

Synopsis of the genus *Diabroctis* Gistel, 1857 (Coleoptera: Scarabaeidae: Scarabaeinae) with a new species description

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Abstract

This paper provides a synopsis of the South American genus *Diabroctis* Gistel, 1858. Five species are assigned to the genus. The type species *D. mimas* is widely distributed and shows considerable morphological variation in male secondary sexual characters. A substantial number of morphological and geographic data are used to provide an updated diagnosis of this species, and to describe intraspecific variation. A new Brazilian species is described as *Diabroctis pseudomimas* **sp. nov.**, which has been recognized among specimens confused with *D. mimas* (Linnaeus) in entomological collections. Additionally, the subspecies *D. mimas venezuelensis* is elevated to species level. Lectotypes are designated for *Phanaeus mirabilis* and *Phanaeus mimaeformis*. Diagnoses, distribution data, and an identification key are provided for all species included in the genus.

Keywords

Coleoptera; *Diabroctis*; dung beetles; Taxonomy; new species; Phanaeini

ZooBank: <http://zoobank.org/20080F3D-B670-4FDF-9D99-0A2362DF0398>

Introduction

Phanaeini (Scarabaeidae: Scarabaeinae) is a monophyletic tribe of dung beetles comprising more than 180 species in 12 genera (Schoolmeesters 2018). Species are found from southwestern United States to southern South America (Edmonds 1972). The largest, colorful and ornamented species in Phanaeini have attracted the attention of amateur and professional taxonomists for centuries.

Of the genera comprising the tribe, the species in the genus *Diabroctis* Gistel, 1857 may be recognized by their large size; green to yellow metallic coloration; the presence of a transverse clypeal carina localized anteriorly to the cephalic process (bearing horns in the male); and the protarsus present in the female (Edmonds 1972). Sexual dimorphism is well developed in the species. In addition to the horns forming the cephalic process, males of *Diabroctis* have an anteriorly excavated pronotum with an enlarged pronotal process (d'Olsoufieff 1924; Edmonds 1972).

The genus includes three species: *D. mimas* (Linnaeus, 1758), *D. cadmus* (Harold, 1867), and *D. mirabilis* (Harold, 1877). Gistel (1857) originally described *Diabroctis* to allocate *Phanaeus mimas* (Linnaeus, 1758) (originally *Scarabaeus mimas*) the type species by monotypy. However, Gistel's work was overlooked by authors in the 19th century and d'Olsoufieff (1924) erected from *Phanaeus* the genus *Taurocopris* including *P. mimas* (Linnaeus) along with *P. mirabilis* from Brazil and *P. cadmus* from Colombia. Martínez and Pereira (1967) synonymized *Taurocopris* with *Diabroctis*, arguing that *P. mimas* was the type species of the two genera. However, Edmonds (1972) pointed out that d'Olsoufieff did not designate a type species for *Taurocopris*, and that the synonym of Martínez and Pereira (1967) was only generic. In order to maintain nomenclatural stability, Edmonds (1972) designated *Scarabaeus mimas* Linnaeus as the type species of *Taurocopris*, making it an objective synonym of *Diabroctis*.

The most recent work on the genus taxonomy was undertaken by Martínez and Clavijo (1990) who described a new subspecies, *D. mimas venezuelensis*, which was later synonymized with *D. mimas*. Despite the taxonomic stability of *Diabroctis*, there are doubtful distributional records that require more scrutiny. The genus has so far been considered as restricted to South America, but *P. mimaeformis* Ancy, 1880, a junior synonym of *D. cadmus* has its type locality in Costa Rica (Central America).

Diabroctis mimas has been considered as a widespread species in South America. Hitherto, it was recorded in 10 of the 12 South American countries and in French Guiana: Cayenne [French Guiana] and Suriname (Olivier 1789, 1790); Argentina (Bruch 1911); Guyana and Brazil (Gillet 1911); Uruguay and Paraguay (d'Olsoufieff 1924); Venezuela (Blackwelder 1944); Bolivia (Arnaud 2002); Colombia (Medina et al. 2001); and Peru (Horgan 2005).

Excluding *D. mimas*, the most widely distributed species in Phanaeini are in the genera *Coprophanaeus* Olsoufieff, 1924 and *Oxysternon* Laporte, 1840. The distribution of *C. lansifer*, the largest known species in the tribe (>50 mm in length), occurs across much of the Amazonian subregion. In addition, to its Amazonian distribution, *O. silenus* extends its range to the Mesoamerican provinces in Central America (Edmonds & Zidek 2004, 2010). Nevertheless, these species have a narrow ecological range since they have been recorded mostly in forested habitats. In dryer habitats they are replaced by the closely related species, *C. ensifer* and *O. palaemon*, respectively. In contrast, *D. mimas* appears to be a habitat generalist, able to occupy broader habitat and ecological niches. Its distribution covers very different types of ecoregions in the Brazilian and Chacoan subregions as defined by Morrone 2014.

A previous examination of *D. mimas* specimens from different localities demonstrated the existence of significant morphological variation in male secondary sexual characters. This paper aims to investigate whether this variation results from an as yet undescribed intraspecific variation of *D. mimas* or from unknown cryptic species that were not previously identified among *D. mimas* populations. To this end, a significant amount of morphological and geographic evidence was compiled to enable an updated diagnosis for *D. mimas* and all other species included in the genus. Additionally, the taxonomy of the genus is reviewed providing distribution data and an identification key to improve species identification.

Material and methods

A total of 295 adult specimens of *Diabroctis* were examined. The material was kindly provided by the curators (in parenthesis) of institutions as listed below.

- BMNH: The Natural History Museum, London, United Kingdom (Max Barclay and Malcolm Kerley).
- CEMT: Seção de Entomologia da Coleção Zoológica, Departamento de Biologia e Zoologia, Universidade Federal de Mato Grosso, Cuiabá, Brazil (Fernando Vaz-de-Mello).
- MIZA: Museo del Instituto de Zoología Agrícola, Universidad Central de Venezuela, Maracay, Venezuela (Luis Joly).
- MNHN: Muséum National d'Histoire Naturelle, Département Systématique et Évolution, Entomologie, Paris, France (Olivier Montreuil and Antoine Mantilleri).
- MNRJ: Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (Miguel A. Monné and Marcela L. Monné).
- MPEG: Seção de Entomologia da Coleção Zoológica, Museu Paraense Emílio Goeldi, Belém, Brazil (Orlando Tobias Silveira).
- MZUFPA: Coleção de Scarabaeinae do Museu de Zoologia, Instituto de Ciências Biológicas, Universidade Federal do Pará, Belém, Brazil (Fernando A. B. Silva).
- MZSP: Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (Carlos Campaner and Sonia Casari).
- IRSNB: Institut Royal des Sciences Naturelle de Belgique, Brussels, Belgium (Alain Drummont and Pol Limboure).
- ZMHB: Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (Manfred Uhlig and Fritz Hieke).

In describing external morphological structures, we generally followed Edmonds (1972) and Arnaud (2002). In *Diabroctis*, the diagnostic characters are generally linked with male's sexual dimorphic features such as the cephalic and pronotal process. As these features tend to vary allometrically with the body size, specimens descriptions and diagnosis were based on well-developed males (Figs. 1, 3–6). Examination of male

genital organs (aedeagus, endophallic sclerites) was undertaken to clarify the taxonomic differentiation of species. The terminology used to describe the endophallic sclerites of the male genitalia followed Tarasov & Solodovnikov (2011) and Tarasov & Génier (2015), with some modifications. For illustration and examination of endophallic sclerites, the endophallus was removed from the aedeagus through the basal foramen of the phallobase and illustrated in the right view (Fig. 6P). The lamella copulatrix was found to be taxonomically useful and was illustrated according to its position into the aedeagus at the right (Fig. 8A, D, G, J, M, P), dorsal (Fig. 8B, E, H, K, N, Q) and ventral view (Fig. 8C, F, I, L, O, R).

Labels of the type specimens are transcribed *verbatim*. Labels were separated by a slash (/) and lines in the same label by commas. Geographic distribution is given according to biogeographic dominions and provinces as defined by Morrone (2014). Distribution maps were made in Quantum GIS (QGIS version 2.10.1).

Taxonomy

Identification key to adult males of the genus Diabroctis

Sexual dimorphic characters are well developed in *Diabroctis*. Females are usually recognizable by the absence of horns on the posterior cephalic carina, except for *D. mirabilis* (Fig. 5D); the pronotum with an anterior arched carina (Figs. 1B, 3B, 4B, 5B–F, 6B–F); and the presence of protarsus. The pronotal and cephalic process in males show variation in the degree of development, with distinct major and minor forms. Minor males have shorter cephalic horns and a reduced pronotal process, which is likely to be confused with the female pronotum. In this case, the absence of protarsus in the males of *Diabroctis* is sufficient to separate the sexes.

1. Paramedian basal foveae of pronotum weakly-impressed (Fig. 5E). Clypeal margin distinctly bidentate (Fig. 5A). Cephalic process forming two long, recurved horns emerging from a single process with a pair of small central tubercles (Fig. 5C). Pronotal process pronounced into a transverse anterior carina, “M”-shaped (Fig. 5E)
Diabroctis mirabilis (Harold) (Brazil, Paraguay and Bolivia) (Figs. 5, 7J–L, 8M–O).
- Paramedian basal foveae of pronotum deeply impressed (Figs. 1F, 3F, 4F, 6E). Clypeal margin with two inconspicuous teeth. The Cephalic process forming two lateral and short horns emerging from transversal carina (Figs. 1E, 3E, 4E, 6C). Pronotal process bi or trilobulate (Figs. 1F, 3E, 4F, 6E) 2
2. Cephalic process with three short horns or tubercles (Fig. 6C); pronotal process with an acute lobe on each side; anterior portion of the pronotal process with transverse arched carina (Fig. 6E)
Diabroctis cadmus (Harold) (Venezuela and Colombia) (Figs. 6, 7M–O, 8P–R).
- Cephalic process forming transverse carina prolonged into short and conical horns on each side (Figs. 1E, 2E, 3E); pronotal process with three subtrapezoid lobes, two lateral and one anterior lobe (Figs. 1F, 3F, 4F) 3

3. Anterior lobe of the pronotal process with two tubercles separated by less than a tubercle width (Fig. 4F)
..... *Diabroctis pseudomimas* **sp. nov.** (Ceará, Brazil) (Figs. 4, 7G–I, 8J–L).
– Anterior lobe of pronotal process with two tubercles separated by at least twice their width (Figs. 1F, 3F) 4
4. Surface between clypeal transverse carina and cephalic process divided by a conspicuous, longitudinal carina; posterior portion of carina higher than its anterior portion (Fig. 1E, arrow); anterior margin of clypeus planar; clypeal transverse carina regularly arched (Fig. 1C, red arrow).....
..... *Diabroctis mimas* (Linnaeus) (South America) (Figs. 1, 7A–C, 8D–F).
– Surface between clypeal transverse carina and cephalic process with elevation only on median portion, limited on each side by slight depressions (Fig. 3E, white arrow); anterior margin of clypeus curved upward (Fig. 3E, black arrow); clypeal transverse carina irregularly arched, almost straight at its central portion (Fig. 3C, red arrow) *Diabroctis venezuelensis* Martínez & Clavijo **stat. rev.** (Venezuela) (Figs. 3, 7D–F, 8G–I).

Diabroctis Gistel, 1857

Diabroctis Gistel, 1857: 92; Edmonds, 1972: 820; Arnaud, 1982: 115; 2002: 18; Vaz-de-Mello, 2000: 193; Gámez, 2004: 51, 52; Vaz-de-Mello et al., 2011: 5, 10, 17, 24, 32, 39, 44, fig. 78; Hamel-Leigue et al., 2009: 60.

Taurocopris d'Olsoufieff, 1924: 18, 19 (figs 6, 7), 21, 61, 139, Plate III, fig. 7–9, 12; Pessôa, 1935: 33–35; Janssens, 1940: 2, 3; Pessôa & Lane, 1941: 473; Blackwelder, 1944: 208.

Type species

Scarabaeus mimas Linnaeus, 1758

Diagnosis

Diabroctis is a member of the New world tribe Phanaeini. The genus definition used here followed d'Olsoufieff (1924) and Edmonds (1972). According to those, *Diabroctis* might be distinguished from the other Phanaeini by presents a transverse clypeal carina anterior to the fronto-clypeal carina (cephalic process). In males, the cephalic process is armed with a pair of horn. In females, the posterior carina is usually blade-shaped, with horns only in *D. mirabilis* (Fig. 5D). Female also has retained the protarsus.

Remarks

In Phanaeini, the cephalic process is an high transverse carina located on the clypeo-frontal junction and this carina is only preceded by a clypeal blade-shaped carina in *Diabroctis*. The tuberculate cephalic carina in *D. cadmus* (male) and *D. mirabilis*

(female) resemble those of some *Coprophanaeus* Olsoufieff, 1924 species. In this later genus, the anterior clypeal carina is absent, and the posterior carina is distinctly or feebly trituberculate, with the median tubercle usually enlarged (Edmonds & Zidek 2010). In *Diabroctis*, only the males of *D. cadmus* have a trituberculate posterior cephalic carina, however, the median tubercle is smaller than the lateral tubercles (Fig. 6C). In the females of *D. mirabilis* the posterior carina bears only two median tubercles (Fig. 5D).

Distribution

South America, except Chile and Ecuador.

Phylogenetic information

Although scarce, phylogenetic studies including *Diabroctis* support the monophyly of the genus. However, its relationship with other genera of Phanaeini remains unclear. Edmonds's (1972) topology has not resolved phylogenetic affinities within phanaeines (which are not referred to as a tribe by Edmonds), and Phillips et al. (2004) have found *Diabroctis* to be close to some species groups of *Sulcophanaeus* d'Olsoufieff, 1924. Using one nuclear (28S) and two mitochondrial (*cox1*, *rrnL*) genes, Monaghan et al. (2007) was the first study to include *Diabroctis* in a phylogenetic reconstruction based on molecular data, but did not include many genera of Phanaeini, such as the, possibly, closely related *Sulcophanaeus*. More recently, Tarasov and Dimitrov (2016) have provided a comprehensive phylogenetic hypothesis for suprageneric taxa of Scarabaeinae, also based on nuclear and mitochondrial gene data. The tribe Phanaeini was recovered as monophyletic, and *Diabroctis mimas*, representing the entire genus, was recovered as sister to *Coprophanaeus lancifer* (Linnaeus, 1767). The aforementioned relationship mitigated against the *Diabroctis-Sulcophanaeus* relationship given in the hypothesis of Phillips et al. (2004). Instead, *Sulcophanaeus* was recovered as sister to *Phanaeus* MacLeay, 1819 in the hypothesis of Tarasov and Dimitrov (2016). Nonetheless, taxon sampling by Tarasov and Dimitrov (2016) was poor in phanaeines and they have not chosen to fully resolve the internal relationships of the tribe. Hence, it is still uncertain if the relationship between *Coprophanaeus* and *Diabroctis* continues to be supported with the inclusion of more species of Phanaeini.

***Diabroctis mimas* (Linnaeus, 1758)** (Figs. 1–2, 7A–C, 8D–F, 9A)

Scarabaeus mimas Linnaeus, 1758: 347; 1767: 545; Fabricius, 1775: 25; 1781: 28; Olivier, 1789: 108; 1790: 156.

Copris mimas: Fabricius, 1801: 45.

Phanaeus mimas: McLeay, 1819: 127, 128; Hope, 1837: 15, 22; Castelnau, 1840: 81; Klug, 1841: 210; Harold, 1869: 1018; Nevinson, 1892: 6; Bruch, 1911: 190; Gillet, 1911: 85; Boucomont, 1928: 7.

Diabroctis mimas: Edmonds, 1972: 820; Arnaud, 1982: 117; 2002: 18; Martínez & Clavijo, 1990: 150; Vaz-de-Mello, 2000: 193; Hamel-Leigue et al., 2009: 60.

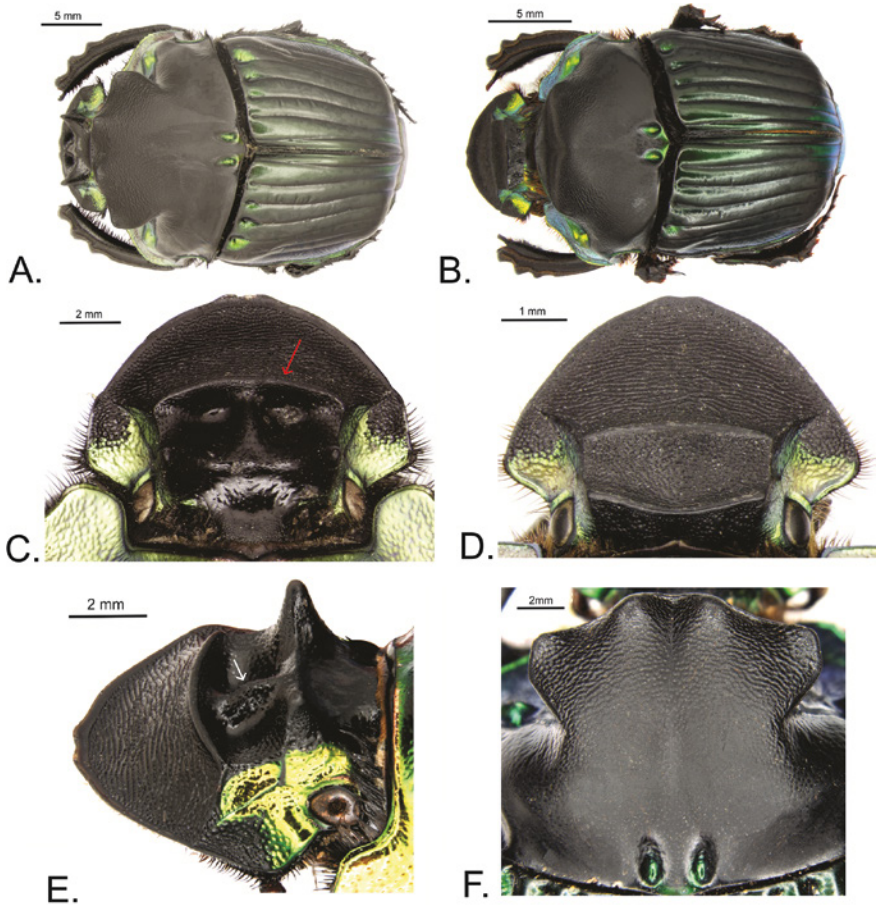


Fig. 1. *Diabroctis mimas*: (A) body, dorsal view, male; (B) body, dorsal view, female; (C) head, dorsal view, male; (D) head, dorsal view, female; (E) head, latero-dorsal view, male; (F) pronotal process, male.

Taurocopris mimas: d'Olsoufieff, 1924: 10, 15, 19, fig. 7, 22, 62, 140, Plate III, fig. 9; Pessôa, 1935: 35; Janssens, 1940: 2; Pessôa & Lane, 1941: 473–475, figs 80, 81; Blackwelder, 1944: 208.

Type information

The characteristics outlined by Linnaeus (1758) for *Scarabaeus mimas* in the original description match with a male specimen (*capite obsolete bicornis*), but it is not possible to affirm through the original description whether the type series is composed of a single specimen. According to Linnaeus (1758), the type was deposited at Martin Luther University Halle-Wittenberg (MLU) [and is currently at Uppsala University, Museum of Evolution, Zoology Section (UUZM)]. There is a catalogue of Linnaean type specimens deposited in this collection (see Wallin 2001). However, *Scarabaeus mimas* is not listed in that catalogue. Wallin has stated that the list of type specimens is not complete because, in many cases, Linnaeus did not label any of the specimens

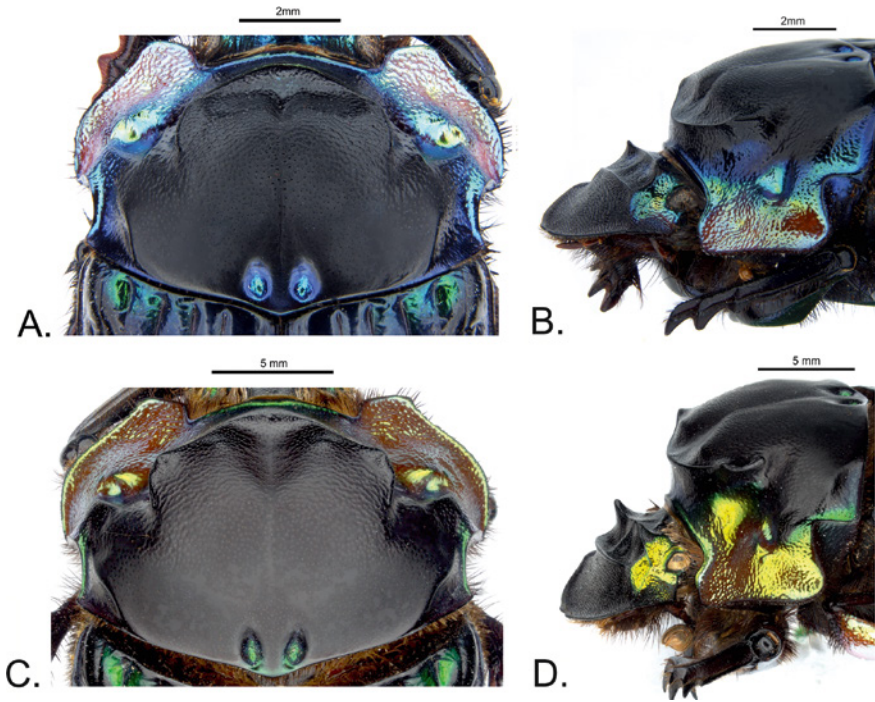


Fig. 2. Morphological variation of *D. mimas*. Minor male: (A) pronotal process, dorsal view; (B) head and pronotum, lateral oblique view. Intermediate male: (C) pronotal process, dorsal view; (D) head and pronotum, lateral oblique view.

included in the “Linnaean collection,” which makes the task of identification more difficult. We have not yet examined this collection and, therefore, further searching is required to locate the type series of this species. However, the original description, as well as the examination of a specimen of the Linnean Society of London (LSL) collection, which was identified by Linnaeus, are sufficient to confirm the identification of this species.

Diagnosis

Males of *Diabroctis mimas* may be distinguished from other *Diabroctis* species by the conspicuous, longitudinal carina on the surface between the clypeal transverse carina and cephalic process, and the posterior portion of the carina higher than its anterior portion (Fig. 1E, white arrow). Anterior margin of the clypeus planar, not reflexed upwards (Fig. 1E). Clypeal transverse carina is regularly arched (Fig. 1C, red arrow). Anterior lobe of the pronotal process with two tubercles separated by a shallow longitudinal sulcus, and the sulcus is at least twice the width of one tubercle (Fig. 1F). Length varies from 20–32 mm. Secondary sexual characters: females differ from males by the cephalic process forming a transverse carina, lacking lateral, conical horns, and by the presence of protarsus.

Morphological variation

Diabroctis mimas shows considerable intraspecific variations in color and body length (25–32 mm). Specimens have dorsal color pattern with a mixture of green, yellow, orange or blue reflections. The cephalic and pronotal processes seem to be in allometry with the body length. This relationship between body length and cephalic and pronotal process has been widely described in “armed” specimens of Phanaeini, where at least two different forms can be distinguished, being so-called “minor” and “major” specimens (Edmonds 2000; Edmonds & Zidek 2004, 2010, 2012; Cupello & Vaz-de-Mello 2013; Génier & Arnaud 2016). In *D. mimas* populations, minor males are smaller than 25 mm. They are hornless or have shorter cephalic horns and only an anterior transverse carina forming the reduced pronotal process (Fig. 2A–B). This male form resembles that of the female (Fig. 1B). An intermediate male form is also found in *D. mimas* populations (Fig. 2C–D).

Distribution and ecological information

Widely distributed in South America, except Chile and Ecuador, *D. mimas* is able to colonize a variety of habitats from the Brazilian and Chacoan subregions. This coprophagous species was found in Atlantic forest remnants, Amazonian forest, Caatinga, Cerrado, and Chaco. *D. mimas* has a preference for dry environments, with the majority of its records created in savanna-type habitats, where it is attracted with bovine, equine, and human feces.

Remarks

Arnaud (1982) has pointed out that the “single” type specimen of *Coprophanaeus costatus* (d’Olsoufieff 1924) [original designation *Phanaeus costatus*] is a “hybrid” combining the probody [head and part of the thorax] of a species of *Coprophanaeus* [misidentified by him as *Coprophanaeus jasius* (Olivier, 1789)] and the hindbody of a *Diabroctis mimas*. He synonymized the forebody with *Coprophanaeus jasius* (Olivier 1789) and the hindbody with *Diabroctis mimas*, mentioning the same synonymy in Arnaud (2002). Edmonds and Zidek (2010) have considered both halves together as the holotype of *Phanaeus costatus* d’Olsoufieff, a new synonym for *C. cyanescens* d’Olsoufieff, 1924. Since only one specimen can be chosen as the name bearer, the synonymies proposed by Arnaud and Edmonds and Zidek are invalid. According to Article 73.1.5 of the Code (ICNZ 1999), “if a subsequent author finds that a holotype which consists of a set of components is not derived from an individual animal, the extraneous components may, by appropriate citation, be excluded from the holotype.” It should be noted that d’Olsoufieff’s aim in describing the type as a species belonging to the genus *Phanaeus* suggests that he has relied primarily on the forebody characteristics to describe *P. costatus*. Therefore, the hindbody [*Diabroctis mimas*] is, here, excluded from the holotype of *Phanaeus costatus* d’Olsoufieff, 1924 in order to maintain nomenclatural stability, and cannot be considered for purposes of nomenclatural treatments according to Article 73.1.5 of the Code (ICNZ 1999).

Non-type material

BRAZIL, *Amapá*: 1♂ (MNRJ), Santana, Porto Santana (I.C.O.M.I), 02.vi.1961, C. M. Carvalho *leg.*; 1♂ (MPEG), Macapá, 16.i.1980, M. C. Lima *leg.*. *Pará*: 1♂, 1♀ (MPEG), vii.1982, Gorayeb *leg.*; 1♀ (MPEG), Paru do Oeste, iv.1966, W. França; 1♂ (MPEG), Vigia, 24.ii.1968, Barata *leg.*; 1♀ (MZUFPA), Fazenda Mangue Seco, 1998, Araujo *leg.*; 1♂, 1♀ (CEMT), v.2012; 1♂ (MPEG), Cassiporé i.1939, no collector; 1♂ (MPEG), Mosqueiro, 01.iv.1990, E. C. Cunha *leg.*; 1♂ (MPEG), Outeiro, Escola Bosque, 5.v.1993, W. França *leg.*; 1♂ (CEMT), Rio Xingú, Victoria no date, no collector; 1♀ (MNRJ), Mocajuba, Mangabeira, iv.1953, Orlando Rego *leg.*; 4♂ (MNRJ), iii.1953, Orlando Rego; 1♂ (MPEG), Belém, 27.iii.1989, R. Lisboa *leg.*; 1♀ (MNRJ), Utinga, 1927, E. May *leg.*; 1♂ (MNRJ), iii.1952, no collector; 1♂ (MPEG), Belém, Campus MPEG, 13.iv.1993, W. França *leg.*; 1♀ (MPEG), Campus MPEG, iv.1979, no collector; 1♀ (MPEG), Utinga, 10.ix.1960, Ynacio *leg.*; 1♀ (MNRJ), Óbidos, iv.1955, J. Brazilino *leg.*; 1♂ (MNRJ), Santarém, i.1923, J. F. Zikan *leg.*; 2♂ (MNRJ), iii.1923, no collector; 1♂ (MNRJ), i.1935, no collector; 9♂, 1♀ (MZUFPA) 19.iv.2011, Victor Hugo *leg.*; 1♂ (CEMT), 19.iii.1993, J. F. Zikán *leg.*; 1♂ (MNRJ), vi.1955, M. Silva *leg.*; 3♀ (MPEG), Bujaru, 25.ii.1978, P. Nolasco *leg.*; 1♂ (MPEG), 24.iii.1978, M. F. Torres *leg.*; 1♀ (MPEG), 2.ix.1979, R. B. Neto *leg.*; 1♂ (MPEG), Paragominas, 18.v.1978, I. S. Gorayeb *leg.*; 1♀ (MPEG), Serra Norte, Estação Fotoca, 20.iv.1983, M. F. Torres *leg.*. *Amazonas*: 1♂ (MNRJ), Manaus, 14.ix.1955, Elias & Roppa *leg.*; 1♂ (MNRJ), 09.iv.1957, no collector; 1♀ (MNRJ), vii.1955, no collector; 1♀ (MNRJ), 1941, Parko *leg.*; 1♀ (MNRJ), 02.i.1956, Elias & Roppa *leg.*; 1♀ (MPEG), Santa Ines, 05.x.1978, P. Mauricio *leg.*; 1♀ (MPEG), Rio Uapés, iv.1960, Hidosi *leg.*; 1♂ (MNRJ), Itacoatiara, vi.1952, Orlando Rego *leg.*; 2♂, 2♀ (CEMT), Barreirinha, ix.1989, no collector. *Acre*: 1♀ (CEMT), Rio Branco, xi.2009, A. M. Oliveira *leg.*; 1♀ (CEMT), 12.vii.1996, P. A. C. Brito *leg.*. *Rondônia*: 1♂, 1♀ (CEMT), Guajara-Mirim, Fazenda benezi (10°44'53.56"S, 65°17'31.10"W), 170 m, Pasto, pitfall fezes humanas, 16.ii.2010, F. Coletti *leg.*; 2♂ (CEMT), (10°44'S, 65°17'W), ii.2010, F. Coletti *leg.*; 1♀ (CEMT), (10°45'S, 65°19'W), 170 m, Pasto fezes humanas, ii.2010, F. Coletti *leg.*; 1♂ (CEMT), Vilhena, x.1986, M. Alvarenga *leg.*; 1♂ (MPEG), 24.ii.1961, Becheyné *leg.*. *Tocantins*: 4♂ 2♀ (MNRJ), Lagoa da confusão, Ilha do bananal, Aldeia Karajá, Santa Isabel do Morro, xi.1955, A. Sarmiento *leg.*; 1♂ (MZUFPA), Miracema, UHE, 15.x.2001, Lajetado *leg.*. *Maranhão*: 1♂ (MZUFPA), Reserva Biológica Gurupi (03°14'05"S, 46°41'83"W), 07-15.i.2011, F. Limeira-de-Oliveira, M. M. Abreu & D. W.A. Marques *leg.*. *Ceará*: 1♂ (CEMT), Ubajara, PN Ubajara, Trilha da Samambaia (3°50'19"S, 40°53'58"W), 880m, 17.ii.2013, pitfall, hum. dung, Vaz-de-Mello & Grossi *leg.*; 1♂ (CEMT), (3°50'26"S, 40°54'29"W), 830m, no collector. *Piauí*: 1♀ (CEMT), S. R. Nonato, P. N. S. da Capivara, i.1999, C. A. Matrangolo *leg.*. *Pernambuco*: 1♂ (MZUFPA), Pombos, 22.x.2006, F. A. Silva *leg.*; 3♂ (MZUFPA), Caruaru, Brejo Novo, (8°42'S, 35°15'W), F.A.B. Silva et al. *leg.*; 1♂ (CEMT), (7°54'19"S, 35°03'27"W), V.A Leão *leg.*. *Bahia*: 1♀ (CEMT), i.2013, P. A. Schmidt *leg.*; 1♂, 2♀ (CEMT), Cruz das Almas, vi.1997, O.M. Marques *leg.*. *Mato Grosso*: 2♂ (MNRJ), Rio Culuene, 1947, J.C.M. Carvalho *leg.*; 1♂ (CEMT), Barra do Garça, 1988, Serrano *leg.*; 1♂, 1♀ (MNRJ), Vila Bela da Santíssima Trindade, iv-1955, M. Braz *leg.*;

1♂ (MZUFPA), Tangará da Serra, Collections students UNEMAT, no collector; 1♀ (CEMT), (17°21'S, 56°41'W), 2010, no collector; 1♀ (CEMT), Poconé, vi.1998, Serrano *leg.*; 1♂ (MNRJ), Nova Xavantina, xi.1946, no collector; 1♀ (CEMT), Campo Verde, 24.x.2009, G. A. Hubner *leg.*; 1♀ (MPEG), Barra dos Burgres, Serra das Araras, 24.i.1986 M. Zanute *leg.*; 1♂ (CEMT), Cáceres, Fazenda Baia da Pedra, iii.2009, D. Pinheiro *leg.*; 1♂, 1♀ (CEMT), Rondonópolis, Fazenda Mônica, (17°32'S, 60°45'W), 28.xii.1990, W. C. Eller *leg.*; 1♂, 1♀ (CEMT), 28.xii.1990, C. Eller *leg.*; 1♂ (CEMT), São Vicente, 17.x.1984, I. Gomes *leg.*; 1♂ (MNRJ), Porto Espiridião, xi.1984, P. Magno & M. Alvarenga *leg.*; 1♀ (CEMT), Lucas do Rio Verde, 15.vi.2009, R. J. Silva *leg.*; 1♀ (MNRJ), Alto Xingu, Capitão Vasconcelos, xi.1958, R. Arle *leg.*. *Mato grosso do sul*: 1♂ (CEMT), Campo Grande, 1997, Gianchin *leg.*; 1♂ (CEMT), Corumbá, Fazenda São Bento, (17°21'S, 56°41'W), iv.2012, F.R. Tortato *leg.*; 1♀ (CEMT), iii.2012; 1♀ (CEMT), xii.2010; 1♂ (CEMT), iii.2013; 2♂ (CEMT), (17°21'32"S, 56°41'55"W), 28.iv.2009, Rossini *leg.*; 2♂ (CEMT), (17°21'S, 56°41'W), 13-ix-2011, R. V. Nunes *leg.*; 1♂ (MNRJ), Porto Murtinho, xi.1924; 1♀ (MNRJ), xi.1929; 1♀ (MNRJ), xi.1927; 1♂ (CEMT), Bodoquena, Canaã, (2043'23"S, 5644'49"W), 17.xi.2008, Pitfall fezes, pasto, M.M. Rodrigues *leg.*; 1♂ (MNRJ), Jaraguá, xii.1935, W. Zikan *leg.*; 1♂ (CEMT), Corumbá, Porto Jofré, Faz. São Bento, iv.2011, F.R. Tornato *leg.*. *Goiás*: 1♂ (MNRJ), Anápolis, no date and collector; 1♀ (CEMT), Bom Jardim, xii.1996, Lima *leg.*. *Distrito Federal*: 1♂ (CEMT), Brasília, xii-1987, C. Godinho *leg.*. *Minas Gerais*: 2♀ (CEMT), Divisa Alegre, xi.1997, C. Godinho *leg.*; 1♀ (MNRJ), Caldas, v.1915, no collector; 1♂ (MNRJ), Pirapora, 1954, no collector; 3♂, 1♀ (CEMT), Paraopeba, (20°43'23"S, 56°44'49"W), iii.1997, S. Lourenço-Jr *leg.*; 1♀ (MNRJ), Tapirarés, 1940, Carvalho *leg.*; 1♀ (MNRJ), Guaxupé, x.1925, no collector; 2♂ (CEMT), Montes Claros, i.2002, G. D. L. Leite *leg.*; 1♂ (CEMT), Águas Vermelhas, xii.1997, A. Bello & Vaz-de-Mello *leg.*; 1♂ (CEMT), Águas Vermelhas, xi.1992, Grossi *leg.*. *Espírito Santo*: 1♂ (CEMT), São Mateus, 01.xi.1999, E. V. Cristé *leg.*; 1♀ (CEMT), Pinheiros, 10.x.1995, D.H.F Gagno *leg.*. *São Paulo*: 1♂ (MNRJ), xii.1936, F. Campos *leg.*; 2♂, 2♀ (MNRJ), no date, Melzer *leg.*; 1♂ (MNRJ), Araçatuba, 20.i.1935, no collector; 1♀ (MNRJ), Marília, xi.1945, H. Zellibor *leg.*; 1♀ (MNRJ), São Caetano do Sul, 1933, no collector; 2♂ (MNRJ), Angatuba, i.1922, A. Marques *leg.*; 1♂ (CEMT), Tabapuá, (10°45'S, 65°19'W), 22.ii.1999, M. Franzote *leg.*; 1♂ (MNRJ), Campinas, C. Rezende *leg.*; 1♀ (MNRJ), São Caetano do Sul, 1993, no collector. *Paraná*: 1♂ (CEMT), Rancho Alegre, Fazenda Congonhas, 28.xi.2012, J. Lopes & P. M. Felix *leg.*; 2♀ (MNRJ), Rolândia, i.1952, A. Maller *leg.*. *BOLIVIA, Santa Cruz*: 1♂1♀ (CEMT), São José de Chiquitos, bosque chiquitano, (17°32'S, 60°45'W), 265m, 19.i.2010, Vidaure et al. *leg.*; 1♂, 1♀ (CEMT), San Ignacio de Velasco, (16°24'S, 61°11'W), 16.i.2010, Bosque Chiquitano, 430m, Vidaure *leg.*

***Diabroctis venezuelensis* Martínez & Clavijo, 1990 stat. rev.** (Figs. 3, 7D–F, 8G–I, 9B)

Diabroctis mimas venezuelensis Martínez & Clavijo, 1990: 147–152; Arnaud, 2002: 18; Gámez, 2004: 48, 51, 52.

Type material

Holotype ♂ (MIZA): HOLOTIPO ♂ *Diabroctis mimas venezuelensis* Martínez y Clavijo [red label]/ Venezuela, Portuguesa, Araure, 1978/ Col. M. Guedez/ MIZA0019856, UCV–Venezuela/.

Alotype ♀ (MIZA): ALOTIPO ♀ *Diabroctis mimas venezuelensis* Martínez y Clavijo/ Tinaquillo, Venezuela, Cojedes m. 15-V-1978/ Col. C. Ortega/4. Em casa en el jardín/ MIZA0019857, UCV – Venezuela/.

Diagnosis

Males of *Diabroctis venezuelensis* may be distinguished from other *Diabroctis* species by the surface between the clypeal transverse carina and cephalic process with weak elevation, limited on each side by a smooth depression, surface of elevation punctate (Fig. 3E, white arrow). Clypeal transverse carina irregularly arched, almost straight at its central portion (Fig. 3C, red arrow). Anterior margin of clypeus curved upward (Fig. 3E, black arrow); anterior lobe of the pronotal process with two tubercles separated by longitudinal sulcus; sulcus with three times the width of one tubercle (Fig. 3F). Anterior tooth of lateral lobe of the pronotal process curved upward (Fig. 3F). Length varies from 25–26.8 mm. *Aedeagus*. [lateral view]—parameres abruptly narrowed toward the apex (Fig. 7D). [dorsal view]—external margin of parameres slightly curved inward (Fig. 7E). *Endophallus*. Lamella copulatrix U-shaped (Fig. 8G); short arm 1/3 shorter than long arm. [dorsal view]—right margin of long arm sub-straight; left margin straight (Fig. 8H). [ventral view]—right margin of short arm slightly curved inward medially (Fig. 8I).

Non-type material

VENEZUELA, *Bolivar*: 1♂, 2♀ (CEMT), close to Rio Paraguaz, 100m, 15.v.2004; 1♂ (CEMT), *Portuguesa*: Araure, 1978; 1♀ (CEMT), Cojedes, Tinaquillo, 15.v.1978.

Remarks

Martínez and Clavijo (1990) first described *D. venezuelensis* as a subspecies of *D. mimas*. Arnaud (2002) regarded it as a junior synonym of *D. mimas*, without providing additional arguments to justify this assertion. Through the original description and photographs of the types (including those of male aedeagus), we recognized voucher specimens of *D. mimas venezuelensis* deposited in CEMT. These specimens were collected in Bolívar and Araure, Venezuela, the latter of which is the type locality of the subspecies. Examining external and male genital morphology under a comparative approach, we encountered characteristics supporting the specific status of *D. venezuelensis*. Within *Diabroctis*, *D. mimas*, *D. venezuelensis*, and *D. pseudomimas* **sp. nov.** now form a species complex with remarkably low interspecific variation. We, therefore, could not find sufficient characteristics to distinguish between the females of the three species. For the purposes of species identification, the concurrent examination of females and males from the same locality is recommended.

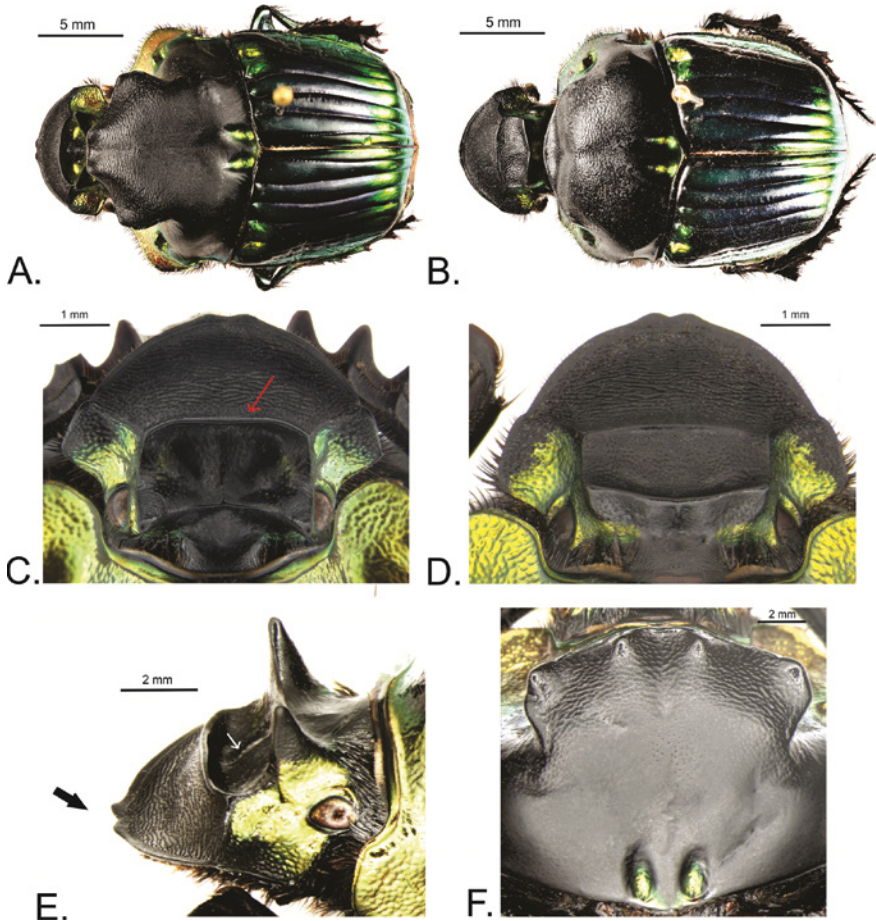


Fig. 3. *Diabroctis venezuelensis* **stat. rev.**: (A) body, dorsal view, holotype; (B) body, dorsal view, allotype; (C) head, dorsal view, male; (D) head, dorsal view, female; (E) head, latero-dorsal view, male (anterior portion of clypeus upward, black arrow); (F) pronotal process, male. Photographs by Marco Gaiani. Available on <http://tipos.miza-ucv.org.ve/es/type-catalog/diabroctis-mimas-venezuelensis>.

***Diabroctis pseudomimas* sp. nov.** (Figs. 4, 7G–I, 8J–L, 9B)

ZooBank: <http://zoobank.org/C1160867-1503-41B1-8959-5F7D9F87213D>

Etymology

The species name is a combination of the Greek “pseudo” (false) and *mimas*, the epithet of *Diabroctis mimas*, because specimens of this species were found mislabeled as *D. mimas* in collections. To be treated as a noun in apposition.

Type material

Holotype ♂ (CEMT): BRAZIL, *Pernambuco*: Itambé, 25–27.iv.2018, 7°24'37"S 35°06'46"W, T. Tomé *leg.*. PARATYPES: BRAZIL, *Pernambuco*: 4♂, 1♀ (MZUFPA)

Itambé, 25-27.IV.2018, 7°24'37"S 35°06'46"W, T. Tomé *leg.*; same data but 1♀ (CEMT); *Ceará*: 2♂ (CEMT), [no date], Dias da Rocha *leg.*; *Paraíba*: 1♂ (CEMT), João Pessoa, Cidade verde fragment, 20.ii.2018, Salomão, R. P. *leg.*; 3♀, 3 [unsexed] (CEMT), same locality, Cuia fragment, 20.ii.2018, Salomão, R. P. *leg.*; 1♀ (CEMT), Universidade Federal da Paraíba (UFPB), 19.ii.18, Salomão, R. P. *leg.*; 1♂, 1♀ (CEMT), same locality, Gole da fruta, 09.v.2017, Rodrigues, W. *leg.*; 2♂, 2♀ (CEMT), Bayeux, Xexem, 24.ii.2018, Salomão, R. P. *leg.*;

Diagnosis

Males of *D. pseudomimas* may be distinguished from other *Diabroctis* species by the surface between the clypeal transverse carina and cephalic process with a shallow, longitudinal carina (Fig. 4E, white arrow). Clypeal transverse carina regularly arched (Fig. 4C, red arrow). Anterior lobe of the pronotal process acuminate, with two tubercles separated by a narrow, longitudinal sulcus; the sulcus with less than a tubercle width (Fig. 4F). *Aedeagus*. [lateral view]—parameres abruptly narrowed toward the apex (Fig. 7G); [dorsal view]—external margin of parameres slightly curved inward medially (Fig. 7H). *Endophallus*. [dorsal view]—right margin of long arm slightly curved inward medially; left margin slightly curved outward at the basal portion (Fig. 8K); [ventral view]—right margin of short arm strongly curved inward; arm bowed at the apical portion (Fig. 8L).

Description. *Length*. 23.6–29.5 mm. *Color*. Posterolateral portion of the head, anterolateral surface and paramedian foveae of pronotum, the surface of elytral interstriae, hypomera, legs, the lateral portion of abdominal sternites and pygidium with yellow-green metallic sheen (Fig. 4A-F); other parts of the body black. *Head*. Clypeal edge semicircular and more margined than genal edge (Fig. 4C). Clypeus with two weak central teeth, separated by inconspicuous emargination (Fig. 4C). Ventral clypeal process as a transverse carina. Genal surface convex and scabrous on the anterior portion; posterior portion smooth. Surface of clypeus substrigulate; surface between ridges densely punctate; punctures noticeable only with high magnification (Fig. 4C). Cephalic process as a transversal carina bearing short and conical horns on each side. Surface between the horns densely punctated, bearing a median tubercle (Fig. 4C, 4E). Dorsal interocular width about six to seven times the eye width (Fig. 4C). Occipital ridge incomplete, and represented on the sides. *Pronotum*. Anteromedian portion widely excavated and bounded on each side by impressions. Anterolateral portion with yellow metallic coloration; surface areolate-rugose. Lateral edge of the pronotum with irregular curvature. Pronotal disc forming a process with three subtrapezoid lobes: two lateral and one central (Fig. 4F). Surface of the pronotal process opaque black, with transverse ridges. Paramedian basal foveae of the pronotum oval-shaped, deeply impressed, and separated by approximately the width of one of them; surface glossy with a green or blue metallic sheen (Fig. 4F). *Hypomera*. Slightly convex anteriorly, smooth, and lacking carina separating anterior and posterior portions; anterior surface with long, sparse setae. Lateral surface with a row of setae visible in the dorsal view. Posterior surface with dense setae. *Elytra*. Elytral striae deeply impressed (Fig. 4A),

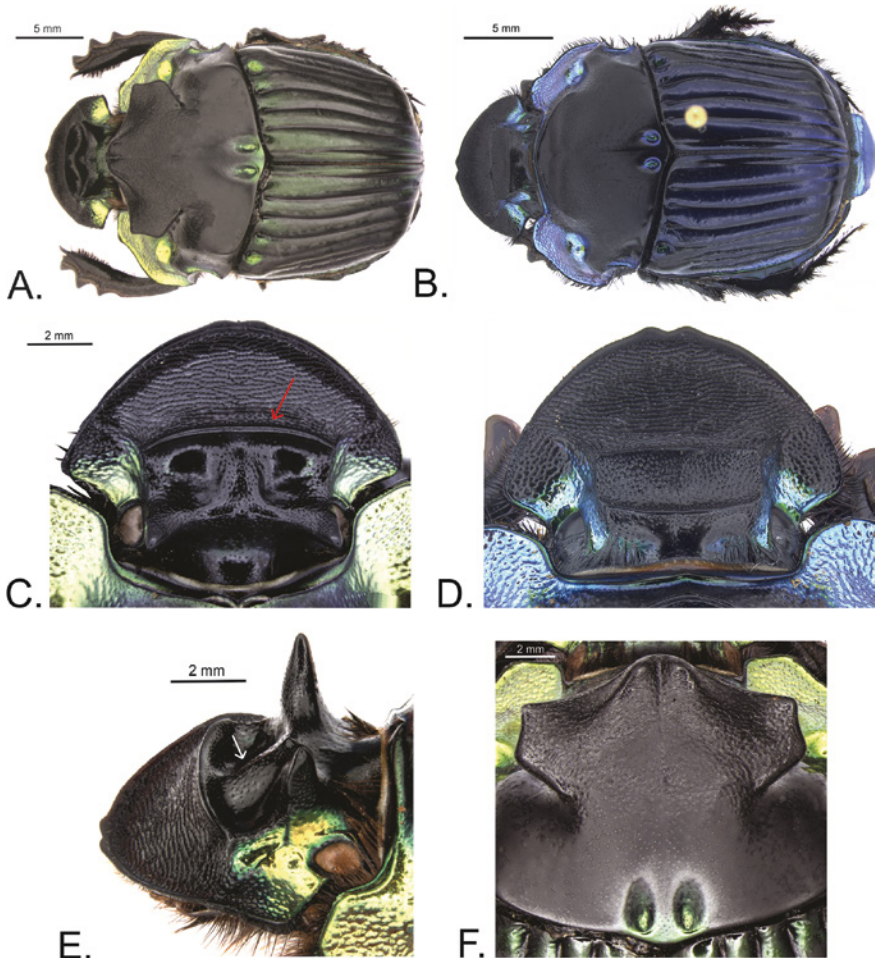


Fig. 4. *Diabroctis pseudomimas* sp. nov.: (A) body, dorsal view, male; (B) body, dorsal view, female; (C) head, dorsal view, male; (D) head, dorsal view, female; (E) head, latero-dorsal view, male; (F) pronotal process, male.

lacking punctures; large fovea, at least, on the base of striae III, V and VI. Interstitial surface strongly convex and smooth. Surfaces of the seventh and eighth interstriae with transversal ridges. *Legs*. External margin of the protibia tridentate. Ventral surface of the protibia with oblique ridges. Ventral surface of the femur with a yellow or green metallic sheen. Ventral surface of the profemur with dense setae on the posterior half. Ventral surface of the middle femur with long setae on the apical half. *Abdomen*. Abdominal sternites bear setigerous punctures and yellow-green metallic sheen on the lateral portion. *Pygidium*. Wider than long, finely margined. Disc with longitudinal ridges on the basal third; median and apical portions punctate, punctures shallow, separated by their diameter. *Aedeagus*. Parameres symmetric, 1/3 shorter than the phallobase (Fig. 7G–I). [ventral view]—the inner margin of the parameres curved outward

on the apical third; apex of parameres convergent (Fig. 7I). *Endophallus*. Lamella copulatrix U-shaped (Fig. 8J). Short arm 1/3 shorter than the long arm.

Remarks

Diabroctis pseudomimas **sp. nov.** and *D. mimas* seem to be closely related. As in *D. mimas*, specimens of *D. pseudomimas* **sp. nov.** vary in color, and have a remarkable variation in secondary sexual dimorphisms. The paratypes of *D. pseudomimas* **sp. nov.** usually have dorsal color pattern with green, yellow or blue reflections. The cephalic and pronotal processes seem to be in allometry with the body length, as observed in populations of *D. mimas*. The pronotal process is not useful to distinguish small specimens of *D. pseudomimas* **sp. nov.** from those of *D. mimas*. In this case, males with less developed allometric structures in *D. pseudomimas* **sp. nov.** may be distinguished from those of *D. mimas* by surface between the transverse clypeal carina and cephalic process with a shallow, longitudinal carina (Fig. 4E, white arrow), and parameres abruptly narrowed toward the apex (Fig. 7G).

The specific locality of two *D. pseudomimas* **sp. nov.** paratypes from the state of Ceará was not stated on labels. The handwriting labels of these specimens indicate only “Ceará, Brasil” and “Dias [da] Rocha” as the collector. According to Nomura (1964), Francisco Dias da Rocha (1869–1960) was a Brazilian naturalist who collected most of the specimens of his particular collection in Serra do Baturité, Ceará and neighboring areas. Therefore, somewhere between Fortaleza and the Serra do Baturité, located in the northern portion of Ceará, is here assumed as the probable locality for these two paratypes.

***Diabroctis mirabilis* (Harold, 1877)** (Figs. 5, 7J–L, 8M–O, 9B)

Phanaeus mirabilis Harold, 1877: 98; Nevinson, 1892: 6; Gillet, 1911: 85.

Taurocopris mirabilis: d'Olsoufieff, 1924: 15, 21, 62, 139, plate III, fig. 7, 12; Pessôa, 1935: 34, 35; Janssens, 1940: 2, 3; 1949: 6; Pessôa & Lane, 1941: 473, figs 82, 83; Blackwelder, 1944: 209; Pereira & Martínez, 1960: 54.

Taurocopris luederwaldti Pessôa, 1935: 33, 34; Janssens, 1940: 3; Pessôa & Lane, 1941: 473, 474, fig. 84; Blackwelder, 1944: 209; Pereira, 1949: 245; Pereira & Martínez, 1960: 54.

Taurocopris mirabiliformis Janssens, 1940: 3, 4, 5; 1949: 6.

Diabroctis mirabilis: Edmonds, 1972: 820; Martínez & Clavijo, 1990: 150; Vaz-de-Mello, 2000: 193; Arnaud, 2002: 18; Hamel-Leigue et al., 2009: 60.

Type material and lectotype designation

A lectotype is hereby designated for *Phanaeus mirabilis* in order to fix the name in a single bearing-type and stabilize taxonomic nomenclature. This lectotype was chosen among the two available syntypes deposited in ZMHB, and it has the following labels:

v. Olf./ 26641/3. Lunus/ Brasilia/ mirabilis, Harold/ LECTOTYPE ♂, *Phanaeus mirabilis*, Harold 1877 [red label]/. Paralectotype labels: Brazil. v. Olf. S. L, Brasil/ 26641/3. PARALECTOTYPE ♂, *Phanaeus mirabilis*, Harold 1877/.

Holotype of *Taurocopris luederwaldti* Pessôa ♂ (MZSP): Brasil/ 1935/ [red label] HOLÓTIPO/.

Holotype of *Taurocopris mirabiliformis* Janssens ♀ (IRSNB): ♀/ Brésil?/ Le Moulte vend./ R. Mus. Hist. Nat., Belg. I. G. 12. 423/ A. Janssens det., 1940; *Taurocopris mirabiliformis* n sp, ♀ type./ TYPE [red label]/ cf. Bull. Mus., Hist. Nat. Belg., XVI, 1940, N° 14, pp. 4–5, pl.1./ A. Janssens det., 1948, *Taurocopris mirabilis* ♀, Harold/.

Diagnosis

Diabroctis mirabilis may be distinguished from other *Diabroctis* species by clypeal margin distinctly bidentate (Fig. 5A), and the paramedian basal foveae of pronotum weakly impressed (Fig. 5E–F). In males, cephalic process forms two long recurved horns emerging from a single process, with a pair of small tubercles on the central portion (Fig. 5C, arrows). Pronotal process with a transverse and high carina anteriorly; carina approximately “M”-shaped (Fig. 5E). Length varies from 23–23.3 mm. *Aedeagus*. [lateral view]—parameres with thin sclerotized region on central portion (Fig. 7J). [dorsal view]—external margin of parameres slightly curved inward medially (Fig. 7K). *Endophallus*. Lamella copulatrix I-shaped (Fig. 8M). Basal portion club-shaped (Fig. 8N–O). In females the cephalic process forms a transverse carina with two short and central horns emerging from a single process (Fig. 5D); lateral portion of carina with deep fovea on side of each horn. Anterolateral surface of pronotum with shallow foveolate punctures, densely distributed (Fig. 5F); anterior portion of the pronotal disc with a transverse and straight carina (Fig. 5F). Surface of pronotal disc black, densely punctuated; foveolate punctures became indistinct toward posterior portion; surface of portion smooth and green (Fig. 5F).

Remarks

The labels of the types and the original description of *D. mirabilis* indicate only “Brasilia” [=Brazil] as its type locality. The lectotype was collected by the naturalist Ignaz Franz Werner Maria von Olfers, who visited several localities from Rio de Janeiro, São Paulo, and Minas Gerais (Papavero 1971). He probably collected the specimens in one of those states. Our data and the literature records, support this supposition, according to which this species is distributed in the central portion of Brazil (States of Minas Gerais, Goiás, Rio de Janeiro, Mato Grosso, Mato Grosso do Sul, west of Bahia, and Distrito Federal).

Pessôa (1935) has described *Taurocopris luederwaldti* based on a less developed male from Brazil. According to the original description, this species may be distinguished from *D. mirabilis* mainly by the short and parallel horns of the cephalic process and its small body size (18 mm). However, Pereira and Martínez (1960) have cited this species as synonymous. Our examination of the *T. luederwaldti* holotype led us to agree with Pereira and Martínez that *T. luederwaldti* was based on a male of *D. mirabilis*.

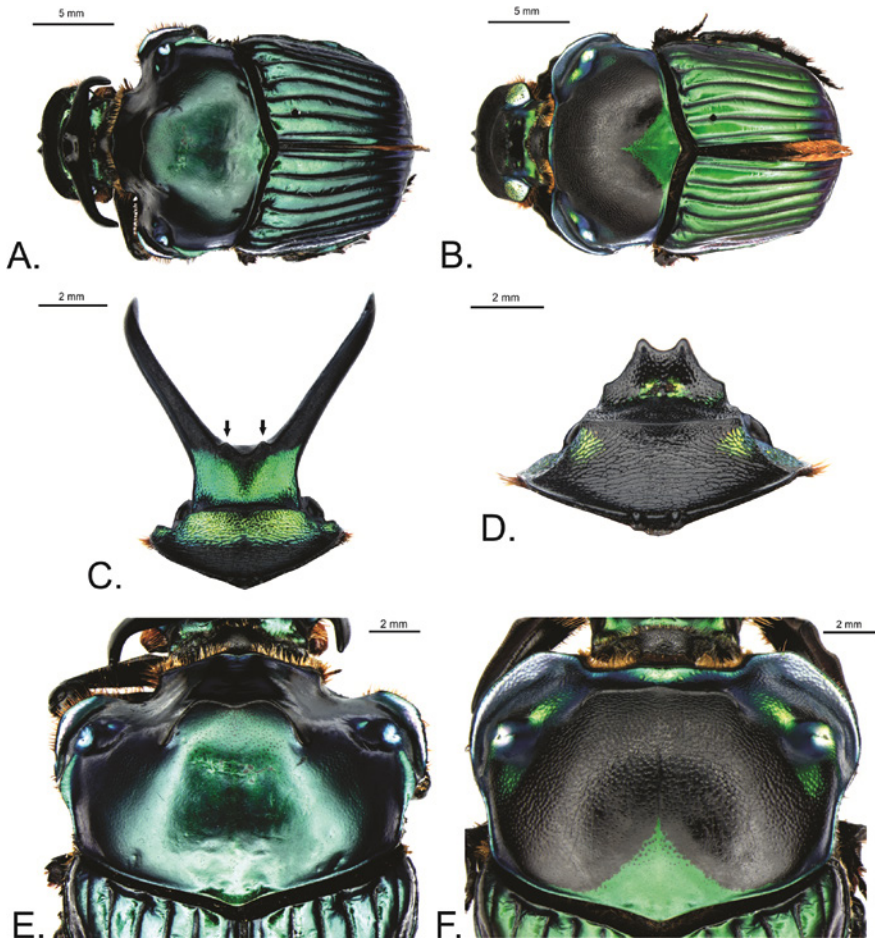


Fig. 5. *Diabroctis mirabilis*: (A) body, dorsal view, male; (B) body, dorsal view, female; (C) head, anterior view, male (arrows, median tubercles); (D) head, anterior view, female; (E) pronotum, male; (F) pronotum, female.

The cephalic and pronotal characteristics vary largely between sexes of the *Diabroctis* species. In 1940, Janssens has described another species that is similar to *D. mirabilis*. Based on a single female, the species was named as *Taurocopris mirabiliformis* and could be distinguished by a cephalic process with two small medial horns and a distinct color pattern on the pronotum and elytral striae. Janssens (1949) cited *T. mirabiliformis* in synonymy with *D. mirabilis*. We have verified that the type of *T. mirabiliformis* is a female of *D. mirabilis*.

In 1830, Perty described *Phanaeus planicollis*, but Castelnau (1840), probably due to a misidentification, provided a description for Perty's species that is compatible with a specimen of *D. mirabilis*. For this reason, the name *Phanaeus planicollis* Castelnau, 1840 was cited as a synonym of *D. mirabilis* by many authors (Nevinson 1892; d'Olsouffief 1924; Blackwelder 1944; Gillet 1911). However, *P. planicollis* must be

attributed to Perty (1830) and currently is considered a junior synonym of *Phanaeus kirbyi* Vigors, 1825.

Distribution

Known from Brazil (Bahia, São Paulo, Mato Grosso, Distrito Federal, Minas Gerais and Goiás), Paraguay (Amanbay) and Bolivia (Santa Cruz).

Non-type material

BRAZIL, *Bahia*: 1♂ 3♀ (CEMT), Barreiras, Fazenda Girasol (11°51'S, 46°10'W), i.2003, P. A. Schmidt *leg.*; 1♀ (CEMT), Fazenda Girasol (11°50'S, 46°10'W), ii.2010, R. V. Nunes *leg.*. *Mato Grosso*: 2♂ (CEMT), Chapada dos Guimarães, i.2013, V. Lemos *leg.*; 1♀ (CEMT), ii.2012, L. M. Peluso *leg.*; 1♂ (CEMT), i.1990; 1♀ (CEMT), iii.2013, G. Moraes *leg.*; 1♀ (CEMT), xi.1991, K. A. Aquino *leg.*; 1♀ (CEMT), Paredão do Eco, (15°20'9"S, 55°47'17"W), iii.2011, R. V. Nunes *leg.*; 1♀ (CEMT), Cidade de Pedra (15°18'3"S, 55°50'22"W), iii.2011, no collector; 1♀ (CEMT), Buriti (15°24'51"S, 55°46'57"W), no collector; 1♀ (CEMT), Escola Buriti, v.1985, JD Ponte & C. Strusmann *leg.*; 1♀ (CEMT), Uirapuru, Chapada dos Parecis, xii.2001, A. Foucart *leg.*; 1♀ (CEMT), (14°17'S, 59°15'W), xii-2001, R.V. Nunes & A. Foucart *leg.*; 2♀ (CEMT), Cuiabá, Fazenda Toa Toa, (15°20'30"S, 55°51'22"W), ii.2011, R. V. Nunes *leg.*; 1♂, 1♀ (CEMT), Fazenda Mutuca, (15°21'18"S, 55°58'6"W), iii.2013, G. M. Daniel *leg.*; 1♀ (CEMT), x.1999, J.S. Couto; 1♂, 1♀ (CEMT), Rio do Forte, x.1991, M.T. Santos *leg.*; 1♂ (CEMT), Itiquira, Fazenda Espigão, (17°19'20"S, 53°50'47"W), iii.2012, FP Florêncio *leg.*; 2♂ (CEMT), Tangará da Serra, no collector; 1♀ (CEMT), Santo Antônio Levensger, v.2011, J. Maia *leg.*; 1♂ (CEMT), Diamantino, Vale da Solidão, (14°22'23"S, 56°7'25"W), i.2009, D.C.T. Oliveira *leg.*; 1♂ (CEMT), Rio Arinos, x.1998, E. Furtado *leg.*. *Goiás*: 1♂ (CEMT), Luziânia, i.1976, A. Bello *leg.*. *Distrito Federal*: 28♂ 36♀ (CEMT), Brasília, ESEC Águas Emendadas, (15°32'31"S, 47°36'49"W), xi.2009, M. Frizzas *leg.*; 2♂ (CEMT), Parna Brasília, x.1999, M. F. Simon *leg.*; 1♂ (CEMT), RE IBGE, x.1997, IR Diniz *leg.*. *Minas Gerais*: 2♂, 1♀ (CEMT), Diamantina, Campus UFVJM, xii.2005, S. L. Assis-Junior *leg.*; 2♂ (CEMT), Januária, APA Pandeiros, (15°30'52"S, 44°54'60"W), xi.2008, J. G. Mota-Souza *leg.*. *Mato Grosso do Sul*: 2♀ (CEMT), Dourados, x.2008, M. M. Rodrigues *leg.*; 1♂ (CEMT), Aquidauana, (20°26'30"S, 55°36'56"W), x.2010, C. M. A. Correa *leg.*. PARAGUAY: *Amanbay*: 1♂3♀ (CEMT), Cero corá, i.1994, Dreschel *leg.*

Diabroctis cadmus (Harold, 1868) (Figs. 6, 7M–O, 8P–R, 9B)

Phanaeus cadmus Harold, 1868: 82; 1869: 1017; Dejean, 1837: 155; Nevinson, 1892: 2; Gillet, 1911: 81.

Phanaeus mimaeformis Ancey, 1880: 205; Nevinson, 1892: 2; d'Olsoufieff, 1924: 63; Bates, 1887: 387.

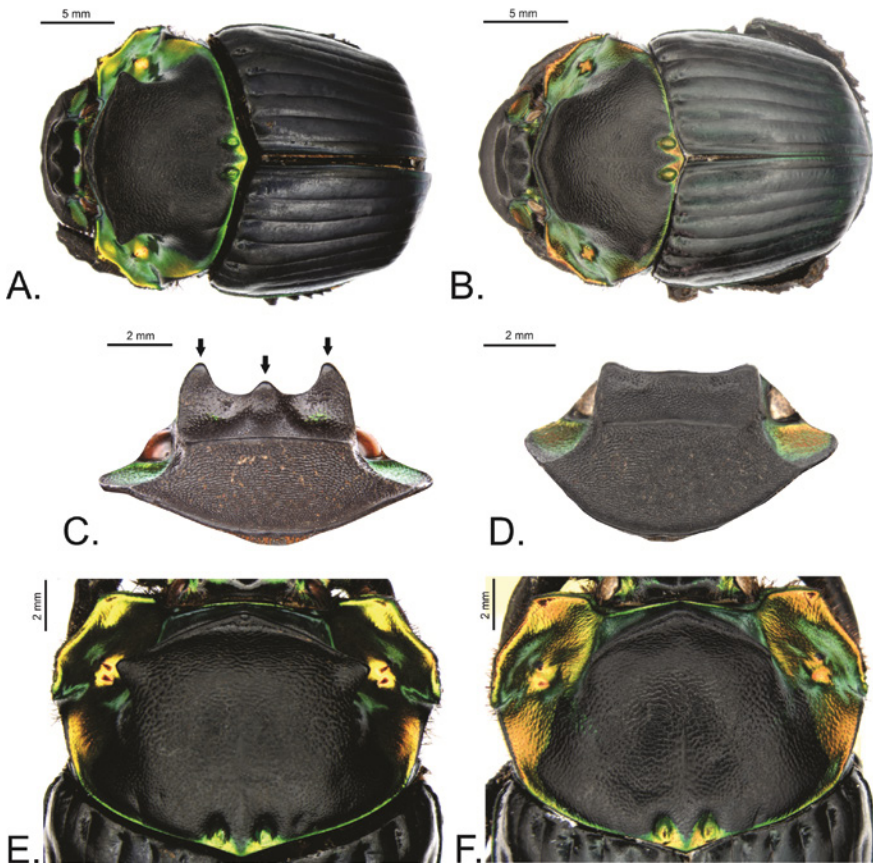


Fig. 6. *Diabroctis cadmus*: (A) body, dorsal view, male; (B) body, dorsal view, female; (C) head, anterior view, male (arrows, horns of the cephalic process); (D) head, anterior view, female; (E) pronotum, male; (F) pronotum, female.

Taurocopris cadmus: d'Olsoufieff, 1924: 15, 19 (fig. 6), 22, 62, 140, plate III, fig. 8; Pessôa, 1935: 35; Blackwelder, 1944: 208.

Diabroctis cadmus: Edmonds, 1972: 820; Martínez & Clavijo, 1990: 150; Vaz-de-Mello, 2000: 193; Arnaud, 2002: 18; Gámez, 2004: 48, 51, 52.

Type material and lectotype designation

Lectotype of *Phanaeus cadmus* Harold ♀ (designated by Arnaud, 1982; MNHN): Carthagena, P. Cadmus, typ. Harold/ E.M.E.H/3. C.R.O/.

Ancy (1880) described *P. mimaeformis* from at least two specimens from Costa Rica. This can be concluded by body length variation and descriptions of both sexes provided by the author in the original description. However, after consulting the Ancy-Le Moults collection in IRSNB, a single male from the type series was found. In order to unambiguously fix the identity of the name, this male is here designated as the lectotype of *P. mimaeformis*. This lectotype has the following labels: Costa Rica/ Le

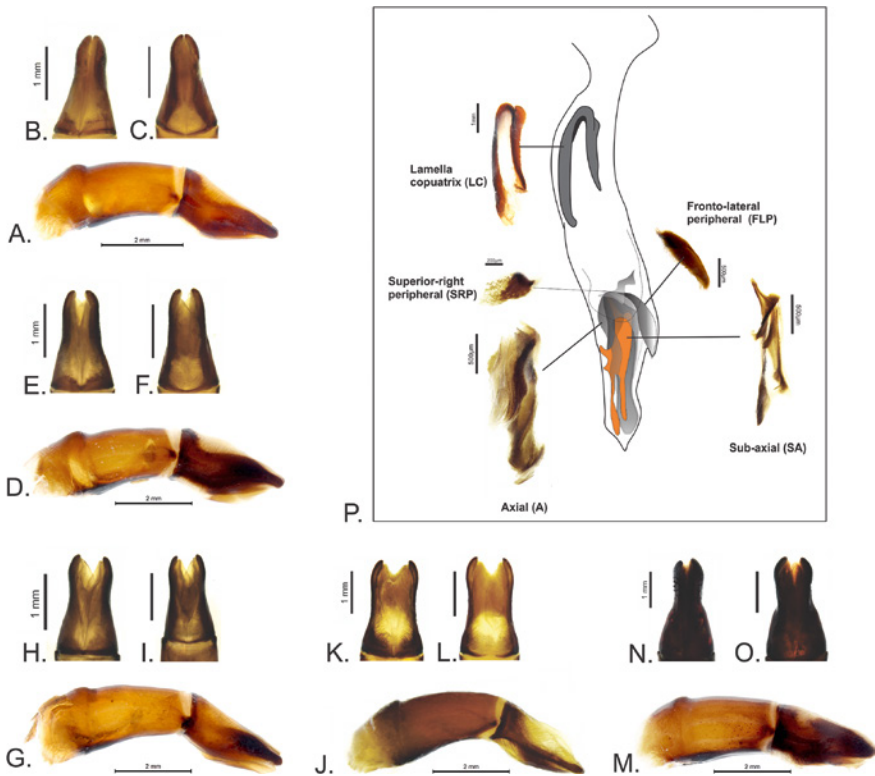


Fig. 7. Aedeagus. *Diabroctis mimas*: (A) lateral view; (B) dorsal view; (C) ventral view. *Diabroctis venezuelensis* **stat. rev.**: (D) lateral view; (E) dorsal view; (F) ventral view. *Diabroctis pseudomimas* **sp. nov.**: (G) lateral view; (H) dorsal view; (I) ventral view. *Diabroctis mirabilis*: (J) lateral view; (K) dorsal view; (L) ventral view. *Diabroctis cadmus*: (M) lateral view; (N) dorsal view; (O) ventral view; (P) Endophallus and dissected sclerites of *D. mimas*, right view.

Moult vend./ A. Janssens det., 1939; Taurocopris, cadmus Har./ R. Mus. Hist. Nat., Belg. I. G. 12. 423/.

Diagnosis

Diabroctis cadmus may be distinguished from other *Diabroctis* species by anterior portion of the pronotal process with transverse and arched carina (Fig. 6E); clypeal margin with two inconspicuous teeth (Fig. 6A); and paramedian basal foveae of pronotum deeply impressed, spaced by the width of one fovea (Fig. 6E). In males, pronotal process bilobulate with an acute lobe on each side. Cephalic process with three short horns or tubercles (Fig. 6C, arrows). Disc of pronotum with transversal ridges anteriorly (Fig. 6E); median portion with dense tubercles; posterior portion with foveolate punctures (Fig. 6E). Length varies from 24–24.8 mm. *Aedeagus*. [lateral view]—parameres slightly narrowed toward the apex (Fig. 7M). [dorsal view]—parameres abruptly narrowed toward the apex, with microtubercles on apical portion (Fig. 7N). *Endophallus*. Lamella copulatrix U-shaped (Fig. 8P). Short arm 1/3 shorter than long arm

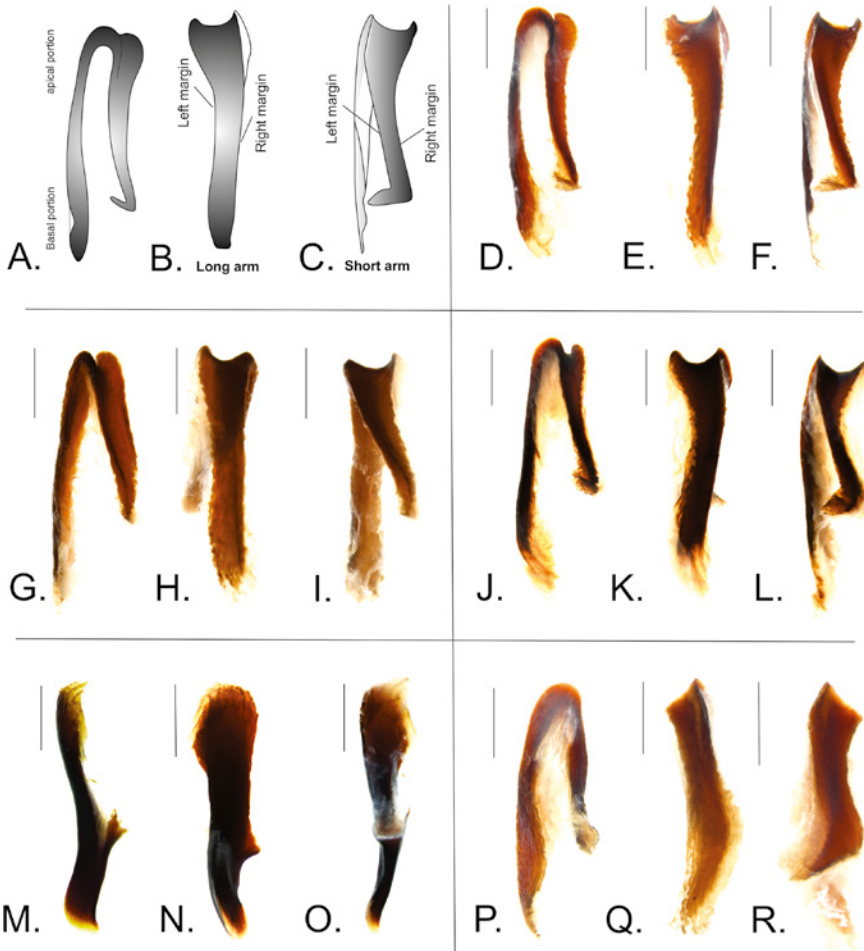


Fig. 8. Lamella copulatrix. (A) right view; (B) dorsal view; (C) ventral view. *Diabroctis mimas*: (D) right view; (E) dorsal view; (F) ventral view. *Diabroctis venezuelensis* **stat. rev.**: (G) right view; (H) dorsal view; (I) ventral view. *Diabroctis pseudomimas* **sp. nov.**: (J) right view; (K) dorsal view; (L) ventral view. *Diabroctis mirabilis*: (M) right view; (N) dorsal view; (O) ventral view. *Diabroctis cadmus*: (P) right view; (Q) dorsal view; (R) ventral view. Scale bar: 1 mm.

(Fig. 8P). [dorsal view]—right margin of long arm sub-straight (Fig. 8Q); left margin strongly curved outward on apical half (Fig. 8Q). [ventral view] – right margin of short arm strongly curved inward medially (Fig. 8R); arm sickle-shaped on apical portion (Fig. 8R). Females present cephalic process as transverse carina with two short horns on each side (Fig. 6D). Anterior portion of pronotal disc bearing anterior transverse carina, arched with two small and acute lobes on each side (Fig. 6D).

Non-type material

COLOMBIA, *Cordoba*: 1♂ (CEMT), Monteria, 1992, A. Uribe *leg.*; 1♀ (CEMT), Cereté, II.1994, Rodriguez *leg.*. *Antioquia*: 1♂ (CEMT), no collector; 1♂ (CEMT),

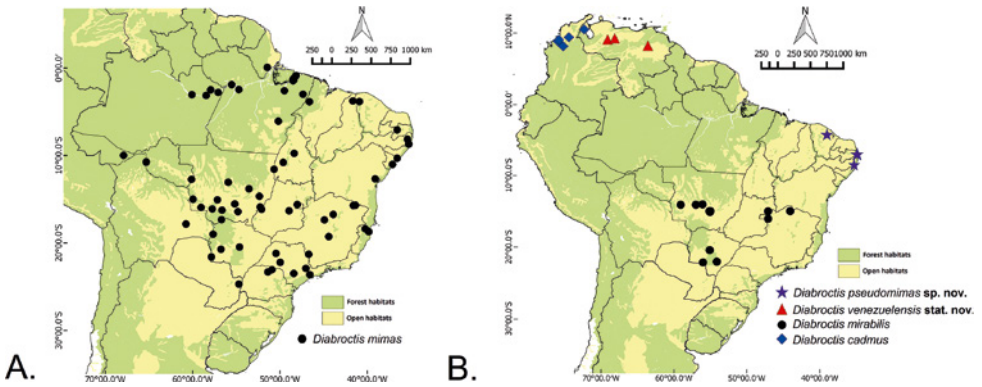


Fig. 9. Distribution maps of *Diabroctis* species: (A) *D. mimas*; (B) *D. venezuelensis* **stat. rev.**, *D. pseudomimas* **sp. nov.**, *D. mirabilis*, and *D. cadmus*.

Medellin, xii.2005, J. Noriega *leg.*; 1♀ (CEMT), Caucasia, vii.1999, Cristo-Perez *leg.*. Bolivar: 1♂ (CEMT), Santa Cruz de Mompox, no collector. VENEZUELA, Zulia: 1♀ (CEMT), Rosario de Perijá, vii.2006, no collector.

Discussion

This paper provides a synopsis of the South American genus *Diabroctis*, which now includes five species: *D. mimas*, *D. venezuelensis* **stat. rev.**, *D. cadmus*, *D. mirabilis*, and *D. pseudomimas* **sp. nov.** The type species *D. mimas* displays a wide distribution comprising Amazonian, Chacoan, and Paranaian biogeographic subregions of the Neotropical region (Fig. 9A). In examining specimens from a large number of localities, we found a new species from the Brazilian northeast, here described as *D. pseudomimas* **sp. nov.** The description was based on 24 specimens that present differently shaped pronotal processes compared to those of *D. mimas* and *D. venezuelensis* **nov. stat.**, which is the most closely related species. In terms of the aedeagus morphology, the parameres abruptly narrow toward the apex is also a diagnostic characteristic that distinguishes the new species.

Three species of *Diabroctis* occur in Brazil, including the new species described here: *D. mimas*, *D. mirabilis*, and *D. pseudomimas* **sp. nov.** *Diabroctis mimas* represents the overwhelming majority of our records, mostly from Chacoan and Parana dominions in the Chacoan subregion (Fig. 8A). Its ecological distribution is mostly in savanna-type habitats, but it can enter rainforest remnants from the Parana dominion and human occupied areas in the Boreal Brazilian dominion. In the latter, *D. mimas* extends its distribution through the eastern biogeographic provinces (Pará and Roraima) reaching lowland forests in the Imeri province.

The eastern Amazonia has long been affected by large-scale deforestation caused by the expansion of agriculture and cattle-raising (Vieira et al. 2008). The so-called “deforestation arc” concentrates most of the deforested areas in Amazonia. Its boundaries comprise the southwest of the State of Maranhão, the north of Tocantins, the south of

Pará, the north of Mato Grosso, the entire State of Rondônia, the south of Amazonas, and the southeast of Acre (INPE 2005). Deforestation directly affects dung beetle communities by reducing species richness and composition (Scheffler 2005). For instance, in the southwestern Amazonia the introduced pastures have been colonized by species of dung beetles, such as *D. mimas*, coming from the adjacent areas of Cerrado (Silva et al. 2004). Therefore, the distribution of *D. mimas* along the eastern Amazonian provinces has probably been expanded along with the cattle-raising frontier in this region.

D. mimas records from Guianan Lowlands province were provided by early authors and, with the exception of Cayenna (French Guiana), include no mention of the precise locality and habitat type (Olivier 1789, 1790; Gillet 1911). However, the literature data for this species in Bolivia, Colombia, and Peru have also attested the presence of *D. mimas* in savanna-type habitats and human occupied areas, such as pastures and farms.

Despite Blackwelder (1944) having cited *D. mimas* in Venezuela, we did not find any additional record. Martínez and Clavijo (1990) have claimed that literature records for *D. mimas* from Venezuela instead referred to *D. mimas venezuelensis*, herein considered a valid species.

Diabroctis mirabilis is a typical member of the dung beetle community from Cerrado. Its distributional range includes much of central Brazil and parts of northeastern Paraguay and eastern Bolivia. In the latter country, Hamel-Leigel et al. (2006) have found records of *D. mirabilis* in the mountain Cerrado (700–780 masl) from Santa Cruz, Huanchaca.

Diabroctis pseudomimas **sp. nov.** was recorded only from Ceará (probably somewhere between Fortaleza and Serra do Baturité), Paraíba (Bayeux, João Pessoa) and Pernambuco (Itambé). These new records show a potential spatial overlapping in the distribution areas of two species of *Diabroctis* (*D. mimas* and *D. pseudomimas* **sp. nov.**) in northeastern Brazil. However, these two species have not been collected together in the same habitat (ecological sympatry). According to the available data, we believe that *D. pseudomimas* **sp. nov.** can be restricted to coastal areas (“Tabuleiro Nordeste” and “Restinga”), while *D. mimas* can occur in surrounding Atlantic forest and Caatinga (Lopes et al. 2006; Silva et al. 2007; Gillett et al. 2010).

Diabroctis cadmus and *D. venezuelensis* are the only species of *Diabroctis* inhabiting the Mesoamerican dominion in the Brazilian subregion. Both have been recorded in Venezuela, and *D. cadmus* also occurs in Colombia. However, *D. venezuelensis* seems to have a preference for the savannas of central Venezuela (Sabana province), while *D. cadmus* inhabits the low plains (0–200 masl) of the deciduous forest in the Maracaibo basin (Venezuela). In Colombia, Navarro et al. (2011) found a positive correlation between precipitation and an abundance of *D. cadmus* in agriculture and livestock areas in the Coraza mountains (220 masl) from the Pericaribbean Arid Belt.

In the original description, Harold (1868) cited “*Cayennae*” [French Guiana] as the type locality of *D. cadmus*, but one year later corrected this to “*Carthagena*” [Colombia] in his *Catalogus Coleopterorum* (Harold 1869). Therefore, the literature records for this species in Cayenne (French Guiana) were erroneous.

The single record of a *Diabroctis* species in Central America is *Phanaeus mimaeformis* Ancey, a junior synonym of *D. cadmus*. However, dung beetle fauna has been

extensively studied in Costa Rica (Kohlmann et. al 2007; González-Maya & Mata-Lorenzen 2008; Solís & Kohlman 2012). Any of the available checklists for this country have confirmed this record suggesting that the genus is restricted to South America.

So far, the species of *Diabroctis* have not had their conservation status evaluated according to criteria of the International Union for Conservation of Nature (IUCN). Among the species of the genus, *D. pseudomimas* **sp. nov.** has the smallest known distribution range. This species may be endangered due to the serious threat to the Atlantic coastal area in northeastern Brazil, its probable habitat. However, due to the poor knowledge of its distribution, we consider data to be insufficient to confidently qualify its level of threat. Further surveying and collecting is needed.

Acknowledgments

We thank Marco Gaiani (MIZA) and Luis Joly (MIZA) for providing *D. mimas venezuelensis* type photographs, Mario Cupello for *D. mirabilis* type photographs, Arturo González-Alvarado for *D. pseudomimas* female photographs, Camille Locatelli and Alain Drumont (IRSNB) for *Taurocopris mirabiliformis* and *Phanaeus mimaeformis* type photographs. Our special thanks are due to Liz Nichols for valuable suggestions on the text of the manuscript. We also thank CAPES/Pro-equipments, for providing the photographic equipment used. CNPq provided research grants for Fernando Silva (444020/2014-4), and UFPA provided PIBIC fellowships for Layse Mitsue Harada. Fernando Vaz-de-Mello and Fernando Silva are CNPq productivity research fellows and parts of this work were funded by CNPq (304925/2010-1, 302997/2013-0, 306745/2016-0, 405697/2013-9, 484035/2013-4, 202327/2013-2, 440604/2015-0) and FAPEMAT (PRONEM2014) and (0147956/2017). This research received further support from the Synthesys Project (<http://synthesys3.myspecies.info>), financed by the European Community Research Infrastructure Action under the FP7 (GB-TAF 3855).

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