Papéis Avulsos de Zoologia
Museu de Zoologia da Universidade de São Paulo

ARTICLE

Description of the puparium and adult genitalia of *Dactylodeictes brevifacies* James, 1974 (Diptera: Stratiomyidae)

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Abstract. The puparium of *Dactylodeictes brevifacies* was described based on fifty-eight specimens reared in laboratory until the emergence of adults. Larvae were collected under the bark of fallen trees in a Cerrado vegetation, Gallery forest; Palm swamp (Vereda) and open grassland (Campo Limpo) in States of Goiás and Tocantins, Brazil (New Record). The puparium was compared with that of *Brachyodina lopesi,* the most closely related species with a described puparium. Despite this species clearly shared the larval pachygastrinae features it has a remarkable character not know before for this subfamily: the presence of four pairs of ventral setae (V) in the eighth abdominal segment in ventral view, while in other larvae and puparia of this subfamily, there are five pairs of ventral setae. The adult male and female were described and figured.

Key-Words. Brazil; Cerrado Bioma; Neotropical region; Pachygastrinae; Taxonomy.

INTRODUCTION

The family Stratiomyidae has 12 subfamilies and more than 2.800 species described in the world, distributed in 378 genera (Woodley, 2001, 2011). Woodley (2001) and Pujol-Luz & Pujol-Luz (2014) asserted that the Neotropical Region has the highest Stratiomyidae diversity, both in relation to the number of genera and the number of species. In this region, 167 genera and approximately 1.000 species were recorded (Woodley, 2001, 2011; Fachin *et al.,* 2016).

Pachygastrinae is one of the largest subfamilies of Stratiomyidae with approximately 600 species in the world (Woodley, 2001, 2011). However, less than 50 species had their larvae or puparia known (Bučánková *et al.,* 2009) and, in the Neotropics, this number decreases to 18 species (Table 1). According to Bučánková *et al.* (2009) the known larvae of pachygastrines can be recognized by the following combination characters: (1) anal segment rounded posteriorly as in other terrestrial larvae, (2) posterior spiracular opening usually placed dorsally (with a few exceptions), without any pinnate float hairs, (3) subapical sensilla on antenna usually absent (but distinct in *Pegadomyia*), (4) setae CF2 and V2 on head inserted far before eye prominence, (5) lateral seta on head placed close to anterior margin of eye, (6) marginal setae of body segments considerably elongate in many species (though not in all), (7) elongate or rounded sternal patch confined to abdominal segment 6, (8) five ventral setae on anal segment, (9) arboreal mode of life (under the bark of trees) distinctly predominating in the known larvae.

The genus *Dactylodeictes* Kertész, 1914 has three species: *D. amazonicus* Kertész, 1914 (Brazil); *D. brevifacies* James, 1974 (Panama and Peru) and *D. medius* James, 1974 (Ecuador and Peru) (Woodley, 2001, 2014). None of these species had their larvae/puparium described yet. Here we described the puparium of *D. brevifacies* based on fifty-eight specimens (34 males and 24 females) that emerged in laboratory conditions. The adults that emerged from these puparia fit perfectly the ones described by James (1974). In addition to the description of the puparium, we registered for the first time the occurrence of this species in Brazil, updating the distribution map and describing male and female terminalia.

MATERIAL AND METHODS

Larvae of *D. brevifacies* were collected individually under the bark of fallen trees in cities

Pap. Avulsos Zool., 2020; v.60: e20206028
http://doi.org/10.11606/1807-0205/2020.60.28
http://www.revistas.usp.br/paz
http://www.scielo.br/paz
Edited by: Carlos José Einicker Lamas
Received: 13/08/2019
Accepted: 26/03/2020
Published: 11/06/2020

ISSN On-Line: 1807-0205
ISSN Printed: 0031-1049
ISNI: 0000-0004-0384-1825

Table 1. Neotropical list of known larvae of Pachygastrinae (Mod. de Bučánková, 2009).

Species	Author	Distribution
Brachyodina lopesi (Lindner, 1964) *	Xerez *et al.,* 2002	From Mexico to Brazil
Chalcidomorphina aurata Enderlein, 1914	Pujol-Luz & Xerez, 1999	From Mexico to Peru and Brazil
Chlamydonotum nigreradiatum Lindner, 1949	Xerez & Garcia, 2008	Argentina, Brazil
Chorophthalmyia brevicornis Lindner, 1964	Pujol-Luz *et al.,* 2016	Brazil, Costa Rica
Cosmariomyia argyrosticta Kertész, 1914	Xerez *et al.,* 2002	Argentina, Brazil, Costa Rica, El Salvador
Dactylodeictes brevifacies James, 1974	This paper	Brazil, Panama, Peru
Eidalimus henshawi (Malloch, 1917)	Kraft & Cook, 1961	Cuba, Mexico
Engicerus major Lindner, 1964	Xerez *et al.,* 2003a	Brazil
Eupachygaster alexanderi (Brèthes, 1922)	Blanchard, 1923	Argentina
Gowdeyana punctifera (Malloch, 1915)	Kraft & Cook, 1961	Mexico
Manotes crassimanus James, 1980	Lopes *et al.,* 2006	Brazil, Mexico
Manotes plana Kertész, 1916	Xerez & Lopes, 2009	Argentina, Bolívia, Brazil, Costa Rica, Mexico, Paraguai
Pedinocera longicornis Kertész, 1909	Lopes *et al.,* 2006	Brazil, Peru
Popanomyia femoralis Kertész, 1909	Xerez *et al.,* 2003a	Brazil, Panama, Peru
Popanomyia kerteszi James & Woodley, 1980	Marques & Xerez, 2009	Brazil, Panama, Peru
Psephiocera modesta (Lindner, 1949)	Xerez *et al.,* 2003b	Brazil
Vittiger schnusei Kertész, 1909	Xerez & Pujol-Luz, 2001	Brazil, Peru
Zabrachia magnicornis Cresson, 1919	James, 1965	Mexico
Zabrachia stoichoides James, 1965	James, 1965	Mexico

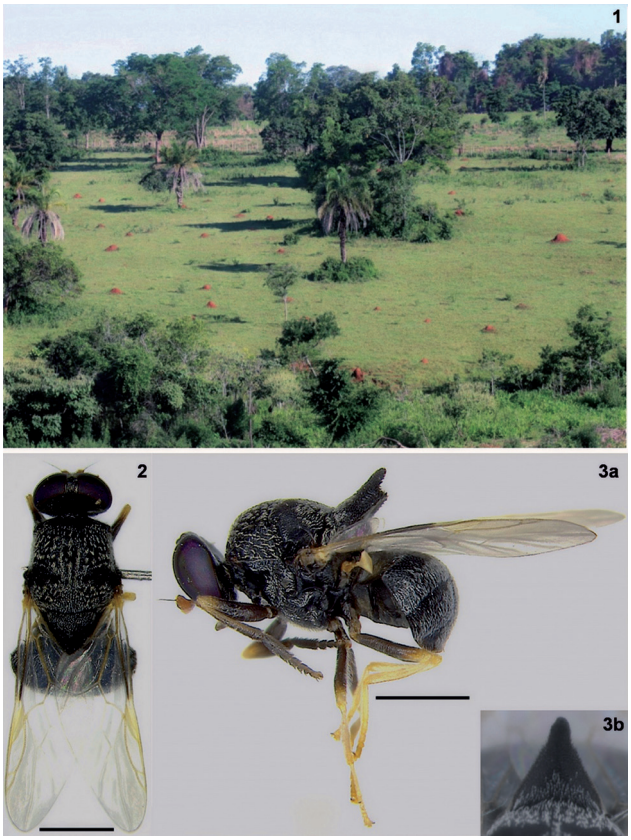
* Former *Dactylodeictes lopesi* (Lindner, 1964)

of Alvorada, Varjão and Goiânia, State of Goiás, and city Peixes, State of Tocantins, Brazil (Fig. 1). They were reared in separate Petri dishes containing substrate (rotting wood and pieces of bark) from the original locale until the emergence of adults. The fifty-eight adults emerged in the laboratory. The adults were mounted on entomological pins (Figs. 2-3) and the puparia were conditioned in microtubes. The material (adults and puparia) were housed in the Entomological collection of the Departamento de Zoologia, Universidade de Brasília (DZUB), Distrito Federal and Zoological collection of the Departamento de Ecologia, Universidade Federal de Goiás (CZUFG), State of Goiás, Brazil.

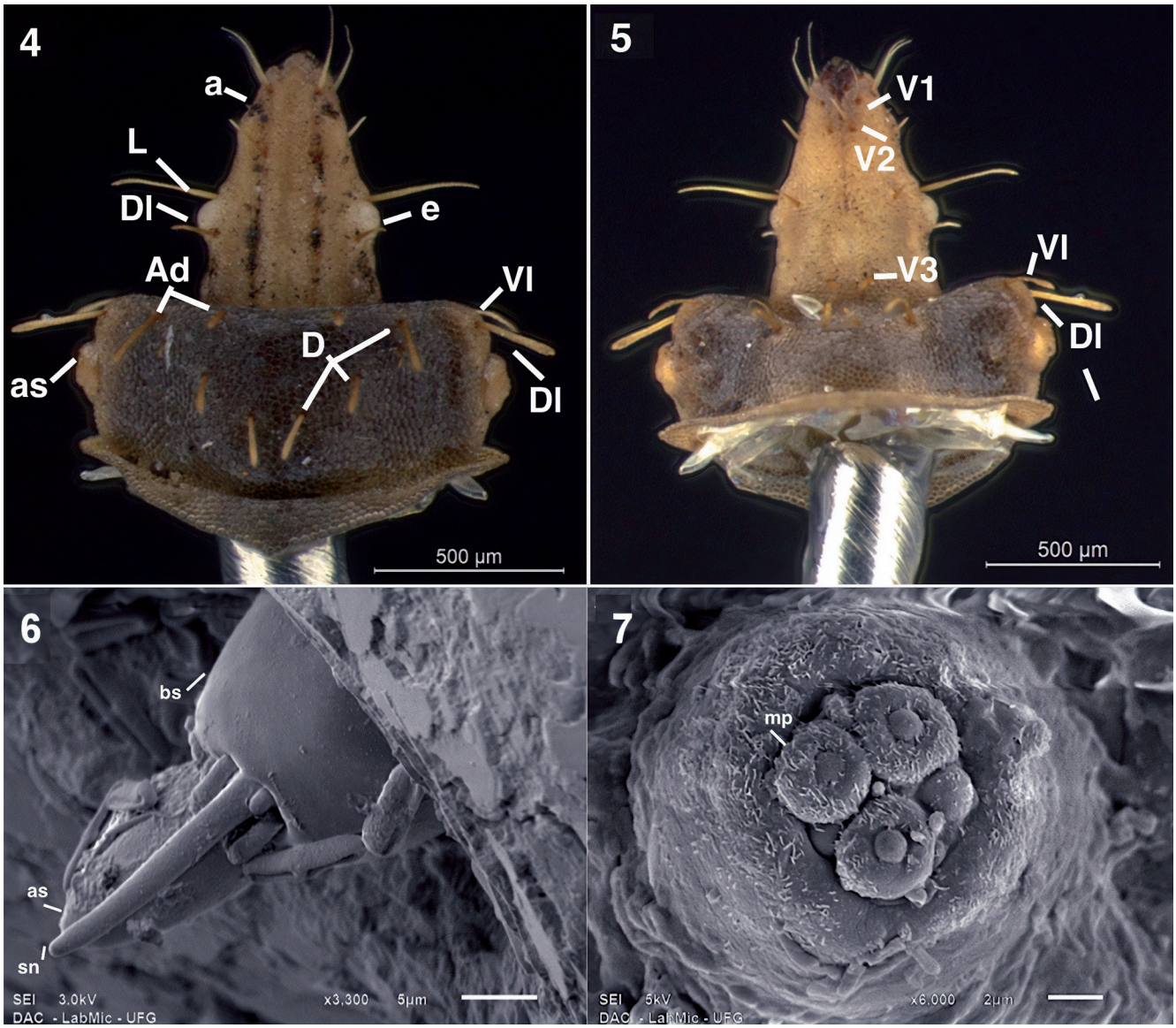
The keys of Woodley (2009), James (1974), James *et al.* (1980) and the original description of *D. brevifacies* James (1974) were used for identification of adults. Male and female terminalia were treated with lactic acid in water-bath for 30 minutes, dissected and temporarily mounted in concave slides with glycerin. The terminalia were preserved in a microvial with glycerin. Photos were taken with Leica DFC295© camera coupled to a Leica M205C© stereomicroscope and Leica DM2000© microscope and measurements (mm) were taken using the LAS-V3-8© software.

The preparation of the puparia for Scanning Electron Microscopy (SEM) was as it follows: After cleaning the puparia, they were preserved in 70% ethanol, dehydrated in a graded series of ethanol solution and dried by the critical point technique with CO2. Dried specimens were mounted on stubs, coated with palladium gold and observed under JEOL JSM 7001 F© scanning electron microscope.

The terminology adopted in the description of the puparia, including the chaetotaxy follows Rozkošný (1982). To describe terminalia we used Sinclair *et al.* (1994). The following abbreviations were used: (a) antenna; (Ad) anterodorsal setae; (Ap) apical setae; (as) anterior spiracle; (bs) basal segment; (cerc) cerci; (Cf) clypeofrontal setae; (D) dorsal setae; (Dl) dorsolateral setae; (e) eye; (epand) epandrium; (goncx) gonocoxites; (goncx apod)



Figures 1-3. (1) Site of collection in the Cerrado vegetation City of Varjão, State of Goiás, Brazil. (2) *Dactylodeictes brevifacies.* Male in dorsal view. Scale bar = 100 µm. (3) *Dactylodeictes brevifacies.* (A) Male in lateral view; (B) Scutellum in dorsal view. Scale bar = 100 µm (Fig. 3a). Scale bar = 200 µm (Fig. 3b).



Figures 4-7. *Dactylodeictes brevifacies.* Puparia. (4) Head and first thoracic segment (dorsal view); (5) Head and first thoracic segment (ventral view); (6) Antennae; (7) Maxillary palpus. Scale bar = 500 µm (Figs. 4-5). Scale bar = 5 µm (Fig. 6). Scale bar = 2 µm (Fig. 7).

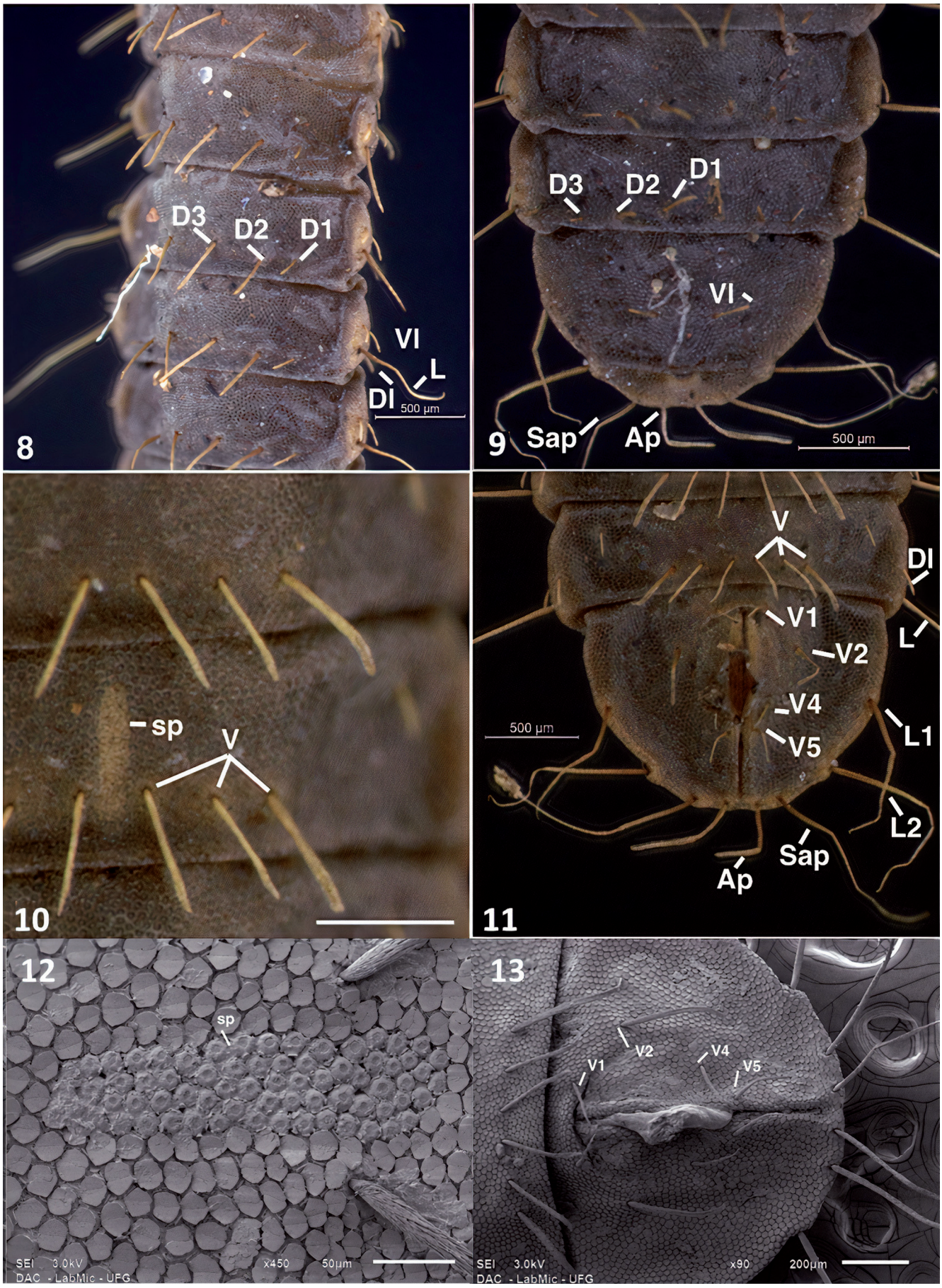
gonocoxal apodeme; (gonst) gonostyles; (hypd) hypandrium; (L) lateral setae; (mp) maxillary palpus; (pb) posterior bridge; (pp) posterolateral process; (sn) sensilla; (Sa) subapical setae; (sp) sternal patch; (V) ventral setae and (Vl) ventrolateral setae.

RESULTS

Dactylodeictes brevifacies James, 1974

Records of geographical distribution: Neotropical: Panama, Peru (Madre de Dios, Avispas), Brasil: (Goiás e Tocantins) new record.

Material examined: Fifty-eight puparia (34 ♂♂ and 24 ♀♀): Brasil, Goiás, *Alvorada,* 09.iii.2004, J. Brandão col. (DZUB), emerged 29.ix.2004 (2 ♀♀), 11.x.2004 (2 ♀♀); *Goiânia,* Campus Samambaia-UFG, 12.xii.2016, W.R. Lopes col. (CZUFG), emerged 25.viii.2017 (1 ♂), 07.ix.2017 (1 ♀), 26.ix.2017 (1 ♂); *Varjão,* 18.xii.2016, W.R. Lopes col. (CZUFG), emerged 09.viii.2017 (1 ♂), 05.ix.2017 (1 ♀), 07.ix.2017 (1 ♂), 09.ix.2017 (1 ♀), 11.ix.2017 (1 ♀), 19.ix.2017 (1 ♀), 01.x.2017 (1 ♂), 09.x.2017 (1 ♀), 24.x.2017 (1 ♀), emerged 20.xii.2017 (1 ♀); *Varjão,* 21.i.2017, W.R. Lopes col. (CZUFG), emerged 09.viii.2017 (1 ♀), emerged 10.viii.2017 (1 ♂), 17.viii.2017 (1 ♂), 22.viii.2017 (1 ♂), 28.viii.2017 (2 ♀♀), 28.viii.2017 (1 ♂), 30.viii.2017 (2 ♀♀), 31.viii.2017 (1 ♂), 04.ix.2017 (1 ♀), 29.x.2017 (1 ♂), 01.xi.2017 (1 ♂, 2 ♀), 02.xi.2017 (1 ♂), 17.xi.2017 (1 ♂), 08.xii.2017 (1 ♂), 27.xii.2017 (1 ♀); *Varjão,* 28.ii.2017, W.R. Lopes col. (CZUFG), emerged 26.viii.2017 (1 ♂), 15.x.2017 (1 ♀), 16.x.2017 (1 ♀), 26.x.2017 (1 ♀), 30.x.2017 (2 ♀♀), 01.xi.2017 (2 ♀♀), 01.xi.2017 (1 ♂), 02.xi.2017 (1 ♂), 22.xi.2017 (1 ♀); *Goiânia,* Campus Samambaia-UFG, W.R. Lopes col. (CZUFG), 29.iii.2017, emerged 13.ix.2017 (1 ♀); 30.iii.2017, emerged 11.ix.2017 (1 ♀), 30.x.2017 (1 ♂), 11.ix.2017 (1 ♀), 31.viii.2017 (1 ♂); Tocantins, *Peixe,* 25.iv.2018, W.R. Lopes col. (CZUFG), emerged 07.xi.2018 (1 ♂), 29.xi.2018 (1 ♀), 28.i.2019 (1 ♂).



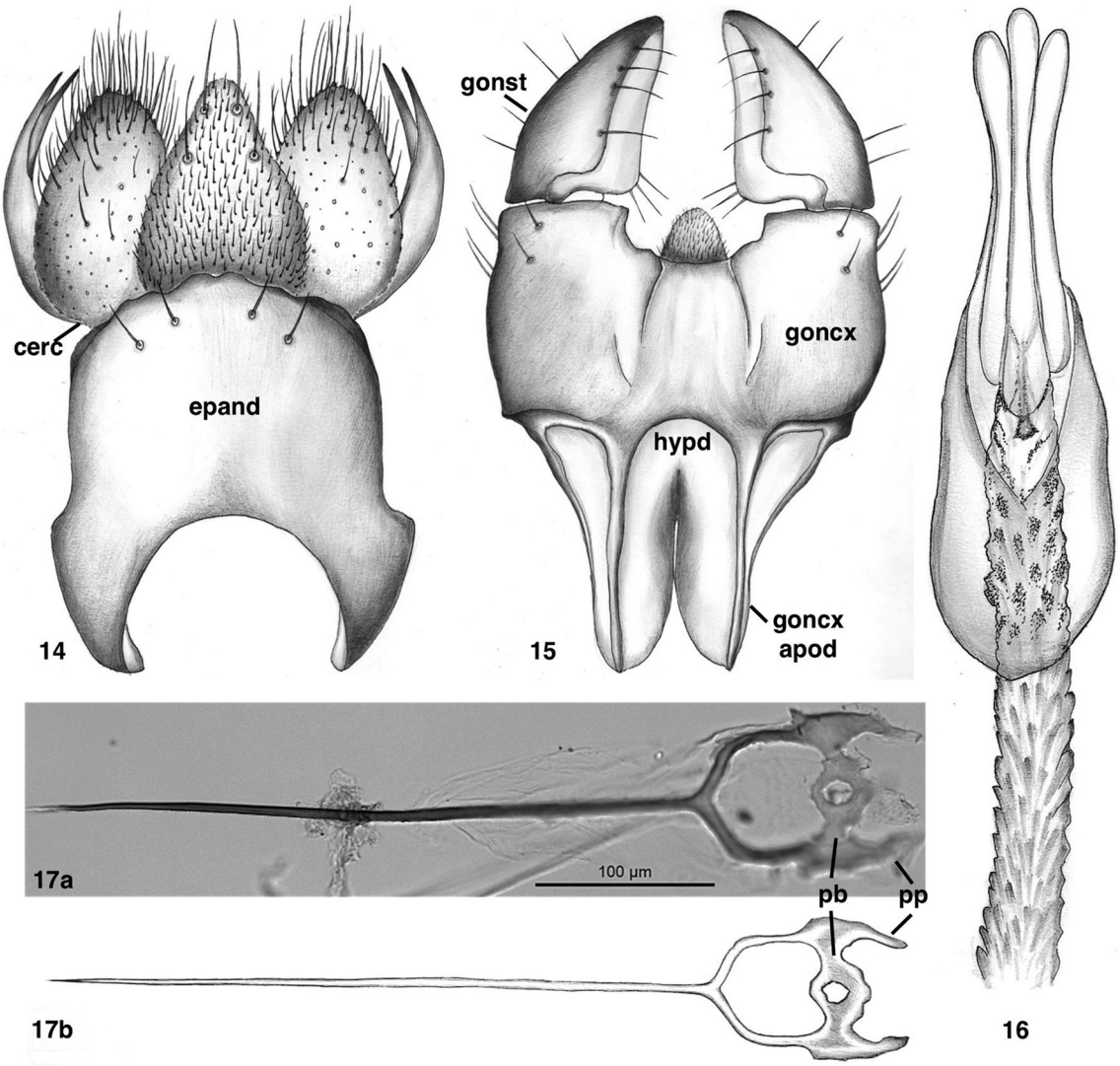
Figures 8-13. *Dactylodeictes brevifacies.* Puparia. (8) Structure of the bristles of the lateral region of the abdominal segments; (9) Abdominal segments (dorsal view); (10) Sixth abdominal segment; (11) Abdominal segments (ventral view); (12) Sternal patch on abdominal segment 6, in ventral view; (13) Abdominal segment 8 in ventral view. Scale bar = 500 µm (Figs. 8-9). Scale bar = 200 µm (Fig. 10). Scale bar = 500 µm (Fig. 11). Scale bar = 50 µm (Fig. 12). Scale bar = 200 µm (Fig. 13).

Puparium: Length 7.2-7.8 mm, body flattened dorsoventrally with head, three thoracic segments, and eight abdominal. Cuticle with usual mosaic appearance. Chromatic pattern dark yellowish-brown. Plumose setae.

Head: Triangular and not dorsoventrally flattened; length slightly larger than the width (Figs. 4-5). In the anterior part of the head, presence of a small antenna with four sensilla, the third much longer than others (Fig. 6; maxillary palpus (mp) with three sensory papillae rounded at apex (Fig. 7). Chaetotaxy: one pair of lateral setae (L) inserted posteriorly to the antenna (a) and ventrally to the eyes (e); two pairs of clypeofrontal setae (Cf) (antenna inserted between the 1st and 2nd pair), dorsolateral setae (Dl) at the height of the final portion of the eye (e) (Fig. 4); three pairs of ventrolateral setae (Vl) and three pairs of ventral setae (V) (Fig. 5).

Thorax: First segment narrower (horizontally) than the other segments and taller (vertically) than the next segment; anterior spiracle (as) prominent with a pair of dorsolateral setae (Dl) and a pair of ventrolateral setae (Vl) above; first segment in dorsal view with two rows of bristles: two pairs of anterodorsal setae (Ad) and three pairs of dorsal setae (D). In ventral view, two pairs of ventral setae (V), the outermost pair being bifurcated (Figs. 4-5); 2nd and 3rd segments with a row with three pairs of dorsal setae (D); two pairs of ventral setae (V), the outermost pair being bifurcated in the 2nd and 3rd segments; a pair of lateral setae (L) and a pair of ventrolateral setae (Vl).

Abdomen: Segments 1-7 with basically the same shape; presence of a row with three pairs of dorsal setae (D) (Figs. 8-9), growing as they move away from the center of the body; three pairs of ventral setae (V) (Figs. 10-11), the outer pair being slightly longer than the others; four pairs of lateral abdominal setae (L) – one dorsolateral pair (Dl), one lateral pair (L), two ventral pairs (V) (Fig. 8); ventromedial line of the sixth segment with a characteristic uniform elliptic sternal patch (sp) (Figs. 10 and 12), the base of the inner ventral setae (V) more distant than in other segments; segment 8 apically rounded, with a pair of dorsal setae; four pairs of ventral setae (V)



Figures 14-17. *Dactylodeictes brevifacies.* Male: (14) epandrium (tergite 9), tergite 10 and cerci, in dorsal view; (15) hypandrium, gonocoxites and gonostyles, dorsal view; (16) aedeagus trifid; Female: (17) genital fork. (A) genital fork optical microscopy; (B) schematic representation draw of genital fork.

(Figs. 11 and 13); two pairs of lateral setae (L), the second pair inserted more dorsally and not facing downwards, a pair of subapical setae (Sap) and a pair of apical setae (Ap).

Male adult terminalia: Epandrium semi-rectangular; proctiger (hypoproct) subtriangular; cerci (cerc) margined with long bristles and bifid spine-like epandrial (Fig. 14); hypandrium (hypd) sub rectangular in dorsal view; gonocoxite (goncx) quadrangular, with gonocoxal apodeme (goncx apod) parallel and rounded ends; posterior margin of the hypandrium is short and arched; gonostyle (gonst) simple, rounded, concave medially (spoon shaped) and arched toward the midline (Fig. 15); aedeagus trifid large with the distal half; lobes of the aedeagus free, projected beyond the distal end of gonocoxite (Fig. 16).

Female adult terminalia: Tergite 9 rounded, wider distally than basally. Genital fork with posterior arm subigual than anterior arm (Fig. 17a-17b); anterior arm arched with an extremely long and thin process; posterior bridge (pb) with a medial orifice, posterolateral process (pp) broader posteriorly. Cercus with only one segment.

TAXONOMIC NOTES

The larvae and puparia of *D. brevifacies* can be identified by the following combination of characters: (1) the first thoracic segment with two rows of setae; (2) two pairs of anterodorsal setae and three pairs of dorsal setae, the third pair of dorsal setae (D3) is longer than the other two pairs of dorsal setae; (3) the sternal patch with elliptical shape in the sixth abdominal segment; (4) the base of the first pair of ventral setae (V1) of the sixth abdominal segment, are more distant than in other segments and (5) the eighth abdominal segment has four pairs of ventral setae. The four pairs of ventral setae (V) in the segment eight of larvae and puparia of *D. brevifacies* was neither observed nor keyed in Rozkošný (1982) nor Pujol-Luz & Pujol-Luz (2014). These authors keyed the Pachygastrinae as having five pairs of setae. The discovery of the immature forms of *D. brevifacies* modifies the Pachygastrinae couplets in the identification keys, update to the presence of 4-5 ventral setae in the eighth segment.

ACKNOWLEDGMENTS

This research was developed with grants from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). We thank Ivan Konstantinov Malinov for the final artwork. To Alexandre Ariel da Fonseca de Souza, Fernando Magela de Jesus and Dr. Martin Hauser (CDFA) for reading the manuscript and making helpful comments and suggestions.

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Published with the financial support of the "Programa de Apoio às Publicações Científicas Periódicas da USP"