WILDLIFE, WIRELESS & EMF

The Case For Science-Based Regulations to Protect Wildlife

Increasing Exposure

Wireless radiofrequency (RF) radiation and other non-ionizing electromagnetic frequency (EMF) are rapidly increasing forms of environmental pollution.

Sources include cell towers, 5G, powerlines and electrical grid infrastructure.

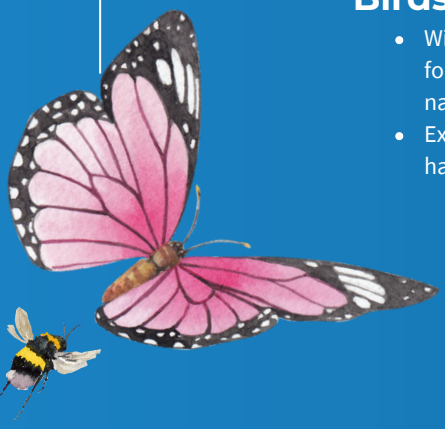
> ***"In addition to its impact on humans, RF radiation poses harmful effects to flora and fauna."***
>
> **— NATURAL RESOURCES DEFENSE COUNCIL**

Scientific Research

has reported a range of harmful effects including:

Insects

- According to a 2023 review published in *Reviews on Environmental Health*, the vast majority of studies on EMF exposure to insects have found impacts.
- Studies on insects have reported impacts to flight, foraging and feeding, memory, and mortality.
- Studies on bees specifically have found decreased egg laying rate, reduced colony strength, and impacts to behavior and physiology.

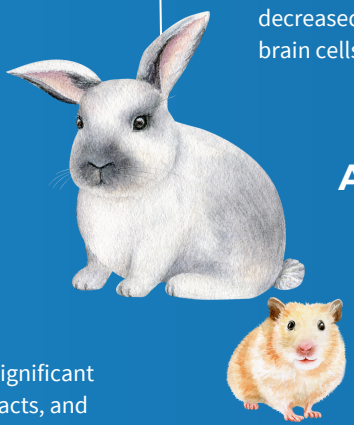


Birds

- Wireless frequencies have been found to interfere with birds' navigation systems.
- Experimental studies have found harm to embryonic development.

Mice, Rats & Bunnies

- Landmark $30 million U.S. government NIH rat study found "clear evidence" of an association with cancer, DNA damage and lower birth weight.
- Yale mice studies found hyperactivity, memory damage, and altered brain function.
- Experiments have found sperm damage, decreased ovarian follicles, and damage to brain cells.



Trees and plants

- EMF exposure can alter growth patterns and lead to thinner cell walls.
- A decade-long study documented significant tree damage from prolonged cell tower radiation.

Amphibians

- Tadpoles exposed to cell tower radiation had altered behavior, asynchronous growth, and a significantly higher mortality rate.

Fish

- Studies on zebrafish have found significant behavioral changes, learning impacts, and altered brain oxidative status.

Text is hyperlinked to published research.

WILDLIFE, WIRELESS & EMF

The Case For Science-Based Regulations That Protect Animals And Their Habitat

Wildlife Are Highly Exposed

Wildlife live, nest, and perch on and near cell towers and power lines.

- Cell towers emit non-ionizing RF radiation that can exceed government exposure limits often from 10 to 40+ feet out from the antennas. However, this is legal since RF compliance tests only measure exposure where humans exist, ignoring wildlife habitats.
- Studies have found decreased diversity and abundance of insects in areas with higher cell tower radiation.

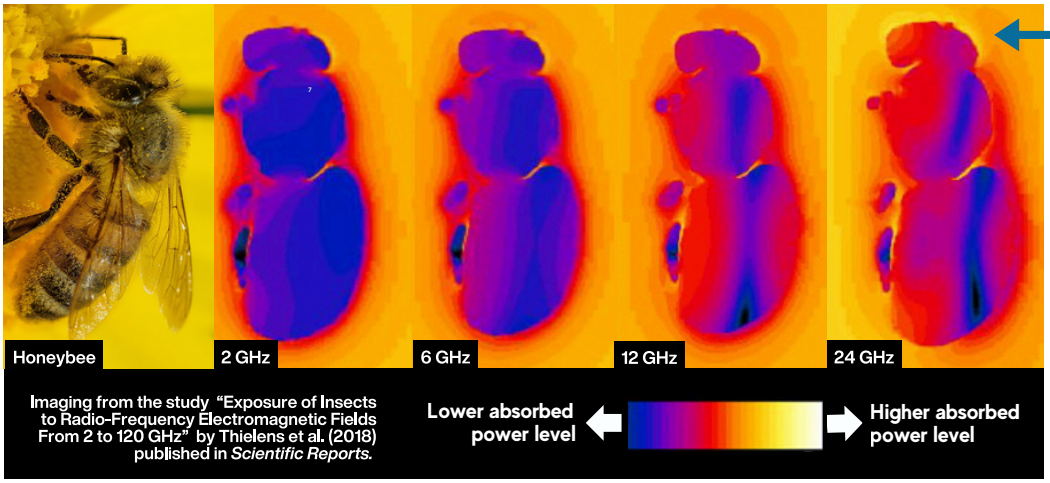
INSECTS AT RISK

5G and emerging network technologies operate at higher millimeter-wave frequencies, which uniquely interact with the smaller size of insects, resulting in increased absorption into their brains and bodies.

Biologists caution that non-ionizing electromagnetic radiation may be a key factor in pollinator and insect decline. Pollinators play a crucial role in ecosystems and any negative impacts could have cascading effects on biodiversity.

SCIENCE ON BEES & EMFS* REPORTS IMPACTS TO:

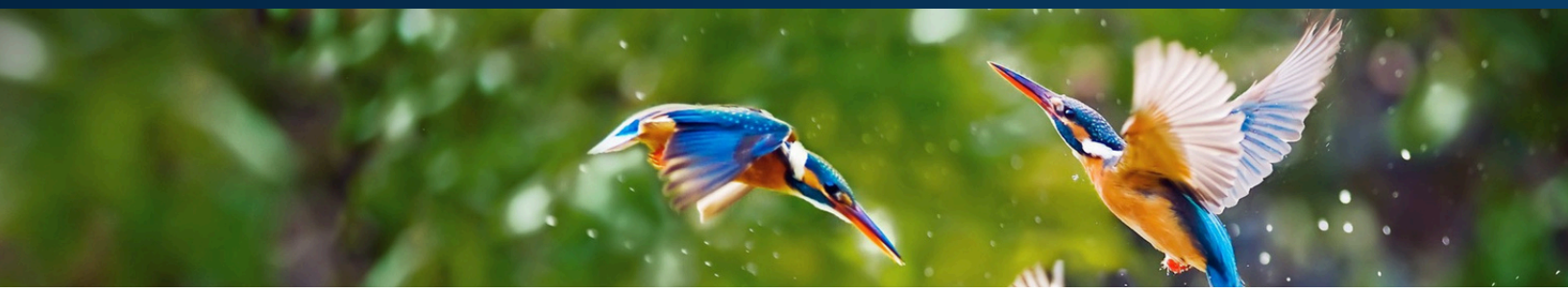
5G CAN INCREASE INSECT EXPOSURE



State of the art modeling by Thielens et al. (2018) found bees and insects can absorb the higher frequencies of 5G at between 3% to 370% ~~at~~ higher levels into their bodies. The scientists state:

"This could lead to changes in insect behaviour, physiology, and morphology over time…."

*All text is hyperlinked to published research.



THE WAY FORWARD

The Current Regulatory Framework Must Be Strengthened to Protect Wildlife

A LACK OF GOVERNMENT PROTECTIONS

U.S. government regulations are inadequate to ensure protection of wildlife and the natural environment.

- Outdated 1996 wireless radiation regulations are designed to protect humans, but not wildlife and trees.
- Regulatory loopholes allow wildlife to be exposed to cell tower radiation at levels higher than federal limits.
- No safety limits exist for magnetic field and powerline EMFs.
- No U.S. agencies are reviewing wildlife impacts.
- No U.S. agencies measure and monitor EMF levels in ecologically-sensitive areas.
- State and federal policies are fast-tracking cellular antenna deployment in parks and forests instead of implementing measures to minimize wildlife exposure.

RECOMMENDED SAFEGUARDS

Scientists are calling for policies that protect the environment.

- Launch an independent international research program focused on animals, plants, and the environment.
- Develop science-based regulations designed to protect wildlife with an ecosystem approach.
- Establish a program for systematic monitoring of exposures and health surveillance.
- Ensure surveillence tools do not emit RF/EMF.
- Update compliance procedures to measure areas where wildlife exist, using non-EMF emitting equipment.
- Conduct full environmental reviews before the licensing and buildout of major new technologies.
- Halt wireless deployment in wilderness areas, national forests, and parks.
- Implement measures to reduce exposures in ecologically-sensitive areas.

Protective policies to reduce EMF exposure are urgently needed for threatened and endangered wildlife.
The current unfettered EMF in critical wildlife habitat is unconscionable and we have a moral obligation to act.
— Albert M. Manville II, Ph.D.
Johns Hopkins University, retired from Division of Migratory Bird Management, U.S. Fish & Wildlife Service

It is time to recognize ambient EMF as a novel form of pollution and develop rules at regulatory agencies that designate air as 'habitat' so EMF can be regulated like other pollutants.
— Levitt, Lai and Manville (2021)
"Effects of non-ionizing EMF on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions"
Reviews on Environmental Health

There is an urgent need for further research to assess the extent of responses of wildlife to RF-EMF exposure.
— Froidevaux et al. (2023)
"Addressing Wildlife Exposure to Radiofrequency Electromagnetic Fields: Time for Action"
Environmental Science & Technology Letters

Scientific Research on Wildlife & EMFs

Key Research Reviews

Effects of non-ionizing electromagnetic fields on flora and fauna, part 1. Rising ambient EMF levels in the environment by Levitt et al. *Reviews on Environmental Health* (2021).

Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: How species interact with natural and man-made EMF by Levitt et al. *Reviews on Environmental Health* (2021).

Radio-tracking systems emit pulsed waves that could affect the health and alter the orientation of animals by Balmori. *Journal for Nature Conservation* (2024).

Health and environmental effects to wildlife from radio telemetry and tracking devices—state of the science and best management practices by Manville et al. *Frontiers in Veterinary Science* (2024).

Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation by Balmori. *Science of The Total Environment* (2015).

Electrosmog and species conservation by Balmori. *Science of The Total Environment* (2014).

A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF) by Cucurachi et al. *Environment International* (2013).

Insects and Bees

Biological effects of electromagnetic fields on insects: a systematic review and meta-analysis by Thill et al. *Reviews on Environmental Health* (2023).

Electromagnetic fields disrupt the pollination service by honeybees by Molina-Montenegro et al. *Science Advances* (2023).

Electromagnetic radiation as an emerging driver factor for the decline of insects by Balmori. *Science of the Total Environment* (2021).

Extremely Low Frequency Electromagnetic Fields impair the Cognitive and Motor Abilities of Honey Bees by Shepherd et al. *Scientific Reports* (2018).

Higher Exposures to Insects

Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz by Thielens et al. *Scientific Reports* (2018).

Numerical dosimetry of specific absorption rate of insects exposed to far-field radiofrequency electromagnetic fields by Jeladze et al. *International Journal of Radiation Biology* (2025).

Radio-Frequency Electromagnetic Field Exposure of Western Honey Bees by Thielens et al. *Scientific Reports* (2020).

Estimation of the Specific Absorption Rate for a Honey bee Exposed to Radiofrequency Electromagnetic Fields from 2.5 to 100 GHz by Jeladze et al. IEEE International Seminar/Workshop on Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (2023).

Trees and Plants

Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations by Haggerty. *International Journal of Forestry Research* (2010).

Radiofrequency radiation injures trees around mobile phone base stations by Waldmann-Selsam et al. *Science of The Total Environment* (2016).

Review on the impact of cell phone radiation effects on green plants by Panda et al. *Environmental Monitoring and Assessment* (2024).

Sensitivity of plants to high frequency electromagnetic radiation: Cellular mechanisms and morphological changes by Kaur et al. *Reviews in Environmental Science and Bio/Technology* (2021).

Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants by Halgamuge. *Electromagnetic Biology and Medicine* (2017).

Amphibian

Mobile phone mast effects on common frog (Rana temporaria) tadpoles: the city turned into a laboratory by Balmori. *Electromagnetic Biology and Medicine* (2010).

The incidence of electromagnetic pollution on the amphibian decline: Is this an important piece of the puzzle? By Balmori. *Toxicological & Environmental Chemistry* (2006).

Birds

Teratogenic effects of radiofrequency electromagnetic radiation on the embryonic development of chick: A study on morphology and hatchability by Augustianath et al. *Research in Veterinary Science* (2023).

Short-term exposure of 2.4 GHz electromagnetic radiation on cellular ROS generation and apoptosis in SH-SY5Y cell line and impact on developing chick embryo brain tissue by Deena et al. *Molecular Biology Reports* (2025).

Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia) by Balmori. *Electromagnetic Biology and Medicine* (2009).

The urban decline of the house sparrow (Passer domesticus): a possible link with electromagnetic radiation by Balmori & Hallberg. *Electromagnetic Biology and Medicine* (2009).

A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding house sparrows (Passer domesticus) by Everaert & Bauwens. *Electromagnetic Biology and Medicine* (2009).

4G mobile phone radiation alters some immunogenic and vascular gene expressions, and gross and microscopic and biochemical parameters in the chick embryo model by Islam et al. *Veterinary Medicine and Science* (2023).

Magnetoreception in birds: The effect of radio-frequency fields by Wiltschko et al. *Journal of The Royal Society Interface* (2015).

Fish

Effects of 700 and 3500 MHz 5G radiofrequency exposure on developing zebrafish embryos by Torres-Ruiz et al. *Science of the Total Environment* (2024).

Short- and long-duration exposures to cell-phone radiofrequency waves produce dichotomous effects on phototactic response and circadian characteristics of locomotor activity rhythm in zebrafish, Danio rerio by Malik et al. *Biological Rhythm Research* (2021).

Neurobehavioural Changes and Brain Oxidative Stress Induced by Acute Exposure to GSM900 Mobile Phone Radiations in Zebrafish (Danio rerio) by Nirwaneet al. *Toxicological Research* (2016).

Transcriptomic and Long-Term Behavioral Deficits Associated with Developmental 3.5 GHz Radiofrequency Radiation Exposures in Zebrafish by Dasgupta et al. *Environmental Science & Technology Letters* (2022).

Mammals

Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans by Lerchl et al. *Biochemical and Biophysical Research Communications* (2015).

Compound exposure of 2.8 GHz and 9.3 GHz microwave causes learning and memory impairment in rats by Sun et al. *Heliyon* (2025).

Fetal RFR Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice by Aldad et al. *Scientific Reports* (2012).

Disruption of the ovarian follicle reservoir of prepubertal rats following prenatal exposure to a continuous 900-MHz electromagnetic field by Türedi et al. *International Journal of Radiation Biology* (2016).

Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure by Smith et al. *Environmental and Molecular Mutagenesis* (2020).

Toxicology and carcinogenesis studies in Hsd: Sprague Dawley SD rats exposed to whole-body RFR at a frequency (900 MHz) and modulations (GSM and CDMA) used by cell phones by the National Toxicology Program. U.S. Department of Health and Human Services, National Institutes of Health (2018).

Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission by Falcioni et al. *Environmental Research* (2018).

Changes in the histopathology and in the proteins related to the MAPK pathway in the brains of rats exposed to pre and postnatal radiofrequency radiation over four generations by Tan et al. *Journal of Chemical Neuroanatomy* (2022).

Policy Recommendations

Addressing Wildlife Exposure to Radiofrequency Electromagnetic Fields: Time for Action by Froidevaux et al. *Environmental Science & Technology Letters* (2023).

Low-level EMF effects on wildlife and plants: What research tells us about an ecosystem approach by Levitt et al. *Frontiers in Public Health* (2022).

Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions by Levitt et al. *Reviews on Environmental Health* (2021).