

THE PROBLEMATIC NEOTROPICAL GENUS *CYRTOPHORINA* BORGMEIER & PRADO (DIPTERA: PHORIDAE)

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Abstract

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The Neotropical genus *Cyrtophorina* is revised, with redescription of the previously known species, *C. deinocerca* Borgmeier & Prado, and description of three new species: *C. kerri* and *C. zamorensis* from Ecuador and *C. gorgonensis* from Colombia. The hypothesized phylogenetic relationships among the species, as well as their possible relationship to *Dohrniphora* Dahl are discussed.

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Introduction

Among the Neotropical phorid flies, *Cyrtophorina* Borgmeier & Prado (1975) is one of the most poorly known genera. Described from two specimens of the type species, *C. deinocerca* Borgmeier & Prado from Brazil and a third specimen later reported from Ecuador (Brown 1993a), there is virtually no other published information.

Based on the relatively dorsal position of the anterior thoracic spiracle, Borgmeier and Prado placed this genus in the subfamily Aenigmatiinae, a possibility supported by Brown (1993a). However, in his revision of the higher classification of phorids, Brown (1992) reorganized the Aenigmatiinae to include many taxa that were previously classified in the non-monophyletic subfamily Phorinae. One such reclassified genus was *Dohrniphora* Dahl, a group with which *Cyrtophorina* is herein suspected of having a close relationship.

In this study, I redescribe and more fully illustrate the type species of *Cyrtophorina*, based a number of newly collected specimens. I also describe three new species, and give evidence for the phylogenetic relationships of the genus.

Dedication

This paper is dedicated to the memory of Dr. David Pengelly, who was the professor for my first university entomology course. Because of his encouragement and inspirational teaching, as well as the acceptance and camaraderie displayed by his group of exceptionally talented graduate students, I decided to pursue entomology as a profession, rather than just as a hobby.

Materials and Methods

Specimens were collected by Malaise traps, dried chemically using HMDS (Brown 1993b), and glued to the side of insect pins. Besides the usual locality label, each specimen also has a barcoded data label with a unique identifier. These identifiers are given for holotypes, for easier recognition in the future.

Specimens examined are from the Natural History Museum of Los Angeles County (LACM), Museu Paraense Emilio Goeldi, Belém, Brazil (MPEG), and the Universidad Nacional de Colombia, Bogotá (UNCB).

Specimen images are archived at MorphBank. Maps of species distributions are available at www.discoverlife.org.

Systematics

Genus *Cyrtophorina* Borgmeier & Prado, 1975

Cyrtophorina Borgmeier & Prado, 1975: 85.

Type species: *Cyrtophorina deinocerca* Borgmeier & Prado, by original designation.

Emended diagnosis. Median furrow of frons absent. Mouthparts, other than palpus, vestigial, probably nonfunctional, except in *C. gorgonensis*. Thoracic spiracle displaced dorsally (less so in *C. gorgonensis*); anepisternum undivided, with few setae ventral to spiracle. Foretibia with dorsal row of small, spinelike setae. Posterior face of hind femur with ventrobasal patch of hairlike setae of two sizes (small and large). Hind tibia with one dorsal longitudinal setal palisade. Wing fully developed, with costal setae extremely short. Wing vein R_1 thickened on apical one-half; vein R_{2+3} present. Male genitalia with epandrium and hypandrium fused anteriorly. Hypandrium extremely deeply cleft, with two lobes only joined at anterior extremity of terminalia (as in *Dohrniphora*).

Phylogenetic relationships. Borgmeier and Prado (1975) diagnosed this genus from two male specimens of the single species *C. deinocerca*, and placed it in the subfamily Aenigmatiinae based on the dorsally-opening anterior thoracic spiracles. They compared it to the genus *Aenigmatopoeus* Schmitz, a genus now classified in the subfamily Metopininae (Disney 2003) and which has little relationship to *C. deinocerca*. In his reanalysis of the subfamilies, Brown (1992) did not place this genus, but noted in another paper (Brown 1993a) that it could be classified with other Aenigmatiinae, unlike some other genera included there.

Upon examination of the specimens herein, there is evidence for a close relationship with *Dohrniphora* Dahl, which is part of Brown's (1992) expanded concept of Aenigmatiinae, a concept that is not equivalent to that of Borgmeier and Prado (1975) or Brown (1993a). Characters that link the three *Cyrtophorina* species with *Dohrniphora* are the dorsally setose anepisternum, a row of enlarged setae on the foretibia, a single dorsal setal palisade on the mid and hind tibia (midtibial palisade absent in some species), and a ventrobasal

patch of setae on hind femur. Furthermore, *C. gorgonensis*, a new species, is apparently a transitional form, as it has *Dohrniphora*-like frontal setae and wing venation. This genus, as well as some others in the Old World tropics (such as *Synaptophora* Brown, *Dicranopteron* Schmitz, *Myopiomyia* Disney) are possibly just highly derived *Dohrniphora* and their recognition could lead to paraphyly of *Dohrniphora* itself. Unfortunately, female specimens of *Cyrtophorina*, which would likely add important new characters for consideration, are still unknown. Further molecular phylogenetic research into the monophyly of *Dohrniphora*, and other questions involving the phylogenetic relationships of non-metopinine phorids, is currently being pursued (B. Brown and P. Smith, in preparation).

The monophyly of the Aenigmatiinae, as defined by Brown (1992) was challenged by Disney (1993) and Disney and Ellwood (2001). They considered Brown's two aenigmatiine subdivisions, Aenigmatiini and Diplonevrini, to be less closely related than did Brown (1992). I agree with some of their criticism, especially that *Synaptophora* is related to *Dohrniphora*, possibly just a highly derived species of this genus, and should not have been placed in the Aenigmatiini, but instead belongs in the Diplonevrini. The monophyly of the Aenigmatiini (as conceived by Brown, 1992) is not well supported, given the repeated evolution of the limuloid body form (e. g. Brown 1993a). The higher taxa of non-metopinine phorids, however, are currently being revised based on molecular characters (as noted above), and it is likely that our ideas about the relationships of many of these higher groups will be changed.

Monophyly of *Cyrtophorina* itself is also questionable. A possible synapomorphic character for the genus is the reduced costal setae, but strong evidence is still lacking. In spite of this uncertainty, I place the new species in *Cyrtophorina* until a better understanding of their relationships can be developed.

Disney and Ellwood (2001) described a new genus, *Dohrnigma*, that has some similarity to *Cyrtophorina*, as it lacks frontal setae, has reduced costal setae, and is probably closely related to *Dohrniphora*. It differs from *Cyrtophorina* by the larger, thicker, more *Dohrniphora*-like setae on the inner face of the hind femur, the lack of wing vein R_{2+3} , and by the shape of the terminalia. Probably a number of currently recognized genera would render *Dohrniphora* paraphyletic if the phylogeny of the group were known; for now it is premature to include *Dohrnigma* within *Cyrtophorina*.

Within the genus *Cyrtophorina*, some preliminary relationships can be hypothesized, based on the following derived character states (see cladogram Fig. 1) polarized with *Dohrniphora* as an outgroup: 1—costal setae reduced (primitive state: costal setae longer); 2—spiracle more dorsal in position (primitive state: spiracle more lateral); 3—mouthparts reduced, probably nonfunctional (primitive state: mouthparts well-developed, functional); 4—midtibia without basal pair of setae (primitive state: basal pair of setae present); 5—wing vein R_s without seta at base (primitive state: seta present); 6—fork of R_s reduced in size (primitive state: fork large, elongate); 7—hind femur thin (primitive state: hind femur broad); 8—ocellar triangle with medial depression (primitive state: ocellar region flat); 9—frontal setation reduced (primitive state: frons with ventral interfrontal, ventral fronto-orbital, and supra-antennal setae present); 10—scutellum with 8 or more setae (primitive state: scutellum with 4 setae).

These traits were analyzed manually, using *Dohrniphora* as an outgroup, and a cladogram (Fig. 1) was produced. A close relationship between *M. deinocerca* and *M.*

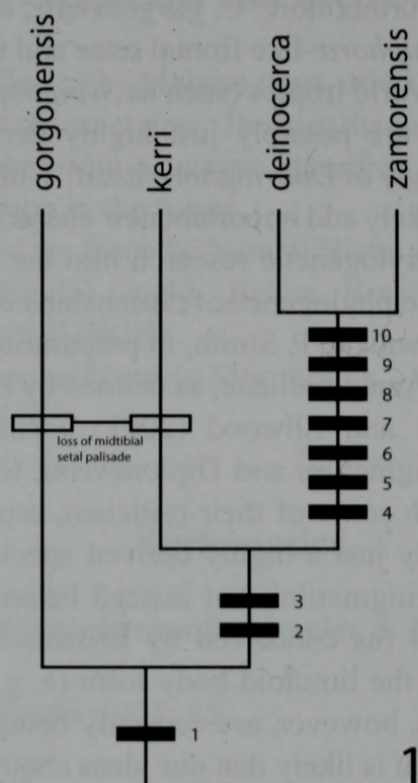


FIGURE 1. Cladogram of hypothesized relationships of genus *Cyrtophorina*.

zamorensis is strongly supported, while there is less evidence for the group *C. kerri* + (*C. deinocerca* + *C. zamorensis*). An apparent homoplasy is the loss of the midtibial setal palisade in *C. gorgonensis* and *C. kerri* new species.

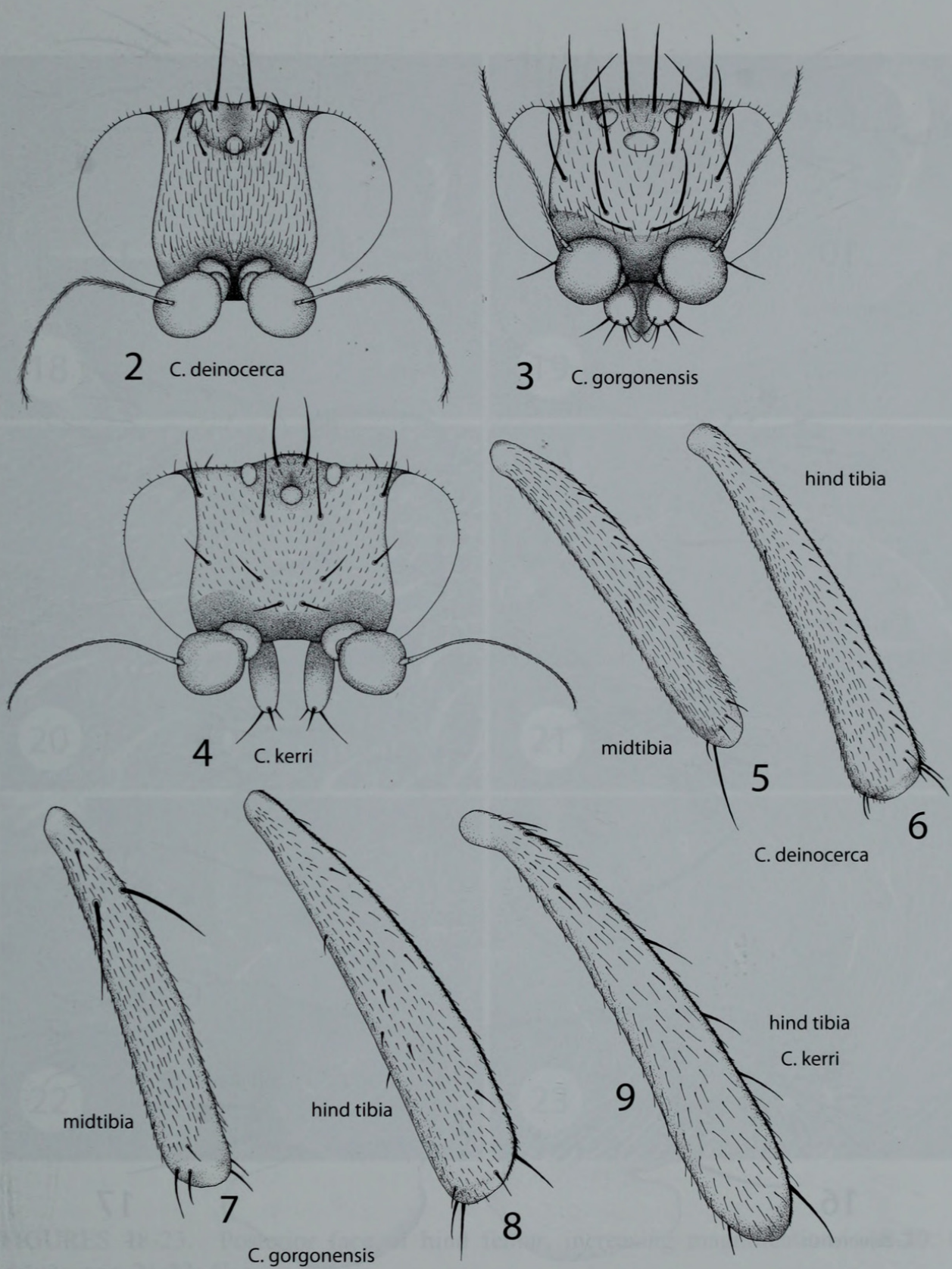
***Cyrtophorina deinocerca* Borgmeier & Prado, 1975**
(Figs. 2, 5, 6, 10, 11, 18, 19, 20, 30)

Cyrtophorina deinocerca Borgmeier & Prado, 1975: 85, 86, figs. 152, 153, 154.

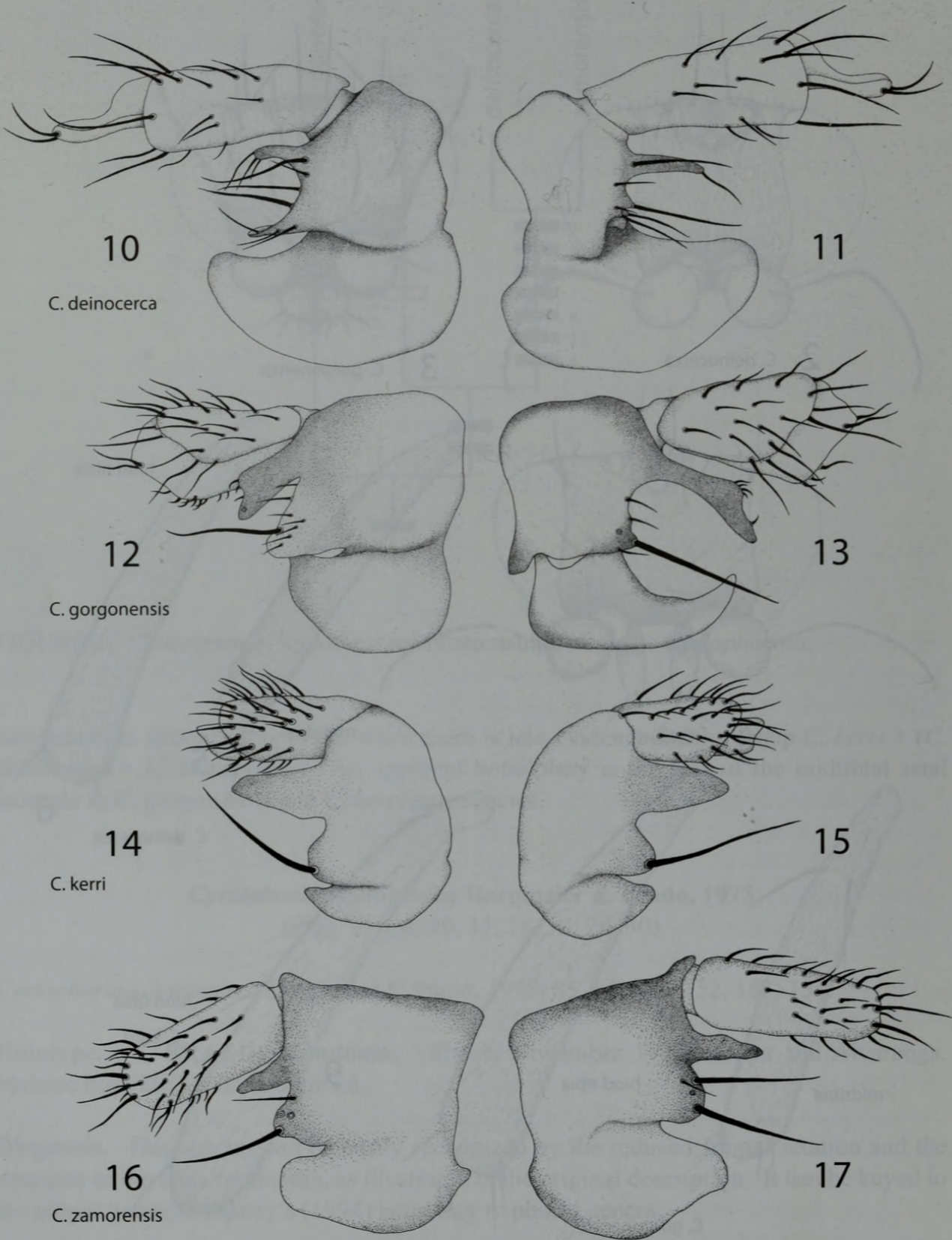
Holotype. ♂, **BRAZIL, Rondônia:** Vilhena, November 1973, Roppa and Alvarenga, Malaise trap, MZSP, not examined.

Diagnosis. This species can be easily recognized by the reduced frontal setation and the structure of the male terminalia, as illustrated in the original description. It can be keyed to the proper genus in Disney's (1994) latest key to phorid genera.

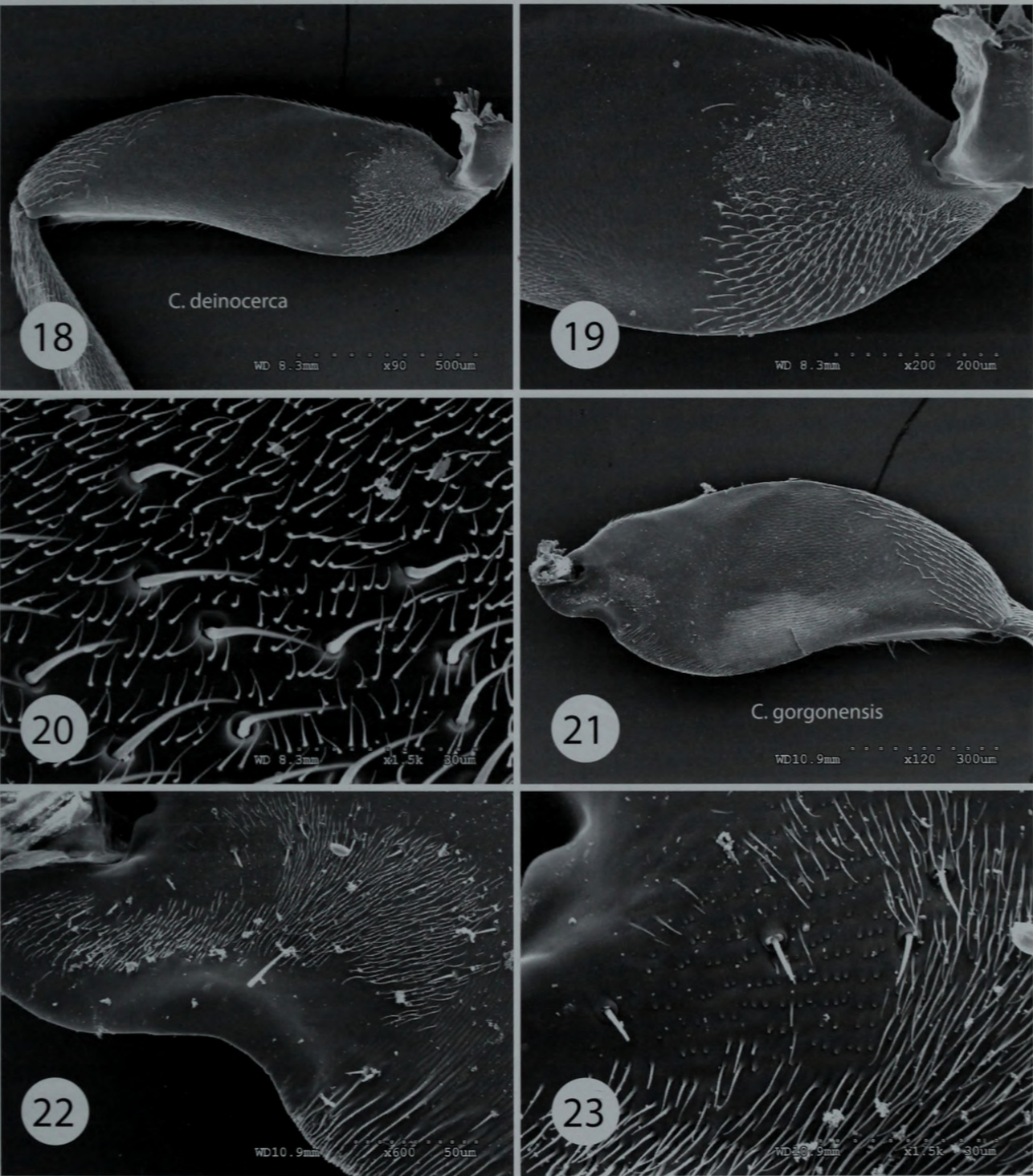
Description. Male. Body length 2.38-2.88 mm. Frons dark brown, broad, with dense, long, fine setulae. Frontal setae represented by dorsal interfrontal, postocellar, and one other pair, possibly dorsal fronto-orbital setae (Fig. 2); ventral fronto-orbital, ventral interfrontal, inner vertical, and supra-antennal setae apparently absent. Ocellar region



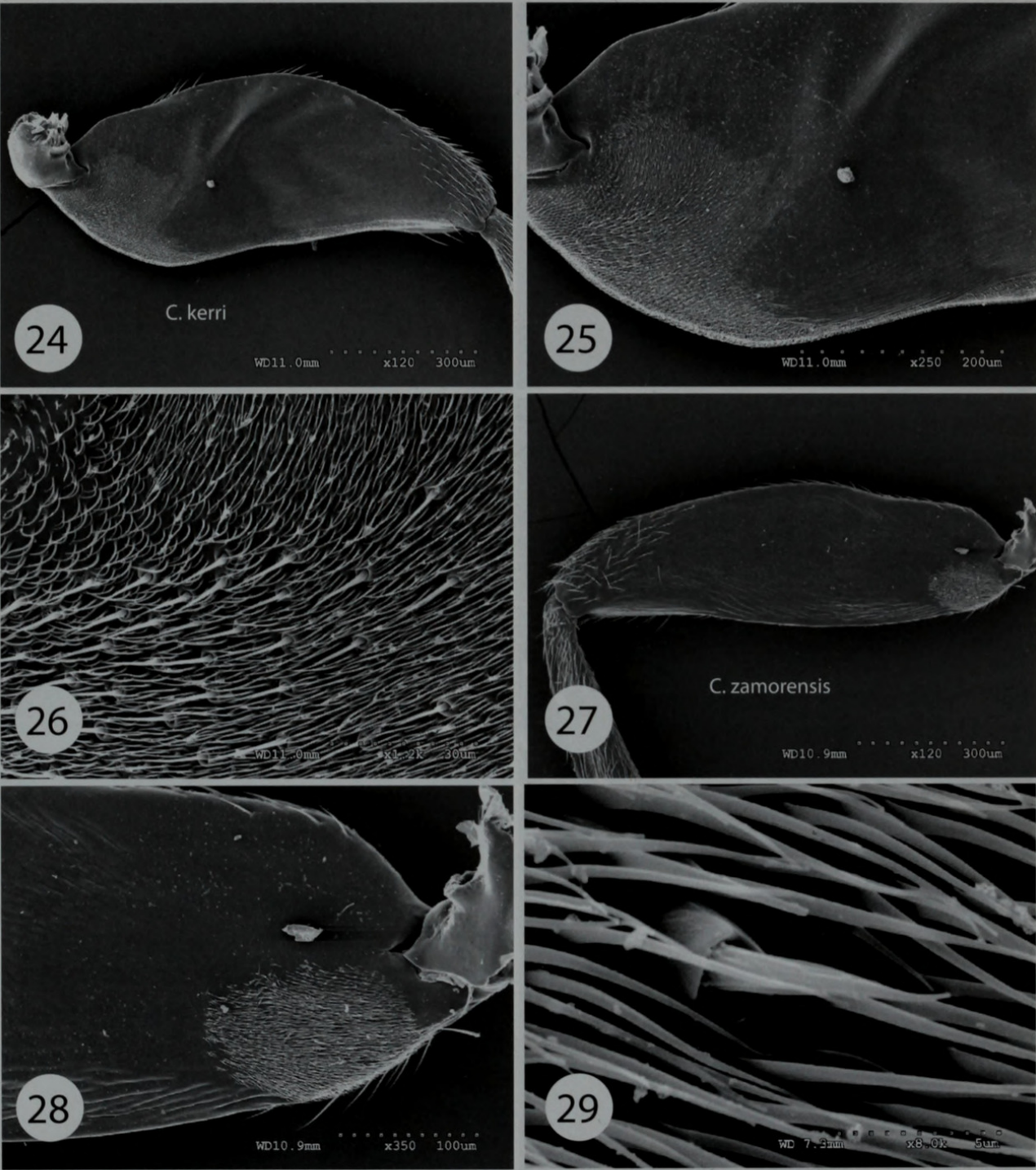
FIGURES 2-9. Heads and tibiae of *Cyrtophorina* spp., anterior view.



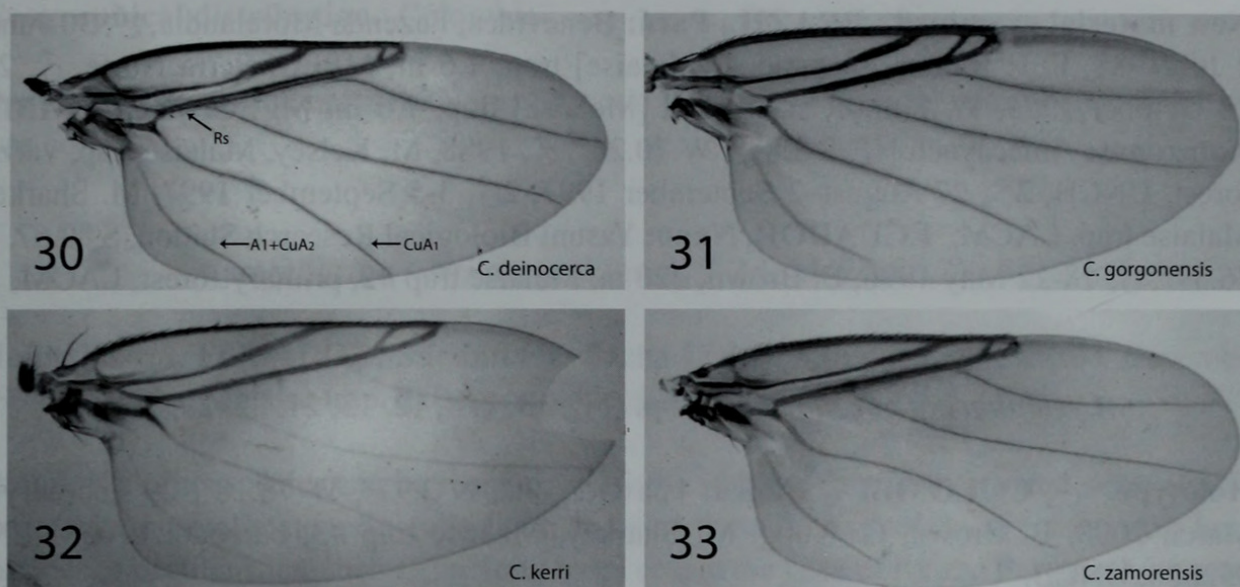
FIGURES 10-17. Terminalia, right side, left side, of *Cyrtophorina* spp..



FIGURES 18-23. Posterior face of hind femur, increasing magnification. 18-20: *C. deinocerca*; 21-23: *C. gorgonensis*.



FIGURES 24-29. Posterior face of hind femur, increasing magnification. 24-26: *C. kerri*; 27-29. *C. zamorensis*.

FIGURES 30-33. Wings of *Cyrtophorina* spp..

raised, concave centrally. Gena with few strong setae. Flagellomere 1 light brown, globose; arista dorsoapical, with relatively long microtrichia. Palpus brown, small, with one medium sized seta and several smaller ventral setae; other mouthparts reduced to two short, yellow, setose lobes. Scutum dark brown, broad; pleuron dark brown anterodorsally (proepisternum, dorsum of anepisternum), yellowish-brown posteriorly. Scutellum with 5-9 setae on each side, four of which (including most medial seta) are largest, others about one-half size. Anterior thoracic spiracle clearly dorsal in position, with several setulae lateral and ventral to it on anepisternum. Legs yellowish-brown. Foretibia with anterior row of about 13 short, enlarged, spinelike setae. Mid and hind tibiae (Figs. 5, 6) with variety of short, spine-like anteroventral to anterodorsal setae; dorsal setal palisade present on basal two-thirds of midtibia and entire length of hind tibia. Hind femur narrow (Fig. 18), with large patch of large and smaller ventrobasal setulae on posterior face (Figs. 19, 20). Mean costal length 0.64 wing length, range 0.62-0.67. Radial veins brown; base of vein Rs without seta; fork of Rs relatively small (Fig. 30). Veins CuA_1 and A_1+CuA_2 complete, extending to margin of wing; A_1+CuA_2 recurved posteriorly at apex. Three alular setae present. Halter light brown. Abdominal tergites dark grayish-brown, venter of abdomen gray. Terminalia yellowish brown, contrasting strongly with rest of dark-colored abdomen. Right side of epandrium (Fig. 10) with long, dorsal, pointed process and extremely short ventral process; posterior margin with several long setae. Left side of epandrium similar (Fig. 11), except ventral process longer and both processes bearing setae. Cercus elongate, deep; hypoproct dorsoventrally flat, arising within cercus at mid-depth. **Female.** Unknown.

Geographical distribution. Amazonian South America. In addition to the records below, the original specimens were collected in Rondônia, Brazil, and Brown (1993a) reported a specimen from Pastaza, Ecuador.

New material examined. **BRAZIL, Pará:** Benevides, Fazenda Morelandia, ♂, 30 June–2 July 1988, F. F. Ramos, suspended [Malaise] trap, 1.6 m, MPEG, Serra Norte, ♂, 25–28 October 1985, W. França, suspended [Malaise] trap, 1.6 m, MPEG. **COLOMBIA, Amazonas:** Amacayacu NP, S 3.82°, W 70.26°, ♂, 1988, M. Kelsey, Malaise trap, varzea forest, UNCB, 2♂, 27 August–2 September 1997, 2♂, 3–5 September 1997, M. Sharkey, Malaise trap, LACM. **ECUADOR, Napo:** Yasuní Biological Research Station, S 0.67°, W 76.39°, ♂, 18–22 May 1996, B. Brown, 220 m, Malaise trap #2, primary forest, LACM.

Cyrtophorina gorgonensis n. sp. (Figs. 3, 7, 8, 12, 13, 21, 22, 23, 31)

Holotype. ♂, **COLOMBIA, Cauca:** Isla Gorgona, N 2.97°, W 78.18°, 29 February–4 March 2000, B. Brown, G. Kung, M. Sharkey, Malaise trap #3, barcode: LACM ENT 152620, UNCB.

Paratype. ♂, **COLOMBIA, Valle de Cauca:** PNN Farallones de Cali, Anchicaya, N 3.43°, W 76.80°, 8 May–19 June 2001, S. Sarria, Malaise trap, 900 m, CAP–1894, LACM.

Diagnosis. This species can be recognized by the complete frontal setation, setation of the tibiae, and shape of the male terminalia.

In Disney's (1994) key to phorid genera, this species more or less keys to *Dohrniphora* (couplet 51), by virtue of it having a few setulae near the dorsal margin of the anepisternum, but differs in other characters given. It also does not match the alternatives for the other two genera keyed at couplet 52 (*Diplonevra* Lioy and *Psyllomyia* Loew).

Description. Male. Body length 2.06 mm. Frons brown, broad, with small setulae (Fig. 3); all major frontal setae present (ventral and dorsal interfrontal and fronto–orbital setae, inner vertical seta, postocellar seta) plus one pair of divergent, dorsally directed supra–antennal setae; all frontal setae of normal size. Ocellar region flat. Gena with few well developed setae. Flagellomere 1 lighter brown, globose, arista dorsoapical, with relatively long trichia. Palpus brown, normal sized, with large apical and smaller ventral setae. Labella well developed, presumably functional. Thorax dark brown, broad dorsally. Scutellum with total of 4 subequal setae. Anterior thoracic spiracle slightly displaced dorsally relative to *Dohrniphora* species, with two setulae posterior and ventral to it on anepisternum. Legs light brown. Foretibia with anterior row of 13 thickened, spinelike setae. Midtibia with basal pair of setae, plus one smaller anterior seta near apex (Fig. 7); lacking dorsal setal palisade. Hind femur relatively broad (Fig. 21), with small concavity near base, and small, round patch of mostly smaller (but also some larger) setulae (Figs. 22, 23). Hind tibia with scattered enlarged setae; with one dorsal setal palisade (Fig. 8). Costa 0.60 wing length. Radial veins dark brown; Rs with small seta at base (not visible in Fig. 31); fork of Rs relatively large, narrow, *Dohrniphora*–like (Fig. 31). Veins CuA₁ and A₁+CuA₂ incomplete, not extending to margin of wing; A₁+CuA₂ not recurved posteriorly at apex. One alular seta present. Halter brown. Abdominal tergites brown, venter of abdomen gray. Male terminalia dark brown; hypandrium joined narrowly to epandrium anteriorly. Posterior margin of right side of epandrium (Fig. 12) with dorsal elongate process and ventral long seta; left side similar (Fig. 13). Cercus and hypoproct deep. **Female.** Unknown.

Geographical distribution. Colombia.

Derivation of specific epithet. Named for Isla Gorgona, where the holotype specimen was collected.

Cyrtophorina kerri n. sp. (Figs. 4, 9, 14, 15, 24, 25, 26, 32)

Holotype. ♂, ECUADOR, Sucumbíos: Sacha Lodge, S 0.5°, W 76.5°, 1-31 December 1994, P. Hibbs, Malaise trap, 270 m, barcode: LACM ENT 050767, LACM.

Diagnosis. This species can be recognized by the reduced size of the frontal setae and the extremely unusual male terminalia (with an exceptionally long seta). The wing also has a number of peculiarities, such as the long basal seta at the base of Rs and the greatly reduced size of the microtrichia on the wing blade.

In Disney's (1994) key to genera, this species keys in a similar manner to *C. gorgonensis* at couplet 51.

Description. Male. Body length 2.25 mm. Frons brown, broad, finely setose, with 4-4-2 frontal setae (lower and upper fronto-orbital and interfrontal setae, plus postocellar setae; inner vertical seta absent) plus one pair dorsally-curved supra-antennal setae (Fig. 4). Ocellar region flat. Gena with few, fine setae. Flagellomere 1 light brown, globose; arista dorsoapical, with extremely short fine pubescence. Palpus orange-brown, well developed, with 2-3 long apical setae and several much shorter, ventral setae; other mouthparts virtually absent. Scutum grayish-brown, broad; pleuron dark brown anterodorsally (proepisternum, dorsum of anepisternum), yellowish-brown posteriorly. Scutellum with short anterior seta (about twice length of short setulae on scutum) and much longer, thicker posterior seta (about 2.5 times length of anterior seta). Anterior thoracic spiracle clearly dorsal, and with many setulae extending lateral and ventral of it to dorsal margin of pleuron. Legs yellowish-brown, except midcoxa dark brown. Foretibia with anterodorsal row of 8 slightly enlarged, spinelike setae on apical two-thirds. Midtibia with anterior and dorsal setal pair near base, plus one subapical anterior seta and two slightly differentiated posterodorsal setae near apical two-thirds; setal palisade absent. Hind femur broad (Fig. 24), with large patch of large and smaller setulae on posterior face (Figs. 25, 26). Hind tibia with one anterior seta near base and three enlarged posterodorsal setae along length; setal palisade present (Fig. 9). Costa 0.68 wing length (Fig. 32). Microtrichia on wing blade extremely small. Radial veins yellowish-brown; base of vein Rs with one long (0.15 mm) seta; fork of Rs relatively broad. Posterior veins faint. Veins CuA_1 and A_1+CuA_2 incomplete, not extending to margin of wing; A_1+CuA_2 not recurved posteriorly at apex. One alular seta present. Halter brown. Abdominal tergites brown, venter of abdomen gray. Male terminalia brown, cercus lighter. Right side of epandrium with large dorsal pointed posterior process and shorter more rounded ventral process, the latter bearing extremely long seta (Fig. 14); left side similar (Fig. 15). Cercus deep, hypoproct normal. **Female.** Unknown.

Geographical distribution. Ecuador.

Derivation of specific epithet. Named for Peter Kerr (formerly Peter Hibbs) who collected two of the new species described herein.

Cyrtophorina zamorensis n. sp. (Figs. 16, 17, 27, 28, 29, 33)

Holotype. ♂, ECUADOR, Zamora Chinchipe: Río Bombuscaro, S 4.12°, W 78.98°, 26 June–4 July 1996, P. Hibbs, Malaise trap, 1050 m, barcode: LACM ENT 134786, LACM.

Diagnosis. This species closely resembles *C. deinocerca*, but the male terminalia differ markedly (especially evident on the right side, contrast Figs. 10, 16), and the mid and hind tibiae lack any enlarged, isolated setae.

In Disney's (1994) key, this species keys at couplet 96 to *Egregiophora* Beyer, a genus that is much larger in body size, has well developed frontal setae, and belongs in another subfamily.

Description. Male. Body length 1.90 mm. Frons brown, broad, setose, bare of large setae except inner vertical seta and postocellar seta. Ocellar region concave. Gena with few medium sized setae. Flagellomere 1 lighter brown, oval, slightly flattened; arista dorsoapical, with relatively long trichia. Palpus dark brown, small, with medium sized setae. Other mouthparts greatly reduced, probably nonfunctional. Scutum brown, broad dorsally. Scutellum with 8 setae. Dorsum of anepisternum brown, rest of pleuron yellowish. Anterior thoracic spiracle clearly dorsal, and with many setulae extending lateral and ventral of it to dorsal margin of pleuron. Forelegs missing in sole specimen. Mid and hind legs yellowish brown. Hind femur narrow (Fig. 27), with small posteroventral, round patch of mostly smaller (but also some larger) setulae (Figs. 28, 29). Mid and hind tibiae with dorsal setal palisade, but lacking large isolated setae. Costa 0.58 wing length. Radial veins dark brown; Rs without seta at base; fork of Rs relatively small. Veins CuA_1 and A_1+CuA_2 incomplete, not extending to margin of wing; A_1+CuA_2 not recurved posteriorly at apex. One alular seta present. Halter brown. Abdominal tergites brown, venter of abdomen gray. Male terminalia dark brown dorsally, lighter ventrally, cercus yellow. Right side of epandrium with two large setae and narrow posterior process dorsally (Fig. 16). Left side of epandrium with two large and one smaller setae, as well as narrow posterior process dorsally (Fig. 17). Cercus deep, hypoproct normal. **Female.** Unknown.

Geographical distribution. Ecuador.

Derivation of specific epithet. Named for the Ecuadorian province in which the specimen was collected.

Key to Males of *Cyrtophorina* species

1. Midtibia with strong basal pair of setae, one near–dorsal, one anterior (Fig. 7); midtibia lacking dorsal setal palisade; frons with usual pairs of setae in three rows (Figs. 3, 4)2
- Midtibia lacking strong basal pair of setae, at most with scattered smaller setae (Fig. 5); midtibia with dorsal setal palisade present at least along most of length; frons lacking some or nearly all setae (Fig. 2)3
2. Hind tibia with three anterodorsal setae and several scattered anterior to ventral setae, lacking posterodorsal setae (Fig. 8); frontal setae stronger (Fig. 3)*Cyrtophorina gorgonensis* n. sp.
- Hind tibia with only a single anterior seta near base, but with three large posterodorsal setae (Fig. 9); frontal setae reduced in size, delicate (Fig. 4)*Cyrtophorina kerri* n. sp.
3. Midtibia with few scattered enlarged dorsal to ventral setae (Fig. 5); right side of epandrium with two long, thin processes (Fig. 10); frons with dorsal interfrontal setae present near anterior ocellus (Fig. 2)*Cyrtophorina deinocerca* Borgmeier & Prado
- Midtibia without isolated setae; right side of epandrium with ventral process broad, short (Fig. 16); frons lacking dorsal interfrontal setae*Cyrtophorina zamorensis* n. sp.

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