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First records of *Apis mellifera* Linnaeus (Insecta: Hymenoptera) open nests in Sofia, Bulgaria

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Abstract. The presence of five feral, exposed nests of Western honey bee, *Apis mellifera* L., is reported for the first time from a populated area in Bulgaria. The survival success of the colony during the winter was observed for two of the nests. Possible reasons for this unusual nesting behavior are discussed.

Key words: Western honey bee, exposed nests, overwintering success.

Introduction

Beyond man-made hives designed to domesticate *Apis mellifera* Linnaeus (Hymenoptera: Apidae) swarms, this species typically nests in tree hollows or other available cavities of sufficient size in the wild, such as artificial nest boxes for wild birds or mammals, old black woodpecker cavities (*Dryocopus martius* L.), rock clefts or even underground holes (Beekman & Oldroyd 2018; Kohl & Rutschmann 2018, etc.). In urban environments the honey bee may also nest in various cavities in anthropogenic structures, such as residential buildings or farms (Browne *et al.* 2020, etc.). On the other hand, in rare instances, atypical open-air nests can be constructed, mostly on three branches, but also on build structures and rocks (Seeley & Morse 1976; Gambino *et al.* 1990; Siegel *et al.* 2005; Tribe *et al.* 2017; Saunders *et al.* 2021; etc.). In cities, such nesting behavior has been infrequently recorded (Bouvier 1906; Daly 1990; Bila Dubaić *et al.* 2021).

In this paper we report five unusual exposed nests of *A. mellifera* found in Sofia city and evaluate the survival of the colonies during the winter months.

Material and Methods

The discovery of open nests within the territory of Sofia occurred randomly, primarily through observations of wild birds in the years 2018, 2019, and 2024. Inhabited nests were observed during the summer and winter months, extending into the period of January–March of the next year. For taking photographs, Canon EOS 70D camera with telephoto lens Canon EF-L 100-400 was used. Data on weather conditions and air temperatures was gathered from https://www.stringmeteo.com/, but only for the winter of 2024-2025.

Results

During the study period, five exposed nests, all located in the central city area of Sofia, were detected. The first one (fig. 1A) was initially found in late spring 2018 on a sweet chestnut tree (*Castanea sativa* Mill.). This nest survived successfully for most of the summer but in the third decade of August it was unexpectedly affected by an unknown force and disappeared. The second nest was found in the summer of 2019. It was constructed

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among twigs of a black mulberry tree (*Morus nigra* L.), and a thriving colony of bees was observed to live inside the combs. In late December, a severe freezing period began, leading to high mortality among the bees. During the first decade of January 2020, many dead and dying worker bees were found on the ground beneath the tree (Fig. 1C). When the weather warmed in spring, no live inhabitants were seen to visit the combs. The third nest was found in late November 2019 and was built on a coniferous tree belonging to the genus *Abies*. This nest was dry and empty when discovered. Thus, the reasons for the absence of the bee colony remain unknown. The fourth nest was found in the winter of 2022, and its structure was built on a branch of a small-leaved lime (*Tilia cordata* Mill.). This nest was uninhabited at the time of discovery, and both the time of its creation and the survival of the bee colony remain unknown. The fifth nest (fig. 1B) was found in early summer of 2024 on a black mulberry tree (*M. nigra*). The colony appeared to be in good condition throughout the warm season and autumn. Despite the cold period in the second decade of January 2025 (min. -3.2°C to -7.4°C, max. -2.0°C to +2.0°C), many worker bees were observed to fly and forage in the nest area as temperatures rose in the third decade of January and early February (Fig. 1D). Later, temperatures dropped again during two periods in February: between the 4th and 12th (min. -11.1°C to -1.0°C; max. +1.8°C to +5.4°C), and between the 17th and 24th (min. -13.3°C to -2.7°C; max. -1.1°C to +3.3°C). In the first and second decades of March the weather was unusually warm (max. +7.0°C to +27.1°C). During this period, however, only individual honey bee specimens were observed near the nest, with the last sighting recorded on March 11. After this date, the nest appeared to be no longer inhabited.

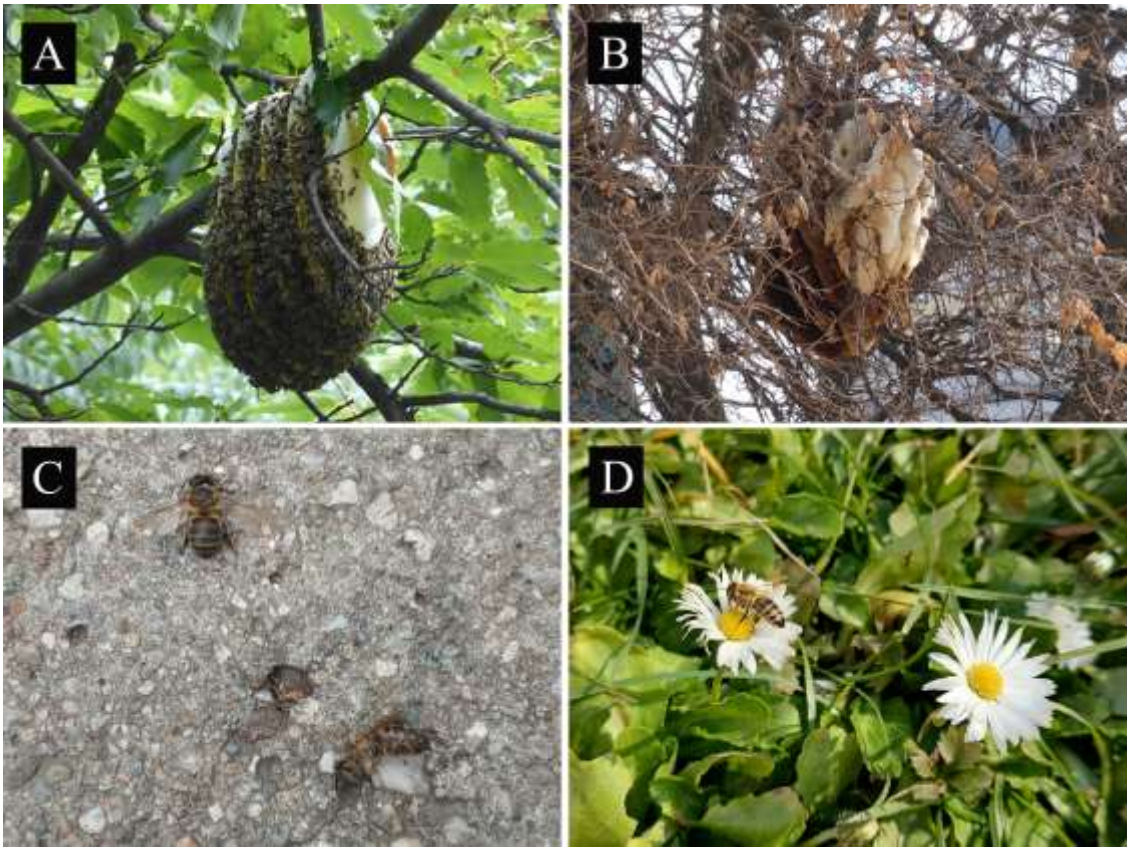

Fig. 1. A. The nest on *C. sativa* during the summer of 2018; B. The fifth nest during January 2025; C. Distressed workers from the second nest during the winter of 2019-2020; D. Worker bee from the fifth nest feeding on a daisy flower (*Bellis* sp.) in early February 2025.

Discussion

The open nesting in genus *Apis* is considered as a trait of an ancestral behavior (Michener 2007), a statement that is independently and strongly supported by a phylogenetic analysis of the honey bee behavioral evolution (Raffiudin & Crozier 2007). Thus, building up of exposed nests by cavity nesting honey bees actually represents a form of reappeared atavistic activity, probably caused by the reduction of nest sites available in a particular area. This unfavorable situation emerges mostly as a result of habitat fragmentation and destruction of old trees with cavities that can successfully host the free-living colonies of honey bees (Vaudo *et al.* 2012; Niklasson *et al.* 2024). Therefore, although the honey bee can successfully nest in alternative sites such as cliffs and man-made structures, the availability of hollow trees, especially in temperate regions, is of great importance. In highly urbanized areas, where old trees are rare or intentionally removed, the occurrence of atypical open nests is more likely to increase. Recently, the presence of such nests in Sofia has grown, possibly as a result of anthropogenic environmental disturbances.

Previous studies on the overwintering of exposed *A. mellifera* nests have been scarce, with reports of colony failure or only short-term survival in regions with cold winters (Bouvier 1906; Daly 1990). The observations in our study support these findings. However, further investigations are needed to identify the key factors driving colony loss in open nests.

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