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Article

Taxonomy, morphology, and new distribution data of *Menenotus* (Coreidae, Coreinae, Spartocerini)

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ABSTRACT. The neotropical *Menenotus* Laporte, 1832 includes *M. lunatus* (Laporte, 1832) and *M. diminutus* Walker, 1871. The genus has never been reviewed, and only the brief original descriptions were available so far. In this paper, we review *Menenotus* and describe, for the first time, genital traits of both sexes. *Menenotus lunatus* and *M. diminutus* are distinguishable by the shape of pronotum, the color pattern of connexivum, the extension of the cuplike sclerite, and the shape of the parameres, among other traits. In addition, *Menenotus* is compared with *Euagona* Dallas, 1852, which shares the prominent and curved humeri. These genera can be distinguished by the broader abdomen and the apparent connexivum in *Menenotus*. Their distribution pattern is different, with *Euagona* showing a more northern distribution in South America than *Menenotus*. We also updated the distribution records in Brazil, providing a map to the species of *Menenotus*.

KEYWORDS. Brazil, *Euagona*, Neotropics, redescription, systematics.

Coreidae comprises 32 tribes, 13 of them distributed exclusively in the Western hemisphere, among them Spartocerini (Brailovsky & Forthman, 2020; CoreoideaSF Team, 2020), which currently includes five genera (Costa *et al*., 2020): *Euagona* Dallas, 1852, *Eubule* Stål, 1868[1867], *Menenotus* Laporte, 1832, *Sephina* Amyot & Serville, 1843, and *Spartocera* Laporte, 1832. The main morphological features described for the tribe are the prominent and unarmed antennifers, slender legs, hind coxae separated from each other by a distance greater than from each one to the lateral margin of the body, and conjunctiva without a pair of lateral lobes and with the membranous dorsal middle lobe (Brailovsky & Sánchez, 1983).

Menenotus was described as a subgenus of *Spartocera*, distinguished from the nominal subgenus only by its developed humeral angle (Laporte, 1832). Spinola (1837) raised its status to genus, with the same diagnostic traits. Since then, many species have been described within *Menenotus*, but most of them are considered synonyms of *M. lunatus* (Laporte, 1832). Currently, *Menenotus* contains two valid species: *M. lunatus* and *M. diminutus* Walker, 1871, distributed exclusively in the Neotropics (Amyot & Serville, 1843; Lethierry & Severin, 1894; Packauskas, 2010) and is very similar to *Euagona* because both genera have prominent humeri. Brailovsky (2010) distinguished *Menenotus* from *Euagona* by presenting scutellum conspicuously wider than long and the broader abdomen. Like many genera of Spartocerini, *Menenotus* has never been reviewed, and only the brief original descriptions are available. A review of the genus is essential to identify correctly its species and to distinguish itself from the other genera of Spartocerini. In this paper, we reviewed *Menenotus* based on morphological characters, describing, for the first time, genital traits. We also updated the distribution records in Brazil.

MATERIAL AND METHODS

We examined 24 specimens, four males and four females of *M. diminutus*, and seven males and nine females of *M. lunatus*. The specimens examined belong to the following collections: Coleção Entomológica do Instituto Oswaldo Cruz (FIOC), Rio de Janeiro, Brazil; Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil; Instituto Biológico de São Paulo (IBSP), São Paulo, Brazil; Museu de Zoologia da Universidade de São Paulo (MZSP), São Paulo, Brazil; Museu de História Natural Capão da Imbuia (MHNCI), Curitiba, Brazil; Museu de Ciências Naturais, Secretaria do Meio Ambiente e Infraestrutura do Rio Grande do Sul (formerly Fundação Zoobotânica do Rio Grande do Sul) (MCNZ), Porto Alegre, Brazil; Universidade Federal do Rio Grande do Sul (UFRG), Porto Alegre, Brazil; Muséum National d'Histoire Naturelle (MNHN), Paris, France; Natural

History Museum (BMNH), London, UK; Oxford University Museum of Natural History (OUMNH), Oxford, UK. Letters in type specimen examined indicate different labels.

The distributional map was based on records from literature (Amyot & Serville, 1843; Berg, 1879; Pennington, 1922) and new occurrences were obtained from labels of the examined material; when exact coordinates were unavailable, we used those of the municipalities. The coordinates were plotted with the program Qgis 2.18, on the shape file provided by Löwenberg (2014) with the biogeographic domains proposed by Morrone (2013). All available specimens were analyzed under a stereomicroscope, and measurements were made with a millimeter lens. The terminology followed Dupuis (1970), Osuna (1984), Brailovsky (2010), and H. G. Rueda (unpubl. data). The genitalia of both sexes was cleared in a hot solution of potassium hydroxide 10%. The aedeagus was eventually everted mechanically and, when necessary, with lactic acid. All the extracted material was preserved in liquid glycerin, together with their respective specimens. Photos were taken in multiple focal planes using a DS-Fi2 camera coupled to a Nikon AZ100M stereomicroscope and stacked with the NIS Elements AR. Images were edited with Adobe Photoshop CS6. Measurements represent variation intervals and are expressed in millimeters.

RESULTS

Menenotus Laporte, 1832
(Figs 1–24)

Spartocera (*Menenotus*) Laporte, 1832:42.
Spartocerus Burmeister, 1835:341; Blanchard, 1840:115, 120; Amyot & Serville, 1843:187; Drapiez, 1845:47.
Menenotus: Spinola, 1837:151 [new status]; White, 1839:542; Westwood, 1842:3; Amyot & Serville, 1843:187; Agassiz, 1843:12; Blanchard, 1848:713; Herrich-Schäffer, 1850[v.9]: 236; Dallas, 1852:375; Herrich-Schäffer, 1853[index9]:125; Chenu & Desmarest, 1859:214; Dohrn, 1859:23; Stål, 1860[1858]:29; Costa, 1868:35; Stål, 1868[1867]:545; 1870:172; Walker, 1871:7; Chenu, 1875:38; Berg, 1879:75-76; Lethierry & Severin, 1894:54; Kirkaldy, 1901:177; Pennington, 1920:14; 1922:137; Packauskas, 2010:192; Costa *et al*., 2020:1, 2, 23, 28, 32; CoreoideaSF Team, 2020.
Monenotus (subsequent misspelling): Blanchard, 1840:120.

Type species: *Spartocera* (*Menenotus*) *lunatus* Laporte, 1832, by monotypy.

Diagnosis (Figs 1–4). Color brown or dark brown; hemelytra light brown; connexiva exposed, with round red or yellow spots. Body oval, stout, covered with numerous setae. Pronotum with humeri projected anteriorly, curved apically, surpassing anterior margin of head and covered with tubercles. Scutellum evidently wider than long.

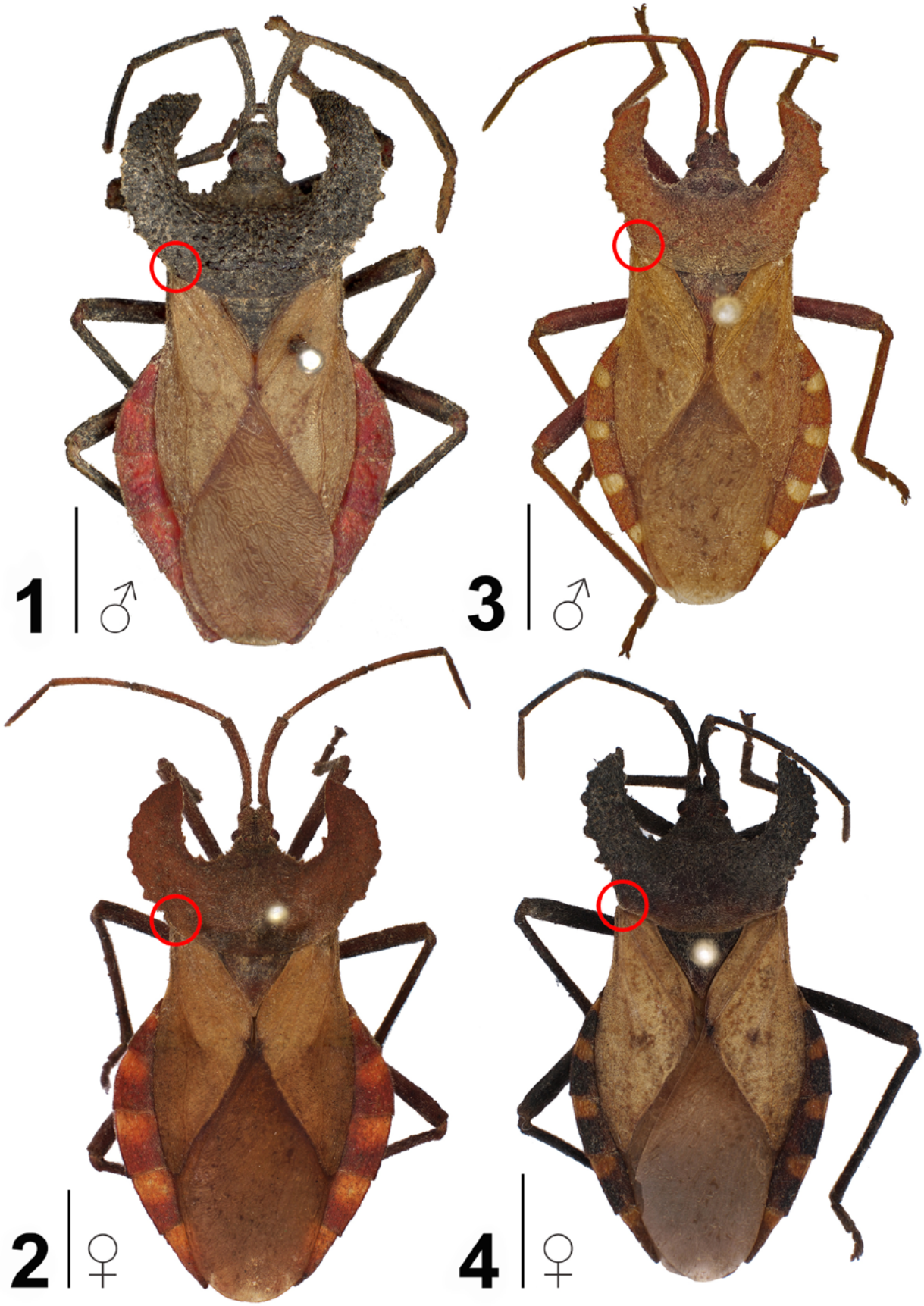
Color. General color variable intraspecifically, brown to dark brown. Bucculae and rostrum light brown, except the darker fourth segment. Femora dark brown to black; tarsi lighter than the remaining of the leg. Corium dark yellow, sometimes with a median dark brown spot; membrane dark brown, with some darker spots. Connexiva with yellow or red spots in the anterior half of each segment. Ventral surface of the abdomen lighter laterally, with lateral bands of numerous setae, from the III to the VII urosternite. Pygophore overall dark yellow, with some dark brown or reddish spots.

Head. Head wider than long, covered with setae. Antennomeres with the following proportion I<II>III>IV; antennomere I thicker, with twice the width of the others and curved outerly. Antennifers broad and stout, parallel to each other; distance between them shorter than their respective width; anterior margin concave. Tylus dorsally deflected; mandibular plates parallel, as long as tylus, positioned under the antennifers, and with a callus anteriorly projected, visible laterally. Rostrum short, not surpassing the half of the mesosternum, the proportion of the rostral segments I≃IV>III>II.

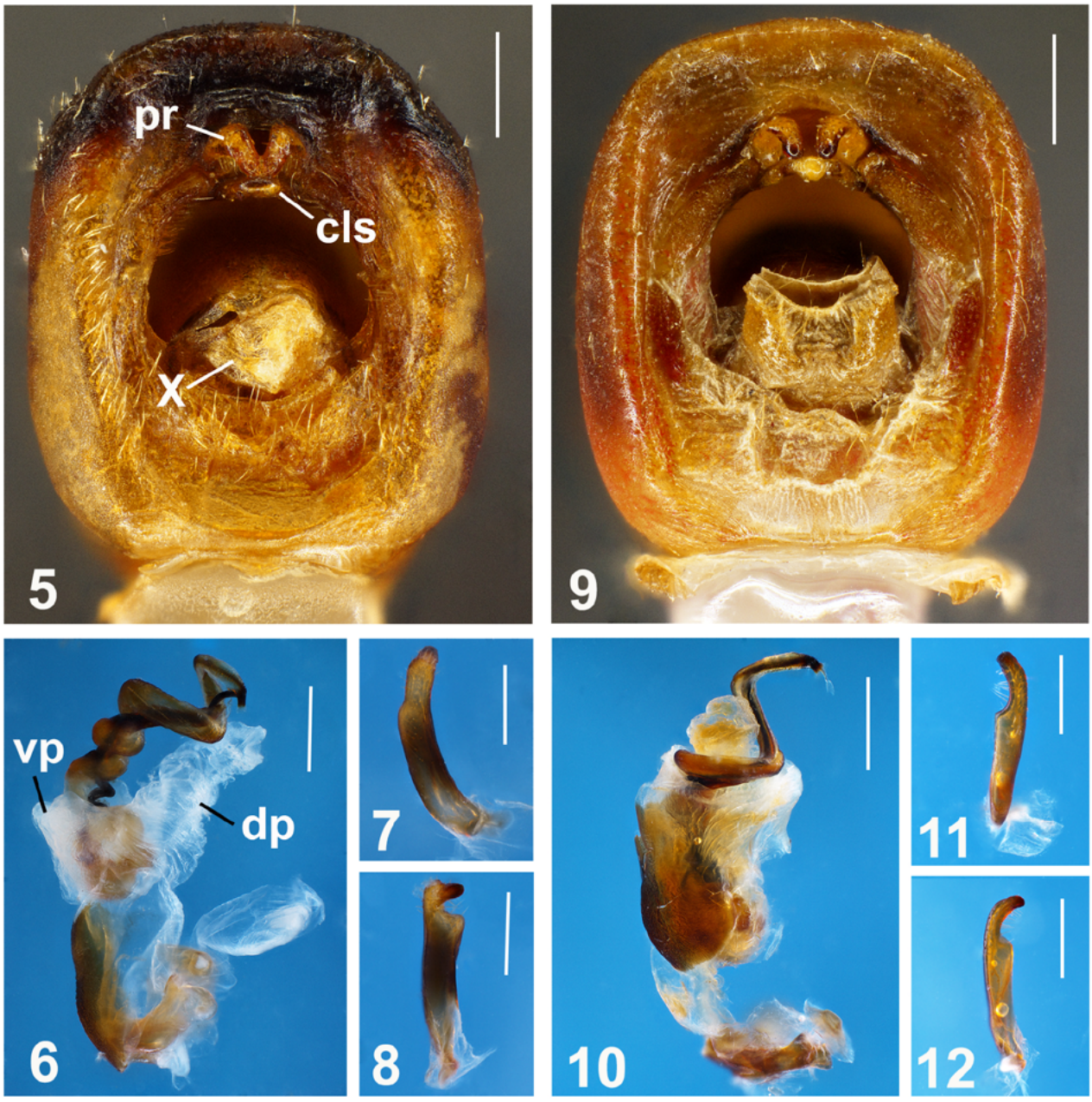
Thorax. Pronotum wider than long, anteriorly sloping, with a thin transversal groove anteriorly to posterior margin. Tubercles on disc and along anterolateral margins. Pronotal collar inconspicuous. Humeri covered with tubercles, expanded and anteriorly surpassing the anterior margin of the antennifers, and raised dorsolaterally. Scutellum evidently wider than long, with longitudinal wrinkles. Corium reaching or slightly surpassing the fifth abdominal segment, sometimes with a central black spot; membrane with anastomosed venation. Pleura covered with setae and tubercles; evaporative area occupying one-third of the width of the metapleura; peritreme ear-shaped with two lobes, the anterior larger than the posterior, with sinuous and concave margins, respectively. Depressed area between mesosternum and metasternum. Metasternum trapezoidal, elevated near posterior margin; anterior and posterior margins concave. Legs unarmed, with setae, without expansions or sexual dimorphism; femora cylindrical, about twice the thickness of the tibiae; tibiae prismatic with a longitudinal groove dorsally; tarsi cylindrical, tarsomere I longer than the others, three times longer than tarsomere II and tarsomere II twice as long as the III.

Abdomen. Oval; dorsally smooth and ventrally covered with whitish pubescence, more concentrated in two longitudinal-lateral lines. Spiracles close to the anterior margin of the urosternites; spiracle VII slightly outer to the imaginary longitudinal line traced from the anterior margin of the segment to the posterolateral angle (Fig 13: stVII). Females with plica (Fig 13: p) anterior to the imaginary transversal line connecting the spiracles of urosternite VII; lobes not projected ventrally.

Genitalia. Male (Figs 5–12). Pygophore covered with setae in the posterior portion, posterior margin convex and projected posteriorly (Figs 5, 9); superior processes of the dorsal rim inserted in the inner sidewalls and with posterior margin truncated; cuplike sclerite triangular, apically tapered and projected, surpassing the dorsal rim of the pygophore (Figs 5: cls, 9). Parameres sclerotized, apex hook-shaped and acute, stem with uniform thickness and bearing a longitudinal groove (Figs 5: pr, 7–9, 11, 12). Phallotheca cup-shaped, more sclerotized dorsally; basal plate triangular, with lateral bridge about twice wider than transverse bridge; ductifer sclerotized,



Figs 1–4. Habitus of *Menenotus lunatus* (Laporte, 1832) (1, 2) and *M. diminutus* Walker, 1871 (3, 4). Red circles highlight posterolateral angles of pronotum. Scale bars: 5.0 mm.



Figs 5–12. Pygophore in dorsal view (5, 9), phallus in lateral view (6, 10) and right paramere in ventral (7, 11) and dorsal view (8, 12) of *Menenotus lunatus* (Laporte, 1832) (5–8) and *M. diminutus* Walker, 1871 (9–12). Subtitle: cls, cuplike sclerite; dp, dorsal processes of conjunctiva; pr, paramere; vp, ventral process of conjunctiva; X, anal tube. Scale bars: 0.5 mm.

with short ligamentous processes and rounded suspensory plate; conjunctiva with a developed dorsal process (Figs 6: dp, 10), and two smaller ventral processes (Figs 6: vp, 10); vesica longer than the phallotheca, more sclerotized apically, and with longitudinal striations (Figs 6, 10).

Female (Figs 13–20). Laterotergites VIII (Figs 13: ltVIII, 14–16) with postero-lateral margins convergent, surpassing the posterior margin of laterotergite IX (Figs 13: ltIX, 14–16); posterior margin of valvifer VIII (Figs 13, 14, 15–16, 17, 19: vfVIII) not surpassing the posterior margin of the urosternite VII; valvifer IX (Figs 14: vfIX, 16) covered by valvifers VIII; valvulae IX (Figs 14: vaIX, 16) sclerotized, with about half of the length of the posterior fibula (Figs 14: pf, 16), posterior margin rectilinear in ventral view and folded as "C" in posterior view; posterior fibula long and sclerotized; ginatrium strap (Figs 14: gs, 16) with about one-fourth of the length of the valvifer VIII, with lateral portion sclerotized and the median region membranous, covered with punctations; valvifer VIII with apodeme (Figs 17: ap, 19) on the lateral margin; anterior leaflet (Figs 17: al, 19) sclerotized; valvulae VIII (Figs 19: vaVIII, 17) with lobular papillae apically (Figs 17: lp, 19) and setae (Figs 17: s, 19) at the inner lateral; anterior fibula (Figs 17: af, 19) sclerotized, positioned on the medial region of valvifer

VIII; gonangulum (Figs 17: g, 19) sclerotized with tapered apex. Spermatheca (Figs 14: sph, 16) with bulb sclerotized, long and finger-shaped, acute apically; distal duct (Figs 18, 20: dds) sclerotized, long and twisted, with callosities and spines; proximal expansion of the pump (Fig 18: pep) membranous and cupuliform; proximal crest of the pump (Figs 18, 20: prp) with sclerotizations, distal crest lacking; proximal duct (Fig 18: pds) wide and moderately long with slight sclerotization, curved in a fold.

Comments. *Euagona* is similar to *Menenotus*. Both genera share the projected humeri, the body size greater than 20 mm, among other characteristics. The results of Costa *et al.* (2020) identified *Euagona* as the sister to *Menenotus*, sharing homoplastic characters, such as the second antennomere cylindrical, the grooved mesosternum, and the distal part of the integument of the vesica wrinkled. However, Costa *et al.* (2020) lack samples of *Euagona* female specimens, thus further studies with a broader sample will test its relationship with *Menenotus*. *Menenotus* differs from *Euagona* by the humeri extending beyond the head, and the broader abdomen, with apparent connexiva, except in *E. hamata* Brailovsky, 2010. From this species, *Menenotus* can be distinguished by its scutellum evidently wider than long and by connexival segments IV-VI wider than half of their own length. Their distributions are also distinct, with *Menenotus* occurring further south from South America in Brazil, Paraguay, and Argentina and *Euagona* in northern South America (Ecuador, Peru, and Bolivia).

Menenotus lunatus (Laporte, 1832)

(Figs 1, 2, 5–8, 13, 14, 17, 18, 21–23)

Spartocera (*Menenotus*) *lunatus* Laporte, 1832:42.

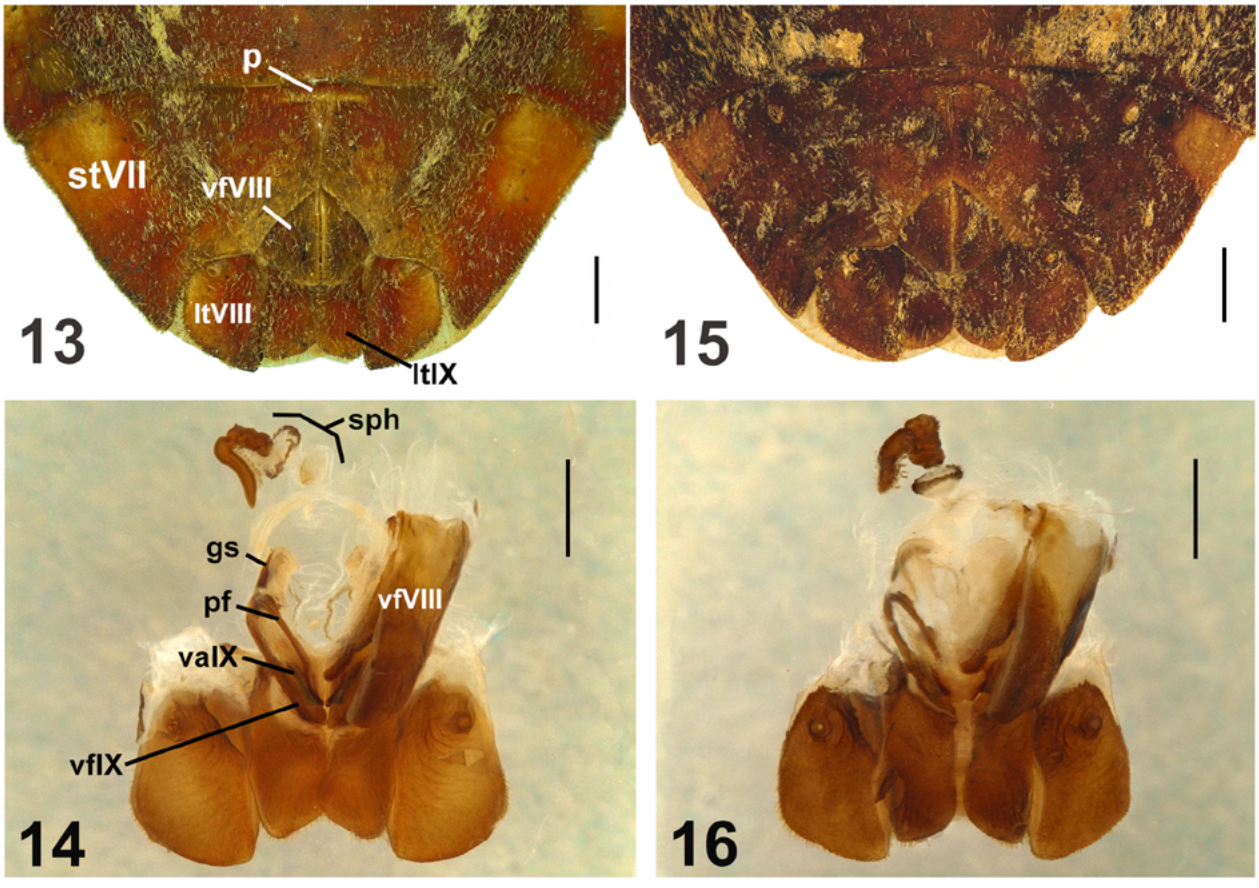
Coreus cornutus Perty, 1833:169 [synonymized by Westwood, 1842:3].

Coreocoris (*Coreocoris*) *lunulatus* Brullé, 1835:365 (misspelling of *lunatus*); Blanchard, 1848:713 [synonymized by Amyot & Serville, 1843:187].

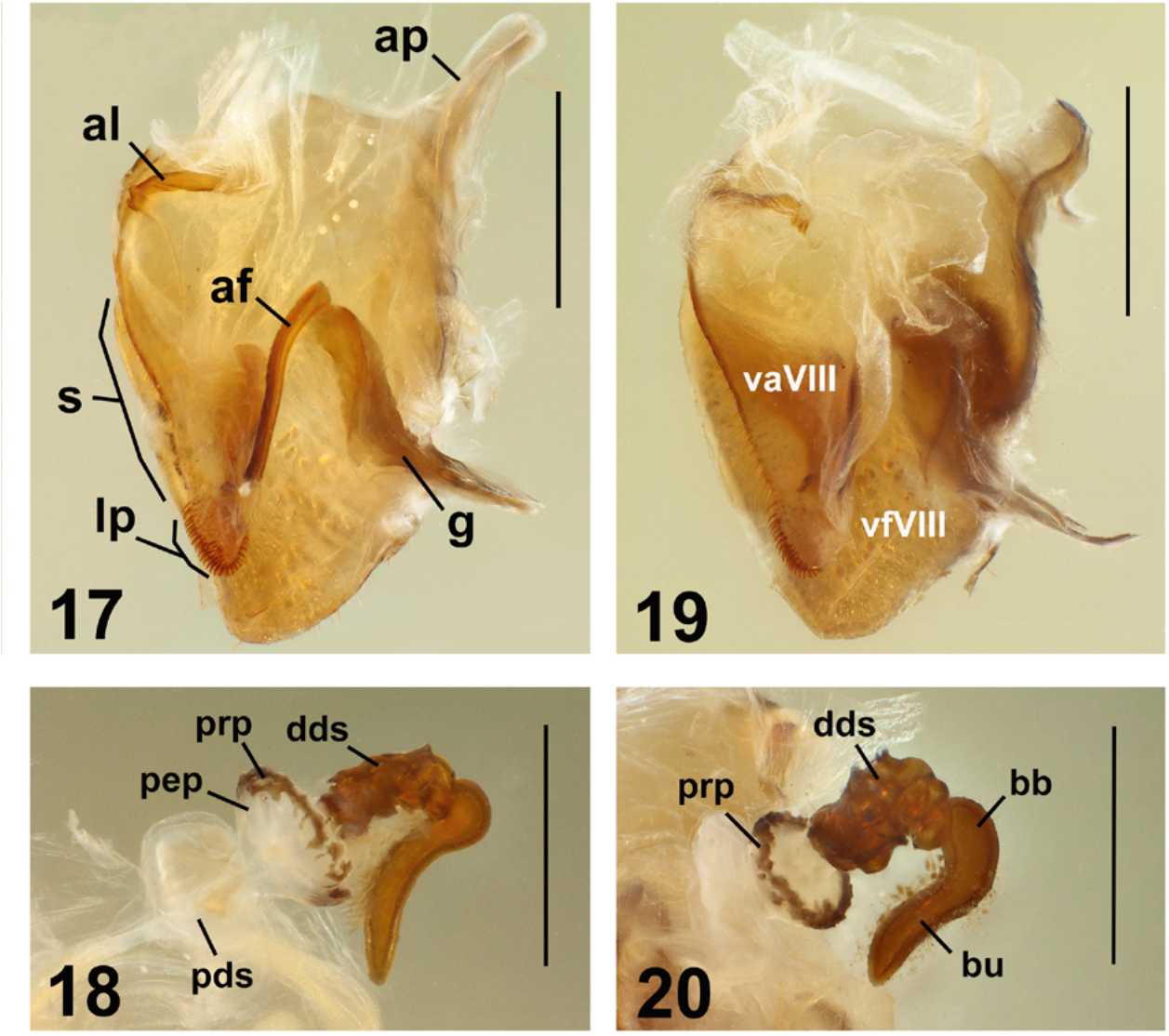
Spartocerus lunatus: Burmeister, 1835:342; Blanchard, 1840:120; Herrich-Schäffer, 1842[v.6]:74; Drapiez, 1845:47 [synonymized by Amyot & Serville, 1843:187].

Menenotus lunatus: Spinola, 1837:151; Westwood, 1842:3; Amyot & Serville, 1843:187; Dallas, 1852:375; Herrich-Schäffer, 1853[index9]:125, 189; Signoret, 1858:294; Dohrn, 1859:23; Stål, 1860[1858]:29; Costa, 1862:21; Stål, 1870:172; Walker, 1871:7; Berg, 1879:75-76; Distant, 1888: viii; Lethierry & Severin, 1894:54; Kirkaldy, 1901:177; Pennington, 1920:14; 1922:137; Blöte, 1936:23; Packauskas, 2010:192; Costa *et al*., 2020:2, 23; CoreoideaSF Team, 2020.

Menenotus unicolor Westwood, 1842:8; Dallas, 1852:376 [synonymized by Stål, 1870:172].



Figs 13–16. Female genitalia *Menenotus lunatus* (Laporte, 1832) (13, 14) and *M. diminutus* Walker, 1871 (15, 16) in ventral view. Subtitle: gs, ginatrium strap; ltVIII, laterotergites VIII; ltIX, laterotergites IX; p, plica; pf, posterior fibula; stVII, urosternite VII; sph, spermatheca; vaIX, valvulae IX; vfVIII, valvifers VIII; vfIX, valvifers IX. Scale bars: 1.0 mm.



Figs 17–20. Valvulae and valvifer VIII in dorsal view (17, 19) and spermatheca in ventral view (18, 20) of *Menenotus lunatus* (Laporte, 1832) (17, 18) and *M. diminutus* Walker, 1871 (19, 20). Subtitle: af, anterior fibula; al, anterior leaflet; ap, apodeme; bb, bulb base; bu, bulb; dds, distal duct of the spermatheca; g, gonangulum; lp, lobular papillae; pds, proximal duct of the spermatheca; pep, proximal expansion of pump; prp, proximal rim of pump; s, setae; vaVIII, valvulae VIII; vfVIII, valvifers VIII. Scale bars: 1.0 mm.

Type material (examined by photo): Holotype *Menenotus lunatus* ♀ (Fig. 22). a) Menenotus lunatus Lap. Rio. Janeiro – brown label, b) museum parts MNHN (EH) 24784 – white label. Holotype *Menenotus unicolor* ♂ (Fig. 23). a) Type Hem: 278, Menenotus unicolor Westwood, Hope Dept. Oxford, b) Type, West W. (Hope) C. Hemipt. 1842, part II p. 8 Distant, P. Z. S., 1901, p. 325-335, c) Type, d) Braz, e) Menenotus unicolor West W.

Distribution: Brazil, Paraguay, and Argentina (Fig. 21).

Head. Mandibular plates ventrally parallel.

Thorax. Posterolateral angles and posterior margin of pronotum forming a semicircle. Evaporative area yellowish to dark brown, with few and minute setae; peritreme yellowish to dark brown. Costal margin of hemelytra slightly sinuous.

Abdomen. Spots of the connexiva without a clear delimitation, ranging from light red on the anterior margin of the segments to dark red on the posterior margins. Pygophore at rest leaving visible an area equivalent to its own length of the urotergite VII, in ventral view.

Genitalia. Male. Pygophore dark yellow, with brown spots laterally and blackish distally. Dorsal rim of pygophore sub hexagonal. Posterior surface of the pygophore, in lateral view, slightly projected subapically. Cuplike sclerite projected as much as its own width in the lateral view of the pygophore. Parameres robust, light yellow, except for the apex of the head and basal region, dark brown; head short, about one-fifth of the total length of the paramere, turned abruptly to the inner side, and with setae distributed ventrally and dorsally. Ventral sclerotization of the phallotheca as a regular shield. Basal

plate triangular, little sclerotized, except for the upper portion more sclerotized with about one-fourth of the transversal bridge thickness; sclerotization of the central part of the ductifer longer than half of the length of the ligamentous processes. Processes of conjunctiva entirely membranous.

Measurements (mm), male and female, respectively: Total length: 21.4–24 and 22.6–27.3; width, on the posterior margin of the IV abdominal segment: 11.1–12.5 and 11.4–15.2. Head length: 1.7–2.0 and 1.6–2.3; width: 2.2–2.4 and 2.2–2.5. Interocular distance: 1.3–1.4 and 1.3–1.5. Antennomeres length I: 3.5–4.5 and 4.0–4.9; II: 3.6–4.7 and 4.1–5.5; III: 3.2–3.9 and 3.2–4.4; IV: 2.4–2.9 and 2.9–3.5. Pronotum length: 7.4–8.8 and 8–10.1; width: 9.5–11.6 and 10.5–13.5. Scutellum length: 2.2–2.6 and 2.4–3.3; width: 2.9–3.5 and 3.1–4.

Material examined. No Data: ♂ (MZSP 4236). BRAZIL, **Rio de Janeiro:** Corcovado, ♂, without date, J. A. P. D (UFRJ); same locality, ♀, 1.XII.1961, G. B. Werner (MZSP 4221); Copacabana, ♀, 20.XI.82, M. Figueiredo (UFRJ); **São Paulo:** Mococa, ♂, X.1994, L. Rocha (MZSP 4228); Cantareira, ♀, I.1949, without collector (MZSP 4227); São Paulo (Horto Florestal), ♀, 1.III.1962, J. Halik (MZSP 4225); Mogi das Cruzes, ♀, 6.I.1939, M. Carrera (MZSP 4231); São Paulo, ♀, (1928?), Stand. (MZSP 4233); Cid. Jardim, ♀, 14.III.1983, R. Geimber (IBSP 179). **Santa Catarina:** Bom Retiro, 3♂, ♀, I.1929, without collector (IBSP 6843; 6844; 6846; 6848). **Rio Grande do Sul:** Lajeado Grande, ♂, ♀, I.1941, without collector (MCNZ 5092, 5093).

Menenotus diminutus Walker, 1871
(Figs 3, 4, 9–12, 15, 16, 19–21, 24)

Menenotus diminutus Walker, 1871:7. Lethierry & Severin, 1894:54; Distant, 1901:430; Packauskas, 2010:192; Costa *et al.*, 2020: fig. 22, 23; Coreoidea SF Team, 2020.

Type material (examined by photo): Holotype – *Menenotus diminutus* ♂ (Fig. 24). a) Holotype, b) Type, c) *Menenotus diminutus* – white label, d) saunders 65′13 – white label, e) Braz – white label, f) Osuna des 1982 *Menenotus diminutus* Walker ♂ Holotype, g) BMNH(E) 651853.

Distribution: Brazil (Fig. 21).

Head. Mandibular plates ventrally convergent.

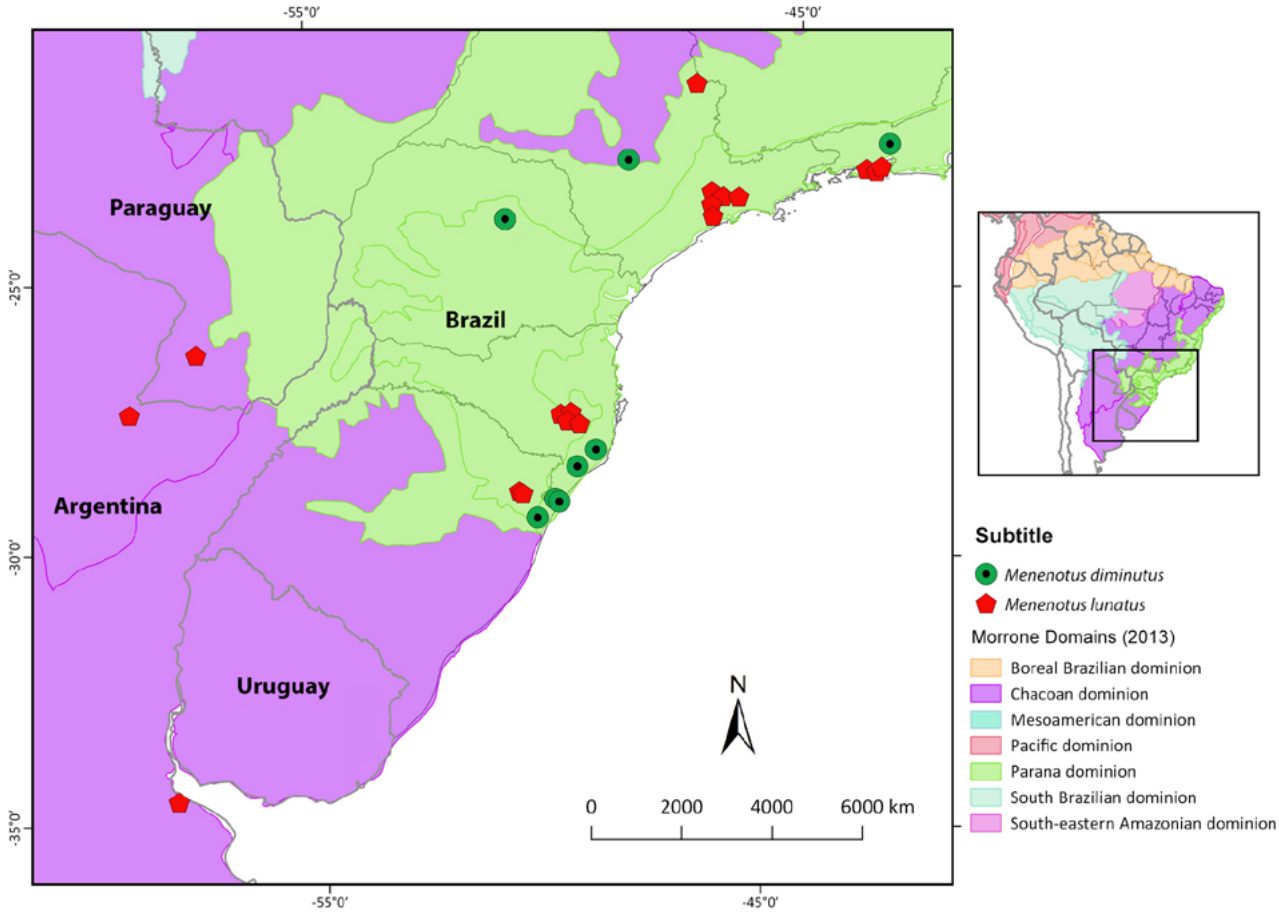
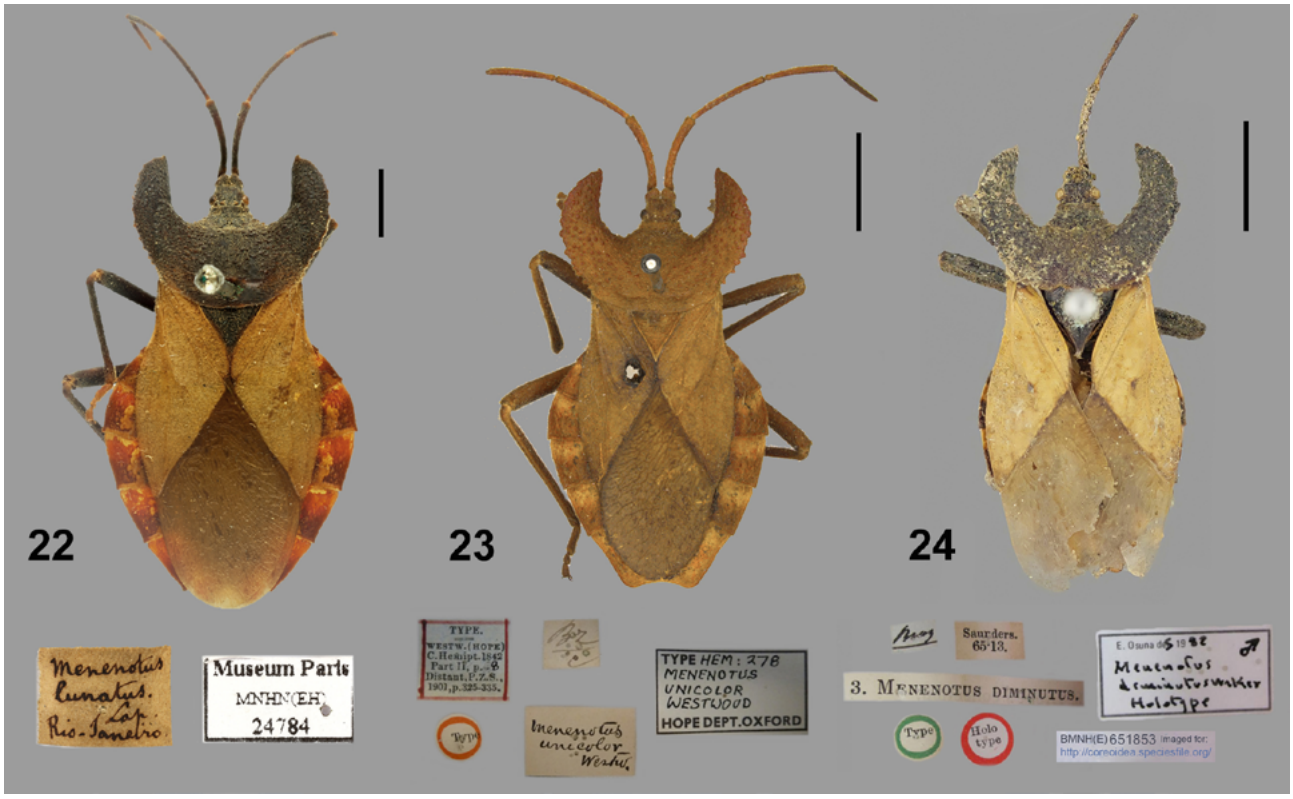


Fig. 21. Distribution map of *Menenotus* Laporte, 1832 species with the biogeographic domains according to Morrone (2013), based on literature and examined material.



Figs 22–24. Habitus of the type specimens of *Menenotus lunatus* (Laporte, 1832), female (MNHN) (22) described under the name *Menenotus unicolor* Westwood, 1842 male (courtesy of Oxford University Museum of Natural History, OUMNH), currently junior synonym of *M. lunatus* (23); *Menenotus diminutus* Walker, 1871 male (BMNH) (24). Scale bars: 5.0 mm.

Thorax. Pronotum with truncated postero-lateral angles, not forming a semicircle and with the posterior margin sub-rectilinear. Evaporative area black or yellow, with few setae; peritreme yellowish. Costal margin of hemelytra subrectilinear.

Abdomen. Connexiva with rounded and well-defined yellowish spots along the anterolateral margin of the segment. Pygophore at rest leaving visible an area equivalent to one third of its own length of the urotergite VII, in ventral view.

Genitalia. Male. Pygophore dark yellow, with irregular red spots laterally. Dorsal rim of pygophore subquadrangular. Posterior surface of the pygophore, in lateral view, markedly projected subapically. Cuplike sclerite projected more than twice its width in lateral view of the pygophore. Parameres slender, light yellow with the apical region of the head, dark brown; head long, almost half the total length, tapered, projected in a smooth curvature to the inner side and with ventral setae. Ventral sclerotization of the phallotheca with irregular shape. Basal plate triangular, densely sclerotized, except for the inferior portion of the transverse bridge, which is less sclerotized, about half its thickness; sclerotization of the central part of the ductifer shorter than half of length of the ligamentous processes. Processes of the conjunctiva with some points of sclerotization.

Measurements (mm), male and female, respectively**.** Total length: 19.9–23.1 and 23.3–24.6; width, on the posterior margin of the IV abdominal segment: 10–10.6 and 12.4–12.7. Head length: 1.5–1.8 and 1.9–2.2; width: 2.1–2.3 and 2.4–2.9. Interocular space: 1.1–1.5 and 1.3. Antennomeres length I: 3.5–4.0 and 3.9–4.2; II: 3.6–4.4 and 4.0–4.5; III: 3.1–3.9 and 3.6–3.7; IV: 2.9 and -. Pronotum length: 7.0–8.1 and 7.9–8.5; width: 9.5–11.5 and 10.5–11.4. Scutellum length: 2.4–2.7 and 2.9–3.4; width: 3.1–3.3 and 3.6–4.0.

Material examined. BRAZIL, **Rio de Janeiro:** Petrópolis, Independência, ♂, 13.III.1995, Ricardo (FIOC 35304); **São Paulo:** Botucatu, ♂, 28.II.1986, Leac (MZSP 5165); **Paraná:** Ortigueira, ♀, I.1946, Ernesto (MHNCI); **Santa Catarina:** Gravatal, ♀, 16.I.1962, Silveira, P. A. (MCNZ 02958); Criciúma, ♀, 21.X.2005, Miranda, A. (UFRGS 1297); **Rio Grande do Sul:** Torres, ♂, 3.X.1985, Fleck, F. K. col. (MCNZ 48837); ♀, 12.I.2005, L. Moura & I. Heydrich (MCNZ 177360); Maquiné, ♂, 20.VII.2006, A. Barcellos (MCNZ).

Comments. *Menenotus diminutus* can be distinguished from *M. lunatus* by the posterior margin of the pronotum sub-rectilinear near the posterolateral angles; connexivum with a well-marked yellow spot; cuplike sclerite projected more than twice its width, in lateral view of the pygophore; and paramere slender, with a smooth curvature of the head.

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