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ResearchArticle

The Influence of Cellular Electromagnetic Radiation on House Sparrow (Passer domesticus) Survival and Breeding Behavior in Jangareddigudem, India

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Abstract

Electronic devices emit electromagnetic radiation, and this study, conducted over four years from 2019 to 2022, investigates the impact of electromagnetic radiation on the survival and breeding behavior of House Sparrows (Passer domesticus) in Jangareddigudem, India. Nest boxes were provided as artificial habitat, and the strength of the electromagnetic field was measured at varying distances from cellular antennae. The results show that there is no significant difference in survival and breeding success among House Sparrows in areas with different levels of electromagnetic radiation.

Keywords: Electromagnetic radiation, House Sparrow, nest boxes, conservation, survival, breeding

Introduction

In our daily lives, various electronic devices emit low levels of electromagnetic radiation (EMR), primarily in the frequency range of 300 Hz to 10 MHz. While radio and television transmitters emit frequencies around 10 MHz, cellular antennae using GSM and CDMA technologies generate EMR in the ranges of 935 to 960 MHz and 1,810 to 1,880 MHz, respectively (Dhami 2020). The proliferation of cellular phone towers has raised concerns about the potential impact of non-ionizing EMR on wildlife, particularly bird species.

Birds, due to their higher surface area-to-body weight ratio and lower body fluid content, are more susceptible

to radiation absorption, potentially leading to rapid body heating. Research has indicated that non-ionizing EMR can disrupt bird navigation, cause disorientation, and even lead to bird fatalities from collisions with telecom masts (Centre for Science & Environment 2012).

The House Sparrow (*Passer domesticus*), a globally distributed bird species, has faced population declines due to various factors, including habitat loss, pesticides, pollution, and electromagnetic smog (Virendra& Kishore 2015). Observational studies have reported coordination and reproductive issues, as well as aggressive behavior, in sparrows exposed to EMF (Balmori 2009). Similar findings have been observed in various regions of India, including Bhopal, Nagpur, Jabalpur, Ujjain, Gwalior, Chhindwara, Indore, and Betal (Dongre&Verma 2009).

India, with its rich avian biodiversity hosting approximately 12% of all bird species, has seen declines in avian populations due to factors like climate change, habitat loss, pollution, and electromagnetic radiation (Kumar 2010, Dongre&Verma 2009, Durgam et al. 2017). Observational studies have reported damage to House Sparrow embryos when exposed to EMR, as well as population declines in multiple bird species (Kumar 2010, Durgam et al. 2017).

While existing research on the impact of EMR on bird survival and breeding behavior has yielded mixed results, this study aims to assess whether there is a significant difference in the survival and breeding success of House Sparrows in three zones located at different distances from cellular towers in Jangareddigudem, India.

Hypothesis:

H0: Electromagnetic radiation emitted by cellular phone towers has no significant effect on the survival and breeding success of House Sparrows in the three studied zones.

Ha: Electromagnetic radiation emitted by cellular phone towers significantly affects the survival and breeding success of House Sparrows in the three studied zones.

Methodology:

Study Area, Cellular Towers, and Nest Box Selection:

Jangareddigudem, located in West Godavari District, Andhra Pradesh, India, served as the study area. It features multiple cellular antenna towers, including one belonging to Bharat Sanchar Nigam Limited (BSNL) and another at Rajula colony operated by BSNL, Airtel, and Jio. Nest boxes were installed within various distances from these towers. Thirty nest boxes were randomly selected from each of the three zones: within 200 m, between 200 and 500 m, and beyond 500 m from the cellular towers.

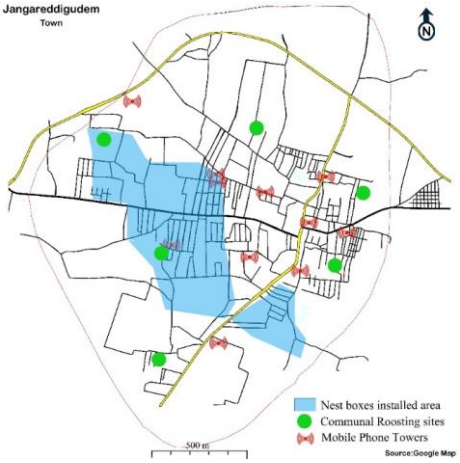

Fig: 1. Map of the study area showing nest boxes installed, communal roosting sites and cellular antennae.

Strength of the Electromagnetic Field:

The strength of the electromagnetic field was measured using an Electromagnetic Radiation Tester (Kkmoon JVW0869076962769CG-EMF Meter Radiation Monitor) in Volts per meter (V/m).

House Sparrow Census:

Census of House Sparrows was conducted quarterly over four years (2019-2022) using the line transect method. Observations were made in the months of February, June, and October to assess seasonal variations in population and study the effects of EMR on survival and breeding behavior.

Breeding Success at Each Nest Box:

Breeding success was determined by monitoring the number of nestlings fledged from the total number of eggs laid in each breeding attempt.

Fig:2. Installed nests

Fig:3. Measuring strength of EMR at Rajula colony cellular antennae

Results:

The study assessed the impact of Electromagnetic Radiation (EMR) on House Sparrows in the presence of cellular antenna towers. EMR strength decreased with increasing distance from the towers. However, there was no significant difference in the occupancy of nest boxes or the breeding activity of sparrows across the three zones. ANOVA analysis confirmed that EMR did not significantly affect the sparrows' survival and breeding success.

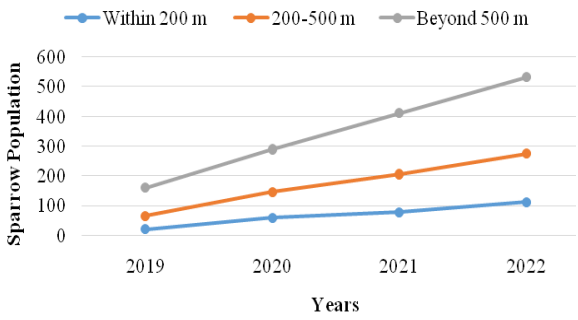

Fig:4. Zone wise population growth of House Sparrow near cellular towers in Jangareddigudem.

Discussion:

While previous studies have suggested a negative impact of EMR on avian populations, including House Sparrows, the results of this study align with research showing no clear scientific evidence linking EMR to the decline of sparrows. Factors such as habitat loss and decreased food availability have likely played a more significant role in sparrow population declines. The abundance of House Sparrows appears to depend on ecological conditions, including habitat structure and vegetation.

As per the observational studies conducted by Bhattacharya and Roy (2014), varying energydensity of electromagnetic radiation is inversely correlated with the numbers of birds.

Table 1. Details of cellular antenna towers located in the study area.

Type of antenna tower	BSNL tower	Rajula colony tower
Location	College road	Rajula colony
Number of Antennae	6	12
Operator	BSNL	BSNL, Airtel &Jio
Type (GSM/CDMA)	GSM	GSM
Frequency released (MHz)	900–2100 MHz	900–2100 MHz
Year of establishment	2002	2014
Number of Nests within 200 m	11	26
Number of Nests from 200–500 m	24	35
Number of Nests beyond 500 m	100+	100+

*Table 2.*Details of average electromagnetic field in various zones near to cellular antenna towers.

	Zone	**Average Electromagnetic Field**
1	Within 200m radius	12 V/m
2	200-500 m radius zone	6.5 V/m
3	Beyond 500 m radius zone	2 V/m

*Table 3.*House Sparrow population growth reflecting breeding success within the three zones in a four year period (2019 -2022)

	Year	**2019**	**2020**	**2021**	**2022**
Zones	Within 200 m	21	59	78	112
	200–500 m	44	87	128	163
	Beyond 500 m	95	143	206	257

*Table 4.*Analysis of Variance (ANOVA) to study the effect of EMR on survival and breeding behaviour of Sparrows.

Level of Distance from Cellular Antennae towers	**N**	**Breeding Success**	
		Mean	**Std Deviation**
Within 200m	30	72.5333333	15.7342879
Between 200 –500 m	30	73.0666667	20.1647239
Beyond 500 m	30	71.0666667	16.2521793

A total of three bird species nests were observed, namely House Sparrow, Jungle babbler (*Turdoidesstriata*)and Tailor bird (*Orthotomussutorius*).

However, such variation was not seen in observational research in the study area along with House Sparrow.However, in addition to the House Sparrow, that variation was not found in observational research carried out within the study region.

Electromagnetic signals have direct or indirect impact on the House Sparrow density. Many observational studies in India endorsed negative impact of EMR on several avian communities resulting in their decline (Dhami 2020). The observational studies by Balmori (2021) in Kalmeswar (India) showed a negative relationship between House sparrow density and distance from cellular antenna. The bird density was less in the habitats nearer to the cellular antennae and vice versa. Nesting, breeding, hatching of White Stroks (*Ciconiaciconia*) significantly reduced in the areas which were near to the cellular tower antennae (Balmori, 2009). The author has studied the impact of EM radiation on the reproduction of White storks during the spring season. In his observational studies, he studied the reproduction of the storks by observing the nests that were placed within 200 meters from radiation antennas and the nests that were placed farther than 300 meters. From the studies, he concluded that EM radiation affected the reproduction of the 40% nests as was indicated by absence of chicks and it was only 3.3% in nests placed farther than 300 meters away from antennas.

Fernie and Reynolds (2005) in their review article opined that overall decline in bird population could be due to the effect of radiation released from cellular phone tower stations on reproductive success of birds. Another study also reported the negative effect of EMR on reproductive success of *Falco sparverius* (kestrels). The study reported a reduction in hatching success though there is an increase in fertility and fledging success (Balmori 2009). But in our study we did not find any influence of electromagnetic radiation on reproductive success of House Sparrows.

In addition to avian species, animals too faced threats with EM radiation like- still births, fetal mortality, disfigurement births, behavioural changes, and other health hazards (Durgam*et al.,* 2017). Batellier et al. (2008) studied the effect of exposing eggs of a chicken to radiations emitted by a mobile phone in "call" during the entire period of incubation and concluded that pulsed magnetic fields released from cell phones can cause significant changes in the development and occurrence of various abnormalities in chicken embryos. This could be due to stressed immune system that in turn may increase the susceptibility of a bird to infectious diseases. The first sign of stress and illness due to exposure to EMR is discoloration and deterioration of plumage in the birds. But the effects may not be the same in all the species and depends on genetic tendency, neurological and physiologic state of the organism subjected to irradiation (Hyland, 2000; Clark, 2001; De Laet and Summers-Smith, 2007).

Though some of the studies showed the negative impacts of EMR on House Sparrows, there were no clear cut scientific proofs pertaining to their impact on absence/decline of sparrows. Because sparrow decline was reported much and much before to the usage of cellular phones and of the establishment

of cellular towers. If radiation is the real culprit for disappearance of sparrows, why pigeons are densely distributed in the cities? So, one cannot completely blame EMR for bird population decline. The contribution of other factors like habitat loss and decreased availability of food resources were found to be the predominant causes. There were also studies which showed no significant ill effect of EMR on the survival of House Sparrow. Nath et al. (2022) observed that the EMR frequency ranging between 3.7 to 5.2 volts/meter doesn't show any critical observable impacts on the fertility in House Sparrow.

Our results are also on par with the studies of Nath et al. (2022). The authors have studied the effect of EMR on the abundance of House Sparrow, and concluded that EMR doesn't show any significant effect. They explained that the abundance of House Sparrow in a particular habitat mainly depends on the ecological conditions of that habitat.

Balmori (2021) opined that the correlation between abundance of House Sparrow and the EMR frequency does not show any interconnection. He also opined that the factors like habitat structure and vegetation also do have possible effect on density of House Sparrow in addition to the EMR

Conclusion

In conclusion, this study has found no significant effects of electromagnetic radiation emitted by cellular towers on the survival and breeding behavior of House Sparrows in Jangareddigudem, India. Further research may be needed to better understand the complex interactions between EMR and bird species in different ecological contexts.

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