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Hidden in the Honeycomb: Diversity and Phylogeny of Bee Parasites

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Bees (Hymenoptera: Anthophila: Apoidea) are taxonomically and ecologically diverse pollinators dependent on pollen and nectar. While their ecological and economic significance is well-documented, research on their parasites has primarily focused on honey bees and bumblebees. The understudied wild bees may harbor a broader and more complex range of parasites and pathogens than managed honey bees.

Microsporidians, obligate parasites of animals and protists, pose a significant threat to honey bees and bumblebees. Monoxenous trypanosomatids colonize arthropod digestive tracts and were considered benign until recent studies suggested their negative impact on pollinator health. Bee amoebae infect Malpighian tubules and gut, causing organ damage that can lead to host death. Despite these effects, the diversity of these parasite groups in bees remains largely unexplored as is the possible parasite spillover between commercial and wild bees. Expanding research beyond domesticated bees and identifying new parasitic species is essential for understanding emerging threats contributing to pollinator declines.

Tissue metabarcoding, a powerful tool for uncovering hidden parasite diversity, has yet to be applied to bee-associated parasites. We employed metabarcoding and high-throughput sequencing (Illumina and Oxford Nanopore Technologies) to detect microsporidian, trypanosomatid, and amoebae diversity in honey bee and wild bee tissues and products in the Czech Republic.

Metabarcoding analyses of bee samples revealed a high parasite prevalence. Sequencing identified multiple microsporidian OTUs clustering within the Nosematidae clade, including Nosema ceranae and potential new microsporidian species in honey bees. Trypanosomatid-specific screening detected Crithidia mellificae, Lotmaria passim, and novel OTUs. Amoebae-specific screening revealed Malpigamoeba and Entamoeba species as distinct insect-infecting lineages. Our findings highlight the potential for bees to harbor a previously unrecognized diversity of parasites. Light and electron microscopy will be employed to confirm infections and provide additional insights into the parasite load and pathogenicity.

Our research underscores the need for further investigation into parasite diversity, transmission dynamics, and their impact on pollinator health. This is critical for maintaining ecological stability and agricultural sustainability, as healthy pollinators are essential for crop production. The outcome of our research highlights the importance for beekeepers to monitor for emerging parasites and adopt management strategies to protect their colonies.