1.6 Evaluating honeybee protection goals using the BEEHAVE model

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Abstract

In recent year the debate about what is causing the decline of honeybees in some parts of the world has been intense. Taking a precautionary principle the European Food Safety Agency (EFSA) has recently issued new guidance documents for risk assessment of plant protection products to honeybees. The protection goals were operationally defined as: colony size (number of bees) and effects should not exceed a 7% reduction and there were additional limits to forager losses [1]. These protection goals were set using a honeybee model available at the time [2, 3], which is very simple and has several shortcomings relative to the recent EFSA Opinion on Good Modelling Practice [4].

Here, we use a more realistic and well-tested honeybee model, BEEHAVE, [3, 5] to explore the potential impact of forager losses on the colony. BEEHAVE combines in-hive processes with landscape level forage availability via a foraging module. We used two measures of bee losses that would be generated from different types of studies: RFID (forager mortality per trip as a multiple of control) and colony assessment (mortality as a fixed proportion of all workers).

We also show how appropriate control scenarios may be developed. Control settings had large impact on colony health and resilience, so we aimed for settings that allowed control colonies to survive while leaving them vulnerable to stressors. Low sugar concentrations in nectar were not compatible with long foraging distances as colonies quickly failed. The colonies are generally most sensitive to worker losses outside of the breeding season, but as exposure is unlikely outside the foraging season it is of limited relevance in the real world. It appears that the colonies are far more resilient to forager losses than predicted by the Khoury model. BEEHAVE predicts that even 3 times the current proposed EFSA negligible effect level of 7% will still have a negligible effect on colony strength and over-wintering success.

References

[1] EFSA Journal 2013 11(7):3295.

[2] Khoury *et al.* 2011; PLoS ONE 6, e18491.

[3] Becher et al. 2013. Journal of Applied Ecology. DOI: 10.1111/1365-2664.12112.

[4] EFSA Journal 2014 12(3):3589.

[5] Becher et al. 2014. doi: 10.1111/1365-2664.12222