APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-563 [Pollination and Bee Flora]

ASSESSING THE IMPACT OF RF-EMF EXPOSURE ON WILD BEES UNDER COMMERCIAL 5G RF-EMF

Varnava Andri[1], Fröhlich Jürg[2], Zahner Marco[2], Kalapouti Anastasia[3], Charistos Leonidas[3], Hatjina Fani*[3], Tsagkarakis Antonios[4], Bouga Maria[4], Thanou Zoi[4], De Boose Pieterjan[5], Ribas Oliveira Felipe[5], Thielens Arno[6], Huss Anke[7], Stavrinides Menelaos[1]

[1] Department of Agricultural Sciences, Cyprus University of Technology, Limassol, Cyprus; [2] Fields at Work GmbH, Zurich, Switzerland; [3] Department of Apiculture Institute of Animal Science, Hellenic Agriculture Org. "DIMITRA", Nea Moudania, Greece; [4] Department of Crop Science, Agricultural University of Athens, Athens, Greece; [5] Department of Information Technology, Ghent University - imec, Ghent, Belgium; [6] Photonics Initiative, Advanced Science and Research Center, the Graduate Center of the City University of New York, New York, USA; [7] Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands

Introduction

- RF-EMF powers modern communication, including 5G networks.
- 5G uses new frequencies, raising concerns about environmental effects.
- Pollinators, especially wild bees (Apoidea), are vital for ecosystems.
- No field studies have tested potential effects on insects.
- This study examines RF-EMF exposure at 3.4 GHz on, wild bees.

Materials and Methods

- A field study in Cyprus uses artificial wild bee nests, either shielded or unshielded from RF-EMF.
- Each nest is built from an outer PVC pipe (19 cm diameter and 38 cm length) and an inner pipe (12 cm diameter and 18 cm length) filled with dry reed stems, 17 cm long, 5-10 mm in diameter (Fig. 1).
- Shielding is created by covering the inner pipe with metal mesh (shielded) or a plastic mesh (unshielded control).
- 50 trap nests were installed near 3.4 GHz 5G-NR antennas across 25 different urban areas on the island and monitored systematically for bee occupation (Fig. 2).

Fig. 1. Close up of bee nests: Detail showing the internal pipe with the reeds nested inside the external pipe (left), inner pipe with metal mesh (center), inner pipe with plastic mesh (right).

Fig. 2. Locations with bee nest placement in Cyprus. A 5G antenna emitting at 3.4 GHz is present at each location.

- Since spring 2024, observations and biodiversity monitoring of wild bees along a variable transect have been carried out at each location once per month [(from April to October 2024 (August excluded)], during the main flowering period (Fig. 3).
- RF-EMF exposure pattern of each location was characterized using the band selective RF-EMF exposure meter (ExpoM-RF 4) at each site along pre-specified route at same time (Fig 3).

Fig. 3. Monitoring the biodiversity of bees, collected bees using an insect net (left), recorded the plants from where bees were caught (center) and RF-EMF measurements (ExpoM-RF 4) (right).

Results and Discussion

- During variable transect walks that were carried out six times at each site, variations in the abundance of wild bees were observed, with some sites hosting higher bee diversity (Fig. 4).
- The bee specimens collected with an insect net were pinned, and their genera were identified first; species-level identification is still in progress.
- Nests were occupied only in three sites, with very low activity, with a few closed reeds across five trap nests (Fig. 4).

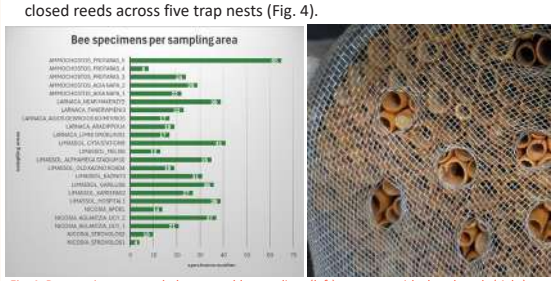

Fig. 4. Bee specimens recorded per monthly samplings (left), trap nest with closed reeds (right).

- RF-EMF measurements using the band selective RF-EMF exposure meter (ExpoM-RF 4) were made to characterize each site in terms of RF-EMF exposure (Fig. 5).
- The abundance and diversity of bees, both in nests and along transects at each location, will be analyzed in relation to the measured RF-EMF characteristics of each site to evaluate potential effects on wild bees (Fig. 6).

Fig. 5. Measurements of RF-EMF intensity at a location with bee nest placement (left - general view of the area, right – close up of the site).

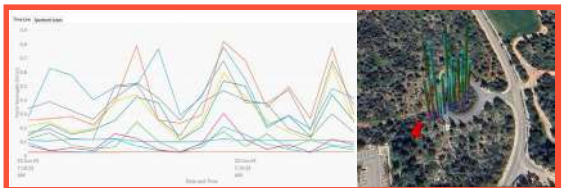

Fig 6. Example of measurement data analysis in one study area (ExpoM- RF 4 Utility).

Future work will include expanding the field study to multiple seasons and additional locations. Further collection of seasonal exposure data at the study locations will allow for quantifying changes in the network topology and power. All this data together will allow for assessing potential risks for wild and managed bees.

- **Contact**: androulla.varnava@cut.ac.cy / m.stavrinides@cut.ac.cy

- **Acknowledgements:** The Exposure To electromAgnetic fields and plaNetary health (ETAIN) project is funded by the European Union's Horizon Europe research and innovation funding programme under grant agreement No 101057216.

PP-563 [Pollination and Bee Flora]
Assessing the Impact of RF-EMF Exposure on Wild Bees Under Commercial 5G RF-EMF

Andri Varnava[1], Jürg Fröhlich[2], Marco Zahner[2], Anastasia Kalapouti[3], Leonidas Charistos[3], Fani Hatjina[3], Antonios Tsagkarakis[4], Maria Bouga[4], Zoi Thanou[4], Pieterjan De Boose[5], Felipe Oliveira Ribas[5], Arno Thielens[6], Anke Huss[7], Menelaos Stavrinides[1]

[1]Department of Agricultural Sciences, Cyprus University of Technology, Limassol, Cyprus
[2]Fields at Work GmbH, Zurich, Switzerland
[3]Department of Apiculture Institute of Animal Science, Hellenic Agriculture Org. "DIMITRA", Nea Moudania, Greece
[4]Department of Crop Science, Agricultural University of Athens, Athens, Greece
[5]Department of Information Technology, Ghent University - imec, Ghent, Belgium
[6]Photonics Initiative, Advanced Science and Research Center, the Graduate Center of the City University of New York, New York, USA
[7]Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands

Electromagnetic radiation such as the one from telecommunication technology is a type of environmental exposure representing a possible stress factor for bees and other flying insects. The current study aims at investigating the effects of radio-frequency electromagnetic fields (RF-EMFs) on wild bees in Greece and Cyprus. In Cyprus, a field study is taking place using artificial wild bee nests shielded or unshielded from RF-EMF radiation. The nests consist of an outer PVC pipe (19 cm diameter and 38 cm length) and an inner pipe (12 cm diameter and 18 cm length) filled with dry reed stems, 17 cm long, 5-10 mm in diameter. RF-EMF shielding of the nests is achieved via covering the inner pipe with a fine metal (shielded) or a plastic mesh (unshielded control). Two trap nests, one RF-EMF-shielded and one RF-EMF-unshielded were placed on each of the 25 studied sites near commercial 3.4 GHz 5G-NR antennas at different locations on the island, in urban areas. Trap nests were placed out in the field in spring 2024 and monitored systematically for bee occupation. In addition, observations of honey bees and wild bees along a variable transect were carried out at each location once per month, during the main flowering period, while simultaneously the RF-EMF exposure pattern of each location was characterized using a specialized instrument for measuring environmental RF-EMF (ExpoM-RF4). We observed very low visitation rates of wild bees in both types of trap nests, as only a few reeds were occupied by bees. However, we noted exceptions in locations surrounded by parks, open spaces, and native plants, where we observed a significantly higher number of bees. The abundance and diversity of bees, both in nests and along transects at each location, will be analyzed in relation to the measured RF-EMF characteristics of each site to evaluate potential effects on wild bees. The study is part of the ETAIN project, funded by the European Union's Horizon Europe research and innovation funding program under grant agreement No 101057216.