

Synopsis of New World Sigalphinae (Hymenoptera, Braconidae) with the description of two new species and a key to genera

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Abstract

We describe and illustrate *Paphanus paloi* sp. n., first generic record for Brazil, and *Minanga patriciamadrigalae*, first generic record for Costa Rica. We present illustrated keys for the New World genera of Sigalphinae, and the New World species of *Paphanus* and *Minanga*. *Minanga patriciamadrigalae* sp. n. was reared from caterpillars of *Chloropteryx nordicaria*DHJ01 (Geometridae).

Keywords

Neotropical, taxonomy, Costa Rica, Brazil, *Minanga*, *Paphanus*

Introduction

Though rarely collected, members of Sigalphinae Blanchard, 1845 are worldwide in distribution (van Achterberg 1985; Iqbal and Austin 2002; Sharkey 2004; Tan et al. 2010; Sharkey and Braet 2012; Braet 2014). The subfamily includes eight genera

(*Acampsis* Wesmael, 1835; *Aposigalphus* van Achterberg & Austin, 1992; *Malasigalphus* van Achterberg & Austin, 1992; *Minanga* Cameron, 1906; *Notosigalphus* van Achterberg & Austin, 1992; *Paphanus* van Achterberg & Riedel, 2009; *Pselaphanus* Szépligeti, 1902; and *Sigalphus* Latreille, 1802) with fewer than 50 described species, all of which are presumably koinobiont endoparasitoids of Lepidoptera larvae (Yu et al. 2016).

Shaw and Quicke (2000) presented a detailed description of the biology and immature stages of *Acampsis alternipes* (Nees). Their major findings include the following. Eggs are placed in host ganglia; early instars are attacked; the first parasitoid instar is polypodiform; and the final instar larvae feed externally on the host.

Sigalphus bicolor is reported as a gregarious, multivoltine parasitoid of *Acronicta clarescens* Cuenée (Noctuidae); first instar larvae are parasitized, and parasitoid cocoons are spun within the host cocoon (Cushman 1913). *Sigalphus romeroi* Sharkey from Costa Rica and *S. irrorator* (Fabricius) from the Palearctic are solitary endoparasitoids of Noctuidae (Sharkey and Janzen 1995) that cut a pupal chamber into rotten wood, in which the parasitoid spins its cocoon that looks much like that of *Minanga* (Fig. 3B). Yu et al. (2016) list all host records for members of Sigalphinae taken from the literature. Some of these may be erroneous from the source. Here we elucidate the biology of a species of *Minanga* for the first time.

Methods

Morphological terms

Metasomal median tergites are abbreviated as follows, T1 = metasomal median tergite 1, T2 = metasomal median tergite 2. T2–3 = metasomal median syntergite 2+3. Morphological terms used can be found in the Hymenoptera Anatomy Ontology (HAO) (Yoder et al. 2010). To find definitions for any structure search for the term at <http://glossary.hymao.org>.

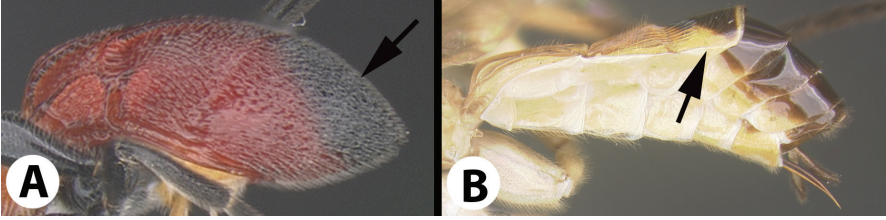
Museum acronyms

DCBU	Collection of the Departamento de Ecologia e Biologia Evolutiva, Universidade Federal de São Carlos, São Carlos, SP, Brazil.
NHMUK	The Natural History Museum, London, UK;
HNHM	Hungarian Natural History Museum, Budapest, Hungary.
NBCN	Naturalis Biodiversity Center, Leiden, The Netherlands.
MNHN	Muséum National d’Histoire Naturelle, Paris, France.
HIC	The Hymenoptera Institute, 116 Franklin Ave., Redlands, California 92373, USA.
EMUS	The Entomological Museum of Utah State University, Logan, Utah, USA.

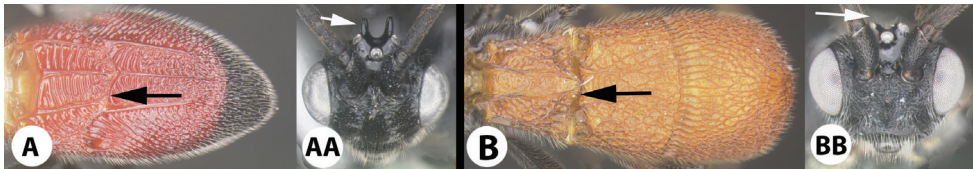
Taxonomy

Key to new world genera of Sigalphinae

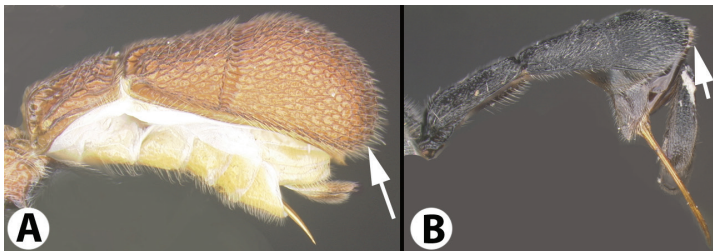
- 1 **A.** Metasomal terga 1–3 forming carapace covering entire metasoma, tergum 4 not visible dorsally **2**
- **B.** Metasomal terga 1–3 not forming carapace covering entire metasoma, tergum 4 visible dorsally **4**



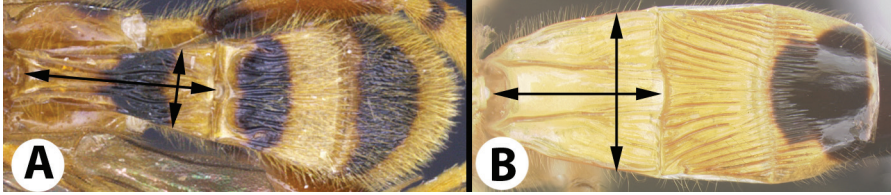
- 2 **A** Joint between terga 1 and 2 fused, not articulating. **AA.** Head with a pair of horns posterior to lateral ocelli or posterior to genae *Minanga* Cameron, 1906
- **B.** Joint between terga 1 and 2 articulating, not fused. **BB.** Head lacking horns **3**



- 3 **A.** Third tergum curved ventrad such that it is visible in posterior view *Sigalphus* Latreille, 1802
- **B.** Third tergum not curved ventrad, comparatively flat and not visible in posterior view *Acampsis* Wesmael, 1835



- 4 A. Median tergite 1 much longer than wide; third median tergite completely sculptured..... *Paphanus*
- B. Median tergite 1 almost as long as wide; third median tergite smooth in the posterior half..... *Pselaphanus Szépligeti, 1902*

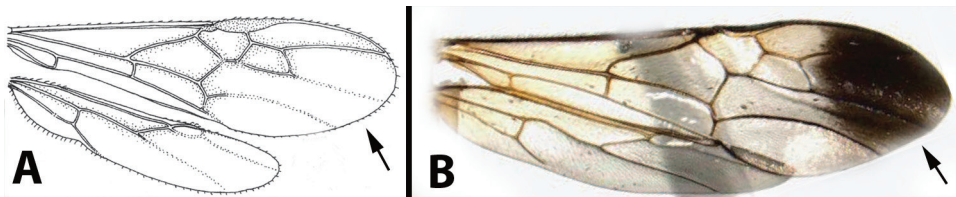


***Paphanus* van Achterberg & Riedel, 2009**

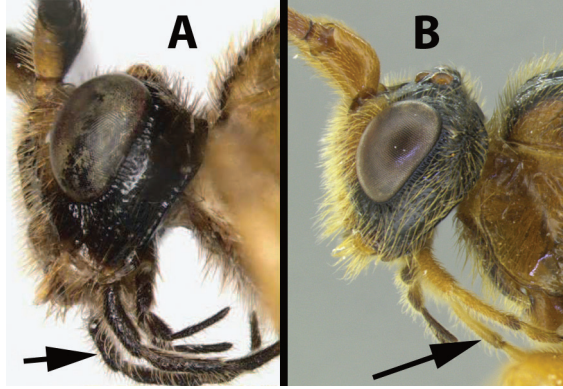
Van Achterberg and Riedel (2009) proposed the genus *Paphanus* (Sigalphinae: Pselaphanini) and described one species, *P. drechseli* van Achterberg & Riedel, 2009, from Paraguay. Subsequently, *P. priscillae* Braet, 2014 was described from French Guiana. Studying the material collected in the Northwest of São Paulo State, Brazil, we found many specimens of a third species of *Paphanus*. This is the first record of the genus in Brazil. The biology of members of *Paphanus* is unknown, although they can be presumed to be koinobiont endoparasitoids of lepidopteran larvae.

Key to species of the genus *Paphanus* van Achterberg

- 1 A. Fore wing lacking an infusate apex (Image modified from van Achterberg and Riedel 2009) *P. drechseli*
- B. Fore wing with a distinctly infusate apex (Image modified from Braet, 2014)..... 2



- 2 **A.** maxillary palpi entirely black. (Image modified from Braet 2014) *P. priscillae*
 – **B.** Maxillary palpi mostly yellow..... *P. paloi* sp.n.



***Paphanus paloi* Pentead-Dias, sp. n.**

<http://zoobank.org/E17B3A96-C6FD-41D1-A444-F9BB538A0C2A>

Fig. 1A–F

Diagnosis. Lengths: body 10.0 mm, fore wing 9.3 mm. The following characters separate this species from *P. drechseli* van Achterberg & Riedel, 2009: fore wing membrane yellowish, infuscate apically, not infuscate near veins and hind wing yellowish with vein 1-M sinuous. The following characters separate this species from *P. priscillae* Braet, 2014: hind coxa yellowish with darkened patch, 1-cu-a of fore wing postfurcal, scutellum not protruding in lateral view and length of first tergite more than 1.8 times the apical width. The following characters separate this species from both *P. drechseli* and *P. priscillae*: face largely rugulose, notauli crenulate.

Male. Unknown

Hosts. Unknown.

Type material. Holotype: ♀ (DCBU 264287), “Magda, SP, Brasil, Fazenda São Francisco BIOTA NOROESTE, 05.XII.2007, Malaise trap, S20 28’25 W50 17’36”, F. Noll coll.. **Paratypes:** 50 ♀♀ (DCBU 264297 – DCBU 264346) same data as holotype except date, 16.X.2007. Same data as holotype, 9 ♀♀ (DCBU 264288 to DCBU 264296), 2 ♀♀ (NHMUK), 2 ♀♀ (HNHM), 2 ♀♀ (NBCN), 2 ♀♀ (HIC), 2 ♀♀ (EMUS), 3 ♀♀ (MNHN).

Etymology. Named in memoriam of our friend, Haroldo Palo Jr., for his work as a photographer and naturalist.

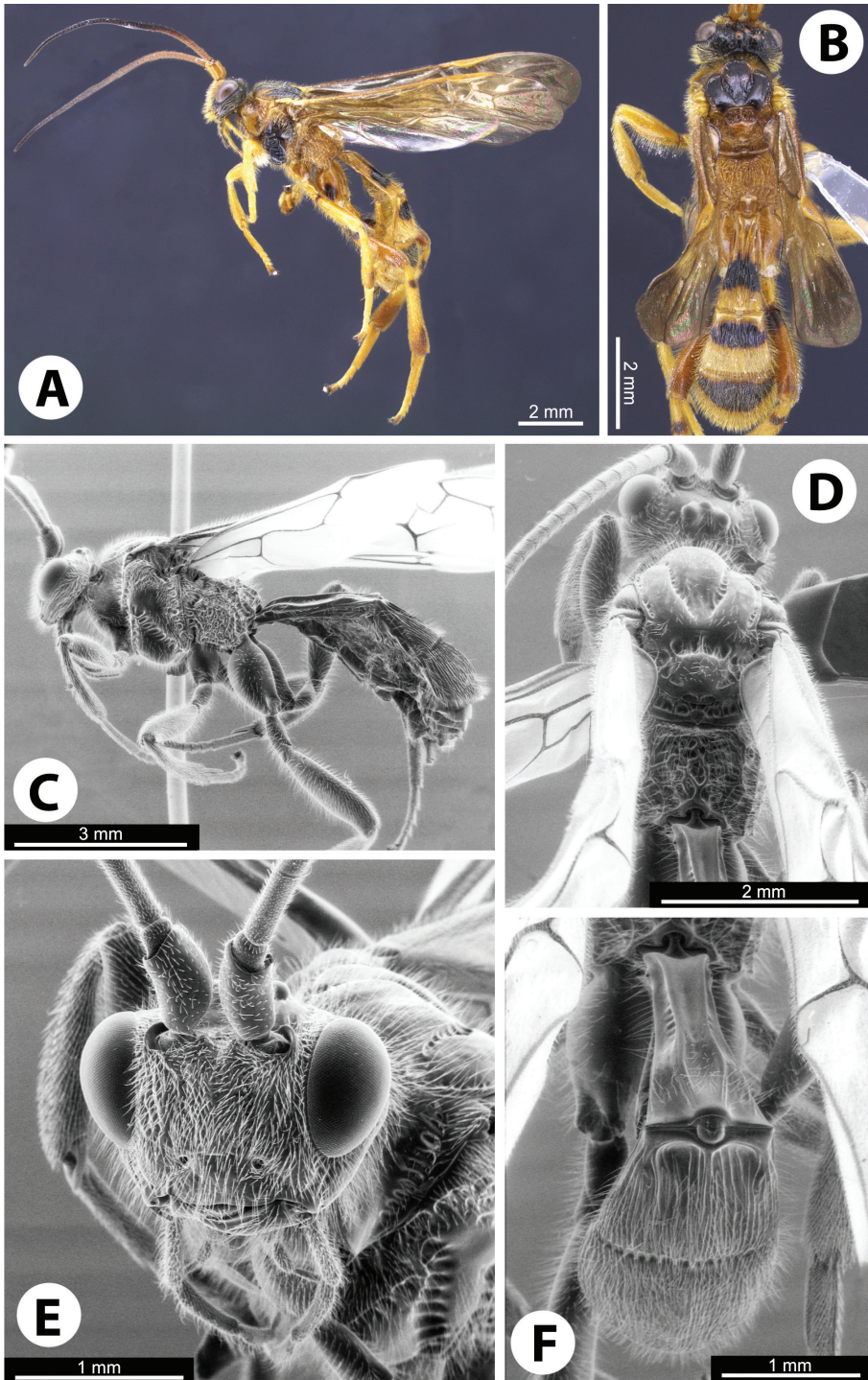


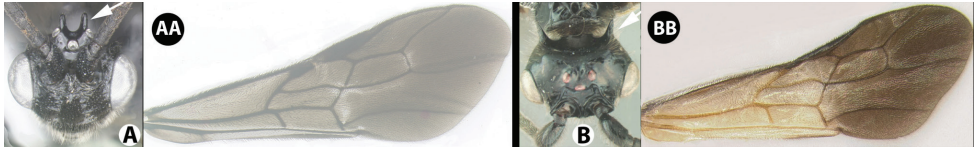
Figure 1. *Paphanus paloi*: **A** Lateral habitus **B** Dorsal habitus **C** Lateral habitus **D** Dorsal head and mesosoma **E** Anterior head **F** Dorsal metasoma.

***Minanga* Cameron, 1906**

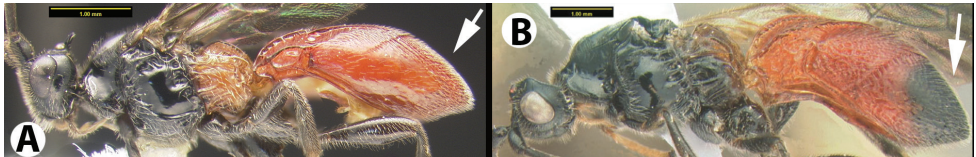
Minanga includes 11 species. Three species, including the species proposed here, are found in the New World, whilst the remaining are in the Oriental and Afrotropical realms. Before this account, no hosts or life-history information were known for members of the genus.

Key to New World species of *Minanga*

- 1 **A.** Horns of head directed dorsally and situated directly posterior to lateral ocelli. **AA.** Fore wing entirely infusate **2**
 – **B.** Horns of head directed posteriorly and situated on lateral occiput. **BB.** Fore wing yellow basally, infusate apically..... *Minanga angelus*



- 2 **A.** Metasoma completely reddish-orange..... *Minanga achterbergi*
 – **B.** Metasoma melanic apically..... *Minanga patriciamadrigalae* sp. n.

***Minanga patriciamadrigalae* Sharkey, sp.n.**

<http://zoobank.org/74324E0B-7051-4E8F-A76A-FFED7F67BE64>

Figs 2 A–F, 3B

Diagnosis (male and female). Similar to *M. achterbergi* but easily separated with the following character states and those in the key. Anterolateral areas of metasomal carapace: smooth in *M. achterbergi*, rugose in *M. patriciamadrigalae*. Medial longitudinal carinae of propodeum: absent in *M. achterbergi*, present in *M. patriciamadrigalae*. Number of depressions in scutellar sulcus: two in *M. achterbergi*, four in *M. patriciamadrigalae*. Medial longitudinal carinae of T2: absent in *M. achterbergi*, present in *M. patriciamadrigalae*. Body length: 5.2 mm. *M. achterbergi*, 7.5 mm. *M. patriciamadrigalae*. Metapleuron color: orange in *M. achterbergi*, melanic in *M. patriciamadrigalae*.

Host/Biology. There are hundreds of species of thin “green twig” species of Geometridae in Area de Conservación Guanacaste (Janzen and Hallwachs 2016), and

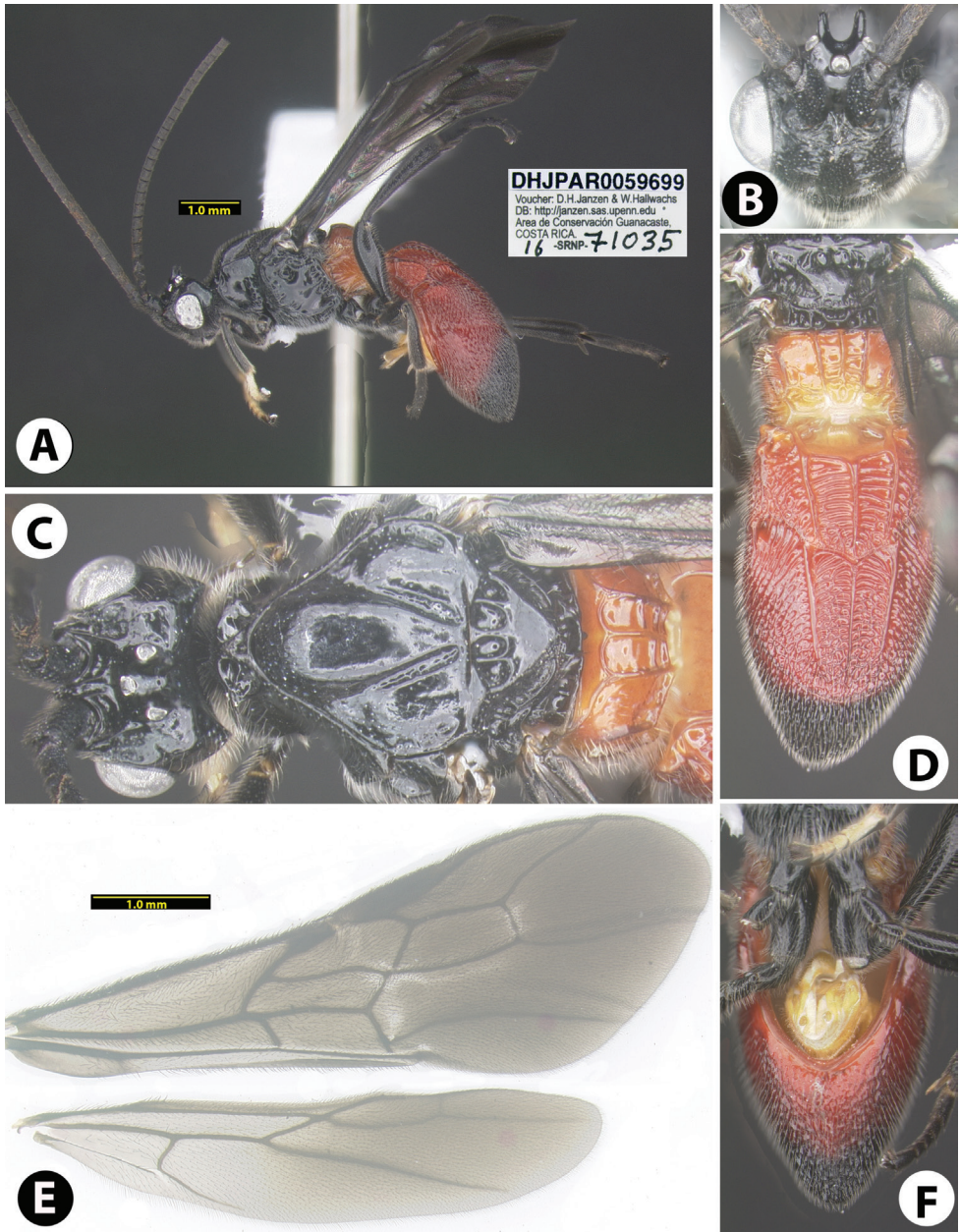


Figure 2. *Minanga patriciamadrigalae*, holotype male **A** Lateral habitus **B** Anterodorsal view of head **C** Dorsal head and mesosoma **D** Dorsal scutellum, propodeum, and metasoma **E** Wings **F** Ventral metasoma.

the host of *M. patriciamadrigalae* (15-SRNP-70988-DHJ727460.jpg) is one of them. As is the case with many of this life form of geometrid caterpillar, its cocoon is merely a flap of lightly-silked green leaf; the larva of *M. patriciamadrigalae* emerges from the prepupal caterpillar in this flimsy cocoon and spins its own rust-colored ovoid tough

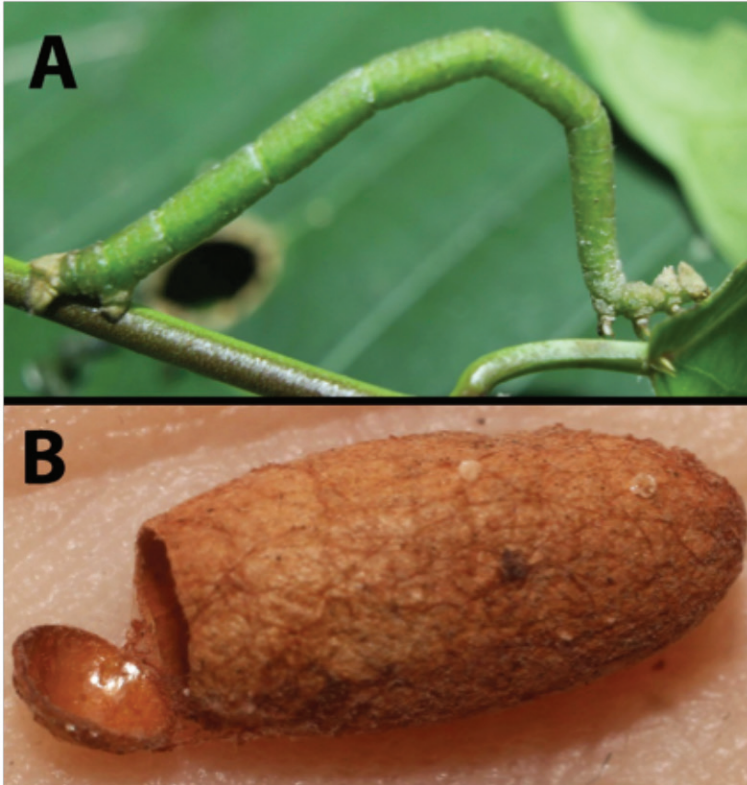


Figure 3. **A** *Chloropteryx nordicaria*DHJ01, host caterpillar of *Minanga patriciamadrigalae* **B** Cocoon of *Minanga patriciamadrigalae*.

cocoon inside the geometrid's cocoon (Fig. 3B). The duration of the wasp cocoon in its rain forest habitat is about 15 days. The host *Chloropteryx nordicaria*DHJ01 feeds on just one species of herbaceous vine Asclepiadaceae (*Blepharodendron mucronatum*). There have been 7 rearings of wild-caught caterpillars over two years, 2 of which had been parasitized. What have been identified as *Chloropteryx nordicaria* (Schaus, 1901), based on their very similar morphological appearance, are in fact two species as demonstrated by their very different DNA barcodes; *Chloropteryx nordicaria*DHJ02 has only been taken with light traps in the same forest and to date the caterpillar has not been located.

Since adults of both species of “*Chloropteryx nordicaria*” occur in ACG early secondary succession, moist rain forest at mid-elevations, year-round, it is not surprising that the caterpillars have been found in May, July and October. Both species are probably multivoltine, as are likely their parasitoids as well.

Etymology. *Minanga patriciamadrigalae* is named for Sra. Patricia Madrigal Cordero, Vice-Ministra of the Ministerio de Ambiente y Energía (MINAE) of Costa Rica, in recognition of her facilitation of the mutualism between Area de Conservación Guanacaste of MINAE and the Instituto Costarricense de Electricidad (ICE) in 2019–2020.

Material Examined. Holotype male, Costa Rica, Area de Conservación Guanacaste, Guanacaste, Sector Pitilla, Coneja, 415 m., latitude: 11.01525, longitude: -85.3977, Dinia Martinez, reared from a caterpillar of *Chloropteryx nordicaria*DHJ01 (Geometridae) (Fig. 3A) feeding on *Blepharodon mucronatum* (Asclepiadaceae), host collection date = 14.vii.2016, host prepupal on 07/19/2016, parasitoid eclosion date = 9.viii.2016, parasitoid voucher = DHJPAR0059699, from deceased caterpillar voucher 16-SRNP-71035 (EMUS). Paratype female, same data as holotype except: eclosion date is 08/09/2016 and caterpillar was prepupal on 22.vii.2016, parasitoid voucher = DHJPAR0059700, from caterpillar voucher 16-SRNP-71036 (HIC).

Acknowledgements

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References

- Achterberg C van (1985) The systematic position of the genera *Ecnomios* Mason and *Pselaphanus* Szépligeti (Hymenoptera: Braconidae). Zoologische Mededelingen Leiden 59: 34–348.
- Achterberg C van, Riedel M (2009) *Paphanus drechseli* gen. nov. & spec. nov. (Hymenoptera: Braconidae: Sigalphinae: Pselaphanini) from Paraguay Zoologische Mededelingen Leiden 83(23): 799–804.
- Braet Y (2014) Discovery of a second species of the rare Neotropical genus *Paphanus* van Achterberg & Riedel, 2009 (Braconidae: Sigalphinae), and a new record for *Nervellius philippus* Braet, 2014 (Braconidae: Doryctinae). Bulletin de la Société royale belge d'Entomologie / Bulletin van de Koninklijke Belgische Vereniging voor Entomologie 150: 149–154. <https://doi.org/10.1046/j.1440-6055.2002.00281.x>
- Cushman RA (1913) Biological notes on a few rare or little known parasitic Hymenoptera. Proceedings of the entomological Society of Washington 15: 153–161.
- Iqbal M, Austin AD (2002) New species of the Australian endemic wasp genus *Notosigalphus* van Achterberg and Austin (Hymenoptera: Braconidae) from Flinders Island, Tasmania. Australian Journal of Entomology 41: 149–154.

- Janzen DH, Hallwachs W (2016) DNA barcoding the Lepidoptera inventory of a large complex tropical conserved wildland, Area de Conservación Guanacaste, northwestern Costa Rica. *Genome* 59: 641–660. <https://doi.org/10.1139/gen-2016-0005>.
- Sharkey MJ, Braet Y (2012) New species of the rare genera *Dentigaster* Zettel, 1990 (Hymenoptera, Braconidae, Cheloniinae) and *Minanga* Cameron, 1906 (Sigalphinae) from French Guiana. *Journal of Hymenoptera Research* 25: 93–102. <https://doi.org/10.3897/jhr.25.2519>
- Sharkey MJ, Janzen DH (1995) Review of the world species of *Sigalphus* (Hymenoptera, Braconidae: Sigalphinae) and biology of *Sigalphus romeroi*, new species. *Journal of Hymenoptera Research* 4: 99–109.
- Shaw MR, Quicke DLJ (2000) The biology and early stages of *Acampsis alternipes* (Nees), with comments on the relationships of the Sigalphinae (Hymenoptera: Braconidae). *Journal of Natural History* 34: 611–628. <https://doi.org/10.1080/002229300299471>
- Tan JL, He JH, Chen XX (2010) The Genus *Minanga* Cameron (Hymenoptera: Braconidae) in China, with description of a new subgenus and species. *Annals of the Entomological Society of America*, 103(3): 360–365. <https://doi.org/10.1603/AN10001>
- Yoder MJ, Mikó I, Seltmann KC, Bertone MA, Deans AR (2010) A gross anatomy ontology for Hymenoptera. *PLoS ONE* 5(12): e15991. <http://dx.doi.org/10.1371/journal.pone.0015991>
- Yu DSK, Acterberg C van, Horstmann K (2016) Taxonomy, Biology, Morphology and Distribution, Ottawa, Taxapad 2016, World Ichneumonoidea. <http://www.taxapad.com> [On USB flash drive]