PoshBee

Mitigating multiple stressors on managed pollinators

Effectiveness and feasibility of implementing response options

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KEY MESSAGES

In the real world, pollinators face multiple interacting pressures, and so response options must be tailored to this. To date, most attention has been on characterising the risks to managed pollinators from single stressors, though recently more attention has been paid to risks from multiple stressors (e.g., pesticides, pathogens and poor nutrition). Until now the focus has been on response to individual stressors, but we are increasingly aware that options that mitigate against multiple stressors are needed.

There are many effective response options to multiple threats. A wide range of response options are available for farmers, beekeepers and policy makers and they vary substantially in their effectiveness for mitigating threats from multiple stressors. In general, the most effective response options are:

- **Farm management:** reducing application rates of pesticides, choosing less toxic active ingredients, reducing drift, adopting IPM, and rewarding farmers for good practices.
- **Habitat management:** Creating flower rich patches, restoring semi-natural habitats, reducing the intensity of grassland management and managing road verges to enhance floral diversity.
- **Bee management:** reducing exposure of hives/ managed colonies to insecticides through placement and temporary closure, selecting colonies with reduced pathogen loads, using healthy local queens, and following best practices for selecting reproductive stocks.

The feasibility of implementing response options is greatly improved with policy and industry support (see table on following page). The overall feasibility of implementing response options is highly variable, but all are more feasible to implement with support through the provision of agri-environment type schemes (e.g., payments), industry or government sponsored training or equipment or consumables (e.g., seeds). The most feasible response options are:

- **Farm management:** with support, the most feasible responses are rewarding farmers, reducing spray drift and adopting IPM practices. Without support, the most feasible options are reducing spray drift, hive placement to reduce exposure and providing mass flowering crops as forage.
- **Habitat management:** with support, flower patches, restoring habitats, and grassland and road verge management are most feasible to implement. However, all of these are more difficult to adopt without support.
- **Bee management:** options easy to implement with additional support include beekeeper training, colony certification, controlling trade, hive closure, monitoring pollinator health, payments to beekeepers for services and certifying products as 'bee friendly. Without additional support, hive closure and using healthy queens are the most feasible options to adopt.

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Support level	Farm management	Habitat management	Bee management
WITH support	Rewarding farmers Reducing spray drift Adopting IPM practices	Flower patches Restoring habitats Grassland management Road verge management	Beekeeper training Colony certification Controlling trade Hive closure Monitoring pollinator health Payments to beekeepers for services Certifying products as 'bee friendly'
WITHOUT support	Reducing spray drift Hive placement to reduce exposure Providing mass flowering crops as forage	All options are difficult to adopt without support	Hive closure Using healthy queens

POLICY RECOMMENDATIONS

- **Pollinators, including managed species, simultaneously face multiple threats and therefore response options should aim to address these in parallel.** Key stressors to managed bees (solitary, bumble, and honey bees) include pesticides, pathogens and poor nutrition, and so combinations of response options need to be implemented to mitigate these, tailored to the local context.
- **There are a variety of effective response options available to farmers, beekeepers and land managers but without policy support, including schemes offering incentives, training and advice, many of these are difficult to implement.** Policies should therefore strengthen commitments to: improve farmer and beekeeper training, support habitat management and creation, reduce exposure to pesticides, and reward farmers for pollinator-friendly practices.
- **A wide range of policies and initiatives offer concrete opportunities to better protect the health of managed pollinators,** and safeguard the benefits they provide to food security and the wider environment. These include:
  - Agriculture: Common Agricultural Policy, Animal Health Strategy and Farm to Fork Strategy
  - Pesticides: Sustainable Use of Pesticides Directive and Pesticide risk assessment and authorisation
  - EU Pollinators Initiative: (including EU Pollinator species action plans)
  - Biodiversity: Biodiversity Strategy to 2030, Nature Restoration Law, and Habitats Directive

BACKGROUND AND CONTEXT

Managed bees, including honey bees, some bumble bees, and some solitary bees, pollinate crops and wildflowers and are essential for the well-being of both humans and biodiversity (Potts et al. 2016). Yet, they face serious threats from anthropogenic disturbances including landscape modification, agrochemicals, pests, pathogens and climate change (Dicks et al. 2021). While each of these threats, individually, can have negative impacts on bee health, evidence is still being accumulated regarding their relative importance, and the interactions of multiple stressors and their impact (Siviter et al. 2021). Supporting managed pollinators therefore requires a joint effort that couples advancing our understanding of the impacts of multiple stressors with identifying appropriate and effective risk responses to mitigate against these multiple concurrent threats.

A diverse range of response options, aimed at mitigating threats to pollinators, have been evaluated and reported in assessments including IPBES (2016) 'Pollinators, Pollination and Food Production' and SETAC (2013) 'MAgPIE: Mitigating the Risks of Plant Protection Products in the Environment'. To date, policy and management approaches have not adopted a systematic way to match response options to multiple stressors. Here we provide a first evidence-based framework to address this gap.

METHODS

Twenty internationally recognised experts participated in an expert elicitation process as part of the H2020 PoshBee project (www.PoshBee.eu). These included members of the project and stakeholders representing farmer, beekeeper, NGO, policy and agri-food sectors across Europe. We used a modified Delphi technique to assess the effectiveness and feasibility of a wide range of farm level options to mitigate multiple stressors impacting on managed bees. A list of 29 potential response options that can be used to reduce the risks from interactions between pesticides, pathogens and poor nutrition on managed pollinators were drawn from the IPBES (2016) and SETAC (2013).

Four published case studies were presented to experts as a basis for scoring (Barascou et al. 2021; Knauer et al. 2022; Wintermantel et al. 2022; Siviter et al. 2020); these included pesticide x nutrition and pesticide x pathogen interactions impacting managed honey bees, bumble bees and solitary bees in a European farming context. Experts scored feasibility and effectiveness of the response options independently followed by a consensus building process in an online workshop (January 2023). More information available here soon.

RESOURCES

Barascou et al. (2021). Pollen nutrition fosters honeybee tolerance to pesticides. *Royal Society* Open Science 8, 210818

Dicks et al. (2021) A global assessment of drivers and risks associated with pollinator decline. *Nature Ecology and Evolution* 10, 1453-1461

IPBES (2016). The assessment report of the intergovernmental science-policy platform on biodiversity and ecosystem services on pollinators, pollination and food production. In: Potts, S.G., Imperatriz-Fonseca, V.L., Ngo, H.T. (Eds), Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany

Knauer et al. (2022). Nutritional stress exacerbates impact of a novel insecticide on solitary bees' behaviour, reproduction and survival. *Proceedings of the Royal Society B* 289, 20221013

Potts et al. (2016). Safeguarding pollinators and their values to human well-being. *Nature* 540, 220-229

SETAC (2013). Mitigating the Risks of Plant Protection Products in the Environment: MAgPIE

Siviter et al. (2020). Individual and combined impacts of sulfoxaflor and *Nosema bombi* on bumblebee (*Bombus terrestris*) larval growth. *Proceedings of the Royal Society B* 287, 20200935

Siviter et al. (2021). Agrochemicals interact synergistically to increase bee mortality. *Nature* 596, 389-392

Wintermantel et al. (2022). Flowering resources modulate the sensitivity of bumblebees to a common fungicide. *Science of The Total Environment* 829, 154450

The full report underpinning this briefing can be found here soon: