Impacts of Communication Towers on Avians: A Review

¹R. Bhattacharya, ²R. Roy

^{1,2}Dept. of Environmental Science, University of Kalyani, Kalyani, India

Abstract

Birds are powerful indicator of an ecosystem because of their thin skull, feathers as dielectric receptor, high mobility and use of areas having high electromagnetic field. Among the total publications on the impact of electromagnetic radiation on living beings, only 3% are on birds. Both positive and negative results are reported regarding the biological responses of birds exposed to electromagnetic fields from communication towers. This review highlights the researches on the potential impact of electromagnetic field radiation on avians. However an uncertainty exists due to small number of investigations and possible biological effects arise from electromagnetic field exposure are inconclusive.

Keywords

Communication Tower, Electromagnetic Field, Avians, Dielectric Receptor

I. Introduction

Rapid development of telecommunication devices in last decade has caused enhancement of human interference with nature. As a result undesirable impacts are noticed on biological, physical and ecological systems. At present 20% of global mobile users are Indians. To combat the need of mobile connection huge number of mobile towers is installed in urban and rural areas. The unseen electromagnetic radiation emitted from the mobile towers, transmission lines and power lines induces undesirable impact on living beings in a multiple ways causing pollution known as electromagnetic smog. We are all surrounded by this newly identified pollution.

First non commercial telephone service was launched in 1995 in India. Before 1990 global use of mobile handsets was a few. But in India the increase in number of mobile users are so rapid that India is in second position in world as mobile subscriber. GSM base stations emit EM radiation at 900MHz and 1800 MHz down link frequencies and pulse modulated low frequency [1-2]. The power density at a distance of 50m, 100m and 150m are respectively $10\mu\text{W/cm}^2$, $1\mu\text{W/cm}^2$ and $0.1\mu\text{W/cm}^2$.

Like power density electric and magnetic fields are high near the base station and diminishes sharply with distance. fig. 1 shows the exposure limit of different countries. It evident from the figure that the exposure limits of India is very high in comparison to many countries.

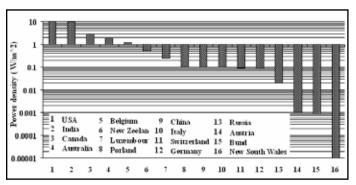


Fig. 1: EMF Exposure Limits of Different Countries [Kumar, 2010]

Among 7000 publications about the potential impacts of EMF from communication systems and power lines, 80% are related to human health hazard. Only 3% are related to birds where both negative (80%) and positive (20%) results are reported. However birds are good monitor of an ecosystem because of their thin skull, high mobility, frequent use of high electromagnetic areas, feathers as dielectric receptors and absence of psychosomatic effects. Penetration of microwaves is greater for birds.

Electromagnetic field exposure is transient in nature but may induced serious hazards during breeding season. Changes of incubation may adversely affect reproductive success [3]. Mixed opinion exists regarding the reproductive success for birds nesting on transmission towers [4]. In UK a decline of urban birds are noticed in the area having high level of EM radiation which is correlated with the increasing number of cell towers. More observations are essential in the vicinity of cell sites. Declination of sparrow population in urban habitat is reported from various locations in India [5-8]. This review is an attempt to get information from different studies all over the world on the impact of EM radiation on avian community.

II. Electromagnetic Field and Avian

Important findings of the researches of the electromagnetic field effects on birds over the globe are summarized in Table 1. Impacts of EM field on avian biology were started after 1960 when declination of different bird species is noticed over the globe in different habitants.

Table 1: Summary of Works on the Influence of EMF on Birds

Investigation	References
Microwave radiation (147 MHz) have an effect on the nervous system of birds depending on the depth of penetration	Tanner, [9]
Chicks exposed to 20 - 50 mW/ sq.cm microwave respond within a few second after onset of radiation	Tanner et al., [10]
EM radiation (9300 MHz) influences equally both on flying and caging birds	Romero et al., [11]
Stabilizing period of the egg production in birds are affected by EM radiation as reported by National Research Centre, Canada. Feather of birds act as a dielectric receptor in the 10 - to 16 - GHz region.	Bigu and Romero, [12]
Productivity of Ferruginous Hawks nesting on 230 kV transmission line have changed in the vicinity but the result is non significant.	Gilmer and Wieche, [4]
Bird species diversity decreased due to transmission line (50 - 60 Hz) corridor	Anderson, [13]

Some studies reflect that birds responded to environmental changes rather than EMF produced by antenna	Rogers et al., [14]
Habitat change caused by transmission corridor of 500 kV and 161 kV power line affects species densities. 36% of the replacement species are migratory	Kroodsma, [15]; Niemi and Hanowski, [16]
Microwave radiation (2.45 GHz) may change avian dominance behavior. Irradiated birds maintained their positions but some appeared to have change their aggression level exposed with 2.45 GHz microwave	Wasserman et al., [17] Wasserman et al., [17]
The tolerance of the bird increases with its body mass when exposed to continuous microwave radiation of 2.45 GHz	Byman et al., [18]
Some birds can detect slight change of magnetic field ~ 200nT and 0.5Hz	Semm and Beasom, [19]
Reproductive success of tree swallow using nest box under the 765 kV,60Hz transmission line shows negative trend while no change is recorded for blue birds and house wren	Doherty and Grubb, [20]
Short term exposure of mobile phone radiation (900 MHz) caused 50% to 60% reduction of insect productivity which is believed to be one of the cases of decline of sparrow in urban areas	Panagopoulos et al., [21]
Microwaves (1 MHz to 3 GHz) may interfere the productivity of white storks. Urban birds are more susceptible to higher risk from EM radiation	Balmori, [22]
Sparrows like to avoid transmission lines. Disappearance of sparrow from urban areas and installation of GSM towers (GSM 900 MHz and DCS 1800 MHz) are interrelated	Balmori, [23]
Malformation chicken embryos was found when exposed to magnetic field(GSM 900 MHz and DCS 1800 MHz)	Balmori and Hallberg, [23]
House sparrow males population is reacted negatively with the intensity of electric field from GSM mobile base stations having 900 MHz and 1800 MHz down link bands	Everaert and Bauwens, [24]
Sparrow population is decreased from areas having cell phone towers with 900 to 1900MHz down link frequency in India	Dongre and Verma, [25]
The eggs of house sparrow irradiated with EMR(900GHz) for 5–30 minutes are damaged	Kumar, [26]

III. Conclusion

An uncertainty exists on the effects of EMR exposure on birds due to lack of studies. Most studies indicate the possibilities of the changes in the behaviour, physiology, breeding success and mortality. Therefore many questions are still remained unanswered and investigations should be continued on the following points. During transportation and distribution of electricity the magnitude of EMF intensity varies with time. The effects of EMF exposure may be examined in light of multiple intensities.

Bird species which are not sensitive to EM field with respect to breeding success but they may have different physiological response to EMF.

Research should be directed to identify the mechanisms involved in the change of egg size and growth if any under the influence of EMF.

The possible biological effects of electromagnetic fields on avian biology are inconclusive. There are ample scopes of research regarding the physiological and reproductive systems of free birds exposed to long term EMF. Moreover the influence of EMF with other environmental factors on birds may provide important information for conservation of birds.

IV. Acknowledgement

Authors are thankful to all the researchers whose published works are utilized in this review.

References

- [1] Hyland GJ.,"Physics and biology of mobile telephony", The Lancet, 2000, 356, pp. 1833-1836.
- [2] Navarro EA, Segura J, Portolés M, Gómez-Perretta de Mateo C.,"The microwave syndrome: a preliminary study in Spain", Electromagnetic biology and medicine, 2003, 22, pp. 161–

169.

- [3] Fernie KJ, Bird DM, Dawson RD, Lague PC,"Effects of electromagnetic fields on the reproductive success of American kestrels", Physiol. Biochem. Zool., 2000, 73 (1), pp. 60–65.
- [4] Gilmer DS, Wiehe JM.,"Nesting by ferruginous hawks and other raptors in high voltage power line towers", Prairie Naturalist, 1977, 9, pp. 1–10.
- [5] Rajashekar S, Venkatesha MG.,"Occurrence of house sparrow Passer domesticus indicus in and around Bangalore", Curr. Sci., 2008; 94, pp. 446-449.
- [6] Shaw LM, Chamberlain D, Evans M.,"The house sparrow Passer domesticus in urban areas: Reviewing a possible link between post decline distribution and human socioeconomic status. J. Orinthol., 2008, 149, pp. 293-299.
- [7] Khera N, Das A, Srivastava S, Jain S.,"Habitat-wise distribution of the House Sparrow (Passer domesticus) in Delhi, India", Urban Ecosyst, 2010, 13, pp. 147-154.
- [8] Bhattacharya R, Roy R, Goswami C.,"Studies on the response of house sparrows to artificial nest", Int. J. Env. Sc., 2011, 1(7), pp. 1574-1581.
- [9] Tanner JA,"Effect of microwave radiation on birds", Nature, 1966, 210, pp. 636.
- [10] Tanner JA, Romero-Sierra C, Davie SJ., "Non-thermal effects of microwave radiation on birds", Nature, 1967, 216, pp. 1139.
- [11] Romero-Sierra C., Husband C., Tanner J.A.,"Effects of microwave radiation on Parakeets in flight", Ottowa: Control Systems Laboratory, 1969.
- [12] Bigu-del-Blanco J, Romero-Sierra C.,"The properties of bird feathers as converse piezoelectric transducers and as receptors of microwave radiation", II. Bird feathers as

- dielectric receptors of microwave radiation. Biotelemetry, 1975, 2, pp. 354-364.
- [13] Andersosn H., "Changesin forest bird species composition caused by transmission-line corridor cuts", Amer. Birds, 1979, 33, pp. 3-6.
- [14] Rogers LE, Warren JL, Hinds NR, Gano KA, "Fitzen RE, Pipel GF. Environmental studies of a 1100 KV prototype transmission line: Annual report for the 1980 study period", Battelle Pacific North west laboratories, Oregon, 1981.
- [15] Kroodsma RL., "Edge effect on breeding birds along a powerline corridor", J. Applied Ecology, 1982, 19, pp. 361-370.
- [16] Niemi GJ, Hanowski JM., "Effects of a transmission line on bird populations in the Red Land Peatiand", Northern Minnesota. Auk. 1984, 101, pp. 487.
- [17] Wasserman FE, Dowd C, Schlinger BA, Byman D, Battista SP, Kunz TH., "The effects of microwave radiation on avian dominance behavior", Bioelectromagnetics, 1984, 5, pp. 331-
- [18] Byman D, Demetri EP, Wasserman FE, Battista SP, Kunz TH., "Thermal modelling of small birds exposed to microwave radiation (2• 45 GHz CW)", J. Applied Ecology, 1986, 23, pp. 449–459.
- [19] Semm P, Beasom RC., "Responses to small magnetic variations by the trigeminal system at the Babolink", Brain Res. Bull., 1990, 25, pp. 735-740.
- [20] Doherty PF, Grubb TC., "Effects of high-voltage power lines on birds breeding within the power lines electromagnetic fields", Sialia, 1996, 18(4), pp. 129-134.
- [21] Panagopoulos DJ, Karabarbounis A, Margaritis LH., "Effect of GSM 900-MHz mobile phone radiation on the reproductive capacity of Drosophila melanogaster", Electromagn. Biol. Med., 2004, 23, pp. 29-43.
- [22] Balmori A., "Possible effects of electromagnetic fields from phone masts on a population of White Stork (Ciconia ciconia)",. Electromagn. Biol. Med., 2005, 24, pp. 109-119.
- [23] Balmori A, Hallberg Ö., "The urban decline of the house sparrow (Passer domesticus): A possible link with electromagnetic radiation", Electromagn. Biol.Med., 2007, 26, pp. 141–151.
- [24] Everaert J, Bauwens D., "A Possible Effect of Electromagnetic Radiation from Mobile Phone Base Stations on the Number of Breeding House Sparrows (Passer domesticus) Electromagnetic Biology and Medicine", 2007, 26, pp. 63-
- [25] Dongre SD, Verma RG., "Effect of cell phone radiation on Gauriya sparrow Passer domesticus", Int. Res. J., 2009, 2 (7), pp. 51-52.
- [26] Kumar G., "Report on cell tower radiation", DOT, Delhi, December, 2010.