



Love isn't in the air: Assessing how air pollution interrupts insect sex pheromone signalling

Lead Supervisor: Robbie Girling, University of Reading, School of Agriculture, Policy and Development

Email: r.girling@reading.ac.uk

Co-supervisors: Steven Elmore, Food and Nutritional Sciences, University of Reading; Ben Langford, Centre for Ecology and Hydrology

As humans, the dominant sense with which we perceive the world is vision, in contrast many insects rely upon odours to perceive and interact with their environment. These odours can be a vital part of many everyday tasks that are critical to their survival, for example insects commonly use odours to locate food (e.g. using a flower's scent) or find a mate (i.e. using pheromones). However, there is growing evidence to suggest that common air pollutants such as ozone and nitrogen oxides (NO_x) may indirectly impair the fitness of plants and insects, by reacting with many of the odour compounds that they use for communication.

We have strong evidence that, under field conditions, pollinating insects are significantly less successful in locating flowers in polluted environments. However, very little is known about how air pollution interferes with the pheromones that many insects use to locate members of the opposite sex.

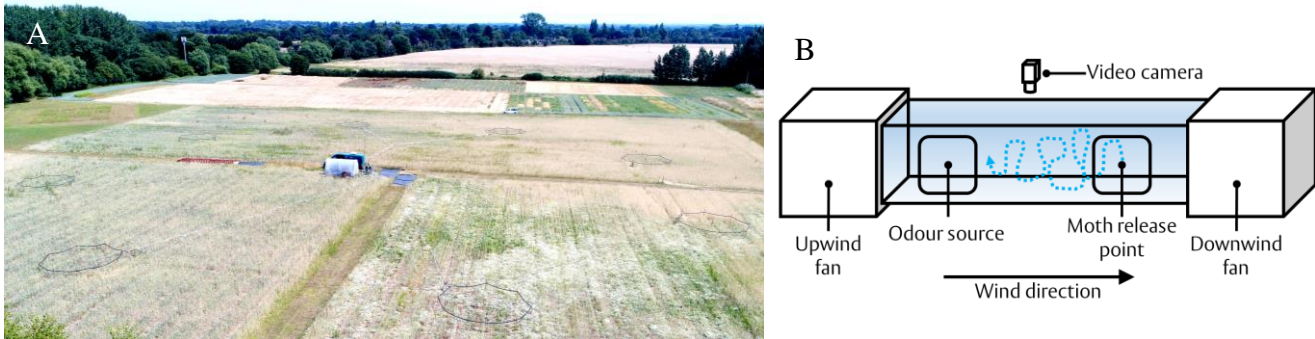


Fig 1. **A.** The Free Air Diesel and Ozone Enrichment (FADOE) research platform at the University of Reading's Sonning Farm site; **B.** A wind tunnel used for moth flight behaviour experiments, blue dotted line indicates a moth's upwind flight path.

This PhD project will provide the first mechanistic field-scale investigation into the effects of common air pollutants on insect pheromone communication. To facilitate this, we will use a new and globally unique state-of-the-art Free Air Diesel and Ozone Enrichment (FADOE) research platform, based at the University of Reading (see Fig 1A). This platform consists of a series of eight-metre-wide rings in which it is possible to elevate the concentration of either diesel exhaust or ozone air pollution. Within these rings it is then possible to

conduct studies on the impacts of air pollution on insect behavioural ecology.

Therefore, the first part of this PhD will investigate the field-scale impacts of diesel exhaust and ozone on the ability of a range of insects to detect and orient towards pheromones within the FADOE rings.

Those insects most disrupted by pollution in the first stage of the PhD will be selected for further laboratory investigations into the mechanisms by which this disruption occurs. This will include studies of insect flight behaviour, using our bespoke insect wind-tunnel (see Fig 1B), to identify the impacts on in-flight orientation behavior of pheromone degradation by air pollution. It will also include chemical analyses, using Gas Chromatography Mass Spectrometry (GC-MS) to understand the chemical changes that occur to these pheromones when combined with the air pollutants.

Finally, these mechanistic laboratory-based studies will then be related back to the field. Inside the FADOE rings, a Proton Transfer Reaction Time of Flight Mass Spectrometer (PTR-TOFMS) will be used to analyse, for the first time in any study, the degradation of pheromones in real-time under field conditions.

Training opportunities:

The project offers training stints at the Centre for Ecology and Hydrology in Edinburgh. Training will be provided in use of the FADOE ring facility PTR-TOFMS, GC-MS, the use of wind-tunnels, behavioural/ecological assays as well as general laboratory and fieldwork skills.

Student profile:

The project is suitable for a student with a first or upper second-class degree in the biological/ecological sciences. Experience of fieldwork or insect behavioural ecology would be beneficial because this will make up the core of the student's research, however these skills are not essential because training opportunities will be provided. A basic understanding of organic chemistry and a prior knowledge of the chemical analysis techniques (GC-MS, PTR-TOFMS) is not essential because training will be provided to enable the student to develop in this area. The student should be able to demonstrate a capacity to quickly learn and master new technologies and techniques.

<http://www.reading.ac.uk/nercdtp>