

SPECIAL FEATURE: DEFENSIVE SYMBIOSIS

Ants, bees, and wasps team up with microbial symbionts for defence

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Insects encounter a multitude of natural enemies, ranging from vertebrate and invertebrate predators to parasites and microbial pathogens. Many species in the insect order Hymenoptera (the ants, bees, and wasps) are especially vulnerable to pathogen infection, because they – like humans – live in large societies that allow detrimental fungi, bacteria and viruses to spread, and/or because they develop in underground nests, surrounded by a plethora of potentially dangerous soil microbes. To counteract these threats, insects have evolved mechanical, chemical and behavioural defences as well as a complex immune system. In addition to the host's own defences, however, some Hymenoptera team up with protective microbial helpers.

As more and more insect-bacteria symbioses are being discovered, it becomes increasingly clear that such defensive alliances constitute an integral part of insect ecology. In leaf-cutter ants and beewolf wasps, symbiotic bacteria produce mixtures of antibiotics that protect the food resources or the developing offspring against pathogenic fungi. Bumblebees cultivate intestinal microbes that fend off a parasitic protozoan, a close relative to the causative agent of human sleeping sickness. And parasitic wasps that develop in living caterpillars team up with symbiotic viruses to protect themselves against the caterpillar's immune response. Thus, protective symbioses can be important in a variety of different contexts, and the study of such interactions not only yields insights into an as yet little-understood aspect of insect biology, but may also provide new ideas for sustainable control of increasingly resistant human pathogens. After all, with the help of their symbionts, some insects have successfully combated pathogenic microbes for millions of years.



Female beewolf wasp (Philanthus coronatus) with prey. Beewolves team up with symbiotic bacteria that produce antibiotics and thereby protect the wasp offspring against detrimental microbes. Photo: M. Kaltenpoth.