Honey bee populations may collapse due to ineffective defenses

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Researchers from the Xishuangbanna Tropical Botanical Garden (XTBG) of the Chinese Academy of Sciences and the University of California San Diego have predicted that the presence of Asian honey

bee hornets would harm Apis mellifera colonies more than Apis cerana colonies because of their different exposure to Vespa velutina over evolutionary time. The study was published in *Entomologia Generalis*.

Collective defense is constrained by co-evolution with the predator. In social insects, such as honey bees, collective defense of the nest is essential. However, the potential cascading effects of predator attack on social insects—directly reducing the number of colony members and, indirectly, stressing the colony to reduce its reproduction—are not well understood.

Asian honey bees (Apis species) have co-evolved with predatory Asian hornets (Vespa species) and have evolved several counter-strategies. A. mellifera colonies can respond to attacks by V. velutina hornets by creating a dense "bee carpet" consisting of large numbers of bees gathered at the nest entrance. However, this defense is not always effective.

In view of this, the researchers measured hornet attacks and honey bee colony fitness proxies (number of eggs, pupae, and workers) in apiaries with both bee species but with and without hornets, and quantified fitness effects across seasons in the presence and absence of hornets.

They found that hornet attacks significantly reduced colony fitness of A. mellifera, but not A. cerana. A. mellifera, unlike the native A. cerana, greatly reduced foraging, and experienced higher hornet predation on foragers when attacked by the native V. velutina auraria.

They observed that hornet attacks elicited more guarding and stop signals from A. mellifera than from A. cerana. Attacks resulted in reduced queen egg production, fewer pupae, and fewer workers, and colony mortality in A. mellifera. In contrast, hornet attacks did not result in declines in the same proxy measures of colony fitness for A. cerana.

"In addition to direct predation, predator-induced stress may contribute to A. mellifera colony decline. Our results suggest that a largely ineffective defense, such as bee carpet response in A. mellifera, can contribute to population collapse in a social group," said Prof. Tan Ken of XTBG.

More information: Shihao Dong et al, Honey bee social collapse arising from hornet attacks, *Entomologia Generalis* (2023). DOI: 10.1127/entomologia/2023/1825

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