



The *Shannoniella* sisters (Diptera: Rhinophoridae)

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Abstract

Shannoniella cuspidata Townsend, 1939 is redescribed and *S. setinervis* **sp. nov.** (Brazil, State of Rio de Janeiro) is newly described as its putative sister taxon, thereby allowing for a strict definition of the genus *Shannoniella* Townsend, 1939 through explicit synapomorphies. An identification key is provided.

Key words: description, Neotropical region, new species, taxonomy, woodlouse flies

Introduction

Much new information has been published on the world fauna of Rhinophoridae in recent years, and although the family is rather small with only some 150 species (Pape *et al.* 2011), it is present on all continents except Antarctica (Crosskey 1977; Pape 2010; Cerretti *et al.* 2014). Biological data are still limited, but there is growing evidence that the diversity of Rhinophoridae may reflect the local diversity and density of suitable woodlouse hosts. In temperate North America a near-absence of native woodlice (*cf.* Schmalfuss 2003) is a good match to the very few native Rhinophoridae (Pape & Arnaud 2001). On the other hand, the Neotropics contain a much higher number of species of this family than previously realized, as shown by Pape & Arnaud (2001), who described 16 new species of *Bezzimyia* Townsend, and Cerretti *et al.* (2014), who added one new Neotropical genus and species. Cerretti *et al.* (2014) provided a detailed morphology-based phylogenetic analysis in which 10 of 25 included genera were monotypic and as such by default monophyletic. Nihei & Andrade (2014) described as new a second species of *Trypetidomima* Townsend, mentioning also an undescribed species of *Shannoniella* Townsend. This new species is described in the present paper, which leaves *Apomorphyto* Cerretti, Lo Guidice & Pape as the only monotypic New World genus.

Material and methods

The examined material belongs to the following institutions: Canadian National Collection of Insects, Ottawa, Canada (CNC); Coleção Entomológica ‘Padre Jesus Santiago Moure’, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil (DZUP); Natural History Museum, London, UK (BMNH); Museu Nacional, Rio de Janeiro, Brazil (MNRJ); Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZSP); Naturhistorische Museum Wien, Wien, Austria (NMW); and National Museum of Natural History, Washington DC, USA (USNM). The morphological terminology used here follows mainly Cumming & Wood (2009), except for “postpedicel” (Stuckenberg 1999). The male terminalia of the paratype of *Shannoniella setinervis* **sp. nov.** (Figs 2e–g) were dissected and prepared for examination following the methods described by Cerretti & Pape (2012). After examination, the terminalia were rehydrated and preserved in glycerol in a plastic microvial pinned below the

specimen. Photographic documentation was prepared as described by Cerretti *et al.* (2014). Label data from type specimens were transcribed verbatim, with double quotation marks (“”) delimiting the label, and a slash (/) separating lines.

Taxonomy

Shannoniella Townsend, 1939

Shannoniella Townsend, 1939: 249. Type species: *S. cuspidata* Townsend, 1939: 251, by original designation.

References. Guimarães 1971: 112 (Neotropical catalogue); Pape & Arnaud 2001: 289 (comments); Peris & González 2007: 52 (check-list, with the following errors: Itaquaquecetuba as type locality of *cuspidata*, and ‘*portalidoptera*’ [sic] as a species of *Shannoniella*—actually *ortalidoptera* is a species of the tachinid *Shannonomyiella* Townsend); Pape 2010: 1340 (key to Neotropical genera); Mulieri *et al.* 2010: 68 (key to New World genera); Cerretti & Pape 2012: 287 (phylogenetic relationships); Cerretti *et al.* 2014: 685 (phylogenetic relationships); Evenhuis *et al.* 2015: 247 (nomenclature); Nihei & Andrade 2014: 727 (comments).

Diagnosis. In addition to the characters included in the key of Mulieri *et al.* (2010), the following features also characterize and can help to distinguish *Shannoniella* from the other rhinophorid genera: head shape strongly modified especially in the males, with sunken face and vibrissal angles conspicuously projected forward and turned inwards apically (Figs 1b, 2b); male proclinate orbital setae present; male first aristomere elongated and more than twice as long as its greatest diameter; metathoracic spiracular lappets practically absent; vein R_1 entirely setulose dorsally; wing infuscated but with 3 or 4 clear (non-infuscated), hyaline spots on cells r_{2+3} , r_{4+5} , dm and m (hyaline spot on r_{2+3} absent in *S. setinervis* **sp. nov.**); male tergite 6 divided into two hemitergites.

Remarks. Neotropical genera of Rhinophoridae can be identified using the keys provided by Pape (2010, with *Apomorphyto* Cerretti, Lo Giudice & Pape 2014 included as “Undescribed Genus A”) and Mulieri *et al.* (2010), with the complement added by Nihei & Andrade (2014) to fit the new redefinition of *Trypetidomima*.

Key to known species of *Shannoniella*

1. Femora brown with at most a yellowish or light brown apex (Fig. 1a); two long anepimeral setulae; vein R_{4+5} setulose dorsally from base almost to crossvein r-m (Fig. 1c); abdominal sytergite 1+2 without median marginal setae (Fig. 1d); tergite 3 with one pair of median marginal setae and one pair of lateral marginal setae (Fig. 1d) *S. cuspidata* Townsend
- Femora yellowish in proximal two thirds and ‘dirty yellow’ or light brown in the distal third (Fig. 2a); three long anepimeral setulae; vein R_{4+5} setulose dorsally from base, setulae surpassing crossvein r-m to reach crossvein dm-cu (Fig. 1c); sytergite 1+2 with one pair of median marginal setae (Fig. 1d); tergite 3 with a row of marginal setae (Fig. 1d) . . . *S. setinervis* **sp. nov.**

Shannoniella cuspidata Townsend, 1939

(Fig. 1a–f)

Shannoniella cuspidata Townsend, 1939: 251. Type locality: Brazil, Rio de Janeiro, Rio de Janeiro. Holotype ♂ (USNM) (examined).

Type material examined: Holotype ♂ (USNM) labeled “Rio de Janeiro / Dist. Federal / Brasil”; Serviço Febre / Amarela / M.E.S., Bras.”; “Abril / 1938”; “Type / Ht ♂” [red label]; “G.N. Tribus Nov. / Shannoniellini / Melanophoridae / Shannoniella / cuspidata TT / ♂ / Det CHTT”. Specimen double mounted, in excellent condition.

Additional material examined: BRAZIL: *São Paulo*: Adutora, R. Claro, Setembro 1940, RC Shannon Collection, Serviço Febre, Amarela, M.E.S., Bras., Townsend Genotype Collection (1 ♂, USNM); Boracéia [Salesópolis], Est. Biol. Boracéia, 21.v–28.vi.2008, Nihei, Figueiredo & Andrade col. (34 ♂, 1 ♀, MZSP); Boracéia [Salesópolis], Travassos, Ventel J. Lane & Rabello col. (1 ♂, USNM); Paranapiacaba [Santo André], REBIO Alto da Serra de Paranapiacaba, Malaise, 13.viii–17.ix.2009, Lamas, Nihei e equipe col. (26 ♂, MZSP); [same data as previous but] 24.x–20.xi.2009, Nihei, S. e eq. col. (1 ♀, MZSP), [same data as previous but] 20.xi–

17.xii.2009, Nihei S. e eq. col. (2 ♂, MZSP); Salesópolis, (Boracea) [Est. Biol. Boracéia], 14.viii.1947, E. Rabello & Trav. F. & J. Lane. col (1 ♂, MZSP); Est. Biol. Boracéia, 850m, 03.i.1966, Rabello col. (1 ♂, MNRJ); 25.x.1963, J.H. Guimarães col. (1 ♂, MZSP); [same data as previous but] 12–19.i.1972, J.H. Guimarães col. (1 ♂, MZSP); [same data as previous but] Malaise, 16–30.iii.2008, Nihei, Lamas e eq. Col. (7 ♂, 1 ♀, MZSP); [same data as previous but] 30.iii–13.iv.2008, Nihei, Figueiredo & Andrade col. (5 ♂); [same data as previous but] 13–29.iv.2008, Fernandes col. (12 ♂, 2 ♀♀, MZSP); [same data as previous but] 29.iv–21.v.2008, Figueiredo & Fernandes col. (11 ♂, 1 ♀, MZSP); [same data as previous but] 21.v–28.vi.2008, Nihei, Figueiredo & Andrade col. (45 ♂, MZSP); [same data as previous but] 28.vi–02.viii.2008, Nihei, Andrade & Moll col. (46 ♂, MZSP); [same data as previous but] 02.viii–01.ix.2008, Nihei, Figueiredo & Leite col. (48 ♂, MZSP); [same data as previous but] 01.ix–23.x.2008, Fernandes col. (33 ♂, 1 ♀, MZSP); [same data as previous but] 23.x–24.xi.2008, Fernandes col. (22 ♂, MZSP); [same data as previous but] 24.xi.2008–07.i.2009, Nihei col. (12 ♂, MZSP); [same data as previous but] Reserva Biológica Boracéia, Trilha do Poço Verde, Malaise, 17–28.iv.2003, AP Aguiar & RM Rodrigues col. (5 ♂, MZSP); *Paraná*: S. José Pinhais [São José dos Pinhais], BR 277, Km 54, Luminosa, 22.iii.1985, C.I.I.F col. (1 ♂, DZUP); [same data as previous but] 27.iii.1985, C.I.I.F col. (1 ♂, DZUP).

Redescription. Male. Body length: 4.8–5.7 mm (n = 8) (holotype 5.2 mm); wing length: 4.1–4.3 mm (n = 3) (holotype 4.2 mm).

Colour (Fig. 1a). Body mostly dark brown to black. Head dark brown to black with grey pruinosity on gena, postgena and face; scape dark brown; pedicel yellowish; postpedicel and arista brown, the latter yellowish at base; palpus yellow. Thorax dark brown to black with grey pruinosity on anepisternum and katapisternum. Legs dark brown to black with grey pruinosity on coxae; trochanter and apex of femur yellow. Wing infuscated with brown, but with 4 clear (non-infuscated), hyaline spots on cells r_{2+3} , r_{4+5} , dm and m (holotype with no spot on cell r_{2+3}). Upper and lower calypters slightly infuscated on borders. Abdomen dark brown to black.

Head (Fig. 1b). Eye bare. Arista thickened almost to the tip; arista thickly micropubescent. First and second aristomere elongated, the second as long as the pedicel; third aristomere very long, about 3.7 times as long as the pedicel. Postpedicel elongate, slightly surpassing lower facial margin, about 5.4 times as long as the pedicel. Frontal stripe with subparallel margins, width at vertex about 1.4 times the eye width in dorsal view, and about 0.4 times the head width. No ocellar setae. Inner vertical seta strong and convergent; outer vertical seta not developed. Two or three laterocline orbital setae, the uppermost stronger. Nine to ten frontal setae. Parafacial bare, very narrow. Face very broad, deeply sunken. Vibrissal angle below ventral margin of gena, distinctly projected forward and turned inwards. Vibrissa not easily distinguished from the several perivibrissal setae. Facial ridge straight and setulose in full length. Postocular setae short. Proboscis and palpus short.

Thorax. Scutum with long, fine clothing setulae; acrostichals not developed; dorsocentrals 2+3, the presutural ones interspersed by moderately long setulae; no intra-alars; supra-alars 1+1, prealar (first postsutural supra-alar before wing insertion) not developed. Postpronotum with 2 strong and long setae, with fine ground setulae. Posthumeral 1; notopleurals 2, the anterior nearly twice as long as the posterior. Prosternum and proepisternum bare. One upcurved proepisternal and one upcurved proepimeral setae. Two katapisternals. Two long anepimeral setulae, one more developed. Katapimeron bare. Anatergite with fine setulae. Scutellum with one pair of long, divergent subapical setae; one pair of median discal setae close to the margin and about 0.75 times as long as the subapicals; several irregularly developed discal setulae.

Legs. Fore femur with a row of long posteroventral setae, and posterior surface with several developed setae. Fore tibia with one weak submedian posterodorsal seta (not erect in all specimens), and one weak submedian posteroventral seta. Mid tibia with one weak submedian posterodorsal seta. Hind tibia with one submedian anterodorsal, one submedian posterodorsal, and some specimens with one weak posterior seta at the apical third.

Wing (Fig. 1c). Costal spine not differentiated. R_1 entirely setulose dorsally; R_{4+5} setulose dorsally from the base until the apical fourth of the distance to r-m, setulae never reaching r-m. Section of M between crossvein dm-cu and apical bend about 1.2 times as long as the preceding section (between dm-cu and r-m crossveins). M reaching costa at wing margin; cell r_{4+5} open, the distance between M and R_{4+5} at wing margin about three times as long as crossvein r-m. Vein R_{4+5} diverging from R_{2+3} , the distance between both at wing margin longer than dm-cu (this about 3/4 the mentioned distance).

Abdomen (Fig. 1d). Tergites covered by long fine setulae. Syntergite 1+2 without the mid-dorsal depression, with several lateral setae, and without median marginal setae. Tergite 3 with one pair of median marginal setae and one pair of lateral marginals. Tergites 4 and 5 each with a row of marginal setae. *Male terminalia* (Figs 1e–f). As in

S. setinervis **sp. nov.** (see full description below) except for shape of posterior tip of lateral lobe of sternite 5 (Fig. 1e) and shape of cerci and surstyli in posterior view (Fig. 1f).

Female. Differs from male as follows: Body length 4.7–4.9 mm (n = 4); wing length 4.6–4.8 mm (n = 3). **Colour.** Postpedicel brown, some specimens with yellowish base; arista varying from yellow to brownish. Femora brown with base and apex yellow (or only the apex). Wing infuscated, but 3 clear (non-infuscated), hyaline spots on cells r_{4+5} , dm and m; these spots are larger than in the males, whereas the fourth clear spot on cell r_{2+3} , which is present in the males, is strongly reduced or even absent in females. **Head.** First aristomere reduced, hardly recognizable; second aristomere elongated, but about 1/3 the length of pedicel; third aristomere very long, 3.4 times as long as the pedicel. Postpedicel conspicuously shorter than in male, about 2.9 times as long as the pedicel. Seven or eight frontal setae. Vibrissal angle less projected forward. **Legs.** Fore femur without a posteroventral row of long setae; fore tarsus conspicuously laterally compressed.

Distribution. The species appears to be restricted to the Brazilian Atlantic Forest (here recorded from the states of Rio de Janeiro, São Paulo and Paraná).

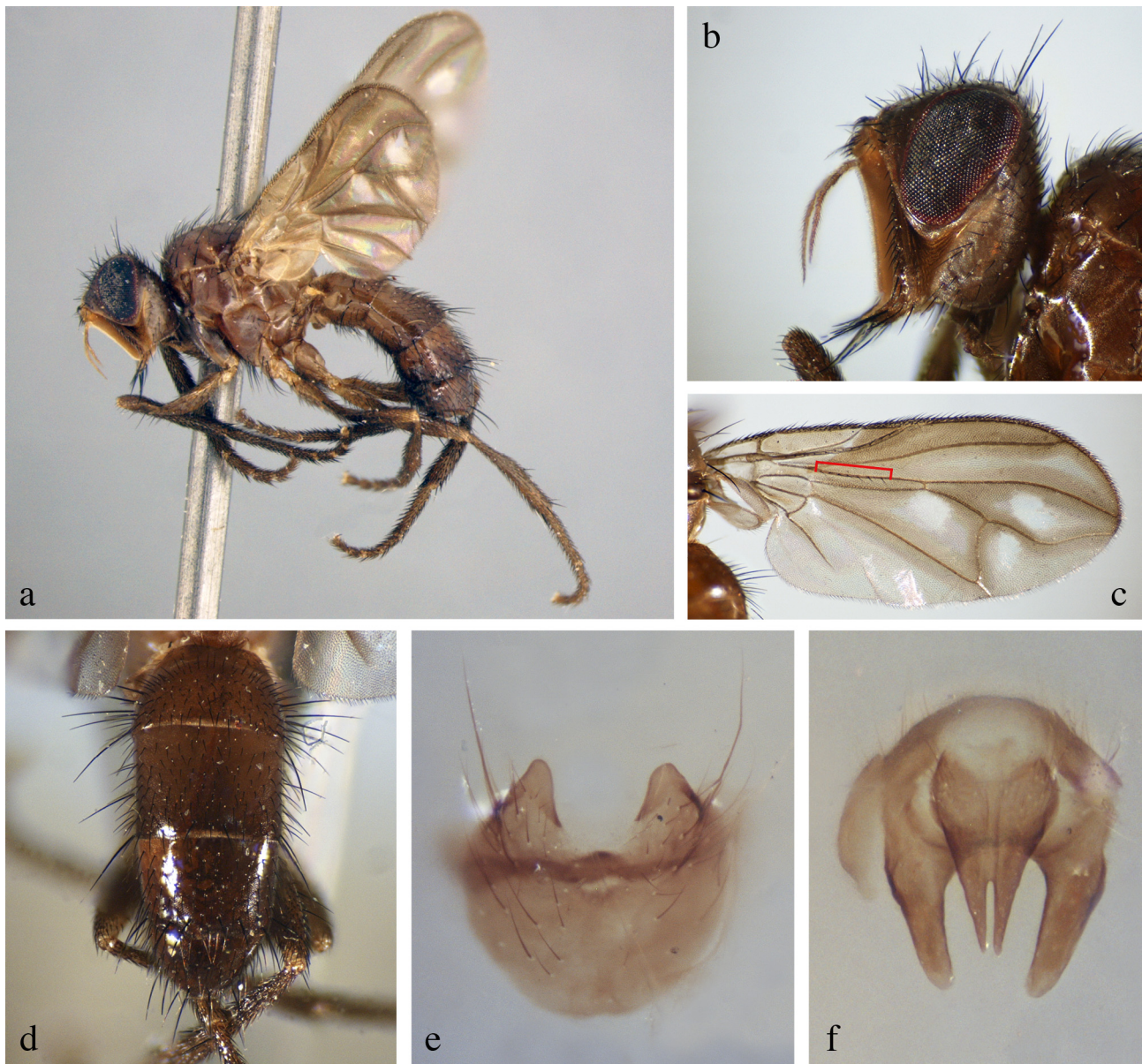


FIGURE 1. *Shannoniella cuspidata* Townsend, details of male morphology (a–d. Specimen from São Paulo State, Adutora, R. Claro (USNM). e–f. Specimen from São Paulo State, Boracéia (USNM)). a. Habitus, left lateral view. b. Head profile. c. Right wing, dorsal view, row of setulae on vein R_{4+5} indicated with red brace. d. Abdomen, dorsal view. e. Sternite 5, ventral view. f. Cerci and surstyli, posterior view.

***Shannoniella setinervis* sp. nov.**

(Figs 2a–g)

References. Cerretti & Pape (2012); Cerretti *et al.* (2014) [both as “*Shannoniella* sp.”].

Type-material examined: Holotype ♂ (MZSP), “Therezopolis [Teresópolis]/ Est. do Rio [Rio de Janeiro State] XI-39 / J. F. T. de Freitas [collector]” (white label with black border), “10C” (white label with black border), “Holotipo” (green label), “*Shannoniella / setinervis / S.S. Nihei* des. 2015”. Paratypes: 2 ♂, Brazil, Paraná, São José dos Pinhais, Serra do Mar, 20.VII.1984, J.A. Rafael (CNC).

Etymology: The species epithet is derived from the Latin *seta* = bristle and *nervus* = vein. The species is named after the more extensive row of setulae dorsally on wing vein R_{4+5} as compared with its sister species *S. cuspidata*.

Description. Male. Body length: 4.3 mm (holotype); wing length: 3.5 mm (holotype).

Colour (Fig. 2a). Body mostly light brown. Head light brown with grey pruinosity on gena, postgena and face; scape brown; pedicel yellow; postpedicel orangish brown, the base near arista yellowish; arista orangish brown with yellow base; palpus yellow. Thorax light brown with grey pruinosity on notopleuron, anepisternum, katepisternum, anatergite and katatergite. Coxae light brown with grey pruinosity; trochanters yellowish; femora yellowish with the apical third light brown; tibiae and tarsi light brown. Wing infuscated with light brown, but with 3 clear (non-infuscated), hyaline spots on cells r_{4+5} , dm and m. Upper and lower calypters slightly infuscated on borders. Abdomen light brown.

Head (Fig. 2b). Eye bare. Arista thickened almost to the tip; arista thickly micropubescent. First and second aristemere elongated, the second as long as the pedicel; third aristemere very long, about 2.9 times as long as the pedicel. Postpedicel elongate, slightly surpassing lower facial margin, about 4.5 times as long as the pedicel. Frontal stripe with subparallel margins, width at vertex about 1.8 times the eye width in dorsal view, and about 0.5 times the head width. No ocellar setae. Inner vertical seta strong and convergent; outer vertical seta not developed. Two laterocline orbital setae, the uppermost stronger. Seven frontal setae. Parafacial bare, very narrow. Face very broad, deeply sunken. Vibrissal angle below ventral margin of gena, distinctly projected forward and turned inwards. Vibrissa not easily distinguished from the several perivibrissal setae. Facial ridge straight and setulose along its full length. Postocular setae short. Proboscis and palpus short.

Thorax. Scutum with long, fine clothing setulae; acrostichals not developed; dorsocentrals 2+3, the presutural ones interspersed by moderately long setulae; no intra-alars; supra-alars 1+1, prealar (first postsutural supra-alar before the wing insertion) not developed. Postpronotum with 2 strong and long setae, with fine clothing setulae. Posthumeral 1; notopleurals 2, the anterior nearly twice as long as the posterior. Prosternum and proepisternum bare. One upcurved proepisternal and one upcurved proepimeral setae. Two katepisternals. Three long anepimeral setulae, one more developed. Katepimeron bare. Anatergite with fine setulae. Scutellum with one pair of long, divergent subapical setae; one pair of median discal setae close to the margin and nearly as long and strong as the subapicals; some irregularly developed discal setulae.

Legs. Fore femur with a row of long posteroventral setae, and the posterior surface with several developed setae. Fore tibia with one weak submedian posterodorsal seta, and one weak submedian posteroventral seta. Mid tibia with one weak submedian posterodorsal seta. Hind tibia with one submedian anterodorsal seta, one submedian posterodorsal seta, and one submedian anteroventral seta (erect in right leg, but not in left leg).

Wing (Fig. 2c). Costal spine not differentiated. Vein R_1 entirely setulose dorsally; R_{4+5} setulose dorsally from the base and reaching the level of crossvein dm-cu. Section of M between crossvein dm-cu and the apical bend about 0.9 times as long as the preceding section (between dm-cu and r-m crossveins). M reaching costa at wing margin; cell r_{4+5} open, the distance between M and R_{4+5} at wing margin about three times as long as crossvein r-m. Vein R_{4+5} diverging from R_{2+3} , the distance between both at wing margin longer than crossvein dm-cu (this about 3/4 times the said distance).

Abdomen (Fig. 2d). Tergites covered by long fine setulae. Syntergite 1+2 without a mid-dorsal depression, with several lateral setae, and one pair of median marginal setae. Tergites 3, 4 and 5 each with a row of marginal setae.

Male terminalia (Figs 2e–g). Sternite 5 (Fig. 2e) upright laterally, with a deep median cleft; lateral lobe characterized by a posterior three-dimensional cap-like apophysis, but slightly bilobed laterally; median basal window absent. Tergite 6 divided medially into two hemitergites, each with a row of setae along posterior margin and separated from segment 7+8 by a very narrow membrane. Sternite 6 almost symmetrical, articulated with



FIGURE 2. *Shanniella setinervis* sp. nov., paratype male, details of morphology. **a.** Habitus, left lateral view. **b.** Head profile. **c.** Right wing, dorsal view, extension of setulae on vein R_{4+5} indicated with red arrows. **d.** Abdomen, dorsal view. **e.** Sternite 5, ventral view. **f.** Cerci and surstyli, posterior view. **g.** Aedeagus, left lateral view.

segment 7+8 on left side, and attached to it by a short membrane on its right side. Epandrium very short and convex. Surstylus well developed, broad in lateral view; surstylus widely fused to epandrium (Fig. 2f). Cerci slightly shorter than surstylus, not fused medially (Fig. 2f), pointed apically (sub-triangular in lateral view). Processi longi strongly widened at mid-length and medially almost touching each other; processus longus firmly and widely fused with surstylus. Basal plate of hypandrium very short, not concave, hypandrial arms very long and

converging. Aedeagus (Fig. 2g) with pregonite well developed, sub-triangular and with 2 setae postero-apically. Postgonite with a long (fine) seta at about mid length of anterior margin. Epiphallus well developed, strongly widened and sub circular distally in lateral view. Dorsolateral processes well fused medially in a single narrow sclerotization. Median process of ventral sclerite of distiphallus firmly fused to the base of ventral sclerite and divided longitudinally into two hemisclerites. Lateroventral lobe of distiphallus in sub-distal position and covered with slightly sclerotized scale-like spinulae. Acrophallus membranous.

Female. Unknown.

Distribution. The species appears to be restricted to the Brazilian Atlantic Forest (here recorded from the states of Rio de Janeiro and Paraná).

Discussion

Pape (1986) provided an early (and non-numeric) phylogenetic analysis including all rhinophorid genera as defined at that time, although excluding the Neotropical genera *Bezzimyia* Townsend, *Shannoniella* and *Trypetidomima*, which were considered Rhinophoridae by Sabrosky & Arnaud (1965; *Bezzimyia* in Rhinophorinae as subfamily of Tachinidae) but Tachinidae by Crosskey (1977) and Guimarães (1971; tribe Shannoniellini in tachinid subfamily Dexiinae). Today, the Rhinophoridae are much better circumscribed (e.g., Cerretti & Pape 2012; Cerretti *et al.* 2014) but a complete generic phylogenetic analysis based on a proper exemplar taxon coding approach (Yeates 1995; Prendini 2001) is not yet available, and molecular sequence data are only now becoming available in an amount that allows for the first insights into the phylogenetic relationships between rhinophorid genera (Kutty *et al.* 2010; Ziegler & Tóthova 2014).

Shannoniella setinervis **sp. nov.** emerged from the analysis of Cerretti *et al.* (2014, as *Shannoniella* sp.) with the following autapomorphies: Male proclinate orbital setae present; metathoracic spiracular lappets practically absent; wing vein R_1 with dorsal setulae; male tergite 6 divided into two hemitergites. These features are shared with *S. cuspidata*, and further synapomorphies that unite the two species of *Shannoniella* and support generic monophyly are: male first aristomere elongated and more than twice as long as its greatest diameter; and third aristomere thickened almost to the tip. The first of these features is unique to *Shannoniella* among the Rhinophoridae, and the other is otherwise known only in *Bezzimyia barbarista* Pape & Arnaud.

It may be surprising that the strongly modified head shape with a sunken facial plate and extended vibrissal angles is not autapomorphic for *Shannoniella*, but the genus is evidently phylogenetically close to (perhaps part of) the genus *Bezzimyia*, where a very similar head profile is widespread (Pape & Arnaud 2001). A well-corroborated rhinophorid phylogeny is needed before a reliable mapping of this feature is feasible.

The present addition of a single new species of *Shannoniella* has brought up the issue of generic monophyly, but it does not bring data that will reflect on the generic topology and as such on the most probable sister taxon of the genus *Shannoniella*. Furthermore, as long as the possible non-monophyly of *Bezzimyia* sensu Pape & Arnaud (2001) is unsettled (Cerretti *et al.* 2014), we consider it premature to propose changes to the generic classification.

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