna.
3. A large number of sugar factories have come up during the last two decades. This means more the withdrawal of groundwater for growing sugarcane, and a decrease of the traditional crop, which is more suitable to the semi-arid climate. Though many sugarcane factories claim to have effluent treatment plants, we have observed slurry and molasses being released into the streams and rivers, which affects the aquatic life of Bhima River and its tributaries.
4. Three roads, Solapur–Pune (250 km), Solapur–Yedshi (100 km), and Solapur–Hyderabad highway (300 km) were widened into four-lane express highways after felling a large number of roadside trees, and extraction of soil from adjoining areas, for land filling.
5. The Government of Maharashtra (<https://maharashtra.mygov.in/en/group/mission-plantation/>) launched a massive plantation drive during which 3 million trees were purportedly planted, mainly in open areas and grasslands. This has resulted in loss of native flora and dependent fauna.
6. An increase in the number of illegal/legal stone quarries and stone crushers are also reducing the potential grassland habitats and affecting flora and fauna because of mining, dust, noise, blasting, and movement of trucks and people.
7. On hundreds of square kilometres, the installation of windmills and solar plants is underway, and many more are proposed. This has already destroyed habitat, displaced wild birds, and increased exotic and invasive species. Now there are greater chances of injury and death to birds due

to collision with power lines [Avian Power Line Interaction Committee (APLIC) 2012; Narwade et al. 2013].

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**Appendix 1.** List of birds recorded in south-western Deccan Plateau region of Maharashtra, India. [W=wetland, OA=open area, and RC=rocky cliff.]

Sr. no.	Species	Habitat	Encounter rate/h: Winter	Encounter rate/h: Summer	Encounter rate/h: Monsoon
1	Lesser Whistling Duck <i>Dendrocygna javanica</i>	W	1.21 (±0.63)	2.45 (±1.45)	0.25 (±0.18)
2	Bar-headed Goose <i>Anser indicus</i>	W	1.92 (±1.06)	-	-
3	Greylag Goose <i>Anser anser</i>	W	[1]	-	-
4	Knob-billed Duck <i>Sarkidiornis melanotos</i>	W	1.04 (±0.65)	-	0.42 (±0.14)
5	Ruddy Shelduck <i>Tadorna ferruginea</i>	W	0.75 (±1.02)	-	-
6	Cotton Teal <i>Nettapus coromandelianus</i>	W	0.63 (±0.51)	0.08 (±0.12)	-
7	Garganey <i>Spatula querquedula</i>	W	3.08 (±2.05)	-	-
8	Northern Shoveler <i>Spatula clypeata</i>	W	0.25 (±0.44)	-	-
9	Gadwall <i>Mareca strepera</i>	W	0.29 (±0.31)	-	-
10	Eurasian Wigeon <i>Mareca penelope</i>	W	1.46 (±0.43)	-	-
11	Indian Spot-billed Duck <i>Anas poecilorhyncha</i>	W	5.35 (±4.52)	7.12 (±4.02)	2.34 (±1.76)
12	Mallard <i>Anas platyrhynchos</i>	W	0.45 (±0.22)	-	-
13	Northern Pintail <i>Anas acuta</i>	W	1.46 (±0.56)	-	-
14	Common Teal <i>Anas crecca</i>	W	8.33 (±3.45)	-	-
15	Common Pochard <i>Aythya ferina</i>	W	0.65 (±0.54)	-	-
16	Tufted Duck <i>Aythya fuligula</i>	W	0.43 (±0.15)	-	-
17	Indian Peafowl <i>Pavo cristatus</i>	OA	1.21 (±0.77)	0.54 (±0.40)	0.90 (±0.36)
18	Rain/Common Quail <i>Coturnix coromandelica/coturnix</i>	OA	0.95 (±0.70)	0.86 (±0.63)	1.02 (±0.96)
19	Jungle Bush Quail <i>Perdica asiatica</i>	OA	0.61 (±0.25)	0.35 (±0.16)	0.81 (±0.33)
20	Rock Bush Quail <i>Perdica argoondah</i>	OA	0.63 (±0.17)	0.82 (±0.58)	0.85 (±0.81)
21	Painted Francolin <i>Francolinus pictus</i>	OA	0.51 (±0.49)	0.45 (±0.33)	0.54 (±0.37)
22	Grey Francolin <i>Francolinus pondicerianus</i>	OA	2.13 (±0.54)	2.69 (±0.65)	1.64 (±1.45)
23	Greater Flamingo <i>Phoenicopterus roseus</i>	W	3.5 (±2.77)	-	-
24	Lesser Flamingo <i>Phoeniconaias minor</i>	W	[1]	-	-
25	Little Grebe <i>Tachybaptus ruficollis</i>	W	1.29 (±0.67)	0.23 (±0.34)	0.46 (±0.21)
26	Rock Pigeon <i>Columba livia</i>	OA	9.25 (±3.54)	4.16 (±1.41)	3.32 (±2.7)
27	Eurasian Collared Dove <i>Streptopelia decaocto</i>	OA	6.83 (±4.70)	6.20 (±7.72)	2.98 (±3.82)

**Appendix 1.** List of birds recorded in south-western Deccan Plateau region of Maharashtra, India. [W=wetland, OA=open area, and RC=rocky cliff.]

Sr. no.	Species	Habitat	Encounter rate/h: Winter	Encounter rate/h: Summer	Encounter rate/h: Monsoon
28	Red Collared Dove <i>Streptopelia tranquebarica</i>	OA	0.09 ( $\pm 0.61$ )	-	0.03 ( $\pm 0.04$ )
29	Spotted Dove <i>Streptopelia chinensis</i>	OA	[1]	-	-
30	Laughing Dove <i>Streptopelia senegalensis</i>	OA	7.95 ( $\pm 1.98$ )	2.58 ( $\pm 1.30$ )	8.25 ( $\pm 4.31$ )
31	Yellow-footed Green Pigeon <i>Treron phoenicopterus</i>	OA	0.57 ( $\pm 0.31$ )	0.29 ( $\pm 0.35$ )	-
32	Chestnut-bellied Sandgrouse <i>Pterodes exustus</i>	OA	0.89 ( $\pm 0.23$ )	0.29 ( $\pm 0.57$ )	$\pm$
33	Great Indian Bustard <i>Ardeotis nigriceps</i>	OA	T-	-	-
34	Lesser Florican <i>Sypheotides indicus</i>	OA	-	-	T
35	Greater Coucal <i>Centropus sinensis</i>	OA	1.04 ( $\pm 0.55$ )	0.32 ( $\pm 0.46$ )	0.52 ( $\pm 0.33$ )
36	Sirkeer Malkoha <i>Taccocua leschenaultii</i>	OA	-	[1]	[2]
37	Blue-faced Malkoha <i>Phaenicophaeus viridirostris</i>	OA	-	-	[2]
38	Pied Cuckoo <i>Clamator jacobinus</i>	OA	0.14 ( $\pm 0.09$ )	-	0.35 ( $\pm 0.14$ )
39	Asian Koel <i>Eudynamis scolopacea</i>	OA	0.58 ( $\pm 0.16$ )	0.53 ( $\pm 0.41$ )	0.70 ( $\pm 0.12$ )
40	Grey-bellied Cuckoo <i>Cacomantis passerinus</i>	OA	0.45 ( $\pm 0.23$ )	-	0.51 ( $\pm 0.68$ )
41	Common Hawk Cuckoo <i>Hierococcyx varius</i>	OA	0.89 ( $\pm 1.01$ )	0.21 ( $\pm 0.08$ )	0.47 ( $\pm 0.22$ )
42	Indian Cuckoo <i>Cuculus micropterus</i>	OA	[1]	-	[2]
43	Jungle Nightjar <i>Caprimulgus indicus</i>	OA	Regularly in dry deciduous plantations, mainly calls in evening	-	-
44	Indian Nightjar <i>Caprimulgus asiaticus</i>	OA	-	[3], mainly calls	-
45	Indian House Swift <i>Apus affinis</i>	OA	8.12 ( $\pm 6.57$ )	4.45 ( $\pm 3.71$ )	2.12 ( $\pm 1.68$ )
46	Asian Palm Swift <i>Cypsiurus balasensis</i>	OA	1.41 ( $\pm 0.42$ )	1.16 ( $\pm 1.21$ )	0.67 ( $\pm 0.14$ )
47	Common Moorhen <i>Gallinula chloropus</i>	W	0.13 ( $\pm 0.16$ )	0.06 ( $\pm 0.04$ )	0.28 ( $\pm 0.07$ )
48	Common Coot <i>Fulica atra</i>	W	12.5 ( $\pm 3.62$ )	1.1 ( $\pm 0.25$ )	6.20 ( $\pm 8.33$ )
49	Grey-headed Swampphen <i>Porphyrio poliocephalus</i>	W	0.54 ( $\pm 0.17$ )	0.20 ( $\pm 0.63$ )	0.08 ( $\pm 0.02$ )
50	White-breasted Waterhen <i>Amaurornis phoenicurus</i>	W	0.13 ( $\pm 0.15$ )	-	0.85 ( $\pm 0.03$ )
51	Brown Crake <i>Zapornia akool</i>	W	-	[1]	-
52	Demoiselle Crane <i>Grus virgo</i>	OA	0.45 ( $\pm 0.60$ )	-	-
53	Common Crane <i>Grus grus</i>	OA	1.25 ( $\pm 0.81$ )	-	-
54	Indian Thick-knee <i>Burhinus indicus</i>	OA	0.12 ( $\pm 0.21$ )	0.15 ( $\pm 0.34$ )	0.16 ( $\pm 0.45$ )
55	Great Thick-knee <i>Esacus recurvirostris</i>	W	-	[1]	[3]
56	Black-winged Stilt <i>Himantopus himantopus</i>	W	2.88 ( $\pm 1.75$ )	1.04 ( $\pm 0.67$ )	1.5 ( $\pm 0.81$ )
57	Pacific Golden Plover <i>Pluvialis fulva</i>	W	[1]	-	-
58	Yellow-wattled Lapwing <i>Vanellus malabaricus</i>	OA	1.07 ( $\pm 0.54$ )	1.16 ( $\pm 0.89$ )	1.04 ( $\pm 0.62$ )
59	Red-wattled Lapwing <i>Vanellus indicus</i>	W	0.25 ( $\pm 0.34$ )	2.75 ( $\pm 1.62$ )	1.21 ( $\pm 1.02$ )
60	Lesser Sand Plover <i>Charadrius mongolus</i>	W	[1]	-	-
61	Kentish Plover <i>Charadrius alexandrinus</i>	W	1.25 ( $\pm 0.65$ )	0.06 ( $\pm 0.15$ )	-
62	Little Ringed Plover <i>Charadrius dubius</i>	W	2.25 ( $\pm 1.41$ )	0.25 ( $\pm 0.45$ )	0.05 ( $\pm 0.06$ )
63	Greater Painted-snipe <i>Rostratula benghalensis</i>	W	0.04 ( $\pm 0.16$ )	-	0.21 ( $\pm 0.08$ )
64	Pheasant-tailed Jacana <i>Hydrophasianus chirurgus</i>	W	0.16 ( $\pm 0.37$ )	-	0.83 ( $\pm 0.67$ )
65	Bronze-winged Jacana <i>Metopidius indicus</i>	OA	0.12 ( $\pm 0.25$ )	0.05 ( $\pm 0.08$ )	0.25 ( $\pm 0.15$ )
66	Whimbrel <i>Numenius phaeopus</i>	W	[1]	-	-
67	Black-tailed Godwit <i>Limosa limosa</i>	W	T	-	-
68	Ruff <i>Calidris pugnax</i>	W	[3]	-	-
69	Temminck's Stint <i>Calidris temminckii</i>	W	[1]	-	-
70	Little Stint <i>Calidris minuta</i>	W	0.70 ( $\pm 0.83$ )	-	-
71	Common Snipe <i>Gallinago gallinago</i>	W	[1]	-	-

**Appendix 1.** List of birds recorded in south-western Deccan Plateau region of Maharashtra, India. [W=wetland, OA=open area, and RC=rocky cliff.]

Sr. no.	Species	Habitat	Encounter rate/h: Winter	Encounter rate/h: Summer	Encounter rate/h: Monsoon
72	Common Sandpiper <i>Actitis hypoleucos</i>	W	1.33 ( $\pm 0.33$ )	-	-
73	Spotted Redshank <i>Tringa erythropus</i>	W	0.04 ( $\pm 0.01$ )	-	-
74	Common Greenshank <i>Tringa nebularia</i>	W	0.09 ( $\pm 0.06$ )	-	-
75	Marsh Sandpiper <i>Tringa stagnatilis</i>	W	0.12 ( $\pm 0.5$ )	-	-
76	Wood Sandpiper <i>Tringa glareola</i>	W	0.83 ( $\pm 0.25$ )	-	-
77	Common Redshank <i>Tringa totanus</i>	W	0.63 ( $\pm 0.13$ )	-	-
78	Small Buttonquail <i>Turnix sylvaticus</i>	OA	[1]	[1]	[1]
79	Yellow-legged Buttonquail <i>Turnix tanki</i>	OA	[2]	[1]	[2]
80	Barred Buttonquail <i>Turnix suscitator</i>	OA	0.71 ( $\pm 0.13$ )	1.06 ( $\pm 0.89$ )	1.33 ( $\pm 0.57$ )
81	Indian Courser <i>Cursorius coromandelicus</i>	OA	0.57 ( $\pm 0.35$ )	0.61 ( $\pm 0.26$ )	1.47 ( $\pm 1.29$ )
82	Oriental Pratincole <i>Glareola maldivarum</i>	W	0.84 ( $\pm 1.2$ )	0.65 ( $\pm 0.41$ )	0.13 ( $\pm 0.06$ )
83	Small Pratincole <i>Glareola lactea</i>	W	4.58 ( $\pm 3.83$ )	0.80 ( $\pm 0.54$ )	1.75 ( $\pm 1.13$ )
84	Black-headed Gull <i>Chroicocephalus ridibundus</i>	W	0.25 ( $\pm 0.34$ )	-	-
85	Brown-headed Gull <i>Chroicocephalus brunnicephalus</i>	W	1.08 ( $\pm 0.58$ )	-	-
86	Little Tern <i>Sternula albifrons</i>	W	0.25 ( $\pm 0.62$ )	0.62 ( $\pm 1.20$ )	-
87	Gull-billed Tern <i>Gelochelidon nilotica</i>	W	[1]	-	-
88	Caspian Tern <i>Hydroprogne caspia</i>	W	[1]	-	-
89	Whiskered Tern <i>Chlidonias hybrida</i>	W	1.84 ( $\pm 1.20$ )	-	-
90	River Tern <i>Sterna aurantia</i>	W	12.92 ( $\pm 7.6$ )	1.62 ( $\pm 2.3$ )	0.38 ( $\pm 1.4$ )
91	Asian Openbill <i>Anastomus oscitans</i>	W	0.63 ( $\pm 0.24$ )	-	0.92 ( $\pm 0.36$ )
92	Black Stork <i>Ciconia nigra</i>	W	[2]	-	-
93	Woolly-necked Stork <i>Ciconia episcopus</i>	W	0.41 ( $\pm 0.54$ )	0.18 ( $\pm 0.07$ )	0.50 ( $\pm 0.76$ )
94	European White Stork <i>Ciconia ciconia</i>	W	[1]	-	-
95	Painted Stork <i>Mycteria leucocephala</i>	W	3.75 ( $\pm 2.34$ )	1.05 ( $\pm 0.71$ )	0.83 ( $\pm 0.45$ )
96	Oriental Darter <i>Anhinga melanogaster</i>	W	0.04 ( $\pm 0.07$ )	0.02 ( $\pm 0.05$ )	0.08 ( $\pm 0.03$ )
97	Little Cormorant <i>Microcarbo niger</i>	W	2.29 ( $\pm 1.06$ )	0.42 ( $\pm 0.19$ )	1.21 ( $\pm 0.75$ )
98	Great Cormorant <i>Phalacrocorax carbo</i>	W	0.57 ( $\pm 0.45$ )	0.21 ( $\pm 0.07$ )	0.53 ( $\pm 0.65$ )
99	Indian Cormorant <i>Phalacrocorax fuscicollis</i>	W	1.25 ( $\pm 0.51$ )	0.17 ( $\pm 0.08$ )	0.79 ( $\pm 0.48$ )
100	Yellow Bittern <i>Ixobrychus sinensis</i>	W	-	-	[2]
101	Cinnamon Bittern <i>Ixobrychus cinnamomeus</i>	W	-	-	[1]
102	Grey Heron <i>Ardea cinerea</i>	W	0.25 ( $\pm 0.16$ )	0.21 ( $\pm 0.32$ )	0.29 ( $\pm 0.23$ )
103	Purple Heron <i>Ardea purpurea</i>	W	0.26 ( $\pm 0.34$ )	-	0.29 ( $\pm 0.18$ )
104	Great Egret <i>Ardea alba</i>	W	1.61 ( $\pm 0.65$ )	0.22 ( $\pm 0.17$ )	0.41 ( $\pm 0.34$ )
105	Intermediate Egret <i>Ardea intermedia</i>	W	1.41 ( $\pm 0.46$ )	0.21 ( $\pm 0.31$ )	0.08 ( $\pm 0.02$ )
106	Little Egret <i>Egretta garzetta</i>	W	1.92 ( $\pm 1.23$ )	0.63 ( $\pm 0.45$ )	1.25 ( $\pm 0.86$ )
107	Cattle Egret <i>Bubulcus ibis</i>	W	4.37 ( $\pm 3.25$ )	6.08 ( $\pm 4.95$ )	7.25 ( $\pm 5.06$ )
108	Indian Pond Heron <i>Ardeola grayii</i>	W	0.75 ( $\pm 1.06$ )	0.46 ( $\pm 0.51$ )	0.69 ( $\pm 0.43$ )
109	Black-crowned Night Heron <i>Nycticorax nycticorax</i>	W	[4]	-	-
110	Glossy Ibis <i>Plegadis falcinellus</i>	W	0.29 ( $\pm 0.45$ )	0.08 ( $\pm 0.23$ )	0.17 ( $\pm 0.21$ )
111	Black-headed Ibis <i>Threskiornis melanocephalus</i>	W	3.13 ( $\pm 1.32$ )	1.09 ( $\pm 0.88$ )	1.29 ( $\pm 0.65$ )
112	Red-naped Ibis <i>Pseudibis papillosa</i>	OA	1.04 ( $\pm 0.73$ )	1.85 ( $\pm 1.12$ )	3.29 ( $\pm 2.07$ )
113	Eurasian Spoonbill <i>Platalea leucorodia</i>	W	4.17 ( $\pm 2.08$ )	1.34 ( $\pm 0.65$ )	1.63 ( $\pm 1.04$ )
114	Osprey <i>Pandion haliaetus</i>	OA	[2]	-	-
115	Black-winged Kite <i>Elanus caeruleus</i>	OA	0.41 ( $\pm 0.32$ )	0.40 ( $\pm 0.18$ )	0.26 ( $\pm 0.13$ )
116	Egyptian Vulture <i>Neophron percnopterus</i>	OA	[1]	-	-
117	Oriental Honey Buzzard <i>Pernis ptilorhynchus</i>	OA	[2]	-	-

**Appendix 1.** List of birds recorded in south-western Deccan Plateau region of Maharashtra, India. [W=wetland, OA=open area, and RC=rocky cliff.]

Sr. no.	Species	Habitat	Encounter rate/h: Winter	Encounter rate/h: Summer	Encounter rate/h: Monsoon
118	Crested Serpent Eagle <i>Spilornis cheela</i>	OA	[2]	-	-
119	Short-toed Snake Eagle <i>Circaetus gallicus</i>	OA	0.17 (±0.08)	-	0.14 (±0.15)
120	Indian Spotted Eagle <i>Clanga hastata</i>	OA	T	-	-
121	Greater Spotted Eagle <i>Clanga clanga</i>	OA	T	-	-
122	Booted Eagle <i>Hieraetus pennatus</i>	OA	[1]	-	-
123	Tawny Eagle <i>Aquila rapax</i>	OA	[2]	-	-
124	Bonelli's Eagle <i>Aquila fasciata</i>	OA	0.58 (±0.28)	0.12 (±0.02)	0.26 (±0.13)
125	White-eyed Buzzard <i>Butastur teesa</i>	OA	0.22 (±0.08)	0.17 (±0.09)	0.12 (±0.06)
126	Western Marsh Harrier <i>Circus aeruginosus</i>	W	0.12 (±0.04)	-	-
127	Pallid Harrier <i>Circus macrourus</i>	OA	0.69 (±0.33)	-	-
128	Pied Harrier <i>Circus melanoleucos</i>	OA	[2]	-	-
129	Montagu's Harrier <i>Circus pygargus</i>	OA	0.52 (±0.25)	-	0.42 (±0.33)
130	Shikra <i>Accipiter badius</i>	OA	0.12 (±0.16)	0.02(±0.13)	0.48 (±0.22)
131	Eurasian Sparrowhawk <i>Accipiter nisus</i>	OA	[1]	-	-
132	Black Kite <i>Milvus migrans</i>	OA	0.69 (±0.13)	0.16 (±0.09)	0.58 (±0.84)
133	Brahminy Kite <i>Haliastur indus</i>	OA	0.21 (±0.09)	0.06 (±0.12)	±
134	Common Buzzard <i>Buteo buteo</i>	OA	[2]	-	-
135	Long-legged Buzzard <i>Buteo rufinus</i>	OA	[1]	-	-
136	Common Barn Owl <i>Tyto alba</i>	OA	Regularly near human habitation	-	-
137	Indian Eagle Owl <i>Bubo bengalensis</i>	OA	[3] near tunnels, old wells in farmlands	-	-
138	Spotted Owlet <i>Athene brama</i>	OA	Regularly and widely	-	-
139	Mottled Wood Owl <i>Strix ocellata</i>	OA	[1]	-	[1]
140	Short-eared Owl <i>Asio flammeus</i>	OA	[2]	-	-
141	Common Hoopoe <i>Upupa epops</i>	OA	0.63 (±0.37)	0.09 (±0.07)	-
142	Indian Grey Hornbill <i>Ocyrocus birostris</i>	OA	0.13 (±0.21)	0.21 (±0.17)	0.49 (±0.14)
143	Common Kingfisher <i>Alcedo atthis</i>	W	[4]	-	-
144	White-throated Kingfisher <i>Halcyon smyrmensis</i>	W	0.37 (±0.16)	0.52 (±0.32)	0.41 (±0.67)
145	Pied Kingfisher <i>Ceryle rudis</i>	W	0.37 (±0.51)	0.08 (±0.04)	0.12 (±0.05)
146	Green Bee-eater <i>Merops orientalis</i>	OA	3.58 (±2.16)	3.29 (±1.92)	1.18 (±0.09)
147	Blue-tailed Bee-eater <i>Merops philippinus</i>	OA	[1]	-	-
148	European Roller <i>Coracias garrulus</i>	OA	0.27 (±0.09)	-	0.15 (±0.11)
149	Indian Roller <i>Coracias benghalensis</i>	OA	1.02 (±0.41)	0.62 (±0.73)	0.13 (±0.11)
150	Coppersmith Barbet <i>Psilopogon haemacephalus</i>	OA	0.26 (±0.07)	0.12 (±0.13)	0.08 (±0.09)
151	Brown-headed Barbet <i>Psilopogon zeylanicus</i>	OA	[1]	-	-
152	Eurasian Wryneck <i>Jynx torquilla</i>	OA	[2]	-	-
153	Yellow-fronted Woodpecker <i>Leiopicus maharattensis</i>	OA	0.08 (±0.12)	0.07 (±0.20)	0.03 (±0.05)
154	Common Kestrel <i>Falco tinnunculus</i>	OA	0.35 (±0.14)	-	-
155	Red-necked Falcon <i>Falco chicquera</i>	OA	0.21 (±0.15)	-	0.13 (±0.09)
156	Laggar Falcon <i>Falco jugger</i>	OA	[1]	-	-
157	Peregrine Falcon <i>Falco peregrinus</i>	OA	[1]	-	-
158	Rose-ringed Parakeet <i>Psittacula krameri</i>	OA	2.08 (±1.68)	4.95 (±3.49)	0.43 (±0.83)
159	Plum-headed Parakeet <i>Psittacula cyanocephala</i>	OA	0.95 (±0.82)	1.62 (±1.08)	-
160	Indian Pitta <i>Pitta brachyura</i>	OA	[1]	-	-
161	Small Minivet <i>Pericrocotus cinnamomeus</i>	OA	0.82 (±1.34)	0.43 (±0.56)	0.71 (±0.37)
162	Large Cuckooshrike <i>Coracina macei</i>	OA	0.14 (±0.91)	-	-

**Appendix 1.** List of birds recorded in south-western Deccan Plateau region of Maharashtra, India. [W=wetland, OA=open area, and RC=rocky cliff.]

Sr. no.	Species	Habitat	Encounter rate/h: Winter	Encounter rate/h: Summer	Encounter rate/h: Monsoon
163	Indian Golden Oriole <i>Oriolus kundoo</i>	OA	0.35 ( $\pm 0.14$ )	-	0.21 ( $\pm 0.13$ )
164	Common Woodshrike <i>Tephrodornis pondicerianus</i>	OA	0.25 ( $\pm 0.15$ )	0.64 ( $\pm 0.41$ )	0.34 ( $\pm 0.15$ )
165	Common Iora <i>Aegithina tiphia</i>	OA	0.21 ( $\pm 0.09$ )	0.34 ( $\pm 0.37$ )	0.23 ( $\pm 0.14$ )
166	Spot-breasted Fantail <i>Rhipidura albogularis</i>	OA	[1]	-	-
167	White-browed Fantail <i>Rhipidura aureola</i>	OA	0.57 ( $\pm 0.14$ )	0.08 ( $\pm 0.06$ )	0.38 ( $\pm 0.67$ )
168	Black Drongo <i>Dicrurus macrocercus</i>	OA	6.76 ( $\pm 1.99$ )	1.58 ( $\pm 0.83$ )	0.54 ( $\pm 0.33$ )
169	Indian Paradise-flycatcher <i>Terpsiphone paradisi</i>	OA	[3]	-	-
170	Isabelline Shrike <i>Lanius isabellinus</i>	OA	[2]	-	-
171	Bay-backed Shrike <i>Lanius vittatus</i>	OA	0.27 ( $\pm 0.62$ )	0.44 ( $\pm 0.25$ )	0.51 ( $\pm 0.22$ )
172	Long-tailed Shrike <i>Lanius schach</i>	OA	1.04 ( $\pm 0.21$ )	0.79 ( $\pm 0.33$ )	0.66 ( $\pm 0.36$ )
173	Great Grey Shrike <i>Lanius excubitor</i>	OA	0.54 ( $\pm 0.41$ )	0.66 ( $\pm 0.35$ )	0.40 ( $\pm 0.29$ )
174	Rufous Treepie <i>Dendrocitta vagabunda</i>	OA	0.23 ( $\pm 0.17$ )	0.09 ( $\pm 0.02$ )	-
175	House Crow <i>Corvus splendens</i>	OA	1.32 ( $\pm 1.05$ )	3.18 ( $\pm 2.91$ )	0.57 ( $\pm 0.29$ )
176	Large-billed Crow <i>Corvus macrorhynchos</i>	OA	0.49 ( $\pm 0.28$ )	0.24 ( $\pm 0.12$ )	0.22 ( $\pm 0.81$ )
177	Grey-headed Canary-flycatcher <i>Culicicapa ceylonensis</i>	OA	[2]	-	-
178	Cinereous Tit <i>Parus cinereus</i>	OA	0.17 ( $\pm 0.14$ )	0.15 ( $\pm 0.13$ )	0.21 ( $\pm 0.15$ )
179	Indian Black-lored Tit <i>Machlolophus apilonotus</i>	OA	[1]	-	-
180	Rufous-tailed Lark <i>Ammomanes phoenicura</i>	OA	2.45 ( $\pm 2.06$ )	0.86 ( $\pm 0.87$ )	3.82 ( $\pm 0.72$ )
181	Ashy-crowned Sparrow Lark <i>Eremopterix griseus</i>	OA	1.43 ( $\pm 0.78$ )	0.83 ( $\pm 0.37$ )	0.88 ( $\pm 0.50$ )
182	Indian Bushlark <i>Mirafra erythroptera</i>	OA	0.54 ( $\pm 0.40$ )	0.77 ( $\pm 0.19$ )	0.95 ( $\pm 0.41$ )
183	Sykes's/Greater Short-toed Lark <i>Calandrella dukhunensis/brachydactyla</i>	OA	17.87 ( $\pm 14.21$ )	-	-
184	Oriental Skylark <i>Alauda gulgula</i>	OA	-	[2]	-
185	Sykes's Lark <i>Galerida deva</i>	OA	2.08 ( $\pm 1.31$ )	2.16 ( $\pm 0.67$ )	4.83 ( $\pm 1.91$ )
186	Common Tailorbird <i>Orthotomus sutorius</i>	OA	0.37 ( $\pm 0.62$ )	1.12 ( $\pm 0.25$ )	0.51 ( $\pm 0.21$ )
187	Grey-breasted Prinia <i>Prinia hodgsonii</i>	OA	0.17 ( $\pm 0.09$ )	0.32 ( $\pm 0.08$ )	0.70 ( $\pm 0.21$ )
188	Jungle Prinia <i>Prinia sylvatica</i>	OA	[2]	-	-
189	Ashy Prinia <i>Prinia socialis</i>	OA	1.12 ( $\pm 0.41$ )	0.89 ( $\pm 1.13$ )	1.34 ( $\pm 1.42$ )
190	Plain Prinia <i>Prinia inornata</i>	OA	4.16 ( $\pm 1.54$ )	3.54 ( $\pm 1.66$ )	3.75 ( $\pm 1.2$ )
191	Zitting Cisticola <i>Cisticola juncidis</i>	OA	0.83 ( $\pm 0.37$ )	0.70 ( $\pm 0.21$ )	0.51 ( $\pm 0.26$ )
192	Blyth's Reed Warbler <i>Acrocephalus dumetorum</i>	OA	1.09 ( $\pm 0.34$ )	-	-
193	Clamorous Reed Warbler <i>Acrocephalus stentoreus</i>	OA	0.07 ( $\pm 0.05$ )	-	0.06 ( $\pm 0.04$ )
194	Barn Swallow <i>Hirundo rustica</i>	OA	4.78 ( $\pm 2.17$ )	-	-
195	Wire-tailed Swallow <i>Hirundo smithii</i>	OA	1.87 ( $\pm 1.62$ )	3.65 ( $\pm 1.87$ )	2.1 ( $\pm 1.21$ )
196	Red-rumped Swallow <i>Cecropis daurica</i>	OA	2.51 ( $\pm 1.91$ )	1.62 ( $\pm 0.55$ )	0.71 ( $\pm 0.62$ )
197	Streak-throated Swallow <i>Petrochelidon fluvicola</i>	OA	[3]	-	-
198	Red-vented Bulbul <i>Pycnonotus cafer</i>	OA	8.41 ( $\pm 1.39$ )	4.09 ( $\pm 1.89$ )	8.41 ( $\pm 0.91$ )
199	Red-whiskered Bulbul <i>Pycnonotus jocosus</i>	OA	[1]	-	-
200	White-browed Bulbul <i>Pycnonotus luteolus</i>	OA	[1]	-	-
201	Sulphur-bellied Warbler <i>Phylloscopus griseolus</i>	RC	[2]	-	-
202	Lesser Whitethroat <i>Sylvia curruca</i>	OA	1.06 ( $\pm 0.35$ )	-	-
203	Yellow-eyed Babbler <i>Chrysomma sinense</i>	OA	0.92 ( $\pm 0.89$ )	1.41 ( $\pm 0.72$ )	1.05 ( $\pm 1.34$ )
204	Indian White-eye <i>Zosterops palpebrosus</i>	OA	0.24 ( $\pm 0.14$ )	-	-
205	Tawny-bellied Babbler <i>Dumetia hyperythra</i>	OA	Only twice	-	-
206	Jungle Babbler <i>Argya striata</i>	OA	[2]	[1]	-
207	Yellow-billed Babbler <i>Argya affinis</i>	OA	-	[1]	[2]
208	Common Babbler <i>Argya caudata</i>	OA	0.20 ( $\pm 0.07$ )	0.31 ( $\pm 0.10$ )	0.63 ( $\pm 0.42$ )

**Appendix 1.** List of birds recorded in south-western Deccan Plateau region of Maharashtra, India. [W=wetland, OA=open area, and RC=rocky cliff.]

Sr. no.	Species	Habitat	Encounter rate/h: Winter	Encounter rate/h: Summer	Encounter rate/h: Monsoon
209	Large Grey Babbler <i>Argya malcolmi</i>	OA	5.6 ( $\pm 1.38$ )	6.20 ( $\pm 1.84$ )	4.04 ( $\pm 2.69$ )
210	Common Starling <i>Sturnus vulgaris</i>	OA	[1]	-	-
211	Rosy Starling <i>Pastor roseus</i>	OA	43.56 ( $\pm 30.12$ )	3.32 ( $\pm 2.06$ )	-
212	Brahminy Starling <i>Sturnia pagodarum</i>	OA	2.02 ( $\pm 1.83$ )	2.95 ( $\pm 2.72$ )	1.23 ( $\pm 0.42$ )
213	Common Myna <i>Acridotheres tristis</i>	OA	4.05 ( $\pm 2.08$ )	6.66 ( $\pm 1.63$ )	1.45 ( $\pm 1.16$ )
214	Orange-headed Thrush <i>Geokichla citrina</i>	OA	[3]	-	-
215	Indian Blackbird <i>Turdus simillimus</i>	OA	[1]	-	-
216	Asian Brown Flycatcher <i>Muscicapa dauurica</i>	OA	0.03 ( $\pm 0.01$ )	-	-
217	Indian Robin <i>Copsychus fulicatus</i>	OA	1.62 ( $\pm 0.65$ )	1.41 ( $\pm 0.56$ )	1.25 ( $\pm 0.77$ )
218	Oriental Magpie Robin <i>Copsychus saularis</i>	OA	0.08 ( $\pm 0.09$ )	-	0.16 ( $\pm 0.14$ )
219	Tickell's Blue Flycatcher <i>Cyornis tickelliae</i>	OA	[1]	-	-
220	Bluethroat <i>Luscinia svecica</i>	OA	0.21 ( $\pm 0.09$ )	-	-
221	Red-breasted Flycatcher <i>Ficedula parva</i>	OA	0.05 ( $\pm 0.03$ )	-	-
222	Black Redstart <i>Phoenicurus ochruros</i>	OA	0.35 ( $\pm 0.14$ )	-	-
223	Blue Rock Thrush <i>Monticola solitarius</i>	OA	0.084 ( $\pm 0.02$ )	-	-
224	Siberian Stonechat <i>Saxicola maurus</i>	OA	2.57 ( $\pm 1.42$ )	-	-
225	Pied Bushchat <i>Saxicola caprata</i>	OA	1.51 ( $\pm 0.43$ )	1.20 ( $\pm 0.84$ )	0.91 ( $\pm 0.38$ )
226	Isabelline Wheatear <i>Oenanthe isabellina</i>	OA	[1]	-	-
227	Desert Wheatear <i>Oenanthe deserti</i>	OA	[1]	-	-
228	Thick-billed Flowerpecker <i>Dicaeum agile</i>	OA	[1]	-	-
229	Pale-billed Flowerpecker <i>Dicaeum erythrorhynchos</i>	OA	[1]	-	-
230	Purple-rumped Sunbird <i>Leptocoma zeylonica</i>	OA	0.19 ( $\pm 0.13$ )	0.12 ( $\pm 0.07$ )	0.37 ( $\pm 0.16$ )
231	Purple Sunbird <i>Cinnyris asiaticus</i>	OA	1.47 ( $\pm 0.38$ )	0.56 ( $\pm 0.24$ )	0.12 ( $\pm 0.09$ )
232	Baya Weaver <i>Ploceus philippinus</i>	OA	9.03 ( $\pm 5.32$ )	4.06 ( $\pm 2.23$ )	11.09 ( $\pm 6.92$ )
233	Red Munia <i>Amandava amandava</i>	OA	3.41 ( $\pm 3.05$ )	3.87 ( $\pm 2.12$ )	1.51 ( $\pm 1.07$ )
234	Indian Silverbill <i>Euodice malabarica</i>	OA	5.4 ( $\pm 4.7$ )	2.33 ( $\pm 5.87$ )	8.83 ( $\pm 5.8$ )
235	Scaly-breasted Munia <i>Lonchura punctulata</i>	OA	6.39 ( $\pm 1.71$ )	2.97 ( $\pm 1.70$ )	7.71 ( $\pm 2.29$ )
236	Tricoloured Munia <i>Lonchura malacca</i>	OA	3.69 ( $\pm 1.42$ )	1.21 ( $\pm 0.87$ )	1.17 ( $\pm 1.41$ )
237	House Sparrow <i>Passer domesticus</i>	OA	7.75 ( $\pm 6.33$ )	0.70 ( $\pm 0.63$ )	1.83 ( $\pm 1.52$ )
238	Yellow-throated Sparrow <i>Gymnoris xanthocollis</i>	OA	5.66 ( $\pm 2.43$ )	3.7 ( $\pm 2.6$ )	-
239	Forest Wagtail <i>Dendronanthus indicus</i>	OA	Present	-	-
240	Grey Wagtail <i>Motacilla cinerea</i>	W	1.38 ( $\pm 0.79$ )	-	-
241	Western Yellow Wagtail <i>Motacilla flava</i>	W	4.04 ( $\pm 1.29$ )	-	-
242	Citrine Wagtail <i>Motacilla citreola</i>	W	0.13 ( $\pm 0.42$ )	-	-
243	White-browed Wagtail <i>Motacilla maderaspatensis</i>	W	0.94 ( $\pm 0.55$ )	[2]	[3]
244	White Wagtail <i>Motacilla alba</i>	W	0.61 ( $\pm 0.23$ )	-	-
245	Richard's/Blyth's Pipit <i>Anthus richardi/godlewskii</i>	OA	2.37 ( $\pm 3.18$ )	-	-
246	Paddyfield Pipit <i>Anthus rufulus</i>	OA	1.79 ( $\pm 0.69$ )	0.58 ( $\pm 0.76$ )	0.49 ( $\pm 0.61$ )
247	Tawny Pipit <i>Anthus campestris</i>	OA	[1]	-	-
248	Tree Pipit <i>Anthus trivialis</i>	OA	[4]	-	-
249	Olive-backed Pipit <i>Anthus hodgsoni</i>	OA	0.58 ( $\pm 0.28$ )	-	-
250	Common Rosefinch <i>Carpodacus erythrinus</i>	OA	[1]	-	-
251	Crested Bunting <i>Emberiza lathami</i>	OA	[1]	-	-
252	Black-headed Bunting <i>Emberiza melanocephala</i>	OA	11.7 ( $\pm 6.04$ )	-	-
253	Red-headed Bunting <i>Emberiza bruniceps</i>	OA	10.43 ( $\pm 8.26$ )	-	-
254	Grey-necked Bunting <i>Emberiza buchanani</i>	OA	4.63 ( $\pm 3.81$ )	-	-

**Appendix 2.** List of birds recorded by others

No	Species	Individuals	Site and District	Reference
1.	Sanderling <i>Calidris alba</i>	50	Vishnupad Temple lake, Pandharpur, SO	Badave (2020)
2.	Dusky Crag-Martin <i>Ptyonoprogne concolor</i>	1 15 8 1	Mohol, SO Great Indian Bustard Sanctuary, Nannaj, SO; Hipparga lake, SO Sambhaji lake, SO	Nalavade (2003); Shenai (2020a) Shenai (2020b) Taylor (2012)
3.	Baillon's Crake <i>Zapornia pusilla</i>	1 2	Yamai lake, SO Great Indian Bustard Sanctuary, Nannaj, SO	Badave (2018) Correia (2019)
4.	Rufous-fronted Prinia <i>Prinia buchanani</i>	4 1	Great Indian Bustard Sanctuary Nannaj, SO	Jacob (2016) Khopkar (2017)
5.	Western Crowned Warbler <i>Phylloscopus occipitalis</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Rahane (2015)
6.	Taiga Flycatcher <i>Ficedula albicilla</i>	1 2	Smruti Udyan, Solapur city, Solapur city	MigrantWatch (2015) Abdulpurkar (2020)
7.	Common Chiffchaff <i>Phylloscopus collybita</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Kher (2014)
8.	Chestnut-tailed Starling <i>Sturnia malabarica</i>	10 1	Great Indian Bustard Sanctuary, Nannaj, SO Solapur city	Staton (2013) Abdulpurkar (2018)
9.	Savanna Nightjar <i>Caprimulgus affinis</i>	X	Great Indian Bustard Sanctuary, Nannaj, SO	Viswanathan (2011)
10.	Booted Warbler <i>Iduna caligata</i>	1 1 1	TISS Campus, Tuljapur, OS Gangewadi, OS; Great Indian Bustard Sanctuary, Nannaj, SO; Hiraj, SO Vishnupad Temple, SO	Thakur (2015) Mohan (2019a) Sagare (2020b)
11.	Brown Shrike <i>Lanius cristatus</i>	1 1	Gangewadi, OS and Great Indian Bustard Sanctuary, Nannaj, SO Yamai lake, Pandharpur, SO	Mohan (2019c) Badave (2017b)
12.	Tawny Pipit <i>Anthus campestris</i>	1 1 1	Gangewadi, OS Yamai lake, Pandharpur, SO Great Indian Bustard Sanctuary, Nannaj, SO	Mohan (2019c) Badave (2017b) Gaekwad (2020b)
13.	Blyth's Pipit <i>Anthus godlewskii</i>	1	Gangewadi, OS	Mohan (2019)
14.	Hume's Warbler <i>Phylloscopus humei</i>	1	TISS Campus, Tuljapur, OS	Thakur (2015)
15.	Ashy Drongo <i>Dicurus leucophaeus</i>	2 4 1	TISS Campus, Tuljapur, OS Great Indian Bustard Sanctuary, Nannaj, SO Hiraj, SO	Dutta (2019); Pawar (2020) Mohan (2019b)
16.	Greenish Warbler <i>Phylloscopus trochiloides</i>	2 1 1	TISS Campus, Tuljapur, OS Great Indian Bustard Sanctuary, Nannaj, SO; Hiraj, SO Sambhaji lake, SO	Thakur (2015); Mohan (2019a) Taylor (2012)
17.	Sykes's Warbler <i>Iduna rama</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Prashanth (2019)
18.	Eurasian Curlew <i>Numenius arquata</i>	1	Hipparga, SO	Abdulpurkar (2013)
19.	White-bellied Drongo <i>Dicurus caerulescens</i>	2	Great Indian Bustard Sanctuary, Nannaj, SO	Mandavkar (2018)
20.	Long-billed Pipit <i>Anthus similis</i>	1 1	Yamai lake, Pandharpur, SO Great Indian Bustard Sanctuary, Nannaj, SO	Badave (2017a) Zaveri (1991)
21.	Common Quail <i>Coturnix coturnix</i>	3	Kumbhargaoon, Bhigwan, PU	Desai (2015)
22.	Alpine Swift <i>Apus melba</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Praveen (2006)
23.	Asian Pied Starling <i>Gracupica contra</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Mehta (2019)
24.	Green Sandpiper <i>Tringa ochropus</i>	1 1 1 1	Hipparga, SO Yamai lake, Pandharpur, SO Great Indian Bustard Sanctuary, Nannaj, SO; Hiraj, SO Sambhaji lake, SO	Gaekwad (2020a) Sagare (2020a) Mohan (2019a,b) Taylor (2012)
25.	Indian Scops-Owl <i>Otus bakkamoena</i>	1	Yamai lake, Pandharpur, SO	Badave (2017a)
26.	Singing Bushlark <i>Mirafra cantillans</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Jacob (2016)
27.	European Bee-eater <i>Merops apiaster</i>	1	Great Indian Bustard Sanctuary, Nannaj, SO	Vaghela (2019)

**Abbreviations:** OS=Osmanabad; SO=Solapur.

**Note:** Checklists from the intensive study area of the Great Indian Bustard Sanctuary, Nannaj, Solapur, and ~50 km radius (Hipparga Lake; Hiraj; Yamai Lake, Pandharpur of District Solapur, and Tata Institute of Social Science, Tuljapur; Gangewadi; Katgao Lake of District Osmanabad) were referred. The Red Spurfowl *Galloperdix spadicea* 10 individuals reported at Hipparga Lake, Solapur, on 01 December 2019, by Vishwanath Vhatkar, are considered doubtful.