A BBSRC-funded computer model predicting how well bees fare under different conditions has been adopted by industry and regulators.

Professor Juliet Osborne1 and colleagues at the University of Exeter, and formerly at Rothamsted Research, created BEEHAVE: a computer model that uses the latest science to calculate how different threats affect the likelihood of honeybee colonies thriving2,3. Having a better understanding of the causes of bee declines will help governments develop strategies to protect pollinators, which we rely on for roughly three quarters of global food crop types, worth up to an estimated $577bn annually4.

Syngenta and Bayer are both using BEEHAVE to assess how their pesticides affect bee colonies, and promoting it to the worldwide agrochemical industry5.

“BEEHAVE will help us improve our understanding of how bee colonies respond to different environmental stressors,” says Dr Pernille Thorbek, Environmental Safety, Syngenta Ltd. “It will be a valuable additional tool for pesticide risk assessment, for example for different crops and different regions.”

The European Food Safety Authority (EFSA) have commissioned a regulatory model, which they will expect industry to employ as part of their risk assessment process when evaluating how their products affect bees, and they are basing this model on BEEHAVE.

EFSA’s Panel on Plant Protection Products and their Residues (PPR) concludes, in a statement on the suitability of BEEHAVE for use in a regulatory context, “The Panel recommends that BEEHAVE should be adopted as the basis for modelling the impact on honeybee colonies of pesticides and other stressors…”6

Scientists are also using BEEHAVE to conduct new research7.

Osborne and her colleague Dr Matthias Becher created BEEHAVE using a BBSRC Industrial Partnership Award8, part-funded by Syngenta. A further BBSRC grant9,10, awarded to Osborne and Professor Dave Goulson at the University of Stirling (and later at the University of Sussex), allowed the researchers to create BumbleBEEHAVE: an equivalent model predicting effects on bumblebees.

“The BBSRC-funded projects were completely crucial,” says Osborne. “These are complicated models that required at least three years of dedicated work to put together, with fieldwork going on at the same time to validate them. So we couldn’t have created them at all without the BBSRC funding.”

Osborne won BBSRC Social Innovator of the Year 2017 for creating these models11.

BEEHAVE is freely available and user friendly, allowing a range of stakeholders to benefit from it, including beekeepers and farmers as well as scientists.

“We were really keen to make it openly available and as easy for people to access as possible,” says Osborne. “We designed it with a user-friendly interface, so you don’t need any modelling experience to run the model and you can see very clearly what’s going on as you run it.”

Understanding pollinator declines is extremely important, yet carrying out experiments on pollinators, including bees, is very difficult, as so many factors affect them.

IMPACT SUMMARY

Professor Juliet Osborne and colleagues at the University of Exeter, and formerly at Rothamsted Research, used BBSRC funding to create a computer model of bee colony health and survival under different conditions. The model is freely available, user-friendly, and predicts how well bee colonies fare in different landscapes and when exposed to threats such as disease and pesticides, based on the latest science.

The European Food Safety Authority (EFSA) are using this model as the basis for creating a regulatory model, which they will recommend industry and other users employ when assessing threats to bees, for example from pesticides. Syngenta and Bayer are already using it to evaluate how their pesticides affect bee colonies, and promoting it to the worldwide agrochemical industry.

Osborne won BBSRC Social Innovator of the Year 2017 for creating this model.
Laboratory-based experiments cannot accurately replicate the situation in the real world, while experiments in the field are influenced by so many factors that it is hard to interpret the results.

BEEHAVE and BumbleBEEHAVE allow scientists to study threats to bees in a virtual world based on everything that is currently known about bee biology, and to hone their experiments on real bees. Researchers enter into the model information about available sources of pollen, presence of pesticides, and any diseases affecting a bee colony, and BEEHAVE predicts the eventual colony size, whether it will survive the winter, and the amount of honey it will produce. BumbleBEEHAVE produces similar results regarding the fate of multiple colonies of different species of bumblebee.

We rely on pollinators for roughly three quarters of global food crop types, worth up to an estimated $577bn annually.