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Black-tie dress code: two new species of the genus *Toxomerus* (Diptera, Syrphidae)

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Abstract

Toxomerus hauseri Mengual **sp. n.** and *T. picudus* Mengual **sp. n.** are described from Peru and Ecuador respectively. *Toxomerus circumcintus* (Enderlein, 1938) is treated as a valid species and not considered synonym of *T. marginatus*, and *Toxomerus ovatus* (Hull, 1942) is considered junior synonym of *Toxomerus nitidus* (Schiner, 1868). An identification key for the *Toxomerus* species with dark abdomens is given along with diagnoses for each studied species.

Keywords

Toxomerus, flower flies, Syrphidae, new species, identification key

Introduction

The tribe Toxomerini (Diptera: Syrphidae) comprises the single genus *Toxomerus* Macquart, 1855. Toxomerini is endemic to the New World, from southern Canada to southern Argentina and Chile (Thompson and Thompson 2006). There are only 6 endemic Nearctic species and more than 130 Neotropical species of *Toxomerus* (Borges and Couri 2009; Thompson et al. 2010), although only 101 species are published and validly named (Thompson 2010). *Toxomerus* species are one of the most abundant flower flies in the New World and they are typically relatively small, usually about 6 mm. Nevertheless, there are some species larger than 9 mm (see Metz and Thomp-

son 2001 for a review). Adults feed on pollen and nectar acting as flower pollinators (Thompson and Thompson 2006; Ssymank and Kearns 2009), but data about larval feeding habits of *Toxomerus* are limited. Most of the known species larvae are predacious feeding frequently on soft-bodied Hemiptera, but also on Acari, Thysanoptera and larvae of Lepidoptera (Rojo et al. 2003). However, there are two well-known pollen-feeder species, *Toxomerus politus* (Say, 1823) (Riley and Howard 1888; Marín A. 1969) and *Toxomerus apegiensis* (Harbach, 1974) (Reemer and Rotheray 2009).

Enderlein (1938) established the tribe Toxomerini for *Toxomerus* and eight other genera but it was Vockeroth (1969) who recognized and re-classified this tribe as monogeneric. Toxomerini taxonomy is based mostly on the characteristic markings of the abdominal tergites and the male genitalia. Unfortunately, the abdominal pattern of some species may show a great variation and it may appear obscured or lost (Curran 1930; Hull 1943; Thompson 1981). Hull (1943) provided the last key for the genus but he did not include all the species. Metz and Thompson (2001) provided an excellent overview on the systematics of *Toxomerus*. More recently, Borges and Couri (2009) presented a key for the Brazilian species of *Toxomerus* with very helpful illustrations.

The monophyly of *Toxomerus* is supported by morphological characters (Vockeroth 1969, 1992; Thompson 1981) and molecular evidence (Mengual et al. 2008) but there is no subgeneric classification for *Toxomerus* (Hull 1943; Vockeroth 1969; Metz and Thompson 2001). Hull (1943) indicated in a scheme the possible relationships among *Toxomerus* species groups based on the abdominal pattern. In that diagram, Hull grouped together the species with uniformly black abdomen or abdomen reddish and gave two examples, *T. anthrax* (Schiner, 1868) and *T. nitidus* (Schiner, 1868).

The aim of this study is to describe two new, very distinct *Toxomerus* species with uniformly black abdomen and to provide an identification key and some diagnostic notes for *Toxomerus* species without a clear yellow/black abdominal pattern. I do not think that "black abdomen" species are a natural group but are a phenotypic cluster instead. However, the abdomen without medial yellow pattern combined with a more important morphological character, the presence/absence of a continuous lateral yellow vitta on scutum, may suggest a clade within *Toxomerus* with phylogenetic importance. Following this argument, Mengual et al. (2011, see also Mengual 2008) recovered a clade with "dark abdomen" species of *Toxomerus* with the lateral yellow scutal vitta interrupted or reduced, which included *T. anthrax*, *T. dispar* (Fabricius, 1794) and *T. flaviplurus* (Hall, 1927).

The two new species, *T. hauseri* sp. n. and *T. picudus* sp. n., are very distinct from the other included species. Both have a continuous lateral yellow vitta from postpronotum to scutellum; scutum without a pollinose pattern; eye with triangular emargination large, approximately the half of eye width in lateral view; face yellow with two sublateral black vittae; and abdomen strongly concave, shiny black with lateral margins yellow from tergum 2 to tegum 5. Moreover, *T. picudus* has a unique morphological character among *Toxomerus* species, a dorsal knob on occiput posterior to ocellar triangle.

Materials and methods

Taxonomic revision

Differential diagnoses, synonymies, and distributions are given for all species included in the study. New species are described in full, with terminology following Thompson (1999). Synonymies in full, citations and other references are given in Appendix I. An asterisk (*) in the distribution statement means records from the literature or from *Systema Dipterorum* (Thompson 2010). The acronyms used for collections follow the standard of the *Systema Dipterorum* (Thompson 2010), and their equivalents are listed below:

AMNH American Museum of Natural History, New York, USA.
ANSP Academy of Natural Sciences, Philadelphia, USA.
BMNH The Natural History Museum [formerly the British Museum (Natural History)], London, Great Britain.
CNC Canadian National Collection, Ottawa, Canada.
CSCA California State Collection of Arthropods, Sacramento, USA.
IRSNB Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.
MCZ Museum of Comparative Zoology, Cambridge, USA.
MRSN Museo Regionale di Scienze Naturali, Torino, Italy.
MTD Museum für Tierkunde, Dresden, Germany.
MUSM Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru.
MZSP Museu de Zoologia da Universidade de São Paulo, Sao Paulo, Brazil.
NHRS Naturhistoriska Riksmuseet, Stockholm, Sweden.
NMW Naturhistorisches Museum Wien, Vienna, Austria.
OSU Ohio State University, Columbus, USA.
OUMNH University Museum of Natural History, Oxford, Great Britain.
SMF Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt, Germany.
RMNH Nederlands Centrum voor Biodiversiteit Naturalis [formerly the Nationaal Natuurhistorisch Museum Naturalis], Leiden, The Netherlands.
ZMHB Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.
ZMUC Zoological Museum, University of Copenhagen, Copenhagen, Denmark.

In the description of type labels, the contents of each label is enclosed within quotation marks (“ ”) and the individual lines of data are separated by a forward slash (/). Complete data for the studied specimens are given in Appendix I. In the material examined section, the use of ellipses follows Standard English practice and merely indicates that the missing information is the same as that in the preceding record. Google Earth was used to find the type locality coordinates of *T. picudus* sp. n.

All measurements are in millimeters and were taken using a reticule in a Wild M5A microscope. Illustrations of male genitalia were drawn using a camera lucida mounted on an Olympus BX51 compound microscope. Manual drawings were redrawn as a vec-

tor image using Adobe Illustrator (version CS3). Photographs were composed using the software CombineZP based on images of pinned specimens taken with a Canon EOS40D mounted on a Microptics Camlift and the help of Adobe Lightroom (version 3.3).

In the identification key, I included four species whose typical form has yellow markings in the center of the abdomen, i.e. *T. hieroglyphicus* (Schiner, 1868), *T. paragrammus* (Schiner, 1868), *T. incaicus* Sack, 1941 and *T. dispar*. The reason of this inclusion is the occurrence of dark forms due to the high variability of the abdominal pattern. The species *Toxomerus* sp. 1 (*CR-11*), *T.* sp. 2 (*75-5*) and *T.* sp. 3 (*CR-B*) are new species to science discovered by F. C. Thompson (USNM, Smithsonian Institution). These codes by F. C. Thompson are placeholders for undescribed species, and are widely used among people working on Syrphidae. Here, I used them for taxa that will be formally described in the future by F. C. Thompson. These codes are not species names and are not valid descriptions according to the code.

Identification key for the *Toxomerus* species with dark abdomens

1 Abdomen with marking pattern; black in background with medial yellow markings either maculae, vittae or fasciae, or abdomen with terga 3-6 yellow (see Figs 1, 2, 4) ..... **other species of *Toxomerus***

– Abdomen black, sometimes reddish posteriorly, without clear medial/central yellow markings (Figs 3, 10, 12). Abdominal terga with or without yellow lateral margins, continuously yellow from tergum 2 to tergum 5 or interrupted yellow lateral margins (Figs 5, 17, 19) **2**

2 Proepimeron black, yellow macula above procoxa absent (Figs 14, 15); scutum variable **3**

– Proepimeron with yellow macula (Fig. 13); scutum with medial white pollinose vitta broadening on posterior margin forming large pollinose macula anterior to scutellum ..... **sp. 1**

3 Scutum all dark [usually only postpronotum yellow] or with lateral yellow vitta interrupted, either between postpronotum and transverse suture or ending at transverse suture (Figs 14, 24, 25) **10**

– Scutum with lateral yellow vitta continuous and extending from postpronotum to scutellum (Figs 16, 18) **4**

4 Scutellum entirely yellow, black pilose (Figs 26, 27) **9**

– Scutellum black with lateral and posterior margins yellow (Figs 17, 19), sometimes yellow margins not well differentiated from central disc covered by bronze pollinosity, black and/or yellow pilose **5**

5 Wing bare basally; costal cell bare on basal half or more, cells CuP, BM and R partly bare (Fig. 6) **7**

– Wing entirely microtrichose, slightly brownish (Borges and Couri 2009: 14, Fig. 13) **6**

6 Scutum and scutellum black pilose. Male genitalia with postanal process very reduced. Females with face yellow medially, dark lateroventrally ..... **sp. 2**

– Scutum and scutellum entirely yellow pilose. Male genitalia with postanal process long, more than half as long as surstylus (Borges and Couri 2009: 21, Fig. 47). Females with yellow face with medial broad black vitta..... ..... ***T. flaviplurus*** **(Hall)**

7 Face yellow with two sublateral black vittae (Figs 20, 21); profemur yellow, mesofemur partly yellow; cell BM bare on basal third and on anterior and posterior margins. Eye with triangular emargination large: approximately the half of eye width in lateral view (Fig. 23) **8**

– Face yellow; pro- and mesofemora mostly black, yellow very basally and apically; cell BM microtrichose on apical 1/4 with microtrichia extending more basally on posterior margin. Eye with triangular emargination small: at most a third of eye width in lateral view (Fig. 22)..... ..... ***T. hieroglyphicus*** **(Schiner) [dark form]**

8 Costal cell entirely bare, at most few microtrichia apically; metafemur black apically, yellow on basal third; occiput with dorsal knob posterior to ocellar triangle pointing posteriorly (Fig. 23) (male unknown) .... ***T. picudus*** **Mengual sp. n.**

– Costal cell bare basally, microtrichose on apical third; metafemur entirely black, at most the apical edge yellow; occiput rounded posteriorly on dorsal section, without any protuberance (Fig. 19) (male unknown)..... .....***T. hauseri*** **Mengual sp. n.**

9 Wing entirely microtrichose; scutum and notopleuron yellow and black pilose ..... ***T. paragrammus*** **(Schiner) [dark form]**

– Wing microtrichose with small bare areas: cells CuP, BM and R bare on anterior margin; scutum and notopleuron entirely yellow pilose..... ..... ***T. incaicus*** **Sack [dark form]**

10 Wing bare basally; cell BM bare on anterobasal third or more, cell R1 bare anterior to RS furcation (Fig. 6)..... **13**

– Wing almost entirely microtrichose, in some cases only a bare line following vein M on anterior margin of cell BM and on posterior margin of cell R... **11**

11 Katepisternal yellow macula well developed (Figs 13, 15). Pro- and mesotibiae yellow with subapical or medial brown to black ring, less evident in the protibia; wing hyaline, extensively microtrichose with small bare area on both sides of vein M on the basal portion of cell bm, and costal cell bare very basally; in males, antennal bases yellow dorsally and laterally, medial black facial vitta not surrounding antennal bases; in females, abdomen shiny or matte black with no pollen pattern **12**

– Katepisternal yellow macula absent or greatly reduced (Fig. 14). Pro- and mesotibiae bright yellow; wing slightly infuscated, brownish, entirely microtrichose; in males, medial black facial vitta surrounding antennal bases form-

ing narrow dark area between antennal bases; in females, abdomen with black pollen pattern forming at least a black pollinose fascia on tergum 2 (Fig. 10) .. .. ***T. flaviplurus*** **(Hall)**

12 Notopleuron yellow; supra-alar area dark and post-alar callus yellow (http://www.eol.org/data_objects/11884429); scutellum black with broad yellow vitta on lateral and apical margins. Male genitalia: postanal process narrower, as long as or a bit longer than basal width (Fig. 28). Female unknown..... ..... ***T. circumcinctus*** **(Enderlein)**

– Notopleuron black, at most with triangular small yellow macula anteriorly, with a submedial position, not on the most lateral margin (Fig. 15); supra-alar area dark and post-alar callus dark brown; scutellum black basally and laterally, yellow only apically. Male genitalia: postanal process more triangular, broader at the base than long (Fig. 29)..... ***T. anthrax*** **(Schiner)**

13 Metacoxa brown to black; metafemur black, at most basal and apical apices yellowish; abdomen entirely black or with yellow vitta on lateral margins, continuous or briefly interrupted at posterior margins of each tergum or abdomen with terga 3–6 yellowish-red **14**

– Metacoxa yellow; metafemur black, yellow on basal 1/4–1/3; abdomen black with terga 2, 3, 4 and 5 with triangular yellow macula on anterior 1/2–2/3 of lateral margins (Borges and Couri 2009: 217, Figs 22, 23) .... ***T. basalis*** **(Walker) [dark form]**

14 Pro- and mesofemora dark brown to black, at least on basal half, with apical apex yellow; katepisternal yellow macula broad, broader than anepisternal yellow vitta and normally wider than mesofemur (Figs 13, 24, 25); scutum with a different pattern **15**

– Pro- and mesofemora entirely yellow (male unknown); katepisternal yellow macula reduced, as broad as anepisternal yellow vitta, as wide as or narrower than mesofemur (see Fig. 14); scutum with three broad blue-steel pollinose vittae divided by two submedial brown-bronze pollinose vittae (http://www.eol.org/data_objects/11884446) ..... ***T. funestus*** **(Doesburg)**
Note: Some specimens of *Toxomerus dispar* may have pro- and mesofemora entirely yellow but they also have katepisternal yellow macula broad and usually abdomen mainly yellow or with evident yellow markings (Figs 1, 2, 4).

15 Postpronotum bright yellow (Fig. 24); notopleuron black or yellow. Postanal process of male genitalia variable..... **16**
Postpronotum dark brown to black (Fig. 25); notopleuron black. Male genitalia with postanal process short, little distinct, much less than half as long as surstylus (Borges and Couri 2009: 22, Fig. 56) ..... ***T. laenas*** **(Walker)**

16 Male face entirely yellow; female face with medial black vitta. Notopleuron entirely black. Female abdomen black, shiny or matte, without clear pollinose pattern, sometimes with small yellow areas along lateral margins or lateral margins entirely yellow **17**

– Male and female face with medial black vitta. Notopleuron partly yellow, usually with triangular small yellow macula anteriorly (Fig. 24). Female abdomen usually shiny black with black lateral margins, or terga 4 and 5 with lateral yellow margins; tergum 2 with submedial black pollinose fascia and terga 3 and 4 with four black pollinose vittate maculae (Fig. 9)..... ..... ***T. nitidus*** **(Schiner)**
Note: Some specimens of *Toxomerus dispar* may have notopleuron entirely yellow but they also have abdomen mainly yellow or with evident yellow markings (Figs 1, 2, 4).

17 Abdomen partially black on lateral margins: male usually with terga 1 and 2 black, and following terga dark reddish-brown; female usually entirely black (Figs 3, 5). Pro- and mesotibiae yellow. Postanal process of male genitalia long, more than half as long as surstylus (Fig. 8). Females with metaepisternum partly or entirely yellow..... ***T. dispar*** **(Fabricius) [dark form]**

– Abdomen uniformly black with continuous yellow on lateral margins, from tergum 2 to apex. Pro- and mesotibiae yellow, usually with medial dark ring of variable **length.** Male genitalia with postanal process short, much less than half as long as surstylus. Females with metaepisternum entirely black..... **sp. 3**

Species accounts

Toxomerus **sp. 1 (*CR–11*)**
Figure 13

Differential diagnosis. Species with face yellow in male and female. Scutum black pilose with medial white pollinose vitta broadening on posterior margin forming a large pollinose macula anterior to scutellum, with a continuous lateral yellow vitta that sometimes looks like interrupted after transverse suture, scutellum entirely black and proepimeron with a yellow macula (Fig. 13). *Toxomerus* sp. 1 has the abdomen metallic blue with black pollinose vittae and fasciae.

Length (4): body, 6.8–7.1 (6.9) mm; wing, 5.3–5.8 (5.6) mm.

Distribution. Cocos Island (Costa Rica).

Material examined. 2♂ 2♀.

Toxomerus **sp. 2 (75–5)**

Differential diagnosis. Species with yellow face medially, brown to black laterally, white pollinose laterally; scutum bronze pollinose with lateral yellow vitta. Scutellum black with lateral and posterior margins yellow, sometimes yellow margins not well differentiated from central disc covered by bronze pollinosity, black and/or yellow pilose.

Wing entirely microtrichose. Male abdomen is shiny black with a central black pollinose macula on terga 2 to 5 and small yellow macula on each anterobasal half of terga 2–4; tergum 5 yellow on lateral margins. Female abdomen similar but medial black pollinose macula extended laterally forming a fascia on terga 2 to 5, and lateral yellow macula extending and broadening towards medial line.

Length (5): body, 6.4–7.1 (6.8) mm; wing, 6.1–6.2 (6.2) mm.

Distribution. Costa Rica.

Material examined. 8♂ 7♀.

Toxomerus sp. 3 (*CR–B*)

Differential diagnosis. Species with yellow face in male, females with a medial broad black vitta continuing along frons and ending at vertex. Scutum black, bronze pollinose wit a medial whitish pollinose vitta and two submedial brown vittae; scutum black laterally except postpronotum yellow, at least on posterior half. Scutellum black, sometimes with apical margin yellow, pale pilose. Wing partly bare, costal cell bare only very basally, cell BM bare on basal half and anterior margin, cell CuP bare basally, cells R and R1 bare before bifurcation RS. Abdomen black, in some specimens becoming reddish at terga 4 and 5, with lateral margins yellow, although this character is not present in all the studied specimens.

Species very similar to *Toxomerus dispar*, but *T.* sp. 3 has pro- and mesotibiae yellow usually with medial dark ring of variable **length**, the postanal process of the male genitalia is short, much less than half as long as surstylus, and female has metaepisternum entirely black.

Length (5): body, 6.3–7.1 (6.7) mm; wing, 5.0–5.9 (5.5) mm.

Distribution. Costa Rica.

Material examined. 11♀ 8♂.

Toxomerus anthrax (Schiner)

http://species-id.net/wiki/Toxomerus_anthrax

Figures 15, 29

Mesogramma anthrax Schiner, 1868: 350. Type Locality: South America [ST 3♂, 3♀, NMW].

Mesogramma vitrescens Hull, 1930: 142. Type locality: Colombia, Magdalena, Aracataca [HT ♂, ANSP].

Mesogramma anthrax var. *flammaria* Hull, 1943: 27. Type locality: Honduras, Puerto Castilla [HT ♂, unknown].

Differential diagnosis. Male and female with medial black facial vitta, but in males does not continue laterad or dorsad antennal bases. Scutum black laterally except post-

pronotum yellow and notopleuron sometimes with a small yellow vitta sublaterally, not on the most lateral margin. Wing extensivey microtrichose with small bare area on both sides of vein M on the basal portion of cell bm, and costal cell bare very basally or along vein SC (posterior margin). Abdomen black, terga 3–5 sometimes dark brown to yellowish-orange, with or without yellow lateral margins; shiny, without pollinose markings.

T. anthrax is similar to *T. circumcinctus* but the last has the notopleuron entirely yellow and postalar callus yellowish and the scutellum black with a well-defined broad yellow margin. Male genitalia are different.

Length (5): body, 6.0–7.2 (6.6) mm; wing, 4.8–5.5 (5.2) mm.

Distribution. Costa Rica, Venezuela, Colombia, Ecuador, Guyana*, Peru*.

Material examined. 2♂ syntypes, 28♂ 17♀.

***Toxomerus basalis* (Walker)**

http://species-id.net/wiki/Toxomerus_basalis

Syrphus basalis Walker, 1836: 345. Type Locality: Brazil, St. Paul Island [HT ♂, BMNH].

Syrphus portius Walker, 1852: 239. Type Locality: Brazil [T ♂, BMNH].

Mesogramma rhea Hull, 1949: 228. Type Locality: Brazil [ST ♂, AMNH].

Mesogramma harlequina Hull, 1951: 69. Type Locality: Brazil, São Paulo [HT ♀, MZSP].

Differential diagnosis. Species with yellow face. Scutum black, bronze pollinose with a medial bluish pollinose vitta, yellow pilose; postpronotum yellow and notopleuron black with a small yellow macula posteriorly. Metacoxa yellow and metafemur black, yellow on basal 1/4–1/3. Abdomen shiny black with a medial black pollinose vitta on terga 2 to 5; terga 2, 3, 4 and 5 with triangular yellow macula on anterior 1/2–2/3 of lateral margins (see Borges and Couri 2009: 17, Figs 22 and 23). Diffuse, dark yellow markings might be observed in some pale forms in the center of terga 3 to 5. *Toxomerus basalis* has the wing partially bare, with costal cell bare on basal half, cell R1 bare basal to bifurcation RS, cell R bare basal to bifurcation RS and vein bm-cu, cell BM bare on anterior margin and on basal half of posterior margin, and cell CuP bare on anterior margin.

Length (4): body, 6.0–6.5 (6.3) mm; wing, 5.0–5.2 (5.1) mm.

Distribution. Southeastern Brazil.

Material examined. 3♂ 1♀.

Remarks. The illustration of *Mesogramma portia* in Hull (1943: 31, Fig. 17) has two submedial short yellow vittae on terga 3, 4 and 5, forming a U-shaped macula on tergum 5. These submedial yellow vittae are at both sides of the medial black pollinose vitta. This illustration refers to a paler form of *T. basalis*.

***Toxomerus circumcinctus* (Enderlein) stat. n.**
http://species-id.net/wiki/Toxomerus_circumcinctus
http://eol.org/pages/753233/overview
Figure 28

Mesogramma circumcincta Enderlein, 1938: 232. Type Locality: Peru, Lima [HT ♂, ZMHB].

Toxomerus circumcinctus as synonym of *Toxomerus marginatus*: Thompson et al. 1976: 52 (cat.).

Differential diagnosis. Species with yellow face and a medial broad black vitta, which ends ventrad to antennal bases. Scutum black, yellow pilose, with postpronotum and notopleuron entirely yellow; supra-alar area looks black, although it might have a thin yellow vitta connecting to the yellow postalar callus. Scutellum black with lateral and apical margins yellow. Pleuron black except katepisternum with a dorsal broad yellow macula and posterior anepisternum yellow on posterior third. Halter and calypter yellow. Femora dark brown with yellow apical tips, pro- and mesotibia yellow, metatibia brown with basal and apical extremes yellow, and tarsi brown. Abdomen dark brown, becoming yellowish brown on terga 4 and 5, with continuous yellow lateral margins from tergum 1 to tergum 5.

Toxomerus circumcinctus is similar to *T. anthrax* but the last has the notopleuron black and postalar callus dark brown, and the scutellum black with apical margin yellow (Fig. 15). Male genitalia are different (see Figs 28, 29).

Length. body, 6.0 mm; wing, 5.1 mm.

Distribution. Species only known from the holotype, collected in Peru.

Material examined. ♂ holotype.

Remarks. After the original publication (Enderlein 1938), this species has been only cited in two works. Fluke (1956) listed *T. circumcinctus* in his Neotropical catalogue as *Mesograpta circumcinctum*, and Thompson et al. (1976) synonymized it with *Toxomerus marginatus* (Say, 1823). *T. marginatus* occurs from Canada south to Central America and it was introduced in Hawaii (Thompson 2010) and it has a typical yellow/black abdominal pattern (http://eol.org/pages/750927/overview). After my study of the *circumcinctus* type, I consider them two different valid species based on morphological characters and male genitalia.

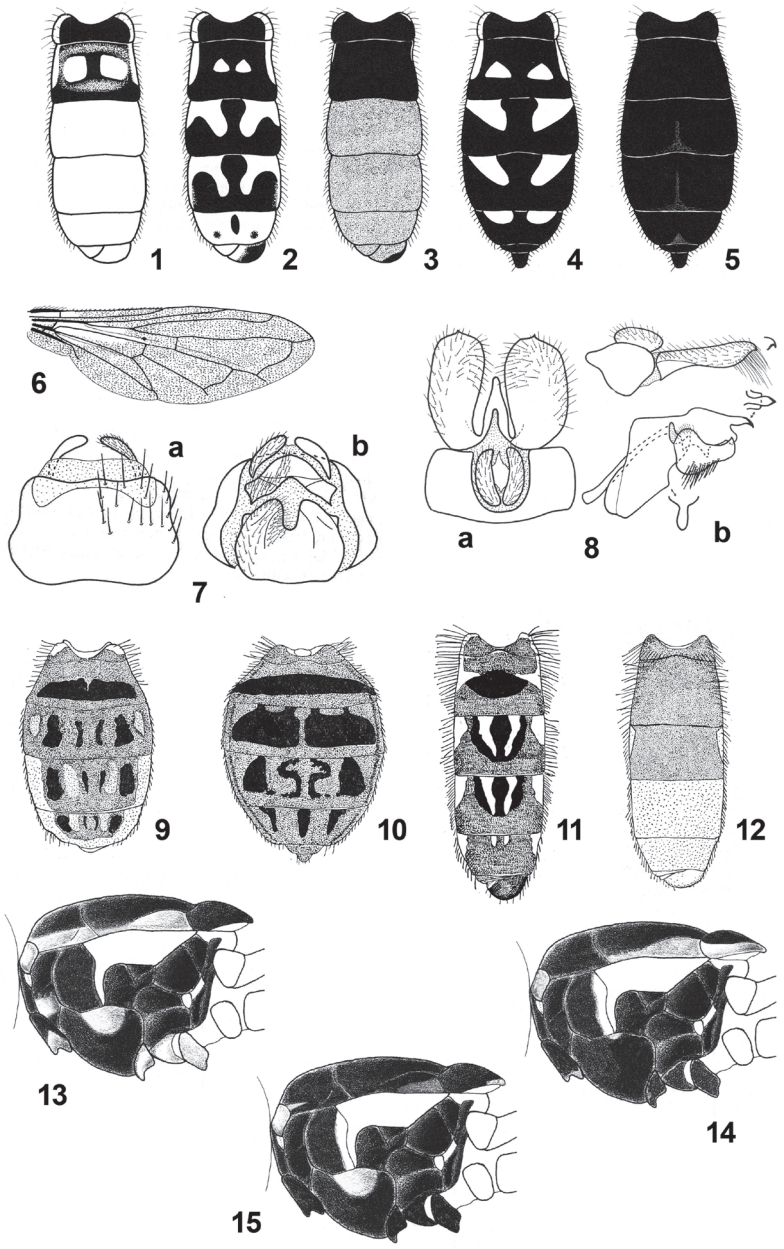
***Toxomerus dispar* (Fabricius)**
http://species-id.net/wiki/Toxomerus_dispar
Figures 1–8

Syrphus dispar Fabricius, 1794: 309. Type locality: «Americae meridionalis» restricted to Virgin Islands, St. Croix (Thompson 1981: 86) [ST ♂ ♀, ZMUC, destroyed, see Thompson 1981: 86].

Syrphus basilaris Wiedemann, 1830: 143. Type locality: Brazil [HT ♂, SMF].
Syrphus vicinus Macquart, 1846: 264. Type locality: Brazil [HT ♀, OUMNH].
Mesogramma soror Schiner, 1868: 350. Type locality: "America" [HT ♂, NMW]; Thompson et al., 1976: 48 (cat.).
Syrphus tridentatus Rondani, 1868: 24. Type locality: Argentina, Patagonia [HT ♂, unknown].
Syrphus melanogaster Thomson, 1869: 495. Type locality: Brazil, Rio de Janeiro [HT ♀, NHRS].
Mesograpta variabilis Wulp, 1883: 6. Type locality: Guadeloupe, Delaunay [HT ♂, IRSNB].
Melanostoma annulifera Bigot, 1884b: 84. Type locality: Mexico [HT ♀, OUMNH].
Mesograpta trilobata Bigot, 1884b: 109. Type locality: Mexico [HT ♂, OUMNH].
Orthonevra annulifera Bigot, 1884a: 556. Type locality: Brazil [HT ♀, OUMNH].
Paragus ruficaudatus Bigot, 1884a: 541. Type locality: Brazil [HT ♂, BMNH].
Mesogramma –? (*bidentata*) Williston, 1891: 25. Type locality: Mexico, Acaguizotla, Chilpancingo, Tepetlapa, Medellin near Vera Cruz, Teapa in Tabasco, Orizaba [ST ♂ ♀, unknown].
Mesogramma bidentatum Giglio-Tos, 1893: 49. Type locality: Mexico, Acaguizotla, Chilpancingo, Tetetlapa, Medellin presso Vera Cruz, Orizaba, Tampico [ST 6♂ 3♀, MRSN].
Mesogramma imperialis Curran, 1926: 103. Type locality: Jamaica, Blue Castle [HT ♀, BMNH].
Mesogramma lutzi Curran, 1930: 7. Type locality: Panama, Canal Zone, Grijoles [HT ♀, AMNH].
Mesogramma basilaris var. *flavocuneus* Hull, 1940: 433. Type locality: Honduras, Salada River, near Ceiba [HT ♀, CNC].
Mesogramma triangulata Hull, 1942a: 104. Type locality: Paraguay, Villarica [HT ♀, AMNH].
Mesogramma basilaris var. *bifida* Hull, 1943: 26. Type locality: Ecuador, Baños [HT ♂, CNC].
Mesogramma basilaris var. *neotropica* Hull, 1943: 36.
Mesogramma lutzi var. *fasciata* Hull, 1948: 8. Type locality: Venezuela. San Esteban [HT ♀, USNM].

Differential diagnosis. Male has yellow face, females a medial broad black vitta continuing along frons and ending at vertex. Scutum black, bronze pollinose wit a medial whitish pollinose vitta and two submedial brown vittae; scutum black laterally except postpronotum yellow, at least on posterior half. Scutellum black, sometimes with apical margin yellow, pale pilose. Wing partly bare basally. *Toxomerus dispar* has the abdominal pattern very variable, from almost entirely yellow to entirely black (see Figs 1–5), and this is the main reason to have such a high number of synonyms.

Species very similar to *Toxomerus* sp. 3, but *T. dispar* has pro- and mesotibiae yellow, postanal process of male genitalia long, more than half as long as surstylus and



Figures 1–15. 1–8 *Toxomerus dispar*: **1** Abdomen of pale male, dorsal **2** Abdomen of dark male, dorsal **3** Abdomen of very dark male, dorsal **4** Abdomen of dark female, dorsal **5** Abdomen of very dark male, dorsal **6** wing **7** Female genitalia: a dorsal, b ventral **8** Male genitalia, 9th tergum and associated structures: a dorsal b lateral **9** *Toxomerus nitidus*, abdomen of female, dorsal **10** *Toxomerus flaviplurus*, abdomen of female, dorsal **11** *Toxomerus hieroglyphicus*, abdomen of male, dorsal **12** *Toxomerus laenas*, abdomen of male, dorsal **13** *Toxomerus* sp. 1, thorax, lateral **14** *Toxomerus flaviplurus*, thorax, lateral **15** *Toxomerus anthrax*, thorax, lateral (Figs 1, 2, 4, 6, 7 and 8 from Thompson 1981; Figs 9–15 from Hull 1943).

female has metaepisternum partly or entirely yellow. The present key only works for dark forms of this species.

Length (5): body, 6.4–7.1 (6.7) mm; wing, 5.1–5.4 (5.3) mm.

Distribution. Widespread in the New World, from USA to Argentina.

Material examined. More than 100 specimens from Mexico, Honduras, El Salvador, Guatemala, Costa Rica, Panama, Ecuador, Venezuela and Brazil.

***Toxomerus flaviplurus* (Hall)**
http://species-id.net/wiki/Toxomerus_flaviplurus
Figures 10, 14

Mesogramma flaviplurus Hall, 1927: 239. Type Locality: Guatemala, Puerto Barrios [HT ♀, OSU].

Differential diagnosis. Male with yellow face with a medial broad dark vitta surrounding antennal bases forming narrow dark area between antennal bases and dorsad to antennal bases, black ventrolaterally, yellow pilose, white pollinose laterally. Female face and frons yellow with medial black vitta joining medial black frons vitta until the vertex, surrounding laterally the antennal bases. Scutum black, greenish-brown pollinose with dorsomedial broad bluish pollinose vitta and two submedial bronze pollinose vittae, entirely yellow pilose; postpronotum yellowish-brown, slightly lighter than scutum, notopleuron black; supra-alar area and postalar callus yellowish; scutellum black with broad yellow vitta on lateral and apical margins, pale pilose. Pleuron mostly black, except posterior anepisternum black on posterior third, pale pilose; katepisternum with dorsal yellow macula reduced. Wing membrane light brown, entirely microtrichose. Male abdomen shiny black, pale pilose, with tergum 8 as long or longer than tergum 5; male genitalia with long postanal process (Borges and Couri 2009: 21, Fig. 47). Female abdomen a bit more oval, shiny black with a black pollinose pattern (Fig. 10)

Length (5): body, 7.2–7.7 (7.4) mm; wing, 6.6–6.9 (6.8) mm.

Distribution. Guatemala, Costa Rica, Brazil, Panama, Trinidad*.

Material examined. 2♂ paratypes, 50♂ 37♀.

Remarks. *Toxomerus flaviplurus* can have yellow markings in the abdomen, with yellow fasciate vittae on terga 2 to 4 and submedial yellow vittae on terga 3 to 5 (see Borges and Couri 2009: 17, Fig. 28). The species key works for the dark form of this species. Some dark specimens of *T. flaviplurus* can have an almost continuous lateral yellow vitta on the scutum. For this reason, *T. flaviplurus* appears in two different couplets in the key.

Reemer (2010) synonymised *flaviplurus* under *T. costalis* (Wiedemann) based on the overall similarity of these species after studying photographs of the paratypes of *T. flaviplurus* and the holotype of *T. costalis*. Reemer (2010: 185, Figs 94, 95) included photographs of new *costalis* material from Surinam and male and female look similar to pale forms of *flaviplurus*. The holotype of *T. costalis* has glued an abdomen of a *Eupeodes* species; the head is also glued but it is the original. After the study of the paratypes of

flaviplurus and the holotype of *costalis*, I found only a minor difference that is within the variability range of this species: the holotype of *costalis* has the scutellum with a broad yellow vitta on lateral and apical margins. Based on my limited material of *T. costalis* and the fact that the holotype lacks the abdomen, I have no morphological characters to disagree with Reemer, but I have molecular evidences to not accept this synonym at this moment. Mengual et al. (2011, but see Mengual 2008) inferred the phylogenetic relationships among the genera *Toxomerus* and *Ocyptamus* Macquart, 1834 and their results placed a specimen of *T. costalis* from Surinam (identified by M. Reemer) distantly related to a specimen of *T. flaviplurus* from Venezuela. The study of more material and a broader sample of specimens for DNA studies are required to better understand these taxa.

***Toxomerus funestus* (Doesburg)**
http://species-id.net/wiki/Toxomerus_funestus
http://www.eol.org/pages/753247

Mesograpta funesta Doesburg, 1966: 65. Type locality: Surinam, Zanderij [HT ♀, RMNH].

Differential diagnosis. The female holotype has yellow face with a medial broad black vitta continuing until the vertex, surrounding antennal bases. Scutum black with three broad blue-steel pollinose vittae divided by two submedial brown-bronze pollinose vittae. Pro- and mesofemora entirely yellow, katepisternal yellow macula reduced, as broad as anepisternal yellow vitta, as wide as or narrower than mesofemur. Wing partly bare basally. Abdomen entirely black with terga 2 to 5 with a medial black pollinose vitta and two submedial triangular macula of black pollen.

Toxomerus funestus is a very distinct species with a unique abdominal and scutal patterns, and pro- and mesolegs yellows except coxae, trochanters and femora basally brown.

Length: body, 7.2 mm; wing, 5.4 mm.

Distribution. Surinam, Brazil.

Material examined. ♀ holotype.

***Toxomerus hauseri* Mengual, sp. n.**
urn:lsid:zoobank.org:act:1A51A3E2-FB67-4601-86A2-BCE8B11CB7AE
http://species-id.net/wiki/Toxomerus_hauseri
Figures 18, 19, 20

Description. FEMALE. *Head*: Face with distinct low facial tubercle, which ends at oral margin, yellow with two submedial black vittae that end before the oral margin, brownish lateroventrally, scarcely yellow pilose; gena brown to black; lunule yellow, yellow also between antennal bases; frons yellow laterally with broad medial black vitta that surrounds antennal bases and continues with the two submedial facial vittae, yel-

low pilose; vertical triangle shiny black, black pilose; antennae on small produced tubercle, antenna orangish, basoflagellomere brown, orange basoventrally; arista brown, bare (Fig. 20); eye bare, lateral triangular eye emargination large, approximately the half of eye width in lateral view; occiput black, grey pollinose, yellow pilose on ventral 2/3 and black pilose on dorsal 1/3.

Thorax: Scutum shiny with a continuous lateral yellow vitta, yellow pilose laterally and anteriorly, black pilose posteriorly; postpronotum yellow, bare; notopleuron yellow with a black vitta on the lateral side narrowing the lateral yellow scutal vitta; supra-alar area and postalar callus yellow; scutellum black with well-defined yellow margin apically and laterally, black pilose with a row of bristle-like black pile in the posterior margin, subscutellar fringe absent (Figs 18, 19). Pleuron mostly black, except posterior anepisternum yellow on posterior third and katepisternum with dorsal broad yellow macula; metasternum bare; calypter yellow; plumula yellow; halter bright yellow; posterior spiracular fringes yellow. *Wing*: Wing membrane hyaline, stigma brown; extensively microtrichose, except costal cell bare on basal 2/3, cells R1 and R bare basal to furcation of RS, cell BM bare basally and on anterior margin. Alula microtrichose. *Legs*: Proleg yellow except coxa brown and femur orangish on apical half, yellow pilose; mesoleg yellow except coxa black, mesofemur black on apical half with apical tip yellow, yellow and black pilose; metaleg black except femur yellow on apical tip, tibia yellow on basal tip and on apical 1/6–1/5 (Figs 18, 19).

Abdomen: Slightly oval, distinctively convex, unmargined. Dorsum shiny black, black pilose; terga 2, 3, 4 and 5 with lateral margins yellow forming a continuous lateral yellow vitta, barely interrupted at the posterior margin of tergum 4. Sterna shiny black; sterna 1 and 2 with brownish-yellow fascia on posterior margin (Figs 18, 19).

Differential diagnosis. Species with yellow face with two sublateral black vittae, and eye with triangular emargination large, approximately the half of eye width in lateral view. Profemur yellow; cell BM bare on basal third and on anterior and posterior margins. Scutum shiny black with lateral yellow vitta and abdomen shiny black, convex, with lateral margins entirely yellow. Very similar to *T. picudus* sp. n. but differs by having costal cell microtrichose on apical third, metafemur entirely black with at most the apical edge yellow, and occiput rounded posteriorly on dorsal section, without any protuberance.

Length: body, 6.6 mm; wing, 5.9 mm.

Distribution. Species only known from the holotype, collected in Peru.

Etymology. This species is named after Martin Hauser in recognition of his work on Diptera and his help during my study of flower flies.

Type locality. PERU: Pasco Region, Oxapampa Province, Huancabamba District, Yanachaga-Chemillén N. P., Canon of Huancabamba, Biological Station Huampal, 1050 m, 10°11'08.95"S, 75°34'27.12"W, collected using a Malaise trap, D. Takiya, C. Peña and R. Rakitov leg.

Type specimen. Holotype female, pinned, deposited at Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru. Original label: "PERU, Pasco 6–9. Oct. 2002 / Yanachaga-Chemillén N. P. / Canon of Huancabamba R. / Biol. Station Huampal, 1050 m / S 10,18582°, W 75,57420° / Malaise trap across

river / D. Takiya, C. Peña, R. Rakitov" "HOLOTYPE / *Toxomerus* / *hauseri* / *Mengual 2011*" [red, handwritten except first line] (♀, MUSM).

***Toxomerus hieroglyphicus* (Schiner)**
http://species-id.net/wiki/Toxomerus_hieroglyphicus
Figures 11, 22

Mesogramma hieroglyphica Schiner, 1868: 348. Type locality: South America [LT ♂, NMW].

Differential diagnosis. Species with yellow face in male, sometimes with a brownish macula on tubercle. Scutum black, bronze pollinose medially and a medial bluish pollinose vitta, with a continuous lateral yellow vitta from postpronotum to scutellum, narrowed on notopleuron and supra-alar area. Scutellum black with yellow lateral and apical margins. Wing partially bare basally, costal cell bare on basal half or a bit more. Abdomen with medial yellow markings on terga 3 to 5; tergum 1 with yellow lateral margins, tergum 2 black with a yellow macula on anterolateral half extending narrowly towards the center of the tergum, and with a roundish black pollinose macula in the center; tergum 3 and 4 black with anterolateral yellow maculae and two submedial curved yellow vittae that divides a central black pollinose area; tergum 5 black with anterolateral yellow maculae and two submedial short yellow vittae.

Toxomerus hieroglyphicus is close in the key to the two new species, *T. picudus* and *T. hauseri*, but they are very different as already noted in the key.

Length (4): body, 5.6–6.2 (5.9) mm; wing, 5.0–5.7 (5.2) mm.

Distribution. Venezuela, Ecuador, Colombia*.

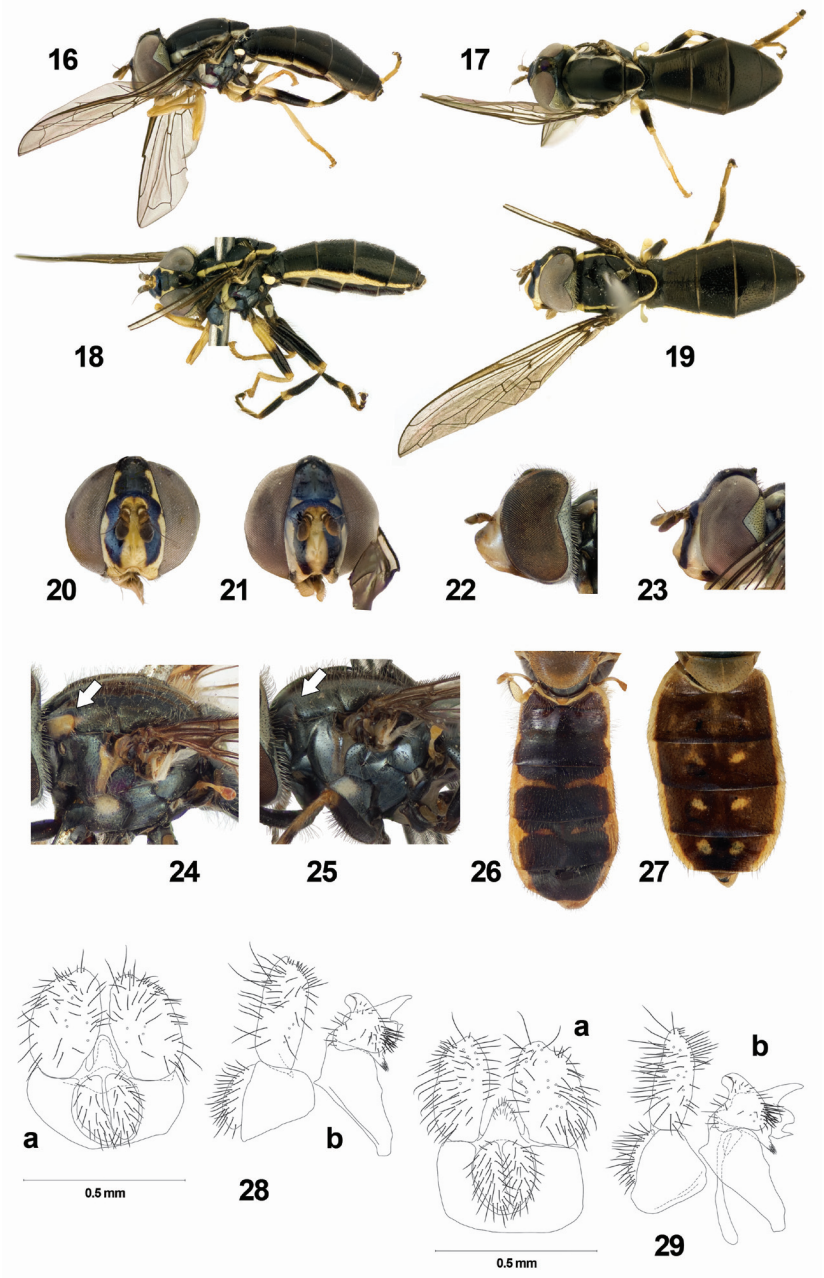
Material examined. ♂ lectotype, ♂ paralectotype, 3♂.

Remarks. *Toxomerus hieroglyphicus* has usually yellow markings in the center of the abdomen. Thus, it should not be included in the present key. However, the study of a dark specimen prompted me to tentatively include this species in case darker specimens might appear with completely black abdomen with lateral yellow maculae.

***Toxomerus incaicus* Sack**
http://species-id.net/wiki/Toxomerus_incaicus
Figure 27

Toxomerus incaicus Sack, 1941: 101. Type locality: Peru, Querobamba, and Bolivia [LT ♂, MTD].

Differential diagnosis. Species with yellow face in both sexes, frontal triangle of male yellow and female frons with a medial broad black vitta. Sucutm black, green-grey pollinose with a lateral broad yellow vitta from postpronotum to scutellum. Scutellum



Figures 16–29. 16 *Toxomerus picudus*, lateral **17** *Toxomerus picudus*, dorsal **18** *Toxomerus hauseri*, lateral **19** *Toxomerus hauseri*, dorsal **20** *Toxomerus hauseri*, head, frontal **21** *Toxomerus picudus*, head, frontal **22** *Toxomerus hieroglyphicus*, head, lateral **23** *Toxomerus picudus*, head, lateral **24** *Toxomerus nitidus*, thorax, lateral **25** *Toxomerus laenas*, thorax, lateral **26** *Toxomerus paragrammus*, abdomen, dorsal **27** *Toxomerus incaicus*, abdomen, dorsal **28** *Toxomerus circumcinctus*, male genitalia, 9th tergum and associated structures: a dorsal b lateral **29** *Toxomerus anthrax*, male genitalia, 9th tergum and associated structures: a dorsal b lateral.

yellow, black pilose. Legs entirely yellow except metatarsi dark brown. Wing mostly microtrichose, bare only on anterior margin of cells R, BM and CuP and cell R1 basally. Abdomen black with lateral margins yellow, tergum 1 with anterior margin yellow, and terga 6 to 9 yellow; terga 2 to 5 with a central dark pollinose macula; and terga 3 to 5 with two submedial, small, round yellow maculae.

Length (2): body, 6.0–6.2 (6.1) mm; wing, 5.7–5.8 (5.7) mm.

Distribution. Peru, Bolivia*.

Material examined. 1♂ 1♀ paralectotypes.

Remarks. *Toxomerus incaicus* has usually medial yellow maculae on terga 3 to 5. Again, this species should not appear in the present key. However, I included this species in case darker specimens might appear with completely black abdomen with lateral yellow margins.

***Toxomerus laenas* (Walker)**
http://species-id.net/wiki/Toxomerus_laenas
Figures 12, 25

Syrphus barbulus Walker, 1852: 238. Type locality: Brazil [HT ♀, BMNH].
Syrphus laenas Walker, 1852: 241. Type locality: Brazil [HT ♂, BMNH].
Mesogramma nitidiventris Curran, 1930: 9. Type locality: Brazil, Espirito Santo, Vitoria [HT ♂, AMNH].
Mesogramma vitrea Hull, 1941: 45. Type locality: Brazil, São Paulo, Juquia [HT ♂, CNC].

Differential diagnosis. Species with yellow face in male and female with a medial, very broad, black vitta, gena black. Scutum black, green-gray pollinose with a medial white pollinose vitta, dark laterally. Postpronotum black, sometimes brownish posteriorly. Scutellum black, sometimes with apical margin yellow, pale pilose. Wing bare on anterior margin of cells R, BM and CuP and cell R1 basally. Abdomen shiny black, pale pilose; sometimes becoming reddish-brown apically. Male genitalia with postanal process short, little distinct, much less than half as long as surstylus.

Length (5): body, 6.2–6.8 (6.6) mm; wing, 5.7–6.1 (5.8) mm.

Distribution. Venezuela, Brazil, Paraguay*.

Material examined. ♂ holotype of *nitidiventris*, ***Non-type material*:** 12♂ 9♀.

***Toxomerus nitidus* (Schiner)**
http://species-id.net/wiki/Toxomerus_nitidus
Figure 24

Mesogramma nitida Schiner, 1868: 349. Type locality: South America [Venezuela] [ST ♂, NMW].

Mesogramma ovata Hull, 1942b: 19. Type locality: Panama, Yape, Tuirar [HT ♀, MCZ] syn. n.

Differential diagnosis. Species with yellow face and a medial black facial vitta in both sexes, geba black. Scutum black, green-bronze pollinose with a medial bluish-white pollinose vitta, sometimes with two submedial whitish vittae. Postpronotum yellow and notopleuron partly yellow, usually with triangular yellow macula anteriorly narrowing towards transverse suture. Wing partly bare basally, with costal cell entirely microtrichose and brown, darker than the rest of the wing except stigma. Male abdomen usually bicolor, with terga 1 and 2 black (tergum 1 with yellow anterior corners) and terga 3 to 5 reddish-orange; postanal process of the male gentialia long. Female abdomen usually shiny black with black lateral margins; tergum 2 with submedial black pollinose fascia and terga 3 and 4 with four black pollinose vittate maculae (Fig. 9).

Species close to *T. dispar* and *T.* sp. 3 but males of *nitidus* have black facial vitta and notopleuron partly yellow.

Length (5): body, 6.1–7.4 (6.9) mm; wing, 5.5–6.9 (6.1) mm.

Distribution. Guatemala, Costa Rica, Panama, Colombia.

Material examined. 2♂ syntypes, ♀ holotype of *ovatus*, ***Non-type material*:** 7♂ 10♀.

Remarks. Males of *Toxomerus nitidus* always have a bicolored abdomen and females may have yellowish markings as noted by Hull (1943) (see Fig. 9), although most of the studied specimens had shiny black abdomens with a black pollinose pattern.

Toxomerus nitidus has been cited few times after its original description but only in catalogues (see Appendix I). I had the possibility to study two syntypes of *T. nitidus* and compared them with males of *T. ovatus* at USNM. Male genitalia were identical and females of *ovatus* did key out as *nitidus*. Thus, I realized that *T. nitidus* was only known from male specimens. Therefore, *T. ovatus* is here considered to be a junior synonym of *T. nitidus*.

***Toxomerus paragrammus* (Schiner)**
http://species-id.net/wiki/Toxomerus_paragrammus
Figure 26

Mesogramma paragramma Schiner, 1868: 349. Type locality: South America [Venezuela] [ST ♂, NMW].

Differential diagnosis. Species with face produced forward, yellow, with gena brown. Scutum black, bronze pollinose, with a broad yellow lateral vitta, yellow and black pilose. Scutum yellow, black pilose. Pleuron mostly black except posterior anepisternum yellow on posterior 2/3, katepisternum with a dorsal yellow macula and anepimeron yellow on anterior and dorsomedial sections. Wing hyaline, microtrichose. Abdomen

mainly black, with a broad yellow lateral margin in terga 1 to 5; tergum 2 with a medial black pollinose macula; terga 3 and 4 with two subanterior fasciate maculae that can eventually meet in the middle with a central yellow vitta (Fig. 26).

Length (2): body, 6.8–7.0 (6.9) mm; wing, 6.3–6.5 (6.4) mm.

Distribution. Venezuela.

Material examined. 2♂ syntypes.

Remarks. *Toxomerus paragrammus* is another species that most of the times will not run through the key because the presence of yellow maculae on the abdomen. I included this species because I think some dark specimens might have black abdomen with yellow lateral margins.

Toxomerus picudus **Mengual, sp. n.**
urn:lsid:zoobank.org:act:FCDB7EE3-F121-4192-A463-3752E15CC4CA
http://species-id.net/wiki/Toxomerus_picudus
Figures 16, 17, 21, 23

Description. FEMALE. *Head*: Face with distinct low facial tubercle, more pointed forward than rounded, yellow with two submedial black vittae that reach oral margin, brownish lateroventrally, scarcely yellow pilose; gena brown to black; lunule yellow, yellow also between antennal bases; frons yellow laterally with broad medial black vitta that surrounds antennal bases and continues with the two submedial facial vittae, yellow-golden pilose; vertical triangle shiny black, black pilose; antennae on small produced tubercle, antenna orangish, basoflagellomere dark brown dorsally; arista brown, bare (Fig. 21); eye bare, lateral triangular eye emargination large, approximately the half of eye width in lateral view; occiput with dorsal knob posterior to ocellar triangle, black, grey pollinose, yellow pilose on ventral 2/3 and black pilose on dorsal 1/3 (Fig. 23).

Thorax: Scutum shiny, bronze pollinose very anteriorly, with a continuous lateral yellow vitta, yellow pilose; postpronotum yellow, bare; notopleuron yellow with a black vitta on the lateral side narrowing the lateral yellow scutal vitta; supra-alar area and postalar callus yellow; scutellum black with well-defined lateral yellow vitta, slightly narrowed apically, black pilose, subscutellar fringe absent (Figs 16, 17). Pleuron mostly black, except posterior anepisternum yellow on posterior third and katepisternum with dorsal broad yellow macula; metasternum bare; calypter yellow; plumula yellow; halter bright yellow; posterior spiracular fringes yellow. *Wing*: Wing membrane hyaline, stigma brown; extensively microtrichose, except costal cell bare, cell R1 bare beyond RS furcation until the middle of the stigma, cell R bare basal to furcation of RS, cell BM bare on basal fourth and on anterior margin, cell CuP bare on anterior margin. Alula microtrichose. *Legs*: Proleg yellow except coxa black, yellow pilose; mesoleg yellow except coxa black, mesofemur black on apical half with apical tip yellow, mesotarsi orangish; metaleg black except femur yellow on basal third and on apical tip, tibia yellow on basal tip and on apical 1/6-1/5 (Figs 16, 17).

Abdomen: Slightly oval, distinctively convex, unmargined. Dorsum shiny black, black pilose; terga 2, 3, 4 and 5 with lateral margins yellow forming a continuous lateral yellow vitta, barely interrupted at the posterior margin of tergum 4. Sterna shiny black; sterna 1 and 2 with brownish-yellow fascia on posterior margin (Figs 16, 17).

Differential diagnosis. Species with yellow face with two sublateral black vittae, and eye with triangular emargination large, approximately the half of eye width in lateral view. Profemur yellow; cell BM bare on basal third and on anterior and posterior margins. Scutum shiny black with lateral yellow vitta and abdomen shiny black, convex, with lateral margins entirely yellow. Very similar to *T. hauseri* sp. n. but differs by having costal cell entirely bare, at most few microtrichia apically, metafemur black apically, yellow on basal third, and occiput with dorsal knob posterior to ocellar triangle pointing posteriorly. Moreover, the submedial black facial vittae reach oral margin in *T. picudus* but not in *T. hauseri*.

Length: body, 6.2 mm; wing, 5.1 mm.

Distribution. Ecuador.

Etymology. The specific epithet is derived from the Spanish *picudo* that means having a knob, protuberance. It refers to the dorsal occipital knob that this species has. Species epithet is treated as adjective.

Type locality. ECUADOR: Orellana Province, Aguarico Canton, Tiputini Biodiversity Station, 227 m., 0°38'13.73"S, 76°08'59.62"W, collected using a Sante trap, upper jar, A. Tishechkin leg.

Type specimen. Holotype female, pinned. Original label: "ECUADOR: Orellana Prov, Tiputini / Biodiversity Stan, Canopy 30m, Sante / trap, upper jar, 29.VII-3. VIII.2008. / AT1090, A. Tishechkin" "HOLOTYPE / *Toxomerus* / *picudus* / *Mengual 2011*" [red, handwritten except first line] (♀, CSCA).

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Appendix I

List of examined material and additional citations and references of the studied species of *Toxomerus*. (doi: 10.3897/zookeys.140.1930.app1)

Citation: Mengual X (2011) Black-tie dress code: two new species of the genus Toxomerus (Diptera, Syrphidae). ZooKeys 140: 1–26. doi: 10.3897/zookeys.140.1930.app1

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Revision of the orchid bee subgenus *Euglossella* (Hymenoptera, Apidae), Part I, The *decorata* species group

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Abstract

Euglossella, one of the most distinctive subgenera of orchid bees of the genus *Euglossa*, is composed of two characteristic assemblages of species, one of them comprising bees bearing the strongly metallic integument trademark of the genus (*viridis* species group), and the other consisting of bees with a brown integument shaded with metallic iridescence (*decorata* species group). Here we provide the first of two parts of a revision of *Euglossella*, providing diagnostic definitions for the subgenus, the *decorata* species group, and all the species included therein. Six species are included in the *decorata* group, one new: *Euglossa* (*Euglossella*) *aurantia*, **sp. n.**; *E.* (*E.*) *apiformis* Schrottky, resurrected status; *E.* (*E.*) *decorata* Smith, revised status; *E.* (*E.*) *singularis* Mocsáry, revised status; *E.* (*E.*) *cosmodora* Hinojosa-Díaz and Engel; and *E.* (*E.*) *perpulchra* Moure and Schlindwein. *Euglossa meliponoides* Ducke and *E. urarina* Hinojosa-Díaz and Engel are newly synonymized under *E. decorata*, *E. decorata ruficauda* Cockerell is synonymized under *E. singularis*, and a neotype is designated for *E. apiformis*.

Keywords

Hymenoptera, Apoidea, Anthophila, Euglossini, *Euglossa*, new species, taxonomy, orchid bees

Introduction

Among orchid bees of the genus *Euglossa*, one of the most distinctive groups are those species of the subgenus*Euglossella*, with their tridentate mandibles, lamellate pronotal dorsolateral angles, slender mesobasitarsi, truncate ventral margins of the metabasitarsi, and scalene triangular metatibiae. This subgeneric assemblage was originally established by Perty (1833) under the generic name *Cnemidium*, a homonym, but renamed and more truly characterized by Moure (1967) to encompass those *Euglossa* in which the males have tridentate mandibles. Dressler (1978b) reinterpreted the subgenus by considering additional characters, most of them secondary sexual features of the males, making it a more coherent taxonomic unit. Hinojosa-Díaz (2008), when discussing the male genitalic morphology across *Euglossa*, gave an account of features that further contributed to the cohesiveness of *Euglossella* as a subgenus. Recent phylogenetic analyses based both on external morphology (Hinojosa-Díaz 2010, in prep.) and molecular data (Ramírez et al. 2010), situate *Euglossella* as a monophylelic entity sister to all other *Euglossa sensu lato*, either alone (morphology) or in a clade together with the subgenus *Dasystilbe* (molecular). Within *Euglossella* a clear distinction can be traced to group the species in two easily recognizable species groups. The first includes all those species that, as is the rule for all other *Euglossa* outside of *Euglossella*, have strongly and brightly metallic body integument, which is those species resembling *Euglossa* (*Euglossella*) *viridis* (Perty), type species of the subgenus. The second species group includes species characterized by a distinctive yellow-brownish coloration with secondary iridescence on the head and mesosoma, and an almost complete absence of metallic color on the metasoma, and includes thosetaxa resembling *E.* (*E.*) *decorata* Smith. Besides the morphological distinction, the *viridis* species group has a wide Neotropical distribution, from southern Mexico to southern Brazil, while the *decorata* species group is restricted to South America East of the Andes, in areas surrounding the Amazon Basin. A taxonomic revision of the *decorata* species group is here presented as the first of two parts dedicated to the subgenus *Euglossella*. Diagnoses for each recognized taxon are provided, along with detailed descriptions for four species – one of them proposed as new and another resurrected from synonymy – and two others with clarified status.

Material and methods

Material examined in this study is deposited in the following collections: Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA (SEMC); Florida Museum of Natural History, University of Florida, Gainesville, Florida, USA(FLMNH); The Natural History Museum, London, United Kingdom (NHML); American Museum of Natural History, New York, New York, USA (AMNH); Museu Paraense Emílio Goeldi, Belém, Pará, Brazil (MPEG); Museu de Historia Natural, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil (BHMH); Hungarian Natural History Museum, Budapest, Hungary (HNHM); Departamento

de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil (DZUP); Zoologische Staatsammlung München, Munich, Germany (ZSSM); National Museum of Natural History (Smithsonian Institution), Washington, D.C., USA (USNM); Claus Rasmussen personal collection, Denmark (CRAS). The enumeration of specimens examined follows a detailed description of the label data, the information for each specimen enclosed by quotation marks (“”), each label separated by double slash symbols (//), and every row on individual labels separated by a semicolon in italics (;).

Morphological terminology in general follows that of Engel (2001), Michener (2007), and Hinojosa-Díaz (2008), while someprocedures for establishing metrics follow those of Brooks (1988). The species descriptions follow the overall format for other *Euglossa* species as presented by Hinojosa-Díaz and Engel (2007) and Hinojosa-Díaz et al. (2011).Photomicrographs were prepared using a Cannon EOS 7D digital camera and an Infinity K-2 long-distance microscope lens. Multilayer images were produced by using the software CombineZP.

Systematics

Genus *Euglossa* Latreille

Subgenus *Euglossella* Moure

http://species-id.net/wiki/Euglossella

Cnemidium Perty, 1833: 148, *nomen praeoccupatum* (*nec* Goldfuss, 1826). Type species: *Cnemidium viride* Perty, 1833, monobasic.

Euglossa (*Euglossella*) Moure, 1967: 401, *nomen novum pro Cnemidium* Perty, 1833. Type species: *Cnemidium viride* Perty, 1833, autobasic.

Diagnosis. Mid-sized metallic bees, with rather robust habitus; both sexes with tridentate mandibles and pronotal dorsolateral angles projected as acute prong or lamella (Fig. 3); female metabasitarsus trapezoidal with noticeably narrow distal margin (Figs 26, 46, 56, 65, 74); male mesotibia with two tufts, anterior tuft ellipsoidal, occupying about one-third of the outer tibial surface, posterior tuft rounded in a variety of shapes (Figs 24, 44, 54); male mesobasitarsus characteristically elongate and slender (Fig. 4), distal mesotarsomeres (specially second) unmodified; inner surface ofmale metafemur with ventral margin distinctively straight; male metatibia scalene triangular, metatibial organ slit basal and distal sections separated by a constriction distinctively narrower than width of contiguous basal section, basal section ellipsoidal, distal section separated from ventral margin of tibia by less than its own length (Fig. 6); ventral margin of inner metatibial surface with a blunt projection adjacent to spur attachment; male metabasitarsus roughly rectangular, ventral margin roughly straight in respect to sagittal body plane, appearing truncate and without noticeable projections of posterior margin. Eighth metasomal sternum of male with lateral edges of posterior section deeply

invaginated, lobes strongly projected (Fig. 26); posterior margin of apical process of gonocoxite oblique (inner-posterior corner displaced posteriad) (Fig. 30); lateral area of gonostylar process of gonocoxite truncate; spatha surface with longitudinal striae (Fig. 30); dorsal sector of lateral section of gonostylus convex, covered with distinctive plumose setae, gonostylar ventral lobe thumb-like (Figs 33–34).

Key to species groups of *Euglossella*

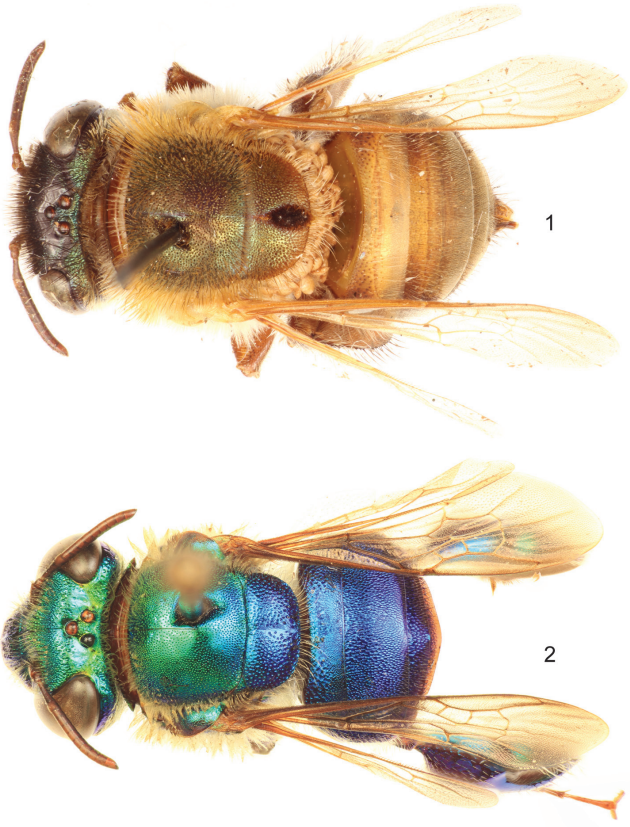
1 Integument of entire body strongly and brightly metallic blue, green, purple or reddish (e.g., figure 2); tegula metallic (usually same color as mesoscutum), never completely translucent (sometimes translucent on margins);metasomal terga usually with dense strong punctation..... ***viridis* species group**

– Integument of head and mesosoma with a dominant basal brown to dark brown color, shaded by a varying degree of metallic iridescence, particularly green, cyan, and coppery; integument of metasoma varying from golden-orange to dark brown with very faint metallic hue or iridescence (Fig. 1); tegula hyaline translucent with faint metallic hue; punctures on metasomal terga usually shallow..... ***decorata* species group**

The *decorata* species group

Recognition. The bees of the *decorata* species group are easily recognizable from other *Euglossella* species mainly based on their integumental coloration. Species of the *decorata* group,unlike all other *Euglossa sensu lato*, have brown as the base color of their head and mesosoma, tinged with iridescence to different degrees but on close observation the underlying brown coloration can be seen. This integumental color feature can be appreciated more easily as it is expressedon the tegula, which in these bees is characteristically hyaline with no metallic coloration on it beyond some faint hue. The legs and the metasoma are practically devoid of metallic coloration, and can be of any color between yellow and very dark brown, although as for the tegula, they can have some faint hue. This rather distinctive coloration makes the species of the *decorata* species group appear at first sight similar to species of the genus *Melipona* (Apinae, Meliponini). The integumental sculpturing,especially on the metasoma, is rather shallow, contrasting with the usually strong punctures present on the metasomal terga of all other *Euglossella*. Additionally, the upper interorbital distance in these bees is wider than the lower interorbital distance by about 10%, while in other *Euglossella* both distances are either equal or the lower distance is wider than the upper. Lastly, these species are restricted to the Amazon Basin and contiguous areas East of the Andes.

Included species. The present species group comprises *E.* (*E.*) *aurantia* sp. n., *E.* (*E.*) *apiformis* Schrottky, *E.* (*E.*) *decorata*, *E.* (*E.*) *singularis* Mocsáry, *E.* (*E.*) *cosmodora* Hinojosa-Díaz and Engel, and *E.* (*E.*) *perpulchra* Moure and Schlindwein.



Figures 1–2. Dorsal habitus of representative species of the two species groups within *Euglossa* (*Euglossella*). **1** *Euglossa* (*Euglossella*) *singularis* Mocsáry, female, *decorata* species group **2** *E.* (*E.*) *cyanura* Cockerell, male, *viridis* species group.

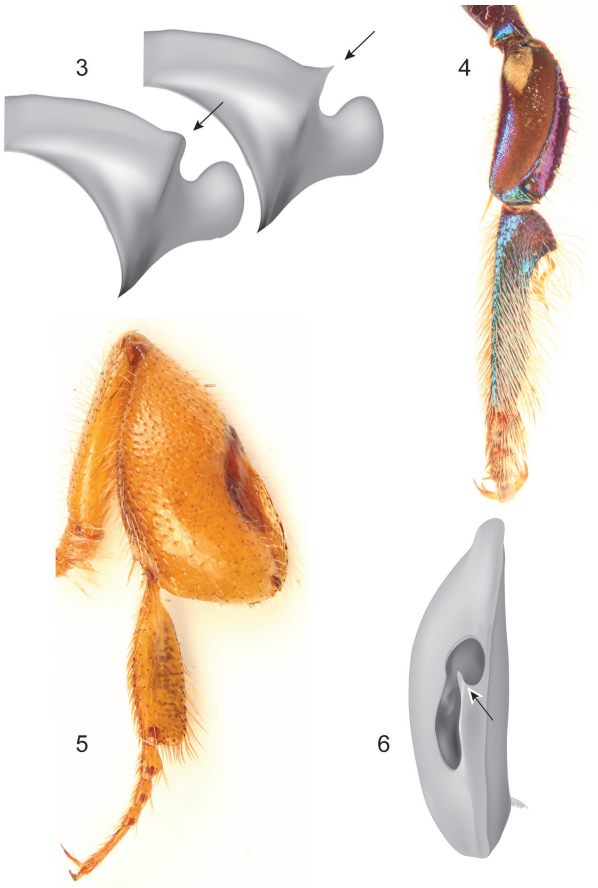
Key to species of the *decorata* species group (males only)

1 Mesotibial tufts appearing distinct from each other, with a noticeable gap between anterior and posterior tuft; posteror tuft circular (or almost circular) (Fig. 54); clypeus with coppery/green iridescence (Guiana Shield) .... ***E.* (*E.*) *singularis* Mocsáry**

– Mesotibial tufts appearing fused at least on proximal section; posterior tuft teardrop-shaped (Figs 14, 24, 44); coloration of clypeus variable **2**

2 Mesotibia with a noticeable,rather abrupt convexity on proximal area of anterior mesotibial surface, along anterior margin of anterior tuft (Fig. 13); integument of head dark brown (Bolivia)..... ***E.*(*E.*) *aurantia* sp. n.**

– Mesotibia with no noticeable convexity on proximal area along anterior margin of anterior tuft (sometimes weakly convex, but never as abrupt as in other couplet); integument of head variable **3**



Figures 3–6. Some diagnostic features of the subgenus *Euglossella*. **3** Schematic representation of pronotal dorsolateral angle **4** Mesothoracic leg of male of *E.* (*E.*) *cyanura* Cockerell **5** Metathoracic leg of female of *E.* (*E.*) *singularis* Mocsáry **6** Schematic representation of metatibia of *E.* (*E.*) *decorata* Smith, showing the constriction in the metatibial organ slit.

3 Metasoma with at least some terga exhibiting a clear banding pattern, involving either dark and light contrasting areas on individual terga, or posterior margin noticeably translucent contrasting with anterior area **4**

– Metasoma either uniformly colored or colored in a gradient, if bands present, thencolors involved are never contrasting **5**

4 Second metasomal tergum with noticeably dark brown band on anterior half bordered anteriorly and posteriorly by contrasting yellow areas, remaining terga with similar pattern, sometimes hidden when metasoma is contracted (Figs 57, 59); clypeus coppery-green (Andean foothills of central Peru to Bolivia) ..... ***E.*(*E.*) *cosmodora* Hinojosa-Díaz & Engel**

– Metasomal terga dark brown with posterior half noticeably translucent, forming a band pattern (Figs 66, 68); clypeus with strong coppery iridescence (northeast Brazil, Pernambuco)... ***E.*(*E.*) *perpulchra* Moure & Schlindwein**

5 Metasoma mainly dark brown with coppery iridescence; posterior margin of mesoscutellum truncate (laterally rounded) (Figs 17–20); clypeus with faint coppery iridescence (eastern Andean foothills from southern Ecuador to southern Peru) ..... ***E.*(*E.*) *apiformis* Schrottky**

– Metasoma coloration generally orange-brown, some specimens dark brown; posterior margin of mesoscutellum evenly convex (Figs 35–40); clypeus with green iridescence dominant (Amazon Basin) ..... ***E.*(*E.*) *decorata* Smith**

***Euglossa* (*Euglossella*) *aurantia* sp. n.**
urn:lsid:zoobank.org:act:CD07D9F6-85A9-44FF-A133-FF3F4F7C2A74
http://species-id.net/wiki/Euglossa_(Euglossella)_aurantia
Figs 7–16

Holotype. ♂, labeled: "Bolivien, Chapare,; Rios, 11.11.2002.; leg. B. Bembé // an gelber; Solanaceae; ~~Apocynaceae~~ // Euglossa; decorata ♂; det. B. Bembé 2001 [second line handwritten]". The holotype is in the Zoologische Staatssammlung München, Munich, Germany.

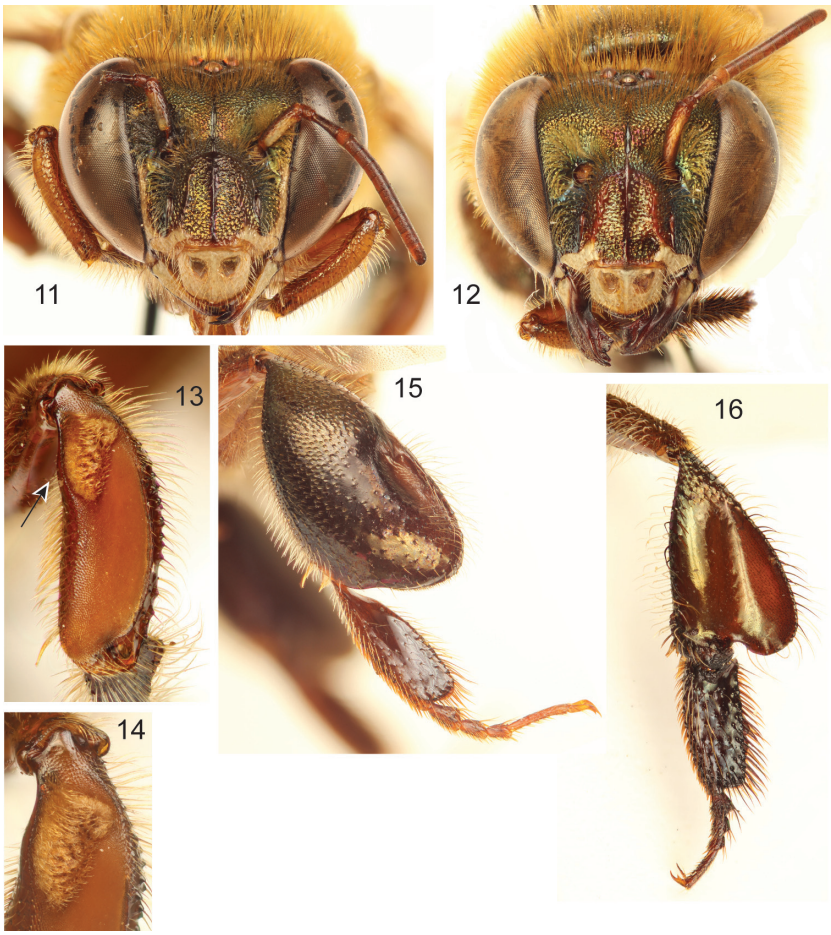
Paratype. ♀, labeled: "Bolivien, Chapare,; Villa Tunari, 320 m; Mai – Nov. 2002; leg. F. Heider// Euglossa; decorata ♀; det. B. Bembé 2001 [second line handwritten]". The paratype is in the same institution as the holotype.

Diagnosis. Labiomaxillary complex in repose reaching posterior tip of metasoma in the male (estimate), and posterior margin of third metasomal sternum in the female (Fig. 8, 10);integument of head of both sexes dark brown to black, with green-cyan hue on frons and coppery hue on clypeus (Figs11–12); mesosoma dark brown with green hue; mesotibia with a noticeable convexity on proximal area of anterior mesotibial surface, along anterior margin of anterior setal tuft (Fig. 13); first and second metasomal terga orange-brown, turning brown on posterolateral margins; third to seventh terga mainly brown except orange-brown on anterior margin,coppery hue iridescence on all terga; sterna orange-brown (Figs 7–10);malar area length on average 0.25 the basal mandibular width; male mesotibial tufts appearing fused (except for a distal separation),posterior tuft teardrop shaped (Fig. 14); male metatibia scalene obtuse triangular (forming a clearly obtuse angle at intersection of anterior and ventral margins) (Fig. 15).

Description. ♂: *Structure*. Total body length 12.44 mm; labiomaxillary complex in repose reaching posterior tip of metasoma (estimate) (Fig. 8). Head length 2.85 mm, width 5.11 mm; upper interorbital distance 2.44 mm; lower interorbital distance 2.26 mm; upper clypeal width 1.19 mm; lower clypeal width 2.19 mm; clypeal protuberance 0.81 mm; medial and paramedial clypeal ridges well developped; labrum slightly wider than long, length 1.19 mm, width 1.26 mm; medial labral ridge sharp; paramedial labral ridges noticeable but weaker than medial ridge, oblique, present in proximal three-fourths of labrum; labral windows ovoid, occupying proximal half of labrum; interocellar distance 0.30 mm; ocellocular distance 0.74 mm; first flagel-

Figures 7–8. *Euglossa* (*Euglossella*) *aurantia* sp. n., male holotype. **7** Dorsal habitus **8** Lateral habitus.

Figures 9–10. *Euglossa* (*Euglossella*) *aurantia* sp. n., female paratype. **9** Dorsal habitus **10** Lateral habitus.



Figures 11–16. *Euglossa* (*Euglossella*) *aurantia* sp. n. **11** Facial aspect of male holotype **12** Facial aspect of female paratype **13** Outer surface of male mesotibia (arrow pointing to anterior surface convexity) **14** Mesotibial tufts **15** Outer view of male metatibia and metatarsus **16** Outer view of female metatibia and metatarsus.

lomere as long (0.59 mm) as second and third flagellomeres combined (0.59 mm); length of malar area 0.19 mm. Mandible tridentate. Pronotal lateral angle projected postero-laterally as a truncate lamella (Fig. 3); intertegular distance 3.93 mm; mesoscutal length 3.04 mm; mesoscutellar length 1.48 mm; posterior margin of mesoscutellum weakly convex (Fig. 7); mesotibial length 2.59 mm, with a noticeable convexity on proximal area of anterior mesotibial surface, projected along anterior margin of anterior setal tuft; mesobasitarsal length 2.59 mm, width 0.81 mm (as measured at proximal posterior keel), posterior keel projected in a rounded orthogonal angle; metatibial shape triangular, forming a clearly obtuse angle at intersection of anterior and ventral margins (scalene obtuse triangular) (Fig. 15), metatibial anterior margin length 4.22 mm, ventral margin length 2.30 mm, postero-dorsal margin length 4.89 mm, maximum metatibial thickness 1.44 mm; metatibial organ slit dorsal and outer

sections as described for subgenus; anterior margin of distal section of metatibial organ slit evenly convex, maximum width occupying slightly less than one-third of metatibial outer surface width (Fig. 15); basal section of metatibial organ slit as described for subgenus, length 0.59 mm; metabasitarsal length 2.67 mm, mid-width 0.89 mm; metabasitarsal ventral border truncate. Forewing length 10.22 mm; jugal comb with 15 blades; hind wing with 24 hamuli. Maximum metasomal width 5.19 mm; second metasomal sternum noticeably elevated mesially forming two protuberances as "false cowled slits" separated from each other by about width of labiomaxillary complex.

Coloration. Head mainly dark brown (except as described below), with green-cyan hue on frons and paraocular areas, mid-clypeus with coppery hue; paraocular ivory marks well developed, triangular, lower width one-half length of lower lateral parts of clypeus or slightly wider; lower lateral parts of clypeus ivory, amber-translucent at edge; labrum ivory; labral anterior and posterior edges as well as labral windows amber-translucent; malar area brown on sides (condyle, acetabulum), ivory at center; mandible ivory on basal outer surface, teeth and ridges brown; antenna light brown; scape with ivory spot covering roughly all anterior surface (Fig. 11).Pronotum, mesoscutum and propodeum dark brown with strong green hue episternum dark brown with a combination of green and coppery hue, mesoscutellum orange-brown (Figs 7–8); legs brown, turning dark brown on mesotarsomeres, metatibia and metatarsomeres, all with faint coppery hue (Figs 7–8); tegulae and wing veins light amber, hyaline, with light coppery-golden hue. First and second metasomal terga orange-brown, turning brown on posterolateral margins; third to seventh terga mainly brown, except orange-brown on anterior margin (if visible); coppery hue iridescence on all terga, appearing coppery-golden on translucent posterior sections of first to sixth terga. (Fig. 7).Sterna orange-brown, fith and sixth sterna slightly darker, posterior sections of all sterna translucent; faint coppery hue on all sterna integument.

Sculpturing. Face areolate-punctate, with dense, strong areole-punctures, denser and slightly smaller (nearly one-fifth of median ocellar diameter) on frons; paraocular marks and lower lateral parts of clypeus less densely sculptured; vertex moderately areolate-punctate, smooth on anterior ocellar area; gena densely areolate-punctate, smooth on a narrow streak close to compound eye (except for scattered large punctures on upper margin). Mesosoma with round, moderately-dense punctures, as big as punctures on frons; punctures separated by about one half of a puncture diameter on mesoscutum and mesepisternum, contiguous and slightly bigger on mesoscutellum (specially towards posterior margin); metatibia moderately dense punctate on antero-proximal region (along anterior margin and postero-dorsal margin previous to metatibial organ slit), becoming gradually smooth towards posterior area, especially on surface near distal section of metatibial organ slit (Fig.15). Metasomal terga densely punctate (except smooth, polished on ventro-lateral sections and small antero-mesal surface of first tergum), puncture size comparable to that of frons punctures, increasing size ventro-laterally; metasomal sterna densely punctuate, punctures as big as ventro-lateral ones on terga, shallow, posterior margin of all sterna and contiguous areas to first sternum "false slits" smooth.

Vestiture. Facial setae of two kinds, some minutely branched (appearing simple), fulvous, long and sturdy, other plumose, rather fulvous, shorter and thinner. Frontal fringe with dense, fulvous, sturdy setae as long as about three mid-ocellus diameters, fulvous thin setae nearly two thirds as long as first; clypeus, supraclypeal area, and contiguous areas to clypeal disc moderately dense with an even combination of above described kinds of setae, both of about same length (about two median ocellar diameters); antennal depressions with moderately-dense, fulvous, plumose setae; paraocular marks, malar area, labrum and anterior surface of mandibles with scattered, fulvous, rather simple, short setae; vertex with scattered, fulvous, pectinate, minute setae around ocelli, interocellar area with a tuft of brown, sturdy setae; preoccipital ridge with a dense fringe comparable to the frontal one, but with brown, sturdy setae, as long as about four times median ocellar diameter; gena with dense, fulvous, plumose setae, short on upper section (where they intermix with similarly sized brown, simple, sturdy setae), increasing in length and becoming darker towards lower section, and continuing on outer mandibular margin where they become sparser, simpler and sturdier; antenna with fulvous, simple setae, long and scattered on scape, and dense and minute on flagellum. Prothorax with moderately dense fulvous, plumose, short setae; Mesoscutum, mesoscutellum and pronotal lobes covered with a combination of setae similar to that of frontal fringe, slightly longer and sturdier on pronotal lobes; mesepisternum densely covered with fulvous, plumose, long setae, becoming lighter on pleural and ventral areas; proximal podites (mainly coxae, trochanters, and part of femora) with setae as on ventral part of mesosoma; fulvous, simple, setae on femora (except as previously noted), tibiae (exceptions noted hereafter), and outer surface of tarsal articles; chemical gathering tufts on second through fourth protarsomeres made of dense, orange, long, setae; inner surfaces of probasitarsus, meso- and metatarsomeres with dense, brown, sturdy setae; mesotibia with two proximal tufts sitting on integumental concavities, anterior tuft ellipsoidal, occupying about one-third of outer tibial surface, posterior tuft teardrop shaped, slightly less than one-third as long as major axis of anterior tuft, laying on proximal posterior margin of anterior tuft, such that both tufts appear fused; both tufts made of fulvous setae directed posteriad, longer on anterior tuft (Fig. 14); microtrichia on outer mesotibial surface (velvety area) composed of dense, fulvous, simple, minute setae; anterior margin of velvety area strongly concave (Fig. 13); mesobasitarsus with three to four major wavy setae on inner surface right after proximal keel, all brown; metatibia with longer setae on anterior border and distal half of postero-dorsal margin, outer surface with scattered, brown, short, erect setae, bare on contiguous depression to metatibial organ; metatibial organ slit closed with brown setae (Fig. 15). First metasomal tergum with a mixture of setae comparable to those on posterior margin of mesoscutellum, but less dense, posterior half covered with moderately dense, fulvous, simple, minute appressed setae; second to seventh metasomal terga covered with scattered, dark brown, simple, sturdy setae as long as a median ocellar diameter, second through sixth metasomal terga with posterior bands of moderately dense, fulvous, appressed setae, as well as dense, fulvous, simple, long setal tufts on lateral margins; false slits of second metasomal sternum with tufts of moder-

ately dense, fulvous, simple, long setae, directed posteriorly reaching posterior edge of sternum, remainder sterna with similar erect setae, mesially bare.

Terminalia. Genital capsule as described for subgenus. Lateral section of gonostylus with a straight dorsal sector.

♀: *Structure*. Total body length 12.22 mm; labiomaxillary complex in repose reaching posterior margin of third metasomal sternum. Head length 3.11 mm; head width 5.04 mm; upper interorbital distance 2. 59 mm; lower interorbital distance 2.37 mm; upper clypeal width 1.22 mm; lower clypeal width 2.22 mm; clypeal protuberance 0.74 mm; clypeal ridges, labral ridges and labral windows as in male; labrum rectangular, wider than long, length 1.11 mm, width 1.26 mm; anterior edge of labrum arched outwards; interocellar distance 0.37 mm; ocellocular distance 0.81 mm; length of first flagellar article (0.44 mm) equal to combined lengths of second and third flagellar articles (0.44 mm); length of malar area 0.15 mm. Mandible tridentate. Pronotal lateral angle as in male; intertegular distance 3.78 mm; mesoscutal length 3.11 mm; mesoscutellar length 1.41 mm; posterior border of mesoscutellum as in male (Fig. 9); mesotibial length 2.37 mm; mesobasitarsal length 2.30 mm, maximum width 0.74 mm; metatibia triangular; metatibial anterior margin length 3.41 mm; metatibial ventral margin length 2.07 mm; metatibial postero-dorsal margin length 3.78 mm. Forewing length 9.48 mm; hind wing with 22 hamuli. Maximum metasomal width 5.41 mm.

Coloration. Generally as described for male, with a mixture of coppery and green hue on face and mesosoma. Paraocular marks absent; ivory coloration on mandible restricted to proximal one-third, antennal scape with thinner yellow spot occupying upper two thirds of antero-lateral surface (Fig. 16).

Sculpturing. As described for male except punctures of mesepisternum less dense.

Vestiture. As described for male (setal features on protarsi, meso- and metatibia are exclusive of male) except as follows: Mesoscutellar tuft rhomboid, composed of dense, fulvous, erect, thick, multibranched (branches minute) setae (Fig. 19). Mesotibia with a streak of spur-like, dark brown setae on posterior and ventral edges; metatibial corbicula surrounded by long, dark brown setae. Mesial sections of all sterna nearly bare (where labiomaxillary complex resides when in repose).

Etymology. The specific epithet is a reference to the orange coloration of the metasoma in this bee species (Greek, *aurantium*, meaning "orange").

Comments. On initial observation the two specimens here included as type material for this species look very similar to individuals of *E. decorata* from the western Amazon Basin, particularly in coloration. However, aside from the generally more robust habitus of both the male and female by comparison to *E. decorata*, the dominant coppery iridescence of the clypeus is notably different, which, despite a range of variation in the latter, has a consistently dominant green coloration on the clypeus. Coloration alone is not necessarily a good indication of species boundaries, so the main character that distinguishes *E. aurantia* from any other species in the *decorata* group is the proximal convexity on the anterior surface of the male mesotibia along the anterior margin of the anterior mesotibial tuft (Fig. 13). Besides *E. singularis*, in which this mesotibial surface is straight, all other species have a slight deviation of the integument near the

distal end of the anterior margin of the anterior mesotibial tuft, but this is only appreciable at higher magnification, and does not continue as a noticeable convexity along that margin. When looking at the mesotibia of the male of *E. aurantia*, the convexity in this area is immediately recognizable.

Euglossa (*Euglossella*) *apiformis* Schrottky, nomen revivisco

http://species-id.net/wiki/Euglossa_(Euglossella)_apiformis
Figs 17–34

Euglossa apiformis Schrottky, 1911: 39. Holotype ♀ (lost).

Neotype. ♂, labeled: "PERU: Huánuco, Llulla-; pichis [Llullapichis], Rio Pachitea; 15 II 1975 [day handwritten]; R. L. Dressler 1623 [number handwritten diagonally] // Vanillin [label upside down] // Euglossa; singularis Mocs.; det. R.L.Dressler 196". The neotype is in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA.

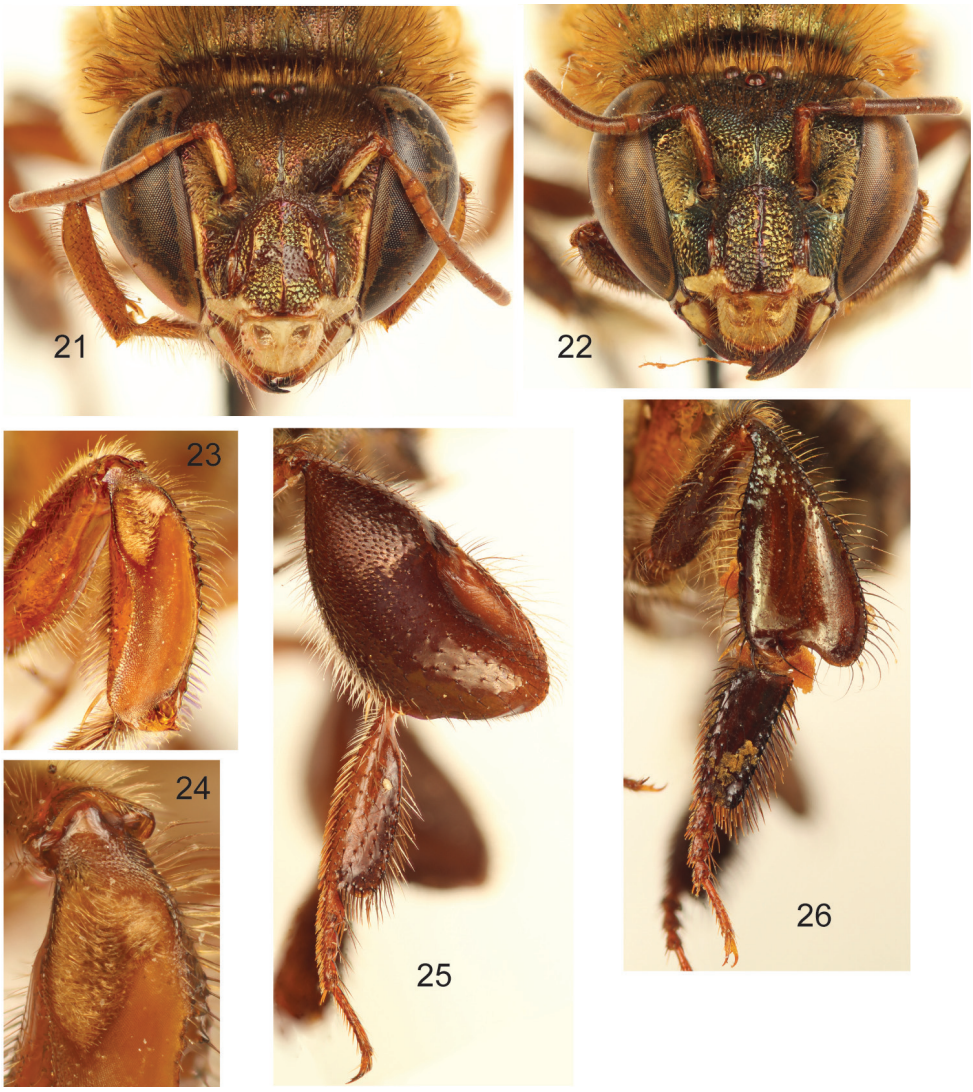
Additional material. 4♂♂, 2♀♀: labeled as follows: labeled as neotype except missing identification label (1♂) FLMNH; labeled as Neotype except date "14 II 1975 [day handwritten]" (1♂) SEMC;"PERU: Huanuco, Tingo María; Carlos Atachahua E.; 7 Aug. 1989 [day handwritten] // vanillin" FLMNH(1♂); "PERU: Madre de Dios; 30 km sw Pto. Maldonado; 1 July 1983 [day and month handwritten] M. P. Frisbie // terre firma // VANILLA [handwritten]" USNM(1♂); original collection data label as top label of Neotype except date "14 II 1975 [day handwritten]", and diagonal handwritten number "1633" (1♀) FLMNH; "Achinamiza,; Peru I-5-26 [date handwritten]; F 6001 [number handwritten] // H.Bassler; Collection; Acc. 33591 // Euglossa; decorata Sm; Det. J.S. Moure 1957 [first two lines and last two digits of date handwritten]" (1♀) AMNH. 1♂ labeled as follows: "Ecuador: Zamora; 5-7III 1982; N. H. Williams // 89 [handwritten on the underside] // vanillin [underside]" FLMNH, this specimen is missing the head.

Diagnosis. Labiomaxillary complex in repose slightly exceeding posterior tip of metasoma in the male, and posterior margin of second metasomal sternum in the female (Figs 18, 20); integument in both sexes dark brown (noticeably metasoma), with coppery-cyan hue all over (especially on clypeus), legs brown, turning dark brown on metatibia and metatarsomeres (Figs 18, 20); malar area length on average 0.25 the basal mandibular width; male mesotibial tufts appearing fused (except for a distal separation),posterior tuft teardrop shaped (Fig. 24); male metatibia scalene obtuse triangular (Fig. 25).

Description. ♂: *Structure*. Total body length 11.56 mm (10.74–12.74; n=5); labiomaxillary complex in repose slightly exceeding posterior tip of metasoma (Fig. 18). Head length 2.92 mm (2.73–3.11; n=5), width 4.81 mm (4.67–5.07; n=5); upper interorbital distance 2.37 mm (2.26–2.59; n=5); lower interorbital distance 2.18 mm

Figures 17–18. *Euglossa* (*Euglossella*) *apiformis* Schrottky, male neotype. **17** Dorsal habitus **18** Lateral habitus.

Figures 19–20. *Euglossa* (*Euglossella*) *apiformis* Schrottky, female **19** Dorsal habitus **20** Lateral habitus.



Figures 21–26. *Euglossa* (*Euglossella*) *apiformis* Schrottky **21** Facial aspect of male neotype **22** Facial aspect of female **23** Outer surface of male mesotibia **24** Mesotibial tufts **25** Outer view of male metatibia and metatarsus **26** Outer view of female metatibia and metatarsus.

(2.15–2.22; n=5); upper clypeal width 1.17 mm (1.11–1.19; n=5) (as measured between dorsolateral angles of clypeus); lower clypeal width 2.09 mm (2.02–2.15; n=5) (as measured at level of lower lateral parts); clypeal protuberance 0.67 mm (0.52–0.81; n=5) [following measurement method of Brooks(1988)]; clypeal ridges, labral ridges

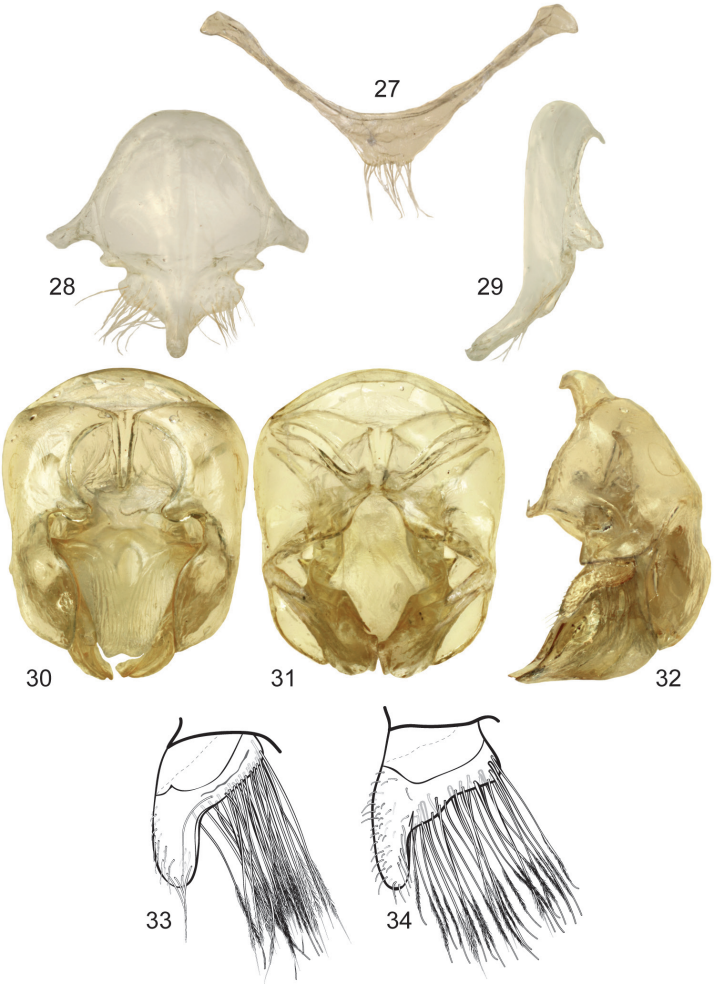
and labral windows as described for *E. aurantia*; labrum slightly wider than long, length 1.13 mm (1.04–1.19; n=5), width 1.16 mm (1.11–1.20; n=5); interocellar distance 0.30 mm (n=5); ocellocular distance 0.74 mm (0.67–0.78; n=5); first flagellomere as long [0.49 mm (0.44–0.52; n=5)] as second and third flagellomeres combined [0.50 mm (0.44–0.56; n=5)]; length of malar area 0.21 mm (0.19–0.22; n=5). Mandible tridentate. Pronotal lateral angle as described for *E. aurantia*; intertegular distance 3.48 mm (3.41–3.56; n=5); mesoscutal length 2.87 mm (2.81–2.96; n=5); mesoscutellar length 1.33 mm (1.26–1.41; n=5); posterior margin of mesoscutellum truncate (laterally rounded) (Fig. 17); mesotibial length 2.44 mm (2.37–2.59; n=5); mesobasitarsal length 2.56 mm (2.44–2.67; n=5), width 0.73 mm (0.67–0.79; n=5); posterior keel as described for *E. aurantia*; metatibial shapeas described for *E. aurantia*, metatibial anterior margin length 3.56 mm (3.41–3.85; n=5), ventral margin length 2.44 mm (2.37–2.52; n=5), postero-dorsal margin length 4.52 mm (4.37–4.59; n=5), maximum metatibial thickness 1.31 mm (1.19–1.41; n=5); metatibial organ slit dorsal and outer sections well defined with a junction noticeably narrower than contiguous width of basal section; anterior margin of distal section of metatibial organ slit evenly convex, maximum width occupying about one-third of metatibial outer surface width (Fig. 25); basal section of metatibial organ slit oval-rhomboid, length 0.64 mm (0.59–0.74; n=5); metabasitarsal length 2.57 mm (2.44–2.81; n=5), mid-width 0.85 mm (0.74–0.93; n=5); metabasitarsal ventral border truncate. Forewing length 9.78 mm (9.11–10.44; n=5); jugal comb with 13–16 (n=5) blades; hind wing with 18–23 (n=5) hamuli. Maximum metasomal width 4.77 mm (4.52–4.96; n=5); second metasomal sternum integumental modifications as described for *E. aurantia*.

Coloration. Head similarly colored as in *E. aurantia*, but with coppery-cyan hue all over (very few green highlights) (Fig. 21). Mesosoma dark brown, slightly lighter on mesoscutellar posterior margin, coppery iridescent hue throughout mesosomal integument (Figs 17–18); legs brown, slightly lighter than in *E. aurantia* (Figs 18, 23–25); tegulae and wings as described for *E. aurantia*. Metasomal terga dark brown, except as follows: first metasomal tergum lighter (average brown) on ventro-lateral and anterior sections, appearing even yellow in anterolateral edges; first to sixth terga with posterior margin slightly translucent; coppery iridescence on all terga, appearing coppery-golden on posterior sections of first to sixth terga. (Figs 17–18). Sterna brown, darker laterally at area of contact with terga, posterior sections of all sterna translucent; faint coppery hue on all sterna integument.

Sculpturing. As described for *E. aurantia* (*vide supra*).

Vestiture.General vestiture as described for *E. aurantia*, except as follows: of two kinds of setae generally present all over body, minutely branched (rather simple or serrate), sturdier ones appear darker (dark brown) than plumose ones (fulvous).

Terminalia. Posterior margin of seventh metasomal sternum shallowly invaginated mesally, covered with setae; eighth sternum and genital capsule as described for subgenus. Lateral section of gonostylus with dorsal sector variable, either straight or slightly projected on a hump (Figs 33–34).



Figures 27–34. Male genitalic features of *Euglossa* (*Euglossella*) *apiformis* Schrottky **27** Seventh metasomal sternum, ventral aspect **28** Eighth metasomal sternum, ventral aspect **29** Eighth metasomal sternum, lateral aspect **30** Genitalic capsule, dorsal aspect **31** Genitalic capsule, ventral aspect **32** Genitalic capsule, lateral aspect **33** Lateral section of gonostylus, variety with straight dorsal sector **34** Lateral section of gonostylus, variety with projections on dorsal sector.

♀: *Structure*. Total body length 11.11–12.07 mm; labiomaxillary complex in repose reaching posterior margin of second metasomal sternum. Head length 2.96 mm; head width 4.74–4.81 mm; upper interorbital distance 2.48–2.52 mm; lower interorbital distance 2.25–2.30 mm; upper clypeal width 1.19 mm; lower clypeal width 2.15–2.19 mm; clypeal protuberance 0.67 mm; medial and paramedial clypeal ridges well developed; labrum rectangular, wider than long, length 1.04–1.11 mm, width 1.19–1.26 mm; labral ridges and windows as in male; anterior edge of labrum arched outwards; interocellar distance 0.33–0.37 mm; ocellocular distance 0.78–0.80 mm;

length of first flagellar article (0.44–0.52 mm) equal to combined lengths of second and third flagellar articles (0.44–0.56 mm); length of malar area 0.15–0.17 mm. Mandible tridentate. Pronotal lateral angle as in male; intertegular distance 3.48–3.56 mm; mesoscutal length 2.59–2.89 mm; mesoscutellar length 1.30–1.41 mm; posterior border of mesoscutellum as in male (Fig. 19); mesotibial length 2.30–2.37 mm; mesobasitarsal length 2.15–2.37 mm, maximum width 0.70–0.74 mm; metatibia triangular; metatibial anterior margin length 3.19–3.41 mm; metatibial ventral margin length 1.85 mm; metatibial postero-dorsal margin length 3.78–3.93 mm. Forewing length 9.04–9.11 mm; hind wing with 20–22 hamuli. Maximum metasomal width 5.04–5.19 mm.

Coloration. In general as described for male but with a stronger coppery-cyan hue on face and metasoma. Paraocular marks absent; ivory coloration on mandible restricted to proximal one-third, antennal scape with yellow spot occupying upper half of antero-lateral surface (Fig. 22).

Sculpturing. As described for male except mesepisternum with punctures not as dense (separated by about one puncture diameter).

Vestiture. As described for male except as follows: Mesoscutum and mesoscutellar vestiture dominated by fulvous thinner setae, although dark brown kind is still present; mesoscutellar tuft rhomboid, composed of dense, fulvous and brown, erect, thick, multibranched (branches minute) setae (Fig. 19). Mesotibia with a streak of spur-like, dark brown setae on posterior and ventral edges; metatibial corbicula surrounded by long, dark brown setae. Mesial sections of all sterna nearly bare.

Comments. Schrottky (1911) described *E. apiformis* from an unspecified number of females presumably from Marcapata, Cuzco, Peru (Rasmussen et al. 2010). The original description (Schrottky 1911) refers to a species in the *E. decorata* species group with a dark brown metasoma and a bronze-green mesosoma, besides other characters common to all species of the group. Although some specimens of *E. decorata* have a dark metasoma (see comments for *E. decorata*), it usually comes with a darker mesosoma altogether, and only some *E. decorata* specimens from the eastern Amazon Basin have similar coloration to the one described by Schrottky (1911) and observed in the specimens here examined. Characters not mentioned by Schrottky (1911) that distinguish this species from *E. decorata* (with which it shares some distributional range) include the coloration of the clypeus being more coppery than green, a labiomaxillary complex in the male extending slightly beyond the tip of the metasoma (not surpassing it in *E. decorata*), and a truncate posterior mesoscutellar margin (evenly convex in *E. decorata*). *Euglossa apiformis* appears as a synonym of *E. singularis* in the euglossine checklist of Moure (1967) and Kimsey and Dressler (1986), as well as in Moure et al. (2007) and Nemésio and Rasmussen (2011). This synonymy was most likely based on the assumption that any darker looking bee resembling *E. decorata* would correspond to *E. singularis* but as discussed later in this work this color distinction disregarded all other morphological evidence. The set of characters here presented and the locality records located in a continuous region along the lowlands contiguous to the Andes on the Amazon Basin of Peru and Ecuador justify the validity of the species. A neotype is here designated in order to validate the status of the species as described by Schrottky (1911)

Figures 35–36. *Euglossa* (*Euglossella*) *decorata* Smith, male. **35** Dorsal habitus **36** Lateral habitus.

since the original type materialis presumed lost (Moure 1967, Kimsey and Dressler 1986, Moure et al. 2007, Rasmussen et al. 2009). The localities of the specimens here examined are in the same region and with similar elevations as the type locality (Schrottky 1911, Rasmussen et al. 2009). Although the original description was based solely on female characters, and therefore the original type corresponded to a female, a male is here designated as the neotype since males carry the most distinctive specific characters in *Euglossa* and designation of a female would carry the potential for further confusion in the future.

***Euglossa* (*Euglossella*) *decorata* Smith**
http://species-id.net/wiki/Euglossa_(Euglossella)_decorata
Figs 35–46

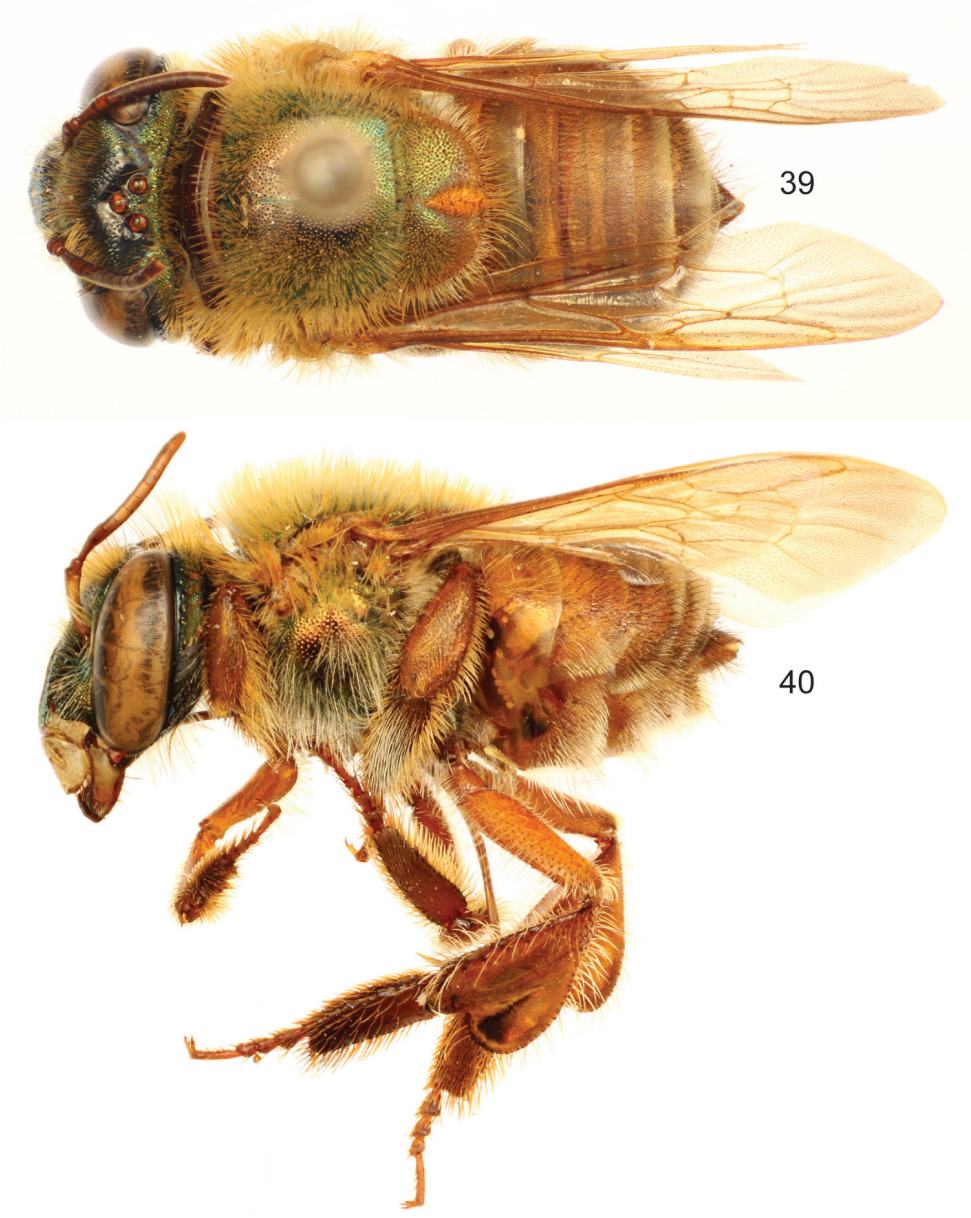
Euglossa decorata Smith, F., 1874: 440-446 [444]. Holotype ♀ (NHML, *visum*).
Euglossa meliponoides Ducke, 1902: 569. Lectotype ♀ (MPEG, *non visum*, *vide* Comments *infra*), **syn. n.**

Euglossa (*Euglossella*) *urarina* Hinojosa-Díaz and Engel, 2007: 100-103. Holotype ♂ (FLMNH, *visum*), **syn. n.**

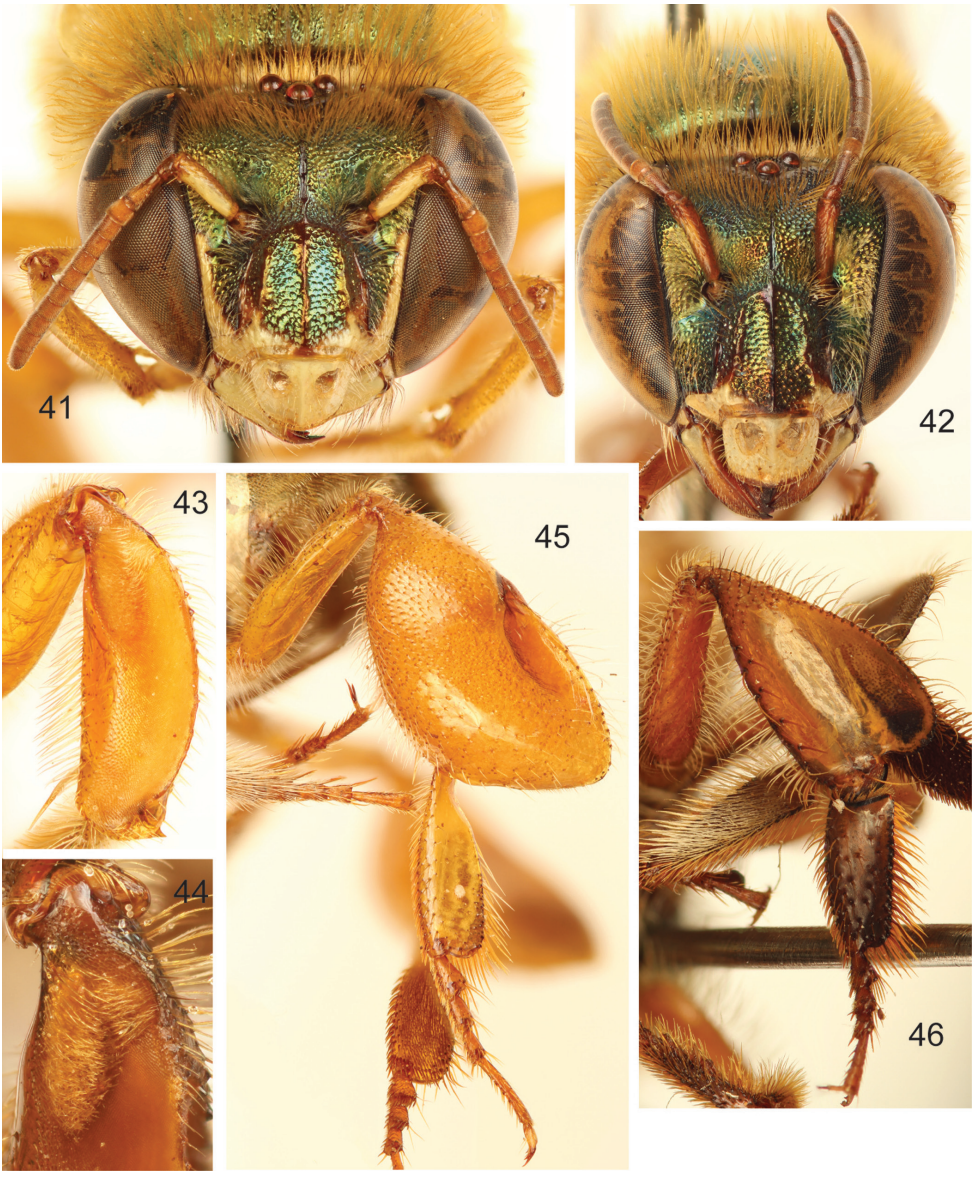
Material examined. Colombia: "COLOMBIA: Caqueta; Yuruyaco, 73k. sw Flo-; rencia 17.i.1979 [day handwritten]; M. Cooper; B.M. 1979-106" (1♀) NHML; five extra specimens with same collection data except for date "30.i1979[day handwritten]" (1♀) BMNH, "3.ii1979[day handwritten]" (1♀) NHML, "9.ii1979[day handwritten]" (1♂) NHML "13.ii1979[day handwritten]" (1♀) NHML; "primary forest [handwritten]; COLOMBIA:Putu-; mayo, Villa Garzón,; 8mi, s. Mocoa; 17 vii.1978[day handwritten]; M. Cooper; B.M. 1978-431" (1♀) NHML; same data except missing first handwritten line and different date "19.vii.1978[day handwritten]" (1♀) NHML; "COLOMBIA:Putu-; mayo, Mocoa; 10 vii.1978[day handwritten]; M. Cooper; B.M. 1978-431" (1♂) NHML; "Colombia: Putumayo,; Mocoa, 530 m, 10 I 2003; S. Ramírez 345, V" (1♂)FLMNH; same data except number on last line "348" (1♂) FLMNH, "349" (1♂) FLMNH; "Colombia; Amazonas; Leticia; 7 VI 1974 [handwritten]; 1554 [handwritten vertical on left margin]" (1♂, missing abdomen; glued abdomen in data label does not belong to the specimen)FLMNH; same data except date "7 VI 1974 [handwritten]" (1♂) FLMNH; "Macarena Mts.; Colombia I-II-;1950. 500-650 m.; L. Bichter // Euglossa; decorata; Sm; Det. J.S. Moure 1952 [first three lines and last two digits of date handwritten]" (1♂)SEMC; same data except second label "Euglossa;decorata ♂; Sm; J.S. Moure 1963 [first three lines and last two digits of date handwritten]" (1♂) SEMC; "Villavicencia.; Columbia [Colombia]; V-28-42; W. Kamp [all label handwritten] // Euglossa; decorata; Sm; Det. J.S. Moure 1952 [first three lines and last two digits of date handwritten]" (1♂) SEMC.

Brazil: "Type; H.T. [type label, round with orange edge] // B.M. TYPE;HYM.; 17B.949 [handwritten] // Euglossa; decorata; S$^{t.}$ Paulo: Smith. [all label handwritten] // S^{t} Paulo [underside handwritten]" (1♀) NHML; "R. Tapajós; Itaituba; 5.9.1902; Ducke [all label handwritten] // Euglossa ♂ typ.; meliponoides Ducke; det. A. Ducke. [first two lines handwritten] // Euglossa; singularis;Mocs.; Det.J.S. Moure 1957 [first three lines and last two digits of date handwritten] // Am. Mus. Nat. Hist.; Dept. Invert. Zool.; No.26003 [number handwritten] // Euglossa; meliponoides; Ducke [handwritten]" (1♂) AMNH; "Brasil Pará Con-; ceição do Araguala; 17-21 nov 1979 // Brasil Pará; W Frange" (1♀) MPEG; "Brasil; Para; 1920 [first two digit handwritten] // Euglossa; decorata; Sm.; ♂1909 Friese det. [first three lines and sex handwritten] // E. (Euglossa); decorata Sm.; J.S. Moure 57 [first two lines and two digits of date handwritten] // Am. Mus. Nat. Hist.; Dept. Invert. Zool.; No.28264 [number handwritten] (1♂) AMNH; "PA P de Pedras; 02-III-1979 [date handwritten] // Brasil Pará; P Tadeu" (1♀) MPEG; "OBIDOS; Pará BRASIL; IX-1953; F.M. Oliveira // COLECÃO; CAMPOS SEABRA [turned upside down]" (1♀) FLMNH; "TABATINGA; Amazonas BRASIL; Nov. [illegible] 1958 [date handwritten]; F.M. Oliveira // COLECÃO; CAMPOS SEABRA [underside] // decorata [handwritten]" (1♂) DZUP; "Tapuruquara – AM; Brasil VII-62; F.M. Oliveira leg" (1♂) FLMNH; "♂ // S. Gabriel; Rio Negro,; Amaz.; 27,VIII,1927; J.F. Zikán [vertical writing on left]"

Figures 37–38. *Euglossa* (*Euglossella*) *decorata* Smith, male, dark variety, **37** Dorsal habitus **38** Lateral habitus.



Figures 39–40. *Euglossa* (*Euglossella*) *decorata* Smith, female. **39** Dorsal habitus **40** Lateral habitus.



Figures 41–46. *Euglossa* (*Euglossella*) *decorata* Smith **41** Facial aspect of male **42** Facial aspect of female **43** Outer surface of male mesotibia **44** Mesotibial tufts **45** Outer view of male metatibia and metatarsus **46** Outer view of female metatibia and metatarsus.

(1♂) FLMNH; "Belém Mocambo; 26.XII.1979 [handwritten except first two digits of year] // Brasil Pará; M F Torres" (1♀) MPEG; "Est. Ecol. do; Panga; 12663 – 36987 // Uberlândia MG; BRASIL 04/02/1989; C. H. Marchini // F.90 10.12; 42:89; Marchini, CH [underside, handwritten] // E. (Euglossella); decorata; Smith, 1874; Det. Camargo 1989 [first three lines and last digit of year handwritten]" (1♂) NHML.

Ecuador: "Mishaualli [handwritten]; Napo, Ecuador; D. Velastegui; 4/12/69 vanillin [handwritten] // E. singularis [handwritten]" (1♂) FLMNH; same collection data except missing identification label (1♂) FLMNH; "Choluyaco 1/7/69 [handwritten]; Napo, Ecuador; D. Velastegui; vanillin [handwritten]" (1♂) FLMNH; "ECUADOR, Coca; on Rio Napo, Napo; Pastaza Prov.; V. .1965 // L.E. Pena; Collector // Euglossa; (Euglossella); aff. singularis; det. J.S. Ascher" (1♂) AMNH; "ECUADOR: Mor.-Stgo.; E. Patuca; 27-31 Aug.;1987; Dressler, Hills,; Whitten, Williams // geraniol [underside]" (1♂) FLMNH; same data except second label "caryophylleus [unclear writing]; oxide 31" (1♂) FLMNH; "Ecuador, Orellana, Estacion; Cientifica Yasuni; to dead fish; in butterfly trap in jungle; on Sendero Napo Trail; 20Oct.; 2003;D. Robacker, W.Warfield;& M.H.Evans // Euglossa; singularis ♀; det. Claus Rasmussen 2004 [first two lines and last digit of year handwritten] // Euglossa; decorata ♀; det. Claus Rasmussen [first two lines and last digit of year handwritten]" (1♀) CRAS; "ECUADOR, Napo; September 1987; Dressler, Hills,; Whitten, Williams // vanillin" (1♂) FLMNH; same collection data without second label (1♀); "Via Tena [handwritten]; Napo, Ecuador; D. Velastegui; Nerol 1/6/1969 [handwritten] // E. decorata [handwritten]" (1♂) FLMNH; "Rio Maya 1/6/1969 [handwritten]; Napo, Ecuador; D. Velastegui; Nerol [handwritten]" (1♂) FLMNH; "Apuya 1/9/1969 [handwritten]; Napo, Ecuador; D. Velastegui; Geraniol [handwritten]" (1♂) FLMNH; "Rio Cumayacu [handwritten]; Napo, Ecuador; D. Velastegui; Nerol 3/21/1969 [handwritten] // E. decorata [handwritten]" (1♂) FLMNH; "Sarayacu 6/16/69 [handwritten]; Napo, Ecuador; D. Velastegui; Vanillin [handwritten]" (2♂♂) FLMNH; "Rio Hanzo [Anzu?] [handwritten]; Napo, Ecuador; D. Velastegui; Nerol 12/14/1968 [handwritten]" (1♂) FLMNH; "Rio Porotoyacu [handwritten]; Napo, Ecuador; D. Velastegui; MS 3-17-69 [handwritten] // Euglossa; decorata Smith" (1♂) FLMNH; "Rio Pomayaco 8/24/69 [handwritten]; Napo, Ecuador; D. Velastegui; Citronellol [handwritten]" (1♂) FLMNH; "Rio Anzo [Anzu?] 1/19/1969 [handwritten]; Napo, Ecuador; D. Velastegui; Nerol [handwritten]" (1♂) FLMNH; "Zazuyacu, Napo; Ecuador 2/12/1969; D. Velastegui; on flower [handwritten] // [second label hard to read, has some information in Spanish about the bee visiting a flower]" (1♂) FLMNH; "ECUADOR: Napo [second word handwritten]; Via Tena [handwritten]; 6 I 1969 [handwritten] // Nerol; D. Velastegui [underside, handwritten]" (1♂) FLMNH; "Satzayacu [handwritten]; Napo, Ecuador; D. Velastegui // vanillin; 9 XII 1969 [underside handwritten]" (1♂) FLMNH; "Ecuador: Pastaza; nr. Puyo 2 XI 1981; N. H. Williams // 11 [handwritten] // vanillin [underside]" (1♂) FLMNH; "Ecuador: Zamora-Ch.,; Ecuagenera, Pangüí; Williams & Whitten // at Geonoma, Whitten; 2480, QCA; 3 oct. 2003, [underside]" (1♂) FLMNH; "ECUADOR Oriente; 00°24'S, 76°36'W; Limoncocha; 25 July 1970; M. G. Naumann // Euglossa; decorata F. Smith; Det. R.L.Dressler, 1987" (1♀) SEMC.

Peru: "Iquitos; Peru // 8 Sept 64; C H Dodson // On *Gongora*; *maculata*; 2734 // *E. decorata* Smith // HOLOTYPE; Euglossa; urarina; I.A. Hinojosa-Díaz;& M.S. Engel [red type label]" [first three labels handwritten] (1♂) FLMNH; "Iquitos; Peru // 8 Sept 64; H Moore 20May65 // *Gongora maculata*; 20May65; Helen Moore [underside]// PARATYPE; Euglossa; urarina; I.A. Hinojosa-Díaz; & M.S. Engel [yellow label]" [first three labels handwritten] (1♂) SEMC; "Iquitos; Peru // 31 Dec 64; C H Dodson // On *Gongora*; 2771 // 70 // *Euglossa*; *decorata* Smith; det. R.L. Dressler 1968" [first four labels handwritten] (1♂); "Iquitos, Peru; F 606 [number handwritten // H. Bassier; Collection; Acc. 33591 // Euglossa; meliponoides; Ducke; Det. J.S. Moure 1952 [first three lines and last two digits of date handwritten] // Euglossa; singularis♀; Mocs.; J.S. Moure 1962 [first three lines and last two digits of date handwritten] // Euglossa; singularis; Mocs. (1♀) SEMC; "~~Lower~~ Rio Tapiche,; Peru I.5.24 [date handwritten]; F 6/54 [numbers handwritten] // H. Bassier; Collection; Acc. 33591 // E. (Euglossa); singularis; Mocs.; J.S. Moure 57 [first three lines and digits of date handwritten]" (1♂) AMNH; "Peru, LO, Maynas,; Varillal; C.R.I. – km 15; 28 vi01Rasmussen [day handwritten] // vanillin // HYM; Euglossa; singularis; det. C. Rasmussen, 2002 [first two lines handwritten]" (1♂) CRAS; "PERU, SM, Tarapoto-; Yurimaguas, km 20; "BIODIVERSIDAD"; 0634/7620 950 masl; IV-VI.2002 C.Rasmussen // Euglossa sp.; decorata ? ♀ ; Det. Claus Rasmussen, 2002 [first two lines handwritten]" (1♀) CRAS; "PERU, Huánuco:; Tingo Mario [María], Rio; Huallaga, July 9,1974; C. Porter & L. Stange // Euglossa (Euglossella); decorata Smith, 1874; det. J.S. Ascher" (1♀) AMNH; " Carlos Atachahua E.; 30 April 87; Tingo Maria, Peru // Vanillin // E. decorata [handwritten]" (1♂) FLMNH.

Diagnosis. Both sexes with labiomaxillary complex in repose reaching tip of metasoma, but not surpassing it (Figs 36, 38, 40); head integument brown (variable, see comments), with a varying degree of dominant green iridescence evident on clypeus (Fig. 41); integument of mesosoma colored as head, mesoscutellum partially (see comments) light brown with diminished iridescence (Figs 35, 37, 39); metasoma generally orange-brown, terga usually darker posteriorly, coppery-golden hue all over (Figs 35–40); malar area length on average 0.20 the basal mandibular width; male mesotibial tufts appearing fused (except for a distal separation), posterior tuft teardrop shaped (Fig. 41); male metatibia scalene obtuse triangular (Fig. 45).

Description. ♂: *Structure*. Total body length 11.43 mm (10.30–12.59; n=7); labiomaxillary complex in repose reaching (or at most slightly exceeding) posterior tip of metasoma (Figs 36, 38). Head length 2.67 mm (2.59–2.78; n=7), width 4.63 mm (4.52–4.81; n=7); upper interorbital distance 2.28 mm (2.13–2.37; n=7); lower interorbital distance 1.99 mm (1.93–2.15; n=7); upper clypeal width 1.08 mm (1.04–1.26; n=7) ; lower clypeal width 1.94 mm (1.85–2.11; n=7); clypeal protuberance 0.71 mm (0.67–0.74; n=7); clypeal ridges, labral ridges and labral windows as described for *E. aurantia*; labrum slightly wider than long, length 1.05 mm (0.98–1.11; n=7), width 1.11 mm (1.06–1.19; n=7); interocellar distance 0.27 mm (0.22–0.30; n=7); ocellocular distance 0.70 mm (0.67–0.81; n=7); first flagellomere as long [0.49 mm (0.44–0.54; n=7)] as second and third flagellomeres combined [0.48 mm (0.44–0.52; n=7)];

length of malar area 0.17 mm (0.15–0.22; n=7). Mandible tridentate. Pronotal lateral angle as described for *E. aurantia*; intertegular distance 3.37 mm (3.33–3.48; n=7); mesoscutal length 2.80 mm (2.70–2.96; n=7); mesoscutellar length 1.31 mm (1.19–1.41; n=7); posterior margin of mesoscutellum evenly convex (Figs 35, 37); mesotibial length 2.37 mm (2.30–2.44; n=7); mesobasitarsal length 2.42 mm (2.37–2.52; n=7), width 0.71 mm (0.67–0.74; n=7); posterior keel as described for *E. aurantia*; metatibial shape as described for *E. aurantia*, metatibial anterior margin length 3.57 mm (3.26–3.70; n=7), ventral margin length 2.21 mm (2.00–2.37; n=7), postero-dorsal margin length 4.32 mm (3.85–4.67; n=7), maximum metatibial thickness 1.24 mm (1.11–1.33; n=7); metatibial organ slit as described for *E. aurantia* (Fig. 45); basal section of metatibial organ slit length 0.58 mm (0.48–0.67; n=7); metabasitarsal length 2.48 mm (2.37–2.59; n=7), mid-width 0.85 mm (0.81–0.96; n=7); metabasitarsal ventral border truncate. Forewing length 9.36 mm (8.67–10.15; n=7); jugal comb with 12–14 (n=7) blades; hind wing with 20–23 (n=7) hamuli. Maximum metasomal width 4.57 mm (4.44–4.74; n=7); second metasomal sternum integumental modifications as described for *E. aurantia*.

Coloration. Head integument brown, frons with cyan iridescence on frontal fringe area, clypeus with green iridescence, other areas with some coppery-cyan hue (see comments); ivory areas as in *E. aurantia*, except lower width of paraocular marks in several specimens extending all the length of lateral parts of clypeus (Fig. 41). Mesosoma brown, mesoscutellum with at least some light brown integument usually towards posterior margin (see comments), olive-green(dominant)/coppery iridescence on mesoscutum, coppery on episternum (Figs 35–36); legs brown (variable, see comments), with a similar pattern as in *E. aurantia* (Figs 36–38); tegulae and wings as described for *E. aurantia* (Figs 35–38). Metasomal terga in most specimens (see comments) orange-brown, terga turning darker on poster section, sterna generally orange-brown, coppery-golden hue all over metasoma (Fig 35–38).

Sculpturing. As described for *E. aurantia* (*vide supra*).

Vestiture. General vestiture as described for *E. aurantia*.

Terminalia. Hidden sterna and capsule as described for *E. apiformis*, lateral section of gonostylus variable, ranging from flat dorsal sector to large projections (Figs 33, 34).

♀: *Structure*. Total body length 11.30 mm (10.96–11.56; n=5); labiomaxillary complex in repose reaching approximately posterior margin of third metasomal sternum (Fig. 40). Head length 2.90 mm (2.78–3.04; n=5); head width 4.86 mm (4.74–4.96; n=5); upper interorbital distance 2.53 mm (2.44–2.63; n=5); lower interorbital distance 2.30 mm (2.26–2.37; n=5); upper clypeal width 1.20 mm (1.15–1.26; n=5); lower clypeal width 2.19 mm (2.15–2.26; n=5); clypeal protuberance 0.61 mm (0.52–0.67; n=5); medial and paramedial clypeal ridge well developed; labrum rectangular, wider than long, length 1.15 mm (1.07–1.19; n=5), width 1.24 mm (1.19–1.30; n=5); labral ridges and windows as in male; anterior edge of labrum arched outwards; interocellar distance 0.32 mm (0.30–0.33; n=5); ocellocular distance 0.78 mm (0.74–0.81; n=5); length of first flagellar article [0.50 mm (0.48–0.52; n=5)] equal to combined lengths of second and third flagellar articles [0.50 mm (0.47–0.52; n=5)]; length of

malar area 0.17 mm (0.15–0.19; n=5). Mandible tridentate. Pronotal lateral angle as in male; intertegular distance 3.65 mm (3.56–3.78; n=5); mesoscutal length 2.95 mm (2.89–3.00; n=5); mesoscutellar length 1.40 mm (1.33–1.48; n=5); posterior border of mesoscutellum as in male (Fig. 39); mesotibial length 2.36 mm (2.30–2.44; n=5); mesobasitarsal length 2.27 mm (2.22–2.30; n=5), maximum width 0.75 mm (0.70–0.81; n=5); metatibia triangular; metatibial anterior margin length 3.27 mm (3.04–3.44; n=5); metatibial ventral margin length 1.93 mm (1.74–2.00; n=5); metatibial postero-dorsal margin length 3.64 mm (3.26–3.78; n=5). Forewing length 9.23 mm (8.74–9.70; n=5); hind wing with 21–22 hamuli. Maximum metasomal width 5.13 mm (4.96–5.26; n=5).

Coloration. In general as described for male but with a stronger coppery-cyan hue on face and metasoma. Paraocular marks absent; ivory coloration on mandible restricted to proximal one-third, antennal scape with yellow spot occupying most of antero-lateral surface although noticeably narrower than in male (Fig. 42).

Sculpturing. As described for male except mesepisternum with punctures not as dense (separated by about one puncture diameter).

Vestiture. As described for male (see comments); mesoscutellar tuft rhomboid, composed of dense, fulvous and/or brown (see comments), erect, thick, multibranched (branches minute) setae (Fig. 39). Mesotibia with a streak of spur-like, dark brown setae on posterior and ventral edges; metatibial corbicula surrounded by long, dark brown setae. Mesial sections of all sterna nearly bare.

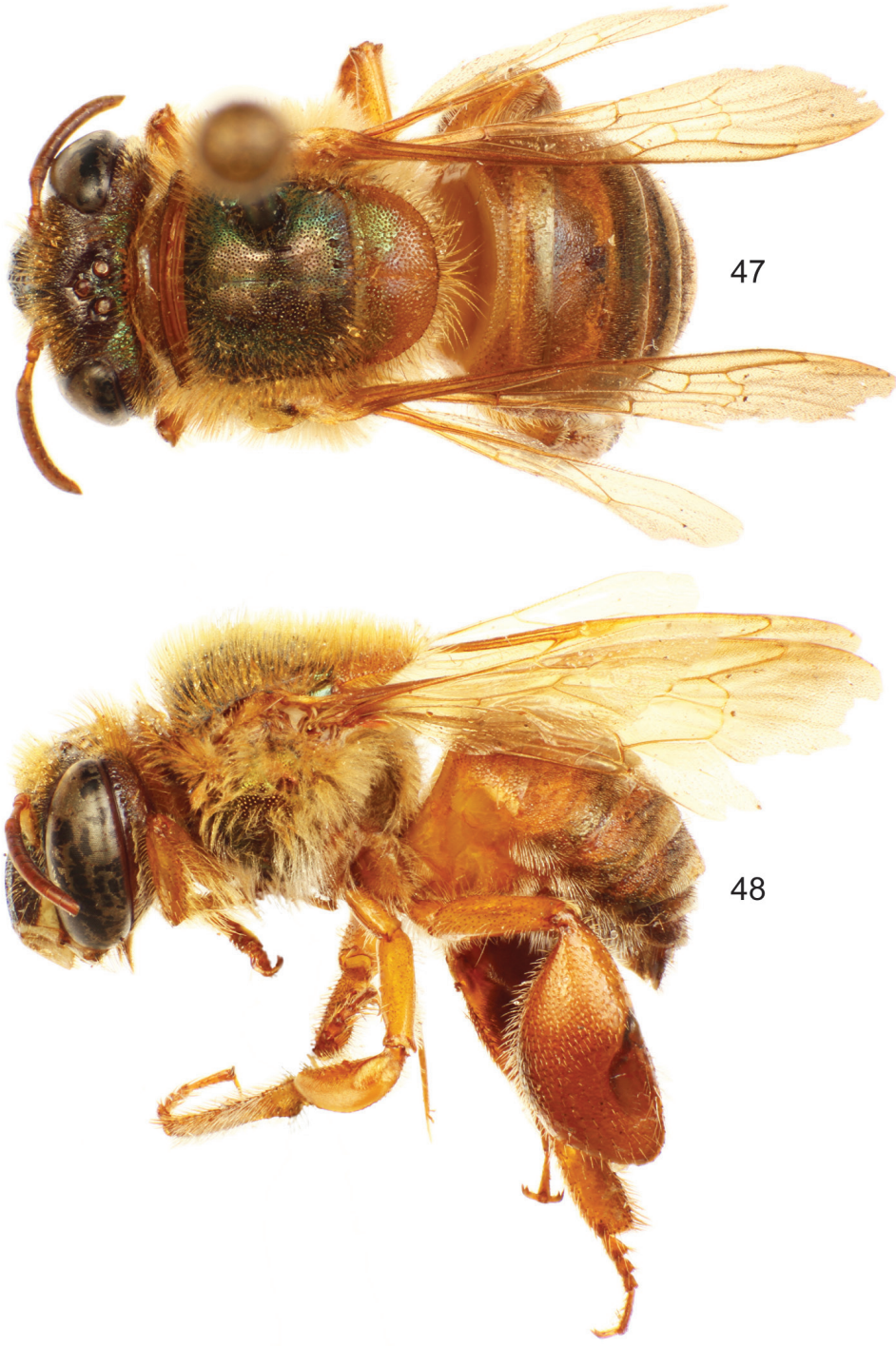
Comments. Smith (1874) described *E. decorata* from a female labeled as from "S^{t}. Paulo", and referred to its habitat as "St. Paulo (Brazil)". Moure (1967) referred to the type locality as São Paulo de Olivença in the state of Amazonas, Brazil, which was repeated in Moure et al. (2007) [it is well known that old uses of S. Paulo refer to a locality in the Amazon and not today's State or Municipality in southern Brazil: e.g., Papavero (1971)]. The majority of the specimens here examined are from the Amazon Basin, which agrees with the locality interpretation of the latter authors. Several of the distinctive features of the species are male features (as with most *Euglossa s. lat*.); however, the females are recognized also for the prevalence of green iridescence on the clypeus and the evenly convex mesoscutellar posterior margin. The original description of *E. decorata* var. *ruficauda* by Cockerell (1918) assumed the female holotype of that variety to be conspecific with *E. decorata* most likely based on coloration, which is in fact very similar in both specimens; however, as discussed later, *E. decorata ruficauda* is here synonymized with *E. singularis*. *Euglossa meliponoides* was synonymized with *E. singularis* both by Cockerell (1918) and by Moure (1967), most likely based on the dark coloration of the specimens used in the description of these two species; however, the male of *E. meliponoides* here examined and belonging to the type series exhibits the morphological features of *E. decorata*, notably the mesotibial posterior tuft of the male. Interestingly, Ducke (1902),when providing the original description of *E. meliponoides*, noted that his species wasvery likely just a dark variety of *E. decorata*, but proposed the name in the absence of intermediate specimens in terms of coloration. The surviving holotype is a female and provides no useful characters for identification

beyond color. However, we examined the paratype male from the same collecting event which clearly demonstrates the taxon to be a synonym. Given that the male exhibits more useful characters it might be worth petitioning the ICZN to have Ducke's holotype set aside in favor of his male paratype, thereby even more strongly clarifying the status of the epithet *meliponoides*. Hinojosa-Díaz and Engel (2007) described *E. urarina* as a new species in the *decorata* group addressing particularities in the male genitalia, more specifically the lateral section of the male gonostylus having a prominent dorsal projection; otherwise the specimens used by those authors had external features just like any other male of *E. decorata*. As more specimens have been available for dissection of the genital capsule, it has come clear that the morphology of the lateral section of the gonostylus is highly variable in *E. decorata*, ranging from simple non-projected (besides the ventral lobe), to abruptly projected as seen in the specimens described as *E. urarina* (the same variation has been observed for *E. apiformis*). There is no pattern of covariation with other external characters in the male that indicates at the moment a possible species-specific morphology of the gonostylus. The same can be said in terms of coloration. There is a broad range of color variation across the specimens examined for *E. decorata*, most of them bearing the distinctive pattern of the holotype, with a rather golden-yellow to orange metasoma; however, all possible intermediates can be found between this and the very dark specimens from Loreto, Peru (Figs 37–38); specimens on the west range of the species seem to be darker, although not as dark as the Peruvian ones. It must be noted that wherever dark specimens occur there are also some light ones in the same habitat, and there is no major morphological difference among these. The extent of the lighter brown (turning yellowish) coloration on the mesoscutellum is also quite variable, some specimens having the whole mesoscutellum uniformly light brown or yellow (like the holotype), others having this coloration restricted to the marginal posterior edge. The vestiture color also exhibits a range of variation, correlated with the integumental coloration. The length of the labiomaxilalry complex in *E. decorata* reaches the tip of the metasoma, although some females, most notably the specimen here examined from Minas Gerais, Brazil have a noticeably shorten labiomaxillary complex. Given that we could find no further distinguishing evidence, it is assumed here that these females belong to *E. decorata* although we note that further review of new evidence could reveal largely cryptic species requiring recognition.

***Euglossa* (*Euglossella*) *singularis* Mocsáry**
http://species-id.net/wiki/Euglossa_(Euglossella)_singularis
Figs 47–56

Euglossa singularis Mocsáry *in* Friese, 1899: 169. Holotype ♀ (HNHM, *visum*).
Euglossa decorata ruficauda Cockerell, 1918: 688. Holotype ♀ (AMNH, *visum*), syn. n.

Material examined. Brazil: "SERRA do NAVIO; Terr. Amapá BRASIL; K. Lenko leg. // COLECÃO; CAMPOS SEABRA" (1♂) FLMNH.

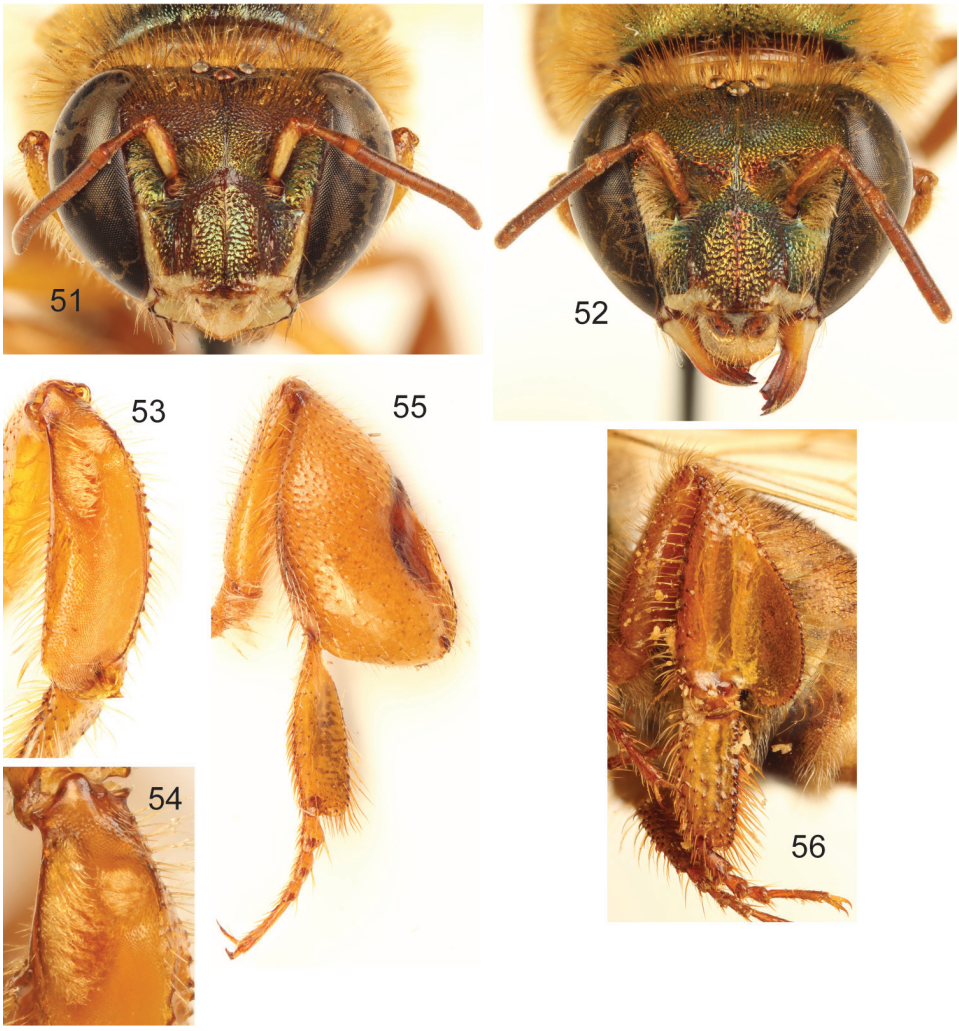


Figures 47–48. *Euglossa* (*Euglossella*) *singularis* Mocsáry, male. **47** Dorsal habitus **48** Lateral habitus.

Figures 49–50. *Euglossa* (*Euglossella*) *singularis* Mocsáry, female holotype **49** Dorsal habitus **50** Lateral habitus.

French Guiana: "FRENCH GUIANA; Saül, Mt. Galbao Summit, 740 m; 3°37'18"N, 53°16'42"W; 6 JUN 1997; J.Ashe, R.Brooks; FG1AB97 152 // Euglossa; *decorata* F. Smith 1874 ♀ [sex handwritten]; det. R.W. Brooks 1998 // [bar code]; SM0103108; KUNHM-ENT" (1♀) SEMC; "FRENCH GUIANA; 19 km. SW. Kourou; 16 July 1977. C.D.; Michener, T.Kukuk" (1♀) SEMC; "FRENCH GUIANA; Kourou, Km. 17 SW. [number handwritten]; 20Feb77; D. Roubik.No.91" (1♀) FLMNH; "FRENCH GUIANA; Kourou, Km. 16 SW. [number handwritten]; 13 April 1977 [date handwritten]; D. Roubik. No.127 // *Euglossa*; *decorata* Smith; det. R.L. Dressler 1978 [last two digits handwritten]" (1♀) SEMC.

Guyana: "Kalacoon; Bartica District; British Guiana // TYPE [red label] // Am. Mus. Nat. Hist.; Dept. Invert. Zool.; No.24484 [number handwritten] // Trop. Research Station; New York Zool. Society; No.; ac: 531b [last line handwritten on underside] // Euglossa; decorata n [?]; ruficauda; Ckll. TYPE. [label handwritten]"



Figures 51–56. *Euglossa* (*Euglossella*) *singularis* Mocsáry **51** Facial aspect of male **52** Facial aspect of female **53** Outer surface of male mesotibia **54** Mesotibial tufts **55** Outer view of male metatibia and metatarsus **56** Outer view of female metatibia and metatarsus.

(1♀) AMNH; "BRITISH GUIANA:; Kartabo, Bartica; Dist. 1920 [last two digits handwritten] // Trop. Research Station; New York Zool. Society; No.201122 [number handwritten] // Gift of New York; Zoo.Soc.,Dept.; Tropical Research; William Beebe. Dir // Euglossa; decorata ♀; var. ruficauda; Cockerell; Det. Schwarz // Comment on; intermixed; dark hairs on; thorax and; vertex; darker; scutellar cushion,; etc. [last two labels handwritten]" (1♀) AMNH; Kartabo; Bartica District; British Guiana; 17-III-1922 [month and day handwritten] // Gift of New York; Zoo.Soc.,Dept.; Tropical Research; William Beebe. Dir // // Euglossa; decorata ♀; var. ruficauda; Cockerell;

Det. H.F. Schwarz [label handwritten] " (1♀) AMNH; "Dawa, Tapakuma; Pomeroon, Guyana; C.Dodson 3-27-1970 [day handwritten]; Vanillin // Euglossa; decorataSmith; det. R.L. Dressler 1968 [last digit handwritten]" (1♂) FLMNH; same collecting data, no identification label (1♂) FLMNH; same collection data except date missing the day (3♂♂); "Kamakusa; Brit.Guiana; H.Lang // Euglossa; singularis; Mocs.; Det. J.S.Moure 1957 [first three lines and last two digits of year handwritten]" (1♀) NHML.

Surinam: "Amer. mer.; Surinam // Euglossa TYPE [second word handwritten]; singularis Mocs.; det. R.L.Dressler, 1975 // [big red label with no writing]" (1♀) HNHM; "[small pink label with no writing] // Surinam [handwritten] // Euglossa; singularis; ♂ Mocs.; 1910 Friese det. [first three lines handwritten, third and fourth lines overlapped] // Am. Mus. Nat. Hist.; Dept. Invert. Zool.; No.26004 [number handwritten] // Head fell off; and was reattached; by I. Hinojosa-Díaz 2006 [all handwritten except for name and first three digits of year]" (1♂) AMNH.

Venezuela: "VENEZUELA: BO. [state acronym handwritten]; Icabaru [handwritten]; 25 II 1967 [handwritten except first three digits of year] // Euglossa;singularisMocs.; det. R.L. Dressler 1968 [last digit handwritten]" (1♂) FLMNH.

Diagnosis. Labiomaxillary complex in repose barely reaching sixth metasomal sternum in the male, and posterior margin of third metasomal sternum in the female (Figs 48, 50); both sexes with posterior margin of mesoscutellum evenly convex (Figs 47, 49); integument of head and mesosoma of both sexes brown to dark brown, with coppery-green hue, greener on mesoscutum (Figs 47–52); malar area length on average 0.15 the basal mandibular width; male mesotibia with posterior and anterior tufts separated by a distinguishable gap, posterior tuft characteristically circular (Fig. 54); male metatibia scalene right triangular (forming a right or slightly obtuse angle at intersection of anterior and ventral margins) (Fig. 55); first metasomal tergum orange, second tergum orange anteriorly, brown on posterior third, remaining terga brown to dark brown, similar pattern on sterna (some specimens, especially females with all metasoma dark brown), entire metasoma with faint coppery hue; legs yellow to dark brown (Figs 48, 50, 53–56); lateral section of gonostylus with dorsal sector straight, not projected, ventral lobe apically acute.

Description. ♂: *Structure*. Total body length 10.81 mm (10.59–10.96; n=5); labiomaxillary complex in repose reaching anterior margin of sixth metasomal sternum (Fig. 48). Head length 2.73 mm (2.67–2.89; n=5), width 4.38 mm (4.22–4.48; n=5); upper interorbital distance 2.21 mm (2.19–2.22; n=5); lower interorbital distance 1.87 mm (1.81–1.93; n=5); upper clypeal width 1.01 mm (0.96–1.11; n=5) ; lower clypeal width 1.84 mm (1.78–1.89; n=5); clypeal protuberance 0.58 mm (0.44–0.67; n=5); clypeal ridges, labral ridges and labral windows as described for *E. aurantia*; labrum about as wide as long, length 0.98 mm (0.96–1.04; n=5), width 1.00 mm (0.93–1.04; n=5); interocellar distance 0.3 mm (n=5); ocellocular distance 0.70 mm (0.67–0.74; n=5); first flagellomere as long [0.45 mm (0.44–0.48; n=5)] as second and third flagellomeres combined [0.45 mm (0.44–0.48; n=5)]; length of malar area 0.10 mm (0.09–0.11; n=5). Mandible tridentate. Pronotal lateral angle as described for *E. aurantia*; intertegular distance 3.32 mm (3.19–3.41; n=5); mesoscutal length 2.62 mm (2.52–2.67; n=5);

mesoscutellar length 1.27 mm (1.19–1.33; n=5); posterior margin of mesoscutellum evenly convex (Fig. 47); mesotibial length 2.13 mm (2.00–2.30; n=5); mesobasitarsal length 2.13 mm (2.20–2.30; n=5), width 0.62 mm (0.56–0.67; n=5); posterior keel as described for *E. aurantia*; metatibial shape scalene right triangular (forming a right or slightly obtuse angle at intersection of anterior and ventral margins) (Fig. 55), metatibial anterior margin length 3.19 mm (2.93–3.41; n=5), ventral margin length 1.97 mm (1.56–2.22; n=5), postero-dorsal margin length 3.90 mm (3.78–4.15; n=5), maximum metatibial thickness 1.19 mm (1.04–1.33; n=5); metatibial organ slit as described for *E. aurantia* (Fig. 55); basal section of metatibial organ slit length 0.55 mm (0.48–0.67; n=5); metabasitarsal length 2.48 mm (2.37–2.59; n=5), mid-width 0.85 mm (0.44–0.59; n=5); metabasitarsal ventral border truncate. Forewing length 8.74 mm (8.07–9.26; n=5); jugal comb with 12–15 (n=5) blades; hind wing with 18–21 (n=5) hamuli. Maximum metasomal width 4.28 mm (4.07–4.44; n=5); second metasomal sternum integumental modifications as described for *E. aurantia*.

Coloration. Head integument and ivory areas as described for *E. decorata*, except coppery iridescence dominant on clypeus (Fig. 51). Mesosoma as described for *E. decorata* (Figs 47–48); legs yellow to dark brown, with a similar pattern as in *E. aurantia* (Figs 48, 53–55); tegulae and wings as described for *E. aurantia* (Figs 47–48). First metasomal tergum orange, second tergum orange anteriorly, brown on posterior third, remaining terga brown to dark brown, similar pattern on sterna (some specimens, specially females with all metasoma dark brown), all metasoma with faint coppery hue (Figs 47–48).

Sculpturing. As described for *E. aurantia*.

Vestiture. General vestiture as described for *E. aurantia*.

Terminalia. Hidden sterna and capsule as described for *E. apiformis*, lateral section of gonostylus with a straight or slightly convex dorsal sector (Fig. 33).

♀: *Structure*. Total body length 10.92 mm (10.00–11.63; n=5); labiomaxillary complex in repose reaching posterior margin of third metasomal sternum (Fig. 50). Head length 2.78 mm (2.67–2.85; n=5); head width 4.53 mm (4.41–4.59; n=5); upper interorbital distance 2.37 mm (2.26–2.44; n=5); lower interorbital distance 2.06 mm (2.00–2.11; n=5); upper clypeal width 1.11 mm (1.11–1.13; n=5); lower clypeal width 1.99 mm (1.93–2.00; n=5); clypeal protuberance 0.59 mm (0.52–0.67; n=5); medial and paramedial clypeal ridges well developed; labrum about as wide as long, length 1.02 mm (0.96–1.05; n=5), width 1.08 mm (1.04–1.11; n=5); labral ridges and windows as in male; anterior edge of labrum arched outwards; interocellar distance 0.30 mm (0.30–0.31; n=5); ocellocular distance 0.74 mm (n=5); length of first flagellar article [0.43 mm (0.41–0.44; n=5)] almost equal to combined lengths of second and third flagellar articles [0.45 mm (0.44–0.48; n=5)]; length of malar area 0.11 mm (0.08–0.15; n=5). Mandible tridentate. Pronotal lateral angle as in male; intertegular distance 3.33 mm (3.26–3.41; n=5); mesoscutal length 2.63 mm (2.44–2.78; n=5); mesoscutellar length 1.26 mm (1.19–1.33; n=5); posterior border of mesoscutellum as in male (Fig. 49); mesotibial length 2.19 mm (2.07–2.30; n=5); mesobasitarsal length 2.02 mm (1.93–2.15; n=5), maximum width 0.63 mm (0.52–0.70; n=5); metatibia triangular; metatibial anterior margin length 3.01 mm (2.96–3.19; n=5); metatibial

ventral margin length 1.74 mm (1.56–1.93; n=5); metatibial postero-dorsal margin length 3.39 mm (3.33–3.48; n=5). Forewing length 8.34 mm (8.00–8.59; n=5); hind wing with 20–21 hamuli. Maximum metasomal width 4.67 mm (4.59–4.74; n=5).

Coloration. In general as described for male. Paraocular marks absent; ivory coloration on mandible restricted to proximal one-third, antennal scape with yellow spot occupying most of antero-lateral surface although noticeably narrower than in male (Fig. 52).

Sculpturing. As described for male except mesepisternum with punctures not as dense (separated by about one puncture diameter).

Vestiture. As described for male (see comments); mesoscutellar tuft rhomboid, composed of dense, fulvous and/or brown (see comments), erect, thick, multibranched (branches minute) setae (Fig. 49). Other features as described for female of *E. aurantia*.

Comments. Within the variety of specimens examined in the present study, most of those that exhibited a darker coloration deviating from the orangish color of the *E. decorata* type bore identification labels from several experts referring to them as *E. singularis*. As was noted above for *E. decorata* in which there is a range of color variation, including numerous intermediates, blending to very dark specimens, the same can be recognized for *E. singularis*. Despite the fewer number of specimens of *E. singularis* (as here recognized) available for this study, a similar (although not as extreme) variation of integumental coloration can be appreciated. The female holotype is the darkest of the specimens examined for this species, and the holotype of *E. decorata ruficauda* is the lightest. All specimens examined, both male and female, are on average smaller than any other species in the *decorata* group and the males are easily recognizable by the shape of the mesotibial posterior tuft. The rather copperyclypeus added to the previous features, and the restriction of these specimens to the Guiana Shield region, makes *E. singularis* a distinctive species, for which characterization should not rely solely on integumental color.

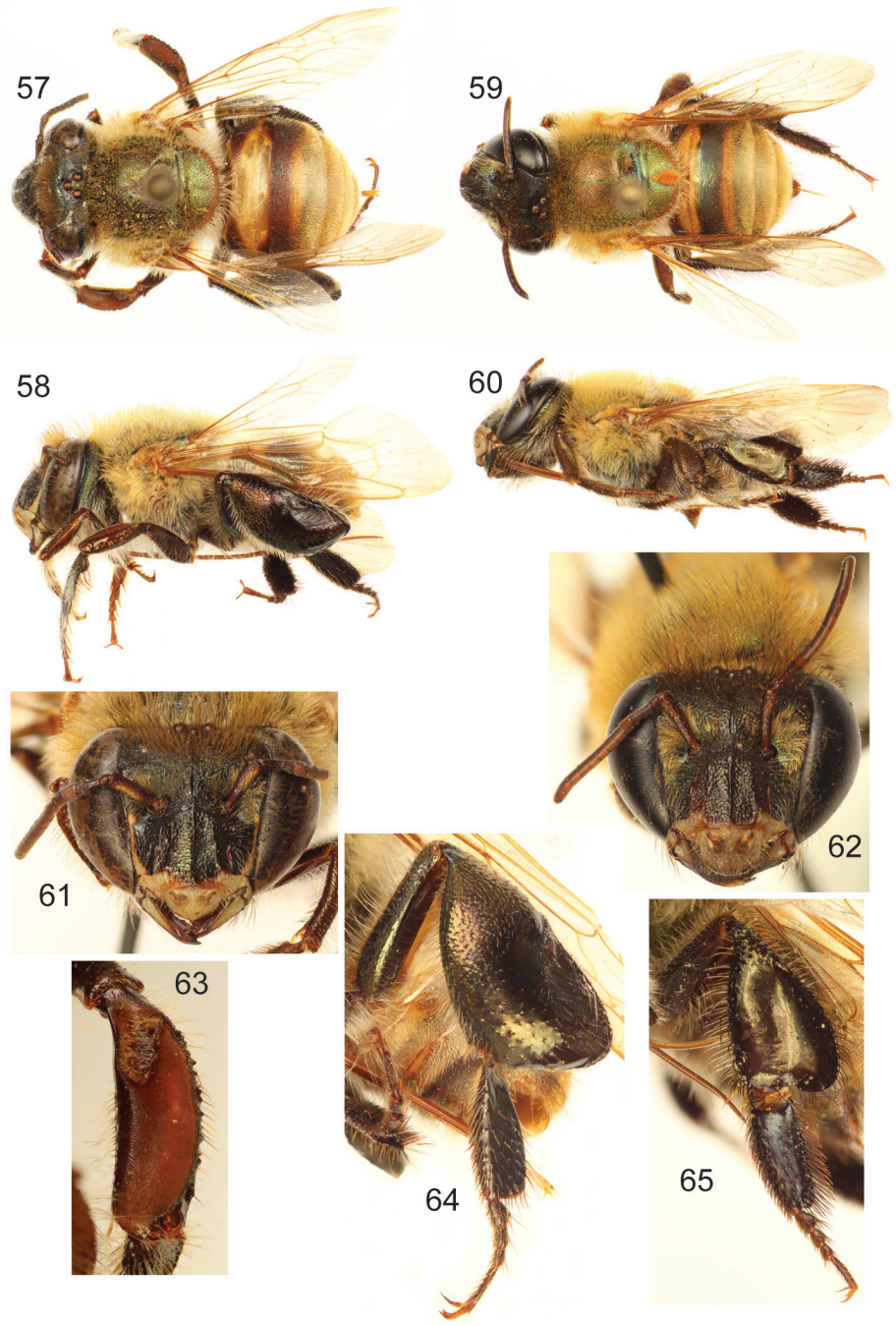
Euglossa (*Euglossella*) *cosmodora* Hinojosa-Díaz & Engel

http://species-id.net/wiki/Euglossa_(Euglossella)_cosmodora
Figs 57–65

Euglossa (*Euglossella*) *cosmodora* Hinojosa-Díaz and Engel, 2007: 93. Holotype ♂ (SEMC, *visum*).

Material examined. Bolivia: "Bolivia; Tarata; 1900 // Euglossa; decorata; ♂ Sm.; 1909 Friese det. [first three lines handwritten, third and fourth lines overlapped] // Am. Mus. Nat. Hist.; Dept. Invert. Zool.; No.26005 [number handwritten]" (1♀) AMNH.

Peru: "PERU: Junín Dept.; Villa-Oxapampa Rd.; 1200 m 10°45'36"S,75°21'30"W; 18 OCT 1999; R. Brooks; PERU 1B99 056; ex: on red flowering 'Zauschneria like' // [bar code; SMO 148056; KUNHM-ENT // Euglossa; singularis ♂; Mocsáry; det. R.W. Brooks 19 [first three lines handwritten] // HOLOTYPE; Euglossa; cosmodora; I.A. Hinojosa-Díaz; & M.S. Engel [red type label]" (1♂) SEMC; same labels and



Figures 57–65. *Euglossa* (*Euglossella*) *cosmodora* Hinojosa-Díaz and Engel. **57** Dorsal habitus of male holotype **58** Lateral habitus of male holotype **59** Dorsal habitus of female paratype **60** Lateral habitus of female paratype **61** Facial aspect of male holotype **62** Facial aspect of female paratype **63** Outer surface of male mesotibia **64** Outer view of male metatibia and metatarsus **65** Outer view of female metatibia and metatarsus.

data, except code on barcode label "SMO 148057", sex on identification label "♀" and "PARATYPE" on yellow type label (1♀) SEMC; "Valle Chanchamayo; (Peru) 800 m; 5.2.1939 [day and month handwritten]; leg. Weyrauch; W.K.W.; 3356 [last two lines handwritten on underside] // decorata [handwritten on underside] // PARATYPE; Euglossa; cosmodora; I.A. Hinojosa-Díaz; & M.S. Engel [yellow type label]" (1♀) DZUP; "166 [handwritten] // PERU, JU,; San Ramon; 1985; G. Arellano [label handwritten] // Euglossa; n.sp?!; det. D. Roubik 2003 [first two lines handwritten]" (1♀) CRAS.

Diagnosis. Labiomaxillary complex in repose slightly (but clearly) surpassing metasoma (both sexes) (Figs 58, 60); both sexes with head integument very dark (appearing black), with faint coppery hue on clypeus (mixed with some green-cyan higlights) (Fig. 61); integument of mesosoma with dark brown base and strong metallic olive-green, and coppery hue (especially on episternum); metasoma golden olive-green, with a noticeably dark brown band on anterior half of second metasomal tergum bordered anteriorly and posteriorly by yellow streaks (Figs 57, 59); malar area length on average 0.30 the basal mandibular width; male mesotibial tufts appearing fused (except for a distal separation),posterior tuft teardrop shaped (Fig. 63); male metatibia scalene slightly obtuse triangular (forming a slightly obtuse angle at intersection of anterior and ventral margins) (Fig. 64).

Comments. Given that a detailed description of both sexes was provided only recently by Hinojosa-Díaz and Engel (2007) and that we have no further modifications to that as presented in our earlier account, this material is not repeated here.

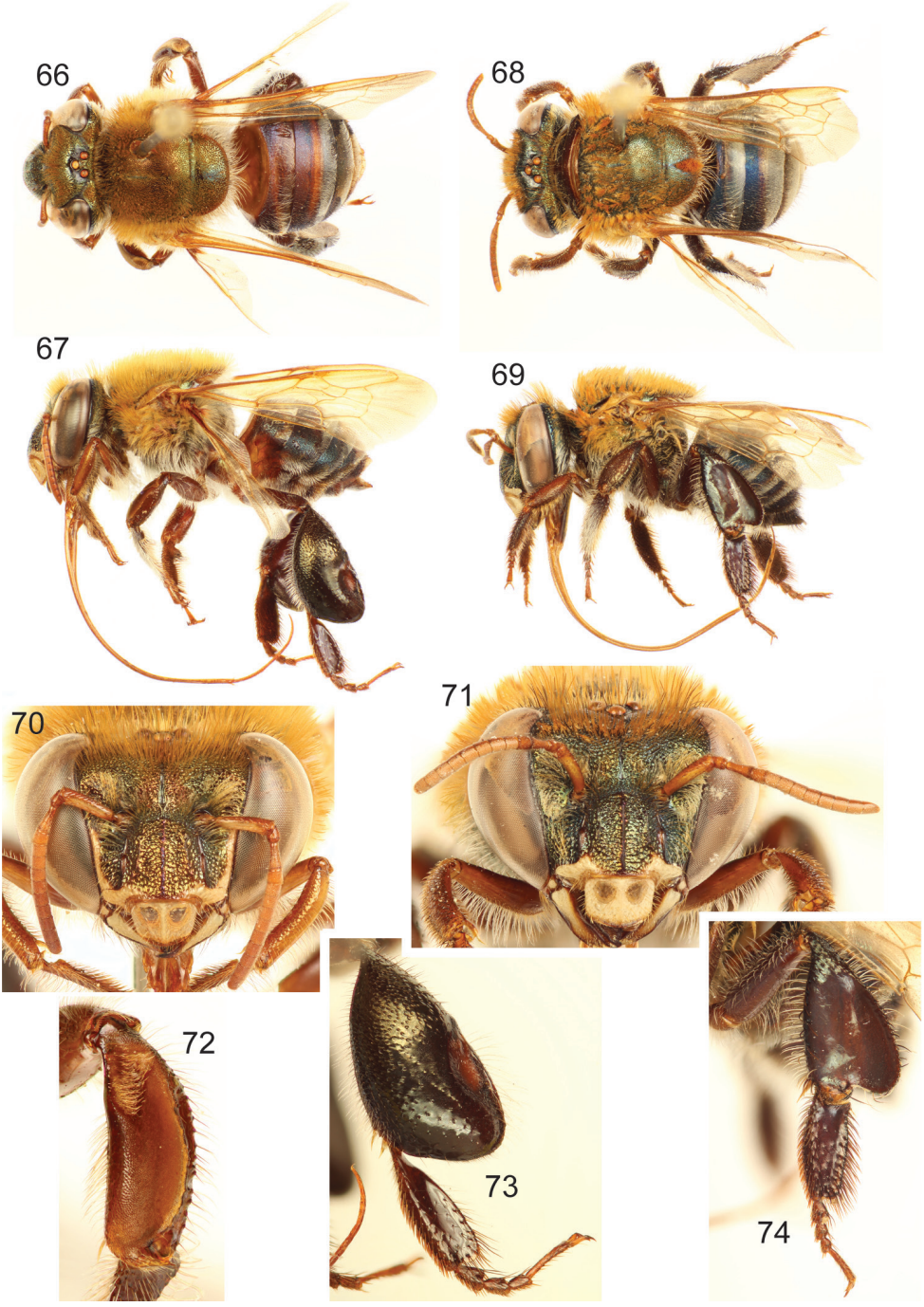
This species is quite distinctive, not only due to the banding pattern on the metasoma but also as it is the species withthe longest malar space of all taxa in the *decorata* species group. The specimen included herein from Bolivia extends the range of the species to the South, and is slightly lighter in coloration, although the exact locality data for this specimen is not clear (Tarata, Bolivia), the elevation of the two possible places with that locality name is clearly the highest (above 2000 m) for any specimen of this species group.

Euglossa (*Euglossella*) *perpulchra* Moure & Schlindwein

http://species-id.net/wiki/Euglossa_(Euglossella)_perpulchra
Figs 66–74

Euglossa (*Euglossella*) *perpulchra* Moure and Schlindwein, 2002:586. Holotype ♂ (DZUP, *visum*).

Material examined. Brazil: "IGARASSU PE; Ref. Ecol. C. Darwin; Brasil, 21.9.2001; Schlindwein & Martini // 7753 UFPE [underside] // L121 β-Ionone; 9-9:30 // HOLOTYPUS ♂; Euglossa; perpulchra; Pe J. S. Moure 2001 [red label; sex, second and third line, and year handwritten]" (1♂) DZUP; "IGARASSU PE; R. E. Charles Darwin; Brasil, 20.03.2001; P. Martini leg. // L121; (1) β Ionone; 08:00-08:30 // 5415 UFPE // Euglossa (Euglossella); perpulchra Moure &; Schlindwein 2002 ♂" (1♂) SEMC; same data and labels except date "19.11.2000" and number on third label "3914 UFPE"



Figures 66–74. *Euglossa* (*Euglossella*) *perpulchra* Moure and Schlindwein. **66** Dorsal habitus of male paratype **67** Lateral habitus of male paratype **68** Dorsal habitus of female **69** Lateral habitus of female.**70** Facial aspect of male paratype **71** Facial aspect of female. **72** Outer surface of male mesotibia **73** Outer view of male metatibia and metatarsus **74** Outer view of female metatibia and metatarsus.

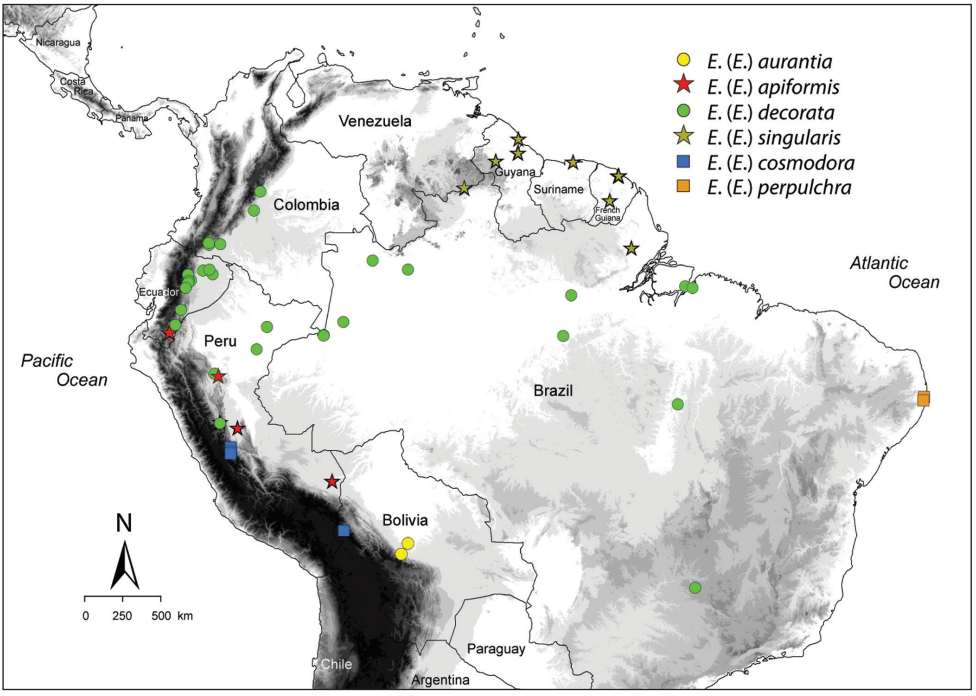


Figure 75. Collection localities for material examined of the six species of *Euglossella* considered herein.

(1♂) NHML; "IGARASSU PE; Ref. Ecol. C. Darwin; Brasil, 21.9.2001; Schlindwein & Martini // L121 β-Ionone; 10-10:30 // 7161 UFPE // PARATYPUS; Euglossa ♂; perpulchra; Pe J. S. Moure 2001 [second and third line, and year handwritten]" (1♂) DZUP; "CAMARAGIBE PE; Aldeia; Brasil, 29.5.2002; C. Schlindwein leg. // 8319 UFPE // L120 P541; 7:50; Tecoma stans" (1♀) DZUP; same data except time "7:30" (1♀) DZUP.

Diagnosis. Both sexes with labiomaxillary complex in repose nearly reaching metasomal posterior tip (estimation) (Figs 67, 69); integument of head very dark (appearing black) with strong coppery iridescence on clypeus, and green iridescence on frons (Figs 70–71); mesosoma dark brown (appearing black in most parts) with strong coppery iridescence intermixed with some cyan iridescence (Figs 66–69); metasoma dark brown (appearing black in some parts), all terga (except last) with posterior half noticeably translucent, forming a band pattern, all metasoma with cyan-coppery hue (Figs 66–69); malar area length on average 0.25 the basal mandibular width; male mesotibial tufts appearing fused (except for a distal separation), posterior tuft teardrop shaped (Fig. 72); male metatibia scalene slightly obtuse triangular (Fig. 73).

Comments. Given that a detailed description for the species has been published relatively recently (Moure and Schlindwein 2002), we have not repeated that material herein. The only additions needed are that the male terminalia, unfortunately not examined or discussed by Moure and Schlindwein (2002),are as described for *E. apiformis* in terms of the hidden sterna, while the genital capsule, and particularly the gonostylus,

is as described for *E. aurantia*. The female was also not known at the time of the original description (Moure and Schlindwein 2002). We were able to examine two female specimens in the course of this study. The female exhibits basically the same features as the male (*i.e.*, coloration, punctation, and vestiture), besides having antennae light-brown with a small yellowish spot on the upper anterior surface of the scape, and the regular features observed in other females of the species group (Figs 68–69, 71, 74).

Discussion

Prior to the the description of *E. perpulchra* and *E. cosmodora* (Moure and Schlindwein 2002; Hinojosa-Díaz and Engel 2007), this group of bees had been regarded as consisting of merely two species, vaguely separated by integumental coloration. Specimens with a generalized light color were assigned to *E. decorata*, while any specimen showing some darkening of the integument, mostly on the metasoma, was assigned to *E. singularis*. Two other dark colored forms – *E. apiformis* and *E. meliponoides* (Schrottky 1911; Ducke 1902) – were considered synonyms of *E. singularis*. Herein we reinterpret the group to include at least six distinctive species based on a combination of external characters that is concordant with distributional ranges. The scarcity of specimens for the group makes it likely that as more of them become available and additional characters are added, more species will be recognized. It is interesting to note the ranges of color and gonostylar variation within individual populations of some species, variations not correlated with each other nor with any other structural features. The maintenance of such variation might serve some function but it is entirely obscure at present. Population genetic studies on *E. decorata* and *E. singularis* would be fascinating, although the relative rarity of these bees is at present a hindrance to such work. It is possible that *E. decorata* is a broad-ranging species with considerable variation (as we have herein conceived) and that it has given rise to peripheral isolates which eventually formed the other species in the group [e.g., perhaps via modes similar to ones suggested by Mayr (1954, 1959) or Brown (1957)]. For the time being, we hope that this brief contribution will highlight what we believe to be congruent patterns among evolutionary species of the *decorata* group, and spur continued collection and field investigation into this highly unique lineage of *Euglossella*, and *Euglossa* as a whole.

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Triteleia peyerimhoffi comb. n., a remarkably variable circum-Mediterranean scelionid (Hymenoptera, Platygastroidea)

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Abstract

Triteleia peyerimhoffi **comb. n**. (Kieffer, 1906) is redescribed taking into account its great variability and is considered the senior synonym of *Triteleia dubia* (Kieffer, 1908), *Calliscelio lugens* (Kieffer, 1910) and *Triteleia striolata* Kononova & Petrov, 2000, **syn. n.** Neotypes are designated for *T. dubia* and *T. peyerimhoffi*. *Triteleia peyerimhoffi* is a new record for Greece, France and Croatia and was reared for the first time from eggs of Orthoptera laid in the dead wood of *Quercus* sp. and *Tilia* sp. in Romania.

Keywords

Hymenoptera, Platygastroidea, microhymenoptera, egg parasitoids, *Caloteleia peyerimhoffi*, *Triteleia dubia*, variability

Introduction

Jean-Jacques Kieffer (b. 1857 – d. 1925) was an Abbé, a clergyman, and taught natural history and religion at the Collége Saint-Austin at Bitche in Lorraine (Nominé 1926). His taxonomic work was published in a large number of scientific papers and in some

comprehensive monographs, e.g. *Das Tierreich* and André's *Hyménoptères d'Europe et d'Algérie*. During his life, he described 49 genera and 465 species belonging to the Platygastroidea (Johnson 1992). Kieffer had a private collection, the remnants of which are at the Muséum national d'Histoire naturelle in Paris (Notton 2004). He also published on much material belonging to other collectors and museums, and this was returned to them, so Kieffer's types are scattered in collections around the world and many types have yet to be found. Hence, many species described by Kieffer have an uncertain status today.

Triteleia peyerimhoffi was described by Kieffer (1906) under the name *Caloteleia peyerimhoffi* (Kieffer interpreted *Calotelea* following Ashmead rather than Walker). The type material, all female, was obtained from eggs of *Ephippiger confusus* (now *Uromenus brevicollis* (Fischer) according to Sahnoun et al. (2010) from Algeria by Dr. Paul Peyerimhoff. Peyerimhoff (1908) published a paper about the biology of *Ephippiger confusus* and mentioned *Caloteleia peyerimhoffi,* including some notes about its oviposition behaviour.

In 1908, Kieffer, described *Ceratoteleia,* including species with a characteristic long metasoma with a horn on the first metasomal tergite, and with the length of the marginal vein varying from punctiform to the same length as the stigmal vein. Two years later (Kieffer 1910a), transferred *Caloteleia peyerimhoffi* to *Ceratoteleia*. In this genus Kieffer (1910b) described two more new species similar to *C. peyerimhoffi*: *Ceratoteleia lugens* from France and *Ceratoteleia mediterranea* from Italy. *Ceratoteleia* Kieffer is in fact the same as *Caloteleia* sensu Ashmead (Ashmead's unjustified emendation of *Calotelea* Westwood).

Kieffer obviously did not study Ashmead's type of *Caloteleia grenadensis* (in BMNH) and therefore his concept of *Ceratoteleia* is very heterogeneous, containing species of several genera (e.g. *Triteleia*, *Calliscelio*, *Holoteleia*, *Probaryconus*, etc.). Masner (1976) synonymized *Ceratoteleia* under *Calliscelio* Ashmead.

Silvestri (1939) described the biology of *Uromenus* and gave some information about its parasitoids. He showed a picture of some parasitoids ovipositing into eggs of *Uromenus*, identified as *Ceratoleia* (a misspelling of *Ceratoteleia*). Petit et al. (2007) have some excellent pictures of *Uromenus brevicollis* and scelionids ovipositing into its eggs. They identified these as *Catoteleia peyerimhoffi* (a misspelling for *Caloteleia peyerimhoffi*).

Triteleia dubia was described by Kieffer (1908) in *Apegus*, subgenus *Parapegus* based on one male from Hungary. According to Kieffer, the subgenus *Parapegus* is distinct from the rest of *Apegus* because of the long marginal vein (almost equal with the stigmal in *Parapegus* and punctiform in other *Apegus*) and because of the sculpture of the head (foveolate in *Parapegus* and with striae in other *Apegus*). Kieffer (1908) divided all genera known to him without a dorso-ventrally flattened body and with the scutellum unarmed into two groups: firstly genera with three longitudinal grooves on the mesoscutum and secondly those with two or no longitudinal grooves on the mesoscutum. He included *Triteleia* and *Apegus* in the second group.

Two years later Kieffer (1910a) kept *Apegus* divided into two subgenera: *Apegus* and *Parapegus* on the basis of the same characters, but later he considered *Parapegus* as a distinct genus (Kieffer 1914, 1926).

Masner (1956) revised *Parapegus* and described a female allotype of *P. dubius* from one specimen from Moravia caught on 14 September 1936 by F. Gregor in grassland (specimen catalogue no. 3 109 – NMPC). Later Masner (1976) synonymized *Parapegus* with *Macroteleia* and transferred *Parapegus dubius* to *Triteleia*. This was correct because Masner recognised that the median longitudinal mesoscutal furrow in *Triteleia* is only a specific, not a generic character. *Parapegus dubius* was transferred to *Triteleia* because of the shape of T6 in the female, which is depressed dorsoventrally to form a flat triangle, and because T7 in the male is armed posterolaterally with two sharp spikes, or at least tiny points.

Kozlov (1978), probably without seeing Masner's (1976) paper, described the genus *Parapegus* again, adapting Masner's (1956) description and reusing drawings from the same paper. This was the only mention of this species in the Russian literature. Kozlov and Kononova (1985, 1990), Kononova and Petrov (2000) and Kononova and Kozlov (2008) do not mention *Parapegus dubius* or *Triteleia dubia*. Conversely Johnson (1992) mentioned *T. dubia* (Kieffer, 1908) as a valid Palaearctic species, Bin et al. (1995) recorded it from Italy, and Popovici (2005) recorded this species from Romania based on one female from the Bârnova forest (N.–E. Romania).

Our goal in this paper is to provide a modern description of this species, document its unusual variability and provide new data about its biology. The contributions of the authors are as follows: O.A. Popovici (character definition, species concept development, imaging, collection of new material, manuscript preparation); F. Bin (had the idea for the paper, provided most of the Italian material, and contributed to the section on biology); L. Masner (character definition, species concept development, provided new material from Italy, Hungary and France and elaborated the plan for this paper); M. Popovici (geometric morphometric analysis); David Notton (provided specimens from the BMNH and corrected the English of the paper). Any nomenclatural acts in this paper are to be attributed to O. A. Popovici and L. Masner.

Material and methods

Most of specimens seen were caught with a Malaise trap in various parts of Europe, especially the south and west including: France, Greece, Hungary, Italy and Romania. One specimen each from Croatia and Romania were swept. The remaining specimens were reared from the dead wood of *Tilia* species and *Quercus* species. Specimens were glued to triangular card points. For better examination, the maxillo-labial complex, one antenna, legs and wings of some specimens were removed and mounted on microscope slides. Specimens were examined using a Kruss MSZ54 stereomicroscope. Microscope slides were analyzed with a Euromex GE 3045 microscope, and drawings were made using a Reichart drawing tube.

Abbreviations and morphological terms used in text:

A1, A2, ... A12: antennomeres 1-12; **DPO**: diameter of posterior ocellus; **fmc**: foramen magnum capitis; **gen**: gena; **ha**: hypostomal area; **HE**: height of compound eye; **hf**: hypostomal folds; **Hfd**: height of frontal depression; **ihc**: inner hypostomal carina; **Lck**: length of central keel; **LE**: length of compound eye; **Lfw**: length of fore wing; **LH**: length of head (measured at level of anterior ocellus); **Lhw**: length of hind wing; **LOL**: lateral ocellar line, the shortest distance between inner margins of anterior and posterior ocellus; **Lscut**: length of scutellum; **Lt**: length of temple; **MLC**: maxillo-labial complex; **ocp**: occiput; **ocpc**: occipital carina; **ohc**: outer hypostomal carina; **OOL**: ocellar ocular line, the shortest distance from inner orbit of compound eye to the outer margin of lateral ocellus; **pg**: postgena; **pgb**: postgenal bridge; **POL**: posterior ocellar line, the shortest distance between inner margins of posterior ocelli; **sgp**: sub-genal process; **T1, T2, ... T6**: metasomal terga 1-6; **tb**: tentorial bridge; **Wfw**: maximum width of fore wing (measured perpendicular to fore wing margin); **WH**: maximum width of head; **Whw**: width of hind wing; **Wscut**: width of scutellum.

Morphometric analysis. In total 82 specimens of *Triteleia* were measured. 60 females: Croatia (1); France (18); Greece (7); Hungary (3); Italy (27); and Romania (4), and 22 males: Greece (3); and Italy (19). All measurements were made using a Kruss MSZ54 stereomicroscope at 90× magnification.

The following characters were measured: body length; LH; WH; POL; LOL; DPO; HE; LE; distance between compound eyes (measured at level of anterior ocellus); Lt; distance between toruli; Lck; Hfd; surface of frontal depression covered with transversal striae; distance between compound eye and frontal depression; length of cheek; length and width for all antennal segments (A1….A12); length of mesosoma; width of mesosoma; length of mesoscutum; Lscut; Wscut; length of metascutellum; width of metascutellum; distance between lateral propodeal carina; width of lateral propodeal area; Lfw; Wfw; length of marginal vein; length of stigmal vein; length of postmarginal vein; Lhw; Whw; length of marginal fringe of hind wing (at level of hamuli); length of metasoma; length of T1; minimum width of T1; maximum width of T1; length of T2; maximum width of T2; length of T3; maximum width of T3; length of T4; minimum width of T4; length of T5; minimum width of T5; length of T6; minimum width of T6.

For each ratio in the description of species we used minimum – maximum (mean ± standard deviation).

The relationships between specimens were analyzed using Principal Component Analysis (PCA). This was performed using log-transformed data on a variance–covariance matrix (Klingenberg 1996). The Jolliffe cut-off value was used to indicate the number of significant principal components and standard errors of these were also determined with a bootstrap procedure (Boot N = 1000). We used the Kolmogorov-Smirnov test to show the distribution of metric data within all populations (all

populations were normally distributed, $p>0.05$). The Levene test was used to test the homogeneity of the variance, a one-way ANOVA was conducted on the whole data set to test significant differences between variables and then a *post hoc* test defined pairwise differences in variables of populations (Sokal and Rohlf 1995). Depending on the result of the Levene test we used the Tukey or Games–Howell test.

The metasoma was analyzed using geometric morphometric methods based on the Kendall theory of shape (Kendall 1977). The shape is a configuration of Cartesian coordinates of landmarks which are discrete anatomical homologues (Zeldith et al. 2004). Generalized Procrustes Analysis (GPA) was performed to superimpose landmark configuration; it removes variation due to differences in translation, orientation, size and superimposes the objects in a common coordinate system. We generated thin-plate spline deformation grids to visualize metasomal shape differences. Size and shape components of this configuration were separately analyzed. The size of the metasoma was measured as a centroid size (CS). The CS is a geometric scale which is mathematically defined by the square root of the sum of squared distances between all landmarks and their centroid (Zelditch et al. 2004).We collected 21 homologous landmarks on the metasoma using tpsDig2 (Rohlf 2006). The overall metasomal size variation has been presented as a box plot, while differences between populations have been tested with a Pairwise Analysis of Variance (ANOVA) using post-hoc Tukey Least Square Distance test.

Relationships between metasoma shapes were investigated using Principal Component Analysis (PCA). PCA was performed on all shape variables in order to define the greatest axes of metasoma shape variation in the dataset. The visualization of the shape differences was made with thin-plate spline deformation grids. Overall differences between metasoma shapes have been tested by a Multivariate Analysis of Variance (MANOVA) and the permutation tests (1000 permutations) for Mahalanobis distances among populations were performed to confirm the significant differences. The effect of size on shape was investigated by multiple regression.

Statistical analysis was performed using Morpho J (Klingenberg 2008), tps software (Rohlf 2007), SPSS vers. 13 and PAST vers. 2.09 (Hammer et al. 2001).

Morphological terminology follows Masner (1980, 1983) and Mikó et al. (2007). Terminology of surface sculpturing is from Harris (1979).

Acronyms of collections:

CNCI Canadian National Collection of Insects, Ottawa, Canada
OPPC O. Popovici personal collection, University 'Al. I. Cuza' Iasi, Romania
FBIN Collection of F. Bin, Università di Perugia, Perugia, Italy
BMNH Natural History Museum, London, United Kingdom
MNHN Muséum national d'Histoire naturelle, Paris, France
HNHM Hungarian Natural History Museum, Budapest, Hungary

Results

***Triteleia peyerimhoffi* (Kieffer, 1906), comb. n.**
http://species-id.net/wiki/Triteleia_peyerimhoffi

Caloteleia peyerimhoffi Kieffer 1906: 6; Peyerimhoff 1908: 515.
Apegus dubius Kieffer 1908: 151, 163. syn. n.
Apegus (*Parapegus*) *dubius* : Kieffer 1910a: 86.
Ceratoteleia peyerimhoffi: Kieffer 1910a: 89; Kieffer 1914: 321; Kieffer 1926: 501, 503.
Ceratoteleia lugens Kieffer 1910b: 310; Kieffer 1914: 317; Kieffer 1926: 501, 502. syn. n.
Parapegus dubius: Kieffer 1914: 310; Kieffer 1926: 497, 498; Masner 1956: 237; Kozlov 1978: 616; Cavalcaselle 1968: 319.
Triteleia dubia: Masner 1976: 29; Johnson 1992: 507; Bin et al. 1995: 15; Popovici 2005: 16.
Calliscelio peyerimhoffi: Johnson 1992: 359; Kononova and Kozlov 2008: 258, 262.
Calliscelio lugens: Johnson 1992: 358, Kononova and Kozlov 2008: 259, 266.
Triteleia striolata Kononova and Petrov 2000. syn. n.
Catoteleia peyerimhoffi (misspelling): Petit et al. 2007: 148.

Description. Body size: female 3.0–4.6 mm (3.9 ± 0.4, n = 60); male 3.4–4.1 mm (3.6 ± 0.2, n = 22).

Colour: body black; antenna brown with reddish tint on some parts: radicle yellow with reddish tint; A1–5 with reddish tint on the ventral side; wing veins brown; legs light brown, sometime yellowish; middle of femora with dark tint.

Head shape: dorsal view transverse, width 1.6–2.0 times length in female (1.8 ± 0.1, n = 60), 1.6–1.8 times length in male (1.7 ± 0.05, n = 22), 1.0–1.1 times width of mesosoma in female (1.02 ± 0.03, n = 60). Hyperoccipital carina absent. Occipital carina present, smooth, almost absent in median part**.** Compound eye large, glabrous. Eye width 1.6–2.8 times temple width in female (2.2± 0.3, n = 60), 1.5–2.3 times temple width in male (1.9 ± 0.2, n = 22) and 1.7–4.1 times distance between eye and frontal depression in female (3.1 ± 0.5, n = 60), 2.0–3.3 times distance between eye and frontal depression in male (2.5 ± 0.3, n = 22). Eye height 1.2–1.4 times width of eye in female (1.2 ± 0.05, n = 60), 0.8–1.0 times width of eye in male (0.9 ± 0.06, n = 22) and 1.6–3.2 times length of cheek in female (2.3 ± 0.25, n = 60), 1.9–2.4 times length of cheek in male (2.1 ± 0.1, n = 22). Inner orbits nearly parallel, diverging only in ventral half. Length of diameter of posterior ocellus 1.3–2.7 times OOL in female (2.0 ± 0.3, n= 60), 1.3–2.5 times OOL in male (2.2 ± 0.3, n = 22). POL 1.3–2.3 times LOL in female (1.7 ± 0.19, n= 60), 1.3–2.0 times LOL in male (1.7 ± 0.2, n = 22). Distance between compound eyes (measured at level of anterior ocellus) 1.5–2.1 times POL in female (1.8 ± 0.12, n = 60), 1.6–2.1 times POL in male (1.9 ± 0.09, n = 22). Orbital carina absent; frontal depression shallow, unmargined, submedian carina absent; antennal scrobe present, shining; central keel on frons (ctk Fig. 1c), present, not bifurcate, only a weak trace in some specimens. Length of central keel 0.2–0.9 (0.5

± 0.2, n = 60) times height of frontal depression in female. Base of frontal depression transversely striate (Fig. 1c). The transverse striation is very variable 0.1–0.5 (0.3 ± 0.09, n = 60) times height of frontal depression in female. Interantennal prominence (iap Fig. 1c) moderately produced, torulus opening on antero-frontal surface of prominence (in one specimen, the interantennal prominence was hypertrophied, so that the distance between the toruli was twice than of normal specimens (Fig. 1d). Malar sulcus (mas, Figs 1c; 1d; 2a; 2b) present, fine, deeply incised, almost straight, running from lower margin of eye to mandibular articulation. Genal carina absent. Cheek without costae arising from anterior mandibular articulation. Clypeus (cly Fig. 1c) very small, narrow, semicircle, without corners produced laterally. Mandible strong, relatively short and broad, apex tridentate, teeth subequal in length, acute, ventral tooth slightly longer. Number of maxillary palpomeres 4; labial palpomeres 2.

Sculpture of head (Figs 1a; 1b; 1c; 1d; 1e; 2a; 2b): vertex, interocellar space, cheek and space between compound eye and frontal depression foveolate. Frontal depression shining in apical half, transversely striate basally (Fig. 1c). In some specimens the lateral sides of frontal depression are longitudinally striate.

Antenna 12-segmented in both sexes (Figs 2a; 3a; 3b; 3c). Length of A1 4.0–6.25 times width in female (4.8 ± 0.38, n= 60), 4.0–4.6 times width in male (4.3 ± 0.2, n = 22), 2.0–2.8 times length of A2 in female (2.4 ± 0.18, n= 60), 2.1–2.6 times length of A2 in male (2.4 ± 0.13, n = 22). Length of A2 2.0–3.6 times width in female (2.5 ± 0.29, n= 60), 1.8–3.3 times width in male (2.2 ± 0.3, n = 22) and 0.7–1.57 times length of A3 in female (0.9 ± 0.14, n= 60), 0.9–1.1 times length of A3 in male (1.0 ± 0.07, n = 22). A3, in female, the longest funicular segment, 2.3–4.6 times width (3.4 ± 0.4, n= 60), 2.0–3.3 times width in male (2.5 ± 0.3, n = 22), 1.0–2.25 times length of A4 in female (1.4 ± 0.18, n= 60), 1.3–1.7 times length of A4 in male (1.5 ± 0.13, n = 22). Length of A4 1.3–3.6 times width in female (2.1 ± 0.4, n= 60), 1.25–2.0 times width in male (1.5 ± 0.2, n = 22) and 0.8–1.4 times length of A5 in female (1.0 ± 0.12, n= 60), 0.6–0.9 times length of A5 in male (0.8 ± 0.06, n = 22). Width of A4 0.6–1.0 times width of A5 in female (0.88 ± 0.1, n= 60), 0.7–1.0 times width of A5 in male (0.8 ± 0.06, n = 22). Length of A5 1.3–2.5 times width in female (1.8 ± 0.3, n= 60), 1.4–2.0 times width in male (1.7 ± 0.1, n = 22) and 1.0–1.75 times length of A6 in female (1.3 ± 0.15, n= 60), 1.1-1.5 times length of A6 in male (1.3 ± 0.08, n = 22). Length of A6 1.0–2.0 times width in female (1.2 ± 0.2, n= 60), 1.2–1.8 times width in male (1.4 ± 0.1, n = 22) and 0.8–1.4 times length of A7 in female (1 ± 0.14, n= 60), 0.9–1.0 times length of A7 in male (1.0 ± 0.01, n = 22). Clava in female non-abrupt; claval formula A7–12: 1:2:2:2:2:1, differing from claval formula of *Apegus* and *Macroteleia* (in both cases 2:2:2:2:2:1; (Figs 3e; 3f; 3g)). Male antenna non-clavate; A5 sexually modified (Figs 3c; 3d). Length of A12 1.0–1.75 times width in female (1.4 ± 0.02, n= 60), 1.8–2.5 times width in male (2.3 ± 0.3, n = 22) and 1.0–1.75 times length of A11 in female (1.2 ± 0.15, n= 60), 1.5–2.0 times length of A11 in male (1.7 ± 0.1, n = 22).

Back of head (Fig. 1e): occipital carina present, with vertical part well developed and with horizontal part shallow. Temples well developed behind eyes; occiput smooth,

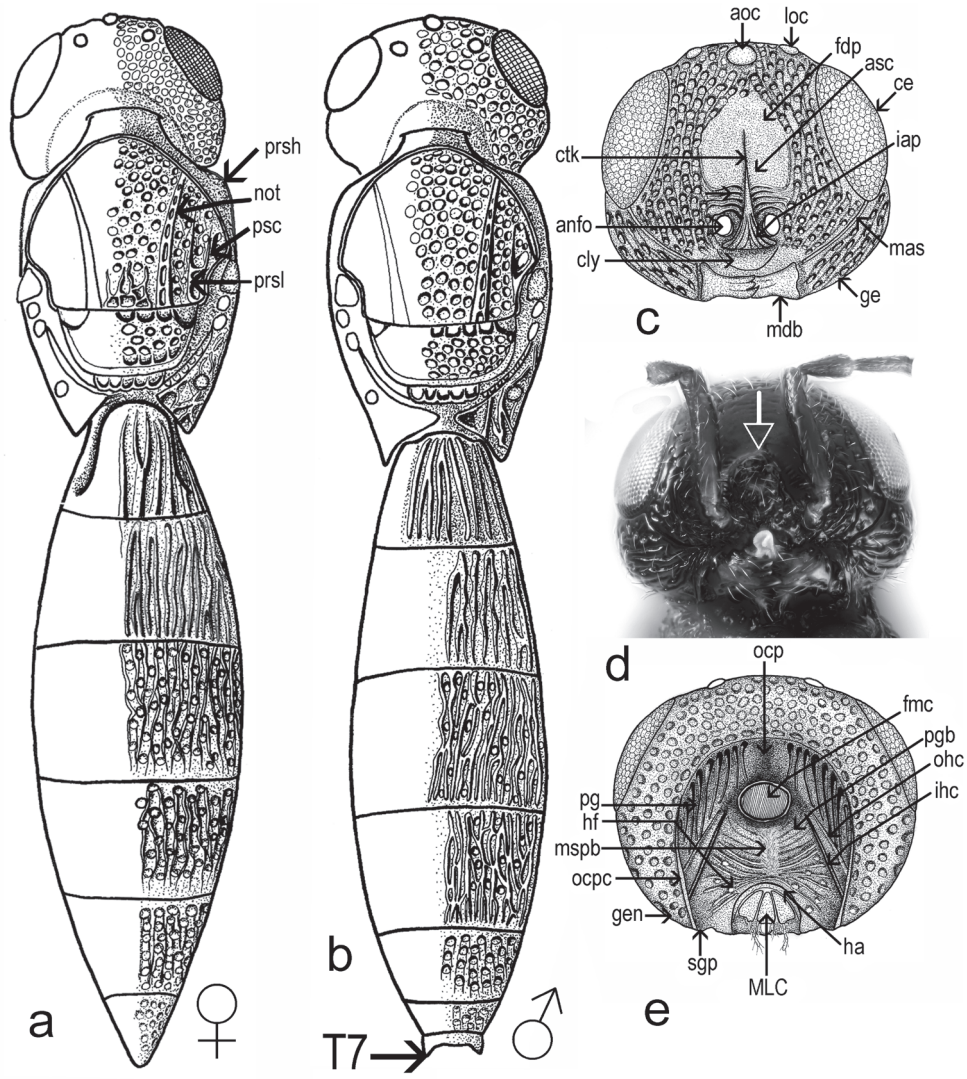

Figure 1. *T. peyerimhoffi*: **a** – habitus female, dorsal view **b** – habitus male, dorsal view **c** – head, frontal view **d** – head, frontal view in malformed specimen **e** – back of head.

deeply concave. Foramen magnum capitis well developed, surrounded by a deep fossa, distance between foramen and occipital carina c. 1.5 times its diameter. Postgena covered with vertical folds. Postgenal bridge smooth. Hypostomal folds present. Median sulcus of the postgenal bridge present. Inner hypostomal carina well developed, more distinct that outer hypostomal carina. Maxillo-labial complex with stipes, prementum, maxillary and labial palpi visible. Subgenal process weakly developed. Hypostomal area narrow. Hypostomal tooth not visible.

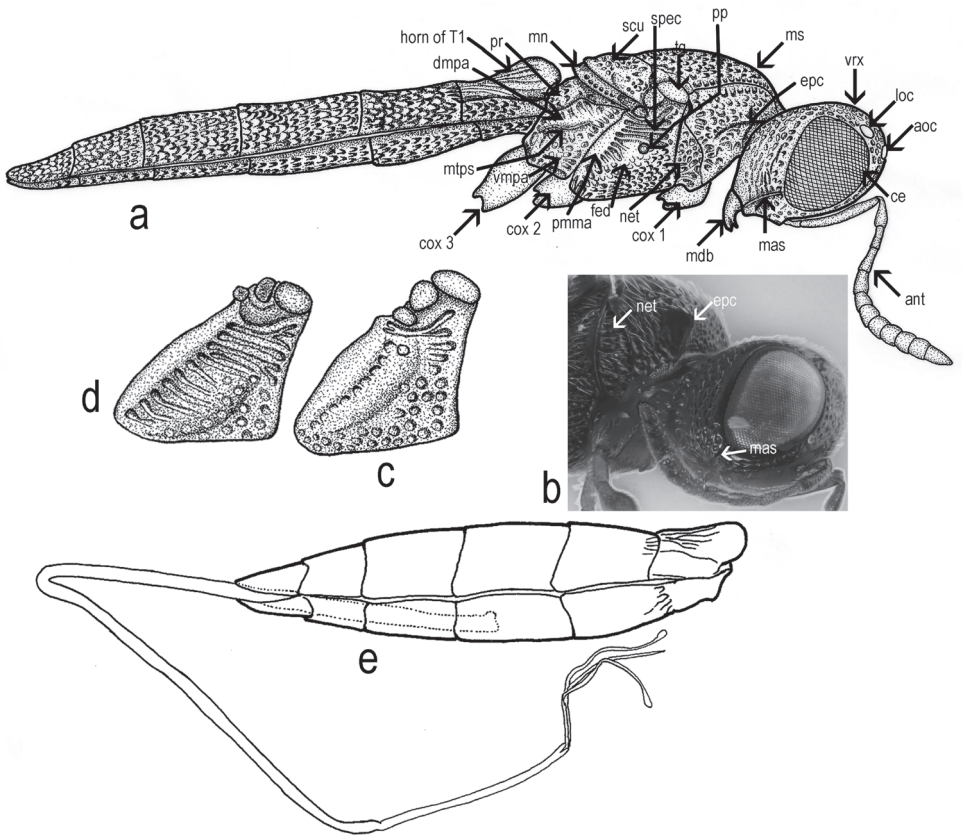

Figure 2. *T. peyerimhoffi*: **a** – habitus, lateral view **b** – head and pronotum, lateral view **c** and **d** – variability of sculpture in mesopleuron **e** – metasoma and ovipositor system.

Mesosoma (Figs 1a; 1b) length 1.2–1.4 times width in female (1.3 ± 0.05, n = 60), 1.3–1.5 times width in male (1.4 ± 0.04, n = 22). Dorsal margin of mesosoma weakly convex in lateral view.

Transverse pronotal carina absent, pronotal shoulders strongly developed, rounded anteriorly. Vertical epomial carina present; horizontal epomial carina present (Figs 2a; 2b). Cervical pronotal area oblique, largely hidden in dorsal view. Lateral pronotal area broad, weakly concave. Netrion present (net Figs 2a; 2b), broad, approximately triangular, open ventrally, with foveolate sculpture.

Mesoscutum (Figs 1a; 1b), weakly convex, 2.1–2.8 times as long as scutellum, (2.4 ± 0.2, n = 60). Skaphion absent. Admedian lines absent. Notauli present, percurrent, usually deeply incised, crenulate. Notauli converging, closely approximated posteriorly, slightly dilated posteriorly. Humeral and suprahumeral sulci crenulate, but indistinct. Parapsidal lines present. Parascutal carina distinct. Mesoscutum foveolate. Transscutal articulation deep, crenulate. Mesoscutellum transverse, width 1.9–2.4 times length, (2.1 ± 0.13, n = 60); weakly convex, unarmed, posterior rim crenulate,

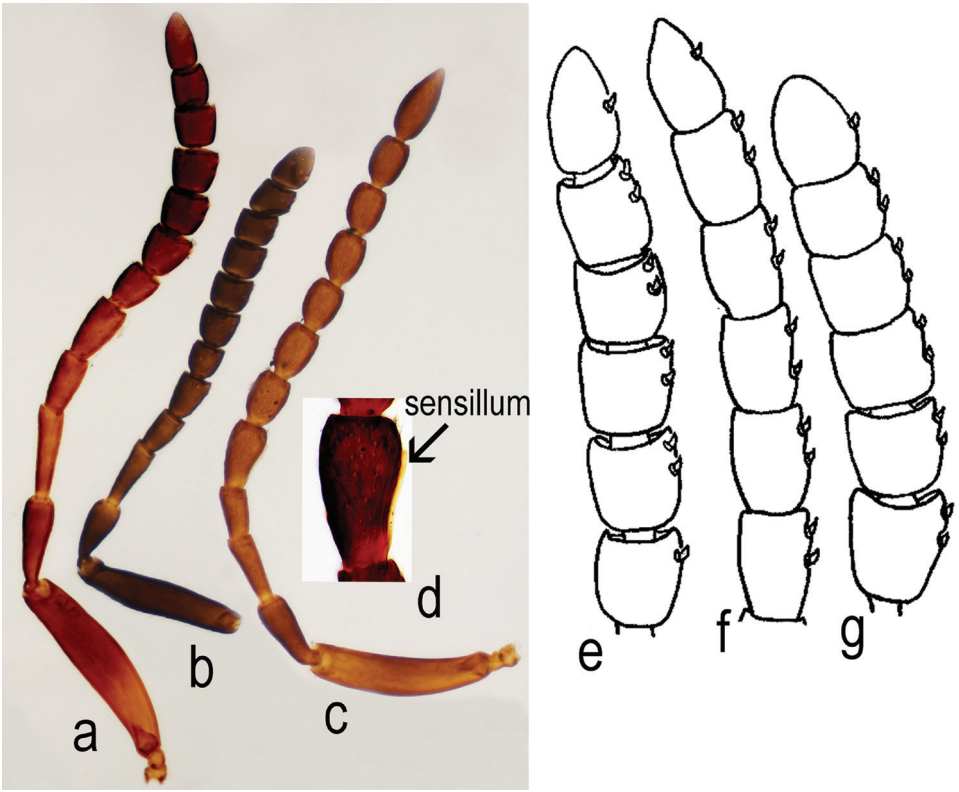

Figure 3. *T. peyerimhoffi*: **a** – antenna in female from Italy **b** – antenna in the smallest specimen female **c** – antenna in male **d** – detail with 5 antennal segment, "sex – segment" **e** – clava in female of *T. peyerimhoffi* **f** – clava in female of *Apegus* sp. **g** – clava in female of *Macroteleia* sp.

sculpture like mesoscutum; length 3.3–8.0 times length of metascutellum in female (5.0 ± 0.75, n = 60), 3.8–5.7 times length of metascutellum in male (5.0 ± 0.6, n = 22). Metascutellum produced into a distinct rectangular plate, 4.0–8.0 times wider than long in female (5.0 ± 0.8, n = 60), 3.2–5.3 times wider than long in male (4.7 ± 0.6, n = 22).

Mesopleuron (Figs 2a; 2c; 2d) almost glabrous, with some scattered hairs. Speculum visible above the femoral depression, with a variable number of transverse ridges. Femoral depression large, deep, shining or with very smooth sculpture. Pleural pit distinct. Mesopleural carina indistinct. Posterodorsal corner of mesopleuron obtuse. Posterior mesepimeral area broad and shining. Sternaulus indistinct.

Propodeum (Figs 1a; 1b) in dorsal view, reduced and deeply excavate medially, lateral propodeal carinae separate the lateral propodeal areas from the deep and large metasomal depression which accommodates the horn of T1. The antero-dorsal ends of the carinae extend over the dorsal margin of the propodeum to form a projection.

Metapleuron entirely sculptured, divided by metapleural sulcus into a small dorsal area and in a large ventral area (Fig. 2a).

Macropterous, fore wings variable in length, not reaching apex of metasoma. Fore wing (Fig. 4a) covered with dense, short microtrichia. Length of fore wing 2.7–3.3 times width in female (3.0 ± 0.14, n = 60), 2.8–3.1 times width in male (2.9 ± 0.09, n = 22), 1.13– 1.5 times length of hind wing in female (1.3 ± 0.05, n = 60), 1.3–1.4 times length of hind wing in male (1.3 ± 0.04, n = 22), 2.7–3.3 times width of mesosoma in female (3.0 ± 0.11, n = 60), 2.7–3.1 times width of mesosoma in male (2.9 ± 0.1, n = 22). Fore wings with tubular submarginal, marginal, postmarginal and stigmal veins and with nebulous medial, cubital, anal, basal, discoidal and radial veins (Fig. 4a). Length of postmarginal vein 0.91–2.9 times length of marginal vein in female (1.3 ± 0.3, n = 60), 1.0–1.5 times length of marginal vein in male (1.2 ± 0.2, n = 22). Marginal vein length 0.7–1.3 times length of stigmal vein in female (1.03 ± 0.11, n = 60), 0.9–1.3 times length of stigmal vein in male (1.1 ± 0.09, n = 22).

Hind wing 4.0–6.1 times as long as wide in female (4.8 ± 0.4, n = 60), 4.4–5.7 times as long as wide in male (4.8 ± 0.3, n = 22), with three hamuli and complete submarginal vein. Marginal fringe short, width of hind wing 7.6 time length of marginal fringe.

Trochantellus present on all legs, tibial spur formula 1-1-1. The middle leg is the shortest (Fig. 4b).

Metasoma (Figs 1a; 1b) broadly sessile, depressed, in male with seven terga and seven sterna, in female with six terga, six sterna visible externally, homonomously segmented, T2–T4 subequal in length, T3 slightly the longest. Laterotergites well developed, narrow. Length of metasoma 2.0–2.6 (2.2 ± 0.13, n = 60) times length of mesosoma, 2.6–3.9 times width in female (3.2 ± 0.2, n = 60), 2.7–3.5 times width in male (3.0 ± 0.2, n = 22).

T1 with anterior margin carinate (especially visible in male), sublaterally with shallow depressions, with horn in female usually longitudinally costate. The apex of horn can be smooth, almost shining, or with longitudinally costae or with areolate rugulae (Fig. 4c). Length of T1 1.0–1.3 times its minimum width in female (1.1 ± 0.07, n = 60), 0.8–1.1 times its minimum width in male (1.0 ± 0.06, n = 22). Ratio between maximum and minimum width of T1 is 1.3–1.7 in female (1.5 ± 0.08, n = 60) and 1.3–1.5 in male (1.4 ± 0.05, n = 22).

Length of T2, 0.9–1.4 times the length of T1 in female (1.05 ± 0.06, n = 60) and 1.1–1.4 times the length of T1 in male (1.2 ± 0.07, n = 22). Maximum width of T2 1.4–2.0 its length in female (1.7 ± 0.1, n = 60) and 1.3–1.8 its length in male (1.6 ± 0.1, n = 22). Ratio between maximum and minimum width of T2 1.0–1.4 in female (1.3 ± 0.05, n = 60) and 1.2–1.4 in male (1.3 ± 0.04, n = 22). T3 is slightly the longest metasomal tergite, T3 length 1.0–1.3 times length of T2 in female (1.1 ± 0.05, n = 60), 1.0–1.2 times length of T2 in male (1.1 ± 0.04, n = 22) and 1.0–1.25 times length of T4 in female (1.1 ± 0.06), 1.0–1.2 times length of T4 in male (1.1 ± 0.04, n = 22). Maximum width of T3 1.3–1.8 times length in female (1.5 ± 0.11, n = 60), 1.3–1.6 times length in male (1.5 ± 0.1, n = 22). Ratio between maximum and minimum width of T3 is 1.0–1.1 in female (1.0 ± 0.01, n = 60) and 1.0–1.1 in male (1.0

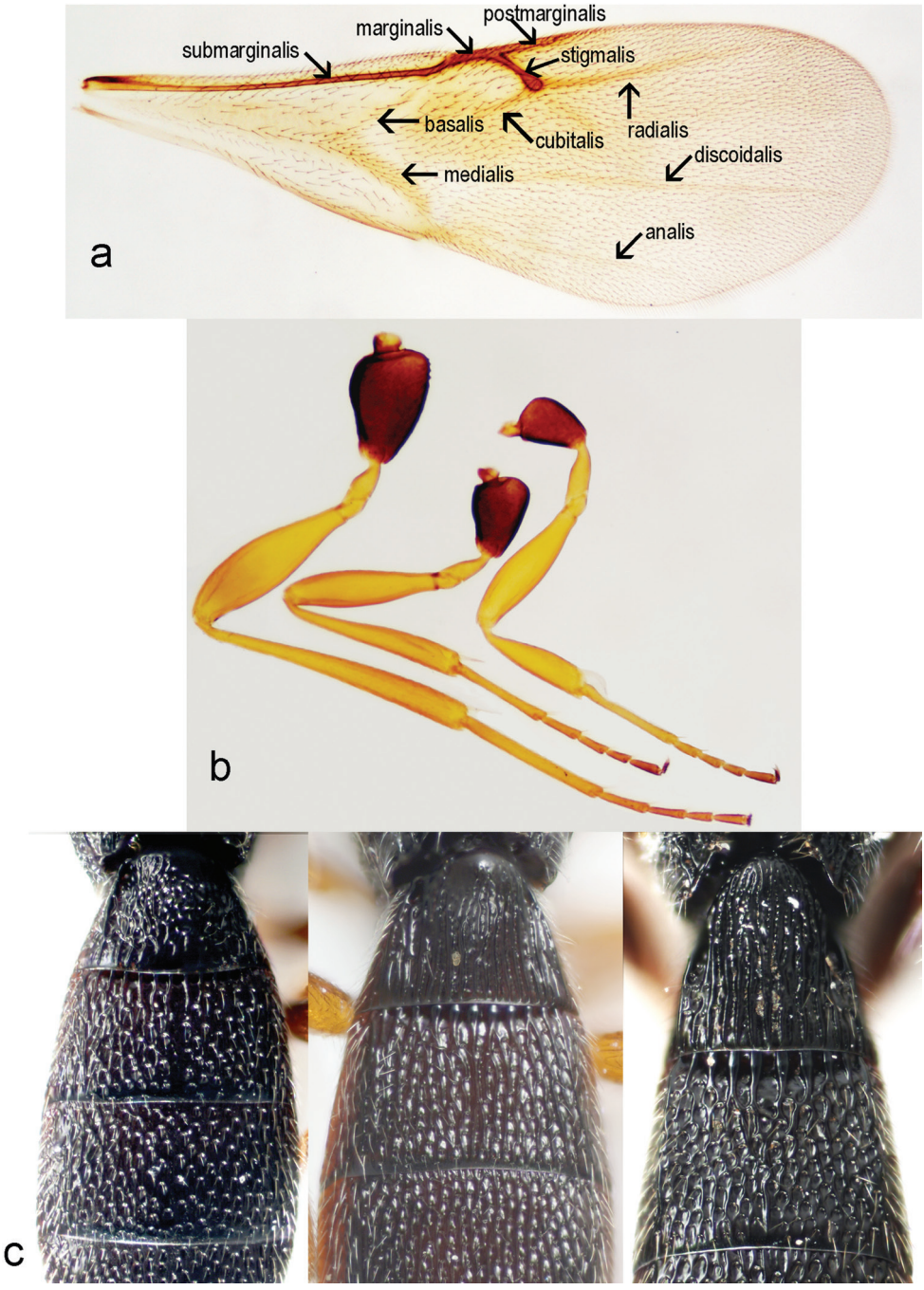

Figure 4. *T. peyerimhoffi*: **a** – fore wing **b** – legs **c** – variability of sculpture of first 2 terga.

± 0.02, n = 22). Length of T4 1.2–1.6 times length of T5 in female (1.4 ± 0.07, n = 60), 1.3–1.6 times length of T5 in male (1.5 ± 0.08, n = 22) and length of T5 0.94–1.5 times length of T6 in female (1.2 ± 0.1, n = 60) and 1.7–3.3 times length of T6 in male (2.1 ± 0.4, n = 22). Ratio between maximum and minimum width of T4 is 1.2–1.4 in female (1.3 ± 0.05, n = 60), 1.1–1.3 in male (1.2 ± 0.04, n = 22) and ratio between maximum and minimum width of T5 is 1.2–2.1 in female (1.8 ± 0.13, n = 60) and 1.4–1.7 in male (1.5 ± 0.07, n = 22). Length of T6 0.6–1.2 times its maximum width in female (0.9 ± 0.01, n = 60) and 0.3–0.5 times its maximum width in male (0.4 ± 0.05, n = 22).

Ovipositor *Scelio*–type (Fig. 5b); the relation between ovipositor assembly length and metasoma length is shown in Fig. 2e.

Ovipositor assembly, very tiny, elongate. Proximal arms slender, short, 0.11 times length of ovipositor assembly; second gonapophyses assembly complex; gonoplacs elongate, 0.62 times ovipositor length; second gonocoxa 0.54 times gonoplac length. Gonoplacs weakly spatulate apically. First gonapophyses apically sharp. We cannot identify the proximal part of ventral membranous plate present in other *Triteleia* (Fig. 5c).

Lateral apodemes present, incorporated into wall of telescopic tube (Fig. 5e). Telescopic tube membranous with three or four sections. S6 without medial apodeme (Figs 5h; 5j).

Structure of ovipositor in *T. dubia*, shows this species was misplaced in *Apegus* by Kieffer, because in *Apegus*, the ovipositor has a completely different structure, being *Ceratobaeus*–type (Fig. 5d).

The aedeagus (Fig. 5a) has two parts: the basal ring and aedeago-volsellar shaft. The basal ring is well developed, and represents 0.4 of copulatory organ length and 0.7 of aedeago-volsellar shaft. The aedeago–volsellar shaft has two aedeagal apodemes and two digiti volsellares. Each digitus has a row of five pits, each with a short tooth. The digiti, teeth and aedeagal apodemes are darker, more sclerotized than the rest of the copulatory organ.

Biology. *Triteleia peyerimhoffi* is the third member in a tritrophic system, the other two being the plant-hosts and the orthopteran-host. We examined specimens of *T. peyerimhoffi* obtained from the following plants: *Asphodelus* sp. (Asphodelaceae); *Ferula* sp., *Magydaris tomentosa* (both Apiaceae), *Tilia* sp. (Malvaceae) and *Quercus* sp. (Fagaceae). In most cases, *T. peyerimhoffi* was obtained from the tettigoniids *Uromenus brevicollis insularis* or *Platycleis albopunctata* (Fig. 6). The relationship between *Asphodelus ramosum – Uromenus brevicollis insularis – Triteleia peyerimhoffi* (under the name *T. dubia*) was previously noted by Cavalcaselle (1968) and the relationship between *Uromenus brevicollis – Triteleia peyerimhoffi*, was noted by Silvestri (1939) and Petit *et al*. (2007). *Triteleia peyerimhoffi* was collected from the end of June until the first part of October, with peak numbers in August.

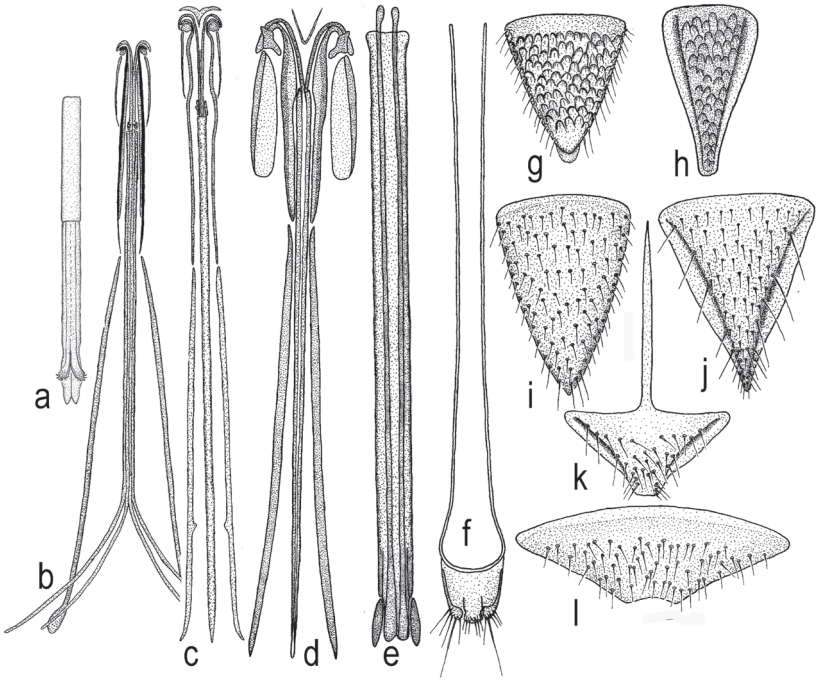

Figure 5. a – aedeagus in *T. peyerimhoffi* **b** – ovipositor assembly in *T. peyerimhoffi* **c** – ovipositor assembly in *Triteleia* sp. **d** – ovipositor assembly in *Apegus* sp. **e** – telescopic tube with lateral apodemes, incorporated into wall in *Triteleia* sp. **f** – T7, cerci and lateral apodeme in *Apegus* sp. **g** – T6 in female of *T. peyerimhoffi* **h** – S6 in female of *T. peyerimhoffi* **i** – T6 in female of *Triteleia* sp. **j** – S6 in female of *Triteleia* sp. **k** – S6 in female of *Apegus* sp. **l** – T6 in female of *Apegus* sp.

Taxonomic comments. Kieffer did not appreciate the variability of this species since he described the female of this species in 1906 in *Caloteleia*; males two years later in *Apegus*; and the male and female again (1910b) as *Ceratoteleia lugens*. According to Kieffer (1910a) *Ceratoteleia* and *Apegus* are very close, differing in details of the female clava and first metasomal tergite. We did not find the type specimens of these species. It seems that the types of *Ceratoteleia peyerimhoffi* and *Parapegus dubius* are lost. We looked for them in the collections of BMNH (Popovici and Notton), MNHN (collections of Jean-Jacques Kieffer and Paul de Peyerimhoff de Fontenelle) (Dr. Masner, Dr. Fusu & Dr. Claire Villemant) and HNHM (Dr. Sandor Csősz) but without success. It is possible that the type specimens of *Ceratoteleia lugens* are in the Naturhistorisches Museum, Vienna or in the Museo Civico di Storia Naturale di Trieste, but we have not visited these collections (Dr. Dominique Zimmermann and Dr. Fusu looked for this species in the Naturhistorisches Museum, but without success). When describing

Figure 6. A female of *T. peyerimhoffi* and its egg – host belongs to *Platycleis albopunctata.*

the male of *Ceratoteleia lugens*, Kieffer mentioned: '*chez le mâle, tous les tergites sont transversaux, le 6e porte de chaque côté de son bord postérieur un petit appendice*'. The bidentate or bispinose last tergite is a character state confirming that this species belongs to *Triteleia*. This species was obtained from *Foeniculum* sp. (Apiaceae); the host plant of the tettigoniids which *Triteleia peyerimhoffi* is known to attack. From Kieffer's original descriptions it is impossible to find reliable characters to separate *Ceratoteleia peyerimhoffi* from *Ceratoteleia lugens* and from *Parapegus dubius*.

To clarify the taxonomic status of these species (ICZN, article 75.3.1), we here designate neotypes for *Parapegus dubius* and *Ceratoteleia peyerimhoffi*. We consider that the types of these species have been lost or destroyed: since we were unable to locate them in BMNH, MNHN, HNHM or in the Naturhistorisches Museum, Vienna.

For *Parapegus dubius* we designate as neotype one female labeled: Hungary, Veröce 47°49.58'N, 19°1,30'E, 122m, 2–18.ix.2005, leg. Z. Nyiro (Malaise trap, CNCI). For *Ceratoteleia peyerimhoffi* we only have one male from Algeria. Because we have many specimens from Italy from the same host as the type specimens and because the male from Algeria is very similar to males from Italy, we decided to designate as a neotype a female of *Ceratoteleia peyerimhoffi* labeled: Italy, Guspini, 3.VIII.1933 (reared from *Asphodelus*). This neotype will be deposited in BMNH.

Kononova and Petrov (2000) described a new Palaearctic species of *Triteleia* from southeast Bulgaria, *T. striolata*, based on two females, adding Israel to the distribution in 2008. Based on the description of its sculpture, ratios between sclerites, emergence dates, distribution and examination of pictures of the habitus, antenna and forewings of the holotype, we conclude that *T. striolata* is a junior synonym of *T. peyerimhoffi*.

Among the Palaearctic species described by Kieffer in *Ceratoteleia* there is one further species that has an uncertain status: *Ceratoteleia mediterranea*. Currently it is placed in *Calliscelio* (Johnson 1992; Kononova and Kozlov 2008), but we are convinced it is a *Triteleia*, and possibly another junior synonym of *T. peyerimhoffi*. We have not found the type specimens, although the senior author and Dr. Masner saw two females in MNHN identified by Maneval as *C. mediterranea* and the senior author saw a similar specimen in FBIN also identified as *C. mediterranea*. The main difference between these specimens and *T. peyerimhoffi* is the overall size and the ratio between the length and maximum width of the metasoma. It is possible these specimens are extreme examples of *T. peyerimhoffi*, but until we see more specimens we prefer to not include these specimens in *T. peyerimhoffi*.

Material examined. FRANCE: 17 females, Lot Escamps, 5–31.viii.1995, Malaise trap, leg. H. Tussac (CNCI); **1 male,** Lot Escamps, 5–31.viii.1995, Malaise trap, leg. H. Tussac (CNCI); **1 female,** Dordogne, Couze St. Front, 27.vi–11.vii.1993, Malaise trap, leg. H. Tussac (CNCI); **2 females,** Dordogne, Couze St. Front, 1.ix.1994–22.ii.1995, Malaise trap, leg. J. N. Revol (CNCI); **1 female,** Gard, St. Félix de Paulliéres, La Hourne Haute, 7–14.vii.1996, Malaise trap, leg. J. F. Vayssiéres (CNCI); **2 females**, Bouches-du-Rhône, Fonscolombe, 17.vii.1990, leg. M. de V. Graham (BMNH(E)1995-489); **1 male**, Bouches-du-Rhône, nr. Rognes, 16.vii.1979 (BMNH(E)1995-489); **1 female**, Bouches-du-Rhône, Fonscolombe, 25.vii.1990, leg. M. de V. Graham (BMNH(E)1995-489); **1 female**, Bouches-du-Rhône, Fonscolombe, 4.viii.1986, leg. M. de V. Graham (BMNH(E)1995-489); **1 female**, Bouches-du-Rhône, Fonscolombe, 15.viii.1980, ex. *C. coriaria* (Fabaceae) gall, leg. M. de V. Graham (BMNH(E)1995-489); **1 female**, Bouches-du-Rhône, Fonscolombe, 29.vii.1979, leg. M. de V. Graham (BMNH(E)1995-489); **1 female**, Pignans, 4.ix.1965, leg. J. Barbier (MNHN, 7237); **1 female**, Esbarres, C. D'OR, 6.viii.1955, leg. J. Barbier (MNHN, I536)

HUNGARY: 3 females, Veröce, 47°49.58'N, 19°1.30'E, 122m, 2–18.ix.2005, Malaise trap, leg. Z. Nyiro (CNCI).

ITALY: 3 females, Bienca, 20.ix–19.x.1985, leg. A. Casale (CNCI); **2 females,** Toscana Sesto Fior. ix.1943, leg. L. Ceresa (OPPC); **1 male & 2 females**, Sardegna, Macomer, 8.vii.1957, reared from *Uromenus brevicollis insularis* on *Ferula* sp. (FBIN);

3 males & **3 females**, Sassari, Bunnari, 8.vii.1957, reared from *Uromenus brevicollis insularis* on *Magydaris tomentosa* (FBIN); **13 males & 52 females**, Guspini, vii.1934, reared from *Asphodelus* (FBIN); **24 males & 114 females**, Guspini, 7.vii.1934, reared from *Asphodelus* (FBIN); **24 males & 1 female**, Guspini, vi–vii.1933, reared from *Asphodelus* (FBIN); **11 males & 79 females**, Guspini, 19.vii.1934, reared from *Asphodelus* (FBIN); **67 males & 38 females**, Sessa Aurunca, 7.vii.1934, reared from *Asphodelus* (FBIN); **2 females & 4 males**, Matera, 1934, reared from *Platycleis grisea* (FBIN); **1 male & 7 females**, ?locality, 1964, reared from *Uromenus brevicollis insularis*, leg. Crovetti (FBIN); **189 males & 84 females**, Guspini, vi.1934, reared from *Asphodelus* (FBIN); **1 female & 1 male**, Toscana Sesto Fior. vii.1943, leg. L. Ceresa (FBIN); **25 males & 13 females**, Mandas vii.1933, reared from *Asphodelus* (OPPC); **5 females**, Guspini, vii.1933, reared from *Asphodelus* (FBIN); **2 males & 1 female**, Guspini, 4.viii.1933 (OPPC); **2 females**, Guspini, 3.viii.1933, reared from *Asphodelus* (OPPC); **1 female**, Caprioli, 21.vii.1936 (OPPC); **2 males & 1 female**, Nuoro, 13.vii.1933, reared from *Asphodelus* (OPPC); **1 female**, Sessa Aurunca 27.vii.1934 (OPPC); **6 males**, ?locality, viii.1933, reared from eggs of Orthoptera, leg. Dr. Provasoli (OPPC).

CROATIA: 1 female, Krk Isle 24.viii.2007, swept, leg. M. Mitroiu (OPPC).

ROMANIA: 1 female, Bârnova forest, N46°59'37.0", E27°35'27.1", 8.ix.2004, swept, leg. O. Popovici (OPPC); **1 female,** Bârnova forest, N46°59'37.0", E27°35'27.1", 12.viii.2010, Malaise trap, leg. M. Popovici (OPPC); **2 females,** Bârnova forest, 27.iii.2006, obtained from dead wood of *Tilia* sp., leg. L. Fusu & M. Dascălu, (OPPC); **1 female,** Mârzeşti forest, 14.ii.2006, from dead wood of *Quercus* sp., leg. L. Fusu & M. Dascălu (OPPC).

GREECE: **1 female & 1 male,** Krousia Mts., N41°11'32,4'', E23°03'59,5'', 18–24.vii.2007, Malaise trap, leg. G. Ramel (OPPC); **1 female,** Krousia Mts., N41° 11' 32,4'', E23° 03' 59,5'', 8–14.viii.2007, Malaise trap, leg. G. Ramel (OPPC); **1 female,** Promohonas site, N41°22' 25.32'', E23°22' 18.84'', 11–17.vii.2007, Malaise trap, leg. G. Ramel (OPPC); **2 females,** Midway site, N41°18'49.8'', E23°16'35,6'', 14–21. vii.2008, Malaise trap, leg. G. Ramel (OPPC); **1 male & 1 female,** Midway site, N41°18'49.8'', E23°16'35.6'', 21– 7.vii.2008, Malaise trap, leg. G. Ramel (OPPC), **1 female,** Midway site, N41°18'49.8'', E23°16'35.6'', 8–14.ix.2008, Malaise trap, leg. G. Ramel (OPPC); **1 male,** Midway site, N41°18'49.8'', E23°16'35.6'', 28.vii–3. viii.2008, Malaise trap, leg. G. Ramel (OPPC); **2 females & 1 male,** Thessalia, Kalambaka, 14–20.viii.1979, hillside meadow, leg. M. C. Day, G. R. Else & D. Morgan (BMNH(E)1979-312).

SPAIN: 1 male, Andalucía, Jaén, Santa Elena, 5.vii.1974, leg. Z. Bouček (BMNH(E)1974-321).

PORTUGAL: 1 male, Madeira, pre-1855, leg. Wollaston (BMNH(E)1855-7,).

ALGERIA: 1 male, Oran, Douar belbaid, reared from *Asphodelus,* leg. J. Barbier (6565 MNHN).

JORDAN: 1 male, NW corner, c. 16 km WWN Aljun, 21.v.2007,
32° 27.074'N, 35°42.404'E, 600m, leg. J. Bezdek (CNCI).

Discussion

Triteleia peyerimhoffi is a widely distributed species in southern Europe and because of this wide distribution it appears to form local races which appear different. Therefore, it is easy for researchers working with a limited series of specimens from a limited geographic region to misinterpret this intraspecific variability as representing additional species. Indeed, specimens from the extremes of the species' distribution may look like different species; however, studying a large number of specimens shows an almost continuous morphological gradation between these extremes.

In other parasitic Hymenoptera PCA was successfully used to separate closely related species (Popovici and Buhl 2010; Fusu 2010; Polaszek 2004; Bernardo et al. 2008). We used PCA here to see if, and how morphology of this species varied with distribution.

The first six principal components of PCA explain 80.34% of the total variance (one indicated by Jolliffe cut-off value = 0.002; eigenvalues of the first six PCs > 0.002). 95% bootstrapped confidence intervals are given for the eigenvalues (Table 1). The first three principal components of this analysis are plotted in Figures 7a and 7b; they explain 67.35% (PC1), 6.99% (PC2) and 6% (PC3) respectively of the total variance. Both graphs of PC1 on PC2 and PC1 on PC3 displayed a trend of separation between specimens (Figs 7a, 7b). The contributions of variables in this dispersion are showed in the Table 2.

Because in both the graph of PC1 on PC2 and PC1 on PC3, but especially in PC1 on PC2 we obtained a relatively clear separation between the specimens from France and specimens from Italy, we wanted to see if there is a significant difference between these two populations.

One-way ANOVA of all variables indicated significant differences between populations for all variables excepting one (LT6 min: $F= 1.865$, $p= 0.13$). The analysis proceeded by pair-wise comparisons (post-hoc) using the Games Howel test after the Levene test revealed unequal variances ($p <0.05$). The Games Howel test indicated small but significant differences between populations for most variables ($p<0.05$) (Table 3). The main differences appear between specimens from Italy and specimens from France, in this case almost all characters showed significant differences. Also there were a few significant differences between specimens from France and specimens from Greece (for six characters), between specimens from France and specimens from Hungary (for one character) and between specimens from France and specimens from Romania (for one character). There were no significant differences between specimens from France and the specimen from Croatia. Interestingly there weren't any significant differences between specimens from Italy and specimens from Greece, Croatia, Romania and Hungary. Also, there were no significant differences between specimens from Greece, Romania, Croatia and Hungary. These results demonstrate that all these specimens from different populations belong to the same species, specimens from France and specimens from Italy being at different extremes with populations from Greece, Croatia, Romania and Hungary, lying between these two populations.

Table 1. Principal Components and the bootstrapped confidence intervals.

PC	Eigenvalue	% variance	Eig 2.5%	Eig 97.5%
1	0.063821	67.351	61.114	74.243
2	0.00663	6.997	4.5251	10.308
3	0.005683	5.9973	3.2998	10.638
4	0.004301	4.5388	2.7452	72.321
5	0.002332	2.4606	1.1542	41.235
6	0.002188	2.3087	1.2735	33.399

Table 2. The contribution of the variables along the first three principal components

Axis	Loading	Variables
PC1	0.2951	LA3
	0.2375	LT5
	0.2348	width of metascutellum
	0.209	LT4
	0.2032	LE
	0.2024	LT6
PC2	0.7473	minimum width of T6
	0.2352	length of T6
	0.2321	Lt
	0.1575	length of T3
	0.1565	length of T4
	0.1146	length of T2
	0.09395	length of T5
PC3	0.4948	minimum width of T6

Because characters of the metasoma were very important in the PCA analysis we decided to analyze the size and shape of the metasoma in *T. peyerimhoffi* to reveal more detail of the variability within this species.

One way ANOVA found significant differences in centroid size between populations (F= 7.17; P = 0.001). The distribution of the log-transformed centroid size is shown in Fig. 8. Levene's test revealed a normal distribution of all populations (p>0.05) and Tukey's pairwise mean comparisons showed a significant difference between three of them (Table 4). Again, in the analysis of the metasoma, there were some significant differences between France and Italy, Greece and Romania and between France and Greece. There were no differences however between Hungary and Romania or between Hungary and Greece, no difference between Italy and Romania or between Italy and Greece, no difference between France and Romania, or between specimens from France and Hungary or Croatia (Table 4). We conclude, as before, that although there are some significant differences between some populations, overall the specimens belong to the same species.

The result of analysis of the shape of the metasoma is shown on the plot of principal components. The first two principal components are shown in Figure 9. PC1 ac-

Table 3. Results of Multiple Comparisons: Games – Howell test (the Table includes only variables and populations with only significant differences)

Variables	Populations		Mean Difference	Std. Error	p- value	95% Confidence Interval	
						Lower Bound	Upper Bound
LH	France	Italy	0.04	0.01	0.000	0.02	0.05
WH	France	Italy	0.08	0.01	0.000	0.06	0.09
WH	France	Greece	0.06	0.02	0.045	0.00	0.12
POL	France	Italy	0.05	0.01	0.000	0.03	0.08
distance between eyes at level of anterior ocellus	France	Italy	0.06	0.01	0.000	0.05	0.08
Hfd	France	Italy	0.08	0.01	0.000	0.06	0.11
distance between compound eye and frontal depression	Romania	France	-0.08	0.02	0.031	-0.16	-0.01
distance between compound eye and frontal depression	France	Italy	0.06	0.02	0.027	0.01	0.12
HE	France	Italy	0.09	0.00	0.000	0.07	0.10
LE	France	Italy	0.09	0.01	0.000	0.07	0.11
gen	France	Italy	0.08	0.01	0.000	0.04	0.11
width of mesosoma	France	Italy	0.07	0.01	0.000	0.05	0.09
length of mesoscutum	France	Italy	0.07	0.01	0.000	0.05	0.08
Wscut	France	Italy	0.08	0.01	0.000	0.06	0.09
width of metascutellum	France	Italy	0.10	0.01	0.000	0.07	0.12
length of T1	France	Italy	0.05	0.01	0.000	0.03	0.08
minimum width of T1	France	Italy	0.08	0.01	0.000	0.06	0.10
maximum width of T1	France	Italy	0.06	0.01	0.000	0.05	0.08
maximum width of T1	France	Greece	0.06	0.02	0.040	0.00	0.11
length of T2	France	Italy	0.05	0.01	0.000	0.03	0.07
maximum width of T2	France	Italy	0.04	0.01	0.000	0.03	0.06
length of T3	France	Italy	0.03	0.01	0.030	0.00	0.05
maximum width of T3	France	Italy	0.06	0.01	0.000	0.04	0.07
length of T4	France	Italy	0.05	0.01	0.000	0.03	0.08
minimum width of T4	France	Italy	0.09	0.01	0.000	0.07	0.10
minimum width of T1	France	Greece	0.08	0.02	0.010	0.02	0.14
length of T5	France	Italy	0.07	0.01	0.000	0.04	0.10
minimum width of T5	France	Italy	0.08	0.01	0.000	0.05	0.10
minimum width of T5	France	Greece	0.11	0.02	0.002	0.05	0.16
minimum width of T6	France	Hungary	0.00	0.00	0.003	0.00	0.00
Lfw	France	Italy	0.07	0.00	0.000	0.06	0.09
Wfw	Greece	France	-0.05	0.01	0.041	-0.10	0.00
Wfw	France	Italy	0.06	0.00	0.000	0.05	0.07
length of marginal vein	France	Italy	0.08	0.01	0.000	0.05	0.12
Lhw	France	Italy	0.07	0.01	0.000	0.05	0.09
Whw	France	Italy	0.09	0.01	0.000	0.06	0.11
Whw	France	Greece	0.07	0.01	0.008	0.02	0.11

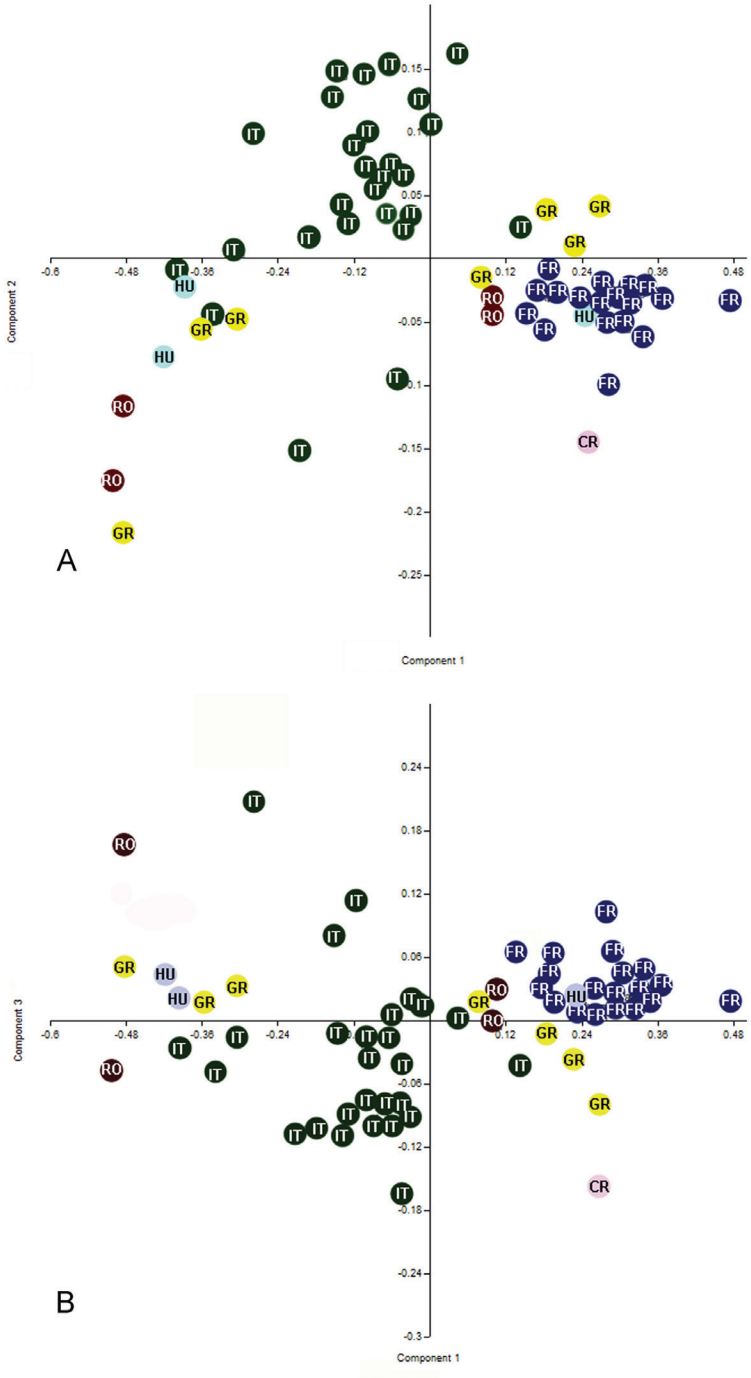

Figure 7. Scatter plots of the first three factors from the analysis of the log–transformated data for some population belongs to *T. peyerimhoffi* (A – PC1 and PC2; B– PC1 and PC3); RO– Romania, IT– Italy, GR– Greece, FR– France, CR– Croatia, HU– Hungary.

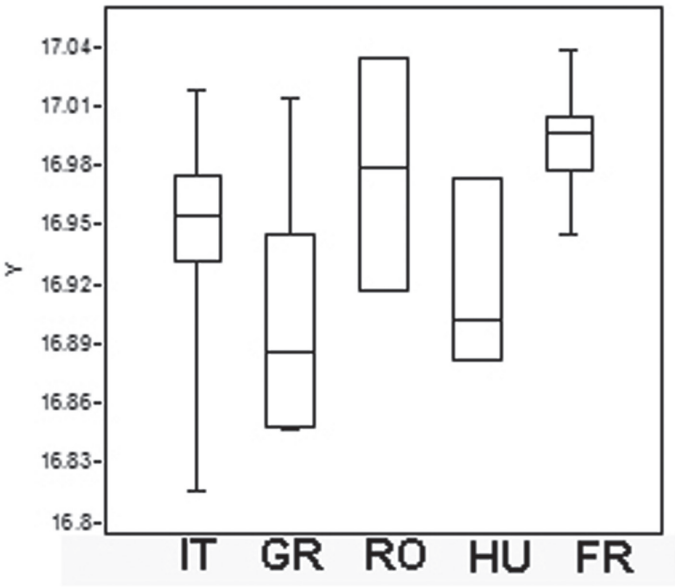

Figure 8. Boxplot of metasoma Log– Transformed Centroid Size (Log–CS) screening the metasoma size variation in *Triteleia peyerimhoffi* populations. (IT– Italy, GR– Greece, RO– Romania, HU– Hungary, FR– France).

Table 4. Results of Multiple Comparisons: Tukey's test (the table includes only populations with significant differences)

Populations		Mean Difference	Std. Error	P value	95% Confidence Interval	
Italy	France	-0.04	0.01	0.01	-0.08	-0.01
Greece	Romania	-0.08	0.03	0.03	-0.16	-0.01
France	Greece	0.09	0.02	0.00	0.04	0.15

counts for 35.21% of the shape variability and PC2 explains 31.38% of the variability. Thin plate deformation grids show the transformation of shape along the two axes. The MANOVA permutation test found insignificant overall difference between shapes ($p>0.05$) of metasoma in the six examined populations. The result of this test, confirm our view that all populations belong to the same species. So, in Fig. 9 it is impossible to separate specimens from their provenance, because there is a mixture of specimens belonging to the different populations. Hence we consider this variation in size and shape of the metasoma to be intraspecific variability. Furthermore, we found an almost continuous gradation between the shortest and the longest metasoma (Fig. 10).

Multiple regression of shape on size was performed. The results revealed that only 10.88% of variability of shape is predicted by size (Permutation test against the null hypothesis of independence/ Number of randomization rounds: 10000, P-value: <0.001).

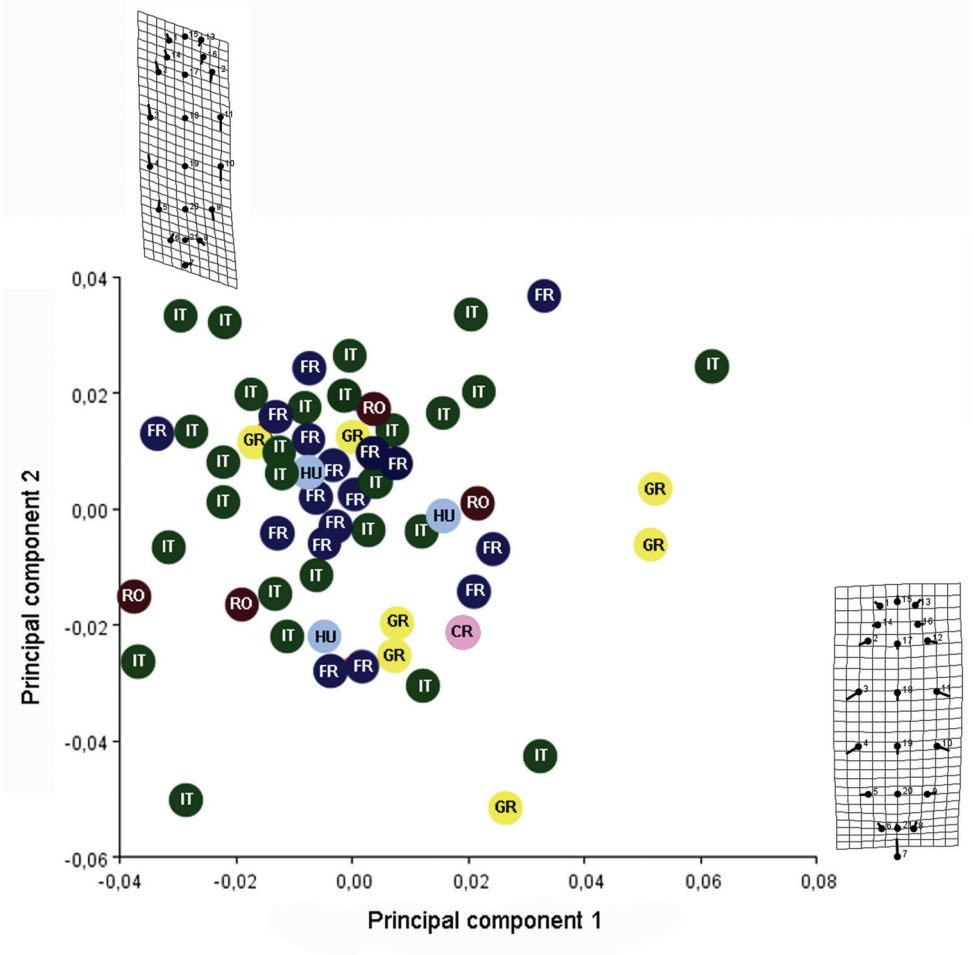

Figure 9. PC1 vs PC2 screen plot and thin plate deformation grids show the transformation of shape of metasoma along the two axes. (RO– Romania, IT– Italy, GR– Greece, FR– France, CR– Croatia, HU– Hungary).

We therefore assert that the great variability of this species to geographical variation. The correlation of geography with these variables was shown by Spearman's rank coefficient. There was a significant correlation between longitude and PC1 (Spearman's correlation = - 0.52; $p<0.01$) and latitude and PC2 (Spearman's correlation = - 0.62; $p<0.01$). Therefore, in the case of this species, there is a correlation between longitude and LA3, LT5, width of metascutellum, LT4, LE and LT6 and also, between latitude and minimum width of T6, length of T6, Lt, length of T3, length of T4, length of T2 and length of T5. The relation between latitude and longitude on PC1 and PC2 can be seen in Fig. 11A & B. So, the gap between populations on Fig. 7A and 7B can be explained as a gap between the sites where the specimens were collected. The majority of specimens from Italy were collected from Sardinia and

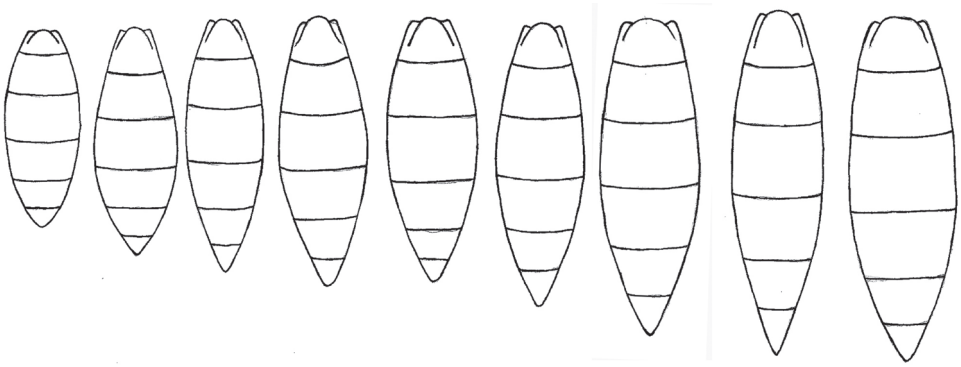

Figure 10. Morphological gradation between the shortest metasoma and the longest metasoma in *T. peyerimhoffi*.

just three from continental Italy. Similarly for the other material: from Greece we analyzed specimens from northern Greece only; from Romania, only specimens from the North-East; from France, only specimens from a limited area. Hence there are many unrepresented areas between the sampled populations. Consequently we think this is the reason for the gap between the populations from France and Italy. Also, we have few specimens from northern Italy, and this population is separated from that in France by the Western Alps.

A large variation in size, shape and sculpture of the metasoma is not something that is unusual within scelionid species, e.g., Vecher (1980) notes the intraspecific variability of the metasoma in *Telenomus angustatus* reared from tabanid eggs. He analysed 5274 females and 1009 males and noted great variability in the shape and size of the metasoma and in the sculpture of T1 and especially T2. The most interesting thing is that variability was observed in specimens which were the progeny of thelytokous females. He confirmed his conclusion that all specimens belonged to the same species with allozyme electrophoresis.

Within the Chalcidoidea, Popescu (2004) found a great variability in the size and shape of antennomeres in females of *Idiomacromerus pallistigmus* Askew and *Eridontomerus arrabonicus* Erdös (both Torymidae). The specimens were reared as from *Blascoa ephedrae* Askew (Pteromalidae) from *Ephedra distachya* L. (Ephedraceae) and *Tetramesa scheppigi* (Schlechtendal) (Eurytomidae) from *Stipa lessingiana* (Poaceae) respectively.

Kononova (2001) gave great importance to the influence of hosts in the morphology of parasitoids. She wrote: 'adaptation of scelionids to hosts from more advanced orders cause sharp modifications of not only the habitus (strongly shortened body), but also some other morphological characters (e.g. shortening of the abdomen through reduction of its apical segments)'.

The influence of hosts on the morphology of parasitoids was demonstrated by Johnson et al. (1987). They studied the intraspecific variability in *Telenomus alsophilae* reared from different hosts in the laboratory under controlled conditions and empha-

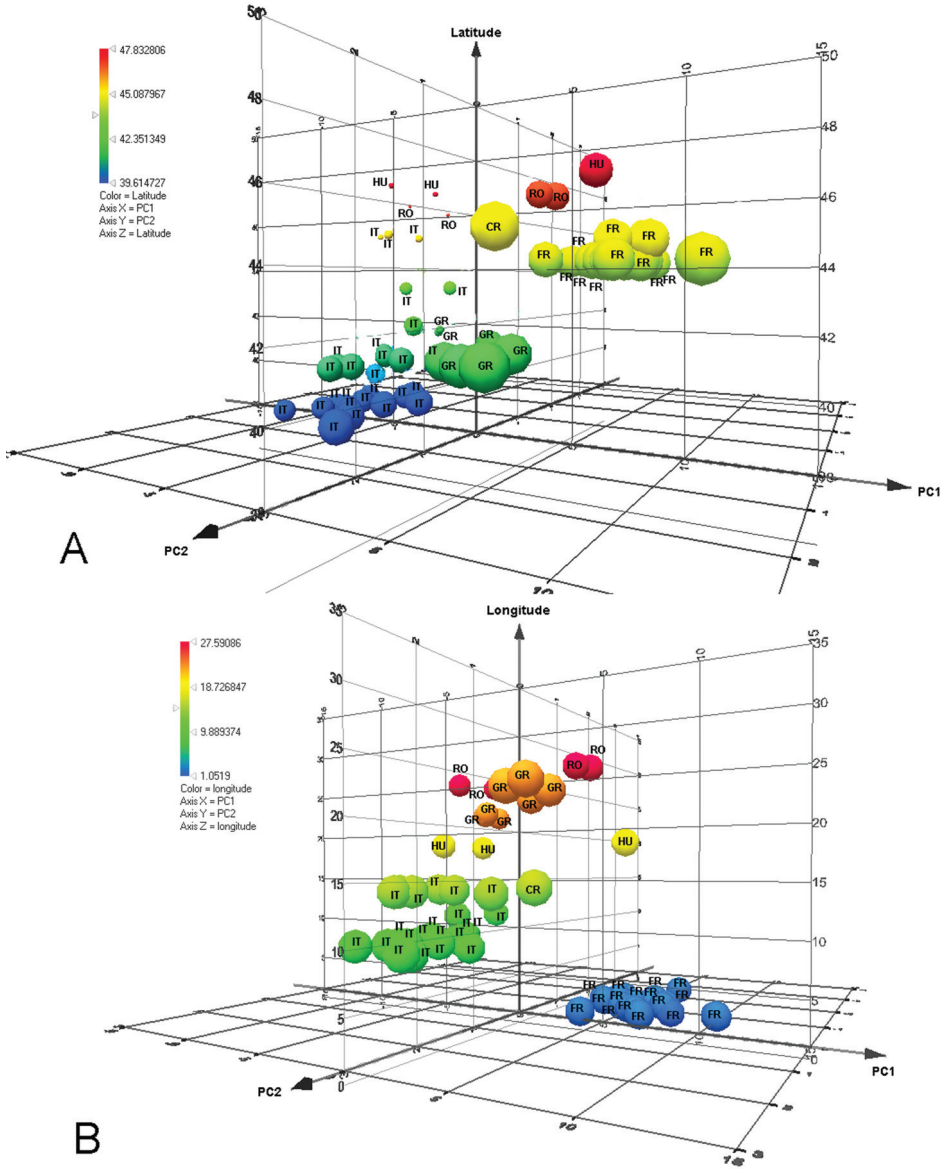

Figure 11. 3D–plot of distribution of data according to PC1 and PC 2 and A: latitude; B: longitude. (RO– Romania, IT– Italy, GR– Greece, FR– France, CR– Croatia, HU– Hungary).

sised the strong influence of hosts in the morphology of the antennae of their parasitoids. Another interesting fact shown by Johnson et al. (1987) was that specimens reared from field collected eggs showed substantially greater coefficients of variation than the laboratory-reared specimens most likely as a result of uncontrolled environmental variables.

It is very probable that *T. peyerimhoffi* has not just a single host, but uses a number of similar tettigoniid hosts and differences between the size and shape of the eggs of different host species, and differences between the size and shape of eggs within the same host species under different environmental conditions are a source of intraspecific variability within and between parasitoid populations.

We conclude that *T. peyerimhoffi* is a species with a wide circum-Mediterranean distribution and is one of the most important eggs parasitoids of *Uromenus brevicollis*. As an alternative host it uses *Platycleis albopunctata* which explains its presence in areas (e.g. Romania) where there is no *Uromenus*, but where *Platycleis albopunctata* common (Iorgu I., pers. comm.).

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