

# Discovery of the Old World genus *Rogas* Nees (Hymenoptera, Braconidae, Rogadinae) in the New World by DNA barcoding

Donald L.J. Quicke<sup>1</sup>, Michael J. Sharkey<sup>2</sup>, Daniel H. Janzen<sup>3</sup>, Winnie Hallwachs<sup>3</sup>, Buntika A. Butcher<sup>1</sup>

<sup>1</sup> Integrative Insect Ecology Research Unit, Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand

<sup>2</sup> The Hymenoptera Institute, 1339 La Loma Dr., Redlands, CA, 92373, USA

<sup>3</sup> Department of Biology, University of Pennsylvania, Philadelphia, PA 19104-6018, USA

<https://zoobank.org/2EDA9D02-8F97-4E4D-AC6D-1F135B250971>

Corresponding author: Buntika A. Butcher (buntika.a@chula.ac.th)

Academic editor: Jose Fernandez-Triana ♦ Received 28 November 2024 ♦ Accepted 13 January 2025 ♦ Published 5 March 2025

## Abstract

Morphological taxonomy and a molecular phylogenetic analysis led to the recognition of a new species of *Rogas* Nees from Costa Rica, *R. shimborii* Quicke & Sharkey, **sp. nov.** This represents the first discovery of the genus from the Americas; all previous records being the results of misidentifications and alternative interpretations. The new species is illustrated photographically, a minimalist diagnosis based on the COI DNA barcode is provided, supplemented by morphological and color diagnostic features.

## Key Words

Distribution, Malaise traps, new species, parasitoid wasps, systematics, *Triraphis*

## Introduction

Historically there has been much confusion about the identity of the rogadine braconid genus *Rogas* Nees, 1819 and several authors (e.g. Marsh 1979) combined it with the far commoner genus *Aleiodes* Wesmael, 1838 as well as with *Triraphis* Ruthe, 1855; therefore for much of the 20<sup>th</sup> century *Rogas* was widely treated as a massive “dumping ground” for a majority of rogadine species. Although many species of New World Rogadinae have been referred to in the past under the generic name *Rogas* (or its invalid emendation *Rhogas*), (e.g. Marsh et al. 1979, Shaw 1997), nearly all of these have subsequently been transferred either to *Aleiodes* or to *Triraphis* Ruthe, leaving typical *Rogas* interpreted as small and (up to now) an entirely Old World genus (Shaw et al. 1998; Valerio 2006; Gates et al. 2012; Shimbori and Martínez 2016; Broad 2021). In fact, *Aleiodes* and *Rogas* are not closely related and belong to different, well-separated, tribes (Jasso-Martínez et al. 2020; Quicke et al. 2021; Shimbori et al. 2024).

Shenefelt (1975) treated *Triraphis* as a junior synonym of *Rogas*, however, van Achterberg (1991), resurrected

*Triraphis* and included three species: the western Palearctic *T. tricolor* (Wesmael 1838), the type-species, and two north American species, *T. harrisinae* (Ashmead, 1889), and *T. discoideus* (Cresson 1869). Subsequently, a number of Costa Rican *Triraphis* species have been described and named including 13 new species by Valerio and Shaw (2015) and 30 new species by Sharkey et al. (2021). However, the anticipated number from Costa Rica alone based on extensive collecting, rearing and barcoding there, greatly exceeds the current total. Morphologically, *Triraphis* differs from those of *Rogas* mainly by the shape of the basal lobe of the claw, and in the ventral part of the occipital carina.

During preparation of a new key to a New World genera of Rogadinae, (Sharkey et al., in prep.) two Costa Rican specimens originally identified as members of *Triraphis*, were recovered in a neighbor-joining tree based on DNA barcodes, remote from other members of the genus.

Zaldivar-Riveron et al. (2004) noted that New World ‘*Rogas*’ species exhibit a unique venom apparatus and commented that they may not be closely related to the Old World ones. The situation was clarified by the publica-

tion of van Achterberg's key to the Afrotropical genera of Rogadinae which included a redescription of *Rogas* and presented a key that separated *Rogas* from other genera of Rogadini including *Triraphis* (van Achterberg, 1991).

## Materials and methods

Morphological terminology follows van Achterberg (1988) except for wing venation which follows Sharkey and Wharton (1997) (see also figures in Quicke (2015) and Sharkey et al. (2023)).

### Collection acronym for specimen deposition

**CNC** Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada

### Molecular and phylogenetic methods

We conducted a phylogenetic analysis with the barcoding region of cytochrome oxidase *c* subunit 1 (COI; Hebert et al. 2003) and the D2–D3 expansion region of 28S rDNA (28S). We included the most complete DNA sequences for every species of Rogadini for which a barcode BIN was available (Ratnasingham and Hebert 2013).

Alignment of COI was trivial as there were no indels. The length-variable 28S sequences were aligned according to the secondary structure model of Gillespie et al. (2005) as in other studies (Butcher et al. 2014; Quicke et al. 2016). For the 28S gene, only confidently alignable positions were included in the analyses. Data were partitioned into the three COI codon positions and pairing and non-pairing bases of the RNA gene (Quicke et al. 2020, 2021; Shimbori et al. 2024). The concatenated data set was analyzed using the maximum likelihood program RAXML-NG (ver. 8.2.12, see <https://github.com/stamatak/standard-RAXML>; Kozlov et al. 2019) with the GTR+G model selected for all partitions.

## Results

### Genus *Rogas* Nees, 1818

*Rogas* Nees, 1818: 306 (type species: (designated by Curtis 1834): *Ichneumon testaceus* Fabricius, 1798 [nec *I. testaceus* Gmelin, 1790; = *Rogas luteus* Nees, 1834]).

*Pelecystoma* Wesmael, 1838: 91; Shenefelt 1975: 1206–1209; Tobias 1976: 89; Marsh 1979a: 178; Tobias 1986: 84–85 (included in *Rogas* auct). Syn. by van Achterberg 1982. Type species (designated by Foerster 1862): *Rogas luteus* Nees, 1834 [type lost]. Synonymy.

*Rhogas* Agassiz, 1846: 325 (invalid emendation).

**Diagnosis.** Antenna with more than 50 flagellomeres. Maxillary palpus segment 3 strongly enlarged and laterally flattened in both sexes (Fig. 1D,F), segment 4

distinctly expanded basally. Labial palpus segment 2 inflated. Propodeum with short mid-longitudinal carina medioanteriorly which divides to form a pair of near parallel submedial carinae. Hind wing veins 1rs-m and M joining at an acute angle, much less than 75°. Hind wing vein M 1.15–1.5 × longer than M+CU. Hind tibia with comb of modified setae distomedially (Fig. 2B). Hind tibial spurs straight and evenly setose. Tarsal claws with large, dark, rather square basal lobe. Metasomal tergite 1 approximately 1.2 × longer than posteriorly wide. Dorsople present, large and deep; dorsal carinae of metasomal tergite 1 remaining separate or joined to form point (Fig. 2E). Metasomal tergite 2 with wide polygonal midbasal area (Fig. 2F); midlongitudinal carina variably present. Metasomal tergites 2–5 with sharp lateral crease. Female hypopygium ventrally nearly straight and posteriorly truncate.

*Rogas* was redescribed and illustrated by van Achterberg (1991), reproduced and slightly modified by Chen and He (1997), and the holotype of *Rogas luteus* was illustrated by van Achterberg (1991). Chen and He (1997) provide a key to Old World species.

*Rogas* may be distinguished from both Old and New World *Triraphis* by its maxillary palpi having the third segment swollen and laterally flattened having the swollen third segment (Fig. 1D, F), the occipital carina being complete (although sometimes weak) ventrally and joining hypostomal carina (reduced ventrally, without ventral junction with hypostomal carina in *Triraphis*) (Fig. 1C) (Ratnasingham and Hebert 2013), and with claws which have a large, dark square (truncate) basal lobe (small, acute and pale in *Triraphis*) (Fig. 2C) (van Achterberg 1991; Chen and He 1997).

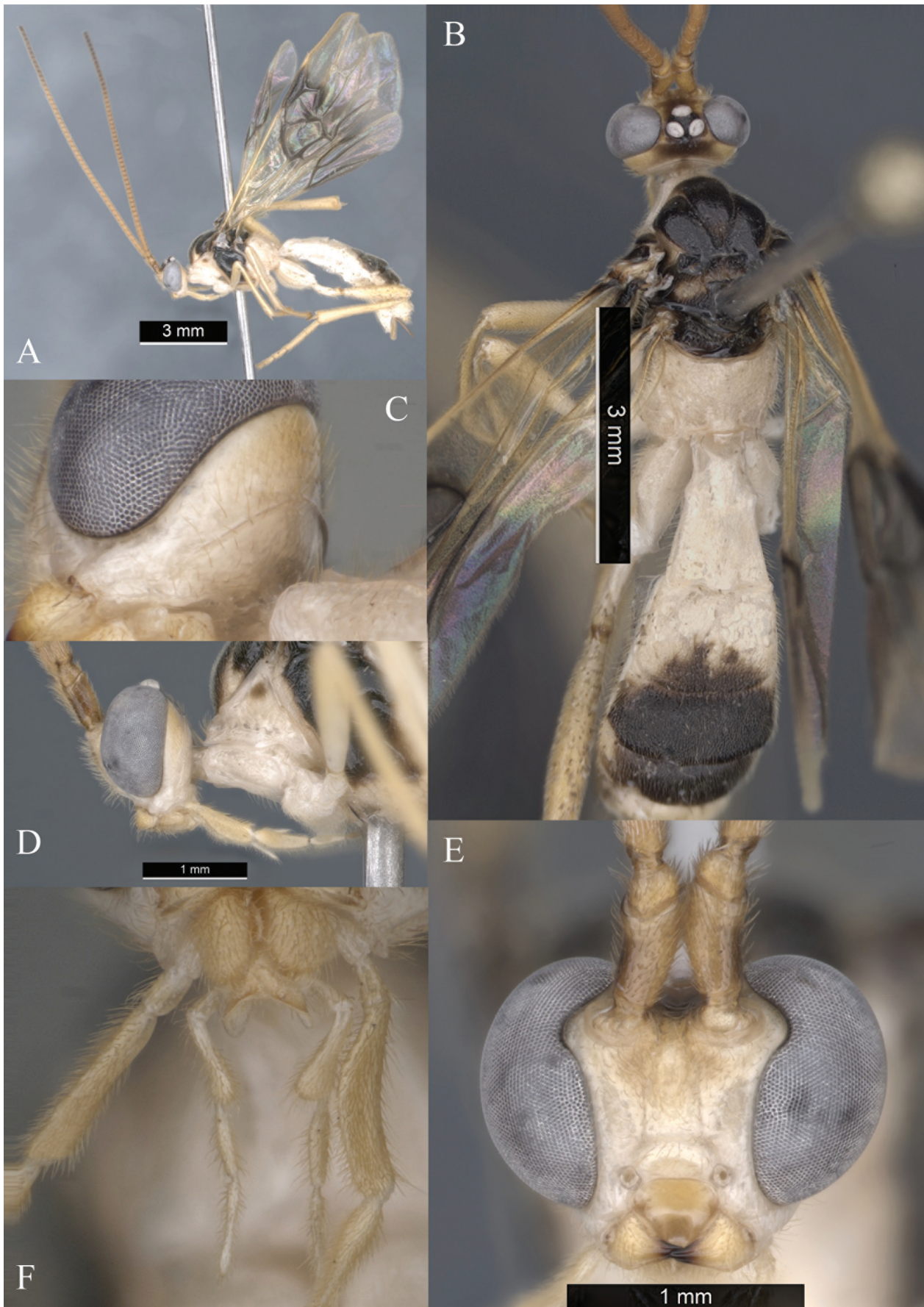
All reliable host records for *Rogas* are from Limacodidae caterpillars (Quicke and Shaw 2006). Published records from Zygaenidae result from failure to recognize *Triraphis* as a distinct genus (Quicke et al. 2003) and records from other families might result from misidentifications of *Aleiodes* species.

### *Rogas shimborii* Quicke & Sharkey, sp. nov.

<https://zoobank.org/16ccb84c-a585-455d-a31c-76521b7710f2>

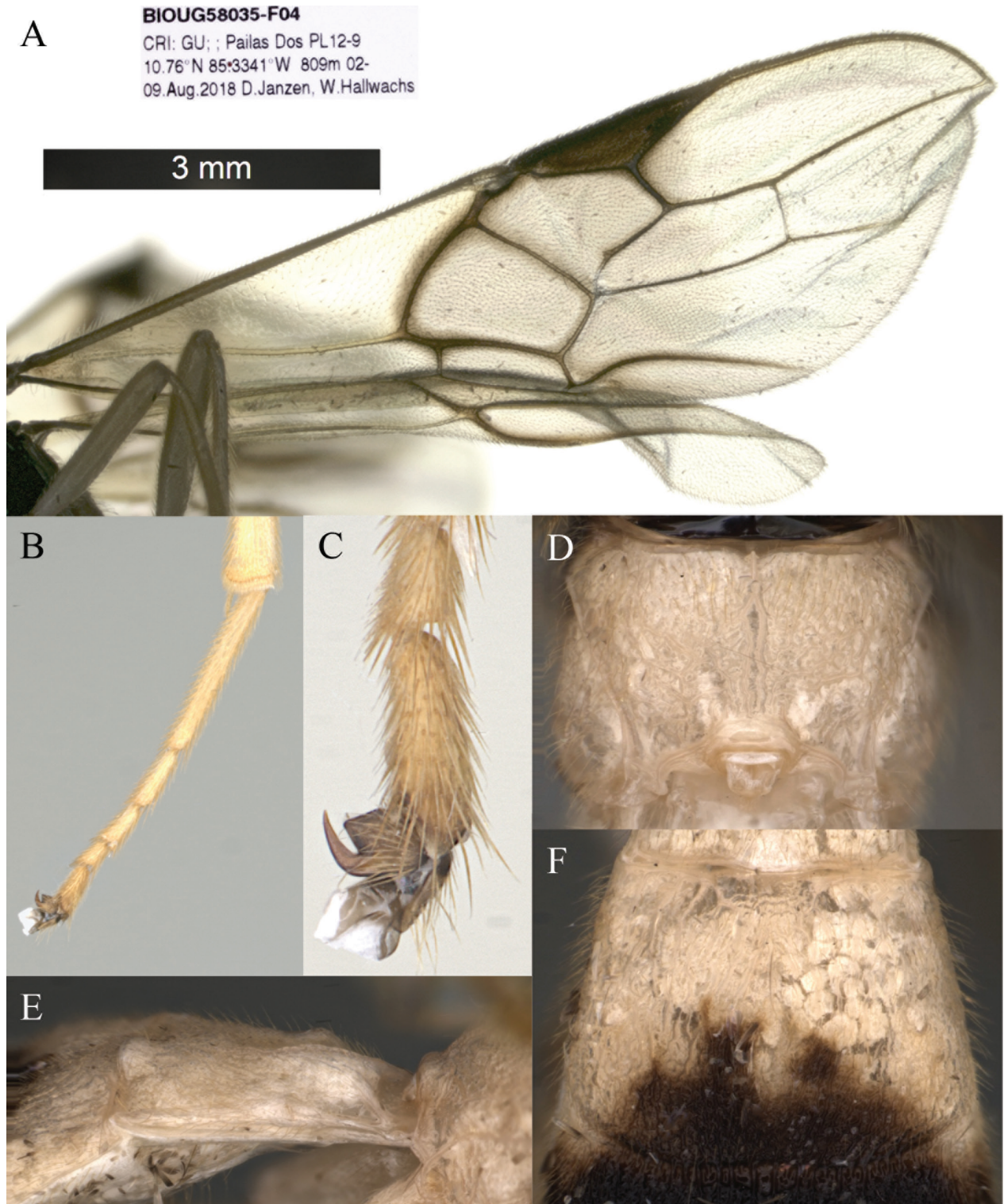
**Type material. Holotype.** COSTA RICA • ♀; Area de Conservación Guanacaste, Guanacaste Province, Sector Pailas, Pailas Dos, 10.76°N, 85.334°W, 809 m, 2.viii.2018, leg. D. Janzen, W. Hallwachs, ecotone between lowland tropical dry forest and intermediate elevation rain forest, Malaise trap PL12-9); CNC (Specimen voucher: BIOUG58035-F04; BIN BOLD:AEF7075). **Paratype:** COSTA RICA • 1 ♀; Area de Conservación Guanacaste, Guanacaste Province, Sector Pailas, Pailas Dos, 10.764°N, 85.333°W, 853 m, 25.vi.2020, leg. D. Janzen, W. Hallwachs, ecotone between lowland tropical dry forest and intermediate elevation rain forest, Malaise trap (PL12-6); CNC. (Specimen voucher: BIOUG63902-A02; BIN BOLD:AEF707).





**Figure 1.** *Rogas shimborii* Quicke & Sharkey, sp. nov., holotype, female, specimen voucher BIOUG58035-F04 **A.** Habitus, lateral view; **B.** Habitus oblique dorsal view; **C.** Head, postero-ventral view showing connection between occipital and hypostomal carinae; **D.** Head and anterior mesosoma, lateral view; **E.** Head, anterior view; **F.** Labial palps, anterior view.





**Figure 2.** *Rogas shimborii* Quicke & Sharkey, sp. nov., holotype, female, specimen voucher BIOUG58035-F04; **A.** Forewing and part of hind wing (inset data label); **B.** Apex hind tibia and hind tarsus, inner view; **C.** Hind claw; **D.** Propodeum; **E.** Metasomal tergite 1 oblique lateral; **F.** Metasomal tergite 2.

**Diagnostics.** BOLD:AEF7075. Consensus barcode: TTTATATTTTTATTTGGTATTTGAGCGGG-GCTTTTAGGGCTATCTATAAGGTTAATTATTCG-GTTAGAATTAAGTATACCTGGGAGGTTATTAG-

GTAATGATCAGATTTATAATGGAATAGTAACT-GCACATGCATTTATCATAATTTTTTTTATAGTATACCTATTATAATTGGGGGGTTTGGTAATT-GATTAATTCCTTAATATTAGGGGCTCCTGATAT-

GGCTTTCCCTCGTATAAATAATATAAGATTTT-  
 GATTGTTAATCCCGTCATTAATTTTATTATTATA-  
 AGAGCTATTGTAATGTAGGGGGTTGGTACAG-  
 GTTGAACAATTTATCCTCCTTTATCTTCTTTA-  
 ATAGGGCATGGAGGGATATCTGTTGATTAGC-  
 TATTTTTTCTTTACATTTAGCAGGTATCTCTTC-  
 TATTATAAGGGGTTGTAAATTTTATTCTA-  
 CAATTTTTAATATAAAGTTAATTTCTATT-  
 AGTCTAGATCAGATTAATTTATTTGTATG-  
 GTCTGTTTTAATTACTGCTATTTTATTATTAT-  
 TATCTTTACCTGTATTAGCGGGGGCCATTA-  
 CAATATTATTAACAGATCGTAATTTAAATA-  
 CAACTTTTTTTGATTTTTTTCAGGGGGGGG-  
 GATCCTGTTTTATTCAACATTTATT

The new species may be distinguished from all other described species by its bicolorous (black and ivory-white metasoma (Fig. 1A, B); these are reddish-yellow, ochreous-yellow or brown in *R. luteus*, *R. oeyyamensis* (Watanabe, 1937), *R. roxana* (Telenga, 1941), *R. nigrovenosus* (Vojnovskaja-Krieger, 1935), *R. nigristigma* Chen & He, and *R. flavus* Chen & He, 1997 largely uniformly black in *R. nigricans* Chen & He, 1997, and *R. nigridorsum*

Belokobylskij, 1996. The infusate median transverse band of the forewing (Fig. 2A) is also unique to this species.

**Etymology.** Named in honor of Eduardo Mitio Shimbori in recognition of his contributions to Neotropical Rogadinae systematics.

### Molecular results

Analysis of the concatenated two gene data set recovers the new species nested within the Old World *Rogas* representatives, and as sister group to *R. roxana* from the Russian Far East, though with low support (Fig. 3), and far removed from *Triraphis*. However, the latter genus was not recovered as monophyletic and its two clades were well separated. The larger clade was entirely comprised of Meso- and South American species whereas the smaller clade largely contained Old World species but also including *T. discoideus* (Cresson, 1869) from North America and one species, *T. robertomirandai* Sharkey, 2021, from Costa Rica.

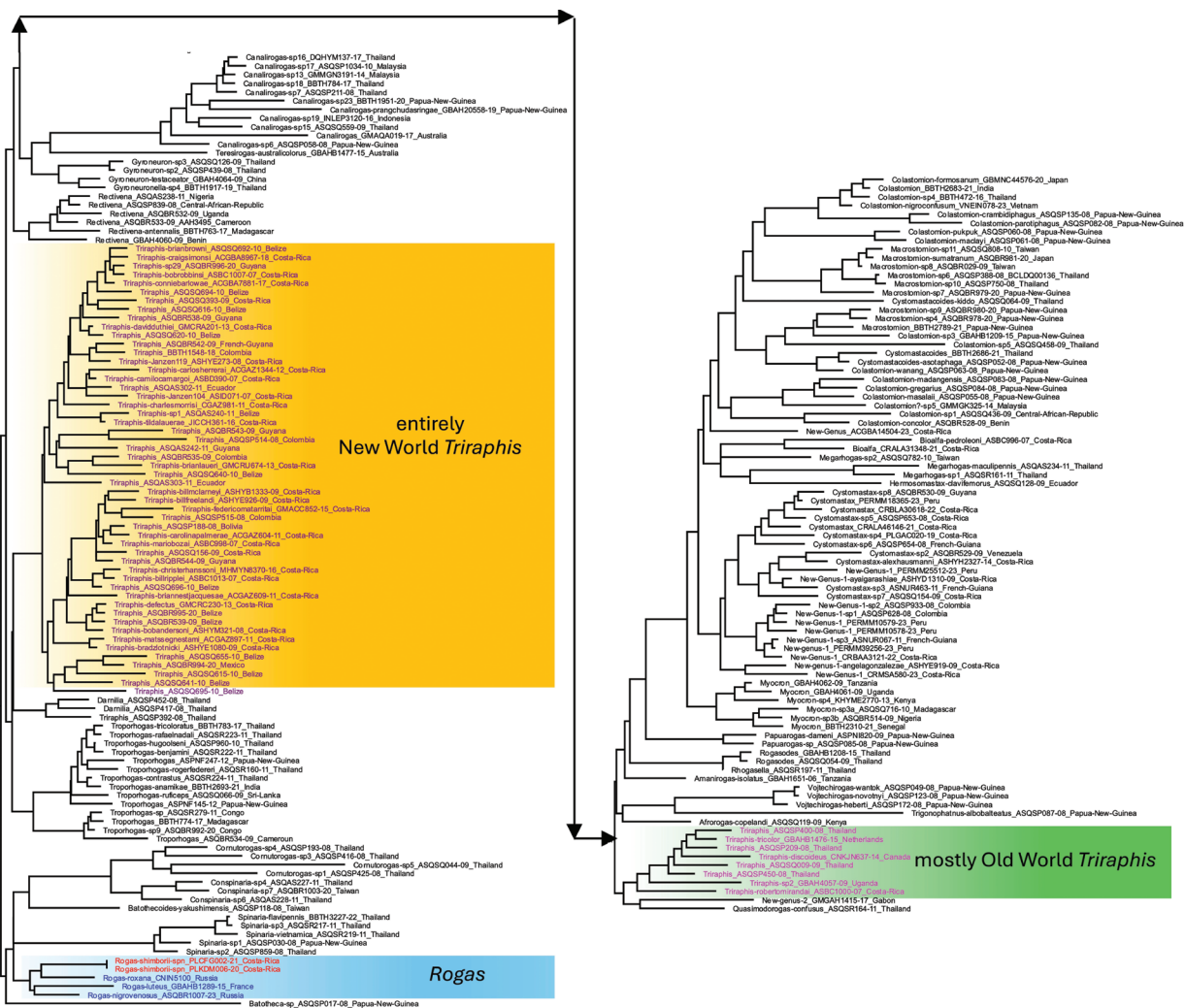


Figure 3. Maximum likelihood phylogenetic tree of the Rogadinae based on concatenated COI and 28S sequences.



## Discussion

Superficially, *R. shimborii* sp. nov. quite closely resembles New World *Triraphis* whose members quite frequently have the veins and adjacent wing membrane in the middle part of the forewing, black or darkened (Vale-rio and Shaw 2015; Sharkey et al. 2021; Jasso-Martínez et al. 2024). In light of this discovery of a typical “true” *Rogas* species in the New World region, it seems prudent that future studies of *Triraphis* proceed carefully with the new knowledge that both genera occur in the Americas.

## Acknowledgments

We are grateful to parataxonomist Guillermo Pereira for weekly servicing these PL-12 Malaise traps for seven years, and Scott R. Shaw (Wyoming) for helpful comments. All specimens were collected, exported and DNA barcoded under Costa Rican government permits issued to BioAlfa (Janzen and Hallwachs 2019) (R-054-2022-OT-CONAGEBIO; R-019-2019-CONAGEBIO; National Published Decree #41767), JICA-SAPI #0328497 (2014) and D.H.J. and W.H. (ACG-PI-036-2013; R-SINAC-ACG-PI-061-2021; Resolución N°001-2004 SINAC; PI-028-2021). D.L.J. Quicke was supported by the Rachadaphisek Somphot Fund for postdoctoral fellowship, Graduate School, Chulalongkorn University, Bangkok, Thailand. This research is supported by Thailand Science Research and Innovation Fund Chulalongkorn University and Chulalongkorn University, Rachadaphiseksomphot Fund (BCG\_FF\_68\_178\_2300\_039) to BAB.

## References

- Ashmead WH (1889) Descriptions of new Braconidae in the collection of the US National Museum. *Proceedings of the US National Museum* 11(1888): 611–671. <https://doi.org/10.5479/si.00963801.11-760.611>
- Belokobylskij SA (1996) Contribution to the knowledge of braconid fauna of the subfamily Rogadinae (Hymenoptera, Braconidae) of Russian Far East and eastern. Part 1. *Far Eastern Entomologist = Dal’nevostochnyi Entomolog* 27–28: 1–12.
- Broad GR (2021) Taxonomic changes in Ichneumonoidea (Hymenoptera), and notes on certain type specimens. *Zootaxa* 4941: 511–541. <https://doi.org/10.11646/zootaxa.4941.4.3>
- Butcher BA, Zaldivar-Riverón A, Van de Kamp T, Dos Santos Rolo T, Baumbach T, Quicke DLJ (2014) Extension of historical range of Betylobraconinae (Hymenoptera: Braconidae) into Palaearctic Region based on a Baltic amber fossil, and description of a new species of *Mesocentrus Szépligetii* from Papua New Guinea. *Zootaxa* 3860: 449–463. <https://doi.org/10.11646/zootaxa.3860.5.4>
- Chen X, He J (1997) Revision of the subfamily Rogadinae (Hymenoptera: Braconidae) from China. *Zoologische Verhandlungen Leiden* 308: 1–187.
- Cresson ET (1869) List of the North American species of the genus *Aleiodes* Wesm. *Transactions of the American Entomological Society* 2: 377–382. <https://doi.org/10.2307/25076223>
- Curtis J (1834) *British Entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland*, 11: 512.
- Foerster A (1862) *Synopsis der Familien und Gattungen der Braconen*. *Verhandlungen des naturhistorischen Vereines der preussischen Rheinlande und Westphalens* 19: 225–288.
- Gates MW, Lill JT, Kula RR, O’Hara JE, Wahl DB, Smith DR, Whitfield JB, Murphy SM, Stoepler TM (2012) Review of parasitoid wasps and flies (Hymenoptera Diptera) associated with Limacodidae (Lepidoptera) in North America with a key to genera. *Proceedings of the Entomological Society of Washington* 114: 24–110. <https://doi.org/10.4289/0013-8797.114.1.24>
- Gmelin JF (1790) *Caroli a Linne Systema Naturae* (Ed. XIII). Tom I., G.E. Beer. Lipsiae, 2225–3020. [Ichneumon 2674–2722]
- Gillespie JJ, Yoder MJ, Wharton RA (2005) Predicted secondary structure for 28S and 18S rRNA from Ichneumonoidea (Insecta: Hymenoptera: Apocrita): impact on sequence alignment and phylogeny estimation. *Journal of Molecular Evolution* 61: 114–137. <https://doi.org/10.1007/s00239-004-0246-x>
- Hebert PDN, Cywinska A, Ball SL, de Waard JR (2003) Biological identification through DNA barcodes. *Proceedings of the Royal Society of London Series A: Biological Sciences* 270: 96–99. <https://doi.org/10.1098/rspb.2002.2218>
- Jasso-Martínez JM, Quicke DLJ, Belokobylskij SA, Meza-Lázaro RM, Zaldivar-Riverón A (2020) Phylogenomics of the lepidopteran endoparasitoid wasp subfamily Rogadinae (Hymenoptera: Braconidae) and related subfamilies. *Systematic Entomology* 46: 83–95. <https://doi.org/10.1111/syen.12449>
- Jasso-Martínez JM, Martínez JJ, Aguilar-Velasco RG, Zaldivar-Riverón A (2024) 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. *European Journal of Taxonomy* 917: 50–73.
- Kozlov AM, Darriba D, Flouri T, Morel B, Stamatakis A (2019) RAXML-NG: A fast, scalable, and user-friendly tool for maximum likelihood phylogenetic inference. *Bioinformatics* 35: 4453–4455. <https://doi.org/10.1093/bioinformatics>
- Marsh PM (1979) Braconidae. In: Krombein KV, Hurd PD, Smith DR, Burks BD (Eds) *Catalog of Hymenoptera in America north of Mexico* 1: 144–313.
- Nees von ECG (1834) *Hymenopterorum Ichneumonibus affinium monographiae, genera Europaea et species illustrantes*. 1. Stuttgartiae et Tubingae, 320 pp.
- Quicke DLJ (2015) *The Braconid and Ichneumonid Parasitic Wasps: Biology, Systematics, Evolution and Ecology*. Wiley Blackwell, Oxford, 688 pp. <https://doi.org/10.1002/9781118907085>
- Quicke DLJ, Shaw MR (2006) First host records for the rogadine genera *Rogasodes* Chen and He and *Canalirogas* van Achterberg & Chen (Hymenoptera: Braconidae) with description of a new species and survey of mummy types within Rogadinae s.str. *Journal of Natural History* 39: 3525–3542.
- Quicke DLJ, Yen S-H, Mori M, Shaw MR (2003) First host records for the rogadine genus *Conspinarina* (Hymenoptera: Braconidae), and notes on Rogadinae as parasitoids of Zygaenidae (Lepidoptera). *Journal of Natural History* 38: 1437–1442. <https://doi.org/10.1080/00222930500392782>
- Quicke DLJ, Belokobylskij SA, Smith MA, Rota J, Hrcek J, Butcher BA (2016) A new genus of rhyssipoline wasp (Hymenoptera: Braconidae) with modified wing venation from Africa and Pap-

- ua New Guinea, parasitoid on Choreutidae (Lepidoptera). *Annales Zoologici* 66: 173–192. <https://doi.org/10.3161/00034541ANZ2016.66.2.003>
- Quicke DLJ, Ward DF, Belokobylskij SA, Butcher BA (2020) *Zealastoa* Quicke & Ward gen. nov., a new basal cyclostome genus of braconid wasp (Hymenoptera: Braconidae) from New Zealand. *Austral Entomology* 59: 455–466. <https://doi.org/10.1111/aen.12463>
- Quicke DLJ, Fagan-Jeffries EP, Jasso-Martínez JM, Zaldívar-Riverón A, Shaw MR, Butcher BA (2021) A molecular phylogeny of the parasitoid wasp subfamily Rogadinae (Hymenoptera: Ichneumonoidea: Braconidae) with descriptions of three new genera. *Systematic Entomology* 46: 1019–1044. <https://doi.org/10.1111/syen.12507>
- Ratnasingham S, Hebert PDN (2013) A DNA-based registry for all animal species: The Barcode Index Number (BIN) system. *PLoS ONE* 8(7): e66213. <https://doi.org/10.1371/journal.pone.0066213>
- Ruthe JF (1855) Beiträge zur Kenntnis der Braconiden. *Stettiner Entomologische Zeitung* 16: 291–294.
- Sharkey MJ, Wharton RA (1997) Morphology and terminology. In: Wharton RA, Marsh PM, Sharkey MJ (Eds) *Identification manual to the New World genera of Braconidae*. Special Publication of the International Society of Hymenopterists 1: 19–37.
- Sharkey MJ, Janzen DH, Hallwachs W, Chapman EG, Smith MA, Dapkey T, Brown A, Ratnasingham S, Naik S, Manjunat R, Perez K, Milton M, Hebert PDN, Shaw SR, Kittel RN, Solis A, Metz M, Goldstein PZ, Brown JW, Quicke DLJ, van Achterberg C, Brown BV, Burns JM (2021) Minimalist revision and description of 411 new species in 11 subfamilies of Costa Rican braconid parasitic wasps, including host records. *Zootaxa* 1013: 1–665. <https://doi.org/10.3897/zookeys.1013.55600>
- Sharkey MJ, Athey KJ, Fernández-Triana JL, Pentead-Dias AM, Monckton SK, Quicke DLJ (2023) Key to the New World subfamilies of the family Braconidae (Hymenoptera: Ichneumonoidea). *Canadian Journal of Arthropod Identification* 49: 1–43.
- Sharkey MJ, Quicke DLJ, Shaw SR, van Achterberg C, Shimbori E (in prep.) Key to the New World genera of the subfamily Rogadinae (Hymenoptera: Ichneumonoidea: Braconidae) and synopses of the genera. *Canadian Journal of Arthropod Identification*.
- Shaw SR (1997) Subfamily Rogadinae s.s. In: Wharton RA, Marsh PM, Sharkey MJ (Eds) *Manual of the New World genera of the family Braconidae* (Hymenoptera). No. 1. Special publication of the International Society of Hymenopterists, 403–412.
- Shaw SR, Marsh PM, Fortier JC (1998) Revision of North American *Aleiodes* Wesmael (Part 2): the *apicalis* (Brullé) species-group in the New World (Hymenoptera: Braconidae, Rogadinae). *Journal of Hymenoptera Research* 7: 62–73.
- Shenefelt RD (1975) Braconidae 8, Exothecinae and Rogadinae. Part 12. In: van der Vecht J, Shenefelt RD (Eds) *Hymenoptera Catalogus*, Junk, The Hague, 1115–1262.
- Shimbori EM, Martínez JJ (2016) *Aleiodes* Wesmael (Hymenoptera, Braconidae, Rogadinae) species described by Brèthes: Taxonomic clarification. *Studies on Neotropical Fauna and Environment* 51: 128–134. <https://doi.org/10.1080/01650521.2016.1198587>
- Shimbori EM, Castañeda-Osorio R, Jasso-Martínez JM, Pentead-Dias AM, Gadelha SS, Quicke DLJ, Kula RR, Zaldívar-Riverón A (2024) UCE-based phylogenomics of the lepidopteran endoparasitoid wasp subfamily Rogadinae (Hymenoptera: Braconidae) unveils a new Neotropical tribe. *Invertebrate Systematics* 38: IS24040. <https://doi.org/10.1071/IS24040>
- Telenga NA (1941) Family Braconidae, subfamily Braconinae (continuation) and Sigalphinae. *Fauna USSR. Hymenoptera* 5(3): 1–466.
- Valerio AA (2006) Some taxonomic notes on named *Rogas* Nees species (Hymenoptera: Braconidae: Rogadinae) for the New World. *Methods in Ecology and Systematics* 1: 37–46.
- Valerio AA, Shaw SR (2015) Thirteen new Costa Rican species belonging to the genus *Triraphis* Ruthe (Braconidae: Rogadinae) with their host records. *Zootaxa* 3904: 501–540. <https://doi.org/10.11646/zootaxa.3904.4.2>
- van Achterberg C (1988) Revision of the subfamily Blacinae Foerster (Hymenoptera: Braconidae). *Zoologische Verhandelingen Leiden* 249: 1–324.
- van Achterberg C (1991) Revision of the genera of the Afrotropical and W. Palaearctic Rogadinae Foerster (Hymenoptera: Braconidae). *Zoologische Verhandelingen Leiden* 273: 1–102.
- Vojnovskaja-Krieger T (1935) Neue Braconiden-Arten aus der UdSSR. *Entomologicheskoye Obozreniye* 25: 304.
- Watanabe C (1937) Contribution to the knowledge of braconid fauna of the Empire of Japan (Hymenoptera). *Journal of the Faculty of Agriculture. Hokkaido Imperial University* 42: 1–188.
- Wesmael C (1838) *Monographie des Braconides de Belgique* 4. *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-lettres de Bruxelles* 11: 1–166. <https://doi.org/10.3406/marb.1837.2702>
- Zaldívar-Riverón A, Areekul B, Shaw MR, Quicke DLJ (2004) Comparative morphology of the venom apparatus in the braconid wasp subfamily Rogadinae (Insecta, Hymenoptera, Braconidae) and related taxa. *Zoologica Scripta* 33: 223–238. <https://doi.org/10.1111/j.0300-3256.2004.00144.x>