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ARTICLE

Contributions to the taxonomy of the Brazilian *Leurus* Townes, 1946 (Hymenoptera: Ichneumonidae, Metopiinae)

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Abstract. *Leurus* Townes, 1946 is a small genus of Metopiinae (Hymenoptera: Ichneumonidae), consisting of 13 described species distributed in the Neotropics and the Nearctic region. The present work aims to contribute to the taxonomic knowledge of *Leurus* in Brazil. A total of 109 specimens were identified and 15 literature records were analyzed. The genus geographical occurrence was evaluated according to data obtained from the literature and labels of analyzed specimens. Five species of *Leurus* were identified for the Brazilian fauna: *L. angustignathus, L. caeruliventris, L. discus, L. gracius* and *L. nostrus.* New municipality records of occurrence were made for *L. angustignathus* in the state of São Paulo, *L. caeruliventris* in the states of Bahia, Distrito Federal, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Piauí and Rondônia; for, *L. discus* in the state of Alagoas and São Paulo, and *L. gracius* in the state of Minas Gerais, Rio de Janeiro, and São Paulo. Females of *L. angustignathus* and *L. gracius* were described for the first time in the present study. The genitalia of males of *L. caeruliventris, L. discus* and *L. gracius* were described and illustrated for the first time.

Keywords. Wasps; Ichneumonoidea; New Records; Parasitoids.

INTRODUCTION

Ichneumonidae is the largest family in the order Hymenoptera and comprises 25,285 valid species worldwide (Yu *et al.,* 2016), classified into 42 subfamilies (Bennett *et al.,* 2019; Quicke *et al.,* 2019; Jasso-Martínez *et al.,* 2022). Approximately 4,000 species of Ichneumonidae are known for the Neotropical region, but this number is notably underestimated due to the small number of studies on the Neotropical fauna, especially the Brazilian fauna (Melo *et al.,* 2012). For Brazil, about 1,060 species are known, distributed in 28 subfamilies and 237 genera (Fernandes *et al.,* 2023).

Metopiinae is a cosmopolitan subfamily in Ichneumonidae, consisting of 27 genera with 862 described species (Yu *et al.,* 2016). For Brazil, 9 genera and 34 species are recorded (Fernandes *et al.,* 2023). Metopiinae species are endoparasitoid cenobionts of a wide variety of Lepidoptera larvae (Hanson & Gauld, 2006). Some larger species have aposematic coloring patterns, resembling aggressive vespids, in contrast with smaller species that usually have darker colors and may be easily hidden in dense vegetation (Gauld & Sithole, 2002).

Leurus Townes, 1946 is a small genus of Metopiinae, with 12 species occurring in the Neotropical region and with solely *L. caeruliventris* (Cresson, 1868) also occurring in the Nearctic region (Yu *et al.,* 2016; Alvarado & Palacio, 2021). Five species of *Leurus* are recorded for Brazil (Araujo, 2011; Fernandes *et al.,* 2022): *L. angustignathus, L. caeruliventris, L. discus, L. gracius* and *L. nostrus.* Species of *Leurus* can be easily diagnosed using the

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following combination of characters: the presence of a robust mandible with a ventral lobe, except in *L. angustignathus* Herrera, 2011a; the presence of a strong lateromedial longitudinal carina on the propodeum, converging posteriorly to the insertion region of the metasoma, except in *L. fascialis* Gauld & Sithole, 2002, which has weak impressions instead of strong carinae (Gauld & Sithole, 2002; Herrera *et al.,* 2011); palp formula 5:3 or 4:3; and mid tibias with spurs with equal length (Alvarado, 2018).

The genus was revised for Costa Rica by Gauld *et al.* (2002). More recent studies within the group include the report of male swarming behavior for *L. caeruliventris* in Costa Rica (Eberhard, 2007); a new record of *L. caeruliventris* in Oaxaca, Mexico (Sánchez-García *et al.,* 2015); a taxonomical revision for the genus from Peru (Ballon, 2021); and the new combination of *Forrestopius larryi* Gauld & Sithole, 2002 under *Leurus* (Alvarado & Palacio, 2021); regarding the Brazilian fauna: Fernandes *et al.* (2010) reported on *L. caeruliventris* parasitizing twirler moths (*Dichomeris* sp. (Lepidoptera: Gelechiidae)) and *Leurus* sp. parasitizing leafroller moths (Olethreutinae sp. (Lepidoptera: Tortricidae)) on the Euphorbiaceae *Croton floribundus* Spreng; Araujo (2011) reported four new occurrence records (*L. caeruliventris, L. discus, L. gracius* and *L. nostrus*) for the country. Herrera *et al.* (2011a) described *L. angustignathus* based on a male specimen collected in Serra do Japi, São Paulo state; Santos *et al.* (2021) reported two morphospecies of *Leurus* occurring in the municipality of Aquidauana, Mato Grosso do Sul state.

Studies on occurrence records provides valuable data for the comprehension of species distribution patterns (Lamoreux *et al.,* 2006; Hortal *et al.,* 2015). Many efforts have been made in the last few years to mitigate the Wallacean shortfall of Metopiinae in Brazil (Araujo & Penteado-Dias, 2012; Herrera *et al.,* 2011b; Hortal *et al.,* 2015; Melo *et al.,* 2015). However, given the diversity of the group, new studies are needed for a better understanding of the subfamily's distribution in Brazil. The relatively high number of specimens of *Leurus* found in entomological collections motivated this work which aims to fill gaps in distributional patterns of *Leurus* Townes from Brazil and to describe for the first time the females of *L. angustignathus* and *L. gracius* and the male genitalia of *L. caeruliventris, L. discus,* and *L. gracius.*

MATERIAL AND METHODS

Bibliographic data and material examined

The species list was gathered from (i) literature data (Yu *et al.,* 2016; Fernandes *et al.,* 2023; and the main online databases, namely Google Scholar, Web of Science, and Scielo, using "Metopiinae", "Brazil", and "*Leurus*" as keywords, both in Portuguese and English); and (ii) examined specimens of *Leurus* deposited in entomological collections. New records from Brazilian municipalities are indicated with an asterisk (*).

The examined material was gathered from the Brazilian institutions that house the largest collections of Ichneumonidae in Brazil. The material was examined in person during visits to the collections by the first, second and last authors. The morphological terminology and keys used for the identification of specimens follows Townes (1971), Gauld & Sithole (2002) and Alvarado (2018). Depository collections are listed here and subsequently referred to by their curator in parenthesis: CNC: Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada (Andrew Bennett, Sophie Cardinal, and Jose Fernández-Triana); DZUP: *Coleção Entomológica Padre Jesus Santiago Moure,* Curitiba, Brazil (Gabriel Augusto Rodrigues de Melo); DCBU: *Coleção Taxonômica do Departamento de Ecologia e Biologia Evolutiva,* UFSCar, São Carlos, Brazil (Angélica Maria Penteado-Dias); MZSP: *Museu de Zoologia da Universidade de São Paulo,* São Paulo, Brazil (Gabriela Procópio Camacho, and Carlos Roberto Ferreira Brandão); USUC: Utah State University, Logan, Utah, USA (David Wahl).

Genitalia preparation

For genitalia preparation, seven male specimens were selected from the MZSP collection. The metasoma was sectioned between the sixth and seventh tergites, and the genitalia region was immersed for 24 hours in 10% KOH solution for soft tissue dissolution. After this step, the specimen sections were transferred to a Petri dish containing 70% EtOH solution, in which they were dissected with the help of entomological needles. After dissection, the genitalia were mounted on slides containing glycerol for photographic documentation. The terminology used for the description of male genitalia followed Snodgrass (1941) and Alvarado (2018).

Photographic documentation

The specimens were photographed using a Leica M205C® stereomicroscope with a Leica DFC 295® camera and mounted using the z-stacking method, in which several high-definition photographs with different focuses are grouped into one all-focused image. The images were captured using Leica Application Suite V3® and mounted using Helicon Focus Pro® software at the *Laboratório de Hymenoptera* – MZSP. Corrections and adjustments were made in Adobe Photoshop CS5®. Vectorial drawings were made using Adobe Illustrator CS5.

Distribution maps

The information gathered from specimen labels and the bibliography was used in the construction of species distribution maps. The coordinates were converted into the decimal format and exported in CSV format to Quantum Gis3.26.0® software, which was used to generate the occurrence maps.

RESULTS AND DISCUSSION

A comprehensive examination of 109 specimens revealed the presence of five distinct *Leurus* species, which were identified as *L. angustignathus* Herrera, 2011a, *L. caeruliventris* (Cresson, 1868), *L. discus* Gauld & Sithole, 2002, *L. gracius* Gauld & Sithole, 2002, and *L. nostrus* Gauld & Sithole, 2002. The present study considers new records of *Leurus* occurrence in municipalities where the species had not been previously recorded, resulting in an increase of 44 new records in Brazil. Specifically, two new records were found for *L. angustignathus,* 35 for *L. caeruliventris,* two for *L. discus,* and five for *L. gracius* (Figs. 35-38).

The male genitalia of *L. caeruliventris, L. discus* and *L. gracius* were described and illustrated for the first time, which demonstrated that they have distinct morphologies among the species analyzed, mainly in the shape of the hypopygium. Recently Alvarado (2018) used the morphological characters of the genitalia to analyze the phylogenetic relationships of the genera of Metopiinae. She noted that both sexes have informative characters and that some species exhibit sexual dimorphism, but several *Leurus* species were known from single sex. In addition, the inclusion of the description of the male genitalia provides new morphological evidence for better delimitation of the Brazilian species.

Studies of the genitalia are being used as important evidence for functional morphology, taxonomy and evolution in Hymenoptera (Schulmeister, 2002; Archer, 2016; Torres-Moreno *et al.,* 2021; Barroso *et al.,* 2022). Kikuchi & Konishi (2015) described the male genitalia of *Cratolaboides palpalis* Tereshkin, 2009 (Hymenoptera: Ichneumonidae: Ichneumoninae). Sobczak *et al.* (2017a) described the male genitalia of *Zatypota riverai* Gauld, 1991 (Hymenoptera: Ichneumonidae: Pimplinae). Sobczak *et al.* (2017b) described the male genitalia of *Flacopimpla varelae* Gauld, 1991 (Hymenoptera: Ichneumonidae: Pimplinae). Sobczak *et al.* (2019) described for the first time the female and male genitalia of *Hymenoepimecis bicolor* (Brullé, 1846) (Hymenoptera, Ichneumonidae, Pimplinae). Pádua *et al.* (2020) described the male genitals of the genus *Acrotaphus* Townes, 1960 (Hymenoptera: Ichneumonidae: Pimplinae). However, among Metopiinae these studies are relatively scarce.

In the section below, females of *L. angustignathus* and *L. gracius* were described for the first time in the present study. The female of *L. angustignathus* showed morphological differences when compared to the male of the species, such as fewer flagellomeres and a longer anterior wing. The female of *L. gracius* showed differences about the higher number of flagellomeres in the female when compared to the male, besides a slightly shorter length of the lateromedial longitudinal carina of the first metasomal segment. The descriptions of the females of *L. angustignathus* and *L. gracius* contribute to a better understanding of the species of the genus.

Analysis of specimen labels deposited in the collections revealed an average time lapse of approximately 32 years between collection and specific determination of the specimens. These findings underscore the significance of entomological collections in safeguarding critical biological information. Nevertheless, it is important to ensure continuous funding for these institutions and to train new taxonomists to help minimize the time gap between specimen collection and identification. Such efforts would significantly reduce the time required for accessing biological data.

Species accounts

Leurus angustignathus Herrera, 2011a (Figs. 1-7; 35)

Type material: Holotype ♂ (DCBU) Brazil, São Paulo, Jundiaí, Serra do Japí, 20.x.2007, Malaise, Sobczak, J.F. col. (high resolution images examined).

Material examined: 01♀ (MZSP 91980), **Brazil: São Paulo,** São Paulo, Municipal Park M'Boi Mirim (Brejo), 23°42′24.5″S, 46°46′48.0″W, Malaise, 30.v-04.vii.2020, H.P. Moleiro; A.D. Santos & F.Z. Ferreira cols. (*); 01♀ (MZSP 23084), Salesópolis, Biological Station Boraceia, Divisor Trail, 23°39′22.9″S, 45°53′48.1″W, Malaise, pt. 10, 18-28. iv.2003, A.P. Aguiar, F.M. Rodrigues & cols. (*); 01♀ (MZSP 23085), same data as MZSP 23084 except Pilões Trail, 23°39′S 45°05′W Malaise, pt. 03.

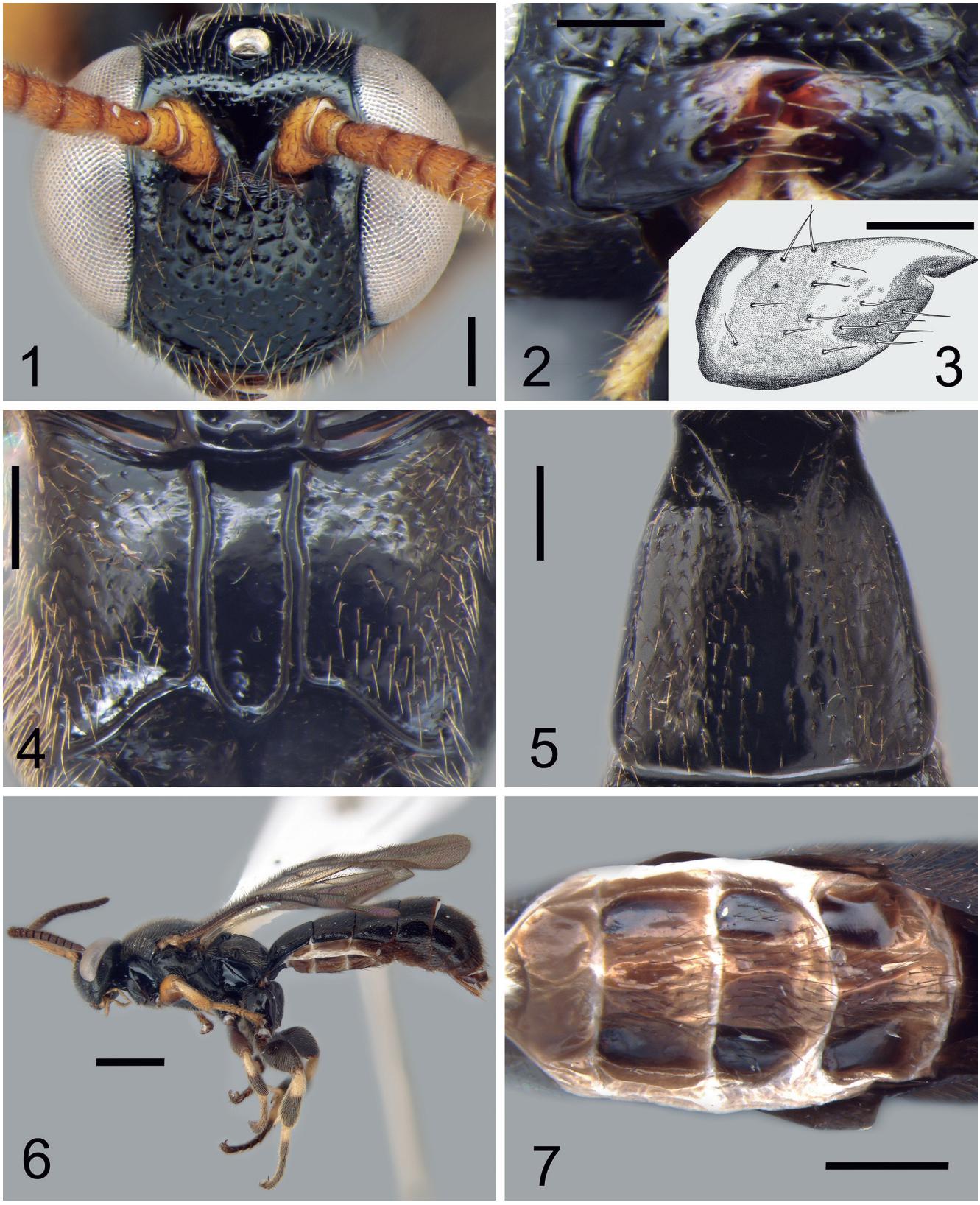
Diagnosis: mandible evenly tapered from base to apex; antenna with 22-23 flagellomeres; scapus and pedicel brownish; tegula brownish; fore wing without areolet; tergite I narrowed anteriorly and with poorly developed lateromedial longitudinal carina extending to about 0.3× of the segment length; lateromedial longitudinal carina united after the posterior transverse carina.

Description: Female

Head: Face slightly convex, with a raised point at the base of the antenna (Fig. 1); clypeus uniformly convex, not apically flattened; mandible tapered from base to apex, with rounded distal apex; mandible with two teeth (Figs. 2, 3); malar space (0.15-0.20 mm) the same width of the base of the mandible; palp formula 5:3; antenna with 22 flagellomeres, with homogeneous pilosity; eye emarginated; face with erect and sparse setae.

Mesosoma: In lateral view pronotum and metapleuron shinny; in dorsal view, pronotum finely punctuated; mesopleuron finely punctuated; propodeum with strong lateromedial longitudinal carina, parallel, converging in the petiolar area to merge with the posterior transverse carina (Fig. 4); posterior transverse carina complete; submetapleural carina small, expanding anteriorly into a very small, rounded, smooth lobe; fore wing 4.20-5.00 mm; fore wing with areolet absent; hind wing with distal vein abscissa *Cu1* very weak, almost spectral, joining *cu-a,* closer to *1A* than *M;* pilosity sparse, greater concentration on dorsum of mesosoma, lateral of propodeum, legs and anterior region of mesopleuron.

Metasoma: Tergite I narrowed anteriorly and with poorly developed lateromedial longitudinal carina extending to about 0.3× of segment length (Fig. 5); tergite II 1.50× as long as posteriorly broad, with close punctures; tergite II with small and inconspicuous laterotergites (Fig. 7); tergite III ending with progressively broader with weakly sclerotized laterotergites; ovipositor short, about 0.75 mm, equivalent to 0.70× the length of posterior femur; ovipositor sheaths 0.86× the length of the ovipositor; ovipositor without a notch.



Figures 1-7. *Leurus angustignathus,* Female. (1) Face in frontal view. (2, 3) Detail of the mandible, with the presence of the ventral lobe short, in frontal view. (4) Lateromedial longitudinal carina of propodeum in dorsal view. (5) Lateromedial longitudinal carina in the first metasomal tergite in dorsal view. (6) Habitus. (7) Metasoma in ventral view. Scale bars: 200 µm (1), 100 µm (2), 100 µm (3), 200 µm (4), 200 µm (5), 1.0 mm (6) and 500 µm (7).

Coloration: Body predominantly black with yellow or hyaline pilosity (Fig. 6); palps yellowish; mandible black with reddish brown teeth; scape and pedicel and the first flagellomeres orangish brown ranging to dark brown from mid to apex; tegula light brown; fore, mid and hind coxa black; fore femur orangish brown; fore tibia light brown at the base and orangish brown near apex to tarsal claws; mid trochanter and femur reddish brown; mid tibia bicolor whitish at the base and black near apex; mid tarsi black but basitarsus basally light-brown; hind trochanter and trochantellus reddish brown; hind femur black; hind tibia whitish on the first half close to the base and black on the half close to the apex; hind basitarsus with the same pattern as tibia; remaining tarsomeres black; wings slightly tinged with yellow; with brownish pterostigma and veins; metasomal tergites black; laterotergites and sternites reddish brown; ovipositor orangish brown.

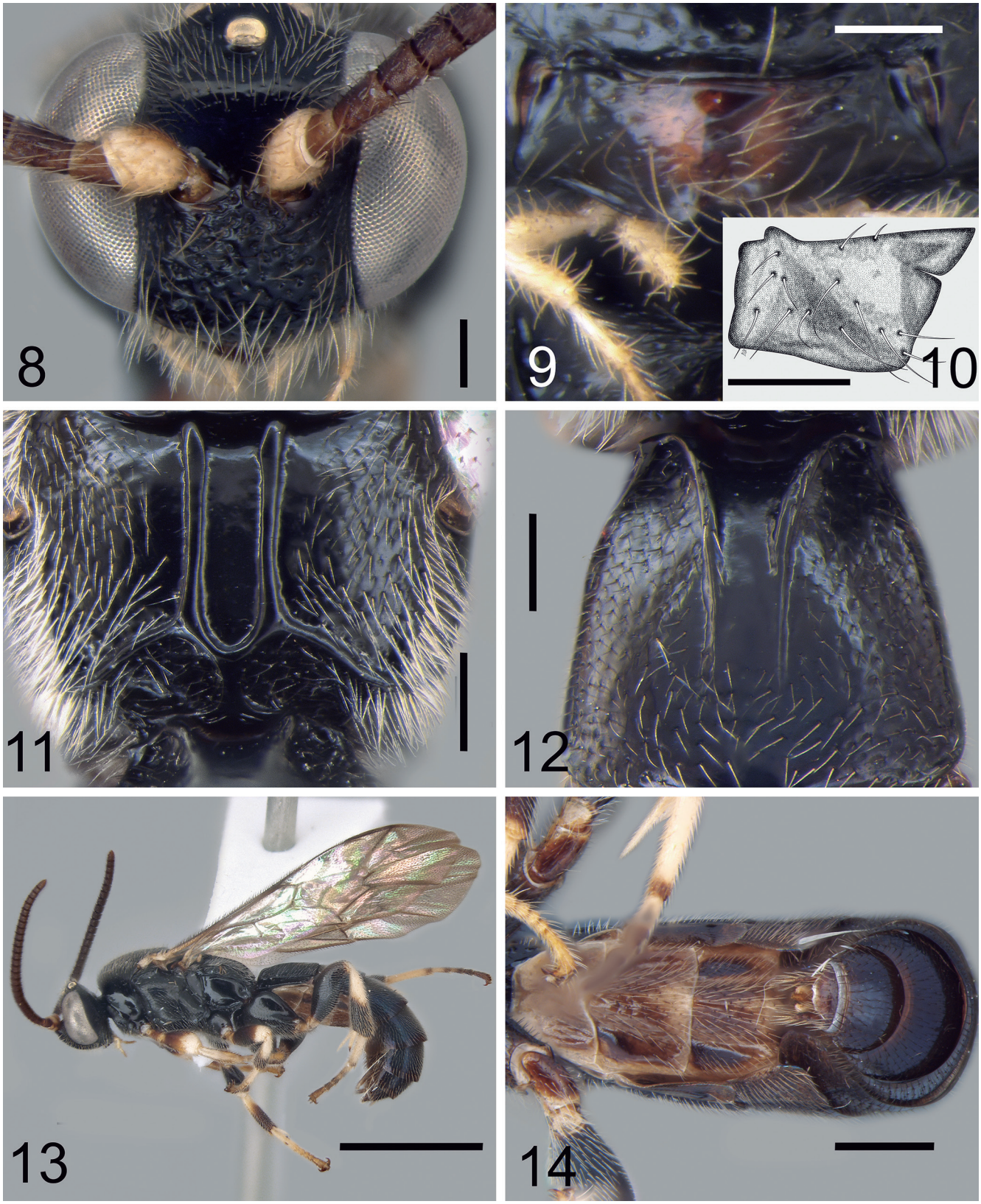
Distribution (Fig. 35): São Paulo state.

Comments: *L. angustignathus* differs from *L. xalifer* in having lateromedial longitudinal carina fused with the posterior transverse carina (vs. not fused and faint); differs from *L. caeruliventris* in having tergite I with poorly developed lateromedial longitudinal carina, about 0.30× the segment length (vs. extending beyond center of tergite); and differs from *L. eraticus* in having 22-25 flagellomeres (vs. 19 flagellomeres). The female of *L. angustignathus* differs from the male in having antenna with 22 flagellomeres (vs. 25 flagellomeres) and a larger fore wing length of 4.20-5.00 mm (vs. 3,80 mm). Females are very similar to males in color.

Leurus caeruliventris (Cresson, 1868) (Figs. 8-14; 31; 34; 36)

Material examined: 01♀ (MZSP 91983), **Brazil: Bahia,** Utinga, área de Caatinga, Chapada Diamantina, 11°58′25.80″S, 41°03′37.81″W, Malaise, 22.ii.2022, H.P. Moleiro col. (*); 01♂ (DZUP), Maracás, 13°24′46.3″S, 40°25′50.1″W, ix.1965, F.M. Oliveira col. (*); 01♂ (CNC), **Distrito Federal,** Brasília, Parque Nacional de Brasília, 1,000 m, 11.iii.1970, J.M. & B.A. Campbell (*); 01♂, (DZUP), **Espiríto Santo,** Santa Teresa, 19°55′55.5″S, 40°35′56.6″W, 02.iv.1964, C. Elias col.; 01♂ (DZUP), same data as before, except 28.iii.1964; 02♂ (DZUP), same data as before, except Fundão, 19°55′59.2″S, 40°24′25.2″W, 20.v.1964 (*); 01♂ (DZUP), same data as before, except Baixo Guandu, 19°30′40.7″S, 41°00′32.3″W, 19.ix.1971 (*); 02♂ (DZUP), same data as before, except 09-15.ix.1971; 01♂ (DZUP), same data as before, except Cariacica, 20°15′54.2″S, 40°24′53.7″W, 02-08.v.1967 (*); 01♀ (DZUP), same data as before, except Itarana, 19°52′20.7″S, 40°52′28.6″W, 12.ii.1966 (*); 01♂, (DZUP), Vitória, 20°16′45.4″S, 40°17′08.6″W, 20.iv.1952, O. Rego col. (*); 01♀, (DZUP), Baixo Guandu, 19°30′40.7″S, 41°00′32.3″W, 02-09.i.1971, Tadeu & C. Elias cols.; 01♀ (DCBU), **Mato Grosso,** Itiquira, Faz. Santo Antônio do Paraíso, Malaise, 30.x.2003. M. Barros col. (*); 03♂, 01♀ (MZSP 52876, 52877, 52880, 52884), **Mato Grosso do Sul,** Porto Murtinho, Faz. Retiro Conceição, Espinhadeira Trail, 21°40′59.7″S, 57°46′42.5″W, Malaise 31, 29.iii-18.iv.2012, Lamas, Nihei & eq. col. (52876, 52880 and 52884 specimens dissected) (*); 01♂ (MZSP 52875), same data as MZSP 52876 except 20°40′59.7″S, 56°46′42.5″W, 25.i-29.iii.2012; 05♂ (MZSP 52337, 52338, 52339, 52341, 52342) same data as MZSP 52876 except Mata Bruta Trail, 21°41′42.9″S, 57°45′51.2″W, Malaise 32, 15.v-01.vi.2012; 02♀ (MZSP 91981, 91982), same data as MZSP 52337 except 01.vii-15.viii.2015; 01♂ (MZSP 52158), same data as MZSP 52337 except 01-15.vi.2012; 01♂ (MZSP 52343), same data as MZSP 52158 except 01-15.vi.2012; 02♂ (MZSP 52881, 52883), same data as MZSP 52158 except 21°41′52.0″S, 57°45′57.1″W, Malaise 33, 18.iv-15.v.2012; 04♂ (MZSP 52887, 52882, 52874, 52878), same data as MZSP 52881 except 21°41′52.0″S, 57°45′57.1″W, 15.v-01.vi.2012; 01♂ (MZSP 52879), same data as MZSP 52887 except 15.viii-01.xi.2012; 01♂ (MZSP 91978), same data as MZSP 52887 except 29.iii-18.iv.2012 (specimen dissected); 02♀ (MZSP 52156), same data as MZSP 52879 except 21°41′42.9″S, 57°45′51.2″W, Malaise 32, 15.vi-01.vii.2012; 01♀ (MZSP 52348), Bodoquena, Faz. California, Ciliar, 20°41′49.9″S, 56°52′54.0″W, Malaise 04, 21.v-06.vi.2012, Lamas, Nihei & eq. col. (*); 01♂ (MZSP 52155), same data as MZSP 52887 except Transition, 20°41′53.5″S, 56°52′55.7″W, Malaise 05, 06-21.vii.2012; 01♀ (MZSP 52885), Aquidauana, Reserva ecológica UEMS, Vegetação aberta, Floresta Estacional Semidecidual, 20°25′59.0″S, 55°39′20.8″W, Malaise 08, 26.vii-11.viii.2012, Lamas, Nihei & eq. col. (*); 01♀, (MZSP 95632), **Minas Gerais,** Mar de Espanha, 21°51′52.4″S, 43°00′35.5″W, 27-28.ii.1962, J. Bechyné col. (*); 02♂, (DZUP), Araxá, 19°35′04.4″S, 46°56′36.3″W, 15.v.1965, C. Elias col. (*); 01♀, (DZUP), same data as before, except Tapirá, 19°55′30.4″S, 46°49′23.4″W, 27.v.1965 (*); 01♂ (DZUP), same data as before, except Perdizes, 19°15′44.9″S, 47°18′09.0″W, vii.1965 (*); 01♀ (DZUP), same data as before, except Passos, 20°43′15.9″S, 46°36′35.6″W, 01-08.iii.1962 (*); 01♂ (DZUP), same data as before, except 19-24.iii.1962; 01♀, 01♂ (CNC), Pedra Azul, 16°00′01.0″S, 41°16′08.4″W, xi.1972, M. Alvarenga; 02♀, 02♂, (MZSP 91984, 91985, 95637, 95638), **Paraná,** Colombo, Canguiri, 25°22′44.65″S, 49°07′53.30″W, Malaise, 910 m, i.2015, M. Savaris & Lampert cols. (*); 01♀ (MZSP 91986), same data as MZSP 91984 except iii.2015; 01♀ (MZSP 91991), same data as MZSP 91984 except i.2014; 01♀ (MZSP 95636), same data as MZSP 91984 except Bairro Santa Rita, 913 m, 25°22′45.91″S, 49°07′56.73″W, xi.2014; 01♀ (DZUP), Ilha do Mel, Praia Grande, 25°30′47.6″S, 48°20′05.0″W, 18.xii.1988, R. Dutra (*); 01♀ (DZUP), Curitiba, 25°26′18.1″S, 49°15′56.8″W, 18.v.1983, C. Bortoli (*); 01♂ (DZUP), Guaratuba, 25°52′48.4″S, 48°34′39.4″W, i.1978, V. Graf (*); 01♀, (DCBU), **Piauí,** Piripiri, Parque Nacional de Sete Cidades, 4°06′04.6″S, 41°42′45.3″W, Malaise, 25.vi.2013, C.R. Araujo & eq. cols. (*); 01♀, (DZUP), **Rio de Janeiro,** Duque de Caxias, Imbariê, 22°38′12.7″S, 43°13′06.5″W, 14.ix.1961, M. Alvarenga col. (*); 01♂ (DZUP), same data as before, except Muriqui, 22°55′22.6″S, 43°56′28.3″W, x.1961 (*); 01♀ (DZUP), same data as before, except Santa Maria Madalena, Santo Antônio Imbé, 21°59′18.9″S,

41°52′29.7″W, vii.1960; 01♀, (MZSP 95632), **Rondônia,** Porto Velho, Rio Madeira, 09°26′08.20″S, 64°48′60″W, Malaise, 18-29.vi.2011, E.Z. Albuquerque & L.S. Ferreira cols. (*); 01♂ (MZSP 95633), same data as MZSP 95632 except Rio Madeira, área Caiçara, AHE Jirau, Transects C1-C3 (Left margin), 09°26′14.6″S, 64°49′58.2″W, 07-20. ii.2013, F. Fernandes col.; 01♂ (MZSP 95641), same data as MZSP 95633 except Rio Madeira, área Mutum, AHE Jirau, Transects M6-M8 (Right margin), 09°35′54.4″S, 65°02′53.7″W, 28.iv-12.v.2013; 01♀, (DZUP), Vilhena,



Figures 8-14. *Leurus caeruliventris,* Female. (8) Face in frontal view. (9, 10) Detail of the mandible, with the presence of the ventral lobe, in frontal view. (11) Lateromedial longitudinal carina of propodeum in dorsal view. (12) Lateromedial longitudinal carina in the first metasomal tergite in dorsal view. (13) Habitus. (14) Metasoma in ventral view. Scale bars: 200 µm (8), 100 µm (9), 100 µm (10), 200 µm (11), 200 µm (12), 2.0 mm (13) and 500 µm (14).

Polo noroeste, 12°44′06.9″S, 60°07′20.9″W, 22.xii.1986, C. Elias col. (*); 01♀ (MZSP 91979), **São Paulo,** São Paulo, Parque Municipal M'Boi Mirim (Brejo), 23°42′24.5″S, 46°46′48.0″W, Malaise, 30.v-04.vii.2020, H.P. Moleiro; A.D. Santos & F.Z. Ferreira cols. (*); 02♂ (DCBU), Porto Ferreira, Cerrado, Malaise, 28.iv.2006, A.M. Penteado-Dias col. (*); 01♀ (DCBU), same data as before, except Malaise 02, 09.vi.2006; 01♀ (DCBU), Santa Rita do Passa Quatro, State Park of Vassununga, Wonder Forest, 21°40′56″S, 47°37′13″W, Malaise, 31.iii.2006, A.M. Penteado-Dias col. (*); 01♀ (DCBU), same data as before, except 23.viii.2007; 02♀, 01♂ (DCBU), same data as before, except 09.vi.2006; 01♂ (DCBU), Dourado, Parque do Lago, 22°07′73″S, 48°16′15″W, Malaise-Mata Ciliar, 07.iii.2006, A.M. Penteado-Dias col. (*); 05♀ (DCBU), Pedregulho, Parque Estadual Furnas do Bom Jesus, 20°13′37.5″S, 47°25′23.7″W, Malaise 01, A.M. Penteado-Dias col. (*); 02♀ (DCBU), same data as before, except 20°13′33.0″S, 47°25′23.6″W, Malaise 02; 01♀ (DCBU), Matão, Mata Faz. Cambuhy, *Croton floribundus,* 25.ii.2000, L.B.R. Fernandes col.; 03♀ (MZSP 95629, 95630, 95631), Rio Claro, Floresta Estadual Edmundo Navarro de Andrade, 22°24′39″S, 47°33′39″W, Malaise, 17.ix-01.x.2005, J.T. Dias e eq. cols. (*); 01♀ (MZSP 95635), Santo André, REBIO Paranapiacaba, 23°46′44″S, 46°18′40″W, Malaise, 21.i-19.ii.2011, Gudin & Dios cols. (*); 01♀ (MZSP 95640), same data as MZSP 95635 except 23°46′38″S, 46°18′42″W, 21.viii-21.ix.2010, Gudin & Nihei cols.; 01♀ (MZSP 95639), Bertioga, Parque Estadual Restinga de Bertioga, Trilha Cachoeira, 23°45′15″S, 45°56′46″W, Malaise, 21.xi.2012-05.i.2013, Biffi, Cezar & Fuhrmann cols (*).

Diagnosis: Body predominantly black or bluish-black (Fig. 13); head black (Fig. 8); antenna with 23-27 flagellomeres, with light brown scape; mid and hind tibia bicolor whitish at the base and black near apex; anterior wing with vein *3rs-m* present, absent, or incomplete, with areolet present or absent; first metasomal segment with lateromedial longitudinal carina strong extending about 0.60-0.70× of segment length (Fig. 12); metasomal tergite II with narrow and inconspicuous laterotergites (Fig. 14).

Description of male genitalia (Fig. 31): Genital capsule length 0.63 mm and width 0.36 mm; basal ring, dorsally interrupted; paramere in dorsal view basally almost straight and not fused, concave at the middle of the inner margins; in ventral view, with straight pre-apical margin; pilosity concentrated in the region apical of the paramere bearing sparse and long setae; digitus wider than half of the cuspis width; apodeme of aedeagus shorter than aedeagus; tubular aedeagus with slightly dilated apical region, with two dilated lobes; aedeagus about ⅔ of the total length of the genital capsule; hypopygium with lateral margins converging distally; longer than wide; distal end emarginated, with dense setae centrally; smooth surface (Fig. 34).

Distribution (Fig. 36): Alagoas, Espírito Santo, Rio de Janeiro, São Paulo (Araujo, 2011; Fernandes *et al.,* 2010), Santa Catarina (Gauld & Sithole, 2002). **New records:** Bahia, Distrito Federal, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Piauí, and Rondônia states. The distributional pattern of *Leurus caeruliventris* is broadly expanded for Brazil and now includes the following Brazilian biomes: Amazon, Caatinga, Mata Atlântica, and Pantanal.

Comments: The specimens examined showed high variability in morphology, with subtle variations in the size of individuals, presence, or absence of areolet on the fore wings, and intensity of leg coloration of specimens, even within specimens collected at the same locality. The coloration of the legs ranged from whitish to yellowish.

Leurus discus Gauld & Sithole, 2002 (Figs. 15-21; 29; 32; 37)

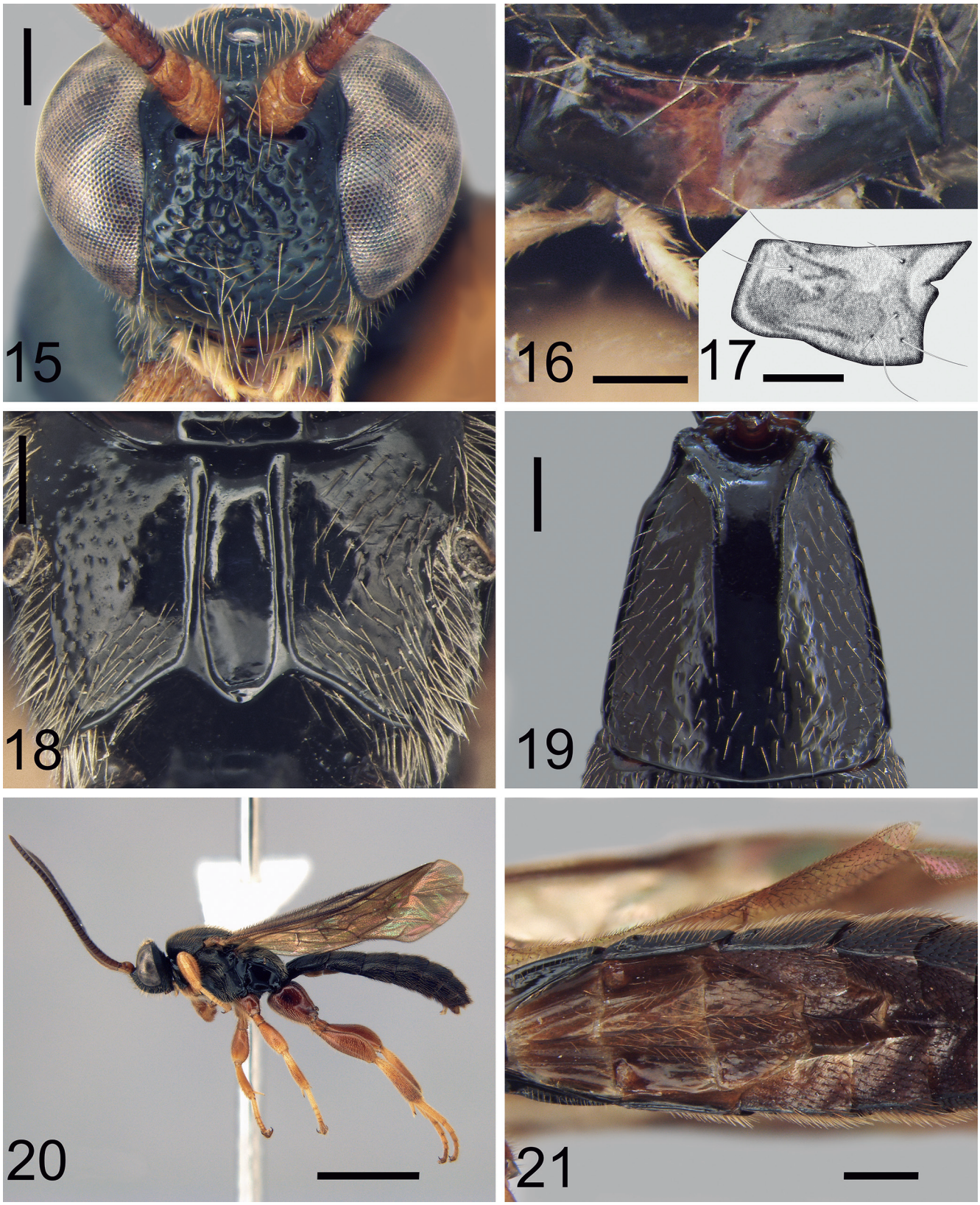
Material examined: 01♂ (MZSP 95642) **Alagoas,** Satuba, APA do Catolé, 09°33′29.1″S, 35°47′42.1″W, Malaise, 25-26.vii.2012, Nihei, Dias, Alcantara & Costa cols. (*); 01♀ (MZSP 23119), **São Paulo,** Ubatuba, Parque Estadual Serra do Mar, Núcleo Picinguaba, 23°18′21.6″S, 44°48′25.2″W, Malaise, ponto 01, 400 m, 02-05.ii.2006, E.F. Santos, C.P. Scott-Santos cols. (*); 01♀ (MZSP 23117), same data as MZSP 23119 except point 03, 600 m, 20-23.i.2006; 3♂ (MZSP 91987, 91988, 91989), same data as MZSP 23119 except 23°19′08.4″S, 44°49′04.8″W 200 m, 21-24.ii.2007 (MZSP 91987 and 91988 specimens dissected).

Diagnosis: Body coloration predominantly black (Fig. 20); face black (Fig. 15); antenna with 32-33 flagellomeres; tibia of hind legs orange-yellow; mandible black with reddish brown teeth (Figs. 16, 17); anterior wing with vein *3rs-m* present and well developed, with areolet present; propodeum with transverse posterior carina forming a 60° angle to the lateromedial longitudinal carina (Fig. 18); metasomal tergite I with short lateromedial longitudinal carina reaching less than 0.50× of segment length (Fig. 19); metasomal segment II with inconspicuous laterotergites (Fig. 21).

Description of male genitalia (Fig. 29): Genital capsule length 0.80 mm and width 0.40 mm; basal ring, dorsally interrupted; paramere in dorsal view basally, concave and not fused; concave at the middle of the inner margins; paramere, in ventral view, with margin straight pre-apically; pilosity concentrated in the region of the apical margin of the paramere, with dense and long setae; apodeme of aedeagus shorter than aedeagus; tubular aedeagus with slightly dilated apical region, with two dilated lobes; aedeagus about ½ of the total length of the genital capsule; hypopygium with lateral margins converging distally; longer than wide; distal end continuous, with dense setae centrally; smooth surface (Fig. 32).

Distribution (Fig. 37): Paraná and São Paulo states (Araujo, 2011). **New record:** Alagoas state.

Comments: The specimens examined showed variation in leg coloration, ranging from yellow to brownish.

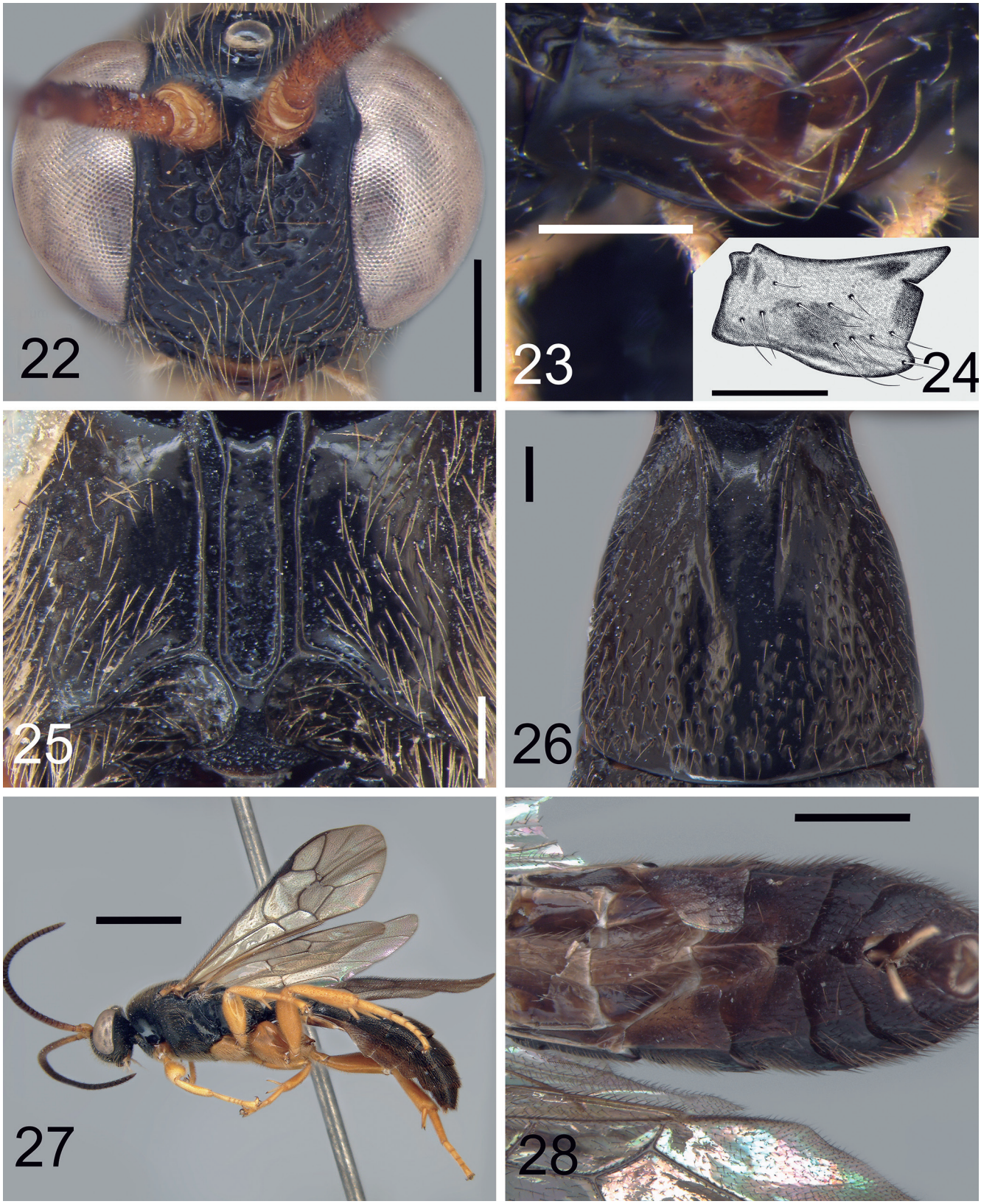


Figures 15-21. *Leurus discus,* Male. (15) Face in frontal view. (16, 17) Detail of the mandible, with the presence of the ventral lobe, in frontal view. (18) Lateromedial longitudinal carina of propodeum in dorsal view. (19) Lateromedial longitudinal carina in the first metasomal tergite in dorsal view. (20) Habitus. (21) Metasoma in ventral view. Scale bars: 200 µm (15), 100 µm (16), 100 µm (17), 200 µm (18), 200 µm (19), 2.0 mm (20) and 500 µm (21).

Leurus gracius Gauld & Sithole, 2002 (Figs. 22-28, 30, 33, 38)

Material examined: 01♂ (MZSP 91990), **Brazil: Minas Gerais,** Conceição do Mato Dentro, Serra da Serpentina, 19°10746"S, 43°29874"W, Malaise, Área 4, Mata, 17-27.iv.2011, R.R. Silva & E.Z. Albuquerque cols. (specimen dissected) (*); 01♂ (USUC), **Rio de Janeiro,** Parque Nacional da Tijuca, Floresta da Tijuca, iv.1966, Alvarenga & Seabra (*); 01♀ (MZSP 23074),

São Paulo, Salesópolis, Estação Biológica de Boracéia, 23°37′35.8″S, 45°56′43.8″W, Malaise, 30.iii-02.iv.2001, S.T.P. Amarante *et al.,* cols. (*); 01♂ (MZSP 23093), same data as MZSP 23119 except 23°39′18.2″S, 45°53′18.0″W, Malaise, 22.ii.2005, J.C. de Souza, A.P. Aguiar cols.; 01♀ (MZSP 23103), Ubatuba, Parque Estadual Serra do Mar, 23°17′49.2″S, 44°47′31.2″W, Malaise ponto 02, 800 m, 11-14.i.2006 (*); 1♀ (DCBU), Itapeva, Est. Ecológica de Itapeva, 24°04′08.7″S, 49°03′53.1″W, Cerrado, Malaise 01, 14.iv.2008, A.M. Penteado-Dias col (*).



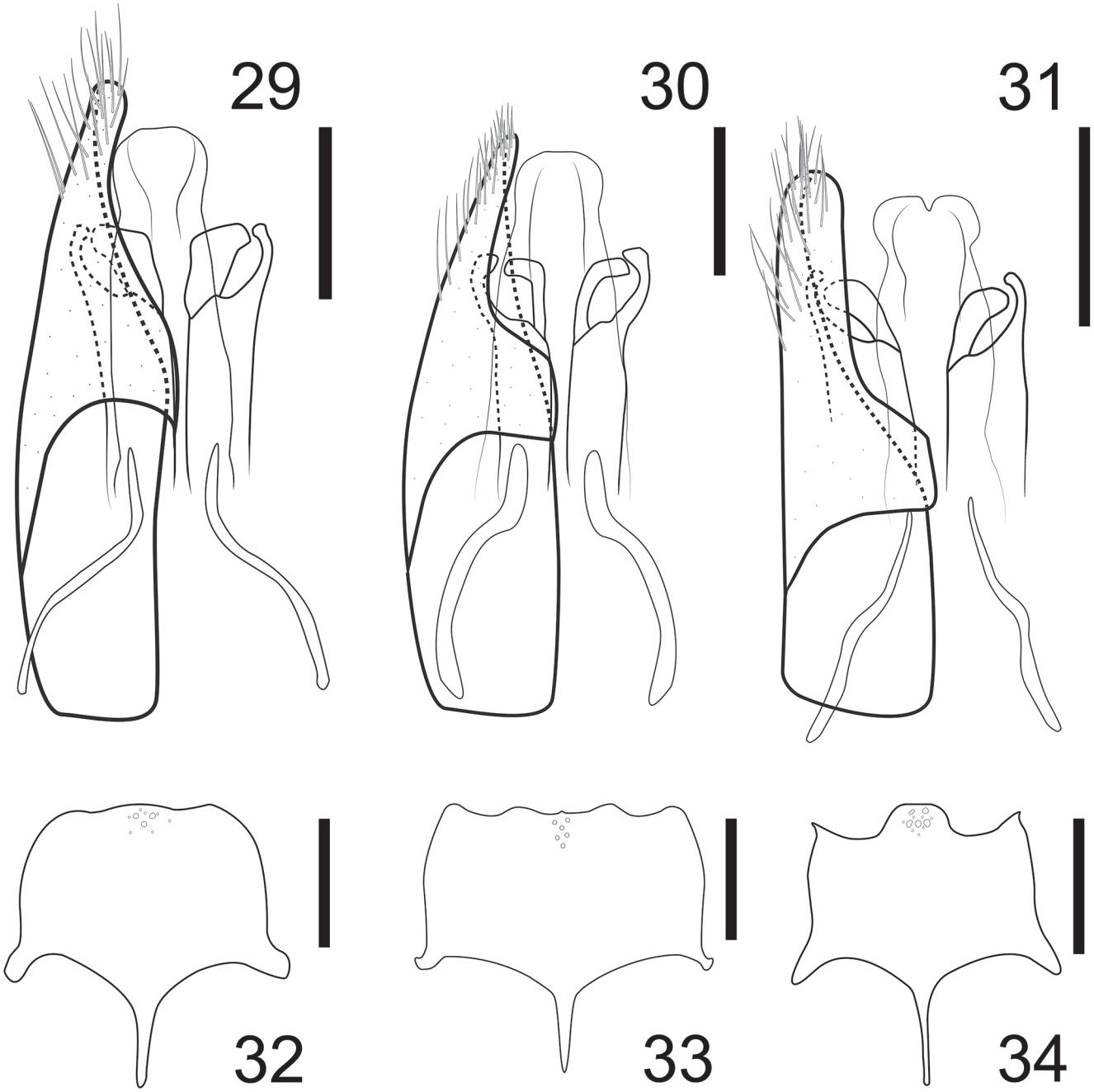
Figures 22-28. *Leurus gracius,* Male. (22) Face in frontal view. (23, 24) Detail of the mandible, with the presence of the ventral lobe, in frontal view. (25) Lateromedial longitudinal carina of propodeum in dorsal view. (26) Lateromedial longitudinal carina in the first metasomal tergite in dorsal view. (27) Habitus. (28) Metasoma in ventral view. Scale bars: 200 µm (22), 100 µm (23), 100 µm (24), 200 µm (25), 200 µm (26), 2.0 mm (27), and 2.0 mm (28).

Diagnosis: Body predominantly black; antenna with 32-34 flagellomeres reddish brown; legs with orange or yellow coloration; anterior wing with vein *3rs-m* present and well developed, with areolet present; posterior region of the tegula brown; tergite I of the metasoma with a developed lateromedial longitudinal carina, extending posteriorly about 0.70× of the segment length; segment II of metasoma with broad laterotergites about 0.50× wider than long.

Description: Female

Head: Face slightly convex; clypeus uniformly convex, not apically flattened (Fig. 22); mandible flange with distal end angled with two teeth (Figs. 23, 24); malar space (0.15-0.20 mm) with 0,80× base of the mandible; palp formula 5:3; antenna with 34 flagellomeres, with homogeneous pilosity; eye emarginated; face with erect, sparse setae with greater concentration at the base of the antenna.

Mesosoma: In lateral view, pronotum and metapleuron shinny; in dorsal view, pronotum finely punctuated; mesopleuron finely punctuated; propodeum with lateromedial longitudinal carina strong, parallel, converging to merge with posterior transverse carina (Fig. 25); posterior transverse carina complete; submetapleural carina small, expanding anteriorly into a long, rounded lobe; fore wing 7.80-8.00 mm; areolet present and well developed; hind wing with distal vein abscissa *Cu1* very weak,



Figures 29-34. Males. Genital capsules and hypopygium of *Leurus* in dorsal view. (29) Genital capsule of *L. discus,* (30) Genital capsule of *L. gracius* and (31) Genital capsule of *L. caeruliventris.* (32) Hypopygium of *L. discus,* (33) Hypopygium of *L. gracius* and (34) Hypopygium of *L. caeruliventris.* Scale bars: 200 µm.

almost spectral, joining *cu-a;* pilosity sparse, greater concentration on dorsum of metasoma, lateral of propodeum and anterior region of mesopleuron.

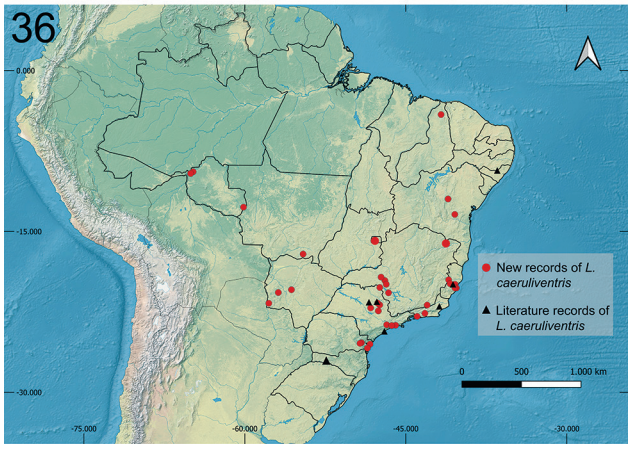
Metasoma: Tergite I narrow anteriorly and with lateromedial longitudinal carina extending to about 0.50-0.60× of segment length (Fig. 26); tergite II with close punctures; tergite II with laterotergites broadly, weakly sclerotized, about 0.50× as broad than long (Fig. 28); tergites III to ending with progressively broader but weakly sclerotized laterotergites; ovipositor short, about 0.80 mm, which is equivalent to 0.50× of the length of the posterior femur; ovipositor sheaths 0.87× of the length of the ovipositor; ovipositor without a notch.

Coloration: Body predominantly black with yellow or hyaline pilosity (Fig. 27); palps yellowish; mandible black with reddish brown teeth; scapus and pedicel and the first flagellomeres yellowish brown ranging to dark brown from mid to apex; tegula yellowish; posterior region of the scutellum with dark brown coloration; legs yellowish brown; wings slightly tinged with yellow, with brownish pterostigma and veins; metasomal tergites black; laterotergites and sternites reddish brown; ovipositor orangish brown.

Description of male genitalia (Fig. 30): Genital capsule length 0.80 mm and width 0.40 mm; basal ring, dorsally interrupted; paramere in dorsal view basally, concave and not fused; concave at the middle of the inner margins; paramere, in ventral view, with margin straight pre-apically; pilosity concentrated in the region of the apical margin of the paramere, with dense setae; apodeme of aedeagus shorter than aedeagus; tubular aedeagus with slightly dilated apical region, with two dilated lobes; aedeagus about ⅔ of the total length of the genital capsule; hypopygium with lateral margins converging distally; longer than wide; distal end emarginated, with dense and sparse setae in the central region; smooth surface (Fig. 33).

Distribution (Fig. 38): São Paulo, Espírito Santo, and Rio de Janeiro states (Araujo, 2011). **New record:** Minas Gerais state.

Comments: *L. gracius* differs from *L. fascialis* by having the propodeum with lateromedial longitudinal carina, in addition to having the pronotum of exclusively black coloration; it differs from *L. discus* especially by having metasoma tergite II with laterotergites broadly, weakly sclerotized, about 0.50× as broad than long, in addition to having tergite I of the metasoma with lateromedial longitudinal carina extending to about 0.50-0.60× the length of the segment. The female differs from the male in having 34 flagellomeres on the antenna (vs. 32 flagellomeres) and as well as having a shorter lateromedial longitudinal carina of the first metasomal segment, about 0.50-0.60× the length of the segment (vs. 0.70×



Figures 35-36. Map of known distribution occurrences of *Leurus* in Brazil. (35) *L. angustignathus.* (36) *L. caeruliventris.*

Figures 37-38. Map of known distribution occurrences of *Leurus* in Brazil. (37) *L. discus.* (38) *L. gracius.*

the length of tergite I). Color variation was observed in the legs of specimens collected from the same locality, ranging from yellow to orange.

AUTHORS' CONTRIBUTIONS: HPM, ADS, HCO: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology; HPM, ADS: Writing – original draft; HCO, GPC: Supervision; HCO, GPC, AMPD, MA, RJB: Writing – review & editing. All authors actively participated in the discussion of the results, reviewed, and approved the final version of the paper.

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