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On the Diversity and Abundance of Avian Species from Grassland and Wetland Areas of an Industrial Zone of Tropical Maharashtra

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ABSTRACT

India is a very rapidly growing country, with respect to its economy, world recognition, infrastrcture and industrilization. These surfacing industries need a large area for the operation and shouldn't near the human settelments, generally the city outskirts grasslands are choosen for convinience. This leads to loss of well settled grassland habitat or a wetland and therefore many species fostering in these habitas also get affected due to this. This study is selected because there is a lack of data concerning the avian diversity and their abundance associated to the grasslands and wetlands of wide spread Maharashtra Industrial Development Co-operation (MIDC) areas specifically. The study area is a richly diversified, with patches of grassland and wetland in all over the MIDC area. Hence this attempt has been made to know the present status of the avian fauna and its diversity associated with the grasslands and wetlands in MIDC area near Amravati a city having tropical climate . The study was carried out in November 2018 to February 2019 for four Months and monthly four visits were made in the study area. Line transect and belt transect methods of quantification was used for grassland bird study and point transect was used for wetland birds. Total 221 species were reported in the study area, out of which 126 birds were observed in grassland area and 95 species were recorded from the wetlands. In grassland a total of 1473 individuals from all the species were reported and from wetland 909 individuals were reported. The diversity index, species evenness, relative density, species abundance for grassland were 3.96, 0.81, 0-5.43 and 80 whereas 3.87, 0.85, 0-7.7 and 70 for wetland respectively. These entire parameters exhibit high avian faunal existence in MIDC area of Amravati. This indicates that the MIDC grasslands and wetlands provide a very rich avian diversity. The study showed a preliminary data regarding avian diversity and abundance in MIDC area of Amravati. But it would be useful for the study of environmental impacts of industrialization on bird population and diversity

KEY WORDS: AVIAN SPECIES, DIVERSITY, ABUNDANCE, GRASSLAND, WETLAND AND MIDC AMRAVATI.

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INTRODUCTION

The Indian subcontinent, a part of vast Oriental biogeographic regions, is very rich in bio-diversity. India hosts 1300 species of birds out of the 9000 of the total birds in the world, constituting 13 percent of the total bird population and thus is an area of high avian diversity. Bird fauna of India represents 48 families out of the total 75 families in the world. Ali and Ripley (1987) considered 176 species endemic to Indian subcontinent. Grasslands, Wetlands, Bushlands, Forests provide appropriate dwelling places for these organisms. Out of 1300 species of Indian subcontinent (Grimmett et al., 2009) more than 577 species have been reported from Maharashtra State (Kasambe 2016). In Vidarbha, a total of 417 species has been reported (Anon, 2009) and overall Amravati district has 392 birds species (Wadatkar et al., 2016).

Total Forest cover in Indian geography is 21.54 percent, wetlands (under the Ramsar Convention, excluding rivers) has an area of 60 million hectare, grasslands or bushlands occupy nearly 24 percent of the geographical area in India. Moreover, increasing demands on these fragile grassland ecosystems from multiple quarters, notably agricultural intensification, infrastructure development, mining, quarrying, industrial and commercial development, invasive species, and what is more, the very neglect of the common property resources, have eroded much of the native grasslands in the subcontinent with faunal diversity. However the biodiversity in the grassland is not studied to a depth. Comparative studies of avian community composition in different habitat inculding Forests, Wetlands, Grasslands and even in Urban and Sub-urban area can improve our knowledge of general pattern and process that characterize bird species and communities. Birds that depend on grassland and scrub vegetation was experienced a greater decline than any other habitats. Habitat loss and degradation of winter foraging and breeding ground observed leading causes of this decline. (Mankadan 2014, West , 2016, Johnson et al., 2019).

Hence, the present study was carried out for the documentation of diversity, species richness, abundance and evenness of birds associated to the grasslands and wetlands and to know the present status of avian fauna in and around the MIDC area of Nandgaonpeth Amravati specifically.

MATERIAL AND METHODS

Maharashtra Industrial Development Co-operation (M.I.D.C) was established in 1962. MIDC manages its 289 industrial complexes spread over 66,000 hectares of land. Amravati zone (21°01'20" N and 77°51'41" E), with an elevation of 364 meters, is divided in two Parts Amravati MIDC Badnera old bypass and MIDC Nandgaonpeth (NP). It is an area of 2800 hectare, distributed in Commercial, Industrial and Residential zones. The complete 2800 hectare is not a plot able land, 1124 hectare land occupied by textile industrial stakeholders. Rest of the 2800 hectare of land is divided amongst other zones, roads, open spaces, grasslands, wetland and other amenities. The selected study area was 24.79 kms, including grasslands, bush lands forests and wetland. All these lands were connected by major road-ways; one of such was Amravati-Nagpur Expressway (National Highway No. 6).

Figure 1: Map showing the study area (Nandgaonpeth MIDC area), Amravati M.S

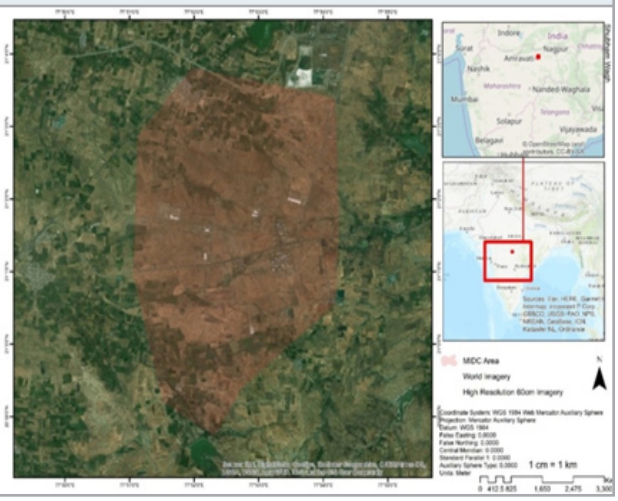


Figure 2: (A) Showing the grassland habitat and (B) Showing the wetland habitat in study area

(A)

(B)

The study was carried out in November 2018 to February 2019 (Four Months) in MIDC Nandgaonpeth, Amravati. (Fig.1and2). For this study, 5 zones were chosen in study area. Monthly four visits were made in the study area. Observations were made during 7:30 am to 10:00 am and 4:00 pm to 6:30 pm. Various Quadrates were selected from the study area. Line Transect and Belt Transect bird survey methods of quantification were used for Grassland bird study and Point transect was used for Wetland birds.

Observation and Identification was done using Nikon 8-16x40 mm Binocular. Photographic observations were taken by using Nikon D90 DSLR Camera with 70-300mm and 80-400mm Zoom lens and 18-105mm normal lens. Nikon P600 Point-shoot Camera with a fixed lens, Go pro Hero 5 action camera was also used. Coordinates of the study area were recorded by GPS Garmin-60. Map of the study area was created using Arch Map 10.5 and

Arch GIS software. Birds were identified and listed with the help of available resources, books and checklist (Ali S., and Ripley (1987), Grimmet et al., (2000). Rasmussen, P.C. and Anderton, P.C., (2012) and Checklist of Birds of Amravati District, Wadatkar et al.,(2016).

Data Analysis: All the recorded species were statistically analyzed using various parameters like Diversity Index (Shannon-Wiener's Index; H'), Species Evenness, Relative Density, Species Abundance and Richness.

Shannon-Wiener Index (1963): – The recorded number of Individuals of each Species were Statistically evaluated using Species Diversity index (H') {Shannon-Wiener Index},The values ranging between 0, indicating Low community complexity and 4 and above indicating High community complexity.

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Relative Density: –

$$\text{Relative Density (RD)} = \frac{\text{Number of individual of species}}{\text{Total number of individual of all species}} \times 100$$

Relative Density (RD) = (Number of individual of species)/ (Total number of individual of all species) ×100

Abundance:– It is the number of birds of particular species as a percentage of total bird population of a given area.

$$\text{Abundance} = \frac{\text{Total number of individuals in all sampling units}}{\text{Total number of sampling units of occurance}}$$

Evenness: – It is a measure of relative abundance of different species, it is calculated by using,

$$\text{Evenness} = \frac{H}{H_{max}}$$

Where, H=Shannons Diversity Index, and H_{max}= maximum diversity possible.

RICHNESS: – The number of species per sample is a measure of Richness. The more the species present in the sample, the "richer" the sample. Margalef's index was used as a simple measure of species richness.

Margalef's index=(S-1/In N

Where S=total number of Species, N=total number of individuals in the sample and In= natural logarithm.

RESULTS AND DISCUSSION

Total 221 species were reported in the study area, out of which 126 birds were observed in Grassland area and 95 species were recorded from the Wetlands. In Grassland a total of 1473 individuals from all the bird species were reported and from Wetland 909 individuals were reported. The study area is a richly diversified, with patches of grassland and wetland in all over the MIDC area.(Table 1&2).In all 59 Families of birds were observed in the course of study. Out of which 35 families belong to the grassland birds, and 24 families are of wetland birds. In the families of grassland birds, maximum 14 Species were recorded from, Accipitridae family and in Wetland bird's maximum 15 Species were recorded from two families, Scolopacidae and Anatidae each. (Fig.3&4).Accipitridae family includes (Raptors) Black kite, Eurasian Sparrow-hawk, Short-toed Snake Eagle, Harriers, Booted Eagle etc. while Scolopacidae family include (Waders) Sandpipers, Snipes, Spotted Redshank, Common Greenshank, Godwit, Stint, etc. Indian Silver bill recorded the maximum number of individuals (80) of a Grassland Species, and Black-winged Stilt recorded the maximum number of individuals (70) from Wetlands.

Recorded species were also assorted according to the IUCN's list of Threatened species (2018) categorized. In grassland 122 species belong to Least Concerned and 4 species belong to Near-Threatened (Fig. 5). In wetland 85 species belongs to LC, 8 species were of NT status and 2 species belonged to VU (Fig 6). All the recorded species were statistically analyzed using various parameters like Diversity Index (Shannon-Wiener's Index; H') and Species Evenness , Relative Density, Species Abundance and species Richness. The diversity index, species evenness, relative density, species abundance for Grassland were 3.96, 0.81, 0-5.43,80 and 17.13 whereas 3.87,0.85,0-7.7,70 and 13.79 for wetland respectively. (Table no.3).

All the recorded species were categorized according to their presence in the study area. In grassland resident (R) constitutes 96 species, winter visitors (W) includes 23 species, breeding migrants (BM) includes 4 species and passage visitor (PV) 3 species (Fig. 7).Whereas in wetland, resident (R) constitutes 47 species, Winter visitors (W) constitutes 36 species, resident migrant (RM) include 4 species, breeding migrant (BM) include 2 Species and passage visitor (PV) include 3 species.(Fig. 8).

The extensive grasslands in the region have a very rich fauna of birds, especially grassland birds. They have large patches of steppe grasslands which have places for Feeding and Roosting and hence, it is a preferred habitat for various migratory and resident birds. Birds like Munias, Larks, Pipits, Baya weavers, Sparrows, Coursers, Partridges and Quails were amongst the most occurring in the wide spread grassland. Apart from these grassland dwellers this area hosts a wide-ranging raptor population. Many migratory birds recite here for definite period of time, various Falcons, Harriers, Eagles, Kites and Hawks were recorded during the course of study.In the Wetland region; Storks, Sandpipers, Plovers, Ducks, Water hens, and many other waders were recorded. The wetland patches every-year hosts a wide range of migratory birds

in huge numbers, Bar-headed Geese every-year come and rest here during their migration in 100 of numbers. Apart from these, little waders including Stints, Plovers and Sandpipers also turn up in large numbers.

Table 1. Checklist of Grassland Avian Fauna from MIDC area(NP), Amravati

Sr no	Common Name	Scientific Name	Family	ST	IUCN status
1	Grey Francolin	*Francolinus pondicerianus*	PHASIANIDAE (8)	R	LC
2	Painted Francolin	*Francolinus pictus*		R	LC
3	Common Quail	*Coturnix coturnix*		W	LC
4	Rain Quail	*Coturnix coromandelica*		R	LC
5	Jungle Bush Quail	*Perdicula asiatica*		R	LC
6	Rock Bush Quail	*Perdicula argoondah*		R	LC
7	Barred Buttonquail	*Turnix suscitator*		R	LC
8	Small Buttonquail	*Turnix sylvaticus*		R	LC
9	Eurasian wryneck	*Jynx torquilla*	PICIDAE (4)	W	LC
10	Common Flameback	*Dinopium javanense*		R	LC
11	Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*		R	LC
12	White-naped Woodpecker	*Chrysocolaptes festivus*		R	LC
13	Coppersmith Barbet	*Megalaima haemacephala*	MEGALAIMIDAE (1)	R	LC
14	Common Hoopoe	*Upupa epops*	UPUPIDAE (1)	R	LC
15	Indian Roller	*Coracias benghalensis*	CORACIIDAE (2)	R	LC
16	European Roller	*Coracias garrulus*		PV	NT
17	Green Bee-eater	*Merops orientalis*	MEROPIDAE (2)	R	LC
18	Pied Cuckoo	*Clamator jacobinus*	CUCULIDAE (6)	BM	LC
19	Common Hawk Cuckoo	*Hierococcyx varius*		R	LC
20	Indian Cuckoo	*Cuculus micropterus*		R	LC
21	Eurasian Cuckoo	*Cuculus canorus*		BM	LC
22	Grey-bellied Cuckoo	*Cacomantis passerinus*		BM	LC
23	Asian Koel	*Eudynamys scolopaceus*		R	LC
24	Southern Coucal	*Centropus sinensis*	CENTROPODIDAE (1)	R	LC
25	Alexandrine Parakeet	*Psittacula eupatria*	PSITTACIDAE (3)	R	NT
26	Rose-ringed Parakeet	*Psittacula krameri*		R	LC
27	Plum-headed Parakeet	*Psittacula cyanocephala*		R	LC
28	Little Swift	*Apus affinis*	APODIDAE (2)	R	LC
29	Asian Palm Swift	*Cypsiurus balasiensis*		R	LC
30	Common Barn Owl	*Tyto alba*	TYTONIDAE (1)	R	LC
31	Eurasian Eagle Owl	*Bubo bubo*	STRIGIDAE (4)	R	LC
32	Spotted Owlet	*Athene brama*		R	LC
33	Brown Hawk-Owl	*Ninox scutulata*		R	LC
34	Short-eared Owl	*Asio flammeus*		W	LC
35	Indian Nightjar	*Caprimulgus asiaticus*	CAPRIMULGIDAE (2)	R	LC
36	Indian Jungle Nightjar	*Caprimulgus indicus*		R	LC
37	Rock Pigeon	*Columba livia*	COLUMBIDAE (6)	R	LC
38	Yellow-footed Green Pigeon	*Treronphoenicoptera*		R	LC
39	Eurasian Collard-Dove	*Streptopeliadecaocto*		R	LC
40	Red Collard-Dove	*Streptopelia tranquebarica*		R	LC
41	Spotted Dove	*Spilopelia chinensis*		R	LC
42	Laughing Dove	*Spilopelia senegalensis*		R	LC
43	Chestnut-bellied Sandgrouse	*Pterocles exustus*	PTEROCLIDAE (2)	R	LC
44	Painted Sandgrouse	*Pterocles indicus*		R	LC
45	Yellow-wattled Lapwing	*Vanellus malabaricus*	CHARADRIIDAE (2)	R	LC
46	Red-wattled Lapwing	*Vanellus indicus*		R	LC
47	Indian Courser	*Cursoriuscoro mandelicus*	GLAREOLIDAE (1)	R	LC
48	Black-shouldered Kite	*Elanus axillaris*	ACCIPITRIDAE (14)	R	LC

Continue Table 1

49	Black Kite	*Milvus migrans*		R	LC
50	Black-eared Kite	*Milvus migranslineatus*		W	LC
51	Shikra	*Accipiter badius*		R	LC
52	Eurasian Sparrow Hawk	*Accipiter nisus*		W	LC
53	Booted Eagle	*Hieraaetus pennatus*		W	LC
54	Eurasian Marsh Harrier	*Circus aeruginosus*		W	LC
55	Short-toed Snake Eagle	*Circaetus gallicus*		R	LC
56	Pallid Harrier	*Circus macrourus*		W	NT
57	Pied Harrier	*Circus melanoleucos*		W	LC
58	Montagu's Harrier	*Crcus pygragus*		W	LC
59	Crested Serpent Eagle	*Spilornis cheela*		R	LC
60	Oriental Honey Buzzard	*Pernis ptilorhynchus*		R	LC
61	White-eyed Buzzard	*Butastur teesa*		R	LC
62	Common Kestrel	*Falco tinnunculus*	FALCONIDAE (5)	R	LC
63	Lesser Kestrel	*Falco naumanni*		PV	LC
64	Eurasian Hobby	*Falco subbuteo*		W	LC
65	Red-necked Falcon	*Falco chicquera*		R	NT
66	Amur Falcon	*Falco amurensis*		PV	LC
67	Cattle Egret	*Bubulcus ibis*	ARDEIDAE (1)	R	LC
68	Bay-backed Shrike	*Lanius vittatus*	LANIIDAE (3)	R	LC
69	Long-tailed Shrike	*Lanius schach*		R	LC
70	Brown Shrike	*Lanius cristatus*		W	LC
71	Rufous Treepie	*Dendrocitta vagabunda*	CORVIDAE (7)	R	LC
72	House Crow	*Corvus splendens*		R	LC
73	Small Minivet	*Pericrocotus cinnamomeus*		R	LC
74	Black Drongo	*Dicrurus macrocercus*		R	LC
75	White-browed Fantail	*Rhipidura aureola*		R	LC
76	Asian Paradise-flycatcher	*Terpsiphone paradisi*		R	LC
77	Common Iora	*Aegithina tiphia*		R	LC
78	Oriental Magpie Robin	*Copsychus saularis*	MUSCICAPIDAE (8)	R	LC
79	Desert Wheatear	*Oenanthe desertii*		W	LC
80	Orange-headed Thrush	*Zoothera citrina*		R	LC
81	Indian Robin	*Saxicoloides fulicatus*		R	LC
82	Black Redstart	*Phoenicurus ochruros*		W	LC
83	Indian Chat	*Cercomela fusca*		R	LC
84	Common Stonechat	*Saxicola torquata*		W	LC
85	Pied Bushchat	*Saxicola caprata*		R	LC
86	Brahminy Starling	*Sturnia pagodarum*	STURNIDAE (5)	R	LC
87	Rosy Starling	*Sturnia roseus*		W	LC
88	Asian Pied Starling	*Gracupica contra*		R	LC
89	Common Myna	*Acridotheres tristis*		R	LC
90	Chestnut-tailed Starling	*Sturnia malabarica*		W	LC
91	Dusky Craig Martin	*Ptyonoprogne concolor*	HIRUNDINIDAE (4)	R	LC
92	Grey-throated Martin	*Riparia chinensis*		R	LC
93	Barn Swallow	*Hirundo rustica*		W	LC
94	Wire-tailed Swallow	*Hirundo smithii*		R	LC
95	Red-vented Bulbul	*Pycnonotus cafer*	PYCNONOTIDAE (1)	R	LC
96	Zitting Cisticola	*Cisticola juncidis*	CISTICOLIDAE (1) SYLVIIDAE (5)	R	LC
97	Jungle Prinia	*Prinia sylvatica*		R	LC
98	Plain Prinia	*Prinia inornate*		R	LC
99	Ashy Prinia	*Prinia socialis*		R	LC
100	Blyth's Reed Warbler	*Acrocephalus dumetorum*		R	LC
101	Lesser Whitethroat	*Sylvia curruca*		W	LC
102	Common Tailor Bird	*Orthotomus sutorius*		R	LC
103	Yellow-eyed Babbler	*Chrysomma sinense*		R	LC
104	Large Grey Babbler	*Turdoides malcolmi*		R	LC

Continue Table 1

105	Jungle Babbler	*Turdoides striatus*		R	LC
106	Common Babbler	*Turdoides caudatus*		R	LC
107	Indian Bush Lark	*Mirafra erythroptera*		R	LC
108	Ashy-crowned Sparrow Lark	*Eremopterix griseus*	ALAUDIDAE (6)	R	LC
109	Sykes's Lark	*Galerida deva*		R	LC
110	Singing Bushlark	*Mirafra cantillllans*		W	LC
111	Rufous-tailed Lark	*Ammomanes phoenicura*		R	LC
112	Greater Short-toed Lark	*Calandrella brachydactyla*		W	LC
113	Purple-rumped Sunbird	*Leptocomazeylonica*	NECTARINIDAE (2)	R	LC
114	Purple Sunbird	*Cinnyris asiaticus*		R	LC
115	Paddyfield Pipit	*Anthus rufulus*	PASSERIDAE (8)	R	LC
116	Tawny Pipit	*Anthus campestris*		W	LC
117	House Sparrow	*Passer domesticus*		R	LC
118	Chestnut-shouldered Petronia	*Petronia xanthocollis*		R	LC
119	Baya Weaver	*Ploceus philippinus*		R	LC
120	Red Avadavat	*Amandava amandava*		R	LC
121	Indian Silverbill	*Euodice malabarica*		R	LC
122	Scaly-breasted Munia	*Lonchura punctulata*		R	LC
123	Indian Pitta	*Pitta brachyura*	PITTIDAE (1)	BM	LC
124	Asian paradise Flycatcher	*Terpsiphone paradisi*	MONARCHIDAE (1)	R	LC
125	Grey-necked Bunting	*Emberiza buchanani*	FRINGILLIDAE (1)	W	LC
126	Oriental White-eye	*Zosterops palpebrosus*	ZOSTEROPIDAE	R	LC

R=Widespread Resident; W=Widespread Winter Visitor; PV=Passage Visitor; RM=Resident Migrant and BM=Breeding Migrant.

IUCN's list of Threatened species (2018), categorized as Least Concerned (LC), Near Threatened (NT) and Vulnerable (VU).

In grassland total of 91% were Least concerned and 9% were Near Threatened species (European Roller, Alexandrine Parakeet, Pallid Harrier, Red-necked Falcon). Similarly, in wetland 90% was Least Concerned, 8% were Near Threatened (Ferruginous Pochard, Black-tailed Godwit, Curlew Sandpiper, River Tern, Darter, Black-headed Ibis, Painted Stork and Great Stone Curlew) and 2% were vulnerable species (Common Pochard and Wooly-necked Stork). Also, the Avian diversity was classified according their status, 96 Resident species, 23 Winter visitors species,4 Breeding Migrants species and 3 Passage visitor species in grassland patches and in Wetland, out of 95 Species, 47 Resident species, 36 Winter visitor species, 4 Resident Migrants species, 2 Breeding Migrants and 3 Passage visitors species.

The Grasslands hosts a wide variety of avian life. Large patches of land provide space for Roosting and a rich prey base too. Most occurring Family was the Accipitridae, which includes mostly Raptors. The preference of this type of habitats by these birds indicates their presence in the particular area for Prey base hunting, and Roosting purposes. However, the number of Individuals or Frequency of their sightings is very insignificant. Loss of habitat could be one reason leading to this. One of such very rare Raptor species visiting MIDC grassland Amravati, is the Amur Falcon *Falco amurensis*. The Amur Falcon is a fascinating migratory raptor. Every year, they migrate west through India and across the Arabian Sea to Southern Africa. Because of the long journey, stopover sites are important for these birds to maintain energy level. Amravati lies in their migratory Flyway, although it is very rare to sight the bird in the vast grasslands around the city. Also, a very rich number of Larks, Sliver Munia, Red Avadavat and Scaly-breasted Munia were also observed. This could be because, these species are particularly granivores and the habitat provides a lot of different grasses and seeds dispersed all over the place, which is the specific diet for them.

Family Scolopacidae and Anatidae, recorded the maximum number of species in the Wetlands. Snipes, Sandpipers, Shanks, Stints and Ducks and Goose, constitute this family. Bar-headed Goose *Anser indicus* another prominent winter visitor observed in the wetlands of the study area. Their number is fairly enough and each year they arrive in flocks of 70-100 individuals. Their abundant number is due to the Food preference they exhibit. Bar-headed Goose prefers small lush green grasses around the water bodies. Another winter sojourning bird is the Painted Stork *Mycteria leucocephala*, is a member of Stork family, which is found in the wetlands, and prefer Fishes as major food item. Hence, their presence in the wetlands of study area is justified. Wading across the banks of the water body these birds constantly search for small fishes, snails etc. Apart from these, the wetlands host a variety of other ducks, migrating from right from the colder regions like Siberia, Russia to Africa, for various reasons.

Table 2. Checklist of Wetland Avian Fauna associated to MIDC area (N.P), Amravati

Sr no	Common Name	Scientific Name	Family	ST	IUCN status
1	Lesser Whistling Duck	*Dendro cygnajavanica*	DENDROCYGNDIAE (1)	R	LC
2	Bar-headed Goose	*Anser indicus*	ANATIDAE (15)	W	LC
3	Northern Pintail	*Anas acuta*		W	LC
4	Common Teal	*Anas crecca*		W	LC
5	Red-crested Pochard	*Rhedonessa rufina*		W	LC
6	Common Pochard	*Aythya ferina*		W	VU
7	Indian Spot-billed Duck	*Anas poecilorhyncha*		R	LC
8	Gadwall	*Mareca strepera*		W	LC
9	Garganey	*Anas querquedula*		W	LC
10	Tufted Duck	*Aythya fuligula*		W	LC
11	Northern Shoveller	*Anas clypeata*		W	LC
12	Eurasian Wigeon	*Anas penelope*		W	LC
13	Ruddy (Brahminy) Duck	*Tadorna ferruginea*		W	LC
14	Comb Duck (Knob-billed)	*Sarkidiornis melanotos*		R	LC
15	Ferruginous Pochard	*Aythya nyroca*		W	NT
16	Cotton Pigmy goose	*Nettapus coromandelianus*		R	LC
17	Common Kingfisher	*Alcedo atthis*	ALCEDINIDAE (1)	R	LC
18	White-throated Kingfisher	*Halcyon smyrnensis*	HALCYONIDAE (1)	R	LC
19	Pied Kingfisher	*Ceryle rudis*	CERYLIDAE (1)	R	LC
20	White-breasted Waterhen	*Amanrornis phoenicurus*	RALLIDAE (3)	R	LC
21	Purple Swamphen	*Porphyrio porphyrio*		R	LC
22	Common Coot	*Fulica atra*		R	LC
23	Black-tailed Godwit	*Limosa limosa*	SCOLOPACIDAE (15)	W	NT
24	Pintail Snipe	*Gallinago stenura*		W	LC
25	Common Snipe	*Gallinago gallinago*		W	LC
26	Jack Snipe	*Lymnocryptes minimus*		W	LC
27	Common Greenshank	*Tringa nebularia*		W	LC
28	Spotted Redshank	*Tringa erythropus*		W	LC
29	Green Sandpiper	*Tringa ochropus*		W	LC
30	Common Sandpiper	*Actitis hypoleucos*		W	LC
31	Wood Sandpiper	*Tringa glareola*		W	LC
32	Marsh Sandpiper	*Tringa stagnatilis*		W	LC
33	Little Stint	*Calidris minuta*		W	LC
34	Temminck's Stint	*Calidris temminckii*		W	LC
35	Curlew Sandpiper	*Calidris ferruginea*		PV	NT
36	Ruff	*Philomachus pugnax*		W	LC
37	Pied Avocet	*Recurvirostra avosetta*		PV	LC
38	Greater-painted Snipe	*Rostratula benghalensis*	ROSTRATULIDAE (1)	R	LC
39	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	JACANIDAE (2)	R	LC
40	Bronze-winged Jacana	*Metopidius indicus*		R	LC
41	Black-winged Stilt	*Himantopus himantopus*	CHARADRIIDAE (4)	RM	LC
42	Little-ringed Plover	*Charadrius dubius*		W	LC
43	Kentish Plover	*Charadrius alexandrinus*		BM	LC
44	Yellow-wattled Lapwing	*Vanellus malabaricus*		R	LC
45	Red-wattled Lapwing	*Vanellus indicus*	GLAREOLIDAE (3)	R	LC
46	Small Pratincole	*Glareola lactea*		R	LC
47	Collard Pratincole	*Glareola pratincola*		PV	LC
48	Brown-headed Gull	*Larus brunnicephalus*	LARIDAE (5)	W	LC
49	River Tern	*Sterna aurantia*		RM	NT
50	Little Tern	*Sterna albifrons*		BM	LC
51	Whiskered Tern	*Chlidonias hybrida*		W	LC

Continue Table 2

52	Gull-billed Tern	*Gelochelidon nilotica*		PV	LC
53	Little Grebe	*Tachybaptus ruficollis*	PODICIPEDIDAE (1)	R	LC
54	Darter	*Anhinga melanogaster*	ANHINGIDAE (1)	R	NT
55	Little Cormorant	*Phalacrocorax niger*	PHALACROCORACIDAE (3)	R	LC
56	Indian Cormorant	*Phalacrocorax fuscicollis*		R	LC
53	Little Grebe	*Tachybaptus ruficollis*	PODICIPEDIDAE (1)	R	LC
54	Darter	*Anhinga melanogaster*	ANHINGIDAE (1)	R	NT
55	Little Cormorant	*Phalacrocorax niger*	PHALACROCORACIDAE (3)	R	LC
56	Indian Cormorant	*Phalacrocorax fuscicollis*		R	LC
57	Great Cormorant	*Phalacrocorax carbo*		R	LC
58	Little Egret	*Egretta garzetta*	ARDEIDAE (10)	R	LC
59	Great Egret	*Casmerodius albus*		R	LC
60	Intermediate Egret	*Mesophoyx intermedia*		R	LC
61	Cattle Egret	*Bubulcus ibis*		R	LC
62	Grey Heron	*Ardea cinerea*		R	LC
63	Purple Heron	*Ardea purpurea*		R	LC
64	Indian Pond Heron	*Ardeola grayii*		R	LC
65	Little Green Heron	*Butorides striatus*		R	LC
66	Yellow Bittern	*Ixobrychus sinensis*		R	LC
67	Black Bittern	*Ixobrychus flavicollis*		R	LC
68	Black-headed Ibis	*Threskiornis melanocephalus*	PHOENICOP TERIDAE (4)	R	NT
69	Black Ibis	*Pseudibis papillosa*		R	LC
70	Eurasian Spoonbill	*Platalea leucorodia*		RM	LC
71	Glossy Ibis	*Plegadis falcinellus*		W	LC
72	Painted Stork	*Myeteria leucocephala*	CICONIIDAE (4)	RM	NT
73	Asian Openbill	*Anastomus oscitans*		W	LC
74	Wooly-necked Stork	*Ciconia episcopus*		R	V
75	Black Stork	*Ciconia nigra*		W	LC
76	White Wagtail	*Motacilla alba*	PASSERIDAE (6)	W	LC
77	White-browed Wagtail	*Motacilla maderaspatensis*		R	LC
78	Citrine Wagtail	*Motacilla citreola*		W	LC
79	Yellow Wagtail	*Motacilla flava*		W	LC
80	Grey Wagtail	*Mptacilla cinereal*		W	LC
81	Paddy-field Pipit	*Anthus rufulus*		R	LC
82	Sykes's Lark	*Galerida deva*	ALAUDIDAE (2)	R	LC
83	Ashy-crowned Sparrow Lark	*Eremopterix grisea*		R	LC
84	Dusky-craig Martin	*Hirundo concolor*	HIRUNDINIDAE (7)	R	LC
85	Grey-throated Martin	*Riparia chinensis*		R	LC
86	Barn Swallow	*Hirundo rustica*		W	LC
87	Wire-tailed Swallow	*Hirundo smithii*		R	LC
88	Red-rumped Swallow	*Hirundo daurica*		R	LC
89	Streak-throated Swallow	*Hirundo fluvicola*		R	LC
90	Pale Sand Martin	*Riparia diluta*		W	LC
91	Clamorous Reed Warbler	*Acrocephalus stentoreus*	SYLVIIDAE (2)	W	LC
92	Booted Warbler	*Iduna caligata*		R	LC
93	Indian Stone-Curlew	*Burhinus indicus*	BRUHINIDAE (2)	R	LC
94	Great Stone Curlew	*Esacu srecurvirostris*		R	NT
95	Osprey	*Pandion haliaetus*	PANDIONIDAE (1)	R	LC

Recorded species from grasslands and Wetlands of MIDC (N.P.), Amravati were statistically analyzed using various parameters like Diversity Index (Shannon-Wiener's Index; H'), Species Evenness, Relative Density, Species Abundance and Richness.

For Grassland bird Species:

H=3.936

H(max)= ln(N)= 4.836

Evenness=H/H(max)=0.813, (here H=3.936)

Shannon's Diversity Index (H)=3.963 and Evenness= 0.813

For Wetland bird Species:

H=3.874

H(max)= ln (N)= 4.553

Evenness= H/H(max)= 0.850, (here H=3.874)

Shannon's Diversity Index (H)=3.874 and Evenness=0.850

Table 3. Summary of Data Analysisarea(NP), Amravati

Observations	Grassland bird Species	Wetland bird Species
Total Individuals	1473	909
Total Species	126	95
Species Richness	17.13	13.79
Shannon's Diversity Index(H')	3.963	3.874
Evenness	0.813	0.850
Relative Density	0 - 5.431	0 – 7.700
Abundance	80 Min=1 Max=80	70 Min=1 Max=70

Figure 3: Graph showing family wise species number of birds associated to Grassland

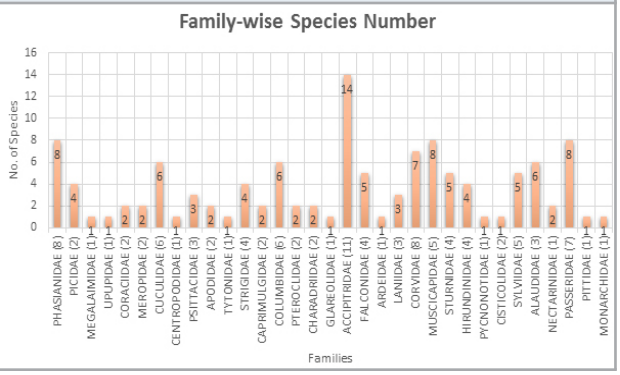
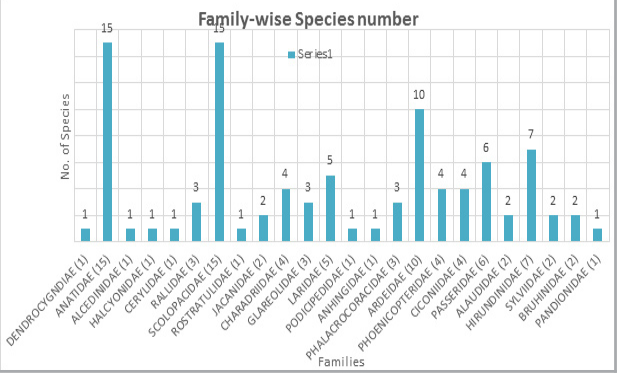


Figure 4: Graph showing family wise species number of birds associated to Wetland



From the report of birds of Banni Grassland Gujrat submitted by the Koladiya ,et.al (2011) . The grassland species of birds almost similar to our observations done in MIDC area, mostly the Raptor family was prominently seen at both the places i.e., Red-necked Falcon, Eurasian Hobby, Pallid and Pied Harriers, Eagles and Kites. Water birds like Red-crested Pochard, Common Pochard, Gadwall etc. were recorded from both the areas.

Figure 5: Graph showing IUCN status of birds in Grassland

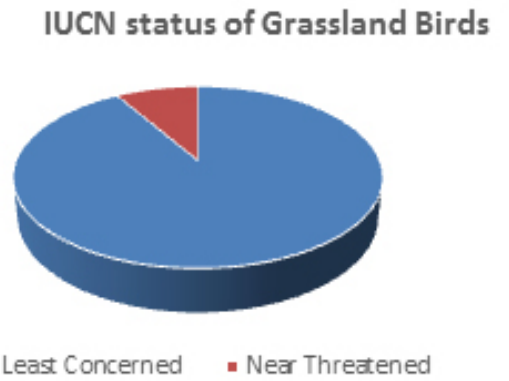


Figure 6: Graph showing IUCN status of birds in Wetland

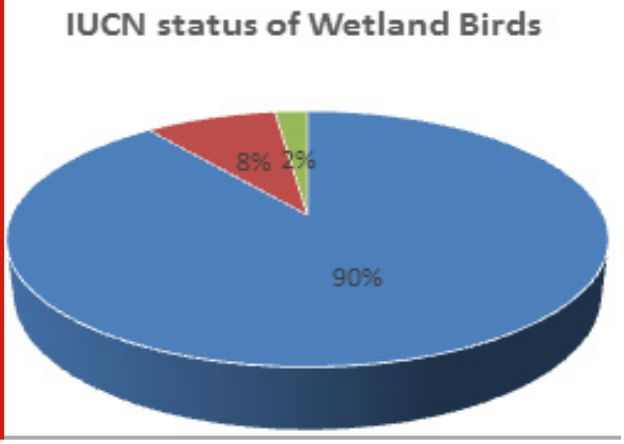
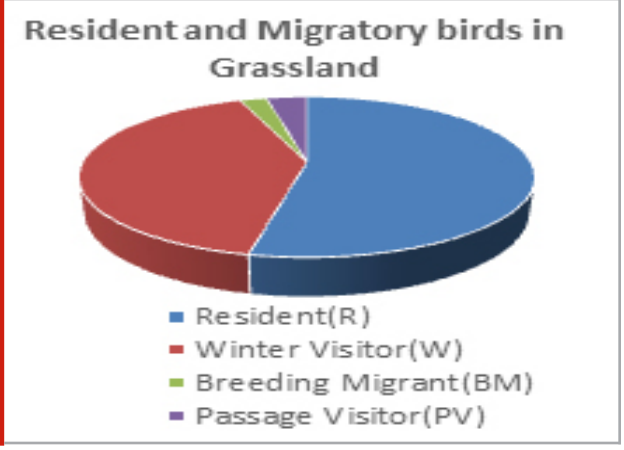


Figure 7: Graph showing percentage of (R) and (M) birds in Grassland



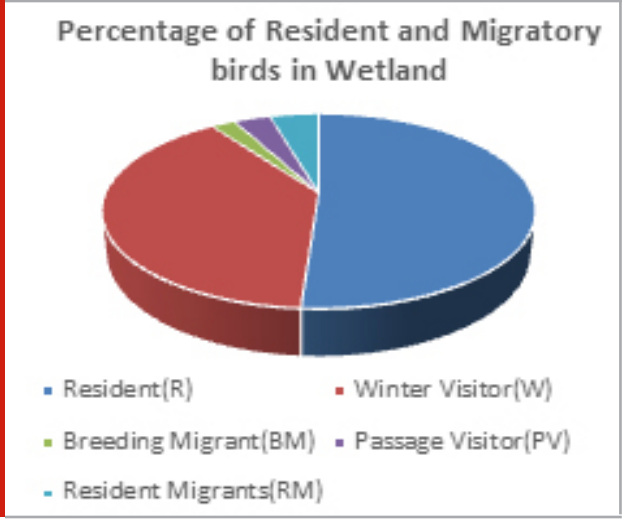
This depicts the species diversity and richness of the grasslands and wetland associated to MIDC Amravati.

Short-eared Owl *Asio flammeus*, one of the rarest-winter migratory bird also showed its presence in the study

area. this could be a positive sign, as their presence in the area marks the potential for new species to migrate here. Another unforeseen sighting from MIHAN Nagpur, a Lesser Florican female *Sypheo tidesindica* was recently recorded. It is endemic to Indian subcontinent and is declared as 'Endangered' species by the IUCN. MIHAN is an under developing Industrial Cargo-Hub, which was previously an extensive farm land. Due to relocation of the farms and conversion of left-over undeveloped areas as Grasslands, it could have established as a potential Habitat for Lesser Florican and hence, noted its presence. This could help in 'Species Restoration' of these birds in a newer developing grassland habitat might be leads to increasing their number, as the whole Vidarbha region was once their natural habitat. Apart from all the negative wreck, this takeover by MIDC authority of the farm lands, converting the unutilized part to grasslands, is causing their (Short-eared Owl, Lesser Florican), positive comeback too.

On statistically analyzing the observed avian diversity, it shows the ambit, a bit in control. But the rising industrial cover and anthropogenic pressure could lead to drastic effects on these species. Upon calculating the Relative Density of Grassland birds, the range was from (0 - 5.431) and Wetland Relative Density range was (0 – 7.700). Highest Abundance was 40 in grassland birds and 70 for wetland birds. The Species Diversity index was calculated as 3.963 for Grassland and 3.874 for Wetland birds. (Table 3). According to Shannon and Weiner (1963), if the value of Diversity is ranging between 0 indicates Low community complexity and 4 and above indicating High community complexity. All these parameters exhibit a fair presence of faunal diversity in MIDC area Amravati, but at the same time it showcases an Alarming-signal for future conservation measures.

Figure 8: Graph showing percentage of (R) and (M) birds in Wetland.



With such rich faunal diversity of Birds, the rising Industrialization has started to exhibit its consequences. Every year the number of visiting birds is on a fall, loss of Habitat could be one of the major causes of this loss. Loss of Roosting grounds, open prairies, leading to insufficient food and water supply to birds are also contributing majorly. Factors like construction of road-ways, involvement of domestic animals for grazing, disturbance by stray dogs, heavy transportation activities through grassland patches, Clamorous noises from the nearby factories also leads the neighboring species to choose another area, water shortage due to uncontrolled usage for commercial and residential are also associated to loss of bird diversity from grasslands. Regrettably, the inimitable biodiversity of the Grasslands remains poorly documented in our region and hence, this study could provide a base-line data and could be helpful in future studies.

CONCLUSION

In all 395 species of birds recorded from Amravati District, out of which 221 species were observed only in MIDC area of Nandgaonpeth Amravati. This is almost 50% of the entire Amravati district bird's species observed till now. This study also presented the Species Diversity Shannon-Wiener index, Species Abundance, Relative Density, Evenness and Richness of the avian species in MIDC area. These entire parameters exhibit high avian faunal existence in MIDC area of Amravati. This shows that the MIDC grasslands and wetlands provide a very rich fauna to the avian diversity, and would be a potential habitat for many others, like Short-eared Owl and Lesser Florican. However, MIDC of Nandgaonpeth Amravati was established in 2012 and since then developmental works started to bloom. This region has since been growing industrially at the cost of loss of Habitat. Once this region could have hosted a varied variety of Avian Fauna, but Industrialization has affected on their existence as well on their numbers. Hence, in this alarming situation this study showed a preliminary documentation of avian fauna in MIDC area, even though this is just a Base-line data but it would be of great use for future avian studies. Also, this study would be useful for establishing the environmental impacts of industrialization of MIDC area on bird diversity. There is critical demand for continuous study in this field.

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