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Impact of Radiations from Communication Towers on the Wetlands Avifaunal Diversity

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KEYWORDS

Avifauna, Electromagnetic Radiations, Communication towers, Biodiversity, Point Count

ABSTRACT:

Background: A field survey was conducted from January 2021 to December 2022 in the wetlands of Aligarh region to access the impact of electromagnetic radiations emitting from communication towers on the avifaunal diversity. For the purpose of study three major sites were selected in this region comprising one control site without any communication tower. At all the Sites avifaunal species abundance, richness and evenness was recorded along with observation on certain behavioral aspects of birds.

Results: The survey revealed high impact of electromagnetic radiations on the avifaunal diversity at one site under strong electromagnetic field whereas at the other site under electromagnetic field the effect was minimal. Moreover some distortions in the breeding & feeding patterns as well as migration rate were also observed.

Conclusion: During study we found that electromagnetic radiations from the cell phone towers not only impacted the diversity and migration in birds but also altered their physiological and behavioral conditions hence posing a great threat to avifaunal biodiversity.

1. Background

The diversity of birds is severely threatened by the electromagnet radiations due to the abrupt increase in the number of communication towers. Bio-electromagnetism is an emerging field that involves interaction between electromagnetic fields and biological entities. Now a day's it becoming hot topic of discussion; as we are witnessing upsurge in the intensity of electromagnetic radiations over the biosphere globally. Electromagnetic radiations are the major contributor of environmental pollution impacting wildlife and avifauna adversely (Balmori, 2016). The population of both animal and plant species is declining rapidly in the areas with strong electromagnetic fields (Dhami, 2020). Electromagnetic Radiations induce behavioral and cognitive effects due to thermal changes causing tissue heating which in turn induce thermoregulatory alternate behavior among organisms (Andrea and Adair, 2003). In almost all studies adult organisms are considered neglecting immature from attentions that are more prone to impacts of electromagnetic radiations (Anders et al, 2008). Radiation exposures on wildlife induce bio-negative and bio-positive effect on fertility, tumorigenesis and life span depending on genetic background, age, sex, the nature of radiation exposure may be acute or chronic (Adekunle and Kpanaki, 2015). Short term EMR effects are unrecognizable but prolonged exposure to even low level EMR is effective (Johnson and Spackman, 1983). In a cross-sectional multiphase study in Germany, it was concluded species living in close proximity are more prone to toxic e-smog or radio frequency electromagnetic radiations (Shannoun et al., 2008**).** The wireless technology made humans addict over it neglecting the dark side moreover it's not environmentally friendly (Roye, 2021).

The bird diversity is important for preserving plant diversity and in maintaining ecological balance as such researches to find alternatives that are free from environmental concerns are need of the hour (Roye, 2021). The study area wetland landscape of Aligarh has too seen increase in the installation of towers. In the urban landscape of Aligarh EMR from cellular masts made the conditions worse for the sustenance of birds specifically at locations where air, water, soil and noise pollution levels were high (Sharma, 2023) and a similar study to check the impact of electromagnetic pollution

Journal of Chemical Health Risks

www.jchr.org

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stated birds respond actively and sharply to electrochemical alterations in the environment brought up by the electrical impulses since they have internal electromagnetic field which is characterized by some frequencies (Bhattacharya, 2014).

After the review of literature, it has been noticed that research work is on infancy stage on the effect of magnetic field on avian diversity and no such work is on wetlands in the Aligarh region of India. Hence the present study was designed to understand the effect the electromagnetic radiation on the avian diversity in Wetland Landscape of the Aligarh Region, India.

This study enumerates the possible effects of said radiations on avian species in the natural conditions focusing on effects on species abundances rate, richness, diversity and evenness along with alterations found in the behavioral patterns such as nesting activities, breeding and feeding rate, migration etc. This study adds a significant importance for analyzing overall situation responsible for alterations in avifaunal diversity due to the increase in electromagnetic waves specifically in the Aligarh region that is devoid of any such scientific work till now.

2. Methods

2.1 Study Area- The present study was carried out in the wetlands located in Aligarh region of Uttar Pradesh in the northern part of India. Geographically, the wetland is bound by 27°55'N and 78°03′E, and avifaunal diversity was analyzed from the selected sites covering an area of 35 km throughout the landscape from January 2021 to December 2022. The region is loaded with communication towers, and for this study, three major sites were selected in this region, comprising one control site without any communication tower. In this study, the impact of electromagnetic radiation emitted from these communication towers on avian diversity was studied.

Sites under location:

Location	Sites
Wetland landscape of Aligarh region Geographical Coordinates- 27°55'N and 78°03′E. Height from sea level- 178 m	Sheekha Jheel (Site-1) Rati Ka Nagla (Site-2) Aama Khera (Site-3) *Control Site*

Site 1- Shiekha Jheel is a bird sanctuary comprising 25 hectare lake near the village of Sheekha, 17 km east of Aligarh and 5 km from the Grand Trunk Road in the state of Uttar Pradesh. It's a natural water body which attracts lots of birds. The place is one of the important bird areas. In winter season, it's the best place to visit and observe migratory birds coming through the Russia and Siberia. About 166 water bird species have been reported in and around Sheikha. Some of these include, the Sarus crane, Black necked stork, bar-headed goose, Indian Pond heron, and so on. (Rahmani and Sharma, 1997)

Site 2- Rati Ka Nagla is a small Village/hamlet in Hasayan Block in Mahamaya Nagar District of Uttar Pradesh. It comes under Kallupura Panchayat. Located at a distance of 38 Km towards North from District head quarters Hathras, it belongs to Aligarh Division. The place comprises of a beautiful wetland serving as a paradise for many avian species where one can experience a variety of resident as well as migratory birds captivating eyes (Bird life International, 2023). But due to the huge industrialization in the area we have seen increasing cell phone towers also and consequently the population of birds is significantly decreasing. It is assumed that Pollution from industries altogether with radiation pollution from cell phone masts is proved to be detrimental for bird's diversity (Balmori, 2012).

Site 3 -Ama khera village falls in Gopi taluka of Aligarh district in Uttar Pradesh. Situated 40 km away from Aligarh city, this wetland habitat is typical of the Gangetic plains. Each year the place attracts about 7000 birds belonging to 70 species like Indian skimmer and the threatened bar-headed geese (Bird Life International, 2023). The legal status of the protected land is village commons. This wetland lies very close to the village and has been traditionally used by the villagers for irrigation as well as fishing purposes. It is not known whether there is any active community participation in the protection of the birds, although all inhabitants take into consideration that no one kills or disturbs birds.

2.2 Procedure: 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. S,

Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 610-619 | ISSN:2251-6727

2012). Readings were taken once a week for one site alternatively during complete study period. Data was 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.

3. Results

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 (Rajashekar and Venkatesha, 2008). Using the RF meter average power density at all the selected sites was recorded as depicted below:

Table 1: Average Power density range recorded at different sites through various distances from the transmitting towers during the study period:

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	0.19-0.22	0.08-0.16	0.036-0.043	0.007-0.013	0.000312-0.000396
Site-2	0.29-0.35	0.15-0.21	0.038-0.047	0.008-0.016	0.000318-0.000424
Site-3	No tower present at this site (control site)				

Power density Pd at a distance R is given by:

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

Where, Pt = Transmitter power in Watts, G t = Gain of transmitting antenna, R = Distance from the antenna in meters. Location of the Study area includes wetlands. Three Major wetlands of the area were selected for the purpose of study. Among the three Site-1 and Site-2 were taken as sites with a cell phone tower in the vicinity where as Site-3 was considered as control site without cell phone tower.

Analysis of biennial relative abundance at Site-1 Sheekha Jheel: During the study period (Jan. 2021 to Dec. 2022) we found a total of 26 avian species among which 12 were aquatic and 14 were terrestrial. Sarus Crane was found to be highest abundant species with biennial relative abundance percentage of (26.80), which was followed by Bar Headed Goose (20.48). Common Myna was third abundant species (18.44), then Rock Pigeon (16.36), India Spot Billed Duck (15.25) and others. Among the least abundant include Jungle Babbler with Biennial abundance rate of (1.02), Egyptian Vulture (1.54), Crow Phesant (1.64), Purple Sunbird (1.78), Spotted Owlet (1.88) and Booted Eagle (1.82). **(Tab. 2)**

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 610-619 | ISSN:2251-6727

Table 2: Quarterly relative abundance percentage of bird species within 500 meters of radius of cell phone tower at Shekha Jheel from Jan 2021 to Dec 2022:

S. No.	Species	Jan 2021 to March 2021	Apr 2021 to Jun 2021	Jul 2021 to Sep 2021	Oct 2021 to Dec 2021	Jan 2021 to March 2022	Apr 2021 to Jun 2022	Jul 2021 to Sep 2022	Oct 2021 to Dec 2022	Annual abundance
01	Bar-headed goose	16.48	17.36	20.50	22.74	15.55	16.54	21.74	21.44	20.48
02	White ibis	5.87	3.92	11.72	9.26	4.57	2.88	11.98	8.76	8.20
03	Indian spot-billed duck	12.24	13.68	16.48	18.06	12.68	11.68	17.84	14.22	15.25
04	Sarus crane	24.45	26.34	30.18	28.76	25.66	24.78	29.32	16.99	26.80
05	Red-breasted flycatcher	3.70	0.00	0.00	2.09	3.11	0.00	0.00	1.96	2.10
06	Black- necked stork	7.35	6.18	9.56	9.05	6.45	6.88	10.67	7.16	8.72
07	Indian Peafowl	6.92	7.33	4.41	0.00	6.46	5.58	4.88	1.29	5.88
08	Cattle Egret	1.55	3.41	2.14	0.00	0.00	2.76	2.96	0.00	2.28
09	Indian Pond-Heron	3.87	2.88	6.35	4.26	3.42	3.28	5.44	3.64	5.08
10	Black-headed Ibis	5.28	6.68	7.05	4.73	5.66	6.14	8.24	3.75	6.96
11	Black-shouldered Kite	0.00	2.24	4.16	3.86	0.00	0.00	3.66	3.10	3.18
12	Booted Eagle	1.66	2.35	0.00	0.00	0.74	1.88	0.00	0.00	1.82
13	Egyptian vulture	0.00	2.04	0.00	0.00	0.00	1.13	0.00	0.00	1.54
14	Rock Pigeon	19.56	15.93	14.88	17.22	18.32	13.27	11.33	16.49	16.36
15	House Sparrow	20.43	7.86	12.66	18.26	21.56	7.66	11.70	15.40	15.68
16	Common Myna	18.50	20.66	15.75	17.92	16.32	18.76	15.42	17.33	18.44
17	Rose Ringed Parakeet	13.00	12.58	10.18	9.36	09.86	11.16	08.53	8.95	11.65
18	Asian Koel	0.00	5.34	11.44	4.68	1.20	4.89	10.92	5.24	6.72
19	Eurasian Collared Dove	1.38	4.16	3.64	0.00	1.64	4.78	2.15	0.00	3.34
20	Red Wattled Lapwing	5.62	4.36	2.84	2.02	5.25	4.13	1.30	0.63	4.45
21	Spotted Owlet	0.00	2.74	1.12	0.00	0.00	1.76	0.58	0.00	1.66
22	Black Drongo	11.44	8.66	3.12	1.46	13.35	8.50	4.17	1.95	7.64
23	Crow Phesant	1.84	0.00	0.00	1.12	1.98	0.00	0.00	0.00	1.40
24	Red Vented Bulbul	2.78	3.86	2.94	1.64	3.14	3.69	2.76	1.18	3.62
25	Jungle Babbler	0.00	0.00	0.94	0.62	0.00	0.00	0.66	0.00	1.02
26	Purple Sunbird	1.16	2.67	0.00	0.00	0.00	1.48	0.00	0.00	1.48

Community Characteristics of Site 1: *Species Richness* was found highest in the Quarter 2nd with 23 species observed followed by Quarter 6th having 22 species, Quarter 1st, 3rd and 7th were having 21 species each. The least Species Richness was found in Quarter 4th and 8th with 19 and 18 species observed. So we can clearly depict that during the months of April, May and June there were more number of species at the Site I whereas during the months of October, November and December the Species found were least in number.

Species diversity was found highest during the months of April, May and June i.e. 4.16 for the year 2021 and 3.74 for the year 2022 followed by July, August and September i.e. 3.10 during the year 2021 and 3.16 during the year 2022. The avian diversity was found least during the months of October November and December i.e. 1.84 for the year 2021 and 1.36 for the year 2022.

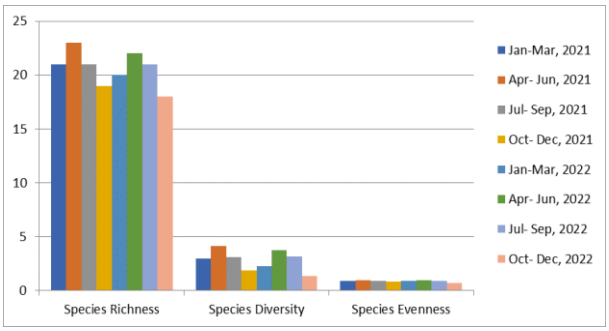
Species Evenness was found highest during the months of April, May and June with values 0.98 for the year 2021 and 0.95 for the year 2022 which was followed by July,

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(6), 610-619 | ISSN:2251-6727

August and September having values 0.90 during the year 2021 and 0.86 during the year 2022. Lowest Species Evenness was seen in the months of October November and December with values 0.84 for the year 2021 and 0.68 for the year 2022. (**Graph-1)**



Graph-1: Community Characteristics observed at Site - 1

Analysis of Biennial and Quarterly Relative abundance at Site-2 Rati Ka Nagla: During the study period (Jan. 2021 to Dec. 2022) we found a total of 13 avian species. Sarus Crane was found to be highest abundant species with biennial relative abundance percentage of (26.74), which was followed by Bar Headed Goose (20.72). Common Myna was third abundant species (20.05), then House Crow (14.24), India Spot Billed Duck (14.22), Rose Ringed Parakeet (8.18), Black Necked Stork (7.66), Rock Pigeon (6.58) and others. Among the least abundant species include Indian Peafowl with Biennial abundance rate of (4.28), Asian Koel (3.46), House Sparrow (3.62), Cattle Egret (2.26) and Eurasian Collared Dove (1.92) **(Tab. 3)**

Table 3: Quarterly relative abundance percentage of bird species within 500 meters of radius of cell phone tower at Rati Ka Nagla from Jan 2022 to Dec 2022:

S. No.	Species	Jan 2021 to March 2021	Apr 2021 to Jun 2021	Jul 2021 to Sep 2021	Oct 2021 to Dec 2021	Jan 2022 to March 2022	Apr 2022 to Jun 2022	Jul 2022 to Sep 2022	Oct 2022 to Dec 2022	Average Abundance from Jan 2021 to Dec, 2022
01	House Crow	18.56	9.60	10.26	14.42	17.75	8.54	10.58	15.32	14.24
02	Rock Pigeon	2.08	8.36	6.12	4.34	2.86	7.43	6.68	4.66	6.58
03	House Sparrow	2.18	2.38	2.84	1.22	2.96	3.43	3.18	1.68	3.62
04	Common Myna	20.72	22.24	18.48	19.65	18.65	21.59	18.88	20.16	21.12
05	Rose Ringed Parakeet	9.64	6.95	5.44	8.50	8.46	6.72	4.22	6.86	8.18
06	Asian Koel	2.92	3.88	2.12	0.86	3.18	3.92	1.54	0.00	3.46
07	Eurasian Collared Dove	1.76	1.46	0.00	0.00	2.08	1.32	0.00	0.00	1.92
08	Bar-headed goose	23.08	21.16	19.36	18.28	25.58	20.17	20.78	17.38	21.84
09	Indian spot-billed duck	9.50	11.44	13.48	15.06	8.64	13.62	16.22	16.86	14.22
10	Sarus crane	22.60	24.74	29.46	26.30	24.16	24.54	27.35	25.62	26.74
11	Black- necked stork	3.43	5.65	8.72	6.74	3.34	5.15	9.52	8.66	7.66
12	Indian Peafowl	4.65	5.02	3.56	0.00	3.72	4.68	2.54	0.36	4.28

Journal of Chemical Health Risks

www.jchr.org

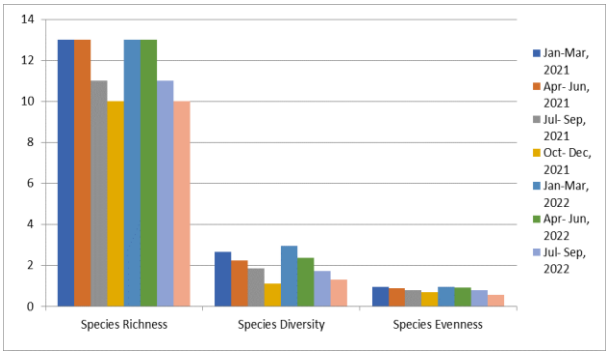
JCHR (2023) 13(6), 610-619 | ISSN:2251-6727

13	Cattle Egret	1.18	2.30	0.00	0.00	1.84	2.14	0.00	0.00	2.26

Community Characteristics of Site 2: *Species Richness* was found highest in the Quarter 1st, 2nd , 5th and 6th with 13 species each followed by Quarter 3rd and 7th having 11 species, Quarter 4th and 8th were having 10 species each. The least Species Richness was found in Quarter 4th and 8th with 19 and 18 species observed. So we can clearly depict that during the months of Jan, Feb, Mar, Apr, May and Jun there were more number of species at the Site II whereas during the months of October, November and December the species found were least in number.

Species diversity was found highest during the months of Jan, Feb and Mar, i.e. 2.86 for the year 2021 and 2.96 for the year 2022 followed by Apr, May and Jun i.e. 2.24 during the year 2021 and 2.28 during the year 2022. The avian diversity was found least during the months of October November and December i.e. 1.12 for the year 2021 and 1.06 for the year 2022.

Species Evenness was found highest during the months of Jan, Feb and Mar with values 0.94 for the year 2021 and 0.96 for the year 2022 which was followed by July, August and September having values 0.80 during the year 2021 and 0.78 during the year 2022. Lowest Species Evenness was seen in the months of October, November and December with values 0.68 for the year 2021 and 0.56 for the year 2022. (**Graph-2)**



Graph 2: Community Characteristics observed at Site-2

Analysis of Biennial and Quarterly Relative abundance at Site-3 Ama Khera:

During the study period (Jan. 2021 to Dec. 2022) we found a total of 19 avian species (Table 6) among which 10 were aquatic and 09 were terrestrial a similar study in Aligarh region showed 14 avian species belonging to 5 different families (Mohit et al., 2011). Sarus Crane was found to be highest abundant species with biennial relative abundance percentage of (24.84), which was followed by Bar Headed Goose (20.65). Common Myna was third abundant species (16.68), then House Crow (14.18), India Spot Billed Duck (13.62) and others. Among the least abundant include Booted Eagle with Biennial abundance rate of (1.66), Black Shouldered Kite (1.96), Pariah Kite (2.46) and Eurasian Collard Dove (2.48). **(Tab. 4)**

Table 4: Quarterly relative abundance percentage of bird species at Ama-Khera from Jan 2021 to Dec 2022

S. No.	Species	Jan 2021 to March 2021	Apr 2021 to Jun 2021	Jul 2021 to Sep 2021	Oct 2021 to Dec 2021	Jan 2022 to March 2022	Apr 2022 to Jun 2022	Jul 2022 to Sep 2022	Oct 2022 to Dec 2022	Average Abundance from Jan 2021 to Dec, 2022
01	House Crow	17.56	9.20	10.76	14.84	18.34	8.44	11.33	13.68	14.18
02	Rock Pigeon	2.08	6.36	4.12	3.34	2.16	6.88	5.14	2.15	5.25
03	House Sparrow	2.18	2.38	2.84	1.22	3.34	2.32	2.18	1.84	3.30
04	Common Myna	18.72	16.44	14.88	12.94	17.65	15.35	15.96	13.76	16.58
05	Pariah Kite	1.12	2.84	1.98	0.00	1.76	2.18	2.38	0.68	2.46
06	Rose Ringed Parakeet	11.64	9.95	7.44	8.58	10.22	10.28	8.66	7.74	10.48

Journal of Chemical Health Risks

www.jchr.org

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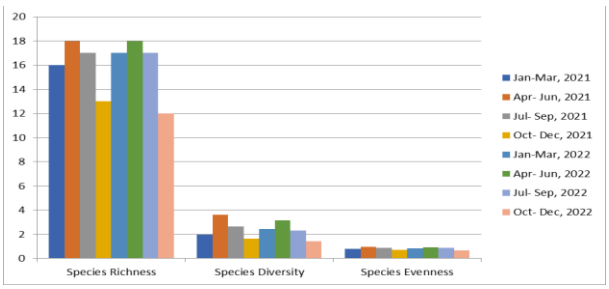
S. No.	Species	Jan 2021 to March 2021	Apr 2021 to Jun 2021	Jul 2021 to Sep 2021	Oct 2021 to Dec 2021	Jan 2022 to March 2022	Apr 2022 to Jun 2022	Jul 2022 to Sep 2022	Oct 2022 to Dec 2022	Average Abundance from Jan 2021 to Dec, 2022
07	Asian Koel	2.92	3.88	2.12	0.00	2.76	2.73	2.10	0.00	3.14
08	Eurasian Collared Dove	2.86	1.44	0.00	0.60	2.98	1.86	0.66	0.00	2.48
09	Bar-headed goose	16.34	18.12	21.55	22.11	17.36	16.76	20.87	21.90	20.65
10	White ibis	5.45	4.16	12.26	9.64	4.56	4.85	10.32	9.10	8.74
11	Indian spot-billed duck	9.16	11.33	15.25	16.42	8.54	10.10	13.96	14.88	13.62
12	Sarus crane	21.36	22.46	26.80	24.64	22.16	22.94	25.66	23.00	24.82
13	Booted Eagle	0.00	1.68	0.00	0.00	0.25	1.76	0.00	0.00	1.66
14	Black- necked stork	6.18	4.76	9.22	8.16	6.86	5.42	8.14	7.20	7.90
15	Indian Peafowl	4.06	5.24	2.86	0.00	4.84	5.88	2.06	0.00	4.36
16	Cattle Egret	3.12	2.36	0.76	0.00	2.18	2.76	0.00	0.00	2.58
17	Indian Pond-Heron	0.00	2.86	3.22	0.00	0.00	2.85	2.54	0.00	2.75
18	Black-headed Ibis	3.46	4.12	6.04	3.10	2.68	3.82	2.58	0.00	4.46
19	Black-shouldered Kite	0.00	0.00	2.44	1.78	0.00	0.00	1.88	0.96	1.96

Community Characteristics of Site 3: *Species Richness* was found highest in the Quarter 2nd and 6th with 18 species each which was followed by Quarter 3rd, 5th and 7th having 17 species each. Quarter 1st was having 16 species. The least Species Richness was found in Quarter 4th and 8th with 13 and 12 species observed. So we can clearly depict that during the months of April, May and June there were more number of species at the Site I whereas during the months of October, November and December the Species found were least in number.

Species diversity was found highest during the months of April, May and June i.e. 3.62 for the year 2021 and 3.14 for the year 2022 followed by July, August and September i.e. 2.65 during the year 2021 and 2.32 during the year 2022. The avian diversity was found least during the months of October November and December i.e. 1.64 for the year 2021 and 1.42 for the year 2022.

Species Evenness was found highest during the months of April, May and June with values 0.94 for the year 2021 and 0.92 for the year 2022 which was followed by July, August and September having values 0.88 during the year 2021 and 0.82 during the year 2022. Lowest Species Evenness was seen in the months of October November and December with values 0.72 for the year 2021 and 0.66 for the year 2022. (**Graph-3)**



Graph 3: Community Characteristics observed at Site-3

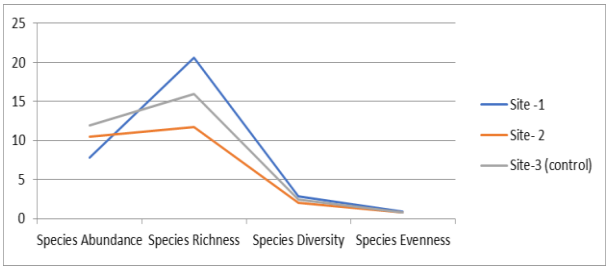
Journal of Chemical Health Risks
www.jchr.org
JCHR (2023) 13(6), 610-619 | ISSN:2251-6727

4. Discussion

The Wetland landscape comprise of three main wetlands in the area under study among which Site-1 (Sheekha Jheel) is also regarded as Birds Sanctuary but it was noticed that the other two wetlands serve no less support to accommodate the avifauna. While performing a comparative analysis of species abundance, diversity, richness and evenness among the three sites under study it was observed that although we considered area with strong EMR at Site I but it offered the highest number of species with diversity and evenness also higher than the other two sites. The species abundance was found highest at Site-3 (control site). From such result it is analyzed that the effect of Electromagnetic radiations seemed to be minimal on the avifaunal diversity at Site I and a similar study conducted in Punjab and Bijapur district of Uttar Pradesh enumerated a declined in abundance and richness of bird's species in the areas lying in close proximity to the communication towers (Durgam et al. 2017) But the results of present study are contradictory that may be due to the high vegetation cover in the area, also it's a conserved area where people and vehicular movement is restricted, though accounting reduction in pollution levels in comparison to other sites. Moreover the birds observed at the location are not restricted to this area only and as such were not under the continuous exposure of Electromagnetic radiations. **(Tab. 5)**

Table 5: Comparative analysis of average relative abundance, richness, diversity and evenness of avian species at three Sites from January 2021 to December 2022:

Community Characteristics	Site -1	Site- 2	Site-3 (control)
Species Abundance	7.79	10.47	11.96
Species Richness	26	13	19
Species Diversity	2.82	2.02	2.40
Species Evenness	0.86	0.81	0.82



Graph-4 Comparative analyses of average relative abundance, richness, diversity and evenness of avian species at three Sites from January 2021 to December 2022:

During an analysis on the behavioral characteristics of the species at all the Sites (Table 7) under study it was assessed that nesting, breeding and feeding activities of some birds were distorted at Site 3 whereas at Site 1 it was normal. We observed some nests closely and carefully and noticed a normal incubation rate of 10-15 days with hatching success of approximately 90% at Site-1. Around 0.5% of the Fledgling were visualized with lack in flight feathers whereas some Juvenile showed sleepy and dilating body at Sites with strong Electromagnetic radiations. Some similar study also reported the detrimental effect of microwaves on the productivity of white storks (Balmori, 2005). It's also reported radiofrequency pollution is a potential source of declining animals and bird's population (Balmori, 2006; Salmart and Hallberg, 2007). At Sites 1 and 2 aggressiveness and feather fluffing was enhanced in some birds, some birds were observed with sleepy and dilating eyes with distorted postures, along with difficulty in perch balancing clearly indicating serious health issues whereas at Site 3 control Site all such activities observed were normal. The migration rate at all the sites was declined that indicates a serious concern even at locations without cell phone towers. **(Tab. 6)**

Table 6: Comparative analysis of behavioral patterns observed at three sites:

Behavioral Patterns	Site-1	Site-2	Site-3
Nesting activities	Normal	Normal	Normal
Breeding rate	Normal	Distorted	Normal
Feeding rate	Normal	Distorted	Normal
Migration	Distorted	Distorted	Distorted

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Aggressive behavior	Observed	Observed	Not observed
Biting	Enhanced	Enhanced	Normal
Feather fluffing	Enhanced	Enhanced plucking	Normal plucking
Eyes & body positions	Sleepy	Sleepy& dilating	Normal
Regurgitation	Proper as usual	Enhanced	Proper as usual
Perch balancing	Highly difficult	With difficulty	Normal as usual

5. 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 more worse for the sustenance of birds specifically at locations where air, water, soil and noise pollution levels was high. Studies on impact of Cell phone tower radiation on birds and wildlife in natural conditions are almost nonexistent in India although some laboratory and specimen species studies are there. During study we found that electromagnetic radiations from the cell phone towers not only impacted the diversity and migration in birds but also altered their physiological and behavioral conditions hence posing a great threat to avifaunal biodiversity.

List of Abbreviations: EMR-Electromagnetic Radiations, RF- Radio frequency, Km- Kilometer, m-Meter

Declaration:

Ethics approval and consent to participate - Not applicable

Consent for publication – This study was conducted in natural conditions. No organism was harmed or disturbed during the field work.

Availability of data and material - All data generated or analyzed during this study are included in this article.

Competing interests - Authors declare no conflict of interest.

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