Imperial College London

Natural Environment Research Council

2024_44_DoLS_SSe: Real-time acoustic monitoring of insect pollinators and their behaviours

Supervisors: Dr. Sarab Sethi (mailto:sarab.sethi@imperial.ac.uk); Dr. Lorenzo Picinali, Dyson School of Design Engineering

Department: Department of Life Sciences

Maintaining a healthy diverse community of insect pollinators is essential for global food security. However, habitat destruction and climate change are threatening the survival of species across many key taxonomic groups (e.g., bees, hoverflies, beetles). Growing policy and conservation efforts are being made to try to protect pollinators, but basic gaps in our knowledge around how these species react to human pressures pose a barrier to progress.

Current insect pollinator monitoring methods are only partially filling the data gap (Wagner et al., 2021). Traditional methods are often destructive, laborious, expensive, and suffer from both observer and taxonomic biases. Molecular methods have been an important advance but still are not able to deliver the scale of monitoring that is required. Data is therefore temporally and spatially limited, and often we can only measure presence without quantitative insight into activity and behaviour.

Acoustic monitoring, however, provides an excellent opportunity to scale pollinator monitoring to provide data which augments and directs more detailed surveys. Small lab studies have demonstrated that insect pollinators of different species and sizes exhibit unique acoustic signatures. Additionally, autonomous devices (e.g., https://www.bugg.xyz/) can record and transmit audio in real-time over long time periods, and are increasingly used to track mammal, herpetofaunal, and avian biodiversity at scale (e.g., https://thesoundofnorway.com/). Passive acoustic monitoring of pollinators, however, has not yet been successfully demonstrated.

The student will aim to develop the first fully autonomous acoustic monitoring system for real-time tracking of pollinators. With an initial focus on bumblebees, we will:

1. Develop custom hardware optimised for recording of low-amplitude wingbeat sounds in the field. Strategies might include using beamforming to amplify relevant sounds, 3D printing artificial flowers embedded with microphones, or employing chemical baits.

2. Develop a machine learning model to automatically classify pollinator presence, traits, and/or behaviours from passively recorded audio. Training data will be collected by exposing bees to a variety of foraging challenges in controlled flight arenas.

3. Deploy the system in human modified landscapes (UK farms; in collaboration with AgriSound) and pristine habitats (an Arctic field site) to investigate how land management practices and climate change, respectively, impact insect pollinators on spatial/temporal scales that could not previously be addressed.

We will work with industry partners, AgriSound, to ensure our solutions remain targeted at solving real-world challenges. This will include a three-month internship during the project.

Prior experience with pollinators or acoustics is not needed. Those with strong quantitative skills and interests are encouraged to apply.