Stamford, Connecticut Land-Use Commission of the Board of Representatives October 18, 2023

Presentation by B. Blake Levitt

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General Information

- Stamford has an interesting history in the 1980's-1990's with radiofrequency radiation (RF). It was the first municipality in the nation to have a Health Department review all RF applications before approved by land-use boards.
- Dr. James McBride, MD., and Phyllis Erlandson measured ambient background levels before – and after – RF facilities were erected. The program faded after they retired in the late 1990's. (If that data is still available, it would make excellent baselines v. today.)
- Up until the late 1990's, states could write their own RF exposure standards. Massachusetts was the first to adopt stringent Russian standards. Connecticut adopted the 1000x more lenient industry-IEEE standards.
- The Telecommunications Act of 1996 preempted key state powers but not all... (others will address)
- Small cells are changing everything now.

Stamford's Unique Situation Today

- Before the land-use Board of Representatives is a proposal that took
 2 years and 5 towns to hammer out with telecom providers and a court arbitrator.
- Much work clearly went into it. However, classic mistakes were made regarding too little information and narrow interpretation of existing laws.
- The decision made here has the ability to affect statewide land-use laws and far beyond. Stamford has the opportunity to "get it right" and perhaps even change national law.
- The group of speakers tonight has in-depth knowledge that is rarely available at the local level. Please make good use of us!

Stamford con't 2

- In nutshell, don't fall for conspiracy nuttiness.
- There are good reasons why people are concerned about 5G and small cells positioned close to where people live and work.
- We are in an exponential infrastructure leap that creates exposures unlike any we have ever experienced before in kind, duration, and intensity.
- There are major holes at federal and state agencies that leave all living things vulnerable to a novel genotoxin that's increasing daily as new tech is introduced.
- RF is a form of energetic air pollution.

Senator Blumenthal's 2004 Amicus Brief

- Problems at the FCC have been known for decades.
- FCC is not a health agency -- it defers to outside entities. Yet it controls exposures.
- In 2004, then- CT Attorney General Richard Blumenthal wrote an amicus curiae brief for a petition for certiorari at the U.S. Supreme Court for Petitioner EMF Network.
- The brief strongly pointed out the dereliction of FCC's duty when it has the "awesome power to protect," yet refuses to take current science into consideration. That brief was almost 20 years ago. Nothing has changed.
- Today, there are no agencies to advise FCC, other than the FDA which has jurisdiction over devices like cell phones – not ambient exposures from infrastructure like towers and small cells.
- The Stamford BOR is therefore working in a state and federal vacuum -- and certainly has the right to challenge it. Theodora Scarato and others will address...

Levitt & Lai, 2010 Vanishingly low-level effects near cell towers

Levitt BB, Lai H (2010)

Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays. Environ Rev 18:369–395. https://doi.org/10.1139/A10-018

- The 2010 Levitt and Lai paper was the first to tease out vanishingly low-level biological effects studies comparable to ambient far-field exposures near cell towers.
- This is exactly the information needed to establish health-effects patterns for today's chronic exposures.
- Unfortunately, that information has been historically "averaged away" in meta analysis and lost to important public policy formation.
- Culling the <u>right</u> information goes far beyond accusations of "cherry picking."
- Our 2010 paper directly challenged the status quo. It has had over 70k downloads.
- We then applied the same approach, along with Albert Manville, a renowned wildlife biologist, to nonhuman species after determining there was enough data on <u>measured</u> rising ambient RF levels to match the low-level effects literature <u>to nonhuman species</u>.
- This was something never done before.

Humans not the only species impacted

- The primary concern of the Stamford BOR is for human health, but that fits into a much larger environmental "envelope."
- The FCC has never conducted NEPA reviews for RF or 5G, which is required by federal law. In fact, FCC has tried to eliminate involvement with all NEPA reviews -- including the increasing satellites filling the lower atmosphere, radiating back to every area of the planet today.
- The state of Connecticut has not requested a NEPA review, nor conducted any environmental assessments regarding 5G small cell buildouts. These are serious omissions at the federal and state levels, given what is known about unique sensitivities of other species to nonionizing radiation, and their unusual physical characteristics adapted over eons to very low levels – perceptual abilities they rely on for survival.
- What adversely affects the environment and nonhuman species eventually affects humans too.

Unique Wildlife Sensitivities

- All living organisms evolved in a matrix of natural nonionizing electromagnetic fields (EMF).
- It has long been known that the geomagnetic field is needed to coordinate embryonic development in many species, and provides directional information for many migratory species, including birds, fish, turtles, and insects.
- Highly sensitive natural mechanisms are widely found in many nonhuman species in specialized electroreceptor cells that enable living organisms to detect the presence, and immediate changes in, environmental fields at very low intensity.
- Many species can be easily disturbed by the presence of unfamiliar lowintensity man-made fields.

5G Is Different

- Man-made fields use unusual signaling characteristics, odd waveforms, and modulations at intensities not found in nature.
- 5G utilizes for the first time even more novel signaling characteristics phased arrays with high peak exposures, Massive MIMO, and beam steering -- and higher frequencies that are capable of affecting insect populations in particular.
- Nothing like 5G has ever been used before in broad civilian applications.
- 5G is being deployed without environmental review of any kind.
- Biological disturbance happens at very low intensities to unfamiliar fields far below even the geomagnetic field, similar to natural cellular biocurrent.
- Novel EMF exposures do not allow living organisms to adjust since signaling characteristics change rapidly as new technologies are constantly being developed. Species cannot adapt or evolve with them.

Insects Most Vulnerable

- What impacts insects impacts us all.
- 5G in particular may impact insect populations as millimeter wave (MMW) frequencies couple maximally with some insects. Insects the size of fruit flies reach peak absorption in the upper microwave bands. Both thermal and nonthermal effects will likely occur.
- Honey bees are well modeled; 5G is particularly lethal.

- <u>Thielens, A., Bell, D., Mortimore, D.B., Greco, M.K., Martens, L., and Joseph, W.</u> 2018. Exposure of insects to radio-frequency electromagnetic fields from 2 to 120 GHz. <u>Sci Rep.</u> 8(1):3924, 2018.

- Thielens, A., Greco, M.K., Verloock, L., Martens, L., and Joseph, W. 2020. Radio-Frequency Electromagnetic Field Exposure of Western Honey Bees. Scientific Reports (2020) 10:461 <u>https://doi.org/10.1038/s41598-019-56948-0</u>

- V. Jeladze, A. Thielens, T. Nozadze, G. Korkotadze, B. Partsvania and R. Zaridze 2023. Estimation of the Specific Absorption Rate for a Honey bee Exposed to Radiofrequency Electromagnetic Fields from 2.5 to 100 GHz. 2023 IEEE XXVIII International Seminar/Workshop on Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED), Tbilisi, Georgia, 2023, pp. 180-185, doi: 10.1109/DIPED59408.2023.10269454.

Insects con't

- Insects are inefficient thermoregulators and are particularly vulnerable to temperature changes.
- New exposure regulations in Europe allow for higher RF exposures in the 5G ranges and are expected to top heating thresholds even for humans. US regulations already allow higher exposures in 5G frequencies.
- One review of 73 reports found extinction rates had greatly accelerated. Insects in particular showed dramatic declines that could lead to a 40% extinction rate over the next several decades.

- Sanchez-Bayo, F., and Wyckhuys, A.G. 2019. Worldwide decline of the entomofauna: A review of its drivers. <u>Biological Conservation</u>, <u>Volume 232</u>, April 2019, Pages 8-27.

• We are flirting with catastrophic impacts from insect deaths alone, capable of punching holes in the entire food web. Human food supply is endangered.

First Studies of EMF Effects to Wildlife at Ecosystem Levels

Levitt, Lai and Manville papers: 2021-2022

Authors: B. Blake Levitt, Henry C. Lai, and Albert M. Manville II.

- Levitt BB, Lai HC, Manville AM. <u>Effects of non-ionizing</u> <u>electromagnetic fields on flora and fauna, part 1. Rising ambient</u> <u>EMF levels in the environment.</u> Rev Environ Health. 37(1):81-122, 2021. <u>https://doi.org/10.1515/reveh-2021-0026</u> (open access)
- Levitt BB, Lai HC, Manville AM. <u>Effects of non-ionizing</u> <u>electromagnetic fields on flora and fauna, Part 2 impacts: how</u> <u>species interact with natural and man-made EMF.</u> Rev Environ Health. 37(3):327-406, 2021. <u>https://doi.org/10.1515/reveh-2021-0050</u> (open access)
- Levitt BB, Lai HC, Manville AM. <u>Effects of non-ionizing</u> <u>electromagnetic fields on flora and fauna, Part 3. Exposure</u> <u>standards, public policy, laws, and future directions.</u> Rev Environ Health. 37(4):531-558, 2021. <u>https://doi.org/10.1515/reveh-2021-0083</u> Print 2022 Dec 16.
- Levitt BB, Lai HC and Manville AM II (2022) Low-level EMF effects on wildlife and plants: What research tells us about an ecosystem approach. Front. Public Health, 25 November 2022 Sec. Radiation and Health (open access: <u>https://doi.org/10.3389/fpubh.2022.1000840</u>)

Other Lai & Levitt papers

2022-2023

- Henry Lai & B. Blake Levitt (2022). The roles of intensity, exposure duration, and modulation on the biological effects of radiofrequency radiation and exposure guidelines, Electromagnetic Biology and Medicine, DOI: 10.1080/15368378.2022.2065683 To link to this article: https://doi.org/10.1080/15368378.2022.2065683
- Lai H, Levitt BB (2023). Cellular and molecular effects of non-ionizing electromagnetic fields. Rev Environ Health. 2023 Apr 7. doi: 10.1515/reveh-2023-0023. Epub ahead of print. PMID: 37021652.

What We Found

All species studied showed effects -- from mammals & plants to microbiota

- There was enough recent research on increasing ambient levels, and an overwhelming amount of evidence in all 5 animal kingdoms and taxa studied.
- Dr. Lai created extensive tables contained in the Supplements of biological effects:
 - Rising background levels: 27 studies
 - Combined animal/flora studies: 123 studies
 - Genetic effects: ELF, 12 studies; RF, 47 studies
- Flora: static magnetic fields, 16 studies; pulsed magnetic fields, 5 studies;
- Flora: ELF magnetic fields, 8 studies; RF, 9 studies.
- We cited over 1000 studies in the three papers, and many more have been added to the database since then too.

What We Found cont'd

No one had compared rising background levels with the low-level effects literature before. Wealth of data led to the ecosystem perspective for the first time.

- Rising EMF/RF levels are a ubiquitous unrecognized environmental cyto-and-genotoxin.
- Low-intensity studies far below FCC regs -- had greatly increased between 2010 and 2021: from 57+ to 123.
- A clear pattern emerged in the flora studies: Plants, trees, and seeds respond positively to natural static ELF fields but adversely to AC ELF and especially to RF.
- This is particularly relevant for any city concerned with urban forestry, parks, and tree cover in a warming world.
- Small cells bring RF very close to flora. Expect defoliation.
- There are devastating photos from Europe of slow tree dieback after cell antennas were installed. (See Environmental Health Trust.)
- Increases in ambient levels between the 1980's and today directly parallel unprecedented species losses, among other factors like climate change.

Wildlife Reviews (See appendices for more studies)

- Major literature reviews exist in all frequencies on low-level EMF effects to non-human species.
- Most environmentalists and regulators are unaware of this body of work.
- **Balmori, A. 2003.** The Effects of Microwave Radiation on Wildlife, Preliminary Results. February 2003, available from http://www.emrpolicy.org/litigation/case_law/beebe_hill/balmori_wildlife_study.pdf
- Balmori, A. 2009. Electromagnetic pollution from phone masts. Effects on wildlife. Pathophysiology. Electromagnetic Fields (EMF) Special Issue, 16 (2-3): 191-199.
- Balmori, A. 2010. The incidence of electromagnetic pollution on wild mammals: A new "poison" with a slow effect on nature? The Environmentalist. 30(1): 90-97. DOI:10.1007/s10669-009-9248-y
- Balmori, A. 2014. Electrosmog and species conservation. Science of the Total Environment 496 (2014) 314–316
- Balmori, A. 2015. Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation. <u>Science of The Total Environment</u>, <u>Volumes 518–519</u>, 15 June 2015, pp. 58-60.
- Balmori, A. 2016. Radiotelemetry and wildlife: Highlighting a gap in the knowledge on radiofrequency radiation effects. <u>Science</u> <u>of The Total Environment Volume 543, Part A</u>, 1 February 2016, pp. 662-669
- <u>Cucurachi, S., Tamis, W.L.M., Vijver, M.G., Peijnenburg, W.L.G.M., Bolte, J.F.B., and de Snoo, G.R.</u> 2013. A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF). Elsevier Environmental International, <u>Volume 51</u>, January 2013, Pages 116-140, <u>https://doi.org/10.1016/j.envint.2012.10.009</u>
- Panagopoulos, D.J., and Margaritis, L.H. 2008. Mobile telephony radiation effects on living organisms. *In* Mobile Telephones. *Edited by*. A.C. Harper and R.V. Buress. Nova Science Publishers, Inc. ISBN: 978-1-60456-436-5, Chapter 3, pp. 107-149.
- Sivani, S., Sudarsanam, D., 2013. Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem a review. Biology and Medicine, 4 (4): 202–216, 2013.

What Can Be Done Nationally:

- EMF/RF levels are now a ubiquitous, 24/7 form of novel energetic air pollution -- even in rural and remote areas.
- It is largely unregulated.
- We must refund the U.S. EPA and U.S. Fish and Wildlife Service to investigate this work.
- The exact RF bands (between 30 kHz 3GHz) used in telecom technology have precisely tracked accelerating wildlife disappearance.
- No other pollutant has increased in parallel like this.
- FCC human standards are for short term, acute exposures to control for heating effects.
- There are no exposure standards for wildlife species by any standards-setting group or for long-term, low level chronic exposures today from myriad sources.
- We need to incorporate the larger vision of Aeroecology <u>air as habitat</u> into our ecological understanding.
- Wireless technologies would then fall into perspective as a biologically active pollutant, even at very low intensities, that it is.
- It's time we recognized that other species have perceptual sensitivities that <u>far</u> surpass our own.
- We need full NEPA reviews and Environmental Assessments before we deploy whole new RF networks.

What Can Stamford Do?

- Refuse to regulate in a vacuum. It makes the city complicit in this untenable dereliction of duty at the state and federal level.
- Senator Blumenthal has said that when the federal government refuses to regulate adequately, that duty then falls to the states.
- No federal entity especially the FCC with overriding jurisdiction -- is regulating RF adequately, given what is known.
- The Connecticut Public Utility Regulatory Authority (PURA) has jurisdiction over small cells because they are mounted on utility poles. Traditionally PURA has regulated service delivery issues – gas & electric rates, etc., -- not RF infrastructure like small cells. This is new for PURA.
- The CT Siting Council (CTSC) has far more savvy with transmitting infrastructure. PURA barely knows the questions to ask of telecom service providers and takes them at their word.
- It is assumed at both PURA and the CTSC that if an applicant applies for permits, they MUST need that location or they would avoid the time and expense.
- Everyone hides behind federal preemptions and low-emissions computer models compared to FCC standards. But the way those models are presented, such as in PURA's "Findings of Fact" re: the Shippan Road site, are a smokescreen to create a sense of safety that does not exist.

What Can Stamford Do con't 2

- Get True RF Assessments!
- Insist on far more accurate exposure projections from AT&T and Verizon for total RF load from combined city-wide sites.
- That will be closer to what this board is being asked to approve for a ubiquitous 24/7 exposure in public rights-of-way.
- Insist on RF exposure projections for total number of antennas for all providers and projected providers -- within each small cell. PURA's "Findings of Fact" allowed AT&T to submit <u>only one</u> antenna's maximum permissible exposure (MPE).
- There can be dozens of antennas in one small cell, and hundreds of transmitting channels within each antenna. Actual exposures are much higher.
- Get independent verification from a licensed RF engineer.
- Stamford unlike any other municipality might have baseline RF data in their health department from the pre-cell-phone-era 1980-1990's for many city sites, against which to compare today's exposures. Small cells will add significantly to that load at ground level.

What Can Stamford Do Now con't 3 What This Board is Asked to Do

- Understand what is being used in small cells today are often 4GLTE. But 5G can be remote-activated at will as those antennas are embedded in all new small cells.
- No notification will be given to the city under the land-use proposal.
- True 5G is machine-to-machine communication.
- Where existing poles cannot be used, the municipality is being asked to grant by-right the erection of new mini-towers/poles in the public rights-of-way without further review.
- This is a massive give-away for little financial gain, potential property devaluation, and large potential liability.
- The proposal pits the city against the citizens it represents, should those citizens challenge individual sites.

Conclusion

- Stamford is in a unique position to help both the state and federal agencies make a beneficial course correction.
- Far better understanding needs to be brought regarding the broad environmental effects of these biologically active exposures – for humans and non-human species alike.
- You may end up in state and/or federal court, but with the right legal arguments, you could very well win.
- In the very least, the Board of Representatives will have done excellent due diligence if you wander into the right weeds!

Appendices Additional wildlife studies of interest

• Below is a small sampling of studies for individual species. There are many more... see Levitt, Lai and Manville, slide 12.

Birds

- Tanner, J.A. 1966. Effect of Microwave Radiation on Birds. Nature 210, 636 (07 May 1966); doi:10.1038/210636a0
- Tanner, J.A., Romero-Sierra, C., and Davie, S.J. 1967. Non-thermal Effects of Microwave Radiation on Birds. *Nature* 216, 1139 (16 December 1967); doi:10.1038/2161139a0
- Balmori, A. 2005. Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia). Electromagnetic Biology and Medicine 24:109-119.
- Balmori, A., and Hallberg, O. 2007. The urban decline of the House Sparrow (*Passer domestics*): a possible link with electromagnetic radiation. Electromagnetic Biology and Medicine 26:141-151.
- Engels, S., Schneider, N.L., Lefeldt, N., Hein, C. M., Zapka, M., Michalik, A., Elbers, D., Kittel, A., Hore, P.J., and Mouritsen, H.
 2014. Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. *Nature* 509, 353–356 (2014).
- Everaert, J., and Bauwens, D. 2007. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding House Sparrows (Passer domesticus). <u>Electromagn Biol Med.</u> 2007;26(1):63-72. DOI:<u>10.1080/15368370701205693</u>
- Fernie, K.J., Bird, D.M., and Petitclerc. D. 1999. Effects of electromagnetic fields on photophasic circulating melatonin levels in American kestrels. Environ Health Perspect.107(11): 901–904. <u>http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566687/</u>
- Fernie, K.J, Bird, D.M., Dawson, R.D., and Lague, P.C. 2000. Effects of electromagnetic fields on the reproductive success of American kestrels. Physiol. Biochem. Zool. 73 60–65. <u>http://www.ncbi.nlm.nih.gov/pubmed/10685907</u>

Birds con't 2

- Fernie, K.J., Leonard, N.J., and Bird. D.M. 2000. Behavior of free-ranging and captive American kestrels under electromagnetic fields. J. Toxicol. Environ. Health, Part A 59. 597–603. <u>http://www.ncbi.nlm.nih.gov/pubmed/10839495</u>

- Fernie, K.J., and Bird, D.M. 2001. Evidence of oxidative stress in American kestrels exposed to electromagnetic fields. Environ. Res. 2001 Jun;86(2):198-207. doi: 10.1006/enrs.2001.4263. http://www.ncbi.nlm.nih.gov/pubmed/11437466

- <u>Fernie, K.J., and Reynolds, S.J.</u> 2005. The effects of electromagnetic fields from power lines on avian reproductive biology and physiology: a review. <u>Toxicol Environ Health B Crit Rev.</u> 8(2):127-40. ISSN: 1093–7404 print / 1521–6950 onlineDOI: 10.1080/10937400590909022

- Ritz, T., Thalau, P., Phillips, J. B., Wiltschko, R., and Wiltschko, W. 2004. Resonance effects indicate a radical pair mechanism for avian magnetic compass. Nature 429, 177–180. doi:10.1038/nature02534

- Ritz, T., Wiltschko, R., Hore, P. J., Rodgers, C. T., Stapput, K., Thalau, P., Timmel, C. R., and Wiltschko, W. 2009. Magnetic compass of birds is based on a molecule with optimal directional sensitivity. Biophys. J. 96, 3451–3457. doi:10.1016/j.bpj.2008.11.072

Birds con't 3

- Wiltschko, W., Munro, U., Beason, R. C., Ford, H. and Wiltschko, R. 1994. A magnetic pulse leads to a temporary deflection in the orientation of migratory birds. Experientia 50, 697-700.

- Wiltschko, W., and Wiltschko, R. 2007. Magnetoreception in birds: Two receptors for two different tasks. Journal of Ornithology, Volume 148, Issue SUPPL. 1, December 2007, pp. S61-S76.

-Wiltschko, W., Freire, R., Munro, U., Ritz, T., Rogers, L., Thalau, P., and Wiltschko, R. 2007. The magnetic compass of domestic chickens, Gallus gallus. J. Exp. Biol. 210,2300– 2310. doi:10.1242/jeb.004853)

- Wiltschko R., and Wiltschko W. 2014. Sensing magnetic directions in birds: radical pair processes involving cryptochrome. Biosensors 4, 221–243. doi:10.3390/bios4030221

- Wiltschko, R., Thalau, P., Gehring, D., Nießner, C., Ritz, T., and Wiltschko, W. 2015. Magnetoreception in birds: the effect of radio-frequency fields. J. R. Soc. Interface 12:20141103. <u>http://dx.doi.org/10.1098/rsif.2014.1103</u>

Insects

- Cammaerts, M.C., De Doncker, P., Patris, X., Bellens, F., Rachidi, Z., and Cammaerts, D. 2012. GSM900 MHz radiation inhibits ants' association between food sites and encountered cues. Electromagnetic Biology and Medicine, 31:2, 151-165, DOI: <u>10.3109/15368378.2011.624661</u>

- <u>Cammaerts, M.C., Rachidi, Z., Bellens, F., and De Doncker, P</u>. 2013. Food collection and response to pheromones in an ant species exposed to electromagnetic radiation. <u>Electromagn</u> <u>Biol Med.</u> 32(3):315-332, 2013.

- **Cammaerts, M.C., Vandenbosch, G.A.E., and Volski, V. 2014.** Effect of short-term GSM radiation at representative levels in society on a biological model: the ant Myrmica sabuleti. J Insect Behav 27:514-526, 2014.

- Greggers, U., Koch, G., Schmidt, V., Dü'rr, A., Floriou-Servou, A., Piepenbrock, D., Gö'pfert, M.C., and Menzel, R. 2013. Reception and learning of electric fields in bees. Proc R Soc B 280:20130528. doi:10.1098/rspb.2013.0528 <u>https://doi.org/10.1098/rspb.2013.0528</u>

- Guerra, P., <u>Gegear</u>, R.J., and <u>Reppert</u>, S.M. 2014. A magnetic compass aids monarch butterfly migration. Nature Communications, 5:4164 doi: 10.1038/ncomms5164 (2014).

Insects con't 2

- Kirschvink J.L., Padmanabha, S., Boyce, C.K., and Oglesby, J. 1997. Measurement of the threshold sensitivity of honeybees to weak, extremely low-frequency magnetic fields. The Journal of Experimental Biology 200:1363–68 <u>http://jeb.biologists.org/content/200/9/1363.full.pdf+html</u>

- Kumar, N. R., Sangwan, S., and Badotra, P. 2011. Exposure to cell phone radiations produces biochemical changes in worker honey bees. Toxicol. Int.. 18:70–72. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3052591/

- Lazaro, A., Chroni, A., Tscheulin, T., Devalez, J., Matsoukas, C., and Petanidou, T. 2016. Electromagnetic radiation of mobile telecommunication antennas affects the abundance and composition of wild pollinators. J Insect Conserv 20:315–324, 2016.

- Odemer, R., and Odemer, F. 2019. Effects of radiofrequency electromagnetic radiation (RF-EMF) on honey bee queen development and mating success. Science of The Total Environment. 661:553-562. April 15, 2019.

- Sutton, G.P., Clarke D., Morley E. L., and Robert D. 2016. Mechanosensory hairs in bumble bees (Bombus terrestris) detect weak electric fields. *Proceedings of the National Academy of Sciences*, 2016.

Insects con't 3

 - <u>Vácha M</u>, <u>Puzová T</u>, and <u>Kvícalová M</u>. 2009. Radio frequency magnetic fields disrupt magnetoreception in American cockroach. <u>J Exp Biol</u>. 2009 Nov;212(Pt 21):3473-7. doi: 10.1242/jeb.028670. <u>https://www.ncbi.nlm.nih.gov/pubmed/19837889</u>

- Vargová, B., Kurimský, J., Cimbala, R., Kosterec, M., Majláth, I., Pipová, N., Tryjanowski, P., Jankowiak, L., and Majláthová, V. 2017. Ticks and radio-frequency signals: behavioural response of ticks (*Dermacentor reticulatus*) in a 900 MHz electromagnetic field. *Systematic & Applied Acarology* 22: 683–693, 2017.

- <u>Vargová, B., Majláth, I., Kurimský, J., Cimbala, R., Kosterec, M.,</u> <u>Tryjanowski, P., Jankowiak, Ł., Raši, T., and Majláthová, V. 2018.</u> Electromagnetic radiation and behavioural response of ticks: an experimental test. <u>Exp Appl Acarol.</u> 2018 May;75(1):85-95. doi: 10.1007/s10493-018-0253-z. Epub 2018 Mar 31.

Mammals: cows, bats, (rodent <u>studies are too numerous to mention)</u>

- Löscher, W., and Käs, G. 1998. Behavioral abnormalities in a dairy cow herd near a TV and radio transmitting antenna. *Prakt Tierarzt*, 1998, 79:437-444 (*German*)

- Löscher, W. 2003. Survey of effects of radiofrequency electromagnetic fields on production, health and behavior of farm animals. *Prakt Tierarzt*, 2003, 84:11 (*German*)

- Fedrowitz, M. 2014. Cows: a big model for EMF research, somewhere between Vet-Journals and "Nature." Bioelectromagnetics Society, Sep 05, 2014 <u>https://www.bems.org/node/14835</u>

- Rodriguez, M., Petitclerc, D., Burchard, J.F., Nguyen, D.H., Block, E., and Downey, B.R. 2003. Responses of the estrous cycle in dairy cows exposed to electric and magnetic fields (60 Hz) during 8-h photoperiods. Anim. Reprod. Sci., 15: 11-20. https://www.sciencedirect.com/science/article/pii/S0378432002002737

- Nicholls, B., and Racey, P.A. 2007. Bats avoid radar installations: could electromagnetic fields deter bats from colliding with wind turbines? PLoS One. 2(3):e297, 2007.

- Nicholls, B., and Racey, P.A. 2009. The aversive effect of electromagnetic radiation on foraging bats: a possible means of discouraging bats from approaching wind turbines. PLoS One. 16;4(7):e6246. <u>http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2705803/?tool=pubmed</u>

Bacteria and Protozoa: (implications for antibiotic resistance)

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