



UNIVERSIDADE ESTADUAL DE MARINGÁ  
CENTRO DE CIÊNCIAS BIOLÓGICAS  
DEPARTAMENTO DE BIOLOGIA  
PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA DE  
AMBIENTES AQUÁTICOS CONTINENTAIS

NADINY MARTINS DE ALMEIDA

**Description of seven new species and two new genera of *Physocypria sensu  
latu* (Crustacea, Ostracoda) from Brazilian floodplains**

Maringá  
2022

NADINY MARTINS DE ALMEIDA

**Description of seven new species and two new genera of *Physocypria sensu latu* (Crustacea, Ostracoda) from Brazilian floodplains**

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.  
Área de concentração: Ecologia e Limnologia

Orientadora: Dr.<sup>a</sup> Janet Higuti  
Coorientador: Professor Dr. Koen Martens

Maringá  
2022

"Dados Internacionais de Catalogação na Publicação (CIP)"  
(Biblioteca Setorial - UEM. Nupélia, Maringá, PR, Brasil)

A447d Almeida, Nadiny Martins de, 1997-  
Description of seven new species and two new genera of *Physocypria sensu latu*  
(Crustacea, Ostracoda) from Brazilian floodplains / Nadiny Martins de Almeida. --  
Maringá, 2022.  
115 f. : il. (algumas color.).  
Dissertação (mestrado em Ecologia de Ambientes Aquáticos Continentais)--  
Universidade Estadual de Maringá, Dep. de Biologia, 2022.  
Orientadora: Dr.<sup>a</sup> Janet Higuti.  
Coorientador: Prof. Dr. Koen Martens.  
1. *Physocypria sensu latu* (Crustacea, Ostracoda) - Taxonomia descritiva - Planícies  
de inundação - Brasil. 2. Candonidae - Morfologia descritiva. 3. Microcrustáceos de  
água doce - Taxonomia descritiva. I. Universidade Estadual de Maringá. Departamento  
de Biologia. Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos  
Continentais.

CDD 23. ed. -595.330981

NADINY MARTINS DE ALMEIDA

**Description of seven new species and two new genera of *Physocypria sensu latu* (Crustacea, Ostracoda) from Brazilian floodplains**

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 Doutor ou Mestre em Ecologia e Limnologia e aprovada pela Comissão Julgadora composta pelos membros:

COMISSÃO JULGADORA

Dr.<sup>a</sup> Janet Higuti  
Nupélia/Universidade Estadual de Maringá (Presidente)

Prof. Dr. Ricardo Lourenço Pinto  
Universidade de Brasília (UnB)

Dr. Ricardo Massato Takemoto  
Nupélia/Universidade Estadual de Maringá (UEM)

Aprovada em: 8 de abril de 2022.

Local de defesa: Anfiteatro Prof. “Keshiyu Nakatani”, Nupélia, Bloco G-90, *campus* da Universidade Estadual de Maringá.



## **AGRADECIMENTOS**

Aos meus pais, Maria e Carlos por não medirem esforços pela minha educação e apoio, e minhas irmãs, Daniele e Ariadny, pelo companheirismo.

À minha orientadora Dr.<sup>a</sup> Janet Higuti, por todo apoio, ensinamentos e atenção em todas as etapas do mestrado. Ao Professor Dr. Koen Martens, pela contribuição científica essencial para a minha formação.

Aos membros titulares da minha banca, Dr. Ricardo Lourenço Pinto e Dr. Ricardo Massato Takemoto, e aos suplentes e Dr. Gilmar Perbiche Neves e Dr.<sup>a</sup> Carla Simone Pavanelli, por aceitarem prontamente o convite de participar na avaliação deste trabalho.

Aos programas PELD (Programa de Estudos Ecológicos de Longa Duração, sítio 6) e SISBIOTA (Sistema Nacional de Pesquisa em Biodiversidade), e aos órgãos de fomento CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) e Fundação Araucária pelo suporte financeiro.

Ao Dr. Kennedy Francis Roche da Universidade Federal do Mato Grosso do Sul pelo apoio logístico para a realização da coleta no Pantanal Sul Matogrossense e áreas adjacentes. À Fundação de Apoio e Desenvolvimento do Ensino, Ciência e Tecnologia do Mato Grosso do Sul (Fundect) pelo auxílio financeiro.

Aos colegas Eliezer, Jonathan, Lara, Ramiro e Vitor, que conheci no laboratório e sempre contribuíram para a minha formação.

Aos marinheiros Alfredo e Tião pelo auxílio nas coletas de campo.

À secretaria do PEA, Elizabete Custódio de Oliveira e Jocemara Celestino dos Santos.

À Biblioteca Setorial do Nupélia, Salete e João.

Ao CNPq pela bolsa de mestrado concedida.

Ao Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos Continentais (PEA) e ao Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura (Nupélia) da Universidade Estadual de Maringá (UEM) pelo apoio logístico.

## **Descrição de sete novas espécies e dois novos gêneros de *Physocypria sensu latu* (Crustacea, Ostracoda) de planícies de inundação brasileiras**

### **RESUMO**

Sete novas espécies de *Physocypria sensu latu* foram descritas de três das principais planícies brasileiras: Gen. 1 spec. A gen. et spec. nov. e Gen. 1 spec. B gen. et spec. nov. da planície de inundação do alto rio Paraná e do Pantanal Sul Matogrossense, Gen. 2 spec. C gen. et spec. nov., Gen. 1 spec. D gen. et spec. nov. e Gen. 2 spec. E gen. et spec. nov. somente do Pantanal Sul Matogrossense e Gen. 1 spec. F gen. et spec. nov. e Gen. 1 spec. G gen. et spec. nov. somente da planície de inundação do rio Amazonas. Todas as novas espécies aqui descritas foram encontradas em populações sexuadas. Em geral, as novas espécies têm uma carapaça curta e suboval, com a valva esquerda sobrepondo a valva direita em todos os lados, com exceção do lado dorsal em algumas espécies. A morfologia do hemipênis e dos palpos preênseis, juntamente com a forma das valvas, foram as mais importantes para distinguir as espécies. A ausência em todas as novas espécies das cerdas curtas que acompanham as cinco cerdas natatórias nas antenas; a presença em todas as novas espécies de uma cerda longa ao lado das duas a-cerdas no primeiro toracópode e a presença/ausência ou comprimento de cerdas específicas no segundo e terceiro toracópodes são características presentes nos apêndices utilizadas para distinção dos novos gêneros e espécies. Discutiu-se a posição taxonômica das sete novas espécies avaliando a validade dos gêneros existentes, especialmente da *Keysercypria* Karanovic, 2011, e concluiu-se que nossas sete novas espécies representam dois novos gêneros de Cyclocypridinae.

**Palavras-chave:** Microcrustáceo. Candonidae. Cyclocypridinae. Endemismo. Neotrópico.

# **Description of seven new species and two new genera of *Physocypria sensu latu* (Crustacea, Ostracoda) from Brazilian floodplains**

## ***ABSTRACT***

We describe seven new species of *Physocypria sensu latu* from three of the main Brazilian floodplains: Gen. 1 spec. A gen. et spec. nov. and Gen. 1 spec. B gen. et spec. nov. from the Upper Paraná River floodplain and the South Matogrossense Pantanal, Gen. 2 spec. C gen. et spec. nov., Gen. 1 spec. D gen. et spec. nov. and Gen. 2 spec. E gen. et spec. nov. from the South Matogrossense Pantanal only and Gen. 1 spec. F gen. et spec. nov. and Gen. 1 spec. G gen. et spec. nov. only from the Amazon River floodplain. All new species here described were found in sexual populations. Generally, the new species have a short and suboval carapace, with the left valve overlapping the right valve on all sides, except for the dorsal side in some species. The morphology of hemipenis and prehensile palps, together with the shape of the valves, were most important to distinguish the species. However, several other morphological characters from limb chaetotaxy are discussed, e.g., the absence in all new species of the short accompanying seta of the five natatory setae on antenna; the presence in all new species of a long seta next to the two a-seta on the first thoracopod and the presence/absence or length of specific setae on second and third thoracopod. We discuss the taxonomic position of the seven new species by evaluating the validity of extant genera, especially of *Keysercypria* Karanovic, 2011, and foreshadow that our seven new species represent two new genera of Cyclocypridinae.

**Keywords:** Microcrustaceans. Candonidae. Cyclocypridinae. Endemism. Neotropical.

Dissertação elaborada e formatada conforme as normas de publicações científicas da *Zootaxa*. Disponível em: <<https://www.mapress.com/zt/about/submissions>>.

## SUMMARY

<b>1</b>	<b>INTRODUCTION .....</b>	<b>7</b>
<b>2</b>	<b>MATERIAL AND METHODS .....</b>	<b>8</b>
<b>2.1</b>	<b>Study area.....</b>	<b>8</b>
2.1.2	Sampling .....	9
2.1.3	Morphological analyses .....	9
2.1.4	Abbreviations used in the text, tables and figures .....	10
<b>3</b>	<b>RESULTS.....</b>	<b>11</b>
<b>4</b>	<b>DISCUSSION.....</b>	<b>50</b>
<b>5</b>	<b>CONCLUSION .....</b>	<b>57</b>
	<b>REFERENCES.....</b>	<b>58</b>
	<b>APPENDIX - TABLES .....</b>	<b>65</b>
	<b>APPENDIX - FIGURES .....</b>	<b>71</b>

## 1 INTRODUCTION

Freshwater ostracods are represented by three superfamilies: Cypridoidea Baird, 1845, which comprise 75.5% of all living species, Cytheroidea Baird, 1850 with 22.8%, and Darwinuloidea Brady & Robertson, 1885 with 1.5% of the extant species (Meisch *et al.* 2019).

The subfamily Cyclocypridinae Kaufmann, 1900 in the family Candonidae Kaufmann, 1900 for the longest time comprised only three genera: *Cyclocypris* Brady & Norman, 1889, *Cypria* Zenker, 1854 and *Physocypris* Vávra, 1897. Rome (1962) added two more genera from Lake Tanganyika (East Africa), both presumed endemic to this ancient lake: *Allocypris* Rome, 1962 and *Mecynocypris* Rome, 1962 (the latter synonymised with *Physocypris* by Karanovic, 2011). Karanovic (2011) added *Kempfcyclocypris* Karanovic, 2011 from interstitial waters in Eastern Australia and *Keysercypris* Karanovic, 2011 from South America. *Namiotkocypris* Külköylüoğlu, 2018 was added from interstitial habitats from North American, while Savatnalinton (2017) described four species in the new genus *Dentocypris* Savatnalinton, 2017 from Thailand and also presented a taxonomic analysis of the genera described at that stage.

Only three genera, *Cypria*, *Physocypris* and *Keysercypris* have thus far been recorded from the Neotropical region. These genera share some similarities, for instance, the shape of the carapace and the overlap of the left valve over the right valve and the absence of d2-seta on the first segment of the second and third thoracopods. Meisch *et al.* (2019) synonymised *Keysercypris* partly with *Cypria* and partly with *Physocypris* for reasons explained below. We re-instate the genus here, albeit in a much more focused form.

The genus *Physocypris* thus far comprises 37 species worldwide, of which 13 occur in the Neotropical region (Martens & Behen 1994; Meisch *et al.* 2019) and five species in Brazil (Martens & Behen 1994; Martens *et al.* 1998). The species in this genus are all small (ca. 400–600 µm in length) and generally have a very similar appearance. They can be distinguished based on details in the morphology (mostly the outline) and the anatomy of the valves, in the chaetotaxy of the limbs (presence/ absence and size of claws and setae) and especially by the morphology of the two (asymmetrical) prehensile palps and of the hemipenes in the males. However, Karanovic (2011) correctly argued that the Neotropical (South and Central America) species presently in *Physocypris* do not belong in this genus, because of differences in several morphological characters.

Here, we describe seven new species in two new genera from Brazil, and discuss morphological, taxonomic and ecological aspects of these taxa.

## 2 MATERIAL AND METHODS

### 2.1 Study area

The study area covers the four largest Brazilian floodplains and adjacent areas: Upper Paraná River floodplain (22°40'–24°00' S, 54°20'–53°00' W), South Matogrossense Pantanal (18°50'–19°30' S, 57°40'–57°00' W), Araguaia River floodplain (12°50'–13°20' S, 50°40'–50°30' W) and Amazon River floodplain (3°02'–3°34' S, 60°50'–60°10' W) (Fig 1, Table 1). No specimens of *Physocypria s.l.* were found in the Araguaia sampling, therefore these localities are not included in Figure 1, and this area is not further described below.

>>> Figure 1

>>> Table 1

The Upper Paraná River covers a drainage area of ca. 891,000 km<sup>2</sup> in Brazil and constitutes the first third of the Paraná River basin (Agostinho *et al.* 2008). The Upper Paraná River floodplain has an extensive area, which is ca. 230 km long and more than 20 km wide, between Porto Primavera and Itaipu dams (Agostinho & Gomes 2002; Agostinho *et al.* 2009). The floodplain comprises channels, lakes and tributaries. Apart from the main channel, it is the Taquaruçu system, which comprises only closed lakes and forms the “Alluvial valley of the upper Paraná River” (Souza Filho & Steaux 2004). This stretch includes three geographical units of conservation: the “Área de Proteção das Ilhas e Várzeas do Rio Paraná”, “Parque Nacional de Ilha Grande” and “Parque Estadual do Ivinhema” (Agostinho *et al.* 2004).

The Pantanal is located in the Upper Paraguay River basin. The Upper Paraguay basin, in the Brazilian territory, covers 393,600 km<sup>2</sup> (Por 1995), which encompasses two states: Mato Grosso State, where the Pantanal is located, and the Mato Grosso do Sul State, with the South Matogrossense Pantanal (present sampling area and adjacent areas). The drainage areas of these environments, known as “várzeas”, are influenced by the flooding of the Upper Paraguay River basin (Oliveira & Calheiros 2000). The Pantanal is recognized as a Biosphere Reserve (Lourival *et al.* 2012).

The Amazon River is formed by the confluence of the rivers Negro and Solimões in Brazil. The Amazon River is the second longest river in the world and its tributaries are accompanied by large floodplains covering an area of about 300,000 km<sup>2</sup>. The present sampling area is located next to the Manaus city. The Amazon floodplain is part of one of the most important Brazilian biomes (Amazon biome) and includes areas of conservation, for instance,

protected areas (PAs), as well as indigenous lands and parks and biological reserves (Soares-Filho *et al.* 2004, 2010).

### 2.1.2 Sampling

The material used in the present study results from several projects developed by the Centre of Research in Limnology, Ichthyology and Aquaculture (Nupélia) from the State University of Maringá (UEM), including the Long Term Ecological Research (LTER, site 6) and the National System of Biodiversity Research (SISBIOTA) programs. In addition, we also used results from the project “Microbiota biodiversity of aquatic ecosystems of the Pantanal of Nhecolândia 2003–2004” developed by the Federal University of Mato Grosso do Sul.

*Physocypria s.l.* species were examined from three Brazilian floodplains, namely from collections made in the Upper Paraná River floodplain from 2004 to 2020, from the South Matogrossense Pantanal between 2003 and 2011 and from the Amazon River floodplain in 2011 and 2012, in different types of environments. No species of *Physocypria s.l.* were found in the samples from the Araguaia floodplain (2011 and 2012).

The aquatic macrophytes (e.g., *Eichhornia azurea* (Sw) Kunth, *E. crassipes* (Mart.) Solms, *Pistia* sp., *Salvinia* sp. and *Utricularia* sp.) were manually collected, placed in a plastic bucket, and washed to remove the ostracods associated with the roots and submerged leaves of these plants (see Higuti *et al.* 2010; Campos *et al.* 2017). The water was filtered over a net with a mesh size of 160 µm, and the material was fixed in alcohol, buffered with sodium tetraborate. The ostracods were sorted from these samples under a stereoscopic microscope (Olympus SZX16) and stored in fresh 70% alcohol. Ostracods from the littoral (sediment) were collected using a rectangular hand net (28 cm x 14 cm, mesh size of 160 µm) which was moved over the bottom to whirl up top sediment and associated fauna.

Water temperature (WT), dissolved oxygen (DO) concentration (YSI 550A oximeter), pH (pHmeter Digimed) and electrical conductivity (EC) (conductivimeter-Digimed), were measured *in situ*. The geographical coordinates were obtained using a GPS Garmin.

### 2.1.3 Morphological analyses

The valves were opened and separated from the body with dissection needles. The valves and the carapaces were stored dry in micropaleontological slides for illustration with Scanning Electron Microscopy (SEM; Fei Qanta 200 ESEM, - Royal Belgian Institute of



Natural Sciences, Brussels, Belgium) in different views (valves: internal and details; carapaces: lateral, dorsal, ventral and details).

The body was removed from the carapace and the appendages (antennula, antenna, mandibula, maxillula, three thoracopods and the caudal ramus and for males also hemipenes and Zenker's organs) were dissected and mounted on a slide in a drop of glycerine, covered with cover slip and sealed with nail polish. The illustrations (drawings) of the appendages from the body of the ostracods were made with the aid of a *camera lucida* (Olympus UDA) attached to a transmission light microscope (Olympus CX-41). The SEM were to allow interpretation of the following descriptions of the anatomy of the valve margins, the terminology is illustrated in Figure 2.

The type material and all illustrated specimens are stored in the Museum of Zoology of the University of São Paulo (MZUSP).

#### 2.1.4 Abbreviations used in the text, tables and figures

Carapace and valves:

Cp = carapace

CpD = carapace in dorsal view

CpRl = carapace in right lateral view

CpV = carapace in ventral view

DV = dorsal view

H = height of Cp

L = length of Cp

LV = left valve

LVi = left valve inner view

RV = right valve

RVi = right valve inner view

V = valve

W = width of Cp

Soft parts:

A1 = antennula

A2 = antenna

CR = caudal ramus

db = dorsal branch of support of CR

Hp = hemipenis

Lpp = left prehensile palp

ls = lateral shield of Hp

Md = mandibula

Md-coxa = mandibular coxa

Md-palp = mandibular palp

ms = medial shield of Hp

Mx1 = maxillula

Rpp = right prehensile palp

T1 = first thoracopod

T2 = second thoracopod

T3 = third thoracopod

vb = ventral branch of support of CR

Thoracopod terminology follows Broodbakker & Danielopol (1982), of the second antenna the revised model proposed by Martens (1987), and of the second and third thoracopods Meisch's nomenclature (2000). Higher taxonomy of the Ostracoda follows Horne *et al.* (2002) and Meisch *et al.* (2019).

### **Disclaimer**

Given the large global number of species described in the genera *Cypria* and *Physocypria*, we will here mainly concentrate on species described from South and Central America. This decision is also supported by the apparently high number of endemic species, as is also demonstrated by the present work. If certain characters are clearly described in non-Neotropical species, we will refer to them.

## **3 RESULTS**

### **Taxonomic descriptions**

Class Ostracoda Latreille, 1802

Subclass Podocopa G.O. Sars, 1866

Order Podocopida G.O. Sars, 1866

Suborder Cypridocopina G.O. Sars, 1866

Superfamily Cypridoidea Baird, 1845

Family Candonidae Kaufmann, 1900

Subfamily Cyclocypridinae Kaufmann, 1900

**Diagnosis for *Physocypria* s.l.** (= for all four subsequent genera)

Cp suboval in lateral view, LV overlapping RV, along all margins, except in some species in the middle of dorsal margin of RV. Valve margins of LV smooth and devoid of external tubercles. RV with anterior and/or posterior marginal tubercles of various numbers, size and shapes; anteriorly with an inner list, strongly developed or only visible in part, sometimes strongly inwardly displaced, in other cases submarginal. Carapace without obvious external ornamentation.

A2 with five long natatory setae well-developed; in male with four-segmented endopodite and with setae t2 and t3 transformed into sexual bristles. Mx1 with second palp segment about as long as wide. T1 with one long seta next to the two a-setae; Rpp and Lpp asymmetrical, with Rpp most elongated, both consisting of two segments. T2 without d2-seta. CR well-developed, with two claws and two setae. Zenker's organ with few (5-8) spinous whorls.

***Physocypria* s.s.** Vávra, 1897

**Type species:** *Physocypria bullata* (Vávra, 1897) G. W. Müller, 1912

**Abbreviated diagnosis of *Physocypria* s.s.** (see also Table 3)

A2 with short seta accompanying natatory setae present. Md-palp with  $\beta$ -seta small, short and broad; length of last segment ca. 2x the basal width, apically set with three claws and two setae. Mx1-palp set with six structures (claws and setae). T1 with setae b and d both long. T2 with d1-setae present, setae e and h3 short. T3 with setae d2 and dp present; setae h1 and h2 subequal. Proximal seta on CR of medium length. Hemipenes with lobe ls generally elongated; lobe ms elongated or broad, generally shorter than ls. Ovarium ventrally turned forwards.

**Other species:** see Meisch *et al.* (2019)

***Keysercypria* Karanovic, 2011**

**Type species:** *Keysercypria affinis* (Klie, 1933)

**Abbreviated diagnosis of *Keysercypria*** Karanovic, 2011 (see also Table 3)

A2 with short seta accompanying natatory setae absent. Md-palp with length of last segment ca. 5x the basal width, apically set with three claws and two setae. Mx1-palp set with four structures (claws and setae). T2 with d1-setae absent, e-setae in male short (long in some species), h3-setae long in male. T3 with d2-setae absent, dp-setae present; h2-setae ca. 2x the length of h1-seta. Proximal seta on CR of medium length. Hemipenes with lobe ls generally elongated; lobe ms elongated or broad, generally shorter than ms. Ovarium ventrally turned back and upwards.

**Other species:** *K. deformis* (Klie, 1933); *K. schubarti* (Farkas, 1958) (see discussion)

**Genus 1 gen. nov.**

**Type species:** Gen. 1 spec. A gen. et spec. nov.

**Abbreviated diagnosis of Genus 1 gen. nov.** (see also Table 3)

A2 with short seta accompanying natatory setae absent. Md-palp with  $\beta$ -seta long and stout; length of last segment ca. 3x the basal width, apically set with three claws and one seta. Mx1-palp set with five structures (claws and setae). T1 with b-setae short and d-setae long. T2 with d1-setae absent, setae e and h3 in male short. T3 with d2-setae absent, dp-seta present; setae h2 ca. 2x the length of h1-seta. Proximal seta on CR long. Hemipenes with lobe ls generally elongated; lobe ms elongated or broad, generally shorter than ls. Ovarium ventrally turned back and upwards.

**Differential diagnosis**

The new genus can be separated from the genera *Cyclocypris*, *Kempecyclocypris*, *Cypria*, *Mecynocypris* and *Allocypris* by the presence of marginal tubercles on the RV; furthermore, from *Cypria*, *Physocypris* and *Dentocypris* by the absence of the short seta accompanying the natatory setae on the A2 and from *Physocypris* also by the absence of d2-seta on T2 and T3

(these setae present in *Physocypria*) and by the ovary which curves backward and upward (downward and forward in *Physocypria*). Genus 1 gen. nov. differs from *Keysercypria* by the relatively shorter final segment of the Md-palp ( $L = 3 \times W$  in Genus 1 gen. nov.,  $L = 5 \times W$  in *Keysercypria*), by the presence of 5 setae/claws on the second segment of the Mx1-palp (4 in *Keysercypria*), by the long proximal seta on the CR (medium length in *Keysercypria*) and especially by the short seta h3 in the male (very long in *Keysercypria*). Genus 1 gen. nov. is further distinguished from Genus 2 gen. nov. by the presence of dp-seta on T3 (absent in Genus 2 gen. nov.) and by the hemipenes and prehensile palps which follow the body plan of *Physocypria* (hyper-developed and with swollen shields and segments in Genus 2 gen. nov. – see below). Genus 1 gen. nov. furthermore, differs from the subterranean genera *Kempfcyclocypris* and *Namiotkocypria* by at least the reduced natatory setae on the A2 in these genera.

### **Gen. 1 spec. A gen. et spec. nov.**

(Figs 3–15)

- 2009 *Physocypria* sp. 2 n.sp. Higuti *et al.*: table 1.
- 2010 *Physocypria* sp. 2 n.sp. Higuti *et al.*: table 2.
- 2015a *Physocypria* sp. 2 n.sp. Matsuda *et al.*: 326, table 1.
- 2015b *Physocypria* sp. 2 n.sp. Matsuda *et al.*: 118, 122, table 1, fig. 5.
- 2017 *Physocypria* sp. 2 n.sp. Campos *et al.*: 38, table 2.
- 2018 *Physocypria* sp. 2 n.sp. Conceição *et al.*: table S1.
- 2017a *Physocypria* sp. 1 Higuti *et al.*: 327, table 2.
- 2017b *Physocypria* sp. 2 n.sp. Higuti *et al.*: 5, appendix 1.
- 2018 *Physocypria* sp. 1 n.sp Campos *et al.*: 6, table 2.
- 2019 *Physocypria* sp. 1 Campos *et al.*: 375, table 1.

### **Diagnosis**

Cp suboval shape, LV overlapping RV along all valve margins, except along posterior part of dorsal margin; anterior overlap the widest. Posterior marginal tubercles on RV more prominent than anterior ones.

A2 with five well-developed and long natatory setae, short accompanying seta missing. A2 in male with four-segmented endopodite and with t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. Rpp with first segment narrow and elongate, distal edge moderately

pointed. Lpp with first segment equally elongated; second segment sickle shaped, narrow. T1 with one long and hirsute seta next to the two a-setae. T2 without setae d1 and d2. T3 without d2-seta. CR with a long proximal seta. Hemipenis with ls long and narrow, ms triangular, reaching about halfway ls.

### **Differential diagnosis**

Gen. 1 spec. A gen. et spec. nov. can be distinguished from other *Physocypria* s.l. species by the moderatedorsal expansion on the RV. *Physocypria gibbera* (Furtos, 1936a), *P. inflata* Furtos, 1933 and *P. pustulosa* (Sharpe, 1897) have much larger dorsal expansions of the RV. Gen. 1 spec. A gen. et spec. nov. is somewhat similar to *P. schubarti* Farkas, 1958, with the ls of the hemipenis being almost twice the length of the ms, while the ms is also pointed. These two species mainly differ in the morphology of the Cp, where *P. schubarti* has a much larger anterior overlap of the LV over the RV. Furthermore, the Rpp and Lpp in *P. schubarti* are smaller and more robust, while in Gen. 1 spec. A gen. et spec. nov. the Rpp is much more elongated than the Lpp. Finally, *P. schubarti* also has a very long seta h3 on T2, so that it most likely belongs to *Keysercypria* (see discussion).

Regarding to other species belonging to the Genus 1 gen. nov., Gen. 1 spec. A gen. et spec. nov. is differentiated by the dorsal margin on RV, which is more rounded in this species and straighter in Gen. 1 spec. B gen. et spec. nov. and Gen. 1 spec. F et spec. nov. Also, the overlap of LV on RV in Gen. 1 spec. A gen. et spec. nov. are more prominent, as in Gen. 1 spec. B et spec. nov., however, both species can also be distinguished by the wide of anterior side, which is broader in Gen. 1 spec. A gen. et spec. nov.

### **Material examined**

**Type locality:** Upper Paraná River floodplain, Aurélio Lake (PAR 150), in floating macrophytes. Coordinates: 22°41'36.5" S, 53°13'52" W.

### **Type material:**

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA120).

**Allotype:** A female, dissected and stored as the holotype (NA121).

**Paratypes:** Two males dissected and stored as the holotype (NA114, NA192). Three male carapaces stored dry in micropaleontological slides (NA213, NA214, NA215).

Two females dissected and stored as the holotype (NA122, NA193). One female carapace stored dry in micropaleontological slide (NA245).

**Other material illustrated:** Upper Paraná River floodplain: Two females carapaces stored dry in micropaleontological slides (NA217 and NA218 both lost after use for SEM) from Aurélio Lake (PAR 150).

South Matogrossense Pantanal: One male dissected and stored as the holotype (NA118). Three male carapaces stored dry in micropaleontological slides (NA219, NA220, NA221) from Carenda Forest Road, Lake 1 (PAN 09).

One female dissected and stored as the holotype (NA195). Three female carapaces stored dry in micropaleontological slides (NA222, NA223, NA224) from Carenda Forest Road, lake 1 (PAN 09).

**Other material examined:**

Upper Paraná River floodplain: Two males dissected and stored as the holotype (NA116, NA119) from Aurélio Lake (PAR 1631).

South Matogrossense Pantanal: One male dissected and stored as the holotype (NA097) from Carenda Forest Road, lake 1 (PAN 09). One female dissected and stored as the holotype (NA194) from Carenda Forest Road, lake 1 (PAN 09).

**Measurements of illustrated specimens**

See Table 2.

>>> Table 2

>>> Figure 3

**Description of male**

Valves with suboval shape, with greatest height just behind the middle of the valves. LVi (Figs 3A, C–D) with narrow calcified anterior and posterior inner lamella; an inwardly displaced inner list running along the anterior margin, ending in an internal anteroventral tooth; tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 3B, E–F) with narrow calcified anterior and posterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in the middle; strong marginal tubercles along the anteroventral and posteroventral margins, weakly along the ventral margin.

CpRI (Fig 3G) with a suboval shape, with greatest height in the middle; LV overlapping RV along all margins, except in the middle of the dorsal side. CpD (Fig 3H) and CpV (Fig 3I) with greatest width slightly behind the middle, external surface set with few short setae and shallow pits (Fig 3J).

#### >>> Figure 4

A1 (Fig 4A) with seven segments. First segment large, with two long hirsute ventroapical setae; one short hirsute dorsal seta; Wouter's organ not seen. Second segment wider than long, with one short hirsute dorsal seta; Rome organ not seen. Third segment with two apical setae: ventrally with one short seta reaching middle of fifth segment and dorsally with one long hirsute seta reaching beyond tip of middle of terminal segment. Fourth segment with two long dorso-apical setae and two unequally short ventro-apical setae. Fifth segment with four apical setae: two long dorsal ones reaching beyond tip of terminal segment and two ventral, ca. 2x length of fifth segment. Sixth segment with four long apical setae and one short hirsute seta (4x length of terminal segment). Terminal segment with two long setae, one short aesthetasc Ya and one short hirsute seta, the latter twice length of aesthetasc Ya.

A2 (Fig 4B–C) with protopodite, exopodite and four-segmented endopodite. Protopodite ventrally with three setae: two short seta and one long apical hirsute seta reaching tip of end claws. Exopodite reduced to a small plate with one long hirsute seta (slightly longer than first endopodite) and two unequally long setae (long one ca. 3x length of short one). First endopodal segment ventrally with aesthetasc Y (ca. 1/2 length of segment), one long ventroapical hirsute seta (reaching beyond tip of terminal segment), and five natatory setae, reaching well beyond tip of end claws; short accompanying seta missing. Second endopodal segment with four t-setae of unequal length (t1 long and hirsute, t2 and t3 stout and t4 short); dorsally with two unequally short setae; ventrally with aesthetasc y1 (same length of second endopodal segment) and aesthetasc y2 (reaching middle of terminal segment). Third endopodal segment apically with four claws (G1, G2, z1, z2) and two setae (G3, z3). Terminal segment (Fig 4C) with two claws, one long (GM) and one slightly short (Gm) claw, one aesthetasc y3 with accompanying seta (ca. 3x length of aesthetasc y3) and one g-seta, ca. 2/3 length of y3.



Md-palp (Fig 5A) with four segments. First segment with two long plumose setae ( $S_1$  and  $S_2$ ), one long smooth seta and one short slender smooth  $\alpha$ -seta. Second segment with two dorsal, unequally short setae; ventrally with one stout hirsute  $\beta$ -seta (ca.  $2/3$  length of third segment) and four long setae (three hirsute and one smooth). Third segment with three groups of setae: one dorsal group of four setae (three unequally long and one short ca.  $1/4$  length of longest); one lateral group with one apical  $\gamma$ -seta ( $1/2$  the length of terminal segment) and three smooth short setae; one ventral group with a single short seta. Terminal segment with L ca.  $3\times$  basal width, with three unequally long claws and two short setae.

Md-coxa (Fig 4D) elongated, dorsally with a short seta, and with strong and apical teeth, interspaced with some setae.

### >>> Figure 5

Mx1 (Fig 5B – chaetotaxy not complete) consisting of three masticatory lobes (endites), a two-segmented palp and a large branchial plate (not illustrated). Branchial plate elongated, with ca. 16 respiratory rays, some quite short, others longer. First segment of palp with five unequally short setae and one stout plumose setae at base of segment. Terminal segment of palp rectangular, ca. half length of first segment of palp, apically with three claws and two setae (one long  $2/3$  length of claws, and one short  $1/3$  length claws). Third and second endites with two smooth claws. First endite short with two basal setae (one short and one long, about  $4\times$  length of short one).

T1 with protopodite (Fig 6A) and endopodites (asymmetrical prehensile palps) (Figs 6B–C). Protopodite apically with a group of 12 unequal and hirsute setae, two short smooth a-setae, one short smooth b-seta, one long and smooth d-seta (ca.  $3\times$  length of b-seta), and one long and hirsute seta next to two a-setae (almost  $3\times$  length of d-seta). Rpp (Fig 6B) first segment very elongated, distal margin with a small subtriangular protrusion and one subapical spine; second segment with triangular lobe and concave distal margin. Lpp (Fig 6C) with first segment shorter and smaller than Rpp, with one long subapical spine; second segment small, narrow and sickle-shaped, with pointed distal part.

T2 (Fig 5C) with protopodite, a ‘knee’-segment and four endopodite segments. Protopodal segment without d1-seta. “Knee”-segment without d2-seta. First endopodal segment with one apical hirsute e-seta, reaching tip of second endopodal segment. Second endopodal segment with one apical hirsute f-seta, reaching beyond middle of third endopodal segment. Third endopodal segment with one subapical hirsute g-seta, reaching the tip of terminal

segment. Terminal segment with one short ventrally hirsute h1-seta, one dorsally hirsute h3-seta longer than h1 and apically one long and serrated h2-claw.

#### >>> Figure 6

T3 (Fig 6E) with four segments. First segment with one long and hirsute dp-seta and one short hirsute d1-seta (the latter ca. 1/2 the length of dp), seta d2 absent. Second segment with one very short subapical e-seta. Third segment with two very short setae: medially f-seta and subapically g-seta. Terminal segment short, longer than wide, with three hirsute setae: one short seta h1, one seta h2 more than twice the length of h1 and one long seta h3, about as long as T3.

CR (Fig 6F) well-developed and robust, with one proximal seta of medium length (ca. 1/2 length of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

CR attachment (Fig 6G) robust, with two branches: db short with a rounded protrusion distally and vb longer than db and without a protrusion.

Zenker's organ (Fig 6D) about 3x longer than wide, with ca. 6 spiny whorls.

Hemipenis (Fig 6H) with ls-lobe elongated, ms-lobe short (ca. 1/3 length of the ms-lobe), subtriangular, with pointed tip.

#### >>> Figure 7

### **Description of female**

Valves with suboval shape, with greatest height slightly behind middle of valves. LVi (Figs 7A, C–D) higher than male, with narrow calcified anterior and posterior inner lamella, with an inner list running along anterior margin, disappearing in an anteroventral internal tooth; tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 7B, E–F) higher than male, with narrow calcified anterior and posterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in the middle; strong marginal tubercles along the anteroventral and posteroventral margins, weakly along the ventral margin; detail of muscles scars (Fig. 7J); CpRl (Fig 7G) with suboval shape, with greatest height in the middle; LV overlapping RV along all margins, except in middle of dorsal side. CpD (Fig 7H) and CpV (Fig 7I) wider than male, with greatest width behind the middle.

## &gt;&gt;&gt; Figure 8

A1 (Fig 8A) with seven segments. First segment large, with two long ventroapical hirsute setae and one short dorsal hirsute seta; Wouter's organ not seen. Second segment wider than long, with one short hirsute dorsal seta; Rome organ not seen. Third segment with two apical setae: ventrally with one short seta reaching beyond middle of fifth segment and dorsally with one long seta reaching tip of sixth segment. Fourth segment with two long dorsoapical setae and two unequally short ventroapical setae. Fifth segment with four apical setae: two long dorsal reaching beyond tip of terminal segment and two ventral twice length of fifth segment. Sixth segment with four long apical setae and one short hirsute seta (3x length of terminal segment). Terminal segment with two long setae, one short aesthetasc Ya and one short hirsute seta, the latter twice length of aesthetasc Ya.

A2 (Fig 8B–C) with protopodite, exopodite and three-segmented endopodite. Protopodite ventrally with three setae: two short seta and one long apical hirsute seta reaching beyond tip of end claws. Exopodite reduced to small plate with one long hirsute seta (reaching tip of terminal segment) and two unequally short setae (long one ca. 3x length of short one). First endopodal segment ventrally with aesthetasc Y (ca. 1/2 length of segment), one long ventro-apical hirsute seta (reaching beyond tip of terminal segment), and five long natatory setae, reaching well beyond tip of end claws; short accompanying seta absent. Second endopodal segment with four t-setae of unequally length (t1, t2 and t3 long and t4 very short); dorsally with two unequally short setae; ventrally with aesthetasc y1 (ca. 1/4 length of second endopodal segment) and aesthetasc y2 (reaching beyond middle of terminal segment). Third endopodal segment apically with three claws (G1, G2, G3) and three setae (z1, z2, z3). Terminal segment (Fig 8C) with two claws, one long (GM) and one slightly short (Gm), one aesthetasc y3 with accompanying seta (ca. 3x length of aesthetasc y3), and one g-seta, ca. 2/3 length of y3.

Md-palp (Fig 9A) with four segments. First segment with two long plumose setae (S<sub>1</sub> and S<sub>2</sub>), one long smooth seta and one short slender smooth  $\alpha$ -seta. Second segment with two dorsal unequally short setae; ventrally with one stout hirsute  $\beta$ -seta (ca. 2/3 length of third segment) and four long setae (three hirsute and one smooth). Third segment with three groups of setae: dorsal group with four setae (three unequally long and one short, ca. 1/4 length of longest); lateral group with one apical  $\gamma$ -seta (1/2 the length of terminal segment) and three smooth short setae; ventral group with one short seta. Terminal segment with L ca. 3x basal width, with three unequally long claws and two short setae.

Md-coxa (Fig 8D) elongated, dorsally with a short seta, and with strong and apical teeth, interspaced with some setae.

>>> Figure 9

Mx1 (Fig 9B – chaetotaxy not complete) consisting of three masticatory lobes (endites), a two-segmented palp and a large branchial plate (not illustrated). Branchial plate elongated with ca. 16 respiratory rays, some quite short, others longer. First segment of palp with five unequally short setae and one stout plumose setae at base of segment. Terminal segment of palp rectangular, ca. half length of first segment of palp, apically with three claws and two setae (one long  $\frac{2}{3}$  length of claws, and one short  $\frac{1}{3}$  length of claws). Third and second endite with two smooth claws. First endite short with two basal setae (one short and one long, about 4x length of previous one).

T1 (Fig 9C) with protopodite apically with a group of 12 unequal and hirsute setae; two short smooth a-setae, one short smooth b-seta and one long and hirsute d-seta (ca. 6x length of b-seta), and one long and hirsute seta next to the two a-setae (ca. 2x length of d-seta). Endopodite apically with one long and two short setae (one ca.  $\frac{2}{3}$  length of the long and one  $\frac{1}{2}$  length of the long).

>>> Figure 10

T2 (Fig 10A) with protopodite, a ‘knee’-segment and four endopodite segments. Protopodal segment without d1-seta. “Knee”-segment without d2-seta. First endopodal segment with one apical hirsute e-seta, reaching tip of second endopodal segment. Second endopodal segment with one apical hirsute f-seta, slightly shorter than third segment. Third endopodal segment with one subapical hirsute g-seta, reaching tip of terminal segment. Terminal segment with one short hirsute h1-seta, one hirsute h3-seta, slightly shorter than seta h1 and apically with one long, strongly curved and serrated h2-claw.

T3 (Fig 10B) with four segments. First segment with one long and hirsute ventral dp-seta and one short hirsute d1-seta, ca.  $\frac{1}{2}$  length of dp-seta, d2-seta missing. Second segment with one very short subapical e-seta. Third segment with two very short setae: medially f-seta and subapically g-seta. Terminal segment short, slightly longer than wide, with three hirsute setae: one short h1-seta, one h2-seta, more than twice the length of seta h1 and one very long h3-seta, about same length as T3.

CR (Fig 10C) well-developed and robust, with one long hirsute proximal seta (ca. half length of ramus), subapically with one shorter serrated claw, apically with one long serrated claw and one short and smooth seta.

CR attachment (Fig 10D) robust, with two branches: db short with a rounded protrusion distally and vb longer than db and without a protrusion.

**Remarks:** As this species occurs in two floodplains, we also illustrate valves of males (Fig 11, 12) and females (Fig 13) and carapaces of males and females (Fig 14) from the South Pantanal Matogrossense to show the similarities among them. We also illustrate the outline of Hp and prehensile palps of four males that can show some variabilities between specimens (Fig 15), e.g., some ms lobe of Hp are slightly less pointed (Fig. 15E–F, M–N), than others (Fig. 15 A–B, I–J). Also, Rpp (Fig.15C) is more robust than in other specimens, while Lpp first segment can be wider in basal segment (Fig. 15D, H), or slender (Fig. 15L, P).

>>> Figures 11–15

### **Ecology and distribution**

Gen. 1 spec. A gen. et spec. nov. was recorded from two tropical Brazilian floodplains (Paraná and Pantanal), associated with different types of macrophytes. The water temperature ranged between 21 and 26°C. The pH ranged from 5 to 7. The range of electrical conductivity was between 31.1 and 215  $\mu\text{S} \cdot \text{cm}^{-1}$  and the values of dissolved oxygen varied from 1 to 2.3 mg.  $\text{L}^{-1}$  (see Table 1).

### **Gen. 1 spec. B gen. et spec. nov.**

(Figs 16–19)

2007 *Physocypria schubarti* Higuti *et al.*: 1935, table 2.

2009 *Physocypria schubarti* Higuti *et al.*: 664, table 1.

2010 *Physocypria schubarti* Higuti *et al.*: 267, 269, tables 2, 4.

2015a *Physocypria schubarti* Matsuda *et al.*: 326, table 1.

2015b *Physocypria schubarti* Matsuda *et al.*: 118, table 1.

2017b *Physocypria schubarti* Higuti *et al.*: 5, appendix 1.

2017 *Physocypria schubarti* Conceição *et al.*: 5, table 2.

2020 *Physocypria schubarti* Conceição *et al.*: 1670, 1677, fig. 4, table 2.

2020 *Physocypria schubarti* Higuti *et al.*: 2, table S1.

2020 *Physocypria schubarti* Rosa *et al.*: 29, table 1.

2021 *Physocypria schubarti* Campos *et al.*: 7, table 1.

2021 *Physocypria schubarti* Rosa *et al.*: 229, 230, 234, 235, figs. 2,6, tables 1,3.

### Diagnosis

Cp suboval shape, LV overlapping RV, except in the middle of dorsal margin, anterior overlap the largest. Posterior marginal tubercles more prominent than anterior ones. CpV and CpD narrow. A2 with natatory setae well-developed, accompanying seta absent; male A2 with four-segmented endopodite, setae t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. Rpp with sharply pointed distal corner of first segment; second segment with curved dorsal margin. Lpp shorter and narrower, distal segment sickle-shaped, smoothly curved. T1 with one long and hirsute seta next to the two a-setae. T2 without d1 and d2 setae. T3 without d2-seta. CR with a long proximal seta. Hemipenis with ls and ms elongated and subequal in length.

### Differential diagnosis

Gen. 1 spec. B gen. et spec. nov. can be distinguished from other *Physocypria s.l.* species by the morphology of the prehensile palps and hemipenis. Thus far, no other species of *Physocypria s.l.* have been recorded with similar morphological characteristics of the male reproductive organs. However, regarding the shape of the carapace, especially by the presence of a large overlap of the LV over the RV, especially anteriorly, Gen. 1 spec. B gen. et spec. nov. is similar to *P. affinis* Klie, 1933, *P. biwaensis* (Okubo, 1990), *P. bullata*, *P. deformis* Klie, 1940 and *P. longiseta* Klie, 1930.

However, the new species differs from all of these species in the shape of the dorsal margin of the LV, which is rounded and with the greatest height situated at the middle of the valve in *P. affinis* and *P. longiseta*, near to the anterior region in *P. deformis* and is also more straight in Gen. 1 spec. B gen. et spec. nov., with the greatest height situated closer to the posterior region. *Physocypria biwaensis* has an arched dorsal margin of the LV, while *P. bullata* has a very large dorsal expansion on the RV and both of these characters are absent in Gen. 1 spec. B gen. et spec. nov.

Gen. 1 spec. B et spec. nov. have a flat shape in lateral view, which is also observed in Gen. 1 spec. F et spec. nov., but, the first species have a big overlap in antero and posteroventral margins, and the second species have a small overlap of LV on RV.

### **Material examined**

**Type locality:** Alluvial valley of the upper Paraná River floodplain, Banhado Lake (PAR 255), in floating macrophytes. Coordinates: 22°33'58.6" S, 53°23'10.4" W.

### **Type material:**

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA150).

**Allotype:** A female, dissected and stored as the holotype (NA152).

**Paratypes:** Two males dissected and stored as the holotype (NA111, NA149). Three males' carapaces stored dry in micropaleontological slides (NA181, NA182, NA183).

Two females dissected and stored as the holotype (NA151, NA153). Three females' carapaces stored dry in micropaleontological slides (NA184, NA185, NA186).

### **Measurements of illustrated specimens**

See Table 2.

>>> Figure 16

### **Description of male**

Valves with suboval shape, with greatest height in front of the middle of the valves. LVi (Figs 16A, C–D) with narrow calcified anterior and posterior inner lamella; an inwardly displaced inner list running along the anterior margin, ending in an internal anteroventral tooth, tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 16B, E–F) with narrow calcified anterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in ventral margin; strong marginal tubercles along the anteroventral and posteroventral margins, weakly along middle of ventral margin.

CpRl (Fig 16G) with a suboval shape, with greatest height in front of middle; LV overlapping RV along all margins, except in middle of dorsal side, with the greatest overlap in anterior side. CpD (Fig 16H) and CpV (Fig 16I) with flat shape, with greatest width slightly behind middle, external surface with shallow pits and setae (Fig 16J).

>>> Figure 17

Only the differences with the male of Gen. 1 spec. A gen. et spec. nov. are described here.

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta almost reaching middle of fourth segment and dorsally with one long seta reaching the tip of fourth segment. Sixth segment with four long apical setae and one short hirsute seta (5x the length of the terminal segment).

A2 (not illustrated) exopodite reduced to a small plate with two unequal length setae (the long one ca. 6x the length of the short). Terminal segment with one g-seta, ca. 1/3 length of y3.

Md-palp (not illustrated) with second segment with one stout hirsute  $\beta$ -seta (ca. 1/2 of the length of the third segment).

Mx1 (not illustrated) with terminal segment of palp apically with three claws and two setae (both ca. 1/2 length of claws).

T1 with protopodite (Fig 17A) and endopodites (asymmetrical prehensile palps) (Figs 17B–C). Protopodite apically with a group of 12 unequal and hirsute setae, two short smooth a-setae, one smooth b-seta and one long and smooth d-seta (6x length of b-seta), and one long and hirsute seta next to the two a-setae (2x length of d-seta). Rpp (Fig 17B) with sharply pointed distal corner of first segment; second segment with curved dorsal margin. Lpp (Fig 17C) shorter and narrower, distal segment sickle-shaped, smoothly curved.

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, almost reaching tip of third endopodal segment. Second endopodal segment with one apical hirsute f-seta, reaching tip of third endopodal segment. Third endopodal segment with one subapical hirsute g-seta, ca. 2x length of terminal segment. Terminal segment with one h3-seta slightly shorter than h1.

CR (Fig 17D) well-developed and robust, with one long proximal hirsute seta (ca. 1/2 of ramus), subapically with one serrated claw, apically with one long serrated claw and one shorter and smooth seta.



Hemipenis (Fig 17E) with ls and ms both elongated and subequal in length. Ms distally slightly curved, ls distally slightly swollen.

>>> Figure 18

### **Description of female**

Only the differences with the male of Gen. 1 spec. D gen. et spec. nov. are described here.

LVi (Figs 18A, C–D) and RVi (Figs 18B, E–F) higher than male. CpRI (Fig 18G) as in the male; CpD (Fig 18H) and CpV wider than male (Fig 18I) and external surface with shallow pits and setae (Fig 18J).

>>> Figure 19

A1 (not illustrated) third segment ventrally with one seta slightly longer than fourth segment and dorsally with one long seta reaching tip of the fourth segment. Sixth segment with one short hirsute seta (5x length of terminal segment). Terminal segment with one short hirsute seta, ca. 2x length of aesthetasc Ya.

A2 (not illustrated) protopodite with one long apical hirsute seta reaching tip of end claws. Exopodite reduced to a small plate with one long hirsute seta (reaching tip of the second endopodal segment) and two unequally length setae (the long one ca. 6x length of the short). Third endopodal segment apically with three claws (G1, G2, G3) and three setae (z1, z2, z3).

T1 (Fig 19A) with protopodite apically with a group of 12 unequally and hirsute setae; two short smooth a-setae, one short and smooth b-seta, one long and smooth d-seta (6x length of b-seta), and one long and hirsute seta next to the two a-setae (2x length of d-seta). Endopodite apically with one long and two short setae (one ca. 2/3 length of the long and one 1/2 length of the long).

CR (Fig 19B) well-developed and robust, with one long proximal seta (ca. 2/3 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

>>> Figure 19

## Ecology and distribution

Gen. 1 spec. B gen. et spec. nov. was recorded from only one Brazilian floodplain (Paraná), associated with floating macrophytes. The water temperature registered was 28°C. The pH was 5.2 and the value of electrical conductivity was 31.8  $\mu\text{S}\cdot\text{cm}^{-1}$  (see Table 1).

## Gen. 1 spec. D gen. et spec. nov.

(Figs 20–26)

### Diagnosis

Cp suboval, rather wide in DV, LV overlapping RV, except in the middle of dorsal margin. Anterior and posteroventral overlap the largest. Posteroventral tubercles more prominent than anteroventral ones. A2 with natatory setae well developed, short accompanying seta absent; male A2 with four-segmented endopodite and with t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. First segment of Rpp stout, broad and long, with V-shaped dorsal margin and distally with a curved spinal edge; second segment sub-triangular, with a curved dorsal margin and a rectangular dorso-distal edge. Lpp with shorter first segment, distally slightly tapering; second segment smoothly curved, second half elongated. T1 with one long and hirsute seta next to the two a-setae. T2 without d1 and d2 setae. T3 of male without dp and d2 setae; female only without d2-seta. CR with a long proximal seta. Hemipenis with broad body; ls elongated, with parallel edges; ms consisting of two lobes, ventral lobe broadly and irregularly curved, not reaching middle of ls, ventral lobe elongated with blunt point.

### Differential diagnosis

Gen. 1 spec. D gen. et spec. nov. resembles *Physocypria deformis* in the shape of the dorsal margin of the RV. But in the new species, the overlap of LV on RV is similar along all margins, except in the middle of dorsal side, while in *P. deformis* the overlap along the anterior side is much larger. In *P. deformis*, the lobe ms of the Hp is more than 2/3 the length of the ls, while in Gen. 1 spec. D gen. et spec. nov., the ms is much shorter than ls, i.e., ca. 1/2 the length of ls. The second segment of the Rpp in Gen. 1 spec. D gen. et spec. nov. is short and has a rounded distal margin, while in *P. deformis* this second segment is larger and has a sinuous margin. In addition, the seta h3 of the T2 is very large, and therefore this species most likely belongs in *Keysercypria* (see discussion).

*Physocypria granadae* Hartmann, 1959 and *P. schubarti* also have a similar morphology of the Hp as in Gen. 1 spec. D gen. et spec. nov., but the prehensile palps of the first species are

more slender, while the second segment of the Rpp is much more robust than in Gen. 1 spec. D. gen. et. spec. nov. Furthermore, the dorsal margin of the LV of *P. granadae* is more straight than in Gen. 1 spec. D gen. et spec. nov. and in *P. schubarti*, the greatest overlap of the LV over the RV is situated along the anterior margin, while this anterior overlap is much less pronounced in Gen. 1 spec. D gen. et spec. nov.

Gen. 1 spec. D gen. et spec. nov. have a similar shape of Cp with Gen. 1 spec. A gen. et spec. nov., but dorsal margin is straighter in the former species, besides the Gen. 1 spec. A gen. et spec. nov. is generally bigger (in length).

### **Material examined**

**Type locality:** South Matogrossense Pantanal, Miranda II River (PAN 66), in *Eichhornia azurea*, *Ludwigia* sp., *Pistia* sp. and *Salvinia* spp. Coordinates: 19°2'7.7" S, 57°18'49" W.

### **Type material:**

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA095).

**Allotype:** A female, dissected and stored as the holotype (NA142).

**Paratypes:** Two males dissected and stored as the holotype (NA141, JH1084). Two males' carapaces stored dry in micropaleontological slides (JH1085, JH1087).

One female dissected and stored as the holotype (JH1080). Three female's carapaces stored dry in micropaleontological slides (JH1081, JH1082, JH1083).

**Other material illustrated:** South Matogrossense Pantanal: One male dissected and stored as the holotype (NA076) from Curva Doleque Road, lake 4 (PAN 08).

One male dissected and stored as the holotype (NA101) from Corumba Road, pool 2 (PAN 14).

One male dissected and stored as the holotype (NA196) from Corumba Road, lake 4 (PAN 18).

One male dissected and stored as the holotype (NA091) and three males' carapaces stored dry in micropaleontological slides (NA240, NA241, NA242) from Camp Road, pool 4 (PAN 31).

One female dissected and stored as the holotype (NA140) and one female carapace stored dry in micropaleontological slides (NA243) from Camp Road, pool 4 (PAN 31).

**Other material examined:** South Matogrossense Pantanal: Two males dissected and stored as the holotype (NA080, NA096) from Curva Doleque Road, lake 4 (PAN 08). Two females dissected and stored as the holotype (NA081, NA082) from Curva Doleque Road, lake 4. One male dissected and stored as the holotype (NA107) from Corumba Road, lake 4 (PAN 18). One male dissected and stored as the holotype (NA094) from BEP wetland 2 (PAN 27). One male dissected and stored as the holotype (NA087) from Camp Road, pool 4 (PAN 31).

#### **Measurements of illustrated specimens**

See Table 2.

>>> Figure 20

#### **Description of male**

Valves with suboval shape, with greatest height in middle of valves. LVi (Figs 20A, C–D) with narrow calcified anterior and posterior inner lamella; an inwardly displaced inner list running along the anterior margin, ending in an internal ventral tooth; tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 20B, E–F) with narrow calcified anterior and posterior inner and an inwardly displaced inner list along the anterior margin, disappearing in the anteroventral margin; strong marginal tubercles along posteroventral margin, weakly along middle and anteroventral margins.

CpRi (Fig 20G) with a suboval shape, with greatest height in middle; LV overlapping RV along all margins, except in middle of dorsal side. CpD (Fig 20H) and CpV (Fig 20I) with greatest width in middle, external surface with shallow pits (Fig 20J).

>>> Figure 21

Only the differences with the male of Gen. 1 spec. A gen. et spec. nov. are described here.

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta reaching middle of fifth segment and dorsally with one short hirsute seta reaching tip of fifth segment.

A2 (not illustrated) exopodite reduced to a small plate with one long hirsute seta (reaching tip of the terminal segment) and two unequally length seta (the long ca. 10x length of short). Terminal segment with one g-seta, ca. 1/2 length of y3.

Md-palp (not illustrated) with second segment with one stout hirsute  $\beta$ -seta (ca. 1/2 of the length of the third segment).

Mx1 (not illustrated) first endite short with two basal setae (one short and one long, about 6x length of previous one).

T1 with protopodite (Fig 21A) and endopodites (asymmetrical prehensile palps) (Figs 21B–C). Protopodite apically with a group of 14 unequally and hirsute setae; two short smooth a-setae, one smooth b-seta, one long and smooth d-seta (6x length of b-seta), and one long and hirsute seta next to the two a-setae (almost 2x length of d-seta). Rpp (Fig 21B) with first segment stout, broad and long, with V-shaped dorsal margin and distally with a curved spinal edge. Lpp (Fig 21C) with shorter first segment, distally slightly tapering; second segment smoothly curved, second half elongated.

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, reaching middle of third endopodal segment. Second endopodal segment with one apical hirsute f-seta, almost reaching tip of third endopodal segment. Third endopodal segment with one subapical hirsute g-seta, reaching beyond tip of terminal segment. Terminal segment with h3-seta slightly shorter than h1.

T3 (not illustrated) first segment without dp-seta and with one short d1-seta (ca. 1/4 of length of segment).

CR (Fig 21D) well-developed and robust, with one long proximal seta (ca. 2/3 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

Hemipenis (Fig 21E) with broad body; ls elongated, with parallel edge; ms consisting of two lobes, ventral lobe broadly and irregularly curved, not reaching middle of ls, ventral lobe elongated with blunt point.

>>> Figure 22

### **Description of female**

Only the differences with the male of Gen. 1 spec. D gen. et spec. nov. are described here.

LVi (Figs 22A, C–D) and RVi (Figs 22B, E–F) higher than male. RVi with tubercles along posteroventral margin, disappearing in middle and few tubercles next to anterior side. CpRl (Fig 22G) as in the male. CpD (Fig 22H) and CpV (Fig 22I) with greatest width behind middle, external surface with shallow pits and setae (Fig 22J).

>>> Figure 23

A2 (not illustrated) exopodite reduced to a small plate with one long hirsute seta (reaching tip of second endopodal segment). Third endopodal segment apically with three claws (G1, g2, g3) and three setae (z1, z2, z3).

Mx1 (not illustrated) first endite short with two basal setae (one short and one long, about 3x length of previous one).

T1 (Fig 23A) with protopodite apically with a group of 15 unequally and hirsute setae; two smooth a-setae, one short and smooth b-seta, one long and smooth d-seta (ca. 7x length of b-seta), and one long and hirsute seta next to the two a-setae (almost 2x length of d-seta). Endopodite apically with one long and two short setae (one ca. 2/3 length of the long and one 1/2 length of the long).

T3 (not illustrated) first segment with one long and hirsute dp-seta and one short d1-seta (the latter ca. 1/2 of length of dp).

CR (Fig 23B) well-developed and robust, with one long proximal hirsute seta (ca. 2/3 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

**Remarks:** As this species occurs in more than one locality in South Matogrossense Pantanal, we also illustrate valves of males and female (Fig 24) and carapaces of male and female (Fig 25) from others lakes of the South Pantanal Matogrossense, to show the similarities among them. We also illustrate the outline of Hp and prehensile palps of four males that can show some variabilities between specimens (Fig 26).

### **Ecology and distribution**

Gen. 1 spec. D gen. et spec. nov. was recorded only from South Matogrossense Pantanal, associated with different species of macrophytes. The water temperature recorded was 19 to 24°C. The pH ranged from 6 to 8.1, while range of electrical conductivity was between 140 and 415  $\mu\text{S}.\text{cm}^{-1}$  and the value recorded of dissolved oxygen was 4.5 mg.  $\text{L}^{-1}$  (see Table 1).

**Gen. 1 spec. F gen. et spec. nov.**

(Figs 27–33)

**Diagnosis**

Cp with suboval shape, LV slightly overlapping RV along dorsoanterior margin and in the middle of posterior side only; LV rather elongated. RV with small marginal tubercles on anterior and posterior sides of ventral margin. CpD and CpV narrow. A2 with natatory setae well-developed, short accompanying seta absent. A2 in male with a four-segmented endopodite and with t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. Rpp with relatively short and broad first segment, with curved dorsal margin; second segment subtriangular, with dorsal margin strongly curved, dorso-distal corner pronounced and distal margin straight. Lpp with first segment long and with sub-parallel margins; second segment small and short, smoothly rounded. T1 with one long and hirsute seta next to the two a-setae. T2 without d2 setae. T3 without dp and d2 setae. CR with a long medially seta. Hemipenis with ls long and pointed; ms a broad lobe, distally asymmetrically and bluntly pointed, reaching to halfway ls, with internal trabecula long and pointed.

**Differential diagnosis**

Gen. 1 spec. F gen. et spec. nov. can be distinguished from other *Physocypria s.l.* species by the presence of a long and pointed internal trabecula in the Hp. This species is most similar to those species without large overlap of the LV over the RV, such as *P. dentifera* (Sharpe, 1918), *P. kraepelini* G. W. Müller, 1903, *P. larensis* Hartman, 1964 and *P. xanabanica* Furtos, 1936b. However, the dorsal margin in the LV of *P. larensis* and *P. xanabanica* is slightly rounded, while in the new species, the LV is more elongated and the dorsal margin is more straight. In *P. kraepelini*, both valves have a similar shape, while in the new species, the RV is higher than the LV and in *P. dentifera*, the CpD is wider than in Gen. 1 spec. F gen. et spec. nov.

Gen. 1 spec. F gen. et spec. nov. can be distinguished from other species of Genus 1 gen. nov. by the CpRI dorsal margin, which is characterized by greatest height in middle (in males) and in dorsoposterior side (in females). Additionally, this species has a small LV overlap on RV, which is significantly bigger in other species, as Gen. 1 spec. A gen. et spec. nov. and Gen. 1 spec. B gen. et spec. nov.

### **Material examined**

**Type locality:** Amazon River floodplain, Manacapuru Lake (AMA 38), in macrophytes. Coordinates: 3°12'53" S, 60°42'36.4" W.

### **Type material:**

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA104).

**Allotype:** A female, dissected and stored as the holotype (NA187).

**Paratypes:** Two males dissected and stored as the holotype (NA146, NA147). Three males' carapace stored dry in micropaleontological slides (NA159, NA160, NA161).

One female dissected and stored as the holotype (NA148). Three females' carapaces stored dry in micropaleontological slides (NA162, NA163, NA164).

**Other material illustrated:** Amazon River floodplain: One male dissected and stored as the holotype (JH889). Three males' carapace stored dry in micropaleontological slides from Cadete Lake (JH890, JH891, JH892).

One female dissected and stored as the holotype (JH893). Three females' carapaces stored dry in micropaleontological slides (JH894, JH895, JH896).

One male dissected and stored as the holotype (NA105) from Castanho Lake (AMA 80).

One female dissected and stored as the holotype (NA191) from Castanho Lake (AMA 80).

**Other material examined:** Amazon River floodplain: Three males dissected and stored as the holotype (NA072, NA073, NA103) from Cadete Lake (AMA 22).

Two males dissected and stored as the holotype (NA102, NA155) from Cadete Lake (AMA 23). Two females dissected and stored as the holotype (NA188, NA189) from Cadete Lake (AMA 23).

Two males dissected and stored as the holotype (NA156, NA157) from Cadete Lake (AMA 24). One female dissected and stored as the holotype (NA190) from Cadete Lake (AMA 24).

### **Measurements of illustrated specimens**

See Table 2.



>>> Figure 27

### **Description of male**

Valves with suboval shape, with greatest height just in middle of valves. LVi (Figs 27A, C–D) with narrow calcified anterior and posterior inner lamella; an inwardly displaced inner list running along the anterior margin, ending in an internal anteroventral tooth; tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 27B, E–F) with narrow calcified anterior and posterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in the middle; strong marginal tubercles along the anteroventral and posteroventral margins, weakly along the middle of ventral margin.

CpRi (Fig 27G) with a suboval shape, with greatest height in middle; LV overlapping RV in dorsoanterior side and in middle of posterior side. CpD (Fig 27H) and CpV (Fig 27I) with a flat shape, with greatest width in middle, external surface with shallow pits and setae (Fig 27J).

>>> Figure 28

Only the differences with the male of Gen. 1 spec. A gen. et spec. nov. are described here.

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta reaching middle of fifth segment and dorsally with one short hirsute seta reaching middle of fourth segment.

A2 (not illustrated) exopodite reduced to a small plate with one long hirsute seta (reaching tip of first endopodal segment) and two unequally length setae (the long one ca. 6x length of short). First endopodal segment ventrally with aestethasc Y (ca. 1/3 of length of first endopodal segment). Second endopodal segment with an aesthetasc y2 ca. 2/3 of length of the terminal segment. Terminal segment with one g-seta, slightly longer than y3.

Mx1 (not illustrated) with terminal segment of palp apically with four claws and one seta (ca. 1/2 length of claws). First endite short with two basal setae (one short and one long, about 6x length of previous one).

T1 with protopodite (Fig 28A) and endopodites (asymmetrical prehensile palps) (Figs 28B–C). Protopodite apically with a group of 14 unequally and hirsute setae, two short smooth a-setae, one short smooth b-seta, one long and smooth d-seta (ca. 6x length of b-seta), and one

long and hirsute seta next to the two a-seta (2x length of d-seta). Rpp (Fig 28B) with relatively short and broad first segment, with curved dorsal margin; second segment subtriangular, with dorsal margin strongly curved, dorso-distal corner pronounced and distal margin straight. Lpp (Fig 28C) with first segment long and with sub-parallel margins; second segment small and short, smoothly rounded.

T2 (not illustrated) first endopodal segment with one e-seta, slightly shorter than second endopodal segment. Second endopodal segment with one apical f-seta, reaching middle of third endopodal segment. Terminal segment with h3-seta same length of h1-seta.

T3 (not illustrated) first segment with one long hirsute dp-seta and one long hirsute d1-seta (the latter ca. 2/3 of dp).

CR (Fig 28D) well-developed and robust, with one long proximal hirsute seta (more than 1/2 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

Hemipenis (Fig 28E) with ls long and pointed, ms a broad lobe, distally asymmetrically and bluntly pointed, reaching to halfway ls, with internal trabecula long and pointed.

>>> Figure 29

### **Description of female**

Only the differences with the male of Gen. 1 spec. F gen. et spec. nov. are described here.

LVi (Figs 29A, C–D) and RVi (Figs 29B, E–F) higher than male. RVi with greatest height behind middle of dorsal margin. CpRl (Fig 29G) with LV overlapping RV in dorsoposterior and ventroposterior side. CpD (Fig 29H) and CpV (Fig 29I) with the greatest width behind middle, external surface with shallow pits and setae (Fig 29J).

>>> Figure 30

A1 (not illustrated) third segment with two apical setae: ventrally and dorsally with one short seta reaching middle of fourth segment.

A2 (not illustrated) third endopodal segment apically with three claws (G1, G2, G3) and three setae (z1, z2, z3).

T1 (Fig 30A) with protopodite apically with a group of 14 unequally and hirsute setae; two short smooth a-setae, one short smooth b-seta, one long and smooth d-seta (ca. 6x length

of b-seta), and one long and hirsute seta next to the two a-setae (2x length of d-seta). Endopodite apically with three unequally smooth and short setae.

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, reaching tip of second endopodal segment.

T3 (not illustrated) first segment with one long hirsute dp-seta and one long hirsute d1-seta (the latter ca. 1/2 of dp).

CR (Fig 30B) well-developed and robust, with one long proximal hirsute seta (ca. 1/2 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

**Remarks:** As this species occurs in more than one locality in Amazon River floodplain, we also illustrate valves and Cp of males (Fig 31) and valves and Cp of females (Fig 32) from others lakes of the Amazon River floodplain, to show the similarities among them. We also illustrate the outline of Hp and prehensile palps of two males that can show small variabilities between specimens (Fig 33).

>>> Figure 31–33

### **Ecology and distribution**

Gen. 1 spec. F gen. et spec. nov. was recorded only from Amazon River floodplain, associated with various species of macrophytes. The water temperature recorded was between 32 and 37°C. The pH varied from 6.4 to 6.8. The range of electrical conductivity was between 1.8 to 81.7  $\mu\text{S}\cdot\text{cm}^{-1}$  and the values of dissolved oxygen varied from 0.9 to 116.8 mg. L<sup>-1</sup> (see Table 1).

### **Gen. 1 spec. G gen. et spec. nov.**

(Figs 34–37)

### **Diagnosis**

Cp suboval, LV overlapping RV, except in the middle of dorsal margin. Male valves more elongated than female valves. Anterior and posteroventral overlap the largest. RV with small marginal tubercles along anteroventral and posteroventral margins. External surface with ‘stretch marks’. A2 with natatory setae well- developed, short accompanying seta absent; male

A2 with four-segmented endopodite and with t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. Rpp and Lpp asymmetrical, but both with short and broad first segments. Rpp first segment with V-shaped dorsal margin, distally with large pointed hook; second segment rounded, bluntly pointed toward ventral side. Lpp with first segment with parallel margins; second segment short and strongly curved, smoothly rounded. T1 with one long and hirsute seta next to the two a-setae. T2 without d2 setae. T3 without dp and d2 setae. CR with a short proximal seta in male and very long proximal seta in female. Hemipenis generally rather narrow, with ls long, narrow and distally rounded; ms triangular, distally sharply pointed and almost as long as ls.

### Differential diagnosis

Gen. 1 spec. G gen. et spec. nov. can be distinguished from other species of *Physocypria* s.l. by the stretch marks present on the Cp of males. *Physocypria biwaensis* and *P. bullata*, also have a pointed lobe ms on the Hp, but in Gen. 1 spec. G gen. et spec. nov., the ms is not curved at the tip and the triangular and pointed end is shorter than in *P. biwaensis* and *P. bullata*. *Physocypria capensis* (Sars, 1895), *P. kraepelini* and *P. nipponica* also have a pointed end of the ms, however, this lobe in these species is more slender and less triangular than in the new species (Table 3).

The stretch marks present in the Cp surface of male of Gen. 1 spec. G gen. et spec. nov. are a unique characteristic, which is not observed in other species from the same genus.

### Material examined

**Type locality:** Amazon River floodplain, Castanho Lake (AMA 80), in *Eichhornia crassipes* and *Paspalum* sp. Coordinates: 3°23'57" S, 60°13'27.8" W.

### Type material:

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA106).

**Allotype:** A female, dissected and stored as the holotype (NA138).

**Paratypes:** One male carapace stored dry in micropaleontological slide (NA165).

Three females' carapaces stored dry in micropaleontological slides (NA166, NA167, NA168).

## Measurements of illustrated specimens

See Table 2.

>>> Figure 42

## Description of male

Valves with suboval shape, with greatest height just in middle of valves. LVi (Figs 34A, C–D) with narrow calcified anterior and posterior inner lamella; an inwardly displaced inner list running along the anterior margin, ending in an internal anteroventral tooth; tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 34B, E–F) with narrow calcified anterior and posterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in the anteroventral margin; strong marginal tubercles along the anteroventral and posteroventral margins, weakly along the middle of ventral margin.

CpRl (Fig 34G) with a suboval shape, with greatest height in middle; LV overlaps RV in all margins. CpD (Fig 34H) and CpV (Fig 34I) with a flat shape, with greatest width in middle, external surface with shallow pits and setae and ‘stretch marks’ (Fig 34J).

>>> Figure 35

Only the differences with the male of Gen. 1 spec. A gen. et spec. nov. are described here.

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta almost reaching middle of fifth segment and dorsally with one short seta reaching middle of fourth segment. Sixth segment with one short hirsute seta (more than 5x length of terminal segment).

A2 (not illustrated) exopodite reduced to a small plate with one long hirsute seta (reaching middle of second endopodal segment). First endopodal segment ventrally with aestethasc Y (ca. 1/3 of length of segment). Second endopodal segment with aesthetasc y1 not seen. Terminal segment with one g-seta, ca. 1/2 length of y3.

Md-palp (not illustrated) with second segment with one stout hirsute  $\beta$ -seta (ca. 1/2 of the length of the third segment).

T1 with protopodite (Fig 35A) and endopodites (asymmetrical prehensile palps) (Figs 35B–C). Protopodite apically with a group of 12 unequally and hirsute seta, two short smooth

a-setae, one long and hirsute b-seta, one long and smooth d-seta, and one long and hirsute seta next to the two a-setae (2x length of d-seta). Rpp (Fig 35B) first segment with V-shaped dorsal margin, distally with large pointed hook; second segment rounded, bluntly pointed toward ventral side. Lpp (Fig 35C) with first segment with parallel margins; second segment short and strongly curved, smoothly rounded.

T2 (not illustrated) terminal segment with one dorsally h3-seta slightly shorter than h1.

T3 (not illustrated) first endopodal segment with one hirsute dp-seta and one short and hirsute d1-seta (ca. 1/3 the length of dp).

CR (Fig 35D) well-developed and robust, with one short proximal seta (ca. 1/3 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

Hemipenis (Fig 35E) generally rather narrow, with ls long, narrow and distally rounded; ms triangular, distally sharply pointed and almost as long as ls.

>>> Figure 36

### **Description of female**

Only the differences with the male of Gen. 1 spec. G gen. et spec. nov. gen. nov. spec. nov. are described here.

LVi (Figs 36A, C–D) and RVi (Figs 36B, E–F) wider than male. RVi with tubercles in posteroventral and anteroventral margins, absent in middle of the ventral margin. CpRl (Fig 36G) with LV overlapping RV in all margins, except in dorsal side in front of middle. CpD (Fig 36H) and CpV (Fig 36I) with greatest width behind middle, external surface with shallow pits and setae, without ‘stretch marks’ (Fig 36J).

>>> Figure 37

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta almost reaching the tip of the fifth segment and dorsally with one short seta reaching the middle of the fifth segment.

A2 (not illustrated) exopodite reduced to a small plate with one long hirsute seta (reaching tip of second endopodal segment). Third endopodal segment apically with three claws (G1, G2, G3) and three setae (z1, z2, z3).

T1 (Fig 37A) with protopodite apically with a group of 12 unequally and hirsute setae; two short a-setae, one short smooth b-seta, one long and smooth d-seta (more than 5x length of b-seta), and one long and hirsute seta next to the two a-seta (2x length of d-seta). Endopodite apically with one long and two short setae (one ca. 2/3 length of the long and one 1/2 length of the long).

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, reaching beyond middle of third endopodal segment. Third endopodal segment with one subapical hirsute g-seta, reaching beyond tip of the terminal segment. Terminal segment dorsally with one hirsute h3-seta, slightly longer than h1.

CR (Fig 37B) well-developed and robust, with one long proximal seta (more than 2/3 of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and hirsute seta.

### **Ecology and distribution**

Gen. 1 spec. G gen. et spec. nov. was recorded only from Amazon River Floodplain, associated with different two different macrophytes. The water temperature was 33°C. The pH recorded was 6.4. The electrical conductivity value was 43.5  $\mu\text{S}\cdot\text{cm}^{-1}$  and the dissolved oxygen was 0.9 mg. L<sup>-1</sup> (see Table 1).

### **Remarks**

The sexual dimorphism in valve shape in this species is unusual. Care was taken to evaluate all available specimens. No males were found with the present female morphology or vice versa, so that at this stage we present both gender forms here as being conspecific.

## **Genus 2 gen. nov.**

**Type species: Gen. 2 spec. C gen. et spec. nov.**

**Abbreviated diagnosis of Genus 2 gen. nov.** (see also Table 3)

A2 with short seta accompanying natatory setae absent. Md-palp with beta-seta long and stout; length of last segment ca. 2x the basal width, apically set with three claws and one seta. Mx1-palp set with five structures (claws and setae). T1 with b-setae short and d-setae long; right prehensile palp with distal protrusion on first segment and second segment hyper-

developed. T2 with d1-setae absent, setae e and h3 in male short. T3 with setae d2 and dp absent; h2-setae ca. 2x length of h2-seta. Proximal seta on CR short. Hemipenes with lobes ls and ms both broad and strongly developed. Ovarium ventrally turned back and upwards.

### Differential diagnosis

The new genus can be separated from the genera *Cyclocypris*, *Kempcylocypris*, *Cypria*, *Mecynocypris* and *Allocypris* by the presence of marginal tubercles on the RV; furthermore, from *Cypria*, *Physocypris* and *Dentocypris* by the absence of the short seta accompanying the natatory setae on the A2 and from *Physocypris* also by the absence of seta d2 on T2 and T3 (these setae present in *Physocypris*) and by the ovary which curves backward and upward (downward and forward in *Physocypris*). Genus 2 gen. nov. differs from *Keysercypris* by the relatively shorter final segment of the Md-palp ( $L = 2x W$  in Genus 2 gen. nov.,  $L = 5x W$  in *Keysercypris*), by the presence of 5 seta/claws on the second segment of the Mx1-palp (4 in *Keysercypris*), by the short proximal seta on the CR (medium length in *Keysercypris*) and especially by the short seta h3 in the male (very long in *Keysercypris*). Genus 2 gen. nov. is further distinguished from most (all?) other genera in the Cyclocypridinae by the absence of seta dp on T3? It is further distinguished from Genus 1 gen. nov. and by the hemipenes and prehensile palps which are hyper-developed and with swollen shields and segments (these follow the classic *Physocypris* body plan in Genus 1 gen. nov.). Genus 2 gen. nov. furthermore, differs from the subterranean genera *Kempcylocypris* and *Namiothocypris* by at least the reduced natatory setae on the A2 in these genera.

### Gen. 2 spec. C gen. et spec. nov.

(Figs 38–41)

### Diagnosis

Cp suboval, LV overlapping RV, except in the middle of dorsal margin. Anterior and posteroventral overlap the largest. Posteroventral tubercles more prominent than anteroventral ones. A2 with natatory setae well developed, short accompanying seta absent; male A2 with four-segmented endopodite and with t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. Rpp first segment strongly constricted in middle; with large dorsal outgrowth; second segment large, subtriangular, with curved dorsal side and a dorso-distal knob. Lpp with stout first segment, distally narrowing; second segment small and sickle-shaped, smoothly curved. T1 with one long and hirsute seta next to the two a-setae. T2 without d1 and d2 setae.



T3 without dp and d2 setae in both male and female. CR with proximal seta short. Hemipenis with large and broad lobes; ls with broad stem, distally dilated and rounded; ms subquadrate, twice broader than long, reaching beyond halfway ls.

### Differential diagnosis

Gen. 2 spec. C gen. et spec. nov. can be distinguished from other *Physocypria s.l.* species mainly by the exceptional morphology of the Hp and prehensile palps. Up to now, no *Physocypria s.l.* species has characteristics of the male reproductive appendages that even remotely approach those of Gen. 2 spec. C gen. et spec. nov. Regarding Cp morphology, Gen. 2 spec. C gen. et spec. nov. is somewhat similar to *Keysercypria affinis*, but has broader anterior and posterior sides of CpRl. Gen. 2 spec. C gen. et spec. nov. also lacks the long seta h3 on d2 which is characteristic of *Keysercypria affinis* and diagnostic of the genus (see discussion). The general shape of *P. circinata* Würdig & Pinto, 1993 and of *P. longiseta* is also similar to the new species. However, in *P. circinata*, the LV does not overlap the RV as much as in the new species, especially in the antero and posteroventral sides.

Gen. 2 spec. C gen. et spec. nov. differs from Gen. 2 spec. E gen. et spec. nov. by LV overlap on RV, which is smaller in the first species and bigger in the second species. Also, the anterior and posterior side are broader in Gen. 2 spec. E gen. et spec. nov., and narrower in Gen. 2 spec. C gen. et spec. nov.

### Material examined

**Type locality:** South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09), in macrophytes. Coordinates: 19°43'39" S, 57°4'19" W.

### Type material:

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA126).

**Allotype:** A female, dissected and stored as the holotype (NA124).

**Paratypes:** Two males dissected and stored as the holotype (NA123, NA098 (LV lost)). Three males' carapaces stored dry in micropaleontological slides (NA175, NA176, NA177).

One female dissected and stored as the holotype (NA125). Three female's carapaces stored dry in micropaleontological slides (NA178, NA176, NA180).

**Other material examined:** South Matogrossense Pantanal: One male dissected and stored as the holotype (NA099 (Cp lost)) from Carenda Forest Road, stream 1 (PAN 10).

### **Measurements of illustrated specimens**

See Table 2.

>>> Figure 38

### **Description of male**

Valves with suboval shape, with greatest height just behind the middle on LV and in middle on RV. LVi (Figs 38A, C–D) with narrow calcified anterior and posterior inner lamella; and inwardly displaced inner list running along the anterior margin, ending in an internal anteroventral tooth; tubercle-sockets displaced along anteroventral and posteroventral margins.

RVi (Figs 38B, E–F) with narrow calcified anterior and posterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in the anteroventral margin; strong marginal tubercles along the anteroventral and posteroventral margins, weakly along the middle of ventral margin.

CpRI (Fig 38G) with a suboval shape, with greatest height behind middle; LV overlapping RV along all margins, except in middle of dorsal side, with greatest overlap in anterior and posteroventral side. CpD (Fig 38H) and CpV (Fig 38I) with greatest width behind middle, external surface with shallow pits (Fig 38J).

>>> Figure 39

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta slightly longer than fourth segment and dorsally with one short seta reaching middle of fourth segment. Sixth segment with one short hirsute seta (5x length of terminal segment). Terminal segment with one short hirsute seta ca. 3x of length of the aesthetasc Ya.

A2 (not illustrated) protopodite ventrally with one long apical hirsute seta reaching tip of terminal segment. Exopodite reduced to a small plate with one long hirsute seta (reaching tip of the terminal segment). Terminal segment with accompanying seta (ca. 4x length of aesthetasc y3).

Md-palp (not illustrated) third segment with three groups of setae: dorsally one group of four setae (three unequally long and one short ca. 1/3 length of longest), and laterally with three smooth setae (one long and two short, ca. 2/3 of longest). Terminal segment with L ca. 2x basal width.

T1 with protopodite (Fig 39A) and endopodites (asymmetrical prehensile palps) (Figs 39B–C). Protopodite apically with a group of 15 unequally and hirsute setae, two short a-setae, one smooth b-seta, one long and hirsute d-seta (ca. 2x length of b-seta), and one long and hirsute seta next to the two a-seta (almost 2x length of d-seta). Rpp (Fig 39B) with first segment strongly constricted in middle, with large dorsal outgrowth; second segment large, subtriangular, with curved dorsal side and a dorso-distal knob. Lpp (Fig 39C) with stout first segment, distally narrowing; second segment small and sickle-shaped, smoothly curved.

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, slightly longer than second endopodal segment. Terminal segment with one short ventrally hirsute h1-seta, one dorsally hirsute h3-seta slightly shorter than h1.

T3 (not illustrated) first segment without dp-seta and with one short hirsute d1-seta (ca. 1/5 length of first segment).

CR (Fig 39D) well-developed, with one short proximal hirsute seta (ca. 1/5 length of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and hirsute seta.

Hemipenis (Fig 39E) with large and broad lobes; ls with broad stem, distally dilated and rounded; ms subquadrate, twice broader than long, reaching beyond halfway ls.

>>> Figure 40

### **Description of female**

Only the differences with the male of Gen. 2 spec. C gen. et spec. nov. are described here.

LVi (Figs 40A, C–D) and RVi (Figs 40B, E–F) higher than male. RVi with tubercles along postero-ventral margin, disappearing in the middle and few tubercles next to anterior side. CpRl (Fig 40G) as in the male. CpD (Fig 40H) and CpV (Fig 40I) with greatest width behind middle, external surface with shallow pits and setae (Fig 40J).

>>> Figure 41

A1 (not illustrated) third segment with two apical setae: ventrally with one long seta slightly longer than fourth segment and dorsally with one short seta reaching middle of fourth segment. Sixth segment with one short hirsute seta (more than 5x length of terminal segment).

A2 (not illustrated) with protopodite, exopodite and four-segmented endopodite. Protopodite ventrally one long apical hirsute seta almost reaching tip of end claws. Exopodite reduced to a small plate with one long hirsute seta (reaching tip of terminal segment). Third endopodal segment apically with three claws (G1, G1, G3) and three setae (z1, z2, z3). Terminal segment with accompanying setae (ca. 5x length of aesthetasc y3).

T1 (Fig 41A) with protopodite apically with a group of 15 unequally and hirsute setae; two short a-setae, one smooth b-seta, one long and hirsute d-seta (more than half of the length of the segment), and one long and hirsute seta next to the two a-setae (almost 2x length of d-seta). Endopodite apically with one long and two short setae (one ca. 2/3 length of the long and one 1/2 length of the long).

T3 (not illustrated) first segment without dp-seta and with one hirsute d1-seta (ca. 1/2 the length of the first segment).

CR (Fig 41B) well-developed, with one long proximal hirsute seta (ca. 1/3 length of segment), subapically with one strong serrated claw, apically with one long serrated claw and one short and hirsute seta.

### **Ecology and distribution**

Gen. 2 spec. C gen. et spec. nov. was recorded only from South Matogrossense Pantanal, associated with different types of macrophytes. The water temperature was 21°C. The pH recorded was 7 and the electrical conductivity was 215  $\mu\text{S}\cdot\text{cm}^{-1}$  (see Table 1).

### **Gen. 2 spec. E gen. et spec. nov.**

(Figs 42–45)

### **Diagnosis**

Cp suboval, LV strongly overlapping overlapping RV, except in the middle of dorsal margin, and especially along the anteroventral and posteroventral margins; flanges broad there. Marginal tubercles weakly developed. A2 with natatory setae well-developed, short accompanying seta absent; male A2 with four-segmented endopodite and with t2 and t3 transformed into sexual bristles. Rpp and Lpp asymmetrical. Rpp with broad first segment, with

slightly curved dorsal margin and strongly developed, bluntly pointed distal margin; second segment subtriangular, with pronounced dorso-distal corner and straight distal margin. Lpp with first segment with a broad base, distally tapering; second segment with broad base, distal part narrow. T1 with one long and hirsute seta next to the two a-setae. T2 without d1 and d2 setae. T3 without dp and d2 setae in both male and female. CR with a short proximal seta. Hemipenis with ls broad, distally bird-shaped with ventrally directed 'beak'; ms a broad, elongated and slightly dorsally curved lobe, distally asymmetrically rounded and almost reaching the edge of ls.

### Differential diagnosis

Gen. 2 spec. E gen. et spec. nov. can be distinguished from other *Physocypria* *s.l.* species mainly by the aberrant morphology of the Hp and prehensile palps, which is comparable (yet still very different) only to that of Gen. 2 spec. C gen. et spec. nov. (see above), and by the large flanges on the LV, which cause an exceptionally large overlap of the LV over the RV, especially along the anterior and antero-ventral sides and along the posteroventral margin. *Physocypria deformis* (now in *Keysercypria*, see discussion), *P. longiseta* and *P. nipponica* Okubo, 1990 somewhat resemble Gen. 2 spec. E gen. et spec. nov. in the shape of the valves. However, the dorsal margin of the LV is more straight in the new species and also, the overlap in the new species is much more prominent than in these taxa, while the morphology of the male reproductive organs is radically different.

Gen. 2 spec. E gen. et spec. nov. is different from Gen. 2 spec. C gen. et spec. nov. in reason to the presence of geometric ornamentation in Cp surface, which is absent in the latest species. Also, the dorsal margin is more rounded in previous species.

### Material examined

**Type locality:** South Matogrossense Pantanal, Camp Road, pool 4 (PAN 31), in macrophytes. Coordinates: 19°34'34" S, 57°1'7" W.

### Type material:

**Holotype:** A male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (NA108).

**Allotype:** A female, dissected and stored as the holotype (NA145).

**Paratypes:** Three males dissected and stored as the holotype (NA088, NA090, NA139). One male carapace stored dry in micropaleontological slides (NA170).

Two females dissected and stored as the holotype (NA136, NA137). Three females' carapaces stored dry in micropaleontological slides (NA171, NA172, NA173).

### **Measurements of illustrated specimens**

See Table 2.

>>> Figure 42

### **Description of male**

Valves with suboval shape, with greatest height just in front of middle on LV and in middle on RV. LVi (Figs 42A, C–D) with narrow calcified anterior and posterior inner lamella; an inwardly displaced inner list running along the anterior margin, ending in an internal anteroventral tooth; tubercle-socked displaced along anteroventral and posteroventral margins.

RVi (Figs 42B, E–F) with narrow calcified anterior and posterior inner lamella and an inwardly displaced inner list along the anterior margin, disappearing in anteroventral margin; strong marginal tubercles along posteroventral margin, weakly along the anteroventral margin and absent in the middle of ventral margin.

CpRl (Fig 42G) with a suboval shape, with greatest height behind middle; LV overlapping RV along all margins, with greatest overlap in anterior and posteroventral side. CpD (Fig 42H) and CpV (Fig 42I) with greatest width in middle, external surface with shallow pits and setae and geometric ornamentation (Fig 42J).

>>> Figure 43

Only the differences with the male of Gen. 2 spec. C gen. et spec. nov. are described here.

A1 (not illustrated) third segment with two apical setae: ventrally with one short seta almost reaching tip of fourth segment and dorsally with one short seta reaching middle of fourth segment. Terminal segment with one short hirsute seta, ca. 3x of length of aesthetasc Ya.

A2 (not illustrated) exopodite reduced to a small plate with one long hirsute seta (slightly longer than the second endopodal segment). Terminal segment with one g-seta slightly short than y3.

Md-palp (not illustrated) third segment with three groups of setae: dorsally one group of three setae (one long and two short, ca. 1/3 of longest). Terminal segment with L ca. 2x basal width.

Mx1 (not illustrated) first endite short with two basal setae (one short and one long, about 5x length of previous one).

T1 with protopodite (Fig 43A) and endopodites (asymmetrical prehensile palps) (Figs 43B–C). Protopodite apically with a group of 16 unequally and hirsute setae, two short smooth a-setae, one short smooth b-seta, one long and hirsute d-seta (6x length of b-seta), and one long and hirsute seta next to the two a-setae (2x length of d-seta). Rpp (Fig 43B) with broad first segment, with slightly curved dorsal margin and strongly developed, bluntly pointed distal margin; second segment subtriangular, with pronounced dorso-distal corner and straight distal margin. Lpp (Fig 43C) with first segment with a broad base, distally tapering; second segment with broad base, distal part narrow.

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, reaching beyond tip of second endopodal segment. Second endopodal segment with one apical hirsute f-seta, reaching the tip of third endopodal segment. Third endopodal segment with one subapical hirsute g-seta, reaching beyond tip of the terminal segment. Terminal segment with one dorsally hirsute h3-seta, same length of h1.

T3 (not illustrated) first segment without dp-seta and with one short and hirsute d1-seta (ca. 1/2 length of first segment).

CR (Fig 43D) well-developed and robust, with one short proximal seta (ca. 1/4 length of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and smooth seta.

Zenker's organ (not illustrated) about 3x longer than wide, with ca. 6 spiny whorls.

Hemipenis (Fig 43E) with ls broad, distally bird-shaped with ventrally directed 'beak'; ms a broad, elongated and slightly dorsally curved lobe, distally asymmetrically rounded and almost reaching the edge of ls.

>>> Figure 44

### **Description of female**

Only the differences with the male of Gen. 2 spec. E gen. et spec. nov. are described here.

LVi (Figs 44A, C–D) and RVi (Figs 44B, E–F) higher than male. CpRl (Fig 44G) with a suboval shape, with greatest height behind middle; LV overlapping RV along all margins, except in the middle of dorsal margin, with greatest overlap in anterior and posteroventral side. CpD (Fig 44H) and CpV (Fig 44I) with greatest width in middle, external surface with shallow pits and setae and geometric ornamentation (Fig 44J).

>>> Figure 45

A2 (not illustrated) protopodite with one long apical hirsute seta reaching well beyond tip of end claws. Exopodite reduced to a small plate with one long hirsute seta (reaching beyond tip of terminal segment). Third endopodal segment apically with three claws (G1, G2, G3) and three setae (z1, z2, z3). Terminal segment with accompanying seta (ca. 5x length of aesthetasc y3).

T1 (Fig 45A) with protopodite apically with a group of 16 unequally and hirsute setae; two short smooth a-setae, one short smooth b-seta, one long and hirsute d-seta (6x length of b-seta), and one long and hirsute seta next to the two a-setae (almost 3x length of d-seta). Endopodite apically with three unequally smooth and short setae.

T2 (not illustrated) first endopodal segment with one apical hirsute e-seta, slightly shorter than second endopodal segment. Terminal segment with one short ventrally hirsute h1-seta, one dorsally hirsute h3-seta, slightly shorter than h1.

T3 (not illustrated) first segment without dp-seta and with one short and hirsute d1-seta (ca. 1/4 length of first segment).

CR (Fig 45B) well-developed and robust, with one short hirsute proximal seta (ca. 1/3 of length of ramus), subapically with one serrated claw, apically with one long serrated claw and one short and hirsute seta.

### **Ecology and distribution**

Gen. 2 spec. E gen. et spec. nov. was recorded only from South Pantanal Matogrossense, associated with different types of macrophytes. The water temperature was 23°C. The pH recorded was 7 and the electrical conductivity was 209  $\mu\text{S}\cdot\text{cm}^{-1}$  (see Table 1).



## 4 DISCUSSION

### Validity of *Keysercypria*

Karanovic (2011) correctly decided that the Neotropical species thus far allocated to *Physocypria* did not belong in this genus. She found, amongst other differences, that the short seta, accompanying the five natatory setae, was missing in all South and Central American species of which she could investigate the type material. This seta was present in all other known Cyclopyridinae, including *Physocypria bullata* from East Africa. As the type species determines the definition of the genus, this meant that this seta should be present in genuine *Physocypria* species. Hence, the Neotropical species needed a new generic assignment. Karanovic (2011) described the genus *Keysercypria* (with type species *K. affinis*) and included a further 8 Neotropical species in this genus, applying applied varying (and often unclear) sets of characters.

However, in establishing *Keysercypria*, Karanovic (loc.cit.) ignored the previously generally accepted delimitation between species of *Cypria* (without marginal tubercles on the RV) and *Physocypria* (with marginal tubercles on the RV). This is an important consideration, as Cyclopyridinae are abundantly present in the fossil record, especially in the northern hemisphere, and such a character (presence/ absence of marginal tubercles) is most useful for palaeontologists. To abandon such a character in favour of a number of soft part characters, should be avoided. The result was generally that *Keysercypria sensu* Karanovic (2011) was not accepted, which lead Meisch *et al.* (2019) to reject the genus, and to re-integrate its species back into *Cypria* and *Physocypria*.

However, during the present study it became clear that the Neotropical *Physocypria* species indeed do not belong to this genus, as defined by the type species, the African *P. bullata*, but form a cluster of at least three genera, including the two new genera described here and the genus *Keysercypria*, albeit with a more restricted and amended diagnosis (see above, Results). Indeed, when using the type species, *K. affinis* as the basis for the concept of this genus, it appeared that several characters were not used for the delimitation of the genus. The most important one is the long seta h3 on the T2 of the male (Table 3).

The following species were correctly included in *Keysercypria*, apart from the type species, by Karanovic (2011).

***Keysercypria deformis*:** both h3-seta (as in *K. affinis*) and e-seta on T2 are unusually long in this Brazilian species. Seta e on T2 is short in *K. affinis*, so this might exclude *K. deformis* from the genus *Keysercypria*. However, *P. bullata*, the type species of *Physocypria* also has a short e-seta on the T2, whereas the common European species *P. kraepelini* does

have a long e-seta. The four species of *Dentocypria* Savatnalinton, 2017 all have a long e-seta. Here, we consider the length of e-seta on T2 to be a character of relevance at the level of species, not of genera and thus maintain *K. deformis* as a species within *Keysercypria*. One additional reason to consider the length of the h3-seta on T2 as a generic feature is that this was already done in other ostracod genera, e.g., the South African *Amphibolocypis* Rome, 1965 and the Australian *Platycypris* Herbst, 1957 (see discussion in Jocque *et al.* 2010).

***Keysercypria schubarti*:** none of the characters relevant to distinguish species of *Keysercypria* were illustrated by Farkas (1958), but in the description he wrote that the “slim seta situated dorsal to the end claw in the walking leg (seta h3 in T2) is at least 1.5 times longer than the said end claw” (translation by KM). Even though other relevant characters (short seta next to the natatory setae on A2, mandibular palp terminal segment, ...) cannot be assessed, it would seem that one of the main characters of *Keysercypria* is present in *K. schubarti* and therefore we also maintain this species within *Keysercypria*.

For the other species assigned to *Keysercypria*, no conclusive evidence can be found for their assignment to this genus. In *Physocypria longiseta* from Paraguay, the h3-seta on the T2 is short and no other relevant characters are described. Karanovic (2011) partially redescribed the type material of *Cypria obtusa* Klie, 1940 from Brazil, but did not mention the presence or absence of the short accompanying seta on the A2, while in her illustration of the T2 (fig 17E in Karanovic, loc.cit.) the h3-seta on the T2 is only slightly longer than normal in *Cypria*/*Physocypria*. Of *P. circinata* from southern Brazil, no characters relevant to *Keysercypria* are cited, only the fact that, according to Karanovic (2011) “this species also lacks marginal tubercles”, whereas Würdig & Pinto (1993: 286) clearly wrote in their description “small tubercles at the anterior and posterior ventral border of the RV”. Karanovic (2011) re-investigated one of the types of *Cypria pellucida* Sars, 1901 from Itatiba in Brazil (one undissected female in a slide) and could see that setae e, f and h3 on the T2 were all short, but that h2-seta was about twice the size of the h1-seta. All other relevant characters remained invisible. *Physocypria sanctaeannae* Margalef, 1961 from Venezuela might indeed not be a true *Physocypria* s.s. (Md-palp terminal segment is 5x longer than the width), but no other real identifying characters of *Keysercypria* were mentioned (T2, setae e, f and h3 were all short). *Physocypria xanabanica* from Yucatan lacks all relevant character descriptions and thus maintains an uncertain position in *Physocypria*, but can also not be transferred to *Keysercypria*. Six months after the description of *Keysercyria*, Díaz & Lapretto (2011) described *K. ivanae* from Argentina. Illustrations indicate that the short accompanying seta on the A2 is indeed missing, but also that the h3-seta on T2 is short. The lack of many details in the chaetotaxy

prevents to determine the exact position of this species, but the brief mention that marginal tubercles occur on both valves urges a re-examination of this species, which does not seem to fit in any of the present genera. We re-instate the validity of the genus *Keysercypria*, but can at present only support the inclusion of three species in this genus *Keysercypria*.

### **Morphological characters used (Table 3)**

Table 3 shows major characters distinguishing genera that are potentially relevant for the placement of the present seven new species. At the same time, however, it is also clear that for several genera, mostly *Cypria* and *Keysercypria*, several vital aspects of the chaetotaxy remain unknown. Our seven new species share many characters with each other and with *Keysercypria*, showing that indeed the South and Central American group(s) of *Physocypria s.l.* is/are different from the African *Physocypria s.s.*

Savatenaliton (2017) already provided an extensive discussion on the degree to which characters in Cyclocypridinae can be applied at the specific or generic levels and we shall here not repeat all arguments.

#### **Anteroventral tooth in LV**

This structure has thus far been reported for *Cypria exculpta* (Fischer, 1855), *Cypria ophthalmica* (Jurine, 1820) and *Physocypria kraepelini* by Fuhrmann (2012) in his excellent atlas of Palaearctic fossil freshwater ostracods, as well as by Savatenaliton (2017) for all four species of *Dentocypria*. We report it for all of our seven new species described here. It would thus seem to be a common character in most (all?) of the genera in the Cyclocypridinae, and we thus expect that it occurs in all South and Central American species of *Physocypria s.l.*, therefore also in *Keysercypria*.

#### **Sexual dimorphism in valve shape**

A certain degree of sexual dimorphism in the shape and size of valves is normal in many ostracod groups and this for a variety of reasons. For example: when females have a more swollen posterior part of their carapace this is mostly related to the presence of an externally visible broodpouch in darwinulids (eg. *Penthesilenula* Rossetti & Martens, 1998, *Vestalenula* Rossetti & Martens, 1998,...) and cytherids (*Elpidium* F. Müller, 1880, *Cytheridella* Daday, 1905, and others). Males in limnocytherids are larger and more elongated to accommodate the very large hemipenes (up to one third of the total body mass).

In Cyclocypridinae, males are generally somewhat smaller and more elongated than females, but the two genders mostly still share the same general morphology. The difference in valve shape between males and females in our Gen. 1 spec. G gen. et spec. nov. is therefore unusually large and cannot readily be explained. Possibly, some specimens were somewhat decalcified, but this was not directly noticeable. Future research will show whether or not the specimens of the two genders are indeed conspecific.

#### Accompanying seta to natatory setae on A2

One of the most surprising characters of the seven new species described here, and of *Keysercypria*, is the absence of the short accompanying seta to the five long natatory setae on the A2. In Cyprididae, even in species where the natatory setae themselves are strongly reduced, such as in *Humphycypris subterranean* (Hartmann, 1964) (see Martens 1997), or even completely absent, this seta is often still present with its normal length. The complete disappearance of this seta is therefore as unexpected as it is unexplainable. However, such characters are often overlooked in descriptions, so it is possible that this seta also disappeared in other lineages. But at this stage, it appears to be a synapomorphy, at least within the Cyclocypridinae, of the Neotropical group of *Physocypria* s.l., including *Keysercypria* and the two new genera described here.

#### Length of terminal segment and chaetotaxy of the Md-palp

The Md and the Md-palp are involved in feeding of the ostracods and modifications in its morphology can constitute a different trait related to trophic adaptations. As an example: most darwinulid species have a ‘basket’ of long plumous setae on their mandibular palp, which could be related to filter feeding (Pinto *et al.* 2003).

The change in length of the terminal segment of the Md-palp might also be functional in targeting different trophic resources, although it is at present not quite clear how longer or shorter segments would be differentially functional. In species of the Candonopsini Karanovic, 2004, this segment can also be long (in *Latinopsis* Karanovic & Datry 2009) or short (*Candobrasilopsis* Higuti & Martens 2012), even in closely related genera.

In any case, there is a clear dynamic in the length of this segment in the Cyclocypridinae, as even between related genera, the length can vary between twice the (basal) width to more than 5x the basal width. Details of the chaetotaxy of this segment are even more difficult to interpret, as number of claws and setae is often difficult to see in dissections and is therefore also often not reported in descriptions.

### Terminal segment, chaetotaxy of terminal segment of the Mx1-palp

Also in this limb, the terminal segment of the palp can differ in shape and size, for example the spatulate form of this segment in the genus *Potamocypris* Brady, 1870 is unique in the Cypridopsinae, where the 22 other genera all have cylindrical segments (Almeida *et al.*, 2021). In the two new genera described here and in their related genera, the terminal segment of the Mx1-palp is always rectangular and the chaetotaxy changes little, between 4 and 6 claws or setae. The same remark as above is also valid here, nl. that such details are often difficult to see and to interpret, and are therefore often not reported in descriptions.

### Chaetotaxy of T1

Savatenalinton (2017) extensively discussed the relevance of the chaetotaxy of this limb, which is sadly enough also the one limb most often ignored in descriptions. Within the genera of *Physocypris* s.l. in South and Central America, we see a changing length ratio between setae b and d, which could be helpful in a cladistic analysis. However, the most interesting observation is the presence in most (all?) genera of the Cyclocyridinae of an additional long seta right next to the two short a-setae. According to Savatenalinton (2017), this seta was interpreted by Karanovic (2012) as the c-seta of the T1 (a synapomorphy of the Eucypridinae Bronshtein, 1947). This constitutes a possible homology, as the c-seta is indeed situated closer to the a-setae than the d-seta (Martens 1989), but also here the functionality of its hyper-development in this subfamily remains unclear.

### Chaetotaxy of T2

The presence or absence and the length ratio of the setae d1 and d2 on the first segment of the T2 have shown to be useful characters in taxonomy at the generic level for a variety of ostracod groups in the Cyprididae (Martens 1990; 1992; 2001). In Cyclocypridinae, the d2-seta appears to be consistently absent, but the d1-seta can be either present (*Physocypris* s.s) or absent (*Keysercypris* and the new genera described here), and might thus be synapomorphic to certain clades.

In most Cypridoidea, the setae e, f and g on T2 have a stable size and morphology. However, in some Cyclocypridinae, seta e can be hyperdeveloped and very long. Table 3 shows that this seta is long in the four species of *Dentocypris* (Savatenalinton, 2017) and short in the type species of all other genera listed here. However, there is variability between the species in the same genus. For example, this seta is short in *Physocypris bullata*, the type species of the genus, but it is long in several other species in the genus: *Physocypris kraepelini* and *P. dumonti*

Martens, 1982, but also in our new species Gen. 1 spec. B gen. et spec. nov. Gen. 1 spec. D gen. et spec. nov. Also, this seta is short in *Keysercypria affinis*, the type species, but long in *K. deformis*. The suggestion of Savatnalinton (2017) that the length of this seta can be used at the generic level will therefore require a trade-off. If priority is given to the length of the e-seta to unite species in a genus, then other characters such as the length of the h3-seta on T2 will have to be seen as homeomorphic. If priority is given to the relevance of h3-seta, then the morphology of e-seta becomes the homeomorphic joker in the taxonomic pack (McKenzie 1982). The importance of the relative length of the h3-seta in taxonomy, however, has already been illustrated in other groups (see above – Jocqué *et al.* 2010), as it is considered to be a more stable character in species groups. Therefore, this character is here included in the amended diagnosis of *Keysercypria*. This inclusion appears warranted, as this long h3-seta occurs in at least three related species, now all included in *Keysercypria* (see above).

#### Chaetotaxy of T3

The basal segment of T3 generally bears three setae: d1, d2 and dp. Apparently, the d1-seta is present in all genera of the Cyclocypridinae. Seta d2 is absent in *Keysercypria* and in the seven new species of the two new genera described here, and therefore seems to constitute another synapomorphy of the Neotropical clade of *Physocypria s.l.* Savatnalinton (2017) cited this absence of d2-seta as the main diagnostic character of *Keysercypria*, but as was shown above, this is just one of the relevant characters in the diagnosis of this genus, while the present study indicates that it is actually a character for the entire clade, not just for the one genus.

An even more unexpected discovery of the present study is the absence of the seta dp in the two species of Genus 2 gen. nov. This character is, as far as is known, unique for this subfamily, and maybe also beyond it.

The length ratio between the distal setae h2 and h1 is also a useful character, and unites *Dentocypria* with the species of the Neotropical species of *Physocypria s.l.* However, it appears that the real differences in length between these two setae in individual species can vary considerably more than what is noted in Table 3. For example, in *P. longiseta*, this length ratio can be as much as 4, which is double of what is noted for *P. bullata*, the type species. This length ratio should not be used as a diagnostic character at the generic level.

#### The proximal seta on CR

Species in Cyclocypridinae generally have well-developed caudal rami, with full chaetotaxy of two setae (one proximal one distal) and two distal claws. Whereas there may be

general patterns in the length of the proximal seta at the genus level, there is always a degree of intrageneric variability and this character remains mainly of specific value.

### Ovarium

The difference of the ovarium imprint on the valves in different ostracod genera was first mentioned by Rome (1962) for the Tanganyikan cyclocypridinid genera *Allocypria* and *Mecynocypris* and later (by Rome, 1965) also for the giant ostracod genera *Sclerocypris* Sars, 1924 and *Hyselecypria* Rome, 1965. In spite of the clear usefulness of this character, it has rarely been illustrated for other genera. In the present situation, it appears to be a useful character to distinguish species of *Physocypris* s.s. from the taxa of the Neotropical genera (Table 3).

### Taxonomic position of the seven new species (Table 3)

Based on the above appraisal of the different morphological characters used, our seven new species fall apart into two new genera. The two new species of Genus 2 gen. nov. differ from the five species of Genus 1 gen. nov. by (1) the reduced length of the terminal segment of the Md-palp (L 2x the W in Genus 2 gen. nov. versus 3x the W in Genus 1 gen. nov.), (2) the absence of the dp-seta on T3 in Genus 2 gen. nov. and (3) the morphology of the hemipenis and of the prehensile palps, which are significantly different in the new species of Genus 2 gen. nov. compared basically all other species in the Cyclocypridinae. But also, the absence of the dp-seta on the T3 in Genus 2 gen. nov. appears to be unique in the Cyclocypridinae (see above and Table 3).

We feel confident that other described Neotropical species, including some of which were here extracted from *Keysercypria sensu* Karanovic (2011), could be accommodated in Genus 1 gen. nov., but this would require analyses of type materials, if available, and is beyond the aim of the present paper.

### Ecology and distribution of the new species in the Brazilian floodplains

The seven new species and two new genera of Cyclocypridinae described in the present paper were recorded associated with different species of macrophytes, and in the sediment (littoral), but none of them appeared to be restricted to only one type of substrate. The new species also occurred in several types of environments, such as lakes, ponds, streams, and rivers. However, most of the new species are restricted to one single Brazilian floodplain, such as Gen.

1 spec. D gen. et spec. nov., Gen. 2 spec. C gen. et spec. nov., Gen. 2 spec. E gen. et spec. nov. (South Matogrossense Pantanal), and Gen. 1 spec. F gen. et spec. nov. and Gen. 1 spec. G gen. et spec. nov. (Amazon), while Gen. 1 spec. A gen. et spec. nov. and Gen. 1 spec. B gen. et spec. nov. can be found in more than one floodplain (Paraná and South Matogrossense Pantanal). With regard to occurrence, the most frequent species were Gen. 1 spec. D gen. et spec. nov. and Gen. 1 spec. F gen. et spec. nov., while spec. Gen. 1 spec. A gen. et spec. nov. and Gen. 2 spec. C gen. et spec. nov. occurred in few localities. Gen. 1 spec. B gen. et spec. nov., Gen. 2 spec. E gen. et spec. nov. and Gen. 1 spec. G gen. et spec. nov. were restricted to one single locality.

## 5 CONCLUSION

It is quite clear when discussing the various morphological characters that the evolution in the Cyclocypridinae, both at generic and at intra-generic levels, has been a case of mosaic evolution. Some characters have a congruent pattern of taxonomic distribution, others are incongruent with those patterns. This will always leave taxonomic decisions open to discussions, and this way of taxonomic research is (sadly) much more common than the direct path towards a consensus.

A case in point is the discussion on the Neotropical taxa of Cyclocypridinae: on which characters should genera be based? In ostracods, a rule of fist is that both valve and soft part characters should present roughly the same solution. But what if even soft part characters are not congruent? Should the taxonomic position of our new species be based on the occurrence of a long e-seta, or on that of a long h3-seta on T2? Preferably, a consensus should be found on a combination of several congruent characters, which is what is proposed here, but there will always be incongruent characters. The solution will be to conduct phylogenetic analyses based on morphological or molecular data, preferably both.



## REFERENCES

- Agostinho, A.A., Bonecker, C.C. & Gomes, L.C. (2009) Effects of water quantity on connectivity: the case of the upper Paraná River floodplain. *Ecohydrology & Hydrobiology*, 9 (1), 99–113.  
<https://doi.org/10.2478/v10104-009-0040-x>
- Agostinho, A.A. & Gomes, L.C. (2002) Biodiversity and fisheries management in the Paraná River Basin: successes and failures. In: World Fisheries Trust (Org.), *The Blue Millennium Project: Managing Fisheries for Biodiversity*. World Fisheries Trust-CRDI - UNEP, Victoria, British Columbia, pp. 1–30.
- Agostinho, A.A., Gomes, L.C., Thomaz, S.M. & Hahn, N.S. (2004) The Upper Paraná River and its Floodplain: Main Characteristics and Perspectives for Management and Conservation. In: Thomaz, S.M., Agostinho, A.A. & Hahn, N.S. (Eds.), *The Upper Paraná River and its Floodplain: Physical Aspects, Ecology and Conservation*. Backhuys Publishers, Leiden, pp. 381–393.
- Agostinho, A.A., Pelicice, F.M. & Gomes L.C. (2008) Dams and the fish fauna of the Neotropical region: impacts and management related to diversity and fisheries. *Brazilian Journal of Biology*, 68 (4), 1119–1132.  
<https://doi.org/10.1590/S1519-69842008000500019>
- Broodbakker, N.W. & Danielopol D.L. (1982) The chaetotaxy of Cypridacea (Crustacea, Ostracoda) limbs: proposals for a descriptive model. *Bijdragen tot de Dierkunde*, 52, 103–120.  
<https://doi.org/10.1163/26660644-05202003>
- Campos, R., Conceição E.O., Martens, K. & Higuti, J. (2019) Extreme drought periods can change spatial effects on periphytic ostracod metacommunities in river-floodplain ecosystems. *Hydrobiologia*, 828 (1), 369–381.  
<https://doi.org/10.1007/s10750-018-3825-3>
- Campos, R., Conceição E.O., Pinto M.B.O., Higuti, J. & Martens, K. (2017) Evaluation of quantitative sampling methods in pleuston: An example from ostracod communities. *Limnologica—Ecology and Management of Inland Waters*, 63, 36–41.  
<https://doi.org/10.1016/j.limno.2017.01.002>
- Campos, R., Lansac-Tôha, F.M., Conceição, E.O., Martens, K. & Higuti, J. (2018) Factors affecting the metacommunity structure of periphytic ostracods (Crustacea, Ostracoda): a deconstruction approach based on biological traits. *Aquatic Sciences*, 80 (2), 1–12.  
<https://doi.org/10.1007/s00027-018-0567-2>

- Campos, R., Rosa, J., Ferreira, V.G., Conceição, E.O., Martens, K. & Higuti, J. (2021) Macrophyte life forms influence the effects of environmental and spatial factors on the beta-diversity of associated ostracod communities (Crustacea). *Aquatic Sciences*, 83 (2), 1–15.  
<https://doi.org/10.1007/s00027-021-00777-9>
- Conceição, E.O., Higuti, J., Campos, R. & Martens, K. (2018) Effects of flood pulses on persistence and variability of pleuston communities in a tropical floodplain lake. *Hydrobiologia*, 807 (1), 175–188.  
<https://doi.org/10.1007/s10750-017-3392-z>
- Conceição, E.O., Higuti, J. & Martens, K. (2017) Variability in ostracod communities (Crustacea, Ostracoda) in connected and isolated tropical floodplain lakes. *Annales de Limnologie–International Journal of Limnology*, 53, 325–332.  
<https://doi.org/10.1051/limn/2017016>
- Conceição, E.O., Mantovano, T., Campos, R., Rangel, T.F., Martens, K., Bailly, D. & Higuti, J. (2020) Mapping the observed and modelled intracontinental distribution of non-marine ostracods from South America. *Hydrobiologia*, 847 (7), 1663–1687.  
<https://doi.org/10.1007/s10750-019-04136-6>
- Díaz, A.R & Lopretto, E.C. (2011) A new species of *Keysercypria* Karanovic (Crustacea: Ostracoda) from Argentina. *Zootaxa*, 3063 (1), 64–68.  
<https://doi.org/10.11646/zootaxa.3063.1.5>
- Farkas, H. (1958) Über einige Stisswasser-Ostrakoden von Stidamerika. *Annales HistoricoNaturales Musei Nationalis Hungarici*, Series nova, 9 (50), 307–312.
- Fischer, S. (1855) Beitrag zur Kenntnis der Ostracoden. *Abhandlungen der Mathematisch-Physicalischen Classe der Königlich Bayerischen Akademie der Wissenschaften*, 7, 635–666.
- Fuhrmann, R. (2012) Atlas quartärer und rezenter Ostrakoden Mitteleuropas. *Altenburger Naturwissenschaftliche Forschungen*, 15, 1–320.
- Furtos, N.C. (1933) The Ostracoda of Ohio. *Ohio Biological Survey*, 5 (6), 11–524.
- Furtos, N.C. (1936a) Freshwater Ostracoda from Florida and North Carolina. *American Midlan Naturalist*, 17 (2), 491–522.
- Furtos, N.C. (1936b) On the Ostracoda from the cenotes of Yucatan and vicinity. *Publications of the Carnegie Institution of Washington*, 457, 89–115.
- Hartmann, G. (1959) Beitrag zur Kenntnis des Nicaragua-Sees unter besonderer Berücksichtigung seiner Ostracoden (mit Beschreibung von 5 neuen Arten). *Zoologischer Anzeiger*, 162, 269–294.

- Hartmann, G. (1964) Asiatische Ostracoden. Systematische und zoogeographische Untersuchungen. *Internationale Revue der gesamten Hydrobiologie, Systematische Beihefte*, 3, 1–155.
- Higuti, J., Conceição, E.O., Campos, R., Ferreira, V.G., Rosa, J., Pinto, M.B.O. & Martens, K. (2017a) Periphytic community structure of Ostracoda (Crustacea) in the river-floodplain system of the Upper Paraná River. *Acta Limnologica Brasiliensia*, 29 (120), 1–17.  
<https://doi.org/10.1590/s2179-975x12217>
- Higuti, J., Declerck, S.A.J., Lansac-Tôha, F.A., Velho, L.F.M., Martens, K. (2010) Variation in ostracod (Crustacea, Ostracoda) communities in the alluvial valley of the upper Paraná River (Brazil) in relation to substrate. *Hydrobiologia*, 644 (1), 261–278.  
<https://doi.org/10.1007/s10750-010-0122-1>
- Higuti, J., Lansac-Tôha, F.A., Velho, L.F.M., Martens, K. (2009) Biodiversity of non-marine ostracods (Crustacea, Ostracoda) in the alluvial valley of the upper Paraná River, Brazil. *Brazilian Journal of Biology*, 69 (2), 661–668.  
<https://doi.org/10.1590/S1519-69842009000300020>
- Higuti, J., Roche, K.F. & Martens, K. (2017b) Checklist de ostrácodos (Crustacea, Ostracoda) dulcícolas do Pantanal Sul Mato-grossense, Brasil. *Iheringia, Série Zoologia (Online)* 107 (suppl.): e2017114.  
<https://doi.org/10.1590/1678-4766e2017114>
- Higuti, J., Rosa, J., Ferreira, V.G., Almeida, N.M., Campos, R., Conceição, E.O. & Martens, K. (2020) Inter-annual variation of ostracod (Crustacea) communities in the Upper Paraná River floodplain, Brazil. *Oecologia Australis*, 24 (1), 474–488.  
<https://doi.org/10.4257/oeco.2020.2402.17>
- Higuti, J., Velho, L.F.M., Lansac-Tôha, F.A. & Martens, K. (2007) Pleuston communities are buffered from regional flood pulses: the example of ostracods in the Paraná River floodplain, Brazil. *Freshwater Biology*, 52 (10), 1930–1943.  
<https://doi.org/10.1111/j.1365-2427.2007.01821.x>
- Horne, D.J., Cohen, A. & Martens, K. (2002) Taxonomy, morphology and biology of Quaternary and living Ostracoda. In: Holmes, A.J. & Chivas, A.R. (Eds.), *The Ostracoda: Applications in Quaternary Research*, AGU Geophysical Monograph Series 131, pp. 5–36.  
<https://doi.org/10.1029/131GM02>
- International Commission on Zoological Nomenclature. (2000) International Code on Zoological Nomenclature, fourth edition. <http://www.nhm.ac.uk/hosted-sites/iczn/code/>

- Jocque, M., Brendonck, L., Riddoch, B. & Martens, K. (2010) On *Amphibolocypis arida* n.sp. (Crustacea, Ostracoda), from rock pools in Botswana (southern Africa). *Zootaxa*, 2408 (1), 47–58.
- Jurine, L. (1820) Histoire des Monocles, qui se trouvent aux environs de Genève. I–XVI, 1–260.
- Karanovic, I. (2011) On the recent Cyclocypridinae (Podocopida, Candonidae) with description of two new genera and one new species. *Zootaxa*, 2820, 1–61.  
<https://doi.org/10.11646/zootaxa.2820.1.1>
- Karanovic, I. (2012) *Recent Freshwater Ostracods of the World. Crustacea, Ostracoda, Podocopida*. Springer, Berlin Heidelberg, 608 pp.  
<https://doi.org/10.1007/978-3-642-21810-1>
- Klie, W. (1930) Ostracoden aus den paraguayischen Teile des Gran-Chaco. *Sonder-Abdruck aus dem Archiv für Hydrobiologie*, XXII, 221–258.
- Klie, W. (1933) Die Ostracoden der Rift-Tal-Seen in Kenia. *Internationale Revue der gesamten Hydrobiologie und Hydrographie*, 29, 1–14.
- Klie, W. (1940) Süßwasserostracoden aus Nordostbrasilien, VII. Ilyocyprinae und Candocyprinae. *Zoologischer Anzeiger*, 130, 219–229.
- Lourival, R., Watts, Mourão, G.M. & Possingham, H.P. (2012) Systematic Zoning Applied to Biosphere Reserves: Protecting the Pantanal Wetland Heritage. In: Ioris, A.A.R. (Eds.), *Tropical Wetland Management*, pp. 135–171.
- Margalef, R. (1961) La vida en los charcos de agua dulce de Nueva Esparta (Venezuela). *Memoria de la Sociedad de Ciencias Naturales La Salle*, 21, 75–110.
- Martens, K. (1982) On a small collection of freshwater ostracods (Crustacea Ostracoda) from Somalia, with description of two new species. *Monitore zoologico italiano, Italian Journal of Zoology*, 5, 149–170.
- Martens, K. (1987) Homology and functional morphology of the sexual dimorphism in the antenna of *Sclerocypris* Sars, 1924 (Crustacea, Ostracoda, Megalocypridinae). *Bijdragen tot de Dierkunde*, 57 (2), 183–190.  
<https://doi.org/10.1163/26660644-05702003>
- Martens, K. (1989) On the systematic position of the *Eucypris clavata* - group, with a description of *Trajanocypris* gen. nov. (Crustacea, Ostracoda). *Archiv für Hydrobiologie, Supplements*, 83 (2), 227–251.

- Martens, K. (1990) Taxonomic revision of African Cypridini. Part I. The genera *Cypris* O.F. Müller, *Pseudocypris* Daday and *Globocypris* Klie. Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, *Biologie*, 60, 127–172.
- Martens, K. (1992) Taxonomic revision of African Cypridini. Part II. Description of *Ramotha* gen.nov. *Annals of the south African Museum*, 102 (2), 91–130.
- Martens, K. (1997.) On two new crenobiont ostracod genera (Crustacea, Ostracoda, Herpetocypridinae) from Africa and Asia Minor, with the description of a new species from dolomitic springs in South Africa. *South African Journal of Science*, 93, 542–554.
- Martens, K. (2001) Taxonomy of the Herpetocypridinae (Crustacea, Ostracoda). *Crustaceana* 74 (3), 295–308.
- Martens, K. & Behen, F. (1994) A checklist of the non-marine ostracods (Crustacea, Ostracoda) from the inland waters of South America and adjacent islands. *Travaux Scientifiques du Musée d' Histoire naturelle de Luxembourg*, 22, 1–81.
- Martens, K., Würdig, N.L. & Behen, F. (1998) Maxillopoda, non-marine Ostracoda. In: Young, P. S. (Eds.), *Catalogue of Crustacea of Brazil*. Rio de Janeiro: Museu Nacional, pp. 45–65.
- Matsuda, J.T., Lansac-Tôha, F.A., Martens, K., Velho, L.F.M., Mormul, R.P. & Higuti, J. (2015a) Association of body size and behaviour of freshwater ostracods (Crustacea, Ostracoda) with aquatic macrophytes. *Aquatic Ecology*, 49 (3), 321–331.  
<https://doi.org/10.1007/s10452-015-9527-2>
- Matsuda, J. T., Martens, K. & Higuti, J. (2015b) Diversity of ostracod communities (Crustacea, Ostracoda) across hierarchical spatial levels in a tropical floodplain. *Hydrobiologia*, 762 (1), 113–126.  
<https://doi.org/10.1007/s10750-015-2342-x>
- McKenzie, K.G. (1982) Homeomorphy: Persistent joker in the taxonomic pack, with the description of *Bradleycypris* gen. nov. In: Bate, R.H., Robinson, E. & Sheppard, L.M. (Eds.), *Fossil and Recent Ostracods*. Ellis Horwood Ltd, Chichester, pp. 407–438.
- Meisch, C. (2000) *Freshwater Ostracoda of western and central Europe*. Spektrum Akademischer-Verlag, Berlin, 522 pp.
- Meisch, C., Smith, R.J. & Martens, K. (2019) A subjective global checklist of the extant non-marine Ostracoda (Crustacea). *European Journal of Taxonomy*, 492, 1–135.  
<https://doi.org/10.5852/ejt.2019.492>
- Müller, G.W. (1903) Hamburgische Elb-Untersuchung. 3. Ostracoden. *Mitteilungen aus dem naturhistorischen Museum in Hamburg*, 19, 163–167.

- Okubo, I. (1990). Seven new species of freshwater Ostracoda from Japan (freshwater Ostracoda from Japan XIV). *Researches on Crustacea*, 19, 1–12.
- Oliveira, M.D. & Calheiros, D.F. (2000) Flood pulse influence on phytoplankton communities of the south Pantanal floodplain, Brazil. *Hydrobiologia*, 427, 101–112.  
<https://doi.org/10.1023/A:1003951930525>
- Por, F.D. (1995) *The Pantanal of Mato Grosso (Brazil). World's Largest Wetlands*. Kluwer Academic, Dordrecht, pp. 124.  
<https://doi.org/10.1007/978-94-011-0031-1>
- Pinto, R.L., Rocha, C.E.F. & Martens, K. (2003) On two new species of the genus *Vestalenula* Rossetti & Martens, 1998 (Crustacea, Ostracoda, Darwinulidae) from semi-terrestrial habitats in Sao Paulo State (Brazil). *Zoological Journal of the Linnean Society*, 139 (2), 305–313.  
<https://doi.org/10.1111/j.1096-3642.2003.00070.x>
- Rome, D.R. (1962) Ostracodes: Exploration hydrobiologique du Lac Tanganika (1946–1947). Résultats scientifiques 3 (8), Institut royal des sciences naturelles de Belgique, Bruxelles.
- Rome, D.R. (1965) Ostracodes. Parc National d'Upemba. Mission G.F. De Witte. *Institut des Parcs nationaux du Congo Belge, Bruxelles*, 69, 3–71.
- Rosa, J., Campos, R., Martens, K. & Higuti, J. (2020) Spatial variation of ostracod (Crustacea, Ostracoda) egg banks in temporary lakes of a tropical flood plain. *Marine and Freshwater Research*, 72 (1), 26–34.  
<https://doi.org/10.1071/MF19081>
- Rosa, J., Petsch, D.K., Martens, K. & Higuti, J. (2021) Species' traits and taxonomic distance can predict the hatching phenology of ostracod (Crustacea) resting eggs from tropical floodplain lakes. *International Review of Hydrobiology*, 106 (5/6), 226–238.  
<https://doi.org/10.1002/iroh.202102105>
- Sars, G.O. (1895) *On some South-African Entomostraca raised from dried mud. Videnskabs-selskabets skrifter, I. Matematik-Naturvidenskab Klasse*, 8, 1–63.
- Sars, G.O. (1901) Contribution to the knowledge of the fresh-water Entomostraca of South America. *Archiv for Matematik og Naturvidenskab*, 24, 1–52.
- Savatenalinton, S. (2017) A new genus and four new species of subfamily Cyclocypridinae (Crustacea, Ostracoda) from Thailand. *Zootaxa*, 4243 (2), 329–365.  
<https://doi.org/10.11646/zootaxa.4243.2.4>

- Sharpe, R.W. (1897) Contributions to a knowledge of the North American Freshwater Ostracoda including the families Cytheridae and Cyprididae. *Bulletin of the Illinois State Laboratory of Natural History*, 4, 414–484.
- Sharpe R.W. (1918) The Ostracoda. In: Ward, H.B. & Whipple, G.C. (Eds), *Fresh-Water Biology*, Wiley, New York City, pp. 790–828.
- Soares-Filho, B., Alencar, A., Nepstad, D., Cerqueira, G., Diaz, M.C.V., Rivero, S., Solórzano, L. & Voll, E. (2004) Simulating the response of land-cover changes to road paving and governance along a major Amazon highway: the Santarém-Cuiabá corridor. *Global Change Biology*, 10 (5), 745–764.  
<https://doi.org/10.1111/j.1529-8817.2003.00769.x>
- Soares-Filho, B., Moutinho, P., Nepstad, D., Anderson, A., Rodrigues, H., Garcia, R., Dietzsch, L., Merry, F., Bowman, M., Hissa, L., Silvestrini, R. & Maretti, C. (2010) Role of Brazilian Amazon protected areas in climate change mitigation. *Proceedings of the National Academy of Sciences*, 107, 10821–10826.  
<https://doi.org/10.1073/pnas.0913048107>
- Souza-Filho, E.E. & Stevaux, J.C. (2004) Geology and geomorphology of the Baía-Curutuba-Ivinheima River complex. In: Thomaz, S.M., Agostinho, A.A. & Hahn, N.S. (Eds.), *The Upper Paraná River and its Floodplain: Physical Aspects. Ecology and Conservation*. Backhuys Publishers, Leiden, pp. 1–29.
- Vávra, W. (1897) Die Süßwasser-Ostracoden Deutsch-Ost-Afrikas. In: Möbius, K. (Eds.), *Deutsch Ost-Afrika*. Vol. 4. Die Thierwelt Ost-Afrikas und der Nachbargebiete, Wirbellose Thiere. Verlag Dietrich Reimer, Berlin, pp. 1–28.
- Würdig, N.L. & Pinto, I.D. (1993) New species of Cyclocyprididae (Ostracoda) from the north coast of the State of Rio Grande do Sul, Brazil. *Anais da Academia Brasileira de Ciências*, 65 (3), 285–294.

## APPENDIX - TABLES

**TABLE 1.** Localities and some environmental characteristics from where the new species of Genus 1 gen. nov. and Genus 2 gen. nov. were found. Bold = type locality of the new species of the new genera; AMA = Amazon floodplain; PAN = South Matogrossense Pantanal; PAR = Upper Paraná floodplain; WT = water temperature; EC = electrical conductivity; DO = dissolved oxygen; “nd” = no data; Ea = *Eichhornia azurea*; Ec = *Eichhornia crassipes*; Lu = *Ludwigia* sp.; Pa = *Paspalum* sp.; Pi = *Pistia* sp.; Sap = *Salvinia* sp.; Ut = *Utricularia* sp.; Gen. 1 spec. A = Gen. 1 spec. A gen. et spec. nov.; Gen. 1 spec. B = Gen. 1 spec. B gen. et spec. nov.; Gen. 1 spec. D = Gen. 1 spec. D gen. et spec. nov.; Gen. 1 spec. F = Gen. 1 spec. F gen. et spec. nov.; Gen. 1 spec. G = Gen. 1 spec. G gen. et spec. nov.; Gen. 2 spec. C = Gen. 2 spec. C gen. et spec. nov.; Gen. 2 spec. E = Gen. 2 spec. E gen. et spec. nov.

Locality	Sample number	S°	S'	S''	W°	W'	W''	Date	substrate type	WT (°C)	EC ( $\mu\text{S.cm}^{-1}$ )	pH	DO (mg.L <sup>-1</sup> )	Species
<b>1. Aurélio Lake</b>	<b>PAR 150</b>	<b>22</b>	<b>41</b>	<b>37</b>	<b>53</b>	<b>13</b>	<b>52</b>	<b>07.11.2004</b>	<b>Floating</b>	<b>26</b>	<b>31.1</b>	<b>5</b>	<b>1</b>	<b>Gen. 1 spec. A</b>
1. Aurélio Lake	PAR 1631	22	41	36	53	13	52	17.02.2020	Macrophytes	25	44	5.1	2.3	Gen. 1 spec. A
2. Carenda Forest Road, lake 1	PAN 09	19	43	39	57	4	19	04.06.2003	Macrophytes	21	215	7	nd	Gen. 1 spec. A
<b>2. Carenda Forest Road, lake 1</b>	<b>PAN 09</b>	<b>19</b>	<b>43</b>	<b>39</b>	<b>57</b>	<b>4</b>	<b>19</b>	<b>04.06.2003</b>	<b>Macrophytes</b>	<b>21</b>	<b>215</b>	<b>7</b>	<b>nd</b>	<b>Gen. 2 spec. C</b>
<b>3. Banhado Lake</b>	<b>PAR 255</b>	<b>22</b>	<b>33</b>	<b>59</b>	<b>53</b>	<b>23</b>	<b>10</b>	<b>12.11.2004</b>	<b>Floating</b>	<b>28</b>	<b>31.8</b>	<b>5.2</b>	<b>3.9</b>	<b>Gen. 1 spec. B</b>
4. Carenda Forest Road, stream 1	PAN 10	19	42	19	57	3	31	nd	nd	nd	nd	nd	nd	Gen. 2 spec. C
<b>5. Miranda II River</b>	<b>PAN 66</b>	<b>19</b>	<b>25</b>	<b>7.7</b>	<b>57</b>	<b>18</b>	<b>49</b>	<b>23.08.2011</b>	<b>Ea, Pi, Sap, Lu</b>	<b>20</b>	<b>140</b>	<b>8.1</b>	<b>4.5</b>	<b>Gen. 1 spec. D</b>
6. Curva Doleque Road, lake 4	PAN 08	19	31	34	57	2	27	03.06.2003	Macrophytes	24	161	6	nd	Gen. 1 spec. D
7. Corumba Road, pool 2	PAN 14	19	35	38	57	8	3	04.06.2003	nd	19	292	7	nd	Gen. 1 spec. D
8. Corumba Road, lake 4	PAN 18	19	37	13	57	5	3	04.06.2003	Macrophytes	23	415	7	nd	Gen. 1 spec. D
9. BEP wetland 2	PAN 27	19	34	38	57	1	11	07.06.2003	nd	24	190	7	nd	Gen. 1 spec. D
10. Camp Road, pool 4	PAN 31	19	34	34	57	1	7	07.06.2003	Macrophytes	23	209	7	nd	Gen. 1 spec. D
<b>10. Camp Road, pool 4</b>	<b>PAN 31</b>	<b>19</b>	<b>34</b>	<b>34</b>	<b>57</b>	<b>1</b>	<b>7</b>	<b>07.06.2003</b>	<b>Macrophytes</b>	<b>23</b>	<b>209</b>	<b>7</b>	<b>nd</b>	<b>Gen. 2 spec. E</b>
<b>11. Manacapuru Lake</b>	<b>AMA 38</b>	<b>3</b>	<b>12</b>	<b>53</b>	<b>60</b>	<b>42</b>	<b>36</b>	<b>16.10.2011</b>	<b>Ut</b>	<b>32</b>	<b>1.8</b>	<b>6.6</b>	<b>1.8</b>	<b>Gen. 1 spec. F</b>
12. Cadete Lake	AMA 22	3	24	4.6	60	33	20	14.10.2011	Pi, Grass	37	81.7	6.8	116.8	Gen. 1 spec. F
12. Cadete Lake	AMA 23	3	24	4.6	60	33	20	14.10.2011	Pi, Grass	37	81.7	6.8	116.8	Gen. 1 spec. F
12. Cadete Lake	AMA 24	3	24	4.6	60	33	20	14.10.2011	Pi, Grass	37	81.7	6.8	116.8	Gen. 1 spec. F
13. Castanho Lake	AMA 80	3	23	57	60	13	28	17.05.2012	Pa, Ec	33	43.5	6.4	0.9	Gen. 1 spec. F
<b>13. Castanho Lake</b>	<b>AMA 80</b>	<b>3</b>	<b>23</b>	<b>57</b>	<b>60</b>	<b>13</b>	<b>28</b>	<b>17.05.2012</b>	<b>Pa, Ec</b>	<b>33</b>	<b>43.5</b>	<b>6.4</b>	<b>0.9</b>	<b>Gen. 1 spec. G</b>



**TABLE 2.** Measurements of the illustrated specimens of the new species of *Physocypria s.l.* Gen. 1 spec. A = Gen. 1 spec. A gen. et spec. nov.; Gen. 1 spec. B = Gen. 1 spec. B gen. et spec. nov.; Gen. 1 spec. D = Gen. 1 spec. D gen. et spec. nov.; Gen. 1 spec. F = Gen. 1 spec. F gen. et spec. nov.; Gen. 1 spec. G = Gen. 1 spec. G gen. et spec. nov.; Gen. 2 spec. C = Gen. 2 spec. C gen. et spec. nov.; Gen. 2 spec. E = Gen. 2 spec. E gen. et spec. nov.

Species	Floodplain	Locality name	Sample number	Sex	Slide	V/Cp	L (µm)	H (µm)	W (µm)
Gen. 1 spec. A	Paraná	Aurélio Lake	PAR 150	♂	NA120	LV	445	321.7	
						RV	436.7	310.8	
					NA114	LV	484.2	316.7	
						RV	474.2	317.6	
					NA192	LV	476.7	310	
						RV	464.2	318.4	
				♀	NA215	CpRl	485.8	313.3	
					NA214	CpD	477.5		265.9
					NA215	CpV	485.8		282.5
					NA121	LV	566.7	394.2	
						RV	544.2	394.2	
					NA122	LV	543.3	401.7	
						RV	533.3	391.7	
					NA193	LV	551.7	399.2	
						RV	534.2	390.1	
					NA245	CpRl	550.8	402.5	
					NA217	CpD	555.8		335.8
					NA218	CpV	562.5		350.9
Gen. 1 spec. A	South Matogrossense Pantanal	Carenda Forest Road, lake 1	PAN 09	♂	NA118	LV	483.3	335.9	
						RV	467.5	320.1	
					NA097	LV	485.8	339.2	
						RV	469.2	325.8	
					NA219	CpRl	486.7	325.8	
				♀	NA220	CpD	490		272.5
					NA221	CpV	502.5		279.2
					NA195	LV	568.3	392.5	
						RV	553.3	395.8	
					NA194	LV	572.5	399.2	
						RV	552.5	392.5	

Species	Floodplain	Locality name	Sample number	Sex	Slide	V/Cp	L (µm)	H (µm)	W (µm)
Gen. 1 spec. B	Paraná	Banhado Lake	PAR 255	♂	NA222	CpRl	568.3	388.4	
					NA223	CpD	549.2		325
					NA224	CpV	540.8		325.5
				♀	NA150	LV	468.3	282.5	
						RV	448.3	291.7	
					NA181	CpRl	469.2	292.6	
					NA182	CpD	455		205.8
					NA183	CpV	453.3		212.5
					NA152	LV	590	390	
						RV	571.7	389.2	
					NA184	CpRl	552.5	361.7	
					NA185	CpD	574.2		297.5
					NA186	CpV	569.2		298.3
Gen. 1 spec. D	South Matogrossense Pantanal	Miranda II River	PAN 66	♂	NA095	LV	395	265.8	
						RV	385.8	265.7	
					JH1085	CpRl	398	259	
				♀	JH1087	CpD	402		228
						CpV	402		233.3
					JH1081	CpRl	457	313	
					NA142	LV	455	300	
						RV	438.3	308.3	
					JH1081	CpRl	457	313	
					JH1082	CpD	478		291
					JH1083	CpV	467		278
Gen. 1 spec. D	South Matogrossense Pantanal	Camp Road, pool 4	PAN 31	♂	NA091	LV	432.5	292.5	
						RV	420.8	283.3	
					NA240	CpRl	447.5	283.3	
				♀	NA241	CpD	448.3		248.3
					NA242	CpV	440		252.5
					NA140	LV	504.2	367.5	
						RV	491.7	355.8	
					NA243	CpRl	488.3	328.3	
						CpD	489.2		286.7
						CpV	493.3		293.4
Gen. 1 spec. D	South Matogrossense Pantanal	Curva Doleque Road, lake 4	PAN 08	♂	NA076	LV	403.3	289.2	

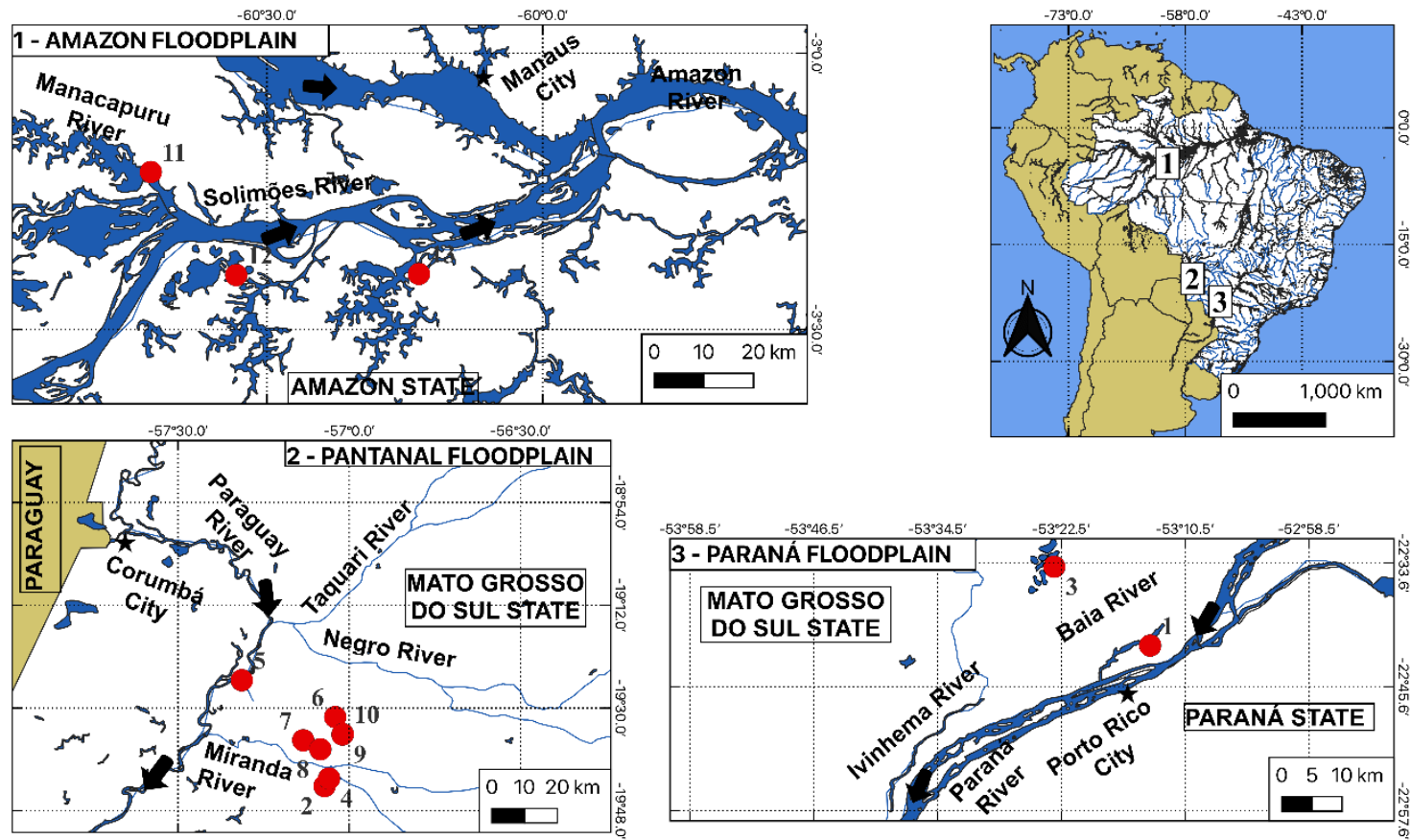
Species	Floodplain	Locality name	Sample number	Sex	Slide	V/Cp	L (µm)	H (µm)	W (µm)
Gen. 1 spec. D	South Matogrossense Pantanal	Corumba Road, lake 4	PAN 18	♂	NA196	RV	396.7	278.3	
						LV	440.8	299.2	
						RV	423.4	284.2	
Gen. 1 spec. F.	Amazon	Manacapuru Lake	AMA 38	♂	NA104	LV	537.5	352.5	
						RV	529.2	344.2	
						NA159 CpRl	553.3	339.2	
						NA160 CpD	531.7	245.8	
				♀	NA161	CpV	545.8	242.5	
						LV	645.8	388.3	
						RV	616.7	379.2	
						NA162 CpRl	640.8	409.2	
						CpD	640.8		318.3
						CpV	639.2		317.5
Gen. 1 spec. F	Amazon	Castanho Lake	AMA 80	♂	NA105	LV	540	283.4	
						RV	522.5	315	
				♀	NA191	LV			
						RV			
Gen. 1 spec. F	Amazon	Cadete Lake	AMA 23	♂	JH889	LV	552	313	
						RV	541	335	
						JH890 CpRl	530	332	
						JH891 CpD	538		222
				♀	JH892	CpV	518		229
						LV	698	428	
						RV	690	443	
						JH894 CpRl	629	398	
						JH895 CpD	627		325
						CpV	632		322
Gen. 1 spec. G	Amazon	Castanho Lake	AMA 80	♂	NA106	LV	518.3	271.7	
						RV	490	284.2	
					NA165	CpRl	470	265.8	
						CpD	466.7		197.5
				♀	NA138	CpV	458.3		205.8
						LV	504.2	336.7	
						RV	490	342.5	
						NA166 CpRl	486.7	332.5	

Species	Floodplain	Locality name	Sample number	Sex	Slide	V/Cp	L (µm)	H (µm)	W (µm)
Gen. 2 spec. C	South Matogrossense Pantanal	Carenda Forest Road, lake 1	PAN 09	♂	NA167	CpD	493.3		273.3
					NA168	CpV	481.7		278.3
					NA126	LV	586.7	387.5	
				♀		RV	580	403.3	
					NA175	CpRl	613.4	395	
					NA176	CpD	586.7	300	
					NA177	CpV	580	306.7	
					NA124	LV	609.8	481.7	
						RV	648.3	456.7	
					NA178	CpRl	658.3	427.5	
					NA179	CpD	649.2		367.5
					NA180	CpV	686.7		390
Gen. 2 spec. E	South Matogrossense Pantanal	Camp Road, pool 4	PAN 31	♂	NA108	LV	666.7	446.7	
						RV	643.3	428.4	
					NA170	CpRl	657.5	406.7	
				♀		CpD	658.3		323.3
						CpV	653.3		330.9
					NA145	LV	710.8	473.3	
						RV	695.8	485	
					NA171	CpRl	727.5	515.8	
					NA172	CpD	753.3		410
					NA173	CpV	704.2		392.5

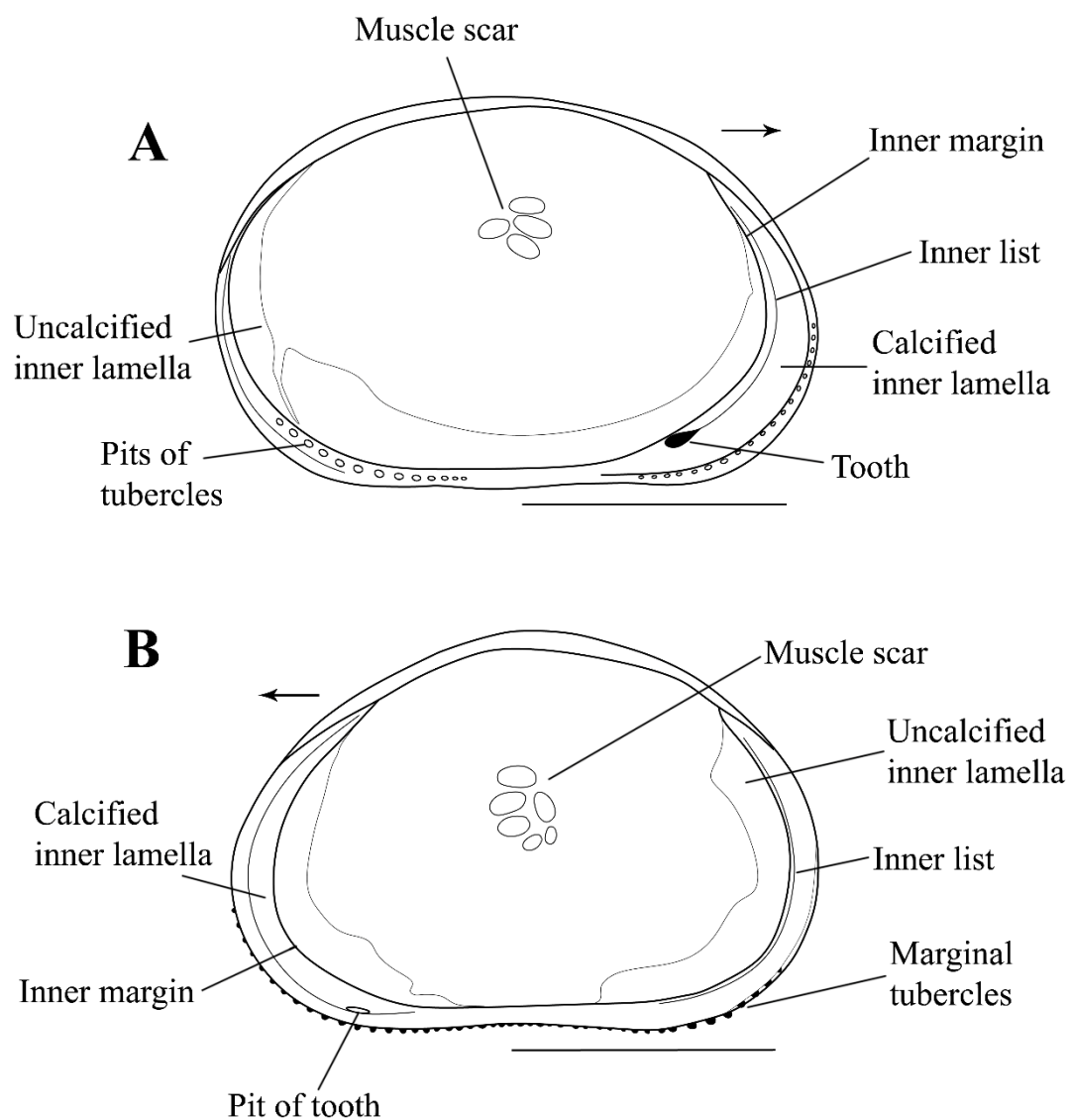
**TABLE 3.** Comparative morphology amongst the genera *Cypria*, *Physocypria*, *Keysercypria*, *Dentocypria* and Genus 1 gen.nov. and Genus 2 gen. nov. The other genera *Cyclocypris* and *Kempfcyclocypris* (different lineage within Cyclocypridinae), *Mecynocypria* (endemic to Lake Tanganyika) and *Namiotkocypria* (subterranean) are not considered here.

character	<i>Cypria</i> <i>exculpta</i>	<i>Physocypria</i> <i>bullata</i>	<i>Dentocypria</i> <i>mezquिताe</i>	<i>Keysercypria</i> <i>affinis</i>	Genus 1 Species A, B, D, F, G	Genus 2 Species C, E
LV antero-ventral tooth	unknown	unknown	present	unknown	present	present
A2 short accompanying nat seta	present	present	present	absent	absent	absent
Md palp beta seta	unknown	very short, thick	very short, thick	unknown	broad, elongated	broad, elongated
Md palp length last segment	L= c 2.5xW	L=2xW	L= c 4xW	L=>5xW	L = 3xW	L = 2xW
Md palp last segment chaeto	unknown	3 claws + 2 setae	3 claws + 1 seta	unknown	3 claws + 1 seta	3 claws + 1 seta
Mx1-palp last segment chaeto	unknown	6 claws and setae	6 claws and setae	4 claws and setae	5 claws and setae	5 claws and setae
T1 setae b	unknown	long	short	unknown	short	short
T1 setae d	unknown	long	long	unknown	long	long
T2 setae d1	absent	present	absent	absent	absent	absent
T2 seta d2	absent	absent	absent	absent	absent	absent
T2 seta e (male)	short	short	long	short	short	short
T2 seta h3 (male)	short	short	short	long	short	short
T3 seta d2	present	present	present	absent	absent	absent
T3 seta dp (male)	present	present	present	present	present	absent
T3 setae h2 vs h1	subequal	subequal	h2 > 2x h1	h2 > 2x h1	h2 > 2x h1	h2 > 2x h1
ovarium posteriorly	unknown	down /forwards	unknown	up/backwards	up/backwards	up/backwards
CR proximal seta (Fem > Male)	short	medium	long	medium	long	short

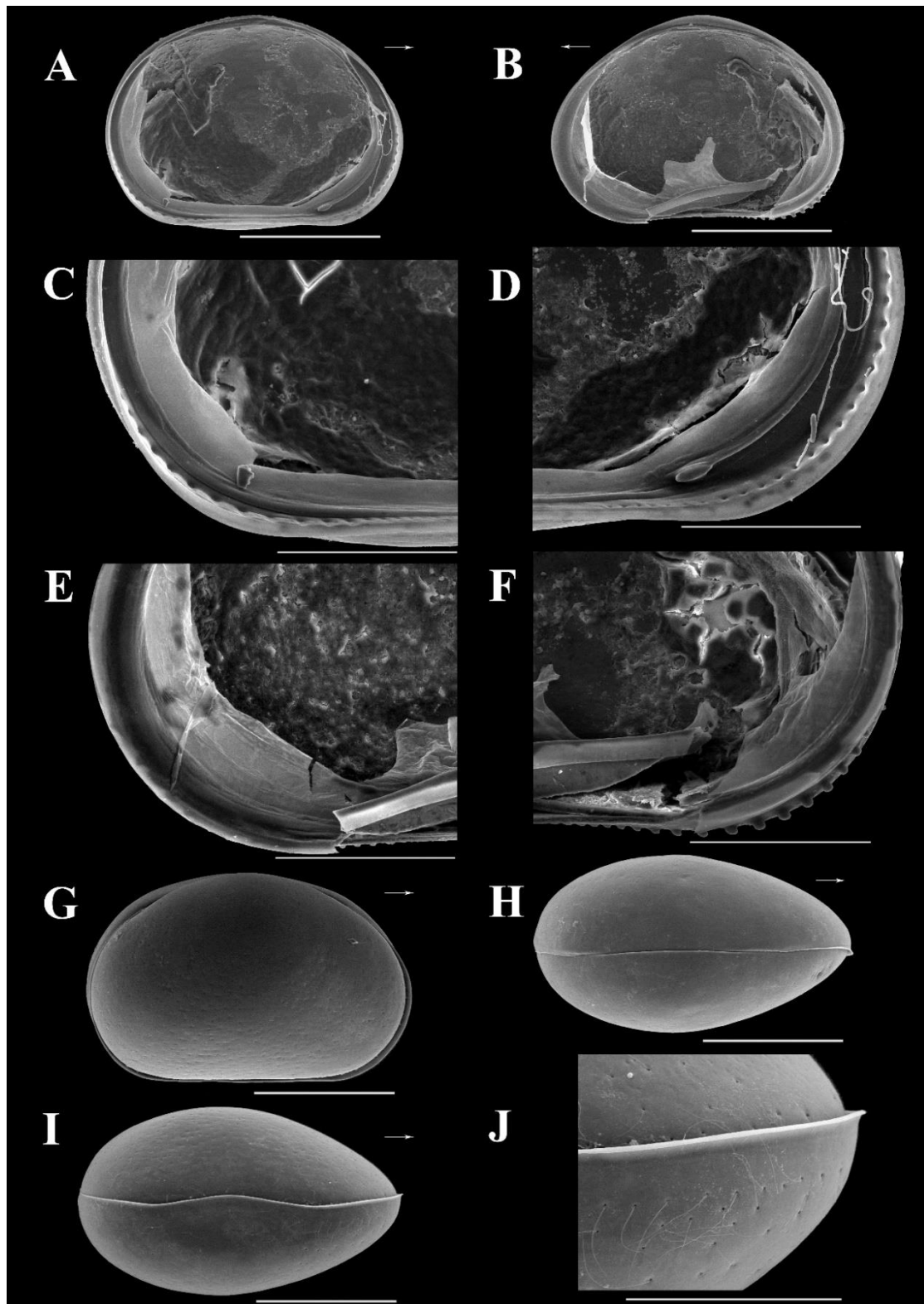
## APPENDIX - FIGURES



**FIGURE 1.** Localities where the new species of Genus 1 gen. nov. and Genus 2 gen. nov. were collected See Table 1.

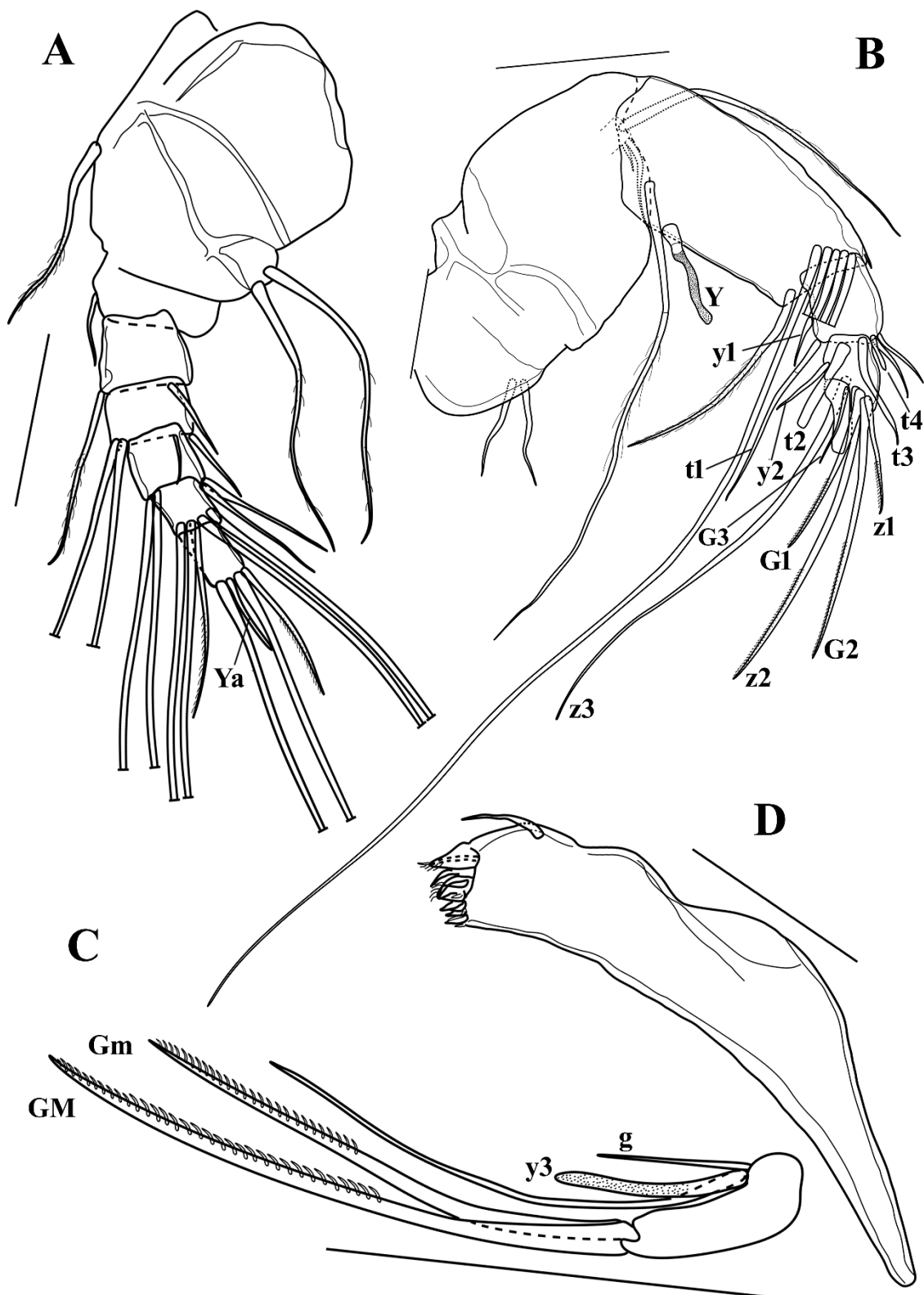


**FIGURE 2.** Illustration of valve morphology. **A.** LVi. **B.** RVi. Scale bars: 250  $\mu\text{m}$ .

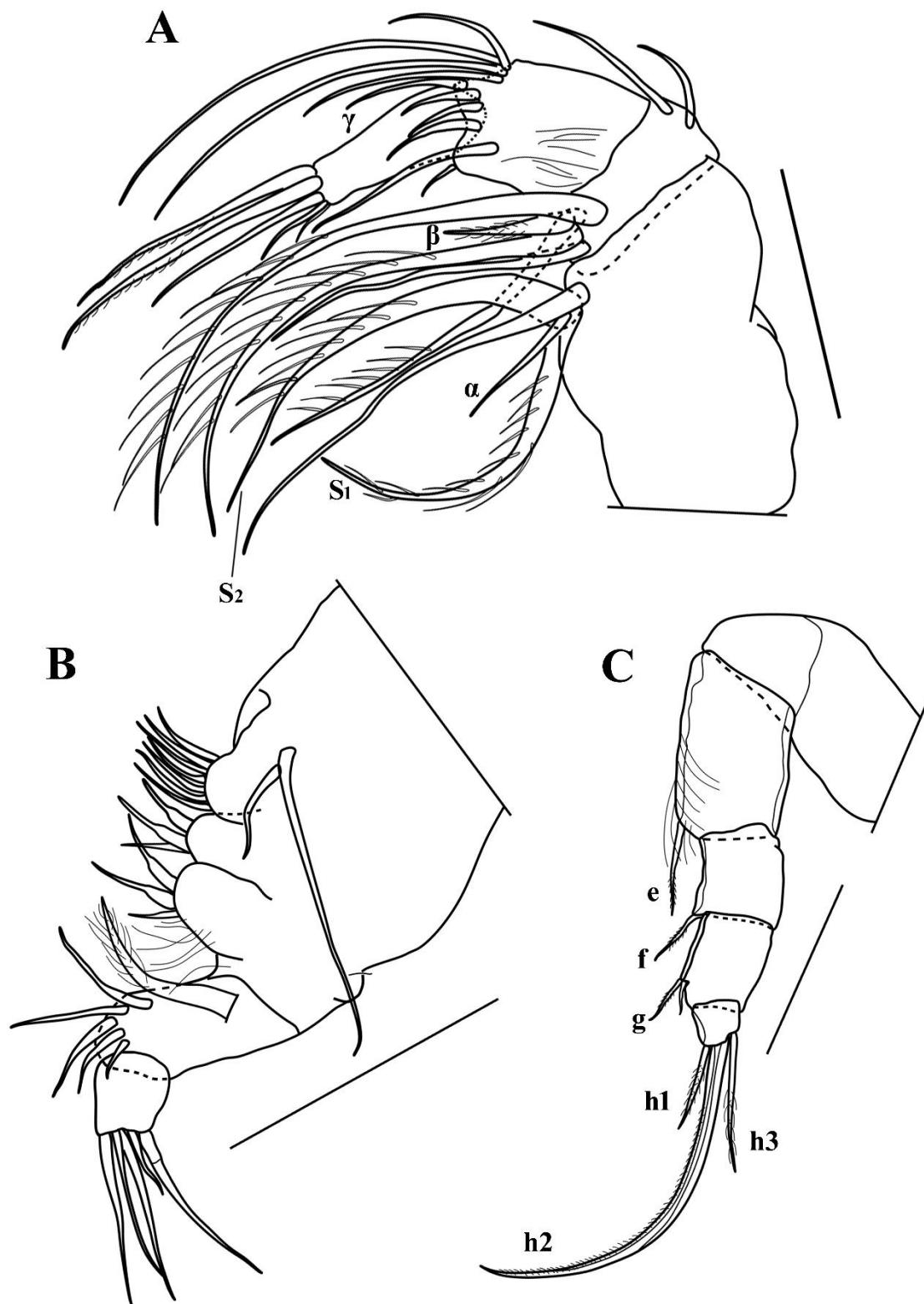


**FIGURE 3.** Gen. 1 spec. A gen. et spec. nov. ♂ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** LVi (NA120). **B.** RVi (NA120). **C.** LVi, detail of posterior part (NA120). **D.** LVi, detail of anterior part (NA120). **E.** RVi, detail of anterior part (NA120). **F.** RVi, detail of posterior part (NA120). **G.** CpRl (NA215). **H.** CpD (NA214). **I.** CpV (NA215). **J.** CpV, detail of anterior part showing the surface of Cp (NA215). Scale bars: A–B, G–I = 250  $\mu$ m; C–F, J = 100  $\mu$ m.

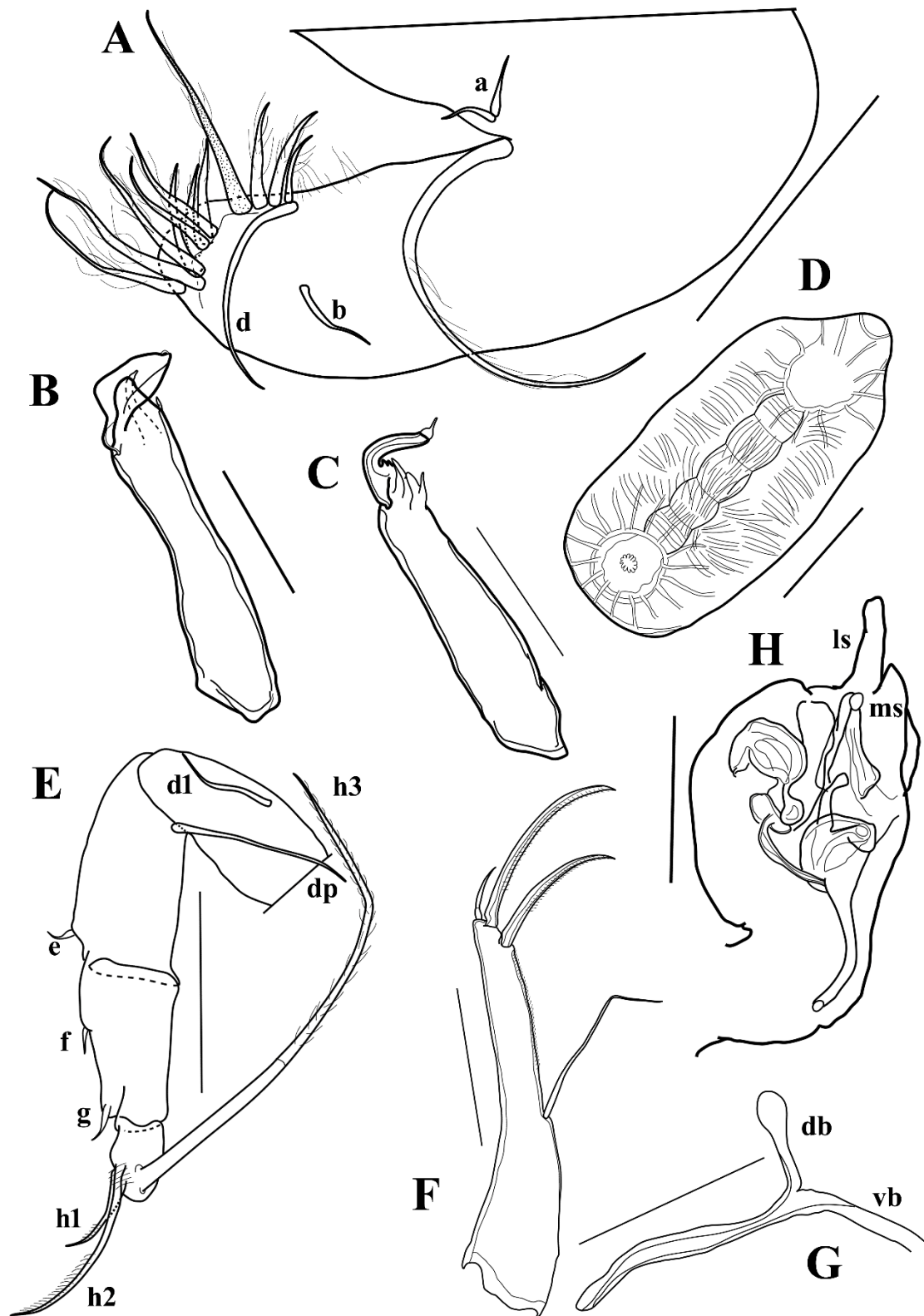




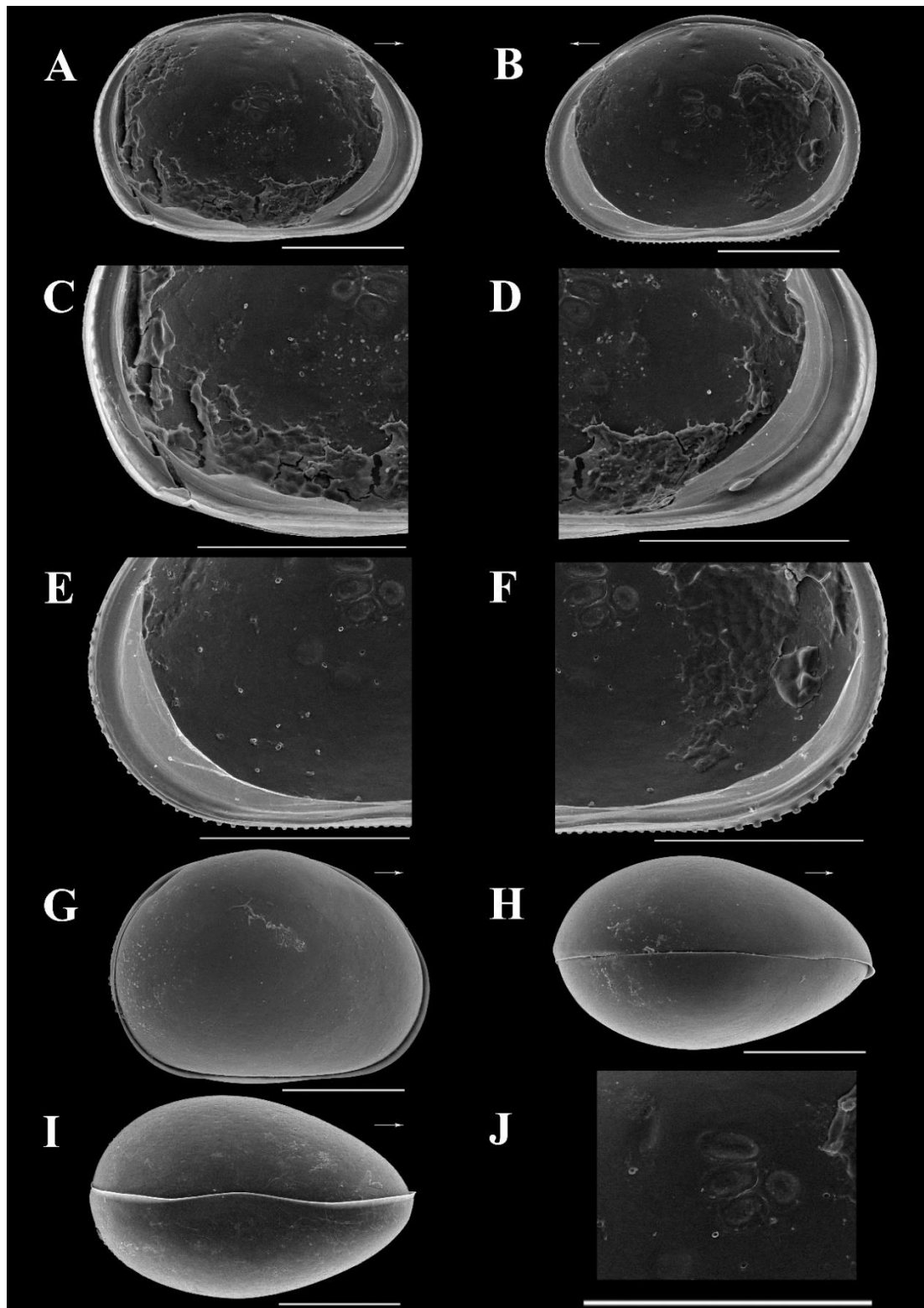
**FIGURE 4.** Gen. 1 spec. A gen. et spec. nov. ♂ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** A1 (NA120). **B.** A2, without the terminal segment (NA120). **C.** A2, terminal segment (NA120). **D.** Md-coxa (NA120). Scale bars: A–D = 50 µm.



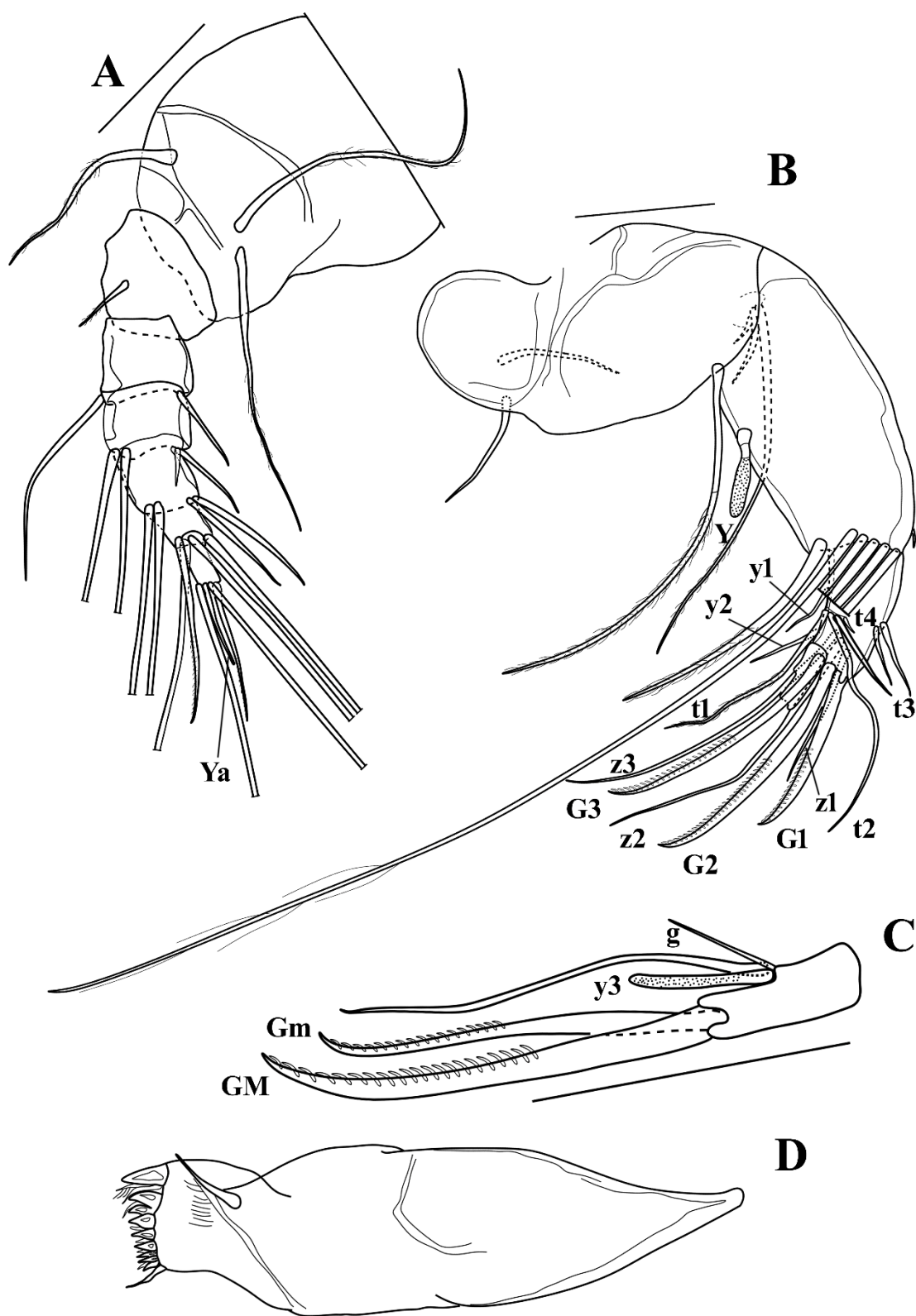
**FIGURE 5.** Gen. 1 spec. A gen. et spec. nov. ♂ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** Md-palp (NA120). **B.** Mx1 (NA120). **C.** T2 (NA120). Scale bars: A–C = 50  $\mu$ m.



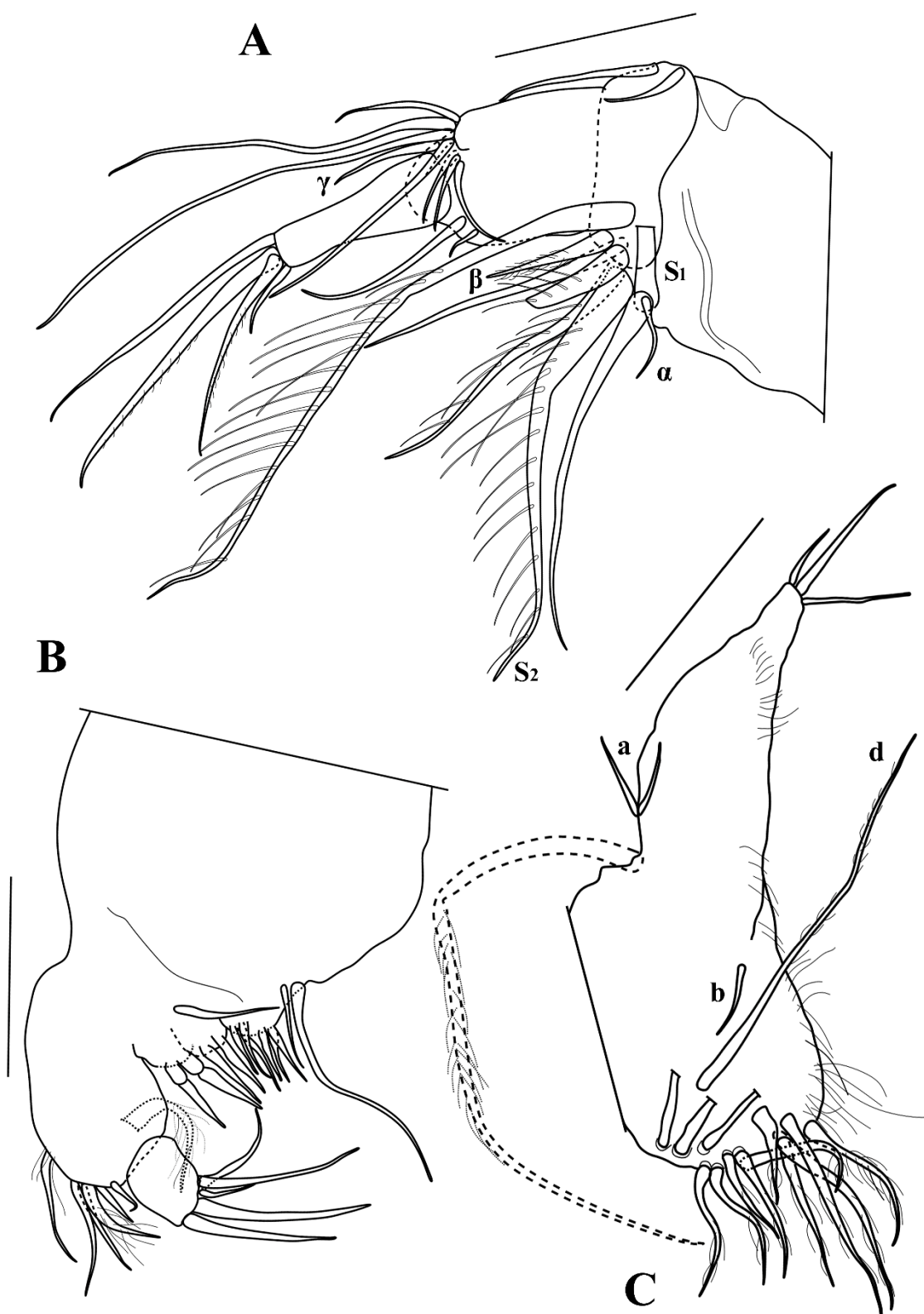
**FIGURE 6.** Gen. 1 spec. A gen. et spec. nov. ♂ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** T1 (NA120). **B.** Rpp (NA120). **C.** Lpp (NA120). **D.** Zenker's organ (NA120). **E.** T3 (NA120). **F.** CR (NA120). **G.** CR attachment (NA120). **H.** Hemipenis (NA120). Scale bars: A–H = 50  $\mu$ m.



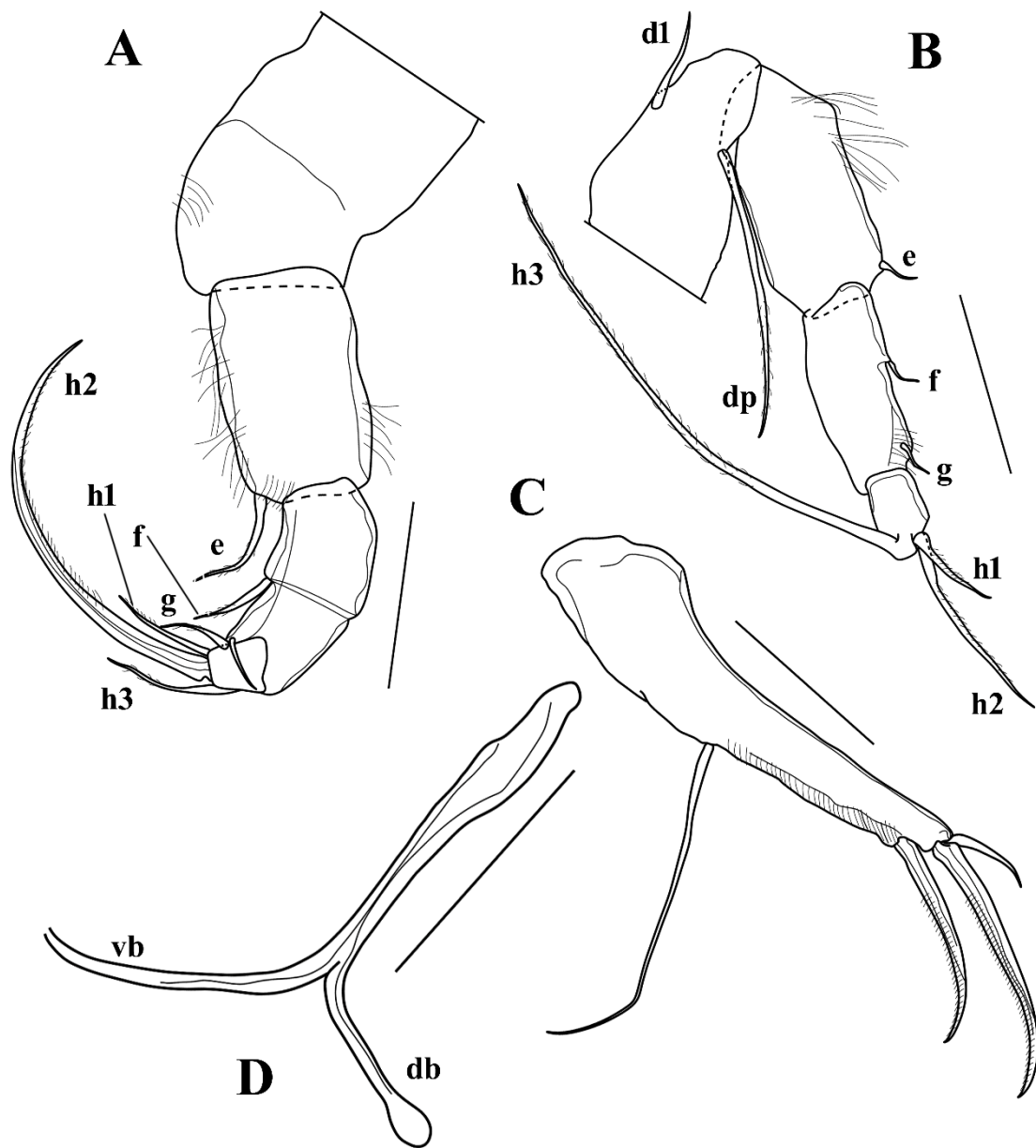
**FIGURE 7.** Gen. 1 spec. A gen. et spec. nov. ♀ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** LVi (NA121). **B.** RVi (NA121). **C.** LVi, detail of posterior part (NA121). **D.** LVi, detail of anterior part (NA121). **E.** RVi, detail of anterior part (NA121). **F.** RVi, detail of posterior part (NA121). **G.** CpRl (NA245). **H.** CpD (NA217). **I.** CpV (NA218). **J.** RVi, detail of muscle scars (NA121). Scale bars: A–B, G–J = 250 µm; C–F = 200 µm.



**FIGURE 8.** Gen. 1 spec. A gen. et spec. nov. ♀ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** A1 (NA121). **B.** A2, without the terminal segment (NA121). **C.** A2, terminal segment (NA121). **D.** Md-coxa (NA121). Scale bars: A–D = 50 μm.

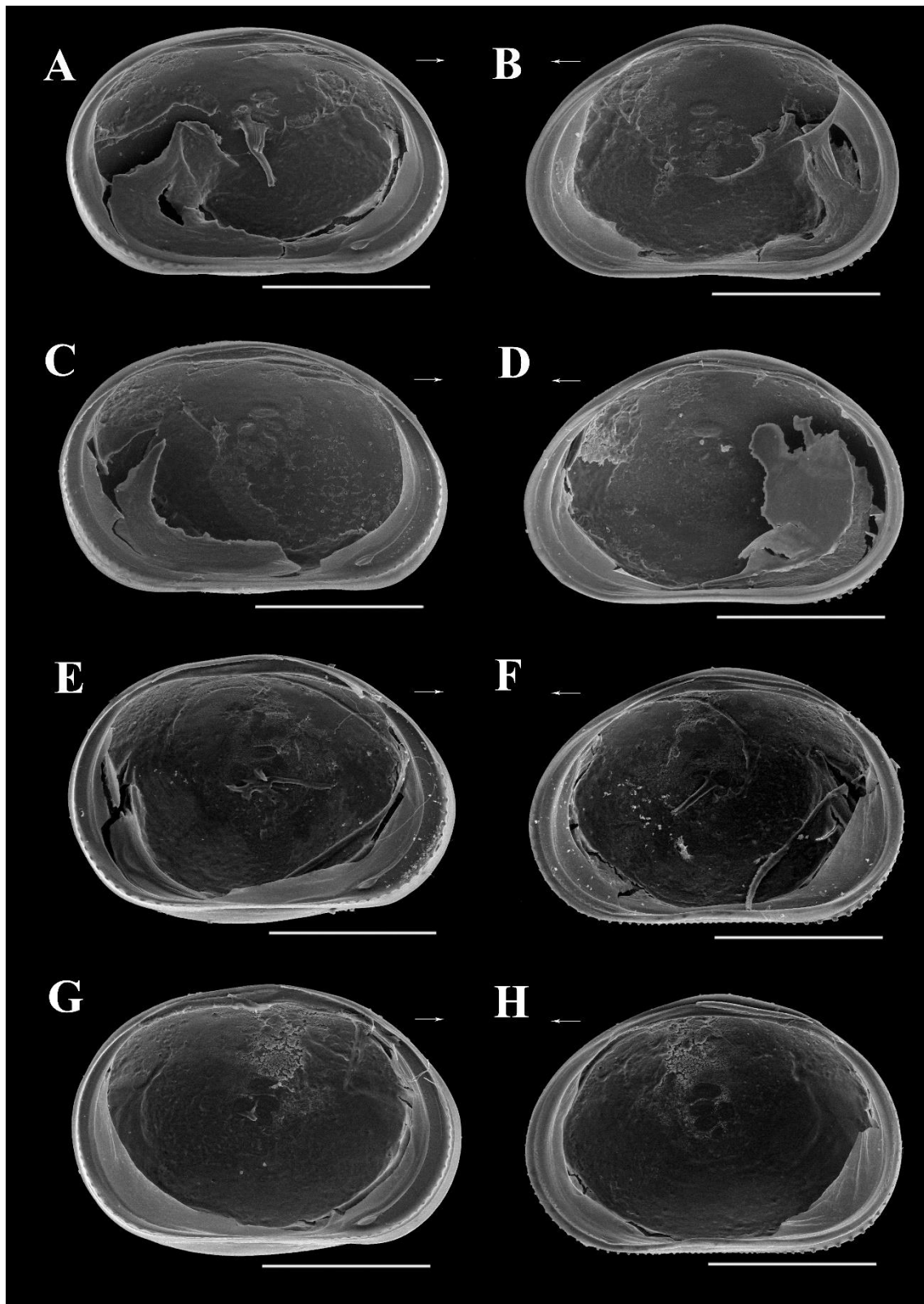


**FIGURE 9.** Gen. 1 spec. A gen. et spec. nov. ♀ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** Md-palp (NA121). **B.** Mx1 (NA121). **C.** T1 (NA121). Scale bars: A–C = 50  $\mu$ m.



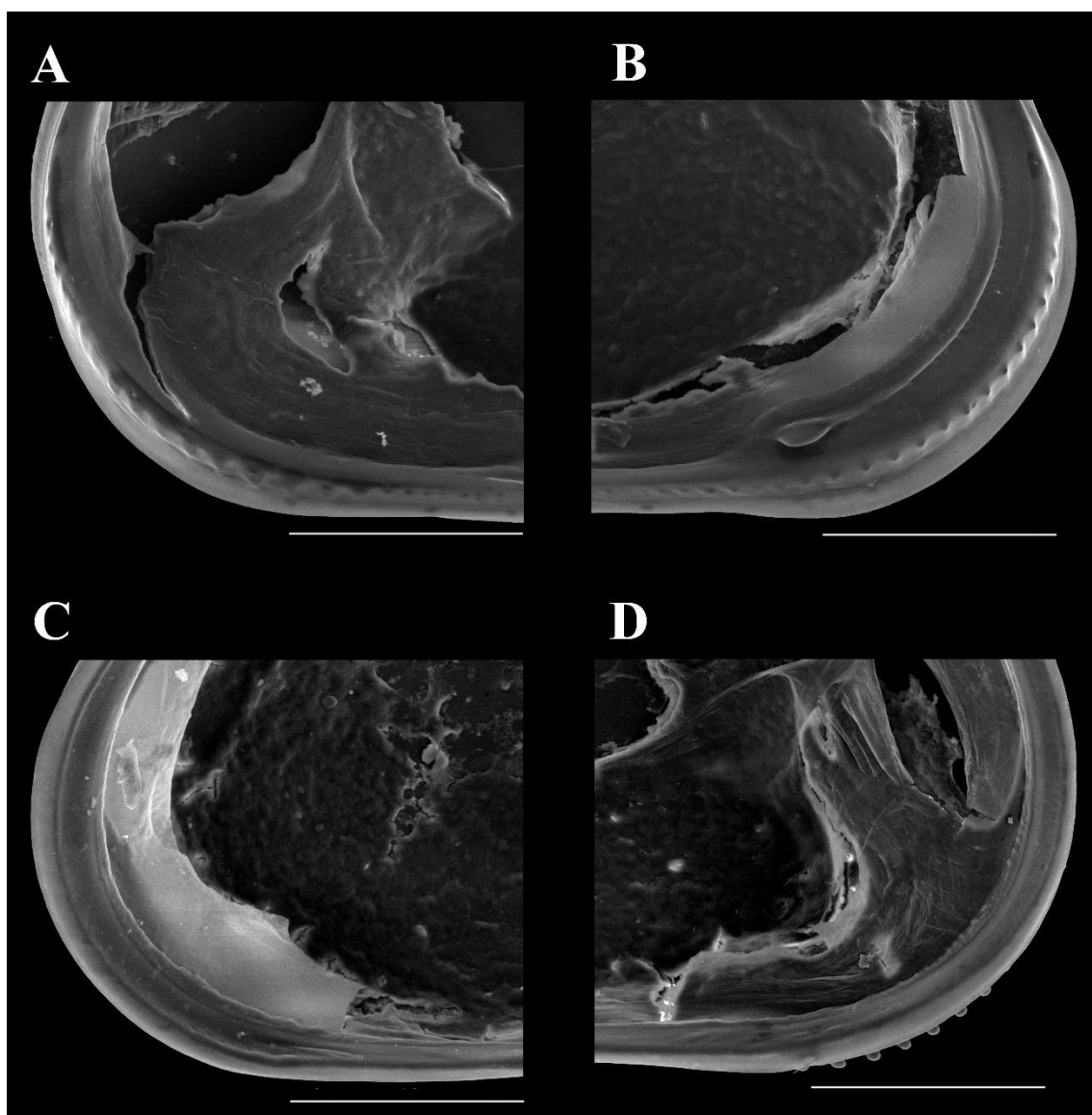
**FIGURE 10.** Gen. 1 spec. A gen. et spec. nov. ♀ from Upper Paraná River floodplain, Aurélio Lake (PAR 150). **A.** T2 (NA121). **B.** T3 (NA121). **C.** CR (NA122). **D.** CR attachment. Scale bars: A–D = 50 µm.



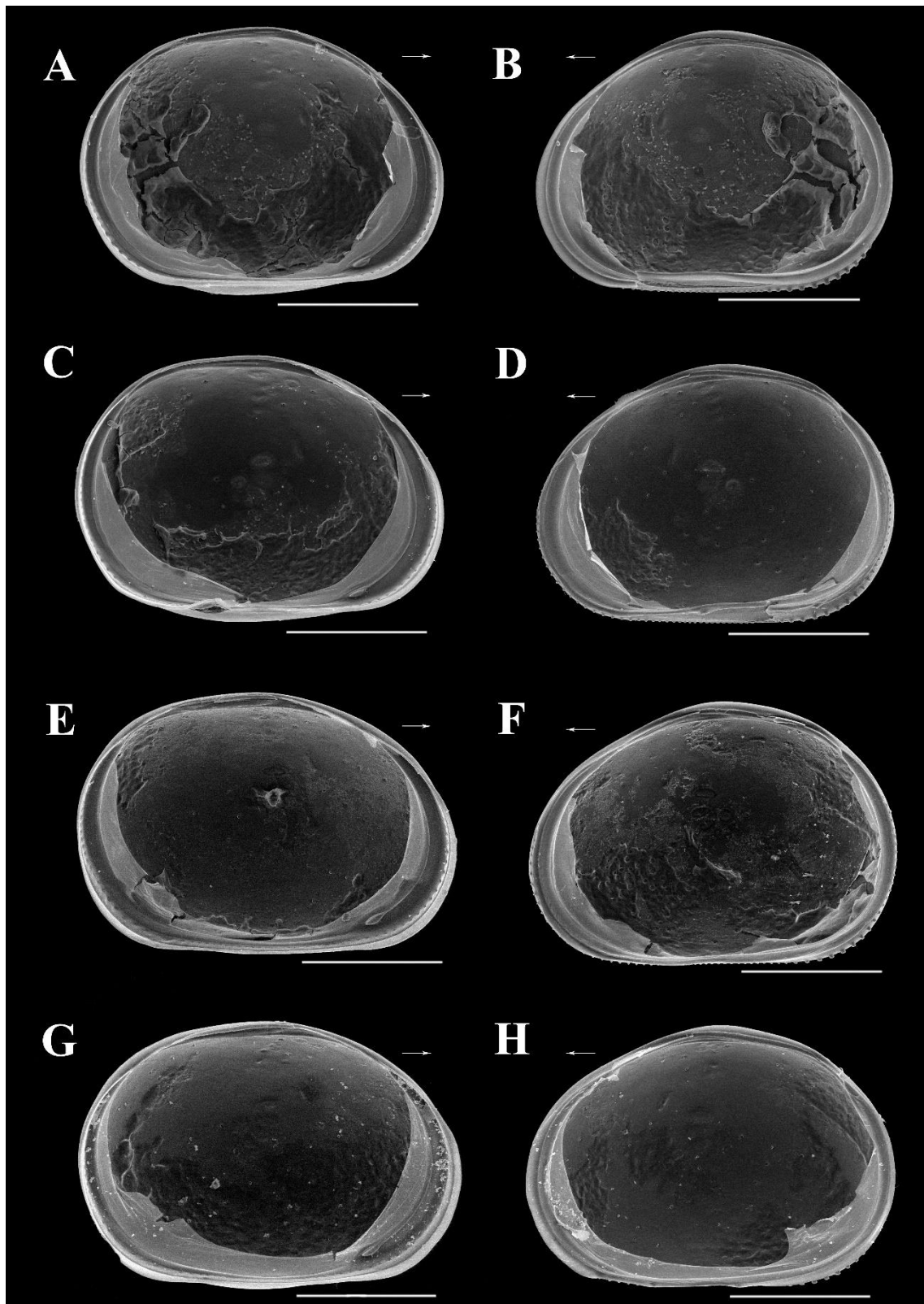


**FIGURE 11.** Gen. 1 spec. A gen. et spec. nov. ♂ A from: **A–D** = Upper Paraná River floodplain, Aurélio Lake (PAR 150) and **E–H** = South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A.** RVi (NA192). **B.** RVi (NA192). **C.** LVi (NA114). **D.** RVi (NA114). **E.** LVi (NA118). **F.** RVi (NA118). **G.** LVi (NA097). **H.** RVi (NA097). Scale bars: A–H = 250  $\mu$ m.

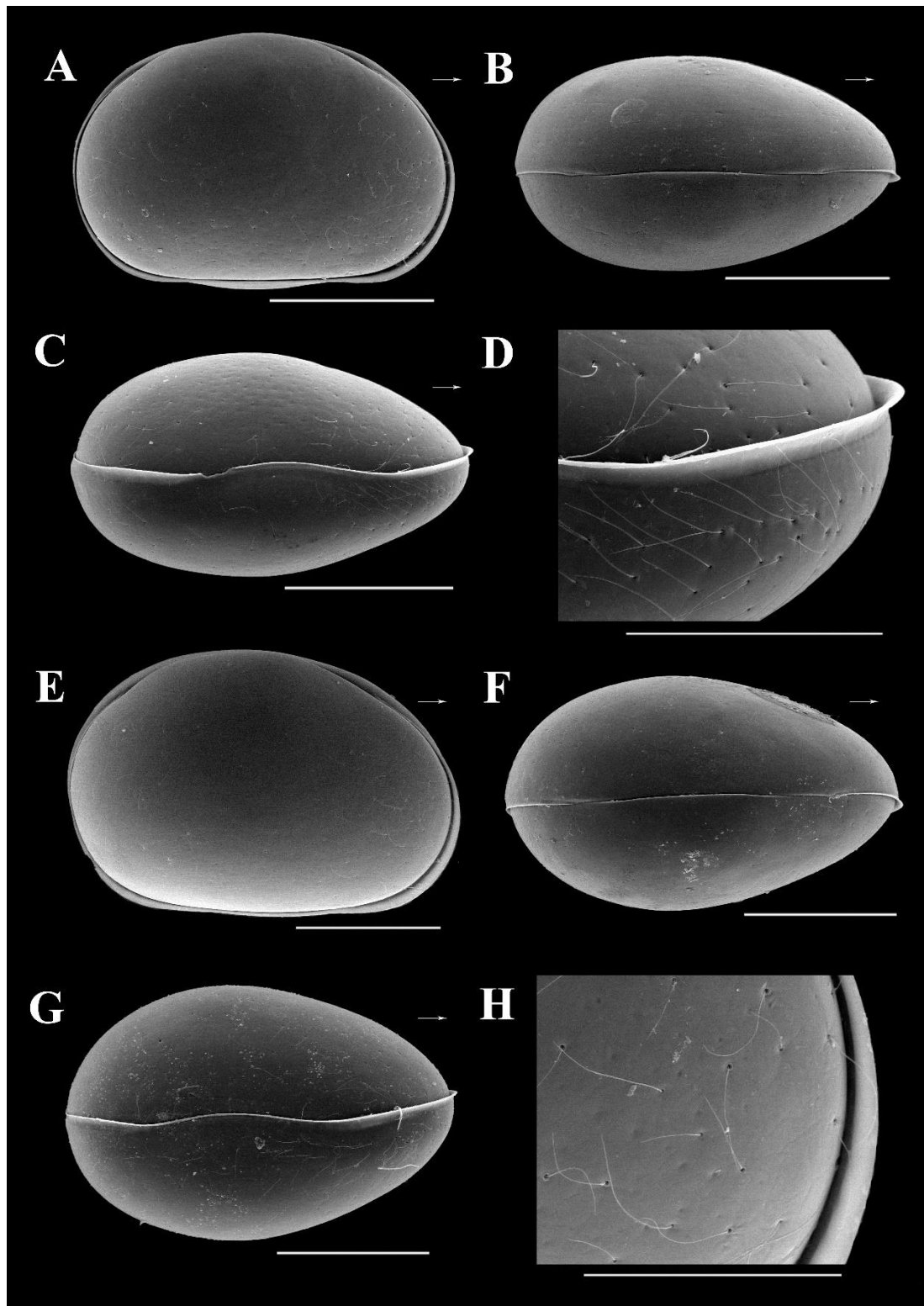




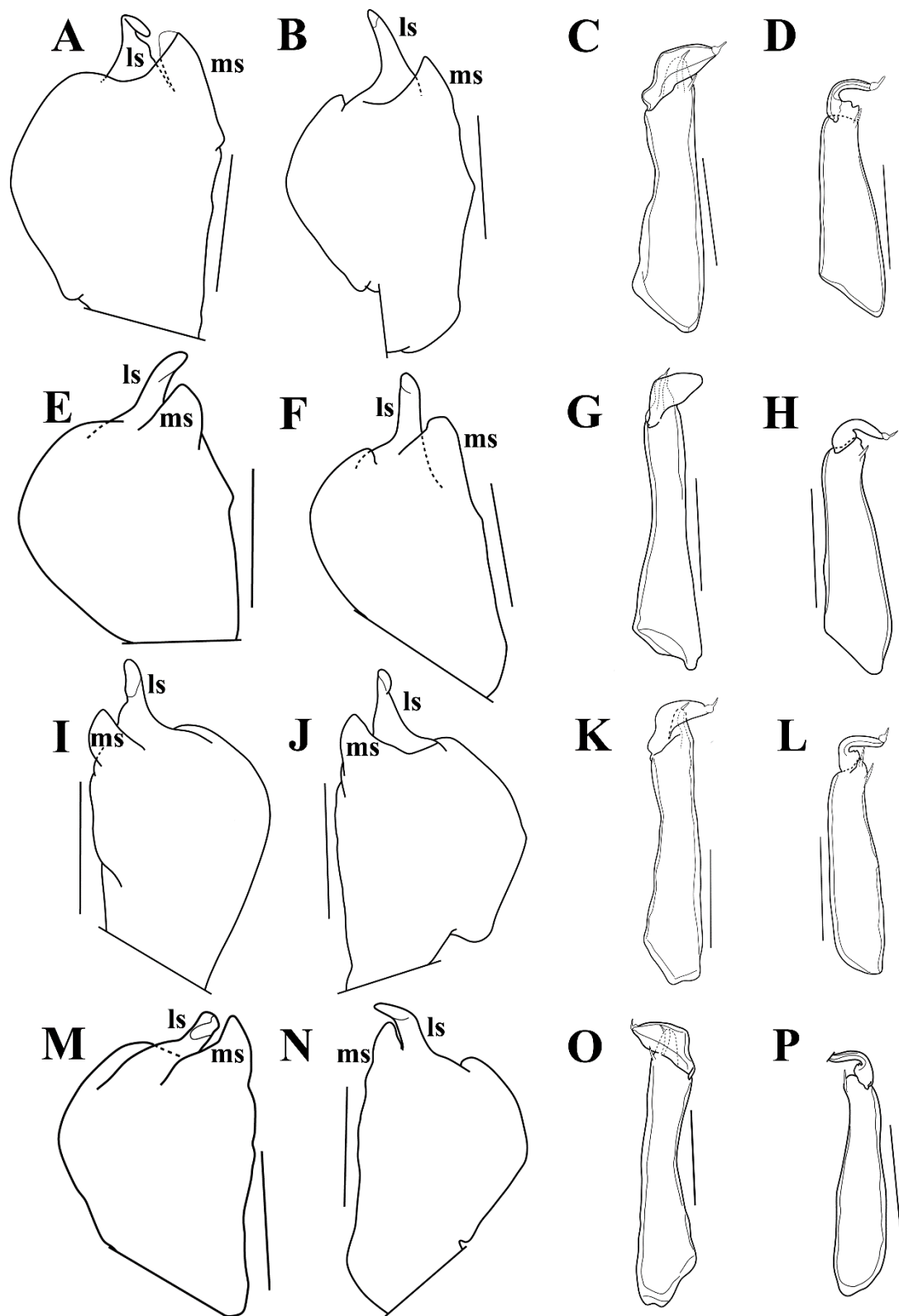
**FIGURE 12.** Gen. 1 spec. A gen. et spec. nov. ♂ A from Upper Paraná River floodplain, Aurélio Lake (PAR150). **A.** LVi, posterior part (NA192). **B.** LVi, anterior part (NA192). **C.** RVi, anterior part (NA192). **D.** RVi, posterior part (NA192). Scale bars: A–D = 100  $\mu$ m.



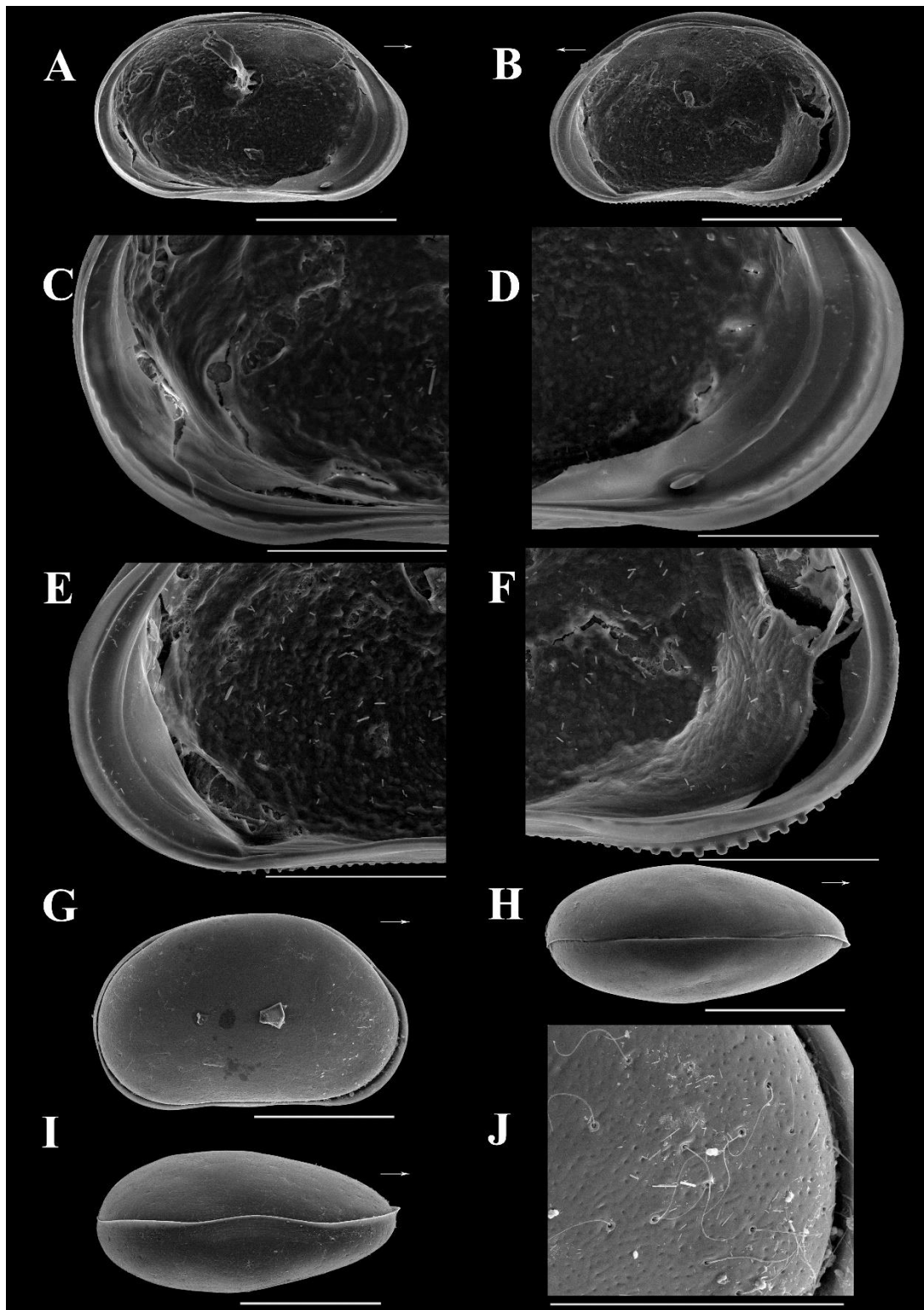
**FIGURE 13.** Gen. 1 spec. A gen. et spec. nov. ♀ A from: **A–D** = Upper Paraná River floodplain, Aurélio Lake (PAR 150) and **E–H** = South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A.** RVi (NA122). **B.** RVi (NA122). **C.** LVi (NA193). **D.** RVi (NA193). **E.** LVi (NA195). **F.** RVi (NA195). **G.** LVi (NA194). **H.** RVi (NA194). Scale bars: A–H = 250  $\mu$ m.



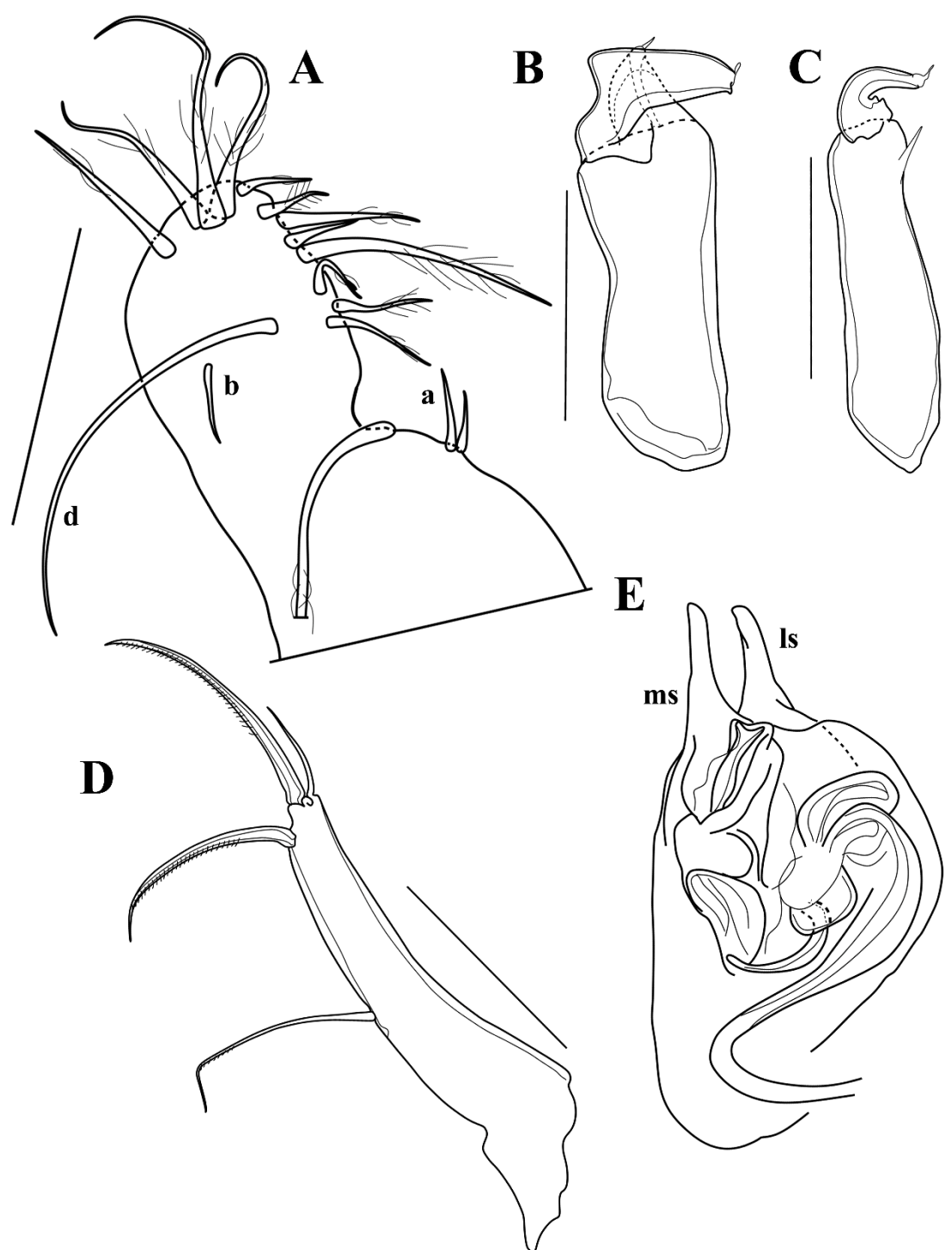
**FIGURE 14.** Gen. 1 spec. A gen. et spec. nov. from South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A–D.** ♂. **E–F.** ♀. **A.** CpR1 (NA219). **B.** CpD (NA220). **C.** CpV (NA221). **D.** CpV, detail of the anterior part showing the surface of Cp (NA221). **E.** CpR1 (NA222). **F.** CpD (NA223). **G.** CpV (NA224). **H.** CpR1, detail of the anterior part showing the surface of Cp (NA222). Scale bars: A–C; E–G = 250 µm; D, H = 100 µm.



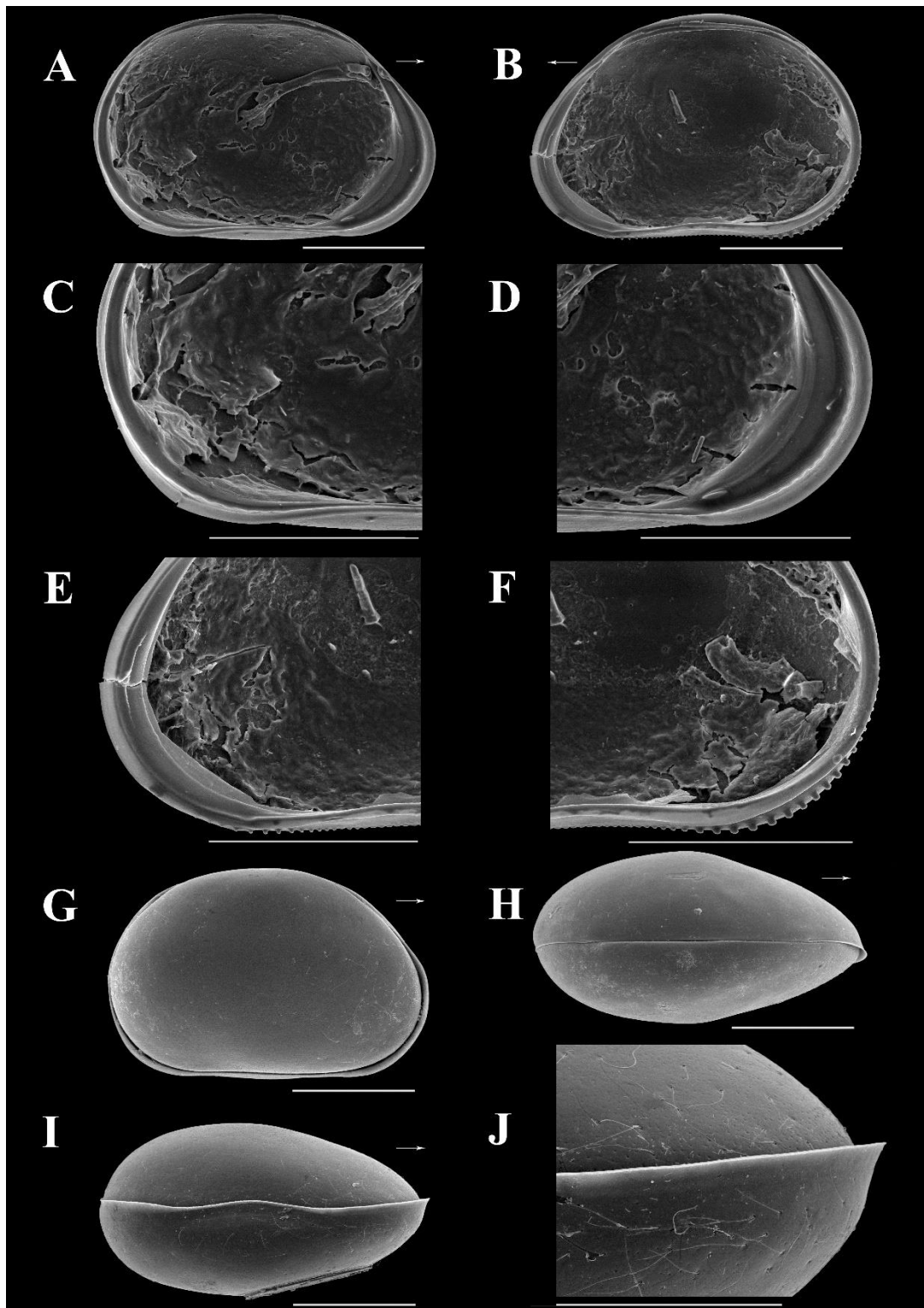
**FIGURE 15.** Gen. 1 spec. A gen. et spec. nov. ♂ from: **A–H** = Upper Paraná River floodplain, Aurélio Lake (PAR 150) and **I–P** = South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A–D**. NA192. **E–H**. NA114. **I–L**. NA118. **M–P**. NA097. **A–B; E–F; I–J; M–N**. Hemipenis. **C, G, K, O**. Rpp. **D, H, L, P**. Lpp. Scale bars: A–H = 50  $\mu$ m.



**FIGURE 16.** Gen. 1 spec. B gen. et spec. nov. ♂ from Alluvial valley of the upper Paraná River floodplain, Banhado Lake (PAR 255). **A.** LVi (NA150). **B.** RVi (NA150). **C.** LVi, detail of posterior part (NA150). **D.** LVi, detail of anterior part (NA150). **E.** RVi, detail of anterior part (NA150). **F.** RVi, detail of posterior part (NA150). **G.** CpRl (NA181). **H.** CpD (NA182). **I.** CpV (NA183). **J.** CpRl, detail of anterior part showing the surface of Cp (NA181). Scale bars: A–B, G–I = 250 µm; C–F, J = 100 µm.

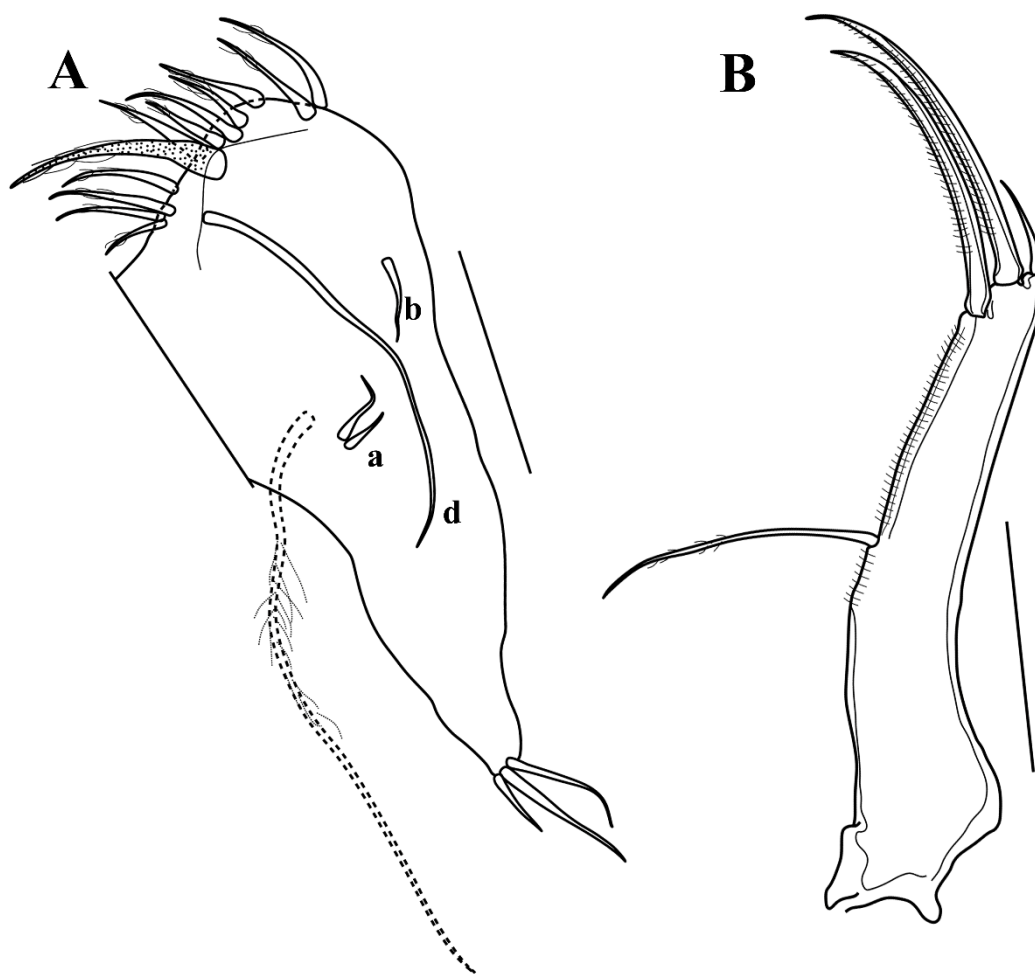


**FIGURE 17.** Gen. 1 spec. B gen. et spec. nov. ♂ from Alluvial valley of the upper Paraná River floodplain, Banhado Lake (PAR 255). **A.** T1 (NA150). **B.** Rpp (NA150). **C.** Lpp (NA150). **D.** CR (NA150). **E.** Hemipenis (NA150). Scale bars: A–E = 50  $\mu$ m.



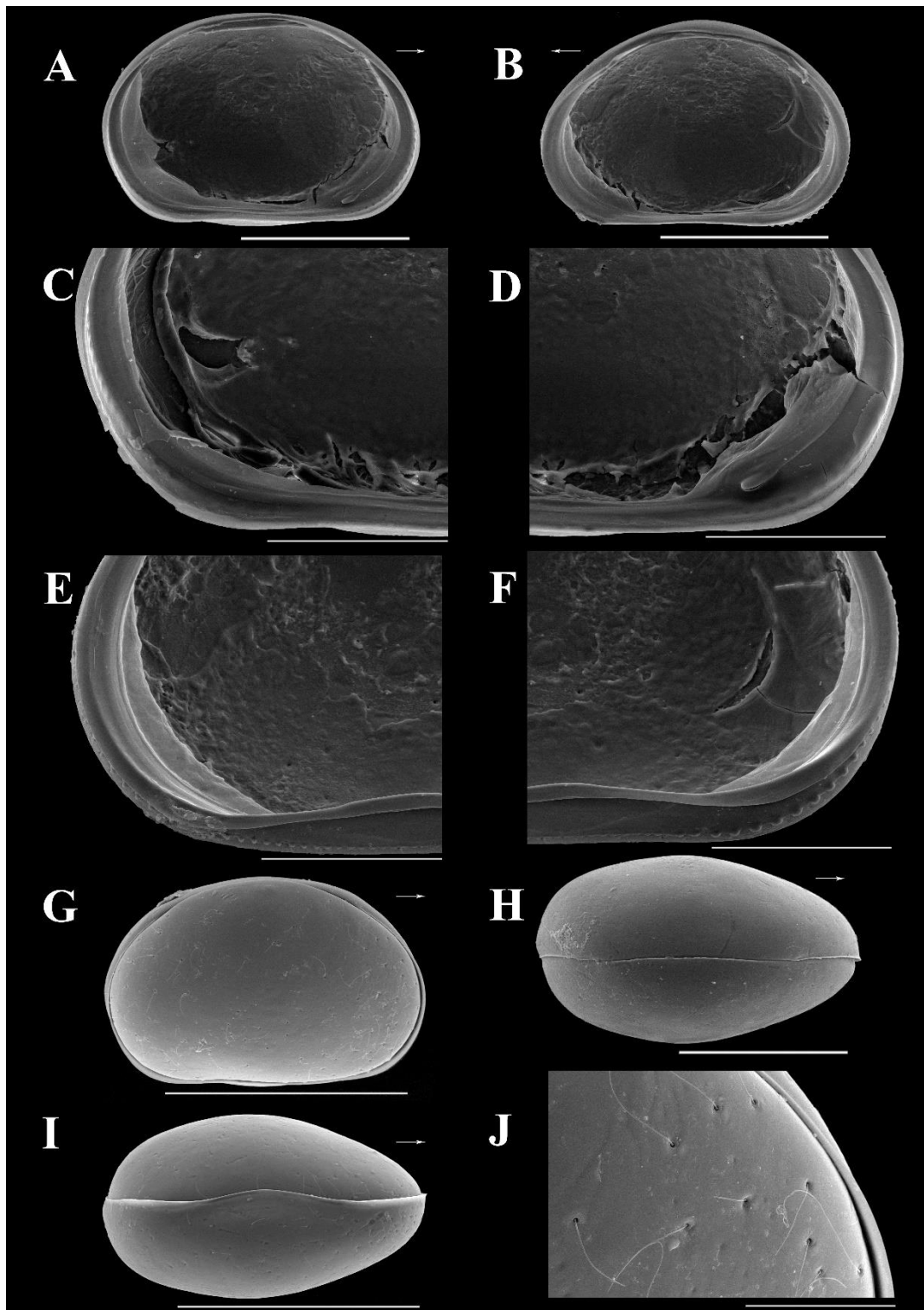
**FIGURE 18.** Gen. 1 spec. B gen. et spec. nov. ♀ from Alluvial valley of the upper Paraná River floodplain, Banhado Lake (PAR 255). **A.** LVi (NA152). **B.** RVi (NA152). **C.** LVi, detail of posterior part (NA152). **D.** LVi, detail of anterior part (NA152). **E.** RVi, detail of anterior part (NA152). **F.** RVi, detail of posterior part (NA152). **G.** CpRl (NA184). **H.** CpD (NA185). **I.** CpV (NA186). **J.** CpV, detail of anterior part showing the surface of Cp (NA186). Scale bars: A–B, G–I = 250 µm; C–F = 200 µm; J = 100 µm.



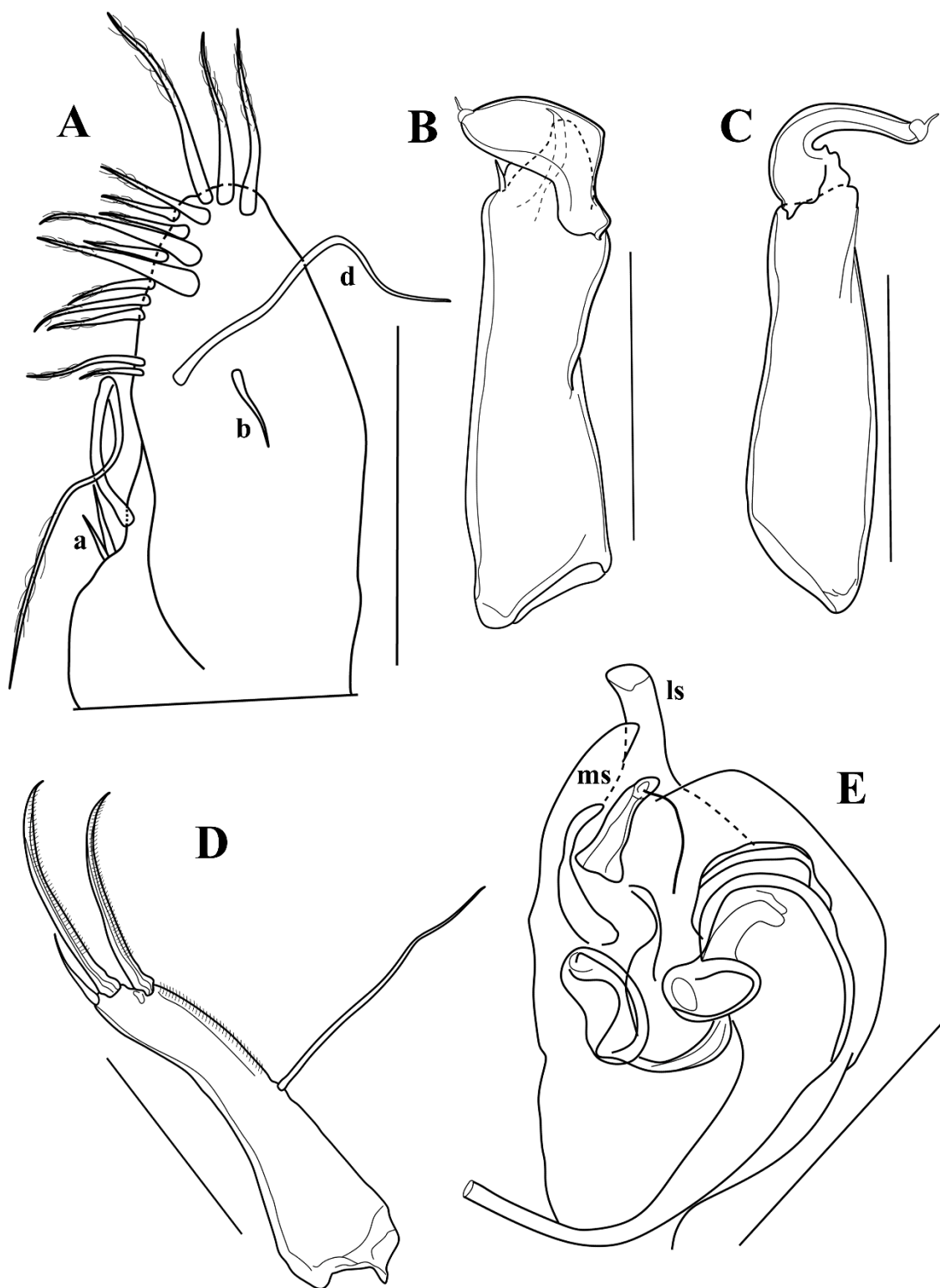


**FIGURE 19.** Gen. 1 spec. B gen. et spec. nov. ♀ from Alluvial valley of the upper Paraná River floodplain, Banhado Lake (PAR 255). **A.** T1 (NA152). **B.** CR (NA152). Scale bars: A–B = 50  $\mu$ m.

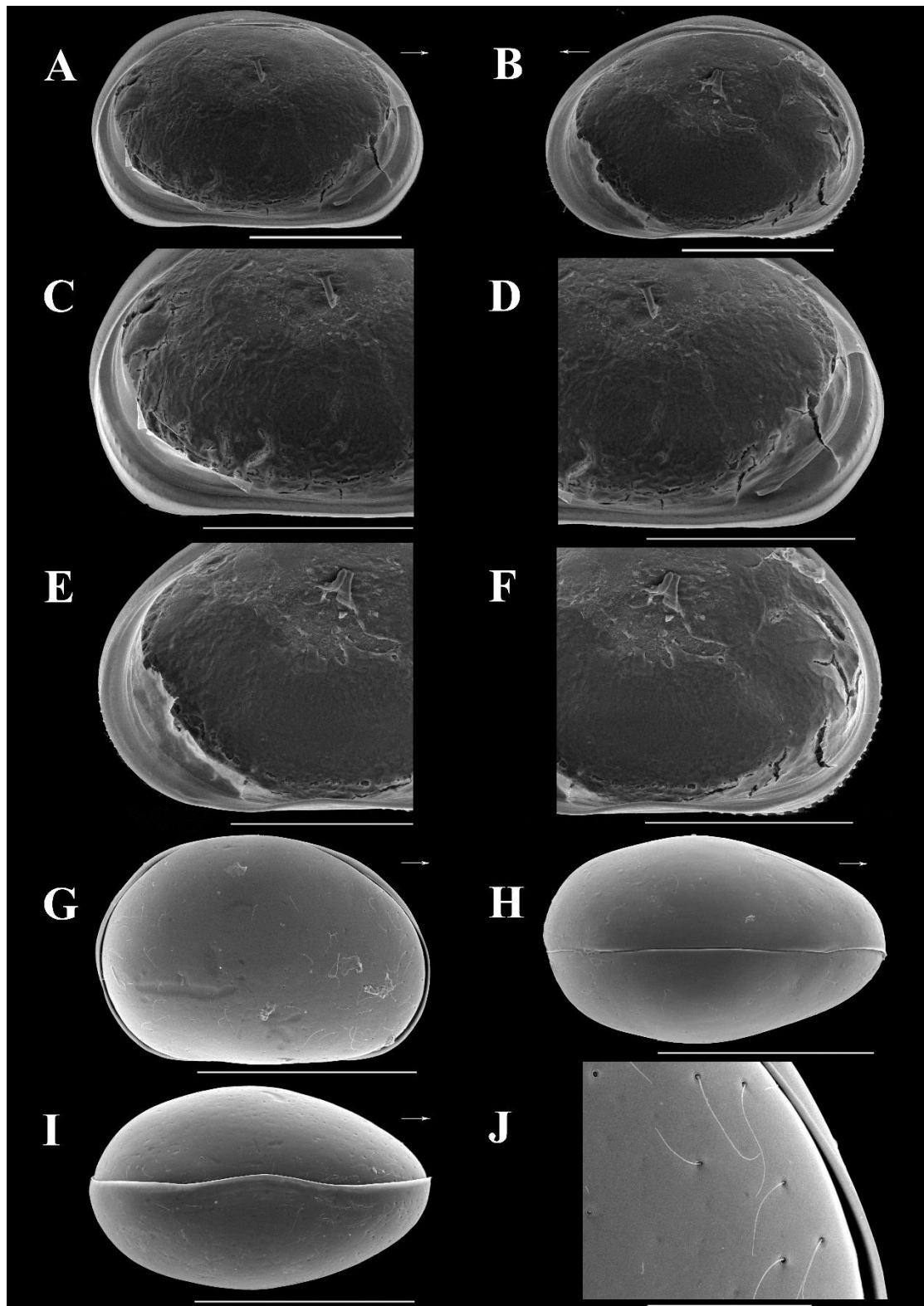




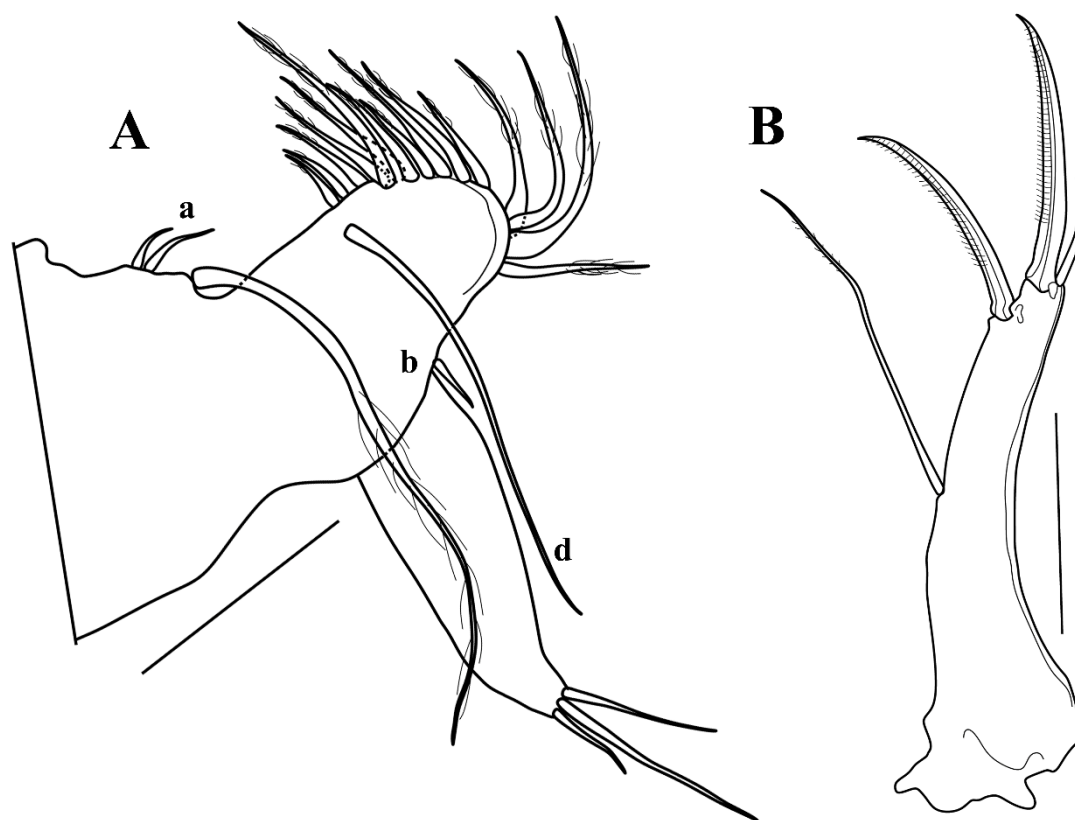
**FIGURE 20.** Gen. 1 spec. D gen. et spec. nov. ♂ from South Matogrossense Pantanal, Miranda II River, (PAN 66). **A.** LVi (NA095). **B.** RVi (NA095). **C.** LVi, detail of posterior part (NA095). **D.** LVi, detail of anterior part (NA095). **E.** RVi, detail of anterior part (NA095). **F.** RVi, detail of posterior part (NA095). **G.** CpRl (JH1085). **H.** CpD (JH1087). **I.** CpV (JH1087). **J.** CpRl, detail of anterior part showing the surface of Cp (JH1085). Scale bars: A–B, H = 250 µm; C–F = 100 µm; G, I = 300 µm; J = 50 µm.



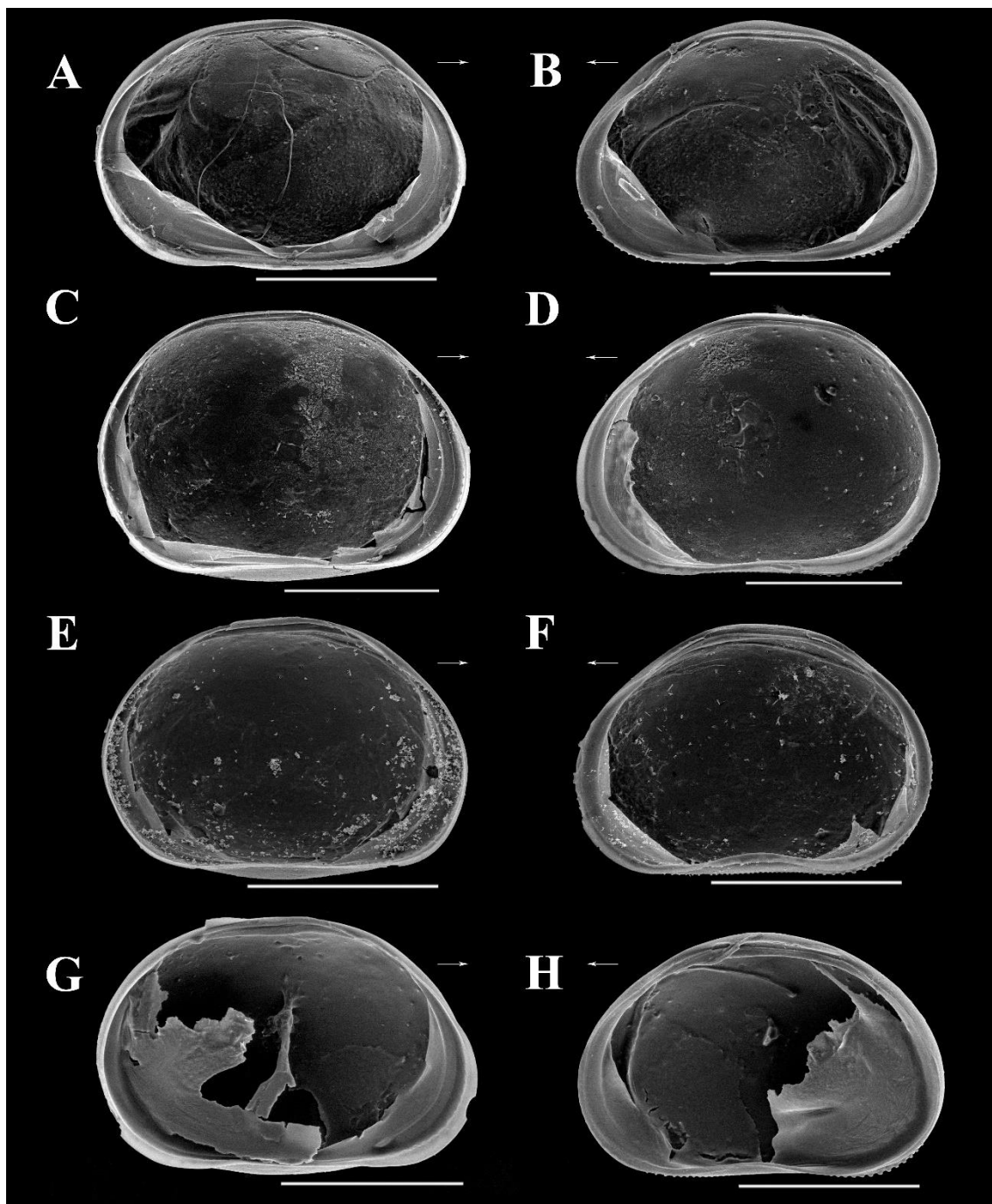
**FIGURE 21.** Gen. 1 spec. D gen. et spec. nov. ♂ from South Matogrossense Pantanal, Miranda II River, (PAN 66). **A.** T1 (NA141). **B.** Rpp (NA095). **C.** Lpp (NA095). **D.** CR (NA141). **E.** Hemipenis (NA095). Scale bars: A–E = 50  $\mu$ m.



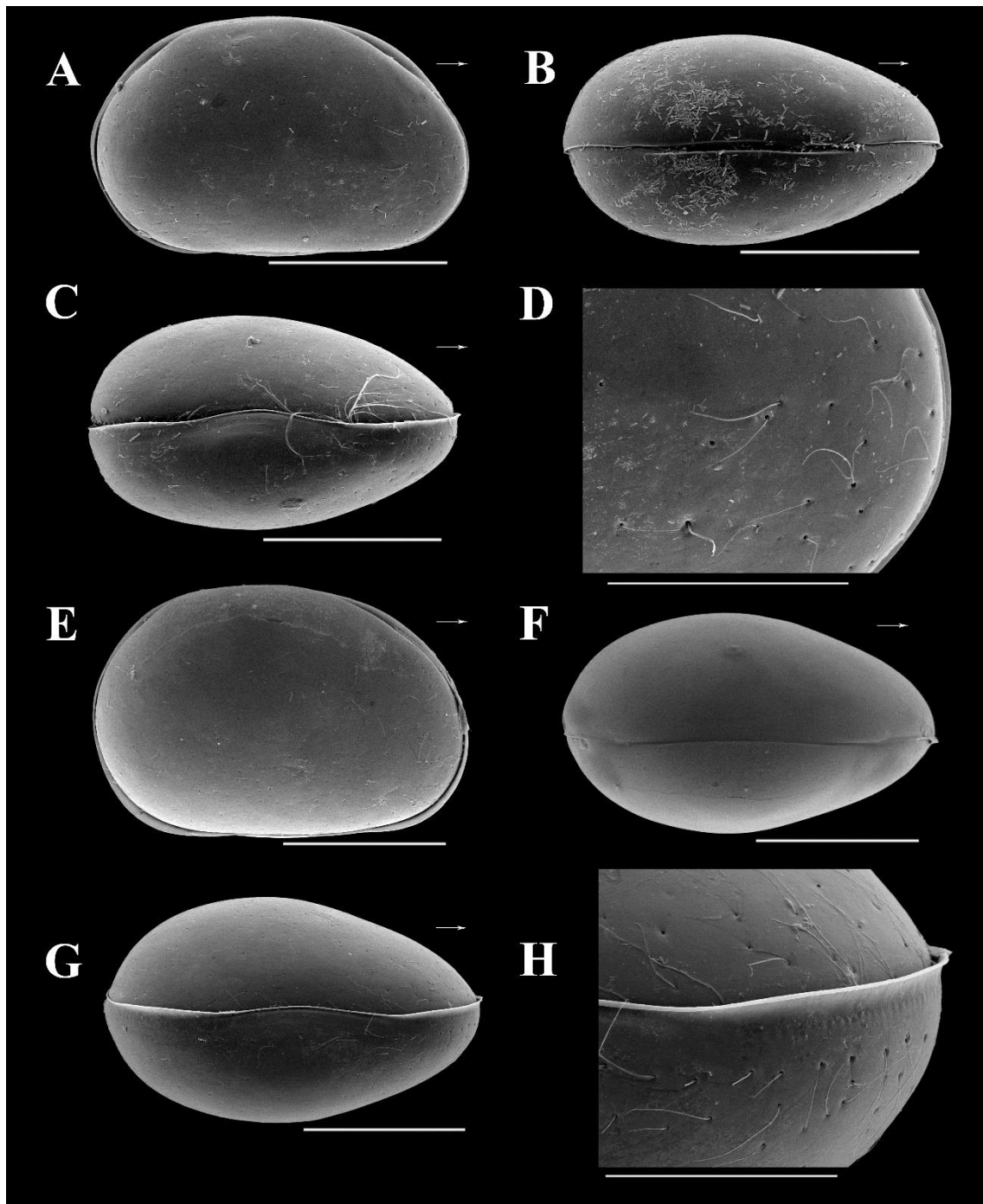
**FIGURE 22.** Gen. 1 spec. D gen. et spec. nov. ♀ from South Matogrossense Pantanal, Miranda II River, (PAN 66). **A.** LVi (NA142). **B.** RVi (NA142). **C.** LVi, detail of posterior part (NA142). **D.** LVi, detail of anterior part (NA142). **E.** RVi, detail of anterior part (NA142). **F.** RVi, detail of posterior part (NA142). **G.** CpRl (JH1081). **H.** CpD (JH1082). **I.** CpV (JH1083). **J.** CpRl, detail of anterior part showing the surface of Cp (JH1081). Scale bars: A–B = 250 µm; C–F = 200 µm; G–I = 300 µm; J = 50 µm.



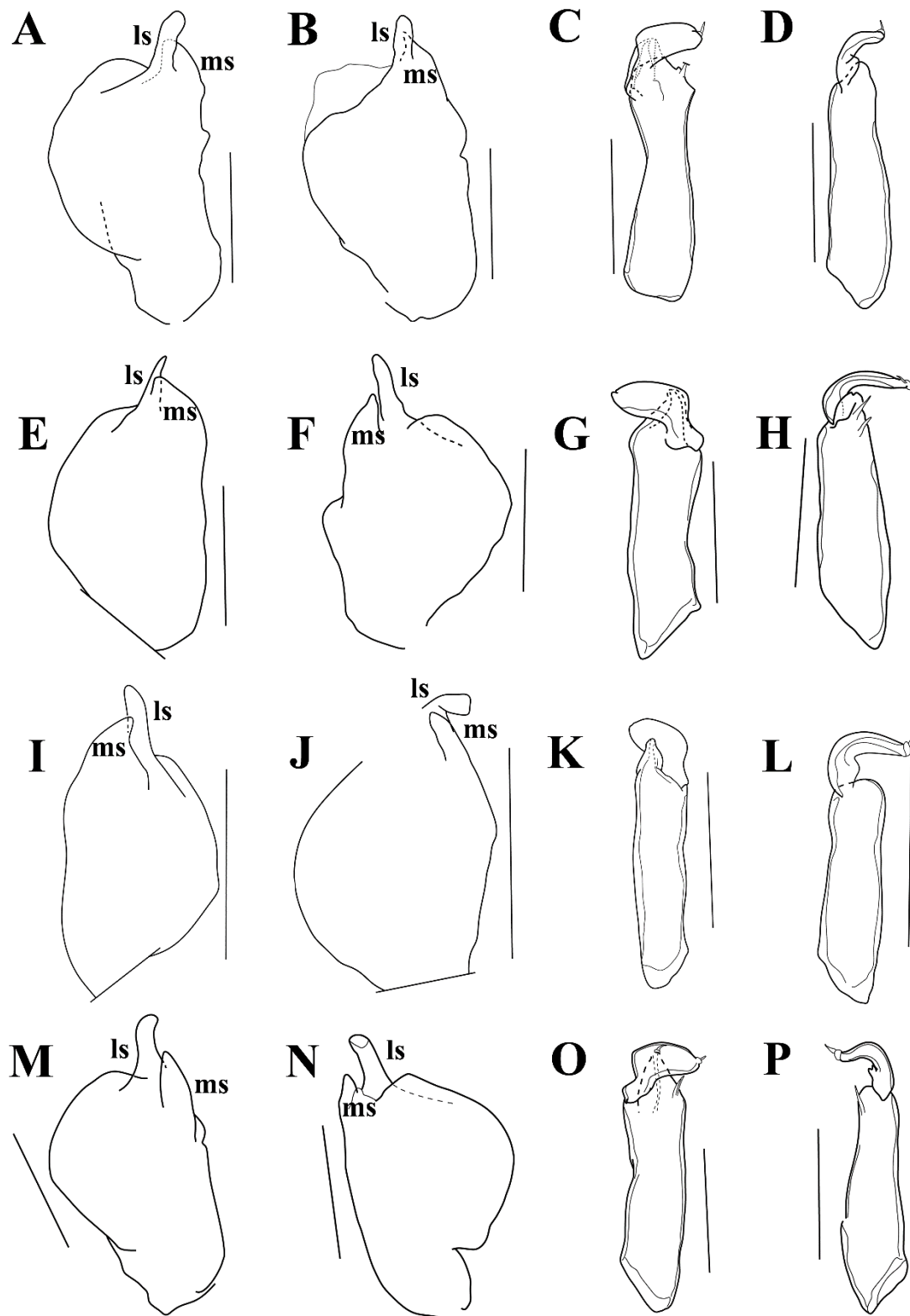
**FIGURE 23.** Gen. 1 spec. D gen. et spec. nov. ♀ from South Matogrossense Pantanal, Miranda II River, (PAN 66). **A.** T1 (NA142). **B.** CR (NA142). Scale bars: A–B = 50  $\mu$ m.



**FIGURE 24.** Gen. 1 spec. D gen. et spec. nov. from South Matogrossense Pantanal. **A–B, E–H.** ♂. **C–D.** ♀. **A–D.** Camp Road, pool 4 (PAN 31): **A.** LVi (NA091). **B.** RVi (NA091). **C.** LVi (NA140). **D.** RVi (NA140). **E–F.** Curva Doleque Road, lake 4 (PAN 08): **E.** LVi (NA076). **F.** RVi (NA076). **G–H.** Corumbá Road, lake 4 (PAN 18): **G.** LVi (NA196). **H.** RVi (NA196). Scale bars: A–H = 250  $\mu$ m.

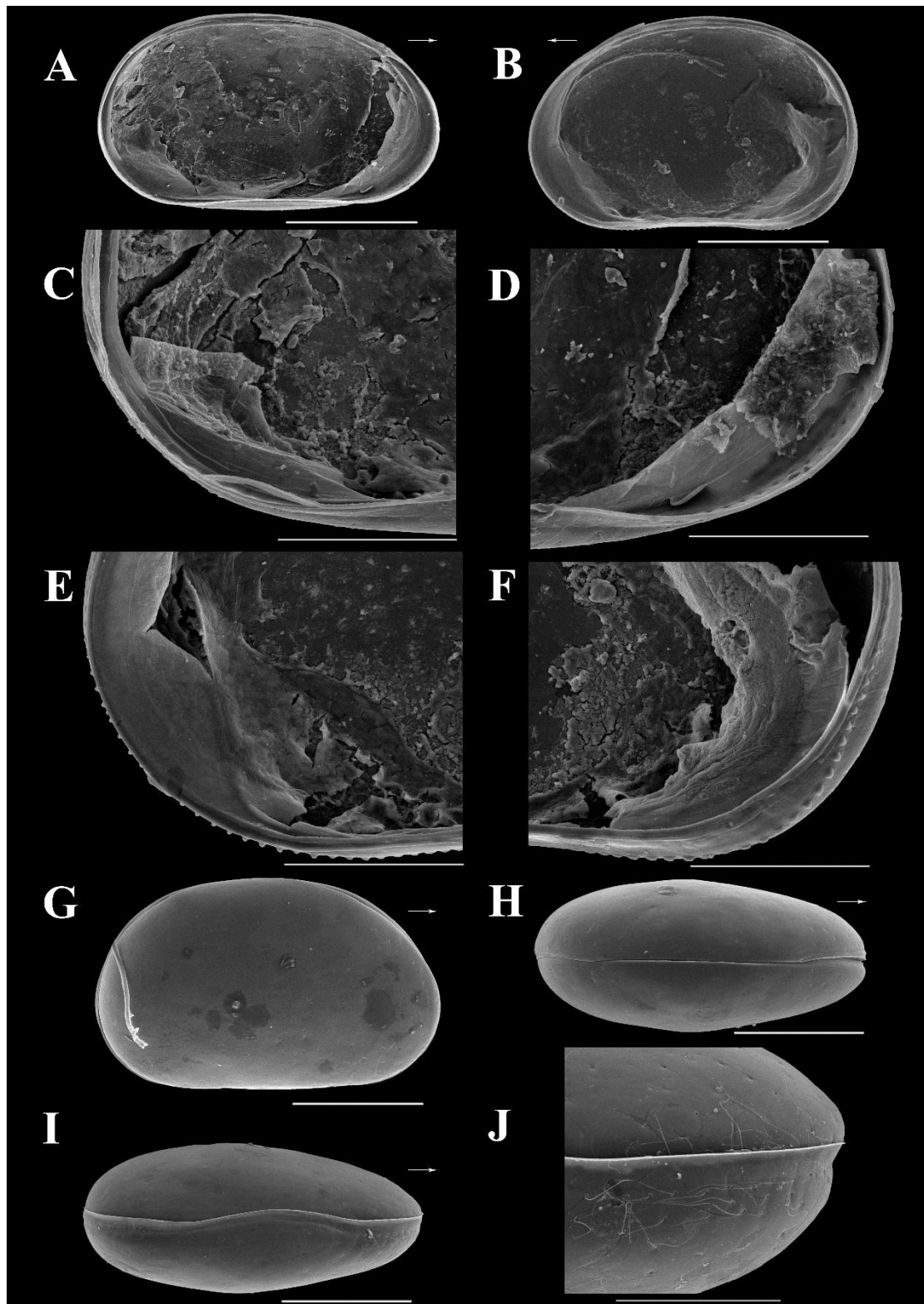


**FIGURE 25.** Gen. 1 spec. D gen. et spec. nov. from South Matogrossense Pantanal, Camp Road, pool 4 (PAN 31). **A–D.** ♂. **E–H.** ♀. **A.** CpRl (NA240). **B.** CpD (NA241). **C.** CpV (NA242). **D.** CpRl, detail of anterior part showing the surface of Cp (NA240). **E.** CpRl (NA243). **F.** CpD (NA243). **G.** CpV (NA243). **H.** CpV, detail of anterior part showing the surface of Cp (NA243). Scale bars: A–C, E–F = 250  $\mu$ m; D, H = 100  $\mu$ m.



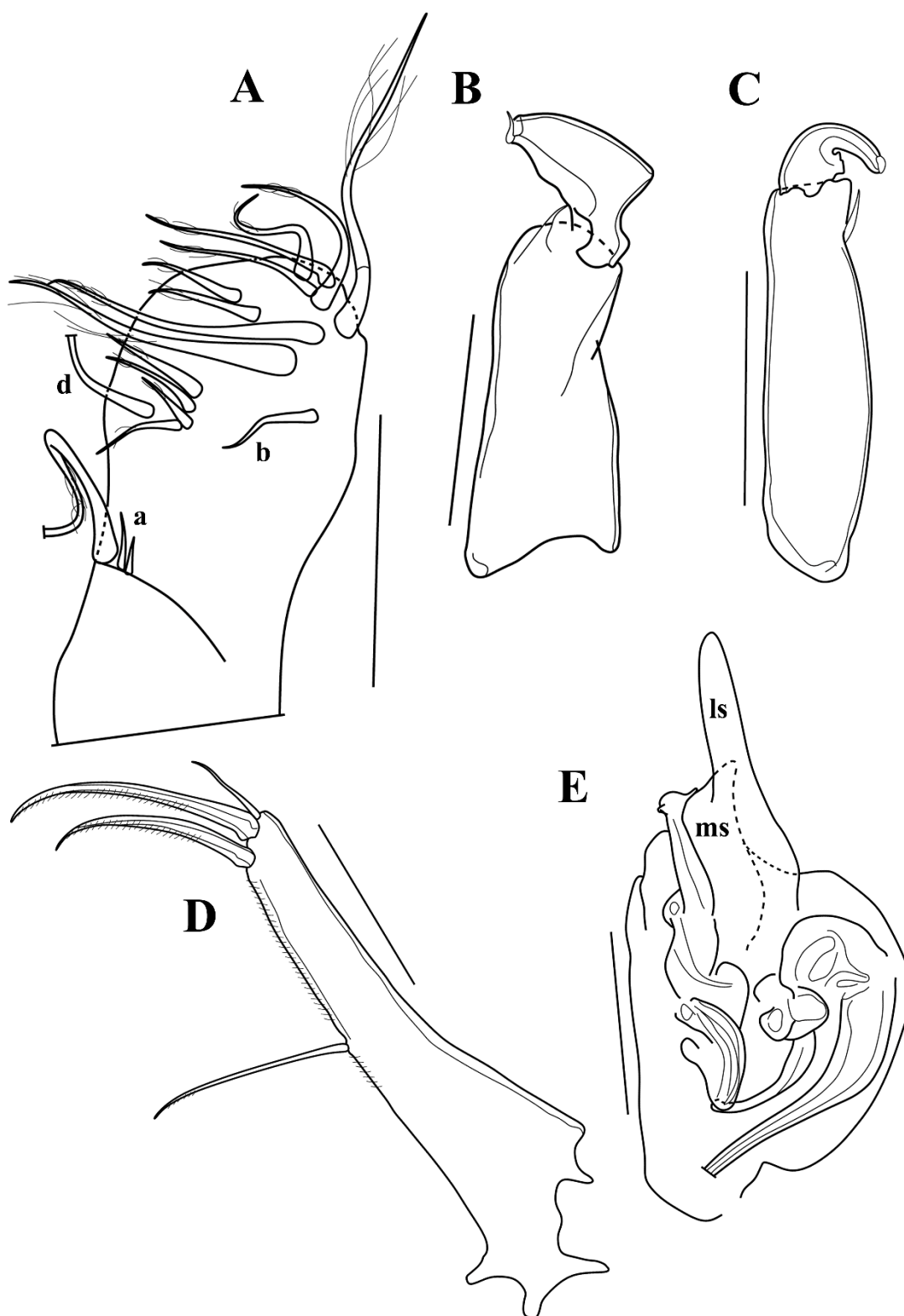
**FIGURE 26.** Gen. 1 spec. D gen. et spec. nov. ♂ from South Matogrossense Pantanal. **A–D.** Camp Road, pool 4 (PAN 31) (NA091). **E–H.** Corumbá Road, pool 2 (PAN 14) (NA101). **I–L.** Curva Doleque Road, lake 4 (PAN 08) (NA076). **M–P.** Corumbá Road, lake 4 (PAN 18) (NA196). **A–B; E–F; I–J; M–N.** Hemipenis. **C, G, K, O.** Rpp. **D, H, L, P.** Lpp. Scale bars: A–P = 50 µm.



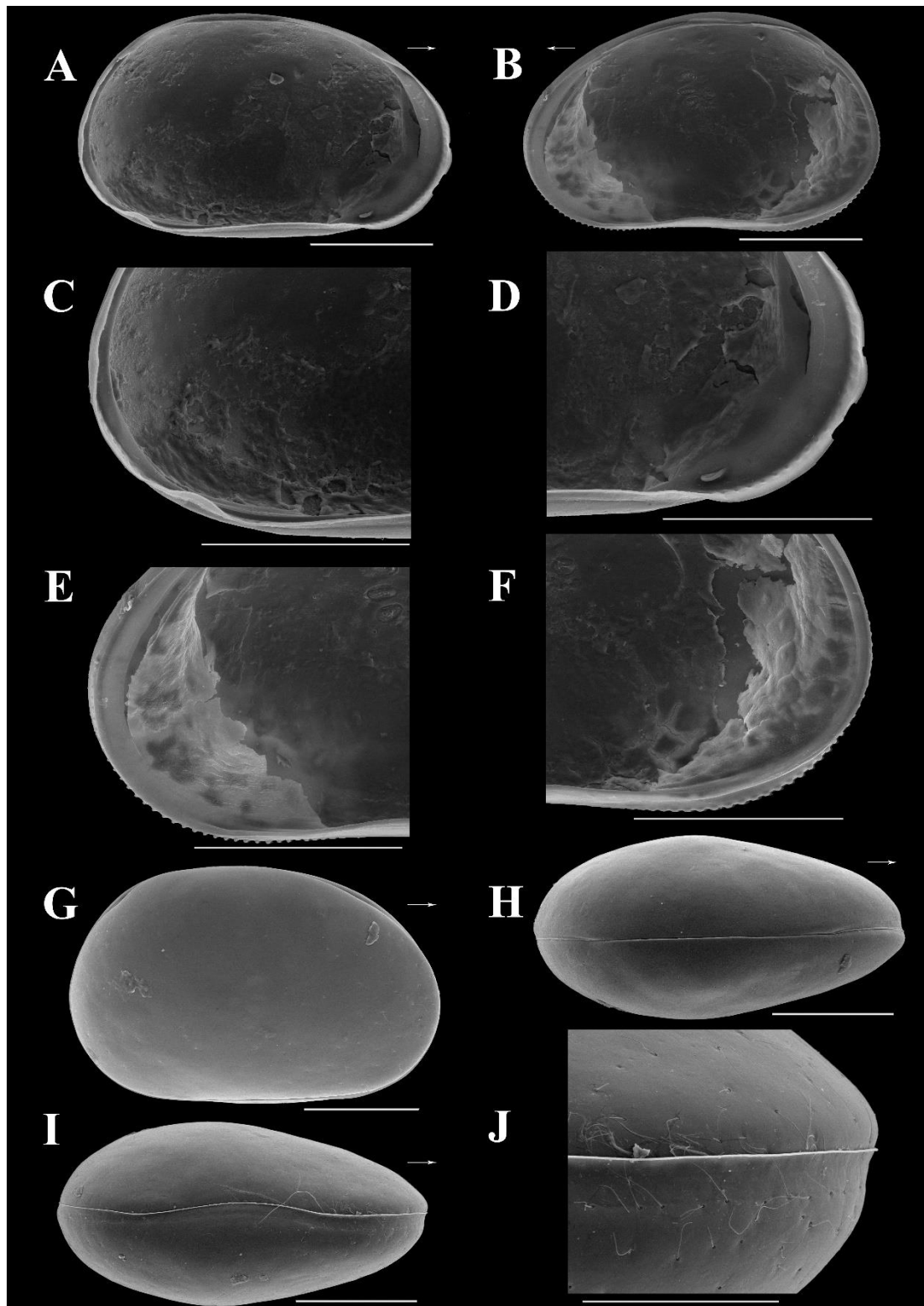


**FIGURE 27.** Gen. 1 spec. F gen. et spec. nov. ♂ from Amazon River floodplain, Manacapuru Lake (AMA 38). **A.** LVi (NA104). **B.** RVi (NA104). **C.** LVi, detail of posterior part (NA104). **D.** LVi, detail of anterior part (NA104). **E.** RVi, detail of anterior part (NA104). **F.** RVi, detail of posterior part (NA104). **G.** CpRl (NA159). **H.** CpD (NA160). **I.** CpV (NA161). **J.** CpV, detail of anterior part showing the surface of Cp (NA161). Scale bars: A–B, G–I = 250  $\mu$ m; E = 300  $\mu$ m; C–F, J = 100  $\mu$ m.

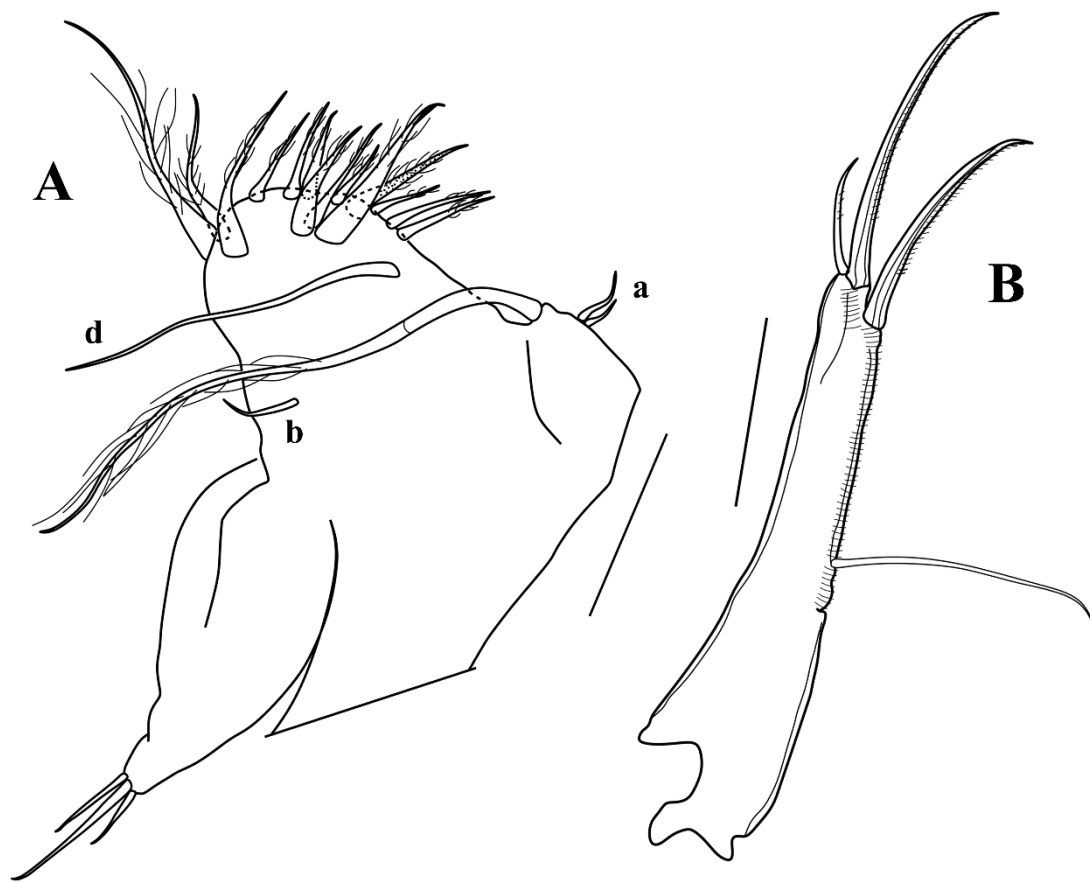




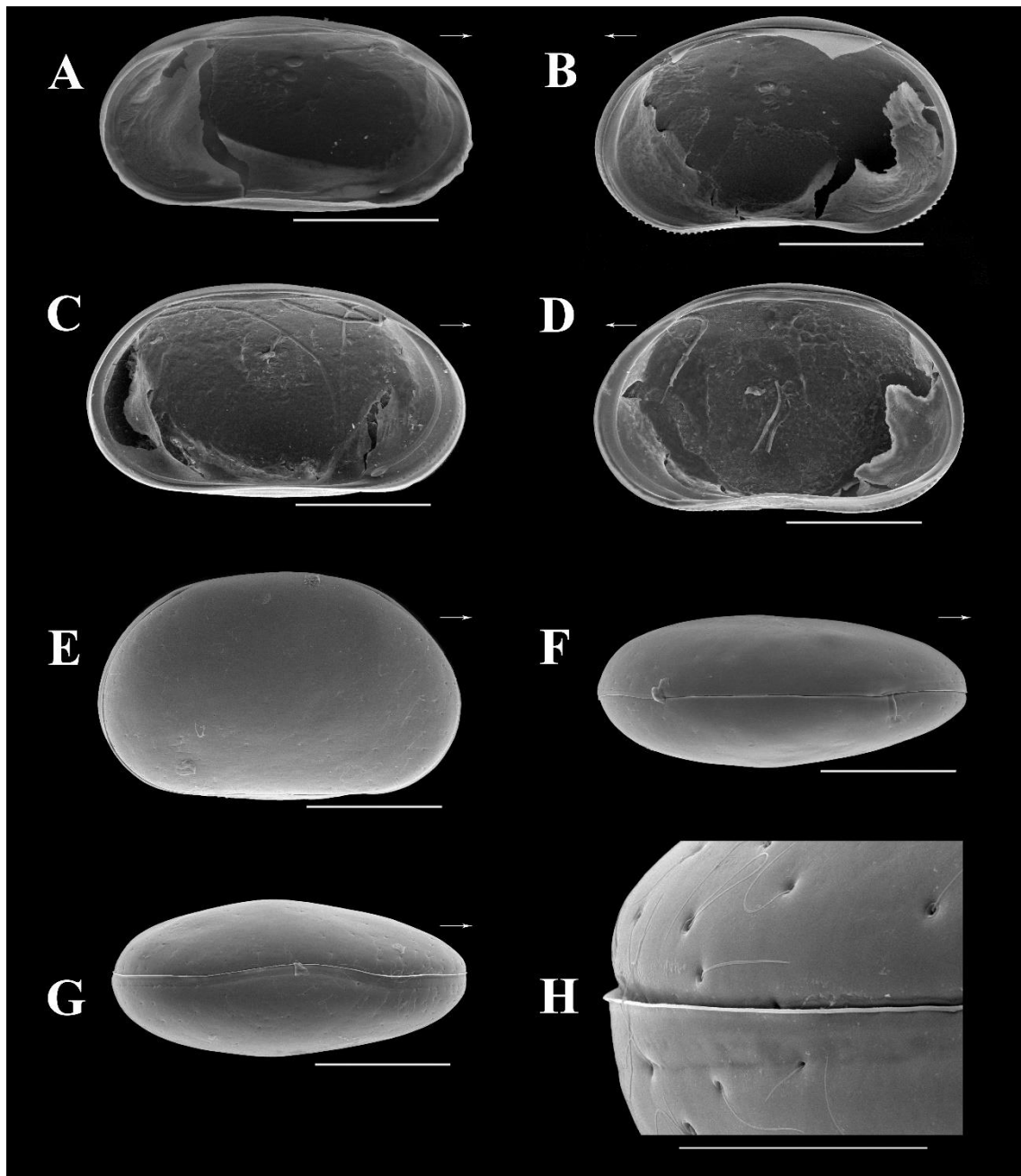
**FIGURE 28.** Gen. 1 spec. F gen. et spec. nov. ♂ from Amazon River floodplain, Manacapuru Lake (AMA 38). **A.** T1 (NA104). **B.** Rpp (NA104). **C.** Lpp (NA104). **D.** CR (NA104). **E.** Hemipenis (NA104). Scale bars: A–E = 50  $\mu$ m.



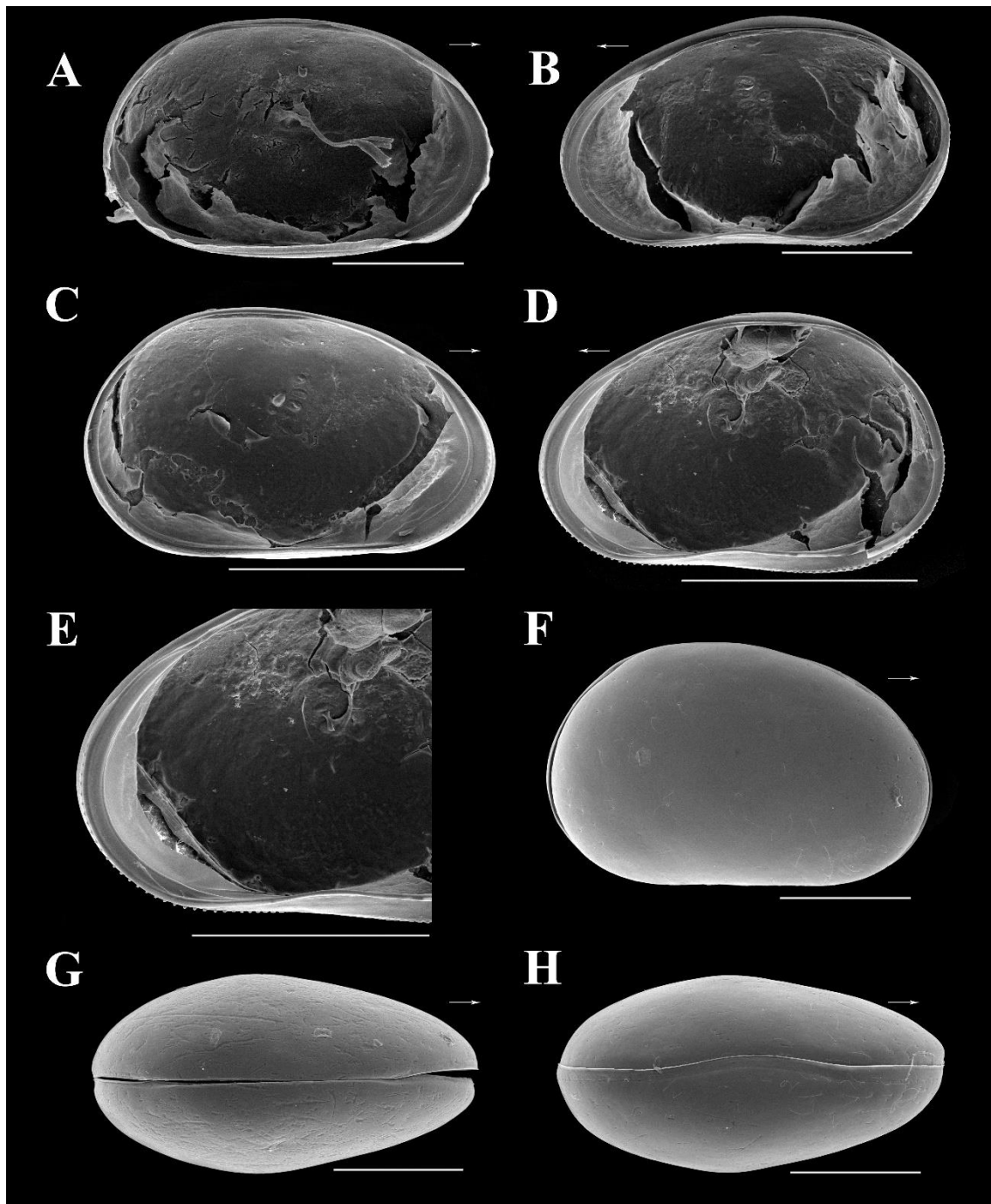
**FIGURE 29.** Gen. 1 spec. F gen. et spec. nov. ♀ from Amazon River floodplain, Manacapuru Lake (AMA 38). **A.** LVi (NA187). **B.** RVi (NA187). **C.** LVi, detail of posterior part (NA187). **D.** LVi, detail of anterior part (NA187). **E.** RVi, detail of anterior part (NA187). **F.** RVi, detail of posterior part (NA187). **G.** CpRl (NA162). **H.** CpD (NA162). **I.** CpV (NA162). **J.** CpV, detail of anterior part showing the surface of Cp (NA162). Scale bars: A–B, G–I = 250 µm; C–F = 200 µm; J = 100 µm.



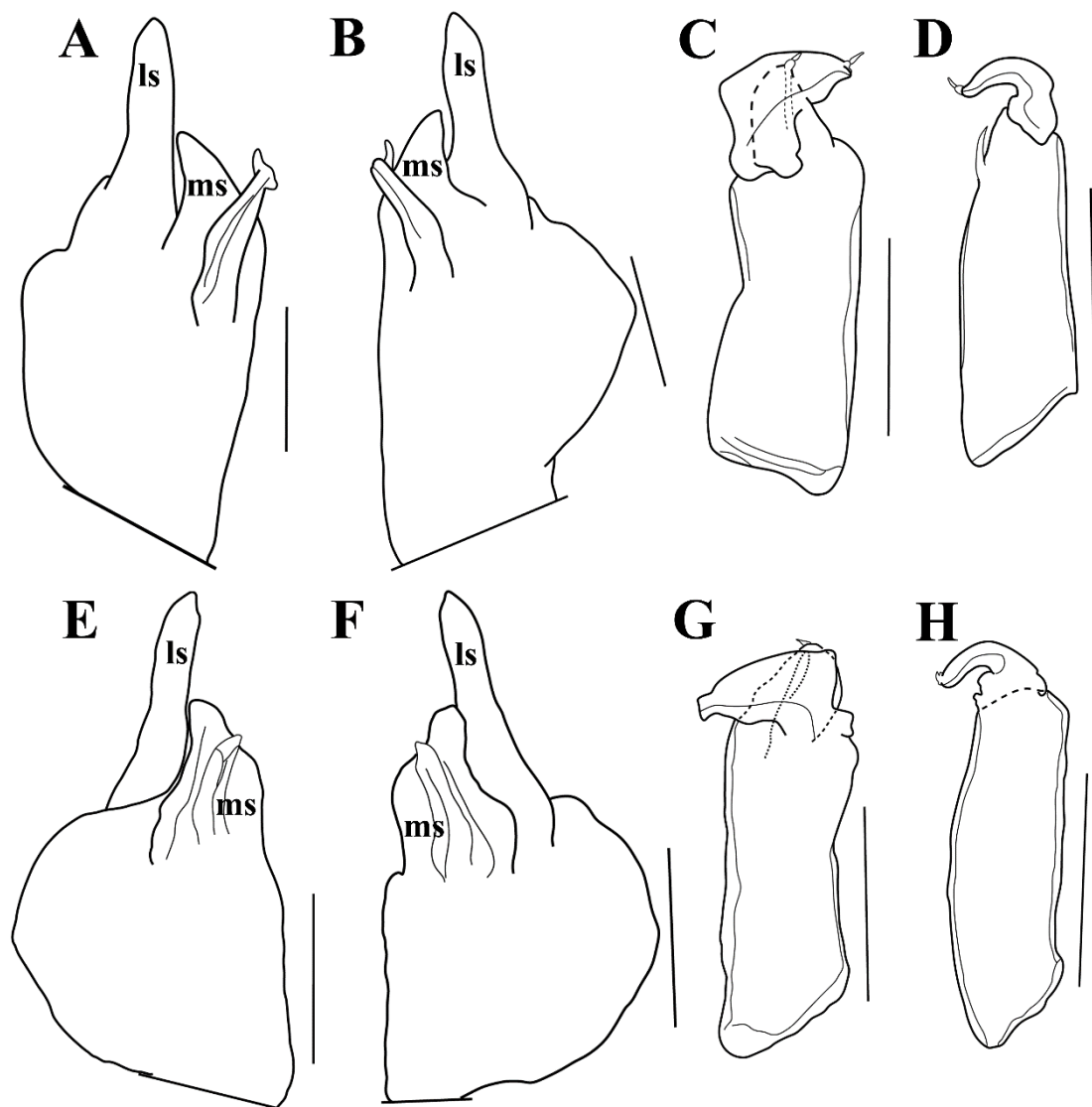
**FIGURE 30.** Gen. 1 spec. F gen. et spec. nov. ♀ from Amazon River floodplain, Manacapuru Lake (AMA 38). **A.** T1 (NA148). **B.** CR (NA187). Scale bars: A–B = 50  $\mu\text{m}$ .



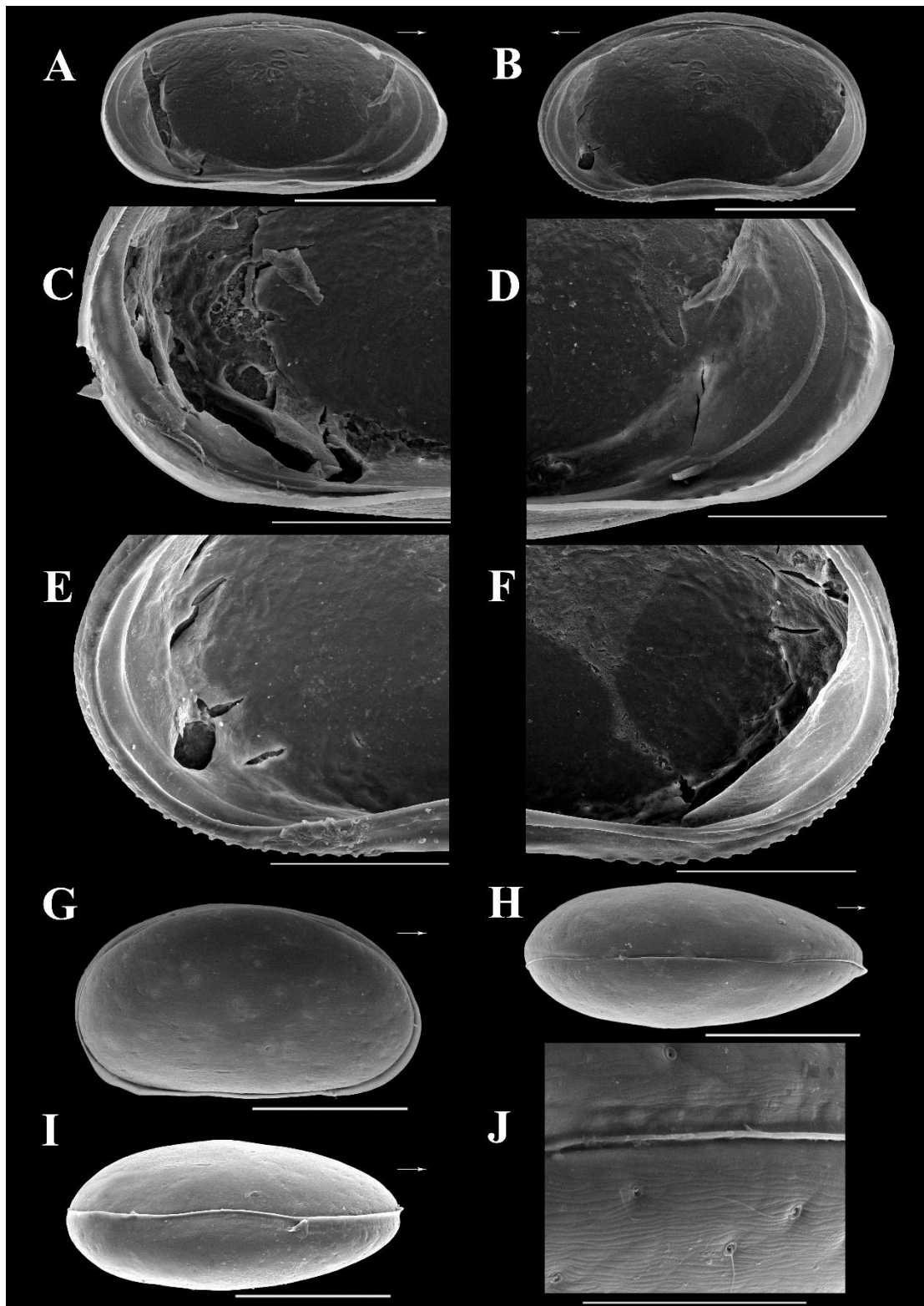
**FIGURE 31.** Gen. 1 spec. F gen. et spec. nov. ♂ from Amazon River floodplain. **A–B** = Castanho Lake (AMA 80); **C–H** = Cadete Lake (AMA23). **A.** LVi (NA105). **B.** RVi (NA105). **C.** LVi (JH889). **D.** RVi (JH889). **E.** CpRl (JH890). **F.** CpD (JH891). **G.** CpV (JH892). **H.** CpD, detail of posterior part showing the surface of Cp (JH891). Scale bars: A–G = 250  $\mu$ m; H = 50  $\mu$ m.



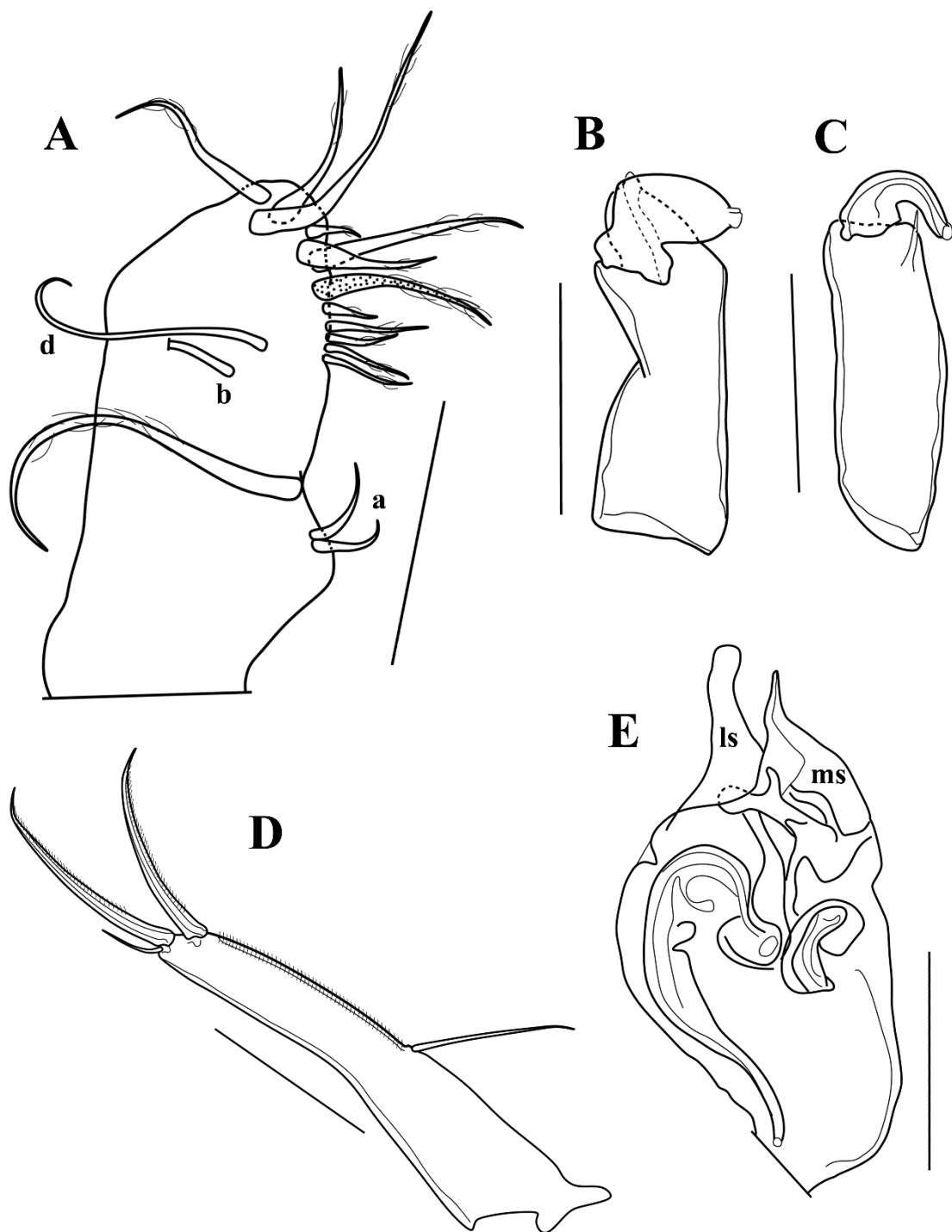
**FIGURE 32.** Gen. 1 spec. F gen. et spec. nov. ♀ from Amazon River floodplain. **A–B** = Castanho Lake (AMA 80); **C–H** = Cadete Lake (AMA23). **A.** LVi (NA191). **B.** RVi (NA191). **C.** LVi (JH893). **D.** RVi (JH893). **E.** RVi, detail of anterior part (JH893). **F.** CpRl (JH894). **G.** CpD (JH895). **H.** CpV (JH896). Scale bars: A–B, D, F–H = 250 µm; C = 400 µm; E = 50 µm.



**FIGURE 33.** Gen. 1 spec. F gen. et spec. nov. ♂ from Amazon River floodplain. **A–D** = Castanho Lake (AMA 80) (NA105); **E–H** = Cadete Lake (AMA23) (JH889). **A–B**; **E–F**. Hemipenis. **C**, **G**. Rpp. **D**, **H**. Lpp. Scale bars: A–H = 50  $\mu$ m.

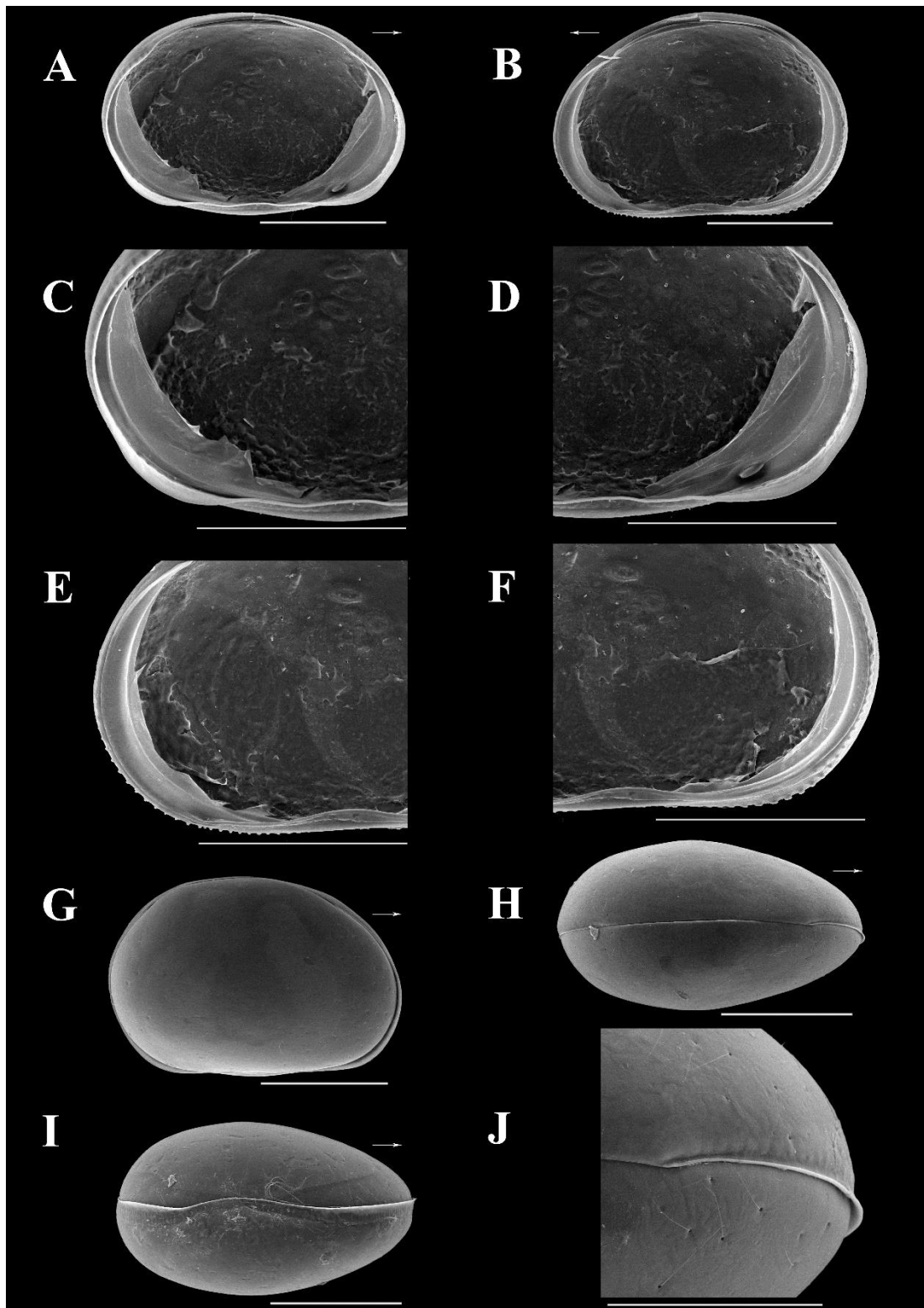


**FIGURE 34.** Gen. 1 spec. G gen. et spec. nov. ♂ from Amazon River floodplain, Castanho Lake (AMA 80). **A.** LVi (NA106). **B.** RVi (NA106). **C.** LVi, detail of posterior part (NA106). **D.** LVi, detail of anterior part (NA106). **E.** RVi, detail of anterior part (NA106). **F.** RVi, detail of posterior part (NA106). **G.** CpRl (NA165). **H.** CpD (NA165). **I.** CpV (NA165). **J.** CpD, detail of anterior part showing the surface of Cp (NA165). Scale bars: A–B, G–I = 250  $\mu$ m; C–F = 100  $\mu$ m; J = 50  $\mu$ m.

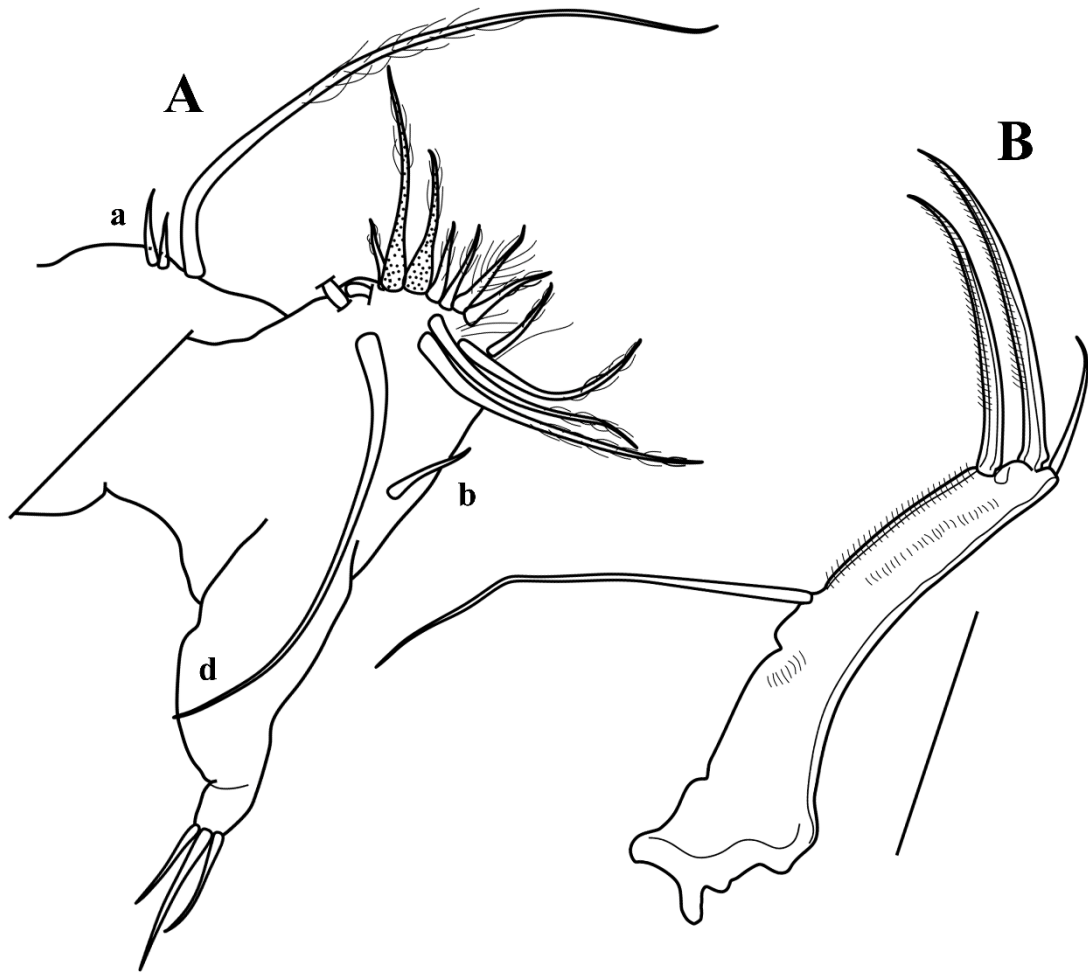


**FIGURE 35.** Gen. 1 spec. G gen. et spec. nov. ♂ from Amazon River floodplain, Castanho Lake (AMA 80). **A.** T1 (NA106). **B.** Rpp (NA106). **C.** Lpp (NA106). **D.** CR (NA106). **E.** Hemipenis (NA106). Scale bars: A–E = 50  $\mu$ m.

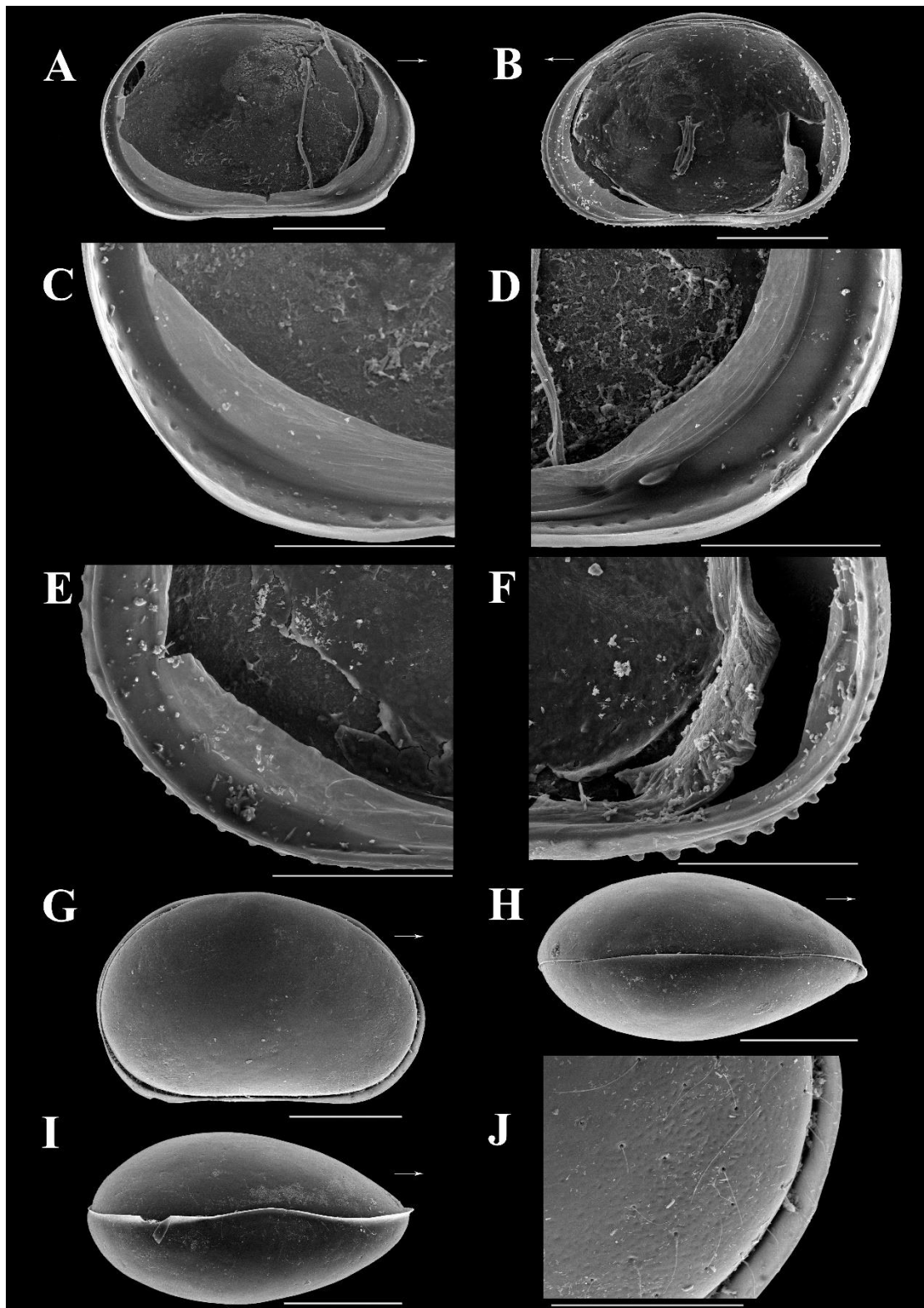




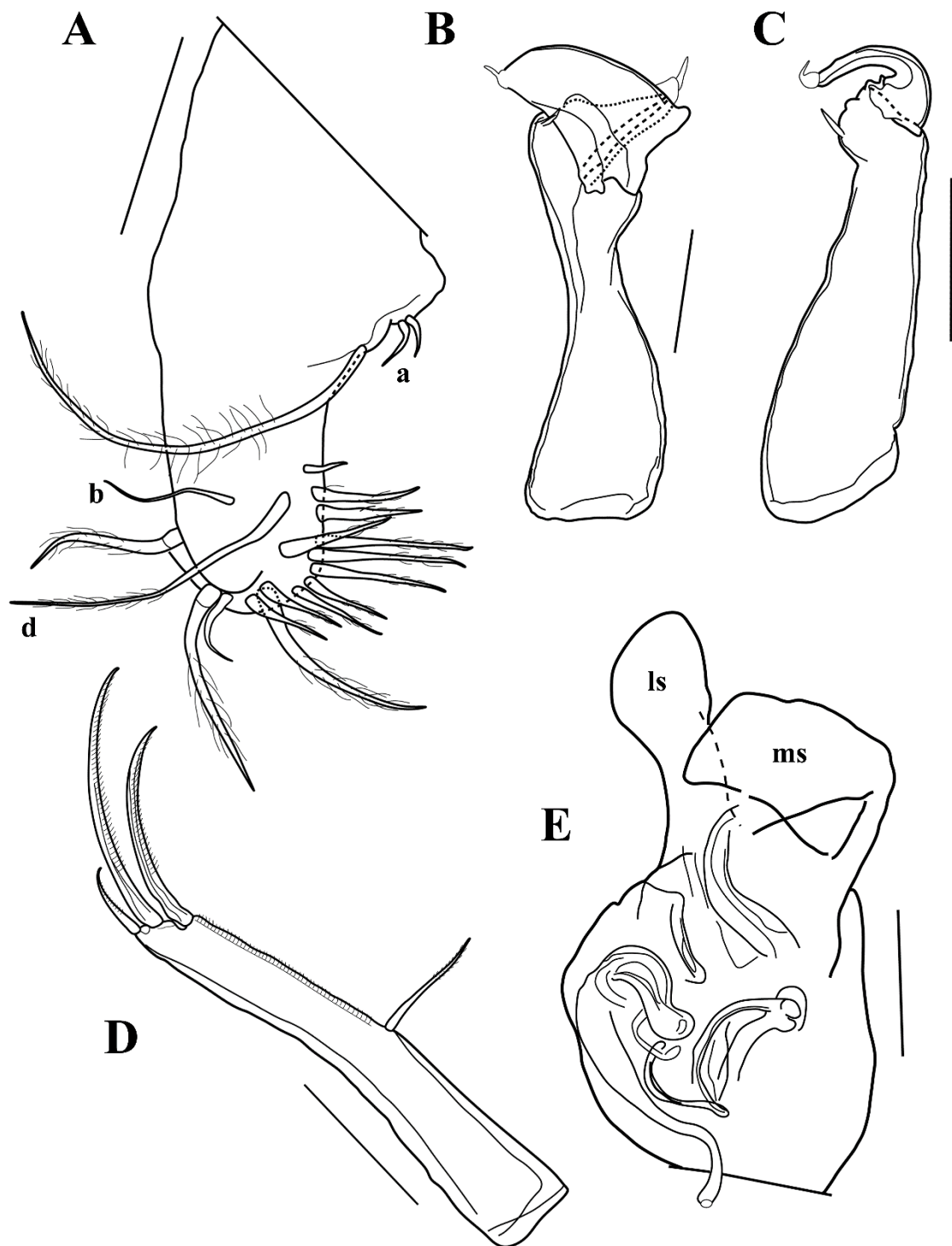
**FIGURE 36.** Gen. 1 spec. G gen. et spec. nov. ♀ Amazon River floodplain, Castanho Lake (AMA 80). **A.** LVi (NA138). **B.** RVi (NA138). **C.** LVi, detail of posterior part (NA138). **D.** LVi, detail of anterior part (NA138). **E.** RVi, detail of anterior part (NA138). **F.** RVi, detail of posterior part (NA138). **G.** CpRl (NA166). **H.** CpD (NA167). **I.** CpV (NA168). **J.** CpD, detail of anterior part showing the surface of Cp (NA167). Scale bars: A–B, G–I = 250 µm; C–F = 200 µm; J = 100 µm.



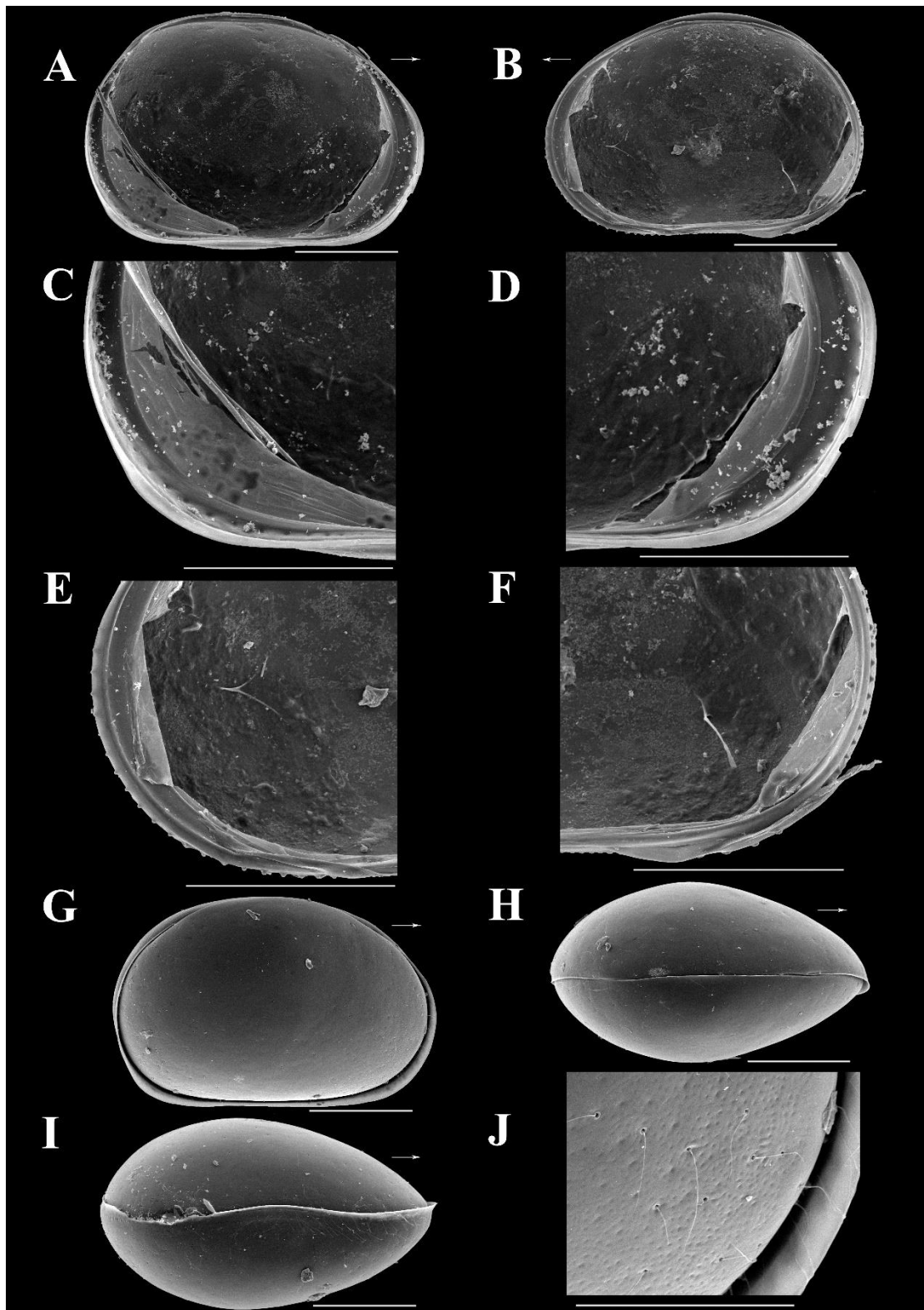
**FIGURE 37.** Gen. 1 spec. G gen. et spec. nov. ♀ Amazon River floodplain, Castanho Lake (AMA 80). **A.** T1 (NA138). **B.** CR (NA138). Scale bars: A–B = 50  $\mu$ m.



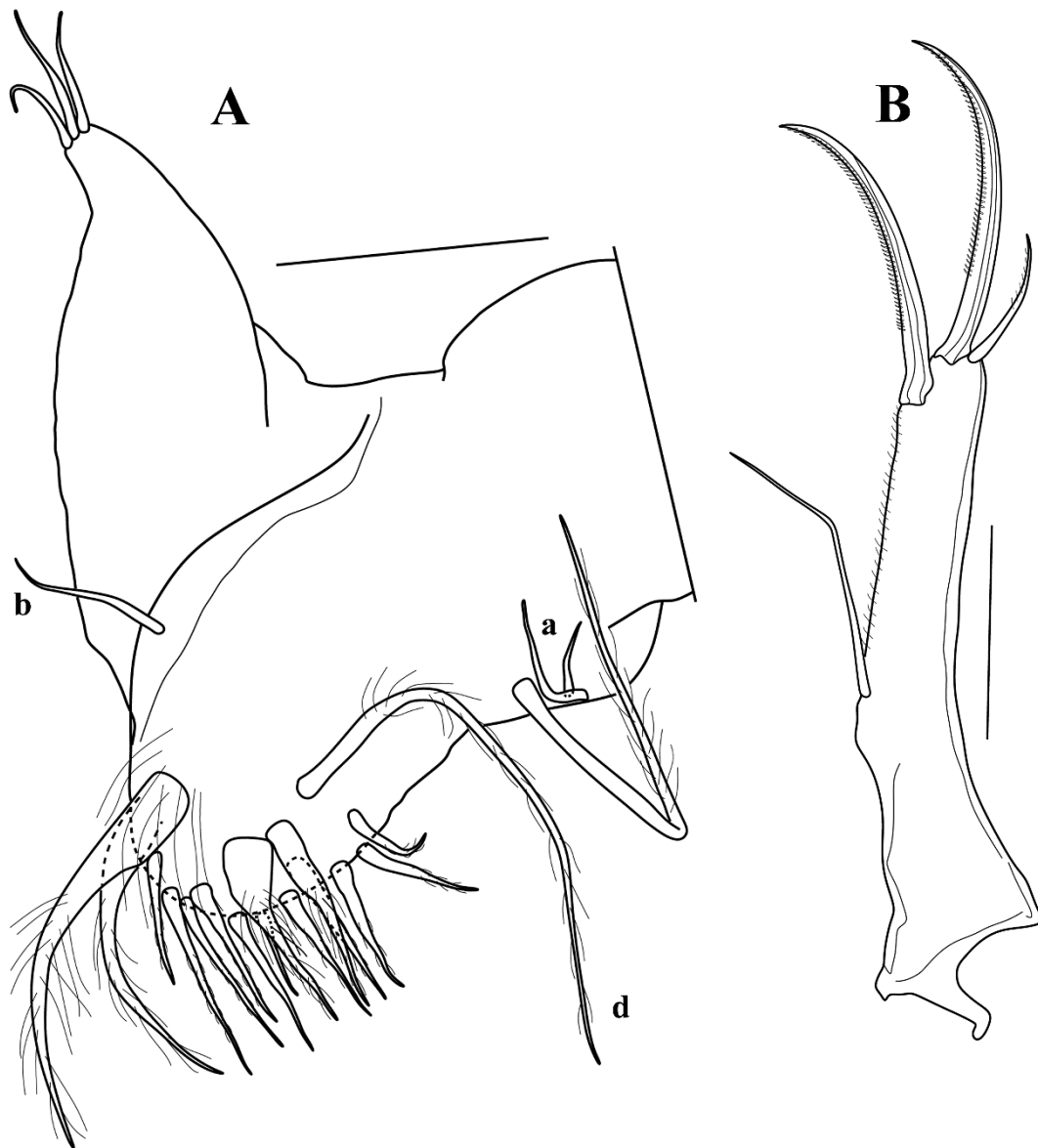
**FIGURE 38.** Gen. 2 spec. C gen. et spec. nov. ♂ from South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A.** LVi (NA126). **B.** RVi (NA126). **C.** LVi, detail of posterior part (NA126). **D.** LVi, detail of anterior part (NA126). **E.** RVi, detail of anterior part (NA126). **F.** RVi, detail of posterior part (NA126). **G.** CpRl (NA175). **H.** CpD (NA176). **I.** CpV (NA177). **J.** CpRl, detail of anterior part showing the surface of Cp (NA175). Scale bars: A–B, G–I = 250 µm; C–F, J = 100 µm.



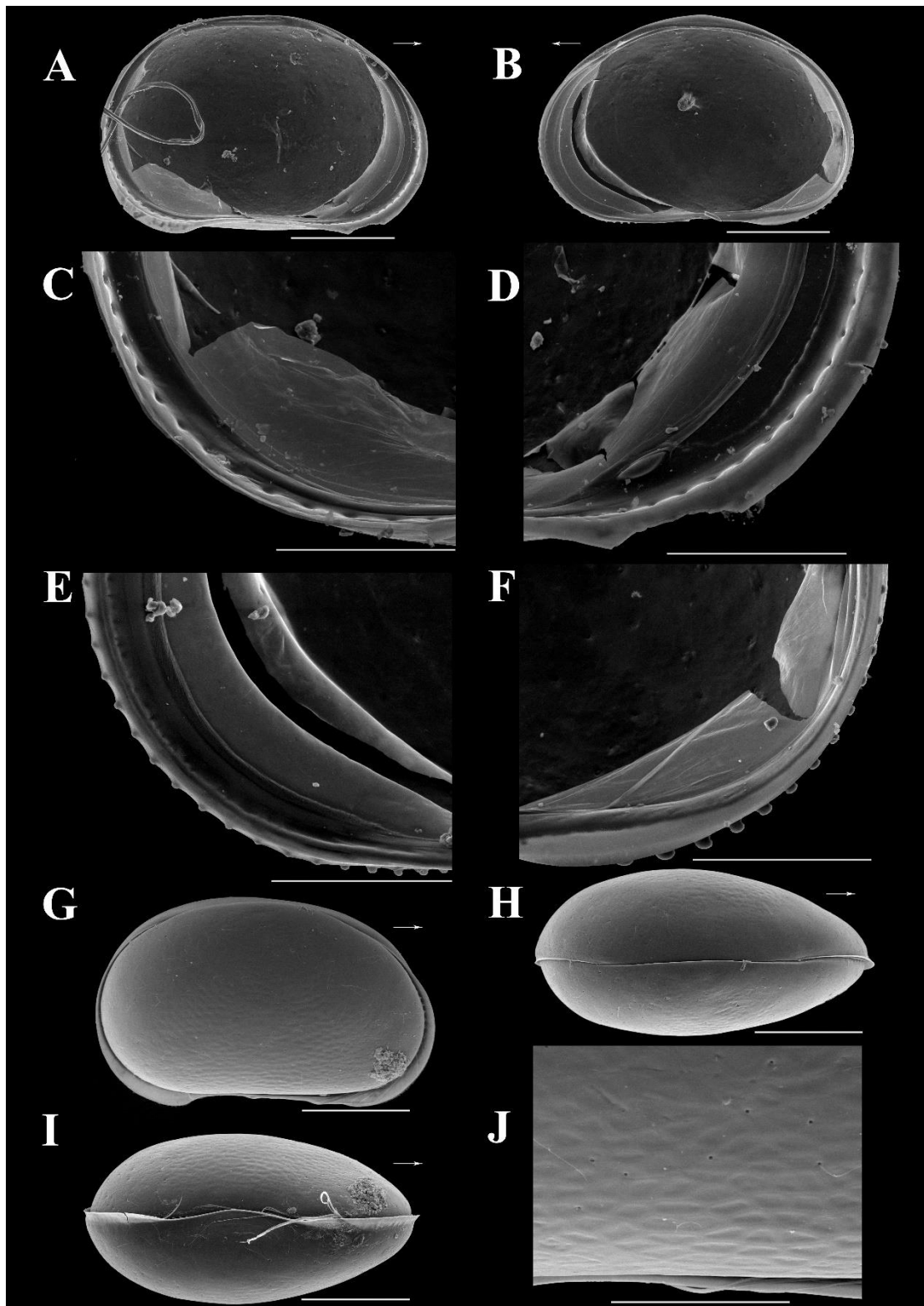
**FIGURE 39.** Gen. 2 spec. C gen. et spec. nov. ♂ from South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A.** T1 (NA126). **B.** Rpp (NA126). **C.** Lpp (NA126). **D.** CR (NA126). **E.** Hemipenis (NA126). Scale bars: A–E = 50  $\mu$ m.



**FIGURE 40.** Gen. 2 spec. C gen. et spec. nov. ♀ from South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A.** LVi (NA124). **B.** RVi (NA124). **C.** LVi, detail of posterior part (NA124). **D.** LVi, detail of anterior part (NA124). **E.** RVi, detail of anterior part (NA124). **F.** RVi, detail of posterior part (NA124). **G.** CpRl (NA178). **H.** CpD (NA179). **I.** CpV (NA180). **J.** CpRl, detail of anterior part showing the surface of Cp (NA178). Scale bars: A–B, G–I = 250 µm; C–F = 200 µm; J = 100 µm.

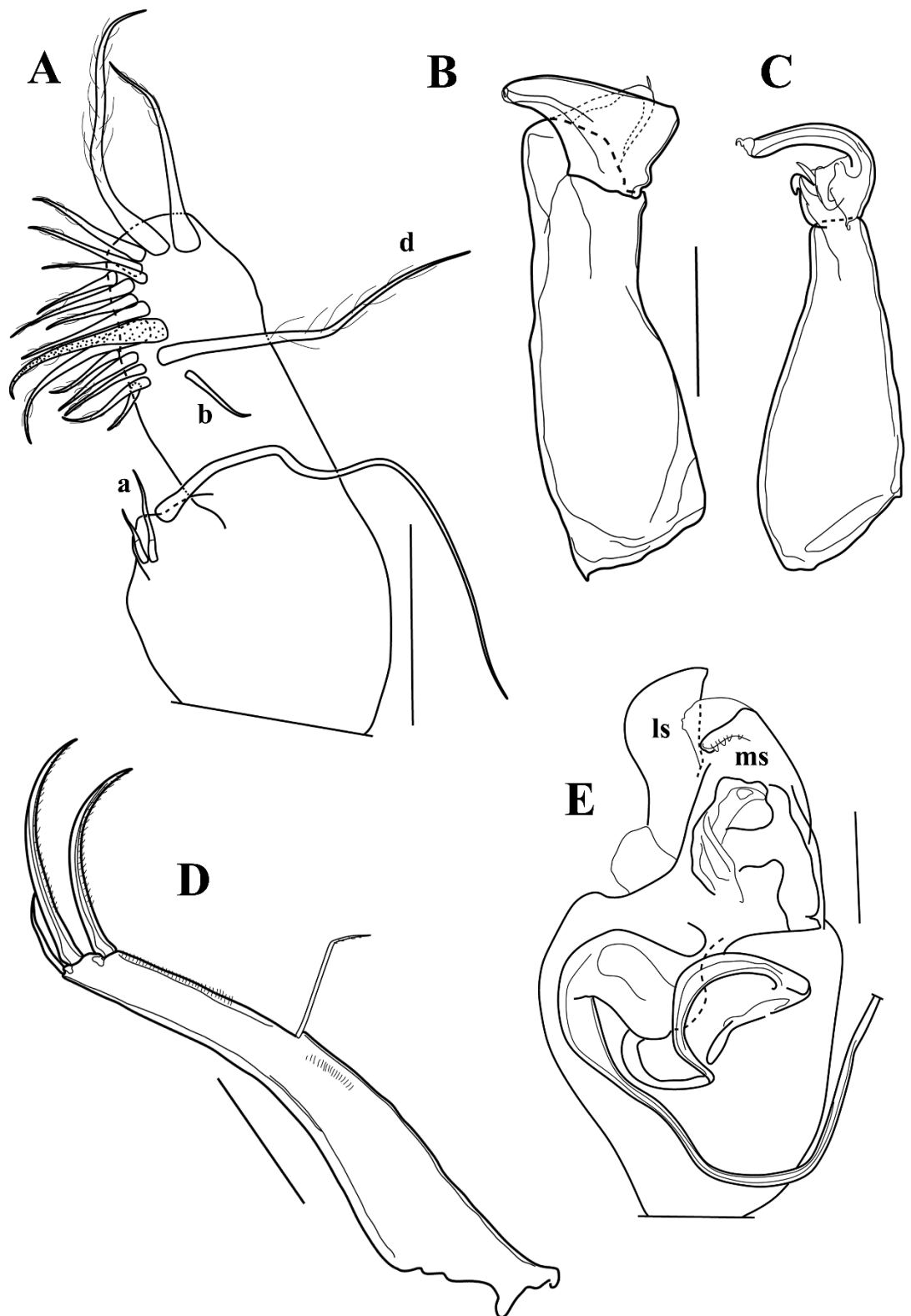


**FIGURE 41.** Gen. 2 spec. C gen. et spec. nov. ♀ from South Matogrossense Pantanal, Carenda Forest Road, lake 1 (PAN 09). **A.** T1 (NA125). **B.** CR (NA124). Scale bars: A–B = 50  $\mu$ m.



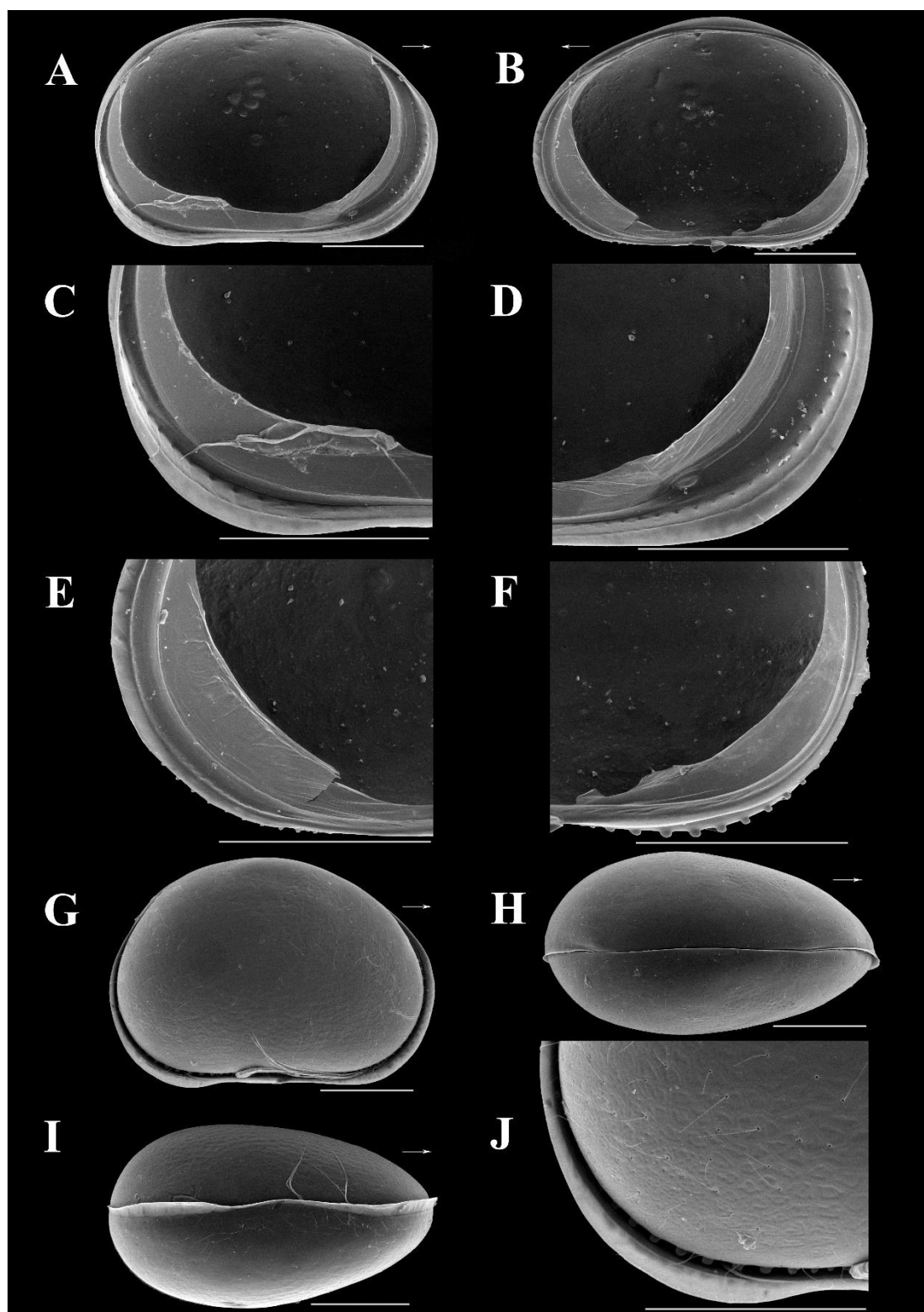
**FIGURE 42.** Gen. 2 spec. E gen. et spec. nov. ♂ from South Matogrossense Pantanal, Camp Road, pool 4 (PAN 31). **A.** LVi (NA108). **B.** RVi (NA108). **C.** LVi, detail of posterior part (NA108). **D.** LVi, detail of anterior part (NA108). **E.** RVi, detail of anterior part (NA108). **F.** RVi, detail of posterior part (NA108). **G.** CpRl (NA170). **H.** CpD (NA170). **I.** CpV (NA170). **J.** CpRl, detail of ventral margin showing the surface of Cp (NA170). Scale bars: A–B, G–I = 250  $\mu$ m; C–F = 200  $\mu$ m; J = 100  $\mu$ m.



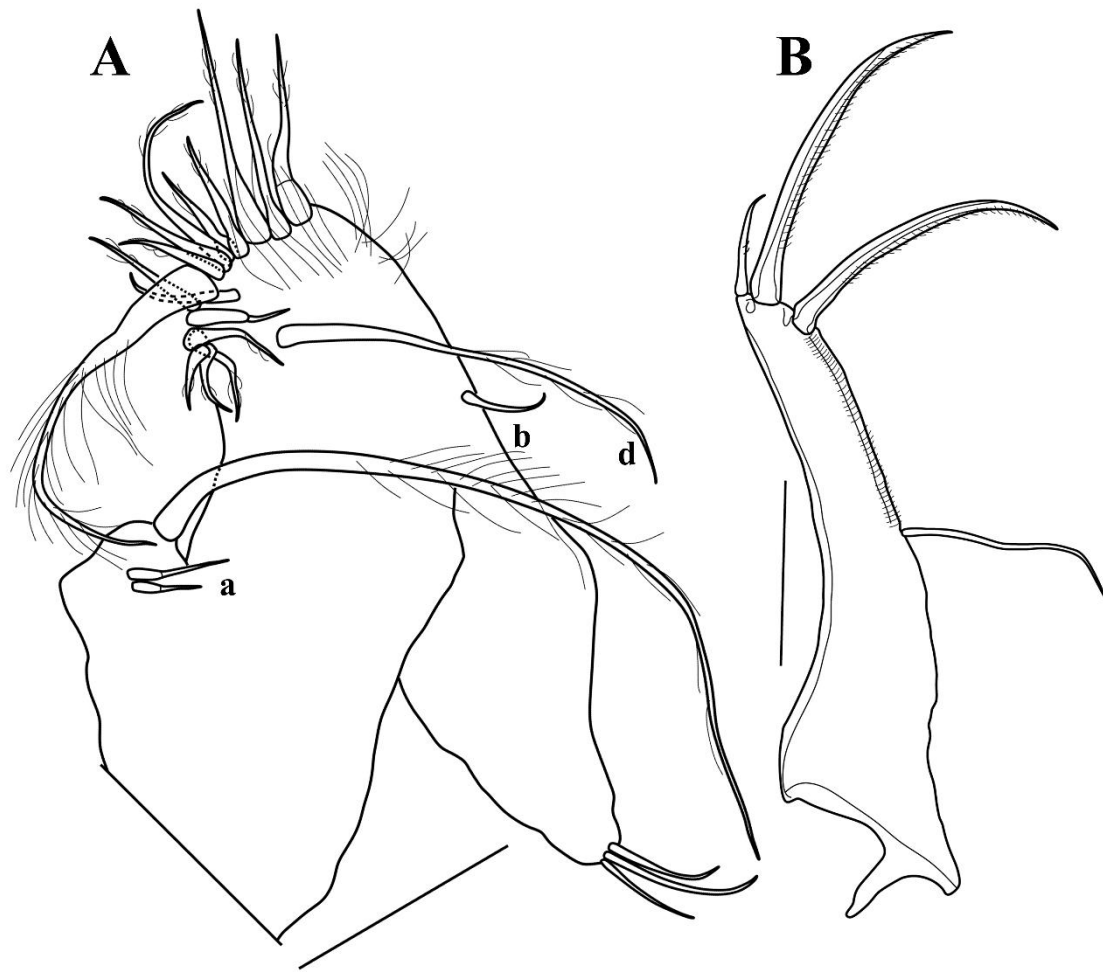


**FIGURE 43.** Gen. 2 spec. E gen. et spec. nov. ♂ from South Matogrossense Pantanal, Camp Road, pool 4 (PAN 31). **A.** T1 (NA108). **B.** Rpp (NA108). **C.** Lpp (NA108). **D.** CR (NA108). **E.** Hemipenis (NA108). Scale bars: A–E = 50  $\mu$ m.





**FIGURE 44.** Gen. 2 spec. E gen. et spec. nov. ♀ from South Matogrossense Pantanal, Camp Road, pool 4 (PAN 31). **A.** LVi (NA137). **B.** RVi (NA137). **C.** LVi, detail of posterior part (NA137). **D.** LVi, detail of anterior part (NA137). **E.** RVi, detail of anterior part (NA137). **F.** RVi, detail of posterior part (NA137). **G.** CpD (NA171). **H.** CpV (NA172). **I.** CpL (NA173). **J.** CpL, detail of posterior part showing the surface of Cp (NA171). Scale bars: A–B, G–I = 250 µm; C–F = 200 µm; J = 100 µm.



**FIGURE 45.** Gen. 2 spec. E gen. et spec. nov. ♀ from South Matogrossense Pantanal, Camp Road, pool 4 (PAN 31). **A.** T1 (NA137). **B.** CR (NA145). Scale bars: A–B = 50  $\mu\text{m}$ .