

Predation of *Apiomerus pilipes* (Fabricius) (Hemiptera, Reduviidae, Harpactorinae, Apiomerini) over Meliponinae bees (Hymenoptera, Apidae), in the State of Amazonas, Brazil

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ABSTRACT. The present work shows the occurrence of an intense predatory activity on adults working Meliponinae bees (Hymenoptera, Apidae), by *Apiomerus pilipes* (Fabricius, 1787) (Hemiptera, Reduviidae, Harpactorinae, Apiomerini) at a meliponary in the Instituto Nacional de Pesquisas da Amazônia (INPA, Manaus), Amazonas State, Brazil.
KEY WORDS. Assassin bugs, natural enemies, stingless bees.

RESUMO. O presente trabalho registra a ocorrência de intensa atividade predatória de *Apiomerus pilipes* (Fabricius, 1787) (Hemiptera, Reduviidae, Harpactorini, Apiomerini) sobre operárias adultas de meliponíneos (Hymenoptera, Apidae), no meliponário experimental do Instituto Nacional de Pesquisas da Amazônia (INPA, Manaus), Estado do Amazonas, Brasil. O meliponário se encontra num fragmento de vegetação secundária no próprio INPA.
PALAVRAS CHAVE. Abelhas sem ferrão, inimigos naturais, percevejos predadores.

Sting bee keeping has been done since ancient times. Before Christ civilizations, mainly those from the Mediterranean Area, Asia Minor, Egypt, India and China have in some instances been known to establish rustic systems for maintaining a feasible exploitation of species of *Apis* Linnaeus, 1758 honeybees for well over 5400 years. However, prior to the sugar cane and European bee introduction by the newly arrived European settlers, there were no bees belonging to *Apis*, both in the American and Australian continents. Instead there was a large variety of species of bees possessing non-functional stings, such as the meliponines – considered to be good honey producing bees and hence were considered to be the main source for sugar at that time (ZOZAYA RUBIO & ESPINOSA MONTAÑO 2001, HOGUE 1993). The keeping of those bee species got to be known as meliponiculture, a term which was initially proposed by NOGUEIRA-NETO (1953).

In the past, the pre-Columbus people were the first to domesticate several species of stingless bees, which led to the development of this activity in at least four places in Central and South America (KERR *et al.* 2001b). These people learned how to develop several useful manners of taking advantage of this product, such as for the production of candles, waterproofing material to be used on ships, and medicines, which are still being used by country folks nowadays (HOGUE 1993).

Among the meso-american indigenous cultures, the

Mayans showed to possess a lot of useful and good quality information concerning the development of this subject in the Mexican southern and south-eastern areas, as well as other countries such as, Belize, Guatemala, Honduras, El Salvador, Nicaragua and a part of the southern Costa Rica (ZOZAYA RUBIO & ESPINOSA MONTAÑO 2001). *Melipona beecheii* Bennet, 1831 were the principal domesticated bee among the Mayan, in the peninsula Yucatan, in Mexico (revision in WEAVER & WEAVER 1981), being still used for the meliponiculture in this country. That bee, commonly known as “Xunan kab” and “colecab”, which mean “lady bee”, was held as a deity symbol in the Mayan religious culture (KERR *et al.* 2001b, ZOZAYA RUBIO & ESPINOSA MONTAÑO 2001, DE JONG 2001). Differently from other species such as *Melipona yucatanica* Camargo, Moure & Roubik, 1988, *Frieseomellita nigra* Cresson, 1878, *Trigona fulviventris* Guérin, 1835 and many others, *Melipona beecheii* Bennet, 1831 is the only one that was domesticated, and for that reason the Mayans believed that it should live together with their people (DE JONG 2001).

In the recent past the Kayapó indians have shown the greatest amount of good quality useful knowledge on meliponiculture among all Brazilian indigenous people (POSEY 1981, 1983a,b, POSEY & CAMARGO 1985, CAMARGO & POSEY 1990). However, for several reasons their knowledge is not being used by the present generations and thus will not be conveyed to the

future generations, which can lead to the complete loss of this valuable information by the Kayapó population. Nowadays, stingless bee keeping is still expressive among the country folk population. They are able to obtain several products like brews, seasonings and medicines from this activity (HOGUE 1993).

Several institutions and organizations have been doing diligent efforts to develop the meliponicultura in Brazil. In the North area, the Group of Bees Researches (GPA) of the Instituto Nacional de Pesquisas da Amazônia (INPA) through scientific and extension projects have beneficiary at least six different indigenous communities (Ticuna, Cocama, Mura, Saterê Mawé and Mayoruna) and four riverine communities. It is being possible to improve the quality of life of several families in the countryside of the State of Amazonas (KERR *et al.* 2001a) through the use of classic handling techniques allied to the model of modified rational box designed by OLIVEIRA & KERR (2000).

The stingless bees are common and conspicuous in the center of the Neotropical area, especially in low lands, with humid forests (HOGUE 1993). KERR (1998) affirms that in Brazil, those bees are responsible for 30 to 90% of the pollination of the native plants depending on the geographical place considered.

As any type of animal breeding, the meliponicultura also faces problems with natural enemies of the bees that can commit the state of the beehives taking, in some cases, even the destruction of the colony. The man can be considered the largest enemy of the native bees, for the destruction of the forests and consequently of their nests, placing them in extinction risk (KERR *et al.* 1994, 1999). Another examples of bees' natural enemies constantly mentioned in the literature are: the spiders, flies (Diptera, Phoridae), other species of pillage bees, ants, termites and even some lizards (KERR *et al.* 1996, NOGUEIRA-NETO 1970, 1997).

This work focuses in behaviour observations of predation of stingless bees for a natural enemy of the group of the apiomerines.

The Apiomerini species are exclusive of the New World, now represented by 11 genera, all with amazon species, while in the Neartic area there are only some species of *Apiomerus* Hahn, 1831 (FROESCHNER 1988, MALDONADO CAPRILES 1990, GIL-SANTANA *et al.* 2002, 2003).

Apiomerus species are diurnal predators that live on the plants and at least some of them use sticky material (resins) on the anterior tibia to hold prey (SCHUH & SLATER 1995).

All the species of Apiomerini have been revealed polyphagous, attacking plague insects as useful insects (GIL-SANTANA *et al.* 2003).

Apiomerus is composed now for about 110 species (SCHUH & SLATER 1995), and most of them were studied in the revision of COSTA LIMA *et al.* (1951). In that work, the authors felt emphasis to the aspect of the 7th urotergite of the female, including the presence of foliaceous appendages to that level and the size of it.

On *Apiomerus vexillarius* Champion, 1899, whose females possess big foliaceous appendages, very similar to *Apiomerus*

pilipes (Fabricius, 1787) (Fig. 2), CHAMPION (1899) wrote that: "The foliaceous appendages of the female of *A. vexillarius* plows bright sanguineous in life, and very conspicuous, looking like two red flags waving about, the insect runs over the surface of fallen timber in search of its prey".

Apiomerus pilipes is distributed by several countries of the Neotropical region (Venezuela, Colombia, French Guyana, Brazil). The adult specimens (Fig. 1) vary among 20 to 27 mm length, and they have a general pattered coloration varying from gray to dark colour, with clearer hemelytra (COSTA LIMA *et al.* 1951). The females have well developed hind abdominal foliaceous appendages which, as seen before, they present orange coloration when alive (*in vivo*) (Fig. 2), that sometimes is maintained in the conserved specimens.

The possible use of Apiomerini species for the biological control of plagues, and its controversies were summarized by GIL-SANTANA (2002) and by GIL-SANTANA *et al.* (2003).

It was observed that *Beharus cylindripes* (Fabricius, 1803) (Apiomerini) uses vegetable resins in its front legs for attraction and capture species of *Trigona* Jurine, 1807 bees, while *Manicocoris rufipes* (Fabricius, 1787) (Apiomerini) awaits for the arrival of the bees close to the entrance of the beehive, in order to capture them (ADIS 1984).

NOGUEIRA-NETO (1997) reported that in São Paulo and Goiás States, individuals of a relatively ordinary species of *Apiomerus* wait for the bees, mainly among the flowers, to attack them. However, sometimes they are seen in the meliponaries, killing the bees close to the entrance of the beehives, or near a wild nest (MARQUES *et al.* 2003).

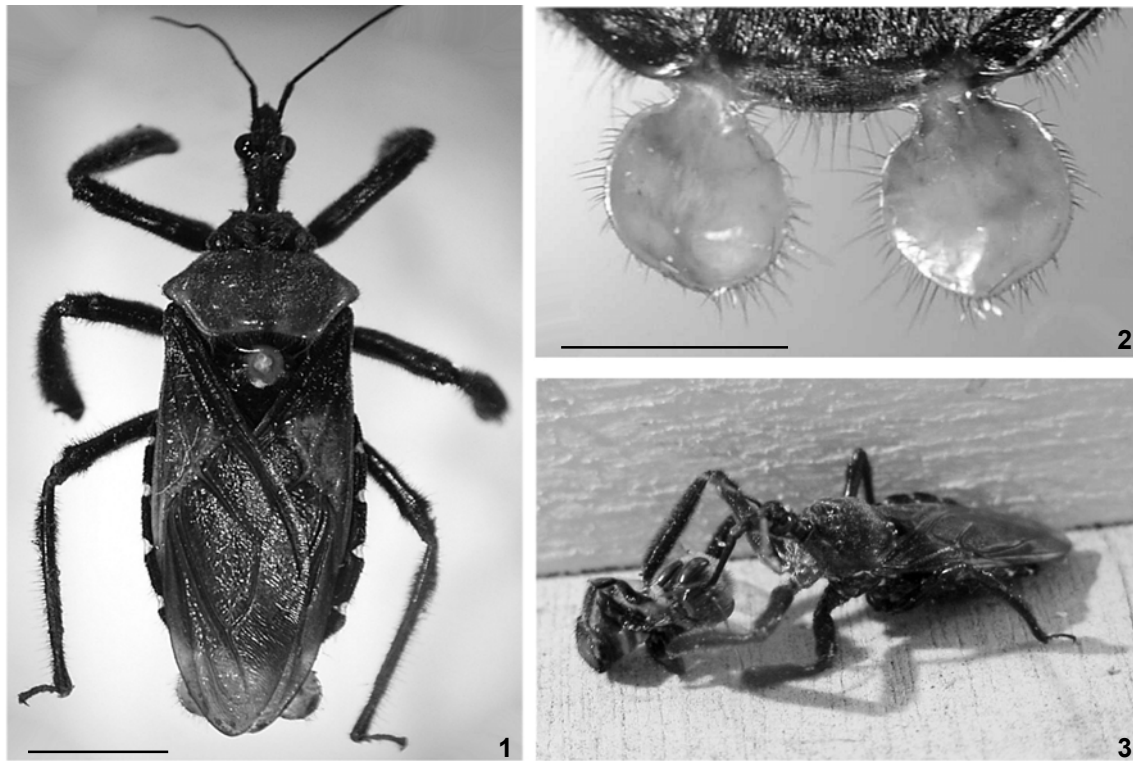
A summary of reports of predation made by *Apiomerus* species on bees was presented by MARQUES *et al.* (2003).

Considering that the scientific works made on the apiomerines are scarce and that the biological data are extremely important for the study of them as agents with potential for use in integrated handling of plagues (AMARAL FILHO *et al.* 1994, GIL-SANTANA 2002), this article reports the attack of *Apiomerus pilipes* against Meliponinae bees.

MATERIAL AND METHODS

The observations were led between September and November 2003. The work took place in an experimental meliponary in the campus of the Instituto Nacional de Pesquisas da Amazônia (INPA), in Manaus, Amazonas State. The place, considered an urban forest fragment, is an extensive green area preserved partially with introduction of some species of ecological, ornamental and economical importance (FERREIRA & RAMOS 1993).

The vegetation of the campus is characterized as a secondary forest (GENTRY 1978), with the majority part constituted by primary forest species, and the remaining area is constituted by typical species of secondary forest (PRANCE 1975). The Campus of INPA with 14 ha is separated by an avenue, of an area with 540 ha of forest belonging to the Universidade Federal do Amazonas (UFAM).



Figures 1-3. *Apiomerus pilipes*: (1) dorsal view of an adult female; (2) dorsal view of the abdominal foliaceous appendages of an adult female; (3) manipulation of the prey (worker bee of *M. seminigra merrillae*) for *A. pilipes* that introduces the buccal apparatus in the base of the antenna of the bee. Scale bars = 5 mm.

The climate of the place is characterized like “Afi” in the Köpen’s classification, with rainfall and annual medium temperature of 2458 mm and 25,6°C respectively, with a dry season from June to October (RIBEIRO 1976). In the data of Instituto Nacional de Meteorologia (INMET) referring to the years from 1961 to 1990 there are records that show the maximum temperature of 31,5°C and low temperature of 23,2°C, average temperature of 26,7°C, rain precipitation of 2.291,8 mm and relative humidity of the air of 83%.

The beehives in the meliponary of the INPA campus that were used in this experiment were placed in rational wood boxes and disposed in two systems, individual and collective supports.

The identification of the Apiomerini species was made with the aid of the taxonomic key and respective description, contained in COSTA LIMA *et al.* (1951) and by comparison with the data taken from Entomological Collections of Instituto Oswaldo Cruz (IOC) and from the Museu Nacional – Universidade Federal do Rio de Janeiro (MNRJ).

In the first behavioural observation, some drops of artificial feeding syrup 50% (water + sugar) were placed on a piece of alveolus wax of *Apis*. On the second behavioural observa-

tion it was possible to train bees to feed themselves closer the *A. pilipes* with the aid of the same system (artificial feeding syrup and a piece of alveolus wax).

RESULTS

Observation 1. A female of *A. pilipes* was observed on a roof covering a stingless beehive. With the aid of the piece of wax containing the syrup it was possible to attract a worker bee of *Melipona compressipes manausensis* Schwarz, 1932 from another beehive nearby the *A. pilipes*. While the bee fed itself with the syrup the wax piece that supported it was moved closer to the *A. pilipes*. As soon as the bee got near the *A. pilipes* walked toward it and after approximately two seconds it was captured. *A. pilipes* introduced its rostrum in the membrane between the head and the pronotum, in its dorsal part. Later *A. pilipes* began to rotate the bee seeking other holes for introduction of its rostrum.

Observation 2. The presence of a female of *A. pilipes* was observed on a rational box of *Melipona seminigra merrillae* Cockerell, 1919. Initially the female of *A. pilipes* positioned itself opposite to the entrance of the beehive. Three observers were positioned around the box. *A. pilipes* slowly changed posi-

tion and came close to the hive entrance. When surrounding the beehive to visualize the entrance, as well as the flow of bees, *A. pilipes* approached slowly and climbed on the mud and vegetable resins (batume) tube present in the entrance of the beehive. *A. pilipes* waited on this tube for some seconds the opportunity to capture its prey. As there was an intense flow of bees leaving and entering the beehive speedily, *A. pilipes* was hindered to capture a single bee. Simultaneously, one of the observers trained two worked bees of another species (*Melipona rufiventris* Lepeletier, 1836), in a beehive inside another box placed a few meters from where this observation took place. The phase of conditioning of the bees finished when they were able to collect the syrup close to where *A. pilipes* was placed in the beehive. In this way, the alveolus wax used in the training was placed near the entrance tube of the beehive and carefully the behaviour observations began. With the first pair of legs positioned upwards *A. pilipes* awaited for the appropriate moment to attack the bee that was feeding itself on the wax. When it captured the prey, *A. pilipes* began a manipulation ritual that seems to be a pattern, which consists of some stages that will be explained later. It is worth to point out that in this observation, as well as in the previous observation, the worker bees that were offered to *A. pilipes* were previously trained.

Observation 3. An attempt of predation of bees by *A. pilipes* in the entrance door of a beehive was observed. *M. seminigra merrillae* bees were attacked by *A. pilipes*. The bees tried to capture *A. pilipes* and take it to the interior of the beehive through the entrance tube. A great confusion of bees started in the beehive entrance involving at least 20 worker bees. In order to scape, *A. pilipes* killed three bees that tried to defend the colony, taking one of them. In this case there was not training of bees and nor manipulation of *A. pilipes* which were already positioned in the entrance of the beehive.

Observations 4, 5 and 6. Six worker bees of *M. compressipes manausensis* and six worker bees of *M. seminigra merrillae* were offered to *A. pilipes* during three different behavioural experiments. In all the experiments were registered (picture and notebook) the same behavioural patterns of manipulation of the prey that will be described below.

Observation 7 and 8. Two worker bees of *M. seminigra merrillae* were offered to *A. pilipes* during two different experiments with the objective of documenting (through filming) the behaviour pattern involved in the predation. In the two experiments were registered the time taken in the immobilization and death of the preys. *A. pilipes* in the first experiment (observation 7) spent six seconds and 10 second hundredths and in the second experiment (observation 8) another sample of *A. pilipes* spent eight seconds and seven second hundredths to kill the preys.

It is important to emphasize that there is a behaviour pattern verified in all of the eight observations done that can be separated in six behavioural acts: a) the approach of the prey, b) elevation of the first pair of legs, c) the capture of the

prey by the dorsal part of its body, d) introduction of the rostrum in the back part of the bee usually between the head and the dorsal part of the body, e) injection of the paralyzing toxin, f) manipulation of the prey and introduction of the rostrum in the soft parts of the body as for instance: the junction part between the head and the thorax, the connection part between the thorax and the abdomen, the base of the wings, the spaces between two adjoining tergites and sclerites, genital pore, insertion points of the rostrum, connections between the parts that form the legs and even the antennal alveoli (Fig. 3).

DISCUSSION

Preliminary data suggest the participation of only females of *A. pilipes* in the predation of the stingless bees. That could be verified because all the species of *A. pilipes* observed possessed the foliaceous appendages in the back part of the abdomen.

There is a behaviour pattern involved in the predation that starts with the capture, death, manipulation and ends with the use of the bee as food source for *A. pilipes*.

Some questions appeared with the present study and they should be the objects of future investigations. For instance, would *A. pilipes* be feeding itself with the hemolymph of the bees or undergoing enzymatic pre-digestion of internal tissues?; What is the biochemical nature of the toxin used by *A. pilipes*?; Does *A. pilipes* have a general diet or is *A. pilipes* a specialist in the predation of bees?; What is the function of the leaf shaped appendages in the end of the abdomen of *A. pilipes*?; Are the foliaceous appendages of *A. pilipes* related with the pollen collected by the bees, which have, in some cases the same orange coloration?; Does *A. pilipes* have the behavioural pattern, common to the some apiomerine species, of capturing vegetable resins to use in the first pair of legs as a way to facilitate the predation of bees?

CONCLUSIONS

With the results obtained through the behavioural observations made in this work, it is concluded that: 1) *A. pilipes* may be considered as a natural enemy of stingless bees; 2) only females of *A. pilipes* were observed preying the *Melipona* worker bees; 3) *A. pilipes* shows a behaviour pattern of predation that involves the capture, immobilization, death and manipulation of the prey; 4) *A. pilipes* by using its rostrum is capable to access the hemolymph of the bees seeking for holes in the skeleton; 5) *A. pilipes* spends a little time (six to eight seconds) to kill your preys; 6) Deeper studies should be led to understand the biochemical nature and the power of action of the toxin used by *A. pilipes* to kill its preys.

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