



## Four new gelechioid species to honor Costa Rica's conservation of wild biodiversity (Lepidoptera)

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### Abstract

We described four new gelechioid species from Costa Rica: *Philtronoma cbdora* Metz, **new species**; *Tinaegeria carlosalvaradoi* Metz, **new species**; *Tinaegeria romanmacayai* Metz, **new species** (Depressariidae: Tinaegeriinae **revised status**); and *Percnarcha claudiadoblesae* Metz, **new species** (Gelechiidae: Gelechiinae). We provide these honorifics to recognize commitment and devotion to conservation of biodiversity. The new species are all highly diagnostic among other species of Gelechioidea, and species of *Tinaegeria* and *Percnarcha* demonstrate striking mimesis for presumed wasp and beetle models. The family-group name Tinaegeriidae Hampson, 1893 is clarified, including the previously overlooked priority of the family-group name synonyms, and is placed as a valid subfamily in Depressariidae comprised of the genera *Filinota* Busck, 1911, *Nematochaes* Meyrick, 1931, *Philtronoma* Meyrick, 1914, *Profilinota* Clarke, 1973, and *Tinaegeria* Walker, 1856.

**Key words:** Gelechioidea, Depressariinae, Stathmopodinae, Peleopodinae, Gelechiidae, Gelechiinae, *Neea psychotrioides*, Nyctaginaceae, *Machaerium salvadorensense*, *Machaerium floribundum*, *Machaerium cobanense*, Fabaceae, mimesis, mimicry

### Introduction

Taxonomists have used honorifics in zoological nomenclature for centuries to acknowledge contributions and inspirations, both great and small, from the authors' point of view. These honorifics are sometimes playful, whimsical, and applied to entities instead of individuals (i.e., not personal names), for example *Terebellides sepultura* Garraffoni & Lana, 2003:

“named to honour Sepultura, the best Brazilian heavy metal band.”

Perhaps, most often, honorifics are Latinizations of personal names as referred to in the ICZN (Article 31.1) and used to honor contributions by individuals to the taxonomic discipline or collection of important specimens, *Struthoscelis davisorum* Metz, 2017:

“dedicated to Donald R. Davis and Mignon B. Davis, collectors of the single known specimen, in recognition of their dedication to the study of microlepidoptera.”

However, as taxonomy-based and integrated biodiversity study moves into conservation and socioeconomics through sustainable development of biodiversity, the application of honorifics sometimes reflect authors' recognition of philosophy or advocacy for a cause, for example *Paulinella suzukii* Nichols, 2009:

“The specific epithet (*suzukii*) pays tribute to the well-known Canadian geneticist, nature advocate and science educator, David Suzuki.”

As long as the authors' follow the rules and guidelines of the Zoological Code, peer-review has a long tradition of condoning, or at least accepting, these nomenclatural acts without questions about geopolitical borders or philosophical issues.

The newly emerging strategy to do a complete eukaryote biodiversity inventory of Costa Rica by Costa Rica is an encouraging example of contributions to a large-scale, taxonomic effort by non-taxonomists who recognize the importance of Earth's biodiversity. These actors through political will, enthusiasm and even human and financial resources “open the door” to new taxonomic discoveries and deserve recognition. Recognizing these new partners in the taxonomic endeavor in turn encourages them to be attentive and build relationships with members of the taxasphere (Janzen 1993) and their doings. It also encourages them to look more closely at the actual organisms and their environs, become more interested in their survival as wild living populations, and incorporate these needs into their more traditional routines and duties. The four new species described here, duly offered to their social “owners” are a specific example. These patrons are proven advocates of the taxonomic tradition, and are influencers of who will decide whether much of Costa Rican wild biodiversity actually survives more than a few more decades.

The gelechioid fauna of Area de Conservación Guanacaste, Costa Rica is expansive and will require years of taxonomic service to document its diversity. Because of this complexity, the species we chose as honorifics are members of diagnostic genera with one to a few taxa with valid names. The chosen species are also quite aesthetic for Gelechioidea and have remarkable morphology and biology. Despite our efforts to keep the effort simple, the new taxa indicate a need to address matters of gelechioid classification and nomenclature. So, in addition to the new species-level taxa, we address the history, synonymy, and nomenclature of the family-group names Tinaegeriidae Hampson, 1893 and Stathmopodidae Meyrick, 1913 and place Tinaegeriinae in the family Depressariidae Meyrick, 1883.

## Materials and methods

Parataxonomists collected larvae as part of the ongoing inventory of the caterpillars of Area de Conservación Guanacaste, Costa Rica and their food plants (Janzen & Hallwachs 2011, 2016). Additional information about specimens of Lepidoptera and their parasitoids can be found in online databases: ACG inventory (Janzen & Hallwachs 2019; indexed by the unique identifier yy-SRNP-nnnnn or DHJPARNnnnnnn) and the USNM Department of Entomology Collections (<http://collections.nmnh.si.edu/search/ento/>; indexed by the unique identifier USNMENTnnnnnnn). MAM dissected and prepared genitalia from pinned specimens following the methods of Clarke (1941) and Robinson (1976). Dissected specimens are denoted with unique identifiers in the form USNM slide # NNNNNN. MAM took measurements with an ocular micrometer on a Leica-Wild M10 stereomicroscope from the left side of the specimen when possible; and used a Visionary Digital imaging station for photographs, GIMP for photo-editing, and Inkscape for layout. Morphological terminology follows Hodges (1998) and Kristensen (2003). MAM used Brown (1978) to source roots and stems for etymologies and composition of new taxon names. All specimens are deposited in USNM (National Museum of Natural History, Washington, D.C., USA) or NHMUK (Natural History Museum, London, United Kingdom) where indicated.

DHJ and WH submitted a single leg from each specimen to the Centre for Biodiversity Genomics (formerly Biodiversity Institute of Ontario), University of Guelph, for DNA barcoding (Ratnasingham and Hebert 2007), where all sequence-based information can be retrieved using the sample ID numbers (yy-SRNP-nnnnn) which are the same as borne by the deposited pinned specimen. Sequence data were obtained from the 5' terminus of the COI gene amplified using standard primers (LepF1–LepR1) following established protocols (Ivanova et al. 2006). We include the BOLD Barcode Index Number (BIN) (Ratnasingham and Hebert 2013) with the ACG species description as well as the individual inventory voucher codes (yy-SRNP-nnnn) for the specimens.

## Nomenclature and taxonomy

The family-group names Tinaegeriidae Hampson, 1893 and Stathmopodidae Meyrick, 1913 are currently subjective synonyms (Becker 1984), however, the principle of priority was not applied when this nomenclatorial decision was formally published (Common 1970). Tinaegeriidae was named by Hampson (1893) when he treated species in the genera *Snellenia* Walsingham, 1889 (now in Stathmopodidae), *Oedematopoda* Zeller, 1852 (now in Stathmopodidae), and *Eretmocera* Zeller, 1852 (now in Scythrididae) in his work on the Indian fauna, but he alluded to Walsingham's (1889) work saying:

“This family is shown by Lord Walsingham, in his Monograph, Trans. Ent. Soc. 1889, to be allied to *Tinthia* in the Sesiidae on the one hand, and on the other to the subfamilies of Tineidae, the Gelechiinae, Dasycerinae, and Butalinae.”

Walsingham (1913) invalidated Tinaegeriidae saying:

“It is now apparent that *Arauzona* Wkr. and *Tinaegeria* Wkr. are earlier forms from which the more specialised Aegeriidae can be derived, and there is no justification for the retention of the family Tinaegeriidae Hmsn. [Fn. Br. Ind. Moths 1 12, 206-8 ff. 134-5 (1862)] to include *Tinaegeria* Wkr., *Snellenia* Wlsm., *Eretmocera* Z., etc.”

Obscure references to Tinaegeriidae being a different taxon than Aegeriidae (=Sesiidae) remained in the scientific literature until Fletcher (1929) considered Tinaegeriidae and Heliodinidae Heinemann & Wocke, 1876 to be synonyms of Schreckensteiniidae Fletcher, 1929, a name he created in the same work. Fletcher tabulated the genera he treated and used the terminology “Other names in current use (as a column heading. He listed the genus *Tinaegeria* (and one of its current synonyms *Arauzona*) under his family Schreckensteiniidae with Tinaegeriidae as the other name in current use (and used Heliodinidae for *Arauzona*). Fletcher (1929) further dedicated a considerable amount of prose explaining his decision to use his current names rather than apply what we call today the principle of priority in nomenclature.

The concept that Tinaegeriidae and Stathmopodidae were the same taxon based on their similar external appearance was retained in practice despite Fletcher's hypothesis. Common (1970) seems to have been first to synonymize the family-group names by intent and publication. In his section “28. Stathmopodidae.\* (he included an asterisked footnote reading “\* = Tinaegeriidae.) Despite this Heppner and Duckworth (1981) explicitly transferred both *Tinaegeria* and *Arauzona* to Oecophoridae: Stathmopodini from Sesiidae, apparently unaware of Common (1970). This taxonomy was repeated by Munroe (1982), Becker (1984), Nye and Fletcher (1991), and Hodges (1998), but priority was never applied and Stathmopodidae was retained as the valid family-group name.

Fortunately, it became clear in this study that species in the genus *Tinaegeria* Walker, 1856 are misplaced in Stathmopodidae. That family has an almost exclusive distribution in the Old World tropics with only a few Nearctic species. Species of *Stathmopoda* Herrich-Shäffer, [1853] have robust spines on the abdomen and a beak-like uncus and gnathos. The gnathos has an acuminate apex without any recurved spines or denticles. In contrast, species in *Tinaegeria* are exclusively Neotropical. They have a split uncus with symmetrical halves; a split gnathos with recurved spines typical of those found in Depressariidae, Coleophoridae, Elachistidae, etc.; and a diagnostic separation of the papilla analis with a larger anterior pad and smaller posterior pad. Species in *Tinaegeria* share these features with species currently in the genera *Filinota* Busck, 1911; *Profilinota* Clarke, 1973; *Philtronoma* Meyrick, 1914 (uncus short); and *Nematochaes* Meyrick, 1931 (Depressariidae: Depressariinae); and the species in these genera seem most closely related to species in the subfamily Peleopodinae Hodges, 1974 rather than species in Depressaria Haworth, 1811. Until a more thorough analysis of generic relationships in Depressariidae, here we take the family-group name out of synonymy with Stathmopodidae and place it as a valid subfamily in Depressariidae with the following classification:

Depressariidae Meyrick, 1883

Tinaegeriinae Hampson, 1893 **revised status**

*Filinota* Busck, 1911

*Nematochaes* Meyrick, 1931

*Philtronoma* Meyrick, 1914

*Profilinota* Clarke, 1973

*Tinaegeria* Walker, 1856

**Genus *Philtronoma* Meyrick, 1914** (Depressariidae: Tinaegeriinae) (from Depressariidae: Depressariinae)

*Philtronoma* Meyrick, 1914: 273. Type species: *Oecophora roseicarpus* Dognin, 1910: 45; St. Laurent du Maroni, French Guiana; by original designation.

Meyrick described *Philtronoma* for Dognin's very diagnostic species with a pink abdomen, *Oecophora roseicarpus*. Dognin's description was based on three male syntypes from French Guiana, but Heppner (2011) expanded the distribution by including similar specimens collected from Belize to Peru and Brazil. Heppner (2011) designated a lectotype (Fig. 4) (USNMENT01480136, USNM slide # 69382) and included the study of females in his work. After closer examination of several specimens and the Dognin lectotype by the first author and the distribution of COI barcode fragment haplotypes in BOLD (Ratnasingham & Hebert 2007), our conclusion is that there are many distinct species across that range including the new species described herein. The male genitalia of the specimens illustrated from Peru (Heppner 2011) and Brazil (Clarke 1963) do not match the male lectotype of *P. roseicarpus*. Likewise, there are at least two species that can be identified by DNA barcode data from French Guiana alone. Species in the genus are large (wingspan  $\geq 30$ mm) gelechioids and can be identified by their diagnostic wing pattern and pink scales. Males have considerably fewer pink scales or no pink scales in the hindwing. A broader treatment of the genus is necessary to appreciate the subtle differences in forewing size, shape, and pattern among species, but both male and female genitalia are diagnostic.

***Philtronoma cbdora* Metz, new species**

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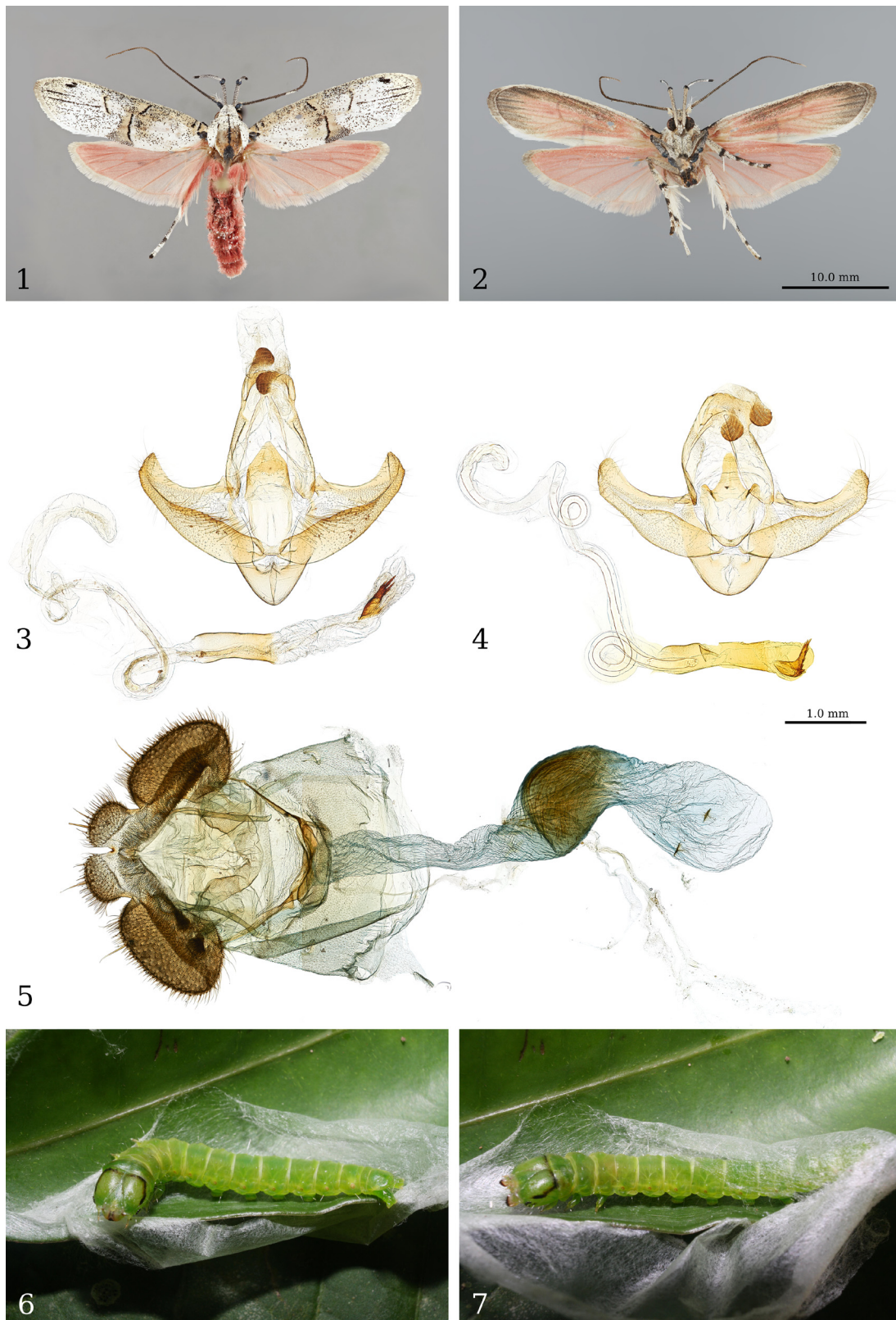
(Figs. 1–3, 5–7)

**Etymology.** The species epithet is a Latinized, arbitrary combination of letters formed to be used as a word (ICZN 11.3). The epithet is in honor of the Convention on Biological Diversity (CBD) efforts to promote sustainable development and conservation of wild biological diversity, and especially Costa Rica's new focus on being an exemplar tropical country for the realization of the goals of the CBD. A note on pronunciation of the species name: the abbreviation for the Convention on Biological Diversity is pronounced SEE-BEE-DEE. The new species name, likewise, should be pronounced SEE-BEE-DOR-A, which is, indeed, quite euphonious and easy to remember. It should be considered a feminine adjective.

**Diagnosis.** *Philtronoma cbdora* can be recognized by forewing pattern. It has three parallel, longitudinal black lines in the forewing apex, the two anterior lines are very distinct, the posterior line is indistinct but visible, the length of the anterior line is 0.6X the length of the middle or posterior lines, narrowest width of bronze patch at hind margin of forewing 3X wider than black line preceding it, hind tibia with pink scales dorsally, apex of valve acute, medial carinate edge continuous to valve apex, juxta broad and tapering to blunt triangle, lateral process of juxta lacking, cornutus straight in line with phallus and apex with five long teeth, corpus bursae 2X longer than widest width, narrower in middle, posterior half sclerotized dorsally, blade-like extension of paired signa length 0.75X width of individual signum, periphery of signum continuous with surface of corpus bursae faint with few darkened denticles.

**Description.** Head scales white, many with black tips creating a speckled look, white tending towards creamy-yellow on lower face and at lower rear eye margin, scales at medial eye margin at base of antenna black iridescent; scales much longer than wide except scales at immediate eye margin almost as wide as long. Ocellus absent. Compound eye 1.2X higher than long. Scape with scales iridescent black dorsally, white ventrally and anteriorly; with a pecten of over 40 narrow white scales; remaining antennal segments with scales iridescent black dorsally, pedicel and basal 1–5 flagellomeres with white scales anteriorly and posteriorly, distal flagellomeres with iridescent black scales ventrally; with numerous long, curved setae at joints ventrally. Labial palpus curved well above top of head, completely smooth-scaled; second segment straight; third segment gently curved; second segment only measurably longer than third segment, almost equal in length; scales of first segment white with a broad, lateral black strip of black scales; second segment scales mostly white with black tips, giving a speckled look, ventral scales completely white, apex capped with iridescent black scales; third segment scales mostly white with black tips, base with only white scales except ventrally, apical 1/7th capped with iridescent black scales with one to few white scales at extreme tip. Maxillary palpus scales white with black tips. Pilifer obscured by labial palpi. At least 0.75 length of haustellum base with dense cover of white scales, some with black tips.





**FIGURES 1–3, 5–7.** *Philtrionoma cbdora* Metz, new species. 1, adult dorsal view ♀ holotype (USNMENT01455825, 04-SRNP-25691); 2, adult ventral view ♀ holotype (USNMENT01455825, 04-SRNP-25691); 3, genitalia ♂ paratype (USNMENT01480176, YB-BCI24465, USNM slide # 146553); 4, genitalia ♂ lectotype *Philtrionoma roseicorpus* Dognin (USNMENT01480136, USNM slide # 69382); 5, genitalia ♀ holotype (USNMENT01455825, 04-SRNP-25691, USNM slide # 146541); 6, larva in situ (11-SRNP-23562-DHJ493122); 7, larva in situ (11-SRNP-23562-DHJ493119). Measure bars. FIGS 1–2 = 10.0 mm; FIGS 3–5 = 1.0 mm.

Thorax with scales mostly white, scattered scales with black tips; dorsum with median strip of black iridescent scales, which is slightly wider on mesonotum; median 1/3 of metascutellum covered with iridescent black scales in an oval shape, longer than broad. Leg scales mostly white with scattered scales with black tips; apex of every foreleg segment and dorsum of fifth metatarsus with black iridescent scales; apex of mid- and hindcoxae and mid- and hindfemora with iridescent black scales, mid- and hindtibiae with subapical ring of matte black scales, metatarsi of mid- and hindleg with matte black annulations; hindtibia with long plume of pink scales dorsally, plume scales at apex white. Forewing length 15.8–17.4 mm (Fig. 1), apex broadly rounded, scales predominantly white, sparsely mixed with black-tipped scales, black-tipped scales more dense along middle half of costa, forming a weak band extending posteriorly in triangular pattern to 1A, and at posterior margin in middle of wing; with beige scales on costal cell from base around wing apex, triangular shaped spots in wing apex over longitudinal veins R to Cu1, in triangular patch from costa to 1A in basal third, in triangular patch from posterior wing margin to radial sector at middle of forewing, and at discal bar; with concentrated black scales on anterior surface of costa along basal 1/6th, and forming two narrow, perpendicular bars at base over costa back to radial sector, one narrow, diagonal bar from middle of discal cell, but not reaching costa, a compound apical spot in the wing apex over R3, a narrow, curved bar in the middle of the wing from M1 posteriorly to but not reaching posterior wing margin, a narrow, diagonal bar at the apex of the discal cell, and three apical lines, the two anterior lines darker and between R5 and M1 and between M1 and M2, the posterior line fainter and between M2 and M3, middle line twice as long as anterior and posterior lines, which are subequal in length; there is an additional black spot at the forewing base in the middle, with some raised black-iridescent scales adjacent over the axial sclerites. Ventral surface of forewing (Fig. 2) with predominantly pink scales, particularly along veins, with dark gray to brown scales on anterior and apical areas between, discal cell and 1A; scales of retinaculum creamy white, with a row of closely associated, posteriorly-directed scales on the base of Sc and a closely associated row of anteriorly-directed scales on the base of M-Cu. Fringe only present along termen, scales white to creamy white, except dark gray to brown in middle. Hindwing 13.3–14.6 mm, broad and triangular, dorsal surface with slightly iridescent, pink scales. Fringe creamy white, scales with compound apices of 5 or more tips around posterior angle. Ventral surface with slightly iridescent, pink scales, fringe dark gray to brown at apex.

Abdomen with pink scales dorsally and white scales ventrally. Male genitalia (Fig. 3). Segment VIII similar in shape to the preceding segments, undifferentiated. Tegumen trapezoidal in ventral view, posterior end narrower, length 1.3X width at middle, dorsal anterior margin deeply emarginate, emargination extending almost entire length of tegumen, emargination in middle as wide or wider than tegumen halves creating broad space with acute apex. Uncus short, forming a narrow strap, lateral ends at articulation with tegumen and gnathos slightly longer, middle third of dorsal posterior margin produced slightly and notched medially. Gnathos bifurcate with symmetrical halves, each half produced as pyriform pad of denticles in ventral view, denticles smaller on lateral arm of gnathos, pad wider than long. Anal tube completely membranous. Vinculum V-shaped; saccus bluntly pointed, not produced. Juxta spanning almost entire width of diaphragm, length 2X width at middle, length equal to length of tegumen, dorsally concave, in lateral view bent ventrally, anterior margin broadly rounded, posterior apex triangular coming to blunt point, lacking lateral process. Diaphragm with slightly darkened plate at midline above phallus that could be vestigial transtilla, otherwise unadorned. Valve simple, sacculus not extremely expanded or separate from cucullus, with no extensions or processes, valves smoothly tapered from base out to acute and angular apex with no ventral expansion, length equal to lengths of tegumen and uncus lengths combined, apex with acute, medial carinate edge continuous to valve apex. Phallus cylindrical, lacking any sclerotized lateral strip, tip blunt; not fused to juxta, with membranous attachment to diaphragm; ductus ejaculatorius 3X longer than phallus, exiting anteriorly with no caecum; cornutus straight in line with phallus and apex with five long teeth. Female genitalia (Fig. 5). Segment VIII width 1.25X length at level of ostium; width 2.0X width of ostium at level of ostium; anterior margin terminate; lamella antevaginalis and lamella postvaginalis with thickened margin medially, lip-shaped; anterior apophysis not strongly sclerotized, base located posterodorsally at posterior margin of tergite VIII, short, thick, and strongly bent after base, terminus at level of ostium. Segment IX entirely membranous, same length as segment VIII, width throughout equal to width of posterior width of segment VIII. Papilla analis divided into larger anterior pad and smaller posterior pad, anterior pad kidney-shaped, posterior pad hemispherical, both pads densely covered with small denticles and filiform setae, anterior pad with a single large seta and posterior pad with two large setae on outer edge, both pads with a medial, channel-like depression filled with the same small denticles, channel adjacent to membrane surrounding anus and ovipore. Posterior apophysis darker than anterior apophysis, base located pos-

terodorsally at anterior margin of papilla analis at division between anterior and posterior pads, mostly straight, terminus not reaching ostium. Antrum extremely short, length 0.2X width of ductus bursae. Colliculum not visible. Ductus bursae 1.4X longer than length of segment VIII, cylindrical, same width as anterior end of antrum posteriorly with three sections of widening and narrowing before smoothly widening into corpus bursae, entire length textured with longitudinal ridges ventrally and diagonal to perpendicular ridges dorsally. Ductus seminalis emerging from dorsum of ductus bursae immediately anterad antrum, width 1/8th width of ductus bursae, with no visible texture. Corpus bursae 2X longer than widest width, narrower in middle, posterior half with deep longitudinal and diagonal ridges, darkened dorsally; blade-like extension of paired signa length 0.75X width of individual signum, part of signum continuous with surface of corpus bursae faint with few darkened denticles.

Immature stages not examined first hand. Larva as in images (Figs. 6–7.)

**DNA Barcode BOLD BIN.** BOLD:AAF6938 (dx.doi.org/10.5883/BOLD:AAF6938)

**Specimens Examined.** Holotype ♀ (USNMENT01455825, 04-SRNP-25691, USNM slide # 146541) COSTA RICA: Area de Conservacion Guanacaste (ACG), Guanacaste Province, Sector Del Oro, Quebrada Trigal, 290m, 11.02681, -85.49547, ec. 18 Oct 2004, leg. Lucia Ríos, ex. *Neea psychotrioides* (Nyctaginaceae). Paratypes (1 ♂, 5 ♀♀): COSTA RICA: Area de Conservacion Guanacaste (ACG): 1 ♀ (USNMENT01480152, 04-SRNP-25689) Guanacaste Province, Sector Del Oro, Quebrada Trigal, 290m, 11.02681, -85.49547, ec. 07 Nov 2004, leg. Lucia Ríos, ex. *Neea psychotrioides* (Nyctaginaceae); 1 ♀ (USNMENT01480149, 04-SRNP-25688) Guanacaste Province, Sector Del Oro, Quebrada Trigal, 290m, 11.02681, -85.49547, ec. 08 Nov 2004, leg. Lucia Ríos, ex. *Neea psychotrioides* (Nyctaginaceae) (deposited in NHMUK); 1 ♀ (USNMENT01480150, 04-SRNP-25690) Guanacaste Province, Sector Del Oro, Quebrada Trigal, 290m, 11.02681, -85.49547, ec. 13 Nov 2004, leg. Lucia Ríos, ex. *Neea psychotrioides* (Nyctaginaceae); 1 ♀ (USNMENT01480151, 11-SRNP-23562) Sector El Hacha, Estacion Los Almendros, 11.03226, -85.52776, 290m, ec. 16 Dec 2011, leg. Roster Moraga, ex. *Neea psychotrioides* (Nyctaginaceae); PANAMA: 1 ♂ (USNMENT01480176, YB-BCI24465, USNM slide # 146553) Panama, Barro Colorado Island, 9.15472, -79.8481, 17 Mar 2010, light trap, LT-ARM3-MAR2010-B, leg. Bobadilla, Gonzalez, Osorio, Perez; 1 ♀ (USNMENT01480148, USNM slide # 146549); Canal Zone, Barro Colorado Island, 03 Jul 1978, Silberglied/Aiello, at light.

**Distribution.** *Philtronoma cbdora* is known from specimens collected at just a few locations in Costa Rica and Panama, but likely occurs throughout the range of the only known food plant.

**Biology.** Larvae of *P. cbdora* lightly roll and silk mature leaves of the treelet *Neea psychotrioides* (Nyctaginaceae) living at the intersection of ACG dry forest and rain forest. Records in GBIF (2019) include localities for *N. psychotrioides* from Sinaloa, Mexico south through Panama, with few records in western Colombia.

**Remarks.** Dognin's original syntype specimens of *P. roseicarpus* may comprise multiple species, so comparisons to the lectotype are important (Fig. 4). Specimens identified as *P. roseicarpus* in the USNM represent several different species. All species of *Philtronoma* we examined can be readily identified by features of the male genitalia including the shapes of the valve, juxta, and cornutus (See Figs. 4 and 5 to compare the two named species.) and these correlate well with species-specific wing patterns.

## Genus *Tinaeergia* Walker, 1856 (Depressariidae: Tinaeergiinae) (from Stathmopodidae)

*Tinaeergia* Walker, 1856: 260. Type species: *Tinaeergia ochracea* Walker, 1856: 260; Para, Brazil; by subsequent designation (Walsingham 1889: 10).

= *Arauzona* Walker, [1865]: 25. Type species: *Arauzona basalis* Walker, [1865]: 26; Ega, Brazil; by monotypy.

= *Machaerocrates* Meyrick, 1931: 175. Type species: *Machaerocrates tunicata* Meyrick, 1931: 176; San Bernardino, Paraguay; by monotypy.

Walker (1856) described *Tinaeergia* for a species he thought was a missing link between the families Tineidae ("Tineities", or clothes moths), and Sesiidae ("Aegeriidae" or clearwing moths). He named the species *Tinaeergia ochracea* because its body is mostly covered with orange scales and the black-scaled wings have bands of orange scales. After several decades, other species looking like small sesiids were discovered in this or other similar genera and moved to this genus, so that there are currently eight described species of *Tinaeergia*, all from South America (Guyana, Colombia, Peru, Brazil, and Paraguay) (Becker 1999). The sesiid-like shape and color suggests that species in this genus may be mimicking some distasteful or otherwise avoided insect, such as lycid beetles, lampyrid



beetles, or stinging wasps. Lycid and lampyrid beetles contain toxic chemicals that make them distasteful. A group of scales on the antennae of *Tinaegeria* make their antennae appear larger, similar to the expanded antennae of the beetle models. These Costa Rican *Tinaegeria* also have white patches of scales near the antennae tips, suggesting that in flight they might mimic small, stinging wasps and therefore be gaining the advantage of both models. Members of the genus have narrow wings with species-specific patterns of black and yellow or orange scales. The hindwing has bare membrane similar to sesiid moths. Both male and female genitalia are diagnostic. Males have a deeply divided uncus; paired, oval, spinose distal gnathos pads; and the ductus ejaculatorius ventral on the phallus. Females have a widely divided papilla analis with a posterior and anterior pad. The posterior pad is narrow, pointed, and dorsoventrally flattened. The anterior pad is broad and laterally flattened with hooked, ventrolaterally directed setae.

### *Tinaegeria carlosalvaradoi* Metz, new species

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(Figs. 8–13)

**Etymology.** This species is named in honor of Carlos Alvarado Quesada, President of Costa Rica, who is philosophically and practically dedicated to facilitating Costa Rica's continued growth into being the most green tropical country of all. He encourages Costa Rican bioliteracy for conservation of its wild biodiversity, which is relevant to the forests in which his patronym moth lives.

**Diagnosis.** *Tinaegeria carlosalvaradoi* can be recognized by having the basal half or more of the forewing, and only the extreme base of the abdomen, covered with orange scales; apical half of hindwing covered with black scales, only basal hind part of the hindwing bare of scales. Triangular, anterior emargination in dorsum of tegumen as wide or wider than tegumen halves creating broad space with broadly rounded apex; uncus half straight from base with little or no narrowing or undulation, tip capitate, spoon-shaped with only a slight lateral extension or lip; spiny gnathos pad ovate nearly as broad as long; valves smoothly tapered from base out to narrow, but broadly rounded apex with no ventral expansion; phallus cylindrical (i.e., dorsum is sclerotized) for almost the posterior half and praephallus lacks any sclerotized lateral strip, tip blunt. Posterior pad of papilla analis narrow, width of capitate apex 1.7X width of narrowest part, apex acute and bluntly pointed, with three long straight setae on apical margin, remaining large setae sinuate; corpus bursae compound, length of neck before apical lobe 1/3 length of apical lobe, basal lobe with no visible darkened signum.

**Description.** Scales predominantly black and orange. Head scales dark gray to black except some scales on lower face orange and white; some scales in patch at upper margin of eye curving medially over head orange; scales originating from back of head longer, unidirectional, curving over top of head and to frons; scales of face and frons shorter, unidirectional directed ventrally; scales at posterior eye margin dark gray to black, orange to white ventrally; with a triangular glabrous spot on vertex dorsad dorsal eye margin and posterad antennal base. Ocellus absent. Compound eye height and length equal through the middle, but dorsal margin sinuate with an acute angle dorsally, an obtuse inward angle at the level of the antenna, and an obtuse outward angle below the antenna. Antenna scales entirely black except scape with orange to white scales ventrally and anteriorly and a patch of bright white scales dorsally at subapex; dorsal scales of flagellomeres up to white scale patch long and densely packed making the antenna appear thicker; extreme tip of antenna lacking scales; pecten absent; in ♂ flagellomeres with numerous long, appressed black setae at joints ventrally, distal flagellomeres with normal, short erect setae; in ♀ flagellomeres with normal, short erect setae ventrally. Labial palpus curved well above top of head, completely smooth-scaled; second and third segments gently curved; third segment 1.2X longer than second; scales of first segment white to orange; second segment scales white to orange at base and ventrally through, scales black dorsally from subbase to apex; third segment scales dark gray to black except extreme tip with few white scales. Maxillary palpus scales orange to white. Pilifer scales orange to white with an apical brush of silver to gold setae. At least 0.75 haustellum with dense cover of orange to white scales basally and dark gray to black scales towards apex.

Thorax scales orange with a broad median, black strip on the dorsum through the mesoscutellum, a broad, black lateral strip through the middle of the pleura, and orange scales tending to white ventrally. Forecoxa scales orange anteriorly, orange to white posteriorly, except extreme base black; forefemur scales white at extreme base and orange on the rest of anterior face, posterior face with white scales on basal half and black scales on apical half;



foretibia with black scales except with orange scales ventrally distad epiphysis; rest of foreleg with black scales except basitarsus with circular patch of orange scales on posterior face; midcoxa scales mostly white with orange and some dark gray scales apically on anterior surface; midfemur scales white basally with a circular patch of dark gray scales on anterior face, scales transitioning to orange through middle, only orange dorsally at apex, scales black on ventrally on apical half; midtibia scales black with orange annular band in middle, with two whorls of longer scales, one at apical margin of first black section and one at tibial apex; rest of midleg with black scales except middle of basitarsus with a orange annular band in middle; hindcoxa scales black except for circular patch of orange to white scales subapically on anterior face and some orange to white scales at extreme apex; hindfemur scales black ventrally, white dorsally except small white patch at extreme base ventrally; hindtibia scales black except semianular patch in middle of orange to white scales, with two whorls of longer scales, one in the middle of the tibia with orange scales dorsally and one at tibial apex; rest of hindleg with black scales except extreme apices of tibial spurs white. Forewing length ♂ 5.4–6.4 mm, ♀ 5.6–7.1 mm (Figs. 8–9), narrow length 5X width at middle, apex rounded. Dorsal scales orange in slightly more than basal half except for small, narrow patch on hind margin at base, rest of wing with black scales. Ventral surface of forewing as dorsal except basal area with fewer orange scales, less densely colored with more black scales along M-Cu; scales of retinaculum orange, with a row of closely associated, posteriorly-directed scales on the base of Sc. Fringe circumventing forewing apex and around the posterior margin to about middle of forewing, scales black with compound apices of 3–5 tips. Hindwing ♂ 4.5–5.6 mm, ♀ 5.1–5.9 mm, length 3X width at middle, apex broadly acuminate; dorsal surface with orange scales at base out to less than half the length of the hindwing, basal 1/2 to 2/3 of costal cell with light, almost white scales, and black scales on the remaining dorsal surface except membrane bare of any scales in small circular patches in middle of cells M2 and CuA2, in cell CuP, and most of anal area. Fringe almost entirely black only a few basal scales orange, scales with compound apices of 5 or more tips. Ventral surface of hindwing as on dorsum, ♂ with a single compound frenular seta, ♀ with two separate frenular setae.

Abdomen with black scales except middle of disc and lateral margins of T II with orange scales, some specimens with base of lateral margin of T III with orange scales, and with a median longitudinal stripe of white scales on most sternites, most caudal sternite with more black scales; lacking any spines in discs or at posterior margins of tergites. Male genitalia (Fig. 10). Segment VIII similar in shape to the preceding segments, undifferentiated. Tegumen rectangular in ventral view, length 2X width at middle, dorsal anterior margin deeply emarginate, emargination extending 0.6X length of tegumen, emargination in middle as wide or wider than tegumen halves creating broad space with broadly rounded apex. Uncus deeply bifurcate with symmetrical halves, each uncus half straight from base with little or no narrowing or undulation, tip capitate, spoon-shaped with only a slight lateral extension or lip; length 0.8X tegumen length. Gnathos bifurcate with symmetrical halves, each half produced as ovate pad of denticles in ventral view, nearly as broad as long; subequal in length to uncus. Anal tube completely membranous. Vinculum U-shaped, ventral part longer, lateral area narrowing to articulation with tegumen, saccus not produced. Juxta a horizontal strap of cuticle, middle with a shallow dip, lateral ends expanded, lateral arms extending posteriorly and sharply tapered, length equal to length of gnathos pad. Diaphragm otherwise unadorned. Valve simple, sacculus not extremely expanded or separate from cucullus, with no extensions or processes, valves smoothly tapered from base out to narrow, but broadly rounded apex with no ventral expansion, longer than vinculum, tegumen, and uncus lengths combined. Phallus cylindrical (i.e., dorsum is sclerotized) for almost the posterior half and praephallus lacks any sclerotized lateral strip, tip blunt; not fused to juxta, with membranous attachment to diaphragm; ductus ejaculatorius as long as phallus, exiting ventrally with a very short caecum. Female genitalia (Fig. 11). Segment VIII width 1.2X length at level of ostium; width 3.25X width of ostium at level of ostium; anterior margin terminate; lamellae antevaginalis with smooth edge; lamellae postvaginalis with pair of hemispherical lobes with microsculpturing; anterior apophysis base located posteriorly and dorsally at posterior margin of tergite VIII, short, thick, terminus slightly beyond level of ostium. Segment IX entirely membranous, length 0.5X length of segment VIII, width 0.75X posterior width of segment VIII. Papilla analis divided into larger anterior pad and smaller posterior pad; anterior pad lamella-shaped, thin and semicircular, inner and outer surfaces covered with filiform setae, outer surface with hook-shaped setae, basal hook-like setae with flattened apices; posterior pad thin and slightly capitate, length 4X widest width of capitate section, covered with short, filiform setae, ventral surface of capitate section with large, hook-shaped setae on apical half, with two larger, filiform setae on outer edge at apex and one on outer margin at subapex. Posterior apophysis base located posterodorsally at anterior margin of papilla analis at division between anterior and posterior pads, mostly straight, terminus just reaching ostium. Antrum funnel-shaped,

terminus reaching anterior margin of segment VIII. Colliculum not visible. Ductus bursae length equal to length of segment VIII, cylindrical, same width as anterior end of antrum, entire length partially textured with longitudinal ridges. Ductus seminalis emerging from dorsum of ductus bursae immediately anterad antrum, width 1/5th width of ductus bursae at base, with no visible texture, continuing past duct to bulla seminalis. Bulla seminalis large and compound, formed from two large roughly hemispherical sacs larger than apical sac of corpus bursae, sacs separate and connected to each other by short duct, dislocated from ductus seminalis by duct almost as long as ductus bursae and twice as wide as ductus seminalis, basal sac attached to duct tangentially, apical sac with duct terminating in its concave center. Corpus bursae compound with an accessory sac anterad separated from main sac by narrow channel; main sac elongate, spindle-shaped, 4X longer than widest width, narrower posteriorly, membrane with longitudinal ridges; accessory sac spherical lengths and widths equal, membrane smoothly textured; signum not evident.

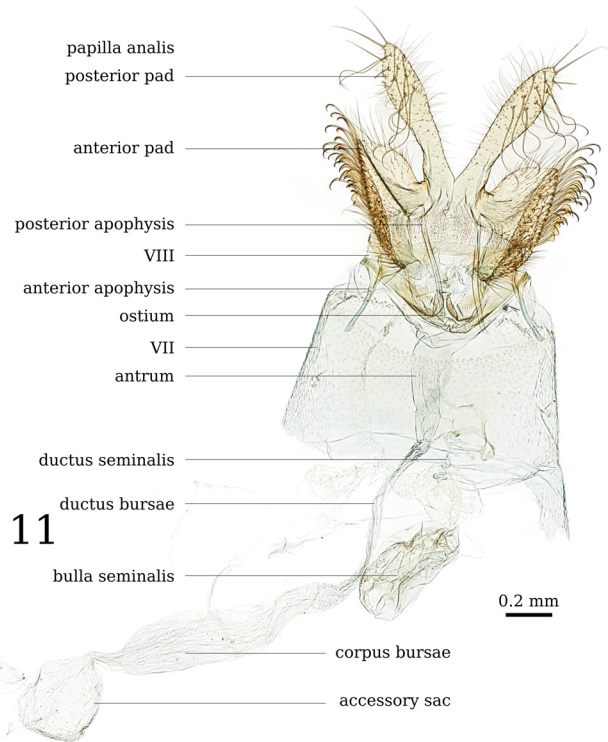
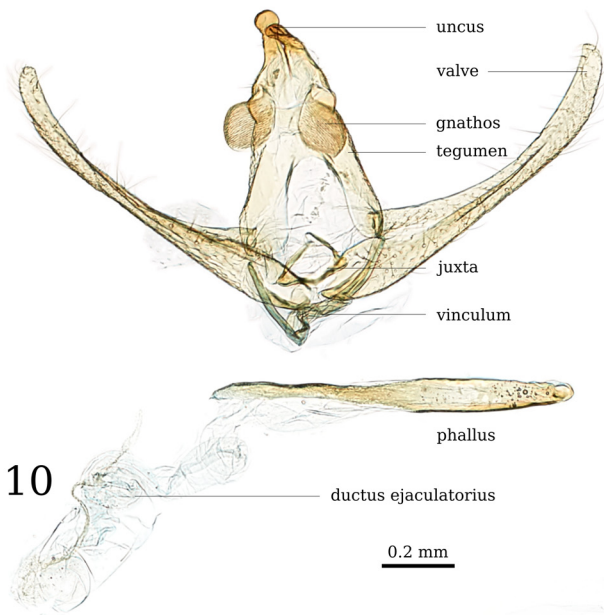
Immature stages not examined first hand. Pupa and cocoon as in images (Figs. 12–13.)

**DNA Barcode BOLD BIN.** BOLD:AAA0208 ([dx.doi.org/10.5883/BOLD:AAA0208](https://dx.doi.org/10.5883/BOLD:AAA0208))

**Specimens examined.** Holotype ♂ (USNMENT01370731, 14-SRNP-2654, USNM slide # 146543), Costa Rica, Area de Conservacion Guanacaste (ACG), Alajuela Province, Sector San Cristobal, Puente Palma, 460m, 10.9163, -85.37869, 28 May 2014, leg. Gloria Sihezar. Paratypes. (43 ♂♂, 48 ♀♀). 1 ♀ (USNMENT01328974, 11-SRNP-66055), Alajuela Province, Sector Rincon Rain Forest, Brasilia, 11.01825, -85.37199, 360m, 18 Oct 2011, leg. Duvalier Briceño; 1 ♀ (USNMENT01328825, 11-SRNP-80887), 2 ♂♂ (USNMENT01328749, 11-SRNP-80888; USNMENT01328947, 11-SRNP-80889) Alajuela Province, Sector Rincon Rain Forest, Cafecito, 10.94404, -85.31738, 455m, 09 Jul 2011, leg. Edwin Apu; 1 ♀ (USNMENT01369405, 11-SRNP-69982), 2 ♂♂ (USNMENT01369399, 11-SRNP-69984; USNMENT01369459, 11-SRNP-69983) Alajuela Province, Sector Rincon Rain Forest, Flecha, 10.94741, -85.31501, 491m, 05 Apr 2011, Edwin Apu; 1 ♂ (USNMENT01369387, 11-SRNP-80071) Alajuela, Province, Sector Rincon Rain Forest, Flecha, 10.94741, -85.31501, 491m, 18 Apr 2011, leg. Edwin Apu; 1 ♂ (USNMENT01328949, 13-SRNP-69424) Alajuela Province, Sector Rincon Rain Forest, Flecha, 10.94741, -85.31501, 491m, 13 Mar 2013, leg. Edwin Apu; 1 ♂ (USNMENT01370848, 13-SRNP-80785) Alajuela Province, Sector Rincon Rain Forest, Flecha, 10.94741, -85.31501, 491m, 05 Dec 2013, leg. Edwin Apu (deposited in NHMUK); 1 ♀ (USNMENT01328746, 11-SRNP-81613) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461m, 19 Oct 2011, leg. Duvalier Briceño; 3 ♀♀ (USNMENT01328762, 11-SRNP-81866; USNMENT01328890, 11-SRNP-81864 (deposited in NHMUK); USNMENT01328892, 11-SRNP-81867) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461m, 18 Nov 2011, leg. Edwin Apu; 1 ♀ (USNMENT01328754, 12-SRNP-69380) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461m, 20 Feb 2012, leg. Edwin Apu; 1 ♀ (USNMENT01328858, 12-SRNP-69892) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461m, 15 May 2012, leg. Edwin Apu; 1 ♂ (USNMENT01328954, 13-SRNP-80065) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461m, 15 Aug 2013, leg. Edwin Apu; 2 ♂♂ (USNMENT01328789, 13-SRNP-80617; USNMENT01328876, 13-SRNP-80616) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461m, 12 Nov 2013, leg. Edwin Apu; 3 ♂♂ (USNMENT01370890, 14-SRNP-80818; USNMENT01370893, 14-SRNP-80817 (deposited in NHMUK); USNMENT01370961, 14-SRNP-80816) Alajuela Province, Sector Rincon Rain Forest, Jacobo, 10.94076, -85.3177, 461, 08 Jul 2014, leg. Edwin Apu; 1 ♀ (USNMENT01369467, 10-SRNP-43579) Alajuela Province, Sector Rincon Rain Forest, Rio Francia Arriba, 10.89666, -85.29003, 400m, 01 Oct 2010, leg. Anabelle Cordoba; 1 ♀ (USNMENT01328885, 11-SRNP-81690), 1 ♂ (USNMENT01480141, 11-SRNP-81691) Alajuela Province, Sector Rincon Rain Forest, Selva, 10.92291, -85.31877, 410m, 31 Oct 2011, leg. Edwin Apu; 1 ♂ (USNMENT01370805, 14-SRNP-2655) Alajuela Province, Sector San Cristobal, Puente Palma, 10.9163, -85.37869, 460m, 28 May 2014, leg. Gloria Sihezar; 2 ♀♀ (USNMENT01370761, 14-SRNP-3962, USNM slide # 146542; USNMENT01370766, 14-SRNP-3960), 1 ♂ (USNMENT01370749, 14-SRNP-3958) Alajuela Province, Sector San Cristobal, Rio Blanco Abajo, 10.90037, -85.37254, 500m, 04 Sep 2014, leg. Gloria Sihezar; 4 ♀♀ (USNMENT01369365, 09-SRNP-2025; USNMENT01369366, 09-SRNP-2023 (deposited in NHMUK); USNMENT01369397, 09-SRNP-2020), 2 ♂♂ (USNMENT01369418, 09-SRNP-2027; USNMENT01369469, 09-SRNP-2017 (deposited in NHMUK)) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 16 May 2009, leg. Elda Araya; 1 ♀ (USNMENT01328956, 11-SRNP-3986) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 11 Oct 2011, leg. Gloria Sihezar; 1 ♂ (USNMENT01328581, 11-SRNP-4310) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 04 Nov 2011, leg. Elda Araya; 2 ♀♀ (USNMENT01328836, 12-SRNP-86; USNMENT01328878, 12-SRNP-87) Alajuela Province, Sector San Cristobal, Sen-

dero Huerta, 10.9305, -85.37223, 527m, 07 Jan 2012, leg. Carolina Cano; 2 ♀♀ (USNMENT01328793, 12-SRNP-857; USNMENT01328918, 12-SRNP-859), 1 ♂ (USNMENT01328807, 12-SRNP-858) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 03 Mar 2012, leg. Elda Araya; 3 ♀♀ (USNMENT01328697, 12-SRNP-1300; USNMENT01328779, 12-SRNP-1311; USNMENT01328887, 12-SRNP-1304) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 01 Apr 2012, leg. Osvaldo Espinoza; 2 ♀♀ (USNMENT01328745, 12-SRNP-1358; USNMENT01328784, 12-SRNP-1354), 3 ♂♂ (USNMENT01328873, 12-SRNP-1356; USNMENT01328937, 12-SRNP-1351; USNMENT01480140, 12-SRNP-1352) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 04 Apr 2012, leg. Gloria Sihezar; 1 ♀ (USNMENT01328851, 12-SRNP-1574) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 20 Apr 2012, leg. Elda Araya; 1 ♀ (USNMENT01328809, 12-SRNP-1722) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 28 Apr 2012, leg. Osvaldo Espinoza (deposited in NHMUK); 1 ♂ (USNMENT01328888, 12-SRNP-1852), Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 10 May 2012, leg. Elda Araya; 1 ♀ (USNMENT01328827, 12-SRNP-2631), 2 ♂♂ (USNMENT01328593, 12-SRNP-2628; USNMENT01328907, 12-SRNP-2629) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 26 Jun 2012, leg. Gloria Sihezar; 1 ♀ (USNMENT01328853, 12-SRNP-2936), 1 ♂ (USNMENT01328776, 12-SRNP-2921) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 09 July 2012, leg. Carolina Cano; 1 ♂ (USNMENT01328852, 13-SRNP-138) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 11 Jan 2013, leg. Osvaldo Espinoza; 1 ♀ (USNMENT01328996, 13-SRNP-137) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 12 Jan 2013, leg. Gloria Sihezar; 1 ♂ (USNMENT01328903, 13-SRNP-644) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 07 Feb 2013, leg. Gloria Sihezar; 1 ♂ (USNMENT01328769, 13-SRNP-3014) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 13 Jun 2013, leg. Gloria Sihezar; 1 ♀ (USNMENT01328992, 13-SRNP-3094), 1 ♂ (USNMENT01328965, 13-SRNP-3093) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 17 Jun 2013, leg. Gloria Sihezar; 1 ♀ (USNMENT01370769, 14-SRNP-3090) Alajuela Province, Sector San Cristobal, Sendero Huerta, 10.9305, -85.37223, 527m, 26 Jun 2014, leg. Gloria Sihezar; 1 ♂ (USNMENT01480139, 10-SRNP-5577) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 26 Sep 2010, leg. Elda Araya; 1 ♀ (USNMENT01369342, 10-SRNP-6906), 1 ♂ (USNMENT01369377, 10-SRNP-6901) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 18 Nov 2010, leg. Elda Araya; 1 ♂ (USNMENT01480138, 10-SRNP-3754) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 12 Jul 2011, leg. Gloria Sihezar; 1 ♀ (USNMENT01328995, 11-SRNP-3252) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 22 Aug 2011, leg. Gloria Sihezar; 1 ♀ (USNMENT01328748, 11-SRNP-3849), 2 ♂♂ (USNMENT01328826, 11-SRNP-3851; USNMENT01328953, 11-SRNP-3846) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 26 Sep 2011, leg. Elda Araya; 4 ♀♀ (USNMENT01328822, 11-SRNP-4934; USNMENT01328838, 11-SRNP-4932; USNMENT01328886, 11-SRNP-4935; USNMENT01328894, 11-SRNP-4936) 1 ♂ (USNMENT01328812, 11-SRNP-4933) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 12 Dec 2011, leg. Carolina Cano; 1 ♀ (USNMENT01328908, 12-SRNP-151), 2 ♂♂ (USNMENT01328868, 12-SRNP-150; USNMENT01328977, 12-SRNP-152) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 16 Oct 2012, leg. Elda Araya; 1 ♀ (USNMENT01328768, 12-SRNP-1338) Alajuela Province, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 03 Apr 2012, leg. Elda Araya; 1 ♂ (USNMENT01455959, 11-SRNP-71665) Guanacaste Province, Sector Pitilla, Manguera, 10.9959, -85.39842, 470m, 02 Aug 2011, leg. Freddy Quesada; 1 ♂ (USNMENT01480160, 17-SRNP-72079), 2 ♀ (USNMENT01480157, 17-SRNP-72080; USNMENT01480159, 17-SRNP-72077) Guanacaste Province, Sector Pitilla, Manguera, 10.9959, -85.39842, 470m, 02 July 2017, leg. Dinia Martinez; 1 ♀ (USNMENT01480158, 17-SRNP-72076) Guanacaste Province, Sector Pitilla, Manguera, 10.9959, -85.39842, 470m, 30 Jun 2017, leg. Dinia Martinez; 1 ♂ (USNMENT01370737, 14-SRNP-71285) Guanacaste Province, Sector Pitilla, Medrano, 11.01602, -85.38053, 380m, 12 July 2014, leg. Dinia Martinez; 1 ♀ (USNMENT01370715, 14-SRNP-71622), 1 ♂ (USNMENT01370732, 14-SRNP-71623) Guanacaste Province, Sector Pitilla, Medrano, 11.01602, -85.38053, 380m, 12 Jul 2014, leg. Ricardo Calero; 1 ♀ (USNMENT01370962, 14-SRNP-71635) Guanacaste Province, Sector Pitilla, Medrano, 11.01602, -85.38053, 380m, 05 Sep 2014, leg. Dinia Martinez.





**FIGURES 8–13.** *Tinaegeria carlosalvaradoi* Metz, new species. 8, adult dorsal view ♂ paratype (USNMENT01370961, 14-SRNP-80816); 9, adult dorsal view ♀ paratype (USNMENT01370769, 14-SRNP-3090); 10, genitalia ♂ holotype (USNMENT01370731, 14-SRNP-2654, USNM slide # 146543); 11, genitalia ♀ paratype (USNMENT01370761, 14-SRNP-3962, USNM slide # 146542); 12, larva in situ (09-SRNP-2020-DHJ462981); 13, larva in situ (09-SRNP-2020-DHJ462982). Measure bars. FIGS 8–9 = 5.0 mm; FIGS 10–11 = 0.2 mm.



**Distribution.** *Tinaegeria carlosalvaradoi* is known from specimens collected at just a few locations in Costa Rica, but likely occurs throughout the range of the only known food plant

**Biology.** The larva of *Tinaegeria carlosalvaradoi* feeds on the mature leaves of the ACG rain forest treelet, *Neea psychotrioides* (Nyctaginaceae). It lives between several leaves lightly silked together and spins a distinctive, ovoid, white, flat cocoon on the leaf surface.

**Remarks.** As described above as a generic trait, it has a sesiid-like shape and color that suggests that it is likely mimicking some other distasteful or painful insect to be avoided, such as lycid beetles, lampyrid beetles, or stinging wasps. It has been seen ostentatiously walking on the upper surface of leaves in full daylight, with the leisurely walking pace of a lycid beetle. While commonly reared, this moth species has not been encountered at an ACG light trap.

### ***Tinaegeria romanmacayai* Metz, new species**

urn:lsid:zoobank.org:act:96AEB2CF-C06B-4B26-95AF-A79A8D253550

(Figs. 14–16)

**Etymology.** This species is named in honor of Dr. Román Macaya, in recognition of his proactive and intense support for BioAlfa, the initiating biodiversity inventory of Costa Rica, while simultaneously being the Costa Rican ambassador to the United States.

**Diagnosis.** *Tinaegeria romanmacayai* can be recognized by its pattern and coloration making it an apparent mimic of a species of Lampyridae, the half-cordate shaped gnathos halves, and the praepallus being mostly membranous.

**Description.** Scales in a pattern to resemble a lampyrid when at rest. Head scales dark gray to black iridescent, some scales at hind margin of head beige and pink, some areas rubbed so scale color is ambiguous. Ocellus absent. Compound eye height and length equal through the middle, but dorsal margin sinuate with an obtuse angle dorsally, an obtuse inward angle at a level dorsad antenna, and an obtuse outward angle dorsad antenna. What is left intact of antenna scales entirely black; image of live specimen shows white, subapical scale patch; at least basal half with long and densely packed ventral setae making the antenna appear thicker, seta length 3X width of antenna; pecten absent. Labial palpus curved well above top of head, completely smooth-scaled; scales dark gray laterally, light medially and at extreme base; second and third segments gently curved; second and third segments lengths equal. Maxillary palpus scales light orange. Pilifer scales light orange with an apical brush of orange setae. Visible part of base of haustellum with white scales.

Thorax scales pink dorsally with a broad median, black strip on the dorsum through the metascutellum; a lateral patch of light orange; a broad, black lateral strip through the middle of the pleura; and white scales ventrally. Legs predominantly white-scaled basally and black distally, but scales rubbed so any pattern is mostly lost. Forewing length 8.4 mm (Figs. 14–15), narrow length 5X width at middle, apex rounded. Dorsal scales dark gray to black with coppery sheen, anterior margin and narrow streak through discal cell light orange to beige, extreme base pink bordered by a subapical band of black scales. Ventral surface of forewing dark gray iridescent with lighter scales anteriorly and pink scales basally; scales of retinaculum mostly light orange, with a row of closely associated, posteriorly-directed scales on the base of Sc. Fringe mostly missing, scales dark gray to black. Hindwing 6.9 mm, length 4X width at middle, apex broadly acuminate; dorsal surface with black iridescent scales, scales at anterior margin light orange, basal 1/6 with light orange and pink scales, membrane bare of any scales in small circular patches in middle of cells CuA2, in cell CuP, and anal area. Remaining fringe almost entirely black only a few basal scales pink. Ventral surface of hindwing as on dorsum, anal area with more pink scales, with a single compound frenal seta.

Abdomen with pink scales except caudal margin of tergite VIII and tegumen with dark gray to black scales, ventrally with ivory white scales exposed where pink scales were rubbed; lacking any spines in discs or at posterior margins of tergites. Male genitalia (Fig. 16). Segment VIII similar in shape to the preceding segments, undifferentiated. Tegumen rectangular in ventral view, length 2X width at middle, dorsal anterior margin deeply emarginate, emargination extending 0.5X length of tegumen, emargination in middle wider than tegumen halves at anterior margin, but tapering quickly to sharp apex posteriorly. Uncus bifurcate with symmetrical halves, uncus half straight from base with little or no narrowing or undulation, tip capitate, spoon-shaped with only a slight lateral extension

or lip; length 0.6X tegumen length. Gnathos bifurcate with symmetrical halves, each half produced as half-cordate pad of denticles with the point ventrad in ventral view and inner margin emarginate, nearly as broad as long; length 0.6Xlength of uncus. Anal tube completely membranous. Vinculum U-shaped, ventral part longer, lateral area narrowing to articulation with tegumen, saccus not produced. Juxta v-shaped, coming to a blunt point ventrally, lateral arms extending posteriorly and sharply tapered surrounding phallus at diaphragm, length equal to length of uncus. Diaphragm otherwise unadorned. Valve simple, sacculus not extremely expanded or separate from cucullus, with no extensions or processes, valve broader at base then smoothly tapered and parallel-sided out to squared apex, apicodorsal angle slightly pointed, longer than vinculum, tegumen, and uncus lengths combined. Phallus straight, praephallus with sclerotized lateral strip that turns dorsomedially at apex, apex mostly membranous except for lateral strip; not fused to juxta, with membranous attachment to diaphragm; ductus ejaculatorius as long as phallus, exiting ventrally with a very short caecum, with a large, kidney-shaped bulla.



**FIGURES 14–16** *Tinaeigeria romanmacayai* Metz, new species. 14, live adult showing resemblance to a lampyrid; 15, adult dorsal view ♂ holotype (USNMENT01441625, 14-SRNP-100909); 16, genitalia ♂ holotype (USNMENT01441625, 14-SRNP-100909, USNM slide # 1465551). Measure bars. FIG 15 = 5.0 mm; FIG 16 = 0.2 mm.

**DNA Barcode BOLD BIN.** BOLD:AAK9344 ([dx.doi.org/10.5883/BOLD:AAK9344](https://dx.doi.org/10.5883/BOLD:AAK9344))

**Specimens examined.** Holotype ♂ (USNMENT01441625, 14-SRNP-100909, USNM slide # 146551), Costa Rica, Area de Conservacion Guanacaste (ACG), Guanacaste Province, Sector Pailas Dos, PDL #10, 788m, 10.76171, -85.32331, 28 Mar 2014, leg. H. Cambroner, S. Rios, light trap. Paratype. 1 ♂ (USNMENT01480156, 14-SRNP-

100830), Costa Rica, Area de Conservacion Guanacaste (ACG), Guanacaste Province, Sector Pailas Dos, PDL #8, 788m, 10.7626, -85.3246, 28 Mar 2014, leg. H. Cambroner, S. Rios, light trap.

Female unknown.

Immature stages unknown.

**Distribution.** *Tinaeergia romanmacayai* is known from two specimens collected in Costa Rica.

**Biology.** Unknown. The specimens were collected at light.

**Remarks.** As is the case with the nocturnal and aposematic distasteful adult Lampyridae, which are hidden in the daytime, we suspect lampyrid mimicry to be effective if this moth is found by a foraging bird.

## Genus *Percnarcha* Meyrick, 1915 (Gelechiidae: Gelechiinae)

*Percnarcha* Meyrick, 1915: 212. Type species: *Tinaeergia trabeata* Meyrick, 1909; 18: [Songo], Bolivia; by original designation.

Meyrick (1915) described the genus *Percnarcha* in the family Heliodinidae for the species *Tinaeergia trabeata* Meyrick, 1909. At the time, the genus *Tinaeergia* was considered to be in the family Sesiidae (clearwing moths) and Meyrick recognized that *T. trabeata* was not in that family (Meyrick 1915). Since then, the genus has been placed in four different families (Becker 1999). Becker (1999) placed the genus in the subfamily Gelechiinae (Gelechiidae) based on wing venation and genitalia. Although the apodemes of sternite II (Fig. 21) are not typical of Gelechiinae, the subfamilial placement of Becker (1999) is not tested here and retained. The confusion over family placement is probably a result of these small moths' mimicry of stinging wasps in the family Braconidae, and wasps in general, since in the daytime it flies like a wasp as well as generally resembling a wasp. All of the species have dark scales with blue iridescent sheen, and patterns of orange, red, or pink scales on the wings and body. They also have distinct patches of white scales on the ends of the antennae and on the underside of the thorax. This coloration, in addition to the way these diurnal moths fly, make them appear quite similar to small wasps that occur in the same rain forest. Until now, the genus was represented by four described species occurring in South America (Brazil, Argentina, and Bolivia) (Becker 1999). Members of the genus have narrow wings with species-specific patterns of black and yellow, orange, or pink scales. The hindwing has bare membrane similar to sesiid moths. Male and female genitalia are typical of Gelechiidae, the male having separate valve components and the juxta fused with the sacculus base and the female having a pheromone gland sac and rhomboid-shaped signum.

### *Percnarcha claudiadoblesae* Metz, new species

urn:lsid:zoobank.org:act:B843E162-3D36-48D1-AAE0-AD88B16410CF

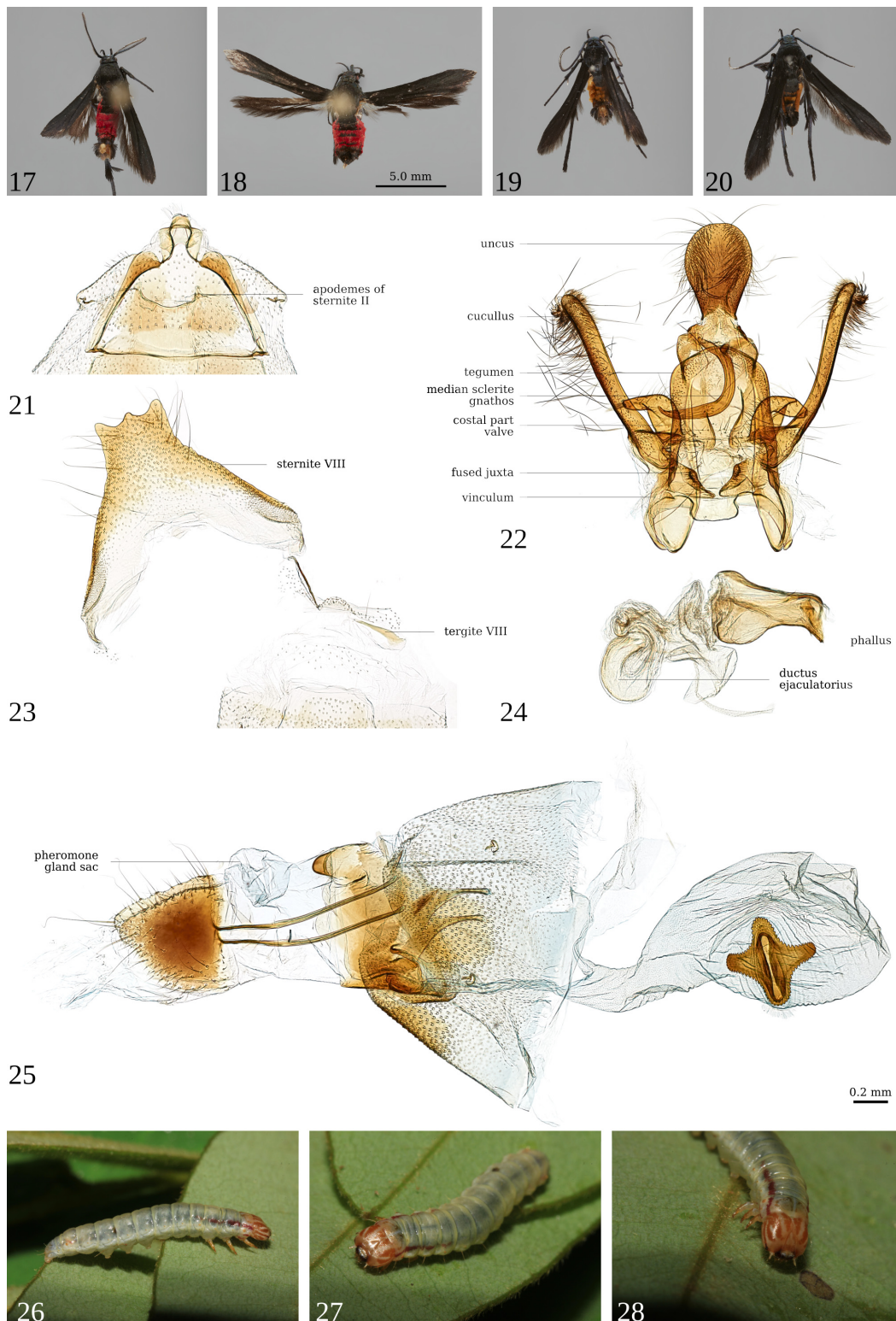
(Figs. 17–28)

**Etymology.** This species is named in honor of Claudia Dobles Camargo, First Lady of Costa Rica and dedicated biopolitical force for Costa Rica's survival and socioeconomic development as a truly green tropical country that is on its way to becoming bioliterate while being an exemplary tropical country for controlling, mitigating and reducing its contributions to climate change.

**Diagnosis.** *Percnarcha claudiadoblesae* can be recognized by having the head, thorax, legs, and forewing scales completely black or dark blue dorsally; a broadly ovate distal uncus in ventral view; the median margin of fused juxta with an acute posteriorly directed extension lateral to phallus; and the costal part of valve apex quickly tapering to blunt point, extreme apex with three long setae directed in line with apex.

**Description.** Scales predominantly black and pink or orange. Head scales black with blue-green iridescent sheen. Ocellus absent. Compound eye height 1.2X length through the middle, dorsal angle slightly acute. Antenna scales entirely black except a patch of bright white scales dorsally at subapex; pecten absent; in ♂ flagellomeres with numerous long, appressed black setae ventrally to apex; in ♀ flagellomeres with sparse, short erect setae ventrally. Labial palpus curved well above top of head, second segment rough-scaled, but scales not excessively long, no longer than width of segment; second and third segments gently curved and equal in length; scales black. Maxillary palpus black. Pilifer with an apical brush of gold setae. At least 0.5 haustellum with dense cover of black scales basally.





**FIGURES 17–28.** *Percnarcha claudiadoblesae* Metz, new species. 17, adult dorsal view ♂ holotype (USNMENT01328585, 04-SRNP-56459); 18, adult dorsal view ♀ paratype (USNMENT01328579, 03-SRNP-20878); 19, adult dorsal view ♂ paratype (USNMENT01328512, 10-SRNP-4852); 20, adult dorsal view ♀ paratype (USNMENT01328534, 10-SRNP-4854); 21, abdominal segment II ♂ holotype (USNMENT01328585, 04-SRNP-56459, USNM slide # 146544); 22, genital capsule ♂ holotype (USNMENT01328585, 04-SRNP-56459, USNM slide # 146544); 23, abdominal segment VIII ♂ holotype (USNMENT01328585, 04-SRNP-56459, USNM slide # 146544); 24, phallus ♂ holotype (USNMENT01328585, 04-SRNP-56459, USNM slide # 146544); 25, genitalia ♀ paratype (USNMENT01328579, 03-SRNP-20878, USNM slide # 146545); 26, larva in situ (15-SRNP-30729-DHJ721915); 27, larva in situ (15-SRNP-30729-DHJ721918); 28, larva in situ (15-SRNP-30729-DHJ721917). Measure bars. FIGS 17–20 = 5.0 mm; FIGS 21–25 = 0.2 mm.



Thorax scales black with blue-green iridescent sheen; except some scales at the base of the forecoxa, apices of all coxae, and extreme apical scales of the tibial spurs shiny white; mid- and hindtibiae with two whorls of longer scales, dorsal scales longer, one at middle and one at tibial apex. Forewing length ♂ 7.6–8.2 mm (Figs. 17, 19), ♀ 8.7–9.4 mm (Figs. 18, 20), narrow length 7X width at middle, apex rounded. Scales black except on ventral surface with some scales on anterior margin and at base into anal area shiny white. Fringe with compound apices of 5 or more tips. Hindwing ♂ 6.7–6.9 mm, ♀ 7.5–7.8 mm, length 5X width at middle, apex broadly acuminate; scales black except membrane bare of any scales in small elongate patches in middle of cells CuA2, CuP, and anal area. Fringe with compound apices of 5 or more tips. Ventral surface of hindwing as on dorsum except with some shiny white scales basally, ♂ with a single compound frenular seta, ♀ with three separate frenular setae.

Abdomen with orange or pink scales except disc of tergite II and sternite III and terminal 1–3 segments with black scales. Segment VIII differentiated in shape from the preceding segments; tergite VIII a narrow, glabrous strap, with an expanded setose disc in middle; sternite VIII triangular and emarginate anteriorly, base wider than apex, densely setose, apex forked with three flat, posteriorly directed, acute extensions, middle extension slightly shorter. Male genitalia (Figs. 23–24). Tegumen rectangular in ventral view, narrowed apically before uncus creating a “shoulder,” length 3X width at middle, dorsal anterior margin broadly emarginate, emargination extending to point 0.3X length of tegumen and apex broadly rounded, dorsal surface convex and densely setose, ventral surface glabrous with a median channel. Uncus paddle-shaped, apex ovate in ventral view, ventral surface concave, dorsal surface convex, densely setose, less densely setose medially on ventral surface; length 0.4X tegumen length. Gnathos 1.2X longer than uncus; lateral arm fused to tegumen laterally, articulating with median sclerite medially, sinuate; median sclerite base v-shaped, base width in ventral view subequal to uncus base width, sharply tapered to point, in lateral view curved 90 degrees with extreme apex curved more forming short hook. Anal tube completely membranous with a slightly expanded pouch at base of gnathos lacking setae, denticles, or sclerotized supports. Vinculum a short strap, saccus length only 2X length of vinculum, broad, width 2X length, apex broadly rounded. Juxta fused to sacculus, split medially ventrad gonopore, median margin setose with an acute posteriorly directed extension lateral to phallus. Diaphragm lateral and dorsal of phallus setose with no extensions or processes. Valve complex, sacculus flat, not expanded, distinct from rest of valve by sulcus; cucullus digitate, roughly parallel-sided with rounded apex, densely setose with apical patch of dense setae; costal part of valve pyriform, bent ventrally 90 degrees at middle, apex quickly tapering to blunt point, extreme apex with three long setae directed in line with apex. Phallus anterior end laterally expanded, praephallus cylindrical, slightly dorsoventrally flattened, posterior end with a ventral lip and single lateral tooth; ductus ejaculatorius length 2X length of phallus, exiting anteriorly with no caecum, bulla narrow and kidney-shaped. Female genitalia (Fig. 25). Segment VIII sclerotized, glabrous, laterally flattened, dorsum with overhanging knob posteriorly; lamellae antevaginalis in a narrow u-shape surrounding ostium creating a sharp lip; lamellae postvaginalis convex forming a knob posterad ostium extending into a longitudinal mound; anterior apophysis base laterad, base broad, terminus extending to middle of segment VII, apex slightly capitate. Segment IX entirely membranous, length 1.2X length of segment VIII, width equal to posterior width of segment VIII; pheromone gland sac spherical, single-lobed. Papilla analis sclerotized, laterally flattened, triangular in lateral view with point directed posteriorly. Posterior apophysis base laterad papilla, mostly straight, terminus just reaching ostium. Antrum funnel-shaped, terminus extending beyond posterior margin of segment VII. Colliculum not visible. Ductus bursae length equal to length of segment VIII, cylindrical, same width as anterior end of antrum, entirely membranous and lacking texture. Ductus seminalis emerging from dorsum of ductus bursae anterad antrum at a distance equal to 3X width of ductus bursae, width equal to width of ductus bursae at base, with no visible texture, continuing past duct to bulla seminals. Corpus bursae simple, pyriform, 2X longer than widest width, narrower posteriorly, membrane with minute denticles and longitudinal ridges around signum; signum cross-shaped, longitudinal and lateral arms equal in length, longitudinal arms blunt with small teeth on inner surface near apex and around margin, lateral arms broadly rounded with small teeth on inner surface near apex and around margin, signum cut by transverse channel on exterior face with overhung flanges from longitudinal arms.

**DNA Barcode BOLD BIN.** BOLD:AAI9186 ([dx.doi.org/10.5883/BOLD:AAI9186](https://dx.doi.org/10.5883/BOLD:AAI9186))

**Specimens examined.** Holotype ♂ (USNMENT01328585, 04-SRNP-56459, USNM slide# 146544), Costa Rica, Area de Conservacion Guanacaste (ACG), Guanacaste Province, Sector Pitilla, Sendero Nacho, 710m, 10.98445, -85.42481, 26 Nov 2004, leg. Calixto Moraga, ex. *Machaerium floribundum*. Paratypes. 1 ♀ (USNMENT01480154, 15-SRNP-30729), 1 ♂ (USNMENT01480155, 15-SRNP-30730) Costa Rica, Area de Conservacion Guanacaste (ACG), Guanacaste Province, Sector Pitilla, Sendero Nacho, 710m, 10.98445, -85.42481, 26 Nov 2004, leg. Ca-

lixto Moraga, ex. *Machaerium salvadorensis*; 1 ♀ (USNMENT01328579, 03-SRNP-20878, USNM slide # 146545), Area de Conservacion Guanacaste, Sector Pitilla, Estacion Pitilla, 10.98931, -85.42581, 675m, 31 Aug 2003, leg. Petrona Rios, ex. *Machaerium salvadorensis*; 2 ♂♂ (USNMENT01328486, 10-SRNP-4853; USNMENT01328512, 10-SRNP-4852), 1 ♀ (USNMENT01328534, 10-SRNP-4854) Area de Conservacion Guanacaste, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 29 Aug 2010, leg. Osvaldo Espinoza, ex. *Machaerium cobanense*; 1 ♂ (USNMENT01328459, 10-SRNP-4990) Area de Conservacion Guanacaste, Sector San Cristobal, Tajo Angeles, 10.86472, -85.41531, 540m, 01 Sep 2010, leg. Elda Araya, ex. *Machaerium cobanense*.

Immature stages not examined first hand. Larva as in images (Figs. 26–28.)

**Distribution.** *Percnarcha claudiadoblesae* is known from specimens collected at just a few locations in Costa Rica, but likely occurs throughout the range of the known food plants.

**Biology.** The larva uses silk to tie mature leaves of rain forest treelets *Machaerium salvadorensis*, *Machaerium floribundum*, and *Machaerium cobanense* (Fabaceae). Instead of chewing off entire leaf pieces, the larva distinctively scrapes off the upper green cells of the leaf while hidden below adjacent leaves silked on top of the one being fed on.

**Remarks.** No specimens of these moths have been collected in ACG light traps at the same localities they have been collected in Malaise traps suggesting they may not be active at night.

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