Electromagnetic fields from power lines, cell phones, cell towers and wireless impacts the birds, bees, wildlife and our environment. Below is just a small example of the critical research that has been done on this issue.

“The electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today.”

- The Department of Interior in a 2014 letter on the impact of cell towers on migratory birds.

**REVIEWS OF THE SCIENCE**


- The growth of wireless telecommunication technologies causes increased electrosmog. Radio frequency fields in the MHz range disrupt insect and bird orientation.
- Radio frequency noise interferes with the primary process of magnetoreception. Existing guidelines do not adequately protect wildlife. Further research in this area is urgent.


- A Review of 113 studies from original peer-reviewed publications. RF-EMF had a significant effect on birds, insects, other vertebrates, other organisms and plants in 70% of the studies. Development and reproduction of birds and insects are the most strongly affected endpoints.


- “Conclusion: At the present time, there are reasonable grounds for believing that microwave radiation constitutes an environmental and health hazard….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.”

Manville, Albert M. “A BRIEFING MEMORANDUM: What We Know, Can Infer, and Don’t Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife.” Wildlife and Habitat Conservation Solutions, 2014.

- “In summary, we need to better understand … how to address these growing and poorly understood radiation impacts to migratory birds, bees, bats, and myriad other wildlife. At present, given industry and agency intransigence … massive amounts of money being spent to prevent addressing impacts from non-thermal radiation — not unlike the battles over tobacco and smoking — and a lack of significant, dedicated and reliable funding to advance independent field studies, … we are left with few options. Currently, other than to proceed using the precautionary approach and keep emissions as low as reasonably achievable, we are at loggerheads in advancing meaningful guidelines, policies and regulations that address non-thermal effects…”

**EKLIPSE REPORT**, an EU-funded review body dedicated to policy that may impact biodiversity and the ecosystem, looked over 97 studies on how electromagnetic radiation may affect the environment. It concluded this radiation could indeed pose a potential risk to bird orientation and plant health. EKLIPSE REPORT WEBPAGE


**Bees, Bugs And Butterflies**

“Cryptochromes are very badly affected by weak oscillating electromagnetic fields that are orders of magnitude weaker than the Earth’s steady magnetic field. This can disrupt both solar and magnetic navigation, which can account for colony collapse disorder in bees.”

—Dr. Andrew Goldsworthy

The decline of domestic bees all over the world is an important problem still not well understood by scientists and beekeepers, and far from being solved. Its reasons are numerous: among others, the use of pesticides and insecticides, the decrease of plant diversity, and bee’s parasites. Besides these threats, there is a potential adverse factor little considered: manmade electromagnetism.

The present paper suggests two simple experimental protocols for bringing to the fore the potential adverse effect of electromagnetism on bees and to act consequently. The first one is the observation of bees’ avoidance of a wireless apparatus; the second one is the assessment of colonies’ strength and of the intensity of the electromagnetism field (EMF) surrounding them. If bees avoid a wireless apparatus, if hives in bad health are located in EMF of a rather high intensity, it can be presumed that bees are affected by manmade electromagnetism. This should enable searching for palliative measures.

Goldsworthy, Andrew. “The Birds, the Bees and Electromagnetic Pollution: How electromagnetic fields can disrupt both solar and magnetic bee navigation and reduce immunity to disease all in one go.” 2009.

- Many of our birds are disappearing mysteriously from the urban environment and our bees are now under serious threat. There is increasing evidence that at least some of this is due to electromagnetic pollution such as that from cell towers, cell phones, DECT cordless phones and Wifi. It appears capable of interfering with their navigation systems and also their circadian rhythms, which in turn reduces their resistance to disease. The most probable reason is that these animals use a group of magnetically-sensitive substances called cryptochromes for magnetic and solar navigation and also to control the activity of their immune systems.


- “Here we use flight simulator studies to show that migrants indeed possess an inclination magnetic compass to help direct their flight equator ward in the fall. Another vulnerability to now consider is the potential disruption of the magnetic compass in monarchs by human-induced electromagnetic noise, which can apparently disrupt geomagnetic orientation in a migratory bird.”


- The present study was carried out to find the effect of cell phone radiations on various biomolecules in the adult workers of Apis mellifera L. The results of the treated adults were analyzed and compared with the control. Radiation from the cell phone influences honey bees’ behavior and physiology. There was reduced motor activity of the worker bees on the comb initially, followed by en masse migration and movement toward “talk mode” cell phone. The initial quiet period was characterized by rise in concentration of biomolecules including proteins, carbohydrates and lipids, perhaps due to stimulation of body mechanism to fight the stressful condition created by the radiations. At later stages of exposure, there was a slight decline in the concentration of biomolecules probably because the body had adapted to the stimulus.


- Electromagnetic waves originating from mobile phones had a dramatic impact on the behavior 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.


- Bees pollinate approximately 1/3 of all crops and they are disappearing by the millions. Warnke raises the concern that the dense, energetic mesh of electromagnetic fields from wireless technologies may be the cause.


- We have compared the performance of honeybees in cell phone radiation exposed and unexposed colonies. A significant (p < 0.05) decline in colony strength and in the egg laying rate of the queen was observed. The behaviour of exposed foragers was negatively influenced by the exposure, there was neither honey nor pollen in the colony at the end of the experiment.


- Of concern to DMBM are the potential impacts of radiation on bird populations. For example, preliminary research on wild birds at cellular phone tower sites in Spain showed strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, and roosting in the vicinity of the electromagnetic fields.


- A pilot study on honeybees testing the effects of non-thermal, high frequency electromagnetic radiation on bee hive weight and flight return behavior. In exposed hives, bees constructed 21% fewer cells in the hive frames after 9 days than those unexposed.


- Recently a sharp decline in population of honey bees has been observed in Kerala. Although the bees are susceptible to diseases and attacked by natural enemies like wasps, ants and wax moth, constant vigilance on the part of the bee keepers can over come these adverse conditions. The present plunge in population (< 0.01)
Insects are continually exposed to Radio-Frequency (RF) electromagnetic fields at different frequencies. The range of frequencies used for wireless telecommunication systems will increase in the near future from below 6 GHz to 120 GHz. A RF electromagnetic power in four different types of insects as a function of frequency from 2 GHz (5 G, 3 G). This paper is the first to report the absorbed RF electromagnetic power in four different types of insects as a function of frequency from 2 GHz to 120 GHz. A set of insect models was obtained using novel Micro-CT (computer tomography) imaging.


There is an urgent need for further research and "of the 919 research papers collected on birds, bees, plants, other animals, and humans, 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies".

"One can take the precautionary principle approach and reduce RF-EMF radiation effects of cell phone towers by relocating towers away from densely populated areas, increasing height of towers or changing the direction of the antenna."

The study concludes, "More must also be done to compensate individuals and communities put at risk. Insurance covering diseases related to towers, such as cancer, should be provided for free to people living in 1 km radius around the tower. Independent monitoring of irradiation levels and overall health of the community and nature surrounding towers is necessary to identify hazards early. Communities need to be given the opportunity to reject cell towers and national governments need to consider ways of growing their cellular networks without constantly exposing people to radiation."
• These models were used for the first time in finite-difference time-domain electromagnetic simulations.

• All insects showed a dependence of the absorbed power on the frequency. All insects showed a general increase in absorbed RF power at and above 6 GHz, in comparison to the absorbed RF power below 6 GHz. Our simulations showed that a shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in power between 3–370%.


• Magnetic compass orientation in night-migratory songbirds is embedded in the visual system and seems to be based on a light-dependent radical pair mechanism. Recent findings suggest that both broadband electromagnetic fields ranging from ~2 kHz to ~9 MHz and narrow-band fields at the so-called Larmor frequency for a free electron in the Earth’s magnetic field can disrupt this mechanism. However, due to local magnetic fields generated by nuclear spins, effects specific to the Larmor frequency are difficult to understand considering that the primary sensory molecule should be organic and probably a protein. We therefore constructed a purpose-built laboratory and tested the orientation capabilities of European robins in an electromagnetically silent environment, under the specific influence of four different oscillating narrow-band electromagnetic fields, at the Larmor frequency, double the Larmor frequency, 1.315 MHz or 50 Hz, and in the presence of broadband electromagnetic noise covering the range from ~2 kHz to ~9 MHz. Our results indicated that the magnetic compass orientation of European robins could not be disrupted by any of the relatively strong narrow-band electromagnetic fields employed here, but that the weak broadband field very efficiently disrupted their orientation.


• Scientists found that migrating robins became disoriented when exposed to electromagnetic fields at levels far lower than the safety threshold for humans. “Here we show that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise...These fully double-blinded tests document a reproducible effect of anthropogenic electromagnetic noise on the behavior of an intact vertebrate.”


• Interesting behavioral observations of the white stork nesting sites located within 100m of one or several cell site antennas were carried out. These results are compatible with the possibility that microwaves are interfering with the reproduction of white storks and would corroborate the results of laboratory research by other authors. In far away areas, where the radiation decreases progressively, the chronic exposure can also have long term effects. Effects from antennas on the habitat of birds are difficult to quantify, but they can cause a serious deterioration, generating silent areas without male singers or reproductive couples.


• “Birds in experimental cages, deprived of visual information, showed the seasonally appropriate direction of intended flight with respect to the magnetic meridian. Weak radiofrequency (RF) magnetic field (190 nT at 1.4 MHz) disrupted this orientation ability.”

• “These results may be considered as an independent replication of earlier experiments, performed by the group of R. and W. Wiltshire with European robins (Erithacus rubecula). Confirmed outstanding sensitivity of the birds’ magnetic compass to RF fields in the lower megahertz range demands for a revision of one of the mainstream theories of magnetoreception, the radical-pair model of birds’ magnetic compass.”

• “As discussed above, the high sensitivity of the birds’ magnetic compass to RF fields, found in [21,22,24] and now confirmed by us, is difficult to explain within the existing radical-pair theory…”

Cammaerts, M.C. and Johansson, O. "Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus." Electromagnetic Biology and Medicine, vol. 33, no. 4, 2014, pp. 282-8.

• “the linear and angular speed of ants are immediately altered by the presence of EMF/RF fields. Based on these results, the authors advise users to deactivate the WiFi function of their PC/laptop.”


• A total of 280 different experiments were performed. Exposure to wireless devices such as WiFi, baby monitors, and phones created statistically significant effects regarding reproduction and cell death apoptosis induction, even at very low intensity levels (0.3 V/m bluetooth radiation), well below ICNIRP’s guidelines.


• Eggs and tadpoles of the common frog were exposed to electromagnetic radiation from cell phone antennas for two months, from the egg phase until an advanced phase of tadpole prior to metamorphosis. Results indicate that radiation emitted by phone masts in a real situation may affect the frogs development and may cause an increase in mortality of exposed tadpoles.” This research may have huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts.”

Plants And Trees

“Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects (89.9%, p < 0.001). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies…”


- The increasing use of mobile phones and wireless networks raised a great debate about the real carcinogenic potential of radiofrequency-electromagnetic field (RF-EMF) exposure associated with these devices. Conflicting results are reported by the great majority of in vivo and in vitro studies on the capability of RF-EMF exposure to induce DNA damage and mutations in mammalian systems. Aimed at understanding whether less ambiguous responses to RF-EMF exposure might be evidenced in plant systems with respect to mammalian ones, in the present work the mutagenic effect of RF-EMF has been studied through the micronucleus (MN) test in secondary roots of Vicia faba seedlings exposed to mobile phone transmission in controlled conditions, inside a transverse electro magnetic (TEM) cell.

- Exposure of roots was carried out for 72h using a continuous wave (CW) of 915 MHz radiation at three values of equivalent plane wave power densities (23, 35 and 46W/m2). The specific absorption rate (SAR) was measured with a calorimetric method and the corresponding values were found to fall in the range of 0.4-1.5W/kg.

- Results of three independent experiments show the induction of a significant increase of MN frequency after exposure, ranging from a 2.3-fold increase above the sham value, at the lowest SAR level, up to a 7-fold increase at the highest SAR. These findings are in agreement with the limited number of data on cytogenetic effects detected in other plant systems exposed to mobile phone RF-EMF frequencies and clearly show the capability of radiofrequency exposure to induce DNA damage in this eukaryotic cell system.

- It is worth noticing that this range of SAR values is well below the international limits for localised exposure (head, trunk), according to the ICNIRP guidelines (35) and IEEE std C95.1 (38), which are 10 (8.0) W/kg for occupational exposure and 2.0 (1.6) W/kg for general public exposure respectively.

Halgamuge, Malka N., See Kye Yak and Jacob L. Eberhardt. “Reduced growth of soybean seedlings after exposure to weak microwave radiation from GSM 900 mobile phone and base station.” Bioelectromagnetics, vol. 36, no. 2, 2015, pp. 87-95.

- The aim of this work was to study possible effects of environmental radiation pollution on plants. The association between cellular telephone (short duration, higher amplitude) and base station (long duration, very low amplitude) radiation exposure and the growth rate of soybean (Glycine max) seedlings was investigated.

- The exposure to higher amplitude (41 V m⁻¹) GSM radiation resulted in diminished outgrowth of the epicotyl. The exposure to lower amplitude (5.7 V m⁻¹) GSM radiation did not influence outgrowth of epicotyl, hypocotyls, or roots. The exposure to higher amplitude CW radiation resulted in reduced outgrowth of the roots whereas lower CW exposure resulted in a reduced outgrowth of the hypocotyl. Soybean seedlings were also exposed for 5 days to an extremely low level of radiation (GSM 900 MHz, 0.56 V m⁻¹) and outgrowth was studied 2 days later. Growth of epicotyl and hypocotyl was found to be reduced, whereas the outgrowth of roots was stimulated.

- Our findings indicate that if the observed effects were significantly dependent on field strength as well as amplitude modulation of the applied field.


- Statistically significant changes to this plant from a non thermal effect.


- Microwave irradiation resulted in thinner cell walls, smaller chloroplasts and mitochondria, and enhanced emissions of volatile compounds, in particular, monoterpenes and green leaf volatiles (GLV). These data collectively demonstrate that human-generated microwave pollution can potentially constitute a stress to the plants.

- The above is only a small sampling of the research showing biological effects at non thermal levels on living organisms.


- “This study suggests that the RF background may have strong adverse effects on growth rate and fall anthocyanin production in aspen, and may be an underlying factor in aspen decline.”

Additional References:

**Effects of EMFs on other animals:**


- The Caribbean spiny lobster, *Panulirus argus*, is a migratory crustacean that uses Earth’s magnetic field as a navigational cue, but how lobsters detect magnetic fields is not known. Magnetic material thought to be magnetite has previously been detected in spiny lobsters, but its role in magnetoreception, if any, remains
As a first step toward investigating whether lobsters might have magnetite-based magnetoreceptors, we subjected lobsters to strong, pulsed magnetic fields capable of reversing the magnetic dipole moment of biogenic magnetite crystals. Lobsters were subjected to a single pulse directed from posterior to anterior and either: (1) parallel to the horizontal component of the geomagnetic field (i.e., toward magnetic north); or (2) antiparallel to the horizontal field (i.e., toward magnetic south). An additional control group was handled but not subjected to a magnetic pulse. After treatment, each lobster was tethered in a water-filled arena located within 200 m of the capture location and allowed to walk in any direction. Control lobsters walked in seemingly random directions and were not significantly oriented as a group. In contrast, the two groups exposed to pulsed fields were significantly oriented in approximately opposite directions. Lobsters subjected to a magnetic pulse applied parallel to the geomagnetic horizontal component walked westward; those subjected to a pulse directed antiparallel to the geomagnetic horizontal component oriented approximately northeast. The finding that a magnetic pulse alters subsequent orientation behavior is consistent with the hypothesis that magnetoreception in spiny lobsters is based at least partly on magnetite-based magnetoreceptors.


- With the growing use of wireless devices in almost all day-to-day activities, exposure to radio-frequency radiation has become an immediate health concern. It is imperative that the effects of such radiation not only on humans, but also on other organisms be well understood. In particular, it is critical to understand if RF radiation has any bearing on the gene expression during embryonic development, as this is a crucial and delicate phase for any organism. Owing to possible effects that RF radiation may have on gene expression, it is essential to explore the carcinogenic or teratogenic properties that it may show. This study observed the effects of RF radiation emitted from a cellular telephone on the embryonic development of zebrafish.
- This study observed the effects of RF radiation emitted from a cellular telephone on the embryonic development of zebrafish. The expression of the gene shha plays a key role in the early development of the fish. This gene has homologs in humans as well as in other model organisms. Additionally, several biomarkers indicative of cell stress were examined: including lactate dehydrogenase (LDH), superoxide dismutase (SOD), and lipid peroxidation (LPO).
- Results show a significant decrease in the expression of shha, a significant decrease in LDH activity. There was no significant increase in SOD and LPO activity.


- In conclusion, the overall results demonstrated that ELF-MF exposure has detrimental effects on the embryonic development of zebrafish by affecting the hatching, decreasing the heart rate, and inducing apoptosis, although such effects were not mortal threat. The results also indicate that zebrafish embryos can serve as a reliable model to investigate the biological effect of ELF-MF.


- In this study, we found that zebrafish, a model organism suitable for genetic manipulation, responded to a magnetic field as weak as the geomagnetic field.

Magneto-reception in cows and other mammals:


- Evidence continues to accumulate that a wide range of organisms, from bacteria to vertebrates, can detect and orient to ambient magnetic fields (for examples see refs 2-4). Since the discovery that magnetic orientation by bacteria was due to the presence within the organism of magnetic particles of the ferric/ferrous oxide, magnetite, the search has begun for other biogenic deposits of inorganic magnetic material and ways in which the possession of such material might confer on the organism the ability to orient to ambient magnetic fields.
- Such magnetic material, often identified as magnetite, has been discovered in bees, homing pigeons, dolphins and various other organisms, including man. A variety of hypotheses for the use of magnetite in magnetic field detection have been proposed. We report here that bones from the region of the sphenoid/ethmoid sinus complex of humans are magnetic and contain deposits of ferric iron. The possible derivations and functions of these deposits are discussed.


- Wood mice exposed to a 0.9 to 5 MHz frequency sweep changed their preference from north-south to east-west. In contrast to birds, however, a constant frequency field tuned to the Larmor frequency (1.33 MHz) had no effect on mouse orientation. In sum, we demonstrated magnetoreception in wood mice and provide first evidence for a radical-pair mechanism in a mammal. Open Access Paper: http://bit.ly/1zh1J91
- In sum, we show that wood mice possess a magnetic sense that they use to position their nests along the NNE-SSW axis relative to the magnetic field. The NNE-SSW preference was not altered by RF fields delivered at the Larmor frequency, but was shifted by approximately 90° by a RF frequency sweep (0.9–5 MHz repeated at 1 kHz) at an intensity of only ~5% that of the Larmor frequency stimulus.
- The results point to the involvement of a radical pair mechanism, the first such evidence for a mammal, although further research is needed to provide a more thorough characterization of the underlying mechanism.

- Effects of electromagnetic fields (EMF) on cows have been frequently discussed in public media as well as in specialist journals and meetings with agricultural, veterinary or dairy backgrounds. Indeed, in view of the available literature, it does seem that cows show EMF susceptibilities and respond to environmental exposures of a broad range of frequencies and properties:
- Cows are sensitive to the Earth’s magnetic field. Bovine magnetoreception can be influenced by external EMF, e.g. powerlines.
- Several physiological alterations in dairy cows exposed to extremely low frequency (ELF) EMF were reported without major indications for adverse health effects. Notably, the observed effects seem to be dependent on the magnetic field component or on combined electric and magnetic fields rather than on electric field exposure alone.
- Cows are sensitive to earth currents (stray voltage) associated with transients in particular harmonics. Milk production, health, and behavior seem to be negatively affected.
- Bovine responses to radiofrequency (RF) exposure include avoidance behavior, reduced ruminating time, and alterations in oxidative stress. These findings indicate possible adverse health effects. However, most of the studies have critical points (one-herd-case report, logistic problems in study design, lack of appropriate exposure assessment) that confirmation of the observed RF effects is clearly needed, though studies in such big animals are time-, place-, and money-consuming, and exposure assessment and dosimetry are challenging issues.
- Overall, cattle seem to be affected by environmental EMF exposure. Cows align to geomagnetic field lines and are influenced by ELF EMF.


Effects of ELF electric and magnetic fields in (dairy) cows:


Effects of stray voltage in cows:


Effects of radiofrequency fields in cows:


