Title: Assessing the impacts of urban beehives on wild bees using individual, community, and population-level metrics

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Abstract

Several species of wild bees are in decline globally and the presence of managed honey bees is one of many proposed stressors on wild bee populations. However, there is limited knowledge of the impacts of honey bee hives on wild bees, especially in urban landscapes. We performed a field study to assess the associations between honey bees and wild bees within the Greater Toronto Area in Ontario, Canada. We measured relative abundance of honey bees, wild bee metrics (abundance, community composition, functional diversity, and body size), and floral resources (floral density and richness); we also calculated impervious surface at 500 m and 1 km for each of our sites. Our main findings were that increasing honey bee abundance was correlated with decreases in wild bee species richness and functional diversity, as well as two wild bee species' abundances and one wild bee species body size, out of many assessed. This research adds to the growing body of literature aiming to evaluate whether honey bees are a stressor on wild bees in urban landscapes, which will be valuable for informing conservation management practices and future research.

Key words: urban ecology; *Apis mellifera*; wild bees; competition; Canada; honey bees

Declarations

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Conflicts of interest/Competing interests

The authors have declared that no competing interests exist.

Availability of data and material

Our trait database is available through our Online Resource 1. Our bee occurence and body size data are available upon request.

Code availability

Our code is available upon request.

Author's contributions

Sarah MacKell and Sheila Colla conceived of the ideas. Sarah MacKell led the development of the field methodology. Sarah MacKell and Hadil Elsayed contributed equally to the collection of data in the field and processing of samples (i.e. identifying and measuring). Sarah MacKell led the data analysis, but Hadil Elsayed conducted the trait composition analysis. Sarah MacKell led the writing of the manuscript and all authors contributed to editing. All authors read and approved the final manuscript.

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We recognize and respectfully acknowledge the land on which our research took place. We are settlers and are very appreciative to work and live on this land and aim to take care and build relations with all people here. Our research was completed on the traditional territories of many Indigenous Nations and has been taken care of by the Anishinabek Nation, the Haudenosaunee Confederacy, and the Huron-Wendat. These lands are now home to many First Nation, Inuit, and Métis communities. We acknowledge the current treaty holders, the Mississaugas of the Credit First Nation.