



Electrosmog and species conservation



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HIGHLIGHTS

- Studies have shown effects in both animals and plants.
- Two thirds of the studies reported ecological effects.
- There is little research in this area and further research is needed.
- The technology must be safe.
- Controls should be introduced to mitigate the possible effects.

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ABSTRACT

Despite the widespread use of wireless telephone networks around the world, authorities and researchers have paid little attention to the potential harmful effects of mobile phone radiation on wildlife. This paper briefly reviews the available scientific information on this topic and recommends further studies and specific lines of research to confirm or refute the experimental results to date. Controls must be introduced and technology rendered safe for the environment, particularly, threatened species.

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1. Introduction

Since the introduction of wireless telecommunication in the 1990s, the roll-out of mobile phone networks has led to a massive increase in environmental exposure to electromagnetic radiation (Levitt and Lai, 2010). The existing standards of public health protection only consider the effects of short-term thermal exposure; however, biological effects resulting from electromagnetic radiation might depend on dosage, including long-term chronic effects, and there is considerable experimental evidence for non-thermal biological effects (Hyland, 2000).

Researchers have also paid little attention to the potential harmful effects of microwaves from mobile phone mast radiation on wildlife. In about two thirds of the reviewed studies ecological effects of RF-EMF were reported, at high as well as at low dosages, linking the hazards with different modes and extents of exposure (Cucurachi et al., 2013). Although the species conservation implications are unclear, current evidence indicates that chronic exposure to electromagnetic radiation, at levels that are found in the environment, may

particularly affect the immune, nervous, cardiovascular and reproductive systems (Balmori, 2009). Animals exposed to radiation emissions from nearby antennas may suffer changes in the enzyme activities that disappear when they are moved away from the source (Hässig et al., 2014), and underlying plausible explanations at the cellular level have been proposed in the findings (Pall, 2013).

There are now calls for action from government agencies, both in the U.S. and Europe. In the U.S. the Director of the Office of Environmental Policy and Compliance of the United States Department of the Interior sent a letter (Feb, 2014) to the National Telecommunications and Information Administration in the Department of Commerce which addressed the Interior Department's concern about the negative impact of cell tower radiation on the health of migratory birds and other wildlife. The Interior Department accused the Federal government of employing outdated radiation standards set by the Federal Communications Commission (FCC) (United States Department of the Interior, 2014). The European Environment Agency states: «Independent research into the many unknowns about the biological and ecological effects of RF are urgently needed, given the global exposure of over 5 billion people and many other species, especially those, like bees and some birds whose navigation systems are possibly being affected

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by such radiations and effects on breeding of wild birds» (European Environment Agency, 2013).

The following are some of the potential effects of anthropogenic electromagnetic radiation on wildlife:

1.1. Effects on behaviour and navigation

Insects and birds are extremely sensitive to electromagnetic fields. Insects use several senses to forage, detecting visual cues such as colour, shape, etc., but also floral electric fields can be discriminated by bumblebees and this sensory modality may facilitate rapid and dynamic communication between flowers and their pollinators (Clarke et al., 2013). In an electric field of about 1 V/m, the microwaves may have a disastrous impact on a wide range of insects using olfactory and/or visual memory (i.e., on bees and ants). This experimentally generated electromagnetic field had a realistic (and even lower) power intensity than those usually encountered by living organisms near phone masts (Cammaerts et al., 2012), and, for this reason, the insects can be used as bioindicators to reveal biological effects from some wireless apparatus (Cammaerts and Johansson, 2013). The audiograms and spectrograms revealed that active mobile phone handsets had a dramatic impact on the behaviour of the bees, namely, by inducing the worker piping signal (in natural conditions, worker piping either announces the swarming process of the bee colony or is a signal of a disturbed bee colony) (Favre, 2011). The migratory birds (*Erithacus rubecula*) are also unable to use their magnetic compass in the presence of urban electromagnetic noise and fully double-blinded tests document a reproducible effect of anthropogenic electromagnetic noise on birds (Engels et al., 2014).

1.2. Effects on distribution and habitat loss

A possible effect of long-term exposure to low-intensity electromagnetic radiation from mobile phone base stations on the number of house sparrows (*Passer domesticus*) was studied in Belgium and Spain and both studies reached the same conclusion: fewer house sparrows were seen at locations where electric fields were stronger (Everaert and Bauwens, 2007; Balmori and Hallberg, 2007). In large cities, such as London, a huge decline in some house sparrow populations has been found in the last 15–20 years (De Laet and Summers-Smith, 2007), so the possible relationship between this decrease and the proliferation and increase in electromagnetic radiation as one of several factors at play should be thoroughly investigated. In a study looking at factors associated with extirpation of sage-grouse (*Centrocercus* sp.), of the five variables most associated with extirpated and occupied ranges, one was the distance to base stations, and this strong association was an especially interesting result (Wisdom et al., 2011). Bat activity is also significantly reduced in habitats exposed to electromagnetic radiation, which elicit an aversive behavioural response and can be used as a possible method of discouraging bats from approaching wind turbines to prevent fatalities (Nicholls and Racey, 2007, 2009).

1.3. Reproduction effects and recruitment reduction

In several research conducted with different animal groups, the exposure to microwave radiations from mobile phone (GSM) base stations caused sperm head abnormalities in mammals, and the radiation from a mobile phone decreased the ovarian development in insects, the amino acid composition changed and the DNA was damaged (Otitoloju et al., 2010; Lu et al., 2010; Panagopoulos, 2012). However, other studies have not found effects on the reproductive capacity of invertebrates exposed to such radiation (Vijver et al., 2013). There are some scientific views that deny any evidence or possibility of effects on human reproduction (Lerchl, 2013), which goes against most of what has been published on this topic (Adams et al., 2014).

In the vicinity of mobile phone base stations, it is possible that microwaves are interfering with the reproduction of birds such as storks and may affect the development and increase the mortality rate of exposed amphibians (Balmori, 2005, 2010). For instance, in chicken eggs exposed over the entire incubation period in laboratory, a significantly higher percentage of embryo mortality was observed (Batellier et al., 2008), although other studies have shown lack of adverse effects of this radiation on rat fetuses (Takahashi et al., 2009).

1.4. Adverse influence of radio-frequency background on trees and plants

A very limited number of studies have addressed the effects of electromagnetic radiation on plants. The findings of these studies indicate that the effects depend on the plant family, growth stage involved and the radiation characteristics, among other factors (Jayasanka and Asaeda, 2013). High-frequency electromagnetic fields alter the chlorophyll in black locust (*Robinia pseudoacacia*) seedlings and in duckweeds (*Lemna minor*) exposed (Sandu et al., 2005; Jayasanka et al., 2013). In tomato plants (*Lycopersicon esculentum*), which were exposed to low-level (5 V/m) electromagnetic fields for a short period (10 min), changes were found in the abundance of three specific mRNAs after exposure, strongly suggesting that they were the direct consequence of application of radio-frequency fields (Roux et al., 2007). The similarities of the changes to wound responses suggest that this radiation is perceived by plants as an injurious stimulus and causes them cell stress in the vicinity of radio-frequency irradiating antennas (Monselise et al., 2011). On 18 February, 2011, the first symposium on this topic, "The effect of electromagnetic radiation on trees", which presented results showing disturbing effects on trees, was held in the Netherlands (<http://www.boomaantastingen.nl/>).

2. Conclusion

At the present time, there are reasonable grounds for believing that microwave radiation constitutes an environmental and health hazard. It is necessary to open specific lines of research to confirm or refute the experimental results cited above, since similar findings were obtained in studies with cattle (Hässig et al., 2014) and humans (Khurana et al., 2010; Dode et al., 2011; Gómez-Perretta et al., 2013), although some governmental reports denied that electromagnetic radiation has adverse effects on human health (e.g. ARPANSA, 2014).

Electromagnetic radiation is among the potential pollutants with an ability to affect wildlife adversely. It is therefore a new area of enquiry deserving of immediate funding and research (Levitt and Lai, 2010). Despite its remarkable expansion in the last twenty years, the rate of scientific activity on the effects of phone masts on wildlife has been very small compared with topics like roads, power lines or wind turbines. The few studies that have been conducted address the impact of collisions (Longcore et al., 2012, 2013), but not the second significant issue associated with phone masts that involves the effects from non-ionising electromagnetic radiation (United States Department of the Interior, 2014). Concerning the exposure to electromagnetic fields, the precautionary principle is needed and should be applied to protect species from environmental non-thermal effects (Zinelis, 2010). Controls must be introduced and technology rendered safe to the environment, since this new ubiquitous and invisible pollutant could deplete the efforts devoted to species conservation.

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