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SIGNIFICANCE OF THE PROTECTION OF HONEY BEES FROM BRAULOSIS (WITH A SPECIAL FOCUS ON MONTENEGRO)

SUMMARY

The causative agent of bee braulosis is ectoparasite, bee louse *Braula coeca* Nitzsch (Insecta: Diptera: Braulidae). Harmful effects are caused by larvae of bee louse which are found in the honeycomb and its adult forms that parasitize on the honeybee *A. mellifera*. Adults bee louse live on the bee body, feeding on nectar, honey and royal jelly from the bee's mouth. A strong invasion can lead to the weakening of the entire bee's society and its death. Damage of honey and wax caused by larvae of bee louse leads to economic losses. There have been no systematic studies in this disease in Montenegro, nor has it been diagnosed in Montenegro so far. Legislation in Montenegro does not prescribe measures for the prevention, suppression and eradication of this disease. Regular diagnostics of this disease should be carried out in order to prevent and eradicate it in the event of its occurrence. In order to detect braulosis, it is necessary to have a regular control of the queens bee and frames with the honeycomb. Braulosis is most often suppressed by the use of thymol or camphor. Good beekeeping practice can significantly influence the prevention of disease.

Keywords: *Braula coeca*, braulosis, *Apis mellifera*, Montenegro

INTRODUCTION

Braulosis can cause five species of bee louses of genus *Braula*, family *Braulidae*: *Braula coeca* Nitzsch, *B. orientalis* Örösi-Pál, *B. schmitzi* Örösi-Pál, *B. kohli* Schmitz, *B. pretoriensis* Örösi-Pál and subspecies *B. coeca ssp. angulata*. *Braula coeca* Nitzsch, *B. orientalis* Örösi-Pál and *B. schmitzi* Örösi-Pál were found in the Palaearctic region, while *B. kohli* Schmitz, *B. pretoriensis* Örösi-Pál and the subspecies *B. coeca ssp. angulata* found in the Afrotropical region. *B. coeca ssp. angulata* was also established in Italy. The most important causative agent of honey bee braulosis is ectoparasite bee louse *Braula coeca* Nitzsch (Dobson 1999). *Braula coeca* is not real louse, but a fly without a wings. It is classified in the phylum *Arthropoda*, class *Insecta*, order *Diptera*, suborder *Brachycera*, superfamily *Ephydroidea*, family *Braulidae* and genus *Braula*. In the literature, it was first mentioned in 1740 by Réaumur and in 1818 was systematized by the German zoologist Christian Ludwig Nitzsch (Phillips, 1925). Bee louses of genus *Braulidae* were found in all parts of the world: Africa, Europe, Australia, North America, South Africa (Gemechu *et al.*, 2013,

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Notes: The author declare that they have no conflicts of interest. Authorship Form signed online.

Kulinčević et al., 1991, Kulinčević, 2006). With the advent of varoosis, braulosis has become less significant, because by treating the varoe also comes to the destruction of bee louse (Alfallah and Mirwa, 2018). There have been no systematic studies in this disease in Montenegro, nor has it been diagnosed in Montenegro so far (Bojanić Rašović, 2019a): However, it should be kept in mind that this disease can occur and spread due to non-implementation of measures of good beekeeping practice, uncontrolled trade and import of bees, bee honey, wax, beekeeping equipment, clothing, bee products, escaping and swarming bees etc. The disease spreads faster when the bee colonies are close together (Gemechu *et al.*, 2013, Bojanić Rašović, 2019a).

Harmful effects are caused by larvae of honey bee louse and its adult forms that parasitize on the honeybee *A. mellifera*. Adults live on the bee body, feeding on nectar, honey and royal jelly from the bee's mouth - which they previously irritate with their claws or during social feeding (*trophallaxis*) - when bee workers feed the queens bee or when they feed bee larvae. That's why they are most often found near the beehive's mouthpiece. Bee louse binds to the mouth of the bee and irritates its upper lip, causing the secretion of drops of honey, nectar or royal jelly with which bee louse feeds. It has not been determined that food of the bees louse are honey from the honeycomb cells, but only from the mouth of the bee. Bee louse are most often found on the queens bee, because they prefer to feed royal jelly, but can also be found on bee workers and drones (Figures 1 and 2). They are most commonly found between the thorax and the abdomen of the queen bee (Ćerimagić *et al.*, 1986, Lolin, 1991, Alfallah and Mirwa, 2018). Over 100 adult forms of bee louse can be found at the queen bee (Martin and Bayfield, 2014). The infested bees are weak, the queens bee are exhausted, they lose the ability to lay eggs and often die. The productivity of the bee colony is decreasing (Gidey *et al.*, 2012). A strong invasion can lead to the weakening of the entire bee's colony and its death. Especially sensitive are the weaker bees colonies that do not have enough food. Damage of the honey and wax caused by larvae activity of bee louse influences the appearance and market value of wax and honey, which causes significant economic losses (Gemechu *et al.*, 2013). The source of infection are sick bees - with adult parasites and honeycomb - infected with eggs and larvae of bee louse. Braulosis most effectively infects bees in late summer and autumn. Bee workers can not recognize and remove bee louse, because the composition of carbohydrate of cuticle of the bee louse is almost identical to the composition of carbohydrate cuticle of the bees (Martin and Bayfield, 2014).

Basic morphological and biological characteristics of the bee louse

Braula coeca

Bee louse has a rounded red-brown body (Figure 3); The length is usually 1.5 mm, and the width is 0.9 mm. The body is segmented and covered with small hairs. Torax and abdomen are not clearly separated; The mouthpiece is suited for sucking. They have atrophied eyes that are located just above the antennas; The

antennas are hidden in grooves. It has three pairs of legs whose segments are trapezoidal; The legs are short, firm and protrude above the body.



Fig. 1. Bee louse on the thorax bee worker

<http://beeaware.org.au/archive-pest/braula-fly/#ad-image-0>



Fig. 2. Bee louse is on the head of an adult bee

<https://bugguide.net/node/view/976856/bqref>



Fig.3. Bee louse (*Braula coeca*) - an adult

<https://www.insectimages.org/browse/detail.cfm?imgnum=5463594>

The last segment of the leg - tarsus is reminiscent of the comb and is important for the fixation and holding for the hairs on the body of bees (Alvarez López, 2016) (Figures 4 and 5).



Fig. 4. End of leg - tarsus of bee louse in the form of comb

<https://www.insectimages.org/browse/detail.cfm?imgnum=5463600>

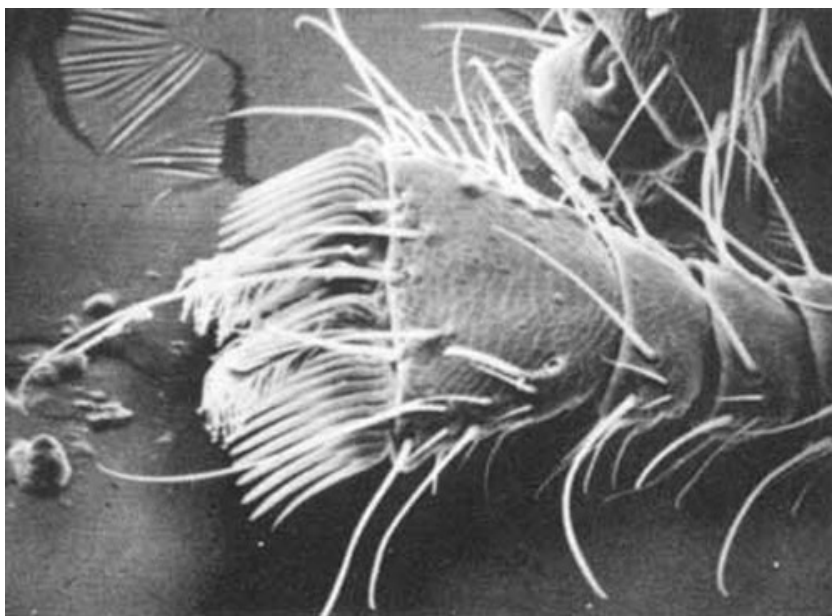


Fig 5. Dorsal side of the tarsus that bee louse holds for the hair on the bee body *A. mellifera* (SEM) http://entnemdept.ufl.edu/creatures/misc/bees/bee_louse.htm

Bee louse has no wings. As it moves quickly, it easily and quickly moves from bee on a bee, but also from one bee colony on the other - through despoilment, bee strangers, mergers of bee colonies, switching the queen bee etc. Due to its similarity to the outer appearance with the varoa, it should be kept in mind that adult bee louse has three pairs of legs, while the adult varoa has four pairs of legs; the adult braula have a rounded appearance while the varoa is flattened and oval-looking (Ćerimagić *et al.*, 1986, Kulinčević *et al.*, 1991) (Figure 6). However, since both parasites are very small, it is difficult to distinguish them with the naked eye, but a safe diagnosis should be made after observing the parasite under the microscope. The results of some authors have shown that only 28% of beekeepers distinguish bee louse from the varoa (Alfallah and Mirwa, 2018).

The mating of male and female bee louse is taking place in all parts of the bee hive, most often on the honeycomb frame or on the thorax of bees and lasts for a few minutes to an hour. Reproduction starts in the spring and ends in autumn. Adult mature bee louses lay eggs in all parts of the bee hive, but larvae develop only from eggs that are laid on the inside of the waxy coverlids of honeycomb cells with honey, immediately before closing cells (Gemechu *et al.*, 2013). Eggs are oval - ellipsoidal, white, 0.84 mm in length and 0.42 mm in width; have two lateral edges. From them, the translucent white larvae develop in 2-7 days - depending on the temperature. The larvae are vermiform, with a flattened rear and a pointed front end - with two buccal hooks. Bee louse larva can reach a length of 2.25 mm; since they are very small, it is difficult to spot

them with the naked eye (Tomašec, 1955, Lolin, 1991). Therefore, the suspicion of braulosis is most often based on the appearance of a damaged honeycomb.

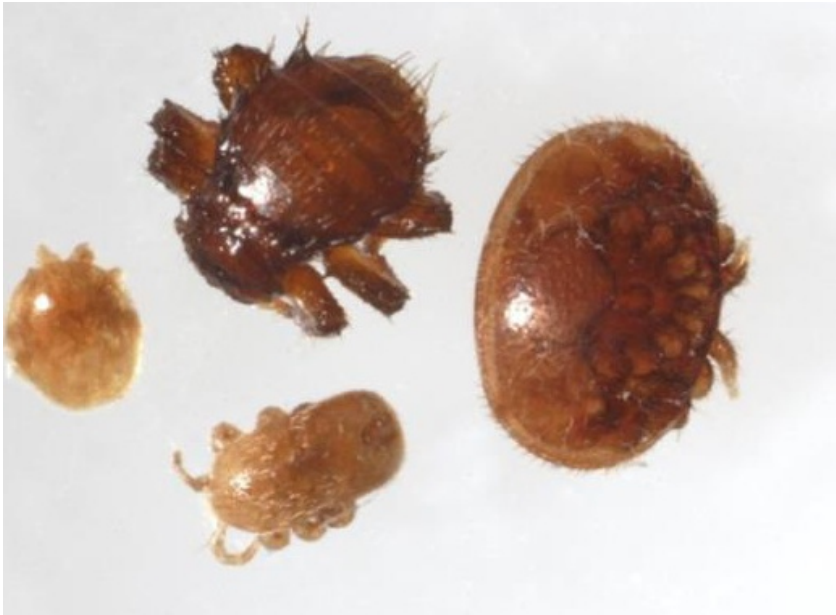


Fig. 6. *Braula coeca* - bee louse (up), *Varroa destructor* - mite (right), *Tropilaelaps spp.* - mite (down below the center), *Mellitiphis alvearius* - mite (left); dorsal - back side (OIE terrestrial Manual 2018)

After the larvae hatch from the eggs, they are drilled tunnels in the honeycomb cell and wherein the food is honey, wax and pollen. Making tunnels, before going to the stage of the puppet, they pass through three larval phases, which last for 7-11 days. On honeycomb it can be seen with naked eye whitish, branched tunnels, about 1 mm in diameter, made by bee louse larva. Tunnels that make larvae in wax give it a cracked and fragile look, which is the basic characteristic of bee louse presence in bee's colony.

On this path the larvae of bee louse damaged also larvae of bees and thus can lead to the complete destruction of the bee's brood. Due to the absorption of water vapor, the honey is of poorer quality, liquid, foamy and leaking from the honeycomb (Lolin, 1991). In the tunnel widening takes place the development of a larva in a puppet which has a flat body white to yellowish, with a length of 1.4-1.7 mm and a width of 0.5-0.75 mm. The puppet stage lasts 1-3 days after which the adult form develops. An adult bee louse must quickly find an adult bee for which it will be hooked and from which it will take food. Without the host - without feeding adult bee louse living longest 6h. The whole development of bee louse from egg to adult shape lasts 10-23 days, which depends on the temperature of the environment (Alvarez López, 2016). Bee louse can live without a bee brood, but it can not live without adult bees from which is taken honey, nectar

and royal jelly. Bee louses can survive the winter on adult bees feeding with honey and after the conditions of the environment become again favorable, the females lay eggs and the life cycle continues (Coffey, 2007).

Measures to combat braulosis

For the purpose of detecting braulosis, it is recommended regularly to control the queens bee and frames with the honeycombs. In order to determine the degree of infestation of bee colonies with bee louse a control treatment with tobacco smoke is carried out. To this end, a white oil-coated paper is placed on the bottom of bee hives. After inserting smoke, the paper is pulled out and bee louse count. If bee colonies has 5 bee louse per 100 bee workers infection is considered low, up to 15 of bee louse middle and over 15 bee louse - strong infection. The best time for suppression the bee louse is start of the summer season. Braulosis is most often suppressed using a thymol oil (Kulinčević, 2006). Mechanical methods consist of removing the infected honeycomb and bee brood and removing adult bee louses from the queens bee using a wooden stick coated with honey. If there are several parasites on the queen bee, they can be removed by a pointed stick dipped in honey; if more parasites are present, the queen bee should be placed in a cage and smoked with tobacco smoke. Dazed bee louses, after smoking fall from the queens bee. Also, bee louse from the queens bee and bee workers can be removed using camphor; The camphor is put on paper covering the entire bottom of bee hive, in the amount of 10-20 g. After releasing the camphor, bee louses are dazed and then fall on the paper. This procedure should be repeated several times (Plavska and Pavlovic, 2018). Freezing of wax lasting at least 48h will kill all life stages of bee louse. It is very important regularly to change the old honeycomb in the bee hive. When extracting honey, in a certain number are removed and bee louse larvae.

In some countries, such as Australia (where braulosis is present in Tasmania), beekeepers are obligated to report suspicion or presence of this parasite at their apiary to veterinary service. It is also prohibited to buy bee colonies that are infected with braulosis and quarantine is required - the isolation of bee colonies during the sale, until it is proven that the colony is free from the this parasite (beeaware.org.au).

Measures to combat braulosis in Montenegro

Legislation in Montenegro does not prescribe measures for the prevention, suppression and eradication of this disease (Bojanić Rašović, 2019a). Bearing in mind the potential opportunities for the emergence of braulosis in Montenegro, measures to combat it should be timely. Regular diagnosis of bees on this disease must be carried out in order to prevent and eradicate it in the event of its occurrence. Good beekeeping and good hygiene practice can significantly influence the prevention of disease (Bojanić Rašović 2018a, 2018b, 2018c, 2018d, 2018e, 2018f, 2018g, 2018h, 2019a, 2019b, 2019c, Bojanić Rašović *et al.* 2018a, 2018b).

CONCLUSION

A strong invasion of bee colonies with bee louse *Braula coeca* can lead to significant economic losses due to damage to honey and wax and the weakening and death of the whole bee colony. There have been no systematic trials in this disease in Montenegro, nor has it been diagnosed in Montenegro yet. Legislation in Montenegro does not prescribe measures for the prevention, suppression and eradication of this disease.

However, it should be kept in mind that this disease can occur and spread due to non-implementation of measures of good beekeeping practice. Regular diagnosis of this disease should be carried out in order to prevent and eradicate it in the event of its occurrence. It is necessary to ban the sale of bee companies that are infected with braulosis and is obliged to quarantine bee companies when buying.

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