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Revision of the Neotropical genus *Paraliodrosophila* (Diptera, Drosophilidae)

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The four species of Drosophilidae currently ascribed to the genus *Paraliodrosophila* Duda, namely *P. antennata* Wheeler, *P. bipartita* Duda, *P. dudai* Wheeler and *P. mihalyii* Wheeler, are redescribed and the genus diagnosis updated. A new species, sibling with *P. bipartita*, is described from Rio de Janeiro and São Paulo cities, Brazil, as *Paraliodrosophila burlai* sp. nov. Illustrations and photomicrographs of male and female terminalia are also included.

Keywords: Brazil, Central America, Jamaica, new species.

INTRODUCTION

The small genus *Paraliodrosophila* was proposed by Duda (1925: 155) to include a single Costa Rican species he described under the epithet *bipartita,* referring to the two sharply contrasting dorsal (black [in fact coffee brown]) and ventral (yellowish white) body colorations. Later on, three additional species were described by Wheeler (1954, 1957, 1963) in this poorly known genus of Drosophilidae. The known geographical distribution of its species was apparently restricted to Southern Mexico, Central America, the Caribbean Island of Jamaica and Northwestern South America. They are relatively tiny flies (body length ca. 2 mm) that might at first sight be mistaken for species belonging to closely related genera such as *Mycodrosophila*, from which they differ mainly by being devoid of a well developed lappet preceding the second costal break of the wing, and by having 2 pairs of dorsocentral setae, instead of just one pair as it occurs in the species of the genus *Mycodrosophila*. They are also similar to some species of the genus *Hirtodrosophila* from which they mostly differ by having glossier and wider than long heads, although this condition also occurs in some broad-headed species of *Hirtodrosophila*. The association with fungi seems to be clear for the species of the genera *Mycodrosophila* and *Hirtodrosophila* but not so, although very likely, for those poorly known species belonging to *Paraliodrosophila*. The main goals of the present paper are to make a revision of the four species included in the genus *Paraliodrosophila*, to describe a new species, sibling with *P. bipartita*, we have found among pinned ordinary specimens housed in the ZMUZ, and to prepare a key to their identification.

MATERIAL AND METHODS

Label data attached to each specimen are cited in full with a backslash indicating a label change. Our own notes or interpretations are included in brackets (also in other items throughout the text). The following determination label: «... Bächli & Vilela det. 2007» was added to the specimens, in addition to the following for the dissected ones: «terminalia illustrated and photographed»

Preparations of microscope slides were made following Wheeler & Kambysellis (1966) and Kaneshiro (1969). The abdominal sclerites, including the disarticulated terminalia, are preserved in microvials filled with glycerin and attached by the stopper to the pin of the respective specimen. Refer to Vilela & Bächli (2000) and Bächli *et al.* (2000, 2004) for further details.

Male and female terminalia were drawn using a camera lucida (1.0x, 1.4x or 1.8x) attached to a compound microscope under a 40x objective. They were photographed with a photomicroscope, under a 6.3x objective. Photomicrographs were taken of the following structures: internal male terminalia in dorsal or ventral and left lateral views and spermathecal capsules in lateral view. Whenever in the same plate all figures were drawn to the same scale and all photomicrographs were taken and enlarged to the same magnification, unless otherwise indicated.

For measurements and indices see Vilela & Bächli (1990), for morphological terminology see Vilela & Bächli (2000) and Bächli *et al.* (2004).

The 29 specimens analyzed in the present revision were loaned from the following institutions: American Museum of Natural History, New York (AMNH), Hungarian Natural History Museum, Budapest (HNHM), National Museum of Natural History, Washington, D.C. (NMNH), Zoologisches Museum der Universität Zürich, Zurich (ZMUZ). Specimens of both sexes were included, except for *Paraliodrosophila bipartita* and *P. dudai*, from which no females were available.

TAXONOMY

Genus *Paraliodrosophila* Duda

Paraliodrosophila Duda, 1925: 184. Duda 1927: 17 [key], 1939: 61, 65 [diagnosis]; Neave 1940: 575 [list]; Wheeler 1954: 56 [diagnosis]; 1970: 79.32 [Neotropical catalog]; 1981: 72 [world catalog]; Okada 1967: 1, 2 [relationship]; 1989: 395 [phylogeny], 397 [key]; Val *et al.* 1981: 156 [distribution]; Grimaldi 1991: 93 [phylogeny]; Ashburner *et al.* 2005: 1125 [species number], 1129 [phylogeny].

Type species. *Paraliodrosophila bipartita* Duda (monotypic).

Diagnosis. Generally small flies. Body color generally dark, predominantly glossy as in *Liodrosophila* etc. Frontal triangle covering most of the front and unusually trapezoidal, except in *P. antennata*. Mesonotum dorsally convex, when seen in lateral view, as in *Mycodrosophila* etc. Pleura contrasting blackish/whitish, as in *Mycodrosophila* etc. Flagellomere 1 covered with prolonged setulae which along the margin are almost half as long as the width of the flagellomere, as in *Hirtodrosophila*. Vibrissa single and prominent (modified after Duda, 1925: 186 and Wheeler, 1954: 56).

Taxa included (5). *Paraliodrosophila antennata* Wheeler, *P. bipartita* Duda, *P. burlai* sp. nov., *P. dudai* Wheeler, *P. mihalyii* Wheeler.

Key to species

1. Base of antenna (scape and pedicel) contrasting whitish, flagellomere 1 brown; pleura blackish in upper $^1/_4$, contrasting whitish below .... ***P. antennata*** Wheeler
— Base of antenna of the same color or darker than flagellomere 1; dark upper pleural stripe also contrasting, but broader, posteriorly covering about the upper half of the whitish pleura 2

2. Cheeks narrow, about $^1/_{12}$ of larger eye width; wing with apex of first costal section distinctly darkened; ventral epandrium lobe rudimentary, distally slightly convex, partially covering surstylus; paraphysis not fused to aedeagal apodeme 3
— Cheeks broader, about $^1/_6$ of larger eye width; wing with apex of first costal section hyaline; ventral epandrial lobe long, sharply pointed at tip and embracing surstylus anteriorly; paraphysis partially fused to aedeagal apodeme .. 4

3. Aedeagus slightly pointed at tip in dorsal view, bearing a laterally serrate, anterodorsal plate ..... ***P. bipartita*** Duda
— Aedeagus roundish at tip in dorsal view, devoid of an anterodorsal plate .... ***P. burlai*** sp. nov.

4. Contrasting dark pleural stripe anteriorly narrow, posteriorly about half of pleural height ..... ***P. dudai*** Wheeler
— Contrasting dark pleural stripe covering the upper half of the pleura .... ***P. mihalyii*** Wheeler

Paraliodrosophila antennata Wheeler, 1957

(Figs 1–3, 16A, 17A, G)

Paraliodrosophila antennata Wheeler, 1957: 109. Wheeler 1970: 79.32 [Neotropical catalog]; 1981: 72 [world catalog]; Val *et al.* 1981: 157 [distribution]; Grimaldi 1988: 208 [list].

Material examined. (5 ♂♂, 5 ♀♀). Holotype ♂ (dissected, deposited in the NMNH), labelled: «Jamaica BWI [British West Indies] \ nr [near] Bath Feb 1956 \ WBHeed \ HOLOTYPE [pink label] \ Paraliodrosophila antennata Wheeler \ Type No. 101,075 USNM [red label]». Paratypes (4 ♂♂, 5 ♀♀, deposited in the AMNH): same labels [except the last two; with yellow paratype labels] as holotype.

Type locality. Near Bath, Jamaica.

Diagnosis. Antenna with a conspicuous whitish base; cheeks broad, whitish behind; pleura whitish with contrasting, narrow dark stripe in upper $^1/_4$; wing's first costal section apex hyaline.

Redescription (n= 5). ♂.

Head. Frons dark brown, partly glossy, upper corners of orbital plates pale yellowish-brown; frontal length 0.31 (0.28–0.32) mm; frontal index = 1.26 (1.18–1.36), top to bottom width ratio = 1.39 (1.25–1.50). Frontal triangle (indeed

antennata

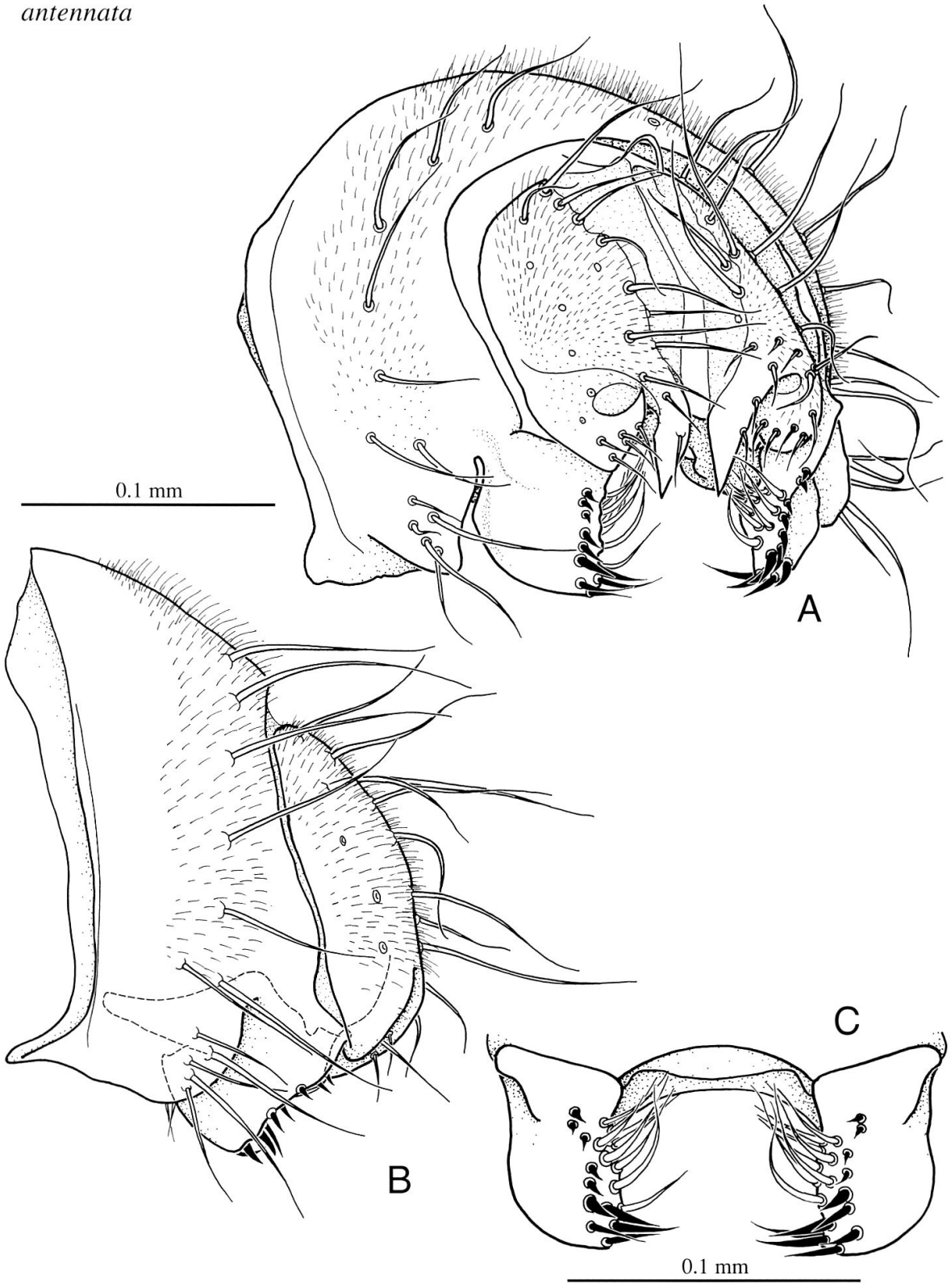

Fig. 1. *Paraliodrosophila antennata* Wheeler, male holotype. — A, epandrium, cerci, surstyli, and decasternum, oblique posterior view. — B, epandrium, cercus and surstylus, left lateral view. — C, surstyli and decasternum, posterior view.

antennata

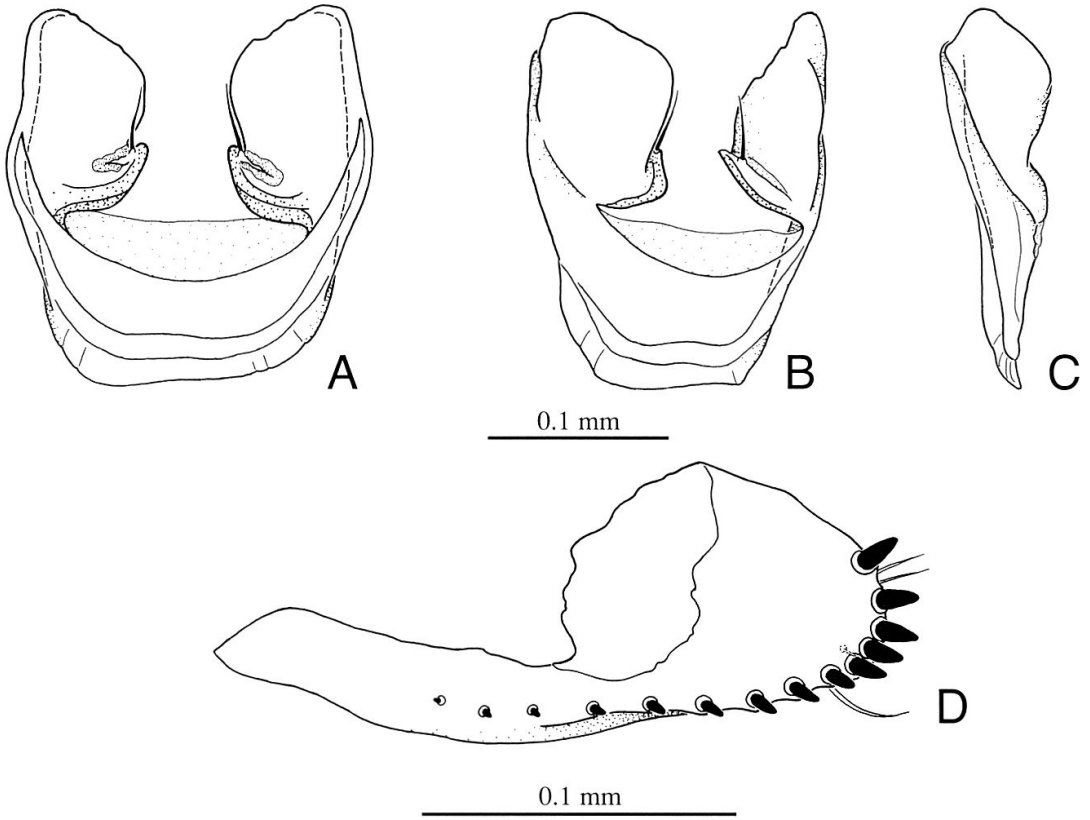

Fig. 2. *Paraliodrosophila antennata* Wheeler, male holotype (A–C), and female paratype (D). — A, hypandrium and gonopods, ventral view. — B, idem, oblique ventral view. — C. idem, left lateral view. — D, left oviscapt valve, left lateral view.

triangle-shaped) well developed, glossy, narrowly reaching frontal margin, laterally distinctly convex; ocellar triangle dark brown, prominent, about 26–35 % of frontal length. Frontal vittae slightly greyish microtrichose. Orbital plates slightly microtrichose, apically somewhat diverging from eye margin, about 74–84 % of frontal length. Orbital setae black, almost in a line, or2 nearer to or1 than to or3, distance of or3 to or1 = 55–75 % of or3 to vtm, or1 / or3 ratio = 1.07 (0.90–1.29), or2 / or1 ratio = 0.41 (0.33–0.44), postvertical setae crossed, 30 (26–39) %, ocellar setae = 62 (53–68) % of frontal length; vibrissa strong, distinct, index = 0.31 (0.25–0.36). Face pale brown. Carina narrow, noselike. Cheek dark brown in anterior half, whitish in posterior half, index about 7 (6–8). Eye roundish-oval, with short, dense pile, index = 1.14 (1.04–1.20). Scape and pedicel conspicuously whitish. Flagellomere 1 dark brown, covered with prolonged setulae which along the margin are almost half as long as the width of the flagellomere, length to width ratio = 1.76 (1.60–1.80). Arista with 4 (–5) long dorsal, 1 long ventral and about 3–5 small inner branches, plus long terminal fork. Proboscis yellowish. Clypeus broadened, brown. Palpus apically darkened.

Thorax length 0.78 (0.69–0.80) mm. Scutum dark brown, almost fully glossy but slightly microtrichose in posterior half, postpronotum paler, about 6 rows of acrostichal setae. h index = 0.92 (0.75–1.00). Transverse distance of dorsocentral setae 283–300 % of their longitudinal distance; dc index = 0.51 (0.47–0.57). Scu-

tellum dark brown, glossy but slightly microtrichose, scutellar setae nearly equidistant; scut index = 0.48 (0.29–0.58). Pleura dark brown in upper ¼, yellowish below wing base, below whitish, sharply delimited, sterno index = 0.51 (0.46–0.60), median katepisternal seta indistinct. Halter stalk brown, knob whitish. Legs pale whitish-yellow, fore tarsus of male with somewhat prolonged setulae, preapical seta on tibia 3, apical seta on tibia 2.

Wing hyaline, veins R4+5 and M apically slightly convergent, length 1.72 (1.54–1.82) mm, length to width ratio = 2.18 (2.08–2.27). Indices: C = 1.22 (1.14–1.32), ac = 4.06 (3.50–5.00), hb = 0.54 (0.39–0.60), 4C = 1.85 (1.75–2.00), 4v = 2.53 (2.25–2.80), 5x = 2.75 (2.50–3.33) M = 0.93 (0.80–1.00), prox. x = 0.57 (0.45–0.64).

Abdomen generally dark brown, glossy in anterior half, slightly microtrichose in behind, tergite 2 with a broad, central, pale yellowish area, tergite 3 with a narrow, central yellowish area, tergites 4 and 5 with paramedian pale yellowish areas which are anteriorly covered by the preceding tergite and rounded along hind margin. Terminalia contrasting pale.

Terminalia (Figs 1–3, 16A, 17A). Epandrium scatteredly microtrichose distally, with about 7 lower and 5 upper setae; ventral lobe not microtrichose, slightly covering surstylus. Cerci scatteredly microtrichose medially, with a pair of ventral lobes and a pair of hypoproctal plates, linked to hypandrium by membranous tissue. Surstylus anterodorsally fused to epandrium, not microtrichose, with ca. 11 cone-shaped, sharply pointed, wide-spaced, and not well defined prensisetae, organized in an irregular row and somewhat gradually decreasing in size from the dorsalmost to ventralmost one. Decasternum horizontally positioned and posteriorly fused to surstyli. Hypandrium as long as epandrium; bow absent, gonopod mostly fused to hypandrium (although a suture is still visible), bearing one seta in a finger-shaped projection of its inner submedian margin. Aedeagus a curved tube, twice as long as aedeagal apodeme, dorsally concave, distally turned upwards and covered with tiny scales, submedianly serrate at dorsal margin and subdistally slightly expanded laterally. Aedeagal apodeme fused to aedeagus, laterally flattened, wide, and linked to paraphyses by membranous tissue, posteriorly projected ventralwards. Ventral rod widely fused to aedeagal apodeme, longer than paraphyses. Paraphyses one third the length of aedeagus, somewhat square-shaped, mostly double-walled, distally linked to gonopod by membranous tissue, and bearing two distal setulae; anteriorly linked to the ventroposterior margin of aedeagal apodeme by membranous tissue. Ejaculatory apodeme distally oval-shaped with a pair of subdorsal membranous foramens, L-shaped in lateral view; rod anteriorly expanded dorsoventrally.

♀. Measurements: Frontal length 0.30 (0.27–0.33) mm; frontal index = 1.10 (1.00–1.20), top to bottom width ratio = 1.34 (1.25–1.53). Ocellar triangle about 31–47 % of frontal length. Orbital plates about 79–88 % of frontal length. Distance of or3 to or1 = 50–71 % of or3 to vtm, or1 / or3 ratio = 1.06 (1.00–1.13), or2 / or1 ratio = 0.49 (0.44–0.56), postvertical setae = 37 (29–44) %, ocellar setae = 59 (53–65) % of frontal length; vibrissal index = 0.31 (0.27–0.36). Cheek index about 8 (5–9). Eye index = 1.12 (1.04–1.17). Thorax length 0.79 (0.73-0.84) mm. h index = 0.88 (0.71-1.00). Transverse distance of dorsocentral setae 243–300 % of longitudinal distance; dc index = 0.56 (0.47–0.71). Distance between apical scutellar setae about 87–100 % of that of apical to basal one; scut index = 0.55 (0.53–0.58), sterno index = 0.54 (0.50–0.56). Wing length 1.69 (1.57–1.79) mm, length to width

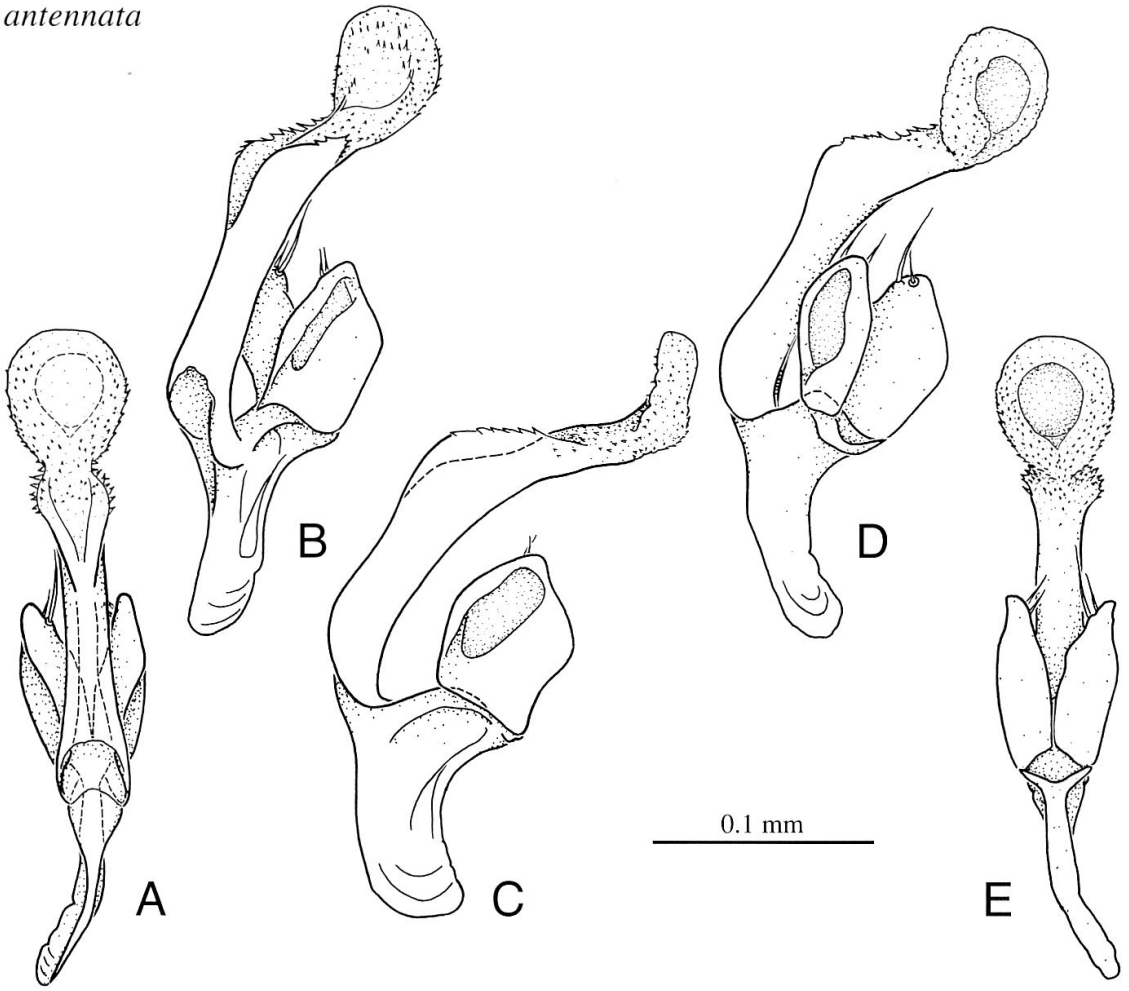

Fig. 3. *Paraliodrosophila antennata* Wheeler, male holotype. A–E, aedeagus+aedeagal apodeme and paraphyses, several views from dorsal through ventral.

ratio = 2.08 (2.04–2.14). Indices: C = 1.12 (1.05–1.14), ac = 4.31 (3.80–5.25), hb = 0.55 (0.52–0.58), 4C = 2.01 (1.91–2.22), 4v = 2.60 (2.45–2.89), 5x = 2.48 (1.67–3.00), M = 0.93 (0.82–1.00), prox. x = 0.58 (0.55–0.67).

Terminalia (Figs 2D, 17G). Valve of oviscapt apically rounded, with 13 marginal plus one discal peglike ovisensilla, which gradually increase in size from the anteriormost to the posteriormost one. Valves anteriorly fused to each other through a narrow bridge; the two dorsalmost inner sensilla well developed, conspicuously close together and not separated from each other by one peglike ovisensillum. Inner spermathecal capsule (Fig. 17G) weakly sclerotized, trapezoidal-shaped in lateral view; basal and distal introverts short, not reaching the median region.

Distribution. Known only from the type locality (Jamaica).

Comments. The male terminalia of the holotype of *Paraliodrosophila antennata* seem to be much more similar to those illustrated by Burla (1956) for a species from Rio de Janeiro (Brazil) he tentatively identified as *Hirtodrosophila thoracis* (Williston) than they are to those of the remaining four species of *Paraliodrosophila*. Whether or not the specimen illustrated by Burla was correctly identi-

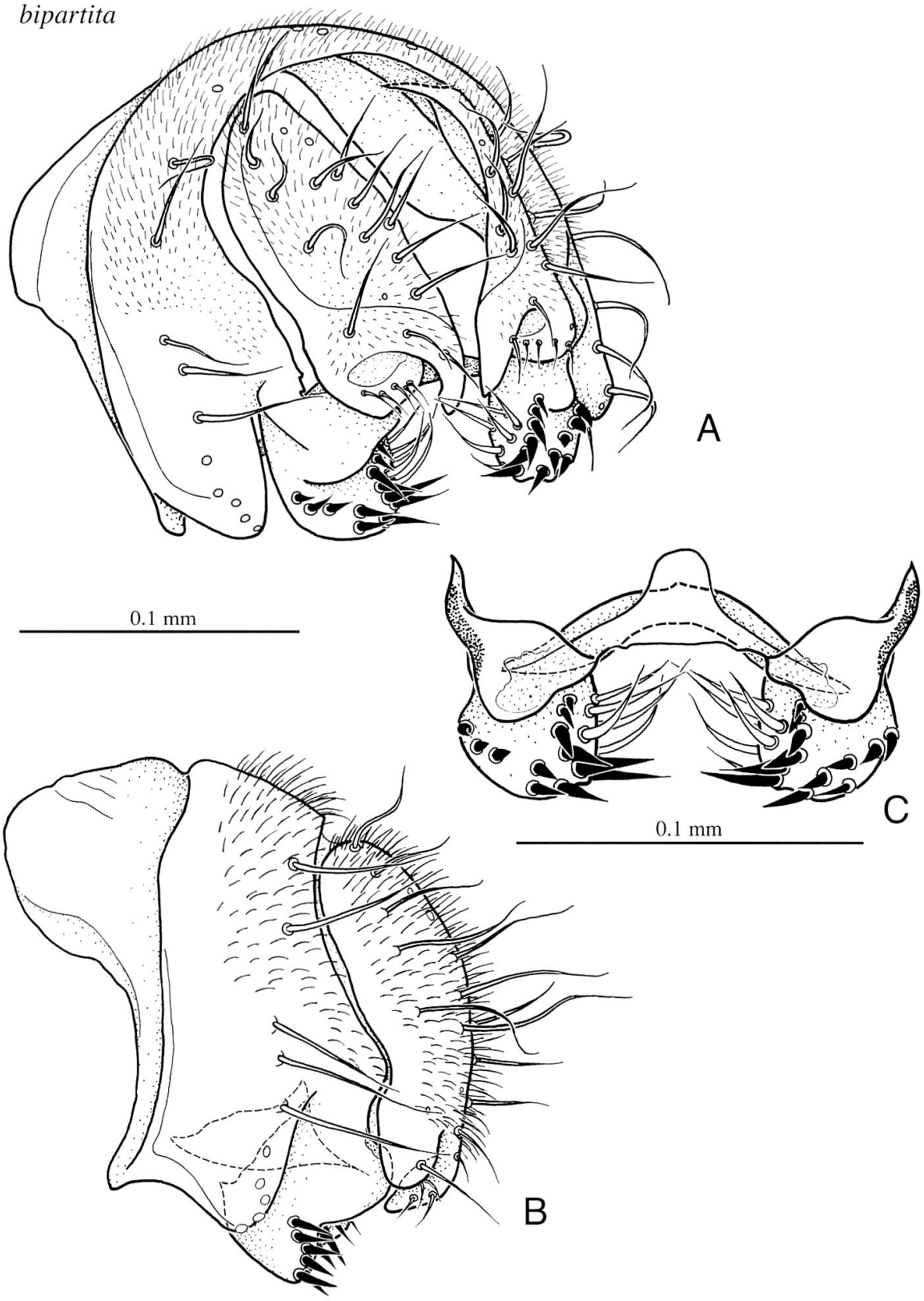

Fig. 4. *Paraliodrosophila bipartita* Duda, male lectotype. — A, epandrium, cerci, surstyli, and decasternum, oblique posterior view. — B, epandrium, cercus and surstylus, left lateral view. — C, surstyli and decasternum, posterior view.

fied remains an open question, considering that the description of *Hirtodrosophila thoracis* made by Williston (1896) was based on a single female specimen from the Caribbean island of St. Vincent; its identity is yet not clear. It should be pointed out that *Hirtodrosophila thoracis* was originally described in the genus *Drosophila*, later transferred to the genus *Mycodrosophila* and then to the subgenus *Hirtodrosophila* of *Drosophila* (currently a genus). Now a possibility arises that it, and other species belonging to the *thoracis* species group, could belong to the genus *Paraliodrosophila*. Or, alternatively, *Paraliodrosophila antennata* could belong to *Hirtodrosophila*. However, we are postponing any nomenclatural change until the identity of *Hirtodrosophila thoracis* could be clarified.

Paraliodrosophila bipartita Duda, 1925

(Figs 4–6, 16B, 17B)

Paraliodrosophila bipartita Duda, 1925: 184. Duda, 1939: 6 [diagnosis]; Wheeler 1954: 56 [distribution], 57 [redescription]; 1963: 57 [lectotype designation]; 1970: 79.32 [Neotropical catalog, distribution in Ecuador]; 1981: 72 [world catalog]; Heed 1956: 61, 65 [distribution]; 1957: 70 [adult feeding site], 76 [distribution]; Wheeler & Takada 1971: 231 [male terminalia]; Val *et al.* 1981: 156 [distribution]; Bächli 1984: 29 [type depository]; Grimaldi 1990: 101 [phylogeny].

Material examined. Lectotype ♂ (dissected, deposited in the HNHM), labelled: «Costa Rica Suiza de Turrialba [back side reads 1921. V. 5] \ Paraliodrosophila n.g. bipartita n.sp. ♂ DET. DR. O DUDA \ syn[black handwriting]typus[red printed][red-bordered label] \ LECTOTYPE bipartita Duda selected by MRWheeler June 1962 [pink label]».

Type locality. La Suiza de Turrialba, Province of Cartago, Costa Rica.

Diagnosis. Antenna almost unicolorous; cheeks narrow; pleura dark in upper half, paler below wing base; tip of first costal section brown; aedeagus slightly pointed at tip in dorsal view, bearing a conspicuous, laterally serrate, anterodorsal plate.

Redescription. ♂.

Head. Frons dark brown, glossy, frontal length 0.22 mm; frontal index = 0.81, top to bottom width ratio = 1.31. Frontal triangle glossy, covering most of front, trapezoidal, broadly reaching frontal margin, laterally distinctly convex, ocellar triangle black, prominent, about 38 % of frontal length. Orbital plates narrow, almost parallel to eye margin, about 92 % of frontal length. Orbital setae black, almost in a line, distance of or3 to or1 = 71 % of or3 to vtm, postvertical setae = 46 % of frontal length; vibrissa strong, distinct. Face dark brown. Carina noselike, narrow, dorsally sharp. Cheek dark brown, paler in posterior half, rather narrow, index about 12. Eye with short, dense pile, index = 1.14. Antennae brown. Flagellomere 1 paler yellowish, covered with prolonged setulae which along the margin are about one third as long as the width of the flagellomere, length to width ratio = 1.75. Proboscis yellow. Lower border of face and clypeus broad, dark brown, glossy. Palpus yellowish-brown.

Thorax length 0.65 mm. Scutum blackish-brown, glossy, about 6 rows of acrostichal setae. h index = 1.40. Transverse distance of dorsocentral setae 214 % of longitudinal distance; dc index = 0.60. Scutellum microtrichose, distance between apical scutellar setae about 133 % of that between apical and basal one, scut index = 0.50. Pleura in dorsal half dark brown, paler around base of wing, lower

bipartita

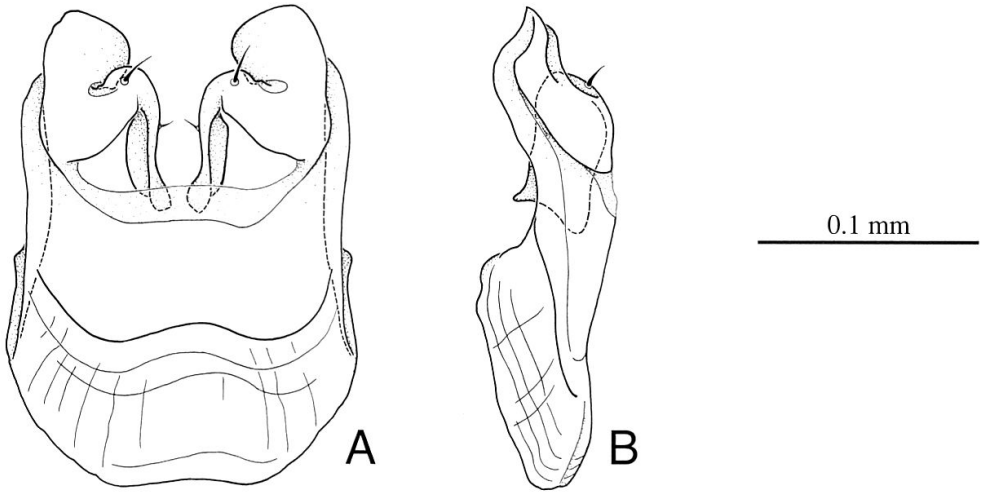

Fig. 5. *Paraliodrosophila bipartita* Duda, male lectotype. — A, hypandrium, gonopods+paraphyses, ventral view. — B, idem, left lateral view.

half (katepisternum etc.) whitish yellow, sharply delimited. Halter stem brownish, knob yellow. Legs whitish yellow, strong preapical seta on tibia 3, apical seta on tibia 2.

Wing hyaline but apex of costal section 1 dark brown, veins R4+5 and M apicallay parallel, length 1.51 mm, length to width ratio = 2.15. Indices: C = 1.31, ac = 3.20, hb = 0.56, 4C = 2.00, 4v = 2.88, 5x = 3.00, M = 1.13, prox. x = 0.75..

Abdomen generally blackish-brown, glossy but in basal half slightly microtrichose, tergite 2 medially pale yellowish-brown, also tergite 3 medially pale, tergite 4 basally with narrow yellowish areas. Terminalia contrasting pale.

Terminalia (Figs 4–6, 16B, 17B). Epandrium scatteredly microtrichose dorsodistally, with about 6 lower and 5 upper setae; ventral lobe short, not microtrichose, partially covering surstylus. Cerci scatteredly microtrichose medially with a pair of ventral lobes and a pair of hypoproctal plates, linked to hypandrium by membranous tissue. Surstylus anterodorsally fused to epandrium, not microtrichose, with 12 long, cone-shaped, sharply pointed, not well defined prensisetae somewhat organized in two convergent rows, those in the inner row being longer and thinner than those in the outer row, plus 5 long inner setae. Decasternum horizontally positioned and fused to the posterodorsal margin of surstyli. Hypandrium slightly longer than epandrium; bow absent, gonopod mostly fused to hypandrium (although a suture is still visible), bearing one seta on its inner median margin. Aedeagus slightly shorter than aedeagal apodeme, dorsally straight and anteroventrally serrate in lateral view, slightly turned ventralwards and laterally membranous at tip, posteriorly expanded laterally, bearing a conspicous, marginally serrate, laterally expanded, anterodorsal plate. Aedeagal apodeme fused to aedeagus, curved, laterally flattened, anteriorly expanded dorsoventrally. Ventral rod rudimentary, laterally expanded. Paraphyses somewhat rectangular, longer than high, anteriorly linked to aedeagal apodeme by membranous tissue, slightly shorter than aedeagus, and medially bearing one setula; anteriorly linked to the posterior margin of the aedeagal apodeme

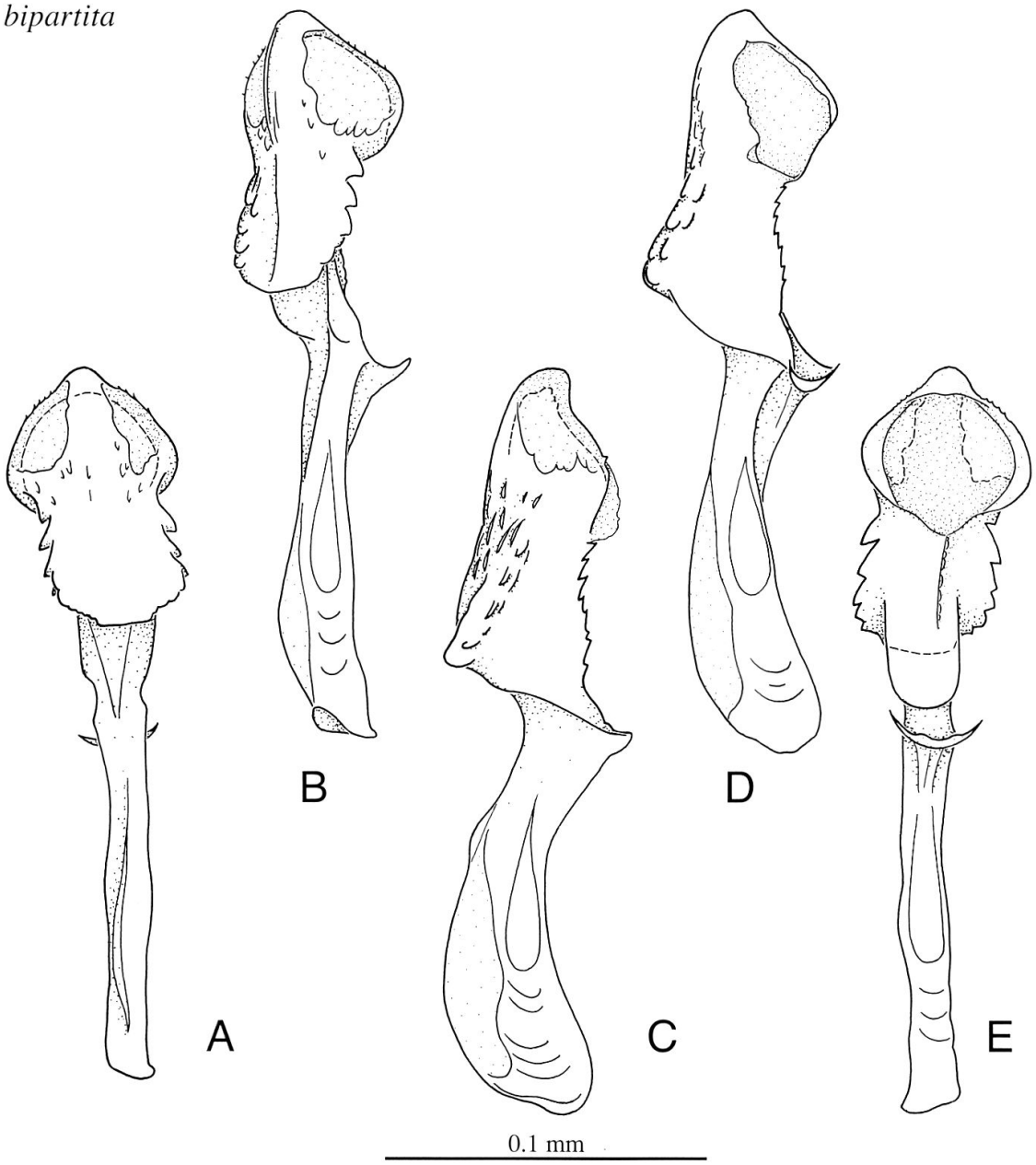

Fig. 6. *Paraliodrosophila bipartita* Duda, male lectotype. A–E, aedeagus+aedeagal apodeme, several views from dorsal through ventral.

by membranous tissue. Ejaculatory apodeme distally oval-shaped with a pair of subdorsal, membranous foramens; rod anterioly turned dorsalwards.

Distribution (after Wheeler, 1981). Mexico, El Salvador, Nicaragua, Costa Rica, Panama, Ecuador.

Comments. We believe that the identity of all ordinary specimens collected from any place cited above in the item distribution, other than the type locality in Costa Rica (Suiza de Turrialba), should be checked for sibling species of *P. bipartita*. It should be pointed out that although they were requested as loans we have received none of them either from the AMNH or the NMNH, and they are most probably lost.

Paraliodrosophila burlai sp. nov.

(Figs 7–9, 16C, D, I, 17C, D, H)

Diagnosis. Antenna brownish; pleura whitish with contrasting, dark stripe in upper half; cheeks narrow; wing with apex of first costal section distinctly darkened; aedeagus roundish at tip in dorsal view, and devoid of an anterodorsal plate.

Material examined. (6 ♂♂, 5♀♀). **Holotype** ♂ (dissected, deposited in the ZMUZ), labelled: «Brasilia [Brazil] Rio de Janeiro XII [December]. 1953 H. Burla leg. \ ♂ \ Paraliodrosophila bipartita Duda G. Bächli det. [misidentification] \ HOLOTYPE [red label]» Paratypes: 4 ♂♂, 5 ♀♀: same labels as holotype; 1 ♂ (dissected) labelled «Brasilia [Brazil] Cantareira [Parque Estadual da Cantareira] \ S.P. [Mairiporã, State of São Paulo] X.1954 da Cunha leg. \ ♂ \ Paraliodrosophila bipartita Duda G. Bächli det. [misidentification]; all deposited at ZMUZ.

Type locality. Rio de Janeiro city, State of Rio de Janeiro, Brazil.

Diagnosis. Antenna almost unicolorous; cheeks narrow; pleura dark in upper half, paler below wing base; tip of first costa section brown; aedeagus roundish at tip in dorsal view, devoid of anterodorsal plate.

Redescription. ♂.

Head. Frons dark brown, glossy, frontal length 0.21 (0.20–0.22) mm; frontal index = 0.79 (0.76–0.81), top to bottom width ratio = 1.37 (1.31–1.41). Frontal triangle glossy, covering most of front, trapezoidal, broadly reaching frontal margin, laterally distinctly convex, ocellar triangle black, prominent, about 31–34 % of frontal length. Orbital plates narrow, almost parallel to eye margin, about 85–92 % of frontal length. Orbital setae black, almost in a line, distance of or3 to or1 = 37–57 % of or3 to vtm, or1 / or3 ratio = 0.78, or2 / or1 ratio = 0.47 (0.43–0.57), postvertical setae = 54 (50–58) %, ocellar setae = 104 (92–108) % of frontal length; vibrissa strong, distinct, index = 0.29 (0.20–0.36). Face dark brown. Carina noselike, narrow, dorsally sharp. Cheek dark brown, paler in posterior half, rather narrow, index about 12 (10–13). Eye with short, dense pile, index = 1.08 (1.00–1.14). Antennae brown. Flagellomere 1 paler yellowish, covered with prolonged setulae which along the margin are about one third as long as the width of the flagellomere, length to width ratio = 1.48 (1.40–1.60). Arista with 4 long dorsal, 1 long ventral and about 3–5 small inner branches, plus long terminal fork. Proboscis yellow. Lower border of face and clypeus broad, dark brown, glossy. Palpus yellowish-brown.

Thorax length 0.71 (0.64–0.76) mm. Scutum blackish-brown, glossy, about 8 rows of acrostichal setae. h index = 0.85 (0.70–1.13). Transverse distance of dorsocentral setae 214–283 % of longitudinal distance; dc index = 0.58 (0.56–0.61). Scutellum microtrichose, distance between apical scutellar setae about 112–160 % of that between apical and basal one, scut index = 0.58 (0.50–0.65). Pleura in dorsal half dark brown, paler around base of wing, lower half (katepisternum etc.) whitish yellow, sharply delimited, sterno index = 0.43, median katepisternal seta indistinct. Halter stem brownish, knob yellow. Legs whitish yellow, strong preapical seta on tibia 3, apical seta on tibia 2.

Wing hyaline but apex of costal section 1 dark brown, veins R4+5 and M apically parallel, length 1.55 (1.43–1.68) mm, length to width ratio = 2.19 (2.14–2.33). Indices: C = 1.14 (1.06–1.21), ac = 3.81 (3.60–4.25), hb = 0.59 (0.56–0.63), 4C = 2.29 (2.11–2.57), 4v = 3.00 (2.56–3.50), 5x = 2.93 (2.67–3.33), M = 1.11 (1.00–1.29), prox. x = 0.73 (0.56–0.86).

burlai

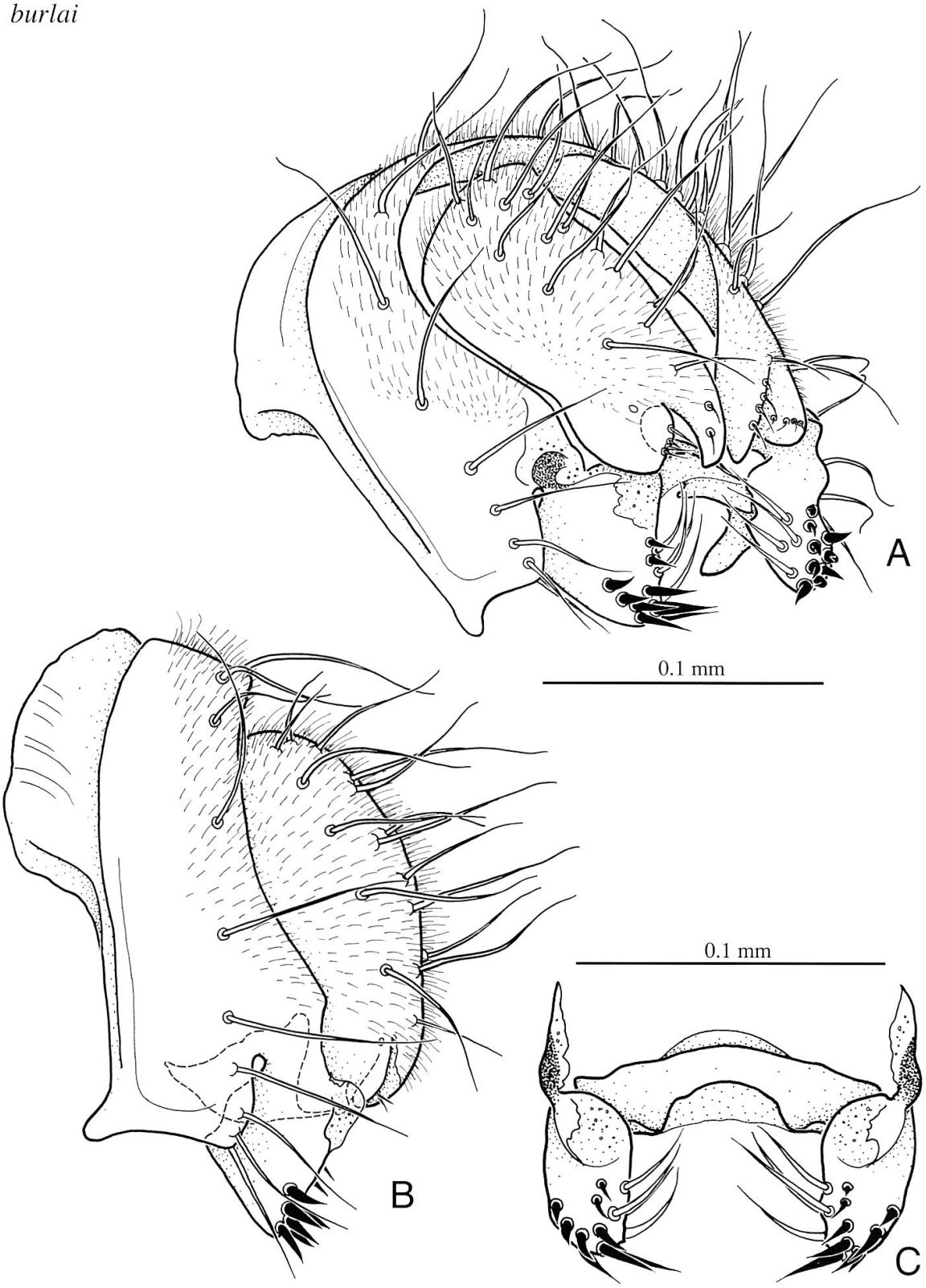

Fig. 7. *Paraliodrosophila burla*i sp. nov., male holotype. — A, epandrium, cerci, surstyli, and decasternum, oblique posterior view. — B, epandrium, cercus and surstylus, left lateral view. — C, surstyli and decasternum, posterior view.

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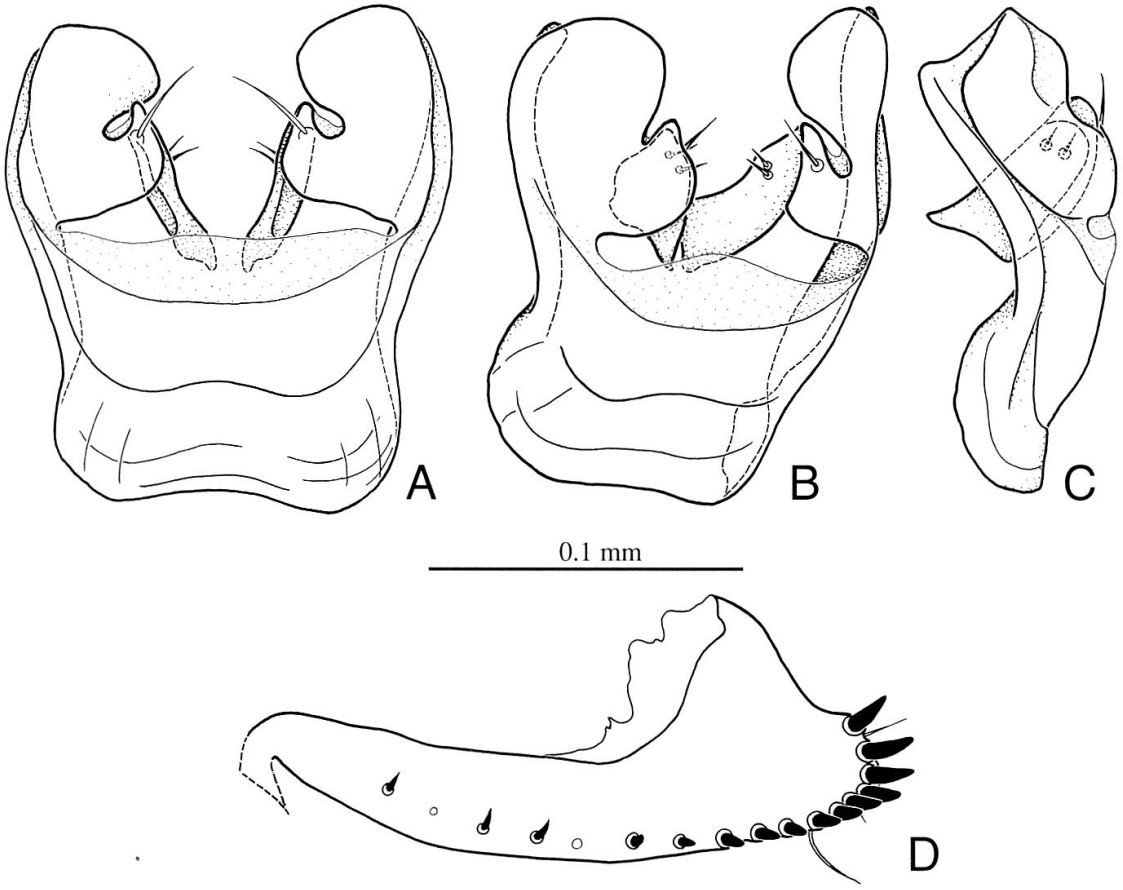

Fig. 8. *Paraliodrosophila burlai* sp. nov., male holotype (A–C), and female paratype from Rio de Janeiro, RJ, Brazil (D).— A, hypandrium, gonopods+paraphyses, ventral view. — B, idem, oblique ventral view. — C. idem, left lateral view. — D, left oviscapt valve, left lateral view.

Abdomen generally blackish-brown, glossy but in basal half slightly microtrichose, tergite 2 medially pale yellowish-brown, also tergite 3 medially pale, tergite 4 basally with narrow yellowish areas. Terminalia contrasting pale.

Terminalia (Figs 7–9, 16C, D, 17C, D). Epandrium scatteredly microtrichose dorsodistally, with about 4 lower and 5 upper setae; ventral lobe rudimentary, not microtrichose, partially covering surstylus anteriorly. Cerci mostly scatteredly microtrichose, with a pair of ventral lobes and a pair of hypoproctal plates, linked to hypandrium by membranous tissue. Surstylus anterodorsally fused to epandrium, not microtrichose, with 9 long, cone-shaped, sharply pointed, not well defined prensisetae somewhat organized in two convergent rows, those in the inner row, except the tiny uppermost two, being longer than those in the outer row, plus 4 long inner setae. Decasternum horizontally positioned and fused to the posterodorsal margin of surstyli. Hypandrium shorter than epandrium; bow absent, gonopod mostly fused to hypandrium (although a suture is still visible), bearing one seta in a finger-shaped projection of its inner median margin. Aedeagus as long as aedeagal apodeme, dorsally slightly convex, distally dilated laterally, distal region ventrally membranous and microtrichose with serrate margin, subdistally conspicuously rugose dorsolat-

burlai

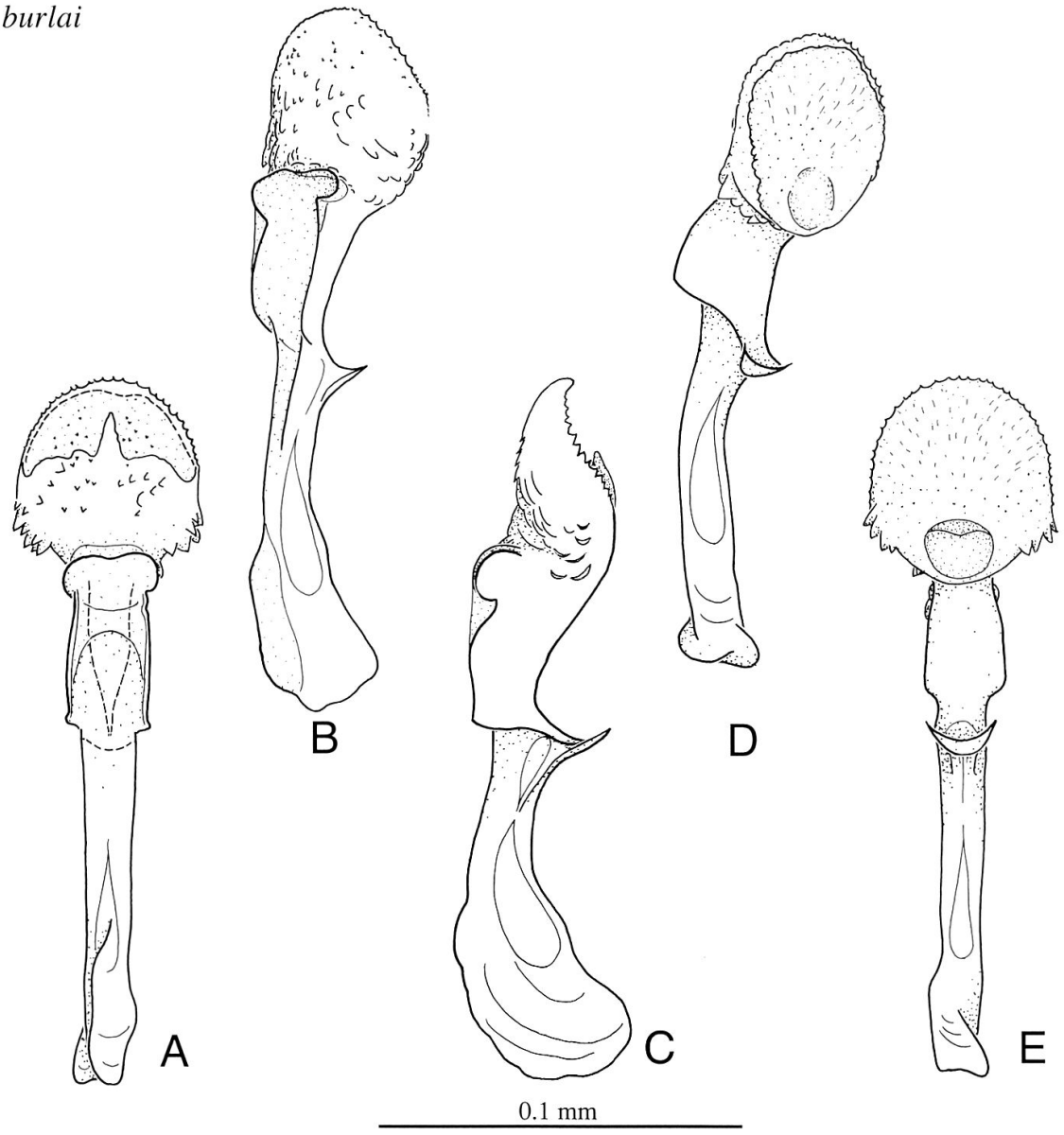

Fig. 9. *Paraliodrosophila burlai* sp. nov., male holotype. A–E, aedeagus+aedeagal apodeme, several views from dorsal through ventral.

erally, bearing a pair of small, booble-shaped expansions in the dorsomedian region. Aedeagal apodeme fused to aedeagus, curved, laterally flattened, anteriorly expanded ventrodorsally. Ventral rod rudimentary, slightly expanded laterally. Paraphyses anteriorly linked to the distal margin of aedeagal apodeme by membranous tissue, shorter than aedeagus, and bearing two subdistal setulae in the inner surface.

♀. Measurements: Frontal length 0.23 (0.20–0.26) mm; frontal index = 0.77 (0.75–0.87), top to bottom width ratio = 1.38 (1.25–1.44). Ocellar triangle about 33 % of frontal length. Orbital plates about 80–93 % of frontal length. Distance of or3 to or1 = 43–44 % of or3 to vtm, or1 / or3 ratio = 0.75 (0.70–0.82), or2 / or1 ratio = 0.47 (0.38–0.57), postvertical setae = 62 (50–71) %, ocellar setae = 97 (93–100) % of frontal length; vibrissal index = 0.31 (0.25–0.36). Cheek index about 13

dudai

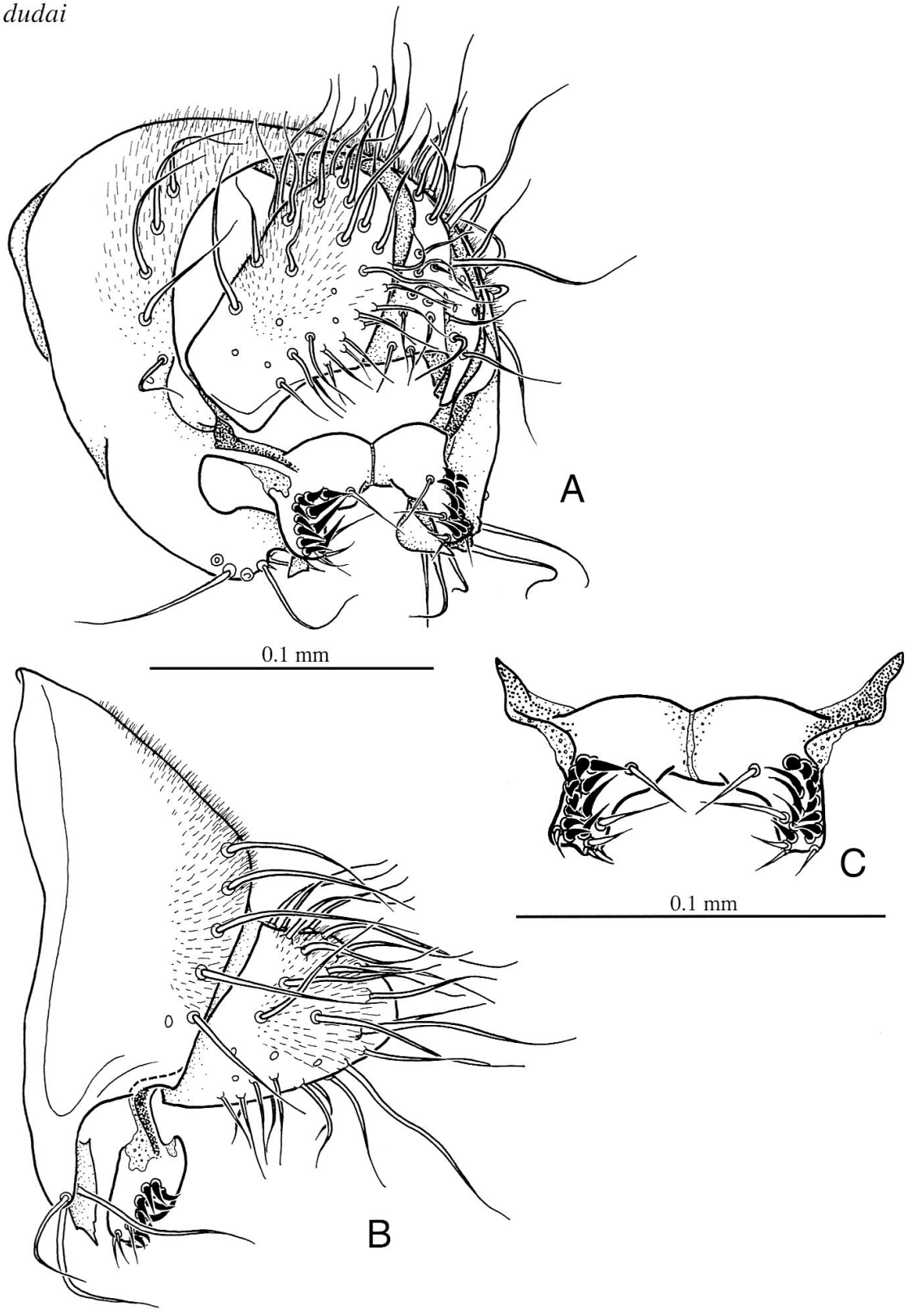

Fig. 10. *Paraliodrosophila dudai* Wheeler, male holotype. — A, epandrium, cerci, surstyli, and decasternum, oblique posterior view. — B, epandrium, cercus and surstylus, left lateral view. — C, surstyli and decasternum, posterior view.

(12–15). Eye index = 1.17 (1.14–1.22). Thorax length 0.80 (0.73–0.84) mm. h index = 0.84 (0.70–1.00). Transverse distance of dorsocentral setae 257–285 % of longitudinal distance; dc index = 0.64 (0.63–0.65). Distance between apical scutellar setae about 143–166 % of that of apical to basal one; scut index = 0.58 (0.53–0.65), sterno index = 0.43 (0.37–0.53). Wing length 1.75 (1.57–1.90) mm, length to width ratio = 2.18 (2.08–2.25). Indices: C = 1.16 (0.81–1.32), ac = 4.36 (3.60–5.25), hb = 0.59 (0.39–0.67), 4C = 2.27 (1.90–3.10), 4v = 2.86 (2.67–3.22), 5x = 2.82 (2.50–3.33), M = 1.04 (1.00–1.11), prox. x = 0.75 (0.67–0.80).

Terminalia (Figs 8D, 17H). Valve of oviscapt apically blunt, subapically expanded dorsalwards, with 15–16 marginal plus one discal peglike ovisensilla, which gradually increase in size from the anteriormost to the posteriormost one. Valves anteriorly fused to each other through an narrow bridge; the two dorsalmost inner sensilla well developed, conspicuously close together and not separated from each other by one peglike ovisensillum [not seen in the illustrated right valve]. Inner spermathecal capsule weakly sclerotized, twice wider than high, trapezoidal-shaped in lateral view; basal introvert deep and reaching the shallow distal one.

Etymology. Named after our admired friend Hans Burla, a retired Professor of the Zoologisches Museum der Universität Zürich and the collector of most of the specimens used in this description, as a recognition to his outstanding contributions to the knowledge of Neotropical Drosophilidae.

Comments. We only realized that this was a new species after analyzing its male terminalia, as it is virtually indistinguishable from *P. bipartita* regarding the extenal morphology.

Paraliodrosophila dudai Wheeler, 1954

(Figs 10–12, 16E, 17E)

Paraliodrosophila dudai Wheeler, 1954: 56. Heed 1956: 6 [distribution]; 1957: 70 [adult feeding sites], 76 [distribution]; Wheeler 1970: 79.32 [Neotropical catalog]; 1981: 72 [world catalog]; Val *et al.* 1981: 157 [distribution].

Diagnosis. Antenna brownish; pleura whitish with contrasting, dark stripe which is narrow anteriorly, broad posteriorly; cheeks broad; wing hyaline; aedeagus conspicuously turned frontwards distally, looking like an elephant proboscis in lateral view.

Material examined. Holotype ♂ (dissected, deposited in the NMNH), labelled: «Huatusco-1.5 mi. S Vera Cruz, Mex. \ Jun 23–4, 1952 W.B.Heed \ HOLOTYPE \ Paraliodrosophila dudai Wh. [red label] \ Type No. 101,076 U.S.N.M. [red label]».

Type locality. Huatusco, 1.5 miles south of Vera Cruz, Mexico.

Redescription, based on the ♂ holotype.

Head. Frons dark brown, paler towards anterior margin, glossy, slightly microtrichose, frontal length 0.98 mm; frontal index = 0.93, top to bottom width ratio = 1.33. Frontal triangle glossy, covering most of front, trapezoidal, broadly reaching anterior margin of front, laterally convex. Ocellar triangle prominent, about 50 % of frontal length. Orbital plates narrow, parallel to eye margin, about 86 % of frontal length. Orbital setae black, distance of or3 to or1 = 50 % of or3 to vtm, or1 / or3 ratio = 0.75, or2 / or1 ratio = 0.33, postvertical setae = 50 %, ocellar setae = 71 %

dudai

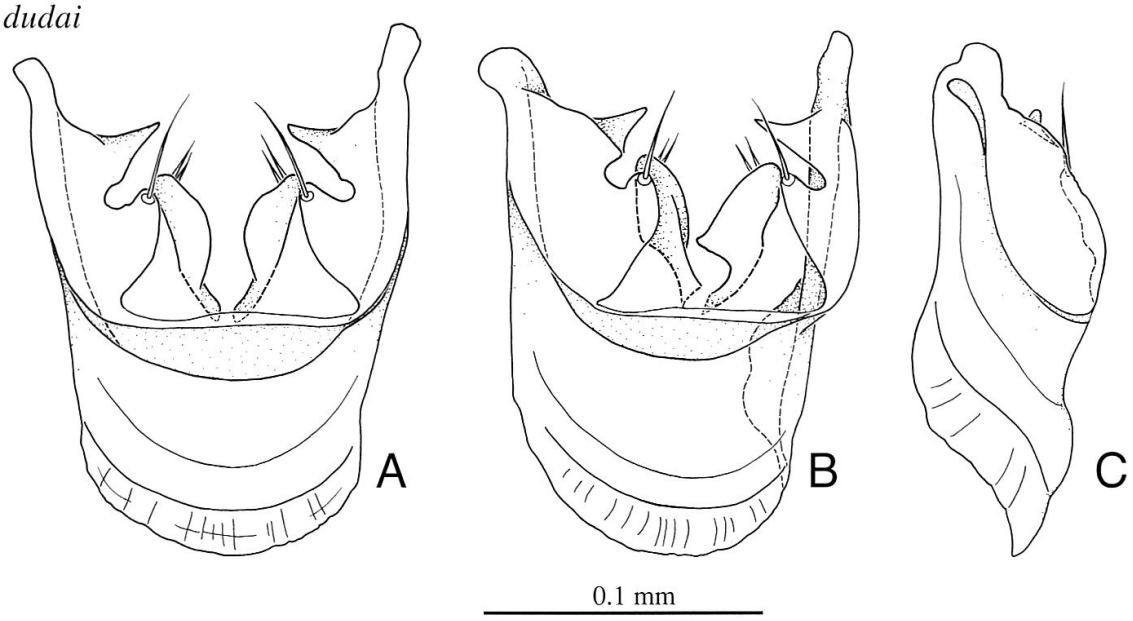

Fig. 11. *Paraliodrosophila dudai* Wheeler, male holotype. — A, hypandrium, gonopods+paraphyses, ventral view. — B, idem, oblique ventral view. — C. idem, left lateral view.

of frontal length; vibrissa strong, distinct, index = 0.38. Face brownish-yellow. Carina about half length of face, noselike, somewhat prominent. Cheek yellowish, broad, index about 6. Eye with short, dense pile, index = 1.06, Antennae yellowish-brown. Flagellomere 1 covered with prolonged setulae which along the margin are about one third as long as the width of the flagellomere, length to width ratio = 1.60. Arista with 5 long dorsal, 1 long ventral and about 6 small inner branches, plus terminal fork. Proboscis yellowish. Clypeus and palpus yellowish.

Thorax length 0.61 mm. Scutum dark brownish, glossy, with faint microtrichosity in posterior half, about 6 rows of acrostichal setae. h index = 1.00. Transverse distance of dorsocentral setae 257 % of longitudinal distance; dc index = 0.63. Scutellum glossy but with fine microtrichosity. Distance between apical scutellar setae about 167 % of that between apical and basal one, scut index = 0.65. Pleura whitish yellow, with a narrow, dark, contrasting stripe in upper 1/4 and a dark patch below halters, forming together an oblique stripe, sterno index = 0.54, median katepisternal seta indistinct. Halter yellowish. Legs pale yellow.

Wing hyaline, length 1.65 mm, length to width ratio = 2.14. Indices: C = 1.56, ac = 3.20, hb = 0.38, 4C = 1.45, 4v = 2.18, 5x = 2.00, M = 0.73, prox. x = 0.64.

Abdomen predominantly yellow, with dark brown lateral hind corners on tergite 2, dark posterior bands on tergites 3 and 4 which are medially and laterally broadened to reach the anterior margin, tergites 5 and 6 whitish, dorsally very narrow, tergite 7 blackish-brown, laterally covered by tergite 6. Terminalia contrasting pale.

Terminalia (Figs 10–12, 16E, 17E). Epandrium dorsally expanded, scatteredly microtrichose dorsodistally, with about 6 lower and 6 upper setae; ventral lobe not microtrichose, expanded inwards and distally sharply pointed, partially embracing surstylus anteriorly. Cerci microtrichose medially, longer than higher, devoid both

dudai

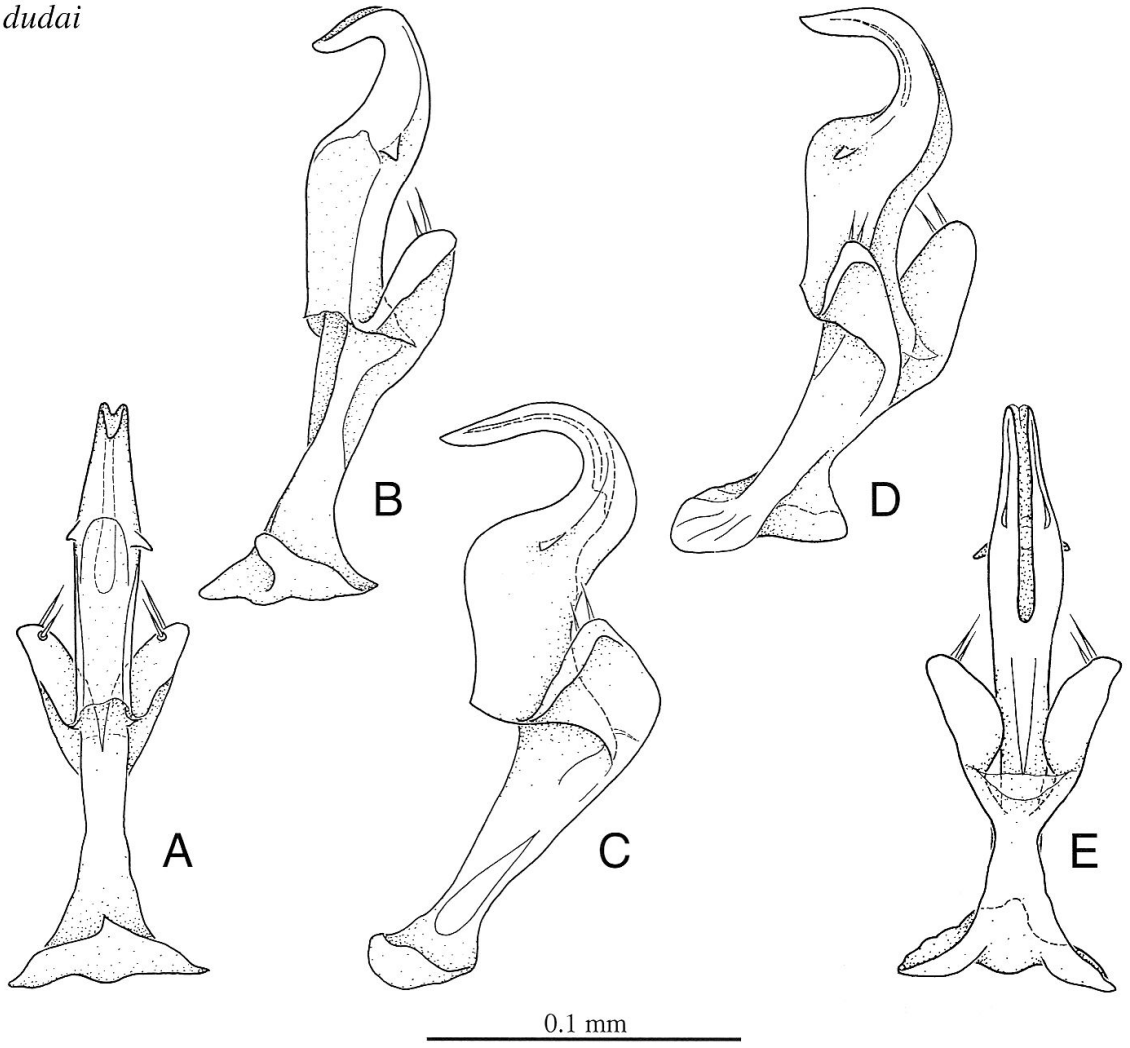

Fig. 12. *Paraliodrosophila dudai* Wheeler, male holotype. A–E, aedeagus+aedeagal apodeme and paraphyses, several views from dorsal through ventral.

of ventral lobe and hypoproctal plate, linked to hypandrium by membranous tissue. Surstylus fused to epandrium through a long, narrow and strongly sclerotized stalk, not microtrichose, with 11–12 long, cone-shaped, sharply pointed, not well defined prensisetae somewhat organized in two parallel rows, those in the inner row being longer and thinner than those in the outer row, 1 outer and 4 long inner setae, the uppermost one widely spaced and close to the uppermost prensisetae. Decasternum reduced to a small bridge and fused to surstyli. Hypandrium shorter than epandrium; bow absent, gonopod mostly fused to hypandrium (although a suture is still visible), bearing one long seta in a finger-shaped projection of its inner median margin; inner posterior margin sharply expanded inwards. Aedeagus as long as aedeagal apodeme, dorsally strongly convex, distally conspicuously turned frontwards so that in profile looks like an elephant proboscis, bearing a pair of tiny lateral processes in the median region. Aedeagal apodeme fused to aedeagus and partially to paraphyses, dorsoventrally flattened; anterior region strongly expanded laterally. Ventral rod

rudimentary, membranous, shorter than paraphyses. Paraphyses somewhat square-shaped, partially fused ventrally to aedeagal apodeme, one third the length of aedeagus, and bearing two dorsodistal setulae; linked dorsoanteriorly to the posterior margin of the aedeagal apodeme by membranous tissue.

Paraliodrosophila mihalyii Wheeler, 1963

(Figs 13–15, 16F, 17F, I)

Paraliodrosophila mihalyii Wheeler, 1963: 60. Wheeler 1970: 79.32 [Neotropical catalog]; 1981: 72 [world catalog]; Val *et al.* 1981: 157 [distribution]; Bächli 1984: 35 [type depository].

Diagnosis. Antenna brownish; pleura whitish with contrasting, dark stripe in upper half; cheeks broad; wing hyaline; aedeagus distally dilated, bearing a pair of conspicuous, fingershaped lateral processes in the median region.

Material examined (5 ♂♂, 1 ♀). Holotype ♂ (dissected, deposited in the NMNH), labelled: «10 klm [sic] N [North] Heredia Costa Rica \ W.B. Heed Sep-[strikethrough] Oct 1955 \ Paraliodrosophila mihalyii Whlr. HOLOTYPE [pink label] \ Type No. 101,077 U.S.N.M. [red label]». Paratypes (4 ♂♂, AMNH): one bearing the same labels [except the last two; with a yellow paratype label] as holotype; three labelled: «Volcan Irazu Costa Rica 9000 ft. \ W.B. Heed Sep-[erased] Oct 1955 \ PARATYPE, one labelled [white label]», «Boquete ChiriquiP. PANAMA \ WBHeed MWasserman August 1958 \ PARATYPE [white label]», «Boquete ChiriquiP.[erased] PANAMA \ WBHeed MWasserman August 1958 \ H. 360 \ PARATYPE [white label]»; plus one ♀ (HNHM) labelled: «Costa Rica Suiza de Turrialba [back side reads 1921. IV. 16] \ bipartita ♀ DET. DR. O DUDA \ syn[black manuscript]typus[red printed] [red-bordered label] \ PARATYPE Paraliodrosophila mihalyii Wheeler [pink label]».

Type locality. 10 km North of Heredia, Province of Heredia, Costa Rica.

Redescription. ♂. Head. Frons dark brown, glossy, frontal length 0.24 (0.22–0.26) mm; frontal index = 0.93 (0.81–1.00), top to bottom width ratio = 1.28 (1.13–1.43). Frontal triangle glossy, covering most of front, trapezoidal, broadly reaching anterior margin of front, laterally convex. Ocellar triangle prominent, about 38–50 % of frontal length. Orbital plates narrow, parallel to eye margin, about 77–93 % of frontal length. Orbital setae black, almost in linedistance of or3 to or1 = 37–57 % of or3 to vtm, or1 / or3 ratio = 0.82 (0.75–0.86), or2 / or1 ratio = 0.39 (0.33–0.50), postvertical setae = 46 (38–50) %, ocellar setae = 62 (57–67) % of frontal length; vibrissa strong, distinct, index = 0.25 (0.22–0.29). Face yellowish-brown. Carina narrow. Cheek broad, pale yellowish, index about 6 (4–7). Eye roundish, with dense, short pile, index = 1.11 (1.06–1.13). Antennae yellowish-brown. Flagellomere 1 brownish, covered with prolonged setulae which along the margin are about one third as long as the width of the flagellomere, length to width ratio = 1.28 (1.20–1.40). Arista with 4(–5) long dorsal, 1 long ventral and about 5 small inner branches, plus long terminal fork. Proboscis, clypeus and palpus yellowish.

Thorax length 0.67 (0.61–0.72) mm. Scutum dark brown, glossy, about 6 rows of acrostichal setae. h index = 1.04 (1.00–1.17). Transverse distance of dorsocentral setae 187–233 % of longitudinal distance; dc index = 0.57 (0.50–0.67). Distance between apical scutellar setae about 117–160 % of that between apical and basal one, scut index = 0.62 (0.53–0.69). Pleura in dorsal half dark brown, paler

mihalyii

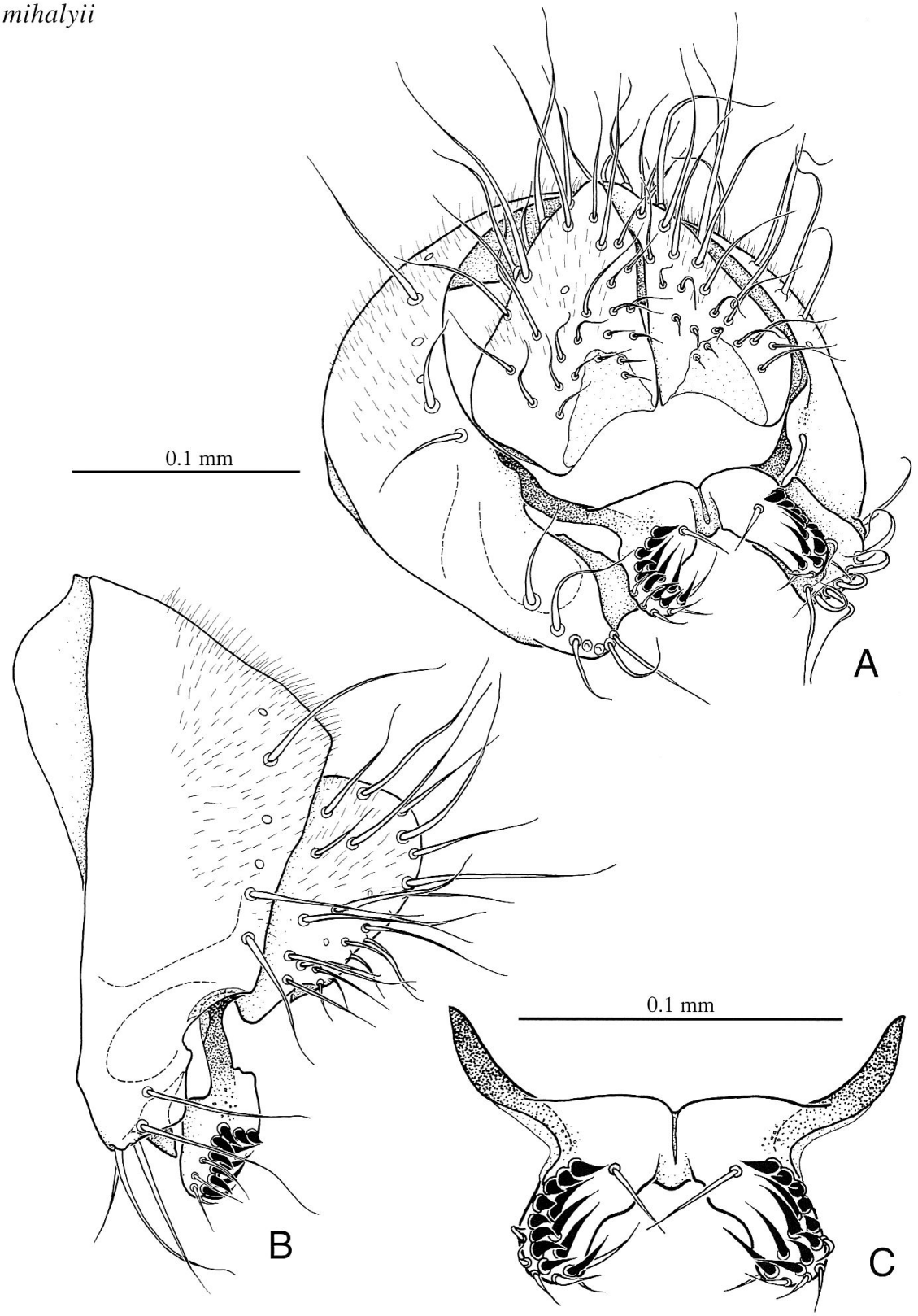

Fig. 13. *Paraliodrosophila mihalyii* Wheeler, male holotype. — A, epandrium, cerci, surstyli, and decasternum, oblique posterior view. — B, epandrium, cercus and surstylus, left lateral view. — C, surstyli and decasternum, posterior view.

mihalyii

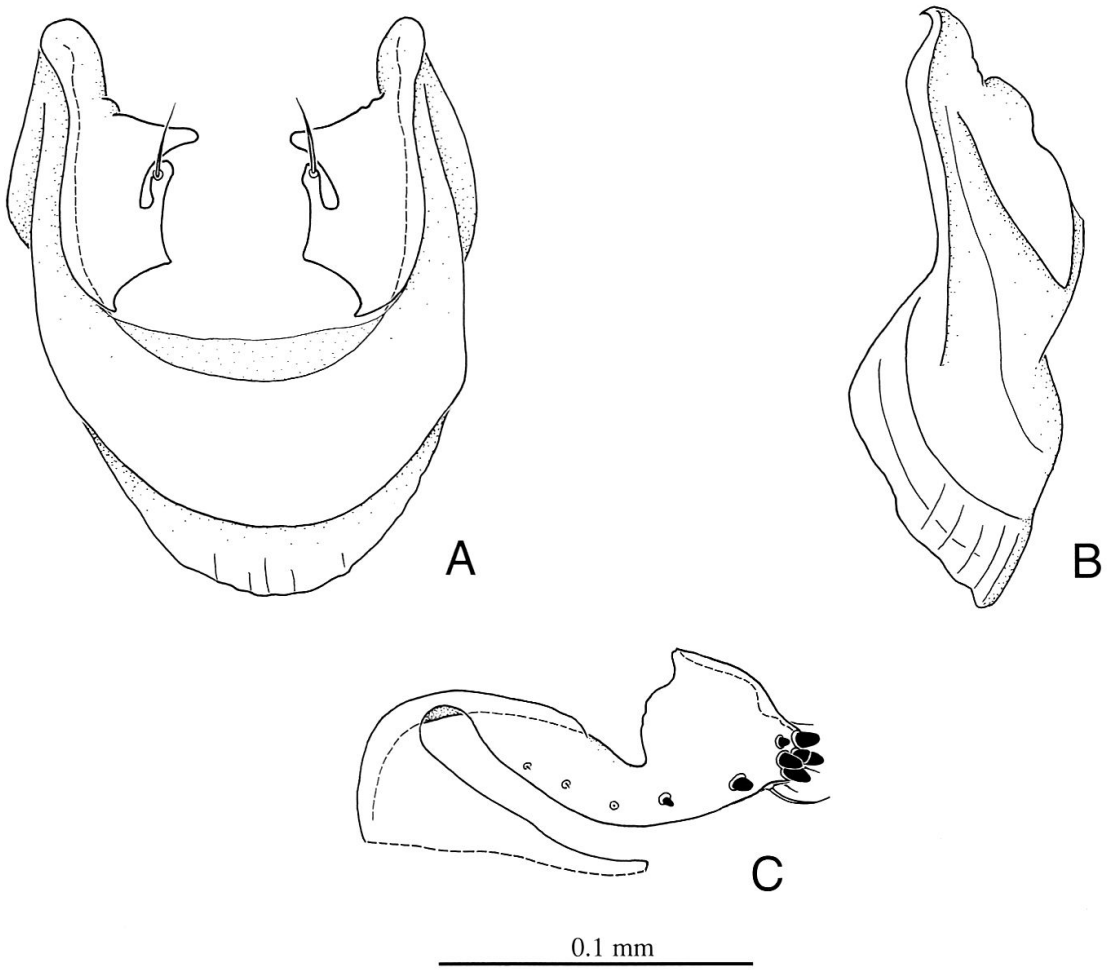

Fig. 14. *Paraliodrosophila mihalyii* Wheeler, male holotype (A, B), and female paratype (C). — A, hypandrium and gonopods, ventral view. — B, idem, left lateral view. — C, left oviscapt valve, left lateral view.

around base of wing, lower half (katepisternum etc.) whitish yellow, sterno index = 0.57 (0.50–0.64), median katepisternal indistinct. Halter yellowish. Legs pale yellowish, fore tarsus with slightly prolonged setulae, strong preapical seta on tibia 3, apical seta on tibia 2.

Wing hyaline, length 1.65 (1.54–1.75) mm, length to width ratio = 2.15 (2.00–2.20). Indices: C = 1.59 (1.47–1.73), ac = 3.34 (2.50–4.00), hb = 0.42 (0.33–0.56), 4C = 1.51 (1.33–1.89), 4v = 2.29 (2.09–2.78),5x = 2.38 (2.00–3.00), M = 0.77 (0.67–0.89), prox. x = 0.51 (0.45–0.56).

Abdomen dark brown, glossy, somewhat microtrichose in posterior half, with a large, basal, pale yellow area on tergite 2, with large, paramedian, roundish, yellowish patches on tergites 3 to 5. Terminalia contrasting pale.

Terminalia (Figs 13–15, 16F, 17F). Epandrium scatteredly microtrichose dorsodistally, with about 7 lower and 6 upper setae; ventral lobe not microtrichose, expanded inwards and distally pointed, partially embracing surstylus anteriorly.

mihalyii

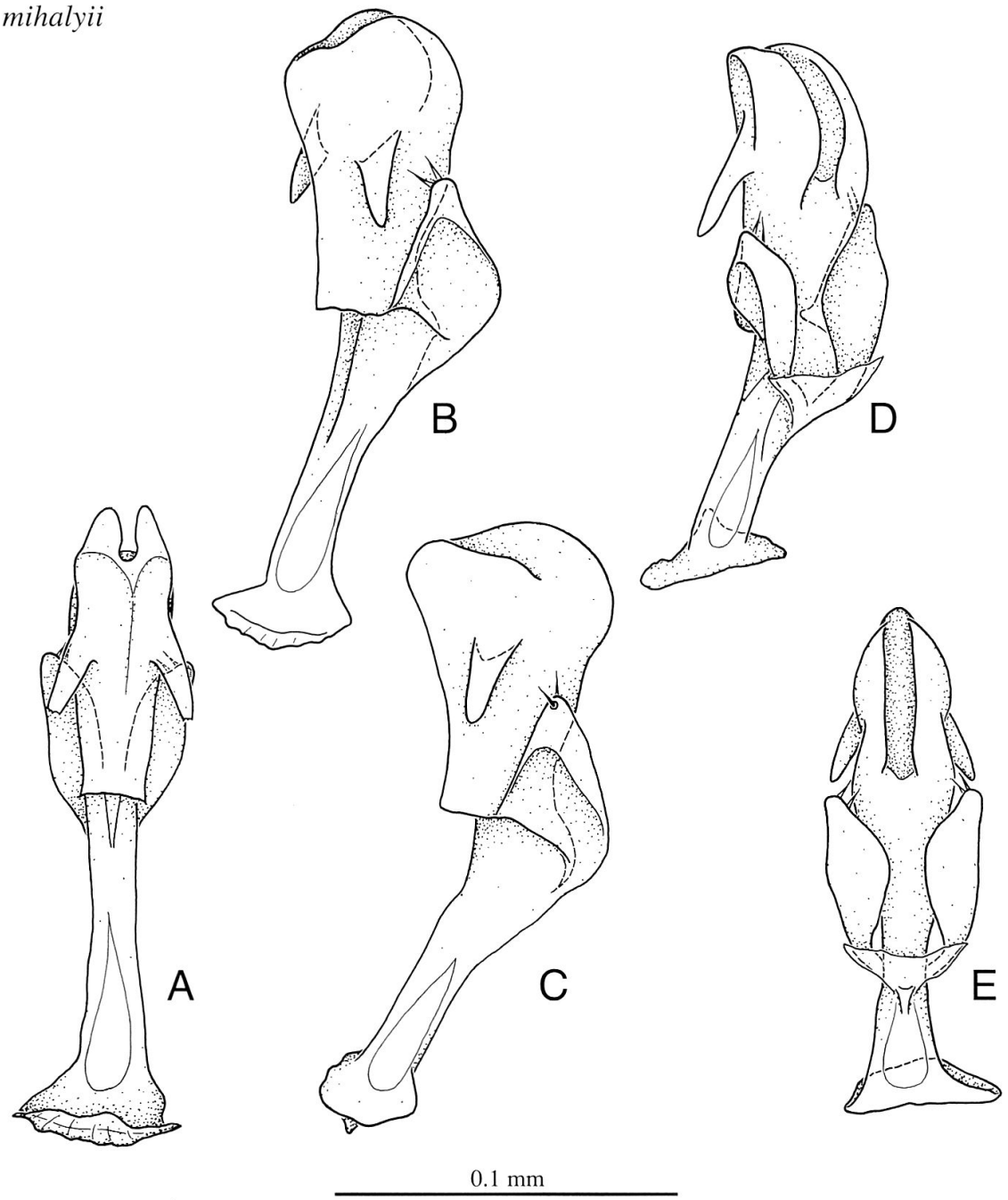

Fig. 15. *Paraliodrosophila mihalyii* Wheeler, male holotype. A–E, aedeagus+aedeagal apodeme and paraphyses, several views from dorsal through ventral.

Cerci scatteredly microtrichose medially, devoid both of ventral lobe and hypoproctal plate, linked to hypandrium by membranous tissue. Surstylus fused to epandrium through a long, narrow and strongly sclerotized stalk, not microtrichose, with 10 long, cone-shaped, sharply pointed, not well defined prensisetae somewhat organized in two parallel curved rows, those in the inner row being longer and thinner than those in the outer row, 5 outer and 2 long widely spaced inner setae, the upper

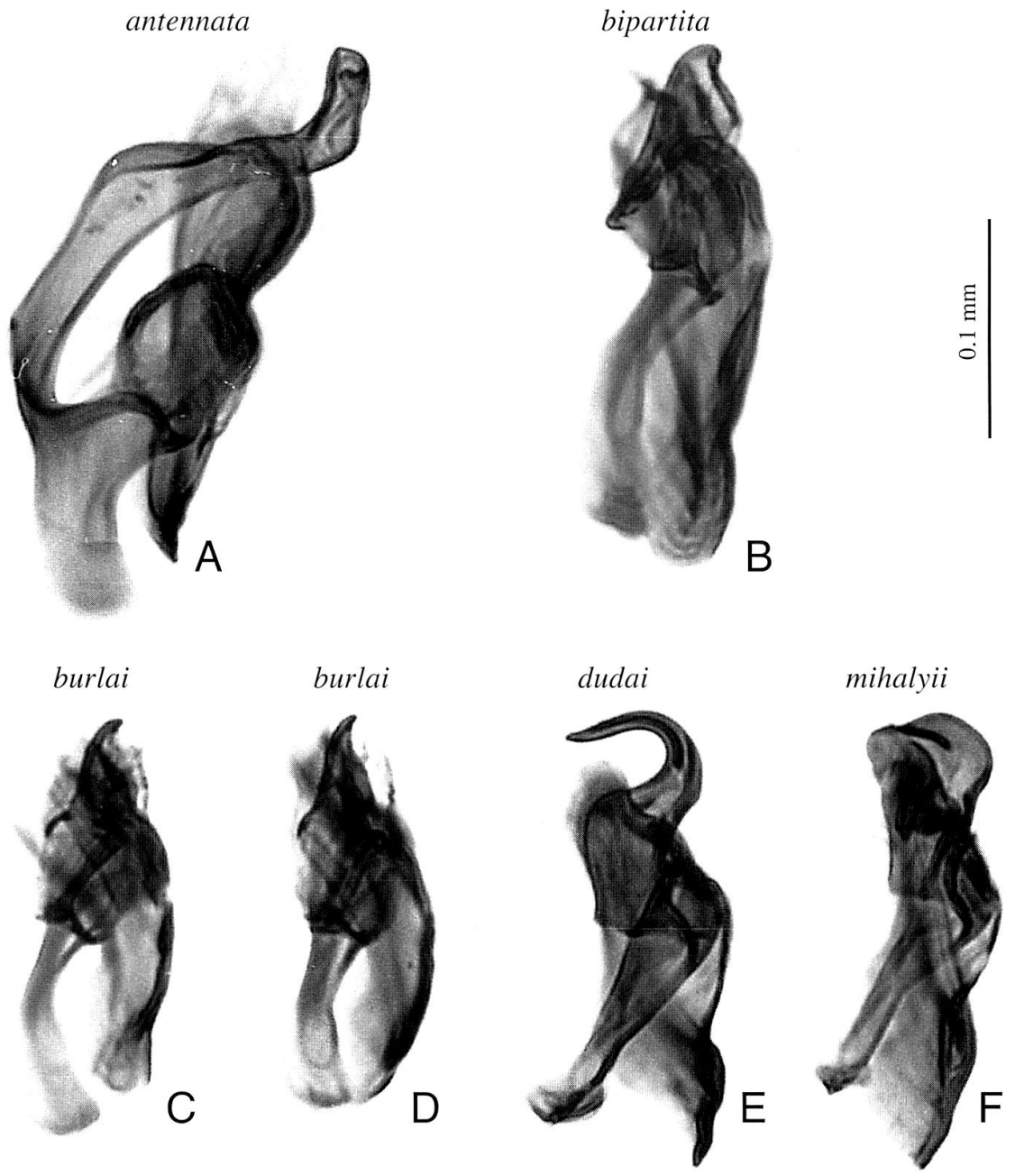

Fig. 16. Photomicrographs of male internal terminalia of species of *Paraliodrosophila*, left lateral view. — A, *P. antennata*, holotype, Bath, Jamaica. — B, *P. bipartita*, lectotype, Suiza de Turrialba, Costa Rica. — C, *P. burlai* sp. nov., holotype, Rio de Janeiro, Rio de Janeiro, Brazil. — D, idem, paratype, Parque Estadual da Cantareira, São Paulo, Brazil. — E, *P. dudai*, holotype, Huatusco, Vera Cruz, Mexico. — F, *P. mihalyii*, holotype, Heredia, Costa Rica.

most one close to the upper most prensisetae. Decasternum reduced to a small bridge and fused to surstyli. Hypandrium shorter than epandrium; bow absent, gonopod mostly fused to hypandrium (although a suture is still visible), bearing one seta in a finger-shaped projection of its inner median margin. Aedeagus shorter than aedeagal apodeme, dorsally slightly concave, distally dilated, bearing a pair of lateral finger-shaped processes in the median region. Aedeagal apodeme fused to aedeagus

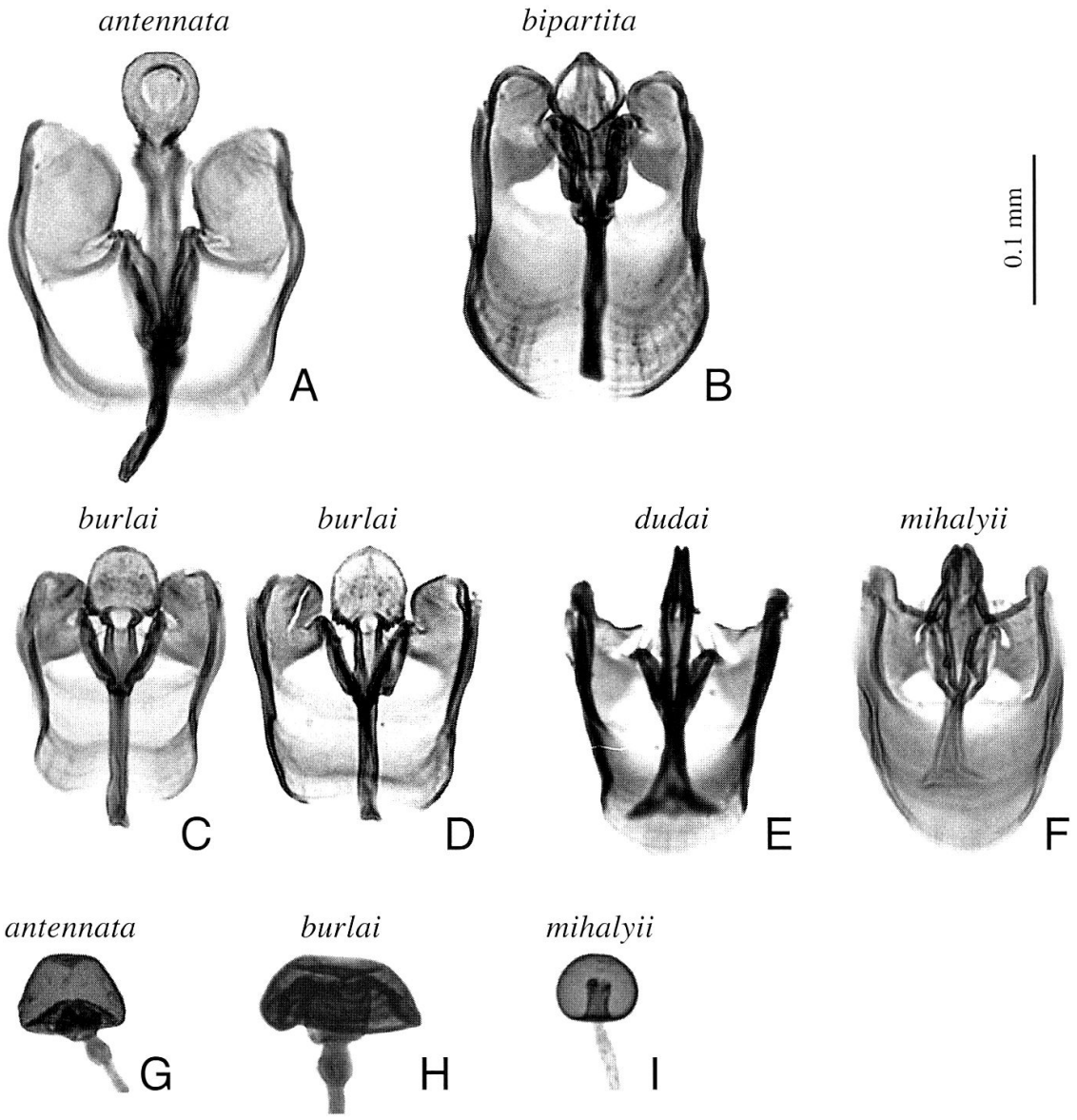

Fig. 17. Photomicrographs of male internal terminalia (A–F) and inner spermathecal capsule (G–I) of species of *Paraliodrosophila*: — A, *P. antennata*, holotype, Bath, Jamaica, dorsal view. — B, *P. bipartita*, lectotype, Suiza de Turrialba, Costa Rica, dorsal view. — C, *P. burlai* sp. nov., holotype, Rio de Janeiro, Rio de Janeiro, Brazil, ventral view. — D, idem, paratype, Parque Estadual da Cantareira, São Paulo, Brazil, ventral view. — E, *P. dudai*, holotype, Huatusco, Vera Cruz, Mexico, dorsal view. — F, *P. mihalyii*, holotype, Heredia, Costa Rica, ventral view. — G, *P. antennata*, paratype, Bath, Jamaica, lateral view. — H, *P. burlai* sp. nov., paratype, Rio de Janeiro, Rio de Janeiro, Brazil, lateral view. — I, *P. mihalyii*, paratype, Suiza de Turrialba, Costa Rica, lateral view.

and partially to paraphyses, straight, rod-shaped, anteriorly expanded laterally. Ventral rod membranous, dorsoventrally flattened, shorter than paraphyses. Paraphyses somewhat triangular, partially fused ventrally to aedeagal apodeme, half the length of aedeagus, and bearing two distal setulae; linked dorsoanteriorly to the posterior margin of the aedeagal apodeme by membranous tissue. Ejaculatory apodeme distally oval-shaped with a pair of subdorsal foramens, L-shaped in lateral view; rod anterioly expanded dorsoventrally.

♀. Measurements: Frontal length 0.24 mm; frontal index = 0.93, top to bottom width ratio = 1.33. Ocellar triangle about 43 % of frontal length. Orbital plates about 86 % of frontal length. Distance of or3 to or1 = 37 % of or3 to vtm, or1 / or3 ratio = 1.00, or2 / or1 ratio = 0.33, postvertical setae = 50 %, ocellar setae = 79 % of frontal length; vibrissal index = 0.22. Cheek index about 6. Eye index = 1.12. Thorax length 0.75 mm, dc index = 0.47, scut index = 0.47. Wing length 1.82 mm, length to width ratio = 2.26. Indices: C = 1.76, ac = 3.40, hb = 0.29, 4C = 1.42, 4v = 2.33, 5x = 2.25, M = 0.75, prox. x = 0.58.

Terminalia (Figs 14C, 17I). Valve of oviscapt apically blunt, ventrally strongly convex, with 11 marginal ovisensilla, the 3 most anteriorly ones tiny and bristle-shaped, the remaining ones peglike, of which the distal 6 are unusually grouped in a rosette at valve's tip; no discal ovisensilla. Valves anteriorly fused to each other through an unusual triangle-shaped bridge. Inner spermathecal capsule weakly sclerotized, spherical; distal introvert absent, proximal introvert about half the length of capsule.

Distribution. Costa Rica.

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