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DESCRIPTIONS OF THE IMMATURE STASES OF *MACROCHELES MYCOTRUPETES* KRANTZ AND MELLOTT (ACARI: MACROCHELIDAE), WITH REMARKS ON FORM, FUNCTION, AND PHORESY

by G. W. KRANTZ and L. A. ROYCE

**ABSTRACT**: The larval and nymphal stases of *M. mycotrupetes* are described and illustrated, and a discussion of characters unique to this phoretic species is presented. Chief among these are the paranal extensions of the cribrum, the occurrence of five pairs of setae in the J series, and the presence of postepigynial platelets in all postlarval instars. Absence of a bidentate tooth on the movable digit of the female chelicera, and persistent deficiencies in number of tarsal sensilla, are discussed in terms of their possible significance in the evolution of phoresy in *M. mycotrupetes*.

**RÉSUMÉ**: Les stases nymphaire et larvaire de *M. mycotrupetes* sont décrites et figurées, et une discussion des caractères particuliers à cette espèce phorétique est présentée. En tête de ceux-ci se trouvent les extensions paranales du cribrum, la manifestation de cinq paires de poils dans les séries J, et la présence de plaquelettes postépigyniales à tous les stades postlarvaires. L’absence d’une dent bidentée au doigt mobile de la chélicère de la femelle, et la persistence de déficiences dans le nombre des sensilles du tarse, sont discutées en vue de leur signification possible dans l’évolution de la phorésie chez *M. Mycotrupetes*.

**INTRODUCTION**

*Macrocheles mycotrupetes* Krantz and Mellott is found in close phoretic association with the geotrupine scarabs *Mycotrupes gaigei* Olson and Hubbell and *Geotrupes egeriei* Germar in the dry sandhill regions of north-central Florida (Krantz and Mellott 1968, 1972). Recent research on the chemical basis of phoresy in *M. mycotrupetes* (Krantz et al. 1991) gave rise to the development of a laboratory culture method that has provided the opportunity to augment our original diagnoses of adult *M. mycotrupetes* (Krantz and Mellott 1968) with descriptions of the previously undescribed immature stases. Larvae, protonymphs, and deutonymphs of *M. mycotrupetes* were separated from the culture, mounted in Hoyer’s solution, and cleared at 50°C for 72 hours prior to study. Illustrations generally were based on study of two or more specimens. Measurements given in the text are in micrometers.

**DESCRIPTIONS**

**LARVA** (Figs. 1-3). Length of idiosoma averages 606 (586-616), width at level of coxae III averages 495 (473-513) (n = 4). Dorsum (Fig. 1) with 14 pairs...
FIGS. 1-4: Macroscheles mycotrupetes K. & M.
1. — Dorsum of larva (scale bar = 100µm). 2. — Terminal portion of tarsus I of larva showing porous (cross-hatched) and non-porous (solid) sensilla (scale bar = 25µm). 3. — Venter of larva (scale bar = 100µm). 4. — Terminal portion of tarsus I of protonymph, with porous sensilla numbered after the system of COONS and AXTELL 1973 (scale bar = 25µm)
of setae, some of which are weakly pilose distally; with two pairs of podonotal and four pairs of opisthonautal pores or pore-like apertures discernible on examined specimens (pj3, pj4, pj6, pj1, pj2, pj4, pj5) (KRANTZ and REDMOND 1987), dorsal shields absent. Venter (Fig. 3) without distinct sclerotization, with three pairs of smooth sternal setae inserted in the podogastral region posterior to a well developed tritosternum; with at least three pairs of opisthal setae, pores shield with lightly tanned unornamented podonotal and opisthonotal shields; podonotal shield with Il averages 493 (435-632) (n = 8). Dorsum (Fig. 5) averages 657 (580-725), width at level of coxae III sensilla, at the tip of tarsus I (Fig. 2) rather than six (CooNs and AxTELL 1973), with only the two more as described for the larva of M. muscaedomesticae (0-4-5-12-11), palpal apotele with rudimentary third tine on proximoventral face of central tine; median element of epistome (Fig. 1) broadly produced, without lateral elements. Legs more or less equal in length (280-300), legs II considerable stouter than legs I and III, leg chaetotaxy (Table 1) normal for the cohort; with only four blunt sensory setae, or sensilla, at the tip of tarsus I (Fig. 2) rather than six as described for the larva of M. muscaedomesticae (COONS and AXTELL 1973), with only the two more proximal sensilla appearing porous.

**Protonymph** (Figs. 4-6). Length of idiosoma averages 657 (580-725), width at level of coxae III averages 493 (435-632) (n = 8). Dorsum (Fig. 5) with tightly tanned unornamented podonotal and opisthonautal shields; podonotal shield with 11 pairs of distally pilose setae, pores pj3, pj4, pj6, and pz5 discernible on specimens examined; pore pz3 in integument laterad from seta z2; opisthonautal shield with 10 pairs of distally pilose setae, including what appears to be an entire complement of J setae and at least nine pairs of pores, with additional pores in integument surrounding shield. Venter (Fig. 6) with a weakly defined sternal and anal shield; sternal shield lying behind a well developed tritosternum, occupying area mediad from coxae II-IV, somewhat broadened medially and narrowed posteriorly, with weak ornamentation in the posterior portion; with three pairs of smooth sternal setae and two pairs of pores; with six narrow postepignyal scutellae lying posterior to the sternal shield, epigynial setae (st5) inserted between the shield and scutellae, somewhat shorter than sternal, epigynial pores absent or obscure. Anal shield ovate, weakly defined, with a pair of smooth paranal setae and a single distally pilose postanal seta; cribrum distinct, extending anterolaterally on shield to level of paranals. With four pairs of opisthogastric setae, of which only Jv1 is without distal pilosity; with at least three pairs of opisthogastric pore-like apertures, including the putative cribral gland apertures adjacent to the cribrum; metapodal platelets weakly developed behind coxae IV. Stigmata laterad from coxae III-IV; peritremes

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**Table 1:** Leg chaetotaxy of immature stages of *Macrocheles mycotrupetes* (tarsi have been omitted).

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<th></th>
<th>Coxa</th>
<th>Troch</th>
<th>Femur</th>
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<td>Larva</td>
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| I    | 0    | 0     | 0     | 2    | 2/
| II   | 0    | 0     | 0     | 1    | 2/
| III  | 0    | 0     | 0     | 1    |

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<tr>
<td>Protonymph</td>
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</table>
| I    | 0    | 0     | 0     | 2/
| II   | 0    | 0     | 0     | 1/
| III  | 0    | 0     | 0     | 1/
| IV   | 0    | 0     | 0     | 1/

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<tr>
<th></th>
<th>Coxa</th>
<th>Troch</th>
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<tr>
<td>Deutonymph</td>
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</table>
| I    | 0    | 0     | 0     | 2/
| II   | 0    | 0     | 0     | 1/
| III  | 0    | 0     | 0     | 1/
| IV   | 0    | 0     | 0     | 1/
abbreviated, curved anterad, peritrematic pores present. Gnathosoma typical for genus; hypostomatic setae 3 present, longer than other hypostomatics, with a pair of short capitular setae, well developed deutosternal groove with five rows of denticles; palpal chaetotaxy holotrichous (1-4-5-12-15), proximal tine of palptarsal apotele distinct, smaller than more distal tines. Lateral elements of epistome produced behind central element (Fig. 5), epistomatic margins serrate. Legs IV well developed, longer than legs I-III, setae of tibia and tarsus IV robust, longer than those of other legs, leg chaetotaxy (Table 1) normal for the cohort; with six blunt sensilla discernible on terminus of tarsus I in available material (Fig. 4) rather than seven as in the protonymph of *M. muscaedomesticae* (COONS and AXTELL 1973); four of the sensilla clearly porous, longer than porous sensilla on tarsus of larva (Fig. 2).

**DEUTONYMPH** (Figs. 7-9). Length of idiosoma averages 838 (748-934), width at level of coxae III averages 624 (580-696) (n=8). Dorsum (Fig. 8) covered in large part by a holonotal shield which is deeply incised laterally at level of setae j6, shield punctate-reticulate more or less throughout, podonotal portion with muscle bundle insertions forming an ornamental pattern; shield setae uniformly pilose distally, 18 pairs of podonotal setae as is typical of "generalized" *Macrocheles* species (HALLIDAY 1987), but with hypertrichy — often asymmetrical — in the opisthnotonal portion (20-22 pairs rather than 10 as in the generalized form (the holotrichous number for the suborder is 15 pairs (EVANS and TILL 1979)), with dorsal pores and pore-like apertures as illustrated; hypertrichy extreme in the integument adjacent to the opisthnotum, integumental setae shorter than most of the shield setae, distally pilose. Venter (Fig. 7) with well developed, basically unornamented peltate sternal shield lying behind well developed tritosternum and mediad of the insertions of coxae II-IV, with four pairs of smooth setae and three pairs of pores, sternals 4 (the metasternals) somewhat shorter than more anterior sternals, with six postepigynial scutalae lying just posterior of the distally pilose s5 and adjacent pores; anal shield distinct, with well developed cribrum extending anteromarginally to insertions of smooth paranals, postanal seta pilose distally; opisthogaster hypertrichrous, setae short and pilose distally, mostly paired; metapodal plates weakly developed. Peritremes extend antero-laterad to the level of coxae I, peritrematic and endopodal shields undefined. Gnathosoma normally developed, similar to that of adult (KRANTZ and MELLOTT 1968) except for the following: proximal tooth of movable cheliceral digit equal in size and form to the more distal adjacent tooth (Fig. 9), fixed digit without internal ridged surface opposing proximal tooth of movable digit, as in adult female (Fig. 10). Palpal chaetotaxy as in adult (2-5-6-14-15), leg chaetotaxy normal for genus, genu IV with six setae (Table 1). Tarsus I with seven blunt sensilla rather than eight as in *M. muscaedomesticae* (COONS and AXTELL 1973), five of the sensilla are clearly porous.

**DISCUSSION**

The immature stases of *M. mycotrupetes* are generally similar to those of other macrochelid species (COSTA 1966, BLASZAK et al. 1988) in body and leg chaetotaxy, porotaxy, and shield development. However, there are some notable differences. Extreme opisthosomatic hypertrichy occurs in the deutonymph (Figs. 7,8), and what appears to be a full complement of J setae is present in all of the postlarval stases (Figs. 5 and 8, and KRANTZ and MELLOTT 1968). This is an unusual character in a genus where only two or three pairs normally occur (i.e., J2, J5 and, in some species, J3). The identity of J1 seems unequivocal, but that of J4 is open to question. While setae Z5 have been identified in the larva (Fig. 3), they appear to be absent in both the proto- and deutonymph (Figs. 7,8). It is likely that the setae tentatively identified as J4 (Fig. 5) are, in fact, setae Z5, displaced anteriorly from their usual marginal position between setae J5 and S5 2. *M.
FIG. 5-10: Macrocheles mycotrupetes K. & M.
mycotrupetes also displays certain ontogenetic characteristics more typical of free-living than of highly derived phoretic Macrocheles species. For example, the cribrum (Fig. 6-7) is not confined to a postanal position as in other phoretic species, but rather extends antero-laterally to the level of the paranal setae in the manner of primitive non-phoretic forms (KRANTZ and REDMOND 1988). Postlarval stases have distinct postepigynial platelets (Fig. 6, 7), a primitive characteristic seen in certain edaphic and nidicolous macrochelid species (BREGETOVA and KOROLEVA 1960).

Deficiencies have been observed in the number of blunt sensory setae, or sensilla, at the tip of tarsus I in pre-adult and adult stases of M. mycotrupetes when compared to those of M. muscaedomesticae (Scopoli), a phoretic associate of synanthropic flies (COONS and AXTELL 1973). These sensilla are considered to be the olfactory receptors that mediate the phoretic response of adult M. muscaedomesticae to their dipteran phoronts (JALIL and RODRIGUEZ 1970). The larva of M. mycotrupetes has only four sensilla rather than six as in M. muscaedomesticae (three rather than four terminal sensilla (Fig. 2)), the protonymph has six rather than seven (Fig. 4), and the deutonymph and adult have seven rather than eight (sensillum 1 of Coons and Axtell 1973 is absent). A similar deficiency in sensory setal number occurs in a free-living member of the macrochelid genus Macrolaspis which, like M. mycotrupetes, achieves a full complement of only seven tarsal sensilla in the adult stase. In light of its primitive cribral trait and the presence of postepigynial platelets behind the sternal shield, it is tempting to consider the sensillar deficiency in M. mycotrupetes as an expression of still another pre-phoretic ancestral character. It should be noted, however, that sensillar deficiencies also occur in the immature stases of M. pisentii (Berlese) and M. saceri Costa, highly derived Old World phoretic species. Both were found to lack sensillum 1 in the adult stase. Comparative SEM studies on the sensory chaetotaxy of tarsus I of a variety of free-living and phoretic Macrocheles species may prove useful in resolving the phylogenetic and behavioral significance of these deficiencies.

Of equal interest is the fact that the movable digit of the female chelicera lacks the bidentate tooth characteristic of other phoretic Macrocheles species, having instead a single enlarged tooth whose ridged proximal surface opposes a weakly ribbed facet on the fixed digit (Fig. 10). Thus, the phoront hair is grasped without benefit of the bidentate “seat” seen in most other phoretic Macrocheles species.

The cheliceral, cribral, and postepigynial platelet characteristics of M. mycotrupetes, coupled with its close phoretic association with a geographically restricted, ecologically isolated phoront (KRANTZ and MELLOTT, 1968), implies a long-term relationship that evolved independently from those of its more conventional phoretic congeners.

REFERENCES


Krantz (G. W.) and Mello\(t\) (J. L.), 1972. — Studies on phoretic specificity in *Macrocheles mycotrupetes* and *M. pelotrupetes* Krantz and Mello\(t\) (Acari: Macrocheleidae), associates of geotrupine Scarabaeidae. — Acarologia, 14 (3) : 317-344.


CORRIGENDUM


In our 1992 paper on the immature stases of *Macrocheles mycotrupetes* Krantz and Mellot, we (Krantz and Royce) considered opisthonotal setae Z5 of the protonymph and deutonymph to be absent. We subsequently recognized that the setal pair tentatively identified in the nymphs as setae J4 (Figs 5 and 8) are somewhat displaced setae J5, and the more posterior pair identified by us in the same paper as setae J5 are Z5. Please make the appropriate corrections in your copy.

G. W. Krantz and L. A. Royce