5G Cell Towers Cause Massive Insect Decline on the Greek island of Samos

Diana Kordas
Ed.M, M.A.
Samos, Greece
diana.kordas@protonmail.com

February 22, 2022

”If we and the rest of the back-boned animals were to disappear overnight, the rest of the world would get on pretty well. But if the invertebrates were to disappear, the world’s ecosystems would collapse.”
Sir David Attenborough

Is the spoonwing lacewing now extinct on Samos?

Abstract

In 2017, a major German study found that flying insects had decreased over 75% in protected areas over the previous 27 years while ruling out climate change and pesticides. In 2021, the bumblebee was declared extinct in nine U.S. states. Insects, including pollinators, are diminishing rapidly worldwide, yet governments, NGOs, the mainstream media and even many scientists are refusing to consider the effects of Radiofrequency (RF) radiation despite an enormous body of independent scientific studies showing harm.

During recent decades, environmental pollution from RF radiation has increased substantially. Currently the fifth generation, 5G, is being rolled out worldwide. Appeals for a moratorium on 5G till proper studies are done to assess potential risks have all failed.

Besides risks to people, such as cancer, neurological disease and sterility, hazards to the environment, especially birds and insects, are a major concern. On our 3½ acre piece of land on the island of Samos, we have seen a dramatic decrease of insects between 2012 and 2021. Some species of insects may be extinct and several species appear to be suffering from DNA damage.

The area where we live had little wireless radiation until 2016, when 4G/LTE networks were installed on Samos and many new cell towers were built, from which time insects and birds began to decline noticeably. A tipping-point was reached in the summer of 2021, after the installation of a new 5G cell tower directly opposite the land. This cell tower is part of a new 5G network on Samos.

Since July 2021, when the 5G network on Samos went live, insects on our land have declined between 80-90% depending on species. All orders of insects are affected. The cause of these insect declines can only be RF radiation from the cell towers. No pesticides are used in this area and nothing else can account for the sudden, severe drop in the number of insects in this place since July 2021. Small mammals, especially rodents, are also declining rapidly.

5G frequencies appear to be the main cause of the most recent insect declines, which are happening all over the island. The consequences of these declines will be far-reaching: this will affect wild plant diversity, agriculture and beekeeping. Worse, they may lead to crop failures and mass bee colony collapse respectively. Insect-eating birds will decline dramatically and may go extinct.

Frequency (i.e., wavelength) appears to be a more important factor than signal strength (power) in insect declines. Greece is using the 0.7 GHz, 3.5 GHz and 22.5 GHz bandwidths; the last of which is often classed as millimeter waves. Wherever 5G signals are present, insects have declined, whether these areas are near to or far from cell towers. Samos is rapidly losing most of its insects including its pollinators.

Introduction

In 2017, a study of insect declines conducted in German nature reserves and spanning nearly three decades, shocked the world. The study, "More than 75 percent decline over 27 years in total flying insect biomass in protected areas," ruled out climate change and pesticides as the cause for the dramatic declines, but did not consider the possible effects of cell towers, which over the study period had grown in number as 2G gave way to 3G and then 4G. Nor did the study break down insect declines into periods corresponding with each generation of cell tower radiation. Had it done so, it might have been possible to observe which generation had the greatest impact on flying insects, many of which are pollinators.

Even before the study was published, many people around the world had noticed a curious phenomenon: insects were no longer being crushed on their windshields as they drove along. This phenomenon appeared soon after the installation of 4G/LTE. It has sometimes been attributed to the more streamlined design of new cars, but this is nonsense; a great many people, my husband and myself included, drive old cars. Our flat-fronted 1975 VW van has the aerodynamics of a brick. If there are no insects being crushed against our windshield, this is simply because there are increasingly fewer insects to crush. Also, it does not matter where we drive—through wetlands, forests, meadows or along highways.

This fact that this phenomenon is worldwide also demonstrates another important point: high or low RF radiation standards do not matter. The U.S. and many European countries, for instance, allow quite high levels of non-ionizing radiation in the environment, from 2 to 10 watts per square meter, depending on frequency. Italy, Poland and other Eastern European countries have the lowest levels at 0.1 watt per square meter, and other countries allow levels somewhere in between. Clearly, power levels of RF radiation are not the driving factor in killing the insects which would otherwise be splattered on windshields. Since this phenomenon only appeared after the introduction of 4G/LTE, the 4G technology itself would seem to be the cause.

Now cell towers for 5G are being rolled out worldwide while a large body of research showing harm to humans and the environment is being ignored. The bumblebee, an important pollinator, has gone extinct in nine U.S. states, which has led to an official inquiry by the U.S. Fish and Wildlife Services. Insect declines due to cell towers were being reported as early as 2003 by Ferdinand Ruzika (Schäden Durch Elektrosmog." *Bienenwelt* 10: 34-35.) yet until now the focus of governments and nature NGOs has been on the use of pesticides and monoculture, along with climate change. Why has no one[1] considered the environmental effects of RF radiation? Why is RF radiation not classified as a pollutant along with pesticides, toxic chemicals, and factory/vehicle emissions?

5G employs a different technology with short pulses of RF radiation using moving, focused beams; the MIMO (Massive Input, Massive Output) technique. In Greece, the frequency bands of 0.7 GHZ, 3.5 GHZ, and 22.5 GHZ are currently in use. The latter, 22.5 GHZ, is not technically millimeter-wave but is often included in this category because the size of the wave is so small. This may be especially dangerous to insects since the wavelength may cause the insect to behave like a secondary antenna due to its size. Studies by Thielens *et al*. have shown that 5G will be especially harmful to insects precisely because the size of the millimeter waves fit into their tiny bodies, where they can do the most harm.

The effects of RF radiation on insects in the field have not been well studied; most work has been done in the laboratory or using computer modeling. This paper is an effort to document what has happened in an area which has cell tower radiation but does not have pesticides or monoculture, which has a rich variety of plant life and is surrounded by wild land. It is based purely on observation and no effort has been made to trap insects and preserve their corpses to verify their existence and for potential future examination.

However, I would contend that in this time of severe insect declines, to trap and kill insects in order to study them is barbaric and counter-productive because it removes them from the environment and stops them from reproducing. Unlike wild animals, insects do not mind being observed, and it is easily possible to stand and watch them at work, to count them, and to draw conclusions about their numbers without killing them.

Samos is a good place to observe insects. It has a large variety of flora and there is not much development, so that many natural habitats have been preserved. Bee-keeping is an important industry here, and Samos is reputed to have the highest proportion of beekeepers for its area and population than anywhere else in the world. Samos, along with Mytilini (Lesvos) is also reputed to have the greatest diversity of wild bee species in the world. Lazaro *et al*. (2016) found 130 species of wild bee on Lesvos in their study of wild pollinators, and Samos, with its diversity of landscapes, may have as many or more. This is why, in the first decade of this century, owners of greenhouses in the Netherlands and Belgium were paying local people on Samos high prices to illegally trap wild bees and bumblebees, which they exported to their home countries where bees were already in trouble.

Footnote:

1. Actually, one nature charity has considered the impact of RF radiation–Buglife UK. They requested and got a meeting of the EU's Eklipse Mechanism in 2017, to look into the topic of the effects of electromagnetic radiation (EMR) on wildlife. However, the Eklipse committee, while issuing a report which stated that EMR does indeed affect wildlife, stopped short of demanding a moratorium on 5G while further studies were done, despite the fact that virtually all the participants in the meeting requested such a moratorium. The EU has reiterated many times its commitment to 5G, and the potential extermination of nature has not deterred it.

Background: Samos 2012-Spring 2021

Insects and birds have been declining on Samos since the introduction of mobile technology. One area where this has been especially evident is in the wetlands on the south coast of the island. After the introduction of 3G, all the frogs disappeared. After the introduction of 4G/LTE (2016) all the terrapins disappeared from the wetlands, while bird numbers and species began to decline rapidly, especially small birds such as sparrows, chaffinches, linnets, greenfinches, goldfinches and serins. Insect numbers also declined. Huge flocks of crows now dominate the area; this is a sign of imbalance in the ecosystem. In addition, after 4G was deliberately aimed at the southern beaches, sea life declined as well. Octopi, sea slugs, sea hares, nudibranches, starfish and a type of sea horse became very scarce or disappeared

altogether. This is not due to pollution of the sea. Although this is a farming area where agrochemicals are used, it has been farmed for many years and sea life did not radically alter until 4G/LTE coverage of the area. The large reed beds function in the area as a filter for agrochemicals, so that the runoff into the sea is clean.

Sea life on Samos has been greatly affected by cell tower radiation, especially since 4G/LTE. The sea bed close to where we live, which does not get agricultural runoff, has lost all its corals, starfish, lobsters, cuttlefish, sea slugs and sea hares as well as most octopi, flounders and urchins. There are far fewer fish; in fact there is very little aquatic life compared to ten years ago.

Another area where the effects of 4G/LTE were very evident is the mountain of Profitis Ilias above Samos town, where the main cell tower array is located. This is a wild area of pine forests and maquis (dense, often high shrubs) with no houses, no agriculture and no pesticides. Prior to 2016, there were many birds and insects including large flocks of chukars (a sub-species of partridge) and numerous species of birds including sardinian warblers, wrens, stonechats, whinchats, robins, blackbirds, song thrushes, Rupell's warblers and cuckoos. There were also many insects and in the summer there would be large numbers of large, colorful spurge hawk-moth caterpillars. There were a great many dung-beetles on the roads because a herd of goats grazed in the area. There were also many flies.[2] The pine trees had an unusual species of stick insect that looked exactly like a dead pine needle. By 2017 the stick insects were gone, all the caterpillars were gone, the flies and dung-beetles were gone, and bird numbers—and species—were declining rapidly. A species of beetle has disappeared altogether—a parasitic but harmless red beetle that appears to be a growth on the holly-shaped leaves of the Kermes Oak.

In the towns and villages, where public and private Wi-Fi was introduced from 2014, there were gradual declines in the numbers of sparrows, swallows and house martins. The main square of Samos town used to be full of sparrows; since 2017, there are none. There are no swallows and house-martins building their nests in the eaves of houses, not only in Samos town but also in the centers of most villages, which also have few or no sparrows, swallows or house martins. In addition, flies began to decline drastically. In the hot Mediterranean summer, rubbish bins attract a lot of flies. By 2019, the bins had very few flies. Even cockroaches were declining. Numbers of bats flying above the town in the evening had also declined.

By 2017 on Samos, the introduction of 4G/LTE led to a dramatic decrease in the number of dead insects squashed on car windshields during driving. We have not had a single dead insect on our windshield for several years. As previously mentioned, many people have noticed this phenomenon, both here on Samos and all over the world.

Footnote:

2. Flies are a good sign of a healthy environment. Greece has many herds of goats and sheep and these tend to attract a great many flies. On Samos these days, even areas where goats graze regularly are tending not to attract flies. We used to camp on a peninsula called Nies in central Greece, below the town of Sourpi between Lamia and Volos. There were several large herds of goats and a great many flies. There was no cell signal at all in the areas where

the goats grazed. On our last visit to that area, in spring of 2017, a small cell booster had been installed on the headland and there were very few flies indeed. At least 90% of the flies had vanished.

Observational Area: 2012-2020

In contrast to many areas of the island, our land had until recently been doing well, although my husband and I have seen declines in both insect and bird numbers (both resident and migratory birds) since 2016, when 4G/LTE was introduced. In May 2012, when we moved here, Samos had 3G and there were few cell towers. Around our land there was only one cell tower and two boosters on the nearby mountain of Profitis Ilias (3.5 kilometers distant), one booster on a hill to the southeast (approx. 6 kilometers distant), and one booster to the west across the bay of Vathi (approx. 8.5 kilometers distant). There was very little wireless signal on the property itself; a cellphone call could only be made from the top two terraces and to use a 3G dongle, my husband would have to open the metal gates at the back of the property which face Profitis Ilias. Even then, he would only get one bar of reception. (We did not, at the time, realize the dangers of RF radiation.)

After 4G/LTE was introduced in early 2016, the number of cell towers increased dramatically, and by 2017 there were two cell towers on Profitis Ilias along with eight booster towers, three cell towers to the southeast along with several boosters, a very large cell tower across the bay with a booster above it, and a booster above Samos town. All of these are visible from our land. Recently one of the cell towers on Profitis Ilias has been taken down and now there is only one.

In the spring of 2021 a very tall 5G cell tower was built at Kokkari, a small tourist village across the bay and about 6 kilometers distant. By early July, 5G panels had been placed on it and on all the cell towers surrounding us. The 5G network on Samos went live in the first half of July, although it was not commercially available then. However, once 5G was operating, the frequencies were polarized/coherent, pulsed, modulated and variable. These are the features of electromagnetic frequencies which cause the most damage to living creatures (see Discussion).

Our property (approximately 12,000 square meters/ about three and a half acres) sits on a peninsula to the north of Samos town and is surrounded by land which is either uncultivated, organically cultivated, or wild. No pesticides are used at all, by us or by any adjoining neighbours. The land is wild both below the property, down to the sea, and up the mountain beyond a couple of small houses and olive groves.

There is a rich variety of trees and plants on the land, providing good cover and a variety of habitats for insects, birds and small mammals. The property is bordered by a wall of mature cypress trees, and there are open fields as well as many mature olive trees, large pine trees, a grove of rare mastic gum trees, and many other trees including carobs, wild pistachio, bay trees, almonds, apricots, plum and pear trees. There are dense thickets of cypress, lentisc (related to mastic) and Kermes Oak along one side and at the back of the property, and a small cypress forest in the northeastern corner. Except for three vegetable beds, everything

is allowed to grow wild, and there are many wildflowers, tall grasses and a great deal of wild fennel, which grows up to two meters high. I have owned this land since 1980, but I have known it since 1963. It was abandoned in World War II, and it has never to our knowledge been cultivated or had any pesticides since that time. A neighbour used to graze his goats here until 2009.

We had, until recently, a great variety and number of pollinators and other insects, more than we have observed anywhere else on Samos. We attribute this partly to lack of pesticides and partly to the abundant vegetation, which we do not cut down. In Greece, people tend to cut down all the vegetation, whether in gardens or olive groves, in the spring/early summer (very few people have lawns). Roadside vegetation is cut down by the local council. This reduces habitats for insects and small creatures.

We grow our own fruit and vegetables, but we do so organically; no pesticides or herbicides of any sort are ever used. We intercrop different plants to reduce pests and plant flowering basils and zinnias along the rows. Basil discourages pests but attracts many pollinators, as do zinnias. We also provide shallow dishes of water, changed daily, for birds and bees to drink from.

Despite our efforts, there has been a decline in insect numbers overall, with some species particularly affected, since we moved here permanently in 2012. We saw the first major decline after 4G was introduced and many new cell towers appeared. For example, by 2017 most of the fireflies had gone, and we have not seen one in over a year. A species of small, night-flying beetle has also completely disappeared in the last two or three years, as has a pretty, iridescent leaf beetle. Fleas have disappeared—we used to see them hopping in the grass and our dogs would be covered in them. In the past two years, neither dog has had a single flea. Dung beetles declined severely, along with other beetle species: indeed, beetles seem to be the most affected of all insect orders. Grasshoppers and crickets declined, and so did flies. Despite all this, insect and pollinator numbers on this land generally remained high compared to other places on the island.

Since 2012, bird numbers have also declined, with the biggest declines since 2016. We had little owls, but we have not seen one for two years though we still have a pair of tawny owls. (All the little owls on Samos have vanished in the past year—we used to know at least nine places where we could always find one, but now they are all gone).

We used to get large flocks of chaffinches, but now we rarely see them. We used to see hoopoes in spring and summer, but they don't come any longer, nor do we now get collared flycatchers on passage. Numbers of wrens and chiffchaffs have declined steadily, as have black-caps and lesser whitethroats, along with orphean warblers. The blue tits are gone. Great tits (still fairly common) are still here but no longer breed in the olive grove as they always used to; for the past two years they have sought deeper cover for their nests. Sardinian warblers are still numerous. We have a good many jays and blackbirds; the latter seek deep cover for nests. Song thrushes have declined. We have many fewer ring-neck doves than we used to. We had wood pigeons until August; we have seen only one since, although they are a resident species. Raptors (short-toed eagles, goshawks, sparrowhawks, Eleanora's falcons, buzzards, ravens) are becoming less common. We have not heard a

night-jar since 2018—they used to be regular summer residents. There are still many yellow-legged gulls. Crows have become more common.

Until this past summer, we also had a good deal of other wildlife: golden jackals are frequent visitors, as are wild boar. We had stoats, weasels, tree rats, field and harvest mice, voles, tortoises, hedgehogs, lizards and snakes, geckos and chameleons—though the latter two are declining. We used to get pine martens but have not seen one in at least four years.

Methodology

This paper is the result of years of observations. I have been interested in wildlife, including insects, since I was a small child. I collected them in jars and watched them in the field. I would collect egg-cases and watch them hatch to see what emerged. I find them extraordinarily beautiful. I am always interested in finding new species and what they are called, though the latter is difficult because there are so many species. Also, most "how to identify" books and websites concentrate on Northern Europe. The Mediterranean region, particularly Greece, is inadequately covered.

Since we began growing our own fruit and vegetables, I have been very interested in watching the pollinators at work: different types of bees and hoverflies, butterflies and some moths. Certain plants attract many pollinators. Onion flowers, for instance, attract a great many wasps and hornets, and species appear which one does not ordinarily see about. Carob flowers, especially of the male tree, attract huge numbers of bees, wasps, hornets, hoverflies, drone flies and some butterflies. These plants, among others, are a good gauge of what is and isn't present, and every season has some plants in bloom, even winter. On summer nights it is easy to observe moths, which are attracted by torchlight, or come inside through open doors and windows, while in daylight they are often found asleep on tree trunks.

I am not an entomologist and primarily my observations have been to satisfy my own interest and curiosity. However, since we first noticed declines following the introduction of 4G, my husband and I have been watching and making mental notes of what is—or increasingly what isn't—there.

As Levitt, Lai and Manville note in their superb three-part review of the effects of RF radiation on wildlife, (see References) it is not always easy to notice declines, even when you are looking. How do you know that this firefly or hawk moth or ant lion is the last one you will ever see in this place? Yet there comes a point, when declines become a serious issue, when you start to look at each insect and wonder if it *is* the last one of its kind you will ever see. This is the point we have now reached, and it sharpens the memory.

I believe that observation rather than trapping and collecting dead insects, is a valid tool for scientific study. We would not kill birds, for instance, in order to determine their prevalence. Killing insects in order to study them removes them from the ecosystem; they will no longer reproduce or pollinate the plants they feed on. Lazaro *et al*. (see bibliography) drowned over 17,000 insects—pollinators—in order to determine if cell towers were having any effect

on pollinator composition and abundance. They concluded that cell towers were indeed harming pollinators. The German insect study by Hallmann, Sorg *et al*. (2017) collected 53.54 *kilograms* of invertebrates, although they were being careful not to overstrain the ecosystem as they note that "the sampling process can negatively impact local insect stocks." Now, with insect declines and extinctions becoming a major issue, other ways must be found to determine species and their abundance—or lack thereof—in a given environment. We cannot set traps, go away and come back days later. We have to take time —and it does take time—to look.

Observational Area: April-November 2021

Insects

In the spring of 2021, insect and pollinators numbers on our land were normal to high compared with other places on the island that we visit frequently (see Table of Insects, below). In the spring we had many varieties of pollinators including wild honeybees, many species of wild bees, bumblebees, carpenter bees, hoverflies and butterflies as well as other insects. Bird numbers were normal (compared to last year) for the time of year.

Sometime in early July, the 5G wireless network on Samos went live. By the end of July, we noticed that tomatoes, melons and courgettes planted in late June were not being pollinated although the plants produced many blossoms. Neighbours also reported that courgettes, as well as pumpkins planted in late June, were not pollinated after July. There were no bees on the vegetable bed where our tomatoes, melons and courgettes were planted, and very few insects overall on this bed, though there were still some bees (wild bees, honey bees, bumblebees) hoverflies and drone flies on our other vegetable bed.

From late July, overall insect numbers visibly diminished; there were fewer butterflies, virtually no moths, and very few beetles (some, like cockchafers, were entirely missing). We found no caterpillars at all, which was unusual because Scarce Swallowtail butterfly caterpillars feed on the wild fennel, which is abundant, and we usually see a number of these. Generally we get many Woodland Grayling butterflies on the pine trees in July and August, and they erupt in a great cloud when we go past; this year there were very few. Other insects were also declining: these include wasps, grasshoppers and crickets, mantises, cicadas, web-spinning and hunting spiders. There seemed to be fewer cicadas than usual. There were definitely fewer hornets than usual; their season is August through October.

Flies were also declining. This was very evident because we have two dogs and many jackals that regularly frequent the property. Their feces should attract many flies (carrion flies, bluebottles and greenbottles) but these days attract few to none. We have noticed that on several occasions when we have seen carrion flies on the feces, they are wingless—or have only vestigial wings. This may be a sign of DNA damage.

We have also noticed other signs of potential DNA damage: last summer (2020) a potter wasp laid four eggs in "pots" on a fennel stalk. We were able to see two of them hatch; one had damaged wings and died. In the early part of this summer (2021) the small cicadas

hatched (we have two species here, large and small). Of the ones we saw hatch, a proportion (perhaps one in ten) had damaged wings. Ant lions were also affected. We saw only two adult ant lions all summer, though we saw a great many ant-lion larvae in their funnel-shaped holes all through July, August and into September. It seems that they did not progress to the adult stage. We saw no spoonwing lacewings at all this summer, although they too used to be common.

In late September, we became very alarmed when a male carob tree (we have two) blossomed but failed to attract pollinators. Normally this carob draws large numbers of pollinators of all sorts from a wide area—hundreds, perhaps thousands of insects. The tree should have been buzzing with insects for about a month (the blooms last a long time) but this year it did not. We checked it every day and most often it had no bees at all, while other days it had two or three honey bees, a couple of bumblebees, two or three hornets, perhaps a hoverfly or two, or a butterfly. There were never more than 4-5 insects at any one time and we were probably seeing the same insects day after day. A second male carob that came into bloom in mid-October similarly failed to attract significant numbers of pollinators: one or two bumblebees, one or two honeybees, or a hoverfly or two at a time. Other flowering plants also failed to attract pollinators: a pear tree that bloomed in November, clumps of heliotrope, the very sweet blossoms of traveller's joy/cat's claw, or the sweet flowers of a prickly weed that usually draws lots of bees.[3]

One area of our property that has always attracted many bees has huge pine trees that were covered in the scale insect called pine bark adelgids. These appear as fluffy white cotton on the bark and are considered a pest (though they don't actually harm the trees) except to beekeepers. They exude a sweet liquid, the by-product of the pine sap which the insects suck from the tree, from which bees make pine honey. Samos produces a great deal of pine honey. Our trees have always been covered in these insects, with some seasonal variation (more in spring and summer) and attract all kinds of bees year-long. Now these insects are all gone, with only a few bits of white fluff remaining to show they were once there.[4]

It is not only the pollinators which are disappearing rapidly. All sorts of insects have vanished: web-spinning spiders (we are seeing virtually no webs where there were thousands), hunting and crab spiders, beetles of all sorts, grasshoppers and crickets, mantises, one species of mosquito, and many more. Of the two species of mosquito we used to have, the one we still have breeds in our covered cistern, which has thick stone walls and a roof; they get in and out through drain holes and the overflow hole. Our next-door neighbour has an open cistern that was filled with mosquito larvae until early August; since then there have been none, though there has been no frost to kill them. Even the ants seem to be affected. Normally in mid-summer we come across piles of dead ants which are the victims of ant wars; this summer we saw none. With the first rain the flying ants (potential future queens) normally come out by the hundreds; this time we saw very few—perhaps twenty. In early summer, the ants were everywhere.

Another indicator of insect decline was the diminishing number of dragonflies and bats, which both feed on insects. In October, the warm, still, slightly foggy days that usually draw thousands of dragonflies (mostly scarlet darters) brought very few of these beautiful

creatures. Bats have also declined. In early summer, we would have between seven and ten bats overhead in the dusk; now we never have more than one.

Also extremely alarming is the lack of insects in the soil. In the spring, when digging up our vegetable plots for planting, we noticed that there were very few earthworms, grubs, or a species of small brown centipede that burrows underground. There should have been many more, especially earthworms. After the first good rain in mid-October, my husband dug a third vegetable bed on the top terrace for winter vegetables. He dug over 40 centimeters deep but found nothing: not one earthworm, one grub or one centipede. In mid-November I dug up one of the summer beds and also found nothing. This implies that soil microorganisms are no longer present. The only earthworms we have seen this year surfaced after a very heavy rain, and there were only four of them.

Table of Insects for the Observational Area

(for a more detailed table, see the end of this paper, after References)

5 = 100% (This is given as a baseline for 2012 and does not reflect insect prevalence of earlier years. Many species have disappeared entirely since the 1960's/1970's, such as the Rhinoceros Beetle and the Great Peacock Moth. A very common large black and yellow web-spinning spider has disappeared since around 1999.) 4 = 80%-61%, 3 = 60%-41%, 2 = 40%-21%, 1 = 20%-1%, 0 = none seen

Type of Insect	2012	2017	Apr-June 2021	July-Dec 2021
Beetles	**5**	**3**	**2**	**1**

Beetles are the most affected category. Some species such as leaf beetles, a species of night-flying beetle and fireflies completely disappeared by 2019, and long-horn beetles were diminishing rapidly. By spring 2021, there were very few dung beetles, ladybirds, gold bugs, click beetles, weevils or glow worms. After July 2021, cockchafers, pine bark adelgids, long-horn beetles, two species of ladybird, dung beetles, click beetles and weevils disappeared altogether.

Bees	**5**	**4**	**3**	**1**

By 2017, honey bees (wild) and carpenter bees had visibly declined. By spring 2021, all types of wild bees except white wild bees and bumblebees had declined somewhat. After July 2021, all bees declined seriously. Tiny wild bees (several species) and white wild bees (one species) appear to be doing somewhat better than other bees so far. Bumblebee numbers are way down this winter.

Wasps	**5**	**3**	**2**	**1**

Wasps started to decline rapidly after 2017, with the exception of digger wasps. By spring 2021, there were no paper wasps. After July 2021, all wasps declined to the extent that some species appear to be extinct. A hatching potter wasp showed DNA damage (damaged wings) in 2020.

Hornets	**5**	**5**	**4**	**3**

Red hornets tend to appear from August, while other hornets only appear in spring. There were fewer red hornets in 2021 than in 2020.

Grasshoppers and crickets **5** **4** **3** **1**

Grasshoppers and crickets have been declining steadily since 2017, and many common species such as red/blue winged grasshoppers and house crickets have all but disappeared since July 2021.

Cicadas (2 species) **5** **5** **4** **4**

Possible DNA damage was observed in about 10% of small cicadas which hatched with crumpled wings.

Leaf hoppers **5** **4** **2** **1**

Flies **5** **4** **3** **1**

Fruit flies disappeared by 2020, and we saw no spoonwing lacewings at all this year, nor any crane flies or lacewing flies after August. There were very few ant lions (only 2 were observed) though there were many larvae (possible DNA damage). All flies have declined and carrion flies with vestigial wings have been found on feces (possible DNA damage). Of all flies, hoverflies and drone flies seem to be doing the best; this may be because of the decline in wasps and other insects which prey on them.

Mantises and stick insects **5** **3** **2** **1**

Mosquitoes and Midges **5** **4** **3** **2**

One species of mosquito has disappeared altogether. Another species breeds in a closed cistern with thick stone walls and a cement roof. Mosquitoes in our neighbour's cistern, which is open, have died.

Dragonflies and Damselflies **5** **4** **3** **1**

Ants (all species) **5** **5** **5** **3** (less activity, very few queens)

Butterflies **5** **4** **3** **2**

Until recently, butterflies were not declining as much as other types of insects, though some species. such as the Southern White Admiral, Cleopatras and fritillaries (all sorts) have disappeared. Since July 2021, all species are declining. This is especially evident in the Cabbage Whites, which were very common. Last year we would find 7-10 clutches of eggs daily on broccoli and cauliflower leaves. This year we found only one, and we have not seen a Cabbage White here since early December.

Moths **5** **3** **2** **1**

Moths have been declining seriously since 2017, and some species such as Burnets, White Ermines and Common Emeralds have disappeared entirely. Since July 2021, all moths have declined seriously with the exception of several species of tiny moths. LED street lighting is known to affect moths, but LED street lighting has only been used on Samos for the past year and cannot account for previous declines. There are only two street lights near our land, but they are screened by trees and the property is dark at night.

A note about butterflies and moths: We have found very few caterpillars or inchworms, and no chrysalises or cocoons at all this summer.

Spiders **5** **4** **2** **1**

Web-spinning, crab and hunting spiders are all declining rapidly.

Snails and Slugs **5** **4** **2** **1**

Earwigs (2 species) **5** **4** **4** **2**

Soil Insects	**5**	**4**	**2**	**1**

Earthworms, grubs and small brown centipedes that live underground have all vanished and we cannot find any when we dig. Earthworms should surface after heavy rain but very few have been seen.

Fleas	**5**	**3**	**0**	**0**

Birds and Animals

As noted earlier, wood pigeons seem to have disappeared since August—we have seen only one, though they were numerous. The autumn migration was essentially a non-event, with very few birds passing through; we saw only a few flycatchers and red-backed shrikes, saw one flock of Little Gulls out at sea and heard a small flock of bee-eaters in the distance. Our robins have returned, as well as the black redstarts, but I do not think they migrate far away. The swallows, house martins, common and alpine swifts left earlier than usual. We saw one spotted eagle on migration, which was unusual because we normally see a family group of three or four, and it does not seem to have stopped at the wetlands on the south of the island where it usually winters. We have heard no birds flying high overhead, which is extremely unusual as autumn nights are typically full of the sound of distant quacking as ducks and geese migrate overhead.

Very alarming is the presence of night-jars which have not been here during the past few summers. They do not sing but we have spotted five or six of them in our area since December. They should not be here now; they should be wintering in Africa. We have also been hearing a nightingale sing in the early mornings since January. It too should not be here; nightingales winter in South Africa. What has happened to these birds?

Look at the Cosmote coverage maps for Greece using the link below; you have to click separately on 2G, 4G and 5G (for some reason they seem to have omitted 3G, which also exists). https://www.cosmote.gr/cs/otegroup/en/kalipsi_diktiou_en.html

The map of 5G coverage is, at the time of writing, out of date, so it does not show coverage of Samos, Ikaria and many other areas that are now 5G. However, you will see that the new 5G signal (in green) covers much the Aegean—you can see how far the signal travels from the islands which do show 5G coverage. Try to imagine what it is like for a bird trying to navigate its way north or south when the 2G, 3G, 4G and 5G signals all overlap each other. And it isn't just Cosmote covering these areas; there are Vodafone, Wind, Forthnet and other companies. In addition there are Turkish 5G, 4G, 3G and 2G wavelengths all along the Turkish coast; Turkish cell signals reach all the Greek border islands and border areas.

Migrating birds and butterflies depend on being able to sense the earth's natural electromagnetic fields in order to navigate. The nightingale and the night-jars we are seeing must have been too confused by the new 5G signals to continue their migration southwards, and have ended up wintering here because they can literally go no farther. It has long been predicted that 5G will interfere with migration, and I believe we are seeing the evidence of it. Will the swallows, martins and swifts return in the spring? What will happen if migrations stop, as seems all too possible?

Animals have also been affected by 5G since July. Boar, for instance, have become very aggressive and all through the summer months were present in daylight hours (they are mostly nocturnal). My husband and I were charged on two occasions, and they have dug up a lot of our land looking for snails which are no longer present. They have also dug up gardens, fruit and olive groves, and large areas of roadside in our neighborhood. They have become a major problem on the island as well as in other parts of Greece.

Because of the lack of snails, I fear we have lost our hedgehogs, which we used to hear every summer night creeping and crunching along the terrace walls. We haven't seen or heard a hedgehog for months.

Also since July, mice, voles and rats have declined hugely, and we have not seen any stoats or weasels recently. The lack of rodents is easily apparent because they have always taken a proportion of our summer crops, and in winter it has always been necessary to cover young broccoli and cauliflowers with plant pots to stop the rats and mice from eating them. This past summer we lost hardly any fruits or vegetables to the rodents, and we no longer have to cover our young cauliflower or broccoli plants. We do not see tree rats in the trees, they did not eat the seeds in carob pods this summer. nothing disturbs the vegetable remains on the compost heap, and our resident weasel has gone. Since raptors (eagles, buzzards, owls etc.) and golden jackals depend largely on rodents for food, it is small wonder that they too are declining.

Footnotes:

3. The insect declines we are seeing on our land are not limited to here. They are everywhere we go on this island, and other people have noticed them. 5G seems to have decimated (I use the word literally) insect life all over Samos, regardless of whether the areas are near to or far from cell towers. In a valley where we often go there are fields of daisies and dandelions, and the almonds are coming into bloom, but we have seen hardly any insects on recent walks. One warm, sunny day in mid-February we stood for an hour observing an area that had anemones, daisies and dandelions—plenty to attract pollinators. In that time we saw one butterfly and one fly. There were no other insects.

A shepherd who lives in the valley told us, "Everything is disappearing—everything. There aren't any insects, or birds, and even the jackals have vanished—there might still be one pack on Tourkovouni (a hill facing Turkey) but the rest are gone because there's nothing for them to eat. All we ever get these days are crows, crows and more crows. No one is hunting any more because there isn't anything to hunt. I've lived here since 1980 and I've never seen anything like it." He should know—as a shepherd, he spends every waking hour out of doors. There are two brand new 5G cell towers in the area, both less than two kilometers away.

4. There are no other pines with these scale insects anywhere in the area, so we are not able to determine if they have also disappeared from other pine trees.

Soil Acidification

Soil acidification caused by electromagnetic radiation has been a problem for the past few years, and all the local garden centers are selling products (calcium pellets supplemented by magnesium[5]) to the increasing number of customers who come in complaining that the bottom halves of their tomatoes are rotting and that their peppers have black spots (for a market gardener, this makes them unsaleable).

German scientist Wolfgang Volkodt (see Balmori 2003) was the first to discover that Rf radiation causes soil acidification through a process of electrolysis: the leaves of plants absorb the radiation and the charge eventually migrates into the ground, changing the balance of ions and retarding soil microorganisms. Hydrogen ions displace ions of calcium and magnesium, which leach out of the soil. Fruits and vegetables rot before ripening or fail to grow to normal size. Adding calcium and magnesium helps the plants to grow normally. However, the underlying soil acidity is not cured, rendering the environment unsuitable for soil insects and microorganisms. In addition to problems associated with soil acidity, we have noticed that compost does not break down as it should. Discarded plant matter withers rather than rots, and there are no insects when piles are turned.

We notice the lack of soil insects because we dig our vegetable beds using hand tools. A farmer using a tractor might not notice that he isn't digging up earthworms and grubs, but he will notice if the newly-dug field doesn't attract birds (crows, gulls, storks, starlings etc.) who come to eat the worms and other insects he has turned up.

Footnote:

5. It is interesting to note that these products are labeled "For soil *acidification*" rather than "For acid soil". Some soils may be naturally acidic, but this labeling implies that formerly sweet soil is now acidic, as is the case with our own land. Also, these calcium pellets are expensive. A 20 kilo bag costs 30 euros and doesn't go very far. If farmers have to start adding calcium pellets to their fields, the cost of fruits and vegetables is going to skyrocket.

The lack of calcium in the soil is also affecting wild plants. Wild plants (spurges, grasses, wild garlic, clovers etc.) growing in the summer bed to which we had added calcium pellets are much bigger than the wild plants growing elsewhere on the land. All these plants used to grow much taller than they do now.

November 2021-February 2022

Although there are fewer insects present in the winter months, there is never a time of year in this climate when there are no insects. Temperatures hardly ever reach freezing point, and at most we get a few cold days before the weather warms up again. A typical winter day varies between 10 and 15 degrees Centigrade. It is only on days that are both very cold and cloudy that we tend not to see many insects. On sunny days the bumblebees, some wild bees, drone flies, hoverflies and sometimes wild honey bees, should be out pollinating winter flowers. If they did not, we would not have winter-blooming plants.

Unfortunately, the declines in insect numbers are continuing. Since October anemones, cyclamen, narcissi, dandelions, daisies and shamrock flowers have bloomed in profusion everywhere. Now the almonds and mimosa trees are blooming, and the orchids are starting. None of these have attracted many pollinators. In October and November there were masses of heather all up the mountainsides, and then the arbutus trees flowered, along with the rosemary bushes. These plants too drew very few pollinators—the occasional bumblebee when there ought to have been many of them. Bumblebees work through the winter here, as do other pollinators when the weather is sunny, and we should be seeing many bumblebees on our land instead of the occasional four or five which are all we see now. Mature almond trees covered in flowers should buzz with all sorts of pollinators, yet they do not.

The damp-loving winter insects such as snails, slugs, common millipedes, and a type of yellow-and-brown millipede are all but gone. We have seen no beetles except for a few European Ground Beetles. We have far fewer Red Admirals, primarily a winter butterfly, than last year, and the Cabbage Whites (both large and small species) have disappeared altogether from our land. Last year we were removing seven to ten clusters of Cabbage White butterfly eggs from cauliflower and broccoli leaves each day throughout the winter and spring; this year we have found only one cluster of eggs. We saw the last Cabbage White in the beginning of December.

Pesticides

In this area, insect declines are definitely *not* a pesticide problem. Neither we nor any of the neighbours whose land borders ours use pesticides or herbicides, and much of the surrounding land is wild down to the sea and up the mountain. There is no commercial farming in this area, only vegetable gardens and olive groves. Most of the agrochemicals used on this part of the island (when any are used at all) tend to be herbicides rather than pesticides. It is the custom on Samos to let others know land has been sprayed by either putting up a sign or, more commonly, to hang the empty pesticide/herbicide bottle from a tree where others can easily see it. A very few people spray weeds rather than cut them down (not near us), and some people spray olives for an olive pest called dakus. No signs or empty bottles have been displayed in our area since 2012. I am quite certain that no land adjoining ours in any direction has been sprayed with anything in years.

It is worth remembering that most pesticides are not intended to target all insects indiscriminately, though neonicotinoids are definitely dangerous to bees. I am *not* saying that pesticides are a good thing and I would personally like to see them all banned. But I do recognize that when, for example, an olive farmer sprays his olives for dakus the chemical used is intended to target that particular pest and not to kill all insects. RF radiation, however, especially 4G/LTE and 5G, *is* killing insects indiscriminately. As the wavelengths get shorter, the insects will die out faster—if they have not died out already.

Climate

I do not believe that the insects declines we have seen since 2016, or the sudden drop in insect numbers this past summer, are a climate problem. As mentioned by Hallmann, Sorg *et al*. in their 27-year study of flying insect declines in Germany, a warmer climate should bring an increase in insects, not a decline. Surely climate change, if it affected insects, would bring about a change in the types of insects that are abundant, rather than causing overall declines? In any case, most of the insects which we have on Samos are common to all of Europe except the far north, and thus capable of living in a variety of climatic conditions, both warmer and cooler than here.

There may or may not have been some overall changes in climate in the past 50 years, but I spent a number of years on Samos as a child, in the 60's and early 70's, and I do not recall great differences from the way things are now. It is a mild, warm climate. Some summers are hotter, some cooler. Some winters are colder and others warmer, but there are always warm and cold spells. Some years we get more rain, and some less. Since 2012, the time period covered by this paper, the climate has not changed noticeably.

Discussion

Although we have 16 cell towers and boosters surrounding this land, we are quite far from most of them, and we are to a large extent protected from the nearest ones by high stone walls, a solid metal gate, tall, thick hedges and many trees. We still get 5G signals clearly, though, as well as 4G, 3G and 2G signals. Signals from all four generations of mobile communications are present all over Samos, and there are very few areas that do not have a 5G wireless signal.

We take long walks in different areas: in some places cell towers are closer than they are to our land, while in others the cell towers or boosters are farther away. The insect declines we have been seeing on our land since 5G came in are happening everywhere on the island, and in some places they are worse than on our land. We know this both from our own observations and from talking to people who live in these areas and who have noticed changes in insect populations since the summer.

Not everyone is as interested in insects as we are, but shepherds and farmers spend a lot of time outdoors. They notice if, for instance, the arbutus or rosemary flowers are not attracting any bumblebees, because they are used to seeing bumblebees on these flowers. The bees should be there and they are not. The landscapes where we walk vary: some places are entirely wild and uncultivated, some are farmed or have olive groves, some are near the sea and others are inland. All of these places have one thing in common: wireless communication signals, which these days also means 5G. All the cell towers have 5G panels on them, many 4G boosters have been replaced by 5G boosters, and at least three new all-5G cell towers have been built. 5G is everywhere on Samos. 4G, 3G and 2G are also still in use. If all these frequencies were visible to the human eye, you wouldn't be able to see the island for the microwaves.

All these frequencies are polarized/coherent, pulsed and modulated, as well as randomly variable in intensity and duration. These features are unique to man-made RF radiation/Electromagnetic Fields (EMFs) and do not exist in nature. Panagopoulos *et al*., in a series of papers (see References) have convincingly demonstrated how these unique features of man-made EMFs make it impossible for living organisms to adapt to them: they damage the DNA of living cells and lead to malformations, infertility, cancer and death.

DNA is DNA. Although we talk of "frog DNA" or "human DNA", there is in fact only one sort, and it is in every living creature on the planet. What damages the fruit fly or the rat or the guinea pig in the laboratory will also damage us. The damage from RF radiation observed in the laboratory translates into damage done to living creatures in the world around us, whether in unseen forests or in our back gardens and our homes. We are not separate from nature; we are part of it, and we depend on it for our own survival. The insects, as Sir David Attenborough says, are more important to the planet than we are.

Thielens *et al*. (2018) state that insects absorb more radiation depending on the frequency: the smaller the wavelength, the more radiation insects absorb. Thus the much smaller wavelengths of 5G will do more damage than the larger wavelengths of 2G, 3G and 4G.. True millimeter waves will do more damage than the small microwaves currently employed by the first generation of 5G.

Wireless communications radiation is assumed to be safe because it is non-ionizing, but compare the results of radiation from mobile communications to the radiation from nuclear fallout. In Chernobyl, 30 years after the disaster and despite all the problems associated with nuclear fallout, wildlife, including insects, is thriving. According to an article on chernobylguide.com, scientists who came to the area to study the results of the disaster "came to a startling conclusion: the wealth of flora and fauna in Chernobyl exposes that the presence of people is more damaging to wildlife than the contamination." (https://chernobylguide.com/chernobyl_wildlife/) [6]

Thirty years after the introduction of mobile telephony, we are seeing unprecedented declines in bird and insect numbers. One wonders if nuclear fallout is ultimately more survivable than wireless technology. It is ionizing radiation, but it is not polarized/coherent, pulsed, modulated or variable, factors which may be even more dangerous to living creatures. Nuclear fallout decays with time; species adapt and survive. With the polarised/coherent, pulsed, modulated and variable non-ionizing radiation of modern wireless communications, the radiation burden is increasing, not decreasing; adaptation is not possible, and species—including our own--will not survive.

Footnote

6. Ironically, the EU has just designated nuclear energy as "green", paving the way for many more nuclear reactors and "neighborhood nukes". Thus ionizing radiation will be used to power the ever-growing sources of non-ionizing radiation, whie the potential for nuclear accidents will grow exponentially.

Conclusion

Cell tower radiation is causing insects to die. An ongoing decline in insect numbers occurred after the introduction of 4G/LTE, and the new 5G network on Samos has caused insect declines to reach a tipping point. Since July, insects have been declining very fast. Small mammals are declining as well. Insect declines will affect insect-eating birds and the decline of small mammals will in turn affect raptors and larger mammals which hunt. It could take some time for these effects to be seen. Very few migratory birds have been seen this year, and some birds which should have migrated to Africa are wintering here. 5G appears to be affecting migration.

Beekeepers on Samos have been experiencing problems with their hives for several years: they find empty hives in spring, and in some places bees have had trouble orienting themselves to return to their hives. Farmers in the main agricultural areas have noticed pollinator declines since the introduction of 4G/LTE. Some have taken to planting banks of flowers to attract pollinators to their crops. There is not much farming where we live, except a few summer gardens, so the lack of pollinators has gone largely unremarked except for the lack of pollination in squashes. Winter crops do not need pollination unless plants are allowed to flower and go to seed, but a lack of pollinators will be very evident come spring when summer crops are planted.

The lack of pollinators as well as soil insects and microbes, caused by soil acidification, will affect agriculture, both locally and globally. Crop yields will be low and some crops may fail altogether. As a result, prices which are already high will rise. It is not inconceivable that, with the introduction of 5G globally, there will be crop failures worldwide. This will lead to mass starvation. Insect declines and extinctions will lead to the extinction of many species of birds, as well as to much of the world's wildlife—the chain of life will have been broken.

It is somewhat beyond the scope of this paper, but from what I am observing, I do not believe that signal strength (power) makes as much difference to the effects RF radiation has on insects or wildlife as other factors. There may be a few more insects or birds in areas far from cell towers, but nowhere are there nearly as many as there used to be. Wherever there is a wireless signal, birds and insects are declining. All wireless communications frequencies, (with the unnatural features of polarization/coherence, pulsation, modulation and variability) damage living creatures. The shorter wavelengths of 5G appear to affect insects much more than the longer wavelengths of 2G, 3G and 4G.

There is a large body of research which shows serious damaging biological effects at extremely low RF radiation levels—levels which are far below permitted RF radiation levels in countries with even the strictest standards. Look at the Bioinitiative Group's Color Charts (https://bioinitiative.org/rf-color-charts/) for examples of this. For instance, changes in genes have been observed at 0.1 nanowatt per square centimeter.

Many people are asking for "safer", by which they mean lower, RF radiation standards, in the belief that these will protect them and the environment. The United States Federal Communications Commission says this is not possible:"No device could reliably transmit any usable level of energy by today's technological standards while meeting those [the BioInitiative Group's biologically-based RF exposure] limits."(p.8 FCC Order 19-126)

RF radiation at lower power will still possess all the features which make it biologically dangerous; it will still be pulsed, polarized/coherent, modulated and variable; mobile communications cannot work without these features.

If we really want to halt insect declines, protect the environment, and protect people, there is only one way to do it—by stopping wireless technology altogether. If we cannot give up mobile communications, we will irreparably damage the environment and ourselves.

Appeal to Readers

Without insects, there will be no life on earth. I realize that many if not most people don't particularly like insects—the word conjures up images of mosquitoes, spiders, flies, or cockroaches rather than butterflies, fireflies, bees or damselflies. In 2018 Bloomberg News ran an article: "Google's Parent Has a Plan to Eliminate Mosquitoes Worldwide. Bite. Breed. Die." which about summed up many people's attitudes to insects: they're horrible, they bite or sting, they may be poisonous or spread diseases, and we don't need them.

The trouble is, we do need insects, even mosquitoes. Life is a chain, and many creatures higher up the chain rely on the mosquito (or some other insect) for food, or eat the creatures that eat the mosquito, to be eaten themselves in turn by other creatures. We break the chain of life at our peril, because we are part of it.

In writing this paper it occurred to me: 5G has been going in around the world for some time now, but I have read hardly anything about it affecting insects, or soil, or bird migration, or animals. Hasn't anyone else noticed? Is Greece the first country to have put 5G all over rural areas? Or are people simply not connecting the dots and continuing to blame pesticides and climate change for everything that goes wrong in nature? Because I don't believe for a second that what's happening here isn't happening in other places. Something caused the bumblebee to become extinct in nine U.S. states. And birdwatcher friends are telling me that they too are seriously concerned about migration.

A big part of the problem is that no one is looking. Every day we take our dogs for a walk and see other people out walking or running, but are they looking around them? Virtually every person we see is carrying a smartphone, and more often than not they are looking at it as they go along. They might notice an elephant if it got in their way, but a bee? Or a lack of bees? They are too involved with "staying connected" to stay connected with the world in front of their eyes. If you don't look you won't see. If you live your life in what NY Times columnist Roger Cohen dubbed "device-distracted apathy" the world around you might as well not exist.

I'm tired of hearing, "Wireless communications are here to stay; we can't do without them; we can't go back to the Stone Age." What we cannot do without—*really* can't do without—is nature. A planet with dead seas and dead land will not support us; we will die of oxygen deprivation or starve to death. Who will you call then?

Now that 5G has arrived, time is running out fast. I don't think it's too late to change things, but I don't think we have much time left to do it. So I ask you—if this paper has meant anything at all to you, think seriously about giving up your wireless devices. There are other ways to communicate. Contact NGOs and ask them to add RF radiation to their list of major threats to the planet, to stop promoting smartphone apps which identify bugs or birds, and to stop tracking animals, birds and insects using wireless devices. Contact government representatives and ask them to support alternatives to wireless technology.

If you don't care, who will?

References:

Balmori, A., (2003) "The Effects of Microwaves on the Trees and Other Plants" http://www.next-up.org/pdf/AlfonsoBalmoriTheEffectsOfMicrowavesOnTheTreesAndOtherPlantsUk.pdf

Balmori, A., (2006) "The incidence of electromagnetic pollution on the amphibian decline: Is this an important piece of the puzzle?" https://www.researchgate.net/publication/228767868_The_incidence_of_electromagnetic_pollution_on_the_amphibian_decline_Is_this_an_important_piece_of_the_puzzle

Balmori, A., (2010) "Mobile Phone Mast Effects on Common Frog (*Rana Tempporaria)* Tadpoles: The City Turned into a Laboratory", https://www.researchgate.net/publication/44685415_Mobile_Phone_Mast_Effects_on_Common_Frog_Rana_temporaria_Tadpoles_The_City_Turned_into_a_Laboratory

Balmori, A., (2021) "Electromagnetic radiation as an emerging driver factor fot the decline of insects", https://www.semanticscholar.org/paper/Electromagnetic-radiation-as-an-emerging-driver-for-Balmori/44614af8c5f3b581ee1fdf48c5ba71abf04c835f

Beety, Nina (2022) 'Hundreds of thousands, if not millions' of birds died during 2020 U.S. Air Force 5G exercise, New Mexico

Bioinitiative Group Reports (2020) https://bioinitiative.org/updated-research-summaries/

Levitt, B. Blake, Lai, Henry C, Manville, Alfred M., (2021) "Effects of non-ionizing electromagnetic fields on flora and fauna"

Part 1. "Rising ambient EMF levels in the environment" https://bloximages.newyork1.vip.townnews.com/santafenewmexican.com/content/tncms/assets/v3/editorial/b/a4/ba4e88d2-808c-11ec-885f-93e31fb2376b/61f473bfea152.pdf.pdf

Part 2. "Impacts: how species interact with natural and man-made EMF" https://bloximages.newyork1.vip.townnews.com/santafenewmexican.com/content/tncms/assets/v3/editorial/0/a9/0a94d74c-808d-11ec-b8ad-07d112f3221e/61f474155a363.pdf.pdf

Part 3. Exposure standards, public policy, laws, and future directions" https://bloximages.newyork1.vip.townnews.com/santafenewmexican.com/content/tncms/assets/v3/editorial/3/9c/39c9e426-808d-11ec-8d57-8796b01ccfca/61f47450226c4.pdf.pdf

Hallmann, CA, Sorg M, Jongejans E, Siepel H, Holland N, Schwan H, *et al.,* (2017) "More than 75 percent decline over 27 years in total flying insect biomass in protected areas" https://doi.org/10.1371/journal.pone.0185809

Lazaro, A., *et al*., (2016) "Electromagnetic radiation of mobile communication antennas affects the abundance and composition of wild pollinators" https://www.researchgate.net/publication/301647025_Electromagnetic_radiation_of_mobile_telecommunication_antennas_affects_the_abundance_and_composition_of_wild_pollinators

Magras, I.N. and Xenos, T. D., (1998) "RF-Radiation-Induced Changes in the Prenatal Development of Mice", https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291521-186X%281997%2918%3A6%3C455%3A%3AAID-BEM8%3E3.0.CO%3B2-1

Panagopoulos, Dimitris J. *et al*. (2015) "Real versus Simulated Mobile Phone Exposures in Experimental Studies", https://www.academia.edu/45342701/Real_versus_Simulated_Mobile_Phone_Exposures_in_Experimental_Studies

Panagopoulos, Dimitris J., (2019) "Comparing DNA damage induced by mobile phone telephony and other types of man-made electromagnetic fields", https://www.semanticscholar.org/paper/Comparing-DNA-damage-induced-by-mobile-telephony-of-Panagopoulos/945a882458450099 24df3f386fdeb0fa715db544

Panagopoulos, Dimitris J. *et al*., (2021) "Human-made electromagnetic fields: ion-forced oscillation and voltage-gated ion channel dysfunction, oxidative stress and DNA damage (Review)" https://www.spandidos-publications.com/ijo/59/5/92

Thielens, A. *et al*., (2018) "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz", https://www.nature.com/articles/s41598-018-22271-3

Thielens, A. *et al*., (2020) "Radio-Frequency Electromagnetic Field Exposure of Western Honey Bees", https://www.nature.com/articles/s41598-018-22271-3

Detailed Table of Insects for the Observational Area

Obviously this is not a complete list of all the insects on our land. The ones listed are—or were-- the most common. Months given for insect prevalence in certain seasons are approximate only. Because this is a warm climate, various plants bloom all year round: almonds in February, different types of flowers and shrubs all through the winter. In a cold spell, insects hibernate, but in a warm spell many insects, especially pollinators, may emerge "out of season". Spring may begin in March in a warm year, or April in a cold year.

List of Abbreviations: NA= Not Applicable; AY= All Year

5 = 100% is given as a baseline for 2012 and does not reflect insect prevalence of earlier years. Many species have disappeared entirely since the 1960's/1970's, such as the Rhinoceros Beetle and the Great Peacock Moth, and a common large black and yellow web-spinning spider has disappeared since around 1999. Although this table shows butterflies to be doing relatively well compared to other insects, some species are now missing and have not been seen for at least several years; the Southern White Admiral is one example that we have not seen anywhere for a long time. Many species of moth have also disappeared, including White Ermines and Common Emeralds.

4 = 80%-61%, 3 = 60%-41%, 2 = 40%-21%, 1 = 20%-1%, 0 = none seen

Type of Insect	**2012**	**2017**	**Apr-June 2021**	**July 2021-Feb 2022**
Beetles				
Ladybirds (Apr-Nov)	5	3	2	1 (seven-spot)/0 (other species)
Cockchafers (Apr-Oct)	5	4	2	0
Pine bark adelgids (AY)	5	5	5	0
Dung beetles (AY)	5	1	1	0
Devil's coach-horses (AY)	5	4	2	1 (only one)
Leaf beetles (Mar-Nov)	5	2	0	0
Goldbugs (May-June)	5	2	1	NA (spring only)
European Ground Beetles (AY)	5	4	4	2
Glow-worms (May-Nov)	5	3	1	1 (only two this year)
Fireflies (May-Sept)	5	2	0	0
Click beetles (Apr-Oct)	5	2	1	0
Shield beetles (many species) (AY, depends on type)	5	4	4	2
Long-horn beetles (Apr-Nov)	5	2	0	0
Wild cockroaches (Apr-Nov)	5	3	2	1

Weevils (Apr-Nov)	5	3	0	0
Night-flying beetles (June-Aug)	5	3	0	0
Bees				
Honey bees (wild) (Apr-Nov)	5	4	3	1
Bumblebees (AY)	5	5	5	1
Carpenter bees (May-Oct)	5	3	2	1
White wild bees (Apr-Nov)	5	5	5	3
Red wild bees (Apr-Oct)	5	5	4	0 (some only early summer)
Flower bees (Mar-July)	5	5	4	NA
Tiny wild bees (Apr-Nov)	5	5	4	2
Wasps				
Common wasps (Apr-Nov)	5	4	2	1
Paper wasps (Apr-Nov)	5	2	0	0
Potter wasps (Apr-Nov)	5	3	1	0
Digger wasps (Apr-Oct)	5	5	4	2
Ruby-tailed wasps (Apr-Oct)	5	3	0	0
Other wasps	5	4	1	1
Hornets				
Red hornets (March-Oct) (especially prevalent August-September)	5	5	3	2
Other hornets (Spring)	5	5	2	NA
Grasshoppers and crickets				
Red/blue-winged grasshoppers (May-Nov)	5	4	3	1
Saga Hellenica (June-Sept)	5	5	0	0
Other grasshoppers (May-Nov)	5	4	3	1
House crickets (Apr-Oct)	5	4	3	0
Great Green Bush Crickets/	5	4	3	1

Night Crickets (June-Nov)				
Other crickets (Apr-Oct)	5	4	3	1
Locusts (June-Sept)	5	4	2	1
Katydids (May-Oct)	5	4	3	2
Cicadas				
Large cicadas (July-Sept)	5	5	4	4
Small cicadas (May-July)	5	5	4	NA
Leaf hoppers (June-Oct)	5	4	2	1
Flies				
Fruit flies (Apr-Nov)	5	1	0	0
Lacewing flies (May-Sept)	5	3	2	0
Ant lions (June-Sept)	5	3	1	0 (many larvae, no flies)
Spoonwing lacewing (May-June)	5	3	0	0
House flies (AY, fewer in winter)	5	4	3	3
Carrion flies (AY, fewer in winter)	5	3	3	1
Horseflies (Aug-Sept)	5	4	NA	3
Hoverflies (April-Oct)	5	4	4	3
Drone flies (Apr-Nov)	5	5	4	4
Crane flies (May-Sept)	5	3	1	0
Blue/Greenbottles (AY if warm)	5	4	3	2
Mantises and stick insects				
Praying mantises (Apr-Nov)	5	4	2	1
Mantises (Apr-Nov)	5	3	1	1
Stick insects (May-Oct)	5	5	2	0
Mosquitoes and Midges				
Black/white striped mosquitoes (May-June)	5	4	0	0

Small mosquitoes (AY esp Aug-Sept)	5	4	3	2
Midges (AY esp summer)	5	5	4	4
Dragonflies and Damselflies				
Damselflies (Apr-Oct)	5	4	2	0
Scarlet Darter (June-Nov, esp. Oct)	5	4	4	1
Emperor (June-Sept)	5	4	3	0
Other dragonflies (June-Oct)	5	4	4	1
Ants (all species)	5	5	5	3 (less activity, very few queens)
Butterflies and Moths (There are many species of butterflies and moths—not a complete list.)				
Woodland Graylings (July-Aug)	5	5	NA	2
Tiger Swallowtails (May-Oct)	5	5	5	2
Scarce Swallowtails (May-Sept)	5	5	5	4
Two-tail Pashas (July-Aug)	5	5	NA	0
Coppers (June-Sept)	5	5	NA	2
Blues (June-Sept)	5	5	NA	2
Red Admirals (AY)	5	5	5	4
Cabbage Whites, Large/Small (AY esp winter/spring)	5	5	5	0 (since December)
Southern Gatekeepers (June-Oct)	5	5	4	4
Fritillaries (various, Apr-Oct)	5	3	1	0
Browns (various, Apr-Oct)	5	5	4	3
Eastern Festoon (Feb-April)	5	5	5	NA
Hummingbird Moth (May-Nov)	5	4	4	4
Dappled Whites (Mar-Apr)	5	5	5	NA
Cleopatras (Apr-May)	5	2	0	NA
Yellow Tips (Apr-May)	5	5	2	NA
Painted Ladies (Apr-Sept)	5	5	5	4

Garden Tigers (May-Sept)	5	3	2	0
Red Underwings (July-Sept)	5	4	NA	0
Burnets (2 types, June-Sept)	5	0	0	0
Various Hawkmoths (Apr-Oct)	5	2	0	0
Cypress Moth (May-Sept)	5	5	3	1
White Ermine (May-Aug)	5	0	0	0
Common Emerald (May-Aug)	5	0	0	0
Other large moths (Apr-Oct)	5	5	1	1
Medium-size moths (Apr-Oct)	5	4	2	1
Airplane moths (May-Sept)	5	3	0	0
Tiny twig-like moths (Apr-Oct)	5	5	5	5

A note about butterflies and moths: Although butterflies especially seem to be doing somewhat better than other insects, moths are not, with the exception of one or two species of tiny moths. We have found very few caterpillars or inchworms, and no chrysalises or cocoons this summer.

Spiders

Web-spinning spiders (AY, esp Apr-Nov)	5	3	2	1
Crab spiders (Apr-Oct)	5	4	3	1
Hunting spiders (Apr-Nov)	5	4	3	2

Snails and Slugs

Snails (AY when damp/wet)	5	4	2	1
Slugs (Oct-Apr)	5	4	2	1 (only tiny black ones)

Earwigs

Common earwigs (AY, fewer in winter)	5	4	4	2
Small earwigs (Mar-Nov)	5	4	3	1

Soil Insects

Earthworms (AY)	5	4	2	1 (very few indeed)
Grubs (Apr-Nov)	5	4	1	0

Small brown centipedes (AY)	5	4	2	0
Woodlice (AY)	5	4	3	1
Silverfish (AY)	5	4	4	1
Fleas (May-Sept)	5	3	0	0
Centipedes and Millipedes				
Large Centipedes (AY)	5	5	4	1
Other centipedes (AY)	5	5	4	1
Common millipedes (Sept-May)	5	5	4	2
Yellow/Brown checked millipedes (Oct-Apr)	5	5	3	1