Mechanisms of electroreception in Bumblebees and Honeybees

Supervisory team:
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Project description:

Bees and flowers share a long co-evolutionary history through the process of pollination. Benefitting both plant and insect, pollination is a prime example of reciprocal adaptation involving complex interactions taking place at the right place and at the right time. Flowers produce nectar and pollen to invite pollinator visit, whilst bees will deploy multiple senses and mechanisms of communication to coordinate their efforts and enhance their foraging efficiency. Our research established that, in addition to visual, olfactory, thermal and structural cues, bumblebees have the capacity to detect the weak electrostatic field that arises when they approach a flower. Also capable of learning the presence, variation and structure of these electric fields, bees were shown to be able to take decision as to where to find nectar resources using electric fields only (Clarke et al. Science). Current evidence shows that mechanosensory hairs are highly sensitive to electric fields like those arising from flowers (Sutton et al, PNAS; Clarke et al. J Comp Physiol; Morley & Robert Current Biology; Koh & Robert Interface), highlighting the importance of a better understanding of what electric information bees actually senses from their information.

Drawing from sensory ecology and neuroethology, this PhD studentship will be integrated in our current research investigating how bumblebees and honeybees detect electric fields and how they do so with in conjunction with visual information. Unlike for olfactory and visual senses, much of sense of electroreception remains to be explored, leaving outstanding questions open such as how far can a bee detect an electric field? What is the behavioural threshold of detection? Are they several types of electric hair receptors? What is the electrostatic information in effect detected by the bee and how does it use it to take behavioural decisions? These are the type of questions that this project will explore, using behavioural and neurobiological methods.

Research will be supported and conducted in the lab and in the field, supervised by Prof D. Robert, sensory ecology, hearing and electroreception, sensory biophysics, School of Biological Sciences at the University of Bristol and Prof N. Hempel de Ibarra, animal vision, learning and memory, neuroethology, School of Psychology at the University of Exeter.