

# Anthropogenic Impact on Species Diversity and Distribution of Birds from Coastal Region of Panvel, Navi Mumbai, India

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**Abstract:** Present study was conducted to assess the impact of over-exploitation of natural resources and deforestation on diversity and distribution of avian species from Panvel, Navi Mumbai. Birds were surveyed during dawn and dusk hours by using point count method in different localities for one year (from June 2019 to May 2020). Varied diversity of birds with 102 species representing 16 orders, 48 families and 84 genera were observed. Number of species of birds distributed in each family reveals that 45 species belongs to family Passeriformes, 12 species to Charadriiformes, 10 species to Pelecaniformes, 8 species to Accipitriformes, 7 species to Coraciiformes, and Gruiformes and 1 species each to Cuculiformes, Galliformes, Phoenicopteriformes, Psittaciformes and Suliformes. At present, ecological conditions in area adjoining Panvel, Navi Mumbai supports moderate avian density but over-exploitation of natural resources and deforestation in Panvel region due to ongoing construction of Navi Mumbai International Airport (NMIA) are the key factors affecting the diversity and distribution of avian species. As the bird community react rapidly to anthropogenic impact, restoration of large forest patches and well planned plantation of conservation plants is recommended. Since no earlier reports are available, data presented here can be taken as a baseline data in knowing the status of birds of Panvel, Navi Mumbai and effect of industrial development on it.

Keywords: Avifauna, Human activity, Navi Mumbai International Airport, Navi Mumbai, Panvel, Species diversity

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#### Introduction

Biodiversity is widely acknowledged to influence the magnitude and stability of a

large array of ecosystem properties, with bio diverse systems thought to be more functionally robust. As such, diverse systems may be safer harbors for vulnerable species, resulting in a positive association between biodiversity and the collective vulnerability of species in an assemblage (Weeks *et al.*, 2016).

was considered among most Asia diversity-rich continents, however, increase in human population has adversely affected the diversity of the region as the increasing populations demanded for food and shelter which resulted in agriculture intensification, urbanization, industrialization, and pollution. Population census of all the species in urbanized peri-urban areas is and а prerequisite for conservation planning (Altaf et al., 2018).

Biodiversity affected might be bv anthropogenic activity which comprises a collection of human created disturbance events that can have long- and short-term impacts on wildlife by inducing changes in behaviour, physiology and reproduction. Increases in anthropogenic activity decrease the persistence of local populations by compromising habitat suitability, restraining feeding and breeding opportunities and increasing regional extinctions of wildlife species (Sheta et al., 2011).

Urbanisation is a dominant geographical trend and an important component of global change, with unprecedented implications for socio-economic, cultural and environmental characteristics (Pedreros *et al.*, 2018). Degradation and destruction of habitats due to anthropogenic actions are major causes of global biodiversity declines. Understanding inter-specific variation in species responses to human disturbances is important to enable effective conservation decision making (Asefa *et al.*, 2017).

Birds are excellent bio-indicators of the effects of urbanization on ecosystems since they are highly diverse and conspicuous elements of the ecosystems. They are key species of different ecosystems because they are highly distributed, easily visible and evocative to us. Bird species richness is influenced by the urban environment, floral diversity, landscape, degree of anthropogenic disturbances, invasion as well as predation, yet they are major part of urban biodiversity (Maurice et al., 2020).

Birds play many roles in maintaining ecosystems and supporting biodiversity like they are bioindicators of healthy ecosystems, regulate disease vectors, biomass recycling and reduce levels of disposable wastes (Gatesire *et al.*, 2014). They are also important as pollinators, scavengers and biomonitors controlling insects, pests and excellent ecology indicators as well as act as primary and tertiary consumers in the food chain and help in recycling of nutrients (Ratchford *et al.*, 2005; Galgani *et al.*, 2010; Sheta *et al.*, 2011; Joshi and Krishna, 2014; Kadam and Dhar, 2017; Kurve, 2017; Altaf *et al.*, 2018; Maurice *et al.*, 2020).

Dey *et al.* (2013) reported that India have more than 1300 species of birds and which is over 13% of the world bird species but, unfortunately India is the third among the countries having the largest number of threatened and rare species followed by Brazil and Indonesia (Rajashekara and Venkatesha, 2015).

Species diversity of birds currently inhabiting any specific area, their distribution records and the levels of threat to the species help in protection efforts. Major threats to birds include illegal hunting, urbanization, agriculture intensification, eutrophication, pollution, and livestock grazing (Bhadouria *et al.*, 2012; Dwivedi and Singh, 2017; Altaf *et al.*, 2018).

Coastal environment of Panvel has been under considerable stress since the ongoing construction of Navi-Mumbai International Airport (NMIA) by the City and Industrial Development Corporation (CIDCO). Construction of NMIA has resulted into deforestation, encroachment, reclamation and urbanization in the study area. It has affected the livelihood of local fishermen and coastal community along with ecology of fauna from Panvel, Navi Mumbai (Pawar *et al.*, 2019 a, b).

Literature review suggests that barring few reports (Quadros, 2001; Nitsure, 2002; Verma *et al.*, 2004; Pawar, 2011; Walmiki *et al.*, 2013), meagre information is available on species diversity of birds from Panvel region. Hence the present study was undertaken to assess the impact of anthropogenic activities on species diversity and distribution of the birds from coastal region of Panvel, Navi Mumbai.

Although many studies have been undertaken to evaluate the species diversity of birds in India, no scientific studies have been carried out on the species composition and distribution of birds of Panvel, Navi Mumbai; hence, the present study is undertaken.

### **Materials and Methods**

# Study Area:

Navi Mumbai is basically a satellite township on the west shore of Maharashtra. It was made in 1971 to be another urban township of Mumbai by Government of Maharashtra. As per Census India 2011, it had a population of 1,119,477. Panvel is located in Raigad district of Maharashtra in Konkan region and is a node of Navi Mumbai city. Geographically, Panvel is near Panvel creek which opens up in Thane creek. Kalundre river flows across the city in the south-west region and opens up into Panvel creek. Panvel with a population of 180,464 (Census India 2011) is a highly populated city due to its closeness to Mumbai. It is located in the Mumbai Metropolitan Region. Panvel is situated on the banks of Panvel Creek. It is also surrounded by mountains on 2 sides (Fig. 1).

### Study Location:

The present study on diversity and distribution of avian species was carried out for the period of one year, from June 2019 to May 2020. Selected sites were visited during dawn and dusk hours, one day in each month and 4 h were spent at each site at both times (total day time was 8 h).

The study sites were regularly surveyed by systematically walking on fixed routes and the bird population in different habitats was estimated by direct count (physical count and calls or voices) and indirect (nests, carcasses) observations. Data on birds was collected by observations with naked eyes and with the aid of 10 X 50 Olympus binocular. Birds were photographed using Cannon 1100 D Zoom camera. For correct identification of birds, field guides and books of Ali (2002) and Arlott (2015) were followed.

# **Results and Discussion**

Varied diversity of birds with 102 species representing 16 orders, 48 families and 84 genera were observed (Figs. 2-5; Tables 1, 2). Number of species of birds distributed in each



Fig. 1. Location map of study area representing Panvel creek.



Hydrocoloeus minutus Sterna aurantia Himantopus himantopus Actitis hypoleucos Calidris falcinelius Fig. 2: Birds recorded in & around Panvel, Navi Mumbai during June 2019 to May 2020 Fig. 3: Birds recorded in & around Panvel, Navi Mumbai during June 2019 to May 2020



 Athene brama
 Ketupa ketupu
 Tyto alba
 Microcarbo niger

 Fig. 5: Birds recorded in & around Panvel, Navi Mumbai during June 2019 to May 2020

family reveals that 45 species belongs to family Passeriformes, 12 species to Charadriiformes, 10 species to Pelecaniformes, 8 species to Accipitriformes, 7 species to Coraciiformes, 3 species each to Columbiformes, Piciformes and Strigiformes: 2 species each to Anseriformes, Bucerotiformes Gruiformes and 1 species each to and Cuculiformes, Galliformes, Phoenicopteriformes, Psittaciformes and Suliformes (Table 2).

Altaf et al. (2018) documented that avian diversity and distribution in different habitats was impacted by factors like food, shelter, human presence, large fragmentation, loss of habitat, invasive plant species, and removal of plantation. Allen et al. (2019) reported that agriculture intensification produces negative impact on the bird diversity by use of chemicals, reduced nesting site, mortality of birds due to farming operations and increase in the predation rate after harvesting the crops. It is also noted that large area with high numbers of trees has positive relation with the bird diversity; the reason is that birds also can get food and shelter from the trees (Asefa et al., 2017; Allen et al., 2019; Maurice et al., 2020).

Pawar *et al.* (2019 a, b) correlated the depletion of coastal marine diversity from Panvel creek to the loss of habitat due to deforestation, overexploitation of natural resources for ongoing construction of Navi-Mumbai International Airport (NMIA), habitat fragmentation due to construction and widening of roads and rampant urbanization and industrialization of the area adjoining Panvel.

Results of the study are in agreement with the findings on anthropogenic impact on avian

Family	No.	Scientific Name	Common name		
Order - Accipitriformes					
Accipitridae	1	Accipiter badius (J. F. Gmelin, 1788)	Indian Shikra		
	2	Buteo buteo (Linnaeus, 1758)	Common Buzzard		
	3	Elanus caeruleus (Desfontaines, 1789)	Black-winged Kite		
	4	Geranoaetus albicaudatus (Vieillot, 1816)	White-tailed Hawk		
	5	Milvus migrans (Boddaert, 1783)	Black Kite/Pariah Kite		
	6	Nisaetus nipalensis (Hodgson, 1836)	Mountain Hawk Eagle		
	7	Pernis ptilorhynchus (Temminck, 1821)	Oriental Honey Buzzard		
	8	Spilornis cheela (Latham, 1790)	Crested Serpent Eagle		
		Order - Anseriformes			
Anatidae	9	Anas querquedula (Linnaeus, 1758)	Garganey		
	10	Anas poecilorhyncha (J. R. Forster, 1781)	Spot-billed Duck		
	1	Order - Bucerotiformes	L		
Bucerotidae	11	Anthracoceros coronatus (Boddaert, 1783)	Malabar Pied Hornbill		
	12	Ocyceros birostris (Scopoli, 1786)	Indian Grey Hornbill		
	1	Order - Charadriiformes	L		
Charadriidae	13	Charadrius dubius (Scopoli, 1786)	Little Ringed Plover		
	14	Vanellus gregarius (Pallas, 1771)	Sociable Plover		
	15	Vanellus indicus (Boddaert, 1783)	Red-wattled Lapwing		
	16	Vanellus malabaricus (Boddaert, 1783)	Yellow-wattled Lapwing		
Jacanidae	Jacanidae 17 <i>Metopidius indicus</i> (Latha		Bronze-winged Jacana		
Laridae	18	Chroicocephalus brunnicephalus (Jerdon, 1840)	Brown-headed Gull		
	19	Hydrocoloeus minutus (Pallas, 1776)	Little Gull		
	20	Sterna aurantia (J. E. Gray, 1831)	River Tern		
Recurvirostridae	Recurvirostridae 21 <i>Himantopus himantopus</i> (Linnaeus, 1758)		Black-winged Stilt		
Scolopacidae	22	Actitis hypoleucos (Linnaeus, 1758)	Common Sandpiper		
	23	Calidris falcinellus (Pontoppidan, 1763)	Broad-billed Sandpiper		
	24	Tringa glareola (Linnaeus, 1758)	Wood Sandpiper		

# Table 1: Preliminary checklist of birds recorded in and around Panvel, Navi Mumbai

Order - Columbiformes						
Columbidae 25		Columba livia (J.F. Gmelin, 1789)	Rock Pigeon/Rock Dove			
	26	Streptopelia chinensis (Scopoli, 1786)	Spotted Dove			
	27 Treron phoenicopterus (Latham, 1790)		Yellow-legged Green Pigeon			
		Order - Coraciiformes				
	1	I				
Alcedinidae	28	Alcedo atthis (Linnaeus, 1758)	Common Kingfisher			
	29	<i>Ceryle rudis</i> (Linnaeus, 1758)	Lesser Pied Kingfisher			
	30	<i>Ceyx erithaca</i> (Linnaeus, 1758)	Oriental Dwarf Kingfisher			
	31	Halcyon smyrnensis (Linnaeus, 1758)	White-throated Kingfisher			
	32	Pelargopsis capensis (Linnaeus, 1766)	Stork-billed Kingfisher			
Coraciidae	33	Coracias benghalensis (Linnaeus, 1758)	Indian Roller			
Meropidae	34	Merops orientalis (Latham, 1801)	Little Green Bee-eater			
	Order - Cuculiformes					
Cuculidae	35	Centropus sinensis (Stephens, 1815)	Greater Coucal			
	Order - Galliformes					
Phasianidae	36	Pavo cristatus (Linnaeus, 1758)	Indian Peafowl			
	Order - Gruiformes					
Rallidae	37	Amaurornis phoenicurus (Pennant, 1769)	White-breasted Waterhen			
	38	Porphyrio porphyrio (Linnaeus, 1758)	Purple Swamphen			
		Order - Passeriformes				
Aegithinidae	39	Aegithina tiphia (Linnaeus, 1758)	Common Iora			
Alaudidae	40	Alauda arvensis (Linnaeus, 1758)	Eurasian Skylark			
Campephagidae	41	Pericrocotus ethologus (Bangs and J. C. Phillips, 1914)	Long-tailed Minivet			
	42	Pericrocotus cinnamomeus (Linnaeus, 1766)	Small Minivet			
Cisticolidae	43	Prinia socialis (Sykes, 1832)	Ashy Prinia			
	44	Orthotomus sutorius (Pennant, 1769)	Common Tailorbird			
Corvidae	45	Corvus splendens (Vieillot, 1817)	House Crow			
	46	Dendrocitta vagabunda (Latham, 1790)	Rufous Treepie			
Dicruridae	47	Dicrurus macrocercus (Vieillot, 1817)	Black Drongo/King Crow			
Emberizidae	48	Melophus lathami (J. E. Gray, 1831)	Crested Bunting			
Estrildidae	49	Amandava amandava (Linnaeus, 1758)	Red Munia			

	50	Lonchura leucogastroides (Moore, F, 1858)	Javan Munia
	51	Lonchura punctulata (Linnaeus, 1758)	Scaly-breasted Munia
	52	Lonchura striata (Linnaeus, 1766)	White-rumped Munia
Fringillidae	53	Fringilla coelebs (Linnaeus, 1758)	Common Chaffinch
Furnariidae	54	Furnarius rufus (Gmelin, JF, 1788)	Rufous Hornero
Hirundinidae	55	Hirundo rustica (Linnaeus, 1758)	Common Swallow
	56	Hirundo smithii (Leach, 1818)	Wire tailed Swallow
Irenidae	57	Chloropsis aurifrons (Temminck, 1829)	Golden-fronted Leafbird
	58	Chloropsis jerdoni (Blyth, 1844)	Jerdon's Leafbird
Laniidae	59	Lanius schach (Linnaeus, 1758)	Long-tailed Shrike
	60	Lanius excubitor (Linnaeus, 1758)	Great Grey Shrike
	61	Lanius vittatus (Valenciennes, 1826)	Bay-backed Shrike
Monarchidae	62	Hypothymis azurea (Boddaert, 1783)	Black-naped Monarch
	63	Terpsiphone paradisi (Linnaeus, 1758)	Indian Paradise-flycatcher
Motacillidae	64	Motacilla alba (Linnaeus, 1758)	White Wagtail
	65	Motacilla cinerea (Tunstall, 1771)	Grey Wagtail
	66	Motacilla maderaspatensis (J. F. Gmelin, 1789)	White-browed Wagtail
Muscicapidae	67	Copsychus saularis (Linnaeus, 1758)	Oriental Magpie-Robin
	68	Eumyias thalassinus (Swainson, 1838)	Verditer Flycatcher
	69	Monticola cinclorhynchus (Vigors, 1831)	Blue-capped Rock Thrush
	70	Oenanthe fusca (Blyth, 1851)	Brown Rock Chat
	71	Saxicola caprata (Linnaeus, 1766)	Pied Stonechat
	72	Saxicola maurus (Pallas, 1773)	Siberian Stonechat
Nectariniidae	73	Leptocoma zeylonica (Linnaeus, 1766)	Purple-rumped Sunbird
Oriolidae	74	Oriolus oriolus (Linnaeus, 1758)	Eurasian Golden Oriole
	75	Oriolus xanthornus (Linnaeus, 1758)	Black-hooded Oriole
Passeridae	76	Passer domesticus (Linnaeus, 1758)	House Sparrow
Ploceidae	77	Ploceus manyar (Horsfield, 1821)	Indian Streaked Weaver
	78	Ploceus philippinus (Linnaeus, 1766)	Baya Weaver, Indian Baya
Pycnonotidae	79	Pycnonotus cafer (Linnaeus, 1766)	Red-vented Bulbul
	80	Pycnonotus jocosus (Linnaeus, 1758)	Red- whiskered Bulbul

Sturnidae	81	Acridotheres tristis (Linnaeus, 1766)	Common Myna	
	82	Gracupica contra (Linnaeus, 1758)	Asian Pied Starling	
Zosteropidae	83	Zosterops palpebrosus (Temminck, 1824)	Oriental White-eye	
		Order - Pelecaniformes		
Ardeidae	84	Ardea alba (Linnaeus, 1758)	Great Egret/Large Egret	
	85	Ardea purpurea (Linnaeus, 1766)	Purple Heron	
	86	Ardeola grayii (Sykes, 1832)	Indian Pond-heron	
	87	Bubulcus ibis (Linnaeus, 1758)	Cattle Egret	
	88	Butorides striatus (Linnaeus, 1758)	Striated Heron	
	89	Egretta garzetta (Linnaeus, 1766)	Little Egret	
Ciconiidae	90	Anastomus oscitans (Boddaert, 1783)	Asian Openbill	
	91	Mycteria leucocephala (Pennant, 1769)	Painted Stork	
Threskiornithidae	92	Pseudibis papillosa (Temminck, 1824)	Red-naped Ibis	
	93	Platalea leucorodia (Linnaeus, 1758)	Eurasian Spoonbill	
	1	Order - Phoenicopteriformes		
Phoenicopteridae	94	Phoenicopterus roseus (Pallas, 1811)	Greater Flamingo	
		Order - Piciformes		
Picidae	95	Chrysocolaptes festivus (Boddaert, 1783)	White-naped Woodpecker	
Ramphastidae	96	Psilopogon haemacephalus (Statius Muller, 1776)	Coppersmith Barbet	
	97	Psilopogon viridis (Boddaert, 1783)	White-cheeked Barbet	
		Order - Psittaciformes		
Psittaculidae	98	Psittacula krameri (Scopoli, 1769)	Ring-necked Parakeet	
		Order - Strigiformes		
Strigidae	99	Athene brama (Temminck, 1821)	Spotted Owlet	
	100	Ketupa ketupu (Horsfield, 1821)	Buffy Fish Owl	
Tytonidae	101	Tyto alba (Scopoli, 1769)	Common Barn Owl	
	1 1	Order - Suliformes	I	
Phalacrocoracidae	102	Microcarbo niger (Vieillot, 1817)	Little Cormorant	
	1			

Sr. No.	Order	Family	Genera	Species	Per cent
					Representation
1	Accipitriformes	01	08	08	7.849
2	Anseriformes	01	01	02	1.960
3	Bucerotiformes	01	02	02	1.960
4	Charadriiformes	05	10	12	11.765
5	Columbiformes	01	03	03	2.941
6	Coraciiformes	03	07	07	6.863
7	Cuculiformes	01	01	01	0.980
8	Galliformes	01	01	01	0.980
9	Gruiformes	01	02	02	1.960
10	Passeriformes	23	31	45	44.118
11	Pelecaniformes	03	09	10	9.804
12	Phoenicopteriformes	01	01	01	0.980
13	Piciformes	02	03	03	2.941
14	Psittaciformes	01	01	01	0.980
15	Strigiformes	02	03	03	2.941
16	Suliformes	01	01	01	0.980
Total	16	48	84	102	

diversity by Lepczyk *et al.* (2008), Debnath *et al.* (2018) and Katia *et al.* (2019). At present, ecological conditions in area adjoining Panvel, Navi Mumbai supports moderate density of birds but due to over-exploitation of natural resources for ongoing construction of Navi Mumbai International Airport, deforestation, intense industrialization and urbanization, coastal pollution will affect the avian diversity in future. Therefore, data presented in this

paper can be taken as a base line data for future study.

#### Conclusion

The study shows that, at present, ecological conditions in area adjoining Panvel, Navi Mumbai supports moderate avian density. It can be concluded that over-exploitation of natural resources and deforestation in Panvel region due to ongoing construction of Navi Mumbai International Airport (NMIA) are the key factors affecting the diversity and distribution of avian species. As the bird community react rapidly to anthropogenic impact, restoration of large forest patches and well planned plantation of conservation plants is recommended. Since no earlier reports are available, data presented here can be taken as a baseline data in knowing the status of birds of Panvel, Navi Mumbai and effect of industrial development on it.

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#### References

- Ali S. (2002) The Book of Indian Birds. Bombay Natural History Society, Oxford University Press. (Thirteenth Edition, Revised by J. C. Daniel), pp. 326. (ISBN 019566523-6).
- Allen DC, HL Bateman, PS Warren, Albuquerque FS, Arnett-Romero S and Harding B. (2019) Long term effects of land-use change on bird communities depend on spatial scale and land-use type. Ecosphere 10: e02952. 10.1002/ecs2.2952.
- Altaf Muhammad, Arshad J, Abdul MK, Khan MSH, Muhammad U and Zulfiqar A. (2018) Anthropogenic impact on the distribution of the birds in the tropical thorn forest, Punjab, Pakistan J. Asia-Pacific Biodiver. 11: 229 - 236. https://doi.org/10.1016/ j.japb.2018.03.001.
- Arlott N. (2015) Birds of India (Pakistan, Nepal, Bhutan, Bangladesh and Srilanka). William Collins, An imprint of Harper Collins Publishers, 1 London Bridge Street, London SE1 9GF. pp. 621. E-book Edition, ISBN: 9780007560684.

- Asefa A, Andrew BD, Andrew E McKechnie, Anouska AK and Berndt JR. (2017) Effects of anthropogenic disturbance on bird diversity in Ethiopian mountain forests. The Condor: Ornithological Appl. 119:416 -430. doi: 10.1650/CONDOR-16-81.1.
- Bhadouria BS, Mathur VB, Sivakumar K and Anoop KR. (2012) A survey of avifaunal diversity in wetlands around Keoladeo National Park, Bharatpur, Rajasthan, India. Bird Populations 11:1-6.
- Debnath S, Souvik B and Panigrahi AK. (2018) Present status and diversity of avian fauna in Purbasthali bird sanctuary, West Bengal, India. Agric. Sci. Digest. D-4711: 1-8. DOI: 10.18805/ag.D-4711.
- Dey A, Dipankar D, Sujitraj DC and Chaudhuri PS. (2013) A preliminary study on avifaunal species diversity of Maharaja Bir Bikram College Campus, Tripura, North East India. Internat. Multidiscipl. Res. J. 3: 36-43.
- Dwivedi U and Singh RK. (2017) Biodiversity of migratory birds in Khutaghat, Ratanpur Dist. Bilaspur (C.G.). World J. Pharm. Pharmaceut. Sci. 6: 1148-1155. doi: 10.20959/wjpps20177-9514.
- Galgani F, Fleet D and Van Franeker J. (2010) Marine Strategy Framework directive-Task Group 10 Report marine litter do not cause harm to the coastal and marine environment. Official Publications of the European Communities.
- Gatesire T, Nsabimana D, Nyiramana A, Seburanga JL and Mirville MO. (2014) Bird diversity and distribution in relation to urban landscape types in Northern Rwanda. The Scientific World Journal. Article ID 157824.. http://dx.doi.org/10.1155/ 2014/157824.
- Joshi P and Vinod KK. (2014) Diversity of avifauna and effects of human activities on birds at Tawa Reservoir area of Hoshangabad district. Adv. Res. Agri. Vet. Sci. 1: 78-82.
- Kadam SS and Dhar AS. (2017) Status and diversity of avian fauna in and around Bordi region, west coast of India. Int. Res. J. Biological Sci. 6: 15-18.
- Katia L, Jose Fernando Villasenor-Gomez, Francisco Roberto Pineda-Huerta and Salgado-Ortiz J. (2019) Temperate forest bird communities associated with a historic mining impact area: do tailing remnant effects modify their structure?. Revista Brasileira de Ornito. 27: 94 - 107.
- Kurve PN. (2017) Habitat dependent avifaunal diversity along the coastline of Raigad district, (M.S.), India. Internat. J. Fauna Biol. Studies 4: 01-06.
- Lepczyk C A, Curtis HF, Volker CR, Anna MP, Roger BH and Liu J. (2008) Human impacts on regional avian

diversity and abundance. Conservation Biol. 22 :405 - 416. doi: 10.1111/j.1523-1739.2008.00881.x.

- Maurice ME, Fuashi NA, Mbua RL, Mendzen NS, Okon OA and Ayamba NS. (2020) The environmental influence on the social activity of birds in Buea University Campus, Southwest Region, Cameroon. Interdiscipl. J. Environ. Sci. Edu. 16: e02210. https://doi.org/10.29333/ijese/6446.
- Nitsure SR. (2002) Study of avifauna at Thane creek near Rituchakkra nature park. Master's thesis submitted to the Indian Institute of Ecology and environment. New Delhi. pp. 265.
- Pawar PR. (2011) Species diversity of birds in Mangroves of Uran (Raigad), Navi Mumbai, Maharashtra, West coast of India. J. Exp. Sci. 2: 73-77.
- Pawar Prabhakar R, Atul JP, Anil GR, Pawar NB and Shreya RP. (2019 a) Monitoring of anthropogenic threats to mangrove ecosystem of Panvel Creek, Navi Mumbai, India. Research Chron. 7: 74-84.
- Pawar Prabhakar R, Meshram LN, Udawant SM and Rauphunnisa FI. (2019 b) Assessment of coastal pollution using faunal composition of macrobenthos from Panvel Creek, Navi Mumbai, West Coast of India. Research Chron. 7: 28-38.
- Pedreros AM, Marilyn GU, Francisco EM and Heraldo VN. (2018) Effects of vegetation strata and human disturbance on bird diversity in green areas in a city in southern Chile. Avian Res. 9: 38. https://doi.org/10.1186/s40657-018-0130-9.

- Quadros G. (2001) Study of inter-tidal fauna of Thane Creek. Ph. D. Thesis, University of Mumbai. pp. 293.
- Rajashekara S and Venkatesha MG. (2015) Temporal and spatial avian community composition in urban landscapes of the Bengaluru region, India. J. Environ. Biol. 36:607-616.
- Ratchford JS, Wittman SE, Jules ES, Ellison AM, Gotelli NJ and Sanders NJ. (2005) The effects of fire, local environment, and time on ant assemblages in fens and forests. Diversity Distribution 11: 487-497.
- Sheta BM, Gamal MO, Mohamed AB, Mohamed ME and Lotfi ZH. (2011) Impact of some anthropogenic activities on the diversity of resident bird species at Damietta Region, Egypt. CATRINA. 6: 59 -74.
- Verma A, Balachandran S, Chaturvedi N and Patil V. (2004) A preliminary report on the biodiversity of Mahul Creek, Mumbai, India with special reference to Avifauna. Zoo's Print J. 19: 1599-1605.
- Walmiki N, Karangutkar S, Yengal P, Pillai R, Ajgaonkar P, Singh N and Sagre P. (2013) Avian diversity in and around Bassein Fort and Creek, district Thane, Maharashtra. Internat. J. Adv. Res. 1: 73-85.
- Weeks BC, Nichar G and Shahid N. (2016) Bird assemblage vulnerability depends on the diversity and biogeographic histories of islands. PNAS. 113:10109-10114. www.pnas.org/cgi/doi/10.1073/ pnas.1603866113.