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Research article

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Four new species of *Triraphis* Ruthe, 1855 (Braconidae, Rogadinae) from a Mexican tropical dry forest and morphological descriptions of *T. bradzlotnicki* Sharkey, 2021 and *T. davidwahli* Sharkey, 2021

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[3] urn:lsid:zoobank.org:author:8A7E8DFB-117D-444D-9505-2BD1458A38C9
[4] urn:lsid:zoobank.org:author:B6E09990-6CA5-403F-AC3F-9498DBB5BEDF

Abstract. The koinobiont endoparasitoid genus *Triraphis* Ruthe, 1855 (Rogadinae Foerster, 1863) is a group of braconid wasps that contains 74 species distributed along the Nearctic, Neotropical, Oriental and Palearctic regions. We amplified a fragment of the cytochrome oxidase subunit I (COI) for 19 specimens of *Triraphis* from the Chamela Biological Station (CBS), a region mainly composed of tropical dry forest near the Pacific coast of Jalisco, Mexico. Based on genetic distances among specimens of *Triraphis* from the CBS and all COI sequences of BINs assigned to *Triraphis* and *Rogas* Nees, 1819 available in the BOLDSYSTEMS database, we identified three clusters in the CBS that correspond with *T. bradzlotnicki* Sharkey, 2021, *T. davidwahli* Sharkey, 2021 and *T. defectus* Valerio, 2015, which were previously described from Costa Rica. Based on morphology, we identified individuals of *T. fusciceps* Cresson, 1869 and provided COI sequences of this species for the first time. Four genetic clusters of *Triraphis* correspond to four new species that are described here: *T. kardia* sp. nov., *T. ocellatus* sp. nov., *T. divergens* sp. nov. and *T. luzabrilae* sp. nov. Since *T. bradzlotnicki* and *T. davidwahli* were exclusively described with molecular data (COI), we morphologically described them based on Mexican specimens.

Keywords. *Triraphis*, Chamela, tropical dry forest, Rogadinae, COI.

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Introduction

Triraphis Ruthe, 1855 is one of the 56 valid genera that belong to the cosmopolitan braconid subfamily Rogadinae Foerster, 1863 (van Achterberg 1991; Quicke *et al.* 2021). This genus was originally described by Ruthe (1855), although it was later regarded as a junior synonym of *Rogas* Nees, 1819 (Shenefelt 1975). As part of van Achterberg's (1991) definition of Rogadinae, *Triraphis* was subsequently resurrected to contain three species, *T. tricolor* (Wesmael, 1838) (type species), *T. harrisinae* (Ashmead, 1889), and *T. discoideus* (Cresson, 1869). More recently, the New World (NW) species of *Rogas* were transferred to *Triraphis*, thus restricting the former genus to the Old World (OW) (Valerio 2006). Species of *Triraphis* can be morphologically distinguished from those of *Rogas* mainly by having an acute lobe in the tarsal claws (thin, large and truncate in *Rogas*) and the occipital carina reduced ventrally, without ventral junction with hypostomal carina (joining in *Rogas*) (van Achterberg 1991).

Currently, *Triraphis* comprises 74 species, of which 53 occur in the Neotropical, two in the Nearctic, one in both the Neotropical and Nearctic and 18 in the Oriental and Palearctic regions (Valerio & Shaw 2015; Yu *et al.* 2016; Sharkey *et al.* 2021a). Members of this genus with host records are known to be koinobiont endoparasitoids of exposed and semi-concealed larvae of species of Lepidoptera Linnaeus, 1758 of the families Limacodidae Duponchel, 1845, Megalopygidae Herrich-Schäffer, 1855, Riodinidae Grote, 1895, Lycaenidae Leach, 1815, Erebidae (Leach, 1815) and Zygenidae Latreille, 1809 that mainly feed on the plant families Fabaceae Lindl., Bromeliaceae Juss., Rubiaceae Juss. and Moraceae Gaudich. (van Achterberg 1991; Valerio & Shaw 2015; Sharkey *et al.* 2021a).

Four species of *Triraphis* have so far been recorded for Mexico, *T. fascipennis* (Cresson, 1869), *T. harrisine*, *T. ornatus* (Cresson, 1869) and *T. fusciceps* (Cresson, 1869) (Yu *et al.* 2016). However, its actual species diversity in this country appears to be considerably higher. As part of a faunistic study carried out for various braconid subfamilies, various specimens of *Triraphis* were collected in the Chamela Biological Station (CBS), located in the Chamela-Cuixmala Biosphere Reserve (CCBR), near the Pacific coast in the state of Jalisco, Mexico. We molecularly characterized most of these specimens using most part of the DNA barcoding locus (cytochrome oxidase I mitochondrial (mt)DNA gene; Hebert *et al.* 2003). Based on a distance analysis of this gene fragment and on an exhaustive examination of external morphological features, we recognized a total of seven species of *Triraphis*, four of which are new to science. Here, we describe these four new species, and morphologically describe for the first time *T. bradzlotnicki* Sharkey, 2021 and *T. davidwahli* Sharkey, 2021, two species that were recently described from Costa Rica exclusively based on their DNA barcodes (Sharkey *et al.* 2021a).

Material and methods

Study area

The specimens were collected within the CBS, which is owned by the Instituto de Biología, Universidad Nacional Autónoma de México (IBUNAM) (19°30′ and 19°33′ N, 105°03′ and 105°01′ W). This station is situated within the CCBR, which is in the intertropical zone in the Mexican Pacific coast in the state of Jalisco. The CBS has an extension of 1600 ha and is classified as tropical dry forest (Noguera *et al.* 2002). The climate is temperate and sub-humid with a rainy summer (July–October) and a dry season (November–June) (Noguera *et al.* 2002). The mean annual temperature is 24.6°C and rainfall averages 748 mm / yr, ranging from 400 to 1300 mm (Bullock 1986).

Field work

The studied material was obtained from 10 sampling events carried out in the CBS for five to 10 days each, which were conducted between the years 2009 and 2011. The entomological material was collected using malaise traps with ethanol at 95% and two types of light trap, one consisting of a lamp covered by a net that allowed to catch small insects that fell in soapy water, and other that used a lamp over a white sheet. Details about the collecting sites in the CBS are mentioned in Gutiérrez-Arellano *et al.* (2015). All the collected material was preserved in 95% ethanol until it was processed for DNA extraction and further morphological examination.

DNA extraction and amplification

We extracted genomic DNA from 19 specimens assigned to *Triraphis* using the non-destructive technique described by Cecarelli *et al.* (2012) with the Dneasy blood and tissue kit (QUIAGEN™). Each specimen was digested overnight with 100 µl of ATL buffer and 20 µl of proteinase K at 55°C. All specimens were washed, labeled and pinned. Locality information and GenBank accession nos are available in Supp. file 1.

PCRs were carried out to amplify 648-base pairs (bp) fragment of the cytochrome oxidase I (COI) mtDNA gene. Amplifications consisted of a total volume of 15 µl containing 1.5 µl of 10× PCR buffer, 1.5 µl of $MgCl_2$, 1.5 µl 10 mm of dNTPs, 0.6 µl 10 mM of each primer, 0.1 µl of platinum Tap polymerase (Invitrogen), 5 µl of DNA template and 4.2 µl of ddH_2O. Non-purified PCR products were sequencing in the High-Throughput Genomic Unit at the University of Washington Seattle, Washington, USA. All sequences were edited using Sequencher ver. 4.1.4 (Gene Codes Corp.).

Data analysis

DNA barcoding data was obtained from two different sources, our generated COI sequences of *Triraphis* from the CBS (19 sequences), and all available COI sequences of specimens assigned to *Triraphis* and *Rogas* obtained from the BOLDSYSTEMS database (https://www.boldsystems.org/index.php/). We also downloaded two COI sequences of *Spinaria* Brullé, 1846 (ASQSP023-08 and ASQSP030-08) to root the distance tree. We aligned the matrix (432 sequences, Supp. file 2) with the program MAFFT ver. 7 (Katoh & Standley 2013). We employed the 2% COI divergence criterion (Hebert *et al.* 2003) for species delimitation. Uncorrected COI distances were thus calculated with the program PAUP ver. 4.0 (Swofford 2004), and we also built a Neighbor Joining (NJ) distance tree with the program PAUP ver. 4.0 (Swofford 2004) to provide a graphical representation of these genetic distances.

External morphological features

We followed the terminology of Sharkey & Wharton (1997) and Harris (1979) for the external morphological and surface sculpture features, respectively. Digital photographs of all described species were taken with a Leica Z16APO-A stereoscopic microscope and a Leica® DFC295/DFC290 HD camera at the IBUNAM. A comparison of external morphological features between our newly and previously described species that occur in Mexico and Costa Rica was conducted revising previous species descriptions (Cresson 1869; Ashmead 1889; Valerio & Shaw 2015). We examined digital photographs of the holotype of *T. fusciceps*, which is deposited in The Academy of Natural Sciences (ANS) of Drexel University, Philadelphia, USA. We also examined specimens of both *T. fusciceps* and *T. harrisine* from Changuinola, Panama and three different localities in the USA, respectively, that are deposited in the Hymenoptera collection of the Smithsonian National Museum of Natural History (NMNH), USA. The type material belonging to the new species that are described in this study is deposited in the Colección Nacional de Insectos, IBUNAM (CNIN-IBUNAM).

Results

Barcoding analysis

We obtained 409 COI sequences of *Triraphis* in the BOLDSYSTEMS database, 387 of which are from 14 NW countries (Argentina, Belize, Bolivia, Brazil, Canada, Colombia, Costa Rica, Ecuador, French Guiana, Guyana, Mexico, Peru, Puerto Rico, USA) and 15 from six OW countries (Gabon, Netherlands, Papua New Guinea, Taiwan, Thailand and UK) (Supp. file 3). The remaining seven sequences lacked locality details.

Of the above 409 COI sequences of *Triraphis*, 297 were identified to species level, including the 31 species that were recently described by Sharkey *et al.* (2021a, 2021b) (287 sequences), as well as *T. defectus* Valerio, 2015 (six sequences) from Costa Rica, *T. discoideus* from Canada (one sequence), and *T. tricolor* from the Netherlands (three sequences) (Supp. file 3). There were 14 records of specimens assigned to *Rogas* in the BOLDSYSTEMS database from Costa Rica, France, Russia, Turkey and Tanzania, although there were only two available COI sequences, one belonging to *R. luteus* Nees, 1834 (GBAHB1289-15, no locality information) and the second to an unidentified *Rogas* species from Tanzania (GBAH1651-06) (Supp. file 4).

The COI distance tree recovered various genetic clusters of species of *Triraphis*, of which five of them contained sequences of *Triraphis* from the Chamela region (Supp. files 5, 6). The COI distances within these five clusters resulted in eight barcoding species (*T.* sp. 1–*T.* sp. 8), of which three were assigned to *T. defectus*, *T. bradzlotnicki* and *T. davidwahli* (*T.* sp 2, *T.* sp 6 and *T.* sp 8, respectively), which were described from Costa Rica (Supp. files 5, 6).

Based on a detailed morphological examination of the specimens belonging to the other five unidentified barcoding species of *Triraphis* from the Chamela region and on the available literature, we consider that four of them represent undescribed species. The specimens of the remaining species (*T*. sp. 3) ran to *T. fusciceps* using Valerio & Shaw's (2015) key to species of *Triraphis*. We compared the latter specimens (Supp. file 7) with the redescription of *T. fusciceps* (Valerio & Shaw 2015: figs 41–46), with digital photographs of its holotype deposited in ANS and with specimens of *T. fusciceps* deposited in the NMNH, and we did not find morphological differences to separate them. We therefore assigned the specimens of *T.* sp. 3 to *T. fusciceps*. Below, we formally describe the four undescribed species from the Chamela region mentioned above and provide a morphological description of *T. bradzlotnicki* and *T. davidwahli*, whose original description was only based on the barcoding locus.

Taxonomy

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Family Braconidae Nees, 1811
Subfamily Rogadinae Foerster, 1863
Genus ***Triraphis*** Ruthe, 1855

Triraphis kardia Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov.
urn:lsid:zoobank.org:act:CA60FAE3-3375-431C-A6A1-EF27E49D333A
Fig. 1

Diagnosis

Triraphis kardia sp. nov. can be distinguished from the remaining species of the genus by having a 'heart-shaped' brown patch on the first metasomal tergite (Fig. 1E–F). *Triraphis kardia* sp. nov. keyed to *T. balteus* Valerio, 2015 following Valerio & Shaw's (2015) key to species of *Triraphis* from Costa

Rica; however, it can be distinguished from the latter species by having a color pattern of metasoma with brown patches in the median area of most tergites (absent in *T. balteus*), a coriaceous metapleuron (granulate and rugose in *T. balteus*), and its yellow color of hind tibia and tarsi (dark brown in *T. balteus*).

Etymology

The name of this new species refers to the Greek word '*kardia*' ('heart'), due to the 'heart-shaped' brown patch on the first metasomal tergite. This specific epithet is in apposition.

Material examined

Holotype

MEXICO • ♀; Jalisco, Chamela Biological Station UNAM, Camino Chachalaca, near lab, Cham006B; 19.4981° N, 105.0444° W; 95 m a.s.l.; 25–26 Nov. 2009; H. Clebsch, A. Zaldívar and A. Polaszck leg.; light trap; DNA voucher no. CNIN958; GenBank accession no. OQ868172; CNIN-IBUNAM.

Paratype

MEXICO • 1 ♀; Jalisco, Chamela Biological Station UNAM, Camino Búho, Cham008B; 19.49885° N, 105.04041° W; 25–26 Nov. 2009; H. Clebsch, A. Zaldívar and A. Polaszck leg.; light trap; DNA voucher no. CNIN933; GenBank accession no. OQ868171; CNIN-IBUNAM.

Description

Female (holotype)

Measurements. Body length 4.8 mm; fore wing length 3.85 mm; ovipositor 1 mm.

Color. Head honey yellow; eyes silverish brown; ocelli with a fine whitish yellow line around edges, ocelar triangle dark brown; mandibles pale yellow, tooth brown; scape, pedicel and basal flagellomeres honey yellow, turning brown to apex; median and lateral mesoscutal lobes honey yellow, median area of median and inner parts of lateral mesoscutal lobes pale yellow; scutellum pale yellow, with a dark brown transversal band apically; metanotum pale yellow with a median dark brown spot apically; legs pale yellow, hind femur with brownish patches near the insertion with tibia; apical tarsomere dark brown; tarsal claws brown. Fore and hind wings hyaline, pterostigma brown medially, pale yellow on both edges, veins pale yellow to brown (hind: 2RS, r, 1M, apical MCU, basal 1CU, 3CU). Metasomal tergites pale yellow; first metasomal tergite with a 'heart-shaped' brown patch; median dark brown area running from apical part of second to fifth metasomal tergites. Ovipositor and ovipositor sheaths honey yellow.

Head. Head 1.6 times wider than its median length (dorsal view); distance between basal edges of tentorial pits and the basal area of toruli 0.7 times maximum width of face; width of oral opening 1.7 times its height. Vertex, temple, and gena mostly smooth; frons transversally striated near toruli, remaining areas mostly smooth; face with irregular to transverse weak rugae, with sparsely long setae, with a median longitudinal swollen area; clypeus poorly defined, weakly sculptured, nearly smooth; malar suture present. Antennae with 32 flagellomeres; first flagellomere 1.6 times longer than wide, as long as second flagellomere; eye 1.5 times higher than broad; malar space 0.2 times height of eye; face width about 1.2 times height of eye, and about 2.0 times the height of face and clypeus combined; occipital carina complete, narrow dorsally; median ocellus as big as lateral ocelli; ocellus-eye distance about 0.5 lateral ocellus width.

Mesosoma. Length of mesosoma 2.2 times its maximum width (dorsal view), 1.4 times its maximum height (lateral view); pronotal groove smooth and scrobiculate; propleuron smooth; median and lateral mesoscutal lobes smooth-colliculate; notauli scrobiculate, distinct, not meeting, medial pit present, elongate; mesopleuron smooth-colliculate, dorso-laterally costate; precoxal sulcus wide, deep, scrobiculate, running along two thirds of mesopleuron; metapleuron coriaceous, with a tubercle above mesocoxa; basal half of propodeum finely-coriaceous anteriorly, remaining area rugose; median carina about ¼ of propodeum length, areola triangular, poorly defined laterally.

Legs. Hind coxa 1.3 times longer than wide. Length of hind femur 4.0 times its maximum width. Hind basitarsus 0.48 times as long as hind tibia. Length of hind basitarsus 0.7 times combined length of second to fifth tarsal segments. Second, third, fourth and fifth (without pretarsus) tarsal segments 0.4, 0.4, 0.2 and 0.4 times as long as basitarsus. Tarsal claws with a basal, pointed lobe, followed by sharp spines.

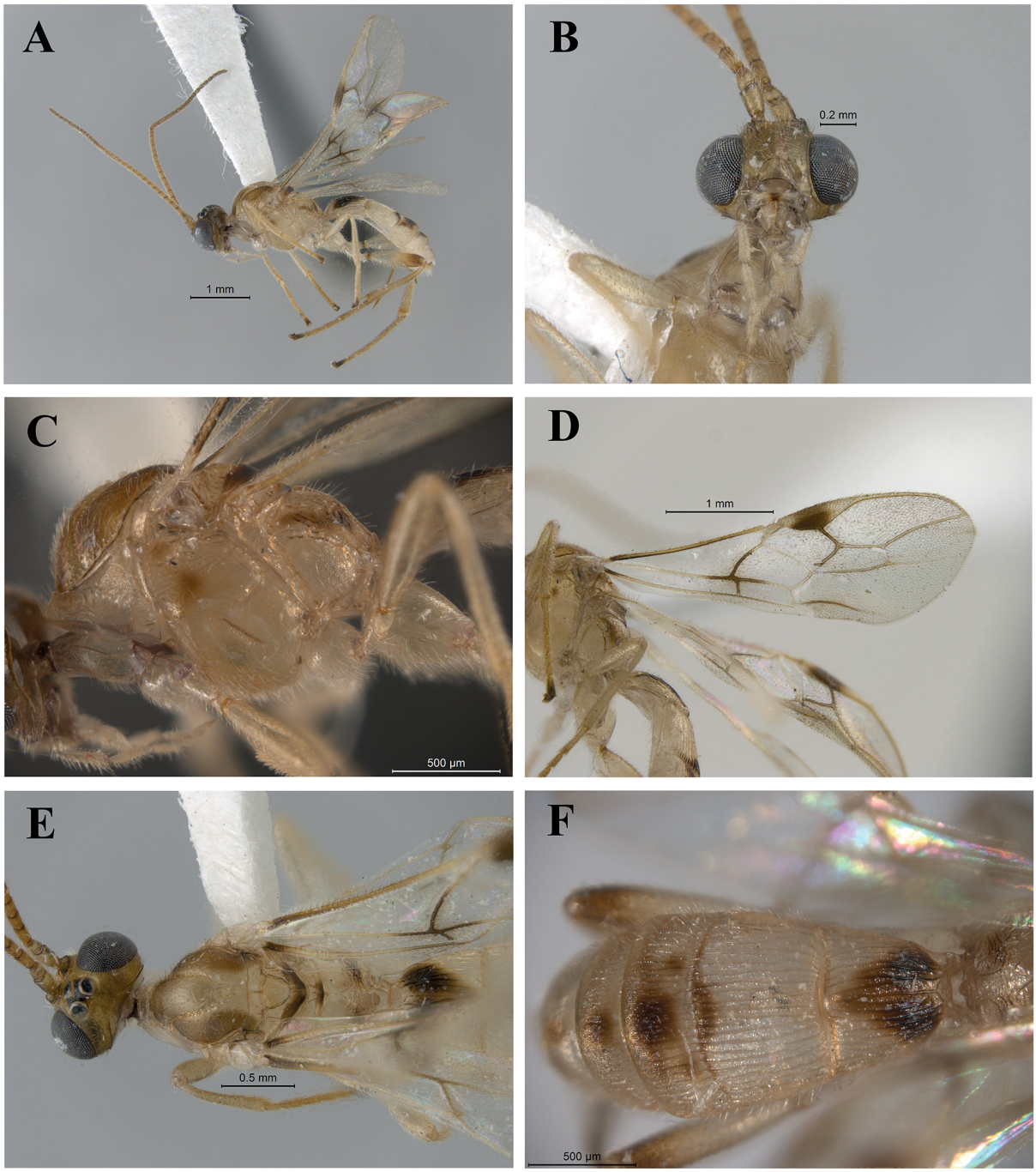

Fig. 1. *Triraphis kardia* Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov.; ♀, holotype (CNIN-IBUNAM). **A**. Lateral habitus. **B**. Head, frontal view. **C**. Mesosoma, lateral view. **D**. Wings. **E**. Head, mesosoma and first metasomal tergite, dorsal view. **F**. Metasoma, dorsal view.

Wings. Fore wing length 2.8 times its maximum width; pterostigma 2.7 times longer than wide; vein lCUb almost as long as vein RS+Ma; vein 3RSa 0.55 times vein 3RSb, 2.0 times vein r; angle at union 2RS and 2M acute. Hind wing length 4.3 times its maximum width; vein M+CU 1.2 times vein 1M and 3.0 times vein r-m; vein 1A 2.0 times vein cu-a.

Metasoma. Almost as long as head and mesosoma combined, with six visible tergites. First tergite, 0.9 times longer than its maximum width; maximum width 1.7 times its basal width; dorso-basal triangular area present; longitudinally costate with coriaceous to acinose sculpture between carinae and with a longitudinal median carina. Length of second tergite 0.7 times its maximum width, 1.8 times length of third tergite. Second to fourth metasomal tergites longitudinally costate with coriaceous to acinose sculpture between carinae; third and fourth tergites finely coriaceous apically. Remaining tergites finely coriaceous. Ovipositor about 0.4 times as long as metasoma.

Variation in females

Body length 4.5–4.8 mm; fore wing length 3.85–4.0 mm; ovipositor 0.7–1.0 mm. Specimen with complete antennae, 32 flagellomeres.

Males

Unknown.

Distribution

The type material was collected at the CBS in the state of Jalisco, Mexico, a region that is mainly composed of tropical dry forest.

Biology

Unknown.

Comments

The genus *Triraphis* was originally named as *Triraphus* by Ruthe (1855). However, the first name has been subsequently employed by different authors (Shenefelt 1975; van Achterberg 1991) and here we have therefore decided to keep it for consistency.

One specimen of *Triraphis* in the BOLDSYSTEMS database (ASQBR994-20, locality labeled only as "Mexico") appears to belong to *T. kardia* sp. nov., since it has a COI distance of 0.0–0.93% (Supp. file 5, Supp. file 6: Subset 5).

Triraphis ocellatus Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov.
urn:lsid:zoobank.org:act:66771218-9162-477D-B4C1-B26D581DF716
Fig. 2

Diagnosis

Triraphis ocellatus sp. nov. is a species with the shortest ocellus-eye distance, which is about ¼ of lateral ocellus width (Fig. 2B). This species keyed to *T. simphlex* Valerio, 2015 using Valerio & Shaw's (2015) key based on the ocellus-eye distance; however, *T. ocellatus* sp. nov. can be distinguished from the latter species by having more than 50 flagellomeres (in one of the paratypes, the remaining type specimens had the antennae broken) and by the brown coloration in the last three metasomal tergites.

Etymology

The name of this species refers to its ocelli, which are distinctly bigger than the ocelli of the remaining species.

Material examined

Holotype

MEXICO • ♀; Jalisco, Chamela Biological Station UNAM, Camino Chachalaca, Cham 113; 19.4559° N, 105.04202° W; 113 m a.s.l.; 19 Nov. 2012; E. Martínez and O. Pérez leg.; Malaise trap; DNA voucher no. CNIN1246; GenBank accession no. OQ868180; CNIN-IBUNAM.

Paratypes

MEXICO • 3 ♀♀; same collection data as for holotype; DNA voucher nos CNIN1179, 1163, 1133; GenBank accession nos OQ868181, OQ868179, OQ868178; CNIN-IBUNAM.

Description

Female (holotype)

Measurements. Body length 10.4 mm; fore wing length 8.0 mm; ovipositor 2 mm.

Color. Head honey yellow to brown; eyes silverish brown; ocelli with a fine whitish yellow line around edges, ocelar triangle dark brown; scape and pedicel dark brown to black; flagellomeres incomplete, dark brown to black, turning honey yellow to apex; mandibles honey yellow, teeth brown; mesosoma, legs and metasoma honey yellow; third to fifth metasomal tergites with brown apical areas, remaining metasomal tergites mostly brown; fore wings hyaline, with a brownish infuscate area below stigma comprising areas surrounding veins r, 2Rs, 2M and CU; pterostigma honey yellow turning dark brown medially; veins honey yellow to brown; hind wings hyaline; tarsal claws brown. Ovipositor and ovipositor sheaths honey yellow to brown.

Head. Head 1.6 times wider than its median length (dorsal view); distance between basal edges of tentorial pits and the basal area of toruli almost as long as maximum width of face; width of oral opening 1.1 times its height. Vertex, temple, and gena mostly smooth; face colliculate turning punctate near clypeus, finely striate near toruli with sparse, long setae; clypeus smooth finely-colliculate; mandible with two teeth; malar suture present. Antennae broken, with 23 and 42 flagellomeres respectively; first flagellomere 2.2 times longer than wide, 1.4 times longer than second flagellomere; eye 1.6 times higher than broad; malar space 0.17 times height of eye; face width about 0.7 times height of eye, almost as long as height of face and clypeus combined; occipital carina complete slightly narrow dorsally; median ocellus as big as lateral ocelli; ocellus-eye distance about ¼ of lateral ocellus width.

Mesosoma. Length of mesosoma 2.4 times its maximum width (dorsal view), 1.3 times its maximum height (lateral view); pronotal groove smooth and scrobiculate, wide apically; propleuron colliculate; notauli wide, deep and scrobiculate, not meeting, finishing just before the end of mesoscutum; medial pit present; median and lateral mesoscutal lobes strongly colliculate, lateral lobes turning coriaceous near notauli posteriorly; mesopleuron smooth-colliculate, dorso-laterally costate; precoxal sulcus wide, deep and scrobiculate, running along two thirds of mesopleuron, almost vertically strigate below precoxal sulcus; metapleuron colliculate-coriaceous turning areolate posteriorly; with a distinct, posterior tubercle; propodeum rugose-areolate, basally colliculate, median carina ¼ of propodeum length, areola and basal areas almost indistinct.

Legs. Hind coxa 1.5 times longer than wide. Length of hind femur 5.0 times its maximum width. Hind basitarsus 0.5 times longer than hind tibia; length of hind basitarsus 0.85 times combined length of second to fifth tarsal segments. Second, third, fourth and fifth tarsal segments 0.4, 0.3, 0.2 and 0.25 times as long as basitarsus. Tarsal claws with a basal, pointed lobe, followed by sharp spines.

Wings. Fore wing length about 2.6 times its maximum width; pterostigma 4.3 times longer than wide; vein lCUb 0.88 times vein RS+Ma; vein 3RSa 0.6 times vein 3RSb, 4.0 times vein r; angle at union 2RS and 2M wide. Hind wing length 3.6 times its maximum width; vein M+CU almost as long as vein 1M and 2.3 times vein r-m; vein 1A 1.2 times vein cu-a.

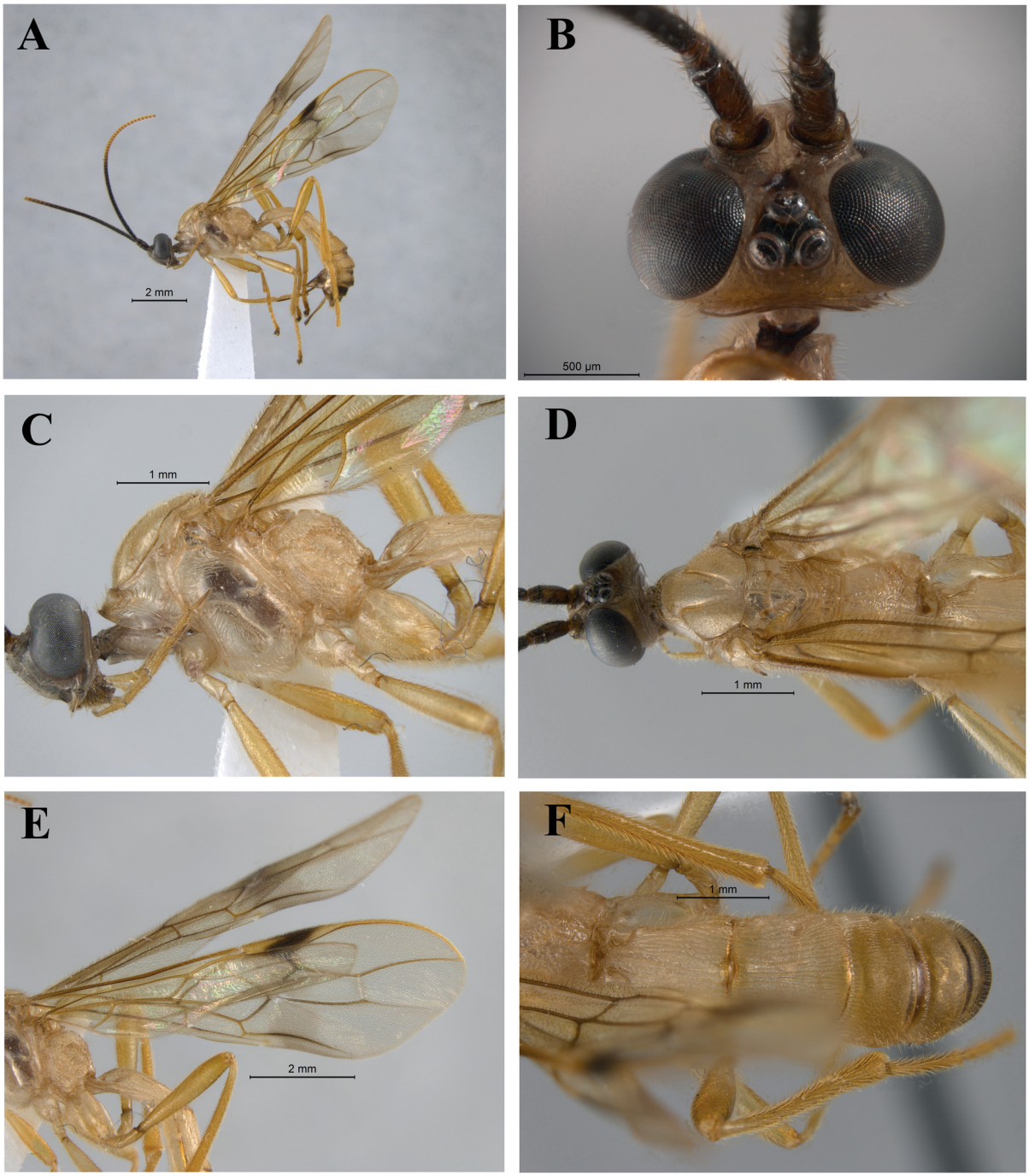

Fig. 2. *Triraphis ocellatus* Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov., ♀, holotype (CNIN-IBUNAM). **A**. Lateral habitus. **B**. Head, dorsal view. **C**. Head and mesosoma, lateral view. **D**. Head and mesosoma, dorsal view. **E**. Wings. **F**. Metasoma, dorsal view.

Metasoma. 1.6 times longer than head and mesosoma combined, with seven visible tergites. First tergite, 1.4 times longer than its maximum width; maximum width about 2.0 times its basal width; longitudinally costate with coriaceous sculpture between carinae, with a longitudinal median carina running along its entire length. Length of second tergite 1.1 times its maximum width, 2.0 times length of third tergite, second tergite longitudinally costate with coriaceous sculpture between carinae; third tergite longitudinally costulate on basal two thirds, finely coriaceous on apical third. Remaining tergites finely coriaceous. Ovipositor about 0.3 times as long as metasoma.

Variation in females

Body length 7.9–10.4 mm; fore wing length 7.0–8.0 mm; ovipositor 2.0–2.5 mm. Almost all antennae broken, with 15–72 flagellomeres.

Males

Unknown.

Distribution

Only known for the CBS in the state of Jalisco, Mexico.

Biology

Unknown.

Triraphis divergens Jasso-Martínez, Zaldívar-Riverón & Martínez, sp. nov.
urn:lsid:zoobank.org:act:459F450A-BF5F-42D5-9724-ACBAF8CC14E4
Fig. 3

Diagnosis

Tiraphis divergens sp. nov. can be distinguished morphologically by the presence of a median longitudinal carinae running along the upper half of face (Fig. 3B), and divergent carinae on its third and fourth metasomal tergites (Fig. 3F) (longitudinal in the other species). This new species runs to *T. fusciceps* following Valerio & Shaw's (2015) key; however, it can be easily distinguished from the latter species by its dorsal brown marks of the mesosoma and metasoma (absent in *T. fusciceps*). *Triraphis divergens* sp. nov. is also similar to *T. bradzlotnicki* and *T. luzabrilae* sp. nov., although it can be distinguished from them by its divergent carinae on the third and fourth metasomal tergites (parallel in both *T. bradzlotnicki* and *T. luzabrilae* sp. nov.).

Etymology

The name of this new species refers to the diverging carinae on its third and fourth metasomal tergites.

Material examined

Holotype

MEXICO • ♀; Jalisco, Chamela Biological Station UNAM, Camino Chachalaca 400 m, Cham 113; 19.4559° N, 105.04202° W; 113 m a.s.l.; 19 Nov. 2011; E. Martínez and O. Pérez leg.; Malaise trap; DNA voucher no. CNIN1153; GenBank accession no. OQ868182; CNIN-IBUNAM.

Paratypes

MEXICO • 1 ♀; same collection data as for holotype; DNA voucher no. CNIN1178, GenBank accession no. OQ868183; CNIN-IBUNAM • 2 ♀♀; Jalisco, Guadalajara, La Huerta Municipality, Chamela Biological Station UNAM, 80 m; 19°48′58″ N, 105°04′2″ W; 9 Aug. 2013; Abel Verduzco leg.; Malaise trap; DNA voucher nos GMMCM161-15 (BOLDSYSTEMS code BIOUG19231-D03) and GMMAA034-15

(BOLDSYSTEMS code BIOUG20632-B08); CNIN-IBUNAM • 1 ♀; Jalisco, Guadalajara, La Huerta Municipality, Chamela Biological Station UNAM, 80 m; 19°40′58″ N, 104°04′2″ W; 6 Jan. 2014; Abel Verduzco leg.; Malaise trap; DNA voucher no. GMMAE098-15 (BOLDSYSTEMS code BIOUG26044-D10); CNIN-IBUNAM.

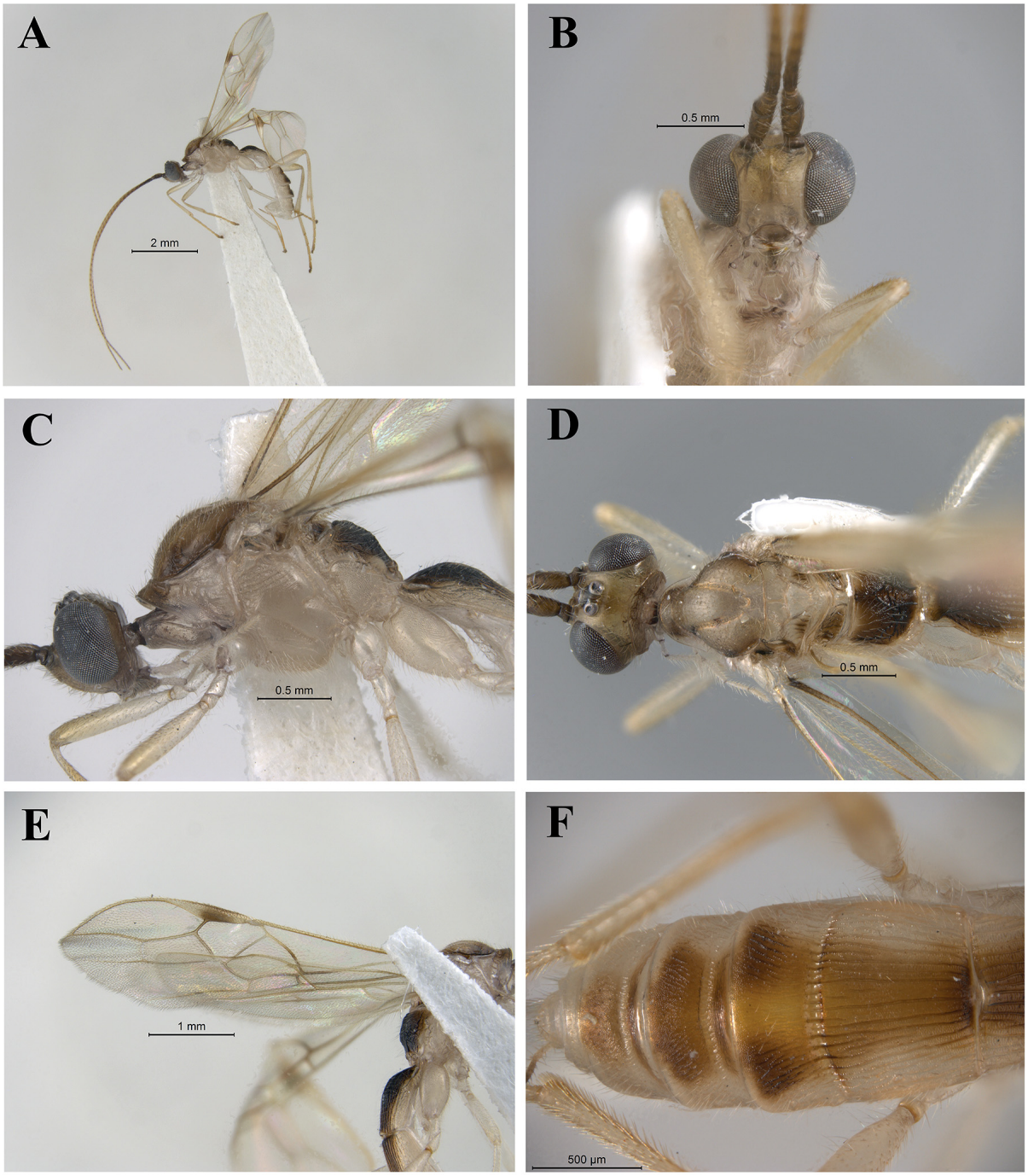

Fig. 3. *Triraphis divergens* Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov., ♀, holotype (CNIN-IBUNAM). **A**. Lateral habitus. **B**. Head, frontal view. **C**. Head, mesosoma and first metasomal tergite, lateral view. **D**. Head, mesosoma and first metasomal tergite, dorsal view. **E**. Wings. **F**. Metasoma, dorsal view.

Description

Female (holotype)

Measurements. Body length 5.5 mm; fore wing length 4.4 mm; ovipositor 1.2 mm.

Color. Head light brown; eyes silverish brown; ocelli with a fine whitish yellow line around edges, ocellar triangle dark brown to black; mandibles pale yellow, teeth brown; scape and pedicel brownish yellow; basal flagellomeres brown, turning slightly lighter apically; median and lateral mesoscutal lobes and scutellum pale yellow; lateral mesoscutal lobes brown to dark brown along edges; metanotum and propodeum brown to dark brown; mesopleuron, metapleuron and legs pale yellow, apical two tarsi honey yellow. Fore and hind wings hyaline; pterostigma honey yellow; stigma dark brown medially, honey yellow laterally; veins yellow to brown. Metasomal tergites dark brown to brown medially, pale yellow laterally. Ovipositor honey yellow; ovipositor sheaths pale yellow basally, turning honey yellow apically.

Head. Head 1.6 times wider than its median length (dorsal view); distance between basal edges of tentorial pits and the basal area of toruli almost as long as width of face; width of oral opening 1.6 times height of oral opening. Vertex, temple, and gena smooth-colliculate; frons smooth, transversally striated near toruli laterally, face with irregular to transverse weak rugae near toruli, colliculate near clypeus and lower orbits, with a median longitudinal carina running along the upper half; with sparsely long setae; clypeus nearly smooth; malar suture present. Antennae with 45 flagellomeres; first flagellomere 2.4 times longer than wide, almost as long as second flagellomere; eye 1.6 times higher than broad; malar space 0.2 times height of eye; face width 0.8 times height of eye, and about the same height of face and clypeus combined; occipital carina complete; median ocellus as big as lateral ocelli; ocellus-eye distance almost as long as width of lateral ocelli.

Mesosoma. Length of mesosoma 2.0 times its maximum width (dorsal view), 1.4 times its maximum height (lateral view); pronotal groove apically wide, slightly coriaceous, scrobiculate medially; propleuron coriaceous; median and lateral mesoscutal lobes mostly smooth; notauli scrobiculate, distinct, not meeting, finishing just before the end of mesoscutum; medial pit present, poorly defined on its basal edge; mesopleuron slightly coriaceous, dorso-laterally costate; smooth-slightly coriaceous; precoxal sulcus wide, deep, scrobiculate, running along two thirds of mesoscutum; mesepimeron smooth-colliculate; metapleuron mostly coriaceous, with rugose-aerolate areas anteriorly, with a distinct, posterior tubercle; propodeum coriaceous basally, apical half strongly rugose-coriaeous; median carina ¼ of propodeum length, triangular areola distinct, poorly delimited laterally.

Legs. Hind coxa 1.6 times longer than wide. Length of hind femur 4.6 times its maximum width. Hind basitarsus 0.5 times longer than hind tibia. Length of hind basitarsus 0.7 times combined length of second to fifth tarsal segments. Second, third, fourth and fifth tarsal segments 0.5, 0.35, 0.3 and 0.33 times as long as basitarsus. Tarsal claws with a basal, pointed lobe, followed by sharp spines.

Wings. Fore wing length about 3.0 times its maximum width; pterostigma 4.1 times longer than wide; vein lCUb almost as long as vein RS+Ma; vein 3Rsa 0.65 times vein 3RSb, 4.0 times vein r; angle at union of veins 2RS and 2M spectral, wide. Hind wing length 4.5 times its maximum width; vein M+CU 0.8 times vein 1M and 1.5 times vein r-m; vein 1A 1.2 times vein cu-a.

Metasoma. 1.2 times longer than head and mesosoma combined. First tergite almost as long as its maximum width; maximum width 2.4 times its basal width; longitudinally costate with coriaceous sculpture between carinae, with a longitudinal median carina running along its entire length. Length of second tergite 0.70 times its maximum width, 1.7 times length of third tergite; second metasomal tergite longitudinally costate with coriaceous sculpture between carinae; third and fourth tergites costulate

with coriaceous sculpture between carinae, which are divergent; remaining tergites finely coriaceous. Ovipositor about 0.4 times as long as metasoma.

Variation in females

Body length 4.5–5.6 mm; fore wing length 3.9–4.5 mm; ovipositor 0.8–1.2 mm. Specimen with complete antennae, 45 flagellomeres.

Males

Unknown.

Distribution

Only known for the CBS in the state of Jalisco, Mexico.

Biology

Unknown.

Comments

Three specimens of *Triraphis* in the BOLDSYSTEMS database from Chamela, Mexico (GMMAA034-15, GMMCM161-15 and GMMAE098-15) apparently belong to *T. divergens* sp. nov. since they had a COI distance of 0.0–0.20% with the specimens of this same species for which we generated COI data (Supp. file 5, Supp. file 6: Subset 2).

Triraphis luzabrilae Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov.
urn:lsid:zoobank.org:act:3AE3F4C4-BD9C-4C20-8378-A1E9538B4B07
Fig. 4

Diagnosis

Tiraphis luzabrilae sp. nov. can be distinguished from the remaining species of *Triraphis*, except *T. bradzlotnicki*, by the presence of a median longitudinal carina running along the upper half of face (Fig. 4B) and parallel carinae in its third and fourth metasomal tergites (Fig. 4F). The median longitudinal carina of face is also present in both *T. divergens* sp. nov. and *T. bradzlotnicki*; however, in the former species the carinae of third and fourth metasomal tergites are divergent. *Tiraphis luzabrilae* sp. nov. runs to *T. fusciceps* following Valerio & Shaw's (2015) key, though it can be distinguished from the latter species by its brown dorsal marks on the mesosoma and metasoma (absent in *T. fusciceps*).

Etymology

This species is named after the late Luz Abril De Jesús Bonilla, sister of our dear friend and colleague Vladimir Salvador De Jesús Bonilla.

Material examined

Holotype

MEXICO • ♀; Jalisco, Chamela Biological Station UNAM, Camino Chachalaca, 400 m; 19.4559° N, 105.04202° W; 113 m a.s.l.; 5 Oct. 2011; Zaldívar A. and Zaragoza S. leg.; Malaise trap; DNA voucher no. CNIN1177; GenBank accession no. OQ868188; CNIN-IBUNAM.

Description

Female (holotype)

Measurements. Body length 4.9 mm; fore wing length 4.0 mm; ovipositor 1.0 mm.

Color. Head light brown; eyes silverfish brown; ocelli with a fine whitish yellow line around edges, ocelar triangle dark brown to black; mandibles pale yellow, teeth brown; scape and pedicel brown, first two flagellomeres brown, turning yellow to apex. Dorsal part of pronotum brown; median and lateral mesoscutal lobes yellow, lateral mesoscutal lobes brown around edges; metanotum and propodeum brown; lateral part of pronotum, propleuron, mesopleuron and metanotum pale yellow. Fore wings hyaline, pterostigma honey yellow; stigma dark brown medially, honey yellow laterally; veins of fore

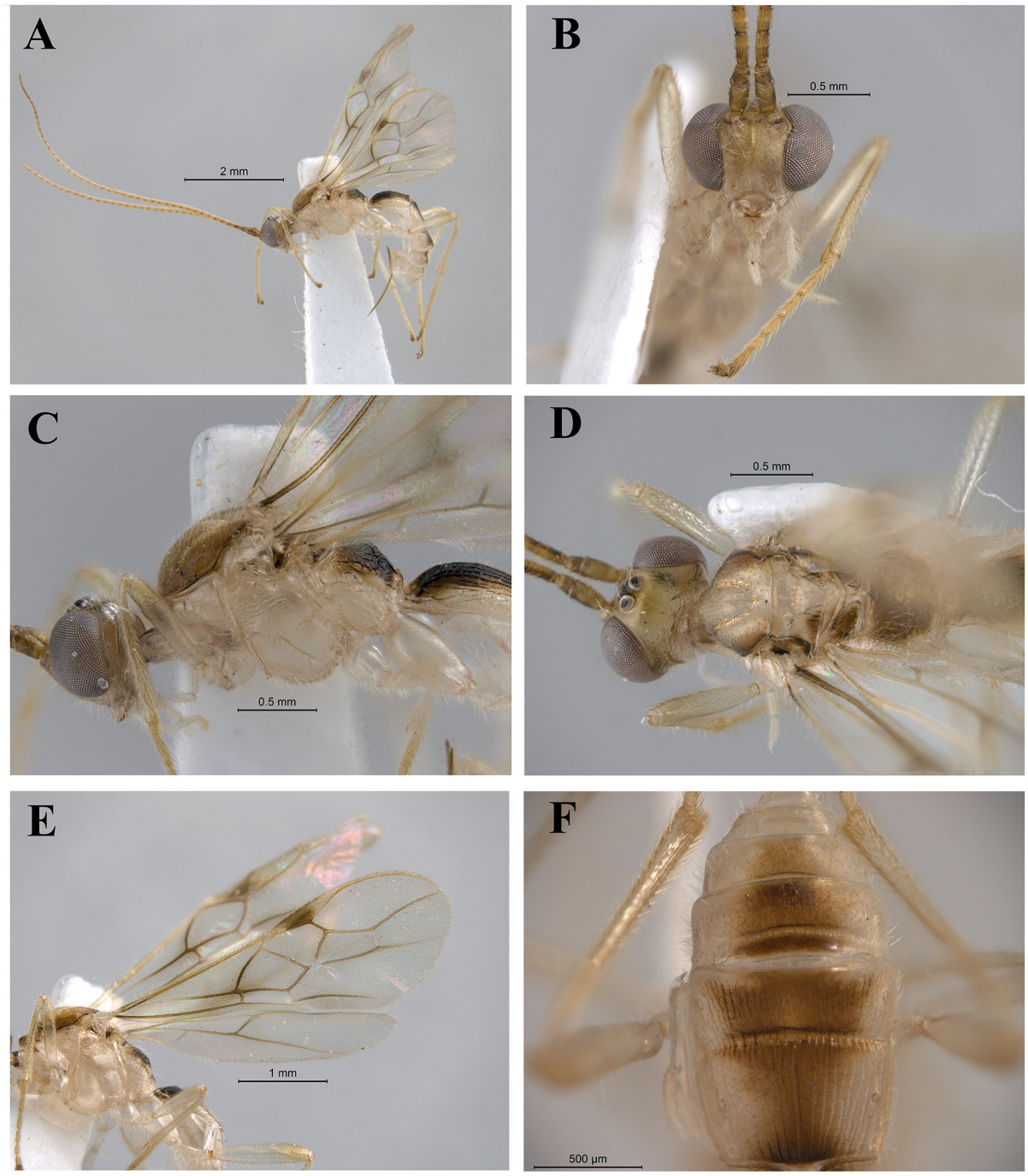

Fig. 4. *Triraphis luzabrilae* Jasso-Martínez, Zaldívar-Riverón & Martínez sp. nov., ♀, holotype (CNIN-IBUNAM). **A**. Lateral habitus. **B**. Head, frontal view. **C**. Head, mesosoma and first metasomal tergite, lateral view. **D**. Head and mesosoma, dorsal view. **E**. Wings. **F**. Metasoma, dorsal view.

and hind wings yellow to brown. Legs pale yellow; fifth tarsomere and tarsal claws light brown. First metasomal tergite brown to dark brown basally, brown to dark brown medially and apically, pale yellow laterally; remaining tergites brown to dark brown medially, pale yellow laterally. Ovipositor honey yellow, ovipositor sheaths pale yellow basally, turning dark brown apically.

Head. Head 1.7 times wider than its median length (dorsal view); distance between basal edges of tentorial pits and the basal area of toruli 0.8 times maximum width of face; width of oral opening 1.6 times height of oral opening. Vertex, temple, gena and frons mostly smooth; face with irregular to transverse weak rugae near toruli, with a median longitudinal carina running along the upper half, with sparsely long setae; clypeus smooth-colliculate; mandible with two teeth; malar suture present. Antennae broken, with 3 and 5 flagellomeres respectively; first flagellomere 2.3 times longer than wide, 1.3 times longer than second flagellomere; eye 1.5 times higher than broad; malar space 0.15 times height of eye; face width 0.88 height of eye, 1.25 height of face and clypeus combined; occipital carina complete; median ocellus as big as lateral ocelli; ocellus-eye distance about 0.8 times lateral ocellus width.

Mesosoma. Length of mesosoma about 2.0 times its maximum width (dorsal view), 1.3 times its maximum height (lateral view); pronotal groove smooth and scrobiculate; propleuron collicullate-coriaceous; notauli scrobiculate, distinct, not meeting, finishing before just before the end of mesoscutum; median pit present, elongate; median and lateral mesoscutal lobes smooth-collicullate; mesopleuron colliculate-coriaceous, dorso-laterally costate; precoxal sulcus deep, wide and scrobiculate, running along two thirds of mesopleuron; metapleuron coriaceous, surrounded by a scrobiculate area, with a distinct, posterior tubercle; propodeum coriaceous basally, remaining areas aerolate-rugose, with coriaceous sculpture between rugae, median carina ¼ of propodeum length, triangular areola poorly defined.

Legs. Hind coxa 1.2 times longer than wide. Length of hind femur 5.0 times its maximum width. Hind basitarsus 0.43 times as long as hind tibia. Length of hind basitarsus 0.6 times combined length of second to fifth tarsal segments. Second, third, fourth and fifth (without pretarsus) tarsal segments 0.5, 0.44, 0.36 and 0.3 times as long as basitarsus. Tarsal claws with a basal, pointed lobe, followed by sharp spines.

Wings. Fore wing length about 3.0 times its maximum width; pterostigma 4.5 times longer than wide; vein lCUb 0.88 almost as long as vein RS+Ma; vein 3Rsa 0.6 times vein 3RSb, 2.2 times vein r; angle at union 2RS and 2M acute. Hind wing length 5.0 times its maximum width; vein M+CU almost as long as vein 1M and 2.2 times vein r-m; vein 1A 2.1 times vein cu-a.

Metasoma. Metasoma almost as long as head and mesosoma combined, with seven visible tergites. First tergite almost as long as its maximum width; maximum width 4.0 times its basal width; longitudinally costate with coriaceous sculpture between carinae, with a longitudinal median carina running along its entire length. Length of second tergite 0.7 times its maximum width, 1.7 times length of third tergite; second and third tergites longitudinally costate with coriaceous sculpture between carinae, fourth tergite mostly coriaceous with faint longitudinal carinae. Remaining tergites finely coriaceous. Ovipositor about 0.5 times as long as metasoma.

Males

Unknown.

Distribution

This species is only known for the CBS in the state of Jalisco, Mexico.

Biology

Unknown.

Comments

We could not find external morphological differences between *T. luzabrilae* sp. nov. and *T. bradzlotnicki*; however, they can be genetically distinguished with the animal DNA barcoding locus, having a distance of 2.99–3.77% (Supp. file 6: Subset 2).

Morphological descriptions of Triraphis bradzlotnicki Sharkey, 2021 and T. davidwahli Sharkey, 2021

Sharkey *et al.* (2021a,b) described more than 400 new species of Braconidae from Costa Rica exclusively based on the animal DNA barcode (a 658 bp fragment of the COI mtDNA gene; Hebert *et al.* 2003). In these studies, the authors identified 31 MOTUs belonging to *Triraphis*, that were further regarded as species under specific BINs on the BOLDSYSTEMS database. In addition to their molecular diagnosis, only a single photograph was included for each described species. Based on our gathered COI dataset, we identified the presence of *T. bradzlotnicki* and *T. davidwahli* in the Chamela Biological Station in Jalisco, Mexico. Below we provide a morphological description of these two species based on our collected material.

Triraphis bradzlotnicki Sharkey, 2021
Fig. 5

Diagnosis

Triraphis bradzlotnicki can be distinguished from the remaining species of the genus, except *T. luzabrilae* sp. nov., by the presence of a median longitudinal carina running along the upper half of the face. The longitudinal carina on the upper half of the face is also present in *T. divergens*; however, the carinae of the third and fourth metasomal tergites of *T. divergens* sp. nov. are divergent. Based on morphology, *T. bradzlotnicki* and *T. luzabrilae* sp. nov. apparently could represent cryptic species and can only be molecularly distinguished by having a COI distance of 2.99–3.77% (Supp. file 6: Subset 2).

Material examined

Material used for morphological description

MEXICO • ♀; Jalisco, Chamela Biological Station UNAM, Camino Chachalaca, Cham113; 19.4959° N, 105.04202° W; 400 m a.s.l.; 19 Jul. 2011; E. Martínez and O. Pérez leg.; light trap; DNA voucher no. CNIN1134; GenBank accession no. OQ868187; CNIN-IBUNAM.

Additional material examined

MEXICO • 2 ♀♀; same collection data as for the material used for morphological description; DNA voucher nos CNIN1154 and CNIN1155; GenBank accession nos OQ868184, OQ868185; CNIN-IBUNAM • 1 ♀; Jalisco, Chamela Biological Station UNAM, Camino Chachalaca, 400 m, CHAM83; 19.4959° N, 105.04202° W; 113 m a.s.l.; 5 May 2011; A. Zaldívar, S. Saragoza and A. Ibarra leg.; Malaise trap; DNA voucher no. CNIN1165; GenBank accession no. OQ868186; CNIN-IBUNAM • 1 ♀; Jalisco, Guadalajara, La Huerta Municipality, Chamela Biological Station UNAM, 80 m; 19°40′58″ N, 105°04′2″ W; 22 Nov. 2013; DNA voucher no. GMMAB975-15 (BOLDSYSTEMS code BIOUG20863-E05); CNIN-IBUNAM • 1 ♀; Jalisco, Guadalajara, La Huerta Municipality, Chamela Biological Station UNAM, 80 m; 19°40′58″ N, 105°04′2″ W; 15 Nov. 2013; Abel Verduzco leg.; Malaise trap; DNA voucher no. GMMAA032-15 (BOLDSYSTEMS code BIOUG20632-B06); CNIN-IBUNAM • 1 ♀; Jalisco, Guadalajara, La Huerta Municipality, Chamela Biological Station UNAM, 80 m; 19°40′58″ N, 105°04′2″ W; 1 Nov. 2013; Abel Verduzco leg.; Malaise trap; DNA voucher no. GMMCY228-15 (BOLDSYSTEMS code BIOUG20584-D04); CNIN-IBUNAM • 1 ♀; Jalisco, Guadalajara, La Huerta Municipality, Chamela Biological Station UNAM, 80 m; 19°40′58″ N, 105°04′2″ W; 18 Oct. 2013; Abel Verduzco leg; Malaise trap; DNA voucher no. GMMCW534-15 (BOLDSYSTEMS code BIOUG20444-H09); CNIN-IBUNAM.

Description

Female (CNIN1134)

Measurements. Body length 5.6 mm; fore wing length 3.9 mm; ovipositor 1.5 mm.

Color. Head light brown; eyes silverfish brown; ocelli with a fine whitish yellow line around edges, ocelar triangle dark brown to black; mandibles pale yellow, teeth brown; scape and pedicel brown, first two flagellomeres brown, turning yellow to apex. Dorsal part of pronotum brown; median and lateral mesoscutal lobes yellow, lateral mesoscutal lobes brown around edges; metanotum and propodeum brown; lateral part of pronotum, propleuron, mesopleuron and metanotum pale yellow. Fore wings hyaline, pterostigma honey yellow; stigma dark brown medially, honey yellow laterally; veins of fore and hind wings yellow to brown. Legs pale yellow; fifth tarsomere and tarsal claws light brown. First metasomal tergite brown to dark brown basally, brown to dark brown medially and apically, pale yellow laterally; remaining tergites brown to dark brown medially, pale yellow laterally. Ovipositor honey yellow, ovipositor sheaths pale yellow basally, turning dark brown apically.

Head. Head 1.7 times wider than its median length (dorsal view); distance between basal edges of tentorial pits and the basal area of toruli 0.9 times maximum width of face; width of oral opening 1.8 times its height. Vertex, temple, gena and frons mostly smooth; face with irregular to transverse weak rugae near toruli, with a median longitudinal carina running along the upper half, with sparsely long setae; clypeus smooth-colliculate; malar suture present. Antennae broken, with 23 flagellomeres and 41 respectively; first flagellomere 1.8 times longer than wide, almost as long as second flagellomere; eye 1.5 times higher

Fig. 5. *Triraphis bradlotnicki* Sharkey, 2021, lateral habitus (CNIN-IBUNAM).

than broad; malar space 0.16 times height of eye; face width 0.8 times height of eye and almost as long as height of face and clypeus combined; occipital carina complete; median ocellus as big as lateral ocelli; ocellus-eye distance about 0.7 lateral ocellus width.

Mesosoma. Length of mesosoma 1.9 times its maximum width (dorsal view), 1.5 times its maximum height (lateral view); pronotal groove smooth and scrobiculate; propleuron collicullate-coriaceous; notauli scrobiculate, distinct, not meeting, finishing before just before the end of mesoscutum; median pit present, deep; median and lateral mesoscutal lobes smooth-collicullate; mesopleuron colliculate-coriaceous, dorso-laterally costate; precoxal sulcus deep, wide and scrobiculate, running along two thirds of mesopleuron; metapleuron coriaceous, surrounded by a scrobiculate area, with a distinct, posterior tubercle; propodeum coriaceous basally, remaining areas aerolate-rugose, with coriaceous sculpture between rugae, median carina ¼ of propodeum length, triangular areola poorly defined.

Legs. Hind coxa 1.7 times longer than wide. Length of hind femur 4.8 times its maximum width. Hind basitarsus 0.5 times as long as hind tibia. Length of hind basitarsus 0.76 times combined length of second to fifth tarsal segments. Second, third, fourth and fifth tarsal segments 0.44, 0.35, 0.25 and 0.3 times as long as basitarsus. Tarsal claws with a basal, pointed lobe, followed by sharp spines.

Wings. Fore wing length about 3.5 times its maximum width; pterostigma 3.8 times longer than wide; vein lCUb 0.89 almost as long as vein RS+Ma; vein 3RSa 0.6 times vein 3RSb, about 3.0 times vein r; angle at union 2RS and 2M wide. Hind wing length 5.3 times its maximum width; vein M+CU almost as long as vein 1M and 2.5 times vein r-m; vein 1A 1.9 times vein cu-a.

Metasoma. 1.2 times longer than head and mesosoma combined, with seven visible tergites. First tergite, 0.9 longer than its maximum width; maximum width 2.2 times its basal width; longitudinally costate with coriaceous sculpture between carinae, with a longitudinal median carina running along its entire length. Length of second tergite 0.8 times its maximum width, 1.75 times length of third tergite; second and third tergites longitudinally costate with coriaceous sculpture between carinae, fourth tergite mostly coriaceous with faint longitudinal carinae. Remaining tergites finely coriaceous. Ovipositor about 0.5 times as long as metasoma.

Variation

Body length 3.2–5.6 mm; fore wing length 2.7–4.5 mm; ovipositor 0.8–1.5 mm. Specimens with complete antennae, 35 and 45 flagellomeres, respectively.

Distribution

This species is known for Guanacaste, Costa Rica, and the Chamela region in Jalisco, Mexico.

Comments

The host of the Mexican specimens is unknown. The holotype of the species from Costa Rica was reared from *Podalia orsilocha* Cramer, 1775 (Megalopygidae) feeding on *Chimarrhis parviflora* Standl. (Rubiaceae).

Triraphis davidwahli Sharkey, 2021
Fig. 6

Diagnosis

This is a species with the longest median carina on the propodeum, which is ⅓ of its length (¼ in remaining species). This species runs to *T. ornatus* in the key provided by Valerio & Shaw (2015); however, it can

be distinguished from this species by the brown surrounding areas of the mesoscutal lobes, scutellum and dorsal portion of the metasoma (completely dark in *T. ornatus*) and for the color of metasoma, which is yellow in *T. davidwahli* and dark brown in *T. ornatus*. The color pattern of the Mexican specimen assigned to *T. davidwahli* (Fig. 6A) is mostly similar to the holotype based on the photograph included in the original description of the species (Fig. 6B).

Material used for morphological description

MEXICO • ♀; Jalisco, Chamela Biological Station UNAM, near lab, Cham60; 19.49858° N, 105.04417° W; 92 m a.s.l.; 29–30 Mar. 2010; A. Zaldívar and V. Salinas leg.; light trap; DNA voucher no. CNIN1083; GenBank accession no. OQ868189; CNIN-IBUNAM.

Description

Female

Measurements. Body length 4.8 mm; fore wing length 3.9 mm; ovipositor 1.1 mm.

Color. Head light brown, body pale yellow to yellow, eyes silverfish brown, ocelli with a wide whitish yellow line around edges, area surrounding ocelli dark brown to black; mandibles yellow, teeth brown; scape, pedicel and first flagellomere brown, remaining flagellomeres yellow, apical twelve flagellomeres turning brown to dark brown. Dorsal part of pronotum, lateral areas of median and lateral mesoscutal lobes, metanotum, propodeum, basal part of mesopleuron, median area of metapleuron, ventral part of hind coxa and portion of hind femur near the insertion with tibia brown; fifth tarsus and tarsal claws brown; wings hyaline, fore wing with an infuscate median area; pterostigma brown, pale yellow on the edges; veins brown to dark brown. Ovipositor and ovipositor sheaths honey yellow.

Head. Head 1.8 times wider than its median length (dorsal view); distance between basal edges of tentorial pits and the basal area of toruli 0.8 times maximum width of face measured at dorsal edge of clypeus; width of oral opening 1.3 times height of oral opening. Vertex, temple, and gena smooth-slightly colliculate; frons smooth-colliculate, slightly strigate near toruli; face transversally striate, with a median longitudinal swollen area and sparsely long setae; clypeus smooth-colliculate; malar suture present. One broken antenna with 11 flagellomeres; complete antenna with 42 flagellomeres, first flagellomere 2.0 times longer than wide, almost as long as second flagellomere; eye 1.6 times higher than broad; malar space 0.17 times height of eye; face width about 0.77 times height of eye, and almost as long as height of face and clypeus combined; occipital carina complete, dorsally almost indistinct; median ocellus as big as lateral ocelli; ocellus-eye distance about 0.5 lateral ocellus width.

Mesosoma. Length of mesosoma 1.9 times its maximum width (dorsal view), 1.5 times its maximum height (lateral view); pronotal groove wide apically, smooth and scrobiculate; propleuron coriaceous; median and lateral mesoscutal lobes smooth-colicullate; notauli wide, scrobiculate, not meeting, finishing before the end of mesocutum in a longitudinally striate area; medial pit obscured by sculpture; scutellar sulcus smooth with one longitudinal carina; scutellar disc subtriangular, smooth-colliculate, mesopleuron mostly smooth, transversally costate dorso-laterally; precoxal sulcus wide, deep and scrobiculate, running along two thirds of mesopleuron; metapleuron coriaceous surrounded by a scrobiculate area, with a distinct, posterior tubercle; propodeum coriaceous basally, remaining area aerolate-rugose with coriaceous sculpture, median carina ⅓ of propodeum length.

Legs. Hind coxa 1.5 times longer than wide. Length of hind femur 4.3 times its maximum width. Hind tibia almost 2.0 times longer than hind basitarsus. Length of hind basitarsus 0.7 times combined length of second to fifth tarsal segments. Second, third, fourth and fifth tarsal segments 0.5, 0.4, 0.25 and 0.4 times as long as basitarsus. Tarsal claws with a basal, pointed lobe, followed by sharp spines.

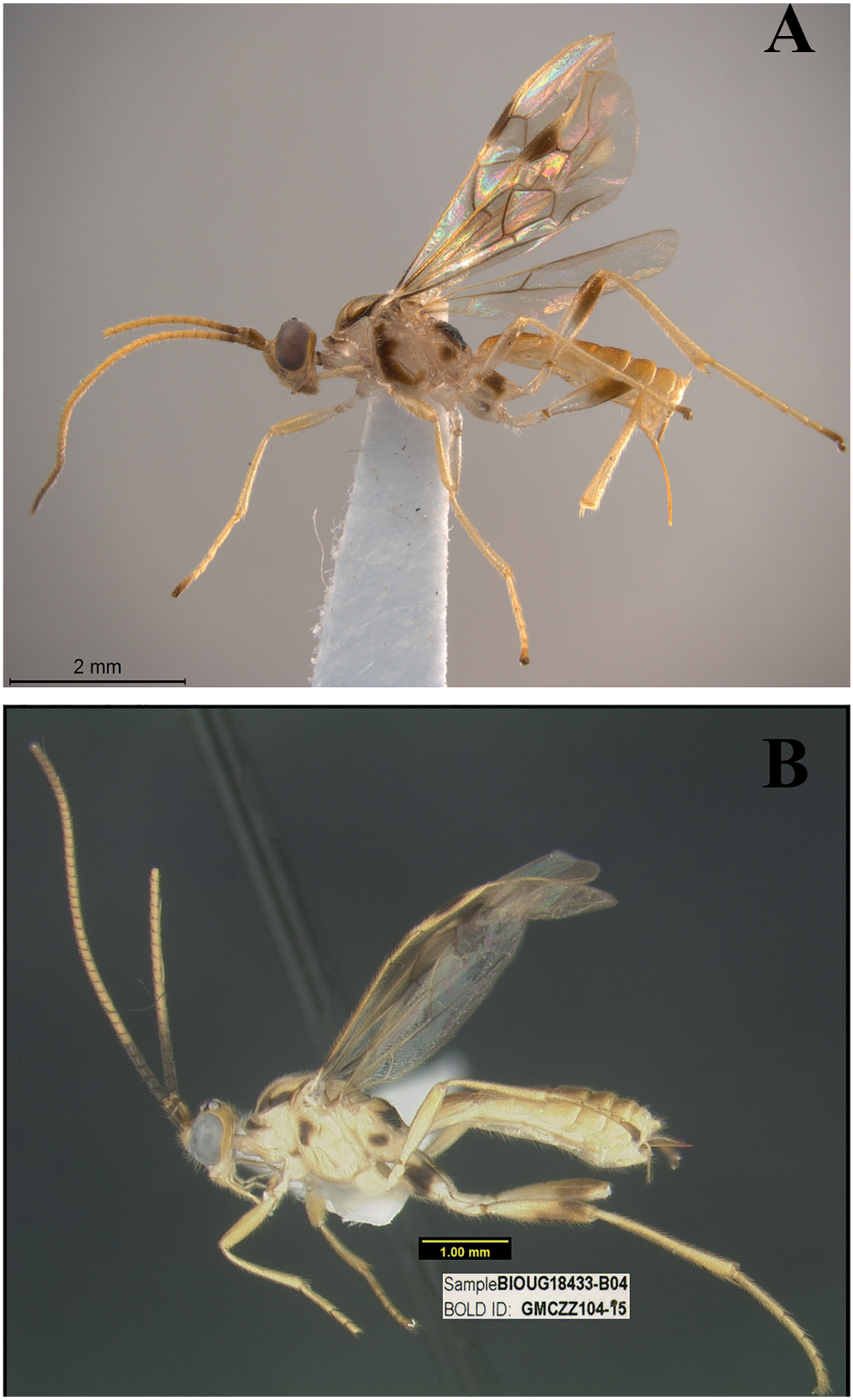

Fig. 6. *Triraphis davidwahli* Sharkey, 2021. **A**. Lateral habitus of a Mexican specimen (CNIN-IBUNAM). **B**. Lateral habitus of female holotype from Costa Rica in Sharkey *et al.* (2021a) (CNC).

Wings. Fore wing length about 3.0 times its maximum width; pterostigma 4.0 times longer than wide; vein lCUb almost as long as vein RS+Ma; vein 3RSa 0.6 times vein 3RSb, 2.3 times vein r; angle at union 2RS and 2M wide. Hind wing length 5.3 times its maximum width; vein M+CU as long as vein 1M and 2.5 times vein r-m; vein 1A 2.4 times vein cu-a.

Metasoma. Almost as long as head and mesosoma combined. First tergite almost as long as its maximum width; maximum width about 2.0 times its basal width; longitudinally costate with coriaceous sculpture between rugae, with a longitudinal median carina running along its entire length. Length of second tergite 0.8 times its maximum width, 1.7 times length of third tergite, longitudinally costate with coriaceous sculpture between rugae. Third tergite longitudinally costulate with coriaceous sculpture between rugae on basal ¾, remaining tergites coriaceous. Ovipositor about 0.5 times as long as metasoma.

Distribution

This species occurs in Costa Rica and Mexico, but probably also in Belize (voucher BMNHE897830) and French Guiana (voucher CCDB-07375 D01) since they have the same BIN on the BOLDSYSTEMS database.

Comments

The holotype of this species is deposited in the Canadian National Collection (CNC; BIN AAM9598 in the BOLDSYSTEMS database). Some paratypes from Costa Rica were reared from *Panthiades bitias* Cramer, 1777 (Lycaenidae).

Discussion

Here we describe four new species of the rogadine genus *Triraphis*, increasing to 78 the number of recognized species for the genus. Of the currently recognized species of *Triraphis* from the New World, only four had been recorded to occur in Mexico previous to this study (Yu *et al.* 2016). Thus, our study elevates to 11 the number of species occurring in this country, considering the four species described here as well as *T. bradzlotnicki*, *T. davidwahli* and *T. defectus*.

We provide for the first time a morphological description of *T. bradzlotnicki* and *T. davidwahli* based on specimens collected in the Chamela region in Mexico. These species were described from Costa Rica, and *T. davidwahli* was also reported to occur in Belize and French Guiana (Sharkey *et al.* 2021a). Our study therefore considerably extends the known geographic distribution of these two species.

Triraphis divergens sp. nov., *T. luzabrilae* sp. nov. and *T. bradzlotnicki* are closely related based on both molecular and morphological information. The latter two are morphologically cryptic, although they can be molecularly distinguished based on the 2% COI divergence criterion (Hebert *et al.* 2003). According to our results, *T. matssegnestami* Sharkey, 2021 is represented by a genetic cluster that is closely related with these three species based exclusively on molecular information. Further morphological studies are needed to identify the morphological features that distinguish *T. matssegnestami* from the above closely related species.

There is no available molecular information either for *T. fascipennis*, *T. harrisine* and *T. ornatus*, which apparently occur in Mexico and Costa Rica, or for 12 out of the 13 Costa Rican species of *Triraphis* described by Valerio & Shaw (2015). Their molecular information is therefore needed to confirm whether they do not belong to any of the molecularly characterized species of the genus described by Sharkey *et al.* (2021a, 2021b).

The identifications of the two records of *Rogas* for which there are COI sequences deposited in the BOLDSYSTEMS database (GBAH1651-06, GBAHB1289-15) need to be revised since both samples were nested within the *Triraphis* cluster in the NJ tree. Similar results were obtained by Quicke *et al.* (2021) in a phylogenetic context, where a non-monophyletic *Triraphis* was recovered with the inclusion

of *Rogas* and other rogadine groups such as *Darnilia* van Achterbeg, 1989 and Spinariina van Achterberg, 1988. Further morphological and molecular studies will help to assess the limits between *Triraphis* and *Rogas*.

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Supplementary files

Supp. file 1. Locality information and GenBank accession nos of the generated 19 sequences of *Triraphis* Ruthe, 1855 occurring in the CBS, Mexico.
https://doi.org/10.5852/ejt.2024.917.2387.10499

Supp. file 2. Aligned COI data matrix (433 sequences) in nexus format. This matrix contains sequences of *Triraphis* Ruthe, 1855, *Rogas* Nees, 1818 and *A. adrianaradulovae* Sharkey, 2021 downloaded from the BOLDSYSTEMS database as well as generated sequences of *Triraphis* occurring in the CBS, Mexico.
https://doi.org/10.5852/ejt.2024.917.2387.10501

Supp. file 3. Metadata of *Triraphis* Ruthe, 1855 (Hymenoptera: Braconidae) records on the BOLDSYSTEMS database from which there are available sequences of COI marker.
https://doi.org/10.5852/ejt.2024.917.2387.10503

Supp. file 4. Metadata of all *Rogas* Nees, 1818 (Hymenoptera: Braconidae) records on the BOLDSYSTEMS database. Samples highlighted in orange correspond to records for which there are available sequences of COI marker.
https://doi.org/10.5852/ejt.2024.917.2387.10505

Supp. file 5. Distance (Neighbor Joining) tree reconstructed with the COI marker including the species of *Triraphis* Ruthe, 1855 for which there are available COI sequences in the BOLDSYSTEMS database and the species for which we newly generated data. The species of *Triraphis* that are present in the Chamela region are indicated in the tree. Terminals with an asterisk are the holotypes of each of the new species described in this work.
https://doi.org/10.5852/ejt.2024.917.2387.10507

Supp. file 6. Genetic distances of the five subsets of data of closely related species to the species of *Triraphis* Ruthe, 1855 occurring in the CBS, Mexico.
https://doi.org/10.5852/ejt.2024.917.2387.10509

Supp. file 7. *Triraphis* cf. *fusciceps*, ♀ (CNIN1167; CNIN-IBUNAM). **A**. Lateral habitus. **B**. Head, frontal view. **C**. Head and mesosoma, lateral view. **D**. Head and mesosoma, dorsal view. **E**. Wings. **F**. Metasoma, dorsal view.
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