

Tracing back the origin of bees: Phylogenomic analysis of Apoidea and its implications

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Apoidea wasps and bees (Apoidea) are an ecologically and morphologically diverse group of Hymenoptera, with some species of bees having evolved eusocial societies. Major problems for our understanding of the evolutionary history of Apoidea have been the difficulty to trace the phylogenetic origin and to reliably estimate the geological age of bees. To address these issues, we compiled a comprehensive phylogenomic dataset by simultaneously analyzing target DNA enrichment and transcriptomic sequence data, comprising 195 single-copy protein-coding genes and covering all major lineages of apoidea wasps and bee families.

The inferred results confirm the polyphyletic status of the former family “Crabronidae”, which comprises nine major monophyletic lineages. We found the former subfamily Pemphredoninae to be polyphyletic, comprising three distantly related clades. One of them, Ammoplanina, constituted the sister group of bees in all our analyses. Species of Ammoplanidae are known to hunt thrips, of which some aggregate on flowers and feed on pollen. The specific biology of Ammoplanidae as predators indicates how the transition from a predatory to pollen-collecting life style could have taken place in the evolution of bees. We estimate the origin of bees to be in the Early Cretaceous (ca. 128 million years ago), a time period during which angiosperms rapidly radiated.

Finally, our phylogenetic analyses revealed that within the Apoidea, (eu)social societies evolved exclusively in a single clade that comprises pemphredonine and philanthine wasps as well as bees. This insight plus the finding that (eu)social societies evolved exclusively in a single subordinated lineage of apoidea wasps provides new perspectives for future comparative studies.

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Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Mitteilungen des Entomologischen Vereins Stuttgart](#)

Jahr/Year: 2018

Band/Volume: [53 2018](#)

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