

## **Predicting and controlling the invasion of honey-bee pests and diseases.**

Bees are of paramount significance to agriculture globally, due to their pollination services (an estimated 70% of crops worldwide are pollinated by bees). Their economic impact through pollination services is hundreds of billions of dollars annually. This was recognised in the last debate of the Royal Geographical Society of London, where the bee was declared the most important living being on earth.

Honeybees are the most common bee species across the world. However, in the past 20 years honeybee diseases have increased markedly, contributing significantly to observed increased mortality of honeybees and contributing to losses of entire hives. These diseases include parasites such as the Varroa mite, and bacterial diseases like American foulbrood.

Work in Warwick has already successfully developed simple spatial-stochastic models of disease spread between apiaries in England & Wales (Datta et al 2013, Keeling et al 2017). This is an individual-based model that operates at the scale of apiaries (sites with honey-bee hives), but there is considerable scope to investigate a suite of other modelling approaches. The focus of the MSc project is to consider invasion and control of a novel pathogen, beginning with relatively small areas and expanding the scale of our model.

There is the potential for this project to feed into existing collaborations with Giles Budge at the University of Newcastle, Jim Bull at the University of Swansea, the National Bee Unit (FERA, York) and researchers at NIWA and Victoria University of Wellington (New Zealand).

Keeling, Datta, Franklin, Flatman, Wattam, Brown & Budge (2017) Efficient use of sentinel sites: detection of invasive honeybee pests and diseases in the UK. *J. Roy. Soc. Interface*.

<https://doi.org/10.1098/rsif.2016.0908>

Samik Datta, James C. Bull, Giles E. Budge and Matthew J. Keeling (2013), Modelling the spread of American foulbrood in honeybees. *Journal of the Royal Society Interface*.

<https://doi.org/10.1098/rsif.2013.0650>