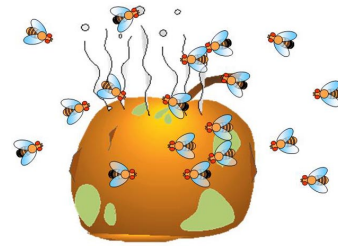


Understanding the Odour World of Insects: Insect Olfaction, Ecology and Practical Applications

Research projects for PhD students.

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General Introduction

As highlighted by the 2004 Nobel Prize in Physiology and Medicine, olfaction (the sense of smell) is perhaps the most complex of all senses, enabling the recognition of thousands of disparate stimuli (odour molecules). In spite of the breakthroughs in identifying olfactory receptors, there is still much work to do before we understand how the olfactory system actually works. At the division of Chemical Ecology we study how organisms use **olfactory information** in their interactions with the environment. Our primary models are **insects** and their **odour-based interactions** with each other, their host plants, and their prey, in their pursuit of mates, food, or oviposition sites. On the other hand, activities in the research group have also included sensory interactions in organisms spanning from fungi to humans and even odour-driven robots. The driving forces behind our research include the urge to answer basic scientific questions about **how organisms acquire and respond to information**, as well as **practical applications**: methods to minimize human impact on the environment by using environmentally friendly ways to monitor and control insect populations. **METHODS** that we utilize include: **chemical identification** of pheromones and other behaviourally relevant odours; **behavioural experiments** featuring odour attraction, learning and memory; **olfactory physiology** - measuring activity from sensory neurons and neurons in the CNS through **electrophysiology** and **optical imaging**; applications of **molecular biology** for manipulating **genes** and **neuronal populations involved in sensory processing**.

Here I present some current and near future projects encompassing questions and techniques within ecology, conservation biology, sensory physiology, and molecular biology. Contact me or check the group web page for further description of these and other projects. Common themes of these projects include: How do insects with varying food and habitat specializations exploit odours to find important resources? How did their olfactory systems evolve to handle the specific odours that they need to detect? However, we can offer a broad range of projects within the framework of our research, and the projects can usually be tailored to include whatever techniques that the student wants to learn.

Characterizing Ecologically Relevant Odours

- Identification of behaviourally active odorants active for insects, from fermenting fruit odours in *Drosophila* to specific plant odours active for moths or beetles.
- Using odours to control insect pests, through insect trapping or modification of host plant odours.
- Studying the relationship between specific host plant odours, olfactory receptor neurons and olfactory receptor genes.

Decoding the Olfactory Message

- Relationships between odour molecules, olfactory receptor neurons, olfactory receptor proteins, and the encoding of olfactory information.
- Identifying new odorant receptor genes from insects, through bioinformatics screening of genomic DNA sequences.

- Characterizing the morphology and physiology of populations of olfactory neurons in the CNS.
- Studying olfactory information processing in the *Drosophila* brain through targeted genetic manipulations of olfactory sensory neurons and the CNS.

Odours, Biodiversity and Conservation

- Identification of attractive pheromones and habitat odours for monitoring populations of rare and threatened insects.
- Characterization of odours that unrelated insects living in specific habitats, such as dead and rotting wood, utilize to locate their habitat.
- Studying migration and dispersal patterns of threatened insects living in fragmented habitats, through the use of genomic markers.