

Bumblebee Infestation and Interspecific Competition with Honeybees Intensify Near Honeybee Hives

Samira Jelizaveta Garajeva¹, Ronalds Krams², Tatjana Grigorjeva¹, Jonathan Willow³, Sergejs Popovs¹, Māris Munkevics⁵, Giedrius Trakimas⁶, Jorge Contreras Garduño⁷, André Rodrigues De Souza⁸, Colton Bryce Adams⁵, Markus Rantala⁹, Eriks Sledevskis¹⁰, Tatjana Krama¹, Indriķis Krams⁴

¹Department of Biodiversity, Institute of Life Sciences and Technology, Daugavpils University, LV-5401, Daugavpils, Latvia ²Department of Biodiversity, Institute of Life Sciences and Technology, Daugavpils University, Daugavpils, Latvia

³Institute of Food Safety, Animal Health and Environment "BIOR", Riga, Latvia

⁴Pheasants Forever and Quail Forever, St James, MN, United States

⁵Section of Ecology, Faculty of Medicine and Life Sciences, University of Latvia, Riga, Latvia

⁶Latvian Biomedical Research and Study Centre, Riga, Latvia

⁷Institute of Biosciences, Life Sciences Center, Vilnius University, Vilnius, Lithuania

⁸Escuela Nacional de Estudios Superiores, Universidad Nacional Autónoma de México, Morelia, México

⁹Departamento de Biología, Universidade de São Paulo, Ribeirão Preto, Brazil

¹⁰Department of Biology & Turku Brain and Mind Centre, University of Turku, Turku, Finland

¹¹Department of Technology, Institute of Life Sciences and Technology, Daugavpils University, Latvia

INTRODUCTION

Human activities are driving declines in insect populations, including a 75% reduction in flying insect biomass in protected areas. This loss is contributing to a pollination crisis, affecting global food production. While honeybees are essential for agriculture, they are often non-native and may not pollinate all plants as effectively as native bumblebees, which are facing declines due to stressors. Honeybees also compete with bumblebees for resources and can transmit pathogens, further threatening bumblebee populations, particularly through parasites like *Aphomia sociella*.

AIMS

- Investigate the dual threats (competition and parasites) to native bumblebees *Bombus terrestris*
- Examine the impact of competition on bumblebee immunity
- Assess the effects of parasite infestation on immunity
- Evaluate the combined effects of competition and infestation
- Implications for agricultural ecosystems and biodiversity conservation

METHODS

Study site and insects: *B. terrestris* colonies were placed near apiaries in southeast Latvia in 2019 and 2024 at distances of 0, 150, 300, 450, and 600 m from honeybee colonies. Colonies were monitored until peak reproductive output in early July.

Infestation monitoring: *A. sociella* infestations were checked 2-3 times weekly, with presence recorded as binary (yes/no) based on silk spin by larvae.

Reproductive effort: Queen and worker cell counts, along with young queens and workers, were measured to assess reproductive success.

Immunity testing: Worker bees from both infested and non-infested colonies were subjected to a sterile nylon monofilament implant to measure the immune response (encapsulation and melanization) after 5 hours.

Immune assays: Melanization of the nylon implant was measured using a microscope and image software to assess immune activity.

Statistical Analysis: Logistic regression assessed infestation rates, while linear models analyzed reproductive success and encapsulation response, with significance determined using two-way ANOVA.

RESULTS

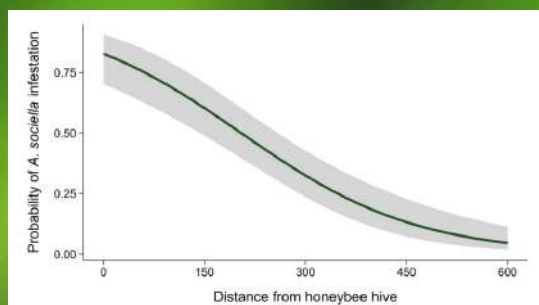


Fig. 1. Probability of *Aphomia sociella* infestation in bumblebee colonies, and its relationship with distance (m) from an apiary. The shaded area represents a 95% confidence interval.

Corresponding author's e-mail: samira.garajeva@du.lv

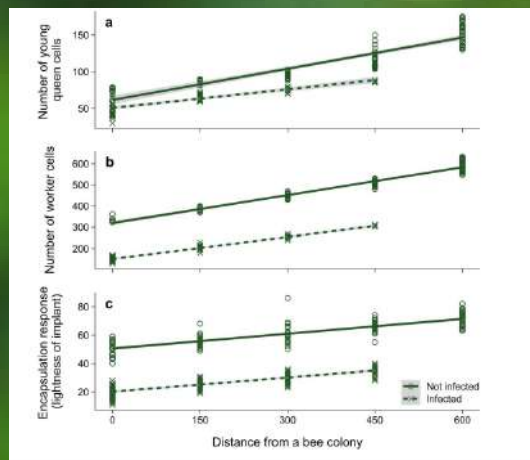


Fig. 2. Relationship between the distance (m) of bumblebee nests from a honeybee colony and (a) number of young queen cells, (b) number of worker cells, and (c) encapsulation response of worker bees, depending on the status of infestation with *Aphomia sociella* larvae. Shaded areas represent a 95% confidence interval.

CONCLUSION

Parasites and pathogens, particularly those potentially spread from honeybees to bumblebees, are a major concern for bumblebee health in both agricultural and natural environments. This study highlights the reduced immune response in bumblebees near apiaries, which could increase their susceptibility to additional infestations and diseases. The findings suggest the need for further research on parasite diversity and its impact on bumblebees near honeybee colonies. Conservation efforts should aim to balance honeybee introduction with minimizing negative effects on native pollinators' health and reproductive success.

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Bumblebee infestation status and interspecific competition between bumblebees and honeybees increase with proximity to honeybee hives

Samira Jelizaveta Garajeva¹, Ronalds Krams², Tatjana Grigorjeva¹, Jonathan Willow³, Sergejs Popovs¹, Māris Munkevics⁵, Giedrius Trakimas⁶, Jorge Contreras Garduño⁷, André Rodrigues De Souza⁸, Colton Bryce Adams⁵, Markus Rantala⁹, Eriks Sledevskis¹⁰, Tatjana Krama¹, Indrikis Krams⁴

¹Department of Biodiversity, Institute of Life Sciences and Technology, Daugavpils University, Daugavpils, Latvia

²Institute of Food Safety, Animal Health and Environment "BIOR", Riga, Latvia

³Pheasants Forever and Quail Forever, St James, MN, United States

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⁵Latvian Biomedical Research and Study Centre, Riga, Latvia

⁶Institute of Biosciences, Life Sciences Center, Vilnius University, Vilnius, Lithuania

⁷Escuela Nacional de Estudios Superiores, Universidad Nacional Autónoma de México, Morelia, Mexico

⁸Departamento de Biologia, Universidade de São Paulo, Ribeirão Preto, Brazil

⁹Department of Biology & Turku Brain and Mind Centre, University of Turku, Turku, Finland

¹⁰Department of Technology, Institute of Life Sciences and Technology, Daugavpils University, Daugavpils, Latvia

Bumblebees are key pollinators in temperate regions of the northern hemisphere. Niche overlap and competition between bumblebees and honeybees may represent a significant stressor to bumblebees by reducing nutrient acquisition and facilitating spillover of pathogens and parasites from honeybees. One of these parasites is the bumblebee wax moth (*Aphomia sociella*), whose larvae can be found in bumblebee and wasp nests, as well as weakened commercial honeybee hives. Using *Bombus terrestris* colonies as experimental models, we expected that young queen and worker bumblebee immunity (measured by encapsulation response) would become weaker under both competitive (i.e., proximity to honeybee hives) and parasite (*A. sociella* infestation) pressure and, specifically, that the immunity of bumblebees in closest proximity to honeybee hives would be weakest in nests infested by *A. sociella*. We observed increased infestation, lower reproductive output, and weaker encapsulation response in bumblebee colonies that were near honeybee hives. Our data provide insights on the ecology of *A. sociella* infestations where honeybees and bumblebees coexist. Our observations of reduced immune response in bumblebees inhabiting colonies nearer to honeybee hives are of critical importance, as this reduction in immune response could facilitate additional infestations of other parasites and pathogens within bumblebee colonies.