ZooKeys 97: 1–10 (2011)
doi: 10.3897/zookeys.97.741
www.zookeys.org

RESEARCH ARTICLE

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A remarkable new species of the sharpshooter genus *Egidemia* (Insecta, Hemiptera, Cicadellidae, Cicadellinae)

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Academic editor: *Mike Wilson* | Received 18 November 2010 | Accepted 15 April 2011 | Published 11 May 2011

urn:lsid:zoobank.org:pub:89D58892-EC1E-4C9F-AA41-984BFE5599B5

Citation: Mejdalani G, Garcia C (2011) A remarkable new species of the sharpshooter genus *Egidemia* (Insecta, Hemiptera, Cicadellidae, Cicadellinae). ZooKeys 97: 1–10. doi: 10.3897/zookeys.97.741

Abstract

A new species of *Egidemia* China, 1927, *E. impudica*, is described and illustrated from the Department of Magdalena (Colombia). The male genitalia of the new species have a very peculiar, diagnostic feature: the pygofer is considerably reduced and truncate posteriorly, so that part of the aedeagus is exposed. A key to males of all known *Egidemia* species is provided. Notes comparing *E. impudica* with the other nine known species of the genus are also given.

Keywords

Auchenorrhyncha, Colombia, identification key, leafhopper, Proconiini, taxonomy

Introduction

The sharpshooter genus *Egidemia* China, 1927 currently includes nine species (Carpi and Mejdalani 2010): *E. anceps* (Fowler, 1899), type species, *E. fowleri* (Distant, 1908), *E. gracilis* Schröder, 1972, *E. inflata* Young, 1968, *E. obtusata* (Melichar, 1925), *E. paranceps* Young, 1968, *E. peruana* Carpi & Mejdalani, 2010, *E. proxima* (Melichar, 1925), and *E. speculifera* (Walker, 1851). This genus is widespread in the Neotropical region, being recorded from Mexico and Panama to Peru, Brazil, and Argentina (Young 1968). *Egidemia* was also recorded from Colombia by Freytag and Sharkey (2002). However, it should be noted that the box 2 of Freytag and Sharkey (2002), in which a synopsis of Colombian Cicadellidae is provided, indicates that the genus is not known from Colombia, whereas their taxonomic list mentions the record of *Epidemia* [sic] sp. from the Colombian Department of Magdalena. *Egidemia* can be distinguished from other genera of the Proconiini by the following combination of features (see key of Young 1968): (1) frons with texture of dorsomedian area granular; (2) metameron exposed when the forewings are in rest position; (3) metepimeron with shelflike projection; (4) forewings hyaline or translucent and (5) with the claval veins consistently fused through a considerable portion of their length. The reader is referred to Carpi and Mejdalani (2010) for additional notes on the taxonomy and possible phylogenetic relationships of *Egidemia* to other genera of the Proconiini.

We describe herein a remarkable new *Egidemia* species from Colombia (Department of Magdalena). The description is based on the material that Freytag and Sharkey (2002) employed to provide the above-mentioned record of *Epidemia* [sic] sp. from Colombia. We consider the new species remarkable because its male pygofer is considerably reduced and with a truncate posterior margin, so that part of the aedeagus is exposed, a very peculiar feature for a Proconiini sharpshooter. A new key to males of the species of *Egidemia*, modified from that of Carpi and Mejdalani (2010), is provided.

Material and methods

Techniques for preparation of the male genital structures follow Oman (1949). The dissected parts are stored in microvials with glycerin and attached below the specimens, as suggested by Young and Beirne (1958). The morphological terminology adopted herein follows mainly Young (1968), except for the facial areas of the head (Hamilton 1981, Mejdalani 1998). Digital images of eight of the nine known *Egidemia* species (body in dorsal and lateral views) are now available in the internet site “Sharpshooter Leafhoppers of the World” (Wilson et al. 2009). These images were useful for the comparisons carried out in the present study. The specimens herein described belong to the Instituto Alexander von Humboldt (IAHC), Villa de Leyva (Colombia) and to the Museu Nacional (MNRJ), Universidade Federal do Rio de Janeiro, Rio de Janeiro (Brazil). Label data are given inside quotation marks with a reversed virgule (\) separating lines on the labels. The photograph of the body in dorsal view was prepared with the software Automontage (Synoptics Inc., Frederick, Maryland, USA) using a digital camera attached to a stereomicroscope.

Results

Genus *Egidemia* China, 1927

Egidemia impudica sp. n.

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http://species-id.net/wiki/Egidemia_impudica
Figs 1–10

Description of the male holotype. Length, 11.5 mm (male paratype, 12 mm) including wings in repose. Head (Fig. 2), in dorsal view, well produced anteriorly; median length of crown approximately seven-tenths interocular width and four-tenths transocular width. Crown (Fig. 2), in dorsal view, with anterior margin broadly rounded; without carina at transition from crown to face; without median fovea; ocelli located slightly behind imaginary line between anterior angles of eyes, each ocellus closer to adjacent eye angle than to median line of crown; without longitudinal keel laterad of each ocellus; with broad M-shaped elevation bordering posterior margin; with pubescence; frontogenal sutures extending onto crown and approaching ocelli; coronal suture distinct. Antennal ledges (Fig. 2), in dorsal view, protuberant; in lateral view (Fig. 3), with dorsal carina, anterior margin strongly declivous and with concavity. Face (Fig. 3) pubescent, especially on inferior portions; frons convex, swollen, muscle impressions distinct, median portion granulate; epistomal suture incomplete medially; clypeus not produced, its contour continuing profile of frons.

Thorax (Fig. 2), in dorsal view, with pronotal width less than transocular width of head; pronotum with lateral margins slightly sinuous and slightly divergent anteriorly; pronotal surface rugose and punctate (except on anterior third) and pubescent; posterior margin distinctly concave; dorsopleural carinae (Fig. 3) complete, slightly arched downward anteriorly, strongly declivous posteriorly. Mesonotum (Fig. 2) with scutellum only very slightly striate. Forewings (Fig. 4) mostly hyaline with large sclerotized area extending mainly over outer discal cell, outer and median anteapical cells and adjacent portions of costal margin; veins elevated and distinct; claval veins fused through most of their length, separated only basally and apically; outer discal cell reduced, about half length of inner discal cell; with three closed anteapical cells (inner one broadened anteriorly) and four apical cells, base of fourth more proximal than base of third; without anteapical plexus of veins and without supernumerary anteapical cross veins to costal margin. Hindwings extending almost as far posteriorly as forewings; vein R_{2+3} incomplete. Hindleg with femoral setal formula (visible only on right leg of holotype) 2:1:1:1 (with additional, unaligned slender seta located anteriorly to the row of three setae; this additional seta absent in the male paratype); length of first tarsomere less than combined length of second and third ones; first tarsomere with two parallel rows of small setae on plantar surface.

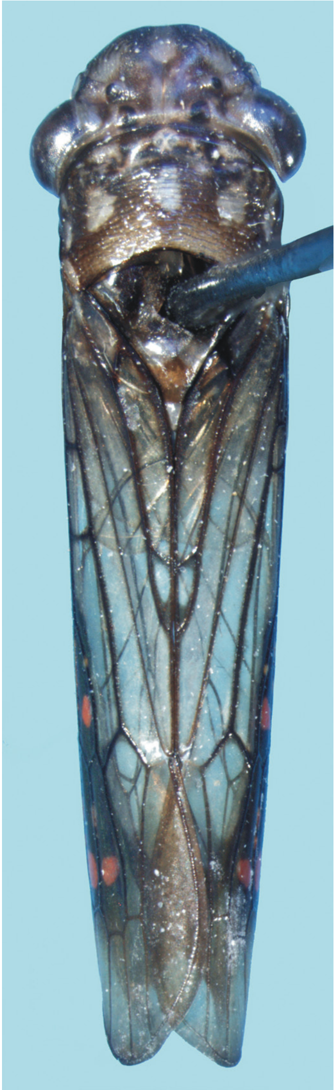
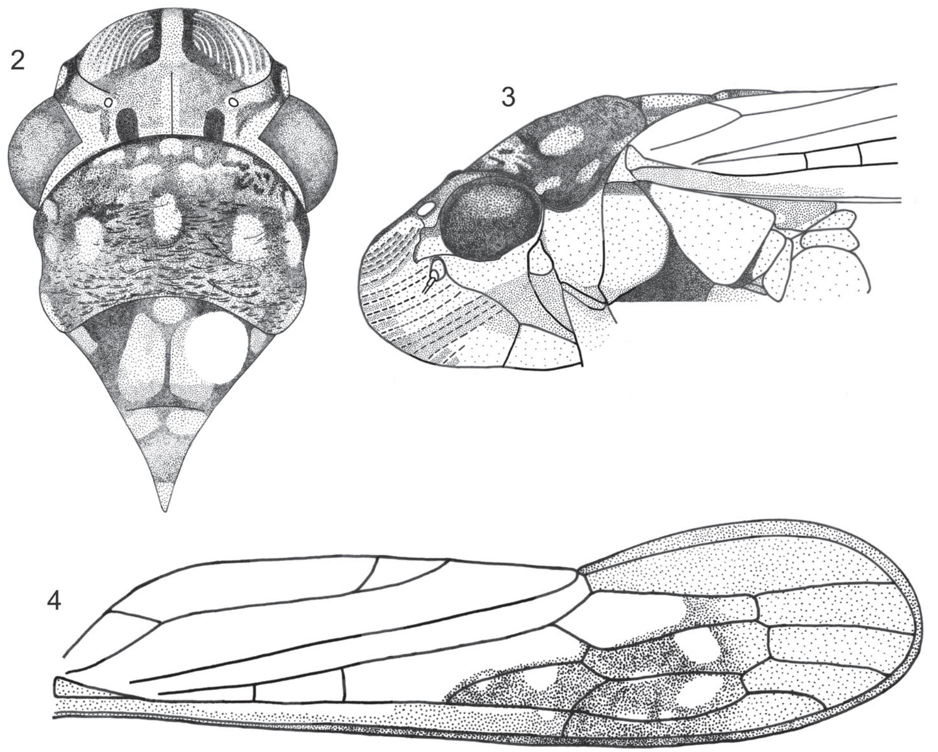


Figure 1. *Egidemia impudica* sp. n. Male holotype (IAHC), body in dorsal view (antennae and legs not depicted, abdomen removed for dissection). Length, 11.5 mm.

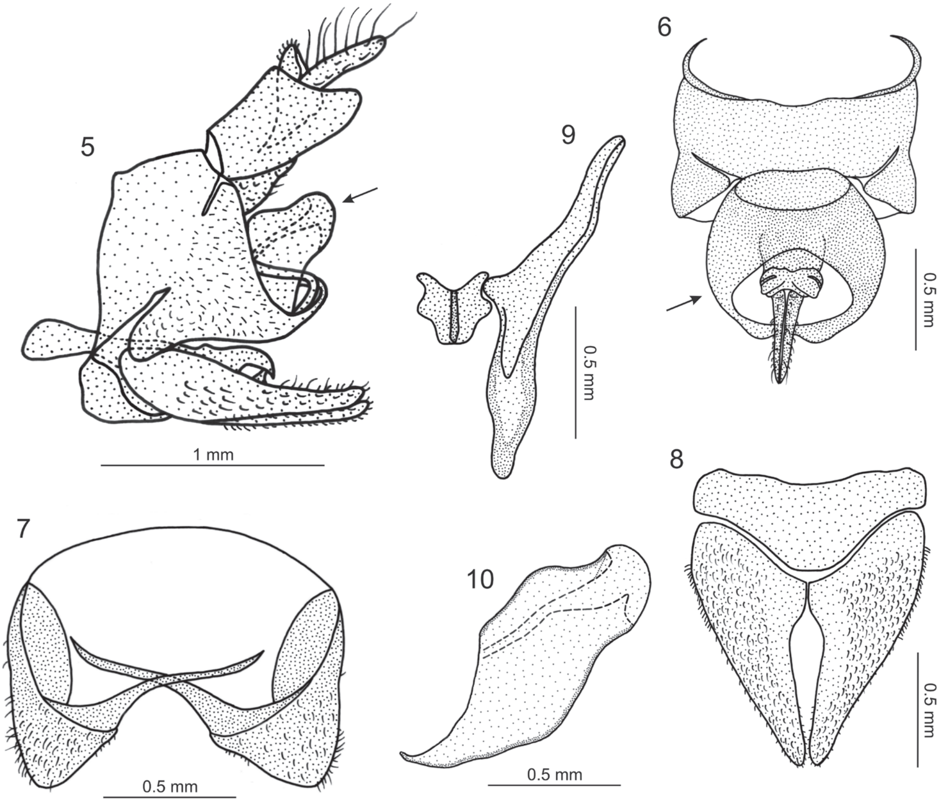
Color. Anterior dorsum (Figs 1–3) mostly brown. Crown with three maculae anteriorly (median one elongate), outer portion of antennal ledges, macula adjacent to inner eye margin, area around ocelli, and elongate macula from posterior margin to interocellar portion, pale yellow; inner portion of antennal ledges and pair of conspicuous maculae on posterior coronal margin, dark brown. Pronotum with irregular maculae on anterior third, five distinct, transversely aligned maculae on median third and pair of maculae on posterior third at lateral margins, pale yellow. Mesoscutum with median macula basally, pair of maculae basilaterally, and pair of irregular areas medially, pale



Figures 2–4. *Egidemia impudica* sp. n. **2** crown, pronotum and mesonotum, dorsal view (the white circle on the mesonotum is the pin perforation) **3** anterior portion of body, lateral view **4** left forewing.

yellow; mesoscutellum with pair of maculae basally and macula on apical portion, pale yellow. Forewings (Figs 1, 4) mostly translucent with brown veins; small brown area along basal portion of costal margin; distal half of costal margin, outer discal cell, outer anteapical cell, median anteapical cell, and part of inner anteapical cell brown (mostly darker than other wing portions); outer discal, outer anteapical, and median anteapical cell each with distinct orange macula; additional orange macula on costal area adjacent to anterior limit of outer anteapical cell; additional irregular yellow to orange marks also present in this area; apical cells brown. Body (Fig. 3), in lateral view, with broad yellow area extending from lateral portions of frons to posterior limit of thorax, bordered inferiorly by irregular brown marks. Face (Fig. 3) mostly pale yellow; muscle impressions and diffuse area on median portion of frons, brown to dark brown.

Male genitalia with pygofer (Fig. 5), in lateral view, short, considerably reduced posteriorly, exposing aedeagal shaft; posterior margin obliquely truncate; ventroapical portion with conspicuous long process directed mesally; in caudal view (Fig. 7), processes crossing each other medially; pygofer surface with small setae distributed mostly ventrally and on posterior half. Valve (Fig. 8), in ventral view, with short lateral



Figures 5–10. *Egidemia impudica* sp. n., male genitalia **5** genital capsule, lateral view (arrow indicates the exposed aedeagus) **6** pygofer and anal tube, dorsal view (arrow indicates the expanded segment X of the anal tube) **7** pygofer, caudal view **8** valve and subgenital plates, ventral view **9** connective and right style, dorsal view **10** aedeagus, lateral view.

margins; posterior margin distinctly produced posteriorly. Subgenital plates (Fig. 8), in ventral view, triangular, narrowing gradually toward apex; not fused to each other, close to each other for short distance on basal portion and then with distinct space between inner margins; surface with many scattered small setae; in lateral view (Fig. 5), plates extending beyond pygofer apex, with small dentiform projection associated with style apical portion. Connective (Fig. 9), in dorsal view, broadly Y-shaped with both arms and stalk short; with short median keel. Styles (Fig. 9), in dorsal view, elongate, extending posteriorly distinctly beyond apex of connective, portion before connective approximately of same size as portion behind it; apical portion directed posteriorly, not distinctly curved; apex obtuse. Aedeagus (Fig. 10) symmetrical; shaft, in lateral view, simple, directed dorsally, lobulate apically; dorsal and ventral margins sinuous; gonopore located on apex. Paraphyses absent. Anal tube (Figs 5, 6), in dorsal view, strongly developed in comparison to pygofer size; segment X (Fig. 5), in lateral view, longer than dorsal pygofer margin, expanded toward apex; in dorsal view (Fig. 6), broad, distinctly rounded.

Female unknown.

Type specimens. Colombia, Magdalena Department. Male holotype (IAHC) with labels “COLOMBIA Magdalena \ PNN Tayrona Zaino \ 11°20’N 74°2’W 50 m” and “Malaise 7/17/00-7/28/00 \ R. Henriquez, leg. M.299”. Male paratype (MNRJ) with same data as holotype, excepting “6/14/00-6/29/00” and “M.240”.

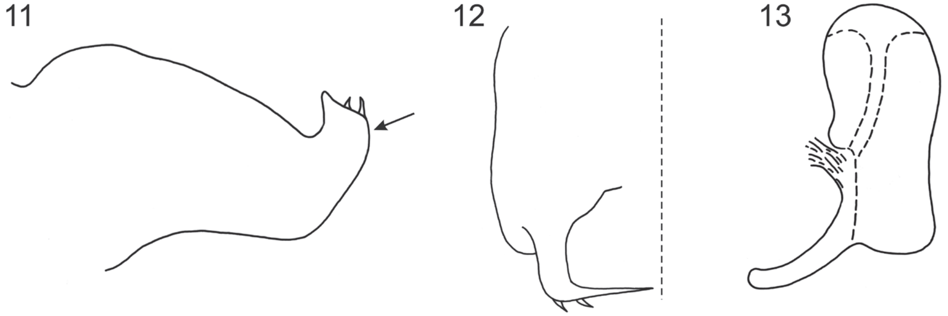
Etymology. The new species name, *impudica*, refers to the distinctly reduced male pygofer, which results in the partial exposure of the aedeagus.

Remarks

Considering the known species of *Egidemia*, the new taxon appears to be most similar to *E. inflata*, both in the color pattern (especially the maculae of the pronotum and forewings) and in certain aspects of the male genitalia (aedeagus, styles, and inner margin of the subgenital plates). *Egidemia inflata* is recorded from Mexico and Belize (Young 1968, McKamey 2007), whereas the new species is known only from Colombia. *Egidemia impudica* can be easily distinguished from *E. inflata*, as well as from the remaining species of the genus, by the following features: (1) male pygofer reduced with (2) obliquely truncate posterior margin (Fig. 5) and (3) a pair of very elongate processes on ventroapical area that cross each other medially (Fig. 7); (4) subgenital plates extending beyond pygofer apex (Fig. 5). Due to the presence of the first two features, the aedeagus is partially exposed. To provide a comparison with *E. impudica*, we have redrawn the illustrations of Young (1968) of the pygofer (Fig. 11), pygofer process (Fig. 12) and aedeagus (Fig. 13) of *E. inflata*. We have added the new species to the key of Carpi and Mejdalani (2010) to males of *Egidemia*. The new key also mentions the countries from which each species has been recorded (based on Young 1968, McKamey 2007, Takiya and Dmitriev 2007 and Carpi and Mejdalani 2010).

Key to males of *Egidemia* (modified from Carpi and Mejdalani (2010) to include *E. impudica* sp. n.)

1 Aedeagus with processes...**2**
– Aedeagus without processes **6**
2 Aedeagus with symmetrical processes...**3**
– Aedeagus with asymmetrical processes (Young 1968: Fig. 169g) ....
....***E. proxima* (Melichar, 1925)**
(Mexico)
3 Aedeagus, in lateral view, with distinct curved lobe arising dorsoapically above pair of strong spiniform processes (Schröder 1972: Fig. 1b) ....
....***E. gracilis* Schröder, 1972**
(“Amaz.” [Amazon region])



Figures 11–13. *Egidemia inflata* Young, 1968 **11** pygofer, lateral view (arrow indicates the process) **12** apical portion of pygofer, caudoventral view **13** aedeagus, lateral view. These figures, redrawn from Young (1968), are in the public domain.

– Aedeagus, in lateral view, without such dorsoapical lobe **4**

4 Pygofer processes arising dorsoapically (Young 1968: Fig. 164c) **5**

– Pygofer processes arising ventrally; pygofer, in lateral view, curved dorsally and with truncate apex (Young 1968: Fig. 170c).. ***E. obtusata* (Melichar, 1925)** (Peru)

5 Styles, in dorsal view, slightly expanded apically; aedeagal processes, in caudoventral view, very short, their length not more than four times their width (Young 1968: Fig. 165g) ....***E. paranceps* Young, 1968** (Costa Rica, Nicaragua, Panama)

– Styles, in dorsal view, not expanded apically; aedeagal processes, in caudoventral view, with length many times their greatest width (Young 1968: Fig. 164g) ....***E. anceps* (Fowler, 1899)** (Mexico, Guatemala, Panama)

6 Pygofer, in lateral view, short, partially exposing aedeagus (Fig. 5), ventroapical margins with pair of elongate processes that cross each other medially (Figs 5, 7) .... ***E. impudica* sp. n.** (Colombia)

– Pygofer, in lateral view, elongate, not exposing aedeagus, ventroapical margins without pair of elongate processes that cross each other medially.........**7**

7 Aedeagus, in lateral view, with shaft rectilinear (Carpi and Mejdalani 2010: Fig. 8); styles, in dorsal view, with apical portion directed outward (Carpi and Mejdalani 2010: Fig. 7) ....***E. peruana* Carpi and Mejdalani, 2010** (Peru)

– Aedeagus, in lateral view, with shaft curved dorsally (Young 1968: Fig. 167f); styles, in dorsal view, with apical portion directed posteriorly (Young 1968: Fig. 168e) **8**

8 Pygofer process branched (Young 1968: Fig. 167c)...***E. fowleri* (Distant, 1908)** (Mexico)

– Pygofer process not branched (but may bear small teeth) **9**

9 Aedeagus, in lateral view, narrowest in apical half of its length (Young 1968: Fig. 169f*); posterior pygofer margin, in lateral view, narrowly round (Young 1968: Fig. 168c) .... ***E. speculifera* (Walker, 1851)** (Brazil, Paraguay, Argentina)

– Aedeagus, in lateral view, inflated, broadest in apical half of its length (Fig. 13); posterior pygofer margin, in lateral view, forming broad process directed dorsally (Fig. 11) .... ***E. inflata* Young, 1968** (Mexico, Belize, Cuba [?])

* **Note.** There is a mistake in the numbers of *Egidemia* figures in Young's (1968) paper. The aedeagi of *E. speculifera* and *E. proxima* had their numbers exchanged. Figure 168f is actually *E. proxima*, instead of *E. speculifera* as given in his legend, whereas figure 169f is *E. speculifera* (*E. proxima* in the legend).

Acknowledgments

The manuscript benefited from the useful comments of Márcio Felix and Rachel Carvalho. The loan of the specimens herein described was kindly arranged by Paul Freytag and Daniela Takiya. The photograph of the body in dorsal view was taken and edited by Rachel Carvalho. This study was in part supported by the Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ (grant number E-26/171.281/2006 to Márcia Couri). The undergraduate junior author received a fellowship from FAPERJ (process number E-26/100.524/2010).

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ZooKeys 97: 11–29 (2011)
doi: 10.3897/zookeys.97.1106
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RESEARCH ARTICLE

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Euglossa obrima, a new species of orchid bee from Mesoamerica, with notes on the subgenus *Dasystilbe* Dressler (Hymenoptera, Apidae)

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Academic editor: *Michael Ohl* | Received 8 February 2011 | Accepted 12 April 2011 | Published 11 May 2011

urn:lsid:zoobank.org:pub:35302F12-F9A7-4453-A4A3-EDB61EEB7799

Citation: Hinojosa-Díaz IA, Melo GAR, Engel MS (2011) *Euglossa obrima*, a new species of orchid bee from Mesoamerica, with notes on the subgenus *Dasystilbe* Dressler (Hymenoptera, Apidae). ZooKeys 97: 11–29. doi: 10.3897/zookeys.97.1106

Abstract

A new species of the orchid bee subgenus *Dasystilbe* Dressler (Euglossini: *Euglossa* Latreille) is described and figured from a series of males and females collected broadly in Mesoamerica. *Euglossa* (*Dasystilbe*) *obrima*, **sp. n.**, is differentiated from the one known species of *Dasystilbe*, *E.* (*D.*) *villosa* Moure, which occurs only in Panamá and perhaps Costa Rica. The subgenus and its constituent species are diagnosed, and comments provided on *Dasystilbe*.

Keywords

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

Introduction

Among corbiculate bees, the tribe Euglossini is famed for the characteristic morphological and behavioral features of its constituent species. In particular, their bright metallic coloration of the body and elongate mouthparts, and the collection and processing of fragrances by males, mainly from flowers of Orchidaceae, to which the group owes its common name – orchid bees. Of the five euglossine genera, *Euglossa* Latreille is the most diverse with about 120 species (Roubik and Hanson 2004, Moure et al. 2007), and six subgeneric names presently in use for their classification. Of the six subgenera, *Dasystilbe* Dressler is the most distinctive owing to its bizarre combination of morphological features that seemingly intermingle attributes of two of the other subgenera (*Euglossella* Moure and *Glossura* Cockerell), and the justification provided by Dressler (1978) for erecting this monotypic unit for *Euglossa villosa* Moure. The rather bizarre combination of characters and relatively restricted distribution of *E. villosa*, combined by its unique status among all orchid bees, make *Dasystilbe* an interesting taxon for understanding euglossine phylogeny and biology. Most recently, phylogenetic analyses based both on molecular (Ramírez et al. 2010) and morphological (Hinojosa-Díaz 2010, in prep.) data place *Dasystilbe* in divergent positions, further stressing the complicated nature of these bees. However, the distinctiveness of *E. villosa* is not exclusive to that species, and a second species of *Dasystilbe* is now known. Most importantly, females are described for the new species, while this sex remains unknown for *E. villosa*.

Herein we provide a brief, illustrated account of the subgenus, as well as the description of a new, second species, including females, and a comparative diagnosis for *E. villosa*.

Material and methods

Material used in this study is deposited in the following collections: Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA; Museo de Zoología Alfonso L. Herrera, Facultad de Ciencias, Universidad Nacional Autónoma de México, México, D.F., Mexico; Florida Museum of Natural History, University of Florida, USA; and the Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

Morphological terminology generally follows that of Engel (2001), Michener (2007), and Hinojosa-Díaz (2008), while the overall format of the descriptions mirrors that used elsewhere for species of *Euglossa* (e.g., Hinojosa-Díaz and Engel 2007). Photomicrographs were prepared using a Nikon D1x digital camera attached to an Infinity K-2 long-distance microscopic lens.

Systematics

Genus *Euglossa* Latreille

Subgenus *Dasystilbe* Dressler

http://species-id.net/wiki/Euglossa_(Dasystilbe)

Euglossa (*Dasystilbe*) Dressler, 1978: 193. Type species: *Euglossa villosa* Moure, 1968, by original designation.

Diagnosis. Large bees (body length nearly 15 mm), body coloration bright metallic green with either bronzy or blue iridescence and noticeable differently-colored apical bands on first four metasomal terga (Figs 1–3); body covered with noticeable long dense fulvous setae especially on lateral and ventral sides; upper and lower interorbital distances equal; clypeus not noticeably protuberant (no more than 0.90 mm); labrum rectangular, wider than long; male mandible bidentate, female mandible tridentate; labiomaxillary complex in repose reaching at most posterior margin of second metasomal sternum; pronotal dorsolateral angle projected laterally as an acute prong (Fig. 10); posterior border of mesoscutellum semi-ellipsoidal, female with a large dark mesoscutellar patch (Fig. 3); male mesotibia with two setose patches, anterior one large, ellipsoidal, occupying nearly one-third of mesotibial length, posterior one ovoid-oblong about one-third as long as anterior patch (Figs 15–16); microtrichia of velvety area on male mesotibia becoming sparser anteriorly (Fig. 15–16); inner surface of male mesobasitarsus with a prominent distal elevation obliquely ridged (Fig. 11); second mesotarsomere of male with basal emarginations on both anterior and posterior margins (this may sometimes be obscured by expansion of the inner surface); male metatibia triangular with no evident furrow on posterodorsal margin; metatibial organ slit not reaching ventral margin of male metatibia, but separated from it by less than its own length (Figs 19–20); male metabasitarsus lanceolate, anterior margin conspicuously convex especially on proximal section (Fig. 12); metafemur of male with ventral margin strongly concave especially as seen on inner surface (Fig. 14); male second metasomal sternum with two cowled slits [*sensu* Roubik (2004)] posteriorly narrowed and separated by about one and a half times width of an individual slit (Fig. 13); eighth metasomal sternum with noticeable lobes on lateral margins (Fig. 22), with posterior section of eighth metasomal sternum laterally about as wide as lateral width of anterior section (Fig. 23); dorsal process of gonocoxite noticeably longer than wide; lateral section of gonostylus with concave inner setose area covered by long simple setae (Figs 24–26).

Euglossa (*Dasystilbe*) *obrima* Hinojosa-Díaz, Melo, & Engel, sp. n.

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http://species-id.net/wiki/Euglossa_(Dasystilbe)_obrima
Figs 1, 3, 4, 6, 7, 9, 10–15, 17, 19, 21–26

Holotype. ♂ (Figs 1, 4, 7), labeled, "Mexico, VeraCruz; 34 km N Catemaco; UNAM Reserve; Jan. 6, 1982; John W. Wenzel // Euglossa; villosa Moure; Det. R.L. Dressler, 1987". The holotype is in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA.

Paratypes. 16♂♂, 13♀♀: labeled as follows: data as holotype except date "Jan. 10, 1982" (1♂); "MEXICO: Vera-; cruz. Fortin; 4 XI 1966 [date handwritten except three first digits of year]; R.L. Dressler 591 [number handwritten]" (1♂); "MEXICO, Veracruz; Teocelo; 25-VIII-1989; 12:00 1080m; A. Callejas" (1♀); Chalchijapa, Santa María; Chimalapa, Oaxaca. [Mexico]; 22-III-1995; J.L. Salinas 100 m; Selva Alta Perennifolia; Atraida con Esencias JL-183; Galera Rolando 08:28 h // MUSEO DE ZOOLOGIA; HYMENOPTERA; 10576" (1♂); same data except last number in second label "10583" (1♂); "10585" (1♂); same data except: date "24-III-1995", last two lines on first label "Atraida con Esencias JL-191; Campamento 12:48 h", last number in second label "10631" (1♂); same data except: date "26-III-1995", last two lines on first label "Atraida con Esencias JL-194; 10:00 h", last number in second label "10646" (1♂); same data except: date "24-VIII-1995", last two lines on first label "Atraida con Esencias RL-1007; 12:30 h", last number in second label "11308" (1♀); "MEXICO, Hidalgo; Tlanchinol 1516 m; Tlanchinol-Apantlazol Km 1; 29[20°?] 59'13" N 98[°] 39'04" W; 14-09-1993 10:45 Hrs.; L. Godínez LG-898" (1♂); same data except last two lines: "14-09-1993 12:30 Hrs.; R. López RL-81" (1♂); same data except last two lines: "05-06-1993 11:00 Hrs.; L. Godínez LG-787" (1♀); "MEXICO, Hidalgo; Tlanchinol 1600 m; Tlanchinol-Apantlazol Km 4; 20[°] 59'04" N 98[°] 38'13" W; 13-09-1993 10:20 Hrs.; R. López RL-76" (1♂)"; "Museo de Zoología; Fac. De Ciencias; U.N.A.M. // MEX[Mexico]: Oax.[Oaxaca]; Metates.; 13-IX-1987 // MUSEO DE ZOOLOGIA; HYMENOPTERA; 10441" [second label handwritten] (1♀); "Museo de Zoología; Fac. De Ciencias; U.N.A.M. // MEX[Mexico]: Oax.[Oaxaca]; Macultianguis [Macuiltianguis?]; 17-IX-1987; A. Luis // MUSEO DE ZOOLOGIA; HYMENOPTERA; 10422" [second label handwritten] (1♀); "Museo de Zoología; Fac. De Ciencias; U.N.A.M. // Edo. Oax.,[Oaxaca, Mexico] Pto; Eligio. Mpio.; Comaltepec; 600 msnm.; 9-VIII-1986, A. Luis // MUSEO DE ZOOLOGIA; HYMENOPTERA; 10421" [second label handwritten] (1♀); "MEXICO: San Luis; Potosi, El Limon 70 km S; Ciudad Valles on Hwy 85; RL Minckley & BN; Danforth 29–30 Dec 1988 // Euglossa villosa [handwritten]; Moure; det. R.W.Brooks 1996 [last two digits handwritten]" (1♂, 1♀); "MEXICO: San Luis; Potosi, San Juan, 16 Feb.; 1992, L. Godinez, #818; *ex Bidens odorata* // Euglossa [handwritten]; villosa Moure [handwritten]; det. R.W.Brooks 1996 [last two digits handwritten]" (1♀); "MEXICO: San Luis; Potosi, Xilitla, 1km E; Xilitla at river 400m; 9 July 1990, I. Yarom" (1♀); "Atoyac,; Vera Cruz.; Schumann// Godman-Salvin; Collection.; 1913-214.// Euglossa; villosa ; m. [hand-

Figures 1–3. Dorsal habitus of species of *Euglossa* (*Dasystilbe*). **1** *Euglossa* (*Dasystilbe*) *obrima*, sp. n., male holotype **2** *E.* (*D.*) *villosa* Moure, male **3** *E.* (*D.*) *obrima*, sp. n., female paratype.

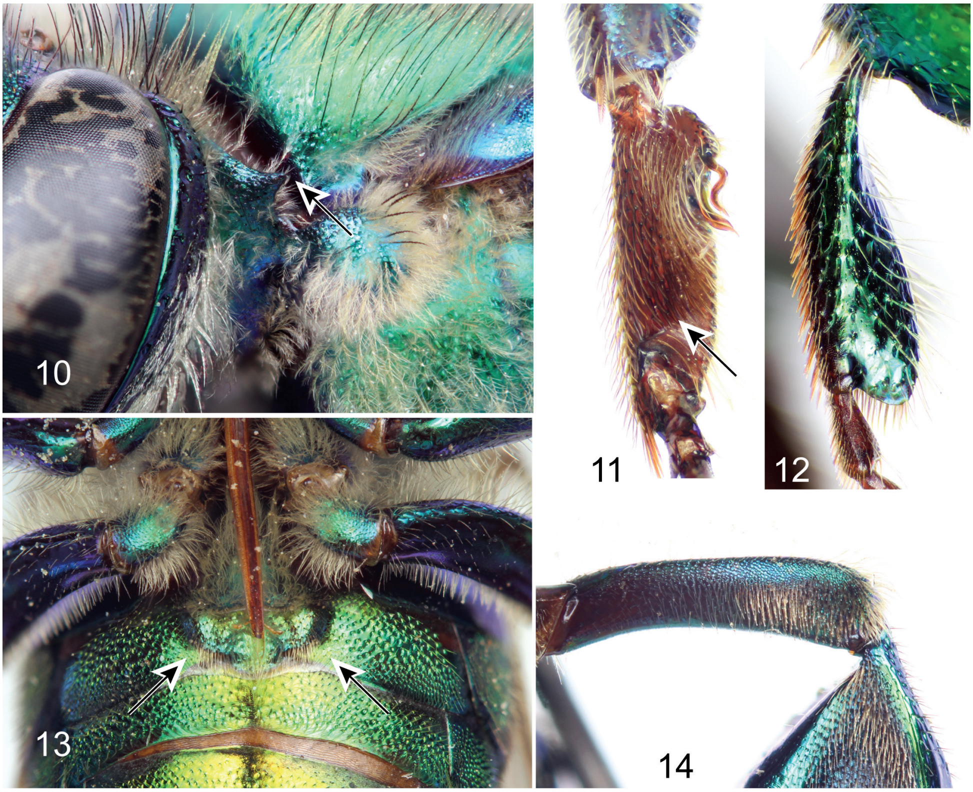
Figures 4–6. Lateral habitus of species of *Euglossa* (*Dasystilbe*). **4** *Euglossa* (*Dasystilbe*) *obrima*, sp n., male holotype **5** *E.* (*D.*) *villosa* Moure, male **6** *E.* (*D.*) *obrima*, sp. n., female paratype.

written]; Det. J.S. Moure 1958 [last two digits handwritten]" (1♂); "MEX[Mexico]: S.[San] L.[Luis] P.[Potosi]; Tamazunchale; IV-12-54// D.H. Janzen; Collector" (1♂); "Finca' La Isle'; Chiapas, Mex.[Mexico]" (1♀); "4 mi[miles] NW Ocosingo; Chiapas. MEX.[Mexico]; III-8-1953" (1♀); "San Juan,; Vera Paz; Champion.// Godman-Salvin; Collection.; 1913-214.// viridissima; Friese [handwritten]; Pe J. S. Moure 1968 [last two digits handwritten] [underside of label: MUS. HUNGARICUM; C.[compared] W.[with] T.[type] ♀; MEXICO; Ctba.[Curitiba] 29-XI-1968 [handwritten]]" (1♀); "GUATEMALA: Zacapa; Prov., 3.5 km SE La Union; 1500m, 25–27 June 1993; J.Ashe&R.Brooks#128; *ex*:flight intercept trap // Euglossa [handwritten]; villosa Moure [handwritten]; det. R.W.Brooks 19" (1♂); "La Conquista; Guatemala// Euglossa ♀;

Figures 7–9. Facial aspect of species of *Euglossa* (*Dasystilbe*). **7** *Euglossa* (*Dasystilbe*) *obrima*, sp. n., male holotype **8** *E.* (*D.*) *villosa* Moure, male **9** *E.* (*D.*) *obrima*, sp. n., female paratype.

villosa m. [handwritten]; Pe J. S. Moure 1968 [last two digits handwritten]" (1♀); "Honduras: Santa Barbara; Finca Las Quebradas, W; of Lake Yojoa, Oct. 1991" (1♂); "Jinotega; NICARAGUA; C.H. Dodson [underside of label: Sept. 1963]// HOLOTYPUS [labelled as a holotype by Moure but never published]; Dasystilbe [plus male symbol]; smaragdula [handwritten]; Pe. J. S. Moure 1985 [last two digits handwritten]" (1♂). Paratypes are deposited in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA; Museo de Zoología Alfonso L. Herrera, Facultad de Ciencias, Universidad Nacional Autónoma de México, México, D.F., Mexico; Florida Museum of Natural History, University of Florida, USA; and Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

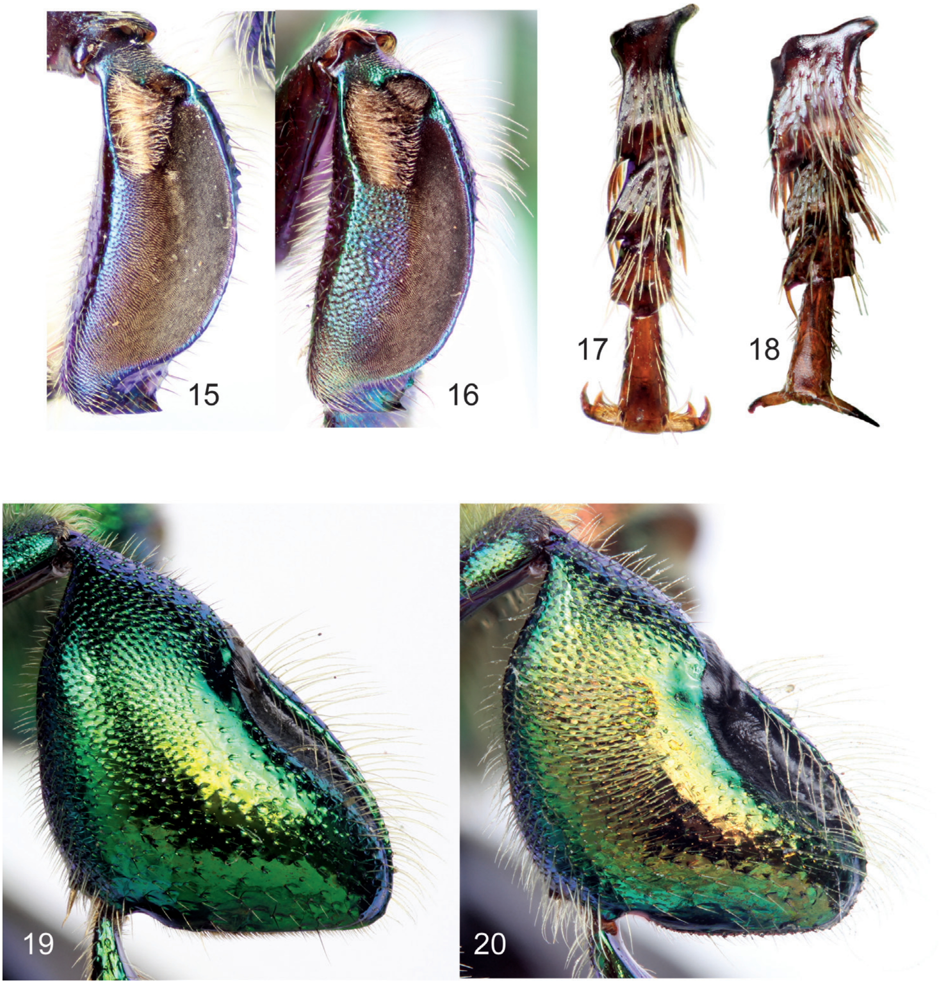
Diagnosis. Bees with a rather stocky habitus, both sexes with body coloration bright metallic green, with faint bronzy hue and blue iridescence, posterior section of first four metasomal terga with noticeable cyan-blue iridescence forming a band along tergal margins (Figs 1, 3); punctation moderately dense; body with dense, fulvous, long setae especially on lateral and ventral sides of head and mesosoma; female with conspicuous ellipsoidal setal patch on mesoscutellum made of dense, dark setae (Fig. 3); male with mesotibial anterior tuft ellipsoidal with a diagonally truncate base and a distal rounded margin, posterior tuft round, oblong partially lying on posterior half of truncate margin of anterior tuft, velvety area noticeably sparser along anterior



Figures 10–14. Diagnostic features of the subgenus *Dasystilbe*, as observed on male specimens of *Euglossa* (*Dasystilbe*) *obrima*, sp. n. **10** Acute projection of pronotal dorsolateral angle (arrow) (some setae were removed to expose this feature) **11** Ridge on inner surface of mesobasitarsus (arrow) **12** Metabasitarsus **13** Cowled slits on second metasomal sternum (arrows) **14** Metafemur.

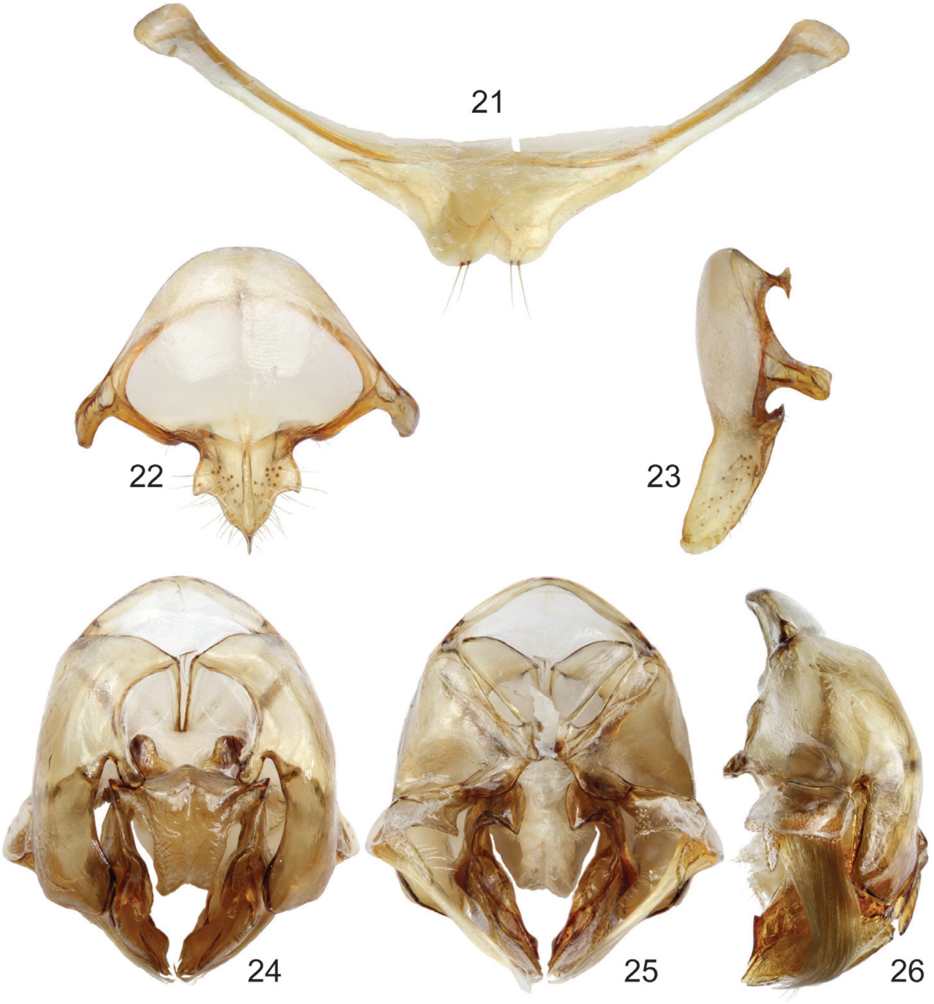
mesotibial margin (Fig. 15); mesotarsomeres beyond mesobasitarsus longer than wide, especially second mesotarsomere (Fig. 17); distal section of metatibial organ slit lanceolate (spur-like), slender (maximum width occupying about one-fifth of metatibial outer surface width) (Fig. 19); second metasomal sternum with two narrow cowled slits (Fig. 13).

Description. ♂: *Structure*. Total body length 13.54 mm (12.30–14.67; n=5); labiomaxillary complex in repose reaching sternum III (not exceeding it) (Fig. 13). Head length 3.11 mm (2.96–3.33; n=5), width 5.19 mm (5.11–5.26; n=5); upper interorbital distance 2.31 mm (2.30–2.37; n=5); lower interorbital distance 2.29 mm (2.22–2.37; n=5); upper clypeal width 1.39 mm (1.26–1.48; n=5) (as measured between dorsolateral angles of clypeus); lower clypeal width 2.22 mm (2.19–2.30; n=5) (as measured at level of lower lateral parts); clypeal protuberance 0.76 mm (0.74–0.81; n=5) (following measurement method of Brooks 1988); medial clypeal ridge sharp, paramedial clypeal ridges not as sharp but well developed; labrum rectangular, wider than long, length 1.09 mm (1.04–1.11; n=5), width 1.27 mm (1.26–1.33; n=5)



Figures 15–20. Features to differentiate males of the two species of subgenus *Dasystilbe*. **15** Mesotibia of *Euglossa* (*Dasystilbe*) *obrima*, sp. n. **16** Mesotibia of *E.* (*D.*) *villosa* Moure **17** Mesotarsomeres (excluding mesobasitarsus) of *E.* (*D.*) *obrima*, sp. n. **18** Mesotarsomeres (excluding mesobasitarsus) of *E.* (*D.*) *villosa* **19** Metatibia of *E.* (*D.*) *obrima*, sp. n. **20** Metatibia of *E.* (*D.*) *villosa*.

(Fig. 7); medial labral ridge sharp; paramedial labral ridges not as sharp, oblique, well developed along entire labral length; labral windows ovoid, occupying proximal one-half of labrum; interocellar distance 0.35 mm (0.30–0.41; n=5); ocellocular distance 0.67 mm (n=5); first flagellomere nearly as long [0.52 mm (n=5)] as second and third flagellomeres combined [0.50 mm (0.48–0.52; n=5)]; length of malar area 0.13 mm (0.11–0.15; n=5). Mandible bidentate. Dorsolateral angle of pronotum projected laterally as an acute prong (Fig. 10); intertegular distance 3.94 mm (3.85–4.07; n=5); mesoscutal length 3.19 mm (3.07–3.41; n=5); mesoscutellar length 1.50 mm (1.48–1.56; n=5); posterior border of mesoscutellum demi-ellipsoidal (Fig. 1); mesotibial



Figures 21–26. Male genitalic features of *Euglossa* (*Dasystilbe*) *obrima*, sp. n. **21** Seventh metasomal sternum, ventral aspect **22** Eighth metasomal sternum, ventral aspect **23** Eighth metasomal sternum, lateral aspect **24** Genitalic capsule, dorsal aspect **25** Genitalic capsule, ventral aspect **26** Genitalic capsule, lateral aspect.

length 2.68 mm (2.59–2.74; n=5); mesobasitarsal length 2.36 mm (2.30–2.37; n=5), width 0.84 mm (0.81–0.89; n=5) (as measured at proximal posterior keel), posterior keel projected in a right or slightly acute angle, inner surface with a prominent distal elevation obliquely ridged forming concavity contiguous to emarginated joint with second mesotarsomere (Fig. 11); mesotarsomeres beyond mesobasitarsus longer than wide, especially second mesotarsomere in which posterior margin is conspicuously concave (Fig. 17); metatibial shape triangular (scalene right triangular); metatibial anterior margin length 3.84 mm (370–3.93; n=5), ventral margin length 3.19 mm

(2.89–3.33; n=5), postero-dorsal margin length 4.97 mm (4.74–5.19; n=5), maximum thickness 1.44 mm (1.41–1.48; n=5); metatibial organ slit basal and distal sections well defined with junction nearly as wide as contiguous width of basal section; distal section of metatibial organ slit lanceolate (spur-like), maximum width occupying about one-fifth of metatibial outer surface width (Fig. 19); dorsal section of metatibial organ slit rhomboid, length 0.62 mm (0.52–0.81; n=5); metabasitarsal length 2.78 mm (2.67–2.96; n=5), mid-width 0.98 mm (0.89–1.04; n=5); metabasitarsal ventral margin projected posteriorly on a rounded slightly obtuse angle. Forewing length 10.40 mm (10.07–10.89; n=5); jugal comb with 13–15 (n=5) blades; hind wing with 22–28 (n=5) hamuli. Maximum metasomal width 5.54 mm (5.41–5.70; n=5); second metasomal sternum as described for subgenus (Fig. 13).

Coloration. Head bright metallic green (except as described below), with faint bronzy hue, specially on midclypeus, and blue iridescence adjacent to torulus; paraocular ivory marks well developed, slightly wider basally (around half distance to lateral margin of clypeal disc), inner margin of marks irregular; labrum ivory; labral anterior and posterior edges as well as labral windows amber-translucent; malar area metallic-green on condyle, brown on acetabulum, ivory in between; mandible ivory on about two thirds of outer surface, teeth and ridges brown; antenna brown, lighter on posterior surface of flagellum; scape with ivory spot covering entire anterior surface (Fig. 7). Mesosoma bright metallic green with faint bronzy hue (darker and more evident on anteriorly oriented episternal surface), blue highlights specially along sutures and sulci (Figs 1, 4); legs metallic-green on outer surface of all major podites, darker and duller than mesosoma (except meta-leg), with same combination of faint bronzy hue and blue highlights on edges, inner surfaces of most podites and most integument of meta- and mesotrochanters as well as all tarsomeres beyond mesobasitarsus, shiny brown combined with blue-green iridescence (Figs 14, 17); tegula colored as rest of mesosoma, wings bright amber, with brown veins and stigma (Figs 1, 4). Metasomal terga bright metallic green, noticeable bronzy-gold iridescence on anterior section of first four terga and on entire surface of the remainder ones, posterior section of first four terga with noticeable cyan-blue iridescence band along tergal margins, slightly wider mesally, covering about half of dorsal surface of first tergum and about one-third of second to fourth tergal dorsal surfaces (Fig. 1), ventro-lateral sections of first metasomal tergum with amber glow. Sterna metallic-green with strong bronzy-gold iridescence especially on narrow anterior sections and posterior margins, sometimes turning into amber-brown glow, especially noticeable on first sternum and on cowled slits of second sternum (Fig. 13).

Sculpturing. Frons areolate, with dense, strong punctures (rather areole-punctures) small (diameter about one tenth of mid-ocellus diameter), increasing in size towards lower facial sections, especially on clypeal disc between paramedial ridges (punctures two to three times as large as on frons), puncture density diminishing on paraocular areas (punctures not contiguous), leading to narrow smooth integumental areas on antennal depression around torulus, and on a deep, narrow groove between torulus and frontal line; ivory areas (paraocular marks, clypeal lateral portions, mandibles and labrum) with shallow sparse punctures; vertex with moderately dense, shallow, small punctures on posterior margin, and interocellar area, areas of smooth, shiny integument present on anterior section of mid-ocellus and antero-lateral sections of lateral ocelli, smooth (minutely rugulose), dull integument on ocello-ocular groove (Fig. 1); posterior half of gena sculptured as posterior section of vertex, anterior half with sparse minute punctures, and scattered, large, round punctures along compound eye. Mesoscutum moderately punctate, round punctures about one-tenth of mid-ocellus diameter, separated by about half to one puncture diameter, puncture size slightly increasing on narrow anterior margin; mesoscutellum with similar general pattern as mesoscutum, specially on anterior half (except rather smooth along anterior margin), puncture size gradually increasing towards posterior margin such that posteriormost punctures are nearly four times as large as those on anterior half, except on mid groove where punctures are denser (contiguous) and of same size as those on anterior mesoscutellar half; mesepisternum punctation as that on mesoscutum, except larger, denser punctures on uppermost section; major leg podites dense to moderately dense punctate on outer surfaces, punctures generally shallow, punctures on metatibia dense (contiguous) on upper anterior margin, puncture size increasing, and density decreasing towards posterior and ventral margins, such that there is rather smooth integument along tibial organ slit and ventral margin. Metasomal terga in general densely punctate, dorsal surface of first tergum with relatively large punctures (as large as those on posterior margin of mesoscutellum) on anterior half especially on mesal area, punctures on posterior portion slightly smaller than those on frons or on mesoscutum, ventrolateral sections polished smooth; second to fourth terga with dense punctures equivalent in size to those on frons or on mesoscutum, only slightly smaller towards posterior margin along the characteristic cyan-blue iridescence bands, these three terga with larger and not as dense punctures on ventrolateral margins; anterior half of dorsal surface and lateral area of fifth to seventh terga with moderately dense large punctures as large as those on posterior margin of mesoscutellum, posterior mesal half of these three terga with punctation equivalent to that on second to fourth terga; metasomal sterna densely punctate, punctures as large or larger than those on posterior margin of mesoscutellum, decreasing slightly in size towards posterior margin of each sternum, although more noticeably on second sternum, lower puncture density on anterior margin and on medial body line.

Vestiture. Frontal fringe composed of two kinds of moderately dense setae, fulvous, plumose (moderately long branches), rather long (length around one and a half mid-ocellus diameter), setae covering the lower anterior area of the fringe, and dark brown, minutely branched (appearing simple), slightly longer, sturdier, setae long, both intermixing midway on the fringe; clypeus, paraocular area, antennal depression, labrum, mandible and malar area, with moderately dense, fulvous setae similar to those on lower half of frontal fringe, except as follows: appressed and noticeably plumose (long branches) on antennal depression, less dense, and with very short branches (appearing simple) on clypeus disc, labrum, mandibles and malar area, these last also having intermixed some scattered brown simple setae; vertex with some scattered, fulvous short, plumose setae on ocello-ocular groove and posterior area of ocellar triangle; dark setae of the same nature as those on posterior half of frontal fringe scattered (but slightly longer) on interocellar area, ocello-ocular groove, and posterior margin, where density increases and they intermix with fulvous setae similar to those on lower half of frontal fringe; gena with dense, fulvous, setae, short and simple on upper section and becoming longer and with longer branches toward lower genal section. Prothorax with setae as those on lower half of frontal fringe, intermixed with the other kind of setae on pronotal lobe; mesoscutum and mesoscutellum covered with a combination of dense setae of the same nature as the two kinds on frontal fringe, slightly longer towards anterior margin of mesoscutum and posterior margin of mesoscutellum, on this last area the fulvous setae are minutely branched and rather appearing as the dark ones except different coloration; mesepisternum and entire lateral mesosomal areas covered with dense, fulvous, moderately long, plumose setae, with very few scattered dark, hirsute setae on uppermost mesepisternal areas (Fig. 4); all coxae and trochanters with vestiture agreeing with that of mesepisternum, except for mesotrochanter with a rather bare anterior surface, and ventral surface with a particular patch of appressed, short, simple setae contiguous to femur joint; inner surface of all basitarsi with dense, brown, simple, strong setae, pointing ventrally, additionally, mesobasitarsal inner surface with three major wavy setae arising along edge of proximal keel; posterior surface of profemur covered with dense, fulvous, plumose, setae, proximally about as long as those on lower gena section, becoming shorter distally; posterior surface of protibia and outer surface of probasitarsus with similar setae, however not as plumose, anterior and inner surface of profemur and protibia with moderately dense, fulvous, simple, short setae; distalmost margin of probasitarsus and second and third protarsomeres with chemical gathering tufts composed of tightly dense, reddish-ochre, simple, long setae; outer surface of mesotibia with two proximal tufts, anterior tuft ellipsoidal with a diagonally truncate base and rounded on its distal end (Fig. 15), about one-third as long as velvety area, posterior tuft round, oblong, about one-third as long as major axis of anterior tuft, and partially lying on posterior half of truncate margin of anterior tuft (Fig. 15), both tufts on deep cavities, and composed of dense, fulvous, plumose setae directed posterad, longer on anterior tuft; microtrichia of velvety area covering the remainder outer surface, although noticeably sparser along anterior margin (Fig. 15); outer surface of metafemur, metatibia and metabasitarsus with moderately dense, pale, rather simple (minutely branched) setae, as long as those on frontal fringe, especially on metafemur, slightly shorter on metabasitarsus and metatibia, except this last with a fringe of enlarged setae on postero-dorsal margin along distal section of organ slit, some of these setae appressed over organ slit; metatibial organ slit closed with dark brown setae (Fig. 19). Dorsal surface of first metasomal tergum covered with moderately dense, fulvous, rather simple setae as long as those on frontal fringe, ventro-lateral sections bare; second to fourth metasomal terga covered with dense, fulvous, simple, very short setae all throughout, intermixed with scattered, dark-brown, erect, simple, short, setae especially on dorsum towards posterior margin; fifth to seventh terga with setae as those on dorsum of first tergum; first metasomal sternum mesally with a dense patch of fulvous, plumose, appressed, long setae; all remaining sterna with vestiture as that on dorsum of first metasomal tergum; cowled slits on second sternum covered with moderately dense, pale, simple, setae oriented posterad, and also forming a fringe along edge of openings (Fig. 13).

Terminalia. Posterior margin of disc of seventh metasomal sternum invaginated mesally, with two apical setae on each side of invaginated section (Fig. 21). Eighth metasomal sternum with anterior section wider than long (not considering apodemes); posterior section projected ventrally making an angle of ~160° respect to longitudinal axis of anterior section; lateral lobes of posterior section with lateral edge slightly convex and an acute point posteriorly, some rather long setae inserted mainly on ventral surface of lobes; lateral width of posterior section comparable to lateral width of anterior section (without apodemes) (Fig. 23). Dorsal process of gonocoxite longer than wide; incision between posterior and dorsal processes of gonocoxite forming an acute angle (Fig. 24). Gonostylus with a lateral section projected beyond the margin of gonocoxite (in dorsal or ventral views), bearing dense, fulvous, simple, long setae on concave inner surface (setae slightly surpassing posterior margin of blades of penis valves); ventral lobe of gonostylar lateral section triangular, bearing some scattered setae on inner surface (Figs 24–26).

♀: *Structure*. Total body length 12.87 mm (12.44–13.56; n=5); labiomaxillary complex in repose reaching posterior margin of first metasomal sternum. Head length 3.31 mm (3.19–3.41; n=5); head width 5.27 mm (5.19–5.48; n=5); upper interorbital distance 2.54 mm (2.50–2.59; n=5); lower interorbital distance 2.49 mm (2.44–2.63; n=5); upper clypeal width 1.36 mm (1.33–1.41; n=5); lower clypeal width 2.30 mm (2.22–2.37; n=5); clypeal protuberance 0.86 mm (0.74–0.89; n=5); medial clypeal ridge sharp, paramedial ridges sharp on lower half; labrum rectangular, wider than long, length 1.11 mm (n=5), width 1.34 mm (1.31–1.41; n=5) (Fig. 9); labral ridges and windows as in male; distal margin of labrum with a submarginal carina produced outwards; interocellar distance 0.37 mm (0.36–0.37; n=5); ocellocular distance 0.74 mm (0.73–0.78; n=5); first flagellomere nearly as long [0.53 mm (0.52–0.58; n=5)] as second and third flagellomeres combined [0.50 mm (0.48–0.52; n=5)]; length of malar area 0.13 mm (0.11–0.15; n=5). Mandible tridentate, basal tooth broader than other two teeth. Dorsolateral angle of pronotum as in male; intertegular distance 3.99 mm (3.63–4.07; n=5); mesoscutal length 3.29 mm (3.11–3.41; n=5); mesoscutellar length 1.56 mm (1.52–1.63; n=5); posterior border of mesoscutellum as in male (Fig. 3; mesotibial length 2.73 mm (2.67–2.96; n=5); mesobasitarsal length 2.33 mm (2.15–2.44; n=5), maximum width 0.75 mm (0.74–0.81; n=5); metatibia triangular; metatibial anterior margin length 3.96 mm (3.78–4.15; n=5), ventral margin length 2.28 mm (2.22–2.44; n=5); postero-dorsal margin length 4.29 mm (4.19–4.52; n=5); metatibial ventro-posterior angle evenly rounded. Forewing length 10.00 mm (9.63–10.81; n=5); hind wing with 24–27 (n=5) hamuli. Maximum metasomal width 5.61 mm (5.48–5.85; n=5).

Coloration. As described for the male except as follows: paraocular marks and spot on antennal scape absent; ivory coloration on outer surface of mandible covering no more than one-third of it; labrum with distal margin dark brown to black, mid surface between paramedial ridges with a noticeably dark brown spot (Fig. 9).

Sculpturing. As described for the male except mesepisternum slightly denser all over and no major puncture size distinction on upper section. Metatibial corbicular concavity smooth.

Vestiture. As described for the male except as follows: mesoscutellar patch oblong, composed of dense, dark, erect setae with some pale setae intermixed, length of patch occupying about three-quarters of mesoscutellar length, and width of patch about one-fifth of mesoscutellum (Fig. 3). Mesotibia with some spur-like, dark brown setae on posterior and ventral edges; metatibial corbicula surrounded by long, pale setae, and near anterior margin with a few sturdy simple dark setae. Mesal sections of second to fourth metasomal sterna nearly bare.

Distribution. Known from as far south as Nicaragua, and as north as the central Mexican state of San Luis Potosí (Fig. 27). *Euglossa obrima* is found in humid environments with specimens collected in lowland areas with tropical rain forest (Chimalapas, Oaxaca, Mexico), or at mid altitudes (as high as 1600 m) in cloud mountain forest (Tlanchinol, Hidalgo, Mexico). Although collecting records are scarce, beyond the Isthmus of Tehuantepec going north, the species is absent from the Mexican lowlands along the Pacific Ocean, with records only from the lowlands along the Gulf of Mexico.

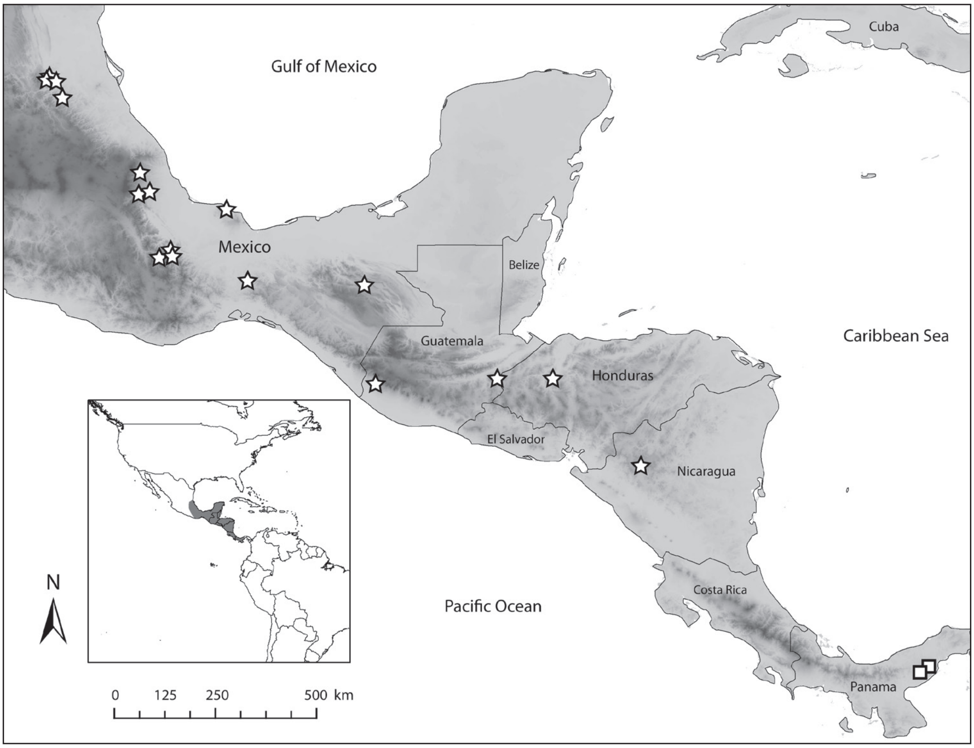


Figure 27. Distribution of the two species of *Euglossa* (*Dasystilbe*). Stars indicate localities for *Euglossa* (*Dasystilbe*) *obrima* sp. n., squares indicate localities for *E.* (*D.*) *villosa* Moure.

The distribution of *E. obrima* is apparently disjunct to the known distribution of *E. villosa* which is known only from a couple of localities in Panamá, although some specimens missing locality data, deposited in the Florida Museum of Natural History, University of Florida, USA, may be from Costa Rica (Mark Whitten, pers. comm. 2006).

Comments. The males collected in Chalchijapa, Santa María Chimalapa, Oaxaca, Mexico as well as those from Tlanchinol, Hidalgo, Mexico, were captured using a mix of chemicals including eugenol and methyl salicylate. One male from Guatemala was captured in a flight intercept trap, while one female from San Juan, San Luis Potosi, Mexico was collected while visiting flowers of *Bidens odorata* Cavanilles (Asteraceae).

Etymology. The specific epithet is a reference to the slightly broader general habitus of this species when compared to *E. villosa* (Greek, *obrimos*, meaning "strong", "mighty").

Euglossa (*Dasystilbe*) *villosa* Moure

http://species-id.net/wiki/Euglossa_(Dasystilbe)_villosa
Figs 2, 5, 8, 16, 18, 20

Diagnosis. Only males presently known; body coloration metallic-green with noticeable bronzy iridescence particularly on mesoscutum, metatibia, and metasoma (Figs 2, 5, 20); first four metasomal terga with noticeable green band along tergal margins as opposed to their conspicuously bronzy iridescent major anterior sectors (Figs 2, 5); punctation moderately dense; body with dense, fulvous, long setae especially on lateral and ventral sides of head and mesosoma; mesotibial anterior tuft ellipsoidal with a diagonally truncate base and also a truncate distal margin, posterior tuft oval, almost completely lying on two-thirds of truncate proximal margin of anterior tuft, sparse section of velvety area covering about anterior half of it (Fig. 16); second mesotarsomere quasi square-shaped, posterior margin concavity obscured by projection of posterior margin of inner surface (Fig. 18); third and fourth mesotarsomeres about as long as wide or slightly wider; distal section of metatibial organ slit lanceolate (spur-like), broad, maximum width occupying about one-third of metatibial outer surface width (Fig. 20); second metasomal sternum with two narrow cowled slits.

Discussion

As alluded to, while proposing the first comprehensive infrageneric classification for the genus *Euglossa*, Dressler (1978) created *Dasystilbe* as a monotypic subgenus to accommodate *E. villosa*, which in his view shared features of bees included in two other subgenera. In this way, *Dasystilbe* represented an annectant taxon in Dressler's system, bridging the divide between classificatory units as then proposed. In accordance with Dressler's notion, it is true that the external morphology of *E. villosa* exhibits features similar to *Glossura* and *Euglossella*. As already recognized by Dressler

(1978), the facial and prothoracic features of *E. villosa* resemble those of *Euglossella*, while the distinctive sternal cowled slits of the species are also a feature of several of the most common species of *Glossura*. The morphology of the male genitalia of *E. villosa* similarly reveals a mosaic of characters, while features of the gonostylus clearly link it with *Glossura*, but most features of the hidden sterna are distinctly not as in *Glossura* (e.g., Hinojosa-Díaz 2008). As a monotypic entity in the classificatory scheme adopted for *Euglossa* by most researchers [i.e., the one established by Dressler (1978), and emended by the same author (Dressler 1982) and Moure (1989)], *Dasystilbe* is considered as having a rather stable position. However, these schemata lack phylogenetic validation, meaning that it is possible that *Dasystilbe* could be nested within another group. A molecular phylogeny for orchid bees and including a robust sampling of species from the genus *Euglossa* was recently completed (Ramírez et al. 2010). This study recovered *E. villosa* as sister to *Euglossella* and together as sister to the remainder of the species in the genus. Morphological features that have historically been used to support such a placement include the strong clypeal ridges [which in recent analyses are highly homoplastic and of little phylogenetic value: Hinojosa-Díaz (2010, in prep.)], the pointed pronotal dorsolateral angle, the shape of the mesoscutellum (but, like the clypeal ridges, this same shape occurs in *Euglossella* and some species groups of *Glossura* and so its utility is unclear), the inflated and relatively smooth metatibia, and, most significantly, the morphology of the mesotibia, including the tufts. By contrast, a phylogenetic analysis conducted by Hinojosa-Díaz (2010, in prep.), based on morphology of the males and emphasizing numerous new genitalic characters, recovered *E. villosa* as sister to a derived and redefined clade of *Glossura*. Curiously the results of both analyses reinforce the conflictive ideas on which Dressler based the erection of *Dasystilbe*, with each study supporting one of the two subgenera to which the species is purported to be allied. Regardless of the incongruent phylogenetic position of *E. villosa* in both analyses, it is not nested within another subgenus as they are presently employed. Indeed, some additional external morphological attributes, not mentioned in the original description of *E. villosa* by Moure (1968), are important as diagnostic features highlighting its distinctiveness from all other species of *Euglossa*, and provide additional insight into its phylogenetic placement. Aside from the gonostylar morphology, which is very close to that of some derived clades within the genus (i.e., *Euglossa* s.str. and *Glossura*) and totally dissimilar to that of *Euglossella*, the morphology of the second mesotarsomere is also shared with more derived clades. All other orchid bee genera have a generalized, unmodified second mesotarsomere, and this is certainly true for *Euglossella*, with the remainder of *Euglossa* s.l. having a basal emargination on the anterior margin of this tarsomere. Under the homology interpretation of Hinojosa-Díaz (2010, in prep.), *E. villosa* has this emargination as well as a posterior basal emargination on the same podite unit (Figs 17–18). This feature is just another one of the many modifications in the legs of male orchid bees (particularly *Euglossa*) related to the handling of chemicals (e.g., Eltz et al. 2005) that seem to have had an impact on the diversification of the group.

Acknowledgements

Most of the present work resulted from the doctoral research of IAH-D, work which was partially funded by CONACYT (Consejo Nacional de Ciencia y Tecnología, México). William Norris and Mark Whitten permitted study of specimens from the Florida Museum of Natural History, University of Florida, USA, and Armando Luis Martínez loaned us the material from the Museo de Zoología Alfonso L. Herrera, Facultad de Ciencias, UNAM, Mexico. Our gratitude is extended to Dr. Charles D. Michener and two anonymous reviewers for their valuable comments on earlier drafts of the manuscript, and to Andres Lira for assistance in producing the distribution map. Partial support was provided by US National Science Foundation grants DBI-0096905, EF-0341724, and DEB-0542909 (to MSE). GARM thanks CNPq for a PQ-2 fellowship. This is a contribution of the Division of Entomology, University of Kansas Natural History Museum.

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ZooKeys 97: 31–38 (2011)
doi: 10.3897/zookeys.97.1223
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A second species of *Oculogryphus* (Coleoptera, Lampyridae), with notes on the phylogenetic affinities of the genus

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Academic editor: *Terry Erwin* | Received 10 March 2011 | Accepted 18 April 2011 | Published 11 May 2011

urn:lsid:zoobank.org:pub:F86020FD-82DF-44E4-881C-029748B1356D

Citation: Jeng M-L, Branham MA, Engel MS (2011) A second species of *Oculogryphus* (Coleoptera, Lampyridae), with notes on the phylogenetic affinities of the genus. ZooKeys 97: 31–38. doi: 10.3897/zookeys.97.1223

Abstract

A second species of the enigmatic lampyrid genus *Oculogryphus* is described and figured as *Oculogryphus bicolor* **sp. n.** from Vietnam. The definition of the genus is slightly modified with consideration of newly detected morphological variation from this species. According to a comprehensive phylogenetic analysis including nearly 80% of documented lampyrid genera, *Oculogryphus* is the putative sister group to *Stenocladius* s. str. within the paraphyletic group of Ototretinae-Ototretadrilinae. The classification of *Stenocladius* is briefly discussed in this context.

Keywords

Oculogryphus, Lampyridae, phylogenetic position, *Stenocladius*, Vietnam, taxonomy

Introduction

The genus *Oculogryphus* was established for a single male specimen of a peculiar species, *Oculogryphus fulvus* Jeng, from Vietnam (Jeng et al. 2007). A second species of the genus, also from Vietnam, was recently identified while examining material in the American Museum of Natural History (AMNH). Herein we describe and figure this new species and discuss some morphological variations between it and *O. fulvus*, requiring a slight modification to the generic diagnosis. In addition, comments are provided regarding the phylogenetic position of *Oculogryphus* in the light of a comprehensive phylogenetic analysis of Lampyridae conducted by the senior author (Jeng 2008).

Material and methods

The methodology and morphological terminology used herein follows that of Jeng et al. (2007). The body length (BL) is the sum of the pronotal and elytral lengths (PL and EL, respectively) plus length of those exposed portions of the head from the pronotum; while body width is considered as twice the elytral width (BW = 2EW). Pronotal width was abbreviated as PW. The nomenclature of the hind wing venation follows that of Kukalová-Peck and Lawrence (2004) rather than that of Kukalová-Peck and Lawrence (1993) which was employed by Jeng et al. (2007). In reporting label data the symbol "/" indicates separate lines on a single labe, while "//" denotes material located on separate labels.

Results

Genus *Oculogryphus* Jeng, Engel & Yang, 2007

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

Oculogryphus Jeng, Engel & Yang, 2007: 4.

Type-species. *Oculogryphus fulvus* Jeng, 2007, by original designation.

Diagnosis. The original diagnosis of the genus provided by Jeng et al. (2007) was based strictly on *O. fulvus*. The genus is characterized by its large and ventrally approximate compound eyes which are clearly emarginate posteriorly, filiform antennae, unmodified mandibles (*sensu* Green 1959), considerably exposed head from pronotum, absence of tibial spurs and lanterns, progressively shortened tarsomeres from I–IV, eight abdominal ventrites which are not lobed, dorsal abdominal spiracles not enclosed by parasternites, symmetrical aedeagal sheath and aedeagi, and several other characters

(Jeng et al. 2007). The new species demonstrates some variations in hind wing venation (bifurcate MP_{3+4}). The following pairs contrast the different hind wing venations under the two nomenclatural systems used between Jeng et al. (2007) and the current work: CuA = Cu; CuA_{1+2} = CuA; AA = AA_{3+4}; CuA_{3+4} + AA = AA_3. Otherwise the original definition of the genus remains unchanged. These modifications do not affect the key to Oriental genera provided by Jeng et al. (2007).

***Oculogryphus bicolor* sp. n.**

urn:lsid:zoobank.org:act:649F93C0-8F6F-46A8-A163-040DB4AFA3CE
http://species-id.net/wiki/Oculogryphus_bicolor
Figs 1–6

Holotype. ♂, "VIETNAM: Ha Tinh, Huong/ Son, 18°22'N, 106°13'E/ 900m, April 20–28, 1998/ Malaise, AMNH, Carpenter/ Grimaldi, Herman, Silva, Long". Deposited in the Division of Invertebrate Zoology (Entomology), American Museum of Natural History, NY, with eventual deposition in the Institute of Ecology and Biological Resources Collection (IEBR), Hanoi, Vietnam.

Paratypes. 4 ♂♂, with identical data as holotype; 1 ♂, with identical data except collected on 18 May 1998; 1 ♂, with identical data as holotype except collected at 600m above sea level on 7–14 April 1998 by K. Long; 1 ♂, with identical data as holotype except collected on 5 May 1998 by K. Long. All deposited in the AMNH.

Type-locality. Vietnam, Ha Tinh Province, Huong Son, 18°22'N, 106°13'E.

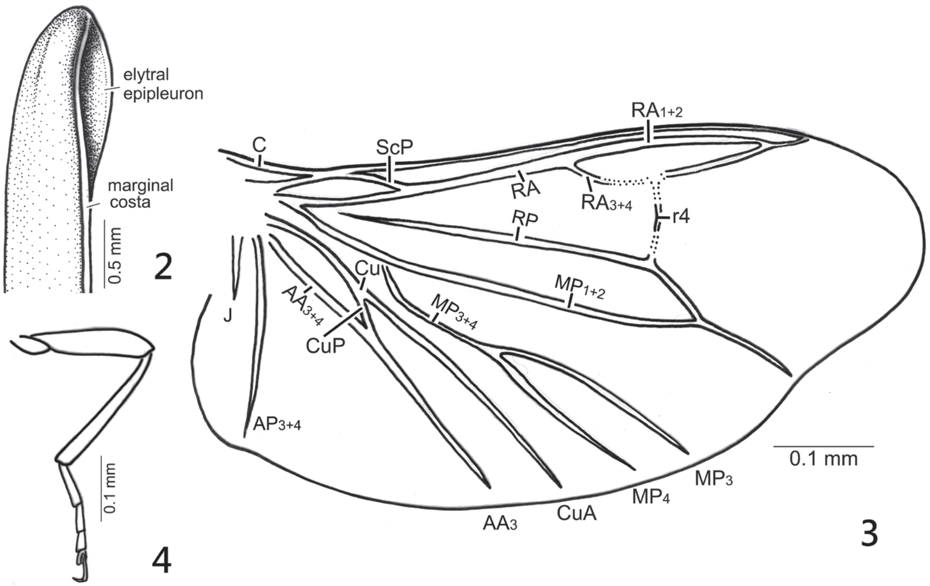
Diagnosis. The species has several diagnosable characters separating it from the type species: 1) body size slightly larger (6.2–8.2 vs. 6.0 mm); 2) more vivid light brown-tan bicoloration (Fig. 1); 3) slightly broader elytral epipleura (Fig. 2); 4) bifurcate MP_{3+4} in the hind wing (Fig. 3); 5) more slender metatibia (Fig. 4); and, 6) more elongate parameres in the male genitalia (Fig. 6).

Description. Male. BL: 6.2–8.2 mm; BW: 2.7–3.4 mm; PW/PL = 1.5–1.6; EL/EW = 3.6–3.8; EL/PL = 3.8–4.4; BW/PW = 1.4–1.5. The species is very similar to the type species in general morphology except the aforementioned differences, and need not be repeated here. As described for *O. fulvus* except: aedeagal sheath has length of 0.9 mm and width of 0.6 mm; abdominal tergites IX and X clearly recognizable individually (Fig. 5); aedeagus about 0.75 mm in length and 0.4 mm broad; parameres comparatively elongate, about as long as basal piece laterally (Fig. 6).

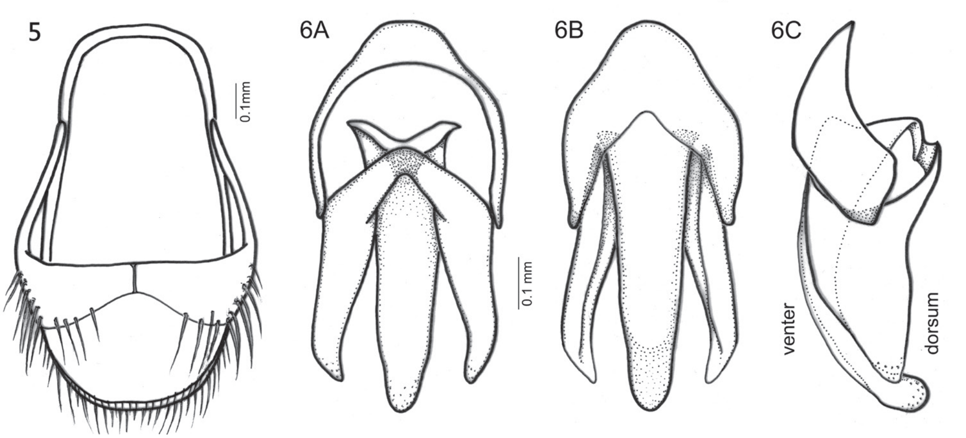
Etymology. The specific epithet refers to the two-toned coloration which is more vivid in the new species than in *O. fulvus*.

Phenology. According to the available collection data, males appear at least from April to May.

Figure 1. Habitus of male of *Oculogryphus bicolor* sp. n. Scale bar = 1.5mm. Elytra somewhat twisted in outer margin of apical half due to dehydration.



Figures 2–4. *Oculogryphus bicolor* sp. n., male **2** basal part of right elytron, lateral aspect, showing epipleuron **3** right hind wing **4** left metatibia, from trochanter to pretarsal claws, ventral aspect.



Figures 5–6. *Oculogryphus bicolor* sp. n., male **5** aedeagal sheath, dorsal aspect **6** male genitalia, dorsal (A), ventral (B), and lateral (C) aspects.

Oculogryphus fulvus Jeng

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

Oculogryphus fulvus Jeng, *in* Jeng, Engel and Yang, 2007: 7.

Comments. A second specimen of *O. fulvus*, deposited in Magyar Természettudományi Múzeum, Budapest, was discovered. No significant variation was detected between this specimen and the holotype for the species. Refer to Jeng et al. (2007) for a complete account of this species.

New material. ♂, “Vietnam: Cuc Phuong/ Ninh binh, 3-10.V.1966. Exp. Gy. TOPÁL// Nr. 261/ beaten from bushes”.

Key to *Oculogryphus* species

1 Elytra vividly bicolor, with base, lateral margins, and sutures yellowish brown and disc dark brown; body size larger (body length 6.2–8.2 mm); male genitalia with median lobe slightly surpassing apex of parameres .... ***O. bicolor* sp. n.**

– Elytra more or less uniformly brown in coloration; body size smaller (body length 6.0 mm); male genitalia with median lobe far surpassing apex of parameres by about 1/3 length of median lobe .... ***O. fulvus***

Discussion

Oculogryphus has a mosaic of features intermingling those of Rhagophthalmidae (e.g., large and posteriorly emarginate compound eyes), Luciolinae (e.g., large head partially exposed from pronotum; filiform antennae), Ototretinae (e.g., similar morphology of abdomen; symmetrical aedeagal sheath and aedeagus; absence of lanterns), Ototretadrilinae (e.g., abdominal spiracles not enclosed by parasternites), and Lampyrinae (e.g., ventrally approximate compound eyes) (Jeng et al. 2007). Based on their morphological comparison across 80 documented genera of Lampyridae, Jeng et al. (2007) inferred that the genus was either a member of Ototretinae or a stem taxon linking Luciolinae and some basal lineages of Lampyridae. It now appears that this inference was quite accurate. In the most comprehensive phylogenetic analysis of Lampyridae conducted to date (Jeng 2008, in prep.), *Oculogryphus* was found to be the sister group of *Stenocladius* Fairmaire within the paraphyletic group of Ototretinae-Ototretadrilinae complex (both subfamilies were defined by Crowson 1972). Morphologically this position appears intuitive, and seems further supported by the discovery of *O. bicolor* which shows an even more similar morphology with that of *Stenocladius*, especially in the aedeagal sheath and male genitalia (*cf.* Kawashima 1999). However, *Stenocladius* is a problematic taxon. The type species, *Stenocladius davidis* Fairmaire from China, has pectinate antennae bearing branches arising from the base of flagellar articles I–VIII, and with flagellar articles that are not abbreviated. All *Stenocladius* species from Japan, Taiwan, and adjacent islands share a more-or-less uniform male genital structure (Kawashima 1999). By contrast, some species of *Stenocladius* are questionably assigned to this genus, especially those from India and Sri Lanka [e.g., *S. basalis* Pic which was the only representative of *Stenocladius* examined by Crowson (1972) when establishing his new subfamilial classification for Lampyridae]. We have termed the former group as *Stenocladius* s .str. so as to differentiate them from those atypical group(s) within the genus. Several significant differences have been detected among these atypical species, such as the position of the abdominal spiracles (enclosed by parasternites rather than adjacent to them), a different kind of pectinate antennae (abbreviated flagellar articles and branches arising from the article apex rather than the base), and male genitalia (short median lobe and parameres somewhat hooked inward apically or subapically). It is likely that many of the Oriental *Stenocladius* do not truly belong to this genus but are allied to some other ototretines. Further differentiation of *Stenocladius* is under investigation by the senior author. Regardless, the discovery of enigmatic new taxa like *O. bicolor* and the recognition of significant difficulties in the current classification of some diverse genera, highlights the need for continued exploration and taxonomic study of Asian Lampyridae.

Acknowledgments

We are grateful to Sacha Spector (AMNH) for loaning material of the new species described herein. This study was supported financially by a summer scholarship from the Division of Entomology, University of Kansas Natural History Museum, and National Science Council, Republic of China, grant NSC 100-2631-H-178 -003.

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ZooKeys 97: 39–73 (2011)
doi: 10.3897/zookeys.97.753
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Biology and systematics of the New World *Phyllocnistis* Zeller leafminers of the avocado genus *Persea* (Lepidoptera, Gracillariidae)

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Academic editor: *E. van Nieukerken* | Received 19 November 2010 | Accepted 7 March 2011 | Published 11 May 2011

urn:lsid:zoobank.org:pub:6FC5A865-0C6F-4F90-9BC0-B49615B7658F

Citation: Davis DR, Wagner DL (2011) Biology and systematics of the New World *Phyllocnistis* Zeller leafminers of the avocado genus *Persea* (Lepidoptera, Gracillariidae). ZooKeys 97: 39–73. doi: 10.3897/zookeys.97.753

Abstract

Four New World species of *Phyllocnistis* Zeller are described from serpentine mines in *Persea* (Family Lauraceae). *Phyllocnistis hyperpersea*, new species, mines the upper leaf surfaces of avocado, *Persea americana* Mill., and red bay, *Persea borbonia* (L.) Spreng. and ranges over much of the southeastern United States into Central America. *Phyllocnistis subpersea*, new species, mines the underside and occasionally upper sides of new leaves of *Persea borbonia* in southeastern United States. *Phyllocnistis longipalpa*, new species, known only from southern Florida also mines the undersides of new leaves of *Persea borbonia*. *Phyllocnistis perseafolia*, new species, mines both leaf surfaces and possibly fruits of *Persea americana* in Colombia, South America. As in all known species of *Phyllocnistis*, the early instars are subepidermal sapfeeders in young (not fully hardened) foliage, and the final instar is an extremely specialized, nonfeeding larval form, whose primary function is to spin the silken cocoon, at the mine terminus, prior to pupation. Early stages are illustrated and described for three of the species. The unusual morphology of the pupae, particularly the frontal process of the head, is shown to be one of the most useful morphological sources of diagnostic characters for species identification of *Phyllocnistis.* COI barcode sequence distances are provided for the four proposed species and a fifth, undescribed species from Costa Rica.

Keywords
Biogeography, hypermetamorphosis, genital morphology, larval morphology, pupal morphology, cocoon cutter, serpentine mine, DNA barcodes

Introduction

Although the genus *Phyllocnistis* Zeller, 1848 is one of the more speciose genera in the Gracillariidae, its diversity is greatly underestimated in existing taxonomic literature. Currently 90 valid names are known for the world (DePrins and Kawahara 2009, De Prins and De Prins 2011), with 28 listed for the New World (Davis and Miller 1984, Kawahara et al. 2009). During 1996 – 1998, as part of the Arthropods of La Selva (ALAS) Project, the authors conducted a preliminary survey of the Gracillariidae of La Selva Biological Station, a lowland rain forest site in northwestern Costa Rica. Because our visits to the study site were limited to less than 15 days each year, our survey was restricted largely to the collection of leafmines and examination of plant specimens in the station's herbarium. Relying primarily on mine morphology and host plant information, we estimated that as many as 200 species of Gracillariidae were present at La Selva Biological Station. By far the most speciose genus in our survey was *Phyllocnistis* with an estimated 60 species, of which we recognized only a single previously known species, the invasive citrus leafminer, *P. citrella* Stainton. Interestingly, this globally monitored species had been first reported in the Americas (Florida and the West Indies) only three years earlier in 1993 (Heppner 1993, Hoy and Nguyen 1997). Further, we believe it probable that several more *Persea*-feeding *Phyllocnistis* will be found considering that there are more than 200 species of *Persea* known globally (Mabberley 2008), and that as many as three species may use a single host species at a single location: e.g., *Persea borbonia* at Pa-hay-okee Overlook in the Florida Everglades. Although only four species are proposed in this report, a fifth species based on COI barcode sequences (Fig. 1) and unique pupal characters (but without properly associated adults) has been examined from *Persea americana* collected in Costa Rica. While preliminary, our studies suggest that tropical diversity of *Phyllocnistis* will someday tally in the hundreds of species.

Adults of the genus *Phyllocnistis* are very small moths with wing spans generally not exceeding 5 mm. Both fore- and hindwings are lanceolate and predominantly white; the forewings are marked with yellow to orange, longitudinal and oblique striae, often bordered by gray or black (Figs 2A–D). A few species are known to possess much darker or strikingly color patterns. Terminology used for describing forewing pattern follows that of Kawahara et al. (2009). The compound eyes of *Phyllocnistis* are reduced, with an interocular index (vertical eye diameter/minimum interocular distance) of approximately 0.9. The maxillary palpi are the most reduced among Gracillariidae, being barely evident as vestigial, non-segmented lobes at the base of the elongate proboscis. The wing venation (Forbes 1923) is also reduced with M1 stalked to Rs4; M3 and

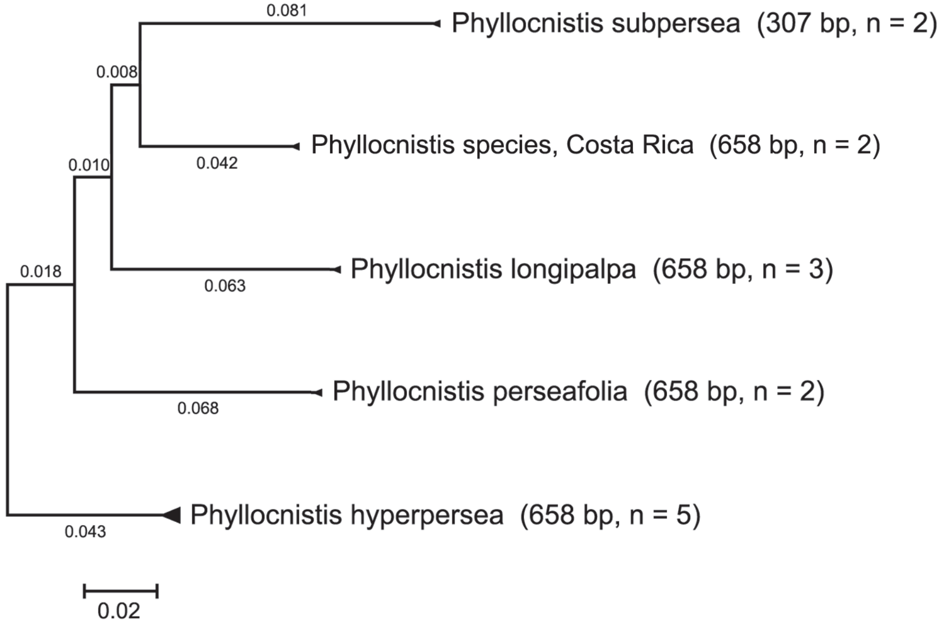

Figure 1. COI distance tree of five *Persea*-mining species of *Phyllocnistis* based upon neighbor-joining analysis with Kimura 2-parameter model.

CuA2 are lost in the forewing; the base of M is absent within the forewing discal cell, and the cell is open in the hindwing. The apex of the forewing is unusual in being greatly attenuated with Rs4 extending to the apex.

The morphology of the male genitalia is relatively simple and usually characterized by a relatively broad vinculum, narrow tegumen and slender valvae, and species-level differences are modest relative to other gracillariids or Lepidoptera in general. Homology of what appears to be segment 10 is uncertain and consists of a mostly membranous cylinder extending caudally from the sclerotized tegumen that mostly encompasses the anal tube (Fig. 16A).

The female genitalia, although characteristic for the genus, likewise appears relatively uniform among species, consisting primarily of very short papillae anales, a comparatively large, oblong corpus bursae often containing a pair of similar, fusiform signa bearing a short median projection (Fig. 16D); a pair of similar, slender, elongate ducts that extend from usually opposite ends of the corpus bursae, one (ductus bursae) leading to the ostium and the other (ductus spermathecae) to the spermatheca.

The larvae of *Phyllocnistis* are among the most specialized Lepidoptera (Trägårdh 1913). Four instars appear to be the norm (Condrashoff 1962, Wagner and Davis unpublished data), with the first three instars possessing a sapfeeding morphology and behavior (Davis 1987). Sapfeeding instars create a long serpentine, subepidermal mine on either the upper or lower surfaces of the host leaf. A few species also form subepidermal mines on stems and various fruits, including avocado. A characteristic, median frass trail extends the length of the mine, usually as a dark, unbroken line. The fourth instar is a highly specialized, apodal, non-feeding instar whose primary function is to spin the cocoon, at the mine terminus, prior to pupation.

In contrast to the conservative morphology of the larval and adult stages, the pupae of *Phyllocnistis* are structurally diverse, particularly with regard to the development of the frontal process (cocoon-cutter) of the head (Figs 6A, B; 12A, B; 14A, B; see also Kawahara et al. 2009). In addition, the mid-dorsal areas of abdominal terga 3–7 possess a mostly symmetrical cluster of recurved spines that frequently differ in their arrangement and form among species. Given the uniformity in both male and female genital characters in *Phyllocnistis,* it is surprising to us to find reliable species-level differences in pupal morphology across what appear to be closely-related congeners feeding on *Persea*. We certainly encourage others to collect and illustrate pupae whenever new species are described in the genus.

Consistent differences in wing patterns were noted for each of the four species described here—although such are easily abraded if specimens are not collected and prepared with care. We note that our descriptions are based solely on reared material and thus might differ in appearance from flown specimens. Because of the general similarity of both male and female genitalia that exists among most members of *Phyllocnistis*, species identification relying upon standard genitalic characters may be impossible at times. We expect that the application of COI barcoding will be especially useful in this large genus of minute moths.

The plant genus *Persea* includes approximately 200 species worldwide, with a majority of the species concentrated in Central America and southeast Asia (Mabberley 2008); Kopp (1966) recognized 81 species for the New World. The most important species economically is the avocado, *Persea americana* Mill., which is grown throughout the tropics for its fruit.

Half of the *Phyllocnistis* found in eastern North America are hostplant specialists on archaic families of woody plants: 3 species feed on *Persea* in the Lauraceae, 2 on *Magnolia* and *Liriodendron* in the Magnoliaceae, and 1 on *Liquidambar* in the Hamamelidaceae (or Altingaceae), all plant families that date to the Cretaceous. Ninety seven-million-year-old (more recently estimated at 102 mya, Brenner et al. 2000) phyllocnistine leafmines provide the oldest fossil evidence of Ditrysian Lepidoptera (Labandeira et al. 1994). Phylogenetic studies will be needed to ascertain if the association of the genus with archaic plant families is a testament to the ancient and often conservative nature of insect-plant associations (Farrell et al. 1992, Labandeira et al. 1994, Wilf et al. 2000) or the result of more recent host colonizations.

The damage inflicted by *Phyllocnistis* larvae feeding on avocado may vary according to region and the species of miner involved. Wysoski et al. (2002) reported major damage to avocado caused by an unknown *Phyllocnistis* in Peru that could reduce tree vigor, but only minor damage on avocado by *Phyllocnistis* in Florida. Larval feeding by *P.*

perseafolia on avocado leaves in Colombia is known to cause serious damage (Francisco Posada, *in litt.*, Fig. 4). Possibly the damage to avocado in Peru reported by Wysoski et al. (2002) was also produced by *P. perseafolia.*

Material

The material examined is deposited in the collections listed below:

BMNH	The Natural History Museum (formerly the British Museum (Natural History)), London, United Kingdom.
FSCA	Florida State Collection of Arthropods, Gainesville, Florida, USA.
UCMS	University of Connecticut, Storrs, Connecticut, USA.
UNCM	Museo Entomolgico Francisco Luis Gallego, Universidad Nacional de Colombia, Medellín, Colombia.
USNM	Collections of the former United States National Museum, now deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

Methods

Collecting and rearing. Nearly all of the adults in this study were reared from their plant hosts. Leaves containing mines with larvae were placed in plastic bags or large plastic tubes and examined daily thereafter. Newly-eclosed adults were killed with ammonium hydroxide fumes or frozen, pinned, and spread. Some larvae representing different instars and pupae were fixed in Pampel fluid and preserved in 75% ethanol. Samples of alcohol-preserved larvae and pupae were gently washed in 409® detergent, then dried in a critical point drier, sputter coated with 20–25 gold palladium 60:40 alloy, and photographed with an Amray 1810 scanning electron microscope.

Genitalic dissections were cleared by heating in hot 10% KOH for ~ 30 minutes, and subsequently cleaned and stained with either 2% chlorazol black E or mercurochrome solutions. All genitalic illustrations were drawn from dissections temporarily stored in glycerine, which were later permanently embedded in Euparal or Canada balsam. Genitalic terminology follows Klots (1970).

Molecular analysis. DNA **s**equences were produced at the Biodiversity Institute of Ontario, University of Guelph, Canada. DNA was extracted from legs or entire bodies of adult moths using a QIAGEN DNeasy Tissue Kit. Primers LepF1 and LepR1 (Herbert et al. 2004) were used to obtain a 658 base pair fragment of COI with a standard thermocycling regime (Hajibabaei et al. 2006). Sequences are available at the National Center for Biotechnology Information GenBank database and at the Barcode of Life Database (BOLD). Neighbor-joining (NJ) trees were generated from 14 nucleotide sequences as implemented in BOLD (Ratnasingham and Hebert 2007).

Results

Exemplars of all five species clustered as each other's closest neighbors. A compressed subtree (Fig. 1) of the COI barcode sequences from the 14 specimen samples was computed using Molecular Evolutionary Genetics Analysis (MEGA) version 4 (Tamura et al. 2007). Only partial sequence data were obtained for *P. subpersea*. Uncorrected pairwise distances exceeded 10% between species. *P. hyperpersea*, the only species in our study that preferentially mines upper leaf surfaces, clustered outside of the group that mine lower leaf surfaces.

Table 1. Sample information for specimens submitted for COI barcoding. Additional specimen data as well as sequence data are available on the BOLD website at RDOPO Basal Lepidoptera.

Sample ID	Species of *Phyllocnistis*	Locality	BOLD Process ID	GenBank Accession number
DDAV–D557	*hyperpersea*	USA:FL: Pah-hay-okee	RDOPO395-10	HQ971045
DDAV–D558	*hyperpersea*	USA:FL: Pah-hay-okee	RDOPO396-10	HM382098
DDAV–D559	*hyperpersea*	USA:FL: Tamarind Hammock	RDOPO397-10	HQ971046
USNM ENT 00730716	*hyperpersea*	USA:FL: Tamarind Hammock	EPNG1734-10	HQ946656
USNM ENT 00730718	*hyperpersea*	USA:FL: Pah-hay-okee	EPNG1735-10	HQ946657
DDAV–D555	*perseafolia*	Colombia: Caldas	RDOPO393-10	HM382096
DDAV–D556	*perseafolia*	Colombia: Caldas	RDOPO394-10	HM382097
DDAV–D562	*longipalpa*	USA:FL: Tamarind Hammock	RDOPO400-10	HM382099
DDAV–D564	*longipalpa*	USA:FL: Cheika	RDOPO402-10	HM382100
USNM ENT 00718383	*longipalpa*	USA:FL: Pah-hay-okee	EPNG1759-10	HQ946666
DDAV–D565	species	Costa Rica: Cart.: Tres Rios	RDOPO403-10	HM382101
DDAV–D566	species	Costa Rica:	RDOPO404-10	HM382102
USNM ENT 00730717	*subpersea*	USA:FL: Tamarind Hammock	EPNG1736-10	
USNM ENT 00730756	*subpersea*	USA:FL: Pah-hay-okee	EPNG1737-10	

Taxonomy

Key to Adults and Pupae

1 Forewing tornus with raised row of broadened, black fringe scales; labial palpus short (circa 1.3× height of eye), roughened at apex; forewing often with fuscous subbasal spot; apical spot poorly developed, never blackened; frontal process (cocoon-cutter) of pupa consisting of a pair of stout, conical spines arising near apex, and single, more subapical, strongly curved spine from upper frons (Figs 12A–C) .... ***subpersea***

– Forewing tornus without distinct row of broadened, raised, black fringe scales; labial palpus short (less than height of eye) or long (circa height of head) smooth at apex; forewing without dark subbasal spot (although basal area may have fuscous scales); apical spot present or absent; frontal process of pupa a single spine (unknown for *P. longipalpa*) **2**

2 Palpi short (less than height of eye); smaller, FW < 2.2 mm; prominent black apical spot; frontal process relatively large, broadly triangular, acute (Figs 6A–B) .... ***hyperpersea***

– Palpi long (>2× height of eye), slightly upcurved; FW > 2.2 mm; apical spot present or absent **3**

3 Forewing length ≤ 2.6 mm; apical spot vague; orange scales at base of wing not extending to costa; basal streak narrowly edged with black; pupa unknown. North American .... ***longipalpa***

– Forewing length ≥ 2.6 mm; apical spot prominent; orange scales at base of wing reaching to costa, basal streak not edged with black; frontal process of pupa composed of single, large apical spine with minutely serrated, low ridge descending laterally from spine (Figs 14A–B). South American ...... ***perseafolia***

Species descriptions

Phyllocnistis hyperpersea Davis and Wagner, sp. n.

urn:lsid:zoobank.org:act:896DF46D-4693-4028-A909-0C9B3DC5E41C
http://species-id.net/wiki/Phyllocnistis_hyperpersea
Figs 2A, 3A, 5A, 6A–7D, 16 A–E

Diagnosis: *Phyllocnistis hyperpersea* is the smallest of the species treated here with FW lengths < 2.3 mm. The short labial palpi (less than height of eye) and prominent black apical spot, taken together, distinguish *hyperpersea* from the other *Persea*-feeding *Phyllocnistis*. The second costal fascia is weakly developed and does not fuse with the transverse fascia as in other *Phyllocnistis* treated here. Hind tarsomere 3 is more likely to be black than that of the other species. The black fringe scales about the tornus are less conspicuous: fewer in number, narrower, and less blackened relative to those of *Phyllocnistis subpersea* with which it commonly co-occurs. The frontal process of the pupa extends forward as a relatively large, broadly triangular, acute spine (Figs 6A–B).

Adult (Fig. 2A): Length of forewing: 1.9–2.2 mm.

Head: Frons shiny white, smooth glabrous, with subtle faint orange tints over vertex. Flagellomeres with orange-fuscous luster above. Labial palpus white, reduced, length less than height of eye.

Thorax: Patagia and tegulae with silvery stramineous to orange tints. Forewing with longitudinal fascia usually ending before joining transverse fascia, thinly edged with black scales above and below except distad. Transverse fascia usually complete, leaving costal margin at 45° angle; usually more thickly edged with black scales along

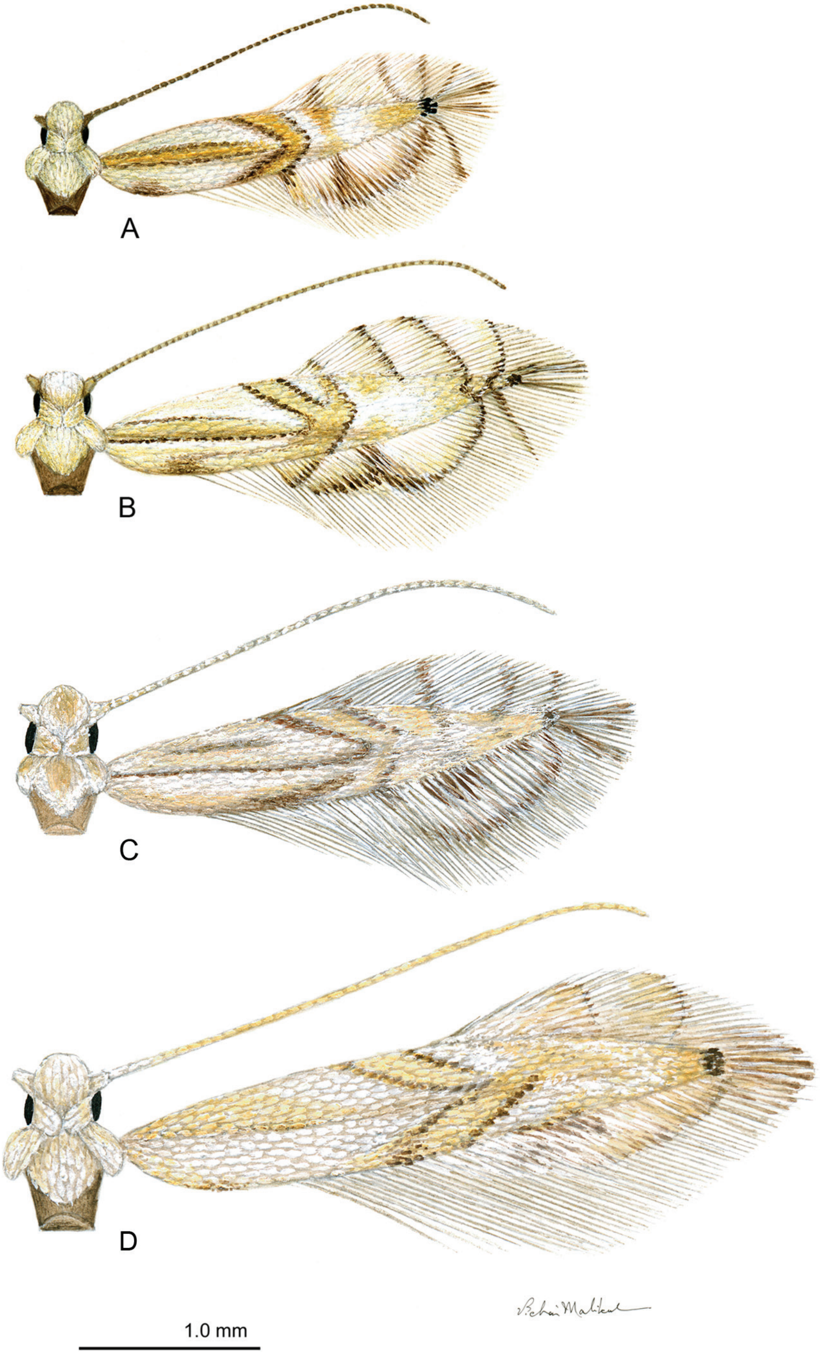

Figure 2. *Phyllocnistis* adults. **A** *P. hyperpersea* sp. n. (2.1 mm) **B** *P. subpersea* sp. n. (2.5 mm) **C** *P. longipalpa* sp. n. (2.6 mm) **D** *P. perseafolia* sp. n. (3.0 mm). (Drawn approximately to scale; forewing length in parentheses.)

proximal side; distal side somewhat rounded with black, edge-scaling weakened medially. Second costal fascia poorly differentiated, not fusing with transverse fascia. Apical spot of black scales well developed. Costal and apical strigulae modestly differentiated, often only two of latter evident. Black fringe scales about tornus only modestly differentiated: few in number, not strongly raised, and not appreciably broadened. Dorsal and outer surfaces of foretibiae and foretarsi, and to lesser extent those of mesothoracic legs, with fuscous metallic orange; third tarsomere of hindleg often darkened; otherwise legs mostly silvery white and unmarked.

Abdomen: Silvery white and unmarked.

Male Genitalia (Figs 16A–C): Uncus absent. Tegumen complex, consisting of narrow, sclerotized dorsal arch, continuing caudally as far as apex of valva as an elongate, mostly membranous, basally spinose cylinder which encloses anal tube. Vinculum well developed, ~ 0.5× length of valva, U- to V-shaped with relatively narrow anterior end. Valva simple, relatively long, ~ 2.0× length of vinculum, very slender and straight; broad at extreme base, then narrowing along middle, becoming slightly broader over apical third; apex of valva evenly rounded; basal apodeme of valva directed mesad at nearly right angle to valva. Transtilla arising from mesal base of valva as an elongate, acute process, and continuing mesally to articulate at midline with process from opposite valva. Aedeagus slender, weakly sclerotized, externally finely wrinkled cylinder ~ half length of valva; cornuti absent; phallobase greatly extended as membranous tube ~ 6× length of aedeagus; terminal hood of phallobase abruptly inflated and curved at ~ right angle to phallobase.

Female Genitalia (Figs 16D–E): Oviscapt greatly reduced; anterior and posterior apophyses of about equal lengths, very short, ~ 0.4× length of papillae anales. Ostium bursae opening in membrane between sterna 7 and 8; ductus bursae completely membranous, slender, moderately long, ~ 2.7× length of papillae anales and terminating near caudal third of corpus bursae; corpus bursae greatly enlarged, ~ 1.5× length of ductus bursae; walls of corpus bursae membranous except for pair of approximately identical, fusiform signa, with each bearing single inward-projecting, acute, blade-like process; length of process ~ 0. 2× length of signum; ductus seminalis extremely slender, elongate, ~ 1.3× length of corpus bursae, arising from cephalic end of corpus bursae.

Larva: Sapfeeding instar (Fig. 5A): Similar to *P. subpersea* except: length of largest larva examined ~ 4.4 mm; labrum well developed, with lateral margins evenly rounded, not produced caudally as in *subpersea*; caudal processes of last (9+10th) abdominal segment ~ half length of entire segment.

Last instar larva not examined, but probably similar to that of *P. subpersea*.

Larval Mine (Fig. 3A): A long, slender, serpentine gallery, with a relatively broad, dark brownish, median frass trail, almost always located on the upper (adaxial) side of the leaf (only 1 under (abaxial) side mine found). The egg is deposited on the upper leaf surface away from the midrib. Mine begins on one side of the blade, but after much of one side is consumed, crosses over near the leaf apex to the other side. The median frass line is unusually broad for a species of *Phyllocnistis*, resembling more that of the Chilean genus *Prophyllocnistis* (Davis 1994). As previously noted (Davis 1994),

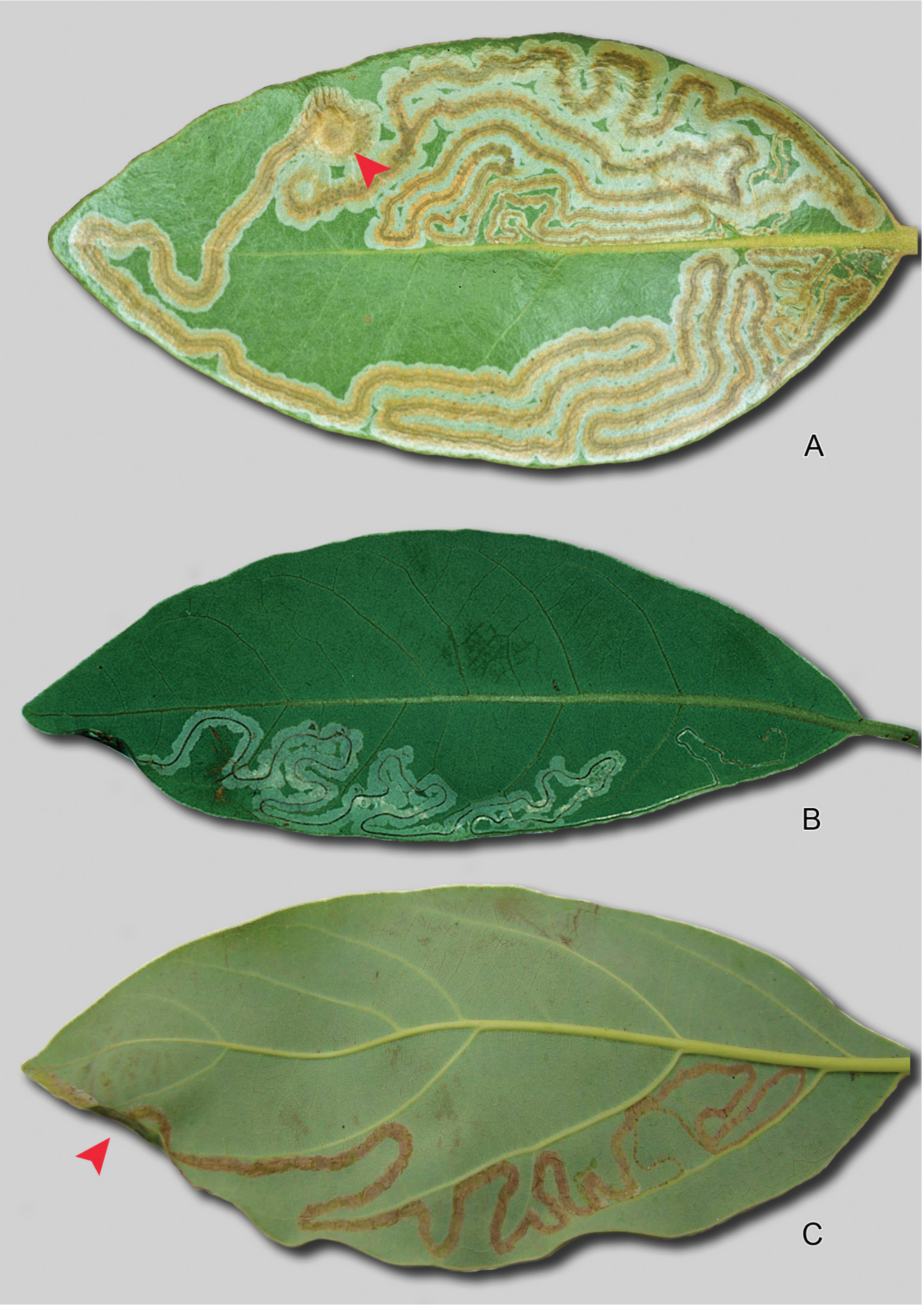

Figure 3. *Phyllocnistis* leafmines. **A** *P. hyperpersea* sp. n., upper-side mine on *Persea borbonia* **B** *P. subpersea* sp. n., lower side mine on *Persea borbonia*. Pupal crypts indicated by arrows in A and C. **C** *P. perseafolia* sp. n., lower-side mine on *Persea americana* (~ 15 cm).

Figure 4. Leafmines of *Phyllocnistis perseafolia* sp. n. on *Persea americana*. **A** General habitus, note lower side mine (arrow) **B** Leaf damage caused by upper and lower side larval mining.

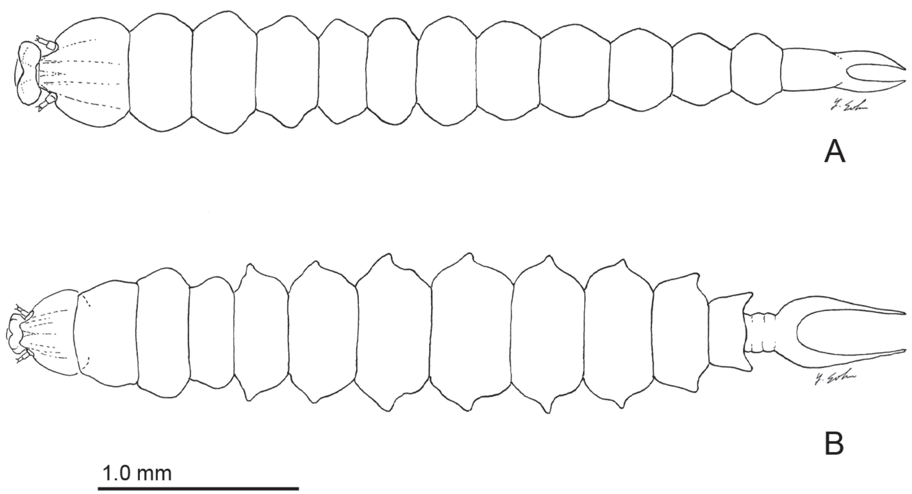

Figure 5. Late instar sapfeeding larvae. **A** *Phyllocnistis hyperpersea* sp. n. (length 4.3 mm) **B** *Phyllocnistis subpersea* sp. n. (length 4.4 mm).

the mines of *hyperpersea* are also similar in general morphology to early Cenomanian phyllocnistine leafmines (Labandeira et al. 1994). Pupation occurs in the lamina, away from the leaf edge (~ 5–7 mm in diameter) in a circular nidus, similar to that fashioned by *Prophyllocnistis*. The serpentine portion of the mine begins as a narrow tract ~ 0.3 mm wide and gradually enlarges before the pupation chamber to a width of ~ 2–2.5 mm. The median frass line is ¼ of the mine width in the early instars and gradually broadens to more than half the mine width.

Pupa (Figs 6A–7D): Length of largest pupa 2.8 mm, maximum diameter 0.7 mm. Vertex with relatively large, broadly triangular, acute frontal process (cocoon-cutter) similar to that of *Metriochroa psychotriella* Busck, but with base constricted slightly on each side (Fig. 6A); lower frons with 2 pairs of short frontal setae. Antenna long and straight, extending almost to 7th abdominal segment (A7); forewing extending almost to A6. Abdominal setae generally short except for greatly lengthened SD1 on A2–7; apex of SD1 on A2–7 slightly enlarged, but not spatulate; abdomen with 6 mid-dorsal pairs of spine clusters (Figs 6C–D) beginning near anterior margins of terga 2–7; each cluster with series of similar, low, strongly recurved spines arranged in 4 irregular columns of about 4–6 ranks; pair of much larger, strongly recurved spines immediately lateral to central cluster and adjacent to seta D1 on A4–7; sternum A6 with spinules evenly scattered over surface (Fig. 6F); A10 with pair of relatively large, stout, caudal projections arising laterally and directed ventrally (Figs 7A–D).

Host: *Persea americana* Mill., variety Blair, *Persea borbonia* (L.) Spreng.

Type Material: Holotype: ♂, USA: FLORIDA: Dade Co: Everglades National Park, Pa-hay-okee Overlook, 26°27'N / 80°47'W, 24 Nov 1991, emerged 2 Dec 1991, D. Davis, DRD 1020.1, host: *Persea borbonia*, USNM slide 31635

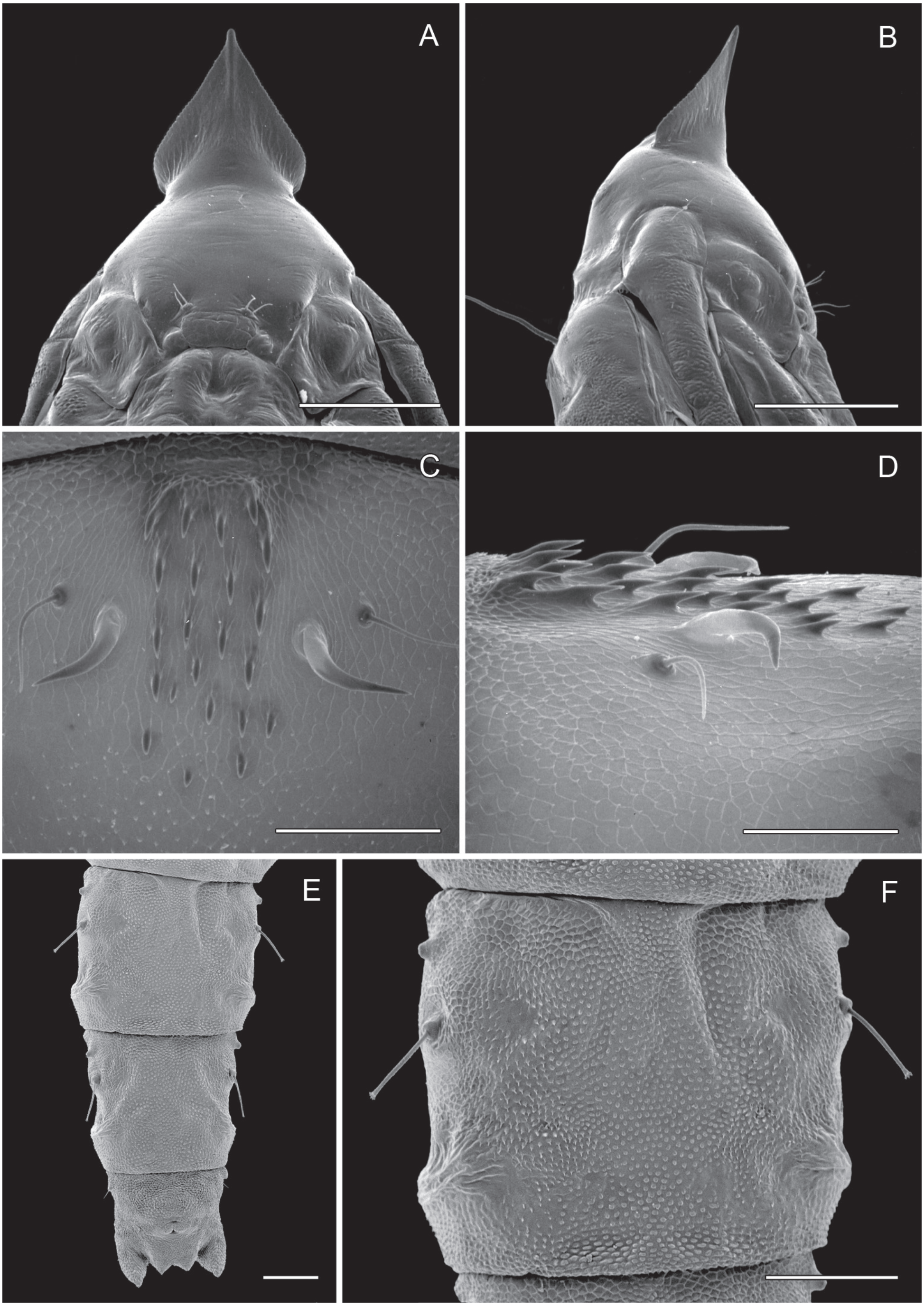

Figure 6. *Phyllocnistis hyperpersea* sp. n. pupa. **A** Head, ventral view (176 µm) **B** Head, lateral view (200 µm) **C** Dorsal spines of abdominal tergum 5 (76 µm) **D** Lateral view of **C** (60 µm) **E** Abdominal sterna 6–10 (100 µm) **F** Scattered spinules of sternum 6 (100 µm). (Length of bar scales shown in parentheses.)

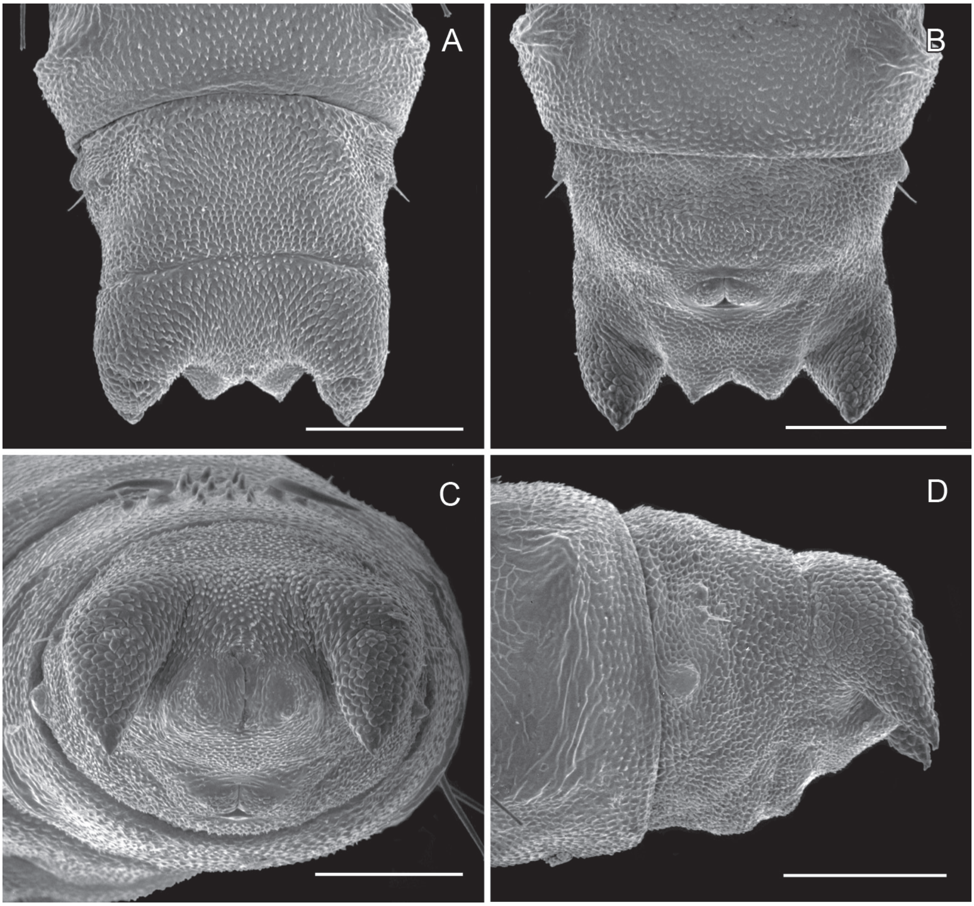

Figure 7. *Phyllocnistis hyperpersea* sp. n. pupa. **A** Abdominal terga 6–10 (100 µm) **B** Abdominal sterna 6–10 (100 µm) **C** Caudal end of abdomen (100 µm) **D** Lateral view of abdominal segments 6–10 (100 µm). (Length of bar scales shown in parentheses.)

(USNM). Paratypes: USA: FLORIDA: Dade Co: Everglades National Park, Pahay-okee Overlook, 26°27'N / 80°47'W, mine 24 Jun 1990, DRD 724, host: *Persea borbonia*: 1♀ emerged 26 Jun 1990, USNM slide 31637; mines 25 Nov 1991, D. L. Wagner and D. R. Davis, DLW Lot: 91L121, host: *Persea borbonia*: 4♂, 2♀ emerged 27 Nov to 4 Dec 1991 (UCMS); mines 16 Apr 1995, D. Davis, DRD 1626.1, host: *Persea borbonia*: 7♂, 2♀ emerged 26 Apr 1995, BOLD ID: RDOPO396-09, 2♂ emerged 27 Apr 1995, 3♂, 2♀ emerged 28 Apr 1995, DRD 724, BOLD ID: RDOPO395-09, host: *Persea borbonia* (BMNH, NMNH). Dade Co: Everglades National Park, Long Pine Key, 26°24'N / 80°41'W, mines 21 Feb 1992, D. and S. Davis, DRD 1060, host: *Persea borbonia*: 1♀, emerged 27 Feb 1992, slide USNM 31636 (USNM). Homestead: 1♂, 1♀ 1 Sep 1993, R. E. Duncan, J. E. Pena, M. Biondo, host: *Persea americana*, (USNM); 1♂, 1 May 2008, J. E. Pena, 08-2811, 4 upperside leafmines, 2 pupae, host: avocado (FSCA).

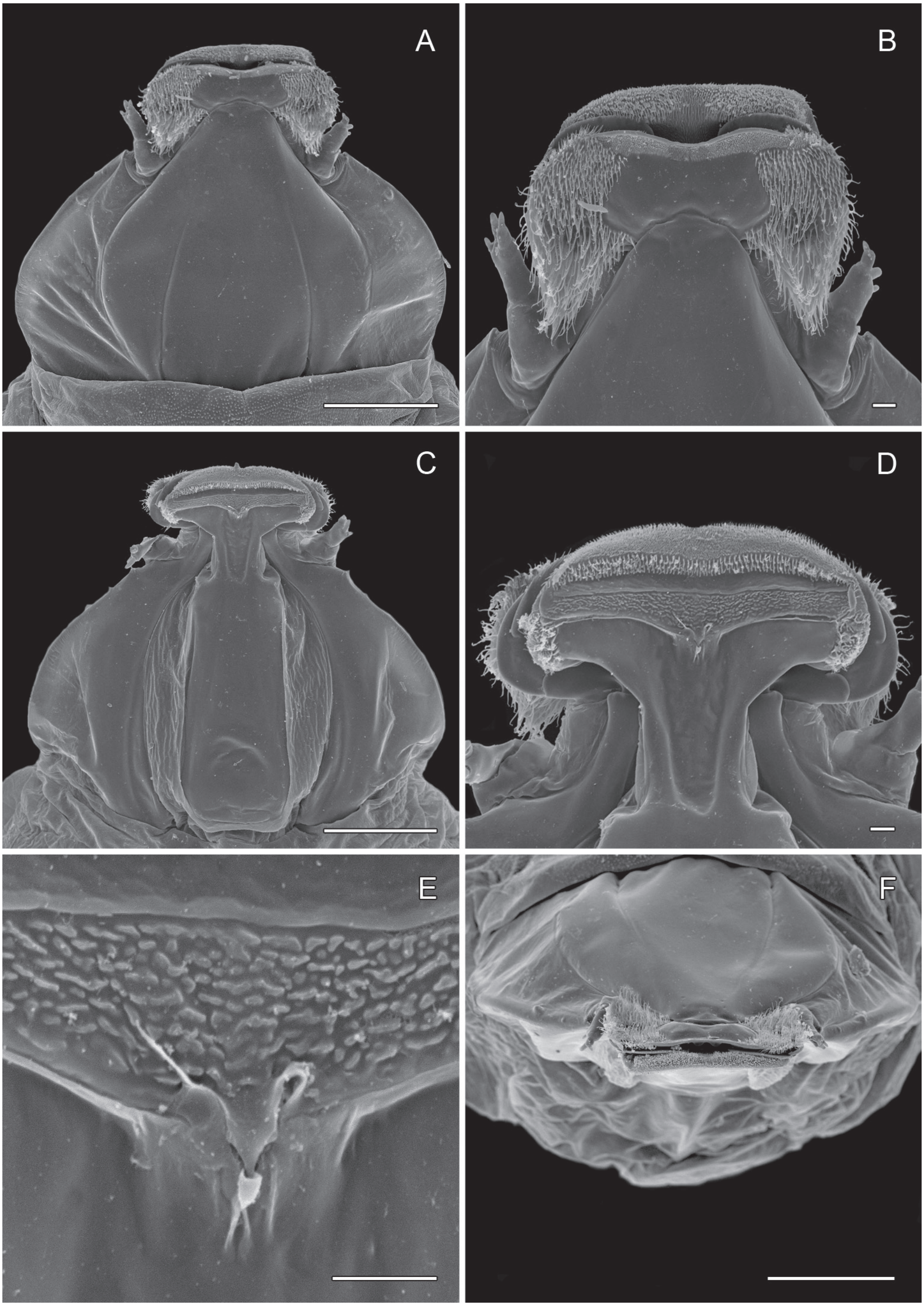

Figure 8. *Phyllocnistis subpersea* sp. n. head of sapfeeding larva, late instar **A** Dorsal view (100 µm) **B** Detail of labrum and antennae in **A** (10 µm) **C** Ventral view (100 µm) **D** Detail of labium in **C** (10 µm) **E** Spinneret (10 µm) **F** Anterior view of head (100 µm). (Length of bar scales shown in parentheses.)

Highlands Co: Archbold Biological Station, 11 km S. Lake Placid: 8 leafmines, 14 Jun 1992, DRD 1097, host: *Persea borbonia* (USNM); Highland Hammock State Park: 7 leafmines, 15 Jun 1992, DRD 1097.1, host: *Persea borbonia* (USNM). Liberty Co: Appalachicola National Forest: 2 leafmines, 18 Jun 1992, DRD 1097.2, host: *Persea borbonia* (USNM). Monroe Co: Big Cypress National Preserve: Loop Road near Tamarind Hammock, 26°27'N / 80°31'30"W: mines 13 Mar 1991, D. L. Wagner and D. R. Davis, DLW Lot: 91C138, host: *Persea borbonia*: 1♀ emerged 18 Mar 1991 (UCMS); mines 22 Feb 1994, T. Dickel, DRD 1489, host: *Persea borbonia*: 1♂, 1♀ emerged 27 Feb 1994, 4♂, 2♀ emerged 4 Mar 1994, 1♂ emerged 7 Mar 1994, 1♂ emerged 8 Mar 1994 (USNM); 1 km W. Tamarind Hammock, 29 April 1992, T. Dickel, DRD 1088, host: *Persea borbonia*: 28 leaf mines, 1♂ emerged 7 May 1992, 1♂, 5♀ emerged 10–11 May 1992, 1♂ emerged 14 May 1992, (USNM); DRD 1020, 5 leafmines, 21 Nov 1991, D. Davis, host: *Persea borbonia*; DRD 1060.1, host: *Persea borbonia*, 17 Feb 1992, D. and S. Davis: 1♂ emerged (DOA) 12 Mar 1992, 1♂ emerged 24 Mar 1992 (USNM). VIRGINIA: Nansemond Co: Dismal Swamp near Lake Drummond: 1 leafmine, 7–8 Jul 1962, D. Davis, DRD 187, host: *Persea borbonia*; 1♂ with pupal exuvium, 8–10 June 1974, emerged 16 Jun 1974, D. and M. Davis, DRD 187.2, host: *Persea borbonia*; Virginia Beach Co: Seashore State Park [First Landing State Park]: 7 leafmines, 9 July 1962, D. Davis, DRD 187, host: *Persea borbonia* (USNM).

Parasitoids: Hymenoptera: Eulophidae: *Chrysocharis* sp., *Cirrospilus* sp., *Closterocerus* sp., *Elasmus* sp., *Horismenus* sp., *Sympiesis* sp.

Flight Period: We have had adults issue from our mine collections from southern Florida during September, December, February, March, April, May, and June; and in southern Virginia during June.

Distribution: This species has been found from Nansemond and Virginia Beach Counties, Virginia, USA, south along the lowland Atlantic coastal region to the Florida Everglades. Adults in the collections of the USNM, from avocado, some with associated mines and collected at various localities in Honduras, may also represent this species. No pupae were available for study and attempts to barcode two specimens were unsuccessful. Mines with associated pupae of what appear to be *hyperpersea* have also been intercepted on shipments of avocado within the United States from unspecified localities in Mexico. Some fluctuation in the northern limits of this leafminer may have occurred in recent years. As late as June 8–11, 1974, DRD and Mignon Davis found mines of *P. hypersersea* common on leaves of *Persea borbonia* within First Landing State Park and Dismal Swamp, Virginia. On March 14, 1992 and during August 1993 no mines could be found at First Landing State Park (Dismal Swamp was not visited in 1993). These localities have not been surveyed for leafminers since 1993.

Etymology: The specific name is derived from the Greek, *hyper* (above, over) and the generic plant name of its host, *Persea*, in reference to the characteristic leafmining habit of the larva on the upperside of the leaf. The specific epithet is a noun in the nominative singular.

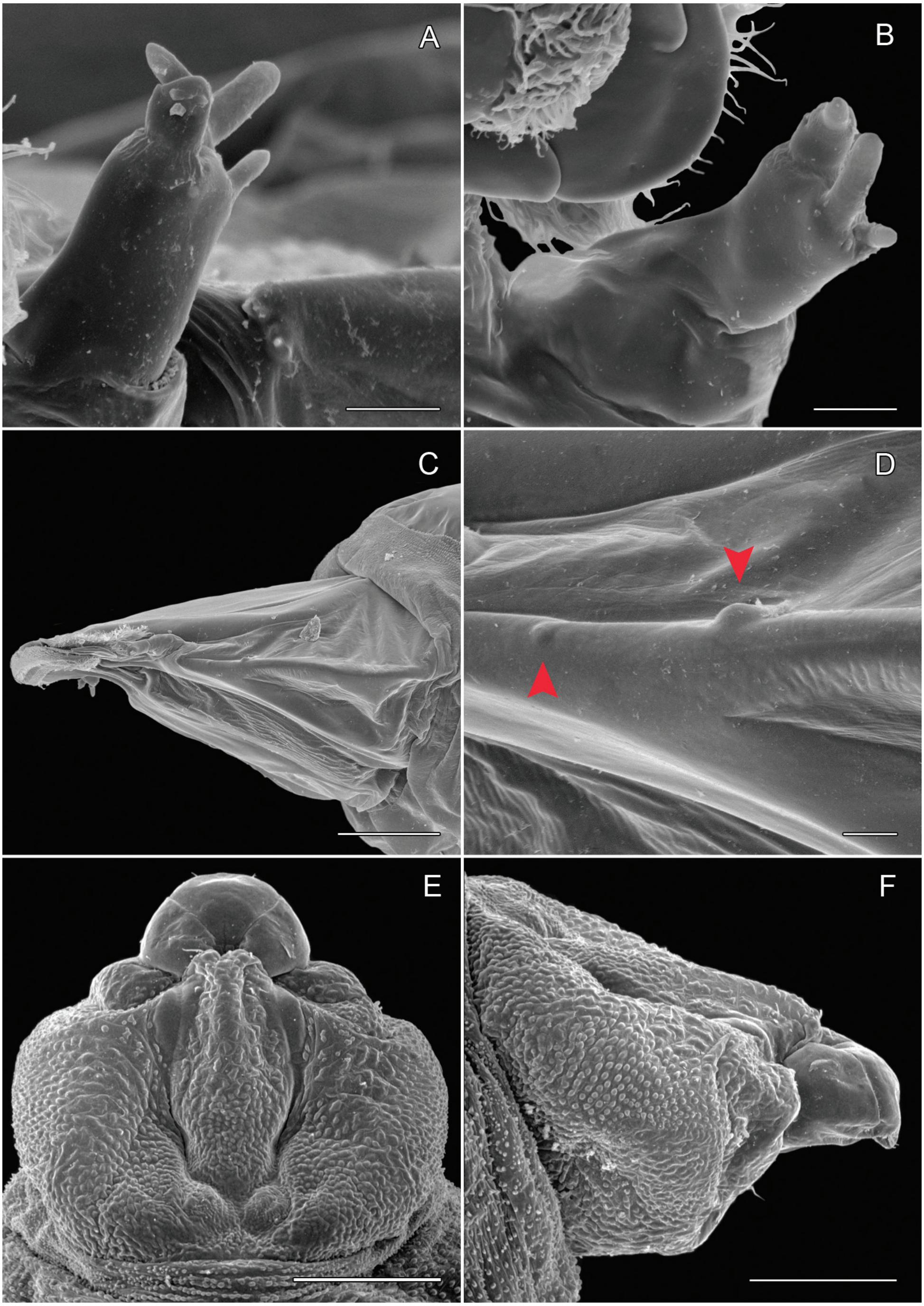

Figure 9. *Phyllocnistis subpersea* sp. n. head of larva. **A–D** Head of sapfeeding larva, late instar. **A** Antenna, dorsal view (10 µm) **B** Antenna, ventral view (10 µm) **C** Lateral view (100 µm) **D** Stemmata (indicated by arrows; 10 µm) **E–F** Head of last instar (spinning) larva: **E** Dorsal view (111 µm) **F** Lateral view (100 µm). (Length of bar scales shown in parentheses.)

Phyllocnistis subpersea Davis and Wagner, sp. n.

urn:lsid:zoobank.org:act:20FB0553-E021-401D-9475-9F0B06E115DA
http://species-id.net/wiki/Phyllocnistis_subpersea
Figs 2B, 3B, 5B, 8A–13F, 17A–E

Diagnosis: *P. subpersea* is the phenotypic outlier among the four *Persea*-feeding species that we treat here: the row of raised, broadened, black-tipped fringe scales along the tornal margin of the forewing is unique. The apical dot tends to be poorly developed. It is the only *Persea* feeder that consistently has a subbasal fuscous spot along the inner margin of the forewing (*P. hyperpersea* sometimes has fuscous scales in the subbasal area of the forewing, but these do not form a spot but rather extend as a diffuse patch to the wing base). The hind tarsomeres (especially segments 2–3) often bear orange to fuscous scaling that is somewhat more pronounced than that of the species that follow. The ductus bursae is broadly joined to corpus bursae. The frontal process of the pupa consists of a pair of stout conical spines arising near the apex, and a single, more subapical, strongly curved spine from the upper frons (Figs 12A–C).

Adult (Fig. 2B): Length of forewing: 2.0 to 2.7 mm, although most measure between 2.4–2.6 mm.

Head: Frons shiny white, smooth glabrous, with subtle faint orange tints over vertex. Flagellomeres with faint orange luster above. Labial palpus white, short, roughened apically, length > height of eye; distal segment subequal to segment 2; segment 1 very short.

Thorax: Patagia and tegulae with stramineous to orange tints. Longitudinal fascia joining transverse fascia but weakened distad, edged with black scales above and below, with those below more consistently present distad. Transverse fascia leaves costal margin at 45° angle; lower arm where it leaves inner margin poorly defined, often fusing with diffuse subbasal patch of fuscous scales. Second costal fascia usually fusing with transverse fascia distally. Apical spot weakly developed, small, fuscous but not black in our material, composed of apices of a few to several scales. Apical strigulae vague and poorly differentiated. Black fringe scales about tornus broadened, conspicuously blackened apically, raised appreciably above plane of wing. Legs silvery white with exception of faint orange luster to dorsal and outer surfaces; foretibiae, foretarsi, and distal tarsomeres sometimes modestly darkened; hind tarsi with tarsomeres 2–4 with faint orange to fuscous tint.

Abdomen: Silvery white and unmarked.

Male Genitalia (Figs 17A–C): Similar to *P. hyperpersea* except valva curved slightly dorsad; relatively shorter, ~ 1.6× length of vinculum; basal apodeme of valva directed slightly caudad in repose.

Female Genitalia (Figs 17D–E): Similar to *P. hyperpersea* except ductus bursae slightly shorter, ~ 2.2× length of papillae anales and gradually enlarging to moderately slender, elliptical corpus bursae; ductus seminalis ~ 1.8× length of corpus bursae.

Larva (Figs 5B): Hypermetamorphic; early instars with highly modified, depressed body for sapfeeding. Final instar non-feeding, with all mouthparts reduced or absent except for functional spinneret.

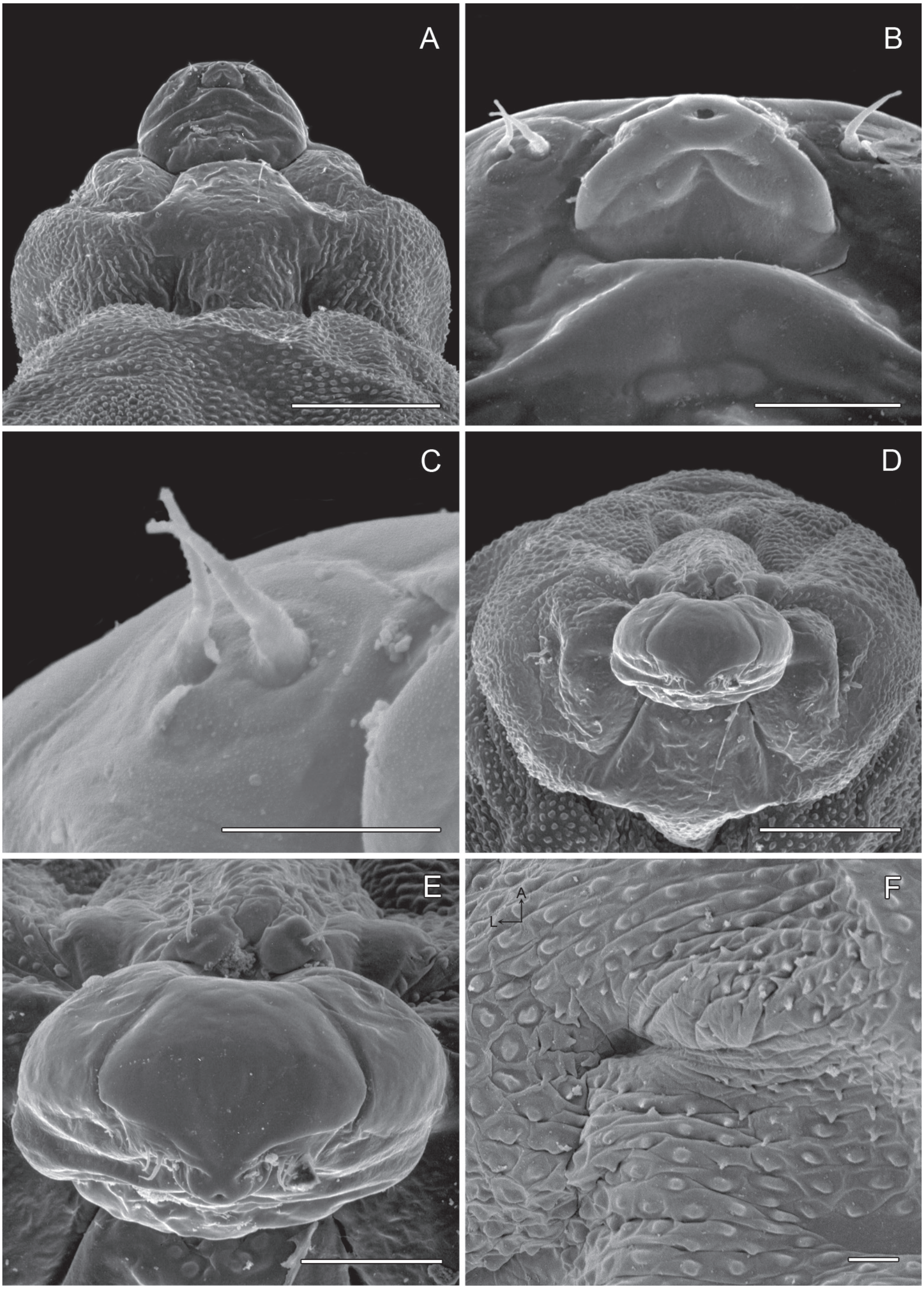

Figure 10. *Phyllocnistis subpersea* sp. n. last instar (spinning) larva. **A** Head ventral view (111 µm) **B** Detail of spinneret in **A** (17.6 µm) **C** Detail of maxilla in **B** (10 µm) **D** Anterior view of head (100 µm) **E** Detail of anterior trophic lobe in **D** (43 µm) **F** Left ambulatory callus on abdominal sternum 6 (10 µm). (Length of bar scales shown in parentheses.)

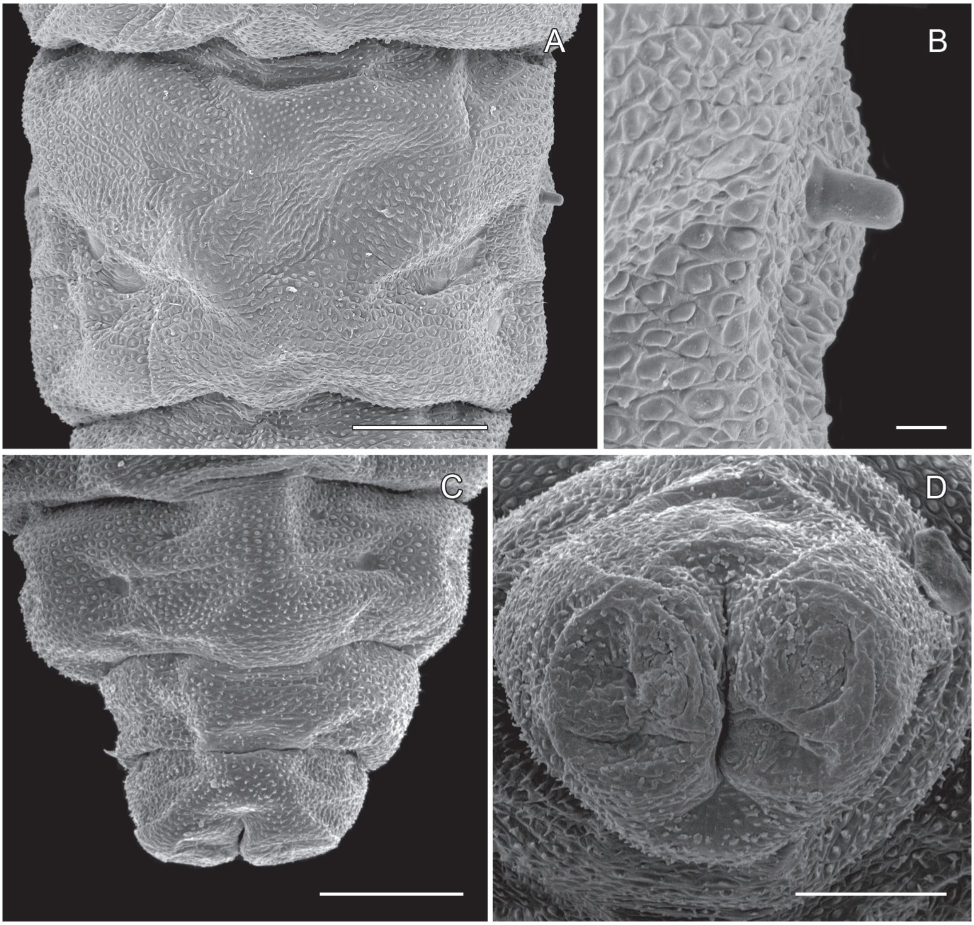

Figure 11. *Phyllocnistis subpersea* sp. n. last instar (spinning) larva. **A** Abdominal tergum 7 (100 µm) **B** Detail of seta SD1 in **A** (10 µm) **C** Abdominal sterna 7–10 (100 µm) **D** Caudal view of abdomen (60 µm). (Length of bar scales shown in parentheses.)

Sapfeeding instar (Figs 5B, 8A–9D): Length of largest larva examined ~ 4.7 mm. Head prognathous, greatly depressed; primary setae either lost or reduced; two stemmata present laterally in a single, well-spaced horizontal alignment; antenna 3-segmented (Figs 9A–B), second segment more slender than first, with 2 moderately stout and 1 short sensillae; third segment less that 1/3 the length of second, with single, apical sensillum basiconicum; labrum with well-developed, densely spinose, lateral lobes; anterior lateral margins rounded; posterior lateral margins extended caudally as triangular lobes; anterior ventral margin densely spinose. Labium also with well-developed lateral lobes; rugose band of cuticle extending across anterior ventral margin (Fig. 8D). Spinneret rudimentary, with narrow, acute extension of cuticle largely covering aperture (Fig. 8E). Legs and prolegs absent. Last (9+10th) segment of abdomen with pair of caudal processes ~ 0.75× length of entire segment (Fig. 5B).

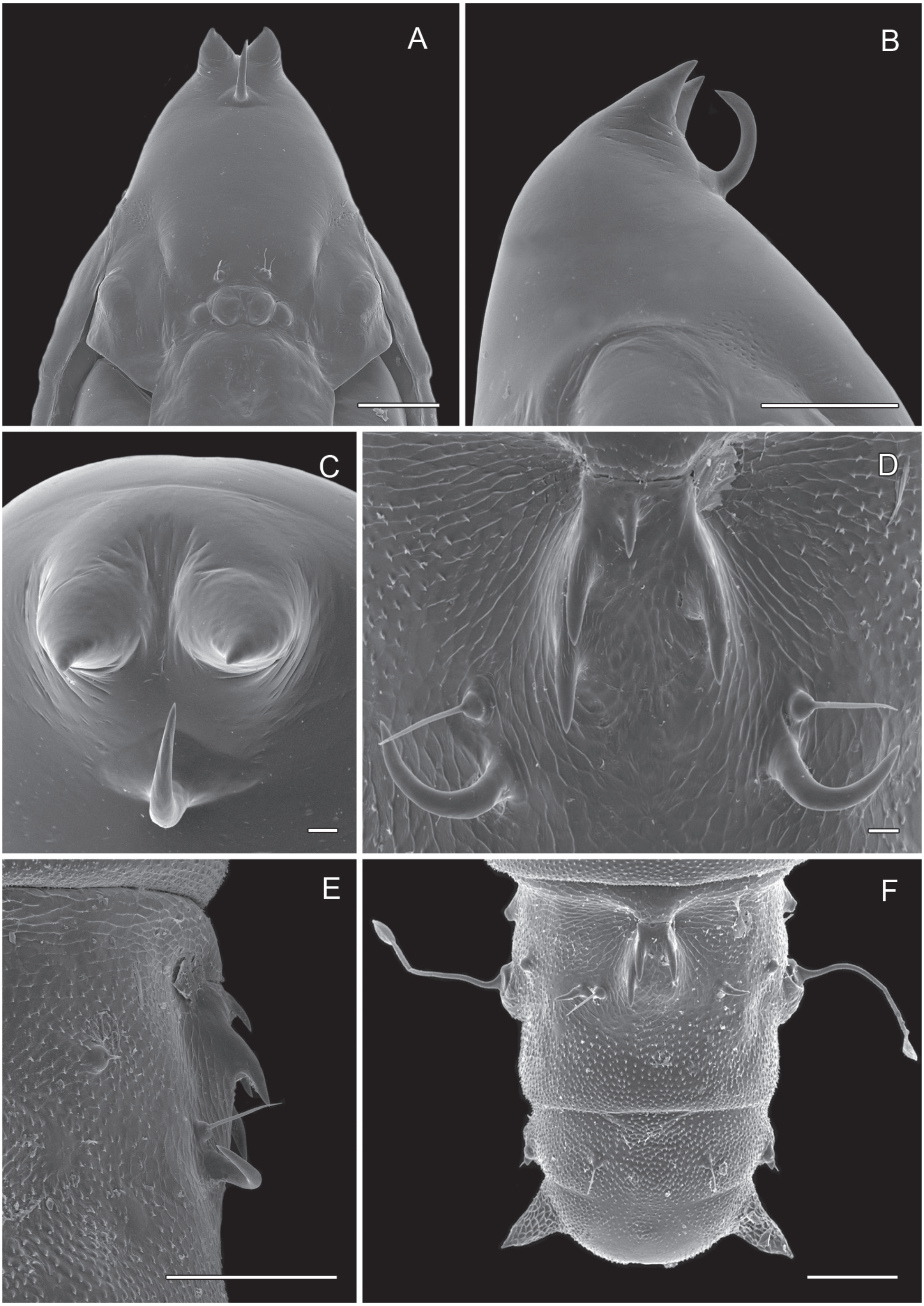

Figure 12. *Phyllocnistis subpersea* sp. n. pupa. **A** Head, ventral view (100 µm) **B** Head, lateral view (100 µm) **C** Head, anterior view (10 µm) **D** Dorsal spines of abdominal tergum 6 (10 µm) **E** Lateral view of **D** (100 µm) **F** Abdominal terga 7–10 (100 µm). (Length of bar scales shown in parentheses.)

Spinning (last) instar (Figs 9E-11D): Body cylindrical, with all appendages and setae greatly reduced; integument finely tuberculate; length of largest larva examined ~ 4.1 mm. Head capsule weakly sclerotized, slightly broader than long; integument finely tuberculate; trophic region extended anteriorad as well-defined lobe; stemmata absent; antenna 2-segmented; first (basal) segment greatly reduced, nearly flush with head capsule, with 2 sensilla basiconica and 1 sensillum chaeticum; apical segment consisting of single sensillum basiconicum. Trophic lobe (Figs 10A–E) with relatively broad but shortened spinneret with simple, terminal opening and rudimentary maxilla; maxilla flush with head capsule and represented by pair of moderately long and one very short sensilla chaetica. Thoracic legs absent, with only indistinct paired ventral callosities on T1–3. Abdomen without prolegs; paired ventral callosities present on A3–6 (Fig. 10F); seta SD1 much larger than other setae, relatively stout and short (Figs 11A–B); A10 truncate, without caudal lobes or callosities (Fig. 11C–D).

Larval Mine (Figs 3B): Similar to that described for *P. longipalpa*. A long, slender, serpentine gallery, containing a dark, median frass trail, on the underside or occasionally the upperside of the leaf, with pupation occurring in a slightly enlarged, elliptical chamber at the mine terminus along a leaf edge. The egg is deposited away from the midrib, usually on the lower side of the leaf. Mine width increases from ~ 0.3 mm broad to a maximum width of ~ 2–2.5 mm; width of the frass trail is usually about half the mine width.

Pupa (Figs 12A–13F): Similar to *P. hyperpersea* except: length of largest pupa 3.2 mm. Vertex with pair of stout conical, spines arising near apex, and single, slender, more subapical, strongly recurved spine from upper frons (Figs 12A–C). Abdomen with 6 pairs of small, sclerotized, oval, median pits near anterior margins of terga 2–7; each sclerotized pit giving rise to 2 columns of low, strongly recurved spines, relatively larger than in *hyperpersea* and fewer in number, arranged in about 1–3 ranks (Figs 12D–E); pair of slightly larger, strongly recurved spines immediately lateral to caudal end of median cluster and nearly contiguous to seta D1; A2–7 with SD1 setae greatly lengthened, apices spatulate (Fig. 13A); sternum A6 with spinules evenly scattered over surface as in *hyperpersea* (Fig. 13D); A10 with pair of relatively large, stout, caudal processes directed mostly laterally (Figs 13E–F).

Host: *Persea borbonia* (L.) Spreng.

Type Material: Holotype: ♂, USA: FLORIDA: Dade Co: Everglades National Park, Long Pine Key, 26°24'N / 80°41'W, mine 21 Feb 1992, emerged 28 Feb 1992, D. and S. Davis, DRD 1061, host: *Persea borbonia*, (USNM). Paratypes: USA: FLORIDA: Dade Co: Everglades National Park: Long Pine Key, 26°24'N / 80°41'W, mines 21 Feb 1992, D. and S. Davis, DRD 1061, host: *Persea borbonia*, 1 ♀ emerged 22 Feb 1992, BOLD ID: RDOPO391-09, 1♂ emerged 26 Feb 1992, USNM slide 31632; 1♂ emerged 28 Feb 1992; 1♂ emerged 1 Mar 1992, USNM slide 31634; 2♂, 2♀ emerged 3 Mar 1992, 1♂, BOLD ID: RDOPO388-09, 2♀ emerged 6 Mar 1992, 1♀ emerged 10 Mar 1992 (USNM). Pa-hay-okee Overlook, 26°27'N / 80°47'W: mines 16 Apr 1995, D., M., and S. Davis, DRD 1624.1, host: *Persea borbonia*: 2♂, 4♀

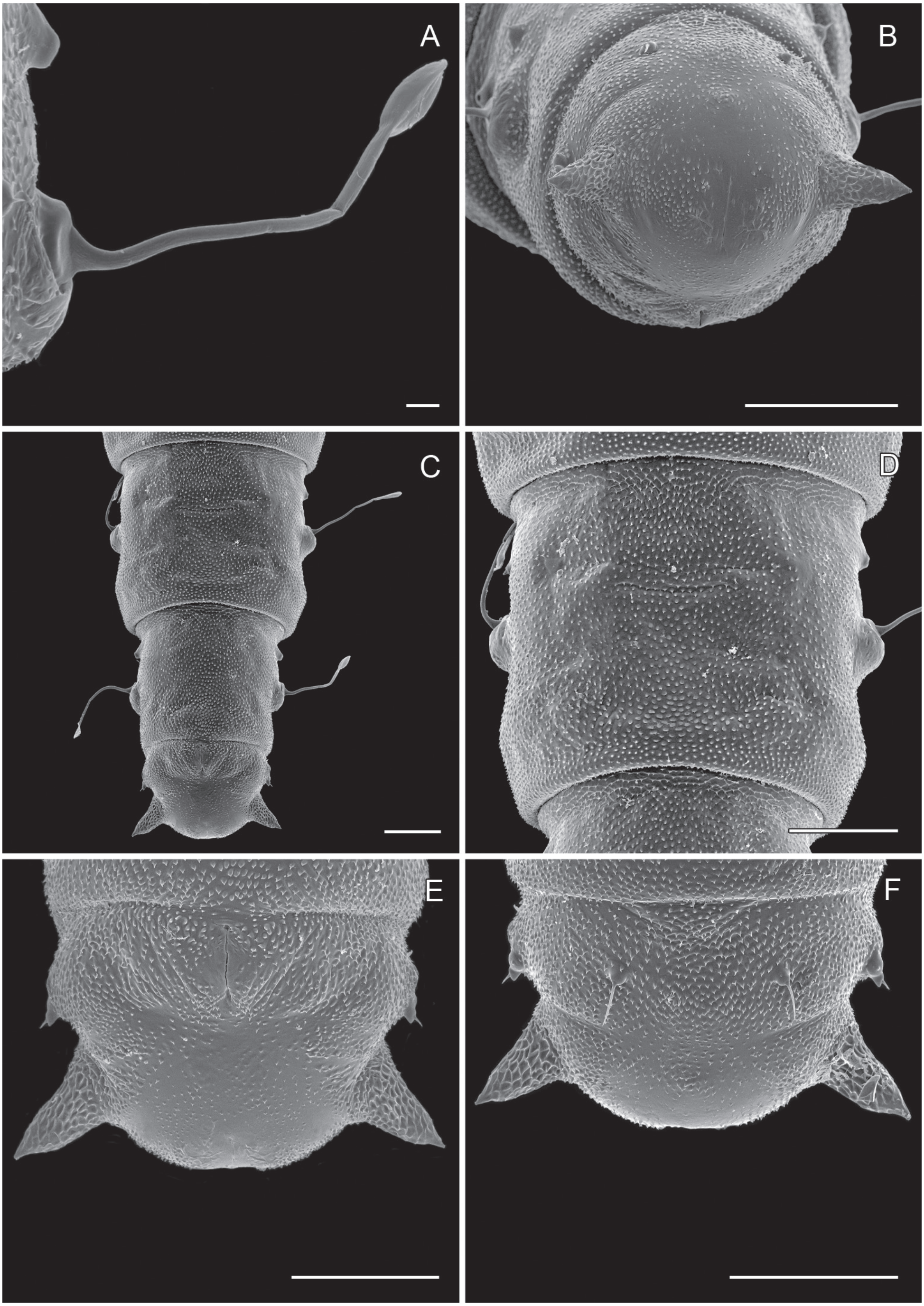

Figure 13. *Phyllocnistis subpersea* sp. n. pupa. **A** Lateral seta of abdominal segment 6 (10 µm) **B** Caudal end of abdomen (100 µm) **C** Abdominal sterna 6–10 (100 µm) **D** Scattered spinules of abdominal sternum 6, (100 µm) **E** Abdominal sterna 8–10 (100 µm) **F** Abdominal terga 8–10 (100 µm). (Length of bar scales shown in parentheses.)

emerged 28 Apr 1995, BOLD ID: RDOPO389-09. Monroe Co: Big Cypress National Preserve, Loop Road near Tamarind Hammock, 26°27'N / 80°31'30"W, mines 13 Mar 1991, D. L. Wagner and D. R. Davis, DLW Lot: 91C139, host: *Persea borbonia*: 8♂, 9♀, 2 unsexed emerged 15–25 Mar 1991 (UCMS); mines 21 Nov 1991, D. L. Wagner and D. R. Davis, DLW Lot: 91L35, host: *Persea borbonia*: 4♂, 8♀, 4 unsexed, emerged 25 Nov-4 Dec 1991 (UCMS); mines 22 Feb 1994, D. Davis, DRD 1490, host: *Persea borbonia*: 1♀ emerged 7 Mar 1994, BOLD ID: RDOPO392-09, 1♂ emerged 8 Mar 1994; 3♂, 2♀ emerged 4 Mar 1994; mines 25 Mar 1994, T. Dickel, DRD 1490.1, host: *Persea borbonia*: 2♀, emerged 4 Apr 1994, (USNM). Loop Road, Tamarind Hammock, 25°27'N / 81°16'W: 11 Apr 1995, D., M., and S. Davis, DRD 1624, host: *Persea borbonia*, 2 ♂, emerged 11 Apr, 1995, BOLD ID: RDOPO390-09 (USNM).

Parasitoids: Hymenoptera: Eulophidae: *Cirrospilus* sp., *Galeopsomyia* sp., *Horismenus* sp.

Flight Period: Adults (from recently collected mines) have emerged from February 22 to April 11 in Florida.

Distribution: At least Dade and Monroe Counties, Florida. We have found mines of what appear to be this species on *Persea borbonia* as far north as the Green Swamp in coastal South Carolina.

Etymology: The specific name is derived from the Greek, *sub* (under) and the generic plant name of its host, *Persea*, in reference to the characteristic leafmining habit of the larva usually on the underside of the leaf. The specific epithet is a noun in the nominative singular.

Phyllocnistis longipalpa Davis and Wagner, sp. n.

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http://species-id.net/wiki/Phyllocnistis_longipalpa
Figs 2C, 18A–E.

Diagnosis: *Phyllocnistis longipalpa* can be distinguished from other *Persea*-feeding *Phyllocnistis* in the southeastern United States, by its long, slightly upcurved labial palpi (> height of head). The apical spot is poorly developed, which distinguishes it from *hyperpersae*. It lacks the run of raised black scales from the forewing tornus characteristic of *P. subpersea*.

Adult (Fig. 2C): Length of forewing: 2.3 to 2.6 mm.

Head: Frons shiny white, smooth with subtle faint orange tints over vertex. Flagellomeres with faint orange luster above. Labial palpus white, long, 1.2× height of head, slightly upcurved; basal segment subequal to segments 2 + 3.

Thorax: Patagia and tegulae with subtle, silvery, stramineous to orange tints. Longitudinal fascia joining transverse fascia, edged with black scales above and below, with those below more consistently present distad. Transverse fascia leaves costal margin at 45° angle; proximal edge of transverse fascia where it leaves the inner margin vague, composed of 2–3 rows of dark scales. Second costal fascia fusing with transverse fas-

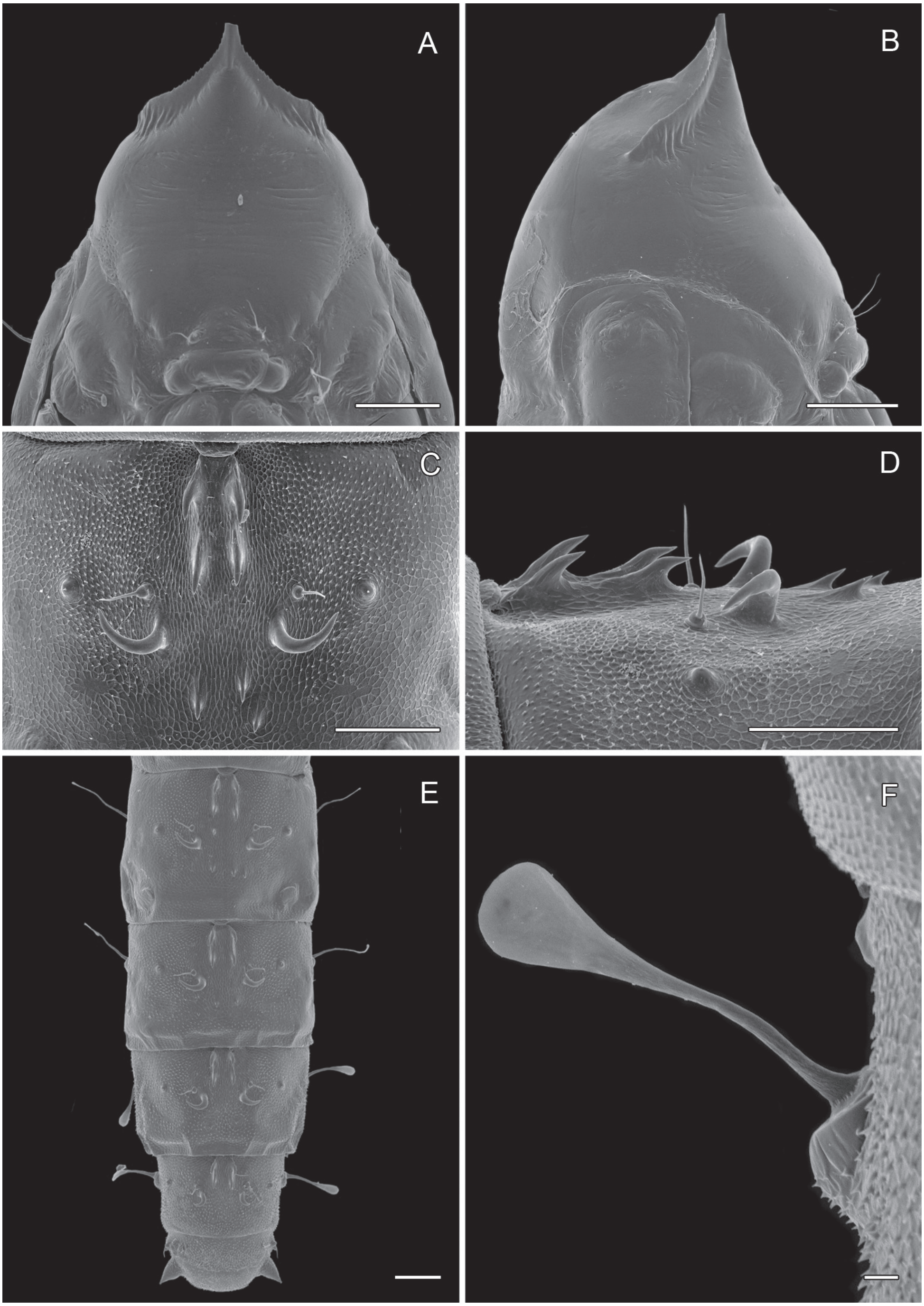

Figure 14. *Phyllocnistis perseafolia* sp. n. pupa. **A** Head, ventral view (176 μm) **B** Head, lateral view (200 μm) **C** Dorsal spines of abdominal tergum 5 (76 μm) **D** Lateral view of **C** (60 μm) **E** Abdominal terga 4–10 (100 μm) **F** Lateral seta of abdominal segment 6 (10 μm). (Length of bar scales shown in parentheses.)

cia distally. Apical spot poorly differentiated; likewise apical strigulae vague and poorly developed. Black fringe scales about tornus little broadened and not conspicuously elevated above plane of wing. Legs essentially silvery white and unmarked with exception of faint orange luster to dorsal and outer surfaces of foretibiae and foretarsi; distal tarsomeres sometimes modestly darkened.

Abdomen: Silvery white and unmarked.

Male Genitalia (Figs 18 A–C): Similar to *P. hyperpersea* and *subpersea* except apex of valva not evenly rounded, instead more oblique and extended dorsad; total length of valva ~ 2.0× length of vinculum; basal apodemes of valva less divergent than in other species, with ventral apodeme strongly curved (Fig. 18B). Aedeagus ~ 0.65× length of valva.

Female Genitalia (Figs 18 D–E): Similar to *P. perseafolia*, with ductus bursae long, ~ 6.5× length of papillae anales and terminating near caudal end of corpus bursae; corpus bursae elongate-ovoid, enlarged, ~ 0.6× length of elongate ductus bursae; ductus seminalis ~ 2.4× length of corpus bursae.

Larva and pupa: Not examined.

Larval Mine: Similar to that described for *P. subpersea*. A long, slender, serpentine gallery, containing a dark, narrow, median frass trail, present on the underside of the leaf, with pupation occurring in a slightly enlarged, elliptical chamber at the mine terminus along the leaf edge.

Host: *Persea borbonia* (L.) Spreng.

Type Material: Holotype: ♂, USA: FLORIDA: Dade Co: Everglades National Park: Pa-hay-okee Overlook, 26°27'N / 80°47'W: mines 12 Apr 1998, emerged 29 Apr 1998, D., M., and S. Davis, DRD 2135.1, host: *Persea borbonia*, (USNM). Paratypes : USA: Same data as holotype except: 1 ♂, emerged 14 Apr 1998; 3 ♂, 2 ♀ emerged 19 Apr 1998, ♀ slides 34206, 34209; 2 ♂, 1 ♀ emerged 29 Apr 1998, ♂ slides 34176, 34178, ♀ slide 34177, BOLD ID: RDOPO401-09 (USNM). Cheika [Recreation Area], NW Homestead: mines 12 Apr 1998, D., M., and S. Davis, DRD 2135, 1♀ emerged 14 Apr 1998; 2♂ emerged 19 Apr 1998, BOLD ID: RDOPO402-09 (USNM). Monroe Co: Loop Road, Tamarind Hammock, 25°27'N / 81°16'W: mine 11 Apr 1995, D., M., and S. Davis, DRD 1624, host: *Persea borbonia*, 1 ♂, emerged 11 Apr, 1995, BOLD ID: RDOPO400-09 (USNM). The holotype is provisionally deposited at the USNM, Washington, D.C., pending mutual resolution and agreement with the National Park Service regarding specimen deposition.

Parasitoids: Unknown.

Flight Period: Adults have emerged in April in southern Florida.

Distribution: Known only from the Everglades National Park, Dade County, and along the Loop Road near Tamarind Hammock, Monroe County, Florida.

Etymology: The specific name is derived from the Latin *longus* (long) and *palpus* (feeler), in reference to the elongate labial palpi, which are diagnostic for this species. The specific epithet is a noun in the nominative singular.

Remarks: We initially "discovered" *Phyllocnistis longipalpa* intermixed among our series of *P. subpersea* in 2009. As noted in the diagnosis, adults are reliably distinguished from that species by their longer labial palpi, the absence of the numerous,

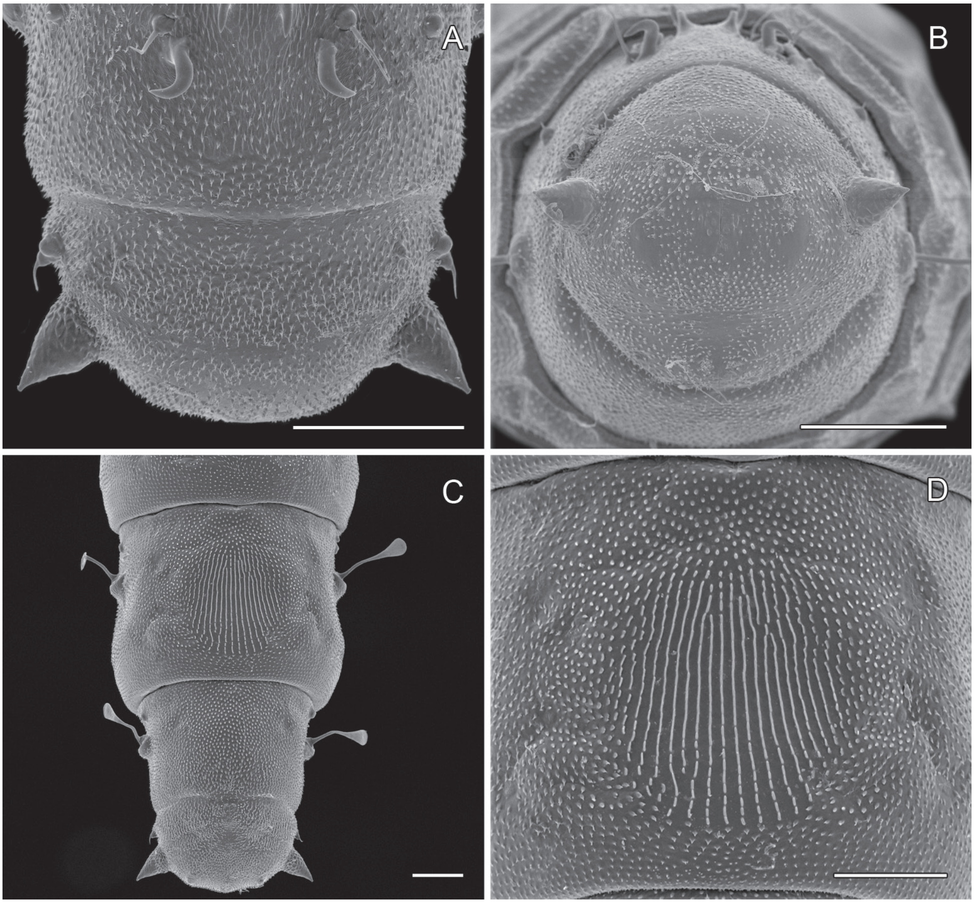

Figure 15. *Phyllocnistis perseafolia* sp. n. pupa. **A** Abdominal terga 7–10 (100 µm) **B** Caudal end of abdomen (100 µm) **C** Abdominal sterna 6–10 (100 µm) **D** Spinules of sternum 6 in longitudinal rows (100 µm). (Length of bar scales shown in parentheses.)

broad, raised tornal scales, and absence of the fuscous subbasal spot along the inner margin on the forewing which occurs in most *subpersea.* The larvae form serpentine mines on the undersides of new leaves, similar to those of *P. subpersea*.

Phyllocnistis perseafolia Davis and Wagner, sp. n.

urn:lsid:zoobank.org:act:D4F0984F-4A66-4FF6-AB1A-9C716E326361
http://species-id.net/wiki/Phyllocnistis_perseafolia
Figs 2D, 3C, 4A–B, 14A–15D, 19A–E.

Diagnosis: *Phyllocnistis perseafolia* is the largest of the *Persea*-feeding species: forewing lengths typically exceed 2.6 mm, with that of intact specimens often reaching lengths of 2.9 or more mm. The well-developed black apical dot distinguishes *P. perseafolia* from

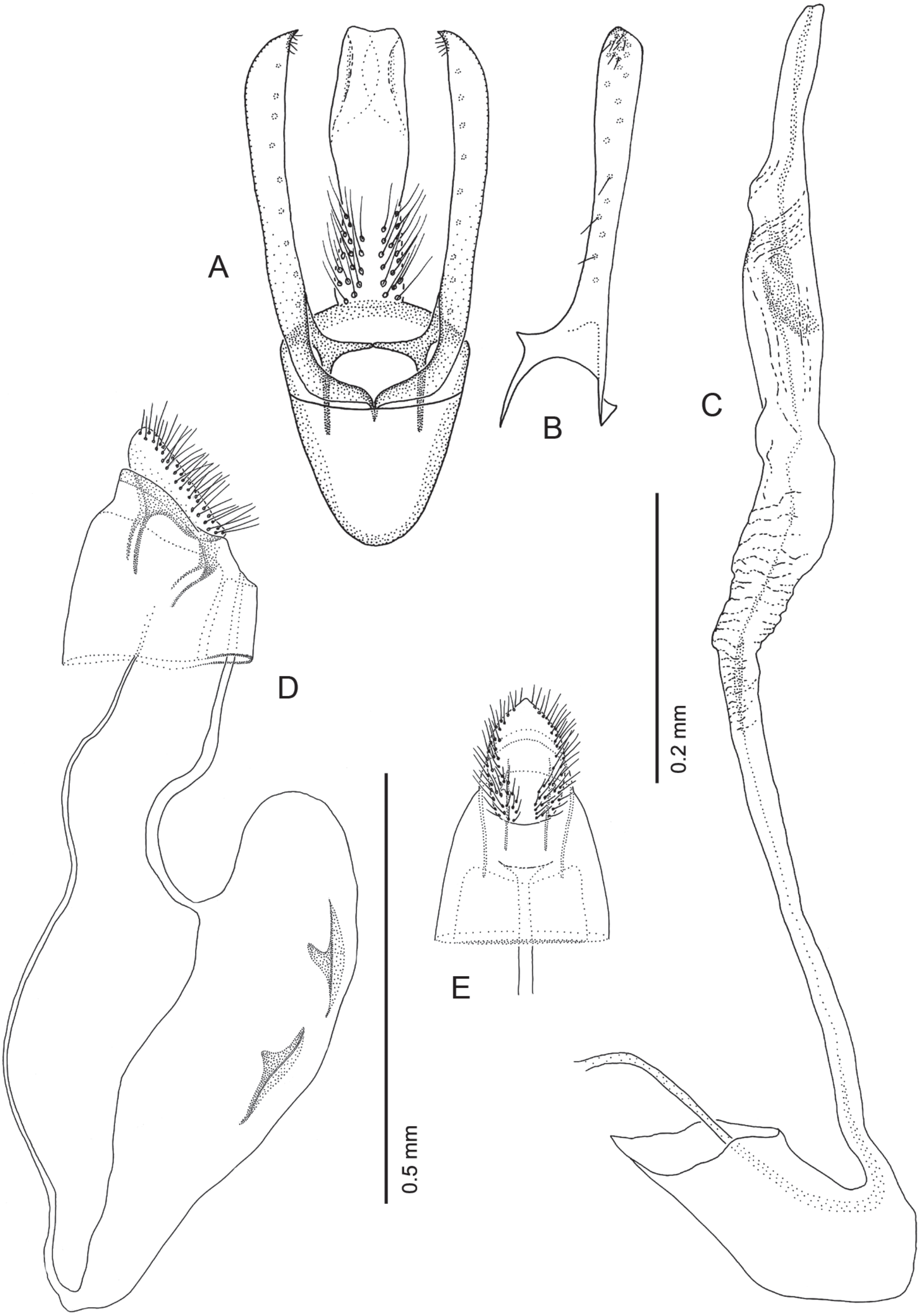

Figure 16. *Phyllocnistis hyperpersea* sp. n. genitalia. **A** Male, ventral view **B** Mesal view of valva **C** Aedeagus **D** Female, lateral view **E** Ventral view of **D** segments 7–10.

all but *P. hyperpersea*. The forewing is the palest of the four *Phyllocnistis* described here: the black scaling--in the subbasal and tornal areas, as well as that which edges the longitudinal and transverse fascia--is reduced relative to the other species described here. The transverse fascia is often interrupted through the center of the forewing because the arms are so strongly angled outward that they may not meet; likewise the longitudinal fascia frequently does not join the transverse fascia in *persaefolia* for the same reason.

Adult (Fig. 2D): Length of forewing: 2.6–3.2 mm.

Head: Frons shiny white, smooth glabrous. Flagellomeres with faint orange luster above but becoming smoky toward apex. Labial palpus white, long, slender, subequal to height of head, slightly upcurved; basal segment subequal to segments 2 + 3.

Thorax: Scaling of patagia and tegulae damaged. Longitudinal fascia ending before transverse fascia; anterior side ill-defined with orange scales often reaching to costa, especially towards base of wing; lower side straight and clearly delineated; fuscous scales, if present, only along lower edge. Transverse fascia edged inwardly and outwardly with black scales; upper arm leaving costal margin at 30–35° angle, with distal reach curving toward apical dot; often interrupted through cell; arm of transverse fasciae from inner margin more strongly edged with black along outer edge; proximal edge of fascia where it leaves the inner margin vague, with faint dark scaling. Second costal fascia ill-defined, with little black scaling, sometimes conjoined with transverse fascia. Three costal and three apical strigulae modestly differentiated. Apical spot well developed. Black fringe scales about tornus reduced in extent, many replaced with smoky orange fringe scales; none raised appreciably above plane of wing. Legs essentially silvery white and unmarked with exception of faint orange luster to dorsal and outer surfaces foretibiae and foretarsi and distal tarsomeres sometimes with smoky overscaling.

Abdomen: Silvery white and unmarked.

Male Genitalia (Figs 19A–C): Similar to *P. hyperpersea,* with approximately straight valva, except valva relatively shorter, ~ 1.6× length of vinculum; basal apodemes of valva more widely divergent than in other species, with ventral apodeme approximately straight (Fig. 19B).

Female Genitalia (Figs 19D–E): Similar to *P. longipalpa*, with ductus bursae joining corpus bursae near caudal end; corpus bursae elongate-ovoid, enlarged, ~ 0.5× length of elongate ductus bursae; ductus seminalis ~ 2.25× length of corpus bursae.

Larva: Not examined.

Larval Mine (Figs 3C, 4A–B): Similar to that described for *P. subpersea*. A long, slender, serpentine gallery, containing a dark, narrow, median frass trail, present on either the underside or upperside of the leaf, with pupation occurring in a slightly enlarged, elliptical chamber at the mine terminus along the leaf edge. Serpentine mines of possibly this species have also been observed by Francisco Posada on avocado fruit at the type locality.

Pupa (Figs 14A-15D): Similar to *P. hyperpersea* except: Length of largest pupa 3.4 mm. Vertex similar to that of *P. vitegenella* Clemens in possessing single, large apical spine (tip of spine broken in all 3 pupae examined) with minutely serrated, low ridge descending laterally from spine (Figs 14A–B). Abdomen with apices of greatly lengthened SD1 seta on A2–7 spatulate; mid-dorsal cluster of spines on abdominal terga 2–7

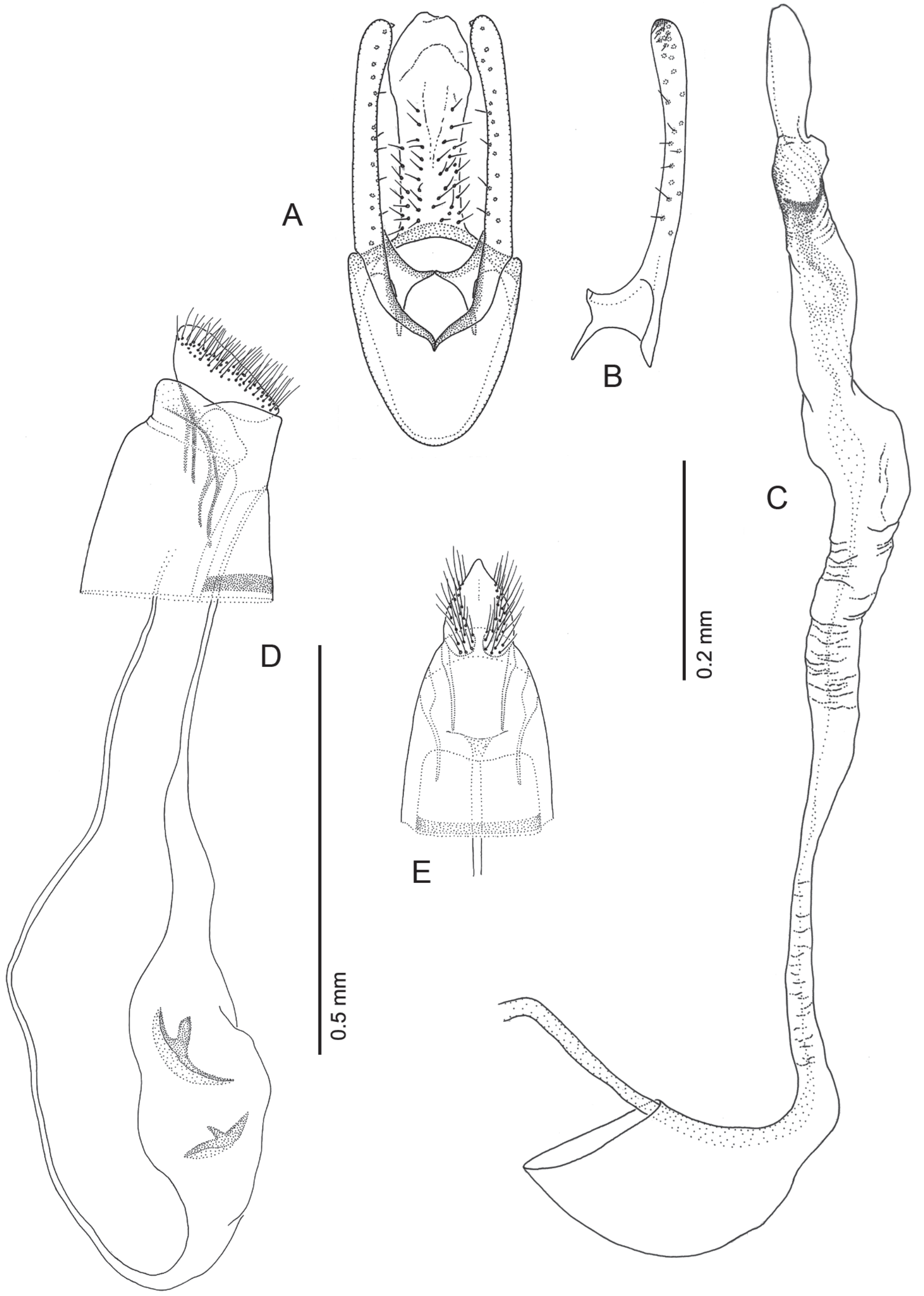

Figure 17. *Phyllocnistis subpersea* sp. n. genitalia. **A** Male, ventral view **B** Mesal view of valva **C** Aedeagus **D** Female, lateral view **E** Ventral view of **D** segments 7–10.

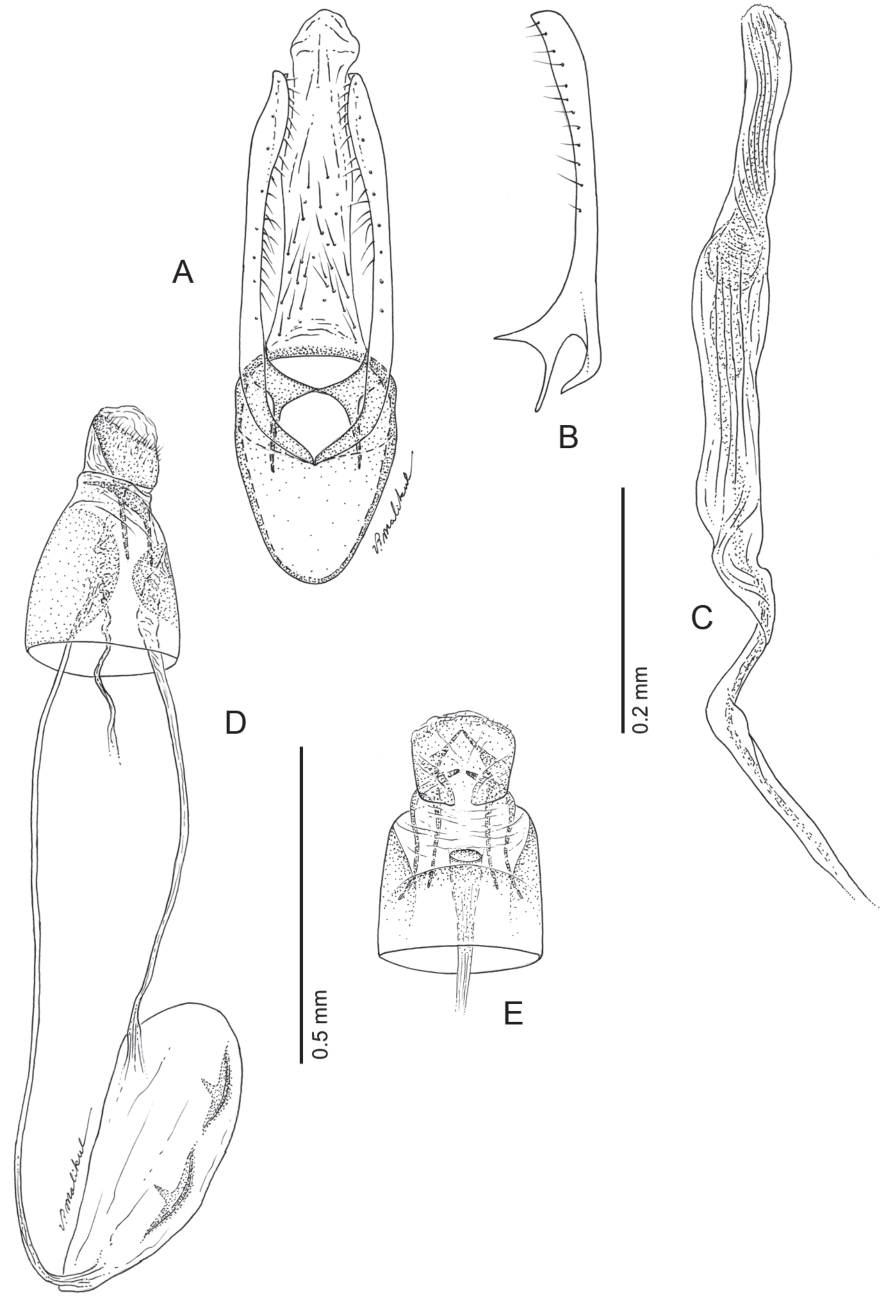

Figure 18. *Phyllocnistis longipalpa* sp. n. genitalia. **A** Male, ventral view **B** Mesal view of valva **C** Aedeagus **D** Female, lateral view **E** Ventral view of **D** segments 7–10.

(Figs 14C–D) with median series of low, strongly recurved spines relatively larger than in *hyperpersea* and fewer in number, arranged instead in 2 short columns as in *subpersea* in about 2 ranks; 3–4 smaller, scattered spines immediately caudad to larger, median spine rows; pair of slightly larger, strongly recurved spines immediately lateral to caudal end of median cluster and nearly contiguous to D1 seta; sternum A6 with spinules arranged in ~ 20 longitudinal ridge-like rows (Fig. 15D); A10 with pair of relatively large, stout, caudal processes directed mostly laterally (Figs 15A–C) as in *subpersea*.

Host: *Persea americana* Mill., variety Hass.

Type Material: Holotype: ♂, COLOMBIA: Caldas Department, Villamaria, April 2008, Francisco Posada, reared from Avocado, *Persea americana*, variety Hass, slide USNM 34075 (USNM). Paratypes: COLOMBIA: Same locality and data as holotype: 9 ♂, slides USNM 34078, 8 ♀, slides USNM 34076, 34077, BOLD ID: RDOPO393-10, RDOPO394-10; 5 pupae, USNM slide 34072 (UNCM, USNM).

Parasitoids: Unknown.

Flight Period: Adults have emerged in April in Colombia.

Distribution: Currently reported only from the type locality in the Department of Caldas, west-central Colombia, but probably widespread over northern South America wherever avocado is cultivated.

Etymology: The specific name is derived from the generic plant name of its host, *Persea* and the Latin, *folium* (leaf), in reference to its leafmining habit. The specific epithet is a noun in the nominative singular.

Remarks: All adults examined were received unpinned, unspread, and slightly damaged to the extent that we are uncertain of some scaling characters. The apex of the large frontal process was broken in all 3 pupae available for study. A fragment of one spine remaining in a vial with a pupa of *perseafolia* was observed to be slightly recurved, but not to the extent observed in pupae of the North American *Phyllocnistis vitegenella*. The spatulate apex of abdominal SD1 setae of *perseafolia* (Fig. 14F) is notable in being the broadest of the three species examined.

One other species of *Phyllocnistis*, *P. aurilinea* (*auriinea* [sic]) Zeller, has been described from Colombia (Bogotá). However, that species mines the leaves of a distinctly different host in the family Ericaceae, "*Uva camarona*" (Zeller 1877), (probably *Macleania rupestris* A. C. Smith, according to W. and J. De Prins 2011), Because larvae of *Phyllocnistis* and related gracillariids are known to be stenophagous, *P. aurilinea* is believed to represent a different species from *P. perseafolia*, whose larvae are leafminers in Lauraceae.

Acknowledgements

We wish to thank several individuals who have assisted our work by providing critical information, loans of specimens under their care, or for other special assistance: Francisco Javier Posada, Laurel, Maryland generously provided specimens of the new species, *Phyllocnistis perseafolia*, for study as well as images of the leafmines; John Heppner, Florida State Collection of Arthropods, Gainesville, Florida provided specimens of *Phyllocnistis*

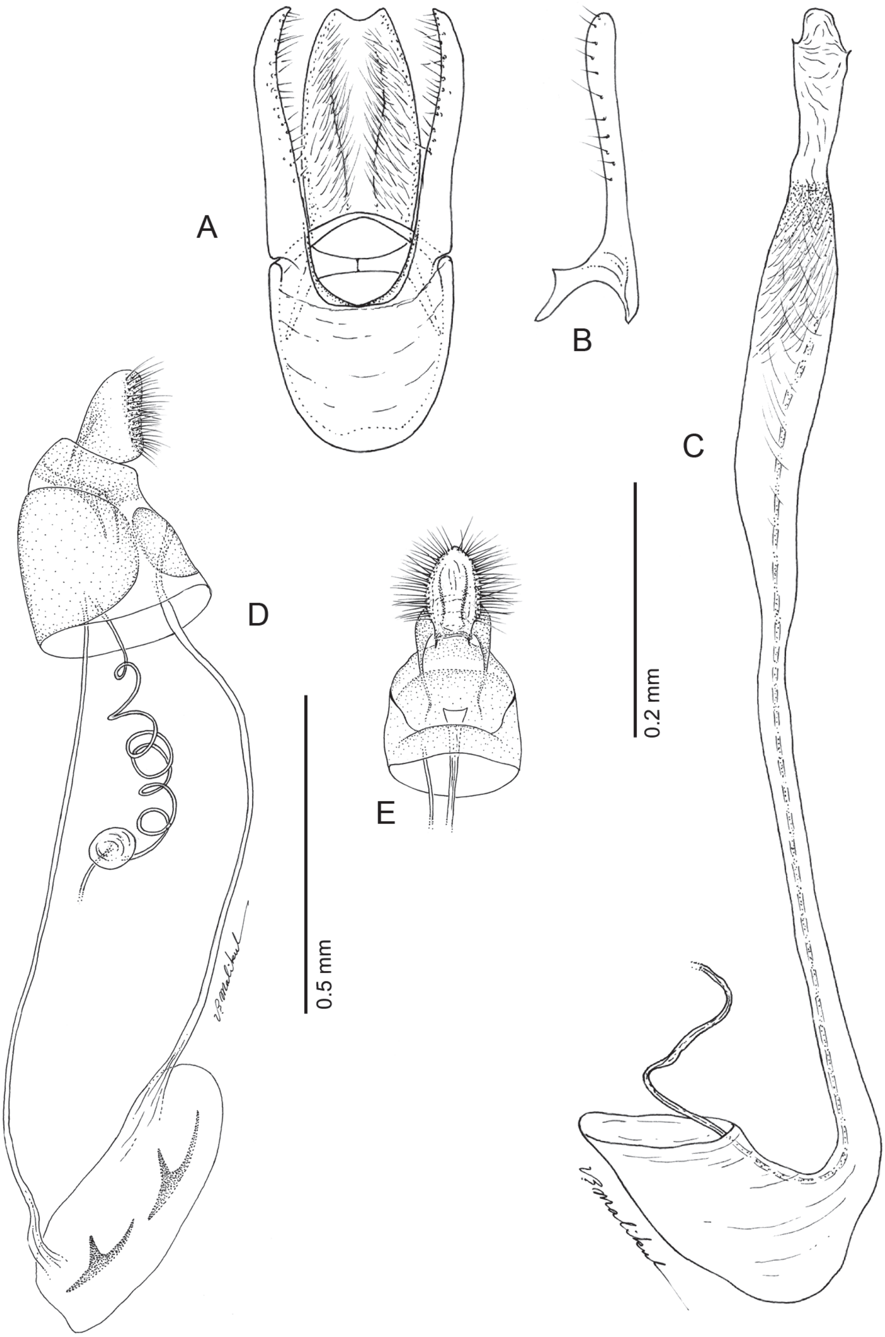

Figure 19. *Phyllocnistis perseafolia* sp. n. genitalia. **A** Male, ventral view **B** Mesal view of valva **C** Aedeagus **D** Female, lateral view **E** Ventral view of **D** segments 7–10.

hyperpersea reared from avocado; Jorge Peña, University of Florida, Homestead, Florida provided information on the pest status of certain *Phyllocnistis*; and Mignon Davis assisted with fieldwork in Florida, in data recording, and curation of reared material. For collecting permits in protected areas of southern Florida and other assistance, we are indebted to Renata Skinner, Jeanne Parks, and staff of the Division of Recreation and Parks, Florida Department of Environmental Protection, Key Largo, Florida; Ben Kohl of the Big Cypress National Wildlife Preserve, Ochopee, Florida; and Roger Hammer, formerly of Castellow Hammock Park, Redland, Florida. We thank DRD research assistant Patricia Gentili Poole and illustrators Vichai Malikul and Young Sohn of the Department of Entomology, Smithsonian Institution for their graphics assistance and line illustrations respectively; the color illustrations were by V. Malikul. P. Gentili Poole and DRD, assisted by Scott Whittaker, manager of the Natural History Museum SEM lab, are responsible for the SEM images. The Hymenoptera parasitoids were identified by Michael Gates of the Systematic Entomology Laboratory, USDA, Washington, D.C. The DNA barcode sequences were generated at the Biodiversity Institute of Ontario with funding to Paul D.N. Hebert from Genome Canada through the Ontario Genomics Institute, NSERC, and the Ontario Ministry of Research and Innovation. We would also like to acknowledge the support for fieldwork on Lepidoptera leafminers in Costa Rica provided by the ALAS (Arthropods of La Selva) III project (funded by National Science Foundation grants DEB-9706976, DEB-0072702) and co-principal investigator John Longino. We are also grateful for the assistance provided by the parataxonomists at the La Selva Biological Station formerly working on this project, Danilo Brenes, Flor Cascante, Nelci Oconitrillo, Maylin Paniagua, and Ronald Vargas.

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