EFFECT OF MOBILE TELECOMMUNICATION ANTENNAS ON THE ABUNDANCE OF WILD POLLINATORS

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Pollinators represent a key ecosystem service that is vital to the maintenance of wild plant communities and agricultural productivity (Klein *et al*. 2007; Kremen *et al*. 2007; Potts *et al*. 2010), and that is highly threatened by anthropogenic disturbances (Hegland *et al* 2009; Potts *et al* 2010). The exponential growth of mobile telephony has led to a pronounced increase in electromagnetic fields in the environment that may affect pollinator communities (Cucurachi *et al*. 2013; Balmori 2015). The studies of electromagnetic radiation on insects have shown negative effects of electromagnetic radiation on reproductive success (e.g. Panagopoulos *et al*. 2004; Atli and Ünlü 2006), colony strength (Sharma and Kumar 2010), cognition, locomotion, orientation (Cammaerts *et al*. 2014) and navigation (e.g. Favre 2010; Sharma and Kumar 2010). However, most of these studies have been conducted on model organisms and under laboratory conditions (Cucurachi *et al*. 2013), and the real effect of electromagnetic radiation on natural pollinator communities is still far from known. The objective of this study is to test whether the presence of telecommunication masts in natural habitats modifies the composition of wild pollinator communities, thus threatening the maintenance of pollination as an ecosystem service.

For this, we studied the relationship between electromagnetic radiation (EMR) from telecommunication antennas and the abundance of key pollinator groups (bees, beetles, wasps, butterflies, bee flies, hoverflies and other flies) in 10 study sites from two Mediterranean islands (5 in Limnos and 5 in Lesvos, Greece). All the study sites were located in phrygana and olive grove habitats, and in the vicinity of telecommunication antennas. In each site, electromagnetic radiation (V/m; EMR, hereafter) was measured at four distances (50m, 100m, 200m and 400m) from the antenna. To estimate pollinator abundance, we sampled three times during the main flowering period (April, May and June) in 2012, using pan-traps located at each site and distance to the antenna. Pan-traps were arranged in triplet units, each triplet comprising three pan-traps of a different UV-bright colour: white, blue, and yellow, to account for different colour preferences among pollinating insects. We calculated insect abundance at each sampling point for each pollinator group (bees, beetles, bee flies, wasps, butterflies, hoverflies and other flies) as the total number of individuals collected at each site and distance, and conducted Generalized Linear Mixed Models separately for each pollinator group, to test the relationship between EMR and insect abundance

EMR intensity modified the abundance of all the studied pollinator groups apart from the butterflies. Besides, the effects of EMR on insect abundance were consistent in both islands for all the pollinator groups except for the broad group 'other flies'. Thus, bee abundance increased significantly with EMR in both islands, and beetle abundance decreased significantly with EMR in both islands, although in both cases the relationships were steeper in Limnos than in Lesvos, as shown by significant interactions between EMR and Island. In addition, the abundance of bee flies increased significantly with EMR, whereas the abundance of hoverflies and wasps decreased (significantly and marginally significantly, respectively) as EMR increased. The effect of EMR on other fly abundance, however, differed between islands (significant interaction between EMR and island): while EMR was positively related to the abundance of other flies in Lesvos, these variables were negatively related in Limnos.

In this study we show that electromagnetic radiation from telecommunication antennas affects the abundance of wild pollinators in natural habitats. Since EMR has contrasting effects on the abundance of different pollinator groups (likely due to different susceptibilities to radiation), EMR modifies also the composition of wild pollinator assemblages. These changes in the composition of pollinator communities associated to the electromagnetic smog may have important ecological and economic impacts that could significantly affect the maintenance of wild plant diversity, crop production, and human welfare (Gallai 2009; Potts *et al*. 2010).

Keywords: bees, bee flies, beetles, butterflies, distance to the antenna, electromagnetic smog, electromagnetic radiation, EMR, hoverflies, wasps.

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