

Birds and Trees of Northern Greece: Population Declines since the Advent of 4G Wireless; an Observational Study

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Executive Summary

My husband and I have been avid birdwatchers for more than twenty years. During that time we have travelled extensively throughout Greece watching birds, and have made many trips to the north of the country. We own a rural property on Samos where, since 1979, neither we nor our neighbors use pesticides, and where we strive to maintain a bird-friendly habitat.

In the winter of 2016-2017, my husband and I realized that nearly all the birds in the vicinity of local cell towers on the island of Samos had disappeared. In fact, numbers had been steadily falling since the island's wireless networks had been upgraded to 4G in late 2014. As no other local environmental factors had changed, we wondered whether the wireless signals were to blame. After doing a lot of research, we concluded that the electromagnetic radiation from the cell towers and from local Wi-Fi was probably responsible for the birds' disappearance.

We wondered if bird populations were also declining in other parts of the country. In the spring of 2017, my husband and I spent over two months (April through mid-June) visiting the important birding sites of northern Greece including Lake Kerkini, Lake Ismarida, the Nestos Delta, the Evros Delta, Dadia and the Prespa Lakes. We have spent considerable time in these areas in the past decade and we know them well.

We observed one significant change since our last visit in 2014. A great many new cell towers have been installed and wireless coverage has increased exponentially. Highway corridors and major towns are now 4G/LTE, as are many beach resorts. In other vicinities which are still 3G, there are only a few areas with poor or no coverage. These are due primarily to Greece's mountainous terrain.

We saw far fewer birds on this trip than on any other visit to the north of Greece. In some areas like the Nestos Delta, Porto Lagos, Lake Ismarida and the Evros Delta, there are virtually no birds at all. Most of the birds we did see congregated in areas of weak or no reception. There were nowhere near as many warblers, finches and small waders as we would have expected to see based on past experience and birder guidebook entries. Some species of bird were entirely absent, or represented by just one or two birds.

Crows, gulls and pigeons seemed to be the least affected. The Hellenic Ornithological Society says that unusually large numbers of crows points to an imbalance in the ecosystem.

Many larger birds also seemed to be profoundly affected by electromagnetic radiation from cell towers. Owls, nightjars, spoonbills and glossy ibis were scarce; the Egyptian vulture is on the verge of extinction. Some of the birds that are scarcest migrate across the Mediterranean, where many islands are 4G, or up the coast of Turkey, which is all LTE (4.5G). Studies show electromagnetic radiation from wireless communications can disrupt bird migration as well as cause biological effects that may directly or indirectly kill them through a variety of mechanisms, including reproductive failure. Fatal biological effects may be more likely to occur when birds are under stress during migration. Exposure to cell tower radiation during breeding may damage DNA in eggs and result in infertility.

At Lake Kerkini, scientists at the bird center have fought to reduce electromagnetic radiation levels from the new cell towers. These towers (still 3G) now operate at 85% signal strength. There are more birds at Lake Kerkini than almost anywhere else. The Prespa Lakes are also 3G. These towers operate at full signal strength, but there are fewer of them due to these lakes' isolated position and tiny population. There are also more birds at these lakes.

In addition to a lack of birds, we were struck by the many dead and dying trees we saw on our way. Lake Kerkini and the Prespa Lakes did not have dying trees. In other areas, especially east of Kavala towards Alexandroupolis, more than a third of mature pine forests look to have died

very recently, as the trees were still covered in reddish-brown needles. It is not only pines which are affected. We saw dead trees of almost every type: cypress, olive, poplar, oak, juniper, pine, fir, eucalyptus and others. The damage is not limited to northern Greece. There were dying trees and plants all along all the highway corridors as far south as Athens. Highway corridors have higher wireless radiation levels due to cell towers lining the highways, as well as cellphones in cars and GPS and other tracking systems integral to many new cars.

When we returned to Samos, we saw that many new cell towers and booster masts had gone up in our absence. Bird populations continue to diminish. In addition, many trees are now dying. Pine trees are turning brown and drying up. Olives, cypresses and poplars are dying, as are fruit trees. Other trees show damage: parts of the trees which face cell towers are discoloring or losing their leaves and dying. Research shows that radiation from wireless technology can have this effect.

Although we did not visit Northern Greece to study insects, we could not help but notice what has now become a common phenomenon: a lack of dead insects on our windshield as we drove along. This was especially noteworthy because most of the places we visited were wetlands, which traditionally have a great deal more insect life than other places. A drive through the Evros Delta, for instance, ought to have left our windshield plastered with bugs, but it did not. The same thing is happening on Samos.

Studies on the effects of electromagnetic radiation from wireless technology demonstrate that sustained exposure has negative consequences for all life. The World Health Organization currently classifies such radiation as Group 2B, possibly carcinogenic to humans. This puts it in the same category as lead or DDT, both of which are highly toxic to birds. Recently, longtime WHO advisor and cancer researcher Dr. Anthony B. Miller stated that radiofrequency radiation from any source (including cell towers and wireless devices) meets the criteria to be reclassified as Group 1, carcinogenic to humans, based on scientific evidence of studies done since 2011. Many other scientists agree. For birds, an environment full of electromagnetic

radiation from cell towers is habitat destruction comparable to widespread pesticide use or the loss of wetlands and forests.

With the advent of boosted 3G, 4G and LTE wireless communications, birds and trees, as well as insects, are rapidly disappearing from the Greek landscape. Telecommunications companies plan to launch 5G in 2020. If all continues as planned, the consequences will be catastrophic for nature in Greece.

Introduction

When the main town of Vathi on the Greek island of Samos was upgraded to 4G, sometime in late 2014, the birds on the mountain near the cell towers began to disappear gradually. By late 2016, there were virtually no birds left on the mountain at all except for the occasional buzzard and even more occasional small bird: a single chaffinch where there were flocks, perhaps a robin. Our resident short-toed eagles have gone, and in general we have very few raptors left. We used to have many buzzards, kestrels, Eleanora's falcons, goshawks and sparrowhawks, but now there are very few left.

In other areas such as the town center, where there is public Wi-Fi, all the sparrows disappeared. There were hundreds in the main square, and now there are none. The same thing has happened in many of the villages on Samos: as public Wi-Fi has been installed, and all the shops and cafes have installed Wi-Fi, the sparrows have disappeared along with the swallows and house martins that used to breed in these places.

A protected area to the south of the island, site of a former salt works and gifted with large reed beds, began to lose its bird life when local hotels installed Wi-Fi. Now a large communications tower dominates the landscape, the area is 4G, and the birds have almost all gone, except for the flamingoes that come in winter, a few mallards and ruddy shelduck, and enormous flocks of crows. The little egrets and grey herons have gone, as have the reed warblers, coots, moorhens, rails, kingfishers, marsh harriers

and many other birds that were once common. Even the terrapins, of which there used to be many, have vanished.

Research on the Internet uncovered a large body of scientific papers showing that electromagnetic radiation is harmful to humans and nature. Birds cannot breed, or abandon nesting sites. They cannot migrate properly; they get lost. They become confused and disoriented in the presence of pulsed electromagnetic signals. They disappear, probably because they are failing to breed; there is much research showing that electromagnetic radiation from wireless communications causes oxidative stress (leading to weakened immune system and illness) as well as DNA damage. Some frequencies may even kill birds in flight. In the winter of 2016 we found several dead Sardinian warblers in the vicinity of the communications towers. They had not been shot, nor did they look starved or sick. They seemed to have dropped dead in the road in mid-flight.

I wrote to the Hellenic Ornithological Society (HOS). The Samians are well aware that the birds are disappearing, but HOS told me that they do not have an up-to-date picture of what is happening here. They try to keep track of small bird populations, but this is not easy. They are a small organization of about 450 members, strapped for resources and dependent on volunteers. The geography of Greece, with its high mountains and many islands, makes it almost impossible to know what is happening everywhere.

We decided to visit the important birding sites of Northern Greece to see if what was happening on Samos was happening elsewhere. From the moment our ferry docked in Kavala, we were struck by the proliferation of cell towers. They are now everywhere. Mountains and hilltops that did not have any cell towers have as many as eleven or twelve in a single spot (usually two cell towers and a large number of booster masts, all grouped together). They mar the landscape in every direction. Small towns have clusters of cell towers. The island of Thassos, which dominates the northern coast, has at least 20 on adjoining hilltops. Every village has at least one booster.

According to OTE (Organization of Greek Telecommunications), all the main towns (in the north this includes Serres, Kavala, Xanthi, Komotini and

Alexandroupolis) are 4G/LTE (boosted 4G). So are all the toll motorway corridors throughout the country. So are all the market towns, many coastal and beach areas, and many of the islands. The rest of the country is still 3G, but the move to 4G is an ongoing process with places being upgraded all the time. A list of places which have 4G is published on www.otenet.gr.

Part I. Birds of Northern Greece

Lake Kerkini

When we arrived at Lake Kerkini, the first thing we saw was the communications tower array at Lithotopos, the town at the southern end of the lake near the dam. When we reached the lake itself, our first thought was, “Where are all the birds?” For the southern end of the lake has virtually no birds, and on that day there were none at all. No cormorants sitting on pilings. No great crested grebes in full mating regalia. (On every other visit, the great cresteds were all over the lake, hundreds of pairs of birds). No pelicans, grey herons, little egrets, or night herons. Nothing. The lake appeared empty.

We were later to find that the birds now tend to congregate on the northern shores of the lake. In the two weeks we spent at Lake Kerkini, and on our return visit in late May, we consistently found that the birds are avoiding the southern part of the lake. Sometimes we saw the odd grebe, grey heron or little egret on our way down towards Lithotopos, but they tend to stay away.

Lithotopos is still at 3G. So is all the area around Lake Kerkini. But at Lithotopos the cell towers are very near the lake. There are in fact many, many new cell towers all around Lake Kerkini, which sits in a kind of bowl surrounded by hills and mountains on three sides. However, at the northern end the cell towers are farther away. The birds seem to know this.

Our general impression of Kerkini was one of fewer birds than on previous visits. A buffalo farmer who has been running his herds along the banks of the Strymon River for decades told us that bird populations have declined hugely since he was a boy. He blames the loss of riparian forest, engineers

manipulating the levels of the lake (it is actually a reservoir), and more recently, cell towers. Bird numbers have fallen, he said, since all the new towers went in over the past two years. He has never seen the area so empty.

Little did we know that Lake Kerkini would prove to be by far the best site we would visit, and that the staff who run the bird center there are more enlightened than in any other area. For they have insisted, based on a regulation by the Hellenic Telecommunications and Post Commission which protects national parks, that all cell towers in the area be turned down by 15%. Thus, the cell towers around Lake Kerkini operate at 85% signal strength, and are still 3G. It was not, apparently, an easy thing to accomplish, and they nearly had to fight it out in the courts—until a sympathetic District Attorney took their side. However, virtually all the purple herons, storks, squacco herons, night herons, little egrets, grey herons and pelicans in northeastern Greece are all at Lake Kerkini. We also saw three spoonbills, the only ones we found this year. The staff at the information center assured us that little bitterns are there too, though we did not personally see any.

The smaller birds are another story. Lake Kerkini is home to, or is visited by, nearly 400 species of birds. But they do not keep track of the smaller birds. Of all the bird species which reside, breed, winter or stop at the lake on passage, only 100 species are counted. Results are tallied every five years to determine whether populations have increased or declined. In 2017, Lake Kerkini was in the third year of this five-year cycle.

Pelicans, cormorants and pygmy cormorants are doing well. Most of the telegraph poles in the villages host a stork's nest (though a local resident says that fewer storks arrived this year than on previous years, and that some poles which should be occupied are empty). Lake Doirani (on the FYROM border but within the Lake Kerkini area, administratively) hosts a huge population of purple herons. The swallows, martins and swifts arrived on time, along with the bee-eaters and the hoopoes. Raptors are doing well. But they are not counting the small songbirds or the little waders.

We spent two weeks driving and taking long walks all over the area in an attempt to discover for ourselves how well small birds were faring. Some small birds such as Spanish, house and tree sparrows, corn buntings and crested larks are plentiful around the lake. There is much animal husbandry in this area (cows, water buffalo, sheep, some goats) and this attracts small birds. However, we did note differences in the number of other small birds (especially songbirds and waders) compared to previous visits.

Most striking was the low numbers of warblers and finches. Most of the former are migratory; the latter are resident. Two weeks of searching yielded one lesser whitethroat, one olive-tree warbler, several black-caps (resident), one Sardinian warbler (resident) one orphean warbler (migratory) and a number of olivaceous warblers (migratory). We saw a few goldfinches and chaffinches (very few of the latter compared to other years) but no greenfinches, hawfinches, serins or linnets.

Most of the small songbirds we observed were concentrated in an area of very poor to no reception, several miles from the lake. This area had many nightingales, great tits, blue tits, long-tailed tits, tree pipits, great spotted woodpeckers, grey-headed woodpeckers, green woodpeckers and a pair of white-backed woodpeckers. However, we saw no lesser spotted woodpeckers, formerly quite common, and found only one pair of penduline tits—the only pair we saw in all of northern Greece. In the reed-beds surrounding the lake we heard only a few Cetti's warblers (resident). Great reed warblers (migratory) were also present, but our impression (it is very hard to count reed warblers) was of fewer birds generally—reed-beds are usually noisy, but not this year. On our return in June we saw a small flock of bearded reedlings (resident). We saw very few small waders--some oystercatchers, a snipe, two common sandpipers and three rails.

Walks into the mountains around the lake produced very few birds indeed—only a few great tits and blackbirds. I believe this is because there are now so many new cell towers in these hills. We also noticed on Samos that these two bird species are among the last to go in the presence of electromagnetic radiation from cell towers.* (see Discussion, p. 28) Eventually their

numbers diminish when 4G comes online. But Kerkini is still 3G, with a reduced signal strength.

Lake Kerkini was our first stop of the trip. Overall, we found fewer small birds, and fewer birds generally, than on previous visits. Little did we know it was a veritable paradise compared to other birding areas.

The Nestos Delta

The Nestos Delta is unfortunately situated between Kavala, Xanthi and Thassos, all of which are 4G, as is Egnatia toll highway that runs between these cities and the local airport which serves the area. We camped on a beach backed by a lagoon near the airport. Compared to previous visits, there were very few small birds—a few crested larks, a few sparrows, swallows, and nightingales singing in the water channels. The reed beds in the area were quiet: we heard two Cetti's warblers and a few great reed warblers. Other than a few oystercatchers, there were no small waders, nor were there any stone curlews, which we had always seen on previous visits.

Fortunately, the spur-wing lapwing population that nests on the western sand-dunes seems to be unaffected so far. This is one of only two areas in Europe where this bird breeds (the Evros Delta is the other). Larger birds were present: grey herons, two purple herons, little egrets, one squacco heron, five night herons, and a few coots and moorhens.

Also present were a great many crows, lesser black-backed and yellow-legged gulls, common terns, magpies and ring-necked doves. We have noticed on Samos that crows, jays, gulls and pigeons, seem to be more resistant to electromagnetic radiation from cell towers. On Samos these are, in many places, almost the only birds left: huge flocks of crows, jays (we don't get magpies), yellow-legged gulls, domestic pigeons and ring-neck doves. In the past two years, most of the doves have disappeared.

The Nestos River and its delta had virtually no birds at all. The reception center was closed and the silence was eerie. Dave Gosney, author of *Finding Birds in Northern Greece*, says of the woods near the center, "...continue for a further 3 km through excellent woodland for woodpeckers and orioles. Six

species of woodpeckers...breed in this area...[A]fter just over 2 km there is a track to the right over an embankment...This is a good place to stop and scan for raptors; several pairs of Lesser Spotted Eagle and Levant's Sparrowhawk breed in the forest along with a pair of White-tailed Eagles.”

When we went, the area looked and sounded as though a neutron bomb had gone off. There was no birdsong at all, no hammering of woodpeckers. The forests are mature and should support many birds; there is animal husbandry in the area, with flocks of sheep by the river and a herd of cows. Despite all this, there were no birds. After an entire day of driving and walking around the area we had seen one golden oriole, one kestrel, a few sparrows and a few yellow-legged gulls. We had heard two chaffinches (one either side of the river) and one nightingale. That was all.

We did not continue down to the delta itself because we met a couple of German birdwatchers returning and they assured us it was not worth a long drive on a rough road. For their pains they had seen only one nightjar, a few plovers (ringed, little ringed and Kentish), one redshank, one greenshank, a few little egrets and a few reed warblers.

Porto Lagos

The next evening we camped in a pine wood outside Porto Lagos, famed for its heronry, where scores of grey herons and little egrets breed. Used to breed—we saw very few grey herons and no little egrets. There were no stone curlews on the weed-strewn coast (on previous visits we had always found them there), only a few Mediterranean gulls and oystercatchers, and one long-eared owl hunting in the gloaming (there used to be a pair). On our previous visit in 2014, the wood was full of little owls and small birds. This time the woods were empty: we heard one chaffinch and one cuckoo. In the morning, there was no dawn chorus. The sun rose in total silence. In town there were only magpies, crows and starlings—all members of the crow family.

Porto Lagos has not been gifted with 4G yet, but neighboring Xanthi and the nearby beach resort are of Fanari are both 4G. The lagoons of the area—there are many—are empty, though we saw a small flock of flamingoes and several oystercatchers in one of them. Fanari has no sparrows or any other birds except a few yellow-legged gulls. Only the salt pans west of Porto Lagos had any birds (dunlin, spotted redshanks, greenshanks, oystercatchers, black-winged stilts, shelduck, common terns, Mediterranean gulls, corn buntings, crested larks, barn swallows and yellow wagtails) but the flocks of waders were small compared to previous visits and there were fewer species.

Lake Ismarida and Environs

This has always been one of the better places to watch birds in Northern Greece. A dike runs alongside the Ismara River and the lake itself, with shallow pools and wet meadows alongside. There are vast reed-beds, and several acres of riparian forest at the north end of the lake. In the past we have seen large numbers of species around here, all sorts of small and large waders in the shallows, woodpeckers, songbirds, raptors and so on. The access is brilliant: in few other places is it possible to get so close to birds that are normally hard to find.

This year there were no birds, but there were a number of new communications towers. Lake Ismarida is very close to Komotini, which like all cities in Greece is 4G, and even closer to the Egnatia Highway (4G/LTE) running south of the city. This area of the country is flat farmland, and mobile communications towers have an effective range of some fifty miles. Lake Ismarida is well within the range of Komotini's 4G.

The contrast with other years was shocking: the river, its shallows and the wet meadows were virtually empty, the riparian forest had many dead and dying trees, and the vast reed-beds surrounding the lake were silent. There were hardly any songbirds, waders or even raptors: one flight of red-footed falcons on passage and one pair of marsh harriers. The sand martins that usually nest in the nearby cliffs weren't there, and most disappointing, there were no glossy ibis. We did see two ibis at the village of Mosaico, which

sits on the banks of another river a few miles away, but these were the only two ibis we saw in the whole of northern Greece this year.

The situation improved somewhat when we visited the Ptelea and Elos Lagoons, on the coast south of Lake Ismarida. The land drops towards the coast, and mobile reception is very poor. There we found hundreds of flamingos, and more waders than we were to see any other point in the trip. There were several large flocks of dunlins and little stints as well as smaller numbers of redshanks, greenshanks, spotted redshanks, ruffs, curlew sandpipers, avocets, black-tailed godwits, black-winged stilts, oystercatchers, squacco herons, turnstones, Kentish plovers, collared pratincoles, common terns, little terns and white-winged terns. More numerous were little egrets, grey herons, white pelicans, cormorants and yellow-legged gulls. We also found one wood sandpiper, one grey plover, one purple sandpiper and one stone curlew—the only representatives of these species we encountered on this trip.

The salt-pans at Glyfada village, normally quite good for small waders, had small numbers of little stints, shanks, black-wing stilts and ruffs. There we saw the only lesser grey shrike of the trip.

The coast west of these lagoons as far as Imaros beach is all 3G with fairly poor reception. Both the Imaros River and the Lissos River find their way to the sea along this coast. The Lissos is bordered by dense riparian forest, including tall poplars and many tamarisks, which appeared to be in good condition unlike the forest near Lake Ismarida. In the forest, we found a booted eagle, a hobby, a Levant sparrowhawk and a pair of nesting white-tailed eagles with a single chick. We saw several great spotted woodpeckers but very few small birds: two back-headed buntings, one lesser whitethroat, one spotted flycatcher and several chaffinches.

At Imaros beach, nightingales sang in the tamarisks and flocks of Spanish sparrows chattered in the hedgerows. There were chaffinches in the pines and small waders on the beach, including collared pratincoles and a small flock of sanderlings on passage. At the mouth of the Ismara we found a

black-throated loon in summer plumage, and the area behind the beach was full of red-backed and woodchat shrikes.

Maronia

Leaving Ismarida, we tried to reach Alexandroupolis via a very rough dirt road that parallels the coast from the site of ancient Maronia. We made it about halfway in our ancient VW camper before we had to turn back. We did, however, make an interesting discovery.

West of the ancient site the low mountains are composed of granite, that heaviest and most impermeable of stones. There are no cell towers in sight, and reception becomes poor, then sporadic, then dies altogether. As the signal faded, birdsong increased. Within two kilometers of the ancient site the olive groves rang with the calls of great tits, chaffinches, ciril buntings and Sardinian warblers.

In late afternoon, we found ourselves in a kind of granite bowl, the sea far below. The road was too bad to continue, so we decided to spend the night. The olive grove was full of birds; there was no cell reception at all. We awoke in the morning to the most incredible dawn chorus I have heard for many years: masked shrikes, nightingales, chaffinches, great tits, Sardinian warblers, orphean warblers, ciril buntings, blackbirds—an orchestra of birdsong.

We walked around the corner, and a cell tower came into view. All bird song ceased abruptly. Back in the granite bowl, small birds were everywhere.

A grocer in the modern village of Maronia told me that local environmentalists are fighting to stop local authorities from paving that dirt road. If it is ever paved, cell towers will follow. Then there will be no more dawn chorus.

The Evros Delta and Environs

The Evros Delta used to be one of the best birding areas in all of Europe, with more than 400 species of bird living, breeding and wintering here, or stopping over on migration. It is one of Europe's largest river deltas, with vast wetlands. The view from the hill above Traianoupolis, where the Visitors' Center is located, shows an endless series of lagoons going down to the faraway sea.

This was a dry spring, so there were fewer wet meadows than usual. But as Dave Gosney says in his guide *Finding Birds in Northern Greece*, "There are so many wetlands in this area that at least some of them are likely to have suitable water levels during wader passage..." Normally, low water levels cause birds to congregate where pools are suitable. But this year there were virtually no birds at all.

There were, however, lots of new communications towers. Alexandroupolis is 4G. The airport, halfway to the delta, is 4G. The Egnatia toll highway that runs westward across Greece from the Turkish border at Kipi, circling the city to the north, is 4G/LTE. All the small towns and villages have their own booster masts in addition to the new cell towers. The villages are still 3G, but the electromagnetic waves from Alexandroupolis and the airport travel easily over the flat lands of the delta. The Turkish coast is all LTE/4.5G, and five large cell towers near the banks of the Evros River on the Turkish side are clearly visible from the Greek side. The military also has its own frequencies.

A representative of the Organization of Greek Telecommunications (OTE) told me that Turkish cell towers emit far stronger signals than are permitted in Europe, and this is why Turkish signals frequently override Greek signals in border areas. Turkcell launched 4.5G coverage on April 1, 2016, and it now covers 83% of its population across 81 cities. Turkey is among the countries (the U.S. is another) with plans to set up pre-standards 5G networks in the near future.

In 2014, Dave Gosney visited Turkey to update his guide, *Finding Birds in Turkey*. The west coast of Turkey was already operating at 4G by then.

Though Gosney did not make the connection between what he observed and wireless signal strengths, he was shocked to find that all the good birding sites he had discovered in 1996 were almost empty of birds. In 1996 he found 207 species of birds on the west coast of Turkey. In 2014, “the difference was shocking...nowadays almost all the coastal wetlands have hardly any waders or marsh terns, most of the nearby countryside has hardly any shrikes, buntings or Sylvia warblers and raptors are much scarcer...in too many places I visited it seemed like the only birds I could hear were Blackbird, Great Tit and Collared Dove.” (From the introduction to *Finding Birds in Turkey*, 2014) Gosney’s observations in Turkey are scarily similar to what we have been seeing on Samos and in Northern Greece. How can birds that depend on the earth’s magnetic field to navigate on migration find their way through such electromagnetic smog? How can they live and breed in it?

We didn’t expect to find many birds in the Evros Delta, but we tried. We had plenty of time. Our passes for the restricted military zone of the delta were delayed, and we had some days to fill. We began by checking the Anthia marshes, in the western zone of the delta. Gosney says in *Finding Birds in Northern Greece*, 2014, “For much of the year, the best birding is at the Anthia marshes...this track passes through a series of pools and marshes which are usually teeming with birds, many of which can be viewed at very close range...These are likely to include dozens of Glossy Ibis (over a thousand have been counted)...The area is extensive, with further tracks to either side...”

There were no glossy ibis, either here or anywhere else. In 2014, the ditches were full of little grebes, the tamarisks hopping with small birds, the marshes so full of waders we could hardly decide where to look first. We used to see great spotted cuckoos here; this year we saw none. In 2014 we even saw a pair of little curlews, a most rare sight. This time, one could hardly believe birds had ever inhabited this place, there were so few. We drove up one track, down another, crossed and re-crossed. We came back and did it again several days later. There were no grebes, and only a few Spanish sparrows and yellow wagtails. These are all the birds we observed in the marshes over several visits: two gagarneys, one ruff, one wood

sandpiper, one black stork, four lapwings, four squacco herons, two little egrets, one Syrian woodpecker and several shelduck. There were bee-eaters (they were everywhere in the north)* (see p. 28) but we saw only one roller. There were lots of crows.

On another day, we walked the beach to the mouth of the Loutros River. The beach wasn't much better: small numbers of plovers (Kentish, ringed and little ringed), a few curlew sandpipers, a few dunlin, a few oystercatchers, five curlews fishing in the river, and several grey herons.

We explored the Drana Lagoon and other areas of the western delta. This was no better and in some ways even worse. The reed-beds were silent except for a few great reed warblers and a single Cetti's. The lagoon and nearby pools had very few birds: one stilt sandpiper, two Kentish plover, one redshank, one curlew, several great egrets and grey herons, a few oystercatchers, a few little stints. Other than these we saw one goldfinch, several yellow wagtails, corn buntings and crows. There were no semi-collared flycatchers anywhere in the delta, no penduline tits, no bearded tits, no Isabelline wheatears, no coots or moorhens, and no black-throated or little grebes. And there were very few raptors, save for a pair of marsh harriers.

Up in the forested hills behind Alexandroupolis, the situation was better where it was 3G, and even better in those pockets with little or no signal. North of the city, the forest continues virtually unbroken all the way to the Bulgarian border. The villages are still 3G. But there are many new communications towers and booster masts, and the Egnatia Highway runs along here. Overall, there were fewer small birds than on previous visits and some species, such as calendra larks, we did not see here at all.

Especially sad for us was a forested area behind the village of Nipsa, where there is lots of animal husbandry (sheep, goats, pigs, horses) and the oak trees are huge and ancient. In previous years, the trees were full of cuckoos, starlings, orioles, goldfinches, chaffinches, ciril buntings, masked shrikes, nightingales (in 2014, in one spot we heard about twenty nightingales singing at once!) great tits and blue tits. And there were other birds,

including wrynecks, nuthatches and a great many raptors. In the past, this was a cell phone black hole. Now it has full signal in many parts, and the birds are correspondingly fewer. There are very few cuckoos, and no nightingales. There are very few masked shrikes, and no wrynecks or nuthatches we could find. The few families of goldfinches, chaffinches, blue tits, great tits and ciril buntings are now confined to the area of the forest with a weak signal.

The one exception is the large raptors. Small raptors such as kestrels, sparrowhawks and goshawks seem to have greatly diminished in numbers throughout the north, though we did see a small family of lesser kestrels at the Avas Gorge. But there are still many large raptors, presumably because there is such a huge area of forest. From the ridge above Nipsa, which we visited many times towards the end of the day, we saw a juvenile white-tailed eagle, many booted eagles, short-toed eagles, a Montagu's harrier, a hen harrier, a goshawk, a peregrine falcon and several black storks.

When we finally got permission to enter the eastern side of the Evros Delta, we believed we were prepared for inevitable disappointment. But as we drove mile after mile along bone-jarringly rough tracks, the utter desolation and silence wore on our nerves. There were very few birds: seven white pelicans, small waders singly or in very small groups of three or four, occasional grey herons, little and great egrets, two purple herons, two black storks, three white storks, three mute swans, a few shelduck, several pairs of smaller ducks (three pin-tails, two ferruginous, five gargarneys, one mallard). As at the Nestos, spur-wing lapwings were present—we counted seven. There were very few hedgerow birds: a few nightingales, black-headed buntings, crested larks, corn buntings and red-backed shrikes. The reeds were silent.

There were hardly any raptors. The great highlight was a pair of white-tailed eagles that circled low, eyeing us with as much curiosity as we had for them. We saw one kestrel, one red-footed falcon and one pair of marsh harriers. The only birds we saw in any number were barn swallows, crows and bee-eaters. There were only two rollers: we saw only three on the whole trip.

Communications towers now ring the delta. The pumphouses which contain the machinery for redirecting flood waters have booster masts. There is a tall new cell tower at Feres, where the delta begins. Turkey, as aforementioned, has five cell towers and two radar domes. I can't begin to guess what the Greek and Turkish armies have in the way of wireless communications.

At the Information Center, the staff were in full denial. Crisis, what crisis? Of course there were plenty of birds; we just weren't looking hard enough. Still, word had obviously got round. Other than one pair of Englishmen, we met no other birdwatchers on any of our forays into the delta.

I asked at the center whether anything had been done to reduce wireless signals as at Lake Kerkini. They knew nothing about the steps taken at Kerkini to protect the birds. It had never occurred to them that wireless signals might affect birds. One woman, justifiably, was concerned about spraying. Every year the delta is sprayed to reduce the number of mosquitoes, and this year they had left it late; spraying was about to begin. Although the chemicals sprayed are EU-approved and allegedly don't affect the birds, she has her doubts.

At the center, they were preparing to host a Festival of the Storks to celebrate the fact that in 2016 the village of Poros, on the Evros River, was named the EU Village of the Storks. We went to Poros. On previous visits, there had indeed been many storks, white and black, continually crossing the river. Also, in previous years we had seen many storks in the fields around Alexandroupolis; once we saw more than fifty in a single field that was being plowed. This year there were hardly any storks. Poros had four nests. At Lake Kerkini, by contrast, there were many storks. Kerkini Village had at least twenty nests, and all along the north shore of the lake the villages were full of storks' nests.

Dadia and Environs

People go to Dadia to see the vultures, but it is also a good area to view raptors and small birds. We approached by the old road through thickly-forested mountains. Not surprisingly, we saw a number of new cell towers along the way, though this is a 3G area, as is Dadia village. The highway running parallel to the Evros River is 4G, however and there are huge communications towers all along, including opposite the turn to Dadia. The highway is being turned into another toll motorway (it is slated to become one of the EU's first 5G highways sometime in 2020, and will run past most of the birding sites mentioned in this paper, barring Lake Kerkini—all the way to Thessaloniki) and workmen have been building an exit/entrance ramp at the Dadia turn for the past three years. At Kapsalo, up a steep nearby mountain with its own enormous communications tower, the Turkish signal sometimes overrides the Greek one.

We saw plenty of black and griffon vultures during the ten days we spent in the area, and were lucky to see two Egyptian vultures. In 2014 we had seen quite a few Egyptian vultures, but now there are fewer than ten pairs in the region. An English birdwatcher we met told us that one reason for this species' rapid decline is that young birds are trying to migrate over the Mediterranean rather than overland down the Turkish coast. As a result, many young birds are dying.

We talked to a young woman at the information center about this. Ten years ago, we said, we had been under the impression that Egyptian vultures were not particularly endangered.

“That’s true,” she agreed. “Ten years ago, they weren’t.”

“What about three years ago?” We saw quite a number of them then. At the time no one said anything about their being critically endangered.”

“Maybe they didn’t announce it.”

We asked her about young vultures getting lost when they flew over the Med. She said it wasn’t unusual, that young birds tended to take off before the older birds, migrating solo, and lost their way.

This does not seem to be true. When I looked up Egyptian vulture migration, the websites said that vultures do not migrate alone. However, a lack of experienced adult birds to lead the way is one factor being blamed for this species' rapid decline. It is also possible that the presence of LTE/4.5G wireless signals along the Turkish coast and 4G on many of the Greek islands is rendering it impossible for young vultures to accurately read the earth's magnetic fields. (Many studies have been done on cryptochromes, which enable migrating birds to read the earth's magnetic fields. Other studies have looked at how anthropogenic magnetic fields affect migration). Possibly older birds have enough visual clues along known migration routes to compensate for the electromagnetic clutter. Poisoned baits are also blamed for the vultures' decline, but two forestry officials we met assured us that these are far less of a problem around Dardia than they used to be. And why would Egyptian vultures be more vulnerable to poisoned baits than griffon or black vultures? This does not make sense.

Many large raptors are still present around Dardia, though we saw more in the mountains than around the flood plain, which is near the highway. We saw no small raptors at all, other than a lanner falcon which breeds on the cliffs at Kapsalo. Small songbirds are diminishing in number. The area around the river, where flocks of sheep graze, used to attract a great many small birds. We used to see many masked shrikes, which were absent this year, as were wrynecks, and we saw only one chaffinch. We saw only one warbler here—an olivaceous warbler, and heard only one nightingale. We did see great tits, woodchat and red-backed shrikes, corn buntings, turtle doves, black-headed buntings, three mistle thrushes, golden orioles, hoopoes, starlings and little ringed plovers. We walked by the river on several occasions; there were definitely many fewer small birds, and fewer species, than on previous visits.

We spent quite a lot of time in the mountains, with superb views of vultures, golden eagles and other raptors. We found one campsite by a stream where a fold of the mountain blocked the wireless signal, and woke up to a lovely dawn chorus: black-caps, chaffinches, goldfinches, long-tailed tits, great tits and blackbirds. But at other locations which we knew to have many small birds, and where Dave Gosney found such species as Orphean, olive-tree,

marsh and Bonelli's warblers, as well as middle spotted woodpeckers and sombre tits in 2014, there were virtually no small birds at all. We found two olive-tree warblers after much searching, and some sombre tits high up the mountain. Ortolan buntings, formerly numerous, were also harder to find. Again, birds tended to congregate where wireless signals were weak or absent.

Soufli, the regional market town, now boasts a small antenna park of eleven masts: two large cell towers and assorted booster masts. While having coffee, we remarked to an elderly couple at the next table that there didn't seem to be any sparrows. They told us that there are still some sparrows away from the center of town (where all the cafes have Wi-Fi) but that small bird numbers in the area are definitely down. The farmers, the old man said, are rejoicing because there are fewer small birds to eat their seeds. He complained that in town, jackdaws have chased all the pigeons away. (Indeed, the town is full of jackdaws.) The old woman couldn't remember the last time she heard an owl (we heard very few on our trip). A man at a nearby table, who likes to hunt, has given up hunting birds. "Everyone knows," he said, that the songbirds are disappearing."

Prespa Lakes

These two lakes are on the border with FYROM and Albania, and the larger of the two is shared out between the three countries, which cooperate in bird conservation. Within Greek territory, the signal is 3G. There are several new towers, and booster masts outside the villages, but mobile signals from FYROM and Albania frequently override local cell signals in some areas. This may not have to do with a stronger signal coming from these countries, but more to do with geography. There are also areas with poor or no signal. The Prespa lakes are isolated by high mountains; toll highways and 4G are mercifully far away. No special provision is being made, as at Lake Kerkini, to keep signal strength down, but there are nowhere near as many towers around the Prespa Lakes as in other places, probably because the local population is too small to justify the expense of more infrastructure.

The Prespa Lakes are famous for the huge numbers of pelicans, which seem to be doing well. There were many night herons, squacco herons, grey herons, mute swans, cormorants and pygmy cormorants, as well as some great egrets, white storks and a few ducks (one mallard, one pochard, and four ferruginous—we didn't see any goosanders, which are supposed to breed here). There were no glossy ibis, spoonbills, bitterns or little bitterns. There were no cuckoos. There were many jackdaws and crows.

There were probably more small birds here than anywhere except Lake Kerkini: house and tree sparrows, alpine swifts, corn buntings, ciril buntings, goldfinches, blue tits, sombre tits, rock buntings, goldfinches, greenfinches, chaffinches, nightingales, golden orioles and blackbirds, as well as many red-backed shrikes. Black-caps sang in the riparian forest, but the only migratory warblers we saw were an olivaceous warbler and some great reed warblers.

Western Greece, November-December 2015

Western Greece has some fantastic birding sites that are especially good in the winter. On our last trip, in 2015, we saw many changes that we did not at the time understand but which we now believe were caused by the introduction of 4G into these areas. Small songbirds and little waders were very scarce, as were kingfishers, grebes, coots and moorhens.

The lack of songbirds and waders makes sense in the context of improved telecommunications. Like Samos, the towns of Arta, Preveza, Agrinio and Missalonghi were upgraded to 4G sometime in 2014. This has had a huge impact on the Amvrakikos Gulf as well as the lagoons around Missalonghi.

In the winter of 2015, we saw very few small waders or small birds around the Amvrakikos. We spent many days along the Salaora Dike, which sits directly between Arta and Preveza. There we used to see flocks of linnets, serins, chaffinches, greenfinches and many other small birds. In 2015, they were virtually all gone. The shallows along the southern side of the dike had always been great for observing small waders. In 2015, there were hardly

any, and the flamingoes were avoiding the area as well. The north end of the gulf by the Rodia Lagoon was kingfisher territory—we used to see dozens in the time it took to cover the few kilometers to the end of the road. In 2015, there were very few, and also fewer coots and moorhens, formerly very common.

The Missalonghi area was similarly lacking in small birds. Again, there were very few small waders, songbirds or little grebes, and the coots around Aetoliko (usually there are thousands around this island town in winter) were mostly gone. The marshes further north were a bit more lively than the salt pans and lagoons closer to Missalonghi, but compared to former years bird numbers were down.

In both places, larger birds seemed less affected. There were still thousands of flamingoes, and at the Amvrakikos we saw more large egrets than we had ever seen before. However, even these larger birds tended to avoid the lagoons close to the big towns.

On August 24, 2017, the new Ionian Highway between Patra and Ioannina was officially opened. It runs very close to Missalonghi and above the Amvrakikos Gulf. Like all the new toll roads, it is served with 4G/LTE wireless communications. I expect this will also affect bird populations in these areas.

Discussion: Birds

Overall, we found far fewer birds in Northern Greece than on previous visits. As on Samos, wherever mobile signals have been upgraded to 4G, and in towns and villages with Wi-Fi, there are hardly any birds, and birds seem to avoid the vicinity of cell towers, especially multi-tower arrays, even when the signal is 3G. Where 4G is dominant, and especially in border areas within range of Turkey's 4.5G (and military radar), practically all the birds vanish. Less affected are areas that are farther from cell tower signals and without Wi-Fi.

With the exception of proliferating cell towers, and many new windmills in mountainous areas (and the electricity pylons that carry the electricity from them), the countryside did not seem much changed. There has been no new development or infrastructure (except the TAP pipeline cutting a fifty-meter wide swathe through forest and farmland. It runs north of Alexandroupolis, but it has not affected the important bird areas). Farmers appear to be using the same agrochemicals (mainly glyphosate). The biggest changes we saw was in the number of dead and dying trees (see Part II, below) and many fewer insects.

Obviously agrochemical use/overuse is a possible factor in diminishing bird populations. I do not think they are the chief culprit in this case. Northern Greece has huge forests. On Samos, the areas around the main cell towers are pine forest and maquis scrub, not farmed or sprayed, and many of the olive groves are untended. There is no industry and no air pollution. The mountains that host the cell towers are wild, with populations of wild boar and golden jackals. Agrochemicals didn't cause the bird declines in these areas. If 4G wireless didn't cause this, then what did?

Given the difficulty of counting small birds and the fact that information is not available for all areas of the country, it is impossible to get a picture of how numbers have diminished and which species are most affected. From our own observations, finch and warbler numbers are way down, and there is a general consensus among country folk who know their own patch extremely well that small bird numbers are falling generally. Many times on our trip north I was told that this or that riverbank/ bit of forest used to have this or that bird and that they don't come anymore. We saw very few greenfinches, only one serin and only one hawfinch on the whole trip. Chaffinches used to be very common, yet in some parts there are hardly any. We see very few on Samos these days.

Small wader numbers are also way down. We saw almost no flocks of small waders of any size, and when we did they were either little stints or dunlin. With many small waders, such as stone curlews, we saw only one or two representatives of the species. I believe that electromagnetic radiation from cell towers must be affecting migration. Some of these birds come a very

long way. I read in *Birdlife News* that 45% of birds that migrate to the arctic in spring via the Pacific coast of the Americas have not arrived this year (2017). This is being investigated. I hope that electromagnetic radiation from cell towers is being considered as a possible cause.

Many other species of bird we expected to see on our trip were absent, or only present in small numbers. There were no semi-collared flycatchers or stonechats. There were very few masked shrikes, penduline tits (one pair) or calendra larks (three, at the Ptelea Lagoon), and wrynecks only in Kerkini. There were very few wheatears of any kind. Outside of Kerkini there were very few woodpeckers (all woodpeckers are resident here except the wryneck), and we only saw one pair of the smallest woodpeckers, the lesser spotted. We saw only two nuthatches.

Throughout the trip, we camped in the countryside, well away from people and bright lights. Yet we heard very few nightjars: a total of four in two and a half months. We also heard very few owls. We heard only four scops owls, a bird once described as “the characteristic sound of the Greek night.” We heard only six or seven tawny owls, two little owls, and one barn owl. My husband saw one eagle owl. There were also very few cuckoos outside Lake Kerkini; we found none at Dadia or the Prespa lakes.

Except for the great crested grebes of Lake Kerkini, we saw no grebes anywhere. There should have been black-throated and little grebes, both of which are resident. We saw only two glossy ibis, only three spoonbills (at Lake Kerkini) and no little bitterns anywhere, even the Prespa Lakes (though the staff at Lake Kerkini say that they are there this year). We saw no coots or moorhens (both resident) anywhere, except for a few in the lagoon near the airport in the Nestos region.

Small raptors also seem to be diminishing in number. Kestrels, sparrowhawks and goshawks (all resident) are normally quite common, but we saw very few.

The lack of migratory birds implies that something is interfering with migration. Studies show that there is too much radiation from cell towers and that birds are having trouble finding their way because they cannot

orient properly. However, not all species seem equally affected. Bee-eaters were plentiful in the north, as were swallows, whereas small waders arrived in small groups or not at all. Possibly this has to do with the visual acuity of some species that would enable them to easily recognize specific landmarks. Bee-eaters, swallows, swifts and martins need excellent vision to capture small insects in mid-air. Raptors and vultures are known for their extraordinarily sharp vision. But species that hunt for food by grubbing in shallow water or pecking along the ground may have poorer eyesight, or be less attuned to visual cues.

In any case, migration is only one factor affecting bird populations, and it would not affect resident birds, which are also disappearing at much the same rate. Why are resident bird populations falling? Perhaps other factors are at play.

In humans, chronic exposure to pulsed electromagnetic radiation causes a host of problems, and various studies have demonstrated reduced sperm counts, DNA damage, cardiovascular damage, chronic physiological stress, oxidative stress and changes in genes as well as various tumors. Why should birds not suffer the same problems? Their much smaller body mass (even a large bird like a stork weighs less than five kilos) suggests they would be far more vulnerable than we are.

At the end of this paper, there are links to a number of studies about the effects of electromagnetic radiation. Most of these are laboratory studies using exposures that are well within the parameters of what is considered “safe” for humans. (For a discussion of those standards, see the Bioinitiative Report). There are no established safety standards for birds or nature. However, birds are not safe from harm simply because they do not use mobile devices; they are still being irradiated by the cell towers 24 hours a day, seven days a week, 365 days a year.

There are very few observational studies about this subject, and none that I can find which compare bird numbers in an area before and after cell tower introduction, or before and after cell tower upgrades. Yet they would be easy to do, as birding organizations often employ ringers stationed in various

places, and many birdwatchers keep written records of what they have seen each year. I correspond with a birdwatcher in Ireland who has noticed falling bird numbers since a nearby cell tower was upgraded to 4G over a year ago. His observations tally with my own in many respects: small birds are disappearing, but he is seeing a disproportionate number of great tits and crows.

A letter from the U.S. Department of the Interior shows that the U.S. Fish and Wildlife Service has been concerned about the effects of cell tower radiation, and indeed the cell towers themselves, since at least 2002. Impacts of birds with towers and guy-wires have been known to cause “mass mortality events” during peak migration seasons, and are estimated to cause four to five million bird deaths per year. The author goes on to say, “The second significant issue associated with communications towers involves impacts from non-ionizing electromagnetic radiation emitted by these structures...Study results have documented nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship and death...Nesting migratory birds have apparently been affected by the radiation from cellular phone towers in the 900 and 1800 MHz ranges...” For the full letter, see the bibliography.

Bird flu outbreaks have been much in the news in recent years. Last year there was a severe outbreak of bird flu among swans in Dorset, southern England. I spoke to Professor Loukas Margaritis, a biologist at the University of Athens who has done much seminal work on the effects of electromagnetic radiation on living organisms. I asked him whether cell tower radiation could weaken birds’ immune systems and make them more vulnerable to bird flu. He assured me it was possible. How many other diseases which affect bird populations may have electromagnetic radiation from cell towers as an underlying cause?

Electromagnetic radiation from cell towers and devices is not safe for humans or birds. Dr. Olle Johansson of the Karolinska Institute in Sweden, a leading authority on the health effects of electromagnetic radiation from wireless communications, points out that if this type of radiation had been proven to be safe, it would be classified by the World Health Organization

as Group 4, proven human non-carcinogen. But it is not. It is presently classified as Group 2B, possibly carcinogenic to humans. This puts it in the same category as DDT or lead, both of which are highly toxic to birds. DDT has been banned outright and lead has been removed from automotive fuels and many other commercial uses such as paints. But electromagnetic radiation from cell towers has not been banned—yet.

Recently, longtime World Health Organization advisor and expert cancer researcher Dr. Anthony B. Miller stated that radiofrequency radiation from any source (including cell towers and mobile wireless devices) fully meets the criteria to be reclassified by the WHO as Group 1, carcinogenic to humans, based on evidence from scientific research done since 2011. Many scientists, including Dr. Johansson, agree with Dr. Miller. Sooner or later radiofrequency radiation (including cell tower radiation) will be reclassified as carcinogenic to humans. How many birds will have been wiped out by then?

Even if birds can sense that cell towers are dangerous, where are they to go? Many birds are territorial, and cell towers are everywhere. With more and more cell towers being erected, and more areas being upgraded to 4G, the problem becomes more acute: this is habitat degradation as serious as widespread pesticide use or the loss of wetlands and forests.

Electromagnetic radiation from mobile communications towers may be directly killing birds through a variety of mechanisms, as well as causing birth defects or reproductive failure. In this case there will be fewer birds to migrate, even if they do not lose their way.

*I have noticed that species that breed in habitats where nests are protected from cell tower radiation seem to do better than species that nest high up in trees where they may be more exposed to cell tower radiation. Bee eaters, for instance, nest underground, where the eggs will not be exposed to any cell tower radiation. Similarly, species that nest in dense brush, such as wrens, blackbirds and Sardinian warblers, do not seem to be diminishing as fast as birds that nest high in trees or on the ground (e.g. partridges, which are disappearing very fast). Great tits breed in deep holes in trees; they too are doing well. On the contrary, birds such as large raptors or ravens often

nest in high trees on mountains where they may be highly exposed to cell tower radiation; large raptors are disappearing very fast on Samos and I believe, worldwide. See the paper by Lazaro et. al (2017) which found that pollinators which breed underground are less affected by cell tower radiation.

Wireless telecommunications expansion is growing at such a pace that there are fewer and fewer places which do not have some wireless signal. 5G, which will use a combination of microwave and millimeter-wave technology, may be especially harmful to nature, as the enormous number of small cells, both in cities and lining highways everywhere to allow for self-driving cars, will expose both people and nature to far more radiation, at far closer quarters, than we are exposed to today. Even more frightening is the prospect of Global Wi-Fi, in which 3G, 4G, Wi-Fi and 5G will be broadcast from drones, weather balloons and satellites so that wireless coverage will be total, with no signal-free areas in any part of the world.

A note concerning insects: As mentioned in the introduction, we noticed far fewer insects on our trip north than we were accustomed to seeing, and our windshield did not become covered with dead insects as we drove along, which was highly unusual given that we were primarily traveling through wetlands. We especially noticed a lack of beetles, among them fireflies, which used to provide a wonderful display in some places like Lake Ismarida. In several places we noticed a plague of caterpillars, hatching into small brown moths, that devoured foliage everywhere; this indicates an imbalance in the system, perhaps a lack of natural predators, either bird or insect, that would usually eat them before they overbred to such a degree.

Since our trip in 2016, a German study conducted in nature reserves has found a more than 75% decrease in flying insect biomass since 1989 (about the same time as wireless technologies really got going, though the study does not consider the effects of cell towers though it does dismiss climate change as a cause for the declines) and there is general concern that we are losing the insects, especially the pollinators, on which all life depends. Two studies by Thielens et al (see bibliography) have examined how electromagnetic radiation is absorbed by insects, and they warn that 5G is

likely to have a huge impact on insects; it will perhaps wipe them out altogether.

Part II. Trees of Northern and Central Greece

Introduction

We went to Northern Greece to look for changes in bird populations. As we went east, we noticed many dead and dying trees. I knew from my research that trees are also affected by electromagnetic radiation from cell towers. What we saw, and learned, about the dying trees leads me to believe that cell tower radiation may be responsible for what is now becoming large-scale forest die-off.

Lake Kerkini

At Lake Kerkini, we did not see of dying trees. It is a heavily forested area, mainly oak, and poplars are grown in great numbers for wood pulp. There is a good deal of riparian forest along the riverbanks, though sadly the riparian forest along the lake shores is hugely diminished due to encroaching agriculture in recent years. There are many new cell towers at Lake Kerkini, but they operate at 85% signal strength due to the intervention of the scientists at the bird center. Although this was done to protect the birds, it may also protect the trees.

The Nestos Delta

It was at the reception center of the Nestos Delta that we first noticed dying trees. A row of mature pines opposite the center had all dried up on one side, needles rusty-red. The next day, driving towards Xanthi on our way to

Porto Lagos, we saw many dead and dying pines and cypresses. I called the Forestry Department in Xanthi. Were they aware that many trees were dying, and did they know why? My enquiries were met with hostility and suspicion: Who was I and what business was it of mine? My questions went unanswered.

Lake Ismarida

The area around Lake Ismarida is flat farmland and has very few trees, except the tamarisks which line the roads. There are several acres of riparian forest at the north end of the lake, stands of acacias grown because the EU gives subsidies for them, and riparian forest along the banks of the Lissos River as well as many tamarisks. A few new groves of fruit trees have been recently planted. The rest of the area is given over to huge fields: a lot of wheat and cotton are grown here. The riparian forest along the banks of the Lissos River looks normal. In this area the signal is 3G and signal strength is poor. The riparian forest by Lake Ismarida is suffering. There are numerous dying trees—old cottonwoods and poplars seem especially affected. The lake is very close to both to Komotini (4G) and the Egnatia Highway (4G/LTE). There are many new cell towers in the vicinity, though as far as I can determine the nearest ones to the lake still operate at 3G.

Between Komotini and Alexandroupolis the pine forests are in very bad shape. There are many, many dead and dying trees—recently dead, because the pines are still covered in red needles. In some places the forests are dotted with a few dying trees while in other areas nearly half the trees are dead. We also saw dead ilex (normally a very tough plant indeed), dead cypresses, dead poplars and dead junipers. Most of the dead trees seem to lie along the highway corridor, where the new Egnatia toll motorway runs. The Egnatia is served with 4G/LTE along its entire length. Although we did not drive on the Egnatia, the old national road runs parallel to it along this section.

Alexandroupolis and Environs

There are many dead and dying trees in the pine forests around Alexandroupolis also. The damage is very visible as one approaches the city from the west: the rusty red of dead pines stands out against the darker green of the live pines. North and east of Alexandroupolis there are also dead and dying trees in the pine forests, but the problem seems most acute to the west along the highway corridor.

Dadia and Environs

Dadia and surrounding areas also have dead pines. Some trees are newly affected, and some clearly died some time ago as only the leafless trunks and branches remain. In the mountains, we spoke at length to two forestry officials patrolling the area. We asked them about the dying trees.

They told us that trees have been dying for the past four to five years, but the problem has become much more acute in the last year or two. All species of tree are affected. When asked what is causing the trees to die, they said they didn't know because no one has been able to determine what is killing the trees. Samples of trees have been sent for analysis but scientists have found no disease or fungus. Traps have been set for insects but they have not caught any insects that could be killing the trees. The trees are simply dying. The dead trees seem to share one characteristic: when cut down, they are hollow at the core. (We later saw logged oak trees of which a number of trunks were hollow, as described). When asked about the many new cell towers, the forestry officials said they had all been put up in the last two years.

The Prespa Lakes

At the Prespa Lakes, which is a 3G area, there were hardly any dying trees. Most of the forest is oak (mainly young oak—I believe the area was napalmed by the US during the Greek civil war) and it looks healthy. The

exception was several dead ancient junipers in the rare and protected juniper forest above the lakes. These are only two or three kilometers from the nearest cell tower, situated on a hill opposite. These trees are over 400 years old. I have no idea how long junipers can live, but it would be a great shame if the cell tower radiation is affecting them.

Central Greece: Larissa to Athens

We avoided the motorway between the Prespa Lakes and Larissa, so the areas we passed through were mainly 3G. From Larissa, where we picked up the toll motorway (4G/LTE), we started to see large numbers of dead and dying trees. All sorts of trees were affected: poplars and eucalyptus (most of the trees we saw were dead), pine and fir, and many olives. In some places, even the oleanders that line the highway were dying.

At Pelasghia, midway between Volos and Lamia, I spoke to an uncle who is an olive farmer. This region of the country grows a lot of olives; it is the main crop. Everyone is very concerned about the dying trees. My uncle told me that they have not been able to work out what is killing the olives. As in Dadia, they have sent tree samples for analysis and set traps for insects—all without result. This is not the same fungus that was affecting olives some years ago, known as “the rust”; that has been and gone.

If the farmers can’t identify what is killing the trees, they can’t save them. I talked to other people in the area: everyone is concerned, not only about the olives but also about all the other trees that are dying. This area is primarily 4G. The cities (Volos and Lamia) and larger villages (Almyros, Pelasghia, Stylida) are all 4G, as is the toll highway that runs along besides them. There are a great many cell towers.

If the dying trees have nothing to do with electromagnetic radiation from cell towers, why are so many more trees dying in 4G areas? On the way to Athens we continued to see dead and dying trees on both sides of the road.

Samos

Just before we left Samos at the beginning of April, small pines had started to die on the mountain below the cell tower array that serves the capital of Vathi. The smallest ones virtually dried up and died overnight; mid-sized pines were also starting to die.

In our absence, many new cell towers and booster masts went up. Now many trees that were alive when we went away are dead. All sorts of trees: we have seen dead pines, cypresses, poplars, firs, olives and fruit trees, both in the town of Vathi and outside it. The pines and cypresses seem to die from the top; the crown turns red-brown and the rest follows. On olive trees, the outer branches lose their leaves first.

In addition, many trees are exhibiting damage on the part of the tree that faces the new cell tower. A section of the tree dries out and loses its leaves, or the leaves/needles of the affected area change color. In town, the tamarisks that line the waterfront show such damage where they face the new booster masts. Vathi can ill afford to lose any trees.

Discussion: Trees

Greece is a hot country, and we already lose too many trees each year to summer forest fires—around 50,000 hectares annually. A recent fire northeast of Athens destroyed more than 4,000 acres of forest. Large-scale tree die-off would be ruinous, climatically and economically. It would be disastrous for already-struggling bird populations.

We considered whether climatic conditions could be causing the trees in Greece to die, but this does not seem to be the case. The past two winters have not been especially wet, but it has rained; there has not been a drought. Water fountains, many of which are connected to natural springs, were flowing normally, and it rained many times during our trip north. There was a cold snap this past winter, with temperatures reaching -17 degrees C at Lake Kerkini and the Prespa Lakes, but these areas do not have dying trees. The ancient junipers at Prespa must have experienced many freezing

winters, since temperatures of -15 to -20 degrees C are common in this mountain region in January-February. The winter of 2005-2006 was much colder than last winter, with huge snowfalls all over Greece. Winter crops were damaged, but the trees did not die. If drought or cold weather is not killing the trees, and if the forestry service and the farmers cannot identify diseases or pests which are killing trees, something else is to blame. Now crops are dying, too. A number of farmers have told me that, this summer, crops such as melons, tomatoes and peppers which were doing well suddenly dried up and died.

Studies on the effects of electromagnetic radiation on plants show that it hampers germination and reduces crop yields. Many livelihoods depend on farming. Greece has a huge diversity of wild plants; there are some 6,000 varieties of wildflower, many unique, more than anywhere else in Europe except Spain. If cell tower radiation is killing the trees, it will sooner or later affect these as well. It could take a long time before anyone noticed that small plants and flowers were dying off. Many are considered weeds, and small plants are no easier to count than small birds; no one notices them.

It will be very difficult to persuade the Greek Forestry Service to consider cell tower radiation as a possible cause of forest die-off. Farmers in Pelasghia may be open to the suggestion that cell towers are killing their olives, but the Forestry Service neither shares information with nor takes advice from members of the public, especially non-scientists like myself, no matter how many studies one presents them with.

Worldwide, tree die-off will be a huge driver of climate change. A quick search of the Internet shows this is a major problem everywhere. Tree die-off is being attributed to specific pests and fungi, in some cases, whereas in others there is speculation that trees are dying because of too much lighting or because of climate change itself.

I am neither a scientist nor an expert on electromagnetic radiation, but I have gathered that it weakens the immune system of living things. There are increasing numbers of studies showing that cell tower radiation directly

harms trees, causing all or part of the tree to die. Cell tower radiation would also make trees and plants vulnerable to fungi and disease.

Bibliography/Suggested Reading

There are more than 20,000 studies about the effects of electromagnetic radiation on people, birds, animals, plants and trees. I believe there is more than enough scientific evidence that electromagnetic radiation is dangerous to humans and wildlife to make us rethink whether we want this technology at all. By any standards there is enough evidence to demand that governments enact the precautionary principle with regard to 4G and 5G.

I list a few articles here, but many more can be found on the website www.emf-portal.org/en as well as on PubMed—or you can simply search the web.

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