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Synopsis of the myrmecophilous cockroach genus *Myrmecoblatta* (Blattodea: Nocticolidae: Latindiinae), with description of a new species; including data to tribe Compsodini Rehn, 1951 in America

Sinopsis del género de cucarachas mirmecófilas Myrmecoblatta (Blattodea: Nocticolidae: Latindiinae), con la descripción de una especie nueva; incluyendo datos para la tribu Compsodini Rehn, 1951 en América

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Abstract: The ecological associations of cockroaches with other animals are poorly studied, with most records limited to reports of cohabitation. These interactions extend to various groups, including birds, mammals, reptiles, and social insects, but the adaptations of myrmecophilous cockroaches remain enigmatic. This work presents a comprehensive examination of the genus *Myrmecoblatta*, including their poorly known biology and interactions. It introduces a new tribe and describes a newly discovered species in the Sierra de Huautla Biosphere Reserve, Morelos, Mexico.

Keywords: new taxa, biotic association, species interaction, coevolution.

Resumen: Las asociaciones ecológicas de las cucarachas con otros animales están poco estudiadas, con la mayoría de los registros limitados a registros de cohabitación. Estas interacciones involucran varios grupos, incluyendo aves, mamíferos, reptiles e insectos sociales, pero las adaptaciones de las cucarachas mirmecófilas siguen siendo desconocidas. Este trabajo presenta un examen exhaustivo del género *Myrmecoblatta*, incluyendo su biología poco conocida y sus interacciones. Introduce una nueva tribu y describe una especie recientemente descubierta en la Reserva de la Biosfera Sierra de Huautla, Morelos, México.

Palabras clave: nuevos taxones, asociación biótica, interacción entre especies, coevolución.

Introduction

The ecological association of cockroaches with other animals is poorly studied, and most records are merely reports of instances where they have been observed sharing a microhabitat with other animals (Roth & Willis, 1960; Schal *et al.*, 1984; Bell *et al.*, 2007). Perhaps one of the least understood cases is that of myrmecophilic cockroaches, for which their adaptations and life strategies allow them to live within ant nests (Bell *et al.*, 2007). Amongst cockroaches with this particular lifestyle, the genus *Myrmecoblatta* Mann, 1914 was established based on material collected in Hidalgo, Mexico, found within ant nests (Mann, 1914; Roth & Willis, 1960; Estrada-Álvarez & Guadarrama, 2013; Estrada-Álvarez & Rojas, 2020). In subsequent years, Hebard described a new species for the genus, *Myrmecoblatta wheeleri* Hebard, 1917, also associated with ant nests (Hebard, 1917; Roth & Willis, 1960; Fisk *et al.*, 1976; Deyrup & Fisk, 1984; Roth, 1995; Bell *et al.*, 2007; Estrada-Álvarez & Guadarrama, 2013; Estrada-Álvarez & Rojas, 2020; Maes *et al.*, 2020). In 2013, a third species for the genus was described, *Myrmecoblatta hebardi* Estrada-Álvarez & Guadarrama, 2013, this species has not been reported in association with ants or termites and was recently transferred to the genus *Paralatindia* Saussure, 1868 (Estrada-Álvarez *et al.* 2022), leaving the genus with only two species.

This work provides an overview of the genus *Myrmecoblatta*, considering the available information about the biology of these cockroaches and their hosts, establishes a new tribe, and describes a new species from the Sierra de Huautla Biosphere Reserve in the state of Morelos, Mexico.

Materials and Methods

To validate the identity of the new species, we examined images of the type specimens (males) of *Myrmecoblatta rehni* Mann, 1914, and *Myrmecoblatta wheeleri* Hebard, 1917. The holotype specimen of the new species underwent dissection: the abdomen was carefully detached from tergite one (T-1) using a fine needle. Subsequently, the abdomen was subjected to digestion in a 10% KOH solution for approximately 2 hours at a temperature of around 70°C in a water bath. The resulting dissected structures were then examined after embedding them in 70% alcohol and glycerin; special care was taken to position the sclerites of the male genitalia accurately. The imagery was captured by manually attaching a digital camera to a stereomicroscope and subsequently refined using Photoshop (version 13.0 x 32). The dissected structures were meticulously preserved in microvials filled with glycerin and appropriately labeled.

To compile distribution data for the genus, a comprehensive review was conducted involving all available records in the scientific literature, collection information, and the citizen science platform iNaturalist (2023). Additionally, species of ants with which species of the genus maintain any relationships were identified and reviewed in AntWeb (https://www.antweb.org). In total, 12 records were compiled, forming the basis for creating a distribution map for the genus using QGIS software (version 3.30.2-'s-Hertogenbosch). Lastly, a dichotomous key was constructed to identify male specimens of this genus.

ABBREVIATIONS USED

Morphology (following Mckittrick 1964; Roth 2003; Gutiérrez 2012; with modifications):

sap=Supra-anal plate.

hw=Hyaline window of male supra-anal plate (membranous area in Gutiérrez 2012; hyaline macula in Lucañas 2018; median hyaline broadly in Qiu *et al.* 2016; hyaline area in Qiu *et al.* 2019).

lp= left paraproct.

rp= rightparaproct.

sgp=Sub-genital plate.

ap=Apodemes.

L. ph.=Left phallomere.

L $_1$=First left phalomere sclerite.

L $_2$=Second left phalomere sclerite.

L $_3$=Third left phalomere sclerite (genital hook).

R. ph.=Right phallomere.

R $_1$=First right phalomere sclerite.

R $_2$=Second right phalomere sclerite.

R $_3$=Third right phalomere sclerite.

v.ph.=Ventral phalomere

General terms:

TL=Type Locality.

D♀=Description Female.

D♂=Description Male.

D♂♀=Description of both sexes.

ID err.=Erroneous identification.

Table 1. Ant species recorded in association with myrmecophilic cockroaches of the genus *Myrmecoblatta* (Nocticolidae).

Cockroach	Ant Species	Exotic or Native to America
M. rehni	*Formica subcyanea* Wheeler, 1913	Native to Mexico
	Formica rufibarbis Fabricius, 1793	Exotic
	Camponotus maculatus (Fabricius, 1782)	Exotic
M. wheeleri	*Camponotus atriceps* (Smith, 1858)	Native
	Solenopsis geminata (Fabricius, 1804)	Native
	Camponotus sp.	unknown

COLLECTIONS MENTIONED IN THE TEXT

ANSP: The Academy of Natural Sciences of Drexel University [of Philadelphia]. Philadelphia, USA.

CNIN: Colección Nacional de Insectos, Instituto de Biología, UNAM. Mexico City, Mexico.

MCZ: Harvard University, Museum of Comparative Zoology. Cambridge, Massachusetts, USA.

IEXA: Colección Entomologica del Instituto de Ecología, Xalapa, Veracruz, México.

LESM: Laboratorio de Ecología y Sistemática de Microartrópodos, Facultad de Ciencias, UNAM, Ciudad de México, México.

CER: Colección Entomológica Entomological Research, Metepec, Estado de México, México.

Results

All species of *Myrmecoblatta* have been observed in interactions with ants (Hymenoptera: Formicidae). *Myrmecoblatta rehni* is associated with two exotic species and one native species to Mexico, while *M. wheeleri* have only been found on nests of species native to the American continent (Table 1). Interestingly, there is a record of an interaction between unidentified termites of the genus *Microcerotermes* sp. and the latter species. The biology of the new species is entirely unknown since it was collected using pitfall tramps.

Two of the three species (*M. rehni* and *M. cuauchichilolana* **sp. nov.**) are endemic to Mexico and have a seemingly very restricted distribution, as they are only known from their type localities. In the case of *M. wheeleri* it has a few records in Central America (Guatemala, Nicaragua, Costa Rica) and one in the United States, being the most widely distributed species.

Systematics

Order **BLATTODEA** Brunner von Wattenwyl, 1882

Suborder **Blattaria** Burmeister, 1829

Superfamily **CORYDIOIDEA** Saussure, 1864

Family **Nocticolidae** Bolívar, 1892

Subfamily **Latindiinae** Handlirsch, in Schröder 1925

Tribe **Compsodini** Rehn, 1951

CompsodesHebard, 1917; Rehn, 1951: 39

Diagnosis of the tribe: (**1**) Small size (5mm or less). (**2**) Sexual dimorphism present, with males having varying degrees of wings and females being wingless (both sexes winged in Latindiini). (**3**) Males possessing a hyaline window (vh) on the supra-anal plate (membranous area in Gutiérrez, 2012; hyaline macula in Lucañas, 2018; median hyaline broadly in Qiu *et al.*, 2016; hyaline area in Qiu *et al.*, 2019) (e.g. Fig. 2g), not mentioned in *Austropolyphaga*. (**4**) Tergite four with tergal gland, found in *Paralatindia, Compsodes* and *Myrmecoblatta* (e.g. Fig. 2e, f).

Due to these similarities, the tribe **Compsodini** Rehn, 1951 includes the nine genera from **AMERICA** (Nearctic and Neotropical regions): ***Paralatindia*** Saussure, 1868 (2 spp.) (Mexico); ***Compsodes*** Hebard, 1917 (5 spp.) (USA, Mexico, Guatemala, and the Dominican Republic); ***Stenoblatta*** Walker, 1868 (1 sp.) (Brazil); ***Myrmecoblatta*** Mann, 1914 (3 spp) (USA, Mexico and Central America). Four from **ASIA** (Palearctic and Indomalayan regions): ***Brachylatindia*** Qiu, Wang & Che, 2019 (1 sp.) (China); ***Beybienkonus*** Qiu, Wang & Che, 2019 (1 spp.) (China); ***Gapudipentax*** Lucañas, 2018 (1 sp.) (Philippines); ***Sinolatindia*** Qiu, Che & Wang, 2016 (1 sp.) (China). And one from **AUSTRALIA**: ***Austropolyphaga*** Mackerras, 1968 (2 spp) (Australia).

Distribution: Mostly Amphiberingian (except *Austropolyphaga*). This distribution pattern is the outcome of biotic exchanges facilitated by a land bridge created by the lowering of sea levels, which connected Asia and America. This land bridge is referred to as Beringia or the Beringian Bridge. It formed on multiple occasions, allowing for biotic exchange between these two continental masses

(Hopkins, 1967; Clark et al., 2009; 44; Estrada-Álvarez and Sormani, 2023: 3).

Genus *Myrmecoblatta* Mann, 1914

Myrmecoblatta Mann, 1914: 172 [Blattidae: Blattinae]. in: Hebard (1917: 360) [re-diagnosis] [Latindiinae]. Estrada-Álvarez & Guadarrama (2013: 93) [Latindiinae]. Estrada-Álvarez *et al.* (2022: 4, 14) [Guide and Diagnosis].

Type species: *Myrmecoblatta rehni* Mann, 1914; by monotypy.

Diagnosis: Myrmecophilic and termitophilic small cockroaches (4-5mm total length in males) possessing a robust body structure; sexual dimorphism evident, with males having tegmina and wings, while females are apterous. Males exhibit variable stages of tegmina and wing development. The pronotum features a posteriorly recurved border, forming lateral-posterior projections. The rostrum bears a pointed clypeus.

Species included: *Myrmecoblatta rehni* Mann, 1914 (♂♀) Mexico. *Myrmecoblatta wheeleri* Hebard, 1917 (♂♀) USA. (introduced), Guatemala, Nicaragua and Costa Rica. *Myrmecoblatta cuauchichinolana* **sp. nov.** (♂) Mexico. Distribution in Fig. 4.

Bionomy: Species associated with ant and termite nests.

Key to the males of *Myrmecoblatta* Mann, 1914(Nocticolidae)

1a. Long tegmina that almost cover the abdomen and has a rounded apex (Fig. 1a) ..... ***M. rehni*** Mann

1b. Short tegmina that barely reach the third tergite, at most and has a truncated apex (Figs. 2a, 3a) **2**

2a. Compact form, body almost as wide as long (Fig. 2a) ..... ***M. wheeleri*** Hebard

2b. Slender shape, body conspicuously longer than wide (Fig. 3a) ..... ***M. cuauchichinolana* sp. nov.**

Myrmecoblatta rehni Mann, 1914 (♂♀) (Fig. 1a-d; 4)

Myrmecoblatta rehni Mann, 1914: 173; Fig. 1, 2. (D♂♀) [sp. nov.] [Guerrero Mill [=Real del Monte, Hidalgo] (TL)] [in nests of *Formica subcyanea* Wheeler, *F. rufibarbis* Fab. var. *gnava* Buckley, and *Camponotus maculatus* Fab. subsp. *picipes* Olivier]. Hebard, 1917: 360. Princis, 1963: 108. Fisk *et al.*, 1976: 318; Fig. 1, 2. Roth & Willis, 1960: 312. Estrada-Álvarez & Guadarrama, 2013:95; Fig. 10 (♂). Estrada-Álvarez, 2013: 273 [Guerrero Mill= Molino Guerrero, during the specimen collection period, this was a mining area; however, the locality is currently untraceable]. Beccaloni, 2014.

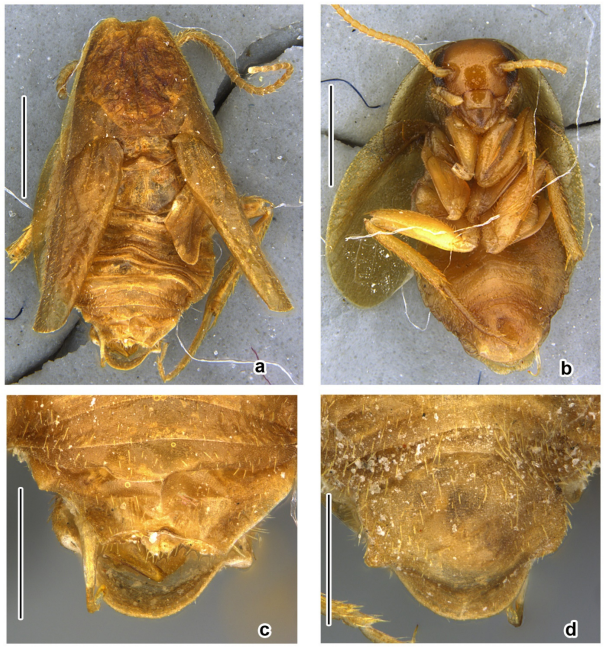

Figure 1a-d. *Myrmecoblatta rehni* Mann, 1914. Holotype male (MCZ); (a) dorsal view, (b) ventral view, (c) detail of the last tergites, absent *sap*, (d) detail of the subgenital plate. Scale bar a, b = 1 mm, c, d = 0.5 mm. Photos by Charles Farnum.

Type Material: ♀ Holotype, 2♂ and juvenile Paratypes (MCZ; Type 9023), revised photos of holotype male by Charles Farnum available in https://mczbase.mcz.harvard.edu

Distribution: MEXICO, ***Hidalgo*** , Municipality Omitlán de Juárez, Vicente Guerrero [formerly Hacienda de molienda Guerrero], locality amended in Estrada-Álvarez (2013) (Fig. 4).

Bionomy: Recorded living in nests of *Camponotus maculatus*, *Formica rufibarbis*, and *Formica subcyanea*. (Estrada-Álvarez & Rojas, 2020).

Myrmecoblatta wheeleri Hebard, 1917 (♂♀) (Fig. 2 a, b; 4)

Myrmecoblatta wheeleri Hebard, 1917: 361; Figs. 1, 2 in text page 260 [San Lucas Toliman, Sololá, Guatemala (TL); Lake Atitlan] [colony of the ant, *Solenopsis geminata* (Fabricius), 10 found under a stone]. Princis, 1963: 109. Fisk *et al.*, 1976: 318; Fig. 3-10 [n. rec. Cachí, Prov. Cartago, near a nest of *Camponotus* sp. ants; San Juan de Dios de Desamparados, Aserrí, and Campus, University of Costa Rica, San Pedro, Prov. San Jose in the nests of *Camponotus abdominalis* (Fabricius)]. Deyrup & Fisk, 1983: 183; Fig. 1, 2. [n. rec. Highlands County, Florida]. Estrada-Álvarez & Guadarrama, 2013: 95; Fig. 10. Beccaloni, 2014. Estrada-Álvarez & Rojas, 2020: 2.

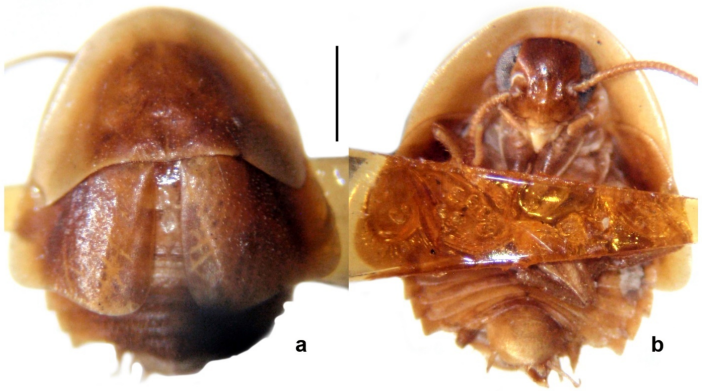

Figure 2a-b. *Myrmecoblatta wheeleri* Hebard, 1917. Male holotype; (**a**) dorsal view, (**b**) ventral view. Photos by Heidi Hopkins. Scale bar a, b = 1 mm

Maes *et al.*, 2020: 13; Fig. 4, 5 (♀) [First rec. Nicaragua: León: camino al Chague, en nido de *Microcerotermes* sp.]. Estrada-Álvarez & Sormani, 2021: 174. Estrada-Álvarez *et al.*, 2022: Fig. 6C.

Type Material: ♂ Holotype San Lucas Toliman, Solola, Guatemala; Junary 3, 1912; W. M. Wheeler col (ANSP), reviewed images, courtesy of Dr. Hopkins (Fig. ♂, ♀juv y juv. Lake Atitlan colony of the ant *Solenopsis geminata* under a Stone; W. M. Wheeler col (ANSP).

Distribution: **USA,** Florida. **GUATEMALA**, Depart. Sololá, San Lucas Tolimán, Lake Atitlán. **NICARAGUA**, Depart. León, on the way to Chague. **COSTA RICA**, Prov. Cartago, Cachí; Prov. San José. San Juan de Dios de Desamparados, Aserrí, Universidad de Costa Rica in San Pedro (Fig. 4).

Bionomy: Found in the nests of *Camponotus* sp.; *C. atriceps*; *Formica* sp.; *Solenopsis* sp.; *S. geminata*, and the termite *Microcerotermes* sp. (Maes *et al.* 2020; Estrada-Álvarez & Rojas 2020).

***Myrmecoblatta cuauchichinolana* sp. nov. Estrada-Álvarez & Núñez-Bazán** (♂) (Figs. 3a-j; 4)

Type material: 1 Male holotype. El limón, REBIOSH, Parcela 8, trampa de caída; 08/V/2020; Itzel Gonzales col. (CNIN).

Description Holotype male: (4mm total length, 2mm maximum width). Light brown color, slightly darker face; with long, thick, and truncated bristles across the integument (Fig. 3 a, b, c). Pronotum (1.8mm length, 2mm width), with anterior and lateral margins recurved, posterior margin recurved, generating latero-posterior projections (Fig. 3c). Face (0.95mm length, 0.93mm width), reduced eyes, distance 0.65mm; absent ocelli, antennal insertions 0.1mm in diameter with 0.41mm between them (Fig. 3 b, d); short and sub-moliniform antennas, triangular clypeus, not tapered. Tegmina (1.2mm length, 1.1mm width), without venation, posterior margin truncated, not exceeding the third tergite (Fig. 3 a). Reduced wings, shorter than the metanotum. Short legs with spination on reduced tibiae confined to the apex, anterior femur with spination type D_1 (*sensu* Roth, 2003). Pulvilli absent. Arolia absent. Simple and symmetrical tarsal claws. Abdomen with tergal gland on T-4 (Fig. 3 e, f). Supra-anal plate with a hyaline window (hw); paraprocts subequal (Fig. 3g). Subgenital plate symmetrical, equal apodemes located laterally, styles digitiform (detached and lost during digestion) (Fig. 3 b, g). Male genitalia (Figs. 3i, j): Left phallomere (L. ph.) complex with several sclerites being the most relevant; L_1 with bifid process (Figs. 3i, j); L_2 with long and tapered spiny process (Figs. 3i, j); L_3 (*genital hook*) twisted (Figs. 3i, j). Right phallomere (R. ph.) very complex with several sclerites (Figs. 3i, j).

Females: Unknown.

Etimology: The species name is derived from El Limón de Cuauchichinola, a locality in the municipality of Tepalcingo, Morelos, where it was discovered.

Distribution: **MEXICO**, Morelos, Reserva de la Biosfera Sierra de Huautla, El Limón Biological Station (Fig. 4).

Discussion

In Estrada-Álvarez *et al.* (2022), based on bibliographic data, it was inferred that *Myrmecoblatta* lacks a hyaline window on the male supra-anal plate. However, upon reviewing new material and images of the type specimens of *Myrmecoblatta rehni* Mann, 1914, and *M. cuauchichinolana* **sp. nov**, it was found that this genus does indeed exhibit such a window (Figs. 1c and 3g), in addition to having a tergal structure on tergite four (T-4) (Fig. 3 e, f).

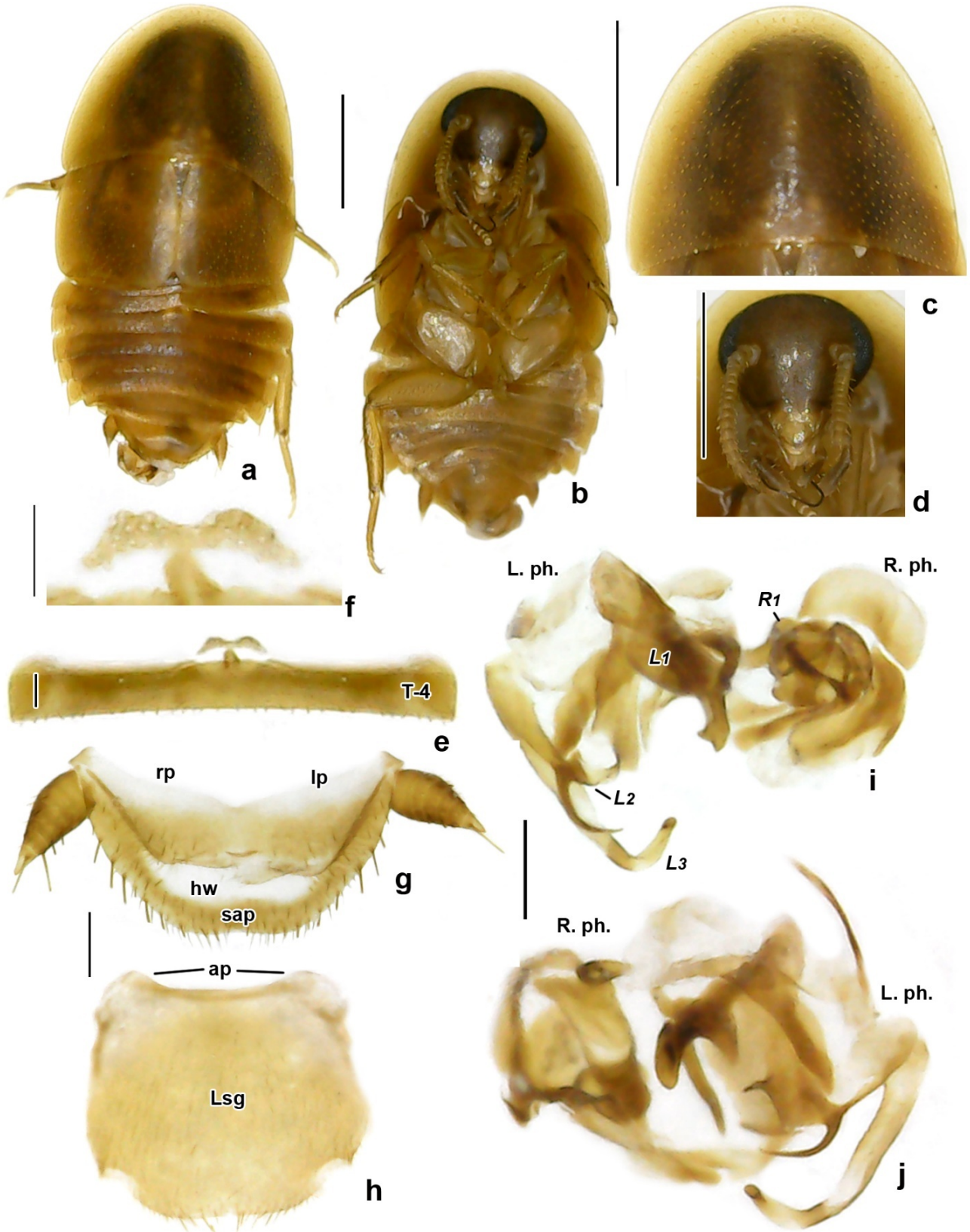

Figure 3a-j. *Myrmecoblatta cuauchichinolana* **sp. nov.** Male holotype; (**a**) dorsal view, (**b**) ventral view, (**c**) pronotum, (**d**) rostrum, (**e**) fourth tergite (T-4), (**f**) detail of the tergal structure on T-4, (**g**) supra-anal plate, (**h**) subgenital plate, (**i-j**) male genitalia (**i**) dorsal view, (**j**) ventral view. Scale bar a-d = 1mm, e, g, h, i, j = 0.2mm, f = 0.25mm.

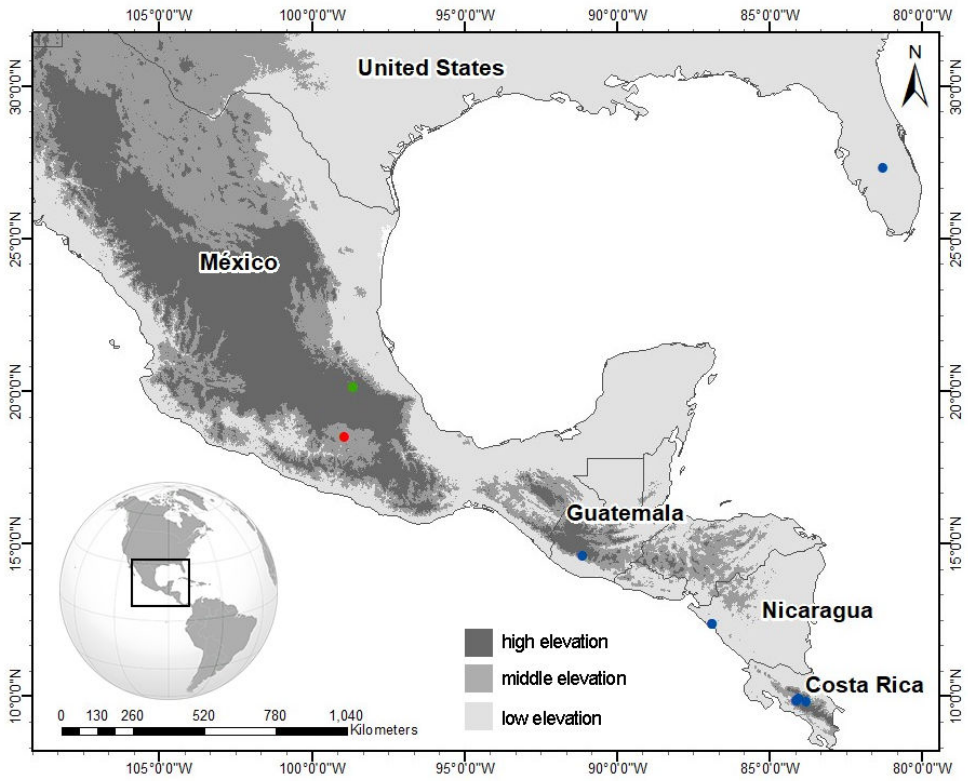

Figure 4. Distribution of *Myrmecoblatta* spp. *M. rehni* (green point); *M. wheeleri* (blue points); *M. cuauchichinolana* **sp. nov.** (red point).

The genus *Myrmecoblatta* has been poorly studied, and to date, many aspects of its biology, taxonomy, and phylogenetics remain unsolved. The presence of a hyaline window on the supra-anal plate of *Myrmecoblatta* males, in addition to the tergal structure on tergite four, might suggest a possible relationship of this genus with the North and Central American genus *Compsodes* Hebard, 1917 and *Paralatindia* Saussure, 1868.

The fact that all species of *Myrmecoblatta* interact with social insects (mostly ants) is fascinating from ecological and evolutionary perspectives. This interaction might be indicative of mutualistic or commensalistic relationships, where the cockroaches potentially gain protection or resources from their association with ants. Some myrmecophile species are known to mimic the cuticular hydrocarbons of their hosts (Bell *et al.*, 2007) and can detect and follow ant trails of pheromones (Moser, 1964), adaptations that evidence deep coevolution processes. Other than eating the remains of dead guests (Bell *et al.*, 2007), there is no clear information about the host's benefit (if there is one at all). While the specific nature of these interactions requires further research, studying the biology within ant nest tunnels presents a truly challenging task.

Analyzing distribution patterns in this genus is challenging due that two clearly understudied species (*M. rehni* and *M. cuauchichilolana*) are known only from their type localities. Increasing collection efforts in nearby areas with similar conditions and records of the hosts could expand their current distribution. Regarding *M. wheeleri*, its wide distribution might be attributed to anthropogenic causes.

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