Silver linden trees and bumblebee mortality

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Introduction

In summer, accumulations of dead bumblebees are frequently found under late-blooming linden. This phenomenon is mostly associated with silver linden (*Tilia tomentosa*). Silver linden originate in South-Eastern Europe and bloom during July and August. Because of their resistance to aridity, surface sealing and air pollution, silver linden trees were introduced to parks and roads in Germany. Over the past decades, various hypotheses have been posed and tested to explain bumblebee mortality underneath *T. tomentosa.* Speculations ranged from the toxity of trees to predation, age of bees, floral scent as trap or death by starvation. However, since the topic is complex including a multitude of influencing parameters, a final explanation is still lacking.

In this study, we analysed the bee mortality under linden trees from a new perspective. Therefore, linden trees in the area of Würzburg, Germany, were sampled in summer of 2019. We compared silver linden, large-leaved and small-leaved linden regarding traits such as floral scent and their attractiveness for bees. Our aim was to identify factors influencing bumblebee mortality and thereby contribute to the efforts of unravelling this long-investigated topic.

Methods

Collection of dead bees under *T. tomentosa* trees every 48h during bloom (July)

3 study sites: decreasing landscape complexity → increasing isolation between trees

Thüngersheim

Lengfeld

Thüngen

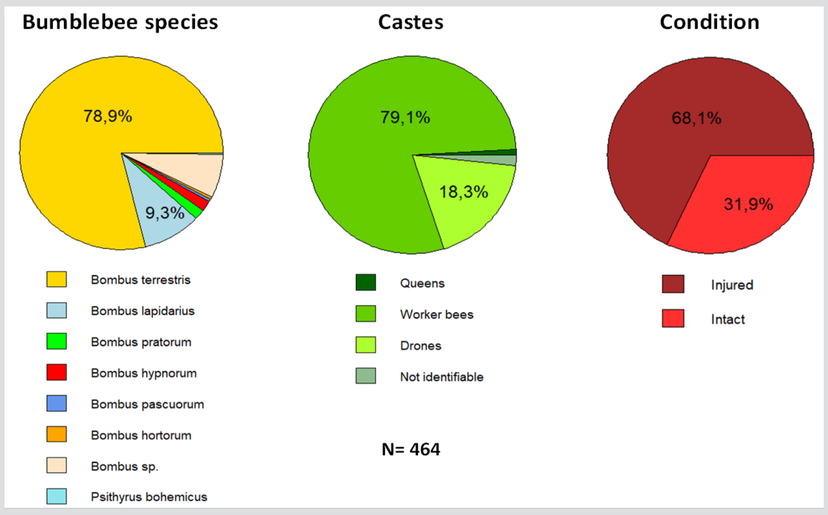
Treetop observations of 1m² tree crown, 7min/day

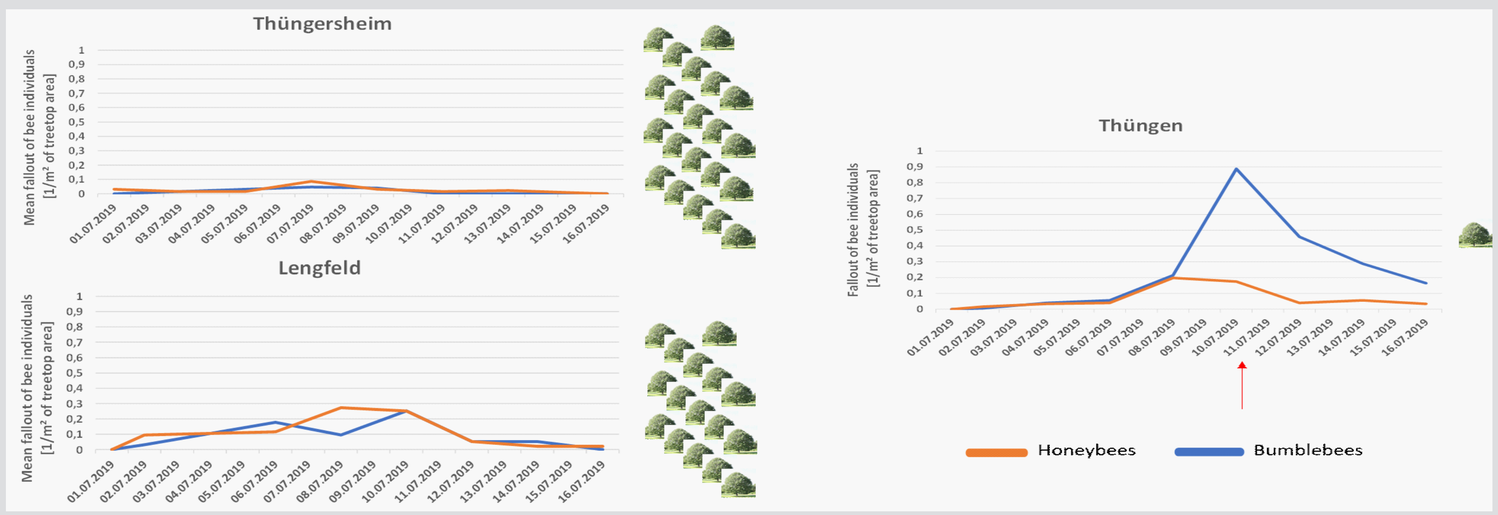
1 min 08:00-09:00
5 min 10:00-12:30
1 min 13:00-14:30

In vivo dynamic headspace sampling of **floral linden scent**

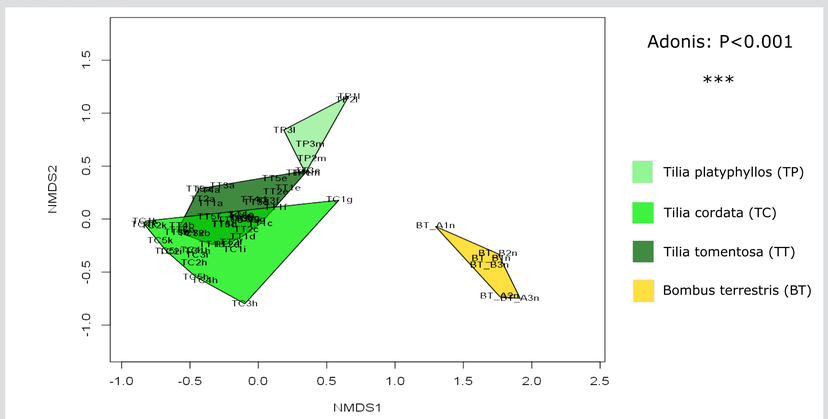
Results

Mortality

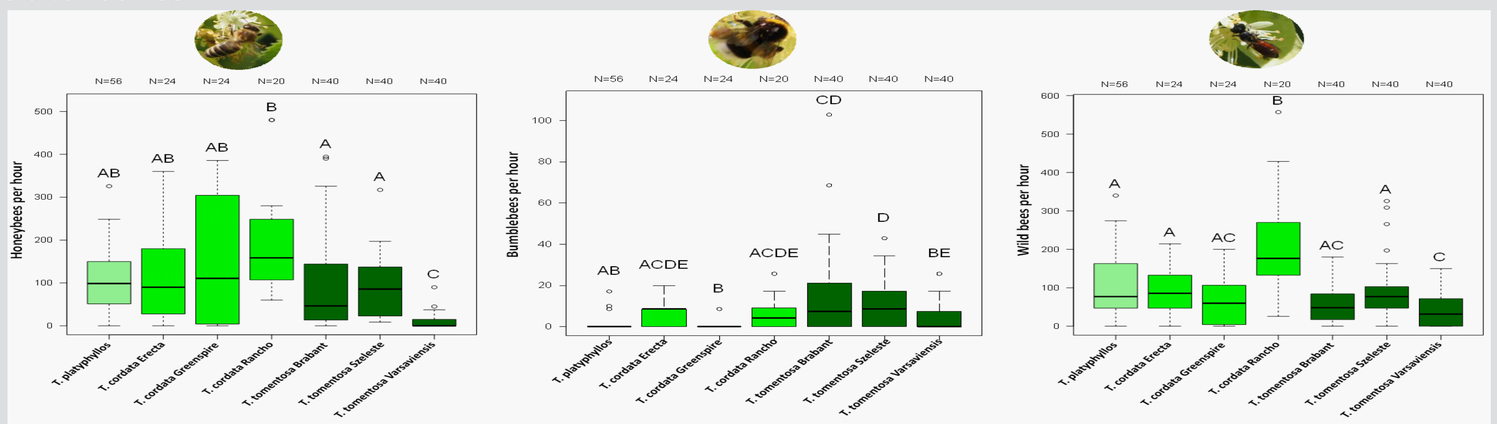




Floral scent



Bee abundance



Discussion

Regarding bumblebee mortality we assume that isolation of linden trees and lack of alternative flowering species in the surrounding area might be the important factors. Especially in late summer, when silver linden are in bloom, isolated trees without other close food sources lead to enhanced competition for the nectar available in the blossoms. Consequently, the bumblebees are unable to fully cover their energy requirements anymore as they spend more energy during foraging flights than gaining by nectar intake, hence dying on the ground. Floral scents of different linden species are unique in their composition and might be important to lure bees to the trees for pollination. The specific role of single compounds must be analysed further in detail for possible impacts on bumblebee behavior or physiology. However, all investigated linden species (including silver linden) are valuable trees for bee pollinators as they are visited by various bumblebees, other wild bees and honeybees foraging for nectar and pollen.

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