A new giant cypridid ostracod (Crustacea) from southern Buenos Aires Province, Argentina

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Abstract

Amphicypris argentinensis sp. nov., is described and illustrated from Laguna Caliba, an ephemeral fresh water lake from the southern coast of Buenos Aires Province, Argentina. Specimens were raised from dried sediment recovered from a bank of ostracod shells found at the edges of the lake. Deposition of progressively smaller ostracod valves stacked one into another (cup-in-cup structure) is documented. The geographical distribution and ecology of the genus is briefly discussed.

Introduction

The genus *Amphicypris* (Cyprididae) was created by Sars (1901), with *A. nobilis* as the type species, raised in aquaria from dried mud sent to him from Argentina. The genus *Amphicypris* was synonymized with *Eucypris* by Daday (1905). *Amphicypris nobilis* was re-described by Swain & Gilby (1969) on some specimens of the type material housed in the British Museum (Natural History), London, re-establishing *Amphicypris* as a valid and independent genus.

Martens & Behen (1994), in their checklist of Recent non-marine ostracods from South America and adjacent islands, included three species in the genus *Amphicypris*: the type species *A. nobilis*, occurring in Argentina and Paraguay; *A. obliqua* (Daday) from Argentinean Patagonia and *A. pestai* (Graf) from South Georgia, an island in the South Atlantic Ocean. *Amphicypris obliqua* was considered by Martens & Behen (1994) most likely to be a junior synonym of *A. nobilis*. The similarity between these two species had also been mentioned by Farkas (1972). Martens & Behen (1994) also remarked that *Eucypris trapezoides* Hartmann recovered in Los Vilos, Chile (Hartmann, 1962), could be a juvenile of *A. nobilis*.

The present contribution describes and illustrates a new species within the genus *Amphicypris* raised from dried sediment of a shell bank encountered at Laguna Caliba, south of Buenos Aires Province, Argentina (Fig. 1).

Study area and biota

The coastal strip of Buenos Aires Province is characterized by large dune systems that extend 4–5 km inland and reach heights of over 20 m above sea level. Diverse aquatic environments occur between and within these dunes. They occupy shallow depressions which are filled with water after rainfall. Some lakes are isolated basins, while others are connected to one other at high water
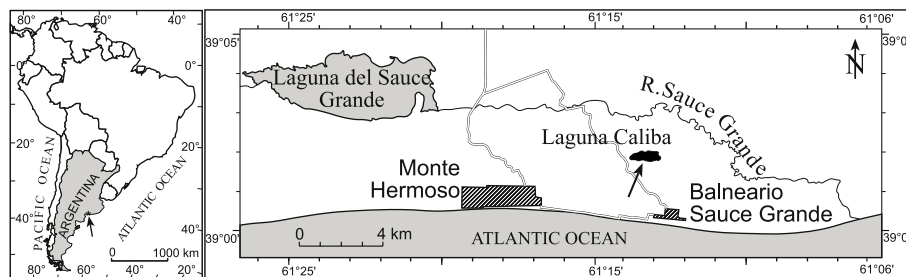
Figure 1. Location of the study area.

levels. Most of these lakes dry out during the summer season, due to the dry sub-humid climate of the area (Burgos & Vidal, 1951).

Laguna Caliba is an ephemeral lake of about 2 km by 0.5 km, situated 3 km north of the Balneario Sauce Grande and 3 km inland from the present coastline (Fig. 1).

Samples were taken in January 2001, during the summer season while the lake was dry. Ostracod shells are concentrated by wave action along its southern shoreline and a shell bank of ostracods was found at the southeastern corner of the lake. The shell bank extended approximately 2 m in diameter with a thickness of ca. 15 cm. This structure consisted mainly of disarticulated ostracod valves and some carapaces. The ostracod assemblage is dominated by *Amphicypris argentinensis* sp. nov., *Limnocythere* sp., and *Neocypridopsis frigogena* (Graf) together with *Sarscypridopsis aculeata* (Costa), *Eucypris virens* (Jurine) and *Eucypris fontana* (Graf). A number of specimens of *Amphicypris argentinensis* sp. nov. occurred as 2–9 progressively smaller valves stacked one into another known as 'cup in cup' structure (Fig. 2K). The accompanying biota comprise abundant resting eggs of Cladocera and Rotifera, a few seeds of *Ruppia* cf. *maritima* (Ruppiaceae) and some Chenopodiaceae and Cyperaceae seeds from plants growing at the edges of the lake.

The locality was revisited in January 2003. At this time the lake was about 1.5 m deep, the water temperature 23.6 °C and the conductivity 8.9 mS cm^{-1}.

Methods

A few grams of sediment were cultured in jars with water. After 3–4 weeks, continuously reproducing populations of *Amphicypris argentinensis* sp. nov. were established. After dissection, limbs were mounted in glycerine in sealed slides and valves were stored dry in micropaleontological slides.

The population age structure of *Amphicypris argentinensis* sp. nov. in the bank of shells was analysed and typified following Whatley (1983, 1988).

Additionally, syntypes of *Amphicypris nobilis* (catalog number F12544) held by the Zoological Museum of Oslo, Norway were examined.

The suprageneric classification follows that proposed by Martens & Behen (1994). The nomenclature of the limbs chaetotaxy follows Broodbakker & Danielopol (1982); for the second antenna the revised model proposed by Martens (1987) is used. Terminology of hemipenis anatomy is in accordance with Martens (1986).

The following abbreviations are used: Valves: H = height; L = length; LV = left valve; RV = right valve. Limbs: An1 = first antenna; An2 = second antenna; CR = caudal ramus; CRa = caudal ramus attachment; Mb = mandibula; Mxu = maxillula; S = segment on An1 and An2; T1 = maxilla; T2 = second thoracic limb; T3 = third thoracic limb.

The term 'giant' used in the text refers to size larger than 3 mm.

Systematic description

Class OSTRACODA Latreille, 1806.
Order PODOCOPIDA Sars, 1866.
Superfamily CYPRIDOIDEA Baird, 1845.
Family CYPRIDIDAE Baird, 1845.
Subfamily EUCYPRIDINAE Bronshtein, 1947.
Genus *Amphicypris* Sars, 1901.
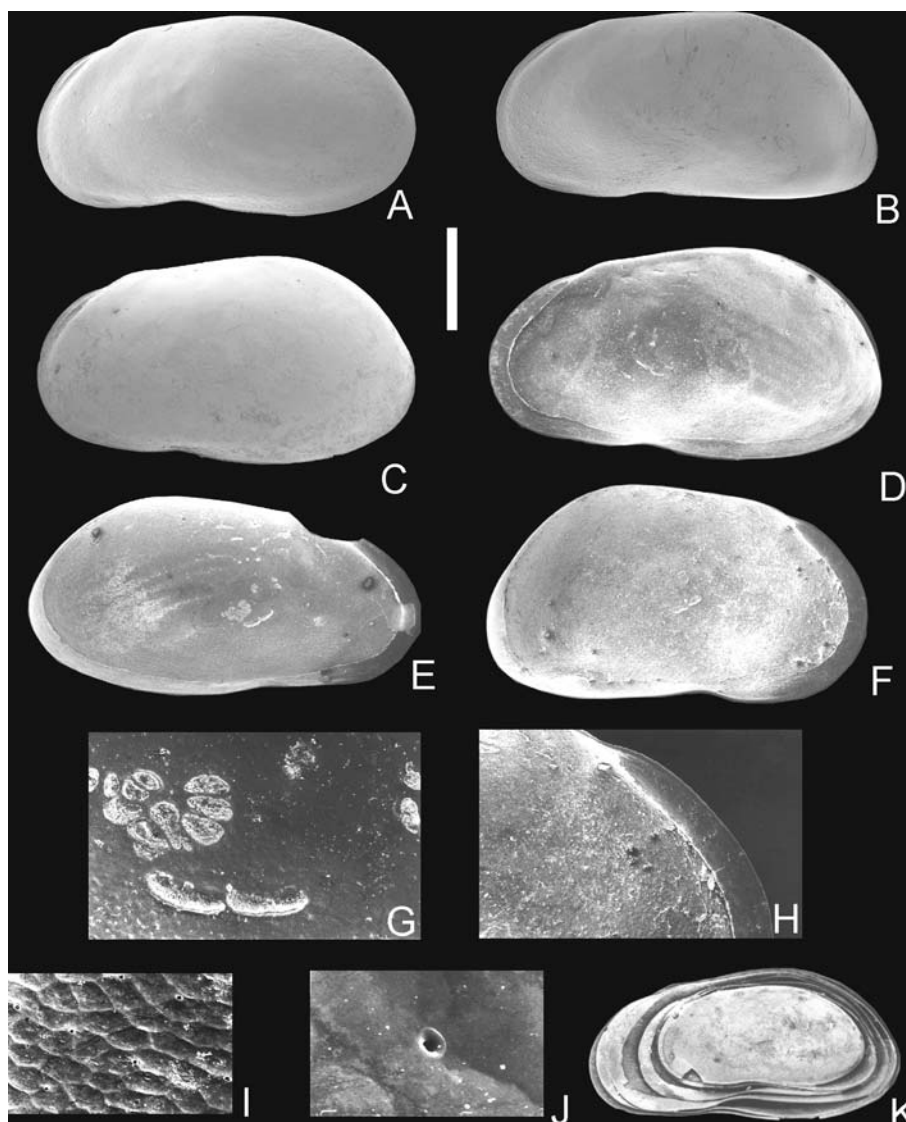Type species. *Amphicypris nobilis* Sars, 1901: 17–20, pl. 4.

Figure 2. *Amphicypris argentinensis* sp. nov. (A) ♂, LV, external view, holotype (MLP-Mi 1309). (B) ♀, LV, external view, allotype (MLP-Mi 1310). (C) ♂, LV, external view, paratype (MLP-Mi 1322). (D) ♂, RV, internal view, paratype (MLP-Mi 1332). (E) ♂, LV, internal view, paratype (MLP-Mi 1331). (F) ♀, LV, internal view, paratype (MLP-Mi 1328). (G) ♂, internal view, detail of muscle scars (MLP-Mi 1331 same specimen as E). (H) ♀, internal view, detail of anterior marginal zone (MLP-MI 1328 same specimen as F). (I) ♂, RV, external view, detail of ornamentation, paratype (MLP-Mi 1329). (J) ♂, detail of normal pore (idem). (K) cup-in-cup structure (MLP-Mi 1139). Scale (in μm) = 920 for (A); 980 for (B); 1045 for (C); 1070 for (D); and (F); 1120 for (E); 190 for (G); 370 for (H); 77 for (I); 12 for (J); 1340 for (K).

Amphicypris argentinensis *sp. nov. (Figs 2–6)*

Type locality: Laguna Caliba (39°2″ S, 61°13″ W), southwestern Buenos Aires Province, Argentina.
Type material

Holotype: a male, with soft parts dissected in glycerine in a sealed slide and with valves stored dry in a micropaleontological slide (MLP-Mi 1309).

Allotype: a female, dissected and stored in the same manner as the holotype (MLP-Mi 1310).

Paratypes: Two females (MLP-Mi 1312, 1314) and 2 males (MLP-Mi 1311, 1313), dissected and stored in the same manner as the holotype; 1
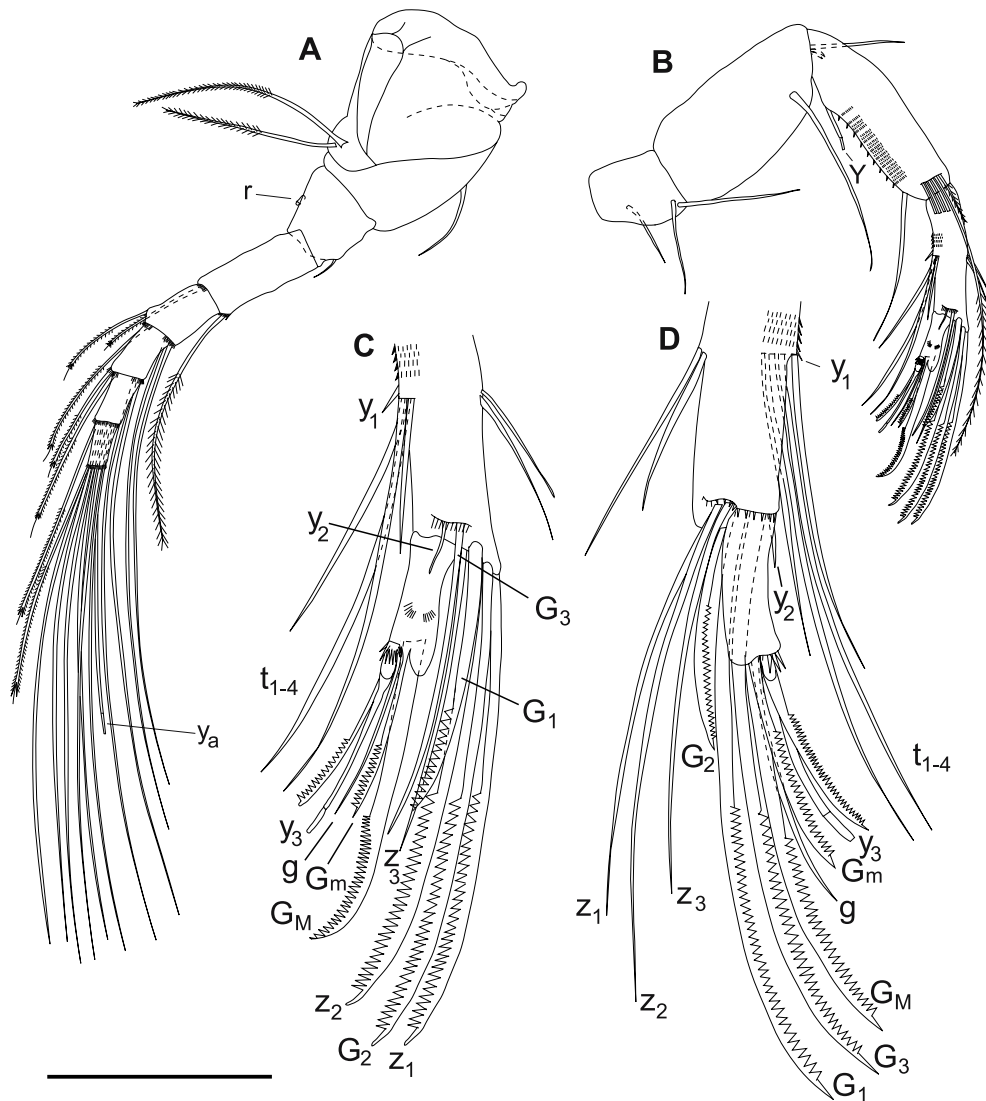
Figure 3. *Amphicypris argentinensis* sp. nov. (A) ♀, left first antenna (internal view), allotype (MLP-Mi 1310). (B) ♂, left second antenna (internal view), holotype (MLP-Mi 1309); (C) ♂, detail of two distal segments (idem). (D) ♀, left second antenna (external view), detail of two distal segments, allotype (MLP-Mi 1310). Scale (in μm) = 500 for (A) and (B); 200 for (C) and (D).

female (MLP-Mi 1315) and 1 male (MLP-Mi 1316) carapaces used for SEM, 7 adults valves (used for SEM: MLP-Mi 1322, 1323, 1324, 1328, 1329, 1331, 1332), 1 juvenile valve (used for SEM: MLP-Mi 1340) valves with 'cup-in-cup' structure (used for SEM: MLP-Mi 1339) and adult (MLP-Mi 1317, 1318), juvenile (MLP-Mi 1319) and 'cup-in-cup' (MLP-Mi 1339) valves stored dry in a micropaleontological slide; 20 specimens in EtOH (MLP-Mi 1320).

Repository: holotype, allotype and paratypes are stored in the micropaleontological collections of MLP-Mi (La Plata, Argentina).

Studied material: some 1000 dead valves and 30 living specimens raised from resting eggs, recovered on 04-01-2001 from a bank of ostracod shells.

Derivation of name: with reference to the occurrence of the species in Argentina.

Diagnosis: a giant species of *Amphicypris*, sub-ovoidal to subtrapezoidal in lateral view. Pren-
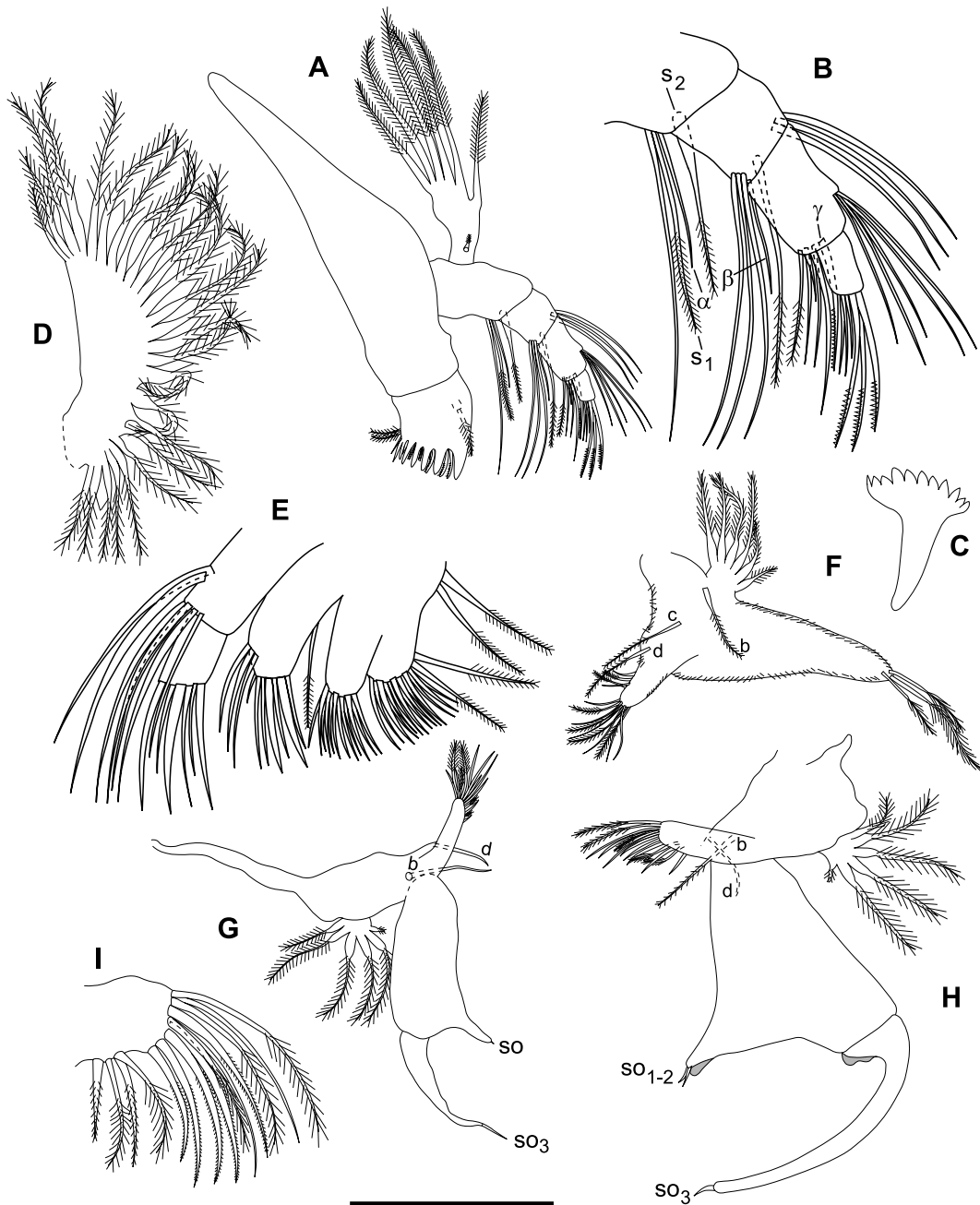
Figure 4. *Amphicypris argentinensis* sp. nov. (A) ♀, left mandibula (internal view), allotype (MLP-Mi 1310). (B) ♀, detail of the mandibular palp (idem). (C) ♂, rake-like organ, holotype (MLP-Mi 1309). (D) ♂, respiratory plate of the right maxillula (internal view), holotype (MLP-Mi 1309). (E) ♀, left maxillular palp and masticatory processes (external view), allotype (MLP-Mi 1310). (F) ♀, right maxilla (external view), allotype (MLP-Mi 1310). (G) ♂, right maxilla (external view), holotype (MLP-Mi 1309). (H) ♂, left maxilla (external view), paratype (MLP-Mi 1311). (I) ♂, detail of masticatory processes of the left maxilla, paratype (MLP-Mi 1313). Scales (in μm) = 500 for (A) and (D), (F)–(H); 250 for (B) and (E); 200 for (C) and (I).

hensile palps large, strongly asymmetrical; left palp more stout; penultimate segment wider with ventral processus inserted distally to the middle of the ventral margin and with a subapical outgrowth; last segment more curved, wider and also with an outgrowth at the base.
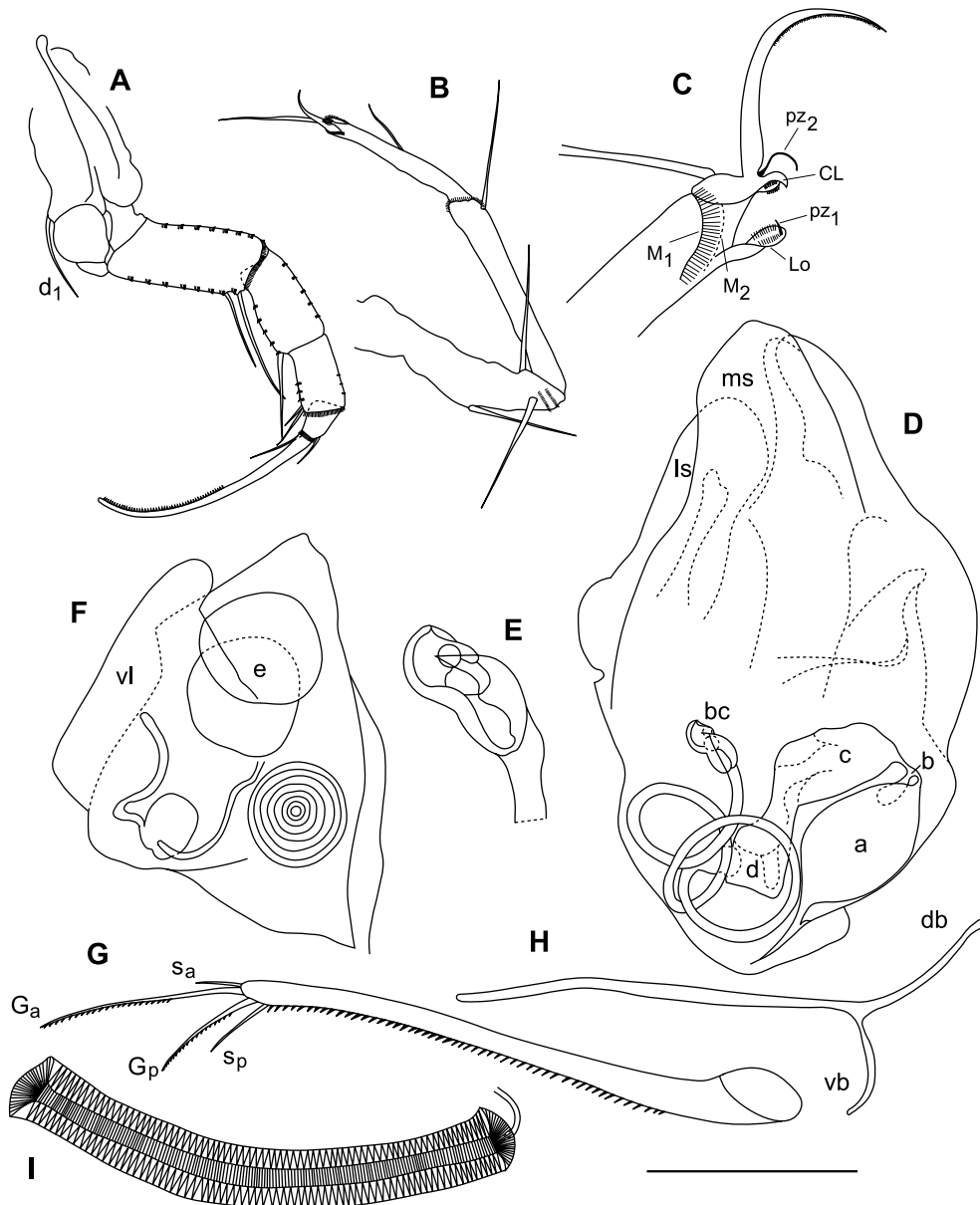
Figure 5. *Amphicypris argentinensis* sp. nov. (A) ♀, left second thoracic limb (internal view), allotype (MLP-Mi 1310). (B) ♀, third thoracic limb, allotype (MLP-Mi 1310). (C) ♂, detail of the pincer organ of T3, paratype (MLP-Mi 1313). (D) ♂, hemipenis, paratype (MLP-Mi 1311); (E) ♂, detail of the bursa copulatrix (idem). (F) ♀, genital organ, allotype (MLP-Mi 1310). (G) ♀, caudal ramus, paratype (MLP-Mi 1312). (H) ♀, caudal ramus attachment, paratype (MLP-Mi 1312). (I) ♂, zenker organ, holotype (MLP-Mi 1309). Scale (in μm) = 500 for (A), (B), (D), (F), (G)–(I); 100 for (C); 200 for (E).

Description (Fig. 2): carapace large; thin and transparent. Sexually dimorphic, males (Fig. 2A, C, D, E) longer, higher, more subelliptical in outline than females (Fig. 2B and F) and with truncated postero-ventral shape. Subovoidal to subtrapezoidal in lateral view; greatest height occurring in posterior half of the valve. In females, the greatest height is behind mid-length. Dorsal margin slightly convex and sloping weakly to the anterior border; ventral margin slightly concave antero-medially with anterior extremity obtusely rounded. Anterior margin broadly, rounded and
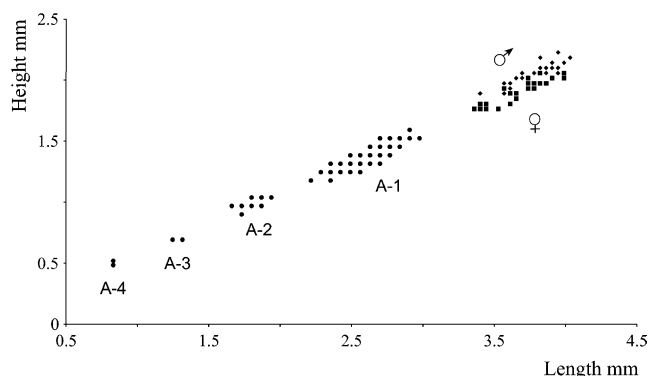
Figure 6. Ontogeny of *Amphicypris argentinensis* sp. nov. Dimension of 313 valves from the bank of shells encountered at Laguna Caliba. ◆ = males; ■ = females; ● = juveniles.

very compressed; posterior margin obliquely rounded, ventrally extended in females. Greatest length occurring in the lower half of the valves. Surface ornamented by a fine and delicate reticulation, observed with SEM, giving to the surface the aspect of an irregular polygonal (mainly pentagonal) pavement (Fig. 2I). A 'fringe' of small pustules disposed parallel to the anterior margin. Normal pores numerous, circular raising and small (Fig. 2J).

Hinge adont. Muscle scars conspicuous and typically visible on both exterior and interior of valve (Fig. 2G). Adductors in a cluster of some 10 scars; two large and elongated antennal scars anteroventrally and two oval frontal scars anterodorsally; other minor dorsal and anterodorsally scars also present. Inner lamella narrow and concentrically striated (Fig. 2H). Vestibulum present. Anterior radial pore canals simple and very numerous; posterior radial pore canals simple and less numerous. Colour of valves light yellow to transparent; eggs reddish.

Measurements: sizes are given in millimeters. Paratypes values are means, standard deviation and ranges over all observed values.

Holotype: LV: L = 3.44, H = 1.76; RV: L = 3.44, H = 1.76.

Allotype: LV: L = 3.7, H = 1.81; RV: L = 3.65, H = 1.81.

Paratype from culture:
♂ ($n = 3$) LV: L = 3.58 ± 0.12 (3.44–3.65); H = 1.89 ± 0.08 (1.81–1.97).
♀ ($n = 4$) LV: L = 3.45 ± 0.40 (3.11–3.95); H = 1.76 ± 0.15 (1.60–1.93).

Paratype from shell bank:
♂ ($n = 30$) LV: L = 3.78 ± 0.15 (3.40–4.03); H = 2.06 ± 0.08 (1.89–2.23).
♀ ($n = 30$) LV: L = 3.67 ± 0.19 (3.36–3.99); H = 1.90 ± 0.10 (1.76–2.06).

Anatomy of soft parts: living specimens were cultured from dried sediment from a bank of ostracod shells encountered at Laguna Caliba. They are visible to the naked eye with their translucent pale yellow valves, the females carrying bright reddish-hued eggs, active swimmers.

An1 (*Fig. 3A*): Eight-segmented. Chaetotaxy identical for males and females. Number of setae per segment (from S I to S VIII): 2, 1, 1, 1+1, 2+2, 2+2, 4+1, 2+1+ya. Most plumose natatory setae slightly shorter than all segments together. Rome-organ (r) small. Aesthetasc y_a about 2.5 times as long as S III.

An2 (*male: Fig. 3B and C; female: Fig. 3D*): Five-segmented. Chaetotaxy of the first 3 segments identical for males and females. S I with 2+1 setae; S II with 1 terminal seta; remainder of exopodite with 2 short and 1 setae of medium length; S III large, bearing the aesthetasc Y on the ventral proximal area and 1 ventral seta and 1+5 natatory setae on the distal zone (the outermost short, the other five not extending beyond the tips of the claws); feathering of the natatory setae present on the terminal 3/5 of their length.

Difference in the chaetotaxy of second antenna of females and males occurring in the last two segments (Fig. 3C–D).

Female (Fig. 3D): S IV with 2 unequal mediodorsal setae and 4 unequal, ventrally situated

t-setae; a short aesthetasc (y_1) occurring ventrally on the second segment of the endopodite, inserted proximally to the t-setae; this segment also with 3 subapical z-setae (inserted on the external side) and apically with 1 aesthetasc (y_2) and 2 medium-sized (G_1, G_3) and 1 small (G_2) claws. Terminal segment apically bearing 1 medium (G_M) and 1 small (G_m) claws, 1 seta (g), 1 aesthetasc (y_3) and 1 claw-like setae, fused at the base with y_3. Claws G_1-G_3, G_M, G_m and claw-like seta of terminal segment 2-serrate.

Male (*Fig. 3C*): only differences with the female pattern are cited below.

Only 1 z-seta (z_3) occurring on the external side of S IV. This segment also with 4 terminal claws (3 medium and 1 short one) and 1 medium-sized seta beside y_2. Claw G_M on the terminal segment bearing 1 row of stout teeth, the latter more strongly developed. The following nomenclature is proposed to homologize the male chaetotaxy:

The two most dorsal z-setae (z_{1-2}) have become two long claws and both have altered their absolute positions slightly. G_1, a medium claw in the female, is a short claw in the male. G_2, a small claw in the female is a medium-sized claw in the male. G_3, a strong medium-sized claw in the female, is reduced to 1 medium-sized setae.

Md (*Fig. 4A and B*): chaetotaxy without sexual dimorphism. Mandibular coxal with seven teeth; inner tooth longer than the other ones; near its base three setae inserted, two of which setose. Respiratory plate with five long plumed setae plus a shorter one at mid-length and a short, stout and pilose seta at its base. Mandibular palp (Fig. 4B) 4-segmented; first segment with 1 long, smooth setae, 2 plumose setae (s_1 and s_2), seta s_2 with swollen basis and between s_1 and s_2 1 small and thin α-seta; second segment dorsally with 3 medium-long setae, ventrally with 3 long setae, a β-seta, thin and slightly longer than the third segment and 1 plumed long setae; third segment with on its dorsal side 5 subapical setae, on its ventral side with 2 unequal setae and subapically with 4 setae (5 on the left mandibular palp of holotype MLP-Mi 1309) slightly longer than the third segment: 1 plumed seta, 2 (3) claw-like setae and a γ-seta; the latter claw-like 2-serrate; apical segment with 3 claw-like, 2-serrate setae and 3 small setae of varying length.

Rake-like organ (*Fig. 4C*): T-shaped, with 11 teeth.

Mxu (*Fig. 4D and E*): Maxillula identical in males and females; with 2-segmented palp, 3 endites and a large respiratory plate. First segment of palp with 7 subapical setae; second segment subrectangular, apically with 3 setae and 3 claws, about twice the length of their segment. Third endite with 8 terminal setae and 2 smooth tooth-like setae. Respiratory plate (Fig. 4D) with 21 long rays and 5 long ventrally inserted plumose setae.

T1 (*Fig. 4F–I*): chaetotaxy of protopodite and exopodite without sexual dimorphism. Protopodite without a-setae; c and d-setae setose; masticatory process with $10 + 4$ unequal setae distally situated (for a detail of the chaetotaxy see Fig. 4I). Respiratory plate with five long and a shorter plumed setae. Endopodite sexually dimorphic. Male endopodites (Fig. 4G and H) modified to 2-segmented strongly asymmetrical prehensile palps. Left palp (Fig. 4H) more stout; penultimate segment wider with ventral process inserted distally to the middle of the ventral margin and with a subapical outgrowth; last segment more curved, wider and also with an outgrowth at the base; sensory organs (so_{1-3}) relatively shorter. Right palp (Fig. 4G) with ventral process distally inserted and tapering, bearing one sensory organ.

Female endopodite (Fig. 4F) 1-segmented, bearing at the end three plumose setae, the middle one about twice the length of the other two, the latter subequal.

Some female specimens with protopodite bearing a plumed b-seta (right maxilla, allotype MLP-Mi 1310, Fig. 4F) or with a fourth seta on the distal half of the endopodite (left maxilla paratype MLP-Mi 1314).

T2 (*Fig. 5A*): protopodite 2-segmented, with 1 long d_1-seta on the first segment; seta d_2 absent. Endopodite 4-segmented; first and third segment with two unequal ventral setae, subapically inserted; second segment with one terminal seta; fourth segment short, with a terminal long and strong curve claw 2-serrate, a ventro-apical setae and a subapical seta.

T3 (*Fig. 5B and C*): third thoracic leg distally with pincer shaped organ. Protopodite consisting of 1 elongated segment with 3 medium-sized setae. Endopodite 3-segmented; first segment elongated and with 1 subapical seta; second segment with 1

medio-lateral seta and the apical part together with the fourth segment forming the pincer shaped organ; last segment with two setae, the shorter strongly bent and serrate; beak-shape claw (CL) serrate; concave lobe (Lo) finely haired; pseudo-chaetal formations M_1 and M_2 well developed; pz_1 and pz_2-setae present.

Hemipenis (*Fig. 5D and E*): medial shield (ms) larger than lateral shield (ls); labyrinth sclerotised, with 4 parts (a–d); tubular part of the internal spermiductus with 3 loops; bursa copulatrix (bc) as in Fig. 5E.

Female genital organ (*Fig. 5F*): with a large elongated ventral lobe (vl).

CR (*Fig. 5G*): caudal ramus long, 2.5 times the length of the anterior claw (G_a). Posterior claw (G_p) 0.6× and anterior seta (s_a) 0.2× of the length of G_a. The posterior seta (s_p) is two-third of the length of G_p.

CRa (*Fig. 5H*): long and narrow with distal end bifurcate; ventral branch (vb) strongly arched, shorter than the dorsal one (db) which follows curvature of median branch.

Zenker organ (*Fig. 5I*): immature in all specimens dissected; with about 76 rosettes.

Differential diagnosis: Amphicypris argentinensis sp. nov. can easily be distinguished from the type species *Amphicypris nobilis* Sars by the morphology of the valves and the shape of the prehensile palps. The new species is larger and subovoidal to subtrapezoidal with the greatest height in the posterior half of the valve, rather than ovoidal and with the greatest height in the posterior third as in the type species. Also, the ventral margin of the former species is distinctly concave antero-medially with anterior extremity obtusely rounded. Prehensile palps of the new species are larger and more stout; left palp with penultimate segment distally wider. *Amphicypris argentinensis* sp. nov. differs from *Amphicypris pestai* (Graf) and *Amphicypris obliqua* (Daday) in the outline of the valves.

Population age structure of Amphicypris argentinensis *sp. nov. in the shell bank*

The population age structure of *Amphicypris argentinensis* sp. nov. comprises adults of both sexes and large numbers of juveniles of A-1 to A-4 instar stages (Fig. 6). It consists of 30.9% ♂, 37.6% ♀, 26.8% A-1, 3.8% A-2, 0.7% A-3 and 0.3% A-4.

Discussion

Distribution and ecology

Species of *Amphicypris* mostly inhabit temporal fresh water bodies. In South America, *Amphicypris nobilis* was collected from two small periodical water bodies in the vicinity of Aregua, Paraguay (Daday, 1905). Méhes (1914) recognized *A. nobilis* from the Tupongato area, Mendoza, at 3200 m. above sea level in the Argentinean Cordillera. Recently, this species was found living in the Bolivian Altiplano at a salinity of 0.8–1 g l^{-1} (Mourguiart & Roux, 1990; Mourguiart & Carbonel, 1994) and in springs, vegetated pools and ponds from Patagonia, Argentina (Schwalb et al., 2002).

In Russia, specimens of *A. nobilis* have been collected from oxbow lakes of the Volga basin near Saratov (Klie, 1923) and from floodplains of the River Ob close to Obdorsk, today Salegard (Bronshtein, 1947).

Decksbach (1924) also found *A. nobilis* in water bodies of the Turgai River basin, in the Kirguiz Step, Kazakhstan.

In Quaternary sediments, *A. nobilis* is known from Lake Titicaca, Bolivia (Mourguiart et al., 1998) and from the Chilean Altiplano (Schwalb et al., 1999).

Amphicypris obliqua is mentioned from a mire in Santa Cruz Province, Argentina (Daday, 1902), while *Amphicypris pestai* was collected from a permanent fresh water lake between Grytviken and Maiviken, South Georgia (Graf, 1931).

Depositional environment conditions

Banks of shells are often formed of bivalve molluscs: e.g. *Crassostrea virginica*, *Chlamys* spp. (Grinnell, 1974; Sanderson & Donovan, 1974). They are associated with marginal shallow marine or lacustrine environments. Waves and/or tidal currents are responsible for their origin.

Despite the size difference between these molluscs and ostracods, the occurrence of a bank of ostracod shells should need similar hydrodynamic

conditions, albeit with considerable lower energy (Wakefield, 1995). Thus, small, shallow water bodies should be suitable environments for the formation of ostracod biofabrics.

Wakefield & Athersuch (1990) documented a nested ostracod biofabric of *Theriosynoecum conopium* Wakefield & Athersuch containing several individuals.

The population age structure of the *Amphicypris argentinensis* sp. nov. shell bank results in a histogram between type A and B of Whatley (1983, 1988), clearly indicating a biocoenosis assemblage. A Type A population structure comprises large numbers of adults of both sexes and juvenile instars well back into the ontogeny of the species. It is common in low-energy lacustrine environments (Whatley, 1983, 1988). In our case, the smallest and most fragile instar stages have most likely been removed or broken by wave action leading to the deposition of the shell bank.

Cup-in-cup arrangement of ostracods valves has been reported on several occasions, mainly from fossil sequences (e.g. Wakefield & Athersuch, 1990; Wakefield, 1995; Boomer et al., 2001). Whatley (as mentioned in Boomer et al., 2001: 342) recorded this phenomenon in Recent ostracods in the Coorong in South Australia. This type of record has been associated with shallow-water depositional environments and seems to occur at the shoreline by the action of wavelets. Guernet & Lethiers (1989) suggested that the imbricate 'cup-in-cup' stack of ostracod shells is favoured by monospecific assemblages and high number of individuals.

Although the three dominant species, *Amphicypris argentinensis* sp. nov., *Limnocythere* sp. and *Neocypridopsis frigogena* represent more than 90% of total individuals in the present ostracod assemblage, the cup-in-cup structure is limited to the biggest form, *Amphicypris argentinensis* sp. nov. The high ratio of specimens to species is typical of most non-marine environments.

Acknowledgements

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