Eco. Env. & Cons. 29 (May Suppl. Issue) : 2023; pp. (S327-S331)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i03s.059

Effects of Electromagnetic Radiations emitted from Cell Phone towers on Avifaunal diversity in urban landscape of Aligarh region, India

Atul Sharma[1], Meera Singh[2], Mani Gahlaut[3] and Mukesh Kumar[4]

[1]Department of Zoology, Dr. Bhimrao Ambedkar University Agra, U.P., India
[2]Department of Zoology, Dharam Samaj College Aligarh, U.P., India

(Received 25 December, 2022; Accepted 17 February, 2023)

ABSTRACT

A field survey was conducted from January 2022 to December 2022 in the urban area of Aligarh region to access the possible effects of electromagnetic radiations emitted from cell phone towers on the avifaunal diversity. For the purpose of study three sites were selected in this region comprising one control site without any cell phone tower. Data were collected on the basis of point count and sighting method. Calculations were carried using Shannon and Weiner's diversity index. Electric Field strength was measured using instrument LATNEX Triple Axis HF-B3GR meter. The survey revealed high impact of electromagnetic radiations on the avifaunal species abundance and richness, behavior, breeding, feeding patterns and migration rate.

***Key words**: Avifaunal diversity, Electromagnetic Radiations, Cell Phone towers, Biodiversity*

Introduction

The revolution in the field of telecom and communication sector has changed our living styles drastically. We are absolutely dependent on the diverse communication modes these days. We can not even imagine ourselves without cell phones as they provide us ease of doing business. Within a decade we have witnessed a rapid influx of cell phone users and consequently cell phone towers. Aligarh region has too seen increase in the installation of towers especially in urban landscape. The cell phones towers emit electromagnetic radiations that are like a sweet poison and are impacting all the living creatures including avifauna. The birds have internal electromagnetic field which is characterized by some frequencies. Also birds respond actively and sharply to electrochemical alterations in the environment brought up by the electrical impulses. Several studies on the impact of electromagnetic radiations on biodiversity revealed its adverse effect as such present study was conducted to evaluate the possible effects of said radiations on avian species. As no such study has been initiated in this region this survey will be first of its kind and will add a significant importance for analyzing overall situation responsible for alterations in avifaunal diversity due to increase in electromagnetic waves.

Materials and Methods

This study was conducted from Jan. 2022 to Dec. 2022 in the urban landscape of Aligarh region. For the purpose of study three different sites were se-

([1]Research Scholars, Meera Singh[2])

lected. The two sites selected were busy areas and include cell phone towers whereas one site was taken as control site without any cell phone base station.

Sites under location

Location	Sites
Urban landscape of Aligarh region Geographical Coordinates- 27°55′N and 78°032E. Height from sea level- 178 m	1. Jewar Toll Plaza at Yamuna Expressway (Site-1) 2. Harduaganj Centre of town (Site-2) 3. Kochhor Agricultural fields (Site-3)

Diversity of avifauna at selected sites was recorded on the basis of point count, transact walk and sighting method. Birds were counted within radius of 500 m. of selected cell phone towers at selected sites. Identification of birds was done on the basis of morphological features like shape, size, color, beak, wings, eyes, feathers, legs and other body parts (Ali, 2012). Readings were taken once a week for one site alternatively during complete study period. Data were recorded from 6-8 am in the morning and 5-7 pm in the evening during summers and in winters 8-10 am in the morning and 4-6 pm in the evening.

For measuring electric field strength from the tower instrument –LATNEX Tri-axis HF- B3GRF meter was used. Calculations were carried out for the following parameters.

Species diversity- Using Shannon-Weiner Index as per formula H=″ [(pi) ×*l*n (pi)] where H is Shannon Index and p*i* represents proportion of the *i*th species of birds.

Relative abundance- Using formula- n*i*/N x100, where n*i* represents number of species and N represents total number of birds.

Species evenness- Using equation J=H/H*max, where H* represents log of total number of species richness and H is observed species diversity.

Species richness - Total number of species in the given area.

Results and Discussion

This study revealed that increased exposure to electromagnetic field and radiations in the surrounding air support a decline in the population of various species in the region though the impact of other factors like urbanization, climate change, global warming, habitat loss and environmental pollutants cannot be completely neglected.

Using the RF meter average power density at all the selected sites was recorded as depicted below:

Power density Pd at a distance R is given by:

$$P_{d=}\frac{Pt\times Gt}{4\pi R2}\ Watt/m^2$$

Where, Pt = Transmitter power in Watts, G t = Gain of transmitting antenna, R = Distance from the antenna in meters.

Site -1 (Jewar Toll Plaza)

In the urban landscape of Aligarh at Site-1 we found small vegetation with shrubs and weeds of many types. This area is located on Yamuna expressway that is every time busy with vehicular movements and thus the environment here is comprised of extremely high noise and air pollution that when coupled with high frequencies of electromagnetic radiations emitted from cell phone masts installed here make it more hazardous for the avifauna to sustain their normal lives.

Site-2 (Harduaganj Town)

Harduaganj is a town in Aligarh district which comprise a thermal power plant that is responsible for soil, air and water pollution thus effecting flora and fauna widely and when accompanied with electromagnetic pollution emitting from cell towers installed in the area the place has become more stress-

Table 1. Average Power density recorded at different sites at various distances from the transmitting towers

Sites	Power density near the base of the cell phone tower	25 m away from the cell phone tower	50 m away from the cell phone tower	100 m away from the cell phone tower	500 m away from the cell phone tower
Site-1	0.19	0.08	0.036	0.007	0.000312
Site-2	0.29	0.15	0.038	0.008	0.000318
Site-3	No tower present at this site (control site)				

ful for all living creatures including birds. As such this study is presenting its overall environmental impact on birds.

Site 3 Kochhor Village (Control Site)

Kochhor is a small village located in Koil tehsil of Aligarh district in Uttar Pradesh. The total geographical area of village is 315.62 hectares. Kochhor has a total population of 3,472 peoples that are majorly dependent on agricultural fields. The agricultural landscape accompanied by trees and shrubs vegetation here supports a lot of avifauna. For the purpose of study agricultural fields with no communication towers were selected.

Table 2. Quarterly relative abundance of bird species within 500 meters of radius of cell phone tower at Jewar Toll Plaza from Jan 2022 to Dec 2022

		Quarterly relative abundance %				
S. No.	Species	Jan 2022 to March 2022	Apr 2022 to Jun 2022	Jul 2022 to Sep 2022	Oct 2022 to Dec 2022	Annual abundance
01	House Crow	22.33	9.90	14.44	20.21	17.24
02	Rock Pigeon	0.00	8.24	10.54	5.48	7.68
03	House Sparrow	5.82	4.16	3.34	2.82	3.62
04	Common Myna	28.50	31.66	27.75	25.72	22.18
05	Pariah Kite	1.38	4.16	3.64	0.68	2.94
06	Rose Ringed Parakeet	18.00	12.58	11.11	15.36	13.45
07	Asian Koel	4.18	5.74	3.12	2.66	3.28
08	Eurasian Collared Dove	11.44	8.66	3.12	1.46	5.08
09	Spotted Owlet	1.84	0.00	0.22	1.12	1.04
10	Indian Silverbill	2.78	3.86	2.94	1.64	1.98
11	Spotted Eagle	0.00	0.00	0.88	0.62	0.40

Table 3. Community Characteristics observed at Site -1

	Jan-Mar, 2022	Apr- Jun, 2022	Jul- Sep, 2022	Oct- Dec, 2022
Species Richness	9	9	11	11
Species Diversity	1.27	1.68	2.08	1.92
Species Evenness	0.74	0.83	0.94	0.89

Table 4. Quarterly relative abundance of bird species within 500 meters of radius of cell phone tower at Harduaganj Town from Jan 2022 to Dec 2022.

		Quarterly relative abundance %				
S. No.	Species	Jan 2022 to March 2022	Apr 2022 to Jun 2022	Jul 2022 to Sep 2022	Oct 2022 to Dec 2022	Annual abundance
01	House Crow	28.18	9.60	11.26	16.42	16.92
02	Rock Pigeon	0.00	6.36	4.12	3.34	4.05
03	House Sparrow	2.18	2.38	2.84	1.22	2.16
04	Common Myna	29.72	26.24	23.48	20.94	25.34
05	Pariah Kite	1.12	2.84	1.98	0.00	2.04
06	Rose Ringed Parakeet	13.64	9.95	7.44	10.50	9.86
07	Asian Koel	2.92	3.88	2.12	0.86	2.68
08	Eurasian Collared Dove	1.76	1.46	0.00	0.00	1.52

Table 5. Community Characteristics observed at Site-2

	Jan-Mar, 2022	Apr- Jun, 2022	Jul- Sep, 2022	Oct- Dec, 2022
Species Richness	7	8	7	6
Species Diversity	1.68	2.06	1.88	1.12
Species Evenness	0.67	0.83	0.78	0.72

The present study clearly depicts the negative impact of electromagnetic radiations from cell phone towers on bird diversity. At Site 1 we found 11 species of birds in which Common Myna and House Crow were most abundant. The species richness was highest in the months of April, May and June during the study period.

At Site 2 we came across with 08 species of birds in which most abundant were Common Myna, House Crow and Rose ringed Parakeet. The species richness and evenness was recorded highest during the months of July, August and September.

At Site 3 the number of species observed were 17, the most abundant species included Common Myna, House Crow, Rose Ringed Parakeet and Jungle Babbler. The species abundance and richness was highest during the months of April, May, June.

Behavioral patterns of the species were also noticed at all the Sites under study. During vigorous sighting it was assessed that nesting, breeding and feeding activities of some birds were distorted at locations within strong EMR field where as at Site 3(Control Site) all such activities seemed to be normal. Migration rate at all the three Sites under consideration seemed to be distorted that indicates a serious concern even at locations without cell phone

Table 6. Quarterly relative abundance of bird species in the agricultural fields at Kochhar village from Jan 2022 to Dec 2022

		Quarterly relative abundance %				
S. No.	Species	Jan 2022 to March 2022	Apr 2022 to Jun 2022	Jul 2022 to Sep 2022	Oct 2022 to Dec 2022	Annual abundance
01	House Crow	30.16	12.80	15.65	23.64	21.46
02	Rock Pigeon	1.92	11.28	13.74	8.14	7.66
03	House Sparrow	8.22	6.54	5.24	3.32	5.98
04	Common Myna	31.31	38.26	28.44	25.18	29.16
05	Pariah Kite	1.68	3.74	0.00	0.00	2.16
06	Rose Ringed Parakeet	19.62	13.16	12.08	16.56	16.21
07	Asian Koel	6.73	5.35	2.60	1.98	4.33
08	Eurasian Collared Dove	14.92	12.84	6.72	3.27	7.54
09	Red Wattled Lapwing	0.00	2.93	1.24	0.00	1.08
10	Spotted Owlet	2.06	0.00	0.00	0.95	0.97
11	Black Drongo	4.46	6.23	8.14	1.65	5.80
12	Crow Phesant	2.22	6.32	9.24	2.06	5.27
13	Red Vented Bulbul	6.18	12.36	7.68	3.32	6.85
14	Jungle Babbler	10.60	15.28	17.56	9.96	12.68
15	Purple Sunbird	0.00	3.12	1.64	0.00	1.93
16	Indian Peafowl	0.00	1.32	0.46	0.00	0.24
17	Cattle Egret	2.85	5.16	8.64	7.44	6.02

Table 7. Community Characteristics observed at Site-3

	Jan-Mar, 2022	Apr- Jun, 2022	Jul- Sep, 2022	Oct- Dec, 2022
Species Richness	14	16	15	13
Species Diversity	1.56	2.16	1.96	1.28
Species Evenness	0.88	0.94	0.90	0.72

Table 8. Comparative analysis of average relative abundance, richness, diversity and evenness of avian species at three Sites from January 2022 to December 2022

Community Characteristics	Site -1	Site- 2	Site-3 (control)
Species Abundance	8.64	7.23	9.75
Species Richness	10	07	14
Species Diversity	1.72	1.38	2.24
Species Evenness	0.86	0.78	0.96

Table 9. Comparative analysis of behavioral patterns observed at three sites:

Behavioral Patterns	Site-1	Site-2	Site-3
Nesting activities	Normal	Distorted	Normal
Breeding rate	Distorted	Distorted	Normal
Feeding rate	Distorted	Distorted	Normal
Migration	Distorted	Distorted	Distorted
Aggressive behavior	Mildly	Observed	Not observed
Biting	Not Assessed	Enhanced	Normal
Feather fluffing	Enhanced	Enhanced plucking	Normal plucking
Eyes & body positions	Normal	Sleepy& dilating	Normal
Regurgitation	Proper	Enhanced	Proper as usual
Perch balancing	Highly difficult	With difficulty	Normal as usual

towers. Other activities like aggressiveness, biting and perch balancing were also observed in which we found nearly normal behavior at Site 1 and 3 where as at Site 2 in some species it has been found elevated or abnormal. Also at Site 2 the birds showed dilating and bulging eyes with distorted postures clearly indicating serious health issues due to the electromagnetic radiations and other pollutants in the environment.

Conclusion

The Electromagnetic radiations from cell phone towers seem to be a potential invisible pollutant in the biosphere having detrimental effect on the avifaunal diversity. In some recent studies we came to know about the declining of bird's species in Aligarh landscapes. However in the present study we analyzed that EMR from cellular masts made the conditions for more worse for the sustenance of birds specifically at locations where air, water, soil and noise pollution levels was high. Along with this anthropogenic activities are also going on as such the position of avifaunal diversity is on the verge of ruination. As we know the diversity of birds is important to maintain the ecological balance we must look into alternate technologies so as to conserve these beautiful feathered bipeds.

Acknowledgement

We are highly thankful to the Department of Zoology, Dharam Samaj College, Aligarh for providing relevant literature useful in this research work. A special thanks to Himani Dutta who helped a lot in the field exercise.

Conflict of Interest

All the authors presenting this research work declare that they have no conflict of interest.

References

Ali, S. and Futehally, L. 2008. About Indian Birds. *Wisdom Tree*. 4779-4723.

Aldad, T.S., Gan, G. and Gao, X.B. 2012. Taylor HS. Fetal radio frequency radiation exposure from 800-1900 MH-rated cellular telephones effects neurodevelopment and behavior in mice. *Sci Rep.* 2: 312.

Kaur, G. and Dhami, A.K. 2012. Orientation studies of a cell-phone mast to assess electromagnetic radiation exposure level. *Int. J. Env. Sc.* 2(3): 2285-2294.

Lee, P. and Rotenberry, JT. 2005. Relationships between bird species and tree species assemblages in forested habitats of eastern North America. *Journal of Biogeography*. 32: 1139–1150.

Manoj, K., Nandkishor, D., Raju, K., Sanjay, C. and Prosun, B. 2012. Impact of urbanization on avian population and its status in Maharashtra state, India. *Int. J. App. Env. Sci.* 7(1): 59-7

Noor, A., Mir Z.R., Khan, M.A.R., Kamal, A., Habib, B. and Shah, J.N. 2014. Summer population estimates and diversity of some common bird species along the bank of Dal Lake, Srinagar, Jammu and Kashmir. *Podoces*. 9 (2): 47-53.

Rajashekar, S. and Venkatesha, M.G. 2008. Occurrence of House sparrow, Passer domesticus indicus in and around Bangalore. *Curr. Sci.* 94(4): 446-449.

Saeid, S. H. 2013. Study of the Cell Towers Radiation Levels in Residential Areas, *Proc. Int. Conf. Elec. And Comm. Sys*. 87-90.

Sekercioglu, C.H., Primack, R.B. and Wormworth, J. 2013. The effects of climate change on tropical birds. *Biological Conservation*. 148 : 1–18.

Shannon, C.E. and Weaver, W. 1949. The Mathematical Theory of Communication. Urbana, *University of Illinois Press*. 117pp.

Slabbekoorn, H. and Ripmeester, E.A.P. 2008. Birdsong and anthropogenic noise: implications and applications for conservation. *Molecular Ecology*. 17(1): 72–83.