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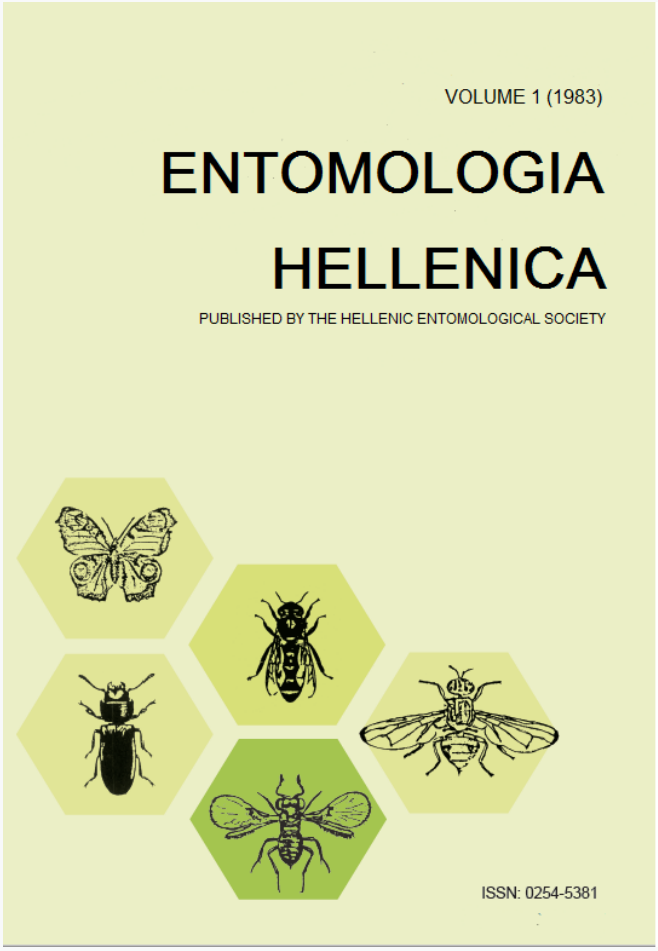

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Harmful Mesostigmatic Mites Ectoparasitic to Honey Bees[1]

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ABSTRACT

Mites of the order Mesostigmata are among the frequent and dominant components of the beehive acarofauna. Several of them belonging to the families: Varroidae, Laelapidae and Ameroseiidae are important parasites or capably harmful species to the honey bee. Among them, *V. jacobsoni* and *Neocypholaelaps favus* are widespread in Greece, while the existence of a third species *Mellitiphis alvearius* is quite probable. A brief treatise of the harmful mesostigmatic mites found in the beehives all over the world is given. Detailed drawings of all stages of *V. jacobsoni* are given, of which drawings the immature stages appear for the first time.

Introduction

A large number of mites belonging to the orders Mesostigmata, Prostigmata, Astigmata and Cryptostigmata have been found in association with the beehive environment by several workers in various countries. For example, Chmielewski (1971, 1975) in Polland, Grobov (1975) in USSR, Haragsim et al. (1978) in CSR, Pelekassis and Emmanouel (in press) in Greece. Mesostigmata form an important component of that fauna both quantitatively and qualitatively. Thus, from a total number of about 160 known bee-mite species more than 60 belong to that group and several of them are important parasites of the honeybees.

Most of the species are found on the beehive debris but they can be also found on the honeybee's brood, pollen, honey and empty cells. Their association with the honey bees may rank from commensalism to true parasitism. Although it seems that the great majority of Mesostigmatic species found in beehives are predaceous, their exact feeding habits, biology and role in the beehive community has not been sufficiently studied. Available data are confined only to parasitic or capably harmful species which belong to the families Varroidae, Ameroseiidae and Laelapidae of the suborder Gamasina.

[1] Received for publication June 18, 1982.

Results and Discussion

FAMILY VARROIDAE

Delfinado and Baker (1974) utilized Oudemans description for the genus *Varroa* as the basis for the definition of the new family Varroidae. That genus was originally placed by Oudemans in Laelapinae and later (Baker and Wharton 1952) in Hypoaspidinae of Laelapidae. Descriptive features mentioned for the new family (Varroidae) by Delfinado and Baker (1974) are the complete lack of the fixed digit of chelicerae, the number and arrangement of hypostomatic setae and the reduction of palp and leg chaetotaxies. This family contains only two species, namely: *Varroa jacobsoni* Oudemans, a parasite of *Apis mellifera* and *A. cerana* and *Euvarroa sinhai* Delfinado and Baker, a parasite of *Apis florea*.

Varroa jacobsoni. This species can be considered as a highly specialized laelapid-type mite. It is an obligatory ectoparasitic species feeding on the adult and brood of the honey bee and very well adapted to the life of the bee-colony. That adaptation linked to the parasitic way of life is expressed by certain morphologi-

cal and biological features in the female, i.e. the dorsoventrally depressed body (which helps it to move between narrow spaces), the rich idiosomal setation (which prevents the mite from adhering to the cell surfaces and to the bee brood), the strong sclerotized brown coloured body, the shape and structure of the chelicerae and corniculi. Further adaptations are also the presence of free mobile portion of peritremal tube which enables the mite to regulate its respiration under different concentrations of 0_2, the powerful legs and pulvilli of the tarsi which help for the quick movement and the fixation on the bees body, the absence of anal valves which permits the excretion in narrow spaces, the presence of numerous sensillae on the first pair of legs which work as chemoreceptors and olfactory organs, and the periodical sucking of haemolymph in small amounts which results in no swelling of the mite's idiosoma.

The process of metamorphosis of the mite occurs only inside the brood-cell and is synchronized with the development of the bee larva to adult stage. The male lives and mates with the female only inside the cell too. The female enters the cell at a late larval instar of the bee, feeds for a certain period of time and starts laying a number of eggs. Due to discontinuous feeding there is no gonotrophic uniformity and the eggs mature and are laid one by one (Smirnov 1978). The first immature stage appearing from the egg is the protonymph, the larva being developed inside the egg. A thorough study of the external morphology of all developmental stages of this mite have been made by Pelekassis et al. (1979). Drawings of the above stages are presented here for the first time (Figs. 1-6).

Parasitism by *V. jacobsoni* leads to a serious disease of honey bees known in Greece as "Varroiki Acariasis". Both the brood and the adult bees are affected. In infested colonies, deformed pupae and young bees can be seen, as well as dead bees, around the beehive entrance while larvae on the bottom board can also be found. The rate of the colony development declines and most often loss of the whole colony occurs. New data on the pathogenic effect of the Varroa mite have shown that the ammount of haemolymph and the total protein content and its fractions is reduced in the infested adult bees and pupae, which results in less resistance to various diseases. In addition, this parasite is able to carry the pathogenic agents of A.F.B., haffniosis, virus paralysis and Nosema disease. Combined infestations of Varroa and Nosema or A.F.B. will lead to a quick death of the colony (Smirnov 1978).

To control Varroa disease is not an easy task and requires complex measures to be taken. The early diagnosis is advantageous and recommendable as well as the maintainance of the colony in good condition and vigor. The manipulation of the brood (mainly that of drones) and especially the proper treatment of the bee colonies with various acaricidal chemicals helps to prevent economic losses to the apiaries.

Euvarroa sinhai. The genus *Euvarroa* obviously differs from that of *Varroa* in having 13-14 small triangular denticles in the deutosternal groove (Delfinado and Baker 1974).

This moderately sized (about 900 μ long) with a broadly pear-shaped body species is a permanent ectoparasite of the dwarf honey bee (*Apis florea*). It was first described from specimens (females) collected in India in 1974. The association between the mite and *A. florea* was studied by Akratanakul (1976)[2] in Thailand. From that study it was shown that the life cycle of this mite is "bionomically similar" to that of *Varroa jacobsoni*. In both species the life cycle has a limited period of acceptable host form, i.e. the late larval instar and the pupal stage of the host. For this reason the mites have shortened their life cycle by reducing one of the developmental stages, that is the larval one.

By examining comparatively the structure of the chelicerae of *V. jacobsoni* and *E. sinhai* (Fig. 7) it is evident that all immature stages of both sexes and the adult females are able to pierce the host's cuticula. The fixed digit of the chelicerae is simple pointed and edentate in the protonymph, while it is pointed and dentate in the deutonymphs, except in male deutonymph of *V. jacobsoni* where the chelicerae are not pointed but blunt. The male chelicerae in both species, highly modified to sperm transfer organs, do not permit feeding. This phenomenon (male aphagia) is common in nidicolous mite species.

E. sinhai was found almost exclusively on drones (brood and adult) while it is known that *V. jacobsoni* prefers drone's brood too. This may be explained by the larger size of the drone and its cell, the longer immature life, the passive and drifting behaviour of the drone and

[2] Akratanakul, P. 1976. Biology and Systematics of Bee Mites of the Family Varroidae (Acari: Mesostigmata). M.Sc. Thesis, Oregon State University, 64 pp.

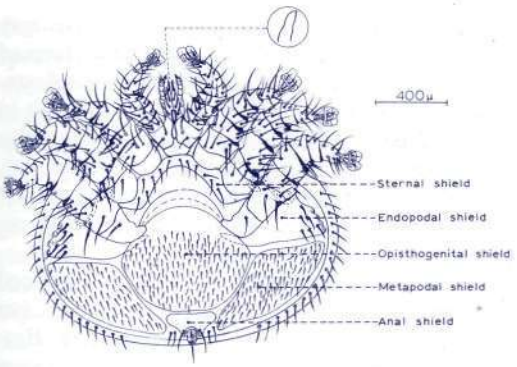

Fig.1. ♀

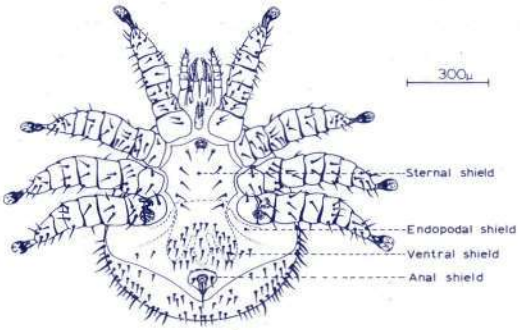

Fig.2. ♂

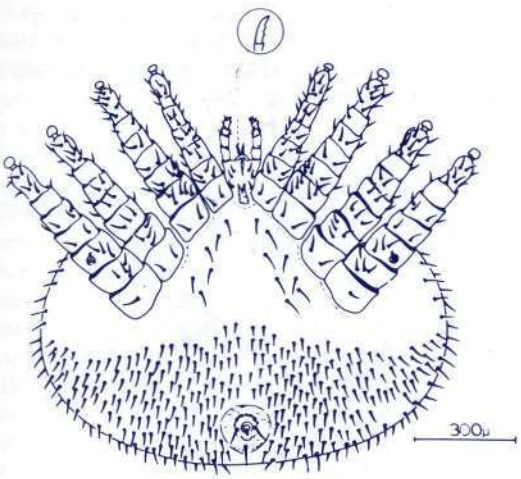

Fig.3. ♀ Deutonymph

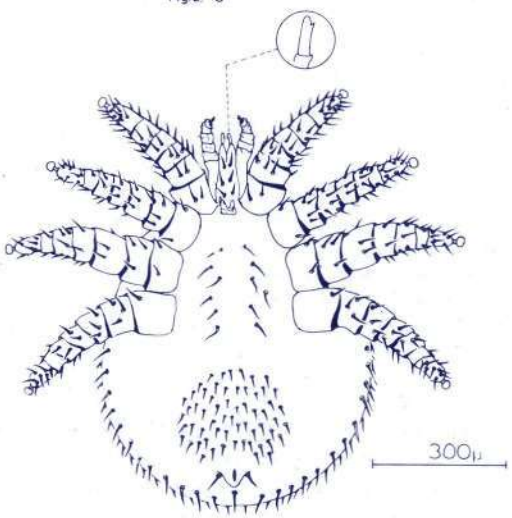

Fig.4. ♂ Deutonymph

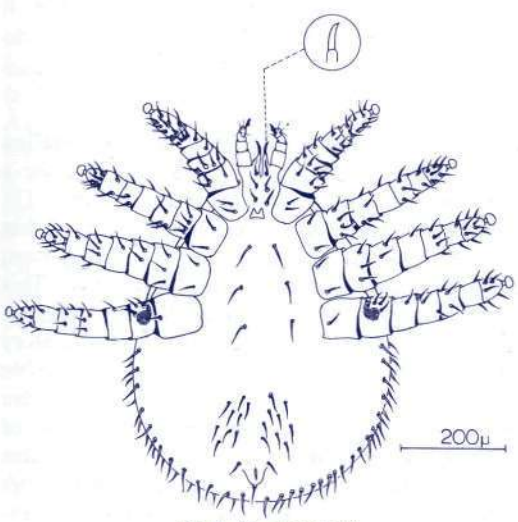

Fig.5. Protonymph

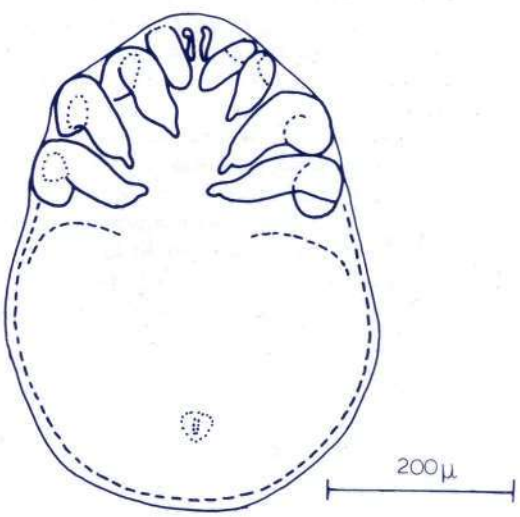

Fig. 6 Larva

FIGS. 1-6. Ventral aspect of female, male, deutonymph (female) deutonymph (male) protonymph and larva of *V. jacobsoni*.

possible biochemical and/or physiological interactions between the parasite and the host. This mite has not been found in the bee acarofauna of Greece.

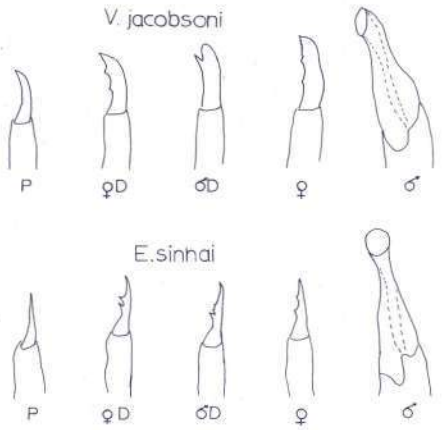

FIG. 7. Chelicerae of protonymph (P), deutonymph female (♀ D) deutonymph male (♂ D), female (♀) and male (♂) of *V. jacobsoni* and *E. sinhai* (after Akratanakul 1976) respectively.

FAMILY LAELAPIDAE

This family contains many members which are free living species or showing a range of association with insects, birds and mammals, as inhabitants of nests or scavengers and facultative or obligatory haematophagous ectoparasites of their hosts. Among the several species found in beehives, the most important and widespread are: *Tropilaelaps clareae* Delfinado and Baker 1961 and *Mellitiphis alvearius* (Berleze 1895).

Tropilaelaps clareae. This species was first described by Delfinado and Baker (1961) from specimens collected from *A. mellifera* in the Philippines. Its known distribution also includes Vietnam, India and Hong Kong. It is of a moderate size (about 900 μ long) fast moving, redish-brown and elongate oval mite. Its dorsal and ventral surfaces are covered with numerous strong setae. The chelicerae are large and strong, furnished with truncate weakly dentate tips without pilus dentilis. The peritremes are long, the metapodal shields small and elongate while the genital and anal shields are elongate and narrow.

Complete morphological and biological studies on that mite have not been made. The honey bees are affected throughout their development. Inside the cells, almost immobile deutonymphs of the parasite can be found, which later turn into imagos. The brood is adversely affected and the larvae or pupae may die or the emerged adults may be deformed (Laigo and Morse 1968). Simultaneous infestations of *T. clareae* with *V. jacobsoni* result in heavy losses. The natural host of that mite seems to be *Apis dorsata* and for control, besides treatment with various chemicals, the destruction of nearby *A. dorsata* nests is also recommended.

Mellitiphis alvearius (Fig. 8). This mite, placed by some authors in the family Eviphiidae, has long been known as a beehive inhabitant. Berleze (1895) was the first who found this species and he reported that its habitat was "plurima collegi exempla in alveribus in agro Neapolitans (Portici) super lignes interiores parietes, inter apereclerrime currentia et obvia semper vidi, apibus tamen non invosta".

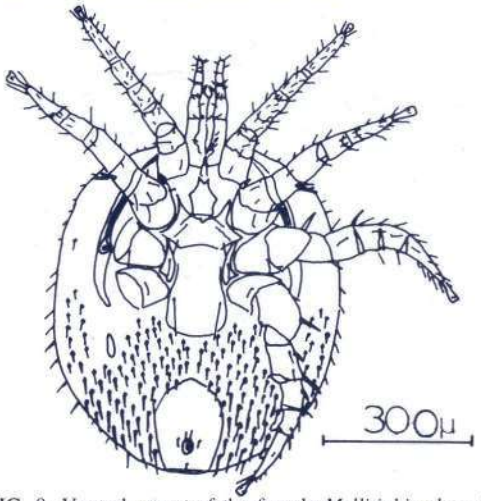

FIG. 8. Ventral aspect of the female *Mellitiphis alvearius* (after Vitzthum 1943).

Vitzthum (1930), who gave the first detailed description of the female, believed it to be a parasite of the honey bee. Evans and Till (1966) are referring to the description of that mite too. Outside Europe it is known only from New Zealand (Delfinado and Baker 1974). This mite is not known to occur in Greece, although two mounted specimens sent to our Laboratory from Gavrion, Naxos island, closely resemble it. Unfortunately the bad condition of the specimens doesn't permit the identification of the species with certainty. Although this species seems to be in close association with the bee colonies, we know almost nothing about its biology and its possible harmfulness to the bees.

FAMILY AMEROSEIIDAE

In that family, which unlike the majority of the

Gamasina contains mainly microphytophagous species, belongs the genus *Neocypholaelaps* which is closely associated with the honey bees. The genus is characterized by the conspicuously arranged chelicerae having the fixed digit with a transparent lobed pilus dentilis (Fig. 9). Evans (1963) in his revision on this genus states that the species belonging to it are probably pollen feeders. The weakly dentate chelicerae suggest a non-parasitic relationship between the mites and the bees. Apparently the mites are phoretic and hence they can be found on many pollinators. Five (5) species of that genus have been found on the honey bees in various parts of the world:

Neocypholaelaps ampullula (Berleze 1910). It is the first described species of the genus being collected from *A. cerana* and its hive in Java. It is also present in Malaysia.

Neocypholaelaps indica (Evans 1963). It was originally found on *A. indica* (=*cerana*) in Ceylon. Subsequently heavy infestation of this mite was observed in Southern India during the flowering of Eucalyptus by Percy and Kschirsagar (1964). Baker and Delfinado (1976) found this species in heavily infested *A. indica* from Nepal. Lo Kang-Chen and Chao Rou-Su (1975) found this species to be a most common mite associated with both *A. cerana* and *A. mellifera* in China. Percy and Kschirsagar (1964) and Delfinado and Baker (1976) observed 30-35 and 39 mites on a single bee, respectively.

N. novaehollandiae (Evans 1962). It was found on *A. mellifera* in New Zealand.

N. africanus (Evans 1963). It was first collected from the Hymenoptera *Trigon* (?) *tomentosa* in Angola. It was subsequently found on *A. mellifera* in Australia.

N. favus (Ishikawa 1968) (Fig. 10). This species was originally collected in Japan from *A. mellifera*. In Europe it is known only from Chechoslovakia and Greece. In Greece, this species was frequently found in breeding population on the honey bee body and to a lesser extent on the beehive floor debris (Pelekassis and Emmanouel in press).

Apart from the above mentioned mites, a large number of other Mesostigmatic species belonging to the families Parasitidae, Veigaiidae, Ameroseiidae, Ascidae, Macrochelidae, Laelapidae and Uropodidae can also be found in bee colonies.

Unfortunately, almost no work has been done to elucidate the exact role of those species in the biocoene of the beehive. Another aspect which should be treated with increased interest is the fact that several Mesostigmatic mites found in beehives are known to be vectors or act as reservoirs for important pathogens of medical and veterinary importance. For example, the species *Laelaps algericus* is known to be vector of the haemorrhagic fever, while the rickettsiae of Q-fever (*Coxiella burneti*) has been isolated from *Androlaelaps casalis*.

The contact of the honey bees with rats, mice, other small mammals and birds is possible in nature and thus external parasites of those animals may be found in the beehives too (Grobov 1975).

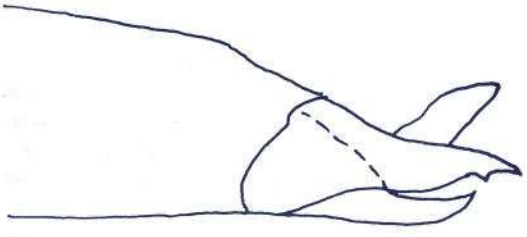

FIG. 9. *Neocypholaelaps favus* chelicera showing the lobed pilus dentilis.

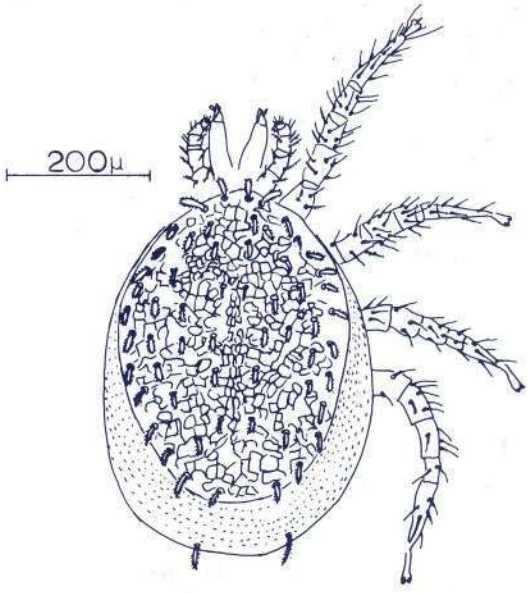

FIG. 10. Dorsal aspect of *Neocypholaelaps favus*.

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KEY WORDS: Mesostigmatic mites, Honey bee, *Varroa jacobsoni*, *Apis mellifera*, *Apis cerana*, *Apis florea*, *Euvarroa sinhai*, Varroiki Acariasis, *Tropilaelaps clareae*, *Apis dorsata*, *Mellitiphis alvearius*, *Neocypholaelaps ampulnula*, *N. indica N. novaehollandiae*, *N. africanus*. *N. favus*, *Laelaps algericus*, *Androlaelaps casalis*

POSTSCRIPT

When this publication was set in print, the following article came to our attention:
De Jong, D., R.A. Morse and G.C. Eickwort. 1982. Mite pests of honey bees. Ann. Rev. Entomol. 27: 229-252.

Βλαβερά Mesostigmata Ακαρεα Εκτοπαράσιτα στις Μέλισσες

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ΠΕΡΙΛΗΨΗ

Από ένα σύνολο 160 περίπου ακάρεων που είναι γνωστό ότι υπάρχουν στις κυψέλες, πάνω από 60 ανήκουν στην τάξη Mesostigmata. Ένας αριθμός από αυτά είναι επιβλαβή εκτοπαράσιτα των μελισσών, ανήκουν δε στις οικογένειες Varroidae, Laelapidae και Ameroseiidae.

Στην οικογένεια Varroidae είναι γνωστά δύο είδη, τα: *Varroa jacobsoni* και *Euvarroa sinhai*. Το πρώτο είδος υπάρχει και στη χώρα μας και προκαλεί την ασθένεια των μελισσών γνωστή ως Βαρροϊκή Ακαρίαση. Το άκαρι αυτό παρουσιάζει πλήθος μορφολογικών προσαρμογών που συνδέονται με την παρασιτική ζωή στα τέλεια και στο γόνο των μελισσών.

Λεπτομερής απεικόνιση των ατελών σταδίων του ακάρεος αυτού δίδεται για πρώτη φορά. Κρίνοντας από τη διαμόρφωση των χηληκεράτων, συμπεραίνεται ότι τόσο στο *V. jacobsoni* όσο και στο *E. sinhai* όλα τα κινητά στάδια εκτός του ακμαίου δύναται να παρασιτούν τόν γόνο των μελισσών.

Από την οικογένεια Laelapidae το επιβλαβές είδος *Tropilaelaps clareae* δεν ανευρέθη σε κανένα από τα εξετασθέντα δείγματα που προέρχονταν από διάφορες περιοχές της Ελλάδας, ενώ υπάρχουν ενδείξεις ότι το *Mellitiphis alvearius* πιθανόν υπάρχει στα Ελληνικά μελισσοσμήνη.

Από την οικογένεια Ameroseiidae το *Neocypholaelaps favus* φαίνεται ότι είναι διαδεδομένο στη χώρα μας. Το είδος τούτο χρησιμοποιεί την μέλισσα για την μεταφορά του επηρεάζοντας πιθανόν την ικανότητα πτήσεώς της.

Ο ρόλος γενικά πολλών από τα Mesostigmata ακάρεα των κυψελών δεν είναι επαρκώς γνωστός. Ιδιαίτερη σημασία έχει ακόμη το γεγονός ότι ένας αριθμός από τα ακάρεα αυτά είναι γνωστό ότι αποτελούν φορείς διαφόρων ιών και ρικκετσιών ιατρικής και κτηνιατρικής σημασίας.