



## *Mansonia (Mansonia) iguassuensis* sp. nov. (Diptera: Culicidae) from Brasil

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### Abstract

A new species, *Mansonia (Mansonia) iguassuensis* sp. nov., is described and defined based on morphological characters of adult male and female, male genitalia, fourth-instar larvae and pupae. Descriptions were based on specimens collected in the states of Paraná and São Paulo. Female and male genitalia, fourth-instar larvae and pupae are illustrated.

**Keywords:** Culicidae, *Mansonia iguassuensis*, new species, morphology, systematics

### Introduction

The Mansonini includes two genera *Coquillettidia* Dyar and *Mansonia* Blanchard. The latter contains two subgenera, *Mansonia* Blanchard with 14 Neotropical species (Guimarães, 1997; Barbosa *et al.*, 2005) and *Mansonioides* Theobald with ten oriental species (Ronderos & Bachmann, 1963a) and two Ethiopian species. All species of *Mansonia* and *Coquillettidia* and some species of the non-mansoniine genus *Mimomyia* Theobald have the spiracular apparatus modified for piercing submerged vegetation and obtaining oxygen from plant tissue (Service, 1996).

During ecological studies on Culicidae at the Parque Regional do Iguaçu (PRI), Curitiba, State of Paraná, from 1999 until 2002, we collected several specimens of *Mansonia (Mansonia)* spp. Initially, part of these adults were identified as either *Mansonia titillans* (Walker) or *Mansonia wilsoni* (Barreto & Coutinho). Based on morphological comparisons of the structure of the male genitalia of a paratype of *Ma. wilsoni* and several specimens of *Ma. titillans* collected in Óbidos and Santarém municipalities, both in the State of Pará, we concluded that the specimens collected at PRI were distinctively different from those of *Mansonia titillans* and *Mansonia wilsoni*.

When examining *Mansonia* specimens deposited in the Entomological Collection of Faculdade de Saúde Pública of the Universidade de São Paulo (FSP-USP), we found adult specimens that were morphologically similar to specimens collected at the PRI. Moreover, based on published records on *Mansonia (Mansonia)* species and careful morphological comparison with other *Mansonia* species deposited in the collection, it became evident that the PRI specimens belong to an undescribed species. Diagnostic characters are mainly those of the male genitalia.

In the current study, we describe adult male and female, fourth-instar larva and pupa of a new species, *Mansonia iguassuensis* sp. nov. Male and female genitalia, fourth-instar larva and pupa are illustrated.

## Materials and methods

Adult females of *Mansonia (Mansonia) iguassuensis* **sp. nov.** were collected in the Regional Park of Iguaçú (25° 25' 04" S 49° 14' 30" O), Curitiba, State of Paraná, Brazil. These were transported to the Medical and Veterinary Entomology Laboratory of the Universidade Federal do Paraná, where the field-collected females were fed on blood and kept in individual plastic rearing vials of 50 ml, each containing a sample of *Pistia stratiotes* (L.). After egg hatching, each larva was kept in an individual plastic vial and reared until the adult stage. Individually reared and associated fourth-instar larvae, pupae, and adult males and females were used for species identification and morphological diagnosis. A subset of the larval specimens was preserved in 80% ethanol alcohol and used for morphology and biometry.

Female and male genitalia, fourth-instar larvae, and pupal exuviae were mounted on microscope slides. For descriptions we follow the morphological nomenclature of Belkin *et al.* (1970) and Harbach & Knight (1980). Morphological study included 10 individuals of each stage and calculations of larval and pupal indices followed Forattini (1996).

The holotype is deposited in the Coleção Entomológica Pe. Jesus Santiago Moure (DZUP), Curitiba, Paraná, Brazil. Paratypes are deposited in the DZUP and Faculdade de Saúde Pública, Universidade de São Paulo (FSP-USP), São Paulo, Brasil.

### *Mansonia (Mansonia) iguassuensis* **sp. nov.**

(Figs. 1,2)

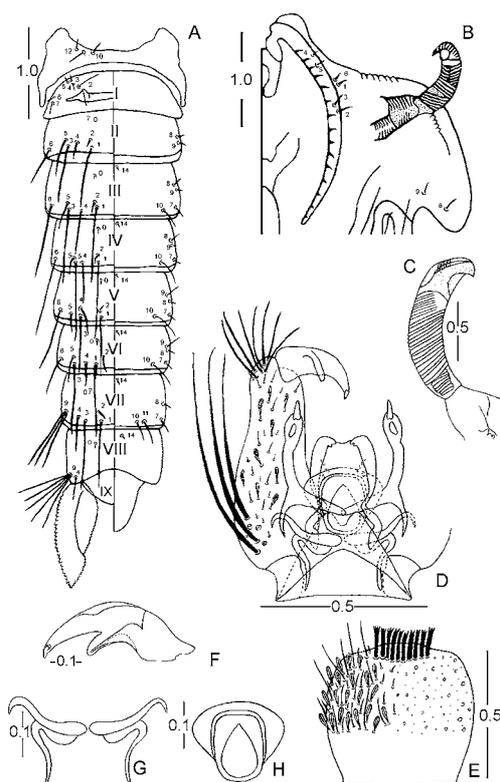
*Mansonia titillans* in part of Costa Lima (1935); Barreto & Coutinho (1944); Pratt (1945); Navarro-Silva *et al.* (2004); Tissot & Navarro-Silva (2004).

*Mansonia wilsoni* in part of Navarro-Silva *et al.* (2004); Tissot & Navarro-Silva (2004).

**Diagnosis.** Scutum of adult male and female covered with small, narrow, dark brown scales, without glabrous areas; abdominal terga with distinct lateral patches of white scales; gonostyle of male genitalia elongate, ventral margin regular, without indentation; pupal setae 4-VIII as long as 0.25 paddle length.

**Female.** Medium-sized mosquito with dark-brown integument; proboscis, maxillary palpi, wings, femora spotted with pale and dark scales. Head: vertex and ocular margin with light golden, slender, decumbent scales; occiput with erect forked dark scales, ocular margin with long, strong, curved and dark setae. Proboscis slightly longer than the anterior femur ( $2.58 \pm 0.10$  mm), predominantly covered with dark scales, middle third mostly covered with light golden scales. Maxillary palpus about 0.33 of the proboscis total length ( $0.88 \pm 0.06$  mm), palpomeres 2 and 3 light and dark-scaled laterally, inner surface without scales, palpomere 4 minute, white and without scales. Antenna shorter than proboscis ( $2.23 \pm 0.17$  mm), flagellomeres whitish at base and darker distally, pedicel with few light scales on medial surface. Thorax: acrostichal, dorsocentral, prescutellar, medial, posterior acrostichal, supraalar and fossal areas with numerous long, strong, curved and dark brown setae. Scutum completely covered by scales, without glabrous areas. Acrostichal, dorsocentral, fossal area, prescutellar and supraalar areas mostly covered with thin, short, dark brown scales with bronzy sheen, except for a large tuft of long and truncate scales among the supraalar setae. Scutum with brown integument, prescutellar area dark brown and the fossal area light to medium brown. Scutellum with light golden scales and long, strong chestnut-colored setae in middle and lateral lobes. Antepronotum, postpronotum, proepisternum, upper and lower mesoepisternum, lower mesoepimerum with strong chestnut-colored setae. Postspiracular area, upper and lower mesokatepisternum and lower mesepimeron with narrow, light golden setae. Antepronotum and postpronotum with narrow, light golden scales; proepisternum, upper and lower mesokatepisternum, anterior and superior mesepimeron with broad light-golden scales Coxae and trochanters with patches of light and dark scales and strong, dark setae. Femur spotted with dark and pale scales, inner

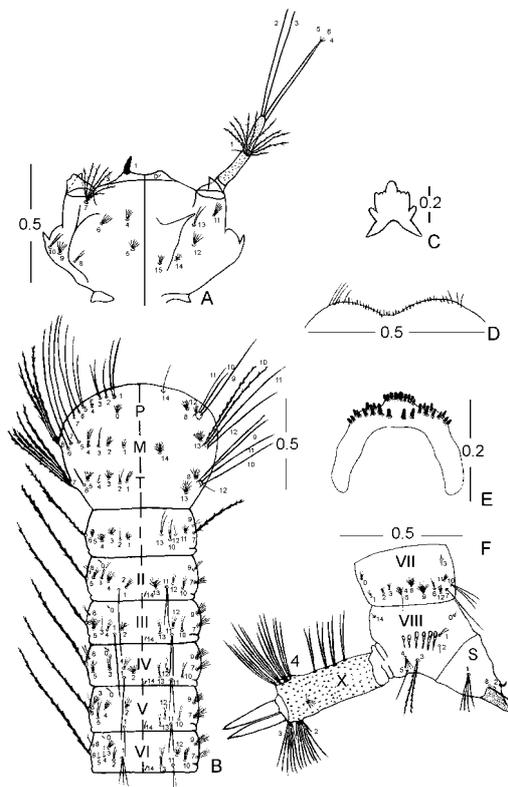
surface of the middle and posterior femur mainly pale-scaled. Anterior femur length  $2.23 \pm 0.13$  mm. Tibiae mostly dark-scaled. Fore and midtarsomeres 1, 2, 3 and 4 with pale scales at base, not forming complete ring; tarsomere 5 entirely dark-scaled. Hindtarsomeres 1-5 with white pale scales at base not forming complete ring. Wings covered with broad asymmetrical and elongated scales. Wing scales predominantly dark, intermixed with pale scales. Wing length  $5.23 \pm 0.30$  mm. Wing fringe with elongated, light grey, scales. Halter: pedicel pale, capitellum dark-scaled. Abdomen: length  $4.46 \pm 0.15$  mm; tergum I with medial, somewhat rounded patch of pale scales; tergum II mainly dark-scaled, with a small lateral apical patch of white scales. Terga III-VII with light golden scales intermixed with dark scales laterally, with a small lateral apical patch of white scales. Tergum VII (Fig. 2D) with apical posterior row of short spines; tergum VIII (Fig. 2E) with anterior row of about 14 strong dark spines and one posterior row of about 7 spines and one central group with nine.



**FIGURE 1.** *Mansonia iguassuensis* sp. nov. (A) Pupal metanotum and abdomen (dorsal and ventral views), (B) Pupal cephalothorax, (C) Pupal respiratory trumpet, (D) Male genitalia (dorsal and ventral views), (E) Male tergum VIII (ventral view), (F) Male gonostyle (lateral view), (G) Paramere and gonocoxal apodeme (dorsal view), (H) Male aedeagus (dorsal view). Scale bars in mm.

**Male.** Similar to female except pale scales more abundant on terga. Abdomen: tergum I almost entirely covered by light scales, tergum II with pale scales covering posterior 0.5 of segment; terga III-V with posterior band of pale scales, narrower than band of tergum II, tergum VI-VIII without a conspicuous band of pale scales. Maxillary palpus longer than the proboscis by the length of the palpomere 5; dorsal surface with light scales intermixed with dark scales, with conspicuous bands of white scales on palpomeres articulations; medial surface without scales; apex of palpomere 3 with tuft of fine straight setae ventrally, extending to middle of palpomere 5; palpomeres 4 and 5 with long, strong, straight setae projecting downward. Wing length  $4.44 \pm 0.13$  mm; forefemur  $2.08 \pm 0.13$  mm; maxillary palpus length  $2.48 \pm 0.11$  mm; proboscis length  $2.31 \pm 0.12$  mm; abdomen length  $5.12 \pm 0.12$  mm; antennal length  $1.61 \pm 0.07$  mm. *Male genitalia:* tergum VIII (Fig 1E) with a row of 10 setae posteriorly, apex of each setae divided into 2-5 branches. Segment IX poorly devel-

oped, membranous, covered with minute spicules. Gonocoxite (Fig. 1D) elongated, base wider than apex, dorsal and ventral surfaces separated by medial membrane. Gonocoxite with tuft of somewhat curved, long and strong setae arising apicolaterally, these setae shorter than gonocoxite length, basolateral surface with tuft of long, strong setae, extending beyond apex of gonocoxite, area of gonocoxite between basolateral and apicolateral setal tufts with short, sparse setae; lateral and ventral surfaces with scales. Gonostyle (Fig. 1F) long, arising from gonocoxite apex, with width similar in all its length, curving and tapering to a narrow apex, ending in one short, strong apical seta, gonostyle with ventral margin smooth, and basolateral lobe projecting distally and downward; well pigmented, except for the light brown area of the gonostyle ventral margin. Claspette (Fig. 1D) long, nearly reaching apex of gonocoxite; stem of claspette long, narrowing towards distal end; apical setae of claspette short and thick; claspette forked at base, internal branch of claspette joined to that of the opposite side, lateral branch of claspette articulated with base of gonocoxite. Proctiger (Fig. 1D) long, wide at base, subtriangular and membranous, paraprot strongly sclerotized, 16 minute cercal setae, medial constriction at the level of the insertion of the tergite X. Paramere (Fig. 1G): elongated, wide, narrowed, and curved distally; gonocoxal apodeme (Fig. 1G) elongated, base widened and slightly rounded, external margin with angular projection facing outside, with an angle less than 90, that articulates with the base of the paramere, supporting around half the width of the base of the latter. Aedeagus (Fig. 1H) short and thick, conspicuously swollen and less sclerotized at distal 0.5, basal more sclerotized than distal part.



**FIGURE 2.** *Mansonia iguassuensis* sp. nov. (A) Larval head (dorsal and ventral views), (B) Larval thorax and abdomen (dorsal and ventral views), (C) Larval mental plate (dorsal view), (D) Female tergum VII, (E) Female tergum VIII, (F) Larval terga VII, VIII, X and siphon (lateral view). Scale bars in mm.

**Pupa.** Chetotaxy as in Figure 1A and B; setae single and simple, except 9-VII, VIII. Cephalothorax (Fig. 1B): integument and setae light brown; respiratory trumpet brown (Fig. 1C), trumpet index 8.5 ( $n=10$ ), tracheoid area dark brown, extending along posterior surface to pinna; pinna light brown, curved laterally at distal part, with brown apical process adapted to perforate and fixes pupae to plant tissues. Metanotum and abdomen

(Fig. 1A): integument light brown. Abdomen (Fig. 1A): dorsal setae strongly developed, ventral setae shorter; setae 1,5-II not extending beyond following segment; 6-III-VI extending beyond following segment; 2-I-VII, 3-I-VII and 6-I-VI present, 6-VII and 8-I absent, seta 9-I absent, 9-II-VII present, 10-I,II absent, 11-VII present. Paddle light brown, with serrated edges; paddle index 2.85 ( $n=10$ ).

**Fourth-instar larva.** Chetotaxy as in Figure 2A, B and F. Most setae strongly developed. Head (Fig. 2A): moderately pigmented, except for the darkened collar and ocular region; length  $0.98 \pm 0.04$  mm ( $n=10$ ), width  $1.52 \pm 0.07$  mm ( $n=10$ ). Cephalic capsule distinctly wider than long; ocular region with conspicuous spike-like anterior projection; setae light colored except setae 1-C, which is dark brown, seta 7-C prominent, multi-branched, strongly spiculate. Apex of antennal socket with long, smooth spine arising ventrolaterally. Antenna: light brown with short spicules, more prominent and dense dorsolaterally; apical flagellar appendix yellowish, slightly shorter than antenna, seta 1-A multibranched, dark brown, setae 2,3-A simple, slightly longer than last flagellomere. Thorax (Fig. 2B): tubercles of thoracic setae light brown, integument without spicules, setae long and well pigmented, most setae long, flattened and multibranched. Abdomen (Fig. 2B): as pigmented as thorax; setal tubercles moderately pigmented; seta 1 II-V single, 6 I-VI single and multi-branched, 11-II-VI double, sometimes triple. Segment VIII (Fig. 2F) with 6 (5-7) comb scales, scales unequal in size; seta 3-VIII doubled; seta 5-VIII single. Siphon (Fig. 2F): moderately pigmented, light brown, dark pigmented at apex and adapted to perforate and fix larva to plant tissues; siphon index 1.28 ( $n=10$ ). Seta 1-S with four branches, rarely with five branches. Segment X (Fig. 2F): saddle slightly longer than the siphon, saddle yellowish to beige in color, with strong spicules on dorsal surface, 2-4-X brown, strongly pigmented at base, 4-X comprising four pairs of flattened, strongly pigmented, multiple setae arising from a grid, four double setae inserted outside the grid.

**Etymology.** The name *iguassuensis* is derived from Iguau, the type locality of the new species.

**Geographical distribution.** *Mansonia iguassuensis* **sp. nov.** is known from the type-locality, Curitiba (25°25'04"S 49°14'30"W), Paraná, Brazil; São Paulo (23°33'45"S 46°41'15"W), São Paulo, Brazil; and Miranda (20°11'15"S 56°26'15"W), Mato Grosso do Sul, Brazil. The geographical distribution is possibly underestimated because this species has been misidentified as *Ma. titillans*, *Ma. indubitans* Dyar & Shannon and *Ma. wilsoni*.

**Bionomics.** Immatures of *Ma. iguassuensis* **sp. nov.** are associated with the roots and leaves of the aquatic plant *Pistia stratiotes*. Adult females are aggressive blood feeders, with biting activity at sunset and throughout the night (Navarro-Silva *et al.*, 2004; Tissot & Navarro-Silva, 2004). *Mansonia iguassuensis* were collected in a forest environment; however, the species is found in cities and nearby areas when favorable breeding habitats exist. In the Parque Regional do Iguaçu, where there is a large lake with floating vegetation, *Ma. iguassuensis* **sp. nov.** is a nuisance, biting throughout the day.

**Medical importance.** Nothing is known about the medical importance of *Mansonia iguassuensis* **sp. nov.**

**Material examined.** *Mansonia iguassuensis*. HOLOTYPE: adult male with associated larval and pupal exuviae and genitalia on a microscope slide, collected in Curitiba (25°25'04"S 49°14'30"W), state of Paraná, BRAZIL, 12/X/ 2005, D.C. Calado coll. deposited in the Coleo Entomologica Pe. Jesus Santiago Moure (accession number DZUP 160440). PARATYPES: 3 adult males with associated larval and pupae exuviae and genitalia on microscope slides, same data as the holotype (DZUP); 1 male and 2 females with associated larval and pupal exuviae and genitalia mounted on slides, same data as the holotype, deposited in Faculdade de Sade Pública da Universidade de So Paulo (FSP-USP). OTHER MATERIAL: BRAZIL: So Paulo, So Paulo, Represa Billings, VII/ 1956, Crrea, F. & Ramalho, A. coll., 1 male with genitalia mounted on slide (FSP-USP). Mato Grosso do Sul: Miranda, Fazenda Guaicurus, 19/IX/2001, Koller, W.W. coll., 5 females (DZUP). Paraná: Curitiba, Parque Regional do Iguau, 12/X/2005, D.C. Calado coll., 2 males with larval and pupae exuviae, 2 females with larval and pupae exuviae, 5 larval exuviae and entire pupae, 5 entire larvae (DZUP); Parque Regional do Iguau: 7/XII/2000, M. Chrestani *et al.* coll., 3 male genitalia mounted on slides (DZUP); Parque

Regional do Iguau : 18/XII/2000, M. Chrestani *et al.* coll., 1 male genitalia mounted on slide (DZUP); Parque Regional do Iguau : 18/V/2001, M. Chrestani *et al.* coll., 1 male genitalia mounted on slide (DZUP). OTHER SPECIES EXAMINED: *Mansonia wilsoni*. PARATYPE, BRAZIL: So Paulo, So Paulo, 1941, Barreto, M.P. & Coutinho, J.O. coll, 1 male with genitalia mounted on slide (FSP-USP). *Mansonia titillans*, BRAZIL: Paribidos, Ilha do Amador Ilha Grande, Paran do Capivara, Rio Amazonas, 29-30/X/2003, R.S.G. Hutchings *et al.* coll., 4 males with associated genitalia mounted on slides (INPA); Santarm: Paran de Ituavi, Rio Amazonas, 25-26/X/2003, R.S.G. Hutchings *et al.* coll., 1 male with associated genitalia mounted on slide (INPA); Amazonas: Manacapur, Paran do Cururu, Rio Solimes, 29-30/IX/2003, R.S.G. Hutchings *et al.* col., 3 males with associated genitalia mounted on slides (INPA).

## Taxonomic discussion

Separating species of *Mansonia* (*Mansonia*) remains problematic, mainly because of polymorphisms, morphological similarities and overlapping characters among congeneric species (Costa Lima 1935; Barreto & Coutinho; 1944, Pratt, 1953; Boreham, 1970; Belkin *et al.*; 1970; Lane, 1992). Additionally, some species are known only from one life stage, e. g. *Mansonia amazonensis* (Theobald), *Mansonia chagasi* (Costa Lima), *Mansonia cerqueirai* (Barreto & Coutinho), *Mansonia pessoai* (Barreto & Coutinho), *Mansonia suarezi* (Cova-Garcia & Sutil) and *Mansonia wilsoni*.

Consequently, it is possible that these poorly known and potentially new species have been misidentified as other *Mansonia* (*Mansonia*) species in the literature. This may be the case for *Ma. iguassuensis* because adults of this species can be misidentified as *Ma. titillans*, *Ma. indubitans*, *Ma. wilsoni* and *Ma. humeralis* Dyar & Knab when using available identification keys. However, in a taxonomic revision conducted by Barbosa (unpublished), it was possible to separate adult females and males of all four species. Our observations indicate that characters of the male genitalia of *Ma. iguassuensis* are more similar to those of *Ma. humeralis* than those of any other *Mansonia* species. In contrast, adult females of *Ma. iguassuensis* can be misidentified as *Ma. titillans*. This could partially explain the wide distribution of *Ma. titillans* reported in the literature. Costa Lima (1935), Barreto & Coutinho (1944) and Pratt (1945) illustrated the male genitalia of specimens that were identified as *Ma. titillans* but are similar to those of *Ma. iguassuensis*.

*Mansonia iguassuensis* can be distinguished from *Ma. titillans* in the adult stage by the following characters: abdominal terga with light golden scales intermixed with dark scales laterally and a small apicolateral patch of white scales; scutum entirely covered with short, narrow scales, without glabrous areas; and gonostyle smooth, without an acute angular projection on ventral margin. In *Ma. titillans* the abdominal terga are mostly dark-scaled, with light golden scales intermixed with dark scales laterally, without apicolateral patch of pale scales; scutum glabrous between acrostichal and dorsocentral areas; and gonostyle with one or two acute angular projections on ventral margin.

Adult females of *Ma. iguassuensis* can be easily distinguished from those of *Ma. indubitans* by a row of minute black spines at the apex of tergum VII, and by possessing a central group of contiguous spines that form a compact row in the posterior part of tergum VIII. In *Ma. indubitans*, tergite VII has no apical spines, and in tergum VIII the spines of the central group arise equidistant, and consequently do not form a compact group. Regarding the male genitalia, the gonostyle of *Ma. indubitans* is shorter and thicker than that of *Ma. iguassuensis*.

In comparing adults of *Ma. wilsoni* with those of *Ma. iguassuensis* it is apparent that in the former species the central part of the mesokatepisternum, mesepimeron and mesomeron is dark-brown and the region between the acrostichal and dorsocentral areas is glabrous, whereas in *Ma. iguassuensis* the central part of the mesokatepisternum, mesepimeron and mesomeron is chestnut in color and the scutum is uniformly covered with scales, without glabrous areas. The male genitalia of *Ma. wilsoni* can be easily distinguished from that of

*Ma. iguassuensis* by the presence of an apical lobe in the gonocoxite and a strongly developed, club-shaped claspette. In *Ma. iguassuensis* the apical lobe of the gonocoxite is absent and the claspette is columnar.

*Mansonia iguassuensis* and *Ma. humeralis* are morphologically similar in several features. The scutum is uniformly covered with short, narrow scales, without glabrous areas; the gonostyle is elongated, without an angular acute projection on ventral margin; in pupae, setae 4-VIII is approximately 0.25 the length of the paddle; in fourth-instar larvae, setae 4-X consists of four pairs of elements inserted on the grid, and four double elements inserted outside the grid. *Mansonia iguassuensis* can also be distinguished from *Ma. humeralis* by having acrostichal, dorsocentral, fossal, prescutellar, and supraalar areas entirely covered with bronze scales that are uniform in size, shape and color, and by the absence of semi-erect scales on the basal half of the hindtibia. In *Ma. humeralis*, the scales on the fossal area are golden, forming a distinct anterolateral pattern, the remaining scutal scales are bronze, and the basal half of the hindtibia is covered with semi-erect scales. Based on characters of the male genitalia, *Ma. iguassuensis* can be distinguished from *Ma. humeralis* by possessing the gonostylus somewhat broader than that of *Ma. humeralis* from base to median region, tapering to apex ending in a somewhat narrow apex, width of base and apex distinct. In *Ma. humeralis*, the gonostylus is somewhat narrow and regular in width from base to median region, slightly tapering to apex, width of base and apex not strongly distinct. In the pupae of *Ma. humeralis*, setae 1-II and VII are strong and short, whereas in *Ma. iguassuensis* these setae are long and slender. Fourth-instar larvae of *Ma. iguassuensis* differ from those of *Ma. humeralis* by possessing a seta 3-VIII that is double (vs. triple in *Ma. humeralis*).

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