

## Research article

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# Four new species of *Hecabolus* Curtis, 1834 (Braconidae, Doryctinae) from south and southwestern Brazil, with notes on the morphological variation and geographic distribution of *H. mexicanus* Zaldívar-Riverón & Belokobylskij, 2009

Rubén CASTAÑEDA-OSORIO<sup>1</sup>, Sergey A. BELOKOBYSKIJ<sup>2</sup> &  
Alejandro ZALDÍVAR-RIVERÓN<sup>3,\*</sup>

<sup>1,3</sup>Colección Nacional de Insectos, Instituto de Biología, Universidad Nacional Autónoma de México, 3<sup>er</sup> circuito exterior s/n, Ciudad Universitaria, Coyoacán, A.P. 70–233, C.P. 04510, Ciudad de México, México.

<sup>1</sup>Posgrado en Ciencias Biológicas, Unidad de posgrado, Edificio A, 1<sup>er</sup> piso, Circuito de Posgrados, Universidad Nacional Autónoma de México, Ciudad de México, México.

<sup>2</sup>Zoological Institute of the Russian Academy of Sciences, Universitetskaya naberezhnaya 1, St Petersburg, Russia.

\*Corresponding author: [azaldivar@ib.unam.mx](mailto:azaldivar@ib.unam.mx)

<sup>1</sup>Email: [ruben.castaneda@st.ib.unam.mx](mailto:ruben.castaneda@st.ib.unam.mx)

<sup>2</sup>Email: [doryctes@gmail.com](mailto:doryctes@gmail.com)

<sup>1</sup>urn:lsid:zoobank.org:author:1F7F62A3-3F42-4FF6-B955-EED6628037F8

<sup>2</sup>urn:lsid:zoobank.org:author:13EDEDEF-68BA-430B-8FC3-0096874859AB

<sup>3</sup>urn:lsid:zoobank.org:author:B6E09990-6CA5-403F-AC3F-9498DBB5BEDF

**Abstract.** Four new species of the braconid wasp genus *Hecabolus* Curtis, 1834 (Doryctinae Foerster, 1863) are described for the Neotropical region in south and southwestern Brazil: *H. acutus* sp. nov., *H. chrisaxeli* sp. nov., *H. gavinbroadi* sp. nov., and *H. transversalis* sp. nov. We also report the morphological variation of females and males of *H. mexicanus* Zaldívar-Riverón & Belokobylskij, 2009, originally described based on a single female, and provide its first precise geographical distribution records. An updated key to the 13 described species of *Hecabolus* is provided.

**Keywords.** New species, parasitoid wasp, Hecabolini, Hymenoptera, Apocrita.

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## Introduction

*Hecabolus* Curtis, 1834 is a braconid genus that belongs to the speciose, cosmopolitan subfamily Doryctinae, and currently contains nine recognized species (Sormus de Castro *et al.* 2013). This genus

was originally described from Europe in the 19<sup>th</sup> century based on its type species, *H. sulcatus* Curtis, 1834, which is currently known to be widely distributed across the western Palaearctic, and in Arizona, California, Colorado and Florida, USA, in the south of the Nearctic region (Shenefelt & Marsh 1976; Marsh 2002; Zaldívar-Riverón & Belokobylskij 2009). It was not until the early 21<sup>st</sup> century that a second species of *Hecabolus*, *H. costaricensis* Marsh, 2002, was described and the genus was recorded for the first time in the Neotropical region in Costa Rica (Marsh 2002). More recently, six Neotropical species were described from Mexico and Brazil (Zaldívar-Riverón & Belokobylskij 2009; Sormus de Castro *et al.* 2013), showing that the species richness of *Hecabolus* is apparently higher in this region than in the Old World.

Scientific museum collections have proved to be of great importance for biodiversity studies, as they house historical biological material that can be consulted to corroborate identifications and for descriptions of new taxa (e.g., Kemp 2015; Meineke *et al.* 2018; Rainbow 2019). This historical material is usually not accurately labelled, with the locality details being imprecise or incomplete. This was the case for *H. mexicanus* Zaldívar-Riverón & Belokobylskij, 2009, the second species of *Hecabolus* described for the Neotropics, which was erected based on a single female collected in the early 20<sup>th</sup> century with imprecise locality data, only labelled as “Mexico; Mendico” (Zaldívar-Riverón & Belokobylskij 2009).

During an examination of unidentified material collected in the middle of the 20<sup>th</sup> century by Fritz Plaumann that is deposited at the Natural History Museum, London, UK, we discovered four new species of *Hecabolus* from south and southwestern Brazil. Here, we describe these new species, for the first time provide precise locality records for *H. mexicanus*, as well as external morphological variation of specimens that were recently collected in Mexico. We also provide a key to the 13 recognised species of *Hecabolus*.

## Material and methods

### Specimens examined

Twenty-nine specimens from Brazil (including holotypes of the new species) assigned to *Hecabolus* and deposited in the Natural History Museum, London, UK (NHMUK), were examined. These specimens were collected between April 1937 and October 1956 by the German entomologist Fritz Plaumann in Nova Teutonia, municipality of Seara in the state of Santa Catarina and in Rio Caraguata in the state of Mato Grosso, Brazil. We also examined specimens collected at three different localities in Mexico that were deposited in the Colección Nacional de Insectos, Instituto de Biología, Universidad Nacional Autónoma de México (CNIN-IBUNAM).

Digital colour photographs of representative specimens of each of the described species and of *H. mexicanus* were taken and edited with a Leica® Z16 APO-A stereoscopic microscope, a Leica® DFC490 camera and the Leica Application Suite® program (LAS) version 4.3.0 at IBUNAM. Morphological terminology follows Sharkey & Wharton (1997), except for terminology for the surface sculpture and wing venation, which follows Marsh (2002). The term “sternaulus” was replaced by “precoxal sulcus” following Wharton (2006).

### Abbreviations for morphological terms

POL = postocellar line  
OOL = ocular-ocellar line  
Od = maximum diameter of lateral ocellus

### Abbreviations used for the world’s biogeographic regions

NA = Nearctic region

NT = Neotropical region

PA = Palaeartic region

## Results

### Taxonomy

Class Insecta Linnaeus, 1758  
Order Hymenoptera Linnaeus, 1758  
Family Braconidae Nees, 1811  
Subfamily Doryctinae Foerster, 1863

Genus *Hecabolus* Curtis, 1834

*Hecabolus* Curtis, 1834: 507.

*Anisopelma* Wesmael, 1838: 134 (type species: *A. belgicum* Wesmael, 1838).

### Type species

*Hecabolus sulcatus* Curtis, 1834.

### Diagnosis

The main diagnostic characters that define the genus *Hecabolus* are an open first subdiscal cell, absence of vein r-m, antefurcal position of m-cu vein, and a distinctly wide hind femur (Tobias 1971, 1976; Marsh 2002). Other diagnostic features that have been proposed for *Hecabolus* are the hind coxa distinctly protruding forward and without a ventro-anterior tooth, and a deep and wide mesosternal suture (Belokobylskij & Tobias 1995).

### Composition

*Hecabolus acutus* sp. nov. (NT); *H. assis* Sormus de Castro & Zaldívar-Riverón, 2013 (NT); *H. chrisaxeli* sp. nov. (NT); *H. costaricensis* (NT); *H. gavinbroadi* sp. nov. (NT); *H. julianoi* Sormus de Castro & Zaldívar-Riverón, 2013 (NT); *H. mexicanus* (NT); *H. robustus* Zaldívar-Riverón & Sormus de Castro, 2013 (NT); *H. semiaridus* Sormus de Castro, Zaldívar-Riverón & Briceño, 2013 (NT); *H. shimborii* Sormus de Castro & Zaldívar-Riverón, 2013 (NT); *H. sulcatus* (NA, PA); *H. sulmatogrossensis* Sormus de Castro & Zaldívar-Riverón, 2013 (NT); *H. transversalis* sp. nov. (NT).

### Hosts

The type species, *H. sulcatus*, has been recorded to be an idiobiont ectoparasitoid of coleopteran larvae of the families Anobiidae Fleming, 1821 (Elliot & Morley 1911; Györfi 1941; Thompson 1953; Stary 1957; Hickin 1961; Tobias 1976; Belokobylskij & Tobias 1986; Zaldívar-Riverón & Belokobylskij 2009); Buprestidae Leach, 1815 (Halperin 1986); Cerambycidae Latreille, 1802 (Kolubajiv 1962); Chrysomelidae Latreille, 1802 (Belokobylskij & Tobias 1986); Curculionidae Latreille, 1802 (Marshall 1897; Mantero 1904; de Gaulle 1907; Kleine 1909; Györfi 1943; Čapek 1960; Kolubajiv 1962; Belokobylskij & Tobias 1986; Hedqvist 1998); Lyctidae Billberg, 1820 (Donisthorpe 1940); and Ptinidae Latreille, 1802 (Rondani 1871; Marshall 1885; Mantero 1904; de Gaulle 1907; Elliot & Morley 1907, 1911; Rudow 1918; Leonardi 1926; Hellén 1927; Cotton & Good 1937; Telenga 1941; Thompson 1953; Stary 1957; Wegelius 1959; Tobias 1976; Čapek 1982; Belokobylskij & Tobias 1986; Zaldívar-Riverón & Belokobylskij 2009).

### Distribution

Nearctic, Neotropical and Palaeartic regions.

**Key to all described species of *Hecabolus* Curtis, 1834**

1. Basal sternal plate (acrosternite) of first metasomal segment  $\leq 0.4 \times$  length of tergite ..... 2
  - Basal sternal plate (acrosternite) of first metasomal segment  $> 0.4 \times$  length of tergite..... 5
2. Vertex at least partially striate; hind femur of female moderately swollen,  $2.7\text{--}3.5 \times$  its maximum width ..... 3
  - Vertex smooth; hind femur of female considerably swollen,  $2.0\text{--}2.2 \times$  its maximum width..... 4
3. Median lobe of mesoscutum without antero-lateral pointed edges above notauli; prescutellar depression with 3–5 carinae; propodeum without defined carinae; first metasomal tergite without defined lateral carinae; second metasomal tergite entirely striate, with wide and shallow baso-lateral subparallel depressions ..... *H. sulcatus* Curtis, 1834
  - Median lobe of mesoscutum with antero-lateral pointed edges above notauli; prescutellar depression with 10–12 carinae; propodeum with a median irregular carinae; first metasomal tergite with two defined lateral longitudinal carinae; second metasomal tergite entirely smooth, without depression ..... *H. acutus* sp. nov.
4. First and second tergites entirely and third tergite partially striate, remaining area of third tergite and following tergites smooth and polished; lateral area of pronotum weakly rugose ..... *H. assis* Sormus de Castro & Zaldívar-Riverón, 2013
  - First and second tergites striate, remaining tergites entirely acinose; lateral area of pronotum strongly rugose ..... *H. robustus* Zaldívar-Riverón & Sormus de Castro, 2013
5. Vertex entirely smooth; mesoscutal lobes mainly smooth (except *H. gavinbroadi* sp. nov.) ..... 6
  - Vertex at least partially striate; mesoscutal lobes coriaceous. .... 8
6. Mesoscutal lobes densely coriaceous; pterostigma wide,  $< 3.0 \times$  as long as wide; second metasomal tergite entirely striate; antennae with 12–14 flagellomeres ..... *H. gavinbroadi* sp. nov.
  - Mesoscutal lobes smooth; pterostigma narrow,  $4.0 \times$  as long as wide; second metasomal tergite partially striate; antennae with  $> 14$  flagellomeres ..... 7
7. Vein 2CU of fore wing arising behind middle of subdiscal cell; first discal cell of fore wing short,  $1.6 \times$  as long as wide; veins 1M and m-cu of fore wing parallel ..... *H. semiaridus* Sormus de Castro, Zaldívar-Riverón & Briceño-G., 2013
  - Vein 2CU of fore wing interstitial to vein 1CU; first discal cell of fore wing long,  $2.5 \times$  as long as wide; veins 1M and m-cu of fore wing slightly divergent posteriorly ..... *H. sulmatogrossensis* Sormus de Castro & Zaldívar-Riverón, 2013
8. Pterostigma wide,  $< 3.0 \times$  as long as wide; first discal cell of fore wing short,  $< 2.5 \times$  as long as than wide ..... 9
  - Pterostigma narrow,  $\geq 3.3 \times$  as long as wide; first discal cell of fore wing long,  $2.7\text{--}2.8 \times$  as long as wide ..... 11
9. Second metasomal tergite entirely sculptured, longitudinally carinate-rugose ..... *H. costaricensis* Marsh, 2013
  - Second metasomal tergite only anteriorly sculptured, remaining area smooth ..... 10
10. Propodeum without distinct carinae; second metasomal tergite with two densely striate subparallel anterior depressions; vein 1M of forewing  $1.7\text{--}1.8 \times$  as long as vein 1RS, vein cu-a posfurcal to vein 1M; vein RS of hindwing weakly defined, almost spectral ..... *H. chrisaxeli* sp. nov.



- Propodeum with distinct median and lateral carinae; second metasomal tergite densely striate transversally, without basal depressions; vein 1M of forewing  $1.0\text{--}1.1 \times$  as long as vein 1RS, vein cu-a interstitial to vein 1M; vein RS of hindwing absent ..... *H. transversalis* sp. nov.
- 11. Basal sternal plate of first metasomal segment distinctly long,  $0.5\text{--}0.6 \times$  as long as tergite; fourth tergite partially basally sculptured (reticulate-punctate), remaining tergites smooth; ovipositor and sheaths long,  $3.2\text{--}3.5 \times$  as long as metasoma .....  
..... *H. julianoi* Sormus de Castro & Zaldívar-Riverón, 2013 [we reexamined specimens of this species and found that the fourth metasomal segment is partially sculptured, not the fifth].
  - Basal sternal plate of first metasomal segment moderately long, about no more than  $0.5 \times$  as long as tergite; fourth tergite entirely smooth; ovipositor and sheaths short,  $1.5\text{--}2.3 \times$  as long as metasoma ..... 12
- 12. Vein 2CU of fore wing interstitial to vein 1CU; vein M+CU of hind wing  $1.4 \times$  as long as vein 1M; mesopleuron with coriaceous sculpture .....  
..... *H. shimborii* Sormus de Castro & Zaldívar-Riverón, 2013
  - Vein 2CU of fore wing arising after middle of subdiscal cell; vein M+CU  $\times$  as long as 1M; mesopleuron without coriaceous sculpture .....  
..... *H. mexicanus* Zaldívar-Riverón & Belokobylskij, 2009

*Hecabolus acutus* sp. nov.

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Fig. 1

**Diagnosis**

*Hecabolus acutus* sp. nov. is morphologically similar to *H. assis*, *H. robustus* and *H. sulcatus* as all have a moderately short basal sternal plate of the first metasomal segment; and similar to *H. shimborii* and *H. mexicanus* in the narrow pterostigma, vertex at least partially striate, and lobes of the mesoscutum coriaceous. *Hecabolus acutus* sp. nov. can mainly be distinguished from the remaining species of *Hecabolus* by having the distinctly lateral pointed edges of the median mesonotal lobe above the notauli (Fig. 1A, D) (absent in the remaining species); prescutellar depression with 10–12 carinae (12 carinae in *H. semiaridus* and 3–8 carinae in the remaining species), and the second and remaining metasomal tergites entirely smooth and polished (at least basal part of the second tergite sculptured in the remaining species).

**Etymology**

The specific epithet comes from the Latin word ‘*acutus*’, in reference to the antero-lateral pointed edges of the middle mesoscutal lobe above the notauli.

**Material examined**

**Holotype**

BRAZIL • ♀; Santa Catarina, Nova Teutonia; 27 Oct. 1956; F. Plaumann leg.; B.M. 1957–341; NHMUK.

**Paratypes**

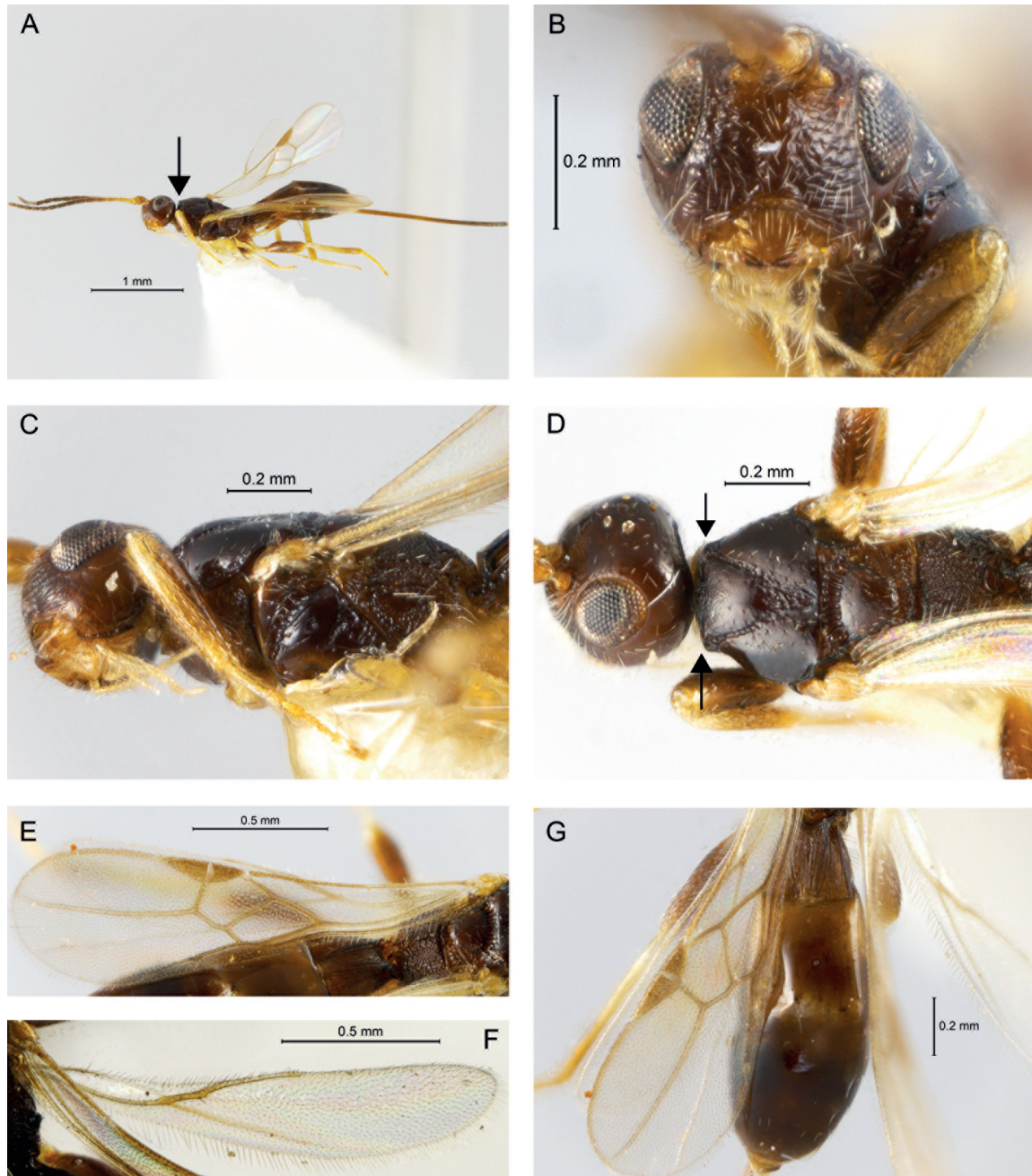
BRAZIL • 3 ♀♀; same collection data as for holotype; NHMUK • 2 ♀♀; same collection data as for holotype; CNIN-IBUNAM • 1 ♀; same collection data as for holotype; 24 Mar. 1941; NHMUK • 1 ♀; same collection data as for holotype; 20 Oct. 1956; CNIN-IBUNAM • 1 ♀; same collection data as for holotype; 22 Oct. 1956; CNIN-IBUNAM • 3 ♀♀; same collection data as for holotype; Oct. 1956; NHMUK • 2 ♀♀; same collection data as for preceding; CNIN-IBUNAM.

## Description

### Female

MEASUREMENTS. Body length 1.8–2.7 mm; fore wing length 1.5–2.1 mm; ovipositor and sheaths length 1.2–2.2 mm.

HEAD (Fig. 1B). Width  $1.3\text{--}1.5 \times$  median length (dorsal view),  $0.9\text{--}1.0 \times$  width of mesoscutum. Head behind eyes (dorsal view) convex. Transverse diameter of eye  $1.9\text{--}2.0 \times$  length of temple. Ocelli rather



**Fig. 1.** *Hecabolus acutus* sp. nov., ♀, holotype (NHMUK). **A.** Habitus, lateral view. **B.** Head, frontal view. **C.** Mesosoma, lateral view. **D.** Mesosoma, dorsal view, black arrows indicate the middle mesoscutal pointed edges above notauli. **E.** Fore wing. **F.** Hind wing. **G.** Metasoma, dorsal view.

small, arranged in a sub-equilateral triangle; POL  $0.9\text{--}1.1 \times$  Od,  $0.3\text{--}0.5 \times$  OOL. Eyes glabrous, height  $1.1\text{--}1.3 \times$  its maximum width. Malar space  $0.7\text{--}0.9 \times$  height of eye,  $0.5\text{--}0.7 \times$  basal width of mandible. Face convex, its width  $1.3\text{--}1.5 \times$  height of eye, and  $1.0\text{--}1.3 \times$  height of face and clypeus combined. Malar suture absent. Clypeus high, with no distinct lower flange. Hypoclypeal depression small and nearly round, its length  $0.8\text{--}1.1 \times$  its maximum width. Occipital carina wide, complete, not joined with hypostomal carina below. Hypostomal flange wide. Antennae with 12–13 flagellomeres. Scapus  $2.1\text{--}2.2 \times$  as long as its maximum width, widened medio-apically. First flagellomere straight, not widened medially,  $3.5\text{--}3.8 \times$  as long as its maximum width;  $0.9\text{--}1.0 \times$  as long as second flagellomere.

MESOSOMA (Fig. 1C–D). Length  $1.8\text{--}2.0 \times$  its height. Pronotum rather short, dorsally convex, without distinct transverse pronotal carina. Mesoscutum (lateral view) highly and roundly elevated above pronotum; its length (dorsal view)  $0.8\text{--}1.0 \times$  maximum width. Median lobe of mesoscutum protruding forward, with pointed antero-lateral projection-like edges above both notauli; without anterolateral corners. Notauli narrow, more or less shallow, scrobiculate anteriorly and slightly rugose posteriorly. Prescutellar depression considerably long and shallow, with 10–12 transverse carinae,  $1.0\text{--}1.4 \times$  as long as scutellum. Scutellum weakly convex and with no lateral carinae. Precoxal sulcus rather shallow and straight, running along anterior half of mesopleuron. Metanotal tooth absent. Metapleural lobe short and narrow. Propodeum without lateral tubercles or projections.

WINGS (Fig. 1E–F). Fore wing  $3.3\text{--}3.6 \times$  as long as its maximum width. Pterostigma narrow,  $3.7\text{--}3.9 \times$  as long as wide. Vein r arising shortly before the middle of pterostigma. Marginal cell long, its length  $3.2\text{--}3.5 \times$  maximum width. Vein R1  $1.5\text{--}1.8 \times$  as long as pterostigma. Vein r  $1.1\text{--}1.3 \times$  maximum width of pterostigma. Vein 3RS slightly curved towards apical margin of wing, almost straight;  $6.8\text{--}7.2 \times$  as long as vein r,  $7.8\text{--}9.4 \times$  as long as vein 2RS. Vein 2RS  $0.7\text{--}0.9 \times$  as long as vein r, and  $1.0\text{--}1.6 \times$  as long as vein m-cu. Vein m-cu slightly antefurcal to vein 2RS; vein RS+Mb considerably short. Vein (RS+M) a slightly curved distally. First discal cell moderately long,  $1.9\text{--}2.3 \times$  as long as wide. Veins 1M and m-cu slightly divergent posteriorly, almost parallel. Vein 1M  $1.2\text{--}1.5 \times$  as long as vein 1RS,  $2.5\text{--}3.3 \times$  as long as vein m-cu. Vein M+CU moderately curved medially. Vein 1cu-a absent; subdiscal cell open basally joining subbasal cell, considerably long and narrow. Vein 1-1A considerably long, reaching the middle of vein 1CU. Vein 2CU interstitial to vein 1CU. Vein 2M not sclerotized, reaching apical margin of wing,  $0.9\text{--}1.1 \times$  as long as vein 3RS. Hind wing  $5.0\text{--}5.3 \times$  as long as its maximum width. Vein C+Sc+R moderately long,  $2.5\text{--}3.2 \times$  length of vein SC+R, vein SC+R rather short, unsclerotized, apically in line with vein 2M. Basal cell considerably narrow and long, its length  $7.5\text{--}8.3 \times$  its maximum width,  $0.2\text{--}0.3 \times$  length of wing. Vein M+CU long. Vein cu-a absent. Vein r-m short,  $0.3\text{--}0.5 \times$  length of vein R. Vein m-cu absent. Vein RS almost absent. Vein 2M long,  $0.2\text{--}0.4 \times$  length of hind wing, almost reaching the margin of the wing.

LEGS (Fig. 1A). Fore tibia with a narrow row of slender spines. Hind coxa protruding forwards in ventro-anterior corner,  $1.3\text{--}1.7 \times$  as long as maximum width. Hind femur moderately wide,  $2.9\text{--}3.3 \times$  as long as its maximum width. Hind tibia slightly wide. Hind tarsus  $0.8\text{--}1.0 \times$  as long as hind tibia. Basitarsus  $0.7\text{--}1.0 \times$  as long as second–fifth segments combined. Second segment of hind tarsus  $0.2\text{--}0.3 \times$  length of basitarsus,  $0.6\text{--}1.0 \times$  the length of the fifth segment (without pretarsus).

METASOMA (Fig. 1G). Metasoma  $0.8\text{--}1.1 \times$  as long as head and mesosoma combined. First segment with basal sternal plate moderately short,  $0.3\text{--}0.4 \times$  as long as first tergite; with distinct dorsope. Maximum width of first tergite  $1.8\text{--}2.2 \times$  its minimum width; length of first tergite  $0.8\text{--}1.0 \times$  its apical width,  $0.9\text{--}1.2 \times$  length of propodeum. Second tergite without depressions (furrows) nor carinae. Median length of second tergite  $0.9\text{--}1.1 \times$  its basal width,  $1.5\text{--}1.8 \times$  length of third tergite. Combined length of second and third tergites  $1.0\text{--}1.4 \times$  their maximum width. Ovipositor sheaths slender,  $1.4\text{--}1.8 \times$  as long as



metasoma,  $2.0\text{--}2.4 \times$  as long as mesosoma,  $0.7\text{--}0.9 \times$  length of the body,  $0.9\text{--}1.1 \times$  length of the fore wing.

**SCULPTURE AND PUBESCENCE.** Vertex finely aciculate, sometimes smooth in posterior half; frons striate, sometimes smooth, without emargination opposite antennal sockets. Face rugose near antennal sockets, striate above clypeus; malar space and temple striate to slightly striate, almost smooth. Sides of pronotum smooth in upper half and transversely striate in lower half; propleuron striate. Median lobe of mesoscutum coriaceous anteriorly and smooth posteriorly; lateral lobes smooth. Scutellum smooth. Metanotum distinctly rugose. Mesopleuron smooth in anterior half, rugose in posterior half; precoxal sulcus slightly scrobiculate. Metapleuron entirely and coarsely rugose. Propodeum entirely and densely rugose with dense rugulose microsculpture, with central carina. Hind coxae striate dorsally, slightly rugose laterally and ventrally. Hind femur smooth. First metasomal tergite densely and longitudinally striate with a medial striate area delimited by distinct lateral carinae; remaining tergites smooth and polished. Vertex and frons with very scarce and short setae; face with dense and erect long setae. Scape and flagellomeres with dense short semi-erect setae. Pronotum and mesoscutum scarcely with short and pale setae, with narrow median glabrous areas on lateral lobes. Mesopleuron, metapleuron and propodeum laterally with scarce long and erect setae. Wings with dense short setae, especially on posterior margins. Hind coxae laterally with dense semi-erect long setae. Hind femur with scarce short setae. Hind tibia dorsally and laterally with dense short setae; tarsus with short and very fine setae. First tergite laterally with scarce short and erect setae. Pygidium and hypopygium with scarce long pale setae.

**COLOUR.** Mesosoma dark brown, anterior and posterior thirds of metasoma brown to dark brown, its middle third with light brown areas. Head brown; vertex, and frons dark brown. Basal flagellomeres and scape light brown to honey yellow, apical flagellomeres dark brown. Palpi light brown to pale yellow. Hind legs: coxa brown; trochanter and trochantellus light brown; femur brown; tibiae light brown in basal half, golden to brown in apical half; tarsus yellow to light brown, tarsal claw brown. Fore and hind wings entirely hyaline; pterostigma light brown.

#### **Male**

Unknown.

#### **Distribution**

All specimens, including the holotype, were collected in Nova Teutonia region in the state of Santa Catarina, Brazil.

#### **Hosts**

Unknown.

#### ***Hecabolus chrisaxeli* sp. nov.**

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Fig. 2

#### **Diagnosis**

*Hecabolus chrisaxeli* sp. nov. is morphologically similar to *H. costaricensis* by having mesoscutal lobes coriaceous, forewing with wide pterostigma, and mesopleuron almost entirely smooth, longitudinally striate on posterior third. It can be morphologically distinguished from the remaining species of *Hecabolus* by having the second metasomal tergite with two distinctively striate subparallel anterior depressions (without subparallel anterior depressions in the remaining species); hindwing with r-m very

short (medium in the remaining species), and veins RS and cu-a weakly defined, almost spectral (absent in the remaining species).

### **Etymology**

The specific epithet of this species is dedicated to the first author's life partner.

### **Material examined**

#### **Holotype**

BRAZIL • ♀; Nova Teutonia; 9 Nov. 1941; F. Plaumann leg.; B.M. 1957–341; DNA voucher no. CNIN4369; NHMUK.

#### **Paratypes**

BRAZIL • 1 ♀; same collection data as for holotype; 3 Apr. 1941; NHMUK • 1 ♀; same collection data as for holotype; 9 Apr. 1941; NHMUK • 1 ♀; same collection data as for holotype; 10 Apr. 1941; CNIN-IBUNAM • 2 ♀♀; same collection data as for holotype; 12 Apr. 1941; CNIN-IBUNAM.

### **Description**

#### **Female**

MEASUREMENTS. Body length 3.6–4.3 mm; fore wing length 2.2–2.9 mm; ovipositor length 3.1–4.2 mm.

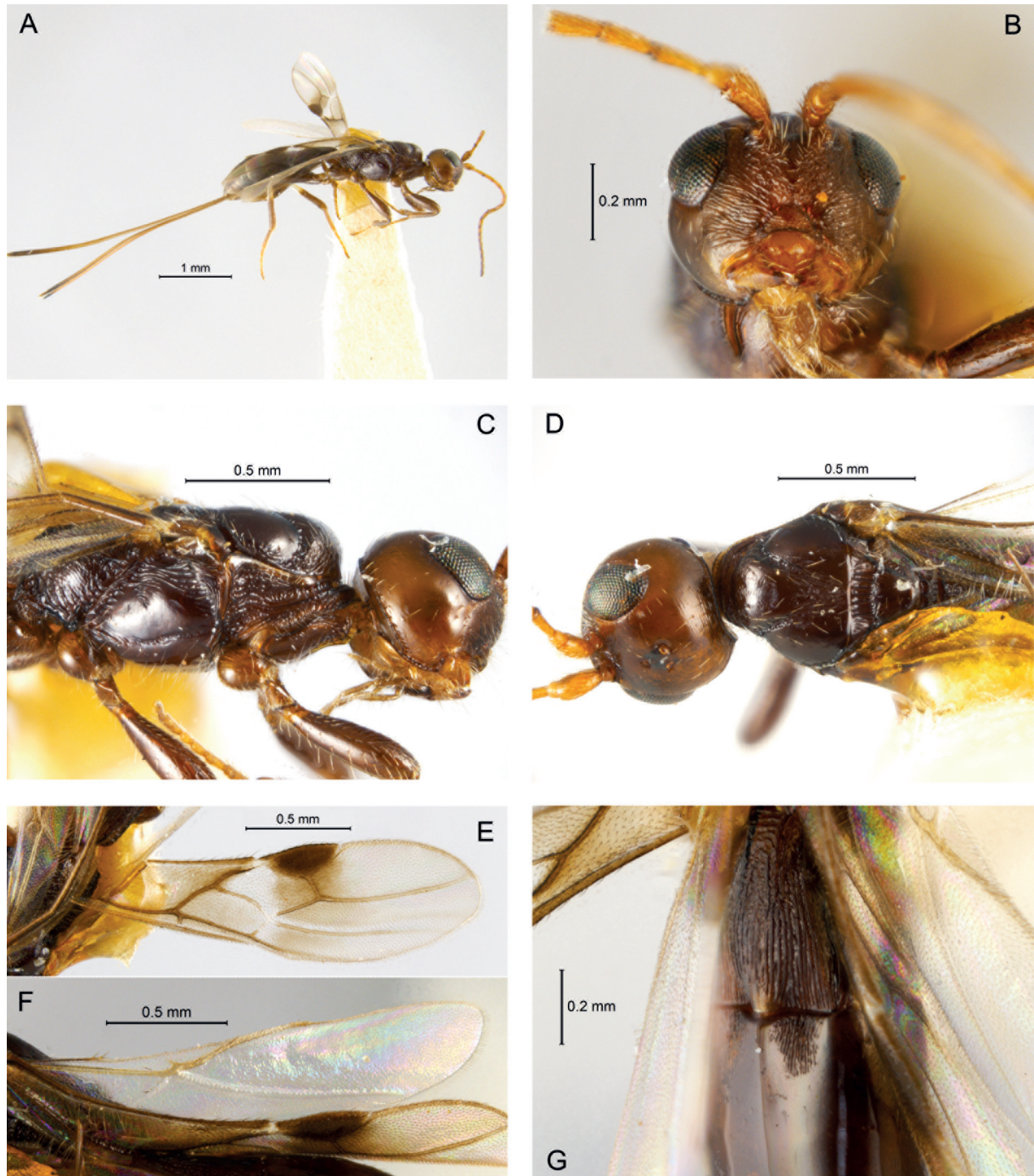
HEAD (Fig. 2B). Width 1.4–1.6 × median length (dorsal view), 1.4 × width of mesoscutum. Head behind eyes (dorsal view) convex in anterior half, and weakly, roundly narrowed in posterior half. Transverse diameter of eye 0.9–1.0 × as long as temple. Ocelli rather small, arranged in an equilateral triangle; POL 0.1 × Od, 0.5–0.6 × OOL. Eyes glabrous, with a distinct emargination opposite antennal sockets, 1.1–1.2 × as high as broad. Malar space 0.5–0.6 × height of eye, 1.0–1.1 × basal width of mandible. Face convex, its width 1.4–1.5 × height of eye and 1.1–1.2 × height of face and clypeus combined. Malar suture absent. Clypeus high, with a distinct lower flange. Hypoclypeal depression small and elliptical, 0.3–0.4 × as long as wide. Occipital carina wide, complete, ventrally joined with hypostomal carina. Hypostomal flange wide. Antennae with 16 flagellomeres. Scapus 2.5 × as long as its maximum width. First flagellomere slightly curved, slightly widened medially, 2.5 as long as its maximum width; 0.9–1.0 × as long as second flagellomere; the last flagellomere pointed apically.

MESOSOMA (Fig. 2C–D). Length of mesosoma 2.1–2.2 × its height. Pronotum short, dorsally weakly convex, without distinct submedian pronotal carina. Mesoscutum (lateral view) highly and roundly elevated above pronotum; its length (dorsal view) 2.5 × maximum width. Median lobe of mesoscutum shortly protruding forward, without anterolateral corners. Notauli wide, shallow, scrobiculate anteriorly and striate posteriorly. Prescutellar depression rather shallow, long, with 7–8 carinae, 0.4 × as long as scutellum. Scutellum weakly convex and with fine lateral carinae. Precoxal sulcus distinct, rather shallow, distinctly crenulate anteriorly and striate posteriorly, running along 0.6–0.7 of lower length of mesopleuron. Metanotal tooth blunt, almost indistinct. Metapleural lobe long and narrow, rounded apically. Propodeum with very small and blunt lateral tubercles.

WINGS (Fig. 2E–F). Fore wing 3.5–3.6 × as long as its maximum width. Pterostigma 3.0 × as long as wide. Vein r arising in the middle of pterostigma. Marginal cell long, its length 2.6–2.7 × maximum width. Vein R1 1.5–1.6 as long as pterostigma. Vein r 0.9–1.0 × as long as maximum width of pterostigma. Vein 3RSa slightly curved towards posterior margin of wing, 5.3–5.4 × as long as vein r, 2.6–2.7 × as long as vein 2RS. Vein 2RS 2.0 × as long as vein r and 3.0 × as long as vein m-cu. Vein m-cu interstitial to vein 2RS. Vein (RS+M)a slightly curved medially. First discal cell long, 2.0–2.5 × as long as wide. Veins 1M and m-cu parallel. Vein cu-a postfurcal to vein 1M. Vein 1M 1.7–1.8 × as long as vein 1RS, 1.8 × as long as vein m-cu. Vein cu-a short and straight, vein 1M 3.5 × cu-a length. Vein M+CU distinctly



sinuate. Vein 2CU interstitial to vein 1CU. Hind wing  $4.6\text{--}4.7\times$  as long as wide. Vein C+Sc+R  $1.6\text{--}1.7\times$  as long as than Sc+R. Vein r-m very short, almost indistinguishable. Basal cell considerably narrow, its length  $15.0\text{--}16.0\times$  its maximum width,  $0.2\text{--}0.3\times$  length of wing. Vein M+CU  $0.8\text{--}0.9\times$  as long as vein 1M. Vein cu-a poorly defined, almost spectral. Vein m-cu unsclerotized, almost straight, weakly oblique



**Fig. 2.** *Hecabolus chrisaxeli* sp. nov., ♀, holotype (NHMUK). **A.** Habitus, lateral view. **B.** Head, frontal view. **C.** Mesosoma, lateral view. **D.** Mesosoma, dorsal view. **E.** Fore wing. **F.** Hind wing. **G.** Metasoma, dorsal view.

toward base of wing. Vein RS poorly defined, almost spectral. Vein 2M unsclerotized, slightly curved anteriorly, almost straight towards apex of wing.

**LEGS** (Fig. 2A, C). Fore tibia with few slender spines arranged in a narrow row. Hind coxa protruding forwards in ventro-anterior corner,  $1.5\text{--}1.6 \times$  as long as maximum width. Hind femur moderately wide,  $2.8 \times$  as long as its maximum width. Hind tibia slightly wide. Hind tarsus  $0.9 \times$  as long as hind tibia. Basitarsus about  $0.8 \times$  as long as second–fifth segments combined. Second segment of hind tarsus  $0.3\text{--}0.4 \times$  as long as basitarsus,  $1.0\text{--}1.1 \times$  as long as fifth segment (without pretarsus).

**METASOMA** (Fig. 2G). Metasoma  $1.2\text{--}1.3 \times$  as long as head and mesosoma combined. First segment with basal sternal plate moderately long,  $0.4\text{--}0.5 \times$  as long as first tergite; with distinct dorsope, with small spiracle in basal 0.3. Maximum width of first tergite  $3.5 \times$  its minimum width; length equal to its apical width,  $1.4\text{--}1.6 \times$  length of propodeum. Second tergite with wide and shallow lateral subparallel depressions (furrows) not delineated by carinae. Median length of second tergite  $1.3 \times$  its basal width,  $1.5\text{--}1.6 \times$  length of third tergite. Combined length of second and third tergites  $1.1 \times$  their maximum width. Ovipositor sheaths slender,  $1.5\text{--}1.6 \times$  as long as metasoma,  $0.8\text{--}0.9 \times$  as long as mesosoma,  $1.2\text{--}1.3 \times$  as long as body,  $1.1\text{--}1.2 \times$  as long as fore wing.

**SCULPTURE AND PUBESCENCE.** Vertex finely striate posteriorly, smooth medially; frons smooth below ocelli, emargination opposite antennal sockets densely rugose. Face entirely, distinctly, and densely rugose; densely striate near malar space below eyes; temple smooth and polished. Sides of pronotum distinctly longitudinally striate in upper half and transversely striate in lower half. Mesoscutum densely and finely coriaceous, lateral lobes finely coriaceous. Scutellum entirely smooth. Mesopleuron almost entirely smooth, longitudinally striate in upper third; precoxal sulcus scrobiculate anteriorly, striate posteriorly. Metapleuron entirely and coarsely reticulate-striate. Propodeum entirely and densely rugose with dense rugulose microsculpture, without areas delineated by carinae. Hind coxae smooth medially, slightly striate dorsally, and slightly rugose ventrally. Hind femur smooth. First metasomal tergite densely and longitudinally striate with rugose microsculpture medially; second metasomal tergite with short lateral subparallel depressions densely and longitudinally striate, its remaining area smooth and polished; remaining metasomal tergites smooth and polished. Vertex with very sparse and short setae; frons with dense long setae. Pronotum and mesoscutum scarcely with long and pale setae, with narrow median glabrous areas on lateral lobes. Mesopleuron, metapleuron and propodeum almost glabrous. Both wings with dense short setae, especially on wing margins. Hind coxae with scarce semi-erect setae. Hind femur with scarce setae. Hind tibia dorsally and laterally with dense setae; tarsus with short and very dense setae. Metasoma glabrous, hypopygium apically with scarce, more or less long pale setae.

**COLOUR.** Body brown or dark reddish brown, anterior half of metasoma dark reddish brown. Antenna brown to light brown. Palpi light brown or almost yellow. Legs brown or light brown, hind coxa dark, hind tibiae yellowish or pale in basal third. Fore wing infuscate basally, hyaline in apical third; pterostigma dark brown. Hind wing entirely hyaline.

#### **Male**

Unknown.

#### **Distribution**

The locality of the six specimens, including holotype, is Nova Teutonia in the state of Santa Catarina in southern Brazil.

#### **Hosts**

Unknown.

*Hecabolus gavinbroadi* sp. nov.

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Figs 3–4

**Diagnosis**

*Hecabolus gavinbroadi* sp. nov. is morphologically similar to *H. costaricensis* and *H. transversalis* as they have a wide pterostigma; however, it can be distinguished from the latter species by having lateral blunt tubercles on the propodeum (tubercles absent in *H. costaricensis* and *H. transversalis*). Moreover, it can be distinguished from the remaining species of the genus by the combination of its smooth vertex and mesoscutal lobes strongly and densely coriaceous (vertex and mesoscutal lobes smooth in *H. semiaridus* and *H. sulamtogrossensis*, vertex partially striate and mesoscutal lobes coriaceous in all the remaining species).

**Etymology**

This species is named in honour to the principal curator in charge of the insect collection of the Natural History Museum, London, UK, who kindly lent us the entomological material for morphological examination.

**Material examined**

**Holotype**

BRAZIL • ♀; Mato Grosso, Rio Caraguata; 4 Apr. 1953; F. Plaumann leg., B.M. 1957–341; NHMUK.

**Paratypes**

BRAZIL – **Mato Grosso** • 1 ♀; same collection data as for holotype; Mar. 1953; CNIN-IBUNAM. – **Nova Teutonia** • 2 ♂♂; 9 Apr. 1941; F. Plaumann leg; B.M. 1957–341; NHMUK • 1 ♂; same collection data as for preceding; 10 Apr. 1941; CNIN-IBUNAM.

**Description**

**Female**

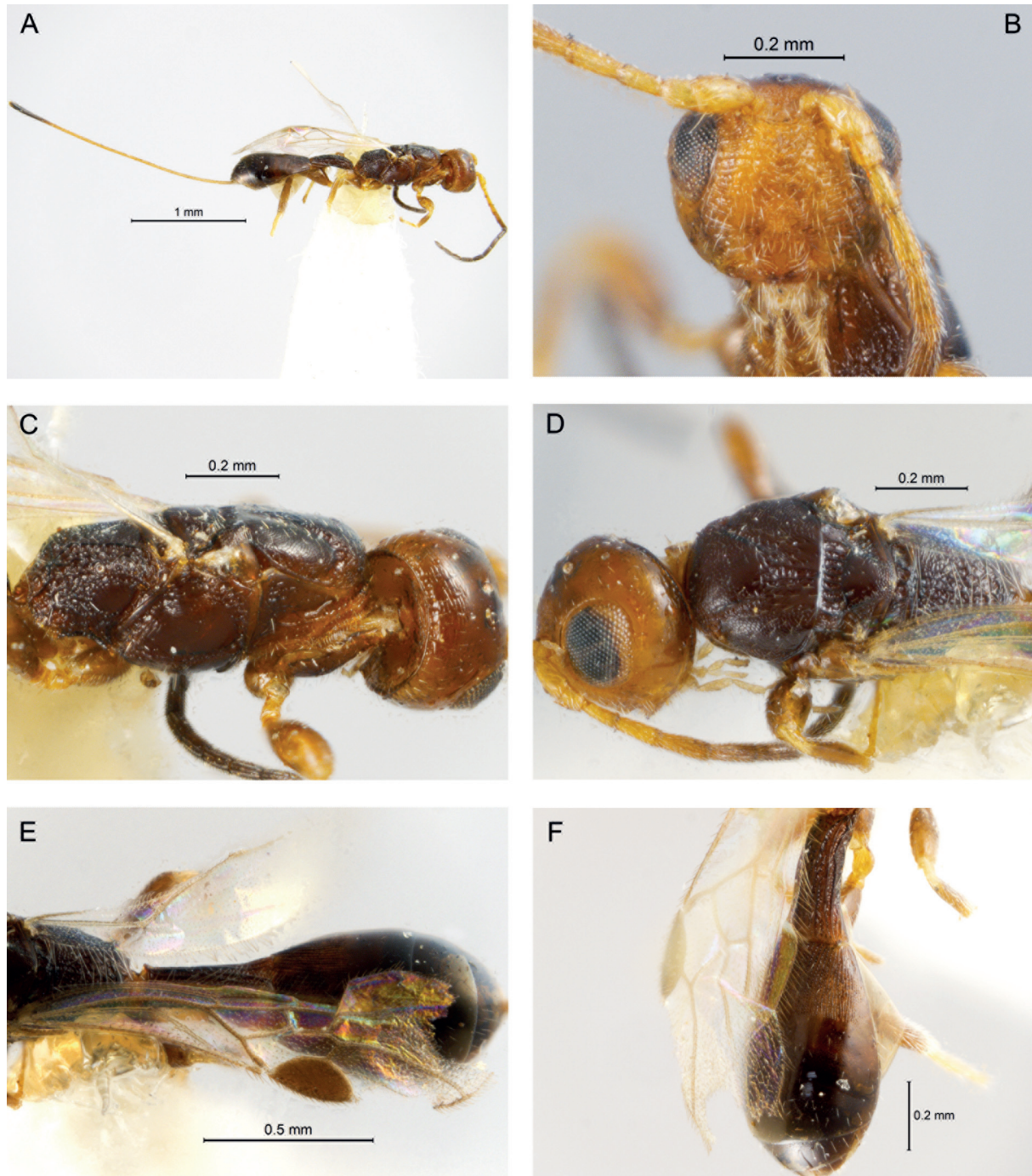
MEASUREMENTS. Body length 1.8–2.2 mm; fore wing length 1.3–1.4 mm; ovipositor and sheaths length 1.8–2.3 mm.

HEAD (Fig. 3B). Head width  $1.3\text{--}1.4 \times$  median length (dorsal view),  $1.2\text{--}1.3 \times$  width of mesoscutum. Head behind eyes (dorsal view) convex in anterior half, and weakly, roundly narrowed in posterior half. Transverse diameter of eye  $1.2\text{--}1.3 \times$  length of temple. Ocelli rather small, arranged in a subequilateral triangle; POL  $1.0\text{--}1.3 \times$  Od,  $0.3\text{--}0.4 \times$  OOL. Eyes glabrous, its height  $0.6\text{--}0.7 \times$  its maximum width. Malar space  $1.0\text{--}1.1 \times$  height of eye,  $0.6\text{--}0.7 \times$  basal width of mandible. Face convex, its width  $2.0\text{--}2.2 \times$  height of eye, and  $1.0\text{--}1.3 \times$  height of face and clypeus combined. Malar suture absent. Clypeus high, with a distinct lower flange. Hypoclypeal depression small and round, as long as its width. Occipital carina complete, joined with hypostomal carina. Hypostomal flange wide. Antenna with 12–14 flagellomeres. Scapus  $2.0\text{--}2.2 \times$  as long as its maximum width. First flagellomere slightly curved medially, not widened,  $2.2\text{--}2.3 \times$  as long as its maximum width;  $0.8\text{--}0.9 \times$  as long as second flagellomere.

MESOSOMA (Fig. 3C–D). Length of mesosoma  $2.0\text{--}2.3 \times$  its height. Pronotum rather short, dorsally convex, without distinct submedian pronotal carina. Mesoscutum (lateral view) highly and roundly elevated above pronotum; its length (dorsal view)  $0.7\text{--}0.8 \times$  maximum width. Median lobe of mesoscutum protruding forward, without anterolateral corners. Notauli wide, more or less shallow, scrobiculate anteriorly and striate posteriorly. Prescutellar depression moderately shallow, long, with 8 carinae,  $1.3\text{--}1.4 \times$  as long as scutellum. Scutellum weakly convex and with no lateral carinae. Precoxal sulcus distinct (lateral view),



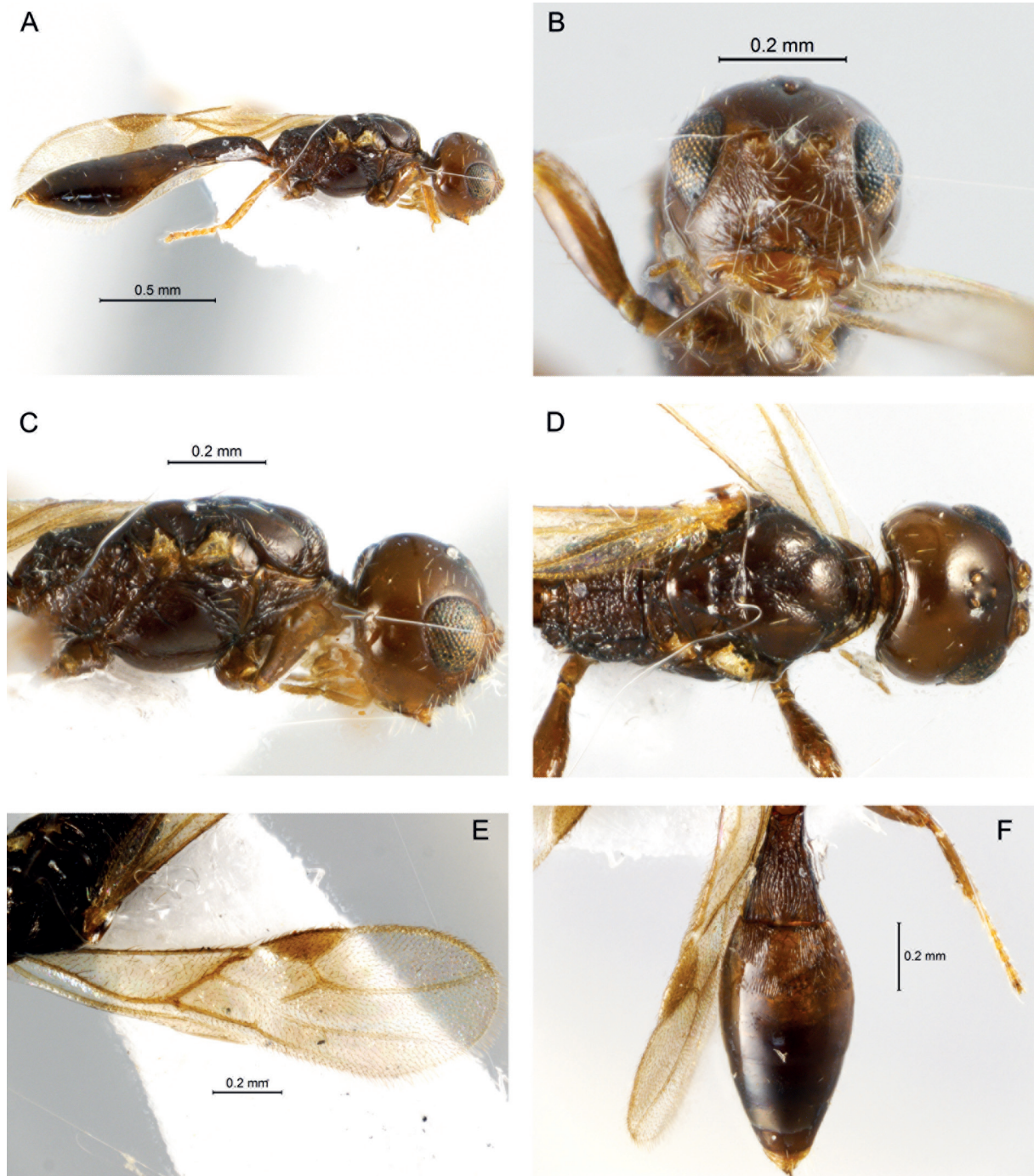
more or less shallow, crenulate anteriorly and rugose posteriorly, incomplete, running along anterior half of lower length of mesopleuron. Metanotal tooth absent. Metapleural lobe relatively short but wide, slightly curved apically. Propodeum with lateral small, blunt tubercles.



**Fig. 3.** *Hecabolus gavinbroadi* sp. nov., ♀, holotype (NHMUK). **A.** Habitus, lateral view. **B.** Head, frontal view. **C.** Mesosoma, lateral view. **D.** Mesosoma, dorsal view. **E.** Fore and hind wings, showing the wide pterostigma. **F.** Metasoma, dorsal view.



WINGS (Fig. 3E). Fore wing  $3.3\text{--}3.5\times$  as long as its maximum width. Pterostigma wide,  $2.5\text{--}3.0\times$  as long as wide. Vein r arising in the middle of pterostigma. Marginal cell long, its length  $2.7\text{--}3.0\times$  maximum width. Vein R1  $1.1\text{--}1.2\times$  as long as pterostigma. Vein r  $0.5\text{--}0.6\times$  maximum width of pterostigma. Vein 3RSa straight, reaching apical margin of wing,  $7.5\text{--}8.0\times$  as long as vein r,  $2.9\text{--}3.2\times$  as long as vein 2RS. Vein 2RS  $2.3\text{--}2.8\times$  as long as vein r, and  $2.0\text{--}2.8\times$  as long as vein m-cu. Vein m-cu interstitial to vein



**Fig. 4.** *Hecabolus gavinbroadi* sp. nov., ♂, paratype (CNIN-IBUNAM). **A.** Habitus, lateral view. **B.** Head, frontal view. **C.** Mesosoma, lateral view. **D.** Mesosoma, dorsal view. **E.** Fore wing, showing the moderately wide pterostigma. **F.** Metasoma, dorsal view.



2RS. Vein (RS+M)a slightly curved medially, almost straight. First discal cell considerably short,  $1.8\text{--}2.0 \times$  as long as wide. Veins 1M and m-cu divergent posteriorly. Vein cu-a postfurcal to vein 1M. Vein 1M  $1.1\text{--}1.3 \times$  as long as vein 1RS,  $2.0\text{--}2.1 \times$  as long as vein m-cu. Vein cu-a rather short and straight, vein 1M  $3.3\text{--}5.0 \times$  cu-a length. Vein M+CU slightly sinuate. Vein 2CU interstitial to vein 1CU; vein 2M short, not reaching apical margin of wing,  $0.5\text{--}0.6 \times$  vein 3RS. Hind wing  $5.2 \times$  as long as its maximum width. Vein C+Sc+R long, vein SC+R absent. Basal cell long and narrow, its length  $5.0 \times$  its maximum width,  $0.3\text{--}0.4 \times$  length of wing. Vein M+CU and 1M long. Vein cu-a absent. Vein r-m short,  $0.2 \times$  length of Vein R. Vein m-cu absent. Vein RS absent. Vein 2M unsclerotized, spectral, slightly curved anteriorly, straight posteriorly, almost reaching the margin of the wing; vein 1A present, considerably short,  $0.1 \times$  length of veins M+CU and 1M combined.

LEGS (Fig. 3A). Fore tibia with a narrow row of slender spines. Hind coxa protruding forwards in a ventro-anterior corner,  $1.2\text{--}1.5 \times$  as long as maximum width. Hind femur considerably wide,  $2.0 \times$  as long as its maximum width. Hind tibia slightly wide,  $1.2\text{--}1.3 \times$  length of hind femur. Hind tarsus  $1.0 \times$  as long as hind tibia. Basitarsus about  $0.4 \times$  as long as second–fifth segments combined. Second segment of hind tarsus  $0.6 \times$  length of basitarsus, equal to length of the fifth segment (without pretarsus).

METASOMA (Fig. 3F).  $0.9\text{--}1.0 \times$  as long as head and mesosoma combined. First segment with basal sternal plate distinctly long,  $0.5\text{--}0.7 \times$  as long as first tergite; with distinct dorsope and laterope. Maximum width of first tergite  $2.5\text{--}3.0 \times$  its minimum width; length of first tergite  $1.0\text{--}1.3 \times$  its apical width,  $1.0\text{--}1.3 \times$  length of propodeum. Second tergite without basal depressions (furrows) nor carinae. Median length of second tergite  $0.9\text{--}1.0 \times$  its basal width,  $1.0\text{--}1.1 \times$  length of third tergite. Combined length of second and third tergites  $0.9\text{--}1.1 \times$  their maximum width. Ovipositor sheaths slender,  $2.1\text{--}2.3 \times$  as long as metasoma,  $2.9\text{--}3.0 \times$  as long as mesosoma,  $1.0 \times$  as long as the body,  $1.4\text{--}1.6 \times$  length of the fore wing.

SCULPTURE AND PUBESCENCE. Vertex smooth, sometimes slightly striate posteriorly; frons rugose below ocelli with shallow emargination opposite antennal sockets. Face distinctly, and densely striate near antennal sockets and above clypeus; malar space smooth; temple entirely smooth and polished. Sides of pronotum entirely striate longitudinally; propleuron rugose. Lateral and middle lobes of mesoscutum densely and distinctively coriaceous. Scutellum smooth, scutellar sulcus striate. Mesopleuron almost entirely smooth, longitudinally striate in upper anterior corner; precoxal sulcus scrobiculate anteriorly, striate posteriorly. Metapleuron entirely and coarsely rugose, with a small smooth area anteriorly. Propodeum entirely and densely rugose with dense rugulose microsculpture, with a middle carina. Hind coxae slightly striate dorsally, distinctively striate laterally. Hind femur smooth. First and second metasomal tergites densely and longitudinally striate with rugose microsculpture; third metasomal tergite slightly acinose basally; remaining tergites smooth and polished. Vertex and frons with very scarce and short setae; face with dense setae. Pronotum and mesoscutum with scarce short setae. Mesopleuron, metapleuron and propodeum with scarce setae. Wings with dense short to medium setae, especially on wing margins. Hind coxae with scarce semi-erect setae. Hind femur with sparse setae. Hind tibia dorsally and laterally with dense short setae; tarsus with short and very fine setae. Last tergites with very sparse pale setae.

COLOUR. Head, metasoma and mesosoma brown to dark brown. Antenna brown; scape light brown. Palpi light brown to almost honey yellow. Legs brown; hind coxa light brown to brown; trochanter and trochantellus light brown; hind femur brown; hind tibia brown, its basal quarter yellowish; tarsus light brown, tarsal claw dark brown. Fore and hind wings entirely hyaline, pterostigma brown.

### Male

Larger than female (Fig. 4A). Body length 2.1–3.0 mm; fore wing length 1.5–2.1 mm. Basal sternal plate of first metasomal segment 0.4–0.5 × as long as first tergite. Hind femur 3.0–4.0 × as long as its maximum width. Fore wing with moderately wide pterostigma, 2.5–3.0 × its maximum width (Fig. 4E). Hind wing without stigma-like enlargement, with short r-m, veins RS and m-cu absent; vein 2M not sclerotized, spectral. Both wings with a line of medium-size setae along the margins. Vertex entirely smooth (Fig. 4D). Second metasomal tergite striate in anterior two thirds, with irregular striation in posterior third (Fig. 4F). Body colour dark brown (Fig. 4C–D); antenna brown; all coxae, femora, and tibiae dark brown, trochanters and tarsi brown; tarsal claws brown to dark brown. Forewing hyaline, with an infuscate band in basal half and another infuscate band under pterostigma (Fig. 4E).

### Distribution

Specimens of this species were recorded from Rio Caraguata in the state of Mato Grosso, and in Nova Teutonia in the state of Santa Catarina, Brazil.

### Hosts

Unknown.

### *Hecabolus transversalis* sp. nov.

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Fig. 5

### Diagnosis

*Hecabolus transversalis* sp. nov. is morphologically similar to *H. costaricensis* and *H. gavinbroadi* as they have a wide pterostigma; and to *H. mexicanus* and *H. shimborii* by the coriaceous lateral mesoscutal lobes. In addition, it is morphologically similar to *H. assis*, *H. robustus*, *H. semiaridus*, and *H. sulmatogrossensis* by the presence of a median and lateral longitudinal carinae on the propodeum. However, it can be morphologically distinguished from the remaining species of *Hecabolus* by having a transversely striate anterior area on the second metasomal tergite (smooth or not transversely striate in the remaining species), middle mesoscutal lobe strongly coriaceous to rugose (coriaceous or smooth in the remaining species); and vein 2M almost spectral (well defined in the remaining species).

### Etymology

The specific epithet of this species comes from the Latin word ‘*transversalis*’, in reference to the distinctive transverse anterior striation on the second metasomal tergite.

### Material examined

#### Holotype

BRAZIL • ♀; Santa Catarina, Nova Teutonia; 27°11' S, 52°23' W; 17 Jun. 1937; Fritz Plaumann leg; B.M. 1937–656; NHMUK.

#### Paratype

BRAZIL • 1 ♀; Mato Grosso, Rio Caraguata; 4 Apr. 1953; F. Plaumann leg; B.M. 1957–341; CNIN-IBUNAM.

## Description

### Female

MEASUREMENTS. Body length 2.9–3.1 mm; fore wing length 2.1–2.3 mm; ovipositor and sheaths length 1.7–2.0 mm.

HEAD (Fig. 5B). Width  $0.8\text{--}0.9 \times$  median length (dorsal view),  $0.8\text{--}0.9 \times$  width of mesoscutum. Head behind eyes (dorsal view) convex in anterior half, and weakly, roundly narrowed in posterior half. Transverse diameter of eye  $0.5\text{--}0.7 \times$  length of temple. Ocelli rather small, arranged in an equilateral triangle; POL  $1.0\text{--}1.3 \times$  Od,  $1.0\text{--}1.6 \times$  OOL. Eyes glabrous, height  $1.2\text{--}1.4 \times$  its maximum width. Malar space  $2.0 \times$  height of eye,  $0.3\text{--}0.5 \times$  basal width of mandible. Face convex, its width  $0.3 \times$  height of eye and  $0.5 \times$  height of face and clypeus combined. Malar suture absent. Clypeus high, with a distinct lower flange. Hypoclypeal depression small and nearly round, as long as its width. Occipital carina wide, complete, not joined with hypostomal carina. Hypostomal flange wide. Antenna with at least 9 flagellomeres (antennae incomplete). Scapus  $1.5 \times$  as long as its maximum width. First flagellomere straight, not widened medially,  $3.5 \times$  as long as its maximum width;  $1.0 \times$  as long as second flagellomere.

MESOSOMA (Fig. 5C–D). Length of mesosoma  $2.0\text{--}2.2 \times$  its height. Pronotum short, dorsally convex, without submedian pronotal carina. Mesoscutum (lateral view) highly and roundly elevated above pronotum; its length (dorsal view)  $0.4\text{--}0.5 \times$  maximum width. Median lobe of mesoscutum protruding forward, without anterolateral corners. Notauli wide, more or less deep, scrobiculate anteriorly and slightly striate posteriorly. Prescutellar depression moderately shallow, long, with 6–7 carinae,  $0.7 \times$  as long as scutellum. Scutellum weakly convex and without lateral carinae. Precoxal sulcus distinct (lateral view), more or less deep, distinctly crenulate anteriorly and slightly striate posteriorly, complete along lower length of mesopleuron. Metanotal tooth absent. Metapleural lobe relatively short but wide, rounded apically. Propodeum without lateral tubercles or projections.

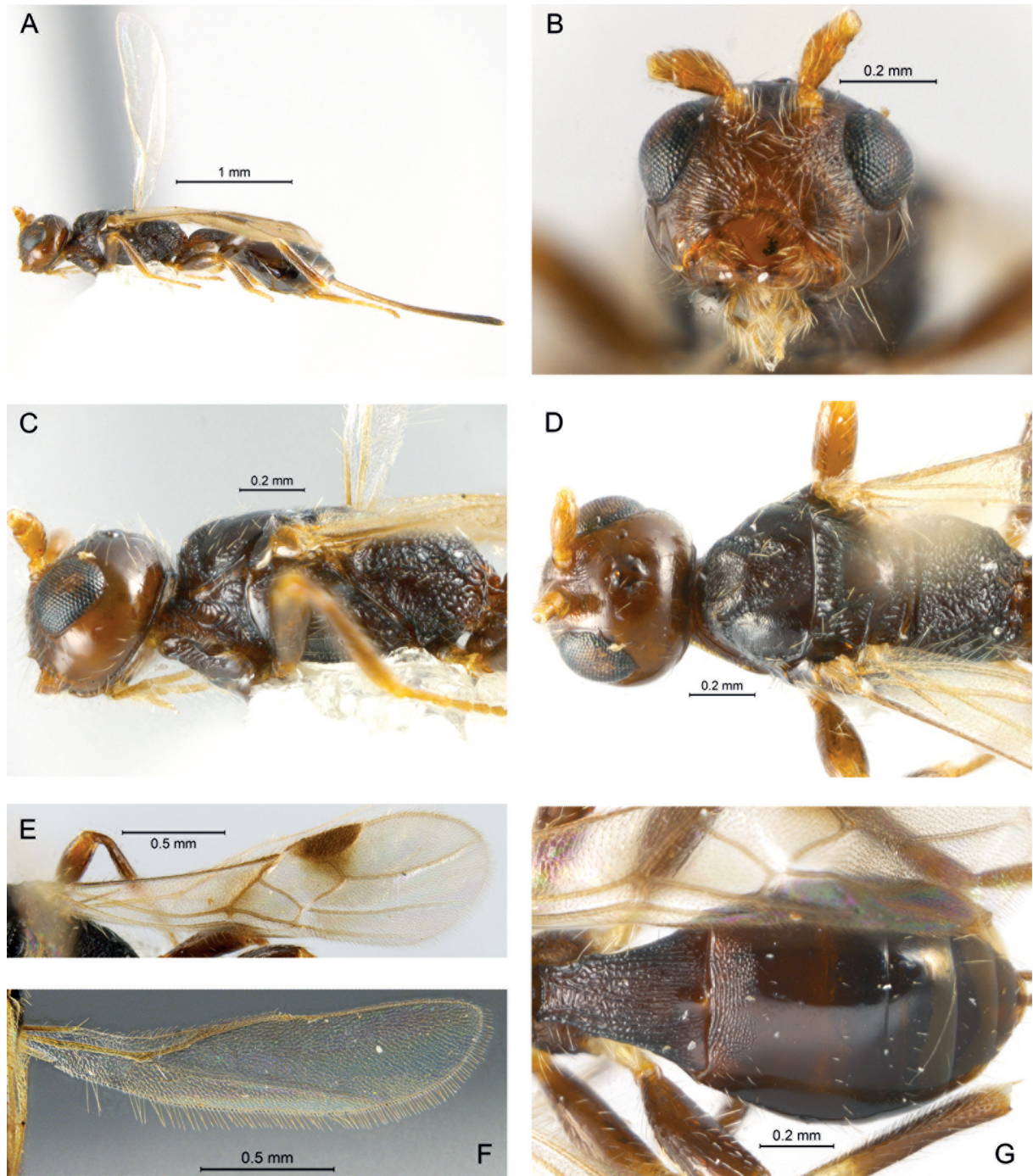
WINGS (Fig. 5E–F). Fore wing  $3.3\text{--}3.5 \times$  as long as its maximum width. Pterostigma  $2.9\text{--}3.3 \times$  as long as wide. Vein r arising in middle of pterostigma. Marginal cell long, its length  $2.9\text{--}3.0 \times$  maximum width. Vein R1  $1.2\text{--}1.5 \times$  as long as pterostigma. Vein r  $0.7\text{--}0.8 \times$  maximum width of pterostigma. Vein 3RSa slightly curved towards apical margin of wing,  $6.0\text{--}7.0 \times$  as long as vein r,  $2.8\text{--}3.0 \times$  as long as vein 2RS. Vein 2RS  $2.0\text{--}2.5 \times$  as long as vein r, and  $2.0\text{--}2.5 \times$  as long as vein m-cu. Vein m-cu interstitial to vein 2RS. Vein (RS+M)a slightly sinuate. First discal cell considerably long,  $1.5 \times$  as long as wide. Veins 1M and m-cu slightly divergent posteriorly. Vein cu-a interstitial to vein 1M. Vein 1M  $1.0\text{--}1.1 \times$  as long as vein 1RS,  $1.8\text{--}2.0 \times$  as long as vein m-cu. Vein cu-a short and straight, vein 1M  $3.6\text{--}4.0 \times$  as long as vein cu-a. Vein M+CU slightly sinuate. Vein 2CU interstitial to vein 1CU. Hind wing  $4.8\text{--}6.0 \times$  as long as its maximum width. Vein C+Sc+R  $1.0\text{--}1.5 \times$  as long as vein SC+R. Basal cell greatly narrow and long, its length  $8.8\text{--}11.4 \times$  its maximum width,  $0.3\text{--}0.4 \times$  length of wing. Vein M+CU short,  $0.7\text{--}0.8 \times$  the length of vein 1M. Vein cu-a absent. Vein r-m short,  $0.5 \times$  length of vein R. Vein m-cu unsclerotized, poorly defined, almost straight, weakly oblique toward base of wing. Vein RS absent. Vein 2M unsclerotized, poorly defined, very slightly curved anteriorly, almost reaching margin of wing.

LEGS (Fig. 5A, G). Fore tibia with a narrow row of few slender spines. Hind coxa protruding forwards in ventro-anterior corner,  $1.2\text{--}1.3 \times$  as long as maximum width. Hind femur moderately wide,  $2.0\text{--}2.5 \times$  as long as its maximum width. Hind tibia slightly wide. Hind tarsus  $0.9 \times$  as long as hind tibia. Basitarsus about  $0.7 \times$  as long as second–fifth segments combined. Second segment of hind tarsus  $2.3 \times$  length of basitarsus,  $0.2 \times$  the length of fifth segment (without pretarsus).

METASOMA (Fig. 5G).  $1.0\text{--}1.1 \times$  as long as head and mesosoma combined. First segment with basal sternal plate moderately long,  $0.5\text{--}0.6 \times$  as long as first tergite; without distinct dorsope, with small spiracle in anterior half. Maximum width of first tergite  $2.7\text{--}3.0 \times$  its minimum width; length of first



tergite  $1.3\text{--}1.5 \times$  its apical width,  $1.5\text{--}1.7 \times$  length of propodeum. Second tergite without depressions (furrows) nor carinae. Median length of second tergite  $0.8\text{--}1.3 \times$  its basal width,  $1.8\text{--}2.0 \times$  length of third tergite. Combined length of second and third tergites  $0.7\text{--}0.8 \times$  their maximum width. Ovipositor sheaths slender,  $1.1\text{--}1.3 \times$  as long as metasoma,  $1.6\text{--}1.8 \times$  as long as mesosoma,  $0.7\text{--}0.8 \times$  length of body,  $0.8\text{--}0.9 \times$  length of fore wing.



**Fig. 5.** *Hecabolus transversalis* sp. nov., ♀, holotype (NHMUK). **A.** Habitus, lateral view. **B.** Head, frontal view. **C.** Mesosoma, lateral view. **D.** Mesosoma, dorsal view. **E.** Fore wing. **F.** Hind wing. **G.** Metasoma, dorsal view, showing the transverse anterior striation of the second metasomal tergite.

SCULPTURE AND PUBESCENCE. Vertex entirely striate; frons striate below ocelli with shallow rugose emargination opposite antennal sockets. Face distinctly and densely rugose near antennal sockets, densely striate above clypeus; malar space smooth; temple entirely smooth and polished. Sides of pronotum slightly striate longitudinally in upper half and transversely striate in lower half; propleuron distinctly striate. Mesoscutum densely and strongly coriaceous, almost rugose, lateral lobes densely coriaceous. Scutellum smooth. Metanotum transversely striate. Mesopleuron smooth, longitudinally striate in upper anterior third; precoxal sulcus scrobiculate anteriorly, striate posteriorly. Metapleuron entirely and coarsely reticulate to rugose. Propodeum entirely and densely rugose with dense rugulose microsculpture, with central and lateral incomplete carinae. Hind coxa distinctly striate dorsally, smooth laterally. Hind femur smooth. First metasomal tergite densely and longitudinally striate with rugose microsculpture anteriorly; second metasomal tergite with a transversely striate area in anterior half, remaining area smooth and polished; remaining metasomal tergites smooth and polished. Vertex and frons with very sparse short setae; face with dense setae. Pronotum and mesoscutum with sparse, long, and pale setae, with narrow median glabrous areas on lateral lobes. Mesopleuron, metapleuron and propodeum with sparse setae laterally. Wings with dense short to medium setae, especially on wing margins. Hind coxa with sparse semi-erect setae. Hind femur with sparse setae. Hind tibia dorsally and laterally with dense short setae; tarsus with short and very fine setae. Metasoma with very sparse pale setae.

COLOUR. Body brown to dark brown, anterior half of metasoma dark reddish brown. Head brown. Antenna light brown. Palpi light brown to almost honey yellow. Legs brown; hind coxa reddish brown; trochanter and trochantellus light brown; hind femur brown; hind tibia brown, light brown in basal third; tarsus light brown, tarsal claw brown. Fore wing hyaline, slightly infuscate below pterostigma; pterostigma dark brown. Hind wing entirely hyaline.

#### Male

Unknown.

#### Distribution

Specimens of this species were collected in Rio Caraguata in the state of Mato Grosso, and Nova Teutonia in state of Santa Catarina, Brazil.

#### Host

Unknown.

### *Hecabolus mexicanus* Zaldívar-Riverón & Belokobylskij, 2009

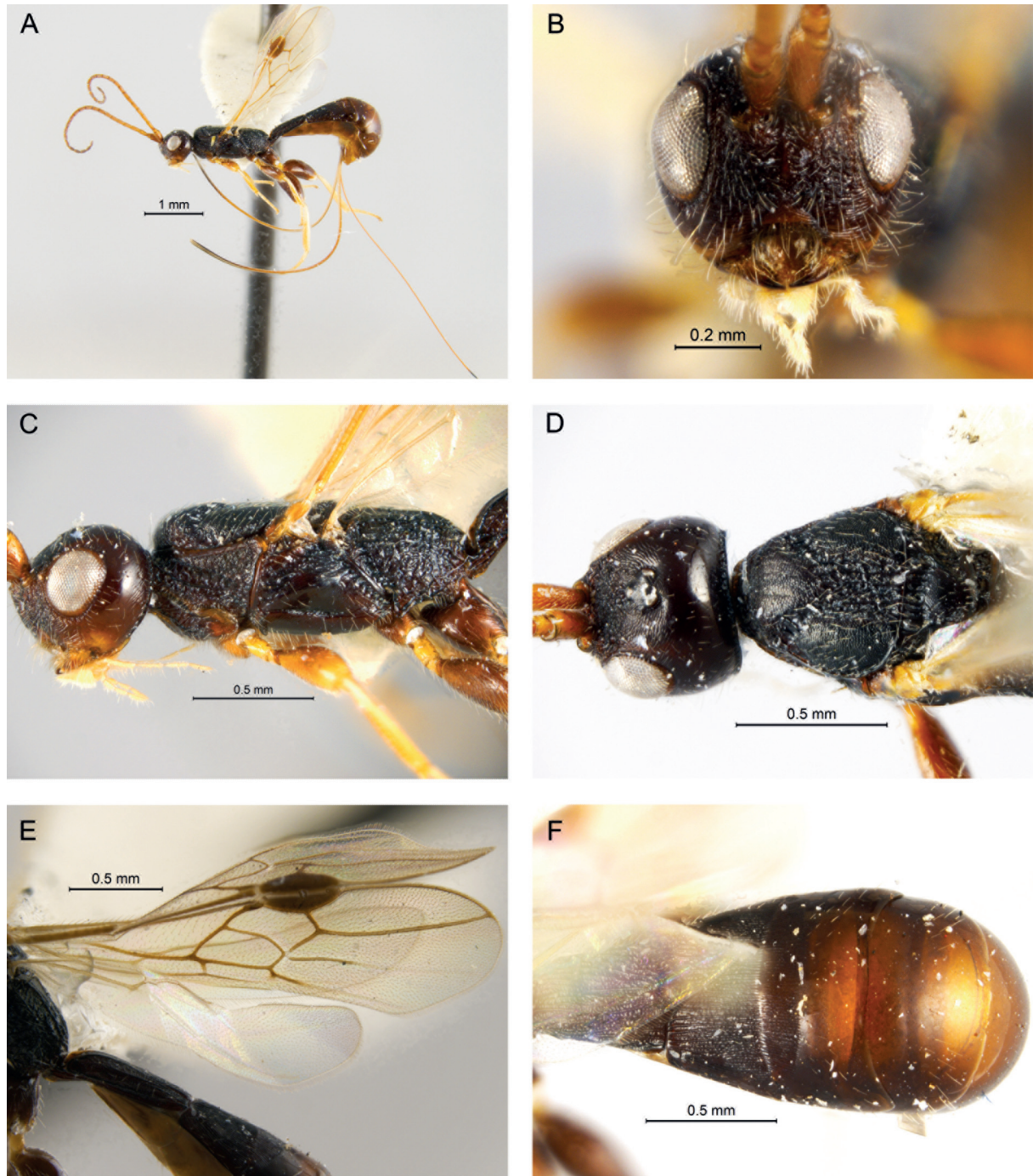
Figs 6–7

#### Material examined

MEXICO – **Jalisco** • 1 ♀; Chamela Biological Station, Calandria road, near laboratory; 19.50501° N, 105.03791° W; alt. 34 m; 16–17 Jun. 2017; Alejandro Zaldívar-Riverón and Hans Clebsch leg.; UVLT (3) [Ultraviolet light 3], selva baja caducifolia [dry forest]; DNA voucher no. CNIN4388; CNIN-IBUNAM • 1 ♀; Chamela Biological Station; 19.4986° N, 105.04411° W; alt. 122 m; 10 Aug. 2010; Zaldívar, Salinas and García leg.; light trap, selva baja caducifolia; BOLD ASDOR: 859; Cham-70; CNIN-IBUNAM • 1 ♂; Chamela Biological Station, 50 m from lab; 19.49923° N, 105.04388° W; alt. 101 m; 9–10 Aug. 2010; A. Zaldívar, V. Salinas, Mario-García and Vladimir de Jesús leg.; light trap, selva baja caducifolia; Cham-68; CNIN-IBUNAM • 1 ♂; Chamela Biological Station, Calandria road; 19.50485–19.50369° N, 105.03786–105.03642° W; alt. 45–62 m; 23 Feb. 2010; Alejandro Zaldívar leg.; sweep net, selva baja caducifolia; BOLD ASDOR: 609; Cham-51; CNIN-IBUNAM • 1 ♀; San



Buenaventura; 19°47.61' N, 104°03.32' W; alt. 720 m; 2–7 Dec. 1996; V.H. Toledo, M.E. Guardado, A. Soria, S. Zaragoza and L.F. Novelo leg.; Malaise trap 5; CNIN-IBUNAM • 1 ♀; same collection data as for preceding; 30 Apr.–4 May. 1997; F.A. Noguera, M.E. Guardado, A. Soria, C.A. Uribe, A. Rodríguez, S. Zaragoza, E. Ramírez and L.F. Novelo leg.; Malaise trap 3; CNIN-IBUNAM. – **Mexico City** • 3 ♀♀; Federal District; “*Hecabolus* sp. Det. José A. Sánchez G., [19]98”; CNIN-IBUNAM.

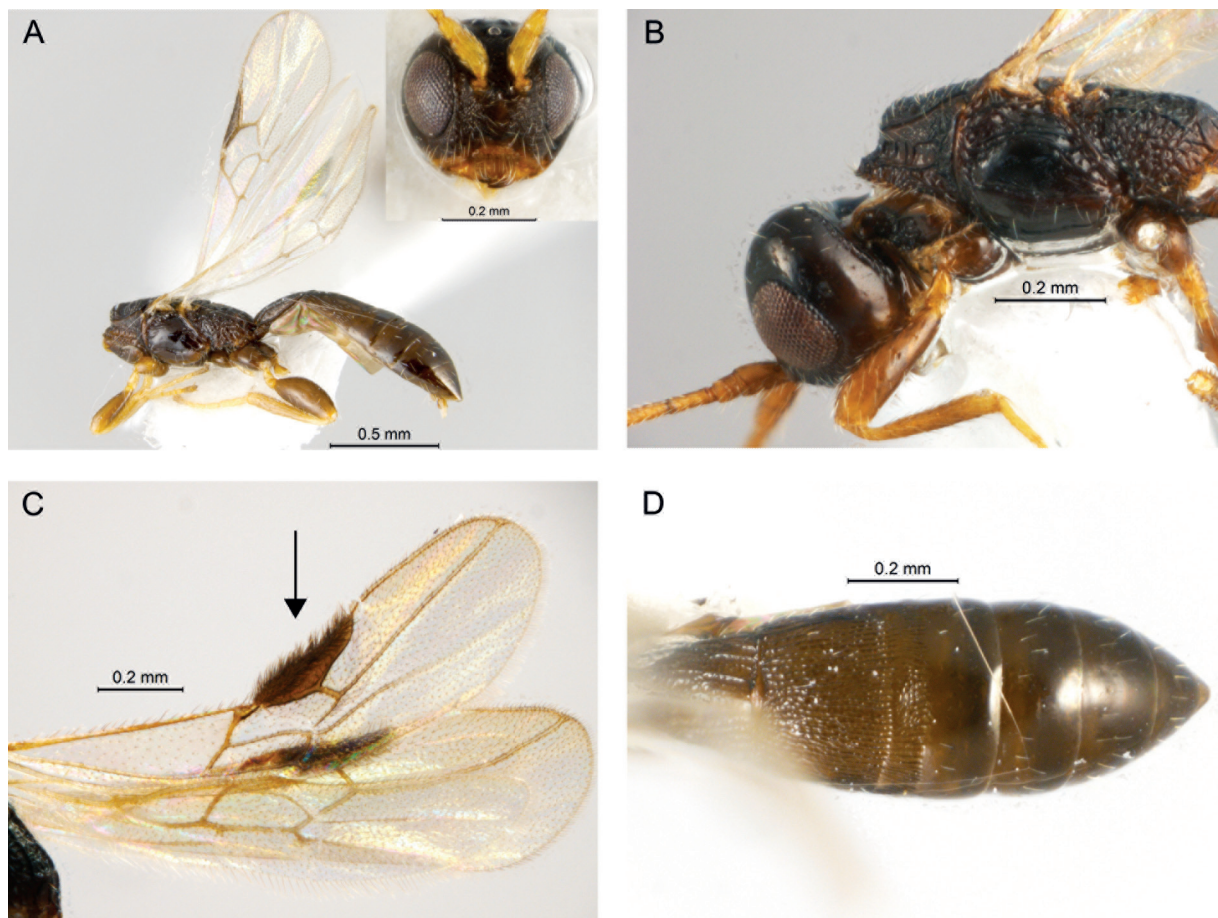


**Fig. 6.** *Hecabolus mexicanus* Zaldívar-Riverón & Belokobylskij, 2009, ♀ (CNIN-IBUNAM). A. Habitus, lateral view. B. Head, frontal view. C. Mesosoma, lateral view. D. Mesosoma, dorsal view. E. Fore and hind wings. F. Metasoma, dorsal view.

## Variation

### Females (Fig. 6A–F)

Body length 3.2–5.3 mm. Fore wing length 1.9–3.2 mm. Ovipositor length 2.7–5.2 mm,  $1.3\text{--}2.3 \times$  as long as metasoma. Vertex very finely striate to smooth medially, sometimes entirely smooth. Frons distinctly, weakly-curvedly, and transversely striate near ocelli, with a rugose shallow depression near antennal sockets. Face transversely striate to rugose. Antenna more or less thickened, weakly setiform, with 21–22 flagellomeres. Scapus more or less narrow and long, sometimes slightly curved,  $1.8\text{--}2.0 \times$  as long as its maximum width; last flagellomere pointed apically,  $0.5\text{--}0.7 \times$  length of scapus. Mesopleuron smooth in lower 0.6, coarsely longitudinally striate in upper 0.4, finely and densely striate in posterior lower corner, sometimes very finely coriaceous near precoxal furrow. Vein m-cu of the hind wing almost straight, weakly oblique towards base of wing and unsclerotized, sometimes very poorly defined, almost spectral. Hind coxa dorsally and ventrally striate, smooth medially, inner lateral part completely striate; coxa sometimes completely striate. Hind femur wide,  $2.0\text{--}2.5 \times$  as long as its maximum width. Basal sternal plate  $0.4\text{--}0.6 \times$  as long as first metasomal segment. First tergite entirely, densely, and longitudinally striate, without areas delimited by carinae. Second tergite entirely, and third in anterior  $0.1\text{--}0.3$  very densely longitudinally striate, remaining area of third tergite smooth. Remaining tergites smooth, sometimes very finely coriaceous. Ovipositor sheaths slender,  $1.3\text{--}2.0 \times$  as long as metasoma,  $0.8\text{--}1.0 \times$  as long as body,  $1.3\text{--}1.8 \times$  as long as fore wing. Body black to dark brown, sometimes light



**Fig. 7.** *Hecabolus mexicanus* Zaldívar-Riverón & Belokobylskij, 2009, ♂ (CNIN-IBUNAM). **A.** Habitus, lateral view; inset: head, frontal view. **B.** Mesosoma, lateral view. **C.** Fore wings showing pterostigma with dense dark setae (arrow). **D.** Metasoma, dorsal view.



brown. Metasomal tergites sometimes completely black or dark brown; in one specimen almost all tergites light brown but apical two tergites dark brown; in two specimens first two tergites completely and anterior half of third tergite dark brown, remaining tergites light brown; in one specimen anterior part of first tergite dark brown, posterior 0.3 light brown to honey-yellow, remaining tergites honey yellow. Head black, sometimes dark brown. Antenna brown, sometimes light brown. Mandibles dark brown to brown to light brown, sclerotized apically. Palpi yellow to pale yellow. Fore and middle coxae and femora light brown; trochanters, tibiae and tarsi honey yellow; hind coxa dark brown, hind femur brown to dark brown ventrally, trochanter and tarsi light brown; legs sometimes completely brown to dark brown; in one specimen fore coxa and fore femur honey yellow, middle and hind coxae and femora brown to dark brown, all trochanters, tibiae and most tarsi light yellow to pale yellow, tarsal claw dark brown to black. Fore and hind wings hyaline, sometimes fore wing faintly infusate. Pterostigma brown to dark brown.

#### **Male** (Fig. 7A–D)

Smaller than female. Body length 4.5–4.6 mm; fore wing length 2.9–3.0 mm. Antennae with more than 14 flagellomeres (apical segments missing); basal segments honey yellow to brown, apical segments brown to dark brown. Basal sternal plate 0.3–0.4 × as long as first segment. Hind femur 2.3 × as long as its maximum width. Fore wing pterostigma with thick, long, and very dense setae, sometimes with few, short, semierect setae; hind wing without stigma-like enlargement. Hind wing with rather short r-m, without vein RS; veins 2M, m-cu, and cu-a not sclerotized, very weakly defined. Both wings with a line of setae along margins. Body colour dark brown to black; all coxae and femora brown, tibiae light brown, trochanters, and tarsi light brown to honey yellow; tarsal claws brown to dark brown.

#### **Distribution**

The precise geographic records of this species are presented here for the first time, which include localities in the state of Jalisco and Mexico City in central Mexico.

#### **Hosts**

Unknown.

#### **Discussion**

Here, we describe four new species of the genus *Hecabolus* from South Brazil based on historical material deposited in the NHMUK. All these specimens were collected in the mid-20<sup>th</sup> century by Fritz Plaumann in South and Southwestern Brazil. These new species, together with those described by Sormus de Castro *et al.* (2013), make evident the high species richness of *Hecabolus* in Brazil. Moreover, this study emphasizes the importance of examining historical entomological material deposited in scientific collections for the discovery of new taxa.

We also provide here, for the first time, information about the morphological variation of both sexes of *H. mexicanus*, and also document its precise geographic distribution in two Mexican states in central Mexico (Jalisco and Mexico City). Further taxonomic and systematic studies combining both morphological and molecular data will help to elucidate the phylogenetic relationships and biogeographic history of this genus, which apparently has its main species diversity in South America.

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