Journal of Global Biosciences
Peer Reviewed, Refereed, Open-Access Journal
ISSN 2320-1355
Volume 9, Number 12, 2020, pp. 8188-8198
Website: www.mutagens.co.in
URL: www.mutagens.co.in/jgb/vol.09/12/091206.pdf

SCAN ME

Research Paper

ABUNDANCE AND DISTRIBUTION OF BIRD SPECIES IN LOCKDOWN AND POST-LOCKDOWN PERIODS OF MYSURU CITY, KARNATAKA

Chethan, B. K.

Faculty in Zoology,
Maharani's science college for women, Mysuru-570005,
India.

Abstract

Bird species are often encountering repeated disturbances from human activities. The Lock down period of COVID-19 is one of the important times for avifauna with less human disturbances. Relative abundance and distribution of bird species in Mysuru city during the lockdown and post-lockdown period was assessed. In the present study, line and point transect method was followed in 4 different study areas of Devaraja mohalla, Gangothri, Bogadhi and Srirampura localities of Mysuru city. The relative abundance of birds during the lockdown period was much higher than in post-lockdown period. The finding of results showed greater relative abundance in Devaraja Mohalla area, while least in Bogadhi area. The avian fauna of study area is dominated by insectivorous birds. The results emphasize that the richness of bird numbers are likely to be favored with less human disturbance in the study areas of Mysuru city.

Key words: Bird species, lockdown, post-lockdown, Mysuru city.

INTRODUCTION

Birds are among the best indicators of environmental changes. They are being eye-catching and sensitive towards environmental change, seen as most suitable biological indicators for monitoring the ecosystem health [1]. Birds are often common denizens of the ecosystem and they have been considered as an indicator species of inhabited areas [2]. Studies of avifaunal diversity is an essential ecological tool in the ecosystem. Bird species not only add aesthetic value to our life but also help in control of pest in agricultural crops, dispersal of seeds and also in maintaining a health ecological balance, thus they form an important components in natural ecosystem.

Mysuru city has an excellent landscape for several resident and migratory species of birds. There are well detailed bird documentations since 1940's. Salim Ali in his historical landmark survey of Mysore state [3-6] covered 343 species from Mysore state (earlier it was Mysore state; as now Mysuru District) characterized by passerines and non passerine avifauna. The present modern field ornithologist and amateus bird

watchers organization have contributed significantly in adding many bird species in to the checklist (www.mysorenature.org). Recently, 517 species of birds are enlisted as part of bird count by several bird survey groups from Mysuru area [7]. Mysore city with its semi-arid climate, freshwater lakes, several human planted vegetations provide an excellent habitats for several residential and migratory species of birds.

Anthropogenic activities have made greater impact on distribution and abundance of avian fauna in urban settings. Several studies reported that human disturbance could have negative effect on fitness such as reproduction, feeding and even normal social behaviour [8-10]**.** Human disturbance is caused by mere presence of people in environment, visiting bird habitat areas and increased traffic rate and also walking nesting sites, the reaction of birds to the change in their habitat is very rapid due to their high mobility [11]. Birds are even more disrupted by their noise and air pollution made by human activities, they react to humans as they were natural predators and birds combat escape from that area [12-15]. Research studies were also evident that human made noise pollution has impact on bird habitat and direct influence on their ability to communicate and response its territory. However avifaunal abundance in lesser human interference has not been documented. Interestingly, due to lockdown by COVID-19 there is less interference of human beings with reduced noise and air pollution created favorable environment for avifauna. The present study aims to understand bird abundance and its distribution during lockdown and post-lockdown periods. This study would also be the baseline for further studies on bird species distribution and its abundance in Mysuru city.

MATERIAL AND METHODS:

Relative abundance of bird species were recorded in 4 different study areas of Mysuru city, keeping in view of occurrence of large avifauna in 4 regions such as Devaraja Mohalla, Gangothri, Bhogadi and Srirampura were selected as study areas (Image-1). In this study, 15 sites in each region are selected as count points. Thus in each study area 60 count point station at 100 meters interval were established. Line transect method were followed to study the birds count. Data was gathered through transect walks from one count point to another for the opportunistic sightings of birds. Bird survey was done in all 4 regions during the COVID-19 lockdown period from March 5, 2020 to May 31, 2020 and post-lockdown i.e., after closing of lockdown from June 1, 2020 to August 31, 2020. Birds were counted at each station in early morning from 7.00 to 11.00 hrs for 10 minute following method of Gutzwiller [16], Jimence [17] and Lee and Marsden [18]. The birds were counted by visiting 4 alternative days of intervals for each region in order to obtain reliable estimate and reduce bias. During each count, all bird species and individual bird calls were identified and recorded. Photography was done by using binoculars (8 x 42) and Nikon D5600 SLR camera with 70-300mm Zoom lens. Captured photos were identified using bird's field guide books of Ali and Ripley [19], Richard Grimmelt [20]. The relative abundance (%) of bird species were

estimated according to Gutzwiller [16] with following expression of n/ N X 100, where 'n' is the number of a particular bird species and 'N' is the total observations detected for all bird species. The percentage of food habit was calculated to understand the occurrence of different food preference in bird's community.

Table 1. Relative abundance and percentage of occurrence of bird species during Lockdown period in the study areas.

					Number Of Observation Within study areas						
Family	**Scientific name**	**Common name**	**Devaraja Mohalla**		**Gangothri**		**Bogadhi**		**Srirampura**		
			Observation	**% of all detection**	**observation**	**% of all detection**	**observation**	**% of all detection**	**observation**	**% of all detection**	**Food Habits**
Sturnidae	Acridotheres tristis	Common myna	266	7.82	174	5.11	120	3.52	112	3.29	O
Psittaculidae	Psittacula krameri	Rosering-parakeet	136	4.00	98	2.88	74	2.17	65	1.91	F,G
Corvidae	Corvus splendens	House crow	131	3.85	89	2.61	128	3.76	83	2.44	O
Columbidae	Columba livia	Rock Dove	128	3.76	65	1.91	82	2.41	17	0.50	G,F
Pycnonotidae	Pycnonotus jocosus	Red-whiskered bulbul	93	2.73	76	2.23	89	2.61	51	1.50	I
Megalaimidae	Megalaima viridis	White-cheeked Barbet	54	1.58	25	0.73	21	0.61	21	0.61	F
Sturnidae	Pastor roseus	Rosy starlings	42	1.23	00	0.00	00	0.00	63	1.85	C
Cisticolidae	Prinia socialis	Ashy prinia	32	0.94	27	0.79	30	0.88	24	0.70	I
Bucerotidae	Ocyceros birostris	Indian grey Hornbill	26	0.76	12	0.35	17	0.50	09	0.26	I
Threskironithidae	Pseudibis papillosa	Red-naped Ibis	26	0.76	13	0.38	08	0.23	02	0.05	P,I
Accipitridae	Milvus migrans	Black kite	20	0.58	13	0.38	11	0.32	37	1.08	C
Nectariniidae	Leptocoma zeylonica	Purple-rumped sunbird	19	0.55	15	0.44	10	0.29	16	0.47	I
Strigidae	Athene brama	Spotted owlet	18	0.52	02	0.05	05	0.14	01	0.02	C
Ardeidae	Bubulcus ibis	Cattle egret	15	0.44	25	0.73	28	0.82	48	1.41	P
Cuculidae	Eudynamys scolopaceus	Asian koel	13	0.38	07	0.20	04	0.11	06	0.17	F
Cuculidae	Centropus sinensis	Greater coucal	11	0.32	09	0.26	08	0.23	07	0.20	I
Muscicapidae	Copsychus savlaris	Oriental magpie robin	09	0.26	02	0.05	04	0.11	02	0.05	I
Accipitridae	Haliastus Indus	Brahminy kite	08	0.23	11	0.32	05	0.14	18	0.52	C
Columbidae	Streptopelia chinenis	Spotted dove	08	0.23	04	0.11	05	0.14	04	0.11	C
Accipitridae	Accipiter badius	Shikra	05	0.14	01	0.02	01	0.02	06	0.17	C
Muscicapidae	Cyornis tickelliae	Tickell's blue flycatcher	04	0.11	05	0.14	08	0.23	02	0.05	I
Muscicapidae	Saxicoloides fulicatus	Indian robin	04	0.11	01	0.02	02	0.05	15	0.44	I
Alcedinidae	Halcyon snyrnensis	White throated kingfisher	03	0.08	06	0.17	07	0.20	04	0.11	P,I
Charadriidae	Vanellus indicus	Red-wattled lapwing	02	0.05	25	0.73	12	0.35	38	1.11	I
Leiothrichidae	Turdoides affinis	Yellow-billed babbler	02	0.05	15	0.44	5	0.14	17	0.50	I
Rhipiduridae	Rhipidura albicollis	White throated fantail	02	0.05	06	0.17	10	0.29	08	0.23	I
Pycnonotidae	Pycnonotus cafer	Red-vented bulbul	02	0.05	05	0.14	03	0.08	37	1.08	F
Burhinidae	Burhinus indicus	Indian thick knee	02	0.05	01	0.02	01	0.02	02	0.05	I
Phasianidae	Pavo cristatus	Peafowl	01	0.02	08	0.23	14	0.41	03	0.08	O

Threskiornithidae	Threskiornis melanocephalus	Oriental white Ibis	00	0.00	94	2.76	05	0.14	14	0.41	P,I
Picidae	Dinopium bengahalense	Black rumped flame back	00	0.00	05	0.14	03	0.08	08	0.23	I
Phasianidae	Frankolinus pondeceranus	Grey Frankolin	00	0.00	04	0.11	03	0.08	12	0.35	F
	Total		**1082**		**843**		**723**		**752**		

Table 2. Relative abundance and percentage of occurrence of bird species during post- lockdown period in the study areas.

					Number Of Observation Within study areas						
Family	**Scientific name**	**Common name**	**Devaraja Mohalla**		**Gangothri**		**Bogadhi**		**Srirampura**		
			Observation	**% of all detection**	**observation**	**% of all detection**	**observation**	**% of all detection**	**observation**	**% of all detection**	**Food Habitas**
Sturnidae	Acridotheres tristis	Common myna	204	10.26	72	3.62	41	2.06	37	1.86	O
Psittaculidae	Psittacula krameri	Rosering-parakeet	44	2.21	21	1.05	17	0.85	29	1.45	F,G
Corvidae	Corvus splendens	House crow	31	1.55	20	1.00	27	1.35	18	0.90	O
Columbidae	Columba livia	Rock Dove	94	4.72	32	1.60	20	1.00	13	0.65	G,F
Pycnonotidae	Pycnonotus jocosus	Red-whiskered bulbul	26	1.30	12	0.60	22	1.10	18	0.90	I
Megalaimidae	Megalaima viridis	White-cheeked Barbet	36	1.81	15	0.75	8	0.40	7	0.35	F
Sturnidae	Pastor roseus	Rosy starlings	0	0	0	0	0	0	0	0	C
Cisticolidae	Prinia socialis	Ashy prinia	10	0.50	18	0.90	35	1.76	43		I
Bucerotidae	Ocyceros birostris	Indian grey Hornbill	20	1.00	11	0.55	6	0.30	7	0.35	I
Threskironithidae	Pseudibis papillosa	Red-naped Ibis	13	0.65	8	0.40	4	0.20	5	0.25	P,I
Accipitridae	Milvus migrans	Black kite	10	0.50	29	1.45	18	0.90	30	1.50	C
Nectariniidae	Leptocoma zeylonica	Purple-rumped sunbird	30	1.50	30	1.50	12	0.60	22	1.10	I
Strigidae	Athene brama	Spotted owlet	16	0.80	5	0.25	6	0.30	7	0.35	C
Ardeidae	Bubulcus ibis	Cattle egret	5	0.25	8	0.40	18	0.90	21	1.05	P
Cuculidae	Eudynamys scolopaceus	Asian koel	22	1.10	12	0.60	8	0.40	18	0.90	F
Cuculidae	Centropus sinensis	Greater coucal	10	0.50	16	0.80	4	0.20	9	0.45	I
Muscicapidae	Copsychus savlaris	Oriental magpie robin	6	0.30	8	0.40	8	0.40	12	0.60	I
Accipitridae	Haliastus indus	Brahminy kite	3	0.15	8	0.40	9	0.45	5	0.25	C
Columbidae	Streptopelia chinenis	Spotted dove	10	0.50	15	0.75	11	0.55	23	1.15	C
Accipitridae	Accipiter badius	Shikra	5	0.25	2	0.10	6	0.30	6	0.30	C
Muscicapidae	Cyornis tickelliae	Tickell's blue flycatcher	8	0.40	4	0.20	2	0.10	2	0.10	I
Muscicapidae	Saxicoloides fulicatus	Indian robin	0	0	0	0	13	0.65	5	0.25	I
Alcedinidae	Halcyon snyrnensis	White throated kingfisher	3	0.15	6	0.30	9	0.45	21	1.05	P,I
Charadriidae	Vanellus indicus	Red-wattled lapwing	2	0.10	4	0.20	14	0.70	17	0.85	I
Leiothrichidae	Turdoides affinis	Yellow-billed	8	0.40	12	0.60	25	1.25	28	1.40	I

		babbler									
Rhipiduridae	Rhipidura albicollis	White throated fantail	8	0.10	4	0.20	5	0.25	11	0.55	I
Pycnonotidae	Pycnonotus cafer	Red-vented bulbul	2	0.10	5	0.25	18	0.90	8	0.10	F
Burhinidae	Burhinus indicus	Indian thick knee	2	0.10	2	0.10	4	0.20	0	0	I
Phasianidae	Pavo cristatus	Peafowl	0	0	8	0.10	11	0.55	17	0.85	O
Threskiornithidae	Threskiornis melanocephalus	Oriental white Ibis	5	0.25	13	0.65	19	0.95	31	1.55	P,I
Picidae	Dinopium bengahalense	Black rumped flame back	4	0.20	8	0.10	16	0.80	11	0.55	I
Phasianidae	Frankolinus pondeceranus	Grey Frankolin	3	0.15	6	0.30	16	0.80	21	1.05	F
	Total		**640**		**414**		**432**		**502**		

Note: Food habits, C- carnivorous, F- frugivorous, G- grainivorous, I- insectivorous, O- omnivorous, P-piscivorous.

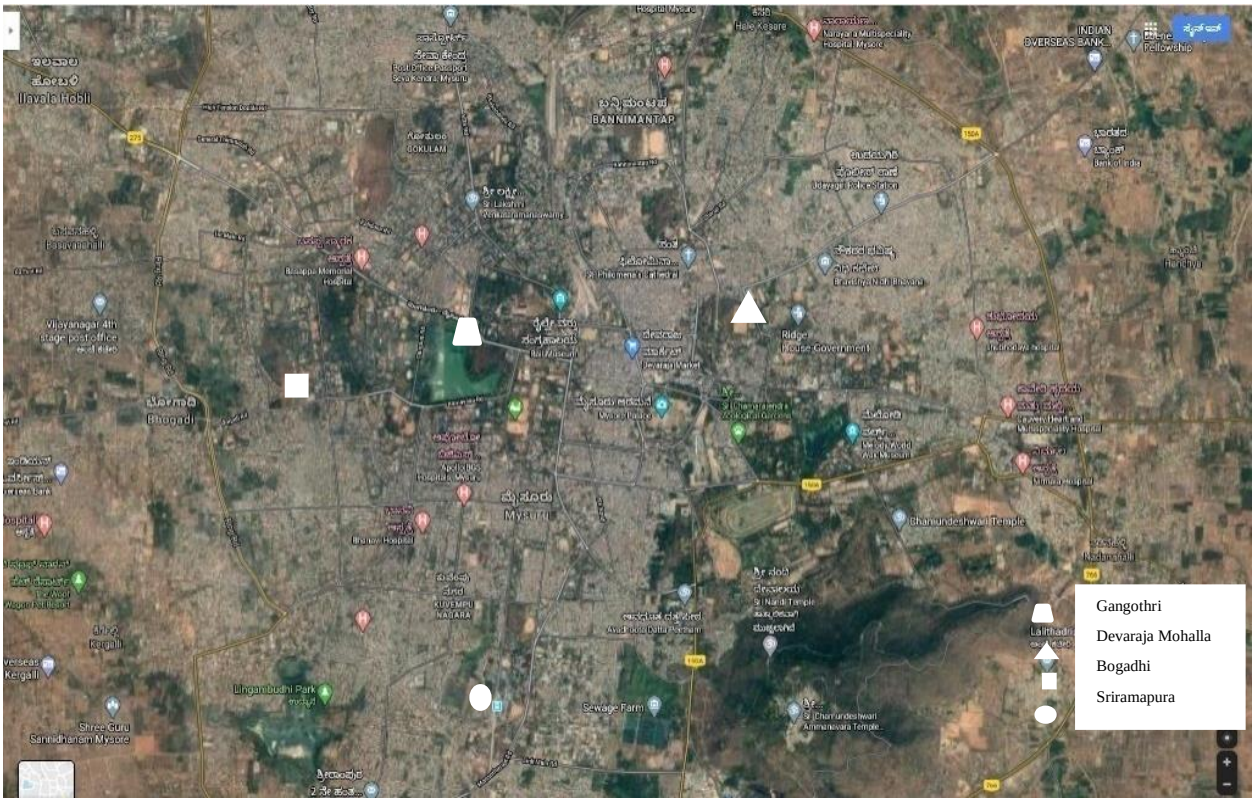
Table 3. Showing difference in percentage of birds recorded in different study areas during lockdown and post-lockdown periods.

Study area	Total birds in lockdown period	Total birds in post-lockdown period	Difference in Percentage
Devaraja Mohalla	1082	640	25.66%
Gangothri	843	414	34.12%
Bogadhi	723	432	25.19%
Srirampura	752	502	19.93%

Table 4 : Showing difference in Percentage of feeding habits of bird species.

Food habits	Number of bird species	% in total of bird species
Insectivorous	16	44.44%
Frugivorous,	6	16.66%
Carnivorous,	5	13.88%
Piscivorous,	4	11.11%
Omnivorous	3	8.33%
Granivorous	2	5.55%

IMAGE 1: Google earth image showing habitats of the study area.



RESULTS:

During lockdown period, a total 3400 birds of 20 families have been recorded from the study areas. Out of them two families *Accipitidae* and *Muscicapidae* (n=3) represented more than the other families (Table, 1). Among 4 study areas, Devaraja Mohalla area is observed with more bird species, while Bogadhi area was least. Out of the recorded birds, five bird species are maximum in all the four study areas. Common myna-*Acridotheres tristis* (7.82%), Rosering parakeet- *Psittaculia krameri* (4.0%), House crow-*Coruvus splender* (3.8%), Rock dove -*Columba livia* (3.7%) and Red whiskered bulbul-*Pycnonotus jocusus* (2.7%) shows the highest relative abundance. On contrary 3 bird species White cheeked barbet – *Megalaim viridis* (1.5%) and Rosy starling – *Pastoroseus* was least abundant from one study area to other. Three species, Oriental white ibis-*Threskiornis melanocephals*, Black rumped flame back-*Dinopium bengahalense* and Grey Frankolin- *Frankolinus pondeceranus* were not recorded in Devaraja Mohalla area, but found in habitats of Srirampura area. Furthermore, Oriental headed ibis-*Threskiornis melanocephalus* were near threatened and other rest bird species was least concerned in IUCN red list 2015 [21]. On the other hand, during post-lockdown period, a total 1988 birds was recorded (Table.2). Out of them, Devaraja Mohalla area observed with more bird numbers, while Gangothri area was least. Four maximum bird species were recorded in all the four study areas. Common myna- *Acridotheres tristis* (10.26%), Rock dove- *Columba livia* (4.72%), Rosering parakeet- *Psittacula krameri* (2.21%), White cheeked Barbet- *Megalaima viridis* (1.81%) showed highest relative abundance. However, House crow- *Corvous splendens* (1.55%), purple rumped sunbirds- *Leptocoma*

zeylonica (1.50%) and Asian koel- *Eudynamys scolopaceus* (1.10%) were moderately abundant, while White throated fantail -*Rhipidura albicollis* (0.40%), Shikra –*Accipiter badius* (0.25%) and Indian thick knee- *Burhinus indicus* (0.10%) were less abundant in the study areas. Consequently, the percentage of birds recorded during the lockdown period was larger when compared with the closing of the lockdown period (Table, 3). The difference in their percentage was more in Gangothri area (34.14%) and least in the Srirampura area (19.93%). Further, based on the food habits, it is noticed that the avifauna of these study area is dominated by insectivorous (16 species) followed by Frugivorous, carnivorous, piscivorous, omnivorous and granivorous birds with 6, 5,4,3,2 species respectively (Table, 4).

DISCUSSION:

Relative abundance of birds was substantially greater during the lockdown period when, compared with that of post-lockdown period over the study areas. With a consequence of less noise pollution and reduced human activities in lockdown period, large number of individual bird species was observed. In contrast with the increased traffic and human intrusion of post-lockdown period certain bird species like Rosey starling, Indian robin, Indian thick knee, Tickell's blue flycatcher and Red wattled lapwing were greatly reduced in their numbers with moderate counts of bird species. This finding also emphasizes the importance of role played by human disturbance on species abundance and their distribution.

Consequently in all 4 study areas, the highest relative abundance of 5 bird species like Common myna, Rosering parakeet, Rock dove, House crow and Red whisked bulbul were gathering together due to their coexistence of species. The possible reasons for increase number of birds in city limits are due to stronger association with human population and were roughly classified as obligatory commensals of humans, their dependence primarily on left-over food disposed in open area around the residence, grain-shops and restaurant wastes. The above observations were in consistent with Mukherjee et al. [22] stated that certain birds are known commensals of humans their emerging roadside vegetation also helped them in getting food along with their daily activities of roosting, foraging and nesting behaviours.

However comparing the bird species in between the lockdown and post-lockdown periods, certain birds Ashy prinia, Great coucal, Oriental Magpie robin, Indian robin, white throated kingfisher, red vented bulbul, peafowl, oriental white ibis, Black rumped flame back, Grey fronklin were moderately abundant from one study area to other. This might be due to distribution of bird species to lesser human interference areas. Our result is in consistent with findings of Gutzwiller and Anderson [23]; Ferbabdez-Juricic [24] on the effect of human disturbance in bird assemblage composition and distribution.

Consequently, the insectivorous birds Ashy prinia, Purple sunbird, Red whiskered bulbul, Rosy starlings and Indian Grey hornbill were relatively higher

percent of abundance in all study areas. It is apparent from the Table 4, that the avifauna of study areas is dominated by insectivorous birds. The availability of phytophagous insects in turn substantially increased the number of insectivorus passerine birds. The possible reasons of their higher density are with the substantial increase in insect population over the monsoon season might have avail the coexistence of bird specis. However, It was also observed that lesser human disturbance with absence of noise pollution helped these bird song signals connecting many individual species resulting in communication network and their gathering. Increasing levels of anthropogenic noise interferes with such communication [25], it is the fact that birds also change the frequency and amplitude of their songs in response to noise. Increasing the calling amplitude by the signaler under greater noise exposure is termed the Lombard effect [26]. Further in the present study it is observed that birds singing calls were made from higher canopies of trees in noisy environment during post-lockdown period. However, interestingly with the advance of Monsoon season (report from Indian meteorological Department- https://mausam.imd.gov.in/imd) increase number of Asian koel, purple rumped sunbirds and black kite bird species was due to seasonal differences in movement of birds during post-lockdown period.

However, White ibis, Brahminy kite, Cattle egret, Red naped ibis and White throated kingfisher species are being found occurring largely on the water sources. This is due to the preference of water resources to look for their food. It was observed that the availability of food resources in waste water running along the city and marsh pools is best locations for sitting of these birds. This result indicated that the relationship between birds and habitats influence on the distribution and diversity of avian species. The study clearly indicates that the relationship between birds and habitats was shaped by availability of food resources and type of vegetative structure. These birds also preferred to forage in less human interference avoid disturbance made by various human activities.

Blair [27] and Salahudeen *et al*. [10] suggested that the human disturbance negatively affect the richness and diversity of birds. Although some bird species avoid human intruders and increased traffic disturbance. We had the same observation that the Peafowls, Grey francolin, Greater coucal and Red vented bulbuls observed in groups in places of least human disturbances. The lockdown period has undoubtedly helped them gathering in large numbers in their habitats. In context to human disturbance, Black rumped flame black, Rosy starlings, Indian thick knee and Indian robin which were not found on one study area have made their appearance in other areas, showing interesting spatial distribution patterns which are mainly depends on the microclimatic conditions with their habitats. Consequently, birds are often been correlated with their habitats [28]. Further, systematic investigation is required to understand the fine-scale relationship between birds and their habitat.

CONCLUSION:

Lesser human activities and noise pollution during Lockdown period of COVID-19 is favorable conditions for bird abundances and its distributions. In absence of human disturbances it was considered as an important time for bird species to perform roasting, communication and foraging behaviors. The results emphasis that relative abundance of bird numbers among all the four study areas was greater during lockdown than in post-lockdown period. The impact of human activities on bird species is apparent with decline or absence of certain bird species number during post-lockdown period. Further occurrence and coexistence of bird community in the study areas were also largely dependent on availability of food resources such as water bodies or Insect abundance in their habitats. Bird species abundance not only adds aesthetic value to human life but also good indicators of biological richness.

ACKNOWLEDGMENT:

Author is grateful to Department of Zoology, Maharani's science college for women for providing the laboratory facilities.

REFERENCES:

[1] . Gregory, R. D., Noble, D., Field, R., Marchant, J. H., Raven, M and Gibbons, D. W., 2003, Using birds as indicators of biodiversity, Ornis Hungarica, 12; 11-24.

[2] . Blair R.B., 1999, Land use and avian species diversity along an urban gradient, Ecol. Appl, 6; 506-519

[3]. Ali S and Whistler H., 1942a, The birds of Mysore. Part I, Journal of the Bombay Natural History Society, 43; 130-147.

[4]. Ali S and Whistler H., 1942b, The birds of Mysore. Part II, Journal of the Bombay Natural History Society, 43; 318-341.

[5]. Ali S and Whistler H., 1943a, The birds of Mysore. Part III, Journal of the Bombay Natural History Society, 43; 573-595.

[6]. Ali S and Whistler H., 1943b, The birds of Mysore. Part II, Journal of the Bombay Natural History Society, 44; 9-26.

[7]. Source-http://www.ebird.org/India > Mysore city Bird Atlas.

[8]. Summers P. D, Cunnington G. M, Fahrig L., 2011, Are the negative effects of roads on breeding birds caused by traffic noise, J Appl Ecol, 48; 1527-1534.

[9]. Dutta H., 2017, Insight into the impact of four current environmental problems on flying birds, Energy, Ecology and Environment, 2; 329-349

[10]. Salahudeen M, Saranya E, Gunasekaran C and Vadivalagan C., 2013, Studies on the abundance and Distributon of birds in three different Habitats of Karur District, South India, J. Entomol. Zool. Stud, 1; 57-63.

[11]. Morrisson M. L., 1986, Bird populations as indicators of environmental changes, Curr. Ornithology, 3; 429-451

[12]. Frid, A and Dill, L. 2002, Human-caused disturbance stimuli as a form of predation risk, Conservation Ecology, 6; 11-26.

[13].Blumstein, D.T., Anthony, L.L., Harcourt, R and Ross, G., 2003, Testing a Key assumption of wildlife buffer Zones; is flight initiation distance a species-specific trait ?, Biological Conservation, 110; 97-100.

[14].Beale C. M, Monaghan P., 2004, Human disturbance: people as predation- free predators? J. Appl. Ecol, 41; 355-343.

[15] Sapolsky. R. M., Romero, L. M and Munck, A.V., 2000, How do glucocorticoids influence stress response: Integrating permissive, suppressive, stimulatory and preparative actions, Endocrine Reviews, 21; 55-89.

[16]. Gutzwiller J., 1991, Estimating winter species richness with unlimited-distance point counts, Auk, 108; 853-862.

[17]. Jimenez J. E., 2000, Effect of sample size, plot size, and counting time on estimates of avian diversity and abundance in a Chilean rainforest, Journal of Field Ornithology, 71; 66-87.

[18]. Lee D C and Marsen, S J., 2008, Adjusting count period strategies to improve the accuracy of forest bird abundance estimates from point transect distance sampling surveys,150; 315-325.

[19]. Ali S and Ripley S. D., 1987, A compact Handbook of the Birds of India and Pakistan, Second Edition, Oxford University press, Mumbai.

[20]. Grimmelt R, Carol Inskipp, and Tim Inskipp., 2010, Helm Field Guides; Birds of the Indian subcontinent (2nd edition), Oxford press.

[21]. IUCN., 2015, Birdlife International. The IUCN Red List of Threatened Species. WWW.iucnredlist.org, Accessed on 10 August 2020.

[22]. Mukherjee A, Borad C. K and Parasharya B. M., 2002, A study of the ecological requirements of waterfowl at man-made reservoirs in kheda District, Gujarat, India, with a view towards conservation, management and planning, Zoos' Print Journal, 17; 775-785.

[23]. Gutzwiller K. J and Anderson, S. H., 1999, Spatial extent of human intrusion effects on subalpine bird distributions, Condor, 101; 378-389

[24]. Fernandez-Juricic, E., Blumstein, D.T., Abrica, G., Manriquez, L., Adams, L.B., Adams, R., Daneshrad, M and Rodriguez-Prieto, I., 2006, Relationship of anti-predator escape and post –escape responses with body mass and morphology; a comparative avian study, Evolutionary Ecology Research, 8; 731-752.

[25]. Diaz M, Parra A, Gallardo C., 2011, Serins respond to anthropogenic noise by increasing vocal activity, Behav Ecology.

[26]. Sue Anne Zollinger, Peter , J. B, Slater, Erwin Nemeth and Henrik Brumm., 2017, Higher songs of city birds may not be an individual response to noise, Proceeding Royal Society B, 284; 1-8.

[27]. Blair , R. B., 1996, Land use and avaian species diversity along an urban gradient, Ecol. Appl, 6 (2); 506-519.

[28]. Seymour C. L and. Simmons R .E., 2008, "Can severely fragmented patches of riparian vegetation still be important for arid-land bird diversity", Journal of Arid Environments, 72; 2275-2281