A new species of *Cyrtoneuropsis* (Diptera: Muscidae) with considerations on the phylogeny of the genus

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ABSTRACT. We describe a new species of *Cyrtoneuropsis* Malloch, 1925 (Diptera, Muscidae) from Brazil. The new species is included in a previously published key to species. Additionally, we review a previously published matrix to *Cyrtoneurina* Giglio-Tos, 1893 and *Cyrtoneuropsis*. A total of 52 character states were modified and the new species was added to it. The modified matrix was analyzed under equal and implied weights. In all topologies, *Cyrtoneuropsis spiloptera* (Wiedemann, 1830) came up as the sister group of the new species. The monophyly of *Cyrtoneurina* and *Cyrtoneuropsis* were recovered, but the relationships among their species, in our data, differ from those obtained in the past.

KEY WORDS. Morphological characters; Neotropical; species key; taxonomy.

MATERIAL AND METHODS

The studied material is deposited in the DZUP – Coleção Entomológica Padre Jesus Santiago Moure Curitiba, Brazil, and INPA – Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil.

The morphological terminology follows McAlpine (1981) with the following modifications (de Carvalho 1989): humeral callus for postpronotum; posthumeral and presutural setae for presutural intra-alar setae; prealar setae for the first postsutural supra-alar setae; calcar for the developed setae at the distal third of the posteroventral surface of the hind tibiae. For the antennal structures we use the terminology from Stuckenberg (1999) and for the scutal setae, we follow Nihei & de Carvalho (2007).

We used the character-states matrix for *Cyrtoneurina* and *Cyrtoneuropsis* (Pamplona 1999) to determine the phylogenetic position of *Cyrtoneuropsis nisae* sp. nov. The matrix was partially modified using information available from redescriptions and original descriptions (Snyder 1954, Couri 1982, 1995) (see Phylogeny section).

We carried out a parsimony analysis using TNT (Goldoboff et al. 2008). Tree search was heuristic with 1,000 replications (10 trees saved in each replication) and tree-bisection reconnection branch swapping; clades were collapsed after search when branch lengths equaled zero; characters were treated as unordered; character optimization and tree edition were performed using Winclada (Nixon 2002). Analyses were carried out using both equal weights and implied weighting approaches (Goldoboff 1993). Under implied weighting, we
tested the constant concavity \((k)\) values between 1 and 10. We used the same outgroups as PAMPLONA (1999) in order to be able to compare our results against hers. Accordingly, *Morelia humeralis* (Stein, 1918) was used to root the trees for display and character optimization.

**TAXONOMY**

**Key to the species of Cyrtoneuropsis (modified from PAMPLONA 1999)**

1. Female: interfrontal seta absent. Male: pre-alar seta not developed or, if present, not more than 2/3 as long as posterior notopleural seta ................................................... 2
1'. Female: interfrontal seta present. Male: pre-alar seta fully developed .................. (see step 15: PAMPLONA 1999: 23)
2. Dorsocentral setae 2:3 ........................................................... 3
2'. Dorsocentral setae 2:4 .... (see step 3: PAMPLONA 1999: 16)
3. Fore tibia with a median seta ............................................. Cyrtoneuropsis glutata (Giglio-Tos, 1893)
3'. Fore tibia without a median seta ........................................ 4
4. Prosternum bare ............ Cyrtoneuropsis walkeri (Pont, 1972)
4'. Prosternum setulose ................ Cyrtoneuropsis nisae sp nov.

**Cyrtoneuropsis nisae sp. nov.**

Figs 1-8

Diagnosis. This new species can be easily recognized by the following combination of characters: interfrontal seta absent in both sexes; dorsocentral setae 2:3; prosternum setulose; fore tibia without median seta; first sternite bare.

Description. Male: measurements (holotype): 3.2 mm – body length (from the head to the posterior tip of the scutellum), 5.6 mm – wing length, 0.16 mm – distance between eyes at level of anterior ocellus. Color. General color dark brown with silver pruinosity (Figs 1 and 2). Palpus dark brown, yellow apically; post-pedicel yellow to light brown with silver pruinosity; arista yellow to light brown on basal fourth, reddish-brown apically; frontal vitta and ocellar triangle dark grey. Humeral callus light brown to yellow. Calypters yellowish. Wing hyaline yellowish with conspicuous brown spots at the apex of veins \(R_{1}\), \(R_{2}\) and less conspicuously on \(R_{3}\) and \(M\) apex (the latter just before the apex), cross veins \(dm\)-cu, \(r\)-m and bm-cu well marked. Legs dark brown with paler tibiae. Head. Holoptic, but fronto-orbital plates not in contact; eye with short, sparse setulae; antero-internal ommatidia slightly larger than remaining ommatidia; post-pedicel ending before insertion of vibrissa; parafacial and fronto-orbital plate bare; vibrissa fully developed, inserted below the ventral margin of the eye, twice as long as sub-vibrissal setae; 6 pairs of fronto orbital setae, the second pair well developed; 1 pair of short proclinated setae and 1 pair of long reclinated fronto-orbital setae; inner vertical setae convergent; outer vertical setae divergent; arista plumose with about 25 hairs; developed secondary setulae on inner-dorsal surface of arista; palpus cylindricall but slightly dilated apically. Thorax. Scutum uniformly covered by setulae; acrostichal setae 0:1; dorsocentral setae 2:3, anterior presutural about half length of posterior presutural; paranumeral seta absent; posthumeral seta present; presutural seta present and twice as long as posthumeral seta; notopleuron with 2 setae, with a few setae near posterior seta; prealar seta present, about one third length of anterior supra-alar seta; supra-alar setae 2, posterior slightly longer than prealar; intra-alar seta 1; postsupra-alar setae 2; intrapostalar seta not developed; basal scutellar setae: 1 pair; lateral scutellar setae: 1 pair, shorter than basal pair, preapical scutellar setae: 1 pair, same size as lateral pair; apical scutellar setae: 1 pair, same size as basal pair; prosternum setulose; propopleuron, anatergite, katatergite, katepimeron, meron and greater ampulla, bare; anepimeron, anepisternum, katepisternum, metakatepisternum and anterior lateral portion of scutellum setulose; katepisternal setae 1:2; anepisternal with row of 5 setae and one seta at anterodorsal corner; metathoracic spiracle setulose on posterior margin. Wing. Distal portion of M slightly converging to \(R_{4}\); microtrichia cover...
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Entire membrane; R1 entirely setulose dorsally; R1 with few setulae ventrally before curve to costal vein and fully setulose on apex; R4+5 setulose to r-m dorsally and ventrally. Legs. Fore femur with a complete row of setae on posterodorsal, dorsal and posteroventral surfaces. Mid femur with 1 stout preapical anterodorsal seta and 3 dorsal to posterodorsal subapical setae; mid tibia with 2 posterior setae, 1 median and 1 on apical third. Hind coxa bare on posterior surface; hind femur with an anteroventral row of setae on distal half; a complete row of setae on anterodorsal surface; 2 subapical dorsal to posterodorsal setae and an irregular posteroventral row of setae; hind tibia with 2 median anteroventral seta and 1 strong median anterodorsal seta; calcar slightly differentiated from covering setulae. Abdomen. First sternite bare.

Figures 3-8. *Cyrtoneuropsis nisae* sp. nov. (3-6) Male terminalia: (3) fifth sternite, ventral view; (4) epandrium, surstylus and cercal plate, ventral view; (5) epandrium, surstylus and cercal plate, lateral view; (6) aedeagal complex, lateral view; (7-8) female terminalia: (7) ovipositor, ventral view; (8) ovipositor, dorsal view. Scale bar: 0.5 mm.
Female: measurements (n = 20): 3.6 mm – body length (head to the posterior tip of the scutellum), 5.6 mm – wing length, 0.5 mm – distance between eyes at level of anterior ocellus. Diffs from male in the following: ocellar triangle light brown; humeral callus yellow; eyes dichoptic; interfrontal seta absent; 6-7 pairs of frontal setae, the second more developed; 2 pairs of reclined fronto-orbital setae; R₄₅ seto-late beyond r-m (about half its extension) both dorsally and ventrally.

Variations. Humeral callus can vary from brown with grey pruinosity to yellow; upper calypter can be entirely yellowish; R₁ can be entirely yellow; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; upper calypter can be entirely yellowish; 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| Table I. Modified character states matrix for *Cyrtoneurina* and *Cyrtoneuropsis*. The modified states are highlighted by gray-filled cells. |

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were used, and k values were 3 and 4, the topologies recovered
had the outgroup taxa within the ingroup. The analysis stabi-
lized at k = 5 (that is, k values five to ten yielded the same
results) and 6 trees were recovered with total fit = 14.49-14.61;
190 steps; CI = 24 and RI = 70. The trees differed mainly in the
relationships within the clades containing: *Cyrtoneuropsis
mellina* (Stein, 1918), *Cyrtoneuropsis varicolor* (Hough 1900),
*Cyrtoneuropsis inuber* (Giglio-Tos, 1863), *Cyrtoneuropsis veneseta*
(Stein 1904) and *Cyrtoneuropsis ocasionalis* (Couri, 1982),
*Cyrtoneuropsis pararescita* (Couri, 1995), *Cyrtoneuropsis rescita*
(Walker, 1861).

In the discussion that follows, we present the strict con-
sensus cladogram of the six fittest trees recovered (Fig. 9). Our
topology substantially differs from PAMPLONA’s (1999) in the rela-
tionships within both *Cyrtoneurina* and *Cyrtoneuropsis*. In
PAMPLONA’s (1999) hypothesis, *Cyrtoneurina uber* (Giglio-Tos,
1893) is basal to the remaining *Cyrtoneurina*. In our hypothesis,
by contrast, *C. uber* is placed in an apical clade as the sister group
of *Cyrtoneurina geminata* (Stein, 1904); the basalmost species of
the genus, in our topology, is *Cyrtoneurina arleriopsis* Couri, 1982.
In the case of *Cyrtoneuropsis*, even though the species level rela-
tionships between the two hypotheses were different, for the
most part species clustered in groups that are similar in composition. For example, Pamplona’s (1999) clade (Cyrtoneuropsis ocasionalis, (C. pararescita, C. rescita)) was recovered in our analysis as (C. pararescita, (C. ocasionalis, C. rescita)). On the other hand, the positions of some species are radically different. For instance, Cyrtoneuropsis maculipennis (Macquart, 1843), which clustered with Cyrtoneuropsis praenubila (Snyder, 1954) and C. spiloptera in Pamplona’s topology, in the present study is the sister-group of the clade indicated by letter A (Fig. 9). It is in the clade indicated by letter B (Fig. 9), however, that most differences are concentrated. Cyrtoneuropsis similata (which clustered with C. mimica and C. multomaculata in Pamplona’s topology), clustered with (C. spiloptera, (C. similata, C. praenubila)) in our data. The species C. wulpi, C. beebei, C. protosetosa, C. neotrita, C. mimica and C. multomaculata, which were in three independent clades in Pamplona’s topology, are successive sisters in ours.

The analysis using equal weights in the modified matrix with Cyrtoneuropsis nisae sp. nov. resulted in 551 trees with 190 steps. A total of 25 nodes were collapsed in the strict consensus cladogram, leaving 13 informative nodes. When implied weights was used, low k values (3-5) resulted in topologies in which the outgroup was within the ingroup. The analysis stabilized when k was set to six. Six topologies were recovered, with total fit = 13.34-13.45; length = 192-194 steps; CI = 24; RI = 69. In all analyses under equal and implied weighting, Cyrtoneuropsis spiloptera is the sister species of Cyrtoneuropsis nisae sp. nov. The addition of Cyrtoneuropsis nisae sp. nov. promoted a single change in the fittest trees recovered using the modified matrix (clade C, Fig. 9): Cyrtoneuropsis spiloptera is now the sister species of C. nisae sp. nov., and they form a monophyletic clade with the sister species C. praenubila and C. similata (Fig. 10). In spite of the aforementioned differences, the hypothesis of monophyly was corroborated for both genera. Furthermore, even though our topology differed from Pamplona’s (1999), the main trends in character evolution recovered by both hypotheses are not significantly different.

One of the most interesting characters in the phylogeny of Cyrtoneurops is the general shape of the ovipositor. Cyrtoneurina has a delicate, narrow and long ovipositor, whereas Cyrtoneurops has a less delicate and wider ovipositor. The ovipositor in the clade represented by number 1 (Fig. 9) is medium-sized, but in clade 2 it is shorter. Also, all Cyrtoneurops lost the setae on the intersegmental membranes. The wider and shorter ovipositor is associated with the habit of larviposition (Müer et al. 1999). Though the biology of most species is unknown, we conjecture that species of Cyrtoneurina lay eggs and those of Cyrtoneurops lay larvae (Snyder 1954). Cyrtoneurops maculipennis and Cyrtoneurops polystigma (Wulp, 1896) were found to bear a single third instar larva (Snyder 1954). Species in clade 2 also have spicules on sternite VIII, whereas species in clade 3 have strong spines instead. We hypothesize that these spicules and spines are associated with shifts in the reproductive strategy, but this conjecture will require further study.

The consistency index (CI) of the analysis of Pamplona’s original matrix was 27 (Pamplona 1999), whereas that obtained with our modified matrix was 25. This low CI value indicates a high degree of homoplasy in our data (Kügle & Farris 1969). Thus, our data should be re-evaluated against other character systems with a stronger phylogenetic signal.

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LITERATURE CITED


