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Electromagnetic Radiation And Bees, Again…

Norman Carreck

Among the more controversial explanations for honey bee colony losses, various forms of electromagnetic radiation have from time to time been implicated. As mentioned in earlier articles (Carreck, 2008, 2009), this seems to have started in 2007 when a national newspaper in the UK *The Independent* ran a story entitled: "Are mobile phones wiping out our bees?" This eye catching headline was taken up by the world's press and repeated endlessly. The original article suggested that Dr Jochen Kuhn and colleagues from the University of Landau, Germany had implied that experiments that they had recently carried out could provide "a hint" towards the causes of Colony Collapse Disorder (CCD). Examination of their experiments in fact suggested something very different. Kuhn and his colleagues were actually working on the possible effects of electromagnetic radiation from sources such as mobile phones on humans, and had suggested that, given their known sensitivity to electromagnetic radiation, honey bees could perhaps be studied as a model organism.

Their experiments (Harst *et al.*, 2007; Kimmel *et al.*, 2007a,b) were however poorly designed, and given the very small sample size and the variability inherent in bee experiments, there are many possible explanations for their results. The story was, however, enthusiastically adopted by a single issue pressure group opposing mobile phones, and in the glare of the ensuing publicity, Kuhn and his colleagues were forced to distance themselves from claims that they had solved the problem of CCD.

Since the furore, some US scientists have carried out some more carefully planned studies to determine the effects of mobile phones on honey bee behaviour (Mixon *et al.*, 2009). They tested three sub-species of honey bees (*Apis mellifera carnica, caucasiaca* and *syriaca*) in a series of experiments. In laboratory

experiments they found no effects of mobile phones on proboscis extension or feeding. They found no effects of mobile phones on navigation of free flying bees. Finally, they tested the effects of mobile phones on aggression in bees, and found no effects.

Very early on in the CCD story, mobile phones were dismissed as an explanation, since many of the colony losses had occurred in remote areas such as isolated valleys in California where there are no mobile phone masts and no mobile phone signals. Conversely, in cities where mobile phone signals are powerful, few losses have occurred. In 2011, however, Favre, published a paper which suggested that proximity of mobile phone handsets induced honey bee workers to "pipe", but his experimental setup was clearly a very unnatural situation.

A recent authoritative review of the effects of mobile phone radiation on wildlife (Verschaeve, 2014) was highly critical of the methods used in these studies, and concluded: "although some studies suggest an influence of mobile phone radiation on the occurrence of CCD... and related effects, there is no solid scientific basis for this. A combination of different other causes may provide a more plausible explanation for this phenomenon".

Nonetheless, a paper published in the latest issue of the *Journal of Apicultural Research* adds a further twist to the story of electromagnetic radiation and bees (Ferrari, 2014). The study suggests that fluctuations in magnetic fields, including those caused by solar storms, may interfere with the magnetoreceptors in honey bees so that fewer bees return to their hives from foraging trips. The authors suggest that this disruption could be so severe that the flying bees disappear from their hive and that these losses may contribute to colony failure.

It has been known for some time that honey bees are sensitive to electro-magnetic radiation, but it is still far from clear what role this ability plays in normal bee navigation (Carreck, 2008). Like humans, bees use several different senses for navigation, often simultaneously, but it is possible that magnetoreception becomes increasingly important the further the bee is from its hive. In the paper Ferrari carried out a series of experiments that subjected foraging bees to magnetic fields, which appeared to disrupt their ability to navigate so they became less able to find their way home. Their homing ability also seemed to be affected by uncontrolled, natural fluctuations in the Earth's magnetosphere. The study linked documented periods of increased levels of solar storms and disruption to the magnetosphere, to increased levels of honey bee colony loss.

For humans, the impact of sunspots on magnetic fields and their effects on bees is a difficult concept to grasp. Perhaps we could liken it to humans, who rely on sight, becoming lost in fog when we have no visual clues to help us identify our location. In unfamiliar territory any landmarks would be harder to recognise, so we find it harder is to work out where we are. This interesting study throws light on a curious aspect of bee biology. It is only part of the story of colony losses, but an aspect which merits further study.

Finally, in a paper contributed at the recent EurBee conference in Murcia, Blacquière *et al.* (2014) described an experiment in which 20 colonies of honey bees were placed in a Faraday Cage to exclude radio frequency magnetic fields, with another 20 colonies nearby in a similar but plastic cage. They measured field strengths in and around the cages and various biological parameters. They found no effect on development from egg to larvae, on morphometric and physiological parameters at emergence, on the flight performance of adults, or on the longevity of workers. Curiously, they did, however, find a difference in colony survival, but the experimental design did not permit a statistical analysis. This is clearly an area for fruitful further study.

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