

Description of the Larvae of *Tapinoma melanocephalum* (Hymenoptera: Formicidae)

Authors: Jesus, Carlos Massuretti De, Fox, Eduardo Gonçalves Paterson, Solis, Daniel Russ, Yabuki, Antonio Teruyoshi, Rossi, Monica Lanzoni, et al.

Source: Florida Entomologist, 93(2) : 243-247

Published By: Florida Entomological Society

URL: <https://doi.org/10.1653/024.093.0214>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

DESCRIPTION OF THE LARVAE OF *TAPINOMA MELANOCEPHALUM* (HYMENOPTERA: FORMICIDAE)

CARLOS MASSURETTI DE JESUS¹, EDUARDO GONÇALVES PATERSON FOX¹, DANIEL RUSS SOLIS¹,
ANTONIO TERUYOSHI YABUKI¹, MONICA LANZONI ROSSI² AND ODAIR CORREA BUENO¹

¹Centro de Estudos de Insetos Sociais, Instituto de Biociências, São Paulo State University (UNESP), Rio Claro,
São Paulo, Brazil

²Laboratório de Histopatologia e Biologia Estrutural de Plantas, Centro de Energia Nuclear na Agricultura,
University of Sao Paulo (USP), Piracicaba, Sao Paulo, Brazil

ABSTRACT

Morphological descriptions of the 4 instars of the ghost-ant *Tapinoma melanocephalum* Fabricius are presented along with illustrations and comparisons with other species of the same genus. Instars were similar, differing only in body length. The analyzed larvae presented many characteristics in common with other *Tapinoma* Förster larvae, such as: dolichoderoid body and mandibles, 9 pairs of spiracles, the presence of a terminal boss, and scarce body and head setae, all simple and short. We observed the following differences from other previous descriptions: the presence of a subapical mandibular tooth, setaceous sensilla on the medial anterior surface of the labrum, and fewer sensilla on maxillary and labial palps.

Key Words: ghost-ant, tramp species, Dolichoderinae, larval description

RESUMO

O presente estudo teve como objetivo descrever os quatro instares larvais da formiga-fantasma *Tapinoma melanocephalum* Fabricius. As larvas dos diferentes instares são parecidas, diferindo apenas nas dimensões do corpo. As larvas desta espécie apresentam algumas características em comum com outras espécies do gênero *Tapinoma* Förster como: forma do corpo e mandíbulas dolichoderóide; nove pares de espiráculos; presença de uma protuberância na região posterior do corpo e setas do corpo e da cabeça escassos, curtos e simples. Em comparação a outras descrições foi observado que: as larvas desta espécie apresentam mandíbulas contendo um denticulo em sua lâmina, sensilas setáceas na região anterior mediana do labro, e um menor número de sensilas nos palpos maxilar e labial.

Translation provided by the authors.

The genus *Tapinoma* Foerster comprises 126 described species and subspecies (Bolton et al. 2006), among which *Tapinoma melanocephalum* Fabricius figures as a typical tramp species, presenting all sets of characteristics particular to this group of ants (Passera 1994). In Brazil, *T. melanocephalum* is commonly found infesting residences, industrial environments, and crops, and it can also be a mechanical vector of pathogenic microbes in hospitals (Fowler et al. 1993; Delabie et al. 1995; Campos-Farinha et al. 2002). Despite the pest status, *T. melanocephalum* remains poorly studied.

It is well established how larvae play a paramount role in the social organization of ants (Hölldobler & Wilson 1990). Thus, closer examination of their morphology and biology might offer new paradigms in ant biology (Fox et al. 2007). Moreover, morphological descriptions of ant larvae are useful to taxonomy and phylogenetic analysis (Wheeler & Wheeler 1976; Schultz & Meier 1995).

Wheeler & Wheeler (1951) described the larvae of *T. melanocephalum* and other *Tapinoma* species, however without specifying the larval instar being described and based on few specimens. Jesus & Bueno (2007) determined that there are 4 larval instars in *T. melanocephalum* based on the frequency distribution of maximum larval head widths, but the authors did not examine morphological differences among instars in detail. Thus, the aim of the present study is to describe the morphological characteristics of the 4 instars of *T. melanocephalum*.

MATERIALS AND METHODS

Collection of Specimens

Four colonies of *T. melanocephalum* were collected in the municipality of Rio Claro (22°23'44.09"S and 47°32'39.98"W), State of São Paulo, Brazil. The ants collected were transferred to artificial nests and reared in the laboratory.

Three groups of larvae were taken from the established laboratory colonies during the period when only workers emerged from brood. These specimens were fixed in Dietrich's solution (900 mL of distilled water, 450 mL of 95% ethanol, 150 mL of 40% formaldehyde, 30 mL of acetic acid) for 24 h and then preserved in 80% ethanol. Voucher specimens were deposited at "Adolph Hempel" Entomological Collection of the Centro de Pesquisa e Desenvolvimento de Sanidade Vegetal of Instituto Biológico, São Paulo, Brazil.

Larval Descriptions

Larvae were sorted into 4 instars according to head width (Jesus & Bueno 2007): the specimens presenting head width of 0.10-0.18 mm were assigned to the first instar, those with 0.19-0.24 mm to the second instar, those with 0.25-0.32 mm to the third instar, and larvae with head width of 0.33-0.47 mm to the fourth instar. For general morphology, 10 larvae of each instar were observed under a compound microscope (Zeiss MC80 DX) and scanning electron microscope (Phillips SEM-505). The total body length and the body width were measured with a stereomicroscope (Zeiss Stemi SV11; maximum magnification of 66X) equipped with a micrometric ocular lens. Also, the body length through spiracles was measured for 10 larvae of each instar. For microscopic observations, specimens were briefly boiled in 10% KOH and placed in a small droplet of glycerine on a microscope slide. For SEM study, specimens were dehydrated with a graded series of acetone solutions and critical point dried (Balzers CPD/030). The dry specimens were attached on aluminum stubs with a double-faced conductive adhesive tape and gold-sputtered with Balzers SCD/050. All terminology used in the present paper followed Wheeler & Wheeler (1976). All measurements were submitted to analysis of variance (ANOVA) and differences among means were compared by Tukey's test ($\alpha = 0.05$).

RESULTS

General Description

Body robust and compact in full frontal view, with head capsule nearly or totally merged; body shape rounded and slightly elongate, shape in profile tending to dolichoderoid (Wheeler & Wheeler 1976) (Fig. 1A). Body segmentation was indistinct in some specimens and clearly distinct in others. Well-developed terminal boss or rounded protuberance posterodorsal to anus (Fig. 1A) and projecting backwards, with spinules and simple setae scattered over it; 1 specimen presented a slit-like opening on this protuberance. Anus as subterminal transversal slit. Body setae always simple, at total number of 40-120

($n = 20$); integument presenting rows of spinules following body segmentation (Fig. 1B). Nine pairs of spiracles with no peritreme ornamentation (Fig. 1C), being 2 thoracic and 7 abdominal; third pair significantly larger and the ninth pair significantly smaller, and the others of about the same size.

Head capsule not protruding, standing for about 1/6 of body length, with smooth surface. Capsule shape subheptagonal in anterior view, with mouthparts proportionally small and on the lower half of the cranium. Antennae are discreet slight elevations placed high on the head with 2 or 3 small basiconic sensilla each (Figs. 1D, E). Upper half of the cranium in anterior view with rugged surface and slight depressions on the clypeal region; clypeus indistinct and totally fused with the rest of the head. Few simple setae on head: 3 on each gena and 2 on frons, forming an arched row in frontal view (Fig. 1F). There are 4 conspicuous symmetrical openings on the tegument: 2 formed by the tentorial pits (Fig. 1F) and 1 on each gena; these openings varied from slit-like to rounded holes among different specimens.

All mouthparts fused to a single piece under the mouth, movable parts being surrounded by integument folds (Fig. 1G). Labrum ($l = 0.052-0.065$ mm long; $n = 4$), reduced and largely fused with the head capsule, shape rather short and paraboloidal in anterior view, with 2 simple setae on the anterior dorsal region ($l = 0.005-0.009$ mm; $n = 14$), 2 medial setaceous sensilla, and 2 basiconic sensilla near the ventral border. Mandibles poorly sclerotized, dolichoderoid in shape, but with a well-developed subapical tooth (Fig. 1H). One or 2 (depending on the specimen) simple setae ($l = 0.005-0.010$ mm; $n = 17$) over the base of each fused maxillae, and 1 setaceous sensilla under each maxillary palp. Maxillary palp a skewed peg with a large apical encapsulated sensillum and 2 lateral basiconic sensilla; galea an oval elevation ($h = 0.007-0.010$ mm; $n = 4$) with 2 basiconic sensilla. Between those 2 structures stands a pair of encapsulated sensilla (not shown). Two simple setae ($l = 0.010-0.012$ mm; $n = 8$) on the ventral region of the labium; labial palp an oval elevation ($h = 0.011-0.015$ mm; $n = 4$) with 2 basiconic sensilla and a skewed peg with one apical encapsulated sensillum; there is a pair of setaceous sensilla under each labial palp. Spinneret a horizontal slit just under mouth entrance, with 2 conspicuous asymmetrical basiconic sensilla below. Hypopharynx presenting few scattered flattened spinulose papillae (Fig. 1H).

Differences Between Instars

First instars are less plump and more tapered towards distal end, with body seta evenly distributed. General characteristics of each instar, including body measures, are presented in Table 1.

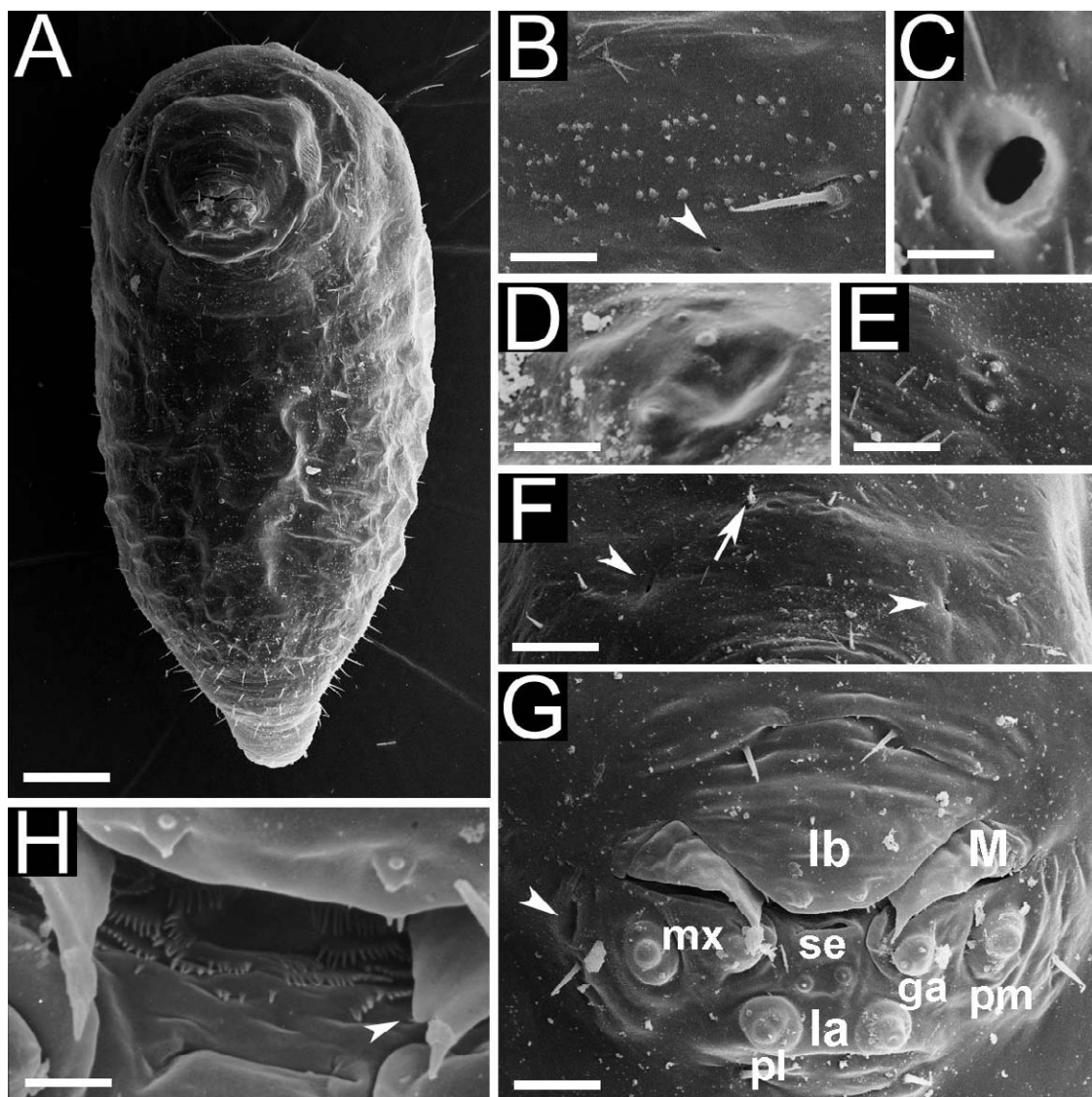


Fig. 1. Larvae of *Tapinoma melanocephalum*: (A) ventral view of second instar; (B) spinules and simple seta of first instar, arrowhead indicates abdominal spiracle; (C) spiracle of third instar; (D) antenna of third instar, with basiconic sensilla; (E) antenna of second instar, with basiconic sensilla; (F) head capsule of second instar displaying openings (arrowheads) and seta (arrow); (G) mouthparts of fourth instar: labrum (lb), mandibles (M), maxilla (mx), labium (la), galea (ga), maxillary palpus (pm), labial palpus (pl), sericteries (se), opening on base of maxilla (arrowhead); (H) hypopharynx of fourth instar with rows of spines, arrowhead indicates subapical tooth. Sizes of scale bars: (A) 0.081 mm; (B) 0.010 mm; (C) 0.005 mm; (D) 0.006 mm; (E) 0.006 mm; (F) 0.023 mm; (G) 0.013 mm; (H) 0.005 mm.

DISCUSSION

Some typical traits of *Tapinoma* Förster larvae (Wheeler & Wheeler 1951, 1976; Shattuck 1992) were confirmed in this species such as the mandible and body shape, 9 pairs of spiracles (first abdominal pair largest and last smallest), terminal body protuberance, scarce body and head pilosity,

all setae simple and short, number of antennal sensilla. Previously unmentioned traits were a subapical mandibular tooth and setaceous sensilla on the medial anterior labral surface. Moreover, both labial and maxillary palps had fewer sensilla than previously reported in Wheeler & Wheeler (1951). We wonder if the latter difference would be indicative of intraspecific regional variation.

TABLE 1. BODY DIMENSIONS OF LARVAE OF THE INSTARS OF *TAPINOMA MELANOCEPHALUM*.

Instar	Body length ¹	Body length through spiracles ¹	Diameter of spiracles	Width of anal opening	Length of body setae	Length of posterior boss	Length of head setae	Length of mandibles
First	0.42 ± 0.03 mm	0.81 ± 0.10 mm	0.003-0.013 mm (n = 90)	0.049 mm (n = 1)	0.013-0.023 mm (n = 50)	0.075 ± 0.013 mm (0.053-0.095 mm) ² (n = 10)	0.006-0.010 mm (n = 13)	0.028 ± 0.003 mm (0.023-0.033 mm) ² (n = 10)
	0.34-0.47 mm (n = 63)a	(0.62-0.96 mm) ² (n = 10)a						
Second	0.83 ± 0.08 mm	1.12 ± 0.13 mm	0.005-0.013 mm (n = 90)	0.062 mm (n = 1)	0.013-0.023 mm (n = 50)	0.084 ± 0.010 mm (0.063-0.100 mm) ² (n = 10)	0.004-0.008 mm (n = 14)	0.027 ± 0.004 mm (0.018-0.033 mm) ² (n = 10)
	0.72-1.01 mm (n = 58)b	(0.93-1.38 mm) ² (n = 10)b						
Third	1.11 ± 0.07 mm	1.52 ± 0.18 mm	0.005-0.013 mm (n = 90)	0.063 mm (n = 1)	0.015-0.025 mm (n = 50)	0.081 ± 0.007 mm (0.070-0.088 mm) ² (n = 10)	0.004-0.008 mm (n = 10)	0.029 ± 0.004 mm (0.023-0.035 mm) ² (n = 10)
	0.92-1.20 mm (n = 101)c	(1.26-1.80 mm) ² (n = 10)c						
Fourth	1.19 ± 0.05 mm	1.61 ± 0.22 mm	0.005-0.013 mm (n = 90)	0.080 mm (n = 1)	0.013-0.028 mm (n = 50)	0.094 ± 0.007 mm (0.080-0.105 mm) ² (n = 10)	0.004-0.007 mm (n = 2)	0.027 ± 0.006 mm (0.018-0.035 mm) ² (n = 10)
	1.02-1.32 mm (n = 189)d	(1.25-2.03 mm) ² (n = 10)c						

¹Means followed by the same letter were not different by Tukey's test at 5%.
²Minimum and maximum lengths.

The fact that different instars described in this paper were morphologically similar was striking, because in other ant species different instars generally present different body traits or morphological adaptations (Petralia & Vinson 1979; Fox et al. 2007; Solis et al. 2009). For example, the fourth instar of *Solenopsis invicta* has a specialization in the antero-ventral body region for feeding on solid food (Petralia & Vinson 1978). Therefore, some aspects of the biology of *T. melanocephalum* might have been determinant to this uniform morphology, e.g., similar feeding habits. According to Petralia & Vinson (1978), *S. invicta* larvae from the first to the third instar basically feed on liquids, while fourth instars additionally feed on solid food, as reflected by their morphological specializations. Smith (1928), while making biological observations with *Tapinoma sessile* Say, mentioned that workers of this species apparently feed larvae only with liquid food. However, little is known about the actual feeding habits of *T. melanocephalum* larvae.

ACKNOWLEDGMENTS

We thank Elliot Watanabe Kitajima and Francisco André Ossamu Tanaka (NAP/MEPA ESALQ-USP) for granting ample access to the microscopy facilities. We thank André Rodrigues for helping with the English language and 2 anonymous reviewers for helpful comments on the manuscript. First author was supported by a grant from FAPESP Institution (Proc: No 01/06298-4).

REFERENCES CITED

- BOLTON, B., ALPERT, G., WARD, P. S., AND NASKRECKI, P. 2006. Bolton's Catalogue of Ants of the World. CD-ROM, Harvard University Press.
- CAMPOS-FARINHA, A. E. C., BUENO, O. C., KATO, L. M., AND CAMPOS, M. C. G. 2002. Formigas urbanas no Brasil: retrospecto. O Biológico 64: 129-133.
- DELABIE, J. H. C., NASCIMENTO, I. C., PACHECO, P., AND CASIMIRO, A. B. 1995. Community structure of house-infesting ants (Hymenoptera: Formicidae) in southern Bahia, Brazil. Florida Entomol. 78: 264-267.
- FOWLER, H. G., BUENO, O. C., SATATSUME, T., AND MONTELLI, A. C. 1993. Ants as potential vectors of pathogens in hospitals in the state of São Paulo, Brazil. Insect Science and its Applications 14: 367-370.
- FOX, E. G. P., SOLIS, D. R., JESUS, C. M., BUENO, O. C., YABUKI, A. T., AND ROSSI, M. L. 2007. On the immature stages of the crazy ant *Paratrechina longicornis* (Latreille 1802) (Hymenoptera: Formicidae). Zootaxa 1503: 1-11.
- HOLDOBLER, B., AND WILSON, E. O. 1990. The Ants. Harvard University Press. 733p.
- JESUS, C. M., AND BUENO, O. C. 2007. Ghost-ant: Post-embryonic development of the worker caste of *Tapinoma melanocephalum* (Hymenoptera: Formicidae). Sociobiology 50: 583-597.
- PETRALIA, R. S., AND VINSON, S. B. 1978. Feeding in the larvae of the imported fire ant, *Solenopsis invicta*: behavior and morphological adaptations. Ann. Entomol. Soc. America 71: 643-648.
- PETRALIA, R. S., AND VINSON, S. B. 1979. Developmental morphology of larvae and eggs of the imported fire ant, *Solenopsis invicta*. Ann. Entomol. Soc. America 72: 472-484.
- SCHULTZ, T. R., AND MEIER, R. 1995. A phylogenetic analysis of the fungus-growing ants (Hymenoptera: Formicidae: Attini) based on morphological characters of the larvae. Systematic Entomol. 20: 337-370.
- SHATTUCK, S. O. 1992. Generic revision of the ant subfamily Dolichoderinae (Hymenoptera: Formicidae). Sociobiology 21: 1-181.
- SMITH, M. R. 1928. The biology of *Tapinoma sessile* Say, an important house-infesting ant. Ann. Entomol. Soc. America 21: 307-330.
- SOLIS, D. R., FOX, E. G. P., KATO, L. M., JESUS, C. M., YABUKI, A. T., CAMPOS-FARINHA, A. E. C., AND BUENO, O. C. 2009. Morphological description of the immatures of the ant, *Monomorium floricola*. J. Insect Science 10(15): 1-17.
- WHEELER, G. C., AND WHEELER, J. 1951. The ant larvae of the subfamily Dolichoderinae. Proc. Entomol. Soc. Washington 53: 169-210.
- WHEELER, G. C., AND WHEELER, J. 1976. Ant larvae: Review and synthesis. Mem. Entomol. Soc. Washington 7: 1-108.