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Systematics of the South American species of *Cylindrostethus* Mayr, 1865 (Hemiptera : Heteroptera : Gerridae), with a new species from Amazonian Brazil and Peru

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Abstract. Water striders (pond skaters) occur worldwide and are conspicuous in most aquatic environments, but the taxonomy of many groups remains unresolved. Here we revise the South American species of the Palaeo- and Neotropically distributed *Cylindrostethus* Mayr, 1865, a genus characterised by its long, cylindrical body and fast jumping-gliding locomotion. Using a cladistic analysis of morphological characters, we confirm the subdivision of Neotropical *Cylindrostethus* into two major groups. Nine species of *Cylindrostethus* are recognised from South America, one of which was recently discovered in Amazonian Brazil and Peru: *C. bassleri* Drake, 1952; *C. bilobatus* Kuitert, 1942; *C. drakei*, sp. nov.; *C. hungerfordi* Drake & Harris, 1934; *C. linearis* (Erichson, 1848); *C. meloi* Floriano & Cavichioli, 2013; *C. palmaris* Drake & Harris, 1934; *C. podargus* Drake, 1958; *C. regulus* (White, 1879). Two species are placed in synonymy: (*C. podargus* = *C. stygius* Drake, 1961, syn. nov.); (*C. linearis* = *C. erythropus* (Herrich-Schäffer, 1850), syn. nov.). A key to the nine species is provided, along with detailed descriptions and illustrations.

Additional keywords: Cylindrostethinae, Neotropical, taxonomy, water striders.

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Introduction

The family Gerridae Leach, 1815 currently comprises 75 genera and over 700 species of true bugs commonly called water striders or pond skaters (Polhemus and Polhemus 2008). The family is classified in eight subfamilies: Charmatometrinae, Cylindrostethinae, Eotrechinae, Gerrinae, Halobatinae, Ptilomerinae, Rhagadotarsinae and Trepobatinae (Andersen 1975; Damgaard *et al.* 2005; Polhemus and Polhemus 2008).

Cylindrostethinae includes three genera: *Cylindrostethus* Mayr, 1865 with 18 species from Neotropical, Oriental and Ethiopian regions (nine Neotropical, nine Palaeotropical) (Hungerford and Matsuda 1960); *Potamobates* Champion, 1898 with 19 species from the Neotropical region (Buzzetti 2006) from Peru to southern Mexico (Hungerford 1936; Polhemus and Polhemus 1995; Padilla-Gil and Damgaard 2011; Morales-Castaño *et al.* 2013); and *Platygeris* White, 1883 with three species occurring in Central America and northern South America (Hungerford and Matsuda 1960). According to Hungerford and Matsuda (1960), Cylindrostethinae is characterised by a short rostrum surpassing the prosternum;

male proctiger usually with various degrees of asymmetry; apical margin of abdominal sternum VIII asymmetrical in species of *Potamobates* and *Platygeris*; meso- and metathoracic tarsal claws absent in all species occurring in the western hemisphere; antennomere IV short and curved distally; and apical margin of clypeus loosely connected with base of the labrum by a membranous region. Despite these apparent synapomorphies, a phylogenetic study combining morphological and molecular data (Damgaard 2008) did not support the monophyly of the subfamily.

Within the genus *Cylindrostethus*, species share the following features: body cylindrical and elongate, at least four times as long as wide; head strongly narrowed anteriorly and widened posteriorly; antennomere II longer than III; abdominal spiracles closer to the anterior margin of the segment; and male genitalia bilaterally symmetrical in South American species (Drake and Harris 1934; Kuitert 1942; Hungerford and Matsuda 1960). According to Hungerford and Matsuda (1960), Palaeotropical species of *Cylindrostethus* are characterised by the following features: proctiger rounded, with basolateral processes directed

posteriorly; meso- and metathoracic femora as long as the maximum length of body, except in *C. productus* (Spinola, 1840) and *C. costalis* Schmidt, 1915; hind legs longer than length of body; anterior margin of mesosternum less pronounced; and presence of tarsal claws in meso- and metathoracic legs. On the other hand, the Neotropical species are characterised by having: basolateral processes of proctiger directed anteriorly; meso- and metathoracic femora distinctly shorter than maximum length of body; legs almost as long as body; anterior margin of mesosternum more pronounced; and meso- and metathoracic legs lacking tarsal claws.

To date, all known Neotropical species of *Cylindrostethus* are restricted to South America. *Cylindrostethus palmaris* has been found in all South American countries except Chile and Uruguay (Nieser 1970; Mazzucconi *et al.* 2008), whereas the remaining Neotropical species – *C. bassleri* Drake & Harris, 1952; *C. bilobatus* Kuitert, 1942; *C. erythropus* (Herrich-Schäffer, 1850); *C. hungerfordi* Drake & Harris, 1934; *C. linearis* (Erichson, 1848); *C. meloi* Floriano & Cavichioli, 2013; *C. podargus* Drake, 1958; *C. regulus* (White, 1879); and *C. stygius* (Drake, 1961) – are known only from northern South America (Drake 1952; Nieser 1970; Moreira *et al.* 2011a, 2011b).

The lack of a robust phylogenetic hypothesis for *Cylindrostethus* reflects its systematics. Andersen (1982) suggested that *Cylindrostethus* might not be monophyletic given that Palaeotropical species have tarsal claws on the meso- and metathoracic legs whereas the Neotropical species do not.

Drake (1952) proposed two groups to accommodate the Neotropical species of *Cylindrostethus*. His Group 1 (*C. bassleri*, *C. bilobatus*, *C. erythropus* and *C. linearis*) is characterised by: a unicoloured mesonotum with longitudinal impressions; posterior margin of sternum VI deeply excavated in the middle; first genital segment broad, not tapering posteriorly, truncate apically; and upper lobe of second genital segment with a pair of long, divergent, prong-like processes at base, directed anterolaterally and downwards. Group 2 (*C. hungerfordi*, *C. palmaris*, *C. regulus*, *C. podargus* and *C. stygius*) is characterised by: the mesonotum with dark stripes on each side; the posterior margin of sternum VI with broad, rounded emargination in males; the first genital segment tapering towards the apex, then abruptly narrowed into an acute tip; and upper lobe of second genital segment expanded sideways at base, forming a small, plate-like structure.

The only previous phylogenetic analysis of *Cylindrostethus*, conducted by Polhemus (1994), was based on morphological data and yielded two sister clades, each exclusively comprising either Neotropical or Palaeotropical representatives. However, the author adopted the ground-plan character approach such that the data matrix has the Neotropical species represented as a single terminal, i.e. Polhemus assumed monophyly of the Neotropical *Cylindrostethus*. According to Polhemus, the lineage including South American species is supported by two synapomorphies: the absence of claws in mesothoracic legs and the apex of the proctiger being elongate and acute. In order to test the monophyly of the Palaearctic and Neotropical lineages, it will be important to sample all species for a comprehensive character list.

Ecological and biological data on species of *Cylindrostethus* are scarce. In Brazil, some authors observed a few species in streams, rivers and ponds (Moreira *et al.* 2011a), usually in shaded habitats (Nieser and Melo 1997). They can be found in association with macrophytes, floating litter banks and exposed roots (Pereira *et al.* 2007). Roback (1966), in his expedition to the Peruvian Amazon, reported the curious behaviour of specimens of *C. erythropus* that were on trunks near water bodies and which jumped in any direction when disturbed.

All species belonging to *Cylindrostethus* have a conspicuous behaviour when moving on the water surface, characterised by a strong push with the meso- and metathoracic legs followed by a long glide alternating between jumps and glides along a straight line. Species of other genera in the family are not as efficient when sliding at great speed over the water (Polhemus 1994).

Taxonomic studies of the South American species of *Cylindrostethus* are also scarce and are mostly represented by descriptions of new species. The main goals of this paper are:

- (1) to provide a revision of *Cylindrostethus* with an identification key to all valid species; and
- (2) to present a phylogenetic hypothesis for the South American species of *Cylindrostethus* and to evaluate the species-groups proposed by Drake (1952).

Materials and methods

Specimens were borrowed from several Brazilian and international institutions, here listed in alphabetical order of the abbreviation: AMNH, American Museum of Natural History, New York, United States of America; BMNH, Natural History Museum, London, United Kingdom; DZRJ, Coleção Entomológica Prof. José Alfredo Pinheiro Dutra, Rio de Janeiro, Brazil; DZUP, Coleção Entomológica Padre Jesus Santiago Moure, Curitiba, Brazil; INPA, Coleção de Invertebrados do Instituto Nacional de Pesquisa da Amazônia, Manaus, Brazil; SEMC, Snow Entomological Collection, University of Kansas, Lawrence, United States of America; LACM, Natural History Museum of Los Angeles County, Los Angeles, United States of America; MPEG, Museu Paraense Emílio Goeldi, Belém, Brazil; UEMS, Coleção Entomológica da Universidade Estadual do Mato Grosso do Sul, Mundo Novo, Brazil; UPTC, Museo de Historia Natural Luis Gonzalo Andrade, Tunja, Colombia; USNM, National Museum of Natural History, Smithsonian Institution, Washington D.C., United States of America; ZSMC, Zoologisches Staatssammlung, Munich, Germany.

Label data are given inside quotation marks, with a reversed slash (\) and separating lines on the labels.

Specimens were examined and illustrated using a Zeiss dissecting microscope (SV 6, Jena, Thuringia, Germany) and Leica MZ 12.5 (Wetzlar, Hesse, Germany) and camera lucida. Phallus sclerites were illustrated with a camera lucida connected to an optical microscope (Wild M20, Gais, Appenzell Ausserrhoden, Switzerland). Specimens were identified based on the examination of original descriptions, type specimens, photographs and keys provided by Drake and Harris (1934), Kuitert (1942) and Moreira *et al.* (2011a). Genitalia of males and

females were detached, immersed in a solution of 10% potassium hydroxide and placed in a warm bath for ~15 min. Dissected structures were then washed with water, warmed up in a solution of 3% hydrogen peroxide to clear structures and then washed in 50% alcohol to remove air bubbles. After examination, dissections were stored in vials with glycerin and attached to the same pin as the specimen. Type specimens were not dissected.

In this paper, the visible abdominal sternites are considered to represent sternites II–VII because the first abdominal sternite is reduced in individuals of all subfamilies except Rhagadotarsinae (Hungerford and Matsuda 1960; Andersen 1982).

Series of photographs were taken using a Leica camera attached to a dissecting microscope and combined into multi-focal images using the Syncroscopy Auto-Montage software (High Wycombe, Buckinghamshire, England). Subsequently, stacked images and drawings were edited in Adobe Photoshop and Adobe Illustrator. Scanning electron microscope (SEM) images were obtained at the Centro de Microscopia Eletrônica da Universidade Federal do Paraná. Distribution records were retrieved from the literature and data from labels on specimens.

A data matrix (Table 1) of 34 morphological characters (23 external and 11 male/female genitalia; Table 2), including 29 binary and five multistate characters, was assembled using WinClada (Nixon 1999–2002). Non-applicable characters were coded as ‘–’ and missing data were coded as ‘?’. Parsimony analyses were performed using TNT software (Goloboff *et al.* 2008) with all characters treated as unordered using two character-weighting schemes: equal weights and implied weights (Goloboff 1993), choosing values of K from three to seven. Tree searches were run using the implicit enumeration option, an exhaustive search function that computes all possible trees when taxon sampling includes fewer than 24 terminals. Clade support was calculated using Bremer support (i.e. decay index; Bremer 1994) and 100 bootstrap pseudoreplicates implemented in TNT under an equal-weighting scheme. Only unambiguous characters were optimised on the resulting cladogram.

We used morphological characters to partition the study specimens into distinct phenotypes, with the most useful characters being the length of the connexival spines and the proctiger, the shape of the basolateral processes of the

proctiger, phallus, and phallic sclerite and colouration. After completing a preliminary phylogenetic analysis using these phenotypes, those that were sympatric with their sister lineage were considered to be distinct species. If a phenotype was allopatric with its sister lineage, we then looked at geographic variation to determine whether it would be better to consider it a geographic variant or a distinct species.

Results and discussion

The phylogenetic analysis performed in this study yielded one most parsimonious cladogram (Fig. 1) of 43 steps, CI=97 and RI=98. The genus *Cylindrostethus* is supported by four synapomorphies: the elongated body (character 1₀), the acute connexival spines (character 19₁), the symmetrical male genitalia (character 21₀) and the elongated phallus (character 30₁). The two groups proposed by Drake (1952) were recovered in this morphology-based phylogenetic analysis.

Polhemus (1994) conducted a phylogenetic analysis of the Palaetropical species of *Cylindrostethus*; however, he assumed that the Neotropical species were monophyletic, and treated them as a single terminal. The author concluded that *Cylindrostethus* was divided into two sister clades, represented by the Neotropical and Palaetropical species, and the phylogenetic relationships were addressed only in the latter group. In order to make further progress into the systematics of *Cylindrostethus*, to test and corroborate the monophyly of the Palaearctic and Neotropical lineages, it is important to sample all the species including an adequate characters list. The topology obtained in this study corroborates Group 1 proposed by Drake (1952). This clade is supported by one synapomorphy, the presence of spinules on abdominal sternites (character 12₀), with low Bremer support (1). We suggest this clade to be named *linearis*-group, because *C. linearis* is the oldest described species in the group.

Five species are included in *linearis*-group: *C. bassleri*, *C. bilobatus*, *C. linearis*, *C. meloi* and *C. drakei*, sp. nov. The first three species were placed in Group 1 by Drake (1952), and *C. erythropus* is herein considered to be synonymous with *C. linearis*; *C. drakei*, sp. nov. and *C. meloi*, the latter included in this group by Floriano and Cavichioli (2013), are within the *linearis*-group in this phylogenetic analysis.

Table 1. Data matrix comprising 34 morphological characters for *Cylindrostethus* taxa and outgroups
(–) not applicable; (?) missing; (bold) outgroup; (*) polymorphic character

| Taxa | 0 | | | | | | | | | 1 | | | | | | | | | 2 | | | | | | | | | 3 | | | | | | |
|-----------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 |
| <i>P. sumaco</i> | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | 1 | – | – | 1 | – | 1 | 1 | 0 | 0 | 1 | 1 | 1 | ? | ? | ? | ? | ? | ? | 2 | ? | ? | ? | – |
| <i>P. horvathi</i> | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | 1 | – | – | 1 | – | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | ? | ? | ? | ? | ? | 2 | ? | ? | ? | – |
| <i>C. bassleri</i> | 0 | 0 | – | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 1 | 0 | ? | ? | ? | 1 | 1 |
| <i>C. bilobatus</i> | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | – | 0 | 0 | 0 | 1 | 1 | – | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | ? | ? | ? | 0 | 1 |
| <i>C. hungerfordi</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | – | – | 1 | – | 0 | – | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| <i>C. linearis</i> | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| <i>C. meloi</i> | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| <i>C. palmaris</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | * | 1 | – | 1 | – | 0 | – | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| <i>C. podargus</i> | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | * | 1 | – | 1 | – | 0 | – | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 1 |
| <i>C. regulus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | – | – | 1 | – | 0 | – | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| <i>C. drakei</i> | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | – | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |

Table 2. Explanation of characters used in cladistics analysis

| Character | States | Statistics | Notes |
|---|--|------------------------------|--|
| 1. Body shape | (0) Elongated and cylindrical (length superior 4× the width) (Figs 10–13); (1) not elongated and cylindrical (length inferior 4× the width). | Length: 1 IC: 100 RI: 100 | The elongated cylindrical body (Drake and Harris 1934; Hungerford and Matsuda 1960; Hungerford and Matsuda 1962; Polhemus 1994) is a synapomorphy for <i>Cylindrostethus</i> . |
| 2. Antennomere IV, shape | (0) Cylindrical (Fig. 6A, B); (1) flattened (Fig. 6C). | Length: 1 CI: 100 RI: 100 | The flat antennomere IV is an autapomorphic feature of <i>C. podargus</i> . Drake (1958) described the antennae in this group as ‘fairly stout’. In some specimens, it shows a median longitudinal groove. |
| 3. Antennomere IV, orientation | (0) Straight (Fig. 6B, C); (1) curved (Fig. 6A). | Length: 1 CI: 100 RI: 100 | Hungerford and Matsuda (1960) suggested that the posterior curve of antennomere IV could be a putative synapomorphy of <i>Cylindrostethinae</i> . However, some species of <i>Cylindrostethus</i> (<i>C. hungerfordi</i> , <i>C. palmaris</i> , <i>C. podargus</i> and <i>C. regulus</i>) have a straight antennomere. Members of the subfamily Ptilomerinae also have a curved antennomere IV, varying from slightly to strongly curved (Andersen 1982). The studied specimens of <i>C. bassleri</i> lack the antennomere IV, so it was not possible to code the character in this case. The straight antennomere IV is a synapomorphic feature of the <i>regulus</i> -group. |
| 4. Vertex punctations | (0) Present (Fig. 4D); (1) absent (Fig. 4C). | Length: 1 CI: 100 RI: 100 | All species in the <i>regulus</i> -group (except <i>C. podargus</i>) have small punctations on the vertex, a synapomorphic character of this group. In other species, punctations are absent in the apical portion of the vertex. |
| 5. Clypeus, pilosity | (0) Glabrous (Fig. 4B); (1) densely pilose (Fig. 4A). | Length: 1 CI: 100 RI: 100 | The glabrous clypeus is a synapomorphic character of the <i>regulus</i> -group (except <i>C. podargus</i>). In other species of <i>Cylindrostethus</i> the clypeus is covered with setae. |
| 6. Eyes, size of spines | (0) Robust/large (Fig. 4F); (1) minute (Fig. 4E). | Length: 1 CI: 100 RI: 100 | The spiny ventral margin of eyes is a synapomorphy of the <i>regulus</i> -group. They are well visible when specimens are examined in lateral view. In other species of <i>Cylindrostethus</i> , these spines are inconspicuous, forming small elevations on the margin of the eyes. |
| 7. Female, mesonotum, posterior region of dorsal margin | (0) Not extended above the metanotum (Fig. 2G); (1) extended above the metanotum, forming a protuberance (Fig. 2F). | Length: 1 CI: 100 RI: 100 | The protuberant dorsal margin extending above the metanotum is only present in females of <i>C. bilobatus</i> . Kuitert (1942) used this character in female descriptions. |
| 8. General colouration | (0) Predominantly black (Figs 10A, B, 12, 13); (1) predominantly yellow (Figs 10C–F, 11). | Length: 1 CI: 100 RI: 100 | Species of <i>Cylindrostethus</i> are generally yellow or black. The yellow colouration is a synapomorphy of the <i>regulus</i> -group (except <i>C. podargus</i>), it may vary from lighter to darker yellow, but never black. |
| 9. Apterous, mesonotum and metanotum, black stripes | (0) Present (Figs 10C, D, 11); (1) absent (Figs 10A, B, 12, 13). | Length: 1 CI: 100 RI: 100 | The black stripes in the <i>regulus</i> -group (except <i>C. podargus</i>) is a synapomorphic character. This feature has previously been used by Drake and Harris (1934), Drake (1952) and Kuitert (1942). |
| 10. Mesonotum, width of black | (0) Narrow, 3× narrower than median yellow stripe (Fig. 11A, B); (1) as wide as central yellow stripe (Figs 10C, D, 11C, D). | Length: 1 CI: 100 RI: 100 | The narrow black stripes in the mesonotum (state 0) was observed in a single species, <i>C. hungerfordi</i> . In the description of this species, Drake and Harris (1934) used this character as a diagnostic feature. When the stripes are as wide as the median yellow stripe, they may exhibit slight variation in conspecific specimens. |
| 11. Male, anterior region of the metacetabulum | (0) Without tuft of setae; (1) with tuft of setae (Fig. 2A). | Length: 1 CI: 100 RI: 100 | |

(continued next page)

Table 2. (continued)

| Character | States | Statistics | Notes |
|---|--|------------------------------|--|
| 12. Abdomen, sternites, spinules | (0) Present; (1) absent. | Length: 1 CI: 100 RI: 100 | The spinules on the abdominal sternites of males are synapomorphic to the Neotropical species of <i>Cylindrostethus</i> . Old World <i>Cylindrostethus</i> have spinules on both abdominal and thoracic sternites. The absence of spinules is considered plesiomorphic for the genus. According to Polhemus (1994), the spinules first evolved in the abdomen, and later in the meso- and metathoracic sternites; in the same contribution, the author indicated that the absence of spinules was a synapomorphy of the Neotropical species. However, several Neotropical species have spinules on abdominal sternites, and this is a synapomorphic feature of the <i>linearis</i> -group. The spinules are also present in <i>C. palmaris</i> and <i>C. podargus</i> , but they are polymorphic in these species. |
| 13. Abdomen, sternites, spinules, amount and distribution | (0) Abundant and agglomerated; (1) sparse and scattered. | Length: 1 CI: 100 IR: 100 | The spinules on abdominal sternites may be sparsely distributed (as in <i>C. palmaris</i> and <i>C. podargus</i>) or numerous and clumped together (a synapomorphic feature of the <i>linearis</i> -group). |
| 14. Abdomen, sternites, location of spinules | (0) On the centro-posterior region; (1) on the posterior region. | Length: 1 CI: 100 RI: 100 | Abdominal spinules are numerous and agglomerated in the <i>linearis</i> -group, and are located on the posterior region of sternites (as in <i>C. bilobatus</i>); alternatively, they can be located on the central region (as in <i>C. bassleri</i> , <i>C. linearis</i> , <i>C. meloi</i> and <i>C. drakei</i> , sp. nov.). |
| 15. Abdomen, sternites, central concavities | (0) Present; (1) absent. | Length: 1 CI: 100 RI: 100 | Species in the <i>linearis</i> -group (except for <i>C. bilobatus</i>) have concavities in the posterior region of abdominal sternites, a synapomorphic feature of <i>C. meloi</i> (<i>C. meloi</i> (<i>C. bassleri</i> (<i>C. linearis</i> <i>C. drakei</i> , sp. nov.))). |
| 16. Abdomen, sternites V–VII, location of concavities | (0) Encompassing sternites V–VII; (1) only on sternite VII. | Length: 1 CI: 100 RI: 100 | The concavities on sternites V–VII are an autapomorphic feature of <i>C. linearis</i> ; in <i>C. bassleri</i> , <i>C. meloi</i> and <i>C. drakei</i> , sp. nov. the concavity is seen only in sternite VII. |
| 17. Abdomen, sternite VII, emarginate at middle | (0) Absent (margin rounded) (Fig. 8A–D); (1) present (emarginate at middle) (Fig. 8E–I). | Length: 1 CI: 100 RI: 100 | Drake (1952) observed a conspicuous notch in sternite VII, and used it as a character to differentiate species in Group 1 from species in Group 2. This median notch is also found in two outgroup taxa (<i>Potamobates horvathi</i> Esaki, 1926 and <i>Potamobates sumaco</i> Cognato, 1998). |
| 18. Abdomen, sternite VII, shape of median notch | (0) Strongly marked (Fig. 8E–I); (1) subtle. | Length: 1 CI: 100 RI: 100 | In the <i>linearis</i> -group, the median notch is strongly marked, whereas in <i>P. sumaco</i> and <i>P. horvathi</i> the median notch is much less conspicuous. |
| 19. Abdomen, connexival spines, shape | (0) Rounded; (1) acute (Figs 7, 8). | Length: 1 CI: 100 RI: 100 | The conspicuous connexival spines is a synapomorphy of <i>Cylindrostethus</i> . When present, the spines in species of <i>Potamobates</i> are not acute (Hungerford and Matsuda 1960; Polhemus and Polhemus 1995; Polhemus 1994). |
| 20. Abdomen, connexival spines, length | (0) Very short; (1) short, ~3/10 the length of tergite VIII (Fig. 7C, D); (2) intermediate, ~1/2 the length of tergite VII (Fig. 7A, B); (3) long, 3/5 the length of tergite VIII (Fig. 7E–I). | Length: 3 CI: 100 RI: 100 | In Palaeotropical species, the connexival spines may be elongate (longer than the tergite VIII), and usually reach the apex of tergite VIII in Neotropical species. The progressive prolongation of the connexival spines is considered apomorphic (Polhemus 1994). These spines are long in the <i>linearis</i> -group, of intermediate length in <i>C. palmaris</i> and <i>C. podargus</i> and short in <i>C. hungerfordi</i> and <i>C. regulus</i> . |

(continued next page)

Table 2. (continued)

| Character | States | Statistics | Notes |
|---|---|------------------------------|---|
| 21. Abdomen, genitalia, shape | (0) Bilaterally symmetrical (Figs 7–9); (1) asymmetrical. | Length: 1 CI: 100 RI: 100 | The male genitalia is bilaterally symmetrical in the Neotropical species of <i>Cylindrostethus</i> , and asymmetrical in Palaeotropical species (Hungerford and Matsuda 1960; Hungerford and Matsuda 1962; Polhemus 1994). The bilaterally symmetrical proctiger is a plesiomorphic condition, and the asymmetry is a consequence the enlargement of the left basolateral process (Polhemus 1994). The genitalia in species of <i>Potamobates</i> exhibit asymmetric variations, like processes in the posterior margin of tergite VIII (Hungerford and Matsuda 1960; Polhemus & Polhemus 1994;). |
| 22. Genitalia, orientation | (0) Not rotated (Figs 7–9); (1) rotated. | Length: 1 CI: 100 RI: 100 | In <i>Potamobates</i> , the male genitalia is rotated counterclockwise, except in <i>P. thomasi</i> (Hungerford and Matsuda 1960; Polhemus 1994;). |
| 23. Sternum VIII, shape of margins | (0) Constricted centrally (Fig. 8A); (1) straight (Fig. 8B–J). | Length: 1 IC: 100 IR: 100 | The constricted sternum VIII is an autapomorphy of <i>C. podargus</i> ; however, this feature may not be as conspicuous in some specimens; in such cases, the specimen needs to be slightly rotated to accurately observe the shape of the sternum. |
| 24. Proctiger, length | (0) Long, with short basolateral processes (Fig. 9A–D); (1) short, with long basolateral processes (Fig. 9E–G). | Length: 1 CI: 100 RI: 100 | Species in the <i>linearis</i> -group have a short proctiger with long basolateral processes, whereas species in the <i>regulus</i> -group have a long proctiger with short basolateral processes. |
| 25. Basolateral processes, length in relation to width | (0) Elongate (Figs 8E–I, 9E–G); (1) subequal (Figs 8A–B, 9A, B); (2) 2 × wider than long (Figs 8C, D, 9C, D). | Length: 2 CI: 100 RI: 100 | In <i>Cylindrostethus</i> , the proctiger has lateral expansions that show great variation (Polhemus 1994). For instance, in species of the <i>linearis</i> -group, the basolateral processes are longer than wide, in <i>C. palmaris</i> and <i>C. podargus</i> are nearly as long as wide and in <i>C. hungerfordi</i> and <i>C. regulus</i> are wider than long. |
| 26. Basolateral processes, shape | (0) Rectangular (Figs 8A, 9A); (1) oval (Figs 8B–D, 9B–D); (2) cylindrical (Figs 8G–I, 9F, G); (3) triangular (Figs 8E, F, 9E). | Length: 3 CI: 100 RI: 100 | The cylindrical basolateral processes are a synapomorphic feature of (<i>C. bassleri</i> (<i>C. linearis</i> <i>C. drakei</i> , sp. nov.)), <i>Cylindrostethus bilobatus</i> and <i>C. meloi</i> have triangular basolateral processes, and only in <i>C. podargus</i> the process is rectangular. In the remaining species, the processes are oval. |
| 27. Proctiger, distance between the apices of basolateral processes in relation to proctiger length | (0) Longer than proctiger (Figs 8H, I, 9F, G); (1) narrower than proctiger (Figs 8E–G, 9E); (2) very narrow (Figs 8A–D, 9A–D). | Length: 2 CI: 100 RI: 100 | The distance between the apices of basolateral processes apex greater than the length of proctiger is a synapomorphic feature of <i>C. linearis</i> + <i>C. drakei</i> , sp. nov. In <i>C. bassleri</i> , <i>C. bilobatus</i> and <i>C. meloi</i> , the distance is nearly equivalent to proctiger length. In the remaining species, the apices of basolateral processes are closer to each other. |
| 28. Basolateral process, length | (0) Long, reaching the connexival spines (Fig. 8H, I); (1) short, not reaching the connexival spines (Fig. 8A–G). | Length: 1 CI: 100 RI: 100 | The elongated basolateral process (reaching the connexival spines) is a synapomorphy of <i>C. linearis</i> + <i>C. drakei</i> , sp. nov. |
| 29. Basolateral processes, shape of the apex | (0) Rounded (Figs 8B–D, G–I, 9B–D, F, G); (1) acute (Figs 8E, F, 9E); (2) truncate (Figs 8A, 9A). | Length: 3 CI: 66 RI: 0 | In <i>C. meloi</i> and <i>C. bilobatus</i> , the apex of basolateral processes is acute; in <i>C. podargus</i> , the apex is truncate, and in the remaining species, the apex is rounded. |
| 30. Phallus, shape | (0) Semicircular; (1) elongate. | Length: 2 CI: 100 RI: 100 | The elongate phallus was recovered as a synapomorphy of <i>Cylindrostethus</i> . |
| 31. Phallic sclerite, shape | (0) Semicircular (Fig. 2C); (1) distinctly expanded, apex emarginate medially (Fig. 2B). | Length: 1 CI: 100 RI: 100 | The emarginate apex is an autapomorphy of <i>C. hungerfordi</i> . |

(continued next page)

Table 2. (continued)

| Character | States | Statistics | Notes |
|--|--|------------------------------|--|
| 32. Phallus, apex of sclerite, length of the projections | (0) ~2× longer than the width of its confluence area; (1) as long as the width of its confluence area. | Length: 1 CI: 100 RI: 100 | The apical projections in the phallic sclerite as long as the width of its confluence area are considered a synapomorphic feature of the clade <i>C. hungerfordi</i> + <i>C. regulus</i> . |
| 33. Tergite VIII, shape | (0) Elongate; (1) subquadrangular. | Length: 1 CI: 100 RI: 100 | The subquadrangular tergite VIII is a synapomorphy of (<i>C. meloi</i> (<i>C. bassleri</i> (<i>C. linearis</i> <i>C. drakei</i> , sp. nov.))). |
| 34. Apex of tergite VIII, shape | (0) Acute (Fig. 2E); (1) rounded (Fig. 2D). | Length: 1 CI: 100 RI: 100 | The acute apex of tergite VIII is an autapomorphy of <i>C. palmaris</i> . |

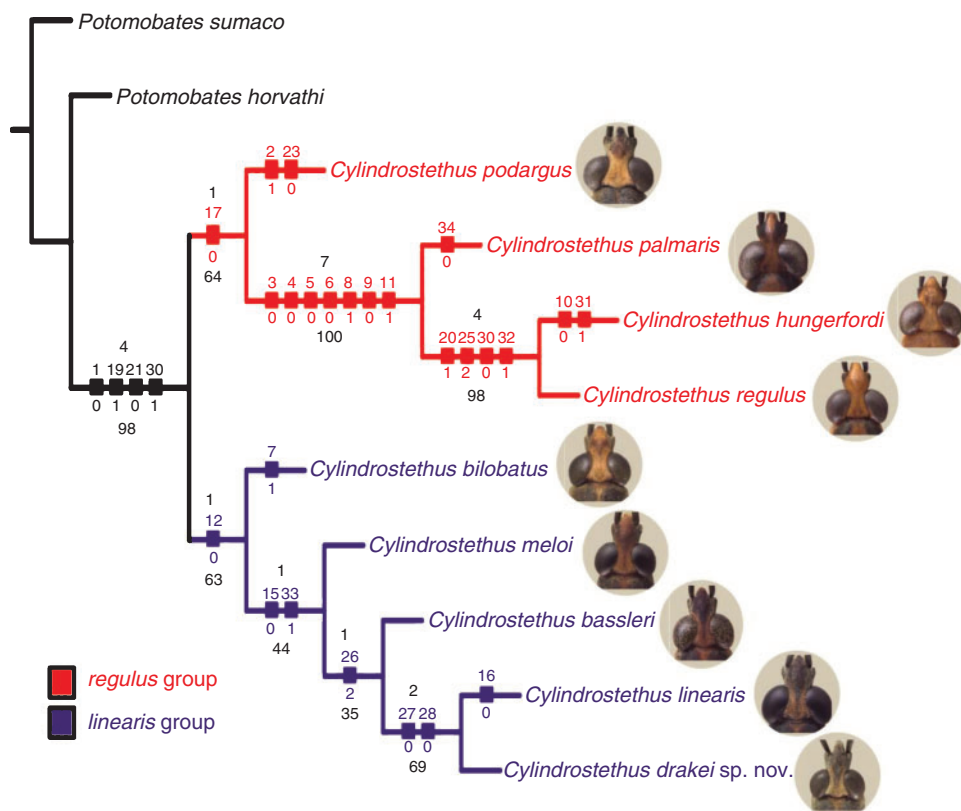


Fig. 1. Most parsimonious cladogram obtained with equally weighted characters. Relative Bremer support is indicated above each node. Bootstrap is indicated below each node.

The clade (*C. bilobatus* (*C. meloi* (*C. bassleri* (*C. linearis*, *C. drakei*, sp. nov.)))) is supported by a single synapomorphy: sternites abdominal with spinules (character 12₀). The clade (*C. meloi* (*C. bassleri* (*C. linearis*, *C. drakei*, sp. nov.))) is supported by two synapomorphies: abdominal sternites with medial concavities (character 15₀), and subquadrangular tergite VIII (character 33₁). The clade (*C. bassleri* (*C. linearis*, *C. drakei*, sp. nov.)) is supported by a single synapomorphy: the cylindrical basolateral processes of proctiger (character 26₂). *Cylindrostethus linearis* + *C. drakei*, sp. nov. share two synapomorphies: the distance between the apices of basolateral

processes is greater than the length of the proctiger (character 27₀), and the basolateral process reaches and overlaps the connexival spines (character 28₀).

Group 2 *sensu* Drake (1952) was also recovered as monophyletic, but with low Bremer support (1). This clade is supported by a single synapomorphy: apex of sternite VII rounded in males (character 17₀). We suggest this clade to be named the *regulus*-group, because *C. regulus* is the oldest described species included in the group. It consists of (*C. podargus* (*C. palmaris* (*C. hungerfordi*, *C. regulus*))). The clade comprising *C. hungerfordi* + *C. regulus* is well supported

(Bremer=4) by four synapomorphies: short connexival spines (20₁); the shape of the basolateral processes (wider than long) (25₂); semicircular phallus (30₀); and apical projection of sclerite as long as its confluence area (32₁).

According to Polhemus (1994), *Cylindrostethus* species are similar in their external morphology, differing primarily in small details of the male and female genital and pregenital structures. Comparing South American species of *Cylindrostethus* with species of other genera of Cylindrostethinae (e.g. *Platygeris* and *Potamobates*), we can affirm that the former show less intra- and interspecific variation. However, even the small morphological variation of the South American *Cylindrostethus* clade allows us to define characters and to resolve its internal relationships.

Taxonomy

Cylindrostethus Mayr, 1865

Type species: Cylindrostethus productus (Spinola, 1840) (= *Cylindrostethus fieberi* Mayr, 1865) by monotypy.

Cylindrostethus Fieber, 1861: 33. [gen. nov.: nom. nud.; key to genus]. Mayr, 1865: 444. [redescription of genus, description of first species, *C. fieberi*=*Gerris productus* Spinola, 1840]. Drake & Harris, 1934: 218, 238–239 [redescription, key to species, illustration]. Kuitert, 1942: 135 [redescription, key to species]; Drake, 1952: 3 (new species-groups). Hungerford & Matsuda, 1960: 224–227, 504–509 [redescription, illustration]. Hungerford & Matsuda, 1962: 83–84, 103–111 [taxonomic remarks]. Polhemus, 1994: 3–6, 26–27 [redescription, key, illustration]; Aristizábal, 2002: 81 [key, illustration].

Hydrobates Erichson, 1848: 614 [gen. nov.; name preoccupied by *Hydrobates* Boie, 1822 in Aves].

When erecting *Cylindrostethus*, Fieber (1861) did not include any species. The International Code of Zoological Nomenclature (Article 12.2) states that nominal genera described before 1931 must include one or more available nominal species, which should be clearly stated in the description (ICZN 2000). For this reason, the name *Cylindrostethus* Fieber, 1861 was unavailable (nomen nudum) until Mayr (1865) described a new species in the genus, *C. fieberi*. Although the genus authorship is sometimes attributed to Fieber (1861), Mayr is the authority of *Cylindrostethus*, the publication date is 1865 and *C. fieberi* Mayr, 1865 is the type species by monotypy.

The genus redescription below refers only to the South American species.

Diagnosis

Body cylindrical and elongate, six times as long as wide (Figs 10–13); maxillary and mandibular plates fused, rostrum short, not reaching the mesosternum (Figs 3A, 15); usually apterous (except for *C. palmaris*); meso- and metathoracic tarsal claws absent (Fig. 3A, B); connexival spines shorter than the length of tergite VIII (Fig. 7); proctiger bilaterally symmetrical, basolateral processes directed laterally or anteriorly (Figs 8, 9).

Redescription

Male and female: apterous except for *C. palmaris*. Body cylindrical and elongate (Figs 10–13). Head: with median length 2/3 shorter than transocular distance, in dorsal view; lateral margins of vertex diverging anteriorly and posteriorly, C-shaped; antennal tubercles projecting and divergent, in dorsal view; eyes oval and protuberant, 1–2× as large as interocular width (Fig. 14); antennae smaller than prothoracic legs; antennomere I longer than II and III combined; antennomere III approximately half as long as IV; clypeus rounded anteriorly, basal margin absent (Fig. 4A, B); mandibular and maxillary plates fused (Fig. 3A); rostrum short, not reaching the mesosternum (Figs 3A, 15), article III 1.4–2.5× longer than article IV. Thorax: pronotum 1/2–1/3 as long as head width, posterolateral margins oblique, posterior margin slightly curved; mesonotum at least 1.4× as long as pronotum and metanotum combined; posterior margin slightly notched; metanotum subequal or slightly longer than pronotum. Prothoracic femora more robust than meso- and metathoracic femora, bearing spines on anterodorsal region; femora subequal or slightly longer than tibiae, tarsomere II 1.8–3.2× longer than tarsomere I, subapical tarsal claws present. Mesothoracic legs longer than metathoracic legs, femora 1.5–1.8× smaller than body length; mesothoracic tarsi flattened, longer than pro- and metathoracic tarsi, tarsomere I ~3× longer than tarsomere II; meso- and metathoracic tarsal claws absent (Fig. 3B). Metathoracic femora 1.6× as long as tibia; tarsal claws absent (Fig. 3C). Abdomen: approximately as long as mesothoracic femora; lateral margins parallel, divergent or convergent; tergite I ovate or cordate, smaller than others; tergites II–IV rectangular, equal in size.

Male: connexival spines subequal to or shorter than length of tergite VIII (Fig. 7); proctiger bilaterally symmetrical, length variable (0.9–2.2 mm), apical margin acute, basolateral processes variable: short with rounded or truncate apex, or long with rounded or acute apex (Figs 8, 9); apex of pygophore rounded to nearly acute (Fig. 8). Female: connexival spines distinctly smaller than length of tergite VIII, gonocoxae with or without spines.

Colouration: varying from black to yellow, with black antennae and antennal tubercles (Figs 10–13).

Comments

This genus is easily distinguished from the other genera of Cylindrostethinae in having: body cylindrical and elongate, six times as long as wide (Figs 10–13), whereas in *Potamobates* and *Platygeris* the body length is less than four times the width; antennomere II longer than III, whereas in *Potamobates* and *Platygeris* antennomere II is equal to or smaller than III; abdominal spiracles closer to the anterior margin of the segment, whereas in *Potamobates* and *Platygeris* spiracle is located on the middle portion; *Cylindrostethus* has the proctiger bilaterally symmetrical with basolateral processes directed laterally or anteriorly (Figs 8, 9), whereas *Potamobates* and *Platygeris* have the basolateral process of proctiger directed cephalad and asymmetrical.

Species included in *Cylindrostethus*

- Cylindrostethus bassleri* Drake, 1952. Distribution: Peru (Amazonas)
Cylindrostethus bilobatus Kuitert, 1942. Distribution: Bolivia (Beni), Brazil (Mato Grosso*)
Cylindrostethus costalis Schmidt, 1915. Distribution: Indochina
Cylindrostethus drakei, sp. nov. Distribution: Brazil (Amazonas, Pará, Rondônia), Peru (Loreto)
Cylindrostethus hungerfordi Drake & Harris, 1934. Distribution: Bolivia, Brazil (Amapá*, Pará), Guyana (East Berbice), Suriname (Brokopondo, Sipaliwini)
Cylindrostethus linearis (Erichson 1848). Distribution: Bolivia (Beni), Brazil (Amazonas, Pará, Roraima), Ecuador (Napo), Guyana, Peru (Loreto)
Cylindrostethus malayensis Polhemus, 1994. Distribution: Malay Peninsula below the Isthmus of Kra, and northern Sumatra
Cylindrostethus meloi Floriano & Cavichioli, 2013. Distribution: Brazil (Amazonas)
Cylindrostethus palmaris Drake & Harris, 1934. Distribution: Argentina, Bolivia (Beni), Brazil (Amapá, Amazonas, Bahia, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Rio de Janeiro, Rio Grande do Norte, Rondônia, Roraima, São Paulo), Colombia (Caquetá, Casanare, Meta, Putumayo, Vaupés) Ecuador (Napo), French Guyana (Cayenne), Guyana (Demerara-Mahaica, East Berbice-Corentyne, Marowijne), Suriname (Brokopondo, Marowijne, Para, Sipaliwini), Trinidad & Tobago (Diego Martín, San Juan-Laventille, Sangre Grande, Siparia, Tunapuna-Piarco), Venezuela (Amazonas, Aragua, Barinas, Monagas)
Cylindrostethus persephone Kirkady, 1899. Distribution: (Celebes)
Cylindrostethus podargus Drake, 1958. Distribution: Brazil* (Rondônia), Peru (Loreto)
Cylindrostethus productus (Spinola, 1840). Distribution: Ceylon
Cylindrostethus quadrivittatus Bergroth, 1916. Distribution: (West Africa)
Cylindrostethus regulus (White, 1879). Distribution: Brazil (Amazonas, Pará*), Colombia* (Putumayo), Peru* (Loreto)
Cylindrostethus samarinda Polhemus, 1994. Distribution: Borneo
Cylindrostethus scrutator (Kirkaldy, 1899). Distribution: Malaysia
Cylindrostethus sumatranus Lundblad, 1933. Distribution: Sumatra
Cylindrostethus vittipes (Stal, 1870). Distribution: Philippines.

* New records.

5. Body length >20 mm; prothoracic tibiae yellow with longitudinal black stripes; males: basolateral processes of proctiger $2\times$ as wide as long (Fig. 9D); females: apex of tergite VIII rounded (Fig. 2D).....*C. regulus* (White, 1879)
 Body length ≤ 20 mm; prothoracic tibiae black; males: basolateral processes of proctiger $1-1.4\times$ as wide as long (Fig. 9B); females: apex of the tergite VIII acute (Fig. 2E)*C. palmaris* Drake & Harris, 1934
 6. Females: posterior margin of mesonotum projected over metanotum (Fig. 2F); males: basolateral processes of proctiger small, not visible in dorsal view (Fig. 7E); posterior region of sternites V and VI with minute spinules *C. bilobatus* Kuitert, 1942
 Females: apex of mesonotum with indistinct projection, not extended over metanotum (Fig. 2G); male: basolateral processes of proctiger long, visible in dorsal view (Fig. 7F-I); central region of sternites IV-VI with minute spinules..... 7
 7. Male: distance between apices of basolateral processes equal or slightly smaller than median length of proctiger (Fig. 9E); apices of basolateral processes of proctiger not concealed by connexival spines in dorsal view (Figs 7F, G, 8F, G) 8
 Male: distance between apices of basolateral processes larger than $1.2\times$ the median length of proctiger (Fig. 9F, G), apices of basolateral processes of proctiger concealed by connexival spines in dorsal view (Figs 7H, I, 8H, I) 9
 8. Male: basolateral processes of proctiger rounded apically (Figs 7G, 8G)*C. bassleri* Drake, 1952
 Male: basolateral processes of proctiger acute apically (Figs 7F, 8F, 9E)*C. meloi* Floriano & Cavichioli, 2013
 9. Mostly brown; male: lateral margins of abdomen slightly divergent posteriorly, tergite VII $1.2\times$ as wide as tergite II; sternite VI depressed at lateral margins; basolateral processes slightly curved (Fig. 9G), strongly convergent, anterior width $\sim 3/10$ of posterior width*C. drakei*, sp. nov.
 Mostly black or brown; male: lateral margins of abdomen strongly divergent posteriorly, tergite VII $1.3-1.5\times$ as wide as tergite II; sternites IV-V and VII depressed at centre; basolateral processes not curved (Fig. 9F), not distinctly convergent, anterior width about half the posterior width *C. linearis* (Erichson, 1848)

regulus-groupKey to species of South American *Cylindrostethus*

1. Wings well developed (Fig. 10E, F)*C. palmaris* Drake & Harris, 1934 (in part)
 Wings not developed (apterous) (Figs 10A-D, 11-13) 2
 2. Antennomere IV straight (Fig. 6B) or flat and broad (Fig. 6C); male: apex of sternite VII not emarginate at middle (Fig. 8A-D); basolateral processes of proctiger distinctly shorter than wide, directed laterally (Fig. 9A-D) 3
 Antennomere IV slightly curved (Fig. 6A); male: apex of VII sternite conspicuously excavated at middle (Fig. 8E-I); basolateral processes of proctiger $3\times$ longer than wide, directed anteriorly (Fig. 9E-G) 6
 3. Mostly yellow (Figs 10C-F, 11); anterior portion of metacetabula with a tuft of setae (Fig. 2A) 4
 Mostly black (Fig. 10A, B); anterior portion of metacetabula lacking a tuft of setae *C. podargus* Drake, 1958
 4. Lateral black stripes of mesonotum $3\times$ as narrow as central yellow stripe (Fig. 11A, B); male: base of phallic sclerite large and emarginate at middle (Fig. 2B) *C. hungerfordi* Drake & Harris, 1934
 Lateral black stripes of mesonotum approximately as wide as central yellow stripe (Figs 10C, D, 11C, D); male: base of phallic sclerite not enlarged at middle, round (not emarginate) (Fig. 2C) 5

Diagnosis

Antennomere IV straight; ventral margin of eye with large spinules; abdominal sternites without spinules or with few; sternite VII not emarginated; connexival spines short; proctiger long with short basolateral processes.

Cylindrostethus podargus Drake, 1958

Cylindrostethus podargus Drake, 1958: 110-111 [description].

Cylindrostethus stygius Drake, 1961: 65-66 [description], syn. nov.

Material examined

Data labels sent by email by Dr Thomas Henry. Holotype male (USNM): 'San Alejandro R.[.] Loreto, Peru [.] VII 58 [.] F. Woytkowski (White label)' '*Cylindrostethus podargus* Drake[.] ♂'. (Photo by Thomas Henry). Allotype male (USNM): 'San Alejandro R.\ Loreto, Pery\ VII 58\ F. Woytkowski' 'CJDrake\ Coll. 1956' 'PubMed Allotype\ *Cylindrostethus*\ ♀ *podargus*\ Drake'.

Other material examined. One male (SEMC): '[PERU]\ Rio San Alejandro\ (Pampa Sacramento\ Dept. Loreto July 1958\ Woytkowski';

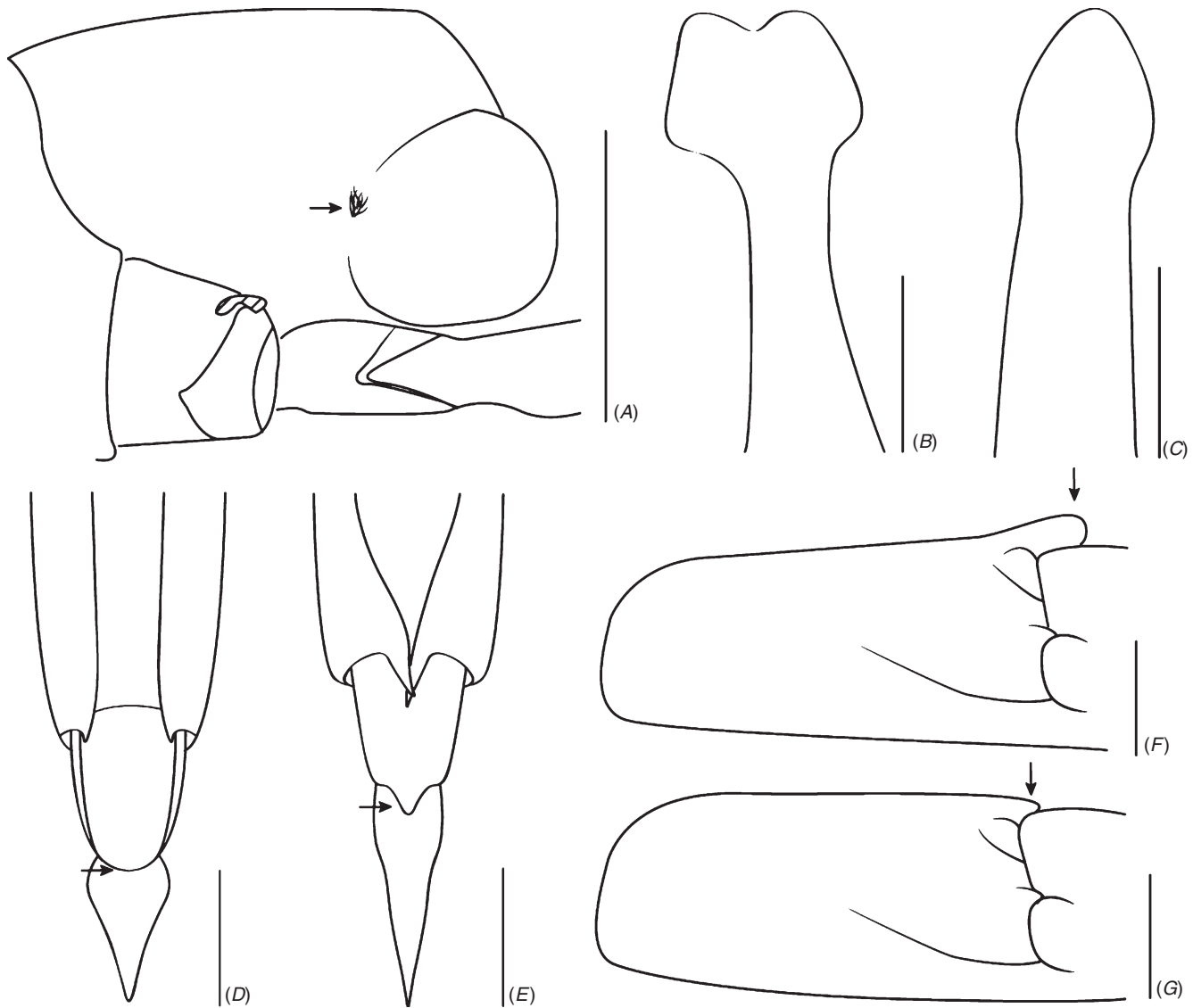


Fig. 2. (A) *Cylindrostethus palmaris*, detail of metanotum, ventral view; (B) *C. hungerfordi* (male), phallic sclerite, ventral view; (C) *C. regulus* (male), phallic sclerite, dorsal view; (D) *C. regulus* (female), genitalia, dorsal view (E) *C. palmaris* (female), genitalia, dorsal view (F) *C. bilobatus* (female), detail of mesonotum, lateral view; (G) *C. linearis* (female), detail of mesonotum, lateral view.

one female (SEMC): '[PERU] Rio San Alejandro (Bampa Sacramento) Dept. Loreto July 1958 Woytkowski' 'Locality: River San Alejandro (Bampa Sacramento) Department of Loreto, Peru. Date: July 1958. Collector: Felix Woytkowski Note: the larger water striders were taken in the middle of the river San Alejandro, far from the shores in places of stronger current.'; one male and two females (MPEG): 'Brasil Rondônia Porto Velho Rio - Madeira 23-V-1984' 'Brasil Rondônia Marcelo Zanuto'; One male (MPEG): 'Brasil Rondônia Porto Velho Ig. Tabocal M.E. R. (Rio) Madeira 23-V-1984' 'Brasil Rondônia Marcelo Zanuto'.

Note on type material. Holotype in excellent state of preservation. Allotype with abdomen broken distal to the VIII segment.

Diagnosis

Pronotum with anteromedial yellow stripe (Figs. (A, B). Males: basolateral processes of proctiger short, subquadrangular (Fig. 9A), directed sideways, 1.2–1.5× wider than long.

Redescription

Apterous. Body length: ♂ 17.3 mm, ♀ 18.8 mm; distance between mesoacetabula: ♂ 2.2 mm, ♀ 2.3 mm. Head: clypeus densely pilose (as in Fig. 4A); vertex not punctate (as in Fig. 4C); eyes 1.1–1.4× wider than interocular distance; ventral margin with inconspicuous spines (as in Fig. 4E); article III of rostrum covered with setae (Fig. 5C), 1.5–1.6× longer than article IV; antennomere I 1.9× longer than antennomeres II and III combined; antennomere III 2/5 the length of antennomere IV, antennomere IV straight and wide, ~4/5 of head width (Fig. 6C). Thorax: mesonotum 2× as long as pronotum and metanotum combined; anterodorsal region of prothoracic femora with fewer than 10 short spines; prothoracic tarsi slightly shorter than metathoracic tarsi; anterior area of metacetabula lacking tuft of setae. Male: lateral margins of abdomen slightly diverging

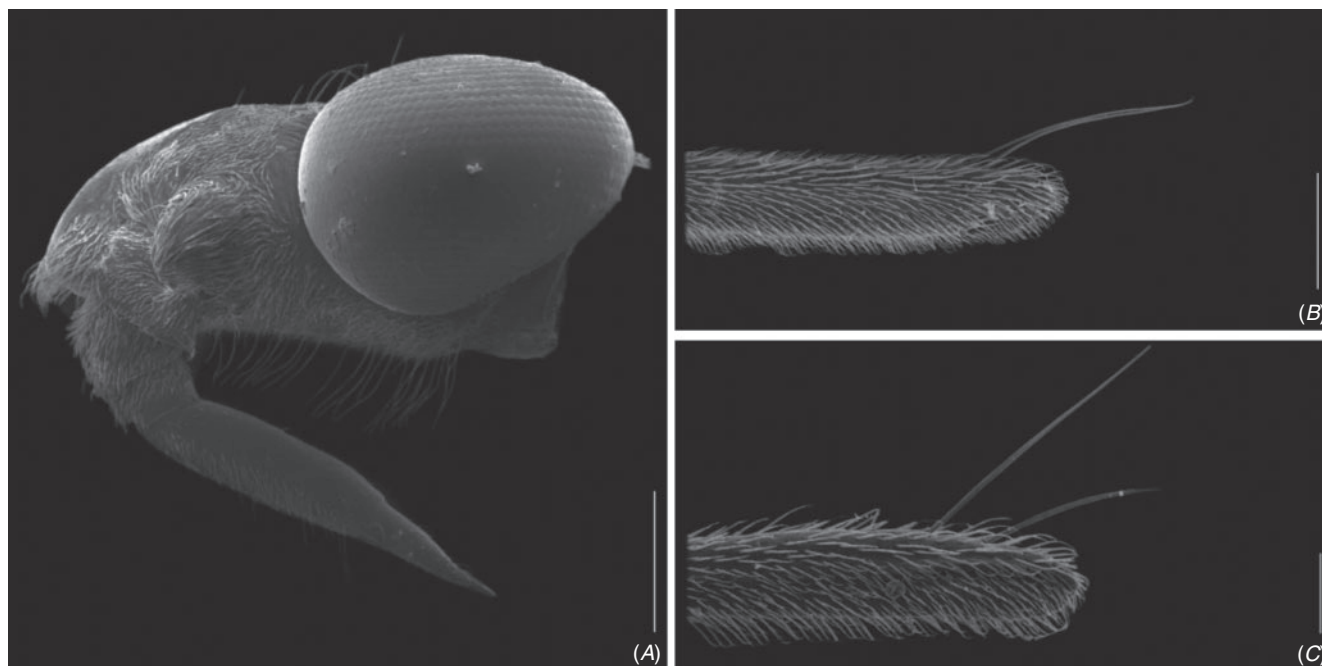


Fig. 3. Ultrastructure of head and thorax. (A) *Cylindrostethus palmaris*, head, lateral view; (B) *C. linearis*, mesothoracic tarsomere II, lateral view; (C) *C. palmaris*, lateral view, detail of posterior tarsomere. Scale bar, Fig. 8 = 500 µm; Fig. 9 and Fig. 10 = 100 µm.

towards posterior region in dorsal view, tergite VII $\sim 1.1\times$ as wide as tergite II; sternites IV–VI lacking small spinules and concavities, sternites VII–VIII with few sparsely distributed spinules; tergite VII not depressed posteriorly; connexival spines $1/2$ the length of tergite VIII (Fig. 7A); sternum VII not emarginate at middle (Fig. 8A); lateral margins of tergite VIII parallel, convergent anteriorly, apex subquadrangular (Fig. 8A), slightly constricted in ventral view; apex of pygophore rounded in ventral view (Fig. 8A); proctiger $2\times$ as long as tergite VIII in dorsal view (Fig. 7A); basolateral processes short, subquadrangular (Fig. 9A) directed sideways, $1.2\text{--}1.5\times$ wider than long; phallus elongate, $2\times$ longer than wide, sclerite basally bifid, branches $2\times$ longer than the area of confluence. Female: posterior margin of mesonotum lacking large protuberances (Fig. 2G); tergite VIII elongate with a slightly rounded apex; gonocoxae with spines on posterior region; connexival spines 0.31 mm in length.

Colouration. Mostly black (Fig. 10A, B). Head: yellow dorsally, lighter between eyes; clypeus black; frons yellow (Fig. 14A); black ventrally; article I of rostrum light brown, article II dark brown, article III varying from brown to black (Fig. 15A). Thorax: pronotum with yellow stripe on anteromedial region; femora and tibiae yellow; mesonotum and metanotum black, covered with golden pubescence, with black longitudinal stripe on each side; mesopleuron, mesosternum, metapleuron and metasternum black, pleurites covered with slightly golden pubescence, sternites covered with slightly silver pubescence; meso- and metathoracic acetabula yellow; femora yellow, $1/6$ of apical portion black. Abdomen: tergites and pleurites covered with golden pubescence, sternites covered with silver pubescence; tergites, pleurites and sternites (I–VII) black, apex

of pleurite VII yellow; connexiva yellow in females, black in males, connexival spines black in both sexes. Male: basal area of tergite VIII black, apical area yellow; sternites and pygophore black, posterior region sometimes brown; central area of proctiger yellow. Female: tergite VIII yellow at lateral margins, brown at anterocentral region; dorsal region of gonocoxa yellow; central area of proctiger yellow.

Comments

Cylindrostethus podargus is easily distinguished from the other South American species by having: a black colouration (Fig. 10A, B); apical margin of sternite VII not emarginate at middle (Fig. 8A) and sternites IV–VI without spinules. Drake (1958) described *C. podargus* (Fig. 16E) and three years later described *C. stygius*, syn. nov. (Drake 1961) (Fig. 16D). Both species are similar and we did not find substantial characters to differentiate them based on the original descriptions. Drake (1961) commented on differences among *C. stygius*, *C. hungerfordi*, *C. palmaris* and *C. regulus*, but did not even mention the previously described *C. podargus*. Additionally, the type specimens designated in both papers are identical (i.e. type locality, date and collector) (Fig. 16F, G). In fact, in the introduction of his 1961 paper, Drake mentions that there were seven Neotropical species of *Cylindrostethus*. However, he had previously described *C. podargus* (Drake 1958) and therefore, at that time, there would have been eight valid species, not seven. According to Drake (1961), type specimens were deposited at the USNM, but Thomas Henry (pers. comm.) has indicated that there are no such specimens in the collection. Marcela Monné photographed the female paratype of *C. stygius* deposited in

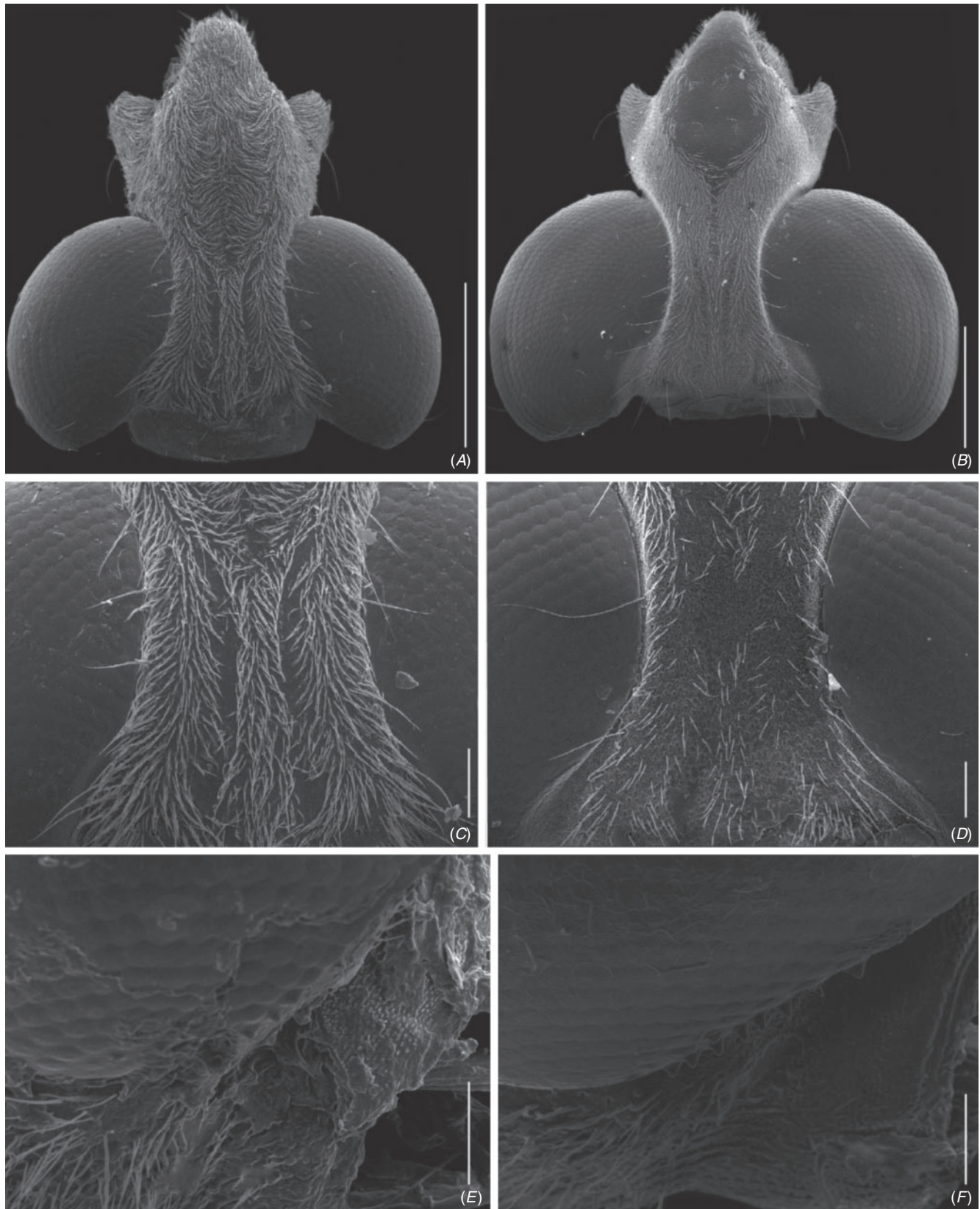


Fig. 4. Ultrastructure of the head. (A) *Cylindrostethus linearis*, dorsal view (B) *C. hungerfordi*, dorsal view; (C) *C. linearis*, dorsal view; (D) *C. palmaris*, dorsal view; (E) *C. linearis*, detail of eye margin, lateral view; (F) *C. palmaris*, detail of eye margin, lateral view. Scale bar, Figs 11, 12 = 500 μm ; Figs 13–16 = 100 μm .

the BMNH, and we confirmed that labels are identical to those in *C. podargus* Drake, 1958. Based on these findings, we consider *C. stygius*, syn. nov. as a junior synonym of *C. podargus*, considering that Drake likely described the same species twice from the same type series.

Ecological notes

The species is known from Peru (San Alejandro River). The specimens were netted in the swift flowing water, off the shore (Drake 1958).

Cylindrostethus palmaris Drake & Harris, 1934

Cylindrostethus palmaris Drake & Harris, 1934: 219, 222 [description, key]. Drake & Harris, 1935: 3 [note]. Kuitert, 1942: 135, 136–137 [redescription, key]. Hynes, 1948: 343, 346 [note]; Kort-Gommers & Nieser, 1969: 78, 79 [note, illustration]. Nieser, 1970: 118–119, 135, 137 [redescription, illustration]. Aristizábal, 2002: 81–86 [redescription, key, illustration]. Moreira *et al.*, 2011a: 270, 273, 274 [redescription, illustration, key]. Moreira *et al.*, 2011b: 6 [checklist].

Material examined

Paratype female (USNM). 'PARATYPE\ *Cylindrostethus\ palmaris*\ D & H (Red label, manuscript)' '*Cylindrostethus\ palmaris* D & H. (Beige label, manuscript)' 'Cadras\ Trinidad BW. I\ Aug 20–21 (Beige label, manuscript)' 'Paratype No\ 51106 (manuscript)\ U.S.N.M (Red label)' 'Aug. Busck\ Collector'.

Other material examined. Nine males, eight females (LACM): 'Imperatriz, on\ Belém, Brasília road\ Maranhao, BRAZIL\ July, 1960\ D. L. Tiemann'; nine males, three females (LACM): '24 kil. E. Formoso,\ Go., Brazil\ May 21, 1956\ F. S. Truxal' 'MACHRIS BRAZILIAN\ EXPEDITION - 1956\ LOS ANGELES\ COUNTY MUSEUM'; one male (SEMC): 'Brazil S. A\ 7–10 9–20–36' 'Vic. Joao Pessoa\ (Sao Phelipe)\ River Jurua\ No. 375'; one male, one female (UEMS): 'Brasil, MS, Tacuru\ Rio Iguatemi\ I-2009\ Floriano'; One male (DZRJ): '#42 Pleuston\ 15-V-2006\ UFRJ Pronex'; one male (INPA): 'Brasil, AM, Manaus\ Rio Cuieiras 11\ 2.458650 lat\ 60. 34600 long'; eight males (LACM): 'Jule 17, 1958, 42 km.\ SE. Maturis, Monagas\ Venezuela\ Arnold Menke'; one female (LACM): 'July 3, 1958, 42 Kms.\ SE. Maturin, Monagas\ Venezuela\ Arnold Menke'; four males, one female (LACM): 'June 16, 1958, 42 km.\ SE. Maturim, Monagas\ Venezuela\ Arnold Menke'; two males (USNM): 'Trinidad B. W. I. Oct. 27–29 1938\ Carl J. Drake'; one female: 'Ama-izonas; Rio Mavaca\ Camp 65°06'W2°2N, 150 m. 16.27.89' 'Fhipps-FUDECI Exped.\ by American Museum\ of Natural History\ D. A. Grimaldi, coli.'; one male, one female (AMNH): 'Berinitas\ Dec 42 Venez\ P. Anduze\ *Cylindrostethus\ palmaris*\ Det. Drake' 'Donation from\ J. A. Slater\ Collection'; one male (USNM): 'Venezuela Exp.\ Territ. Amazonas\ Upper Cunucunuma\ Julian May 27, 1950' 'J. Maldonado\ Capriles Coll.'; three males (DZUP): 'BR – AM Presidente\ Figueiredo\ Lago do Poraque\ 06–2011\ Floriano'; one male (DZUP): 'BR-AM-Manaus\ R. (Reserva) Ducke\ Ig (Igarapé) Branquinho\ 07–2011\ Floriano'; one male (INPA): 'BR 174–61 km de\ Manaus-AM\ 24–01–77\ B. Mascarenhas' '*C. palmaris* - INPA)' '*Cylindrostethus palmaris*\ D&H 1934\ det. R. Sampaio1980'; seven males, five females (INPA): 'Brasil, AM, Manaus\ MAO, IG(Igarapé) Conj.\ Suframa IX 2003\ Sampaio'; two males, two females (AMNH): 'GUYANA: Demerara District\ Yarowkkabre Creek on Linden\ Highway, June 16, 1986, K. & R. Schimidt & E. Traver, ex:\ narrow stream with redwater\ moderate current, no riffle'; one female (AMNH): 'Wismar,\ Brit. Guiana\ V. 9 1936\ *Cylindrostethus\ palmaris*'; one male (AMNH): 'Georgetown, BrM\ II. 1922' '*Cylindrostethus\ palmaris*\ C.J.D. D&H'; one female (INPA): 'CEPLAC-estr. AM-10\ Km 30- Manaus-BR' '18/VI/76\ Mario Dantas'

'Gerridae' '*Cylindrostethus palmaris* - INPA' '*Cylindrostethus palmaris*\ D&H, 1934\ det. R. Sampaio 1980'; four males, four females (INPA): 'BRASIL: Mato Grosso\ Reserva Humboldt\ 10°11'S 59°48'0\ 75-VII-1977\ Norman D. Penny' '*Cylindrostethus palmaris* - INPA' '*Cylindrostethus palmaris*\ D&H, 1934\ det. R. Sampaio 1980'; one male (INPA): 'BRASIL: Amazonas\ Reserva Campinas\ 06/XI/1996\ Bento Mascarenhas'; three males (USNM): 'Brazil.S.Amer.\ Rio Caraguata\ Matto Grosso [Mato Grosso do Sul]\ March 15, 1953\ F. Plaumann' '3' PubMed; 'J C Lutz\ Collection\ 1961'; one male, one female (AMNH): 'Kobrene\ M. Grosso, 947\ J.C.M. Carvalho'; one male (INPA): 'Rio Paru\ Pará\ J.C.M. Carvalho'; one female (MPGE): 'Brasil Pará\ Cap. Poço\ Ig. (Igarapé) Braço\ Do Curral\ 22-IX-1987'; one male (MPEG): 'Brasil Pará\ Irituia\ Ig. Sta. Grande\ 20/X/1987' 'Brasil Pará\ J. Dias'; one female (MPEG): 'Brasil Pará\ S. Miguel do Guamá\ Ig. do Sete\ 19/X/1987'; two males, two females (MPEG): 'Brasil Pará\ Serra Norte\ Serraria-Ig. (Igarapé) Azul\ 27. VI-1985' 'PubMed Brasil Pará\ R B Neto'; two males (MPEG): 'Brasil Pará\ Serra Norte\ Salobo\ 04-VII-1984'; one female (MPEG): 'Brasil Pará\ Serra Norte\ Est. Fofoca\ 07.V.1984' 'Brasil Pará\ M.F. Torres'; one female (MPEG): 'Brasil Pará\ Serra Norte\ Caldeirão\ 21-VI-1985' 'Brasil Pará\ W. França'; two males, three females (MPEG): 'Brasil Pará\ Serra Norte\ Rio Itacaiunas\ Caldeirão\ 21-VI-1985' 'Brasil Pará\ P. Tadeu'; five males, two females (MPEG): 'Brasil Pará\ Serra Norte\ Pojuca\ II-VII-1984' PubMed 'Brasil Pará\ M. F. Torres'; one male (MPEG): 'Brasil Mato Grosso\ Chap. (Chapada) Guimarães\ Faz. (Fazenda) Buriti.Coxipó\ 10-V-1984' 'Brasil Mato Grosso\ Marclo Zanuto'; three males, three females (MPEG): 'Brasil Pará\ Serra Norte\ Serraria\ 27-VI-1985' 'Brasil Pará\ R. D. Thomaz'; one male (MPEG): 'Brasil MT\ Chap. (Plateau) dos Guimarães\ Colégio Agr. Buriti\ 17-II-1986\ Col. I. S. Gorayeb'; one male (MPEG): 'Brasil Mato Grosso\ Rod. AR 1 Vilhena Juína\ IG. (Igarapé)____\ 3\16-V-1984' 'Brasil Mato Grosso' 'B. Mascarenhas'; one male, one female (MPEG): 'Brasil Mato Grosso\ Chap. (Chapada) dos Guimarães\ Faz. Coxipó\ 10-V-1984' 'Brasil Mato Grosso\ Marclo Zanuto'; five males, two females (INPA): 'Brasil: PA\ Sem. Pio X\ 11-VI-1975\ B. Mascarenhas' '*C. palmaris* - Inpa' '*Cylindrostethus palmaris*\ D&H, 1934\ det. R. Sampaio 1980'; one male, one female (AMNH): 'BRASIL: PARA.\ Sta. Isabel\ B. Mascarenhas' 'I nov 1973\ Igarapé corrente\ na mata'; one male (MPEG): 'Pará Carajás\ Est. Tres Alfa-\ 28.IV. 1983\ Tacainha km 5\ Macarena and colleagues'; two males, four females (SEMC): 'British Guiana\ Supuruni Creek\ Aug. 1937\ S. Harris' '(3)' 'PARAMORPHOTYPE\ *Cylindrostethus\ palmaris*\ L. Kuitert'; five males, six females (SEMC): 'Bolivia S. A.\ R. Beni Cachuela\ Esperanza 9–37\ A. M. Olalla' 'PARAMORPHOTYPE\ *Cylindrostethus\ palmaris*\ L. Kuitert'; one female (SEMC): 'Bolivia S. A.\ R. Beni Cachuela\ Esperanza 9–37\ A. M. Olalla' 'ALLOMORPHOTYPE\ *Cylindrostethus\ palmaris*\ L. Kuitert'.

Notes on types. The paratype is poorly preserved: right antennomeres III–IV, left antennae, right mesothoracic leg and left mesothoracic tarsi are missing; the head is reattached (glued) to specimen.

Diagnosis

Polymorphic with respect to presence or absence of wings (Fig. 10C–F); male: basolateral processes of proctiger small, directed sideways, as wide as large, almost semicircular in shape (Fig. 9B). Female: apex of tergite VIII acute (Fig. 2E).

Redescription

Apterous or winged. *Apterous form*: body length ♂ 17.5 mm, ♀ 18.9 mm; distance between mesoacetabula ♂ 2.2 mm, ♀ 2.6 mm. Head: clypeus glabrous (as in Fig. 4B); vertex punctate (Fig. 4D); eyes 1.5 to 2.1× as wide as interocular distance; ventral margin with conspicuous spines (Fig. 4F); rostrum: article III with sparsely distributed setae (as in Fig. 5A), 1.7–2.3× longer than article IV; antennomere I 1.3–1.6× longer than antennomeres II

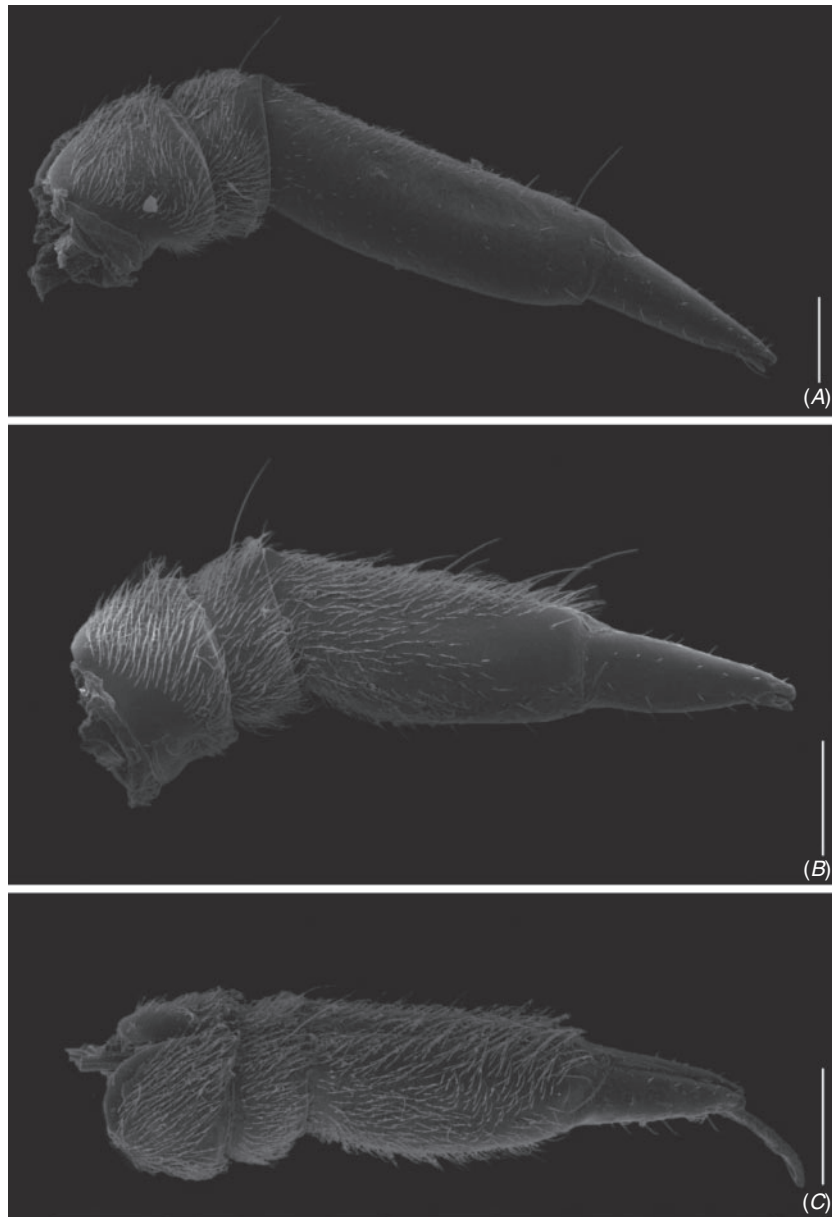


Fig. 5. Ultrastructure of the rostrum, lateral view. (A) *Cylindrostethus hungerfordi*; (B) *C. linearis*; (C) *C. podargus*. Scale bar = 200 μ m.

and III combined; antennomere III $\sim 3/5$ the length of antennomere IV, antennomere IV straight, $3/5$ of head width (as in Fig. 6B). Thorax: mesonotum $1.3\text{--}1.5\times$ longer than pronotum and metanotum combined; anterodorsal region of prothoracic femora often showing more than 15 short spines; prothoracic tarsi longer than metathoracic tarsi; anterior region of metacetabula with a tuft of setae (Fig. 2A). Male: lateral margins parallel or slightly convergent in dorsal view, tergite II $4/5\text{--}1\times$ wider than tergite VII; sternites IV–VI lacking small spinules and central concavities; tergite VII not depressed on the posterior quarter; connexival spine $0.4\text{--}0.6$ smaller in length than tergite VIII (Fig. 7B); sternites VII–VIII with or without a small number of spines; posterior margin not emarginate at

middle (Fig. 8B); lateral margins of tergite VIII parallel or converging towards anterior and posterior regions, posterior margin rounded (Fig. 7B); apex of pygophore varying from rounded to nearly acute, in ventral view (Fig. 8B); proctiger $2\times$ longer than tergite VIII, in dorsal view (Fig. 7B), basolateral processes short, directed sideways, as wide or wider than long, suboval (Fig. 9B); phallus elongate, $\sim 2\times$ as long as wide, sclerite bifid basally, branches $2\times$ longer than area of confluence. Female: posterior margin of mesonotum lacking large protuberances on posterior region (Fig. 2G); tergite VIII elongated, apex slightly acute (Fig. 2E); posterior region of gonocoxae with spines; connexival spine varying $0.5\text{--}0.7$ mm in length.

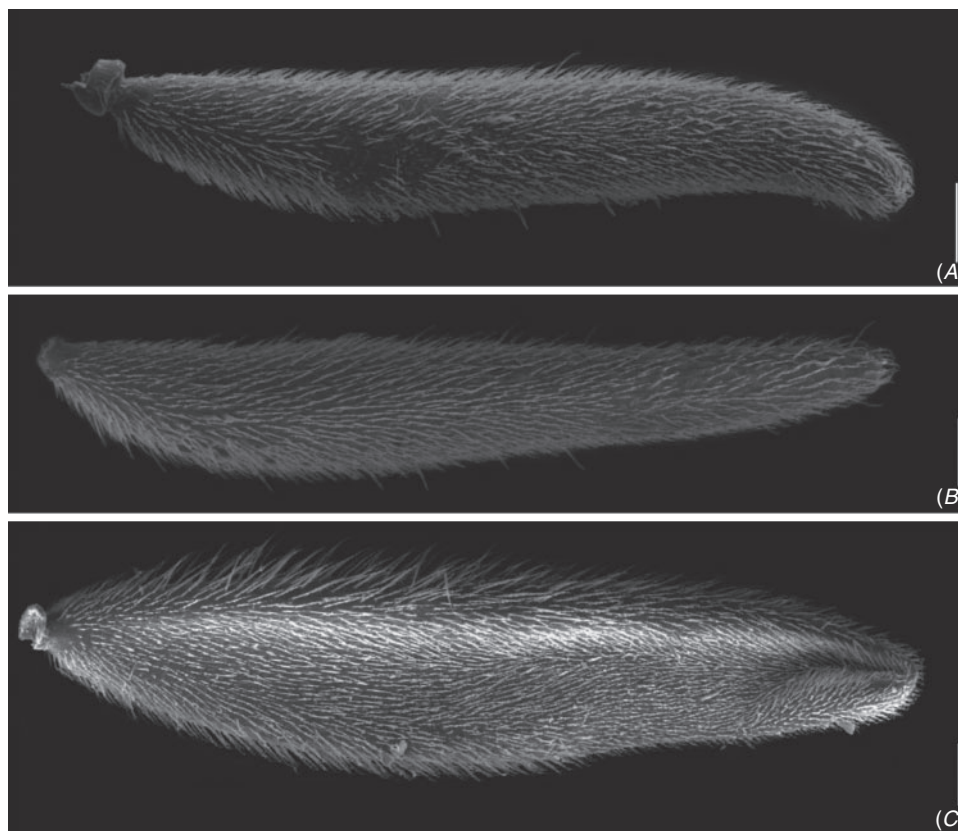


Fig. 6. Ultrastructure of the IV antennomere, lateral view. (A) *Cylindrostethus linearis*; (B) *C. palmaris*; (C) *C. podargus*. Scale bar = 100 μ m.

Colouration (apterous form). Mostly yellow (Fig. 10C, D). Head: in dorsal view, yellow, varying from entirely yellow to black at frons (Fig. 14B); yellow ventrally; articles I and II of rostrum yellow, 1/3 or 2/3 of the posterior region of article III black, anterior region yellow (Fig. 15B). Thorax: pronotum with median yellow spot; femora and basal portion of tibiae yellow; mesonotum and metanotum with black longitudinal stripes, wider than median yellow stripe; mesopleuron, mesosternum, metapleuron and metasternum yellow; mesothoracic and metathoracic acetabula with a laterodorsal brown spot; mesothoracic and metathoracic femora yellow, with black longitudinal stripe on dorsal and ventral region, inconspicuous in specimens of lighter colouration. Abdomen: covered with light brown pubescence; tergites (I–VII) black, sometimes with slightly marked median longitudinal yellow stripe; connexiva, pleurites and sternites (I–VII) yellow; pleurites sometimes showing black dorsolongitudinal stripe. Male: tergite VIII yellow, black at centroposterior region, or black at centroposterior region and at apex; sternite VIII yellow; pygophore yellow, or black apically; proctiger black, with basolateral processes and anterior region yellow. Female: tergite VIII yellow, black apically, or brown at central area; gonocoxae varying from yellow to brown, ventral region usually black; proctiger black, often yellow at margin and apex.

Winged form. Body length: ♂ 18.2 mm, ♀ 19.3 mm; distance between mesoacetabula of ♂ 2.6 mm, ♀ 2.4 mm. Head: eyes, in dorsal view, 1.8–2.0 \times wider than interocular distance; article III of rostrum 2.0–2.3 \times longer than article IV; antennomere I 1.3–1.5 \times longer than articles II and III combined. Thorax: male: lateral margins of abdomen convergent towards the posterior region in dorsal view, tergite II 0.7–0.8 \times wider than tergite VII; connexival spines 0.4–0.6 \times smaller than length of tergite VIII; basolateral processes 1.1–1.5 \times wider than long. Female: connexival spines 0.4–0.6 mm in length.

Colouration (winged form). Pronotum with yellow heart-shaped spot on anterior region, otherwise similar to apterous specimens (Fig. 10E, F).

Comments

Cylindrostethus palmaris differs from other Neotropical *Cylindrostethus* in possessing wing polymorphism (Fig. 10C–E). It superficially resembles *C. hungerfordi* and *C. regulus*, but differs in having basolateral processes of the proctiger with length subequal to width (in males) (Fig. 9D); phallus elongated, and branches of sclerite $\sim 2\times$ larger than its confluence area. It differs from *C. hungerfordi* in having black stripes on the mesonotum, more or less as large as median yellow stripe (Fig. 11A, B); the apical margin of phallic

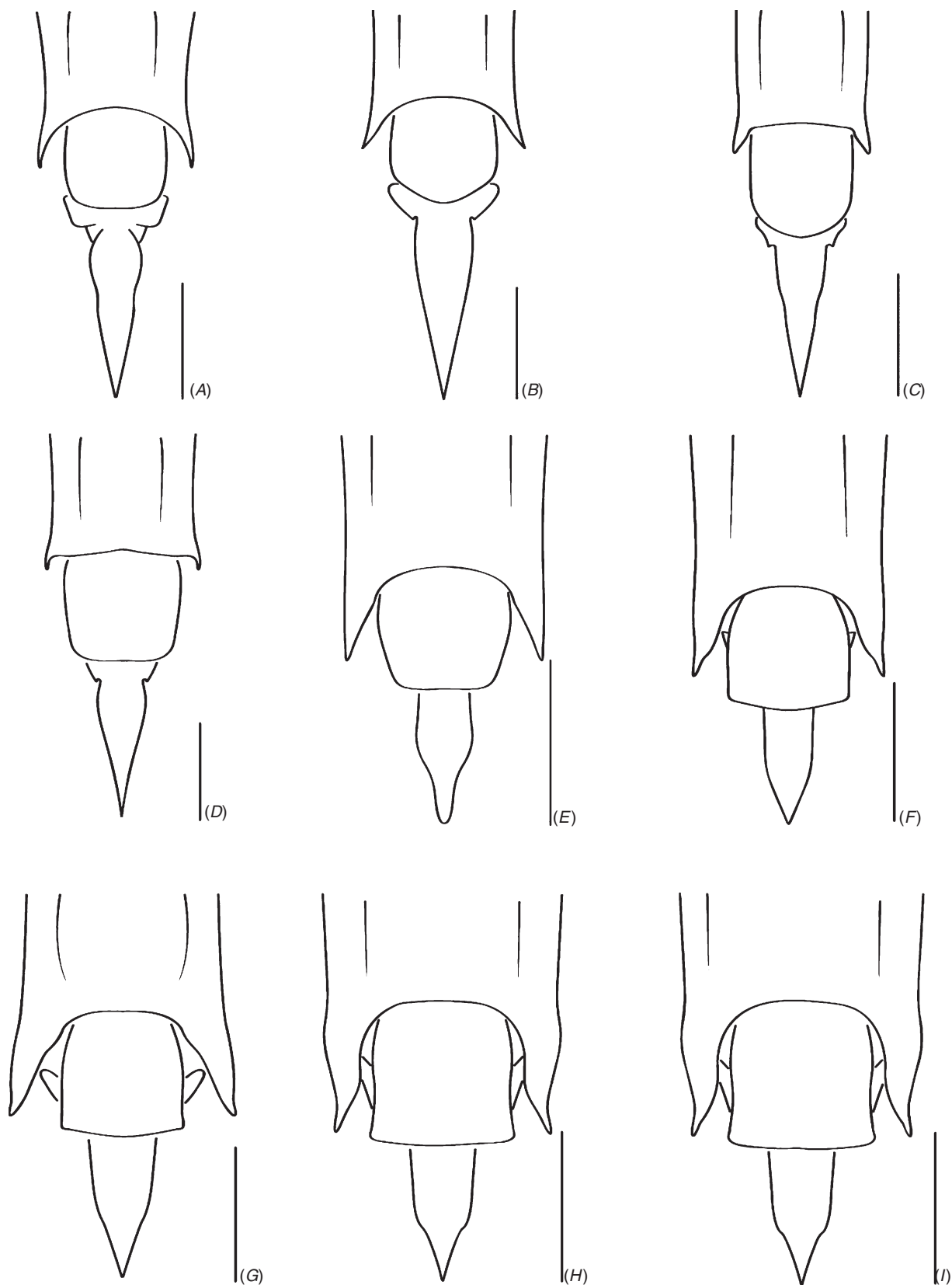


Fig. 7. Male genitalia, dorsal view. (A) *Cylindrostethus podargus*; (B) *C. palmaris*; (C) *C. hungerfordi*; (D) *C. regulus*; (E) *C. bilobatus*; (F) *C. meloi*; (G) *C. bassleri*; (H) *C. linearis*; (I) *C. drakei*, sp. nov. Scale bar = 1 mm.

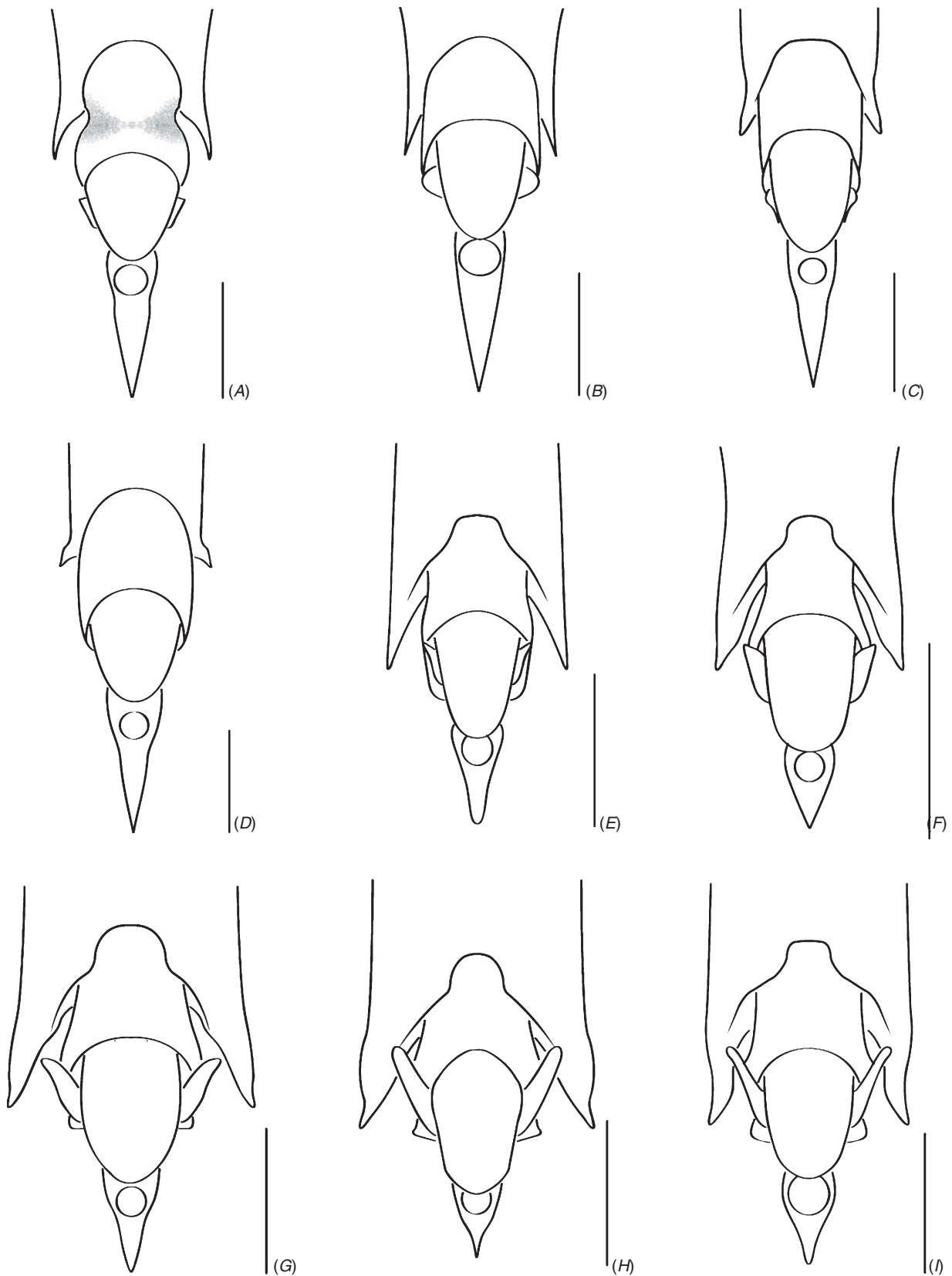


Fig. 8. Male genitalia, ventral view. (A) *Cylindrostethus podargus*; (B) *C. palmaris*; (C) *C. hungerfordi*; (D) *C. regulus*; (E) *C. bilobatus*; (F) *C. meloi*; (G) *C. bassleri*; (H) *C. linearis*; (I) *C. drakei*, sp. nov. Scale bar = 1 mm.

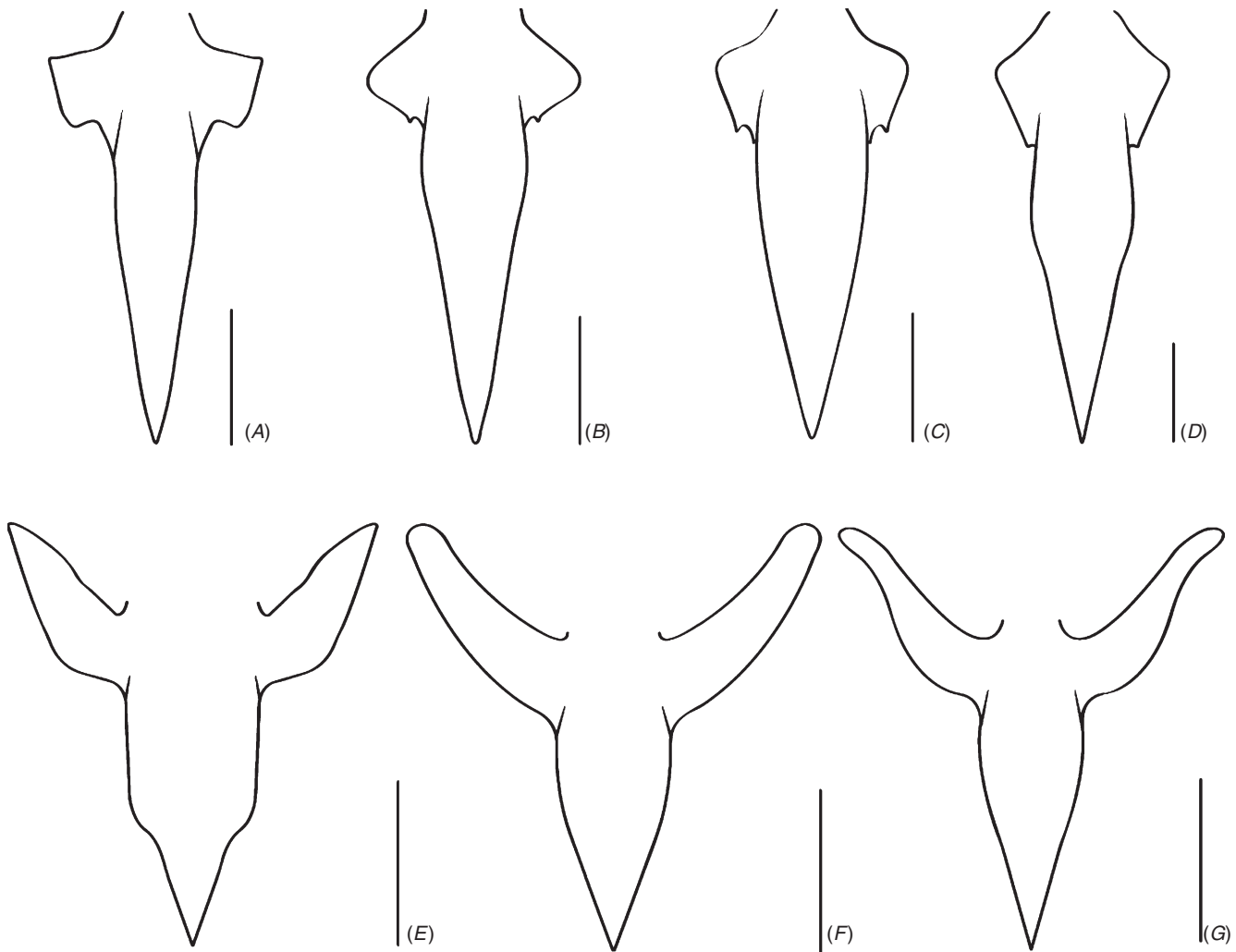


Fig. 9. Proctiger of males, dorsal view. (A) *Cylindrostethus podargus*; (B) *C. palmaris*; (C) *C. hungerfordi*; (D) *C. regulus*; (E) *C. meloi*; (F) *C. linearis*; (G) *C. drakei*, sp. nov. Scale bar = 0.5 mm.

sclerite is also not broad and emarginate (Fig. 2B). It differs from *C. regulus* in the smaller body size; the anterior black tibiae, and tergite VII not depressed apically in males.

Ecological notes

This species is widely distributed, and can be found in rivers, streams and ponds. Some specimens were collected in the Iguatemi River (Mato Grosso do Sul State, Brazil), in shady areas of small forest stream with moderate flow. We collected it in deep parts of the forest stream and also near the margins. In the Branquinho Stream (Amazonas State, Brazil), specimens were in shallow areas with moderate flow and sandy substrate; the width between the stream margins was 1.5 m. Specimens were also collected in a lake without riparian forest, but was shaded by concrete pipe. Hynes (1948) reported that *C. palmaris* specimens were collected in deep ponds and heavily shaded streams, where they are very agile. *Cylindrostethus palmaris* and *C. regulus* are sympatric in Jurua River (Amazonas states, Brazil).

Cylindrostethus hungerfordi Drake & Harris, 1934

Cylindrostethus hungerfordi Drake & Harris, 1934: 221 [description]. Kuitert, 1942: 135–136 [key to species, taxonomic notes]. Nieser, 1970: 117, 137 [redescription, illustration]. Moreira *et al.*, 2011b: 6 [checklist].

Material examined

Holotype male (SEM). ‘New Amsterdam, VII-1930, F.X. Willians\ *Cylindrostethus hungerfordi* Type D & H\ British Guiana S.A Near New Amsterdam. July 30 1923 F.X. Willians’.

Paratype female (SEM). ‘New Amsterdam, VII-1930, F.X. Willians\ *Cylindrostethus hungerfordi* Type D & H\ British Guiana S.A Near New Amsterdam. July 30 1923 F.X. Willians’.

Other material examined. One male (INPA): ‘Serra do Navio\ (I.C.O. M.I)\ Amapá-II-961–4/61\ J.C.M. Carvalho col.’; four males (AMNH): ‘Guyana: Essequibo Prov;\ Little Takutu R. at main\ road from logging camp\ Aug. 15, 1983 K. Schmidt\ On deep & narrow, swift river - without rapids’; one male (AMNH): ‘FR. GUIANA [Suriname]: Lawa River shores\ opp. Anapake Village, muddy\ riv. Str. w/ rot. Foliage\ 22.



Fig. 10. (A) *Cylindrostethus podargus* (male holotype) (image provided by Michele Touchet); (B) *C. podargus* (female); (C) *C. palmaris* (male, apterous form); (D) *C. palmaris* (female paratype, apterous form); (E) *C. palmaris* (male), winged form; (F) *C. palmaris* (female) winged form. Scale bar = 5 mm.



Fig. 11. Body, dorsal view. (A) *Cylindrostethus hungerfordi* (male holotype); (B) *C. hungerfordi* (female paratype) (image provided by Dra. Marcela Laura Monné Freire); (C) *C. regulus* (male); (D) *C. regulus* (female syntype). Scale bar = 5 mm.

XI.1963, B. Malkin' 'FRENCH GUIANA: Lawa river\ shores opposite Anapaiké\ village, muddy river stream\ with much rotted foliage.\ Nov. 22, 1963\ B. Malkin'; one female (AMNH): 'FR. GUIANA: Lawa River shores\ opp. Anapaiké Village, muddy\ riv. Str. w/ rot. Foliage\ 22.XI.1963, B. Malkin'; one female (SEMC): 'Dutch Guiana\ VIII.19.1943\ D.C. Geiskes' 'With Mts, line\ 1 km 62e kamp\ Sanderesk' '*Cylindrostethus\ hungerfordi* ORA\ det. Calabrese 1972'.

Notes on types. The holotype is severely damaged; antennae, left metathoracic leg and left mesothoracic tarsus are absent. In the paratype, the left prothoracic legs and mesothoracic tibiae are missing.

Diagnosis

Pronotum with two black anterolateral spots; anterior region of prothoracic femora bearing more than 30 minute spines; mesonotum with narrow, longitudinal black stripes, 3× as narrow as yellow median stripe (Fig. 11A, B), basolateral processes short, directed sideways, ~2× as wide as long (Fig. 9C); apex of phallus sclerite long and emarginate at the middle (Fig. 2B).

Redescription

Uniformly apterous; body length: ♂ 19.6 mm, ♀ 19.7 mm; distance between mesoacetabula: ♂ 2.8 mm, ♀ 2.9 mm. Head: clypeus glabrous (Fig. 4B); vertex punctate (as in Fig. 4D); eyes 1.8–1.9× as wide as interocular distance, ventral margin showing conspicuous spines (as in Fig. 4F); article III of rostrum 1.8–2× longer than IV, covered with small, sparsely distributed setae (Fig. 5A); antennomere I 1.5× longer than antennomere II and III combined; antennomere III ~3/5 the length of antennomere IV, antennomere IV straight, 7/10 of head width (as in Fig. 6B). Thorax: mesonotum 1.4× longer than pronotum and metanotum combined; anterodorsal region of prothoracic femora usually bearing more than 30 minute spines; prothoracic tarsi 1.6× as long as metathoracic tarsi; anterior region of metacetabula with a tuft of setae (as in Fig. 2A). Male: lateral margins of abdomen parallel or slightly convergent in dorsal view, tergite VII 0.9–1× as wide as tergite II; sternites IV–VI lacking spinules and concavities, tergite VII not depressed at posterior fourth; connexival spines 3/10× smaller than length of tergite VIII; sternite VII not emarginate at middle (Fig. 8C); lateral margins of tergite VIII converging towards basal and apical regions, apex rounded (Fig. 7C); apex of pygophore rounded in ventral view (Fig. 8C); proctiger ~2× as long as tergite VIII (Fig. 7C), basolateral processes short, directed sideways, 1.96–2.2× as wide as long (Fig. 9C); phallus slightly rounded, more or less as wide as long, branches of sclerite approximately as wide as its confluence area, apex of sclerite broad and emarginate medially (Fig. 2B). Female: posterior margin of mesonotum lacking large protuberances (Fig. 2G); tergite VIII elongate, apex slightly rounded; posterior region of gonocoxae bearing spines; connexival spines 0.4–0.5 mm in length.

Colouration. Mostly yellow (Fig. 11A, B). Head: yellow in dorsal view, lateroposterior region of clypeus black (Fig. 14C), yellow in ventral view; I, II and basal 2/3 of article III of rostrum yellow, others black (Fig. 15C). Thorax: pronotum dotted black on anterolateral region; femora and basal area of tibiae yellow; mesonotum with longitudinal black stripes 3× narrower than median yellow stripe; mesopleura and

mesosternum yellow; metanotum black with longitudinal stripes 2× narrower than median yellow stripe, mesopleuron and metapleuron yellow; meso- and metathoracic acetabula with laterodorsal brown spot; meso- and metathoracic femora yellow, black longitudinal stripes ventrally and dorsally. Abdomen: covered with light brown pubescence; tergites I–VII with median longitudinal yellow stripe (as wide as lateral black stripes in males, and distinctly narrow in females); connexiva, pleurites and sternites I–VII yellow. Male: tergite and sternite VIII, pygophore and proctiger yellow, apex of tergite VIII black. Female: tergite VIII, proctiger and gonocoxae yellow, apex of tergite VIII black.

Comments

This species superficially resembles *C. palmaris* and *C. regulus*; however, it differs in having black stripes on the mesonotum, 3× narrower than the median yellow stripe (Fig. 11A, B). In males, the apical margin of the phallic sclerite is broad and emarginate (Fig. 2B). It is also much smaller than *C. regulus*; the tibiae lack black stripes, and the tergite VII is not depressed apically. It differs from *C. palmaris* in having the basolateral processes of the proctiger 2× as wide as long (Fig. 9C); the rounded phallus, and the sclerite branches of the phallus as long as the width of its confluence area.

Cylindrostethus regulus White, 1879

Hydrobates regulus White, 1879a: 488 [description]; White, 1879b: 269 [taxonomic notes].

Cylindrostethus regulus Kirkaldy & Torre-Bueno, 1909 [nov. comb.]. Drake & Harris, 1930: 238 [redescription]. Drake & Harris, 1934: 219, 222–223, 238–239 [redescription, key, illustration]. Kuitert, 1942: 137 [taxonomic notes]. Moreira *et al.*, 2011a: 270, 273, 274, 276. [redescription, key, illustration]. Moreira *et al.*, 2011b: 6 [checklist].

Material examined

The type series was photographed by Dr Marcela MONNÉ, and the photographs were examined in this study. Syntype, female (BMNH): 'Hydrobates *regulus* B.W. \ TYPE' (white label, handwritten) 'Pres. by \ Perth Museum. \ B.M. 1953–629' (white label, handwritten) 'Labria \ R. Purus \ 10/9–74 \ Traill' (white label, handwritten) '*Hydrobates \ regulus*' (yellow label, handwritten) 'SYN- \ TYPE' (white label, outlined in light blue) 'Type' (white label, outlined in red) 'BMNH \ #1005956' (white label) '*Hydrobates regulus* B. W' (white label, manuscript); syntype female (BMNH): '*Hydrobates \ regulus* B. W. \ Paratype.' (white label) 'Pres. by \ J. Ritchie \ Curator Perth Mus. \ B. M. 1929–79.' (white label) 'Labria \ R. Purus \ 16.9.74 \ Traill' (yellow round label, handwritten) 'Para- \ type' (white label, outlined in yellow) [probably this label was placed by the museum curator posteriorly to the syntypes designation] 'SYN- \ TYPE' (white label, outlined in light blue) 'BMNH (E) \ #1010360' (white label).

Other material examined. Two males, three females (SEMC): 'Brazil S.A \ Jan - Apr. 1036 \ A. M. Olalla \ No 1' 'R. (Rio) Amazonas (Nite) \ Region de \ Itacoatiara'; two males, one female (SEMC): 'Brazil S. A \ 9–25, 10–17–36 \ A.M. Olalla' 'Vle. Santo \ Antonio, River \ Eiru No. 3711'; three females (SEMC): 'Brazil S. A \ 7–10 9–20–26 \ A. M. Olalla' 'Vle. Joao Pessoa \ (São Phelipe) [Eurinepe] \ River Jurua \ No. 375'; two males, one female (UPTC): 'Colombia, Putamayo \ Puerto Leguizano \ Caseiro \ Bajo Casacunte \ 00°04'45.8–74°59'43.9' '178 m (metros) \ 19–11–2008 \ Jiménez (UPTC) col.'; two males, one female (INPA): 'BR, AM, Coari, Urucu, Ig. (Igarapé) 05\486894–6541222' 04-II-2006 \ Couceiro col.'; one male,

one female (AMNH): 'PERU: Dept. (Departamento) Loreto:\ Rio Loreto Yacu,\ may 3, 1970, forest\ stream, B. Malkin'; one male (DZRJ): '2057'.

Notes on types. Syntype lacking antennae and left mesothoracic tibiae and other syntypes lacking III–IV antennomere and left mesothoracic legs.

White (1879a) did not designate types in his description of *C. regulus*, and based his description on a series of specimens, so all are syntypes. However, some specimens were wrongly labelled as paratypes, probably labelled by some museum curator posteriorly to the syntypes designation.

Diagnosis

Body length >20 mm; male: tergite VII depressed at posterior fourth; connexival spines 1/5 the medial length of tergite VIII (Fig. 7D).

Redescription

Uniformly apterous; body length: ♂ 21.7 mm, ♀ 22.4 mm; distance between mesoacetabula: ♂ 2.6 mm, ♀ 2.7 mm. Head: clypeus glabrous (as in Fig. 4B); vertex punctate (as in Fig. 4D); eyes 1.6–1.9× wider than interocular distance in dorsal view, ventral margin with conspicuous spines (as in Fig. 4F); article III of rostrum with small, sparsely distributed setae (as in Fig. 5A), 2.0–2.5× longer than article IV; antennomere I 1.5× longer than antennomeres II and III combined; antennomere III 3/5 the length of antennomere IV, the latter straight, 3/5 of head width (as in Fig. 6B). Thorax: wings not developed (apterous); mesonotum 1.3–1.6× longer than pronotum and metanotum combined; anterodorsal region of prothoracic femur with 5–18 small spines; prothoracic tarsi 1.2–1.4× longer than metathoracic tarsi; anterior region of metacetabula with a tuft of setae (as in Fig. 2A). Male: lateral margins of abdomen parallel or slightly diverging in dorsal view, tergite VII slightly wider than tergite II; sternites IV–VI lacking small spinules and concavities; tergite VII depressed posteriorly; connexival spines 1/5 the length of tergite VIII (Fig. 7D); posterior margin of sternite VII rounded (Fig. 8D); lateral margins of tergite VIII parallel, apical and basal area slightly convergent; apex truncate to subacute (Fig. 7D); apex of pygophore rounded to subacute in ventral view; proctiger long, ~2× longer than tergite VIII in dorsal view (Fig. 8D), basolateral processes short, directed sideways, 2.3–2.8× wider than long (Fig. 9D); phallus slightly rounded, more or less as wide as long, branches of sclerite approximately as wide as its confluence area (Fig. 2C). Female: posterior margin of mesonotum lacking large protuberances posteriorly (Fig. 2G); tergite VIII slender, apex rounded, gonocoxae lacking spines posteriorly (some specimens with a single spine); connexival spines 0.2–0.4 mm in length.

Colouration. Mostly yellow (Fig. 11C, D). Head: yellow in dorsal view (Fig. 14D); articles I and III of rostrum yellow, article III brown, sometimes lighter brown basally (Fig. 15D). Thorax: pronotum with black lateral stripes, wider than median yellow stripe; femora yellow; tibiae yellow with dark stripes medially, less conspicuous in darker specimens; mesonotum with black stripe, slightly narrower than yellow median stripe; mesopleuron and mesosternum yellow; metasternum with black stripe, slightly wider or narrower than median yellow stripe; metapleuron and metasternum yellow; meso- and

metathoracic acetabula dorsolateral brown; mesothoracic femora with black stripes ventrally and dorsally, posterior region with or without discreet stripes. Abdomen: covered with light brown pubescence; tergites (I–VII) black with narrow median yellow stripe; connexiva and sternites (I–VII) yellow to brown; dorsal region of pleurites (I–VII) with a brown longitudinal stripe. Male: tergite VIII with longitudinal brown median spot, or entirely brown at the middle; sternite VIII and pygophore yellow. Female: tergite VIII and proctiger with longitudinal median brown stripe at the middle; gonocoxae yellow, with or without ventral black stripe.

Comments

This species superficially resembles *C. hungerfordi* and *C. palmaris*. It differs from those by its larger body size, yellow prothoracic tibia with black stripes, and tergite VII apically depressed in males. It can be readily distinguished from *C. hungerfordi* by the width of the black mesonotum stripes, which are as wide as the median yellow stripe (Fig. 11C, D). Males of *C. regulus* differ from males of *C. palmaris* by the basolateral processes of the proctiger (twice as long) (Fig. 9D) and rounded phallus, with sclerite branches as long as the width of its confluence area.

Examined specimens can be separated into two groups based on colour polymorphism and the variation in the shape of male genitalia. The first group includes yellow insects with a rounded pygophore in ventral view; tergite VIII rounded posteriorly; and apical margin of sternum VII rounded. The second group includes mostly brown insects that are slightly larger, with the posterior margin of pygophore and tergite VIII nearly acute, and apical margin of sternum VII rectangular. In the redescription of this species, Drake and Harris (1930, 1934) described a variation of 18.50 to 20 mm regarding the body size of the specimens. However, in this study all examined specimens have a body size larger than 20 mm.

linearis-group

Diagnosis

Antennomere IV curved; ventral margin of eyes with inconspicuous spinules; abdominal sternites with numerous and agglomerated spinules; sternite VII emarginate; connexival spines long; proctiger short with long basolateral processes.

Cylindrostethus bilobatus Kuitert, 1942

Cylindrostethus bilobatus Kuitert, 1942: 137 [description]. Moreira *et al.*, 2011b: 6. [checklist]. Floriano & Cavichioli, 2013: 191 [key, illustration].

Material examined

Holotype male (SEMC). 'Bolivia, S.A\ R. Beni Puerto\ Salinas 11–37\ A. M. Olalla (beige label)' '♂ (yellow label) 'HOLOTYPE\ *Cylindrostethus bilobatus*\ Det. L.C. Kuitert'; Allotype female (SEMC): 'Bolivia, S.A\ R. Beni

Puerto\ Salinas 11–37\ A. M. Olalla (beige label) 'ALLOTYPE\ *Cylindrostethus\ bilobatus*\ Det. L.C. Kuitert'.

Notes on types. The holotype is in a good state of preservation, except for a hole in the mesopleura. The allotype is poorly preserved; antennomeres III–IV, right prothoracic tarsus and left mesothoracic tibiae are missing, and the tibiae and apex of the article IV of rostrum are damaged.

Diagnosis

Male basolateral processes elongate, projected forwards (Fig. 8E), not visible dorsally, apex acute, not reaching the connexival spines (Figs 7E, 8E); female with large processes on posterior margin of mesonotum (Fig. 2F).

Redescription

Uniformly apterous; body length: ♂ 13.9 mm, ♀ 16.2 mm; distance between mesoacetabula: ♂ 2.1 mm, ♀ 2.2 mm. Head: clypeus densely pilose (as in Fig. 4A); vertex lacking punctations (as in Fig. 4C), eyes 1.3× as wide as interocular width in dorsal view; ventral margin showing inconspicuous spines (as in Fig. 4E); article III of rostrum 1.7× as long as article IV, setae covering 1/3 of anteroventral and dorsal region (as in Fig. 5B); antennomere I 1.6× as long as antennomere II and III combined; antennomere III half as long as antennomere IV; antennomere IV 3/5× as long as head width, slightly curved (as in Fig. 6A). Thorax: mesonotum 1.9–2.1× longer than pronotum and metanotum combined; anterodorsal region of prothoracic femora bearing fewer than 10 short spines; prothoracic tarsi slightly shorter than metathoracic tarsi; anterior region of metacetabula without a tuft of setae. Male: lateral margins of abdomen slightly divergent, towards posterior region, tergite VII 1.1× as wide as tergite II; sternites V–VI bearing small spinules at posterior margins; tergite VII not depressed on posterior fourth; connexival spines 3/5 the length of tergite VIII; sternite VII bearing small, sparsely arranged spinules, lacking concavities, posterior margin conspicuously excavated at middle (Fig. 8E); lateral margins of basal III of tergite VIII slightly rounded, converging towards the anterior and posterior region, posterior margin slightly truncate (Fig. 7E); apex of pygophore rounded in ventral view (Fig. 8E); proctiger more or less equal in size to tergite VIII in dorsal view (Fig. 7E); basolateral processes elongate, directed forwards, apex acute, not visible in dorsal view (Fig. 7E), not reaching connexival spines (Fig. 8E). Female: posterior margin of mesonotum with large protuberances (Fig. 2F); apex of tergite VIII slightly rounded; posterior region of gonocoxae bearing spines; connexival spines 0.2 mm in length.

Colouration. Mostly brown (Fig. 12A, B). Head: yellow in dorsal view, frons brown, clypeus and vertex yellow (Fig. 14E); longitudinal dark brown stripe located medially, in ventral view; rostrum articles I and II yellow, article III black, gradually darkened towards the apex (Fig. 15E). Thorax: pronotum with median, light brown stripe; femora and basal III of tibia yellow; mesonotum and metanotum with brownish stripe; mesopleuron and metapleuron usually showing black dorsal stripe, brown in ventral view; mesosternum and metasternum yellow, covered with golden pubescence; meso- and metathoracic femora yellow, gradually darkened towards apex. Abdomen: covered with golden pubescence; tergites, pleurites and sternites (I–VII)

brown; connexiva yellow. Male: pygophore and proctiger brown. Female: lateral margin of tergite VIII slightly lighter than central area; gonocoxae brown, slightly darker dorsally; proctiger brown.

Comments

This species superficially resembles *C. bassleri*, *C. linearis*, *C. meloi* and *C. drakei*, sp. nov.; however, males of *C. bilobatus* differ in the shape of the basolateral processes of the proctiger, which are longer and concealed in dorsal view, not reaching the connexival spines (Fig. 8E). The females differ from other congeneric species in having a protuberant posterior margin on the mesonotum (Fig. 2F).

Cylindrostethus meloi Floriano & Cavichioli, 2013

Cylindrostethus bassleri, Moreira et al., 2011a: 272–273 [redescription, illustration] [misidentification].

Cylindrostethus meloi Floriano & Cavichioli, 2013: 187–192 [description, key, illustration].

Material examined

Holotype male (INPA). 'Brasil: Amazonas\ Ig. (Igarapé) Boiaçuzinho\ R. [Rio] Demeni - R. (Rio) Negro\ 5-X-1977. Dellone' '*C. erythropus* - Inpa'. Paratype: three males, eight females (INPA): 'Brasil: Amazonas\ Ig. [Igarapé] Boiaçuzinho\ R. [Rio] Demeni - R. (Rio) Negro\ 5-X-1977. Dellone' '*C. erythropus* - Inpa'; one male, one female [DZUP], remaining specimens at (INPA).

Other material examined. One female, one male (INPA): 'BR [Brasil] - AM [Amazonas], Barcelos, Rio\ Acará\ 29-VII-2009\ PT 1006'. One male, four females (INPA): 'BR [Brasil] - AM [Amazonas] R. [Rio Solimões] Jutai igarapé, afluente do rio\ Sapó' '276119° - 6679997°\ 06-IX-2003\ N. Hamada & J. L. Nessimian' '2062'; four males, eight females (INPA): 'Brasil: Amazonas\ Ig. [Igarapé] Boiaçuzinho\ R. Demeni - R. (Rio) Negro\ 5-X-1977. Dellone' '*C. erythropus* - Inpa'; one female, one male (INPA): 'BR [Brasil] - AM [Amazonas], Barcelos, Rio\ Acará\ 29-VII-2009\ PT 1006'; one male (DZUP): 'BR - AM R. (Rio) Solimões J. Itai ifarapé (Igarapé), afluente do rio\ Gapó' '2276119 - 66799976 -\ IX-2003\ Hamada & Nessimian' '2062' PubMed.

Diagnosis

Mostly black (Figs 12C, D, 14F, 15F). Male proctiger with basolateral processes elongate, directed forwards (Fig. 9E), visible in dorsal view, apex acute, not reaching connexival spine (Figs 7F, 8F).

Comments

Cylindrostethus meloi closely resembles *C. bilobatus*, *C. bassleri*, *C. linearis* and *C. drakei*, sp. nov.; however, differs from the latter three species in having the basolateral process of the proctiger with an acute apex (Fig. 9E). It can be distinguished from *C. bilobatus* by the elongated basolateral processes of proctiger in males, which are visible in dorsal view (Fig. 7F). Females of *C. meloi* differ from those of *C. bilobatus* in lacking large protuberances on the posterior region of the mesonotum. This species was described by Floriano and Cavichioli (2013), but the authors did not specify the



Fig. 12. Body, dorsal view. (A) *Cylindrostethus bilobatus* (male holotype); (B) *C. bilobatus* (female paratype); (C) *C. meloi* (male holotype); (D) *C. meloi* (female paratype); (E) *C. bassleri* (male paratype); (F) *C. bassleri* (female paratype) (both at AMNH). Scale bar = 5 mm.

etymology. The specific epithet was given in honour of Dr Alan Lane Melo.

Cylindrostethus bassleri Drake, 1952

Cylindrostethus bassleri Drake, 1952: 2–3 [description]; Floriano & Cavichioli, 2013: 191 [key, illustration].

Material examined

Holotype male (AMNH). 'Rio Santiago, Peru IX-4-24\ F6139' 'Bassler\ Collection\ AcC. 33591' '-Holotype-\ *Cylindrostethus\ bassleri*\ ♂ Drake' 'Holotype\ *Cylindrostethus\ bassleri*\ Drake'.

Paratype male (AMNH). 'Paratype\ by C. J. Drake\ *Cylindrostethus\ bassleri*\ (handwritten)' (red label) 'Rio Santiago\ Peru IX-4-24\ F 6134' (beige label) '*Cylindrostethus\ bassleri* D&H' (beige label) 'H. Bassler\ Collection\ AcC. 33591' (beige label). (Photos sent by Ruth Salas.)

Paratype female (AMNH). 'Allotype\ *Cylindrostethus\ bassleri*\ Drake' (handwritten and red label) 'Allotype\ *Cylindrostethus\ bassleri*\ Drake' (red label) 'Rio Santiago\ Peru IX-2-24\ F 6124' (beige label) 'H. Bassler\ Collection\ AcC. 33591' (beige label).

Notes on types. The male paratype is damaged; antennomeres II–IV are absent. The left mesothoracic tarsus and right mesothoracic tibia are disassociated and glued separately on the label. The paratype female is lacking meso- and metathoracic legs.

Diagnosis

Males: basolateral processes elongate, projected forwards, visible in dorsal view; apex rounded, not concealed by connexival spines (Figs 7G, 8G).

Redescription

Uniformly apterous; body length: 16.9 mm; distance between mesoacetabula: ♂ 2.3 mm. Head: clypeus densely pilose (as in Fig. 4A); vertex lacking punctations (as in Fig. 4C); eyes 2× as wide as interocular width in dorsal view, ventral margin showing inconspicuous spines (as in Fig. 4E); article III of rostrum 1.7× longer than the IV, setae covering dorsal and 1/3 of anteroventral region (as in Fig. 5B). Thorax: mesonotum 2.1× longer than pronotum and metanotum combined; anterodorsal region of prothoracic femora bearing fewer than 10 short spines; prothoracic tarsi slightly shorter than metathoracic tarsi; anterior region of metacetabula without a tuft of setae. Male: lateral margins of abdomen slightly divergent, towards posterior region, tergite VII 1.1× as wide as tergite II; sternites V and VI bearing small spinules located centrally; tergite VII flat; connexival spines 0.9× the median length of tergite VIII; sternite VII lacking spinules, with slightly oblique concavities at sides, posterior margin conspicuously excavated at middle (Fig. 8G); lateral margins of basal III of tergite VIII slightly rounded, posterior region nearly parallel, posterior margin more or less truncate (Fig. 7G); apex of pygophore rounded in ventral view (Fig. 8G); proctiger subequal in length to tergite VIII, in dorsal view; basolateral processes elongated, directed forwards, apex rounded, visible in dorsal view, not reaching connexival spines (Figs 7G, 8G). Female: posterior margin of mesonotum lacking large protuberances (as in Fig. 2G); tergite VIII more or less quadrangular, apex slightly truncate; posterior region of gonocoxae lacking spines.

Colouration. Mostly dark brown (Fig. 12E, F). Head: eye margin yellow in dorsal view, brown longitudinal stripe extending towards anterior region; frontoclypeus black (Fig. 14G), with longitudinal dark brown stripe medially, in ventral view; rostrum articles I and II yellow, III black, gradually darkened towards apex (Fig. 15G). Thorax: pronotum with median light brown stripe; femora yellow; tibiae black; mesonotum and metanotum with black stripe delimited by dark brown stripes, mesopleuron and metapleuron often showing dorsal brown stripe; mesosternum and metasternum brown, covered with silver pubescence; meso- and metathoracic acetabulum and femora yellow, gradually darkened towards apex. Abdomen: covered with sparse golden pubescence; tergites, pleurites and sternites I–VII brown; connexiva yellow. Male: tergite VIII brown; basal area of sternite VIII and pygophore yellow, apical area of sternite VIII and proctiger brown. Female: lateral margin of tergite VIII lighter than central area; dorsal region of gonocoxae yellow, ventral region brown; brown proctiger.

Comments

This species closely resembles *C. bilobatus*, *C. linearis*, *C. meloi* and *C. drakei*, sp. nov. In *C. bassleri*, the basolateral processes of proctiger are elongated, but do not reach the connexival spines (Figs 7G, 8G), unlike *C. linearis* and *C. drakei*, sp. nov. It can be also distinguished from *C. bilobatus* and *C. meloi* in having the apices of the basolateral processes on proctiger rounded (Figs 7G, 8G).

Cylindrostethus linearis (Erichson 1848)

Hydrobates linearis Erichson, 1848: 614 [description]; Lethierry & Severin, 1896: 63 [catalogued].

Cylindrostethus linearis Kirkaldy, 1897: 258 [taxonomy]; Kirkaldy & Torre-Bueno, 1909: 210 [catalogue]. Schmidt, 1915: 362 [taxonomic notes]. Drake & Harris, 1930: 238 [redescription]. Drake & Harris, 1934: 220–221, 238–239 [redescribed, key, illustration]. Kuitert, 1942: 135–136 [key, taxonomic notes]. Nieser, 1970: 120–121, 135–137 [redescribed, illustrated]. Moreira *et al.*, 2011a: 270, 274 [redescription, illustration]. Moreira *et al.*, 2011b: 6 [checklist]; Floriano & Cavichioli, 2013: 191 [key, illustration].

Hydrometra erythropus Herrich-Schäffer, 1850: 68–69, 923 [description, illustration], syn. nov.

Hydrobates erythropus Lethierry & Severin, 1896: 63.

Cylindrostethus erythropus; Kirkaldy & Torre-Bueno, 1909: 210 [catalogued]. Schmidt, 1915: 362 [taxonomic notes]. Drake & Harris, 1934: 219–220, 238–239 [described, illustration]. Kuitert, 1942: 135–136 [key, taxonomic notes]. Nieser, 1970: 119–120, 135–137 [redescription, illustration]. Aristizábal, 2002: 81, 86–87 [key, redescription, illustration]. Moreira *et al.*, 2011a: 270, 273–274 [key, redescription, illustration]. Moreira *et al.*, 2011b: 6 [listed]; Floriano & Cavichioli, 2013: 191 [key, illustration].

Material examined

Pictures taken by Marcela Monné. Syntype male (BMNH): 'Hydrobates\ *linearis* ed.\ Krit. Guy.\ Schomburgk (green label, manuscript)' 'Zool. Mus.\ Berlin (beige label)' '3388 (brownish label)' 'Syn Typus (red label)'; one male syntype (BMNH): 'Brit. Guyana\ Schomburgk\ N. 3388 (green label, manuscript)' 'Zool. Mus.\ Berlin (beige label)' 'Syn Typus (red label)'; one female syntype (BMNH): 'Brit. Guyana\ Schomburgk\ N. 3388 (green label, manuscript)' 'Zool. Mus.\ Berlin (beige label)' '3388 (brownish label)'

'Syn Typus (red label)'; one male syntype (BMNH): 'H. linearis\ Typ\ Brit Guyana\ Schomburgk (beige label, manuscript)' '*Cylindrostethus linearis*\ Erich (brown label, manuscript)' 'Zool. Mus\ Berlin' 'Syn. Typus (red label)'; one female syntype (BMNH): 'H. linearis w.\ typ\ Brit Guyana\ Schomburgk (beige label, manuscript)' 'Zoo. Mus\ Berlin (beige label, manuscript)' 'Syn-Typus (red label)'.

Other material examined. Two males, four females (INPA): '2.76119 – 66799976 – IX-2003\ Hamada & Nessimian' '20603 PubMed >'; four females, one male (INPA): 'BRASIL – AM\ LAGO DE TEFÉ\ RIO SOLIMÕES\ 10-XII-76\ COL – Eduardo' '*C. erythropus* – Inpa' '*Cylindrostethus erythropus*\ (Herrich-Schäffer, 1850)\ det R. Sampaio1980'; four males, three females (INPA): 'BR – AM R. Solimões J.\ Itaí Ifarapé [Igarapé], afluyente do rio\ Gapó' '206'; three males (DZRJ): 'BR – AM – R. Solimões,\ Cadajás [Codajás], Urucuizinho,\ Lago A110 L IX-2003' 'PubMed Hamada & Nessimian\ 2066'; one male (DZRJ): 'BR – AM, R. Solimões,\ Cadajás [Codajás], Urucuizinho,\ Lago Urucyu\ 39196° – 6204738°' 'Lago A101 15-IX-2003\ Hamada & Nessimian\ 2064'; eight males, one female (DZUP): 'BR – AM – Manaus\ R. Solimões\ IG. (Igarapé) Pirapora VII-2011\ Floriano'; one male (AMNH): 'PERU: Loreto: Iquitos,\ Padre Island, 122,\ July 18, 1972\ R. T. & J. C. Schuh' 'In quiet Waters along edge of river'; two males (AMNH): 'PERU:\ Loreto, Pucallpa\ Yarinacocha\ 13 July 1962\ W. T. Van Velzen'; four males, six females (INPA): 'Rio Uraricoera. Ig. (Igarapé) Grande - RR\ Brasil22–10–87. IQ. Granfinale' '*Cylindrostethus erythropus*\ (Herrich-Schäffer, 1850)\ det. R. Sampaio 1850'; two females (INPA): 'BRASIL: AM\ I Careiro\ 20-IX-1976\ B. Mascarenhas' '*C. erythropus* – INPA' '*Cylindrostethus erythropus*\ (Herrich-Schäffer-1850)\ det. R. Sampaio 1980'; one male, one female (INPA): 'BRASIL: Amazonas\ Manaus Rio Solimões\ 20\XI\ 1975\ B. Mascarenhas' '*C. erythropus* – INPA' '*Cylindrostethus erythropus*\ (Herrich-Schäffer-1850)\ det. R. Sampaio 1980'.

Notes on types. The three male syntypes are in a good state of preservation; one male syntype is lacking mesothoracic tarsi. Two female syntypes are in poor condition: one is lacking the right mesothoracic leg, and the other is lacking the right mesothoracic tibiae.

Diagnosis

Male: tergite VII 1.3–1.5× wider than tergite II (Fig. 9F); sternites V–VII with concavities on central area; basolateral processes of proctiger long, visible dorsally, apex rounded, directed forwards, slightly convergent towards posterior region, reaching the connexival spines (Figs 7H, 8H), posterior width 1/2 the size of anterior region (Fig. 9F).

Redescription

Apterous insects; body length: ♂ 14.9 mm, ♀ 16.7 mm; distance between mesoacetabula: ♂ 2 mm, ♀ 2.3 mm. Head: clypeus densely pilose (Fig. 4A); vertex not punctate (Fig. 4C); eyes 1.2–1.6× wider than interocular distance, ventral margin with inconspicuous spines (Fig. 4E); article III of rostrum with setae covering 1/3 of anteroventral and dorsal regions (Fig. 5B), article III 1.4–1.8× longer than article IV; antennomere I 1.3–1.5× longer than antennomere II and III combined; antennomere III half as long as antennomere IV; antennomere IV slightly curved, ~4/5 of head width (Fig. 6A). Thorax: mesonotum 2.2–2.4× longer than pronotum and metanotum combined; anterodorsal region of prothoracic femora with fewer than 10 short spines, prothoracic tarsi slightly shorter than metathoracic tarsi; anterior

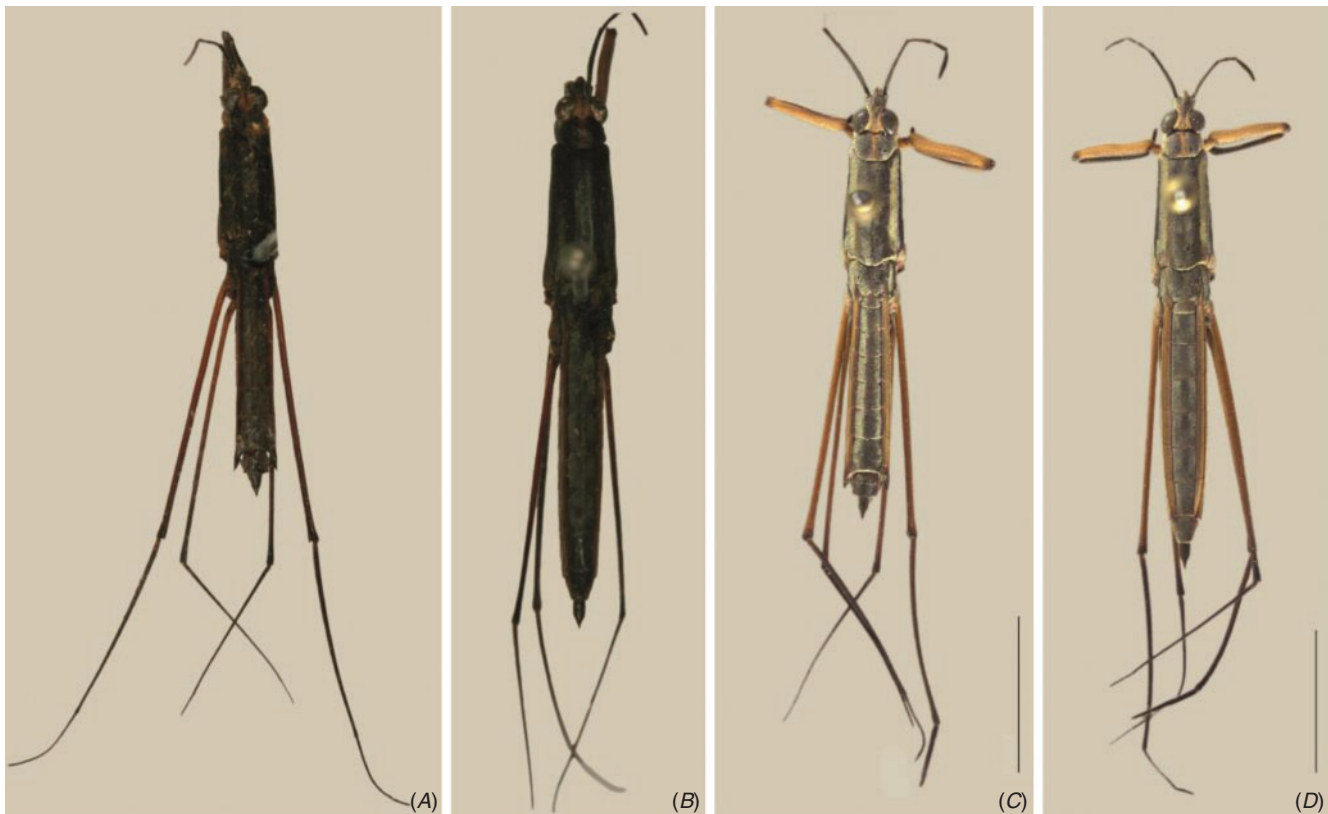


Fig. 13. Body, dorsal view. (A) *Cylindrostethus linearis* (male syntype) (image provided by Dra. Marcela Laura Monné Freire); (B) *C. linearis* (female syntype) (image provided by Dra. Marcela Laura Monné Freire); (C) *C. drakei*, sp. nov. (male holotype); (D) *C. drakei*, sp. nov. (female paratype). Scale bar = 5 mm.

region of metacetabula without a tuft of setae. Male: lateral margins of abdomen diverging towards the posterior region in dorsal view, tergite VII 1.3–1.5× wider than tergite II; sternites IV–VI bearing small spinules located centrally; sternites V–VI with concavities at middle; tergite VII not depressed posteriorly; connexival spines 4/5 the size of medial length of tergite VIII (Fig. 7H); sternite VII with conspicuous medial concavities, posterior margin conspicuously excavated medially (Fig. 8H); basal III of lateral margins of tergite VIII rounded, slightly divergent towards posterior region, posterior margin slightly truncate, median groove slightly marked; apex of pygophore rounded in ventral view (Fig. 8H); proctiger approximately as long as tergite VIII in dorsal view (Fig. 7H); basolateral processes long, apex rounded, directed forwards (Fig. 8H), visible dorsally, reaching connexival spines (Figs 7H, 8H), slightly convergent towards posterior region, posterior width 1/2 the size of anterior region (Fig. 9F); phallus elongated, 2× as long as wide, sclerite

bifid basally, branches 2× longer than its area of confluence. Female: posterior margin of mesonotum lacking large protuberances (as in Fig. 2G); tergite VIII subquadrangular, apex slightly truncate; gonocoxae with spines posteriorly; connexival spines 0.16–0.33 mm in length.

Colouration. Mostly dark brown or black (Fig. 13A, B). Head: eye margin yellow in dorsal view, dark longitudinal stripe enlarged towards anterior region; frontoclypeus black (Fig. 14H); longitudinal dark brown stripe ventrally; articles I and II of rostrum yellow, article III black, gradually darkened towards apex (Fig. 15H). Thorax: pronotum with median light brown stripe; prosternum, acetabula, coxae, trochanter and femora yellow; tibiae black; meso- and metanotum with median black stripe delimited by lighter stripes; mesopleuron and metapleuron with or without dorsal brown stripe, ventral area black; mesosternum and metasternum black, covered with silver pubescence; meso- and metathoracic acetabula yellow; meso-

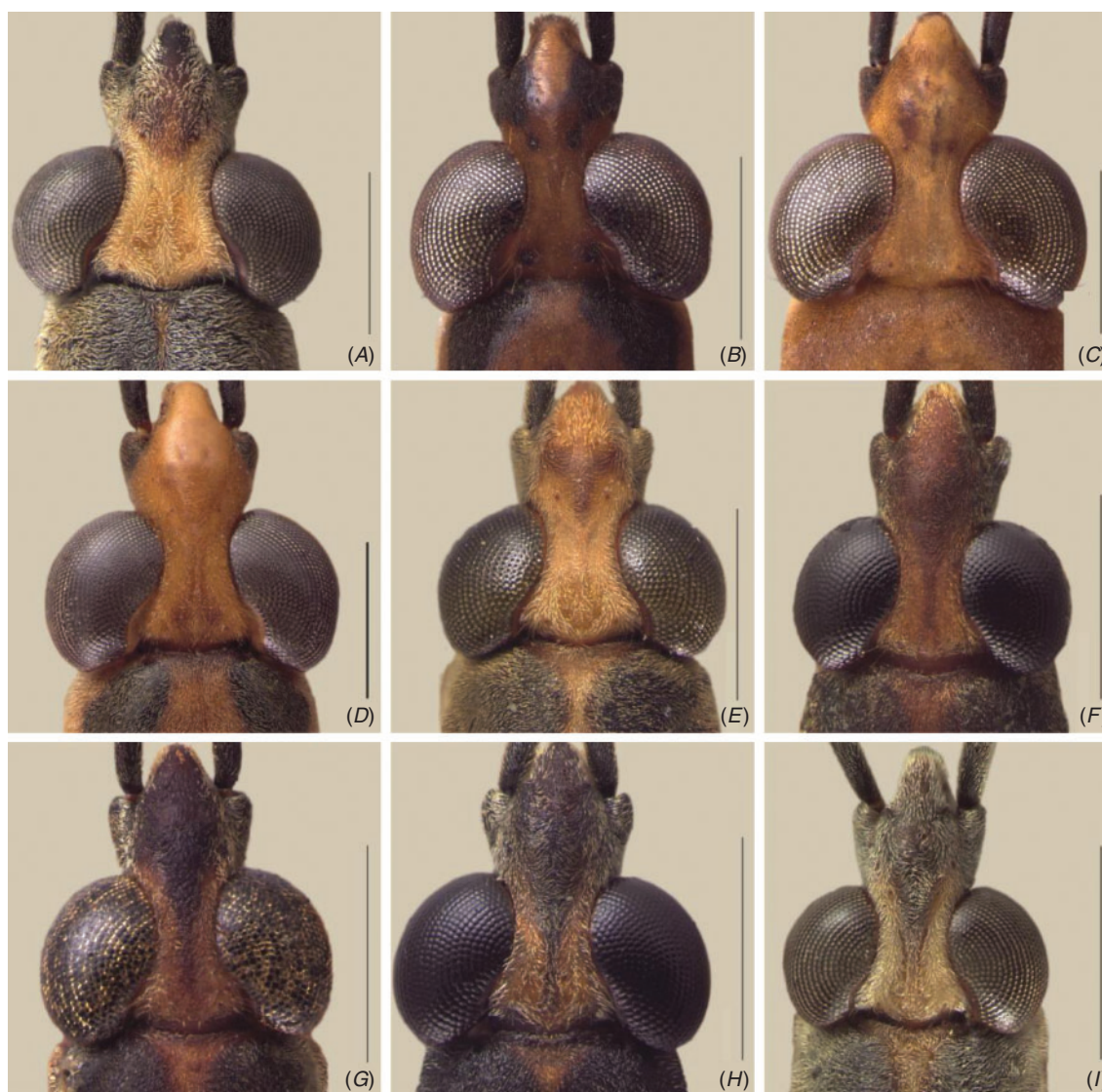


Fig. 14. Head, dorsal view. (A) *Cylindrostethus podargus*; (B) *C. palmaris*; (C) *C. hungerfordi*; (D) *C. regulus*; (E) *C. bilobatus*; (F) *C. meloi*; (G) *C. bassleri*; (H) *C. linearis*; (I) *C. drakei*, sp. nov. Scale bar = 1 mm.

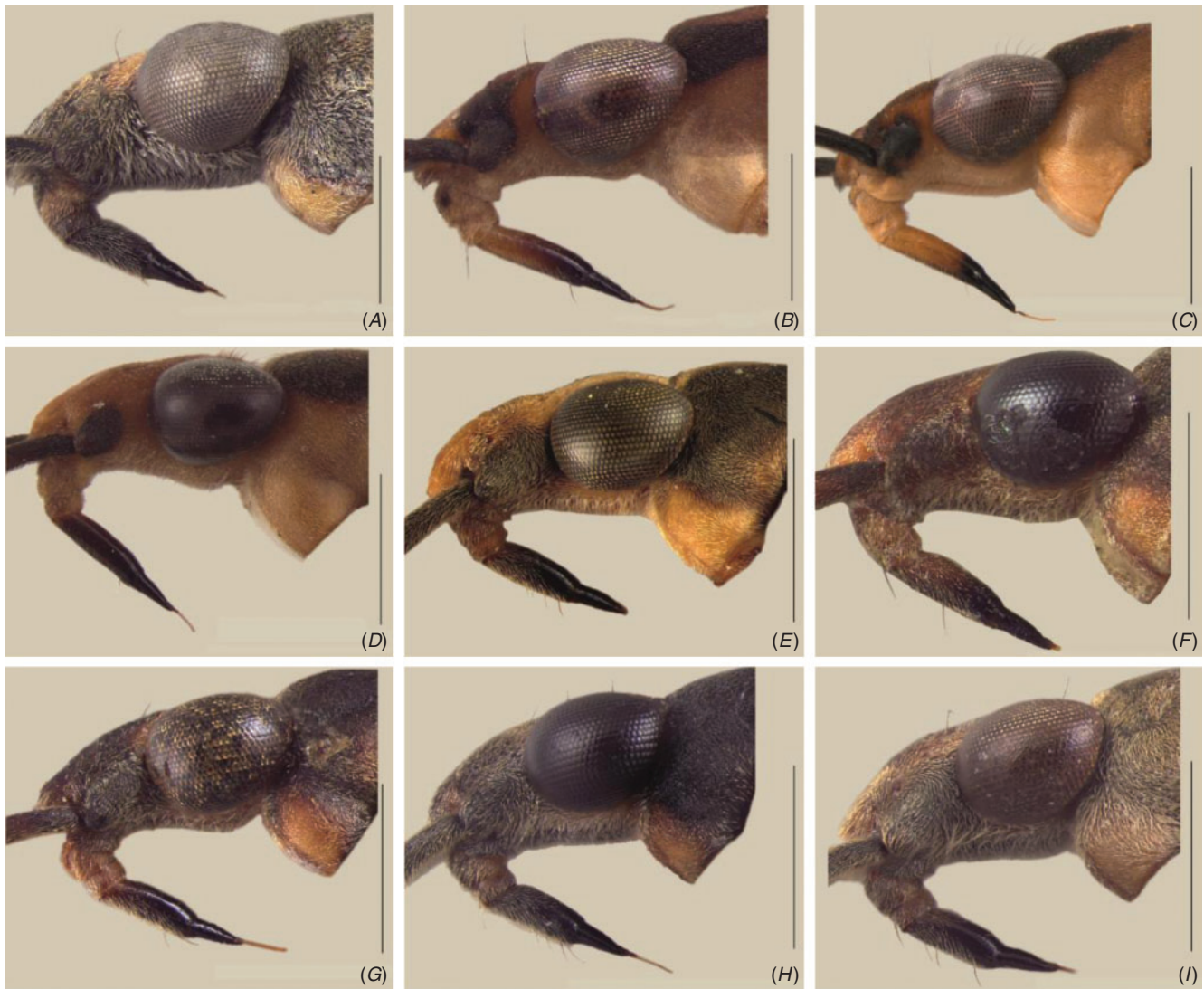


Fig. 15. Head, lateral view. (A) *Cylindrostethus podargus*; (B) *C. palmaris*; (C) *C. hungerfordi*; (D) *C. regulus*; (E) *C. bilobatus*; (F) *C. meloi*; (G) *C. bassleri*; (H) *C. linearis*; (I) *C. drakei*, sp. nov. Scale bar = 1 mm.

and metathoracic femora yellow, gradually darkened towards apex. Abdomen: covered with sparse golden pubescence; tergites, pleurites and sternites (I–VII) brown or black; connexiva slightly lighter than tergites. Male: tergite VIII black, lateral and basal portions sometimes yellow; basal area of sternite VIII yellow, apical area black; pygophore and proctiger brown or black. Female: tergite VIII black, lateral margins yellow in some specimens; gonocoxae and proctiger brown or black, dorsal region of gonocoxae yellow in some specimens.

Comments

Cylindrostethus linearis superficially resembles *C. bassleri*, *C. bilobatus*, *C. meloi* and *C. drakei*, sp. nov. Males of *C. linearis* differ from *C. bassleri*, *C. bilobatus* and *C. meloi* in having the basolateral processes of the proctiger remarkably elongate, reaching the connexival spines, in ventral view

(Fig. 8H). Representatives of *C. linearis* differ from *C. drakei*, sp. nov. in their darker body colouration (Fig. 13A, B), in having the basolateral processes of the proctiger slightly convergent towards apex, with the apex $\sim 0.5\times$ as wide as basal region (Fig. 9F), and sternites V–VII with central concavities.

After analysing illustrations, original descriptions and photos of syntypes of *C. linearis* (Fig. 16A–C), we concluded that specimens previously identified as *C. erythropus*, syn. nov. by Drake and Harris (1934), Nieser (1970) and Moreira *et al.* (2011a) are, in fact, representatives of *C. linearis*.

Drake and Harris (1934) redescribed *C. linearis* based on specimens of the type series; according to the drawings provided by the authors, the basolateral processes of the proctiger are curved with an acute apex. However, the shape of the basolateral processes in syntypes (as seen in photographs provided by Marcela Monné; Fig. 16A, C) differs from those in the illustrations. We did not examine the type series of



Fig. 16. Images of new junior synonyms. (A, B) *Cylindrostethus linearis* (male syntype), ventral view, and corresponding labels, respectively; (C) *C. linearis* (syntype male), genitalia, ventral view; (D) *C. stygius*, syn. nov. (female paratype), dorsal view; (E) *C. podargus* (paratype male), dorsal view; (F) *C. stygius*, syn. nov., label of paratype; (G) *C. podargus*, label of paratype. (Image provided by Dra. Marcela Laura Monné Freire.)

C. erythropus, syn. nov. According to Rider (1993), most of Herrich-Schäffer's types were lost in the First and Second world wars. The illustrations of *C. erythropus*, syn. nov. provided by Herrich-Schäffer (1850) indicate that the lateral margins of the abdomen are strongly divergent, in the same fashion as the syntypes of *C. linearis*. Therefore, *C. erythropus*, syn. nov. is here proposed as a synonym of *C. linearis*.

Ecological notes

In a recent field expedition, specimens of *C. linearis* were obtained from a stream in Amazonas State, Manaus, Brazil (the Pirapora River). The insects were found in groups, usually in shady, deep water bodies with moderate flow; the river was ~10 m wide.

Cylindrostethus drakei, sp. nov.

Cylindrostethus linearis Drake & Harris, 1934: 219, 220–221, 238–239 (misidentification). Nieser, 1970: 120–121, 135, 137 (misidentification). Moreira *et al.*, 2011a: 270, 273, 274 (misidentification).

<http://zoobank.org/urn:lsid:zoobank.org:act:1305BE19-5CE4-4C5A-9D2F-441D7E9849E2>

Material examined

Holotype male (MPEG). 'Brasil Rondônia\ Porto Velho\ Rio Madeira\ 23-V-1984' 'Brasil Rondônia\ Marclo Zanuto'. Paratype (MPEG) (four males, one female): same data as the holotype.

Other material examined. Eight males, 13 females (UFRJ): 'Brasil, AM, R. Solimões, COdojás, Urucurizinho, Lago Urucuri\ -39196° - 6204738°\ Lago. A10 L\ 15-IX-2003\ N. Hamada & J. L. Nessimian'. One male (INPA): 'Coleção\ Campos Seabra' 'Col. Campos SEABRA\ Itacoatiara Amazonas\ BRAZIL 15-VI-952\ Orlando M. Rego'; two males, three females (INPA): 'BR - AM - Rio Solimões\ Coari, Monte das Oliveiras\ 389341 - 6336261\ A08 L 12-IX-2003' 'Hamada & Nessimian\ 2411'; one male (DZRJ): 'BR - AM - R. Solimões\ Cadajás [Codajás], Urucurizinho\ lago Urucyu\ 39196° - 6204738°' 'Lago A101 15-IX-2003\ Hamada & Nessimian\ 2064'; one male (INPA): 'BR - AM - Solimões, Coari, Monte das Oliveiras' '389341° PubMed -6335261°\ Lago A08 L 12-IX-2003\ Hamada & Nessimian'; Five males, five females (AMNH): 'PERU: Loreto: Iquitos, Padre Island, 122 m., July 18, 1972\ R.T. & J. C. Schuh' 'In quiet Waters along\ edge of river'; five males, two females (AMNH): 'PERU: Loreto: Iquitos, Amazon River, 120 m., July 18/1972\ R.T. & J.C. Schuh' '*Cylindrostethus\ regulus*\ (White)\ det. Calabrese'.

Diagnosis

Male: tergite VII 1.1–1.2× wider than tergite II; sternite VII with concavities at each side; proctiger with pair of basolateral processes, strongly converging towards posterior region, reaching and overlapping connexival spines (Figs 7I, 8I); posterior region 3/10 the width of anterior region (Fig. 9G), visible dorsally.

Description

Apterous insects; body length: ♂ 14.2 mm, ♀ 16.2 mm; distance between mesoacetabula: ♂ 2.0 mm; ♀ 2.2 mm. Head: clypeus densely pilose (as in Fig. 4A); vertex not punctate (as in Fig. 4C); eyes 1.4× wider than interocular distance; ventral margin with inconspicuous spines (as in Fig. 4E); 1/3 of anteroventral and dorsal region of article III of rostrum covered with setae (as in Fig. 5B), article III of rostrum 1.5–1.7× longer than article IV;

antennomere I 1.5× longer than antennomeres II and III combined; antennomere III 0.5× as long as antennomere IV, antennomere IV slightly curved, 7/10 the width of head (as in Fig. 6A). Thorax: mesonotum 1.9–2.1× longer than pronotum and metanotum combined; anterodorsal region of prothoracic femora bearing fewer than 10 minute spines; prothoracic tarsi slightly shorter than metathoracic tarsi; anterior region of metacetabula without a tuft of setae. Male: lateral margins slightly diverging from the posterior region in dorsal view, tergite VII 1.1–1.2× wider than tergite II; posterior margin of sternites IV–VI bearing minute spines located centrally; tergite VII not depressed posteriorly; connexival spines 0.8–0.9× smaller than tergite VIII (Fig. 7I); lateral region of sternite VII with conspicuous concavities (Fig. 8I); lateral margins of tergite VIII slightly rounded at basal III, diverging from posterior region, posterior margin slightly truncate, with or without slightly marked median groove (Fig. 7I); apex of pygophore rounded apex ventrally (Fig. 8I); proctiger approximately as long as tergite VIII (Fig. 7I); basolateral processes long, apex rounded, projected forwards (Fig. 9G), visible in dorsal view, reaching connexival spines (Figs 7I, 8I), strongly converging towards posterior region, posterior region 3/10 the width of anterior region (Fig. 9G); phallus slender, 2× as long as wide, sclerite bifid basally, branches 2× longer than its area of confluence; apex slightly rounded (as in Fig. 2C). Female: posterior margin of mesonotum lacking large protuberances (Fig. 2G); tergite VIII subquadrangular, apex slightly truncate; posterior region of gonocoxae with spines; connexival spines 0.3–0.4 mm in length.

Colouration. Mostly brown or dark brown (Fig. 13C, D). Head: eye margin yellow in dorsal view, brown longitudinal stripes extended and enlarged towards apex of frontoclypeus, black (Fig. 14I); longitudinal dark brown stripes medially, in ventral view; articles I and III of rostrum yellow, article III black, gradually darkened towards apex (Fig. 15I). Thorax: pronotum with median light brown groove; femora yellow; tibiae black; meso- and metanotum with black stripe delimited medially by brown stripes; mesopleuron and metapleuron with brown dorsal stripe, ventral region brown to black; mesosternum and metasternum brown to black, covered with greyish pubescence; meso- and metathoracic acetabula yellow, gradually darkened towards apex. Abdomen covered with greyish pubescence; tergites, pleurites and sternites (I–VII) brown to black; connexiva yellow. Male: tergite VIII black, sometimes yellow at base and sides; pygophore and proctiger brown or black. Female: sides of tergite VIII lighter than middle; gonocoxae and proctiger black, dorsal region of gonocoxae slightly lighter.

Comments

This species superficially resembles *C. bassleri*, *C. bilobatus*, *C. linearis* and *C. meloi*. The males differ from those of *C. bassleri*, *C. meloi* and *C. bilobatus* in the long basolateral processes of the proctiger, which overlap the connexival spines (Fig. 9G). This species is also morphologically similar to *C. linearis*, but differs in the following features: lighter colouration (Fig. 13C, D), basolateral processes of proctiger strongly convergent apically, apical region 3/10 the width of

anterior region (Fig. 9G), sternites V–VII with oblique concavities at sides. Although the type specimens here listed were previously identified as *C. linearis* by several authors (also refer to comments in *C. linearis*), we consider these specimens to represent our new species.

Ecological notes

This species can be found in rivers (Drake and Harris 1934). Moreira *et al.* (2011a) observed this species in ponds. It appears to occur in sympatry with *C. linearis*.

Etymology

This species is named in honour of Carl J. Drake, in recognition of his important contributions to hemipteran systematics.

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