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Two new species of *Ulmeritoides* Traver (Ephemeroptera: Leptophlebiidae) from Southeastern Brazil

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Abstract

Two new species of *Ulmeritoides* Traver, 1959 are described from Southeastern Brazil based on male and female imagos. *Ulmeritoides angelus* **sp. nov.** (Holotype male deposited in DZRJ: Minas Gerais State) differs from all other species of the genus by the following combination of characters: forewings hyaline, base dark brown and purplish; veins R1 light brown; dark brown spots on bullae of veins Sc and R2; apex of penis lobes somewhat rounded, each with one central spine. *Ulmeritoides tamoio* **sp. nov.** (Holotype male deposited in DZRJ: São Paulo State) differs from all other species of the genus by the following combination of characters: wings hyaline; veins C, Sc and R1 brownish; brownish spots on bullae of veins Sc and R2; apex of penis lobes straight, ending in rather acute apical and mesal projections. An updated key to the genera *Ulmeritoides* Traver, 1956 and *Ulmeritus* Traver, 1956 is also given.

Key words: Atalophlebiinae, Mayfly, South America, Atlantic Forest, Neotropical

Introduction

Ulmeritoides was established by Traver (1959) as a subgenus of *Ulmeritus* with two other subgenera, *Ulmeritus* Traver, 1956 and *Pseudulmeritus* Traver, 1959. Originally, *Ulmeritoides* included two species: *Ulmeritus* (*Ulmeritoides*) *uruguayensis* Traver, 1959 and *Ulmeritus* (*Ulmeritoides*) *luteotinctus* Traver, 1959, but later Thew (1960) described *Ulmeritus* (*Ulmeritoides*) *adustus* Thew, 1960.

Domínguez (1991) reared for the first time nymphs of the subgenus *Ulmeritoides*, which led him to elevate *Ulmeritoides* to generic status, synonymizing the subgenus *Pseudulmeritus* with *Ulmeritoides* and transferring *Ulmeritus flavopedes* (Spieth, 1943) to this genus. In his cladistic analysis of *Ulmeritus*-*Ulmeritoides* group, Domínguez (1995) demonstrated the monophyly of *Ulmeritus* and *Ulmeritoides*, as well as the position of *U. flavopedes* within *Ulmeritoides.* Since then, several new species were described and the nymphal stages of other species became known (Mariano & Froehlich 2007; Salles & Domínguez 2012). For this reason and the discovery of two new species, Salles & Domínguez (2012) recently performed a new cladistic analysis, again recovering the monophyly of the two genera and finding a clear differentiation between the Central and South American groups. Eight species of *Ulmeritoides* are recorded from Brazil: *Ulmeritoides araponga* Salles & Domínguez, 2012; *Ulmeritoides flavopedes*; *Ulmeritoides haarupi* (Esben-Petersen, 1912); *Ulmeritoides misionensis* Domíguez, 1995; *Ulmeritoides nigribullae* Salles & Domínguez, 2012; *Ulmeritoides passorum* Gama Neto & Hamada, 2014; *Ulmeritoides patagiatus* (Thew, 1960); and *Ulmeritoides uruguayensis*. In this work we describe and illustrate two new species of *Ulmeritoides* based on imagos from Southeastern Brazil. We also describe and illustrate for the first time eggs of *Ulmeritoides*.

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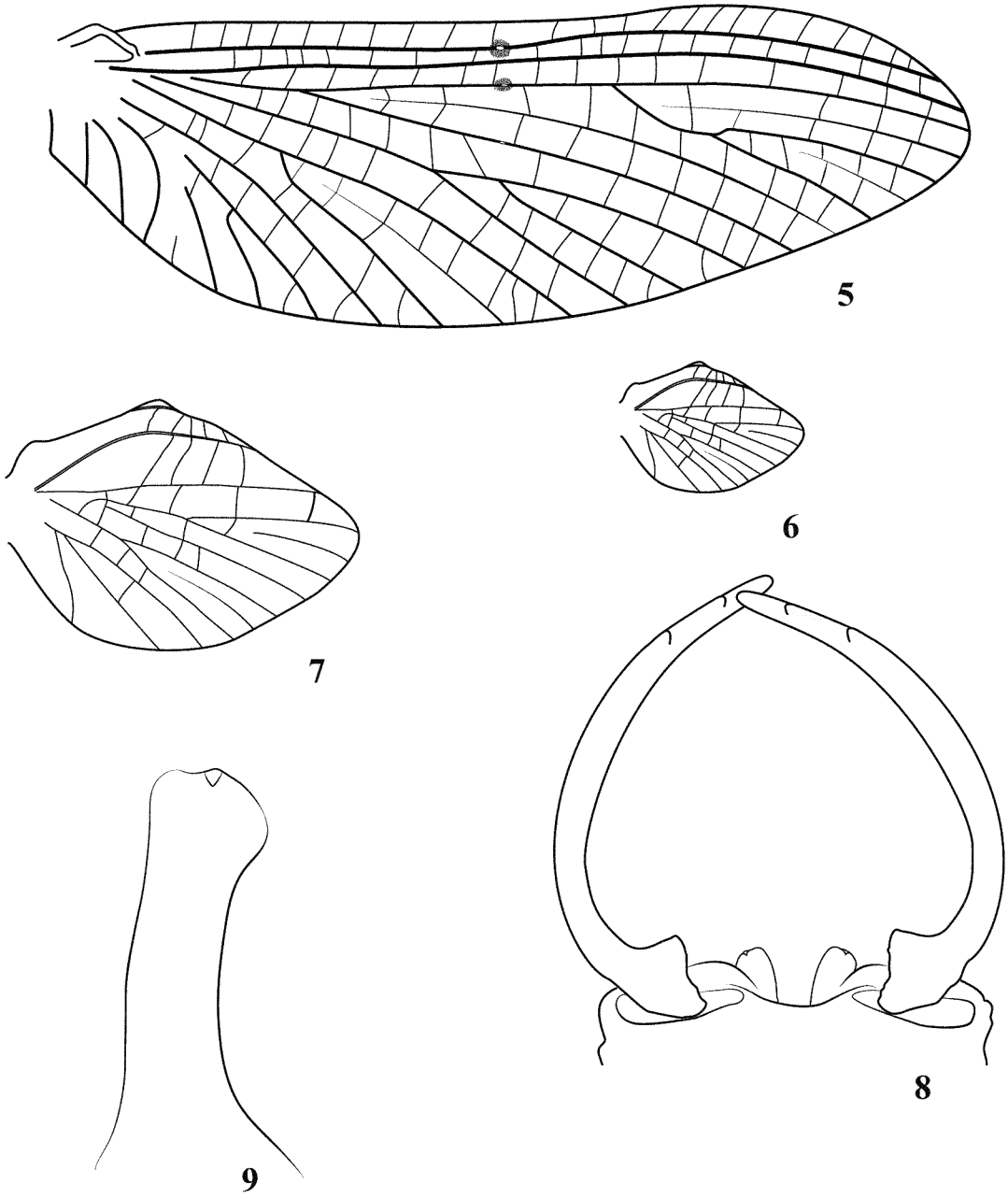
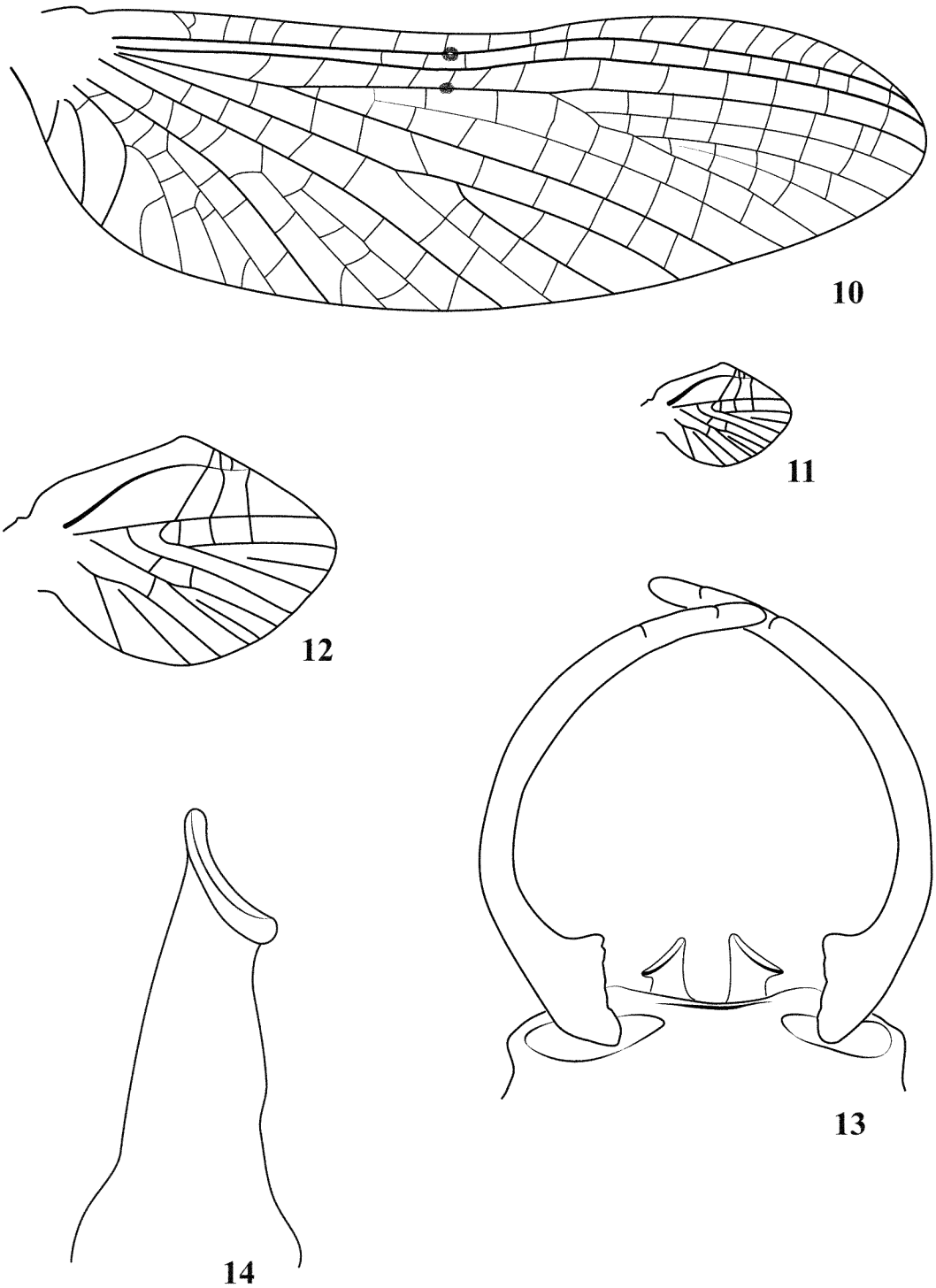
FIGURES 1–4. Male imagos of *Ulmeritoides* species. **1–2**. *U. angelus* **sp. nov.** in dorsal (1) and lateral (2) views; **3–4.** *U. tamoio* **sp. nov.** in dorsal (3) and lateral (4) views.

Material and methods

Specimens are preserved in 80% ethanol and deposited in Coleção Entomológica Professor José Alfredo Pinheiro Dutra (DZRJ—Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil) and Coleção Zoológica Norte Capixaba (CZNC—Universidade Federal do Espírito Santo, São Mateus, Brazil). Specimens were caught on light traps and collecting sites were marked with a GPS device using the datum WGS84. Photographs were taken with digital camera coupled to stereomicroscope Leica S8APO and combined using the software CombineZP®. Then, photographs were used as templates for trace vector graphics in Adobe Illustrator CS6® software to produce the illustrations. Eggs were removed from females of the two new species and then mounted with double sided tape on SEM stubs and sputter coated with gold. They were observed and photographed with Jeol JSM-6510 scanning electron microscope. The terminology proposed by Koss & Edmunds (1974) was used to describe the eggs.



FIGURES 5–9. *Ulmeritoides angelus* **sp. nov.**, male imago. **5.** fore wing; **6.** hind wing; **7.** hind wing (enlarged); **8.** genitalia (ventral view); **9.** penis lobe (ventral view).



FIGURES 10–14. *Ulmeritoides tamoio* **sp. nov.**, male imago. **10.** fore wing; **11.** hind wing; **12.** hind wing (enlarged); **13.** genitalia (ventral view); **14.** penis lobe (ventral view).

***Ulmeritoides angelus* sp. nov.**
(Figures. 1–2, 5–9, 15–18, 20, 21)

Material examined. HOLOTYPE: BRAZIL, Minas Gerais, Conceição do Mato Dentro, Serra do Intendente, Rio Peixe Tolo, 19°00'14.40"S, 43°36'45.00" W, 700 m a.s.l., 08–09.IX.2012, Salles, F.F., Rocha, I. & Braga, A. leg., 1 male imago (DZRJ 2402). 13 PARATYPES: same data as holotype but, 1 male imago reared from subimago

(DZRJ 2403) and 4 female imagos (DZRJ 2404); 4 female imagos (DZRJ 2405); same data as holotype, 1 female imago (CZNC Ep-6428); Jaboticatubas, Parque Nacional da Serra do Cipó, Córrego das Pedras, 19º22'16.7"S, 43º36'02.8"W, 766 m a.s.l., 02.III.2013, Oliveira, A.L.H. leg., 1 male imago reared from subimago (DZRJ 2406); Santana do Riacho, Parque Nacional da Serra do Cipó, Córrego Bocaina, 19°20'45.50"S, 43°35'26.30"W, 796 m a.s.l., 03.III.2013, Oliveira, A.L.H. leg., 1 female subimago (DZRJ 2407); same data, 1 male imago (CZNC Ep-6429).

Holotype Male Imago (in alcohol, wings on slide). Length of body 9.0 mm; forewings: 11.0 mm; hindwings 2.0 mm; General color light brown. Forewings with veins whitish except vein R1 light brown.

Head (Figs 1–2): light brown, shaded with dark brown around base of antennae; anterior margin of head whitish with black tinge. Upper portion of eyes orange brown, lower portion black. Ocelli white surrounded with black. Scape and pedicel light brown, flagella whitish brown. Ventrally, head tinged with black with points of insertion of mouthparts whitish.

Thorax (Figs 1–2): pronotum light brown shaded with black, lateral margins black. Meso and metanotum light brown; mesoscutellar impression yellowish. Sterna light brown tinged with dark brown; sutures dark brown. Pleura beige with strong purplish shade.

Wings (Figs 5–7): membrane hyaline, base tinged with dark brown and purplish; veins whitish. Forewings with vein R1 light brown; membrane with distal half between C and R1 whitish; 10 cross veins basal to bullae; dark brown spots on bullae of veins Sc and R2.

Legs: leg I with coxae and trochanters light brown heavily shaded with dark brown, pleura between both segments beige with strong purplish shade; femora light brown with dark brown maculae, outer surface of femora more heavily shaded with dark brown than inner margin; tibiae light brown shaded with dark brown, particularly on apical half, apex whitish, presence of a median yellowish white maculae; tarsi whitish, tarsi III–V shaded with brown on basal 2/3; tarsal claws whitish tinged with brown. Legs II and III with coxae and trochanters yellowish brown heavily shaded with dark brown, pleura between both segments beige with purplish shade; femora, tibiae, tarsi and tarsal claws yellowish-brown; femora of both legs with dark brown maculae, two on outer and three on inner surface; leg II with dark brown subapical mark on tibiae.

Abdomen (Figs 1–2): terga I–IX beige shaded with black, terga I–III more heavily shaded; tergum X yellowish brown; medial line well marked, dark brown on terga I–III, light brown on remaining terga. Sterna I–VIII beige heavily shaded with dark brown; sternum IX yellowish-brown. Caudal filaments with short simple setae, filaments whitish with alternate dark brown annulations.

Genitalia (Figs 8–9): styliger plate and penes yellowish brown, forceps whitish. Base of forceps with crenulations on inner margin. Apex of penis lobes somewhat rounded, without ventral keel, each lobe with one central spine frontally directed.

Variations in paratypes. One male with 11 crossveins basal to bullae on forewings, other with 8 crossveins on one of the wings. Several color variations: fore femora sometimes lighter in color, maculae on fore femora sometimes not very distinguishable on outer surface, femora of legs II and III sometimes without all of the described maculae.

Male subimago. All specimens collected in this stage molted to imago, subimagos were, however, observed and photographed in the field (Fig. 15). Wings dark grey.

Female Imago. Length of body 8.5 – 9.0 mm; forewings: 11.0 – 11.6 mm; hindwings 2.4 mm; General color light brown and beige. Forewings with veins whitish.

Head: similar to male imago.

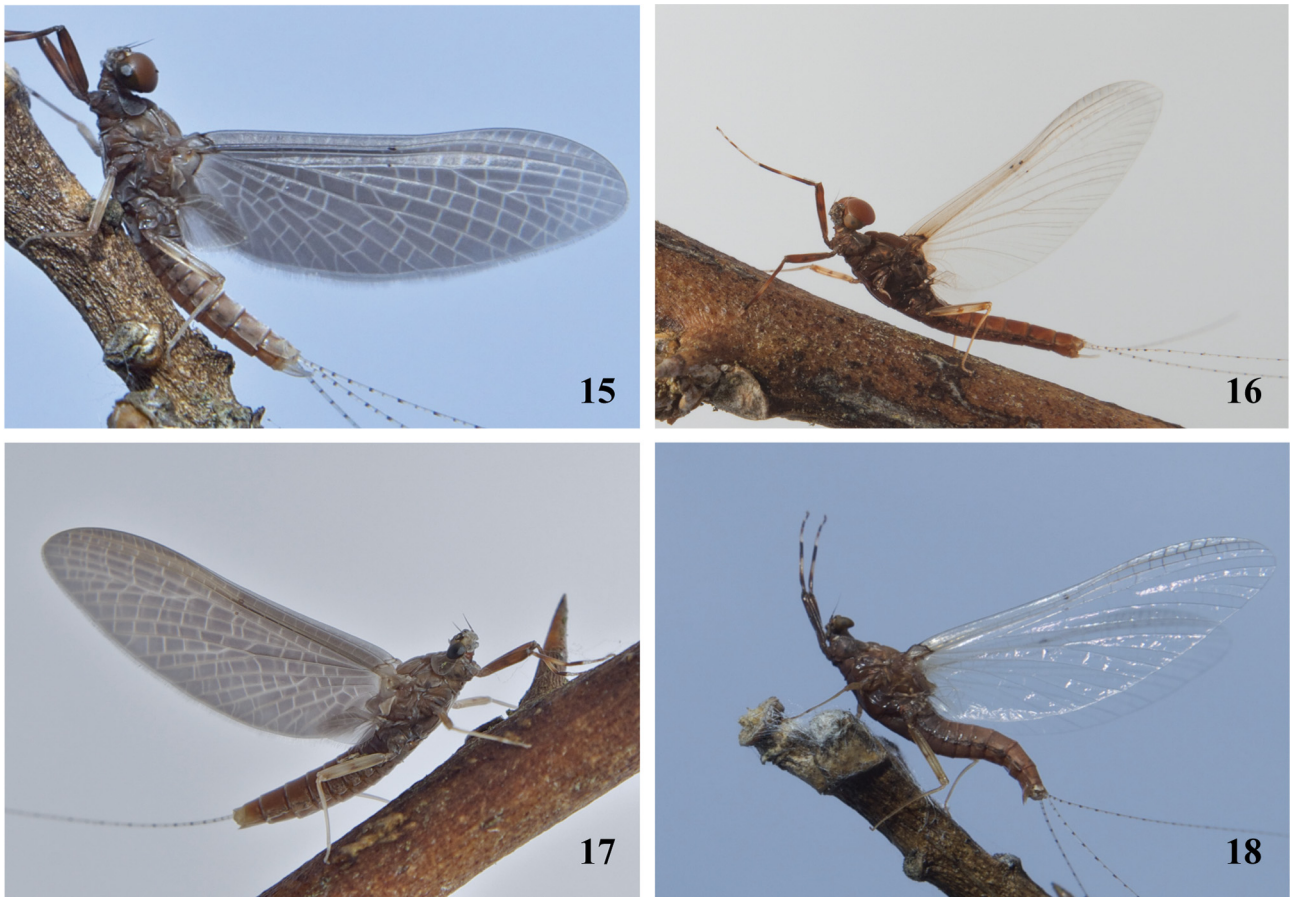
Thorax: similar to male imago.

Wings: hyaline, base tinged with dark brown and purplish. Forewings with longitudinal veins light brown, crossveins whitish; membrane with distal half between C and R1 whitish; dark brown spots on bullae of veins Sc and R2; 8–10 crossveins basal to bullae. Hindwings with veins whitish.

Legs: legs similar to male imago. Leg I with same color pattern only darker and shorter.

Abdomen: when without eggs, same color pattern as male imago except somewhat translucent; when bearing eggs, color pattern altered due to egg color, yellowish. Sternum IX broadly cleft apically. Caudal filaments lost.

Egg (Figs. 20, 21): yellow. Egg mass spherical, eggs elliptical in shape. Attachment structures as sucker-like discs or plates and fiber-coil; chorion punctate and with tubercles.



FIGURES 15–18. *Ulmeritoides angelus* **sp. nov.**, imago and subimago. **15.** male subimago; **16.** male imago; **17.** female subimago; **18.** female imago. Photos by Frederico F. Salles.

Female subimago. similar to imago, except the wings, which have dark grey membrane, even darker in the living specimen.

Nymph. Unknown.

Biology. Unknown.

Etymology. *angelus* specific name after the entomologist colleague Angelo B. M. Machado on the occasion of his 80th birthday. Name in apposition, nominative singular from classical form.

Remarks. *Ulmeritoides angelus* **sp. nov.** can be separated from other species of the genus according to the following combination of characters: (1) forewings hyaline, base dark brown and purplish; (2) veins R1 light brown; (3) dark brown spots on bullae of veins Sc and R2 (Fig. 5); (4) abdominal color pattern as on Figures 1–2; (5) apex of penis lobes somewhat rounded, each with one central spine (Figs 8–9).

The new specie resembles *U. flavopedes* especially because of the abdomen color pattern and black markings on the bullae. However, *U. angelus* **sp. nov.** can be separated from it by the presence of dark brown spots on bullae of veins Sc and R2 and the penis morphology. *Ulmeritoides flavopedes* possess spots on bullae of vein Sc and the apex of penis lobes rounded, each with a lateral groove, whereas the new species possess the apex of penis lobes somewhat rounded, each with one central spine.

***Ulmeritoides tamoio* sp. nov.**
(Figures 3–4, 10–14, 19)

Material examined. HOLOTYPE: BRAZIL, São Paulo, Ubatuba, Parque Estadual da Serra do Mar, Núcleo Picinguaba, Rio da Fazenda, 23°20'16.70"S, 44°50'10.90"W, 28.IV.2013, Souto, P.M. leg., 1 male imago (DZRJ 2376). 11 PARATYPES: same data as holotype, 1 male imago and 1 male subimago (DZRJ 2409); Rio de Janeiro,

Serra da Bocaina, Paraty, Sertão do Taquari, Rio Taquari, 23°02'30.10"S, 44°41'35.30"W, 13.X.2012, Souto, P.M. & Gonçalves, R.S. leg., 1 male imago (DZRJ 2408); same data, 4 male imagos (DZRJ 2377–2378, 2380), 1 female imago (DZRJ 2379), 3 male subimagos (DZRJ 2381).

Holotype male imago (in alcohol, genitalia on slide). Length of body: 8.0 mm; forewings: 8.4 mm; hind wings: 1.1 mm. General color brown. Forewings with costal and subcostal areas tinged with light brown; veins light brown.

Head (Figs 3–4): brown, shaded with black. Upper portion of eyes light brown, lower portion black. Ocelli white, surrounded with brown and black. Antennae with scape and pedicel brown shaded with dark brown, flagella light brown.

Thorax (Figs 3–4): nota orange-brownish shaded with black; sutures light brown; sclerites with darker margin; yellowish pleura; sterna brown shaded with black.

Wings (Figs 10–12): hyaline, with coastal and subcoastal areas tinged with light brown; base brown. Forewings with longitudinal veins light brown, cross-veins yellowish; 7 cross-veins basal to bullae; brownish spots on bullae of veins Sc and R2; distal half of membrane, between C and R1, whitish. Hindwings with veins C, Sc, R and their cross-veins yellowish; other longitudinal and cross-veins hyaline.

Legs: legs I brown, with apex of tibiae and tarsi lighter; tarsal claws light brown. Legs II yellowish; femora with median brown maculae; tibiae with brown apex; tarsi white shaded with brown; tarsal claws light brown. Legs III yellowish; femora with brown maculae on basal half and apex brown; tibiae yellowish; tarsi white weakly tinged with brown; tarsal claws light brown.

Abdomen (Figs. 3–4): terga I–X brown shaded with dark brown, with posterior margins darker; median line dark brown. Sterna brown shaded with dark brown.

Genitalia (Figs. 13–14): styliger plate, penis and forceps light brown, shaded with dark brown. Basal broad region of forceps almost 1/4 length of segment I and with crenulations on inner margin. Apex of penis lobes concave, ending in rather acute apical and mesal projections. [Caudal filaments broken off and lost. Only the bases of caudal filaments are present in one of the paratypes]

Variations in the paratypes. There is a variation in the overall color tone of the body, some paratypes being darker, which may be related to the time delay in fixing specimens in alcohol.

Male subimago. Similar to imago, except the wings, which have dark grey membrane, even darker in the living specimen.

Female imago. Length of body: 9.0 mm; forewings: 10.1 mm.; hind wings: 2.0 mm. General color brown. Wings hyaline with brown veins.

Head: similar to male imago.

Thorax: orange-brownish shaded with darker brown; pleura yellowish; sterna light brown, shaded with darker brown on margin.

Wings: wings with membrane hyaline, except coastal and subcoastal areas light brown; base tinged with dark brown. Forewings with longitudinal and cross-veins brown; 7 cross-veins basal to bullae; brownish spots on bullae of veins Sc and R2. Hind wings with veins C, Sc, R and their cross-veins light brown; other longitudinal and cross-veins yellowish.

Legs: leg I similar to male, only darker and shorter. Legs II and III similar to male.

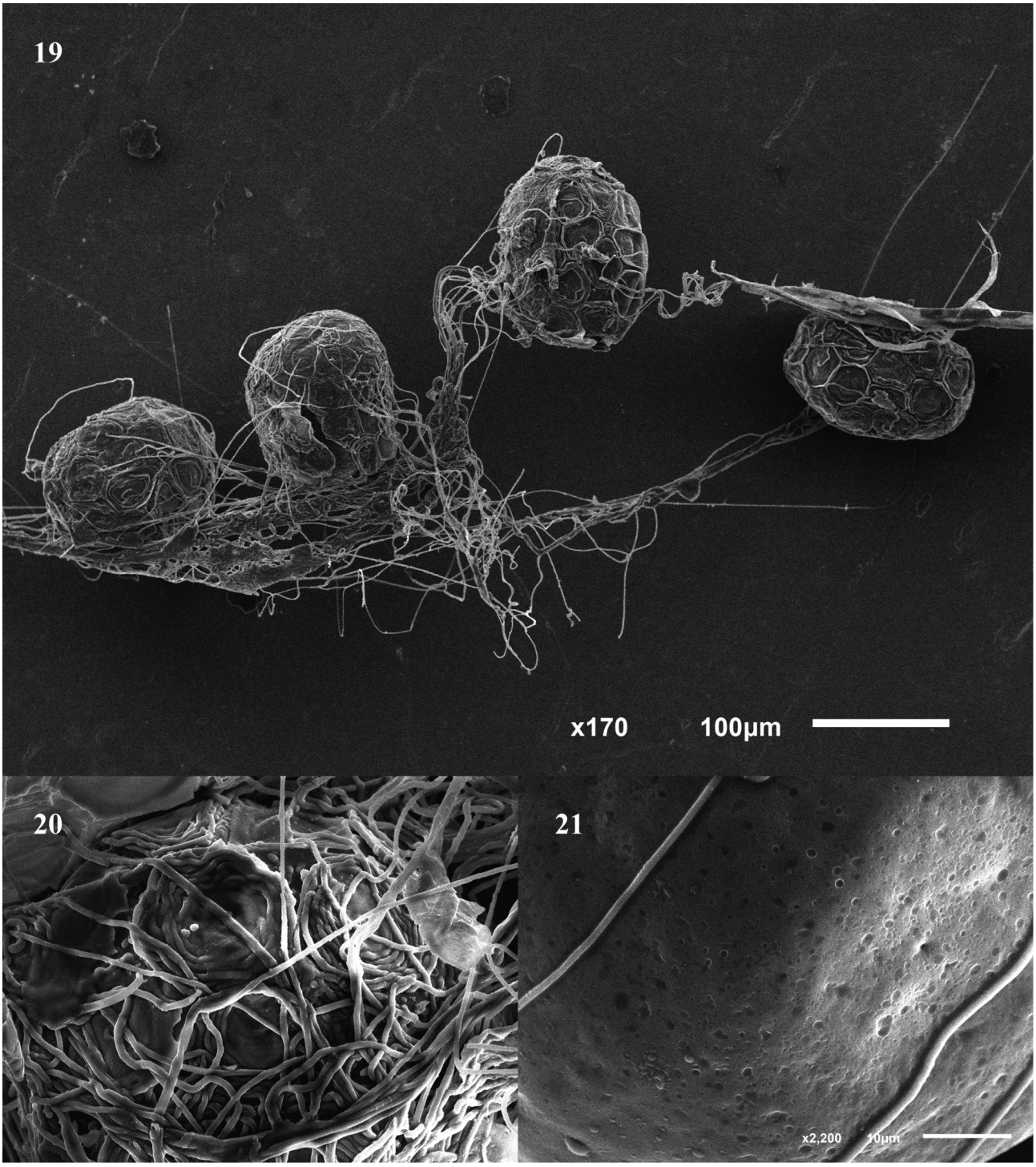
Abdomen: terga I–X brown, shaded with dark brown; with posterior line lighter; median line dark brown. Terga I–V darker than others. Sterna brown, shaded with dark brown, with median line lighter. Apex of sternum X with U-shaped cleft. Caudal filaments lost.

Egg (Fig. 19): yellow. Egg mass spherical, eggs elliptical in shape. Attachment structures as sucker-like discs or plates and fiber-coil.

Female subimago. Not collected. Observed alive just before molting to imago. Wings dark grey.

Nymph. Unknown.

Biology. The swarm is composed by few individuals and, as observed in the field, occurs in a short period of the year, reinforcing that species of this genus are not common and have small populations (Domínguez et al., 2006). The specimens were collected during the summer. The adults were collected at light traps in late evening and remain flying from 23:00 to 02:00. *Ulmeritoides tamoio* sp. nov. occurs together with *Thraulodes jones* Gonçalves, Da-Silva & Nessimian, 2010, however the new species remains flying for longer.



FIGURES 19–21. SEM photographs of eggs of *Ulmeritoides* species. **19.** *U. angelus* **sp. nov.**, general aspect; **20–21.** *U. angelus* **sp. nov.**, attachments structures (20) and chorionic sculpturing showing punctation and tubercules (21).

Etymology. *tamoio*, from the tupi word "tamyîa" (or "tamuîa") meaning "ancestor" or "grandfather". In honor to the Tamoyo Confederation, an alliance led by the tupinambás indigenous people with the guaitacás and aimorés, against the Portuguese colonizers, between the years 1556 and 1567. The confederation occupied the area of the southeastern coast of Brazil, including Ubatuba (São Paulo), the type locality of this new species. Name in apposition.

Remarks. *Ulmeritoides tamoio* **sp. nov.** can be separated from the other species of the genus according to the following combination of characters: (1) Forewings with costal and subcostal areas tinged with light brown; (2) forewings with veins C, Sc and R1 brownish; (3) 7 cross-veins basal do bullae (Fig. 10); (4) forewings with

brownish spots on bullae of veins Sc, R2 and R4 +5 (Fig. 10); (5) basal broad region of forceps almost 1/4 length of segment I (Fig. 13); (6) abdominal color pattern as in Figures 3 and 4; (7) apex of penis lobes slightly concave, ending in rather acute apical and mesal projections (Figs 13–14).

This species keys out to *U. huitoto* Domínguez & Zuñiga, 2003 in Salles & Domínguez (2012). However, the new species can be easily distinguished by the color of the abdomen, penis structure and brownish spots on bullae of the forewings.

Eggs of the new *Ulmeritoides*

The eggs of both new species herein described present two types of attachment structures, sucker-like discs or plates and fiber-coil, a coil of many loosely-arranged fibers (Koss & Edmunds 1974) (Figs 19–21), putatively a generic feature. In only *U. angelus* **sp. nov.** the chorion was visible, presenting punctate and tuberculate sculptures (Fig. 21).

Key to the genera *Ulmeritoides* and *Ulmeritus* (modified from Salles & Domínguez 2012)

The key to male imagos of *Ulmeritoides* and *Ulmeritus* presented by Salles & Domínguez (2012) was modified to include the two new species here described and *Ulmeritoides passorum* Gama Neto & Hamada, 2014, as below.

1. Vein Sc of hind wings 9/10 length of wing; membrane of wings with dark maculae at cross veins (fig. 2 in Domínguez 1991); apex of each penis round, lobe with ventral digitiform projection (fig. 3 in Domínguez 1991) . . . . . 2 *Ulmeritus*
1'. Vein Sc of hind wings 8/10 or less length of wing (Figs 6, 17); membrane of wings without color pattern, except in costal area; penis lobes without digitiform projections (Figs 8, 19) . . . . . 4 *Ulmeritoides*
2(1). Cross veins of hind wings few (around 20); maculae only around subcostal cross veins . . . . . *Ulmeritus saopaulensis*
2'. Cross veins of hind wings numerous (33 to 50); maculae around all cross veins. 3
3(2'). Maculae of fore wings forming bands (fig. 199A in Domínguez *et al*. 2006); ventral prolongation of penes short, approximately as long as wide (fig. 199C Domínguez *et al.* 2006) . . . . . *Ulmeritus balteatus*
3'. Maculae of fore wings not forming bands (fig. 199E in Domínguez *et al.* 2006); ventral prolongation of penes long, approximately twice as long as wide (fig. 199G in Domínguez *et al.* 2006) . . . . . *Ulmeritus carbonelli*
4(1'). Fore wings with costal and subcostal areas tinged with brown 5
4'. Fore wings with costal and subcostal areas hyaline 12
5(4). Penis lobes with apex rounded (Figs 8–9; see also figs 5–8 in Avila & Flowers 2005) 6
5'. Penis lobes with apex straight (figs 8, 19 in Salles & Domínguez 2012) or slightly concave (Figs 13–14) 9
6(5). Penis lobes with a ventral keel (figs 5–8 in Avila & Flowers 2005). 7
6'. Penis lobes without a ventral keel and with a central spine (Fig. 9). . . . . *Ulmeritoides angelus* **sp. nov.**
7 (6). Ventral keel of penis lobe located near apex (figs 9F–G in Domínguez 1995) . . . . . *Ulmeritoides tifferae*
7'. Ventral keel of penis lobe located on median length (figs. 5–8 in Avila & Flowers 2005) 8
8(7'). Abdomen translucent yellowish brown, lacking pattern of pale spots or dark bands. . . . . *Ulmeritoides chavarriae*
8'. Abdominal terga orange-brown with pale basal spots and dark brown apical transverse spots . . . . . *Ulmeritoides acosa*
9(5'). Basal broad region of forceps almost 1/4 length of segment I (Fig. 13, also fig. 196N in Domínguez *et al.* 2006) 10
9'. Basal broad region of forceps about 1/6 length of segment I (figs 7, 18 in Salles & Domínguez 2012) 11
10(9). Abdominal terga brown shaded with dark brown, with posterior margins darker and median line dark brown (Fig. 3). . . . . *Ulmeritoides tamoio* **sp. nov.**
10'. Abdominal terga yellowish-brown, with posterior margins darker, median line absent (fig. 196P in Domínguez *et al.* 2006). . . . . *Ulmeritoides huitoto*
11(9'). Penes with apex ending in an inner acute pointed projection (figs 8F–G in Domínguez 1995). . . . . *Ulmeritoides misionensis*
11'. Inner projection of penes rounded, outer corner with a small ventral spine (fig. 7C in Domínguez 1995) . *Ulmeritoides haarupi*
12(4'). Apex of penis lobes rounded. 13
12'. Apex of penis lobes not rounded. 14
13(12). Each penis lobe cylindrical without a ventral keel (Fig. 4F in Domínguez 1995) 17
13'. Each penis lobe flattened and with a ventral keel (Fig. 12G in Domínguez 1995) . . . . . *Ulmeritoides guanacaste*
14(12'). Penes lobes with several small apical spines (Fig. 6D in Domínguez 1995) . . . . . *Ulmeritoides spinulipenis*
14'. Penis lobes with inner apical margin ending in an acute projection 15
15(14'). Abdominal color pattern with conspicuous lighter rounded marks. . . . . *Ulmeritoides uruguayensis*
15'. Abdominal color pattern never as above. 16
16(15'). Bulla not surrounded with black mark (fig. 5a in Salles & Domínguez 2012). . . . . *Ulmeritoides araponga*
16'. Bulla surrounded with black mark (fig. 16a in Salles & Domínguez 2012). . . . . *Ulmeritoides nigribullae*

17(13). Each penis lobe with a lateral groove (fig. 4F in Domínguez 1995) . . . . . *Ulmeritoides flavopedes*
17'. Penes lobes without lateral groove, apex of posterior scutal protuberance with a yellowish transversal line (fig. 14 in Neto & Hamada 2014) . . . . . *Ulmeritoides passorum*

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