



Entedoninae (Hymenoptera: Eulophidae) associated with gall-inducing insects (Diptera: Cecidomyiidae) in Panama

MIGUEL PANIAGUA^{1,3}, CHRISTER HANSSON² & ENRIQUE MEDIANERO¹

¹Programa Centroamericano de Maestría en Entomología, Vicerrectoría de Investigación y Postgrado, Universidad de Panama, Ciudad de Panama.

²Department of Zoology, Helgonavägen 3, SE-223 62 Lund, Sweden. E-mail: Christer.Hansson@cob.lu.se

³Corresponding author, present address: Compañía Azucarera Salvadoreña, S.A. de C.V., Central Izalco Km 62½ Carretera a Sonsonate, Izalco, Sonsonate, El Salvador; C.A. E-mail: mrpaniagua@gmail.com

Abstract

A new species of *Ametallon* Ashmead, *A. carinatum* sp. n. and five new species of *Chrysonotomyia* Ashmead, *C. dussiae* sp. n., *C. longicaudata* sp. n., *C. machaeriae* sp. n., *C. unimaculata* sp. n. and *C. claviger* sp. n. (Eulophidae: Entedoninae) are described from Panama. New host associations are recorded for *Ametallon gorgonaense* Hansson, *Chrysonotomyia auripunctata* (Ashmead), *Chrysonotomyia galbina* Hansson, *Chrysonotomyia laeviscuta* Hansson, *Chrysonotomyia phenacapsia* Yoshimoto and *Tropicharis cecivora* Hansson. All these species belong to the *Omphale* genus group, and were reared from galls collected in the canopy and understorey of two tropical forests in Panama.

Key words: Parasitoids, *Omphale* genus group, gall-inducing Cecidomyiidae, host-parasitoid relationship, canopy

Introduction

Gall-inducing insects constitute one of the feeding niches with the highest parasitoid species richness, second only to leaf miners (Hawkins 1994). The fact that the gall-associated parasitoid complexes form closed and highly specialized communities (Stone & Schönrogge 2003) make them a suitable model system for community ecology and biological control research.

The parasitoids of gall-inducing insects belong to the superfamilies Chalcidoidea, Platygastroidea and Ichneumonoidea. In Chalcidoidea the families associated with gall inducers are Eulophidae, Eurytomidae, Torymidae, Ormyridae and Pteromalidae (Noyes 2003). Unfortunately the taxonomical knowledge of Neotropical parasitoids of gall-inducing insects is still incomplete, and this imposes serious limitations to the development of comprehensive ecological studies.

While working on Neotropical Entedoninae, Hansson (2004) proposed and revised the *Omphale* genus group based on morphological traits and the association with gall inducers. In the Neotropics the *Omphale* group is composed of the following genera: *Ametallon* Ashmead, *Chrysonotomyia* Ashmead, *Dinopteridion* Hansson, *Driopteron* Hansson, *Eprhopalotus* Girault, *Omphale* Haliday, *Perditorulus* Hansson and *Tropicharis* Hansson.

The main objective of this work is to contribute to the knowledge of the species belonging to the *Omphale* genus group, describing new species and presenting new host records for already described species. The complete parasitoid-host relationship and the food web structure of the communities studied is described in Paniagua *et al.* (2009).

Material and methods

Material. Gall-inducing insect - parasitoid communities were sampled from 1997 to 1999 and from 2005 to 2006 in the understorey and canopy of two tropical forests of Panama: the Parque Natural Metropolitano (PNM) (8°50'N, 79°35'W, 50 masl), a Semideciduous Tropical Dry Forest located at the Pacific coast with an annual average rainfall of 1740 mm, and the San Lorenzo Protected Area (SLPA) (9°17'N, 79°58'W, 125 masl), a Perennial Tropical Forest located at the Caribbean coast with an annual average rainfall of 3400 mm (Basset *et al.* 2003).

Biweekly samples from both understorey and canopy were collected in PNM and SLPA. The forest canopy of PNM was accessed using a canopy crane with a radius of 48 m, within a plot of 1 ha of forest where 316 trees were recorded (diameter at breast height d.b.h. > 10 cm). The tree heights ranged from 30 to 40 m and the basal area was 26 m²/ha. The dominant species was *Anacardium excelsum* (Anacardiaceae), but more than 60 tree and vine species were identified. In SLPA the canopy crane had a radius of 53 m within a 6 ha plot, where more than 240 species of trees and vines were recorded. The mean tree height was 45 m, and the canopy was dominated by *Brosimum utile* (Moraceae) (Basset *et al.* 2003). The understorey was sampled within a plot of 0.4 ha below the crane perimeter in PNM and in a 0.37 ha plot within the 6 ha near the canopy crane in SLPA. The host plants sampled were identified by botanists of the Canopy Program of Smithsonian Tropical Research Institute (STRI). All individual galls found were collected and placed in sealed plastic bags (Gagné 1994). Bags were checked for emerging insects every two days for a minimum of one month. Emerging gall makers and parasitoid adults were preserved in vials with 70% ethanol. The following data were taken for each gall species collected: gall morphology, number of chambers and host plant. The specimens in alcohol were dried using a critical point drier and mounted on paper rectangles as described in Noyes (1982). The scanning electron microscope pictures were made from uncoated specimens using low vacuum mode on a JEOL© JSM 5600LV microscope.

Terminology and abbreviations. The terminology, measurements and acronyms used here follow Hansson (2002, 2004) and are described below:

FM/HM	Placement of mesoscutal setae, ratio of distance to fore/hind margin of mesoscutum.
HE/MS/WM	Ratio of height of eye (HE), malar space (MS) and width of mouth opening (WM).
LF/WF	Ratio of length/width at base of 7 th gastral tergite.
LW/LM/HW	Ratio of length of wing (LW), length of marginal vein (LM) and height of wing (HW).
MM/LG	Ratio of length of mesosoma measured from anterior margin of pronotum to posterior margin of propodeum (MM) and the length of gaster (LG).
PM/ST	Ratio of length of postmarginal vein (PM) and the length of stigmal vein (ST).
POL/OOL/POO	Ratio of distance between posterior ocelli (POL), distance between the posterior ocellus and the compound eye (OOL) and the distance between occipital margin and posterior ocelli (POO).
WH/WT	Ratio of width of head in dorsal view (WH), and the width of thorax (WT), measured across widest part.

Other acronyms

LUZM	Lund University Zoological Museum, Sweden.
MEUP	Maestría en Entomología, Universidad de Panama.
MNCN	Museo Nacional de Ciencias Naturales de España.
PNM	Parque Natural Metropolitano, Ciudad de Panama.
SLPA	San Lorenzo Protected Area.
USJ	Museo de Zoología, Escuela de Biología, Universidad de Costa Rica.

New species

Ametallon carinatum Paniagua & Hansson sp. n.

Figures 1, 8.

Etymology. In reference to the presence of a carina along posterior margin of pronotum.

Material examined. Holotype female labeled “Panama: Provincia de Colón, Fuerte Sherman, San Lorenzo, v.2006, M. Paniagua, Cecidomyiidae galls on *Inga* sp.” (LUZM). Paratypes: three females with the same label data as the holotype (MEUP); two females with same label data as the holotype (USJ).

Diagnosis. Anterior half of propodeum with transverse groove that is strongly sculptured; ratio of FM/HM = 2.2; frontal suture distinct and slightly V-shaped, not reaching the margin of the eyes; frons below frontal suture reticulate, interscrobal area smooth and shiny; vertex dark brown; mesoscutum and scutellum completely reticulate, except a small smooth spot behind the setae on midlobe of mesoscutum; forewing with two admarginal setae and one stigmal hairline; pronotum with a carina along posterior margin; scape 3.8x as long as wide.

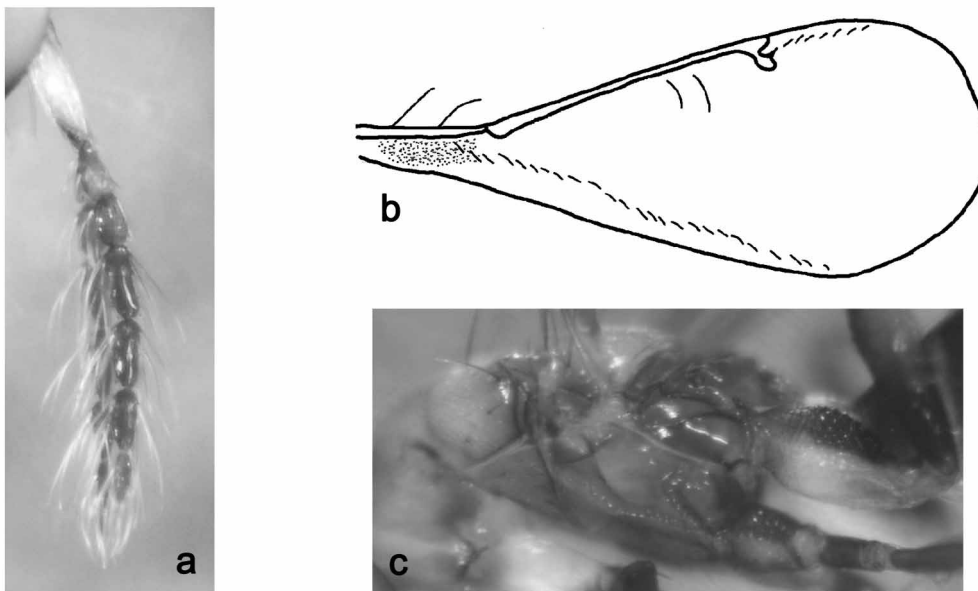


FIGURE 1. *Ametallon carinatum* sp. n., female: a) antenna lateral, b) forewing, c) thorax lateral.

Description (female). Length of body 1.6 mm. Scape yellowish-white with tip infusate, pedicel pale brown, flagellum brown with weak metallic tinges. Frons below frontal suture yellowish-brown, above suture dark brown with metallic tinges. Vertex brown with yellowish-brown spots near lateral ocelli. Occiput yellowish-brown. Midlobe of mesoscutum with anterior half pale brown, posterior half yellowish-brown. Scutellum yellowish-brown, with an anteromedian pale brown spot. Axilla brown. Fore coxa white with apex infusate, mid coxa brown, hind coxa white with dorsal surface dark brown. Fore and mid femora dark brown, hind femur dark brown with ventroapical half pale brown. Fore tibia yellowish-brown, mid tibia with anterior third pale brown, posterior two-thirds yellowish-brown, hind tibia dark brown with apical quarter yellowish, tarsi yellowish-white. Forewing hyaline with basal cell infusate and with infusate spot below base of marginal vein. Petiole yellowish-white. Gaster with first tergite anteriorly dark brown and posterior edge paler, remaining tergites dark brown with metallic purple tinges.

Antenna as in Fig. 1a. Frons below frontal suture with strong small-meshed reticulation, interscrobal area smooth, above suture and vertex smooth and shiny; frontal suture weakly V-shaped, not reaching the eye. Occipital margin rounded. Occiput with strong small-meshed reticulation. Ratios: HE/MS/WM = 4.4/1.0/2.5; LC/WC = 1.2; POL/OOL/POO = 2.7/1.4/2.5; WH/WT = 1.4.

Pronotum with carina along posterior margin. Mesoscutum with strong, small-meshed reticulation, midlobe with a small smooth spot behind the setae. Scutellum with strong, dense reticulation, meshes larger than on mesoscutum. Dorsellum reticulate. Forewing with speculum closed below, with one stigmal hairline, radial cell bare (Fig. 1b). Anterior half of propodeum with a transverse groove with strong irregular sculpture (Fig. 8). Ratios: LW/LM/HW = 1.7/1.0/1.0; PM/ST = 0.8; FM/HM = 2.2.

Gaster elongate. Ratios: MM/LG = 0.7; LF/WF = 0.7.

Male. Unknown.

Host. From lignified galls of an unidentified Cecidomyiidae in the petiole and twigs of *Inga* sp. (Fabaceae).

Biology remarks. *A. carinatum* parasitized 46% of the reared galls. There were also three more species of parasitoids found with *A. carinatum* in the *Inga* sp. galls, two unidentified Braconidae and one unidentified Eurytomidae.

Distribution. Understorey of San Lorenzo Protected Area, Provincia de Colón, República de Panama.

Identification. To accommodate *A. carinatum* in the key to females of Neotropical *Ametallon* in Hansson (2004), the ratio of FM/HM must be changed to 1.0 – 2.2 in the second alternative of couplet 8. This species will then key to couplet 15. This couplet should be modified as follows to include *A. carinatum*:

- 15(14) Toruli high up on frons, ratio of distances from toruli to frontal suture/to mouth margin = 0.6 – 0.7. 15a
- Toruli equidistant between frontal suture and mouth margin. 16
15a(15) Ratio of distances from toruli to frontal suture/to mouth margin = 0.6; mouth opening as wide as height of eye in frontal view *A. barbilla* Hansson
- Ratio of distances from toruli to frontal suture/to mouth margin = 0.7; mouth opening is 0.6x as wide as height of an eye..... *A. carinatum* Paniagua & Hansson **sp. n.**

Chrysonotomyia dussiae Paniagua & Hansson **sp. n.**

Figure 2.

Etymology. In reference to the plant genus *Dussia*.

Material examined. Holotype female labeled “Panama, Prov. Colón. Área Protegida San Lorenzo, Dosel, 1999, galls on *Dussia munda*, E. Medianero” (LUZM). Paratypes: eight females, four males with same label data as holotype (MEUP).

Diagnosis. A completely non-metallic yellowish-white species that is very poorly sclerotized.

Description. Length of body female 0.4–0.5 mm, male 0.4 mm. Female and male with head, antenna and body yellowish-white, without metallic tinges, apical part of ovipositor sheaths pale brown. Wings hyaline in both sexes.

Antenna as in Fig. 2a. Male antenna with short verticillate setae. Frons and vertex weakly reticulate; frontal suture slightly V-shaped. Vertex with very weak reticulation and with grooves. Occipital margin rounded. Ratios: HE/MS/WM = 5.1/1.0/3.4; POL/OOL/POO = 1.6/1.1/1.0; WH/WT = 1.1.

Mesoscutum and scutellum with very weak and medium sized reticulation, notauli visible in anterior fourth. Dorsellum convex not hidden under scutellum, with very weak reticulation. Transepimeral sulcus strongly curved. Forewing with speculum closed below; without stigmal hairlines, radial cell bare (Fig. 2c). Propodeum smooth, without median carina. Ratios: LW/LM/HW = 1.7/1.0/1.2; PM/ST = 0.8.

Female gaster ovate. Male digitus as in Fig. 2b. Ratio of MM/LG = 1.0.

Host. From Cecidomyiidae galls on *Dussia munda* (Fabaceae).

Distribution. Canopy of the San Lorenzo Protected Area, Provincia de Colón, República de Panama.

Identification. This species belongs to the *auripunctata*-group (sensu Hansson 2004) and using the key in Hansson the female runs to couplet 61. This couplet should be modified as follows to include *C. dussiae*:

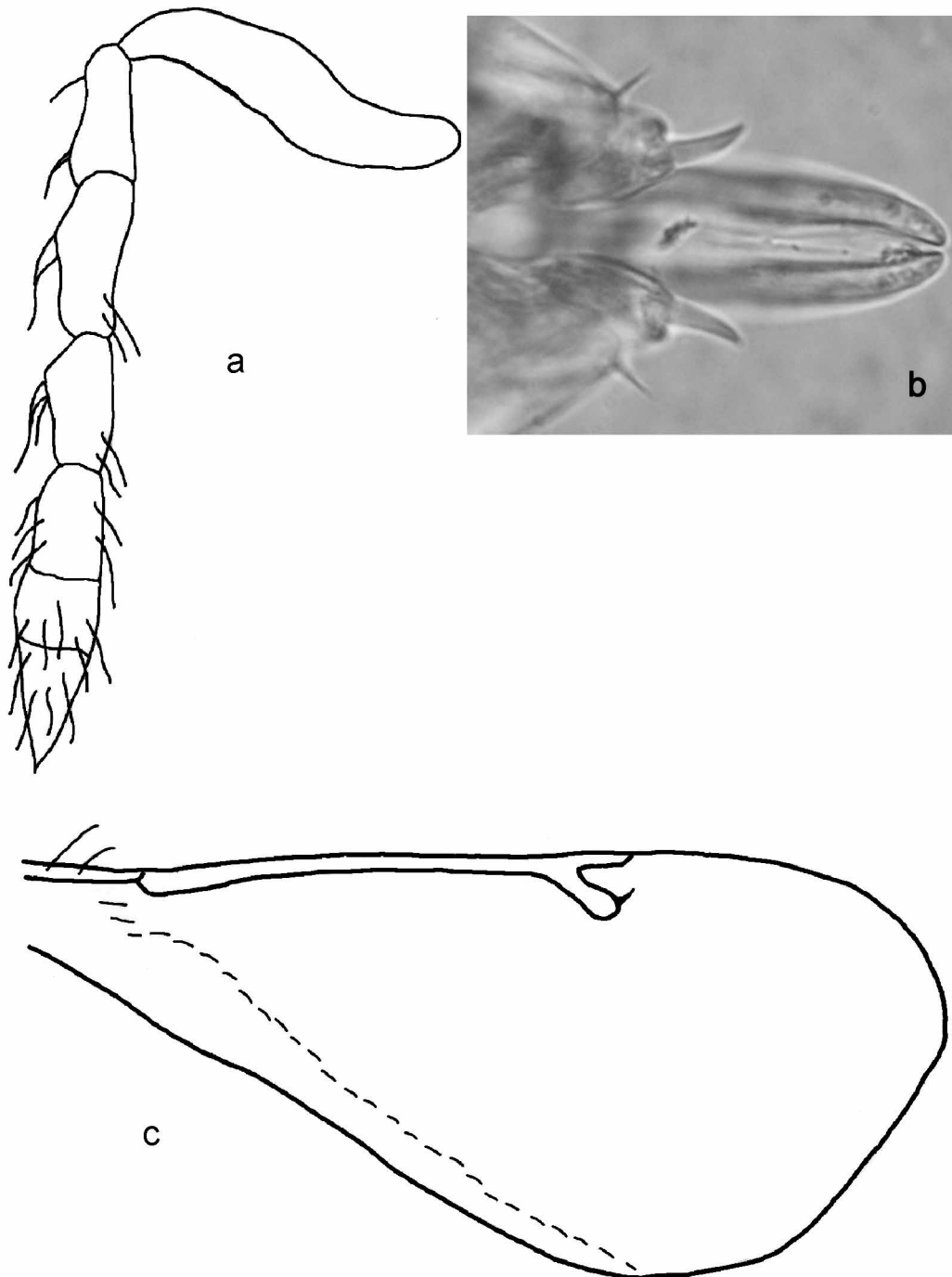


FIGURE 2. *Chrysonotomyia dussiae* sp. n.: a) antenna lateral (female), b) digitus (male), c) forewing (female).

- 61(60) Pronotum comparatively large, especially laterally..... *C. albogilva* Hansson
 - Pronotum hardly visible in dorsal view 61a
 61a(60) Vertex with grooves (Hansson 2004, fig. 25) *C. galbina* Hansson
 - Vertex without grooves *C. dussiae* Paniagua & Hansson sp. n.

The male of *C. dussiae* runs to couplet 65 in Hansson (2004); to include this species the key should be modified as follows:

- 65(64) Mesepimeron yellowish white to pale yellow non-metallic 65a
 - Mesepimeron brown with metallic tinges..... *C. galbina* Hansson

- 65a(65) Midlobe of mesoscutum with anterior half golden-green and scutellum with posterior two thirds golden-purple
..... *C. cnecosoma* Hansson
- Mesoscutum and scutellum yellowish-white..... *C. dussiae* Paniagua & Hansson **sp. n.**

***Chrysonotomyia longicaudata* Paniagua & Hansson sp. n.**

Figures 3, 9, 10.

Etymology. From the Latin: *longus*, long, *caudatus*, tailed, in reference to the elongate apical tergite on female gaster.

Material examined. Holotype female labeled “Panama: Provincia de Colón, Fuerte Sherman, San Lorenzo, iv.2006, M. Paniagua, Cecidomyiidae galls on *Coccoloba parimensis*” (LUZM). Paratypes: two females, three males with same label data as holotype (in coll. Christer Hansson); 11 females, 18 males with the same label data as holotype (MEUP); four females, three males with the same label data as holotype (USJ); five females, five males with the same data as holotype (MNCM).

Diagnosis. Apical tergite of female gaster elongate and parallel-sided (Fig. 10), as long as remaining gaster; frons with pale brown spot in front of anterior ocellus; midlobe of mesoscutum completely and brightly metallic (golden-green); female scutellum without metallic stripe (some specimens with a brownish stripe), male scutellum with a small brownish spot in anterior third; with hind tarsomeres 1–2 brown and 3–4 white; male gaster with first tergite pale brown with weak metallic tinges, tergite 2 yellow, remaining tergites pale brown with metallic purplish tinges; vertex with weak reticulation with transverse meshes.

Description. Length of body female (including last gastral tergite) 1.6–1.8 mm, male 1.1–1.3 mm. Scape with outer surface yellowish inner surface pale brown, pedicel pale brown, flagellum dark brown. Frons yellow. Vertex yellow with pale brown spot in front of anterior ocellus and narrow bluish-purple metallic stripe close to eyes lateral to lateral ocellus. Pronotal collar golden-green, lateral pronotum white. Midlobe of mesoscutum golden-green, sidelobes yellow with area adjacent to notaular depressions golden-green. Scutellum yellowish-brown without metallic stripe (a brown stripe is present in some specimens). Axilla yellowish-brown, anteriorly with a very weak metallic spot. Dorsellum yellowish-brown. Lateral and ventral thorax predominantly yellow; upper mesepimeron with pale brown spot, lower mesepimeron with weak metallic purplish tinges. Propodeum pale brown with metallic golden-green tinges, with two yellowish-brown spots posterolaterally. Fore coxa yellowish-white, mid coxa ventrally pale brown, dorsally white, hind coxa white, anteroventrally infuscate (dark brown); femora pale brown; fore tibia with anterior third yellowish-brown, posterior two thirds yellowish-white; mid tibia yellowish-white; hind tibia with anterior half brown and posterior half yellowish-brown; fore and mid tarsi white, hind tarsus with tarsomeres 1–2 brown and 3–4 white. Female forewing with two infuscate spots, one below middle of marginal vein, one below stigmal vein (Fig. 3b); male forewing completely hyaline. Petiole yellowish. Female gaster pale brown, first tergite with golden-green tinges, remaining tergites with weak metallic purple tinges, posterior edges of tergites 2–6 brown, tergite 7 yellowish-white with apical third dark brown; male gaster with first tergite pale brown with weak metallic tinges, tergite 2 yellow, remaining tergites pale brown with metallic purplish tinges.

Antennae as in Fig. 3c. Frons with weak small meshed reticulation; frontal suture straight. Vertex with weak reticulation, meshes transverse. Occipital margin rounded. Ratios: HE/MS/WM = 4.8/1.0/2.6; POL/OOL/POO = 1.1/1.0/1.0; WH/WT = 1.3.

Pronotum without transverse carina along posterior margin. Midlobe of mesoscutum with strong and large meshed reticulation, sidelobes with weaker reticulation and smaller meshes. Scutellum with strong reticulation, meshes small and elongate (Fig. 9). Forewing with speculum open below; radial cell bare and with one stigmal hairline; area between infuscate spots hairy. Propodeum with complete median carina, otherwise smooth and shiny. Ratios: LW/LM/HW = 2.1/1.3/1.0; PM/ST = 1.6.

Female gaster elongate with last tergite elongate and parallel-sided, as long as remaining gaster. Ratio of MM/LG = 0.3. Male phallobase and digitus as Fig. 3a.

Host. From galls of unidentified Cecidomyiidae on *Coccoloba parimensis* (Polygonaceae).

Biology remarks. *C. longicaudata* parasitized 80.7% of the collected galls. The other parasitoid species found in the galls of *Coccoloba parimensis* was an unidentified species of Platygasteridae.

Distribution. Understorey of San Lorenzo Protected Area, Provincia de Colón, República de Panama.

Identification. This species belongs to *bimaculata*-group (sensu Hansson 2004), and using the key in Hansson (2004) the female runs to couplet 55. To include *C. longicaudata* the key should be modified as follows:

Couplet 54, second alternative leads to 55a, not 55.

- 55a. 7th gastral tergite as long as remaining gaster (Fig. 9)..... *C. longicaudata* Paniagua & Hansson **sp. n.**
 - 7th gastral tergite much shorter 55

The male runs to couplet 65 in Hansson (2004), and to include *C. longicaudata* in the key it should be modified as follows:

Couplet 64, second alternative leads to 65a, not 65.

- 65a Midlobe of mesoscutum completely metallic (golden-green)..... *C. longicaudata* Paniagua & Hansson **sp. n.**
 - Midlobe of mesoscutum with at least posterior 0.2 pale yellow non-metallic 65

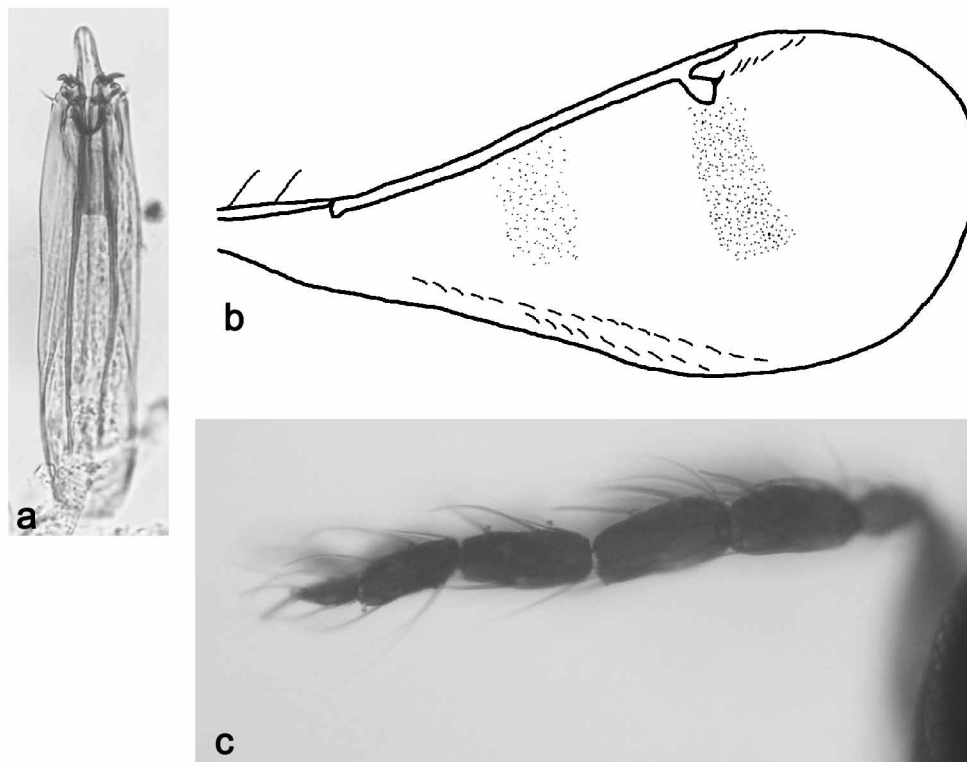


FIGURE 3. *Chrysonotomyia longicaudata* **sp. n.**: a) male phallobase, b) forewing (female), c) antenna lateral (female).

Chrysonotomyia machaeriae* Paniagua & Hansson **sp. n.*

Figures 4, 11, 12, 14f.

Etymology. From the plant genus *Machaerium*.

Material examined. Holotype female labeled “Panama: Provincia de Panama, Parque Natural

Metropolitano, ii.2006, M. Paniagua, Cecidomyiidae galls on *Machaerium milleflorum*" (LUZM). Paratypes: seven females with same label data as holotype (LUZM); 43 females with the same label data as holotype (MEUP); 12 females with same label data as holotype (USJ); 10 females with same label data as holotype (MNCN)

Diagnosis. Body predominantly yellow non-metallic, gastral tergites 1 and 4–7 yellow, tergites 2–3 brown; frons without cross-bands; mesoscutum and scutellum with very weak and small meshed reticulation (Fig. 10).

Description (female). Length of body 0.9–1.0 mm. Scape and pedicel pale yellow, flagellum yellowish-brown. Frons, vertex and occiput yellow. Pronotum with anterior half white, posterior half yellow. Mesoscutum, scutellum, dorsellum and propodeum yellow. Coxae yellow; femora, tibia and tarsi yellowish-white. Forewing hyaline. Petiole yellow. Gaster yellow, tergites 2–3 yellowish-brown to pale brown.

Antenna as in Fig. 4a. Frons reticulate with a sharp ridge in the interscrobal area. Frontal suture straight, bifurcating laterally, ventral arm slightly downcurved. Vertex reticulate with a strong oblique furrow between the anterior ocellus and each posterior ocelli (Fig. 4c). Occipital margin rounded. Ratios: HE/MS/W = 3.1/1.0/2.2; POL/OOL/POO = 3.0/2.2/1.0; WH/WT = 1.1.

Mesoscutum and scutellum with very weak and small meshed reticulation. Notauli visible in anterior fourth (Fig. 11). Transepimeral sulcus strongly curved (Fig. 12). Dorsellum convex with weak reticulation. Forewing with speculum closed below; radial cell bare, without stigmal hairlines (Fig. 4b). Propodeum with very weak reticulation. Ratios: LW/LM/HW = 1.9/1.0/1.1; PM/ST = 0.3.

Gaster ovate, with weak and small meshed reticulation. Ratio of MM/LG = 0.9.

Male: Unknown.

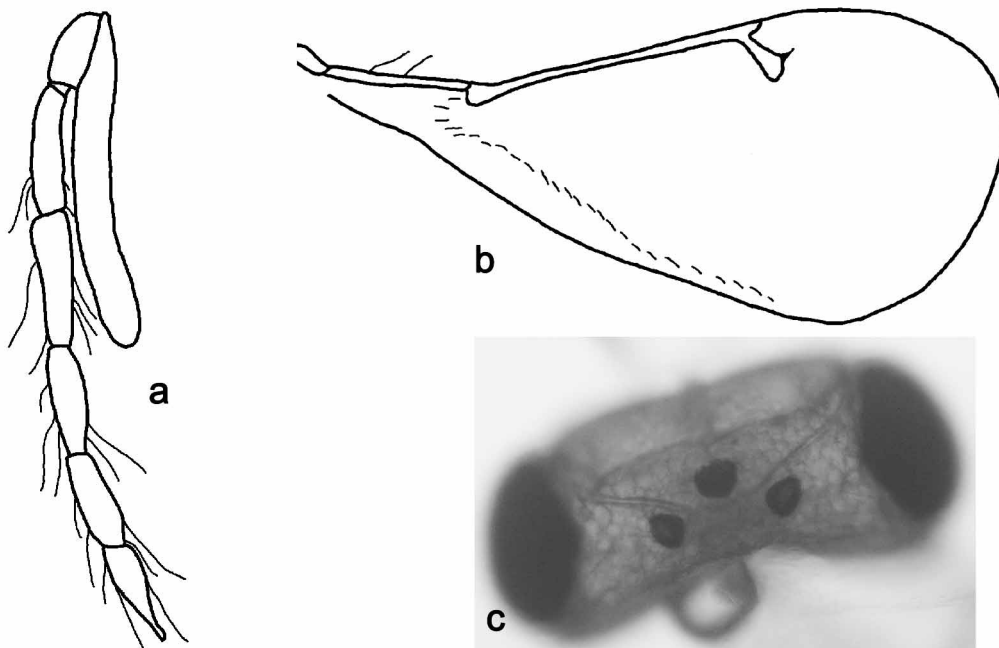


FIGURE 4. *Chrysonotomyia machaeriae* sp. n.: a) antenna lateral (female), b) forewing (female). c) head dorsal.

Host: From blister galls of an unidentified Cecidomyiidae on *Machaerium milleflorum* (Fabaceae) (Fig. 14f).

Biology remarks. The parasitoid complex reared from the galls on *Machaerium milleflorum* is composed of three species; *Ablerus* sp. (Aphelinidae: Azotinae), an unidentified species of Tetrastichinae and *C. machaeriae*. *C. machaeriae* parasitized 34.5% of the collected galls.

Distribution. Canopy of the Parque Natural Metropolitano, Provincia de Panama, República de Panama.

Identification. This species belongs to the *C. auripunctata*-group (sensu Hansson 2004). With the key in Hansson (2004), the female runs to couplet 60. To include *C. machaeriae* the key should be modified as follows:

Couplet 59, second alternative leads to 60a, not 60.

60a. Gaster yellow with tergites 2–3 yellowish-brown to pale brown..... *C. machaeriae* Paniagua & Hansson **sp. n.**
- Gaster completely yellow, or yellow with 4 dark cross-bands 60

***Chrysonotomyia unimaculata* Paniagua & Hansson sp. n.**

Figure 5.

Etymology. From the Latin *uni*, one, and *macula*, spot, in reference to the single infusate spot in female forewing.

Material examined. Holotype female labeled “Panama: Provincia de Panama, Parque Natural Metropolitano, iv.2006, M. Paniagua, Cecidomyiidae galls on *Phryganocydia corymbosa*” (LUZM). Paratype: one male with same label data as holotype (LUZM).

Diagnosis. Scutellum with median metallic stripe that is parallel-sided from transscutal articulation to the level of scutellar setae, and becoming narrower behind the scutellar setae; female forewing with infusate spot below stigmal vein; male gaster dark brown, hind margin of tergite 2 and median area of tergite 3 yellowish; vertex with weak reticulation.

Description. Length of body female 2.2 mm, male 0.9 mm (head+mesosoma, excl. gaster). Scape yellow with inner surface infusate and ventral edge dark brown, pedicel pale brown, flagellum dark brown. Frons and vertex yellow, vertex with a narrow metallic stripe close to eyes lateral to lateral ocelli. Pronotal collar golden-green, lateral pronotum yellowish-white, remaining pronotum yellowish-brown. Midlobe of mesoscutum metallic bluish-green, sidelobes yellowish-brown with area lateral to notaular depression metallic bluish-green. Scutellum yellowish-brown with a median bluish-green metallic stripe which is parallel-sided from transscutal articulation to the scutellar setae and becoming narrower behind the setae, not quite reaching the posterior margin of scutellum. Axillae yellowish-brown, without metallic spots. Dorsellum yellowish-brown. Propodeum yellowish-brown with two metallic bluish spots. Fore and mid coxae yellowish-white, hind coxa white. Fore femur pale brown, mid femur yellow infusate dorsally, hind femur with basal two thirds weakly infusate, distal third yellow; tibiae and tarsi yellow. Female forewing with a single infusate spot below stigmal vein, male forewing completely hyaline. Petiole yellow. Female gaster with first tergite metallic bluish-green, tergites 2–5 yellowish brown with posterior edge brown, tergite 6 entirely yellowish-brown, tergite 7 apically black, apical part of ovipositor sheaths black.

Antennae as in Figs 5a and 5b. Frons with strong small meshed reticulation, frontal suture slightly V-shaped. Vertex with weak reticulation. Ratios: HE/MS/WM = 4.4/1.0/2.4; POL/OOL/POO not measurable due to shrivelled head; WH/WT = 1.2.

Pronotum without transverse carina along posterior margin. Mesoscutum with midlobe with strong and large meshed reticulation, sidelobes with strong reticulation but with small meshes. Scutellum with strong and small meshed reticulation, meshes isodiametric. Propodeum with weak median carina, weakly reticulate. Forewing with speculum closed below, with one stigmal hairline. Ratios: LW/LM/HW = 1.8/1.0/1.9; PM/ST = 1.4.

Female gaster elongate. Ratio of MM/LG: 0.5 (female). Male digitus as in Fig. 5c.

Host. From lignified galls of Cecidomyiidae on petiole of *Phryganocydia corymbosa* (Bignoniaceae).

Biology remarks. The galls on *Phryganocydia corymbosa* were parasitized by *Allorhogas* sp (Braconidae), an unidentified Eurytomidae and *C. unimaculata*. *C. unimaculata* was found in 24% of the galls reared.

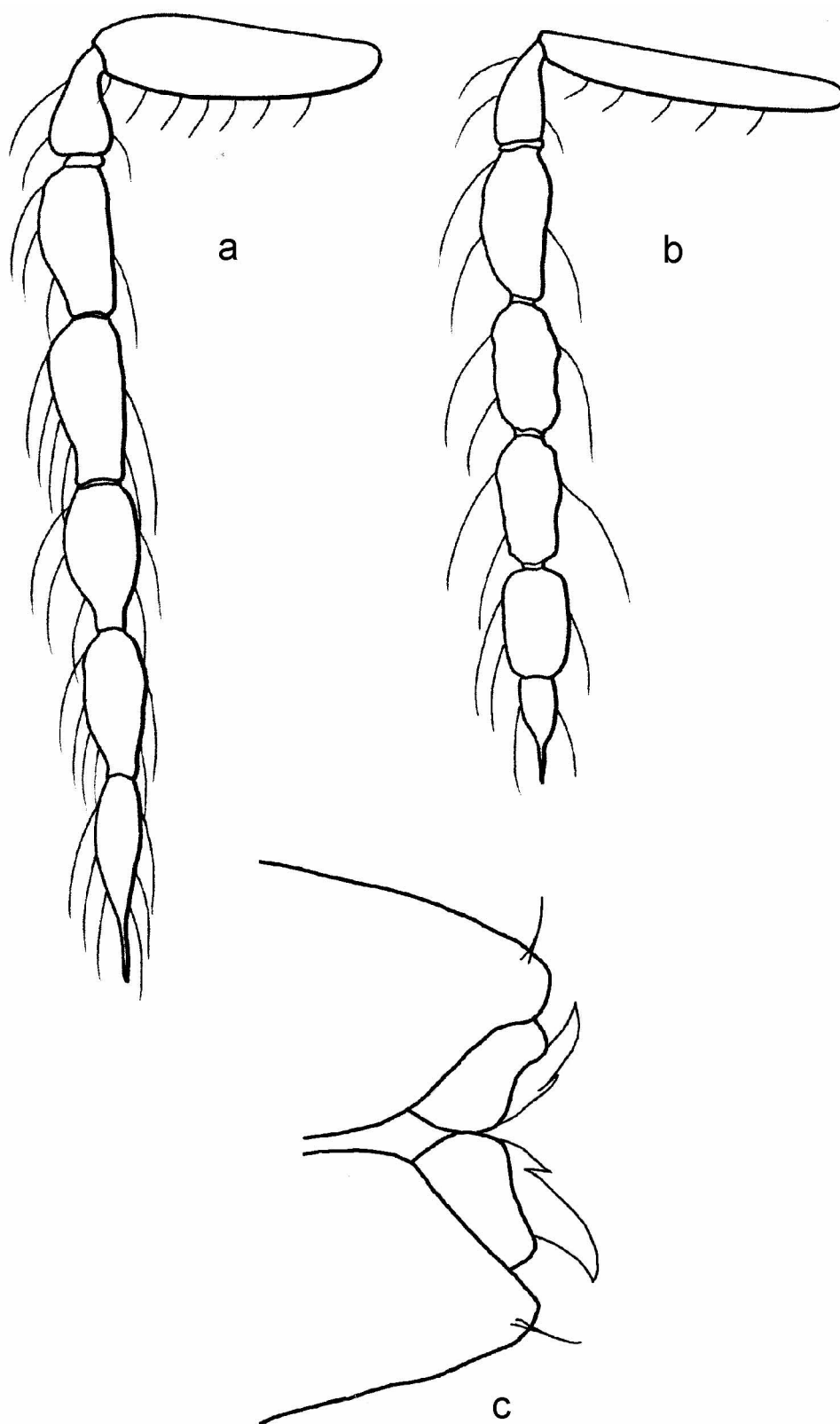


FIGURE 5. *Chrysonotomyia unimaculata* sp. n.: a) male antenna, b) female antenna, c) male digitus.

Distribution. Understorey of Parque Natural Metropolitano, Provincia de Panama, República de Panama.

Identification. This species belongs to the *C. bimaculata*-group (sensu Hansson 2004). Using the key from Hansson (2004) the female runs to couplet 57. In order to include *C. unimaculata*, this couplet should be modified as follows:

57 (52) Gaster elongate, ratio MM/LG = 0.5 – 0.6.....	57a
- Gaster ovate, ratio MM/LG = 0.7 – 1.1	58
57a(52)Ratio MM/LG = 0.6, mesoscutum yellowish-brown, not metallic, with weak reticulation	<i>C. maculata</i> (Delucchi)
- Ratio MM/LG = 0.5, mesoscutum completely metallic bluish-green and strongly reticulate.....	<i>C. unimaculata</i> Paniagua & Hansson sp. n.

The male of *C. unimaculata* runs to couplet 65. To include *C. unimaculata* the key should be modified as follows:

Couplet 64, second alternative leads to 65a, not 65.

65a Midlobe of mesoscutum completely metallic and with strong reticulation	<i>C. unimaculata</i> Paniagua & Hansson sp. n.
- Midlobe of mesoscutum with posterior part yellow non-metallic and with very weak reticulation	65

***Chrysonotomyia claviger* Paniagua & Hansson sp. n.**

Figures 6, 7, 13, 14b.

Etymology. Meaning “carrying a clava” referring to the distinct antennal clava.

Material examined. Holotype female labeled “Panama: Provincia de Panama, Parque Natural Metropolitano, ii.2006, M. Paniagua, agallas de *Copaifera* sp. (Fabaceae)” (LUZM). Paratypes: 21 females with the same label data as holotype (MEUP); one female from same locality as holotype but collected 6.iii.1998 and from an unidentified gall on *Serjania mexicana* (LUZM); six females with the same label data as holotype (USJ); five females with the same label data as holotype (MNCN).

Diagnosis: Postmarginal vein 1.6x as long as stigmal vein; submarginal vein with three setae; antenna with a well defined clava; frons, vertex and mesosoma dark brown with metallic tinges; vertex reticulate; gaster round.

Description (female). Length of body 0.9–1.1 mm. Antenna dark brown. Frons, vertex and occiput dark brown with metallic tinges. Mesoscutum, scutellum and lateral mesosoma black with metallic tinges (golden-green or bluish-purple). Coxae dark brown with metallic tinges; fore and mid femora dark brown with metallic tinges, hind femur dark brown with metallic tinges with apical fourth yellowish-white; fore tibia yellowish-brown, mid and hind tibiae dark brown with metallic tinges, with apical third yellowish-white. Forewing hyaline. Petiole yellowish to pale brown. Gaster pale brown to dark brown with metallic tinges, anterior part of first tergite smooth and shiny with golden-green or green metallic tinges, remaining tergites weakly reticulated, with golden-purple tinges (Fig 7b).

Antenna with apical three flagellomeres fused and forming a well defined clava (Fig. 6a). Frons with strong reticulation, frontal suture straight or slightly V-shaped (Fig. 13). Vertex reticulate. Occipital margin rounded. Ratios: HE/MS/WM = 3.6/1.0/1.7; POL/OOL/POO = 4.4/1.2/1.0; WH/WT = 1.2.

Mesoscutum and scutellum with strong small meshed reticulation, notauli not visible. Dorsellum hidden under scutellum in dorsal view. Transepimeral sulcus weakly curved. Forewing with speculum open below; radial cell bare but without stigmal hair lines (Fig. 6b). Propodeum with very weak reticulation; propodeal callus with three setae. Ratios: LW/LM/HW = 1.9/1.0/1.4; PM/ST = 1.6.

Gaster round. Ratio of MM/LG = 1.2.

Male. Unknown.

Host. From unidentified gall-midges (Diptera: Cecidomyiidae) on *Copaifera* sp. (Fabaceae) (Fig. 14b) and *Serjania mexicana* (Sapindaceae) (Fig. 14d).

Biology remarks. *C. claviger* was the only species found parasitizing the globular galls of *Copaifera* sp.

Distribution. Understorey of Parque Natural Metropolitano, Provincia de Panama, República de Panama.

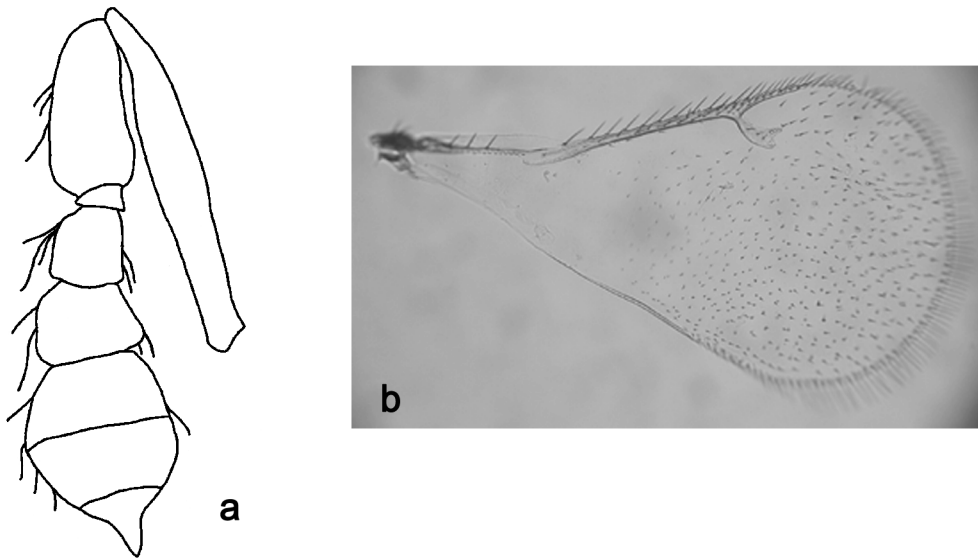


FIGURE 6. *Chrysonotomyia claviger* sp. n.: a) antenna lateral, b) forewing.

Identification. *C. claviger* belongs to *C. neeigena*-group (sensu Hansson 2004) and using the key in Hansson (2004) runs to couplet 78. To include this species in the key, this couplet should be changed as follows:

- 78(77) Postmarginal vein at least 1.6x as long as stigmal vein..... 79
 - Postmarginal vein shorter, at most 0.8x as long as stigmal vein 83

Then, it keys to couplet 82, and to include *C. claviger* the key should be modified as follows:

Couplet 81, second alternative leads to 82a, not 82.

- 82a. Antennal clava distinctly wider than the funicular segments, postmarginal vein only 1.6x as long as stigmal vein ...
 *C. claviger* Paniagua & Hansson sp. n.
 - Antennal clava about as wide as the funicular segments, postmarginal vein 2.9–3.2x as long as stigmal vein..... 82

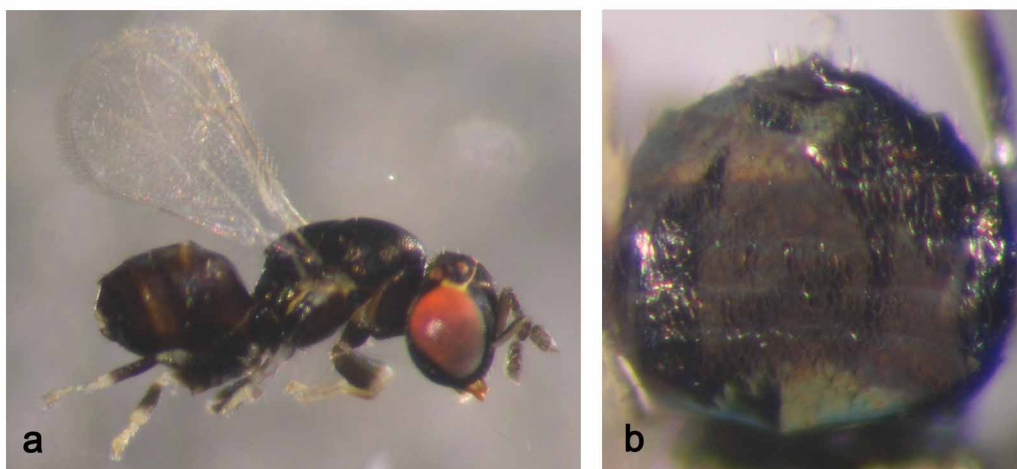


FIGURE 7. *Chrysonotomyia claviger* sp. n.: a) female habitus, b) female gaster.

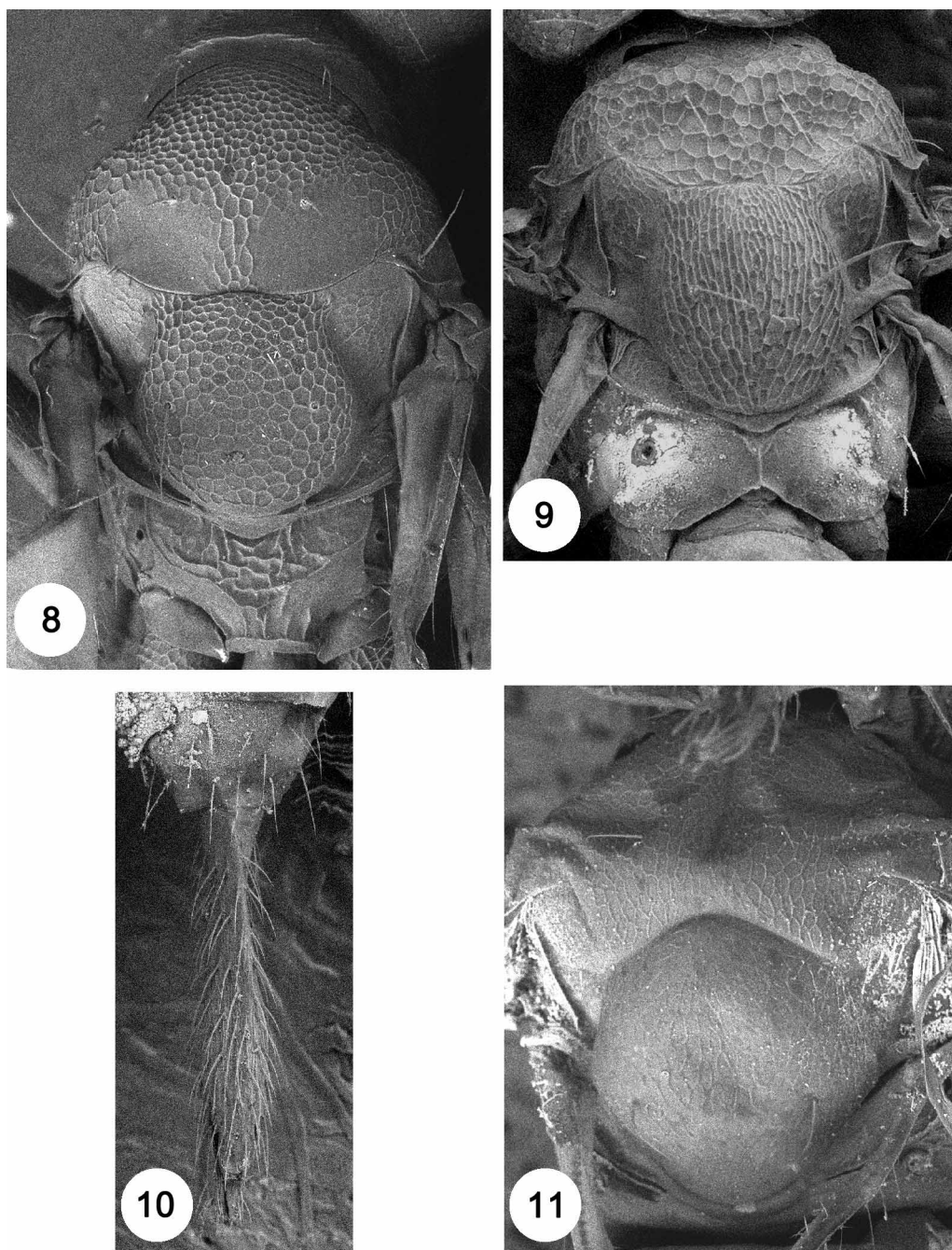


FIGURE 8–11. 8. *Ametallon carinatum* sp. n., thoracic dorsum (female). 9. *Chrysonotomyia longicaudata* sp. n., thoracic dorsum (female). 10. *Chrysonotomyia longicaudata* sp. n., gastral apical tergite (female). 11. *Chrysonotomyia machaeriae* sp. n., thoracic dorsum (female).

New host records

Ametallon gorgonaense Hansson, 2004

New host records. Cecidomyiidae on *Inga* spp. (Fabaceae) and *Serjania mexicana* (Sapindaceae) (Fig. 14c).

Based on 14 specimens from Parque Natural Metropolitano and Área Protegida San Lorenzo, Panama (MEUP).

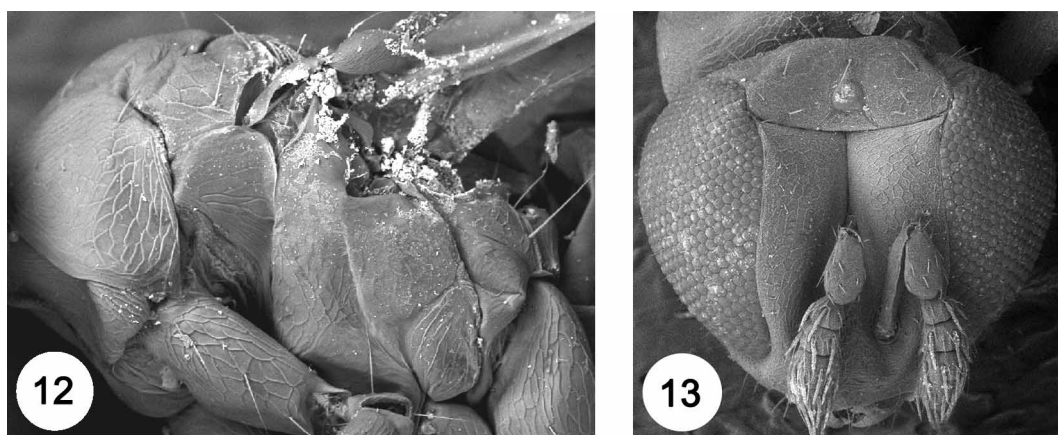


FIGURE 12, 13. 12. *Chrysonotomyia machaeriae* sp. n., thorax lateral (female). 13. *Chrysonotomyia claviger* sp. n., head frontal (female).

Chrysonotomyia auripunctata (Ashmead, 1894)

New host record. Cecidomyiidae on *Hirtella flava* (Chrysobalanaceae) (Fig. 14g).

Based on three females, two male from Cerro Azul – Altos de Pacora. Panama (MEUP). See Hansson (2004) for redescription and other hosts.

Chrysonotomyia galbina Hansson, 2004

New host record. Cecidomyiidae on *Poulsenia armata* (Moraceae).

Based on seven females “Panama, Prov. Colón, Área Protegida San Lorenzo” (MEUP).

Chrysonotomyia laeviscuta Hansson, 2004

New host record. Cecidomyiidae on *Smilax panamensis* (Smilacaceae) (Fig. 14e).

Based on two females from Área Protegida San Lorenzo, Panama (MEUP).

Chrysonotomyia phenacapsia (Yoshimoto, 1972)

New host record. Cecidomyiidae on *Copaifera* sp. (Fabaceae) (Fig. 14a).

Based on 112 specimens (62 females, 50 males), from Parque Natural Metropolitano, Panama (MEUP). See Hansson (2004) for redescription.

Tropicharis cecivora Hansson, 1998

New host records. Cecidomyiidae on *Cydista* sp. (Bignoniaceae), *Inga* spp. (Fabaceae), *Smilax panamensis* (Smilacaceae) (Fig. 14e), *Heisteria acuminata* (Olacaceae), *Unonopsis* sp. (Annonaceae) (Fig. 14h), *Dendropanax arboreum* (Araliaceae), *Philodendron* spp. (Araceae), *Hirtella flava* (Chrysobalanaceae) (Fig. 14g) and two gall midges on *Serjania mexicana* (Sapindaceae) (Fig. 14c–d).

Based on 183 specimens from the understoreys of Parque Natural Metropolitano, Área Protegida San Lorenzo y Cerro Azul – Altos de Pacora, Republic of Panama (MEUP). See Hansson (2004) for other hosts.

Acknowledgements

We thank the STRI Canopy Program for the access to the canopy cranes and collecting sites and for identification of hosts plants, and the Electron Microscopy Unit at COB (Lund University) for the use of their facilities. Miguel Paniagua was supported by a scholarship granted from the Programa Regional DAAD.

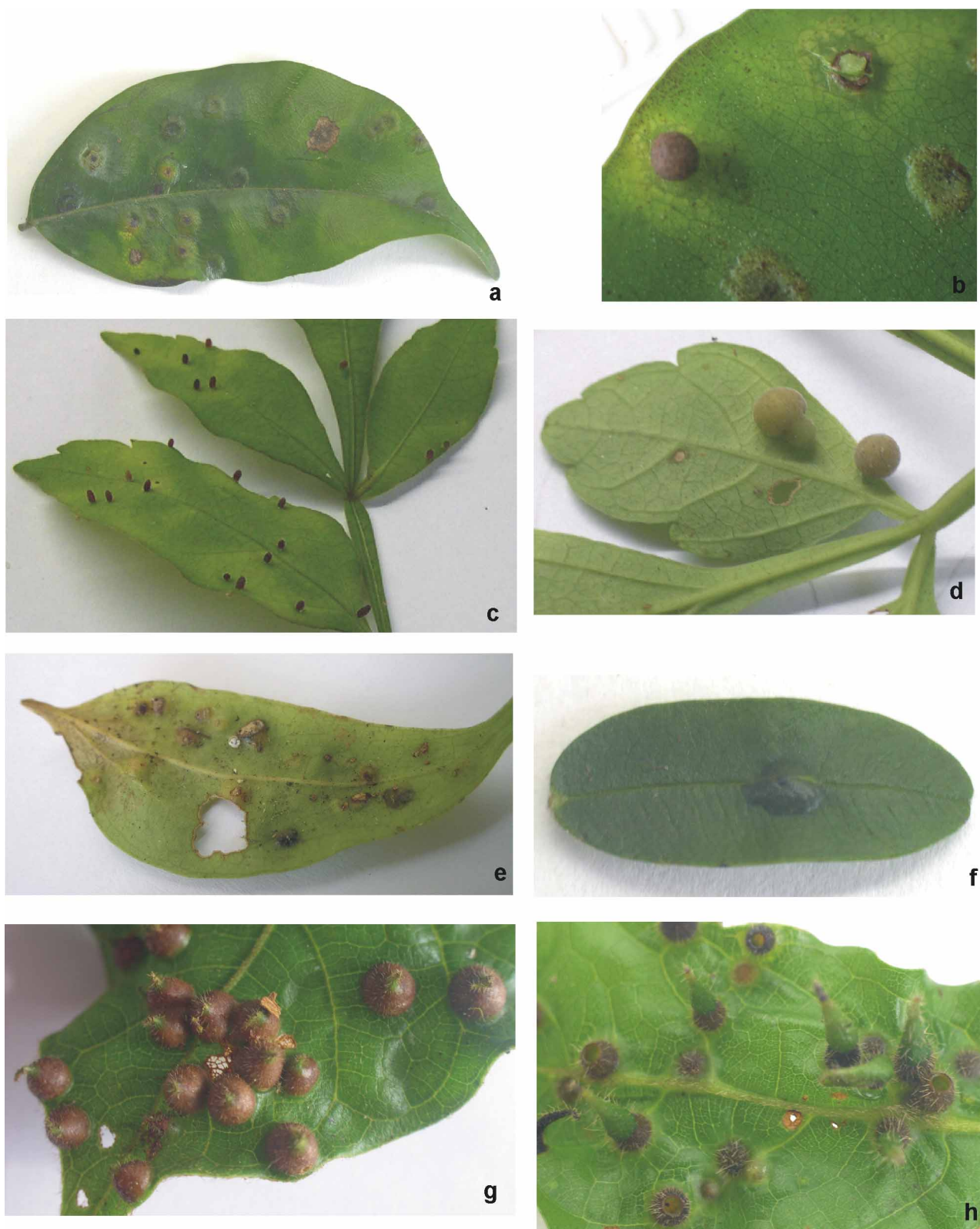


FIGURE 14. Cecidomyiidae galls: a) blister galls on *Copaifera* sp., b) globular gall on *Copaifera* sp., c) cylindrical galls on *Serjania mexicana*, d) globular galls on *Serjania mexicana*, e) blister galls on *Smilax panamensis*, f) blister galls on *Machaerium milleflorum*, g) globular galls on *Hirtella flava*, h) galls on *Unonopsis* sp.

References

- Ashmead, W.H. (1894) Report on the parasitic Cynipidae, part of the Braconidae, the Ichneumonidae, the Proctotrypidae, and part of the Chalcididae. Part II. *Journal of the Linnean Society (Zoology)*, 25, 108–188.
- Basset, Y., Horlyck, V. & Wright, S.J. (eds) (2003) *Studying Forest Canopies from Above: The International Canopy Crane Network*. Smithsonian Tropical Research Institute and UNEP, Panama City, 196 pp.
- Gagné, R.J. (1994) *The gall midges of the neotropical region*. Cornell University Press, Ithaca, NY, 352 pp.
- Hansson, C. (1998) A new genus and species of Entedoninae (Hymenoptera: Eulophidae) from the Neotropical region. *Proceedings of the Entomological Society of Washington*, 100, 689–694.
- Hansson, C. (2002) Eulophidae of Costa Rica, 1. *Memoirs of the American Entomological Institute*, 67, 1–290.
- Hansson, C. (2004) Eulophidae of Costa Rica, 2. *Memoirs of the American Entomological Institute*, 75, 1–536.
- Hawkins, B.A. (1994) *Pattern and process in host - parasitoid interactions*. Cambridge University Press. Cambridge U.K. 190 pp.
- Noyes, J.S. (1982) Collecting and preserving chalcid wasps (Hymenoptera: Chalcidoidea). *Journal of Natural History*, 16, 315–334.
- Noyes, J.S. (2003) Universal Chalcidoidea database. Available from <http://www.nhm.ac.uk/research-curation/projects/chalcidoids> [accessed 25 July 2009].
- Paniagua, M.R., Medianero, E. & Lewis, O.T. (2009) Structure and vertical stratification of plant galler – parasitoid food webs in two tropical forests. *Ecological Entomology*, 34, 310 – 320.
- Stone, G.N. & Schonrogge, K. (2003) The adaptative significance of insect gall morphology. *Trends in Ecology and Evolution*, 18, 512–522.
- Yoshimoto, C.M. (1972) A new species of *Achrysocharis* (Eulophidae, Chalcidoidea) from pine needle scale (Diaspididae, Hom.). *The Canadian Entomologist*, 104, 1483–1485.