

# Diverse Lower Eocene Arthropods in Indian Amber from an Early Tropical Broadleaf Rainforest

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## Introduction

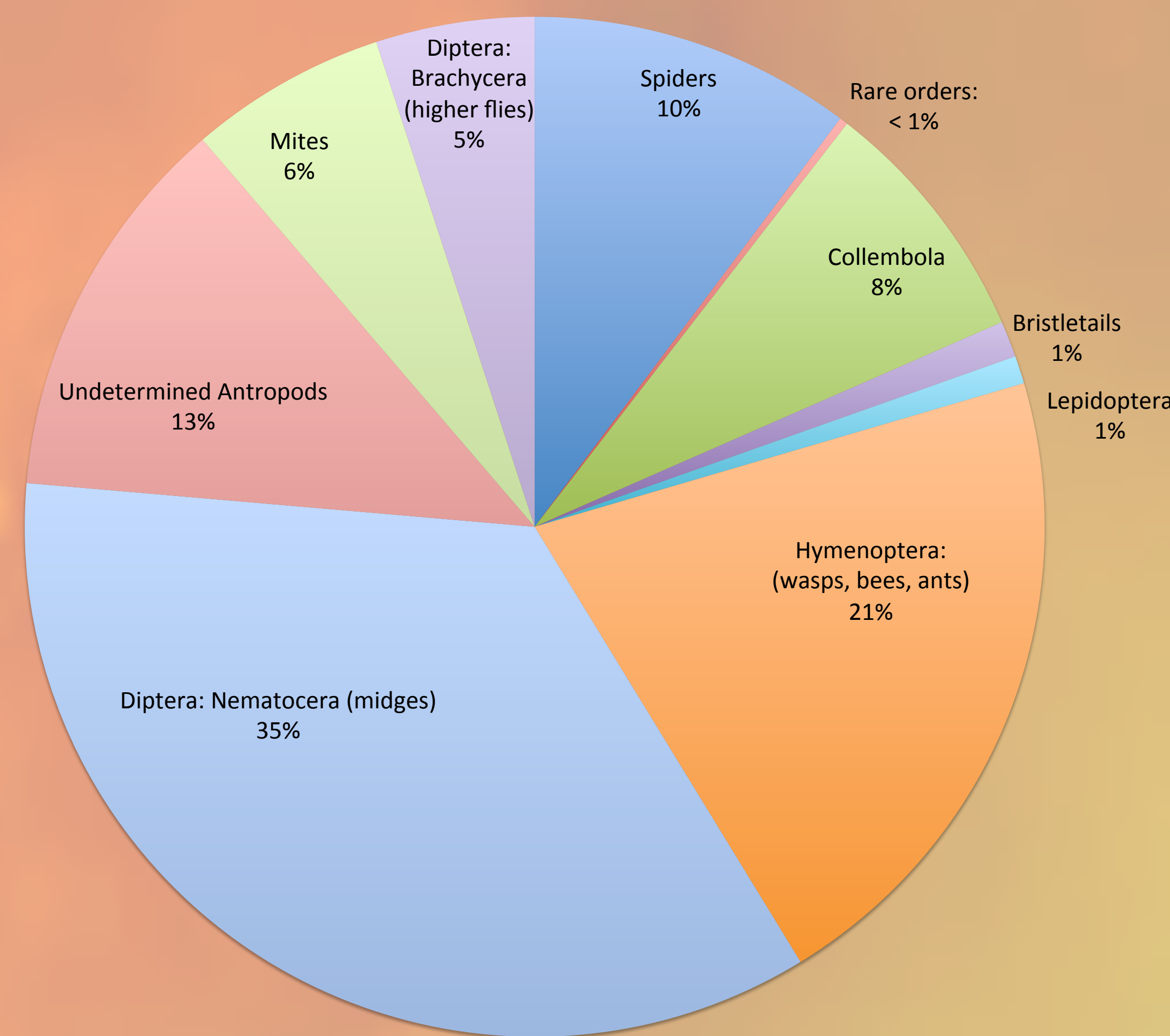
Fossil arthropods were discovered in amber from a Lower Eocene deposit in Western India. These highly diverse animals lived in one of the earliest tropical broadleaf rainforests. Ecosystems based on flowering plants (angiosperms) first became dominant in the Late Cretaceous through the Paleogene, and the social insects – termites, ants and bees – became critically important members of the biota and evolved with it. We looked at: (1) paleogeography: the movement of the Indian subcontinent northward and its role in the dispersal of Asian and Gondwanan faunas; (2) the paleoclimate (particularly the hyper-tropical conditions that existed while the rainforest was on the equator); and (3) competition and evolution within and across faunas. The 52 million-year-old amber recovered from two mines, Vastan and Tadkeshwar, contains over 1400 arthropod inclusions belonging to 24 orders and over a hundred families.

## Material/ Methods

First, raw amber was collected in two lignite mines in Gujarat, India. The amber was screened for inclusions using (1) a stereoscopic microscope with fiber-optics, (2) a variable-speed Buehler Ecomet 3 Grinder/Polisher, and (3) a diamond rock-cutting saw (to trim pieces and to cut larger pieces into smaller sections). Amber was polished using successively finer wet/dry polishing papers – 320, 600, 800 and 1200 grit. After initial preparation, the specimens were embedded in a high-grade conservation epoxy (EpoTek 301-2), repolished, and finally photographed / cataloged for later study. A few specimens were extracted using orange oil to dissolve the amber, and a Scanning Electron Microscope (SEM) was used to image the extracted insects.

## Results

All Arthropod Groups in Lower Eocene  
Indian Amber from Two Mines (2009-2013)



## Discussion

Amber preserves organisms three dimensionally and with great fidelity, so that even submicroscopic details of characters can be seen. Fossil insects in amber can thus be studied the way extant (contemporary) insects are, and comparisons can be made both with the modern fauna, and with other insects in various deposits of amber (older and younger). After analyzing the data, it is clear that eusocial insects are a significant component of the arthropods found in this Lower Eocene amber. The arthropod fauna is very diverse, probably due to the hyper-tropical conditions of the ancient rainforest, which also appear to have encouraged the further development of eusocial behavior at this time in select groups.

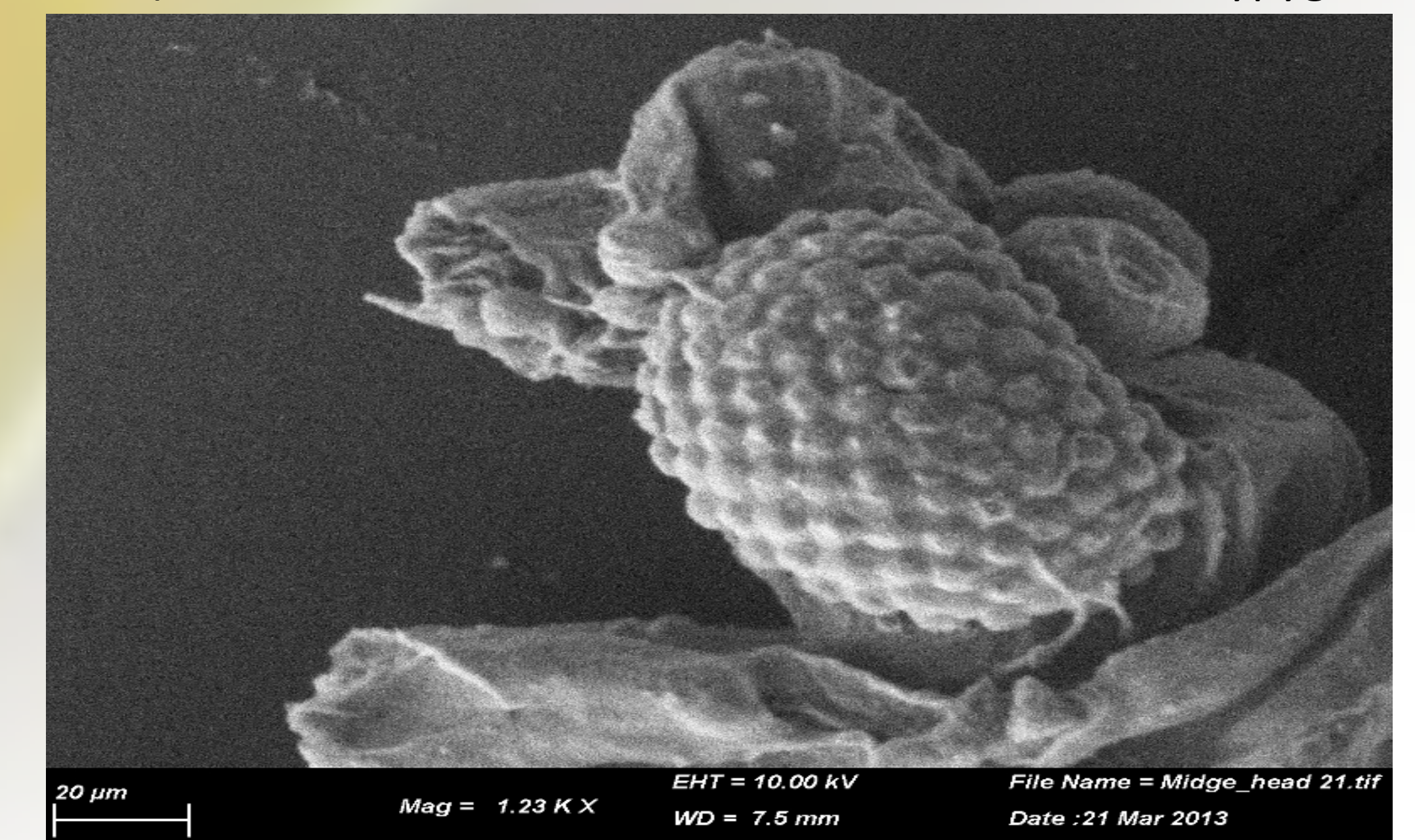
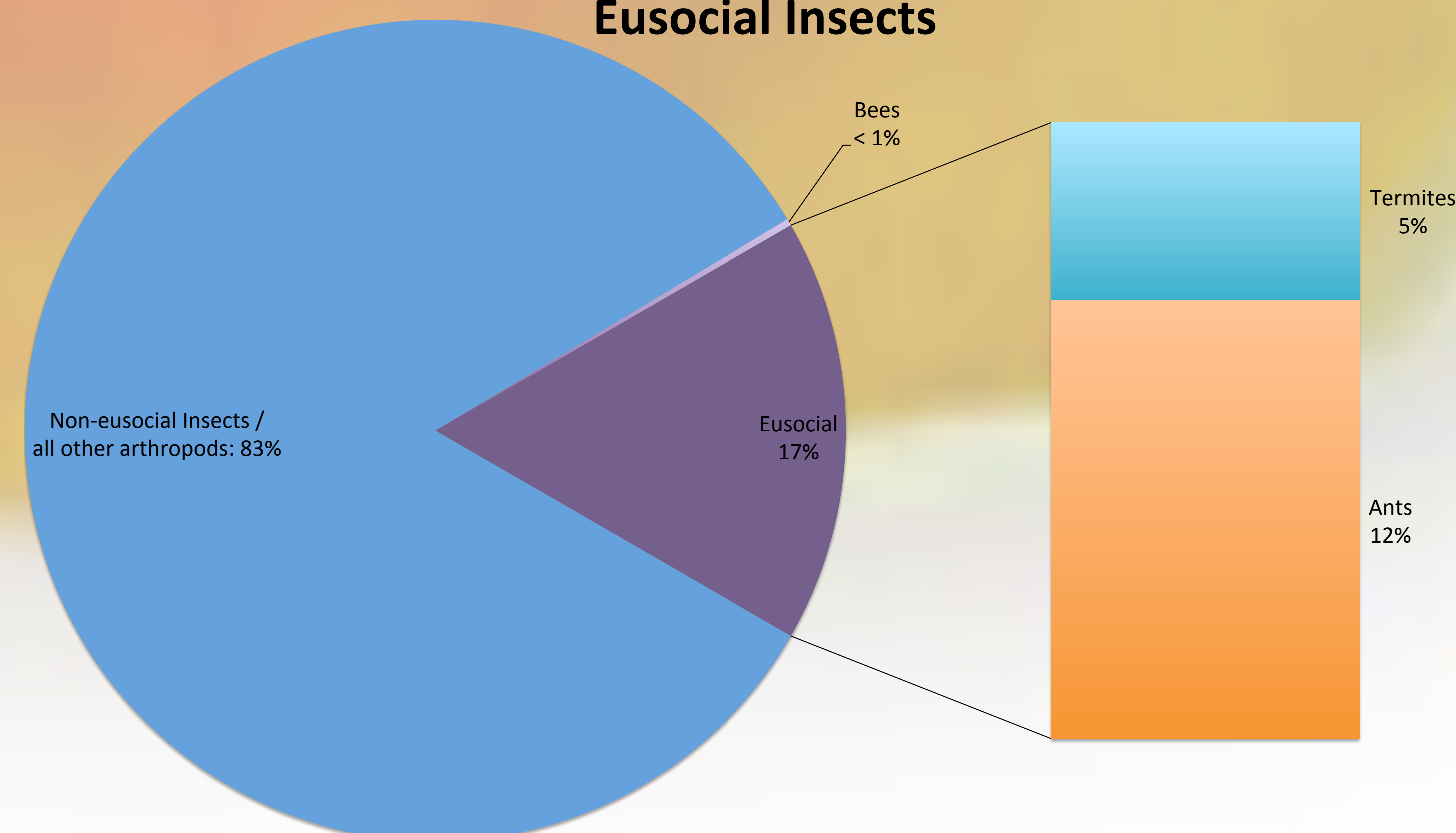


Male spider

Ants

Amblypygid

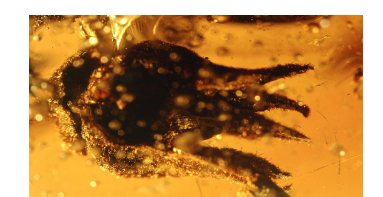
## Eusocial Insects



Head of an insect under the Electron Scanning Microscope

## Acknowledgements

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stereoscopic microscope



Buehler Ecomet 3  
Grinder/Polisher



diamond-bladed  
rock-cutting saw