THE MISSION OF
SUSTAINABLE BEE HEALTH

PoshBee Project by Professor Mark Brown

The use of pesticides has a profound effect on pollinators. However, there are still gaps of knowledge around the hazards that the use of chemical mixtures cause for both healthy bees, and those that may be infected by parasites, or undernourished, at the level of individuals, colonies, and populations. Bee health researchers around the world have been investing considerable effort into understanding these hazards, analysing the different ways in which bees are affected by pesticides, and their interactions with bee nutrition and parasites.

Bumble bees, honey bees, and solitary bees are all groups of bees that are essential for the well-being of humans and the environment. In order to maintain sustainable and healthy bee populations, the PoshBee project aims to help beekeepers, farmers, and environmental managers in their decision-making and everyday practice.

THE POSHBEE PROJECT

PoshBee (Pan-European Assessment, Monitoring, and Mitigation of Stressors on the Health of Bees) is a project funded by EU Horizon 2020's research and innovation programme under grant agreement No 773921. The project runs from 2018 to 2023 and unites partners from 14 European countries under the coordination of Professor Mark Brown, Royal Holloway, University of London.

PARTICIPATING PROJECT PARTNERS

PoshBee aims to support healthy bee populations, sustainable beekeeping and pollination across Europe. The project integrates the knowledge and experience of academics, beekeepers and farmers, and focuses on the provision of the first pan-European quantification of the exposure hazard of chemicals to managed and wild bees. It uses scientific analysis to determine how chemicals alone, in mixtures, and in combination with pathogens and nutrition, affect bee health.

PoshBee aims to achieve a number of objectives, like measuring hazards, drawing on the expertise of a diverse range of actors, and quantifying the exposure of honey bees, bumble bees, and solitary bees to chemicals within major agricultural cropping systems - apple orchards and oil seed rape fields - across Europe. Another goal of the project is to provide toxicity assessment and dynamics of key agrochemicals in bees.

By providing a subsequential estimation of health effects through an approach that combines the skills of bee researchers, research chemists, beekeepers, farmers, and social scientists, PoshBee aims to provide key information for the development of improved policy and regulations for the safe and sustainable use of agrochemicals in Europe.

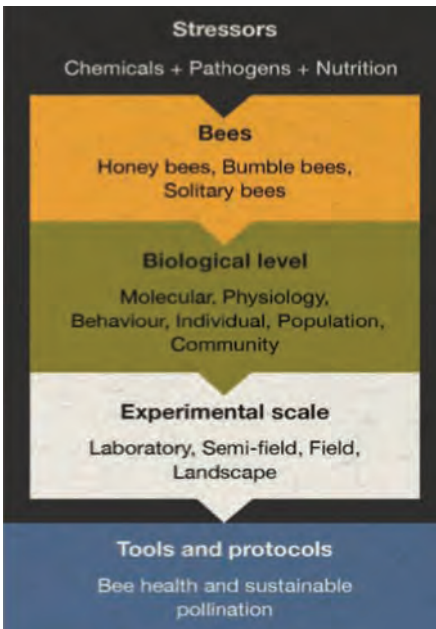PoshBee consortium members in Marseille, France, at the project's second annual meeting

Figure 1: Bee health is dependent on various types of stressors. PoshBee aims to develop tools and protocols for improving bee health and ensuring sustainable pollination.


A PoshBee frame used during fieldwork

RESEARCH DEVELOPMENTS AND OUTCOMES

Within PoshBee, a site network covering 8 countries and many dispersed locations have been developed in order to assess bee health in the face of stressors like pesticides, pathogens, and nutrition. A high number of field and semi-field experiments around Europe have also been completed.

In addition, a holistic bee health model is being developed within PoshBee. The project is related to the **ALMaSS agent-based model** framework for various animal species, with the modelling of honeybee behavior being the most intricate part of the model. By providing a simulation of individual bee behavior combined with different external factors that might affect bees, a new level of understanding and prediction is created, which can then be used by risk managers to develop policy around how and when agrochemicals could be used in agricultural landscapes.

PoshBee scientists are also developing various technical innovations and tools that make the beekeeper's job faster and more precise. The project has presented some technical innovations in beekeeping that aim to help beekeepers by developing bee handling units. Some of the current innovations include a bee-handling box, a dead-bee trap, and etching of serial
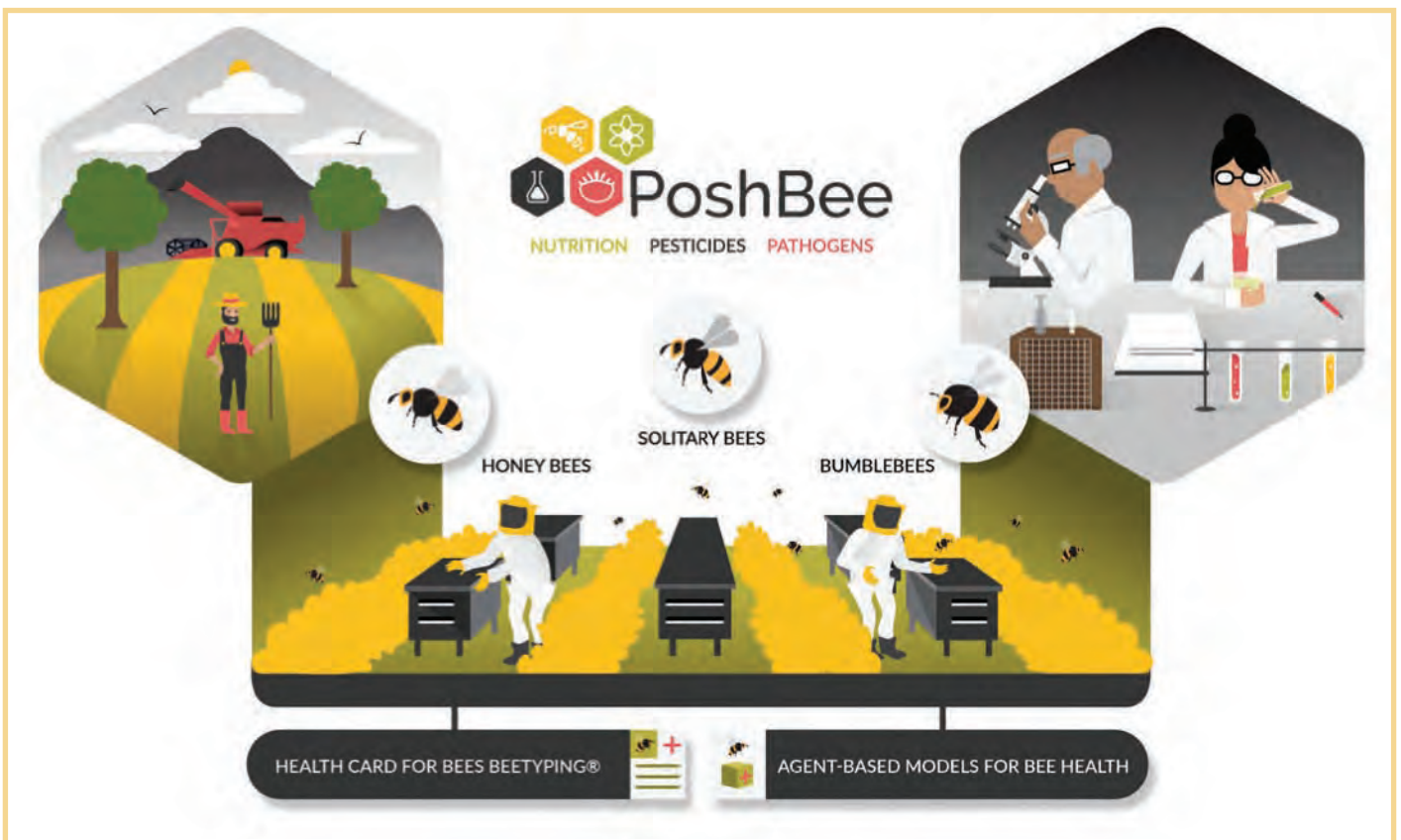
numbers on frames. Ongoing PoshBee research also includes the development of a novel molecular monitoring tool, or 'health card' for bees, which could ultimately be used by individual beekeepers to provide additional information on the health of their hives.

Another goal of PoshBee is to drive policy and practice by working together with key stakeholders in the honey bee, agrochemical, farming, pollination service, research, EU policy and regulatory, and bee conservation sectors. In relation to this, PoshBee has also issued a number of practice abstracts that aim to provide useful project insights to practitioners. The PoshBee practice abstract collection will carry on growing throughout the project, and can be accessed on the **EIP-AGRI online platform.**

HIGHLIGHT 1
The ALMaSS Agent-Based Model System

The Animal, Landscape and Man Simulation System (ALMaSS) agent-based model system models different animal species as individuals (agents), which move around inside a virtual landscape to breed and die much in the same way as the real species do in their natural environment. One type of species used in the model is pollinators.

The honeybee agent-based model is the most complicated model integrated into ALMaSS. The behaviour of this model depends on the individual bee's situation and context, as well as on its individual motivation. The adult honey bee agent may exhibit a variety of behaviours (e.g. guarding, eating, cleaning, depositing nectar, capping honey etc.), all linked with context-dependent rules. We are currently working on a bumblebee version of this model.

Despite its complexity, ALMaSS offers a highly detailed, realistic and reactive model to evaluate the impacts of EcoStack strategies. Moreover, the model can integrate landscape context and multiple stressor interactions for a pesticide risk assessment.

HIGHLIGHT 2
PoshBee Practice Abstracts

Practice abstract 1:
The first practice abstract of the PoshBee project provides a brief overview of the research that is conducted within the project, and it provides a description of project activities that aim at solving practitioners' problems.

Practice abstract 2:
Many recent reports describe long-term declines in insects. 'PoshBee' aims to identify factors negatively impacting bees in European farmland, and in 2019 performed an extensive pan-European field study over 8 countries. The second PoshBee practice abstract features recommendations for groups planning to perform multi-partner, farm-scale, field studies on pollinating insects.

Practice abstract 3:
Scientific analyses showed that clothianidin exposure had no effect on pathogen levels in honeybees, but neonicotinoid exposure in agricultural landscapes strongly affects bumblebees and solitary bees. Farmers are advised to consider adjusting their plant protection strategy to reduce pesticide use, particularly in flowering crops and during bloom.

Practice abstract 4:
Communication between scientists and beekeepers is essential, especially when an experiment is conducted. In the fourth practice abstract project partners make experience-based recommendations for timely planning and the essence of finding a good communicator between scientists and beekeepers when joint research actions are to be made.

HIGHLIGHT 3
EIP-AGRI Focus Group Bee health and sustainable beekeeping: Final report

PoshBee was featured in the EIP-AGRI Focus Group on Bee Health and Sustainable Beekeeping's Final Report. The report provides a detailed overview of a number of initiatives and projects that currently work in the sphere of beekeeping and sustainable management of beehives.

While the last year has been challenging for us all, it has been particularly complex to manage and maintain PoshBee research activities across 14 different countries, each of which has been affected by the Coronavirus pandemic in unique ways.

We are lucky that our major field campaign (described briefly above) - to assess the exposure of honey bees, bumblebees, and solitary bees across Europe to agrochemicals, nutritional stress, and parasites - took place last year. This campaign was led by Professor Jane Stout at Trinity College Dublin, and Irish beekeepers and farmers played an integral and essential role in producing the data for Ireland - thank you! We are still in the process of analysing this data, and will look forward to sharing the results with you as soon as we can.

However, semi-field experiments on honey bees in the UK, assessing interactive impacts of agrochemicals on honey bee health, along with many laboratory studies of honey bee health, have had to be delayed until 2021 due to the pandemic.

We look forward to getting back to normal in 2021, and to pushing forward with PoshBee's work. Healthy bees matter to us all, and we hope that we will be able to contribute to a better future for our bees!

*Photo credit:
Michael Hodgins*