

Contributions to the systematics of New World macro-moths VII

edited by

B. Christian Schmidt, J. Donald Lafontaine



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CONTRIBUTIONS TO THE SYSTEMATICS OF NEW WORLD MACRO-MOTHS VII

edited by B. Christian Schmidt, J. Donald Lafontaine

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Contributions to the systematics of New World macro-moths VII

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This special issue of ZooKeys is the seventh volume in the “Contributions” series, dedicated to disseminating systematics research on the Noctuoidea, Geometroidea, and other macro-moth groups. Previous volumes were published in May 2009 (volume I, ZooKeys # 9), March 2010 (volume II, ZooKeys # 39), November 2011 (volume III, ZooKeys # 149), February 2013 (volume IV, ZooKeys # 264), June 2014 (volume V, ZooKeys # 421) and October 2015 (volume VI, ZooKeys # 527; see Schmidt and Lafontaine 2009, 2010, 2011, 2013, 2014, 2015). Authors interested in contributing to future “Contributions” volumes are encouraged to contact us.

In the current volume, eighteen authors contributed eleven manuscripts on New World taxa in the Erebidae, Noctuidae and Apatelodidae. In addition to numerous taxonomic and nomenclatural changes, 16 new taxa are described from the Nearctic, including 1 new genus, 14 new species and one subspecies: *Hypoprepia lampyroides* Palting & Ferguson, **sp. n.**, *Clemensia ochracea* Schmidt & Sullivan, **sp. n.**, *Euchaetes nancyae* Nagle & Schmidt, **sp. n.**, *Dolocucullia poolei* Crabo & Hammond, **sp. n.**, *Sympistis eleanor* Adams, **sp. n.**, *Sympistis ferrirena* Crabo, **sp. n.**, *Aseptis harpi* Crabo & Mustelin,

sp. n., *Admetovis icarus* Crabo & Schmidt, **sp. n.**, *Rhabdorthodes* Crabo, **gen. n.**, *Rhabdorthodes pattersoni* Crabo, **sp. n.**, *R. petersoni* Crabo, **sp. n.**, *Hypotrix lactomellis* Wikle & Crabo, **sp. n.**, *Plagiomimicus yakama* Crabo & Wikle, **sp. n.**, *P. yakama mojave* Wikle & Crabo, **ssp. n.** and *Plagiomimicus incomitatus* Mustelin, **sp. n.**

An additional eight species are described from the Neotropics: *Apatelodes navarroi* Herbin & Beccacece, **sp. n.**, *Apatelodes chalupae* Herbin & Beccacece, **sp. n.**, *Apatelodes ulfi* Herbin & Beccacece, **sp. n.**, *Lophocampa azuayensis* Vincent, **sp. n.**, *Lophocampa carpishensis* Vincent, **sp. n.**, *Leucosigma solisae* Goldstein, **sp. n.**, *Leucosigma poolei* Goldstein, **sp. n.** and *Leucosigma schausi* Goldstein, **sp. n.**

All updates, additions and corrections to the Check List of North American Noctuoidea (Lafontaine and Schmidt 2010) since the last update in 2015 are summarized.

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Description of three new species of *Apatelodidae* from the southern neotropical region (Lepidoptera, Bombycoidea)

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Abstract

Three new species of *Apatelodidae* are described from Argentina, Bolivia, Brazil, and Paraguay: *Apatelodes navarroi* **sp. n.**, *Apatelodes chalupae* **sp. n.**, and *Apatelodes ulfi* **sp. n.**, and are figured with their genitalia. Detailed examination of primary types leads to the establishment of a new synonymy: *A. florisa* Schaus, 1929 = *A. schreiteri* Schaus, 1924, **syn. n.**, and a revised status for another *Apatelodidae* species previously misplaced in the Bombycidae: *Apatelodes brunnea* (Dognin, 1916), **comb. n.**

Keywords

Apatelodes, Neotropical fauna, *Quentalia*, taxonomy

Introduction

The adults of the American silkworm moths (Lepidoptera, Bombycoidea, *Apatelodidae*) are small to medium size with earthen tones. The larvae are exposed feeders on trees and shrubs and several species are polyphagous (Gillott 2005). This family is mainly Neotropical with a few representatives in North America (Kitching et al. 2018).

An extensive revision of Apatelodidae was published by Draudt (1929). More recently, a checklist was issued by Becker in Heppner (1996), and a Bombycoidea checklist by Kitching et al. (2018). The status of Apatelodidae as a family belonging to the Bombycoidea has been confirmed by morphological and molecular studies (Lemaire and Minet 1998, Zwick et al. 2011).

Recent taxonomic studies of Apatelodidae suggested that this family contains more species than previously thought: Beutelspacher Baigts (1984), Wagner and Knudson (2014), Herbin (2015, 2017), Herbin and Monzón Sierra (2015), Herbin and Mielke (2018), and ongoing taxonomic and phylogenetic work will certainly reveal many more.

Within the Apatelodidae, the most diverse genus is *Apatelodes* Packard, 1864, which contains 115 species of the total of 214 species in the family, as per the most recent report by Kitching et al. (2018). The caterpillars of *Apatelodes* are generally hairy, with long hairs, and pupate under ground. A large variety of food plants seem to be used by species in the genus, as found by extensive rearing conducted in Costa Rica, Guanacaste, and reported on a dedicated Internet site by Janzen and Hallwachs (2009). Hosts of *Apatelodes* include plants from the families: Malvaceae, Chrysobalanaceae, Myrtaceae, Fabaceae, Salicaceae, Meliaceae, Annonaceae, Asteraceae, Piperaceae, Amaranthaceae, Convolvulaceae, Verbenaceae, and Bignoniaceae. An *Apatelodes* species from Colombia has recently been reared in the laboratory in Europe, and accepted a *Salix* Linnaeus sp. (Salicaceae) as a replacement food plant (Herbin unpublished), and some other *Apatelodes* species are reported as pests of banana trees (*Musa* Linnaeus, Musaceae) in Venezuela (Dominguez et al. 2002).

In this study, three new species of Apatelodidae from Argentina and neighboring countries (Brazil, Bolivia and Paraguay) are described in *Apatelodes* based on their habitus, genitalia, and DNA barcoding.

Materials and methods

Materials and methods are as per Herbin (2017) and Herbin and Mielke (2018).

Figures were manipulated with Adobe Photoshop CS4. Green labels in figures relate to a voucher number in CDH (see below for collection abbreviations). White labels with the format “BC-Her####” relate to barcode reference numbers from specimens in CDH. All other labels shown belong to the holotype.

All species treated here were subjected to DNA analysis using the DNA barcode region of the mitochondrial COI gene in BOLD (Barcode of Life Data System: <http://www.boldsystems.org>, see also Ratnasingham and Hebert (2007)). Sequences were aligned using the tools provided in BOLD (BOLD Aligner: Amino Acid Based HMM), exported in fasta format, and imported in MEGA6 (Tamura et al. 2013). The evolutionary history of the taxa was inferred using the Neighbor-Joining method (Saitou and Nei 1987). The phenograms are drawn to scale, with branch lengths (next to the branches) in the same units as the evolutionary distances used to infer the Neighbor-Joining tree. The evolutionary distances were computed using the Kimura 2-distances

(Kimura 1980) and measure the number of base substitutions per site. All codon positions were included and all positions containing gaps and missing data were excluded.

Description of colors in the descriptions refers to the RAL color standard, see <https://www.ral-farben.de/en/home/>.

Abbreviations

CDH	Collection Daniel Herbin, Garidech, France
IFML	Instituto Fundación Miguel Lillo, Tucumán, Argentina
MFN	Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany
MHNG	Museum d'Histoire naturelle de Genève, Genève, Suisse
MNHN	Muséum national d'Histoire naturelle, Paris, France
NHMUK	Natural History Museum, London, U.K.
USNM	National Museum of Natural History [formerly United States National Museum], Washington, D.C., USA

Taxonomy

Apatelodes navarro sp. n.

<http://zoobank.org/360E2A19-1396-438A-BB6D-BA93C28BCD89>

Figs 1–4

Types. Holotype male. ARGENTINA: Jujuy: Parc National Calilegua Km 22, 1.1 km après El Monolito, 23°40'32.7"S; 64°53'56.4"W, Alt. 1693m, 27/XI/2013, *leg.* B. Vincent / genitalia prep. D. Herbin ref. H1381 / HOLOTYPE ♂ *Apatelodes navarro* Herbin & Beccacece. des. / CDH 3.311 / BC-Her4953. (Figs 1, 2). *In* MNHN.

Paratypes. 1 female. **ARGENTINA: Jujuy:** Parc National Calilegua Km 21, El Monolito, 23°40'56.1"S; 64°54'06"W, Alt. 1723m, 01/XII/2013, *leg.* B. Vincent / genitalia prep. D. Herbin ref. H1386 / CDH 3.322. (Fig. 3). *In* CDH.

Etymology. *Apatelodes navarro* sp. n. is named after the late Dr. Fernando Navarro (IFML), who directed the expedition that enabled the discovery of this new species and the following one.

Diagnosis. *Apatelodes navarro* sp. n. belongs to a small group of *Apatelodidae* showing very developed socii. This group includes *A. hierax* Dognin, 1924, *A. schreiteri* Schaus, 1924, *A. florisa* Schaus, 1939, *A. zikani* Draudt, 1929, and *A. combi* Herbin, 2015. *Apatelodes navarro* sp. n. is similar to *A. florisa* and *A. schreiteri*, both described from Argentina, Tucumán (see taxonomical notes hereafter). *Apatelodes navarro* sp. n. is easily distinguished by its very dark brown color, its greater size, the elongated shape of the forewings, and the slightly concave termen of the forewing below apex. The male genitalia exhibit large socii with well-developed teeth.

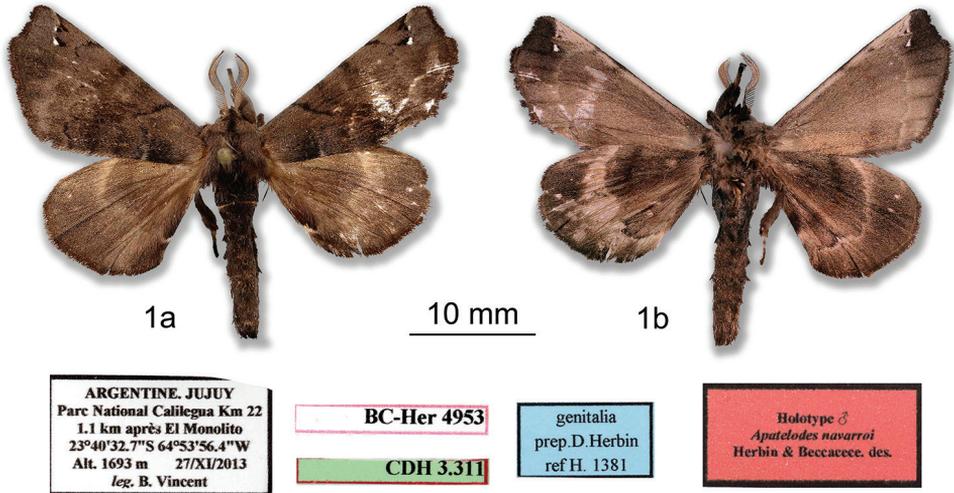


Figure 1. *Apatelodes navarroi* sp. n. male holotype: **a** Dorsal view **b** Ventral view.

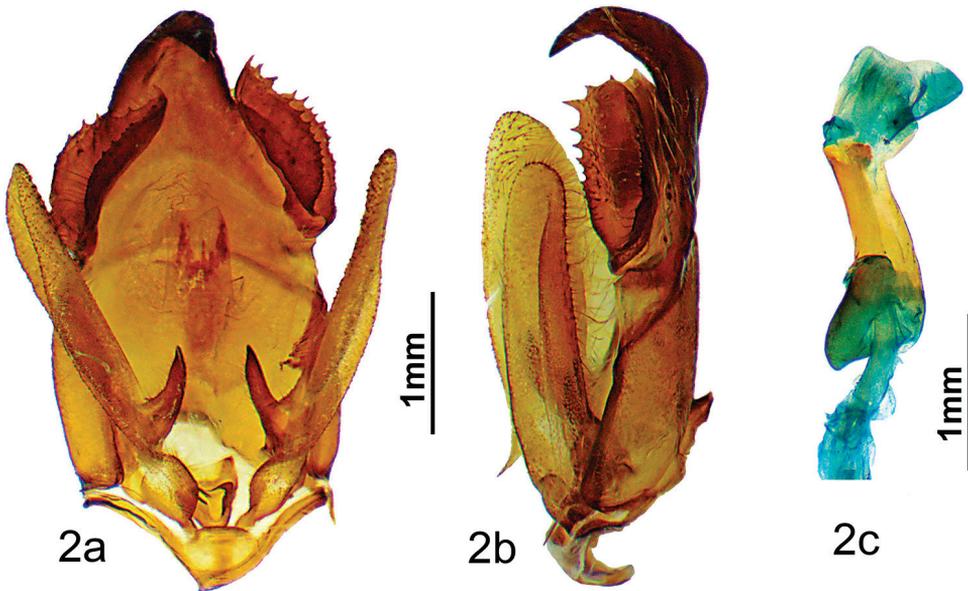


Figure 2. *Apatelodes navarroi* sp. n. male holotype genitalia: **a** Ventral view **b** Lateral view **c** Phallus lateral view.

Description. Male. *Antennae*: antennae bipectinate to the tip. Scape, pedicel, and antennomeres beige, rami brown. *Head*: brown, labial palpi thick, brown, slightly ascending and reaching beyond the front. Eyes naked, dark brown. *Thorax*: coloration terra brown (RAL8028) with a median longitudinal black line. *Legs*: coloration as for thorax, with tibia appearing very thick as covered by long light brown hair like

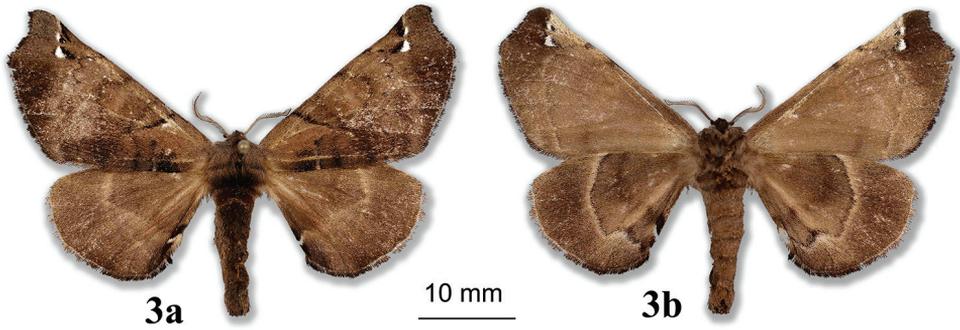


Figure 3. *Apatelodes navarroi* sp. n. female paratype: **a** Dorsal view **b** Ventral view.

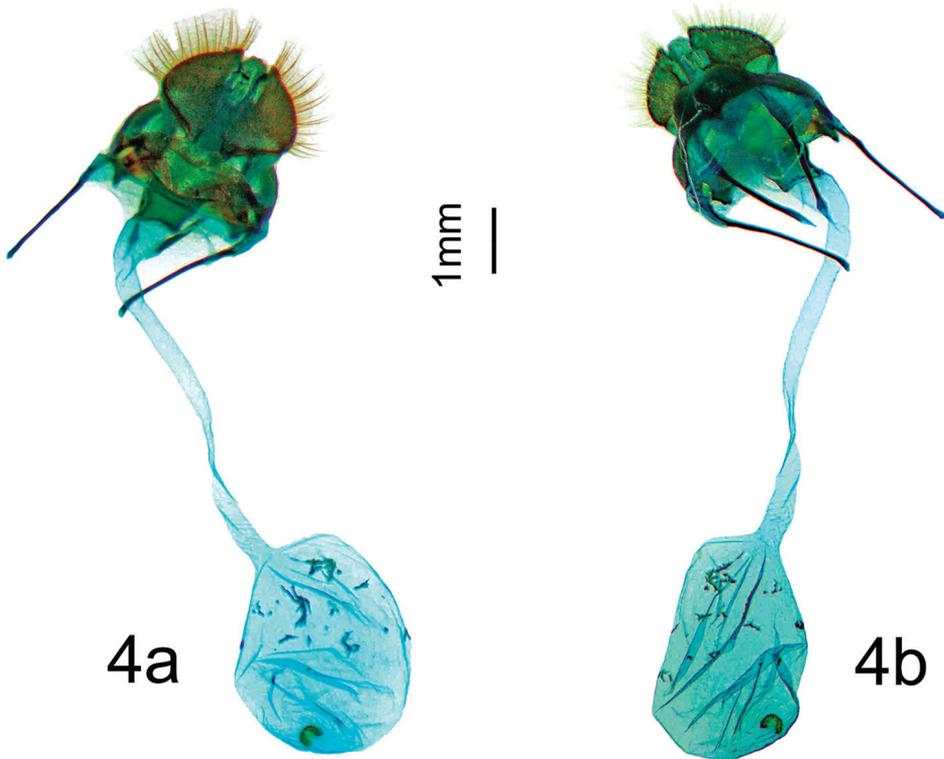


Figure 4. *Apatelodes navarroi* sp. n. female paratype genitalia (H1386): **a** Ventral view **b** Dorsal view.

scales. Femora densely pilose beige with dark brown scales; *Abdomen*: sepia brown (RAL8014). *Forewing dorsum*: Forewing length: 17 mm, wingspan: 34 mm. Triangular, apex acute, outer margin slightly concave below apex. Coloration terra brown (RAL8028), antemedial line black, a basal rectangular black mark in antemedial area, postmedial line wavy, black. Two small hyaline spots near apex and costa: one tiny spot

near costa, bordered proximally with small black triangular mark, second spot posterior to first slightly larger, triangular, and bordered proximally with black scales. Between costa and first tiny hyaline spot, a black comma marking present. *Forewing ventrum*: Similar to dorsum, but lighter in color: pale brown (RAL8025), with postmedial line lighter in color, darker terra brown patch at apex. *Hindwing dorsum*: homogenous terra brown coloration, slightly lighter than forewing. Medially, a curved transverse line lighter brown. *Hindwing ventrum*: Dark terra brown with a pale brown transverse line. *Genitalia* (Figure 2).

Uncus strongly sclerotized, with wide base and single bent hook-like apex. Base of uncus with a pair of large socii made of a two folded sclerotized sheet bordered with numerous strong teeth. Valves elongated, not reaching the uncus, rather narrow, with apex rounded and a strong sclerotized spine at the dorsal base of the valve. Aedeagus short and cylindrical, with no teeth or cornuti. Caecum penis present. Vesica with a ventral diverticulum. No cornuti on vesica.

Female. *Antennae*: similar to male but rami shorter. *Head*: Similar to male but labial palpi thinner and shorter, not reaching front. *Thorax, Legs*: As in male. *Forewing dorsum*: Forewing length: 22 mm, wingspan: 42 mm. Similar to male but broader, apex slightly more falcate, and termen below apex more concave. *Forewing ventrum, hindwing dorsum, hindwing ventrum*: As in male. *Genitalia* (Figure 4).

Papillae anales hemispherical, slightly bulbous and covered with setae. Apophyses thin and cylindrical, slightly spatulate at tip, anteriores about the same length as posteriores. Ductus bursae as a very long (about 5 mm, twice the length of corpus bursae), narrow, sinuous ribbon, of equal diameter for entire length. Ductus bursae sclerotized at entry near ostium bursae. Bursa copulatrix smooth and ovoid with a horse-shoe shaped, semi circular, single signum at extremity of bursa, signum equipped with minute teeth, inward pointing.

Distribution. *A. navarroi* sp. n. is presently only known from Argentina, Jujuy, at medium altitude.

Apatelodes chalupae sp. n.

<http://zoobank.org/CF2AE03B-75CD-4791-9BF4-8C6DA342EF4D>

Figs 5, 6

Type. Holotype male. ARGENTINA: Jujuy: Parc National Calilegua Km 22, 1.1 km après El Monolito, 23°40'32.7"S; 64°53'56.4"W, Alt. 1693m, 27/XI/2013, leg. B. Vincent / D. Herbin genitalia prep. H1380/ HOLOTYPE ♂ *Apatelodes chalupae* Herbin & Beccacece des. / CDH 3.310 / BC-Her4954. (Figs 5, 6). In MNHN. No paratypes.

Etymology. *Apatelodes chalupae* is named after Dr. Adriana Chalup (IFML), Geometridae and Noctuidae lepidopterist specialist.

Diagnosis. *Apatelodes chalupae* sp. n. is similar to *A. navarroi* sp. n., but is much lighter in color (see comparison in Figs 10–11), bears two small hyaline spots near apex bordered proximally by black scales. The male genitalia also show structures similar to

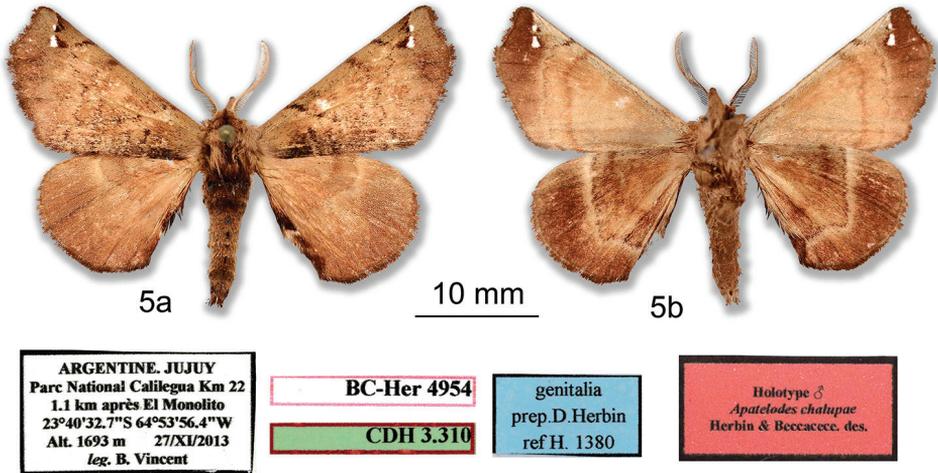


Figure 5. *Apatelodes chalupae* sp. n. male holotype: **a** Dorsal view **b** Ventral view.

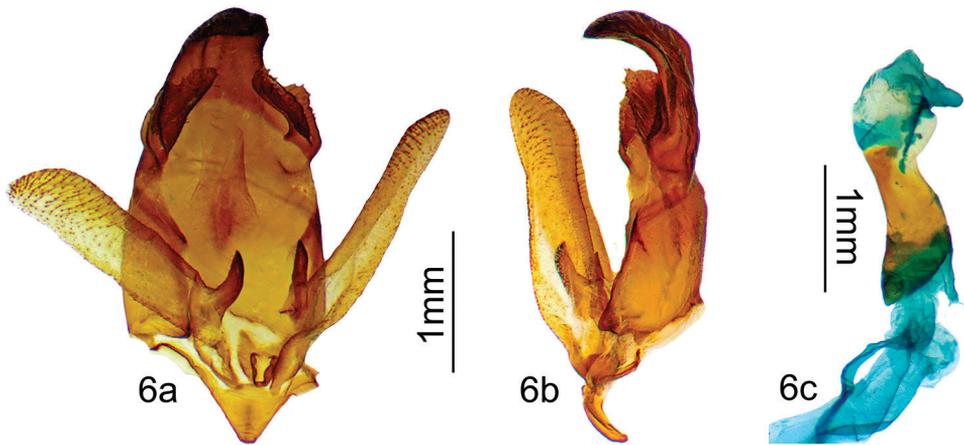


Figure 6. *Apatelodes chalupae* sp. n. male holotype genitalia: **a** Ventral view **b** Lateral view **c** Phallus lateral view.

those of *A. navarroi* sp. n., but reduced in size, and with less developed socii, including less developed teeth bordering the socii. A distance in COI barcodes of 4.3% is found between these two species, as shown in the tree in Figure 16.

Description. Male. Antennae: Bipectinate to the tip. Scape, pedicel and antennomeres beige, rami beige brown. **Head:** beige brown, labial palpi thick, beige brown, slightly ascending and reaching beyond the front. Eyes naked, dark brown. **Thorax:** ochre brown with longitudinal black central line. **Legs:** beige brown, tibia appearing thick due to long beige brown scales. **Forewing dorsum:** Forewing length: 16 mm, wingspan: 32 mm. Triangular, apex acute, outer margin slightly concave below apex.

Ground color light ochre brown (RAL8001), maculation similar to previous species with two small hyaline spots near apex, bordered proximally by tiny black marking. A black comma-shaped mark exists between costa and the smaller hyaline spot. A dark brown diffuse marking present basally in antemedial area. Antemedial and post-medial lines faint. *Forewing ventrum*: Ground color beige (RAL1001). Outer margin copper brown (RAL8004). Postmedial line light brown. *Hindwing dorsum*: coloration uniform light ochre brown, a faint lighter beige longitudinal line present. *Hindwing ventrum*: coloration rather uniform copper brown with contrasting beige distal longitudinal line inwardly bent at CuA2 and diffuse brown proximal longitudinal line. *Abdomen*: a black collar at interface of thorax/abdomen. First two abdominal segments dorsally reddish brown, remaining segments ochre brown. Black spot present dorsally on each abdominal segment. *Genitalia* (Figure 6).

Uncus heavily sclerotized, wide, bent mesally, with a simple hooked apex. Base of uncus with a pair of medium size socii made of a two folded sclerotized sheet bordered with few small teeth. Valves elongated, rather narrow, not reaching the uncus, with apex rounded and a strongly sclerotized spine at the dorsal base of the valve. Aedeagus short and cylindrical, with no teeth or cornuti. Caecum penis present. Vesica with a ventral finger like diverticulum and a smaller lateral diverticulum. No cornuti on vesica.

Female. Unknown.

Distribution. *A. chalupae* sp. n. is only known from the type locality in Argentina.

Remarks. Initially, we thought that the type specimen of *A. chalupae* sp. n. was a lighter colored representative of *A. navarroi* sp. n., however the COI barcodes showed a significant distance between the two species (4.3%), further confirmed by the differences found in the male genitalia.

Figure 7 presents a side-by-side comparison between the genitalia of both species, from a photo taken under a microscope with both male genitalia taken in the same picture, therefore at the same scale. Smaller genitalia size for *A. chalupae* sp. n., the most striking difference is in the relative size of the socii, and the much stronger teeth present on the edge in *A. navarroi* sp. n.

In Figure 16, we present the tree built with MEGA6, with the new taxa *A. navarroi* sp. n., *A. chalupae* sp. n., and the most similar previously described species: *A. schreiteri*.

***Apatelodes ulfi* sp. n.**

<http://zoobank.org/628182A5-B35C-470B-A16D-00B2156E5E2A>

Figs 8, 9

Types. Holotype male. PARAGUAY: Dept Presidente Hayes: Estancia 4L, 28-30. III.2014, 22°42'S; 58°37'W, 94m, *leg.* U. Drechsel, Coll. D. Herbin / genitalia prep. D. Herbin H1379 / HOLOTYPE ♂ *Apatelodes ulfi* Herbin & Beccacece des. / CDH 3.309 / BC-Her4933. (Figs 8, 9). *In* MNHN.

Paratypes (14 males total): **BOLIVIA:** 1 male. **Dept Tarija:** Camatindi à Capirenda km 16, 493 m, 07.XI.2007, 21°01'07"S; 63°15'51"W, *leg.* Barbut, Vincent

7

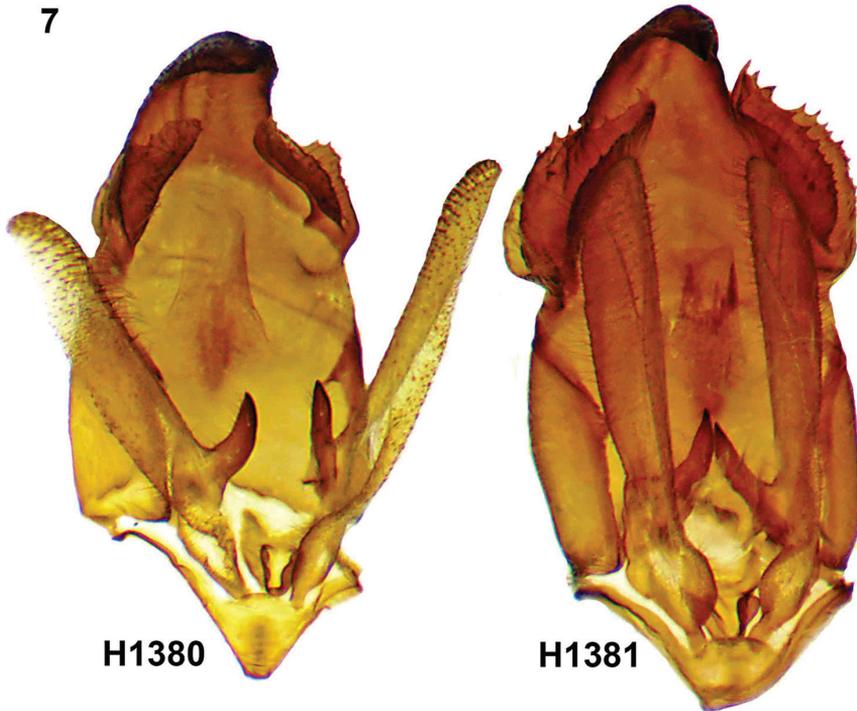


Figure 7. Comparative views of male genitalia: Left: *Apatelodes chalupae* (H1380) Right: *Apatelodes navarroi* (H1381).

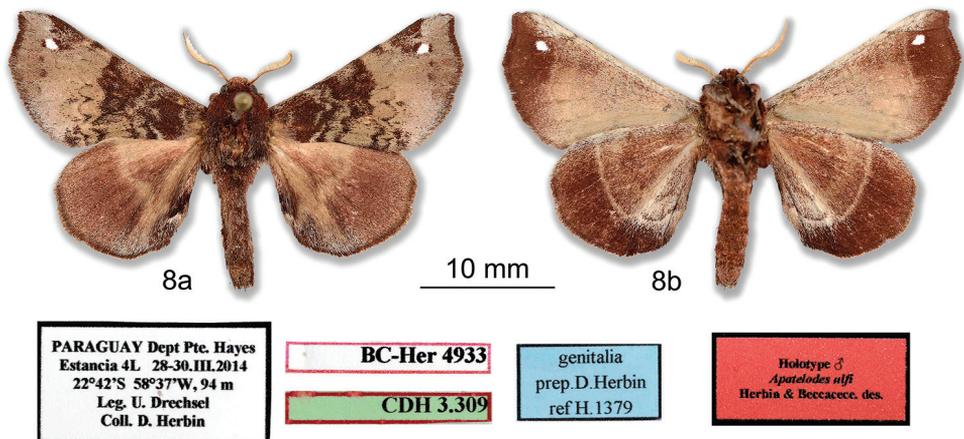


Figure 8. *Apatelodes ulfi* sp. n. male holotype: **a** Dorsal view **b** Ventral view.

& Levêque/ genitalia prep.D. Herbin H830/ CDH 3.321/ BC-Her1918. *In* CDH;
BRAZIL: 1 male. **Mato Grosso do Sul:** Environs de Rio Brillhante, Fazenda Senhor João Brandão, III.1966, *leg.* Cl. Moinier, Collection Jacques Plante. *In* MHNG; 1

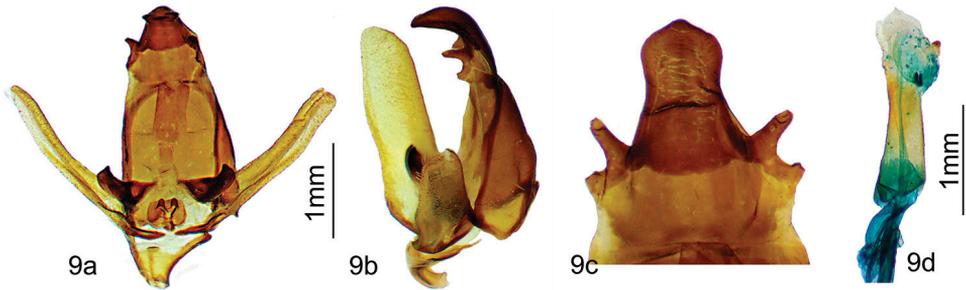


Figure 9. *Apatelodes ulfi* sp. n. male holotype genitalia: **a** Ventral view **b** Lateral view **c** Uncus and socii details (ventral view) **d** Phallus lateral view.

male. **Mato Grosso do Sul:** Environs de Rio Brillhante, Fazenda Senhor João Brandão, III.1966, *leg.* Cl. Moinier, Collection Jacques Plante/ genitalia prep. D. Herbin H1423. *In* MHNG; **PARAGUAY:** 1 male. **Dept Presidente Hayes:** Estancia Tendota, 28-30. III.2014, 25°00'S; 58°05'W, 80m, *leg.* U. Drechsel, coll. D. Herbin/ CDH 3.317. *In* CDH; 2 males. **Dept Concepción:** Garay Cue, 04-09.VI.2013, 22°42'S; 57°22'W, 212m, *leg.* U. Drechsel, Coll. D. Herbin/ CDH 3.313 and CDH 2.803. *In* CDH; 1 male. **Dept Concepción:** Garay Cue, 25-29.IV.2013, 22°42'S; 57°22'W, 212m, *leg.* U. Drechsel, coll. D. Herbin/ CDH 3.318. *In* CDH; 1 male. **Dept Concepción:** Garay Cue, 27-30.IX.2014, 22°42'S; 57°22'W, 212m, *leg.* U. Drechsel, coll. D. Herbin/ CDH 3.319. *In* CDH; 3 males. **Dept Canindeyú:** 15-17.III.2016, 24°08'S; 55°31'W, 195m, *leg.* U. Drechsel, coll. D. Herbin/ CDH 3.312, CHD 3.314 and CDH 3.315. *In* CDH; 2 males. **Dept Boquerón:** Aurora Chaquena, 02.V.2015, 22°44'S; 60°00'W, 212m, *leg.* U. Drechsel, coll. D. Herbin/ CDH 3.316 and CDH 3.320. *In* CDH; **ARGENTINA:** 1 male. **Salta:** RN50 a Isla de Cañas Km31, 04.XII.2013, 23°04'06"S; 64°33'29.8"W, 547m, *leg.* B. Vincent/ CDH 3.323/ BC-Her4936. *In* CDH;

Etymology. *Apatelodes ulfi* sp. n. is named after Ulf Drechsel in Paraguay, who collected the majority of the known specimens.

Diagnosis. *Apatelodes ulfi* sp. n. is a rather small species, with the basal half of the forewing *dorsum* dark reddish brown very contrasting with the light colored (grey beige) postmedial and marginal area. A single hyaline preapical spot. The *ventrum* with inverted contrasting area compared to *dorsum*: darker on the marginal area, and lighter in median and basal area. The particular feature of the male genitalia lies in the socii, showing two ventral projections, one very short and truncated, another slightly longer.

Description. Male. Antennae: Bipectinate to the tip. Scape, pedicel, antennomeres and rami beige. **Head:** brown red (RAL3011) with some beige-tipped scales, labial palpi thick, brown, projected forward, eyes dark brown. **Thorax:** prothoracic collar brown red, thorax vinaceous red (RAL3005). **Legs:** Tibia thick with long hair like scales, brown and whitish for prothoracic legs, brown red for mesothoracic and metathoracic legs. **Abdomen:** brown red. **Forewing dorsum:** Forewing length (n = 13): 13–17 mm, wingspan: 28–35 mm (holotype: length 16 mm and wingspan 34 mm). Ground coloration grey beige (RAL1019), with basal half oxide red (RAL3009) con-

trasting with two grey beige undulating antemedial lines. Single elliptic hyaline spot, bordered proximally with an oxide red small triangle, distally by a small oxide red spot present near apex. Termen bordered with narrow oxide red. Postmedial line crenulated, oxide red. *Forewing ventrum*: Ground color beige (RAL1001) with some oxide red scales near costa. Marginal area oxide red with beige triangle above hyaline spot. *Hindwing dorsum*: Ground color red brown (RAL8012) with beige median line. Termen bordered by nut brown (RAL8011). *Hindwing ventrum*: Marginal area oxide red with beige postmedial line, antemedial and medial areas of lighter color due to beige scales interlaced with oxide red scales. *Genitalia* (Figure 9):

Uncus downcurved, strongly sclerotized, wide, with a single small spine at apex. At base of uncus, socii exhibit two finger-like extensions, one short and truncated and one longer (see Figure 9c). Valves elongated, rather narrow, with apex rounded. Process at base of valve strongly sclerotized with two small apical teeth. Aedeagus short and cylindrical, caecum penis present, with no teeth or cornuti. Vesica with a small ventral finger like diverticulum, then a very small diverticulum laterally, slightly sclerotized (appearing orange in Figure 9d).

Female. Unknown.

Distribution. Specimens of *A. ulfi* sp. n. have been collected in various localities in northern Argentina, southern Bolivia, central western Brazil and north to south Paraguay. Possible extension of the range to Peru remains to be investigated.

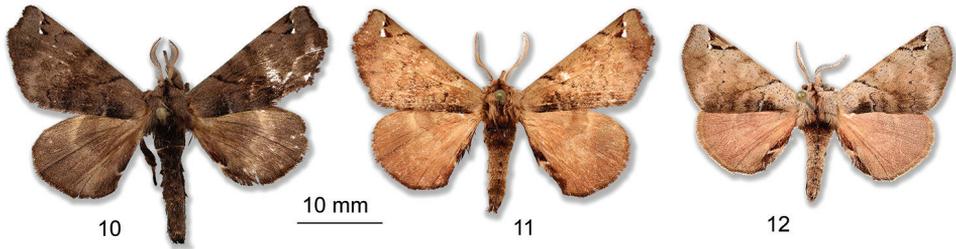
Remarks. DNA barcoding of specimens from various localities reveal that these populations are all perfectly aligned (i.e. 0% distance between specimens of northern Argentina, southern Bolivia and Paraguay. Specimens from Brazil in MHNG not bar-coded) despite some variation in wingspan.

A similar specimen in CDH, from northern Bolivia (Nor Yungas, Coroico area), shows a larger size and some differences in habitus, and has therefore not been included in paratype series. Similar specimens are likely to be found in southern or central Peru, this will then enable to verify identity or not with *A. ulfi* sp. n.

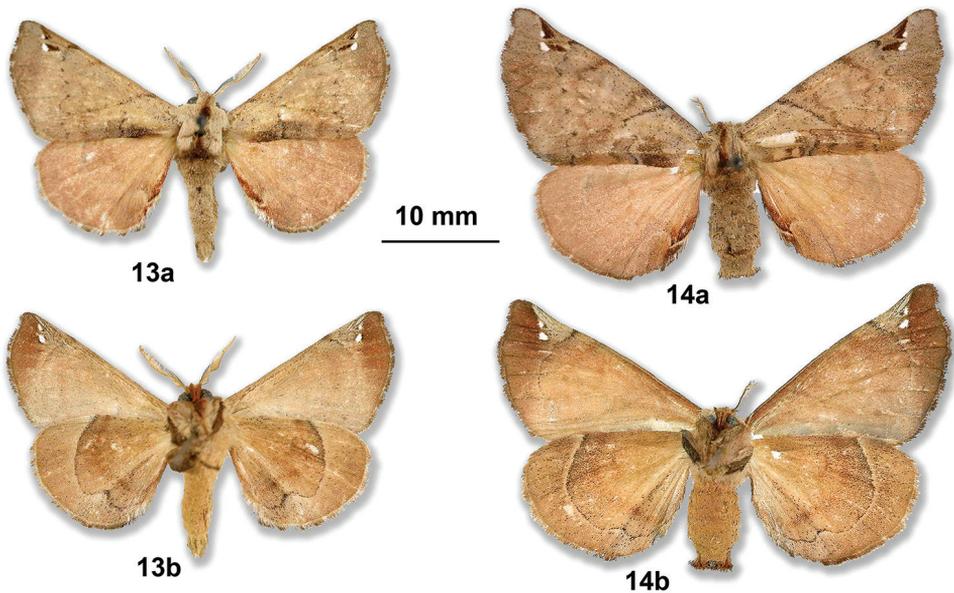
Additional taxonomic notes

Note 1: A comparison of species similar to *A. schreiteri*.

As illustrated in Figures 10–12, where a specimen of *A. schreiteri* is figured together with *A. navarroi* sp. n. and *A. chalupae* sp. n., differences in size of the specimens is obvious. The figured *A. schreiteri* specimen (Figure 12) was also collected in Argentina, Jujuy, Parc Calilegua, 1028 m (specimen CDH3.334, barcode BC-Her4940, barcoded and belonging to the *A. schreiteri* clade shown in Figure 16). Apart from the smaller size of this species compared to *A. navarroi* sp. n. and *A. chalupae* sp. n., the shape of the forewing in *A. schreiteri* is such that the termen is rather rounded, without the truncated apex found in the two newly described species. A significant difference also lies in the black marking proximal to the larger hyaline spot: in *A. schreiteri* this marking is more elongated than in the other two species.



Figures 10–12. Comparison of similar *Apatelodes* species from the southern Neotropical region: **10** *A. navarroi* sp. n., male **11** *A. chalupae* sp. n., male **12** *A. schreiteri*, male.



Figures 13–14. **13** *A. schreiteri* male syntype (type n° 26354 USNM) **a** dorsal view **b** ventral view **14** *A. florisa* female holotype (type n° 34696 USNM) **a** dorsal view **b** ventral view (photos D. Herbin, courtesy USNM).

Re-examination of the types in the USNM reveals exactly the same configuration of moth size, termen, and black markings in the syntype male of *A. schreiteri*, and in the female holotype of *A. florisa* Schaus, 1939. Both type specimens originate from Argentina, Tucumán. Figures 13–14 present the holotypes of both *A. schreiteri* and *A. florisa*: the female is slightly larger than the male, as observed in all other Apatelodidae species. We can observe the exact identical configuration of the forewing dark markings and hyaline spot in the male and female, this being generally a key in all species of *Apatelodes* to correctly allocate a female to the corresponding male.

We therefore consider that *A. florisa* Schaus is a subjective junior synonym of *A. schreiteri* Schaus and propose: *Apatelodes florisa* Schaus, 1929 = *Apatelodes schreiteri* Schaus, 1924, syn. n.



Figure 15. Holotype of *Carthara brunnea* Dognin, 1916 (photos D. Herbin, courtesy USNM).

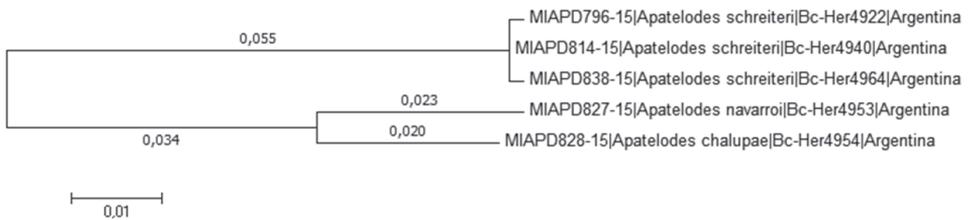


Figure 16. Phylogenetically inferred evolutionary relationships between related *Apatelodes*, using COI. The tree was constructed with the neighbor-joining method.

Note: the genitalia of these holotypes have not been examined, but being the case of a male compared to a female this would not have actually helped in demonstration.

Note 2: The examination of various primary types enables the recognition of an anomaly in the present classification of Bombycoidea: *Carthara brunnea* Dognin, 1916 (holotype male examined in USNM) was previously placed in the genus *Quentalia* Schaus, 1929 (Becker 1996), and more recently with the same combination in the global Bombycoidea checklist (Kitching et al. 2018). The genus *Quentalia* being now included in Bombycidae (Zwick 2011, Kitching et al. 2018) and separated from Apatelodidae, this species should instead be classified in the apatelodid genus *Apatelodes*.

Figure 15 illustrates the type specimen of *Carthara brunnea* (photo courtesy USNM), supporting the obvious proposed reclassification. The habitus, venation, antennae, and patterning, all suggest that this species belongs in Apatelodidae.

Draudt (1928: 681) established the new genus *Quentalia* and indicated: “This genus will contain the many species described under *Carthara* Wlkr which was first

used in Cat. Lep. Het. B.M. 33, p.914....”, and this is likely the root of the transfer of *brunnea* to *Quentalia*, as Dognin originally placed this species in *Carthara*.

The taxon *brunnea* is not addressed in the text nor in the color plates by Draudt (1928), but can be found in the same work under: Alphabetical List of the American Bombycidae on page 710 under *Q. brunnea*. It is likely that since Draudt (1928), no one has re-examined the holotype, and the mistaken classification has been propagated. Here, the following taxonomical rearrangement is proposed: *Carthara brunnea* Dognin, 1916 = *Quentalia brunnea* (Dognin, 1916) = *Apatelodes brunnea* (Dognin, 1916), comb. n.

We notice a similarity of *A. brunnea* to the species newly described above, but no hyaline spot exists on the forewings in *A. brunnea*.

Acknowledgements

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A new species of *Hypoprepia* from the mountains of central Arizona (Lepidoptera, Erebidae, Arctiinae, Lithosiini)

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Abstract

A new firefly-mimicking lichen moth of the genus *Hypoprepia*, *H. lamproides* Palting & Ferguson, **sp. n.**, is described from the mountains of east-central Arizona and the Sierra Madre Occidental of Mexico. *Hypoprepia* Hübner, 1831 is a North American genus of lithosiine tiger moths, previously consisting of five species: *H. fucosa* Hübner, 1831 and *H. miniata* (Kirby, 1837), both of eastern and central North America; *H. cadaverosa* Strecker, 1878 from the Rocky Mountains into New Mexico and west Texas; *H. inculta* H. Edwards, 1882, a widespread western USA species and *H. muelleri* Dyar, 1907 from the vicinity of Mexico City. The latter is herein synonymized under *H. inculta* (= *H. muelleri* **syn. n.**), resulting in the total number of taxa in the genus unchanged at five.

Keywords

Lithosiini, Madrean fauna, mimicry, Sky Islands

Introduction

The mountains of southeastern Arizona and northeastern Sonora are well known as a biological blending zone between the fauna of the Rocky Mountains to the north and Mexico's Sierra Madre Occidental to the south. Positioned between these two great mountain ranges, the Sky Island Region contains a series of smaller mountain ranges that have oak and pine at higher elevations, each range being separated from one another by expanses of drier grasslands and desert. Sky Island ranges often harbor relict populations of plants and animals that suggest that in the distant past, both geology and climate allowed connections between the flora and fauna of the Rockies and the Sierra Madre (Warshall 1995). Examples among Lepidoptera of this connection include *Chiricahua multidentata* (Guedet, 1941) and *Chiricahua lichenaria* Ferris, 2010 (Geometridae, Ennominae), known in the US only from the highest elevations of the Chiricahua Mountains in SE Arizona, with the next nearest recorded population being in El Salto, Durango, nearly 900 miles to the south. A similarly striking disjunct population occurs with *Nemoria splendidaria* (Grossbeck, 1910) (Geometridae, Geometrinae) known only from the top of the Huachuca Mountains, Arizona in the US with the nearest Mexico records also being from Durango. *Alexicles aspersa* Grote, 1883 (Erebidae, Arctiinae) occurs sporadically from Colorado to several places in the White Mountains of central Arizona, adjacent parts of New Mexico, and not again until the top of the Sierra Madre in the vicinity of Yecora, Sonora, Mexico, skipping the Sky Island ranges entirely. Other rare US Lepidoptera that exhibit similar but less dramatically disjunct distributions include the lasiocampids *Caloecia entima* Franclemont, 1973 and *C. juvenalis* (Barnes & McDunnough, 1911) (Lasiocampidae, Lasiocampinae), *C. entima* known in the US only from the high elevations of the Chiricahuas, and *C. juvenalis* only from the Chiricahuas and Huachucas, with spotty distributions in the Mexican state of Sonora (Sierra Mariquita, Sierra del Tigre and Yecora). *Agylla septentrionalis* Barnes & McDunnough, 1911 (Erebidae, Arctiinae, Lithosiini) is also known from isolated high-elevation populations in the Chiricahua and Huachuca Mountains, separated from the nearest Sierra Madre populations in Yecora, Sonora by 400 miles. These are just a few of many examples among Lepidoptera species with relict disjunct distributions indicating an historical Rocky Mountain-Madreaan connection in this region.

We can now add another rare species of Lepidoptera from Arizona to the body of evidence supporting this past faunal connectivity. The moth was first noticed by the late Ron Leuschner, who collected a specimen on the door of a rental cabin in the hamlet of Greer, White Mountains, Arizona in 1988. Leuschner sent this specimen to Ferguson, who, prior to his death in 2002, recognized it as new and started to describe it based upon this specimen and two additional specimens he located in collections. Ferguson had dissected and made some comments on the male genitalia, but had not examined the internal structures of the female.

In June 2017, JDP and Ray Nagle had the good fortune of collecting more than 30 specimens of this new species along Highway 191 in the vicinity of Rose Peak, Blue Ridge Primitive Area, Greenlee County, Arizona. Flying sympatrically with *Hypoprepia*

inculta Edwards, 1882 was the similar-looking, but much larger bodied and more boldly colored, *H. inculta* look-alike (Figs 1–5). Finally, here was the almost mythical moth that Leuschner had found nearly 30 years prior in Greer. Its similarity to *H. inculta* (Figure 6), combined with narrow endemism and an early flight period just prior to or at the onset of the summer rains, may account for the paucity of records of this new species. It appears to fly throughout the night, with new individuals showing up on the sheet with regularity until dawn, outnumbered by *H. inculta* by approximately 4 : 1. Most of the specimens collected were males, but two females of the new species were collected and kept alive for ova, allowing for the larvae to be reared and photographed for the first time.

Other noteworthy species flying alongside the *Hypoprepia* were *Nadata gibbosa* (JE Smith, 1797) (Notodontidae, Phalerinae) and *Spilosoma virginica* (Fabricius, 1798) (Erebidae, Arctiinae, Arctiini), both common northern and eastern species, but at the extreme southern limit of their ranges here, as well as *Apantesis f-pallida* (Strecker, 1878) (Erebidae, Arctiinae, Arctiini), a primarily Rocky Mountain species, very rare this far southwest. Also present was the strikingly beautiful *Erastria viridiruferia* (Neumoegen, 1881) (Geometridae, Ennominae), another Madrean species that occurs in central Arizona, with sporadic records from the Sky Islands Region through the Sierra Madre proper, where it occurs regularly at mid to high elevations.

Methods and materials

Phylogenetic analysis

Total genomic DNA was extracted from the right middle leg of each voucher specimen using the Qiagen DNeasy Blood and Tissue Kit (Qiagen, Valencia, CA), according to manufacturer suggested protocol. The barcoding region of the mitochondrial gene cytochrome oxidase subunit 1 (COI) was PCR amplified with primers LCO1490 and HCO2198 (Hebert et al. 2003). PCR products were cleaned, quantified, normalized, and sequenced in both directions at the University of Arizona's Genomic and Technology Core Facility using a 3730 or 3730XL Applied Biosystems automatic sequencer. Chromatograms were assembled and initial base calls were made for each gene with Phred (Green and Ewing 2002) and Phrap (Green 1999) as orchestrated by Mesquite Ver. 3.4 (Maddison and Maddison 2018) and Chromaseq vers. 1.3 (Maddison and Maddison 2017). Final base calls were made in Mesquite and ambiguous bases were designated by a standard ambiguity code. Resulting sequences were deposited in GenBank (Table 1). Previously published COI sequences of *Hypoprepia* and all other members of the tribe Lithosiini were downloaded from GenBank and the Barcode of Life Database (Table 1). All 500 sequences were assembled into a single matrix and were aligned using MAFFT vers. 7 (Katoh and Standley 2013). The aligned matrix was partitioned by codon position, with each codon position allowed to have independent parameter values for the model of evolution. Maximum likelihood (ML)

Table 1. GenBank/BOLD accession number of the species.

Species name	GenBank/BOLD Accession Number
Outgroup	
<i>Abrochocis esperanza</i>	KC571047.1
<i>Balbura dorsisigna</i>	KC571053.1
<i>Balbura intervenata</i>	KC571052.1
<i>Chrysochlorosia magnifica</i>	KC571057.1
<i>Cisthene angelus</i>	BBLOE1648-12
<i>Cisthene barnesii</i>	ABLCW009-10
<i>Cisthene barnesii</i>	LMEM919-09
<i>Cisthene barnesii</i>	RDNMF900-08
<i>Cisthene deserta</i>	ABLCW126-10
<i>Cisthene dorsimacula</i>	RDNMF903-08
<i>Cisthene faustinula</i>	LOCBC003-06
<i>Cisthene juanita</i>	IAWL658-09
<i>Cisthene kentuckiensis</i>	HKONS224-08
<i>Cisthene liberomacula</i>	LOCBC697-06
<i>Cisthene martini</i>	LMEM065-09
<i>Cisthene packardii</i>	LSUSA097-06
<i>Cisthene perrosea</i>	ABLCW128-10
<i>Cisthene picta</i>	LPOKA060-08
<i>Cisthene plumbea</i>	KC571059.1
<i>Cisthene polyzona</i>	BLPDD935-09
<i>Cisthene</i> sp.	LPYPC028-08
<i>Cisthene</i> sp.	LPYPC119-08
<i>Cisthene subjecta</i>	HKONS229-08
<i>Cisthene subrufa</i>	LPYPB681-08
<i>Cisthene subrufa</i>	LPYPC078-08
<i>Cisthene tenuifascia</i>	BBLSW086-09
<i>Cisthene unifascia</i>	ABLCW140-10
<i>Dolichesia falsimonia</i>	KC571062.1
<i>Gardinia anopla</i>	KC571075.1
<i>Lycomorphodes correbioides</i>	KC571088.1
<i>Lycomorphodes sordida</i>	KC571089.1
<i>Talara cara</i>	KC571098.1
<i>Talara lepida</i>	KC571099.1
<i>Talara nr. mona</i>	KC571100.1
Ingroup	
<i>Hypoprepia cadaverosa</i>	KC571080.1
<i>Hypoprepia cadaverosa</i>	MF922743.1
<i>Hypoprepia cadaverosa</i>	MF923063.1
<i>Hypoprepia cadaverosa</i>	MF923535.1
<i>Hypoprepia cadaverosa</i>	MF923758.1

Species name	GenBank/BOLD Accession Number
<i>Hypoprepia cadaverosa</i>	MF923893.1
<i>Hypoprepia cadaverosa</i>	MF924076.1
<i>Hypoprepia fucosa</i>	MF923771.1
<i>Hypoprepia fucosa</i>	MF924037.1
<i>Hypoprepia fucosa</i>	KC571078.1
<i>Hypoprepia fucosa tricolor</i>	KC571079.1
<i>Hypoprepia inculta</i>	ABLWCW242-10
<i>Hypoprepia inculta</i>	CMAZA783-10
<i>Hypoprepia inculta</i> 4170	MH337839
<i>Hypoprepia inculta</i>	RDNMG037-08
<i>Hypoprepia inculta</i> 3259	MH337840
<i>Hypoprepia inculta</i>	ABLWCW240-10
<i>Hypoprepia inculta</i>	ABLWCW241-10
<i>Hypoprepia inculta</i>	ABLWCW244-10
<i>Hypoprepia inculta</i>	ABLWCW245-10
<i>Hypoprepia inculta</i>	RDNME352-07
<i>Hypoprepia inculta</i>	MF923496.1
<i>Hypoprepia inculta</i> 3573	MH337833
<i>Hypoprepia inculta</i> 3574	MH337841
<i>Hypoprepia inculta</i>	ABLWCW071-10
<i>Hypoprepia inculta</i>	ABLWCW056-10
<i>Hypoprepia inculta</i>	ABLWCW055-10
<i>Hypoprepia lampyroides</i> sp. n. 3566	MH337834
<i>Hypoprepia lampyroides</i> sp. n. 3567	MH337835
<i>Hypoprepia lampyroides</i> sp. n. 3568	MH337836
<i>Hypoprepia lampyroides</i> sp. n. 3569	MH337837
<i>Hypoprepia lampyroides</i> sp. n. 3570	MH337838
<i>Hypoprepia miniata</i>	BBLOB1474-11
<i>Hypoprepia miniata</i>	LBCC462-05
<i>Hypoprepia miniata</i>	LBCC769-05
<i>Hypoprepia miniata</i>	LGSMB301-05
<i>Hypoprepia miniata</i>	LGSMB302-05
<i>Hypoprepia miniata</i>	LOFLB682-06
<i>Hypoprepia miniata</i>	LOFLC311-06
<i>Hypoprepia</i> sp.	KT706007.1

heuristic searches were conducted using RAxML 8.0.9 (Stamatakis 2014) under the GTR+gamma model of evolution on CIPRES Science Gateway portal (Miller et al. 2010). 500 search replicates were conducted to find the maximum likelihood tree.

We identified the closest relatives of *Hypoprepia* in the resulting maximum likelihood tree, selected these as our outgroup taxa, and re-ran the ML heuristic searches

(as described above) on the smaller matrix of 73 taxa. Clade support was conducted using rapid bootstrapping with a subsequent ML search and letting RAxML halt bootstrapping automatically (using MRE-based bootstopping criterion).

Taxonomic treatment

Genitalic preparations were made following the methods of Jaeger (2017) by staff at the CNC. Genitalia were slide-mounted using Euparal and photographed with a Leica DFC450 camera, Leica Application Suite 4.8 with a Leica M205C stereo microscope, and processed in Adobe Photoshop. Photographs of the pinned adult male and female paratypes were made using Visionary Digital Imaging System with a Canon EOS 7D digital camera and Canon MP-E65mm *f*/2.8 1–5× lens. Multiple images were combined using Zerene Stacker version 1.04.

Repository abbreviations are as follows:

CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON
USNM	National Museum of Natural History (formerly United States National Museum), Washington, DC
UAIC	University of Arizona Insect Collection, Tucson, AZ
UNAM	Universidad Nacional Autonoma de Mexico, Mexico, DF
DEBC	Don E. Bowman Collection, Golden, Colorado
JDPC	John D. Palting Collection, Tucson, AZ
RBNC	Ray B. Nagle Collection, Tucson, AZ

Results and discussion

Phylogenetic analysis

Our molecular phylogenetic analyses reveal strong support for the monophyly of *Hypoprepia* and a close relationship between *H. inculta* and *H. lamproides* (Figure 15). It is noteworthy that *H. lamproides* is recovered as a single well-supported clade. However, recognizing this clade as a new species renders *H. inculta* paraphyletic in the COI gene tree. Focusing on gene tree topology alone, one might decide not to recognize *H. lamproides* as a new species, but rather view it as a unique population of *H. inculta*. However, we contend that these are two valid species since specimens of both occur in strict sympatry at the Rose Peak locality and they are easy to distinguish morphologically by size, wing color, antennal structure, as well as the form of both male and female genitalia. We predict that the 657 base pair fragment of COI does not contain enough phylogenetic information to infer the *Hypoprepia* species tree with accuracy. This is a common result of phylogenetic analyses of the COI barcoding

region within some Lepidoptera (Beltran et al. 2002, Wiemers and Fiedler 2007) and within noctuoids in particular (Schmidt and Sperling 2008, Zahiri et al. 2017). The lack of reciprocal monophyly among species in the tree could also result from ongoing hybridization events resulting in mtDNA introgression, and/or incomplete lineage sorting (Funk and Omland 2003).

The phylogeny also suggests that *Hypoprepia* is in need of further revisionary work, particularly with respect to species boundaries between *H. miniata* and *H. cadaverosa*. These fully allopatric species (*H. miniata* common in the eastern US and *H. cadaverosa* common in the western US) look quite different from one another. Even so, several authors have suggested that they should be synonymized (Zahiri et al. 2017, Powell and Opler 2009). Given this and that both nominate forms are polyphyletic in our tree, it seems likely that these forms represent regional variation in the same species. Future investigations comparing their anatomy and phylogenetic analysis of additional genes, particularly nuclear genes, will help resolve this taxonomic question.

Taxonomic treatment

Hypoprepia lampyroides Palting & Ferguson, sp. n.

<http://zoobank.org/746F6BFE-47B9-4E47-832B-F75A954A75C2>

Figs 1–5, 8–10, 13–14, 18–19

Type material. Holotype ♂. Arizona: [Apache Co.], White Mountains, Greer, 8,200 ft., 4–5 July 1988, R.H. Leuschner [USNM]. Paratypes 32♂ 3♀. Arizona: Santa Cruz Co., 8.5 mi. SE of Patagonia, Harshaw Canyon, 4,850 ft., 24 July 1998, D.E. Bowman, 1♀ [DEBC]; 29♂ 2♀, Greenlee Co., Blue Ridge Primitive Wilderness, US Hwy 191, vicinity of Rose Peak, 33°26'N 109°22'W, 8084 ft., 19 June 2017 [specimens distributed between JDPC (8♂), UAIC (6♂), CNC (5♂ 1♀), USNM (8♂ 1♀), UNAM (2♂), and RBNC (1♀)]. Mexico: 10 mi. W. of El Salto, Durango, 9,000 ft, 13 June 1964, J.E.H. Martin, 1♂ [CNC]; 2♂, Sonora, Mesa del Campanero, Barranca El Salto, elevation 6561', Municipio de Yecora, , 2 July 2013, J. Palting [JDPC, UNAM].

Etymology. The specific epithet *lampyroides* means “like *Lampyra*” referring to this species’ remarkable mimicry of a sympatric lampyrid beetle species, as discussed below.

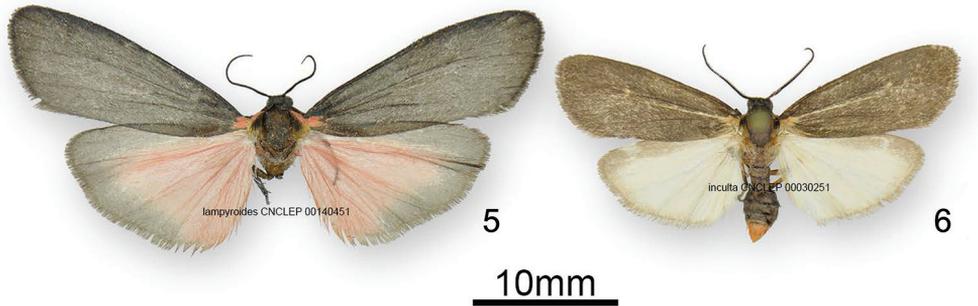
Diagnosis. *Hypoprepia lampyroides* (Figs 1–5) occurs sympatrically with *H. inculta* (Figure 6) and is easily distinguishable externally by its larger size; unmarked blackish forewings; brighter more extensively pink hindwings; somewhat different palpi; and different male antennae that more nearly resemble those of *H. cadaverosa*. The antenna differs structurally from that of *H. inculta* (Figure 7), which exhibit squarish, closely set segments (flagellomeres) with little space between them. The laminae of the antennal segments of *H. lampyroides* (Figure 8) are conspicuously raised, tapered, and appear



Figures 1–2. Two views of living male *Hypoprepia lampyroides*.



Figures 3–4. Adults of *Hypoprepia lampyroides*. **3** male and **4** female.



Figures 5–6. Adult male **5** *Hypoprepia lampyroides* and **6** *Hypoprepia inculta*.

farther apart when viewed laterally. The antenna of *H. lampyroides* is more like that of *H. cadaverosa*, a species that it does not otherwise resemble.

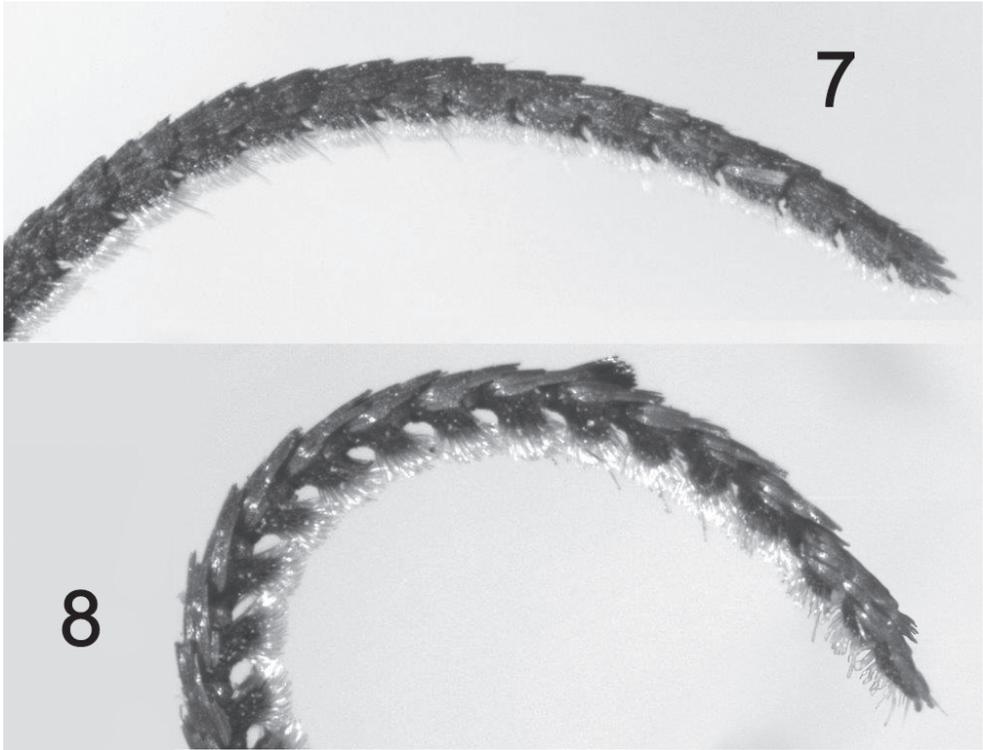
Internally, the male *H. lampyroides* (Figs 9–10) differs from *H. inculta* (Figs 11–12) in the form of the spinose cornutus on the dorsal vesica chamber, which is apically elongated in *H. lampyroides* versus sawblade-like in *H. inculta*. *Hypoprepia lampyroides* males always have three well-developed spinose cornuti (Figure 10), whereas the left ventrolateral cornutus (adjacent to the ductus) is often missing or reduced in *H. inculta* (Figure 12). The shape of the valve and tegumen is stouter and less elongate than in *H. inculta*. In females, the corpus bursae is globose (Figure 13) versus irregularly elongate in *H. inculta* (Figure 14), with four instead of three signa, the right-ventral signa possessing smaller spines than the corresponding right-ventral signa in *H. inculta*.

Description. Sexes similar externally (Figs 3–4), but females with pink area on dorsal hindwing not quite as extensive, and with boundary between pink part and dark outer border more diffuse. **Head.** Vestiture of frons and vertex dark grey; labial palpus dark grey, upturned, slightly larger and longer than that of *H. inculta*, terminal (3rd) segment 1.25 × longer than 2nd; eye large, protuberant, more clearly exceeding a half sphere than those of the other *Hypoprepia* species; male antenna blackish, laminate, densely clothed with short setae beneath and with a few longer setae protruding sublaterally along the sides; female antenna simple, flagelliform.

Thorax. Dark brown or dark gray except for the tegula, which is mostly bright pink, matching basal spot of forewing; patagium blackish; legs entirely blackish or dark gray.

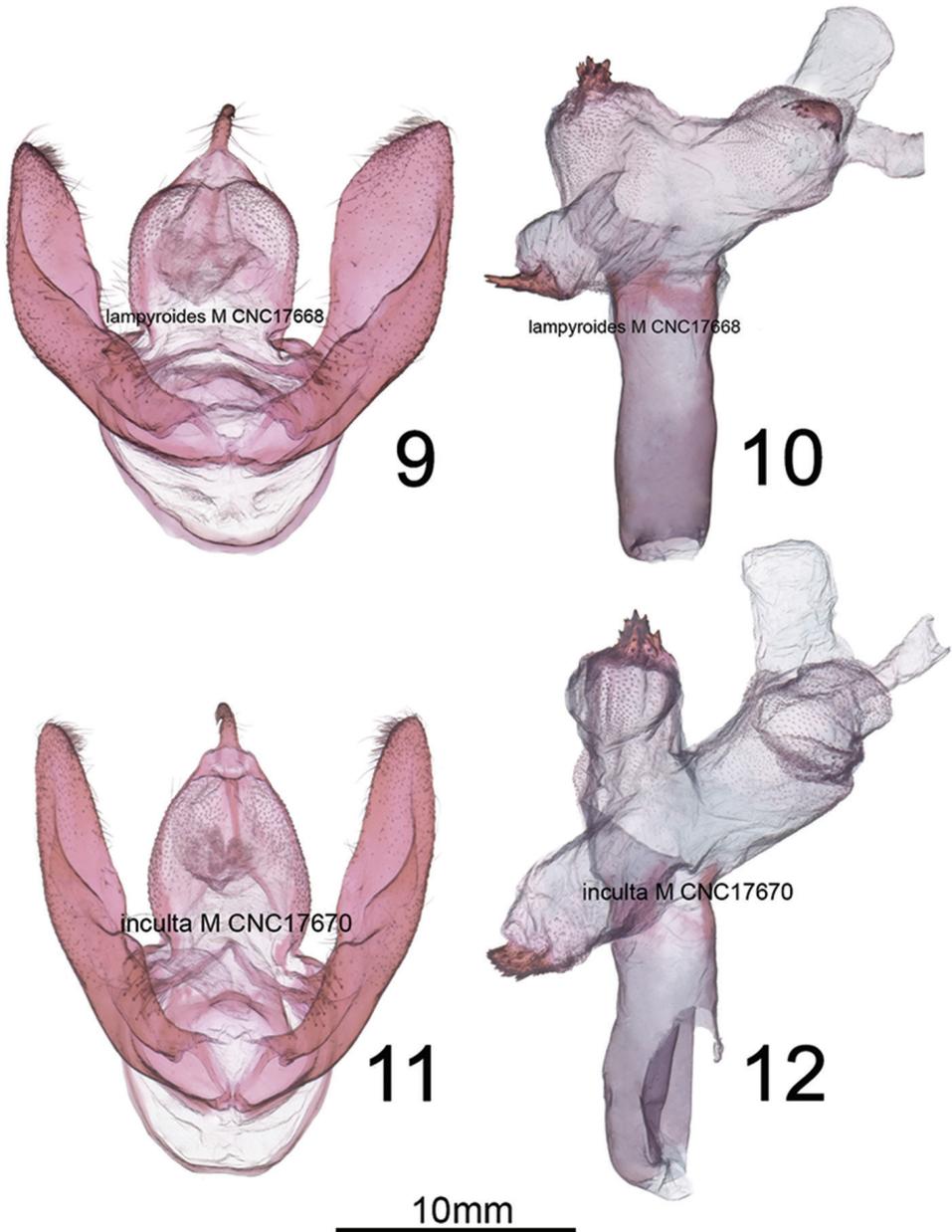
Abdomen. Vestiture gray, flushed with pink basally and terminally, ventrum entirely blackish or dark gray, except for some pink scales at distal end (*H. inculta* also may have a pink-tipped abdomen); ventral sternite A8 of males with reinforced, sclerotized rim-like anterior margin, but no pockets, coremata or androconial setae are visible on segments A7–A8. In females, pleurite of A7 with membranous but thick pockets, appearing somewhat rugose and more heavily sclerotized than surrounding integument.

Forewing. Uniformly dark brown to charcoal gray, appearing blackish, unmarked except for a pink spot at base next to thorax, and lacking the pale streak on basal half of cubital vein seen in many *H. inculta*; male forewing length 17–20 mm, mean 17.5 mm ($n = 6$); female average forewing length 15.8 mm ($n = 2$) (usually 12–15 mm for



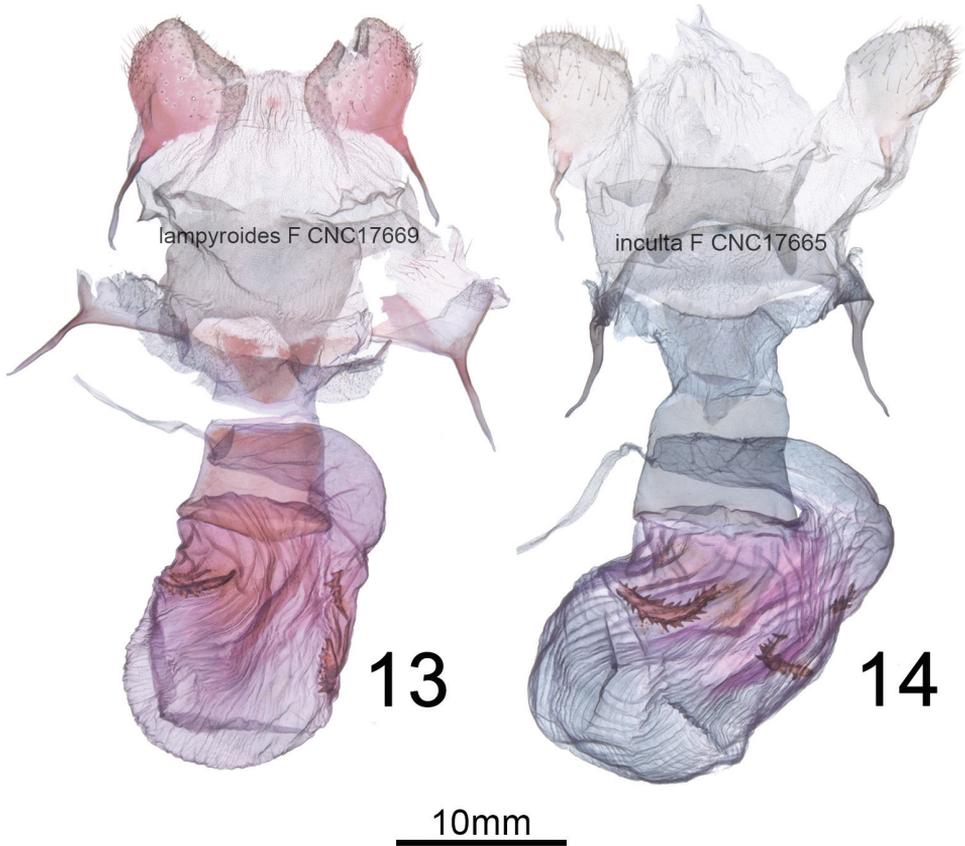
Figures 7–8. Lateral view of male antennae: **7** *Hypoprepia inculta* **8** *Hypoprepia lampyroides*

both sexes of *H. inculta*). *Hindwing*. Hindwing pink, with a uniform, dark-gray costal and outer margin, ending just before anal angle; fringes gray to dark brown; ventrum of both wings similar to dorsum but slightly paler, and with more diffuse boundaries between pink and gray areas. *Male genitalia* (Figs 9–10) Generally similar to those of *H. inculta*; uncus cylindrical, flattened slightly laterally, oval in cross section, $8.8 \times$ longer than wide; apex formed by slightly ventrally-curved, fine spine; basal two thirds with sparse, latero-basally directed setae; tegumen well-defined, rounded quadrate and dorsoventrally flattened with a slight constriction at juncture with vinculum; dorsal surface convex and bubble-like on either side of midline, densely covered in setal sockets distally; valve without clasper or process, slightly constricted basally, distal half rounded triangular, apex a rounded point, with short, broad somewhat spine-like setae along distal third of costal margin; sacculus not differentiated from remainder of valve, with a slight sub-basal, setose bulge; juxta indistinct, forming a dorsally emarginate rounded-rectangular transverse plate, approximately $4 \times$ wider than long; phallus a straight, simple cylinder, $2.5 \times$ longer than wide, coecum lacking; vesica consisting of three adjoining, globose chambers, the phallus appearing more or less as a tripartite club when vesica expanded; ventral chamber adjacent to ductus ejaculatorius, with additional lobe-like diverticulum, and with a spinose crest-like patch apically; laterodorsal chambers also with spinose crests. *Female genitalia*. (Figure 13) Papillae



Figures 9–12. 9–10 Male genitalia of *Hypoprepia lampyroides* 11–12 Male genitalia of *Hypoprepia inculta*.

anales broadly diamond-shaped, sparsely setose; anterior and posterior apophysis relatively short, approximately equal in length to width of papillae; postvaginal area with triangular sclerotization; ductus bursae short and broad, 1.5 × wider than long, highly flattened dorsoventrally and recurved ventrally; corpus bursae relatively small and globose, diameter 1.5–2 × width of ductus; signa consisting of two pairs of spinose



Figures 13–14. Female genitalia of **13** *Hypoprepia inculta* and **14** *Hypoprepia lampyroides*.

straps, situated laterally near junction of ductus; cervix bursae situated right caudo-laterally and recurving left across ventral side of ductus.

Biology and distribution. The brown eggs of *H. lampyroides* (Figure 16) were laid in small clusters inside a vial containing a piece of paper, and under magnification exhibit the “hammered copper” surface texture typical of lithosiine ova. These hatched after 14 days, the larvae being light yellowish initially then darkening as they fed. The larval stages are basically dark brown and unmarked throughout their development. Like other *Hypoprepia* (and other members of the subtribe Cisthenini) the larvae lack true verrucae (Bendib and Minet 1999) and instead have structures technically known as panniculae (Stehr 1987) with just one or two, stiff, black setae emerging from each (Figs 17–19). The larva is similar to *H. inculta*, which is also predominantly brown with black setae, while *H. cadaverosa*, reared by JDP at the same time as *H. lampyroides*, are marked with bright yellow bands (Figure 20). The larval mandible, dissected (Figure 21), shows the enlarged molar region found in other lithosiines. This feature has been suggested as a synapomorphy for the Lithosiini (Bendib and Minet 1999) and is believed to be related to their lichen diet. The larvae fed successfully on a mixed population of lichens obtained

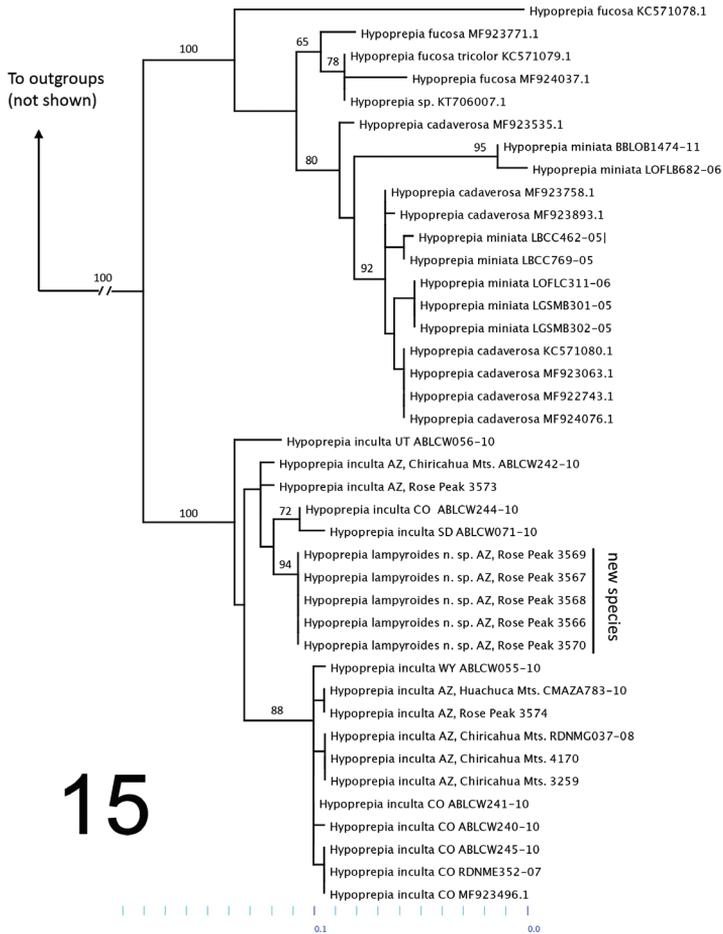


Figure 15. Maximum-likelihood tree of *Hypoprepia* species based on COI. Bootstrap values are reported on the branches subtending nodes with a support value greater than 50.

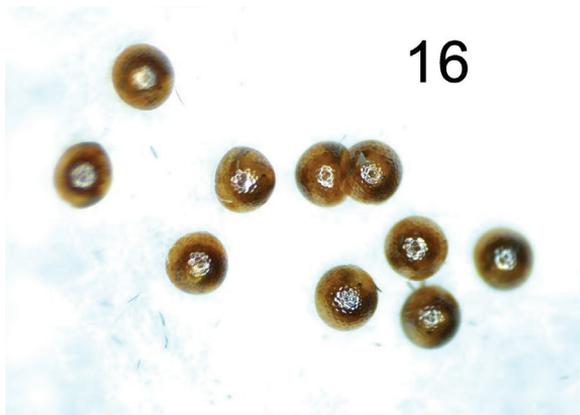


Figure 16. Eggs of *Hypoprepia lampyroides*, approximately 20 \times .



Figures 17–18. Larvae of *Hypoprepia lampyroides*. **17** Living last instar larva and **18** Penultimate instar larvae, preserved.



Figures 19–20. Last instar larvae of **19** *Hypoprepia lampyroides* and **20** *Hypoprepia cadaverosa*, preserved.

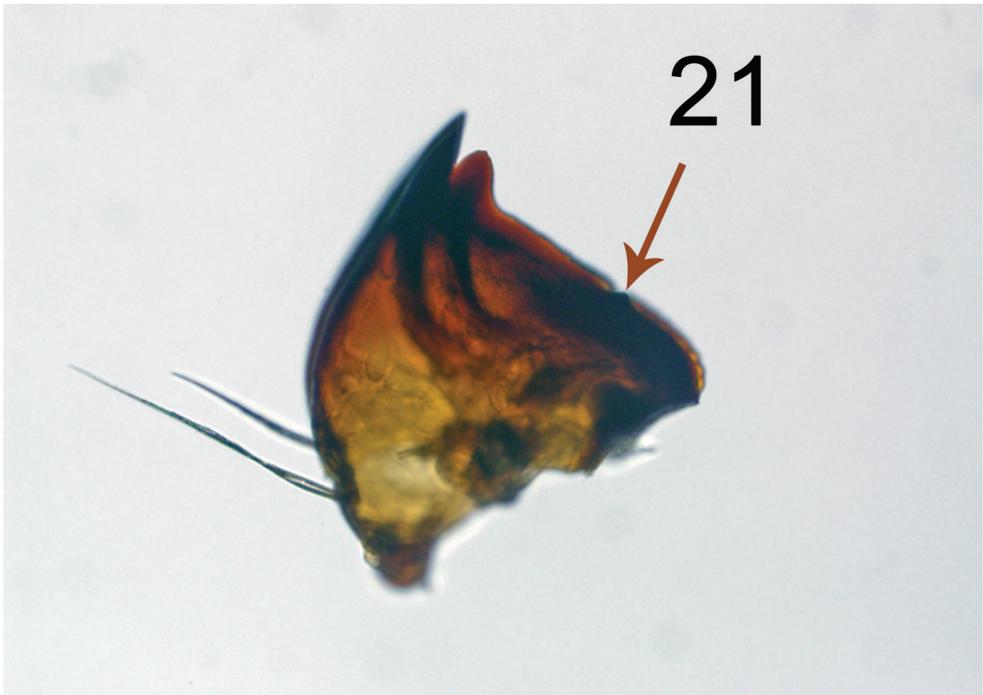
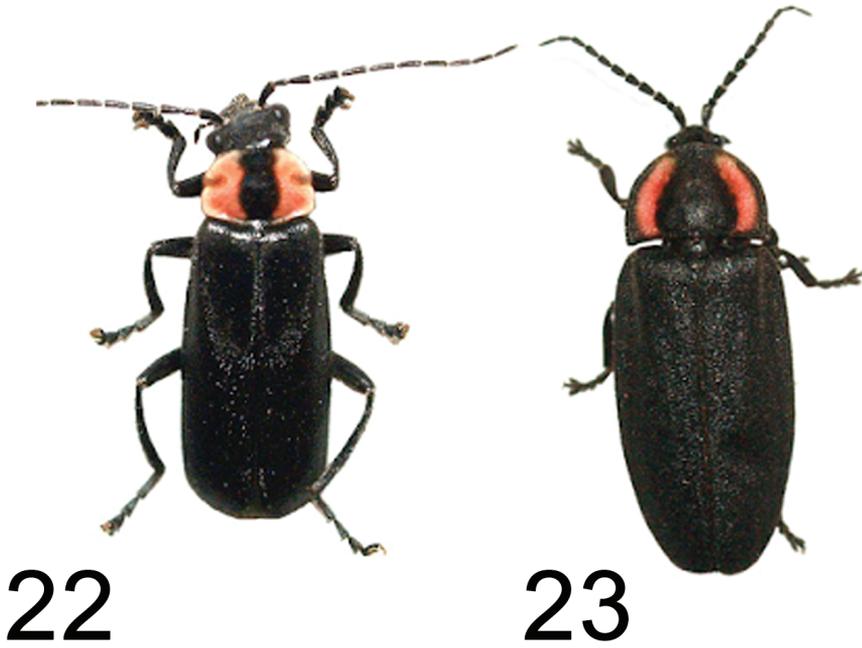


Figure 21. Mandible of last instar *Hypoprepia lampyroides*, approximately 20 \times .

by shaving bark off oak trees, and developed through six instars into a caterpillar large enough to pupate. Unfortunately, lab conditions failed to yield a successful pupation, and the larvae eventually died. It is likely that *H. lampyroides* over-winter as a fully mature larva, pupating in the spring and emerging in early summer.

The striking resemblance of this moth at rest (Figs 1–2) to a common southwest species of firefly, *Ellychnia corrusca* Linnaeus, 1767 (Coleoptera: Lampyridae) (Figure 23), points to them being part of a mimicry ring, which also includes another common



Figures 22–23. Mullerian mimicry with Coleoptera. **22** *Discodon bipunctatum* (Cantharidae) **23** *Ellychnia corrusca* (Lampyridae).



Figure 24. Range map of *Hypoprepia lamproyroides*.

montane beetle, *Discodon bipunctatum* Schaeffer, 1908 (Coleoptera: Cantharidae) (Figure 22). *Ellychnia corrusca* was common during the day in the Rose Peak area, and the bright pink markings on its pronotal region closely match the pink markings at the base of the forewing in *H. lampyroides*, likely affording the resting moths protection should a bird or other predator come upon them. Lampyrids are known to be chemically protected and distasteful to birds, but unlike most familiar nocturnal fireflies, *Ellychnia* lacks an abdominal light and is primarily diurnal. Research on sequestration of lichen polyphenolic compounds by other lithosiine arctiids (Hesbacher et al. 1995, Conner 2009, Scott et al. 2014) suggests that *H. lampyroides* itself has some chemical protection, thus the mimicry between these organisms is likely Mullerian. *H. inculta* is also likely part of this mimicry ring, although with its smaller size, dull pink markings, and grey wing color, it is a much less dramatic match to *Ellychnia* than *H. lampyroides*.

Hypoprepia lampyroides is known from over 30 specimens collected in Arizona, two specimens from Yecora, Sonora, Mexico and one from Durango, Mexico (Figure 24).

Remarks. When examining the nearest relatives of *H. lampyroides*, Ferguson found that *H. inculta* from the southwestern United States is indistinguishable from the type material of *H. muelleri* Dyar, described from the vicinity of Mexico City, *H. muelleri* tends to have darker, more grayish hindwings, although in some *H. inculta* from Arizona they are equally grayish. Such a difference by itself is hardly significant. Unfortunately, fresh collected material of *H. muelleri* was not available for molecular analysis, but Ferguson's conclusion based on his examination of the type material results in the following taxonomic change: *Hypoprepia muelleri* Dyar, = *Hypoprepia inculta* Henry Edwards, syn. n. This extends the known range of *H. inculta* from as far north as Utah to the vicinity of Mexico City. *H. muelleri* had previously been the only member of the genus found exclusively in Mexico.

Ferguson found the Durango, Mexico specimen of *H. lampyroides* among unidentified arctiids from the Canadian National Collection. The region of El Salto, Durango, where it was collected, is mesic, conifer-dominated forest similar to that around Greer, Rose Peak, and Yecora, Sonora. The Harshaw specimen, a female, was collected by Don Bowman of Golden, Colorado and sent to Ferguson for identification. The Harshaw region is rather dry mid-elevation oak woodland/mesquite grassland, very unlike where all the other specimens of this moth have been collected.

Acknowledgments

JDP is greatly indebted to Chris Schmidt for sending him Ferguson's unfinished manuscript on this moth, for extensive help with the genitalic descriptions and for many helpful suggestions to improve the paper; to Christi Jaeger for the genitalic dissections and photos; to Ray Nagle for many years of mentoring and friendship, reviewing the manuscript and for photographing the adult and larvae of *H. lampyroides*; to Charles "Chip" Hedgcock for the exquisite portraits of the new taxa and to Margarethe Brummermann for allowing the use of her combined image of *Ellychnia*

corrusca and *Discodon bipunctatum* to illustrate the similarity in color pattern between these taxa and *H. lamproides*. This work is in partial fulfillment of JDP's Doctorate of Philosophy degree in the Graduate Interdisciplinary Program in Entomology and Insect Science at the University of Arizona and is the product of the Arizona Sky Island Arthropod Project (ASAP) based in WM's laboratory. JDP would like to thank extend special thanks to WM for her guidance in writing this manuscript and for her support and mentoring in the molecular systematics of lithosiines.

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Three species in one: a revision of *Clemensia albata* Packard (Erebidae, Arctiinae, Lithosiini)

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<http://zoobank.org/19AFBDE0-57D6-4EEE-A4C8-2BCE17747989>

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Abstract

Clemensia albata Packard, previously thought to be a single, widely distributed North American species, is here shown to consist of three distinct, primarily parapatric species: *Clemensia albata* Packard, *C. umbrata* Packard, **stat. rev.**, and *Clemensia ochreatea* Schmidt & Sullivan, **sp. n.** Adults and genitalic structures of the three species are illustrated.

Keywords

algivory, cryptic species, lichen moth, lichenivory

Introduction

The genus *Clemensia* Packard encompasses about 55 described species (Seitz 1919–40; Gibeaux 1983; Gibeaux 1988), in addition to numerous undescribed Neotropical species (Sullivan and D. Janzen unpubl. data). There is no modern review of the genus, and the systematic placement of the genus tentatively remains in the tribe Cisthenini (Bendib and Minet 1999). *Clemensia albata* Packard has generally been the only species

attributed to the fauna of the United States and Canada (Franclemont 1983), although Ferguson and Opler (2006) recently recognized a second species, *C. patella*. This species was, however, wrongly attributed to the Pacific Coast fauna (Schmidt and Opler 2008) stemming from a typographical error in Ferguson's manuscript after his death (Lafontaine and Schmidt 2010). This southeastern U.S. species has subsequently been referred to *C. patella* "of authors" (Lafontaine and Schmidt 2010).

The variability of *Clemensia albata* was recognized as early as Seitz (1919), who stated that it is "sometimes of a pure, sometimes dull whitish-grey, clouded or speckled, has, according to its coloring, received five different names." Packard (1864, 1872) described eastern and western North American *Clemensia* as separate species, and although the two names were long ago synonymized, Packard's initial assessment nearly 150 years ago would prove correct. More than 40 years of collecting *Clemensia* in North Carolina by the second author revealed the presence of three phenotypes, and subsequent examination and comparison of eastern North American specimens, together with analysis of DNA barcode sequences (Zahiri et al. 2017), indicate that three separate species occur in North America. The purpose of this paper is to diagnose and illustrate these three species in an effort to clarify what is currently recognized as one variable species, *Clemensia albata* Packard.

Materials and methods

Repository abbreviations. Voucher specimens (Suppl. material 1) are deposited in the following collections:

- BIOUG** Centre for Biodiversity Genomics, University of Guelph, Guelph, Ontario
NHML Natural History Museum, London
CNC Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario
JBS J. Bolling Sullivan Collection, Beaufort, North Carolina, USA
JTT Jim T. Troubridge Collection, Hagersville, ON
MEM Mississippi Entomological Museum, Starkville, MS
NOFC Northern Forestry Centre, Canadian Forest Service, Edmonton, AB
PFC Pacific Forestry Centre, Canadian Forest Service, Victoria, BC
RBCM Royal British Columbia Museum, Victoria, BC
USNM National Museum of Natural History, Washington, District of Columbia, USA

Due to the difficulty in species identification based solely on photographs, records from citizen-science groups such as BugGuide.net and iNaturalist.org were not included here, with the exception of a few records that could be identified with reasonable confidence, and that represent significant range-gap or range-edge records (Suppl. material 1). Procedures for dissecting and preparing genitalia follow those of Lafontaine (2004). Genitalia were photographed using a Leica M205C microscope and DFC450 camera,

and processed using Leica Application Suite 4.8 and Adobe Photoshop. DNA extraction, PCR amplification, and sequencing of the COI barcode region were performed at the Canadian Centre for DNA Barcoding and followed standard protocols (Hebert et al. 2013; <http://www.ccdb.ca/resources.php>). Resulting data were managed and analyzed using BOLD (Barcode of Life Data Systems; Ratnasingham and Hebert 2007), available at <http://v4.boldsystems.org/>. Mitogenomic divergence was calculated based on Kimura 2-Parameter (K2P) distances of COI barcodes. Variation of the 'barcode' section of the COI gene was compared among 150 specimens from across North America (Suppl. material 1). Only sequence records greater than 500 bp (range 500 bp–658 bp) are included. Sequence comparisons were generated on the BOLD website with the following parameters: Distance Summary Model: Kimura 2 Parameter; Deletion Method: Pairwise Deletion; Alignment: BOLD Aligner (Amino Acid based HMM).

Results

The three *Clemensia* phenotypes that occur in North America are shown in Figs 1–12. An initial comparison based on specimens from North Carolina, where the three phenotypes co-occur, permitted a calibrated comparison across eastern North America. This revealed that “*patella* of authors” (in the sense of Lafontaine and Schmidt 2010) is found in the coastal plain from North Carolina south into Florida and west to Texas. This taxon is described herein as *C. ochreata* sp. n., the small, pale phenotype here determined to represent true *C. albata* is found throughout North Carolina from the coast up to 1400 m in the mountains. It is the most common and widespread *Clemensia* in eastern North America, occurring from southern Québec and Ontario to at least Georgia, Oklahoma and Missouri. The third phenotype is restricted to higher elevations in the southern Appalachians, and occurs from 940 m and above throughout the mountains of North Carolina. It replaces *C. albata* to the north, and is found across the boreal forest region from Nova Scotia to the Pacific Northwest. This boreo-Appalachian taxon is *C. umbrata*. *Clemensia umbrata* and *C. albata* overlap in distribution throughout much of the Northeast, but are usually distinguishable based on phenotype, size, and flight period as detailed below in the Diagnosis sections.

Examples of all three phenotypes resolved into three distinct DNA barcode sequence clusters, or BINs (Barcode Index Numbers; see Ratnasingham and Hebert 2013), each containing samples from differing but partially overlapping regions of North America (Figs 19–21, 23). Divergence between *C. umbrata* and *C. albata* ranges from 1.71–2.89 %, with maximum divergence within *C. umbrata* at 0.90 %. Divergence between *C. ochreata* and *C. albata* ranges from 2.18–3.79 %, compared to a maximum of 0.92 % within *C. ochreata* (Figure 23). Barcode sequence clusters for broadly overlapping *C. umbrata* and *C. albata* in Ontario and Québec corroborated the phenology differences between the two taxa, with univoltine *C. umbrata* primarily in July, and bivoltine *C. albata* mostly in June and late August.

***Clemensia umbrata* Packard, stat. rev.**

Figs 1–4, 13, 16

Clemensia umbrata Packard, 1872: 85.

Type locality. Congress Springs, Santa Clara Co, California [lost] male holotype.

Note. The type locality was given as “California” in the original description, and Edwards (1874) later writes that the only type was destroyed in the mail when Packard returned it, and clarifies the source of the type material as “Congress Springs, Santa Clara County.”

Clemensia irrorata H. Edwards, 1874, p.185

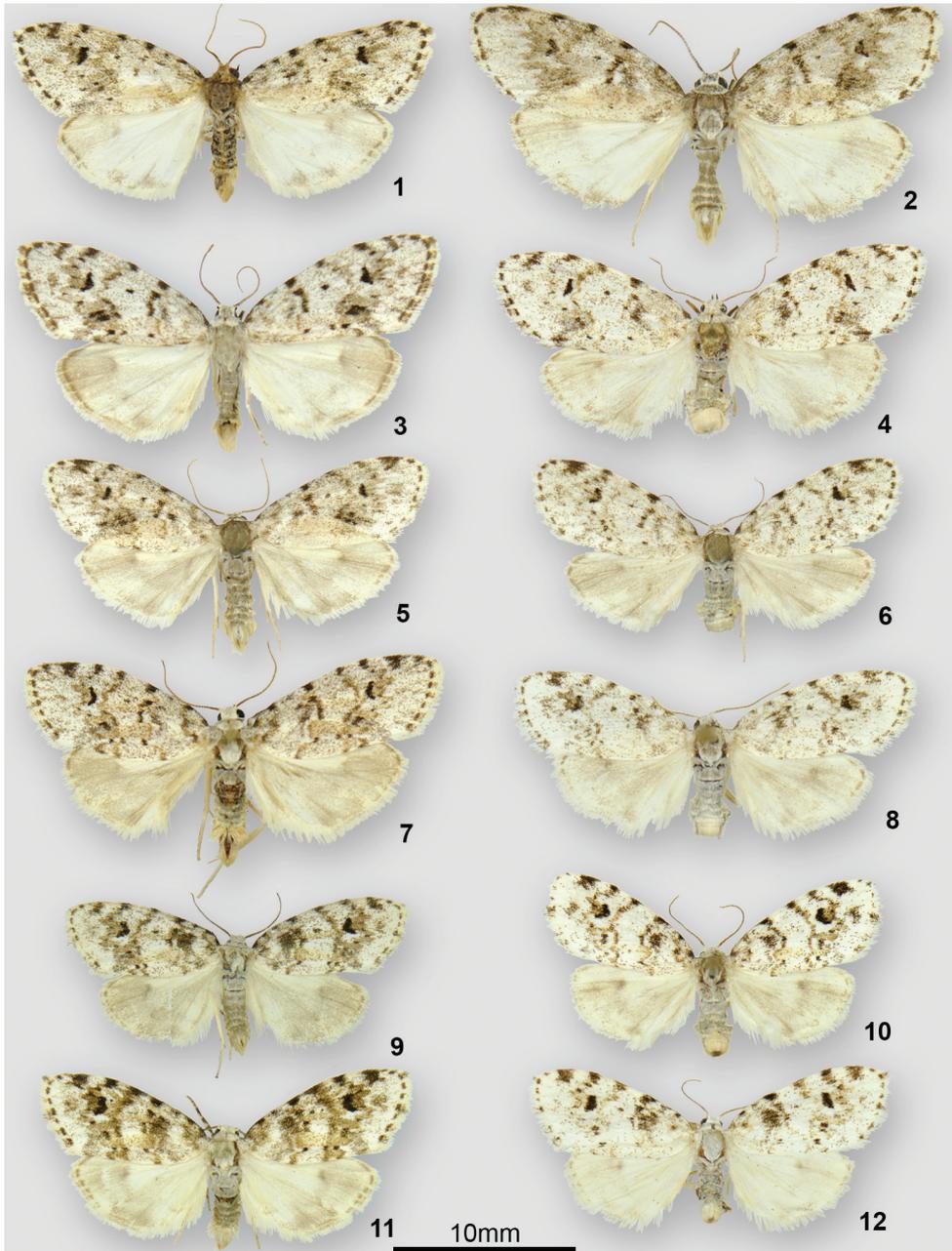
Type locality. “Victoria, V.I. [Vancouver Island, British Columbia]”

Diagnosis. *Clemensia umbrata* is most similar to *C. albata*; flight time and locality aid in separating the two. Both species occur together only from southern Québec and eastern Ontario southward; *C. umbrata* is the only *Clemensia* species across the boreal forest region and the Pacific Northwest (Figure 19). Where the range overlaps that of *C. albata*, the phenology differs in that *C. umbrata* is univoltine with adults in July and early August (as early as June in the southern Appalachians) (Figure 22), whereas *C. albata* is bivoltine in the Northeast and possibly multivoltine farther south. In northeastern North America the flight peaks of *C. albata* are in mid-June and late August largely outside that of *C. umbrata* (Figure 22), but the flight periods of the two overlap in late July and possibly early August. In the eastern US *C. umbrata* becomes increasingly restricted to higher elevations southward, whereas *C. albata* is more widespread. For example, in North Carolina *C. umbrata* is usually found above 3100' whereas *C. albata* occurs below 4600'. Similar habitat/ecozone segregation likely occurs elsewhere, but further study is needed.

Externally, *C. umbrata* differs from *C. albata* in its larger size in regions of sympatry (northern boreal *C. umbrata* are smaller and not noticeably significantly larger than *C. albata*), with male forewing length of 12.3 mm (n = 9) versus 10.8 mm (n = 6) in *C. albata*. Wing pattern differences are difficult to discern, especially flight-worn individuals, but *C. umbrata* has a more contrasting forewing pattern that is more suffused with grey and black, and often with a diffuse dark grey postmedial patch near the anal margin; this patch is absent or much more restricted in *C. albata*.

Internally, the male genitalic structure of *C. umbrata* and *C. albata* differs in the shape of the basal ventral diverticulum of the vesica, which is bilobed in *C. umbrata* versus heart shaped in *C. albata* (Figs 13, 14). The female corpus bursae of *C. umbrata* (Figure 16) is less elongate with longer internal spinules and a more broadly joined appendix bursae compared to *C. albata* and *C. ochreata*.

Biology. Dyar (1904) describes the egg and first two instars based on samples from southeastern British Columbia, stating that larvae overwinter (as second instar?). The egg is unusually large with a diameter of 0.8 mm. The eggs are covered with setae from the female abdominal tip. McCabe (1981) described the larval biology, but it is unclear if his account is referable to *C. albata* or *C. umbrata*. Larvae probably graze algae growing on tree



Figures 1–12. *Clemensia* adults. **1–4** *C. albata*, **1** ♂, Manitoulin Island, Ontario, Canada **2** ♂, Grandfather Mountain, 4850', Avery Co., North Carolina, USA **3** ♂, Langley, British Columbia, Canada **4** ♀, Tweed, Ontario, Canada **5–8** *C. umbrata*, **5** ♂, Backus Woods, Ontario, Canada **6** ♀, Backus Woods, Ontario, Canada **7** ♂, Starkville, Oktibbeha Co., Mississippi, USA **8** ♀, Barksdale A.F.B., Bossier Parish, LA, USA; **9–12** *C. ochreatea*, **9** ♂, Gainesville, Paynes Prarie State Park, Alachua Co., Florida, USA **10** ♀ holotype, Anthony, Marion Co., Florida, USA **11** ♂, Middleton Creek, Franklin Co., Mississippi, USA **12** ♀, Sweetbay Bogs, Stone Co., Mississippi, USA.

bark and possibly other substrates according to McCabe (1981), but both Dyar (1904) and Miller and Hammond (2000) state that larvae feed on lichens; a larva likely referable to *C. umbrata* was found on white birch cut for firewood in Renfrew Co, Ontario in late June (J. Dombroskie, pers. comm.). Miller and Hammond (2000) report this species as feeding in lichens on trees and large shrubs in the Pacific Northwest, especially on gary oak. *Clemensia umbrata* was collected 74 times during the Canadian Forest Insect Survey, always from conifers, and mostly from white spruce (49/74 collections; McGugan 1958). This may however indicate larvae feeding on algae-encrusted conifer twigs, whereas algal growth is usually limited to thicker branches and trunks of birch, where larvae are less likely to be collected by conventional sampling methods. *Clemensia umbrata* is univoltine throughout its range, with peak adult abundance in late July in northeastern North America (Figure 22), but appearing as early as June in the southern Appalachians. In the boreal region the larva is present from mid-May to mid-July (presumably having overwintered as a second or third instar), and with most collections from mid-June (McGugan 1958).

Distribution. *Clemensia umbrata* occurs from Nova Scotia across the boreal region to the Pacific coast, southward into central California and northern Idaho (Figure 19; Pacific Northwest Moths website). The northernmost records are for north-coastal British Columbia (Figure 19), southernmost Northwest Territories (southwest of Hay River; McGugan 1958), and Havre-St.-Pierre, Québec (Handfield 2011). *Clemensia umbrata* is absent from the entire central and southern Rocky Mountain region of the USA. The extent of distribution in the eastern US is still poorly defined; minimally, *C. umbrata* occurs in the northern Great Lakes region, Vermont, and the southern Appalachians (Tennessee and North Carolina), but it is likely more widespread in the Appalachians.

Remarks. As defined here, *C. umbrata* represents the taxon that occurs across most of Canada and western USA that was previously called *C. albata*. In most of its range (except eastern North America), it is the only *Clemensia* species. Although no California specimens of *C. umbrata* were available for DNA analysis, examined California material was not distinguishable morphologically from that of the Pacific Northwest, with the latter genetically very similar to the transboreal/Appalachian taxon. The distribution of *C. umbrata* is continuous along the Pacific coast from southern British Columbia to central California (Figure 19; see also Pacific Northwest Moths website), and we accordingly treat all as a single species under the name *umbrata*.

***Clemensia albata* Packard**

Figs 5–8, 14, 17

Clemensia albata Packard, 1864, p. 101

Type locality. “Norway, Me. (Mus. Comp. Zool., Smith), Brunswick, Me., August.” [unknown]

Note. The holotype of *albata* should be with other Packard types at MCZ, but the online inventory of MCZ types (mczbase.mcz.harvard.edu) indicates it is not, and as such it may no longer be extant.

Uxia albida Walker, 1866, p. 1897

Type locality. "North America;" female type [NHML]

Note. The holotype is a female, mistakenly believed to be a male by Walker, and therefore described as a new species in a separate genus as *Repa cana*. The holotype is a small, poorly-marked specimen typical of female *C. albata*. The type locality is unspecified but is likely the northeastern US.

Repa cana Walker, 1866, p. 1898

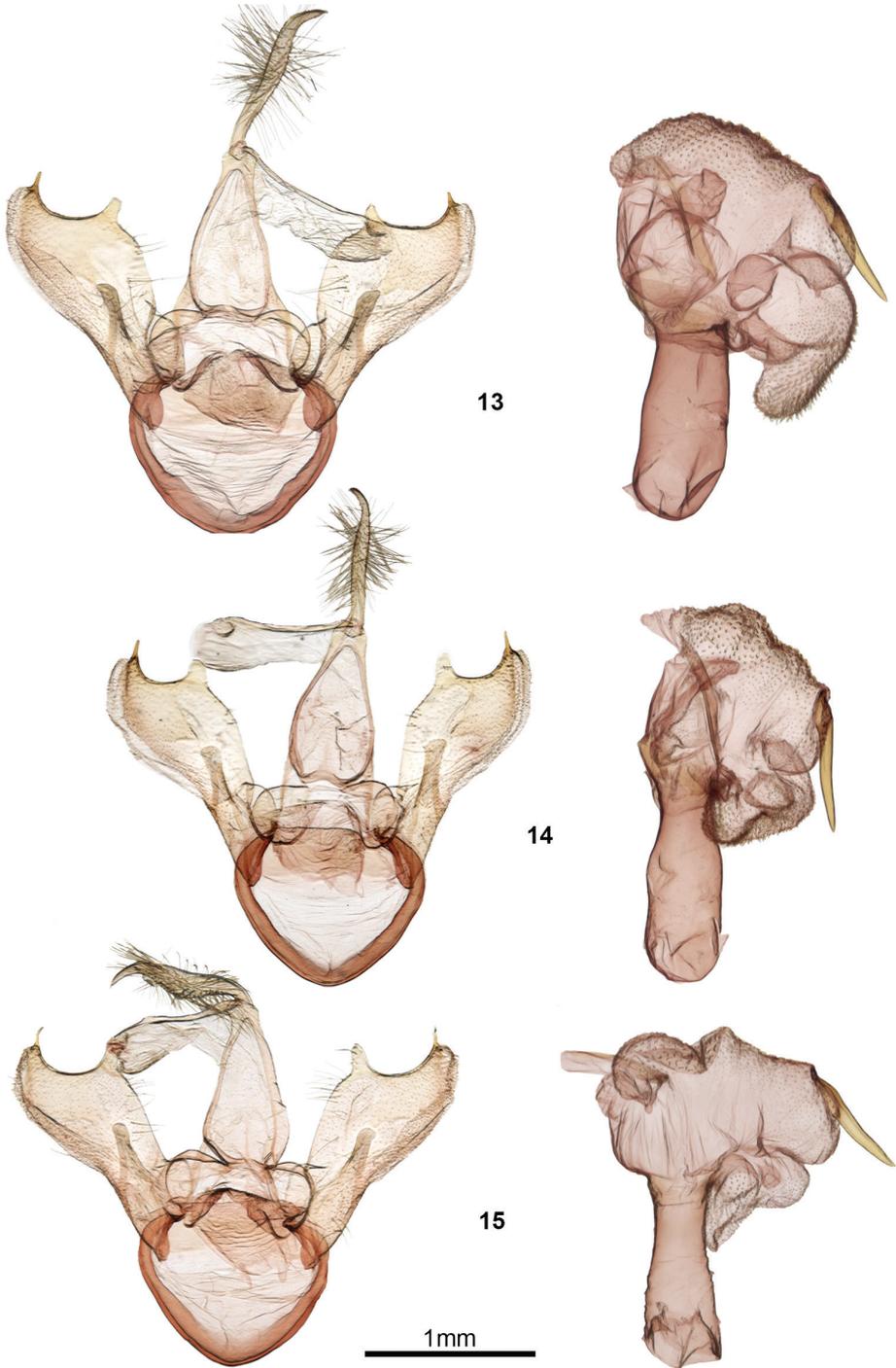
Type locality. "United States;" male type [BMNH]

Note. The holotype is a male without an abdomen.

Diagnosis. *Clemensia albata* is the most common *Clemensia* in most of eastern North America south of the boreal forest region. In the northeastern US and the Appalachians, *C. albata* can be confused with *C. umbrata*, and a differential diagnosis is presented in the *C. umbrata* account. Along the Atlantic coastal plain from North Carolina to Florida and across the southern states to at least Mississippi, *C. albata* can occur with *C. ochreatea*, and the two can be difficult to separate. *Clemensia albata* usually differs from *C. ochreatea* in its pure white rather than ochre-white ground colour, less pronounced dark spots along the forewing costa, a less distinct antemedial dark patch, lack of a well-defined ventral hindwing medial band, and narrower uncus (Figure 14). *Clemensia albata* is slightly larger than *C. ochreatea*, but there is overlap, with an average forewing length of 10.77 mm for *C. albata* (n = 6) versus 9.83 mm for *C. ochreatea* (n = 9) (first brood, barcoded specimens only). Habitat, phenology, and larvae may also differ, but further research on the comparative biology of *C. albata* and *C. ochreatea* is needed. Internally, the male genitalic structure of *C. albata* differs from that of *C. ochreatea* in the shape of the basal ventral diverticulum of the vesica, which is heart shaped in *C. albata* versus bilobed in *C. ochreatea*. The field of spicules on the basal lobe is smaller, and the cornutus relatively shorter in *C. albata*.

Biology. The larvae feed on blue-green algae and lichens growing on tree trunks (Wagner 2005) along with a number of other Lithosiini and small noctuids (Wagner et al. 2011). Color morphs or pattern variability of larvae has not been recorded. The life history data and larva illustrations presented by Wagner (2005) and McCabe (1981) probably apply to this species, but these need to be re-evaluated in light of the current taxonomic results. *Clemensia albata* is bivoltine in the northeast with peak abundance in mid-June and late August (Figure 22), and probably multivoltine in the southern US. In North Carolina it is widely distributed from the coast up to 4600' in the mountains, and occurs from March until September.

Distribution. Examined specimens identified with certainty as *C. albata* are mapped in Figure 20, and this species occurs at least from eastern Ontario and southernmost Québec through New England southward to Georgia, Mississippi and Oklahoma. The northwestern range limit is uncertain but is likely in the western Great Lakes region. Specimen photographs from south-central Minnesota (Wright Co.) in mid-June (butterfliesandmoths.org, record # 978800) and central Wisconsin in early August (butterfliesandmoths.org, record # 1097249) are consistent with *C. albata*, but voucher specimens should be examined.



Figures 13–15. *Clemensia* male genitalia. **13** *C. umbrata* **13a** ON, Carp Ridge, CNC gen. prep. #16762 **13b** ON, Manitoulin Is., CNC gen. prep. #16763 **14** *C. albata* ON, Backus Woods, CNC gen. prep. #16759 **15** *C. ochreata* S.C., The Wedge Plantation, CNC gen. prep. #14769.

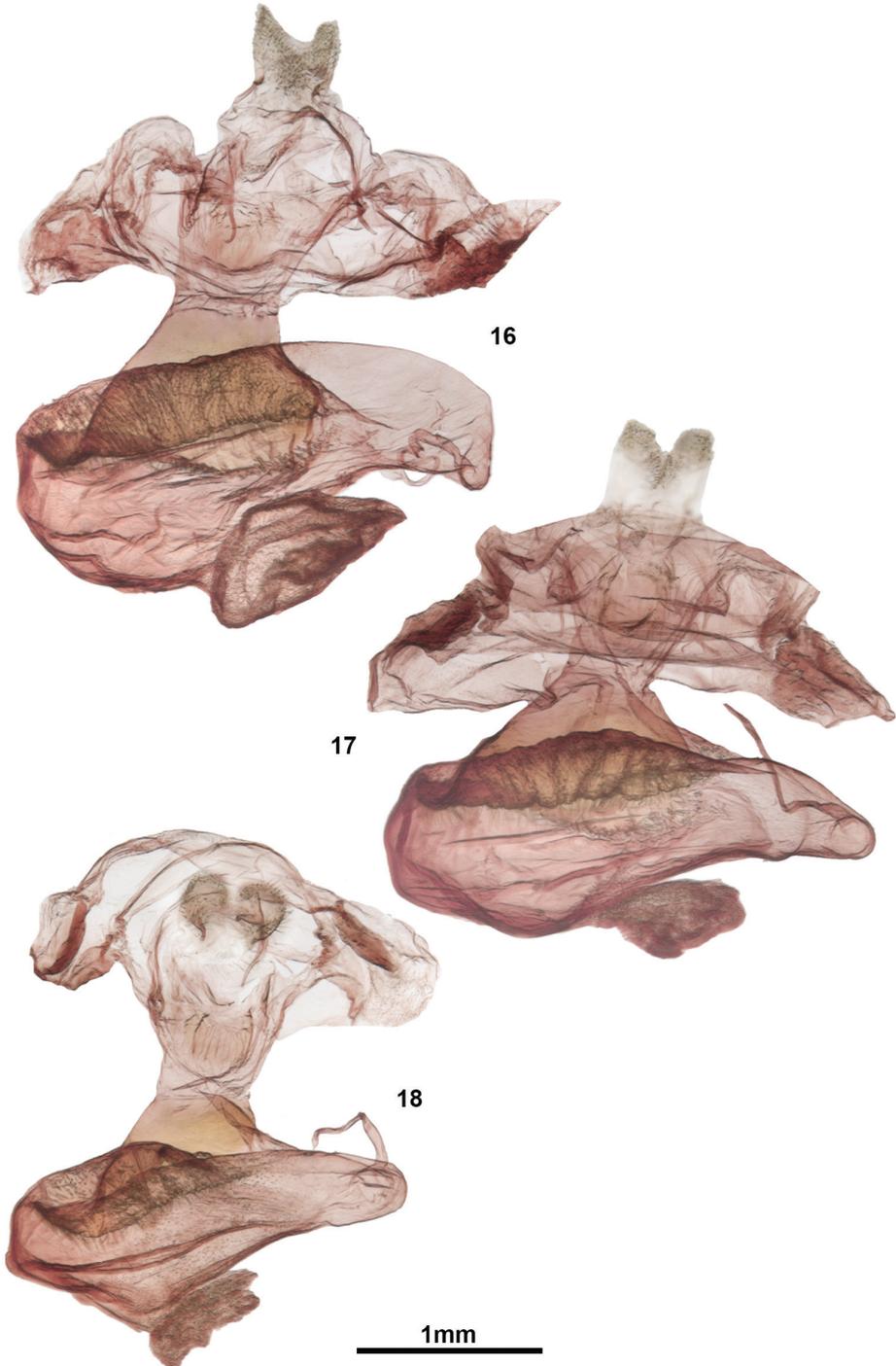
Remarks. There is some uncertainty in the identity of the holotype of *Clemensia albata*, given the type locality and the similarity to *C. umbrata*, but two facts help in ascertaining what taxon the name *albata* applies to: the types were collected in August in southern Maine, pointing to second-brood specimens of the bivoltine eastern species (versus univoltine *C. umbrata* flying mostly in July), and the wing expanse given as 0.83 inch, or 21.1 mm, which is smaller than most eastern *C. umbrata*. Examined specimens from regions adjacent to the *C. albata* type locality in southern Maine (Figure 20) have also so far proven to be the smaller, bivoltine species.

***Clemensia ochreata* sp. n.**

<http://zoobank.org/28C3DAC5-7EDB-4B45-AEDD-28AC3572D68D>

Figs 9–12, 15, 18

Type material. Holotype ♀ (Figure 1). Florida: Marion Co., W. Anthony Rd., 1.4 mi. WSW Anthony, 29°17'N 82°08'W, 13.Jan.2007, T.S. Dickel, DNA voucher # CNC-Noctuoidea13909 [CNC]. **Paratypes** 49♂ 28♀ **Alabama:** Monroe Co., Haines Island Park, 4.Apr.1995, J. A. MacGown, 1♂; **Florida:** same data as holotype, 4.Jan.2007, 1♀, 15.Mar.2006, 1♂; [Pinellas Co.], Dunedin, 22.Mar.1999, J.G. Filiatrault, CNC genitalia slide # 14774, 1♀; [Alachua Co.], Gainesville, 13.Mar.2013, C. Belanger, 2♂; Levy Co., Goethe State Forest, Cow Creek Rd., 10.Feb.2012, T.S. Dickel, 1♀; DeSoto Co., Nocatee, 27°10.07'N 81°54.63'W, 23.Feb.2014, J. Troubridge, 1♂; same locality and collector as previous, 11.Mar.2011, 9♂ 1♀; 20.Mar.2012, 1♂; 1.Apr.2012, 1♂; 3Apr.2011, 2♂; 3.Apr.2013, 6♂; 2.Apr.2010, 2♂ 1♀; 23.Apr.2011, 1♂; 14.Apr.2010, 1♀; 23.Feb.2012, 2♂; 30.Nov.2010, 1♂; 18.Jan.2012, 2♂. Monroe Co., Dagny Johnson State Park, 25.165°N 80.362°W, 22.Mar.2012, J. Troubridge, 1♀. Dixie Co., Hwy 361, 29.564°N 83.380°W, 5.Apr.2016, J. Troubridge, 1♀. Okeechobee Co., Kissimmee Prairie State Park, 27.584°N 81.044°W, 27.Mar.2013, 1♀, 5.Feb.2014, 3♂. Collier Co., Fakahatchee Strand State Park, 25.98°N 81.41°W, 4.Feb.2014, J. Troubridge, 3♀; 21.Dec.2011, 1♀; 23.Mar.2015, 1♂; 21.Feb. 2014, 2♀; 15.Jan.2012, 1♂. Sarasota Co., North Port, 27°02.5'N 82°05.0'W, 29.Nov.2012, J. Troubridge, 1♀; 2.Feb.2011, 1♂; 27.Nov.2011, 1♂; 8.Jan.2012, 1♂; 28.Mar.2012, 1♀; 24.Nov. 2014, 1♂. **Georgia:** Long Co., 3 mi. SW Ludowici, Griffin Ridge, 6.Mar.2008, C. Schmidt & J. Adams, 1♀. **Mississippi:** Stone Co., Sweetbay Bogs, T2S R13W Sec 34SW, 12.Mar.1991, D.M. Pollock, 1♀; Franklin Co., Middleton Creek, T5N R3E Sec.21E, 7.Apr.1992, J. MacGown, T. Schiefer, 1♂; Hancock Co., Stennis Space Center, 21.Mar.1994, R. Kergosien, 1♂; Harrison Co., Long Beach, 20.Mar.1995, R. Kergosien, 1♂; same data as previous, 17.Mar.1996, 1♂; Wilkinson Co., Clark Creek Nat. Area, 10.Mar.1989, T. Schiefer & J. MacGown, 1♂; Claiborne Co., 3.6 mi W Port Gibson, 12.Jul.1993, D. M. Pollock, 1♀; **South Carolina:** [Charleston Co.], The Wedge Plantation, McClellanville, 7.Jun.1977, E.G. & I. Munroe, CNC genitalia slide #14768, 1♂. **North Carolina:** Jones Co. Croatan Natl. Forest, Haywood Landing, 4.May.2008, J. Bolling Sullivan, DNA voucher # 09-NCCC-155, 1♂; Columbus



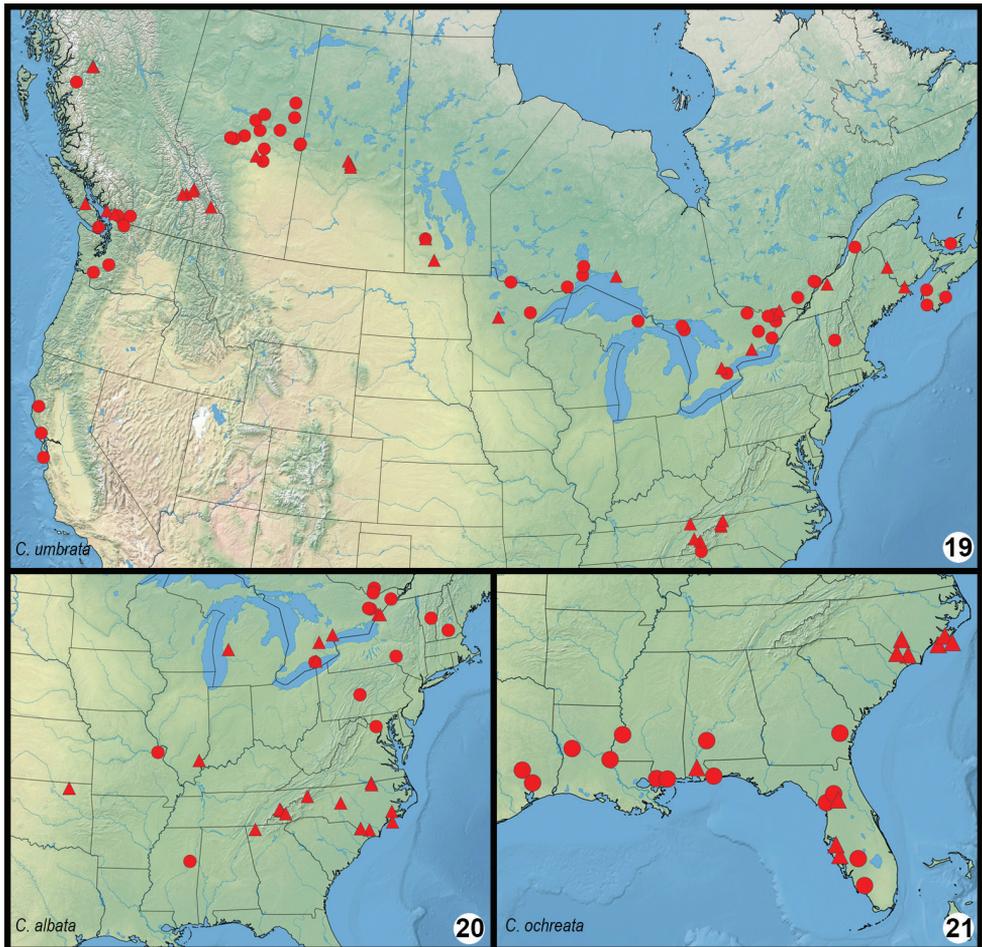
Figures 16–18. *Clemensia* female genitalia. **16** *C. umbrata* MB, Spruce Woods, CNC gen. prep. #14772 **17** *C. albata* ON, Backus Woods, CNC gen. prep. #14773 **18** *C. ochreata* FLA, Dunedin, CNC gen. prep. #14774.

Co., Lake Waccamaw St. Pk., April 16, 2010, J. Bolling Sullivan, DNA voucher # 10-NCCC-281, 1♂. [CNC, MEM, JBS, JTT]

Etymology. The name *ochreata* is a noun in opposition and refers to this species' characteristic ochre forewing tint.

Diagnosis. Very similar to *Clemensia albata*, but differing from that species by the smaller mean forewing length, more extensive, and brighter ochreous scales along the forewing antemedial and postmedial lines; overall more contrasting pattern, especially the heavier costal dark spots (most pronounced on the forewing underside), and the more prominent and better-defined medial dark patch basad of the antemedial line. Internally, the basal diverticulum of the male vesica has much smaller spicules than in *C. albata*. The valve shape is proportionally shorter and stouter than that of *C. albata*. In females, the corpus bursae is more elongate than that of *C. albata* and with shorter spinules lining the interior; the appendix bursae is also smaller and more narrowly joined to the corpus bursae in *C. ochreata*. Compared to *C. albata*, overall shape and structure of the bursa copulatrix is very similar, but the spinules lining the inside of the bursae are smaller in *C. ochreata*.

Description. Head: frons and vertex with mix of dirty-white and dull grey-brown scales; palpi grey brown, terminal (3rd) segment $0.5 \times$ length of second segment; male antenna filiform and finely ciliate, segments approximately width $0.9 \times$ that of length; dorsally with grey-brown scales, finely ciliate ventrally, with two mediolateral setae, these equal in length to antennal segment; female antenna similar to that of male but narrower and less ciliate. **Thorax:** vestiture predominantly dirty white with scattered dull grey-brown scales; pro- and mesothoracic legs appearing striped, grey brown with a ring of dirty white scales at apices of segments, in addition to a mid-tibial pale ring; metathoracic leg entirely dirty white; metepisternal tymbal unscaled, with 9–11 fine grooves. **Abdomen:** vestiture light grey brown dorsally and ventrally; females with apical tuft of incurved setae; males with a series of paired setal tufts ventrally on segments 7, 8 and 9, in addition to two paired lobe-like setal tufts situated within a pouch between segments 7 and 8. **Forewing:** ground color slightly ochre, dirty white; basal line indistinct greyish ochre; antemedial line double, often only with distal line defined; grey ochre; medial line grey ochre; postmedial line an irregular row of disconnected grey-black splotches; terminal line grey black, thin or incomplete, interrupted with white at vein termini; fringe dirty white, often interrupted with grey patch at apex and medial area; reniform spot usually very pronounced, grey black; orbicular spot small and grey black, often absent or tiny; ventrally with large dusky-grey patch medially, pattern inconspicuous, wing edges dull tan white, interrupted at costa by four costal grey-black markings; males with a brown setal (androconial?) tuft in medio-anal area; wing pattern of females similar, but usually with the dark markings reduced considerably, giving the impression of a paler moth. **Hindwing:** dirty white with faint, indistinctly delineated fuscous area in distal third; ventrally with slightly darker fuscous patch in anal angle and discal spot, and faint medial line. **Male genitalia** (Figure 15): Uncus attenuating towards base and to apex, with pronounced ventromedial bulge; apex acute, curved ventrad; long, thin setae in medial area, radiating outward; valval



Figures 19–21. Distribution of examined material for *Clemensia* species (circles), including DNA barcode vouchers (triangles). **19** *C. umbrata* **20** *C. albata* **21** *C. ochreata*.

lobe consisting of an enlarged, flattened costa terminating in a small dorsally projecting apical spine, and a pronounced flange-like medial process, forming an evenly curved concave dorsal margin on the apical half of the valve; valvule consisting of an indistinct, somewhat membranous lobe on the ventrodistal portion of the valve; sacculus with a flattened slightly spatulate dorsally projecting process; juxta poorly defined and not well sclerotized, shield shaped; phallus approximately 4 × longer than wide narrowing slightly subapically; vesica roughly kidney shaped with several lobe-like or globose diverticula; large cornutus situated medio-laterally on left side of vesica main chamber, approximately 2/3 length of phallus, vesica and diverticula finely spiculose. *Female genitalia* (Figure 18): papillae anales poorly sclerotized, relatively small, and slightly cupped; sparsely setose laterally and along caudal margin, dorsally with very fine, dense cilia-like setae caudal to opening of dorsal pheromone gland; anterior and

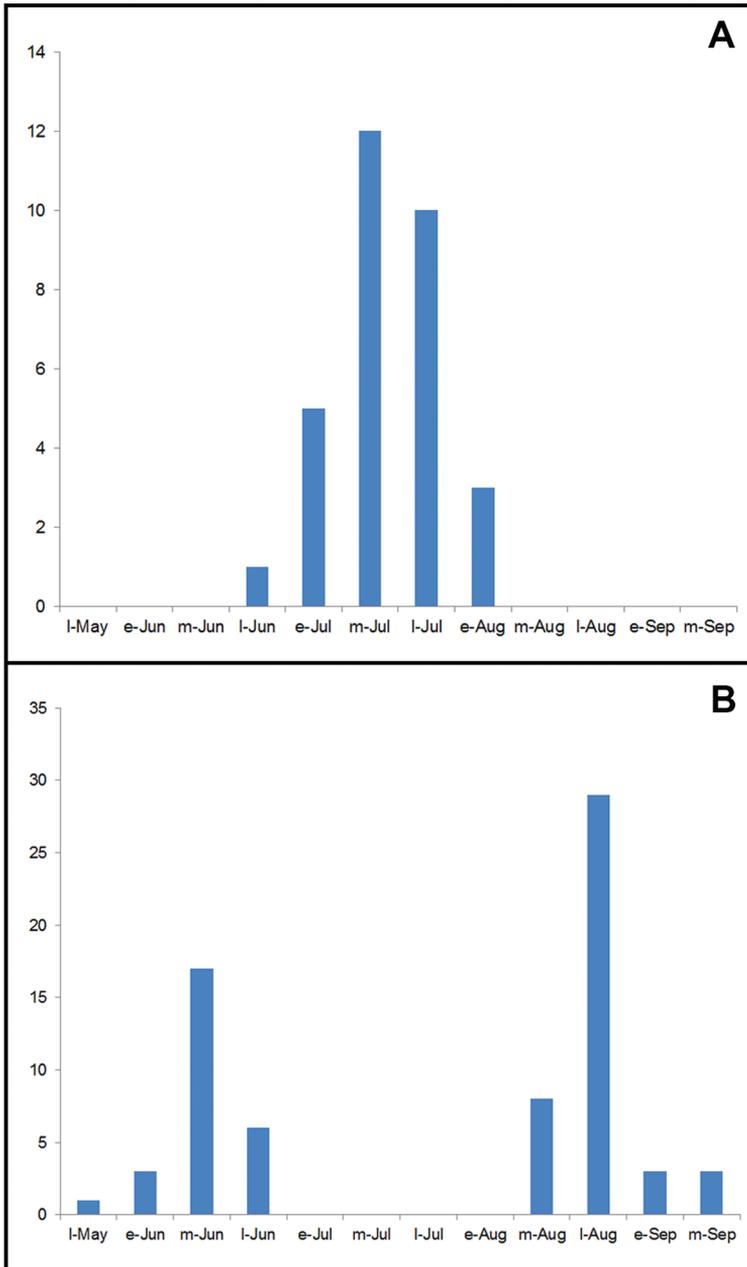


Figure 22. Comparative adult flight times of *Clemensia umbrata* and *C. albata* in northeastern North America, based on collection dates by 10-day monthly intervals.

posterior apophysis short, approximately equal in length to that of papillae; ductus bursae short and broad, about as long as wide and dorsoventrally flattened; ductus and corpus bursae joined by a smoothly sclerotized, broadly flat-conical chamber (cervix

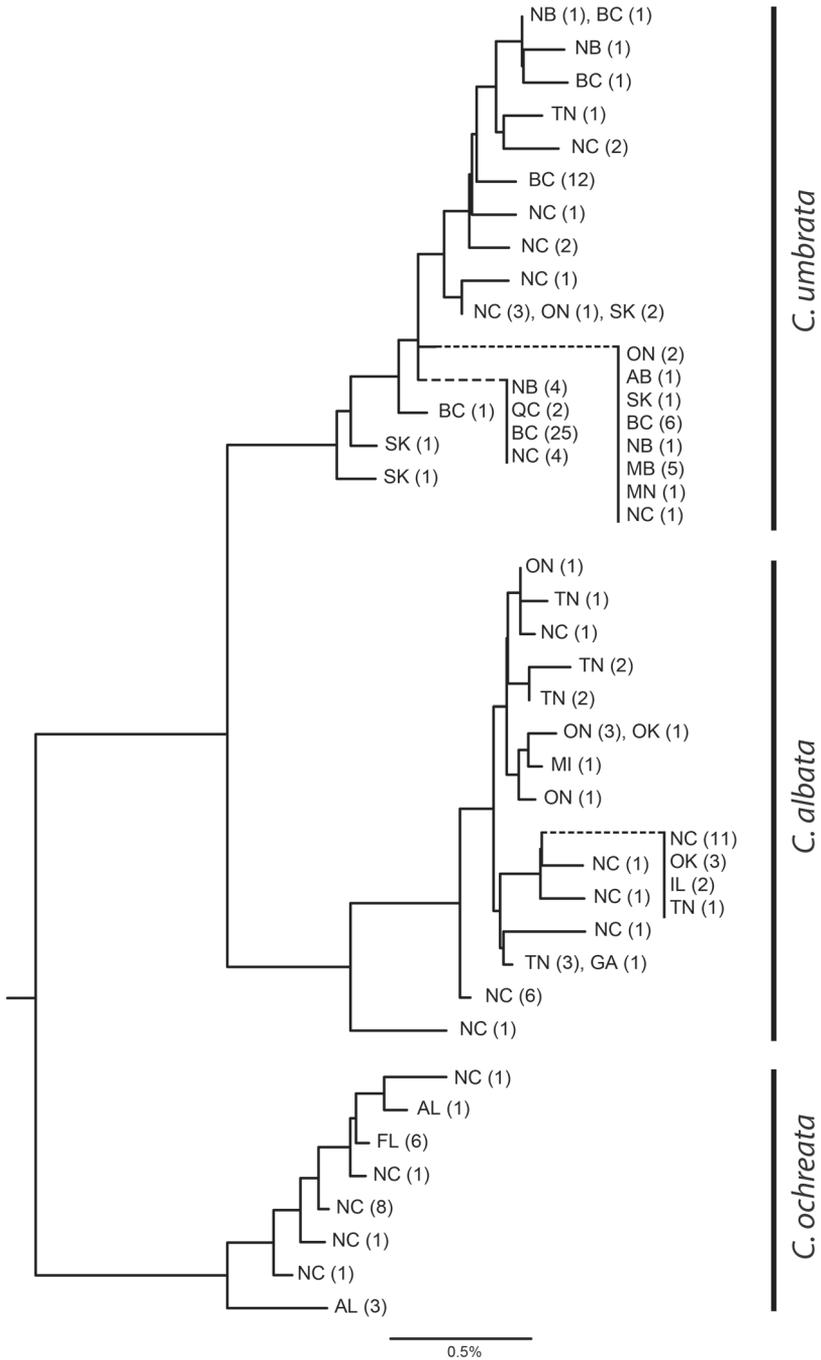


Figure 23. Neighbour-joining tree of representative mtDNA barcode haplotypes in North American *Clemensia* species. Sample size and locality are given in brackets, with number of specimens indicated after two-letter state/province abbreviation. *Laciniipolia sareta* variation is divided into five haplogroups, A–E. Voucher specimen data is given in Suppl. material 1.

bursae); corpus bursae pear shaped but oriented laterally, i.e. narrowing into ductus seminalis to right; appendix bursae a globose bubble-like chamber situated proximally at base of corpus bursae; interior of appendix bursae and corpus bursae with dense field of spinules, in latter situated distally near juncture with cervix bursae; pleurite of A7 with shallow pockets, appearing somewhat rugose and more heavily sclerotized than surrounding integument.

Biology. The immature stages and larval hosts are unknown, but larvae likely feed on algae or lichens growing on tree bark. There are multiple broods starting in March and continuing into September.

Distribution. The Atlantic coastal plain from North Carolina southward into Florida and westward to eastern Texas (Figure 21).

Remarks. The late Douglas Ferguson deemed *C. ochreatea* to be closely related to the Mexican *C. patella* (Druce), and the latter name was therefore applied by him to this taxon (Lafontaine and Schmidt 2010). Examination of Mexican specimens of *C. patella* does indeed show that *patella* belongs to the *albata*-group, but the genitalic structure of *C. patella* is more divergent from the remaining members of this North American group.

Conclusions

Although *Clemensia albata* has been treated as a single species, the concordant variation in phenotype, morphology, phenology distribution, and DNA barcode clearly supports a concept of three species. Further research is needed on *Clemensia* life histories, given the current taxonomic changes. Specifically, it is not known if the differences in voltinism and phenology correspond to differing winter diapause strategies, different food plant requirements or how the larvae differ morphologically. The distributional limits of the genus also requires refining, such as the northwestern range limits of *C. albata* and the full extent of the distribution of *C. umbrata* in the eastern US.

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Richard Brown, Martin Honey, Greg Pohl, Danny Shpeley, and Thomas Simonsen kindly provided access to specimens in their care. James Adams, Jason Dombroskie, and Val Deziel provided specimens and/or additional data. Jocelyn Gill and Christi Jaeger provided technical support.

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Supplementary material I

Table S1. DNA barcode voucher specimen data.

Authors: B. Christian Schmidt, J. Bolling Sullivan

Explanation note: Abbreviations for specimen depositories are as given in the Methods and Materials section.

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Two new species of the Neotropical *Lophocampa hyalinipuncta* (Rothschild) group (Lepidoptera, Erebidae, Arctiinae)

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Abstract

Two new species of *Lophocampa* Harris are described and illustrated, *Lophocampa azuayensis* **sp. n.**, and *Lophocampa carpishensis* **sp. n.** Both new species were confused with *Lophocampa hyalinipuncta* (Rothschild, 1909), and a comparative diagnosis is provided.

Résumé

Deux nouvelles espèces de *Lophocampa* Harris sont décrites et illustrées, *Lophocampa azuayensis* **sp. n.**, et *Lophocampa carpishensis* **sp. n.** Une comparaison avec *Lophocampa hyalinipuncta* (Rothschild, 1909), l'espèce avec laquelle ces taxa étaient confondus, est proposée.

Keywords

Arctiinae, Bolivia, Ecuador, Erebidae, Lepidoptera, *Lophocampa*, new species, Peru

Introduction

The genus *Lophocampa* Harris, 1841 is one of the most speciose in the Neotropical tiger-moths, with 80 species and eight subspecies (Vincent and Laguerre 2014), with a relatively homogeneous habitus: general colour brown to yellow with paler bands of punctuation and generally poor contrast on the forewings, making their identification difficult.

During the consultation of Neotropical Arctiini specimens in the Thomas Witt collection, housed at the ZSM, the author studied a series of *Lophocampa* Harris (Erebidae: Arctiinae) from Ecuador, similar to *Lophocampa hyalinipuncta* (Rothschild, 1909) described from Agualani, Puno, Peru. A comparison of the genitalic structure and the mtDNA barcode sequence demonstrates that the Ecuadorian series contains a new species different from the taxon described by Rothschild. In addition, the comparison of these two species with specimens collected at different localities in northern Peru resulted in the detection of another new species. The aim of this work is to describe the two new species by comparison with *Lophocampa hyalinipuncta* (Rothschild, 1909).

This group of species, with forewings brown and bands formed by large white spots, is very characteristic. It cannot be confused with other species of the Andean cordillera, except for the species of the group *Lophocampa atriceps*, whose white spots are much smaller. A discrimination of *Lophocampa hyalinipuncta* (also valid for the species described in this article) with the group *Lophocampa atriceps* is published in Vincent and Laguerre (2013).

Methods and materials

Morphological study

Abdomens were softened in warm 20% KOH for 15 minutes. Scales were removed with a brush. Abdominal sclerites and genitalia were stained with Chlorazol Black E dissolved in distilled water, then dehydrated, positioned and mounted on permanent slides in Euparal. Photographs from slides mounts were made using a Jenoptik ProgRes C10 camera attached to a Leica MZ 16 stereomicroscope. Dissections were photographed with a Nikon CoolPix 4500 Camera attached to a Nikon SMZ-10A stereomicroscope.

Repository abbreviations are as follows:

NHML	Natural History Museum (formerly, British Museum of Natural History), London, England
MNHN	Muséum national d'Histoire naturelle, Laboratoire d'Entomologie, Paris, France
MUSM	Museo de Historia Natural, Universidad Nacional de San Marco, Lima, Perú
PUCE	Pontificia Universidad Católica del Ecuador, Quito, Ecuador
BVC	Personal collection of Benoit Vincent, Quint-Fonsegrives, France
MLC	Personal collection of Michel Laguerre, Léognan, France
MWM	Museum Witt, München, Germany
ZSM	Zoologischen Staatssammlung, München, Germany

Molecular analyses

Tissue samples of the new species described in the present work were processed through DNA barcoding at the Canadian Centre for DNA Barcoding in Guelph (Ontario, Canada), along with many other arctiid species as the target of a DNA barcoding project for neotropical tiger moths, developed within the iBOL Lepidoptera campaign (see www.lepbarcoding.org for further details). DNA extraction, PCR amplification, and sequencing followed the protocols already described in Vaglia et al. (2008).

The taxa used in this study are detailed in Table 1. In order to fully assess the validity of all described species, a set of six specimens was sequenced for 658 base-pair fragment of the partial mitochondrial gene COI. The sequences were aligned and downloaded from Bold and analysed using Mega 6 (Tamura et al. 2013) for a cladistic analysis. Bootstrap values (Felsenstein 1985) were used to estimate branch support: they were calculated in MEGA6 after 1000 random replications distance calculations were performed using the kimura 2-parameter (k2p) method in Mega 6 (Kimura 1980) including all sites, with the pairwise deletion option and assuming both a homogeneous pattern of divergence among lineages and a uniform rate of substitutions among sites.

Systematics

Lophocampa hyalinipuncta (Rothschild, 1909)

Halisidota (sic) *hyalinipuncta* Rothschild, 1909: 217.

Type material. 4 male syntypes. Type locality: Agualani, Carabaya, [Puno], Peru, 9000 feet [2740m], (wet season), Dec[ember] 1905 (G.R. Ockenden). One specimen from the type locality is labelled “TYPE” and “Lectotype male *Lophocampa hyalinipuncta* Rothschild designated by Vincent, 2018” in NHML. I hereby designate it as lectotype.

Distribution. Peru (Puno) and Bolivia (La Paz, Cochabamba, and Chuquisaca) (Figure 14).

Comments. The description of the habitus of *Lophocampa hyalinipuncta* made by Rothschild (1909) in the original description was supplemented by Hampson (1920: 268). The type specimen, figured in Vincent and Laguerre (2013: 51) and preserved in the NHML, has not been dissected. It was not possible to study specimens from the type locality. Nevertheless, several specimens from Bolivia not far from the type locality and belonging to the same biogeographic zone were dissected.

The male genitalia are identical to that of *L. carpishensis* sp. n. with the following differences: Uncus narrow; cucullus shorter, transtilla with the end of the triangular tongue more acute. Vesica with dorsal diverticula carrying smaller cornuti with very small spines; two lateral larger diverticuli with wider spines.

***Lophocampa azuayensis* sp. n.**

<http://zoobank.org/45F32F49-F7BA-401E-AEAB-EBD121A8CF1B>

Figs 1, 3, 5–6, 9, 11

Type material. Holotype – ♂, Ecuador, Azuay province, 5 km road LA PAZ – ONA, 3°21'50"S; 79°11'31"W, 06.02.2012; 3020 m, leg. R. Brechlin & V. Siniaev, genitalia dissected by Michel Laguerre. n° ML 2514, Barcode ID GWOTP625-15, Sample ID BC ZSM Lep 92116, MWM in ZSM, will be deposited in PUCE.

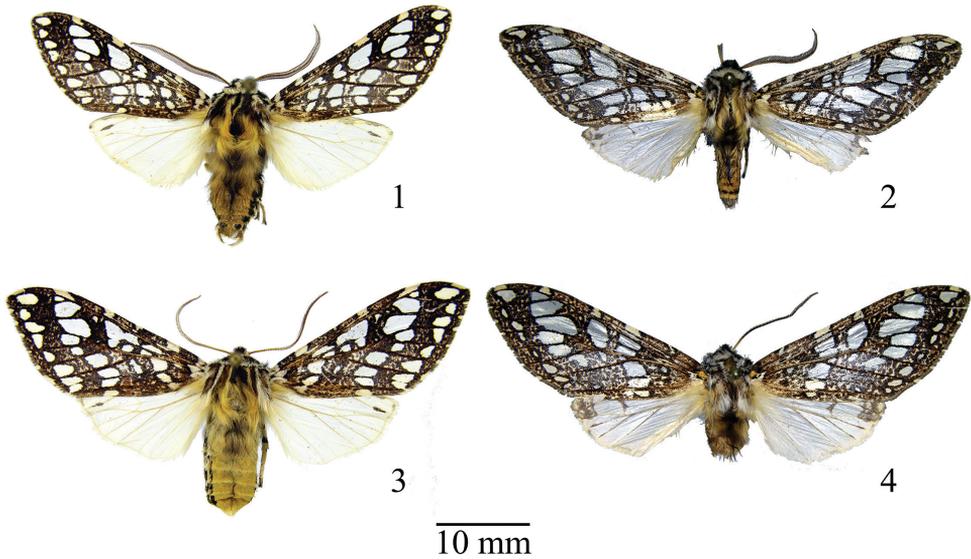
Additional material. Paratype, ♀, same data as holotype, genitalia dissected by B. Vincent. n° BV 482, Barcode ID GWOTP626-15, Sample ID BC ZSM Lep 92117, MWM in ZSM.

Diagnosis. See Table 1.

Description. Female identical to male except as noted. *Head.* Antenna bipectinate, female with pectinations shorter than male, brown with yellowish base and brownish cilia. Frons brown on the inferior half, white on the superior half. Vertex brown, with white setae near the antenna insertion. Palpi erected, brown, the third article very short with white setae at the apex.

Thorax. Patagia white with a square brown spot centred with whitish. Tegulae white except base and inner edge dark brown; presence of two brown spot centred with whitish. Thorax light yellow with a strong medial black line. Legs, femur brown on basal half, bright yellow on apical half, except for brown apex. Prothoracic tibia and tarsi brown on the outer side, whitish on the inner side. Meso- and metathoracic tibia and tarsi brown, ringed with white on the outer side, whitish on the inner side. *Forewing.* Forewing length 22 mm (male) and 25 mm (female). Brown, very lightly sprinkled with light brown. The venation slightly darker than the ground colour. A series of bands formed by white spots as follows: a basal band consisting of three white spots; an post-basal band broken at medial vein an antemedial band incomplete, without spots on costa and anal border; a medial line incomplete, limited to a spot on the costa and a large spot that reaches the medial vein an oblique postmedial band, complete, the spot between veins M2 and M3 very small; a complete subterminal line, made of well aligned rounded spots whose edges almost reach the margin; a terminal line of white dots. *Hindwing.* White, slightly tinged with brown markings at the apex.

Abdomen: Tergites pale yellow with long brownish setae in the basal half of the medial axis, with a lateral series of brown spots. Sternites whitish with brown patches, these centred with yellowish. *Male genitalia.* Uncus rectangular and setose enlarged in the medial area. Tegumen short. Saccus tongue shaped, weakly sclerotized and folded ventrally. Valvae symmetrical, wide at the base then narrowed sharply into a pointed apical end slightly inverted ventrally, greatly exceeding the uncus apex. Cucullus slender, elongate, with an apex slightly curved ventrally. Juxta narrow with two arms fused apically. Transtilla formed by two slightly diverging triangular tongues, separated by a central unsclerotised area. *Aedeagus:* Penis straight, short, caecum penis present. Vesica wide with four diverticuli: one dorsal, the largest, with a patch of long spines; two



Figures 1–4. Habitus of *Lophocampa* species: **1** *Lophocampa azuayensis* sp. n., holotype, male **2** *Lophocampa carpishensis* sp. n., holotype, male **3** *Lophocampa azuayensis* sp. n., paratype, female **4** *Lophocampa carpishensis* sp. n., paratype, female.

Table 1. DNA sequence divergence between holotypes of the new species and specimens of *L. hyalinipuncta*, based on the barcode fragment of the COI gene. The percent divergence from averaging over all sequence pairs is based on analyses using the Kimura 2-parameter model. The analysis involved the six specimens shown in Figure 13.

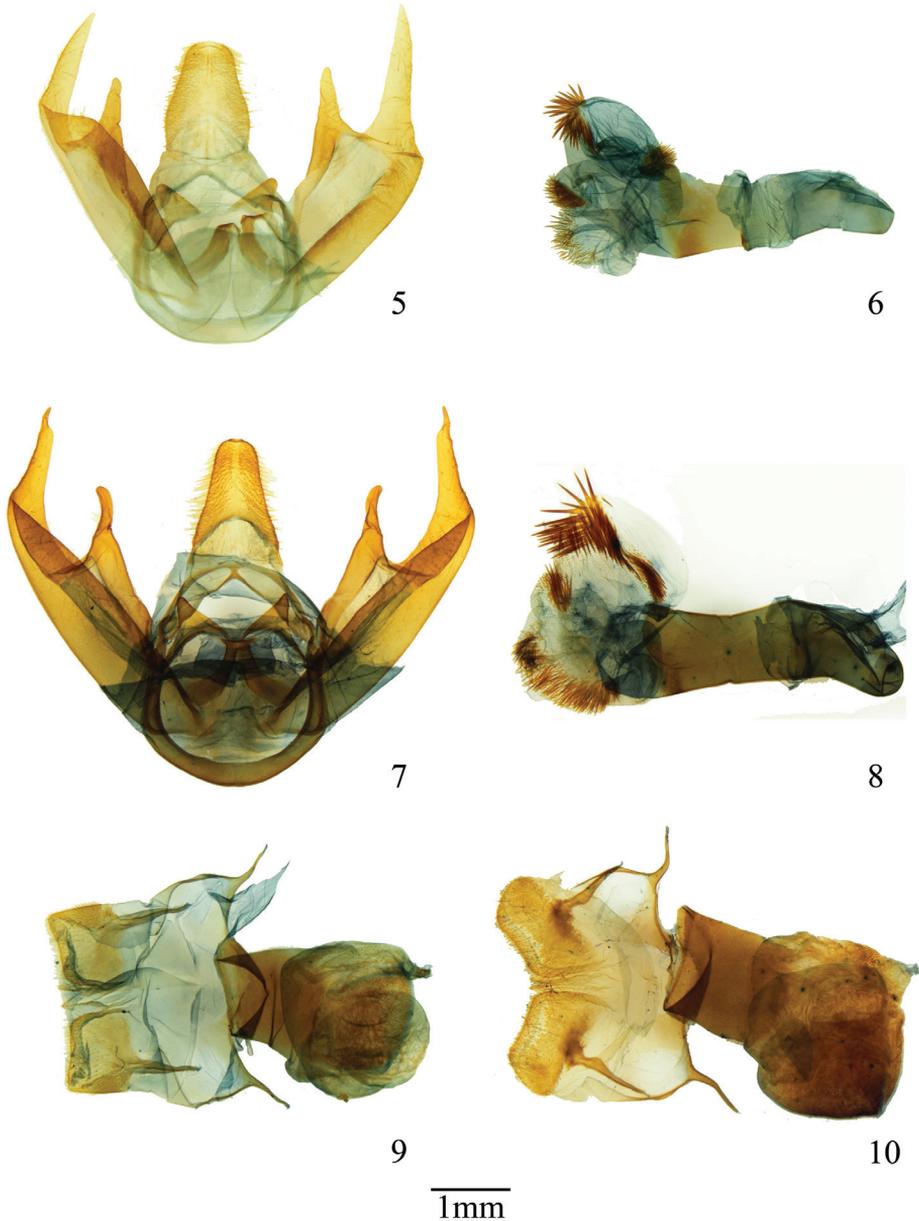
	<i>L. azuayensis</i> sp. n.	<i>L. carpishensis</i> sp. n.	<i>L. hyalinipuncta</i>
<i>L. azuayensis</i> sp. n.	–		
<i>L. carpishensis</i> sp. n.	2.1	–	
<i>L. hyalinipuncta</i>	2.3	1.6	–

lateral, simple, with at the apex a very dense patch of short spines; the last, ventral, multi-lobed with a patch of sparse short spines.

Female genitalia. Apophyses posteriores straight. Apophyses anteriores shorter, very slightly curved. Papillae anales rectangular and setose. Pseudopapillae small. Dorsal saccular pheromone glands reduced. Ductus bursae short, rectangular with an extension on the right (ventral view). Corpus bursae very reduced, wrinkled, formed by two rounded lobes folded one over the other.

Etymology. The specific epithet, *azuayensis*, refers to the province of Azuay, Ecuador where the type locality is located.

Distribution. Ecuador, Azuay province (Figure 14). The type locality corresponds to secondary forest zones of the evergreen high montane formation, which extends from 3000 to 3400 meters above sea level, in the Azuay province. This formation



Figures 5–10. Genitalia male and female of *Lophocampa* species. **5–6** *Lophocampa azuayensis* sp. n. genitalia (5), penis (6), holotype male **7–8** *Lophocampa carpishensis* sp. n., genitalia (7), penis (8), holotype male; *Lophocampa azuayensis* sp. n. genitalia female (9); *Lophocampa carpishensis* sp. n., genitalia female (10).

marks the transition between the cloud forest and the páramo. This forest also called Ceja Andina is very similar to the cloud forest in its physiognomy and in the quantity of epiphytic mosses and plants, but differs in structure and size.

Early stages. Unknown.

***Lophocampa carpishensis* Vincent, sp. n.**

<http://zoobank.org/633DBBE7-392B-4D4C-A9E7-7AA5291BCB42>

Figs 2, 4, 7–8, 10, 12

Type material. Holotype – ♂, Peru, Huanuco, [Paso] Carpish, 2000–2800 m, IV-2009, via R. Marx, genitalia dissected by B Vincent n° BV 484 [MNHN].

Paratypes. 1 ♂ and 2 ♀, same data as holotype, genitalia dissected by B. Vincent respectively n° BV 427, BV 428 and BV 485, in BVC. 1 ♂, Peru, Carpish, Hua[nuco], 21.8.68, ex coll J. Dubois, in MNHN. 1 ♀, Peru, Amazonas, El Paraiso (Pomacochas), 2400m, X/XI-2006, Barcode ID ARCTA845-07, Sample ID MILA 0564, in MLC. 1 ♂, Peru, Pasco, La Antena [S.E. Oxapampa], 1038/7517, 2875m, VII-XII-2005, J. Böttger leg., in MUSM.

Diagnosis. See Table 1.

Description. *Head.* Antenna bipectinate, yellowish on basal half, brown on apical half with brownish cilia. Frons and vertex brown, mixed with white hairs. Palpi erect-ed, black, the third article very short with white hair on the ventral side at the apex.

Thorax. Patagia white with a square brown spot centered with whitish. Tegulae white except for inner edge and center light dark brown. Thorax light yellow. *Legs:* Femur bright yellow, except brown apex. Tibia and tarsi of the first pair, brown on the outer surface, whitish on the inner side. Tibia and tarsi of the second and third pairs, brown ringed with white. *Forewing.* Forewing length 23 mm (male) and 25 mm (female). Brown, slightly lighter between the subterminal band and the fringe. Presence of a yellow spot at the base of the wing and a series of bands formed by white spots and organized as follows: a basal band consisting of three white spots; a postbasal band broken at median vein; an ante median band complete, wide at the anal edge and reducing to the costa; a median band incomplete which merges, between CuA1 and M3 with a postmedian band oblique, complete. Complete subterminal band, formed of small and compressed spots; a terminal line of white dots on the margin, barely visible. Except for the basal and sub-terminal band, spots hyaline white, excluding costa and anal border ivory white. Spots on the subterminal band ivory white. *Hindwing.* White slightly tinged with light brown marks on apex. Ventrally, costa ivory white with several brown spots.

Abdomen: Tergites yellow with long brownish hair in the basal half. The posterior edges of the tergites are highlighted in black. Sternites whitish with brown patches centered with yellowish.

Male Genitalia. Identical to that of *L. azuayensis* with the following differences: Uncus rectangular, slightly narrower in the apical half and not widened in the median area. Valvae, broad at the base, which gradually narrows to a very pointed apical end. Cuculus with an apex strongly curved ventrally. Vesica wide with three diverticuli: one dorsal, the largest, with a patch of long spines; one lateral, simple, without spines; the last, ventral, simple, with a patch of cornuti with long spines and a second patch with shorter spines.

Female identical to male except for the following differences: antennae with pectinations shorter than male. Wingspan slightly larger. Median and postmedian band incomplete, interrupted between CuA2 and the anal edge. The spot of the post median band between CuA1 and CuA2 is kidney-shaped.



Figures 11–12. Detail of genitalia male respectively *Lophocampa azuayensis* sp. n. (11) and *Lophocampa carpishensis* sp. n. (12).

Table 2. Comparison of diagnostic differences among *L. azuayensis* sp. n., *L. carpishensis* sp. n. and *L. hyalinipuncta*.

Character	<i>L. azuayensis</i> sp. n.	<i>L. carpishensis</i> sp. n.	<i>L. hyalinipuncta</i> .
Base of the forewing	Without a yellow spot	With a yellow spot	Without a yellow spot
Post median band of the forewing	With a spot between M2–M3 smaller than spot between M1–M2	With a spot between M2–M3 uniform than spot between M1–M2	With a spot between M2–M3 identical to spot between M1–M2
Subterminal band of the forewing	With rounded spots whose edges reach almost the margin and form a regular alignment	With very small and compressed spots not aligned with the margin	With rounded spots not aligned with the margin
Male with uncus	Enlarged in the median area	Narrowed in the apical half	Longer and slightly narrowed in the apical half
Male with valvae	Narrowed sharply to an apex acute	Narrowed gradually to an apex acute	Narrowed sharply to an apex bevelled
Male with vesica	consisting of 4 diverticuli 2 lateral with spines	consisting of 3 diverticles, 1 lateral without spines	consisting of 4 diverticles, 2 lateral with spines
Female with apophyses posteriores	Not strongly narrowed near their base	strongly narrowed near their base	Not strongly narrowed near their base

Genitalia. Apophyses posteriores straight strongly narrowed near the base. Apophyses anteriores as long, curved. Papillae anales rectangular and setose. Pseudopapillae small. Dorsal saccular pheromone glands reduced Ductus bursae short, rectangular with an extension on the right (ventral view). Corpus bursae very reduced, wrinkled, formed by two rounded lobes folded one over the other.

Etymology. The name *carpishensis* refers to the type locality: Paso Carpish (Carpish Pass), whose most famous place is the tunnel Carpish which is a 2707 m high and

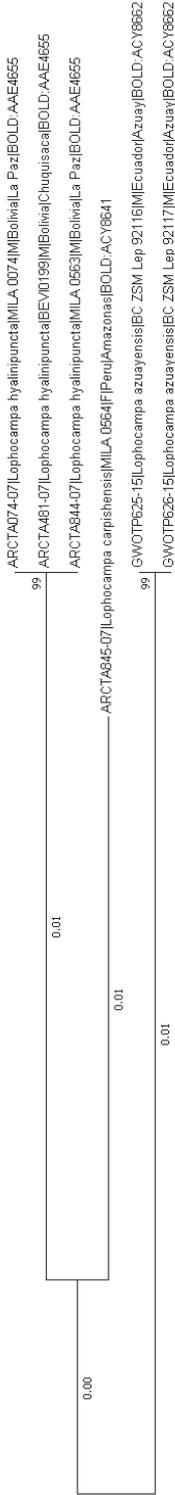


Figure 13. Neighbor-Joining Tree for the six specimens of the *Lophocampa hyalinipuncta* group. Boot-strap values (in %, 1000 replicates) are given on each branch (obtained with MEGA5, see Tamura et al. 2007).

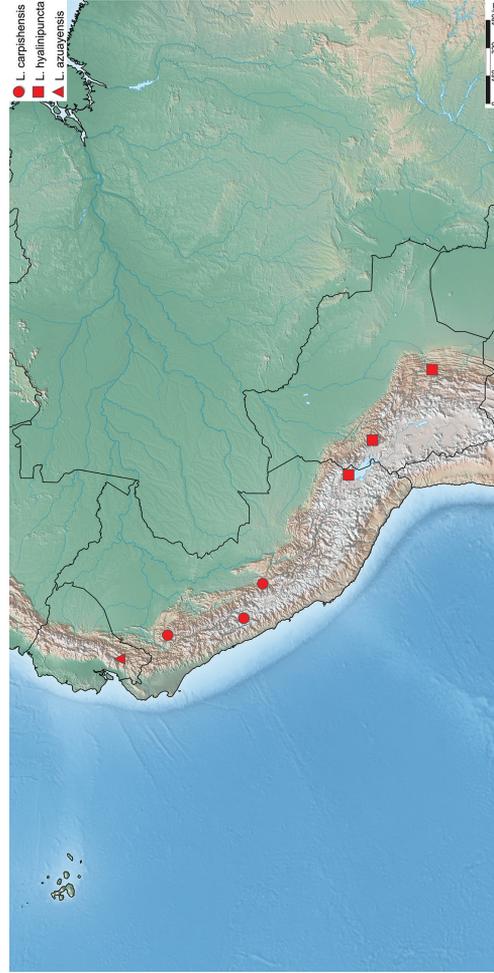


Figure 14. Distribution of examined specimens of *Lophocampa hyalinipuncta* group. Circle: *Lophocampa carpihensis* sp. n., square: *Lophocampa hyalinipuncta*, triangle: *Lophocampa azuayensis* sp. n.

marks the separation between the vegetation of matorral dry Pacific side and forest vegetation Amazon cloud side. The humid montane forests of Carpi are important for their high diversity and endemic species. Beltrán and Salinas (2010) have published additional information on this area and its vegetation.

Distribution. Peru (Amazonas, Huanuco, and Pasco).

Early stages. Unknown.

Results

COI sequence of specimens identified formerly as *L. hyalinipuncta* segregates into three clades (Figure 13), respectively *L. hyalinipuncta*, *L. carpishensis* sp. n., and *L. azuayensis* sp. n. *Lophocampa hyalinipuncta* differs by 1.6 and 2.3% respectively from *L. carpishensis* sp. n. and *L. azuayensis* sp. n. The two new species differ by 2.1% (Table 1).

Discussion

Lophocampa azuayensis sp. n. is only known from the type locality, from a high elevation area of Ecuador that is rarely explored. It would be interesting to determine if the species is present at lower altitudes, or if it is found only above 3000 m. Furthermore, it would be interesting to clarify if the species occupies the western or eastern slopes of the Andes, knowing that Vincent and Laguerre (2013) showed for the *Lophocampa atriceps* group that species are limited to one or the other slope. It is also possible that the species is limited to the high intermontane valleys of southern Ecuador.

Lophocampa carpishensis sp. n. has a larger known distribution with, in addition to the typical locality, localities to the north or south at altitudes always between 2000 and 3000 m. Finally, *L. hyalinipuncta* has a more southern distribution, at the same altitudes as *L. carpishensis* sp. n. (Figure 14).

Morphological differences between the taxa are not obvious, but the pattern of the forewings, in addition to characters of the male and female genitalia, is sufficiently different to easily identify the three species (Table 2). It should be noted that in male *L. carpishensis* sp. n. the medial and postmedial bands merge into a large spot between veins CuA1 and M3. This fusion, which creates a large characteristic hyaline spot, is not found in females.

Acknowledgments

The author would like to acknowledge Tomas Witt that allowed the access to and borrowing of Arctiini specimens from his collection, and Axel Hausmann for his receiving at ZSM and obtaining the COI sequences of the material-types. He is grateful to Dr. Christian Schmidt and an anonymous reviewer for their helpful and insightful comments on the manuscript.

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A new species of *Euchaetes* Harris from southern Arizona (Erebidae, Arctiinae)

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Abstract

Euchaetes nancyae sp. n. is described from southeastern Arizona. Although superficially similar to species of *Pygarctia* Grote, structural and molecular variation shows it to be most closely related to *Euchaetes helena* (Cassino). Adults, genitalic structure, eggs, and first instar larvae are described and illustrated. The larval host plant remains unknown. *Euchaetes helena* is confirmed as occurring in Mexico.

Keywords

Euchaetes helena, *Pygarctia*, Sonoran Desert

Introduction

The genus *Euchaetes* Harris currently encompasses 20 species (Vincent and Laguerre 2014; Lafontaine and Schmidt 2010), most being typical of arid and semi-arid habitats of the American Southwest and Mexico. Two species described from Brazil are not congeneric (Watson and Goodger 1986, Hendrickson 2014). There is no modern revision of the genus, although Hendrickson (2014) provides an as yet unpublished revision wherein a number of new generic combinations are proposed. As a revision will require

a review of all species in the genus, in addition to the closely related *Pygoctenucha* Grote and *Pygarctia* Grote, we place the new species described herein within the current but unrevised concept of *Euchaetes*, pending an in-depth review of the *Euchaetes* group of genera. Preliminary phylogenetic analyses by DaCosta et al. (2006) and Hendrickson (2014) indicate that *Euchaetes* is polyphyletic.

Materials and methods

Genitalic preparation techniques follow Jaeger (2017). Briefly, abdomens were macerated in 10% KOH solution overnight at room temperature, followed by cursory cleaning and separation of the genitalic capsule, and sequential transfer to 50% EtOH, 70% EtOH and 95% isopropanol. Vesica and corpus bursae inflation was carried out in 50% EtOH, followed by transfer to 70% EtOH for staining. Two stains (both in ethanol solution) were used, first chlorazol black (10 sec) then acidified eosin Y (4 + 4 sec in microwave). Stained tissues were dehydrated in 95% isopropanol before slide mounting in Euparal. Genitalia were imaged using a Leica DFC450 camera, Leica Application Suite 4.8 with a Leica M205C stereo microscope, and processed in Adobe PhotoShop. Interpretation of genitalic morphology and associated terminology differs from that of DaCosta et al. (2006) and Hendrickson (2014) in several respects. We consider the female appendix bursae in the sense of DaCosta to actually represent the bulla seminalis (see e.g., Bendib and Minet 1999), whereas the structure termed the “saccus” is the sacculus. Botanical nomenclature follows the PLANTS database (USDA 2018).

Variation of the ‘barcode’ section of the COI gene of two *Euchaetes nancyae* specimens was compared to all other known North American *Euchaetes* species (Zahiri et al. 2017). DNA extraction, PCR amplification, and sequencing of the COI barcode region was performed at the Canadian Centre for DNA Barcoding (CCDB) and followed standard protocols (Hebert et al. 2013; <http://www.ccdb.ca/resources.php>). DNA sequence analysis metrics were obtained from the Barcode of Life web interface. Resulting data were managed and analyzed using BOLD (Barcode of Life Data Systems; <http://v4.boldsystems.org/>). Mitogenomic divergence was calculated based on Kimura 2-Parameter (K2P) distances of COI barcodes.

Repository abbreviations are as follows:

AMNH	American Museum of Natural History, New York, NY
CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON
USNM	National Museum of Natural History (formerly United States National Museum), Washington, DC
RBN	Raymond B. Nagle Collection, Tucson, AZ
EJR	Evan J. Rand Collection, Phoenix, AZ

Results and discussion

Examination of the type specimens of *Euchaetes* and *Pygarctia* described from southwestern USA and Mexico (USNM, AMNH and as illustrated in Hendrickson 2014), in addition to comparison of museum material, shows that the species described here does not have any close relatives in either genus. The lack of a prothoracic foretibial claw, and long second segment of the labial palpus places the new species in *Euchaetes* rather than *Pygarctia* (Forbes 1960; DaCosta et al. 2006: fig. 3). Structural similarities and DNA barcode data associate this new species with *Euchaetes helena* (Cassino), *E. zella* (Dyar) and *E. fusca* (Rothschild), as discussed below.

Euchaetes nancyae sp. n.

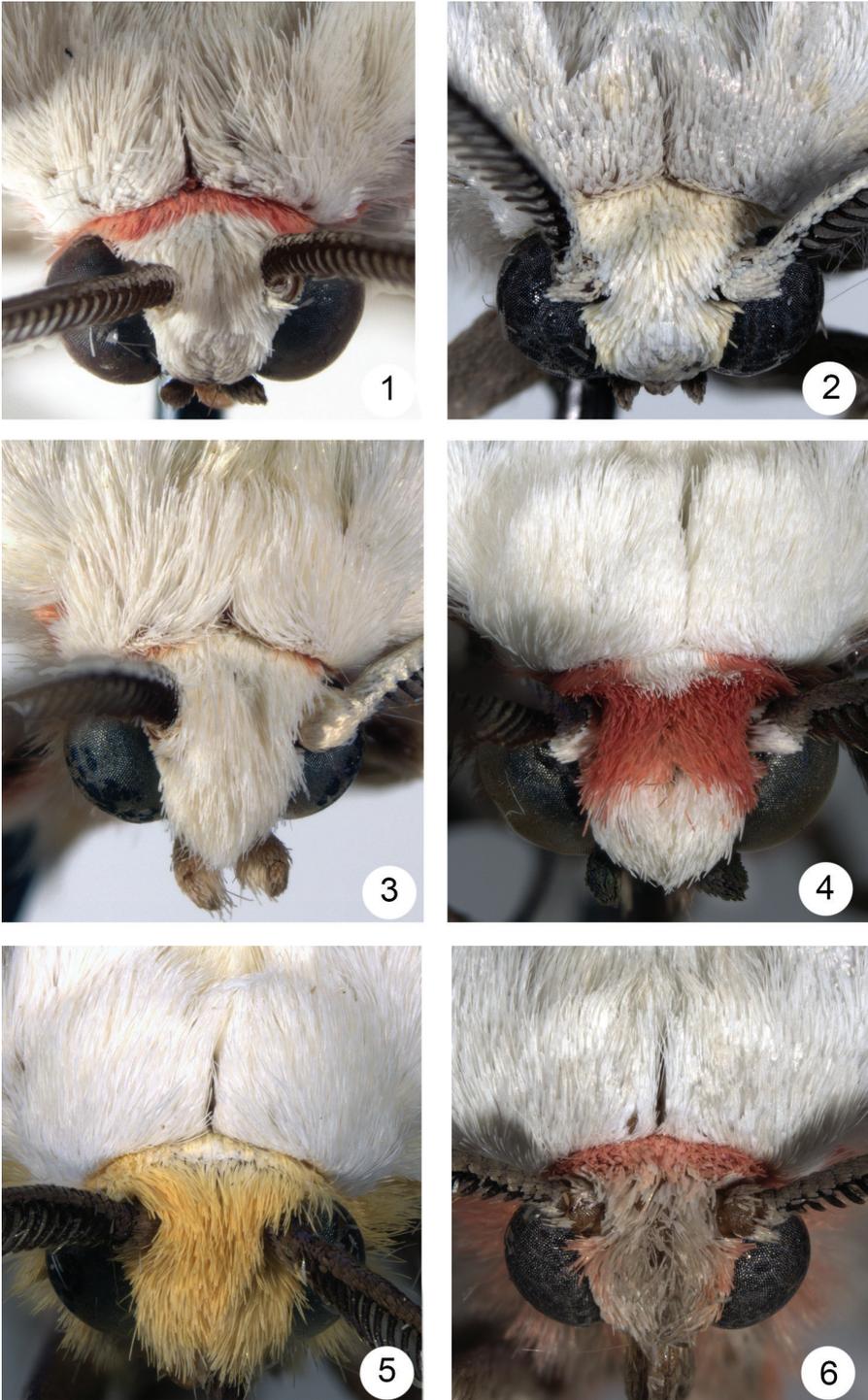
<http://zoobank.org/BA87F037-DB12-4D3D-A76F-B8294D0F1D63>

Figures 1, 7–9, 11

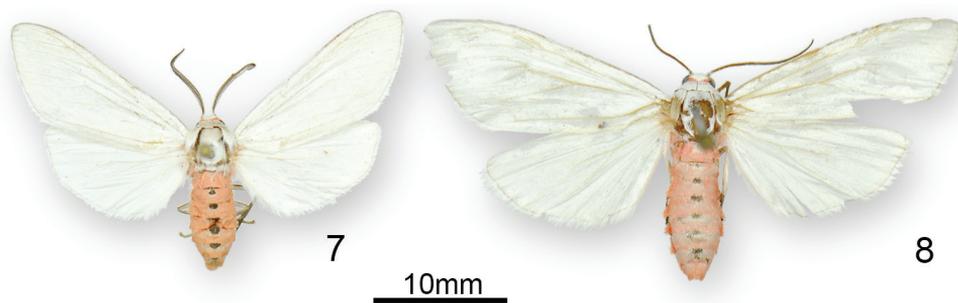
Type material. Holotype ♂. Arizona: Santa Cruz Co., Peña Blanca Canyon, 4000', 22–23 Jul 1999, J. B. Walsh; CNCLEP 79872 [CNC]. **Paratypes** 7♂ 5♀. **Arizona:** Santa Cruz Co., 4 mi W Peña Blanca Lake, 20 Jul 2000, R.B. Nagle, 1♂; CNC dissection # 17027, [CNC]; Santa Cruz Co., Hall Ranch, 31.60° N 110.73° W, [7 km NNE Patagonia], 27 Aug 2016, R. B. Nagle 1♀, CNC dissection # CNC17658, DNA voucher # 16-132 [CNC]; same data as previous, 1♀, dissection # RBN001, DNA voucher # 16-133 [RBN]; same data as previous, 1♂, [RBN]; Santa Cruz Co., Patagonia roadside rest stop, mile marker 15.6, 5 Jul 2004, B. Walsh, 1♀ [RBN]; Santa Cruz Co., California Gulch, 31°25'18.3"N, 111°14'40.02"W, 21 Jul 2012, E. J. Rand, 8♂ 2♀, [EJR].

Etymology. *Euchaetes nancyae* is named in honor of the senior author's wife who not only has long supported her husband's study of southwest moths but has also played host to numerous visiting lepidopterists. Nancy won a weekend trip to the Hall Ranch, which led to the initial capture and discovery of this species.

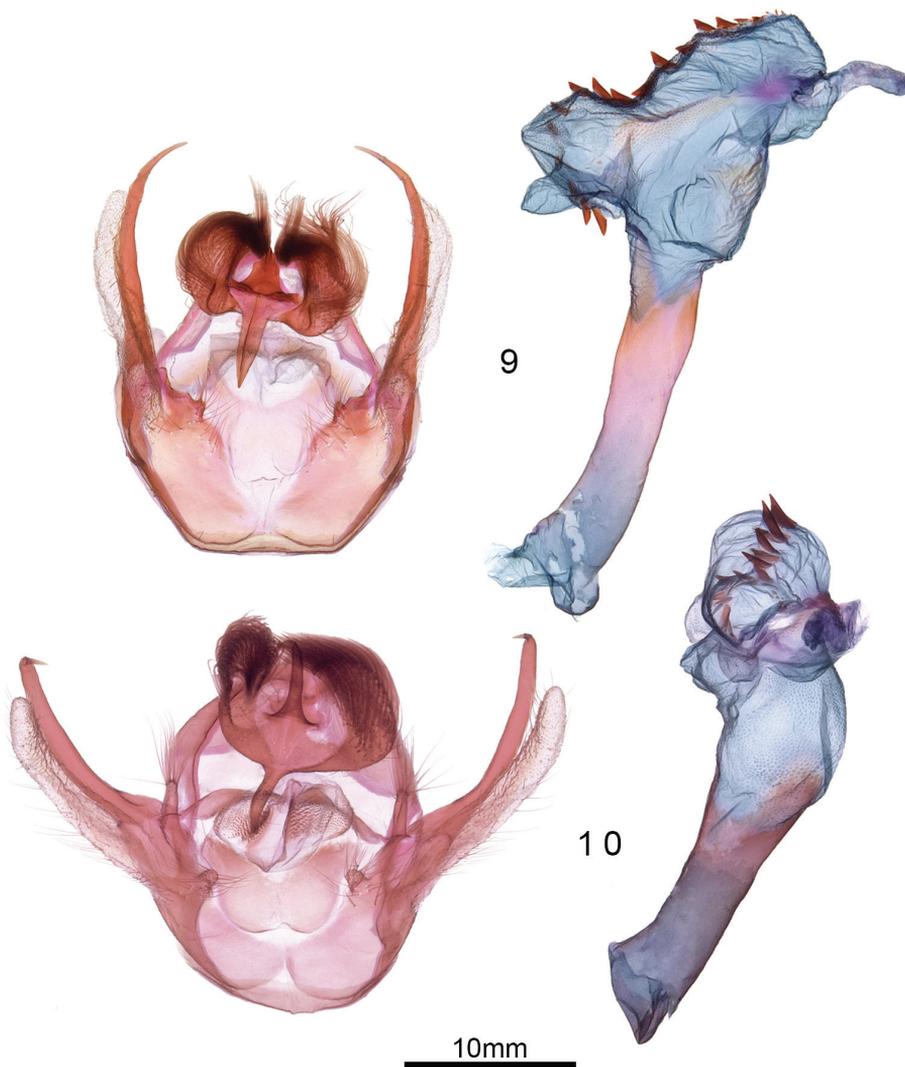
Diagnosis. *Euchaetes nancyae* is superficially similar to other species of *Euchaetes* and *Pygarctia* that have predominantly white or grey-white wings, but can generally be distinguished by examination of the head and thoracic colour patterns alone, as illustrated in Figs 1–6. *Euchaetes helena* and *Pygarctia flavidorsalis* Barnes & McDunnough have yellow instead of pink scaling on the head. The most common look-alike species that is sympatric with *E. nancyae* is *Pygarctia roseicapitis* (Neumögen & Dyar), but *E. nancyae* differs most obviously from that species by the white (Figure 1) rather than pink (Figure 4) vertex of the head. Wing and thoracic colour of *E. nancyae* is also similar to those of *E. castalla* Barnes & McDunnough; however, *E. castalla* has less pink scaling along the posterior margin of the head that is interrupted medially with white; the pink scales are often not visible without magnification and give the prothoracic collar the appearance of being entirely white (Figure 3); females of *E. castalla* have



Figures 1–6. Head and thoracic colour patterns of *Euchaetes nancyae* and similar species. **1** *Euchaetes nancyae* **2** *Euchaetes helena* **3** *Euchaetes castalla* **4** *Pygarctia roseicapitis* **5** *Pygarctia flavidorsalis* **6** *Pygarctia lorula*.



Figures 7, 8. Adults of *Euchaetes nancyae* male (7) and female (8).



Figures 9, 10. Male genitalia of 9 *Euchaetes nancyae* and 10 *E. helena*.

a white abdominal tuft, whereas the tuft is absent in *E. nancyae*. The distributions of *E. nancyae* and *E. castalla* overlap in at least southeastern Arizona (e.g. California Gulch, Pima Co.), and may do so also in northern Mexico. Morphologically, the male uncus and vesica of *E. nancyae* is highly distinctive, particularly the setation of the lateral lobes and the structure of the dorsomedial lobe, as described below and illustrated in Figs 9, 10. Females differ from those of *E. helena* in the shape of the cervix bursae and the papillae anales (Figs 11, 12). Structurally, *E. nancyae* differs from all *Pygarctia* species by the lack of a foretibial spine and a shorter 2nd segment of the labial palpus, in addition to the genus traits given below in the Discussion.

DNA barcode sequences of *E. nancyae* are more than 6% divergent from all other North American *Euchaetes*, in addition to several undescribed Mexican and Central American species. The two sequenced specimens of *E. nancyae* differ by 0.46%, forming a unique BIN (Barcode Index Number; Rathnasingham and Hebert 2013). The most similar species based on nearest-neighbour distance analysis is *Euchaetes helena*, differing by a minimum of 6.61%.

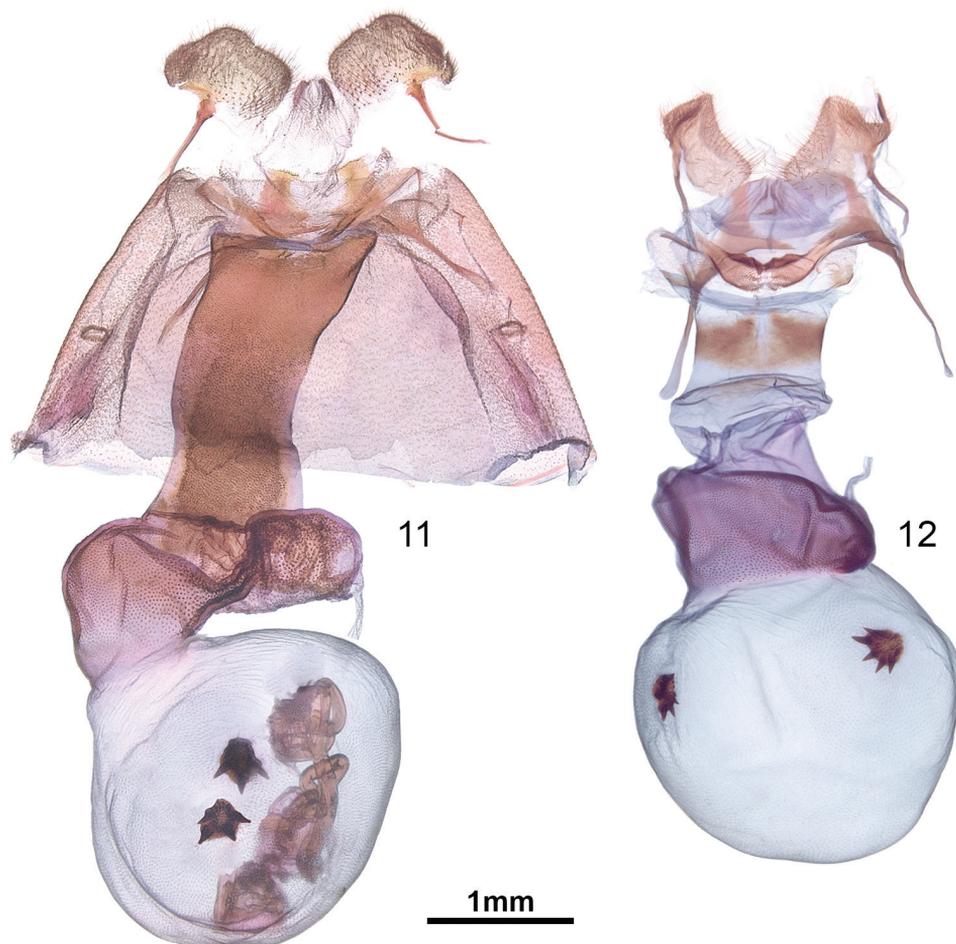
Description. *Head.* Vestiture of sexes similar; frons and vertex covered with white scales; posterior margin of head with a delicate ring or collar of pale orange-pink scales, extending around posterior and ventral margin of eye; male antenna bipectinate, longest rami 2.5 x longer than antennal segment, scape and proximal third dorsally scaled with white, grading into darker pale grey-brown scaling over distal two-thirds; female antenna biserrate, dorsal vestiture similar to that of male. First segment of labial palpus with relatively long, pale orange-pink scales along ventral edge, second segment covered with white scales, third segment covered with light brown scales; length ratio of segments 1:2:3 = 2.2 : 3.0 : 1.0.

Thorax. Vestiture of sexes similar; patagium, tegula, and thorax covered with greyish-white scales, lateral margin of patagium and tegula with a border of long pale pink hairs extending underneath wings; foreleg coxa pale orange pink with a medial patch of pale grey-brown scales; foretibia without claw at apex; femur and tibia white dorsally, ventrally a mix of white and pale grey-brown scales, tibial spurs and tarsal segments pale grey brown; mid and hind legs with coxa, femur, and tibia covered with a mix of white and pale grey brown scales; metepisternum lacking microtymbals.

Forewing and hindwing. Dorsally both wings and fringe entirely silvery greyish white, lacking any distinguishable markings in both sexes; ventrally, forewing a slightly darker shade of greyish white than hindwing. Male forewing length 15.2–15.8 mm (n = 2), female 18.6–19.5 mm (n = 2).

Abdomen. Colouration of sexes similar; dorsum pale silvery pinkish orange with a row of 6–7 dorsomedial macules at anterior tergal margin, this dark grey and indistinctly ringed with whitish grey; laterally with a row of prominent black maculae at anterolateral angle; ventrum silvery whitish grey; female without terminal tuft of long scales; intersegmental membrane between sternites 7–8 of male with well-developed coremata, nearly length of abdomen when fully extended.

Male genitalia. Gross morphology typical of *Euchaetes*, with costa and sacullus deeply divided, costa forming a long prong-like finger, and sacculus forming a mem-



Figures 11, 12. Female genitalia of **11** *Euchaetes nancyae* and **12** *E. helena*.

branous, elongate lobe; saccus broad and collar like, not tapered to a point medio-ventrally as in many arctiines; juxta lightly sclerotized and indistinctly differentiated, broadly U-shaped; uncus complex, with a dorsoventrally flattened lateral lobe; each lobe densely setose, forming an evenly sinuate “hair-do” that terminates in an anteriorly-directed, dense, pointed tuft; dorsomedial process of uncus with a pyramidal base, terminating in a laterally flattened crest; apex of uncus laterally flattened and shaped like a broad bird’s beak in lateral view; phallus 5 × longer than wide, curved slightly dorsad; vesica roughly kidney shaped with small subbasal diverticulum; disto-medial row of approximately 20 sawtooth-like cornuti, decreasing in size towards ductus ejaculatorius.

Female genitalia. Distal margin of papillae anales irregular rounded quadrate; papillae anales moderately setose, densely and finely setose dorsally below apertures of dorsal pheromone gland; pseudopapillae anales membranous; dorsal pheromone gland

unbranched, terminating as pair of openings; length of anterior and posterior apophyses approximately equal to maximum width of papillae; cervix bursae moderately sclerotized, internally rugose near junction with ductus, remainder with regularly spaced microtrichia or spicules; ductus bursa flattened dorsoventrally and ribbon-like; corpus bursa essentially spherical, with two star-like signa, one dorsal and one ventral; ventral signum with four arms or rays, dorsal one with three.

Biology and distribution. The larval hostplants of *E. nancyae* are unknown. Two females oviposited approximately 30 shiny yellow-white eggs measuring 0.8 mm in diameter. *Euchaetes nancyae* lacks female abdominal tufts, and eggs were not covered with abdominal setae. Presumably, all *Euchaetes* species that possess female abdominal tufts cover their eggs, such as *E. egle* (Drury). The first instar larvae were offered several species of Asclepiadaceae including *Funastrum cynanchoides* (Decne.) Schltr. and one species of Euphorbiaceae, *Chamaesyce hysopifolia* (L.), but refused to feed and perished. The related species *Euchaetes zella* and *E. perlevis* feed on *Funastrum cynanchoides*, and *Euchaetes fusca* larvae feed on the *Cnidocolus angustidens* Torr. (Euphorbiaceae). The larval foodplant of the probable sister species *Euchaetes helena* from Texas is also unknown, but larvae of that species also do not accept Asclepiadaceae (D. Wagner, pers. comm.).

Euchaetes nancyae is known only from the type series, collected in Sonoran desert habitat along the Mexican border in Santa Cruz County, Arizona. It undoubtedly also occurs in adjacent parts of Mexico. *Euchaetes helena* occurs in Texas (Davis Mountains), and was listed as likely occurring in Mexico by Vincent and Laguerre (2014); we here confirm the occurrence of *E. helena* from Coahuila, verified by DNA barcode sequence (DNA vouchers CNCLEP 00113425 and CNCLEP00113424).

Conclusion

Based on morphological similarities, *Euchaetes nancyae* is most closely related to *E. helena*, *E. zella*, *E. perlevis* and *E. fusca*. Species in this group all share 1) an untufted female abdomen (tufted in other North American species), 2) a well-developed male abdominal coremata, and 3) lack metepisternal microtymbals (the “Striate Band” of Forbes 1960). With the addition of *E. cressida* (Dyar), this assemblage corresponds to “*Euchaetes* Clade 2” of DaCosta et al. (2006). Despite the similarities of *Euchaetes nancyae* to this group, *E. nancyae* represents a surprisingly divergent evolutionary lineage within *Euchaetes*, and should help resolve the phylogeny of this complex group of genera.

Acknowledgements

We would like to thank Christi Jaeger and Jocelyn Gill who provided technical support, and two anonymous reviewers for editorial comments.

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A new species of *Sympistis* Hübner from Sapelo Island, Georgia, USA (Lepidoptera, Noctuidae, Oncocnemidinae)

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Abstract

A new species of the *Sympistis badistriga* species-group, *Sympistis eleanor* Adams, **sp. n.** is described from Sapelo Island, a back-barrier island in coastal Georgia, United States of America. Adults and genitalia of *S. eleanor* are illustrated, in addition to adults of similar species in the *Sympistis badistriga* species-group. The composition of this species-group is discussed.

Keywords

Atlantic coastal fauna, barrier island, dune habitat, *Sympistis induta*

Introduction

In 2012, John Hyatt, Dr. Lance Durden, and Dr. Brian Scholtens initiated a study of the moth fauna of Sapelo Island, the fourth largest barrier island in Georgia. Previous to this study, no large barrier island along the southeastern United States coastline has had a fully surveyed Lepidoptera fauna. The proposal for a complete faunal study was discussed with the administrators of the Sapelo Island National Estuarine Research Reserve (SINERR), and with the support of SINERR, the project is now entering its

seventh year. Sampling has been carried out in every month several times, and to this point the moth list is over 1000 identified moth species [unpubl. data]. The senior author acted as a taxonomic consultant through the first four years of the Sapelo Island Lepidoptera surveys, and assisted in field work since 2016.

In early May of that year, males of a *Sympistis* Hübner species were collected on Sapelo Island that did not match any of the known species of *Sympistis* from Georgia. Interestingly, this species was not collected in any of the previous years (April–May 2012–2015). Subsequent inquiries to *Sympistis* specialist Jim Troubridge indicated that the specimens possibly represented an unknown species of the *figurata* species-group. Analysis of molecular variation and morphological study revealed that the Sapelo Island *Sympistis* represents a new and likely southeastern endemic species of the *Sympistis badistriga* species-group, described and illustrated herein as *Sympistis eleanor* sp. n.

Methods and materials

Wing pattern and genitalia structure terminology follow Troubridge (2008). The structure forming the large, main chamber of the bursa copulatrix was interpreted by Troubridge (2008) to be the appendix bursae, with the small vestigial side chamber representing a highly reduced corpus bursae. Although the vestigial chamber in *Sympistis* is probably correctly interpreted as the corpus bursae (it is variously lost or well-developed in other species, such that positional homologies can be inferred), the appropriate terminology for the main chamber is not clear. The appendix bursae is a blind chamber rather than that which gives rise to ductus seminalis, according to Tuxen (1956). For the sake of consistency with previous terminology in this genus, we follow that of Troubridge (2008), but further research and comparisons are needed to establish homologies and consistent terminology within the Noctuoidea.

Forewing length was measured to the nearest tenth of a millimeter from base to apex, excluding the fringe. Genitalic preparation techniques follow Jaeger (2017). Briefly, abdomens were macerated in 10% KOH solution overnight at room temperature, followed by cursory cleaning, separation of the genitalic capsule, and sequential transfer to 50% EtOH, 70% EtOH, and 95% isopropanol. Vesica and corpus bursae were inflated in 50% EtOH, then transferred to 70% for staining. Two stains (both in ethanol solution) were used, first Chlorazol Black (Fisher Scientific, 112 Colonnade Rd., Ottawa, Ontario) for 10 seconds, then acidified Eosin Y (Fisher Scientific) for 4 + 4 sec in a microwave (Hamilton Beach model #EM720CPN, 700W). Stained tissues were dehydrated in 95% isopropanol before slide-mounting in Euparal. Genitalia were imaged using a Leica DFC450 camera, Leica Application Suite 4.8 and a Leica M205C stereo microscope, and processed in Adobe PhotoShop. Voucher specimens are deposited in the Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario, Canada (CNC), and the private collections of the senior author (JKA) and Lance Durden (LDC; 115 Turkey Trail, Statesboro, Georgia, 30458, USA).

The 658 base pair DNA “barcode region” of the mitochondrial cytochrome *c* oxidase subunit 1 (CO1) (“DNA barcode”) was used to assess molecular variation. Legs from dried specimens were submitted to the Barcodes of Life Data Systems (BOLD) at the University of Guelph (Ontario, Canada) where they were analyzed by standard DNA extraction, amplification, and sequencing protocols (Hebert et al. 2003). Barcode sequences were compared to a reference library of nearly all North American *Sympistis* species (Zahiri et al. 2017). Sequence comparisons were made using the Kimura-2-Parameter distance model as implemented on the Barcode of Life Data Systems website (<http://www.barcodinglife.org>).

Results

Sympistis eleaner Adams, sp. n.

<http://zoobank.org/D1ABF8C9-F690-4F6A-8734-CF051CB7A351>

Figs 1, 2, 9–11

Type material examined. All specimens from the US. **Holotype** male (Fig. 1). Georgia: McIntosh Co., Sapelo Island, Dune habitat, just S of Beach Rd., light trap, 31°23'26.5"N, 81°15'54.5"W, May 6–7, 2016, James K. Adams, DNA voucher # CNC-CLEP00119937 [CNC]. **Paratypes** (3 males, 2 females). **Georgia:** Same location as holotype, May 7–8, 2016 (2 males); McIntosh Co., Sapelo Island, Greenhouses, 21–22 April 2017, MV light sheet, L. A. Durden & T. Matson, (1 female); McIntosh Co., Sapelo Island, nr. UGA dorms, 31°23'54"N, 81°16'51"W, 9 May 2017, B. Scholtens (1 female; Fig. 2); McIntosh Co., Sapelo Island, “Short Cut” Rd., 31°24'36"N, 81°17'3"W, 9–10 May 2017, light trap, J. Adams and B. Scholtens (1 male) [CNC, JKA, LDC].

Diagnosis. *Sympistis eleaner* (Figs 1, 2) is most similar in appearance to *S. induta* (Harvey) (Figs 3, 4) but the distribution of the two do not overlap, with *S. induta* restricted to Texas. *Sympistis eleaner* is not likely to be confused with any other species *Sympistis* besides *S. induta*. There is a set of rather subtle, but distinct, pattern elements that distinguish the two species: *S. eleaner* has an overall streakier appearance, especially in the male hindwing; the forewing antemedial line takes a distinctive 110° turn inward at the costa that is more irregular in *S. induta*; there is a lighter patch near the anal angle of the hindwing (between Cu2 and A2) that is not present in *S. induta*; the male of *S. induta* has a much “cleaner” hindwing with a less irregular PM line; the female forewing is broader than that of the male in *S. eleaner*, but female *induta* have narrower forewings than the males.

The male genitalia of *S. eleaner* (Figs 9, 10) differ from those of *S. induta* and other species in the *badistriga* species-group by the shorter, broader valve that has a nearly linear costal margin. In females, the combination of a pear-shaped corpus bursae with a relatively short ductus bursae is unique.

Description. Forewing pattern typical of the *Sympistis badistriga* species-group, beige, dark markings limited to sinuous antemedial and postmedial lines. Male and female similar, females slightly larger and darker, especially the distal hindwing (Figs 1, 2).

Head. Labial palpus, frons, head vertex scales light gray beige and scattered dark brown; female darker with more scattered black scales; antenna simple, unscaled; eye without interfacetal setae; labial palpus with heavily scaled basal and second segments, second segment mottled prominently dark brown; third segment very short, stout. **Thorax.** Vestiture grayish beige, concolourous with abdomen and forewing ground; black prothoracic collar pronounced in male, incomplete medially in female; collar with posterior linear extension onto mesonotum in male; leading edge of mesonotum (directly behind collar) with fringe of hair-like, dark brown scales, making collar appear more pronounced. Legs with distal end of femur with black scaling (at “knee”); proximal 2/3 of tarsomeres 1 and 2 on all legs black, proximal 1/2 on remaining tarsomeres black; paired tibial spurs, scaled black, on meso- and metathoracic legs; foretibial spur present but concolorous with rest of thorax; stout apical spur of foretibia typical of many *Sympistis* absent. **Forewing.** Male forewing length 13.7–14.0 mm, female 14.9 mm. Dorsal forewing ground color grayish beige with dusting of black scales, most concentrated along veins; basal dash extending to postmedial line along posterior edge of discal cell; antemedial line with distinct bend at costa (approx. 110°); posteriorly angled slightly outward to anal edge; postmedial line with typical *Sympistis*-bulge from end of basal to costa; costa distad of postmedial line with alternating light beige spots at radial veins and dark gray dashes between veins; fringe with alternating beige at veins and dark grayish tan between; distal half of ventral forewing cream beige to cream (especially in anal area); scattered dark brown scales, denser toward both costa and apex, costa and fringe checkered as above; faint postmedial line short, from radial veins to M2; abundant tan hair-like scales in discal cell. **Hindwing.** Dorsum cream to cream beige basally and along anal; outer fringe scales two-toned, beige basally, cream terminally (no checkering); postmedial line sinuous and discontinuous, separate from outer band in male, fused in female; gray outer band also discontinuous, darkest along veins, lightest at anal angle between Cu and A2. Venter basal 2/3 cream beige to cream; outer band darker distally to smooth curving unbroken PM line (from costa to Cu1); small patch of dark brown scales demarcate small discal spot on both fore- and hindwing ventrum. **Abdomen.** Vestiture grayish beige; female with more extensive dark scaling; black scales concentrated in two ventrolateral dark lines running length of abdomen; male with basal abdominal coremata, levers and associated pocket well-developed; Stobbe’s gland well-developed; female abdomen unmodified. **Male genitalia.** Valve elongate with distal 2/3 somewhat rounded-quadrate, with costal edge nearly linear and distal margin only slightly convex; clasper slightly bulbous with claw-like apex, curving mesad slightly; corona a single row of robust but deciduous spine-like setae; juxta poorly differentiated; uncus curved moderately ventrad, tapering rather abruptly at apex, with small, nearly caudad-directed apical spine; saccus shaped as somewhat convex/curved V; phallus cylindrical and slightly decurved ventrad; distal half slightly narrower than basal portion, length 5.3 × that of diameter; vesica produced at 90° right dorso-laterad, with four spine fields and a terminal cornutus (Fig 10). **Female genitalia.** Papillae anales slender with somewhat rounded distal margin; distally with short sparse setae and a row of subterminal, lateral hook-like spines forming a corona; posterior apophysis long and slender, 3 × length of sclerotized portion of A8; posterior apophysis 2.5 × length



Figures 1–8. 1 *Sympistis eleanor* male (holotype) 2 *S. eleanor* female (paratype) 3 *S. induta* male 4 *S. induta* female 5 *S. tenuistriga* male 6 *S. tenuistriga* female 7 *S. badistriga* male 8 *S. badistriga* female.

of sclerotized portion of A8; lamella antevaginalis weakly sclerotized and unmodified; ostium forming a rounded cone, slightly longer than wide; appendix bursae pear shaped, with ductus seminalis originating at anterior end and directed caudad; corpus bursae reduced to a small, polyp-like vesicle attached to right side of main bursa chamber.

Etymology. The species is named in honor of the mother of JKA, Eleanor Ruth Adams. She continuously encouraged JKA in studying Lepidoptera from a very young age and participated with JKA in many moth outings during her life.

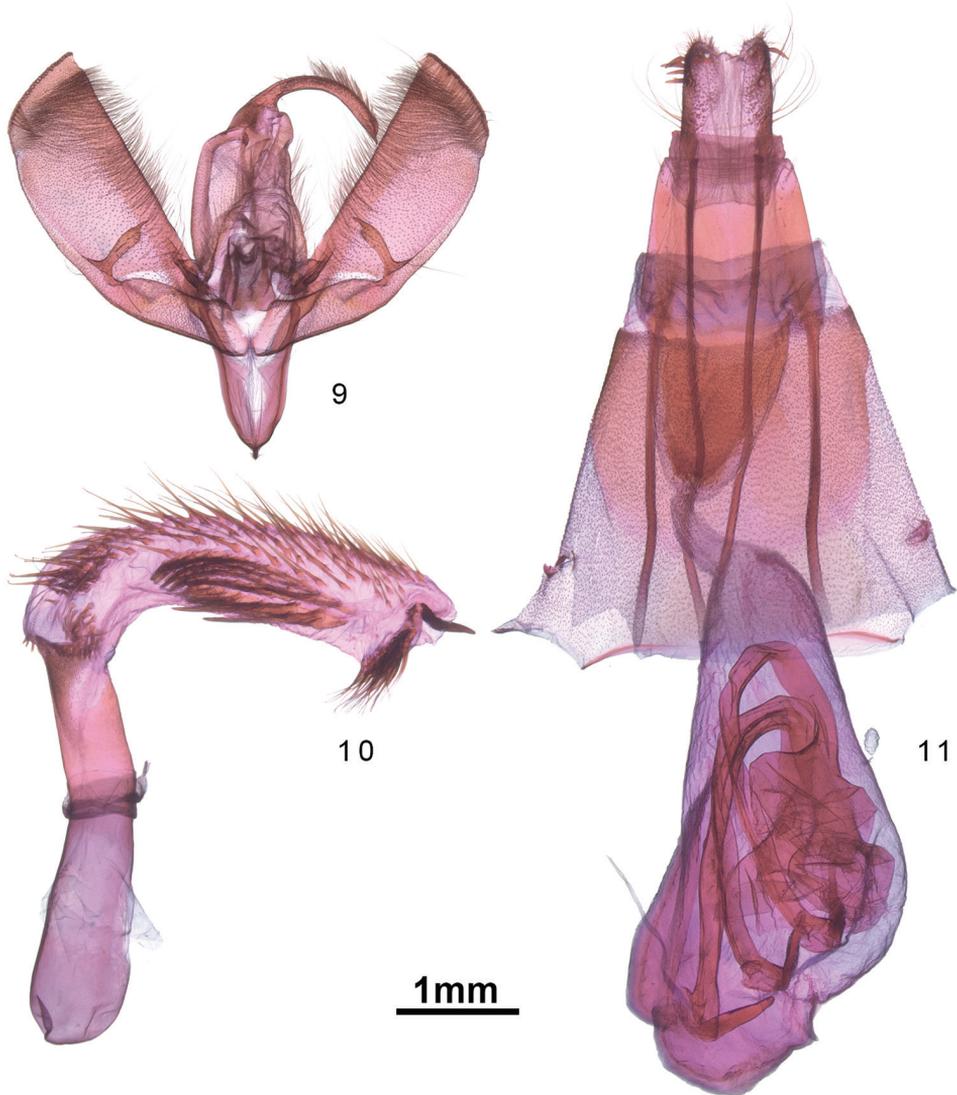
Biology and Distribution. Nothing is known about the early stages of *S. eleanor*. Larval hosts for related species in the *badistriga* species-group are known or thought to be primarily species in the honeysuckle family (Caprifoliaceae); *S. badistriga* (Grote) feeds on *Lonicera* Linnaeus and *S. stabilis* (Smith) feeds on *Symphoricarpos* Duhamel, respectively (Crumb 1956). At least three species of Caprifoliaceae are known to occur on the island: *Sambucus simpsonii* Rehder, *Lonicera japonica* Thunberg, and *L. semper-virens* Linnaeus (Chalmers 1997). The recorded flight time for the species is from April 21 to May 10; it likely flies a bit earlier and/or later than this date range depending on the year. *Sympistis eleanor* is probably univoltine like other members of the species group, and since it has not been collected during any other season despite intensive sampling, although the fact that it took five years to find the moth in the first place does not rule out the possibility of later-flying generations.

The type locality is a large, stabilized dune 0.4 km from the Atlantic shoreline. It is vegetated sparsely (most notably by *Cenchrus tribuloides* Linnaeus (Poaceae) and short *Smilax* Linnaeus (Smilacaceae)) and surrounded by southern red cedar (*Juniperus silicicola* (Small) Bailey, Cupressaceae), various pines (*Pinus* Linnaeus, Pinaceae) and scrub oaks (*Quercus* Linnaeus, Fagaceae). The known distribution of *Sympistis eleanor* is currently defined by the type series. These localities are within a 2.8 km section along the Autobahn/Beach Road on the south side of Sapelo Island. It has been found in dune, grassy (surrounded by forest at the greenhouse) and forested habitats. It could potentially occur on other barrier islands along the southeastern United States coast, but extensive surveys may need to be done to find it considering the species is rarely and only recently collected on Sapelo Island.

Molecular variation. DNA barcode sequence (voucher # CNCLEP11937) of the holotype male formed a unique Barcode Index Number (BOLD:ADG0355), differing by a minimum of 5% from all other North American *Sympistis* species, but consistently clustering with species of the *badistriga* and *infixa* species-groups.

Discussion. *Sympistis* is the second-largest genus of noctuids in North America, with 178 species (Pohl et al. 2016). It is most diverse in xeric habitats of the western United States. Just four species have been recorded previously from Georgia: *S. badistriga*, *S. infixa* (Walker), *S. perscripta* (Guenée), and *S. chionanthi* (Smith). The genus was reviewed by Troubridge (2008), who described many new species (all western), and synonymized eight genera under a revised concept of *Sympistis*. Troubridge (2008) recognized 19 species-groups, defined largely by genitalic morphology, that incorporate about half of the known species.

The forewing traits of *S. eleanor*, with a simple, streaky pattern, dark basal dash and evenly sinuate antemedial and postmedial lines, are shared with members of the *infixa* and *figurata* species-groups. Although these groups are externally similar, they differ significantly in morphology. A subgroup of the *S. badistriga* species-group (Troubridge 2008) comprised of *S. badistriga*, *S. apposita* (Barnes and McDunnough), *S. stabilis*,



Figures 9–11. 9 *S. eleanor* male valve 10 Phallus 11 female bursa copulatrix

S. induta, *S. rayata* (Smith) and *S. tenuistriga* (McDunnough) is defined by absence of the stout foretibial spine, presence of a tiny, vestigial corpus bursae, and the origin of the ductus seminalis from the anterior appendix bursae. *Sympistis eleanor* exhibits all of these synapomorphies, placing it securely within the *S. badistriga* species-group. However, neither its barcode nor morphological features suggest a close relationship to any particular species, seemingly representing a distinct and likely relict eastern member within the group with a long, separate evolutionary history. This underscores the need for a phylogenetic framework for this very large, morphologically and ecologically diverse genus.

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A review of *Leucosigma* Druce, 1908: a newly discovered case of fern-feeding and descriptions of three new species (Lepidoptera, Noctuidae)

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Abstract

Chytonidia Schaus, 1914, is one of two noctuid genera originally described by Schaus that includes species recently found to feed on fern foliage (Pteridophyta) as larvae. By examining museum specimens, including type material and reared specimens accompanied by DNA barcode data, *Chytonidia* Schaus, 1914, **syn. n.** is synonymized with *Leucosigma* Druce, 1908, all currently recognized species are re-described, including males of three species described from female holotypes, and three new species are described: *Leucosigma solisae* Goldstein, **sp. n.**, *Leucosigma poolei* Goldstein, **sp. n.**, and *L. schausi* Goldstein, **sp. n.** Images of adults and, where available, larvae as well as dissected genitalia are presented, with a key to adults.

Keywords

Chytonidia, Costa Rica, DNA barcode, *Leucosigma*, pteridivore

Introduction

Chytonidia Schaus, 1914 represents one of two noctuine genera (Lepidoptera: Noctuidae) described by Schaus (1914) that have recently been found feeding on ferns (Pteridophyta) as wild-caught caterpillars inventoried at Área de Conservación Guanacaste (ACG), northwestern Costa Rica. Fern-feeding (pteridivory) by herbivorous insects is of interest because the age and toxicity of ferns, coupled with the alleged rarity of fern specialists, have occasioned a modest literature that includes hypotheses of their origins (e.g., Balick et al. 1978, Cooper-Driver 1980, Hendrix 1980, Radhika et al. 2012). However, caterpillar sampling efforts during the last four decades in ACG (Janzen and Hallwachs 2016) have documented numerous pteridivorous caterpillars, most of them specialists and most previously unknown. In an effort to characterize better the prevalence of fern-feeding behaviors, as well as to serve the larger aims of Neotropical noctuid systematics, certain basic revisionary work necessary to examine the origins and extent of caterpillar pteridivory more precisely has been undertaken. This paper is a contribution to the systematics of noctuine genera now known to comprise pteridivores, our immediate purpose being to clarify the boundaries of one such genus, describe new species discovered through efforts at ACG, associate undetermined specimens with valid names, and collate life history information to the extent possible.

In the course of this work, existing collection material is complemented with recently reared specimens accompanied by life history data and DNA barcode data, the familiar ~657bp sequence from within the cytochrome oxidase I mitochondrial gene. These data coupled with comparative morphological observations, particularly those of the male genitalic complex, enable the revised taxonomic circumscriptions and descriptions of otherwise cryptic species presented here, and supplemented by a companion piece on the related pteridivorous genus *Lophomyra* Schaus, 1911 (Goldstein et al. 2018, this issue).

Materials and methods

Pinned specimens were examined with an incandescent light source. Genitalic preparations follow Clarke (1941) in part and Lafontaine (2004), but staining with chlorazol black and slide mounting in euparal. Dissections followed either an overnight room-temperature soak in supersaturated sodium hydroxide or a 15 minute heated soak, and were examined under dissecting microscopes prior to slide mounting. Photographs were made using the Microoptics and Visionary Digital imaging systems and images manipulated with Adobe Photoshop (Adobe Systems, Mountain View, CA). Measurements were made with the aid of an ocular micrometer. Forewing length was measured from the center of the axillary area to the apex of the forewing. Terminology generally follows Lafontaine (1998, 2004).

The descriptions by Druce (1908), Dognin (1910), and Schaus (1911, 1914) were thorough, although devoted primarily to wing pattern. Rather than reproduce them, gen-

italia and other characters not treated in the original descriptions are emphasized, and diagnoses generated for each species. Full descriptions are presented for all new species.

The complex, sometimes exaggerated structures associated with the male clasping apparatus requires that the terminology be clarified surrounding at least four sets of homologous structures common to all species examined. These are enumerated in the re-description of the genus and figured and labeled accordingly in Figures 111–126 of select specimens as reference. Because of their unusual configuration, associating these structures unambiguously to corresponding features in the traditional system of Forbes is not straightforward. Forbes himself noted in his introduction to the male genitalia of noctuids that “Here the problem is not to find characters for separation, but to find enough resemblances to make possible the identification of parts” (Forbes 1954: 12). In the case of *Leucosigma*, the appearance of several variously sclerotized structures within the valve complicates the differentiation of clasper from cucullus, for example. Rather than introduce any new vocabularies, our descriptions are anchored in the least ambiguous terms possible, explaining sources of potential ambiguity and our decisions concerning their treatment as they arise.

Provisional (neighbor-joining) analyses of DNA barcode data informed the dissection efforts and were supplemented by partial sequencing of DNA extracted during the course of dissection of the type of *Leucosigma uncifera*. That extraction involved an overnight soak of the abdomen in proteinase K and sequestration of the lysate prior to soaking the abdomen in KOH per the normal dissection protocol.

For specimens recently reared or collected from ACG, the following label data precede Santa Rosa National Park (SRNP) identifier codes, and are not repeated as label data except for newly designated types: Voucher: D.H. Janzen & W. Hallwachs DB: <http://janzen.sas.upenn.edu> Area de Conservacion Guanacaste, COSTA RICA.

Repository abbreviations

The following abbreviations refer to collections from which specimens form the basis of this study:

- NHMUK** The Natural History Museum, London, UK (formerly BMNH)
USNM National Museum of Natural History [formerly, United States National Museum], Washington, District of Columbia, USA

Systematics

Schaus (1914) designated *Chytonidia chloristis* Schaus, 1914 the type species of his monobasic genus *Chytonidia*, having described *Chytonix chloe* Schaus, 1914 one page prior. Poole (1989: 251) transferred *Chytonix chloe* to *Chytonidia*, along with *Miselia albimixta* Schaus, 1911, *Chytonix commixta* Schaus, 1914, and *Gonodes viridipicta*

Dognin, 1910. Although the genus was no longer monobasic, its nomenclatural composition was substantially reshaped. While transferring *commixta* to *Lophomyra* Schaus, 1911 in a separate paper (Goldstein et al. 2018, this issue), we here synonymize *Chytonidia* with *Leucosigma* Druce, 1908) based on a range of morphological characters and in particular similarities in male genitalia. Similarities in adult morphology, wing pattern, larval behavior and a small portion of the mitochondrial genome of *Leucosigma* species to species of *Chytonidia*, including both type species, require that *Leucosigma* be recognized as the senior synonym of *Chytonidia*.

***Leucosigma* Druce, 1908**

Chytonidia Schaus, 1914, syn. n.

Type species. *Leucosigma uncifera* Druce, 1908, by monotypy.

Etymology. *Leucosigma* was presumably named in reference to the white U-shaped forewing stigma. *Chytonidia* likely derives from *χιτών*, a coat, tunic or garment worn under a tunic, possibly in reference to thoracic and abdominal tufts.

Diagnosis. Species of *Leucosigma* are diagnosed most readily by the male genitalia, in particular the nature of the highly differentiated clasping architecture, the most striking feature of which is the heavily sclerotized pincer-like cucullus on each valve. In referring to this as a cucullus, we do not interpret it as homologous to the clasper sensu Forbes; although derived from the basal sclerite, it is distinct if not entirely free of the more reduced clasper proper, which appears embedded within the sacculus and free of the basal sclerite. The cucullus bears a swollen, often bulb-like apex with a single heavily sclerotized spine, and a setose usually finger-like dorsal process (swollen apically in *L. viridipicta*). These most heavily sclerotized parts of the cucullus may appear simple and pincer-like as in *L. uncifera*, *L. poolei*, and *L. solisae*; recurved or falcate as in *L. albimixta*; asymmetrically distended with sinuate edges as in *L. chloe*; or elongate as in *L. schausi*.

Description. *Head.* Labial palpus upturned, densely scaled; second segment usually longer than combined length of the first and third. Eyes smooth or sparsely hairy. Antennae setose-ciliate; bifasciculate in males, scaled above. *Thorax.* Collar green towards the base, the remainder of the thoracic vestiture more uniformly brown, but scales actually pale at the base. *Wings.* With the exception of the type species *L. uncifera*, which exhibits dominantly reddish or russet forewing coloration, the forewings of *Leucosigma* species are mottled with a mixture of brown and mossy green, particularly in the medial and terminal areas. Reniform and orbicular spots elongate and usually fused ventrally or nearly so, forming a roughly U-shaped stigma. At least four costal striae present. Sexual dimorphism in wing pattern is most conspicuous in the hind wings, which tend to be more uniformly dark gray in the females and paler basally in the males. *Legs.* Femoral and tibial scales always with an admixture of lime green among the tan and “lilacine” (cf. Schaus 1914: 488); a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs. *Abdomen.* Vestiture usually paler than on thorax and concolor-

ous with hind wing surfaces. Abdomen without coremata, brushes, pockets or levers. *Male genitalia*. Uncus setose and variously tufted, crested, sinuate, or (in *L. viridipicta*) elongate and densely covered with clustered setae throughout. Tegumen hemi-circular to oblong, in some species raised at the base of the uncus. Vinculum shallow U- or V-shaped. Saccus bluntly pointed, rounded, or squared. Valves symmetrical, highly differentiated. For reference, we call attention to four structures numbered 1–4 in Figs 111–118 which account for much of the conspicuous diagnostic variation and which appear throughout the key and descriptions to follow: (1) the sacculus/saccular extension; (2) the cucullus, identified as such by virtue of reëntrant setae sensu Forbes (1954: 13) and what may be interpreted as an anal spine, as well as (3) a finger-like dorsal process which arcs dorso-medially *in situ* such that the apices of each process flank the uncus; and (4) a smaller finger-like, thorn-like or (in *L. viridipicta*) anvil-like clasper. Vesica unadorned, without spines or cornuti; a subbasal diverticulum ranges from rudimentary, as in *L. un-cifera*, to a large recurved torsion in *L. albimixta*. *Female genitalia*. Papillae anales blunt, subquadrate. Posterior apophyses usually at least twice as long as anterior apophyses. Lamellae antevaginales robust, ranging from narrowly concave or cup-like to more deeply invaginate, apparently co-developed with colliculum. Colliculum usually well developed but reduced or absent in some species. Ductus bursae otherwise unsclerotized, straight or with minimal torsions, attaching dorso-caudally to the corpus, sometimes with a small pre-collicular lobe. Corpus bursae without signa, oblong, sometimes appearing subtriangular when distended by presence of spermatophore(s). Appendix bursae undifferentiated except as a swollen ventral point of attachment to the ductus seminalis. Spermatophore collum, when visible, appears with a single loop; frenum with a concave face matching the interior surface of appendix bursae at its point of attachment to the ductus seminalis. Paired pad-like sternal sclerotizations on A7 are visible in some specimens.

Distribution. Mexico, Caribbean, Central and South America.

Biology. All known caterpillars feed on leaves of ferns (Pteridophyta).

Remarks. As is often the case, the type species of *Leucosigma* is perhaps the most phenotypically atypical of the genus. Known only from adult specimens taken at lights, the life history is unknown, although it may be reasonably suspected that the larva is a fern feeder. Species circumscription and nomenclatural assignment in this work has of necessity involved a combination of recently collected specimens for which DNA barcodes have been generated and historical specimens for which they have not, these latter including (for the present, at least) type specimens, several of which are females.

Key to known species of *Leucosigma* based on structures of the male genitalia.

Numbers 1–4 refer to structures labeled in figures.

- | | |
|---|---|
| 1 | Saccular extension (1) with sclerotized point at apex; clasper (4) well developed, elongate, thorn-like or gently sinuate <i>L. schausi</i> |
| – | Saccular extension not sclerotized apically; clasper (4) club-like, recurved and pointed, or anvil-like..... 2 |

- 2 Dorsal and ventral edges of cucullus (2) sinuate; clasper (4) recurved...***L. chloe***
- Cucullus (2) modified distally to form simple hook- or chelicera-like point, either symmetrical or with deformation confined to the dorsal edge; clasper (4) recurved to a fine point, finger-like, or anvil-shaped..... **3**
- 3 Distal end of cucullus aduncate; distance from vertex at outer edge to tip occupying less than 1/4 length of sclerotized part; clasper (4) simple, recurved, or otherwise modified..... **4**
- Distal end of cucullus (2) chelicerate, the outer edge of apex swollen such that distance to tip occupies ~1/3 length of heavily sclerotized part; clasper (4) rudimentary, finger-like, never sharply recurved or hooked..... **6**
- 4 Distal part of cucullus (2) essentially straight without noteworthy angular deformation, ventral edge bulging; clasper (4) recurved and sharply pointed.....
.....***L. reletiva***
- Distal part of cucullus (2) bent slightly backwards along outer edge, before hooking sharply inward at apex; clasper (4) not sharply hooked..... **5**
- 5 Costal lobe (3) elongate, finger-like; costal process of the sacculus (4) simple ...
.....***L. albimixta***
- Dorsal process (3) swollen at tip; cucullus (#2) with medially produced flange marking developmental separation from dorsal edge of clasper (4) which appears anvil-like..... ***L. viridipicta***
- 6 Inner edge of cucullus (2) distal to its fusion with dorsal process (3) straight for more than half its length before forming 90° angle/curve in its distal half
..... ***L. uncifera***
- Inner edge of cucullus (2) distal to its fusion with dorsal process (3) begins to curve in its basal half..... **7**
- 7 Outer edge of cucullus (2) bending abruptly, the spine perpendicular to the long axis of the cucullar stem (cf. *L. uncifera*) ***L. solisae***
- Outer edge of cucullus (2) bending gradually, the spine at an obtuse angle to the long axis of the cucullar stem ***L. poolei***

***Leucosigma uncifera* Druce, 1908**

Figs 1–6, 13, 14, 23, 24; Male genitalia: Figs 53–56, 77–80, 111, 112; Female genitalia Fig. 105

Leucosigma uncifera Druce, 1908: 302. Type locality: Peru: [Puno] Carabaya, La Oroya. Poole (1989) included *Leucosigma* Hampson, 1908 (preoccupied) as a junior synonym of *Leucosigma* Druce, 1908.

Material examined. Type material. HOLOTYPE ♂: La Oroya, Carabaya, Peru, 3000 ft. iii. 1905. G. Ockenden., B. 433 4462, Brit. Mus. 1930-75, *Leucosigma uncifera* type, Druce, Type, NHMUK010606200. Type at NHMUK (BMNH).

Other material examined. COSTA RICA: (14♂,5♀): *Males:* Guanacaste (9♂): Sector Cacao: Cima, 10.93259, -85.45889, el. 1450m, 07/12/2010, F. Quesada & S. Rios, collector, 10-SRNP-111595, USNMENT01437310, 09-SRNP-100529, USNMENT01437201; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 03/03/2006, H. Cambronero & F. Quesada, collector, 06-SRNP-102855, USNMENT01437242; Sector Del Oro: Serrano, 11.00023, -85.45621, el. 585m, 11/08/2007, F. Quesada & S. Rios, collector, 07-SRNP-109808, USNMENT01437187; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/16/2007, F. Quesada & S. Rios, collector, 07-SRNP-100616, USNMENT01437320; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/17/2007, S Rios & F. Quesada, collector, 07-SRNP-101239, USNMENT01437200; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/16/2007, F. Quesada & S. Rios, collector, 07-SRNP-100629, USNMENT01438859; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 03/01/2006, S. Rios & R. Franco, collector, 06-SRNP-102374, USNMENT01438843, USNM Dissection 148199; Sector Cacao: Cima, 10.93259, -85.45889, el. 1450m, 07/12/2010, F. Quesada & S. Rios, collector, 10-SRNP-111594, USNMENT01437221; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/17/2007, S Rios & F. Quesada, collector, 07-SRNP-101266, USNMENT01437266; Alajuela (5♂): Sector Rincon Rain Forest: Rio Francia, 10.90425, -85.28651, el. 410m, 01/24/2009, R. Franco & S. Rios, collector, 09-SRNP-100529; Sector Rincon Rain Forest: Albergue Oscar, Casa, 10.86623, -85.32693, el. 719m, 01/03/2011, H. Cambronero & F. Quesada, collector, 11-SRNP-100029, USNMENT01438838, USNM Dissection 148102; Sector Rincon Rain Forest: Wege Palmeras, 10.96869, -85.31965, el. 369m, 10/22/2014, S. Rios & H. Cambronero, collector, 14-SRNP-104353, USNMENT01437217; Sector Rincon Rain Forest: Albergue Oscar, Casa, 10.86627, -85.32605, el. 725m, 02/11/2010, S. Rios & F. Quesada, collector, 10-SRNP-104917, USNMENT01437285; Sector San Cristobal: Estacion San Gerardo, 10.88009, -85.38887, el. 575m, 10/11/2007, F. Quesada & R. Franco, collector, 07-SRNP-109451, USNMENT01370293, USNM Dissection 148101. *Females:* Costa Rica. Tuis. 2,500 ft. June. W. Schaus. 1910-110. *Leucosigma uncifera* Druce, NHMUK010606201; Guanacaste (4♀): Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/28/2006, S. Rios & H. Cambronero, collector, 06-SRNP-101607, USNMENT01437350; Sector Pailas: Manta Copelares, 10.81692, -85.34679, el. 1478m, 09/07/2010, S. Rios & R. Franco, collector, 10-SRNP-113265, USNMENT01437197, USNM Dissection 148103; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 04/03/2011, F. Quesada & S. Rios, collector, 11-SRNP-102284, USNMENT01437255, USNM Dissection 148104; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 11/13/2012, S. Rios & H. Cambronero, collector, 12-SRNP-105657, USNMENT01370289.

Diagnosis. The predominantly orange-russet forewing coloration and U-shaped solid white stigma diagnose this species from all others currently described; apical patch reduced to a white line extending from R5 to costa; post-medial line complete

on underside of forewing, where terminal area appears dusted in green and contrasts with medial area; postmedial line almost complete on underside of hind wing. Cucullus pincer-like, the inner edge distal to its juncture with dorsal process straight for more than half its length before bending sharply and terminating in a sharp point.

Re-description. Head. Male and female antennae setose-ciliate with dorsal cupreous scales; male antennae bifasciculate. Frons, vertex, and basal two segments of labial palpus with orange/russet-colored scales; 3rd segment palpus and antennal scape edged with white scaling. Eyes smooth.

Thorax. Patagial “fans” appearing banded, two patches of green scales towards base, purplish medially, becoming paler or sunset-orange towards the crest; remainder of prothoracic vestiture a mix of purplish and russet scales. **Wings.** Forewing length 10.5 mm (holotype, male), average 10.3 mm (males, $n = 4$), 11.0 mm (females, $n = 2$). Predominantly russet orange; grayish purple in the spaces between R4 and R5, M1 and M3, and CuA2 and 1A. U-shaped stigma uniformly white. Moss-green scaling in the outer part of the apical patch and in the medial area towards the inner margin. Basal, antemedial, and postmedial lines white along inner edges, black outward; medial line more faint. Underside pattern elements more distinct than in other *Leucosigma* species): both forewing and hind wing postmedial lines visible, the postmedial area suffused throughout with green scaling. **Legs.** Scales predominantly pinkish; femoral and tibial scales with an admixture of lime green; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Male dorsum covered uniformly in tannish-gray scales and hairs, predominantly lilac gray in females; abdominal underside more variably scaled with lilacine and reddish brown.

Male genitalia. Uncus elongate, widest subapically, upwardly curved with a very small apical point, and bearing ventral setal crest. Tegumen raised at base of uncus. Vinculum a shallow V-shape; saccus bluntly pointed. Juxta pentagonal, dorsal edge horizontal; annellar arms fused, hoop-like. Sacculus (1) rounded apically, without sclerotized tip or point, its edges and those of dorsal process (3) setose; cucullus (2) appearing chelicerate, the sclerotized part occupying $>1/3$ its overall length but bending sharply at the outer edge near the sharply pointed apex with a subapical tuft of reentrant spine-like setae; finger-like dorsal process (3) coequal in width to cucullus, to which it is joined midway; clasper (4) an elongate, bent free sclerite, embedded in sacculus. Distal part of aedeagus and basal part of vesica minimally spinulose, with small sclerotized apical flange and small, bilobate subbasal diverticulum.

Female genitalia. Posterior apophyses less than twice as long as anterior apophyses. Lamella antevaginalis invaginated posteriorly, convex anteriorly. Colliculum undeveloped. Ductus undifferentiated, dimensionally intermediate for genus (cf. *L. chloe*, below), similar in length to 8th abdominal segment. Corpus bursae elongate, obliquely bent, banana-shaped or sub-triangular when distended with spermatophore(s).

Immature stages. Unknown.

Etymology. Likely refers to the u-shaped forewing stigma.

Biology. The life history of this species is unknown; to our knowledge, this species has never been reared, and has only been taken at lights. All SRNP-coded specimens with DNA barcodes examined were light-trapped in ACG rain forest.

Distribution. Costa Rica, Peru. Specimens identified as *L. uncifera* are reported and have been DNA barcoded from Ecuador, Venezuela, and French Guiana.

Remarks. The brightly colored orange-russet *Leucosigma uncifera*, the type species of *Leucosigma*, is the most visually distinct and atypical of the entire group, but the male genitalia are strikingly similar to those of *L. solisae*. DNA barcode data suggest the existence of undescribed species in a complex with *L. uncifera*, and it is not unlikely that additional sampling will reveal that the Costa Rican species are not conspecific with typical *L. uncifera*.

Leucosigma reletiva Dyar, 1914

Figs 19, 20, 29, 30; Male genitalia: Figs 61, 62, 91, 92, 115, 116; Female genitalia: Fig. 110

Leucosigma reletiva Dyar, 1914. Type locality: [Panama] Trinidad River, female.

Material examined. Type material. HOLOTYPE ♀: **PANAMA:** A Busck coll, Rio Trinidad Mar. 12 Pan., Type No. 15839 U.S.N.M., *Leucosigma reletiva* Type Dyar, USNMMENT00973166, ♀ USNM Dissection 148170. Type at USNM.

Other material examined. COSTA RICA (2♂): Alajuela: Sector Rincon Rain Forest: Protrero Chaves, 10.93868, -85.32167, el. 433m, 08/18/2009, R. Franco & S. Rios, collector, 09-SRNP-107116, USNM Dissection 148177, USNMMENT01370297; Guanacaste: Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/17/2007, S Rios & F. Quesada, collector, 07-SRNP-101206, USNM Dissection 148178, USNMMENT01437211.

Diagnosis. Wing patterning not readily differentiated from that of *L. chloe*, although overall paler in the specimens examined and figured here, possibly reflecting wear. Both *L. reletiva* and *L. chloe* have in common with *L. schausi* a reniform spot with a straight outer edge, squared at the lower corner. Male genitalia similar in some respects to those of *L. chloe*, especially in the recurved, pointed clasper, but sacculus wider and cucullus less sinuate apically, aduncate, with pronounced subapical setal fan as in *L. albimixta*; vesica with small distal secondary lobe.

Re-description. Head. Antennae setose-ciliate, bifasciculate in males, scaled above with alternating tan and brown bands of spatulate scales. Frons, vertex, and labial palpus with mixture of gray, brown, and some purplish scales; frons paler than vertex. Eyes sparsely hairy.

Thorax. Thoracic vestiture a mix of grayish-tan scales tipped with brown, a pair of green-scaled patches at base of pagatial fan. **Wings.** Forewing length 11.8 mm (holotype, female), average 12.0 mm (males, $n = 2$). Forewing pale, slightly cupreous baso-medially

such that the gray medial line stands out; fused reniform-orbicular stigmata green, outlined in white, bracket a brown patch outlined in dark brown; terminal area shaded with green; apical patch silvery white; hind wings uniformly gray above in male and female alike, hind wing undersides shaded towards costa, postmedial line broken. *Legs*. Scales grayish brown, mostly concolorous with thoracic vestiture; femora and tibia with an admixture of lime-green scales; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs, as for other members of the genus.

Abdomen. Dorsum covered in uniformly tannish-brown scales and hairs; ventral side more darkly scaled with two rows of paler tan scales on either side of the medial line (cf. *L. chloe*, below).

Male genitalia. Uncus elongate, widest subapically, upwardly curved with a small apical point. and bearing ventral crest of short setae. Tegumen hemi-circular or nearly so. Vinculum cup-shaped. Saccus squared off. Juxta spade-shaped, with a mid-dorsal projection; annellar arms fused, hoop-like. Sacculus (1) bluntly rounded, heavily setose; sclerotized part of cucullus (2) elongate, concave, aduncate with a subapical setal fan; dorsal process (3) widest medially, densely setose apically; clasper (4) recurved to a point. Aedeagus faintly granular towards vesica, where the sclerotized part is narrowed to a sinuous strap. Vesica without cornuti; paired subbasal and medial diverticula knoblike, with a small apical diverticulum present.

Female genitalia. Posterior apophyses less than twice as long as anterior apophyses. Lamella antevaginalis V-shaped, deeply invaginated posteriorly. Ostium wide. Colliculum welldeveloped. Ductus undifferentiated except for small pre-collicular lobe. Corpus bursae obliquely shaped, sub-triangular when distended with spermatophore(s). Ductus bursae robust, not $>3\times$ long as width at middle. Colliculum present, well developed. With two spermatophores, maintaining a very roughly foot-shaped appearance, the distal (anterior) part of the bursa distended to accommodate the corpus of the spermatophore (cf. holotype of *L. uncifera*).

Immature stages. Undocumented.

Biology. Feeding on foliage of *Bolbitis portoricensis* (Dryopteridaceae) in ACG rain forest (96-SRNP-11467).

Distribution. Costa Rica, Panama.

Remarks. Dyar described this species on the basis of a single female holotype specimen in poor condition which he nevertheless recognized as having kinship with *L. uncifera*.

***Leucosigma albimixta* (Schaus, 1911), comb. n.**

Figs 39, 40, 49, 50; Male genitalia: Figs 66–68, 85–87; Female genitalia: Figs 106; Larvae: Figs 131–134

Chytonidia albimixta Schaus, 1911 Type locality: Costa Rica.

Material examined. Type material. Holotype ♀: *Miselia* sp. not in USNM, *Miselia albimixta* type Schs, Type No. 17326 [526?] USNM, Juan Vinas CR, May, USNM Dissection 148184, USNMENT01370283. Type at USNM.

Other material examined (5♂, 1♀). **COSTA RICA** (4♂): Alajuela (2♂): Sector Rincon Rain Forest: Albergue Oscar, Casa, 10.86627, -85.32605, el. 725m, 01/15/2010, F. Quesada & S. Rios, collector, 10-SRNP-104564, USNM Dissection 148,305, USNMENT01370298; Sector Rincon Rain Forest: Manta Hugo, 10.8811, -85.2677, el. 491m, 03/15/2009, H. Cambronero & F. Quesada, collector, 10-RNSP-107587, USNM Dissection 148069, USNMENT01437230. Guanacaste (2♂): Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, larva on *Elaphoglossum doanense*: 02/14/2011, ecl. 03/29/2011, Manuel Rios, collector, 11-SRNP-30511, USNM Dissection 148085, USNM 00105321; Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 03/18/2007, H. Cambronero & S. Rios, collector, 07-SRNP-102199, USNM Dissection 148068, USNMENT01437365 **GUATEMALA** (1♂, 1♀): Chejel Guat, Aug, Schaus and Barnes coll., ♂ genitalia on slide Aug 1953 E.L.T. #138, ♂ USNM Dissection 50,548, USNMENT01437345; Chejel Guat, Aug, Schaus and Barnes coll., ♀ genitalia on slide Aug 1953 E.L.T. #139, ♀ USNM Dissection 50,549, USNMENT01370282.

Diagnosis. Largest *Leucosigma* species, forewing approaching 1.5cm on average (see below), and the only species with most of the medial area of the forewing upper-side dominated by green; the terminal area also with green scaling, the components of the fused reniform-orbicular swollen and outlined in white, appearing more bulbous than in any other species except the much smaller *L. viridipicta*, with which *L. albimixta* is not likely confused; terminal area well defined on hind wing underside, more extensively shaded in green than in other species; clasper swollen, fan-like and concave medially with short acutely recurved apical hook. Ductus bursae narrow as in *L. poolei* but point of attachment to corpus bursae dorsal; colliculum diminutive as in *L. unciifera* and *L. poolei*.

Re-description. Head. Antennae setose-ciliate, bifasciculate in males, scaled above with alternating tan and brown bands of spatulate scales. Scaling on frons, vertex, and labial palpi predominantly brown, interspersed with black and white. Labial palpus with third segment relatively longer than in congeners, almost half the length of the second segment. Eyes sparsely hairy, with a post-ocular ring of dark-purplish hair-like scales.

Thorax. Collar green scaled; a sublabial green beard-like tuft observed in one male specimen (USNM 00105321). **Wings.** Forewing length 14.9 mm (holotype, female), average 14.4 mm (males, $n = 5$), 14.8 mm (females, $n = 2$). Medial and terminal areas of forewing dominated by green, especially so the distended "U" comprising the fused reniform-orbicular complex; basal and postmedial areas dominated by brownish-gray scaling; underside patterning concentrated in costal and terminal areas, with neither a discal spot nor robust antemedial or postmedial lines apparent excepting a partial postmedial on the forewing. **Legs.** Green scale tufts on inner mid- and hind-femora,

the remaining femoral scales white, brown, and black, and the tibial scaling primarily green and white; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Uniform grayish tan above; underside a mix of white and light/dark brown with medial patches of green.

Male genitalia. Uncus elongate, upwardly curved with a small apical point and bearing ventral setal crest. Tegumen \cap -shaped. Vinculum widely V-shaped. Saccus squared off. Juxta dihedral, subquadrate with the dorsal and ventral edges deformed in parallel (the dorsal invaginated and the ventral evaginated); annellar arms fused, hoop-like. Sacculus (1) simple, tapered; cucullus (2) curved outward apically before recurving to a fine point, supapical setal fan prominent; dorsal process (3) elongate, gently tapered, setose throughout; clasper (4) upturned, apex foot-shaped. Aedeagus with a sclerotized band of raised granules and a more distal patch of spinules. Vesica without cornuti; subbasal diverticulum bulbous; medial diverticulum an enlarged simple torsion.

Female genitalia. Posterior apophyses nearly twice as long as anterior apophyses. Lamella antevaginalis deeply invaginated posteriorly. Ostium narrow. Colliculum reduced. Ductus elongate, narrow, $>0.5\times$ length of corpus bursae, itself elongate, obliquely shaped; appendix bursae bulbous.

Immature stages. Known only from images (Figs 131–134). The larva of *L. albimixta* is predominantly light green with a fine, pale ramifying pattern and a series of raised, rust-colored lateral spiracular patches; a broken white supra-spiracular line encloses the antero-ventral half of a small dark spot above each spiracle; dorsal pinacula raised; head capsule yellow with scattered red markings; dorsum of metathoracic segment tapers downward from anterior part of A1 at 45° angle.

Biology. Caterpillar found feeding on foliage of *Elaphoglossum doanense* (Dryopteridaceae) in ACG rain forest. In the reared male specimen for which data are available (11-SRNP-30511; Figs 66, 85, 131–134), 26 days elapsed between the prepupal stage and adult eclosion. Other ACG specimens were light-trapped.

Distribution. Costa Rica, Guatemala.

***Leucosigma chloe* (Schaus, 1914), comb. n.**

Figs 7–12, 21, 22, 31, 32; Male genitalia: Figs 63, 64, 89, 90, 117, 118 (terminalia in situ), 119–123; Female genitalia: Figs 100, 101, 107, 129, 130 (abdominal terminus, ventral aspect)

Chytonix chloe Schaus, 1914. Type locality: French Guyana.

Chytonidia chloristis Schaus, 1914: 489.

Material examined. Type material. HOLOTYPE ♀: St Jean, Maroni, Fr Guiana, *Chytonix chloe* Type Schs, Type No. 16531 U.S.N.M., Collection Wm Schaus, USNM Dissection 148175, USNMENT01370295. Type at USNM.

Other material examined. (11♂, 14♀). **FRENCH GUIANA** (2♀): [HOLOTYPE of *Chytonidia chloristis*, syn. of *chloe*]: ♀ St Jean, Maroni, Fr Guiana, *Chytonidia chloristis* Type Schs, Collection Wm Schaus, Type No. 16533 U.S.N.M., USNM Dissection 148185, USNMENT01370300; Dates 6-8 Mar 1982 Guyane Francaise G. Tavasillian [illeg.] leg. BORWE I [illeg.], 376, USNMENT01370375.

COSTA RICA (11♂, 11♀): *Males*: COSTA RICA: Turrialba 17-21.II.65 SS&WD Duckworth, USNM Dissection 148151, USNMENT01437357 (♂); Guanacaste (10♂): Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 11/10/1996, ecl. 10/21/1996, 96-SRNP-11370, USNMENT01437307; Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 11/12/1996, ecl. 10/21/1996, 96-SRNP-11369, USNM Dissection 148,289, USNMENT01437372; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 03/18/2010, ecl. 02/15/2010, Ricardo Calero, collector, 10-SRNP-70814, USNMENT01437206; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 03/21/2010, ecl. 02/15/2010, Dinia Martinez, collector, 10-SRNP-70815, USNM Dissection 148200, USNMENT01437250; Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 11/13/1996, ecl. 10/21/1996, 96-SRNP-11375, USNM Dissection 148070, USNMENT01438814; Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 11/12/1996, ecl. 10/21/1996, 96-SRNP-11372, USNM Dissection 148071, USNMENT01437315; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 08/22/2010, ecl. 07/23/2010, Ricardo Calero, collector, 10-SRNP-72329, USNM Dissection 148168, USNMENT01437257; Sector Cacao: Estacion Gongora, 10.88449, -85.47306, el. 557m, 09/11/2007, R. Franco & S. Rios, collector, 07-SRNP-108955, USNM Dissection 148055, USNMENT01437367; Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 11/11/1996, ecl. 10/21/1996, 96-SRNP-11373, USNMENT01437360; Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 11/13/1996, ecl. 10/21/1996, 96-SRNP-11371, USNMENT01370286.

Females: Guanacaste (9♀): Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 10/21/1996, ecl. 11/21/1996, 96-SRNP-11376, USNMENT01437271; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 07/20/2010, ecl. 08/17/2010, Ricardo Calero, collector, 10-SRNP-72238, USNMENT01437347; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 07/22/2010, ecl. 08/19/2010, Dinia Martinez, collector, 10-SRNP-72308, USNMENT01437272; Sector Pitilla: Quebradona, 10.99102, -85.39539, el. 475m, larva on *Microgramma percussa*: 02/04/2010, ecl. 03/10/2010, Ricardo Calero, collector, 10-SRNP-70655, USNMENT01437302; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 08/02/2010, ecl. 09/11/2010, Ricardo Calero, collector, 10-SRNP-72520, USNMENT01437280; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 11/07/2010, ecl.

12/20/2010, Ricardo Calero, collector, 10-SRNP-73250, USNMENT01437292; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 07/13/2010, ecl. 08/15/2010, Ricardo Calero, collector, 10-SRNP-72038, USNM Dissection 148072, USNMENT01437382; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 02/04/2012, ecl. 03/07/2012, Ricardo Calero, collector, 12-SRNP-70275, USNM Dissection 148054, USNMENT01437297; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 07/16/2013, ecl. 08/10/2013, Ricardo Calero, collector, 13-SRNP-71183, USNMENT01437287. Alajuela (2♀): Sector Rincon Rain Forest: Estacion Botarrama, Manta Porton, 10.96048, -85.28237, el. 147m, F. Quesada & R. Franco, collector, 09-SRNP-108544, USNM Dissection 148169, USNMENT01437380; Sector Cacao: Estacion Gongora, 10.887, -85.47443, el. 570m, larva on *Bolbitis portoricensis*: 10/21/1996, ecl. 11/12/1996, 96-SRNP-11374, USNMENT01370299.

BRAZIL (1♀): Sao Paulo de Olivenca Amazonas Fassl Novembre-December, USNM Dissection 148152, USNMENT01437322

Diagnosis. Forewing similar to that of *L. reletiva* but forewing overall more darkly shaded in specimens examined; reniform spot with a straight outer edge, squared at the lower corner as in *L. reletiva* and *L. schausi*; male hind wing pale basally in males, not uniformly shaded as in *L. reletiva*. Cucullus with highly distinct asymmetrical deformations along both edges subapically, the apical point (\approx anal spine) ventrally curved.

Re-description. Head. Antennae setose-ciliate, bifasciculate in males, scaled above with indistinctly banded tan and brown scales. Frons, vertex, and labial palpi with scales heterochromously shaded in tannish brown. Eyes sparsely hairy.

Thorax. Prothoracic vestiture brown, sprinkled with green; dorsal tuft well developed. **Wings.** Forewing length 11.8 mm (holotype, female), average 11.3 mm (males, $n = 8$), 11.7 mm (females, $n = 8$). **Legs.** Femora thickly scaled with brown and black, the mid- and hind-femora with green scaling in addition; tibiae uniformly less densely scaled, in pale tan; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Dorsum covered in uniformly tannish-brown scales and hairs; dorso-lateral tufts of hairs on anterior segments; ventral side more darkly scaled with two rows of paler tan scales on either side of the medial (cf. *L. reletiva*, above).

Male genitalia. Most similar to *L. uncifera* in size, but with the shape of the cucullus at its apex highly distorted, asymmetrical. Uncus crested, distended medially, upwardly turned with long apical point and ventral crest of short setae. Tegumen with dorsal edge nearly straight, the lateral edges outwardly sub-parallel. Vinculum cup-shaped. Saccus bluntly triangulate. Juxta spade-shaped, with a mid-dorsal projection; annellar arms fused, hoop-like. Sacculus (1) tapered to a dull point, the dorsal and ventral edges straight. Edges of cucullus (2) asymmetrical, sinuate, apical spine produced along ventral edge; dorsal process (3) undifferentiated. Clasper (4) robust, recurved to a point (cf. *L. reletiva*). Aedeagus with distal sclerotization faintly strap-like, and minimally rugose, somewhat granular towards vesica. Vesica likewise

faintly granular basad, without cornuti; subbasal diverticulum moderately distended with a pair of smaller lobes and a pouch-like invagination with a weakly sclerotized margin as in *L. reletiva*.

Female genitalia. Posterior apophyses more than twice as long as anterior apophyses. Lamella antevaginalis invaginate. Colliculum well developed. Ductus intermediate for genus, 2–4× as long as wide. Corpus bursae sub-triangular when distended; appendix bursae a small bulbous out-pouching.

Immature stages. No images or specimens available.

Biology. Caterpillars found in ACG rain forest feeding on foliage of *Bolbitis portoricensis* (Dryopteridaceae) and *Microgramma percussa* (Polypodiaceae). Of 20 reared specimens (6 males, 14 females) an average of 19 days elapsed between the onset of the prepupal stage and adult eclosion, with most individuals requiring 19 or more days.

Distribution. Costa Rica, French Guiana.

Remarks. *Leucosigma chloe*, its synonym (and the type species) *L. chloristis*, and *L. reletiva* were all described from female holotypes.

***Leucosigma viridipicta* (Dognin, 1910), comb. n.**

Figs 41, 42, 51, 52; Male genitalia: Figs 65, 88, 113, 114, (*terminalia in situ*) 127, 128

Gonodes viridipicta Dognin, 1910: 13. Type locality: French Guiana: St. Laurent du Maroni.

Material examined. Type material. FRENCH GUIANA: HOLOTYPE ♂; S. -Laurent de Maroni Guy Franc; Dognin collection, *Gonodes viridipicta* 1/10 Type ♂ Dognin not in USNM [illeg.], Type No. 32413 U.S.N.M., ♂ USNM Dissection 148176, USNMENT00973419. Type at USNM.

Other material examined. (1♂). PERU: Huacamayo, Carabaya, dry seas., 3100 ft, June 04. (G. Ockenden), Rothschild Bequest B.M. 1939-1, NHMUK01606202.

Diagnosis. Smaller than *L. albimixta*, with fused orbicular and reniform spots similarly swollen, but with the basal, antemedial, and postmedial lines less conspicuously highlighted in black and white. Cucullus with medial flange directed basad, its ventral edge precisely complementing the dorsal edge of clasper from which it appears to have been separated during development; apices of the costal lobes swollen.

Re-description. Head. Antennae setose-ciliate, bifasciculate in males, scaling above uniformly grayish brown. Vertex and labial palpi with scales predominantly grayish brown; frons and inner face of palpus with paler scaling. Eyes smooth.

Thorax. Prothoracic scales grayish brown, concolorous with vertex. **Wings.** Forewing length 10.9 mm (holotype, male), average 10.8 mm (males, $n = 2$). Apical patch dominantly green on forewing upperside and underside, and on underside of hind wing. **Legs**—Scaling predominantly tannish brown, more or less concolorous with thoracic vestiture; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Dorsum covered in uniformly tannish-brown scales and hairs; ventral side more darkly scaled, especially at terminal tuft; some pinkish scaling ventrally.

Male genitalia. Uncus robust and densely setose, almost bottlebrush-like for distal 3/4, the setae blonde, concolorous with neighboring setal tufts, and arranged in clusters sharing a single socket and shingled, appearing scale-like *in situ*. Tegumen raised at base of uncus. Vinculum laterally concave. Saccus blunt. Juxta rhomboid, without a dorsal projection. Sacculus (1) wide, barely tapered. Cucullus (2) bent backward (ventro-cephalad) and bears basally directed flange marking separation from dorsal edge of clasper, evidently ruptured during development of especially robust dorsal processes (3); each dorsal process swollen apically, resembling a ball-headed Native American war club, heavily setose, and with a conspicuous tuft of ventro-medially directed spine-like setae. Clasper (4) anvil shaped, its dorsal edge complementing the ventral edge of the cucullar flange. Aedeagus weakly sclerotized, granular appearance continuing to base of vesica; subbasal diverticulum asymmetrically bulbous, dumbbell-shaped.

Female genitalia. Unknown.

Immature stages. Unknown.

Biology. Unknown.

Distribution. French Guiana, Peru.

Remarks. Female specimens at MNHN (Paris) were not available for study. This species is noteworthy in that the uncus is covered in shingled, scale-like clusters of setae (Figs 65, 127, 128), reminiscent of other fern-feeding species in the genus *Lophomyra*. The relationship between these genera requires more thorough sampling and analysis of both taxa and genes.

***Leucosigma solisae* Goldstein, sp. n.**

<http://zoobank.org/C50ACC24-E816-4019-8FF5-7690574D9D3B>

Figs 15, 16, 25, 26; Male genitalia: Figs 57, 58, 81, 82

Material examined. Type material. HOLOTYPE ♂. Voucher: D.H. Janzen & W. Hallwachs DB: <http://janzen.sas.upenn.edu> Area de Conservacion Guanacaste, COSTA RICA, Sector Pitilla: Estacion Pitilla, 10.98931, -85.42581, el. 675m, 02/17/2007, S. Rios & F. Quesada, collector, 07-SRNP-101229, ♂USNM Dissection 148077, USNMENT01370294.

PARATYPES (2♂). **COSTA RICA:** (1♂): Alajuela: Sector Rincon Rain Forest: Estacion Caribe, 10.90082, -85.2764, el. 391m, 10/10/2007, S. Rios & H. Cambronero, collector, 07-SRNP-109201, ♂USNM Dissection 148078, USNMENT01437370. **PERU** (1♂): La Oroya, R. Inambari, Peru, Sept. 1904 3100 ft, dry seas., (G. Ockenden), Rothschild Bequest B.M. 1939-1., NHMUK010606203. Types at USNM.

Diagnosis. Forewing terminal area and distal part of the medial area appearing more uniform purplish gray than in other species, giving the wing a smoother, less granular appearance overall. The reniform-orbicular complex forms a continuous

green “ Ψ ” (left wing) or “ μ ” (right wing), the outline of which is broader than in other species except *L. albimixta* and *L. viridipicta*; the green (not silvery-white) apical patch distinguishes this and the following species from other members of the genus; hind wing underside with discal spot present but unpronounced, unlike *L. poolei* below. Male genitalia most similar to those of *L. poolei* and *L. uncifera*, distinguished by a shorter and more gently arced distal part of the cucullus; vesica without small basal lobe as in *L. poolei*.

Description. Head. Antennae setose-ciliate, bifasciculate in males, scaled above with alternating bands of gray (basal) and tan (apical). Frons, vertex, and labial palpi scaled with an admixture of white, brown and black. Eyes smooth.

Thorax. Excepting vestiges of green visible immediately behind head, thoracic vestiture uniformly purplish gray. *Wings.* Forewing length 13.7 mm (holotype, male), average 13.3 mm (males, $n = 3$). Forewing predominantly lilacine, russet subcostally in the postmedial; apical and anal patch present; green scaling concentrated at inner margin, apical and anal patch, and Ψ/μ -shaped medial stigma. Medial area cupreous; medial, antemedial, and postmedial lines visibly darker brown; terminal area green in Costa Rican specimens, more closely matching medial coloration or slightly darker reddish brown in Peruvian specimen; apical patch primarily green; forewing underside lightly suffused with green scaling in terminal area; no antemedial or postmedial lines present on underside except at most as costal striae. *Legs.* Scales predominantly purplish gray; femora and tibia with an admixture of lime-green among the tan-lilacine scales; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Vestiture uniformly tannish gray, paler than on thorax.

Male genitalia. Uncus elongate, widest subapically, upwardly curved with a very small apical point, and bearing ventral setal crest. Tegumen roughly hemi-circular, excepting a deformation of the dorsal edge at the base of the uncus. Vinculum a wide V-shape; saccus blunt. Juxta pentagonal, dorsal edge horizontal; annellar arms fused, hoop-like. Sacculus (1) densely setose, tapering to a blunt extension. Cucullus (2) appears chelicerate, the sclerotized part occupying $\sim 1/3$ the overall length and bending sharply at the outer edge near the sharply pointed apex, with a subapical tuft of reëntrant spine-like setae. Dorsal process (3) coequal in width to cucullus, setose apically. Clasper (4) finger-like, gently curved. Aedeagus with minutely but differentially spinulose patch confined to apex. Vesica without cornuti; subbasal and medial diverticula reduced, with a weakly sclerotized ridge.

Female genitalia. Unknown.

Immature stages. Unknown.

Etymology. The name *solisae* is given in honor of Dr. Alma Solis, lepidopterist at USDA/USNM who has contributed her expertise to the systematics of the Costa Rican lepidopteran fauna for three decades.

Biology. Unknown, collected only in rain forest light traps.

Distribution. Costa Rica, Peru.

***Leucosigma poolei* Goldstein, sp. n.**

<http://zoobank.org/13EEBE89-A3B2-4B05-93E9-B8181A9B1CC7>

Figs 17, 18, 27, 28; Male genitalia: Figs 59, 60, 83, 84; Female genitalia: Figs 102, 103; Larvae: Figs 147–154

Material examined. Type material. (6♂, 2♀). **COSTA RICA:** HOLOTYPE: ♀ Voucher: D.H. Janzen & W. Hallwachs DB: <http://janzen.sas.upenn.edu> Area de Conservacion Guanacaste, COSTA RICA, Sector Pitilla: Quebradona, 10.99102, -85.39539, el. 475m, larva on *Microgramma percussa*: 02/09/2010, Ricardo Calero, collector, 10-SRNP-70737, ♀ USNM Dissection 148073, USNMENT01370296.

PARATYPES (5♂, 1♀): Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 10/02/2010, ecd. 11/10/2010, Ricardo Calero, collector, 10-SRNP-73038, ♀ USNM Dissection 148074, USNMENT01438839; Ibid, ♂ [abdomen missing]; Sector Pitilla: Sendero Rotulo, 11.01355, -85.42406, el. 510m, larva on *Elaphoglossum doanense*: 07/10/2010, ecd. 08/17/2010, Manuel Rios, collector, 10-SRNP-31675, USNMENT01438823; COSTA RICA: Turrialba 22-28. II.65 SS & WD Duckworth, ♂ USNM Dissection 148147, USNMENT01370290; Ibid, ♂ USNM Dissection 148149, USNMENT01437186; Ibid, 1-6.III.65, ♂ USNM Dissection 148150, USNMENT01437330; Ibid, ♂ USNM Dissection 148148, USNMENT01438829. Types at USNM.

Diagnosis. Forewing comparable in size but slightly larger on average than that of *L. chloe*, smaller than *L. solisae*; upperside pattern intermediate between the two in several respects, sharing the Ψ/μ -shaped stigma of *L. solisae* rather than the straight/squared reniform of *L. reletiva* and *L. chloe*, but with the stigma narrow as in those latter species and not as swollen as in *L. solisae*. Likewise the overall appearance is more granular than *L. solisae* but with less conspicuous black edging or black wedges at the postmedial line than in *L. chloe* or *L. reletiva*. Hind wing underside with pronounced discal spot, ringed in black in both sexes. **Male genitalia:** Cucullus terminates in a rounded point, less acutely curved apically than in *L. uncifera* or *L. solisae*; inner edge distal to its fusion with finger-like dorsal process curving more gradually beginning in its basal half, the part distal to its articulation with the dorsal lobe the shortest among these three species.

Description. Head. Antennae setose-ciliate, bifasciculate in males, scaled above with alternating bands of gray (basal) and tan (apical). Frons, vertex and labial palpi scaled with an admixture of white, brown and black, tipped with paler scaling. Eyes smooth.

Thorax. Thoracic vestiture chocolate brown. **Wings.** Forewing length 10.9 mm (holotype, male), average 11.4 mm (males, $n = 4$), 11.0 mm (females, $n = 2$). Forewing dominated by chocolate-brown coloration. Hind wing underside with pronounced discal spot ringed in black in both sexes. **Legs.** Scaling predominantly grayish brown or purplish gray with an admixture of green especially on the hind femora; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Vestiture uniformly tannish gray, paler than on thorax.

Male genitalia. Similar overall both to *L. uncifera* and *L. solisae*. Uncus elongate, widest subapically, upwardly curved with a very small apical point, and bearing ventral setal crest. Tegumen dome-shaped, except its dorsal edge deformed at the base of the uncus. Vinculum a wide V-shape; saccus bluntly rounded. Juxta pentagonal, dorsal edge horizontal; annellar arms fused, hoop-like. Sacculus (1) densely setose, tapered; saccular extension without sclerotized point. Cucullus (2) appears chelicerate, the sclerotized part occupying $\sim 1/3$ the overall length, widest medially and arcing gently before tapering to a sharply pointed apex with a subapical tuft of reëntrant spinelike setae. Dorsal process (3) coequal in width to cucullus, setose apically. Clasper (4) finger-like, gently curved. Uncus with ventral setal crest along distal half. Vesica with small basal secondary lobe. Aedeagus with an elongate sclerotized band of raised granules. Vesica without cornuti; paired and medial subbasal diverticular lobes nipple-like.

Female genitalia. Posterior apophyses less than twice as long as anterior apophyses. Lamella antevaginalis invaginated. Colliculum undeveloped. Ductus elongate, narrow as in *L. albimixta*. Corpus bursae oblong.

Immature stages. Known only from images (Figs 147–154). Young caterpillars sparsely setose, particularly on dorsal pinacula; A1 with a medial white spot flanked by a pair of yellowish or cream-colored subdorsal spots that are echoed on A8 but all of which vanish in later instars; mature larva rusty brown above to the lateral line, mottled green below; dorsal markings a series of medial blackish triangles narrowed caudally, each narrow end “cupped” in a lightly mottled mossy green; the effect is one of a series of v-shaped wedges, tapering caudally and enclosed at the narrow/caudal end with green mottling; diffuse brown subdorsal coloration darkens laterally to form an undulating line with each lighter brown abdominal “trough” enclosing a spiracle; the wavy black line separates the brown spiracular triangles from their complementary, dorsally directed green counterparts, continuous with the green venter and expanding with the increasingly distended posterior segments; head capsule brown with two black facial stripes on either side of the frons; antennae yellow.

Etymology. The name *poolei* is given in gratitude to Dr. Robert Poole, noctuidologist and former curator at USNM, who first identified this and other species from among the reared Costa Rican material.

Biology. Caterpillars found feeding on foliage of *Elaphoglossum doanense* (Dryopteridaceae) and *Microgramma percussa* (Polypodiaceae). Two reared male and female specimens (10-SRNP-31675 and 10-SRNP-73038) required 22 and 30 days, respectively, from the onset of the pre-pupal stage to adult eclosion.

Distribution. Costa Rican rain forest.

Remarks. Although the female genitalia are distinctive in the configuration of the ductus, the three recently reared specimens of *L. poolei*, comprising two females and a male with a dissociated abdomen, appear conspecific with four male specimens collected by S.S. and W.D. Duckworth in 1965, and cluster closely with both *Leucosigma solisae*, known only from two males, and the two specimens referred to *L. reletiva*.

***Leucosigma schausi* Goldstein, sp. n.**

<http://zoobank.org/B2CBD402-81BE-41F7-A55B-FF0046F2DBC9>

Figs 35, 36, 37, 38, 45, 46, 47, 48; Male genitalia: Figs 69–72, 96, 97; Female genitalia: Figs 104, 108; Larvae: Figs 139–146

Material examined. Type material. COSTA RICA (3♂, 3♀): HOLOTYPE ♂. Voucher: D.H. Janzen & W. Hallwachs DB: <http://janzen.sas.upenn.edu> Area de Conservacion Guanacaste. Guanacaste: Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 07/19/2010, ecl. 08/16/2010, Ricardo Calero, collector, 10-SRNP-72230, ♂USNM Dissection 148076, USNMENT01370303 PARATYPES (2♂, 3♀): **Males**: Sector Pitilla: Calma, 11.00987, -85.39214, el. 412m, 02/11/2010, ecl. 03/12/2010, Ricardo Calero, collector, 10-SRNP-70740, USNMENT01437325, USNM Dissection 148298; Sector Pitilla: Quebradona, 10.99102, -85.39539, el. 475m, larva on *Microgramma percussa*: 02/04/2010, Ricardo Calero, collector, 10-SRNP-70653, USNMENT01437290 [abd. missing] **Females**: Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 06/23/2013, ecl. 07/17/2013, Ricardo Calero, collector, 13-SRNP-71023, USNM Dissection 148080, USNMENT01437332; Sector Pitilla: Quebradona, 10.99102, -85.39539, el. 475m, larva on *Microgramma percussa*: 01/07/2010, ecl. 02/18/2010, Calixto Moraga, collector, 10-SRNP-70113, USNMENT01370292; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 06/26/2010, ecl. 07/31/2010, Ricardo Calero, collector, 10-SRNP-71934, USNMENT01437312. Types at USNM.

Other material examined (3♂, 7♀). **COSTARICA** (1♂): Golfito 25-28.IV.65 SS & WDD DUCKWORTH, ♂USNM Dissection 148146, USNMENT01370291 **GUATEMALA** (2♂, 3♀): **Males**: Cayuga Guat, June, Schaus and Barnes coll, June, USNM Dissection 41,194, USNMENT01437362; Ibid, April, USNM Dissection 4091, USNMENT01437241 **Females**: Cayuga, Guat., July, Schaus and Barnes coll, *Chytonidia chloristis* Schs WT 6.21, USNMENT01437337; GUATEMALA Dept. Suchitepequez Cutotenango 10-20 June 1966 Flint & B Ortiz, USNMENT01437317; Cayuga, Guat, Aug, Schaus and Barnes coll, USNMENT01437377 **CUBA** (2♀): Baracoa, Cuba, Collection Wm Schaus, ♀ genitalia Slide USNM Noc 4092, USNMENT01370281; Ibid, Oct., ♀ genitalia Slide USNM Noc 4093, USNMENT01437340 **MEXICO** (1♀): MEX: Tmps Gomez Farias 21 III 1981, Nacimiento del Rio Frio, Gillespy & Lara Collectors, USNMENT01437352 **PANAMA** (1♀): Bocas dToro Pan, Apr '07, Collection Wm Schaus, USNMENT01437300

Diagnosis. Most readily differentiated from other *Leucosigma* by the sharply pointed sclerotized saccular extensions and the elongate cucullus reminiscent of the mandibles of trap-jaw ants (*Odontomachus* Latreille). Forewing similar to those of *L. chloe* and *L. reletiva*, the similarities including the pale apical patch, more variably shaded with green in *L. schausi*, and the straight/squared reniform, appearing more “pinched” into two trianguloid green wedges in *L. schausi*. Terminal area of hind wing

underside distinctly paler than basal and medial areas but less extensively scaled with green than *L. albimixta*.

Description. Head. Antennae setose-ciliate, bifasciculate in males, finely scaled above with pinkish tan. Frons, vertex and labial palpi with variously hued brown and tan scales; scaling of the palpi paler underneath and on apical segment. Palps with brown and dark brown scales, paler on apical segment. Eyes sparsely hairy.

Thorax. Anterior part of tegulae green. **Wings.** Forewing length 12.2 mm (holotype, male), average 12.2 mm (males, $n = 8$), 12.8 mm (females, $n = 5$). Pattern elements visible and distinct; variation in hue of brown shading a function of scale density, as the scales are more darkly colored at their tips; U-shaped fusion of reniform-orbicular complex similar to that in *L. poolei*, above; costal striae at basal, antemedial, and postmedial lines consist of juxtaposed black and white, white distal to black in the basal and postmedial striae and black distal to white in the antemedial stria; outermost costal striae white; postmedial line a series of black crescents enclosing pale brown centers; terminal line a series of more compressed such crescents; apical patch predominantly white with some green shading; underside shading concentrated in costal and especially terminal areas of both wings; lines incomplete, typical of genus. **Legs.** Most thickly scaled on femora, with mixture of colors similar to those of head predominantly brown and pinkish tan; femoral and tibial scales with an admixture of lime green; a single pair of striped mid-tibial spurs, two pairs on hind-tibiae; three rows of tibial spines on all legs.

Abdomen. Vestiture uniform pale gray, more or less concolorous with hind wings; slightly darker ventrally.

Male genitalia. Uncus elongate, widest subapically, upwardly curved with a conspicuous apical point, and bearing ventral crest of short setae. Tegumen dome-shaped, with its dorsal edge deformed at the base of the uncus. Vinculum shallow; saccus bluntly rounded. Juxta pentagonal, dorsal edge horizontal; annellar arms fused, hoop-like. Sacculus (1) tapering to a heavily sclerotized point; costal lobe of sacculus densely setose. Cucullus (2) elongate, straight for much of its length but curving apically to a point, with an expanded subapical setal patch. Adjoining dorsal process (3) setose, undifferentiated, coequal in width to cucullus. Clasper (4) elongate, thorn-like or gently sinuate, rendering the valvae with three pair of sharply pointed structures. Aedeagus with an elongate sclerotized band of raised granules. Vesica without cornuti; a small patch of granular spinules evident basad; subbasal diverticulum recurved, appearing trilobate, with medial diverticular "nipple" and a weakly sclerotized C-shaped ridge.

Female genitalia. Posterior apophyses less than twice as long as anterior apophyses. Lamella antevaginalis invaginate. Colliculum well developed. Ductus robust, opening to corpus bursae wide. Corpus bursae subtriangulate when distended.

Immature stages. Known from images of reared specimens (Figs 139–146). Larva predominantly light brown, faintly shaded with green intersegmentally and laterally on A4–6; coloration generally more uniform above spiracular line, reticulate below;

the familiar dorsal herring-bone pattern consisting of a row of Y-shaped markings, the arms of which terminate at the D1 pinacula, which on A1 are partially encircled with anterior cream-colored marking to form a spectacle-like mark. Thoracic segments taper dorsally. Young larvae predominantly greenish gray, with anastomosing pattern visible dorsally; thin white spiracular line beneath a broader reddish-purple supraspiracular line, the upper edge of which runs just above SD1 pinacula.

Etymology. The name *schausi* honors William Schaus, Jr. (January 11, 1858 – June 20, 1942), USDA entomologist and curator at USNM who described both *Chytonidia*, herein synonymized with *Leucosigma*, and the genus *Lophomyra*, also associated with ferns.

Biology. Caterpillars found feeding on foliage of rain forest *Microgramma percussa* (Polypodiaceae) in ACG. Six reared specimens required an average of 22.5 days between the onset of the prepupal stage to adult eclosion.

Distribution. Costa Rica, Cuba, Guatemala, Mexico, Panama.

Other specimens of *Leucosigma*

(4♂, 1♀). Figs 33, 34, 43, 44. Male genitalia: Figs 73, 74, 93, 124–126 (*terminalia in situ*). Female genitalia: Fig. 109. Larvae: Figs 135–138.

Several specimens from the Dominican Republic bear similarities to a subset of those reared from ACG; all may represent variation within *L. schausi*, but because they bear minor genitalic differences consistent with barcodes that differ minimally (a single base pair) from those of *L. schausi*, the possibility that they represent a cryptic species remains open. The male genitalia differ slightly from those of *L. schausi* in the reduced sclerotized point at the apex of saccular extension. If in fact they prove to be distinct, they would be similar to the species pair *Neoxeniades luda* and *Neoxeniades pluviasilva* (Hesperiidae), which co-occur at ACG and differ by only one base pair in their DNA barcode and very slight genitalic differences (Burns et al. 2007). It was decided not to describe a new species based on these characters, but rather to figure specimens and summarize information associated with them as “sp. near *L. schausi*”: **DOMINICAN REPUBLIC** (2♂): ♂, Dajabon Province 13km S. Roma de Cabrera ca. 400m, 20–22 May 1973 Don & Mignon Davis, ♂ USNM Dissection 148142, USNMENT01370285; ♂ Ibid, ♂ USNM Dissection 148297, USNMENT01437231, Male genitalia imaged *in situ* (Figs 124–126). **COSTA RICA** (2♂, 1♀): [♂] Guanacaste: Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m, larva on *Microgramma percussa*: 11/03/2010, ecl. 12/12/2010, Ricardo Calero, collector, 10-SRNP-73224, USNMENT0105325; [♂] Alajuela: Sector Rincon Rain Forest: Jacobo, 10.94076, -85.3177, el. 461m, larva on *Microgramma percussa*: 01/17/2011, ecl. 02/14/2011, Edwin Apu, collector, 11-SRNP-69183, USNM Dissection 148075, USNMENT01438819; [♀] Alajuela: Sector Rincon Rain Forest: Estacion Caribe, 10.90187, -85.27495, el. 415m, larva on *Campyloneurum latum*, 12/04/2011, Jorge Hernandez, collector, 11-SRNP-44977, USNM Dissection 148079, USNMENT01370288 7224.

Discussion

The synonymy of *Chytonidia* with *Leucosigma* is straightforward; the circumscription of species boundaries perhaps less so. The predominance of female types among species in the *L. chloe* complex (*L. chloe*, *L. chloristis*, *L. reletiva*) is unfortunate given the predominance of conspicuous diagnostic features in males. The identification of modern Costa Rican material as conspecific with *L. reletiva* was made in the absence of historical specimens of males and of barcode data from the female holotype; if that determination is incorrect, then *L. reletiva* is likely another synonym of *L. chloe* and the male Costa Rican specimens will represent an undescribed species. Likewise, the pairing of an exclusively female sample of *L. poolei* with an exclusively male series of museum specimens is justified primarily on the basis of wing pattern, and our selection of a female holotype in this case draws from the fact that the specimen is accompanied both by barcode and rearing data.

No doubt that several species of *Leucosigma* remain undescribed, probably including at least one within the *L. uncifera* complex. Provisional (neighbor-joining) analyses of DNA barcode data corroborated the unity of *Leucosigma* and *Chytonidia* by virtue of the proximity of Costa Rican *L. uncifera* to species of *Chytonidia*, as did a partial sequence of the holotype of *L. uncifera* when analyzed against a sample of 1,355 noctuid specimens that included all the available known fern feeders. Since no single mitochondrial marker would be considered an adequate foundation for phylogenetic inference regardless of the analysis, we interpret analyses of COI data with caution (particularly beyond the level of closely related species), but with that said, we also note that the available barcode data are consistent with the hypothesis of *Leucosigma* monophyly delineated here.

Among the more intriguing morphological features are those surrounding the male clasping architecture, specifically the complex of variously sclerotized lobes and the associated arrangement of setal tufts. The possible function of these tufts as courtship structures bears further study, as do the mechanics of the unusually elaborate clasping appendages themselves. The as yet undetermined phylogenetic proximity of *Leucosigma* to the smaller of Schaus' pteridivorous genera *Lophomyra* bears on our interpretation of the collective diet breadths of each, and to whether structures such as the clustered setae on the uncus in *Leucosigma viridipicta* represents a symplesiomorphous condition homologous to that in *Lophomyra*.

In comparison with other noctuid genera now known to comprise fern-feeding species at ACG and elsewhere in the Neotropics, the phylogenetic or taxonomic breadth of host plants recorded for *Leucosigma* is quite narrow, restricted to Polypodiales and specifically the families Polypodiaceae and Dryopteridaceae. These represent the two most widely recorded families among Neotropical pteridivorous noctuid genera at ACG, most of which are known from a much broader range of fern families. The effort to document hostplant associations of Neotropical caterpillars supplements our understanding of unusual genera and of the distribution of fern-feeding. Although less biologically rare than previously supposed, pteridivory appears to be phylogenetically

localized in a small number of Lepidoptera groups whose relationships remain unresolved. Beyond pinpointing these organisms' taxonomic placement, it is likely that a better sampling of genomic data and a more systematic adduction of larval characters will contribute to our understanding of tribal and subfamilial boundaries. Likewise, the non-random distribution of recorded fern hosts across noctuid genera raises a number of specific, testable questions surrounding the evolution of diet breadth, and specifically the origins of peridivory as perhaps a derived outcome of detritivory, moss- and lichen-eating.

Figures



Figures 1–6. Dorsal and ventral habitus and labels of of *Leucosigma uncifera*. (1–3) Holotype ♂, Peru, NHMUK010606200 (4–6) Female, Costa Rica, NHMUK010606201.



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Figures 7–12. Dorsal and ventral habitus and specimen labels of female holotypes of *Chytonix chloe* (7–9) and its synonym *Chytonidia chloristis* (10–12).



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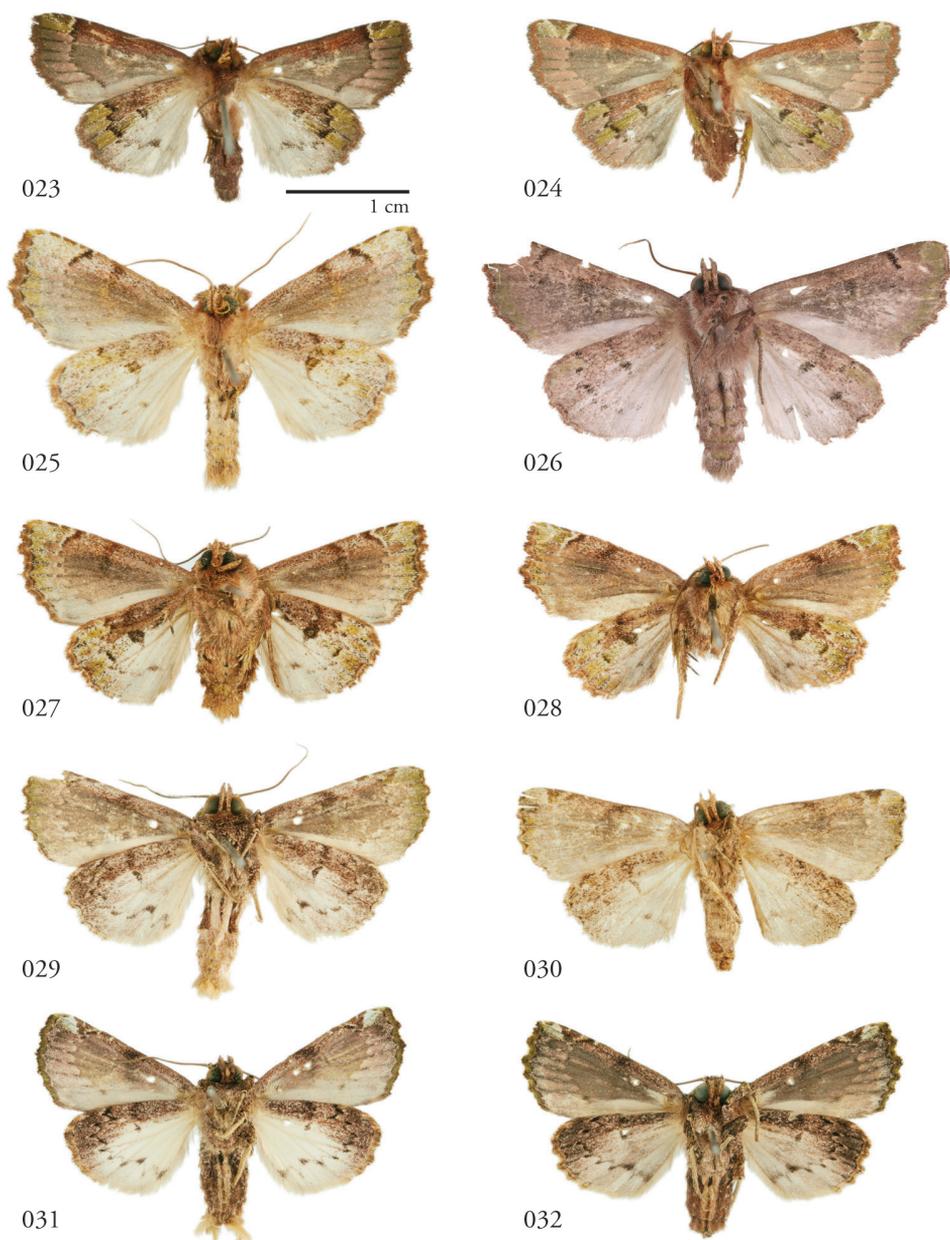


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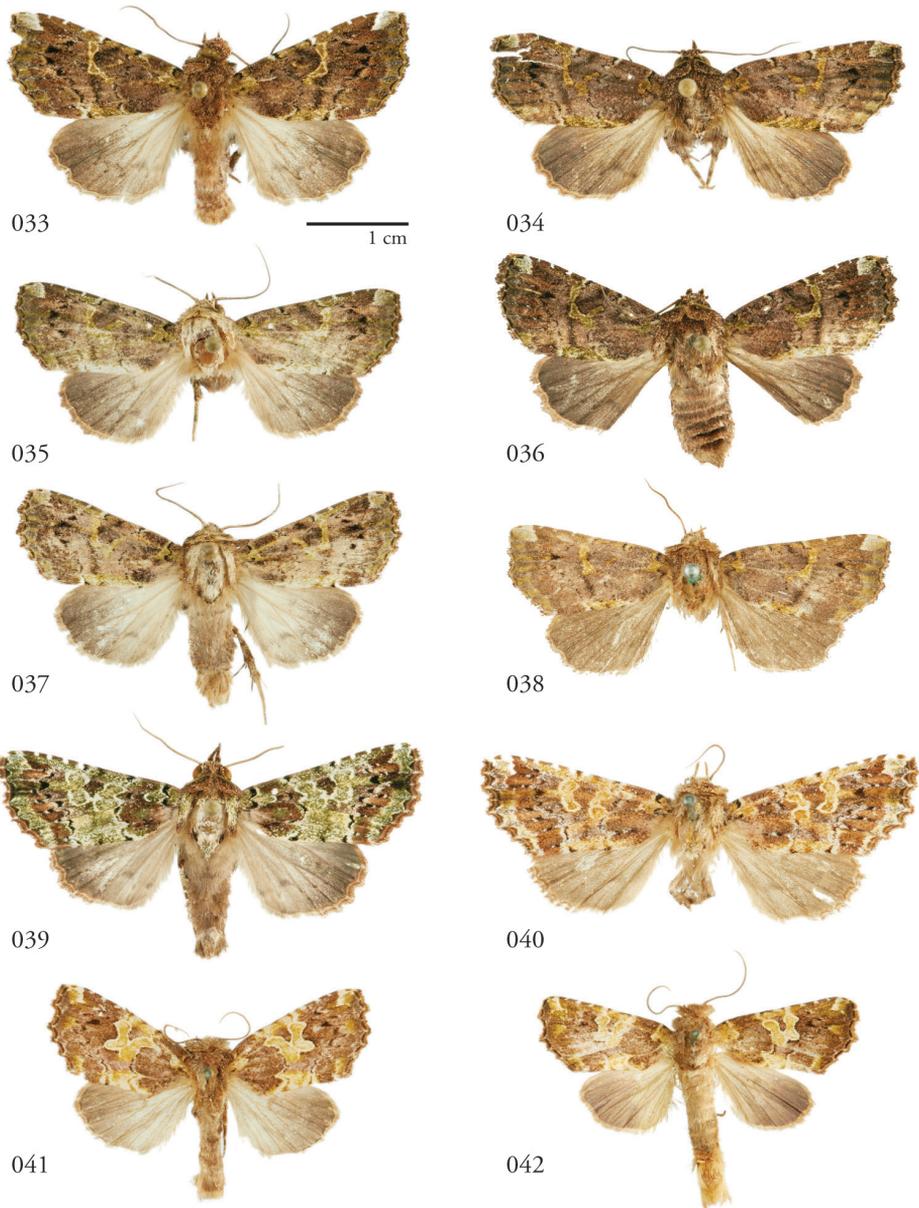


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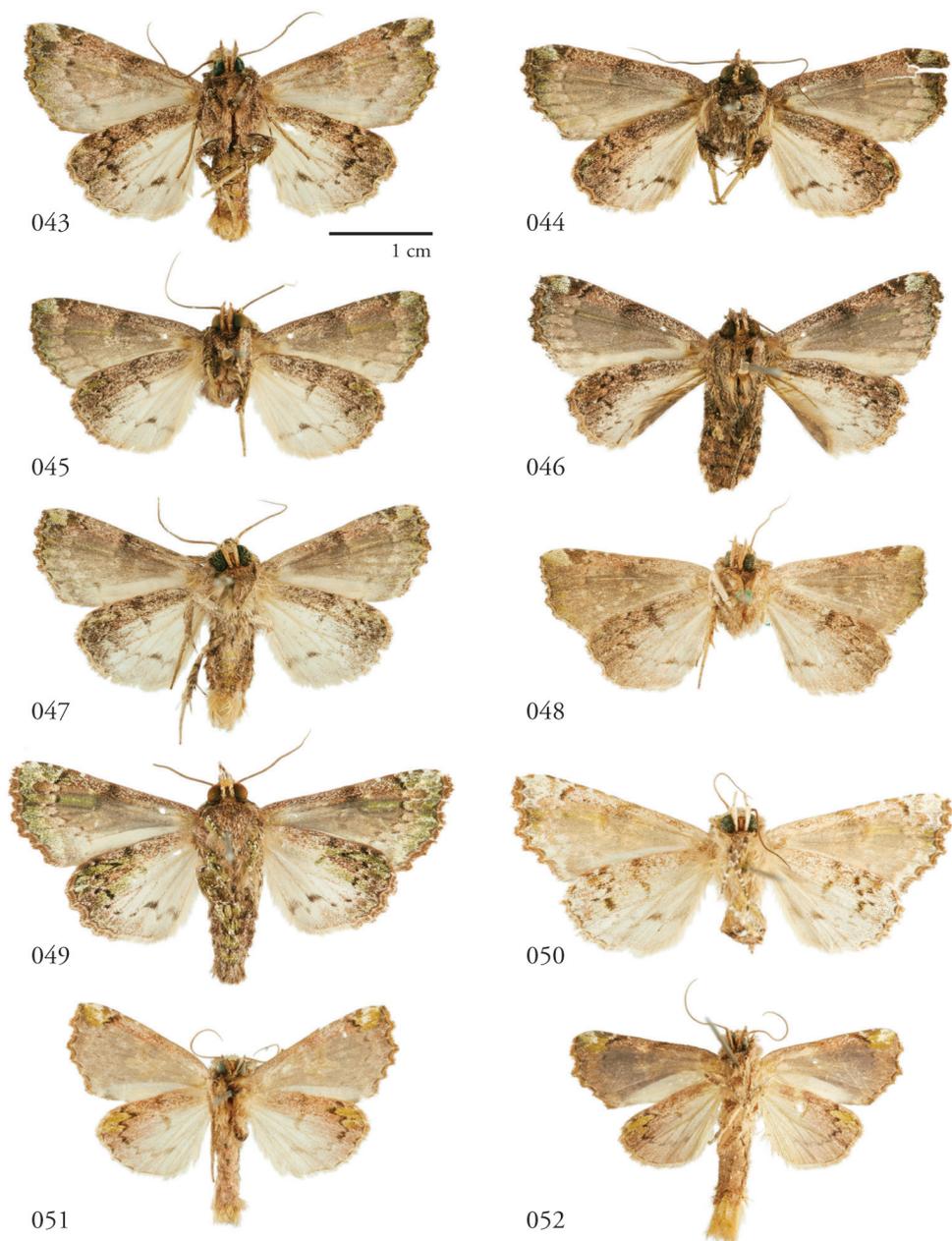
Figures 13–22. *Leucosigma* dorsal habitus. **13** *L. uncifera* ♂, Área de Conservación Guanacaste (ACG), Costa Rica, 07-SRNP-109451, USNMMENT01370293, USNM Dissection 148101 **14** *L. uncifera* ♀, ACG, 12-SRNP-105657, USNMMENT01370289 **15** *L. solisae* ♂, Peru, NHMUK 010606203 **16** *L. solisae* ♂ Holotype, ACG, 07-SRNP-101229, USNMMENT01370294, USNM Dissection 148077 **17** *L. poolei* ♂, Turrialba, Costa Rica, USNMMENT01370290, USNM Dissection 148147; **18** *L. poolei* Holotype ♀, ACG, 10-SRNP-70737, USNMMENT01370296, USNM Dissection 148073 **19** *L. reletiva* ♂, ACG, 09-SRNP-107116, USNMMENT01370297, USNM Dissection 148177 **20** *L. reletiva* Holotype ♀, Panama, USNMMENT00973166, USNM Dissection 148170 **21** *L. chloe* ♂, ACG, 96-SRNP-11371, USNMMENT01370286 **22** *L. chloe* ♀, ACG, 96-SRNP-11374, USNMMENT01370299.



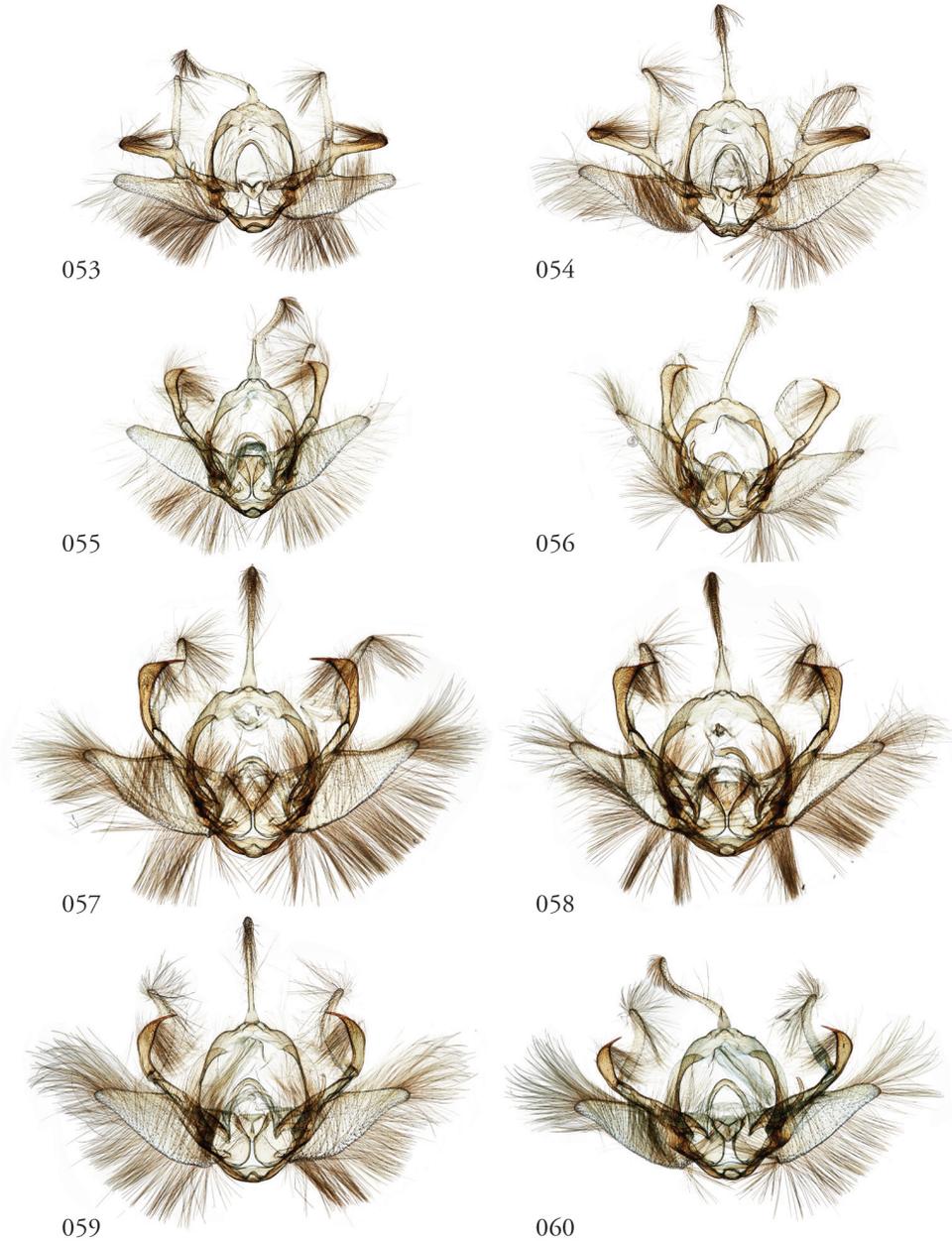
Figures 23–32. *Leucosigma* ventral habitus. **23** *L. uncifera* ♂, Área de Conservación Guanacaste (ACG), Costa Rica, 07-SRNP-109451, USNMENT01370293, USNM Dissection 148101 **24** *L. uncifera* ♀, ACG, 12-SRNP-105657, USNMENT01370289 **25** *L. solisae* ♂, Peru, NHMUK 010606203 **26** *L. solisae* Holotype ♂, ACG, 07-SRNP-101229, USNMENT01370294, USNM Dissection 148077 **27** *L. poolei* ♂, Turrialba, Costa Rica, USNMENT01370290, USNM Dissection 148147 **28** *L. poolei* Holotype ♀, ACG, 10-SRNP-70737, USNMENT01370296, USNM Dissection 148073 **29** *L. reletiva* ♂, ACG, 09-SRNP-107116, USNMENT01370297, USNM Dissection 148177 **30** *L. reletiva* ♀ Holotype, Panama, USNMENT00973166, USNM Dissection 148170 **31** *L. chloe* ♂, ACG, 96-SRNP-11371, USNMENT01370286 **32** *L. chloe* ♀, ACG, 96-SRNP-11374, USNMENT01370299.



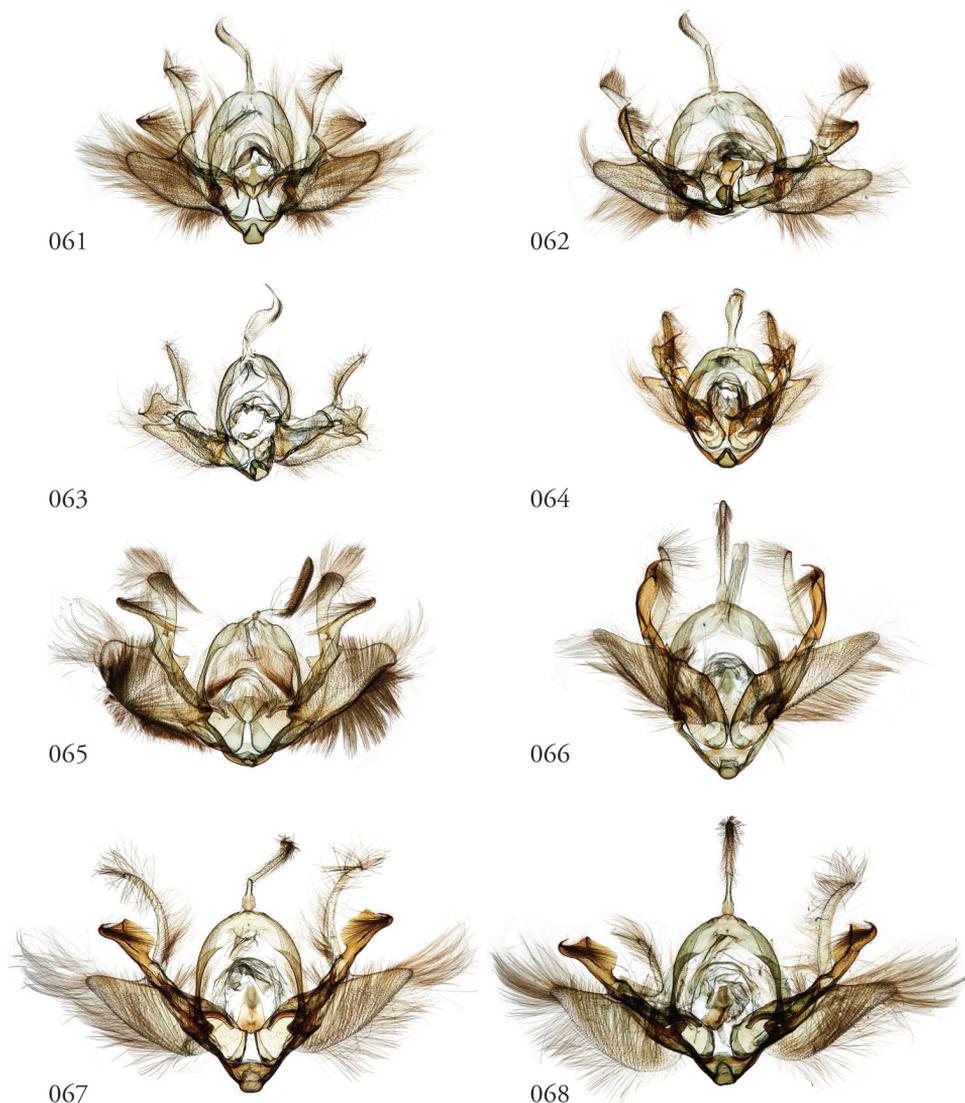
Figures 33–42. *Leucosigma* dorsal habitus. **33** *L.* sp. nr. *schausi*, ♂, Dominican Republic, USNMMENT01370285, USNM Dissection 148142 **34** *L.* sp. nr. *schausi*, ♀, Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-44977, USNMMENT01370288, USNM Dissection 148079 **35** *L. schausi* Holotype ♂, ACG, 10-SRNP-72230, USNMMENT01370303, USNM Dissection 148076 **36** *L. schausi* ♀, ACG, 10-SRNP-70113, USNMMENT01370292 **37** *L. schausi* ♂, Costa Rica, USNMMENT01370291, USNM Dissection 148146 **38** *L. schausi* ♀, Cuba, genitalia Slide USNM Noc 4092, USNMMENT01370281 **39** *L. albimixta* ♂, ACG, 10-SRNP-104564, USNMMENT01370298 **40** *L. albimixta* Holotype ♀, Costa Rica, USNMMENT01370283, USNM Dissection 148184 **41** *L. viridipicta* ♂, Peru, NHMUK010606202 **42** *L. viridipicta* Holotype ♂, French Guiana, USNMMENT 00973419, USNM Dissection 148176.



Figures 43–52. *Leucosigma* ventral habitus. **43** *L.* sp. nr. *schausi*, ♂, Dominican Republic, USNMMENT01370285, USNM Dissection 148142 **44** *L.* sp. nr. *schausi*, ♀, Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-44977, USNMMENT01370288, USNM Dissection 148079 **45** *L. schausi* ♂, ACG, 10-SRNP-72230, USNMMENT01370303, USNM Dissection 148076 **46** *L. schausi* ♀, ACG, 10-SRNP-70113, USNMMENT01370292 **47** *L. schausi* ♂, Costa Rica, USNMMENT01370291, USNM Dissection 148146 **48** *L. schausi* ♀, Cuba, genitalia Slide USNM Noc 4092, USNMMENT01370281 **49** *L. albimixta* ♂, ACG, 10-SRNP-104564, USNMMENT01370298 **50** *L. albimixta* Holotype ♀, Costa Rica, USNMMENT01370283, USNM Dissection 148184 **51** *L. viridipicta* ♂, Peru, NHMUK 010606202 **52** *L. viridipicta* Holotype ♂, French Guiana, USNMMENT 00973419, USNM Dissection 148176.



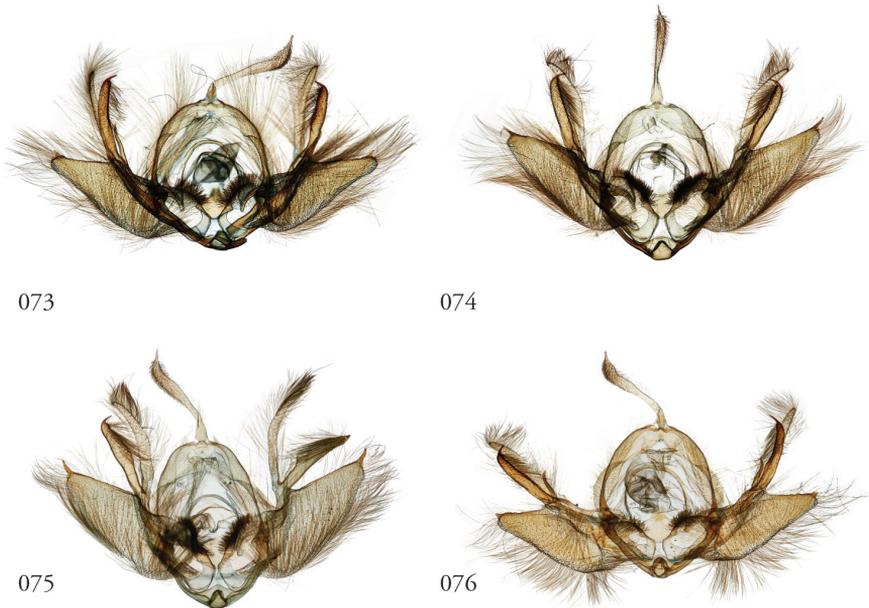
Figures 53–60. *Leucosigma* male genitalia, valves. **53** *L. uncifera* Holotype, Peru, NHMUK010606200 **54** *L. uncifera*, Área de Conservación Guanacaste (ACG), Costa Rica, 06-SRNP-102374, USNMENT01438843, USNM Dissection 148199 **55** *L. uncifera*, ACG, 07-SRNP-109451, USNMENT01370293, USNM Dissection 148101 **56** *L. uncifera*, ACG, 11-SRNP-100029, USNMENT01438838, USNM Dissection 148102 **57** *L. solisae* Holotype, ACG, 07-SRNP-101229, USNMENT01370294, USNM Dissection 148077 **58** *L. solisae*, ACG, 07-SRNP-109201, USNMENT01437370, USNM Dissection 148078 **59** *L. poolei*, Turrialba, Costa Rica, USNMENT01370290, USNM Dissection 148147 **60** *L. poolei*, Turrialba, Costa Rica, USNMENT01438829, USNM Dissection 148148.



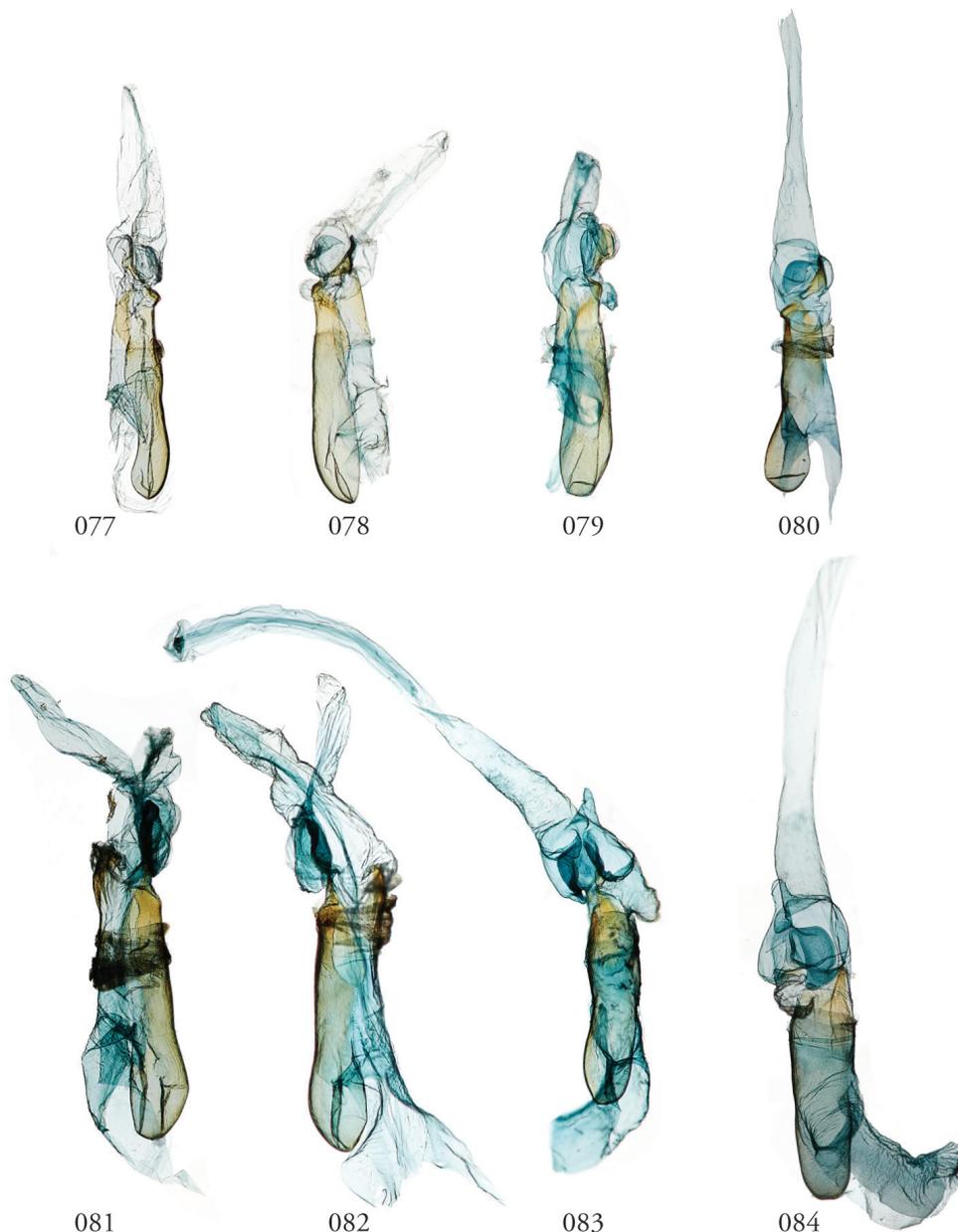
Figures 61–68. *Leucosigma* male genitalia, valves. **61** *L. reletiva*, Área de Conservación Guanacaste (ACG), Costa Rica, 07-SRNP-101206, USNMENT01437211, USNM Dissection 148178 **62** *L. reletiva*, ACG, 09-SRNP-107116, USNMENT01370297, USNM Dissection 148177 **63** *L. chloe*, ACG, 07-SRNP-108955, USNMENT01437367, USNM Dissection 148055 **64** *L. chloe* ♂, ACG, 96-SRNP-11375, USNMENT01438814, USNM Dissection 148070 **65** *L. viridipicta* Holotype, French Guiana, USNMENT00973419, USNM Dissection 148176 **66** *L. albimixta*, ACG, 11-SRNP-30511, USNM 00105321, USNM Dissection 148085 **67** *L. albimixta*, ACG, 07-SRNP-102199, USNMENT01437365, USNM Dissection 148068 **68** *L. albimixta* 10-RNSP-107587, USNMENT01437230, USNM Dissection 148069.



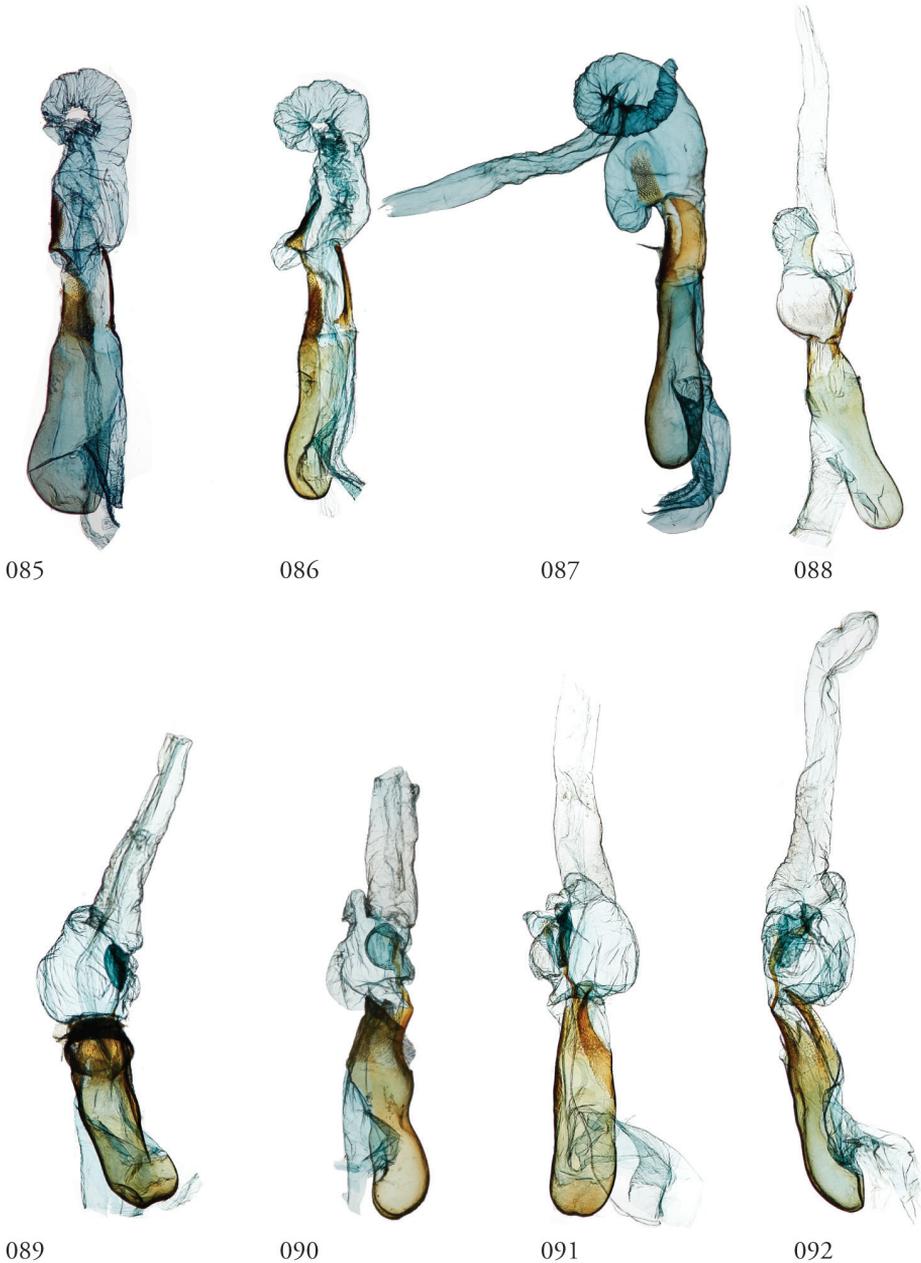
Figures 69–72. *Leucosigma schausi*, male genitalia, valves. **69** Área de Conservación Guanacaste (ACG), Costa Rica, 148298 10-SRNP-70740, USNMENT01437325 **70** USNMENT01437241, USNM Dissection 4091 **71** Costa Rica, USNMENT01370291, USNM Dissection 148146 **72** ACG, 10-SRNP-72230, USNMENT01370303, USNM Dissection 148076.



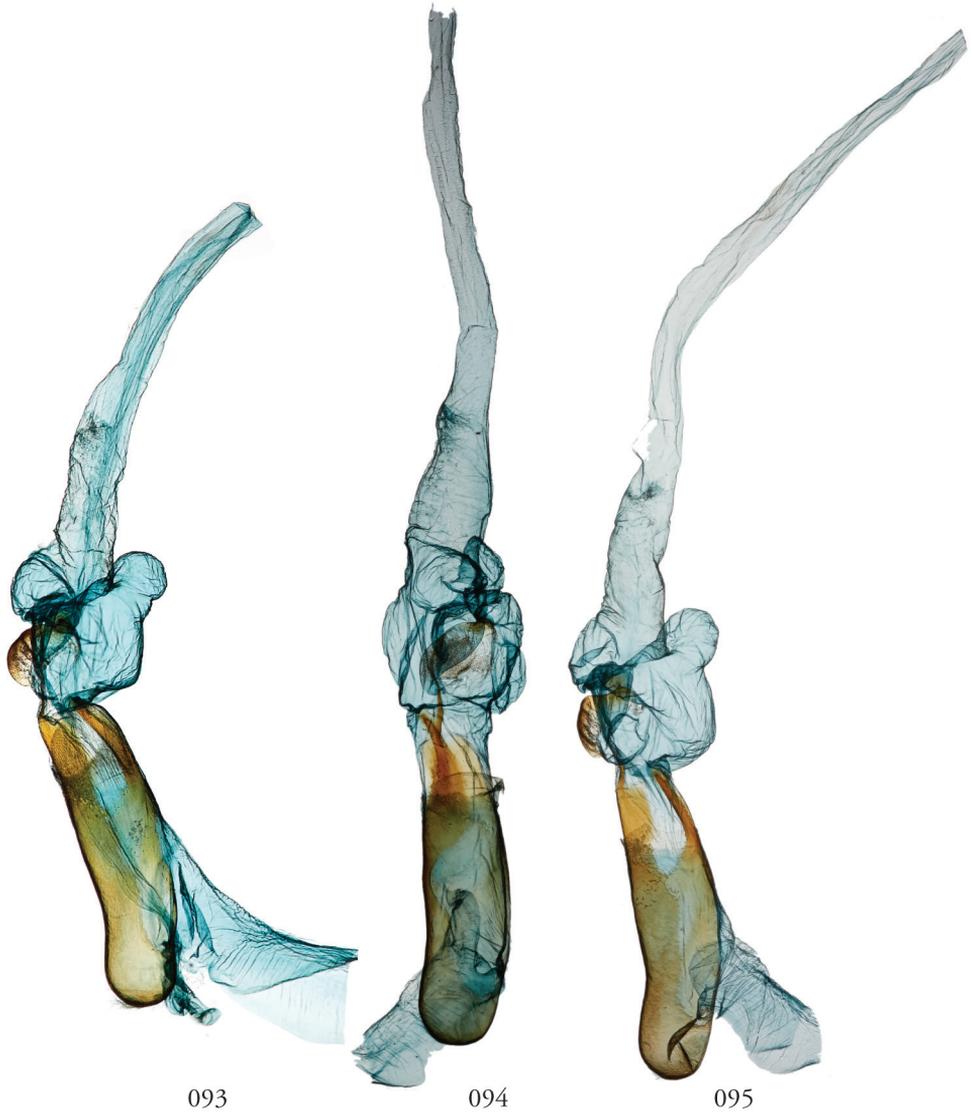
Figures 73–76. *Leucosigma* sp. near *schausi*, male genitalia, valves. **73** Dominican Republic, USNMENT01370285, USNM Dissection 148142 **74** Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-69183, USNMENT01438819, USNM Dissection 148075 **75** ACG, 10-SRNP-73224, USNMENT00105325, USNM Dissection 148296 **76** Dominican Republic, USNMENT01437231, USNM Dissection 148297.



Figures 77–84. *Leucosigma* male genitalia, phalli. **77** *L. uncifera*, Holotype, Peru, NHMUK010606200 **78** *L. uncifera*, Área de Conservación Guanacaste (ACG), Costa Rica, 06-SRNP-102374, USNMENT01438843, USNM Dissection 148199 **79** *L. uncifera*, ACG, 07-SRNP-109451, USNMENT01370293, USNM Dissection 148101 **80** *L. uncifera*, USNMENT01437285, USNM Dissection 148302 **81** *L. solisae*, ACG, 07-SRNP-109201, USNMENT01437370, USNM Dissection 148078 **82** *L. solisae*, ACG, 07-SRNP-101229, USNMENT01370294, USNM Dissection 148077 **83** *L. poolei*, Turrialba, Costa Rica, USNMENT01438829, USNM Dissection 148148 **84** *L. poolei*, Turrialba, Costa Rica, USNMENT01370290, USNM Dissection 148147.



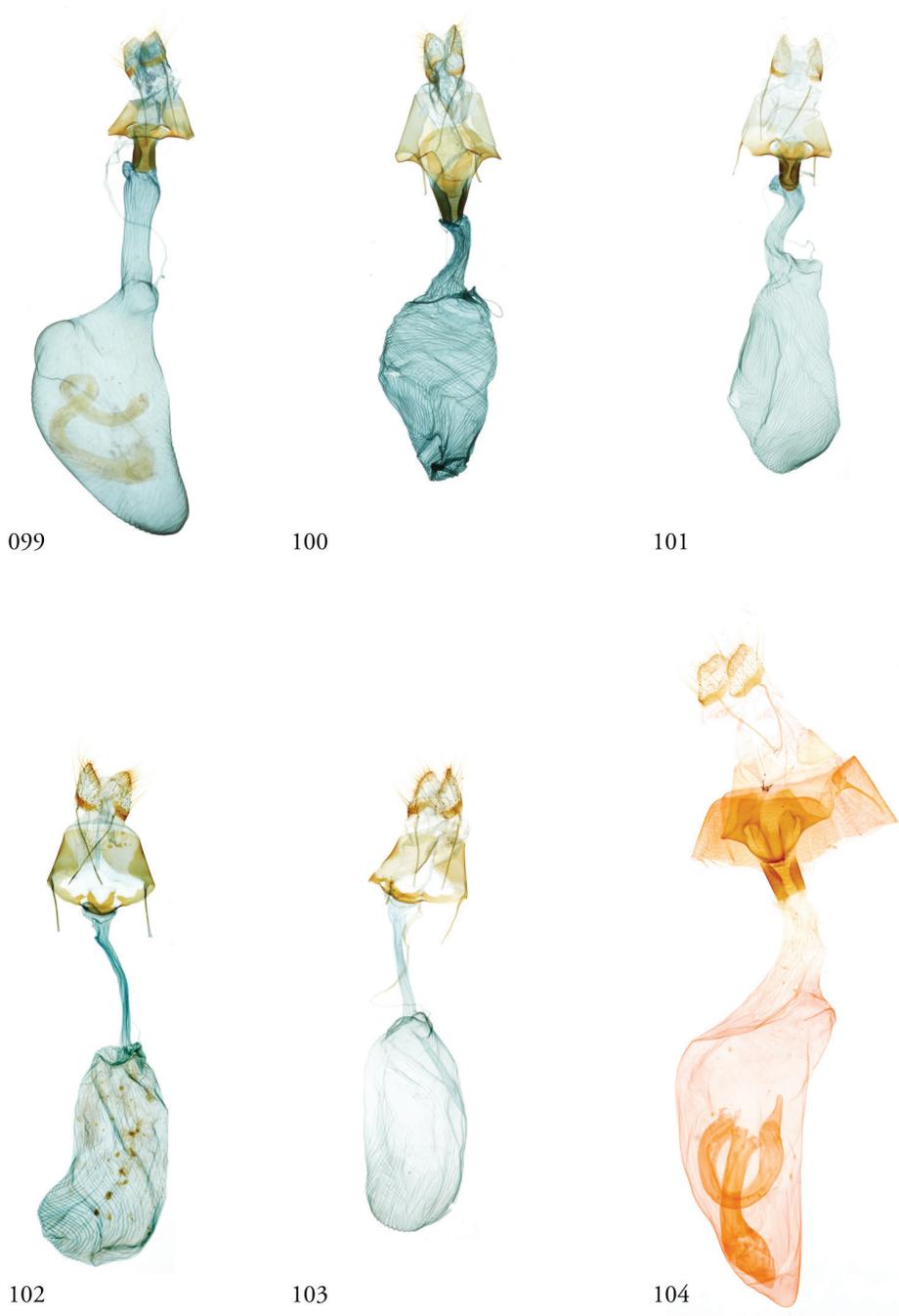
Figures 85–92. *Leucosigma* male genitalia, phalli. **85** *L. albimixta*, Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-30511, USNM Dissection 148085, USNM 00105321 **86** *L. albimixta* 10-RNSP-107587, USNM Dissection 148069, USNMENT01437230 **87** *L. albimixta* USNM Dissection 148305, USNMENT01370298_ **88** *L. viridipicta* Holotype, French Guiana, USNM Dissection 148176, USNMENT 00973419 **89** *L. chloe*, ACG, 96-SRNP-11375, USNM Dissection 148070, USNMENT01438814 **90** *L. chloe*, ACG, 96-SRNP-11369, USNM Dissection 148289, USNMENT01437372_ **91** *L. reletiva*, ACG, 09-SRNP-107116, USNM Dissection 148177, USNMENT01370297 **92** *L. reletiva* USNM Dissection 148178, USNMENT01437211.



Figures 93–95. *Leucosigma* sp. near *schausi*, male genitalia, phalli. **93** Dominican Republic, USNM Dissection 148142, USNMENT01370285 **94** USNMENT00105325, USNM Dissection 148296 **95** Dominican Republic, USNMENT01437231, USNM Dissection 148297.



Figures 96–98. *Leucosigma schausi*, male genitalia, phalli. **96** Costa Rica, USNMENT01370291, USNM Dissection 148146 **97** Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-72230, USNMENT01370303, USNM Dissection 148076 **98** USNMENT01437325, USNM Dissection 148298.



Figures 99–104. *Leucosigma* female genitalia. **99** *L. chloe*, Brazil, USNMMENT01437322, USNM Dissection 148152 **100** *Chytonix chloe* (= *L. chloe*) Holotype USNMMENT01370295, USNM Dissection 148175 **101** *Chytonidia chloristis* Holotype (= *chloe*) USNMMENT01370300 USNM Dissection 148185 **102** *L. poolei*, Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-70737, USNM Dissection 148073, USNMMENT01370296 **103** *L. poolei* USNM Dissection 148074–**104** *L. schausi*, Cuba, USNMMENT01370281, USNM Noc 4092 (cf. 4093).



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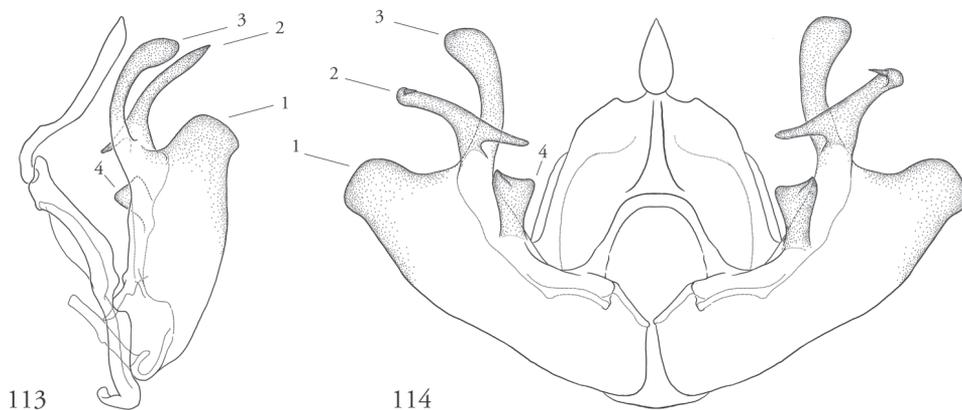
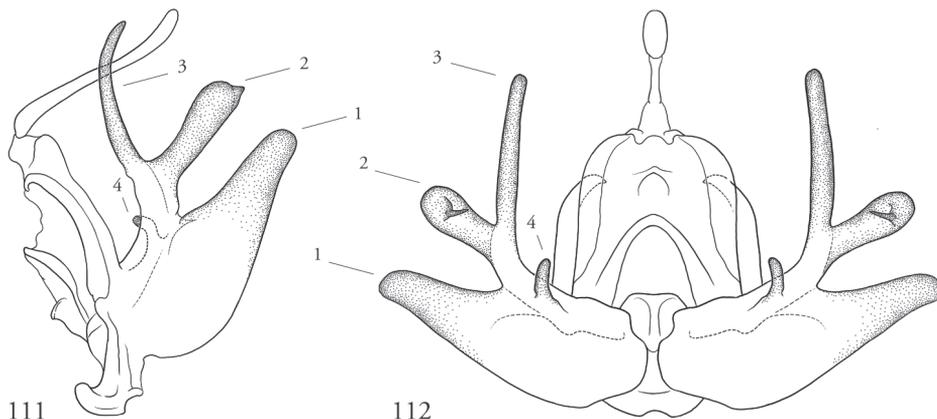


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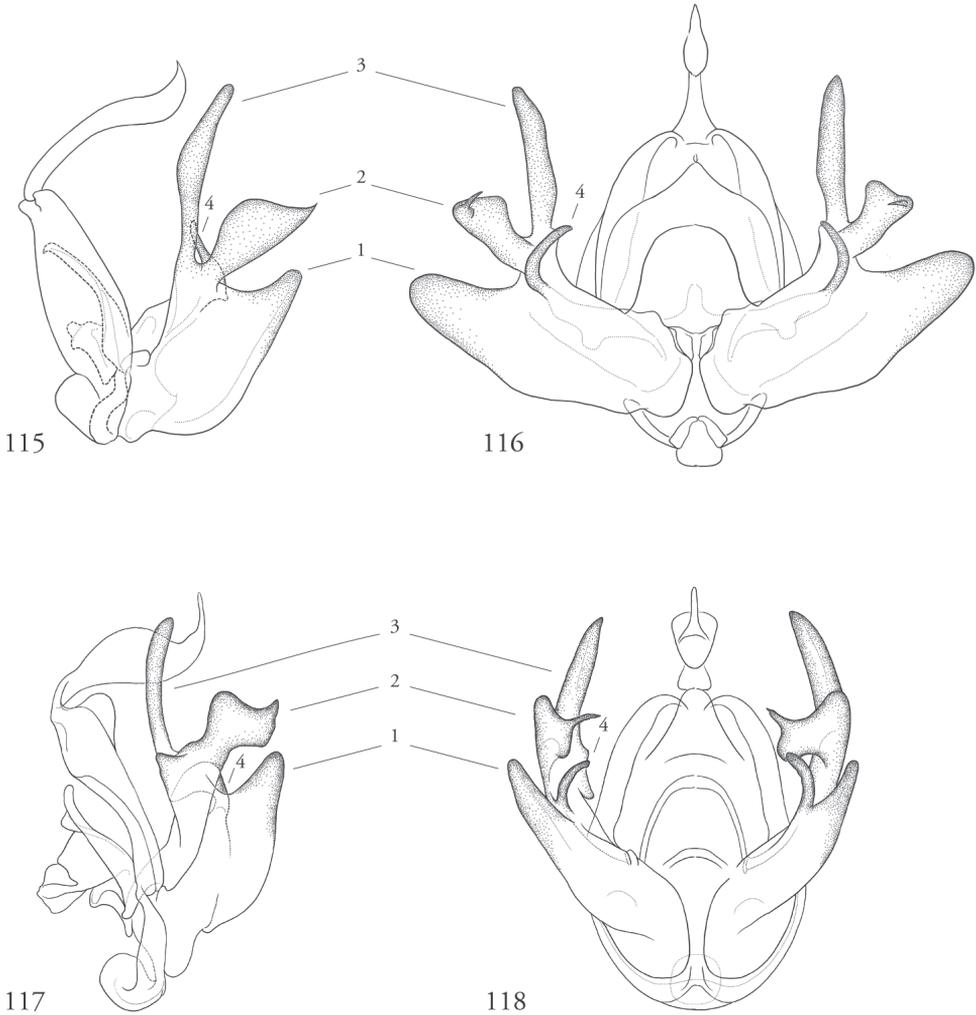


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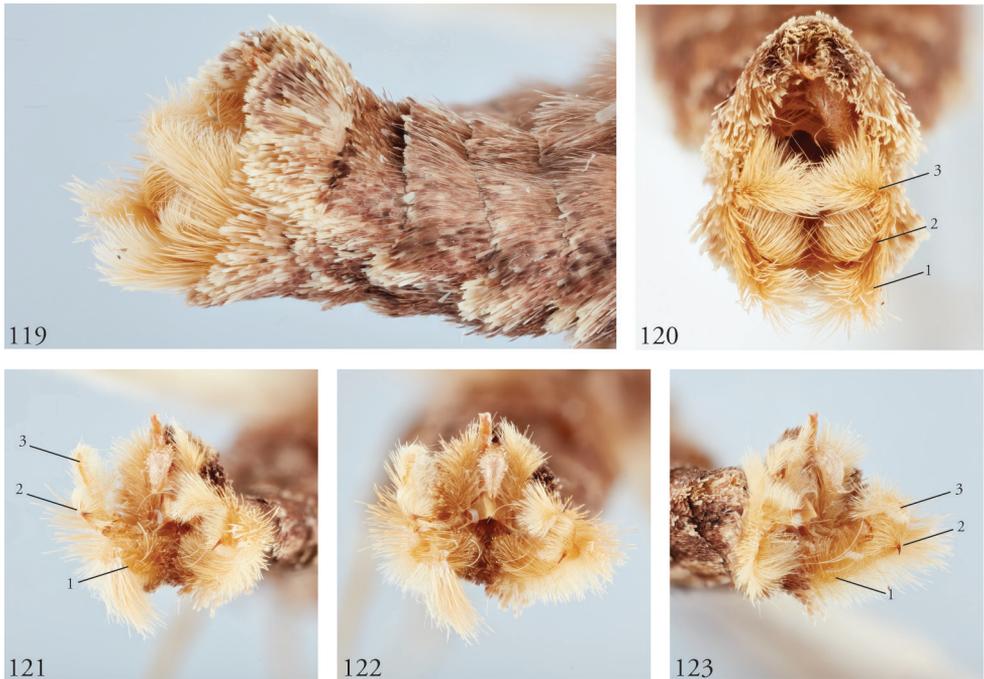
Figures 105–110. *Leucosigma* female genitalia. **105** *L. uncifera*, Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-102284, USNMENT01437255, USNM Dissection 148104 **106** *L. albimixta* Holotype, Costa Rica, USNMENT01370283, USNM Dissection 148184 **107** *L. chloe*, ACG, USNMENT01437380, USNM Dissection 148169 **108** *L. schausi* USNM Dissection 148080 **109** *L.* sp. near *schausi*, ACG, 11-SRNP-44977, USNMENT01370288, USNM Dissection 148079 **110** *L. reletiva* Holotype, Panama, USNMENT00973166, USNM Dissection 148170.



Figures 111–114. Representative male valvae, structures enumerated as in text: (1) sacculus (2) cucullus (3) dorsal process of cucullus and (4) clasper. **111–112** *L. uncifera* ♂ Holotype, Área de Conservación Guanacaste (ACG), Costa Rica, 07-SRNP-109451, USNMMENT01370293, ♂ USNM Dissection 148101 **111** Lateral **112** Caudal **113** *L. viridipicta* Holotype ♂, USNMMENT 00973419, USNM Dissection 148176, Lateral **114** *L. viridipicta* Holotype ♂, USNMMENT 00973419, USNM Dissection 148176, Caudal.



Figures 115–118. Representative male valvae, structures enumerated as in text: (1) sacculus (2) cucullus (3) dorsal process of cucullus and (4) clasper. **115–116** *L. reletiva* ♂, Área de Conservación Guanacaste (ACG), Costa Rica, 07-SRNP-101206, USNM Dissection 148178, USNMENT01437211 **115** Lateral **116** Caudal **117–118** *L. chloe*, ACG, 10-SRNP-70815, USNMENT01437250, USNM Dissection 148200 **117** Lateral **118** Caudal.



Figures 119–123. *Leucosigma chloe* male terminalia illustrating orientation of tufts *in situ*, with structures labeled as in previous figures to indicate (1) sacculus; (2) cucullus and (3) dorsal process. **119–120** *L. chloe*, Área de Conservación Guanacaste (ACG), Costa Rica, 96-SRNP-11373, USNMENT01437360 **119** Lateral **120** Caudal **121–123** *L. chloe*, ACG, 96-SRNP-11371, USNMENT01370286.



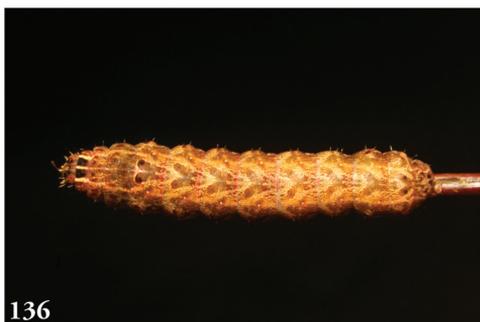
Figures 124–126. *Leucosigma* sp. near *schausi*, terminalia *in situ*, caudal view from a progressively dorsal angle. Structures labeled as in previous figures to indicate (1) sacculus; (2) cucullus and (3) dorsal process. DOMINICAN REPUBLIC: Dajabon Province 13km S. Doma de Cabrera ca. 400 m, 20–22 May 1973 Don & Mignon Davis.



Figures 127–128. *Leucosigma viridipicta* Holotype terminalia *in situ*, indicating clustered setae on the uncus. **127** Lateral **128** Dorsal.



Figures 129–130. Female abdomen, ventral aspect, illustrating paired sternal sclerotizations in two specimens of the *Leucosigma chloe* complex. **129** MEX: Tmps Gomez Farias 21 III 1981, Nacimiento del Rio Frio, Gillespy & Lara Collectors; USNMENT01437352 **130** Bocas d'Toro Pan, Apr '07, Collection Wm Schaus; USNMENT01437300.



Figures 131–138. *Leucosigma* larvae, Área de Conservación Guanacaste (ACG), Costa Rica. **131–134** *L. albimixta* ♂ 11-SRNP-30511 cf. Figs 66, 83 **131** DHJ481612 **132** DHJ48162 **133** DHJ481613 **134** DHJ481621 **135–138** *Leucosigma* sp. near *schausi*, ♀11-SRNP-44977 cf. Figs 34, 44, 104 **135** DHJ489159 **136** DHJ489157 **137** DHJ489154 **138** DHJ489160.



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Figures 139–146. *Leucosigma schausi*, larvae, Área de Conservación Guanacaste (ACG), Costa Rica. **139** ♂ 10-SRNP-70653-DHJ469071 **140–142** ♂ 10-SRNP-70740 **140** DHJ469099 **141** DHJ469108 **142** DHJ469109 **143–146** ♀ 10-SRNP-70113, USNMENT01370292 cf. Figs 36, 46 **143** DHJ467595 **144** DHJ467593 **145** DHJ467592 **146** DHJ467604.



Figures 147–154. *Leucosigma poolei*, larvae, Área de Conservación Guanacaste (ACG), Costa Rica. **147–150, 152–154** ♂10-SRNP-31675 **147** DHJ473617 **148** DHJ4 7361 **149** DHJ473609 **150** DHJ473620 **151** ♀10-SRNP-70737-DHJ469091 cf. Figs 18, 28, 97 **152** DHJ47362 **153** DHJ473626 **154** DHJ47363.

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Review of *Lophomyra* Schaus, 1911 (Lepidoptera, Noctuidae): a new combination and re-descriptions of species newly associated with ferns (Polypodiaceae)

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Abstract

Lophomyra Schaus, 1911 (Noctuidae) is the smaller of two noctuid genera originally described by Schaus that include species recently associated with ferns (Pteridophyta), in this case Polypodiaceae, as larval food plants. Following an examination of type material and reared specimens accompanied by DNA barcode data, *Lophomyra* is revised to include *L. tacita* Schaus, 1911, *L. santista* (Jones, 1914), and *L. commixta* (Schaus, 1914), **comb. n.**, the last of which is transferred from *Chytonidia* Schaus, 1914 (= *Leucosigma* Druce, 1908). *Lophomyra* is characterized based on adult and larval morphology, especially that of the male genitalia. Structures associated with the valvae are discussed with reference to dissected and *in situ* images. Larvae of *L. commixta* and *L. tacita* are described from images, and the recorded food plants of both species are discussed in the context of known New World noctuid pteridivores.

Keywords

Costa Rica, DNA barcode, *Lophomyra*, pteridivore

Introduction

Lophomyra Schaus, 1911 is one of two noctuid genera (Lepidoptera: Noctuidae: Noctuinae) described by Schaus with larvae recently discovered feeding on fern foliage (Pteridophyta) at Área de Conservación Guanacaste (ACG), northwestern Costa Rica. Because of their age and toxicity, ferns and their associated herbivore faunas have been of interest to plant-insect biologists for decades. In part because some fern-feeding insect groups have only recently become known as such and are in need of systematic treatment, the number of origins of pteridivory has likely been underestimated and the diet breadths of pteridivorous insects oversimplified. Sampling of Lepidoptera larvae during the last four decades in ACG (Janzen and Hallwachs 2016) have identified numerous pteridivorous caterpillars, most of them apparent fern specialists and several of which are species new to science. This paper represents an incipient effort to characterize the prevalence of lepidopteran fern-feeding behaviors, as well as to serve the larger aims of Neotropical moth systematics. Our primary purpose is to better diagnose *Lophomyra*, effect the transfer of *commixta* from *Chytonidia* Schaus, 1914 (= *Leucosigma* Druce, 1908), and figure the larvae of two species while characterizing their host plants at ACG.

Materials and methods

Pinned specimens were examined with an incandescent light source. Genitalic preparations follow Clarke (1941) in part and Lafontaine (2004), but staining with chlorazol black and mounted in euparal, with the vesicae everted in water prior to fixation. Dissections followed either an overnight room-temperature soak in supersaturated sodium hydroxide or a 15 minute heated soak, and were examined under dissecting microscopes prior to slide-mounting. Photographs were made using the Microptics and Visionary Digital imaging systems and images manipulated with Adobe Photoshop (Adobe Systems, Mountain View, CA). Higher-resolution images are available from the corresponding author. Measurements were made with the aid of an ocular micrometer. Forewing length was measured from the center of the axillary area to the apex of the forewing. Terminology follows Forbes (1954) and Lafontaine (1998, 2004). Both Jones' (1914) and Schaus' (1914) descriptions were thorough, although for the species treated here devoted primarily to wing pattern. Rather than reproduce them, we provide instead descriptions of the genitalia and other characters of note as well as formal diagnoses.

The male clasping apparatus differs significantly from that of *Leucosigma* Druce, and our terminology warrants clarification supplementary to that in the parallel review of that genus (Goldstein et al. 2018, this issue). We call specific attention to characters enumerated below in the generic re-description and in Figs 91–99. Although analogous in location, these structures do not all correspond to numbered structures referenced in our discussion of *Leucosigma*.

Provisional (neighbor-joining) analyses of available DNA barcode data helped to guide dissection efforts and taxonomic decisions, and were supplemented by a partial

sequence (~562bp) extracted during the dissection of the type of *Lophomyra santista*. That extraction involved an overnight soak of the abdomen in proteinase and sequestration of the lysate prior to soaking the abdomen in KOH per the normal dissection protocol. It is hoped that a more thorough treatment of *Lophomyra* will be enabled by greater availability of specimens and corresponding sequence data.

Repository abbreviations

The following abbreviations refer to collections from which specimens form the basis of this work:

- MNHUK** The Natural History Museum, London, UK (formerly BMNH).
USNM National Museum of Natural History [formerly, United States National Museum], Washington, District of Columbia, USA.

Systematics

Lophomyra Schaus, 1911

Synonym. *Iheringia* Jones, [1915] 1914.

Type species. *Iheringia santista* Jones, 1908 by monotypy.

Diagnosis. Species of *Lophomyra* are most unmistakably diagnosed by the male genitalia, specifically a conspicuous uncus that *in situ* appears swollen with a silvery or dark-gray sheen of scale-like clusters of setae, each cluster sharing a setal socket and shingled (hence scale-like). Forewing variously shaded with moss-green scales; paler scaling, to the extent present, concentrated primarily towards the inner margin; sexual dimorphism discernible with females more darkly colored, their hind wings more uniformly dark gray throughout and forewing pattern elements generally more distinct than in males; males bear a pronounced dorsal tuft on the second abdominal segment.

Description. Head. Labial palpi, frons, and vertex scaled with a mixture of whitish, gray brown, and green. Labial palpi upturned, with second segment longer than the other two segments combined. Proboscis with paired lateral rows of small protuberances towards terminus. Eyes smooth. Antennae filiform, finely scaled dorsally with white or a mixture of white and green.

Thorax. Vestiture predominantly made up of spatulate scales and simple hairs; a mix of gray-brown, purplish, lime-green scaling and black peppering; paired latero-dorsal tufts of elongate hairs arising at base of metathorax towards abdomen. *Wings.* Forewing a mix of gray-brown, black, lime- and moss-green, white and cream-colored scales, the green most prominent in the medial and terminal areas and basally along the inner margin; lines generally incomplete, the black postmedial line most visible but broken, bordered with white on both sides; medial veins edged in black towards the

outer margin. Basal, antemedial and medial costal striae black and white; postmedial striae white only. Pattern element boundaries blurred in part by variably shaded scaling and most particularly by medial streaking in *L. tacita* and *L. santista*. *Legs*. Scaled with a mixture of green and white; a single pair of mid-tibial spurs; two pair on hind-tibiae; 2+ rows of tibial spines on foreleg, three rows on mid- and hind-legs.

Abdomen. Scales predominantly grayish tan. Dorsal tuft of brown scales on second abdominal segment of males. Green scales intermixed with grayish tan, darkening towards in terminal segments. Note the complex of dorsal and ventral tufts enclosing and subtending the uncus and valvae, respectively.

Male genitalia. Uncus shingled with dark gray or silvery scale-like setal clusters, each representing ~7–9 spine-like setae. Saccus blunt. Juxta roughly shield-shaped, the dorsal edge concave, slightly jagged. Each divided valva comprises (1) a weakly sclerotized elongate sacculus; (2) a strongly sclerotized clasper, either a rudimentary beaklike structure or an elongate gently curved and concave spike, fused to the cucullus (3), which is elongate, weakly sclerotized, and may be swollen apically, spatulate or club-like with a heavy covering of setae and slightly recurved, such that the pair of these structures flank the uncus; and (4) a minor, ampulla-like process embedded within the sacculus, with which it may form a crotch that cradles the clasper. Directly beneath this structure on the inner face of the valve is what appears a well-developed editum comprising a raised patch of spine-like setae or, in the larger species, at least 10 fully developed spines directed anteromedially. Vesica unadorned, without cornuti, but a bilobate sub-basal diverticulum, highly bulbous in the larger species.

Female genitalia. Papillae anales blunt-tipped, subquadrate; ductus bursae and corpus bursae flask or wineskin shaped, colliculum absent; ductus bursae narrow relative to caudal region of bursa, constricted at (dorsal) juncture of the two, opposite dorsal opening to ductus seminalis; ductus may have small ventral posterior appendicular lobe; corpus bursae without signa.

Immature stages. Larvae, known exclusively from images, have predominantly orange or reddish-orange heads with 10 black spots, and paired setose dorsal spines.

Key to known species of *Lophomyra*

- 1 Forewing with a mottled appearance overall, but markings generally distinct, including white-outlined figure 8-shaped reniform and orbicular spots and a black spot at the inner margin near the forewing base; forewing margin prominently scalloped; antrum broadly V-shaped, its sides directed away from one another, not parallel; ductus bursae with small dorsal appendicular lobe *L. commixta*
- Forewing with a smudged appearance overall, markings variably distinct; reniform and orbicular spots figure 8-shaped but outlined faintly, if at all; inner edge of forewing smooth gray or grayish green; forewing margin not conspicuously scalloped; antrum chalice-shaped, its sides parallel or nearly so; ductus bursae with or without small dorsal appendicular lobe..... 2

- 2 Forewing with almost no black markings; reniform not outlined in white, appearing as a brown smudge; ductus bursae with small dorsal appendicular lobe..... *L. santista*
- White-outlined figure 8-shaped reniform spot; black basal dash extends almost to antemedial line; ductus bursae without small dorsal appendicular lobe..... *L. tacita*

***Lophomyra commixta* (Schaus, 1914), comb. n.**

Figs 49–56, 57–64; Male genitalia: Figs 69–72, 81–84; Figs 95, 98, 99 (*terminalia in situ*). Female genitalia: Figs 85, 86; Larvae: Figs 100–107

Chytonidia commixta Schaus, 1914. Type locality: French Guiana.

Material examined. Type material. HOLOTYPE ♂: FRENCH GUIANA: St. Laurent, Maroni, *Chytonix commixta* Type Schs, Collection Wm Schaus, Type No. 16530 U.S.N.M., USNMENT01370304, ♂ USNM Dissection 148186. Type at USNM.

Other material examined. (11♂, 14♀) **FRENCH GUIANA** (2♂, 5♀): ♂ AOUT, GUYANE FRANÇAISE St-LAURENT du MARONI COLL LE MOULT, Dognin Collection, USNMENT01437236, Male genitalia imaged *in situ*; ♂ JUILLET, Ibid, USNMENT01438844, USNM Dissection 148087; ♀ JUILLET, Ibid, USNMENT01437245; ♀ JANVIER, Ibid, USNMENT01437277; ♀ Cayenne, F. Guiana., Collection Wm Schaus, USNM Dissection 148086, USNMENT01370319; ♀ Ibid, *Chytonix commixta* Schs., USNMENT01370317; ♀ S.-Laurent du Maroni Guy. Franc, Dognin Collection, *Chytonix commixta* Schs., USNMENT01370327 **COSTA RICA** (9♂, 9♀):

The following label data precede Santa Rosa National Park (SRNP) identifier codes on all reared and light-trapped specimens examined (16♂, 29♀): Voucher: D.H. Janzen & W. Hallwachs DB: <http://janzen.sas.upenn.edu> Area de Conservacion Guanacaste, COSTA RICA. Except for those denoted “Alajuela,” all localities are within Guanacaste Province.

Males: Alajuela: Sector Rincon Rain Forest: Jacobo, 10.94076, -85.3177, el. 461m: larva on *Microgramma percussa*: 01/07/2011, ecl. 02/03/2011, Edwin Apu, collector, 11-SRNP-69041, USNMENT01370325, USNM Dissection 148098; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/27/2010, ecl. 03/05/2010, Ricardo Calero, collector, 10-SRNP-70532, USNMENT01438818; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/27/2010, ecl. 03/06/2010, Ricardo Calero, collector, 10-SRNP-70533, USNMENT01438849; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/29/2010, ecl. 03/06/2010, Manuel Rios, collector, 10-SRNP-70574, USNMENT01437246; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/29/2010, ecl. 03/05/2010, Manuel Rios, collector, 10-SRNP-70573,

USNMENT01437262; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/07/2014, ecl. 02/17/2014, Ricardo Calero, collector, 14-SRNP-70035, USNMENT01438824; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Niphidium oblanceolatum*: 01/25/2010, ecl. 02/27/2010, Ricardo Calero, collector, 10-SRNP-70488, USNMENT01438848, USNM Dissection 148180; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 02/15/2010, ecl. 03/24/2010, Ricardo Calero, collector, 10-SRNP-70810, USNMENT01370328, USNM Dissection 148050; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 02/15/2010, ecl. 03/20/2010, Dinia Martinez, collector, 10-SRNP-70812, USNMENT01437227.

Females: Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Niphidium oblanceolatum*: 01/21/2010, ecl. 03/04/2010, Ricardo Calero, collector, 10-SRNP-70495, USNMENT01437182; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/24/2010, ecl. 03/02/2010, Ricardo Calero, collector, 10-SRNP-70470, USNMENT01437196, USNM Dissection 148299; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 02/03/2010, ecl. 03/17/2010, Ricardo Calero, collector, 10-SRNP-70609, USNMENT01437192; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/07/2010, ecl. 12/22/2010, Ricardo Calero, collector, 10-SRNP-73249, USNMENT01437207; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/29/2010, ecl. 03/11/2010, Manuel Rios, collector, 10-SRNP-70572, USNMENT01437261; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 02/15/2010, ecl. 03/24/2010, Dinia Martinez, collector, 10-SRNP-70811, USNMENT01437202; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/27/2010, ecl. 03/03/2010, Dinia Martinez, collector, 10-SRNP-70534, USNMENT01437267 USNM Dissection 148187; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/23/2010, ecl. 03/02/2010, Ricardo Calero, collector, 10-SRNP-70436, USNMENT01370329, USNM Dissection 148051; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 03/15/2012, ecl. 04/18/2012, Ricardo Calero, collector, 12-SRNP-70644, USNMENT01370326, USNM Dissection 148106.

Diagnosis. Smaller and with distinct patterning and genitalic differences that distinguish it from the other described *Lophomyra*. Overall, we note the more mottled appearance to the forewing than in *L. tacita* or *L. santista*. More specifically, the green orbicular spot outlined in cream and the reniform spot outlined in white form a pair of figure 8's in *L. commixta* that meet at their posterior edges to form a deformed U-shaped stigma. These pattern elements are less obvious in *L. tacita* and *L. santista*, where the fusion of the reniform and orbicular spots is more complete. The male genitalia of *L. commixta* are distinct from and less robust than those of its congeners by virtue of the clasper's being less sharply developed, and the cucullus' appearing simple

and spatulate; the vesica bears a basal diverticular nipple (Figs 81–84). Female *L. commixta* also bear an appendicular lobe at the caudal end of the ductus bursae, a feature shared with *L. santista* but not with *L. tacita*.

Re-description. Head. Labial palpi as for genus. Proboscis with paired lateral rows of ~28 small protuberances at terminus. Frons and vertex scaled with a mixture of whitish and grayish brown. Remaining scales of head and palpi a mixture of white, gray-brown and “lilacine” (cf. Schaus 1914: 487). Antennae filiform, finely scaled, dorsally edged with white and a few green scales toward the base.

Thorax. Male prothorax with two fans of stalked scales, predominantly lime green, each fan gray-brown at its center and peppered with black; a third predominantly brown medial crest immediately posterior. *Wings.* Forewing length 11.5 mm (holotype, male), average 10.6 mm (males, $n = 9$), 11.5 mm (females, $n = 7$). Forewing patterning appearing less blended than in congeners, largely due to visibility of reniform-subreniform complex (see above) and the visibility of the postmedial line; on undersides, green shading confined primarily to forewing terminal areas; post-medial lines present but faint on undersides. *Legs.* Scaling, tibial spurs, and rows of tibial spines as for genus.

Abdomen. Dorsal scales predominantly tannish, except on terminal segments where visibly green; a medial line of dark scaling ventrally. Males with prominent medio-dorsal tuft of brown spatulate scales on A2; dorsal tufts posterior to A2 composed primarily of hairs concolorous with adjacent abdominal scaling.

Male genitalia. Structures less robust than those of larger congeners, including the much-reduced sacculus (1), a barely visible ampulla-like structure within it (4); the spines associated with the editum; the clasper (2), which is small and beak-like; and the cucullus (3), which is spatulate or modestly swollen distally, and not strongly recurved. Vesica with a shallow subbasal diverticular bump and a separate, more conspicuous, basal nipple.

Female genitalia. Antrum narrow, not more than twice the width of the ductus; ventral appendicular lobe present at caudal end of ductus bursae.

Immature stages. Larvae known from images (Figs 100–107). Pattern highly disruptive, with less contrast in coloration amid thoracic than abdominal segments. Head capsule pale with reddish calico patterning and black pinacula; dorsal chalazae red and raised, bearing bicolorous pinacula, black towards the front, red backward, forming setose spines, most prominent on A1–3; cream-colored subdorsal patches lateral to each spine form a series of ventro-caudally directed diagonal streaks, faintly shaded with green, again most conspicuous on A1–3, fainter on A4–7 and stronger again on A8; highly anastomosing pattern of fine pale lines centered mid-dorsally. This color pattern is highly cryptic among tangles of fern rhizomes where the caterpillars rest and pupate.

Biology. Wild-caught caterpillars were found feeding on leaves of *Microgramma percussa*, *Niphidium oblanceolatum*, *Polypodium fraxinifolium* (all Polypodiaceae). Eighteen reared individuals (10 males, 8 females) used an average of 24 days between the onset of the prepupal stage and adult eclosion in their ACG rain forest habitat. All ACG specimens were reared from wild-caught caterpillars and none light-trapped despite massive ACG-wide light-trapping, and all have the same DNA COI barcode and BIN (BOLD:AAY4740). No barcodes were available for South American specimens.

Distribution. French Guiana, Costa Rican rain forest.

Remarks. The conspicuous genitalic similarities as well as provisional analyses of DNA barcode data corroborate the placement of “*Chytonidia commixta*” with *Lophomyra*. The reared Costa Rican specimens may well represent a species distinct from *L. commixta*; they are larger than a small series of topotypic specimens from French Guiana (and reared specimens are commonly smaller than wild-caught adults). However, in the absence of evidence to the contrary, we have elected to continue to include them under *L. commixta*, recognizing that additional data may well separate the two, and that it is not uncommon for South American specimens to be recognized as taxonomically distinct from their Costa Rican look-alikes (e.g., Grishin et al. 2013, Janzen et al. 2017).

***Lophomyra tacita* Schaus, 1911**

Figs 1–10, 11–20, 21–30, 31–40; Male genitalia: Figs 65–68, 73–76, 91, 92, 93, 94, 96, 97; Female genitalia: Figs 88–90; Larvae: Figs 108–115; Pupae: Figs 116–118

Lophomyra tacita Schaus, 1911 Type locality: Costa Rica.

Material examined. Type material. HOLOTYPE ♀: Mar, Sixola Riv CR, Type No. 17334 U.S.N.M., *Lophomyra tacita* Type Schs, USNMMENT00973292, USNM Dissection 148201. Types at USNM.

Other material examined. (22♂, 30♀) **VENEZUELA** (2♂, 1♀): VENEZUELA: Aragua Rancho Grande 1100m 1–3 IV 1978 blacklight, cloud forest, J. B. Heppner, USNM Dissection 148083, USNMMENT01437226 [♂]; VENEZUELA: Ar. Rancho Grande July 1–7 1967 RW Poole 1100m, USNMMENT01370311 [♂]; Ibid July 15–21, USNM Dissection 148084, USNMMENT01370316 [♀].

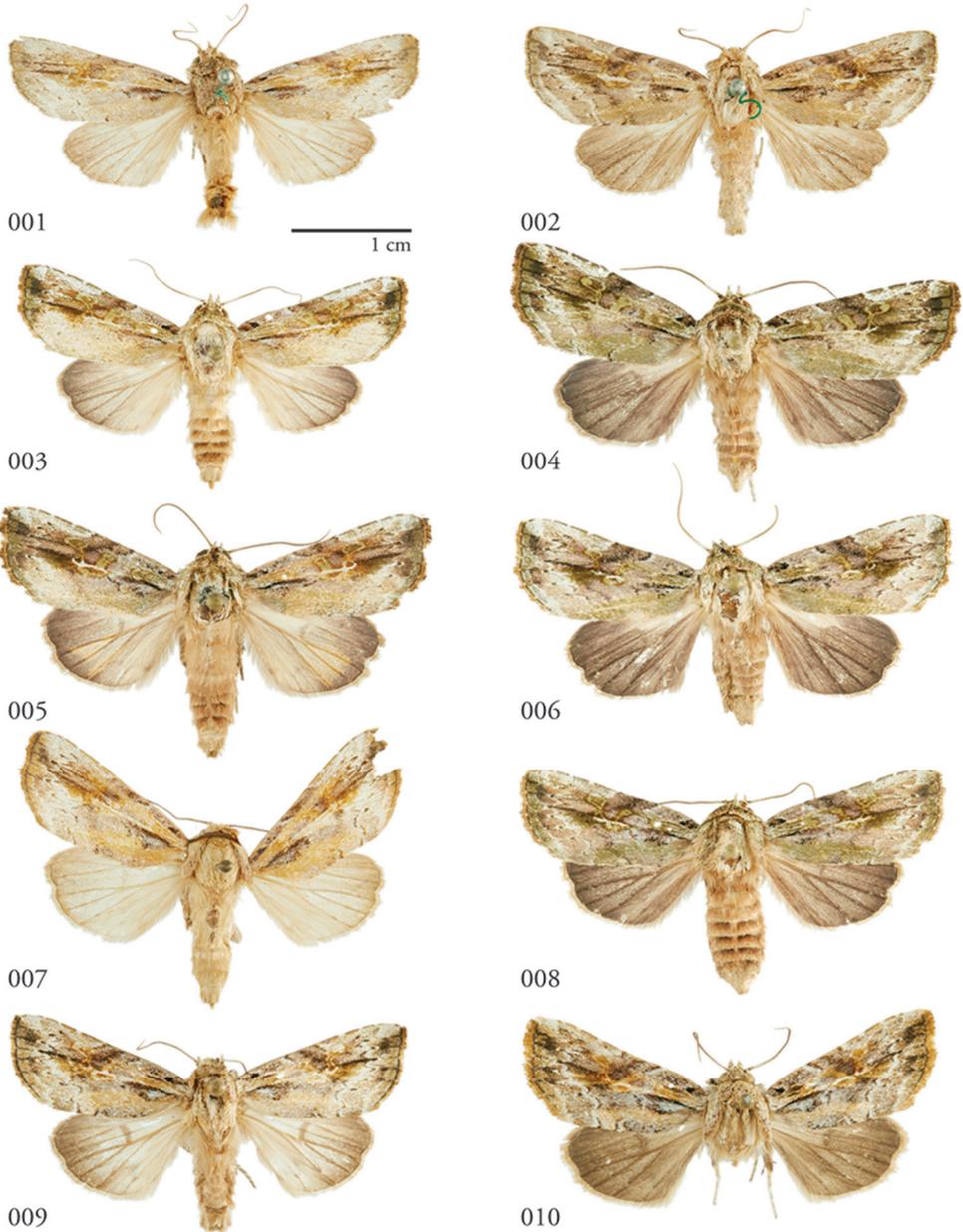
COSTA RICA (19♂, 29♀): ♂Juan Vinas CR, June, *Lophomyra tacita* Schs, gen & sp nov *Xylomyges* group USNMMENT01370323; Turrialba Costa Rica 10 II 1973 V.O. Becker, col. Becker 33420, *Lophomyra tacita* Schs, 1911, USNM Dissection 148143, USNMMENT01370321; Ibid, USNM Dissection 148081, USNMMENT01438834.

The following label data precede SRNP identifier codes on all reared and light-trapped specimens examined (16♂, 29♀): Voucher: D.H. Janzen & W. Hallwachs DB: <http://janzen.sas.upenn.edu> Area de Conservacion Guanacaste, COSTA RICA. Except for those denoted “Alajuela”, all localities are within Guanacaste Province.

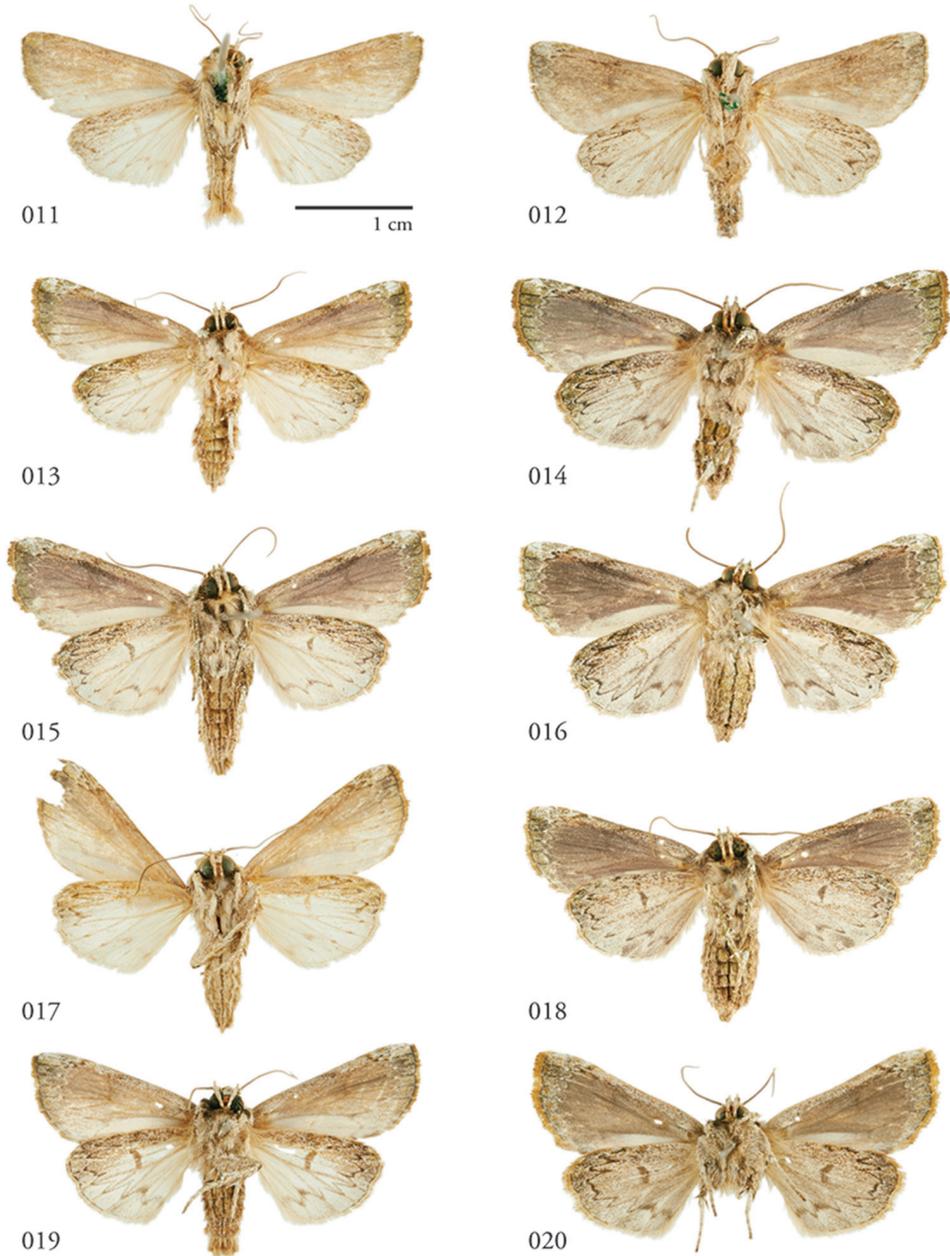
Males (16): Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/29/2009, ecl. 01/05/2010, Dinia Martinez, collector, 09-SRNP-73925, USNMMENT01370314, USNM Dissection 148052; Sector Pitilla: Quebradona, 10.99102, -85.39539, el. 475m: larva on *Microgramma percussa*: 01/10/2010, ecl. 03/02/2010, Ricardo Calero, collector, 10-SRNP-70181, USNMMENT01437251, USNM Dissection 148188; Sector Pitilla: Quebradona, 10.99102, -85.39539, el. 475m: larva on *Pleopeltis polypodioides*: 05/03/2011, ecl. 05/29/2011, Petrona Rios, collector, 11-SRNP-70989, USNMMENT01370310; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Niphidium oblanceolatum*:

11/21/2010, ecl. 12/28/2010, Ricardo Calero, collector, 10-SRNP-73286, USNMENT01370301; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 10/21/2010, ecl., Ricardo Calero, collector, 10-SRNP-73135, USNMENT01438813; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 10/21/2010, ecl. , Ricardo Calero, collector, 10-SRNP-70435, USNMENT01437276, USNM Dissection 148202; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/29/2009, ecl. 01/01/2010, Ricardo Calero, collector, 09-SRNP-73965, USNMENT01438858; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 02/09/2010, ecl. 03/20/2010, Dinia Martinez, collector, 10-SRNP-70707, USNMENT01370287; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/29/2010, ecl. 03/11/2010, Manuel Rios, collector, 10-SRNP-70571, USNMENT01437222; Sector Pitilla: Calma, 11.00987, -85.39214, el. 412m: larva on *Microgramma percussa*: 01/29/2010, ecl. 03/13/2010, Ricardo Calero, collector, 10-SRNP-70569, USNMENT01437252; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 10/21/2010, ecl. 11/20/2010, Ricardo Calero, collector, 10-SRNP-73128, USNMENT01370305; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 02/01/2010, ecl. 03/10/2010, Ricardo Calero, collector, 10-SRNP-70597, USNMENT01438869; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 02/08/2010, ecl. 03/13/2010, Ricardo Calero, collector, 10-SRNP-70719, USNMENT01438854; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/26/2010, ecl. 03/02/2010, Ricardo Calero, collector, 10-SRNP-70530, USNMENT01438809; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 11/26/2010, ecl. 12/03/2010, Dinia Martinez, collector, 10-SRNP-73310, USNMENT01437265, USNM Dissection 148099; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 10/30/2010, ecl. , Dinia Martinez, collector, 10-SRNP-73207, USNMENT01370315.

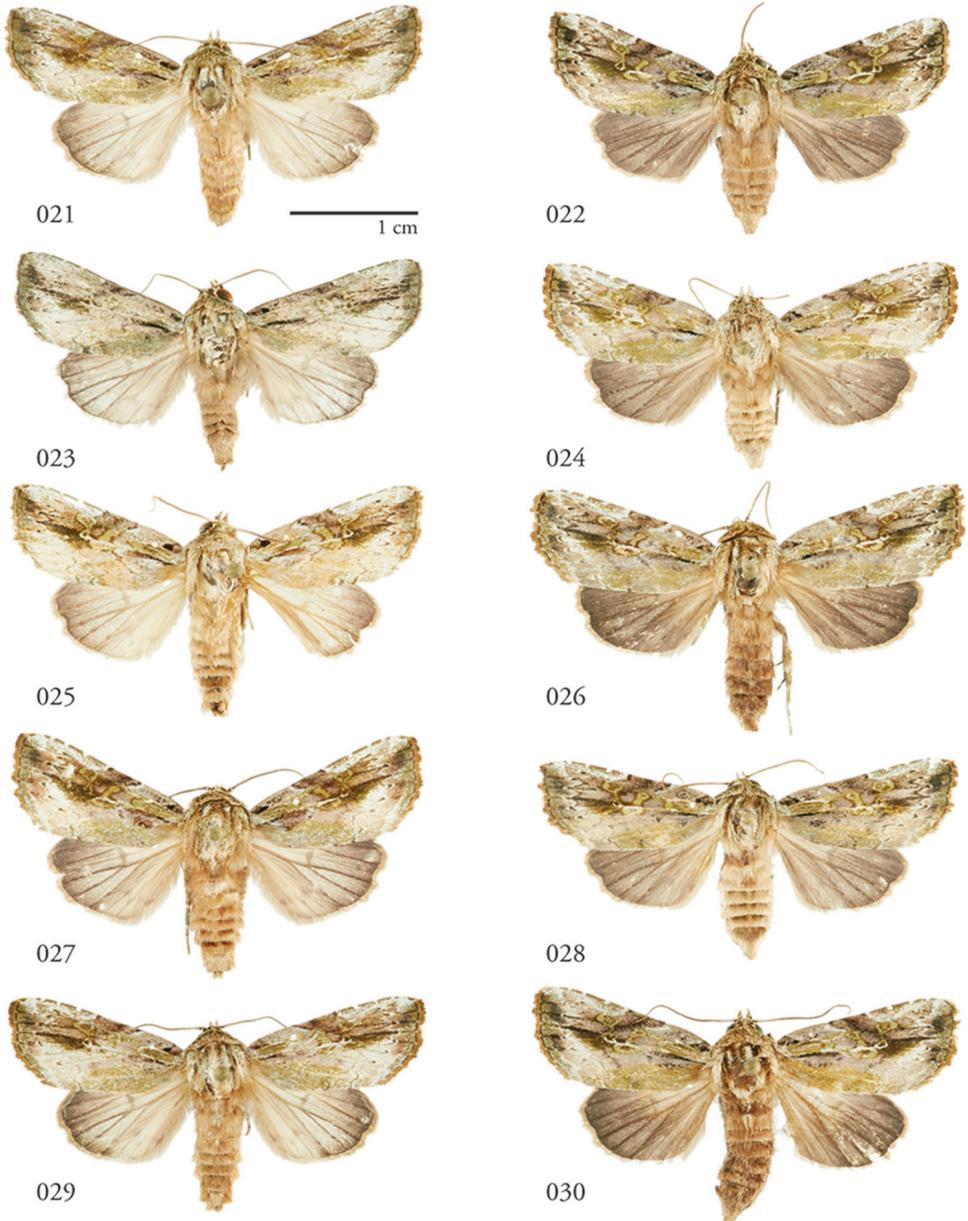
Females (29): ♀ Costa Rica. Juan Vinas. 2500 ft. June Wm Schaus 1911-32, *Loxodes tacita* Schs, NHMUK01606199; Alajuela: Sector San Cristobal: Finca San Gabriel, 10.87766, -85.39343, el. 645m: larva on *Campyloneurum gracile*: 03/19/2012, ecl. 04/20/2012, Elda Araya, collector, 12-SRNP-1080, USNMENT01370309; Alajuela: Sector San Cristobal: Estacion San Gerardo, 10.88009, -85.38887, el. 575m: 11/21/2006, F.Quesada&H.Cambronero, collector, 06-SRNP-109388, USNMENT01437195; Alajuela: Sector San Cristobal: Estacion San Gerardo, 10.88009, -85.38887, el. 575m: 05/04/2011, R.Franco&S.Rios, collector, 11-SRNP-103237, USNMENT01437212; Alajuela: Sector Rincon Rain Forest: Jacobo, 10.94076, -85.3177, el. 461m: larva on *Microgramma percussa*: 01/11/2011, ecl. 02/09/2011, Edwin Apu, collector, 11-SRNP-69085, USNMENT01437180; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/19/2010, ecl. 02/23/2010, Dinia Martinez, collector, 10-SRNP-70396, USNMENT01437191, USNM Dissection



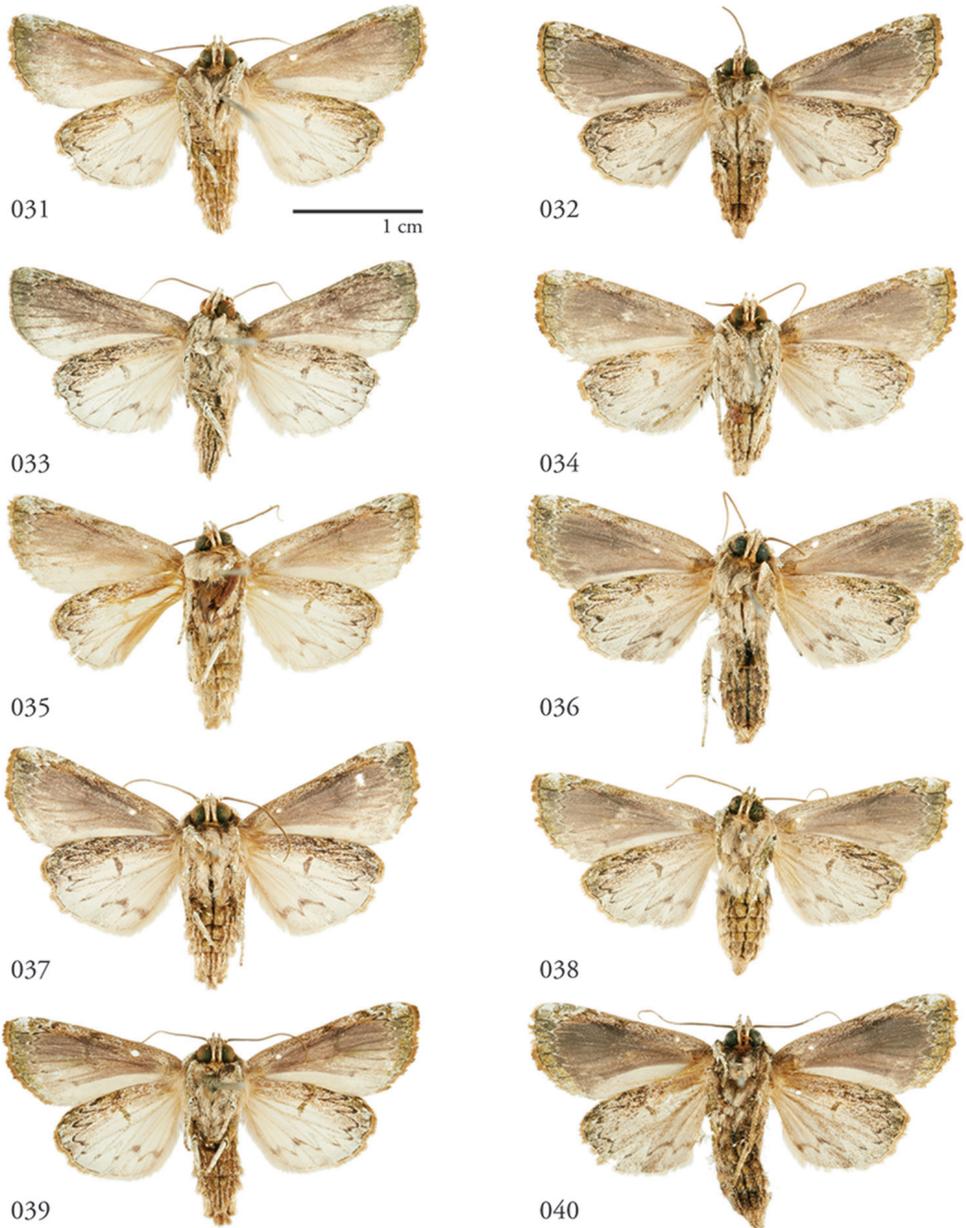
Figures 1–10. *Lophomyra tacita*, dorsal habitus **1** ♂ Turrialba, Costa Rica, USNMMENT01370323 **2** Holotype ♀, Costa Rica, USNMMENT00973292, USNM Dissection 148201 **3** ♂ Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-70989, USNMMENT01370310 **4** ♀ ACG, 10-SRNP-71914, USNMMENT01370306 **5** ♂ ACG, 10-SRNP-73128, USNMMENT01370305 **6** ♀ ACG, 10-SRNP-72638, USNMMENT01370313, USNM Dissection 148145 **7** ♂ Venezuela, USNMMENT01437226, USNM Dissection 148083 **8** ♀ ACG, 10-SRNP-70590, USNMMENT01370320, USNM Dissection 148189 **9** ♂ Venezuela, USNMMENT01370311 **10** ♀ Venezuela, USNMMENT01370316, USNM Dissection 148084.



Figures 11–20. *Lophomyra tacita*, ventral habitus. **11** ♂ Turrialba, Costa Rica, USNMENT01370323 **12** Holotype ♀, Costa Rica, USNMENT00973292, USNM Dissection 148201 **13** ♂ Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-70989, USNMENT01370310 **14** ♀ ACG, 10-SRNP-71914, USNMENT01370306 **15** ♂ ACG, 10-SRNP-73128, USNMENT01370305 **16** ♀ ACG, 10-SRNP-72638, USNMENT01370313, USNM Dissection 148145 **17** ♂, Venezuela, USNMENT01437226, USNM Dissection 148083 **18** ♀ ACG, 10-SRNP-70590, USNMENT01370320, USNM Dissection 148189 **19** ♂ Venezuela, USNMENT01370311 **20** ♀, Venezuela USNMENT01370316, USNM Dissection 148084.



Figures 21–30. *Lophomyra tacita*, dorsal habitus. **21** ♂ Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-73286, USNMENT01370301 **22** ♀ ACG, 12-SRNP-1080, USNMENT01370309 **23** ♂ ACG, 13-SRNP-71895, USNMENT01370324 **24** ♀ ACG, 10-SRNP-73225, USNMENT01370322 **25** ♂ ACG, 10-SRNP-70707, USNMENT01370287 **26** ♀ ACG, 10-SRNP-70072, USNMENT01370280 **27** ♂ ACG, 10-SRNP-70496, USNMENT01370308 **28** ♀ ACG, 11-SRNP-70494, USNMENT01370312 **29** ♂ ACG, 10-SRNP-73310, USNMENT01437265 **30** ♀ ACG, 10-SRNP-70706, USNMENT01370302.



Figures 31–40. *Lophomyra tacita*, ventral habitus **31** ♂ Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-73286, USNMENT01370301 **32** ♀ ACG, 12-SRNP-1080, USNMENT01370309 **33** ♂ ACG, 13-SRNP-71895 USNMENT01370324 **34** ♀ ACG, 10-SRNP-73225 USNMENT01370322 **35** ♂ ACG, 10-SRNP-70707 USNMENT01370287 **36** ♀ ACG, 10-SRNP-70072 USNMENT01370280 **37** ♂ ACG, 10-SRNP-70496 USNMENT01370308 **38** ♀ ACG, 11-SRNP-70494 USNMENT01370312 **39** ♂ ACG, 10-SRNP-73310, USNMENT01437265 **40** ♀ ACG, 10-SRNP-0706, USNMENT01370302.

148181; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 02/02/2010, ecl. 03/04/2010, Ricardo Calero, collector, 10-SRNP-70590, USNMENT01370320, USNM Dissection148189; Sector Pitilla: Coneja, 11.01525, -85.39766, el. 415m: larva on *Microgramma percussa*: 06/24/2010, ecl. 07/29/2010, Ricardo Calero, collector, 10-SRNP-71914, USNMENT01370306; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 02/09/2010, ecl. 03/17/2010, Dinia Martinez, collector, 10-SRNP-70706, USNMENT01370302; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 10/30/2010, ecl. , Dinia Martinez, collector, 10-SRNP-73205, USNMENT01437237; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 08/17/2010, ecl. 09/24/2010, Ricardo Calero, collector, 10-SRNP-72638, USNMENT01370313, USNM Dissection 148145; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 03/26/2011, ecl. 04/26/2011, Dinia Martinez, collector, 10-SRNP-70741, USNMENT01437210, USNM Dissection 148144; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Niphidium oblancoelatum*: 10/21/2010, ecl. 11/30/2010, Ricardo Calero, collector, 10-SRNP-73136, USNMENT01437215; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/23/2010, ecl. 03/06/2010, Ricardo Calero, collector, 10-SRNP-70437, USNMENT01437235; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/03/2010, ecl. , Ricardo Calero, collector, 10-SRNP-73225, USNMENT01370322; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 02/26/2010, ecl. 04/01/2010, Ricardo Calero, collector, 10-SRNP-70954, USNMENT01437190; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/19/2010, ecl. 02/23/2010, Ricardo Calero, collector, 10-SRNP-70395, USNMENT01437256; Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/26/2010, ecl. 03/15/2010, Manuel Rios, collector, 10-SRNP-70493, USNMENT01438828; Sector Cacao: Roca Verde, 10.89354, -85.43603, el. 835m: 08/12/2007, R.Franco&F.Quesada, collector, 07-SRNP-108035, USNMENT01437232; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/27/2013, ecl. 01/05/2014, Ricardo Calero, collector, 13-SRNP-71895, USNMENT01370324; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 10/08/2013, ecl. 11/11/2013, Ricardo Calero, collector, 13-SRNP-71692, USNMENT01437185; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 12/04/2010, ecl. 01/17/2011, Ricardo Calero, collector, 10-SRNP-73361, USNMENT01437205; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/07/2009, ecl. 12/10/2009, Dinia Martinez, collector, 09-SRNP-73662, USNMENT01437270; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 01/06/2010, ecl. 02/19/2010, Ricardo Calero, collector, 10-SRNP-70072, USN-

MENT01370280; Sector Pitilla: Calma, 11.00987, -85.39214, el. 412m: larva on *Niphidium oblanceolatum*: 02/22/2011, ecl. 04/11/2011, Ricardo Calero, collector, 11-SRNP-70494, USNMENT01370312; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Polypodium fraxinifolium*: 01/26/2010, ecl. 03/05/2010, Manuel Rios, collector, 10-SRNP-70496, USNMENT01370308; Sector Pitilla: Amonias, 11.04249, -85.40339, el. 390m: larva on *Microgramma percussa*: 08/21/2010, ecl. 09/19/2010, Manuel Rios, collector, 10-SRNP-31891, USNMENT01438853; Sector Pitilla: Coneja, 11.01525, -85.39766, el. 415m: larva on *Microgramma percussa*: 01/23/2010, ecl. 03/03/2010, Ricardo Calero, collector, 10-SRNP-70460, USNMENT01437275, USNM Dissection 148053; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 11/27/2013, ecl. 01/05/2014, Ricardo Calero, collector, 13-SRNP-71894, USNMENT01438803, USNM Dissection 148105; Sector Pitilla: Estacion Quica, 10.99697, -85.39666, el. 470m: larva on *Microgramma percussa*: 07/02/2010, ecl. 08/07/2010, Ricardo Calero, collector, 10-SRNP-71962, USNMENT01437216.

Diagnosis. Readily distinguished from *L. commixta* as both larva and adult; adult more similar to that of *L. santista* (below) but can be distinguished by white costal frosting on distal half of forewing, the interruption of the U-shaped stigma by a thin longitudinal white streak which partially encircles a black dot at the base of the reniform, and a variable diffuse gray patch between the dash and a more expansive gray-green patch along the inner margin near the base of the wing. Females lack the appendicular lobe on the ductus bursae, present in both the other species.

Re-description. Head. Labial palpus with 2nd segment >2× combined length of first and third combined; all segments scaled with a mixture of whitish, black, brown and green. Proboscis with paired lateral rows of ~28 small protuberances at terminus. Eyes smooth. Antennae filiform, dorsally with fine white scales; frons, vertex, and palpi (all segments) with a mix of white and green scales.

Thorax. Thoracic vestiture a mix of green, white, black, and light brown scales. **Wings.** Forewing length 13.3 mm (holotype, female), average 12.7 mm (males, $n = 9$), 13.2 mm (females, $n = 11$). Forewing patterned with gray, white, black and moss-green scaling, the last predominantly in the subcostal, outer medial, and subterminal areas and along inner margin; basal line confined to a black subcostal spot or (in females) a pair of black subcostal spots; the most extensive green scaling forming a uniform green basal patch along the inner margin between CuA2 and the postmedial line; short, black basal dash black along inner edge of M, forming the leading edge of a purplish-gray wedge; an outer medial wedge, predominantly moss green, between CuA1 and M2, the latter of which is also edged in purplish gray, overlaps with the fusion of the reniform and orbicular spots; subterminal line wavy, shadowed by white scaling and punctuated by black dots at the intersections of each vein; orbicular spot elongate, lime green, outlined in gold scaling, converging below the M vein with dumbbell-shaped, moss-green reniform spot, outlined with lime-green scaling, forming a deformed U-shape; white subcostal frosting along distal half of wing; a pale, washed-out patch in the ventro-posterior part of the wing, most conspicuous in

males. Hind wing uniformly gray in females, pale basally in males, with discal spot faint but present in both. Underside of forewing terminal area with noticeably green shading; inner margin pale; center of wing gray, paler towards inner margin. Pattern elements on underside less conspicuous in males than females, visible primarily in the terminal area of the forewing and the costal margin of the hind wing, where the discal spot is likewise faint, if present in males, and the postmedial line wavy, brown, outwardly white in costal part and increasingly diffuse towards the inner margin. *Legs*. Scales primarily a mixture of green and white; tibial spurs and rows of tibial spines as for genus.

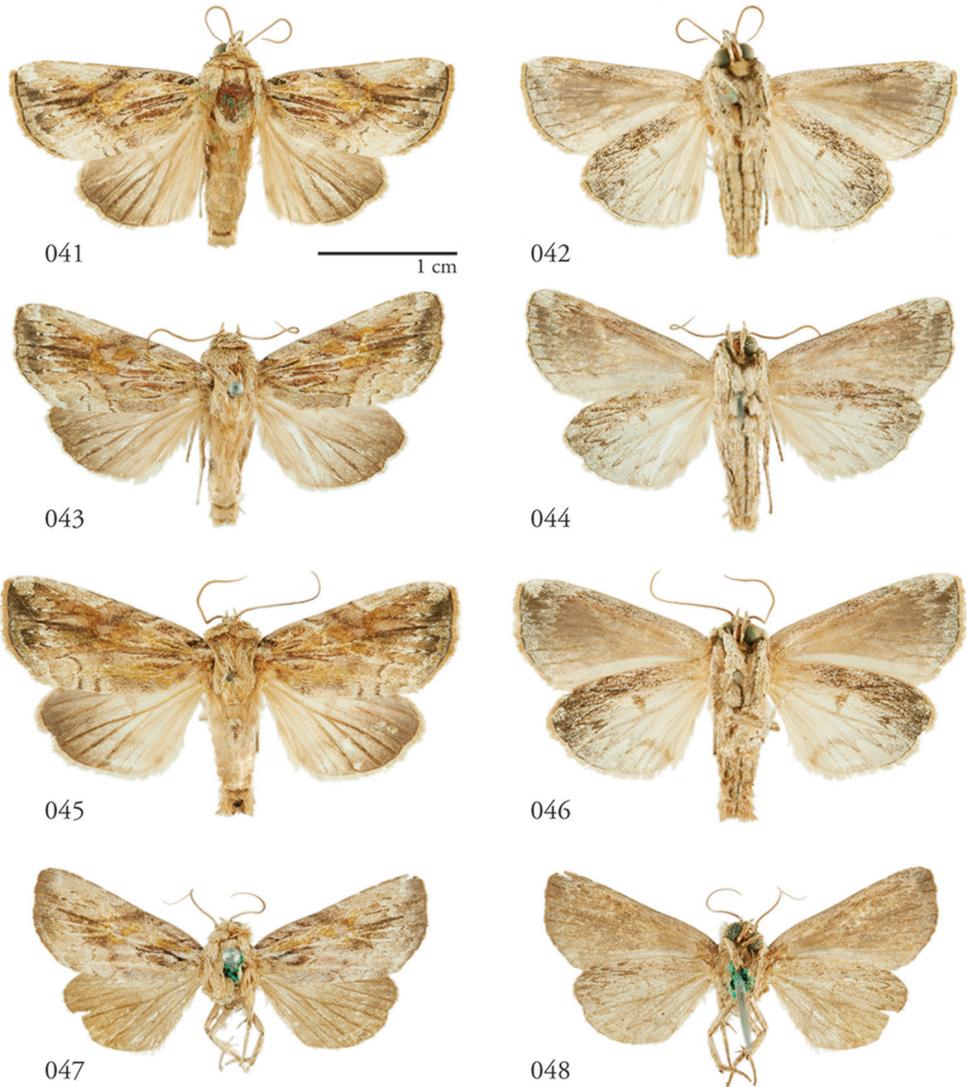
Abdomen. Tan above; abdominal segments with medio-dorsal tufts of tan spatulate scales, tipped brown on A1 and A2, A2 the most prominent, decreasing in size from A3–5; each abdominal segment ringed with an apical ring of elongate, strap-like scales and a basal ring of hairs; medial paired medial tufts of green scales ventrally; terminal tufts elaborate, one pair of lateral tufts arcing medially over uncus, when exposed; recurved, tufted apices of dorsal process of cucullus may direct outwardly when viewed *in situ* (Figs 93, 96, 97).

Male genitalia. Uncus, tegumen, vinculum, and saccus as for genus. Juxta U-shaped, the medio-lateral edges jagged. Sacculus (1) finger-like. Clasper (2) pronouncedly sickle-like and concave. Cucullus (3) especially robust, heavily setose, club-like and recurved apically. Ampulla-like structure (4) embedded within sacculus anterior to a prominent patch of medially directed spines. Vesica with bilobate diverticulum encircling its base.

Female genitalia. Appendicular lobe absent from ductus bursae, which is elongate, $>1/3$ the length of the corpus bursae; antrum wide and well developed.

Immature stages. Larvae known from images (Figs 108–115). Overall coloration orange and black, Cephalic spots larger and somatic chalazae more developed and sharper than in *L. commixta*, the latter black throughout and bearing two setae apiece. Head capsule orange with five black spots on each side: dorsal/vertical, postero-dorsal, anterior, lateral, and substemmatal (genal). Frons black; antennae orange at base, otherwise black. Dorsum tapers downward from A1 to T3 as in *L. commixta*. Chalazae black, raised, the dorsal pairs forming robust bisetose spines most prominent on the thoracic and anterior abdominal segments. Integument orange, dorsum spotted black thoracically, thereafter a combination of linear black dashes and black stripes originating dorsally on either side of the orange mid-dorsal line at the caudal end of each segment, giving rise to a striped “herring-bone” pattern and rendering the appearance of bifurcating orange stripes extending forward and down to form a series of slanting alternating black and orange stripes; the orange subspiracular line becoming cantaloupe orange and broader in later instars.

Biology. Larvae found feeding on leaves of *Microgramma percussa*, *Niphidium oblancoelatum*, *Polypodium fraxinifolium*, *Pleopeltis polypodioides*, *Campyloneurum gracile* (all Polypodiaceae) in ACG rainforest. Thirty-five individuals (11 males, 24 females) took an average of 25 days between the observed onset of the prepupal stage and adult



Figures 41–48. *Lophomyra santista*, habitus. Dorsal (left), Ventral (right). **41, 42** Holotype ♂, Brazil, NHMUK01606195 **43, 44** ♂, Brazil, NHMUK01606196 **45, 46** ♂, Brazil, NHMUK01606198 **47, 48** ♀, French Guiana, USNM Dissection 148082, USNMENT01370318.

eclosion, with ranges of 21–31 days for males and 19–29 days for females. These data are all from their ACG rain forest habitat. Almost all ACG specimens were reared from wild-caught caterpillars and only three light trapped despite massive ACG-wide light trapping, and all have the same DNA COI barcode and BIN (BOLD:AAJ2401). No barcodes were available for other specimens of *L. tacita*.

Distribution. Costa Rica, Venezuela.



049

1 cm



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051



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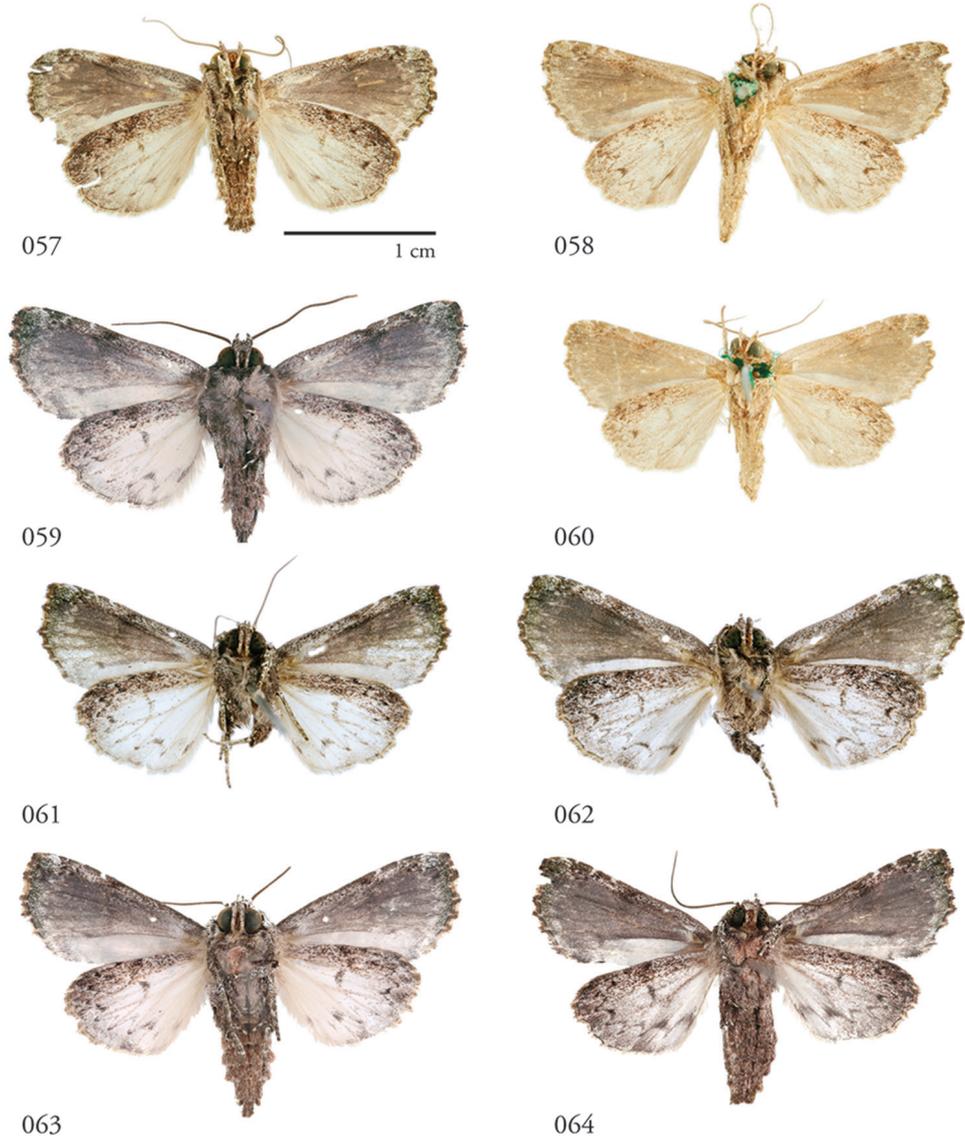


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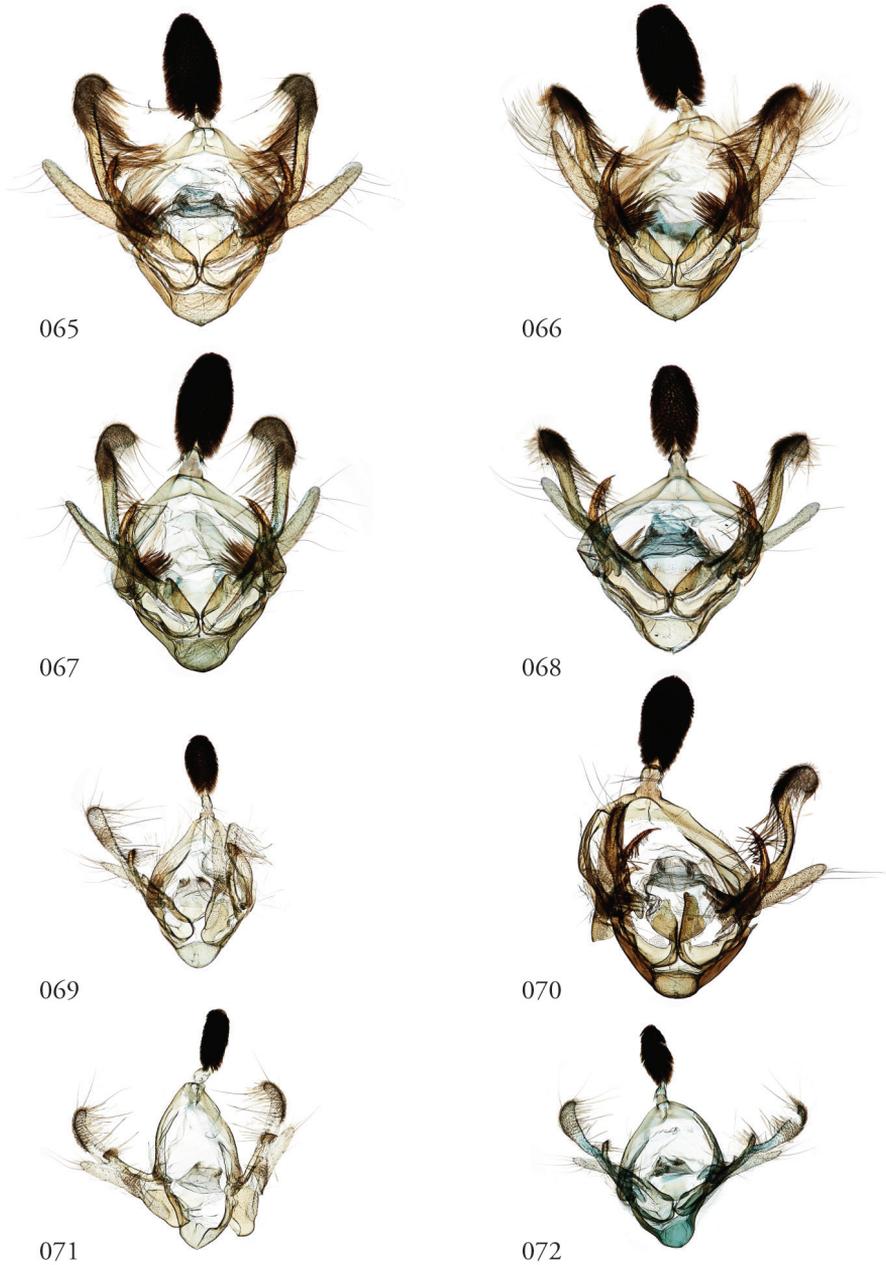


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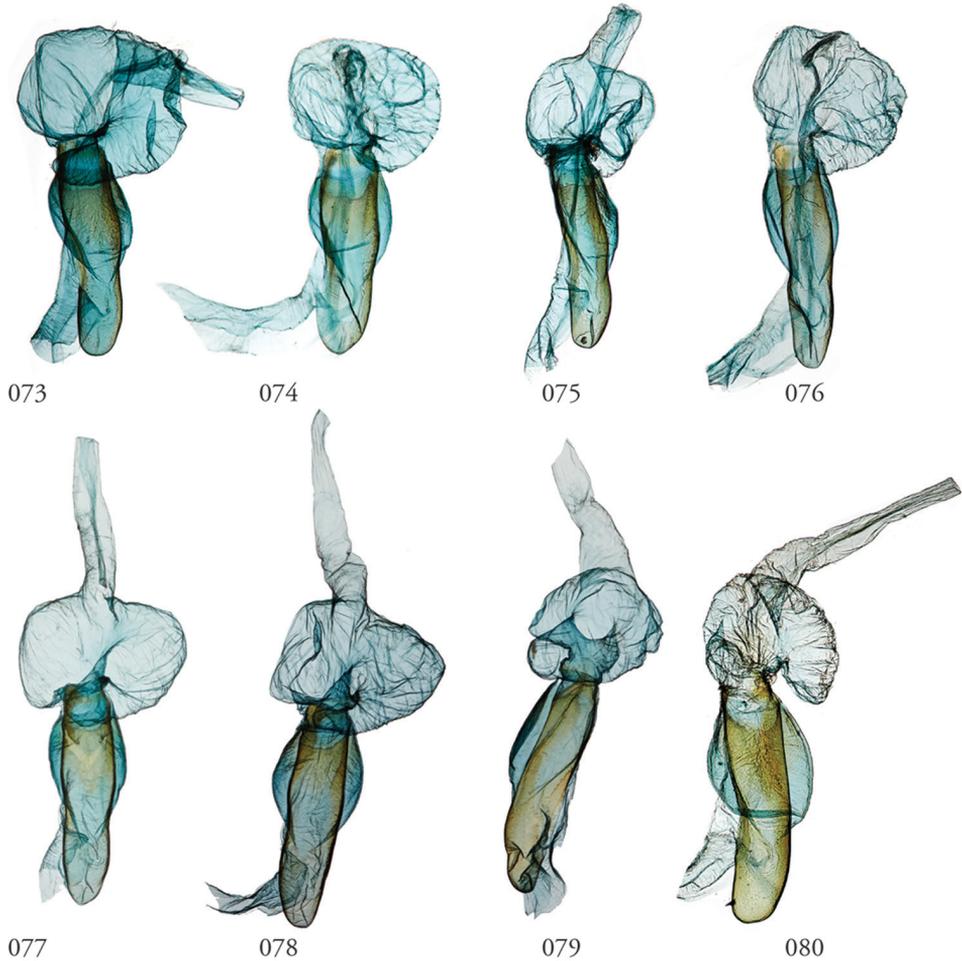
Figures 49–56. *Lophomyra commixta*, dorsal habitus. **49** Holotype ♂, French Guiana, USNMENT01370304, USNM Dissection 148186 **50** ♀ French Guiana, USNMENT01370319, USNM Dissection 148086 **51** ♂ Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-70741, USNMENT01370307 **52** ♀ French Guiana, USNMENT01370317 **53** ♂ ACG, 10-SRNP-70810, USNMENT01370328, USNM Dissection 148050 **54** ♀, ACG, 10-SRNP-70436, USNMENT01370329, USNM Dissection 148051 **55** ♂ ACG, 11-SRNP-69041, USNMENT01370325, USNM Dissection 148098 **56** ♀ ACG, 12-SRNP-70644, USNMENT01370326, USNM Dissection 148106.



Figures 57–64. *Lophomyra commixta*, ventral habitus. **57** Holotype ♂, French Guiana, USNMENT01370304, USNM Dissection 148186 **58** ♀ French Guiana, USNMENT01370319, USNM Dissection 148086 **59** ♂ Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-70741, USNMENT01370307 **60** ♀ French Guiana, USNMENT01370317 **61** ♂ ACG, 10-SRNP-70810, USNMENT01370328, USNM Dissection 148050 **62** ♀ ACG, 10-SRNP-70436, USNMENT01370329, USNM Dissection 148051 **63** ♂ ACG, 11-SRNP-69041, USNMENT01370325, USNM Dissection 148098 **64** ♀ ACG, 12-SRNP-70644, USNMENT01370326, USNM Dissection 148106.



Figures 65–72. *Lophomyra* male genitalia, valves. **65** *L. tacita*, Turrialba, Costa Rica, USNMENT01438834, USNM Dissection 148081, **66** *L. tacita*, Turrialba, Costa Rica, USNMENT0148143, USNMENT01370321 **67** *L. tacita*, Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-73310, USNMENT01437265 USNM Dissection 148099 *tacita* **68** *L. tacita*, Venezuela, USNMENT01437226, USNM Dissection 148083 **69** *L. commixta*, Holotype, French Guiana, USNMENT01370304, USNM Dissection 148186 **70** *L. santista*, Holotype, Brazil, NHMUK01606195 **71** *L. commixta*, ACG, 11-SRNP-69041, USNMENT01370325, USNM Dissection 148098 **72** *L. commixta*, ACG, 10-SRNP-70488, USNMENT01438848, USNM Dissection 148180.



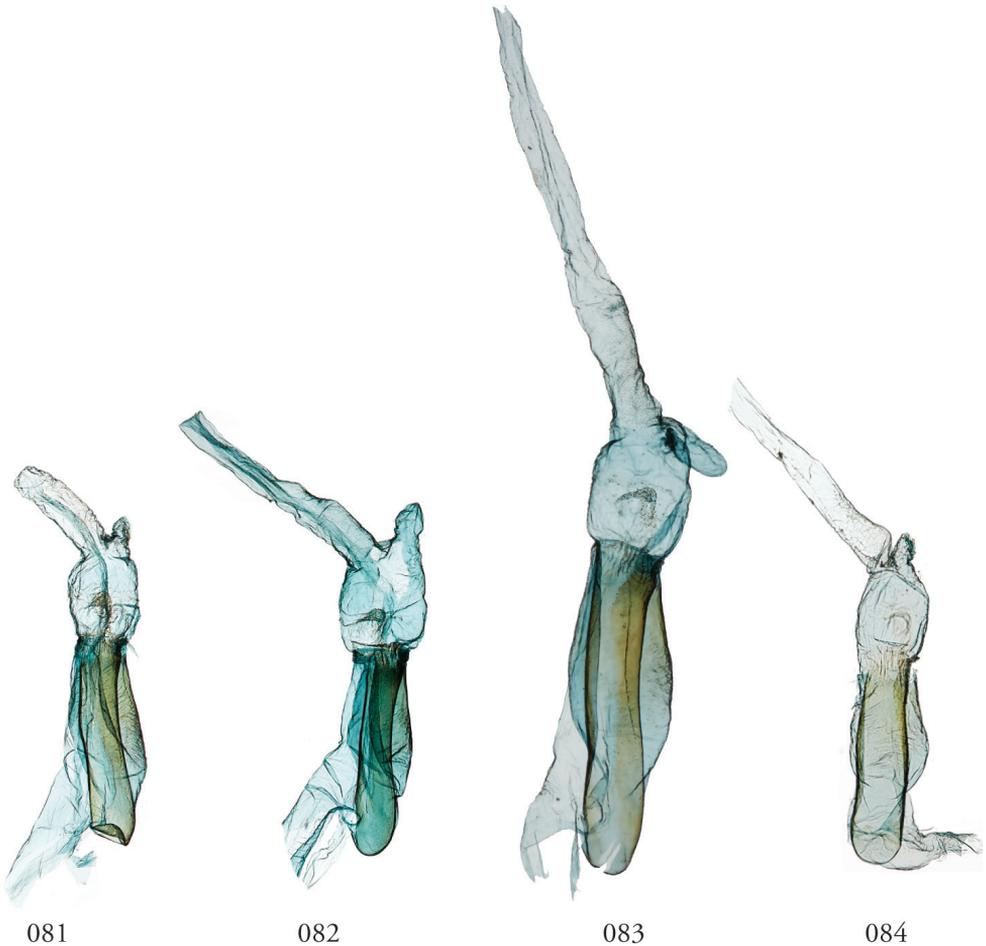
Figures 73–80. *Lophomyra* male genitalia, phalli. **73** *L. tacita*, Turrialba, Costa Rica, USNM Dissection 148143, USNMENT01370321 **74** *L. tacita*, Turrialba, Costa Rica, USNM Dissection 148081, USNMENT01438834 **75** *L. tacita*, Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-73310, USNMENT01437265, USNM Dissection 148099 **76** *L. tacita*, Venezuela, USNMENT01437226, USNM Dissection 148083 **77** *L. tacita*, ACG, USNMENT01438858, USNM Dissection 148290 **78** *L. tacita*, ACG, USNMENT01437222, USNM Dissection 148300 **79** *L. santista*, French Guiana, USNMENT01438868, USNM Dissection 148301 **80** *L. santista*, Holotype, Brazil, NHMUK01606195.

***Lophomyra santista* (Jones, [1915] 1914)**

Figs 41–48; Male genitalia: Figs 70, 80; Female genitalia: Fig. 87

Iheringia santista Jones, (1915) 1914 Type locality: Brazil.

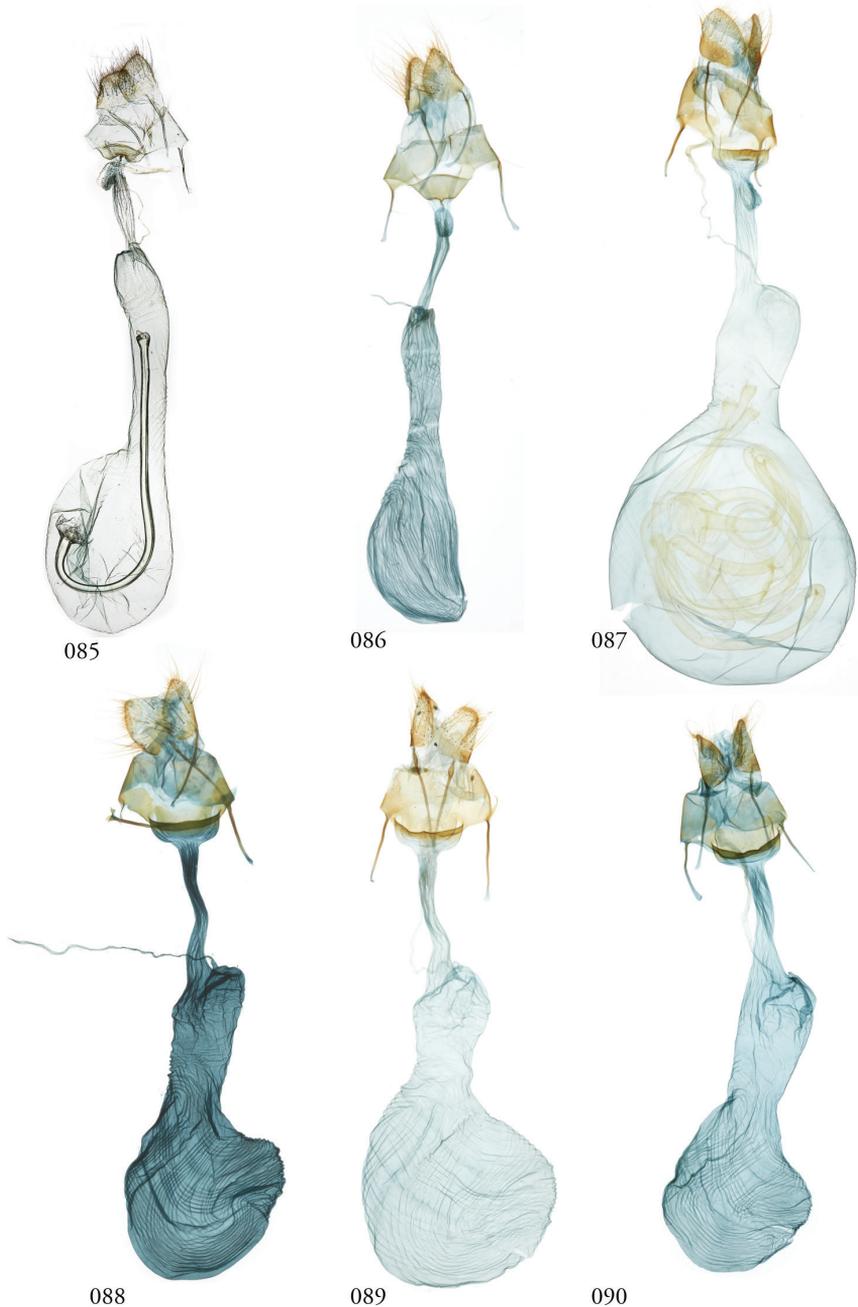
Material examined. Type material (2♂). SYNTYPES: [Brazil] Type, *Iheringia santista* type ♂ Jones, Alto da Serra Santos 800m. 25 Feb. 1913 E.D. Jones, NHMUK01606195;



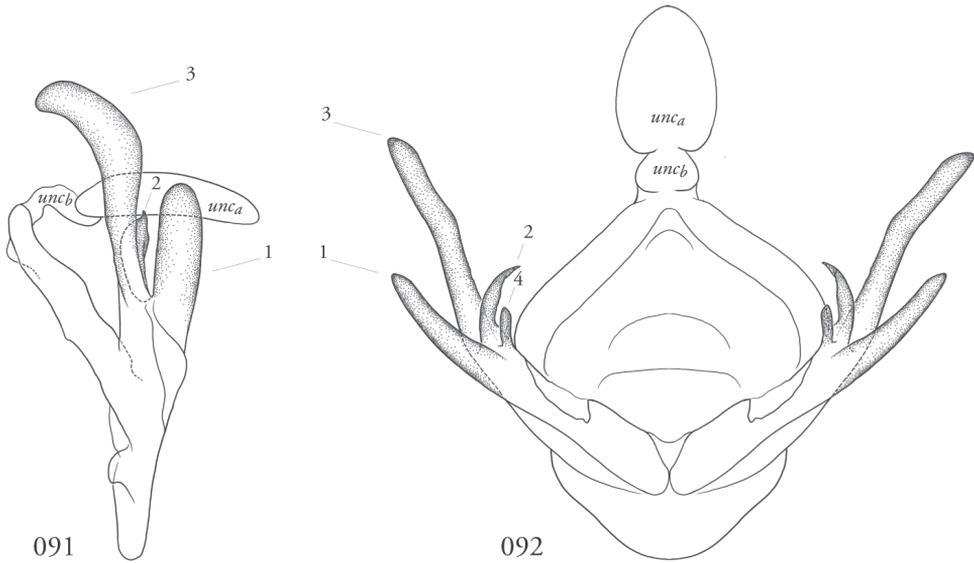
Figures 81–84. *Lophomyra commixta*, male genitalia, phalli. **81** Área de Conservación Guanacaste (ACG), Costa Rica, 11-SRNP-69041, USNMENT01370325, USNM Dissection 148098 **82** ACG, 10-SRNP-70488, USNMENT01438848, USNM Dissection 148180 **83** *L. commixta*, USNMENT01437196, USNM Dissection 148299 **84** *L. commixta*, Holotype, French Guiana, USNMENT01370304, USNM Dissection 148186.

Alto da Serra Santos 800m. 9 Mar. 1913, E.D. Jones coll., Brit. Mus. 1919-295., NHMUK01606197. Types at NMHUK.

Other material examined (3♂, 1♀). **BRAZIL** (2♂): BRAZIL: Santa Catharina. Blumenau. Neu Bremen. 28 VIII. 1932, Fritz Hoffmann. B.M. 1934-63, NHMUK01606196; Alto de Serra, Sao Paulo February, 1933. (R. Spitz), Rothschild Bequest B.M. 1939-1., NHMUK01606198. **FRENCH GUIANA** (1♂, 1♀): Juin, Guyane Franc^{se} Nouveau Chantier Collection Le Moul, *Lophomyra tacita* Schs [illeg.] 6-2-13, Dognin Collection, USNMENT01438868; St. Jean, Maroni, F. Guiana. Collection Wm Schaus, *Lophomyra tacita* Schs, USNM Dissection 148082, USNMENT01370318.



Figures 85–90. *Lophomyra* female genitalia. **85** *L. commixta*, French Guiana, USNMENT01370304, USNM Dissection 148086 **86** *L. commixta*, Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-70436, USNMENT01370329, USNM Dissection 148051 **87** *L. santista*, French Guiana, USNM Dissection 148082, USNMENT01370318 **88** *L. tacita*, ACG, 13-SRNP-71894, USNMENT01438803, USNM Dissection 148105 **89** *L. tacita*, Venezuela, USNMENT01370316, USNM Dissection 148084 **90** *L. tacita*, ACG, 10-SRNP-70460, USNMENT01437275, USNM Dissection 148053.



Figures 91, 92. *Lomphomyra tacita* male terminalia. Área de Conservación Guanacaste (ACG), Costa Rica, 10-SRNP-70435, USNMENT01437276, USNM Dissection 148202. **91** Lateral **92** Caudal. Numbers refer to structures as enumerated in text: 1 = sacculus; 2 = clasper; 3 = cucullus; 4 = ampulla-like process.

Diagnosis. Two elongate chocolate brown patches towards base of forewing; apical spot less pronounced than in *L. tacita*; ventral hind wing with postmedial line less pronounced than in *tacita*; male genitalia nearly indistinguishable from those of *L. tacita* but quite distinct from *L. commixta*; unlike *L. tacita*, female genitalia bear the appendicular lobe at caudal end of ductus bursae.

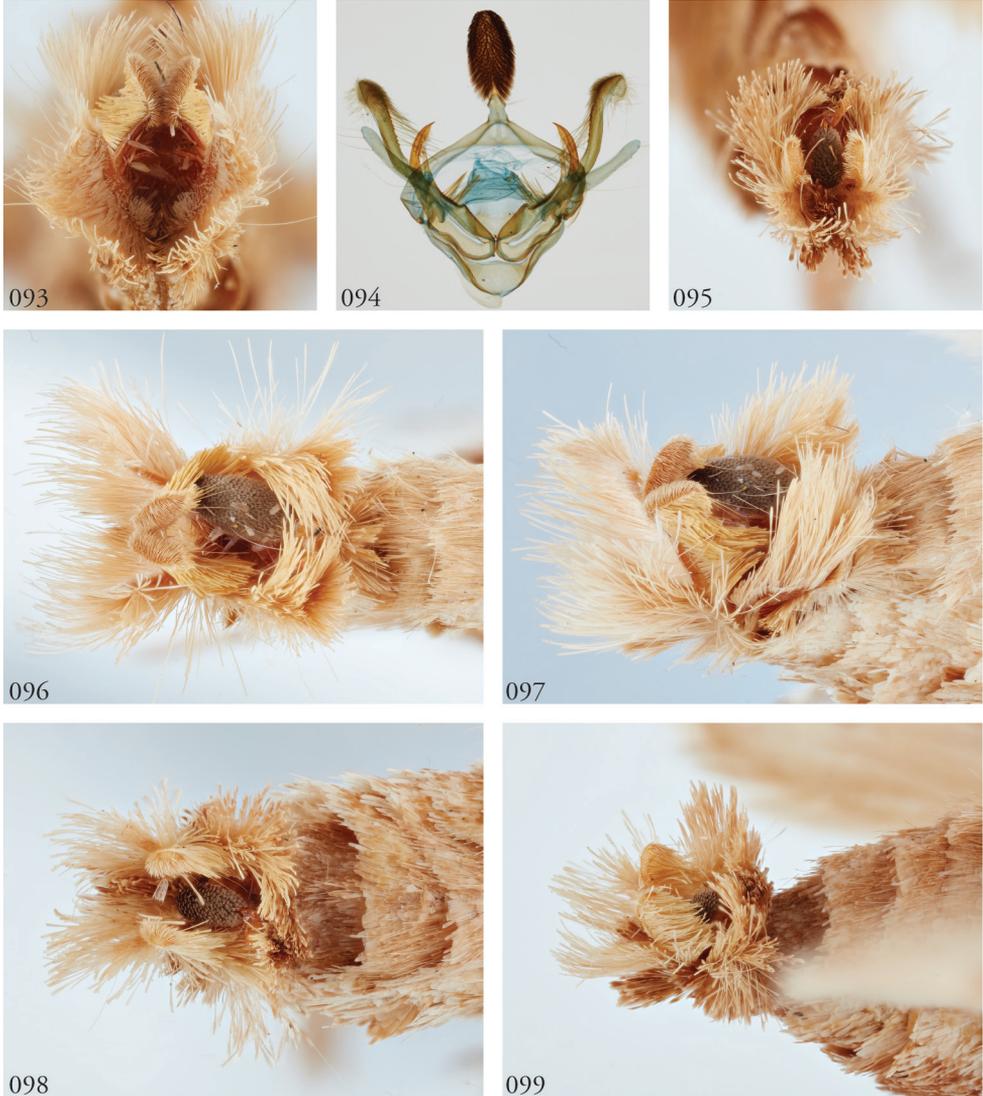
Re-description. Head. Antennae filiform, dorsally with fine white scales; eyes naked; scaling on vertex, frons and palpi much like that of *L. tacita* but greenish scaling faded in available material so direct comparisons difficult except to Costa Rican *L. tacita*.

Thorax. Vestiture similar to that of head. **Wings.** Forewing length 14.4 mm (holotype, male), average 14.3 mm (males, $n = 4$), 13.9 mm (female, $n = 1$). Underside of forewing variably frosted along costal and outer margins, whitish along inner margin, uniformly pale gray throughout outer part of wing; hind wing underside pale inward, gray-brown and white dusting along costal margin; discal spot faint. **Legs.** Scaling, tibial spurs, and rows of tibial spines as for genus.

Abdomen. Although Jones (1915: 440) describes both the thorax and abdomen as “without crests” in the generic description of the monotypic *Iberingia*, of which *L. santista* is the type, there are concolorous dorsal tufts on the first 8 abdominal segments of males of this species and *L. tacita*.

Male genitalia. Structures, including vesica, not readily distinguishable from those of *L. tacita*.

Female genitalia. Based on a single French Guiana specimen (Fig. 87), comparable to *L. tacita* except for the presence of ventral appendicular lobe on the caudal end



Figures 93–99. *Lophomyra* male terminalia *L. tacita* and *L. commixta* **93** *L. tacita*, Turrialba, Costa Rica, USNMENT01370323 **94** *L. tacita*, Venezuela, USNMENT01437226, USNM Dissection 148083 VZ **95** *L. commixta*, French Guiana, USNMENT01370327 **96** *L. tacita*, Turrialba, Costa Rica, USNMENT01370323 **97** *L. tacita*, Turrialba, Costa Rica, USNMENT01370323 **98** *L. commixta*, French Guiana USNMENT01370327 **99** *L. commixta*, French Guiana, USNMENT01370327.

of the ductus bursae. This specimen appears particularly distended because it contains three spermatophores.

Immature stages. Unknown.

Biology. Unknown.

Distribution. Brazil and French Guiana.



Figures 100–107. Larvae of *Lophomyra commixta*, Área de Conservación Guanacaste (ACG), Costa Rica. **100–103.** 11-SRNP-69041, USNMENT01370325, USNM Dissection 148098 (male), cf. Figs 55, 63, 71, 78 **100** DHJ483519 **101** DHJ483520 **102** DHJ483513 **103** DHJ483516 **104–107.** 10-SRNP-70572, USNMENT01437261 (female) **104** DHJ469067 **105** DHJ469064 **106** DHJ469063 **107** DHJ469069.



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Figures 108–115. Larvae of *Lophomyra tacita*, Área de Conservación Guanacaste (ACG), Costa Rica. **108** 10-SRNP-70396-DHJ469022, USNMENT01437191 (female) **109** 10-SRNP-70181-DHJ467611, USNMENT01437251 (top, male), 10-SRNP-70396-DHJ469019 (bottom, female) **110** 09-SRNP-73662-DHJ466954, USNMENT01437270 (female) **111** 09-SRNP-73662-DHJ466960, USNMENT01437270 (female) **112–115.** 10-SRNP-70001 (unreared) **112** DHJ467541 **113** DHJ467542 **114** DHJ467536 **115** DHJ467535.



Figure 116. Cocoon of *Lophomyra tacita* 10-SRNP-70471-DHJ498320.

Remarks. Available barcode data were supplemented by a partial sequence of the holotype of *L. santista*, but were not, in our estimation, sufficient for unambiguous diagnosis or synonymy with *L. tacita*, particularly given that the primary types of *L. santista* are male, and that of *L. tacita* female.

Discussion

Although no sister-group relationship between *Lophomyra* and *Leucosigma* is indicated by analyses of COI barcode data, there are as yet insufficient data to determine whether their shared associations with ferns are independently derived or a function of common ancestry. Beyond their provisional assignment to the Noctuinae, we refrain from naming any higher-level taxonomic assignments. As is certainly the case for *Leucosigma*, there remain a number of cryptic species of *Lophomyra* yet to be described.

Among the more striking features of *Lophomyra* is the complex of what appear to be male courtship tufts and the unusual configuration of setae covering the uncus (which may serve as a pheromone-bearing structure as well) that diagnoses the genus. What appear to be shingled, dark-gray scales are revealed under high magnification to be palmate clusters of setae.

The known host plants of *Lophomyra* represent the phylogenetically narrowest diet breadth of any genus of fern-feeding noctuids thus far documented from ACG. All recorded hosts of *Lophomyra* are polypodiaceous ferns, which are among the more widespread hosts of known Neotropical pteridivorous noctuid genera, most of which include species that have been recorded from Polypodiaceae, Dryopteridaceae, or both at ACG. These include the noctuid genera *Argyrosticta*, *Callopietria*, *Leucosigma*, and *Phu-phena* and the erbid genera *Dusponera*, *Mamerthes*, *Nicetas*, *Rejectaria*, *Salia*, *Scopifera* and *Tarista*. With the exception of *Leucosigma*, each of these includes species that have been recorded from more than two fern families, and a majority from more than five.



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Figures 117–119. Parasitized pupae of *Lophomyra tacita* and larva of *Lophomyra commixta*, Área de Conservación Guanacaste (ACG), Costa Rica. **117, 118** *L. tacita*, 10-SRNP-70472 parasitized by undescribed species of *Atactosturmia* (DHJPAR0038699) (Tachinidae). **117** DHJ498322 **118** DHJ498324 **119** *L. commixta*, 10-SRNP-71801-DHJ498385 *Diradops* (undescribed Banchinae) ichneumonid wasp cocoon from prepupal larva.

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A revision of *Admetovis* Grote, with the description of a new species from western North America (Noctuidae, Noctuinae, Hadenini)

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Abstract

The genus *Admetovis* Grote is revised. *Admetovis icarus* **sp. n.** is described from the mountains of western North America. A lectotype of *Admetovis oxymorus* Grote is designated. Illustrations of the adults, male and female genitalia, and distribution maps are presented, together with an identification key. The classification of the genus is reviewed resulting in its reassignment to the tribe Hadenini from Orthosiini.

Keywords

DNA barcode, Hadenini, Orthosiini, Taxonomy

Introduction

Admetovis Grote is a small genus of three western North American noctuid moths. The species are similar superficially, with a distinctive flame-like mark on the distal third of the otherwise gray forewing. Grote named the genus and first species in 1873. Two species, *Admetovis oxymorus* Grote and *Admetovis similaris* Dyar, have been known

since the turn of the last century. A third species from the Rocky Mountain region and Pacific Northwest resembling *Admetovis oxymorus* Grote was recognized recently. Its description is the main purpose of this article.

The higher classification of *Admetovis* is reviewed. Although the evidence is less than definitive, we recommend reclassification of this genus to the tribe Hadenini.

Methods and materials

Wing pattern and genitalia structure terminology follow Lafontaine (2004). Forewing lengths are measured to the nearest half-millimeter from base to apex, excluding the fringe.

Male and female genitalia were prepared using standard methods (Hardwick 1950, Lafontaine 2004). Detached abdomens were macerated in hot 10 % KOH for 20–40 minutes. Dissection was performed initially in water or an ethanol-water mixture followed by hardening in isopropyl alcohol. The male vesicae and female bursae were inflated. Preparations were stained with orcein [Sigma Chemical Company, St. Louis, Missouri] and mounted in Euparal [Bioquip Products, Rancho Dominguez, California] on glass slides.

The 658 base pair DNA “barcode region” of the mitochondrial cytochrome *c* oxidase subunit 1 (CO1) (“DNA barcode”) was used to assess molecular variation. Legs from dried specimens were submitted to the Barcodes of Life Campaign (BOLD) at the University of Guelph (Ontario, Canada) where they were analyzed by standard DNA extraction, amplification, and sequencing protocols (Hebert et al. 2003). Barcode sequences were compared to pre-existing material at BOLD using the Kimura-2-Parameter distance model as implemented on the Barcode of Life Data System website (<http://www.barcodinglife.org>). The seven-unit BOLD Barcode Index Number (BIN) (Ratnasingham and Hebert 2013) is given in parentheses.

Distribution maps were made using SimpleMappr (<http://simplemappr.net>).

Repository abbreviations:

- AMNH** American Museum of Natural History, New York, New York, USA
- NHML** Natural History Museum, London, England (statutorily, British Museum of Nature History)
- CNC** Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
- JS** Jon Shepard Collection, Corvallis, Oregon, USA
- LGC** Lars Crabo Collection, Bellingham, Washington, USA
- OSAC** Oregon State Arthropod Collection, Oregon State University, Corvallis, Oregon, USA
- TM** Tomas Mustelin Collection, Seattle, Washington, USA
- USNM** Smithsonian Institution (formerly United States National Museum), Washington, D. C., USA

Systematics

Admetovis Grote, 1873

Type species. *Admetovis oxymorus* Grote, 1873 by monotypy.

Diagnosis. Adults. Males and females similar in size and habitus, medium-sized (forewing length 17–21 mm) long-winged, stout noctuid moths; distinguished by combination of densely hairy eyes and gray forewing with a whitish, light tan, and reddish brown flame-like mark in both shape and color from the medial reniform stigma to the jagged subterminal line. *Head* – Male antenna beaded weakly with slight constriction between segments, anterior, posterior, and ventral sides setose with innumerable short fine cilia; female antenna simple with few short lateral cilia. Scape whitish to gray tan, with ventral acute tuft. Eye normal size, densely setose. Labial palpus porrect, third segment length $\sim \frac{1}{3} \times$ second segment. Haustellum normal. Frons rounded, scales short, hair-like, forked, tan, brown, or gray brown. Dorsal head scales longer, forked, tan, gray, orange tan, sculpted weakly with paramedian dorsal and ventral protuberances. *Thorax* – Scales long, hair-like, forked, and scattered trifurcate, light tan, orange tan, and chestnut brown; appearing golden tan, with sculpted broad pale median tufts on mesothorax and metathorax and red-brown paramedian tufts on metathorax; prothoracic collar similar; appearing golden tan with pale-edged red-brown posterior band; tegula scales mostly white-tipped gray, forked; appearing gray with tan to red-brown medial edge. *Legs*: Lateral foretibia with row of 4–6 long, stout, slightly recurved, claw-like setae, proximal and distal longest; mid- and hindlegs lacking modified setae. Tarsal segments except apical segment with three rows of ventral spiniform setae. *Wings*: Forewing: Length 2.3–2.5 \times width; apex pointed bluntly, outer margin slightly to moderately scalloped between veins; dorsal scales flat, fine toothed, elongate to triangular, white, gray, tan, and chestnut brown; ground color gray, darkest at costa and in cell, lightest at base; basal area posterior to vein 1A+2A light tan with anterior chestnut border; medial area distal to reniform spot and postmedial area whitish tan to tan, palest medially, forming with subterminal line and preceding chestnut shade a “flame” mark on distal $\frac{1}{3}$ of wing; basal and antemedial lines double, gray with slightly lighter filling, undulating, perpendicular to wing axis; medial line dark gray, faint, diffuse; postmedial line thin, gray, faint, usually incomplete, scalloped strongly with points extended as thin dark lines and spots on veins, strongly oblique to wing axis from costa to posterior reniform stigma, less strongly to posterior margin; subterminal line thin, white to tan, bordered medially by prominent chestnut-brown and dark brown to black shade, darkest in fold, next darkest opposite reniform stigma, toothed to outer margin at apex and on M1, M3, CuA1, and 1A+2A, concave basad in fold; terminal line thin, black; fringe gray, striped, base pale tan or brown, pale transverse checkering at veins; claviform stigma dark gray to black, incomplete, apex darkest, short and broad, reaching mid-medial area, filling light gray; orbicular stigma black or chestnut brown, relatively large, ovoid to weakly figure-eight-shaped, filled variably with light gray, darker gray, light tan, and brown; reniform stigma moderately large, kidney shaped, usually with absent posterior and distal outline but evident due to whitish

filling that contributes to palest portion of “flame” mark. Hindwing: Margin between M1 and M3 straight or concave; ground color pure white or slightly mottled light tan to brownish gray; veins, discal spot, and terminal line light to dark gray; fringe white to light gray with darker stripes, paler than ground. *Abdomen*. Male with or without basal coremata on segment I and pockets on ventrolateral segment III; when present weak, comprised of few filaments attached directly to base with pockets shallow, or strong, paint brush-like, filaments arising from rod with bulblike base, sometimes with very small medial accessory brushes, with pockets deep. Dorsal tufts on segments I–III. Female sternite VII sclerotized on distal half, with posterior median cleft $0.33\text{--}0.58 \times$ segment length, blunt posterolateral lobes on side of cleft cover ostium bursae and part of ventral segment VIII. *Male genitalia*: Uncus relatively short, curved ventrad, base cylindrical, distal half widened and flattened dorso-ventrally, slightly concave dorsally with flange-like raised edges, tapering to truncate apex with small ventral spine; dorsal edges and ventral apex with numerous short setae. Juxta broadly shield shaped, wider than tall, smooth (*A. similaris*) or with median thorn-like spine directed posterodorsad (2 species). Valve length $\sim 5 \times$ width, S-shaped with slight curve dorsad near mid-point and 90° lateral bend distal to clasper at $\frac{2}{3}$ distance from base to apex, tapered evenly from broad base to end of clasper, narrowing abruptly at bend to thin neck of cucullus, ventral margin of mid valve thickened with short blunt lateral projection ventral to distal clasper; sacculus length $0.4\text{--}0.5 \times$ valve, sclerotized strongly, extending to or slightly above dorsal valve, distal costal margin near dorsal attachment of valve humped dorsad or anvil shaped, covered densely with minute setae; clasper strongly sclerotized, a bowl-like concavity dorsal and distal to sacculus, distal margin a narrow flange-like rim extended to blunt triangular dorsal and broad convex ventral projections, dorsal projection longer than (two species) or similar (one species) to ventral projection; digitus absent; cucullus triangular, $0.6\text{--}1.0 \times$ mid-valve width, with slightly rounded margin bearing simple corona of 15–25 claw-like setae. Phallus tubular, length $6\text{--}7 \times$ width. Vesica length (including right and left limbs) $1.0\text{--}1.5 \times$ phallus, bent slightly ventrad at base then divided into nearly equal limbs directed 90° right and left to form with phallus a “T;” right limb comprised of distal vesica, tapered to ductus ejaculatorius at apex, with subapical broad short ventral diverticulum; left limb variable between species, tapering to conical or thin apical cornutus, bearing an additional thin acute cornutus at dorsal base (absent or diminutive in some specimens of all species) and anteriorly-directed broad conical subapical diverticulum (lacking in *A. icarus*). *Female genitalia*: Papilla analis asymmetrically conical, apex near dorsum, length $1\text{--}1.5 \times$ width, covered sparsely on base and mid-portion by thin hair-like setae, more densely on apex by short setae. Abdominal segment VIII slightly longer than wide, venter length $2 \times$ dorsum, covered sparsely by short hair-like setae; anterior apophyses length $0.57\text{--}0.77 \times$ abdominal segment VIII; posterior apophyses length $2.75\text{--}3.35 \times$ anterior apophyses. Ductus bursae length $1.14\text{--}1.32 \times$ abdominal segment VIII, strongly sclerotized, flattened dorsoventrally, length $\sim 3 \times$ width, ventral surface smooth, dorsum rugose; ostium bursae simple. Corpus bursae length $3.9\text{--}4.6 \times$ abdominal segment VIII, elongate, gourd shaped, anterior portion curved dorsad and leftward, membranous ovate anterior end widest, width $0.35\text{--}0.43 \times$ bursa length, 3–4 longitudinal irregular string-

of-beads signa evenly spaced on surface (left lateral signum absent in two species); appendix bursae projected ventrad and leftward from broad origin at junction with posterior corpus bursae at ductus bursae, length 0.12–0.25 × total corpus bursae length, sclerotized lightly, apex blunt, ductus seminalis at dorsum anterior to apex.

Distribution and ecology. *Admetovis* species occur in western North America, from the Rocky Mountains and Arizona-Mexico border west to the Pacific Coast and north to southern British Columbia. They undoubtedly occur in Mexico but the distribution there is unknown.

The flight period of adults is from early spring (February or March) to as late as August depending on the species and locality. Based on limited information for *Admetovis oxymorus* the larvae feed on woody shrubs and are most likely climbing cutworms (McFarland 1975). All species in the genus are nocturnal and are attracted readily to light.

Discussion. *Admetovis* was historically classified in the subfamily Hadeninae, where it was placed since the early twentieth century (Hampson 1905, McDunnough 1938, Hodges et al. 1982). It was reassigned recently to the tribe Noctuinae: Orthosiini (Lafontaine and Schmidt 2010) stemming from changes in the composition of the Noctuidae (Fibiger and Lafontaine 2005). Although the higher classification, including the recognition of Orthosiini as a tribe, is fairly recent (Fibiger and Lafontaine 2005) the relationship of *Admetovis* to other genera in this tribe is not obvious and had not been recognized widely. More recent molecular approaches to noctuid classification based on mtDNA barcode sequence data (Zahiri et al. 2017) support the current classification of North American Orthosiini in that nearly all included genera cluster together, but with the exception of *Admetovis* – this genus instead groups with genera in the Hadenini, which Godfrey also indicated as being the most closely related group to the orthosiine genera. This warrants a re-examination of Godfrey's (1972) interpretation of larval hypopharynx structure, which forms the basis of the Orthosiini as currently defined.

Godfrey (1972) included nine genera in the *Orthosia* group ("Group 8"), noting that two other genus-groups were likely closely related based on the morphology of the hypopharynx, namely the spining pattern and especially the transverse cleft, the latter shared across the three groups. Godfrey's three "transverse-cleft" groups comprise the *Anarta*-group, *Polia*-group and *Orthosia*-group, the first two now combined in the tribe Hadenini and the third comprising the Orthosiini. Although Godfrey separated the Orthosiini and Hadenini morphologically by two characters (lack of setae above the spinneret and larger spines on the proximolateral hypopharynx in Orthosiini), exceptions occur in both tribes (Godfrey 1972). *Admetovis* differs in the shape of the spinneret and the finely granular (vs. smooth) larval integument from all other Orthosiini, but these characters appear to be autapomorphic because they also do not occur in the Hadenini.

Importantly, *Admetovis* is the sole constituent of Godfrey's Group 8 where adults do not emerge in early spring. Most species in the Orthosiini emerge very early in the season, and some, such as *Orthosia praeses* (Grote) and *Egira hiemalis* (Grote), are the first non-overwintering moths to fly in late winter. While *A. similaris* can be found as

early as February in the deserts of the Southwest, most *Admetovis* differ from other orthosiines in that they fly later in the year from late spring through summer.

Finally, the male valves of *Admetovis*, S-shaped with triangular cuculli, are more similar to those of most hadenine moths (e.g., as shown for European species in Hacker et al. 2002) than they are to orthosiines (shown similarly in Ronkay et al. 2001), as are the everted vesicae. Females of both tribes are rather simple in genital structure and as a result are not highly diagnostic.

The weight of evidence (barcodes, biology, and adult genitalia structure versus somewhat equivocal larva hypopharyngeal structure) suggests that *Admetovis* is better classified in the Hadenini rather than the Orthosiini. A definitive phylogeny of the Noctuidae tribes, using multiple molecular and morphological markers, is still needed. As such, we recommend *Admetovis* as a fertile subject for further investigation.

Key to species of *Admetovis* (adults)

- 1 Dorsal hindwing pure white except thin gray veins and terminal line in some specimens; male juxta smooth, lacking central spine; female corpus bursae with four signa of nearly equal lengths *A. similaris*
- Hindwing off-white with tan or light gray mottling to gray brown, but not white; male juxta with spine-like median projection; female bursa with three signa, lacking one on left **2**
- 2 Hindwing outer margin slightly concave between veins M1 and M3; dorsal hindwing light, tan off-white with scattered gray scales; male abdominal segment III with fully-developed coremata with rod-like base; female genitalia with relatively short appendix and bulbous anterior corpus bursae (corpus bursae width : appendix bursae length > 3.5) *A. oxymorus*
- Hindwing margin straight between veins M1 and M3; hindwing dark, brown gray; male abdominal segment III coremata vestigial, consisting of fine hairs (occasionally lost during genitalia preparation) without a rod; female genitalia with short appendix bursae and narrower corpus bursae (corpus bursae width : appendix bursae length < 2.5) *A. icarus*

Species accounts

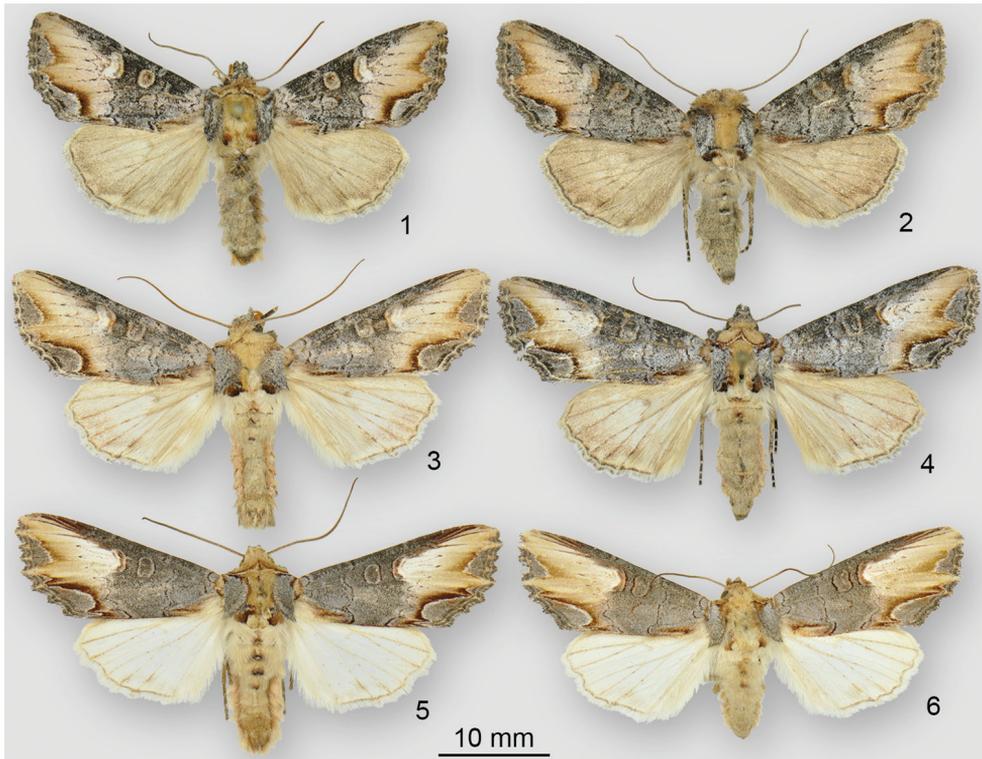
Admetovis icarus sp. n.

<http://zoobank.org/B293564D-4087-4F37-9BDE-FD3659627C15>

Figs 1, 2, 7, 8, 13, 16

Type locality. USA, Colorado, Boulder County, Nederland, 2896 m.

Type material. Holotype, male. [USA]: Colorado: [Boulder County]: Nederland, Science Lodge, 9500' [2896 m], 28 VI 1961, M. R. MacKay. CNC. **Paratypes.** 34 m



Figures 1–6. *Admetovis* adults. **1** *A. icarus*, Holotype male, USA, Colorado, Boulder County, Nederland **2** *A. icarus*, female, Canada, British Columbia, Apex Mountain **3** *A. oxymorus*, male, USA, Oregon, Lane County, Frissell Point **4** *A. oxymorus*, Neotype female, USA, California, Sierra County, Bassetts **5** *A. similaris*, male, Washington, Kittitas County, Umtanum Creek/Durr Road **6** *A. similaris*, female, USA, Washington, Walla Walla County, Walla Walla.

14 f. **CANADA: British Columbia:** Central Kootenay District: Sproule Cr., 49.533°, -117.417°, 2400' [732 m], [no date], J. Shepard leg. / OSAC_0001031226 (1 m); [Okanagan-Similkameen District]: Apex Mt., 7380' [2249 m.], 49°21'N, 119°54'W, 21 VII 2000, J. Troubridge Leg. (1 f); **USA: Colorado:** [Boulder County]: Nederland, Science Lodge, 9500' [2896 m], 26 VI 1961, M. R. MacKay (2 m); Same locality & collector, 27 VI 1961 (4 m 1 f); 28 VI 1961 (1 m 1 f); 29 VI 1961 (9 m 5 f); 30 VI 1961 (3 m 1 f); Same locality, 3 VII 1969, C. H. Mann (1 f); Gunnison County: Gothic, 29 VI 1962, Jon Shepard leg. / OSAC_0000136850 (1 m); Same locality, date, & collector / OSAC_0000136868 (1 f); **Idaho:** Bear Lake County: Emigration Cr. CG, 42.370°, -111.556°, 7200' [2195 m], 14 VII 1993, J. & S. Shepard leg. / OSAC_0001031225 (1 m); **Oregon:** Wallowa County: Wallowa Mts., Mt. Howard summit area, 8075–8176 ft [2461–2492 m], 4 VIII 2016, UVBLT, DNR Ross and GE Pearson leg. / OSAC_0000997854 (1 m); **Utah:** Sanpete County: Ephraim, 8 mi. [12.9 km] E, 10,000' [3048 m.], 39.317–[39].337°N, 111.448–[111].470°W, 21 VII 2008, L. G. Crabo leg. (8 m, 1 f); Same locality, date, & collector / DNA voucher #

CNCLEP 00116343 (1 m); Summit County, Bald Mt. Trailhead, 14 VII 1989, R. C. Mower leg. / Database for CNC Noctuidae [*sic*] 14629 [DNA voucher # NOC14629] / Barcodes of Life Project Leg removed DNA extracted (1 f); **Washington:** Chelan County: Junior Point Cmp. Grd., 6900' [2103 m], 6 VIII 1997, J. Troubridge leg. (1 m); Same locality, date, & collector, DNA / Database for CNC Noctuidae [*sic*] 14627 [DNA voucher # NOC14627] / Barcodes of Life Project Leg removed DNA extracted (1 m); Kittitas County: Lake Kachess (NF-4828), 47°19.21'N, 121°15.4'W, 4 VIII 2011, T. Mustelin (1 f). CNC, JS, LGC, OSAC, TM. Three specimens from Sandon, British Columbia (J. W. Cockle) at the CNC were also examined, but are excluded from the type series because they are worn.

Diagnosis. *Admetovis icarus* is the only species in the genus with a dusky hindwing with a straight outer margin distal to the cell between veins M1 and M3. *Admetovis icarus* is distinguished easily from *A. similaris* by the pure white hindwing of the latter species. It is only subtly different from *A. oxymorus* in habitus and can easily be confused with it, especially in the Pacific Northwest where both species occur. While the hindwing margin shape is the most reliable character for separating these species short of dissection, there are subtle differences in color. *Admetovis icarus* tends to be more mottled on the forewing with a darker “flame-mark,” and its hindwing is consistently darker brownish gray than that of *A. oxymorus*. The forewing orbicular stigma of *A. icarus* is often more conspicuous than in either other species, with pale filling outlining a dark central ocellus.

Structurally, males of *A. icarus* differ from both other species by the presence of weak basal abdominal coremata lacking a strong core; *A. oxymorus* has fully developed coremata with stout rods and *A. similaris* lacks them altogether. *Admetovis icarus* and *A. oxymorus* both differ from *A. similaris* in having a median spine on the juxta. In the valves, the setose dorsal protuberance of the sacculus is triangular to anvil shaped in *A. icarus*, convex in *A. oxymorus*, the dorsal process of the clasper is short and triangular in *A. icarus*, longer and curved in *A. oxymorus*, and the cucullus is relatively small and rounded in *A. icarus*, larger and triangular in *A. oxymorus*. The relative sizes of the cuculli are apparent readily if the two species are compared after the scales are removed with a brush. The vesica of the phallus of *A. icarus* is the simplest in the genus, with a relatively short left limb lacking a subapical diverticulum.

Females of *A. icarus*, like those of *A. oxymorus*, differ from those of *A. similaris* in having three rather than four signa on the corpus bursae. They can be differentiated from those of *A. oxymorus* by the shape of the corpus bursae, narrow with a small bulbous anterior portion in *A. icarus*; curved and broader with a bulbous anterior end in *A. oxymorus*. This difference is quantified in the Key as a ratio between width of the corpus bursae and the length of the appendix bursae.

The barcode of *A. icarus* (BOLD:AAD7456) differs from both other species by about 3.5 %. There is no intraspecific variation in three samples from Washington and Utah.

Description. *Head* – Structure of male and female antennae, eye, palpus, and haustellum as for genus. Dorsal antenna tan with scattered gray scales. Scape off white. Labial palpus with nearly equal mixture of pale tan and dark gray scales. Frons tan, gray periph-

erally. Dorsal head scales white-tipped gray. *Thorax* – Dorsum as for genus; venter scales long, hair-like, white-tipped dark gray. Legs as for genus; tarsal segments dark gray banded distally with off-white. *Wings*: Forewing: length 16–17 mm (males), 17 mm (females), length $2.3\text{--}2.4 \times$ width, outer margin scalloped weakly; ground lead gray, most mottled in genus due to more whitish scales, especially near base; medial area distal to reniform stigma and postmedial area whitish tan to tan, darkest distally; basal, antemedial, and medial lines as for genus; postmedial line dark gray, conspicuous for genus, double with strong inner and incomplete weak outer components, scalloped strongly with dark gray distal extensions on veins; postmedial white with preceding red-brown and black shade; terminal line black, interrupted at veins; fringe gray with light tan base, pale checkering at veins; claviform stigma dark gray, filling light gray; orbicular stigma nearly round, double, outer component darkest, filling light gray, whitish gray, or pale tan, central ocellus gray or mixed gray and brown; reniform stigma moderately large, kidney shaped with slightly larger posterior end, dark gray, incomplete at posterior end, filling of medial $\frac{1}{3}$ light tan and distal $\frac{2}{3}$ whitish tan or gray. Hindwing: margin straight between M1 and M3; powdery dusky gray brown with slight brassy sheen, discal spot and patchy marginal shade slightly darker with lighter patches near outer margin. *Abdomen*. Male coremata very weak, a few filaments arising from button-like base, lacking central stalk; pockets on ventrolateral segment III small, shallow. Female sternite VII posterior median notch $0.36 \times$ length of the segment. *Male genitalia*: Uncus as for genus, wide distal portion only slightly tapered to blunt tip. Juxta height $1.5 \times$ width, median spine present. Valve as for genus, length $5 \times$ width, ventral mid-valve projection short, blunt; sacculus length $\frac{2}{3} \times$ valve, width $1 \times$ valve, setose costal lobe asymmetric, anvil shaped with triangular pointed tip; clasper with short triangular dorsal and broad-based convex ventral processes of similar length, small for genus; cucullus relatively small, $\sim 0.6 \times$ valve width, rounded, corona 15–20 setae. Phallus tubular, length $6.8 \times$ width. Vesica length $1.0 \times$ phallus; diverticulum of right arm broad based, short; left arm tapered to straight spike-like apical cornutus, basal cornutus present or absent, diverticula absent. *Female genitalia*: papilla analis length $1.5 \times$ width, longer and more pointed than in other *Admetovis*. Segment VIII as for genus; posterior apophysis length $0.75 \times$ segment VIII; anterior apophysis length $2.75 \times$ posterior apophyses. Ductus bursae relatively smooth, rugae limited to near junction with corpus bursae. Corpus bursae length $4.6 \times$ abdominal segment VIII, elongate, narrow, curved weakly, bulbous anterior portion relatively small, diameter $\sim 0.4 \times$ total corpus bursae length; signa on dorsal, right lateral, and ventral sides; appendix bursae simple sac-like posterior extension of corpus bursae, length $0.16 \times$ corpus bursae.

Geographic variation. This species is fairly uniform throughout most of its range. The population on the Wasatch Plateau of central Utah is paler and more mottled than those from elsewhere.

Etymology. The species epithet refers to Icarus, son of Daedalus in Greek mythology. Icarus used wings that his father had made to escape from the island of Crete but flew too close to the sun, thereby falling to his death in the sea. The flame marking on the distal forewing and high elevation habitat of this moth bring to mind his story. It is a noun in the genitive in apposition to the generic name.

Distribution and ecology. *Admetovis icarus* occurs in the mountains of western North America, mostly in the Rocky Mountain region. Records extend from central Utah and central Colorado to the Selkirk Mountains of southeastern British Columbia, including a record from northeastern Oregon. Farther west there are scattered records from the Okanagan region of south-central British Columbia and Chelan and Kittitas counties in the northern Cascade Range, Washington. It replaces *A. oxymorus* in Utah and Colorado but is partially sympatric with it in the Pacific Northwest.

Admetovis icarus has been collected almost exclusively in high-elevation forests near tree line, although the habitat in Kaslo and Nelson, British Columbia is transition zone forest. Collection dates are from late June to early August.

The early stages are unknown.

Discussion. *Admetovis icarus* is not rare in collections but has until now been confused with *A. oxymorus*.

***Admetovis oxymorus* Grote, 1873**

Figs 3, 4, 9, 10, 14, 16

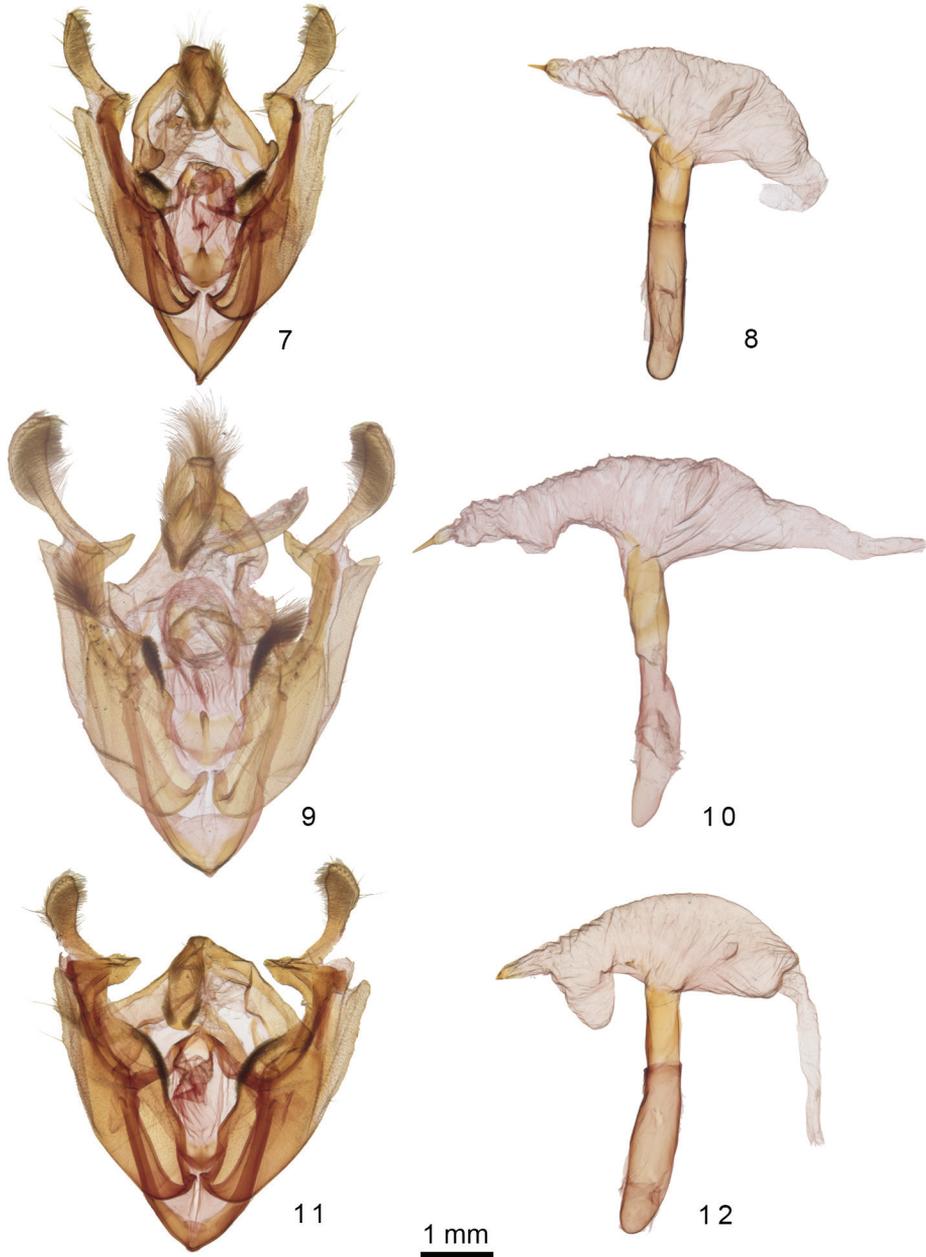
Admetovis oxymorus Grote, 1873: 133.

Type material. *Admetovis oxymorus* was described from two syntypes, one each from Sierra Nevada and Rocky Mountains (Grote 1873), with an illustration of the California type on plate 4, figure 5. The depicted California female is clearly identifiable as the species that is widespread along the West Coast, an important distinction since based on current known distributions the other type specimen from the Rocky Mountains is most likely *A. icarus*.

We found neither type specimen in major collections known to contain Grote type specimens, including AMNH and NHML, and both specimens are most likely lost. This conclusion is supported by the fact that Poole (1989), in the *Lepidopterorum Catalogus* series, appears to not have examined the syntypes or known their whereabouts. He lists the type material noncommittally as “Type(s)” and cites “AMNH London [*sic*]” as the repository collection. In order to fix the identity of the name, we hereby designate a female specimen in the CNC labeled “CA, Sierra Co., 2 mi. E. Bassetts, 5300’ [1615 m], Hwy. 49, SNFC-SF State U., 4–7.Jul.2007, P. A. and E. Opler” as **Neotype** with a red label designating it as such.

Diagnosis. This species and *A. icarus* have dorsal hindwings with gray or tan ground color and are distinguished easily from *A. similaris* that has a pure white hindwing with white or thin gray veins. *Admetovis oxymorus* is best distinguished from *A. icarus* by the shape of the hindwing. The margin between veins M1 and M3 is slightly concave in *A. oxymorus* but straight in *A. icarus*.

Admetovis oxymorus is the only species in the genus with fully developed male coremata; the coremata of the others are either vestigial or absent completely. The cucullus of the male valve of *A. oxymorus* is broadest in the genus, more than 2 × width



Figures 7–12. *Admetovis* male genitalia. **7** *A. icarus*, valves **8** *A. icarus*, phallus with everted vesica **9** *A. oxymorus*, valves **10** *A. oxymorus*, phallus with everted vesica **11** *A. similaris*, valves **12** *A. similaris*, phallus with everted vesica.

of the adjacent neck versus less than $2 \times$ in the other species. The relative sizes can be observed by brushing the scales from the end of the abdomen. Females of *A. oxymorus* have a bulbous anterior corpus bursae bearing three signa. Those of the other species

either have four signa (*A. similaris*) or a smaller anterior bursa (*A. icarus*) as quantified in the Key to species.

The barcode of *A. oxymorus* (BOLD:AAD7455) differs from those of the other *Admetovis* species by slightly more than 3.5 %. Intraspecies variation within *A. oxymorus* is approximately 0.2 % ($n = 7$; British Columbia, California, Oregon).

Distribution and ecology. *Admetovis oxymorus* occurs in the American West between the Rocky Mountains and Pacific Coast, as far north as extreme southern British Columbia. Most records are from the western part of this area, where it occurs throughout much of California, Oregon and Washington. The range is limited to Idaho and immediate vicinity in the Rocky Mountains.

Admetovis oxymorus is most commonly collected in hilly or mountainous areas with at least some trees, and occurs in a variety of habitats from riparian areas in steppe to near timberline.

Adults of *A. oxymorus* have been collected from late May until early August, with most records from mid-June through July. High-elevation populations fly latest, often in late July or August. It is nocturnal and comes to light.

Admetovis oxymorus is the only species in the genus for which the early stages are known. Reared larvae from southern California accepted elderberry (*Sambucus mexicanus* Presl.) in captivity (McFarland 1975). Godfrey (1972) illustrated the head and hypopharyngeal complex of the mature larva.

Discussion. This species has until now been confused with *A. icarus*. Prior records of *A. oxymorus* from Utah and Colorado are referable to *A. icarus*.

***Admetovis similaris* Barnes, 1904**

Figs 5, 6, 11, 13, 15, 17

Admetovis similis Barnes, in Dyar 1903: 157. *Nomen nudum*.

Admetovis similaris Barnes, 1904: 200.

Type material. Three male and three female syntypes from Southern California and Arizona are at NMNH. All are typical of the species indicating that lectotype designation is unnecessary.

Diagnosis. *Admetovis similaris* is the easiest species in the genus to identify without examining structural characters. It is the only one in which the hindwing ground color is pure white.

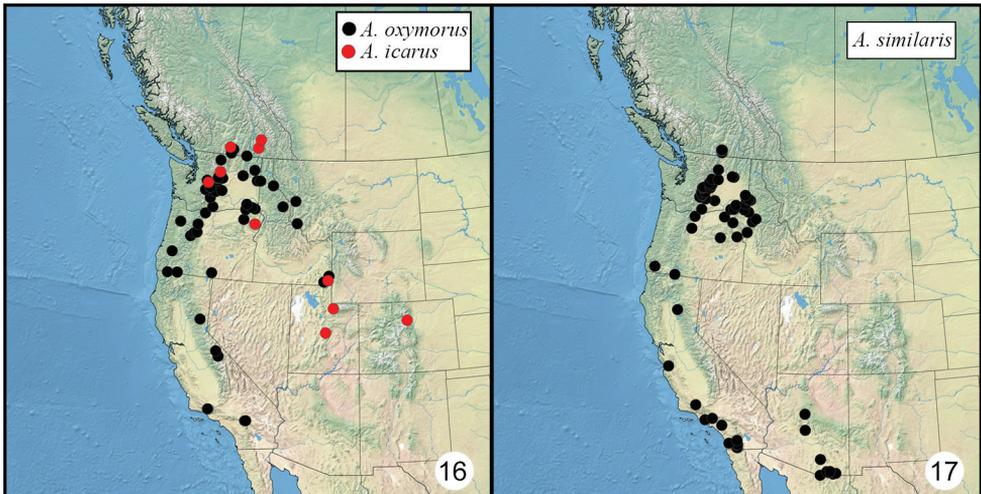
Structurally, both sexes differ in several respects from those of the other two species. Males lack completely basal coremata, present to some degree in the other two. The juxta of *A. similaris* is smooth, lacking the median spine that is found in both other species. The left arm of the vesica bears the largest subapical diverticulum in the genus. Females have four signa on the corpus bursae, three in the other two species. The corpus bursae are similar otherwise to that of *A. oxymorus* in that the anterior end is bulbous, but the appendix bursae is more strongly curved in *A. similaris*.



Figures 13–15. *Admetovis* female genitalia. **13** *A. icarus* **14** *A. oxymorus* **15** *A. similis*.

The barcode of *A. similis* (BOLD:AAB7673) differs from both other *Admetovis* species by at least 3.5 %. Intraspecies variation is less than 0.9 % ($n = 19$; Arizona, California, Washington).

Distribution and ecology. *Admetovis similis* is a species of open habitats in the Southwest, California, and Pacific Northwest. It is found near the border with Mexico from western New Mexico to the coast of southern California, thence north to south-central British Columbia. Although its distribution is mostly in the region near the Pacific Coast it does not occur near the ocean north of the San Francisco Bay area. In the Pacific Northwest *A. similis* is common on the Columbia Plateau, in the adjoining Cascade Foothills, and at low elevations in the Blue Mountains. Interestingly, it is absent from similar steppe habitats in southeastern Oregon and southern Idaho and it does not occur elsewhere in the Great Basin. *Admetovis similis* almost certainly occurs in Mexico as it is found very close to the Mexican border both in Arizona and in California.



Figures 16–17. Distribution of examined material of *Admetovis* in western North America **16** *A. icarus* (red) and *A. oxymorus* (black) **17** *A. similaris*.

This species favors the most xeric environments of any *Admetovis*, as dry as the Sonora and Mojave deserts. Northern populations fly most commonly in sage steppe. The flight time is during spring and early summer, typically earlier in the year than either of the other two species.

The early stages are unknown.

Geographic variation. The color and pattern of this moth are uniform across its range. Specimens from deserts of the Southwest tend to smaller than those from elsewhere.

Discussion. Dyar (1903) included this species in his list of North American Lepidoptera as *Admetovis similis* prior to its proper description by Barnes in 1904. The Dyar mention lacks a description or illustration and is therefore a *nomen nudum*.

Acknowledgements

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A new genus and three new species of noctuid moths from western United States of America and Mexico (Lepidoptera, Noctuidae, Noctuinae, Eriopygini)

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Abstract

The genus *Rhabdorthodes* **gen. n.** is described for three previously unnamed noctuid moths from the mountains of south-western United States and Mexico. It is assigned to subfamily Noctuinae, tribe Eriopygini. *Rhabdorthodes pattersoni* **sp. n.** from the United States and *Rhabdorthodes durango* **sp. n.** and *Rhabdorthodes petersoni* **sp. n.** from Mexico are described. These moths are small, dull gray brown, and lack highly diagnostic wing markings, but are distinctive structurally. The adults and genitalia of both sexes are illustrated and distribution maps are presented. Two species eponyms honor persons who have facilitated the study and enjoyment of moths in North America by creating moth-specific websites.

Keywords

DNA barcode, Durango, Nuevo León, Rocky Mountains, Sierra Madre Occidental, Sierra Madre Oriental

Introduction

Lafontaine and Schmidt (2010) produced the first new major check list of Canadian and United States Noctuoidea since Hodges et al. (1983). Discoveries of novel Erebiidae and Noctuidae have continued unabated since then, with over 40 newly described species added to the fauna in subsequent updates (Lafontaine and Schmidt 2011, 2013, 2015). Herein, yet another new species is named, a widespread nondescript noctuid moth from the Rocky Mountain region of the United States. In contrast to the drab superficial appearance of this moth, reproductive structural features of both sexes are far from ordinary - especially the male juxta and valves and female sternite A7—warranting a new genus for it. In males, a long rod extends posteriorly from the juxta and the distal claspers are massive and ornate. The most distinctive features of females are a fleshy frond like structure at the posterior ductus bursae and external sculpting of the lateral seventh sternite, the latter modification likely to receive the male claspers during coupling.

In addition to the new species from the United States, two unnamed moths from the mountains of Mexico belonging to this genus were discovered amongst unsorted material at the Canadian National Collection.

I honor two persons who have contributed to the study and enjoyment of moths on the Internet by naming moths after them. These tools make accessible to anyone with a computer what was previously the domain of experts with access to large collections and rare literature sources.

Materials and methods

Wing pattern and genitalia structure terminology follow Lafontaine (2004). Forewing length is measured to the nearest half millimeter from base to apex, excluding the fringe. Genitalia are prepared using standard methods (Hardwick 1950, Lafontaine 2004). Detached abdomens are macerated in hot 10% potassium hydroxide for 20–40 minutes. Dissection is performed initially in water or a 30:70 ethanol-water mixture followed by hardening in isopropyl alcohol. Male vesicas and female bursae are inflated. Preparations are stained with orcein [Sigma Chemical Company, St. Louis, Missouri] and mounted in Euparal [Bioquip Products, Rancho Dominguez, California] under elevated cover glass on glass slides.

The 658 base pair “barcode” region of mitochondrial *cox1 mt* DNA was used to assess the taxonomic placement of the new genus. Legs from dried specimens submitted to the Barcodes of Life Data System (BOLD) at the University of Guelph (Ontario, Canada) were analyzed by standard DNA extraction, amplification, and sequencing protocols (Hebert et al. 2003). Barcodes were compared to pre-existing material at BOLD as implemented on the website (<http://www.barcodinglife.org>). The seven-unit BOLD Barcode Index Number (BIN) (Ratnasingham and Hebert 2013) is given for *Rhabdorthodes pattersoni* Crabo.

Distribution maps were made using SimpleMappr (<http://simplemappr.net>).

Repository abbreviations:

- CNC** Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
LGC Lars Crabo Collection, Bellingham, Washington, USA
TM Tomas Mustelin Collection, Seattle, Washington, USA

Taxonomy***Rhabdorthodes* gen. n.**

<http://zoobank.org/4AFE2E20-0A73-42D0-B79D-FA7CB559F05D>

Type species. *Rhabdorthodes pattersoni* Crabo.

Gender. Masculine.

Diagnosis. *Rhabdorthodes* is a distinctive genus with characteristic male and female genitalia. The adults are small to medium-sized, forewing length 13–15.5 mm, and nondescript superficially, with even gray-brown to brown forewings with limited dark markings. The eyes have interfacetal setae. Males have a long rod like extension of the right side of the dorsal juxta (Figs 7–9) that is unknown in any other North American genus. The valves are also distinctive, with massive slightly bilaterally asymmetrical claspers with horn- and molar like processes. Females have diagnostic features of the bursa and segment A7. The posterior ductus bursae is expanded into an amorphous fleshy externally frondlike sac (Figs 10–12). Externally, sternite A7 is broad, sclerotized strongly, with a broad sculpted depression on the ventrolateral surface to each side of midline (Figs 13–15). This is most apparent in intact specimens and is observed easily under low magnification. The papillae anales are very thin and needlelike and the distal abdomen is telescopic with long intersegmental membranes.

The most closely related genus based on structure and barcodes is *Protorthodes* McDunnough, revised recently by Lafontaine et al. (2014). Males of *Protorthodes* lack the rodlike extension of the juxta that is found in *Rhabdorthodes* and have a normal-sized uncus. The valve of *Protorthodes* species differ from those of *Rhabdorthodes* in having a long thin ampulla of the clasper arising from the mesial surface of the valve rather than a stout curved one at the dorsal margin, and lack massive enlargement of the distal clasper with a large ventral extension. Females of *Protorthodes* lack or have only a small fleshy components of the anterior ductus bursae, well developed in *Rhabdorthodes*, and lack sculpting of the ventral seventh sternite.

The barcode of *Rhabdorthodes pattersoni* is closest to *Protorthodes*, differing from barcodes of species in this genus by at least 3.5%. The two Mexican species of *Rhabdorthodes* have not been barcoded.

Description. Adults. Males and females similar in habitus. *Head.* Antenna biserate, rami densely setose, total width 3–4 × shaft, anterior rami slightly longer than posterior rami (male); beadlike, biciliate (female); dorsum with small scales. Eye normal

size, interfacetal setae long, curved apically. Labial palpus reaching dorsal margin of eye; sides of first two segments with short strap like scales, anterior first segment with medium-length simple and long hair-like scales, anterior second segment scales similar, shorter; apical segment $0.2 \times$ second segment, scales very short. Haustellum normal. Frons unmodified, scales simple, medium length; dorsal head scales long, thin, spatulate, forked.

Thorax. Dorsal vestiture dense, long, thin, spatulate and forked scales, medium to dark gray brown; weak mesial tuft on anterior metathorax. Venter scales hair like, dense, dull brown. *Legs:* Tibiae without claws or other modifications, dark gray brown with scattered off-white scales; tarsi except apical segment with three rows of spine like setae, segments dark brown, ringed distally in off-white. *Wings:* Forewing: Length 13.0–14.0 mm (males), 13.5–15.5 mm (females), length $\sim 2 \times$ width; outer margin smoothly convex, strongest near anal angle; dorsal scales short, straplike, uniform medium to dark gray brown or brown; costa with 6 light spots on basal, antemedial, post-medial line origins and 3 spaced evenly between postmedial line and apex; lines and stigmata except subterminal line black; lines double, filling pale; subterminal line pale gray or luteous, preceding shade dark brown or black; fringe ground color. Hindwing: Outer margin slightly concave M1–M3; dorsum gray brown, lightest basally; veins and terminal line dark; fringe lighter than ground.

Abdomen. Male unmodified. Female sternite A7 (Figs 13–15) sclerotized, thickened posteriorly; posterior margin pointed bluntly in midline, concave to each side of midline; ventrolateral surface sculpted with broad central concavity with lateral raised flange (two species) or deep transverse cleft (*R. petersoni*). *Male genitalia:* Uncus weak, length $0.5\text{--}1 \times$ juxta height, shorter and thinner than juxta extension, curved evenly, tapered to thin point, distal undersurface with short thin hair like setae. Juxta base hourglass shaped, elongate, height $2.2\text{--}3.3 \times$ width; dorsum asymmetric: left lobe small, flat; right with long stout tapered rod, length $1.2\text{--}1.5 \times$ juxta height, projecting posteriorly with slight curve ventrad and leftward. Valve length $4.3\text{--}6.0 \times$ width, weak distal to clasper; sacculus $0.5\text{--}0.6 \times$ valve length and $0.75\text{--}0.8 \times$ valve width, smooth; ventral distal clasper distal to ampulla heavily sclerotized, massive, $1.0\text{--}1.2 \times$ valve width, dorsal and ventral toothlike and hornlike processes extending beyond valve margins (dorsal extension reduced in one species); ampulla origin from bulging clasper at dorsal valve, stout, hook-shaped, base oriented $30\text{--}45^\circ$ basad or perpendicular to valve, then curved distad $90\text{--}180^\circ$; digitus thin, membranous, directed distad from origin near ventral valve; cucullus weak, rounded, barely wider than “neck,” covered densely by short thin hairlike setae, lacking corona. Phallus tubular, narrow, length $\sim 10 \times$ width. Vesica membranous, length $\sim 1.5 \times$ and width $2.5 \times$ phallus, base bent 90° left, mid-section coiled 360° counter-clockwise, distal segment bent 45° cephalad to end right or ventral to phallus; small foot-shaped basal diverticulum; no cornuti. *Female genitalia:* Papilla analis length $6\text{--}8 \times$ width, thin, pointed, covered sparsely with short thin hairs on lateral surface and densely with very short thin hairs on medial tip; posterior intersegmental membranes long, eversible. Segment A8 length $1.25\text{--}1.50 \times$ width, with sparse short thin setae; posterior apophysis $2.1\text{--}2.4 \times$ segment A8 length; anterior apophysis $0.4 \times$ posterior apophysis. Ostium bursae sclerotized lightly with

ventral short median cleft or leathery, lacking cleft. Ductus bursae $1.5 \times$ segment A8 length; posterior third sclerotized dorsally, expanded to fleshy frondlike structure filling most of ventral segment A7; middle third sclerotized, tubular; anterior third membranous, tubular. Corpus bursae bisaccate, corpus bursae and appendix bursae similar size; corpus bursae membranous, ovoid, length $2 \times$ width, lacking signa; appendix bursae origin from left posterior corpus bursae, curved 270° anterior, leftward, and posterior to end to left of mid-ductus bursae; ductus seminalis at apex.

Etymology. The name is derived from the Greek *rhabdos*, meaning rod, and *Orthodes*, a genus of moths in the tribe Eriopygini. It refers to the long extension of the male juxta.

Distribution and ecology. *Rhabdorthodes* species occur in the mountains of western United States and Mexico from southern Idaho and southern Wyoming in the United States to Nuevo León and Durango in Mexico. Adults fly in the summer during June and July. All three species in the genus have been collected in montane forests at mid- to high elevations between 1600 and 3150 meters. The early stages are unknown for all species.

Discussion. Assignment of this genus to subfamily Noctuidae tribe Eriopygini is based on the presence of hairy eyes, similarity of the adults to species of other genera in this tribe, and the association of the barcode of *R. pattersoni* sp. n. with those of *Protorthodes* McDunnough on neighbor-joining trees. Although almost certainly correct, this is provisional until the early stages are discovered. The main morphologic difference between tribes Hadenini and Eriopygini is in the mandible and spinneret of the larva (Fibiger and Lafontaine 2005), currently unknown for *Rhabdorthodes*. This classification is supported by the presence of a long coiled vesica in males of *Rhabdorthodes*, since this is a typical feature of many species in the tribe Eriopygini (Fibiger and Lafontaine op. cit.).

The functions of the unique sexual characters of *Rhabdorthodes* can only be surmised. In males, the long rodlike extension of the juxta, diminutive uncus, and the massive sculpted ampulla of the clasper with molar- and hornlike processes are unlike any other in the Eriopygini. In the female, the fleshy enlargement of the posterior ductus bursae and the sculpted lateral segments A7 are similarly unusual. The needlelike ovipositor and telescopic distal abdomen is also distinctive, although similar modifications are known in other taxa.

The fleshy posterior ductus bursae appears gland like and might have a secretory function. It could potentially have a mechanical function as well, receiving the long juxta during copulation. Even if coupling does not occur in this fashion, the male rod must somehow engage the female. The weak uncus suggests that the rod might have supplanted all or part of its function. Similarly, the massive claspers of the distal male valve probably engage the concave pits on the posterior female abdomen. The latter modifications are analogous to those of the noctuid genus *Spaelotis* Boisduval (Noctuidae, Noctuidini)—illustrated in Lafontaine (1998: 73)—in which females have species-specific pits on the ventral posterior abdomen that likely receive the ampullae of the male claspers. The needlelike papillae anales and long eversible posterior abdomen of *Rhabdorthodes* suggest that females lay eggs deep within a specific plant structure, less likely deep in soil.

Key to *Rhabdorthodes* adults

- 1 Male **2**
 – Female **4**
 2 Clasper distad of ampulla with similar sized dorsal and ventral processes, ventral process triangular (Figure 7); United States..... ***R. pattersoni***
 – Clasper distad of ampulla asymmetrical, ventral process long, curved toward valve apex (Figs 8, 9); Mexico **3**
 3 Clasper distad of ampulla two pronged, with molarlike dorsal and curved ventral processes (Figure 8); Sierra Madre Occidental ***R. durango***
 – Clasper distad of ampulla with single curved ventral process (Figure 9); Sierra Madre Oriental..... ***R. petersoni***
 4 Concave lateral part of sternite A7 with deep transverse sulcus (Figure 15); Sierra Madre Oriental, Mexico..... ***R. petersoni***
 – Lateral segment A7 concave without transverse sulcus (Figs 13, 14); United States or Sierra Madre Occidental, Mexico..... **5**
 5 Concave part of sternite A7 shallow, lateral margin quadrate with weakly raised rim (Figure 13); United States..... ***R. pattersoni***
 – Concave part of sternite A7 deeper, lateral margin rounded with lateral flange resembling the helix of a human ear (Figure 14); Sierra Madre Occidental, Mexico..... ***R. durango***

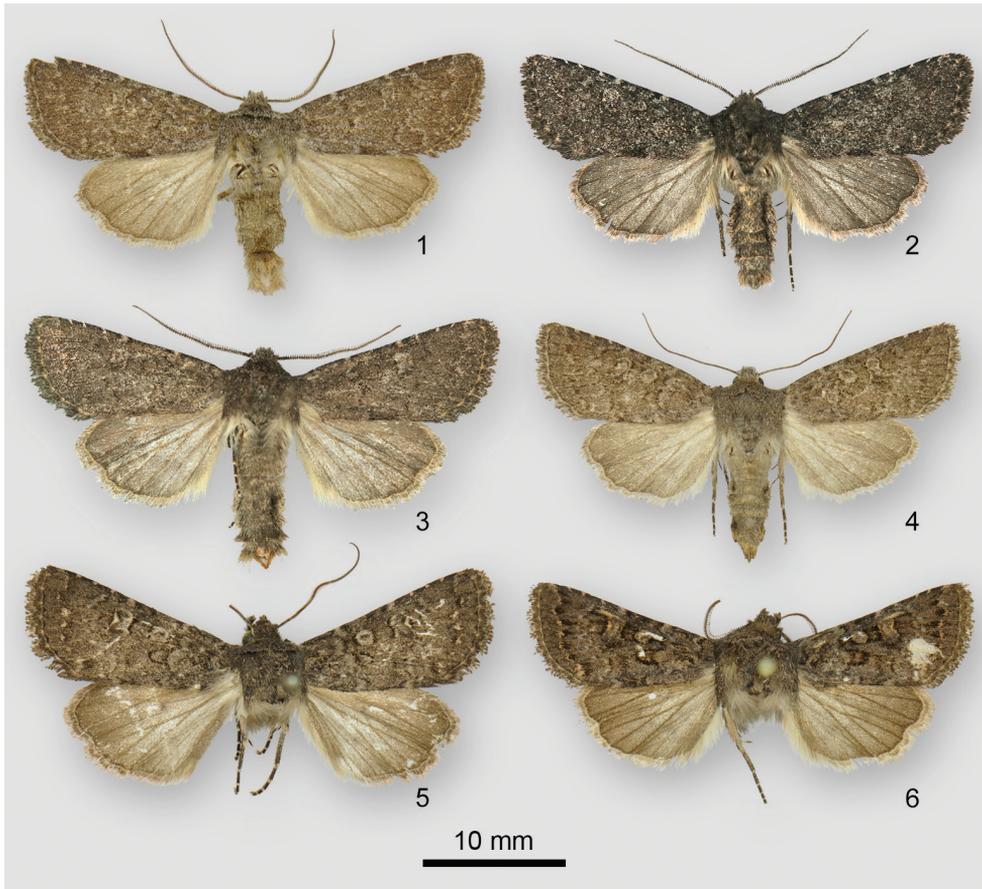
Species accounts***Rhabdorthodes pattersoni* sp. n.**

<http://zoobank.org/DCF3F28F-22BA-473C-B9AC-16A03F32F5CD>

Figs 1–4, 7, 10, 13, 16

Type locality. USA: Colorado: Clear Creek County: Doolittle Ranch, Mt. Evans, 2987 m.

Type material. Holotype, male. USA: Colorado: [Clear Creek County]: Doolittle Ranch, Mt. Evans, 9,800' [2987 m], 10 VIII 1961, E. W. Rockburne. / Specimen ID CNCLEP 00140423. **CNC. Paratypes.** 49 m, 5 f. **USA: Arizona:** Apache County: Alpine, 3–5 mi [4.8–8.0 km] SE, 16 VI 1967 (1 m); Greer, White Mts., 8500' [2591 m], 6 VIII 1962, E. & I. Munroe, black light (1 m); same collection label / Genitalia slide # 11,732 male (1 m); [Greenlee County], Hannagan Meadow, 13 VI 1967, R. F. Sternitzky / Genitalia CNC slide # 17406 female (1 f); same collection label / [CNC] Slide No. 11,734 (1 m); **Colorado:** Archuleta County: [north of Pagosa Springs], 8[000]' [2438 m.], 15 VI 2004, Vargo leg. / Specimen ID CNCLEP 00120092 (1 m); same collection label / Specimen ID CNCLEP 00120092 (1 f); [Boulder County]: Boulder, Silver Saddle Motel, 5500' [1676 m], 5 VI 1961, M. R. MacKay (1 m); [Clear Creek County]: Doolittle Ranch, Mt. Evans, 9800' [2987 m], 16 VII 1961, E. W. Rock-



Figures 1–6. *Rhabdorthodes* adults **1** *R. pattersoni*, holotype male, USA, Colorado, Clear Creek County, Doolittle Ranch, Mt. Evans **2** *R. pattersoni*, paratype male, USA, Colorado, Teller County, Florissant, 5.6 km SW **3** *R. pattersoni*, paratype male, USA, Utah, Sanpete County, Ephraim, 12.9 km E **4** *R. pattersoni*, paratype female, USA, Colorado, Archuleta County, Pagosa Springs **5** *R. durango*, holotype male, Mexico, Durango, El Salto **6** *R. petersoni*, holotype male, Mexico, Nuevo León, Cerro Potosi.

burne / Genitalia CNC slide # 15894 male (1 m); same collection label, 30 VII 1961 (1 m); same collection label / [CNC] Slide No. 10,766 female (1 f); same locality & collector, 31 VII 1961 (4 m); same collection label / [CNC] Slide No. 10,764 male (1 m); same locality & collector, 1 VIII 1961 (8 m); same locality and collector, 2 VIII 1961 (6 m); same collection label / Genitalia CNC slide # 15893 male (1 m); same locality & collector, 3 VIII 1961 (1 m); same locality & collector, 5 VIII 1961 (1 m); same locality & collector, 6 VIII 1961 (1 m); same locality & collector, 6 VIII 1961 (1 m); same locality & collector, 8 VIII 1961 (1 m); Teller County: Florissant, 3.5 mi [5.6 km] SW, 38.904° -105.323°, 8–9 VII 2016, 2660 m, L. G. Crabo & G. Morrell leg. (4 m); **Idaho:** Bear Lake County: Georgetown Cyn., 42.524° -111.263°, 2100 m, 4 VII 2016, L. G. Crabo & G. Morrell leg. / Specimen ID CNCLEP00140350 / Barcode

of Life Project, Leg removed, DNA extracted (1 m); **New Mexico:** Colfax County: Cimarron Canyon, Sangre de Cristo Mts., 7900' [2408 m], 6 VII 1982, black light, E. & I. Munroe (1 m); same collection label / [CNC] slide No. 11733 male (1 m); same locality & collector, 8 VII 1962 (1 m); same locality & collector, 11 VII 1962 (1 m); Lincoln County: Capitan Mts., Capital Ridge, radio towers, summit, 10,000' [3048 m], 3 VII 1982, RWH [Ronald H. Hodges] (2 m); same locality & collector, 10 VII 1982 / Genitalia slide # 17407 female (1 f); Otero County, High Rolls, Karr Cyn., 32.898° -105.813°, 2400 m, 9 VI 2016, L. G. Crabo leg. (1 f); Sandoval County: San Jose Ca[illegible]., 4 mi [6.4 km] E. Regina, Jemez Mts., NW slope, 8500' [2591 m], 26 June, 1983, UV, RWH [Richard W. Holland] (1 m); **Utah:** [Iron County]: Cedar City, 11 mi [17.7 km] SE, 8300' [2530 m], 29 VIII 1965, D. F. Hardwick (1 m); Sanpete County: Ephraim, 8 mi [12.9 km] E, 39.317°–[39.]337° -111.448°–[111.]470°, 10000' [3048 m], 21 VII 2006, L. G. Crabo leg. / Specimen ID CNCLEP00140348/ Barcode of Life Project, Leg removed, DNA extracted (1 m); same collection label / Specimen ID CNCLEP00140349 / Barcode of Life Project, Leg removed, DNA extracted (1m); **Wyoming:** Albany County: T13N R77W, Section 4, 1.5 mi (2.6 km) NW of Woods Landing, Fox Creek, el. 7,600 ft (2316 m), 21 VI 1997, black light trap, J. S. Nordin leg. (1 m): CNC, LGC, TM.

Diagnosis. *Rhabdorthodes pattersoni* is the most drab and poorly patterned of the three *Rhabdorthodes* species, appearing dull dark brown with faint markings. The forewing subterminal line of *R. pattersoni* is faint pale gray, whereas those of the Mexican species are more prominent, luteous preceded by dark wedge-shaped spots. *Rhabdorthodes pattersoni* is the only species in the genus that is known to occur in the United States.

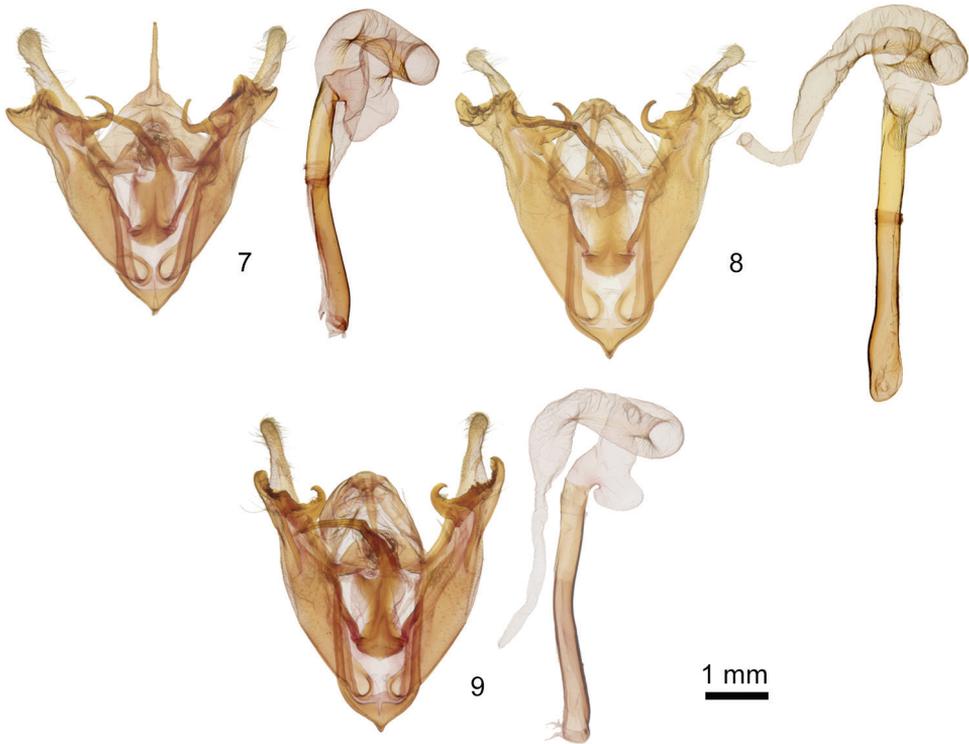
Structurally, males of *R. pattersoni* are distinguished from the Mexican species by the smaller ventral process of the distal clasper (Figure 7), relatively short and triangular. In both other species this process is longer and curves toward the apex of the valve.

The shape of sternite A7 is shallowly concave with a quadrate lateral margin (Fig. 13). Those of the two Mexican species are more complex, with distinct lateral flanges, deeper pits, and more strongly concave edges (Figs 14, 15).

The Barcode Index Number (BIN) of *R. pattersoni* from Colorado and Utah ($n = 5$) is BOLD:ADH0770.

This moth resembles several nondescript brown species of Eriopygini – such as species of *Homorthodes* McDunnough and *Protorthodes* – but is probably most similar superficially to “*Orthosia*” *noverca* (Grote), a common widespread western North American moth that lacks a satisfactory generic placement. Most “*O.*” *noverca* have thicker and more prominent black forewing pattern elements than those of *R. pattersoni*. *Rhabdorthodes* can be identified without dissection by observing the ends of the valves for the chunky claspers in males and the sculpted seventh sternite in females. In addition, males of *Rhabdorthodes* have biserrate antennae, simple in look-alikes other than *Protorthodes*.

Description. Adults. Head. Male antenna total width 3 × shaft; dorsal scales dark gray-brown, scattered off-white on proximal 1/3. Labial palpus scales gray-brown,



Figures 7–9. *Rhabdorthodes* male genitalia, valves and phalluses with everted vesicas **7** *R. pattersoni* **8** *R. durango* **9** *R. petersoni*.

scattered off-white on second and third segments, increasing toward tip. Frons scales gray brown; dorsal head scales white tipped gray-brown.

Thorax. Dorsal scales long, white tipped gray-brown; appearing uniform dull gray-brown to dark brown. *Wings:* Forewing length 13.0–13.5 mm (males); 13.5 mm (females); scales gray-brown, scattered white tipped gray-brown, appearing uniform gray-brown to dark brown; costa spots luteous gray; basal, antemedial, and postmedial lines double, black and dark gray-brown, filling ground and slightly lighter gray; basal line uneven, indistinct; antemedial line slightly irregular, pointed basad on veins; medial line slightly darker than ground, angled distad from mid costa to reniform stigma, thence basad to posterior margin; postmedial line indistinct, evident mostly as black inner part and pale gray filling, scalloped; subterminal line irregular off-white patches between veins, preceding shade faint, brown; terminal line thin, dark gray; fringe striped dark gray, base thin, pale; orbicular stigma round, often incomplete, black, lined with few pale-gray scales, center ground color; claviform stigma small, black, filled with ground color, or reduced to a spot; reniform stigma moderate size, weakly figure-8 shaped, open at posterior end, black, with adjacent luteous and pale-gray lining strongest at medial and lateral sides, center ground color. Hindwing:

Dorsum gray, basal $\frac{1}{2}$ paler; veins and faint discal spot dark; terminal line thin, black; fringe gray with copper luster, base thin, pale.

Abdomen. Male genitalia: (Figure 7) Uncus length $0.9 \times$ juxta. Juxta height $2 \times$ width, rod length $1.2 \times$ height. Valve length $5 \times$ width, part distal to clasper curved slightly dorsad; cucullus weak, paddle shaped; sacculus length $0.5 \times$ and width $0.75 \times$ valve; distal clasper $1 \times$ valve width, left slightly larger than right, thick, mesial surface with molar like ridges, dorsal distal margin expanded to broad rounded projection, ventral distal margin triangular with slight curve distad; ampulla directed 45° basad, scythe shaped with $120\text{--}180^\circ$ curve distad; digitus small, thin. Phallus and vesica as in genus description. **Female genitalia** (Figs 10, 13): Sternite A7 lateral concavity shallow with quadrate raised lateral margin; posterior margin weakly concave. Papilla analis, segment A8, and bursa copulatrix as in genus description.

Etymology. I am pleased to name this moth after Robert (Bob) Patterson of Bowie, Maryland in recognition of his contribution to the study and enjoyment of North American moths through his work on the Moth Photographers Group website (<http://mothphotographersgroup.msstate.edu>).

Distribution and ecology. *Rhabdorthodes pattersoni* occurs in the mountains of the American West (Figure 16). It has been collected from southeastern Idaho and south-central Wyoming in the north to southwestern Utah, eastern Arizona and south-central New Mexico in the south. Most records are from Colorado and New Mexico. It flies in mid- to high-elevation forest at elevations from 1600 to 3050 meters. Collection dates range from early June to early August. The early stages are unknown.

Remarks. This species is moderately common in collections. Specimens are often mixed in with other brown species in the tribe Eriopygini, often “*Orthodes*” *noverca* and “*Orthodes*” *obscura* (Smith).

***Rhabdorthodes durango* sp. n.**

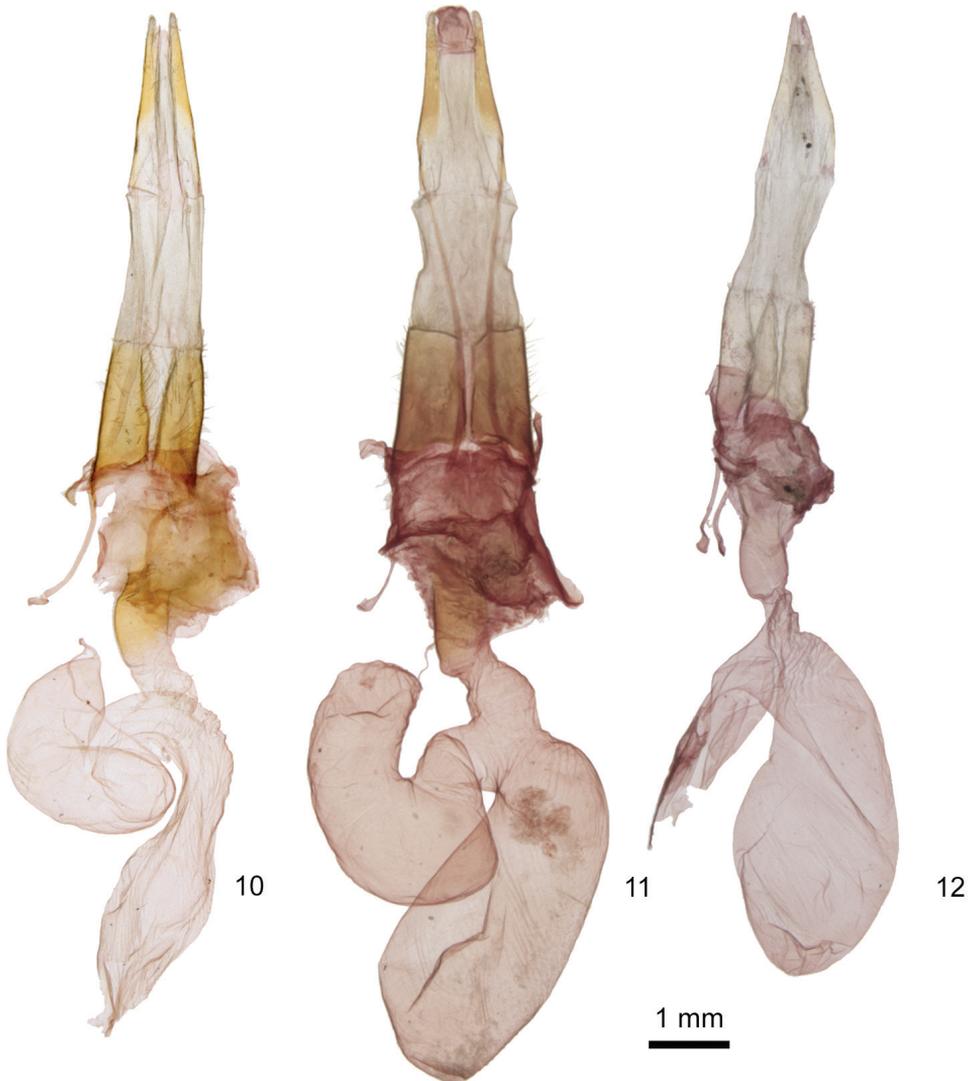
<http://zoobank.org/6622B61A-035E-4DD0-BEFA-99DD5FAA5761>

Figs 5, 8, 11, 14, 16

Type locality. Mexico: Durango: 16 km west of El Salto, 2743 m.

Type material. Holotype, male. Mexico: D[uran]go: 10 mi. [16 km] W El Salto, 9000' [2743 m], 8 VIII 1964, J. E. H. Martin. / Specimen ID CNCLEP 00140425 / Genitalia CNC slide # 17405 male. CNC. **Paratype.** 1 male, 1 female. Same locality as holotype, 9 VIII 1964, W. C. McGuffin / Genitalia CNC slide 15892 male (1 male); same label data as last / Genitalia CNC slide 17437 (1 f). CNC.

Diagnosis. This species and *R. petersoni* sp. n. are closely similar and cannot be distinguished reliably by superficial appearance. Both are more strongly patterned and have more luteous filling of lines and stigmata on the forewing than *R. pattersoni*. In practice, location provides a convenient diagnostic character since it is likely that all three species are allopatric. *Rhabdorthodes durango* sp. n. is the only species that is known from the Sierra Madre Occidental, Mexico.



Figures 10–12. *Rhabdorthodes* female genitalia **10** *R. pattersoni* **11** *R. durango* **12** *R. petersoni*.

Structurally, males of *R. durango* have the largest and most complex distal clasper in the genus, with a blunt curved ventral process that extends ventral to the valve and a molar like mesial process that projects over the distal valve. By comparison, the distal clasper of other species is much smaller (*R. pattersoni*) or lacks the broad mesial process (*R. petersoni*).

Females of *R. durango* can be identified by the shape of the concave ventrolateral sternite A7 (Figure 14). The concavity is similar to that of *R. pattersoni* in that it lacks a transverse sulcus, but the lateral edge of *R. durango* is rounded rather than quadrate. The lateral edge is shaped like the pinna of a human ear.

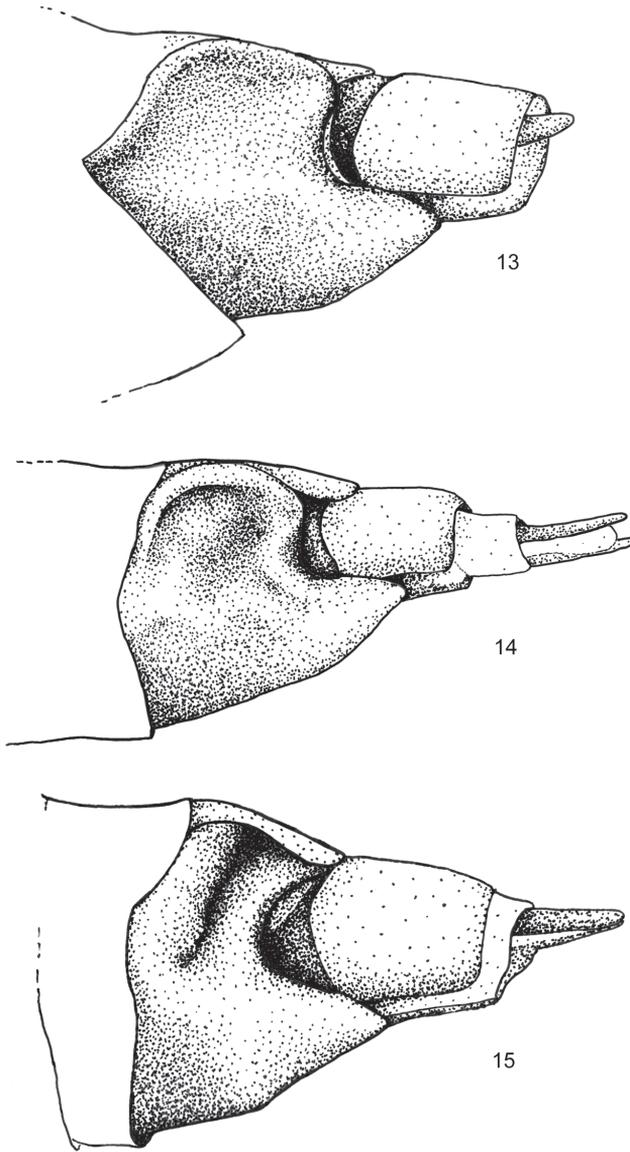
Description. Adults. *Head.* Male antenna total width $3 \times$ shaft; dorsal scales dark gray-brown, occasional off-white on basal third. Labial palpus scales dark gray-brown, occasional off-white. Frons brown; dorsal head scales long, thin, mostly forked, dark gray-brown with pale bases and tips.

Thorax. Dorsum scales similar to dorsal head, appearing uniform dark gray-brown; venter darker. *Legs:* Scales dark gray brown, few off-white; tarsal segments darker brown ringed distally off-white. *Wings:* Forewing: Length 14 mm (male); 15.5 mm (female); dorsal scales nearly uniform dark gray-brown, costa black-brown; costa spots dark ochre-gray; short white veins segments: A1+A2 in proximal medial area, several in subterminal area; basal, antemedial, and postmedial lines double, black and dark-gray brown, filling paler brown-gray; basal line near wing base, indistinct; antemedial line slightly irregular, perpendicular to wing; medial line very faint, evident on anterior $\frac{1}{3}$; postmedial line indistinct, scalloped weakly, evident on costa and posterior to reniform stigma; subterminal line ochreous off-white, irregular, patchy, strongest between branches of medial vein, preceded where strongest by ill-defined triangular black spots; terminal line thin, black, small pale spots on tips of veins; fringe ground color, edge slightly paler; claviform stigma small, black, pale filling like adjacent antemedial line; orbicular stigma nearly round, black, pale brown gray peripherally, ocellus black; reniform stigma moderately large, figure-8 shaped, black, lacking anterior and posterior outline in HT, posterior in PT, filling similar to orbicular medially, luteous laterally, ground color centrally. Hindwing: Dorsum dull medium fuscous, slightly paler on basal $\frac{1}{2}$; veins and indistinct discal spot darker, faint; terminal line thin, black; fringe base dark gray, distal lighter ruddy gray.

Abdomen. Male genitalia (Figure 8): Uncus length $0.5 \times$ juxta height. Juxta length $2.2 \times$ width, rod length $1.5 \times$ juxta. Valve length $4.3 \times$ width, segment distal to clasper diminutive, curved slightly ventrad; cucullus very weak, rounded; sacculus length $0.6 \times$ and width $0.8 \times$ valve; distal clasper $1.2 \times$ valve width, right slightly larger than left, thick, mesial surface with molar like ridges, dorsal margin expanded slightly at ampulla base, mesial lobe broadly triangular, oriented distad along valve axis, ventral process horn shaped, curved 90° distad; ampulla of clasper stout, directed 30° basad, distal ampulla hook shaped with $120\text{--}180^\circ$ curve distad; digitus small, thin. Phallus and vesica as in genus description. *Female genitalia* (Figs 11, 14): Ventrolateral sternite A7 concave, deeper than in *R. pattersoni*, lateral margin rounded with raised flange similar to the dorsal helix of a human external ear; posterior margin thicker and more strongly convex than in *R. pattersoni*, less than in *R. petersoni*. Papilla analis, segment A8, and bursa copulatrix as in genus description; ostium bursae sclerotized with median cleft.

Etymology. The species name refers to the type locality in the state of Durango, Mexico. It is a noun in the nominative singular in apposition to the generic name.

Distribution and ecology. *Rhabdorthodes durango* is known only from the type locality near El Salto in the Sierra Madre Occidental (Figure 16). The area is reported to be open pine-oak forest (D. Lafontaine, pers. Comm.). All three specimens were collected on consecutive days in early August. The early stages are unknown.



Figures 13–15. *Rhabdorthodes* females. Distal abdomen (scales removed), left ventrolateral aspect showing sculpted sternite A7. **13** *R. pattersoni* **14** *R. durango* **15** *R. petersoni*.

Remarks. This species was found by J. Donald Lafontaine amongst unsorted Mexican material at the CNC. Although the type locality is nearly 950 km south of Arizona, it is conceivable that *R. durango* could occur on higher mountains in the Madrean Archipelago ecoregion of south-eastern Arizona, the northernmost extension of the Sierra Madre Occidental. Many of the species collected in this CNC survey near El Salto occur in the mountains of southeastern Arizona (D. Lafontaine, pers. Comm.).

***Rhabdorthodes petersoni* sp. n.**

<http://zoobank.org/D5809F65-2F03-495F-AA72-037AABAD6498>

Figs 6, 9, 12, 15, 16

Type locality. Mexico: Nuevo León: Cerro Potosi, 3139 m.

Type material. Holotype, male. Mexico: N.[uevo] L.[éon], Cerro Potosi, 10,300' [3139 m], 15–16 VII 1963, H. & A. Howden. / Genitalia CNC slide No. 16495 / Specimen ID CNCLEP 00140417. CNC. **Paratype.** Female. Same data as holotype / Genitalia CNC slide 17438 female. CNC.

Diagnosis. This moth is nearly identical to the other Mexican species, *R. durango*. Both Mexican species are more strongly patterned on the forewing than *R. pattersoni*, with stronger black markings and more vivid yellow filling of lines and stigmata. This yellow color is slightly more orange in *R. petersoni* than in *R. durango*. Definitive diagnosis requires examination of the genitalia, although the moths can most easily be identified by locality. *Rhabdorthodes petersoni* flies in the Sierra Madre Oriental and *R. durango* occurs in the Sierra Madre Occidental.

The base of the ampulla of the clasper of *R. petersoni* is oriented perpendicular to the dorsal valve, whereas those of the other two species are directed basad. The ventral process of the clasper is thinner and less strongly curved than in *R. durango*, and there is no significant dorsal process between the ampulla and ventral process. Together, the ampulla and ventral clasper process give the impression of an open lobster claw in *R. petersoni*.

The *R. petersoni* female is the only species in the genus that has a deep transverse sulcus across the ventrolateral part of sternite A7 (Figure 15).

Description. Adults. Head. Male antenna width 4 × shaft; dorsal scales dark gray brown, scattered off-white on basal 1/3. Labial palpus proximal segments scales gray brown, scattered off-white; distal segment pale tipped gray brown. Frons gray brown; dorsal head scales hair like gray brown, pale tipped forked gray brown.

Thorax. Scales similar to head, slightly paler posteriorly; appearing uniform gray-brown, weak pale collar edge. **Wings:** Forewing length: 13.0 mm (male), 13.5 mm (female). Dorsum purplish dark gray-brown, costa black-brown, costa spots dark ochre; basal, antemedial, and postmedial lines double, black and dark gray, filling paler brown-gray; basal line scalloped, incomplete; antemedial line irregular, pointed basad on veins, perpendicular to wing; medial line faint, dark, evident costa to medial reniform stigma; postmedial line indistinct, scalloped, black inner component and pale filling most evident; subterminal line sinuous, pale ochre, strongest between veins, preceded by dark shade forming black wedges opposite cell and in fold; terminal line intervenal dark gray triangles; fringe ground color, base pale, thin; claviform stigma small, black, filling pale, brassy; orbicular stigma nearly round, moderately large (fused to claviform stigma in PT), black, filling slightly paler than line filling, central ocellus weak; reniform stigma moderately large, weakly kidney shaped, black, filling orange ochre peripherally, gray brown centrally. Hindwing: Dorsum dull medium fuscous, slightly paler on basal 1/2; veins and indistinct discal spot barely darker; terminal line thin, black; fringe gray, base luteous, edge light gray.

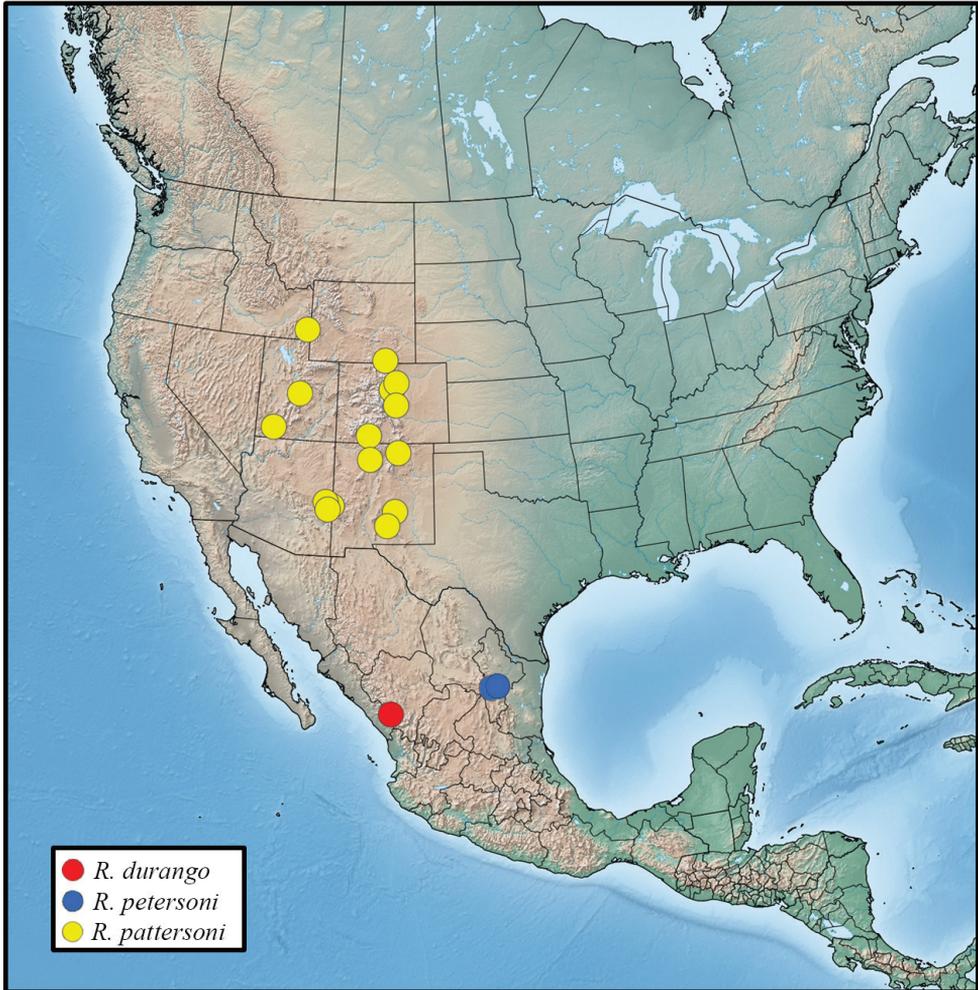


Figure 16. Distribution of examined material of *Rhabdorthodes* in North America. *R. pattersoni* (yellow), *R. durango* (red), *R. petersoni* (blue).

Male genitalia (Figure 9): Uncus length $1 \times$ juxta height. Juxta height $3.3 \times$ width, rod $1.2 \times$ height. Valve length $6 \times$ width, base widest in genus, segment distal to clasper thin, straight; cucullus, very weak, rounded; saccus length $0.5 \times$ and width $0.8 \times$ valve; clasper thick, expanded distal part $1 \times$ valve width, right larger than left, mesial surface spinulose, dorsum lacking process other than ampulla, ventral process long, curved slightly dorsad, claw shaped; ampulla base at dorsal valve $\frac{2}{3}$ from base to apex, base broad, perpendicular to valve, curved 180° distad; digitus weak. Phallus and vesica as in genus description; vesica diverticulum slightly smaller than in the other species.

Female genitalia (Figs 12, 15): Posterolateral sternite A7 bisected by transverse sulcus, deepest laterally; posterior margin strongly concave, nearly semicircular. Papilla

analys, segment A8, and bursa copulatrix as in genus description; ostium bursae leathery without median cleft.

Etymology. I am pleased to name this moth for Merrill Peterson of Bellingham, Washington in recognition of his work on the Pacific Northwest Moths website (<http://pnwmoths.biol.wvu.edu>). This site is a well-illustrated interactive guide to the moths of the northwestern United States and British Columbia, Canada.

Distribution and ecology. *Rhabdorthodes petersoni* is known only from the type locality at 3150 meters on Cerro Potosi, the highest peak in the Sierra Madre Oriental, Mexico (Figure 16). The habitat is unknown, although it is most likely forest. Both known specimens were collected in mid-July. The early stages are unknown.

Remarks. This species was found by J. Donald Lafontaine amongst unsorted Mexican material at the CNC. Although this moth is only known from Mexico it could conceivably occur in western Texas, particularly in the Davis and Chisos mountains. These ranges are the northernmost extension of the Sierra Madre Oriental.

Acknowledgements

This work would not be possible without the encouragement, guidance, and assistance of Don Lafontaine, who found the Mexican species amongst unsorted material at the CNC and performed most of the genitalia dissections. Both he and Chris Schmidt were gracious hosts on several trips by the author to Ottawa. Merrill Peterson photographed *Rhabdorthodes pattersoni* adults. Jocelyn Gill worked tirelessly to prepare the illustrations. She is a gem. Don Lafontaine and Chris Schmidt reviewed the paper and suggested numerous improvements.

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Six new species and one new subspecies of noctuid moths from western United States of America and Mexico (Lepidoptera, Noctuidae)

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Abstract

Six new species and one new subspecies of Noctuidae are described from western United States of America and Baja California, Mexico: *Dolocucullia poolei* Crabo & Hammond, **sp. n.** (Cuculliinae), *Plagiomimicus yakama* Crabo & Wikle, **sp. n.**, *Plagiomimicus yakama mojave* Wikle & Crabo, **ssp. n.**, *Plagiomimicus incomitatus* Mustelin, **sp. n.** (Amphipyriinae), *Sympistis ferrirena* Crabo, **sp. n.** (Oncocnemidinae), *Aseptis harpi* Crabo & Mustelin, **sp. n.**, and *Hypotrix lactomellis* Wikle & Crabo, **sp. n.** (Noctuinae). The adults and genitalia of these species are described, illustrated, and compared to similar related moths. The larvae of the *Plagiomimicus tepperi* species group, unknown previously, are reported to feed on several species of *Brickellia* Ell. (Asteraceae). The early stages of *Plagiomimicus yakama mojave* are described and late instars are illustrated.

Keywords

Amphipyriinae, Brickellia, Cuculliinae, DNA barcode, Eriopygini, Noctuinae, Oncocnemidinae, Xylenini

Introduction

Undescribed species of moths are still found with regularity in North America north of Mexico. This is especially true in the American West. As part of the continuing effort to document the moth fauna of the region we describe five new species and one new subspecies from four different noctuid subfamilies from the United States, mostly from the Southwest and Pacific Coast states. An additional Mexican species of *Plagiomimicus* Grote (Amphipyridae) belonging to the same species-group as other new taxa in this paper is also described.

The species named in this paper are not related closely, but all belong to genera that have been revised since the mid-1990s and are not in need of sweeping changes. It is reasonable, therefore, to combine the descriptions into a single work in the “Contributions to the Systematics of New World Macro-moths” series. In order to provide appropriate context, this paper is organized phylogenetically and the taxon descriptions are preceded by short introductions to the pertinent genera.

In addition to the new species descriptions, early stages of the *Plagiomimicus tepperi* species group, to which the new *Plagiomimicus* taxa in this paper belong, are reported for the first time. Several species in this species-group have been reared by DLW and are described as they pertain to the new taxa.

Materials and methods

Wing pattern and genitalia structure terminology follow Lafontaine (2004). A dark ovoid spot between the postmedial and subterminal lines on the forewing costa of some *Stiriini* is herein referred to as the “subapical spot.” In *Aseptis* McDunnough, a pale marking straddling the postmedial line distal to the reniform stigma is referred to as the postreniform patch (Mustelin and Crabo 2015).

Forewing lengths are measured to the nearest half-millimeter from base to apex, excluding the fringe.

Genitalia were prepared using standard methods (Hardwick 1950, Lafontaine 2004). Detached abdomens were macerated in hot 10% potassium hydroxide for 20–40 minutes. Dissection was performed initially in water, or a 70 : 30 water : ethanol mixture, followed by hardening in isopropyl alcohol. Male vesicas and female bursae were inflated. Preparations were stained with orcein (Sigma Chemical Company, St. Louis, Missouri) and mounted in Euparal (Bioquip Products Inc., Rancho Dominguez, California) on glass slides. Genitalia preparations of male *Sympistis* and *Plagiomimicus incomitatus* are from USNM and are stained differently with an unknown dye.

The 658 base pair DNA “barcode region” of the mitochondrial cytochrome *c* oxidase subunit 1 (CO1) (barcode) was used to assess molecular variation. Legs from dried specimens submitted to the Barcodes of Life Data Systems (BOLD) at the University of Guelph (Ontario, Canada) were analyzed by standard DNA extraction, amplification, and sequencing protocols (Hebert et al. 2003). Barcode sequences were

compared to pre-existing material at BOLD using the Kimura-2-Parameter distance model as implemented on the Barcodes of Life Data Systems website (<http://www.barcodinglife.org>). The seven-unit BOLD Barcode Index Number (BIN) (Ratnasingham and Hebert 2013) is given in parentheses when known.

Distribution maps were made using SimpleMapper (<http://simplemapper.net>).

Repository abbreviations:

- NHML** Natural History Museum (formerly, British Museum of Natural History), London, England
- CH** Chuck Harp Collection, Littleton, Colorado, USA
- CNC** Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
- CSUC** Colorado State University Collection, Fort Collins, Colorado, USA
- DLW** Dave Wikle Collection, San Marino, California, USA
- DNHC** Denver Museum of Nature and Science, Denver, Colorado, USA
- ER** Evan Rand Collection, Phoenix, Arizona, USA
- JS** Jon Shepard Collection, Corvallis, Oregon, USA
- LGC** Lars Crabo Collection, Bellingham, Washington, USA
- MLR** Mike Raschko Collection, Wilsonville, Oregon, USA
- MSU** Albert J. Cook Arthropod Research Collection, Michigan State University, East Lansing, Michigan, USA
- OSAC** Oregon State Arthropod Collection, Corvallis, Oregon, USA
- SDMC** San Diego Natural History Museum, San Diego, California, USA
- TM** Tomas Mustelin Collection, Seattle, Washington, USA
- USNM** Smithsonian Institution (formerly United States National Museum), Washington, DC, USA

Systematics

Noctuidae Latreille, 1809

Cuculliinae Herrich-Schäffer, [1850]

Dolocucullia Poole, 1995

Poole (1995) described *Dolocucullia* for two species from western United States and Mexico, *Dolocucullia dentilinea* (Smith, 1899) and *Dolocucullia minor* (Barnes & McDunnough, 1913), noting that there are additional species in Central and South America. The genus resembles *Cucullia* Schrank in general appearance and structure. Males differ from *Cucullia* in that the cornuti on the vesica are globular instead of spikelike. In *Dolocucullia* females, there is a sclerite between the ovipositor lobes, lacking in *Cucullia*, and the ductus seminalis joins the corpus bursae at the posterior rather than the anterior end (op. cit.).

A relatively common *Dolocucullia* in the coastal Pacific Northwest region has until now been referred to as *D. dentilinea*. The recent discovery of *D. dentilinea* in eastern Oregon and Idaho led PCH to wonder if the disjunct coastal and inland populations could be different species. Independently, JD Lafontaine alerted LGC to large barcode differences between *Dolocucullia*'s from the Rocky Mountain and West Coast regions. Consistent differences in structure and habitus confirm that these populations are different species. The West Coast species is described herein.

A key to the three species of *Dolocucullia* found in the United States is presented below. *Dolocucullia minor* and *D. dentilinea* species accounts are presented in Poole (1995).

Key to *Dolocucullia* adults of North America north of Mexico

- 1 Dorsal hindwing ground color pure white, dark markings limited to terminal line and weak distal suffusion in females; SE Arizona to W Texas..... ***D. minor***
- Dorsal hindwing grayish off-white with broad gray marginal band; western North America, including Arizona and New Mexico **2**
- 2 Antemedial and postmedial lines not fused across medial area; male mid-sacculus width / distal valve width < 2; female corpus bursae length / width > 3; Rocky Mountain region as far west as eastern Oregon and Arizona ***D. dentilinea***
- Antemedial and postmedial lines fused across medial area; male mid-sacculus width / distal valve width > 2; female corpus bursae length / width < 3; West Coast, as far east as the Sierra Nevada in California and the Cascade Range in Oregon ***D. poolei***

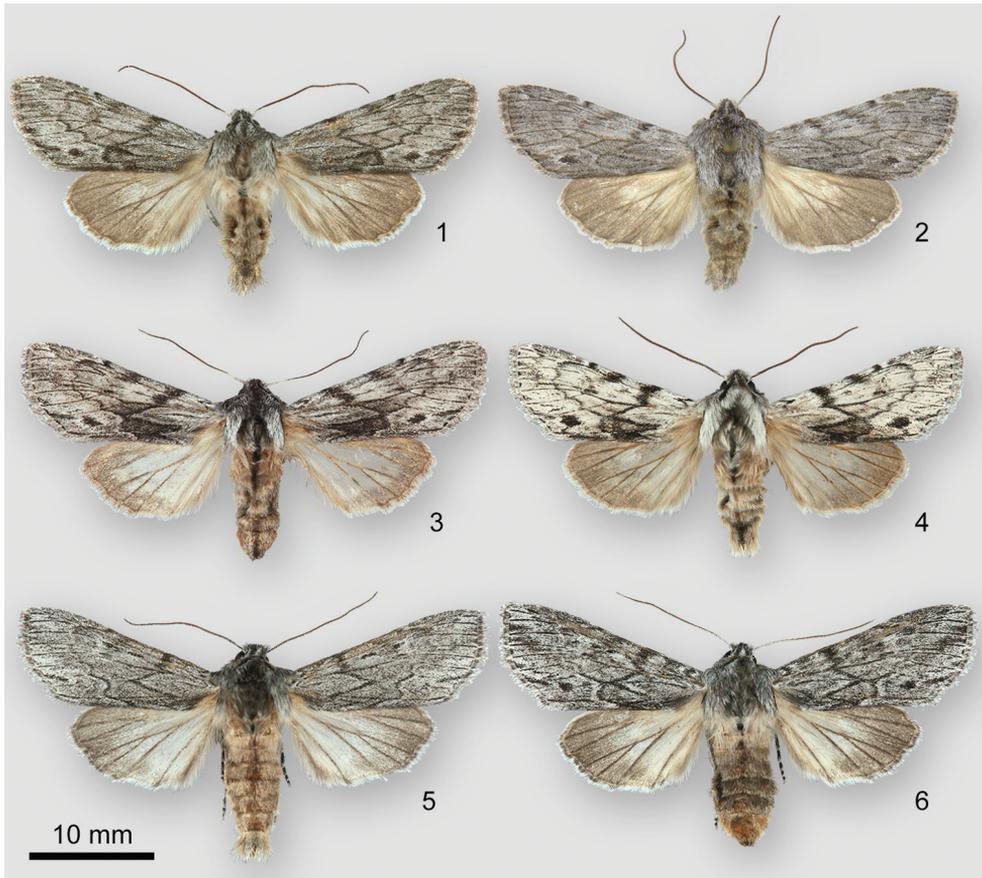
Dolocucullia poolei Crabo & Hammond, sp. n.

<http://zoobank.org/08E66C35-FB8B-4614-9D5C-3C6AF76C3D00>

Figs 1–4, 7, 9, 48

Type locality. USA, Oregon, Marion County, Salem.

Type material. Holotype, male. USA, Oregon, [Marion County], Salem, Blk Lt Trap, 20 VII 1959, Ken Goeden. CNC. **Paratypes.** 18 males, 18 females. **USA: California:** Alameda County: Oakland, 22 VI [19]08, J. R. Pilate / ex. Coll. Wolley-Dod / (*Xylina*) *dentilinea* Sm. A little darker [illegible] than the female type (xd I.10. Dod) (1 m); Marin County: Mill Valley, 20 IV [19]50 / H. B. Leech Collector / Genitalia CNC slide # 17409 female (1 f); Mendocino County: Albion, 14 VIII [no year], J. Sinclair / 15–7 / ex Coll. Wolley-Dod (1 f); Laytonville, 14 VII [no year], J. Sinclair / 15–7 / *C. dentilinea* ex. Coll. Wolley-Dod (1 m); Monterey County: Carmel, 10 VI [19]36, E. C. Johnston (1 f); High Meadow, Carmel, 36.562°N, 121.907°W, 19 IV 1991, F. P. Sala (1 m); San Diego County: S rim of Peñasquitos Canyon, 32°55.4676'N, 117°10.209'W, 5 V 2000, T. Mustelin (1 m);



Figures 1–6. *Dolocucullia* adults. **1** *D. poolei*, male, USA, Oregon, Clatsop County, Elsie, Gronnel Road **2** *D. poolei*, holotype male, USA, Oregon, Marion County, Salem **3** *D. poolei*, female, USA, California, Mono County, Tioga Pass, Saddlebag Lake to Warren Fork **4** *D. poolei*, male, same locality as last specimen **5** *D. dentilinea*, male, USA, Idaho, Franklin County, Willow Flat Campground **6** *D. dentilinea*, female, same locality as last specimen.

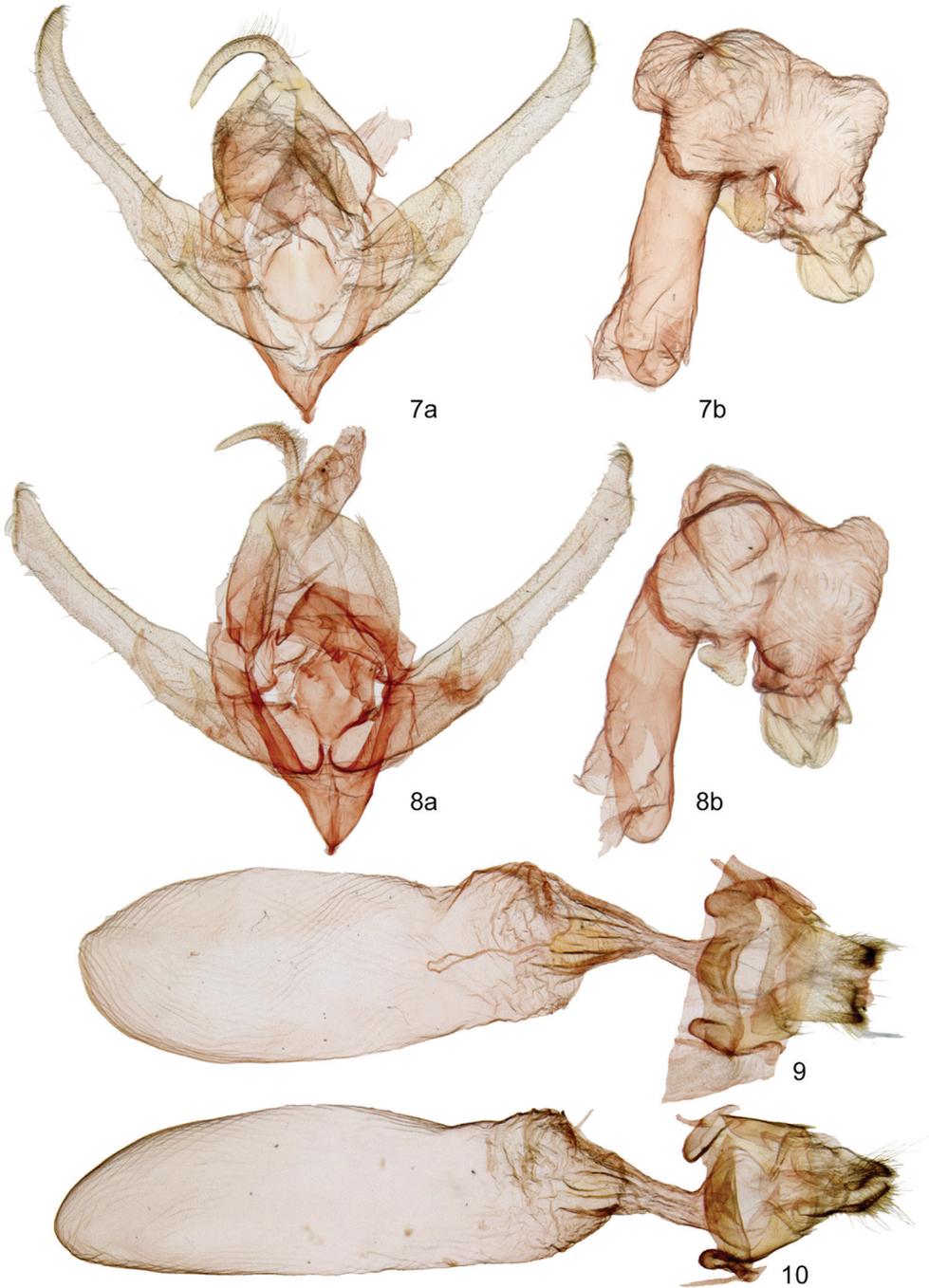
Sonoma County: Petaluma, 8 VI [19]39, Wm. R. Bauer Collector (1 f); Riverside County: 7.8 km N Aguanga, Wilson Vly Pres., 33.511°, -116.879°, 701 m, 10 III 2016, UV It., C. Schmidt, D. Wikle CNC538380 (1 m); Same label data as last / CNC538381 (1 m); **Oregon:** Benton County: Marys Peak, 4021 ft. [1226 m], 7 VII 1991, [no collector] / OSAC_0000164672 (1 f); Corvallis, 225 ft. [69 m], 28 VI 1995, [no collector] / OSAC_0000164718 (1 f); Huntington Drive 4 mi. [6.4 km] N Corvallis, 18 VII 2007, J.C. Miller / OSAC_0000133697 (1 f); Philomath, Blakesley Creek, 300 m, 29 VI 2000, AVZ Brower leg. / OSAC_0000133713 (1 f); same locality & collector 1 VII 2000 / OSAC_0000133690 (1 f); same locality & collector, 24 VII 2001 / OSAC_0000133715 (1 f); same locality & collector, 25 VII 2001 / OSAC_0000133680 (1 f); Philomath, Woods Creek, 100 m, 14 VII 1999, AVZ Brower leg. / OSAC_0000133709 (1 f); Clatsop County: Gronnel Rd.,

Elsie, 24 V 1988, [no collector] (1 m); vic. Gronnel Rd., 2 mi. [3.2 km] E. Elsie, 4 VIII [19]63, Leg. S. G. Jewett, Jr. (1 f); same locality and collector, 9 VIII [19]63 (1 f); Lane County: nr. Triangle Lake, 692 ft. [211 m], 15 VII 1997, [no collector] / OSAC_0000164674 (1 f); Lincoln County: Siletz 25 km NE, 484 m, 24 VI 2012, [no collector] / OSAC_0000445287 & OSAC_0000445288 (2 m); same locality, 19 VII 2012 / OSAC_0000445292 (1 m); same locality, 23 VI 2014. OSU / OSAC_0000448088 (1 m); same locality, 22 VII 2014. OSU. / OSAC_0000448107 (1 f); Nelscott, 9 VI [no year], 0 ft [0 m], C.W. Nelson / OSAC_0000164651 (1 m); Linn County: Hwy. 20, Santiam Pass, 29 NI 1995 / OSAC_0000164662 (1 m); Marion County: same locality, date, and collector as holotype / Genitalia CNC slide # 17398 male (1 m); Polk County: Luckiamute R., 349 m, 19 VII 2012, [no collector] / OSAC_0000445266 (1 m); Tillamook County: Coast Range, Tillamook R., 28 VI 2012, [no collector] / OSAC_0000445111 (1 m); Coast Range, Wilson R., 682 m, 26 VI 2012, [no collector] / OSAC_0000445118 (1 m); Coast Range, Trask R., 934 m, 30 VII 2012, [no collector] / OSAC_0000445367 (1 f); Tillamook 30 km NE, 657 m, 18 VII 2012, [no collector] / OSAC_0000445325 (1 m). CNC, JS, LGC, OSAC.

Differential diagnosis. *Dolocucullia poolei* sp. n. (Figs 1–4) is similar to *Dolocucullia dentilinea* (Figs 5, 6), both in habitus and structure. Since they are allopatric, specimens can be assigned to species by locality: those from California, Oregon west of the Cascade crest, and Washington are *D. poolei* and those from east of California and central Oregon are *D. dentilinea*. Both are distinguished easily from *Dolocucullia minor*, found in Texas, by hindwing color, white in *D. minor* and darker gray in the others.

Dolocucullia poolei and *D. dentilinea* are similar, but can usually be identified without dissection. The forewing lines of *D. poolei* are less distinct than those of *D. dentilinea*, appearing out of focus, whereas those of *D. dentilinea* are thin and crisp. The antemedial and postmedial lines of *D. poolei* are strongly zigzagged, joining once or twice across the medial area. Those of *D. dentilinea* are usually separate. The black spot near the tornus, conspicuous in *D. poolei*, is absent or small and faint in *D. dentilinea*, especially in males. The hindwing base is darker in *D. poolei* than in *D. dentilinea*, gray with a luteous cast in the former and nearly white in the latter. A typical *D. dentilinea* is shown as Figure 5; Figure 6 demonstrates an uncommonly-patterned female with fused lines and a tornal spot.

Structurally, males of *D. poolei* (Figure 7) and *D. dentilinea* (Figure 8) are similar. Both have a two-pronged clasper with medial and lateral spikes, clasper single in *D. minor*. Compared to *D. dentilinea*, *D. poolei* has wider valve base, more cephalad orientation of the base of the lateral ampulla spike, a shorter medial ampulla spike, and a smaller cucullus with fewer coronal setae. The width of the mid-sacculus divided by the width of the distal valve is greater than two in *D. poolei* (2.2–2.3), less than two in *D. dentilinea* (1.6–1.8). The vesicas are similar, but the left-sided diverticulum of the vesica is larger and the apical “sclerotized globule” of *D. poolei* is smaller than the corresponding structures of *D. dentilinea*.



Figures 7–10. *Dolocucullia* genitalia. **7** *D. poolei*, male **a** valves **b** phallus with everted vesica **8** *D. dentilinea*, male **a** valves **b** phallus with everted vesica **9** *D. poolei*, female **10** *D. dentilinea*, female.

The female corpus bursae of *D. poolei* (Figure 9) is slightly wider and shorter than that of *D. dentilinea* (Figure 10). The ratio of length to width is less than three in *D. poolei*, greater than that in *D. dentilinea*. Posterior segment A8 has convex lateral margins on each side of the ostium in *D. poolei*, forming a shallow “M,” but is nearly straight in *D. dentilinea*.

The barcodes of *D. dentilinea* (BOLD:AAF5239) and *D. poolei* (BOLD:AAF5240) differ by 8.0 %. Intraspecific variation is 1.3 % in *D. dentilinea* ($n = 7$; Arizona, Colorado, Idaho, New Mexico) and 1.9 % in *D. poolei* ($n = 11$; California, Washington).

Description. Adult. Head. Antenna of both sexes filiform, pubescent, single short cilia on anterior and posterior sides, dorsal scales sparse, very small, light gray. Scape long with anterior loose tuft, scales white, dark gray. Eye normal, surrounded densely by thin hair-like dark scales. Labial palpus scales dense, long, mixed strap-like white and hair-like dark gray, darkest laterally, longest anteriorly; apical segment short, scales mostly white. Haustellum normal. Frons scales dense, strap-like, mixed light and dark gray, forming median ridge. Dorsal head scales long, white, dark gray, lightest at antenna base and vertex, loose anterior tuft between antennae. **Thorax.** Dorsum, including patagium and tegula, scales long, narrow, hair-like, or apically forked, mixed white, light gray, and dark gray; appearing medium gray, darkest centrally; collar broadly striped, crested. Venter scales long, hair-like, light gray. **Legs:** Tibiae lacking spines; tarsal segments except terminal segment with three rows of spine-like setae. **Wings:** Forewing: Length 15.0–16.5 mm (males), 15.0–17.0 mm (females); elongate, length $2 \times$ width, not strongly pointed, outer margin smoothly convex, strongest near anal angle; dorsal scales elongate, rounded, mixed white, light gray, dark gray; appearing slightly mottled medium gray, medial area posterior to cell darker; Sierra Nevada population lighter gray with contrasting dark areas; veins black, thin, Cu thick across medial area; basal line absent; antemedial line black, costa to Cu thick, indistinct, angled slightly distad, Cu to 1A+2A toothed across medial area to postmedial line, segment near posterior margin less strongly so, reaching postmedial line in some specimens; medial line black, anterior segment similar to anterior antemedial line, then obsolete; postmedial line black, thinner than antemedial line, followed by light gray in most specimens, scalloped, costal origin anterior to reniform stigma, broadly convex around stigma, then nearly straight to mid-posterior margin; subterminal line pale gray or absent, irregular, preceded by indistinct dark gray shade anteriorly and prominent ill-defined dark gray to black spot near tornus; terminal line of intervening small black spots, darkest and longest crossing CuA2 toward tornal spot; fringe light to medium gray, luteous; claviform stigma absent; orbicular stigma absent or small dark gray streak with pale halo; reniform stigma faint to moderately prominent dark gray lunule or smudge. Hindwing: ground light gray, slightly luteous, distal half darker gray; veins dark; discal spot very faint; fringe off-white, base striped yellow, gray. **Abdomen** – Coremata absent. **Male genitalia:** Uncus base and mid-section oval, distal cylindrical, arced evenly, apex with short slightly downturned spine. Juxta heart shaped, broad, height = width. Valve long, gracile, width at mid-sacculus $0.2 \times$ length, tapered slightly to ampulla of clasper, distal half narrower, even,

width $0.1 \times$ valve length; cucullus slightly wider than adjacent valve, pointed bluntly, corona simple, ~ 20 claw-like setae; sacculus $0.4 \times$ valve length and $0.33 \times$ width; clasper base short, ampulla bifid with spike-like medial and lateral prongs extending dorsad from base near ventral margin, right longer than left; medial component triangular, directed dorsad and 20° distad, right process $0.6 \times$ valve width, left process slightly shorter; lateral process length $1 \times$ valve width, base directed distad and 30° cephalad from ventral mid-valve, apex upturned to just dorsal to valve edge; digitus absent. Phallus tubular, length $3.2 \times$ width, bent slightly ventrad. Vesica bulbous, $\sim 1.25 \times$ as long and $\sim 2.5 \times$ as wide as phallus, bent 90° rightward and slightly ventrad at base and 90° rostrad near apex to end to right of phallus; medium-sized subbasal domed diverticulum directed ventrad and leftward from left side; larger subbasal conical diverticulum directed dorsad from dorsal surface bearing small rugose sessile transversely-oriented apical cornutus; two additional globular cornuti: moderate-size foot-shape directed rostrad from mid-vesica between distal phallus and large, complex, irregular, with flat base and perpendicular rhomboid apex from anterodorsal apex. *Female genitalia*: Papilla analis pad-like, blunt, lobes joined by dorsal sclerite, covered sparsely with hair-like setae, longest at base. Segment A8 length $1.8 \times$ width, broad invagination across posterior margin, each side of ostium bursae slightly convex caudad. Posterior apophysis $0.8 \times$ segment A8 length; anterior apophysis $0.8 \times$ posterior apophysis. Ostium bursae funnel shaped. Ductus bursae length $1.25 \times$ segment A8 length, tapering evenly from ostium to near mid-point, widening gradually to broad attachment to corpus bursae. Corpus bursae length $6.3 \times$ ductus length, membranous, ovate, length $3.3 \times$ width, blunt posterior end expanded slightly ventrad and leftward, ductus seminalis at apex.

Geographic variation. Coastal *D. poolei* (Figs 1, 2) are uniform slightly bluish gray. Sierra Nevada populations (Figs 3, 4) are mottled whitish gray with contrasting dark markings. The barcodes of these populations are not significantly different. Specimens from the Sierra Nevada are excluded from the type series because of these differences.

Etymology. The name honors Robert Poole for his work on the Noctuidae of North America. He laid the groundwork for the *Dolocucullia* and *Plagiomimicus* descriptions in this paper.

Distribution and ecology. *Dolocucullia poolei* occurs near the Pacific Coast from southern California to the tip of the Olympic Peninsula, Washington (Figure 48). It is most common in the California and Oregon Coast Ranges, with records as far inland as the Oregon Cascade Range. It is restricted to the immediate coast in Washington. An apparently disjunct population occurs in the Sierra Nevada, California.

Dolocucullia poolei occurs in a variety of habitats, including conifer forest, coastal chaparral, and dry mountain chaparral. It has a long flight season, from as early as March in southern California to as late as August in the Pacific Northwest. The Sierra Nevada population flies at high elevation near timberline during mid- to late summer. *Dolocucullia poolei* is unusual for a noctuid in that females are collected at lights as often as males. The early stages are unknown.

Discussion. Draudt (in Seitz 1924) named *Cucullia dentilinea* form *mexicanus* Draudt, 1924 and *Cucullia emungens* Draudt, 1924. The type localities for both is “Mexico.” Form *mexicanus* describes specimens with “rusty yellow spots” found amongst more typical Mexican specimens of *D. dentilinea* that had been compared by Draudt to material from Arizona and Colorado. The Mexican Draudt types are destroyed according to Poole (1995). Illustrations of both taxa have been examined in Seitz (1924) to ensure that neither name applies to the species named *D. poolei* herein.

The barcode difference of 8 % between *D. poolei* and *D. dentilinea* is large for congeneric noctuids, and somewhat surprising given the similarity of the adult moths.

Amphipyrinae Guenée, 1837

Stiriini Grote, 1882

Subtribe Stiriina Grote, 1882

The Stiriini of North America north of Mexico were revised by Poole (1995). These generally attractive moths are found mostly in the southwest United States and Mexico. They have a short tubular male vesica with basal and mesial patches of spine-like cornuti, a frontal process with a raised outer ring and central cone, a reduced scale-like larval spinneret, and adaptations to desert habitats including a distal foretibial claw (op. cit.). The known larvae feed on flowers of Asteraceae. The female ovipositor lobes are sclerotized strongly and pointed, likely for inserting eggs into buds or flowers.

Many of the genera in the tribe are similar. Females of *Plagiomimicus* Grote, the largest genus in the tribe, have modified ovipositor lobes and lack clear areas on sternite A8 or an invagination of the ostium bursae found in related genera. Males typically have a simple valve with a weak setal corona, a rod-like basal process of the sacculus, and a short ampulla of the clasper from the ventral distal valve (Poole 1995).

Plagiomimicus tepperi Morrison, 1875 and related species form a species-group distinguished by an elongate central process of the frontal tubercle and loss of the corona of the valve and the basal patch of cornuti of the vesica of the male genitalia (Poole 1995). Members of the species-group are small (forewing length 9–15 mm) and have smooth pale grayish green to ochre-yellow forewings with even white transverse lines and faint to dark subapical spots. Poole recognized two similar species in this group from the United States, *P. tepperi* and *Plagiomimicus mimica* Poole, 1995, and mentioned an undescribed central Mexican species.

Poole (1995) considered *P. tepperi*, type locality Texas, to be a widespread and geographically variable species. Under his broad concept of the species, the westernmost populations differ from topotypical populations in color and pattern, either grayer (Pacific Northwest) or paler (Great Basin and California). Poole discussed and illustrated the Washington State population, noting that it differs from nominate *P. tepperi* in habitus and the genitalia of both sexes. Despite this, he maintained this population as

P. tepperi, arguing that *P. tepperi* is a variable moth and that these differences fall within its range of variation.

More recently, the barcodes of the Washington and pale southern populations were found to be nearly identical, and these differ from the barcode of southeastern Arizona *P. tepperi* by a magnitude similar to the difference between those of *P. tepperi* and *P. mimica*. This provides new evidence that these western *Plagiomimicus* populations are a different species than *P. tepperi*. Herein we confirm the structural and superficial differences between these moths, naming the Columbia Basin moth *Plagiomimicus yakama* sp. n., and the southern populations with the same barcode and structure as a subspecies of it, *Plagiomimicus yakama mojave* ssp. n. When these new taxa are removed from *P. tepperi* it becomes a more uniform entity in appearance, structure, and barcodes.

No early stages of the *P. tepperi* species-group were known at the time of Poole's revision. DLW has discovered that the larvae of these moths feed on flowers and seed heads of brickellbushes, *Brickellia* Ell. (Asteraceae). Each species appears to be a specialist on one or a few species in the genus.

TM found at SDMC another new *Plagiomimicus* species from Baja California Sur, Mexico, belonging to the same species group. It is also named herein.

The key to the Stiriini in the MONA fascicle (as Stiriinae) (Poole 1995: 81–85) is not readily modified to include the new taxa. A key to the named North American species in the *Plagiomimicus tepperi* species-group is presented below. *Plagiomimicus tepperi* and *P. mimica* species accounts are given in Poole (1995).

Key to adults of the *Plagiomimicus tepperi* species-group

- 1 Forewing reniform stigma dark and indistinct; Baja Peninsula, Mexico.....
.....*P. incomitatus*
- Forewing reniform stigma a white bar or absent; United States **2**
- 2 Forewing subapical spot darker than cell in medial area; right ampulla of male clasper elongate, curved, base angled strongly distad **3**
- Forewing subapical spot inconspicuous, lighter than cell in medial area; right ampulla of clasper of male valve short, peglike, base oriented dorsad..... **4**
- 3 Distal postmedial area abutting subterminal line significantly darker than medial part; ampulla claspers bilaterally symmetrical, not extending distal to valve edge on either side.....*P. tepperi*
- Distal postmedial area abutting subterminal line not darker than medial part; ampulla of claspers asymmetrical: right longer, straight, extending beyond valve distal edge; left shorter, curved cephalad without extending distal to valve *P. mimica*
- 4 Forewing olive and gray; Columbia Plateau of Washington and Oregon.....
.....*P. y. yakama*
- Forewing ochre or ochre and tan; southern Great Basin, western Arizona, and southeastern California *P. y. mojave*

***Plagiomimicus yakama* Crabo & Wikle, sp. n.**

<http://zoobank.org/D50EEB56-B99D-4FAB-8DB3-0960A8117802>

Figs 11–13, 17, 18, 21, 24, 49

Type locality. USA, Washington, Yakima County, Satus Creek.

Type Material. Holotype, male. [USA], Washington, Yakima County, Satus Creek, 30 V [19]49, E. C. Johnston. CNC. **Paratypes.** 10 males, 3 females. **USA: Washington:** Kittitas County: Schnebly Coulee, 46.95°N, 120.09°W, 500 m, 2 VI 1990, L G Crabo leg (4 males, 2 females); same locality & collector, 3 VII 1990 (1 male); Schnebly Coulee, 46.955°, -120.095°, 500 m, 14 V 2010, L. G. Crabo leg.; Grant County: Wanapum Dam, 1.6 mi [2.6 km] N, 46.900°, -119.948°, 250 m, 14 V 2010, L. G. Crabo leg (1 m); Yakima County: Satus Creek, 30 V [19]49, E. C. Johnston, (2 m); same locality, date, & collector / Genitalia CNC slide # 17068 (1 m); same locality, date, & collector / Genitalia slide by P6 USNM 45.585 (1 f); same locality, date, & collector / Slide No. 10,789 (1 m). CNC, DLW, LGC.

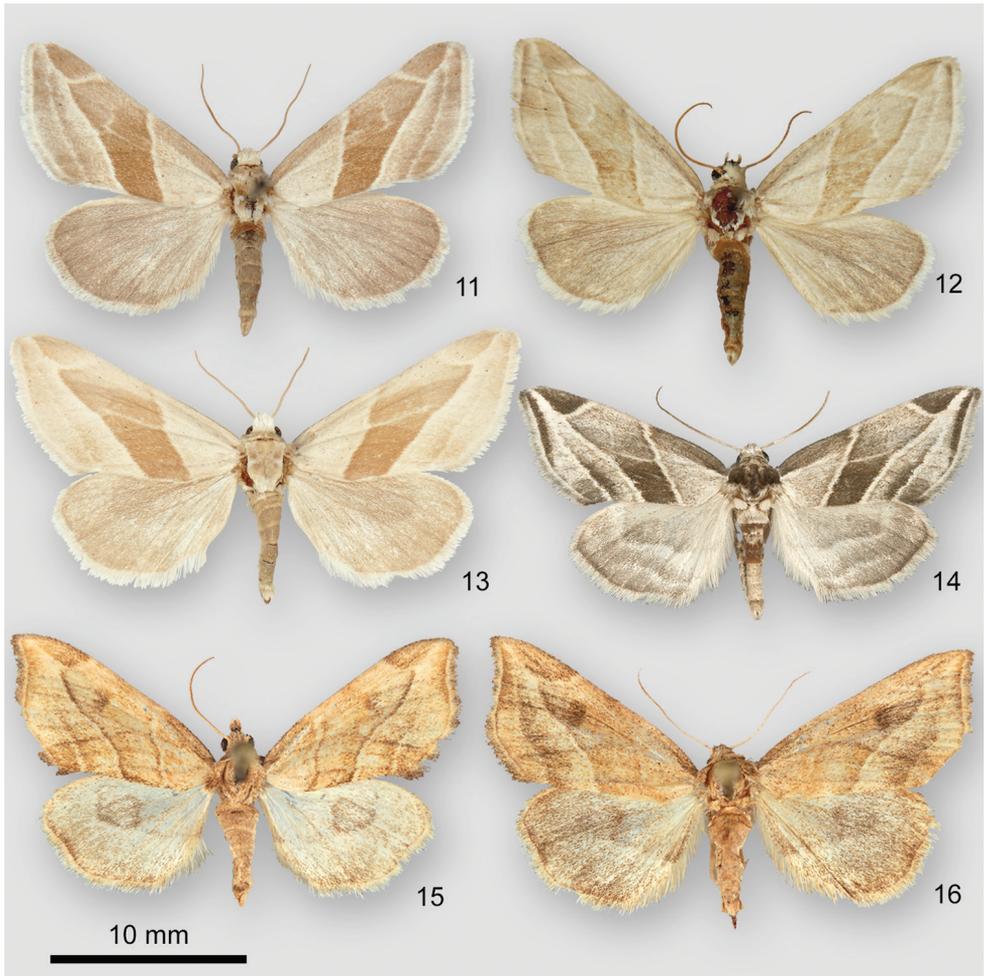
The type series is restricted to Washington State.

Differential diagnosis. *Plagiomimicus yakama* (Figs 11–13) is distinguished from the two other species in the *P. tepperi* species-group found in the United States in having an inconspicuous subapical spot, not darker than the adjacent medial area. Fresh *P. tepperi* (Figure 14) and *P. mimica* (not shown) are greener than *P. yakama*. *Plagiomimicus incomitatus* sp. n. (Figs 15, 16), only found in Mexico, has a dark smudged reniform stigma unlike the pale or absent stigma of *P. yakama*.

The ampullae of the male valve of *P. yakama* (Figs 17a, 18a) are nearly symmetrical, short and needlelike, arising perpendicular to the valve or at a slight angle. Those of *P. tepperi* (Figure 19a) and *P. mimica* (not shown) are longer, curved, and directed distad. Those of *P. mimica* are also asymmetrical. The female of *P. yakama* (Figure 21) has a longer and more strongly curved corpus bursae than *P. tepperi* (Figure 22).

The barcodes of *P. yakama* (BOLD:ACR9301) and *P. tepperi* (BOLD:AAF2198) differ by at least 1.63 %.

Description. N nominate subspecies. **Adults.** Males and females similar in size and habitus. **Head.** Antenna filiform, ventral surface ciliate, dense (male), sparse (female); dorsal scales gray olive. Scape off-white. Eye round, bare. Frontal process sideways D-shaped, straight side ventrad, lateral and dorsal rims raised slightly, central process slightly caudal to “D” center, cone shaped, protruding slightly beyond edges; a transverse ridge caudal to process; frons and dorsal head scales short, tan off-white, palest near vertex. Labial palpus reaching dorsal eye, second segment long, third segment very short, scales short, light olive gray, darker than head. Haustellum normal. **Thorax.** Dorsum, including patagium and tegula, scales short, olive off-white; appearing uniform pale brownish olive gray similar to head and forewing base. Venter lighter. **Legs:** Pale olive gray; distal foretibia claw short, thornlike, tarsal segments equal length. **Wings:** Forewing: Length 11.5–12.5 mm; elongate with slightly pointed apex, lateral margin straight to CuA1, thence convex to posterior margin; scales mixed olive off-white, tan, and gray olive; base to antemedial line and basal postmedial area silver gray, distal postmedial area, terminal



Figures 11–16. *Plagiomimicus* adults. **11** *P. yakama yakama*, holotype male, USA, Washington, Yakima County, Satus Creek **12** *P. yakama mojave*, holotype male, USA, Arizona, Mohave County, Hualapai Mountains, Wikieup 9.7 km W **13** *P. yakama mojave*, male, USA, Nevada, Clark County, Charleston Mountains, Kyle Canyon **14** *P. tepperi*, male, USA Arizona, Maricopa County, Cave Creek **15** *P. incommitatus*, holotype male, Mexico, Baja California Sur, Punta Colorado 11.3 km S **16** *P. incommitatus*, female, same locality as last specimen.

area, and subapical spot slightly darker gray, medial area dark olive gray; cubital vein basal to postmedial line slightly lighter; basal and medial lines absent; antemedial and postmedial lines white, wide, slightly indistinct; antemedial line oblique from mid-costa to inner third posterior margin, slightly convex; postmedial line from outer third costa to R5 angled strongly distad, bent basad acutely on R5 to cubital vein at end of cell, thence parallel to antemedial line to outer $\frac{1}{3}$ of posterior margin; subterminal line pale gray, white adjacent to subapical spot, slightly sinuous; terminal line thin, slightly darker than terminal area or absent; subapical spot slightly lighter than medial area, elongate, cau-

dal margin smoothly convex; fringe olive off-white, base slightly darker; claviform and orbicular stigmata absent; reniform stigma absent or few pale anterior and darker posterior scales. Hindwing: Dorsum uniform medium gray, postmedial area slightly lighter in some specimens; terminal line thin, slightly darker; fringe whitish, base pale olive gray. *Abdomen*. Male lacking basal modifications; scales pale fuscous. *Male genitalia*: Uncus short, thick, curved slightly, point short, covered by sparse short fine setae. Juxta shield shape, height = width. Valve length $2.4\text{--}2.7 \times$ width, simple, outer margin convex, apex blunt, medial surface with sparse fine setae; cucullus unmodified, corona absent; sacculus $\frac{2}{3} \times$ valve length, $0.4 \times$ width, basal process short, spike like, perpendicular to valve, mesial dorsum variable, smooth or with short broad triangular process; clasper base weak, origin near ventral margin; ampulla short, $0.14\text{--}0.18 \times$ valve width, right slightly longer, thin, acute, nearly perpendicular to valve; digitus absent. Phallus cylindrical, straight, length $4 \times$ width; vesica as long and slightly wider than phallus, straight beyond basal 120° bend, mesial and distal surface with large patch of similar-sized basally directed spike-like cornuti. *Female genitalia*: Papilla analis $2 \times$ segment A8 length, width $0.33 \times$ length, sclerotized, distal $\frac{1}{3}$ tapered evenly to acute apex, setae short, sparse, membrane to segment A8 leathery; posterior apophysis $3.3 \times$ segment A8 length; anterior apophysis $0.8 \times$ posterior apophysis; ostium bursae sclerotized, cup shaped, slightly wider than ductus bursae; ductus bursae $0.8 \times$ segment A8 length, sclerotized lightly; corpus bursae elongate, length $3.5 \times$ width, posterior $\frac{1}{3}$ sclerotized; anterior $\frac{2}{3}$ membranous, lacking signa, constricted mesially to width of ductus bursae, anterior end bulbous, curved slightly rightward; appendix bursae short, truncate, moderately sclerotized, joined broadly to corpus bursae at junction with ductus bursae; ductus seminalis at ventral apex.

Geographic variation. Populations of *P. yakama* are arranged in northern and southern subspecies, described below.

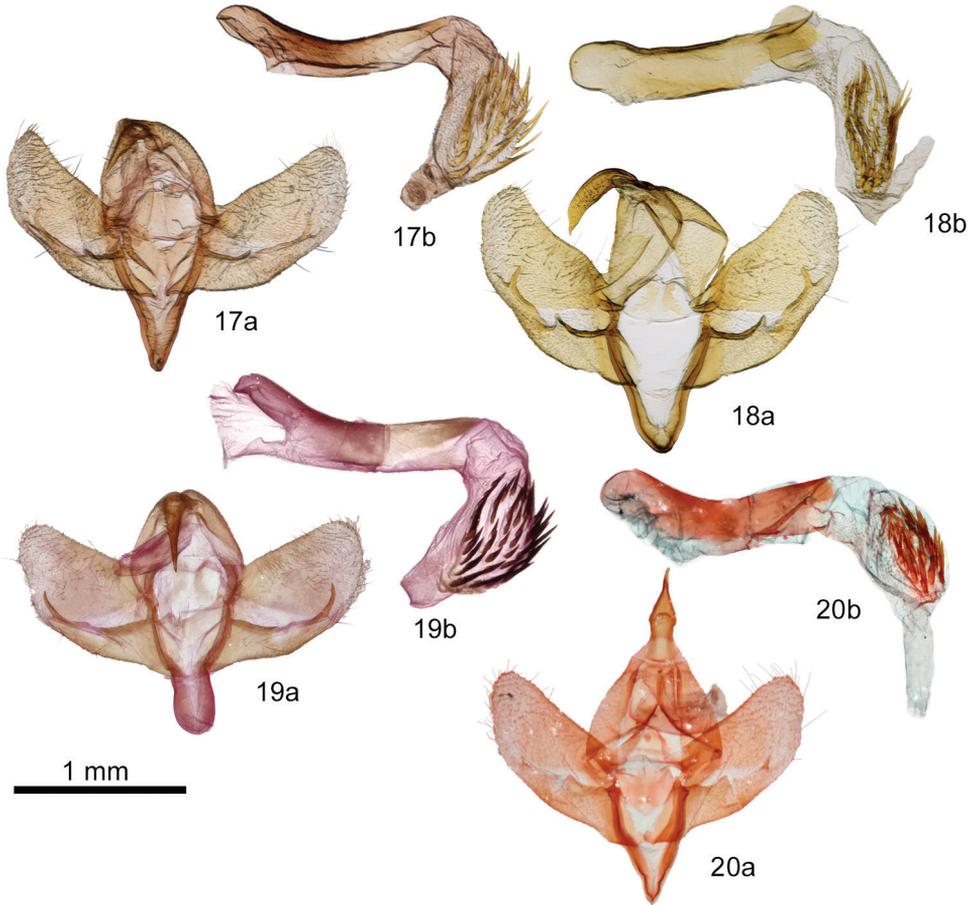
Barcode samples of *P. yakama* exist for Washington ($n = 2$), Utah ($n = 3$), Nevada ($n = 1$), Arizona ($n = 6$), and California ($n = 3$). Washington samples differ from the others by 0.3 %.

Etymology. The name refers to the Yakama people, the original human inhabitants of the type locality of this moth. It is a noun in apposition. The spelling of the Yakama Nation differs from the more familiar spellings of the city of Yakima and Yakima County, Washington.

Distribution and ecology. *Plagiomimicus yakama* is found in two separate parts of the American West (Figure 49). The nominate subspecies occurs on the Columbia Plateau. Subspecies *Plagiomimicus yakama mojave* is found 1000 km farther south in the southern Great Basin and Mojave Desert.

This moth flies in dry desert habitats with exposed soil and rocks, favoring those with varied topography such as rim rock, coulees, and arroyos. Where known, the larva of *P. yakama* feeds on *Brickellia* species. The larva of subspecies *P. y. mojave* is described below.

Adults fly during spring, from April to June, in all parts of the range. Southern populations have at least a partial fall brood.



Figures 17–20. *Plagiomimicus* male genitalia. **17** *P. y. yakama* **a** valves **b** phallus with everted vesica **18** *P. yakama mojave* **a** valves **b** phallus with everted vesica **19** *P. tepperi* **a** valves **b** phallus with everted vesica **20** *P. incomitatus* **a** valves **b** phallus with everted vesica.

Discussion. Syntypes of *Schinia tepperi* Morrison, 1875 at MSU and the holotype of its synonym *Plagiomimicus richii* Grote, 1886 at NHML, both described from “Texas”, match examined material of *Plagiomimicus tepperi* from Texas, New Mexico, and southeastern and central Arizona. When restricted to these populations *P. tepperi* is uniform in habitus and structure. Barcodes of *P. tepperi* from southeast Arizona ($n = 6$) and New Mexico ($n = 1$) differ by 0.3 %. Barcodes of topotypical Texas populations have not been sampled. The range of *P. tepperi* extends northwards to Colorado.

In naming *P. yakama* and restricting *P. tepperi* in the above sense, the species in the *P. tepperi* species-group become more uniform well defined entities. However, ongoing rearing and molecular work by DLW and David Wagner suggest that there could be additional unrecognized cryptic species.

***Plagiomimicus yakama yakama* Crabo & Wikle, ssp. n.**

<http://zoobank.org/9C9015EB-8E77-410A-A07E-1A92FBBE4DCD>

Figs 11, 17, 21, 49

Differential diagnosis. Subspecies *P. y. yakama* (Figure 11) is darker and greener than *P. y. mojave* (Figs 12, 13), and the pale areas of the forewing are grayer. The postmedial line of the nominate subspecies is angled slightly basad on the cubital vein, straight or slightly convex in *P. y. mojave*. Other differences are described under *P. y. mojave*. No significant differences exist in the male or female genitalia. Barcodes of the two subspecies differ by 0.3 percent, similar to intraspecies variation in *P. tepperi* and less than interspecies differences in the species-group (1.5 to 2.6 %).

Distribution and ecology. The nominate subspecies occurs in the Columbia Plateau ecoregion (Figure 49) and is the most northerly of all *P. tepperi* species-group taxa. All Pacific Northwest records are from close to the 120th parallel, from Vantage, Washington to southern Wheeler County, Oregon.

Plagiomimicus y. yakama is single brooded and flies during late spring and early summer. Its early stages are unknown, but the most likely food plant in Washington is *Brickellia oblongifolia* Nutt. based on the presence of this plant near populations of the moth in Grant and Kittitas counties (pnwherbaria.org [accessed 23 January, 2018]).

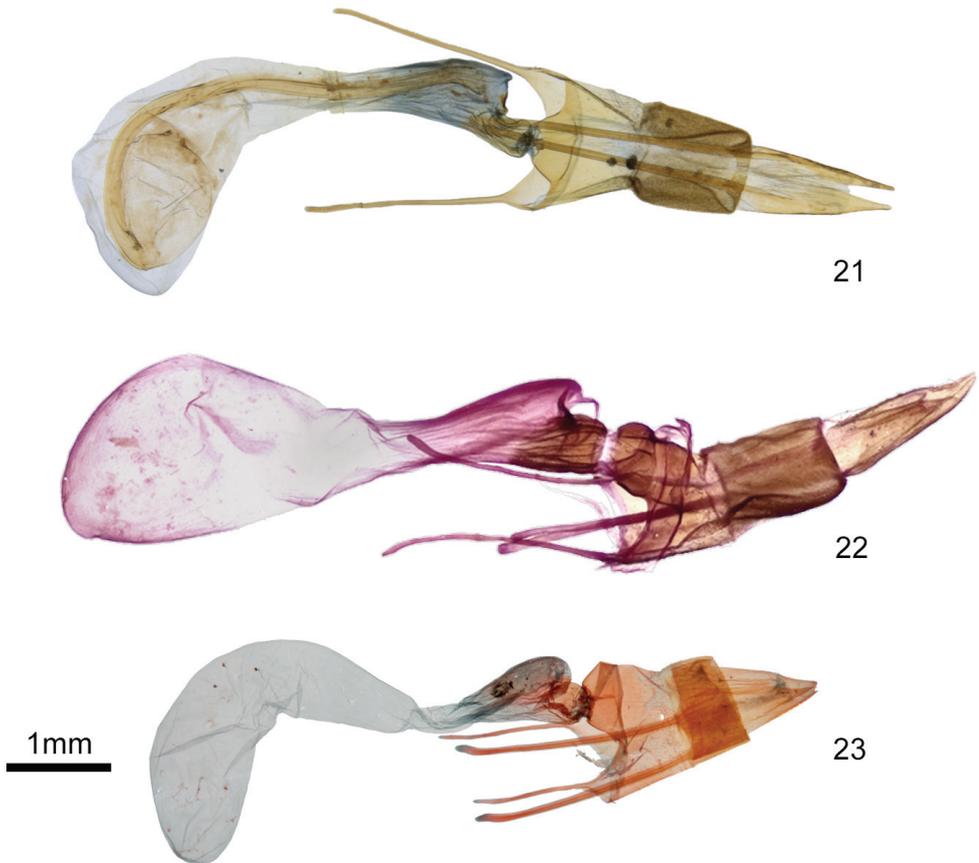
***Plagiomimicus yakama mojave* Wikle & Crabo, ssp. n.**

<http://zoobank.org/302596E9-A32E-4AAD-B038-6AD94F479AEE>

Figs 12, 13, 18, 24, 49

Type locality. USA, Arizona, Mohave County, Hualapai Mountains, 9.7 km west of Wikieup.

Type material. Holotype, male. USA, Arizona, Mohave County, 34°40.478'N, 113°41.934'W, Hualapai Mts., 6 mi [9.7 km] W of Wikieup, 10 IX 2013, leg. D. L. Wikle, to MV / DLWC 011176 / Specimen ID CNCLEP 00116215 / Barcodes of Life Project, Leg removed, DNA extracted. CNC. **Paratypes.** 37 males, 6 females. **USA: Arizona:** Mohave County: Hualapai Mts, 6 mi [9.7 km] W Wikieup, 34°40.212'N, -113°42.299'W, elev 3590' [1094 m], 19 IV 2012, to B[lack] L[ight], D. L. Wikle leg. / DLWC011081 / [Crabo genitalia slide] 615 male / DNA CNCLEP 00116338 (1 m); same locality and collector as holotype, 9 V 2010 / DLWC011153 (1 m), DLWC011273 (1 m); same locality and collector, 5 IX 2012 / DLWC011018 (1 m), DLWC011039 / DNA CNCLEP 00116337 (1 m), DLWC011034 (1 m), DLWC011180 / DNA CNCLEP 00116336 (1 male), DLWC011187 (1 f), DLWC011262 (1 m), DLWC011298 (1 m), DLWC011342 (1 m), DLWC011350 (1 m), DLWC011377 (1 f); same locality and collector, 10 IX 2013 / DLWC 011126 (1 m), DLWC011291 / Specimen ID CNCLEP 00116216 / Barcodes of Life Project, Leg removed, DNA extracted (1 f), DLWC011370 (1 m); Hualapai Mts, Wikieup 9 km WSW, 34.674°, -113.699°, 1060 m, 14 IV 2015, L. G. Crabo leg. / DNA CNCLEP 00116339 (1 m); **Nevada:**



Figures 21–23. *Plagiomimicus* female genitalia **21** *P. y. yakama*, female **22** *P. tepperi*, female **23** *P. incomitatus*, female.

Clark County: Charleston Mts, Kyle Canyon, 26 IV 1950; E. C. Johnston (12 m), Genitalia Slide, By PG, USNM 45696 (1 m), Genitalia Slide, By PG, USNM 45697 (1 m); Spring Mts, Lucky Strike Canyon Rd., 36°18.061'N, -115°29.441'W, elev. 4885' [1489 m], RRCNCA #NV-052, to BL/MV, 21 IV 2013, leg. D. L. Wikle / DLWC011299 (1 f); same locality and collector, 12 V 2013 / DLWC011294 (1 f); **Utah:** Garfield County: Old Sheffield Rd off Hwy 12, 37°43.376'N, -111°26.266'W, elev. 6005' [1830 m], 5 V 2009, leg. D. L. Wikle / DLWC011035 / Specimen ID CNCLEP 00116214 / Barcodes of Life Project, Leg removed, DNA extracted (1 m), DLWC011099 (1 m), DLWC011118 (1 m), DLWC011123 (1 m), DLWC011243 (1 m), DLWC011246 (1 m), DLWC011264 (1 m), DLWC011347 (1 f); Spencer Flat Rd mi 1.7 [2.7 km] sta 1, 37°43.411'N, -111°26.273'W, elev. 6015' [1833 m], lt B[lack] L[ight], 11 V 2012, D. L. Wikle leg., GSENM Permit#UT-12-033-01-B / DLWC011201 / [Crabo genitalia slide] 616 male / DNA CNCLEP00116333 (1 m); Wolverine Loop “draw,” 37°49.924'N, -111°6.535'W, elev. 6440' [1963 m], GSENM #UT-12-033-01-B, leg. Opler + Wikle (1 m). CNC, DLW, LGC.

The type series is restricted to Arizona, Nevada, and Utah.

Differential diagnosis. Subspecies *P. y. mojave* (Figs 12, 13) is pale olivaceous ochre tan, appearing paler, yellower, and more “washed-out” than the nominate subspecies. Dark areas of the forewing are tan rather than olive, less contrasting than in *P. y. yakama* (Figure 11), and the subapical spot is vaguely darker than the adjacent wing if visible at all. Most specimens lack angulation of the postmedial line on the cubital vein resulting in a wider medial area than in *P. y. yakama*. The antemedial and postmedial lines of darker specimens are two toned, tan on the medial-area side, whereas those of *P. y. yakama* are pale. The forewing apex tends to be most pointed in this subspecies. No significant genitalia structural differences are evident between the subspecies.

Plagiomimicus y. mojave is most likely to be confused with *P. tepperi* (Figure 14), the western range of which approaches to within 135 km of *P. y. mojave* in northwestern Arizona. In addition to structural characters noted in the *P. yakama* description *Plagiomimicus tepperi* is distinguished by slightly falcate forewing apex and a dark shade preceding the subterminal line. Differences between *P. y. mojave* and *P. incomitatus* (Figs 15, 16) are described under the latter species, though it is unlikely that these moths occur together.

Description. Adult. Males and females similar in size and habitus. *Head.* Structure and vestiture similar to *P. y. yakama*, paler. *Thorax.* Dorsum pale yellow tan. *Wings:* Forewing: Length 11.0–14.5 mm; apex more pointed than in *P. y. yakama*; scales pale yellow and light tan; uniform pale yellowish tan outside medial area, subterminal area and subapical spot slightly darker in some specimens; medial area darker olivaceous yellow-tan, usually slightly darker on posterior ½; cubital vein slightly lighter basal to postmedial line in some specimens; basal and medial lines absent; antemedial and postmedial lines off-white, bordered by tan in medial area in dark specimens; antemedial line oblique from mid-costa to inner ⅓ of posterior margin, straight; postmedial line similar to nominate subspecies, but slightly convex near cell; subterminal line pale off-white, only visible in dark specimens; terminal line thin, tan, evident on anterior ½; subapical spot indistinct or absent, lighter than medial area when present; fringe same as terminal area; stigmata typically absent, reniform stigma occasionally a bar of few pale scales. Hindwing: Uniform pale yellowish gray, slightly darker on basal ½; fringe off-white. *Abdomen.* Paler than for *P. y. yakama*. *Male genitalia and female genitalia:* as for *P. y. yakama*.

Etymology. The name refers to the distribution of this moth in and near the Mojave Desert. It is a noun in apposition.

Distribution and ecology. This subspecies occurs in the Mojave Desert and southern Great Basin (Figure 49), 1000 km south of nominate *P. yakama*. Specimens have been examined from Garfield and Kane counties of southern Utah, Clark County of southern Nevada, Mohave County in northwestern Arizona, and east of the Coachella Valley in Riverside County, California. The identity of a few populations of superficially similar moths from west of the Coachella Valley remain uncertain. California specimens are therefore excluded from the type series. The apparent large separation of the ranges of the two *P. yakama* subspecies could potentially be an artifact related to limited collection in the Great Basin during the spring flight period of this species.



Figure 24. *Plagiomimicus yakama mojave*, late instars feeding on flowerheads of *Brickellia atrectyloides* (USA, Arizona, Mohave County, Hualapai Mountains) **a** penultimate instar **b** last instar.

Larvae of *P. y. mojave* (Fig. 24a, b) have been collected and reared to adults by DLW on *Brickellia atrectyloides* A. Gray in the Hualapai Mountains of Arizona and *Brickellia oblongifolia* in Nevada. The following description is modified from a work on the larvae of western North American moths (DL Wagner, unpublished):

Ova are placed deep inside the discoid flower heads and the early instars are internal feeders on flowers as they are going to seed. Molting occurs inside the flower head and, as the larvae progress, frass is present externally on some flowers. Larvae leave the flowers as they become spoiled, and later instars rest on stems and seed heads and feed externally on multiple flowers. The early instars are pale with red spotting and a pale supraspiracular stripe.

Penultimate instars (Figure 24a) are similar, but the ground color is green. Red spotting is reduced, remaining most prominent on the thoracic segments. The supraspiracular stripe is better developed.

The last instar is greenish red with well-defined pale mid-dorsal, subdorsal, and lateral stripes. Minute red spots develop diffusely over the course of this stage such that the larva changes from green similar to the penultimate larva initially, to more or less pink through the second half of the instar (Figure 24b). The subdorsal stripe is twice as thick as the mid-dorsal stripe. A faint diffuse supraspiracular stripe extends A1–A8. The lateral (spiracular) stripe begins at A1 and continues to the base of the A10 proleg. The spiracles are black. The primary setae are not borne from white pinacula as in other members of the *P. tepperi* species-group.

The larvae of *P. y. mojave* are similar to those of *P. mimica*, which feeds exclusively on *Brickellia californica* (Torr. & A. Gray) A. Gray throughout its range. Its larva differs from *P. y. mojave* in that the lateral stripe is often cream or yellow rather than white, the subdorsal stripe is well developed, the mid-dorsal stripe is thin, and the larva is thickened through the thoracic segments.

Plagiomimicus y. mojave is at least partially double brooded, flying in late spring and again in early fall in areas where food plants flower in the spring and fall.

***Plagiomimicus incomitatus* Mustelin, sp. n.**

<http://zoobank.org/BC2E4B22-F5C0-4359-B28F-4FFF1F336ED4>

Figs 15, 16, 20, 23, 49

Type locality. Mexico, Baja California Sur, 11.3 km south of Punta Colorada.

Type material. Holotype, male. Mexico, Baja Ca Norte [*sic*] [Baja California Sur], 7 miles [11.3 km] south of Punta Colorada, (arroyo), 23–30 XII, 1987, N. Bloomfield / USNM [genitalia slide] 46113. SDMC. **Paratypes.** 6 m, 3 f. **Mexico: Baja California Sur:** same locality, date, & collector as holotype (5 m 1 f); Same data, [genitalia slide] TM#465 (1 m); same data, [genitalia slide] USNM 46114 (1 f); Punta Colorada, 22 XII 1987, N. Bloomfield (1 f). CNC, SDMC, TM, USNM.

Differential diagnosis. *Plagiomimicus incomitatus* (Figs 15, 16) can be recognized by the combination of small size (FW length 11–13 mm), pale yellow tan color, undulating brown forewing transverse lines, and S-shaped forewing outer margin with pointed apex. It is the only species in the *P. tepperi* species-group that has a large indistinct dark reniform stigma. Males (Figure 20) have short peg-like ampullae similar to those of *P. yakama*, but these are thicker in *P. incomitatus*. Females of *P. incomitatus* (Figure 23) are distinguished by having a long corpus bursae with a strong bend, but are best identified by forewing shape and maculation.

Plagiomimicus incomitatus has not been barcoded.

Description. Adult. Males and females similar in habitus. *Head.* Antenna simple, venter finely setose, dorsal scales ochre. Scape pale ochre, ventral tuft short. Eye normal. Labial palpus reaching top of eye; first 2 segments long, short distal segment angled 45° rostrad; scales ochre. Haustellum normal. Frons scales tan; frontal process similar to *P. yakama*, central cone slightly longer. Dorsal head scales ochre. *Thorax.* Dorsal scales flat, bases moderately narrow, edges finely toothed, ochre, many with tan tips; patagium scales similar, slightly darker; tegula scales similar, many tan gray distally; entire dorsal thorax appearing similar to dorsal forewing; venter scales hair-like, ochre off-white. *Legs:* Foretibia apical spine short, thin; tarsal segments except apical segment with three regular rows of spiniform setae; scales tan. *Wings:* Forewing: length 11.0–12.5 mm (male), 12.0–13.0 mm (female); length 1.65 × maximum width. Apex acute, outer margin S-shaped, concave opposite cell, convex M3–CuA2. Dorsum: Scales mixed light to dark ochre and gray tan; appearing golden tan with dark dusting on costa, along veins (particularly Cu), and posterolateral

medial, subterminal, and terminal areas (darkest in females), a gray-brown band in distal terminal area at concave margin; subapical spot tan, faint; basal and medial lines absent; antemedial and postmedial lines brown and cream, dark component bordering medial area; antemedial line smoothly undulating, convex at cell and fold, concave on mid-wing, angled slightly basad from costa to posterior margin; postmedial line adjacent to subapical spot pale, strongly angled distad, bent acutely basad at posterior subapical spot, thence smoothly S-shaped to posterior margin, convex from subapical spot to Cu, concave thence to posterior margin; subterminal line cream, evident mostly due to dark adjacent scales, evident adjacent to subapical patch and from M2 to posterior margin, latter segment S-shaped, parallel to postmedial line; terminal line, orbicular and claviform stigmata absent; fringe medium grayish tan, base ochre; reniform stigma brown, oval, diffuse. Hindwing: Lateral margin opposite cell weakly concave; ground color paler than forewing, whitish, dusted heavily with grayish tan scales (especially in females), darkest medial to postmedial line and near margin; discal spot diffuse, pale gray, elongate, C-shaped; postmedial line diffuse, light brown gray, anterior $\frac{1}{3}$ perpendicular to costal margin, posterior segment perpendicular to medial margin, touching posterior discal spot; terminal line brown gray, darkest at concave margin; fringe gray off-white. *Abdomen.* scales flat, dorsum ochre tan, venter lighter. *Male genitalia:* Uncus arced, base thick, width $0.33 \times$ length, tapered from mid-section to thin acute point. Juxta broad shield shape, height $0.67 \times$ width. Valve flaplike, ovate, length $2.5 \times$ width, cucullus unmodified, pointed bluntly, corona absent; sacculus $0.67 \times$ valve length and $0.4 \times$ width, basal process, short, triangular, median sacculus with dorsal obtuse triangular projection, shorter (1 specimen) or similar length (1 specimen) to basal process; ampulla of clasper short, $0.11 \times$ valve width, right slightly longer and stouter than left (1 specimen) or much stouter than left (1 specimen), origin near ventral valve at end of sacculus, oriented 45° dorsad and distad to valve. Phallus tubular, length $4.5 \times$ width; vesica length $0.7 \times$ phallus length, width $1.5 \times$ phallus width, bent 90° at base, bearing single median patch of numerous stout spine-like cornuti directed basad, basal cornuti absent. *Female genitalia:* Papilla analis conical, apex acute. Segment A8 length $1.2 \times$ width. Posterior apophysis length $1.5 \times$ segment A8; posterior apophysis $0.5 \times$ anterior apophysis. Ductus bursae short, length $0.4 \times$ segment A8, expanded slightly anterior to slight constriction at posterior origin; ostium bursae broad, funnel shaped. Corpus bursae elongate, length $2.8 \times$ segment A8, slender, width $0.2 \times$ length, anterior segment widest distal to 60° bend; appendix bursae extended posterior from broad junction to corpus bursae at junction with ductus, moderately sclerotized; ductus seminalis at ventral apex.

Etymology. *Incomitatus* is Latin, meaning “unaccompanied” or “alone.” It refers both to the single known locality for this species as well as the solitude of its collector, Norris Bloomfield, during long collecting trips on behalf of SDMC in Baja California in the late 1980s.

Distribution and ecology. *Plagiomimicus incomitatus* is only known from the type locality near the southern tip of the Baja Peninsula, Mexico (Figure 49). The habitat

is a dry arroyo in Baja desert. All specimens were collected with black light in late December. The early stages are unknown.

Discussion. *Plagiomimicus incommitatus* is classified in the *P. tepperi* species-group based the lack of the corona and basal patch of cornuti in the male genitalia. It resembles the other species in the group.

The moth fauna of the Baja Peninsula is poorly known, especially compared with that of adjacent southern California. Of what is known, much is due to Norris Bloomfield who made several collecting trips to the area during the 1980s on behalf of the San Diego Natural History Museum. Although the majority of the Noctuoidea collected by him also occur in southern California, he also encountered many species that are only known from southern parts of Arizona, New Mexico, or Texas, as well as some not known from the United States. *Plagiomimicus incommitatus* is one of the latter species, currently only known from the type locality. The apparent rarity of this moth might be due the lack of collecting in this region as well as its late December flight period.

Oncocnemidinae Forbes & Franclemont, 1954

***Sympistis* Hübner, 1823**

Troubridge (2008) reviewed the genus *Sympistis* for North America north of Mexico. He named 50 new species and figured adults of 177 species. Although it is not a detailed revision of all species-groups, this paper is seminal in defining the genus. Eleven genera were placed in synonymy, including *Oncocnemis* Lederer that previously contained the majority of the species. *Sympistis* species are most numerous in western North America.

According to Troubridge (op. cit.) *Sympistis* is associated with the subfamily Oncocnemidinae by a horizontal transverse foramen across the first abdominal tergite dorsal to the tympanum. The structural features most diagnostic of the genus are found in the female: a corona of stout setae at the apex of the papilla analis and a large appendix bursae that functionally replaces the absent or small corpus bursae. The genus is diverse, and these structures are lost or modified in some species-groups. Most species have a claw-like foretibial seta, an adaptation to living in arid climates.

Male structures of *Sympistis* were not defined specifically by Troubridge other than noting that they are more uniform than those of the females. Typically, they have a simple strap-like valve with a weak sacculus. Most species-groups have a scoop-shaped distal valve lacking a differentiated cucullus but bearing a setal corona; the distal valve is bifurcated asymmetrically in the *Sympistis badistriga* species-group. The base of the clasper is weak, but a thorn-like ampulla variably positioned along the ventral valve is a prominent feature in all species-groups. The digitus is lacking except in the *Sympistis fortis* and *Sympistis chionanti* species-groups. The phallus is tubular with a bent or spiraled vesica bearing one or more elongate patches of spine-like cornuti, often with a single stout cornutus or patch of longer cornuti at the apex.

***Sympistis ferrirena* Crabo, sp. n.**

<http://zoobank.org/89FFD7D1-14EC-4897-8FFB-134A68505ED9>

Figs 25, 26, 29, 31, 48

Type locality. USA, Arizona, Cochise County, 31°55.07'N, 109°16.54'W, 2530 m.

Type specimens. Holotype, male. [USA], Arizona, Cochise County, 31°55.07'N, 109°16.54'W, 8300' [2530 m], 18 VIII 2009, C. D. Ferris leg. / Database # CNCLEP 00080368 / Barcodes of LIFE Project Leg removed DNA extracted. CNC. **Paratypes.** 2 males, 3 females. **USA: Arizona:** Cochise County: Same data as holotype / Database # CNCLEP 00080369 / Barcodes of LIFE Project Leg removed DNA extracted. (1 m); Graham County: Pinaleno Mountains, Grant Creek, 8,800 ft (2682 m), 12 VII 2005, B. Walsh leg., UV light trap, Mountain stream (1 f); **New Mexico:** [Colfax County]: Sangre de Cristo Mts., Cimarron Canyon, 7900' [2408 m], 9 VII 1962, E. & I. Munroe / CNC / Genitalia slide By RS USNM 43,457 (1 m); same locality & collectors, 10 VII 1962 / Genitalia slide By RS USNM 43,458; Otero County: High Rolls, Karr Canyon, 32.898°, -105.813°, 2400 m, 9 VI 2016, L. G. Crabo leg. (1 f). CNC, LGC, TM.

Differential diagnosis. *Sympistis ferrirena* (Figs 25, 26) resembles *S. dunbari* (Figure 27) and *S. definitiva* (Figure 28). *Sympistis definitiva* occurs predominantly in the Great Basin and Colorado but has been collected with *S. ferrirena* in Arizona. *Sympistis dunbari* occurs west of *S. ferrirena* near the West Coast. *Sympistis ferrirena* is slightly larger (forewing length greater than 14 mm in *S. ferrirena*, less in the other two species) and can be distinguished by its smooth thick black transverse lines and large reniform stigma with brick-red filling. The antemedial and postmedial lines of *S. ferrirena* are straight or curved smoothly from the cubital vein to the posterior margin and lack an outer black component. The corresponding lines of *S. dunbari* and *S. definitiva* are toothed on the veins and double with two black components. The reniform stigmata of these species are smaller and contain fewer reddish scales than that of *S. ferrirena*.

The male genitalia of *S. ferrirena* (Figure 29) and *S. definitiva* (Figure 30) are similar. The distal valve of *S. ferrirena* tapers more than that of *S. definitiva*. The sacculus of *S. ferrirena* is narrower relative to valve length: 0.10 × compared to 0.16 × for *S. definitiva*. The anterior (concave surface) cornuti on the vesica of *S. ferrirena* are longer and much stouter than those of the posterior patch; this distinction is less dramatic in *S. definitiva*.

The female corpus bursae and appendix bursae of *S. ferrirena* (Figure 31) are similar in size and shape. In *S. dunbari* and *S. definitiva* the appendix bursae is smaller and more curved than in *S. ferrirena*.

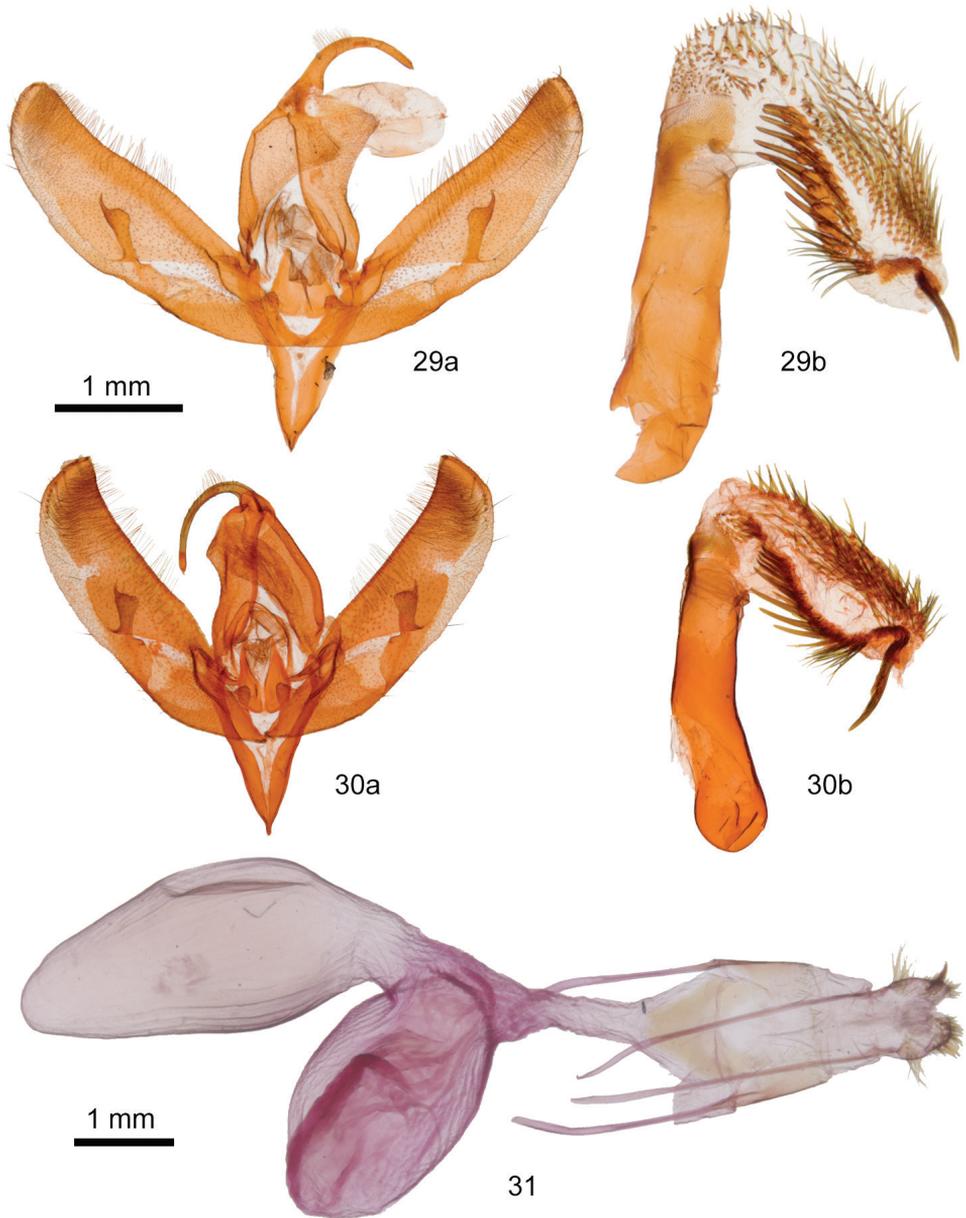
The DNA barcode of *S. ferrirena* (BOLD:AAU2696; $n = 3$) differs from those of *S. dunbari* (BOLD:AAE1138) and *S. definitiva* (BOLD:AAE5103) by at least 4.0 %.

Description. Adults. Males and females similar in size and habitus. **Head.** Antenna filiform, venter densely pubescent, segments with single short anterior and posterior seta, dorsal scales sparse, gray. Scape untufted, scales even length, black or white. Eye normal, adjacent scales except near palpus long, lashlike, dark



Figures 25–28. *Sympistis* adults. **25** *S. ferrirena*, holotype male, USA, Arizona, Cochise County, 31°55.07'N, -109°16.54'W **26** *S. ferrirena*, female, USA, New Mexico, High Rolls, Karr Canyon **27** *S. dunbari*, female, USA, Washington, Whatcom County, W slope Chuckanut Mountain above Chuckanut Bay **28** *S. definitiva*, female, USA, Oregon, Harney County, Catlow Rim.

gray. Labial palpus scales mixed black and gray; flat laterally, long hair-like anteriorly; third segment length $0.3 \times$ second segment, scales very short. Haustellum normal. Frons flat, scales short, mixed gray and off-white. Dorsal head scales narrow, bifurcate, mixed gray, white, and white tipped black; weak paramedian tufts anterior and dorsal to antenna. *Thorax*. Patagium scales mixed black, white, and white tipped light gray, truncate, fine toothed; dorsum appearing medium gray with black and light gray transverse stripes; tegula and dorsum scales mixed black- and white-tipped medium gray strap-like and black hair-like; appearing hoary with black-edged tegula and black weak metathoracic median tuft. Ventral thorax lighter gray, scales hairlike. *Legs*: Distal foretibia with claw-like seta over basitarsus; mid- and hindtibia lacking stout setae; scales spatulate, mixed gray, black, and white. Tarsal segments except distal segment with three rows of ventral spiniform setae, scales mixed black and gray, distal ring irregular, white. *Wings*: Forewing: Length 14.0–15.5 mm; length $2.0\text{--}2.1 \times$ width, apex not pointed strongly, outer margin scalloped weakly, nearly straight from apex to CuA2, then curved slightly to trailing margin; dorsal scales mixed white, medium gray, dark gray, black, and dark umber, appearing hoary; basal line black, thin except tooth distad on R, curved to end at wing base on Cu; antemedial line light gray inner, thick black outer components, gull wing shape, apex basad on Cu; medial line black, thick, blurred, angled distad from mid-costa to orbicular and reniform stigmata; postmedial line components black inner, thinner than antemedial and medial lines, pale gray outer, costal ori-



Figures 29–31. *Sympistis* genitalia. **29** *S. ferrirena*, male **a** valves **b** phallus with everted vesica **30** *S. definita*, male **a** valves **b** phallus with everted vesica **31** *S. ferrirena*, female.

gin near medial line, quadrate distad around reniform stigma, crossing posterior stigma, bent sharply caudad medial stigma to margin near medial line; postmedial line whitish gray irregular chevrons, preceded by long, thin dark, gray, intervenal wedges; terminal area diffuse black spots near costa and CuA2; terminal line black, thickest between veins; fringe scales mixed white and pale base dark gray; stigmata

black lined with pale gray; claviform stigma reduced to curved black tip; orbicular stigma oval, moderately large, filling whitish gray, center slightly darker; reniform stigma ovoid, moderately large, weakly kidney shaped, thickest medially, filling diffuse, rust red. Hindwing: Outer margin straight from Rs to bend between M3 and CuA1, thence straight to anal angle; dorsum whitish gray, slightly opalescent, margin suffused medium gray; veins, discal spot, terminal line darker gray; fringe white, base striped yellow and gray. *Abdomen*. Scales flat, hair-like, medium gray; no tufts. Male with hair-like coremata from rugose patch at end of sclerotized band in membrane lateral to sternite A1. *Male genitalia*: Tegumen widest lateral to uncus base. Uncus thin, cross-section triangular, arced, tip acute. Juxta triangular, apex notched at phallus base, height $1 \times$ width. Valve straplike, widest mesially, tapered slightly to both ends, length $3.6 \times$ width, cucullus convex, lacking “neck,” corona of ~ 20 claw-like setae; sacculus $0.5 \times$ length, $0.36 \times$ width of valve, width nearly even except slight broadening at base and dorsal notch near clasper ampulla; clasper base weak, ampulla origin at mid-valve near ventral margin, directed dorsad and 45° distad, length $0.7 \times$ valve width, straight, clubbed with rounded apex bearing cluster of small setae and thorn-like extension from lateral side; digitus absent. Phallus tubular, length $4.2 \times$ width. Vesica $0.8 \times$ phallus length, straight beyond basal 135° ventral bend; bearing stout apical cornutus $0.25 \times$ phallus length, long broad band from dorsal distal phallus to posteroventral apex of innumerable cornuti, lengthening gradually from short, spike-like at base to quill-like distally, slightly smaller patch on rostradorsal mid- to distal vesica of fewer, ~ 40 , longer, stouter cornuti in parallel rows, and an apical tuft of thinner similar-length cornuti. *Female genitalia*: Papilla analis blunt tipped, trapezoidal, length $1 \times$ basal width, covered moderately densely with fine hair-like setae, densest apically, longest basally; subapical “corona” loose double row of uneven stout, blunt spike-like setae curved slightly away from midline, longest $6 \times$ as long as wide. Segment A8 width $1.5 \times$ length, sparse very fine hair-like setae densest and longest at posterior and inferomedial margins. Posterior apophysis length $3.5 \times$ segment A8; anterior apophysis length $0.7 \times$ posterior apophysis. Ductus bursae length $2.5 \times$ segment A8 length; ostium bursae width $0.67 \times$ segment A8 width, ventral margin sclerotized lightly; posterior $\frac{1}{3}$ ductus bursae triangular, tapered anteriorly, anterior segment membranous, tubular. Corpus bursae bisaccate, U-shaped, length $5 \times$ segment A8 length, main part midline, posterior $\frac{1}{3}$ tubular with broad attachment to appendix bursae on right, anterior ovate, length $2 \times$ width; appendix bursae length $0.6 \times$, width $1 \times$ corpus bursae, elongate, ovate, base perpendicular to corpus bursae, distal $\frac{1}{3}$ bent 90° ventrad, ductus seminalis slightly proximal to posterior apex.

Etymology. The name is from the Latin *ferrum*, meaning iron, and *renis*, meaning kidney. It refers to the prominent rust-red filling of the reniform stigma of this moth.

Distribution and ecology. *Sympistis ferrirena* occurs in Arizona and New Mexico (Figure 48). It has been collected at middle to high elevations within a limited range between 2400 and 2700 meters. The habitat is mixed forest.

The flight period of adults is from June to July. Like most temperate species in the genus, it is nocturnal and comes to light. The early stages are unknown.

Noctuinae Latreille**Xylenini Guenée, 1837****Xylenina Guenée, 1837*****Aseptis* McDunnough, 1937**

Mustelin and Crabo (2015) revised the genus *Aseptis* McDunnough. It contains 16 species from the United States and northern Mexico west of the Great Plains, with the greatest diversity in California. *Aseptis* species occur most commonly in steppe, desert, or shrub habitats.

Most *Aseptis* species are fairly nondescript, medium-sized (wingspan 27.5–45.0 mm), gray or gray-brown moths. Despite their dull appearance they can usually be identified as belonging to the genus by the combination of eyes devoid of setae and the presence of a concave segment of the hindwing margin between veins M1 and M3. Many *Aseptis* species, including the one described herein, have a pale postreniform patch distal to the reniform stigma that is more conspicuous than the stigma.

Structural features of the genus are detailed in the revision. Males have a thin curved uncus, a strap-like valve with weak sacculus, simple curved ampulla of the clasper, a thin pointed digitus oblique to the valve, and a weak cucullus bearing a simple corona. The vesica of the phallus is bulbous with a stout distal cornutus directed basad. Females have a triangular papilla analis, a membranous ductus bursae, and a bilobed corpus bursae with a sack-like or weakly bilobed appendix bursae.

A key to *Aseptis* adults was presented in Mustelin and Crabo (2015: 62–65). Males of *A. harpi* sp. n. will key out to Couplet 11 and females to Couplet 21. In order to include all *Aseptis* species the key can be modified by replacing those couplets with the following:

- 11 Claviform stigma short, not extending distal to mid-medial area; subterminal line ochre to tan, undulating, not extended on veins; widespread in western North America.....***A. binotata***
- Claviform stigma long, nearly reaching postmedial line; subterminal line with whitish W-marks to margin below apex and on veins M3 and CuA1; Arizona, California, Utah..... **11a**
- 11a Forewing postmedial line posterior to reniform stigma faint, when visible filled with similar color as adjacent medial and postmedial areas; digitus of male valve oriented 50° to valve; Arizona and California.....***A. susquesa***
- Postmedial line prominent below reniform stigma, filling whitish, paler than adjacent areas; digitus oriented 30° to valve; Utah.....***A. harpi***
- 21 Apex of papilla with a thin sclerotized flange; dorsal forewing ground color dull brown; California***A. perfumosa***
- Dorsal papilla with or without apical small tooth-like process; if present, forewing not dull brown; multiple western states, including California..... **21a**
- 21a Papilla analis with small apical tooth-like projection AND dorsal forewing mottled gray and orange brown; Utah.....***A. harpi***
- Papilla with or without tooth; if present, forewing not gray and orange brown; multiple western states including Utah **22**

***Aseptis harpi* Crabo & Mustelin, sp. n.**

<http://zoobank.org/2F4866F8-6768-40B5-AFF3-C7426A2A6813>

Figs 32, 35, 38, 48

Type locality. USA, Utah, San Juan County, 1.6 km north of Bluff, 1336 m.

Type material. Holotype. Male. [USA], Utah, San Juan County, 37.2940°N -109.5656°W, 1 mi. [1.6 km] N Bluff, W. 3rd St. above Cottonwood Crk., *Ericameria atriplex* hab[itat], 13 May, 2016, 4382' [1336 m.] elev., Chuck Harp / Specimen ID CNCLEP00140353 / Barcodes of Life Project, Leg removed, DNA extracted. CNC.

Paratypes. 14 males. **USA: Utah,** Emery County: NW of Goblin Valley S[tate] P[ark], San Rafael Desert, 15–16 V 2007, at uv trap, pinyon-juniper desert shrub, 5300' [1615 m] elev., 38.6677°, -110.6293°, Chuck Harp leg. (1 m); Garfield County: Capitol Reef N[ational] P[ark], Pickaboo R[a]ng[e]. St[atio]n., 2 VI 1994, M[ercury] V[apor] L[ight], P. A. Opler [leg.], / [CNC] Slide male No. 11,942 / Specimen ID CNCLEP00140316 / Barcodes of Life Project, Leg removed, DNA extracted (1 m); San Juan County: same locality, date, & collector as holotype / Specimen ID CNCLEP00140354 / Barcodes of Life Project, Leg removed, DNA extracted (1 m); same locality, date, & collector as holotype (8 m); same locality & collector as holotype, 22–23 V 2017, taken at blacklight, blackbrush/*Ericameria atriplex* (5 m, 1 f). CH, CNC, CSUC, DNHC, LGC, TM.

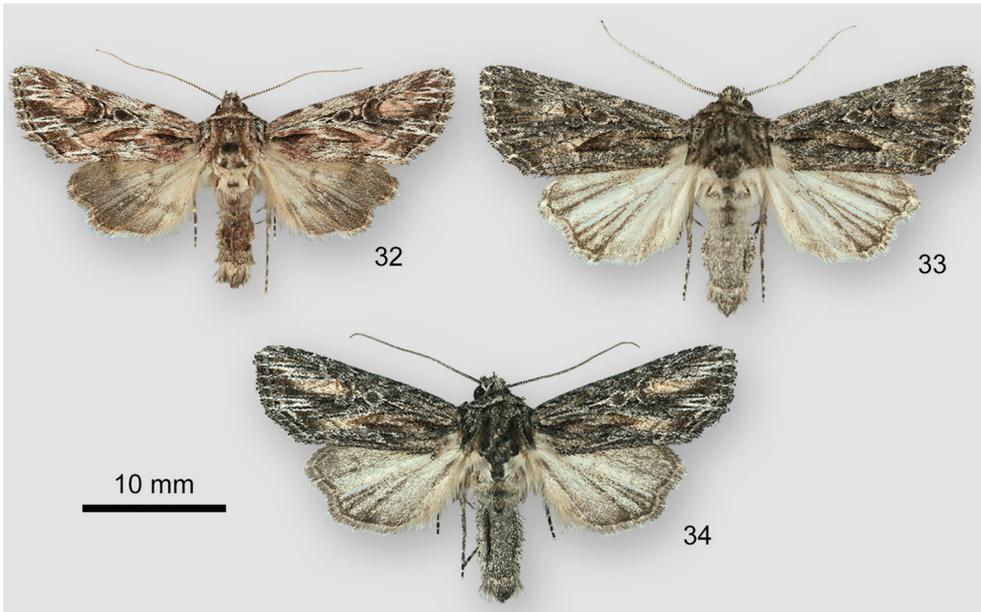
Differential diagnosis. *Aseptis harpi* (Figure 32) is most likely to be confused with *Aseptis serrula* (Barnes and McDunnough, 1918) (Figure 33) and *Aseptis susquesa* (Smith, 1908) (Figure 34). Both of these similar species are from the deserts of southern California, southern Nevada, and Arizona. Although neither species is known currently from Utah, they could potentially occur with *A. harpi* near the Arizona-Utah border.

DNA barcodes suggest that *A. serrula* is the closest relative to *A. harpi*. Males are distinguished easily because the antenna of *A. harpi* is filiform, whereas that of *A. serrula* is serrate. *Aseptis harpi* has a lighter, more mottled, and more colorful forewing than *A. serrula*, with patches of pale gray and orange tan rather than powdery dark gray. The hindwing of *A. harpi* is gray distal to the postmedial line, whereas the entire hindwing of *A. serrula* is whitish.

Superficially, *Aseptis harpi* most closely resembles *Aseptis susquesa*. Both species have narrow male antennae and forewings with patches of orange brown. The forewing spots and postmedial and subterminal lines of *A. harpi* are more sharply defined and conspicuous than in *A. susquesa*. Pale filling of the postmedial line and whitish “W” marks of the subterminal line on veins below the apex and on M3 and CuA1 are particularly prominent in *A. harpi*. Hindwing color differences between these species are similar to those between *A. harpi* and *A. serrula*.

The male genitalia of *A. harpi* (Figure 35), *A. serrula* (Figure 36), and *A. susquesa* (Figure 37) are similar. The angle between the digitus and the valve is narrower in *A. harpi* than in the others, approximately 30° in *A. harpi* compared to nearly 50° in the other species. The digitus of *A. harpi* extends a shorter distance below the valve than in the other species.

Females of can be identified by characters of the papillae anales. The papilla analis of *Aseptis harpi* (Figure 38) has a single short apical process and lacks long basal setae.



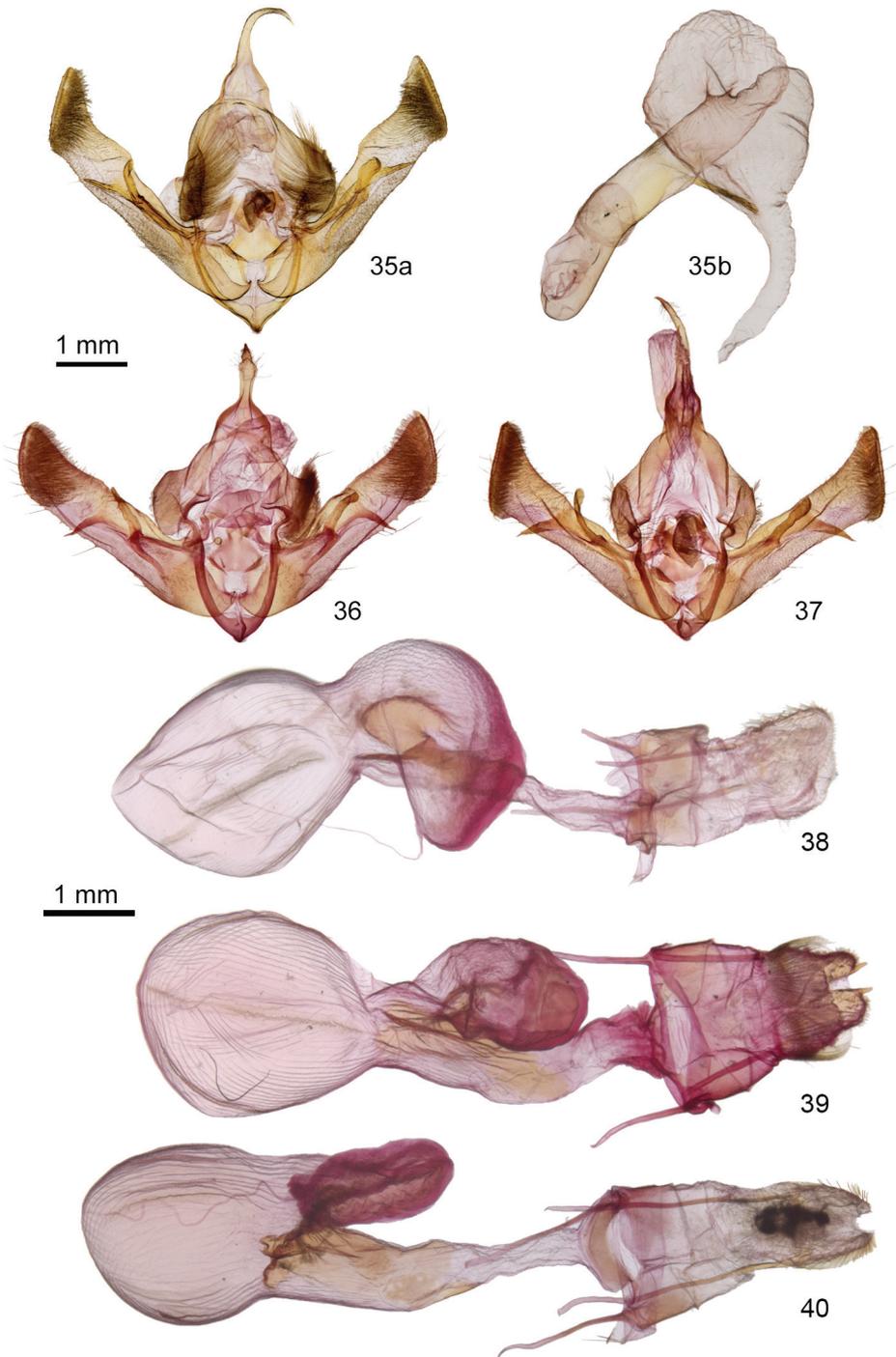
Figures 32–34. *Aseptis* adults. **32** *A. harpi*, male, USA, Utah, San Juan County, 1.6 km N of Bluff, **33** *A. serrula* male, USA, Arizona, Maricopa County, Cave Creek **34** *A. susquesa*, male, USA, Arizona, Mohave County, Wikieup 9 km WSW.

That of *Aseptis serrula* (Figure 39) has a finger-like apical process with adjacent scale-like tubercles and a dense basal collar of long setae. *Aseptis susquesa* (Figure 40) lacks an apical process and has few very long setae at the base. The appendix bursae of *A. harpi* is longer than those of the other two species.

The barcode of *A. harpi* (BOLD:ADH0685; $n = 2$) differs from those of *A. serrula* and *A. susquesa* by approximately 5%. *Aseptis harpi* and *A. serrula* form a sister pair closest to *Aseptis catalina* (Smith) on a similarity tree. Major haplotypes of other *Aseptis* species are listed in Mustelin and Crabo (2015: 59–60).

Description. Adult. Males and females similar in habitus. *Head.* Antenna filiform, ventral male antenna densely setose; dorsal segments barred, scales gray, pale yellowish tan. Scape off-white. Eye normal. Haustellum normal. Labial palpus first and second segments similar, third segment short, porrect; scales short, off-white and gray. Frons smooth; scales strap-like, off-white on lower $\frac{2}{3}$, mixed off-white and gray on dorsal $\frac{1}{3}$, forming slight median ridge. Dorsal head scales longer, strap-like, mixed off-white and gray, sculpted weakly anteriorly and on vertex. *Thorax.* Dorsal scales longer and broader than on head, weakly spatulate, edges finely serrate, mixed tan, off-white, gray, glossy black; appearing powdery brownish tan with irregular dark and light bands on patagium and tegula, metathorax with weak dark tufts. *Venter* scales white and gray. *Legs:* Tibiae lacking spines, scales mixed gray, off-white, darker than venter; tarsi except apical segment with three irregular rows of spine-like setae, gray, off-white distally. *Wings:* Forewing: length 12.5–13.0 mm (males); 14.5 mm (female), length $2.25 \times$ width, apex more pointed than in other *Aseptis*

species, outer margin angled slightly on vein M3; dorsal scales three- and four-toothed, white, light yellow, tan, orange tan, light brown, dark brown, or black; appearing mottled gray brown with light orange brown postreniform patch and in fold near claviform stigma; veins thin, black, terminal R5, M1, M3, CuA1, A1+2 lined on each side with whitish scales; basal line a long dark spot on costa; antemedial line a dark spot on costa, pale posterior to cell, strongly convex on 1A+2A; medial line brown, indistinct, costa to reniform stigma; postmedial double, dark and light spots on costa, faint dark lines across postreniform patch, double dark lines with whitish filling from M3 to posterior margin, angled 45° distad from costa, bent 90° basad on M2 to posterior margin; subterminal line absent; terminal line black, absent at apex; fringe dark gray, base yellow, light checkering at veins; basal dash black, acute, to antemedial line; claviform stigma black, base broad, tip to distal medial area, acute, filling same as adjacent ground; orbicular stigma elongate, oval, thin, black, double, pale gray between lines, black centrally; reniform stigma medium sized, asymmetrically kidney-shaped, largest posteriorly, thin, black, double, filling between lines light gray basally, orange brown distally, center dull black. Hindwing: margin undulating, concave strongly M1–M3 and weakly CuA2–2A; dorsum light gray tan, darker fuscous distal to postmedial line except at inner margin; discal spot and postmedial line slightly darker gray, postmedial line indistinct, undulating; fringe orange brown, edge whitish. *Abdomen*. Male base with brush-like coremata and pockets; scales fuscous; weak median dorsal tufts on segments A1–A3. *Male genitalia*: Uncus slightly flattened at base, cylindrical distally, arced, acute tip hooked slightly downward. Tegumen with broad penicillus lobes. Juxta base broad, narrowing toward base of phallus, height 0.8 × width. Valve length 5.25 × width, strap-like, mid-portion slightly wider due to costa bulge; sacculus small, weak, 0.25 × valve length, 0.8 × width; clasper base weak, ampulla 1 × valve width, rod-like, apex blunt, origin at mesial mid-valve, base directed dorsad and 45° distad, arced with distal portion parallel to dorsal valve; digitus base near ampulla, directed distad and 30° caudal, length 0.9 × valve width, straight, narrow, acute, apex just caudal to valve margin; cucullus 1.75 × valve width, asymmetric, apex elongate, pointed bluntly, anal angle rounded, “neck” weak, corona single row of ~ 30 claw-like setae, longest near apex. Phallus cylindrical, length 4.5 × width. Vesica ~ 1.5 × phallus length, expanding gradually to 2 × width beyond mid-point, curved 180° to end ventral and slightly left of mid-phallus; sub-apex with broad dome-shaped diverticulum and prostrate, rodlike, basally-directed cornutus 0.5 × phallus length opposite diverticulum. *Female genitalia*: Papilla analis truncate, longest dorsally, very small tooth-like process at medial dorsal tip, sparse short hair-like setae densest on dorsum and apex, longest basally without dense “corona.” Posterior apophysis length 2.5 × segment A8; anterior apophysis 0.8 × posterior apophysis. Segment A8 length 0.67 × width, glabrous. Ostium bursae membranous, ventral lip sclerotized, band-like; ductus bursae length 4.5 × segment A8, tubular, posterior 2/3 membranous, anterior 1/3 sclerotized except membranous anterior ventral and right sides; corpus bursae 5 × segment A8 length, ovoid, width 0.6 × length, long signa evenly spaced on anterior, posterior, and lateral sides; appendix bursae length ~ 1 × corpus bursae length, narrower, projecting slightly leftward from origin dorsal to junction with ductus bursae, curved to end ventral and to left of ductus-corporis junction; ductus seminalis at anterior apex.



Figures 35–40. *Aseptis* male and female genitalia. **35** *A. harpi* **a** valves **b** phallus with everted vesica **36** *A. susquesa*, male, valves **37** *A. serrula*, male, valves **38** *A. harpi* female **39** *A. serrula* female **40** *A. susquesa* female.

Etymology. The eponym honors Chuck Harp of Littleton, Colorado who recognized this moth as an undescribed species and brought it to our attention. Most of the known specimens of this species have been collected by him.

Distribution and ecology. *Aseptis harpi* has a limited range in eastern and southeastern Utah (Figure 48). It has been collected in the red rock country of Garfield, Grand, and San Juan counties. The habitat is shrub steppe. Collection dates are from May and early June.

The early stages are unknown. The larva is probably a climbing cutworm that feeds on woody shrubs based on the habits of other *Aseptis* species (Mustelin and Crabo 2015).

Discussion. The discovery of this species is a surprise to us since we revised *Aseptis* recently (Mustelin and Crabo 2015). No new species were recognized at the time, although two new genera were described and the number of recognized species was reduced significantly.

Eriopygini Fibiger & Lafontaine, 2005

Hypotrix Guenée, 1852

Hypotrix Guenée is a moderately large genus of New World moths distributed from the American Southwest to South America. The thirteen previously known species in the United States were revised less than a decade ago (Lafontaine et al. 2010). The genus is diverse, both in external appearance and structure, and is difficult to define concisely. The most diagnostic character is the female papilla analis, swollen basally with rapid taper to a point. The eye is covered with hairs similar those of most genera in the Eriopygini. Tibial spines are variable between species. Males often have brushes on sternites A1 and A8. The uncus is expanded. The distal valve has either a triangular cucullus demarcated from the valve by a ventral notch and bearing a corona and ventral spine, or has a reduced cucullus with a vestigial or absent corona. The sacculus has a sclerotized ventral part and a membranous ventral flap that overlaps adjacent structures. The vesica of the phallus is long, coiled, and bears several groups of cornuti. In addition to the distinct papilla analis, the female has a sclerotized tubular ductus bursae, a membranous bulbous corpus bursae, and a long spiraled appendix bursae (op. cit.).

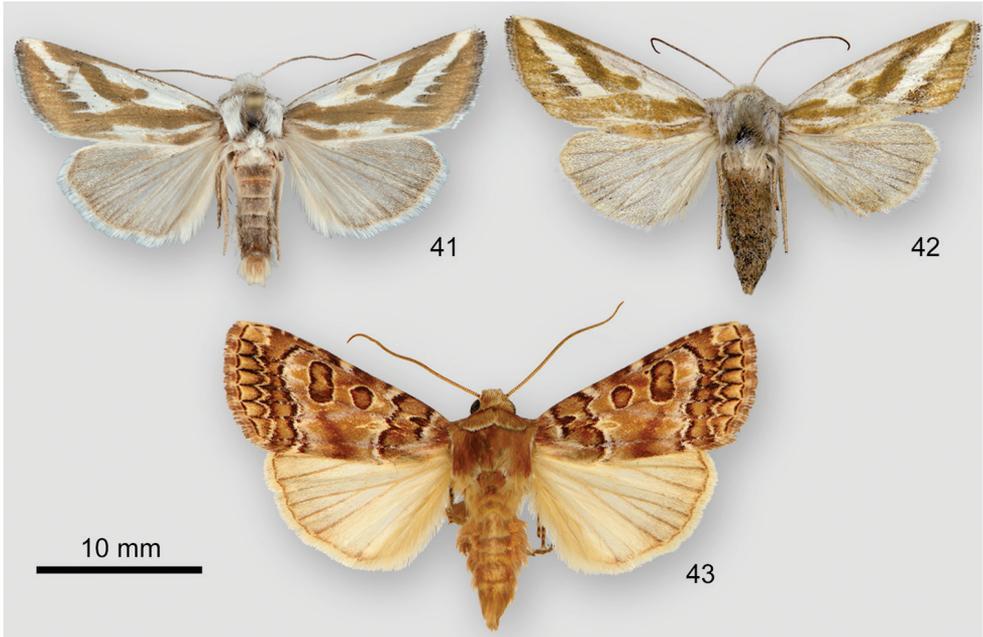
A fourteenth American *Hypotrix* species from Arizona is described below. This moth, although similar structurally to *Hypotrix hueco* (Barnes, 1904), is strikingly patterned olive green and pure white, unlike any other species in the genus.

Hypotrix lactomellis Wikle & Crabo, sp. n.

<http://zoobank.org/DFE33E03-F671-464C-B583-EE44739C8874>

Figs 41, 42, 44, 46, 49

Type locality. USA, Arizona, Apache County, White Mountains, Whiting Knoll, FR117, 2766 m.



Figures 41–43. *Hypotrix* adults. **41** *H. lactomellis*, male, USA, Arizona, Apache County, Eagar, 11.1 km W, South Fork Road at Little Colorado River **42** *H. lactomellis*, female, USA, Arizona, Apache County, White Mountains, South Fork Road **43** *H. hueco*, male, USA, Arizona, Cochise County, Huachuca Mountains, Ash Canyon.

Type specimens. Holotype, male. USA, Arizona, Apache County, White Mts, Whiting Knoll, FR117, 34°9.580'N, 109°34.516'W, elev. 9075' [2766 m], 6 VII 2007, MV, leg. D.L. Wikle. CNC. **Paratypes:** 47 males, 12 females. **Mexico: Coah[UILA]:** nr. Jame, 33 mi [53.1 km] S.E. Saltillo, 7500' [2286 m], 18 VII [19]63, H. and A. Howden / Database # CNC LEP 00094171 / Genitalia CNC slide 16649 male (1 m); **USA: Arizona:** Apache County: Eagar, 6.9 mi [11.1 km] W, South Fork Rd @ Little Colorado [River], 34°05'19.5"N, -109°24'48.76"W, 22–23 VII [20]12, Leg. M. L. Raschko. Light trap (2 m, 1 f); Greer, 20 VI 1986, R. & J, Robertson / Database # CNC LEP 00031876 / Genitalia CNC slide # 16650 male (1 m); Greer, 33°59'50.88"N 109°27'50.73"W, elev. 8450' [2576 m], 3 VII 2013, Leg E. Rand (1 f); same locality & collector, 18 VII 2013 (2 m); White Mts., South Fork Rd., 34°5.371'N, -109°24.599'W, elev 7370' [2246 m], 22 VII 2012, to B[lack]L[ight], M. Raschko leg. (12 m 4 f); same locality, date, & collector, DLWC11043 PARATYPE female / Specimen ID CNCLEP 00113790 / Barcodes of Life Project, Leg removed, DNA extracted / Genitalia CNC slide # 17432 female (1 f); same locality, date, & collector / Specimen ID CNCLEP 00140416 / Genitalia CNC slide 17433 female (1 f); same locality, date, & collector, DLWC11038 PARATYPE male / Specimen ID CNCLEP 00140415 (1 m); same locality, date, & collector, DLWC 11043 PARATYPE female / Database # CNCLEP 00113790 / Barcodes of Life Project, Leg removed, DNA extracted / Genitalia CNC slide # 17805 female

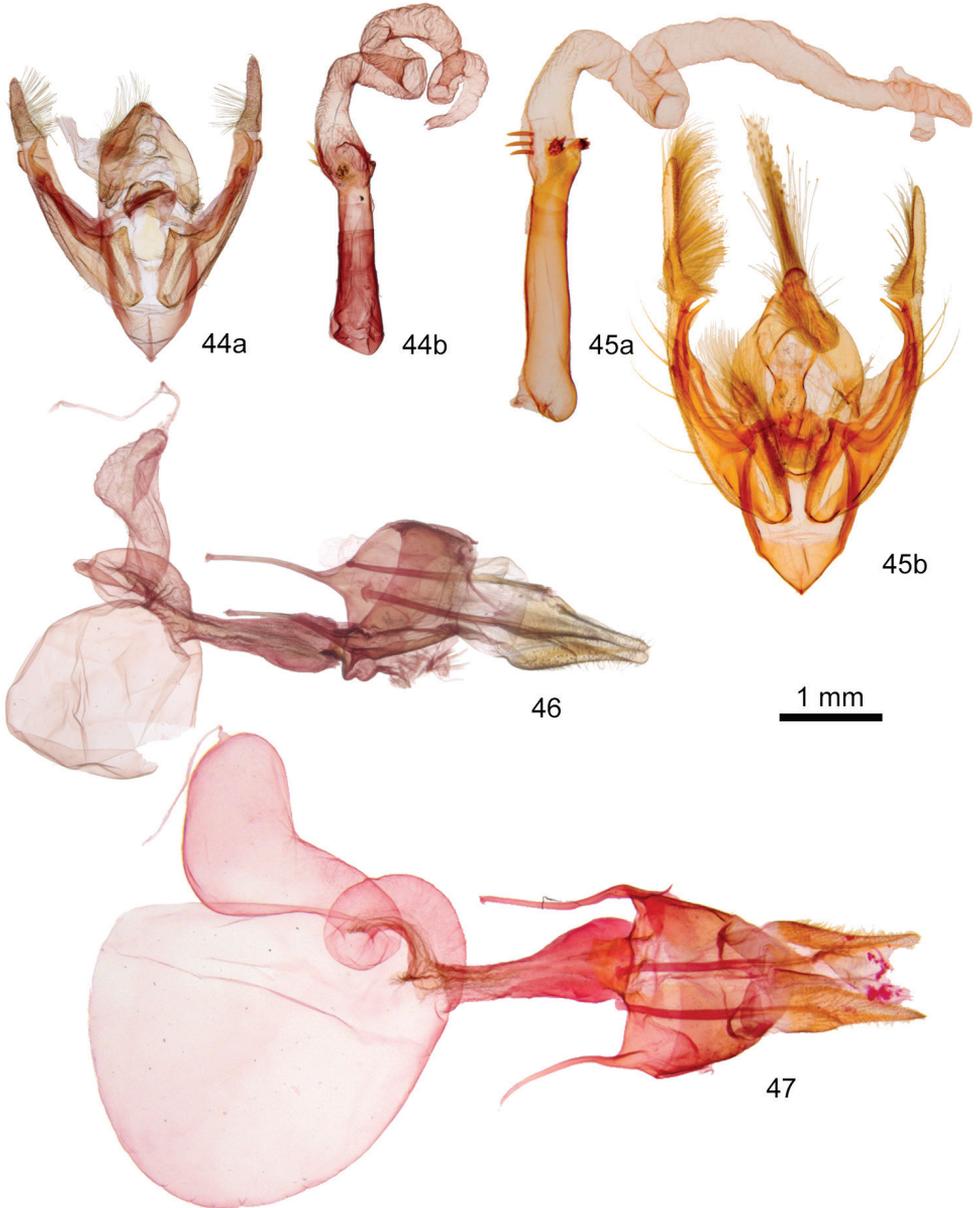
(1 f); Little Colo[rado] R[iver], South Fork Rd, 34°5.371'N, 109°24.599'W, elev. 7370' [2246 m], 25 VII 2013, to BL, leg. D.L. Wikle (1m 2f); South Fork of Little Colorado River, 34°05'19.82"N, 109°24'39.43"W, elev. 7360' [2243 m], 19 VII 2013, Leg E. Rand (2 m); same locality & collector, 28 VI 2014 (4m 1f); Same data as holotype (3 m); White Mts, 3 mi [4.8 km] S Water Cyn, 34°3.976'N, 109°17.571'W, elev. 7500' [2286 m], BL, 22 VII 2012, leg. M. Raschko (1 m); Benny Creek, 34°02'27.16"N, 109°27'25.69"W, elev. 8250' [2515 m], 21 VI 2017, Leg E. Rand (20 m); **New Mexico:** Catron County: Quemado, 8 mi. [12.9 km] S., 27 VI 1987, elev. 7200' [2195 m], Acc. #1117, P.M. Jump (1 m). CNC, DLW, ER LGC, MLR.

Differential diagnosis. *Hypotrix lactomellis* sp. n. (Figs 41, 42) is a distinctive moth. No other species in the tribe Eriopygini has a similar olive and pure white forewing. It is more likely be confused with a *Schinia* Hübner (Heliothinae), such as the silver and olive-gray species allied to *Schinia cumatilis* (Grote), or a species of Acontiinae. The eye of *Hypotrix* is hairy, lacking hairs in these look-alikes.

Structurally, *H. lactomellis* is most similar to *Hypotrix hueco* (Figs 43, 45, 47). Despite the close relationship suggested by the genitalia, these moths could not be more un-alike in appearance. *Hypotrix hueco* is mottled red brown like many moths from pine forest habitats.

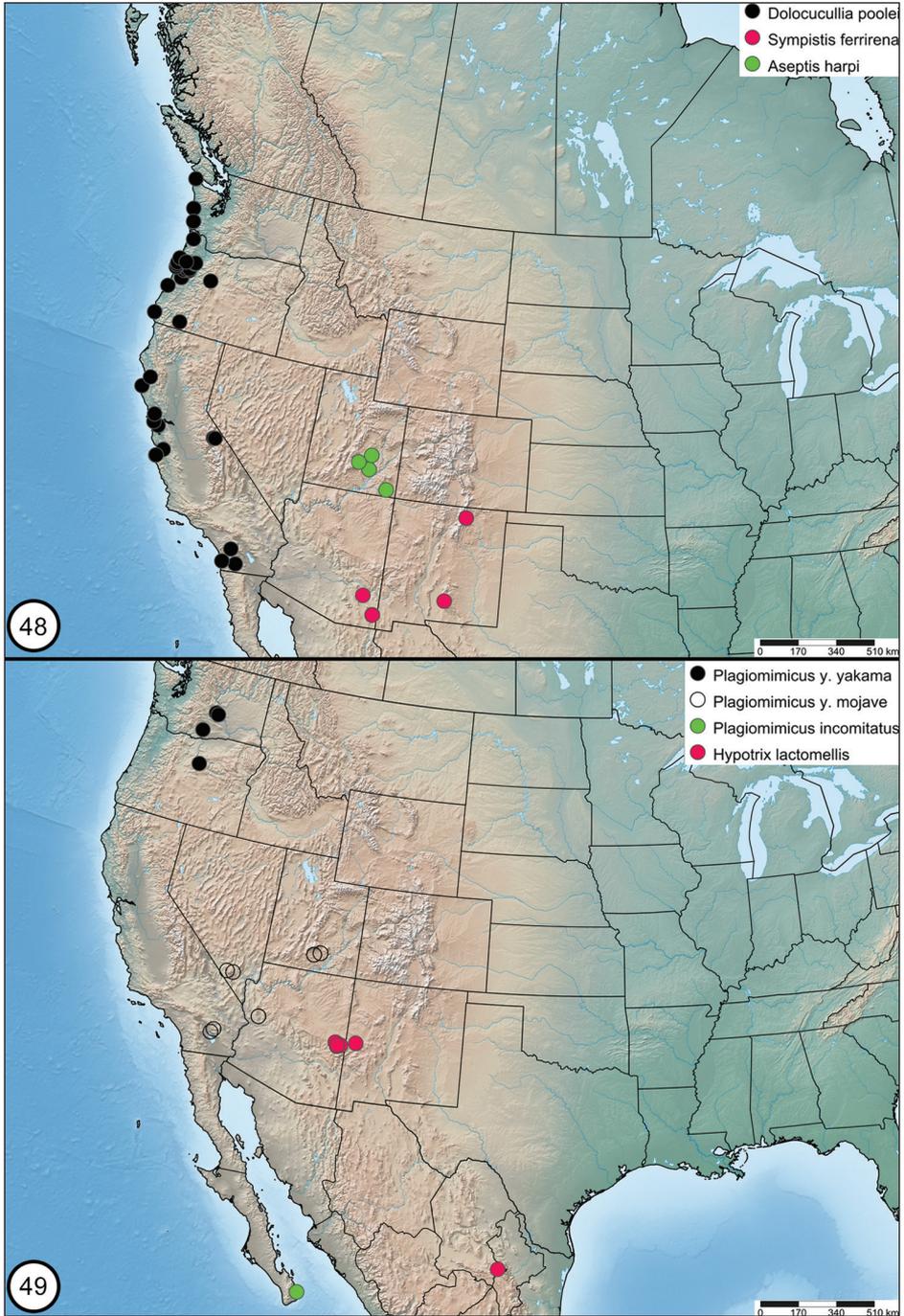
The barcode of *H. lactomellis* (BOLD:ACO7143) is most similar to that of *H. hueco* (BOLD:AAI8440), differing by 4.5 %.

Description. Adults. Males and females similar in habitus. *Head.* Male antenna filiform, ventral surface densely setose; female antenna with fewer setae; dorsal scales off-white, light gray basally. Scape white. Eye normal size, interfacetal setae short, adjacent scales light gray, few hair-like black. Labial palpus scales white, gray, darkest distally, flat on sides, hair-like anteriorly. Haustellum normal. Frons rounded, scales off-white. Dorsal head scales hair-like, white. *Thorax.* Scales mixed hair-like and thin bifurcate; patagium olive off-white; tegula white, a few scales on central portion olive-tipped; central dorsum light olive; metathoracic tuft white, weak. *Legs:* Lateral tibiae lacking spines or other modifications. Tarsal segments except apical segment with 3 irregular rows of ventral spiniform setae. *Wings:* Forewing 12.0–13.0 mm (males), 12.5–13.0 mm (females), length 2.3 × width, apex pointed, outer margin nearly straight from apex to CuA2, then curved basad; dorsal scales mixed white, olive off-white, and olive; appearing uniform greenish olive patterned with white, transverse lines and spots contributing pattern borders but not discernable otherwise; three white areas: 1) Cell except fused olive orbicular and reniform stigmata, white extending to base as line on R; 2) Oblique even-width band from apex toward mid-posterior margin, ending at fold, white extending into postmedial area as lines on M2, M3, CuA1, CuA2; 3) Medial area posterior to fold, extending to base and into subterminal area on 1A+2A; claviform stigma absent; orbicular and reniform stigmas olive green, fused; orbicular stigma small, oval; reniform stigma elongate, weakly S-shaped, oblique, tilted and extended toward apex; fringe olive. *Hindwing:* Dorsum light tan gray, gradually darker gray to outer margin; veins and terminal line thin, gray; discal spot absent; fringe white, base light yellow. *Abdomen.* Scales mostly light tan flat or hairlike, weak white median tuft on dorsal segment A1. Male lacking



Figures 44–47. *Hypotrix* genitalia **44** *H. lactomellis*, male, **a** valves **b** phallus with everted vesica **45** *H. hueco*, male, **a** phallus with everted vesica **b** valves **46** *H. lactomellis*, female **47** *H. hueco*, female.

coremata, pockets, brushes. *Male genitalia*: Uncus base cylindrical, apex flattened to blunt rhomboid tip, $1.67 \times$ basal width, with slight dorsal median crest, distal half with long hair-like setae, shortest beneath tip. Juxta elongate shield shape, height $1.5 \times$ width. Valve length $3.4 \times$ basal width, tapered from base to apex, elongate triangular pointed cucullus demarcated by triangular notch in ventral valve margin, medial surface with



Figures 48–49. 48 Map of western North America showing distribution of examined material. *Dolocuccilia poolei* (black), *Sympistis ferrirena* (red), *Aseptis harpi* (green) 49 Map of western North America showing distribution of examined material. *Plagiomimicus y. yakama* (black dot), *Plagiomimicus yakama mojave* (black circle), *Plagiomimicus incomitatus* (green), *Hypotrix lactomellis* (red).

numerous hair-like setae, corona and spine absent; sacculus $0.6 \times$ valve length, mesial surface flaplike, overlapping clasper base; clasper base long, sclerotized, lacking defined dorsal and ventral divisions, ampulla oriented distad and slightly ventral to valve axis from origin just past mid-valve, horn shaped, curved to overlap digitus base to end at cucullus base; digitus directed ventrad from origin posterior to proximal ampulla, semi-circular, extending just ventral to valve. Phallus length $3.8 \times$ width, tubular, bent 30° ventrad, apex expanded slightly, ventral apex with patch of ~ 10 variable-length short spikes, dorsal apex crenulated. Vesica $\sim 2.5 \times$ phallus length, widened slightly at base, then tubular, coiled counter-clockwise slightly over 720° . *Female genitalia*: Papilla analis base dorsoventrally asymmetrical, ventral aspect extending proximal to dorsolateral attachment of apophysis, lateral base bulging laterally, distal $\frac{2}{3}$ of papilla tapered evenly to rounded point, ventral surface and entire apex with multiple similar-length hair-like setae. Segment A8 length $1 \times$ width, glabrous. Posterior apophysis $1.75 \times$ segment A8; anterior apophysis $0.7 \times$ posterior apophysis. Ostium bursae lightly sclerotized, funnel-shaped, slightly wider than posterior ductus bursae. Ductus bursae straight, length $1.5 \times$ segment A8, posterior $\frac{1}{2}$ leathery, $2 \times$ width of anterior $\frac{1}{2}$, tapered from ostium bursae to mid-ductus, anterior $\frac{1}{2}$ sclerotized, tubular. Corpus bursae anterior and ventral to ductus bursae, membranous, globose, length and width $1.2 \times$ ductus bursae length; appendix bursae directed ventrad from ductus bursae origin, moderately sclerotized, smooth, coiled 360° clockwise, coil strongest at base, ductus seminalis at tip.

Etymology. The species name is from Latin lacteus, meaning of milk, and mellis, honey. Milk and honey are suggested by the colors of the moth.

Distribution and ecology. *Hypotrix lactomellis* (Fig. 49) occurs in central eastern Arizona and adjacent New Mexico in the United States, with the majority of examined specimens from Arizona near the Little Colorado River. A single specimen at the CNC from the Sierra Madre Oriental in northeastern Mexico indicates that it is much more widespread than suggested by the United States records. It is a seldom-collected moth but can be common when encountered.

The flight period is late July. The early stages are unknown. Like other species in the genus, *H. lactomellis* is nocturnal and comes to light.

Discussion. The bicolored olive and white habitus of this moth is unusual. Although *Hypotrix* is highly diverse in color and pattern, illustrated in Lafontaine et al. (2010), this species is unlike any other in the genus. Although eye-catching in a museum specimen, the color and pattern might be cryptic against a plant with lacy silver green foliage, such as sage (*Artemisia* spp., Asteraceae).

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Mike Raschko provided information about *Hypotrix lactomellis* and donated specimens.

Merrill Peterson photographed adults and genitalia.

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Additions and corrections to the check list of the Noctuoidea (Insecta, Lepidoptera) of North America north of Mexico IV

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Abstract

A summary of all taxonomic and nomenclatural changes to the check list of the Noctuoidea of North America north of Mexico since the last update published in 2015 is provided. A total of 64 changes are listed and discussed, consisting of 26 recently published changes and additions, and an additional 38 presented herein. One stat. n., one stat. rev., six syn. n., and two comb. n. are proposed for the first time. *Orthimella* Schmidt & Lafontaine nom. n. is proposed here as an objective replacement name for *Himella* Grote, 1874 [Noctuinae: Orthosiini], a junior homonym of *Himella* Dallas, 1852 [Hemiptera: Coreidae].

Keywords

Canada, United States, Erebidae, Noctuidae, Nolidae

Introduction

Continuing work on the taxonomy and systematics of New World Noctuoidea has resulted in 64 additional changes to the check list of North American Noctuoidea (Lafontaine and Schmidt 2010). In terms of the North American fauna diversity, the

current work summarizes changes with 43 species-level taxa added and nine deleted for a net gain of 34. These are in addition to the 115 changes made in 2011 (Lafontaine and Schmidt 2011), and 64 made in 2013 (Lafontaine and Schmidt 2013), and the 124 made in 2015 (Lafontaine and Schmidt 2015). The new total for Noctuoidea in North America north of Mexico is 3706 species.

Repository abbreviations

Taxonomic changes are based on examination of material, especially type specimens, in the following collections:

AMNH	The American Museum of Natural History, New York, NY, USA
ANSP	The Academy of Natural Sciences, Philadelphia, Pennsylvania, USA
NHMUK	The Natural History Museum, London, UK
CNC	Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
CUIC	Cornell University Insect Collection, Ithaca, New York, USA
KBC	Knudson/Bordelon Collection at MCLB – McGuire Center for Lepidoptera and Biodiversity, University of Florida, Gainesville, FL, USA
MNHN	Muséum National d' Histoire Naturelle, Paris, France
MSU	Michigan State University, East Lansing, Michigan, USA
TLSRC	Texas Lepidoptera Survey Research Collection, Houston, Texas, USA
JTTC	James T. Troubridge Collection, Hagersville, Ontario, Canada
USNM	National Museum of Natural History [formerly, United States National Museum], Washington, District of Columbia, USA

Results

Corrections, additions, and changes (highlighted in bold)

930207.1 *Hypoprepia lampyroides* Palting & Ferguson, 2018

930215.1 *Clemensia umbrata* Packard, 1872

930216 *Clemensia ochracea* Schmidt & Sullivan, 2018

(= *Clemensia patella* of authors)

930233 – 930238 *Chelis* Rambur, 1866

(= *Holoarctia*, *Neoarctia*, *Hyperborea*)

930239 – 930277 *Apantesis*

(= *Holarctia*, *Grammia*, *Notarctia*)

930283 – 930289 *Arctia*

(= *Parasemia*, *Acerbia*, *Pararctia*, *Platarctia*, *Platyrepia*)

930299.1 *Virbia marginata* (Druce, 1885)

- 930409.1 *Euchaetes nancyae* Nagle & Schmidt, 2018
 930468.1 *Nyridela xanthocera* (Walker, 1856)
 930541.1 *Thursania lycimnia* (Druce, 1891)
 930589.1 *Hypena opulenta* (Christoph, 1877)
 930714.1 *Glympis holothermes* Hampson, 1926
 930723.1 *Nychioptera basipallida* Barnes & McDunnough, 1916
 930730 *Hyperstrotia villificans* (Barnes & McDunnough, 1918)
 930822.1 *Catocala ventura* Borth & Kons, 2016
 930829.1 *Catocala slotteni* Kons & Borth, 2016
 930834.1 *Catocala bastropi* Kons & Borth, 2017
 930887.1 *Bulia mexicana* (Behr, 1870)
 930913 *Drasteria howlandii* (Grote, 1865)
 syn. *D. tejonica* (Behr, 1870)
 930968.11 *Mimophisma forbesi* Schaus, 1940
 930969.1 *Tyrisa recurva* Walker, 1866
 931000.1 *Toxonprucha scitior* (Walker, 1865)
 931019 *Zale strigimacula* (Guenée, 1852)
 931020 Delete *Zale obsita* (Guenée, 1852)
 931071.1 *Eulepidotis merricki* (Holland, 1902)
 931143 *Nycteola columbiana* (H. Edwards, [1874])
 931273 Delete *Cobubatha ochrocraspis* Hampson, 1910
 931278 Delete *Cobubatha hippotes* (Druce, 1889)
 931290 *Protodeltote* Ueda, 1984
 931540.1 *Dolocucullia poolei* Crabo & Hammond, 2018
 931659.1 *Plagiomimicus yakama* Crabo & Wikle, 2018
 ssp. *P. y. yakama* Crabo & Wikle, 2018
 ssp. *P. y. mojave* Wikle & Crabo, 2018
 931719 *Neogrotella mcdunnoughi* Barnes & Benjamin, 1922
 syn. *N. macdunnoughi*, misspelling
 931815.1 *Sympistis eleaner* Adams, 2018
 931821.1 *Sympistis tenuistriga* (McDunnough, 1940)
 931927.1 *Sympistis ferrirena* Crabo, 2018
 931970.1 *Neotuerta collectiora* Todd, 1966
 932029.1 *Diastema chuza* (Druce, 1898)
 932045.1 *Helicoverpa armigera* (Hübner, [1808])
 932130.1 *Schinia amblys* (Dyar, 1913)
 932139 *Schinia volupia* (Fitch, 1868)
 syn. *S. masoni* (Smith, 1896)
 932225.1 *Elaphria hypophaea* (Hampson, 1920)
 932587 *Eupsilia vinulenta* (Grote, 1864)
 syn. *E. walkeri* (Grote, 1864)
 932588.1 *Eupsilia colorado* (Smith, 1903)
 932588.2 *Eupsilia schweitzeri* Lavitt & Wagner, 2016

- 932606.1 *Chaetoglaea rhonda* Stead & Troubridge, 2016
 932615.1 *Omphaloscelis lunosa* (Haworth, [1809])
 932643 *Aseptis susquesa* (Smith, 1908)
 syn. *A. monica* (Barnes & McDunnough 1918)
 932645.1 *Aseptis harpi* Crabo & Mustelin, 2018
 932656 *Stretchia plusiaeformis* H. Edwards, 1874
 syn. *S. plusiiformis*, misspelling
 932781 *Orthosia tenuimacula* (Barnes & McDunnough, 1913)
 syn. *O. mediomacula* Barnes & McDunnough, 1924
 syn. *O. nongenerica* Barnes & McDunnough, 1924
 932806 move to 2924.50
 932807 move to 2924.52
 932785 *Orthimella fidelis* (Grote, 1874) **comb. n.**
 932924.50 *Admetovis oxymorus* Grote, 1873 **moved from 932806**
 932924.51 *Admetovis icarus* Crabo & Schmidt, 2018
 932924.52 *Admetovis similis* Barnes, 1904 **moved from 932807**
 932937.1 *Leucania clarescens* Möscher, 1890
 932953.1 *Leucania oregona* Smith, 1902
 932953.2 *Leucania chejela* (Schaus, 1921)
 932955.1 *Leucania rawlini* Adams, 2001
 932961.1 *Leucania latiuscula* Herrich-Schäffer, 1868
 933115.1 *Rhabdorthodes pattersoni* Crabo, 2018
 933181.1 *Hypotrix lactomellis* Wikle & Crabo, 2018
 933207 *Hydroeciodes serrata* (Grote, 1880)
 syn. *H. ochrimacula* (Barnes & McDunnough, 1913)
 933663.1 *Abagrotis benjamini* Franclemont, 1955

Notes

- 93027.1 *Hypoprepia lampyroides* – This species is described in the current volume by Palting et al. (2018).
 930215.1 *Clemensia umbrata* – This species is raised from synonymy by Schmidt and Sullivan (2018).
 930216 *Clemensia ochracea* – This species is described in the current volume by Schmidt and Sullivan (2018).
 930233 – 930238 *Chelis* – The genera *Holarctia*, *Neoarctia*, and *Hyperborea* were subsumed under *Chelis* by Rönkä et al. (2016).
 930239 – 930277 *Apantesis* – The genera *Holarctia*, *Grammia*, and *Notarctia* were subsumed under *Apantesis* by Rönkä et al. (2016).
 930283 – 930289 *Arctia* – The genera *Parasemia*, *Acerbia*, *Pararctia*, *Platarctia*, and *Platyrepia* were subsumed under *Arctia* by Rönkä et al. (2016).

- 930299.1** *Virbia marginata* – the *Virbia* taxon from southernmost Texas previously thought to be *V. aurantiaca* is in fact more closely related to *V. marginata* (described from Guatemala) based on phenotype and DNA barcode, and this species is accordingly added to the North American fauna. The western species treated as *V. marginata* by Zaspel et al. (2008) is a separate, undescribed species maintained as *Virbia* near *marginata*, as per Lafontaine and Schmidt (2010).
- 930409.1** *Euchaetes nancyae* – This species is described in the current volume by Nagle and Schmidt (2018).
- 930468.1** *Nyridela xanthocera* – reported and photographed in southern Texas in 2017 (Krancevic 2018).
- 930541.1** *Thursania lycimnia* – Several specimens of this Mexican species were collected in southern Texas in 2015 by Ed Knudson. Vouchers are in KBC.
- 930589.1** *Hypena opulenta* – this species was approved for release in eastern Canada and is pending approval in the United States of America as a biological control agent of the invasive European swallow-worts (*Vincetoxicum* spp.). It has become established at several locations in eastern Ontario since 2016 (R. Bouchier, pers. comm.).
- 930714.1** *Glympis holothermes* – This species was found at Crocodile Lake National Wildlife Refuge in the Florida Keys by David Fine in 2009.
- 930723.1** *Nychioptera basipallida* – This species was described in the genus *Oxycilla* Grote by Barnes and McDunnough (1916) and has remained there until now. The barcode results suggested the species belonged in the genus *Nychioptera* Franclemont in the Boletobiinae and not in *Oxycilla* in the Rivulinae and examination of the male genital characters confirmed the new placement as *Nychioptera basipallida* (Barnes & McDunnough, 1916), **comb. n.**
- 930730** *Hyperstrotia villificans* – This species was synonymized with *H. nana* (Hübner, 1818) by Lafontaine and Schmidt (2015). New barcode data has shown there are two similar species going under the name *H. nana*. Specimens of the more southern of the two species, with a range extending from Pennsylvania and Illinois southward to Florida, closely match the holotype of *H. villificans*. We therefore re-instate the name *Hyperstrotia villificans*, **stat. rev.** for this taxon. The type specimen for *H. nana*, like those of most names published by Hübner, is lost or destroyed, but the rather schematic painting in Hübner (1818: 14, figs 53, 54) more closely resembles the more widespread species that occurs from southern Canada to Florida, so we apply the name *H. nana* to this species. A neotype should be selected for *H. nana* when the genus *Hyperstrotia* Hampson is revised.
- 930822.1** *Catocala ventura* – Described as being a new species similar to but distinct in appearance and barcodes from *Catocala californiensis* Brower and *C. johnsoniana* Brower (Borth and Kons 2016).
- 930829.1** *Catocala slotteni* – Described from the Florida Panhandle as a southern relict species related to *Catocala whitneyi* Dodge from the northern prairies. Both species are associated with leadplant (*Amorpha* L., Fabaceae) (Kons and Borth 2016).

- 930834.1 *Catocala bastropi*** – Described from western Louisiana and eastern Texas, this new species occurs west of the known range of *Catocala louiseae* Bauer, which occurs as far west as Alabama (Kons and Borth 2017).
- 930887.1 *Bulia mexicana*** – Recently discovered to occur in southern Texas. One of the two vouchers in KBC has been barcoded.
- 930913 *Drasteria howlandii*** – Typical *Drasteria howlandii* is a species of the Great Plains and western mountainous areas and is replaced farther south by a paler desert form in which females look like typical *D. howlandii* but males have more white in the hind wing. Richards (1939) treated them as separate species because their range only overlapped slightly, but he also pointed out that there were many exceptions to the “species” characters with wrong “forms” showing up in each other’s territory and suggested the two “species” hybridize where their ranges meet. The barcodes also do not match either distribution or color forms, and unlike other closely-related *Drasteria*, barcode variation is also very low; we therefore treat *D. tejonica* (Behr, 1870), **syn. n.** as a geographic form of *D. howlandii*.
- 930968.11 *Mimophisma forbesi*** – This species was previously known only from Puerto Rico, but found in the Florida Keys by Jim Troubridge in 2013. The specimen has been barcoded.
- 930969.1 *Tyrissa recurva*** – Specimens were collected at the National Key Deer Refuge in the Florida Keys by David Fine and Jim Troubridge.
- 931000.1 *Toxonprucha scitior*** – This species was described from northwestern Guatemala but is now known to occur through Mexico and into the Hill Country of Texas. Vouchers are in the collection of Hugo Kons Jr., Florida, and the Biodiversity Institute of Ontario, University of Guelph, Ontario.
- 931019 *Zale strigimacula*** – The identity of this species has been a mystery for many years. It had been reported from Florida, but specimens from Florida identified as *Z. strigimacula* and those identified as *Z. viridans* (Guenée, 1852) were found to represent a single undescribed species unknown from the Neotropics or elsewhere in the Caribbean, so both species were removed from the check list of Canada and United States (Lafontaine and Schmidt 2010) in a recent list update (Lafontaine and Schmidt (2015). Unfortunately, the abdomen of the male lectotype borrowed from MNHP by J. G. Franclemont for dissection has been lost. However, Neotropical specimens in USNM dissected and identified as *Zale strigimacula*, and presumably compared to the dissection of the lectotype, give a clue to the identity of this species. The species occurs from Brazil northward into southern Texas and is therefore placed back on the North American checklist; this species is, however, not known to occur in Florida. At least one additional species belonging to the *Z. strigimacula* complex is known from Texas.
- 931020 *Zale obsita*** – As with *Zale strigimacula* above, there has been much confusion as to the correct identity of this species. Specimens identified as *Zale obsita* from Florida are now reidentified as the same undescribed species discussed under *Z. strigimacula*, so this particular species has been the basis for the incorrect reports of *Zale strigimacula*, *Z. obsita*, and *Z. viridans* from Florida. The female genitalia

of the *obsita* type in the NHMUK is unique in having a single elongated lobe to the corpus bursae, unlike the figure 8-shaped bursa of species in the *Z. strigimacula* complex. Alberto Zilli pointed out that the genitalia of specimens from the Galapagos Islands and treated as *Z. obsita* by Hayes (1973) were good matches for the type specimen from Brazil. Dissection and barcoding of specimens from the Galapagos in the CNC confirms this identification and show that *Z. obsita* is known from Brazil, Ecuador, Venezuela, Costa Rica, and Guatemala, but not from farther north.

931071.1 *Eulepidotis merricki* – Specimens were collected at the National Key Deer Refuge in the Florida Keys by Jim Troubridge and David Fine. A specimen has been barcoded.

931143 *Nycteola columbiana* – This species was described in the Proceedings of the California Academy of Sciences, volume 5, 1873, with internal dates through the volume indicating the various fascicles within it were printed in various months of 1873. However, Poole (1989: 1039) and Nye (1975: 410 [under *Pseudalypia*]) give 1874 as the year of publication for this volume. The year used by Nye is based on the postal cancellation date in the library of NHMUK – the library being one of the few that save the postal wrappers. So the date is corrected here to 1874. There being no internal evidence of the Edwards paper being published in 1874, the corrected year is in brackets. Contributed by Lars Crabo.

931273 *Cobubatha ochrocraspis* – This species was added to the North American list (Lafontaine and Schmidt 2010) on the basis of specimens identified as *Cobubatha ochrocraspis* in USNM that closely resemble *Cobubatha metaspilaris* Walker, 1863 from Florida and the Caribbean. Examination of the holotype in the NHMUK shows that the specimens in USNM were incorrectly associated with this name and are *Cobubatha metaspilaris*, which is now known to occur in the United States in Florida, Texas, and Arizona. The holotype of *Cobubatha ochrocraspis* belongs in the genus *Tripudia* Grote, as Poole (1989) correctly determined. *Tripudia ochrocraspis* **comb. rev.** occurs from Jalapa in southern Mexico to Costa Rica.

931278 *Cobubatha hippotes* – This species was described from Guatemala in 1889. It was reported as *C. hippotes* in the Noctuidae MONA check list (Franclemont and Todd 1983), but the species recorded in Texas is now known to be an undescribed species related to *C. hippotes*.

931290 *Protodeltote* – Both *Protodeltote* and *Deltote* were recognized as valid genera in Lafontaine and Schmidt (2010) following the revision by Ueda (1984), but at the time we were unaware that *Protodeltote* had recently been subsumed within *Deltote* as a subgenus by Fibiger et al. (2009). Despite the apparent similarity between the two genera, phylogenetic analysis shows that the two are in fact not closely related (BCS, unpubl. data), and we therefore re-instate *Protodeltote* **stat. rev.** as a valid genus as proposed by Ueda (1984).

931540.1 *Dolocucullia poolei* – This species is described in the current volume by Crabo et al. (2018).

931659.1 *Plagiomimicus yakama* – This species, with two constituent subspecies, is described in the current volume by Crabo et al. (2018).

- 931719** *Neogrotella mcdunnoughi* – The species name was misspelled as *macdunnoughi* following the spelling in Franclemont and Todd (1983). Contributed by Greg Pohl & Steve Nanz.
- 931815.1** *Sympistis eleanor* – This taxon is described in Adams and Schmidt (2018) in the current volume.
- 931821.1** *Sympistis tenuistriga* – *Sympistis badistriga* var. *tenuistriga* (McDunnough, 1940) was first treated as a valid species in Pohl et al. (2018) based on genital and barcode differences.
- 931927.1** *Sympistis ferrirena* – This species is described in the current volume by Crabo et al. (2018).
- 931970.1** *Neotuerta collectiora* – This taxon was described as a Cuban subspecies of *Neotuerta sabulosa* (Felder, 1874), a species mainly occurring in Central and South America and the Caribbean as far north as Puerto Rico. Research by Jim Troubridge indicates the Cuban taxon should be raised to species status as *Neotuerta collectiora* Todd, 1966, **stat. n.** It was collected at Crocodile Lake National Wildlife Refuge in the Florida Keys in 2016 by David Fine.
- 932029.1** *Diastema chuza* – *Diastema chuza* (Druce, 1898), **comb. n.** was included in the genus *Eustrotia* Hübner by Hampson (1910) and Poole (1989), but the barcodes and genitalia associate it with the genus *Diastema* Guenée. It has been found in Texas in Starr County.
- 932045.1** *Helicoverpa armigera* – The Old World Bollworm, a significant pest species native to the eastern hemisphere, is now also established in South America. This species was detected in Florida (Manatee County: Bradenton) in 2015, but appears not to have become established (USDA 2017). This species has the potential to become an agricultural pest in North America (USDA 2017).
- 932130.1** *Schinia amblys* – This mainly Mexican species has recently been found in southeastern Arizona (D. Wikle pers. comm.).
- 932139** *Schinia volupia* – Synonymy with *Schinia masoni* from Pogue et al. 2013.
- 932225.1** *Elaphria hypophaea* – Specimens of *Elaphria fuscimacula* (Grote, 1881) from southern Texas southward have been re-identified by JDL as the central and northern South American species *Elaphria hypophaea* on the basis of barcodes and differences in the male genitalia. *Elaphria fuscimacula* is a complex of three species that occur from Florida and North Carolina to central Texas. The type locality of *Monodes fuscimacula* Grote is Tallahassee, Florida.
- 932587** *Eupsilia vinulenta* – The name *Eupsilia walkeri* (Grote, 1864) was transferred from the synonymy of *Eupsilia sidus* (Guenée, 1852) to the synonymy of *Eupsilia vinulenta* (Grote, 1864) by Lavitt and Wagner (2016).
- 932588.1** *Eupsilia colorado* – This name was previously treated as a synonym of *Eupsilia sidus* (Guenée, 1852), but was raised to the status of a valid species by Lavitt and Wagner (2016). It occurs in southwestern Colorado, highly isolated from populations of *Eupsilia sidus* in eastern United States.
- 932588.2** *Eupsilia schweitzeri* – This new species was initially distinguished from *E. sidus* by barcode and larval differences, but also differs in details of the male genitalia (Lavitt and Wagner 2016).

- 932606.1 *Chaetagma rhonda*** – This recently described species (Stead and Troubridge 2016) refers to populations from the Carolinas northward to southern Ontario previously identified as *Chaetagma tremula*.
- 932615.1 *Omphaloscelis lunosa*** – A European introduction first reported from North America at Potomac, Maryland, 7 October 2015, by Tomas Mustelin.
- 932643 *Aseptis susquesa*** – The synonymy of *Aseptis monica* and *A. susquesa* by Mustelin and Crabo 2015 was inadvertently missed in Lafontaine and Schmidt 2015.
- 932645.1 *Aseptis harpi*** – This species is described in the current volume by Crabo et al. (2018).
- 932656 *Stretchia plusiaeformis*** – The species name *plusiaeformis* was incorrectly updated to *plusiiformis* by Lafontaine and Schmidt (2015) following Poole (1989). The correct original spelling is *plusiaeformis*. Contributed by Greg Pohl & Steve Nanz.
- 932781 *Orthosia tenuimacula*** – Barcodes and dissections confirm that *O. medio-macula* Barnes & McDunnough, 1924, **syn. n.** and *O. nongenerica* Barnes & McDunnough, 1924, **syn. n.** are color forms of *Orthosia tenuimacula*.
- 932785 *Orthimella Schmidt & Lafontaine, nom. n.*** is proposed here as an objective replacement name for *Himella* Grote, 1874 [Noctuidae: Orthosiini, type species *Himella fidelis* Grote, 1874], a junior homonym of *Himella* Dallas 1852 [Hemiptera: Coreidae], a valid genus of neotropical coreids. This action results in the following new combination: *Orthimella fidelis* (Grote, 1874) **comb. n.**
- 932806 – see entry for 2924.51
- 932807 – see entry for 2924.51
- 932924.51 *Admetovis icarus*** – This species is described in the current volume by Crabo and Schmidt (2018). The genus *Admetovis* is re-classified as a member of the tribe Hadenini from its previous placement in the Orthosiini, resulting in the re-assignment of checklist numbers from 932806 – 2807.
- 932937.1 *Leucania clarescens*** – This species was described from Puerto Rico. Jim Troubridge collected specimens at Bahia Honda State Park and Crocodile Lake National Wildlife Refuge in the Florida Keys and identification was made by Cliff Ferris from the male genitalia of one these specimens. The other specimen has been barcoded.
- 932953.1 *Leucania oregona*** – This species was segregated from *Leucania farcta* (Grote, 1881) by Lafontaine and Schmidt (2010) and recognized as a valid species because of significant differences in the genitalia. Barcode results indicate it is closely related to *Leucania imperfecta* Smith, 1894, and the genitalia confirm this association, so we give it a new sequence number to reflect its proper position within *Leucania*.
- 932953.2 *Leucania chejela*** – This Caribbean and Central American species was discovered at Bahia Honda State Park in the Florida Keys by Jim Troubridge in 2013. Specimens have been dissected and barcoded.
- 932955.1 *Leucania rawlini*** – This species was described from Jamaica, but extends as far north as Cuba, the Bahamas, and recently was collected at the National Key Deer Refuge in the Florida Keys by Jim Troubridge. The specimen has been barcoded.
- 932961.1 *Leucania latiuscula*** – This species was described from Cuba and was collected at the National Key Deer Refuge in the Florida Keys by Jim Troubridge. A specimen has been barcoded.

- 933115.1** *Rhabdorthodes pattersoni* – The genus *Rhabdorthodes* and the three constituent species are newly described in the current volume by Crabo (2018).
- 933181.1** *Hypotrix lactomellis* – This species is described in the current volume by Crabo et al. (2018).
- 933207** *Hydroeciodes serrata* – *H. ochrimacula*, **syn. rev.** does not differ from *H. serrata* in structural characters or barcodes, so we consider it to be a form of *H. serrata* and treat it as a synonym.
- 933663.1** *Abagrotis benjamini* – This taxon was described as a “race” of *Abagrotis crumbi*. It was raised to a valid species by Goldstein and Nelson (2017).

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