MATING BEHAVIOR OF *PELECINUS POLYTURATOR* (HYMENOPTERA: PELECINIDAE)[1]

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ABSTRACT: The mating behavior of *Pelecinus polyturator* is described and briefly discussed. It is suggested that the mating behavior of the male *P. polyturator* may have evolved in response to the female's highly specialized gaster.

In spite of its usually large size and peculiar morphology, *Pelecinus polyturator* (Drury) has not attracted much attention and remains poorly known, notably with respect to its biology and behavior. This species is better known as a parasite of Scarabaeidae larvae (Davis 1919; Hammond 1944), but Clausen (1940) believes that the true hosts are probably Coleoptera larvae living in decaying wood. Hammond (*op.c.*) observed larval and pupal stages on *Phyllophaga,* and discussed the economic importance of this parasitism, and Lim *et al.* (1980) described the pupa. The development is internal, and pupation takes place outside the host (Clausen, *op.c.*). Adult males are extremely rare in North America, where females are believed to be mainly parthenogenetic (Brues 1928; Young 1990). In the Neotropics, however, males seem to be as common as females (Masner 1995). In any case, *P. polyturator* is not commonly collected, and no rearing technique is known for this species, making biological studies about it a task usually difficult to achieve. This study was performed after the collection of a male and female in the Atlantic Forest of southern Brazil (Lapa, Paraná State, 25°46´S 49°44´W) on March 14, 1991. Both the male and female were placed in a 400ml jar and observed during the entire mating process, and an additional 20 minutes. Each was then independently mounted as similarly as possible to its respective observed copulatory posture, as reference material for illustrations.

MATING BEHAVIOR

The male mounted the female immediately after they were put together, grasping her first gastral segment with the apex of his fore tibiae (fig. 1). The basitarsal antennal brush and apical spurs apparently helped the male grip the female's gaster. The male vibrated his wings in brief periods of less than one second, at intervals of 1-4 seconds, throughout the mating process. He vibrated

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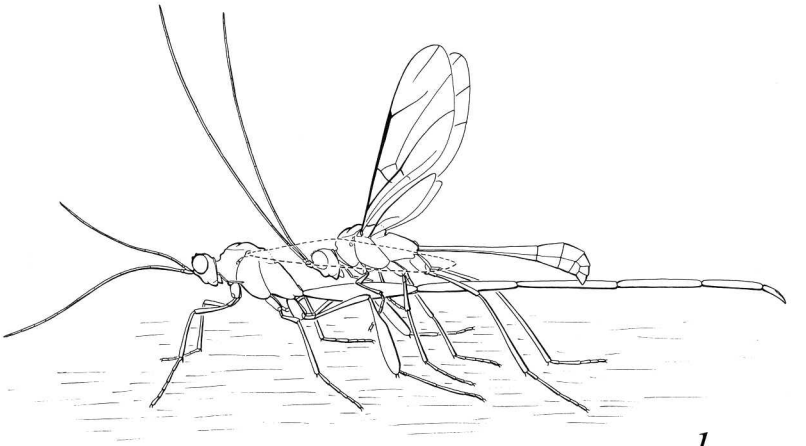
his antennae, in a simple and steady alternate pattern, touching the female with them. The female assumed a passive position at this time, with antennae showing no movement, wings partially retracted, and thorax and gaster stationary, almost touching the substratum. After 1.5 minutes, the female touched the male gaster with her own, by elevating it gently. The male reacted by sliding backwards along the female gaster, while still holding her with his tibiae. The tip of his gaster also slid over the female's until the two tips met. The hook-like male genitalia was then exerted. Soon after copulation started (fig. 2), the male bent his gaster downwards, while the female slightly arched hers upwards. This first copulation ended 15 seconds later but the male kept holding the female while vibrating his wings and antennae. After a few seconds, the male dismounted, walked briefly around, and remounted the female. A second copulation took place 30 seconds after the first one, with male and female showing the same behavior. During the interval between the two copulations, the female kept her gaster laying sideways on the substratum curved in a "C" shape, and was apparently in a very relaxed state. After three more minutes of courtship, the female lashed energetically at the male with her gaster, causing an immediate dismount. The female then entered into a strongly quiescent state, laying sideways, completely motionless, on the substratum during a period of three minutes, after which she recovered totally and started to fly inside the jar. The entire mating process lasted five minutes. During the following 20 minutes no more trials for copulation were observed, and the experiment was terminated.

DISCUSSION

Mounting in *P. polyturator* is singular among Apocrita Hymenoptera in that the male does not mount the female on her thorax as usually observed (*e.g.*, Assem *et al.* 1980a, 1980b, and Assem & Povel 1973 for Pteromalidae, Camargo 1972 for Apidae, Mertins 1980 for Bethylidae, Michener 1948 for Ants, and Vinson 1972 for Ichneumonidae). Nonetheless, gastral mounting in *P. polyturator* may improve efficacy in copulating, since the two genitalia are approximately 40% closer than they would be in a head-over-head mounting, making it easier and/or quicker for the male to access the female's genitalia.

Wing and antennal vibration during courtship seems to be an almost universal behavior of courting male Hymenoptera (Matthews 1975), though the latter can usually show considerable variation among Hymenoptera (*e.g.*, Assem & Povel 1973). For *P. polyturator*, however, both antennal and wing vibration follow a very simple pattern, indicating a generalized courtship behavior.

In spite of the female's inactivity during most of the time, she seems to play a decisive role in starting (and ending, see further below) copulation, since the male slid backwards to copulate only after the female touched his abdomen with hers, apparently signaling her willingness. The need of an acceptance sign



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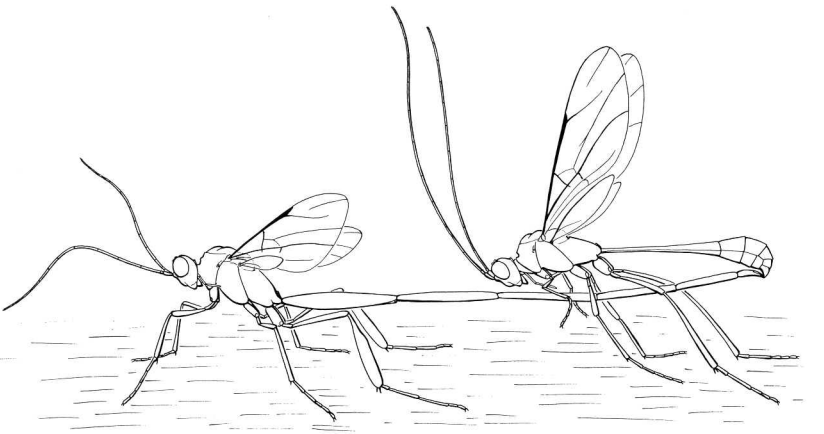

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Mating behavior of *Pelecinus polyturator.* Fig. 1. Mounting. Fig. 2. Copulation.

appears also in a number of Hymenoptera species, albeit it can be expressed in a variety of forms. In several species of Pteromalidae for example, the female signals by a tight flagellar and "chin" retraction (Assem & Povel 1973; Assem *et al.* 1980a).

The possibility of the female simply retracting her gaster to copulate with the male mounted on her thorax (for example by bending it upwards, reducing its length by curving it in a bell-shaped fashion, retracting it through telescoping, or even combining these possibilities) may be a simple evolutionary solution to the problem, but some important flexibility restrictions apply to the female gaster of *P. polyturator*. Mason (1984) discussed the complex mechanics of the gastral articulation in this species; the articulation between gastral segments 1 and 2 allows only a vertical movement, and the posterior segment cannot deflect upwards by more than 10°-20°. Rotary and vertical movements are also restricted in the subsequent segments. In fact, the muscular and sclerotic structure shows a high degree of specialization to a downwards action, used for digging the soil. Thus, if the restricted flexibility of the gaster, crucial for digging the soil for larval hosts, was more valuable to the survival of the species than a more flexible gaster, useful for an "easier" mating, then *P. polyturator* must have had to overcome the "longer female's gaster" problem in an alternative way. The more immediate solution may have been a more active role of the male, by simply sliding backwards to copulate. Selection favoring males using the front legs for grasping the female's gaster can easily follow this sequence, since this behavior helps reduce the chances of losing the female, especially during the male's backward slide.

The short copula suggests a great availability of receptive females, since more prolonged copulations tend to occur only when the probability of acquiring multiple mates is low (Thornhill & Alcock 1983). This apparently implies that females of *P. polyturator* are more numerous than males in the area where the specimens were collected. However, the availability of receptive females may also be increased by other factors, as male/female efficiency in locating each other, and female willingness in copulating with more than one male. Inferences on sex ratio are, therefore, premature.

The firm refusal of the male in trying to copulate again after being lashed by the female gaster strongly indicates that this behavior may serve as a sign for the end of the mating. The succeeding quiescent state of the female was also observed for *Tetrastichus incertus* (Eulophidae, Miller 1966) and *Laelius pedatus* (Bethylidae, Mertins 1980), but not so intense as here observed for *P. polyturator*. Its significance is unknown.

In conclusion, it can be suggested that most of the current mating behavior of *P. polyturator* may have evolved in response to the female's acquisition of a highly specialized gaster.

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