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VITOR GÓIS FERREIRA

Contribution to the taxonomy and ecology of *Strandesia s.l.* (Crustacea, Ostracoda, Cypricercinae) from Brazilian floodplains

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Dissertação apresentada ao Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos Continentais do Departamento de Biologia, Centro de Ciências Biológicas da Universidade Estadual de Maringá, como requisito parcial para obtenção do título de Mestre em Ecologia e Limnologia.

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Contribuição à taxonomia e ecologia de *Strandesia s.l.* (Crustacea, Ostracoda, Cypricercinae) de planícies de inundação brasileiras

RESUMO

O propósito da revisão de espécies de *Strandesia s.l.* do Brasil foi o de validar a posição taxonômica dos seus represetantes. Entre os 11 gêneros de Cypricercinae, *Strandesia* é o mais diverso com 17 espécies registradas no Brasil. O estudo aborda espécies de *Strandesia* das quatro principais planícies de inundação brasileiras: Amazonas, Araguaia, Pantanal e Paraná. Três novas espécies de *Strandesia* são descritas, em conjunto com o primeiro registro e descrição de uma população de macho de outra espécie, *S. obtusata*, do Brasil. Como resultado da revisão, um novo gênero de Cypricercinae e uma nova espécie é descrita. O novo gênero e espécie representam um caso de evolução convergente com *Bradleytriebella lineata* (Victor & Fernando, 1981), devido a similaridades no formato da carapaça e ornamentação, no entanto com claras diferenças em caracteres dos apêndices.

Palavras-chave: Taxonomia morfológica. Cyprididae neotropical. Distribuição. Macrófitas aquáticas.

Contribution to the taxonomy and ecology of *Strandesia s.l.* (Crustacea, Ostracoda, Cypricercinae) from Brazilian floodplains

ABSTRACT

The pourpose of this revision of *Strandesia s.l.* species in Brazil was to validate the taxonomic position of your representants. Among eleven genera, *Strandesia* is the most diverse one in the Cypricercinae, with seventeen species recorded from Brazil. This study reports on *Strandesia* species of four major Brazilian floodplains: Amazon, Araguaia, Pantanal and Paraná. Three new species of *Strandesia* are described, together with the first record and description of a male population of another species, *S. obtusata*, from Brazil. As a result of the revision, one new Cypricercinae genus and a new species are described. The new genus and species represent a case of convergent evolution with *Bradleytriebella lineata* (Victor and Fernando, 1981), owing to the similarities in carapace shape and ornamentation, but clear differences in soft parts characters.

Keywords: Morphological taxonomy. Neotropical Cyprididae. Distribution. Aquatic macrophytes.

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SUMMARY

1 INTRODUCTION

River-floodplain systems are characterized by a great heterogeneity of environments, such as closed and open lakes, backwaters, temporary lakes, connecting channels and main channels of the river and tributaries (THOMAZ; BINI; BOZELLI, 2007). This ecosystem harbours a variety of floating aquatic macrophytes, a feature typical of South American floodplains. These aquatic plants have the potential to maintain a large biodiversity of aquatic invertebrates, such as ostracods (HIGUTI et al., 2010; PEREIRA et al., 2017).

Ostracods are small, bivalved crustaceans, which inhabit freshwater, marine and semi-terrestrial environments. The body size of Neotropical ostracods varies between 0.3 and 5 mm (HIGUTI et al., 2017). These organisms show a variety of reproductive strategies, from fully sexual or asexual to mixed reproduction (HORNE; BALTANÁS; PARIS, 1998). The morphology of non-marine Ostracods consists of eitght paired appendages covered by the valves: Antennula, Antenna, Mandibule, Maxillula, first, second and third thorcopods, caudal rami (uropod). In males with the presence of hemipenis and zenker organ (MARTENS, 1998).

There are currently 2321 ostracods species described worldwide, distributed among three main lineages: Darwinuloidea, Cytheroidea and Cypridoidea. Approximately 75% of all species belong to the superfamily Cypridoidea (MEISCH; SMITH; MARTENS, 2019). Within this superfamily the subfamily Cypricercinae is one of the most speciose with 11 genera (SAVATENALINTON; MARTENS, 2009): *Astenocypris* G.W. Müller, 1912, *Bradleycypris* McKenzie, 1982, *Bradleystrandesia* Broodbakker, 1983, *Bradleytriebella* Savatenalinton & Martens, 2009, *Cypricercus* Sars, 1895, *Diaphanocypris* Würdig & Pinto, 1990, *Nealecypris* Savatenalinton & Martens, 2009, *Pseudostrandesia* Savatenalinton & Martens, 2009, *Spirocypris* Sharpe, 1903, *Strandesia* Stuhlmann, 1888, *Tanycypris* Triebel, 1959.

The lack of distinguishable characters in the Cypricercinae caused taxonomic confusion among genera, such as *Strandesia* and *Cypricercus*. However, the shape and position of the Triebel's loop in the distal part of the attachment of the caudal ramus (see Fig. 4C), amongst other characters, provided some taxonomic order in the group (SAVATENALINTON; MARTENS, 2009, 2010). Usually, differences in the shape of valves, such as body size, external ornamentation or the presence of pits, ridges, spines or tubercles helps to identify different species. Nevertheless, sometimes convergent evolution can occur in ostracod valves, where valves can be highly similar in non-related lineages (BROODBAKKER, 1983; MARTENS; GEORGE, 1992).

Strandesia is the most diverse genus of Cypricercinae. Most of its species are recorded from the (sub-) tropics (BROODBAKKER, 1983) with presently 106 species worldwide (MEISCH; SMITH; MARTENS, 2019). There are 32 species recorded in the Neotropical region, while seventeen *Strandesia* species have thus far been recorded from Brazil (MARTENS; BEHEN, 1994; MARTENS; WÜRDIG; BEHEN, 1998; HIGUTI et al., 2010, 2013, 2017).

Few papers deal with the ecology, taxonomy and biology of non-marine ostracods in Brazil. The absence of identification books or keys and the existence of few specialists make it difficult for new professionals to study this group. Besides, a full dissection of individual ostracods is required to properly visualize the chaetotaxy of the limbs (MARTENS; BEHEN, 1994). In addition, most Brazilian *Strandesia s.l.* species have only old descriptions, where important morphological characters are missing.

This dissertation comprises two manuscripts. In the first one, we describe three new *Strandesia* species, and describe the males of *Strandesia obtusata* (Sars, 1901), and redescribe ten other *Strandesia* species, from four major Brazilian floodplains systems. In the second manuscript, we describe a new genus and species of Cypricercinae, from Amazon and Araguaia river floodplains, which constitutes a case of convergent evolution with *Bradleytriebella lineata* (Victor & Fernando, 1981), which is also redescribed.

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2. REVISION AND DESCRIPTION OF *STRANDESIA* S.S. (CRUSTACEA, OSTRACODA) SPECIES FROM FOUR BRAZILIAN FLOODPLAINS

ABSTRACT

The present paper is a contribution to the taxonomy of the genus *Strandesia*. Here, we describe three new species as well as the male of *Strandesia obtusata* (Sars, 1901) and redescribe ten other *Strandesia* species from the Amazon, Araguaia, Pantanal and Paraná river floodplains. This is the first record of sexual populations of Brazilian *Strandesia* species. Here we propose that *Strandesia trichosa* Roessler, 1990 is a synonym of *Strandesia psittacea* Sars, 1901. Most of the species analysed here are endemic to the Neotropical realm, with the exception of *Strandesia bicuspis* which occurs also in the Palaeartic Realm. This genus occurs in a great range of abiotic variables and aquatic macrophyte species. The species analysed here have a conservative soft parts morphology, but an impressive variety of carapace shapes.

Keywords: Cypricercinae. Cyprididae. Morphology. Taxonomy. Distribution. Neotropics. Aquatic macrophytes.

2.1 INTRODUCTION

There are currently 2321 species of non-marine Ostracoda worldwide. Approximately 43% of them belong to the family Cyprididae (Meisch *et al*. 2019). Of the ca. 317 Neotropical species, more than 50% belongs to this family (Meisch *et al*. 2019). The subfamily Cypricercinae is one of the most diverse of the Cyprididae. This subfamily has several doubtful genera and species (Savatenalinton & Martens 2009a). However, all genera (and species) of the Cypricercinae have a common feature in the attachment of caudal ramus, namely a loop at the distal end, called “Triebel’s loop”, which so far, is unique to this subfamily (Savatenalinton & Martens 2009a).

Strandesia is the most diverse genus of the Cypricercinae, with 106 species worldwide, although most of its species are recorded from the (sub-) tropics (Broodbakker, 1983). There are 32 species recorded in the Neotropical region. Seventeen *Strandesia* species have thus far been recorded from Brazil (Martens & Behen 1994; Martens *et al.* 1998a; Higuti *et al*. 2010, 2013, 2017). Most of these were described in the first half of the 20th century by Sars (1901) and Tressler (1950), based on specimens hatched from dried mud collected from São Paulo and Rio Grande do Sul states. The only recent studies regarding *Strandesia* species of Brazil were performed by Higuti *et al*. (2013), who described three new species of *Strandesia* (*S. lansactohai*, *S. velhoi* and *S. nupelia*) and redescribed *S. tolimensis* from the Upper Paraná River floodplain, applying both molecular and morphological analyses. More recently, Schön *et al*. (2018), using material of *Strandesia* species complex from four Brazilian floodplains, showed that these species cluster actually consists of 13 cryptic species and a fourth morpho-species. This species was provisionally referred to with the moniker “*S. nupelia* II” and was thus far only found in the Araguaia River floodplain. Meanwhile, this species has been identified as *Strandesia obtusata* (Sars, 1901), which was moreover found in both parthenogenetic and sexual populations. In addition, two further new species of *Strandesia* were found in the Araguaia River floodplain and one in Paraná River floodplain, but neither of these belong to the *S. obtusata*-lineage.

The presence of unknown species of *Strandesia* in two of the major floodplains of Brazil, the lack of more detailed descriptions of species described by Sars (1901) and Tressler (1950), which sometimes do not provide taxonomic relevant characters, and the scarce literature about these species, lead us to the present revision and (re-) description of Brazilian *Strandesia* species. Here, we describe three new species of *Strandesia,* and redescribe the following species: *Strandesia bicuspis* (Claus, 1892) G.W. Müller, 1912; *S. obtusata* (Sars, 1901) G.W.

Müller, 1912; *S. lansactohai* Higuti & Martens, 2013; *S. velhoi* Higuti & Martens, 2013; *S. nupelia* Higuti & Martens, 2013; *S. tolimensis* Roessler, 1990; *S. variegata* (Sars, 1901) G.W. Müller, 1912; *S. mutica* (Sars, 1901) G.W. Müller, 1912. *S. psittacea psittacea* (Sars, 1901) Roessler, 1990; *S. psittacea colombiensis* Roessler, 1990. We did not review the species described by Tressler (1950), as these will be discussed elsewhere.

2.2 MATERIAL AND METHODS

2.2.1 Study area

The present study was conducted in four Brazilian river-floodplain systems: Amazon; Araguaia; South Matogrossense Pantanal and Paraná (Fig. 1). These floodplains comprise a large area and cover distinct areas of Brazil. The greatest distance is 2300 km. River-floodplain systems comprise different types of habitats, as open and closed lakes, backwaters, temporary lakes (lentic environments), connecting channels and main channels of the river and tributaries (lotic environments). The environmental heterogeneity is also a characteristic of this ecosystem, most of it owing to the hydrological regime, which drives the ecological patterns and biodiversity in these areas (Agostinho *et al*. 2004; Thomaz *et al*. 2007; Conceição *et al*. 2017).

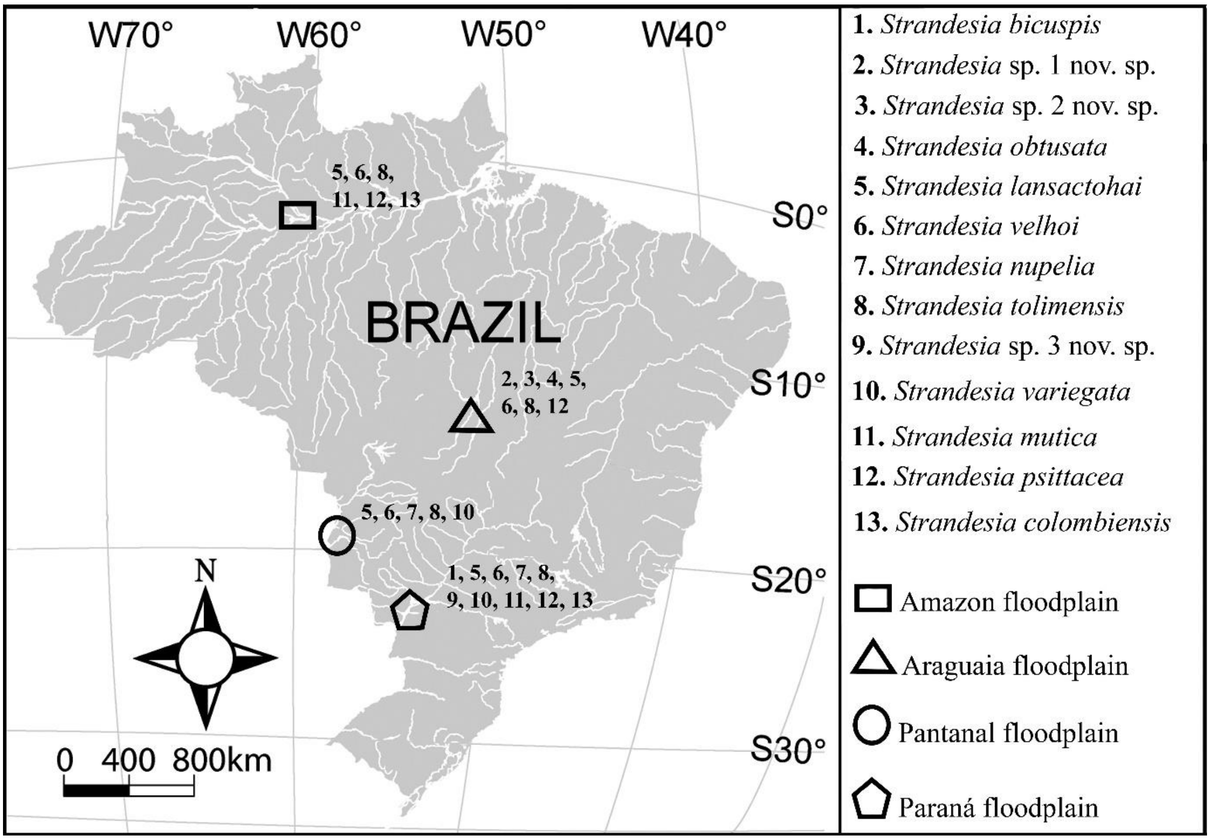

Figure 1 Distribution map of *Strandesia* species of the Amazon, Araguaia, Pantanal and Paraná floodplains.

The Amazon River floodplain is located in the north region of Brazil and covers an area of 6.8 million km^2, the largest draining basin in the world. The rainfall is evenly distributed temporally and spatially (Irion *et al*. 1997; Goulding *et al*. 2003). The Araguaia River floodplain is located in central Brazil, in an area of tropical savanna ("Cerrado") and has a drainage area of 377,000 km^2 and is 2.110 km long (Morais *et al*. 2005). This floodplain is the object of political and environmental discussions owing to the extensive damages caused by farming activities (Latrubesse & Stevaux 2002; Latrubesse *et al*. 2009). The South Matogrossense Pantanal floodplain is located in the Paraguay River basin in the centre of South America. The Paraguay River basin has an area of approximately 1 million km^2. Most of Pantanal area is in Brazil while it also extends into parts of Bolivia and Paraguay. The Pantanal was named as a Biosphere Reserve by UNESCO and was granted the World Heritage Certificate (Barros *et al*. 2004). The Paraná River floodplain has a drainage area covering 280,000 km^2. The first third of this basin, the Upper Paraná River floodplain is located between Porto Primavera Reservoir and Itaipu Reservoir and is about 230 km long and 20 km wide. This section is the last undammed stretch of Paraná River (Agostinho *et al*. 2004).

2.2.2 Sampling

Sampling was performed between 2004 and 2018 in the river-floodplain system of the Upper Paraná River and between 2011 and 2012 in Amazon, Araguaia and Pantanal floodplains. Ostracods were collected from aquatic vegetation, with different life forms: Free floating: *Azolla* sp.; *Eichhornia crassipes* (Mart.) Solms; *Limnobium laevigatum* (Humb. & Bonpl. ex Willd.) Heine; *Limnobium* sp.; *Lindernia althernanthera; Salvinia auriculata* Aubl.; *Salvinia herzogii* de la Sota; *Salvinia minima* Baker; *Salvinia* spp; *Pistia stratiotes* L. and *Ricciocarpus* sp. Emergent: *Ludwigia* sp. and *Paspalum notatum* Flugge. Epiphytic: *Oxycaryum cubense* (Poepp. & Kunth) Palla. Rooted floating-leaved: *Nymphaea amazonum* Mart. & Zucc. Rooted submerged: *Cabomba furcata* Schult. & Schult. f. and *Egeria najas* Planch. Free submerged: *Utricularia foliosa* L. Rooted floating-stemmed: *Eichhornia azurea* (Sw.) Kunth; *Hydrocotyle ranunculoides* L. f.; *Hydrocotyle* sp.; *Paspalum repens* P.J. Bergius; *Polygonum acuminatum* Kunth; *Polygonum ferrugineum* Wedd.; *Polygonum stelligerum* Cham; *Polygonum* sp. (according to Pott & Pott 2000; Souza *et al*. 2017). The vegetation was hand-collected, and the whole plants or roots were washed in a bucket (Campos *et al*. 2017). This material was filtered in a net of 160 µm of mesh size, and then preserved in 70% ethanol buffered with sodium tetraborate.

Ostracods were also collected from the littoral sediment using a rectangular hand net (28cm x 14cm, mesh size ~160 µm). Water temperature (WT) and dissolved oxygen (DO) concentration (YSI 550A oxymeter), pH (pHmeter Digimed) and electrical conductivity (EC) (conductivimeter-Digimed), were measured *in situ* close to the macrophytes.

2.2.3 Preparation and illustration of soft parts and valves

Soft parts were separated from the valves using dissection needles and were then put in a drop of glycerine for the dissection of the appendages. The dissection was covered with cover-slip and sealed with transparent nail polish. Valves were stored dry in micropaleontological slides. Drawings of soft parts were made using a camera lucida (Olympus U-DA) attached to the microscope (Olympus CX-41). Carapace and valves were illustrated and measured using Scanning Electron Microscopy (SEM; Philips XL30, in the Royal Belgian Institute of Natural Sciences, Brussels, Belgium) in different views (valves: internal and external views, carapaces: lateral, dorsal, ventral, and frontal views) The type material and illustrated specimens are presently numbered JHxxx (collection of Janet Higuti) and VFxxx (collection of Vitor Ferreira), but will be stored in the Museum of Zoology of the University of São Paulo (MZUSPxxx) and the Royal Belgian Institute of Natural Sciences (IGxxx - RBINS).

2.2.4 Abbreviations used in text

RV, right valve; LV, left valve; LVi, left valve inner view; RVi, right valve inner view; Cp, carapace; CpLl, carapace left lateral view; CpRl, carapace right lateral view; CpD, carapace dorsal view; CpV, carapace ventral view; CpFr, carapace frontal view; L, length; H, height; W, width; A1, antennula; A2, antenna; CR, caudal ramus; Md, mandibula; Mx1, maxillula; T1, first thoracopod; T2, second thoracopod; T3, third thoracopod; db, dorsal branch of caudal ramus attachment; vb, ventral branch of caudal ramus attachment; RO, Rome Organ on A1; WO, Wouters Organ on A1; ms, medial shield of hemipenis; ls, lateral shield of hemipenis; cr, chitinous rings in Zenker organ; ct, central tube of Zenker organ; dep, distal end plate of Zenker organ; pep, proximal end plate of Zenker organ; sw, spiny whorls in Zenker organ; Lpp, left prehensile palp (male T1); Rpp, right prehensile palp (male T1).

2.3 RESULTS

Class OSTRACODA Latreille, 1806

Subclass PODOCOPA G. W. Müller, 1894

Order PODOCOPIDA Sars, 1866

Suborder CYPRIDOCOPINA Baird, 1845

Superfamily CYPRIDOIDEA Baird, 1845

Family CYPRIDIDAE Baird, 1845

Subfamily CYPRICERCINAE McKenzie, 1971

Tribe Cypricercini McKenzie, 1971

Genus *Strandesia* Stuhlmann, 1888

Type species: *Strandesia mercatorum* (Vavra, 1895)

Diagnosis: see Savatenalinton & Martens (2009a).

The *Strandesia bicuspis* group

1. *Strandesia bicuspis* (Claus, 1892) G.W. Müller, 1912

(Figs. 2-4)

1892 *Acanthocypris bicuspis* Claus: 53

1892 *Strandesia bicuspis* var. *mucronata* (Claus): 53 (fide G.W. Müller, 1912)

1892 *Acanthocypris bicuspis* var. *mucronata* Claus: 53 (fide G.W. Müller, 1912)

1901 *Neocypris gladiator* Sars: 29 (fide Martens & Behen 1994)

1950 *Strandesia denticulata* Tressler: 75 (juveniles, fide Martens *et al.* 1998)

Material examined

Two females (VF062, VF065) were used for soft part illustrations and four females (JH082, JH148, JH154, JH173) were used for SEM from Pontal Lake (22°45'6.2"S, 53°25'24.6"W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=2): 2.046-2.102, H (n=1): 971, W (n=2): 649-660.

Diagnosis

Cp elongated. In dorsal view, Cp with a blunt anterior and posterior beak. LV with straight dorsal margin. RV dorsally with a helmet-like protuberance from the anterior to the middle region (anterior end softly curved, posterior end pointed) A2 with natatory setae not reaching tips of apical claws. Caudal ramus slender and strongly serrated, its attachment with a sub-triangular Triebel's loop in the main branch.

Abbreviated redescription of female

LVi (Fig. 2A) elongated, with a straight dorsal margin; calcified inner lamella wide along anterior and posterior margins and narrow along ventral margin; greatest height in LVi well ahead of the middle.

RVi (Fig. 2B) with calcified inner lamella as in LVi, anteriorly and posteriorly without selvage; dorsally with a protuberance from anterior to middle region (anterior end softly curved, posterior end pointed); slighlty inclinated; greatest height in RVi in the middle because of dorsal protuberance.

CpRl (Fig. 2C) elongated; with a large dorsal protuberance on RV; greatest height situated in the middle. CpD (Fig. 2D), with LV slightly longer than RV; both anterior and posterior margins pointed; greatest width situated in the middle. CpV (Fig. 2E), with LV slightly more extending beyond RV; both anterior and posterior margins with a blunt beak.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO small. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller one with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, one short and two long setae.

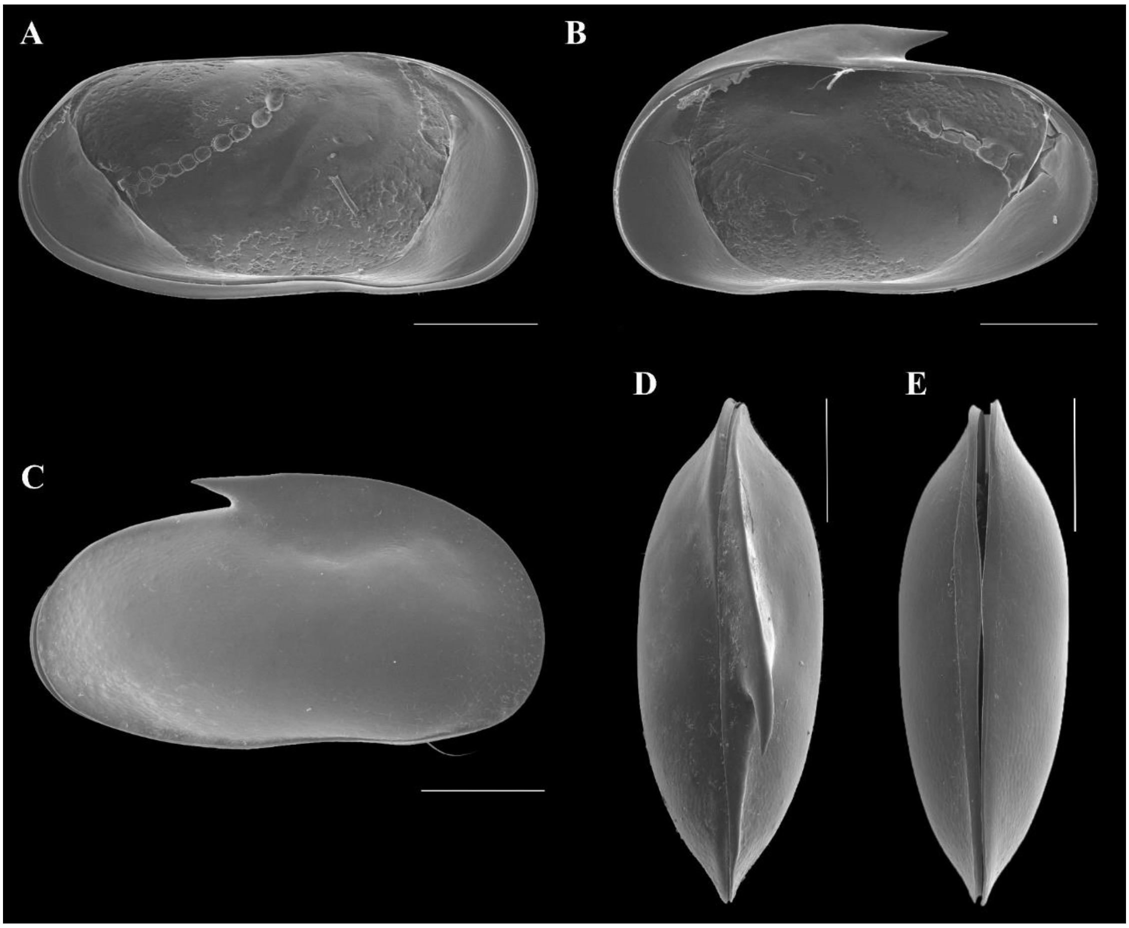

Figure 2 Carapace and valves of *Strandesia bicuspis*. A, LVi (JH173); B, RVi (JH173); C, CpRl (JH082); D, CpD (JH154); E, CpV (JH148). Scale bars, 500 μm.

A2 (Figs. 3A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (not reaching the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae not reaching the tips of the apical claws; the shortest reaching the middle of third segment). Second endopodal segment undivided, with two unequal but long dorsal setae and a group of four unequal ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 3B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

First segment of Md palp (Fig. 3C - chaetotaxy not complete) with one long and smooth α-seta. Second segment ventrally with one long and hirsute ß-seta. Penultimate segment laterally with one elongated cone-shaped, hirsute γ-seta. Terminal segment almost 3x as long as basal with, tapering towards the distal side. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 3D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six apical setae, and one short subapical seta. Terminal palp segment elongated, ca. twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite, reaching almost the end of the segment. First endite with one sideways-directed bristle only.

T1 protopodite (Fig. 3E) with two short a-setae, b and d-setae equally long. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite with three unequal, hirsute apical setae (not illustrated).

T2 (Fig. 3F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 3/4 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment "a" with one long apical hirsute seta (f); segment "b" with one shorter seta (g) reaching beyond the end of the terminal segment. Terminal segment with one apical claw (h2) and two setae (one ventro-apical (h1) and one dorso-apical (h3)).

T3 (Fig. 4A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

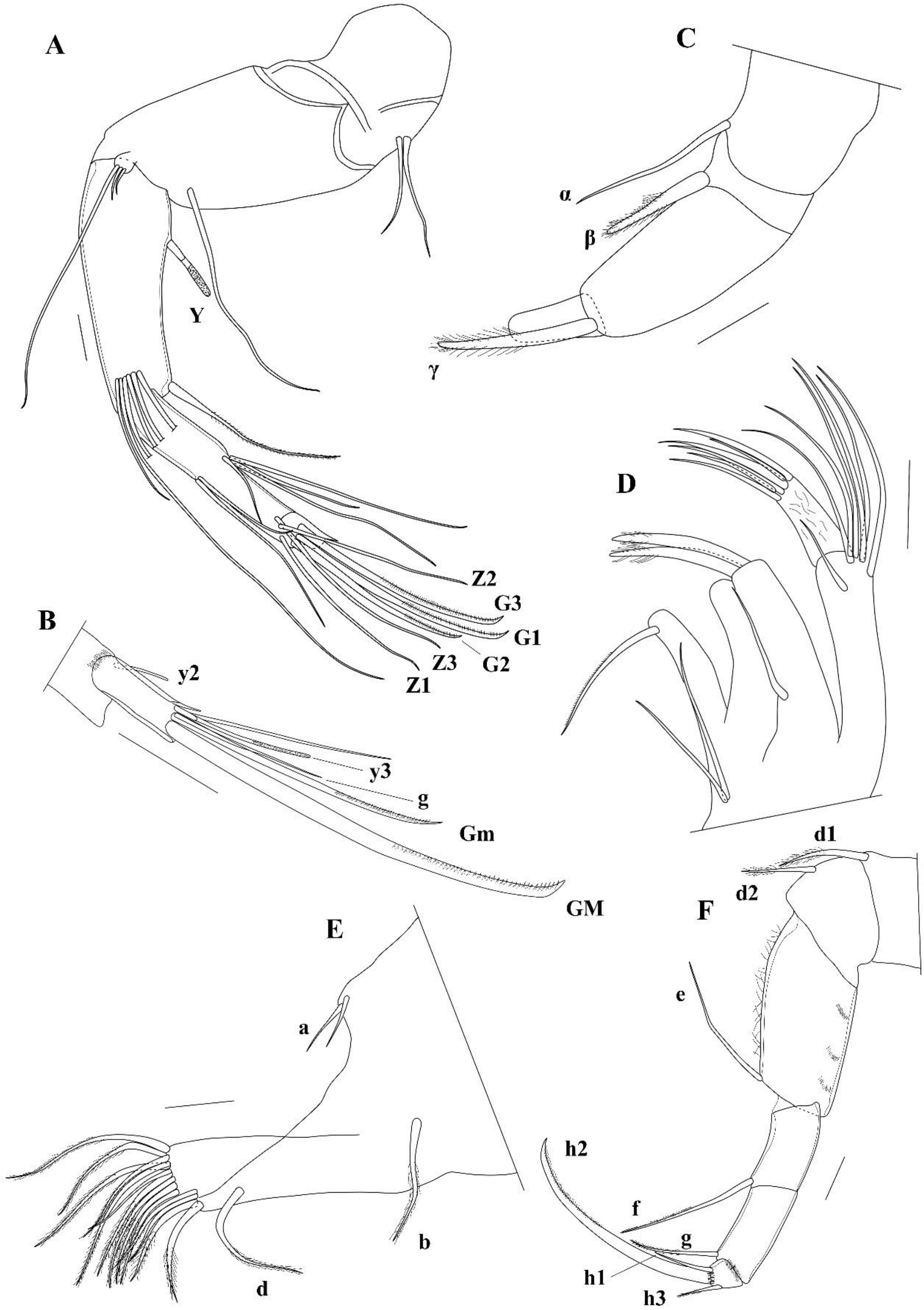

Figure 3 *Strandesia bicuspis*. A, A2 except last segment (VF062); B, A2 last segment (VF062); C, Md palp showing α, ß, γ setae (VF062); D, Mx1 (VF062); E, T1 (VF062); F, T2 (VF062). Scale bars, 50 µm

CR (Fig. 4B) slender and curved, with ventral margin strongly serrated in five distinct groups. Proximal claw half the length of distal claw. Proximal seta smooth, c 1/4 of length of distal seta.

CR attachment (Fig. 4C) stout, with Triebel's loop sub-triangular, situated in the main branch; vb long and curved; db short.

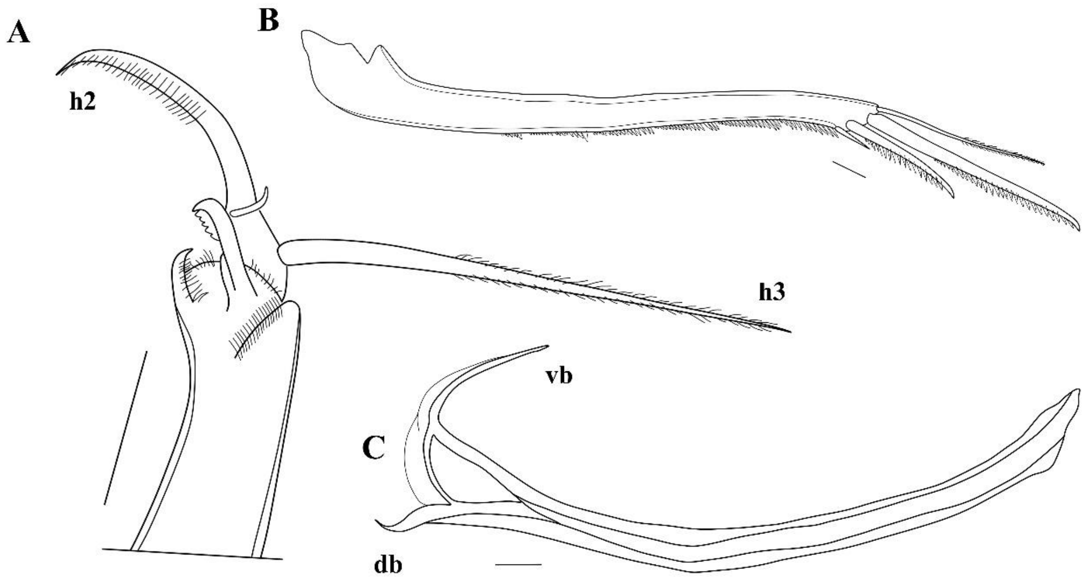

Figure 4 *Strandesia bicuspis.* A, T3 pincer (VF065); B, CR (VF062); C, CR attachment (VF062). Scale bars, 50 μm.

Differential diagnosis

Strandesia bicuspis can be distinguished from other *Strandesia* species by the shape of dorsal protuberance on RV (more posteriorly pointed than in other *Strandesia* species with such a dorsal helmet), and by the elongated LV.

Ecology and distribution

In the present paper *Strandesia bicuspis* was recorded in lentic and lotic environments, associated with free-floating plants and sediment, in the Paraná river floodplain. This species occurred in acid to basic values, with pH range of 5.6 - 7.8. Electrical conductivity and dissolved oxygen ranges were 41.3 - 114.9 $\mu S.cm^{-1}$ and 1.8 - 7.9 mg. L^{-1}, respectively (see Table S1).

Distribution: Argentina, Brazil, Colombia, Germany, Paraguay, Suriname, Venezuela. (Martens & Behen 1994; Matzke-Karasz 2012).

2. *Strandesia* sp. 1 nov. sp.

(Figs. 5-7)

2017 *Strandesia* n. sp. 7 in Pereira *et al*.: 327

Measurements (in µm)

L (n=4): 1.111-1.1154, H (n=2): 700-760, W (n=2): 578-594.

Diagnosis

Cp subovate, with LV anteriorly ventrally and posteriorly overlapping RV; RV overlapping LV dorsally with a rounded protuberance; in frontal view asymmetrical, with RV higher than LV; in dorsal view, Cp with a blunt anterior rostrum. RVi with anterior selvage slightly inwardly displaced. A2 with natatory setae not reaching beyond tips of apical claws. T2 with d1 seta almost twice as long as d2. Caudal ramus slender, its attachment with an oval Triebel's loop situated in the main branch.

Type locality

Araguaia River floodplain, Montaria I Lake in roots of *Paspalum notatum*. Coordinates: 13º24'07.9″S, 50º43'10.2″W, central Brazil.

Type material

Holotype: A female, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (VF029).

Paratypes: Three females dissected and stored as the holotype (VF030, VF034, JH738). Four female carapaces stored dry in micropaleontological slides (JH708-JH711).

Description of female

LVi (Fig. 5A) high, with calcified inner lamella relatively wide along anterior margin, narrow along ventral margin and absent on posterior margin; inwardly displaced selvage absent; greatest height situated in front of the middle.

RVi (Fig. 5B) high and with dorsal protuberance; with calcified inner lamella as in LVi, anteriorly and posteriorly with selvage slightly inwardly displaced, greatest height situated behind the middle because of dorsal protuberance.

CpLl and CpRl (Fig. 5C, D) subovate; greatest height situated behind the middle; external valve surface set with few pits and setae. CpD (Fig. 5E) with LV overlapping RV along the anterior margin; this anterior margin a blunt beak, posteriorly bluntly rounded, also with asymmetrical overlap. CpV (Fig. 5F, H, I) with LV overlapping RV centrally with a flap, and anteriorly. CpFr (Fig. 5G), with valves asymmetrical, RV higher than LV; LV with ventral projection over RV.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; small WO. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with four setae (two short and two long). Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Figs. 6A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (not reaching the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae not reaching the tips of the apical claws; the shortest just reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 6B) with two claws (1 long GM; 1 short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

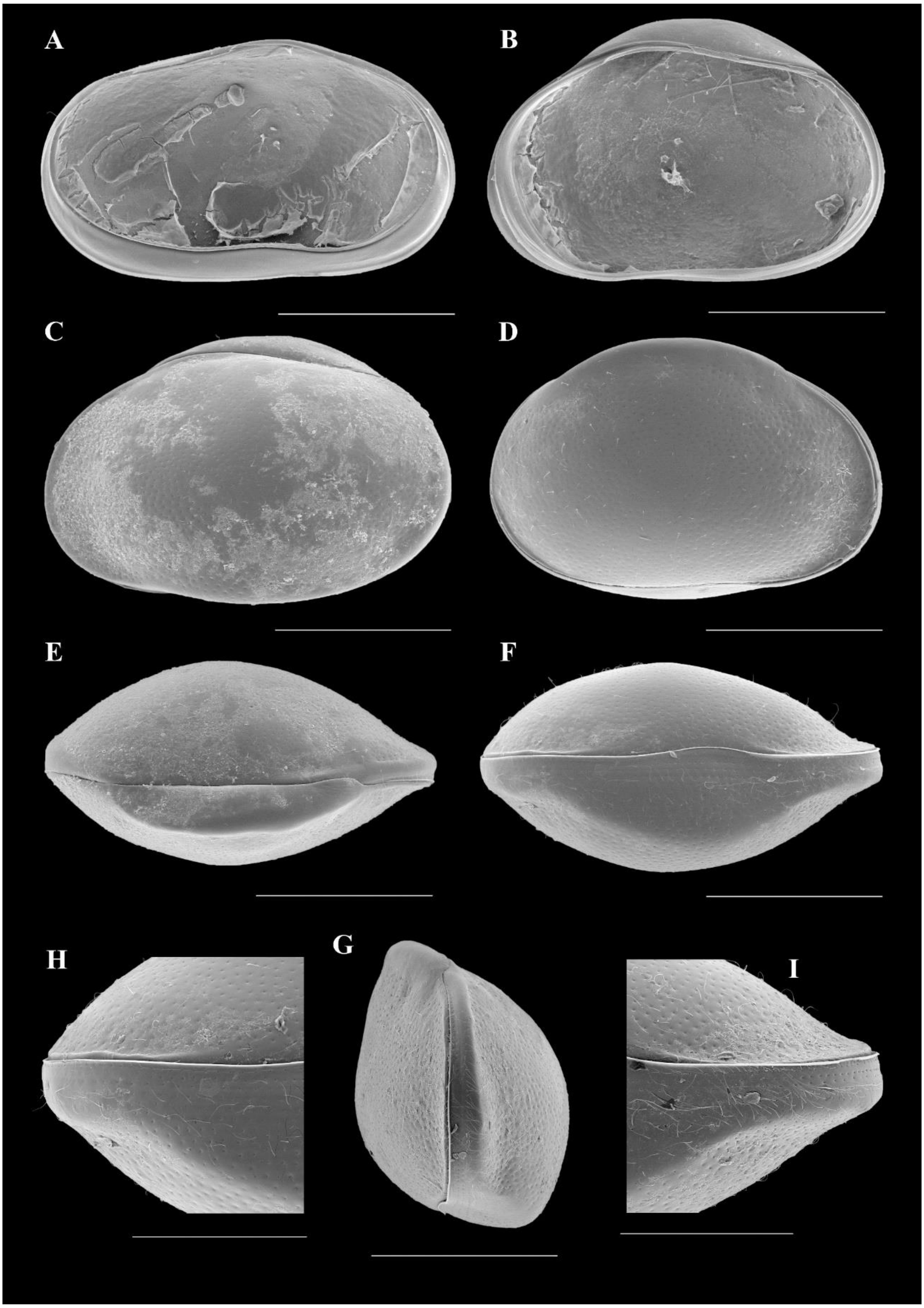

Figure 5 Carapace and valves of *Strandesia* sp. 1 nov. sp. A, LVi (JH738); B, RVi (JH738);765 C, CpLl (JH708); D, CpRl (JH711); E, CpD (JH709); F, CpV (JH710); G, CpFr (JH709); H, CpV detail of posterior part (JH710); I, CpV detail of anterior part. Scale bars, A-G, 500 μm; H, I, 300 μm.

First segment of Md palp (Fig. 6C - chaetotaxy not complete) with one long and smooth α-seta. Second segment ventrally with one long and hirsute ß-seta. Penultimate segment laterally with one cone-shaped, hirsute γ-seta. Terminal segment sub-rectangular, c 1.5 time as long as basal width. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 6D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six apical setae (five long and one short), and one short subapical seta. Terminal palp segment elongated, ca. twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite reaching beyond edge of segment. First endite with two unequal sideways-directed bristles.

T1 protopodite (Fig. 6E) with two short a-setae, one stout hirsute b-seta and one long d-setae, c. twice as long as b-seta. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 6F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 2/3 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment "a" with one long apical hirsute seta (f); segment "b" with one shorter seta (g) reaching beyond the end of the terminal segment. Terminal segment with one apical claw (h2) and two setae (1 subapical (h1) and one apical (h3)).

T3 (Fig. 7A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 7B) slender and curved, with ventral margin weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c 1/3 of length of distal seta.

CR attachment (Fig. 7C) stout, with oval Triebel's loop oval-shaped, situated in the db; vb long.

Male unknown

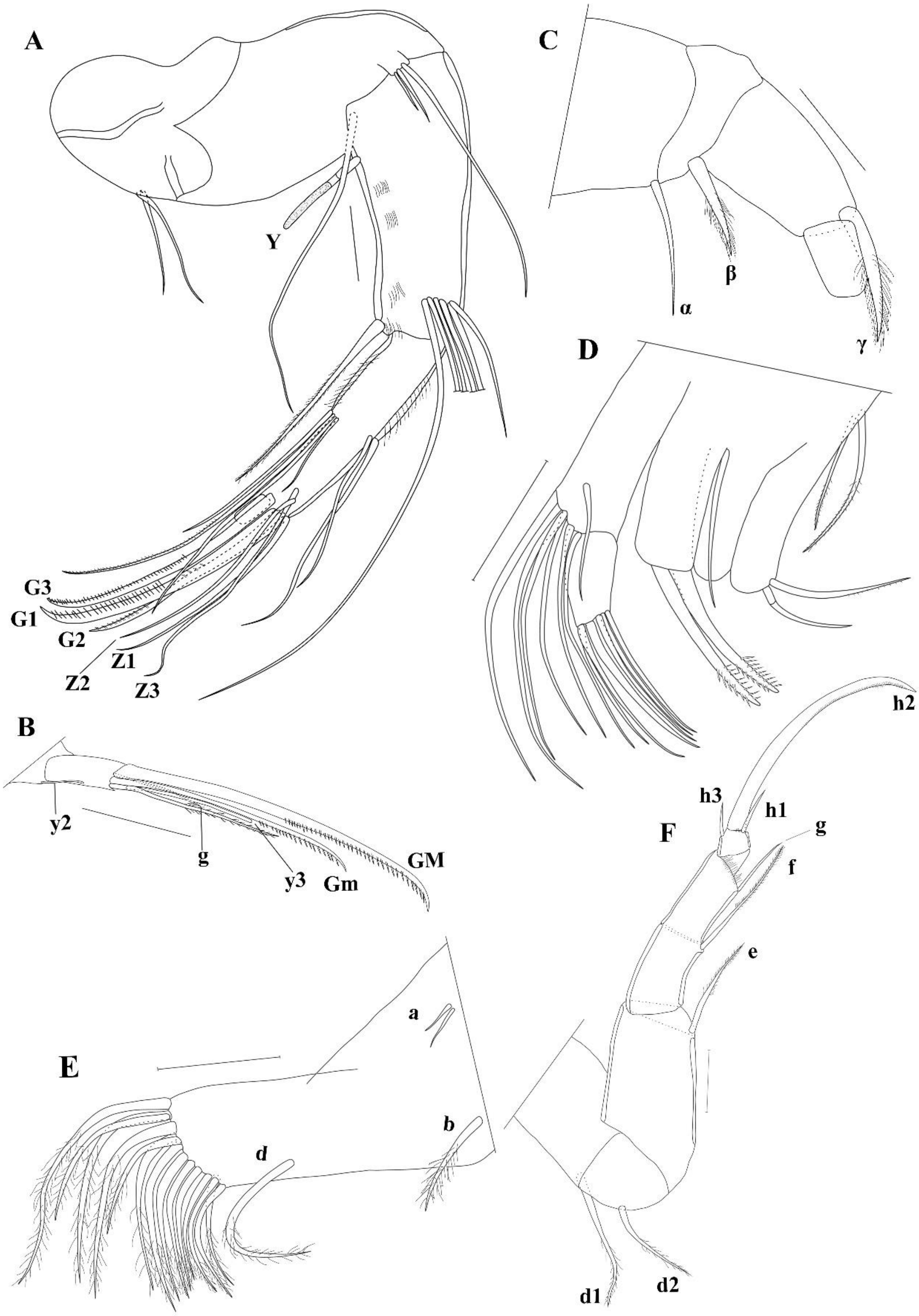

Figure 6 *Strandesia* sp. 1 nov. sp. A, A2 except last segment (VF029); B, A2 last segment (VF029); C, Md palp showing α, ß, γ setae (VF029); D, Mx1 (VF029); E, T1 (VF034); F, T2 (VF029). Scale bars, 50 µm.

Differential diagnosis

Strandesia sp. 1 nov. sp. can be distinguished from other *Strandesia* species by the rounded dorsal protuberance on the RV and the blunt beak on the anterior side of the carapace. The species is most similar in lateral view to the African *S. elatior* (Vavra, 1897), but the carapace in this latter species has no anterior beak in dorsal view. In other species of the genus with a dorsal protuberance on the RV, this structure has a different shape: it has a straight margin and a posterior spine in the African type species of the genus, *S. mercatorum* (Vavra, 1895), *S. bicuspis* (Claus, 1892) has a posteriorly pointed dorsal protuberance, the dorsal protuberance is semi-rectangular and larger in *S. feuerborni* (Klie, 1932), small and sub-quadrate in *S. pistrix* (Broodbakker, 1983), larger in *S. evae* Gauthier, 1951 and smaller and more symmetrically rounded in the *S. cyprinotoides* (Klie, 1938). *Strandesia* sp. 1 nov. sp. differs from *Strandesia* sp. 2 nov. sp. in that it is generally higher and less elongated (especially the LVs) and that the dorsal protuberance is situated more posteriorly.

Ecology and distribution

Strandesia sp. 1 nov. sp. species was recorded in lentic environments, associated with emergent macrophytes, in the Araguaia river floodplain. This species occurred in slightly acid environment, with pH range of 6.2 – 6.7. Electrical conductivity and dissolved oxygen ranges were 42.3 - 43.6 $\mu S.cm^{-1}$ and 1.9 - 2.9 $mg. L^{-1}$, respectively (see Table S1).

Distribution: Brazil.

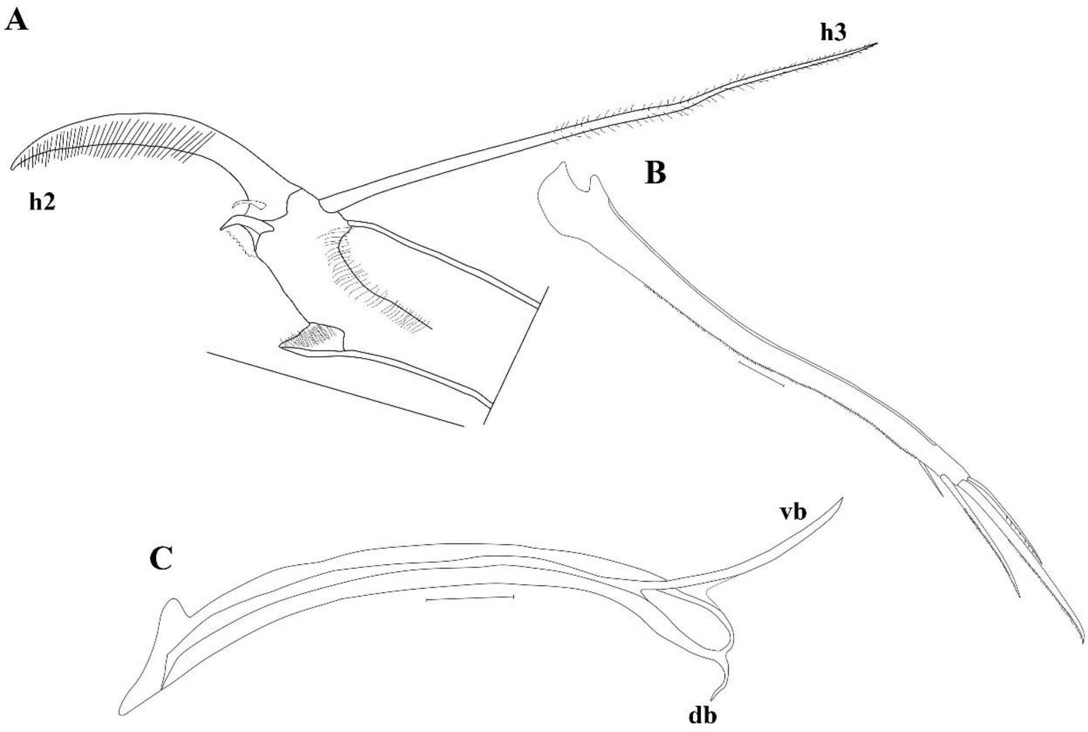

Figure 7 *Strandesia* sp. 1 nov. sp. A, T3 pincer (VF029); B, CR (VF029); C, CR attachment (VF029). Scale bars, 50 µm.

3. *Strandesia* sp. 2 nov. sp.

(Figs. 8-10)

Measurements (in µm)

L (n=1): 1.431, H (n=1): 865, W (n=1) 606.

Diagnosis

Cp in lateral views slightly triangular, with a big dorsal protuberance on RV; greatest height in the middle; anterior region broader than posterior. Cp external surface with a few pits and setae. A2 with natatory setae not reaching beyond tips of apical claws. T2 with seta d2 ca. 3/4 the length of d1. Caudal ramus slender, and strongly serrated; its attachment with a triangular Triebel's loop in the main branch.

Type locality

Araguaia River floodplain, Caixa de Emprestimo, temporary lake, in the littoral region with grass and algae. Coordinates: 13º2'54.3″S, 50º32'29.3″W, central Brazil.

Type material

Holotype: A female, with valves and dried soft parts stored in a in a micropaleontological slide (JH726).

Paratypes: Two females with soft parts dissected in glycerine in a sealed slide, valves decalcified (VF036, VF038).

Description of female

LVi (Fig 8A) elongated, with almost straight but sloping dorsal margin; with calcified inner lamella wide along anterior margin, narrow along ventral and posterior margins; greatest height well in front of the middle.

RVi (Fig. 8B) with anterior margin more broadly rounded than posterior margin, dorsally with a rounded, anteriorly situated protuberance; calcified inner lamella as in LVi; without anterior selvage but with inwardly displaced posterior selvage (Fig. 8F); greatest height in front of the middle.

CpLl (Fig. 8C) slightly triangular due the presence of dorsal protuberance on RV; RV taller than LV; greatest height situated in the middle; anterior region broader than posterior. CpRl (Fig. 8D) slightly triangular; LV overlapping RV on ventral and anterior margin; CpD (Fig. 8E) with greatest width in front of the middle; anterior margin with a blunt beak.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; small WO. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with four setae (two short and two long). Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae).

A2 (Figs. 9A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (not reaching the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae not reaching the tips of the apical claws; the shortest almost reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four unequal ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig 9B) with two claws (1 long GM; 1 short Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

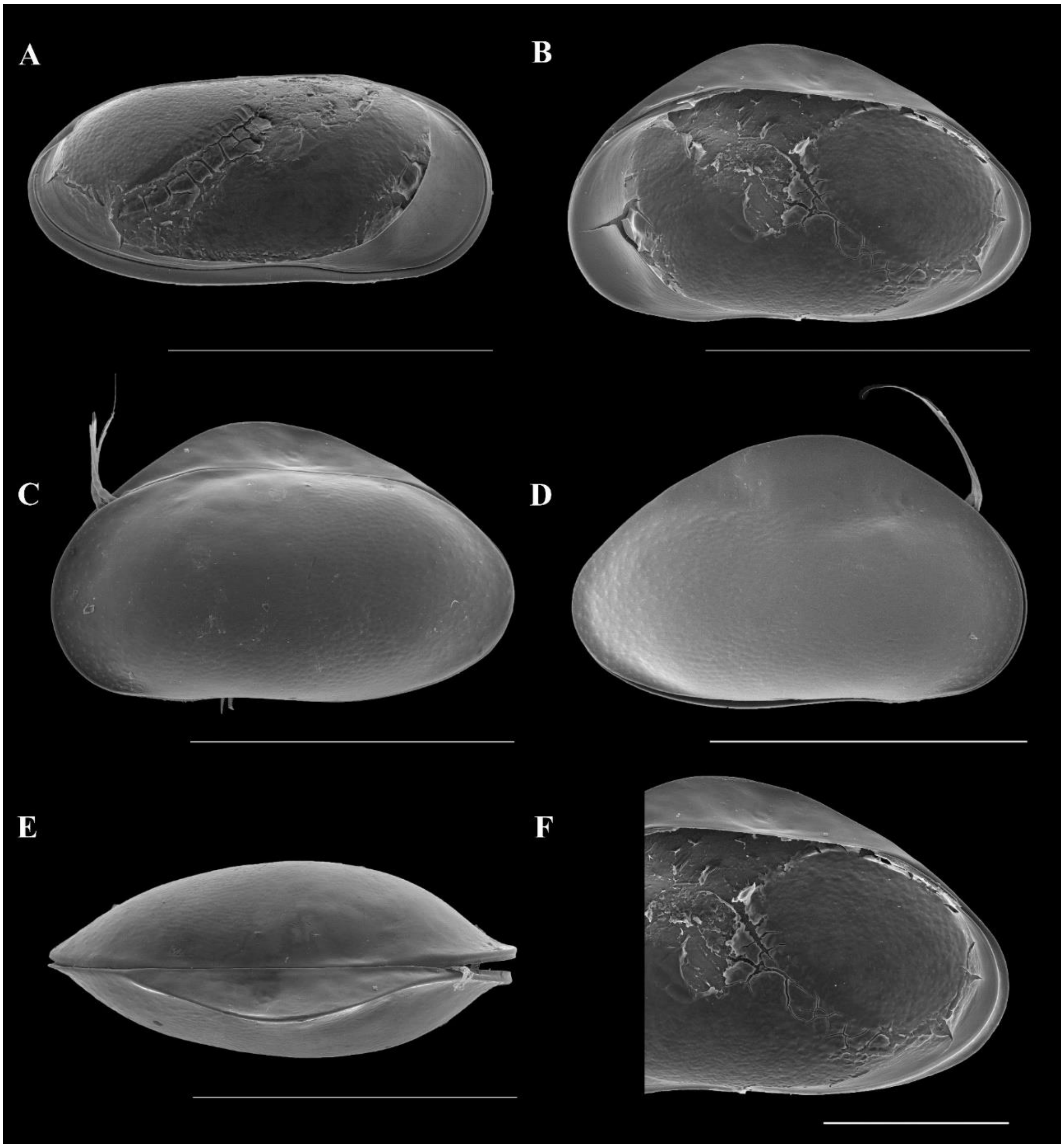

Figure 8 Carapace and valves of *Strandesia* sp. 2 nov. sp. A, LVi (JH726); B, RVi (JH726); C, CpLl (JH726); D, CpRl (JH726); E, CpD (JH726); F, RV detail of posterior part Scales bars, A-E, 1.000 μm; F, 500μm.

First segment of Md palp (Fig. 9C - chaetotaxy not complete) with one long and smooth α-seta. Second segment ventrally with one long and hirsute ß-seta. Penultimate segment laterally with one cone-shaped, hirsute γ-seta. Terminal segment of Md-palp sub-quadrate, c 1.5 times as long ans basal width, slightly tapering. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 9D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six apical setae (five long and one short), and one short subapical seta. Terminal palp segment elongated and tapering, ca. twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite, reaching beyond tip of segment. First endite with two unequal sideways-directed bristles.

T1 protopodite (Fig. 9E) with two short a-setae, b-seta slightly longer than d-setae. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 9F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 3/4 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g) reaching beyond the end of the terminal segment. Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

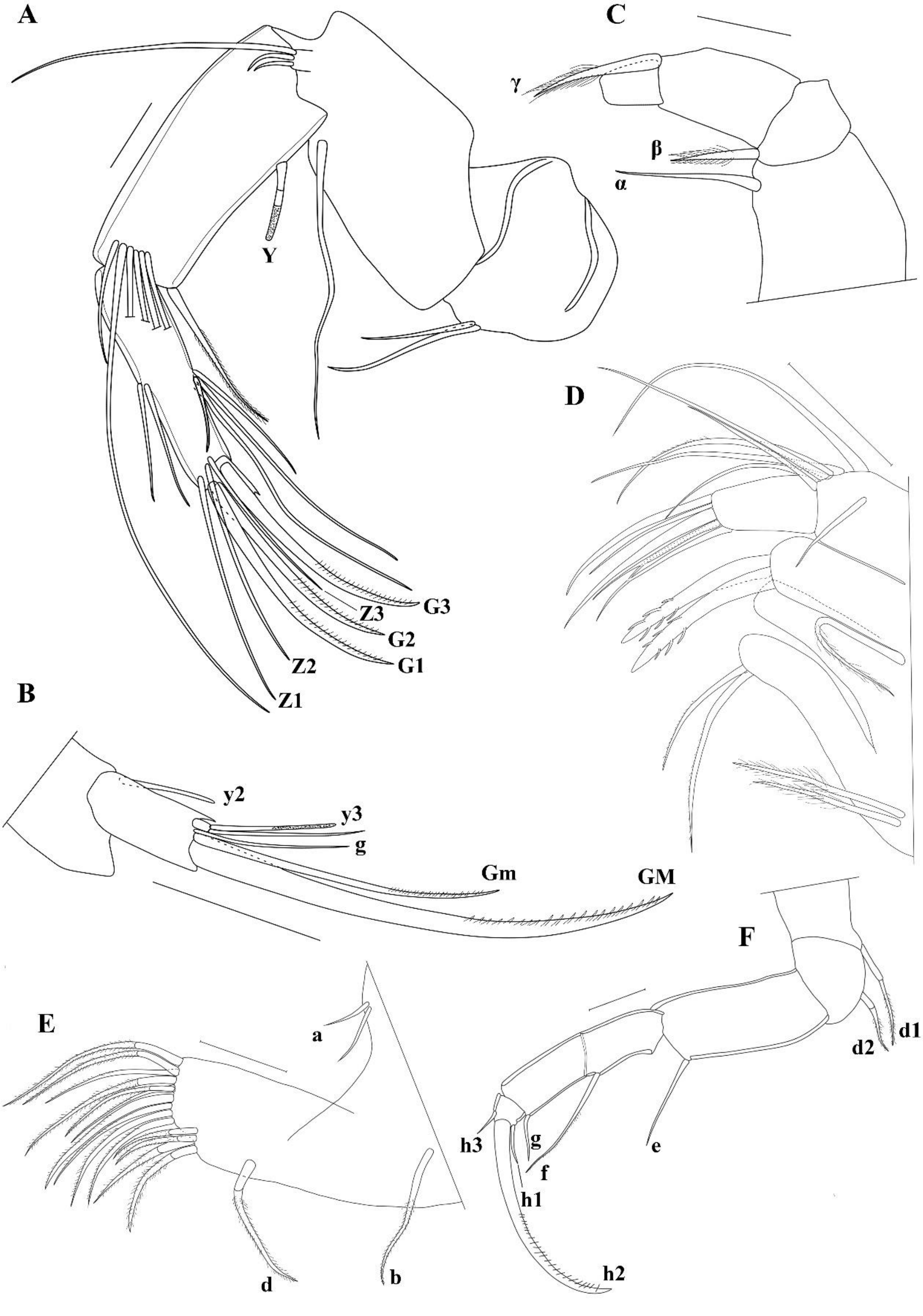

Figure 9 *Strandesia* sp. 2 nov. sp. A, A2 except last segment (VF038); B, A2 last segment (VF038); C, Md palp showing α, ß, γ setae (VF036); D, Mx1 (VF038); E, T1 (VF038); F, T2 (VF038). Scale bars, 50 μm.

T3 (Fig. 10A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2 dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, ca. 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 10B) slender and slightly curved, with ventral margin serrated in 4-5 groups. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c 1/3 of length of distal seta.

CR attachment (Fig. 10C) stout, with oval Triebel's loop in the main branch; vb long and curved; db short and stout.

Male unknown

Differential diagnosis

Strandesia sp. 2 nov. sp. can be distinguished from other *Strandesia* by the dorsal protuberance on the RV by the shape and position of this protuberance: it has a straight margin and a posterior spine in the African type species of the genus, *S. mercatorum* (Vavra, 1895), *S. bicuspis* (Claus, 1892) has a posteriorly pointed dorsal protuberance, the dorsal protuberance is semi-rectangular and larger in *S. feuerborni* (Klie, 1932), small and sub-quadrate in *S. pistrix* (Broodbakker, 1983), larger in *S. evae* Gauthier, 1951 and smaller and more symmetrically rounded in the *S. cyprinotoides* (Klie, 1938). *Strandesia* sp. 2 nov. sp. differs from *Strandesia* sp. 1 nov. sp. in that it is generally more elongated (especially the LVs) and that the dorsal protuberance is situated more anteriorly.

Ecology and distribution

Strandesia sp. 2 nov. sp. was recorded in the littoral region of a temporary artificial lake, in the Araguaia River Floodplain. This species occurred in slightly acid environments with pH of 6.6. Electrical conductivity and dissolved oxygen were 39 $\mu S.cm^{-1}$ and 7.2 $mg.\ L^{-1}$, respectively (see Table S1).

Distribution: Brazil.

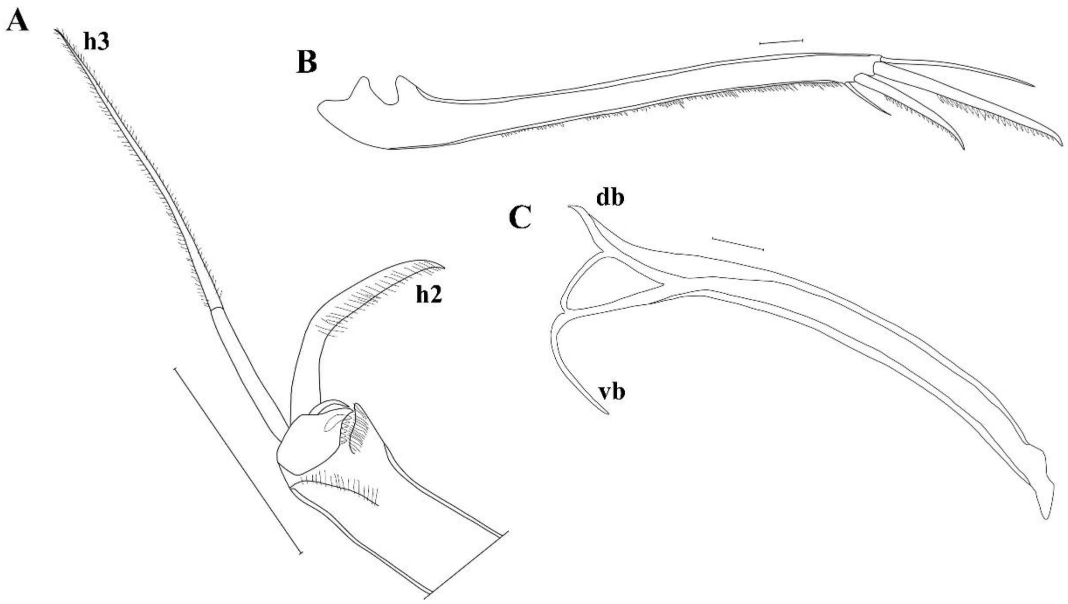

Figure 10 *Strandesia* sp. 2 nov. sp. A, T3 pincer (VF038); B, CR (VF036); C, CR attachment (VF036). Scale bar, 50 µm.

The *S. obtusata/elliptica* group

4. *Strandesia obtusata* (Sars, 1901)

(Figs. 11-14)

1901 *Neocypris obtusata* Sars, 1901: 34

Nec *S. obtusata* Furtos, 1936 (111-112) fide Broodbakker 1983: 356

1983 *Strandesia obtusata* (Sars, 1901) in Broodbakker: 356

Nec *S. obtusata* Tressler, 1937 (197) fide Broodbakker, 1983: 356.

2017 *Strandesia* cf. *nupelia* n. sp. 6 in Pereira *et al*.: 327

2018 *Strandesia nupelia* II in Schön *et al*.: 89

Measurements (in µm)

Male, L (n=3): 883-909, H (n=1): 555, W (n=2): 497-501.

Female, L (n=3): 949-994, H (n=1): 615, W (n=2): 555-556.

Diagnosis

Cp globular, with LV overlapping RV anteriorly. Cp in frontal view asymmetrically skewed with RV placed slightly higher than LV. RVi with anterior selvage inwardly displaced, posteriorly with an obtuse projection reaching beyond the LV. A2 with natatory setae not reaching beyond tips of apical claws. T2 with seta d1 almost twice as long as d2. Caudal ramus slender, its attachment with an oval Triebel's loop in the dorsal branch. Male prehensile palps asymmetrical, Rpp with slender first segment and large triangular second segment. Lpp with basal segment broad and distal segment sickle shaped. Hemipenis with slightly bilobed, broadly rounded ms and a protruding, bluntly pointed ls.

Type locality and material

Itatiba, São Paulo State, Brazil. This species was described based on specimens hatched from dried mud by Sars (1901). Type material (Lectotype and paralectotypes- slides and ethanol material) with n^{o}: F19401a1, a2, b1, b2 in the Sars-collection of the Oslo Zoological Museum, Norway (A. Wilhelmsen, pers. comm. 7/8/2018).

Material examined

Five males with soft parts dissected in glycerine in sealed slides, and with valves stored dry in micropaleontological slides (VF010, VF011, VF014, JH712, JH1238) and three males carapaces stored dry in micropaleontological slides (JH1239, JH1241, JH1281).

Three females with soft parts dissected in glycerine in sealed slides, and with valves stored dry in micropaleontological slides (VF016, VF019, JH1242) and three females carapaces stored dry in micropaleontological slides (JH1243, JH1244, JH1245).

Redescription of male

LVi (Fig. 11A) with calcified inner lamella wide along anterior margin and narrower along ventral and posterior margins. Greatest height situated well in front of the middle.

RVi (Fig. 11B) with calcified inner lamella as in LVi; anteriorly with selvage slightly inwardly displaced and with a prominent posterior projection (flange). Greatest height situated well in front of the middle.

CpLl (Fig. 11C) rounded, with the prominent posterior projection (flange) on of the RV clearly visible; greatest height situated in front of the middle; external valve surface set with few pits and setae. CpD (Fig. 11D) with evenly rounded margins; LV anteriorly overlapping RV, but

RV overlapping LV with one dorsal flap at about 1/6 of the length from the anterior tip; posterior flange projecting beyond the LV. CpV (Fig. 11E) with LV overlapping RV, centrally more so with a (very) weak expansion; posterior flange on RV projecting beyond LV (Fig. 11G). CpFr (Fig. 11F): with valves asymmetrical, RV higher than LV; dorsal flap of RV and ventral overlap of LV conspicuous.

A1 (Fig. 12A) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

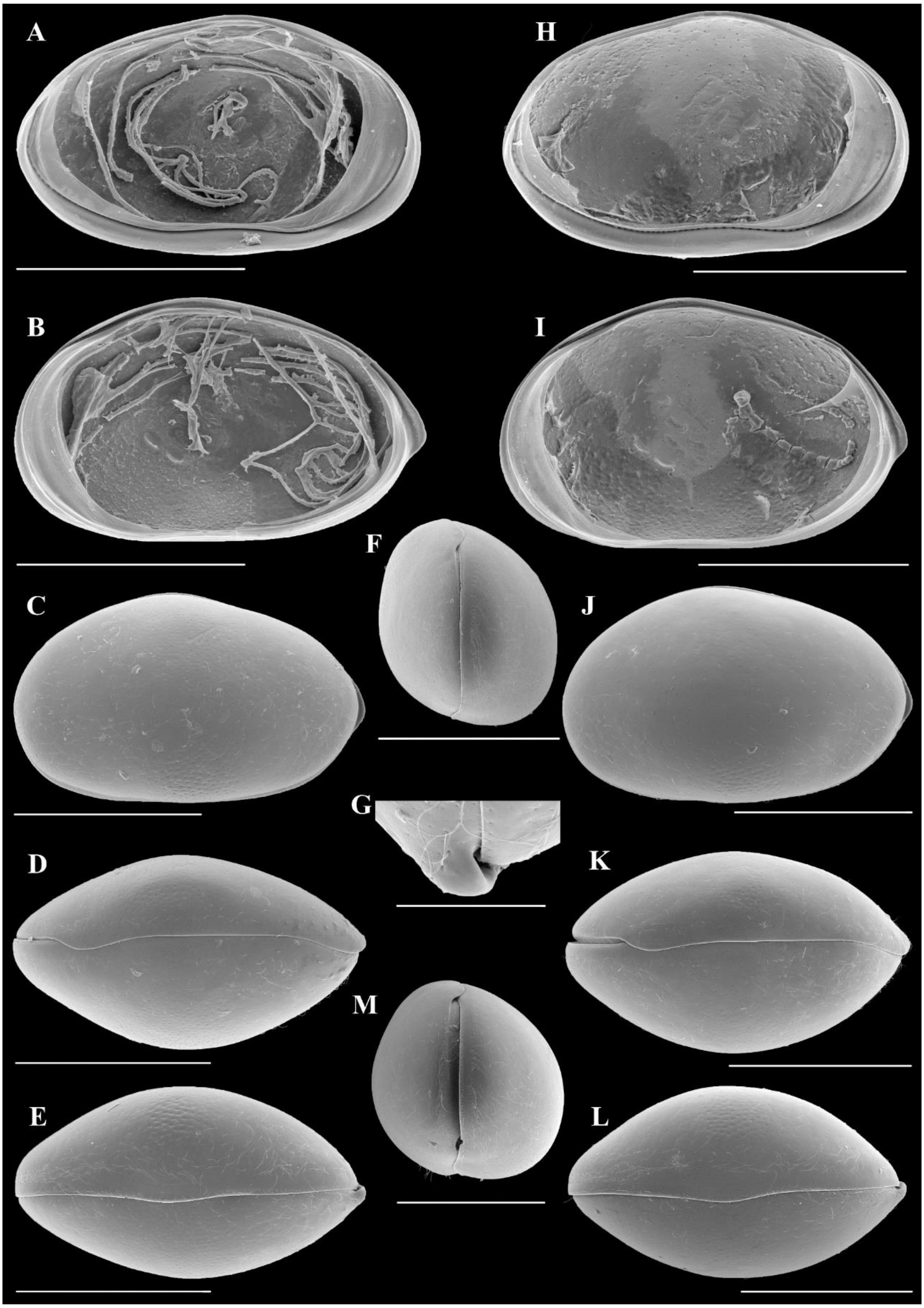

Figure 11 Carapace and valves of *Strandesia obtusata*. A-G, male; H-M, female. A, LVi (JH1238); B, RVi (JH1238); C, CpLl (JH1239); D, CpD (JH1281); E, CpV (JH1241); F, CpFr (JH1241); G, Cp, detail of posterior right valve flap in ventral view (JH1241); H, LVi (JH1242); I, RVi (JH1242); J, CpLl (JH1243); K, CpD (JH1244); L, CpV (JH1245); M, CpFr (JH1244). Scale bars, A-F, 500 µm; G, 100 µm; H-L, 500 µm; M, 300 µm.

A2 (Figs. 12B, C) with four segments, distal three segment forming endopodite. First segment with two ventral setae (one longer; one shorter, with about 3/4 of the length of the longer seta); and one ventro-distal seta, the latter long and hirsute. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching till halfway the endclaws), one group of five long and one short swimming setae (the five long not reaching beyond the tips of the apical claws; the shortest almost reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (z1, z2, and G2), three setae (two long, z3 and G3; one short, G1) and a short aesthetasc y2. Terminal segment (Fig. 12C) with two claws (1 long, GM; 1 short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter longer than accompanying seta of aesthetacs y3.

First segment of Md palp (Figs. 12E, F) with two long plumose setae (s1 and s2); one long smooth seta and one short and smooth α-seta. Second segment dorsally with three setae (two unequal and long; one short, with the length about 1/3 of the longest), and ventrally with one long and hirsute ß-seta; three long hirsute setae and one short seta, with length about 2/3 of the longest. Penultimate segment with two groups of setae, dorsally with a group of four unequal long and smooth setae; laterally with one cone-shaped, hirsute γ-seta and three smooth subapical setae; ventrally with one long and one short (half the length of terminal segment). Terminal segment small and almost as long as basal width, apically with three claws and three setae. Md coxa (Fig. 12D) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 12G - chaetotaxy not complete) consisting of three masticatory lobes (endites), a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six apical setae (five long and one short), and one short subapical seta. Terminal palp-segment with length ca. 1.5 times basal width, slightly tapering, with three claws and three setae. Third endite with two large, weakly serrated bristles. Short subapical seta on third endite, not reaching the tip of segment. First endite with only one true side-ways directed bristle.

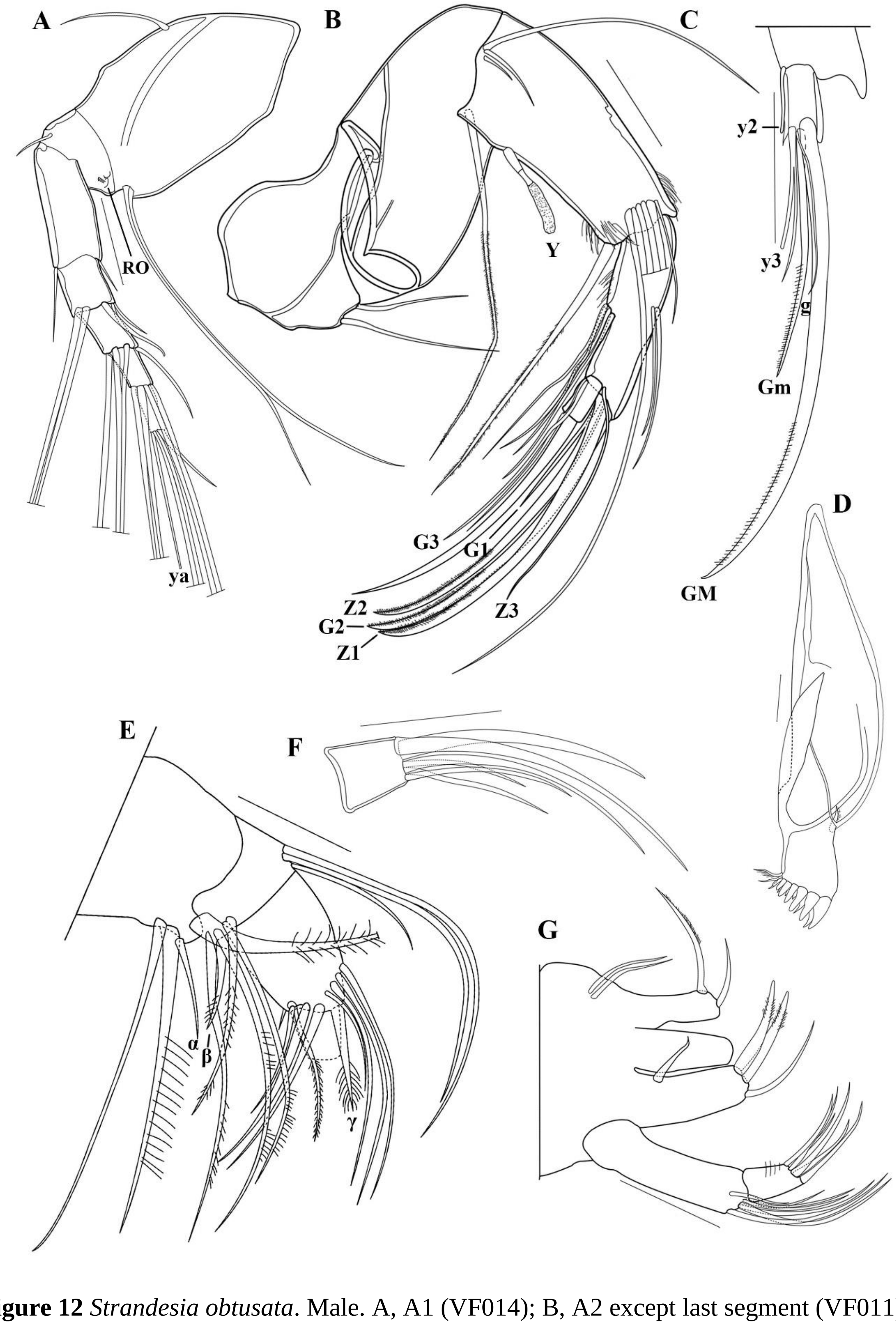

Figure 12 *Strandesia obtusata*. Male. A, A1 (VF014); B, A2 except last segment (VF011); C, A2 last segment (VF011); D, Md coxal plate (VF010); E, Md palp (VF011); F, Md palp last segment (VF011); G, Mx1 (VF014). Scale bars, 50 μm.

T1 protopodite (Fig. 13A) with two short a-setae, one stout and hirsute b-seta and one long d-setae. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite forming two-segmented, asymmetrical prehensile palps. Lpp with first segment broad and second segment sickle-shaped (Fig. 13C). Rpp with first segment slenderer and second segment large and sub-triangular (Fig. 13B). Both palps with first segments carrying two (sub-) apical spines.

T2 (Fig. 13D) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. half the length of seta d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with two setae, one longer reaching the end of the terminal segment (g), and the shorter one about 1/10 of the length of the longer seta. Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h2)).

T3 (Fig. 13E, F) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta(h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 13G) slender and curved, with ventral margin weakly serrated. Proximal and distal claws also weakly serrated. Proximal claw ca. half of the length of distal claw. Proximal seta hirsute, about half of the length of distal seta. Distal seta smooth.

CR attachment (Fig. 13H) slim, with oval Triebel’s loop in the middle of db; vb. long and almost straight.

Zenker’s organ (Fig. 13I) longer than wide, comprising c 20 spinous whorls.

Hemipenis (Fig. 13J) with medial shield (ms) rounded and slightly bilobed. Ventral lobe of lateral shield (ls) elongated, with rounded dorsal and bluntly pointed distal margins. Postlabyrinthal spermiduct with one large additional loop.

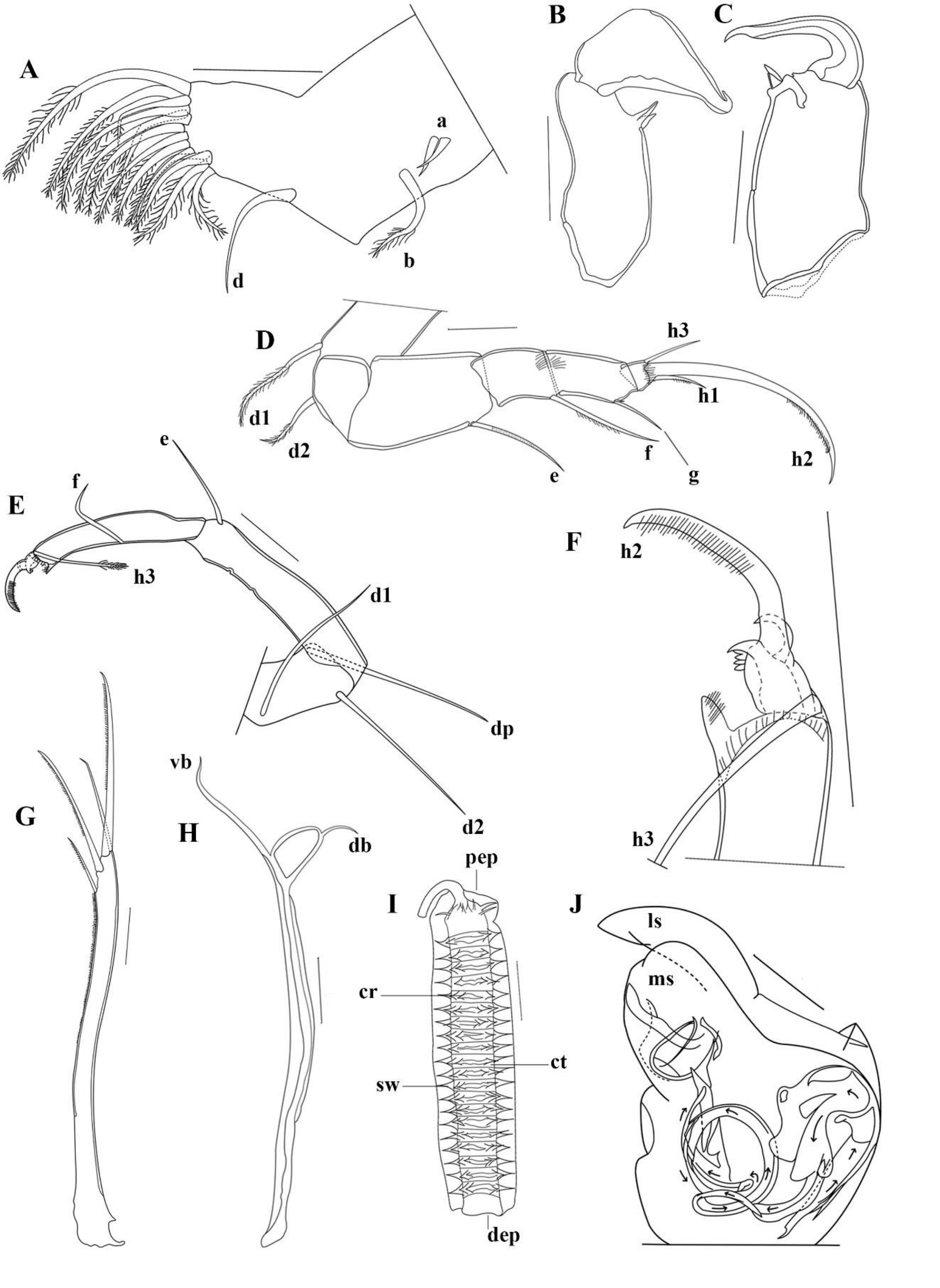

Figure 13 *Strandesia obtusata*. Male. A, T1 (VF010); B, right prehensile palp (VF011); C, left prehensile palp (VF011); D, T2 (VF010); E, T3 (VF011); F, T3 detail of pincer (VF011); G, CR (VF010); H, CR attachment (VF010); I, Zenker organ (VF010); J, hemipenis (VF010). Scale bars, 50 μm.

Abbreviated redescription of female

Carapace and valves (Figs. 11H-M) slightly larger than in the male (see diagnosis), but with shape and structure almost identical.

All characteristics of limbs as in the male, except for the distal chaetotaxy of A2 (Fig. 14A, B) and endopodite of T1.

A2 (Figs. 14A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae (not shown); and one long ventro-distal seta. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching beyond the tip of last endopodal segment), one group of five long and one short swimming setae (the five long not reaching the tips of the apical claws; the shortest reaching beyond the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3) and three setae (z1, z2 and z3). Terminal segment (Fig. 14B) with 2 claws (one long GM; one short Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a short g-seta, the latter the same size than accompanuing seta of aesthetacs y3.

T1-protopodite (Figs. 14C, D) with two short a-setae and hirsute and subequal b-seta and d-seta; apically with a group of 10 hirsute setae, subapically with a group of four such setae. Endopodite with three unequal long and plumose setae (one long, and two about 2/3 of the longer one).

Differential diagnosis

Strandesia obtusata can be distinguished from all other *Strandesia* species by the prominent obtuse projection (flange) on the posterior margin of RV, except from *S. nupelia* where the projection is much smaller and shallower and the carapace more elongated in lateral view. From those species where males are known it can be distinguished by the shape of the hemipenis and of the prehensile palps.

Ecology and distribution

In the present paper *Strandesia obtusata* was recorded in lentic environments, associated with free-floating and free-submerged aquatic macrophytes and littoral sediment (sand and mud), in the Araguaia River floodplain. This species occurred in slightly acid environments, with pH range of 6.1 – 6.9. Electrical conductivity and dissolved oxygen ranges were 28.5 – 53.4 µS.cm^{-1} and 1 - 6.5 mg. L^{-1}, respectively (see Table S1).

Distribution: Brazil, Colombia (Martens & Behen 1994).

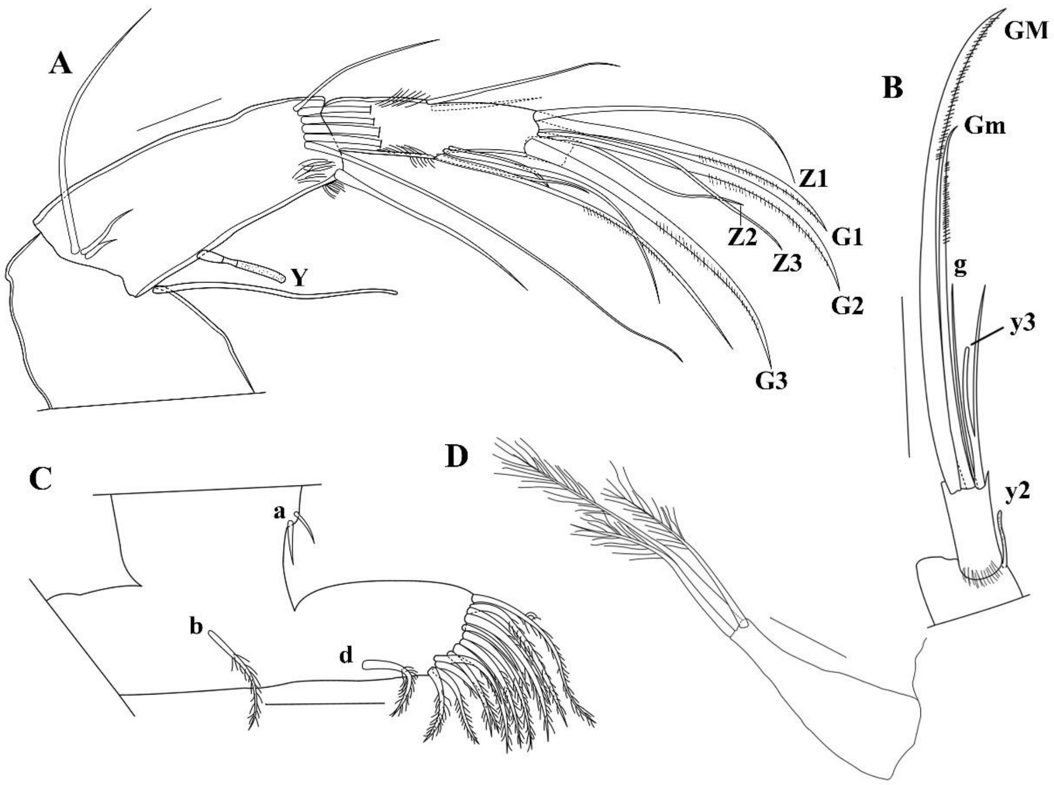

Figure 14 *Strandesia obtusata*. Female. A, A2 except last segment (VF016); B, A2 last segment (VF016); C, T1 (VF019); D, T1 endopodite (VF019). Scale bars, 50 µm.

5. ***Strandesia lansactohai*** Higuti & Martens, 2013

(Figs. 15-17)

2007 *Bradleystrandesia gr. elliptica* sp. 2 in Higuti *et al*.: 1934.

2007 *Bradleystrandesia gr. elliptica* sp. 3 in Higuti *et al*.: 1934.

2009 *Bradleystrandesia gr. elliptica* sp. 2 in Higuti *et al*.: 664.

2009 *Bradleystrandesia gr. elliptica* sp. 3 in Higuti *et al*.: 664.

2009 *Bradleystrandesia gr. obtusata* sp. 4 in Higuti *et al*.: 664.

2010 *Bradleystrandesia gr. elliptica* sp. 2 in Higuti *et al*.: 267.

2010 *Bradleystrandesia gr. elliptica* sp. 3 in Higuti *et al*.: 267.

2010 *Bradleystrandesia gr. obtusata* sp. 4 in Higuti *et al*.: 267.

2010 *Bradleystrandesia elliptica species complex* in Mormul *et al*.: 189.

2013 *Strandesia lasactohai* n.sp. Higuti *et al*.: 199

Material examined

One female (VF073) was used for soft part illustrations from Leopoldo Lake (22°45'27.6''S, 53°16'15.7''W). Two females (OC.3280, MZUSP 27445) were used for SEM from Bilé Backwater (22°45'15.4''S, 53°17'12''W). One female (MZUSP 27447) was used for SEM from Aurélio Lake (22°41'36.5''S, 53°13'52''W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=3): 863-929, H (n=1): 452, W (n=2): 438-459.

Diagnosis (after Higuti *et al*. 2013)

Cp laterally elongated, with a small posterodorsal flange RV; greatest height situated in front of the middle; RVi without anterior selvage; A2 with natatory setae not reaching the tips of apical claws; Md palp with unsegmented long α-seta; CR with ventral margin weakly serrated, its attachment with an oval-triangular Triebel's loop in the main branch.

Abbreviated description of female (after Higuti *et al*. 2013)

LVi (Fig. 15A) elongated in lateral view, with anterior margin rounded and posterior margin bluntly, and almost symmetrically pointed; greatest height situated in front of the middle; without inner list on anterior calcified inner lamella.

RVi (figs. 15B) without anterior selvage; posterior margin somewhat pointed and less broad than LV.

CpLl (Fig. 15C) elongated; postero-dorsal flange on RV slightly protruding past LV (indicated by the arrow). CpD (Fig. 15D) subovate, with LV overlapping RV anteriorly. CpV (not shown) with valve margin of RV very weakly sinuous in the middle. CpFr (not shown), clearly oblique, with LV being the lower one.

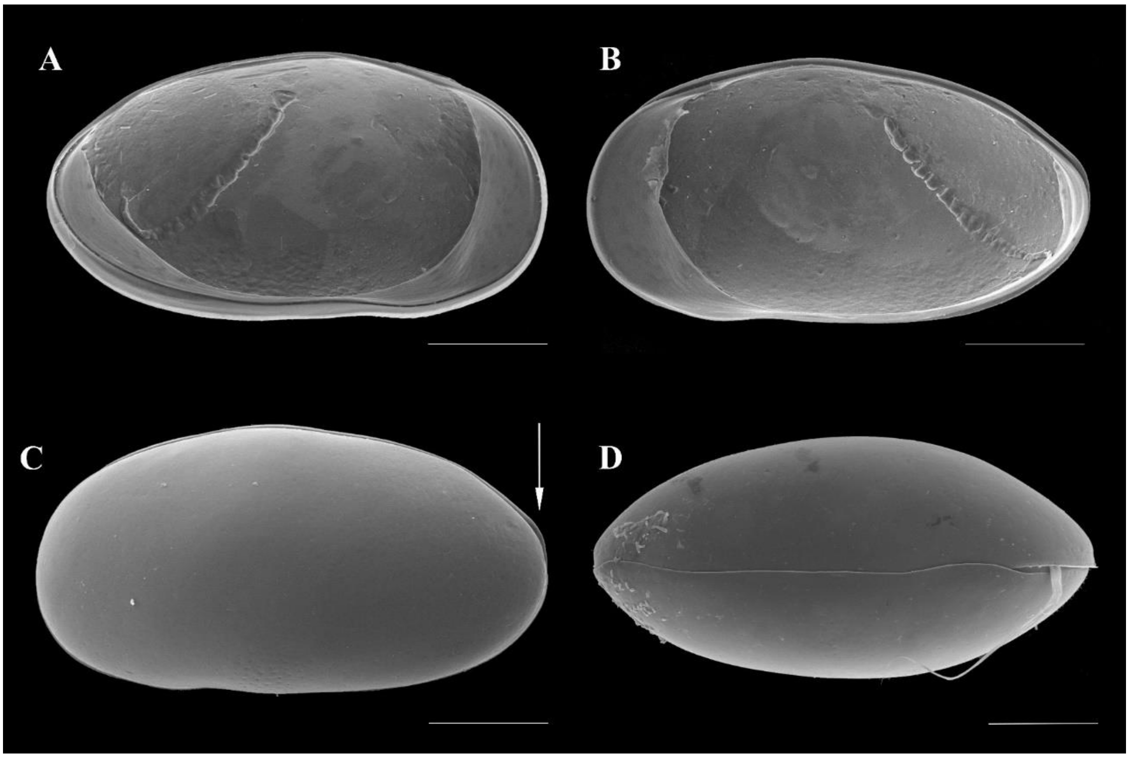

Figure 15 Carapace and valves of *Strandesia lansactohai*. A, LVi (JH3280); B, RVi (JH3280); C, CpLl (MZ27445); D, CpD (MZ27447). Scale bars, 200 μm.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Figs. 16A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one long ventral aesthetasc Y, one long apical seta (reaching the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae just reaching the tips of the apical claws; the shortest not reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig.16B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

First segment of Md palp (Fig. 16C - chaetotaxy not complete) with one long and smooth α-seta. Second segment ventrally with one long and hirsute ß-seta. Penultimate segment laterally with one cone-shaped, hirsute γ-seta. Terminal segment c 1.5 as long as basal width. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 16D – chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six long apical setae, and one short subapical seta. Terminal palp segment ca. twice as long as basal width, slightly curved, apically with three claws (one clearly longer) and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite reaching beyond tip of segment. First endite with only one sideways-directed bristle.

T1 protopodite (Fig. 16E) with two short a-setae, b-seta twice as long d-seta. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 16F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 3/4 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g) reaching well beyond tip of terminal segment. Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

T3 (Fig. 17A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2 dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

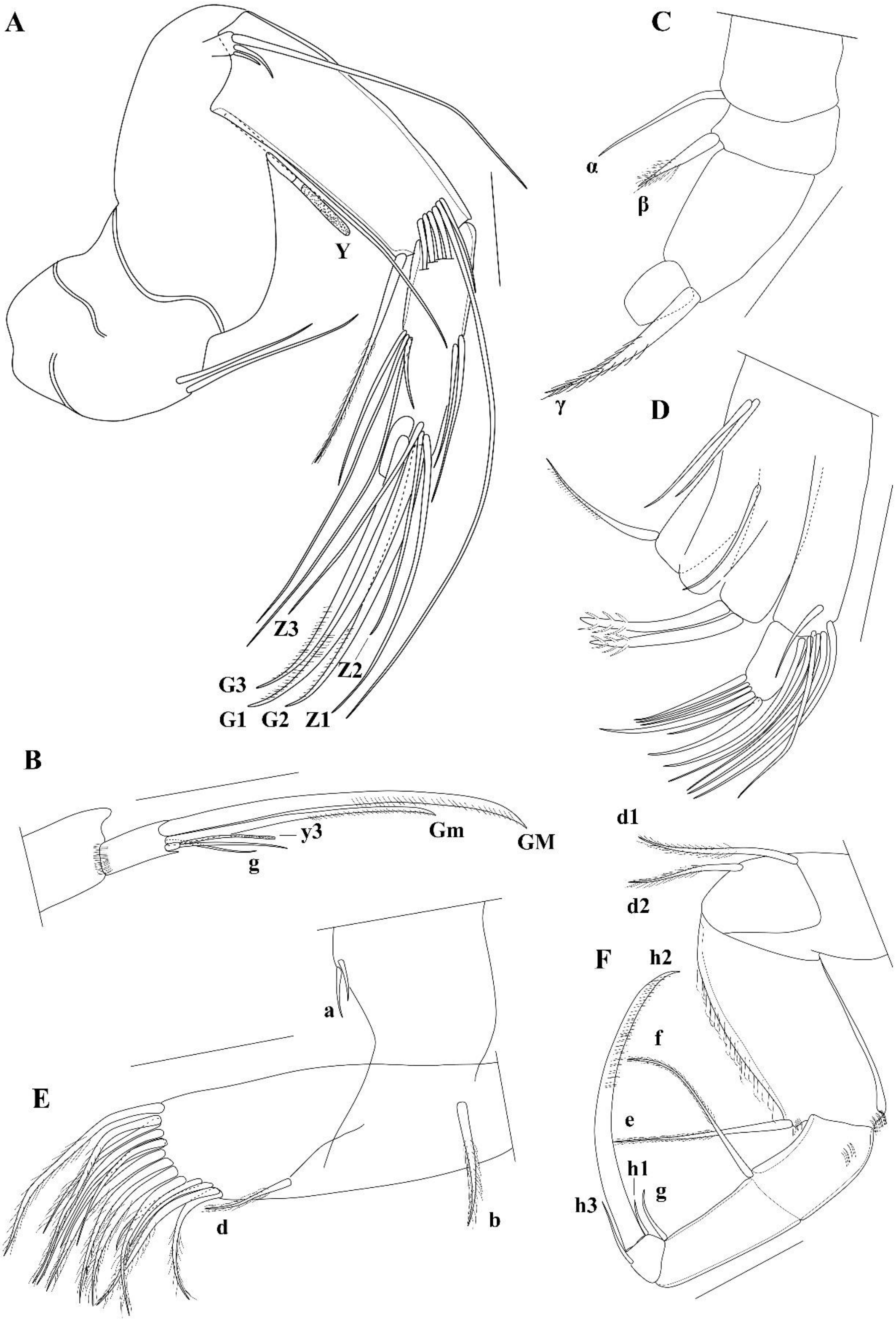

Figure 16 *Strandesia lansactohai*. A, A2 except last segment (VF073); B, A2 last segment (VF073); C, Md palp showing α, ß, γ setae (VF073); D, Mx1 (VF073); E, T1 (VF073); F, T2 (VF073). Scale bars, 50 μm.

CR (Fig. 17B) slender and curved, with ventral margin weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c 1/3 of length of distal seta.

CR attachment (Fig. 17C) stout, with oval-triangular Triebel's loop in the main branch; vb long and curved; db short.

Male unknown

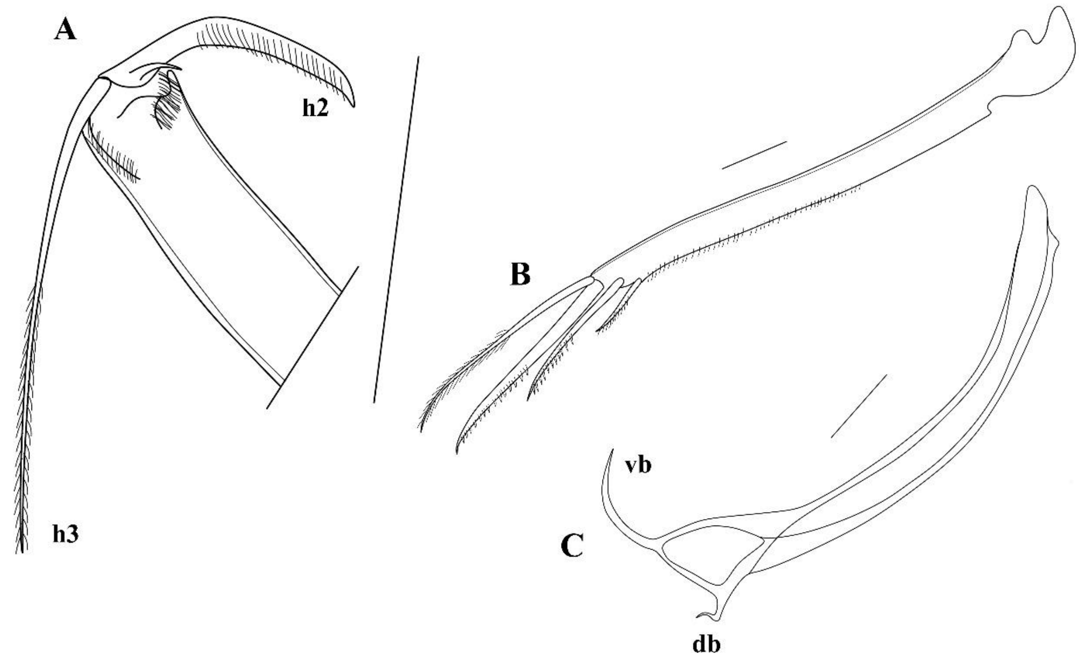

Figure 17 *Strandesia lansactohai.* A, T3 pincer (VF073); B, CR (VF073); C, CR attachment (VF073). Scale bars, 50 μm.

Differential diagnosis (after Higuti *et al.* 2013)

This species can be distinguished from the others in this lineage by the small size and elongated shape of the valves, the complete absence of the anterior selvage of the RV and the morphology of the attachment of the caudal ramus. The species resembles *S. elliptica* Sars, 1901, but differs at least in the more elongated shape and the more pointed posterior margin in lateral view.

Ecology and distribution

In the present paper *Strandesia lansactohai* was recorded in lentic and lotic environments, associated with variety of macrophytes with different life forms, in the Amazon, Pantanal and Paraná river floodplains. This species occurred in acid to basic environments, with pH range 4.4 - 9.7. Electrical conductivity and dissolved oxygen ranges were 12 - 222.5 $\mu S.cm^{-1}$ and 0.07 - 11.8 mg. L^{-1}, respectively (see Table S1).

Distribution: Brazil (Higuti *et al.* 2013).

6. *Strandesia velhoi* Higuti & Martens, 2013

(Figs. 18-20)

2007 *Bradleystrandesia* sp. 3 in Higuti *et al*.: 1934.

2009 *Bradleystrandesia* sp. 3 in Higuti *et al*.: 664.

2009 *Bradleystrandesia gr. obtusata* sp. 3 in Higuti *et al*.: 664.

2010 *Bradleystrandesia* sp. 3 in Higuti *et al*.: 267.

2010 *Bradleystrandesia gr. obtusata* sp. 3 in Higuti *et al*.: 267.

2013 *Strandesia velhoi* Higuti *et al*.: 201

Material examined

One female (VF071) was used for soft part illustrations from Manezinho Backwater (22°46'44.9"S, 53°20'56.3"W). Three females (OC.3285, MZUSP 27453, MZUSP 27454) were used for SEM from Aurélio Lake (22°41'36.5"S, 53°13'52"W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=3): 1167-1204, H (n=1): 706, W (n=2): 648-670.

Diagnosis (after Higuti *et al*. 2013)

Cp in lateral view high and short. Cp in dorsal view with a clear anterior rostrum and a bluntly rounded posterior margin. RV with anterior selvage clearly inwardly displaced. A2 with natatory setae not reaching the tips of apical claws. CR with ventral margin weakly serrated, its attachment with an oval Triebel's loop in the main branch.

Abbreviated description of female (after Higuti *et al*. 2013)

LVi (Fig. 18A) without inner list on anterior calcified inner lamella; this lamella wider anteriorly than posteriorly; greatest height situated in front of the middle.

RVi (Fig.18B) with anterior selvage clearly inwardly displaced; anterior calcified inner lamella wider than posterior one; greatest height situated in front of the middle.

CpLl (Fig 18C) high and short; greatest height situated in front of the middle; both anterior and posterior margins bluntly rounded. CpD (Fig. 18D) with greatest width slightly in front of the middle; with anterior rostrum. CpV (not shown) with ventral valve margin of RV very weakly sinuous in the middle. CpFr (not shown) view weakly oblique, with LV being the lower valve.

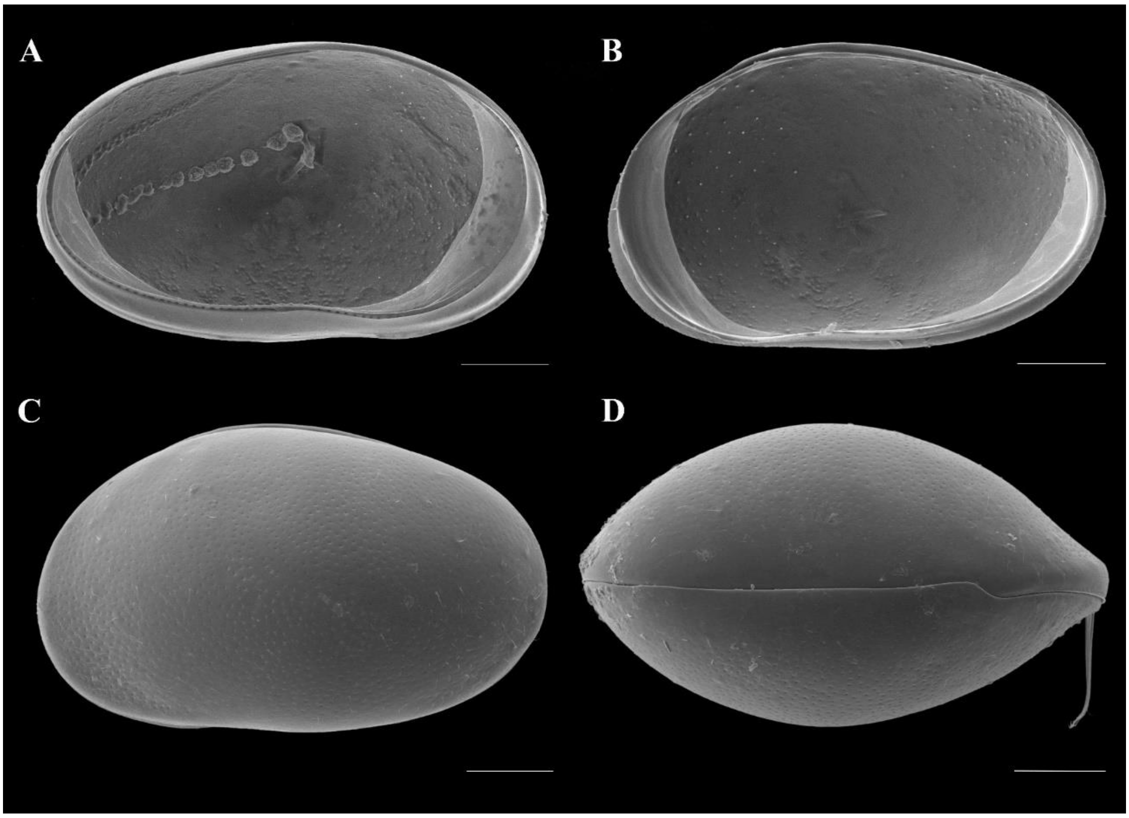

Figure 18 Carapace and valves of *Strandesia velhoi*. A, LVi (OC3285); B, RVi (OC3285); C, CpLl (MZ27453); D, CpD (MZ27454). Scale bars, 200 µm.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta; RO not seen. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Figs. 19A-B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (not reaching the tip of the last endopodal segment) one group of five long and one short swimming seta (the five long setae not reaching the tips of the apical claws; the shortest not reaching the middle of third segment). Second endopodal segment undivided, with two unequal but long dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 19B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

First segment of Md palp (Fig. 19C - chaetotaxy not complete) with one short and smooth α-seta. Second segment ventrally with one long and hirsute ß-seta. Penultimate segment laterally with one cone-shaped, hirsute γ-seta. Terminal segment ca. 1.5 times as long a basal width, slightly tapering. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 19D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six long apical setae, and one short subapical seta. Terminal palp segment ca. twice as long as basal width, slightly curved and tapering, apically with three claws and three setae. Third endite with two large, serrated bristles; subapical seta on third endite reaching the end of the endite. First endite with one sideways-directed bristle.

T1 protopodite (Fig. 19E) with two short a-setae, b-seta longer than d-seta. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

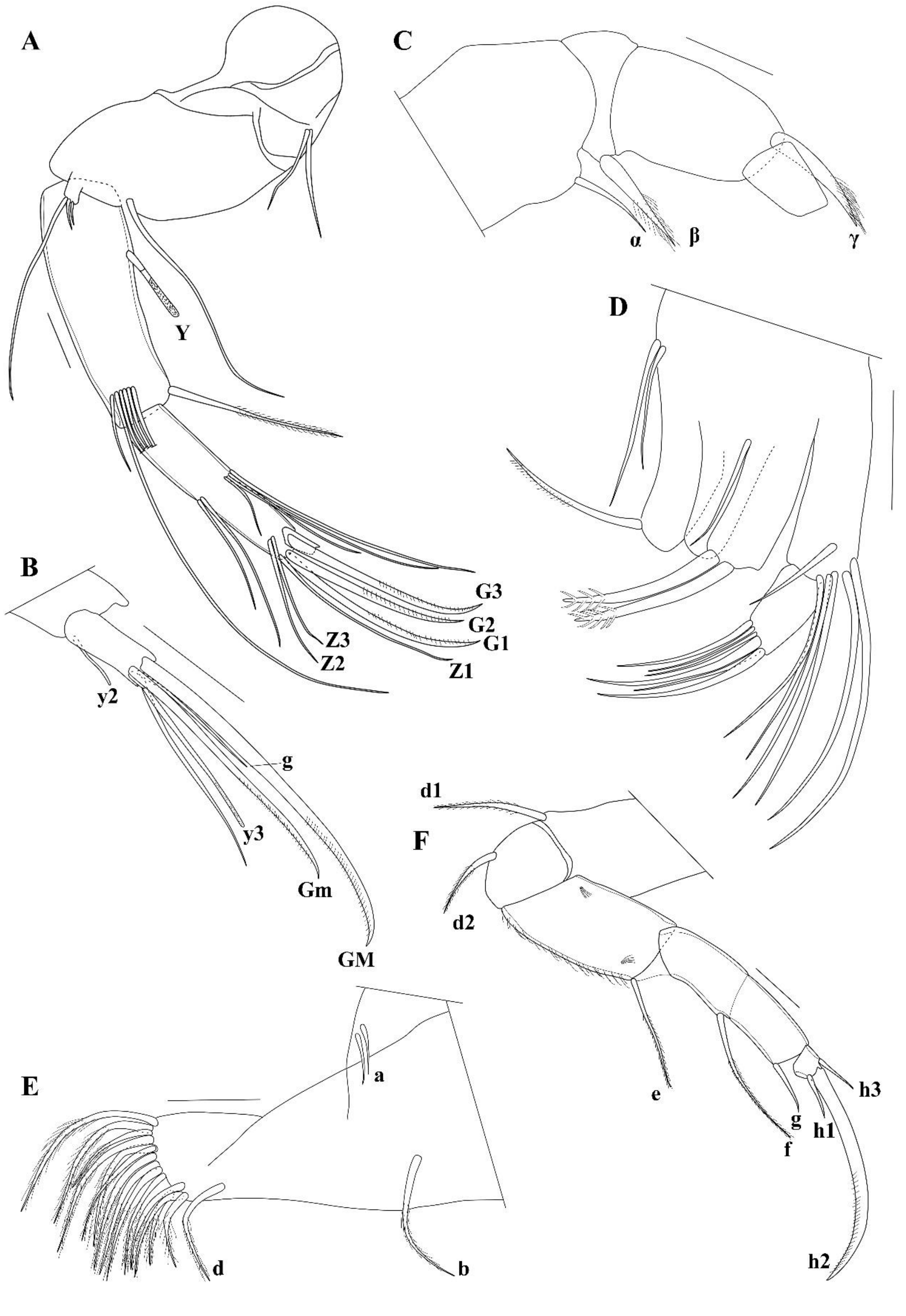

Figure 19 *Strandesia velhoi.* A, A2 except last segment (VF071); B, A2 last segment (VF071); C, Md palp showing α, ß, γ setae (VF071); D, Mx1 (VF071); E, T1 (VF071); F, T2 (VF071). Scale bars, 50 μm.

T2 (Fig. 19F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. half of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment "a" with one long apical hirsute seta (f); segment "b" with one shorter seta (g) reaching beyond tip of terminal segment. Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

T3 (Fig. 20A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 20B) stout and straight, with ventral margin weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c 1/3 of length of distal seta.

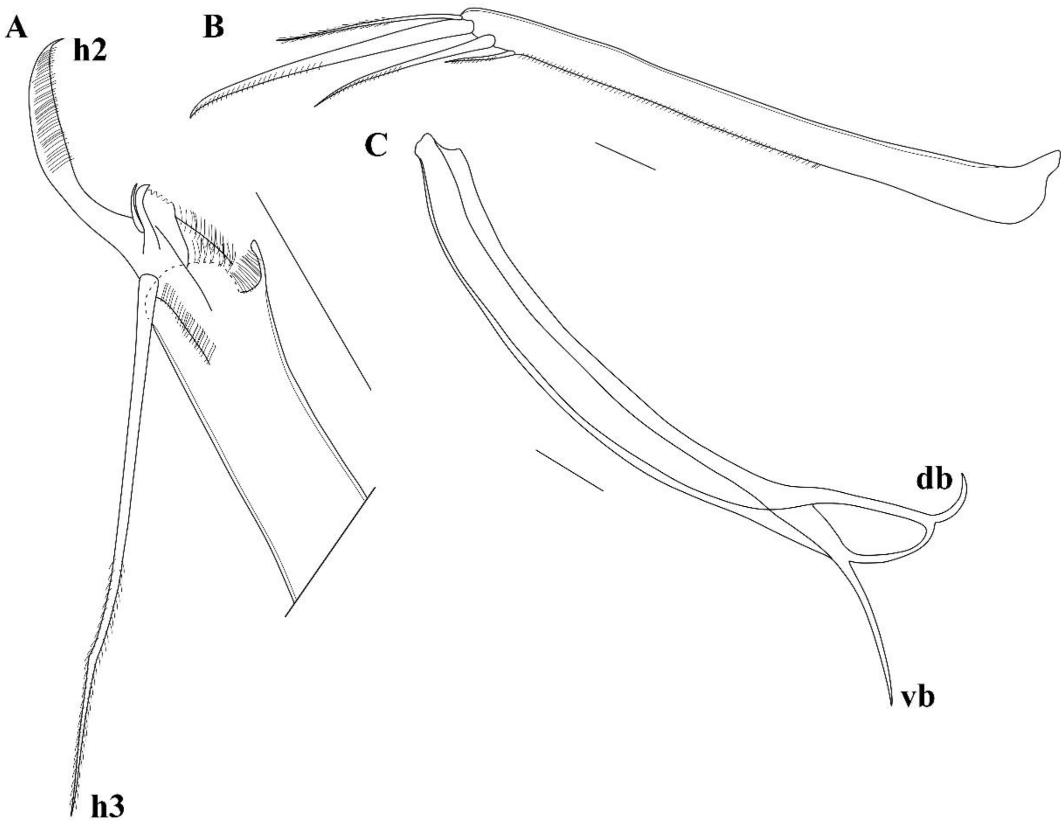

Figure 20 *Strandesia velhoi.* A, T3 pincer (VF071); B, CR (VF071); C, CR attachment (VF071). Scale bars, 50 μm.

CR attachment (Fig. 20C) stout, with oval-triangular Triebel's loop in the main branch; vb long and straight; db short and curved.

Male unknown

Differential diagnosis (after Higuti *et al*. 2013)

This species can be distinguished from the others in this lineage by the large size and the high and short shape of the valves, the presence of the large anterior selvage of the RV and the anterior rostrum, as well as by the absence of a posterior flange on the RV.

Ecology and distribution

In the present paper *Strandesia velhoi* was recorded from lentic environments, associated with a variety of macrophytes with different life forms, in Amazon, Araguaia, Pantanal and Paraná river floodplains. This species occurred in acid to basic environments, with pH range of 4.2 – 9.5. Electrical conductivity and dissolved oxygen ranges were 11 - 222.5 $\mu S.cm^{-1}$ and 0.4 – 11.8 $mg. L^{-1}$, respectively (see Table S1).

Distribution: Brazil (Higuti *et al.* 2013).

7. *Strandesia nupelia* Higuti & Martens, 2013

(Figs. 21-23)

2009 *Bradleystrandesia gr. elliptica* sp. 1 in Higuti *et al*.: 664.

2009 *Bradleystrandesia obtusata* in Higuti *et al*.: 664.

2009 *Bradleystrandesia gr. obtusata* sp. 5 in Higuti *et al*.: 664.

2009 *Bradleystrandesia gr. obliqua* in Higuti *et al*.: 664.

2010 *Bradleystrandesia gr. elliptica* sp. 1 in Higuti *et al*.: 267.

2010 *Bradleystrandesia obtusata* in Higuti *et al*.: 267.

2010 *Bradleystrandesia gr. obtusata* sp. 5 in Higuti *et al*.: 267.

2010 *Bradleystrandesia gr. obliqua* in Higuti *et al*.: 267.

2013 *Strandesia nupelia*: Higuti *et al*.: 202-203, figs.8, 9C.

Material examined

One female (VF072) was used for soft part illustrations from Baía River (22°40'37.5"S, 53°12'29"W). One female (OC3290) from Guaraná Lake (22°43'16.8"S, 53°18'12.9"W) and two females (MZUSP 27459, MZUSP 27460) from Baía River (22°40'37.5"S, 53°12'29"W) were used for SEM. All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=3): 1006-1044, H (n=1): 559, W (n=2): 523.

Diagnosis (after Higuti *et al*. 2013)

Cp in lateral view slightly elongated; with the greatest height situated in front of the middle. Cp in dorsal and ventral views with bluntly pointed anterior and posterior extremities. RV with anterior selvage slightly inwardly displaced, and with rounded protruding posterior flange. A2 with natatory setae reaching well beyond the tips of the apical claws. CR slender and curved, with ventral margin weakly serrated; its attachment with a triangular Triebel's loop in the main branch; vb long and straight; db short and slightly curved.

Abbreviated redescription of female (after Higuti *et al*. 2013)

LVi (Fig. 21A) without inner list on anterior calcified inner lamella; greatest height situated at about 1/3 of the length from the anterior side; anterior margin more broadly rounded than posterior one.

RVi (Fig. 21B) with anterior selvage slightly inwardly displaced, and with (small) protruding postero-dorsal flange; greatest height situated at about 1/3 of the length from the anterior side.

CpLl (Fig. 21C) slightly elongated, with the greatest height situated in front of the middle. CpD (Fig. 21D) with RV overlapping LV with 2 flaps, one situated in the beginning of the hinge fourth of the hinge, the second at the posterior end of the hinge. CpV (not shown) with valve margin of RV very weakly sinuous in the middle. CpFr (not shown), weakly oblique, with LV being the lower one.

A1 (not illustrated) with seven segments. First segment with one short subapical and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with four setae (two short and two long). Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Fig. 22A-B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long distal seta, reaching beyond tip of first endopodal segment. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching beyond the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae reaching well beyond the tips of the apical claws; the shortest reaching the middle of the third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four unequal ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 22B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

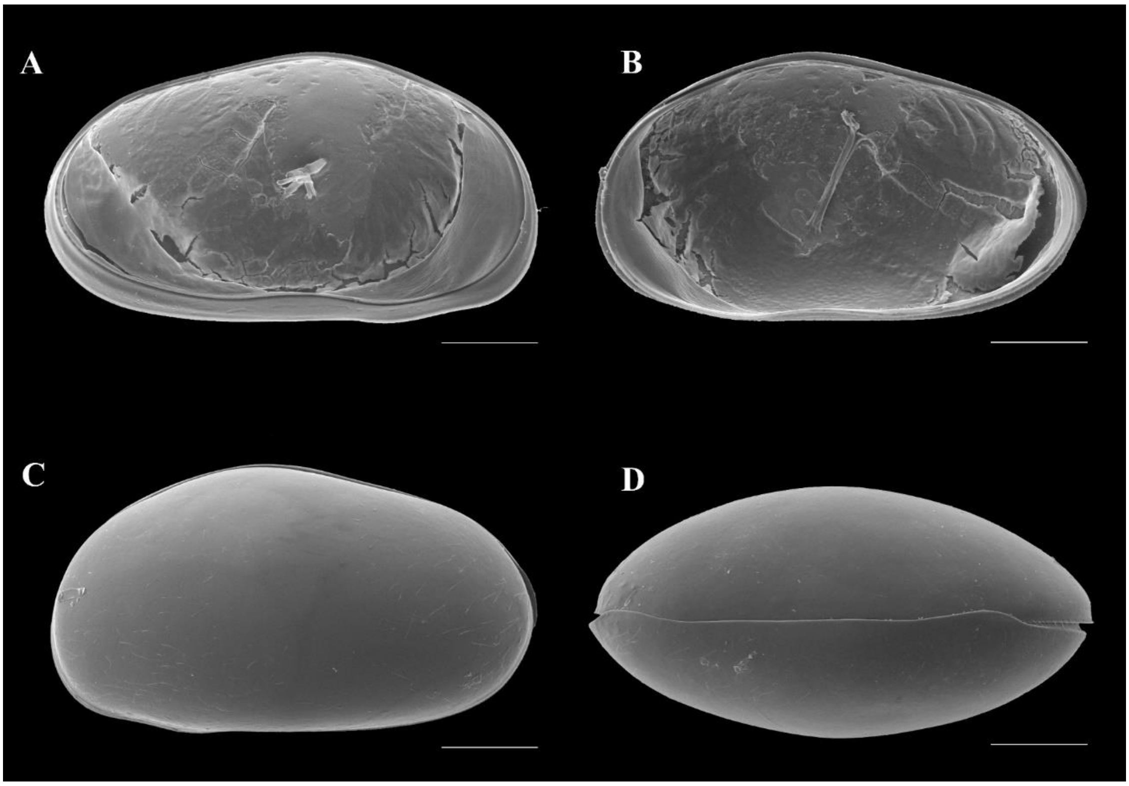

Figure 21 Carapace and valves of *Strandesia nupelia*. A, LVi (OC3290); B, RVi (OC3290); C, CpLl (MZ27459); D, CpD (MZ27460). Scale bars, 200 μm.

First segment of Md palp (Fig. 22C - chaetotaxy not complete) with one short and smooth α-seta. Second segment ventrally with one stout and hirsute ß-seta. Penultimate segment laterally with one elongated cone-shaped, hirsute γ-seta. Terminal segment almost 1.5x as long as basal width. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 22D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six long apical setae, and one short subapical seta. Terminal palp segment, ca. twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite, reaching beyond the tip of the endite. First endite with one sideways-directed bristle.

T1 protopodite (Fig. 22E) with two short a-setae, b-seta slightly longer than d-seta. Apically with 10 hirsute setae, subapically with a group of four setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 22F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 3/4 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one apical hirsute seta of medium length (f); segment “b” with one shorter seta (g). Terminal segment with one apical claw (h2) and one subapical (h1) and one apical (h3) setae.

T3 (Fig. 23A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2 dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 23B) slender and curved, with ventral margin weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c 1/2 of length of distal seta.

CR attachment (Fig. 23C) stout, with Triebel’s loop oval-triangular, situated in the main branch; vb long; db short.

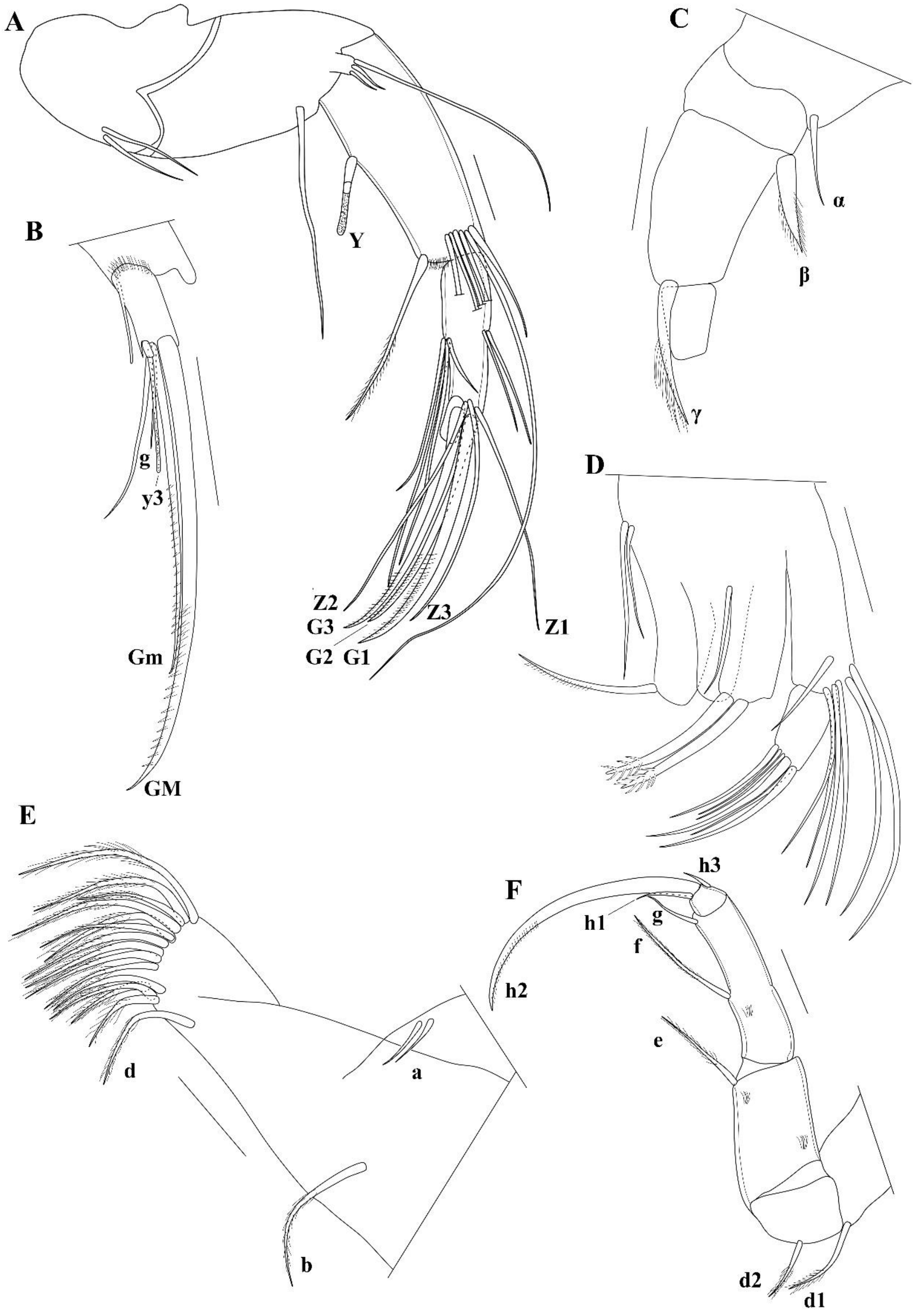

Figure 22 *Strandesia nupelia.* A, A2 except last segment (VF072); B, A2 last segment (VF072); C, Md palp showing α, ß, γ setae (VF072); D, Mx1 (VF072); E, T1 (VF072); F, T2 (VF072). Scale bars, 50 µm.

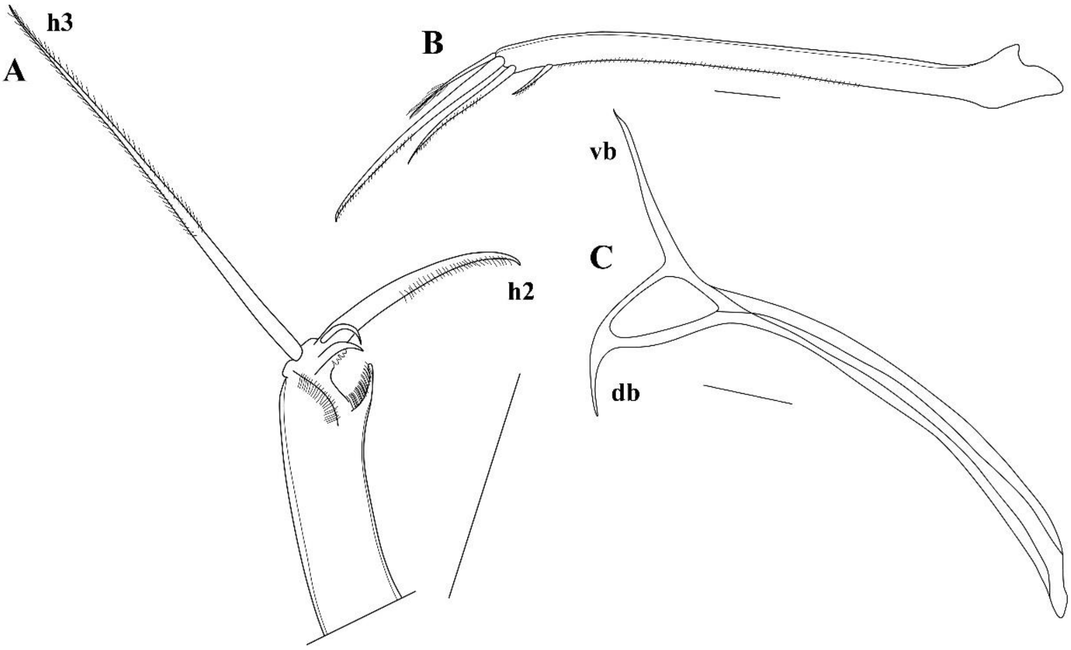

Figure 23 *Strandesia nupelia*. A, T3 pincer (VF072); B, CR (VF072); C, CR attachment (VF072). Scale bars, 50 μm.

Male unknown

Differential diagnosis (after Higuti *et al*. 2013)

Strandesia nupelia can be distinguished from the other species in this lineage by the elongated shape of the valves, the presence of a marginal anterior selvage and a (small) posterior protruding flange on the RV.

Ecology and distribution

In the present paper *Strandesia nupelia* was recorded in lentic and lotic environments, associated with great variety of macrophytes, from different types of life forms, in Pantanal and Paraná river floodplains. This species occurred in acid to basic environments, with pH range of 3.8 – 8.4. Electrical conductivity and dissolved oxygen ranges were 11 - 162.2 $\mu S.cm^{-1}$ and 0.2 - 8.7 mg. L^{-1}, respectively (see Table S1).

Distribution: Brazil (Higuti *et al.* 2013).

8. *Strandesia tolimensis* Roessler, 1990

(Figs. 24-26)

1990 *Strandesia tolimensis*, Roessler: 802

2009 *Bradleystrandesia gr. obtusata* sp. 2 in Higuti *et al*.: 664

2010 *Bradleystrandesia gr. obtusata* sp. 2 in Higuti *et al*.: 267

2013 *Strandesia tolimensis* Roessler, 1990 in Higuti *et al*: 196

Material examined

One female (VF074) was used for soft part illustrations from Mané Cotia Lake (22°43'18.4"S, 53°17'03.6"W). One female (MZ27442) was used for SEM from Aurélio Lake (22°41'36.5"S, 53°13'52"W). One female (OC3278) was used for SEM from Samambaia Lake 1 (22°36'16"S, 53°22'33"W). One female (OC3279) was used for SEM from Campo Verde Lake 2 (22°39'37.5"S, 53°31'27.7"W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=3): 924-959, H (n=1): 626, W (n=2): 559-613.

Diagnosis (after Higuti *et al*. 2013)

Cp broadly rounded, with greatest height and width situated in the middle. RV with anterior selvage submarginal, small protruding flange posteriorly; valve surface pitted and set with two types of setae, normal and stiff setae; A2 with natatory setae reaching the tips of apical claws; CR and its attachment slender, the last with a Triebel's loop sub-triangular in the main branch.

Abbreviated redescription of female (after Higuti *et al*. 2013)

LVi (Fig. 24A) with anterior margin more broadly rounded than posterior margin; with calcified inner lamella wide along anterior margin, narrow along ventral margin and wide on posterior margin; without inner list on anterior calcified inner lamella; greatest height situated in the middle.

RVi (Fig. 24B) with anterior margin more broadly rounded than posterior margin; with submarginal anterior selvage, posteriorly with long and narrow flange; greatest height situated in the middle; inner lamella as in LVi.

CpLl (Fig. 24C) broadly rounded; with greatest height situated in the middle; RV with postero-dorsal flange slightly protruding past LV; Cp surface pitted and set with 2 types of setae, normal and stiff setae. CpD (Fig. 24D) with greatest width in the middle; posterior and anterior extremities bluntly rounded; RV overlapping LV with a flap in the anterior region and in the posterior region. CpV (not shown) with posterior flap forming an opening in the carapace, valve margin of RV very weakly sinuous in the middle. CpFr (not shown) slightly oblique, with LV being the lower one.

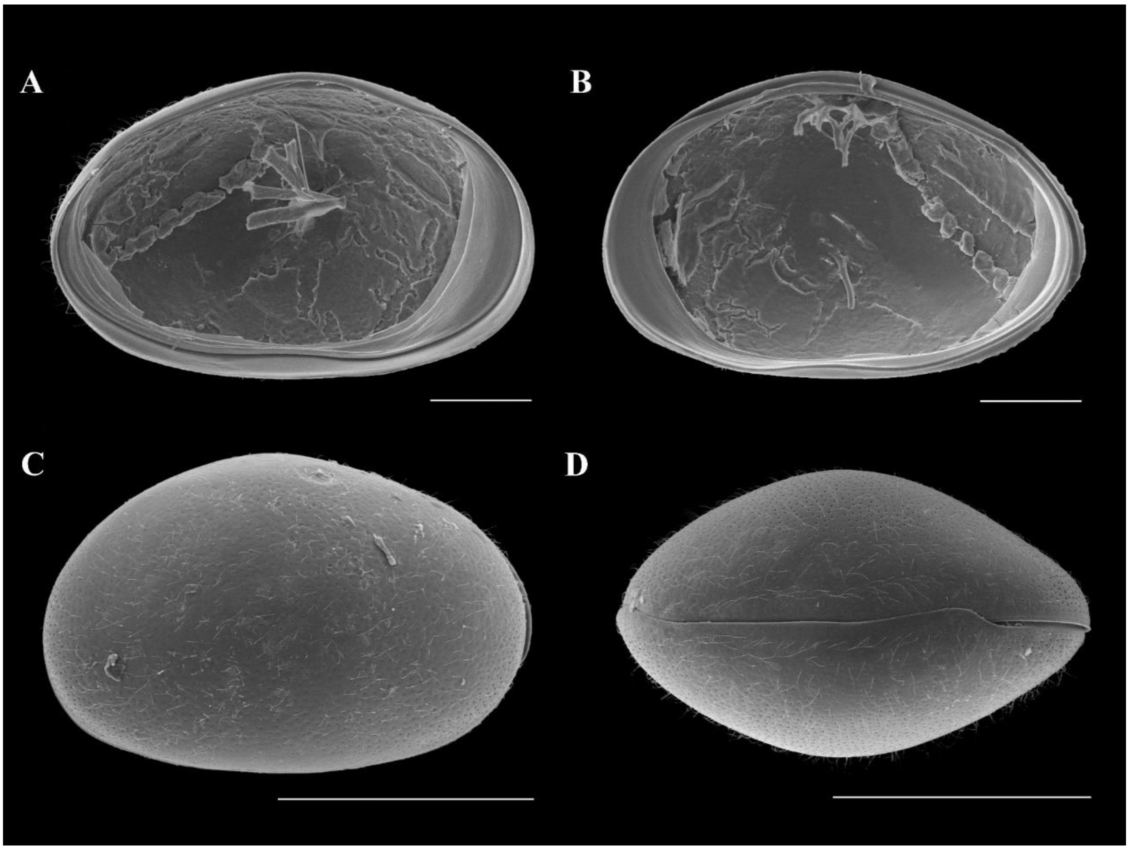

Figure 24 Carapace and valves of *Strandesia tolimensis*. A, LVi (MZ27442); B, RVi (MZ27442); C, CpLl (OC3278); D, CpD (OC3279). Scale bars, A-B – 200µm; B-C -500 µm.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with 1 short ventral seta and a small dorsal RO. Third segment with two setae (the smaller one with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae).

A2 (Fig. 25A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta reaching the middle of the second endopodal segment. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching beyond the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae reaching the tips of the apical claws; the shortest not reaching the middle of the penultimate segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 25B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

First segment of Md palp (Fig. 25C - chaetotaxy not completely shown) with one long and smooth α-seta. Second segment ventrally with one stout and hirsute ß-seta, the latter shorter than the α-seta. Penultimate segment laterally with one cone-shaped, hirsute γ-seta. Terminal segment sub-rectangular, less than 1.5 time as long as basal width. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 25D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six apical setae (four long and two short), and one short subapical seta. Terminal palp segment elongated, c. twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite, reaching beyond the end of the endite. First endite with one sideways-directed bristle only.

T1 protopodite (Fig. 25E) with two short a-setae, and with b and d-seta hirsute and equally long. Apically with 10 hirsute setae, subapically with a group of four such setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 25F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. half the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g). Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

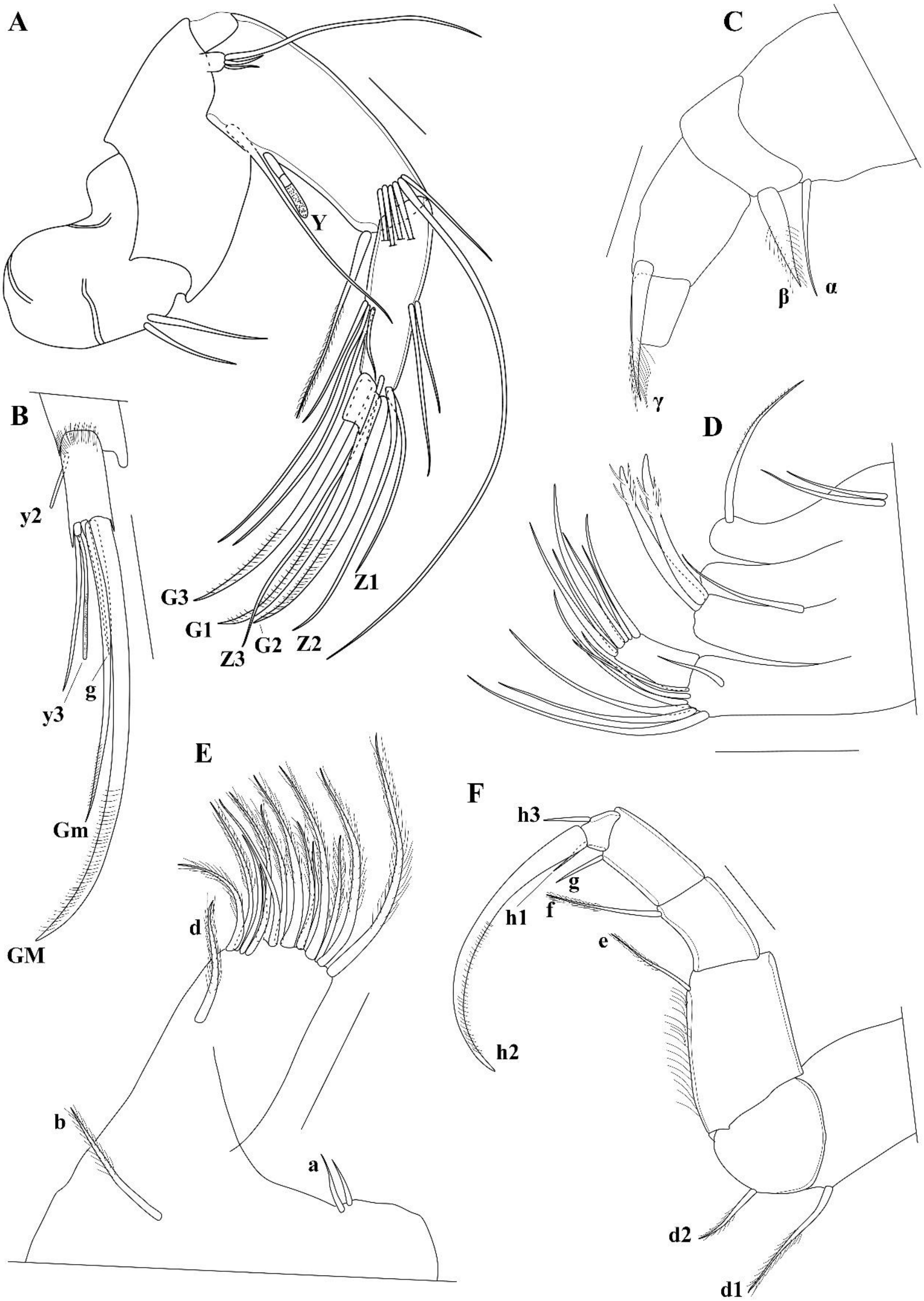

Figure 25 *Strandesia tolimensis*. A, A2 except last segment (VF074); B, A2 last segment (VF074); C, Md palp showing α, ß, γ setae (VF074); D, Mx1 (VF074); E, T1 (VF074); F, T2 (VF074). Scale bars, 50 μm.

T3 (Fig. 26A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2 dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 26B) slender and curved, with ventral margin weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c. 1/2 of length of distal seta.

CR attachment (Fig. 26C) slender, with Triebel's loop sub-triangular, situated in the main branch; vb long and very weakly curved; db short and curved.

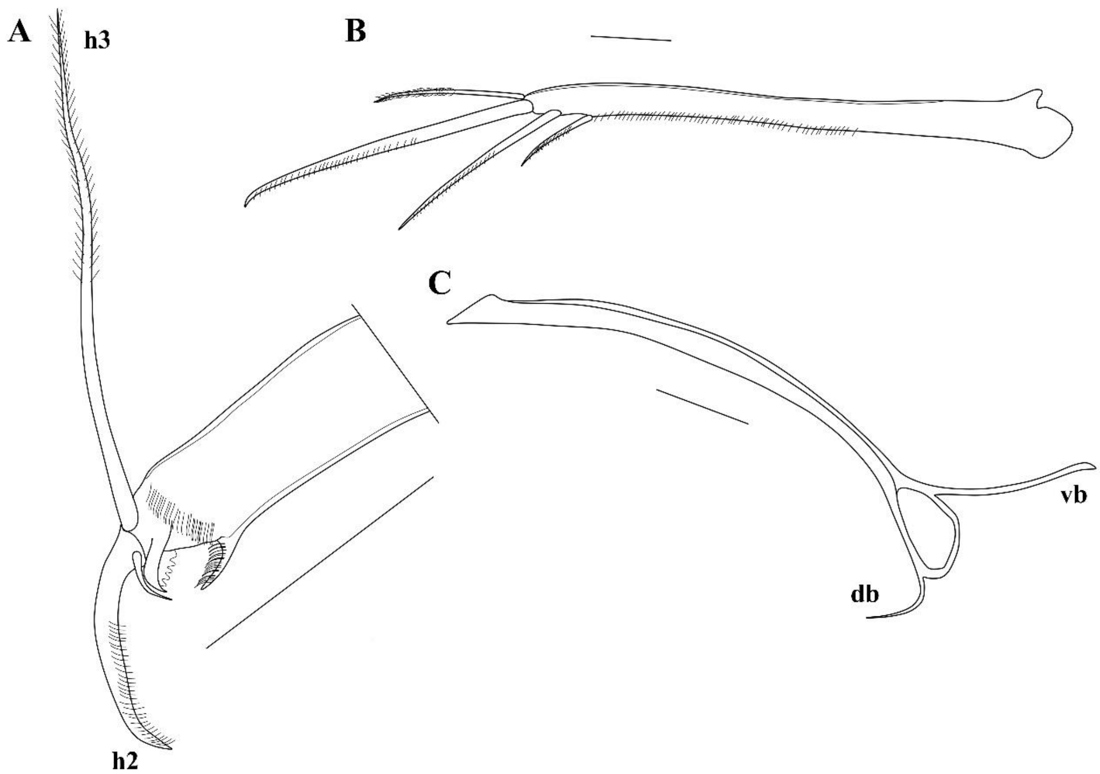

Figure 26 *Strandesia tolimensis.* A, T3 pincer (VF074); B, CR (VF074); C, CR attachment (VF074). Scale bars, 50 µm.

Male unknown

Differential diagnosis (after Higuti *et al*. 2013)

Strandesia tolimensis can be distinguished from the other species in this lineage by the rounded shape of the valves. The species resembles *S. obtusata*, but differs from it, by being less high in lateral view, and wider in dorsal and ventral views, while the posterior protruding flange of the RV in left lateral view is of a different shape: short and rounded in *S. obtusata* and elongated and narrow in *S. tolimensis*.

Ecology and distribution

In the present paper *Strandesia tolimensis* was recorded in lentic and lotic environments, associated with great variety of macrophytes, with different types of life forms, in Amazon, Araguaia, Pantanal and Paraná river floodplains. This species occurred in acid to basic environments, with a pH range of 4.7 – 9.5. Electrical conductivity and dissolved oxygen ranges were 12 - 162.2 $\mu S.cm^{-1}$ and 0.2 – 8.3 $mg. L^{-1}$, respectively (see Table S1).

Distribution: Brazil, Colombia (Higuti *et al.* 2013; Martens & Behen 1994).

9. *Strandesia* sp. 3 nov.sp.

(Figs. 27-29)

2017 *Strandesia* cf. *tolimensis* sp. 2 in Higuti *et al.*: 7

Measurements (in µm)

L (n=3): 784-792, H (n=1): 453, W (n=2): 446-455.

Diagnosis

Cp elongate with LV slightly overlapping RV anteriorly. RV and LV with greatest height situated well in front of the middle. Cp in ventral view with LV overlapping RV centrally with a flap, and anteriorly. RV without anterior inwardly displaced selvage, with a posterior inner list and without postero-dorsal flange. A2 with natatory setae reaching the tips of apical claws. T2 with d1 seta twice as long as d2. Caudal ramus slender and its attachment with a Triebel's loop oval-triangular, situated in the main branch.

Type material

Holotype: Female, soft parts dissected in glycerine and stored in sealed slides. Valves stored in micropaleontological slide (VF024).

Paratypes: Three dissected females stored as the holotype (VF026, VF056, JH1230). Three females, with carapaces stored in micropaleontological slides (JH1231, JH1232, JH1233).

Type locality

Upper Paraná River floodplain, Xirica Lake in roots of *Eichhornia azurea*. Coordinates: 22º 46' 46″ S 053º 22' 47.3″ W, south Brazil.

Description of female

LVi (Fig. 27A) elongate; anterior margin more broadly rounded than posterior one; greatest height situated well in front of the middle; with calcified inner lamella wide along anterior margin, narrow along ventral margin and wide on posterior margin.

RVi (Fig. 27B) elongate; anterior margin more broadly rounded than posterior one; greatest height situated well in front of the middle; inner lamella as in LVi; without anterior selvage and postero-dorsal flange.

CpRl (Fig. 27C) with greatest height situated in front of the middle; LV overlapping RV on anterior and posterior margins; external valve surface with few pits and setae. CpD (Fig. 27D) subovate; LV overlapping RV anteriorly; greatest width in the middle. CpV (Fig. 27E) with LV overlapping RV centrally with a flap, and anteriorly. CpFr (Fig. 27F), with valves asymmetrical, RV placed higher than LV.

A1 (Fig. 28A) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a long dorsal RO. Third segment with two setae. Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya and one short and two long setae.

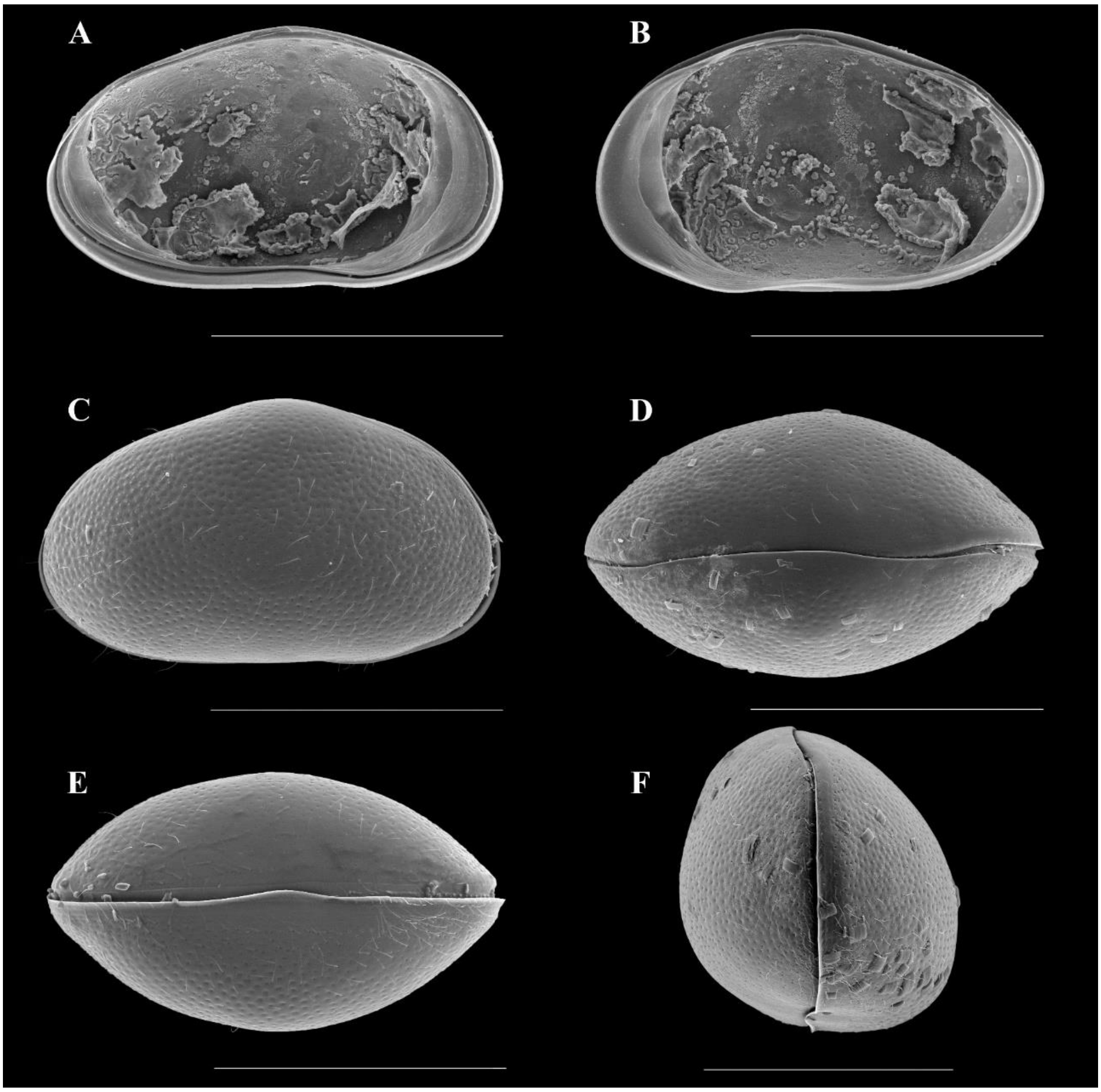

Figure 27 Carapace and valves of *Strandesia* sp. 3 nov.sp.. A, LVi (JH1230); B, RVi (JH1230); C, CpRl (JH1231); D, CpD (JH1232); E, CpV (JH1233); F, CpFr (JH1232). Scale bars: A-E, 500 µm; F, 100 µm.

A2 (Fig. 28B, C) with four segments, distal three segment forming endopodite. First segment with two ventral setae (one longer; one shorter); and one long ventro-distal seta not reaching tip of terminal segment. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching the tip of the last endopodal segment) one group of five long and one short swimming setae (the five long reaching the tips of claws; the shortest not reaching the middle of third segment) and one long apical seta (reaching beyond tip of the last segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2 and G3), three setae (z1, z2 and z3) and a short y2. Terminal segment (Fig. 28C) with two claws (1 long, GM; 1 short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

First segment of Md palp (Fig. 28E, F – respiratory plate not shown) with two long plumose setae; one long smooth setae and one long and smooth α-seta). Second segment dorsally with three setae (two unequal but long; one short, with the length about 1/3 of the longest), and ventrally with one long and hirsute ß-seta; three long hirsute and one short setae, the latter with length about 2/3 of the longest. Penultimate segment with two groups of setae, dorsally with a group of four unequal but long and smooth setae; laterally with one cone-shaped, hirsute γ-seta and three smooth subapical setae; ventrally with one long and one short. Terminal segment with three claws and three setae. Md coxa (Fig. 28D) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (fig. 29A chaetotaxy not complete) with three masticatory lobes (endites), a two-segmented palp and a large respiratory plate (the later not illustrated). Basal segment of palp with six long apical setae (four long and two short) and one short subapical seta. Terminal palp-segment elongated, c. 1.5 as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Short subapical seta on third endite, just not reaching the tip of segment. First endite with two unequal sideways directed bristles.

T1 protopodite (Fig. 29B, C) with two short a-setae, one b-seta slightly longer than d-setae. Apically with 10 hirsute setae, subapically with a group of four such setae. Endopodite (Fig. 29C) with three unequally long hirsute setae.

T2 (Fig. 29D) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. half of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one seta (g). Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h2)).

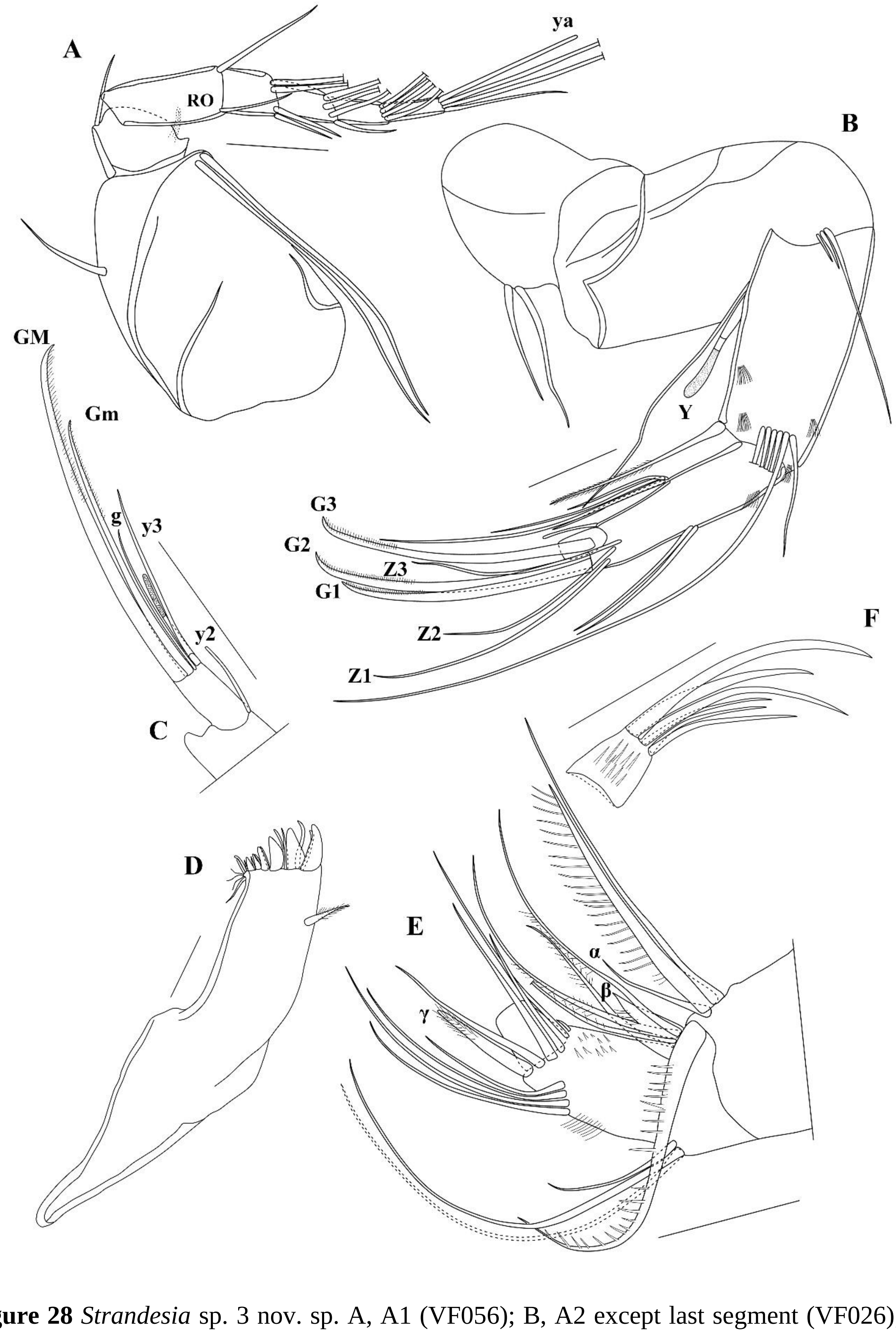

Figure 28 *Strandesia* sp. 3 nov. sp. A, A1 (VF056); B, A2 except last segment (VF026); C, A2 last segment (VF026); D, Md coxal plate (VF024); E, Md palp (VF024); F, Md palp last segment (VF024). Scale bars, 50 µm.

T3 (Fig. 29E, F) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one apical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f; distal); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 29G) slender, with ventral margin weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c. 1/6 of the length of distal seta.

CR attachment (Fig. 29H) stout, with Triebel's loop oval-triangular, situated in the main branch; vb long and slightly curved; db short and curved

Male unknown.

Differential diagnosis

Strandesia sp. 3 nov.sp. has a similar appearance to *Strandesia tolimensis* (Roessler, 1990) but can be distinguished by the more elongated shape, the smaller size and the absence of an anterior selvage and a postero-dorsal flange.

Ecology and distribution

Strandesia sp. 3 nov.sp. species was recorded in lentic and lotic environments, associated with free-floating and rooted floating-stemmed plants, in Paraná River floodplain. This species occurred in acid environment, with pH range of 6.4 – 8.3. Electrical conductivity and dissolved oxygen ranges were 35 - 68.8 $\mu S.cm^{-1}$ and 1.4 - 12.2 mg. L^{-1}, respectively (see Table SI).

Distribution: Brazil.

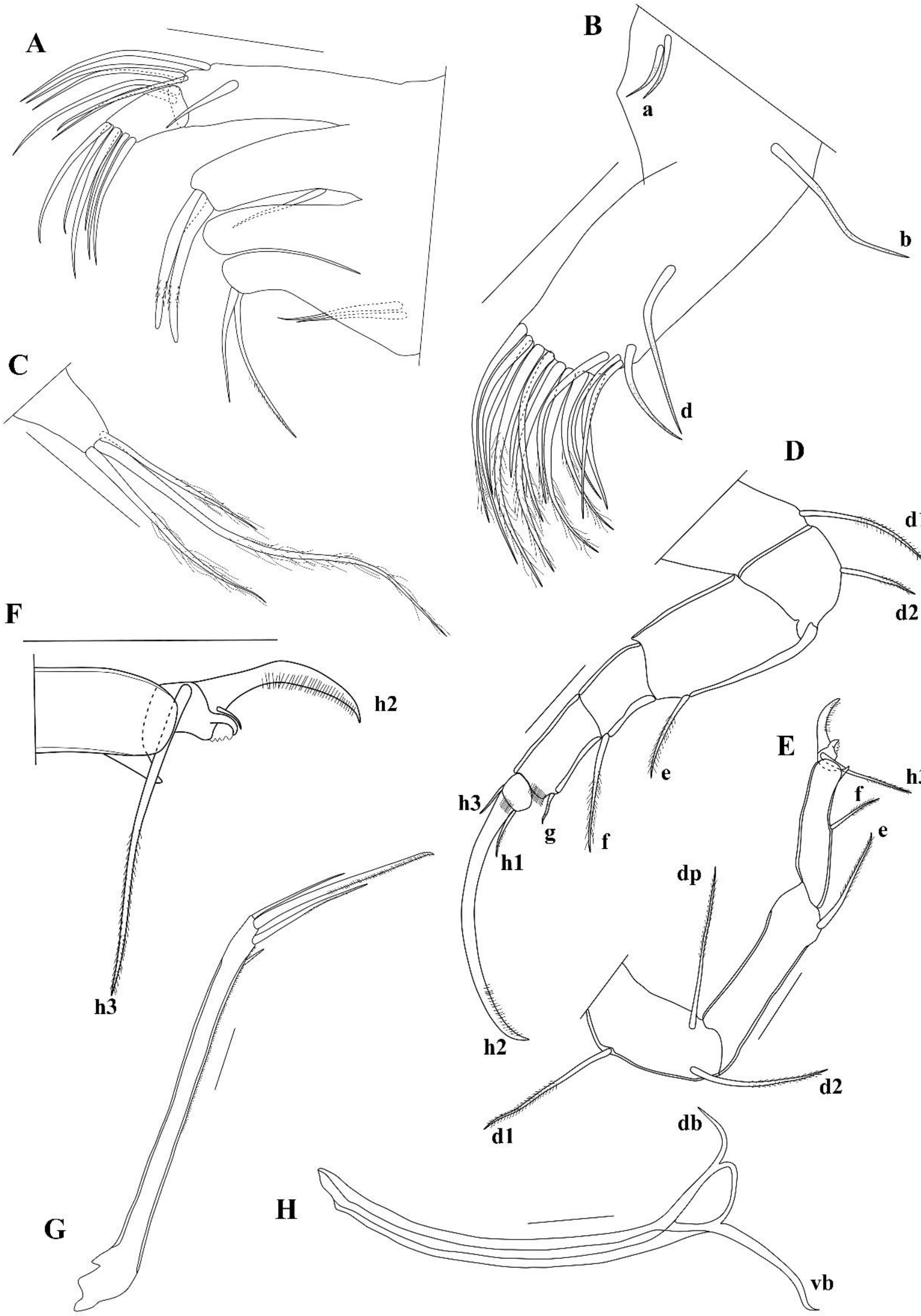

Figure 29 *Strandesia* sp. 3 nov.sp. A, Mx1 (VF024); B, T1(VF024); C, T1 endopodite (VF024); D, T2 (VF024); E, T3 (VF024); F, T3 detail of pincer (VF024); G, CR (VF026); H, CR attachment (VF026). Scale bars, 50 μm.

The *Strandesia variegata* group

10. ***Strandesia variegata*** Sars, 1901

(Figs. 30-32)

1901 *Neocypris variegata* Sars: 33

1912 *Strandesia variegata* (Sars, 1901) G.W. Müller, 1912: 189

Material examined

One female (VF067) used for soft part illustrations and two females (JH077, JH078) were used for SEM from Maria Luiza Lake (22°40'29.4"S, 53°13'5.8"W). Two females (JH145, JH146) from Aurélio Lake (22º41'37.7"S, 53º13'54.3"W) were used for SEM. All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=2): 1.329-1.372, H (n=1): 670, W (n=1): 677.

Diagnosis

Cp subovate, with posterior margin more broadly rounded than anterior margin; RV without anterior selvage and postero-dorsal flange. A2 with natatory setae reaching beyond the tips of the apical claws. CR with ventral margin serrated, its attachment with an oval-triangular Triebel's loop, situated in the main branch.

Abbreviated redescription of female

LVi (Fig. 30A) subovate and with broadly rounded margins; with greatest height situated behind the middle, making the posterior section broader than the anterior part; with calcified inner lamella wide along anterior and posterior margin narrow along ventral margin.

RVi (Fig. 30B) subovate; with greatest height behind the middle, with calcified inner lamella wide along anterior margin, and absent along along ventral and posterior margin; without anterior selvage and postero-dorsal flange.

CpRl (Fig. 30C) subovate; with greatest height situated behind the middle; posterior region broader than anterior. CpD (Fig. 30D) subovate; both extremities broadly rounded. CpV (Fig. 30E) subovate; with both extremities broadly rounded.

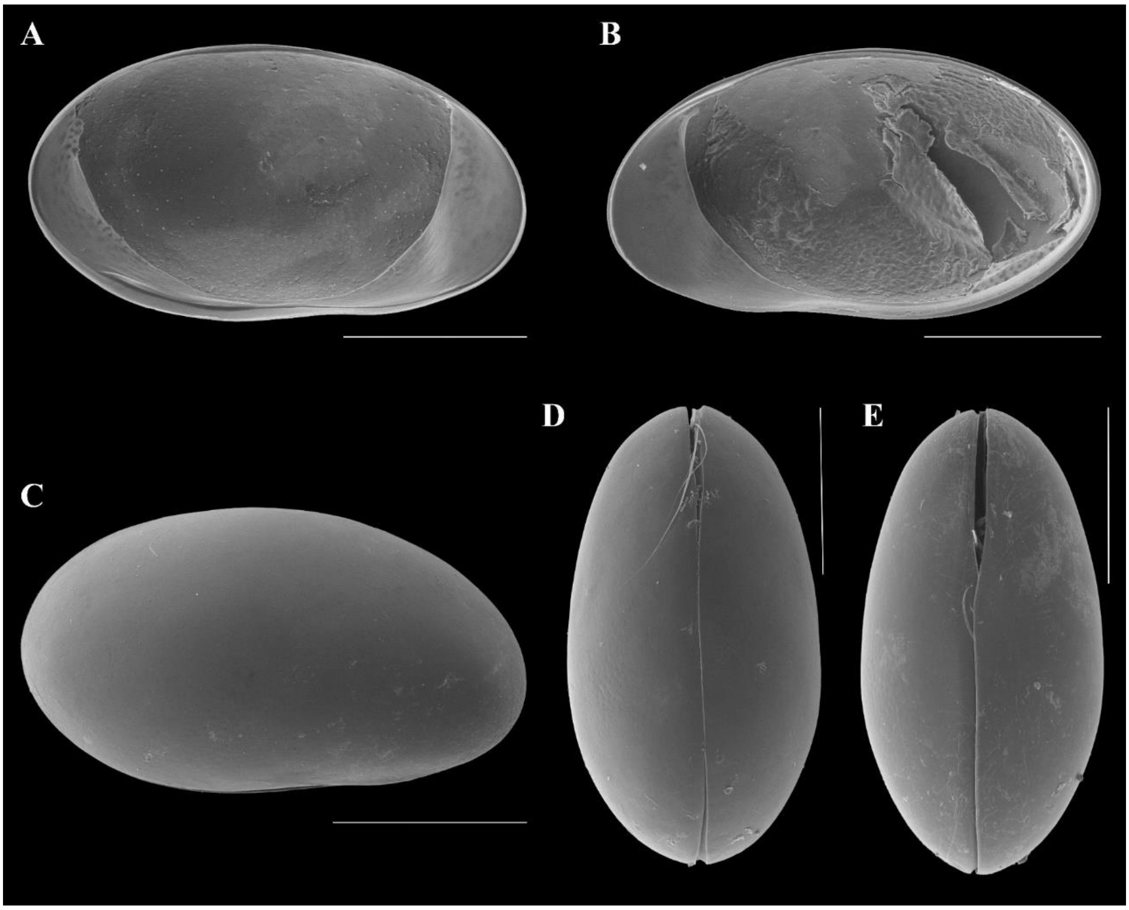

Figure 30 Carapace and valves of *Strandesia variegata*. A, LVi (JH077); B, RVi (JH077); C, CpRl (JH078); D, CpD (JH145); E, CpV (JH146). Scale bars, 500 µm.

A1 (not illustrated) with seven segments. First segment with one short subapical and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller one with the length of the fourth segment). Fourth segment with two short and two long, setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Fig. 31A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long distal seta, the latter not reaching tip of penultimate segment. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching beyond the tip of the last endopodal segment), one group of five long and one short swimming seta (the five long setae reaching beyond the tips of the apical claws; the shortest not reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 31B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

First segment of Md palp (Fig. 31C - chaetotaxy not complete) with one short and smooth α-seta. Second segment ventrally with one long and hirsute ß-seta. Penultimate segment laterally with one cone-shaped, hirsute γ-seta. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 31D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six long apical setae (two slightly longer and four slightly shorter), and one short subapical seta. Terminal palp segment elongated, c. 1.5x as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles; subapical seta on third endite, reaching beyond the end of the endite. First endite with one sideways-directed bristle only.

T1 protopodite (Fig. 31E) with two short a-setae, b-seta slightly shorter than d-seta, both hirsute. Apically with 10 hirsute setae, subapically with a group of four such setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 31F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 3/4 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g). Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

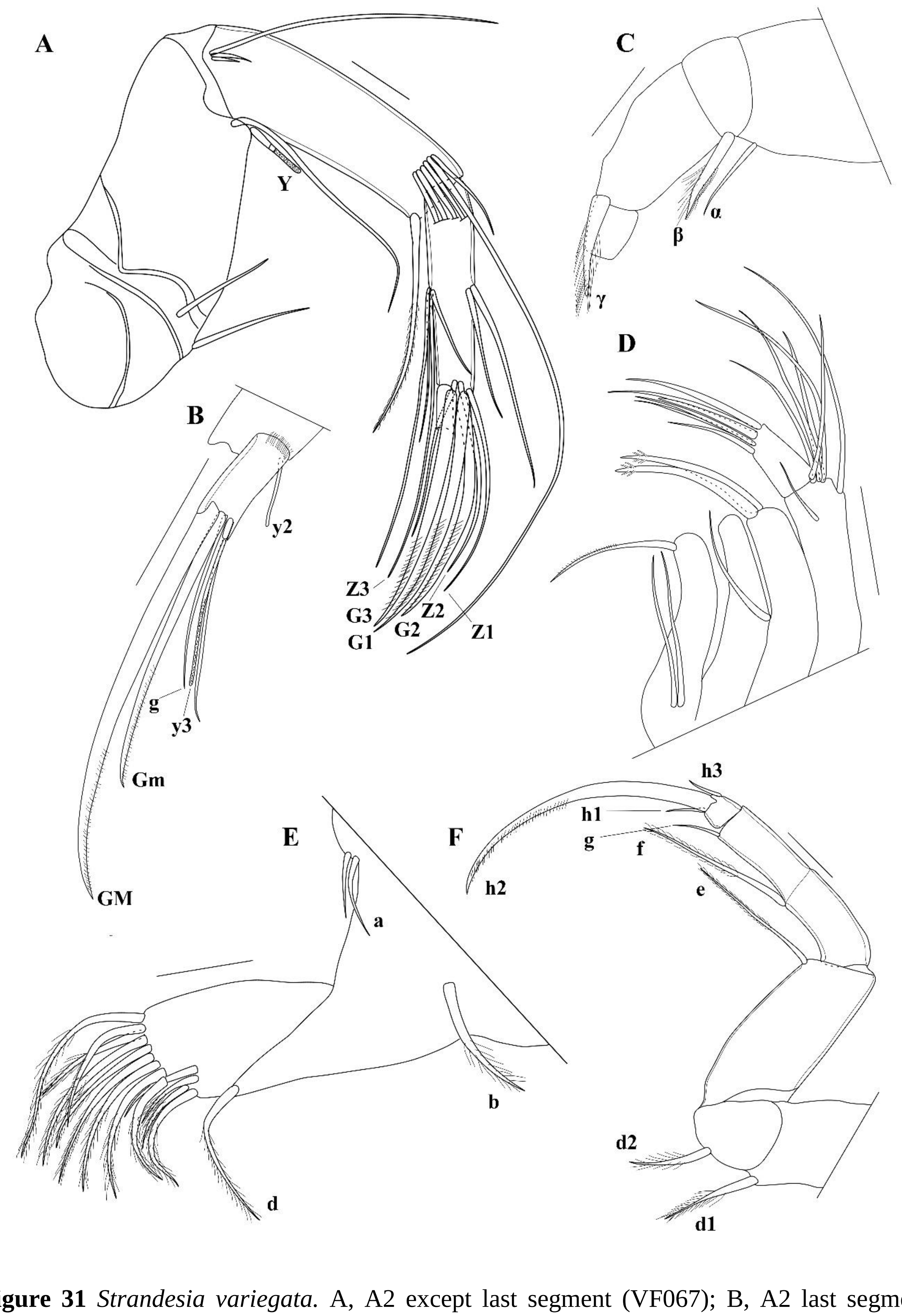

Figure 31 *Strandesia variegata.* A, A2 except last segment (VF067); B, A2 last segment (VF067); C, Md palp showing α, ß, γ setae (VF067); D, Mx1 (VF067); E, T1 (VF067); F, T2 (VF067). Scale bars, 50 μm.

T3 (Fig. 32A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with three subapical seta (e). Third segment, also longer than wide, with three lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with three apical comb-like seta (h2), three small recurved setae, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 32B) slender and curved, with ventral margin serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta smooth, c 1/6 of length of distal seta.

CR attachment (Fig. 32C) stout, with Triebel's loop oval-triangular, situated in the main branch; vb long and straight; db short and curved.

Male unknown

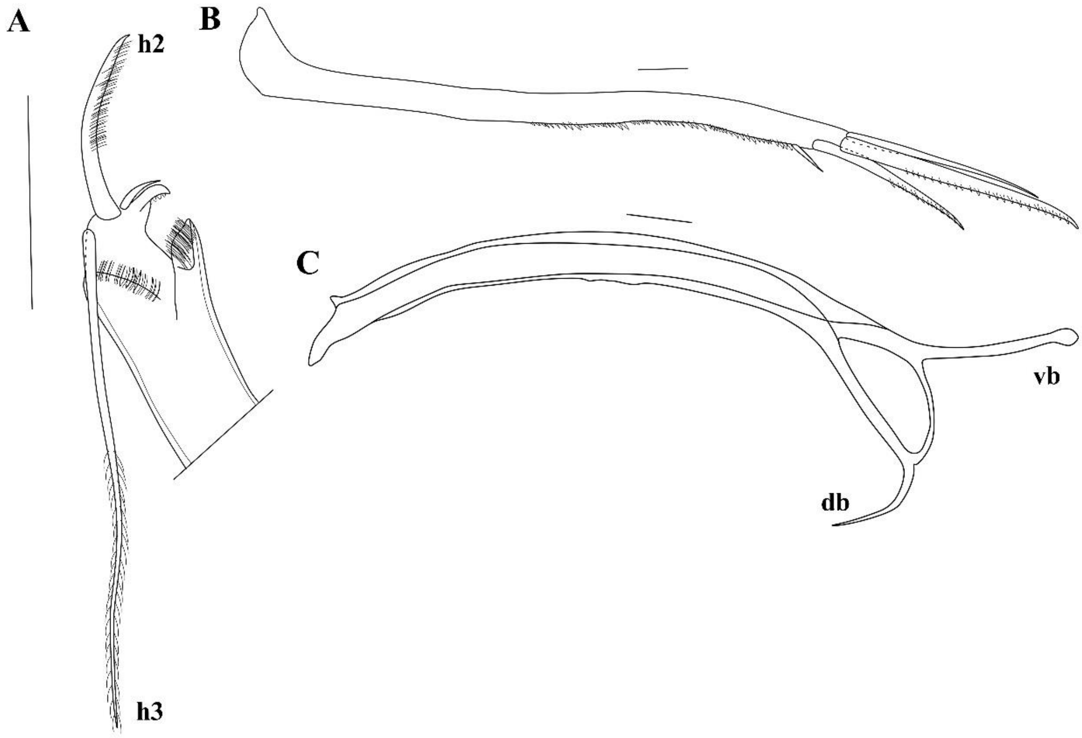

Figure 32 *Strandesia variegata.* A, T3 pincer (VF067); B, CR (VF067); C, CR attachment (VF067). Scale bars, 50 µm.

Differential diagnosis

Strandesia variegata is similar to *Strandesia mutica*, but it has a broader posterior region in lateral and dorsal view.

Ecology and distribution

In the present paper *Strandesia variegata* was recorded in lentic and lotic environments, associated with a variety of macrophytes, with different life forms, in Pantanal and Paraná river floodplains This species occurred in acid to neutral environments, with pH range of 4.2 – 7.4. Electrical conductivity and dissolved oxygen ranges were 11 – 84.8 µS.cm^{-1} and 0.2 - 8.3 mg. L^{-1}, respectively (see Table S1).

Distribution: Brazil, Paraguay and West Indies (Martens & Behen 1994).

11. *Strandesia mutica* (Sars, 1901) G.W. Müller, 1912

(Figs. 33-35)

1901 *Neocypris mutica* Sars: 32

1905 *Eucypris (Eucypris) mutica* (Sars, 1901) Daday: 243

1912 *Strandesia mutica* (Sars, 1901) G.W. Müller, 1912: 189

Material examined

One female (VF070) used for soft part illustrations and two females (JH079, JH080) used for SEM from Aurélio Lake (22°41'36.5"S, 53°13'52.9"W). Two females (JH147, JH150) used for SEM from Ivinhema River (22°54'37.6"S, 53°38'19.4"W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=2): 1.426-1.429, H (n=1): 654, W (n=1): 588.

Diagnosis

Cp subovate, with posterior margin more broadly rounded than anterior margin; RVi with anterior selvage and postero-dorsal flange. A2 with natatory setae reaching beyond the tips of the apical claws. CR with ventral margin serrated, its attachment with an oval-triangular Triebel’s loop, situated in the main branch.

Abbreviated redescription of female

LVi (Fig. 33A) with calcified inner lamella wide along anterior margin, absent along ventral margin and narrow along posterior margin. Greatest height situated well behind the middle. Posterior margin more broadly rounded than anterior margin.

RVi (Fig. 33B) with calcified inner lamella wide along anterior margin, absent along ventral margin and narrow along posterior margin. Greatest height situated well behind the middle. Posterior margin more broadly rounded than anterior margin. Anterior selvage inwardly displaced but valve margin not parallel. Postero-dorsal flange elongated, relatively wide in the center.

CpLl (Fig. 33C) with greatest height situated well behind the middle. CpD (Fig. 33D) and CpV (Fig. 30E) with evenly rounded margins; LV overlapping RV anteriorly, and RV overlapping LV posteriorly; both ends truncated.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae).

A2 (Fig. 34A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta (this seta reaching just beyond tip of first endopodal segment). Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching beyond the tip of the last endopodal segment))), one group of five long and one short swimming seta (the five long setae just reaching the tips of the apical claws; the shortest not reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 34B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

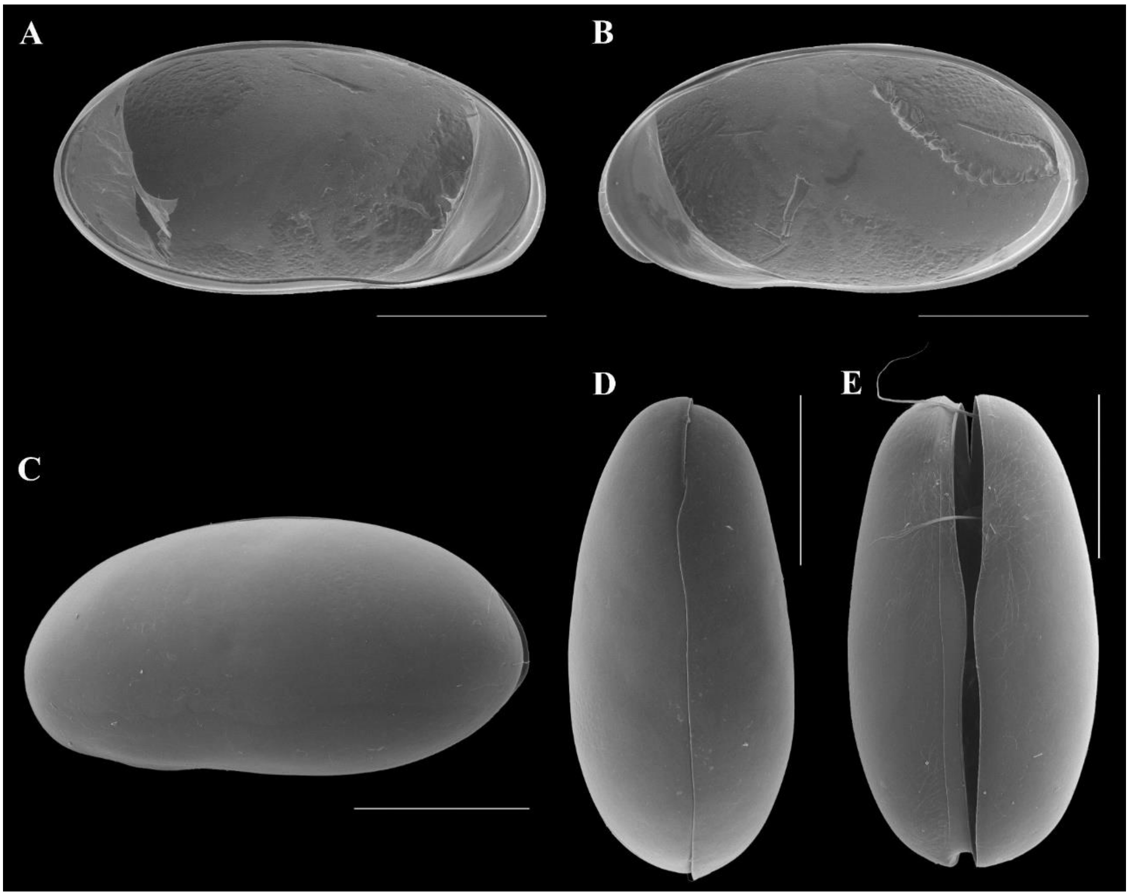

Figure 33 Carapace and valves of *Strandesia mutica*. A, LVi (JH079); B, RVi (JH079); C, CpLl (JH080); D, CpD (JH147); E, CpV (JH150). Scale bars, 500 µm.

First segment of Md palp (Fig. 34C - chaetotaxy not complete) with one short and smooth α-seta. Second segment ventrally with one stout and hirsute ß-seta, slightly longer than α-seta. Penultimate segment laterally with one elongated cone-shaped, stout, hirsute γ-seta. Terminal segment almost 1.5x as long as basal width. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

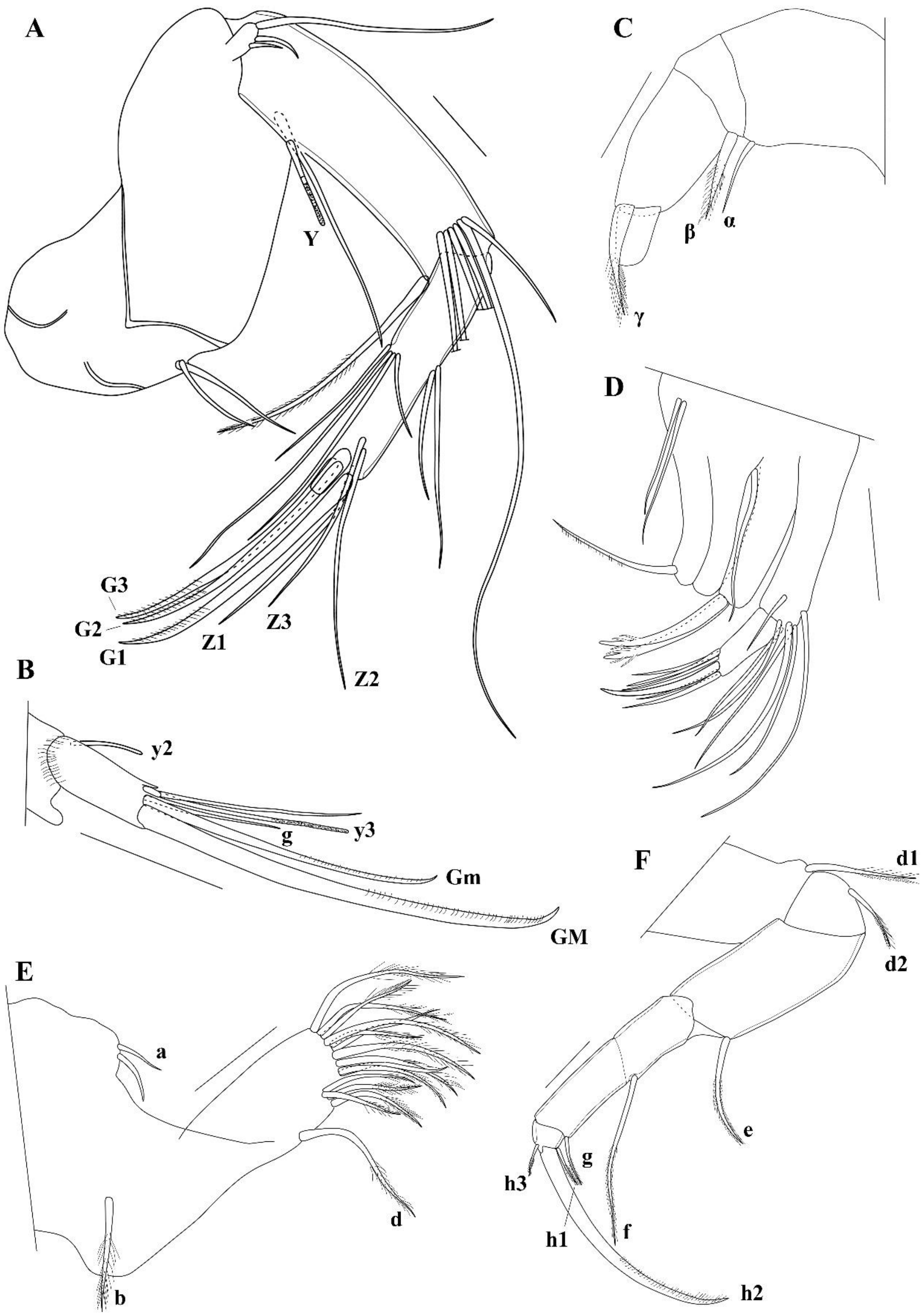

Figure 34 *Strandesia mutica.* A, A2 except last segment (VF070); B, A2 last segment (VF070); C, Md palp showing α, ß, γ setae (VF070); D, Mx1 (VF070); E, T1 (VF070); F, T2 (VF070). Scale bars, 50 µm.

Mx1 (Fig. 34D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six apical setae (four short and two long), and one short subapical seta. Terminal palp segment elongated, more than twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite, reaching beyond the end of the endite. First endite with one sideways-directed bristle only.

T1 protopodite (Fig. 34E) with two short a-setae, one hirsute b-seta and one long d-seta, c. 1/4 longer than b-seta. Apically with 10 hirsute setae, subapically with a group of four such setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 34F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 2/3 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g). Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

T3 (Fig. 35A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 35B) stout and straight, with ventral margin serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta hirsute, c. 1/4 of length of distal seta. .

CR attachment (Fig. 35C) stout, with Triebel’s loop oval-triangular, situated in the main branch; vb long and weakly curved; db relatively long and curved.

Male unknown

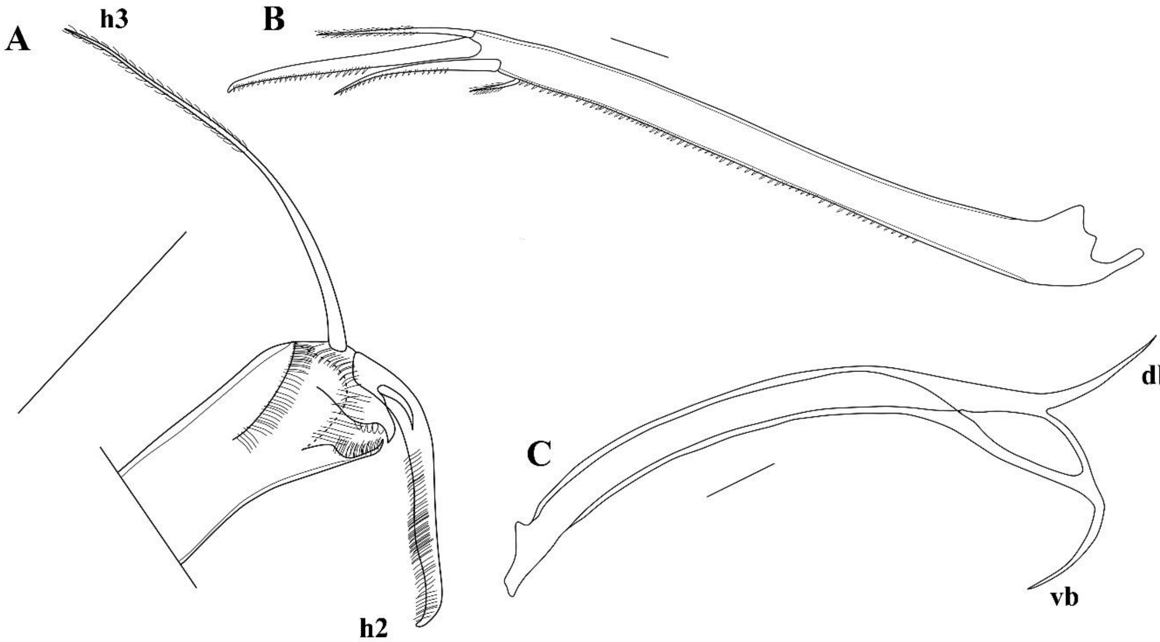

Figure 35 *Strandesia mutica.* A, T3 pincer (VF070); B, CR (VF070); C, CR attachment (VF070). Scale bars, 50 µm.

Differential diagnosis

Strandesia mutica is similar to *Strandesia variegata*, but it is more elongated and less high than *S. variegata*. Also, the RVi in *S. mutica* has an anterior inwardly displaced selvage and a postero-dorsal flange which are missing in *S. variegata.* In dorsal view, *S. mutica* has a sub-rectangular shape, whereas *S. variegata* has a subovate shape and broader posterior region. Still in dorsal view, there are no anterior or posterior overlaps in *S. variegate*, while in *S. mutica* LV overlaps RV anteriorly, while RV overlaps LV posteriorly.

Ecology and distribution

In the present paper *Strandesia mutica* was recorded only in lentic environments, and was found associated with a variety of macrophytes, with different life forms, in Amazon and Paraná floodplains. This species occurred in acid to basic environments, with pH range of 4.2 – 8.3. Electrical conductivity and dissolved oxygen ranges were 11 - 123.8 µS.cm^{-1} and 0.1 – 9.8 mg. L^{-1}, respectively (see Table S1).

Distribution: Brazil, Paraguay and West Indies (Martens & Behen 1994).

12. ***Strandesia psittacea*** Sars, 1901

(Figs. 36-38)

1901 *Cypris psittacea* Sars: 24

1990 *Strandesia psittacea* (Sars, 1901) Roessler, 1990: 216

Syn. *S. trichosa* Roessler, 1990 **nov.syn. (see below 'remarks')**

Material examined

One female (VF057) used for soft part illustrations and five females (JH1367, JH1369-JH1372) used for SEM were from from Gavião Lake (22°40'48.6"S, 53°12'58.6"W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=3): 1.478-1.543, H (n=2): 803-838, W (n=2): 717-785.

Diagnosis

Cp elongated, dorsal region smoothly curved; with greatest height situated in front of the middle. RV with an anteroventral, bluntly pointed beak-like projection; postero-ventrally with one spine; and with a widely inwardly displaced anterior selvage, not parallel to the valve margin. Both valves with calcified inner lamella wide along anterior margin, narrow along ventral and posterior margins. A2 with natatory setae not reaching the tips of apical claws. CR ventrally weakly serrated; its attachment with a triangular Triebel's loop, situated in the main branch.

Abbreviated redescription of female

LVi (Fig. 36A) elongated, with calcified inner lamella wide along anterior margin, narrow along ventral and posterior margins. Greatest height situated well in front of the middle.

RVi (Fig. 36B) elongated, with calcified inner lamella as in LVi; antero-ventrally with a bluntly pointed beak and posteriorly with one spine (broken in this view). Anteriorly with a widely inwardly displaced selvage, not parallel to the valve margin. Greatest height situated well in front of the middle.

CpLl (Fig. 36C) with dorsal region smoothly curved; with greatest height situated in front of the middle; external valve surface densely set with setae; antero-ventrally with a bluntly-pointed beak and postero-ventrally with one spine. CpD (Fig. 36D) and CpV (36E) views subovate; greatest width situated in the middle, anteriorly with a pointed rostrum, posterior margin more rounded. CpFr (36F) slightly oblique, with LV being the lower valve.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta; and a small dorsal RO. Third segment with two setae (the smaller one with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Fig. 37A-B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta, the latter reaching just beyond tip of first endopodal segment. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (not reaching the tip of the last endopodal segment)), and a group of five long and one short swimming seta (the five long setae just not reaching the tips of the apical claws; the shortest not reaching the middle of third segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 37B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

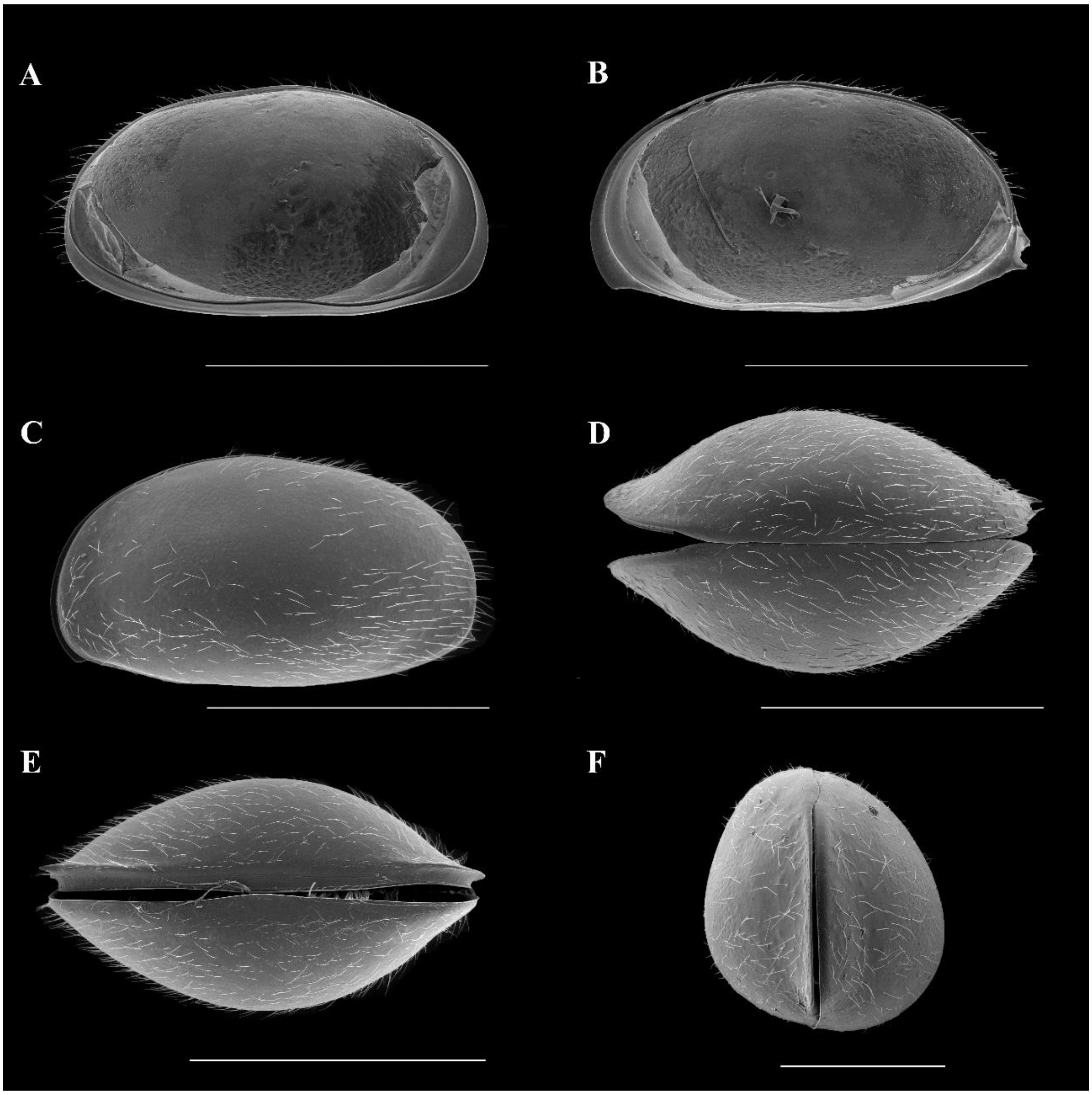

Figure 36 Carapace and valves of *Strandesia psittacea*. A, LVi (JH1367); B, RVi (JH1367); C, CpLl (JH1371); D, CpD (JH1369); E, CpV (JH1370); F, CpFr (JH1372) Scale bars, A-E, 1.000 μm; F, 500μm.

First segment of Md palp (Fig. 37C - chaetotaxy not complete) with one long and smooth α-seta. Second segment ventrally with one stout and hirsute ß-seta. Penultimate segment laterally with one cone-shaped, stout and hirsute γ-seta. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 37D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six long apical setae (four long and two short) and one short subapical seta. Terminal palp segment, c twice as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite, reaching beyond the end of the endite. Fist endite with one sideways-directed bristle only.

T1 protopodite (Fig. 37E) with two short a-setae, b-seta and d-seta, equally hirsute, with d-seta c. 1/4 longer than b-seta. Apically with 10 hirsute setae, subapically with a group of four such setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 37F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 2/3 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g). Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

T3 (Fig. 38A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4th segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 38B) slender and curved, with ventral margin serrated. Proximal claw 3/4 of the length of distal claw. Proximal seta smooth, c. 2/5 of length of distal seta.

CR attachment (Fig. 38C) stout, with Triebel’s loop triangular, situated in the main branch; vb long and straight; db short and curved.

Male unknown

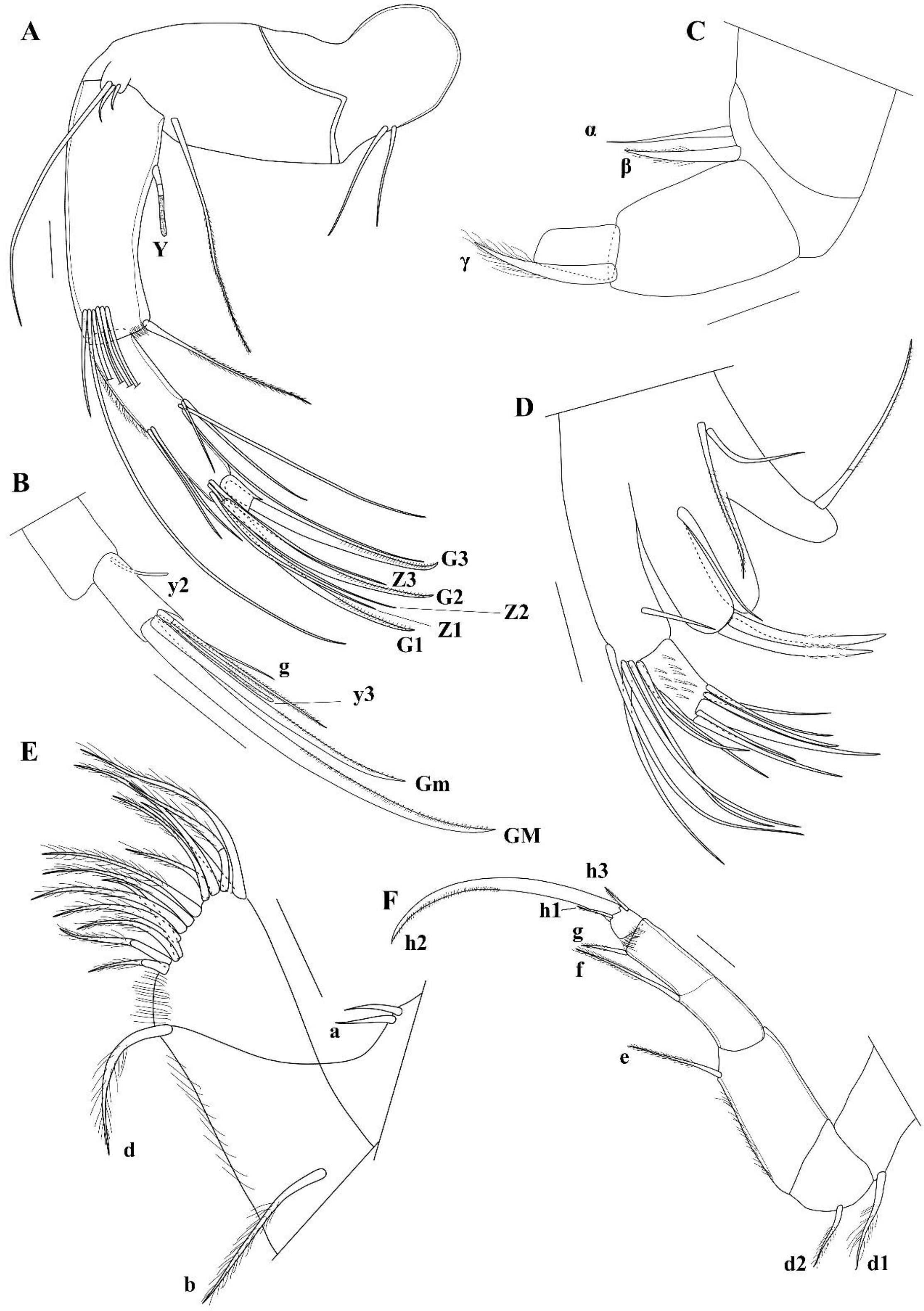

Figure 37 *Strandesia psittacea.* A, A2 except last segment (JH1367); B, A2 last segment (JH1367); C, Md palp showing α, ß, γ setae (VF057); D, Mx1 (VF057); E, T1 (VF057); F, T2 (VF057). Scale bars, 50 μm.

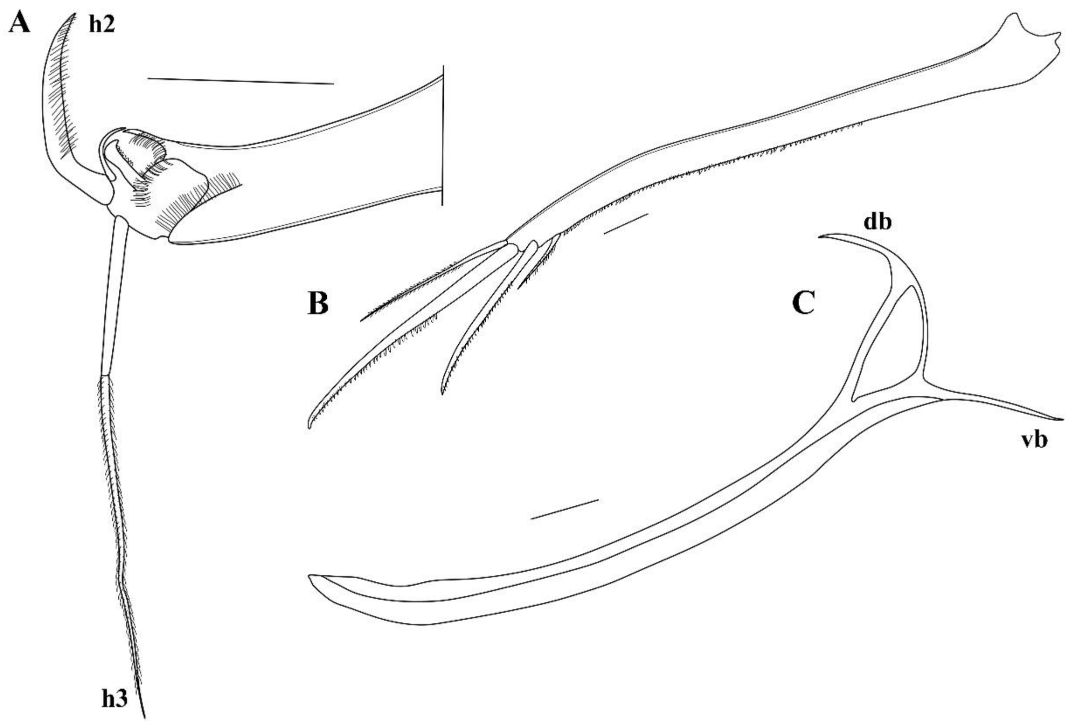

Figure 38 *Strandesia psittacea.* A, T3 pincer (JH1367); B, CR (VF057); C, CR attachment (VF057). Scale bars, 50 µm.

Differential diagnosis

Strandesia psittacea is similar to *Strandesia colombiensis* (see below), but the valves are less high. Both species are well defined by the very hirsute external valve surfaces, the bluntly pointed antero-ventral beak and the postero-ventral spine.

Remarks

Strandesia psittacea (Sars, 1901) resembles *Strandesia trichosa* Roessler, 1990, a Colombian species, in the general shape, the presence of a postero-ventral spine and and antero-ventral bluntly rounded beak on the RV. The size is also quite similar, L: 1.540 µm, H: 800 µm, W: 785 µm for *S. psittacea*, and, L: 1.530 µm, H: 804 µm, W: 840 µm for *S. trichosa.* Roessler (1990) sustained the difference between these two species based on the caudal ramus, more specifically in the curves of the claws. Here, comparing the morphology of the Brazilian specimens and the description of Roessler (1990b), we do not agree with his decisions and thus consider *Strandesia trichosa* (Roessler, 1990b) as a synonym of *Strandesia psittacea*.

Ecology and distribution

In the present paper *Strandesia psittacea* was recorded from lentic and lotic environments, associated with a variety of macrophytes with different life forms, in Amazon, Araguaia and

Paraná river floodplains. This species occurred in acid to basic environments, with a pH range of, 4.7 – 9.7. Electrical conductivity and dissolved oxygen ranges were 12 - 80.4 $\mu S.cm^{-1}$ and 0.2 – 8.2 mg. L^{-1}, respectively (see Table S1).

Distribution: Brazil, Colombia (Sars 1901; Roessler 1990b).

13. ***Strandesia colombiensis*** Roessler, 1990 **change of rank**

(Figs. 39-41)

1901 *Cypris psittacea* Sars, 1901: 24

1990 *Strandesia psittacea* (Sars, 1901) Roessler, 1990: 216

Material examined

One female (VF069) used for soft part illustrations and five females (JH1361, JH1363-JH1366) used for SEM from Gavião Lake (22°40'48.6"S, 53°12'58.6"W). All illustrated specimens are from Paraná River floodplain.

Measurements (in µm)

L (n=3): 1.530-1568, H (n=2): 916-1016, W (n=3): 758-792.

Diagnosis

Cp subovate, with greatest height situated in front of the middle. RV with an antero-ventral pointed beak and a posteroventral spine; with calcified inner lamella wide along anterior margin, narrow along ventral and posterior margins; anterior selvage inwardly displaced and not running parallel to valve margin. LVi with calcified inner lamella as in RV. A2 with natatory setae just not reaching the tips of apical claws. CR with ventral margin strongly serrated, its attachment with a Triebel's loop oval-triangular, situated in the main branch.

Abbreviated redescription of female

LVi (Fig. 39A) with dorsal margin evenly rounded; with calcified inner lamella wide long anterior margin, narrow along ventral and posterior margins; greatest height situated in front of the middle.

RVi (Fig. 39B); with dorsal margin evenly rounded; with calcified inner lamella as in the LVi; with an antero-ventral pointed beak and a posteroventral spine; anterior selvage inwardly displaced and not running parallel to valve margin; greatest height situated in front of the middle.

CpLl (Fig. 39C) with dorsal margin curved; greatest height situated in front of the middle; external valve surface densely set with setae; with antero-ventral beak and postero-ventral spine. CpD (Fig. 39D) and CpV (Fig. 39E) subovate; anteriorly with a skewed rostrum and posteriorly obtusely rounded. CpF. (Fig. 39F), subtriangular and slightly oblique with LV being the lower valve.

A1 (not illustrated) with seven segments. First segment with one short subapical seta and two long apical setae; WO not seen. Second segment wider than long, with one short ventral seta and a small dorsal RO. Third segment with two setae (the smaller with the length of the fourth segment). Fourth segment with two short and two long setae. Fifth segment with three long and one short setae. Sixth segment with four long setae. Seventh segment with one short aesthetasc Ya, and one short and two long setae.

A2 (Fig. 40A, B) with four segments, distal three segments forming endopodite. First segment with two ventral setae; and one long ventro-distal seta, the latter almost reaching the middle of the second endopodal segment. Exopodite reduced to a small plate, with one long and two unequal short setae. First endopodal segment with one ventral aesthetasc Y, one long apical seta (reaching beyond the tip of the last endopodal segment)), one group of five long and one short swimming setae (the five long setae just not reaching the tips of the apical claws; the shortest reaching the middle of third endopodal segment). Second endopodal segment undivided, with two unequal dorsal setae and a group of four unequal, long ventral setae; apically with three claws (G1, G2, and G3), three setae (z1, z2 and z3) and a short aesthetasc y2. Terminal segment (Fig. 40B) with two claws (one long GM; one short, Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance only, and a fine g-seta, the latter shorter than accompanying seta of aesthetacs y3.

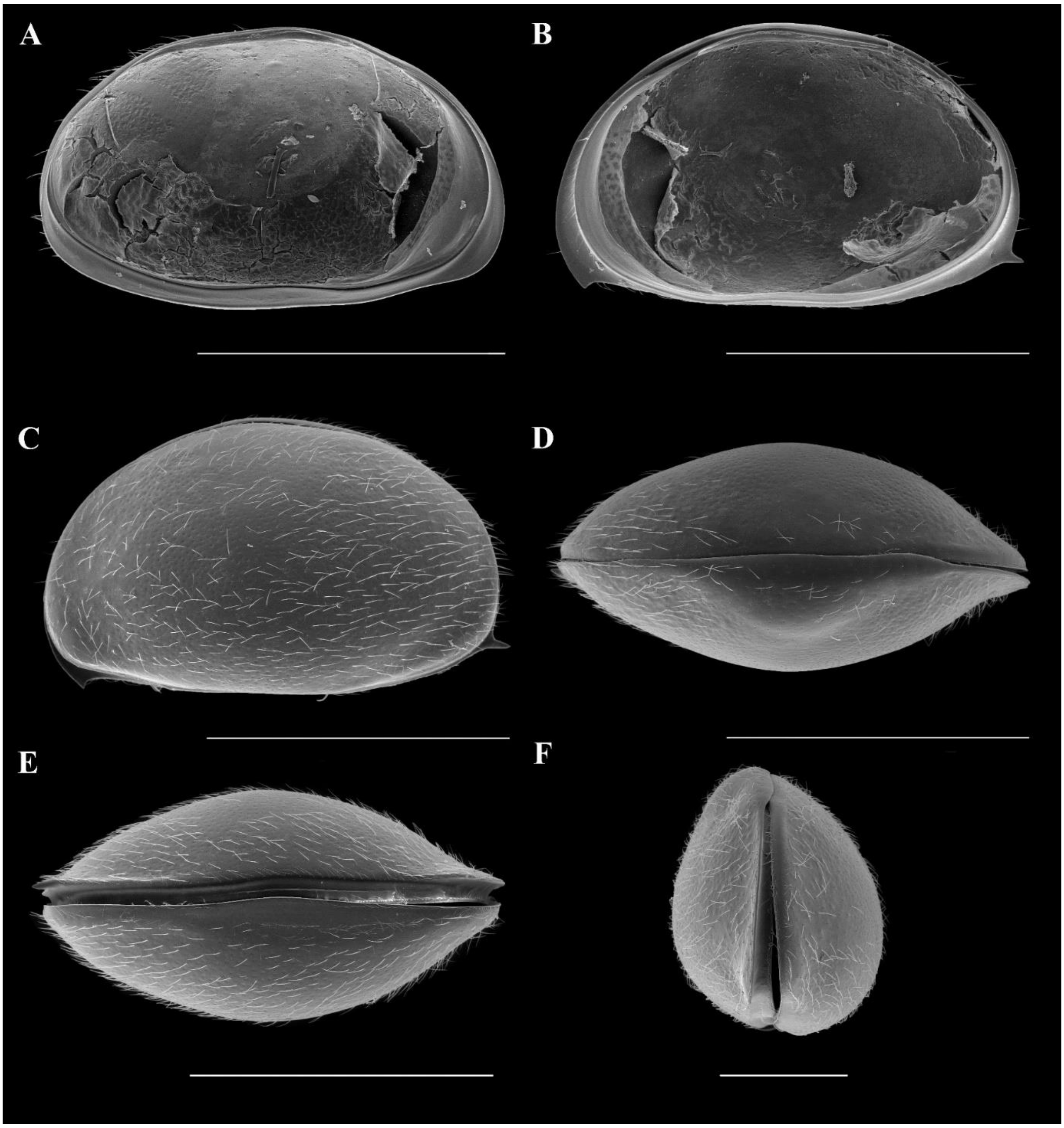

Figure 39 Carapace and valves of *Strandesia colombiensis.* A, LVi (JH1361); B, RVi (JH1361); C, CpLl (JH1366); D, CpD (JH1363); E, CpV (JH1364); F, CpFr (JH1365). Scale bars, A-E, 1.000 μm; F, 500μm.

First segment of Md palp (Fig. 40C - chaetotaxy not complete) with one medium-sized and smooth α-seta. Second segment ventrally with one stout and hirsute ß-seta, slightly longer than α-seta. Penultimate segment laterally with one stout, cone-shaped, hirsute γ-seta. Terminal segment almost 1.5x as long as basal width. Md coxa (not illustrated) as typical of the family, elongated with an apical row of strong teeth of variable size, interspaced with some setae.

Mx1 (Fig. 40D - chaetotaxy not complete) with three masticatory lobes, a two-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with six long apical setae (two slightly longer and four slightly shorter), and one short subapical seta. Terminal palp segment 1.5 times as long as basal width, slightly curved, apically with three claws and three setae. Third endite with two large, serrated bristles. Subapical seta on third endite reaching beyond the tip of this endite. First endite with one sideways-directed bristle only.

T1 protopodite (Fig. 40E) with two short a-setae, b and d-seta equally long; both hirsute. Apically with 10 hirsute setae, subapically with a group of four such setae. Endopodite with three unequal long hirsute apical setae (not illustrated).

T2 (Fig. 40F) with five segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. 3/4 of the length of d1. Third segment with one subapical hirsute seta (e). Fourth segment medially divided into a- and b-segments; segment “a” with one long apical hirsute seta (f); segment “b” with one shorter seta (g). Terminal segment with one apical claw (h2) and two setae (one subapical (h1) and one apical (h3)).

T3 (Fig. 41A - chaetotaxy not complete) with three segments. First segment with three long setae (d1, d2, dp). Second segment, longer than wide, with one subapical seta (e). Third segment, also longer than wide, with one lateral, hirsute seta (f); distal part of the third segment fused with 4^{th} segment into a modified pincer, with one apical comb-like seta (h2), one small recurved seta, with 1/5 of the length of the comb-like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 41B) slender and curved, with ventral margin strongly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta hirsute, ca. 1/5 of distal seta

CR attachment (Fig. 41C) stout, with Triebel’s loop oval-triangular, situated in the main branch; vb long and straight; db short and weakly curved.

Male unknown

Differential diagnosis

Strandesia colombiensis is similar to *Strandesia psittacea*, but it can be distinguished by the higher valves, the more curved dorsal margin, and the more pointed antero-ventral beak. In frontal view, *S. colombiensis* has a subtriangular shape, whereas *S. psittacea* is rounded.

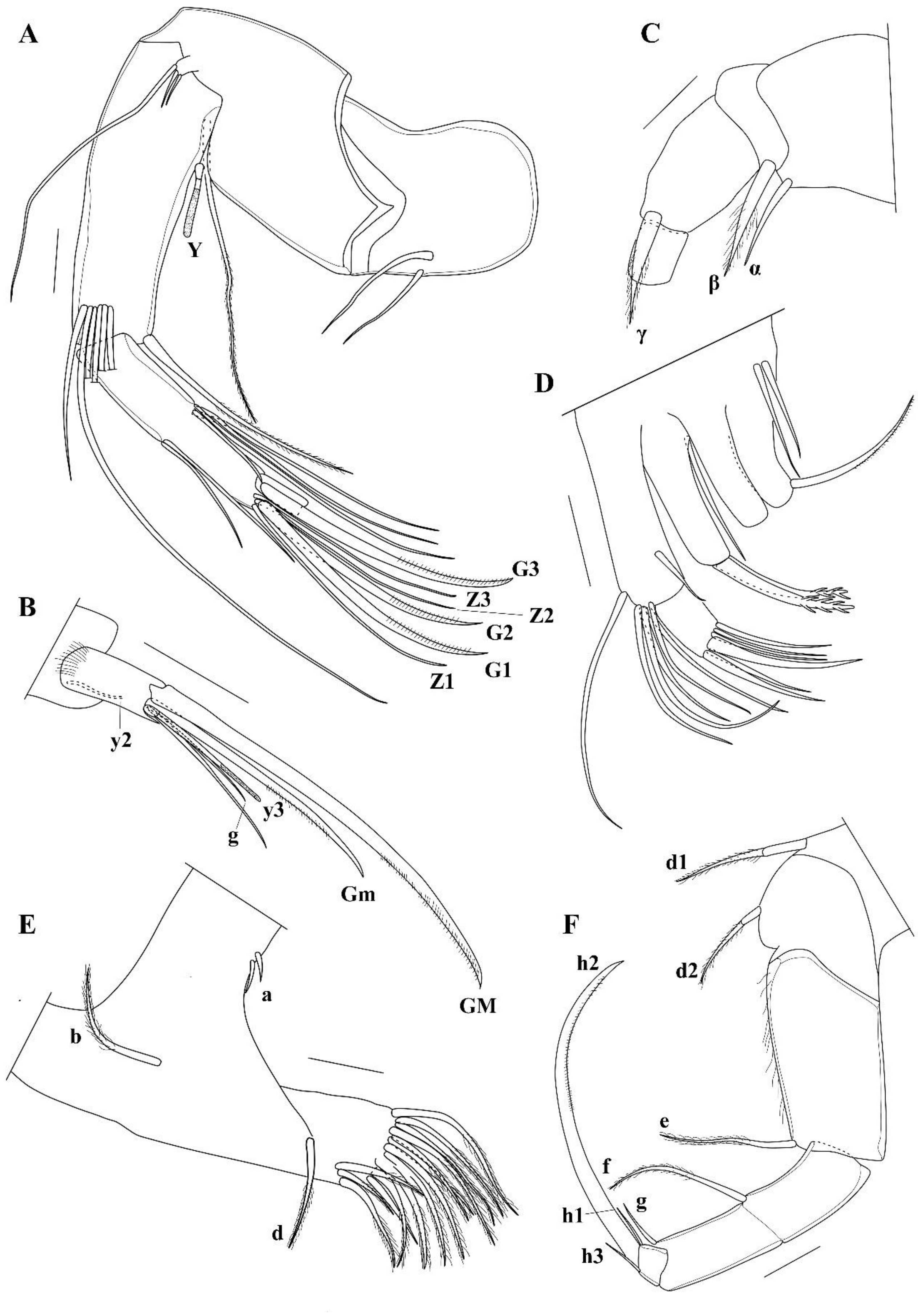

Figure 40 *Strandesia colombiensis.* A, A2 except last segment (VF069); B, A2 last segment (VF069); C, Md palp showing α, ß, γ setae (VF069); D, Mx1 (VF069); E, T1 (VF069); F, T2 (VF069). Scale bars, 50 μm.

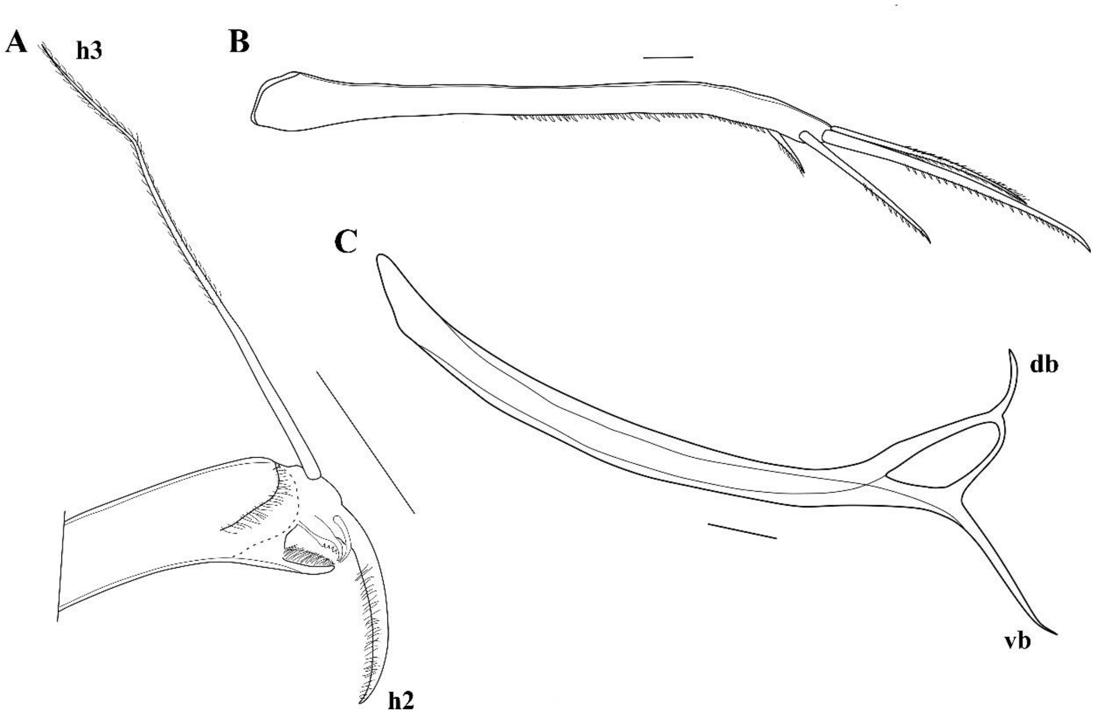

Figure 41 *Strandesia colombiensis.* A, T3 pincer (VF069); B, CR (VF069); C, CR attachment (VF069). Scale bars, 50 µm.

Remarks

This is the first record of *Strandesia psittacea colombiensis* in Brazil. This subspecies was described by Roessler (1990) from temporary pools and lakes near the city of Villavicencio in Colombia. The similarity of this species with *Strandesia psittacea* (Sars, 1901) was discussed by Roessler (1990a) which then allocated it as a subspecies. However, there are significant, and especially consistent, differences in the ratio of L/H of the carapace (*S. psittacea*, 1.84-1.84; *S. psittacea colombiensis*, 1.54-1.67); the more curved dorsal region on *S. psittacea colombiensis;* and the differences in frontal view of the carapace, with *S. psittacea* with a rounded shape, whereas *S. psittacea colombiensis* has a subtriangular shape. Also, the antero-ventral beak is more rounded in *S. psittacea* and more pointed in *S. colombiensis.* These morphological differences support the decision to raise *S. psittacea colombiensis* to the rank of species, with the name of *Strandesia colombiensis.*

Roessler (1990b) described *Strandesia psittacea colombiensis,* while Roessler (1990a) described *S. obtusata colombiensis*. Following the ICZN, names of species and subspecies have the same nomenclatorial rank. Therefore, *S. obtusata colombiensis* is a junior synonym of *S. psittacea colombiensis.* Martens & Behen (1994) therefore renamed the junior name as

Strandesia obtusata roessleri. By here raising the rank of *S. psittacea colombiensis* to species-level, the name *S. colombiensis* can be used.

Ecology and distribution

In the present paper *Strandesia colombiensis* was recorded only in lentic environments, associated with a variety of macrophytes, with different life forms, in Amazon and Paraná river floodplains. This species occured in acid to basic environments, with a pH range of 4.2 – 9.7. Electrical conductivity and dissolved oxygen ranges were 11 - 63 $\mu S.cm^{-1}$ and 0.4 - 6.1 $mg. L^{-1}$, respectively (see Table S1).

Distribution: Brazil, Colombia (Roessler 1990b).

2.4 DISCUSSION

The present paper is a contribution towards a revision of the genus *Strandesia* in Brazil. Here, we follow the definition of the genus *Strandesia* as revised by Savatenalinton & Martens (2009a, b). This means that the suggestion by Broodbakker (1983) to retain the subgenera *Neocypris* Sars, 1901 and *Acanthocypris* Claus, 1892 within *Strandesia* is not followed here.

With the present descriptions of three new species of *Strandesia*, the number of Brazilian *Strandesia* species increases from 17 to 20 species. However, for several of the seven species not discussed here, either their generic assignment or even their status as valid species remains uncertain. This is especially true for the species described by Tressler (1950), which will be discussed elsewhere.

The *S. bicuspis* group received two new species. Both are rare species, *Strandesia* sp. 1 nov. sp. was found in only two lakes and *Strandesia* sp. 2 nov. sp. in only one lake in Araguaia floodplain. These species belong to the group of species in *Strandesia* with a dorsal protuberance or helmet-like expansion (ala), for which Klie (1930) suggested to use the generic name *Acanthocypris*. Klie (1938) placed six species in that genus. However, as Broodbakker (1983) correctly pointed out, the presence of such a structure in a species does not automatically mean that this species belongs to the same monophyletic lineage as other species with dorsal alae. In fact, the profound difference in morphology of the alae in different *Strandesia* species is already an indication that the structure might be the result of convergent evolution in different lineages with the genus.

Strandesia obtusata was first described by Sars (1901) from specimens that he raised from dried mud collected from Itatiba (near São Paulo). The shape of the carapace in lateral and dorsal views (Sars 1901: plate VIII figs. 1 & 2) is almost identical to that of our specimens, but there is a difference in size: Sars's (female) specimens are said to have a length of 1.200 µm, while our female specimens are between 949 and 994 µm long, i.e. less than 1000 µm. Nevertheless, we are confident that we are dealing with the same species, which moreover appears to have a wide distribution: between our new localities in Araguaia floodplain and the type locality near São Paulo, the distance is c. 1400 km).

Broodbakker (1983) already provided a partial redescription of the species based on the type material of Sars (1901) and rejected identifications of *S. obtusata* from Java by Tressler (1937) (see also Victor & Fernando 1981) and from Yucatan by Furtos (1936). In both cases, the species lacked the characteristic dorso-caudal expansion on the right valve. It would thus appear that, to date, *S. obtusata* remains endemic to the Neotropical Realm. Roessler (1990a) extensively described a new subspecies, *Strandesia obtusata colombiensis* Roessler, 1990 from temporary habitats near Juan de Arama in Colombia. However, Roessler (1990b) had already described the subspecies *Strandesia psittacea colombiensis* Roessler, 1990 and as species and subspecies within a genus have the same nomenclatorial rank following the ICZN, Martens & Behen (1994) gave a new name for this subspecies: *Strandesia obtusata roessleri* Martens & Behen, 1994 (see remark above). There are clear morphological differences between the carapaces of this subspecies and of *S. obtusata obtusata*, so that the delimitation of a (probably geographical) subspecies in Colombia seems justified. In fact, the Colombian populations might even belong to a separate species.

Sexual populations of *Strandesia*-species are rare. It is the first time that sexual populations of *S. obtusata obtusata* have been found and we here provide the first description of the male. The hemipenis has the same basic structure as in *S. mercatorum* (Vavra, 1895) (see re-description in Savatenalinton & Martens 2009a), the type species of the genus, also in the inner structure where both species display one additional loop in the postlabyrinthal spermiduct. In both species, the distal segment in the right prehensile palp is much larger than in the left prehensile palp, while the exact shapes of these segments are of course species-specific. Sexual populations of this species were recorded in four lakes, whereas asexual population occurred in three lakes. We can at this stage not see any aspects of water chemistry, size or position of the lakes that might cause the population of this species to be sexual or asexual. We can thus not be sure if we are dealing here with ecological or geographical parthenogenesis (for a review of the latter, see Martens 1998; Horne & Martens 1999).

The appendage morphology of *Strandesia* species is very conservative, with only few differences detected. On the other side, the carapace shape shows a great variety among species. The fact that the soft parts are completely encompassed by the valves should limit the variation, as the contact of the limbs with the environment is reduced by this (Martens et al. 1998b).

The 13 *Strandesia* species (re-) described here were recorded in association with 25 macrophytes species and with sediments of the littoral from open and closed lakes, rivers, channels and backwaters. *Strandesia lansactohai*, *S. velhoi* and *S. tolimensis* were the most common species. All three species were recorded in four floodplains, associated with a variety of macrophytes of different life forms. In contrast, *S. bicuspis*, *Strandesia* sp. 1 nov. sp., *Strandesia* sp. 2 nov. sp. and *Strandesia* sp. 3 nov. sp. were found in only one floodplain each.

No species showed significant ecological preferences regarding macrophyte life form. With the exception of *S. bicuspis*, which occurs in the Neotropics and Paleartic (in the latter Realm as introduced species in containers in a greenhouse of the Munich Botanical Garden by non-native plants), all species discussed here are endemic to the Neotropical Realm.

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APPENDIX A - Table S1 Environment type, substrate type and abiotic variables (mean and standard deviation; minimum and maximum values in parenthesis) where *Strandesia* species were recorded in the river-floodplain systems of Amazon, Araguaia, Pantanal and Paraná. WT, water temperature; EC, electrical conductivity; DO, dissolved oxygen. Az, *Azolla* sp.; Ec, *Eichhornia crassipes* (Mart.) Solms; Ll, *Limnobium laevigatum* (Humb. & Bonpl. ex Willd.) Heine; Lm, *Limnobium* sp.; Sa, *Salvinia auriculata* Aubl.; Sh, *Salvinia herzogii* de la Sota; Sm, *Salvinia minima* Baker; Sp, *Salvinia* spp; Ps, *Pistia stratiotes* L. Rc, *Ricciocarpus* sp.; Lw, *Ludwigia* sp.; Pn, *Paspalum notatum* Flugge.; Oc, *Oxycaryum cubense* (Poepp. & Kunth) Palla.; Na, *Nymphaea amazonum* Mart. & Zucc.; Cf, *Cabomba furcata* Schult. & Schult. f.; En, *Egeria najas* Planch.; La, *Lindernia althernanthera;* Uf, *Utricularia foliosa* L.; Ea, *Eichhornia azurea* (Sw.) Kunth; Hr, *Hydrocotyle ranunculoides* L. f.; Hy, *Hydrocotyle* sp.; Pr, *Paspalum repens* P.J. Bergius; Pa, *Polygonum acuminatum* Kunth; Pf, *Polygonum ferrugineum* Wedd.; Pt, *Polygonum stelligerum* Cham; Pl, *Polygonum* sp; Li, Littoral.

Species	**Floodplain (number of environment)**	**Environment type**	**Substrate type**	**WT (ºC)**	**pH**	**EC (µS.cm^{-1})**	**DO (mg.L^{-1})**
Strandesia bicuspis (Claus, 1892)	**Paraná (3)**	river, closed lake	Sp, Ec, Li	26.3±2.6 (23.6-29.9)	6.4±0.9 (5.6-7.8)	76.7±32.7 (41.3-114.9)	4.5±2.8 (1.8-7.9)
***Strandesia* sp. 1 nov. sp.**	**Araguaia (2)**	open lake	Pn	30±0.7 (29.6-30.5)	6.4±0.3 (6.2-6.7)	42.9±0.9 (42.3-43.6)	2.4±0.6 (1.9-2.9)
***Strandesia* sp. 2 nov. sp.**	**Araguaia (1)**	open lake	Li	30.5	6.6	39	7.2
Strandesia obtusata (Sars, 1901)	**Araguaia (10)**	open lake	Pn, Uf, Az, Lm, Ps, Sa, Li	28.8±0.9 (27.6-30.2)	6.5±0.3 (6.1-6.9)	40.9±7.4 (28.5-53.4)	3.4±1.9 (1.0-6.5)
Strandesia lansactohai Higuti & Martens, 2013	**Paraná (31)**	open and closed lakes, river, channel, backwater	Ec, Li, Oc, Ea, Sp, Ps, Hr, Sh, Na, Sm, En, Uf, Lm, Pl, Cf, Pr, La	27.9±4.5 (12.4-34.1)	6.2±0.6 (4.4-8.1)	45.7±18.8 (12-123.8)	3.7±2.2 (0.1-10.2)
	Amazon (15)	open lake	Pn, Ec, Sm, Ps, Sa, Az, Lm, Lw	32.7±1.6 (31-37.2)	7.4±1.5 (5.4-9.7)	65.8±45 (17.8-222.5)	3.4±3.2 (0.4-11.8)

Species	Floodplain (number of environment)	Environment type	Substrate type	WT (ºC)	pH	EC (µS.cm^{-1})	DO (mg.L^{-1})
	Araguaia (16)	open ake	Pn, Ps, Rc, Ec, Sa, Az, Uf, Li	29.7±0.6 (28.5-30.9)	6.8±0.1 (6.4-7.1)	37.5±9.2 (21.8-54.4)	5.8±1.6 (1.7-7.9)
	Pantanal (16)	open lake	Ec, Sa, Ps, Lw, Ea, Hy	25.0±4.6 (19.7-33.1)	7.1±0.6 (6-8.1)	88.5±46.4 (48.5-166)	3.5±1.7 (0.07-6.1)
Strandesia velhoi Higuti & Martens, 2013	**Paraná (18)**	open and closed lakes	Li, Ea, Ec, Sh, Pl, Ll	28.1±4.4 (14.3-34.1)	5.9±0.9 (4.2-7.8)	40.6±17.9 (11-72)	3.4±2.5 (0.6-8.3)
	Amazon (15)	open lake	Pn, Ec, Ps, Oc, Sm, Az, Sa, Lw, Lm	32.6±1.5 (31-37.2)	6.9±1 (5.4-9.5)	62.3±36.7 (17.8-222.5)	3±3 (0.4-11.8)
	Araguaia (11)	open lake	Pn, Ps, Rc, Ec, Sa, Az, Uf, Oc, Sa	29.9±0.7 (28.5-30.9)	6.8±0.2 (6.4-7.0)	38.1±7.8 (26.5-54.4)	5.6±2.1 (1.8-7.9)
	Pantanal (1)	open lake	Ec	26.5	6.04	58.2	5.5
Strandesia nupelia Higuti & Martens, 2013	**Paraná (31)**	open and closed lakes, river, channel, backwater	Ec, Li, Oc, Ea, Sp, Ps, Hr, Sh, Na, Sm, En, Uf, Lm, Pl, Cf, Pr, La	25.9±5.2 (14.3-34.1)	6.2±0.8 (3.8-8.4)	42.4±17.7 (11-96.6)	3.9±2.1 (0.2-8.7)
	Pantanal (5)	open lake	Ec, Sa, Ps, Ea, Lw	20.5±0.7 (19.7-21.4)	7.8±0.4 (7.05-8.1)	120.4±48.6 (54.3-162.2)	4.5±0.5 (3.6-5.1)
Strandesia tolimensis Roessler, 1990	**Paraná (22)**	open and closed lakes, river	Ec, Li, Fl, Ea, Uf, Lm, Pl, Cf, Pr, Pf, En, Sh	29.8±3.2 (18.4-34.1)	5.7±0.4 (4.7-6.5)	34.2±16.3 (12-67.5)	2.8±2.1 (0.2-8.3)

Species	Floodplain (number of environment)	Environment type	Substrate type	WT (ºC)	pH	EC (µS.cm^{-1})	DO (mg.L^{-1})
	Amazon (5)	open lake	Sa, Ps, Lw, Az, Ec, Uf, Ln, Pn, Lm	32.4±1.2 (31.5-34.3)	7±1 (6.4-9.5)	54±8.9 (43.5-67.8)	2±0.9 (0.9-3.1)
	Araguaia (10)	open lake	Pn, Uf, Ec	29.9±0.7 (28.5-30.9)	6.8±0.1 (6.6-7.0)	35.0±6.8 (26.5-46.6)	6.4±1.3 (3.9-8.0)
	Pantanal (3)	open lake	Ec, Lw, Ps	22.8±2.2 (20.3-24.7)	7.1±0.7 (6.5-7.9)	113.1±44.7 (53.5-162.2)	2.7±1.3 (1.6-4.0)
***Strandesia* sp. 3 nov. sp.**	**Paraná (4)**	river and lake	Ea, Ec, Sa	25.2±4.6 (17.1-30.0)	7.4±0.4 (6.4-8.3)	56.2±10.9 (35.0-68.8)	5.0±3.1 (1.4-12.2)
Strandesia variegata (Sars, 1901)	**Paraná (23)**	open and closed lakes, river.	Ec, Li, Fl, Ps, Sa, Ll, Ea, Sh, Uf, Pf, Pr	29.1±3.5 (18.5-33.1)	5.7±0.5 (4.2-6.9)	33.3±12.4 (11-67.1)	2.6±1.9 (0.2-8.3)
	Pantanal (1)	open lake	Sa, Ea	24.9	7.4	84.8	0.33
Strandesia mutica (Sars, 1901)	**Paraná (30)**	open lake	Ec, Li, Ea, Ps, Md, Sh, Sa, Hr, Ll, Lm, Sh, Sm, Pl, Pf	27.7±4.1 (14.3-33.7)	5.9±0.7 (4.2-8.3)	43.3±21.4 (11.0-123.8)	3.0±2.1 (0.1-9.8)
	Amazon (3)	open lake	Ec, Sa, Ps, Pn	31.9±0.8 (31.5-32.9)	6.5±0.1 (6.5-6.6)	49.9±7.2 (41.5-54.1)	1.2±0.06 (1.2-1.3)

Species	Floodplain (number of environment)	Environment type	Substrate type	WT (ºC)	pH	EC (µS.cm^{-1})	DO (mg.L^{-1})
Strandesia psittacea (Sars, 1901)	**Paraná (24)**	open and closed lakes, river, backwater	Ec, Li, Oc, Ea, Ps, Sa, Ll, Uf, Sh, Lm, Hr, Pl, Pa, Ll, La, Po, Pr, Cf, En	28.3±4.8 (15.4-33.6)	6.2±0.6 (4.7-8.3)	32.7±16.2 (12-80.4)	3.26±1.9 (0.2-8.2)
	Amazon (8)	open lake	Ec, Ps, Oc, Sm, Pn, Sa	32.2±0.8 (31-34.3)	7.8±1.63 (5.4-9.7)	52.2±11.8 (17.8-67.8)	3.1±1.2 (0.4-5.1)
	Araguaia (1)	open lake	Pn	30.9	6.93	33.4	7.9
Strandesia colombiensis Roessler, 1990	**Paraná (12)**	open lake	Ec, Ps, Ea, Ll, Sm, Pr, Pa, Ps, Uf, En	30.3±2.3 (21.7-33.6)	5.7±0.7 (4.2-7.7)	27.2±15.4 (11-63.0)	2.5±1.4 (0.4-6.1)
	Amazon (3)	open lake	Ec, Sa, Ps, Pn	31.4±0.3 (31-31.9)	8.7±1.8 (5.4-9.7)	44.6±15 (17.8-51.5)	2.7±1.3 (2.1-5.1)

3. A STRIKING CASE OF CONVERGENT EVOLUTION IN TWO SPECIES OF CYPRICERCINAE (CRUSTACEA, OSTRACODA), WITH THE DESCRIPTION OF A NEW GENUS AND SPECIES FROM BRAZIL

ABSTRACT

Gen. 1 n. gen. sp. A n. sp. is here described and constitutes an interesting case of convergent evolution with *Bradleytriebella lineata* (Victor and Fernando, 1981). Both cypricercine species look superficially similar, with comparable valve and carapace shapes and especially ornamentation, as in both species the valves are densely set with longitudinal ridges. However, examination of the limb chaetotaxy shows important differences, especially in the chaetotaxy of the Mx1-palp which shows reduced numbers of claws and setae, and in the T1, in which seta ‘b’ has taken a giant aspect in the new taxon. These, and other, differences merit the allocation of these two species to different genera and even tribes within the subfamily Cypricercinae.

Keywords: Amazon River floodplain – Araguaia River floodplain – Paraná River floodplain – cypricercinae – macrophytes.

3.1 INTRODUCTION

There are about 300 species and 62 genera of non-marine ostracods described from the Neotropics (Martens and Higuti, in press). Approximately 62% of all species belong to the family Cyprididae (Martens et al., 2008). Within the Cyprididae, the subfamily Cypricercinae comprises 11 genera and 171 species worldwide, but mostly occur in the (sub-) tropics (Meisch et al., 2019). The taxonomy of the Cypricercinae has, for a long time, been confused because there is a wide plasticity in shape, structure and size of the valves, making these structures rather unreliable in taxonomy. McKenzie (1982) pointed out that "Homeomorphy is a persistent joker in the taxonomic pack" and this is certainly true for the Cypricercinae. In such cases, soft part (limb) morphology is generally more conservative than valve morphology (with the exception of structures used during copulation, mostly in males) and most phylogenetic signal can be found in ostracod limbs. Unfortunately, in many of the descriptions of the older species and genera, also in the Cypricercinae, insufficient attention was given to the description of the chaetotaxy of the limbs.

The confusion in Cypricercine taxonomy was initially caused by the inability to provide good characters to distinguish between the oldest genera *Strandesia* Stuhlmann, 1888 and *Cypricercus* Sars, 1895. The type species of these genera have very different valves (high and rounded, with a helmet like dorsal expansion on the right valve in *Strandesia mercatorum* (Vavra, 1895) and elongated without helmet in *Cypricercus cuneatus* Sars, 1895), but almost no structural differences in the soft part chaetotaxy (Savatenalinton, & Martens, 2009a). In addition, especially in *Strandesia s.l.*, dozens of species have been described that look very different from the type species.

The discovery of the variable Triebels' loop in the attachment of the caudal ramus (Rome, 1969) was the first tool for the construction of a taxonomy the subfamily. It allowed to transfer several genera from other subfamilies to the Cypricercinae and allowed the description of several new tribes and genera within this subfamily. Savatenalinton & Martens (2009a, b, 2010) provided the first revision at the levels of tribes and genera and suggested new characters that could bring taxonomic order in the group.

Convergent evolution in ostracod valves and carapaces is common and is most likely more common than presently known. It is of course especially a problem in fossil ostracods, as no independent test on other characters (such as soft parts) is available to palaeontologists, except in some cases geographic distribution and stratigraphic age. One of the most striking cases of convergent in valve and carapace shape in recent non-marine ostracods is of course that of *Rudjakoviella prolongata* (Triebel, 1962) from a Venezuelan Island and *Strandesia bicornuta* Hartmann, 1964 from southern India. In both species, the right valves have long and pointed anterior and posterior spines, but the soft part morphology shows that the two taxa are not at all closely related (see also Broodbakker, 1983 and Martens & George, 1992).

Here, we provide another striking example of convergent evolution in cypricercine ostracods, namely between the circumtropical *Bradleytriebella lineata* (Victor & Fernando, 1981) and a new genus and species of the same subfamily, all from Brazilian floodplains.

3. 2 MATERIAL AND METHODS

3.2.1 Study area (see Table S1)

3.2.1.1 Araguaia River floodplain

The Araguaia River is located in central Brazil, and runs through four different states: Goiás, Mato Grosso, Pará and Tocantins (Morais et al., 2005). This river is 2.110 km long, is divided in upper, middle and lower Araguaia and has a drainage area of approximately 377,000 km^2. The climate of the tropical savanna ("Cerrado") has two well-distinct seasons, namely rainy season (between November and April) and dry season (May to October). Owing to extensive damages caused by farming activities, such as deforestation and subsequent erosions, the Araguaia river and its floodplain is considered a priority area for the conservation of biodiversity and is the object of political and environmental discussions (Latrubesse and Stevaux, 2002; Latrubesse et al., 2009).

3.2.1.2 Amazon River floodplain

The Amazon River in South America is the second longest and has the largest drainage basin in the world, occupying more than 6.8 million km^2. During the rainy season, the water discharged in the Atlantic Ocean travels approximately 160 km out into the sea. Rainfall is evenly distributed spatially and temporally, ranging from 1500 to 2500 mm annually, for about 6 months a year (Goulding et al., 2003). The Amazon River and its tributaries are accompanied along their middle and lower courses by large fringing floodplains that cover an area of about 300,000 km^2. Every year the river rises more than nine meters, flooding the surrounding forests, known as *várzea* (Irion et al., 1997).

3.2.1.3 Upper Paraná River floodplain

The Paraná River is the tenth longest river in the world and has a drainage area covering 2.8 x 10^6 km^2. The first third of this basin is named Upper Paraná River and most of it runs within Brazil. The Upper Paraná River floodplain is located between the Porto Primavera Reservoir and the Itaipu Reservoir, and is about 230 km long and 20 km wide. In this area, three conservation units were created: “Área de Proteção Ambiental das Ilhas e Várzeas do Rio Paraná” (Environmental Protection Area), the “Parque Nacional de Ilha Grande” (National Park), and the “Parque Estadual do Ivinheima” (State Park). The floodplain, apart from the main channel of the Paraná River, also includes parts of the Ivinheima and Baía rivers (Agostinho et al., 2004).

3.2.2 Sampling

Sampling was done in November 2011 and March 2012 in the Araguaia River floodplain; in May 2012 in the Amazon floodplain and between 2004 and 2018 in the upper Paraná River floodplain. (Fig. 1). Ostracods were collected from the sediment-water interface (littoral) and from aquatic vegetation: *Azolla* sp., *Cabomba furcata* Schult. & Schult, *Eichhornia azurea* Kunth, *Eichhornia crassipes* (Mart.) Solms, *Egeria najas* Planch, *Limnobium* sp.; *Paspalum notatum* Flügge, *Pistia stratiotes* L., *Polygonum* sp., *Salvinia auriculata* Aubl, *Salvinia minima* Baker and *Utricularia foliosa* L. (see Table S1). Littoral sampling was performed using a rectangular hand net (28cm x 14cm, mesh size ~160µm). The floating and submerged vegetation was hand-collected, and the whole plants and/or roots were washed in a bucket (Campos et al., 2017). The material from the bucket was filtered in the net (mesh size 160µm). All material was preserved in 70% ethanol, which was buffered with sodium tetraborate. Limnological variables, such as pH (pHmeter-Digimed), electrical conductivity (conductivimeter-Digimed), water temperature, and dissolved oxygen concentration (DO) were measured *in situ*, close to the aquatic macrophytes.

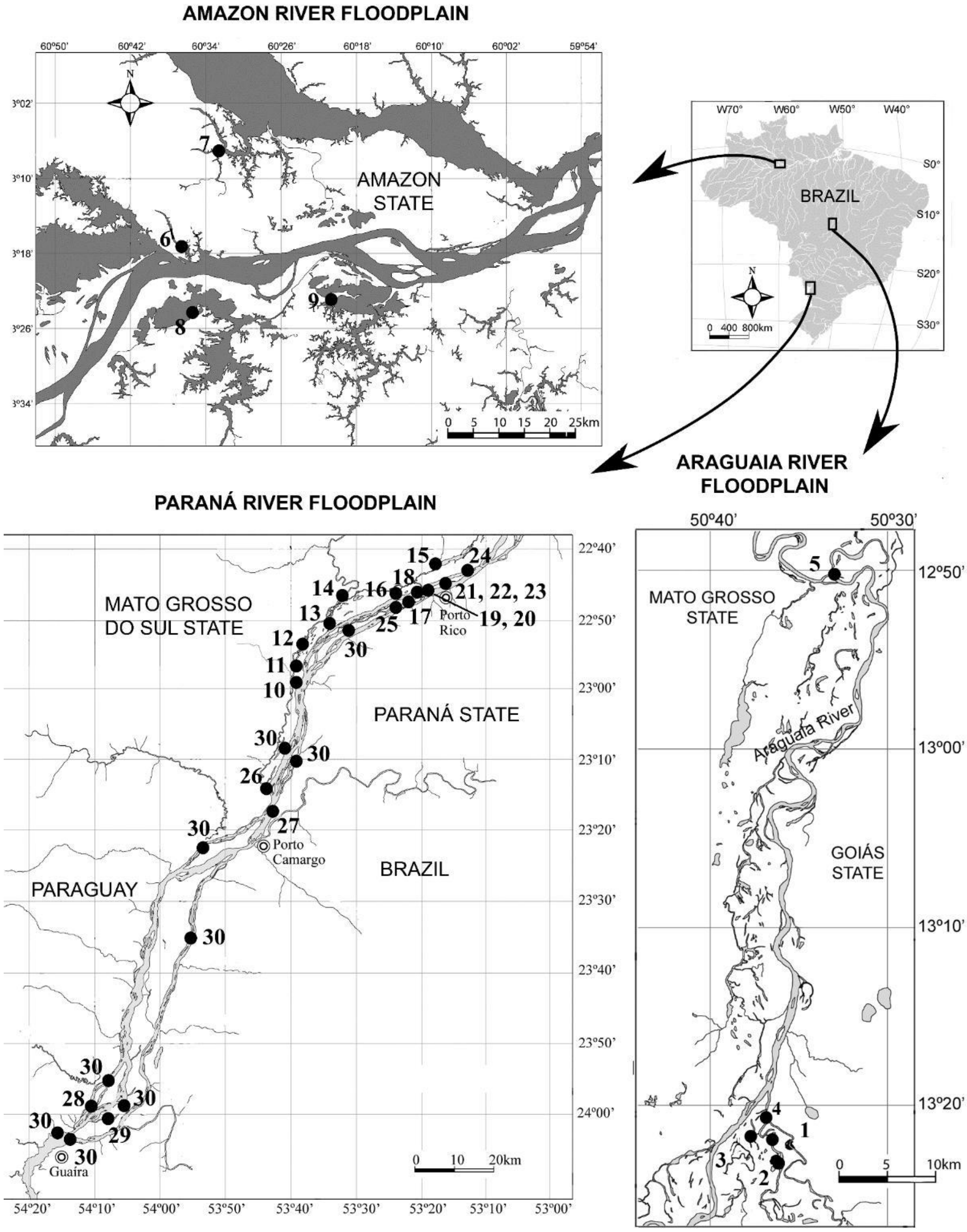

Figure 1 Localities where Gen. 1 n. gen. sp. A n. sp. and *Bradleytriebella lineata* were recorded in the Araguaia, Amazon and Paraná rivers floodplains. Numbers indicate geographic localities (see Table S1).

3.2.3 Preparation and illustration of soft parts and valves

Ostracods were dissected using a stereomicroscope Olympus SZX16. Soft parts were separated from the valves using dissection needles; valves were stored dry in micropaleontological slides. Soft parts were put in a drop of glycerin for the dissection of the appendages and were covered with a cover-slip. The dissection was sealed using nail polish. Drawings were made using a camera lucida (Olympus U-DA) attached to the microscope (Olympus CX-41). Carapace and valves were illustrated and measured in different views (valves: internal, external, carapaces: ventral, dorsal, frontal) using Scanning Electron Microscopy (SEM) (Brussels lab, Philips XL30). The types and illustrated specimens are stored in the Museum of Zoology of the University of São Paulo (MZUSPxxx) and the Royal Belgian Institute of Natural Sciences (IGxxx – RBINS).

3.2.4 Size classes of several soft part features used in the text and in Table 2

Y-aesthetasc: short = distance between tip of Y and tip of segment is about length of Y; normal = distance between tip of Y and tip of segment is less than length of Y; Long = tip of Y reaching beyond tip of segment. T1 b-seta: long = average length about that of apical setae; giant = length > 3 x average length of apical setae. CR: slender = Type E; stout = Type A - C (see Savatenalinton & Martens, 2009b fig. 2).

3.2.5 Abbreviations used in text

RV, right valve; LV, left valve; LVi, left valve inner view; RVi, right valve inner view; Cp, carapace; CpLl, carapace left lateral view; CpD, carapace dorsal view; CpV, carapace ventral view; L, length; H, height; W, width; A1, antennula; A2, antenna; CR, caudal ramus; Md, mandibula; Mx1, maxillula; T1, first thoracopod; T2, second thoracopod; T3, third thoracopod; db, dorsal branch of attachment of caudal ramus; vb, ventral branch of attachment of caudal ramus.

3.3 RESULTS

Class OSTRACODA Latreille, 1806

Subclass PODOCOPA G. W. Müller, 1894

Order PODOCOPIDA Sars, 1866

Suborder CYPRIDOCOPINA Baird, 1845

Superfamily CYPRIDOIDEA Baird, 1845

Family CYPRIDIDAE Baird, 1845

Subfamily CYPRICERCINAE McKenzie, 1971

Tribe Cypricercini McKenzie, 1971

3.3.1 Gen. 1 n.gen.

3.3.1.1 Type species:

Gen. 1 n. gen. sp. A n. sp. (here designated)

3.3.1.2 Diagnosis:

RV with an anterior inwardly displaced selvage. A2 with aesthetasc of normal length, i.e. not reaching beyond tip of segment. Mx1 first endite with 2 side-ways directed bristles. First segment of Mx1-palp with 4+1 setae; second segment of Mx1-palp distally with 1 claw and 3 setae. T1 with long (gigantic) and stout b-seta; d-seta present. Attachment of caudal ramus slender; Triebel's loop situated in the main branch.

Remark: as this genus is thus far monospecific, it is difficult to judge which characters are diagnostic at the generic level and which at the specific level. It would be tempting to cite the external valves ornamentation in the generic diagnosis, but as this is a convergent character with another species in another genus, we refrain from doing so. Future finding of other species in Gen. 1 n. gen. will allow to amend the diagnosis.

3.3.1.3 Differential diagnosis:

The characters by which the 12 genera in the Cypricercinae can be distinguished are listed in Table 2.

The genus is monospecific.

3.3.2 Gen. 1 n. gen. sp. A n. sp.

Figs 2-4

Bradleytriebella cf. *lineata* n. sp. in Pereira et al., 2017: 327, table 2

3.3.2.1 Diagnosis

Cp subovate, with clear striations on the external surface; LV anteriorly overlapping RV. LV with internal marginal groove along the anterior, ventral and posterior margin. RV with marginally inwardly displaced selvage, anterior valve margin crenulate because of ending striations. A2 with natatory setae not reaching beyond tips of apical claws. T2 with seta d1 almost twice as long as d2. Caudal ramus stout, its attachment with an oval Triebel's loop in the main branch.

3.3.2.2 Type locality

Araguaia River floodplain, Lake Crixas IV in *Utricularia foliosa*. Coordinates: 13º20' 3.4″S, 050º36'37.7″, Brazil.

3.3.2.3 Type material

Holotype: A female, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (VF049).

Paratypes: Five females dissected and stored as the holotype (VF042, VF045, VF047, VF049, VF054). Three females stored dry in micropaleontological slides (JH954, JH955, JH956).

3.3.2.4 Other material investigated

A female stored dry in micropaleontological slide (JH986) from Crixas III Lake (ARA52) of Araguaia floodplain. A female dissected with soft parts in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (VF055) from Jutai Lake (AMA76) of Amazon floodplain. See Table S1 for further details.

3.3.2.5 Other localities

See Table S1 for further details.

3.3.2.6 Differential diagnosis

Gen. 1 n. gen. sp. A n. sp. can be distinguished from other species in the subfamily amongst other characters by the striation on the external surface of the carapace and by the presence of a gigantic b-seta (c. twice the length of d-seta) on T1. It has a similar appearance to *Bradleytriebella lineata*, yet the two species are unrelated, with the morphological similarity resulting from convergent evolution (see discussion).

3.3.2.7 Description of female

LV in inner view (Fig. 2A) with calcified inner lamella wide along anterior margin, narrower along posterior margins, and absent along ventral margin; with characteristic "*Strandesia*" inner groove present along the anterior, ventral and posterior margins. RV in inner view (Fig. 2B) with calcified inner lamella as in LV, anterior selvage very slightly inwardly displaced, posterior and postero-ventral selvage more widely inwardly displaced; anterior valve margin crenulate owing to ending striations, posterior selvage partly crenulate. Greatest height in both valves situated well in front of the middle.

Cp in left lateral view (Fig. 2C) sub-ovate, with striations on the surface from posterior do anterior margin. Cp in dorsal view (Fig. 2D), sub-ovate, with striations; LV overlapping RV anteriorly and posteriorly, at the latter edge asymmetrically so. Cp in ventral view (Fig. 2E) with striations; LV overlapping RV with a flap slightly anteriorly to the middle. Cp in frontal view (Fig. 2F), with striations; valves almost symmetrical.

A1 and Md as typical of the subfamily (not illustrated).

A2 (Fig. 3A-B) with 4 segments, distal three segments forming the endopodite. First segment with 2 ventral setae (1 longer; 1 shorter, with the latter about 3/4 of the length of the longer seta); and 1 distal seta, the latter long. Exopodite reduced to a small plate, with 1 long and 2 unequal short setae. First endopodal segment with 1 ventral aesthetasc Y, 1 long apical seta (reaching the last segment) one group of 5 long and 1 short swimming setae (the 5 long setae not reaching beyond the tips of the apical claws; the shortest reaching the middle of third segment). Second endopodal segment undivided, with 2 unequal but long dorsal setae and a group of 4 unequal long ventral setae (the longer one reaching the middle of G2); apically with 3 claws (G1, G2 and G3) and 3 setae (z1, z2 and z3). Terminal segment with 2 claws (GM and Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance, and a short g-seta.

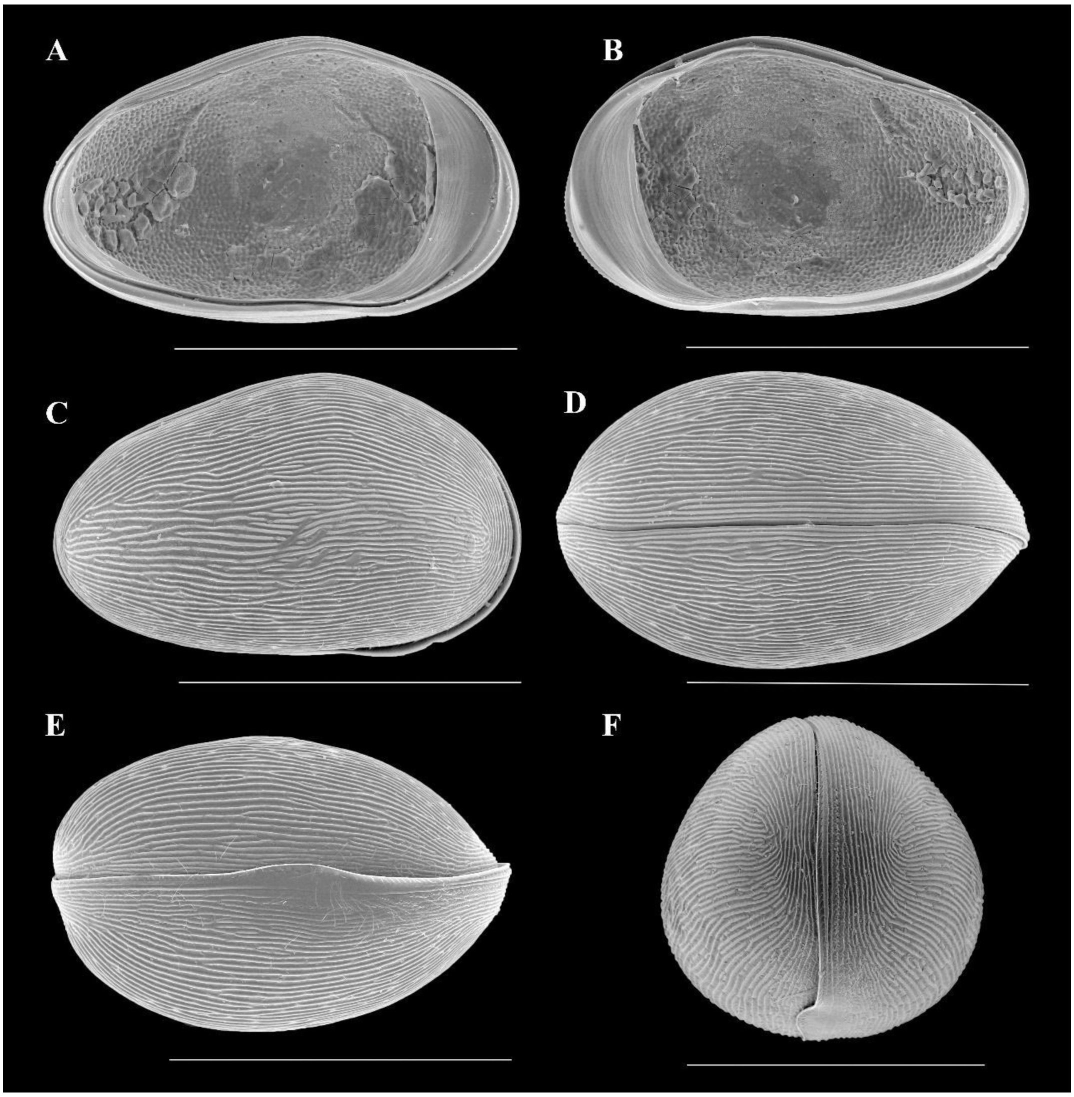

Figure 2. Carapace and valves of Gen. 1 n. gen. sp. A n. sp. (A) LVi (JH954); (B) RVi (JH954); (C) CpRl (JH955); (D) CpD (JH956); (E) CpV (JH957, material lost); (F) CpFr (JH956). Scale bars, A-E, 500µm; F, 100µm.

Mx 1 (Fig. 3C - chaetotaxy not complete) consisting of 3 masticatory lobes, a 2-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with 4 unequal long apical setae, and 1 short subapical seta. Terminal palp-segment with 1 claw and 3 setae. Third endite with 2 large bristles serrated, tips of teeth rounded and with long subapical seta. Two sideways-directed bristles on first endite, the shorter ca. 2/3 of the length of the longer one, both weakly hirsute.

T1 protopodite (Fig. 3D) with 2 short a-setae, 1 stout and hirsute b-seta (ca. 2x the length of d-seta) and 1 long d-seta. Apically with 10 hirsute setae, subapically with a group of 4 hirsute setae. Endopodite with 3 unequal long hirsute setae (not illustrated here).

T2 (Fig. 3E) with 5 segments. First segment with seta d1 long. Second segment with seta d2 shorter, ca. half of the length of d1. Third segment with 1 subapical hirsute seta (e). Fourth segment medially divided into a- and b- segments; segment "a" with 1 long apical hirsute seta (f); segment "b" with 1 shorter seta (g) reaching the end of the terminal segment. Terminal segment with 1 apical claw (h2) and 2 setae (1 subapical (h1) and 1 apical).

T3 (Fig. 4A- chaetotaxy not complete) with 3 segments. First segment with 3 long setae (d1, d2, dp) (not illustrated here). Second segment, longer than wide, with 1 subapical seta (e). Second segment longer than wide, with 1 subapical seta (f). Third segment, also longer than wide, with 1 lateral, hirsute seta (g); distal part of the third segment fused with 4^{th} segment into a modified pincer, with 1 apical comb-like seta (h2), 1 small recurved seta, 1/5 of the length of the comb like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 4B) slender and curved, with ventral margin weakly serrated. Proximal and distal claws also weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta 1/4 of the length of distal seta.

CR attachment (Fig. 4C) stout, with oval Triebel's loop in the main branch. Both ventral and dorsal branches well-developed.

Male unknown

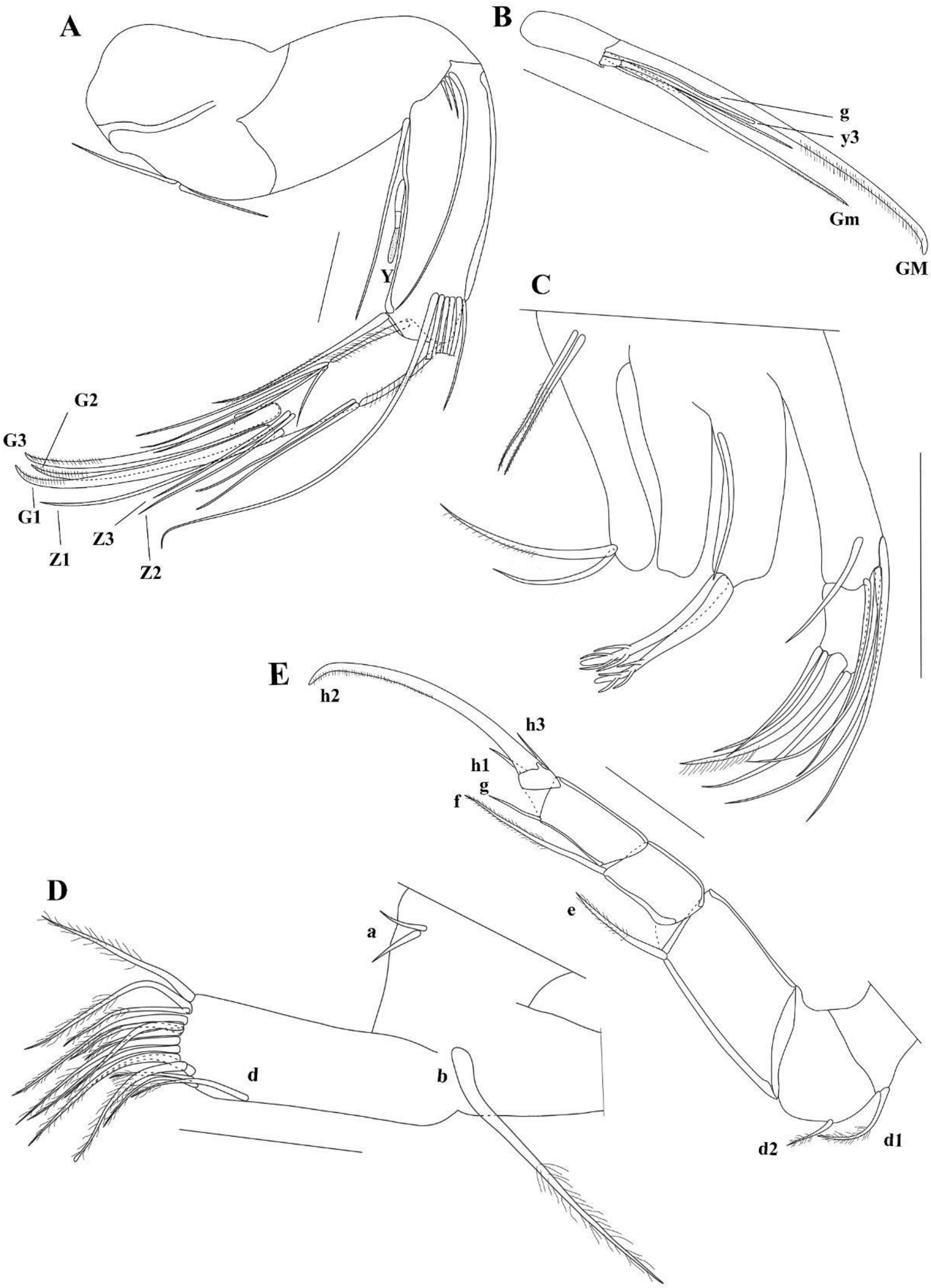

Figure 3 Limbs of Gen. 1 n. gen. sp. A n. sp. (A) A2 except last segment (VF045); (B) A2 last segment (VF045); (C) Mx1 (VF049); (D) T1 (VF047); (E) T2 (VF042). Scale bars, 50µm.

3.3.2.8 Measurements

See Table 1.

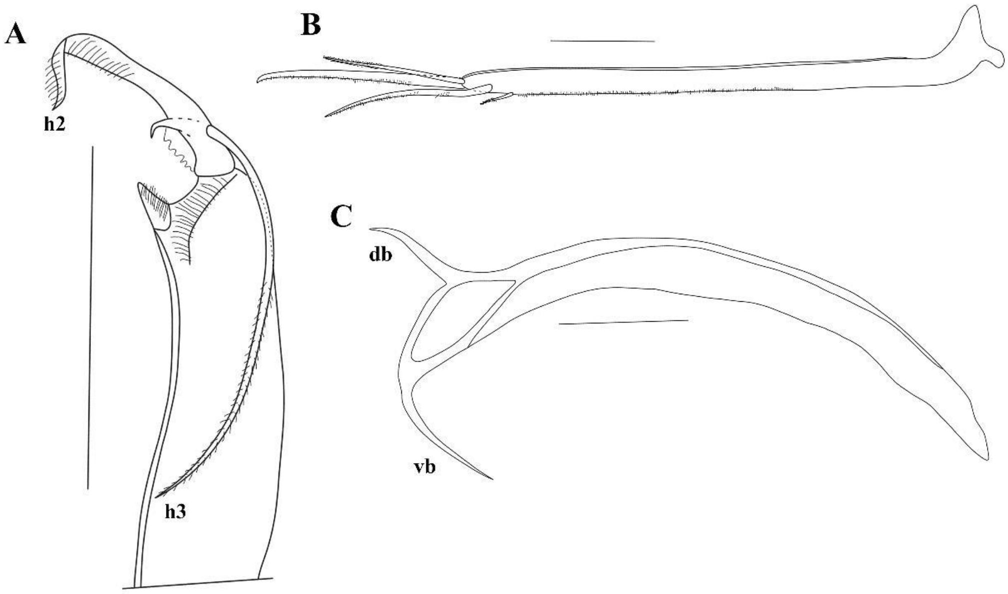

Figure 4 Limbs of Gen. 1 n. gen. sp. A n. sp. (A) T3 pincer (VF049); (B) CR (VF049); (C) CR attachment (VF045). Scale bars, 50µm.

3.3.2.9 Ecology and distribution

Gen. 1 n. gen. sp. A n. sp. was recorded in association with several species of macrophytes in Araguaia River and Amazon floodplains. The range of water temperature recorded in these lakes was 27.6 - 32.1 ºC, whereas the pH range was 6.5 - 6.8, i.e. slightly acid. Electrical conductivity and dissolved oxygen ranges were 39.1 - 69.7 µS.cm^{-1} and 1.05 - 4.01 mg. L^{-1}, respectively (see Table S1).

3.3.3 Genus *Bradleytriebella* Savatenalinton & Martens, 2009

3.3.3.1 Type species

Bradleytriebella tuberculata (Hartmann, 1964)

3.3.3.2 Other species

Bradleytriebella trispinosa (Pinto & Purper, 1965); *B. lineata* (Victor & Fernando, 1981).

3.3.3.3 Diagnosis

See Savatenalinton & Martens (2009)

3.3.4 *Bradleytriebella lineata* (Victor & Fernando, 1981)

Figs 5-7

Strandesia lineata in Victor & Fernando, 1981: 487, fig. 91-102

Paracypretta amati in Martens, 1984: 154, fig. 54-68

2004 *Strandesia biwaensis* in Okubo, 2004: 36, fig. 18

Bradleystrandesia gr. *amati* n.sp. in Higuti et al., 2007:1934, table 2

Bradleystrandesia gr. *amati* n.sp. in Higuti et al., 2009:664, table 1

Bradleystrandesia gr. *amati* n.sp. in Higuti et al. 2010: 267, table 2

Bradleytriebella lineata in Savatenalinton & Martens, 2010: 70, fig. 46

3.3.4.1 Diagnosis

Cp in lateral view subtriangular, with striations and setae on the external surface; greatest height situated well in front of the middle; LV anteriorly and ventrally overlapping RV; anterior and posterior margin rounded. LV with internal groove. A2 with a long aesthetasc Y, reaching beyond the limits of segment. T1 with b and a -setae. T2 with seta d1 narrow and twice as long as d2. Caudal ramus slender, its attachment with Triebel's loop in the dorsal branch.

3.3.4.2 Type locality and material

Recorded in Mindanao, Philippines by Victor & Fernando, 1981 in roadside ditches, 7 ponds, 1 lake and a washing pool.

3.3.4.3 Material examined

Two females dissected with soft parts in glycerine in a sealed slides and valves stored dry in micropaleontological slides (JH361 and VF064). Three females with carapace stored dry in micropaleontological slides (JH682, JH683, JH684).

3.3.4.4 Differential diagnosis

Bradletriebella lineata can be distinguished from other species from this genus by the striation on the external surface of the carapace. Although it has a similar appearance to Gen. 1 n. gen. sp. A n. sp. the former one has a weak striation and a long aesthethasc Y on A2. Such morphological similarity could be resulting from convergent evolution (see discussion).

3.3.4.5 Redescription of female

LV in inner view (Fig. 5A) with calcified inner lamella wide along anterior margin, narrower along posterior margins, and absent along ventral margin; with inner groove present along the anterior, ventral and posterior margins. RV in inner view (Fig. 5B) with calcified inner lamella as in LV. Greatest height in both valves situated well in front of the middle.

Cp in left lateral view (Fig. 5C) subtriangular, with striations and setae on the surface; LV overlapping RV anteriorly and ventrally. Cp in dorsal view (Fig. 5D), sub-ovate, with striations; LV overlapping RV anteriorly. Cp in ventral view (Fig. 5E) with striations; LV overlapping RV with a flap slightly anteriorly to the middle.

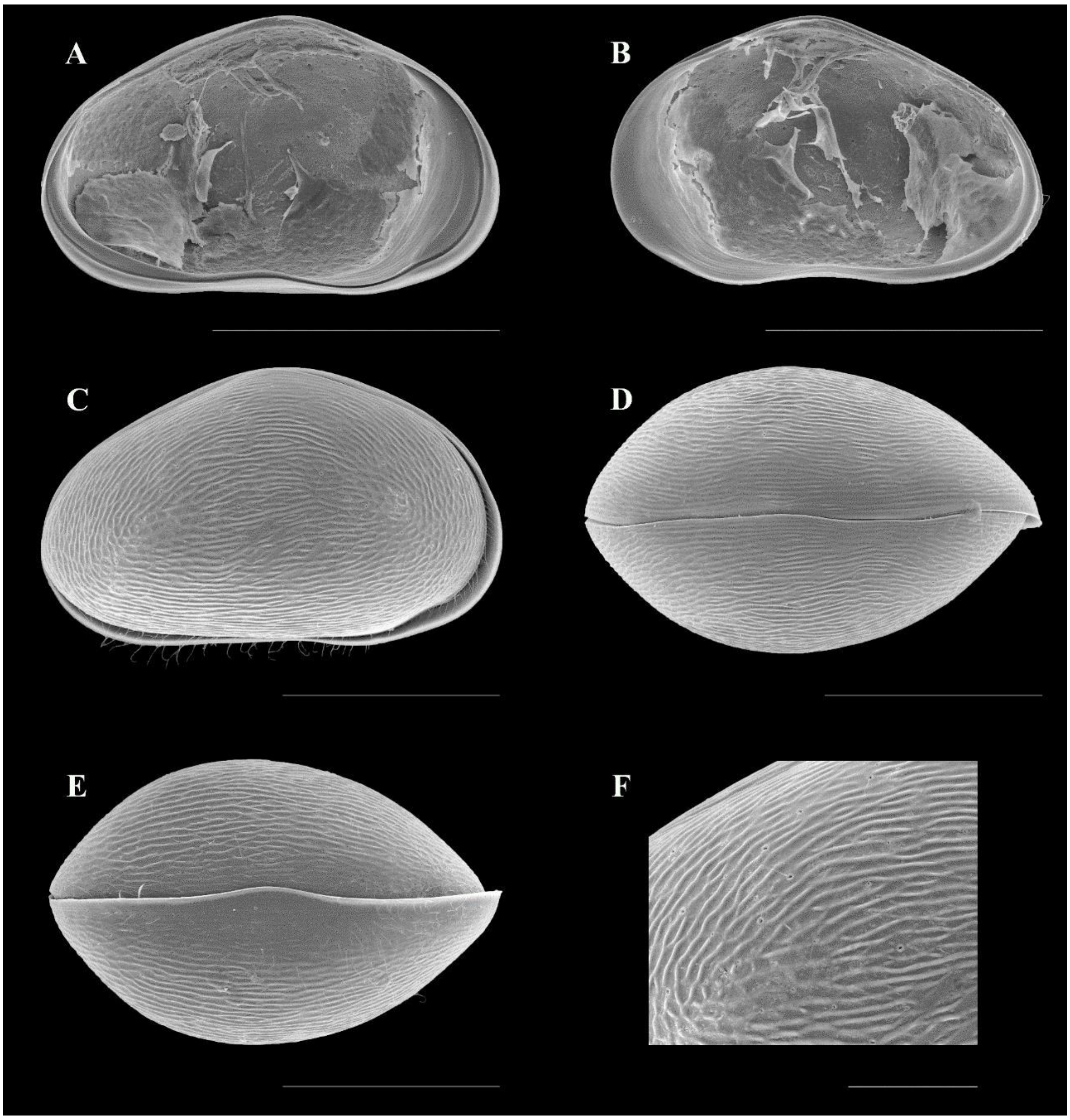

Figure 5 Carapace and valves of *Bradleytriebella lineata*. (A) LVi (JH361); (B) RVi (JH361); (C) CpRl (JH682); (D) CpD (JH683); (E) CpV (JH684). Scale bars, A-B, 400µm; C-E, 300µm; F; 100µm.

A1 and Md as typical of the subfamily (not illustrated).

A2 (Fig. 6A-B) with 4 segments, distal three segments forming the endopodite. First segment with 2 ventral setae (1 longer; 1 shorter, with the latter about 3/4 of the length of the longer seta); and 1 distal seta, the latter long. Exopodite reduced to a small plate, with 1 long and 2 unequal short setae. First endopodal segment with 1 long ventral aesthetasc Y, 1 long apical seta and one group of 5 long and 1 short swimming setae (the 5 long setae not reaching beyond the tips of the apical claws; the shortest reaching the middle of third segment). Second endopodal segment undivided, with 2 unequal but long dorsal setae and a group of 4 unequal long ventral setae (the longer one almost reaching the tip of G3); apically with 3 claws (G1, G2 and G3) and 3 setae (z1, z2 and z3). Terminal segment with 2 claws (GM and Gm), an aesthetasc y3 with an accompanying seta, fused over a short distance, and a short g-seta.

Mx 1 (Fig. 6C - chaetotaxy not complete) consisting of 3 masticatory lobes, a 2-segmented palp and a large respiratory plate (the latter not illustrated). Basal segment of palp with 4 unequal long apical setae, and 1 short subapical seta. Terminal palp-segment with 1 claw and 3 setae. Third endite with 2 large bristles serrated, tips of teeth rounded and with long subapical seta. One sideway-directed bristles on first endite, the shorter ca. 2/3 of the length of the longer one, both weakly hirsute.

T1 protopodite (Fig. 6D) with 2 short a-setae, 1 b-seta. Apically with 10 hirsute setae, subapically with a group of 4 hirsute setae. Endopodite with 3 unequal long hirsute setae (not illustrated here).

T2 (Fig. 6E) with 5 segments. First segment with seta d1 long and narrow. Second segment with seta d2 shorter, ca. half of the length of d1. Third segment with 1 subapical hirsute seta (e). Fourth segment medially divided into a- and b- segments; segment “a” with 1 long apical hirsute seta (f); segment “b” with 1 shorter seta (g) reaching the end of the terminal segment. Terminal segment with 1 apical claw (h2) and 2 setae (1 subapical (h1) and 1 apical).

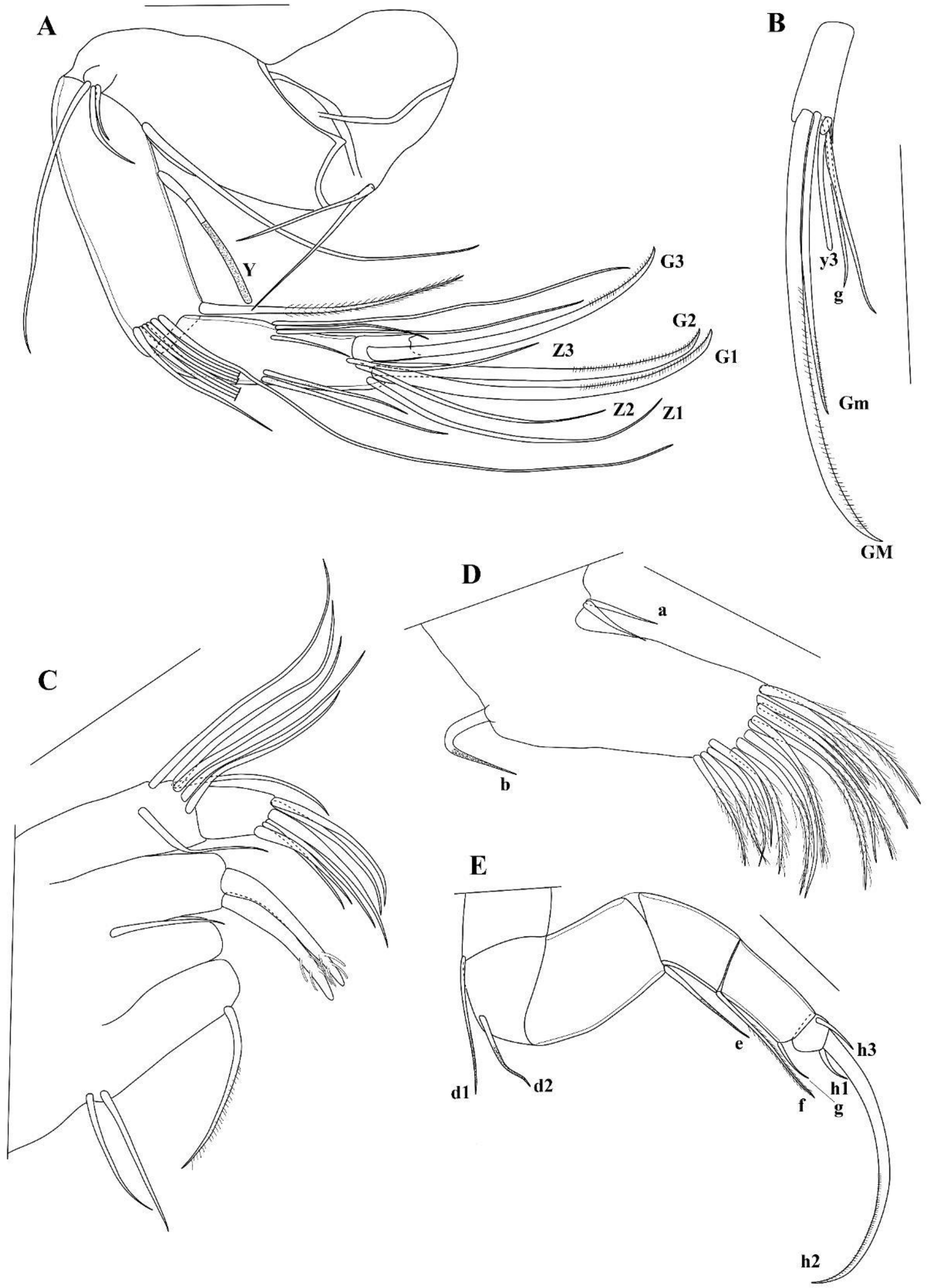

Figure 6 Limbs of *Bradleytriebella lineata*. (A) A2 except last segment (VF064); (B) A2 last segment (VF064); (C) Mx1 (JH361); (D) T1 (JH361); (E) T2 (JH361). Scale bars, 50µm.

T3 (Fig. 7A- chaetotaxy not complete) with 3 segments. First segment with 3 long setae (d1, d2, dp) (not illustrated here). Second segment, longer than wide, with 1 subapical seta (e). Second segment longer than wide, with 1 subapical seta (f). Third segment, also longer than wide, with 1 lateral, hirsute seta (g); distal part of the third segment fused with 4th segment into a modified pincer, with 1 apical comb-like seta (h2), 1 small recurved seta, 1/5 of the length of the comb like seta and one longer and distally hirsute seta (h3). Small tooth-like structures present at the basis of the comb-like seta.

CR (Fig. 7B) slender and curved, with ventral margin weakly serrated. Proximal and distal claws also weakly serrated. Proximal claw 2/3 of the length of distal claw. Proximal seta 1/4 of the length of distal seta.

CR attachment (Fig. 7C) slender, with oval Triebel's loop in the middle of dorsal branch. Ventral branch long with swollen end.

Male unknown

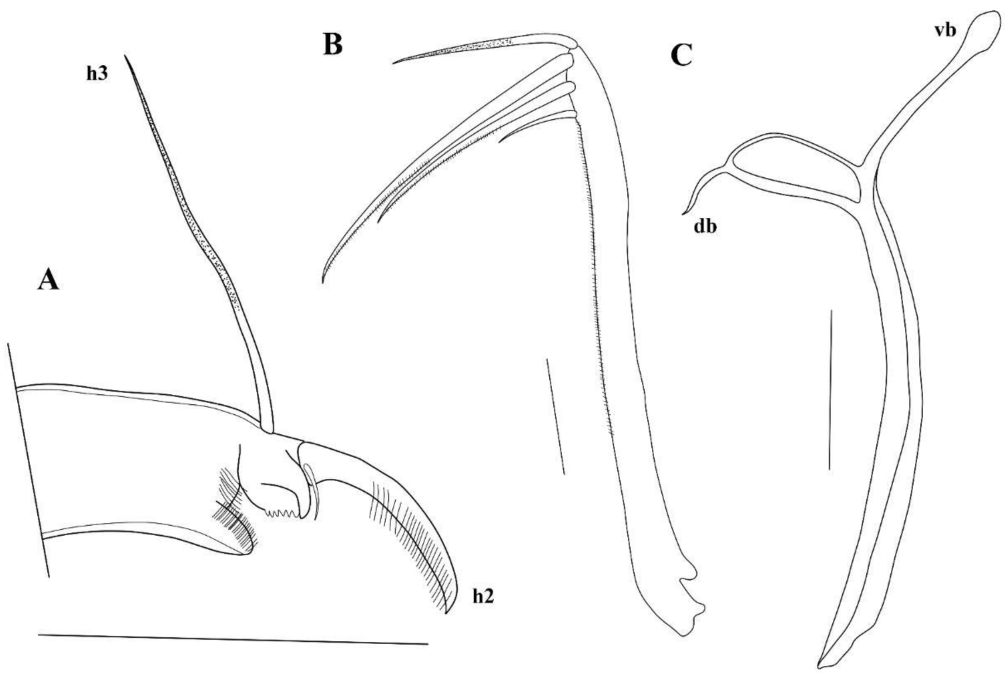

Figure 7 Limbs of *Bradleytriebella lineata*. (A) T3 pincer (JH361); (B) CR (VF064); (C) CR attachment (JH361). Scale bars, 50µm.

3.3.4.6 Measurements

See Table 1.

3.3.4.7 Ecology and distribution

Bradleytriebella lineata was recorded associated with several species of macrophytes and in the sediment (littoral) in the upper Paraná River floodplain (22°20'- 24°10'S and 53°00'-54°20'W). This species was widely distributed across 21 different environments such as rivers, channels, lakes and backwater. It has a high environmental plasticity as it was recorded in Brazilian floodplains with a temperature range of 15.3 - 35.1 ºC, whereas the electrical conductivity range was 16.3 - 73.7 $\mu S.cm^{-1}$, pH between 5.5 - 10.2 and the dissolved oxygen range was 0.8-15.1 $mg. L^{-1}$ (see Table S1).

Table 1 Measurements (in µm) of specimens of Gen. 1 n. gen. sp. A n. sp. in the Araguaia and Amazon River floodplains, and *Bradleytriebella lineata* in the river-floodplain system of the upper Paraná River.

Species	Sex	Code	Valve	L(µm)	H(µm)	W(µm)
Gen. 1 n. gen. sp. A n. sp.	Female	JH954	LVi	696	420	
	Female	JH954	RVi	679	410	
	Female	JH955	CpRl	683	414	
	Female	JH956	CpD	693		435
	Female	JH957	CpV	675		432
Bradleytriebella lineata (Victor & Fernando, 1981)	Female	JH361	LVi	640	389	
	Female	JH361	RVi	626	387	
	Female	JH682	CpRl	640	385	
	Female	JH683	CpD	636		396
	Female	JH684	CpV	629		396

Table 2 Comparative table among the character of genera from subfamily Cypricercinae, according Würdig and Pinto (1990)[b], George and Martens (1993)[c], Meisch (2000)[a], Savatenalinton and Martens (2009b), and several new observations. Y-aesthetasc: short = distance between tip of Y and tip of segment is about length of Y; normal = distance between tip of Y and tip of segment is less than length of Y; Long = tip of Y reaching beyond tip of segment. T1 b-seta: long = average length about that of apical setae; giant = length > 3 x average length of apical setae. CR: slender = Type E; stout = Type A - C (see Savatenalinton & Martens, 2009b fig. 2).

Genera / Character	RV anterior selvage	A2 aesthetasc Y	Mx1 side-ways bristles	Mx1, first palp segment	Mx1 2nd palp segment	T1, d-seta	T1, b-seta	CR ramus	Triebel's loop
Bradleystrandesiini									
Bradleystrandesia	Present	Short	2	6+1	3 claws, 3 setae	Present	Long	Slender	Dorsal branch
Bradleytriebella	Absent	Normal	1	6+1	3 claws, 3 setae	Absent	Long	Slender	Dorsal branch
Spirocypris	Present	Short	2	6+1	3 claws, 3 setae	Present	Long	Slender	Dorsal branch
Cypricercini									
Bradleycypris	Present	Normal	1	6+1	5[a]	Present	?	Slender	Main branch
Cypricercus	Present	Short	2	6+1	3 claws, 3 setae	Present	Long	Slender	Main branch
Pseudostrandesia	Absent	Normal	2	6+1	3 claws, 3 setae	Absent	Long	Slender	Main branch
Strandesia	Present	Short	2	6+1	3 claws, 3 setae	Present	Long	Slender	Main branch
Gen. 1 n. gen.	**Present**	**Normal**	**2**	**4+1**	**1 claw, 3 setae**	**Present**	**Giant**	**Stout**	**Main branch**
Nealecypridini									
Astenocypris	Absent	Normal	?	6+1	5[c]	?	Absent	Stout	Main branch
Diaphanocypris	Absent	Normal	2	5+1[b]	2 claws, 3 setae	Absent	Absent	Stout	Main branch
Nealecypris	Absent	Normal	2	6+1	3 claws, 3 setae	Absent	Long	Stout	Main branch
Tanycypris	Absent	Normal	2	6+1	3 claws, 3 setae	Present	Long	Stout	Main branch

3.4 DISCUSSION

With the present descriptions of Gen. 1 n. gen. sp. A n. sp. the number of Brazilian Cypricercinae species increased to 18. However, for several of these species either their generic assignment or even their status as valid species remains uncertain. This is especially true for the species described by Tressler (1950); their taxonomic position will be discussed elsewhere. In addition, several other new species also await description (Ferreira et al., in prep.).

3.4.1 Convergent evolution between Gen. 1 n. gen. sp. A n. sp. and *Bradleytriebella lineata*

The present paper reports on two ostracod species from Brazilian floodplains which show a striking case of convergent evolution. Both species look almost identical in external view: broadly rounded anterior and more pointed posterior margins and rounded dorsal margin with the greatest height situated well in front of the middle, and with, most markedly, the external valve surface densely set with ridges. There are small differences in valve and carapace shape. For example, in dorsal view the anterior left/ right overlap is more pronounced in *B. lineata,* while the posterior overlap is more asymmetrical in Gen. 1 n. gen. sp. A n. sp. (see also illustrations of *B. lineata* in Martens, 1984), but these differences would normally be considered as either intraspecific variability or as differences between closely related species. The only structural difference in the valves between the two species is the presence of anterior sub-marginal selvages in both valves in Gen. 1 n. gen. sp. A n. sp, which are absent in *B. lineata.* The anterior selvage on the right valve is present in most genera in the Cypricercinae, except in *Bradleytriebella* and in the genera of the Nealecypridini.

However, examination of soft parts in both species show other important differences. All characters and character states discussed below are summarized in Table 2.

The specimens illustrated as species *Strandesia* spec. in Karanovic (2012, figs 112C-E) also have a general shape and external valve ornamentation as in the two species (re-) described here. However, the marginal valve structure of the LV seems different while also the valves are higher in lateral view and the anterior left/ right overlap in dorsal and ventral views is more pronounced.

It could thus constitute a third species in the present cluster of species with convergent morphologies

3.4.1.1 Aesthetasc Y on A2

The length of the aesthetasc Y can be quite variable, even in congeneric species. The size-classes used in Table 2 therefore apply to the type species of the 12 genera. *Bradleytriebella tuberculata* (Hartmann, 1964) also has a 'normal' type of aesthetasc Y (Savatenalinton & Martens, 2009b) so that within the Cypricercinae only *B. lineata* appears to have a "long" aesthetasc Y, i.e. which reaches beyond the tip of the segment (Fig. 6A). The length of the aesthetasc is often correlated to the habitat of the ostracod species, and longer aesthetascs are believed to be linked to an interstitial mode of life, at least in Candoninae (Danielopol, 1973). However, *B. lineata* is a common species in the pleuston of floating plants in the Parana river floodplain (see Table S1) and has not been recorded interstitially yet. The causality of this unusually long aesthetasc Y in this species remains thus far unknown. It is furthermore noteworthy that North African specimens of this species also have a long aesthetasc Y, but less so than in the Brazilian specimens. In addition, threre is some variation between specimens in the same Sudanese population, where this aesthetasc either almost reaches the tip of the segment or fully reaches it (Martens, 1984), but never surpasses it as in the present Brazilian specimens.

3.4.1.2 Sideways-directed bristles

Nearly all genera in the Cypricercinae have two sideways-directed bristles on the first endite of the Mx1, also *Bradleytriebella tuberculata*, the type species of *Bradleytriebella*. It is thus surprising the *B. lineata* has only one such bristle. *Bradleycypris* also has only one bristle there, whereas *Astenocypris* seems to have no sideway directed bristles (checked on specimens used by George and Martens, 1993b).

3.4.1.3 Chaetotaxy of Mx1 first palp segment

This is normally a very conservative feature, comprising of 6 long apical setae and 1 shorter subapical seta. As is apparent from Table 2, this chaetotaxy appears in nearly all cypricercine genera. Only *Diaphanocypris meridana* (Furtos, 1936) has 5+1 setae there, and indeed Gen. 1 n. gen. sp. A n. sp. has only 4+1 setae there, which sets it aside within the Cypricercinae.

3.4.1.4 Chaetotaxy of Mx1 second palp segment

Also this configuration is normally most conservative with 3 apical claws and 3 apical setae, and Table 2 again shows that most genera in the Cypricercinae adhere to this scheme. Once again, both *Diaphanocypris meridana* and Gen. 1 n. gen. sp. A n. sp. are the only aberrant ones, the former with 2 claws and 3 setae, the latter with 1 claw and 3 setae. This reduction in the chaetotaxy of the Mx1 in both of these genera is remarkable, and given that they belong to two different tribes, most likely again constitutes a case of convergent evolution.

3.4.1.5 Seta 'd' on T1

The presence or absence of seta "d" on T1 has been important in delimiting genera within the Cypricercinae (Savatenalinton & Martens, 2009b), but as becomes clear from Table 2 rather forms a mosaic within the subfamily, as the presence or absence is not congruent with the grouping of genera in tribes. This is a pattern inconsistent with the neighbouring seta 'c' on this limb, which occurs in all genera of the Eucypridini (and indeed defines the tribe) and has thus far been found nowhere else in the Cyprididae (Martens, 1989).

3.4.1.6 Seta 'b' on T1

This seta is normally very conservative in the family Cyprididae and is nearly always present with length similar to the average length of the apical setae. The plasticity of this seta (presence, absence) in the Cypricercinae is thus remarkable. Its appearance as a giant seta (more then 3 times longer than 'normal' and much stouter) in Gen. 1 n. gen. sp. A n. sp. is even more unexpected. The potential function of this giant seta remains as yet unknown. In addition, it appears that there can be an asymmetry in this feature, as was observed in several specimens and species of *Bradleycypris* (unpubl. results), hence the double entry in Table 2.

3.4.1.7 Caudal ramus and Triebel's loop

The relevance of this ramus and the shape and position of the Triebel's loop in Cypricercinae has already been discussed in detail by Savatenalinton & Martens (2009b) and needs no further elaboration here.

3.4.2 The taxonomic position of Gen. 1 n. gen. sp. A n. sp.

Within the Cypricercinae, Gen. 1 n. gen. sp. A n. sp. occupies a somewhat special position, especially because of the reduction in the chaetotaxy of the Mx1-palp and the giant aspect of the "b" seta on the T1. However, because of the shape of the Caudal Ramus and the position of the Triebel's loop, we lodge the new genus in the Tribe Cypricercini.

Table 2 nevertheless shows the distribution of several characters and character states over the different genera and tribes follows a rather mosaic pattern, and this does not strengthen the value of the present tribes. Future comparative morphological analyses of a larger set of species will test if this assignment is correct, or if the new genus needs a separate tribe, or indeed whether or not the present classification of 12 genera in three tribes can be maintained.

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APPENDIX A - Table S1 Geographical location, substrate type and abiotic variables where both species were recorded. Gen.1 n. gen. sp. A n.sp. in the Araguaia (ARA) and Amazon rivers (AMA) floodplains, and *Bradleytriebella lineata* in the river-system floodplain of the upper Paraná River (PAR). Bold, type locality of the species of the Gen.1 n. gen. sp. A n. sp.; WT, water temperature; EC, electrical conductivity; DO, dissolved oxygen; Az, *Azolla* sp.; Cf, *Cabomba furcata*; Ea, *Eichhornia azurea*; Ec, *Eichhornia crassipes*; En, *Egeria najas*; Li, *Limnobium* sp.; Pn, *Paspalum notatum*; Ps, *Pistia stratiotes*; Po, *Polygonum* sp.; Sa, *Salvinia auriculata*; Sm, *Salvinia minima;* Ssp, *Salvinia* spp.; Uf, *Utricularia foliosa*.

Locality name	**Sample**	**Date**	**S°**	**S'**	**S''**	**W°**	**W'**	**W''**	**Substrate type**	**WT (°C)**	**EC (μS.cm^{-1})**	**pH**	**DO (mg.L^{-1})**
1. Crixas I	ARA44	09.03.2012	13	21	33.1	50	36	43	Pn, Uf	27.6	46.1	6.1	1.1
2. Crixas II	ARA47	09.03.2012	13	21	58.1	50	36	40	Pn, Az	27.6	46.5	6.4	1.3
3. Crixas III	ARA51	09.03.2012	13	21	4.5	50	37	42	Pn, Az, Le	28.6	37.5	6.8	4
3. Crixas III	ARA52	09.03.2012	13	21	52.6	50	37	20.9	Ec	28.6	37.5	6.8	4
4. Crixas IV	ARA55	09.03.2012	13	20	53.4	50	36	38	Uf, Ps	28.1	44.8	6.8	3.5
4. Crixas IV	**ARA56**	**09.03.2012**	**13**	**20**	**47.5**	**50**	**36**	**42.3**	**Uf**	**28.1**	**44.8**	**6.8**	**3.5**
5. Goiaba	ARA102	12.03.2012	12	51	7.9	50	32	21.7	Pn	29.7	39.1	6.4	1.5
6. Calado	AMA50	15.05.2012	3	18	30.7	60	34	29	Sa, Ps, Az	32.1	69.7	6.7	1.3

Locality name	**Sample**	**Date**	**S°**	**S'**	**S''**	**W°**	**W'**	**W''**	**Substrate type**	**WT (ºC)**	**EC (µS.cm^{-1})**	**pH**	**DO (mg.L^{-1})**
7. Curuca	AMA59	16.05.2012	3	3	7.6	60	34	6.1	Ec, Sa, Az	31.6	51.2	6.6	1.3
8. Cadete	AMA64	16.05.2012	3	24	12.1	60	33	10.6	Ps, Ec, Li, Sa	32.1	48.9	6.7	1.5
9. Jutaí	AMA76	17.05.2012	3	22	37.5	60	18	39.5	Ec	31.9	42.4	6.5	1.7
10. Ivinhema River	PAR56, 57, 58	16.03.2004	22	54	47	53	38	24	As, Hr, Ec	30.5	46.6	7.0	6.5
10. Ivinhema River	PAR221	11.11.2004	22	54	37.6	53	38	19.4	Sa	25.8	41.3	6.3	5.9
10. Ivinhema River	PAR1203	09.11.2014	22	59	14.2	53	39	5.8	Ec	27.2	38.0	6.8	10.4
11. Pintado Lake	PAR53	16.03.2004	22	56	48	53	38	22	Fl	29.9	50.8	6.5	3.4
11. Pintado Lake	PAR215	11.11.2004	22	56	50.1	53	38	36	Ea	25.8	43.3	5.6	4.0
12. Peroba Lake	PAR55	16.03.2004	22	54	45	53	38	27	Ec	31.3	42.6	6.8	6.1
12. Peroba Lake	PAR219	11.11.2004	22	54	32.8	53	38	23.4	Ec	25.6	28.1	5.8	5.6
13. Ipoita Channel	PAR62	16.03.2004	22	50	56	53	33	23	Ea	30.3	60.6	8.6	8.0
13. Ipoita Channel	PAR228	11.11.2004	22	50	51.2	53	33	22.3	Ea	25.4	57.1	6.5	7.3
14. Finado Raimundo Lake	PAR10	13.03.2004	22	47	41	53	32	22	Lt	28.1	39.6	7.2	7.0
14. Finado Raimundo Lake	PAR131	06.11.2004	22	47	38.2	53	32	19.5	Lt	26.2	37.5	5.7	5.7
14. Finado Raimundo Lake	PAR1481	20.03.2018	22	47	42.5	53	32	19.6	Po	33.2	42.0	5.9	4.8
15. Baia River	PAR818	28.08.2013	22	43	48.3	53	17	44.6	Ea	15.3	16.3	8.2	8.5
15. Baia River	PAR881	06.11.2013	22	43	45.3	53	19	32.9	Ec	26.6	24.5	7.2	5.9
15. Baia River	PAR978	12.02.2014	22	43	41.3	53	19	35.3	Ec	31.8	61.6	7.7	6.1

Locality name	**Sample**	**Date**	**S°**	**S'**	**S''**	**W°**	**W'**	**W''**	**Substrate type**	**WT (°C)**	**EC (µS.cm^{-1})**	**pH**	**DO (mg.L^{-1})**
15. Baia River	PAR1306	10.02.2015	22	43	42.7	53	19	19.1	Ec	29.7	31.4	7.0	3.5
16. Xirica Lake	PAR397	31.01.2011	22	46	48.2	53	22	59.6	Ea	30.0	54.2	6.3	3.4
16. Xirica Lake	PAR810	27.08.2013	22	46	45.1	53	22	44.8	Ea	15.6	44.2	8.0	8.2
16. Xirica Lake	PAR874, 875, 876	06.11.2013	22	46	47.4	53	22	56.5	Ea	27.3	56.4	7.7	7.9
16. Xirica Lake	PAR974, 975	12.02.2014	22	46	45.1	53	22	41	Ec	31.0	40.9	7.3	3.4
16. Xirica Lake	PAR1090	14.05.2014	22	46	48.6	53	23	0.1	Ec	24.5	44.4	7.2	5.7
16. Xirica Lake	PAR1204, 1204, 1206	10.11.2014	22	46	47.4	53	22	55.2	Ea	26.5	31.0	7.2	7.0
16. Xirica Lake	PAR1302	10.02.2015	22	46	47.3	53	22	55.2	Ea	30.0	50.1	7.2	4.1
16. Xirica Lake	PAR1390	12.05.2015	22	46	44.9	53	22	42.1	Ea	17.1	45.3	7.9	4.8
16. Xirica Lake	PAR1517	22.03.2018	22	46	47.5	53	22	53.4	Po	28.3	49.0	5.5	3.1
17. Pombas Lake	PAR811, 813	27.08.2013	22	47	57.9	53	21	37.4	Ea	17.7	54.6	10.2	15.1
17. Pombas Lake	PAR877, 878, 879	03.11.2013	22	47	57.1	53	21	37.5	Ea	26.3	66.2	8.9	9.4
17. Pombas Lake	PAR970, 971, 972	12.02.2014	22	47	57.1	53	21	37.5	Ea	29.6	67.3	8.1	7.8
17. Pombas Lake	PAR1208	10.11.2014	22	47	59.7	53	21	63.9	Ea	25.1	35.0	7.6	11.9
17. Pombas Lake	PAR1295, 1296, 1297	10.02.2015	22	47	58.6	53	21	37.5	Ea	27.9	66.4	8.2	2.8
17. Pombas Lake	PAR1394, 1394	12.05.2015	22	47	59.5	53	21	36.8	Ea	18.8	59.2	7.2	2.9
17. Pombas Lake	PAR1404	12.05.2015	22	43	31.3	53	13	16.5	Ea	22.4	53.6	7.3	7.5
17. Pombas Lake	PAR1520	22.03.2018	22	47	56.8	53	21	36.6	Sa	28.3	61.0	5.8	2.4

Locality name	Sample	Date	S°	S'	S''	W°	W'	W''	Substrate type	WT (°C)	EC (µS.cm^{-1})	pH	DO (mg.L^{-1})
17. Pombas Lake	PAR1521	22.03.2018	22	48	0.3	53	21	36.9	Ea	28.9	57.0	6.1	4.2
18. Manezinho Backwater	PAR99	17.03.2004	22	46	55	53	20	59	Ec	31.6	65.2	7.5	6.2
18. Manezinho Backwater	Ec3	15.04.2004	22	46	47.3	53	21.1	57	Ec	28.2	60.1	6.9	8.0
18. Manezinho Backwater	Ec3	13.05.2004	22	46	47.3	53	21.1	57	Ec	22.8	55.6	6.1	8.2
18. Manezinho Backwater	Ec3	10.06.2004	22	46	47.3	53	21.1	57	Ec	20.4	65.7	6.3	4.9
18. Manezinho Backwater	Ec3	15.07.2004	22	46	47.3	53	21.1	57	Ec	22.5	54.5	6.2	8.0
18. Manezinho Backwater	Ec3	11.08.2004	22	46	47.3	53	21.1	57	Ec	19.8	61.0	6.4	9.6
18. Manezinho Backwater	Ec3	16.09.2004	22	46	47.3	53	21.1	57	Ec	21.9	66.1	7.8	7.8
18. Manezinho Backwater	Ec1	11.08.2004	22	46	45	53	20	56.5	Ec	19.8	61.0	6.4	9.6
18. Manezinho Backwater	Ec1	16.09.2004	22	46	45	53	20	56.5	Ec	21.9	66.1	7.8	7.8
18. Manezinho Backwater	Ec2	14.10.2004	22	46	46.5	53	20	59.1	Ec	23.5	66.6	6.7	4.7
18. Manezinho Backwater	Ec3	19.01.2005	22	46	47.3	53	21.1	57	Ec	28.8	51.8	5.6	6.1
18. Manezinho Backwater	Ec3	04.03.2008	22	46	47.3	53	21.1	57	Ec	27.7	68.5	6.8	5.2
18. Manezinho Backwater	Ec3	01.04.2008	22	46	47.3	53	21.1	57	Ec	26.4	61.8	6.4	5.1
18. Manezinho Backwater	Ec3	02.05.2008	22	46	47.3	53	21.1	57	Ec	23.7	53.3	7.3	7.9
18. Manezinho Backwater	Ec3	05.06.2008	22	46	47.3	53	21.1	57	Ec	21.8	60.7	6.4	6.1
18. Manezinho Backwater	Ec3	11.08.2008	22	46	47.3	53	21.1	57	Ec	23.1	52.1	8.2	8.0
18. Manezinho Backwater	Ec3	02.10.2008	22	46	47.3	53	21.1	57	Ec	26.9	57.9	7.0	9.4

Locality name	Sample	Date	S°	S'	S''	W°	W'	W''	Substrate type	WT (°C)	EC (µS.cm^{-1})	pH	DO (mg.L^{-1})
18. Manezinho Backwater	Ec1	02.10.2008	22	46	45	53	20	56.5	Ec	25.7	60.4	6.4	2.7
18. Manezinho Backwater	Ec2	06.02.2009	22	46	46.5	53	20	59.1	Ec	29.7	55.5	6.3	6.4
18. Manezinho Backwater	Ec3	06.03.2009	22	46	47.3	53	21.1	57	Ec	35.1	66.7	7.4	8.1
18. Manezinho Backwater	Ec3	03.04.2009	22	46	47.3	53	21.1	57	Ec	28.3	62.4	7.1	8.2
18. Manezinho Backwater	Ec2	07.05.2009	22	46	46.5	53	20	59.1	Ec	26.6	55.4	6.3	5.9
18. Manezinho Backwater	Ec3	08.06.2009	22	46	47.3	53	21.1	57	Ec	22.1	53.9	7.7	10.8
18. Manezinho Backwater	Ec3	03.07.2009	22	46	47.3	53	21.1	57	Ec	21.5	53.8	6.5	8.7
18. Manezinho Backwater	Ec1	07.08.2009	22	46	45	53	20	56.5	Ec	23.3	55.1	6.3	3.3
18. Manezinho Backwater	Ec1	09.10.2009	22	46	45	53	20	56.5	Ec	25.1	57.5	6.8	2.5
18. Manezinho Backwater	Ec3	09.12.2009	22	46	47.3	53	21.1	57	Ec	30.0	71.6	7.1	5.0
18. Manezinho Backwater	Ec2	07.01.2010	22	46	46.5	53	20	59.1	Ec	29.3	70.2	6.7	5.0
18. Manezinho Backwater	Ec3	10.03.2010	22	46	47.3	53	21.1	57	Ec	27.7	66.6	6.7	6.2
18. Manezinho Backwater	Ec3	04.03.2011	22	46	47.3	53	21.1	57	Ec	27.1	51.8	7.2	7.0
18. Manezinho Backwater	Ec1	07.04.2011	22	46	45	53	20	56.5	Ec	27.9	61.9	6.8	5.6
18. Manezinho Backwater	Ec2	09.05.2012	22	46	46.5	53	20	59.1	Ec	23.8	53.3	6.0	13.5
18. Manezinho Backwater	Ec2	05.06.2012	22	46	46.5	53	20	59.1	Ec	21.4	52.5	6.5	7.7
18. Manezinho Backwater	Ec2	12.07.2012	22	46	46.5	53	20	59.1	Ec	21.0	51.7	6.2	7.9
18. Manezinho Backwater	Ec3	11.01.2013	22	46	47.3	53	21.1	57	Ec	29.4	73.7	6.4	5.1

Locality name	Sample	Date	S°	S'	S''	W°	W'	W''	Substrate type	WT (°C)	EC (µS.cm^{-1})	pH	DO (mg.L^{-1})
18. Manezinho Backwater	Ec3	14.02.2013	22	46	47.3	53	21.1	57	Ec	28.0	65.9	7.2	7.1
18. Manezinho Backwater	Ec2	12.03.2013	22	46	46.5	53	20	59.1	Ec	30.0	66.6	7.1	4.6
18. Manezinho Backwater	PAR1528, 1529, 1530	22.03.2018	22	46	44.9	53	20	56.3	Cf, En, Po	28.7	58.0	6.1	0.9
19. Pacu Lake	PAR1523	22.03.2018	22	47	28.6	53	19	53.8	Sh	29.0	57.0	6.3	4.5
20. Santa Rosa Lake	PAR1525	22.03.2018	22	46	21.2	53	18	15.9	Ea	29.0	61.0	6.1	1.8
21. Bilé Backwater	PAR1533	22.03.2018	22	45	14.2	53	17	8.7	Ea	30.7	58.0	6.4	3.5
22. Leopoldo Backwater	PAR1542	22.03.2018	22	45	24.3	53	16	9.9	Ea	29.1	61.0	6.2	1.3
23. Pau Véio Backwater	PAR43	15.03.2014	22	45	3	53	15	24	Lt	29.8	68.2	6.3	3.2
23. Pau Véio Backwater	PAR172	08.11.2004	22	44	54.1	53	15	24.6	Ea	26.7	67.5	5.8	2.9
23. Pau Véio Backwater	PAR407	31.01.2011	22	44	56.1	53	15	31.6	Ea	30.6	63.6	6.4	3.9
23. Pau Véio Backwater	PAR1539, 1540	22.03.2018	22	44	53.9	53	15	25.6	En, Po	28.6	63.0	6.2	1.5
24. Garças Lake	PAR45	15.03.2004	22	43	40	53	13	22	Fl	32.1	68.2	6.5	4.7
24. Garças Lake	PAR177	08.11.2004	22	43	30	53	13	10.6	Ea	27.3	64.1	6.2	5.9
24. Garças Lake	PAR409	31.01.2011	22	43	31.1	53	13	10.5	Sa	33.1	67.1	6.6	4.4
24. Garças Lake	PAR814	27.08.2013	22	43	31.8	53	43	31.8	Ea, Sh	16.6	54.0	7.9	8.2
24. Garças Lake	PAR883	07.11.2013	22	43	27.7	53	12	51.2	Ea	24.4	59.5	7.6	7.5
24. Garças Lake	PAR982, 983, 984	13.02.2014	22	43	31.1	53	13	8.4	Ea	30.4	60.6	7.7	5.5
24. Garças Lake	PAR1082, 1083, 1084	13.05.2014	22	43	28.2	53	12	51.1	Ea	24.0	49.8	7.5	7.1

Locality name	**Sample**	**Date**	**S°**	**S'**	**S''**	**W°**	**W'**	**W''**	**Substrate type**	**WT (ºC)**	**EC (µS.cm^{-1})**	**pH**	**DO (mg.L^{-1})**
24. Garças Lake	PAR1160, 1161, 1162	12.08.2014	22	43	28.1	53	12	52.1	Ea	25.3	61.0	7.1	6.5
24. Garças Lake	PAR1213, 1214, 1215	11.11.2014	22	43	28	53	12	52.2	Ea	25.1	46.0	8.0	6.9
24. Garças Lake	PAR1308, 1309, 1310	10.02.2015	22	43	27.8	53	12	52.4	Ec	31.4	60.3	7.6	5.2
24. Garças Lake	PAR1535	22.03.2018	22	43	31	53	13	9.8	Ea	31.3	57.0	6.5	4.8
24. Garças Lake	PAR1537	22.03.2018	22	43	27	53	12	50.5	Po	31.4	58.0	6.7	3.2
25. Cortado Channel	PAR69, 70	16.03.2004	22	48	50	53	22	35	Ec, Sa	30.0	66.9	6.6	5.8
25. Cortado Channel	PAR73	16.03.2004	22	48	50	53	22	35	Ps	30.0	66.9	6.6	5.8
25. Cortado Channel	PAR233, 235	11.11.2004	22	48	45.7	53	22	46.3	As,Ec	25.1	61.5	6.3	7.1
26. Ivinheminha River	PAR865	03.11.2013	23	12	50.7	53	43	8.8	Ec, Sm	27.4	33.2	7.1	4.6
26. Ivinheminha River	PAR962	10.02.2014	23	14	22.2	53	43	22.6	Ec	30.3	46.2	7.4	5.3
26. Ivinheminha River	PAR1198	08.11.2014	23	14	20.4	53	43	22.9	Ec	27.8	39.0	6.9	4.0
27. Ivaí Lake	PAR868, 869, 870	04.11.2013	23	16	55.2	53	42	21	Ea, Ec	26.1	61.7	7.9	7.5
27. Ivaí Lake	PAR949, 951	10.02.2014	23	16	57.1	53	42	19.3	Ec	28.8	65.2	7.9	3.6
27. Ivaí Lake	PAR1066, 1067	11.05.2014	23	16	51.6	53	42	16.2	Ec	24.3	50.8	7.0	5.7
27. Ivaí Lake	PAR1139, 1140, 1141	09.08.2014	23	17	0.5	53	42	21.3	Ec	24.0	46.9	7.1	6.4
27. Ivaí Lake	PAR1195/1196/1197	07.11.2014	23	16	55.2	53	42	21	Ec	25.6	66.0	6.9	6.2
27. Ivaí Lake	PAR1275, 1276	08.02.2015	23	17	2	53	42	25.1	Ec	28.6	63.6	8.3	4.3
27. Ivaí Lake	PAR1374	10.05.2015	23	16	55.5	53	42	18.1	Ec	21.7	63.5	7.0	0.8

Locality name	Sample	Date	S°	S'	S''	W°	W'	W''	Substrate type	WT (°C)	EC (μS.cm^{-1})	pH	DO (mg.L^{-1})
27. Ivaí Lake	PAR1376	10.05.2015	23	16	21.9	53	42	17.5	Ec	22.3	63.6	6.4	2.7
28. Pavão Lake	PAR1028	08.05.2014	23	58	38.6	54	9	52.3	Ec	23.6	52.7	6.8	3.7
28. Pavão Lake	PAR1113	06.08.2014	23	58	32.4	54	9	49.8	Ec	20.3	56.7	6.4	3.9
28. Pavão Lake	PAR1228, 1230	03.02.2015	23	58	29.8	54	9	48	Ec	29.1	64.1	7.0	2.0
28. Pavão Lake	PAR1326	06.05.2015	23	58	34.6	54	9	51.1	Ec	23.0	49.6	6.9	4.7
29. Saraiva Lake	PAR1023, 1024	08.05.2014	24	0	31.6	54	8	10.7	Ec	24.8	40.7	6.9	5.7
29. Saraiva Lake	PAR1169, 1170	04.11.2014	24	0	41	54	8	27.1	Ec	27.9	46.0	6.0	7.8
30. Paraná River	PAR66	16.03.2004	22	50	42	53	30	54	Lt	30.0	64.6	8.2	6.7
30. Paraná River	PAR230	11.11.2004	22	50	33.6	53	30	46.8	Lt	26.1	58.4	6.7	7.8
30. Paraná River	PAR803	24.08.2013	22	12	47.2	53	42	35.7	Ea	20.3	54.0	8.2	8.4
30. Paraná River	PAR823, 824, 825, 826	30.10.2013	24	4	10.8	54	14	44.6	Ec	26.0	52.5	7.0	7.2
30. Paraná River	PAR886, 887, 888	05.02.2014	24	2	35.6	54	15	43.3	Ec	29.5	49.5	6.9	5.7
30. Paraná River	PAR891, 892, 893	05.02.2015	24	4	11.8	54	14	44.7	Ec	25.9	59.8	6.7	6.9
30. Paraná River	PAR913, 915	06.02.2014	23	55	22.3	54	9	4.7	Ec	31.6	55.3	6.9	5.8
30. Paraná River	PAR926, 928	07.02.2014	23	39	15.4	53	56	51.8	Ec	31.0	55.4	7.4	7.4
30. Paraná River	PAR954, 955, 956, 957, 958, 959	10.02.2014	23	14	20.8	53	41	0.8	Ea, Sa	29.0	62.6	7.4	5.9
30. Paraná River	PAR1009, 1010	07.05.2014	24	2	35.8	54	15	43.3	Ec	22.7	27.0	6.4	5.3

Locality name	Sample	Date	S°	S'	S''	W°	W'	W''	Substrate type	WT (°C)	EC (µS.cm^{-1})	pH	DO (mg.L^{-1})
30. Paraná River	PAR1013, 1014, 1015	07.05.2015	24	4	12.1	54	14	42.6	Ec	22.9	50.5	6.5	5.9
30. Paraná River	PAR1070, 1071	12.05.2014	23	14	20.9	53	41	0.1	Ea, Sa	23.9	62.5	7.7	6.7
30. Paraná River	PAR1097, 1098, 1099	05.08.2014	24	2	35.4	53	15	47.8	Ec	19.4	31.6	6.9	2.2
30. Paraná River	PAR1100, 1101	05.08.2014	24	4	11.8	54	14	44.3	Ec	20.5	42.3	6.4	3.8
30. Paraná River	PAR1108	05.08.2014	24	0	57.7	54	6	7.4	Ec	21.5	56.8	6.8	6.9
30. Paraná River	PAR1142	10.08.2014	23	14	21.1	53	41	0.7	Ea	20.6	44.5	7.6	6.6
30. Paraná River	PAR1147	10.08.2014	23	12	54.4	53	42	40.9	Ea	21.9	40.3	7.1	6.1
30. Paraná River	PAR1163, 1164	04.11.2014	24	2	35.5	54	15	45.2	Ec	27.7	45.0	6.1	10.4
30. Paraná River	PAR1179	04.11.2014	23	55	21	54	9	2.6	Ec	27.9	48.0	6.3	7.3
30. Paraná River	PAR1216, 1217, 1218	03.02.2015	24	4	11.3	54	14	42.5	Ec	26.8	51.1	6.2	4.0
30. Paraná River	PAR1220, 1221, 1222	03.02.2015	24	2	35.8	54	15	44.3	Ec	28.9	45.4	6.7	6.3
30. Paraná River	PAR1236, 1237, 1238	03.02.2015	23	55	20.9	54	9	4.1	Ec	30.2	53.0	7.0	6.5
30. Paraná River	PAR1248, 1249, 1250	04.02.2015	23	38	48.4	53	56	42.5	Ea	28.8	63.0	7.8	6.7
30. Paraná River	PAR1262	06.02.2015	23	22	3.3	53	53	11.5	Ec	26.4	29.5	7.8	6.0
30. Paraná River	PAR1279	08.02.2015	23	14	20.8	53	41	1.1	Ea, Sa	29.5	68.8	7.2	6.3
30. Paraná River	PAR1280, 1281	08.02.2015	23	14	20.8	53	41	1.1	Ea, Sa	29.5	68.8	7.2	6.3
30. Paraná River	PAR1283, 1284, 1285	08.02.2015	23	12	28.5	53	42	16.1	Ea	29.0	51.0	7.7	6.6
30. Paraná River	PAR1312, 1313, 1314	06.05.2015	24	4	11	54	14	41.8	Ec	21.3	42.7	7.0	7.1

Locality name	**Sample**	**Date**	**S°**	**S'**	**S''**	**W°**	**W'**	**W''**	**Substrate type**	**WT (ºC)**	**EC (µS.cm^{-1})**	**pH**	**DO (mg.L^{-1})**
30. Paraná River	PAR1316, 1317, 1318	06.05.2015	24	2	35.4	54	15	49.4	Ec	21.8	33.5	6.9	4.6
30. Paraná River	PAR1337	06.05.2015	23	55	17.2	54	8	49.8	Ec	23.6	19.1	6.3	6.6
30. Paraná River	PAR1340, 1341	07.05.2015	24	1	2.6	54	6	9.7	Ec	23.9	58.3	7.3	7.4
30. Paraná River	PAR1348, 1349, 1350	07.05.2015	23	38	46.3	53	56	41.7	Ea	24.0	59.2	7.6	7.7
30. Paraná River	PAR1378, 1379, 1380	10.05.2015	23	14	20.8	53	41	1.3	Ea	24.3	53.5	6.8	7.3

4. CONCLUSION

Our study on ostracod Brazilian fauna validate some *Strandesia s.l.* species and describe a new genus and four new species, thus contributing to the enrichment of the biodiversity of ostracods. Morphological characters are not always sufficient to distinguish species, so we recommend to add molecular analyzes, as this method can confirm morphological species and reveal the potential of cryptic diversity.

Several *Strandesia* species have a wide geographical distribution, occurring in more than one floodplain. No species showed ecological preferences regarding substrate (different aquatic plants and sediment) and water chemistry, indicating that these species can tolerate a broad limit of environmental condition. It is worth noting that several habitats, such as interstitial, temporary ponds, streams, reservoirs, terrestrial environments, among others, remain poorly known. In this sense, it would not be surprising to find new taxa of ostracods.

All species here are endemic to the Neotropical Realm, with exception of *S. bicuspis*. However, the biodiversity of non-marine ostracods in South America is ill known, and the lack of identification guides and few specialists in Brazil make it more difficult to train new professionals, creating a vicious cycle.