Pseudoscorpions collected from colonies of the Eastern honey bee in India have been photographed eating arthropod enemies of honey bees, including varroa. Honey bees have not been attacked. Recently pseudoscorpions have been found in colonies of the Western honey bee in India. Much more research is needed, but available evidence strongly suggests that pseudoscorpions have the potential to be restored to colonies of Western honey bees for non-chemical, self-sustaining biological control of many arthropod enemies of the bees. Beehives may need to be modified to provide breeding sites for pseudoscorpions.

Since the varroa mite (*Varroa destructor*) transferred from the Eastern honey bee (*Apis cerana*) to the Western or European honey bee (*A. mellifera*) it has decimated colonies without any of the constraints usually imposed upon parasites by enemies of their own. The reason given for the survival of colonies of the Eastern honey bee when infected with varroa, is that only the drone brood is attacked, leaving the worker brood to develop normally. However, Indian colonies of the Eastern honey bee, often harbor pseudoscorpions – eight-legged arthropods with a body up to about 8 mm long, but which have a pair of comparatively huge pincers projecting well in front. The ‘pseudo’ part of the name means ‘false’, and the name false-scorpion means that although the creatures look very much like real scorpions, they are not very closely related at all. Apart from their small size, a major and very obvious difference compared to real scorpions is the complete lack of a stinging tail. In addition, there are a large number of smaller differences which altogether mean that pseudoscorpions make a well-defined group of about 3,000 species which are distributed world-wide.

The great majority of pseudoscorpions live in soil, plant litter and under loose tree bark, where they prey on small arthropods...
such as caterpillars and other small insect larvae, and insect eggs, and springtails and mites. However, about a dozen species have been reported living in beehives, often mingling with the bees, and some of them clinging on to bees swarming to new nest sites. A recent review by Donovan and Paul (2005) found that historically one species occurred in Europe, 6 in Africa, and 5 in India, but the last report for the European pseudoscorpion in beehives was nearly 60 years ago. Donovan and Paul (2005) surmised that the pseudoscorpion was lost to European beehives because of a lack of small gaps and cracks as refuges and breeding sites in modern clean-sawn hives, and that this has resulted in a lack of knowledge of pseudoscorpions in modern western apiculture.

For the Americas, the only records we are aware of for pseudoscorpions in beehives are one record of 2 females of the South African beehive pseudoscorpion *Ellingsenius sculpturatus*, which was reported from Claremont, California, but Chamberlin (1932) believed this record to be erroneous. Also, pseudoscorpions were seen in each hive in an apiary in Southern Belize in Central America, with over 200 pseudoscorpions in one colony. Bees were grabbed and their insides seemed to be sucked out (Caron 1992). The pseudoscorpions were not identified, but pseudoscorpions are known from colonies of meliponine bees which are native to the Americas, so they probably originated from those colonies. Wherever they came from, they are not the type of pseudoscorpion that lives among honey bees in the Old World where bees are not preyed upon.

Beginning nearly 60 years ago, several Indian researchers began reporting the presence of pseudoscorpions in colonies of the Eastern honey bee, and in an unpublished Ph.D. thesis, Sudarsanam (1989) reported that the pseudoscorpion *Ellingsenius indicus* ate varroa, the mites *Euvarroa* sp. and *Neocypholeaels indicia*, the termite *Termes obesus*, booklice *Liposcelis* sp., and larvae of the wax moths *Gallaria mellonella* and *Achroia grisella*. Feeding by pseudoscorpions was described and some photographs were included, as was a suggestion that pseudoscorpions may have potential as biological control agents for some enemies of bees. Also, the detailed studies of feeding by this pseudoscorpion found that it did not harm adult or larval bees. Further, hives harboring the pseudoscorpion had minimal infestations of varroa, and no wax moth larvae at all. Much the same information was published by Sudarsanam and Murthy (1990).

To further explore the feeding of pseudoscorpions on pests of honey bees, hives of the Eastern honey bee were inspected by Dr. Flora Paul near Ootacamund in the Nilgiri mountains in southwestern India over 10 days in late April this year. Pseudoscorpions and enemies of honey bees were collected from combs, and from debris in and around the bee colonies, and were placed together in small containers. Interactions were photographed with an Olympus SP-500UZ, 6.0 megapixels, 10x optical zoom.

Pseudoscorpions attacked varroa at once, and varroa were fed upon and killed (Figs 1-2). Interestingly, Sudarsanam (1989) recorded feeding times of 20-40 minutes, but at Ootacamund pseudoscorpions took as little as 4 seconds from seizing a varroa to discarding it, dead. When pseudoscorpions were presented with wax moth larvae, from one to as many as eight would feed upon them (Figs 3-5), and eventually all that was left was a deflated larval skin. A larva of an unidentified beetle was also attacked (Fig 6) and a termite was avidly fed upon by two pseudoscorpions (Fig 7). When first encountering a prey, a pseudoscorpion seized it with its long pincers (pedipalps). The claws are equipped with poison glands which inject poison into the victim, and once the struggling ceases the victim is transferred to the mouth area, where sharp
mouthparts called chelicerae pierce the victim. A digesting fluid is then injected into the prey, and once the internal structures have become liquefied, the prey is sucked dry.

Colonies of the Western honey bee were first taken to India about 40 years ago, and many now harbor varroa which transferred from the Eastern honey bee. In late 2005 Dr. Flora Paul examined colonies of the Western honey bee in Chittarikal, Kerala State, South India, and found pseudoscorpions living in the hives. According to local beekeepers, most of their colonies of Western honey bees harbor pseudoscorpions. Silken tunnels made by pseudoscorpions were seen, but whether the pseudoscorpions were breeding is still uncertain. The fascinating aspect of this discovery is that pseudoscorpions have made the same “species jump” from the Eastern honey bee as did varroa.

In May this year pseudoscorpions collected from colonies of the Eastern honey bee were introduced to nucleus colonies of the Western honey bee in Chennai, and recently several have begun spinning silken tunnels, which suggests that breeding may be imminent. If pseudoscorpions can breed, then Western honey bees in India may have gained permanent ‘in house’ protection from imminent. If pseudoscorpions can breed, then Western honey bees may become liquefied, the prey is sucked dry.

We believe that there is more than sufficient evidence to suggest that where they don’t occur, pseudoscorpions could be introduced to colonies of Western honey bees as biological control agents for not only varroa, but also other enemies such as acarine mites, small hive beetle and wax moths. However with a dozen species known, much research will be needed to determine which species might be most effective. Also, perhaps beekeepers might need to be modified to provide nooks and crannies secure from bees as protected refuges and breeding sites. Interior surfaces of roofs, walls and floorboards could be scoured with saw cuts, and even a frame could be replaced with a specially-designed pseudoscorpion breeding frame. Such a frame would allow control of the numbers of pseudoscorpions and quick movement of pseudoscorpions among hives by beekeepers.

The exploitation of pseudoscorpions for biological control of many arthropod pests of honey bees holds out the hope of a cheap, non-chemical and self-replicating means of managing Western honey bees, and also without the possibility of any of the pests developing resistance, because pseudoscorpions will be selected naturally to maintain pace with any changes in their prey. In fact, restoring pseudoscorpions to our Western bee colonies would once again provide our bees with the natural protectors against their enemies with which they co-evolved.

References


