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Systematic Map
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More research is needed on the effects of radio waves from high-frequency wireless technology like 5G on plants and animals

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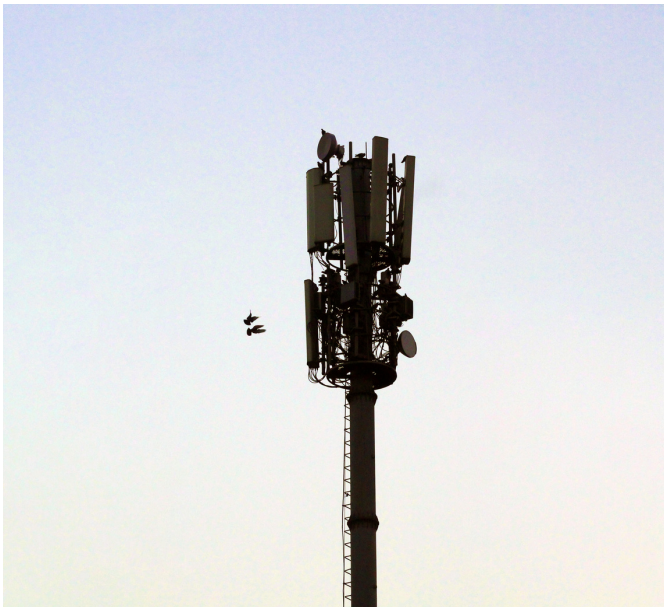


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The literature search for this systematic map initially identified 24,432 studies, of which 334 studies met the inclusion criteria: 97 plant studies and 237 studies on animals (excluding humans). Many of those 334 studies did not include investigation of the effects of radio waves on plants and animals from new and emerging technologies like the 5G network. To ensure that the environment is protected from the harmful effects of radiation, more research is needed on the effects of radio waves including from high-frequency wireless technology to inform radiation and environmental protection agencies.

Why is this Evidence Synthesis Needed?

Exposure to sufficiently high levels [TM1] of radio waves can heat a person's biological tissue and potentially cause damage. Radio waves routinely encountered in the environment by the public are too low to produce any significant heating or increases in body temperature.

Many countries have safety standards to protect humans from harmful or high-level radio wave exposure. Often these standards are based on guidelines by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). [TM2] However, there are currently no recognised international guidelines specific to protecting plants and animals. Awareness of any environmental impacts of radio waves is therefore important to also ensure the protection of animals and plants.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is currently preparing a statement on the environmental effects of radio waves and whether the current human exposure guidelines also protect plants and animals in their natural environment.

This Collaboration for Environmental Evidence systematic map aimed to highlight what research has been done to date on the effects of radio waves on plants and animals. In doing so, this map outlines knowledge gaps for future research and aims to inform regulatory authorities on how to protect the environment from radio waves.

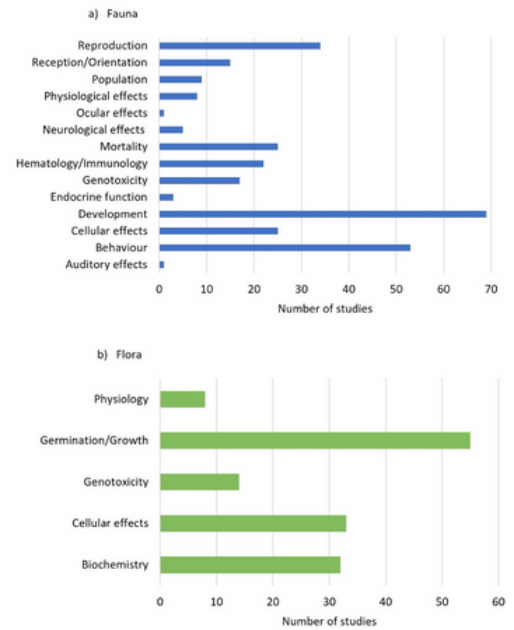
Main Findings

This systematic map shows a clear knowledge gap in understanding the effects of radio waves on plants and animals at higher radio frequencies used by the 5G mobile network and future technologies.

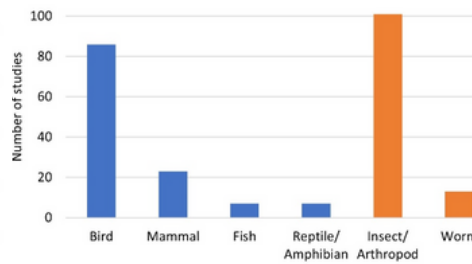
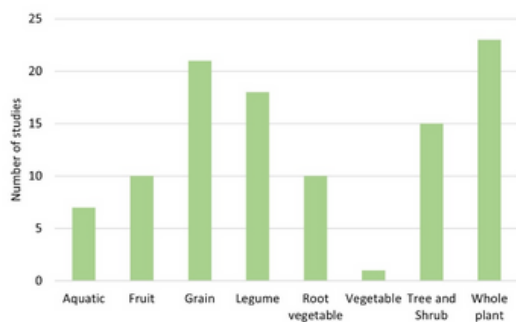
While research on the effects of radio wave exposure on plants and animals is scant overall, the systematic map shows that there are distinct evidence clusters on insect and bird reproduction, development and behaviour for animals, and grain and legume germination and growth for plants. This evidence would benefit from specific systematic reviews and pooling of the data in meta-analyses.

Outside of those evidence clusters, there are knowledge gaps relating to both the range of plant and animal species potentially affected by radio wave exposure, and the types of effects that may occur.

Another finding was that there is a particular need for more observational studies and for an improvement in the quality of all studies. For example, many studies were conducted in laboratory environments that had poor experimental controls of factors like temperature and radiation dose measurement.



Number of studies for different types of effects



Number of studies for different plant groups

Number of studies for different animal groups

What are the Implications of the Review Findings?

This systematic map summarizes the research landscape for the effects of radio waves on plants and animals. The map illustrates that future research should investigate the effect of radio waves that will be used in current and future wireless technologies on plants and animals. This is to understand if the current protections for humans are also adequate for the environment.

This systematic map will feed into the ICNIRP project. Ultimately, this research will help authorities develop policies to specifically protect plants and animals from the harmful effects of radiation. As mentioned earlier, the systematic map identified evidence clusters that would benefit from a systematic review. The authors of this paper are currently preparing a paper that quantifies the overall impact of radio waves on animals and plants.

Synthesis Time Frame

This CEE Systematic Review was published in February 2022. The systematic map authors reviewed all studies published up to 2022. This map was published in *Environmental Evidence* in May 2023.

Full Citation

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