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## INSECTS ARE DISAPPEARING ALL OVER THE WORLD. AN OVERLOOKED FACTOR IS ALSO TO BLAME.

OVER THE LAST 30 YEARS, THERE HAS BEEN A GLOBAL DECLINE IN THE NUMBER OF FLYING INSECTS. INTENSIVE AGRICULTURE, PESTICIDE USE, URBANISATION AND CLIMATE CHANGE ARE SOME OF THE CAUSES. HOWEVER, ANOTHER UNKNOWN FACTOR IS ALSO THOUGHT TO BE TO RESPONSIBLE. THIS PAPER ASSERTS THAT HUMAN-MADE ELECTROMAGNETIC RADIATION (EMR) IS THAT CAUSE.

NEW ANALYSIS SHOWS A CORRELATION EXISTS BETWEEN THE DROP IN INSECT POPULATIONS AND THE WIDESPREAD INCREASE OF EMR IN THE ENVIRONMENT. BY EXAMINING STATISTICAL DATA, LABORATORY STUDIES AND FIELD SURVEYS, THE AUTHOR SHOWS THE CAUSAL LINK.

WITH CONSERVATION EFFORTS WORLD-WIDE TO SAVE THE POLLINATING INSECTS ON WHICH 35% OF FOOD PRODUCTION RELIES, EMR MUST NOT BE IGNORED IF IT IS UNDERMINING THE EFFORT. THE EMR EFFECT ON INSECT DECLINE NEEDS TO BE PUT ON THE POLITICAL AGENDA AS PLANNED TECHNOLOGICAL DEVELOPMENTS WILL ONLY MAKE MATTERS WORSE.

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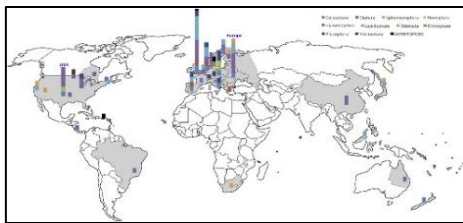


As a citizen scientist, my job as The Insect Inspector, is to investigate why flying insects are disappearing. I have been inspecting insects since I was a boy growing up on a farm. On summer nights, I would open the window, turn on the light and watch the ceiling become covered with a cloud of insects. Over the years, I opened the same window and watched them dwindle to the occasional moth.

For people who don't like insects no bugs in the bedroom is a good thing. But their disappearance has mainly gone un-noticed. There are fewer flies in the house. Less beetles in the garden. Look at spider webs. They used to be worlds of struggle and murder. Now they are mainly empty traps. Also, on a drive many insects used to splatter on the windscreen. Now there are hardly any. While these observations may be anecdotal, they are common around the globe. Things are amiss in the insect world.

## Global Decline

A recent meta-review of all the available bug-based survey data reported a significant drop in numbers of different species in the areas surveyed. Current assumptions are that 40% of species are in decline and a third are endangered (1). Despite a lack of historical data on insect numbers and the different methodologies used to count them, many entomologists and serious bug-hunters believe the trend is global.



*"We are wasting important time if we spend it debating the legitimacy of these studies. There is enough information for the need to act now."*

## Unknown Factor

It is normally pesticides, habitat loss, climate change and artificial light (urbanisation) that are to blame. These are the accepted factors in their decline. However, a report from a respected survey, conducted over a 27-year period by the Krefeld Entomological Society, shows flying insect biomass has dropped by 75%. The report, based on a rigorous science-based methodology, suggests something else is accelerating to process (2). A recent survey of pollinators in the UK shows a similar trend with the same degree of uncertainty about the underlying cause (3).



*The Krefeld study cannot be ignored, as it rested on meticulous surveys by amateur entomologists since 1989. It provides the first hard data showing a full-scale, decline in insect abundance everywhere researchers looked. The decline is apparent regardless of habitat type, changes in weather and land use. There is an urgent need to uncover the cause of this decline.*

## Working Hypothesis

To identify the missing link and explain the unaccountable loss cited by entomologists, it is proposed that: -

**Human-generated electromagnetic radiation (EMR) is a factor in the global decline of flying insects.**

More specifically, many insects are adversely affected by the unintended consequences of ubiquitous, pervasive, anthropogenic EMR in the 300 MHz to 300 GHz microwave bands used by the civil and military wireless device and mobile phone networks around the world.

The Law of Unintended Consequences states: *"Interfering with complex systems tends to create unanticipated outcomes"*.

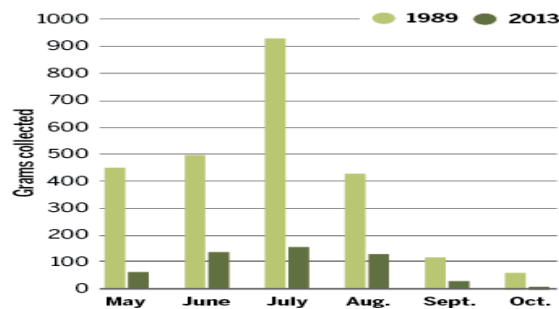


## An Educated Guess

This working hypothesis was developed in Africa while trying to save a starving chameleon. There were no crickets to be found to feed it. A local resident said that since a wireless phone mast had been erected, many insects had vanished. A dictator ran the country at the time and the mast was generating more power than allowed in Europe. In that part of West Africa pesticides are costly and little used. The habitat is stable, artificial light is not to blame, and the rural economy is based on subsistence farming. Based on an educated guess from a career in computing and a knowledge of wireless technology, I set about researching the issue to see if there could be such a connection.

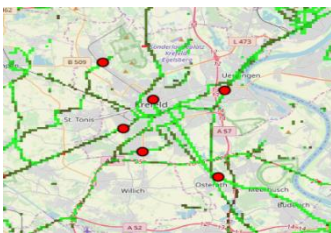
## Key Data

Krefeld Entomological Society regularly surveys several nature reserves in western Germany. Its verifiable findings are widely accepted as reliable. The data is therefore used as a benchmark along with the survey area as a prime example of where insect decline and EMR growth meet; one where the attempt to match the decline with current thinking does not explain the loss (3).



## Cause & Effect

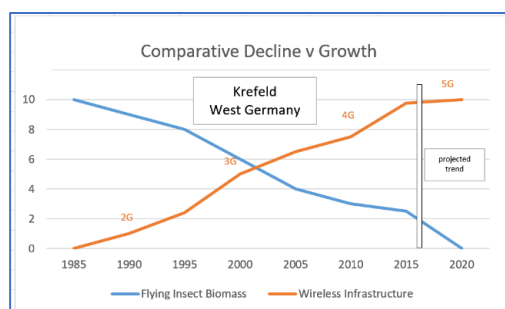
The trend in insect decline from the Kerfeld survey (see graph) was plotted on a graph and then overlaid with the growth of mobile networks coverage in the area over the same time frame (see three maps, for the period 1995 - 2016). Maps from a public database shows three generations of mobile communication infrastructure expanding to improve coverage and bandwidth in and around the survey sites (4).



The growth of GSM - G3 - G4 wireless base stations around Krefeld between 1995 - 2016

## Possible Correlation

In comparing the data sets there was a correlation between the decline of insects and the increase in EMR coverage. However, correlation does not mean causation. It is now a case of providing convincing evidence that human-made EMR can affect the wellbeing of insects, to establish a credible causal link.



## Causal Link

To find a causal link, peer-reviewed scientific papers were examined where microwaves were linked to known biological effects on insects.

The first paper reviewed was published in 2018. It was a repeat of an earlier experiment where microwaves were tested as a control mechanism for insect infestations in stored grain. The system was designed to damage insects but not the food. Generating an effective radiated power (ERP) output of between 200 – 500 watts at 2.45Ghz, microwaves first damaged eggs, then larvae, followed by pupae and adults. As power levels rose, mortality increased (5). Both trials proved that EMR impacts the whole life cycle of insects. For reference, a home Wi-Fi router produces up to 4 watts ERP at the same frequency.

## Dosage

Do negative effects occur at much lower power levels and at other frequencies? In a paper published by the Royal Society in 2019, it was shown that very weak broadband RF interferes with the circadian rhythm (internal clock) of the German cockroach. Interesting though that is, what is more striking, is that the field strength needed to disrupt the process was an extremely small amount of energy in the nanotesla range – a measure of magnetic induction (6). These experiments show that some radio frequencies are both strong enough to kill and weak enough to harm insects.

## Additional Research

What other evidence is there? And why are there gaps in our understanding? Firstly, there is little research and comparative data from earlier times. Secondly, people who study insects are themselves an endangered species, and thirdly, insects are hard to study. However, ants and fruit flies are model organisms. Studies show that EMR affects ants' sense of orientation. And, in the case of fruit flies exposed to low-level radiation from a mobile phone during the first days of adulthood reduced their reproductive capacity (8).

Low level radiation includes; Bluetooth, Wi-Fi, cordless phone base stations and baby monitors.

## Case Studies

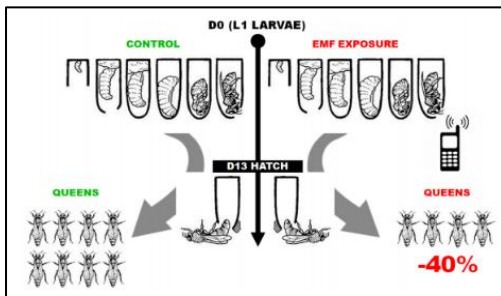
- In one study, fruit flies exposed to mobile phone radiation showed high stress protein levels (7).
- A long-term observation of laboratory ants proved that electromagnetic waves affected their pheromone response and their ability to forage for food (9).
- Research in South Africa found a link between the decrease in ant and beetle diversity and exposure to EMR close to mobile phone masts (10).
- In one experiment, the pupae of the mealworm beetle were irradiated resulting in a rise in the number of abnormalities (11).
- In 2017, German students studied bee behavior and found that EMR made them more aggressive and disorientated (12).
- In field trials on Greek Islands, EMR values were compared with insect numbers. They found that pollinators that lived and bred underground fared better than those that did so above ground (13).

**Over 50 scientific papers link biological changes in insects from low-level exposure to EMR affecting:**

- Growth & Development
- Fertility & Reproduction
- Behaviour & Stress
- Mutation & Mortality

## Empirical Evidence

These examples show how EMR impacts the ability to feed, breed and pollinate in a variety of insects. There is a growing body of evidence showing that damage happens at all phases of their life cycle but especially at the egg and larvae stage (25). The research, a mixture of field and laboratory studies, is complex, often underfunded and difficult to replicate. It is the lack of repeated experiments and knowledge gaps that exposes the connection between EMR and insects to criticism. However, despite questioning the scientific methods in papers asserting the link, an EU funded Eklipse report into examining any Environmental/EMR connection concluded that there is a need for urgent well-funded research. No funding has been granted.



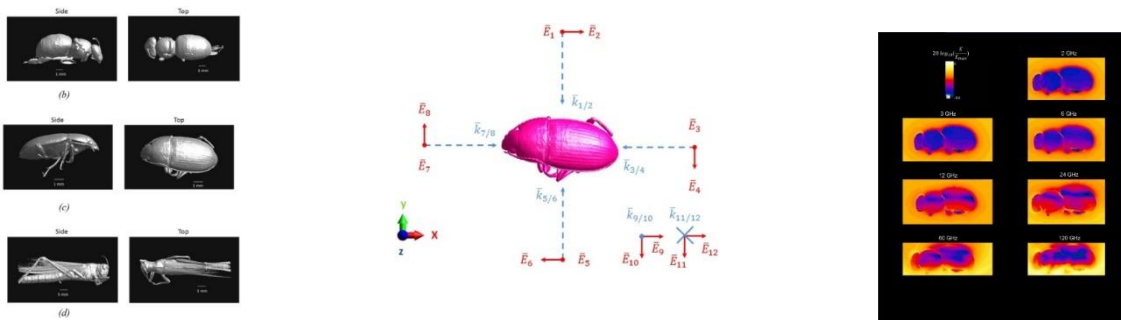
### Eklipse Survey 2018 – Invertebrates

- EMR is an environmental cue detectable by invertebrate physiological mechanisms governing orientation or movement.
- EMR from anthropogenic sources (e.g. mobile phones) represent a potential risk to such physiological mechanisms but current evidence is limited.
- There is some evidence that anthropogenic EMR in laboratory experiments can affect behavior or reproduction of model insect species.

*The Eklipse Report is the source material that entomologists and others refer to when asked about any EMR effect on insects (22).*

## Virtual Simulations

A valuable document published in 2018 details how computer-modelled insects reacted when subjected to EMR. The research team analysed the amount of RF power absorbed over a range of frequencies. The findings showed the greatest absorption is when wavelength and body size are equal. The greatest increase in absorption of energy was at < 6GHz, resonating between 1-10-mm right in the 5G FR2 spectrum (13).



Images reproduced under the Creative Commons license with credit to Arno Thielens, Duncan Bell, David B. Mortimore, Mark K. Greco, Luc Martens, and Wout Joseph (13)

## Global Impact

**If the hypothesis is correct, it is important, not just because of the consequences now but because of the planned deployment of 5G infrastructure that needs to cover 95% of land mass to work at full potential. Today, according to a best guess, wireless networks cover 25%. The intention is to put thousands of satellites in orbit to extend the reach of 5G and blanket the world with EMR signals.**

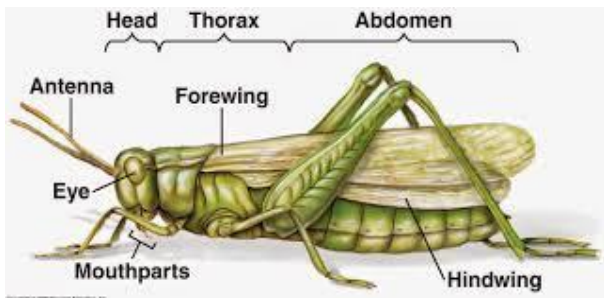
## Thermal Effect

Microwaves cause water molecules to move. This means living tissue absorbs EMR energy as heat. The International Commission on Non-ionizing Radiation Protection (ICNIRP) sets EMR levels solely on the detectable heating of human tissue (SARS). Its 30-year-old guidelines do not consider any other biological impacts. ICNIRP has not undertaken any research into the impact of EMR on insects, nor does it plan to.

*The standard wireless industry test is how much radiation is absorbed by a bag of saline fluid to determine the specific absorption rate (SAR) and ensure extreme heating does not occur. No research is done on people as what they know about EMR from animal studies would render it unethical.*

## Harmful Effects

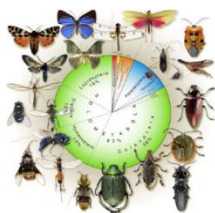
When an insect's body part and an energy wave match in length, there will be a coupling or impedance matching, like any transmitter and receiver designed for good signal transfer. With certain 5G FR2 band frequencies (~20Ghz) there will be a strong coupling to insect body structures at a one-to-one ratio (15). As most bugs have an exoskeleton containing watery, fatty guts this will have consequences. With pulsed frequencies resonating at billions of times per second, insects, which usually manage to regulate temperature, will heat-up over their thermal limit. If any of insect parts are damaged, they are finished.



Insect exposure to EMR is claimed to result in

- effects on the brain, neurons, developing cells and enzyme systems.
- sharp changes in the various enzymes systems of fat body and hematological profile (30).

## Conclusion



The hypothesis that *human-made electromagnetic radiation (EMR) is a factor in the global decline of flying insects*, relies on the premise that there is an unknown cause of insect decline. A cause distinct from the generally accepted reasons. This argument stands because pesticide use, habitat loss, urbanization and climate change cannot be applied in part, or equal measure, in all areas where insect decline has been observed.

Knowing there is one way to the right answer, but an infinite number of ways to go wrong, a scientific method was applied with a dose of scepticism. Despite trying to overturn the hypothesis, it continues to stand. Invisible though it is, EMR is now an omnipresent part of the environment. So, regardless of the claim this may be a speculative ad-hoc approach, I offer up human-made electromagnetic radiation as the villain of the piece in this inquiry.

Tested against Hill's criteria (29)

- Strength
- Consistency
- Specificity
- Temporality
- Biological gradient
- Plausibility
- Coherence
- Analogy

## Postscript

With all the time and resources devoted to species conservation it is odd that a factor suspected by many scientists as contributing to insect decline is overlooked. If anthropomorphic electromagnetic radiation is depleting the conservation effort and we remain ignorant of the fact, we will pay a high price as the pollinators make sure a third of human food can be harvested.

Measuring the problem. The instrumentation currently available for measuring EMR is either expensive, making itself prohibitive to be used for large samples, or cheap and prone to uncertainties and misclassification. It is important to develop new methodologies in collecting exposure data at an environmental level

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Michael Chapman Pincher is the son of a famous investigative journalist and zoologist. He grew up in a house where a connection to nature and an understanding of power went together. As a journalist, Michael wrote about the emerging IT market at the introduction of the PC and has kept up to speed with development in ICT. Moving from writing about technology to consulting to the big IT giants, Michael toured Europe telling people that the Internet was coming. As a communicator, he bridged the gap between the technical and business world, sitting on several boards to lobby for and justify the funds required for big projects. He retired after working as Head of Information Systems on Crossrail, Europe's largest Infrastructure Project.

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