

## Strengthening links between agri-environment management and pollination services for cost-effective bee conservation

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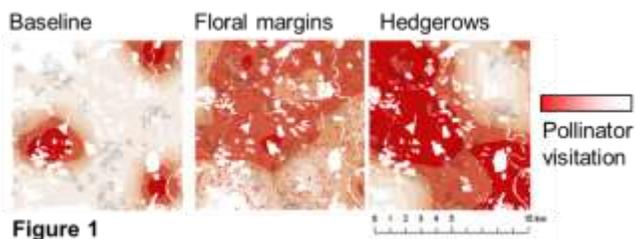
Co-supervisors: Emma Gardner (UKCEH), Tom Breeze (University of Reading), John Redhead (UKCEH)

### Project

Pollination by bees and other insects is vitally important for UK agriculture, improving production by around £630M. However, despite these benefits, pollinator populations are in decline due to changes in land use, land management and climate. As a result, there are growing observations of pollination deficits, where crop production is lower than it could be because of insufficient pollinator visitation ('pollination services'). Unfortunately, uptake of measures to restore pollinators has been limited because of a lack of necessary information on the links between landscape management to crop output and profitability. More broadly, we need greater knowledge of how incremental changes in pollination services affect crop yield.

During the studentship, you will work with state-of-the-art statistical and spatial models to explore how existing and novel landscape management methods, co-developed with farmers, could deliver greater benefits for both pollinators and farmers. These models have been developed by the supervisory team and published in influential journals, but have not yet been combined into a single project. Drawing on an extensive range of datasets from our own and other published research, you will use statistical models to better understand the relationship between the number of bee visits to a crop and yield, including how other factors such as water or fertilizer may influence this relationship. You will then work with a group of case study farmers to identify possible land management methods to maintain or restore pollinators in the landscape. Then, integrating this statistical modelling with our world-leading spatial model that simulates bee behavior (poll4pop), you will explore the effects of implementing these management measures on pollinator populations, pollination services and farm profitability.

This PhD is centered around computer modelling but the project itself involves many different aspects (e.g. statistical modeling, economics, co-development, spatial modelling) giving a great degree of flexibility in terms of which aspects are focused on and enabling you to adjust the balance to fit your own interests and circumstances. The supervisory team will support the successful candidate throughout.



**Fig. 1:** Maps generated using the poll4pop model showing how much different interventions in agricultural landscapes can increase bee visitation and how these increases in pollination service are distributed spatially.

### Training opportunities:

The project will enable you to gain experience in a range of different modelling techniques as well as economics

and stakeholder engagement methods, which will allow you to center your work in an applied, real-world context. The supervisory team will provide training in statistical modelling in R, systematic review, GIS mapping, process-based ecological modelling, economic analysis and interview techniques. You will receive training at both the University of Reading and the UK Centre for Ecology and Hydrology (Wallingford), where you will have the opportunity to develop highly sought-after transferable skills in computer modelling and stakeholder engagement. You will also be given training in developing accessible impact materials (e.g. infographics, videos) to help a wide audience, including land managers, practitioners and policymakers, to engage with your findings.

**Student profile:**

Applicants should hold or expect to gain a minimum of a 2:1 Bachelor Degree, Masters Degree with Merit, or equivalent in the biological/ecological sciences, geography, or applied mathematics, and be enthusiastic about developing solutions to problems in agricultural systems. Experience of ecological modelling, GIS and/or crop sciences would be beneficial, however these are not essential because significant training opportunities will be provided. Likewise, prior economics experience is not essential – students who do not yet have experience of this but are interested to learn these skills are encouraged to apply.

To apply, please follow the instructions at <https://research.reading.ac.uk/scenario/apply/>

**References:**

Gardner, E., Breeze, T. et al., (2021) Field boundary features can stabilise bee populations and the pollination of mass-flowering crops in rotational systems. *Journal of Applied Ecology*. doi: <https://dx.doi.org/10.1111/1365-2664.13948>

Bishop, J., Garratt, M., Nakagawa, S. (2022) Animal pollination increases stability of crop yield across spatial scales. *Ecology Letters*. doi: <https://dx.doi.org/10.1111/ele.14069>