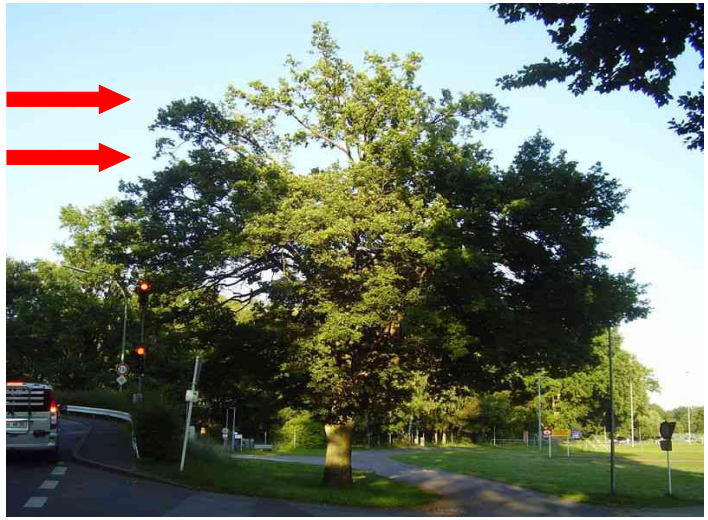
**18 Bug, Südliche Auffahrt zur Brücke, Eiche (Sender Gutenbergstraße 2 km, Sender Hauptsmoorwald 3,6 km)**

**2008**

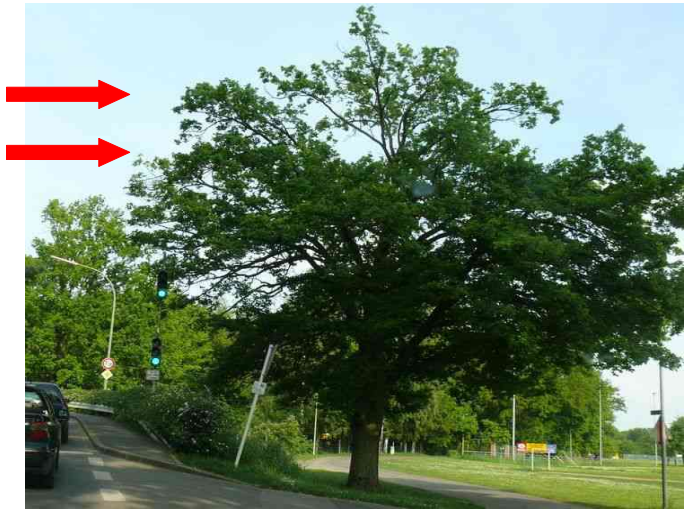
22.10.08 Eiche (Blick von NW)

**2009**



13.06.09

**2010**



25.05.10

Bug, Auffahrt zur Brücke/Zufahrt Sportplatz

**2014**

24.07.14

**2015**

01.07.15

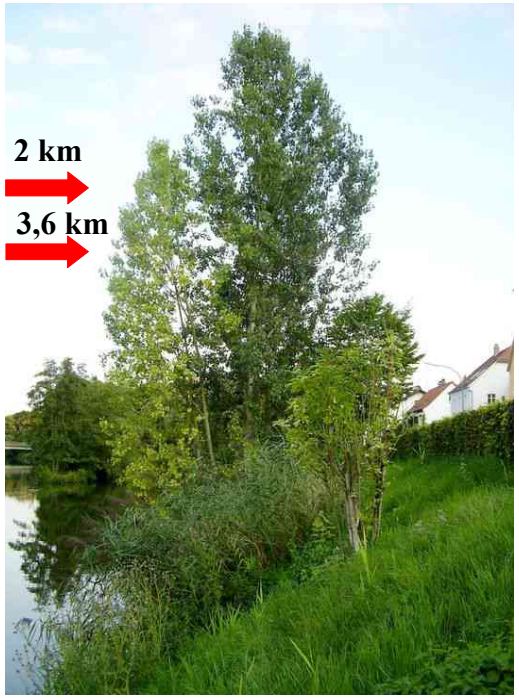
**2017**

24.09.17

**19 Bug, Postsportverein , Eichenwäldchen (Sender Gutenbergstraße 1,9 km, Sender Hauptsmoorwald 3,5 km, Sender A 73/Strullendorf 4,4 km)**

| 2009 | 2016 | 2017 |
|---|---|---|
| | | |
| 14.08.09 Eichengruppe (von SW) | 11.09.16 | 05.07.17 |
| Bug, kleines Wäldchen zwischen Regnitz und Sportplatz | | |
| Entfernungen: Sender Gutenbergstr. 1,9 km, Sender Hauptsmoorwald | 3,5 km, Sender A 73/Strullendorf 4,4 km | |

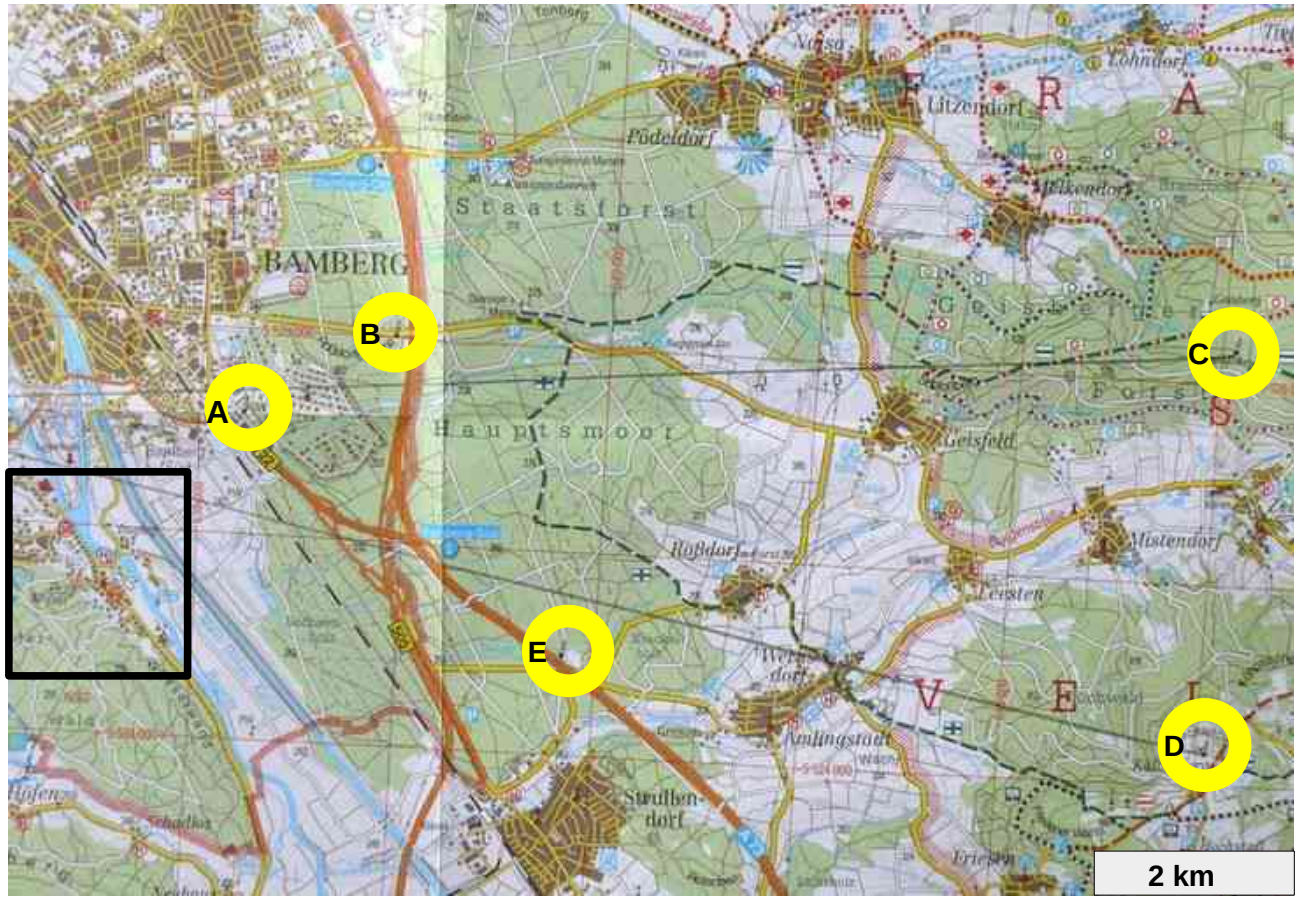
**20 Bug, Am Regnitzufer, Pappel (Sender Gutenbergstraße 2 km, Sender Hauptsmoorwald 3,6 km)**

| 2008 | 2009 | 2013 | 2016 |
|---|---|---|---|
|   | | | |
| 18.08.08 Pappel (Blick von N) | 13.06.09 (Blick von N) | 22.09.13 (Blick von NNW) | 08.04.16 (Blick von NNW) |
| Bug, Am Regnitzufer | | | Fällung wegen Asymmetrie im |
| Sichtverbindung zu Sender Gutenberg- | str. (2 km) und Sender Hauptsmoor- | wald (3,6 km) | im Winter 2014/2015 |

**21 Bug, Karl-May-Straße, Ufergehölze (Sender Gutenbergstraße 2,2 km, Sender Hauptsmoorwald 3,6 km, Sender A 73/Strullendorf 4,1 km)**

| 2009 | 2015 | 2017 |
|---|---|---|
| | | |
| 24.08.09 Pappeln und Erlen (von SW) | 17.06.15 | 14.08.17 |
| Westufer der Regnitz, Blick von Karl-May-Straße | | Die Pappel wurde gefällt. |
| Sichtverbindung zu Sender Gutenbergstraße (2,2 km) | und Sender Hauptsmoorwald (3,6 km) | Entfernung zu Sender an A 73 /Strullendorf 4,1 km |

Von Bug und vom Bruderwald besteht Sichtverbindung zu insgesamt fünf Hochfrequenzsendern mit einer Vielzahl unterschiedlicher Frequenzen, Modulationen und Pulsfolgen: Mobilfunksender A Gutenbergstraße, B Hauptsmoorwald und E an A73 bei Strullendorf, Rundfunksender C Geisberg, Fernsehsender D Kälberberg.




Ausschnitt aus Wanderkarte Fritsch, 66, Bamberg/Forchheim, 4. Auflage
Hinzugefügt wurden Standorte (gelb) von fünf Hochfrequenzsendern:

A Gutenbergstraße 20 (246 m ü. NN)
B Geisfelder Straße/Hauptsmoorwald (275 m ü. NN)
C Rundfunksender Geisberg (585 m ü. NN)
D Kälberberg (558 m ü. NN)
E A 73/Strullendorf (260 m ü. NN)

Sender Gutenbergstraße

Sender Hauptsmoorwald

Sender Geisberg

Sender Kälberberg

**22a Bug, Oberer Leinritt, Weide, Zitterpappeln von S (Sender Gutenbergstraße 1,9 km, Sender Hauptsmoorwald 3,6 km, Sender A 73/Strullendorf 5 km)**

| 2010 | 2016 | 2017 |
|---|---|---|
| | | |
| 25.08.10 Weide, Zitterpappeln (von S) | 11.09.16 | 04.10.17 |
| Oberer Leinritt/Bamberger Straße/Am Regnitzufer | Vorzeitiger Laubfall | Vorzeitiger Laubfall |
| Entfernungen: Sender Gutenbergstraße 1,9 km, | Hauptsmoorwald 3,6 km, A 73/Strullendorf 5 km | Messung: 152 µW/m² |

**22b Bug, Oberer Leinritt, Zitterpappelgruppe von W (Sender Gutenbergstraße 1,9 km, Sender Hauptsmoorwald 3,6 km, Sender A 73/Strullendorf 5 km)**

| | | |
|---|---|---|
| **2017** | **2017** | **2017** |
| 04.10.17 Zitterpappelgruppe (**von S**) | 04.10.17 Zitterpappelreihe (**von W**) | 04.10.17 Zitterpappelreihe (**von W**) |
| Oberer Leinritt/Bamberger Straße | | Ausschnitt Kronen |
| Vorzeitiger Laubfall | Nördliche Bäume noch dicht belaubt, mittlere Bäume rot ver- | färbt, südliche Bäume kahl. |

**Beispiele von Campingplatz und Karl-May-Straße**

Luftbild von BayernAtlas, Bayerisches Landesamt für Digitalisierung, Breitband und Vermessung, 2017
Von Osten treffen seit 2016 die Hauptstrahlen von drei 270°-Sektorantennen (vorher eine 270°-Antenne) der Mobilfunksendeanlage an der A73 bei Strullendorf (Montagehöhe 37-43 m, 21 Sektorantennen) auf den Campingplatz, die Karl-May-Straße und den Bruderwald.
Die Entfernung vom Mobilfunksender an der A73 bei Strullendorf (260 m ü. NN) bis zum Campingplatz (240 m ü. NN) beträgt ca. 4 km, vom Fernsehsender Kälberberg (558 m ü. NN) 10,3 km, vom Rundfunksender Geisberg (585 m ü. NN) 10,8 km.

## 23 Bug, Campingplatz, Erlengruppe (Sender A 73/Strullendorf 3,8 km)

2009

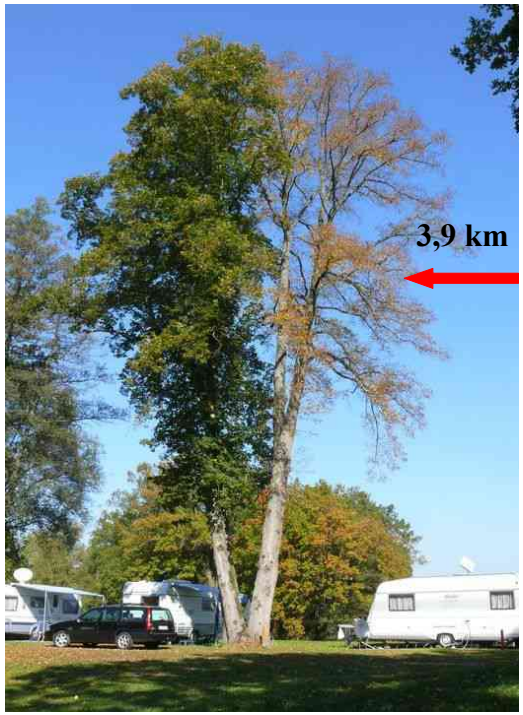
20.10.09 Erlengruppe (von S), Sichtverbindung zu Mobilfunksender an A73 im Osten, Rundfunksender Geisberg und Fernsehsender Kälberberg

2017

17.06.17 Mehrmals mussten jeweils die östlichen Erlen gefällt werden.

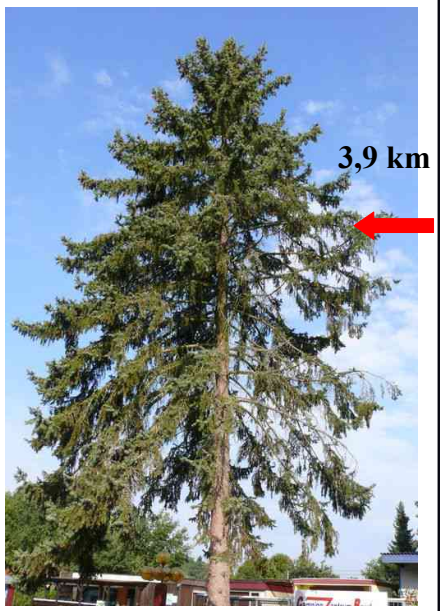
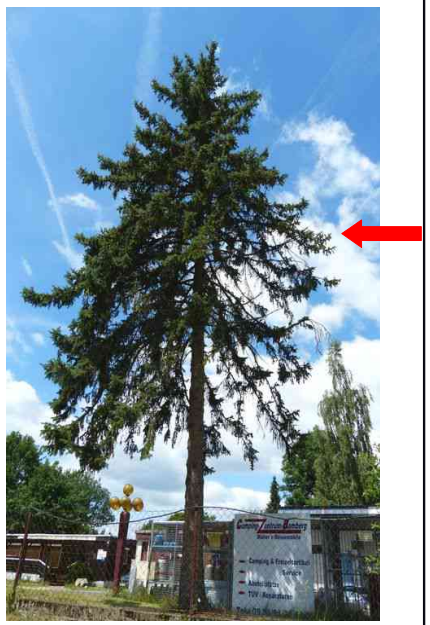
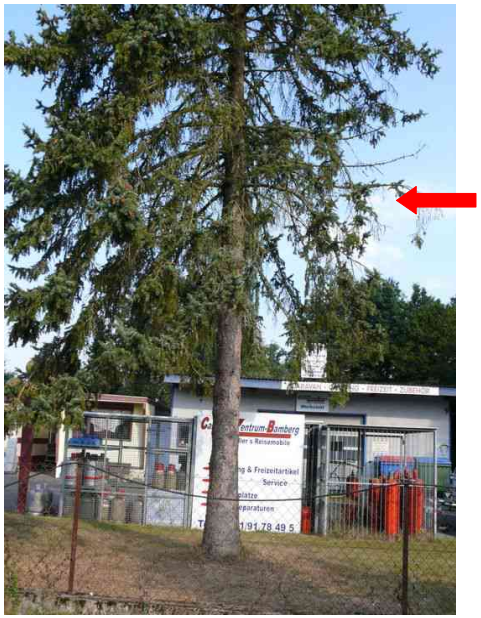
Viele Bäume auf dem Campingplatz zeigten Kronenschäden – häufig beginnend auf der Ostseite. Zum Sender Gutenbergstraße besteht im südlichen Teil wegen dazwischen stehender Bäume keine Sichtverbindung. Daher entstand der Verdacht, dass die weiter entfernten Sender Auswirkungen auf Bäume haben.

**24 Bug, Campingplatz, Linde (Sender A 73/Strullendorf 3,9 km)**

| 2010 | 2012 | 2013 | 2016 |
|---|---|---|---|
|   | | | |
| 12.10.10 Linde (von SW) | 11.09.12 Sichtverbindung zu Sendern | 27.04.13 | 11.09.16 |
| Campingplatz, Nordteil | A73 (3,9 km), Geisberg und Kälberberg | | |

Wegen der Baumgruppe im Hintergrund, auf der Ostseite der Regnitz, besteht keine Sichtverbindung zu den Sendern Gutenbergstraße und Hauptsmoorwald.

## 25 Bug, Campingplatz, Stechfichte (Sender A 73/Strullendorf 3,9 km)

| 2012 | 2014 | 2016 | 2017 | 2016 |
|---|---|---|---|---|
|   | | |  |  |
| 11.09.12 Stechfichte (von S) | 05.06.14 | 11.09.16 | 17.06.17 | 11.09.16 |
| Einfahrt Campingplatz | Stetige Zunahme des | Schadens auf der Ostseite | | Standort der Stechfichte |

## 26 Bug, Karl-May-Straße, Lärche und Kiefer (Sender A 73/Strullendorf 4 km)

| 2009 | 2015 | 2017 |
|---|---|---|
| | | |
| 05.06.09 Kiefer und Lärche (von S) | 17.06.15 | 19.06.17 |
| Karl-May-Straße | Kiefer und Lärche können nicht in die Höhe wachsen. | |
| Entfernung Sender A 73/Strullendorf 4 km | | |

## 27 Bug, Karl-May-Straße, Pappel und Garten (Sender A 73/Strullendorf 4 km)

| August 2003 | August 2009 | August 2017 |
|---|---|---|
| | | |
| 29.08.03 Pappel (von W) | 30.08.09 Vorzeitiger Laubfall | 27.08.17 Vorzeitiger Laubfall |
| Karl-May-Straße | Entfernung Sender Sender A 73 (4 km) | |
| Ab 2006 traten beim Aufenthalt in diesem Garten | | |
| sofort Kopfdruck, Benommenheit und Müdigkeit auf. | | |
| Seither lag der Garten brach. | | |

## 28 Bug, Karl-May-Straße, Kiefern (Sender A 73/Strullendorf 4 km)

| 2009 | 2014 | 2018 |
|---|---|---|
| | | |
| 30.08.09 Kieferngruppe | 15.05.14 | 05.04.18 |
| Haltestelle Campingplatz | Entfernung Sender A 73/Strullendorf (4 km) | |

**29 Bug, Karl-May-Straße, Garten mit Pflaumenbaum (Sender A 73/Strullendorf 4 km)**

| 2007 | 2011 | 2018 |
|---|---|---|
| | | |
| 12.10.07 Pflaumenstamm (von O) | 31.05.11 | 22.04.18 |
| Karl-May-Straße, Garten. | Entfernung Sender A 73/Strullendorf 4 km | |
| Im Jahr 2007 traten kleine Risse am Stamm auf. | Die Risse wurden rasch breiter und länger. | |

**30 Bug, Buger Hof, Linde und Blutbuche (Sender Gutenbergstraße 2,1 km, Sender Hauptsmoorwald 3,7 km, Sender A 73/Strullendorf 4,7 km)**

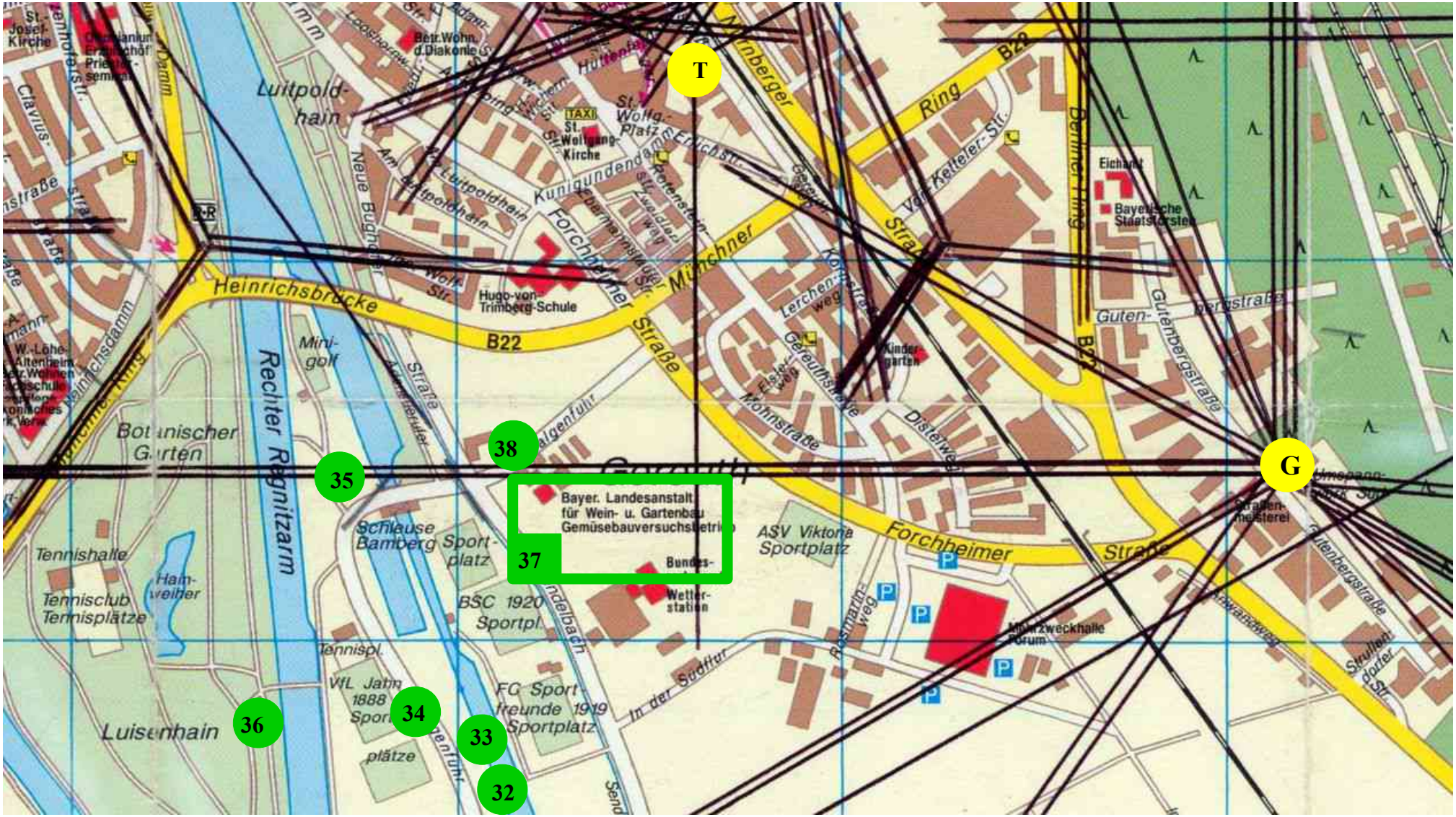
| 2014 | 2015 | 2016 |
|---|---|---|
| | | |
| 24.07.14 Linde und Blutbuche (von O) | 31.07.15 | 11.09.16 |
| Am Regnitzufer 1 | Die Linde hat nur noch wenige Blätter. | Die Linde ist kahl, die Blutbuche licht. |
| Verlichtung von Linde und Blutbuche | Entfernungen: Sender Gutenbergstr. 2,1 km, Sender | Hauptsmoorwald 3,7 km, Sender A 73 4,7 km |

Das Gelände steigt westlich der Regnitz an. Die Hochfrequenz-Immissionen treffen auf den Hang. Auch dort gab es zahlreiche Baumschäden.

**31 Bug, Buger Hauptstraße, Baum (Sender Gutenbergstraße 2,1 km, Sender Hauptsmoorwald 3,7 km, Sender A 73/Strullendorf 4,6 km)**

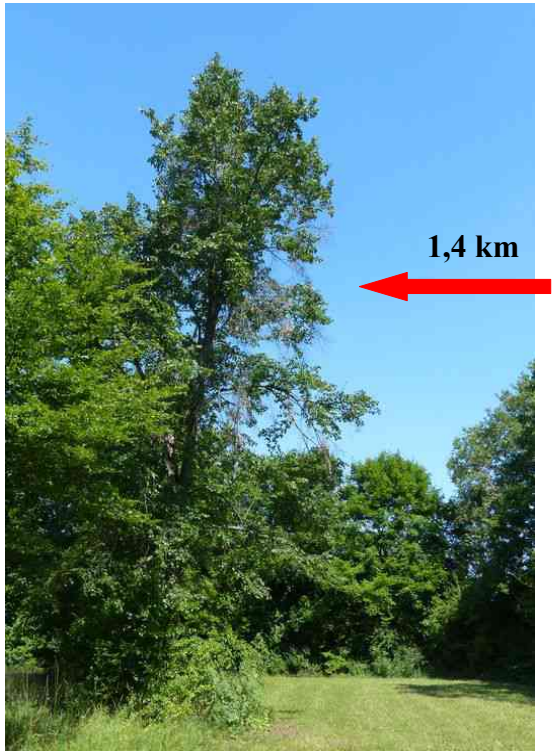
| 2014 | 2016 | 2017 |
|---|---|---|
| | | |
| 24.07.14 Baum (Blick von O) | 11.09.16 Baum (Blick von O) | 05.07.17 Baum (Blick von NO) |
| Buger Hauptstraße, Beginnende Verlichtung | Vorzeitiger Laubfall | Absterben |
| Entfernungen: Sender Gutenbergstr. 2,1 km, Sender | Hauptsmoorwald 3,7 km, Sender A 73 4,6 km | |

**Beispiele von Galgenfuhr, Jahnwiese, Luisenhain**

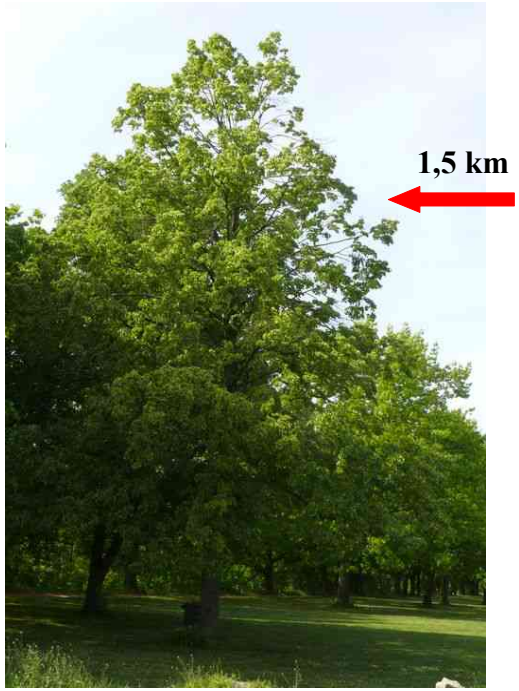



Ausschnitt aus Stadtplan Bamberg, 23. Auflage, Städte-Verlag E.v.Wagner& J. Mitterhuber. Hinzugefügt: Mobilfunkstandorte mit Hauptstrahlrichtungen (schwarz) der Sektorantennen (**Stand 2011**). Die Montagehöhen der Sendeanlage Gutenbergstraße (246 m ü. NN) betragen 38 bis 47 m, der Sendeanlage Theresienstraße (241 m ü. NN) 34 m. Auf der Mehrzweckhalle Forum, Forchheimer Straße, wurde 2015 eine Mobilfunksendeanlage (Montagehöhe 18 m) errichtet.

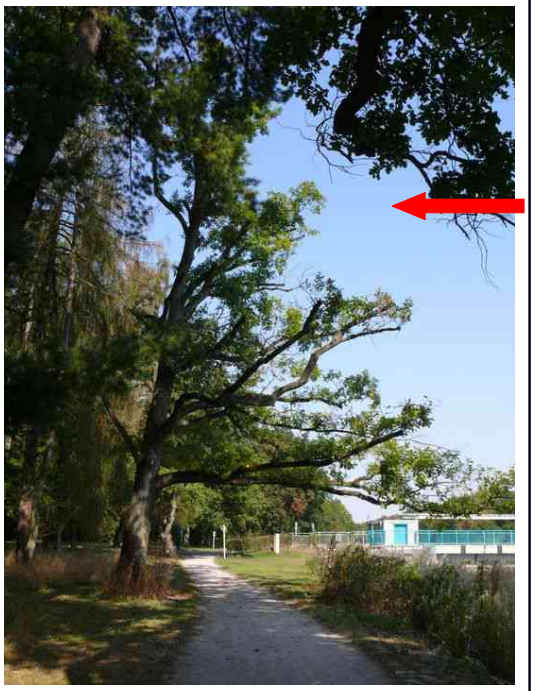
**32, 33, 34 Galgenfuhr, Linden und Eiche (Sender Gutenbergstraße 1,4 km)**

| | | |
|---|---|---|
| 2017<br> <br> | 2017<br>  <br> | 2017<br> <br> |
| 05.07.17 Linde (Blick von S) | weitere Linde, etwas nördlich (von S) | Links Linde, rechts bei Ortsschild Eiche (Blick von SSO) |
| Galgenfuhr, senderseitiger Kronenschaden | Galgenfuhr (241 m ü. NN) | Galgenfuhr |
| Sichtverbindung Sender Gutenbergstraße (1,4 km) | senderseitiger Kronenschaden | senderseitige Kronenschäden |

## 35 Jahnwiese, Linde (Sender Gutenbergstraße 1,5 km)

| 2011 | 2013 | 2015 | 2017 |
|---|---|---|---|
|   | | | |
| 06.05.11 Linde (Blick von SSO) | 22.09.13 Linde (von S), Spielfest | 26.09.15 Linde (von S) | 05.07.17 Linde (von N) |
| Jahn-Halbinsel (239 m ü. NN) | Senderseitiger Kronenschaden | | |
| Entfernung Sender Gutenbergstraße | (1,5 km) | | |

## 36 Luisenhain/Rechter Regnitzarm/Wehr, Eiche (Sender Gutenbergstraße 1,6 km)

| 2010 | 2013 | 2016 | 2017 |
|---|---|---|---|
| | |  | |
| 18.07.10 Eiche (Blick von S) | 22.09.13 | 11.09.16 | 04.10.17 |
| Luisenhain, Wehr | | Rückschnitt war notwendig. | |

**37a Galgenfuhr, Landesanstalt für Weinbau und Gartenbau (LWG), 18.07.10 (Sender Gutenbergstraße 0,8-1,2 km, Sender Theresienstraße 0,5-0,9 km)**

| | | | | |
|---|---|---|---|---|
| **2010** | **2010** | **2010** | **2010** | **2010** |
| | | | | |
| 18.07.10 Mobilfunksender Theresienstraße (von S) Höhe 34 m, drei Sektor-antennen 2011, neun 2018 | 18.07.10 Birken (von W) Landesanstalt für Weinbau und Gartenbau, Südende des Geländes | 18.07.10 Blick von W über Gelände LWG auf Mobilfunk-sender Gutenbergstraße Messwert: 116 µW/m² | 18.07.10 Walnuss Tag der offenen Tür, Kindergärtnerei Walnuss wächst nicht in die Höhe; abgestorbene Äste im Wipfel. | 18.07.10 Mobilfunksender Gutenbergstraße (von W) Rundfunksender Geisberg im Hintergrund |

Ein Mobilfunksender auf der Mehrzweckhalle Forum in der Forchheimer Straße wurde erst im Jahr 2015 installiert.

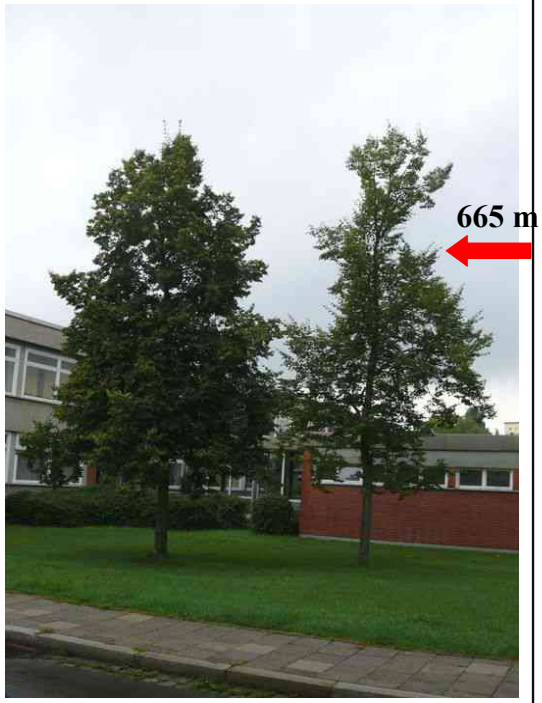
**37b Galgenfuhr, Landesanstalt für Weinbau und Gartenbau, Risse und Flechten an Obstbäumen, 18.07.10**

| | | | |
|---|---|---|---|
| **2010** | **2010** | **2010** | **2010** |
| 18.07.10 Asienbirne | 18.07.10 Asienbirne, Stamm | 18.07.10 Apfelbaum | 18.07.10 Ginkgo |
| | Risse und Flechten | Risse und Flechten | |

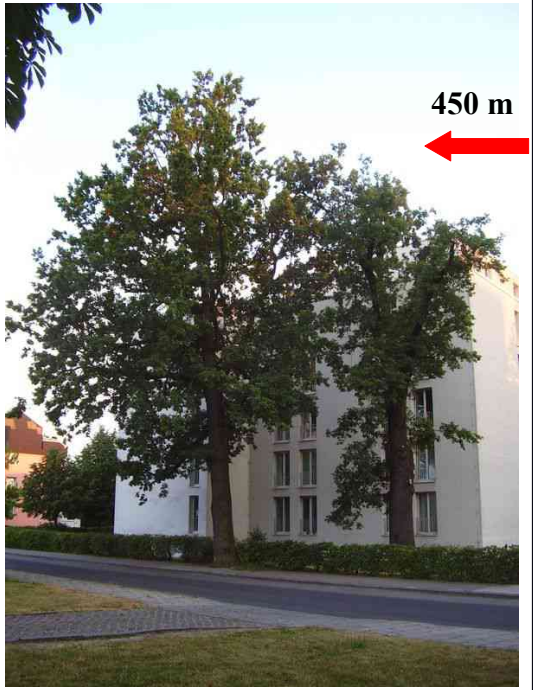
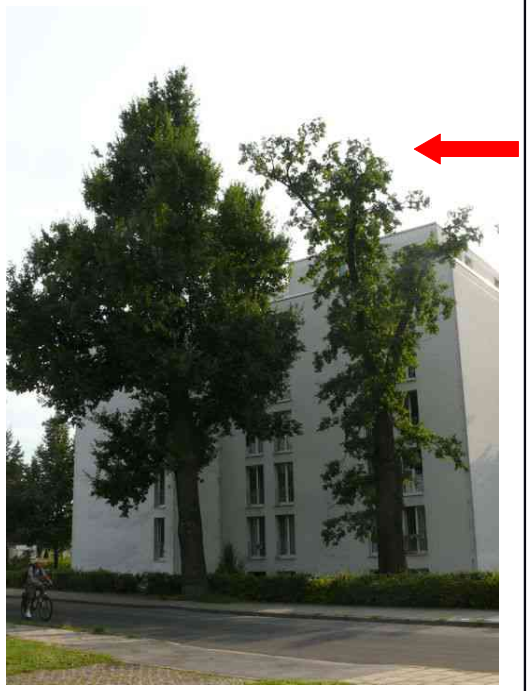
**38 Galgenfuhr, LWG, Birke (Sender Gutenbergstraße 1,2 km, Sender Theresienstraße 706 m, Sender Forchheimer Straße 730 m)**

| 2011 | 2015 | Juli 2017 | November 2017 |
|---|---|---|---|
| | | | |
| 06.05.11 Birke (Blick von W) | 26.09.15 Birke (Blick von WWS) | 05.07.17 Birke (Blick von SW) | 16.11.17 Birke (Blick von SW) |
| Galgenfuhr, Zustand nach Rückschnitt | vorzeitiger Laubverlust | schüttere Belaubung | Rückschnitt, später Fällung |
| Sichtverbindung Sender Theresienstraße | (706 m), Sender Gutenbergstraße | (1,2 km) und ab 2015 Sender | Forchheimer Straße (730 m) |

## 39 Zwei Linden, Veit-Stoß-Straße/Heidelsteigschule (Sender Kantstraße 665 m)

| 2010 | 2012 | 2013 | 2017 |
|---|---|---|---|
|   | | | |
| 17.08.10 zwei Linden (von SO) | 20.09.12 Linde rechts: Laubverlust | 30.04.13 Linde rechts: Laubaustrieb | 05.10.17 Linde rechts: Laubverlust |
| Veit-Stoß-Straße/Heidelsteigschule | vorzeitig, Störung der Entwicklung | später als bei Linde links. | vorzeitig, Absterben von Kronenteilen |
| Sichtverbindung zu Sender Kantstraße | (665 m). | Messung im Jahr 2015 in 6 m Höhe. | links: 40 µW/m² rechts: 170 µW/m² |

**40a Zwei Eichen, Pestalozzistraße (Sender Kantstraße 450 m)**

| 2008 | 2013 | 2015 | 2017 |
|---|---|---|---|
|   |  | | |
| 08.06.08 zwei Eichen (Blick von O) | 29.08.13 Erheblicher Unterschied | 01.11.15 | 26.06.17 |
| Pestalozzistraße, Rückschnitt Eiche re | zwischen den beiden Eichen. | Eiche rechts: Absterben von Kronen- | Bei der Eiche rechts war erneut ein |
| Sichtverbindung zu Sender Kantstraße | (450 m) | teilen. | Rückschnitt notwendig gewesen. |

**40b Zwei Eichen, Pestalozzistraße, in unbelaubtem Zustand (Sender Kantstraße 450 m)**

| | | |
|---|---|---|
| **2011** | **2011** Sender Kantstr. 33 | **2016** |
| 05.02.11 obige zwei Eichen im Vordergrund **(Blick von SO)** | Montagehöhe: 42 m | 04.04.16 zwei Eichen (**Blick von O**) |
| Im Hintergrund: Mobilfunksendeanlage Kantstraße | 9 Sektorantennen | Eiche rechts nach frischem Rückschnitt (vergleiche |
| Rückschnitte waren wiederholt erforderlich: vor 2008, nach 2011, nach 2015. | 11 Richtfunkantennen | Foto oben vom 01.11.15) |

## Baumschäden im weiteren Umkreis von Mobilfunksendeanlagen (Entfernungen zwischen 400 m und 4 km)

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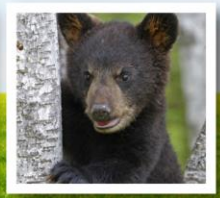
# PROTECT
# Birds, Bees and Trees

# INCLUDE

## Anthropogenic Radiofrequency Electromagnetic Radiation in *Canadian Environmental Protection Act* AMENDMENTS

**WHITE PAPER**
**Updated APRIL 2022**

**Prevent Cancer Now and Canadians For Safe Technology**



## Proposed amendments to include in Bill S-5

**6.1 Section 43 of the Act is amended by adding the following after the last definition in the section:**

"radiofrequency electromagnetic radiation" means:

> radiated energy arising from accelerating electrical charges, having the form of electromagnetic waves and a stream of photons, and in a vacuum travels at the speed of light. The rate of oscillation of the waves is in the range between 3 kilohertz (kHz) to 300 gigahertz (GHz), which corresponds to the frequency of the non-sinusoidal radio waves typically used in radio communications.

**7 Section 44 of the Act is amended by adding the following after subsection (4):**

**Radiofrequency electromagnetic radiation**
(5) The Ministers shall conduct research or studies relating to radiofrequency electromagnetic radiation, methods related to its detection, methods to determine its actual or likely short-term or long-term effect on the environment and human health, and preventive, control and abatement measures to deal with it, and alternatives to its use, to protect the environment and human health.

This updated white paper includes a proposed amendment to the *Canadian Environmental Protection Act, 1999,* and clarifies that this proposal specifically addressed radiofrequency electromagnetic radiation (RF-EMR) in Bill S-5. It is an update of the February 2022 version of **"Protect Birds, Bees and Trees: Include Electromagnetic Radiation* in *Canadian Environmental Protection Act* Amendments. * Anthropogenic Non-ionizing Electromagnetic Radiation**."

The proposed range of radiofrequencies is consistent with "**Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz. Safety Code 6 (2015)."** Consumer and Clinical Radiation Protection Bureau. Environmental and Radiation Health Services Directorate. Healthy Environments and Consumer Safety Branch. Health Canada. https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/consult/_2014/safety_code_6-code_securite_6/final-finale-eng.pdf

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This white paper is a collaborative effort of Prevent Cancer Now and Canadians for Safe Technology. www.preventcancernow.ca and www.c4st.org

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Circles: Satellite, Smart Meter, Fibre To The Premises (PCN/C4ST), WIRE Through The Premises (PCN/C4ST), Cell Antennas (R. Freeman), Cell Towers (M. Friesen).

Squares: Birds (D. Desender), Bee (M. van den Berg), Trees (J. Cornell), Bear, Turtles (T. Hitch), Frog (J. Cornell).

# Modernizing the *Canadian Environmental Protection Act* and Ensuring the "Right to a Healthy Environment" Must Address Anthropogenic† Radiofrequency Electromagnetic Radiation‡ (RF-EMR) ("wireless radiation")

**Highlights**

- Flora and fauna, including insects and birds, can be affected adversely by radiofrequency electromagnetic radiation (RF-EMR) used for wireless telecommunications ("wireless radiation"). Species' collapse lends urgency to assessment and environmental protection from anthropogenic† RF-EMR. Canadian assessment and regulation focuses solely on human health.
- Unlike toxic substances, RF-EMR from modern technologies is not addressed as a risk to the environment under the *Canadian Environmental Protection Act* (CEPA), or other national laws.
- Health Canada's Safety Code 6 "Limits for human exposure to radiofrequency electromagnetic energy" guidelines are implemented by Innovation, Science and Economic Development (ISED) to protect humans from "established," adverse effects, specifically nerve stimulation at lower frequencies and over-heating of tissue at frequencies for telecommunications.
- In other species, biological effects of wireless radiation have been identified in all taxa that were adequately studied. Effects have been observed at ambient and low-intensity levels of exposure, such as from Wi-Fi and cell towers (base stations) at a distance.
- The dramatic worldwide decline of populations of birds, insects and other biota makes this an urgent issue. According to scientists who specialize in this field, exposure to wireless radiation at ambient levels may well be a co-factor, along with pesticides, habitat loss and climate change.
- The rollout of novel technologies is increasing wireless radiation levels, as well as introducing frequencies and modulations not previously used.
- Increasing numbers of structures with multiple cellular network antennas (specifically designed to emit RF-EMR) are being installed across Canada, in urban, rural and wilderness areas. These antennas will support the operation of hundreds of thousands additional smaller antennas (e.g., 4G, 5G) being mounted on non-tower structures (e.g., street furniture, buildings, lamp-posts and other utility poles). At the same time, tens of thousands more telecommunications satellites are being launched to emit RF-EMR.
- Wireless radiation is clearly an environmental agent that is potentially harmful, as a pollutant. Exposure to wireless radiation has serious implications for biodiversity and ecosystem health.
- Cumulative and synergistic effects may occur with wireless radiation plus chemical substances.
- **We believe that the solution is for the federal government to begin to systematically regulate anthropogenic RF-EMR under provisions in an amended *Canadian Environmental Protection Act*. Such an approach will both modernize the Act and further support the key goal to establish a "Right to a Healthy Environment" in CEPA.**

**Protect fauna and flora, as well as human health, by amending the *Canadian Environmental Protection Act, 1999* to address current gaps in the regulatory regime, by making anthropogenic radiofrequency electromagnetic radiation (RF-EMR or "wireless radiation") subject to research and regulation (see page 2).**

† Anthropogenic: originating from human activity.

‡ Radiofrequency Electromagnetic Radiation: see facing page (page 2) for definitions.

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## 1 Background

Canadian society relies heavily on wireless communications. This requires extensive infrastructure of large cell towers (base stations) and smaller antennas (on buildings, utility poles and other structures) to enable communications with wireless devices used by individuals, businesses and a diverse range of organizations. In addition to the existing infrastructure, more and more new cellular antennas, big and small, are being installed and are emitting increasing levels of radiofrequency electromagnetic ("wireless") radiation into the environment.

Radiofrequency is a non-ionizing range of electromagnetic radiation. Unlike the well-recognized direct molecular damage from high-energy photons of ionizing radiation (e.g., x-rays), the lower-energy photons of non-ionizing radiation have been portrayed as harmless at doses that do not cause excessive heating of tissue. There is convincing evidence, however, that ongoing, lower intensities of wireless radiation can cause biological effects via other mechanisms, with serious implications for biodiversity and ecosystem health.

Health Canada guidance (Safety Code 6) addresses human exposure to radiofrequency electromagnetic radiation (RF-EMR), and compliance with Safety Code 6 is enforced by the Ministry of Innovation, Science and Economic Development (ISED) via Administrative Monetary Penalties.[1] No Canadian policy or law is intended to protect non-human species from radiofrequency radiation. As described in Section 3.4 below, ISED regulations and criteria for devices, equipment and antenna-siting for cell towers all reference Safety Code 6, intending to protect people but not other biota. ISED references the *Canadian Environmental Protection Act, 1999* (CEPA), whereas CEPA is silent on this topic.

It is well documented in peer-reviewed scientific literature, however, that wireless radiation used in telecommunications can cause harmful biological effects, at ambient levels. An extensive, authoritative review published in 2021 stated:[2]

> Biological effects have been seen broadly across all taxa and frequencies at vanishingly low intensities comparable to today's ambient exposures. Broad wildlife effects have been seen on orientation and migration, food finding, reproduction, mating, nest and den building, territorial maintenance and defense, and longevity and survivorship. Cyto- and geno-toxic effects have been observed.

Wireless radiation on its own, or acting additively or synergistically with chemical substances, can damage living tissues and genetic material, and cause inflammation, dysfunction, cancers and other effects.[3,4,5]

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[1] Government of Canada. (2018) **Compliance and Enforcement.** https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf10951.html.

[2] Levitt, B. B., Lai, H.C. & Manville, A.M. (2021). **Effects of Non-Ionizing Electromagnetic Fields on Flora and Fauna, Part 1. Rising Ambient EMF Levels in the Environment**. *Reviews on Environmental Health*. https://doi.org/10.1515/reveh-2021-0026.

Levitt, B. B., Lai, H.C. & Manville, A.M. (2021). **Effects of Non-Ionizing Electromagnetic Fields on Flora and Fauna. Part 2 Impacts: How Species Interact with Natural and Man-Made EMF**. *Reviews on Environmental Health*. https://doi.org/10.1515/reveh-2021-0050.

Levitt, B. B., Lai, H.C. & Manville, A.M. (2021). **Effects of Non-Ionizing Electromagnetic Fields on Flora and Fauna, Part 3. Exposure Standards, Public Policy, Laws, and Future Directions.** *Reviews on Environmental Health*. https://doi.org/10.1515/reveh-2021-0083.

[3] Lai, H. (2021). **Genetic Effects of Non-Ionizing Electromagnetic Fields.** *Electromagnetic Biology and Medicine* 40, no. 2: 264–73. https://doi.org/10.1080/15368378.2021.1881866.

[4] Miller, A.B., Sears, M.E., Morgan L.L., Davis D.L., Hardell, L., Oremus M. & Soskolne C.L. (2019). **Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices.** *Frontiers in Public Health* 7. https://doi.org/10.3389/fpubh.2019.00223.

## 2 The *Canadian Environmental Protection Act* (CEPA) is the Logical Law for Regulating Anthropogenic Radiofrequency Electromagnetic Radiation (RF-EMR)

In our view, the *Canadian Environmental Protection Act* (CEPA)[6] is the most logical, effective statute for assessment and regulation of this rapidly increasing environmental agent. Bill S-5 *Strengthening Environmental Protection for a Healthier Canada Act*,[7] introduced in the Senate on February 9th, 2022, is an opportunity to enact specific legislative provisions and enabling legislation to promulgate regulations that can be used to assess and regulate the increasing amounts of anthropogenic RF-EMR emitted by wireless telecommunications devices and infrastructure. Of relevance, safer non-wireless alternative telecommunication technologies using fibre and wired connections are also faster, and more secure, reliable, resilient and energy efficient,[8] making these technologies the climate-wise options.

### 2.1 Environment and Climate Change Canada is Not Engaged; Health Canada is Not Required to Consult

The mandate of Environment and Climate Change Canada (ECCC) is to be "the lead department for a wide range of environmental issues" and includes "minimizing threats to Canadians and their environment from pollution."[9] That said, ECCC has no responsibility or program to monitor, assess and protect the biosphere from anthropogenic RF-EMR generated and used in telecommunications. In October 2021, ECCC confirmed in a response to an Environmental Petition to the Auditor General[10] that,

> "Environment and Climate Change Canada is not conducting research and monitoring activities on the potential impact of radiofrequency/microwave radiation exposure to biota to inform Health Canada or other regulatory organizations." Furthermore, ECCC "is not examining energy and resources implications to sustainability and climate change from the use of various alternative technologies for telecommunications."

In response to the same petition, in reference to doubled exposure limits for frequencies to be used for 5G, Health Canada stated that there is no legislative requirement for public notice and it is not required to consult Canadians regarding "interpretation" of radiation exposure limits from wireless devices and infrastructure. New interpretations are expected with the burgeoning "Internet of Things" and dense deployment of 4G/5G antennas in close proximity to living spaces. The petition response also stated that ISED (not the scientific authority) invited comment to improve the new standard, following publication in the Gazette.

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[5] Falcioni, L., Bua, L., Tibaldi, E., Lauriola, M., De Angelis, L., Gnudi, F., Mandrioli D., et al. (2018). **Report of Final Results Regarding Brain and Heart Tumors in Sprague-Dawley Rats Exposed from Prenatal Life until Natural Death to Mobile Phone Radiofrequency Field Representative of a 1.8 GHz GSM Base Station Environmental Emission**. *Environmental Research*. https://doi.org/10.1016/j.envres.2018.01.037.

[6] Government of Canada. ***Canadian Environmental Protection Act, 1999***. https://laws-lois.justice.gc.ca/eng/acts/c-15.31/

[7] Government of Canada. (February 9, 2022). **Bill S-5, *Strengthening Environmental Protection for a Healthier Canada* Act**. https://www.canada.ca/en/services/environment/pollution-waste-management/strengthening-canadian-environmental-protection-act-1999/bill-c-28-strengthening-environmental-protection-healthier-canada-act-summary-amendments.html

[8] Schoechle, T. (2018**). Re-Inventing Wires: The Future of Landlines and Networks.** *National Institute for Science, Law & Public Policy Washington, DC*, 2018, 156. http://electromagnetichealth.org/wp-content/uploads/2018/05/Wires.pdf.

[9] **Environment and Climate Change Canada's Mandate**. https://www.canada.ca/en/environment-climate-change/corporate/mandate.html

[10] Petition 456. (2021). **The Government of Canada's rigour and transparency in evaluating the science regarding localized exposures to 5G technologies in its update of Safety Code 6**. https://www.oag-bvg.gc.ca/internet/English/pet_456_e_43873.html; Petition and government responses available at: https://preventcancernow.ca/wp-content/uploads/2022/02/5G-Petition-and-Government-Response.pdf

## 2.2 History of Engagement regarding the *Canadian Environmental Protection Act, 1999*

In March 2016, the new federal Liberal government led by Prime Minister Justin Trudeau fulfilled an election commitment to modernize CEPA by delegating to the Standing Committee on Environment and Sustainable Development (ENVI) the task of undertaking a 15-month comprehensive review of CEPA.

Five briefs submitted to the Standing Committee addressed biological harms associated with non-ionizing electromagnetic radiation used for wireless connectivity, and recommended inclusion in CEPA.

1. Prevent Cancer Now, Chemical Sensitivities Manitoba, National Network on Environments and Women's Health. https://preventcancernow.ca/submissions/canadian-environmental-protection-act-cepa-review-controlling-toxic-substances/
2. Canadians for Safe Technology. https://c4st.org/wp-content/uploads/docs/GovRelations/Fed/CEPA/C4ST_CEPA_Brief_9_December_2016.pdf
3. Environmental Health Association of Manitoba. https://c4st.org/wp-content/uploads/docs/GovRelations/Fed/CEPA/EHAMB_CEPA_brief_Dec_2016.pdf
4. Magda Havas, PhD, Professor and Research Scientist, Trent University. https://www.ourcommons.ca/content/Committee/421/ENVI/Brief/BR8708953/br-external/HavasMagda-e.pdf
5. Margaret Friesen, MSc. https://www.ourcommons.ca/content/Committee/421/ENVI/Brief/BR8708951/br-external/FriesenMargaret-e.pdf

In June 2017, the Standing Committee submitted its final report, **Healthy Environment, Healthy Canadians, Healthy Economy: Strengthening the *Canadian Environmental Protection Act, 1999*** [11] to the House of Commons. The report included 87 recommendations such as: recognizing a right to a healthy environment, enhancing considerations of vulnerable populations, addressing cumulative impacts of substances, banning carcinogens and endocrine-disrupting chemicals (EDCs), strengthening transparency and public participation, improving the National Pollutant Release Inventory, establishing a more transparent assessment process for new living modified organisms, adopting a reverse-onus approach for substances of very high concern, adding a definition of "vulnerable populations," and requiring investigations into effects of substances on vulnerable populations as well as cumulative and synergistic effects of multiple toxicants.

**Recommendation 62** addressed electromagnetic radiation:

> The Committee recommends that … Environment and Climate Change Canada conduct studies on the effects of electromagnetic radiation on biota … and report their findings back to the Committee.

A complete response to the Standing Committee was published in June 2018,[12] with the Minister of the Environment and Climate Change committing to "work towards legislative amendments as soon as possible in future Parliamentary sessions." Included in the report was the following commitment:

> Environment and Climate Change Canada *is reviewing the scientific evidence provided to the Committee on the effects of electromagnetic radiation on biota.*[13]

[11] http://www.ourcommons.ca/Content/Committee/421/ENVI/Reports/RP9037962/envirp08/envirp08-e.pdf

[12] ECCC, **Follow-Up Report to the House of Commons Standing Committee on Environment and Sustainable Development on the *Canadian Environmental Protection Act, 1999,*** June 28, 2018.

[13] https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/review/standing-committee-report-cepa-2018/chapter-1.html

No review by ECCC has been made public, and with the response to Petition 456, we now know that there is no plan to do so.

As detailed below, scientific evidence since the 2016 Standing Committee submissions clearly demonstrates that anthropogenic RF-EMR can be harmful to biota, and that this can have consequential cascading effects on biodiversity and ecosystem health. Flora and fauna should be protected; there is currently a gap in the Canadian risk assessment and regulatory regime with regards to this environmental toxicant. Inclusion of anthropogenic RF-EMR in CEPA could rectify this serious gap.

Mandate letters from Canadian Prime Minister Justin Trudeau to both the Minister of Health and the Minister of Environment and Climate Change tabled in December 2019[14] included the expectation "to better protect people and the environment from toxins and other pollution, including by strengthening the *Canadian Environmental Protection Act, 1999*."

The 2019 mandate letters did not, however, include express requirements for the Ministers to address the effects of anthropogenic RF-EMR on biota as part of their work. Similarly, the 2021 mandate letters[15] failed to acknowledge the importance of addressing this key issue.

## 2.3 Increasing Levels of Anthropogenic Radiofrequency Electromagnetic Radiation (RF-EMR) Emissions Have Been Accelerating Over Recent Decades

Ambient levels of wireless radiation continue to increase. There are currently tens of thousands of cell towers[16] across Canada. The number of cellular network antennas is increasing rapidly, as they are installed on new and existing structures in urban, rural and wilderness areas. These can support the operation of hundreds of thousands more small 4G/5G antennas being mounted on non-tower structures (e.g., street furniture, buildings, lamp-posts and other utility poles). Of additional concern is the introduction of novel technologies that use frequencies and modulations not previously widely used outdoors. At the same time, tens of thousands more telecommunications satellites are being launched to transmit RF-EMR.[17]

The medical journal *The Lancet* published a concise summary of increases in radiation for wireless communications, mounting to many-fold greater levels than the natural background.[18] Figure 1, reproduced with permission, illustrates how instantaneous exposures have mounted from the 1950s, through the 1980s and during the 2010s.

Note that the scales are logarithmic – each increment is a 1,000-fold increase. At 1 GHz, within a commonly used frequency range for cell tower antenna emissions, the levels in some areas had increased up to a quintillion times natural background levels (a quintillion is 1 with 18 zeros).

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[14] Prime Minister of Canada. **Archived Mandate Letters.** https://pm.gc.ca/en/all-archived-mandate-letters

[15] Prime Minister of Canada. **Mandate Letters 2021**. https://pm.gc.ca/en/mandate-letters

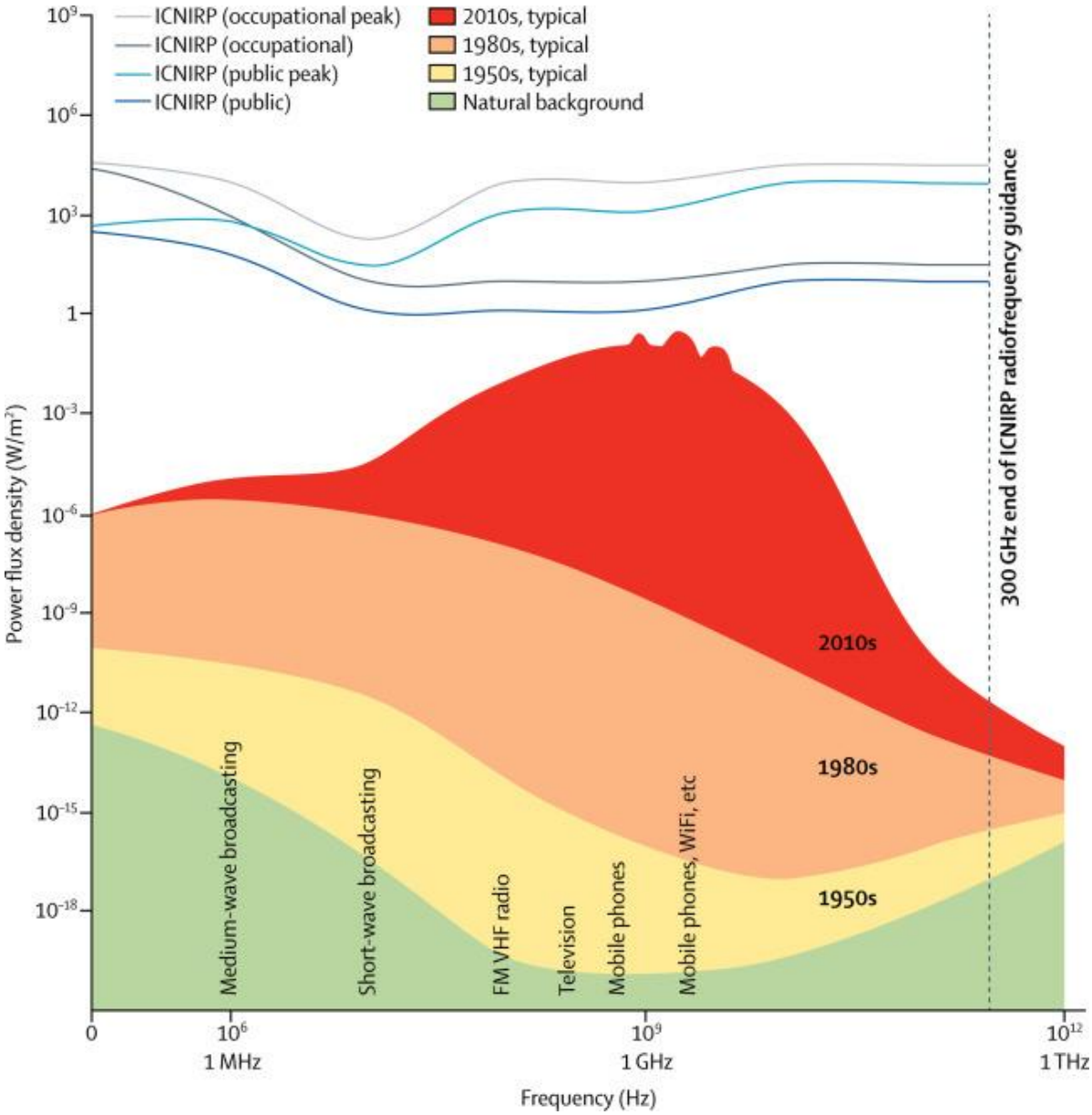
[16] SCADACORE. **Canadian Cell Tower Map**. (2022) https://www.scadacore.com/tools/rf-path/cell-tower-map-canada/

[17] Hecht, J. (2021). **Will Satellites Cripple Ground-Based Astronomy?** *Optics & Photonics News*, May 2021. https://www.optica-opn.org/home/articles/volume_32/may_2021/features/will_satellites_cripple_ground-based_astronomy/

[18] Bandara, P & Carpenter, D.O. (2018). **Planetary Electromagnetic Pollution: It Is Time to Assess Its Impact.** *The Lancet Planetary Health* 2, no. 12: e512–14. https://doi.org/10.1016/S2542-5196(18)30221-3.

**Figure 1. Typical maximum daily exposure to radiofrequency electromagnetic radiation (RF-EMF) from man-made and natural power flux densities in comparison with International Commission on Non-Ionizing Radiation Protection (ICNIRP) safety guidelines.** Reproduced, with permission, from Bandara, P & Carpenter, D.O. (2018). The Lancet Planetary Health 2, no. 12: e512–14. https://doi.org/10.1016/S2542-5196(18)30221-3.

[Canada's guidance is marginally lower for some frequencies.]



## 2.4 Anthropogenic Non-ionizing Electromagnetic Radiation Can Cause Adverse Biological Effects at Low Intensity Levels

Non-ionizing electromagnetic radiation, which includes RF-EMR, is lower energy than ionizing radiation (e.g., x-rays) and by definition does not carry sufficient energy to remove an electron from an atom. Early animal and human experimentation led to the hypothesis (favoured by industry, and implemented by Health Canada) that only excessive heating may cause biological harms ("thermal effects"). Evidence, presented here and in hundreds of peer-reviewed publications, demonstrates that RF-EMR can cause harm at exceedingly low exposure levels. A few of the mechanisms and harmful effects that have been demonstrated in the laboratory and measured in various organisms include oxidative stress, cellular and DNA damage (including in insects),[19,20,21] and effects on receptor proteins[22] and channels through cellular membranes[23] with exposure to purportedly safe intensities of common frequencies. These effects may impact function and viability of organisms, and lead to cancers.[3,4,5]

Non-ionizing radiation is a broad swath of the electromagnetic spectrum, from extremely low-frequency Schumann resonance of the earth, through anthropogenic radiation associated with a wide range of technologies, and also that received from the sun, such as naturally occurring infrared, visible and ultraviolet light (on the nominal borderline of ionizing radiation). Global protection from ultraviolet light is implemented via CEPA, with restriction of atmospheric ozone-depleting substances (ozone absorbs solar ultraviolet light).

All biota evolved in an environment with much lower intensity natural RF-EMR, because the Earth's atmosphere blocks much of this type of radiation. With the addition of anthropogenic RF-EMR, peak levels today can be more than trillions of times higher than historically (Figure 1).

# 3 Current Concerns

## 3.1 A Tipping Point?

Whether or not we sense electromagnetic radiation, electromagnetic interactions are intrinsic in living tissues. Effects may be central to life processes, occurring at the level of cellular membranes,[24] impacting nerves and diverse chemical reactions within cells. As well, the cells of all life forms normally communicate within and among themselves with exquisitely low-intensity electromagnetic and chemical signaling. Ambient

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[19] Blank, M., & Goodman, R.M. (2012). **Electromagnetic Fields and Health: DNA-Based Dosimetry.** *Electromagnetic Biology and Medicine* 31, no. 4: 243–49. https://doi.org/10.3109/15368378.2011.624662.

[20] Yakymenko, I., Tsybulin O., Sidorik E., Diane Henshel, Kyrylenko O., and Kyrylenko S. (2016). **Oxidative Mechanisms of Biological Activity of Low-Intensity Radiofrequency Radiation.** *Electromagnetic Biology and Medicine* 35, no. 2:186–202. https://doi.org/10.3109/15368378.2015.1043557.

[21] Panagopoulos, D.J. **Comparing DNA Damage Induced by Mobile Telephony and Other Types of Man-Made Electromagnetic Fields**. (2019). *Mutation Research/Reviews in Mutation Research* 781:53–62. https://doi.org/10.1016/j.mrrev.2019.03.003.

[22] Ertilav, K., Uslusoy, F., Ataizi S., & Nazıroğlu, M. (2018). **Long Term Exposure to Cell Phone Frequencies (900 and 1800 MHz) Induces Apoptosis, Mitochondrial Oxidative Stress and TRPV1 Channel Activation in the Hippocampus and Dorsal Root Ganglion of Rats.** *Metabolic Brain Disease* 33, no. 3: 753–63. https://doi.org/10.1007/s11011-017-0180-4.

Çiğ, B., & Nazıroğlu, M. (2015). **Investigation of the Effects of Distance from Sources on Apoptosis, Oxidative Stress and Cytosolic Calcium Accumulation via TRPV1 Channels Induced by Mobile Phones and Wi-Fi in Breast Cancer Cells**. *Biochimica et Biophysica Acta (BBA) - Biomembranes, Membrane Channels and Transporters in Cancers*, 1848, no. 10, Part B: 2756–65. https://doi.org/10.1016/j.bbamem.2015.02.013.

[23] Romanenko, S., R. Begley, A.R. Harvey, L. Hool, and V.P. Wallace. **The Interaction between Electromagnetic Fields at Megahertz, Gigahertz and Terahertz Frequencies with Cells, Tissues and Organisms: Risks and Potential.** (2017) *Journal of The Royal Society Interface* 14, no. 137. 20170585. https://doi.org/10.1098/rsif.2017.0585.

[24] Hughes, M. P., Kruchek E.J., Beale A.D., et al. (2021). **Vm-Related Extracellular Potentials Observed in Red Blood Cells.** *Scientific Reports* 11, no. 1: 19446. https://doi.org/10.1038/s41598-021-98102-9.

levels of anthropogenic RF-EMR in some areas now exceed historical natural levels by more than trillions-fold and have reached a level where it interferes with natural signaling. It appears that some biota (e.g., insects) may have reached a "tipping point" for population-wide effects.

## 3.2 Electromagnetic Radiofrequency Radiation (RF-EMR) as a Factor in the Decline of Bird and Insect Populations

Many bird and insect species are in decline worldwide. Interference with magnetoreception for navigation may be a contributing factor, as comprehensively reviewed by Levitt et al. in three recent publications.[2]

The scientific literature was also systematically reviewed at the request of the European Parliament.[25] An extract from the report states (emphasis added):

> Dielectric heating due to RF-EMF [radiofrequency electromagnetic fields] exposure of biological tissue is shown in all categories. … which in turn has biological effects such as a thermoregulatory response. This implies that **there is always a level of RF-EMF power density that will cause biological effects,** referred to as thermal effects. Decoupling effects caused by elevated temperatures and the presence of RF-EMFs within biological tissue are major issues in this field of study.

Concerns that anthropogenic electromagnetic radiation may be a factor in the decline of insect populations were detailed in 2021.[26] Due to insects' size, resonance may result in greater heating, and insects have little capacity to thermo-regulate. Insect declines are widely recognized to present serious ecological as well as economic issues, because insects form the base of food chains, and pollination is essential for biodiversity and agriculture.

Serious adverse effects observed in animals and plants in field and laboratory studies are depicted in Figure 2, at exposure levels 50 to more than 2,000 times below Health Canada's non-occupational human exposure guideline for radiofrequency radiation power density (Safety Code 6).[27] The guideline levels range from 2,000 to 10,000 mW/m$^2$ (2 to 10 W/m$^2$) depending upon the frequency (off the scale of Figure 2).

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[25] Thielens, A. (2021). **Environmental Impacts of 5G. A literature review of effects of radio-frequency electromagnetic field exposure of non-human vertebrates, invertebrates and plants**. *Prepared at the Request of the Panel for the Future of Science and Technology (STOA) and Managed by the Scientific Foresight Unit, within the Directorate-General for Parliamentary Research Services (EPRS) of the Secretariat of the European Parliament*, 149. https://doi.org/10.2861/318352

[26] Balmori, A. (2021). **Electromagnetic radiation as an emerging driver factor for the decline of insects**. *Science of The Total Environment*, *767*, 144913. https://doi.org/10.1016/j.scitotenv.2020.144913.

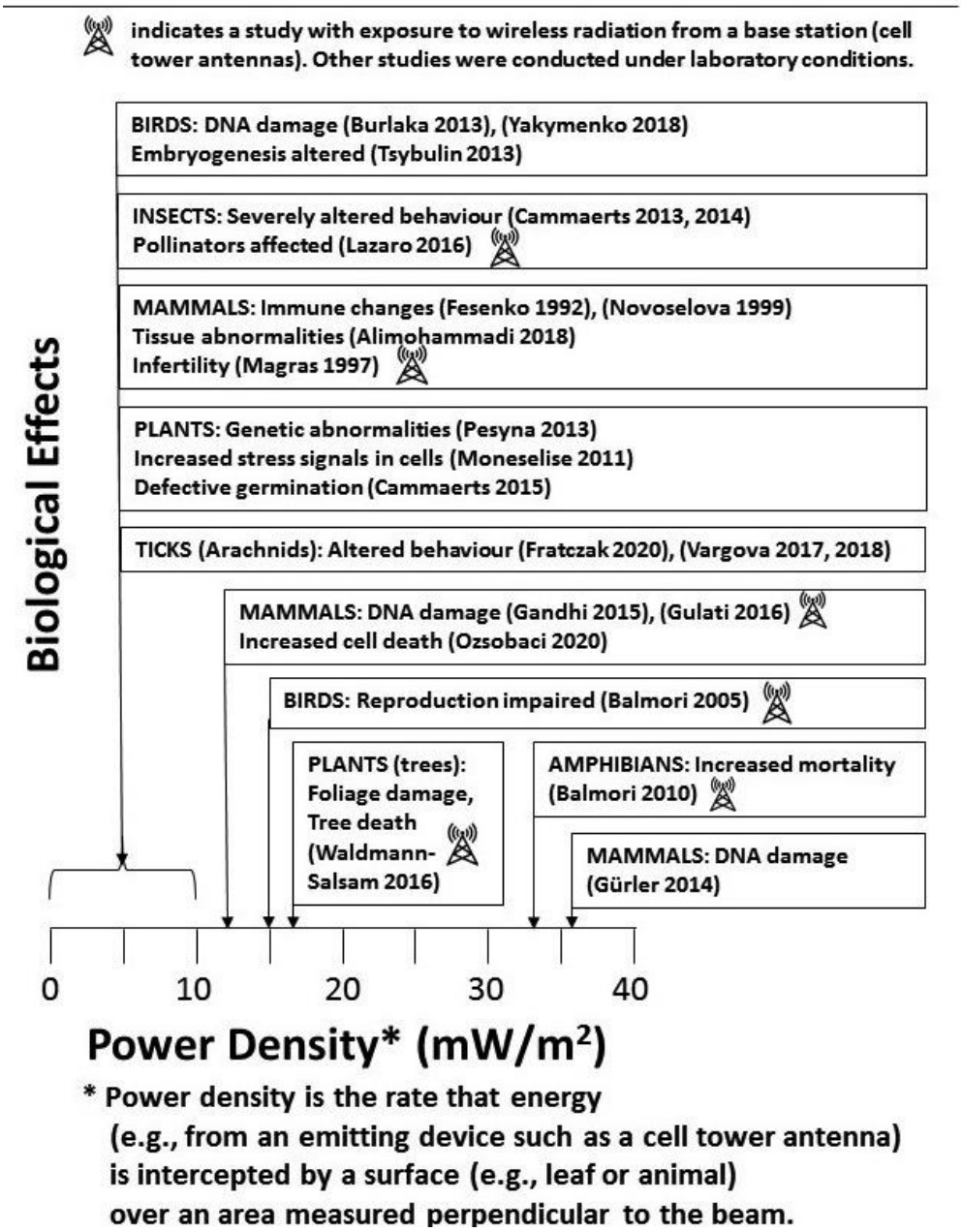
Friesen, M., & Havas, M. (2020). **Effects of Non-ionizing Electromagnetic Pollution on Invertebrates, Including Pollinators such as Honey Bees: What We Know, What We don't Know, and What We Need to Know**. In *Working Landscapes. Proceedings of the 12th Prairie Conservation and Endangered Species Conference, Danyluk (ed.). February 2019, Winnipeg, Manitoba.* (pp. 127–138). Critical Wildlife Habitat Program, Winnipeg, Manitoba. Retrieved from http://pcesc.ca/media/45404/final-2019-pcesc-proceedings.pdf.

Kumar, S., Singh, V. K., Nath, P., & Joshi, P. C. (2020). **An overview of anthropogenic electromagnetic radiations as risk to pollinators and pollination**. *Journal of Applied and Natural Science*, *12*(4), 675–681. https://doi.org/10.31018/jans.v12i4.2420.

[27] **Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz: Safety Code 6** [Health Canada, 2015] https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/limits-human-exposure-radiofrequency-electromagnetic-energy-range-3-300.html

**Figure 2. Examples of biological effects on biota exposed to anthropogenic radiofrequency electromagnetic radiation (RF-EMR or "wireless radiation) levels, 50 to more than 2,000 times below Safety Code 6 limits (2,000 - 10,000 mW/m$^2$ depending upon the frequency).**

(Data from Supplemental Materials Part 2, Levitt et al. 2021,[2] and primary literature, listed in the Appendix.)




## 3.3 Non-ionizing Electromagnetic Radiation and Chemical Substances Can Act Additively or Synergistically

Non-ionizing electromagnetic radiation from communications and other infrastructure can be biologically active and harmful, and can interact with toxic substances with magnification of harmful effects.[28,29] For

[28] Lupi, D., Palamara Mesiano, M., Adani, A., *et al*. (2021). **Combined Effects of Pesticides and Electromagnetic-Fields on Honeybees: Multi-Stress Exposure**. *Insects*, *12*(8), 716. https://doi.org/10.3390/insects12080716.

example, a large 2013 review, further expanded in 2017, summarized synergistic effects with toxicants on carcinogenesis, teratogenesis, mutagenesis, inflammation and other outcomes; amelioration of harmful effects using agents such as antioxidants (e.g., vitamin C); and use of radiofrequency radiation to enhance therapeutic effectiveness.[30]

## 3.4 Unlike Toxic Substances and Ultraviolet Light, Radiofrequency Electromagnetic Radiation (RF-EMR) from Modern Technologies is not Addressed as a Potential Risk to Environmental Health in Canada

Guidance published by Health Canada, **Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz: Safety Code 6**[27] is referenced consistently by the Government of Canada (Health Canada, and ISED) in regulations addressing devices or infrastructure for telecommunications over the air. The *Radiation Emitting Devices Act*[31] and regulations[32] do not mention radiofrequency radiation or telecommunications devices, although a 2020 consultation[33] undertaken by Health Canada did. Cell tower siting Client Procedures Circular CPC-2-0-03[34] stipulates that in addition to requirements of the *Canadian Environmental Assessment Act*[35] (now repealed; the *Interpretation Act* would require application of the *Impact Assessment Act, 2019*[36]), proponents are responsible to ensure that antenna systems are installed and operated in a manner that respects the local environment and that complies with other statutory requirements, such as those under the *Canadian Environmental Protection Act, 1999*, the *Species at Risk Act, 2002*[37] and the *Migratory Birds Convention Act, 1994,*[38] as applicable. None of these Acts address effects of RF-EMR used in telecommunications.

RF-EMR levels are regulated in areas that the public may access (per Safety Code 6), but not other locations accessible only to flora and non-human fauna, including airspace where animals fly.

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Extract: *"The overall results clearly indicate that the multi-stress conditions were able to induce biochemical, physiological and behavioral alterations which severely threatened bee colony survival."*

[29] Boga, A, Emre M., Sertdemir,Y., Akillioglu K., Binokay,S., & Demirhan, O. (2015).**The Effect of 900 and 1800 MHz GSM-like Radiofrequency Irradiation and Nicotine Sulfate Administration on the Embryonic Development of Xenopus Laevis.** *Ecotoxicology and Environmental Safety* 113: 378–90. https://doi.org/10.1016/j.ecoenv.2014.12.020.

[30] Kostoff, R.N., & Lau C.G.Y.(2013) **Combined biological and health effects of electromagnetic fields and other agents in the published literature**. *Technological Forecasting and Social Change*;80(7):1331–49.

Kostoff, R. N. & Lau, C.G.Y. (2017). **Modified Health Effects of Non-Ionizing Electromagnetic Radiation Combined with Other Agents Reported in the Biomedical Literature.** In *Microwave Effects on DNA and Proteins*, edited by Chris D. Geddes, 97–157. Cham: Springer International Publishing, https://doi.org/10.1007/978-3-319-50289-2_4.

[31] Government of Canada. ***Radiation Emitting Devices Act***: https://lois-laws.justice.gc.ca/eng/acts/R-1/ and **Radiation Emitting Devices Regulations** https://lois-laws.justice.gc.ca/eng/regulations/C.R.C.,_c._1370/FullText.html

[32] Government of Canada. **Radiocommunication Regulations**. https://laws-lois.justice.gc.ca/eng/regulations/sor-96-484/index.html

[33] Health Canada. **Consultation: Proposed modernization of the Radiation Emitting Devices Act**. 2020. https://www.canada.ca/en/health-canada/programs/consultation-proposed-modernization-radiation-devices-act.html

[34] Industry Canada [ISED]. (2014) **CPC-2-0-03 – Radiocommunication and Broadcasting Antenna Systems.** https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08777.html

[35] Government of Canada. ***Canadian Environmental Assessment Act, 2012*** *(repealed 2019).* https://laws-lois.justice.gc.ca/eng/acts/C-15.21/index.html

[36] Government of Canada. ***Impact Assessment Act, 2019***. https://laws-lois.justice.gc.ca/eng/acts/I-2.75/index.htm l

[37] Government of Canada. (2022) ***Species at Risk Act, 2002***. https://laws-lois.justice.gc.ca/eng/acts/S-15.3

[38] Government of Canada. ***Migratory Birds Convention Act, 1994***. https://laws-lois.justice.gc.ca/eng/acts/M-7.01/ and **Regulations** https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1035/

Interference with normal function of equipment is addressed in **EMCAB-2 — Criteria for Resolution of Immunity Complaints Involving Fundamental Emissions of Radiocommunications Transmitters**,[39] yet interference with normal functions of biota is not addressed in Canada, to the best of our knowledge.

The Canadian federal policy gap, omitting consideration of effects on non-human species of radiation for wireless communications, parallels a similar gap in the USA. In August 2021, the District of Columbia Court of Appeals ruled that the Federal Communications Commission (FCC) — the USA regulator for cell tower and other wireless device radiofrequency emissions, to which Health Canada looks for guidance in setting its guidelines — had ignored a substantial body of knowledge that had been presented in submissions:[40] *"The Commission failed to provide a reasoned explanation for its determination that its guidelines adequately protect against the harmful effects of exposure to radiofrequency radiation unrelated to cancer."* This is not to say that the Court agreed with FCC conclusions; merely that the FCC had acknowledged the issue of cancer while it did not consider numerous other effects, including effects on fauna and flora.

## 3.5 Climate Change and Broader Environmental Implications

Energy consumption for wireless communications is a climate issue. Overall, greenhouse gas emissions related to information and communication technologies are estimated to be about 3% of global totals (aviation is 2%).[41] These estimates are uncertain as they are based on yet-to-be-attained industry commitments and shifts to "green" energy (that could divert potential capacity from other uses). Nevertheless, estimates reflect a significant contribution to climate change of digital technologies, while fibre and wire connections offer many advantages, including energy efficiency.[8]

Dense deployment of additional hundreds of thousands of cell network antennas across Canada for new technologies (e.g., 5G), and the myriad other devices that manufacturers hope to sell to Canadian consumers, means that much more hardware will be manufactured. Planned obsolescence of technologies ensures ongoing turnover of old for new; devices that are no longer supported are discarded and replaced. As new technology is deployed, sun-setting of 3G disproportionately affects elderly and low-income individuals,[42] and may affect home alarms and medical devices, as well as navigation and aviation. Beyond risks of halting support of important, functional devices, and of associated e-waste, replacement entails petrochemical and mineral resources, and associated mining and pollution.

## 3.6 Safer Alternatives for Telecommunications: Fibre Optic and Wired Connections

An assessment of telecommunications alternatives, considering "substitution" and "essentiality," would reveal that use of hard (fibre and wire) connections to transmit data requires less electricity than use of wireless infrastructure. Fibre optic to the premises (FTTP) and wired connections through the premises (WTTP) would substantially reduce RF-EMR used for wireless technologies. Networks with the hard connections emit minimal radiation and have the added, not insignificant benefits that fibre optic connections

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[39] Government of Canada. (updated 2010). **EMCAB-2 — Criteria for Resolution of Immunity Complaints Involving Fundamental Emissions of Radiocommunications Transmitters.** https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01005.html

[40] Environmental Health Trust, *et al.*, v. Federal Communications Commission and United States of America. (2021) **Decision of the Court of Appeals, District of Columbia.** https://www.cadc.uscourts.gov/internet/opinions.nsf/FB976465BF00F8BD85258730004EFDF7/$file/20-1025-1910111.pdf

[41] Coma, M. (2021). **Energy Policies in the Hyperconnected Era.** *Wall Street International*, September 29, 2021. https://wsimag.com/science-and-technology/67085-energy-policies-in-the-hyperconnected-era.

[42] Ashworth, B. (2021). **3G service is going away next year. Here's what that means.** https://www.wired.com/story/3g-service-sunset-what-it-means/.

will always be faster, higher bandwidth, and more secure, reliable, resilient and sustainable than wireless connections.[8]

# 4 The Solution – Regulate Anthropogenic Electromagnetic Radiofrequency Radiation (RF-EMR) under provisions in an amended *Canadian Environmental Protection Act*

## 4.1 A Protective Law to Address Effects on Environmental and Human Health

Canada needs a law governing environmental hazards, exposures, risks, climate implications, and impacts for the protection of wildlife, indeed, all organisms, from excessive exposures to anthropogenic RF-EMR. Determination of exposure limits must be transparent, based on research, high-quality scientific methodology including systematic scientific review, and public consultation. Once established, standards for ambient levels, emissions and exposures must be monitored, assessed and reported transparently, with enforcement of emission and cumulative exposure limits.

## 4.2 Radiofrequency Electromagnetic Radiation (RF-EMF) as a Pollutant, and Closing the Gap

CEPA is an Act "*respecting pollution prevention and protection of the environment and human health in order to contribute to sustainable development."* Exposures to RF-EMR are in open air and indoors, as the radiation may travel through solids such as walls and windows.

CEPA defines *air pollution* as: *"a condition of the air, arising wholly or partly from the presence in the air of any substance, that directly or indirectly endangers the health, safety or welfare of humans; interferes with the normal enjoyment of life or property; endangers the health of animal life; causes damage to plant life or to property; or degrades or alters, or forms part of a process of degradation or alteration of, an ecosystem to an extent that is detrimental to its use by humans, animals or plants."*

Anthropogenic RF-EMR meets all of these criteria. We propose that to close this gap in CEPA, to protect the flora and fauna in all taxa – the foundation of natural ecosystems and agriculture, as well as human health – that CEPA Section 44 be amended to incorporate anthropogenic RF-EMR as a pollutant to be rigorously and transparently assessed, restricted and monitored, with enforcement and remedies. Decision-making should place priority on pollution *prevention,* implement the principles of *precaution*, *substitution* and *essentiality*, consider cumulative effects, and be informed by independent scientific evaluation and public consultation. It is expected that this would result in some frequency ranges being regulated with scientifically based limits, and regulatory processes to protect environmental and human health and to ensure Canadians' "Right to a Healthy Environment."

***We have a once-in-a-generation opportunity to include modern, escalating, bioactive radiofrequency electromagnetic radiation (RF-EMR) in Canada's flagship legislation protecting the environment and human health.***

**Protect fauna and flora, as well as human health, by amending the *Canadian Environmental Protection Act, 1999* to address current gaps in the regulatory regime, by making anthropogenic radiofrequency electromagnetic radiation (RF-EMR or "wireless radiation") subject to research and regulation (see page 2).**

## Appendix. Reference list, with extracts, for Figure 2.


1. Alimohammadi, I., Ashtarinezhad, A., Asl, B. M., Masruri, B., & Moghadasi, N. (2018). **The effects of radiofrequency radiation on mice fetus weight, length and tissues**. *Data in Brief*, *19*, 2189–2194.
   EXTRACT: Our results showed significant increase in fetus weight and C-R [crown-rump] length and also enlarged liver, tail deformation in mice fetus in exposure group. … The outcome of this study confirms the effects of radiofrequency radiation on growth parameters such as body weight, length and some tissues in mice fetuses …
   https://doi.org/10.1016/j.dib.2018.06.107

2. Balmori, A. (2005). **Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (*Ciconia ciconia*)**. *Electromagnetic Biology and Medicine*, *24*(2), 109–119.
   EXTRACT: Twelve nests (40%) located within 200 m of antennae never had chicks, while only one (3.3%) located further than 300 m had no chicks. The electric field intensity was higher on nests within 200 m (2.36 ± 0.82 V/m) than on nests further than 300 m (0.53 ± 0.82 V/m). Interesting behavioral observations of the white stork nesting sites located within 100 m of one or several cell site antennae were carried out. These results are compatible with the possibility that microwaves are interfering with the reproduction of white storks and would corroborate the results of laboratory research by other authors.
   https://doi.org/10.1080/15368370500205472

3. Balmori, A. (2010**). Mobile phone mast effects on common frog (Rana temporaria) tadpoles: the city turned into a laboratory.** *Electromagnetic Biology and Medicine*, *29*(1–2), 31–35.
   EXTRACT: In the exposed group (n = 70), low coordination of movements, an asynchronous growth, resulting in both big and small tadpoles, and a high mortality (90%) was observed…This research may have huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts.
   https://doi.org/10.3109/15368371003685363

4. Burlaka, A., Tsybulin, O., Sidorik, E., Lukin, S., Polishuk, V., Tsehmistrenko, S., & Yakymenko, I. (2013). **Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation.** *Experimental Oncology*, *35*(3), 219–225.
   EXTRACT: Conclusion: Exposure of developing quail embryos to extremely low intensity RF-EMR of GSM 900 MHz during at least one hundred and fifty-eight hours leads to a significant overproduction of free radicals/reactive oxygen species and oxidative damage of DNA in embryo cells. These oxidative changes may lead to pathologies up to oncogenic transformation of cells.
   http://dspace.nuft.edu.ua/bitstream/123456789/15543/1/Burlaka%202013.pdf

5. Cammaerts, M.-C., Rachidi, Z., Bellens, F., & De Doncker, P. (2013). **Food collection and response to pheromones in an ant species exposed to electromagnetic radiation.** *Electromagnetic Biology and Medicine*, *32*(3), 315–332.
   EXTRACT: Under such an influence, ants followed trails for only short distances, no longer arrived at marked areas and no longer orientated themselves to a source of alarm pheromone. Also when exposed to electromagnetic waves, ants became unable to return to their nest and recruit congeners; therefore, the number of ants collecting food increases only slightly and slowly. After 180 h of exposure, their colonies deteriorated. Electromagnetic radiation obviously affects social insects' behavior and physiology.
   https://doi.org/10.3109/15368378.2012.712877

6. Cammaerts, M.-C., Vandenbosch, G. A. E., & Volski, V. (2014). **Effect of Short-Term GSM Radiation at Representative Levels in Society on a Biological Model: The Ant Myrmica sabuleti**. *Journal of Insect Behavior*, *27*(4), 514–526.
   EXTRACT: The ants' orientation towards their attractive alarm pheromone statistically became of lower quality. The ants still presented their trail following behavior but less efficiently. In this controversial issue, ants could be considered as possible bioindicators.
   https://doi.org/10.1007/s10905-014-9446-4

7. Cammaerts, M.-C., & Johansson, O. O. (2015). **Effect of man-made electromagnetic fields on common Brassicaceae *Lepidium sativum* (cress d'Alinois) seed germination: a preliminary replication study**. *Phyton*, (84).
EXTRACT: [Exposed} seeds of Brassicaceae *Lepidium sativum* (cress d'Alinois) never germinated…. When removed from the electromagnetic field, seeds germinated normally.
http://hdl.handle.net/2013/ULB-DIPOT:oai:dipot.ulb.ac.be:2013/219257

8. Fesenko, E. E., Makar, V. R., Novoselova, E. G., & Sadovnikov, V. B. (1999). **Microwaves and cellular immunity. I. Effect of whole body microwave irradiation on tumor necrosis factor production in mouse cells**. *Bioelectrochemistry and Bioenergetics (Lausanne, Switzerland)*, *49*(1), 29–35.
EXTRACT: Chronic irradiation of mice for 7 days produced the decreasing of TNF production in peritoneal macrophages. The exposure of mice for 24 h increased the TNF production and immune proliferative response…
https://www.sciencedirect.com/science/article/abs/pii/S0302459899000586

9. Frątczak, M., Vargová, B., Tryjanowski, P., Majláth, I., Jerzak, L., Kurimský, J., … Majláthová, V. (2020). **Infected Ixodes ricinus ticks are attracted by electromagnetic radiation of 900 MHz.** *Ticks and Tick-Borne Diseases*, *11*(4), 101416.
EXTRACT: Ticks were attracted to the irradiated area. This effect was significantly stronger for ticks infected with Rickettsia spp., suggesting that pathogens can alter the ticks' response to environmental stimuli. These results lead to the question of whether man-made EMF may have an impact on *I. ricinus* activity and, as such, be a contributing factor to the ongoing changes in the distribution of the tick and its pathogens currently observed in Europe and elsewhere.
https://doi.org/10.1016/j.ttbdis.2020.101416

10. Gandhi, G., Kaur, G., & Nisar, U. (2015). **A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station**. *Electromagnetic Biology and Medicine*, *34*(4), 344–354.
EXTRACT: Genetic damage parameters of DNA migration length, damage frequency (DF) and damage index were significantly (p = 0.000) elevated in the sample group compared to respective values in healthy controls.
https://doi.org/10.3109/15368378.2014.933349

11. Gulati, S., Yadav, A., Kumar, N., Kanupriya, -, Aggarwal, N. K., Kumar, R., & Gupta, R. (2016**). Effect of GSTM1 and GSTT1 Polymorphisms on Genetic Damage in Humans Populations Exposed to Radiation From Mobile Towers.** *Archives of Environmental Contamination and Toxicology*, *70*(3), 615–625.
EXTRACT: There was a significant increase in BMN frequency and TM value in exposed subjects (3.65 ± 2.44 and 6.63 ± 2.32) compared with control subjects (1.23 ± 0.97 and 0.26 ± 0.27).
https://doi.org/10.1007/s00244-015-0195-y

12. Gürler, H. Ş., Bilgici, B., Akar, A. K., Tomak, L., & Bedir, A. (2014). **Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic.** *International Journal of Radiation Biology*, *90*(10), 892–896.
EXTRACT: Conclusions: It may be concluded that low level EMF at 2.45 GHz MWR increases the DNA damage in both brain tissues and plasma of the rats whereas it increases protein oxidation only in plasma. It may also be argued that the use of garlic decreases these effects.
https://doi.org/10.3109/09553002.2014.922717

13. Lazaro, A., Chroni, A., Tscheulin, T., Devalez, J., Matsoukas, C., & Petanidou, T. (2016). **Electromagnetic radiation of mobile telecommunication antennas affects the abundance and composition of wild pollinators**. *Journal of Insect Conservation*, *20*(2), 315–324.
EXTRACT: All pollinator groups except butterflies were affected by EMR... As EMR [electromagnetic radiation] affected the abundance of several insect guilds negatively, and changed the composition of wild pollinators in natural habitats, it might also have additional ecological and economic impacts on the maintenance of wild plant diversity, crop production and human welfare.

https://doi.org/10.1007/s10841-016-9868-8

14. Magras, I. N., & Xenos, T. D. (1997). **RF radiation-induced changes in the prenatal development of mice.** *Bioelectromagnetics*, *18*(6), 455–461.
EXTRACT: A progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility.
http://emfawareness.org/uploads/8/0/9/7/80976394/exhibit_r-62_magras_mice_study.pdf

15. Monselise, E. B.-I., Levkovitz, A., Gottlieb, H. E., & Kost, D. (2011). **Bioassay for assessing cell stress in the vicinity of radio-frequency irradiating antennas.** *Journal of Environmental Monitoring*, *13*(7), 1890.
EXTRACT: The 24 h exposure … resulted in alanine accumulation in the plant cells, a phenomenon we have previously shown to be a universal stress signal… A unique biological connection has thus been made between exposure to RF-EMF and cell stress, in the vicinity of RF transmitting antennas.
https://doi.org/10.1039/c1em10031a

16. Novoselova, E G, Fesenko, E. E., Makar, V. R., & Sadovnikov, V. B. (1999). **Microwaves and cellular immunity. II. Immunostimulating effects of microwaves and naturally occurring antioxidant nutrients**. *Bioelectrochemistry and Bioenergetics (Lausanne, Switzerland)*, *49*(1), 37–41.
EXTRACT: The mitogenic response in T lymphocytes increased after microwave exposure …These results demonstrate that irradiation with low-power density microwaves stimulates the immune potential of macrophages and T cells …
https://doi.org/10.1016/s0302-4598(99)00059-8

17. Özsobacı, N. P., Ergün, D. D., Tunçdemir, M., & Özçelik, D. (2020). **Protective Effects of Zinc on 2.45 GHz Electromagnetic Radiation-Induced Oxidative Stress and Apoptosis in HEK293 Cells.** *Biological Trace Element Research*, *194*(2), 368–378.
EXTRACT: Our findings show that EMR caused oxidative stress and apoptotic activation in HEK293 cells. Zn seems to have protective effects on the EMR by increasing SOD activity and bcl-2 immunopositivity, decreasing lipid peroxidation and caspas-3 immunopositivity.
https://doi.org/10.1007/s12011-019-01811-6

18. Pesnya, D. S., & Romanovsky, A. V. (2013). **Comparison of cytotoxic and genotoxic effects of plutonium-239 alpha particles and mobile phone GSM 900 radiation in the *Allium cepa* test**. *Mutation Research*, *750*(1–2), 27–33.
EXTRACT: Importantly, GSM 900 mobile phone radiation increased the mitotic index, the frequency of mitotic and chromosome abnormalities, and the micronucleus frequency in a time-dependent manner.
https://doi.org/10.1016/j.mrgentox.2012.08.010

19. Tsybulin, O., Sidorik, E., Brieieva, O., Buchynska, L., Kyrylenko, S., Henshel, D., & Yakymenko, I. (2013). **GSM 900 MHz cellular phone radiation can either stimulate or depress early embryogenesis in Japanese quails depending on the duration of exposure.** *International Journal of Radiation Biology*, *89*(9), 756–763.
EXTRACT: The lower duration of exposure led to a significant ($p < 0.001$) decrease in a level of DNA strand breaks in cells of 38-h embryos, while the higher duration of exposure resulted in a significant ($p < 0.001$) increase in DNA damage as compared to the control. CONCLUSION: Effects of GSM 900 MHz cellular phone radiation on early embryogenesis can be either stimulating or deleterious depending on the duration of exposure.
https://doi.org/10.3109/09553002.2013.791408

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EXTRACT: We found that exposure induces an immediate tick locomotor response manifested either in a previously unreported jerking movement of the whole body or in jerking of the first pair of legs. Overall, ticks exhibited

significantly greater movement in the presence of the RF-EMF. Significant sex differences relative to RF-EMF exposure were observed in both response variables. In the presence of RF-EMF, body jerking by females was greater than in males and vice versa for leg jerks.
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EXTRACT: The RF-EMF exposure to 900 MHz induced a higher concentration of ticks on irradiated arm of RST [radiation-shielded tube] as opposed to the RF-EMF at 5000 MHz, which caused an escape of ticks to the shielded arm… The projection of obtained results to the natural environment could help assess the risk of tick borne diseases and could be a tool of preventive medicine.
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EXTRACT: Statistical analysis demonstrated that electromagnetic radiation from mobile phone masts is harmful for trees. These results are consistent with the fact that damage afflicted on trees by mobile phone towers usually start on one side, extending to the whole tree over time.
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EXTRACT: RESULTS: The exposure of quail embryos before and during the incubation period to low intensity GSM 1800 MHz has resulted in expressive statistically significant oxidative effects in embryonic cells, including damages of DNA … Finally, the exposure resulted in a significant, almost twice, increase of embryo mortality. CONCLUSION: The exposure of model biological system to low intensity GSM 1800 MHz MWR resulted in significant oxidative and mutagenic effects in exposed cells, and thus should be recognized as a significant risk factor for living cells.
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