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Taxonomic revision of the genus *Schildia* Aldrich, 1923 (Diptera: Asilidae: Leptogastrinae) with the description of new extant and extinct species

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Abstract

Schildia Aldrich, 1923, a distinctive and rarely collected genus of Leptogastrinae (Diptera: Asilidae), is revised. Ten species are recognized, of which four are new to science. The nine extant species are Afrotropical, Neotropical and Oriental in distribution. The extant Neotropical species are *Schildia alphus* Martin, 1975, *Schildia caliginosa* sp.n. (Ecuador and Venezuela), *Schildia fragilis* (Carrera, 1944), *Schildia guatemalae* Martin, 1975, *Schildia gracillima* (Walker, 1855), *Schildia jamaicensis* Farr, 1963, and *Schildia microthorax* Aldrich, 1923. The only extant Afrotropical species, *Schildia adina* sp.n., is described from extant and subfossilized specimens (Malagasy copal) from south-western Madagascar. The extant Oriental species, *Schildia malaya* sp.n., is described from northern Malaysia. One extinct species, †*Schildia martini* sp.n., is newly described from Dominican amber. Two new synonyms are proposed: *Schildia ocellata* Martin, 1975 is a junior synonym of *Schildia gracillima* and *Schildia zonae* Martin, 1975 is synonymized with *Schildia fragilis*. Redescriptions and descriptions of the genus and all extant and extinct species are provided. An identification key to the extant and extinct species is presented. Illustrations, photographs, and scanning electron micrographs are provided to support the descriptions and key. Distribution, biogeography, occurrence in biodiversity hotspots, seasonal incidence and biology are discussed.

Keywords

Schildia, Leptogastrinae, Asilidae, Neotropical, Afrotropical, Oriental, Dominican amber, biodiversity hotspots

Introduction

The robber-fly genus *Schildia* Aldrich, 1923 is very distinctive within Leptogastrinae, but known only from very few specimens. Until now, *Schildia* was thought to be restricted to the Neotropical region and was recently reviewed by Martin (1975) who added four new species. The discovery of specimens in Dominican amber and Malagasy

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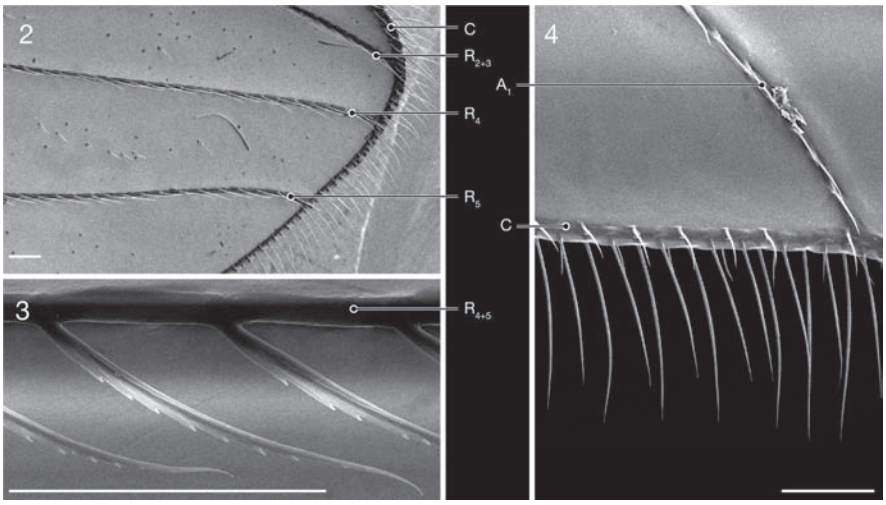
copal resembling extant *Schildia* species very closely, made a comparison to all extant species necessary. It became clear that new, yet undescribed extant and extinct species from the Afrotropical, Neotropical and Oriental regions were awaiting description and are dealt with in this taxonomic revision (Fig. 1).

Species of *Schildia* are very distinct with respect to other Leptogastrinae species (e.g., Aldrich 1923, Carrera 1944, Martin 1975). The most obvious features are: long, regularly spaced trichoid spicules on the R and M wing veins (Figs 2, 3); asymmetrical tarsal claws in which the median claw is shorter than the lateral one (Figs 7, 8); unusually long dorsocentral setae; the medially undivided epandrium in the male terminalia (in most species) (e.g., Fig. 32); and the absence of surstyli in the male terminalia (e.g. Fig. 13, but see also generic description). Martin (1975) relied heavily on coloration of thoracic sclerites in his identification key to the then eight known species. These color characters were found to be inadequate to separate species and other features, e.g., shape of face, frons and vertex, chaetotaxy, and coloration and pruinosity of scutum and legs, are proposed for identification instead.

Biological information about species of *Schildia* is scarce. Farr (1963) recorded *Schildia jamaicensis* Farr, 1962 perching head upwards in secluded areas on spider webs coming and going at will. "Most of the specimens of *S. jamaicensis* have been collected as they rested in spider webs located in niches in banks and cliffs; others were collected as they hovered about the webs" (Farr 1963: 20). However, he did not note any direct interaction, i.e., predation or kleptoparasitism, between the spiders and the flies. Fisher (in press) observed *Schildia microthorax* Aldrich, 1923 perching on shaded wood about a meter off the ground. The Afrotropical Leptogastrinae species *Lasiocnemus lugens* Loew, 1858 has been observed to prey predominantly on spiders by hovering above umbelliferous flower heads and plucking them off by swooping down suddenly (Londt 2006; Dikow 2007). Other genera of Leptogastrinae have been shown to feed on resting prey and are thought to feed on spiders as well (e.g., Melin 1923; Newkirk 1963; Martin 1968a). However, more extensive observations were not recorded until Londt (2006) published his account. That *Schildia* species have an ecological interaction with spiders directly in their webs is a reasonable conclusion and evidence is presented by the unequally long tarsal claws that resemble those of *Lipokophila eberhardi*

Fig. 1. Map of the world with extant and extinct distribution of *Schildia* indicated with solid circles. Note the restricted Old World distribution in Madagascar and Malaysia.



Figs 2–4. SEM micrographs of wing of *Schildia microthorax* (EMF, Costa Rica) with veins labeled. (2) Distal tip of wing; (3) detail of trichoid spicules; (4) posterior margin of wing. Scale bars = 50 µm.

Schuh, 1993 (Heteroptera: Plokiophilidae). This species of true bugs lives in aggregation on the webs of *Tengella radiata* (Kulczynski, 1909) (Araneae: Tengellidae) in Costa Rica, feeding from the spiders' kills and moving around deftly in a web that would trap other insects (Eberhard et al. 1993). The morphological similarity of the tarsal claws to known kleptoparasitic Plokiophilidae species (Figs 7, 8) and field observations of *Schildia* species closely associated with spider webs might suggest that species of *Schildia* use spider webs as refuges, perching sites, feed on the spiders, or are perhaps even kleptoparasites "stealing" the spiders' prey items directly from the web.

Review of previous taxonomic research on *Schildia*

Walker (1855) described *Leptogaster gracillimus* from Brazil.

Williston (1891) listed *Leptogaster gracillima* in his catalogue of South American Asilidae.

Aldrich (1923) erected the genus *Schildia* with its type species *microthorax* from Higuito, Costa Rica. He differentiated the genus from other Leptogastrinae by the trichoid spicules on the wing veins, a pair of presutural dorsocentral setae, and R_1 running parallel to C to the apex of the wing (Fig. 36).

Carrera (1944) described the genus *Shannomyioleptus* with the type species *fragilis* from Maracaju, Brazil. He provided illustrations of the wing, antennae and trichoid spicules on the wing veins of this species. He compared *Schildia* to *Shannomyioleptus* and differentiated it based on the two pairs of presutural dorsocentral setae and the different wing venation in respect to R_1.

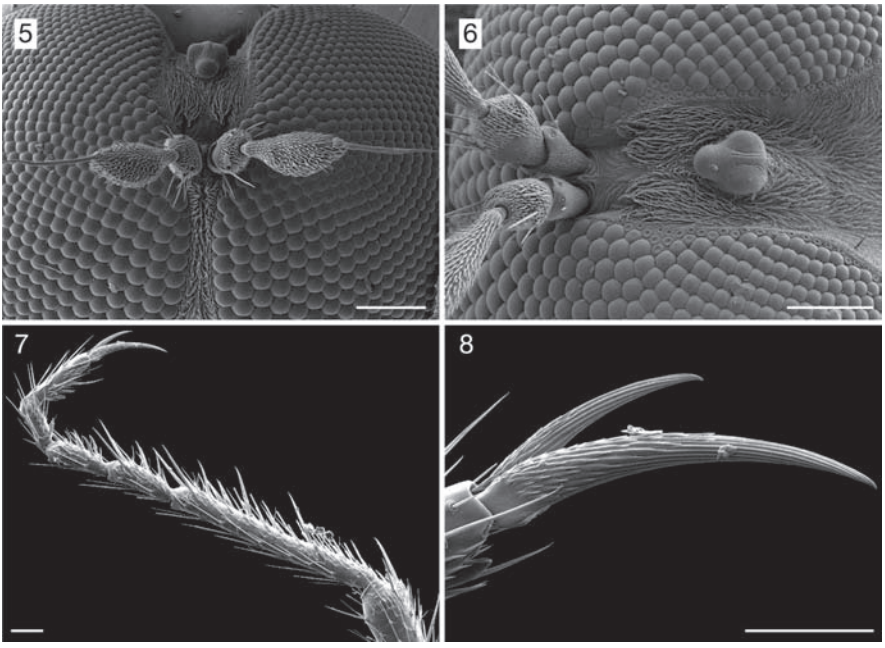
Carrera (1950) provided a key to the Neotropical Leptogastrinae and separated *Schildia* and *Shannomyioleptus* based on the number of presutural dorsocentral setae.

Farr (1962) described *Schildia jamaicensis* from Long Mountain, Jamaica. He noted some behavioral characteristics pertaining to prey selection. He provided illustrations of the head in lateral view, metathoracic legs, wings, male abdomen, male and female external terminalia, aedeagus, gonocoxites, gonostyli and female S8.

Hull (1962) ranked *Shannomyioleptus* as a subgenus of *Schildia* therefore synonymizing the two genera. He provided distinguishing characters for the two subgenera *Schildia* and *Shannomyioleptus*.

Farr (1963) reviewed the Leptogastrinae of Jamaica. He verified that the palpi of *Schildia jamaicensis* are actually one-segmented and not two-segmented as published in the original description (Farr 1962). He also discussed the behavior, distribution, and seasonality of *Schildia jamaicensis*.

Martin (1965) clearly stated that *Shannomyioleptus* is a junior synonym of *Schildia*, but did not accept subgeneric rank for *Shannomyioleptus*. In redescribing *Schildia*, he newly combined *Leptogaster gracillimus* with *Schildia* and provided a redescription of this species. Martin mentioned an undescribed *Schildia* species from Guatemala, a second undescribed species in the BMNH (placed in the wrong genus by Bromley), and another undescribed *Schildia* species "misidentified by Hermann as *Leptogaster kamerlocheri* [sic] Schiner, country unknown" in the Naturhistorisches Museum Wien (Austria). Martin provided illustrations of the wing of *gracillima* and the antennae of *fragilis*, *gracillima* and *jamaicensis*.



Figs 5–8. SEM micrographs of head and metathoracic tarsus of *Schildia microthorax* (EMF, Costa Rica). (5) Head, anterior view; (6) head, dorsal view; (7) tarsus, lateral view; (8) detail of claws, lateral view. Scale bars = 100 µm.

Martin (1968b) provided a checklist of *Schildia*, including *microthorax*, *fragilis*, *jamaicensis*, and *gracillima*, the undescribed species from Guatemala, and an undescribed species from Baja California, Mexico.

Martin (1975) reviewed the genus and described *Schildia alphus* from Cascavel, Brazil, *Schildia guatemalae* from Guazaeápan, Guatemala, *Schildia ocellata* from the Rio Amapari, Brazil, and *Schildia zonae* from the Piña area, Panama. A key to the genus including all then known species was provided. A note was made of the lack of external differences between *Schildia microthorax* specimens over its extensive geographical distribution. Distinguishing characters in relation to other genera of Leptogastrinae were discussed.

Fisher (1985) reported *Schildia microthorax* from the Tambopata Reserved Zone, Madre de Dios, Peru.

Artigas and Papavero (1988) provided a generic key to Neotropical Leptogastrinae as well as illustrations of the tarsi, wing, antennae, female abdomen, and spermathecae of *Schildia fragilis*.

Nagatomi *et al*. (2002) summarized published information of *Schildia* in reviewing the literature of genera of Leptogastrinae.

Fisher (in press) provided a short synopsis of the status and biology of *Schildia* in reviewing and creating a generic key to the Central American Asilidae.

Materials and methods

Morphological terminology follows McAlpine (1981) and Dikow (2009). Abdominal tergites are abbreviated with 'T' in the descriptions, sternites are abbreviated with 'S', and prothoracic, mesothoracic and metathoracic with pro, mes and met, respectively. Other generalized terms refer to the *Torre-Bueno Glossary of Entomology* (Nichols 1989). The adjective pruinose is used here for short, fine cuticular microtrichia that densely cover certain body parts and reflect light in a different way than bare cuticle. Surstyli are defined as secondary, movable lobate differentiations of epandria (see Dikow 2009: 74). The species descriptions are based on composites of all specimens and not based exclusively on the holotype. Dorsocentral setae are listed from anterior to posterior in the description. The female and male terminalia were first excised and macerated in 10% potassium hydroxide (KOH) at 55°C. They were temporarily stored in 75% ethanol for examination and illustration and eventually sealed in polyethylene genitalia vials containing 100% glycerine and attached to the specimen's pin. Morphological features were illustrated using a 10×10 ocular grid on a Olympus SZ60 stereomicroscope and later digitally redrawn using Adobe Illustrator® software. The vestiture on male terminalia is not shown. Wing length was measured from base of wing to distal tip of wing. In recording label data for type specimens a standard format is used, where information on each label is demarcated by a slash (/). If the label data are not printed in black ink on a white rectangular label, information relating to these is added in parentheses. When recording data for other specimens, where available information is also given in a standard manner (locality, coordinates, date of collection (month

indicated in lower case Roman numerals where hyphens indicate missing entries for date or month), collector and depository). Female (♀) and male (♂) symbols indicate the gender, while a question mark (?) refers to specimens of undeterminable gender (i.e., with broken or missing abdomen). The 'material examined' list is organized alphabetically with respect to country and localities within each country. Localities for which no coordinates could be found are arranged at the end of each country's listing. The distribution is illustrated in distribution maps with all localities plotted, for which coordinates were available, and the type locality is plotted with an open symbol. The electronic shape-files of the Biodiversity Hotspots and High-biodiversity Wilderness Areas were obtained from Conservation International (2005a,b).

The majority of specimens studied are housed in the United States National Museum, Smithsonian Institution, Washington, DC, USA (USNM) and the private collection of Eric Fisher, El Dorado Hills, CA, USA (EMF). Institutions providing specimens are listed below, together with the abbreviations used in the text when citing depositories, and the people who kindly assisted: AMNH, American Museum of Natural History, New York City, NY, USA (D. Grimaldi); BMNH, The Natural History Museum, London, UK (E. McAllister); CAS, California Academy of Sciences, San Francisco, CA, USA (C. Griswold); CUIC, Cornell University Insect Collection, Ithaca, NY, USA (J. Liebherr); EMF, Coll. Eric Fisher, El Dorado Hills, CA, USA (E. Fisher); EMUS, Utah State University, Logan, UT, USA (C. von Dohlen); FSCA, Florida State Collection of Arthropods, University of Florida, Gainesville, FL, USA (G. Steck); InBIO, Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (M. Zumbado); MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA (P. Perkins); MZSP, Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (C. Lamas); USNM, United States National Museum, Smithsonian Institution, Washington, DC, USA (F.C. Thompson); ZSMC, Zoologische Staatssammlung, München, Germany (M. Kotrba). The Malagasy copal specimens are deposited in the AMNH, Coll. Hoffeins (Hamburg, Germany), Coll. Stark (Halle/Saale, Germany) and Coll. Stuke (Leer, Germany).

Systematics

Schildia Aldrich, 1923: 4

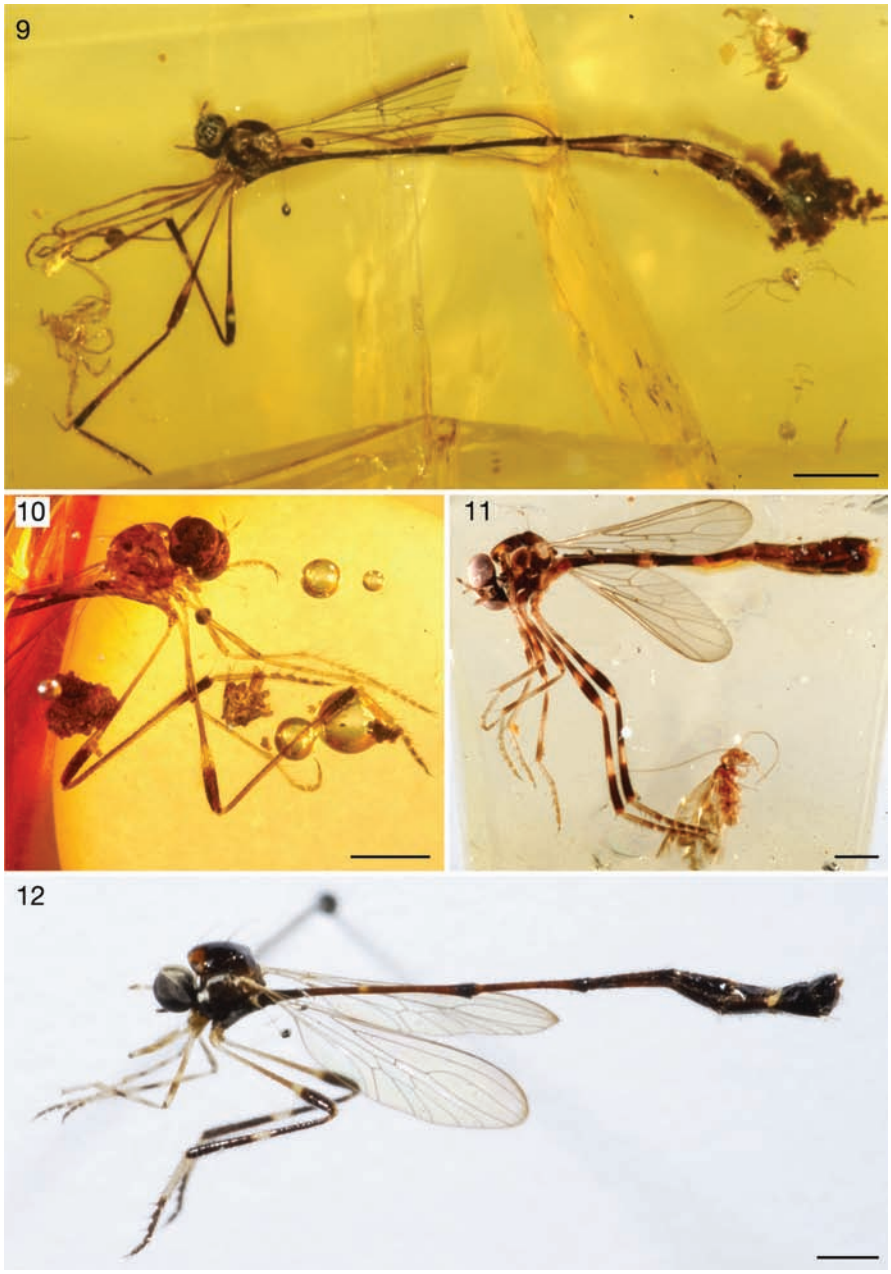
Type species *Schildia microthorax* Aldrich, 1923 by original designation.

Shannomyioleptus (Carrera, 1944: 86). Type species *Shannomyioleptus fragilis* Carrera, 1944 by original designation.

Schildia (Carrera 1944: 86; Carrera 1950: 108; Hull 1962: 313; Martin 1965: 110; Martin 1968b: 5; Martin 1975: 189; Artigas & Papavero 1988: 98, 102; Nagatomi et al. 2002: 38; Fisher in press).

Schildia subgenus *Shannomyioleptus* (Hull, 1962: 314).

Diagnosis. *Schildia* is distinguished from other Leptogastrinae genera by the long, regularly spaced trichoid spicules on dorsal and ventral sides of at least veins R and M (Fig. 2), the asymmetrical tarsal claws wherein the median claw is shorter than the lateral claw (Fig. 8), stipites with two long setae posteriorly, long posteriorly oriented



Figs 9–12. Photographs of extinct and extant species of *Schildia*. (9) †*Schildia martini* sp.n. (holotype, AMNH Luzzi); (10) †*Schildia martini* sp.n. (paratype, AMNH DR-V-7); (11) *Schildia adina* sp.n. preserved in Malagasy copal (Coll. Stuke). (12) *Schildia fragilis* (USNM, Peru). Scale bars = 1 mm. This figure is published in colour in the online edition that can be accessed *via* http://www.brill.nl/ise

presutural, and sometimes postsutural, dorsocentral setae on the scutum, the medially fused male epandrium (in most species) (Fig. 32), the absence of a surstylus on the male epandrium (Fig. 13, but see below), and the very elongate, slender abdomen and gracile appearance (Figs 9, 12).

Remarks. The genus was named in honor of Pablo Schild, who collected the type specimens of the genus in Costa Rica, and is here treated feminine in gender.

Redescription. Head: Brown or black; face silver or grey pruinose, sometimes apruinose in dorsal half; face either narrower or wider than adjacent ommatidium (Fig. 5); mystax always light colored from light yellow to light brown, either 2 or 4 setae, if 4 setae median pair shorter than outer; facial swelling indistinct, not discernible in lateral view; vertex either narrower or wider than face at clypeal–facial margin (Fig. 6), silver or grey pruinose; occipital triangle apruinose, distance between triangle and median eye margin either less or more than adjacent ommatidium (Fig. 6); occiput generally pruinose, sometimes ventral half apruinose; postocular setae always present, often very long and oriented anteriorly; proboscis brown; stipites with 2 long setae posteriorly; Antennae: scape and pedicel generally light yellow, with setae dorsally and ventrally; postpedicel broadest medio-distally, dorsal margin straight and ventral margin concave (Fig. 5), light yellow to brown, silver pruinose, between 1.5–2.0 times as long as combined length of scape and pedicel; stylus brown, 1/6 of postpedicel to as long as postpedicel, composed of either 1 or 2 elements, inserted on dorso-distal margin (Fig. 5).

Thorax: Predominantly brown, generally silver or brown pruinose, apruinose areas sometimes present; mesothorax antero-medially somewhat cone-like and projecting anteriorly over median postpronotal lobes (Fig. 12); prosternum separated from proepisternum; antepronotum, postpronotum and median postpronotal lobes either apruinose or silver pruinose; lateral postpronotal lobes always apruinose, generally lighter colored than scutum (Fig. 12); scutum brown or yellow, predominantly apruinose, only lateral and posterior margins pruinose to varying extent (Fig. 12); presutural dc setae: between 2–5 posteriorly oriented pairs of varying length, postsutural dc setae: generally only short anteriorly oriented setae, sometimes long posteriorly oriented setae, sometimes setae absent, 2–6 acr setae anteriorly, 1 npl and 1 spa seta, pal seta absent; pleurae yellow or brown, generally pruinose, sometimes with apruinose areas on anepisternum, katepisternum, or meron+metanepisternum, few yellow anepisternal setae on anterior and dorsal margins; scutellum usually brown, silver pruinose, apical scutellar setae generally very short, sometimes longer; postmetacoxal bridge present, visible suture medially; Legs: light yellow to light brown (Fig. 12); coxae either light yellow or brown, pruinose; trochanter light yellow with ventral sides sometimes brown; pro and mes femora light yellow with either 1 or 2 transverse brown bands, met femur light yellow proximally, light brown to brown in remaining part, clubbed in distal 2/5 to 1/2, club always brown with yellow transverse band at proximal margin of club (Figs 9–12), scattered brown macrosetae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with either 1 or 2 light brown transverse bands, met tibia brown with or without median yellow transverse band of different width, from 1–3 times as wide as width of tibia, all tibiae with yellow to light brown erect macrosetae in rows, pro and mes

tibiae with 2–3 long apical macrosetae, met tibia with 1–5 median and 1–2 apical macrosetae; tarsus light yellow to light brown, proximal tarsomere always longer than 2 following tarsomeres combined (Fig. 7), short and long macrosetae on all tarsomeres; pro and mes empodia generally minute sometimes 1/3 as long as median claw, met empodium from minute to more than half as long as median claw; median claw always shorter than lateral claw, 1/2–3/4 of lateral claw (Fig. 7, 8); Wings (Figs 11, 35, 36): length = 3.4–5.2 mm, sometimes 5.3–7.8 mm; hyaline, generally few microtrichia scattered on wing, sometimes microtrichia densely arranged throughout, at least R and M veins with conspicuous, regularly spaced, and curved trichoid spicules that can be very short to long (Fig. 2), predominantly symmetrical dorsally and ventrally but sometimes asymmetrical, usually 12–26 on M_1 between r-m and diversion of M_1 and M_2, two species 40–50; cell d generally small and terminating in M_2 and M_3 (Figs 12, 36), sometimes large and terminating in M_1 and M_2, only M_2, or M_1, M_2 and M_3 (Figs 11, 35), r-m generally situated proximal to separation of M_3 and CuA_1, sometimes distal to separation; R_1 generally reaching C proximal to R_5 and M_1 joining C (Fig. 35), sometimes distal to R_5 and M_1 joining C (Fig. 36), R_{2+3} generally straight proximally and smoothly arching posteriad distally (Fig. 36), sometimes sinuous and posterior-most point at mid-length (Fig. 35); all marginal wing cells broadly open (Figs 35, 36); pterostigma absent; alula absent; halter long, light yellow, knob dark brown.

Abdomen: Predominantly brown; T2 length = 1.0–4.0 mm, one species 4.9– 5.1 mm, T2 generally with yellow transverse band medially (Fig. 12), sometimes yellow areas on anterior or posterior margins of T3–6, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae; T7–8 generally with lateral sensory areas of unknown function that are best seen after maceration (Fig. 34), absent in 2 species; Male terminalia: epandrium usually a single sclerite, fused medially (Figs 17, 20, 23, 29, 32), sometimes separated medially and joining proximally (Figs 14, 26), always with finger-like distal projection of varying length and shape, surstyli absent (Fig. 13) (in *S. fragilis* an indentation at the base of the finger-like distal projection of the epandrium might suggest that this projection is the surstylus which is secondarily fused to the epandrium); hypandrium and gonocoxites always fused, but sometimes with visible sutures (Fig. 16), or forming a gonocoxite-hypandrial complex (Figs 13, 22, 25, 28, 31); lateral processes of gonostyli present (Figs 13, 16, 19, 22, 25, 28, 31); gonostyli situated apically on gonocoxite or gonocoxite-hypandrial complex; Aedeagus: sometimes long and protruding from hypopygium (Figs 13, 25, 28), sometimes short (Figs 16, 19, 22, 31); Female Genitalia: ovipositor unspecialized, composed of segments 8 and following; S8 invaginated medio-distally; furca triangular, with two sclerotized processes laterally; bursa copulatrix short, tube-shaped, widest medially; 3 spermathecae of same size generally occupying only segment 8, in one species reaching into segment 7, individual spermathecal ducts generally long, coiled, in one species more or less straight; spermathecal reservoirs generally as wide as individual spermathecal ducts, unsclerotized, in one species clearly sclerotized and wider than ducts.

Distribution. Species of *Schildia* are known from the Afrotropical, Neotropical, and Oriental regions. The center of diversity is found in the Neotropical region with seven species (Fig. 1): from Guatemala in the north to south-eastern Brazil in the south;

Jamaica is the only Caribbean island that is currently inhabited whereas one extinct species is preserved in Dominican amber and occurred on Hispaniola during the Tertiary: Miocene (Figs 1, 37). Within the Afrotropical region *Schildia* is only known from a single species found on Madagascar (Fig. 1) and has not been recorded on mainland Africa although the Leptogastrinae fauna has been extensively studied by the senior author (unpublished data). Within the Oriental region a single species is recorded from the Malaysian peninsula (Fig. 1).

***Schildia adina* sp.n.** (Figs 1, 11, 13–15)

Diagnosis. This species is distinguished from its congeners by the long posteriorly oriented postsutural dorsocentral setae, the very short, dense trichoid spicules, which are not symmetrical dorsally and ventrally, the presence of long apical scutellar setae, and the distribution restricted to Madagascar.

Etymology. Latinized Malagasy adjective *adino* = forgotten. Refers to the fact that this species was initially discovered as subfossilized specimens preserved in Malagasy copal (see Discussion).

Description. Head: Face silver pruinose, wide, wider than an adjacent ommatidium; mystax light yellow, 4 setae, 2 short median and 2 long lateral setae; vertex wide, wider than face at clypeal–facial margin, silver pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput brown pruinose, median dorso-ventral stripe silver pruinose; postocular setae brown; proboscis light brown; Antennae: scape and pedicel light yellow, light brown setae dorsally and ventrally; postpedicel proximally light yellow, brown distally, silver pruinose, about 1.5 times as long as combined length of scape and pedicel; stylus brown, about 1/4–1/3 as long as postpedicel, composed of 2 elements, short cylindrical element which bears the apical 'seta-like' sensory element.

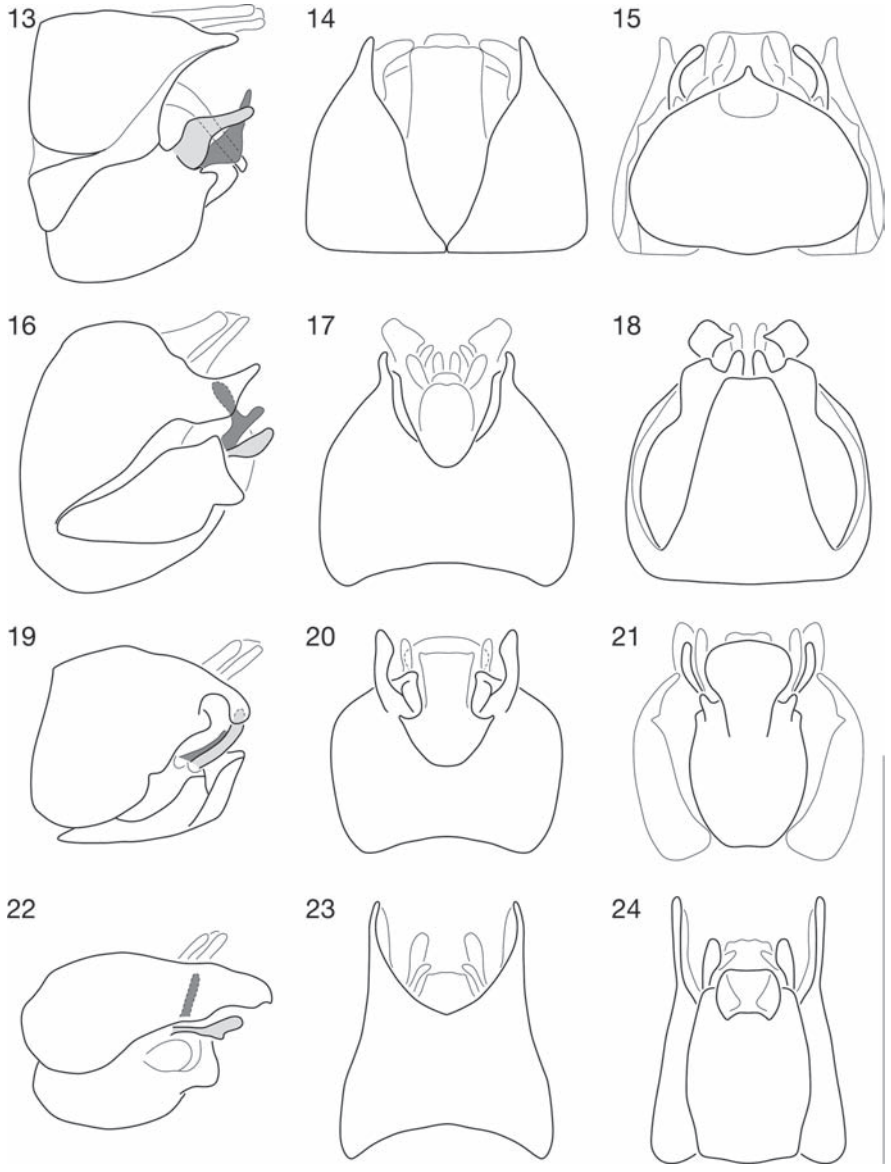
Thorax: Yellow and brown, silver pruinose; antepronotum, postpronotum and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light yellow; scutum brown, 2 yellow longitudinal stripes lateral to midline, neither reaching anterior nor posterior margin, predominantly apruinose, lateral and posterior margins silver pruinose; presutural dc setae: 6 short, postsutural dc setae: 1 long, 2 shorter posteriorly oriented, 5–6 short anteriorly oriented, 3–4 short acr setae, 1 npl and 1 spa seta; anepisternum dorsally yellow, ventrally brown, silver pruinose, few yellow anepisternal 8setae on anterior and dorsal margins; anepimeron brown, silver pruinose, proepimeron silver pruinose, katepisternum dorsally yellow, ventrally brown, mostly silver pruinose but with central apruinose spot, meron+metanepisternum anteriorly brown, posteriorly yellow, medially apruinose, metkatepisternum brown, silver pruinose; scutellum brown, brown pruinose, 5–7 apical scutellar setae; Legs: light yellow to brown; pro and met coxae light yellow, mes coxa brown; trochanters light yellow, met trochanter light brown ventrally; pro and mes femora light yellow proximally and distally, brown otherwise with 1 median transverse yellow band, met femur proximally light yellow, distal half clubbed and brown, proximal and distal part of club yellow, scattered brown setae on pro and mes femora, met femur with distinct rows of brown

macrosetae; pro and mes tibiae light brown with median light yellow transverse band, met tibia brown with median yellow transverse band, 2 times wider than width of tibia, all tibiae with brown erect macrosetae in rows, pro and mes tibiae with 2 long apical macrosetae, met tibia with 2 median sub-apical macrosetae; tarsus light yellow to light brown, proximal tarsomere always longer than two following tarsomeres combined, short and long macrosetae on all tarsomeres; all empodia minute; median claw more than half as long as lateral claw; Wings: length = 3.8–4.8 mm; microtrichia densely arranged in distal cells, trichoid spicules very short, dense, not symmetrical dorsally and ventrally, 40–50 on M_1 between r-m and diversion of M_1 and M_2; cell d large, terminating in M_1, M_2 and M_3, r-m situated at separation of M_3 and CuA_1; R_1 reaching C well proximal to R_5 and M_1 joining C, R_{2+3} more or less straight throughout, but posterior-most point at separation of R_4 and R_5; halter light yellow, knob dark brown, length = 0.72–0.88 mm.

Abdomen: Brown, T3-6 yellow posteriorly; T2 length = 1.7–1.8 mm, T2–8 with irregularly spaced macrosetae, T7–8 without lateral sensory areas; Male terminalia (Figs 13–15): epandrial halves separated medially and only joining proximally, distal tip straight, pointed; gonocoxite and hypandrium fused to form a gonocoxite-hypandrial complex, which is partly fused to epandrium proximally, but distinct suture discernible; Aedeagus: protruding slightly from hypopygium, prong tubular; Female genitalia: spermathecae occupying segments 7–8, individual spermathecal ducts more or less straight; spermathecal reservoirs clearly sclerotized and wider than ducts, loosely intertwined and not forming a coil.

Type material. The ♂ holotype is labeled "MADAGASCAR: Province Fianarantsoa, near Isalo National Park, in dry wash east of Interpretive Center 28 March – 9 April 2003 22°37.60'S, 45°21.49'E collector: R. Harin'Hala California Acad of Sciences malaise trap in open area elev 885 m, MA-02-11B-60 / HOLOTYPE *Schildia adina* sp.n. det. T. Dikow & K. Bayless 2007 (red label)" (CAS, #18438) the specimen is in good condition and double mounted (minuten in silicone). Two ♀ paratypes are labeled: "MADAGASCAR: Tulear Province, Mikea Forest, NW of Manombo, el. 37 m, 22°54.80'S, 43°28.93'E, 6–16 January 2002 collector: R. Harin'Hala California Acad of Sciences malaise trap, spiny forest MA-02-18B-09 / PARATYPE *Schildia adina* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)" (CAS). The specimens are in good condition (one specimen with head attached to pin) and are double mounted (minuten in silicone). A ♀ paratype is labeled: "MADAGASCAR: Tulear Province, Beza Mahafaly Reserve, Parcelle I near research station 2–9 January 2002 23°41.19'S, 44°35.46'E California Acad of Sciences coll: R. Harin'Hala malaise trap in dry deciduous forest elev 165 m, MA-02-14A-09 / PARATYPE *Schildia adina* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)" (CAS). The specimen is in good condition and is double mounted (minuten in silicone). Another ♀ paratype is labeled: "MADAGASCAR: Tulear Province, Mikea Forest, NW of Manombo, el. 30 m, 22°54.22'S, 43°28.53'E, 28–30 October 2002 collector: R. Harin'Hala California Acad of Sciences malaise trap - in deciduous dry forest MA-02-18A-38 / PARATYPE *Schildia adina* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)" (CAS). The specimen is in good condition and is double mounted (minuten in silicone).

Specimens. Malagasy Copal: 3♀ 1♂ (Coll. Hoffeins); 1♀ (AMNH); 1♀ 1♂ (additional inclusions: 14 workers of *Tetraponera* cf. *sahlbergii* (Forel, 1887) Hymenoptera: Formicidae: Pseudomyrmecinae) (Coll. Stark); 1♀ (Coll. Stuke).



Figs 13–24. Male terminalia of *Schildia* species with gonostyli (dark grey) and lateral processes of gonostyli (light grey) shaded in lateral views. (13–15) *S. adina* sp.n.: 13, lateral; 14, dorsal; 15, ventral. (16–18) *S. gracillima*: 16, lateral; 17, dorsal; 18, ventral. (19–21) *S. guatemalae*: 19, lateral; 20, dorsal; 21, ventral. (22–24) *S. jamaicensis*: 22, lateral; 23, dorsal; 24, ventral. Scale bar = 1 mm.

Distribution. Madagascar (Fig. 1). Biodiversity hotspot/high-biodiversity wilderness area: Madagascar and Indian Ocean Islands/–.

Remarks. Only *Schildia* known from the Afrotropical region (Fig. 1). *Schildia adina* sp.n. was the only species of Leptogastrinae found in the Malagasy copal specimens examined by the authors (Fig. 11). Extant specimens have been caught in malaise traps. See Discussion for comments on the generic placement of this species.

***Schildia alphus* Martin, 1975** (Fig. 38) **(Martin, 1975: 190)**

Diagnosis. This species is distinguished from its congeners by the minute metathoracic empodia (never more than 1/4 as long as median claw), the anteriorly apruinose meron+metanepisternum, and the brown postocular setae.

Redescription. Head: Face grey pruinose, wide, wider than adjacent ommatidium; mystax light yellow, 2 setae; vertex wide, wider than face at clypeal–facial margin, grey pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput along eye margin grey pruinose, medially brown pruinose, median dorso-ventral stripe silver pruinose, ventro-laterally apruinose; postocular setae brown; proboscis brown; Antennae: scape and pedicel light yellow, light yellow setae dorsally and ventrally; postpedicel proximally light yellow, brown distally, silver pruinose, about 2 times as long as combined length of scape and pedicel; stylus brown, about 1/2 as long as postpedicel, composed of 1 element.

Thorax: Predominantly brown, parts silver and brown pruinose; antepronotum, postpronotum, and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light yellow; scutum brown, predominantly apruinose, lateral and posterior margins silver pruinose; presutural dc setae: 2 short, 1 long, postsutural dc setae: 2 anteriorly oriented setae as long as short presutural dc setae, 5–6 short acr setae, 1 npl and 1 spa seta; anepisternum predominantly silver pruinose with brown pruinosity posteriorly, few yellow anepisternal setae on anterior and dorsal margins; anepimeron brown pruinose, proepimeron silver pruinose, katepisternum anteriorly silver and posteriorly brown pruinose, meron+metanepisternum anteriorly apruinose, silver pruinose posteriorly, metkatepisternum yellow, silver pruinose; scutellum brown, brown pruinose, few short apical scutellar setae; Legs: light yellow to brown; coxae and trochanters light yellow; pro and mes femora light yellow with 2 transverse light brown bands, met femur mostly light brown, clubbed in distal 2/5, club brown, yellow transverse band at proximal margin of club, scattered brown setae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with 2 light brown transverse bands, met tibia brown with median yellow transverse band, slightly wider than width of tibia, all tibiae with brown erect macrosetae in rows, pro and mes tibiae with 3 long apical macrosetae, met tibia with 1 median and 2 apical macrosetae; tarsus light yellow to brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; all empodia minute; median claw more than half as long as lateral claw; Wings: length = 3.40–3.65 mm; microtrichia scattered on wing, trichoid spicules short, symmetrical dorsally and

ventrally, 16–24 on M_1 between r-m and diversion of M_1 and M_2; cell d large, terminating in M_2 and M_3, r-m situated proximal to separation of M_3 and CuA_1; R_1 reaching C well proximal to R_5 and M_1 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.75 mm.

Abdomen: Brown, T3-6 yellow anteriorly; T2 length = 2.3 mm, T2 with yellow transverse band medially, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae, T7–8 with lateral sensory areas; Male terminalia: ♂ unknown; Female genitalia: spermathecae occupying only segment 8, individual spermathecal ducts long and coiled; spermathecal reservoirs not sclerotized, as wide as individual ducts, forming a coil.

Type material. The ♀ holotype is labeled "Sit. B. Vista Cascavel Ceará, VIII-39 (handwritten) / O.C. Alves Coll. (handwritten) / ♀ / HOLOTYPE *Schildia alphus* Chas. H. Martin (species name handwritten, red label)" (MZSP). The specimen is double mounted (minuten glued into block of cork) and is in good condition. The ♀ paratype is labeled "Ceará Cascavel Shannon + Alves XII-940 (handwritten, black border) / ♀ / PARATYPE *Schildia alphus* Chas. H. Martin (species name handwritten, yellow label) / Charles H. Martin donation to F.S.C.A." (FSCA). The specimen is double mounted (minuten fixed to pin) and is in fair condition (left wing and metathoracic leg broken, abdomen glued to pin).

Distribution. Brazil (Fig. 38).

Remarks. Initially the holotype could not be found in the MZSP collection as indicated by Martin (1975), but was recovered in the FSCA among other Leptogastrinae type specimens. The FSCA purchased Charles H. Martin's private collection after he passed away. The holotype was not collected in December 1940 as stated by Martin (1975) in his original description, but in August 1939 as clearly indicated on the label. This is the only Neotropical species found in xeric shrub lands and not in tropical or subtropical broad leafed forest.

***Schildia caliginosa* sp.n.** (Fig. 38)

Diagnosis. This species is distinguished from its congeners by the apruinose antepronotum, postpronotum, and medial postpronotal lobes, the two brown transverse bands on the mesothoracic tibiae, the yellow transverse band on metathoracic tibiae more than 3 times as long as width of metathoracic tibia, and the entirely dark brown scutum.

Etymology. Latin adjective *caliginosus* = misty or dark. Refers to the dark coloration of this species and its type locality, which is adjacent to the tepui Cerro Neblina in southern Venezuela.

Description. Head: Face silver pruinose, wide, wider than adjacent ommatidium; mystax yellow, 2 setae; vertex wide, wider than face at clypeal–facial margin, silver pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput laterally light brown pruinose, median dorso-ventral stripe silver pruinose; postocular setae yellow; proboscis brown; Antennae: scape and pedicel light yellow, light yellow setae dorsally and ventrally; postpedicel

predominantly light yellow, light brown dorso-distal, silver pruinose, about 1.8 times as long as combined length of scape and pedicel; stylus brown, 1/4 as long as postpedicel, composed of 1 element.

Thorax: Predominantly brown, parts silver and brown pruinose; antepronotum, postpronotum and median postpronotal lobes apruinose; lateral postpronotal lobes apruinose, light yellow; scutum brown, predominantly apruinose, only dorsal of wing base and posterior margin silver pruinose; presutural dc setae: 1–2 short, 1 long, postsutural dc setae: only a few short anteriorly oriented setae close to posterior margin, 3–4 short acr setae, 1 npl and 1 spa seta; anepisternum predominantly brown, dorsal margin yellow, anteriorly and dorsally silver and remaining parts brown pruinose, few yellow anepisternal setae on anterior and dorsal margins; anepimeron, proepimeron, katepisternum, katepimeron and meron+metanepisternum brown, katepisternum predominantly apruinose, anterior margin silver and dorsal margin brown pruinose, meron+metanepisternum apruinose, remaining sclerites brown pruinose, metkatepisternum yellow, silver pruinose; scutellum brown, silver pruinose, few very short apical scutellar setae; Legs: light yellow to light brown; coxae and trochanters light yellow; pro and mes femora light yellow with 2 transverse light brown bands, met femur mostly light yellow to light brown, clubbed in distal 1/3, club brown, scattered brown macrosetae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with 2 light brown transverse bands, met tibia brown with median yellow transverse band, more than 3 times as long as width of tibia, all tibiae with yellow to light brown erect macrosetae in rows, pro and mes tibiae with 3 long apical macrosetae, met tibia with 1 median and 2 apical macrosetae; tarsus light yellow to light brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; pro and mes empodia minute, met empodium more than half as long as median claw; median claw more than half as long as lateral claw; Wings: length = 4.2–4.4 mm; few microtrichia, trichoid spicules short, symmetrical dorsally and ventrally, 12–14 on M_1 between r-m and diversion of M_1 and M_2; cell d small, terminating in M_2 and M_3, r-m situated just distally to separation of M_3 and CuA_1; R_1 reaching C proximal to R_5 and M_1 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.8 mm.

Abdomen: Brown; T2 length = 4.0 mm, T2 with yellow transverse band medially, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae, T7–8 with lateral sensory areas; Male terminalia: ♂ unknown; Female genitalia: spermathecae occupying only segment 8, individual spermathecal ducts long and coiled; spermathecal reservoirs not sclerotized, as wide as individual ducts, forming a coil.

Type material. The ♀ holotype is labeled "VENEZUELA. T.F. Amaz. Cerro de la Neblina Base camp, 140 m. 0°50'N, 66°10'W 23 February 1985 / P.J. and P.M. Spangler R.A. Faitoute W.E. Steiner Collectors / HOLOTYPE *Schildia caliginosa* sp.n. det. T. Dikow & K. Bayless 2007 (red label)" (USNM). The specimen is double mounted (minuten in block of red rubber) and is in very good condition. The ♀ paratype is labeled "Ecuador, Orellana, Yasuni National Park, Onkone Gare Plot, Lot 1591,

00°39'S 076°27'W, 240 m, 26.vi.1996, T. Erwin / PARATYPE *Schildia caliginosa* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)" (USNM). The specimen is doubled mounted (minuten in block of silicone) and is in excellent condition.

Distribution. Venezuela (Fig. 38). Biodiversity hotspot/high-biodiversity wilderness area: –/Amazonia (Fig. 38).

***Schildia fragilis* (Carrera, 1944)** (Figs 12, 31–34, 38) (Carrera, 1944: 88, 89)

Schildia (*Shannomyioleptus*) *fragilis* (Hull 1962: 314).
Schildia fragilis (Martin 1965: 114; Martin 1968b: 5; Martin 1975: 189; Artigas & Papavero 1988: 98, 102).
Schildia zonae (Martin, 1975: 190, 192). syn.n.

Diagnosis. This species is distinguished from its congeners by the wide face, the light brown to brown lateral postpronotal lobes, the long postocular setae, and the long presutural dorsocentral setae.

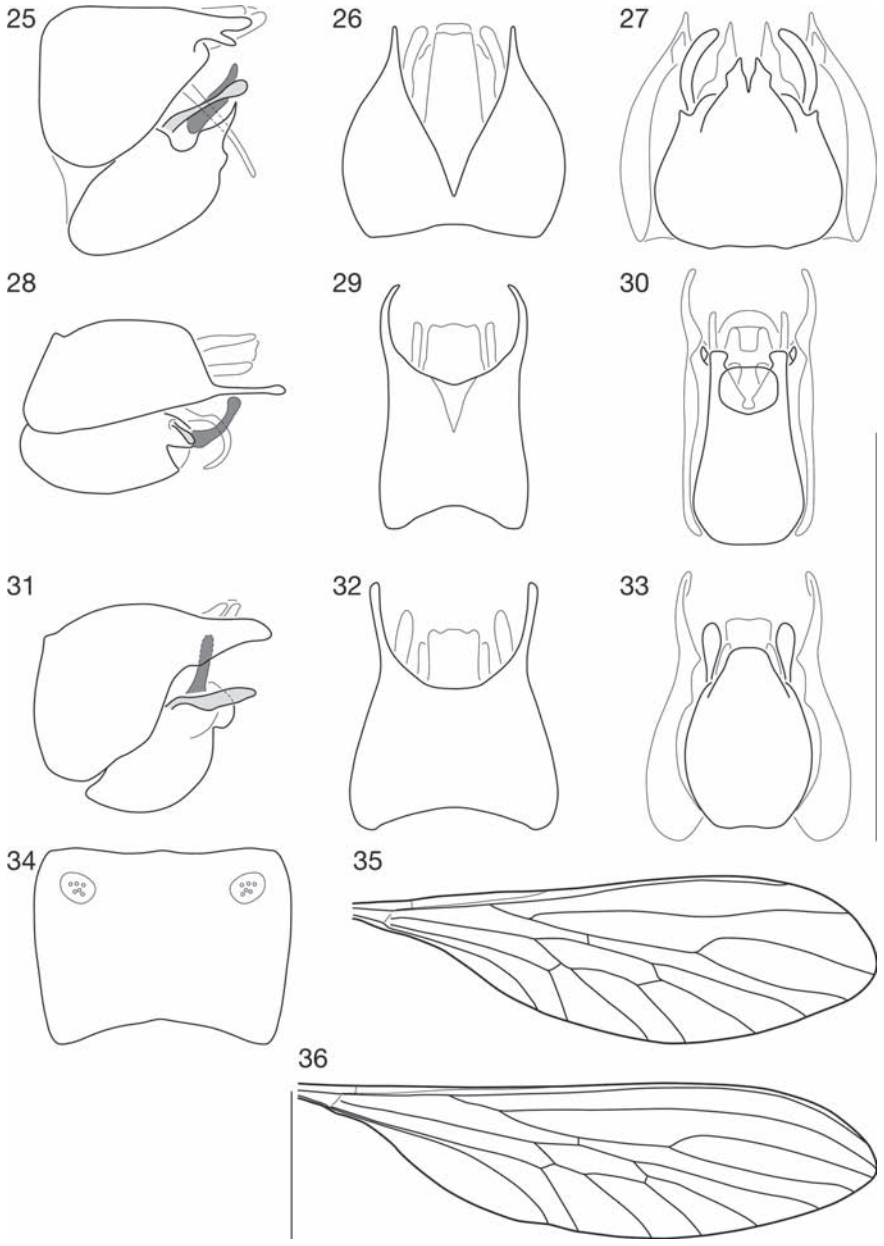
Redescription. Head: Face silver pruinose, sometimes dorsal half apruinose, wide, wider than adjacent ommatidium; mystax light yellow, 2 setae; vertex wide, wider than face at clypeal–facial margin, silver pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput laterally grey pruinose, median dorso-ventral stripe silver pruinose; postocular setae yellow, long; proboscis brown; Antennae: scape and pedicel light yellow, light yellow to light brown setae dorsally and ventrally; postpedicel light yellow proximally, light brown distally, silver pruinose, between 1.5–2 times as long as combined length of scape and pedicel; stylus brown, 1/4 as long as postpedicel, composed of 1 element.

Thorax: Predominantly brown, parts silver and brown pruinose; antepronotum, postpronotum, and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light yellow to light brown; scutum brown, sometimes antero-laterally lighter brown, predominantly apruinose, lateral and posterior margins brown pruinose; presutural dc setae: 1 short, 1 intermediate, 1 long, postsutural dc setae: 3–5 short anteriorly oriented setae, 5–6 short acr setae, 1 npl and 1 spa seta; anepisternum brown, few yellow anepisternal setae on anterior and dorsal margins, anteriorly and dorsally silver and remaining parts brown pruinose; anepimeron, proepimeron, katepisternum, katepimeron and meron+metanepisternum brown, proepimeron silver pruinose, katepisternum anteriorly and antero-dorsally silver pruinose, postero-dorsally brown pruinose, central area apruinose, meron+metanepisternum brown pruinose anteriorly, medially apruinose, posteriorly silver pruinose, metkatepisternum brown, silver pruinose; scutellum brown, silver pruinose, few very short apical scutellar setae; Legs: light yellow to light brown; coxae and trochanters light yellow; pro and mes femora light yellow with 2 transverse light brown bands, met femur mostly light yellow to light brown, clubbed in distal 1/3, club brown, yellow transverse band at proximal margin of club, scattered brown macrosetae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with 2 light brown

transverse bands, met tibia brown with median yellow transverse band, about 2 times as long as width of tibia, all tibiae with yellow to light brown erect macrosetae in rows, pro and mes tibiae with 2 long apical macrosetae, met tibia with 2 apical macrosetae; tarsus light yellow to light brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; all empodia minute, sometimes met empodium 1/4 of median claw; median claw more than half as long as lateral claw; Wings (Fig. 12): length = 4.4–4.7 mm; few microtrichia, trichoid spicules short, symmetrical dorsally and ventrally, about 18–20 on M_1 between r-m and diversion of M_1 and M_2; cell d small, terminating in M_2 and M_3, r-m situated proximal to separation of M_3 and CuA_1; R_1 reaching C well proximal to R_5 and M_1 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.9 mm.

Abdomen: Brown; T2 length = 2.7–3.0 mm, T2 with yellow transverse band medially, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae, T7–8 with lateral sensory areas (Fig. 34); Male terminalia (Figs 31–33): epandrial halves fused medially, distal tip straight, pointed; epandrium and hypandrium fused proximally, gonocoxite and hypandrium fused to form gonocoxite-hypandrial complex; Aedeagus: not protruding from hypopygium, very short, prong a wide tube; Female genitalia (see Figs 9 and 10 in Artigas and Papavero 1988) - spermathecae occupying only segment 8, individual spermathecal ducts long and coiled; spermathecal reservoirs not sclerotized, as wide as individual ducts, forming a coil.

Type material. The ♂ holotype of *Shannomyioleptus fragilis* is labeled "Maracaju Mato Grosso Brasil / Junho 1937 / Serviço Febre Amarela M.E.S., Bras. / ♂ / HOLOTIPO (red label) / *Shannomyioleptus fragilis* Carrera, 1944 ♂ M. CARRERA DET. (species name and author handwritten, black border) / 104435" (MZSP). The specimen was originally double mounted (attached to triangular label paper), but was destroyed when shipped to the authors (the remnants are preserved in a vial). A ♀ paratype is labeled "Maracaju Mato Grosso Brasil / Maio 1937 / Serviço Febre Amarela M.E.S., Bras. / ♀ / ALLOTIPO (red label) / 104436 / *Shannomyioleptus fragilis* Carrera, 1944 ♀ M. CARRERA DET. (species name and author handwritten, black border) / ♀" (MZSP). The specimen was originally double mounted (minuten attached to pin), but has been destroyed when shipped to the authors (the remnants are preserved in a vial). A paratype of undeterminable gender is labeled "Maracaju Mato Grosso Brasil / Junho 1937 / Serviço Febre Amarela M.E.S., Bras. / PARATIPO (red label) / *Shannomyioleptus fragilis* Carrera, 1944 M. CARRERA DET. (species name and author handwritten, black border)" (USNM). The specimen is double mounted (attached to triangular piece of label paper) and is in good condition (abdomen broken posterior to T2). Another paratype of undeterminable gender is labeled "Maracaju Mato Grosso Brasil / Junho 1937 / Serviço Febre Amarela M.E.S., Bras. / ♀ / PARATIPO (red label) / S.W. Bromley Collection 1955 / *Shannomyioleptus fragilis* n. sp. 44 M. CARRERA DET. (species name and author handwritten, black border)" (USNM). The specimen is double mounted (attached to triangular piece of label paper) and is in poor condition (antennae, right wing, most legs, and abdomen broken). Another paratype of



Figs 25–36. Male terminalia with gonostyli (dark grey) and lateral processes of gonostyli (light grey) shaded in lateral views, abdominal T8, and wings of *Schildia* species. (25–27) Male terminalia of *S. malaya* sp.n.: 25, lateral; 26, dorsal; 27, ventral. (28–30) Male terminalia of *S. microthorax*. 28, lateral; 29, dorsal; 30, ventral. (31–33) Male terminalia and T8 of *S. fragilis*: 31, lateral; 32, dorsal; 33, ventral; 34, T8 dorsal. (35–36) Wings: 35, *S. malaya* sp.n.; 36, *S. microthorax*. Scale bars = 1 mm.

undeterminable gender is labeled "Serviço Febre Amarela M.E.S., Bras. / Maracaju Mato Grosso Brasil / Junho 1937 / PARATIPO (red label) / *Shannomyioleptus fragilis* Carrera, 1944 M. CARRERA DET. (species name and author handwritten, black border)" (MCZ). The specimen is directly mounted (glued laterally to pin) and is in fair condition.

The ♀ holotype of *Schildia zonae* is labeled "PANAMA C. Z. Piña Area 18 Nov 57 W.J. Hanson (date handwritten) / USU (red ink) / HOLOTYPE *Schildia zonae* Chas. H. Martin (species name handwritten, red label) / *zonae* (handwritten)" (EMUS). The specimen is doubled mounted (attached to paper point), and is in very good condition. The ♂ paratype of *Schildia zonae* is labeled "PANAMA C. Z. Piña Area 18 Nov 57 W.J. Hanson (date handwritten) / USU (red ink) / ALLOTYPE *Schildia zonae* Chas. H. Martin (species name handwritten, red label)" (EMUS). The specimen is doubled mounted (attached to paper point) and is in good condition (T5–8 glued to paper point).

Specimens. Brazil: Paraná: 2♀ Morretes, 25°34'S 048°53'W, 10–13.iv.2002, M. Tavanes et al. (MZSP); British Guyana: 1? Essequibo R., Moraballi Creek, 12°15'S 070°54'W, 21.ix.1929, Oxford University Expedition (BMNH); Peru: Madre de Dios: 1♀ Manu (Erika near Salvacion), 12°15'S 070°54'W, 5–6.ix.1988, A.Freidberg (USNM).

Distribution. Brazil, British Guyana, Panama, Peru (Fig. 38). Biodiversity hotspot/high-biodiversity wilderness area: Cerrado, Mesoamerica/Amazonia (Fig. 38).

Remarks. *Schildia zonae*, described from Panama, is here synonymized with *S. fragilis* as this species is here shown to be more widespread than initially thought by Martin (1975). Morphologically, the holotypes are indistinguishable and the male terminalia also provide evidence that the two described species are actually one taxon.

Schildia gracillima* (Walker, 1855)** (Figs 16–18, 38) ***Leptogaster gracillimus (Walker 1855: 770, 722)

Schildia gracillima (Martin 1965: 110, 114; Martin 1968b: 5; Martin 1975: 190).
Schildia ocellata (Martin 1975: 189, 192). syn.n.

Diagnosis. This species is distinguished from its congeners by its long body length, the narrow vertex that is as narrow as the face, the laterally apruinose occiput, and the very short and dense trichoid spicules.

Redescription. Head: Face silver pruinose, wide, wider than adjacent ommatidium; mystax light yellow, 2 setae; vertex narrow, narrower than face at clypeal–facial margin, silver pruinose; occipital triangle apruinose, distance between triangle and median eye margin less than adjacent ommatidium; occiput thinly silver pruinose along eye margin, medially silver pruinose, laterally apruinose; postocular setae short, brown; proboscis brown; Antennae: scape and pedicel light brown, light brown setae dorsally and ventrally; postpedicel proximally light yellow, brown distally, silver pruinose, about 1.5 times as long as combined length of scape and pedicel; stylus brown, about 2/3 as long as postpedicel, composed of 1 element.

Thorax: Predominantly light brown, parts silver and brown pruinose; antepronotum, postpronotum, and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light yellow; scutum brown, predominantly apruinose, only posterior margin silver pruinose, 2 yellow lateral longitudinal stripes originating at anterior margin but not reaching posterior margin, broader anteriorly and pointed posteriorly, 2 yellow lateral spots positioned predominantly presutural; presutural dc setae: 2 short, 1 intermediate, 2 long, postsutural dc setae: 2 anteriorly oriented as long as intermediate presutural dc setae, acr setae absent, 1 npl and 1 spa seta; anepisternum predominantly silver pruinose sometimes apruinose dorsally, few yellow anepisternal setae on anterior and dorsal margins; anepimeron anteriorly silver and posteriorly brown pruinose, proepimeron silver pruinose, katepisternum anteriorly silver and posteriorly brown pruinose, meron+metanepisternum anteriorly apruinose and posteriorly silver pruinose, metkatepisternum yellow, silver pruinose; scutellum yellow posteriorly and brown medially, silver pruinose, 4–6 very short apical scutellar setae; Legs: yellow to brown; coxae and trochanters light yellow, trochanters sometimes brown ventrally; pro and mes femora light yellow with 1 transverse light brown band medially, met femur mostly light brown to brown, clubbed in distal 2/5, club brown, yellow transverse band at proximal margin of club, scattered brown setae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with 1 light brown transverse band which is sometimes difficult to discern, met tibia brown with yellow transverse band in distal half, 2 times wider than width of tibia, all tibiae with brown erect macrosetae in rows, pro and mes tibiae with 2 long apical macrosetae, met tibia with 2 apical, 2 medial in distal quarter, 4 lateral macrosetae spaced along tibia; tarsus light yellow to light brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; all empodia 1/3 as long as median claw; median claw about 3/4 as long as lateral claw; Wings: length = 5.3–7.8 mm; few microtrichia scattered on wing, trichoid spicules very short, densely arranged, symmetrical dorsally and ventrally, 40–50 on M_1 between r-m and diversion of M_1 and M_2; cell d large, terminating in M_1 and M_2, r-m situated at separation of M_3 and CuA_1; R_1 reaching C at the point where R_5 joins C but distal to M_1 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.9–1.3 mm.

Abdomen: Brown, T1 yellow, T2 yellow anteriorly, sometimes T3-6 also yellow anteriorly; T2 length = 4.9–5.1 mm, T2 with yellow transverse band medially, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae, T7–8 with large lateral sensory areas; Male terminalia (Figs. 16–18): epandrial halves fused medially, distal tip arching dorsad, pointed; epandrium and hypandrium entirely fused proximally, gonocoxite easily distinguishable but fused to hypandrium, distinct ventral suture discernible; gonostyli bifid with two apices; Aedeagus: not protruding from hypopygium; dorsal aedeagal sheath with curved ventral protuberances; lateral ejaculatory process cylindrical; Female genitalia: spermathecae occupying only segment 8, individual spermathecal ducts long and coiled; spermathecal reservoirs not sclerotized, as wide as individual ducts, forming a coil.

Type material. The ♂ holotype of *Leptogaster gracillimus* is labeled "Type (circular label, green submarginal margin) *Leptogaster gracillimus* Wlk. (handwritten) / Brazil Parà H.W. Bates 51-55 (handwritten) / Holotype (circular label, red border) / Holotype *Leptogaster gracillimus* Walker det. J.E. Chainey 1982 (handwritten) / Bangil (circular label, handwritten) / *gracillimus* (handwritten)" (BMNH). The specimen is directly mounted and is in good condition (missing some legs).

The ♂ holotype of *Schildia ocellata* is labeled "Ter. AMAPA Rio Amapari J. Lane col. (handwritten, black submarginal border) / 2.VII.59 (handwritten) / ♂ / HOLOTYPE *Schildia ocellata* Chas. H. Martin (species name handwritten, red label) / *Schildia ocellata* Martin Det. C.H. Martin 19 (species name handwritten, black submarginal border) / *Schildia gracillima* (Walker, 1855) det. T. Dikow & K. Bayless 2007" (MZSP). The specimen is mounted on label paper and is in good condition (antennae broken).

Specimens. 1♀ Utinga, Belem, 01°27'S 048°30'W, 18.vi.1963, M. Amaral (MZSP), 1? Mocambo do Espirito Santo, 00°42'N 055°55'W, 26.v.1977, M. Torres (MZSP); Peru: 1♀ no locality and date (ZSMC).

Distribution. Brazil, Peru (Fig. 38). Biodiversity hotspot/high-biodiversity wilderness area: –/Amazonia (Fig. 38).

Remarks. *Schildia ocellata*, described from north-eastern Brazil by Martin in 1975, is here synonymized with *S. gracillima* as the holotypes are morphologically indistinguishable.

***Schildia guatemalae* Martin, 1975** (Figs 19–21, 37) (Martin, 1975: 190, 191)

Schildia sp. (Martin 1965: 114; Martin 1968b: 5).

Diagnosis. This species is distinguished from its congeners by the five pairs of presutural dorsocentral setae, the minute empodia, the relatively long anteriorly oriented postsutural dorsocentral setae and the large apruinose spot on the katepisternum.

Redescription. Head: Face grey pruinose, wide, wider than adjacent ommatidium; mystax white, 2 setae; vertex wide, wider than face at clypeal–facial margin, grey pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput laterally brown pruinose, median dorsoventral stripe silver pruinose, ventro-laterally apruinose; postocular setae yellow; proboscis brown; Antennae: scape and pedicel light yellow, light yellow setae dorsally and ventrally; postpedicel proximally light yellow, brown distally, silver pruinose, about 1.5 times as long as combined length of scape and pedicel; stylus brown, 1/3 as long as postpedicel, composed of 1 element.

Thorax: Predominantly brown, parts silver and brown pruinose; antepronotum, postpronotum, and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light yellow; scutum brown, predominantly apruinose, only extreme lateral and posterior margins silver pruinose; presutural dc setae: 2 short, 1 intermediate, 1 short, 1 long, postsutural dc setae: 4 anteriorly oriented setae as long as short presutural dc setae, 3–4 short acr setae, 1 npl and 1 spa seta; anepisternum predominantly silver pruinose with brown pruinosity posteriorly, few yellow anepisternal setae on anterior

and dorsal margins; anepimeron brown pruinose, proepimeron silver pruinose, katepisternum with central apruinose spot, remaining parts brown pruinose, meron+metanepisternum brown pruinose anteriorly, apruinose medially, and silver pruinose posteriorly, metkatepisternum yellow, silver pruinose; scutellum brown, brown pruinose, 4 very short apical scutellar setae; Legs: light yellow to brown; coxae and trochanters light yellow; pro and mes femora light yellow with 2 transverse light brown bands, met femur mostly light brown, clubbed in distal 2/5, club brown, yellow transverse band at proximal margin of club, scattered brown setae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with 2 light brown transverse bands, met tibia brown with median yellow transverse band, as wide as width of tibia, all tibiae with brown erect macrosetae in rows, pro and mes tibiae with 3 long apical macrosetae, met tibia with 1 median and 2 apical macrosetae; tarsus light yellow to brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; all empodia minute; median claw more than half as long as lateral claw; Wings: length = 3.7 mm; microtrichia scattered on wing, trichoid spicules short, symmetrical dorsally and ventrally, 20–25 on M_1 between r-m and diversion of M_1 and M_2; cell d large, terminating in M_2 and M_3, r-m situated proximal to separation of M_3 and CuA1; R_1 reaching C well proximal to R_5 and M_1 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.7 mm.

Abdomen: Brown, T3-5 yellow anteriorly; T2 length = 2.3 mm, T2 with yellow transverse band medially, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae, T7–8 with lateral sensory areas; Male terminalia (Figs 19–21): epandrial halves fused medially, distal tip hook-shaped and arched ventrally, medio-distally with protuberance approximating cerci; epandrium and hypandrium fused proximally, gonocoxite and hypandrium fused to form a gonocoxite-hypandrial complex; Aedeagus: not protruding from hypopygium, very short, prong dorso-ventrally flattened; Female genitalia: ♀ unknown.

Type material. The ♂ holotype is labeled "Guazaeápan Guat. II-VIII-52 (handwritten) / R.H. Painter Col. / HOLOTYPE *Schildia guatemalae* Chas H. Martin (species name handwritten, red label)" (USNM). The specimen is double mounted (minuten in cork) and is in very good condition.

Distribution. Guatemala (Fig. 37). Biodiversity hotspot/high-biodiversity wilderness area: Mesoamerica/– (Fig. 37).

Schildia jamaicensis Farr, 1962 (Figs 22–24, 37) (Farr, 1962: 191)

(Farr 1963: 19; Martin 1965: 114, 115; Martin 1968b: 5; Martin 1975: 190)

Diagnosis. This species is distinguished from its congeners by the medially broad face, the two lateral longitudinal yellowish stripes on the scutum, the white or light yellow postpronotal lobes, the silver pruinose median dorso-ventral stripe on the occiput, and the entirely yellow T6.

Redescription. Head: Face silver pruinose, wide, wider than adjacent ommatidium; mystax light yellow, 2 setae; vertex wide, wider than face at clypeal–facial margin, silver pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput silver pruinose along eye margin and median dorso-ventral stripe, remaining parts grey pruinose; postocular setae light brown, long; proboscis brown; Antennae: scape and pedicel light yellow, light yellow to light brown setae dorsally and ventrally; postpedicel light yellow proximally, light brown distally, silver pruinose, about 1.5 times as long as combined length of scape and pedicel; stylus brown, 1/5 as long as postpedicel, composed of 1 element.

Thorax: Light brown and yellow, parts silver and brown pruinose; antepronotum, postpronotum, and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light yellow; scutum predominantly brown, antero-laterally yellow forming 2 thin lateral yellow stripes not reaching posterior margin, apruinose except for silver pruinose lateral and posterior margins; presutural dc setae: 1 or 2 short, 1 intermediate, 1 long, postsutural dc setae: 2 very short anteriorly oriented setae, 3 short acr setae, 1 npl and 1 spa seta; anepisternum brown with yellow dorsal margins, few yellow anepisternal setae on anterior and dorsal margins, anteriorly and dorsally silver and remaining parts brown pruinose; anepimeron, proepimeron, katepisternum, katepimeron and meron+metanepisternum brown, proepimeron silver pruinose, katepisternum anteriorly and antero-dorsally silver pruinose, postero-dorsally brown pruinose, central area apruinose, meron+metanepisternum brown pruinose anteriorly, medially apruinose, posteriorly silver pruinose, metkatepisternum light brown, silver pruinose; scutellum brown, silver pruinose, few very short apical scutellar setae; Legs: light yellow to light brown; coxae and trochanters light yellow; pro and mes femora light yellow with 2 transverse light brown bands, met femur mostly light brown, clubbed in distal 1/3, club brown, yellow transverse band at proximal margin of club, scattered brown macrosetae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow with 2 light brown transverse bands, met tibia brown with median yellow transverse band, a little more than 2 times as long as width of tibia, all tibiae with yellow to light brown erect macrosetae in rows, pro and mes tibiae with 2 long apical macrosetae, met tibia with 2 apical macrosetae, 1 median sub-distal macroseta, 4 lateral macrosetae along tibia; tarsus light yellow to light brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; pro and mes empodia minute, met empodium 1/4 of median claw; median claw more than half as long as lateral claw; Wings: length = 3.2–4.6 mm; microtrichia scattered on wing, trichoid spicules short, symmetrical dorsally and ventrally, about 12–20 on M_1 between r-m and diversion of M_1 and M_2; cell d small, terminating in M_2 and M_3, r-m situated proximal to separation of M_3 and CuA_1; R_1 reaching C well proximal to R_5 and M_1 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.68–0.86 mm.

Abdomen: Light yellow and brown; T2 length = 2.2–2.8 mm, T2 with yellow transverse band medially and light band sub-distally, T3–5 with yellow anterior

margins, T6 entirely yellow, T2 with erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae, T7–8 with lateral sensory areas; Male terminalia (Figs 22–24): epandrial halves fused medially; epandrium and hypandrium fused proximally; gonocoxite and hypandrium fused to form a gonocoxite-hypandrial complex; Aedeagus: not protruding from hypopygium, very short, prong dorso-ventrally flattened; Female genitalia: spermathecae occupying only segment 8, individual spermathecal ducts long and coiled; spermathecal reservoirs not sclerotized, as wide as individual ducts, forming a coil.

Type material. The ♂ holotype is labeled "♂ (handwritten) / blank paper label / HOLOTYPE *Schildia jamaicensis* T.H. Farr 1962 (handwritten, yellow label) / Jamaica W.I. St. Andrew Long Mountain 3 April 1960 T.H. Farr (date and collector handwritten)" (USNM). The specimen is double mounted (attached to triangle of label paper) and is in very good condition. A ♀ paratype is labeled "ALLOTYPE *Schildia jamaicensis* T.H. Farr 1962 (handwritten, blue label) / Jamaica W.I. St. Andrew Long Mountain 23 FEB. 1961 T.H. Farr (date and collector handwritten)" (USNM). The specimen is double mounted (attached to triangular label paper) and is in very good condition. A further 12 paratypes have all the same locality label with different collecting dates and these are here provided: 2♀ 25.viii.1957 (BMNH, USNM); 1♀ 29.ix.1957 (BMNH); 1♂ 9.iii.1960 (USNM); 1♂ 3.iv.1960 (FSCA); 1♀ 16.iv.1960 (FSCA); 1♂ 23.ii.1961 (FSCA); 1♂ 26.iii.1961 (BMNH); 1♂ 12.iii.1962 (USNM); 1♂ 18.iii.1962 (BMNH); 1♂ 30.iii.1962 (BMNH); 1♀ 15.iv.1962 (USNM). All paratypes in the BMNH bear a circular label with yellow margin 'Paratype' and handwritten label '1963-118'.

Material examined. Jamaica: 3♂ 1? Kingston, 18°00'N 076°47'W, 10.iv.1968, C. Martin (FSCA), 6♀ 8♂ Long Mountain, 18°02'N 076°38'W, T. Farr (see type material above for dates of collection and depository).

Distribution. Jamaica (Fig. 37). Biodiversity hotspot/high-biodiversity wilderness area: Caribbean Islands/– (Fig. 37).

Remarks. This species is consistently caught in association with spider webs.

Schildia malaya **sp.n.** (Figs 1, 25–27, 35)

Diagnosis. This species is distinguished from its congeners by the four mystacal setae, the sinuous R2+3, and the presence of posteriorly oriented postsutural dorsocentral setae.

Etymology. Feminine latinized adjective for Malaysia, refers to the occurrence of this species in the Malaysian peninsular.

Description. Head: Face silver pruinose, wide, wider than adjacent ommatidium; mystax yellow, 4 setae, 2 long lateral and 2 shorter median ones; vertex wide, wider than face at clypeal–facial margin, silver pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput laterally brown pruinose, median dorso-ventral stripe silver pruinose; postocular setae brown; proboscis brown; Antennae: scape and pedicel yellow, yellow setae dorsally and ventrally; postpedicel predominantly brown, silver pruinose, 1.5 times as long as

scombined length of scape and pedicel; stylus dark brown, 1/6 as long as postpedicel, composed of 1 element.

Thorax: Predominantly brown, silver pruinose; antepronotum, postpronotum, and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, light brown; scutum brown, predominantly apruinose, only lateral and posterior margins silver pruinose; presutural dc setae: 2–3 short, 2 long, postsutural dc setae: 1 long posteriorly oriented, 4–5 anteriorly oriented, 4–5 acr setae, 1 npl and 1 spa seta; anepisternum, anepimeron, proepimeron, katepisternum, katepimeron, metkatepisternum, and meron+metanepisternum brown, predominantly silver pruinose; scutellum brown, silver pruinose, 2–3 apical scutellar setae; Legs: light yellow to brown; pro coxa yellow, mes and met coxae brown; pro trochanter yellow, mes and met trochanters brown; pro and mes femora light brown with 1 yellow transverse band in distal half, met femur yellow proximally, brown distally, clubbed in distal 1/2, yellow transverse band proximal to midline and another band at proximal margin of club, rows of brown macrosetae on femora; pro and mes tibiae light brown, met tibia brown with yellow transverse band medially, more than twice as long as width of tibia, erect macrosetae in rows, pro and mes tibiae with 1 long apical macroseta, met tibia with 1 median and 1 apical macroseta; tarsus light brown to brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; empodia minute; mes and met median claw 1/2 of lateral claw; Wings (Fig. 35): length = 3.9 mm; microtrichia throughout, trichoid spicules short, symmetrical dorsally and ventrally, 24–26 on M_1 between r-m and diversion of M_1 and M_2; cell d large, terminating in M_2, r-m situated just distal to separation of M_3 and CuA_1; R_1 reaching C proximal to R_5 and M_1 joining C, R_{2+3} straight proximally and sinuous distally, not arching posteriad distally, posterior-most point just distal of mid length; halter light yellow, knob dark brown, length = 0.8 mm.

Abdomen: Brown, T2 length = 1.8 mm, T2–6 posterior margins yellow; T2–8 with erect, evenly spaced macrosetae, T7–8 without lateral sensory areas; Male terminalia (Figs 25–27): epandrial halves separate medially, but fused partly proximally, distal tip straight, bifid, dorsal lobe longer; gonocoxite and hypandrium fused to form a gonocoxite-hypandrial complex, which is approximating epandrium proximally; *Aedeagus* - protruding from hypopygium, prong tubular; Female genitalia: ♀ unknown.

Type material. The ♂ holotype is labeled "Btwn Pokok Sena and Kuala Nerang 1.i.1973 / W. MALAYSIA Selangor A.E. Stubbs BMNH 1974–87 / HOLOTYPE *Schildia malaya* sp.n. det. T. Dikow & K. Bayless 2007 (red label)" (BMNH). The specimen is paper pointed and in fair condition (some scutal setae broken, left legs broken, and some glue on right side of thorax and head).

Distribution. Malaysia (Fig. 1). Biodiversity hotspot/high-biodiversity wilderness area: Sundaland/–.

Remarks. Only *Schildia* species occurring in the Oriental zoogeographical region and known only from the single type specimen. See Discussion for comments on the generic placement of this species.

†*Schildia martini* sp.n. (Figs 9–10, 37) (extinct species)

Diagnosis. This species is distinguished from its congeners by the long metathoracic empodia, which are about 1/2 as long as the median claw, the wide face, and the antennal style which is composed of two elements. This species is extinct and has only been recovered in Dominican amber.

Etymology. Named after Charles H. Martin in recognition of his contribution to the knowledge of New World Leptogastrinae.

Description. Head: Face wide, wider than adjacent ommatidium; mystax 2 setae; vertex wide, wider than face at clypeal–facial margin; distance between ocellar triangle and median eye margin more than adjacent ommatidium; occiput pruinose; postocular setae brown, short; proboscis light brown; Antennae: scape and pedicel light brown, setae dorsally and ventrally; postpedicel light brown, about 1.5 times as long as combined length of scape and pedicel; stylus 1/2 as long as postpedicel, composed of 2 elements, proximal element longer than apical 'seta-like' sensory element.

Thorax: Brown; scutum brown, predominantly apruinose; presutural dc setae: 1 short, 1 intermediate, 1 long (one paratype with two intermediate setae close together on one side), postsutural dc setae: a few anteriorly oriented setae, few acr setae, 1 npl and 1 spa seta; scutellum brown, pruinose, few short apical scutellar setae; Legs: light yellow to brown; coxae and trochanters light brown; pro and mes femora light brown, without lighter transverse bands (one paratype with slightly darker transverse median band), met femur light yellow proximally, brown distally, clubbed in distal 1/3, yellow transverse band at proximal margin of club, scattered yellow setae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow to light brown, met tibia predominantly brown with median light brown transverse band, all tibiae with yellow to light brown erect macrosetae in rows, pro and mes tibiae with 2 long apical macrosetae, met tibia with 1 disto-median and 2 apical macrosetae, met tibia with 5 lateral macrosetae spaced along tibia; tarsus light brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; pro and mes empodia 1/3 and met empodium about or more than 1/2 as long as median claw; median claw 3/4 of lateral claw; Wings: length = 3.6–4.4 mm; microtrichia scattered in all cells, trichoid spicules short, symmetrical dorsally and ventrally, 15–20 on M_1 between r-m and diversion of M_1 and M_2; cell d large, terminating in M_2 and M_3, r-m situated proximal to separation of M_3 and CuA_1; R_1 reaching C proximal to R_5 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter brown throughout, length = 0.6–0.7 mm.

Abdomen: Brown; T2 length = 1.0–1.3 mm, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae; Male terminalia: ♂ unknown; Female genitalia: not dissected.

Type material. The ♀ holotype is labeled "Luzzi Collection / HOLOTYPE *Schildia martini* sp.n. det. T. Dikow & K. Bayless 2007 (red label)" (AMNH). The specimen is in very good condition (left wing broken proximal to divergence of M_2 from M_{2+3}, T4–T8 partially obscured by fracture in amber). A paratype of undeterminable

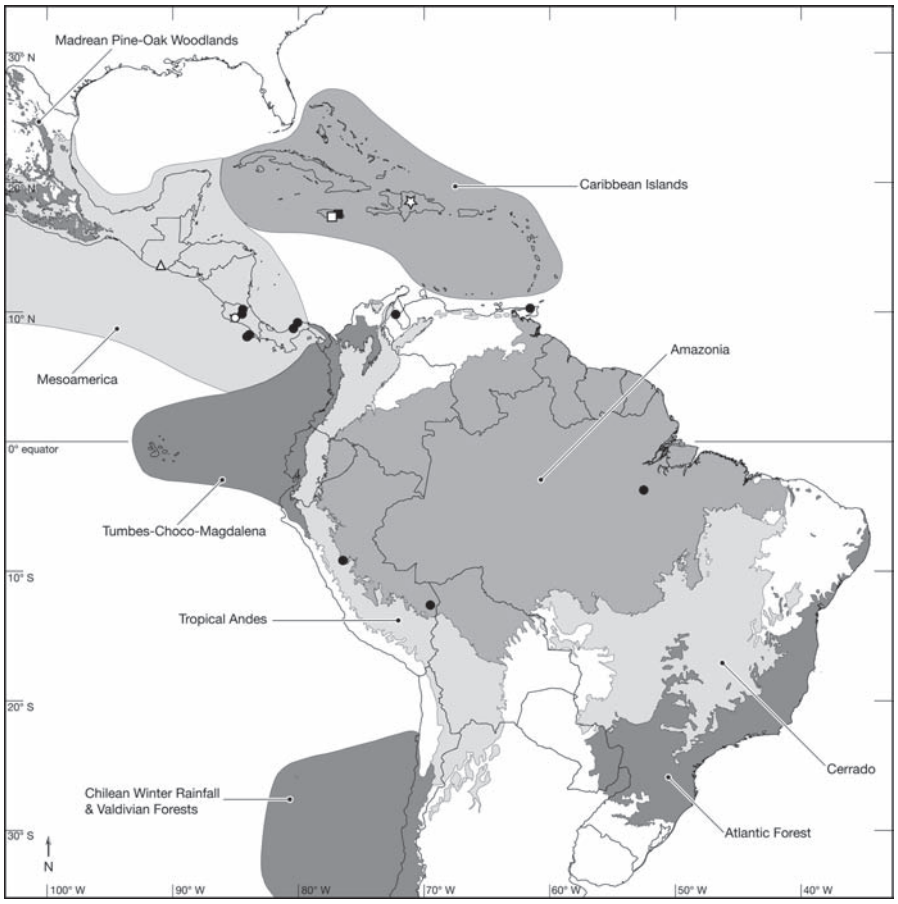


Fig. 37. Map of the Neotropical region with biodiversity hotspots and wilderness areas, shaded in grey, showing distribution of *Schildia guatemalae* (triangle), *S. jamaicensis* (square), †*S. martini* sp.n. (star) and *S. microthorax* (circle). Open symbols, type localities.

gender is labeled "AMBER: Dominican Republic, Specific locality unknown. Purchased from Francisco Valeriano July, 1989 AMNH no. DR-V-7 Inclusions: anterior half of leptogastrine Asilidae (AMNH number and 'anterior half of leptogastrine Asilidae' handwritten) / Leptogaster sp. 2 (handwritten) / PARATYPE *Schildia martini* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)" (AMNH). The specimen is in good condition (abdomen missing posterior to T2, right wing missing posterior to humeral vein and left wing obscured by fracture). A ♀ paratype is labeled "AMBER: Oligo-Miocene Dominican Republic AMNH no. DR-14-1462 *Locality*. (number handwritten) / ASILIDAE: Leptogastrinae** ♂ Chironomidae, small moth / PARATYPE *Schildia martini* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)" (AMNH). The specimen is in good condition although a few fractures obscure the view. A ♀ paratype is labeled "3523 / PARATYPE *Schildia martini* sp.n. det. T. Dikow & K. Bayless 2007 (yellow label)." The specimen is in very good condition

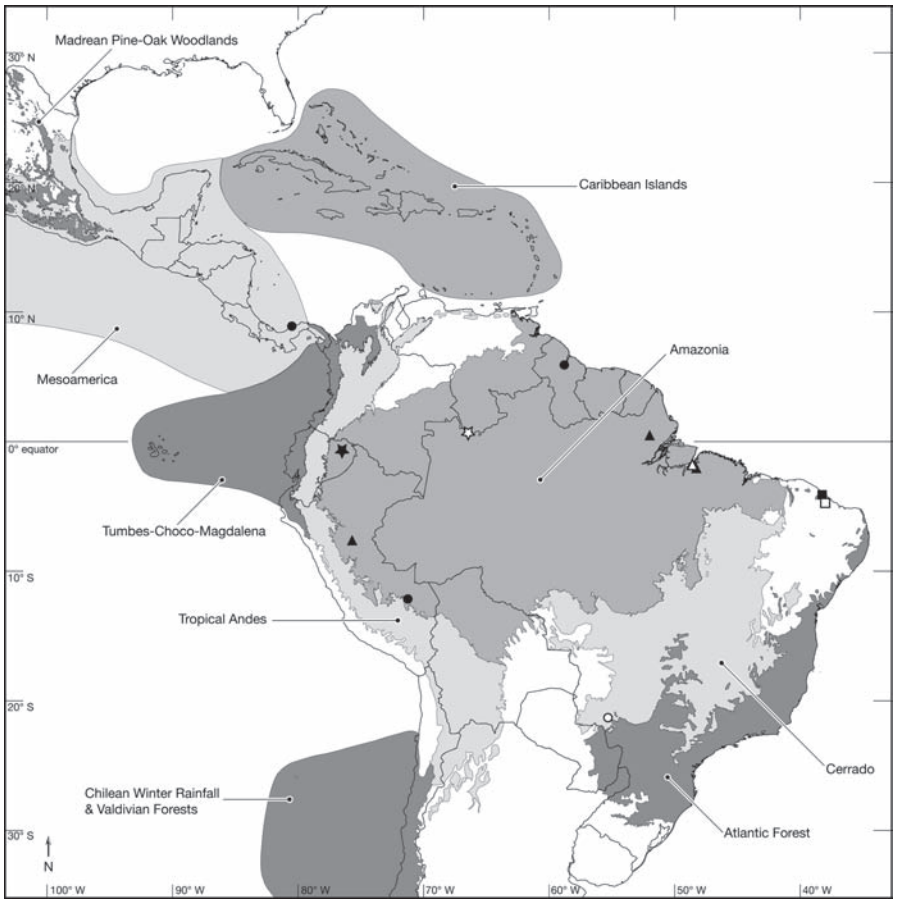


Fig. 38. Map of the Neotropical region with biodiversity hotspots and wilderness areas, shaded in grey, showing distribution of *Schildia alphus* (square), *S. caliginosa* sp.n. (star), *S. fragilis* (circle) and *S. gracillima* (triangle). Open symbols, type localities.

(metathoracic tarsi broken, but present in amber) and is deposited in the private collection of Ettore Morone (Torino, Italy).

Distribution. Hispaniola Island (Fig. 37). Biodiversity hotspot/high-biodiversity wilderness area: Caribbean Islands/–.

Remarks. The holotype specimen is closely associated with a large mite (Acari) (Fig. 9), however, it remains unknown whether this is coincidence or a prey item.

***Schildia microthorax* Aldrich, 1923** (Figs 2–8, 28–30, 36–37) (Aldrich, 1923: 4)

(Carrera 1944: 87; Hull 1962: 314; Farr 1962: 194; Martin 1968b: 5; Martin 1975: 189; Fisher in press)

Diagnosis. This species is distinguished from its congeners by the medially very narrow face, as narrow as width of an adjacent ommatidium at narrowest point, the

entirely brown metathoracic tibia, and R_1 reaching C at or distal to R_5 joining C (Fig. 36).

Redescription. Head: Face silver to yellow pruinose, narrow, narrower than adjacent ommatidium; mystax light brown, 2 setae; vertex wide, wider than face at clypeal–facial margin, yellow pruinose; occipital triangle apruinose, distance between triangle and median eye margin more than adjacent ommatidium; occiput laterally light brown pruinose, median dorso-ventral stripe silver pruinose; postocular setae brown; proboscis light brown; Antennae: scape and pedicel yellow to light brown, yellow or light brown setae dorsally and ventrally; postpedicel predominantly brown, silver pruinose, about 1.5 times as long as combined length of scape and pedicel; stylus dark brown, as long as postpedicel, composed of 1 element.

Thorax: Predominantly brown (sometimes red medially), silver pruinose; antepronotum, postpronotum and median postpronotal lobes silver pruinose; lateral postpronotal lobes apruinose, yellow; scutum brown, predominantly apruinose, only extreme lateral margin and posterior part silver pruinose, 2 light brown longitudinal stripes lateral to median line reaching posterior margin; presutural dc setae: 2–4 short, 1 long, postsutural dc setae: only a few short anteriorly oriented setae close to posterior margin, 5–6 short acr setae, 1 npl and 1 spa seta; anepisternum and anepimeron yellow dorsally and brown ventrally, silver pruinose, few yellow anepisternal setae on anterior and dorsal margins; proepimeron, katepisternum, katepimeron, and meron+metanepisternum brown, predominantly silver pruinose, katepisternum with antero-medial apruinose spot, metkatepisternum yellow, silver pruinose; scutellum brown, silver pruinose, apical scutellar setae absent; Legs: light yellow to brown; coxae light yellow; trochanters light yellow, small brown area ventrally; pro and mes femora light yellow proximally, light brown distally, met femur light yellow proximally, brown distally, clubbed in distal 1/3, yellow transverse band at proximal margin of club, scattered brown macrosetae on pro and mes femora, met femur with distinct rows of brown macrosetae; pro and mes tibiae light yellow to light brown, met tibia brown throughout with distal part darker, all tibiae with yellow to light brown erect macrosetae in rows, pro and mes tibiae with 3 long apical macrosetae, met tibia with 2 median and 2 apical macrosetae; tarsus light brown to brown, proximal tarsomere always longer than 2 following tarsomeres combined, short and long macrosetae on all tarsomeres; pro and mes empodia 1/3 and met empodium 1/5 as long as median claw; pro and mes median claw 3/4 of lateral claw, met median claw 1/2 of lateral claw; Wings (Fig. 36): length = 3.4–5.2 mm; few microtrichia, trichoid spicules short, symmetrical dorsally and ventrally, 12–14 on M_1 between r-m and diversion of M_1 and M_2; cell d small, terminating in M_2 and M_3, r-m situated proximal to separation of M_3 and CuA1; R_1 nearly parallel and close to C, R_1 reaching C at or distal to R_5 joining C, R_{2+3} straight proximally and smoothly arching posteriad distally; halter light yellow, knob dark brown, length = 0.7–1.0 mm.

Abdomen: Brown; T2 length = 2.4–3.7 mm, T2 with yellow transverse band medially, T2–3 with short, erect, evenly spaced macrosetae, remaining T with irregularly spaced and longer macrosetae T7–8 with large lateral sensory areas, nearly touching medially on T8; Male terminalia (Figs 28–30): epandrial halves fused medially, distal tip straight, pointed, narrow lobe extending beyond cerci; epandrium and

hypandrium fused proximally, gonocoxite and hypandrium fused to form a gonocoxite-hypandrial complex; Aedeagus: protruding from hypopygium, distal tip of dorsal aedeagal sheath distinctly arched ventrally, prong dorso-ventrally flattened; Female genitalia: spermathecae occupying only segment 8, individual spermathecal ducts long and coiled; spermathecal reservoirs not sclerotized, as wide as individual ducts, forming a coil.

Type material. The ♂ holotype is labeled "Higuito San Mateo CR / Pablo Schild Coll / Type No. 25308 U.S.N.M. (number handwritten, red label) / *Schildia microthorax* Ald. (handwritten, black border)" (USNM). The specimen is double mounted (wooden minuten in foam), and is in good condition (right meso- and left metathoracic legs broken). The ♀ paratype is labeled "Higuito San Mateo CR / Pablo Schild Coll / Allotype No. 25308 U.S.N.M. (number handwritten, red label) / *Schildia microthorax* Ald. Allotype (handwritten, black border)" (USNM). The specimen is double mounted (minuten in foam) and is in good condition (postpedicel broken).

Specimens. Brazil: Parà: 1♀ Rio Xingo Camp, ca 60 km S Altamira, 03°39'S 052°22'W, 2–8.x.1986, P. Spangler O. Flint (USNM); Costa Rica: Heredia: 1? Basilia, 10°18'N 084°00'W (INBIO); 1♀ F. La Selva, 3 km S Puerto Viejo, 10°26'N 084°01'W, 14.iv.1984, H. Hespenheide (EMF), 1♀ 1♂ Higuito, 09°57'N 084°33'W, -.-.-, P. Schild (holotype, paratype, USNM), Puntarenas: 1♀ Parque Nacional Corcovado, Estancia Sirena, 08°28'N 083°36'W, 25.iii.1981, H. Hespenheide (EMF), 1♂ Parque Nacional Corcovado, Estancia Sirena, -.xii.1989, G. Fonseca (INBIO), 1♂ Peninsular Osa, 5 km N Puerto Jimenez, 08°33'N 083°30'W, 1.ii.1993, P. Hanson (EMF); Panama: 1♀ Barro Colorado Island, 09°09'N 079°54'W, 15.vii.1978, E. Fisher (EMF), 1♀ Barro Colorado Island, 18–23.v.1967, R. Akre (FSCA), 1? Camp Gaillard, 09°30'N 079°40'W, 1.i.1925, Shropshire (USNM); Peru: Madre Dios: 1? Tambopata Reserve, 30 km SW Puerto Maldonado, 12°43'S 069°10'W, 20.xi.1982, E. Fisher (EMF), 1♀ Monsoon Valley, Tingo Maria, 09°12'S 076°12'W, 23.xii.1954, E. Schlinger E. Ross (FSCA); Trinidad and Tobago: 1♀ St. George, Arima, 10°39'N 61°19'W, 27.i.1976, A. Stubbs (BMNH); Venezuela: 1♀ 1♂ Zulia, Los Angeles del Tucuco, 10°14'N 071°54'W, 15–16.iv.1981, E. Grissell (EMF).

Distribution. Brazil, Costa Rica, Panama, Peru, Trinidad and Tobago, Venezuela (Fig. 37). Biodiversity hotspot/high-biodiversity wilderness area: Mesoamerica/Amazonia (Fig. 37).

Remarks. This is the type species of *Schildia*. It is the best represented species in collections, and has the most widespread distribution from Costa Rica in the north to Brazil in the south.

Identification key to species of *Schildia*

1. Four mystacal setae (two long lateral setae and two short median setae); one pair of posteriorly oriented postsutural dorsocentral setae present; Afrotropical, Oriental..... 9

- Two mystacal setae; posteriorly oriented postsutural dorsocentral setae absent (anteriorly oriented postsutural dorsocentral setae may be present); Neotropical.. 2
2. Face narrow, at narrowest point as wide as adjacent ommatidium (Fig. 5); R_1 reaching C at or distal to R_5 and M_1 joining C (Fig. 36).....*S. microthorax*
- Face wide, at narrowest point wider than width of adjacent ommatidium; R_1 reaching C proximal to R_5 and M_1 joining C (Fig. 35) 3
3. Frons and vertex narrow, as wide as face just ventral to antennal insertion and narrower than face at clypeal–facial margin; distal tip of cell d formed by M_1 and M_2; longer flies, T2 length = 4.9–5.1 mm, body length 12–20 mm.....*S. gracillima*
- Frons and vertex wide, wider than face just ventral to antennal insertion and wider than face at clypeal–facial margin (Fig. 6); distal tip of cell d formed by M_2 and M_3; shorter flies, T2 length = 1.0–4.1 mm, body length usually less than 10 mm 4
4. Anteriorly oriented postsutural dorsocentral setae absent..... 7
- Anteriorly oriented postsutural dorsocentral setae present 5
5. Metathoracic empodia about 1/2 as long as median tarsal claw; antennal style composed of 2 elements; extinct: Dominican Amber.....†*S. martini* sp.n.
- Metathoracic empodia small, never more than 1/4 as long as median tarsal claw; antennal style composed of 1 element (Fig. 5); extant: Brazil, Guatemala..... 6
6. Scutum apruinose (pruinosity restricted to extreme lateral and posterior margins); katepisternum with distinct apruinose area above prothoracic coxa; postocular setae light yellow; Guatemala.....*S. guatemalae*
- Scutum grey pruinose on lateral and posterior surfaces (apruinose in the center); katepisternum entirely grey pruinose; postocular setae brown; Brazil.....*S. alphus*
7. Antepronotum, postpronotum, and medial postpronotal lobes apruinose; alternating yellow and brown transverse bands on mesothoracic tibia unequal in width, brown transverse bands much narrower than yellow bands; yellow transverse band on metathoracic tibia more than 3 times as wide as width of tibia; Ecuador, Venezuela .....*S. caliginosa* sp.n.
- Antepronotum, postpronotum, and medial postpronotal lobes silver pruinose; alternating yellow and brown transverse bands on mesothoracic tibia of approximately equal width; yellow transverse band on metathoracic tibia less than 2.5 times as long as width of tibia..... 8
8. Scutum with two lateral longitudinal yellow stripes; postpronotal lobes white to light yellow; T6 yellow; Jamaica .....*S. jamaicensis*
- Scutum without any lighter lateral longitudinal stripes (Fig. 12); postpronotal lobes at most light brown (Fig. 12); T6 brown; Brazil, Panama, Peru ..... *S. fragilis*
9. Tip of metathoracic femur yellow (Fig. 11); metathoracic coxa yellow; cells r_1–r_5 and m1–m3 densely covered with microtrichia; trichoid spicules on R4 shorter than width of R4; Afrotropical: Madagascar ..... *S. adina* sp.n.
- Tip of metathoracic femur brown; metathoracic coxa brown; cells r_1–r_5 and m1–m3 only sparsely covered with microtrichia; trichoid spicules on R4 longer than width of R4; Oriental: Malaysia ..... *S. malaya* sp.n.

Discussion

Martin (1965) mentioned an unstudied specimen of *Schildia* deposited in the Naturhistorisches Museum Wien (Austria), but this specimen was not found in the collection and consequently we could not assign it to any species. In another publication, Martin (1968b) mentions a new species of *Schildia* found from Baja California, Mexico, but does not provide any specimen label data or depository. This fly was not mentioned in his 1975 review of the genus, so we assume that the specimen was later identified as another genus of Leptogastrinae.

Seasonal incidence

Species of *Schildia* have been collected in the following months: *adina*: January, March–April, October–November; *alphus*: August, December; *caliginosa*: February, June; *fragilis*: April–June, September–November; *guatemalae*: August; *gracillima*: March, May–June, November; *jamaicensis*: February–May, September, November; *malaya*: January; *microthorax*: January–May, July, October–December. Farr (1963: 20) states that *jamaicensis* is active during all seasons of the year.

Fossil species and the present distribution of Schildia *in the New World*

One species, †*S. martini* sp.n., is described from Dominican amber, which originated in the Dominican Republic on the island of Hispaniola (Fig. 37). Presently, this species is the only *Schildia* species, extinct or extant, known from this large Caribbean island. In a number of recent publications, Scarbrough and co-authors (Scarbrough 1996, 1997, Scarbrough et al. 2005) reviewed the Leptogastrinae fauna of the Caribbean and focused in particular on the West Indian islands including Hispaniola. They did not report any specimens belonging to *Schildia*. Jamaica is currently the only Caribbean island on which an extant species, *Schildia jamaicensis*, is distributed (Fig. 37). With the historical distributional information at hand, one has to conclude that *Schildia* was more widespread during the Tertiary: Miocene and possibly also inhabited Cuba as well as other smaller Caribbean islands.

The distribution of Schildia *in the Old World*

The Neotropical Leptogastrinae fauna is very distinct with morphologically peculiar genera like *Eurhabdus* Aldrich, 1923, *Leptopteromyia* Williston, 1907, and *Systellogaster* Hermann, 1926 being restricted to this region based on our current knowledge. Before the start of this study, *Schildia* would have no doubt been listed as well as endemic to the New World, but two of the newly described species, *Schildia adina* sp.n. and *Schildia malaya* sp.n., occurring in the Afrotropical and Oriental regions, respectively, extend the distribution of this genus to the Old World (Fig. 1). This distributional pattern is not known from any other genus of Leptogastrinae. Biogeographical connections between the Afrotropical and Oriental Leptogastrinae faunas are known for *Ammophilomima* Enderlein, 1914 (see Martin 1973), *Euscelidia* Westwood, 1850 (see Dikow 2003), and *Lobus* Martin, 1972 (see Martin 1972; Joseph & Parui 1998), which

are distributed in both zoogeographical regions. The genus *Leptogaster* is world-wide in distribution, but a phylogenetic hypothesis supporting its monophyly is needed to examine the distribution in more detail.

The placement of these two new species from the Old World is based on the suite of apomorphic characters delimiting the genus *Schildia*, i.e., unequally long tarsal claws, long trichoid spicules on wing veins that are mostly symmetrical dorsally and ventrally, male epandrium lacking a surstylus. However, *Schildia adina* sp.n. is morphologically quite different (T2 not as elongated (Fig. 11) and trichoid spicules not ventrally and dorsally symmetrical) and also exhibits a different general habitus, i.e., the abdomen is shorter in respect to the wing length (Fig. 11). Although the abdomen of *Schildia malaya* sp.n. is also shorter in respect to the Neotropical species, this species clearly belongs to *Schildia*. It is, however, known only from a single male specimen collected in northern Malaysia close to the border to Thailand. Interestingly, the two Old World species both possess four mystacal setae, posteriorly oriented postsutural dorsocentral setae, and the male epandrium is separated medially and only joined proximally (Figs 14, 26), whereas all Neotropical species exhibit only two mystacal setae, the epandrium is fused medially to form a single sclerite, and the posteriorly oriented dorsocentral setae are confined to the area anterior to the transverse suture (presutural).

The first specimens of *Schildia adina* sp.n. became known to the senior author preserved in Malagasy copal in the year 2000 (Fig. 11). A species identification using the keys provided by Oldroyd (1959) and Martin (1964), who reviewed the Malagasy Leptogastrinae fauna extensively, was not possible and it was concluded that the specimens represent an undescribed species. However, it was not clear to which genus this new species should be assigned as only three genera, i.e., *Euscelidia*, *Leptogaster*, and *Mesoleptogaster* Frey, 1937, have so far been recorded from Madagascar. *Euscelidia* and *Mesoleptogaster* are readily identifiable and *Schildia adina* sp.n. does not share their characteristics. The genus *Leptogaster* is very speciose and most probably not monophyletic so that placement within this genus is difficult. After studying the Neotropical fauna more extensively, it became obvious that this species belonged to the genus *Schildia*, which casted doubt on the origin of the copal specimens. Insects preserved in relatively young resin are also known from the Neotropical region and in particular from Colombia where *Schildia* could be postulated to occur as well (although no extant specimens from Colombia have been examined). The exact collecting locality or mine of the copal pieces at hand could not be established, but additional inclusions, particularly the specimens of *Tetraponera* cf. *sahlbergii* (Hymenoptera: Formicidae: Pseudomyrmecinae), verified its origination in Madagascar. Malagasy copal is a very young resin and it is generally agreed to be of recent age (up to 11 000 years old: Grimaldi pers. commun; Burleigh & Whalley 1983) and a number of insect species have been described from it (Schluter & von Gnielinski 1987, Stroinski & Szwedo 2002, Botosaneanu & Andersen 2003, Wunderlich 2004), which are all present in the extant fauna. Within Asilidae, *Leptogaster exacta* Meunier, 1906 has been described from the copal of Zanzibar, Tanzania. *Schildia adina* sp.n. has recently been collected in malaise traps by an extensive collecting effort in Madagascar co-ordinated by the California Academy of Sciences (San Francisco, CA, USA), on which the type series is based.

Biodiversity hotspots and high-biodiversity wilderness areas

The biodiversity hotspots *sensu* Conservation International (Myers et al. 2000) are areas of high plant endemism in which the habitat has been destroyed to a considerable extant and which are under threat of more destruction. The high-biodiversity wilderness areas (Mittermeier et al. 2003) highlight those landmasses that are largely undisturbed and have a very low population density. Evaluating the presence/absence of Diptera species in these priority areas earmarked for conservation can determine whether these species will also be preserved when funding is made available for their protection (e.g., Dikow et al. 2009). Of the nine extant *Schildia* species, four are endemic to a particular biodiversity hotspot (i.e., *adina* sp.n. in Madagascar and Indian Ocean Islands, *guatemalae* in Mesoamerica, *jamaicensis* in Caribbean Islands, and *malaya* sp.n. in Sundaland (Figs 1, 37–38)). The two most widespread species, *fragilis* and *microthorax*, occur within biodiversity hotspots (Cerrado plus Mesoamerica and only Mesoamerica, respectively), but also occur elsewhere (Figs 37–38). *Schildia alphus* and *Schildia gracillima* both are distributed outside of any biodiversity hotspot. While *S.* gracillima is restricted to the high-biodiversity wilderness area Amazonia, *S.* alphus only occurs in the xeric Caatinga habitats in northeastern Brazil in the state of Ceará (Fig. 38). The biodiversity hotspot with the highest species diversity of *Schildia* is Mesoamerica in which three species occur, i.e., *fragilis*, *guatemalae* and *microthorax*, but only *guatemalae* is endemic to it. The high-biodiversity wilderness area Amazonia harbours four species, i.e., *caliginosa* sp.n., *fragilis*, *gracillima* and *microthorax* but this area also covers a much larger land area than Mesoamerica. In conclusion, with the exception of a single extant species the distribution of *Schildia* species coincides with the biodiversity hotspots and high-biodiversity wilderness areas *sensu* Conservation International and protecting these vast biologically diverse areas will help also to preserve species of the genus *Schildia*. Using the World Wildlife Fund Ecoregions (WWF 2005) as an index of habitat, the majority of species occur in tropical and subtropical moist broad leafed forests. *Schildia malaya* sp.n. is found in tropical and subtropical moist forests whereas *Schildia adina* sp.n. and *Schildia alphus* have been collected in deserts or xeric shrub lands.

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Note Added in Proof

When this paper was already in press two additional specimens of *Schildia gracillima* became available that extend the distribution of this species in northern Brazil. Amazonas: 1M* Querari, Município São Gabriel da Cachoeira, 01°05'N 069°51'W, 5.iv.–27.v.1993, C. Motta et al.; Roraima: 1M* Serra Pacaraima, 04°04'N 061°29'W, 27.viii.1987, J. Rafael J. Elias A. Henriques. Both specimens are deposited in INPA (Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil).

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