A COMPARISON BETWEEN THE OSTRACOD (CRUSTACEA, OSTRACODA) FAUNAS OF THE PANTANAL AND THE UPPER PARANÁ RIVER FLOODPLAINS (BRAZIL)

Report of postdoctoral stay at the Royal Belgian Institute of Natural Sciences, Brussels, Belgium

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Funding Body: Belgian Federal Science Policy (Application document 2010)

Period: 01.04-30.9.2011

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Date of submission of report: 15.12.2011

Summary

The present report presents the results obtained during the post-doctoral fellowship (01/04 to 30/09/2011) developed at the Royal Belgian Institute of Natural Sciences (RBINS), Brussels, Belgium.

The first part of the report summarises the results of identification of species presently in open nomenclature, using literature and collections present at the RBINS, as well as a comparative analysis of ostracod biodiversity between the two floodplains.

The second part of this report comprises 3 appendices:

Appendix 1 (p 18-44): Atlas of the valves of ostracod species found in the floodplains of the Upper Paraná River and of the Pantanal. (Unpublished)

Appendix 2 (p 45-57): "Description of a new genus and species of Candoninae (Crustacea, Ostracoda) from Brazil, with a discussion on the evolution of the *Candonopsini.*" (manuscript in preparation)

Appendix 3 (p 58-104): "On a new cypridopsine genus (Crustacea, Ostracoda, Cyprididae) from the Upper Paraná River Floodplain (Brazil), with a re-appraisal of *Zonocypris s.l.*" (manuscript in press in Zootaxa).

All data presented here were developed during the postdoc on which this document reports.

Acknowledgments

Janet Higuti thanks the Belgian Science Policy (Belspo) for financing the postdoctoral stay in Brussels; the University of Maringa for granting the permission of absence for 6 months, the Royal Belgian Institute of natural Sciences for the hospitality and all members of the Freshwater Biology Section for their kind help and company. Julian Cillis and Claudine Behen (Brussels, Belgium) offered technical assistance with the SEM and the line drawings, respectively.

Introduction

Mussel shrimps, or Ostracoda, are small, bivalved Crustacea. Their calcified carapaces have an average length of c. 1 mm and completely envelop the reduced body. Ostracods are very common in most inland waters, where they abound in the benthic and periphytic animal communities, but also occur in marine, interstitial and even (semi-) terrestrial environments.

The ostracod fauna of South America is ill known (Martens & Behen, 1994), and Brazil is no exception to this (Martens et al., 1998). Only recently was there a revival in research on the ostracods in Brazil, most notably on the ecology of floodplain ostracods (Higuti et al. 2007; 2009a, b, c, 2010; Mormul et. al. 2010) and the taxonomy of terrestrial ostracods (Pinto et al., 2003, 2004, 2005a,b, 2008).

Ostracods are interesting proxies of biodiversity change, because their calcified valves can form abundant microfossils in lake sediments. Sediment cores can then be analysed and changes in densities and various aspects of diversities can be analysed over real-time frames.

During the ecological surveys of the Paraná and Pantanal floodplains, more than 50 ostracod taxa were found. Several of these were either difficult to identfy without further research in extant reference collections, or were new to science at the specific or even generic level.

The present study will make a significant contribution towards the knowledge of the biodiversity of Brazilian floodplains, using Ostracoda (Crustacea) from Paraná and Pantanal floodplains as model group and –systems.

The **strategic objective** of the present study is to increase the taxonomic expertise on Brazilian floodplain ostracods, so that meaningful comparisons between different floodplains can be made at the specific level. These comparisons are important to understand not only alpha (local) and gamma (regional) biodiversity, but also beta diversity (change of faunal composition between areas). A clear understanding of such spatial patterns is vital in order to optimise conservation strategies.

In order to achieve this goal, the **operational objectives** were:

(1) Identification of species presently in open nomenclature, using literature and collections present at the RBINS;

(2) Comparative analysis of ostracod biodiversity between the two floodplains;

(3) Description of new genera and species using facilities of the RBINS (light and scanning electron microscopes).

Material and methods

Study area

The Pantanal is a tropical wetland and the world's largest wetland of any kind. It lies mostly within the Brazilian state of Mato Grosso do Sul, but extends into Mato Grosso as well as into portions of Bolivia and Paraguay, sprawling over an area estimated at between 140,000 square kilometers and 195,000 square kilometers (Fig. 1). Various sub-regional ecosystems exist, each with distinct hydrological, geological and ecological characteristics; up to twelve of these sub-regional ecosystems have been defined.

Figure 1. Pantanal in Mato Grosso do Sul (http://en.wikipedia.org/wiki/Pantanal)

The Upper Paraná River floodplain is located between the Porto Primavera Reservoir and the Itaipu Reservoir, extending about 230km. In this area, three conservation units were created: “Área de Proteção Ambiental das Ilhas e Várzeas do Rio Paraná” (100,310 ha; an Environmental Protection Area), the “Parque Nacional de Ilha Grande” (78,800 ha; National Park), and the “Parque Estadual do Ivinheima” (70,000 ha; State Park) (Agostinho et al., 2004). The floodplain, apart from the main channel of the Paraná River, also includes the Ivinheima and Baía Rivers (Fig. 2).

Figure 2. Upper Paraná River Floodplain

Both of these floodplains comprise a variety of aquatic biotopes, including several tributary rivers, secondary channels, lakes (open and closed) and backwaters.

Field sampling and laboratory analysis

Ostracoda from Pantanal were collected in 2003, from the Paraná River floodplain in 2004. In total, 73 samples were collected in both floodplains, 31 habitats in Pantanal (Table 1) and 36 habitats in Paraná floodplain (Table 2).

Ostracods were sampled using a rectangular net (28 cm x 14 cm, mesh size c 160 µm) hauled close to sediment-water interface for littoral collections. Floating vegetation was hand collected, and roots were thoroughly washed in a bucket. The residues were washed in the same handnet.

The material was preserved in alcohol 70%. Samples were fragmented using a Folsom fractioner, and ¼ of samples was quantified, however, species richness was always estimated from the total sample. Specimens were dissected and illustrated, soft parts with *camera lucida* drawings, and valves were examined using scanning electron microscopy.

Table 1. Localities from which Ostracoda were collected in Pantanal. T= temporary, P= permanent, Sal= salinity, WT= water temperature.

sample code	**S°**	**S'**	**S"**	**W°**	**W'**	**W"**	**Date**	**Locality name**	**T/P**	**Sal**	**WT**	**pH**	**Remarks**
PAN-03-01	19	14	57	57	0	21	3.6.03	Baia Sao Miguel	P	0.5	28.0	10	
PAN-03-02	19	12	32	56	56	34	3.6.03	Baia Reserva	P	3.9	29.1	10	
PAN-03-03	19	15	11	57	0	13	3.6.03	Lecque Road pool 1	P		27.9	7	
PAN-03-04	19	15	6	57	2	49	3.6.03	Lecque Road lake	P		33.0	8	
PAN-03-05	19	15	29	57	3	28	3.6.03	LC Road lake 1	P		26.5	6	Lecque Curve Rd
PAN-03-06	19	21	51	57	3	4	3.6.03	LC Road lake 2	P		27.0	5	Lecque Curve Rd, Rio Negro
PAN-03-07	19	31	34	57	2	27	3.6.03	LC Road lake 3	P		22.5	6	Lecque Curve Rd, Rio Miranda
PAN-03-08	19	31	34	57	2	27	3.6.03	LC Road lake 4	P		24.0	6	Lecque Curve Rd, Rio Miranda
PAN-03-09	19	43	39	57	4	19	4.6.03	CF Road Lake 1	P		20.5	7	Carenda Forest
PAN-03-10	19	42	19	57	3	31	4.6.03	CF Road stream 1	P		20.5	7	Carenda Forest
PAN-03-11	19	41	33	57	2	34	4.6.03	CF Road lake 2	P		21.0	7	Carenda Forest
PAN-03-12	19	35	33	57	8	19	4.6.03	CR lake 1	P		20.8	7	Corumba Road
PAN-03-13	19	35	33	57	8	19	4.6.03	CR pool 1	T		19.5	6	Corumba Road
PAN-03-14	19	35	38	57	8	3	4.6.03	CR pool 2	T		19.2	7	Corumba Road
PAN-03-15	19	37	9	57	5	11	4.6.03	CR lake 2	P		18.5	7	Corumba Road
PAN-03-16	19	36	17	57	6	46	5.6.03	CR pool 3	T		21.1	7	Corumba Road
PAN-03-17	19	37	11	57	5	1	5.6.03	CR lake 3	P		23.0	7	Corumba Road
PAN-03-18	19	37	13	57	5	3	5.6.03	CR lake 4	P		22.8	7	Corumba Road
PAN-03-19	19	37	14	57	4	56	5.6.03	CR pool 4	T		29.5	8	Corumba Road
PAN-03-20	19	37	53	57	3	43	5.6.03	CR lake 5	P		23.5	7	Corumba Road
PAN-03-21	19	37	15	57	2	4	5.6.03	LC Rd lake 5	P		24.0	7	Lecque Curve Rd
PAN-03-22	19	34	55	57	2	14	5.6.03	LC Rd, cattle pond	T		24.0	7	Lecque Curve Rd
PAN-03-23	19	37	2	56	57	48	5.6.03	R Vermelho stat 1	P		20.0	6	side river

sample code	S°	S'	S"	W°	W'	W"	Date	Locality name	T/P	Sal	WT	pH	Remarks
PAN-03-24	19	37	0	56	58	8	5.6.03	R Vermelho stat 2	P		20.0	6	side river
PAN-03-25	19	34	32	57	0	51	7.6.03	Medalha lake	P		24.0	6	near camp
PAN-03-26	19	34	38	57	1	11	7.6.03	BEP wetland 1	T		24.0	7	at camp
PAN-03-27	19	34	38	57	1	11	7.6.03	BEP wetland 2	T		24.0	7	at camp
PAN-03-28	19	34	25	57	1	29	7.6.03	Camp Rd pool 1	T		25.0	8	Camp Road
PAN-03-29	19	34	30	57	1	23	7.6.03	Camp Rd pool 2	T		25.0	7.5	Camp Road
PAN-03-30	19	34	28	57	1	16	7.6.03	Camp Rd pool 3	T		25.0	7.5	Camp Road
PAN-03-31	19	34	34	57	1	7	7.6.03	Camp Rd pool 4	T		23.0	7	Camp Road

Table 2. Localities from which Ostracoda were collected in the Upper Paraná River floodplain. IVI= Ivinheima River System, BAI= Baía River System, PAR= Paraná River System, floating= mixed floating plants, WT= water temperature, EC= electrical conductivity, DO= dissolved oxygen.

sample	**Data**	**Locality name**	**S°**	**S'**	**S"**	**W°**	**W'**	**W"**	**Loc. type**	**Subsystem**	**substrate type**	**T (°C)**	**EC (µS/cm)**	**pH**	**DO (mg/l)**
PAR 1	13.03.04	Lake Ventura	22	51	29	53	36	3	closed lake	IVI	littoral	26.5	36.2	6.6	7.2
PAR 9	13.03.04	Lake Patos	22	49	34	53	33	20	open lake	IVI	*E. crassipes*	27.9	42.5	7	6.5
PAR 10	13.03.04	Lake Finado Raimundo	22	47	41	53	32	22	open lake	IVI	littoral	28.1	39.6	7.2	7
PAR 17	13.03.04	Lake Capivara	22	48	7	53	32	7	closed lake	IVI	littoral	28.3	44.8	6.2	4.2
PAR 21	13.03.04	Lake Jacare	22	47	10	53	29	56	closed lake	IVI	littoral	27.3	48.6	6.4	5.3
PAR 22	14.03.04	Lake Aurelio	22	41	46	53	13	56	closed lake	BAI	littoral	28	36	6	3
PAR 25	14.03.04	Lake Pousada das Garcas	22	42	12	53	15	33	closed lake	BAI	littoral	27.5	29.3	6.2	4.4
PAR 26	14.03.04	Lake Pousada das Garcas	22	42	12	53	15	33	closed lake	BAI	littoral	27.5	29.3	6.2	4.4
PAR 28	14.03.04	Lake Fechada	22	42	40	53	16	29	closed lake	BAI	littoral	28.1	32.5	6.3	5.7
PAR 30	15.03.04	Lake Pombas	22	48	6	53	21	40	open lake	PAR	*E. crassipes*	26.6	96.6	6.5	4
PAR 31	15.03.04	Lake Osmar	22	46	38	53	20	1	closed lake	PAR	littoral	27.6	64.1	6.2	4.2
PAR 33	15.03.04	Lake Ze Marinho	22	47	43	53	21	7	closed lake	PAR	littoral	26.2	70	6.1	2.1
PAR 34	15.03.04	Lake Urbano	22	46	30	53	19	30	closed lake	PAR	littoral	26.5	70.3	6.1	4.9
PAR 36	15.03.04	Leopoldo Backwater	22	45	38	53	16	19	open lake	PAR	*O. cubense*	29.3	80.4	6.2	2.5
PAR 37	15.03.04	Leopoldo Backwater	22	45	38	53	16	19	open lake	PAR	*E. azurea*	29.3	80.4	6.2	2.5
PAR 38	15.03.04	Lake Genipapo	22	45	44	53	16	9	closed lake	PAR	littoral	30.1	83.9	6.1	3.2
PAR 39	15.03.04	Lake Figueira	22	45	31	53	15	36	closed lake	PAR	littoral	29.7	123.8	6.1	4.3
PAR 40	15.03.04	Lake Clara	22	45	26	53	15	28	closed lake	PAR	littoral	29.8	63.1	6.2	4.7
PAR 41	15.03.04	Lake Pontal	22	45	15	53	15	25	closed lake	PAR	littoral	29.9	114.9	6.2	2.6
PAR 43	15.03.04	Pau Veio Backwater	22	45	3	53	15	24	open lake	PAR	littoral	29.8	68.2	6.3	3.2
PAR 45	15.03.04	Lake Garcas	22	43	40	53	13	22	open lake	PAR	floating	32.1	68.2	6.5	4.7
PAR 47	15.03.04	Parana River	22	44	55	53	14	7	river	PAR	littoral	30.1	62.8	7.7	7.9
PAR 48	15.03.04	Lake Pousada	22	44	53	53	14	10	closed lake	PAR	littoral	32.7	79.4	6.5	4.8
PAR 49	15.03.04	Bile Backwater	22	45	26	53	17	18	open lake	PAR	littoral	32.8	70.7	7.2	7.8

sample	**Data**	**Locality name**	**S°**	**S'**	**S"**	**W°**	**W'**	**W"**	**Loc. type**	**Subsystem**	**substrate type**	**T (°C)**	**EC (µS/cm)**	**pH**	**DO (mg/l)**
PAR 53	16.03.04	Lake Pintado	22	56	48	53	38	22	open lake	IVI	floating	29.9	50.8	6.5	3.4
PAR 55	16.03.04	Lake Peroba	22	54	45	53	38	27	open lake	IVI	*E. crassipes*	31.3	42.6	6.8	6.1
PAR 56	16.03.04	Ivinhema River	22	54	47	53	38	24	river	IVI	*Salvinia* spp	30.5	46.6	7	6.5
PAR 57	16.03.04	Ivinhema River	22	54	47	53	38	24	river	IVI	*H. ranunculoides*	30.5	46.6	7	6.5
PAR 58	16.03.04	Ivinhema River	22	54	47	53	38	24	river	IVI	*E. crassipes*	30.5	46.6	7	6.5
PAR 61	16.03.04	Lake Boca do Ipoita	22	50	14	53	33	59	open lake	IVI	*E. crassipes*	33.5	49.6	6.3	4.8
PAR 62	16.03.04	Ipoita channel	22	50	56	53	33	23	channel	IVI	*E. azurea*	30.3	60.6	8.6	8
PAR 66	16.03.04	Parana River	22	50	42	53	30	54	river	PAR	littoral	30	64.6	8.2	6.7
PAR 69	16.03.04	Cortado channel	22	48	50	53	22	35	channel	PAR	*E. crassipes*	30	66.9	6.6	5.8
PAR 70	16.03.04	Cortado channel	22	48	50	53	22	35	channel	PAR	*Salvinia* spp	30	66.9	6.6	5.8
PAR 73	16.03.04	Cortado channel	22	48	50	53	22	35	channel	PAR	*P. stratiotes*	30	66.9	6.6	5.8
PAR 76	17.03.04	Lake Gaviao	22	39	49	53	12	19	open lake	BAI	*E. crassipes*	27.8	31.1	6.2	3.9
PAR 81	17.03.04	Lake Onca	22	39	56	53	12	8	open lake	BAI	littoral	29.1	37.9	6	2.1
PAR 82	17.03.04	Baia River	22	41	8	53	13	3	river	BAI	*H. ranunculoides*	29.4	34.4	6	4.5
PAR 83	17.03.04	Baia River	22	41	8	53	13	3	river	BAI	*E. crassipes*	29.4	34.4	6	4.5
PAR 84	17.03.04	Baia River	22	41	8	53	13	3	river	BAI	*P. stratiotes*	29.4	34.4	6	4.5
PAR 85	17.03.04	Baia River	22	41	8	53	13	3	river	BAI	*Salvinia* spp	29.4	34.4	6	4.5
PAR 88	17.03.04	Lake Maria Luiza	22	40	40	53	13	12	open lake	BAI	*E. crassipes*	30.4	40.8	6.1	3.5
PAR 90	17.03.04	Lake Porcos	22	42	20	53	14	47	open lake	BAI	*E. crassipes*	29.6	41.3	6.1	3.5
PAR 94	17.03.04	Lake Guarana	22	43	26	53	18	12	open lake	BAI	*Salvinia* spp	31.1	52.3	6	2.3
PAR 95	17.03.04	Lake Guarana	22	43	26	53	18	12	open lake	BAI	*P. stratiotes*	31.1	52.3	6	2.3
PAR 99	17.03.04	Manezinho Backwater	22	46	55	53	20	59	open lake	PAR	*E. crassipes*	31.6	65.2	7.5	6.2
PAR 100	17.03.04	Caracu stream	22	46	6	53	15	28	stream	PAR	littoral	27.2	54.3	6.9	6.4

Data analyses

Due to the differences in abundance among the samples, rarefaction curves were used to compare species richness between Pantanal and Paraná floodplains. Rarefaction curves were computed using the Biodiversity Pro.

In addition, Detrended Correspondence Analysis (DCA) (Hill & Gauch, 1980) was used to ordinate sampling units, based on composition and abundance of ostracod species. Abundances were previously log transformed to minimize effects of discrepant values. This analysis was performed in the PC-ORD program (McCune & Mefford, 1999).

Results and discussion

To allow identification, an atlas of valve morphology of the different species was compiled using Scanning Electron Microscopy. A summary of valve morphologies of most of the species is given in Appendix 1 from Pantanal and Upper Paraná River floodplains.

Some species that were previously left in open nomenclature were identified duringt the present postdoctoral stay. These are *Stenocypris malayica* Victor & Fernando, 1981; *Cypretta costata* G.W.Müller, 1898; *Cypretta vivacis* Würdig & Pinto, 1993 and a new species *Cypretta* n.sp..

Both collections yielded about 54 species together, 49 species were recorded in the Paraná River floodplain and 30 in Pantanal. The ostracod community comprised four families, Cyprididae, Candonidae, Darwinulidae and Limnocytheridae (Table 3). The most speciose ostracod family in the different environments of the Paraná River and Pantanal is Cyprididae, a pattern also observed by Würdig and Freitas (1988). Furthermore, Cyprididae may comprise more than 80% of all freshwater species in most tropical regions (Martens, 1998). On a global scale, Cyprididae hold about 1000 species, more than half of all described living non-marine ostracod species (Martens et al., 2008).

Table 3. Ostracoda faunistic survey from Pantanal and Upper Paraná River floodplains. Abbreviations of each taxon are indicated in front of their respective names are used in the DCA analysis (Figure 4).

	Pantanal	Paraná
Family Cyprididae Baird, 1845		
(Dm) ***Diaphanocypris meridana*** (Furtos, 1936) Würdig & Pinto, 1990	+	+
(Eu) ***Eucypris*** **sp.**	+	
(Ht) ***Heterocypris*** **sp.**	+	
(He) ***Hemicypris*** **sp.**	+	
(Smj) ***Stenocypris major*** (Braid, 1859) Daday, 1898	+	+
(Sma) ***Stenocypris malayica*** Victor & Fernando, 1981		+
(Sp) ***Strandesia psittacea*** (Sars, 1901) Roessler, 1990		+
(St) ***S. trispinosa*** (Pinto & Purper, 1965) Broodbakker, 1983	+	+
(Sm) ***S. mutica*** (Sars, 1901) G.W.Müller, 1912		+
(Sv) ***S. variegata*** (Sars, 1901) G.W.Müller, 1912		+
(Sb) ***S. bicuspis*** (Claus, 1892) G.W.Müller, 1912		+
(Snsp) ***Strandesia*** **n.sp.**	+	
(Beb) ***Bradleystrandesia*** **gr.** ***elliptica*** **sp. 1**		+
(Bes) ***B.*** **gr.** ***elliptica*** **sp. 2**	+	+
(Be3) B. gr. elliptica sp. 3		+
(B3) ***Bradleystrandesia*** **sp. 3**		+
(Bo) ***Bradleystrandesia obtusata*** (Sars, 1901)	+	+
(Bo4) ***B.*** **gr.** ***obtusata*** **sp. 4**		+
(Bo5) ***B.*** **gr.** ***obtusata*** **sp. 5**		+
(Boq) ***Bradleystrandesia*** **gr.** ***obliqua***		+
(Bl) ***Bradleytriebella lineata*** (Victor & Fernando, 1981) Savatenalinton & Martens, 2010	+	+
(Cce) ***Cypricercus centrura*** (Klie, 1940) Martens & Behen, 1994	+	+
(Cd) ***Chlamydotheca deformis*** Farkas, 1958	+	+
(Cc) ***C. colombiensis*** Roessler, 1985	+	+
(Ci) ***C. iheringi*** (Sars, 1901) Klie, 1930	+	+
(Cyc) ***Cypretta costata*** G.W.Müller, 1898		+
(Cyv) ***C. vivacis*** Würdig & Pinto, 1993	+	+
(Cynsp) ***C.*** **n.sp.**	+	+
(Cv) ***Cypridopsis vidua*** O.F. Müller, 1776	+	+
(Cvs) ***C.*** **cf.** ***vidua*** **sp. 2**	+	+
(Cng1) “*Cypridopsis*” n.gen. 1 n.sp.		+
(Cng2) “*Cypridopsis*” n.gen. 2 n.sp.		+
(Ch) ***Cabelodopsis hispida*** **n.gen.** Higuti & Martens, in press		+
(Psa) ***Paranacypris samambaiensis*** Higuti et al., 2009	+	+
(Po) ***Potamocypris*** **n.sp.**	+	
(Nn) ***Neocypridopsis nana*** (Sars, 1901) Klie, 1940		+

	Pantanal	Paraná
Family Candonidae Kaufmann, 1900		
(Cb) ***Candobrasilopsis brasiliensis*** **n.gen.** (Sars, 1901) Higuti & Martens, in prep	+	+
(Cr) ***Candobrasilopsis rochai*** **n.gen n.sp.** Higuti & Martens, in prep		+
(Cp3) "*Candonopsis*" n.gen. n.sp. 3	+	+
(Cp4) "*Candonopsis*" n.gen. n.sp. 4		+
(C1) "*Candona*" sp. 1 n.sp.		+
(C2) "*Candona*" sp. 2 n.sp.		+
(C3) "*Candona*" sp. 3 n.sp.	+	+
(C4) "*Candona* "sp. 4 n.sp.	+	+
(CNI) Candonidae (N.I.)	+	
(Psa) ***Physocypria schubarti*** Farkas, 1958	+	+
(P2) ***Physocypria*** **sp. 2 n.sp.**	+	+
Family Limnocytheridae Klie, 1938		
(Cyi) ***Cytheridella ilosvayi*** Daday, 1905	+	+
(L1) ***Limnocythere*** **sp. 1**	+	+
Family Darwinulidae Brady & Norman, 1889		
(Ds) ***Darwinula stevensoni*** (Brady & Robertson, 1870)		+
(As) ***Alicenula serricaudata*** (Klie, 1935) Rossetti & Martens, 1998	+	+
(Vp) ***Vestalenula pagliolii*** (Pinto & Kotzian, 1961) Rossetti & Martens, 1998		+
(Vb) ***V. botocuda*** Pinto et al., 2003		+
(Pb) ***Penthesilenula brasiliensis*** (Pinto & Kotzian, 1961) Rossetti & Martens, 1998		+
(Pa) ***P. aotearoa*** (Rossetti et al., 1998) Rossetti & Martens, 1998		+

Stenocypris malayica, *Strandesia psittacea*, *S. mutica*, *S. variegata*, *S. bicuspis*, *Bradleystrandesia* gr. *elliptica* sp. 1, *B.* gr. *elliptica* sp. 3, *Bradleystrandesia* sp. 3, *B.* gr. *obtusata* sp. 4, *B.* gr. *obtusata* sp. 5, *Bradleystrandesia* gr. *obliqua*, *Cypretta costata*, "*Cypridopsis*" n.gen. 1 n.sp., *Cabelodopsis hispida*, *Neocypridopsis nana*, *Darwinula stevensoni*, *Vestalenula pagliolii*, *V. botocuda*, *Penthesilenula brasiliensis* and *P. aotearoa* were unique to the Upper Paraná River floodplain and *Eucypris* sp., *Heterocypris* sp., *Hemicypris* sp., *Strandesia* n.sp., "*Cypridopsis*" n.gen. 2 n.sp. and *Potamocypris* n.sp. were only found in the Pantanal floodplain (Table 3, Fig. 4).

The cumulative rarefaction curves showed that ostracod richness reached an asymptote in the Upper Paraná River floodplain, which means that most likely almost all species extant in the habitats of this floodplain were recovered. In contrast, there seems to be a slight potential to increase the number of ostracod species in the Pantanal floodplain.

Higher species richness was recorded in Paraná floodplain (Fig. 3). The higher richness is mainly related to the variety of substrate type (different species of floating aquatic macrophytes) sampled in the Upper Paraná River floodplain. Aquatic macrophytes provide environmental heterogeneity and are important micro-habitats for aquatic communities (Cyr & Downing, 1988; Kurashov et al., 1996; Cheruvelil et al., 2000; Padial et al., 2009).

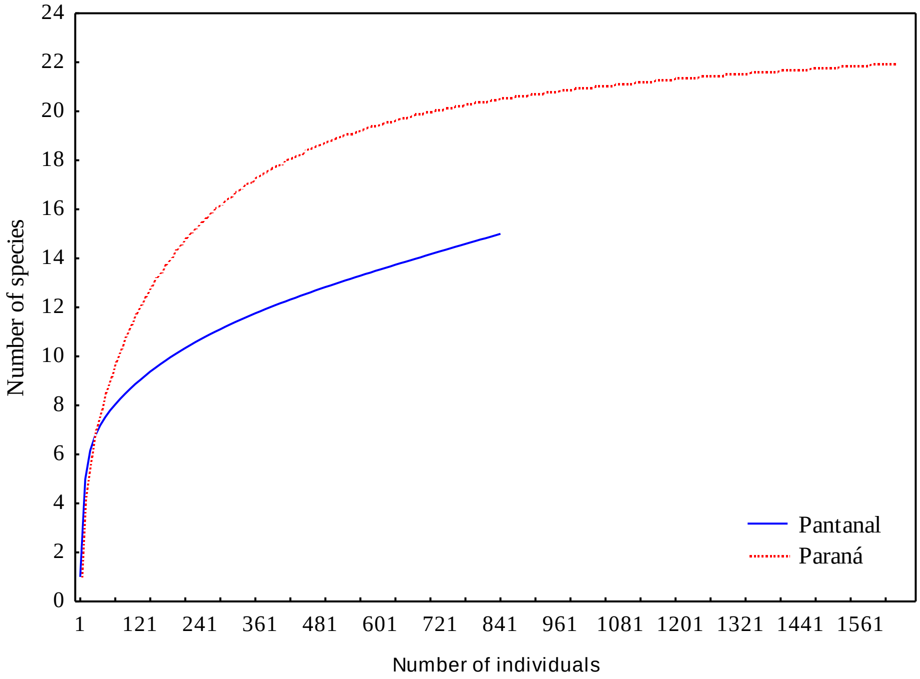

Figure 3. Rarefaction curves of ostracods species in the Pantanal and Upper Paraná River floodplains.

The first and second axes of the DCA had eigenvalues that explain 58 and 36 percent of the variance in our data, respectively. The taxa that contributed most to axis 1 were *Hemicypris* sp., *Heterocypris* sp., *Physocypria* sp. 2, *Strandesia* n.sp., *Bradleystrandesia obtusata*, *Potamocypris* n.sp. and “*Cypridopsis*” n.gen. 2 n.sp.. For axis 2, the principal species were *Hemicypris* sp., *Cypricercus centrura*, *Eucypris* sp., *Strandesia bicuspis*, *S. mutica*, *Paranacypris samambaiensis* and *Chlamydotheca iheringi* (Fig. 4).

Ostracods community was distinct between both floodplains, Upper Paraná River and Pantanal, as evidenced by DCA, with higher species richness recorded in upper Paraná River floodplain.

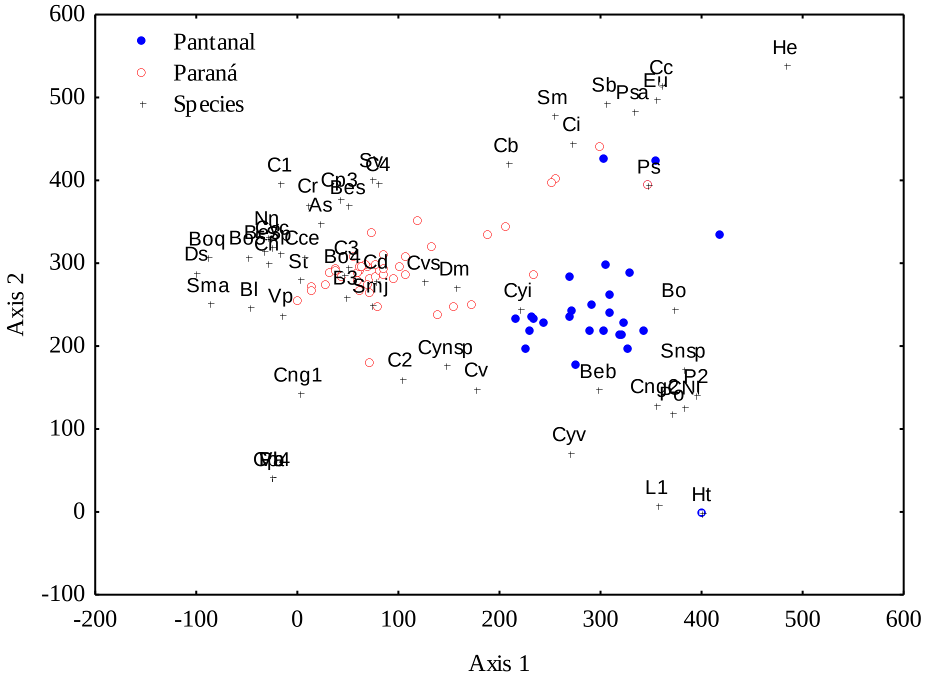

Figure 4. DCA plots based on ostracod distribution data (abundances log transformed), showing distribution along two DCA axes of Pantanal and Upper Paraná River floodplains.

References

Cheruvelil, K.S.; Soranno, P.A.; Serbin, R.D. 2000. Macroinvertebrates associated with submerged macrophytes: simple size and power to detect effects. Hydrobiologia, 441: 133 - 139.

Cyr, H.; Downing, J.A. 1988. The abundance of phytophilous invertebrates on different species of submerged macrophytes. Freshwater Biology, 20: 365 - 374.

Higuti J., De Clerck S., 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: 261 - 278.

Higuti, J., Velho, L.F.M., Lansac-Tôha, F.A.; Martens, K. 2009c. Biodiversity of non-marine ostracods (Crustacea, Ostracoda) in the alluvial valley of the upper Paraná River, Brazil. Brazilian Journal of Biology, 69 (suppl), 661 - 668.

Higuti, J.; Lansac-Tôha, F.A.; Velho, L.F.M.; Pinto, R.L.; Vieira, L.C.G.; Martens, K. 2009b. Composition and distribution of Darwinulidae (Crustacea, Ostracoda) in the alluvial valley of the upper Paraná River, Brazil. Brazilian Journal of Biology, 69 (2): 253-262.

Higuti, J.; Meisch, C.; Martens, K. 2009a. On *Paranacypris samambaiensis* n.gen. n.sp. (Crustacea, Ostracoda), the first South American psychrodromid, from the floodplain of the Upper Paraná River (Paraná, Brazil). Journal of Natural History, 43: 769-783.

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: 1930 - 1943.

Hill, M.O.; Gauch, H.G. 1980. Detrended correspondence analysis: an improved ordinations technique. Vegetatio, 42: 4758.

Kurashov, E.A.; Telesh, I.V.; Panov, V.E.; Usenko, N.V.; Rychkova, M.A. 1996. Invertebrate communities associated with macrophytes in Lake Ladoga: effects of environmental factors. Hydrobiologia, 322: 49 - 55.

Martens K.; Behen, F. 1994. A checklist of the non-marine ostracods (Crustacea, Ostracoda) from South-American inland waters and adjacent islands. Travaux scientifiques du Musée d'Histoire naturelle de Luxembourg, 22: 81 pp.

Martens, K. 1998. Diversity and endemicity of recent non-marine ostracods (Crustacea, Ostracoda) from Africa and South America: a faunal comparison. Vereinigung Internationale füer Theoretische und Angewandte Limnologie Verhandlungen, 26: 2093-2097.

Martens, K.; Schön, I.; Meisch, C.; Horne, D.J. 2008. Global biodiversity of non-marine Ostracoda (Crustacea). Hydrobiologia, 595: 185 - 193.

Martens, K.; Würdig, N.L.; Behen, F. 1998. Maxillopoda. Non-Marine Ostracoda: In: Young, P.S. (ed.). Catalogue of Crustacea of Brazil. Rio de Janeiro: Museu Nacional, Série Livros 6: 45-65.

McCune, B.; Mefford, M.J. 1999. PC-ORD. Multivariate Analysis of Ecological Data, Version 3.15. Gleneden Beach, Oregon: MJM Software.

Mormul, R.P.; Thomaz, S.M.; Higuti, J.; Martens, K. 2010. Ostracod (Crustacea) colonization of a native and a non-native macrophyte species of Hydrocharitaceae in the Upper Paraná floodplain (Brazil): an experimental evaluation. Hydrobiologia, 644: 185 - 193.

Padial, A.A.; Thomaz, S.M.; Agostinho, A.A. 2009. Effects of structural heterogeneity provided by the floating macrophyte *Eichhornia azurea* on the predation efficiency and habitat use of the small Neotropical fish *Moenkhausia sanctaefilomenae*. Hydrobiologia, 624: 161 - 170.

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 São Paulo State (Brazil). Zoological Journal of the Linnean Society, 139: 305 - 313.

Pinto, R.L.; Rocha, C.E.F.; Martens, K. 2004. On the genus *Penthesilenula* Rossetti & Martens, 1998 (Crustacea, Ostracoda, Darwinulidae) from (semi-) terrestrial habitats in São Paulo State (Brazil), with the description of a new species. Journal of Natural History, 38: 2567 - 2589.

Pinto, R.L.; Rocha, C.E.F.; Martens, K. 2005a. On the evolution of the genus *Microdarwinula* Danielopol, 1968 (Ostracoda, Darwinulidae) with the description of a new species from semi-terrestrial habitats in São Paulo State (Brazil). Crustaceana, 78: 975 - 986.

Pinto, R.L.; Rocha, C.E.F.; Martens, K. 2005b. On new terrestrial ostracods (Crustacea, Ostracoda) from Brazil, primarily from São Paulo State. Zoological Journal of the Linnean Society, 145: 145 - 173.

Pinto, R.L.; Rocha, C.E.F.; Martens, K. 2008. On the first terrestrial ostracod of the superfamily Cytheroidea (Crustacea, Ostracoda). Zootaxa, 1828: 29 - 42.

Würdig, N.L.; Freitas, S.M.F. 1988. Distribuição espacial e temporal da comunidade de ostrácodes na lagoa emboaba, Rio Grande do Sul, Brasil. Acta Limnologica Brasiliensia, 2: 677 - 700.

Appendix 1 (Figures 1 – 27): Scanning Electron Microscopy images of Ostracoda from Pantanal and Upper Paraná River floodplains)

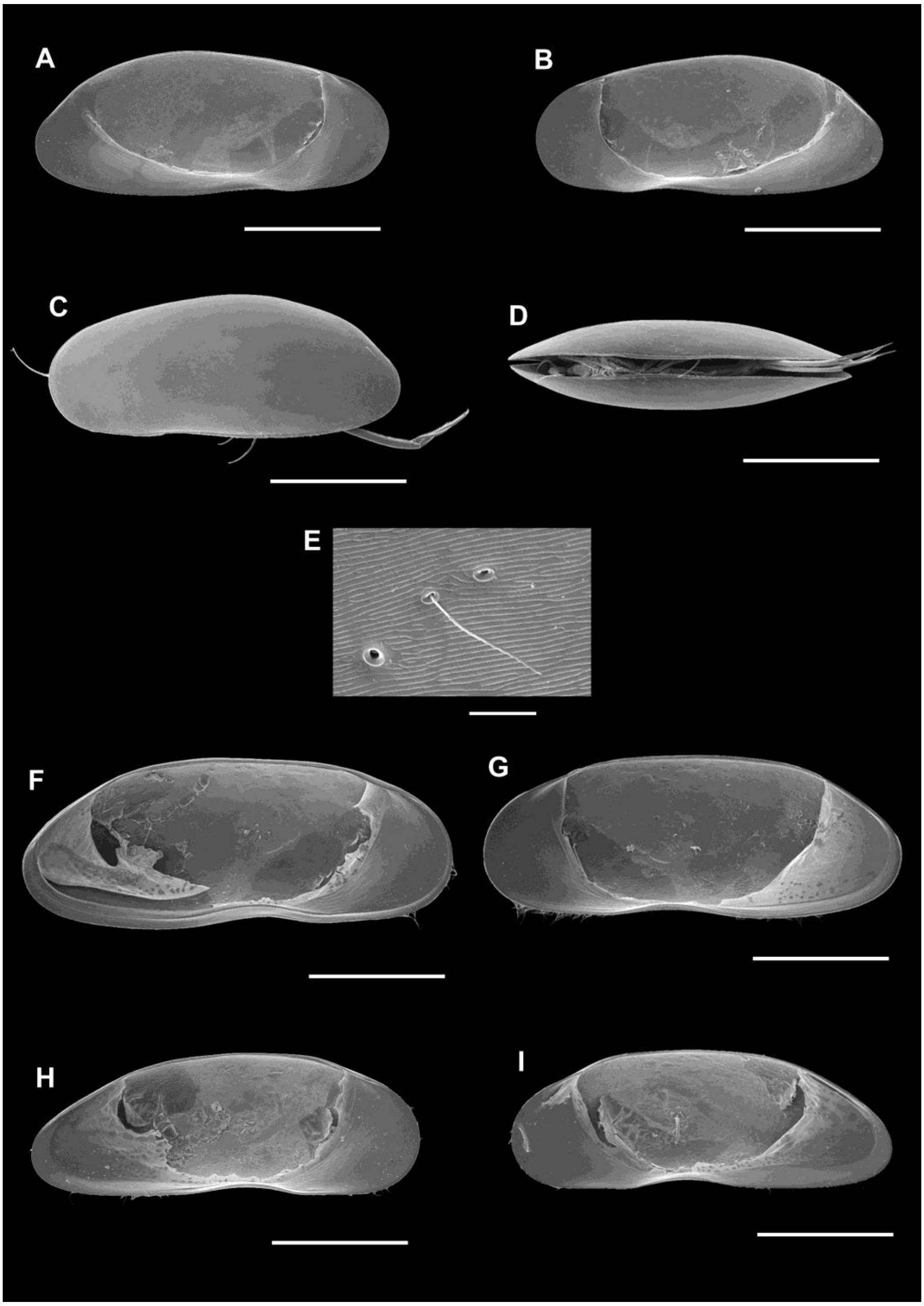

Figure 1. A-E: ***D. meridana***; F-G: ***S. major***; H-I: ***S. malayica***. A, F and H. LV, internal view. B, G and I. RV, internal view. C. Cp, right lateral view. D. Cp, dorsal view. E. detail of valve. Scale bars: A-D, F-I = 500 µm; E = 10 µm.

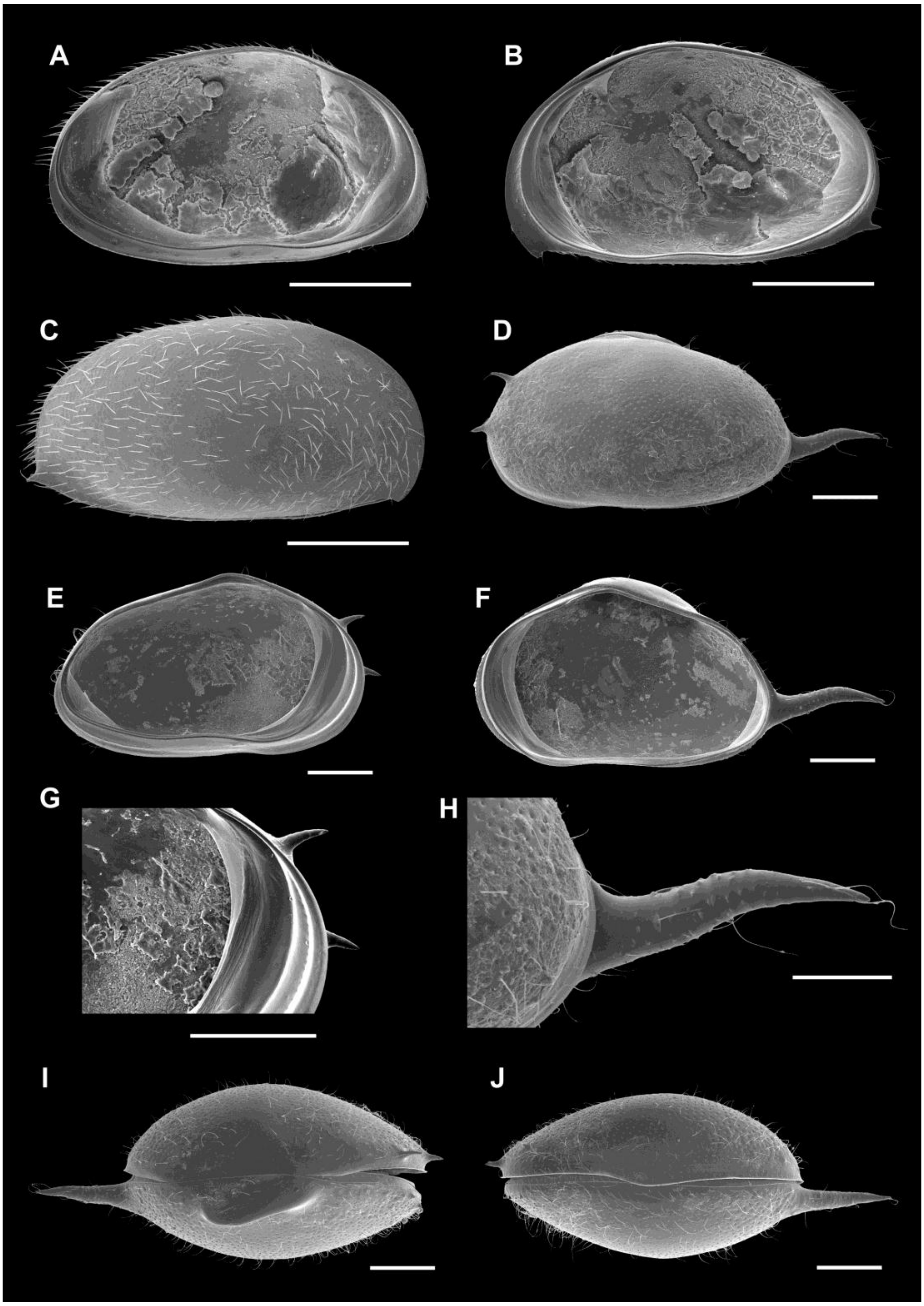

Figure 2. A-C: ***S. psittacea***; D-J: ***S. trispinosa***. A and E. LV, internal view. B and F. RV, internal view. C. Cp, right lateral view. D. Cp, left lateral view. G. detail of anterior part of LV. H. detail of posterior part of RV. I. Cp, dorsal view. J. Cp, ventral view. Scale bars: A-C = 500 µm; D-G, I, J = 200 µm; H = 100 µm.

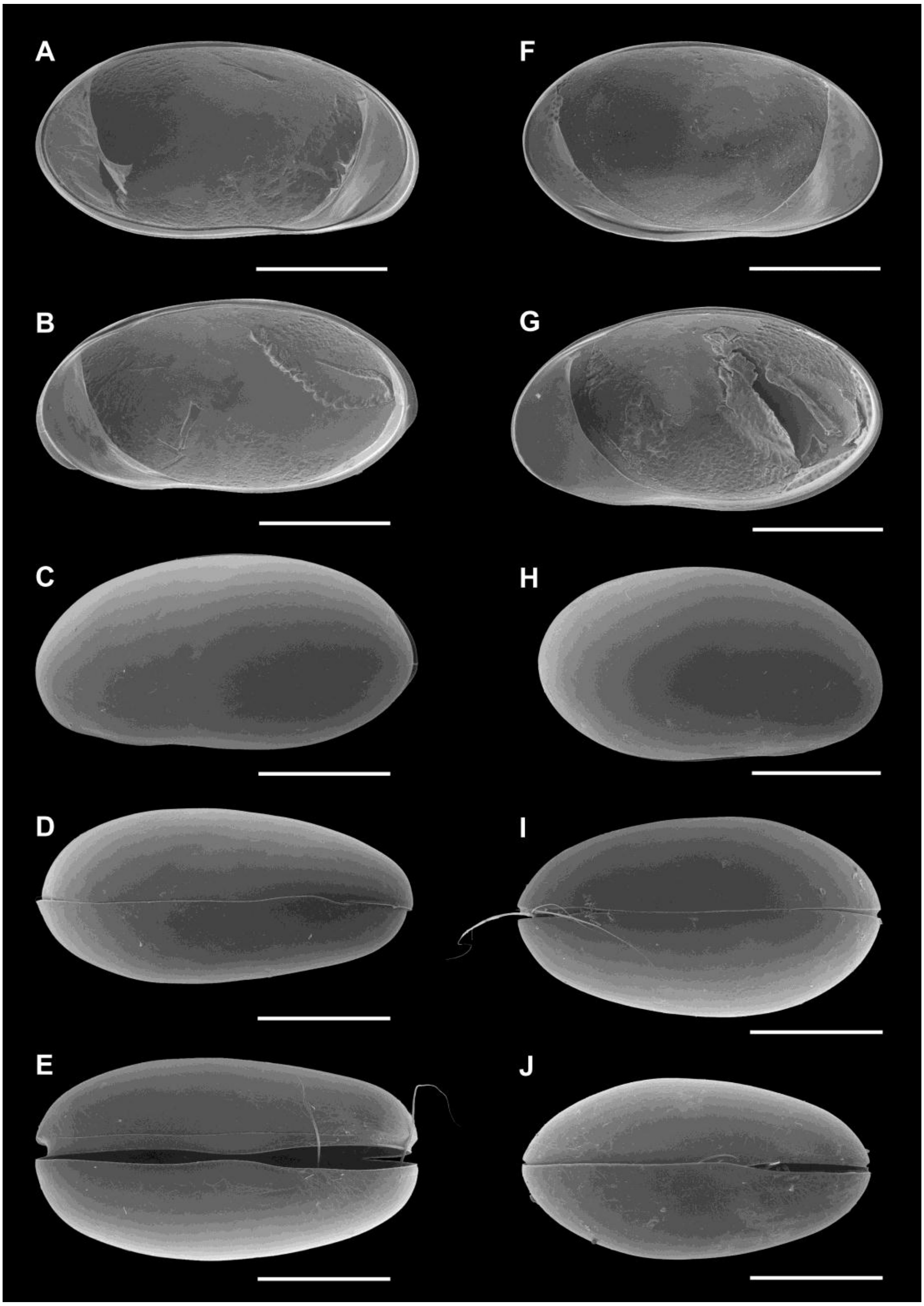

Figure 3. A-E: ***S. mutica***; F-J: ***S. variegata***. A and F. LV, internal view. B and G. RV, internal view. C. Cp, left lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. H. Cp, right lateral view. Scale bars: A-J = 500 µm.

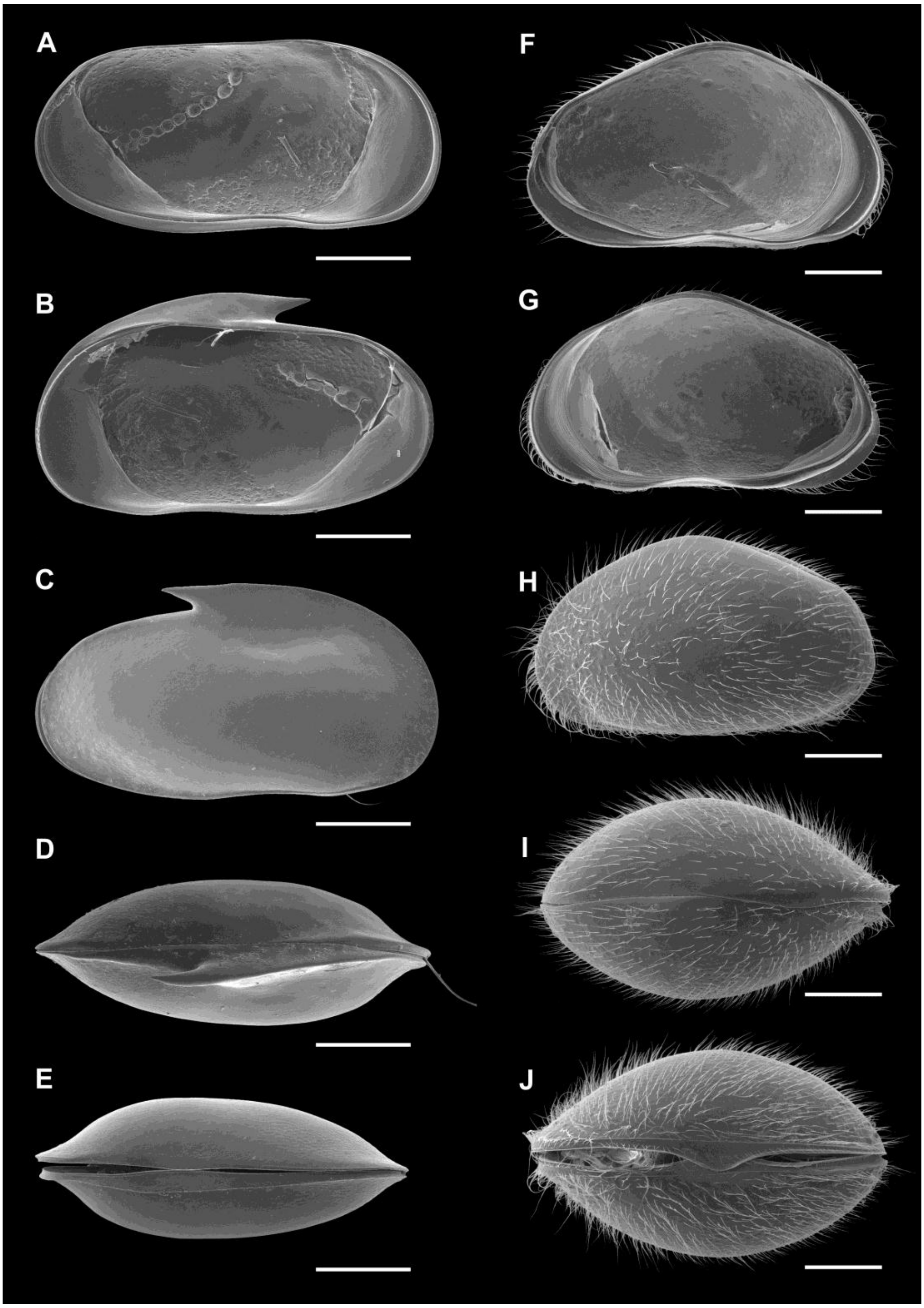

Figure 4. A-E: ***S. bicuspis***; F-J: ***C. hispida* gen. nov.**. A and F. LV, internal view. B and G. RV, internal view. C. Cp, right lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. H. Cp, left lateral view. Scale bars: A-E = 500 µm; F-J = 200 µm.

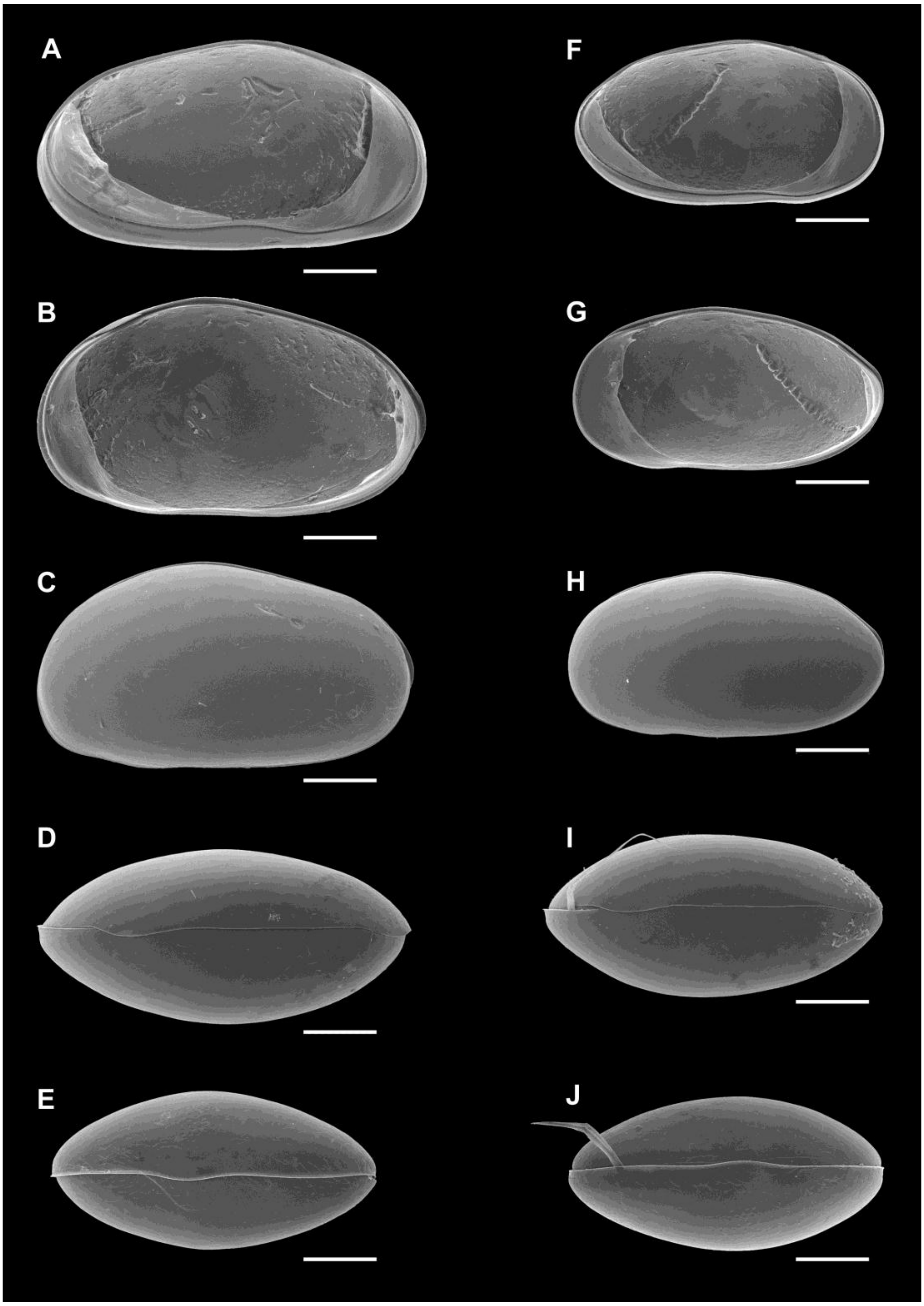

Figure 5. A-E: ***B.* gr. *elliptica* sp. 1**; F-J: ***B.* gr. *elliptica* sp. 2**. A and F. LV, internal view. B and G. RV, internal view. C and H. Cp, left lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-J = 200 µm.

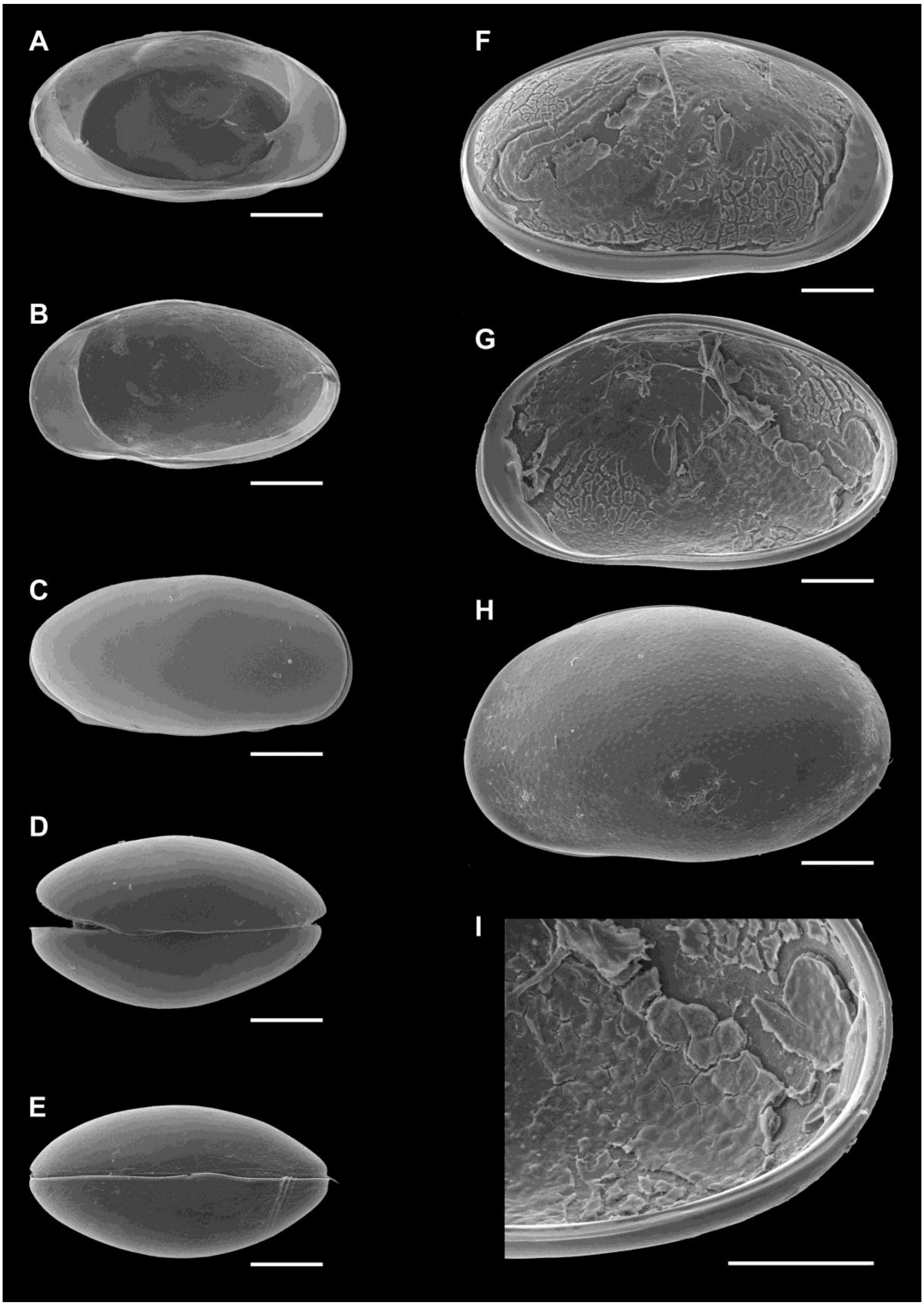

Figure 6. A-E: ***B.* gr. *elliptica* sp. 3**; F-I: ***Bradleystrandesia* sp. 3**. A and F. LV, internal view. B and G. RV, internal view. C. Cp, right lateral view. D. Cp, dorsal view. E. Cp, ventral view. H. Cp, left lateral view. I. detail of posterior part of RV. Scale bars: A-I = 200 µm.

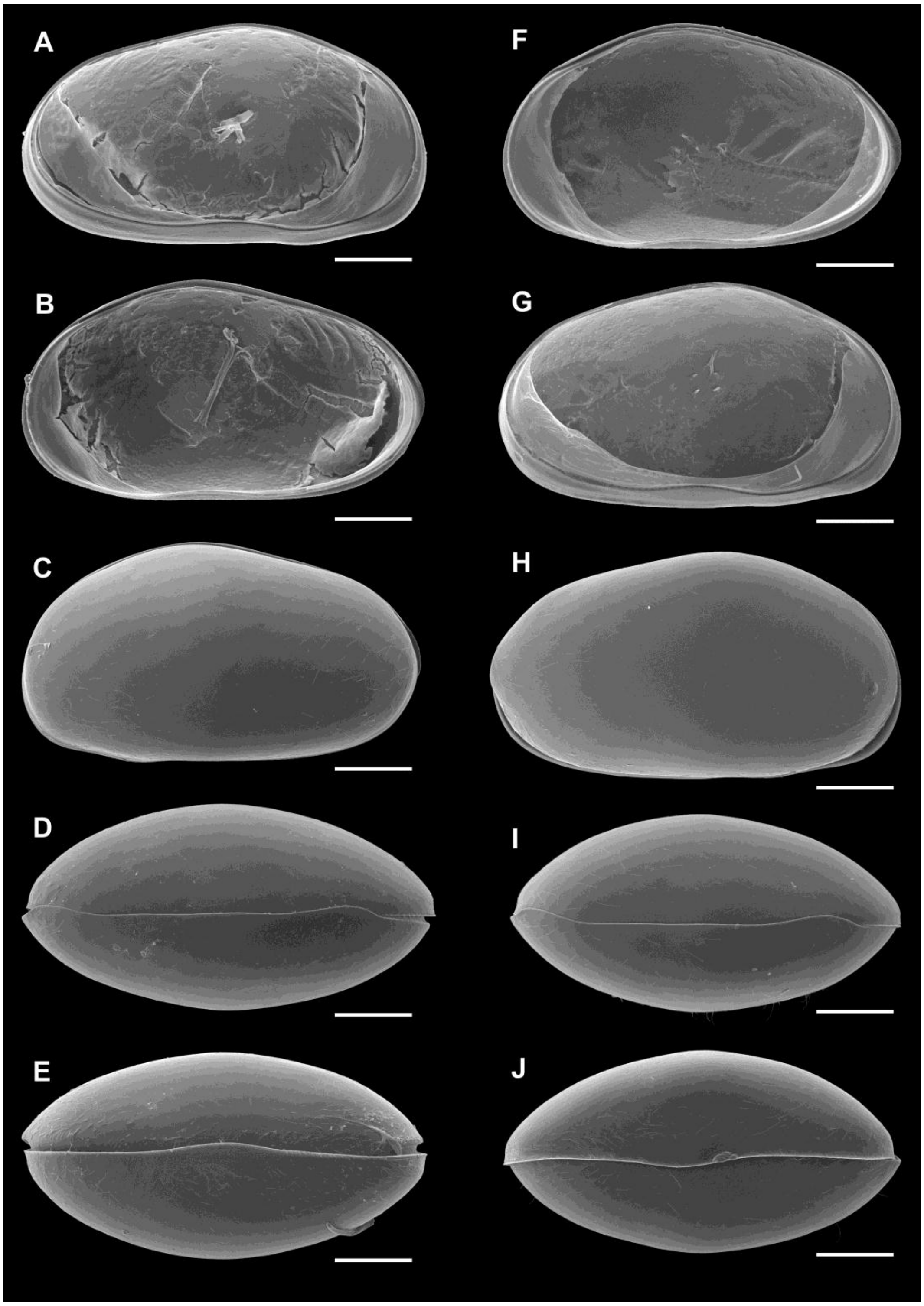

Figure 7. A-E: ***B.* gr. *obtusata* sp. 5**; F-J: ***B. obliqua***. A and F. LV, internal view. B and G. RV, internal view. C. Cp, left lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. H. . Cp, right lateral view. Scale bars: A-J = 200 µm.

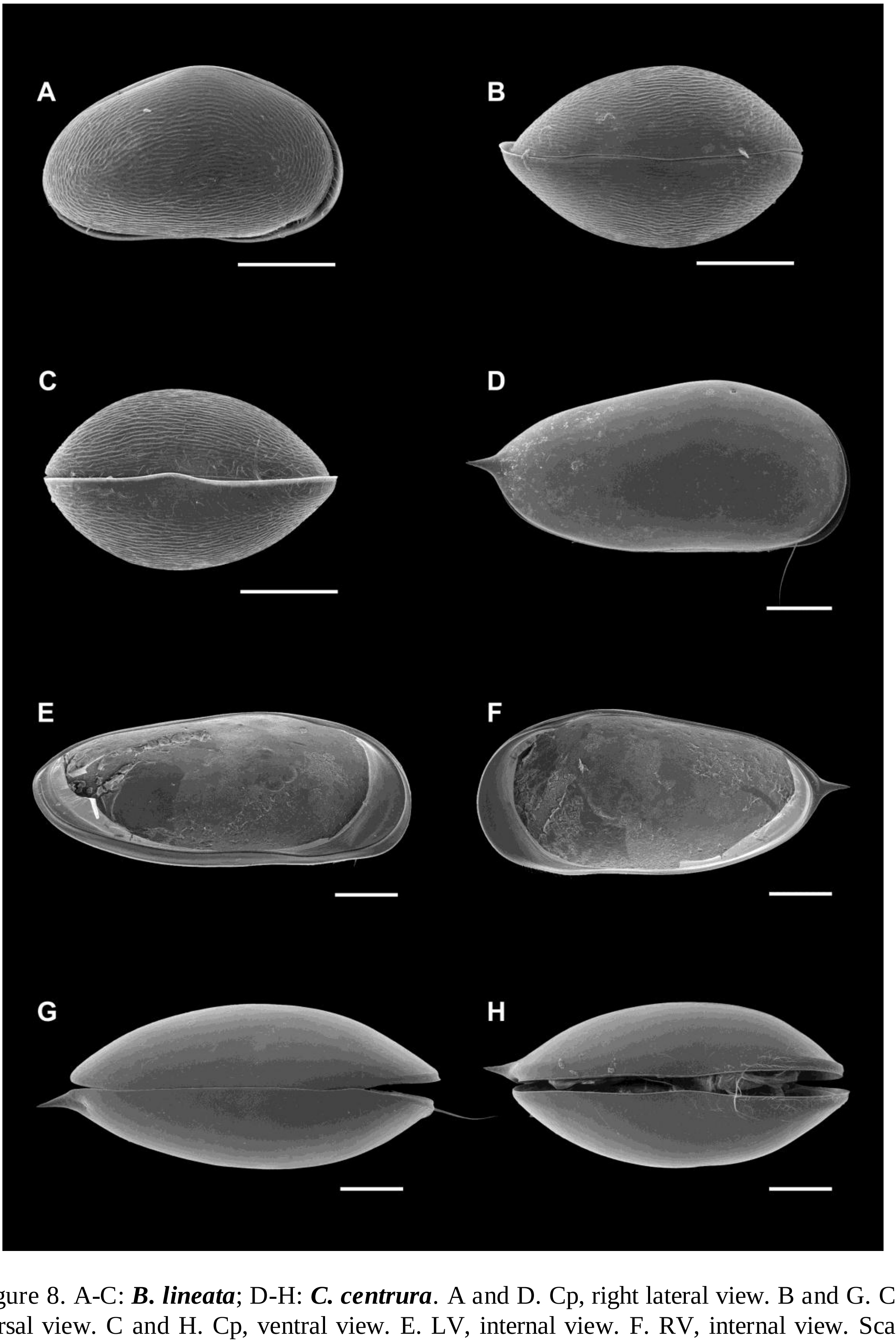

Figure 8. A-C: ***B. lineata***; D-H: ***C. centrura***. A and D. Cp, right lateral view. B and G. Cp, dorsal view. C and H. Cp, ventral view. E. LV, internal view. F. RV, internal view. Scale bars: A-H = 200 µm.

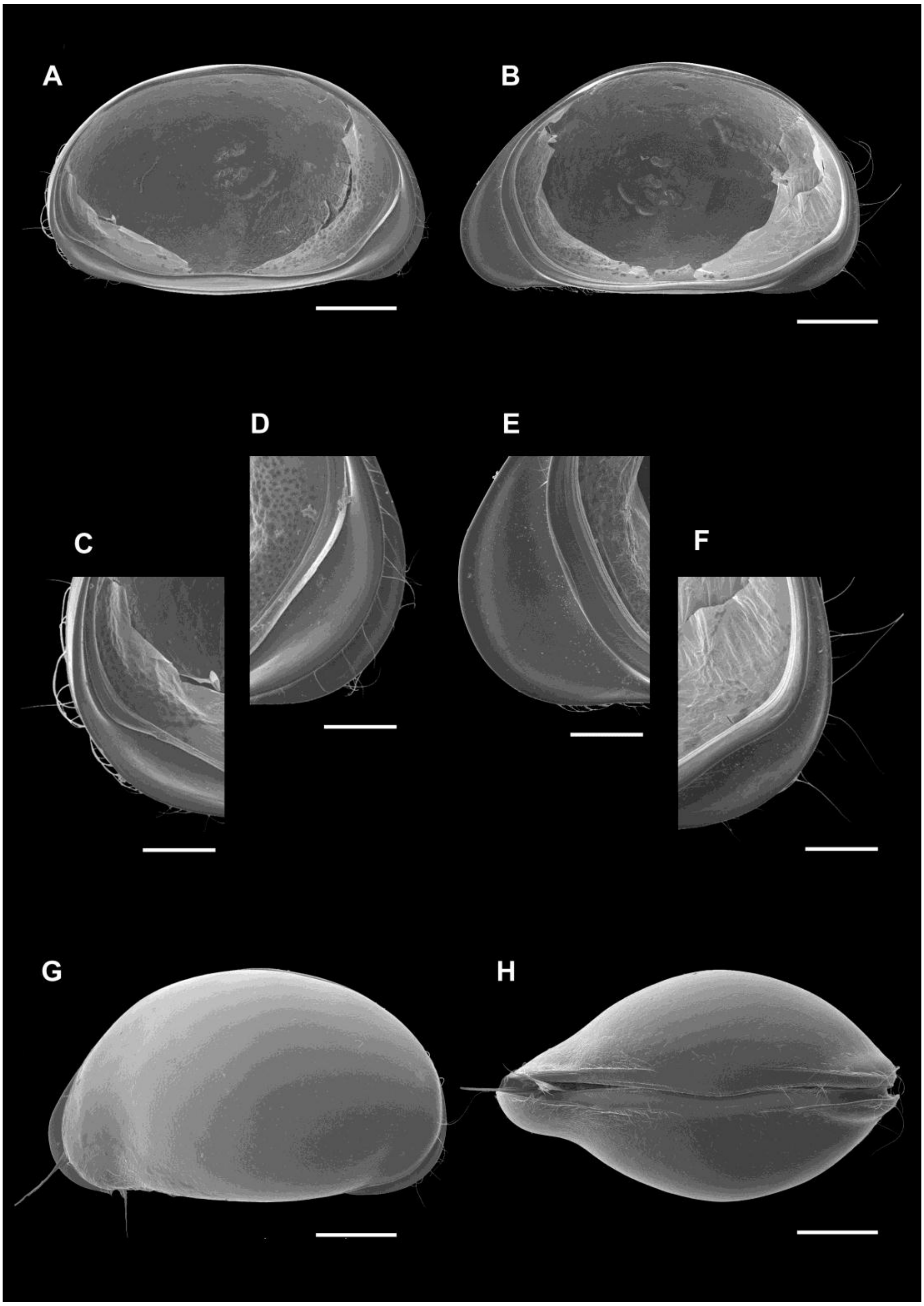

Figure 9. A-H: ***C. deformis***. A. LV, internal view. B. RV, internal view. C. detail of posterior part of LV. D. detail of anterior part of LV. E. detail of anterior part of RV. F. detail of posterior part of RV. G. Cp, left lateral view. D. Cp, ventral view. Scale bars: A, B, G, H = 500 µm; C-F = 200 µm.

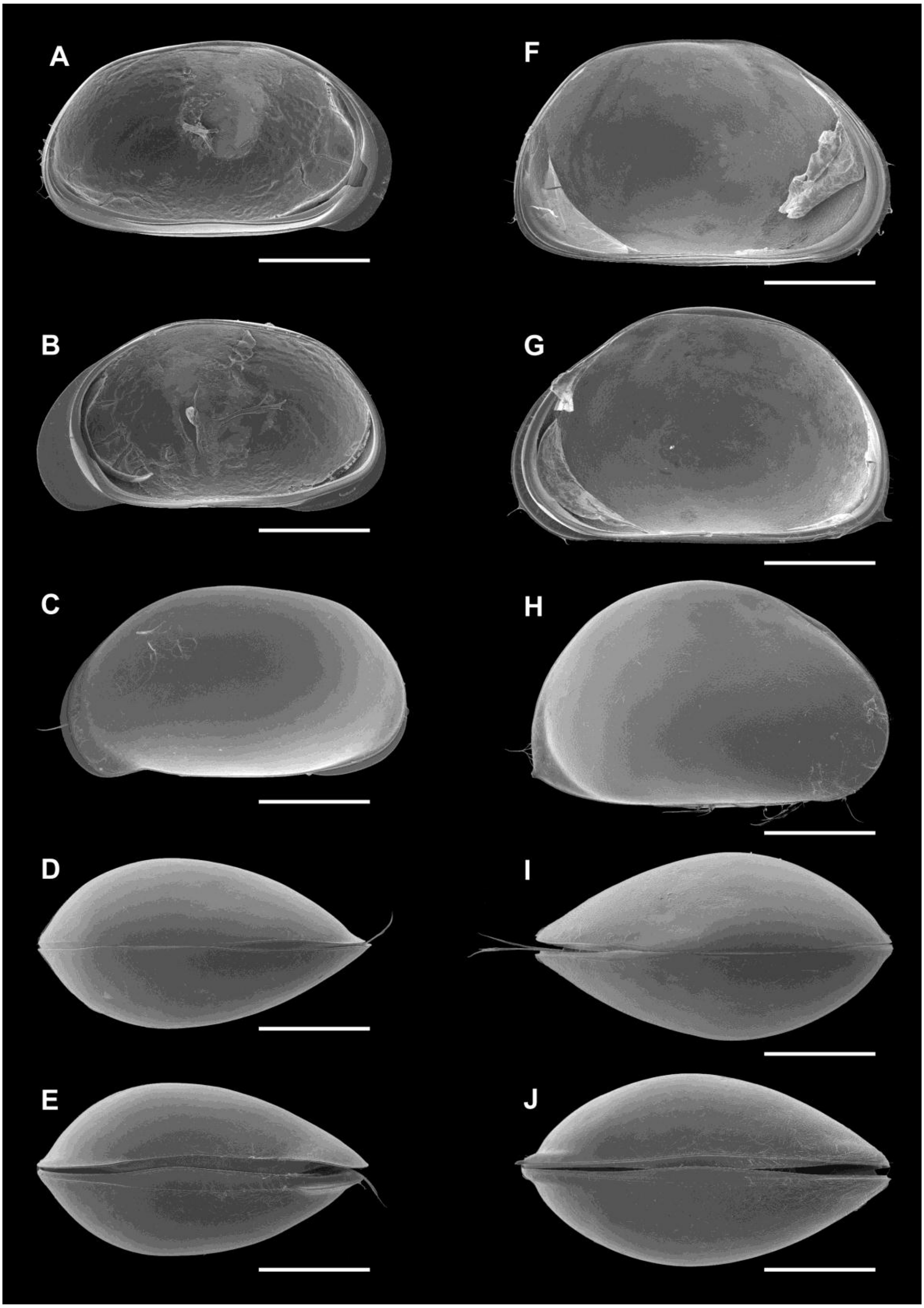

Figure 10. A-E: ***C. colombiensis***; F-J: ***C. iheringi***. A and F. LV, internal view. B and G. RV, internal view. C. Cp, left lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. H. Cp, right lateral view. Scale bars: A-J = 1000 µm.

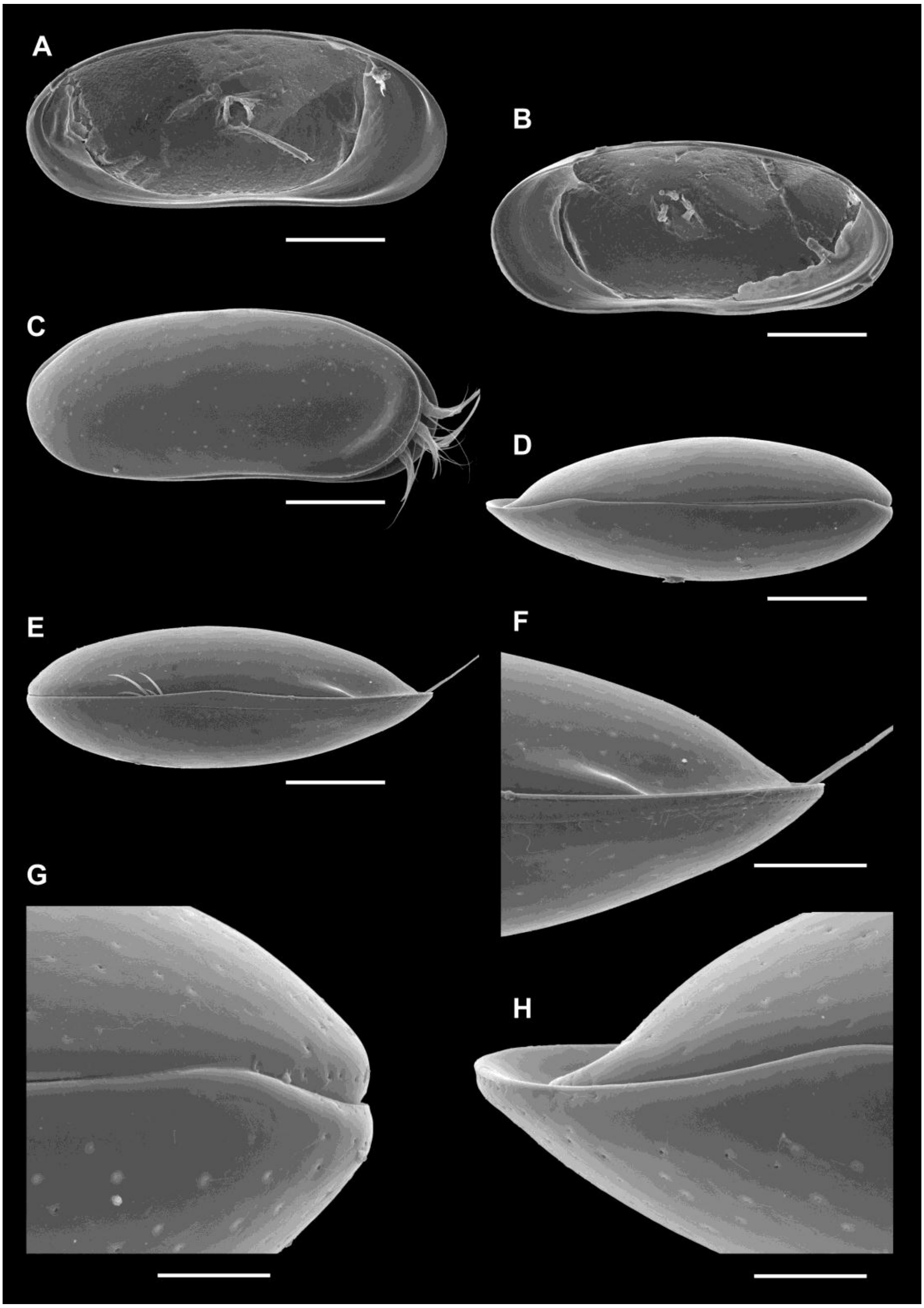

Figure 11. A-H: ***P. samambaiensis***. A. LV, internal view. B. RV, internal view. C. Cp, right lateral view. D. Cp, dorsal view. E. Cp, ventral view. F. detail of anterior part of ventral view. G. detail of posterior part of dorsal view. H. detail of anterior part of dorsal view. Scale bars: A-E = 200 µm; F = 100 µm; G-H = 50 µm.

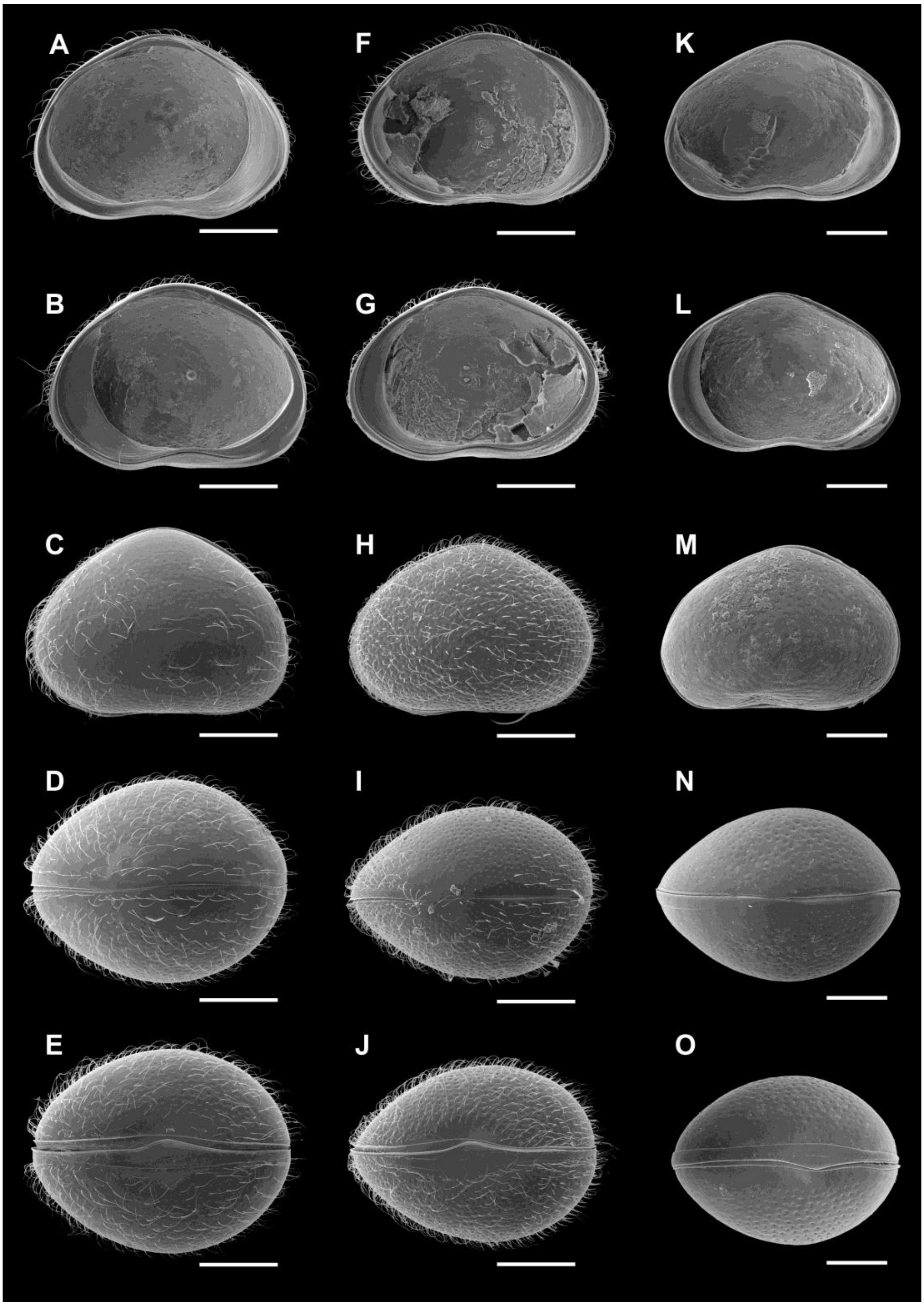

Figure 12. A-E: ***Cypretta costata***; F-J: ***Cypretta vivacis***; K-O: ***Cypretta* n.sp.** A, F and K. LV, internal view. B, G and L. RV, internal view. C, H and M. Cp, left lateral view. D, I and N. Cp, dorsal view. E, J and O. Cp, ventral view. Scale bars: A-J = 200 µm; K-O = 100 µm.

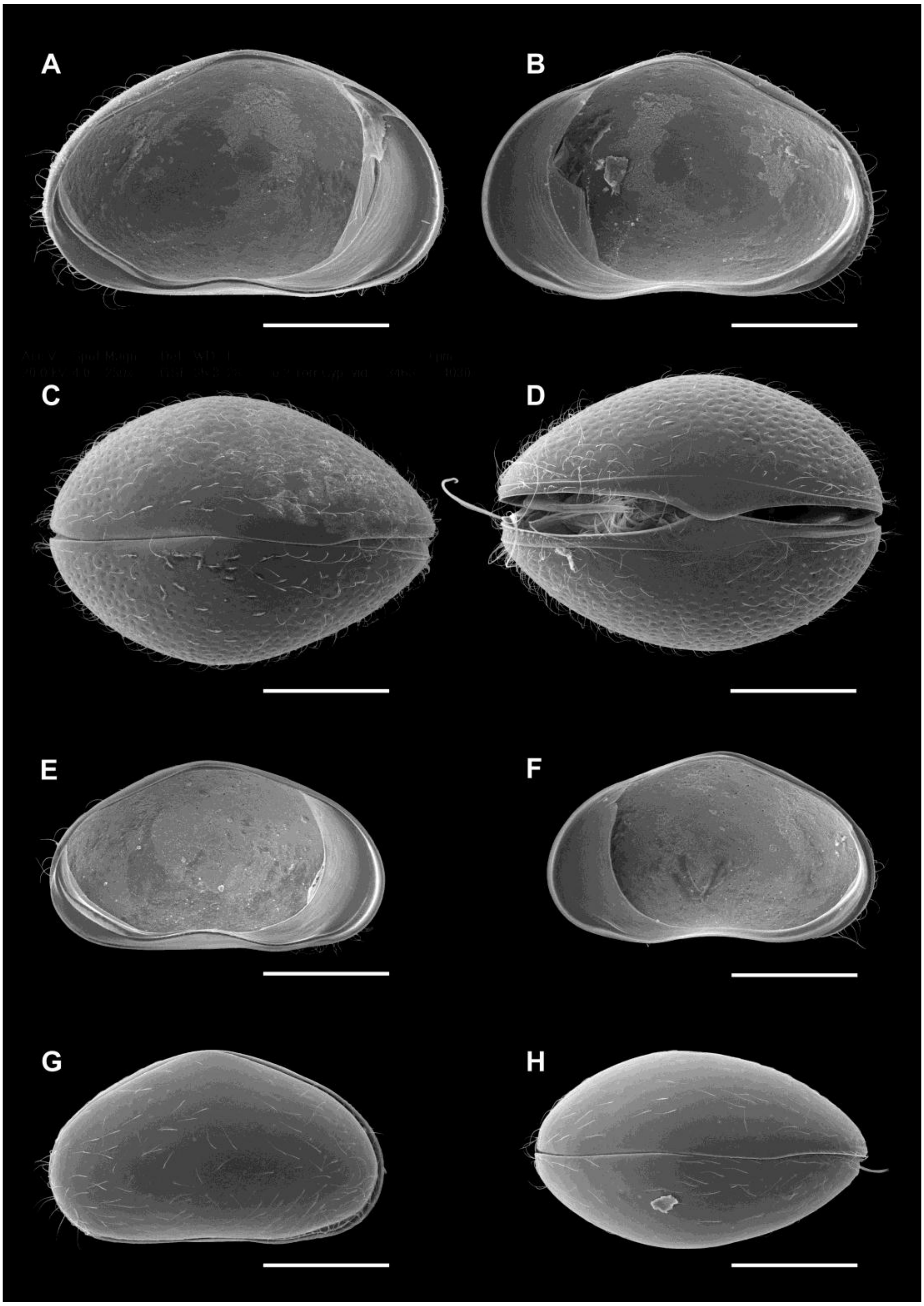

Figure 13. A-D: ***Cypridopsis vidua***; E-H: ***C. vidua*** **sp. 2**. A and E. LV, internal view. B and F. RV, internal view. C and H. Cp, dorsal view. D. Cp, ventral view. G. Cp, right lateral view. Scale bars: A-H = 200 µm.

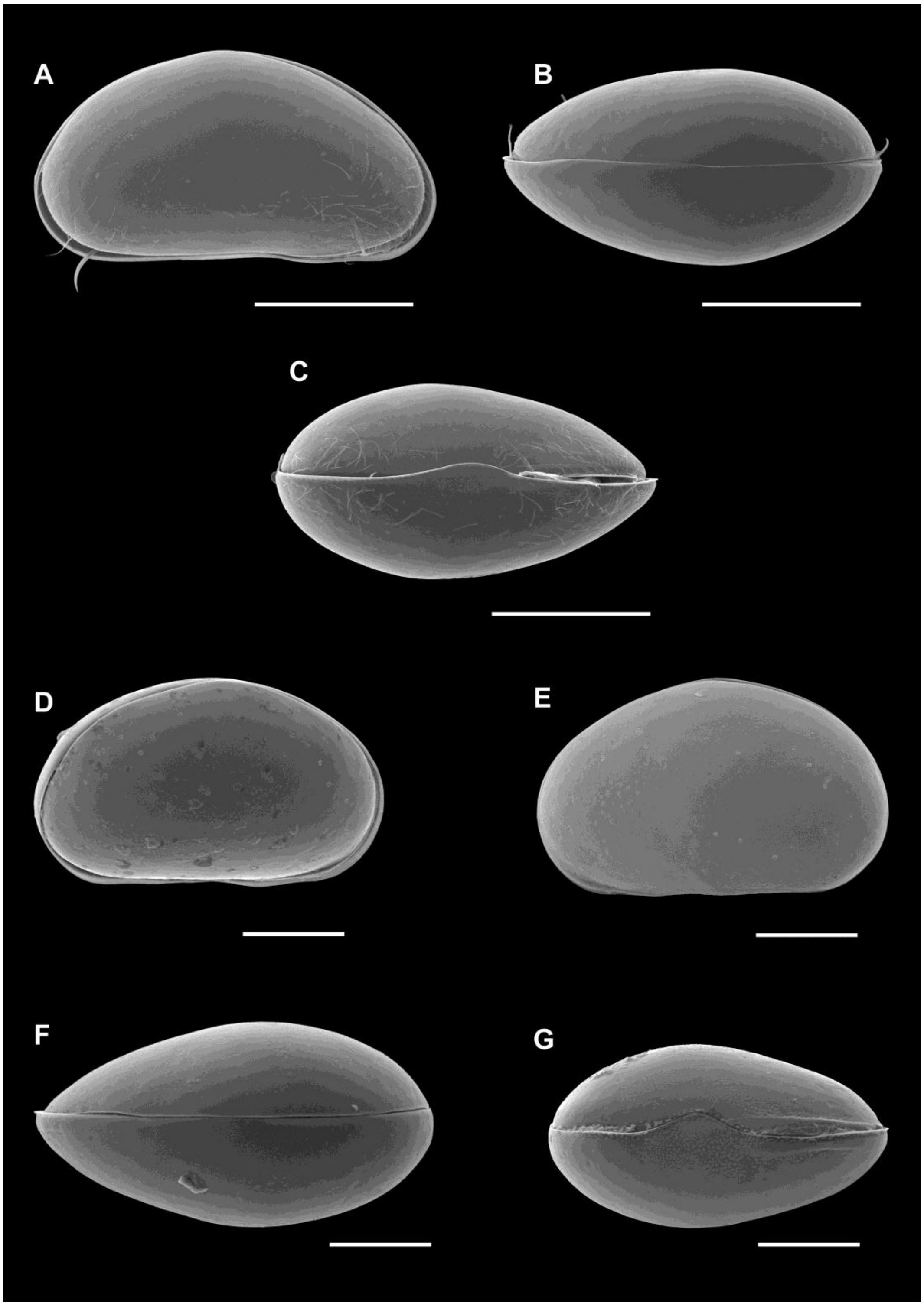

Figure 14. A-C: **“*Cypridopsis*” n.gen. 1 n.sp.**; D-G: ***Neocypridopsis nana***. A and D. Cp, right lateral view. B and F. Cp, dorsal view. C and G. Cp, ventral view. E. Cp, left lateral view. Scale bars: A-C = 200 µm; D-G = 100 µm.

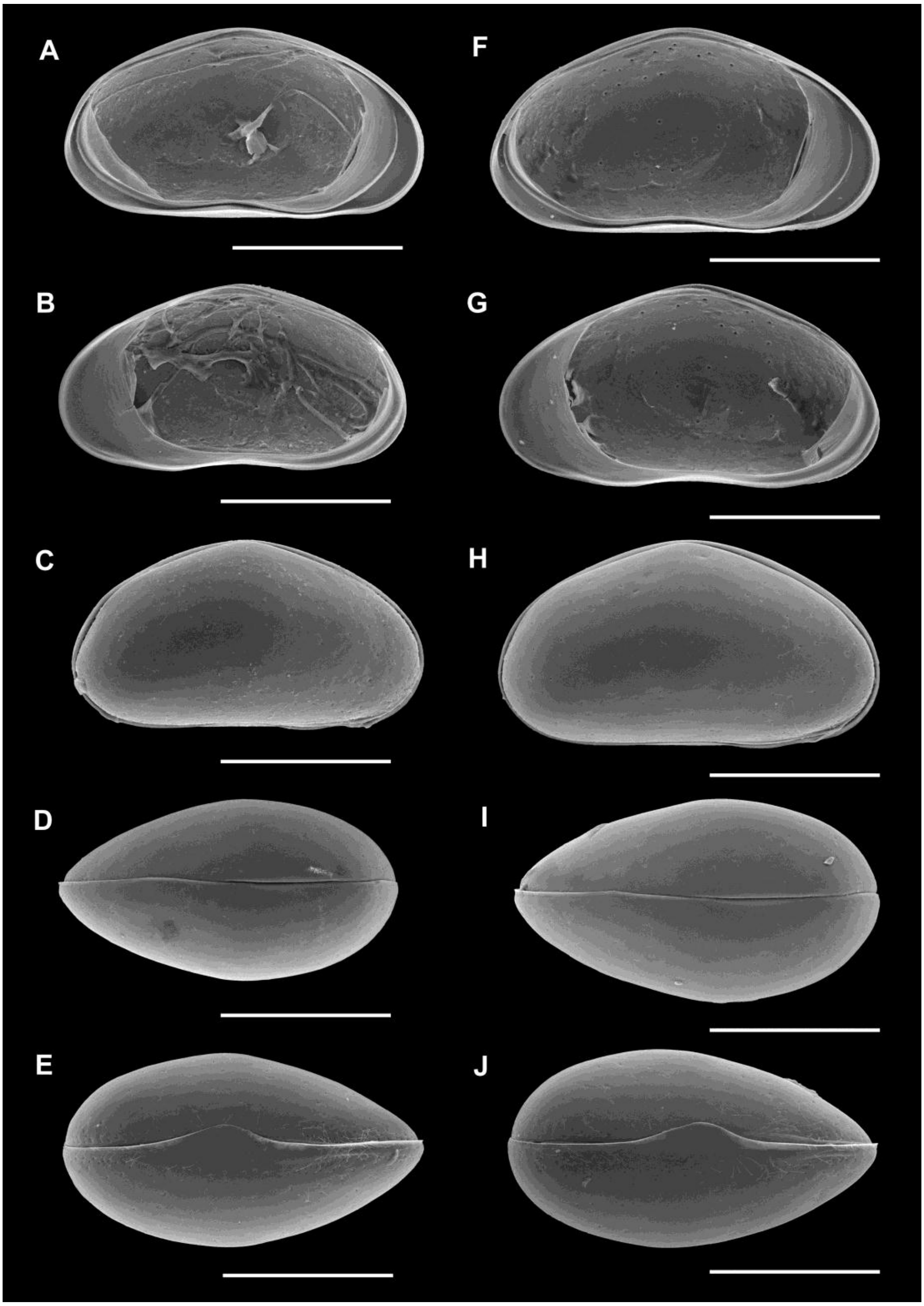

Figure 15. A-E: ***“Cypridopsis”*** **n.gen. 2 n.sp.** ♂; F-J: ***“Cypridopsis”*** **n.gen. 2 n.sp.** ♀. A and F. LV, internal view. B and G. RV, internal view. C and H. Cp, right lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-J = 200 µm.

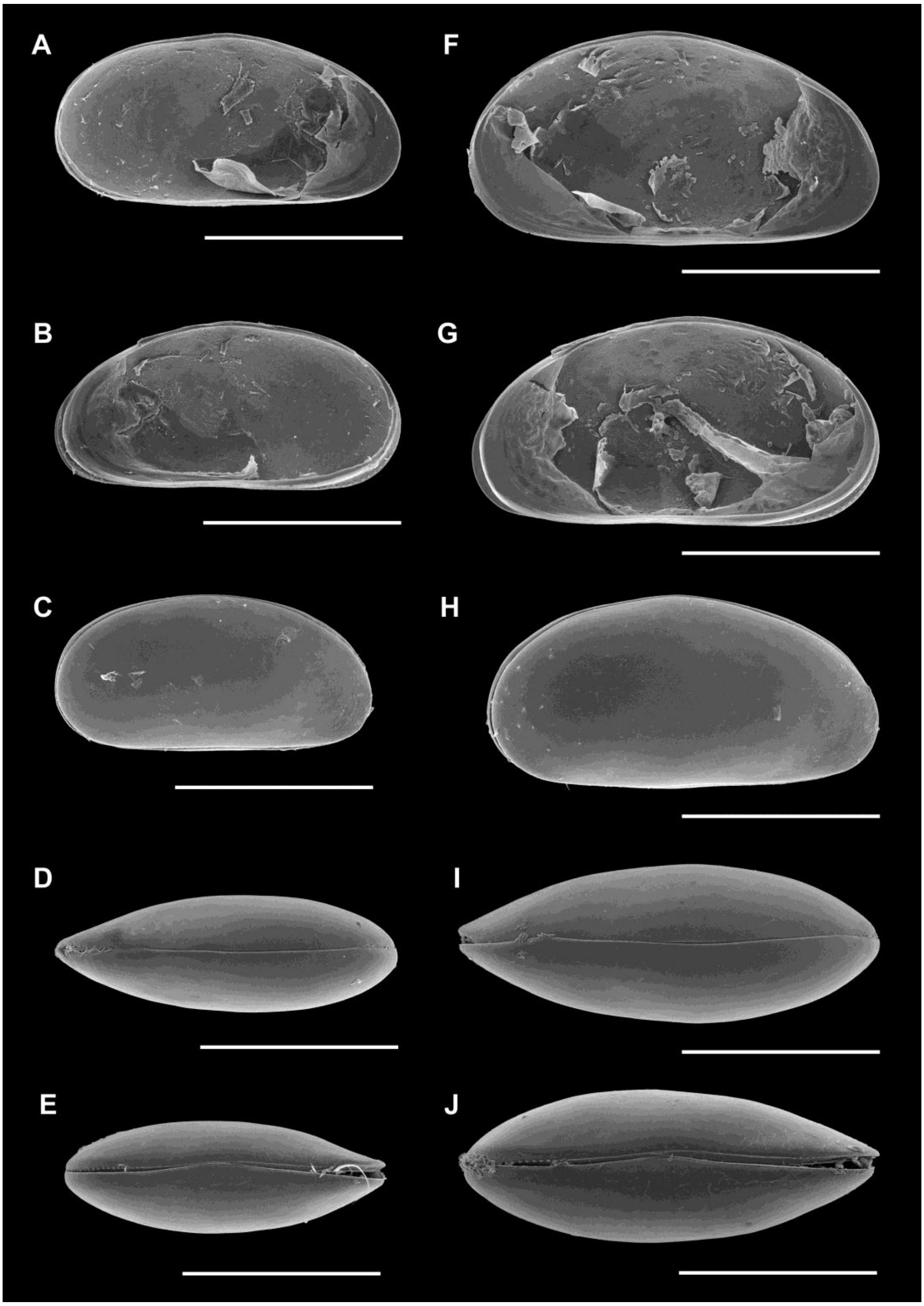

Figure 16. A-E: ***Heterocypris* sp.** ♂; F-J: ***Heterocypris* sp.** ♀. A and F. LV, internal view. B and G. RV, internal view. C and H. Cp, right lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-J = 500 µm.

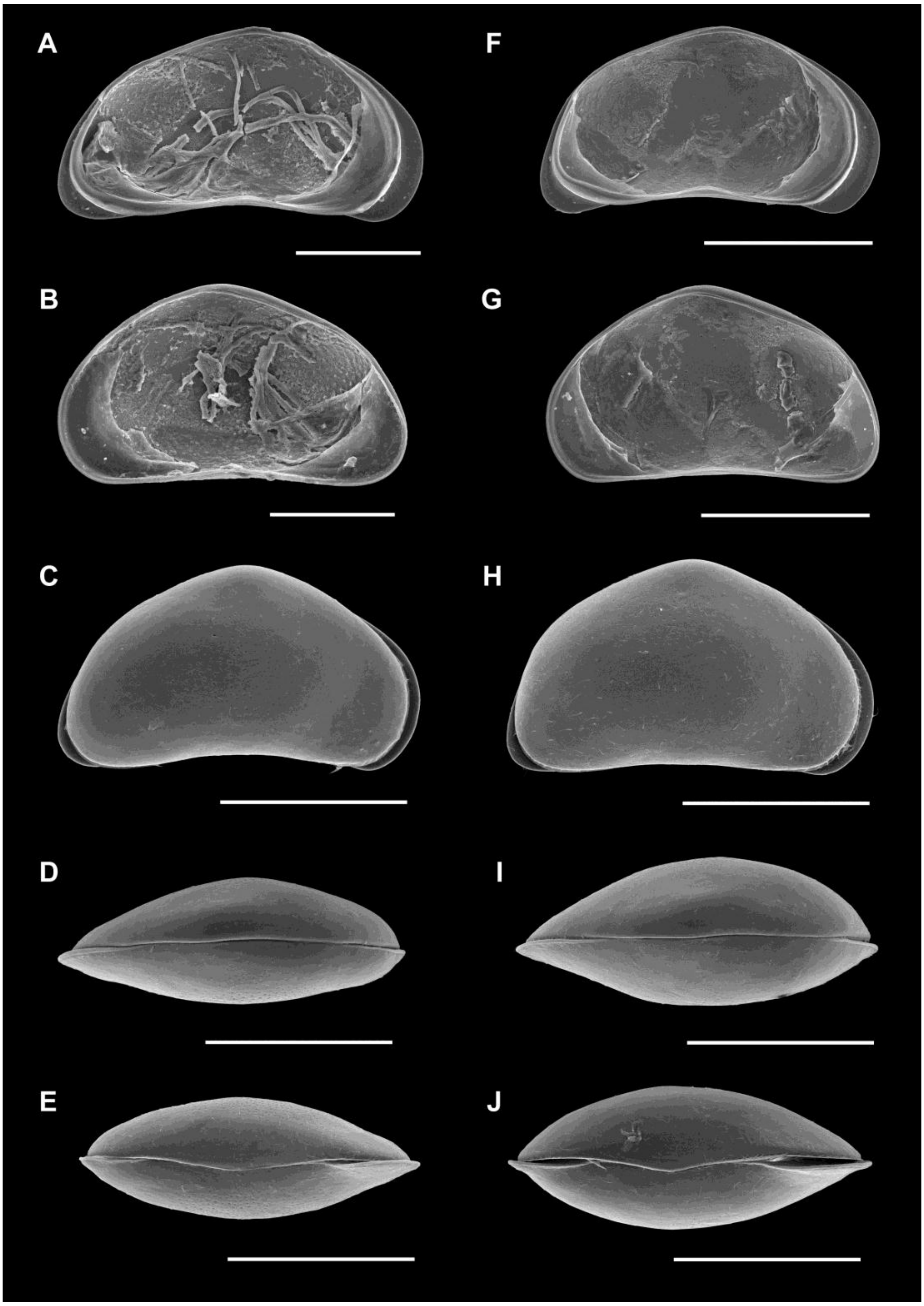

Figure 17. A-E: ***Potamocypris* n. sp.** ♂; F-J: ***Potamocypris* n. sp.** ♀. A and F. LV, internal view. B and G. RV, internal view. C and H. Cp, right lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-B = 200 µm; C-J = 300 µm.

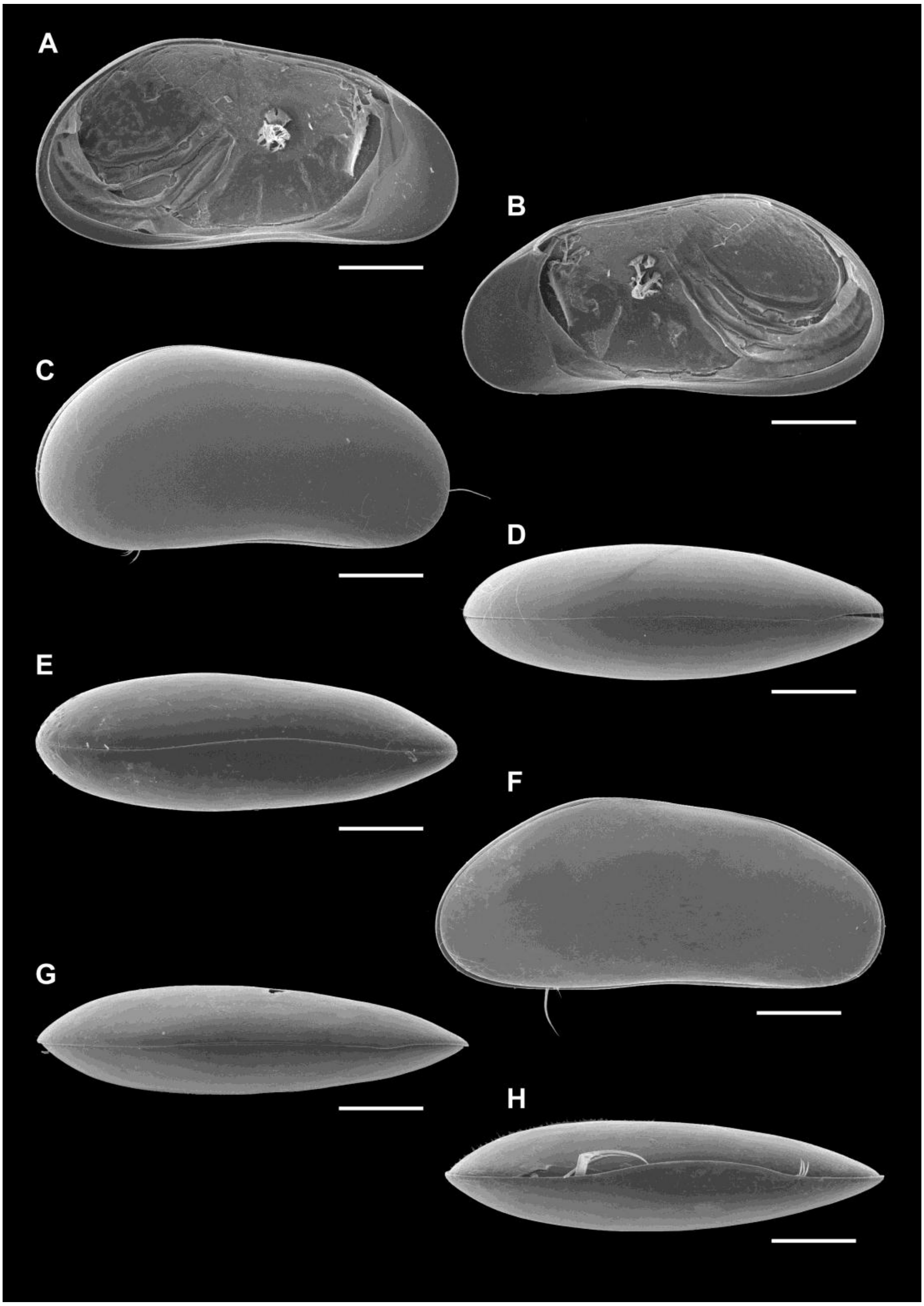

Figure 18. A-E: ***C. brasiliensis* n.gen.** ♂♀; F-H: **“*Candonopsis*” n.gen. n.sp. 3**. ♂. A. LV, internal view. B. RV, internal view. C. Cp, right lateral view (♀). D. Cp, dorsal view (♀). E and H. Cp, ventral view. F. Cp, right lateral view. G. Cp, dorsal view. Scale bars: A-H = 200 µm.

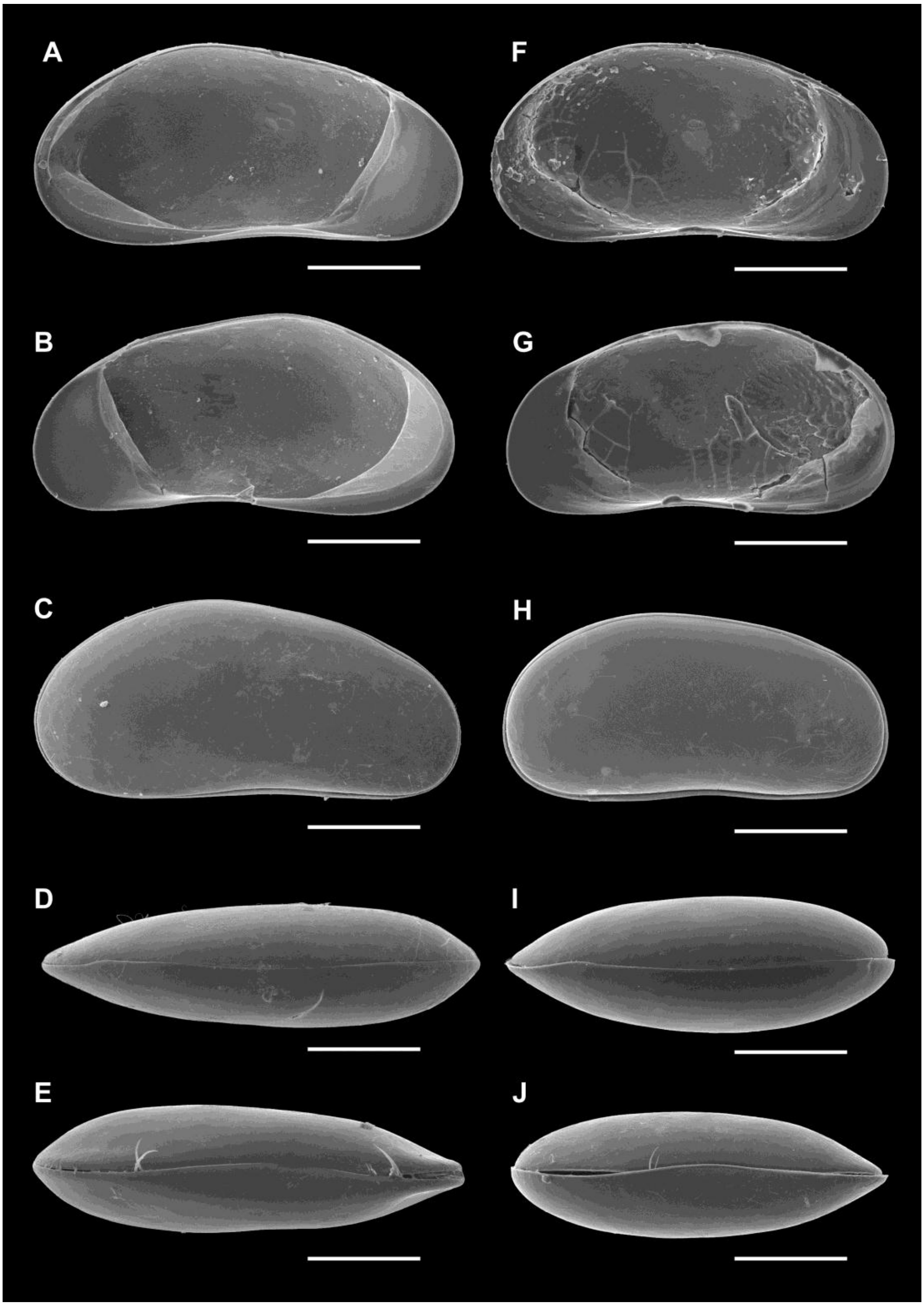

Figure 19. A-E: ***C. rochai* n.gen. n.sp**. ♂; F-J: **"*Candonopsis*" n.gen. n.sp. 4.** ♀. A and F. LV, internal view. B and G. RV, internal view. C and H. Cp, right lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-J = 200 µm.

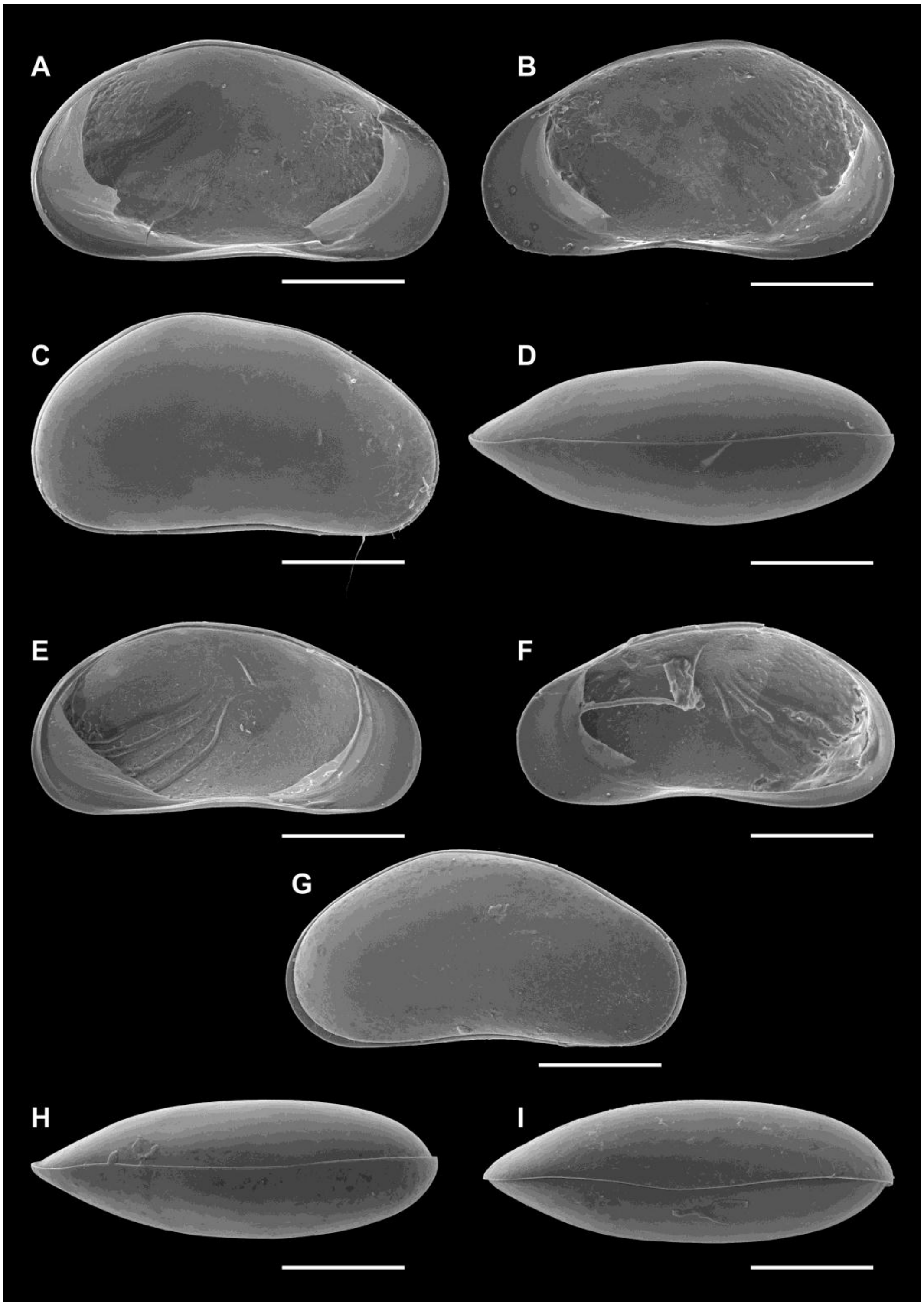

Figure 20. A-D: ***“Candona”* sp. 1 n.sp.** ♂; E-I: ***“Candona”* sp. 2 n.sp.** ♂. A and E. LV, internal view. B and F. RV, internal view. C and G. Cp, right lateral view. D and H. Cp, dorsal view. I. Cp, ventral view. Scale bars: A-I = 200 µm.

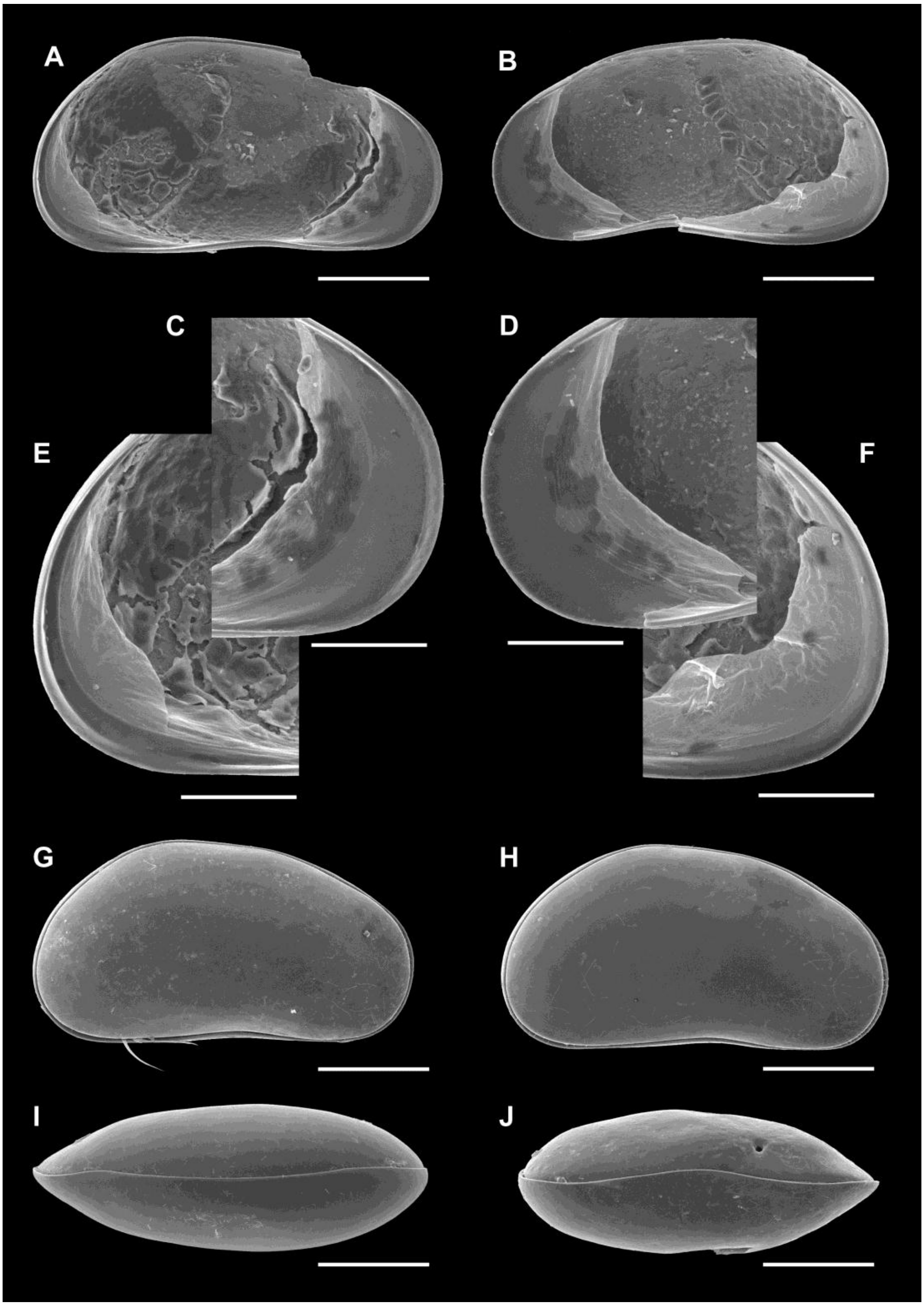

Figure 21. A-G: ***“Candona”* sp. 3 n.sp.** ♀; H-J: ***“Candona”* sp. 4 n.sp.** ♀. A. LV, internal view. B. RV, internal view. C. detail of anterior part of LV. D. detail of anterior part of RV. E. detail of posterior part of LV. F. detail of posterior part of RV. G and H. Cp, right lateral view. I. Cp, dorsal view. J. Cp, ventral view. Scale bars: A, B, G-J = 200 µm; C-F = 100 µm.

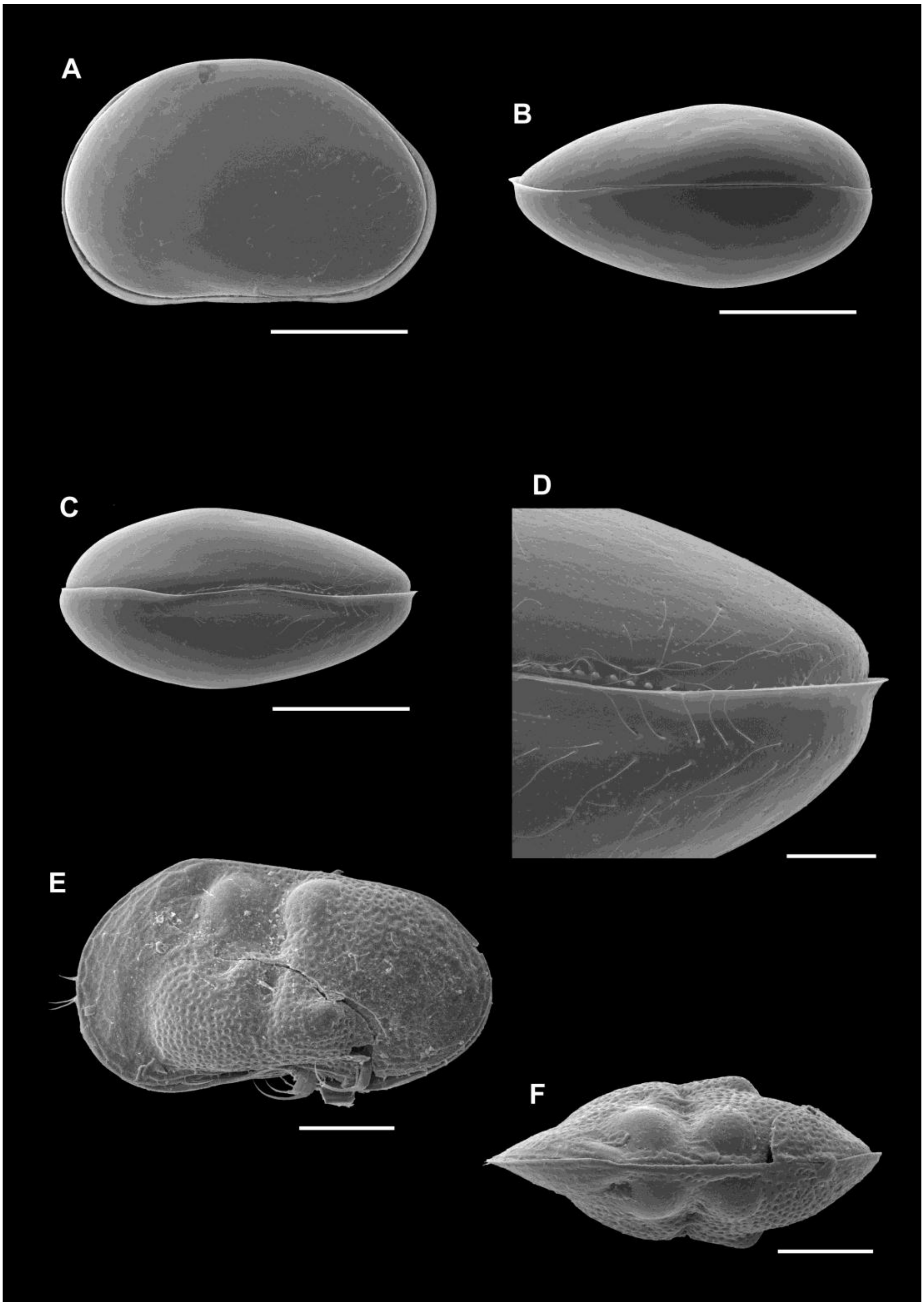

Figure 22. A-D: ***Physocypria schubarti***; E-F: ***Limnocythere* sp. 1**. A Cp, right lateral view. B and F. Cp, dorsal view. C. Cp, ventral view. D. detail of anterior part of ventral view. E. Cp, left lateral view. Scale bars: A-C = 200 µm; D = 50 µm; E-F = 100 µm.

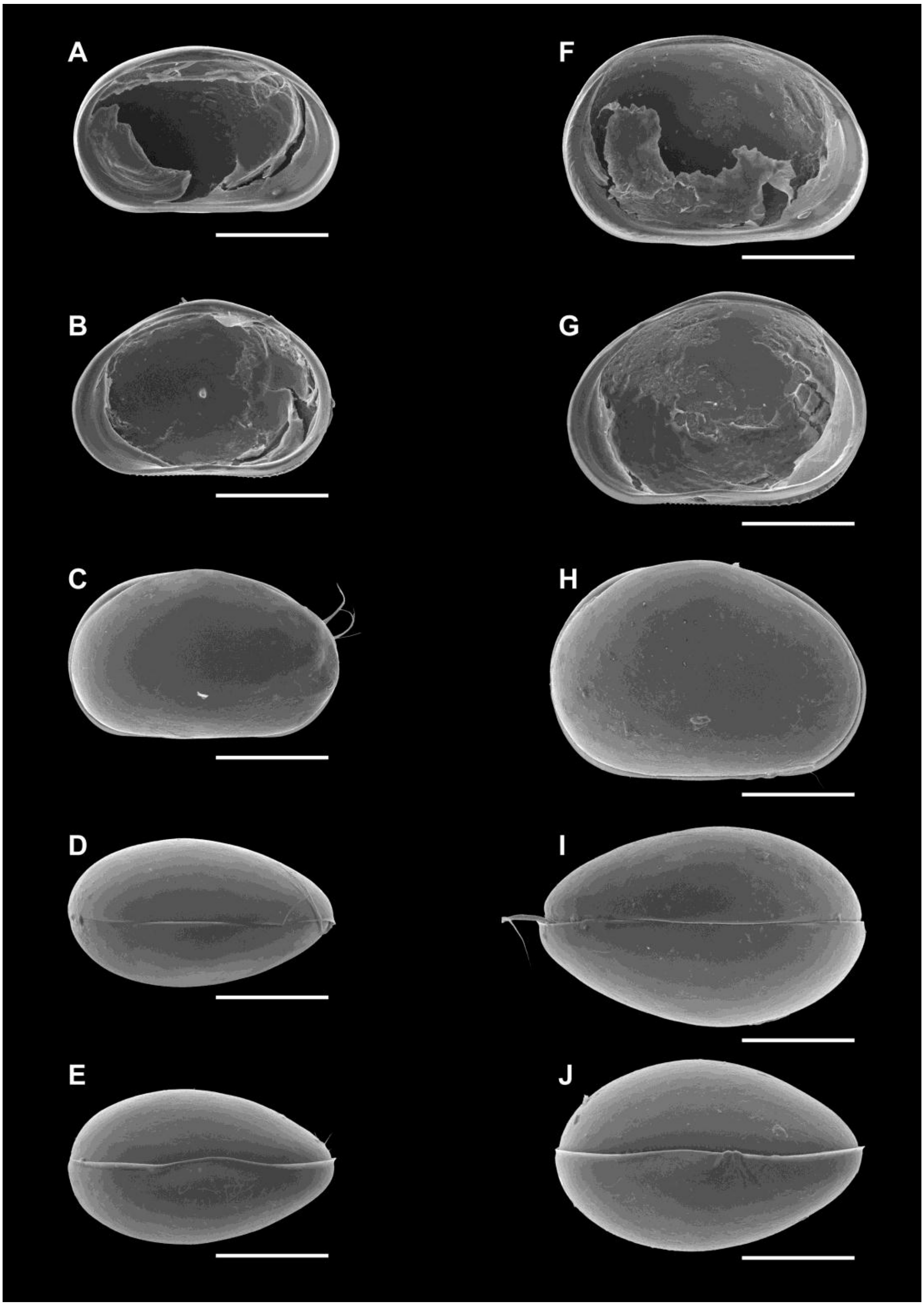

Figure 23. A-E: ***Physosypria* sp. 2** ♂; F-J: ***Physosypria* sp. 2** ♀. A and F. LV, internal view. B and G. RV, internal view. C and H. Cp, right lateral view. D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-J = 200 µm.

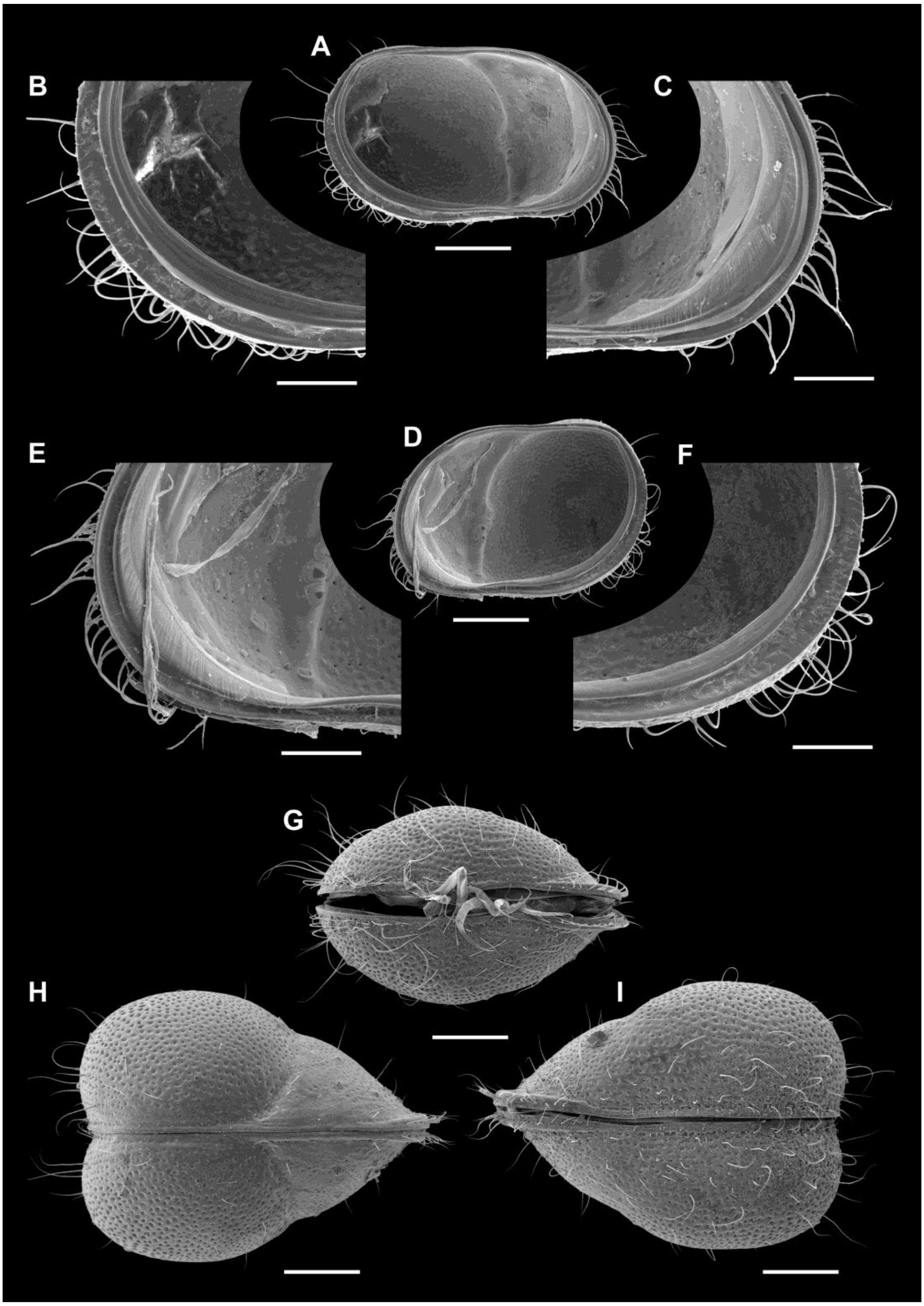

Figure 24. A-I: ***C. ilosvayi***. A. LV, internal view. B. detail of posterior part of LV. C. detail of anterior part of LV. D. RV, internal view. E detail of anterior part of RV. F. detail of posterior part of RV. G. Cp, ventral view of male. H. Cp, dorsal view of female. I. Cp, ventral view of female. Scale bars: A, D, G-I = 200 µm; B, C, E, F = 100 µm.

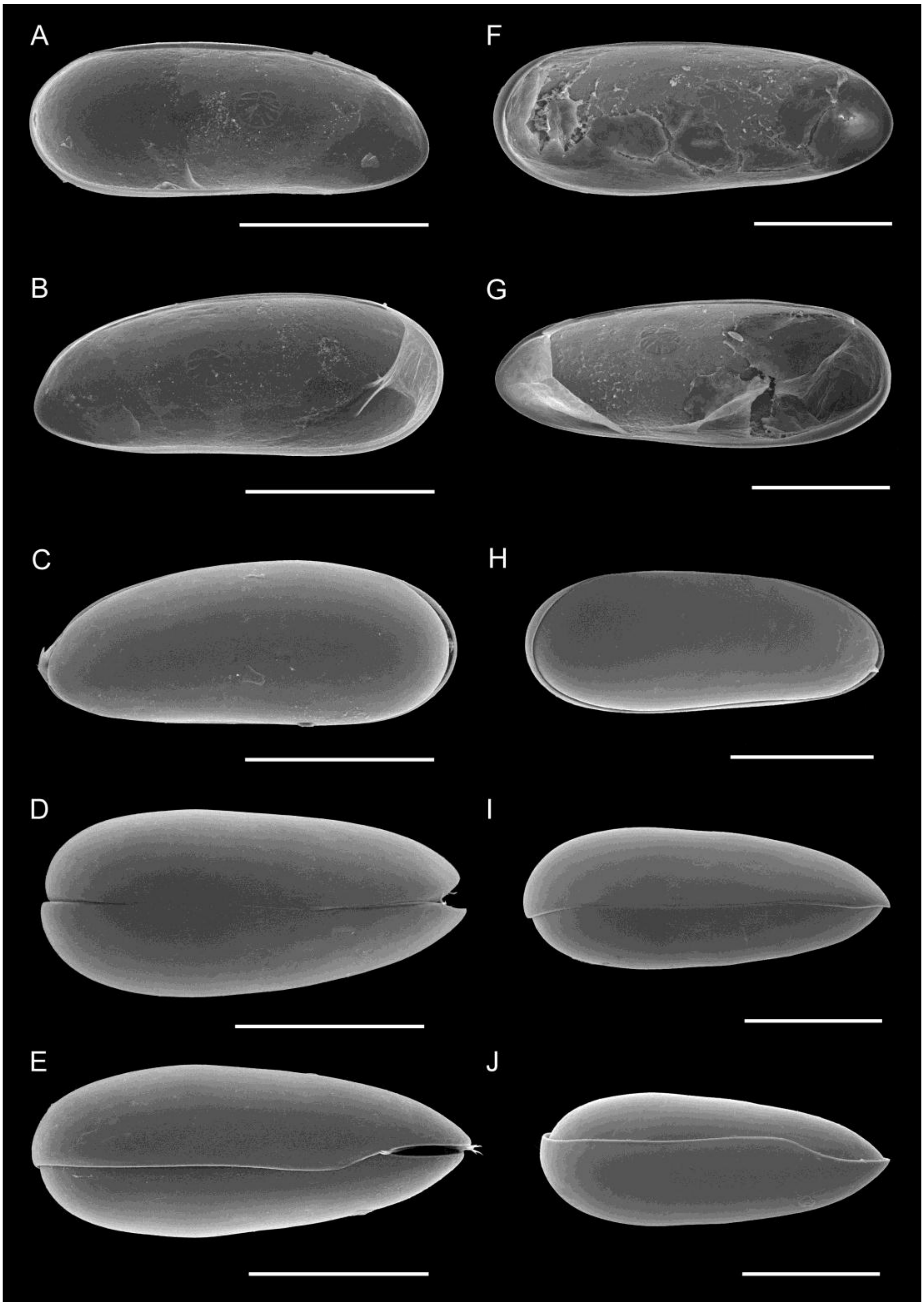

Figure 25. A-E: ***D. stevensoni***; F-J: ***A. serricaudata***. A and F. LV, internal view. B and G. RV, internal view. C. Cp, left lateral view. H. Cp, right lateral view D and I. Cp, dorsal view. E and J. Cp, ventral view. Scale bars: A-E = 300 µm; F - J = 200 µm.

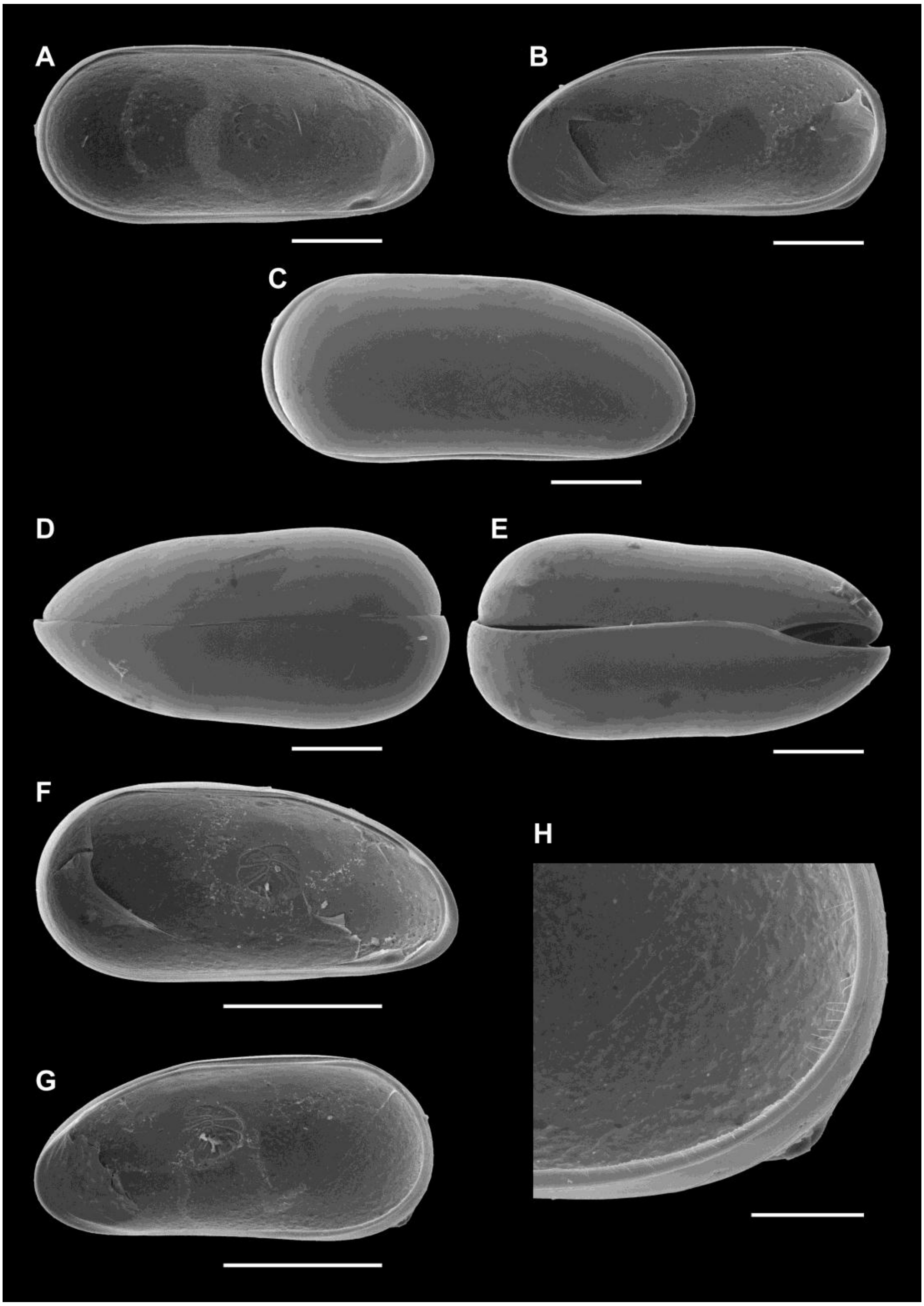

Figure 26. A-E: ***V. pagliolii***; F-H: ***V. botocuda***. A and F. LV, internal view. B and G. RV, internal view. C. Cp, right lateral view. D. Cp, dorsal view. E. Cp, ventral view. H. detail of posterior part of RV. Scale bars: A-E = 100 µm; F, G = 200 µm; H = 50 µm.

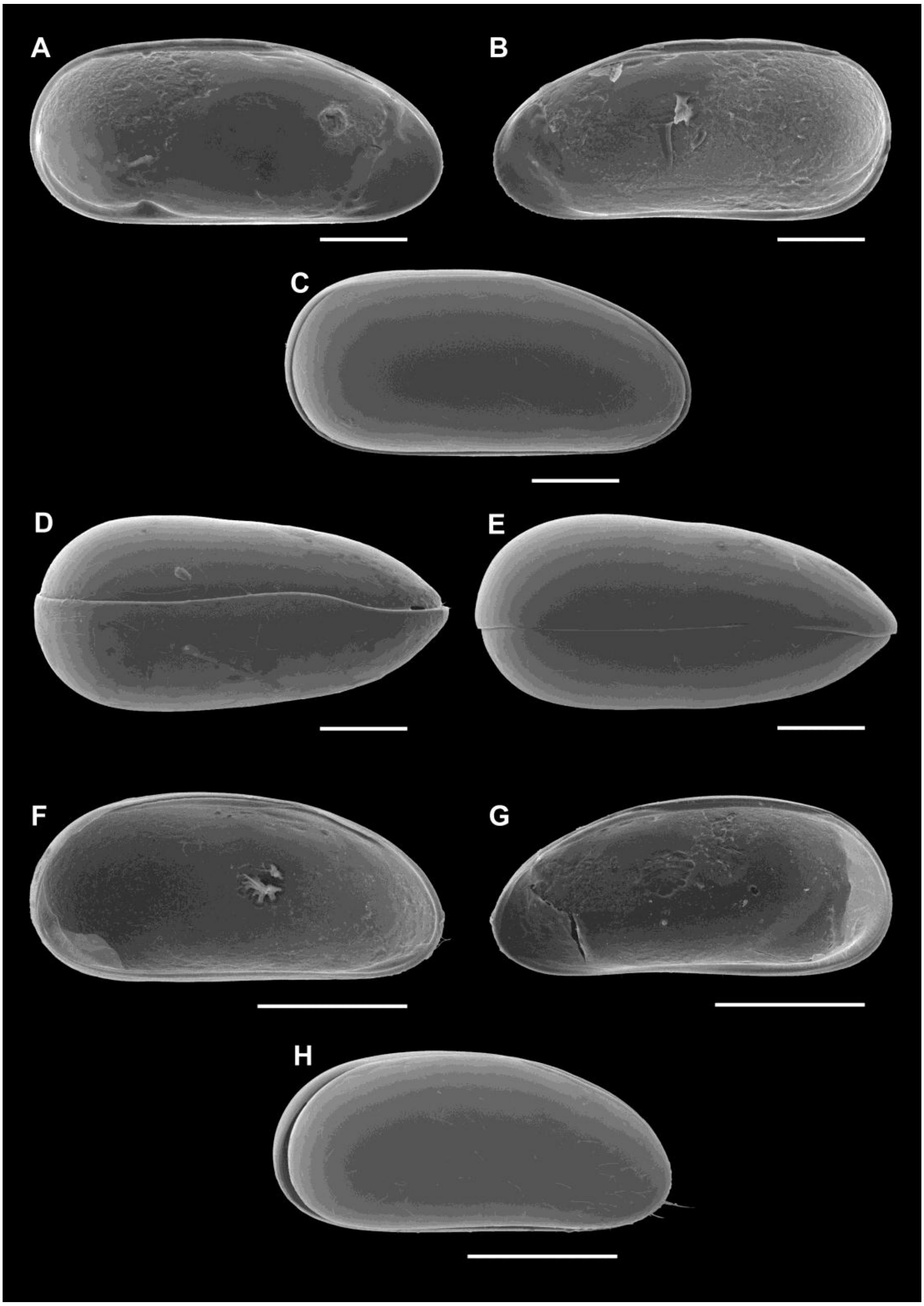

Figure 27. A-E: ***P. brasiliensis***; F-H: ***P. aotearoa***. A and F. LV, internal view. B and G. RV, internal view. C and H Cp, right lateral view. D. Cp, dorsal view. E. Cp, ventral view. Scale bars: A-E = 100 µm; F-H = 200 µm.

Appendix 2

Description of a new genus and species of Candoninae (Crustacea, Ostracoda) from Brazil, with a discussion on the evolution of the *Candonopsini*.

Janet HIGUTI and Koen MARTENS

This manuscript is in preparation. The valves of *Candobrasilopsis rochai* gen.nov., sp. nov. and of *C. brasiliensis* gen. nov. are illustrated in figures 1 and 11, respectively. The soft parts of *Candobrasilopsis rochai* gen.nov., sp. nov. are illustrated in figures 2, 3, 4, 5 and 6, and of *C. brasiliensis* gen. nov. in figures 6, 7, 8, 9 and 10.

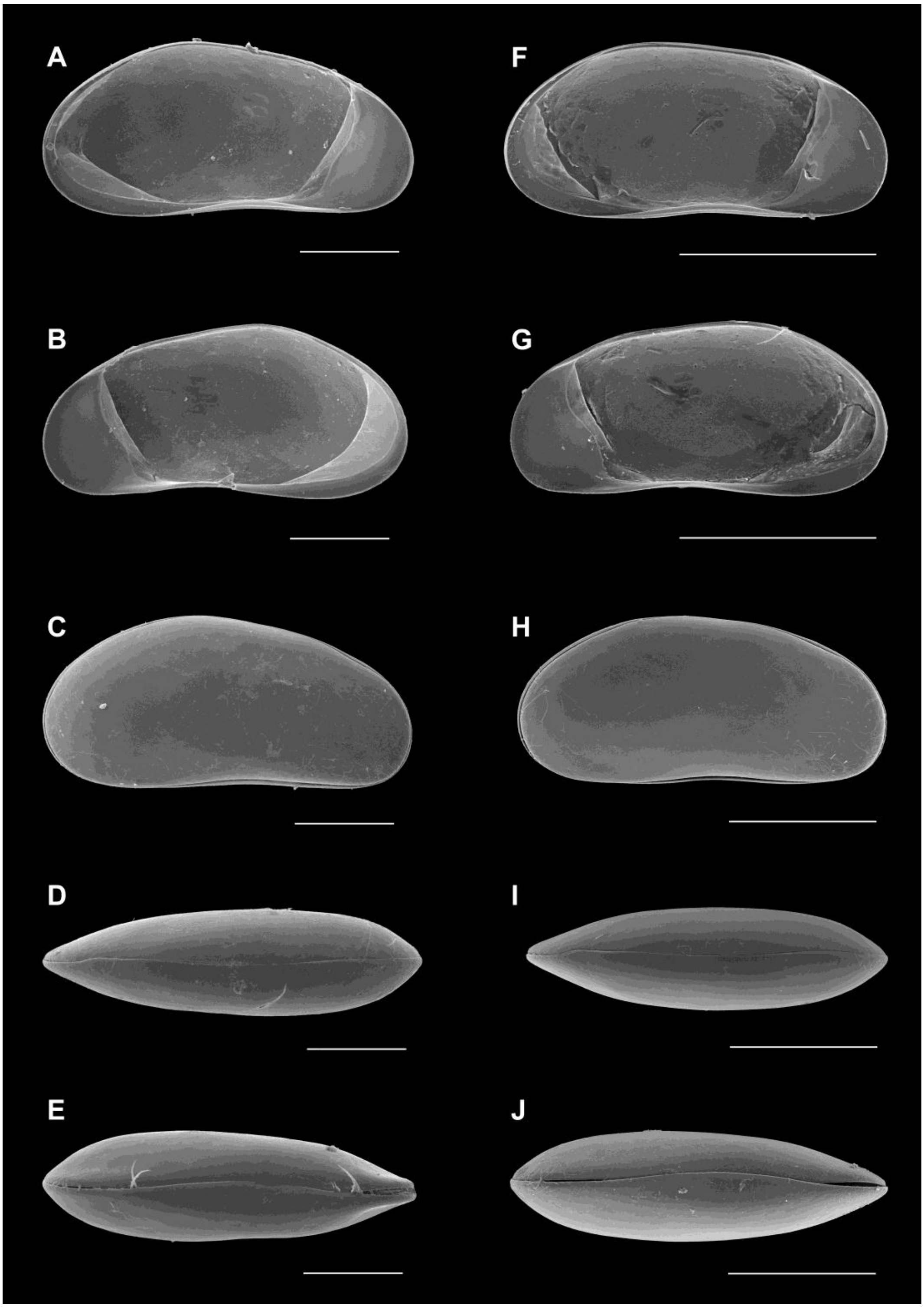

Figure 1. Valves of *Candobrasilopsis rochai* gen.nov. sp. nov. A-E male and F-J female. A (JH 071), F (JH 240) LV, internal view. B (JH 071), G (JH 240) RV, internal view. C (JH 072), H (JH 241) Cp, right lateral view. D (JH 166), I (JH 242) Cp, dorsal view. E (JH 165), J (JH 243) Cp, ventral view. Scale bars: A-E, 200 µm; F, G, 400 µm; H-J, 300 µm.

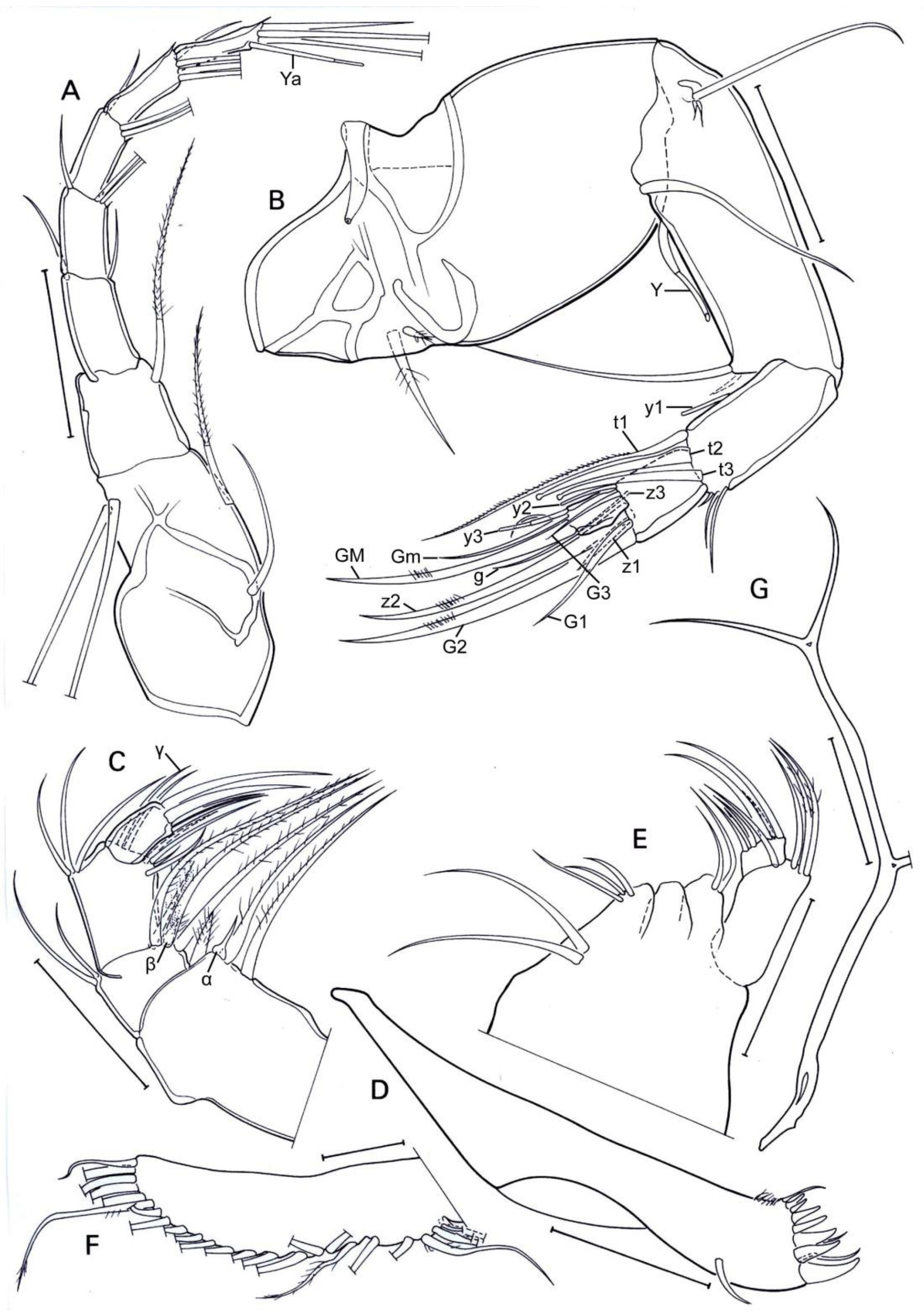

Figure 2. Limbs of *Candobrasilopsis rochai* gen.nov. sp. nov. (male). A. A1 (JH 215). B. A2 (JH 222). C. Md palp (JH 222). D. Md, coxal plate (JH 220). E. Mx1 (JH 229). F. Mx1, respiratory plate (JH 222). G. attachment of the caudal ramus (JH 217). Scale bars: A-G, 50 μm.

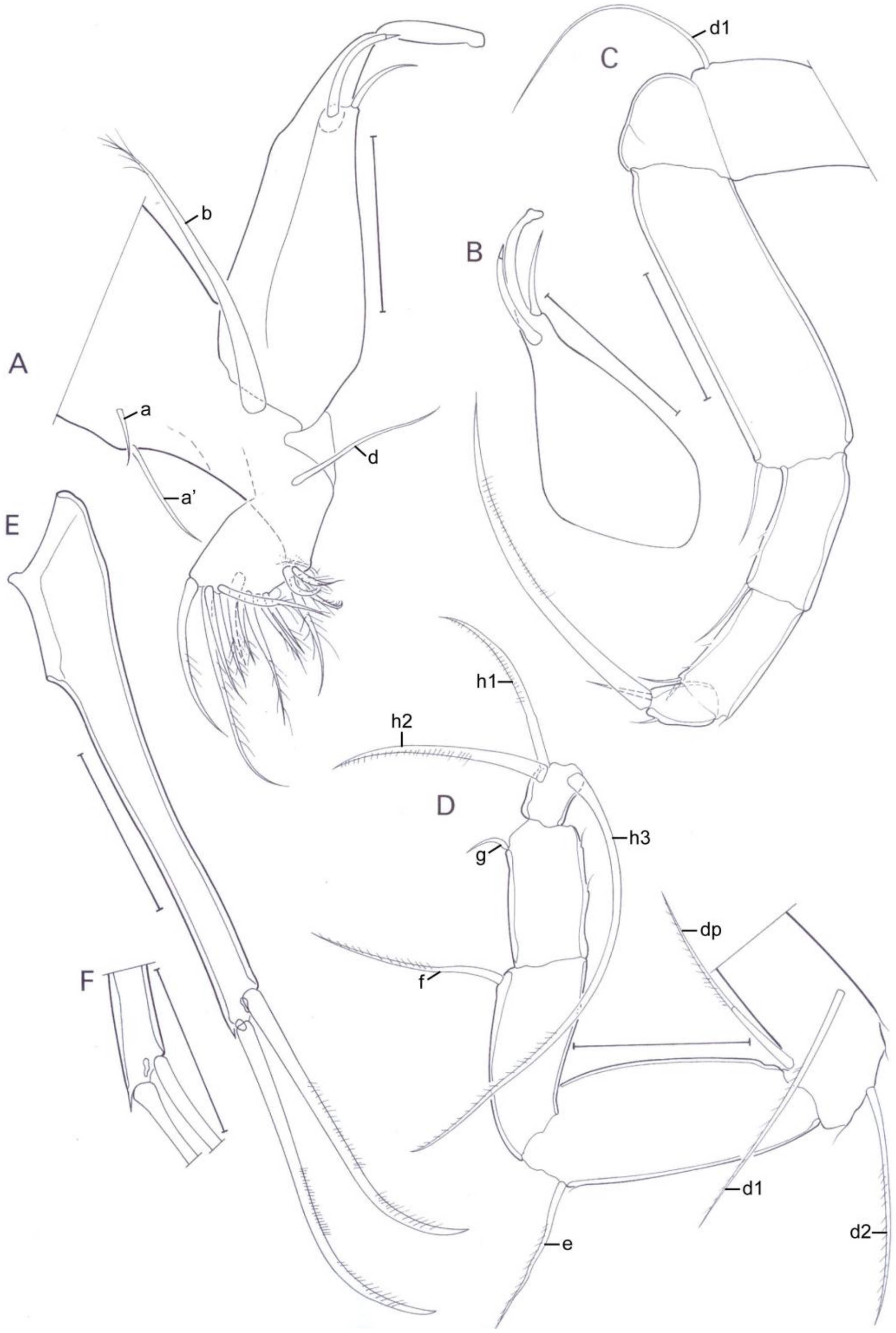

Figure 3. Limbs of *Candobrasilopsis rochai* gen.nov. sp. nov. (male). A. T1, left clasping organ (JH 222). B. right clasping organ (JH 222). C. T2 (JH 222). D. T3 (JH 217). E. caudal ramus (JH 217). F. details, caudal ramus (JH 226). Scale bars: A-F, 50 μm.

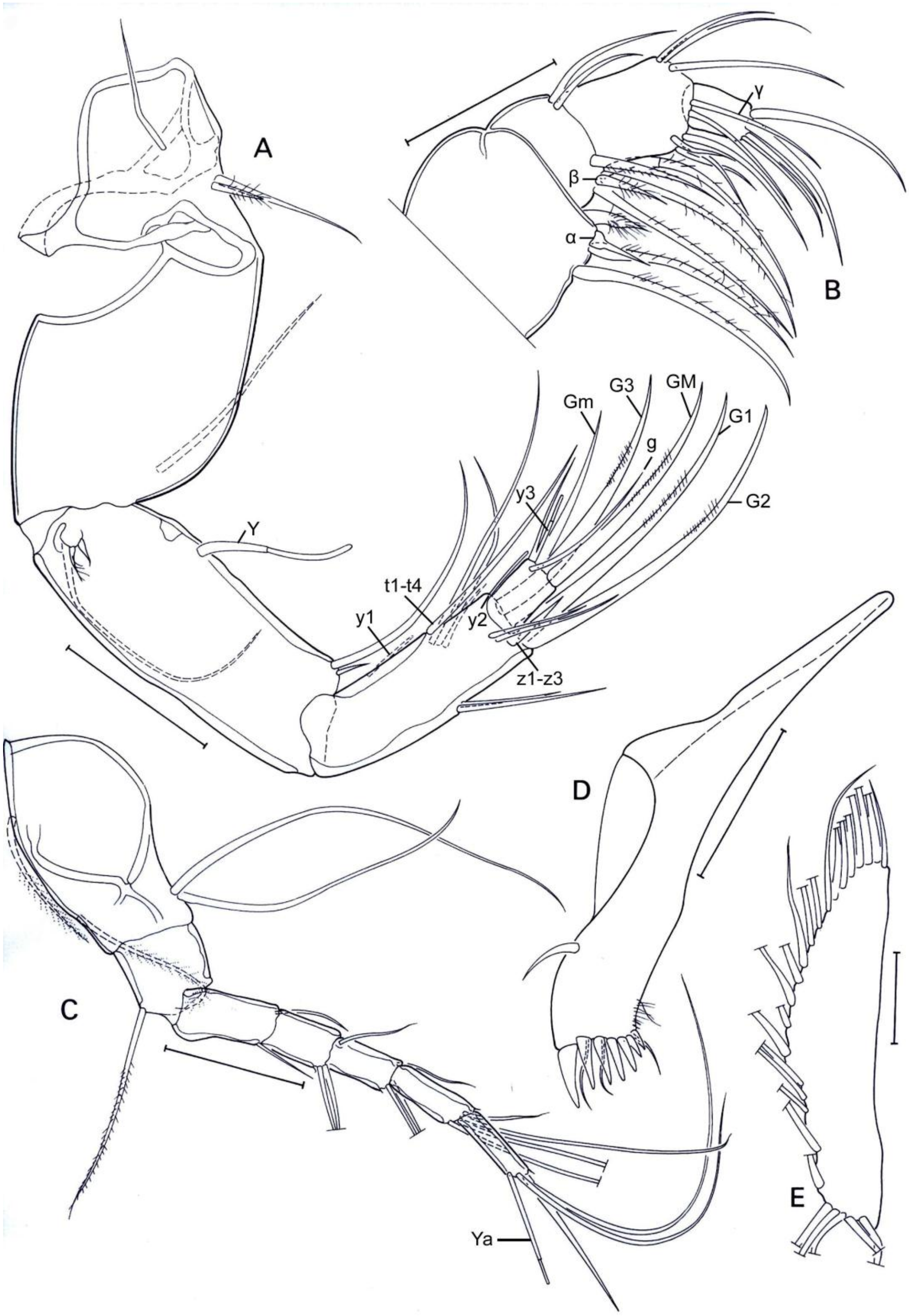

Figure 4. Limbs of *Candobrasilopsis rochai* gen.nov. sp. nov. (female). A. A2 (JH 228). B. Md palp (JH 214). C. A1 (JH 214). D. Md, coxal plate (JH 216). E. Mx1, respiratory plate (JH 221). Scale bars: A-E, 50 μm.

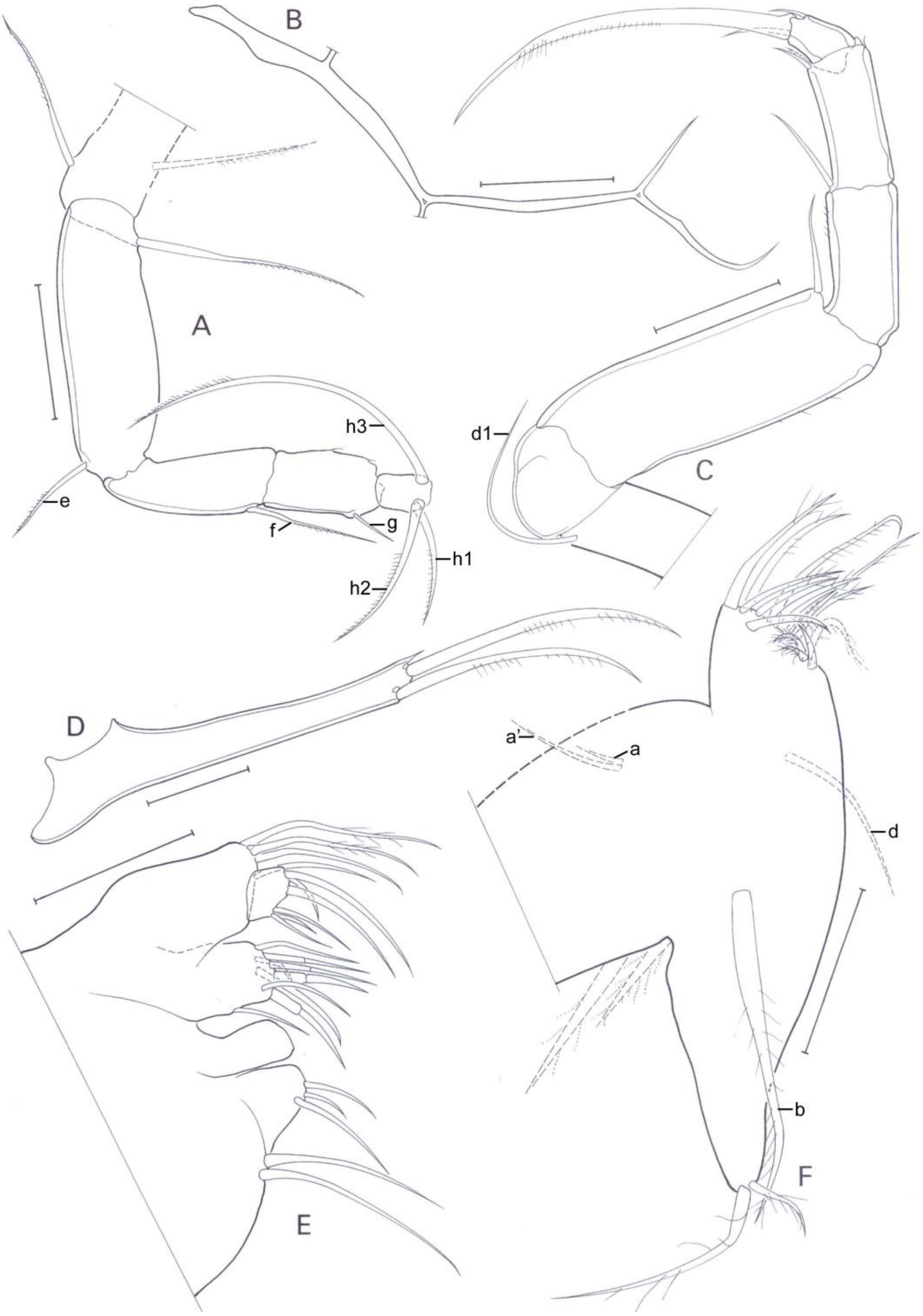

Figure 5. Limbs of *Candobrasilopsis rochai* gen.nov. sp. nov. (female). A. T3 (JH 214). B. attachment of the caudal ramus (JH 228). C. T2 (JH 216). D. caudal ramus (JH 214). E. Mx1 (JH 214). F. T1 (JH 223). Scale bars: A-F, 50 µm.

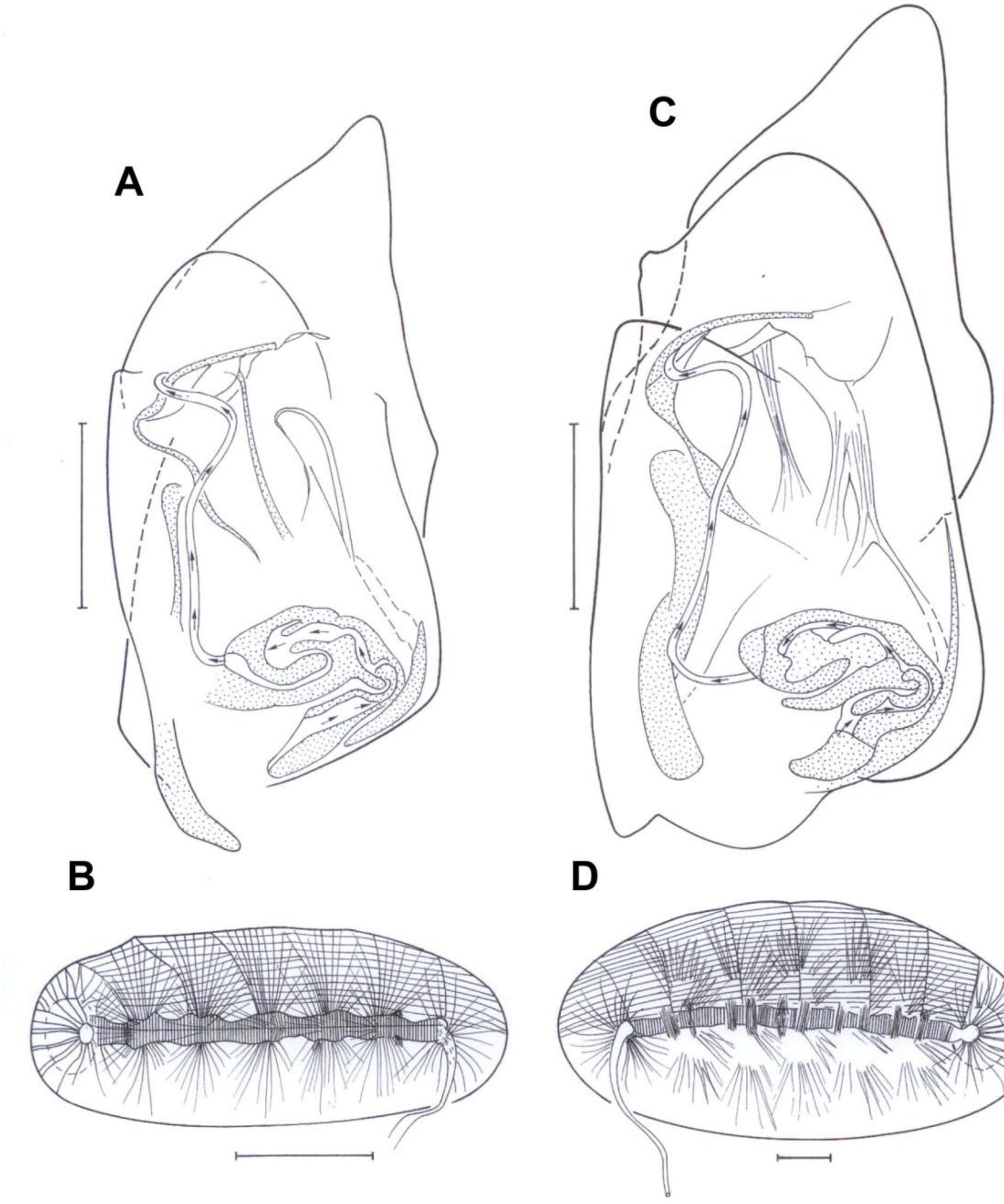

Figure 6. Limbs of *Candobrasilopsis rochai* gen.nov. sp. nov. (A, B) and *C. brasiliensis* gen. nov. (C, D). A. (JH 217) and C. (JH 435) hemipenis. B. (JH 226) and D. (JH 435) Zenker organ. Scale bars: A, C, D, 50 µm; B, 100 µm.

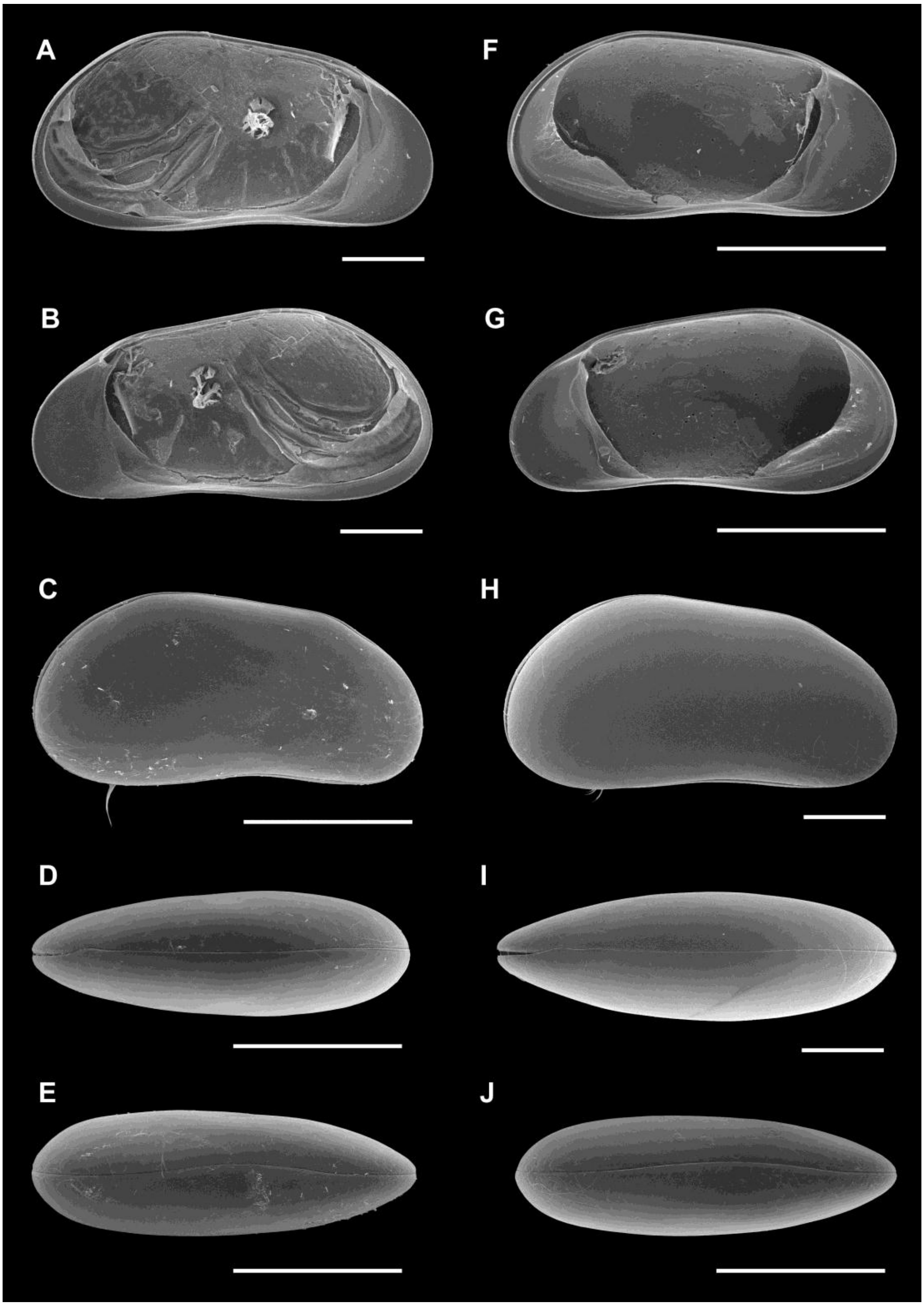

Figure 7. Valves of *Candobrasilopsis brasiliensis* gen. nov. A-E male and F-J female. A (KM 3462), F (JH 264) LV, internal view. B (KM 3462), G (JH 264) RV, internal view. C (JH 258), H (KM 3460) Cp, right lateral view. D (JH 259), I (KM 3461) Cp, dorsal view. E (JH 260), J (JH 263) Cp, ventral view. Scale bars: A, B, H, I, 200 μm; C-E, F, G, J, 400 μm.

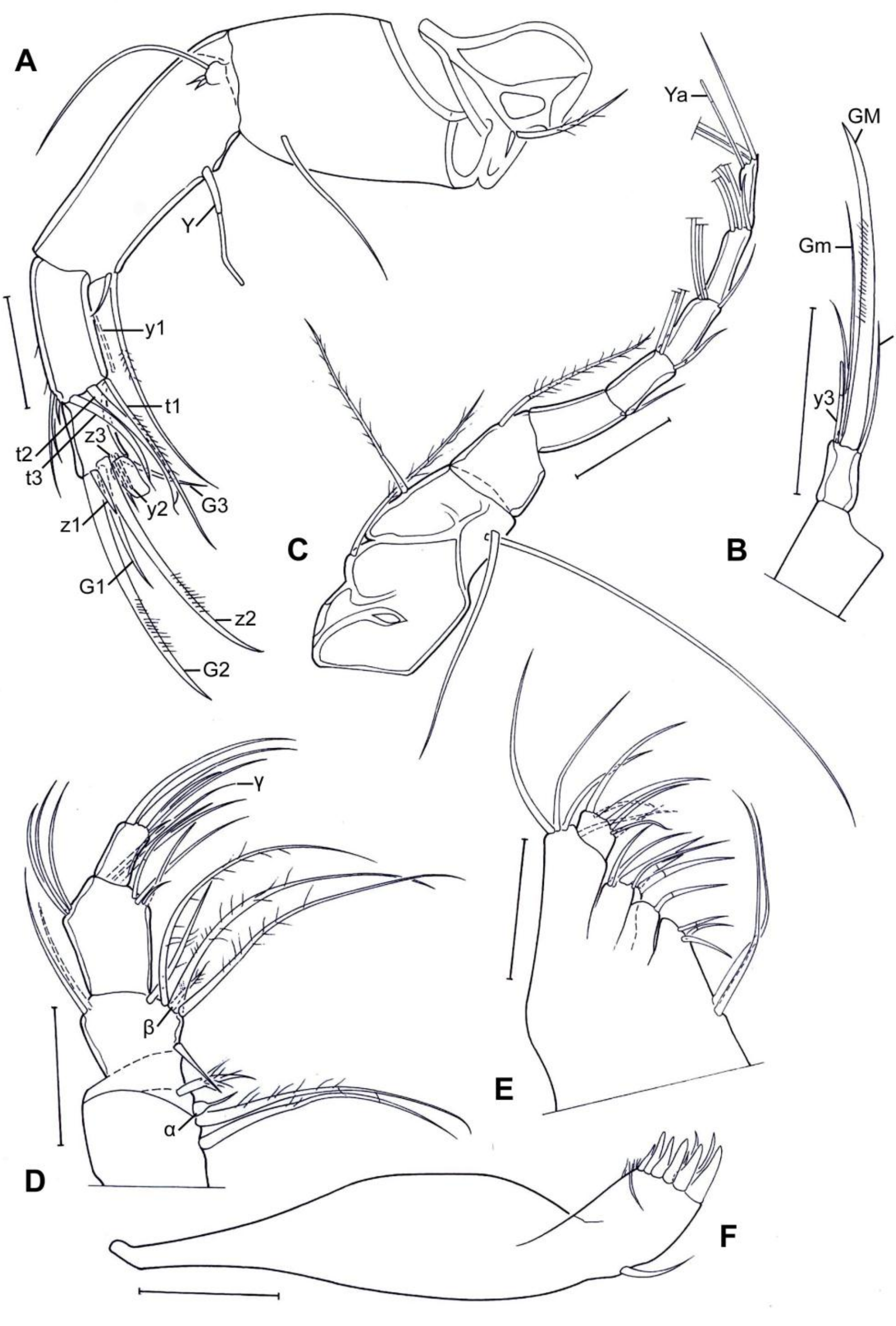

Figure 8. Limbs of *Candobrasilopsis brasiliensis* gen. nov. (male). A. A2 (JH 265). B. A2, detail of the last segment (JH 265). C. A1 (JH 265). D. Md palp (JH 265). E. Mx1 (JH 435). F. Md, coxal plate (JH 265). Scale bars: A-F, 50 μm.

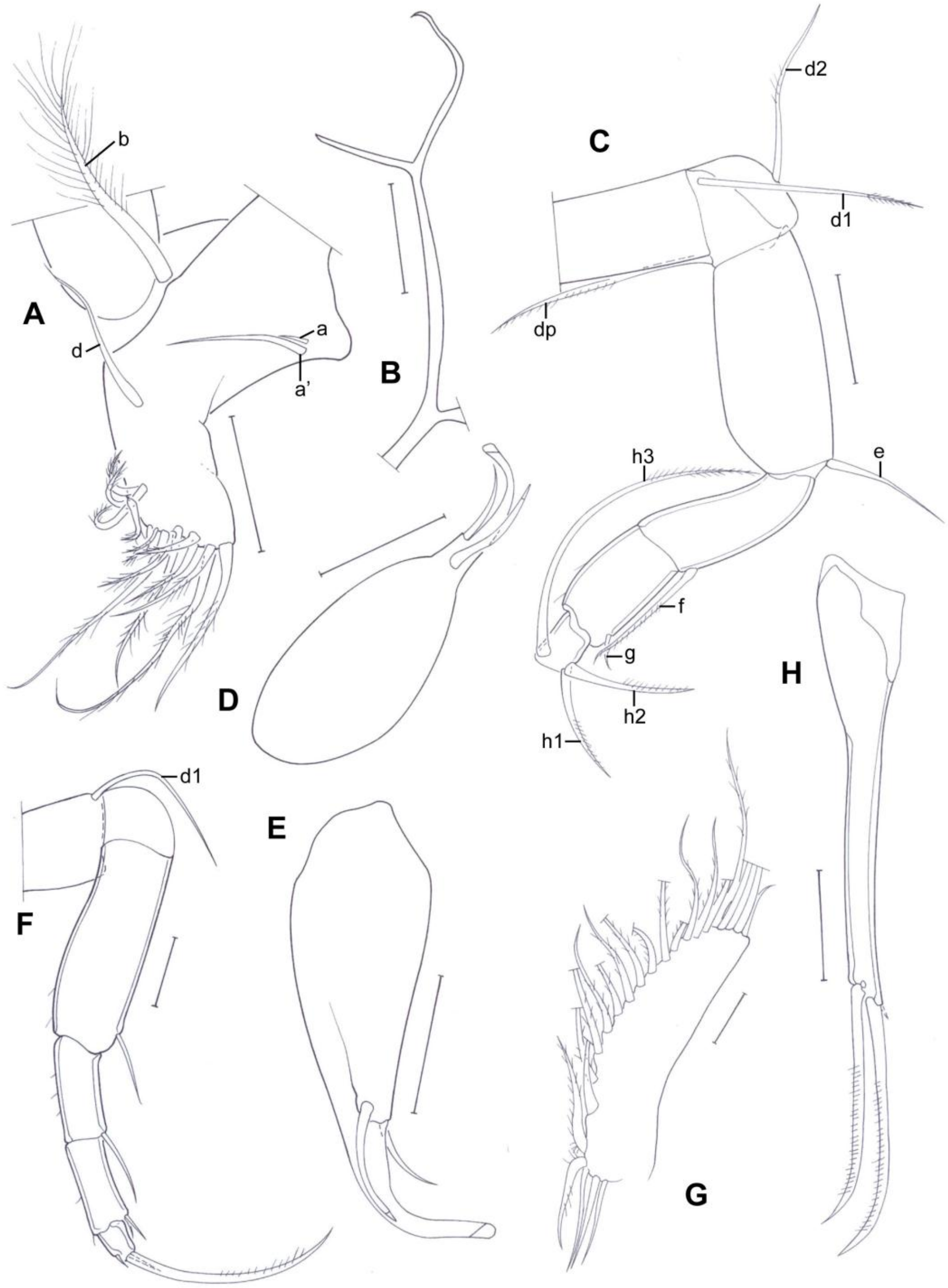

Figure 9. Limbs of *Candobrasilopsis brasiliensis* gen. nov. (male). A. T1 (JH 265). B. attachment of the caudal ramus (JH 434). C. T3 (JH 265). D. right clasping organ (JH 265). E. left clasping organ (JH 265). F. T2 (JH 265). G. Mx1, respiratory plate (JH 435). H. caudal ramus (JH 434). Scale bars: A-H, 50 μm.

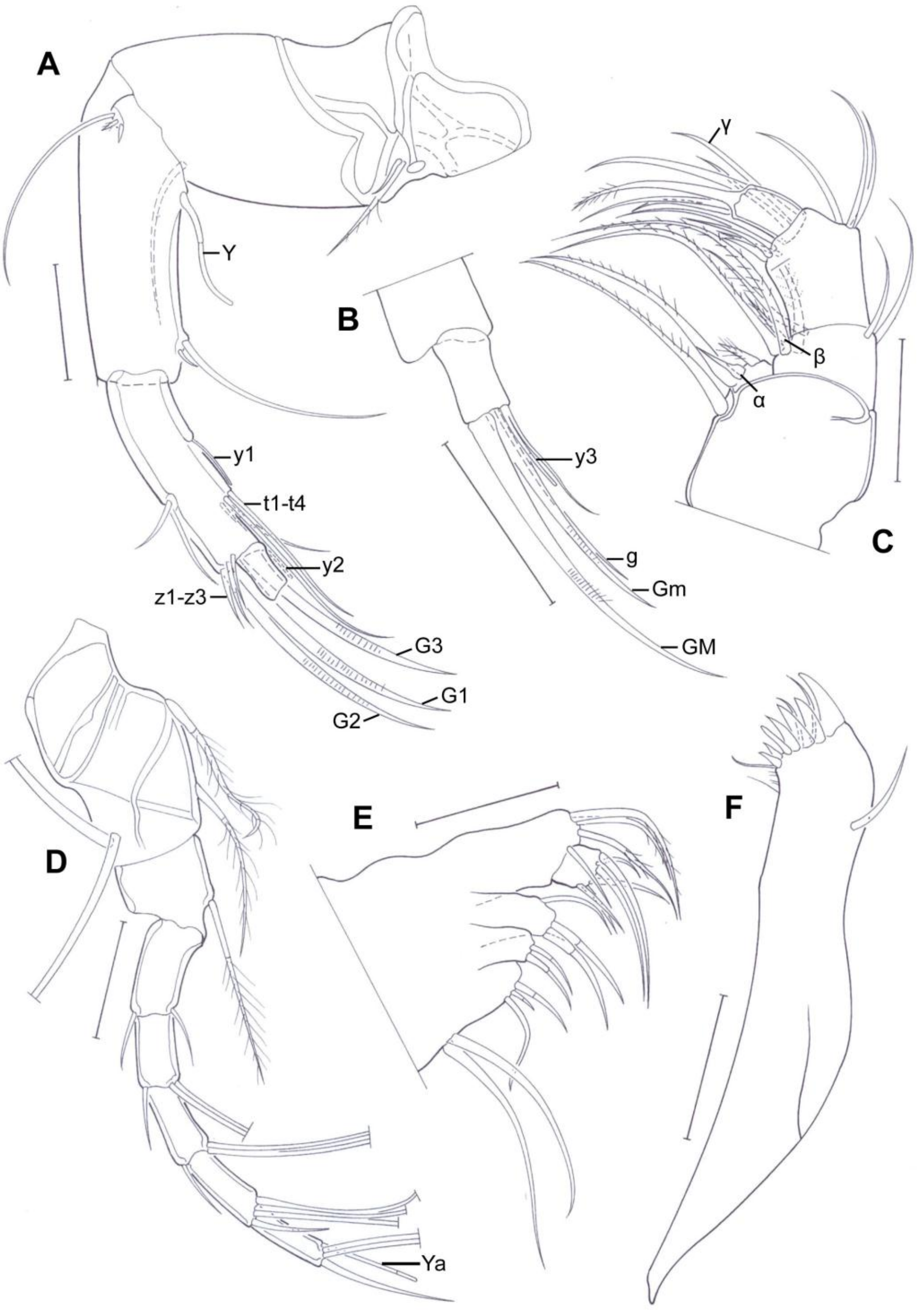

Figure 10. Limbs of *Candobrasilopsis brasiliensis* gen. nov. (female). A. A2 (JH 264). B. A2, detail of the last segment (JH 264). C. Md palp (JH 264). D. A1 (JH 264). E. Mx1 (JH 432). F. Md, coxal plate (JH 264). Scale bars: A-F, 50 μm.

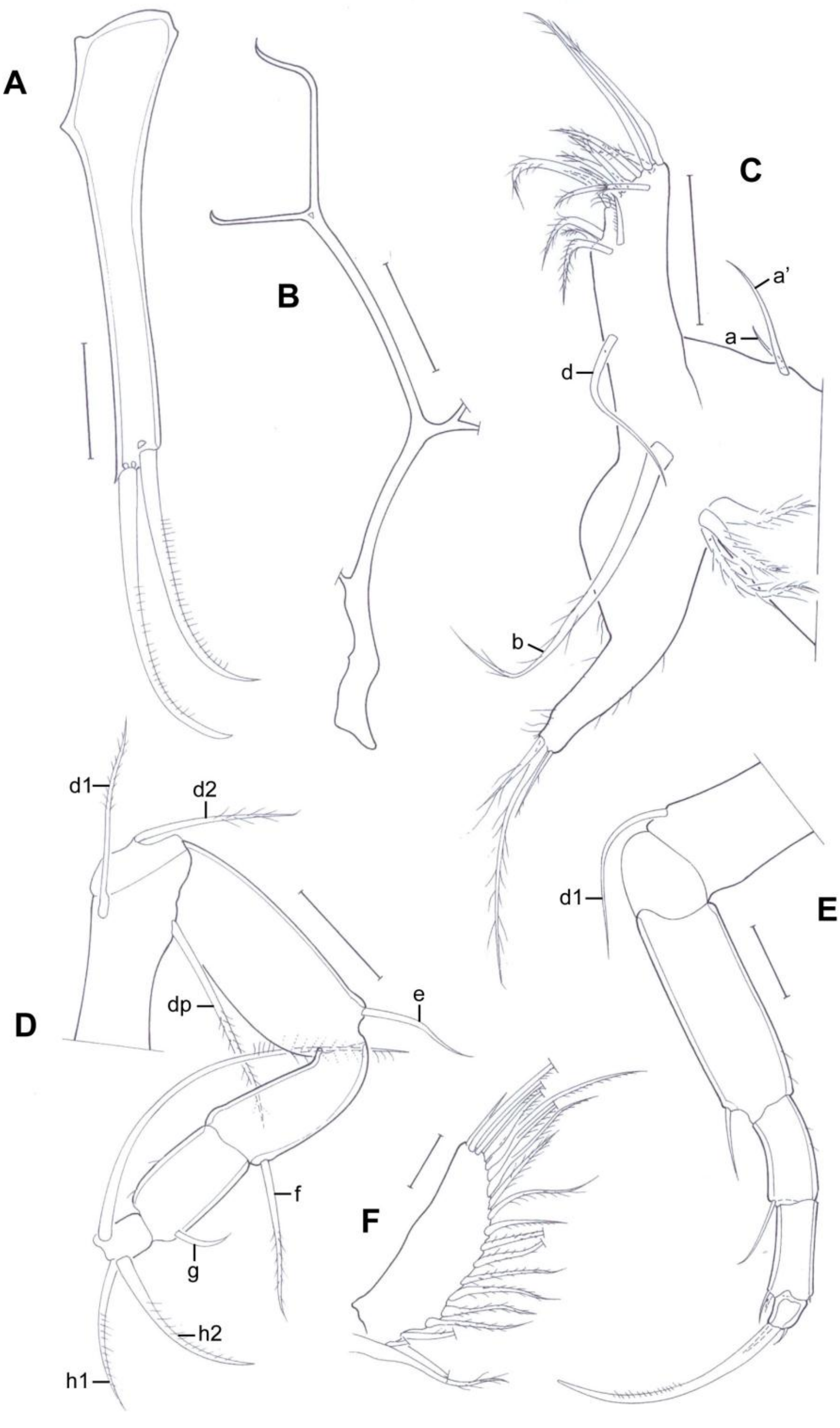

Figure 11. Limbs of *Candobrasilopsis brasiliensis* gen. nov. (female). A. caudal ramus (JH 264). B. attachment of the caudal ramus (JH 264). C. T1 (JH 436). D. T3 (JH 436). E. T2 (JH 264). F. Mx1, respiratory plate (JH 432). Scale bars: A-F, 50 μm.

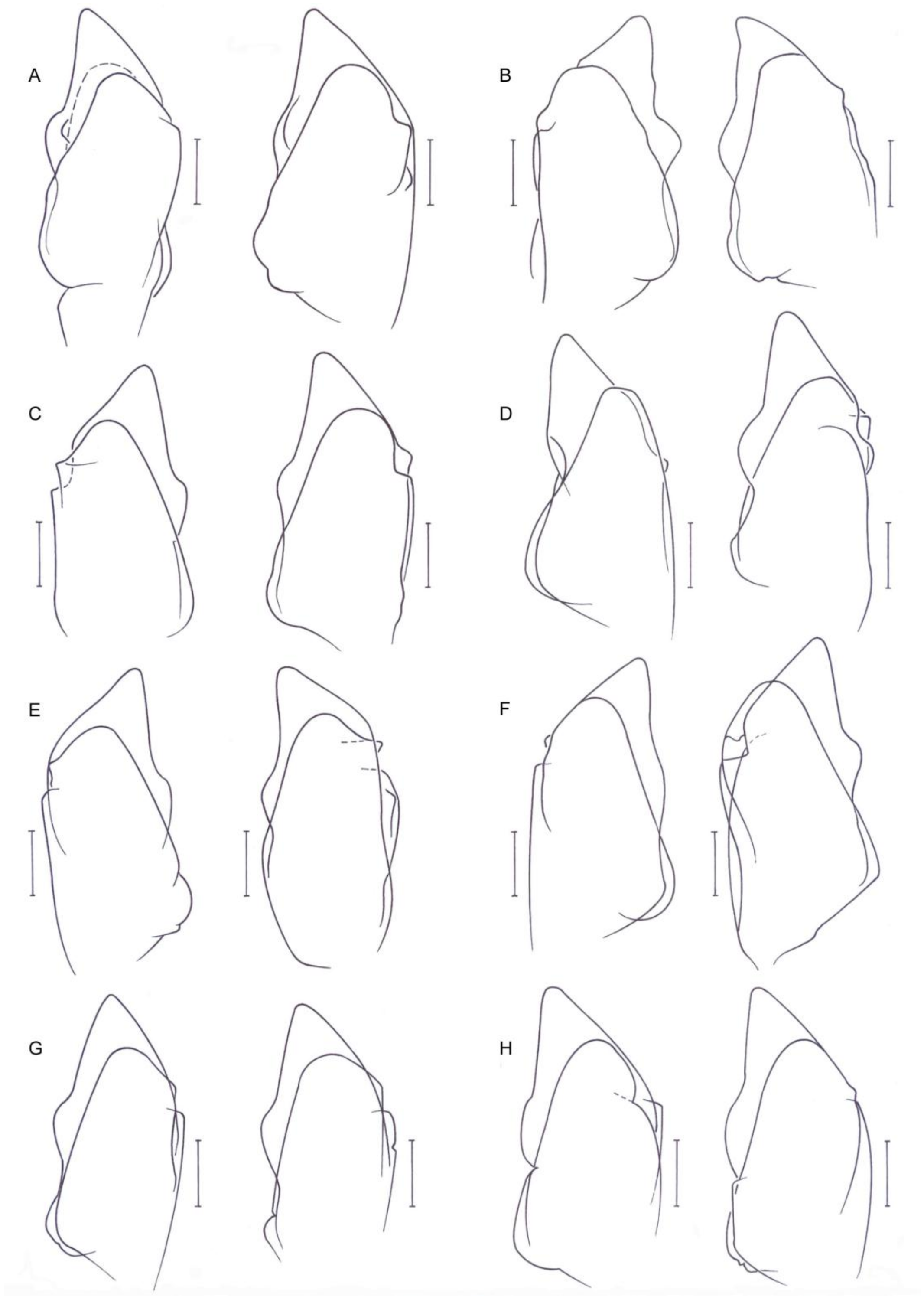

Figure 12. Hemipenis of *Candobrasilopsis brasiliensis* gen. nov. A. (JH 265). B. (JH 434). C. (JH 435). D. (JH 438). E. (JH 440). F. (JH 441). G. (JH 444). F. (JH 451). Scale bars: A-F, 50 μm.

Appendix 3

On a new cypridopsine genus (Crustacea, Ostracoda, Cyprididae) from the Upper Paraná River Floodplain (Brazil), with a re-appraisal of *Zonocypris s.l.*

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This manuscript is presently in press in the journal Zootaxa.

Abstract

We describe a new genus, *Cabelodopsis* n.gen., for the South American ostracod species *Zonocypris hispida* (Sars, 1901). *Zonocypris* s.s. and *Cabelodopsis* n.gen. are together united in the new tribe Zonocypridini n.trib., which is characterised by the large claw on the female A2. In order to determine the exact differences between both genera, the valves of four African species of *Zonocypris s.s.* are here redescribed, thus establishing the morphology differences in between both genera. *Cabelodopsis* n.gen. differs from *Zonocypris s.s.* in the general appearance of the carapace and of the valve ornamentation, as well as in the structure of the hinge.

Two further lineages are presently comprised within *Zonocypris s.l.*, but are different from *Zonocypris* s.s. in the shape and the ornamentation of the valves. Species of these lineages (which differ from each other by inverse valve overlap) should be investigated to determine if they also belong in Zonocypridini n.trib. or if they belong elsewhere within the Cypridopsinae. In the latter case, the large claw on the female A2 would be a homeomorphic feature.

The distribution of the zonocypridinids as well as the validity of some fossil identifications are discussed. *Zonocypris calcarata* Klie, 1936 is synonymised with *Zonocypris alveolata* Klie, 1936, as the former are clearly the juveniles of the latter.

Keywords: Cypridopsinae, pleuston, parthenogenesis, *Zonocypris*

Introduction

Martens and Behen (1994) summarized the literature on South American recent, non-marine ostracods and listed 260 species in 53 genera; with 96 species in 32 genera reported from Brazil (Martens *et al.* 1998). Recent additions to the Brazilian ostracod fauna (Würdig & Pinto 2001; Pinto *et al.* 2003; 2004; 2005a,b; 2008; Higuti *et al.* 2009a; Karanovic & Datry 2009) increased this number to 109 species in 36 genera (see also Martens *et al.* 2008; Martens & Savatenalinton 2011 for recent summaries). It is nevertheless evident that many new species and genera await discovery and subsequent description.

Large sampling campaigns in the alluvial valley of the Upper Paraná River were conducted by Nupélia (the "Núcleo de Pesquisas em Limnologia, Ictiologia e Aqüicultura" of the University of Maringá) in 2004 to study the ecology of ostracods in the pleuston and the benthos of these lakes (Higuti *et al.* 2007; 2009a,b,c; 2010). Fifty-four species were found, of which several genera and species are new to science (Higuti *et al.* 2009a; Higuti *et al.* 2010)

The family Cyprididae has more than 20 subfamilies and comprises about half of all extant freshwater ostracods species (1000 out of c 2000 described, subjective species) and genera (about 100 out of almost 190) (Martens *et al.* 2008) in the world. One of these subfamilies, the enigmatic Cypridopsinae, to date comprises 16 genera, plus the one described in the present paper, and more than 200 species. The species in this subfamily are characterized by generally small size (<1 mm and smaller), and especially by the caudal ramus which is reduced to a flagellum in females and is incorporated in the hemipenis in males (Martens & Meisch 1985), or has disappeared completely. Cypridopsinae are especially common in Africa (which made Klie (1935) remark on the fact that *Africa is das Dorado der* Cypridopsis-*Arten*), but are also quite abundant on other continents. The suprageneric taxonomy of the group remains thus far unresolved, with only the genus *Potamocypris* (including *Cyprilla*) being lodged into the separate tribe Potamocypridini (as Potamocypridinae in Ghetti & McKenzie 1981), because of its spatulate second Mx1-palp segment (cylindrical in all other genera).

Here, we describe a new genus for *Zonocypris hispida* Sars, 1901, namely *Cabelodopsis* n.gen., and lodge both *Zonocypris s.s.* and *Cabelodopsis* n.gen. into a new tribe, the Zonocypridini n.trib., characterized mainly by the large and stout claw on the A2. The genus *Zonocypris s.l.* nevertheless remains polyphyletic, as it comprises species that should be lodged into separate genera.

Material and Methods

Study area

The Paraná River Basin covers a large area in Brazil (ca. 802,150 Km^2) and it is intensely dammed with more dams than any other basin in South America. In its upper stretch is Paraná River floodplain, the last undammed portion of this river in Brazilian territory. The Upper Paraná River floodplain is located between the Porto Primavera Reservoir and the Itaipu Reservoir, extending about 230km. In this area, three conservation units were created: "Área de Proteção Ambiental das Ilhas e Várzeas do rio Paraná" (100,310 ha; an Environmental Protection Area), the "Parque Nacional de Ilha Grande" (78,800 ha; National Park), and the "Parque Estadual do Ivinheima" (70,000 ha; State Park) (Agostinho *et al*. 2004).

The floodplain, apart from the main channel of the Paraná River, comprises the variety of aquatic biotopes, formed by tributaries (including Ivinheima and Baía Rivers), secondary channels, lakes and backwaters (Agostinho & Zalewski 1996) (Figure 1).

Material

The material of *C. hispida* was sampled monthly from March 2004 to February 2005 in Manezinho Backwater, and in March and November of 2004 in various localities in the Upper Paraná River floodplain. The collections were sampled in several environments (closed lakes - including backwaters, open lakes, rivers and channels) and substrate types (littoral = shallow benthic, and root systems of floating plants such as *Eichhornia crassipes* (Mart.) Solms, *Eichhornia azurea* (Sw.) Kunth, *Pistia stratiotes* L., *Salvinia* spp, *Hydrocotyle ranunculoides* L.F., *Oxycaryum cubense* (Poeppig & Kunth), as well as stands of mixed floating plants), distributed among the Taquaruçu, Paraná, Ivinheima and Baía systems (Table 1).

Ostracods were sampled using a rectangular net (mesh size c 160 µm) hauled close to the sediment-water interface for littoral collections. Floating vegetation was hand-collected, and roots were thoroughly washed in a bucket. The residues were washed in the same hand net (see Higuti *et al.* 2007; 2010 for more details on the methodology).

Water temperature and dissolved oxygen (oxymeter-YSI), pH (pHmeter-Digimed) and electrical conductivity (conductivimeter-Digimed) were measured close to the surface of the water.

Material of the African *Zonocypris* species was sampled in a similar way. For the different locality data, see Table 2.

Morphological analyses

Ostracods were dissected with valves stored dry in micropalaeontological slides and soft part in glycerine in sealed slides. Drawings of soft parts were made with *camera lucida* with a compound microscope (WILD HEERBRUGG) Valves were illustrated and measured using scanning electron microscopy (Philips XL30 SEM at RBINS, Brussels).

Abbreviations used in text and figures

A1 = Antennula. A2 = Antenna. Cp = Carapace. H = Height of valves. L = Length of valves. LV = Left valve. RV = Right valve. Md = Mandibula. Mx1 = Maxillula. T1 = First thoracopod. T2 = Second thoracopod. T3 = Third thoracopod.

Chaetotaxy of the limbs follows the model proposed by Broodbakker and Danielopol (1982), revised for the A2 by Martens (1987) and for the T3 by Meisch (2000). Higher taxonomy of the Ostracoda follows the synopsis by Horne *et al.* (2002).

Results

Taxonomic descriptions

Class	Ostracoda Latreille, 1806
Subclass	Podocopa G.W. Müller, 1894
Order	Podocopida Sars, 1866
Suborder	Cypridocopina Baird, 1845
Superfamily	Cypridoidea Baird, 1845
Family	Cyprididae Baird, 1845
Subfamily	Cypridopsinae Kaufmann, 1900

Remarks: This subfamily now comprises 16 genera (Table 3), including the one newly described below.

Tribe *Zonocypridini* **n.trib.**

Genera: *Zonocypris, Cabelodopsis* n.gen.

Diagnosis: Carapace mostly rounded, and surface set with pits, reticulate or hirsute. Both valves with large frontal and ventral outer lists. LV with large and double posterior inner list, RV with large posterior selvage. Anterior calcified inner lamella broad, posterior one narrow or absent.
A2 short and stout, with final segment (4) small and rectangular, segments 2 and 3 large and relatively short and wide; all claws short, end claw G2 in female very wide and stout, with a series of rounded teeth in the distal 2/3. Distal segment of Mx1-palp elongated, c 3x as long as basal width. T2 with penultimate segment divided, seta d1 absent, d2 of medium length. Caudal ramus elongated triangular, with a long apical and a short subapical seta.

Remarks:
So far this tribe comprises two genera, but as will be discussed below, the genus *Zonocypris s.l.* might actually comprise at least 3 monophyletic clades.

***Cabelodopsis* n.gen.**

Type species: Zonocypris hispida Sars, 1901 (here designated)

Origin of name: the name is a contraction of “Cabelo” meaning ‘hair’ in Portuguese (referring to the hirsute aspect of the type species) and ‘opsis’, referring to the *genus typicus* of the subfamily, *Cypridopsis*.

Diagnosis: Carapace hirsute, but without external valve ornamentation and of medium size, LV overlapping RV on all sides, RV with large posterior selvage, LV with large, double posterior inner list. Hinge simple and adont, LV at the apex with a slight cardinal groove.

A2 with end claw G2 very wide and stout in the female, and with a series of rounded teeth in the distal 2/3. Distal segment of Mx1-palp elongated, c 3x as long as basal width. T2 with penultimate segment divided, seta d1 absent, d2 of medium length.

The genus is thus far monospecific

Differential diagnosis: the new genus is mostly closely related to *Zonocypris* with which it shares the short and stout claw G2, by which both genera are easily separated from all other cypridopsine genera. The new genus furthermore differs from *Potamocypris* by the cylindrical distal palp segment of the Mx1 (spatulate in *Potamocypris*). From *Zonocypris s.s.*, *Cabelodopsis* n.gen. can be distinguished by the absence of prominent valve surface ornamentation, except for the fact that its type species is most hirsute. The other main differences are in the hinge, which is simple and adont in *Cabelodopsis* n.gen., but which has a strongly developed postero-dorsal tooth in *Zonocypris* s.s., either in the RV or in the LV (see below)

Cabelodopsis hispida (Sars, 1901) **n.comb.**

(Figures 2–5)

Synonymies

Cypridopsella hispida Sars, 1901
Zonocypris hispida (Sars, 1901) Klie, 1940
Bradleystrandesia hispida (Sars, 1901) Higuti *et al.*, 2007
"*Cypridopsis"* n.gen. 2 *hispida* Higuti *et al.*, 2009c; 2010; Mormul *et al.*, 2010

Type locality and type material

Sars (1901) only found few female specimens which he raised from dried mu collected near Itatiba (São Paulo State). These specimens are still in the collections of the Museum of Oslo (1–2 specimens in EtOH in a large jar nr 53.3 and slide 11535 in map 496 (P. DeDeckker, pers.comm.).

Diagnosis:

It is at present difficult to distinguish between generic and specific characters because only one species is thus far known in this genus and because males are unknown. Male copulatory appendages and prehensile palps generally offer the best features to distinguish between species. At this stage, we consider the elongated shape of the carapace, with greatest height situated in front of the middle, and the hirsute aspect of it to be specific characters. *'Zonocypris' inornata* Klie, 1936 from Cameroon is quite similar in appearance (subtriangular valves, very hirsute, no additional valve ornamentation), but whereas in *C. hispida* the LV overlaps the RV anteriorly, this is the inverse in *'Z.' inornata*.

Remarks: Sars (1901) described this species, in a most incomplete way, in the genus *Cypridopsella* Klie (1940) transferred it to *Zonocypris*, to which indeed it bears some resemblance. However, detailed analysis of the anatomy of this species show that it belongs to a lineage related to, yet different from, *Zonocypris*. It is here thus lodged in a new genus.

Additional description of female

Cp hirsute, entirely covered with strong setae, but valves smooth. Cp in lateral view (Figure 2G) oval triangular in form, greatest H somewhat exceeding half the L, and situated slightly in front of the middle, dorsal margin sloping towards the front, rather straight towards the posterior side, ventral margin straight to slightly convex, both extremities rounded, the anterior one somewhat more broadly than the posterior one.
Cp in dorsal (Figure 2I) and ventral view (Figure 2J) oblong ovate in form; greatest width (about half of the length) situated in the middle; LV overlapping RV in both extremities and along the ventral margin. Both valves with a strong ventral outer list.
Both valves in internal view with relatively wide anterior and very narrow calcified inner lamella. Muscles scars with the typical cypridopsine pattern.

LV in interior view with antero-ventral remnants of an inner list (Figure 2A, B), this list continuing along the ventral side and posteriorly developing in a widely inwardly displaced and double inner list; postero-dorsally without hinge-like structures (Figure 2A, C).
RV in internal view with antero-ventral remnants of an inner list (Figure 2D, E), this list continuing along the ventral side and posteriorly developing in a strong and double, but submarginal inner list, postero-ventrally with a wide flange, caused by a strong selvage

(Figure 2F, H), the latter carrying 4–5 small tubercles, the latter only visible with Scanning Electron Microscopy and with tilted valve (Figure 2H).

A1 (Figure 3E) with 7 segments. First segment with 2 long ventral setae, and one dorsal seta. Second segment with one short dorsal seta. Third segment ca. 1.5 times as long as wide, with one shorter ventral and one longer dorsal seta. Fourth segment almost as long as wide, with 1 short ventral setae and 2 long dorsal natatory setae. Fifth segment slightly longer than wide, with 1 medium ventral seta and 3 long dorsal natatory setae. Sixth segment slightly longer than wide, with 4 long natatory setae. Terminal (seventh) segment about 1.5 times as long as wide, with 1 shorter seta, 1 aesthetasc ya about 1/5 longer than the shorter seta and 2 long natatory setae.

A2 (Figure 3B) with exopodite reduced to a small plate, bearing 2 short setae. Endopodite 3-segmented. First segment long and stout, aesthetasc Y short (about 1/5 of length of segment). Five natatory setae with long hair reaching the tips of the end claws, accompanying (6th) seta reaching 1/3 of the length of second segment. Second segment with 2 dorso-lateral and 4 ventro-lateral setae, distal chaetotaxy, with three z-setae, z1 differently of the other, it strong claw-like, and 3 relatively long G-claws, claws G1 and G2 thick, G1 smooth and G2 with teeth, claw G3 slender and with hair. Terminal (third) segment with long claw GM with hair, shorter claw Gm with teeth, short aesthetasc fused with a seta, the latter longer than the aesthetasc and shorter seta g.

Md (Figures 5B, 4C) with coxa elongated, distally set with rows of teeth and small setae, a seta on outer edge, near the articulation with the palp. Palp with alpha-seta rather long, slender and smooth, beta-seta short, stout and hirsute, gamma-seta long, slender and smooth. First segment with two long barbed setae, one long smooth seta and the alpha seta. Second segment dorsally with 3 smooth setae, 2 longer setae than the other one, ventrally with 3 long and 1 shorter smooth setae as well as the beta seta. Third segment dorsally with 4 subapical setae, 2 longer setae (1/3 of the length of the other 2 setae), ventrally with 1 long subapical seta and a short seta, medially with 4 setae (3 plus gamma-seta). Terminal segment with 3 long slender claws and 4 shorter setae.

Rake like organ (Figure 3A) with 8 teeth.

Mx1 (Figure 4A) with second palp-segment longer than broad, teeth bristles of third endite serrated. Respiratory plate (not drawn) large and elongate, distally with a row of ca. 18 or 19 ‘normal’ rays and 5 ‘reversed’ rays.

T1 (Figures 5A, 3G) with 2 a-seta, 1 d-seta and b- seta absent. Distal chaetotaxy of coxal plate (Figure 5A) consisting of 14 setae of sometimes very different shape and length. Respiratory plate with 5+1hirsute rays. Endopod (Figure 3G) apically with 2 long setae and 1 short seta.
T2 (Figure 4B): first segment with seta d1 absent, the second (knee-) segment with seta d2 of medium length. Third segment with 1 long ventro-apical seta, reaching beyond segment 4a. Fourth segment divided into two sub-segments: 4a with a ventro-apical seta, reaching beyond tip of segment 4b, this segment with 1 subapical seta. Fifth segment with 1 short subapical seta and 1 apical seta and 1 long and thick apical claw.
T3 (Figure 3C, F) a cleaning limb. First segment with 3 setae. Second segment with 1 apical seta. Third segment with 1 short lateral seta. Distal part of 3rd segment and 4th segment fused to a pincer shaped organ, bearing 1 long seta, 1 seta of medium length, two rows of setulae and 1 comb-like seta.
Caudal ramus (Figure 5C) with elongated, triangular base, a short subapical and a long flagellar apical seta.

Males unknown

Material used for the present redescription and illustrations
All material of this species used in the present paper originated from Manezinho Backwater (coordinates: 22° 46’ 55”S, 53° 20’ 59”W), a lentic water body, originated by the recently abandoned channels formed by lateral bars, located at Mutum island, and connected to Paraná River by a narrow and short channel (Figure 1, Table 1).

Seven dissected females (JH 208; JH 210; JH 211; JH 213, JH220; JH231), with soft parts dissected in glycerine in a sealed slide, and five dissected females (KM 3418; KM 3419; KM 3420; KM 3421; JH 220) withvalves stored dry in a micropalaeontological slide (valves lost for KM 3418).

The material will be deposited as follows: All OC numbers will be stored in the Ostracod Collection of the Royal Belgian Institute of Natural Sciences, Brussels and the MZUSP numbers will be stored in the Museu de Zoologia da Universidade de São Paulo, Brazil.

See Table 1 for an overview of other localities where this specie was found in the upper Paraná floodplain: Lakes: Ventura, Patos, Jacaré, Pombas, Pintado, Peroba, Boca do Ipoitã, Gavião, Maria Luiza, Porcos, Guaraná, Zé Marinho, Garças, Rivers: Ivinheima, Paraná, Baía, Backwater: Leopoldo and Channel: Cortado.

Measurements (see also Table 4)
KM 3418: LV: L = 928 µm, H = 534 µm; RV: L = 922 µm, H = 524 µm; KM3420: L = 891 µm, H = 518 µm.

Ecology and distribution

The species has been found in 19 localities out of 48 sampled in the alluvial valley of the upper Paraná River, including lakes, backwaters, rivers and channels; it is thus quite common there. It occurred mostly in pleuston, especially in the root systems of *Eichhornia crassipes*. pH ranged between 4.7 and 8.2, electrical conductivity between 28.1 and 96.6 µS cm^{-1} and dissolved oxygen between 2.3 and 7.2 mg L^{-1}. The species was found all year around.

Zonocypris G.W. Müller, 1898

Type species:
Cypridopsis costata Vavra, 1897.

Remarks:

1. G.W. Müller (1898) erected the genus *Zonocypris* to comprise his new species *Z. madagascarensis* and *Z. elegans* from Madagascar and also transferred *Cypridopsis costata* Vavra, 1897 from East Africa to his genus. He described *Z. madagascarensis* as first species in the genus, which thus automatically becomes the type species, as no type species is explicitly designated (ICZN, 1999). Sars (1910) later on synonymised *Z. madagascarensis* with *Z. costata*, so that the latter becomes the nominal type species of the genus. However, Sars (loc.cit.) did not see type material and furthermore assumed that Müller's species was from East Africa, ignoring the fact that the specimens came from Madagascar. Rome (1962) disagreed with this unfunded synonymy and based on clear differences in valve shape and morphology of prehensile palps (but again only from the published illustrations) reinstated *Z. madagascarensis* as a valid species. Rome (loc.cit.)

however, failed to see the paper by Klie (1933) on East African Rift lakes, in which that author re-investigated Vavra's type material and concluded that the illustrations of *Z. costata* were not accurate, thus confirming the synonymy by Sars (1910). We accept Klie's point of view and will thus consider *Z. costata* as type species of the genus. This is relevant, as we use new material from this species group to compare to *C. hispida* from Brazil.

2. The genus *Zonocypris* s.l. comprises 18 described species (Martens & Savatenalinton 2011) and is united by the presence of the large and broad claw on the A2 in females, yet displays a wide range of carapace shapes and forms. Based on a preliminary analysis of the valve morphologies, we conclude that the genus as it is defined up to now comprises at least 4 different lineages: *Zonocypris s.s.*, *Cabelodopsis* n.gen. and two potentially new genera (Table 3). This will be further discussed below, but the following diagnosis is valid for *Zonocypris s.s.* only.
3. Below, we briefly (re-) describe 4 species of *Zonocypris s.s.* to compare the morphology of this genus to the newly described *Cabelodopsis* n.gen.

Diagnosis of Zonocypris s.s.

Carapace small, globular in dorsal view and triangular or rounded in lateral view; external surface always with clear ornamentation, either strongly ridged, pitted or tuberculate, or with a combination of these ornamentations; tubercles sometimes set with long setae, but generally valves not hirsute. LV overlapping RV on posterior and ventral side, but widely so anteriorly. RV with large posterior selvage, the latter either sinuous or straight, but always set with a row of large spines underneath. LV with a prominent, double inner list. Hinge with an elongated, posterior cardinal socket in LV (as in Figures 6A, C and 9A, C) and matching cardinal tooth in RV, or with cardinal tooth in LV (as if Figures 10A, C or 11A, C) and weakly matching socket in RV; dorsal cardinal bars and grooves mostly well-developed.

A2 with end claw G2 very wide and stout in the female, and with a series of rounded teeth in the distal 2/3. Distal segment of Mx1-palp elongated, c 3x as long as basal width. T2 with penultimate segment divided, seta d1 absent, d2 of medium length.

Distribution

See discussion.

Zonocypris* spec.** cf ***costata

(Figures 6–8, 12C)

Material and occurrence:

See Table 2.

The real *Z. costata* is a very common species in East Africa (and Madagascar if the synonymy of Sars (1910) and Klie (1933) is accepted) and has been reported from Tanzania (Lake Victoria, Sars 1910), Zimbabwe (Brehm 1911), Mozambique (Delachaux 1919), Kenya (Klie 1933; 1939; Lindroth 1953), Malawi (Lake Malawi, Fryer 1957) and from the Pliocene of Ethiopia (Carbonel & Peypouquet 1979) and as *Z. madagascarensis* from Madagascar (G.W. Muller 1898) and the Isle of Aldabra (McKenzie 1971).

Diagnosis:

Valves and carapace in lateral view (Figure 6A–F, I) high (H/L= 0.75), and with greatest height situated in the middle, dorsal margin almost symmetrically rounded. Cp in dorsal and ventral views (Figure 6G, H) with width more than half the length (W/L = 0.83). Cp set with broad, more or less concentric, ridges and especially towards the ventral side pitted (Figure 6G–I). Valve structure typical of *Zonocypris s.s.* (see above), with posterior hinge-like structure in LV an elongated socket (Figure 6A, C) and matching tooth on RV and with ventro-posterior selvage on RV sinuous and set with c 10 tubercles (Figure 6D, F, J, K). The internal marginal structures of both RV and LV of this species are additionally illustrated in Figure 7 (A–F).

Soft parts as illustrated in Figure 8A–F; claw G2 (Figure 12C) in females less broad than in other zonocyprid cypridopsines, somewhat resembling male morphology.

Measurements:

See Table 4.

Remarks:

This species has valves which are much higher and wider than the real *Z. costata* as illustrated by both Vavra (1897) and G.W. Müller (1898). It could either constitute a new species, or the shape of the valves has been influenced by water chemistry. The most striking feature of this species is the fact that the claw on A2 in the female does not have the typically swollen and stout claw, this claw is only marginally larger than in non-*Zonocypris* cypridopsines (Figure 12C), and in fact resembles the morphology in males. This is most bizarre, as in all other aspects, this species clearly belongs in *Zonocypris s.s.*

Zonocypris cordata Sars, 1924

(Figures 9, 12B)

1996 Martens *et al.*, Afr. J. Zool. 31, pp 34, Figure 5 E,J–L. (same population as illustrated here - see Table 4)

Material and occurrence:

The species was originally described from pools in the neighbourhood of Cape Town (RSA) (Sars 1924). It was further reported from Lake Naivasha, Kenya (Lowndes 1936) and three lakes in Rwanda (Kiss 1959). Martens *et al.* (1996) reported it from Verlorenvlei, a large wetland c 100 km N of Cape Town.

Diagnosis:

Valves and carapace in lateral view (Figure 9A–F, I) quite high (H/L= 0.66), and with greatest height situated in the middle, dorsal margin bluntly pointed. Cp in dorsal and ventral views (Figure 9G, H) with width more than half the length (W/L = 0.76). Cp set with deep pits, roughly arranged in concentric ovals (Figure 9G–I). Valve structure typical of *Zonocypris s.s.* (see above), with posterior hinge-like structure in LV a relatively short socket (Figure 9A, C) and with matching tooth on RV and ventro-posterior selvage on RV sinuous and set with a row of c 10 tubercles (Figure 9D, F). Female A2 with the typical broad and stout claw (Figure 12B).
Juveniles with different morphology (Figure 9J, K), but also with pitted surface and with small posteroventral spines in both valves.

Measurements:

See Table 4

Zonocypris* spec. cf *cordata n.sp.

(Figures 10, 12A)

Material and occurrence:

The species has thus far only been found in Lake Sibaya (Kwazulu-Natal, RSA) and is to all probability a new, endemic species of this enigmatic, Holocene lake.

Diagnosis:

Valves and carapace in lateral view (Figure 10A–F, I) relatively elongated (H/L= 0.55), and with greatest height situated just anterior to the middle. Cp in dorsal and ventral views (Figure 10G, H) with width more than half the length (W/L = 0.77). Cp set with deep pits, roughly arranged in concentric ovals (Figure 10G–I). Valve structure typical of *Zonocypris s.s.* (see above), with posterior hinge-like structure in both RV (Figure 10D, F) and LV (Figure 10A, C) a relatively short tooth; ventro-posterior selvage on RV rounded and set with c 10 large spines; valve-margin significantly elongated and pointed (Figure 10D, F).

Female A2 with the typical broad and stout claw (Figure 12A).

Measurements:

See Table 4.

Remarks:

In spite of the fact that the hinge-like structure on the LV appears to be reversed from the previous species describe here (a tooth instead of a socket), the valve overlap remains the same. The RV appears to have maintained the tooth-like structure on the matching site.

Zonocypris tuberosa G.W. Müller, 1908

(Figures 11, 12D)

1996 Martens *et al.*, Afr. J. Zool. 31, pp 34, Figure 5 F–I (same population as illustrated here)

Material and occurrence:

G.W. Muller (1908) described this species from Zeekoevlei, near Plumstead, Simonstown, presently in Cape Town (RSA). It was further reported from Zandvlei near Lake Side (G,W. Muller 1914), old gravelpits on Bergvliet (Sars 1924) and Verlorenvlei, c 100 km N of Cape Town (Martens *et al.* 1996), all in South Africa.

Diagnosis:

Valves and carapace in lateral view (Figure 11A–F, I) rather elongated (H/L= 0.53), and with greatest height situated just anterior to the middle. Cp in dorsal and ventral views (Figure 11G, H) with width more than half the length (W/L = 0.69). Cp with a variety of valve ornamentations: a network of fine ridges, larger and smaller tubercles, with some of the larger ones set with long and stout bristles (Figure 11G–J). Dorsal margin rounded and slowing towards the posterior side.

Valve structure typical of *Zonocypris s.s.* (see above), with posterior hinge-like structure in LV a relatively short tooth (Figure 11A, C), no matching structure (tooth or socket) on RV and with ventro-posterior selvage on RV rounded and set with c 10 large spines and with valve-margin elongated and pointed (Figure 11D, F); posterior valve margin on RV asymmetrically expanded.

Female A2 with the typical broad and stout claw (Figure 12D).

Measurements:

See Table 4.

Remarks:

In spite of the fact that the hinge-like structure on the LV appears to be reversed from the first two species described above (a tooth instead of a socket), the valve overlap remains the same. The RV appears to have lost the tooth-like structure on the matching site, nor is there a socket there.

This is the most striking species in the genus, one could even call it beautiful!

Discussion

Morphology

The genus *Zonocypris* offers an interesting illustration of how neontologists (biologists) and palaeontologists apply the same taxonomic names, but, by necessity, with a different interpretation of characters. *Zonocypris* was described by a biologist (G.W. Muller) and was mainly characterised by the stout claw G2 in the female A2. Newly discovered species with that character were included in this genus, regardless of valve morphology and at least half a dozen species with that claw-morphology are very different from *Zonocypris s.s.* (Table 5).

The type species (*Z. costata*, syn. *Z. madagascarensis*) has globular valves with semi-concentric ridges on the outside of the valves, and in several cases fossil species have been allocated to *Zonocypris,* simply based on this character, although other species in *Zonocypris s.s.* can have very different external valve ornamentation, and species unrelated to *Zonocypris* can also show the concentric ridges.

McKenzie (1982) already pointed out that homeomorphy is a persistent joker in the taxonomic pack, and it appears that several characters in ostracod morphology are a case in point. Jocque *et al.* (2010) showed that the claw-like subpacial seta on the distal segment of the walking leg (T2) in Cyprididae is not a homologous character in all genera in which it occurs. This character might indicate a close relationship between the South African *Amphibolocypris* Rome, 1965 and the Australian *Platycypris* Herbst, 1957, but its occurrence in Siberian *Limanocypris* Schornikov, 1961 (in Limanocypridinae Hartmann & Puri, 1974) and the Iberian *Candellacypris* Baltanas, 2001 (in Eucypridinae Bronshtein, 1947) are cases of parallel evolution and this is certainly true for the most distant *Scotttia pseudobrowniana* Kempf, 1971 (in Scottiinae Bronshtein, 1947).

There are three possible ways in which the large claw G2 on the female A2 could have evolved: (1) in a neutral way, without adaptive advantages, and as a result of neutral mutations in genes that direct developmental pathways. This is an entirely possible scenario, but to demonstrate this would require involved studies on the developmental pathways of the A2 chaetotaxy in this group. One possible beginning would be to study the ontogeny of a species of each of the lineages that show this character and to see when (in which juvenile stage) this aberrant claw appears. (2) through natural selection and as an adaptation to similar environments. It would be difficult at present to say which part of the environment would favour the development of such a claw, which moreover occurs only in females and not in males. For the claw to have developed as an adaptation through natural selection, males and females must have at least some differences in their life style. (3) if the claw is part of the copulatory complex, which is the set of phenotypic (morphology, behaviour, chemical,…) characters used by the partners (mostly the male) to stimulate each other into copulation, then the character could have evolved through sexual selection (Danielopol *et al.* 1990). In favour of this hypothesis is certainly that the character is sexually dimorphic. If it were to appear only after the final moult, this would offer additional evidence. But it would certainly be an exceptional case in mate selection in ostracods, as most such characters appear in the male, who uses them to stimulate the female into accepting him for copulation and hence reproduction. This might be the first indication in ostracods that also females have to convince males to mate. It would also require quite a different copulatory position than the possibilities illustrated by Cohen and Morin (1990), if the female has to touch the male in a way that he can detect the presence of the overgrown claw.

Taxonomy

The Cypridopsinae are one of the most speciose subfamilies in the Cyprididae. It comprises about a fifth of all the species in the Cyprididae (in which it is only one of more than 20 subfamilies) and about 10% of all described free-living, Recent non-marine ostracods (200 species out of c 2000, Martens *et al.* 2008).

The taxonomy of the Cypridopsinae is confused, mainly because earlier descriptions of genera and species are rather brief, because species are invariably small (rarely larger than 0.8 mm), which hampers complete dissection and interpretation of characters, and because many populations are parthenogenetic, so that male morphology is not available. The Cypridopsinae as a whole are united by the fact that their caudal ramus (furca) is reduced to a short ramus bearing mostly a short subapical seta and a longer apical one in female; in males these structures are incorporated in the hemipenis. In two genera, the caudal ramus also disappeared in the female (*Pseudocypridopsis* Karanovic, 1999 from Montenegro and *Martenscypridopsis* Karanovic & Pesce, 2000).

For a long time, Cypridopsidae was regarded as a valid family, next to Cyprididae, because of this character. However, reduction in the caudal ramus has also occurred in several other lineages, for example in the Oncocypridinae of the Notodromatidae and in several lineages of the (subterranean) Candonidae. Therefore, this character is again homeomorphic within the Podocopida and it cannot be used as a sole supporting character of a family. Cypridopsidae was thus again lowered to the rank of subfamily within the Cyprididae. The taxonomy within the Cypridopsinae is even more confused (Karanovic & Pesce 2000) and it has thus far been difficult to create order through the erection of different tribes, because several genera show a mixture of characters, so that unequivocal delimitation of phylogenetic lineages based on shared, unique characters appears unreliable. Only the shape of the terminal segment of the Mx1 palp has allowed to separate *Potamocypris* (spatulate) from all other cypridopsine genera (cylindrical). Here, we attempt to make a further step in resolving the internal relationships between genera in the Cypridopsinae by creating the tribe *Zonocypridini* n.trib., and by defining this tribe on both valve and soft part characters. However, the creation of this taxon is a working hypothesis only, which can be tested by further resolving the position of the two '*Zonocypris' s.l.* lineages with smooth valves.

Distribution

It was commonly thought that the group was especially common in Africa (Klie 1935), but recent collections show the presence of many as yet undescribed taxa also in South America and Australia, so maybe Cypridopsinae are most common in the southern Hemisphere as a whole.

Zonocypris s.s. occurs mostly in South and East Africa and in Madagascar. The other lineages within *Zonocypris s.l.* appear to be more common in West and Central Africa, although '*Z.' glabra* Klie, 1944 is common in and around Lake Kivu, while '*Z'. uniformis* Rome, 1962 (Lake Kivu), '*Z.' pilosa* Rome, 1962 (Lake Bangwe near Lake Tanganyika in Tanzania) and *'Z.' laevis* Sars, 1910 (Lake Victoria, Tanzania) are clearly East African (Martens 1984).

Nazik and Gokcen (1992) described three new fossil ostracod species from the lower Miocene of Turkey and allocated these to *Zonocypris*. These species indeed have the striated external valve ornamentation that is typical of some species in this genus, but this morphology is by no means restricted to this genus; it can also occur in *Paracypretta* Sars, 1924, certain groups in the Cypricercinae (e.g. *Bradleytriebella lineata* (Victor & Fernando, 1981)) and the enigmatic *Eucypris striata* (Jurine, 1820), redescribed and reported from Budapest by Daday (1900). The Turkish Miocene species show a clear anterior selvage in the RV (*loc.cit.* plate 1(3)), much as in *Cypris* or indeed in the Recent *E. striata.* These Miocene species do not belong in *Zonocypris* s.s.. Cabral *et al.* (2004)

reported a species of *Zonocypris* from the Pleistocene of Portugal and tentatively named it *Zonocypris cf. costata* (Vavra, 1897). These authors provide only external views, on which indeed the semi-concentric ridges can be seen. However, the shape in dorsal view is quite different. Moreover, as no internal views were provided, one cannot confirm the identity of these fossil specimens with certainty. As all recent occurrences of *Zonocypris s.s.* are thus far at least south of the Sahara, both reported fossil occurrences of this genus seem unlikely, though of course not impossible.

Zonocypris inconspicua Schäfer, 1952 from Turkey belongs to the second non-*Zonocypris* lineage (with LV>RV and smooth valves) and whereas this also means a considerable extension of this lineages' areal to the East, it is more likely that the distribution of this lineage includes the Mediterranean basin.

Acknowledgements

JH acknowledges Sukonthip Savatenalinton and Thijs Van der Meeren (Brussels, Belgium) for help with the drawings. Julian Cillis and Claudine Behen (Brussels, Belgium) offered technical assistance with the SEM and the line drawings, respectively. Jaime Luiz Lopes Pereira (Maringá, Brazil) offered help with the map and with the SEM plates. JH received postdoctoral grants for short to more extended stays in the Royal Belgian Institute of natural Sciences (Brussels, Belgium) from CAPES (Process: BEX1452/08-8), from The Global Taxonomic Initiative (GTI- CBD/GTI-02/2010) and from the Belgian Science Policy. This research is part of projects supported by CNPq (Process: 472434/03-9, 478487/2010-0 and through the Long-Term Ecological Research (LTER) Program) and CNPq/Fundação Araucária (n. 232/10) and Nupélia.

References

Agostinho, A.A. & Zalewski, M. (1996) *A planície Alagável do Alto Rio Paraná: Importância e Preservação. (Upper Paraná River Floodplain: Importance and Preservation)*. EDUEM, Maringá, 100 pp.

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.

Brehm, V. (1911) Einige Beitrage zur Aussereuropaische Entomostrakenfauna. *Archiv für Hydrobiologie*, 6, 486–488.

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.

Cabral, M.C., Colin, J.P. & Carbonel, P. (2004) First occurrence of the genus *Zonocypris* (Ostracoda) in the Pleistocene of Western Europe (Portugal). *Journal of Micropalaeontology*, 23, 105–106.

Carbonel, P. & Peypouquet, J.P. (1979) Les ostracodes des series du Bassin de l'Oma. *Bulletin de l'Institut géologique du Bassin d'Aquitaine*, 25, 167–199.

Cohen, A.C. & Morin, J.G. (1990) Patterns of reproduction in ostracodes: a review. *Journal of crustacean Biology*, 10, 184–211.

Daday, E. von (1900) Ostracoda Hungariae. *Magyarorszagi Kagylosrakok Maganrajza I-IV*, 1–320.

Danielopol, D.L., Martens, K. & Casale, L.M. (1990) Revision of the genus *Leucocythere* Kaufmann, 1892 (Crustacea, Ostracoda, Limnocytheridae), with the description of a new species and two new tribes. *Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, 59, 63–94.

Delachaux, T. (1919) Déscription d'un Ostracode nouveau De l'Afrique portugaise (*Stenocypris junodi* sp.nov.) *Bulletin de la Societé Portugaise pour les Sciences Naturelles*, 8, 145–147.

Fryer, G. (1957) Freeliving freshwater Crustacea from Lake Nyasa and adjoining waters. General remarks with notes on certain Malacostraca and Ostracoda. *Archiv für Hydrobiologie*, 53, 527–536.

Ghetti, P.F. & McKenzie, K.G. (1981) *Ostracodi (Crustacea, Ostracoda). Guide per il reconoscimento delle specie animali delle acque interne italiane*. Consiglio Nazionale delle Ricerche, Roma, 83 pp.

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, 1930–1943.

Higuti, J., Meisch, C. & Martens, K. (2009a) On *Paranacypris samambaiensis* n.gen. n.sp. (Crustacea, Ostracoda), the first South American psychrodromid, from the floodplain of the Upper Paraná River, Brazil. *Journal of natural History*, 43, 769–783.

Higuti, J., Lansac-Tôha, F.A., Velho, L.F.M., Pinto, R.L., Vieira, L.C.G. & Martens, K. (2009b) Composition and distribution of Darwinulidae (Crustacea, Ostracoda) in the alluvial valley of the upper Paraná River, Brazil. *Brazilian Journal of Biology*, 69, 253–262.

Higuti, J., Velho, L.F.M., Lansac-Tôha, F.A. & Martens, K. (2009c) Biodiversity of non-marine ostracods (Crustacea, Ostracoda) in the alluvial valley of the upper Paraná River, Brazil. *Brazilian Journal of Biology*, 69 (suppl), 661–668.

Higuti J., De Clerck S., 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, 261–278.

Horne, D.J., Cohen, A. & Martens, K. (2002) The Ostracoda: Applications in Quaternary Research. *In*: Holmes, J.A. & Chivas, A.R. (Eds), *Biology, Taxonomy and Identification*, Washington DC: American Geophysical Union. Techniques, pp. 5–36.

Jocque, M., Brendonck, L., Riddoch, B. & Martens, K. (2010) On *Amphibolocypris arida* n.sp. (Crustacea, Ostracoda), from rock pools in Botswana (southern Africa). *Zootaxa*, 2408, 47–58.

Karanovic, I. & Datry, T. (2009) Overview of the Candoninae (Crustacea, Ostracoda) of South America and the West Indies, with the description of two new species and one new genus. *Zootaxa*, 2267, 1–25.

Karanovic, I. & Pesce, G.L. (2000) *Martenscypridopsis* a new ostracod genus (Crustacea, Ostracoda) from African Inland waters. *Annales de Limnologie*, 36, 149–155.

Karanovic, I. (1999) On *Pseudocypridopsis* n.gen., with a redescription of *Pseudocypridopsis clathrata* (Klie, 1936) and a first description of the male (Ostracoda, Cypridopsinae). *Bulletin Zoologisch Museum Universiteit Amsterdam*, 17, 1–8.

Kiss, R. (1959) Ostracodes de l'Afrique tropicale. *Revue de Zoologie et Botanie Africaine*, 60, 1–16.

Klie, W. (1933) Die Ostracoden der Rift Tal Seen in Kenia. *Internationale Revue der gesamten Hydrobiologie und Hydropgeographie*, 29, 1–14.

Klie, W. (1935) Ostracoda aus dem tropischen West-Afrika. *Archiv für Hydrobiologie*, 28, 35–68.

Klie, W. (1939) Ostracoden aus dem Kenia-Gebiet, vornehmlich von dessen Hochgebirgen. *International Revue der gesamten Hydrobiologie und Hydrogeographie*, 39, 99–161.

Klie, W. (1940) Süsswasserostracoden aus Nordostbrasilien VI. Cyprinae mit geiselförmiger Furka. *Zoologischer Anzeiger*, 130, 59–73.

Lindroth, S. (1953) Taxonomic and zoogeographical studies of the ostracod fauna in the inland waters of East Africa (Results of the Swedish East Africa Expedition 1948). *Zoologiske Bidrage Uppsala*, 30, 43–156.

Lowndes, A.G (1936) Scientific results of the Cambridge expedition to the East African Lakes. *Journal of the Linnean Society, Zoology*, 40, 1–31.

Martens, K. (1984) *Annotated checklist of non-marine ostracods (Ostracoda, Crustacea) from African inland waters*. Zoologische Bijdragen van het koninklijk Museum voor Midden Afrika, Tervuren, 20, 51 pp.

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, 183–190.

Martens, K. & Meisch, C. (1985) Description of the male of *Potamocypris villosa* (Jurine, 1820) (Crustacea, Ostracoda). *Hydrobiologia*, 127, 9–15.

Martens, K. & Behen, F. (1994) *A checklist of the non-marine ostracods (Crustacea, Ostracoda) from South-American inland waters and adjacent islands*. Travaux scientifiques du Musée d'Histoire naturelle de Luxembourg, 22, 81 pp.

Martens, K., Davies, B.R., Baxter, A.J. & Meadows, M.E. (1996) Taxonomy and ecology of the Ostracoda (Crustacea) from the Verlorenvlei (Southwestern Cape, RSA). *South African Journal of Zoology*, 31, 23–36.

Martens, K., Würdig, N.L. & Behen, F. (1998) Maxillopoda. Non-marine Ostracoda: *In*: Young, P.S. (ed.), *Catalogue of Crustacea of Brazil*. Museu Nacional, Série Livros 6, Rio de Janeiro, pp. 45–65.

Martens, K., Schön, I., Meisch, C. & Horne, D.J. (2008) Global biodiversity of non-marine Ostracoda (Crustacea). *Hydrobiologia*, 595, 185–193.

Martens, K. & Savatenalinton, S. (2011) A subjective checklist of the recent, free-living, non-marine Ostracoda (Crustacea). *Zootaxa*, 2855, 1–79.

McKenzie, K.G. (1971) Entomostraca of Aldabra, with special reference to the genus *Heterocypris* (Crustacea, Ostracoda). *Philosophical Transactions of the Royal Society of London*, 260, 257–297.

McKenzie, K.G. (1982) Homeomorphy: persistant 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, Heidelberg, Berlin, 522 pp.

Mormul, R.P., Thomaz, S.M., Higuti, J. & Martens, K. (2010) Ostracod (Crustacea) colonization of a native and a non-native macrophyte species of Hydrocharitaceae in the Upper Paraná floodplain (Brazil): an experimental evaluation. *Hydrobiologia,* 644, 185–193.

Müller, G.W. (1898) Wissenschaftlichen Ergebnisse der Reisen in Madagaskar und Ost Afrika in der Jahren 1889-1895 von Dr A. Voeltzkow. Die Ostracoden. *Abhandlungen den Seckenbergischen naturforschende Geselschaft*, 21, 255–296.

Müller, G.W. (1908) Die Ostracoden der Deutsche Südpolar-Expedition 1901-1903. *In*: Drygalski, E.V. (Ed.), *Deutsche Südpolar-Expedition 10 (zoologie 2)*. pp. 51–182.

Müller, G.W. (1914) Die Ostracoden der Deutsche Südpolar-Expedition 1901-1903. Nachtrag. *In*: Drygalski, E.V. (Ed.), *Deutsche Südpolar-Expedition 16 (zoologie 8)*. pp. 67–78.

Nazik, A. & Gokcen, N. (1992) Ostracod genus *Zonocypris* and its species in Kurtulmustepe formation of Ulukisla basin (Turkey). *Revista Espanola de Micropaleontologia*, 24, 63–69.

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 São Paulo State (Brazil). *Zoological Journal of the Linnean Society*, 139, 305–313.

Pinto, R.L., Rocha, C.E.F. & Martens, K. (2004) On the genus *Penthesilenula* Rossetti & Martens, 1998 (Crustacea, Ostracoda, Darwinulidae) from (semi-) terrestrial habitats in São Paulo State (Brazil), with the description of a new species. *Journal of natural History*, 38, 2567–2589.

Pinto, R.L., Rocha, C.E.F. & Martens, K. (2005a) On the evolution of the genus *Microdarwinula* Danielopol, 1968 (Ostracoda, Darwinulidae) with the description of a new species from semi-terrestrial habitats in São Paulo State (Brazil). *Crustaceana*, 78, 975–986.

Pinto, R.L., Rocha, C.E.F. & Martens, K. (2005b) On new terrestrial ostracods (Crustacea, Ostracoda) from Brazil, primarily from São Paulo State. *Zoological Journal of the Linnean Society*, 145, 145–173.

Pinto, R.L., Rocha, C.E.F. & Martens, K. (2008) On the first terrestrial ostracod of the superfamily Cytheroidea (Crustacea, Ostracoda). *Zootaxa,* 1828, 29–42.

Rome, D.R. (1962) *Ostracodes. Exploration hydrologique du lac Tanganyika (1946-1947).* Institut Royal des Sciences naturelles de Belgique, Bruxelles, 305 pp.

Sars, G.O. (1901) Contributions to the knowledge of the freshwater Entomostraca os South America, as shown by artificial hatching from dried material. Part 2. *Archiv for Mathematik og Naturvidenskab*, 24, 1–52.

Sars, G.O. (1910) Zoological results of the third Tanganyika Expedition, conducted by Dr W.A. Cunnington 1904-1905. *Report on the Ostracoda. Proceedings of the Zoological Society of London*, 2, 732–760.

Sars, G.O. (1924) The freshwater Entomostraca of the Cape Province (Union of South Africa). *Annals of the South African Museum*, 20, 105–193.

Vavra, W. (1897) Die Süsswasser-Ostracoden Deutsch-Ostafrikas. *Deutsch Ost-Afrika*, 4, 1–28.

Victor, R. & Fernando, C.H. (1981) Freshwater ostracods (Crustacea, Ostracoda) of the genus *Strandesia* Vavra, 1895 from Malaysia, Indonesia and the Philippines. *Archiv für Hydrobiologie, supplementband* 58, 469–522.

Würdig, N.L. & Pinto, I.D. (2001) *Pseudocandona pumilis* sp. nov. (Ostracoda). Ecological data and distribution in the Tramandai lagunar system, RS, Southern Brazil. *Nauplius*, 7, 39–51.

Table captions

Table 1. Localities from which *Cabelodopsis hispida*. n.gen. was collected. IVI= Ivinheima River System, BAI= Baía River System, PAR= Paraná River System, floating= mixed floating plants, WT= water temperature, EC= electrical conductivity, DO= dissolved oxygen.

Table 2: Locality data of African *Zonocypris* material used here.

Table 3: Genera of Cypridopsinae of the world. Higher taxonomy follows the synopsis by Horne *et al.* (2002).

Table 4: Measurements of specimens used for descriptions in this paper.

Table 5: List of species in *Zonocypris s.l.* (* = type species), grouped in presumed monophyletic units. Note that it is not certain that all groups belong in Zonocypridini n.trib.

Figure captions

Figure 1. Map of the area, indicating localities from where *Cabelodopsis hispida* was collected.

Figure 2. Valves of *Cabelodopsis hispida*, all female. A. LV, internal view (KM 3418). B. LV, internal view (KM 3418), detail of anterior part. C. LV, internal view (KM 3418), detail of posterior part. D. RV, internal view (KM 3418). E. RV, internal view (KM 3418), detail of anterior part. F. RV, internal view (KM 3418), detail of posterior part. G. Cp, left lateral view (KM 3420). H. RV, detail of postero-ventral part, tilted (JH 220). I. Cp, dorsal view (KM 3419). J. Cp, ventral view (KM 3421).
Scale bars: A, D, G, I, J, 200 μm; and B, C, E, F, H, 100 μm.

Figure 3. Limbs of *Cabelodopsis hispida*, all female. A. Rake like organ (JH 231). B. A2, for chaetotaxy of terminal segment see Fig 3D (JH 220). C. T3, detail of pincer (JH 211). D. A2, detail of the last segment (JH 220). E. A1 (JH 232). F. T3 (JH 211). G. T1, palp (JH 220).
Scale bars: A–G, 50 μm.

Figure 4. Limbs of *Cabelodopsis hispida*, all female. A. Mx1 (JH 208). B. T2 (JH 210). C. Md palp (JH 213).
Scale bars: A–C, 50 μm.

Figure 5. Limbs of *Cabelodopsis hispida*, all female. A. T, chaetotaxy of palp see Fig. 3G (JH 220). B. Md (JH 210). C. Caudal Ramus.
Scale bars: A–C, 50 μm.

Figure 6. Valves of *Zonocypris* cf. *costata*. A. LV, internal view (JH 275). B. LV, internal view (JH 275), detail of anterior part. C. LV, internal view (JH 275), detail of posterior part. D. RV, internal view (JH 275). E. RV, internal view (JH 275), detail of anterior part. F. RV, internal view (JH 275), detail of posterior part. G. Cp, dorsal view (JH 277). H. Cp, ventral view (JH 278). I. Cp, right lateral view (JH 281). J. RV, detail of postero-ventral part, tilted (JH 280). K. RV, detail of posterior part.
Scale bars: A, D, G, H, I, 200 μm; B, C, E, F, 100 μm; and J, K, 50 μm.

Fig 7: Valves of *Zonocypris* cf. *costata*, details in tilted position. All from a female (JH 280), from Fish Hoek Pool (RSA). A–C: LVi, D–F: RVi, A. posterior part. B. Posterior and ventral part, showing outer list and posterior double inner list. C. Oblique anterior view, showing curved ventral inner list. D. Anterior part of valve in ventral view. E. Posterior part of valve in dorsal view. F. Anterior part of valve in dorsal view.
Scale bars: A–C, E, F = 100 µm, D = 50 µm.

Figure 8. Scanning electronic microscopy of limbs of *Zonocypris* cf. *costata*. A, B. detail of A2. C. detail of mouth region, showing rake-like organs. D, general ventral view. E. general, latero-ventral view. F. latero-ventral view of anterior part.
Scale bars A, B, 40 μm; C, 30; D, F, 100 μm; and E, 100 μm.

Figure 9. Valves of *Zonocypris cordata*. A. LV, internal view (JH 290). B. LV, internal view (JH 290), detail of anterior part. C. LV, internal view (JH 290), detail of posterior part. D. RV, internal view (JH 290b). E. RV, internal view (JH 290), detail of anterior part. F. RV, internal view (JH 290), detail of posterior part. G. Cp, dorsal view (JH 291). H. Cp, ventral

view (JH 293). I. Cp, right lateral view (JH 292). J. RV, internal view of juvenile (JH 316). K. LV, internal view of juvenile (JH 316b).

Scale bars: A, D, G, H, I, J, K 200 µm; and B, C, E, F, 100 µm.

Figure 10. Valves of *Zonocypris* cf. *cordata*. A. LV, internal view (JH 279). B. LV, internal view (JH 279), detail of anterior part. C. LV, internal view (JH 279), detail of posterior part. D. RV, internal view (JH 279). E. RV, internal view (JH 279), detail of anterior part. F. RV, internal view (JH 279), detail of posterior part. G. Cp, dorsal view (JH 288). H. Cp, ventral view (JH 288). I. Cp, right lateral view (JH 289). J. Cp, right lateral view (JH 289), detail of antero-ventral part.

Scale bars: A, D, G, 200 µm; B, C, E, F, J, 100 µm; and H, I, 300 µm.

Figure 11. Valves of *Zonocypris tuberosa*. A. LV, internal view (JH 294). B. LV, internal view (JH 294), detail of anterior part. C. LV, internal view (JH 294), detail of posterior part. D. RV, internal view (JH 294). E. RV, internal view (JH 294), detail of anterior part. F. RV, internal view (JH 294), detail of posterior part. G. Cp, dorsal view (JH 296). H. Cp, ventral view (JH 295). I. Cp, right lateral view (JH 297). J. Cp, right lateral view (JH 297), detail of valve ornamentation.

Scale bars: A, D, G, H, I, 400 µm; and B, C, E, F, J 200 µm.

Figure 12. Penultimate segment of A2, showing large claws G2. A. *Zonocypris* cf. *cordata* (JH 279). B. *Zonocypris cordata* (JH 303). C. *Zonocypris* cf. *costata* (JH 299). D. *Zonocypris tuberosa* (JH 304). Scale bars: A, B, C, D, 50 µm.

Table 1.

Sample	**Data**	**Locality name**	**S°**	**S'**	**S"**	**W°**	**W'**	**W"**	**Habitat**	**System**	**Substrate**	**T (°C)**	**EC (µS.cm^{-1})**	**pH**	**DO (mg.L^{-1})**
PAR 1	13.03.04	Lake Ventura	22	51	29	53	36	3	closed lake	IVI	littoral	26.5	36.2	6.6	7.2
PAR 9	13.03.04	Lake Patos	22	49	34	53	33	20	open lake	IVI	*Eichhornia crassipes*	27.9	42.5	7	6.5
PAR 124	06.11.04	Lake Patos	22	49	33.2	53	33	13.8	open lake	IVI	*E. crassipes*	26	48.2	5.4	2.7
PAR 21	13.03.04	Lake Jacaré	22	47	10	53	29	56	closed lake	IVI	littoral	27.3	48.6	6.4	5.3
PAR 137	06.11.04	Lake Jacaré	22	46	59.1	53	29	52.9	closed lake	IVI	*P. stratiotes*	28.5	35.4	4.7	4.1
PAR 30	15.03.04	Lake Pombas	22	48	6	53	21	40	open lake	PAR	*E. crassipes*	26.6	96.6	6.5	4
PAR 158	08.11.04	Lake Zé Marinho	22	47	33.5	53	21	4.4	closed lake	PAR	*E. crassipes*	22.7	69.6	5.1	2.5
PAR 176	08.11.04	Lake Garças	22	43	30	53	13	10.6	open lake	PAR	*Salvinia* spp	27.3	64.1	6.25	5.9
PAR 36	15.03.04	Leopoldo Backwater	22	45	38	53	16	19	open lake	PAR	*Oxycarum cubense*	29.3	80.4	6.2	2.5
PAR 37	15.03.04	Leopoldo Backwater	22	45	38	53	16	19	open lake	PAR	*Eichhornia azurea*	29.3	80.4	6.2	2.5
PAR 53	16.03.04	Lake Pintado	22	56	48	53	38	22	open lake	IVI	floating	29.9	50.8	6.5	3.4
PAR 213	11.11.04	Lake Pintado	22	56	50.1	53	38	36	open lake	IVI	*Salvinia* spp	25.8	43.3	5.6	4
PAR 55	16.03.04	Lake Peroba	22	54	45	53	38	27	open lake	IVI	*E. crassipes*	31.3	42.6	6.8	6.1
PAR 219	11.11.04	Lake Peroba	22	54	32.8	53	38	23.4	open lake	IVI	*E. crassipes*	25.6	28.1	5.8	5.6
PAR 57	16.03.04	Ivinhema River	22	54	47	53	38	24	river	IVI	*Hydrocotyle ranunculoides*	30.5	46.6	7	6.5
PAR 58	16.03.04	Ivinhema River	22	54	47	53	38	24	river	IVI	*E. crassipes*	30.5	46.6	7	6.5
PAR 221	11.11.04	Ivinhema River	22	54	37.6	53	38	19.4	river	IVI	*Salvinia* spp	25.8	41.3	6.3	5.9
PAR 61	16.03.04	Lake Boca do Ipoitã	22	50	14	53	33	59	open lake	IVI	*E. crassipes*	33.5	49.6	6.3	4.8
PAR 226	11.11.04	Lake Boca do Ipoitã	22	50	7.3	53	33	58.7	open lake	IVI	*E. crassipes*	25.7	41.8	5.8	3.5
PAR 66	16.03.04	Paraná River	22	50	42	53	30	54	river	PAR	littoral	30	64.6	8.2	6.7
PAR 69	16.03.04	Cortado Channel	22	48	50	53	22	35	channel	PAR	*E. crassipes*	30	66.9	6.6	5.8
PAR 70	16.03.04	Cortado Channel	22	48	50	53	22	35	channel	PAR	*Salvinia* spp	30	66.9	6.6	5.8
PAR 73	16.03.04	Cortado Channel	22	48	50	53	22	35	channel	PAR	*Pistia stratiotes*	30	66.9	6.6	5.8
PAR 233	11.11.04	Cortado Channel	22	48	45.7	53	22	46.3	channel	PAR	*Salvinia* spp	25.1	61.5	6.3	7.1
PAR 234	11.11.04	Cortado Channel	22	48	45.7	53	22	46.3	channel	PAR	*P. stratiotes*	25.1	61.5	6.3	7.1
PAR 235	11.11.04	Cortado Channel	22	48	45.7	53	22	46.3	channel	PAR	*E. crassipes*	25.1	61.5	6.3	7.1

Sample	Data	Locality name	S°	S'	S"	W°	W'	W"	Habitat	System	Substrate	T (°C)	EC (µS.cm^{-1})	pH	DO (mg.L^{-1})
PAR 76	17.03.04	Lake Gavião	22	39	49	53	12	19	open lake	BAI	*E. crassipes*	27.8	31.1	6.2	3.9
PAR 82	17.03.04	Baía River	22	41	8	53	13	3	river	BAI	*H. ranunculoides*	29.4	34.4	6	4.5
PAR 83	17.03.04	Baía River	22	41	8	53	13	3	river	BAI	*E. crassipes*	29.4	34.4	6	4.5
PAR 84	17.03.04	Baía River	22	41	8	53	13	3	river	BAI	*P. stratiotes*	29.4	34.4	6	4.5
PAR 85	17.03.04	Baía River	22	41	8	53	13	3	river	BAI	*Salvinia* spp	29.4	34.4	6	4.5
PAR 192	10.11.04	Baía River	22	40	37.5	53	12	29	river	BAI	*H. ranunculoides*	26.7	30.9	5.7	3.1
PAR 193	10.11.04	Baía River	22	40	37.5	53	12	29	river	BAI	*P. stratiotes*	26.7	30.9	5.7	3.1
PAR 194	10.11.04	Baía River	22	40	37.5	53	12	29	river	BAI	*Salvinia* spp	26.7	30.9	5.7	3.1
PAR 195	10.11.04	Baía River	22	40	37.5	53	12	29	river	BAI	*E. crassipes*	26.7	30.9	5.7	3.1
PAR 88	17.03.04	Lake Maria Luiza	22	40	40	53	13	12	open lake	BAI	*E. crassipes*	30.4	40.8	6.1	3.5
PAR 90	17.03.04	Lake Porcos	22	42	20	53	14	47	open lake	BAI	*E. crassipes*	29.6	41.3	6.1	3.5
PAR 94	17.03.04	Lake Guaraná	22	43	26	53	18	12	open lake	BAI	*Salvinia* spp	31.1	52.3	6	2.3
PAR 95	17.03.04	Lake Guaraná	22	43	26	53	18	12	open lake	BAI	*P. stratiotes*	31.1	52.3	6	2.3
PAR 207	10.11.04	Lake Guaraná	22	43	16.8	53	18	12.9	open lake	BAI	*P. stratiotes*	27.4	40.5	5.2	3.3
PAR 99	**17.03.04**	**Manezinho Backwater**	**22**	**46**	**55**	**53**	**20**	**59**	**open lake**	**PAR**	***E. crassipes***	**31.6**	**65.2**	**7.5**	**6.2**
PAR 211	**10.11.04**	**Manezinho Backwater**	**22**	**46**	**45.7**	**53**	**20**	**57.7**	**open lake**	**PAR**	***E. crassipes***	**26.6**	**58.8**	**6**	**5.4**
S1	**15.04.04**	**Manezinho Backwater**	**22**	**46**	**55**	**53**	**20**	**59**	**open lake**	**PAR**	***E. crassipes***	**28.2**	**60.1**	**6.9**	**8**
S1	**13.12.04**	**Manezinho Backwater**	**22**	**46**	**55**	**53**	**20**	**59**	**open lake**	**PAR**	***E. crassipes***	**28.5**	**56.1**	**5.8**	**3.3**

Table 2:

Cabelodopsis hispida (female) – All from Manezinho backwater, in roots of *Eichhornia crassipes*
Valves:
KM 3418; KM 3419; KM 3420; KM 3421– coll. 15.04.2004
JH 220– coll. 10.11.2004
Soft parts:
JH 208; JH 220– coll. 10.11.2004
JH 210; JH 211; JH 213, JH 231; JH 232– coll. 13.12.2004

Zonocypris cf. *cordata* (female) – All from littoral
Valves:
JH 279– Lake Sibaya jetty, RSA/94/71, coll. 26.10.1994
JH 288; JH 289– Verlorenvlei 2, RSA/94/002, coll. 19.10.1994
Soft parts:
JH 279– Lake Sibaya jetty, RSA/94/71, coll. 26.10.1994

Zonocypris cf. *costata* (female) – All from Fish Hoek Pool, RSA/DJ/001 (55), littoral
Valves:
JH 275; JH 277; JH 278; JH 280; JH 281– all coll. 11.1982
Soft parts:
JH 299–JH 302– coll. 11.1982

Zonocypris cordata (female) – All from littoral samples
Valves:
JH 290–JH 293– Verlorenvlei 8, RSA/94/008, coll. 19.10.1994
JH 316– Verlorenvlei 2, RSA/94/002, coll. 19.10.1994
Soft parts:
JH 303–Verlorenvlei 8, RSA/94/008, coll. 19.10.1994

Zonocypris tuberosa (female) – All from Verlorenvlei 8, RSA/94/008, littoral
Valves:
JH 294–JH 297– coll. 19.10.1994
Soft parts:
JH 304– coll. 19.10.1994

Table 3:

Class	Ostracoda Latreille, 1806
Subclass	Podocopa G. W. Müller, 1894
Order	Podocopida G.O. Sars, 1866
Suborder	Cypridocopina Baird, 1845
Superfamily	Cypridoidea Baird, 1845
Family	Cyprididae Baird, 1845
Subfamily	**Cypridopsinae Kaufmann, 1900**

Tribe Cypridopsini Kaufmann, 1900

- *Austrocypridopsis* McKenzie, 1982
- *Bryocypris* Røen, 1956
- *Cavernocypris* Hartmann, 1964
- *Cypridopsis* Brady, 1867 (genus typicus)
  - Syn.: *Pionocypris* Brady & Norman, 1896
  - Syn.: *Cypridopsella* Kaufmann, 1900 (partim)
  - Syn.: *Proteocypris* Brady, 1907 (partim)
- *Kapcypridopsis* McKenzie, 1977
- *Klieopsis* Martens, Meisch & Marmonier, 1991
- *Martenscypridopsis* Karanovic, 2000
- *Neocypridopsis* Klie, 1940
- *Plesiocypridopsis* Rome, 1965
- *Pseudocypridopsis* Karanovic, 1999
- *Sarscypridopsis* McKenzie, 1977
- *Tanganyikacypridopsis* Martens, 1985
- *Thermopsis* Kulkoluoglu et al, 2003
- *Tungucypridopsis* Victor & Fernando, 1983

Tribe Potamocypridini (as Potamocypridinae in Ghetti & McKenzie, 1981)

- *Potamocypris* Brady, 1870
  - Syn.: *Cyprilla* Sars, 1924
  - Syn.: *Proteocypris* Brady, 1907 (partim)
  - *Syn.: Cypridopsella* Kaufmann, 1900 (partim)
  - Syn.: *Paracypridopsis* Kaufmann, 1900

Tribe Zonocypridini n.trib.

- ***Cabelodopsis* n.gen.**
- *Zonocypris ss.*. G.W. Müller, 1898
- *“Zonocypris” n.gen.1*
- *“Zonocypris” n.gen.2*

Table 4

species	code	valve	L µm	H µm	W µm
Cabelodopsis hispida	KM 3418	LVi	928	534	
	KM 3418	RVi	922	524	
	KM 3419	CpD	912		521
	KM 3420	CpLl	891	518	
	KM 3421	CpV	927		539
Zonocypris cf. *cordata*	JH 279	LVi	688	403	
	JH 279	RVi	690	392	
	JH 288	CpD	573		432
	JH 288	CpV	570		431
	JH 289	CpRl	570	368	
Zonocypris cf. *costata*	JH 275	LVi	525	363	
	JH 275	RVi	517	354	
	JH 277	CpD	505		406
	JH 278	CpV	499		413
	JH 281	CpRl	519	357	
Zonocypris cordata	JH 290	LVi	570	377	
	JH 290	RVi	553	361	
	JH 291	CpD	580		447
	JH 292	CpRl	575	374	
	JH 293	CpV	576		453
	JH 316	Rvi	471	284	
	JH 316	LVi	477	289	
Zonocypris tuberosa	JH 294	LVi	792	460	
	JH 294	RVi	778	456	
	JH 295	CpV	669		452
	JH 296	CpD	710		490
	JH 297	CpRl	672	386	

Table 5:

***Zonocypris* s.s.**

Zonocypris alveolata Klie, 1936
    Syn. Zonocypris calcarata Klie, 1936: **n.syn**. (= juvenile)
Zonocypris cordata Sars, 1924
Zonocypris corrugata Rome, 1965
* *Zonocypris costata* (Vávra, 1897)
    Cypridopsis costata Vávra, 1897
    Syn.: **Zonocypris madagascarensis* G.W. Müller, 1898 (syn fide Sars 1910 and Klie, 1933 based on study of Vavra's type material, see also Martens 1984 and remarks in text)

Zonocypris dadayi Lowndes, 1932
    Oncocypris costata Daday, 1910
    Neocypridopsis costata (Daday, 1910) fide Klie 1940
Zonocypris elegans G.W. Müller, 1898
Zonocypris lata Rome, 1962
Zonocypris tuberosa G.W. Müller, 1908

"Zonocypris" n.gen.1 (smooth valves, W= c ½ L, RV>LV)

Zonocypris inornata Klie, 1936
Zonocypris laevis Sars, 1910
Zonocypris peralta Rome, 1969
Zonocypris pilosa Rome, 1962

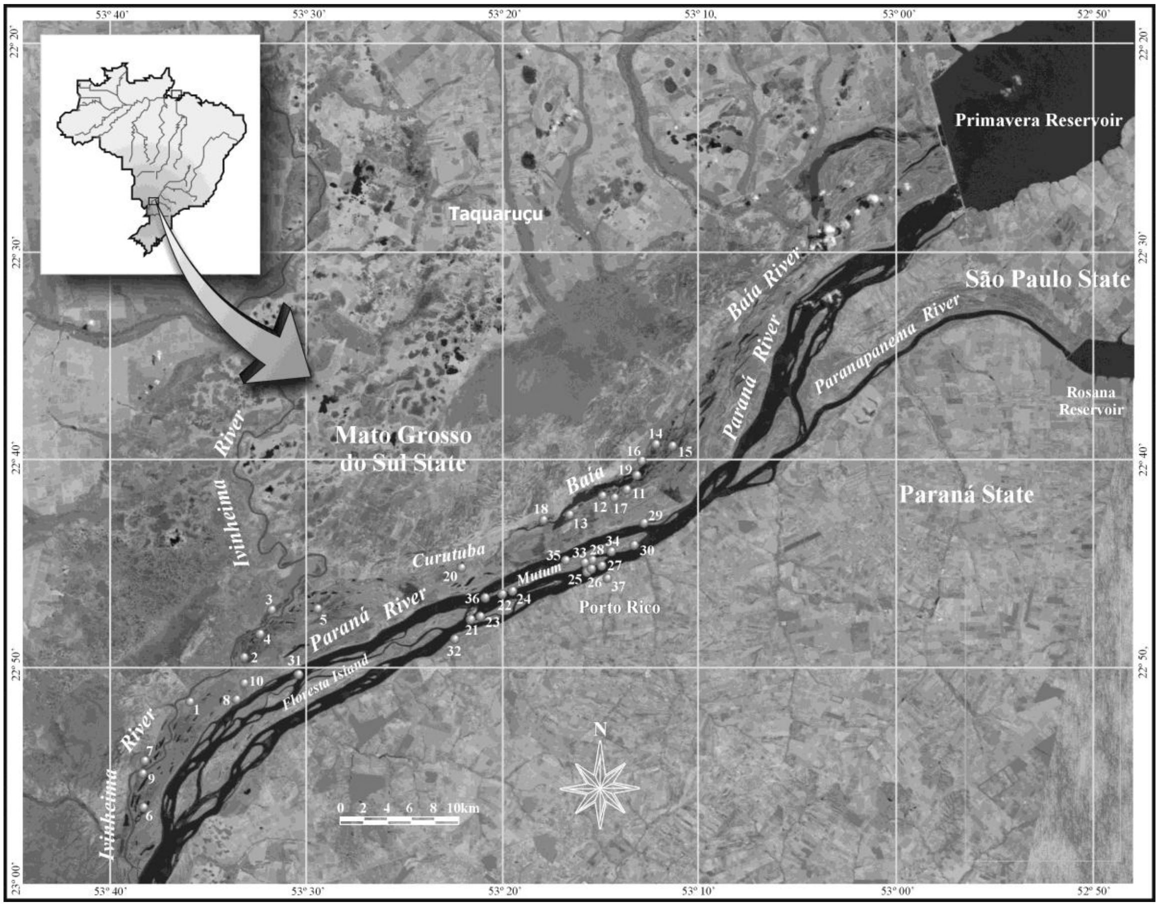
"Zonocypris" n.gen.2 (smooth valves, W= c ½ L, LV>RV)

Zonocypris glabra Klie, 1944
Zonocypris inconspicua Schäfer, 1952
Zonocypris uniformis Rome, 1962

Species removed from *Zonocypris*

Zonocypris hispida = *Cabelodopsis hispida* (Sars, 1901) this paper

Zonocypris laevigata Klie, 1935 = *Plesiocypridopsis laevigata* (Klie, 1935) Martens, 1984


53° 40'
53° 30'
53° 20'
53° 10'
53° 00'
52° 50'
22° 20'
22° 30'
22° 40'
22° 50'
23° 00'
Primavera Reservoir
Taquaruçu
Baía River
Paraná River
São Paulo State
Paranapanema River
Rosana Reservoir
Mato Grosso do Sul State
Ivinheima River
Paraná State
Baía
Curutuba
Mutum
Porto Rico
Paraná River
Floresta Island
Ivinheima River
1
2
3
4
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0 2 4 6 8 10km
N

Figure 1

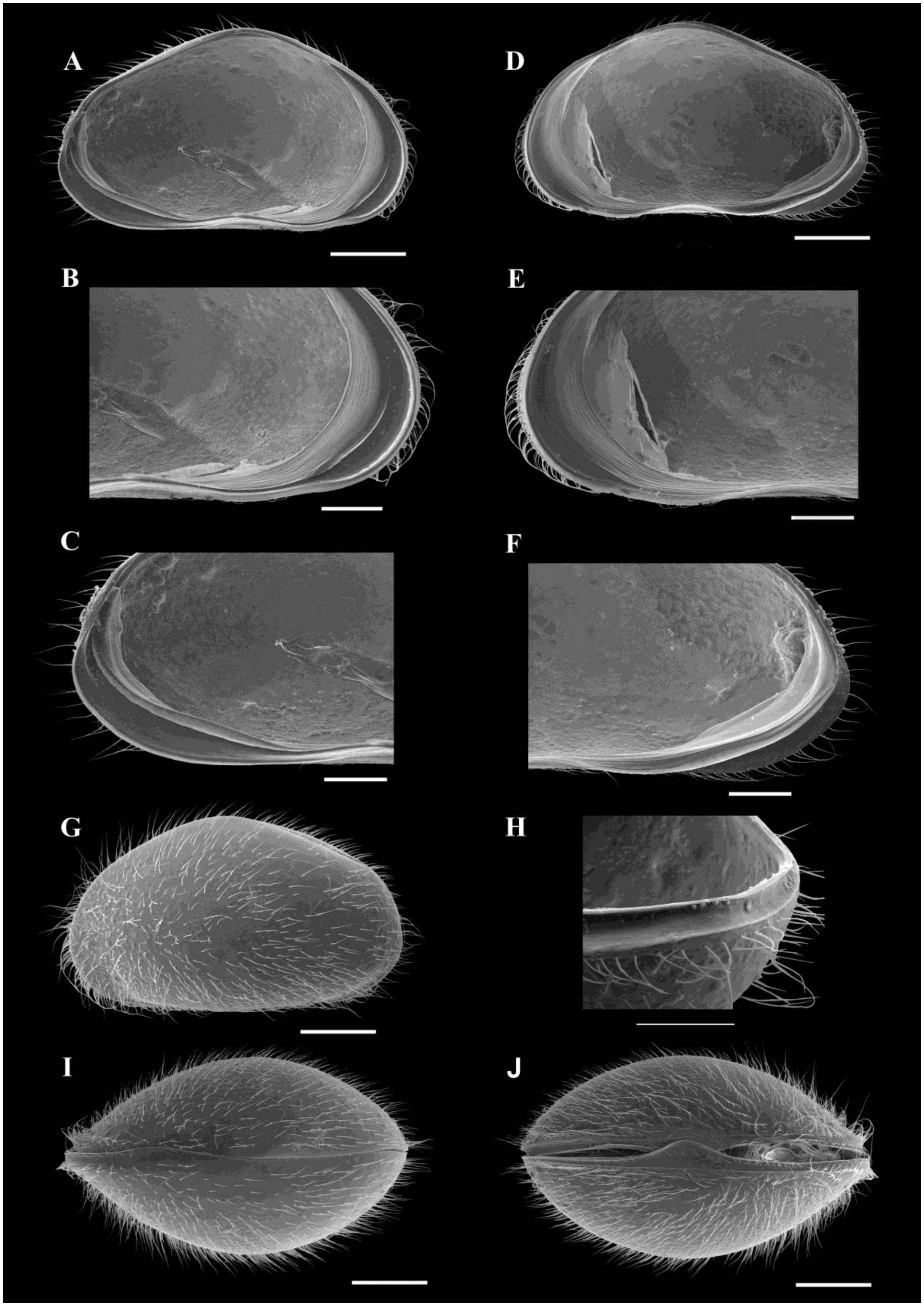

Figure 2

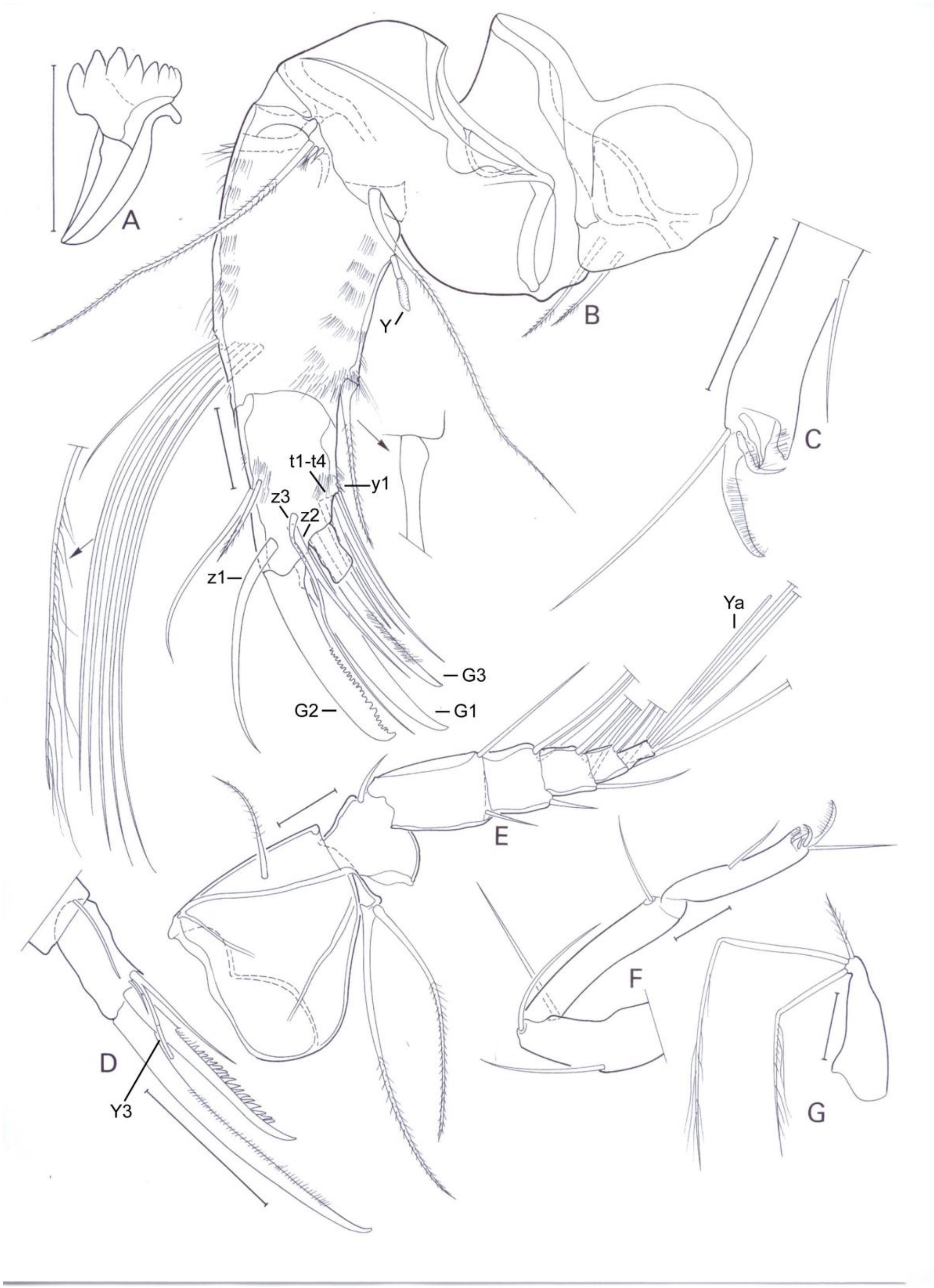

Figure 3

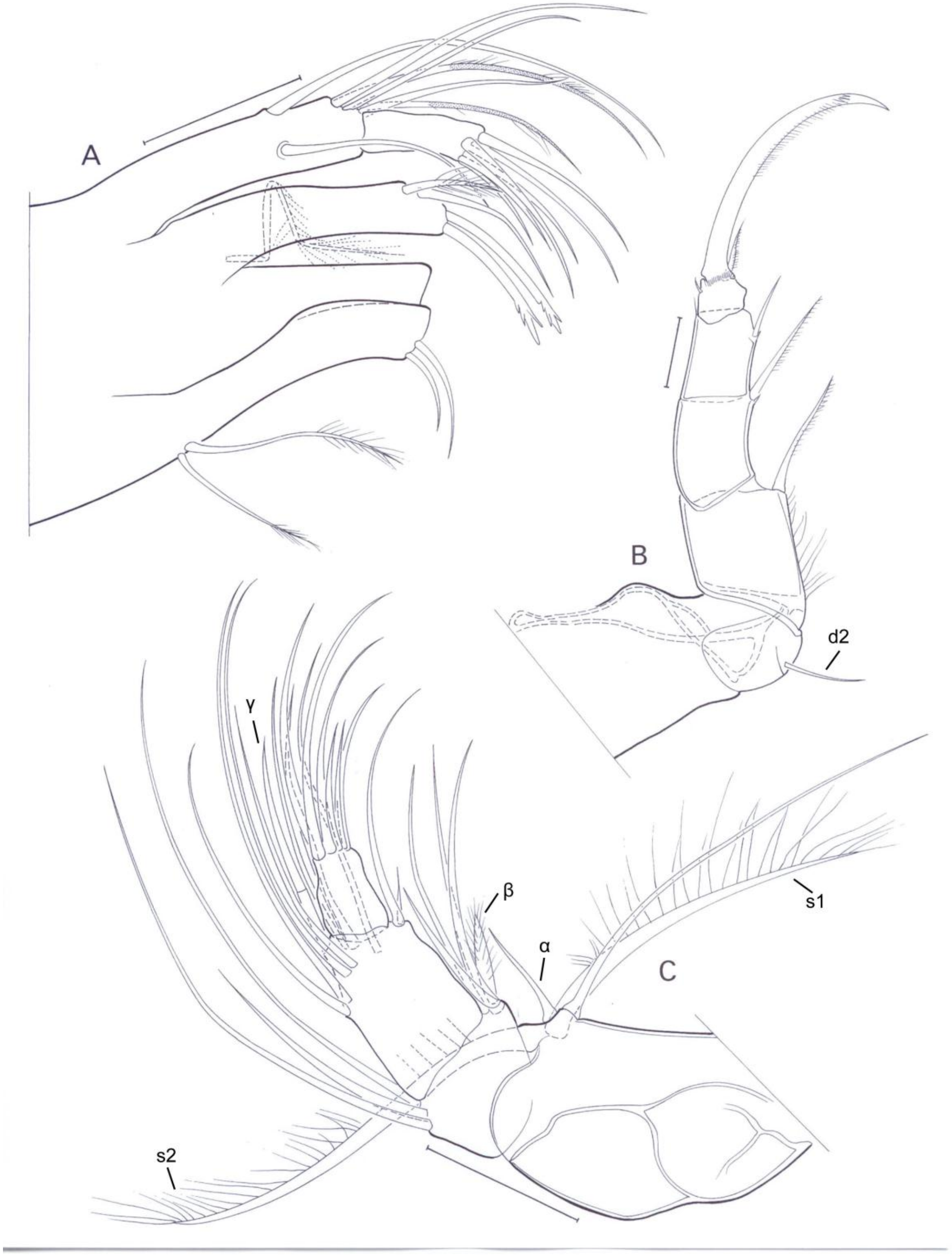

Figure 4

Figure 5

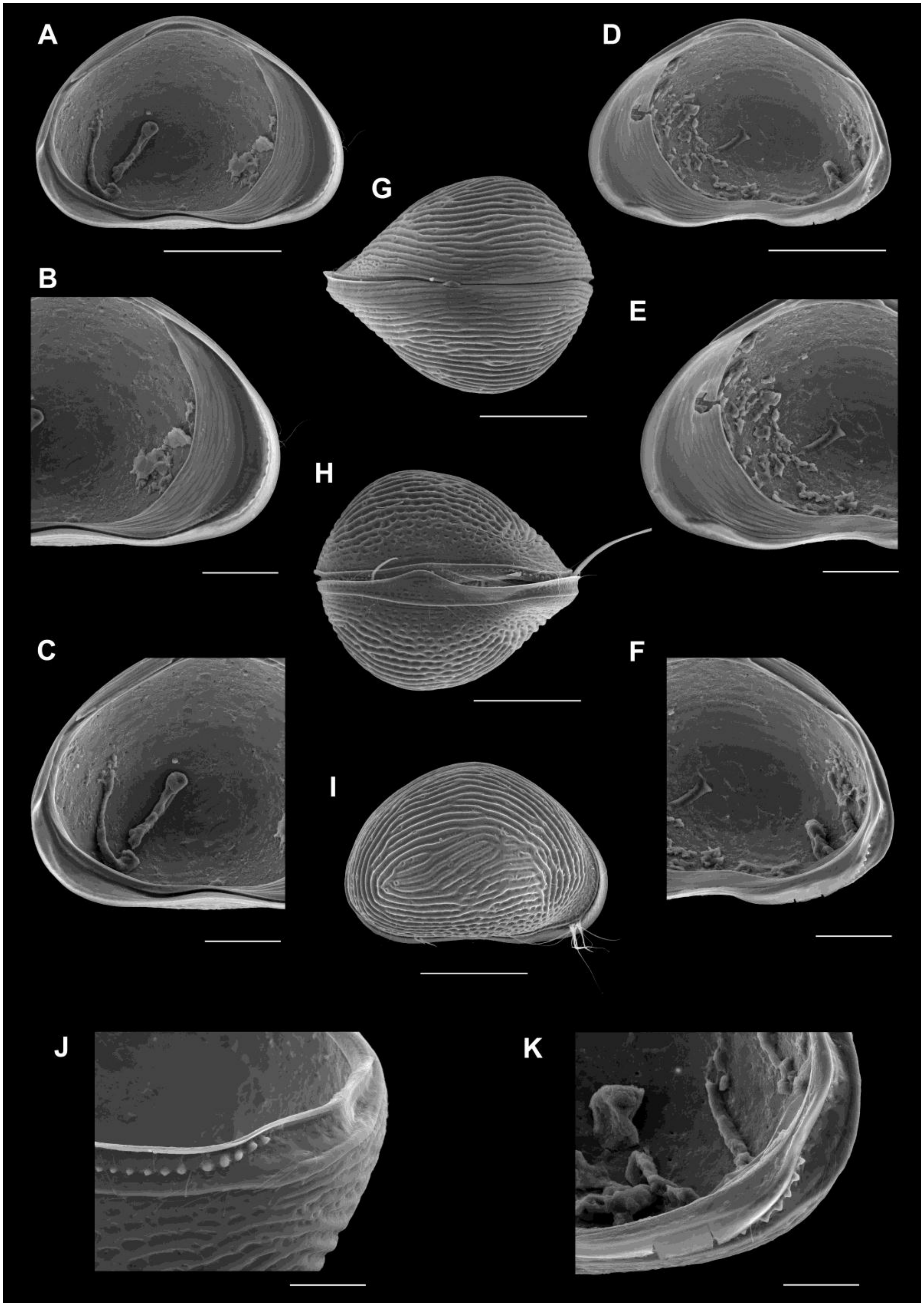

Figure 6

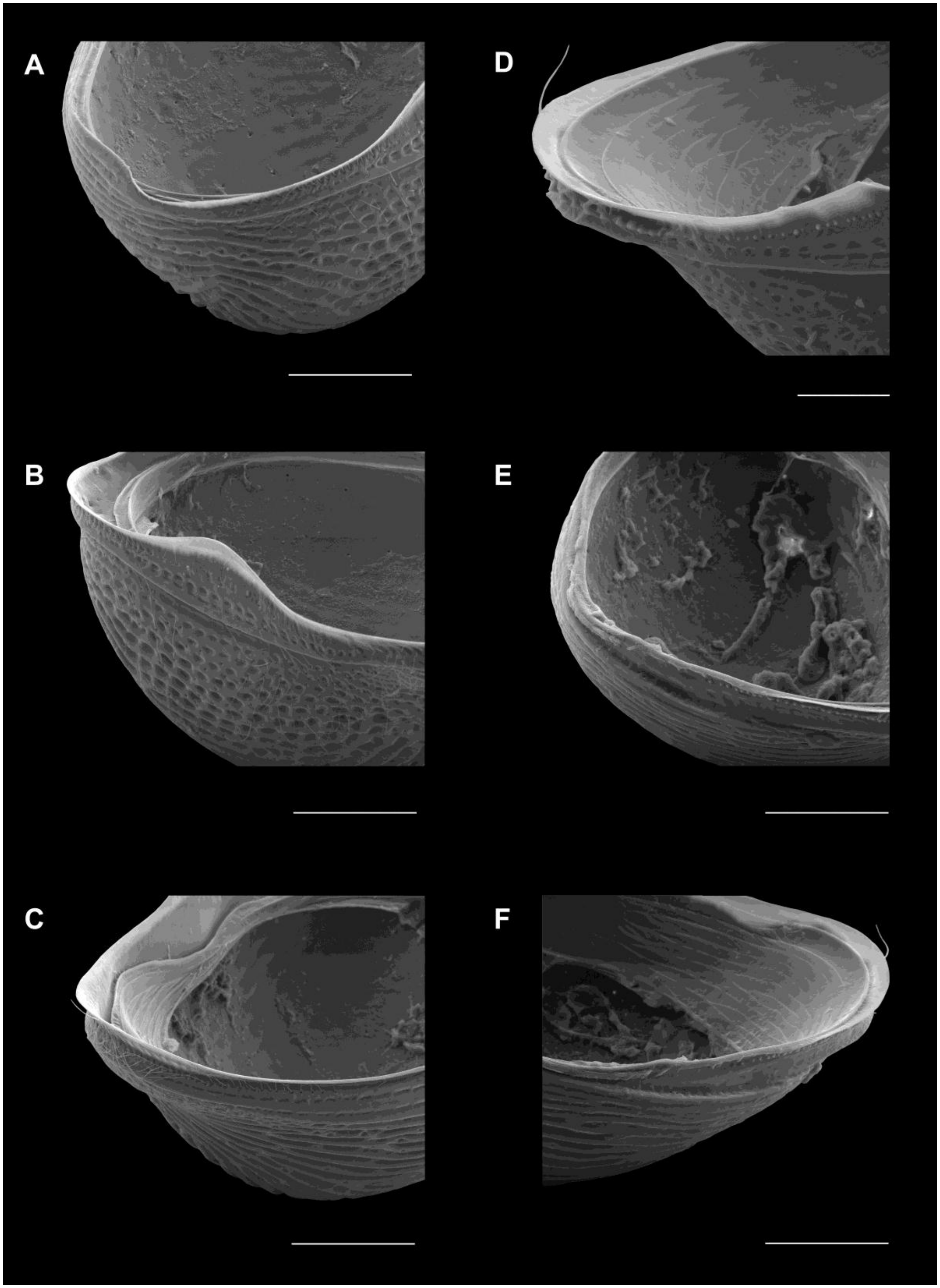

Figure 7

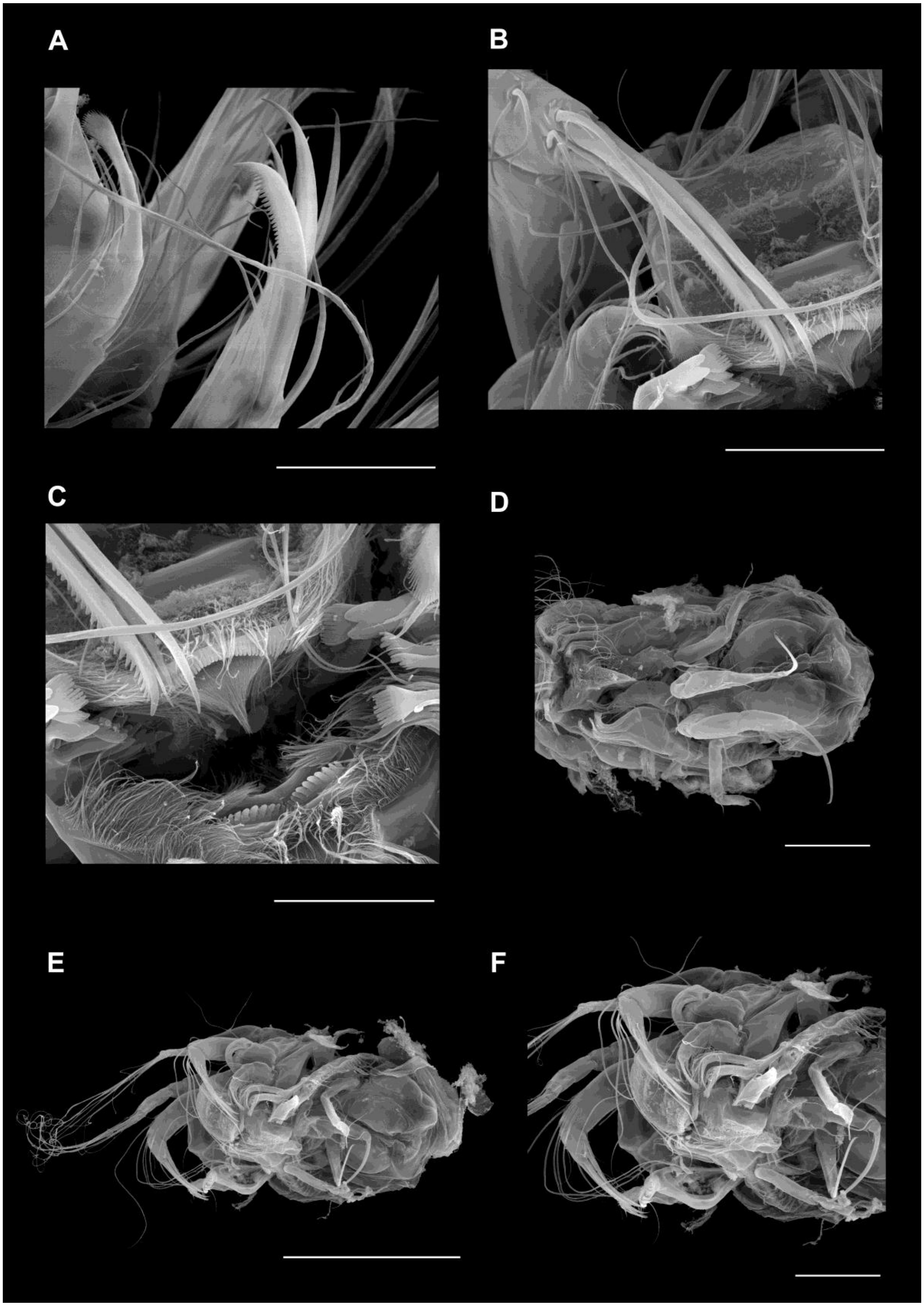

Figure 8

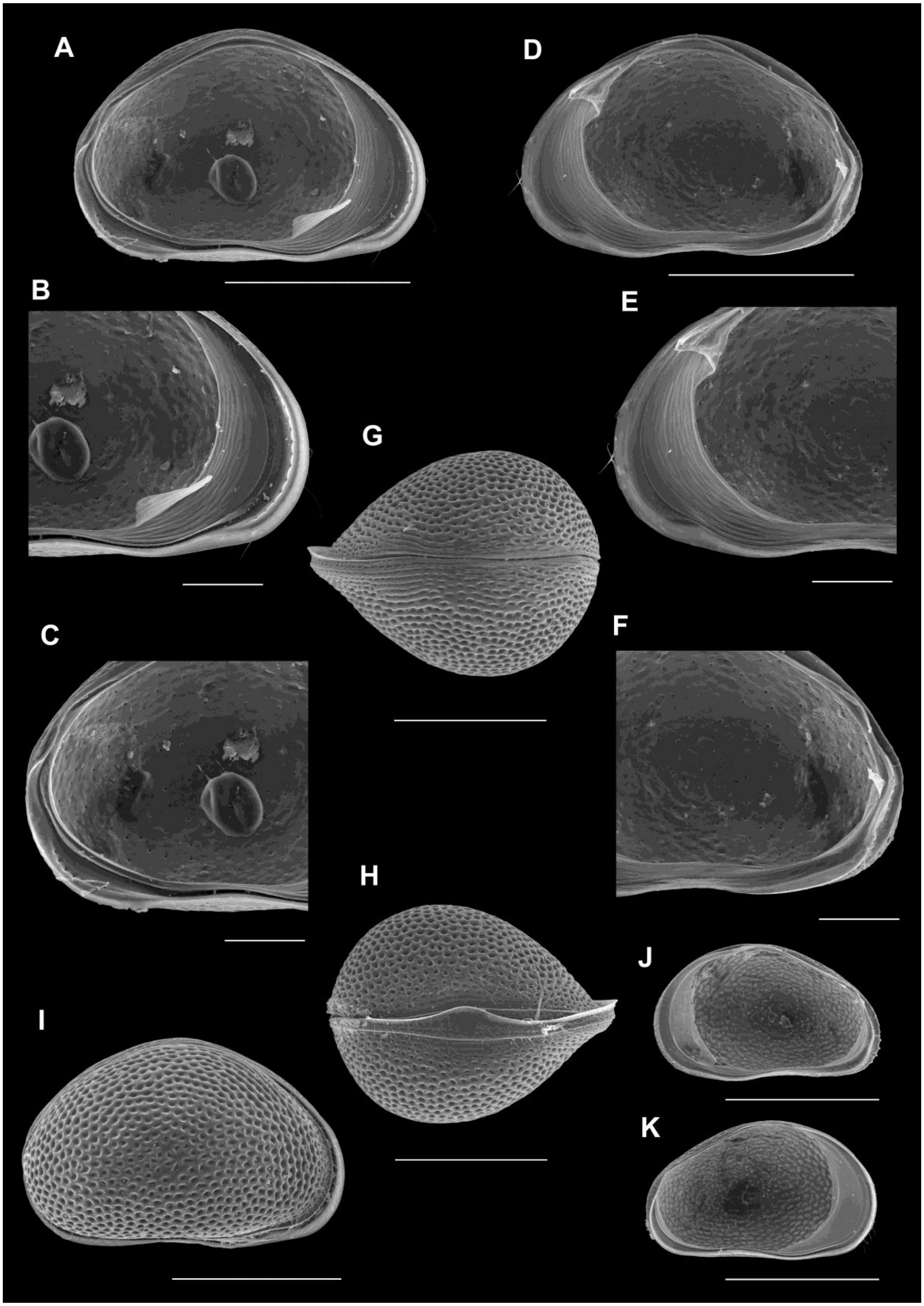

Figure 9

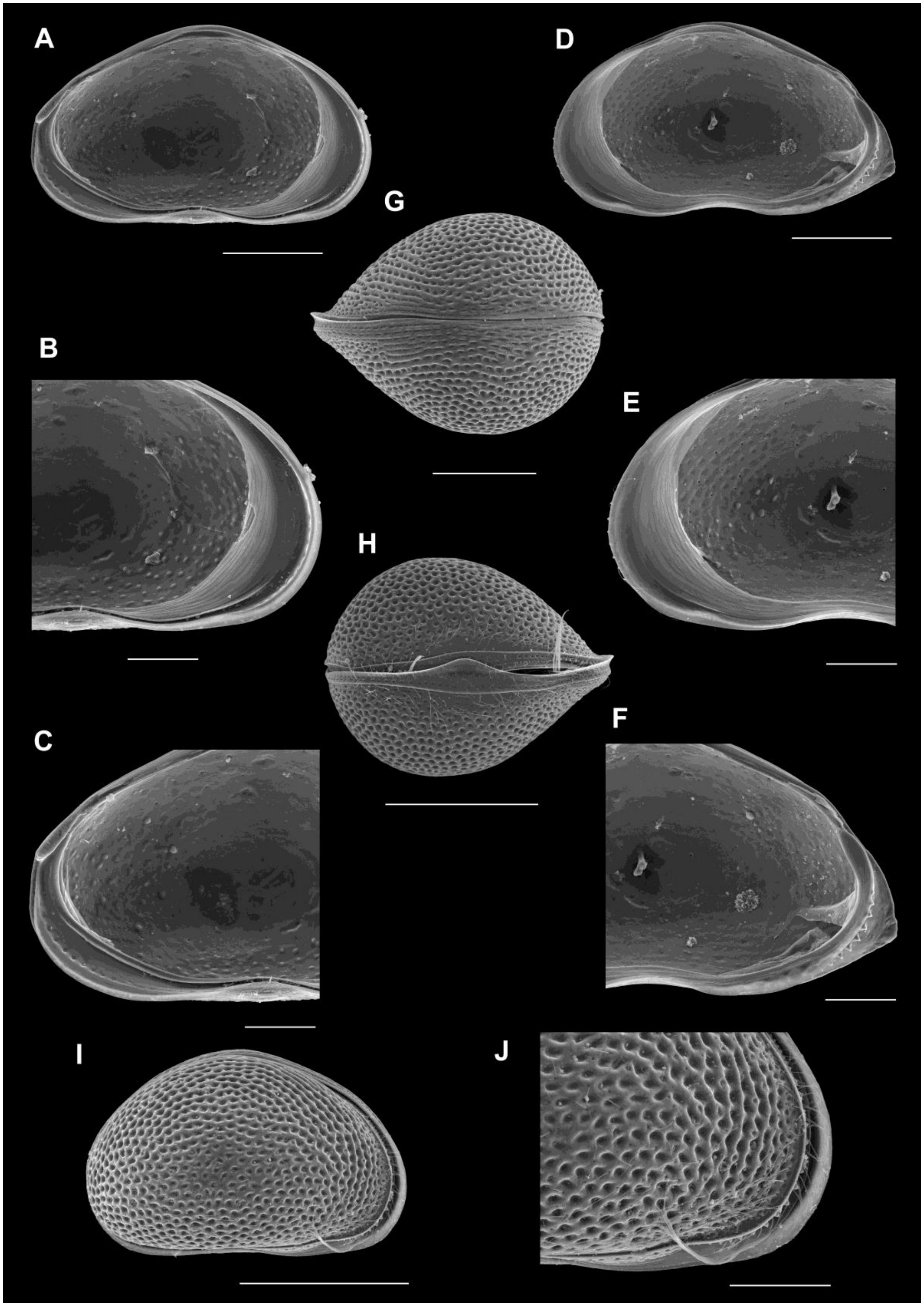

Figure 10

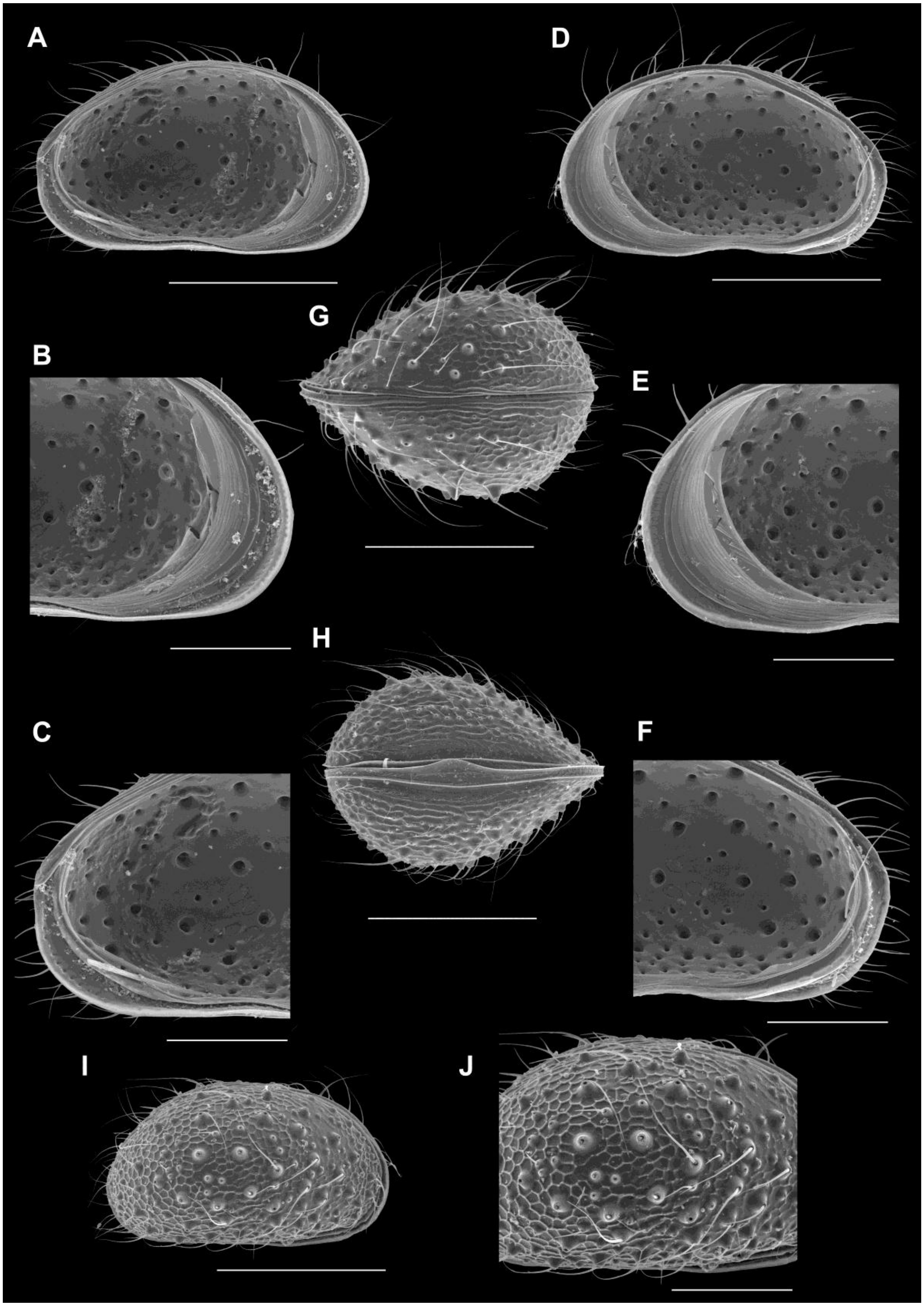

Figure 11

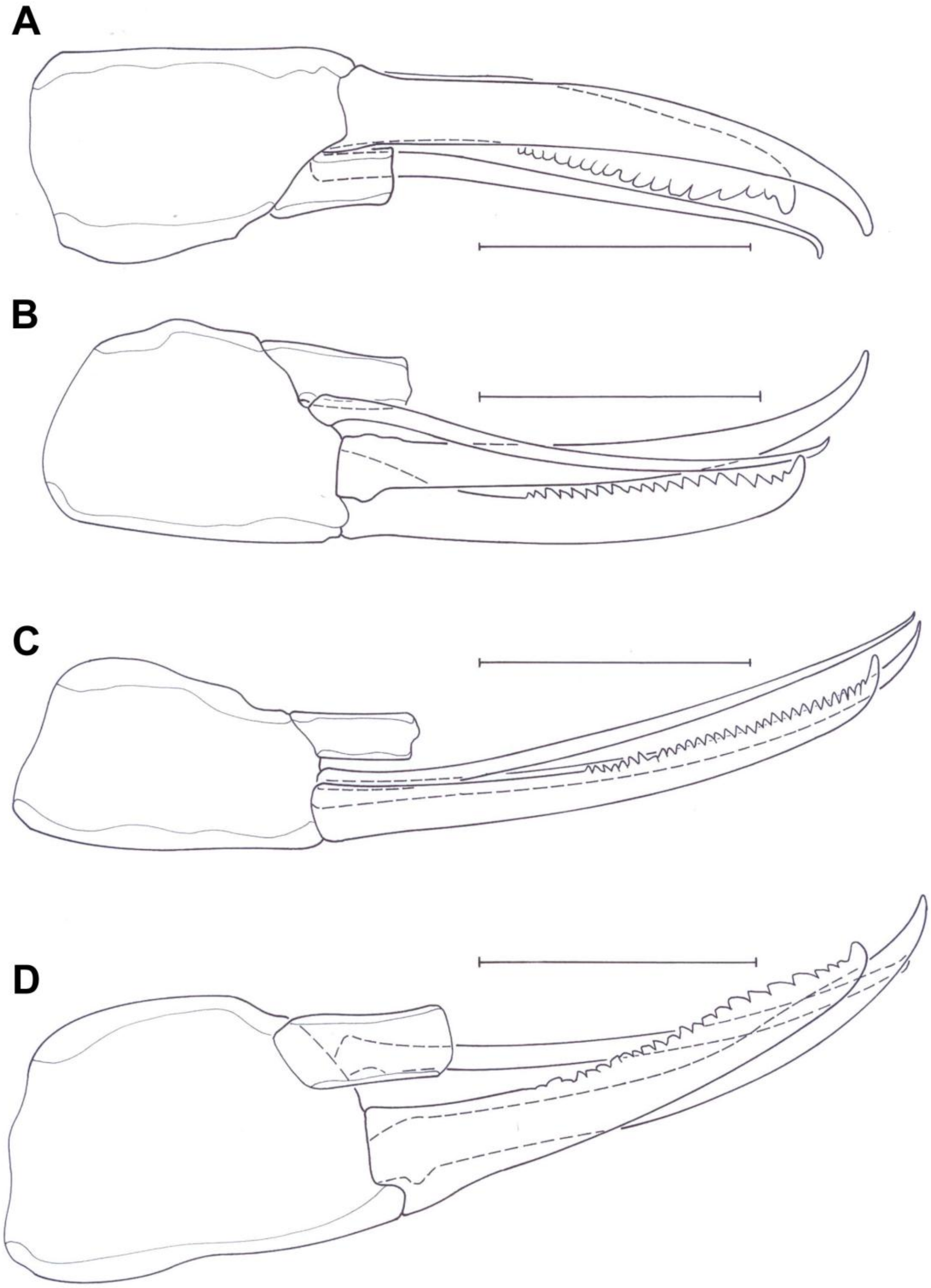

Figure 12