Freshwater Ostracoda (Crustacea) collected from caves and the interstitial habitat in Herzegovina, NW Balkan, with the description of two new species

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Abstract. Freshwater Ostracoda (Crustacea) collected from three caves and one riverine interstital site in the Karst region of Herzogevina are recorded. Two new species, *Pseudocypridopsis hartmanni* n. sp. and *Pseudocypridopsis sywulai* n. sp., are described. A key to the four presently known species of the genus *Pseudocypridopsis* is given.

Keywords. Ostracoda, Crustacea, *Pseudocypridopsis*, caves, Dinaric Karst, Herzegovina, Balkan

The present work is dedicated to Prof. Dr. Gerd Hartmann for his 80th birthday.

1. Introduction

The Dinaric Karst, which is part of the Dinaric Alps in SE Europe, consists of a belt of uninterrupted carbonate sediments running from northeastern Italy along the Adriatic Sea (Slovenia, Croatia, Bosnia, Herzegovina and Montenegro) to the extreme NW of Albania. This area exists as part of the northern Aegean mainland since the Eocene, when it formed a spacious, low altitude plain connected to the Tyrrhenian mainland and partly to today's Crimean and Caucasus areas. This plain was covered with rivers running frequently in different directions.

During the heavy orogenic movements in the Pliocene, the area between the Pannonian plain and the Adriatic Sea was elevated. This strongly modified the flowing direction of the rivers, and the whole hydrographical situation in general. During this time the freshening of the Pannonian Sea took place and the geosynclinals produced a lot of freshwater lakes. Following the tectonic activities, the widespread homogenous Pliocene fauna of this area was split into many isolated centres. This explains the existence of the particularly rich and diverse fauna in the present-day Dinaric Karst.

The denudation and deforestation of the Eocene Flysch enabled the water to reach the underlying soluble carbonate layers and this process started the karstic change. This in turn led to a desiccation of the uppermost karstic layer and to the drying up of the karstic lakes. The latter process has led to the formation of karstic poljes (valley plains), which are characterized by a low and only periodic water supply (Sket 2004).

Flooding of the poljes through carstic springs and estavelles (reversible sinkholes) located around the plains occurs after the thaw during each spring. The water supply persists until late spring, after which the water bodies empty, through underground sinks, directly or indirectly into the Adriatic Sea.

The study area of Popovo Polje is the largest and deepest karstic field in Herzegovina. The NW area is surrounded by a large number of marginal karstic springs, caves and estavelles. The Vjetrenica cavern is one of the largest caves in the Dinaric Karst and has tunnels that are about 6 km in length. This

cavern is known to have one of the richest fauna of speleobionts in the area, with over 40 aquatic species (Culver & Sket 2000).

The caves of the Dinaric Karst, and in particular those in Herzegovina are known to have a rather ancient and rich fauna (for a review see Sket 2005).

Considering the cave living ostracods in Herzegovina it has to be said that there is nearly no record available. Only Hubault (1937) mentioned the commensal species *Sphaeromicola stammeri* Klie, which was found in the cavern Vjetrenica living in the gill holes of *Monolistra hercegovinensis* Absolon. In several other regions of the karstic area, so in Slovenia, Dalmatia (Croatia) and Montenegro, they are only mentioned to live there (Danielopol 1969; Hubault 1938; Karanovic 1999a, 1999b, 2000; Klie 1930, 1931, 1937, 1937a, 1940; Petkovski 1976; Petkovski & Meisch 1994; Wagenleitner 1990).

We here report on the ostracods collected from caves and the interstitial habitat in Herzegovina (Fig. 1). Two species assigned to the genus *Pseudocypridopsis* Karanovic are described as new. Additionally, a key to the extant species of the genus *Pseudocypris* is given.

2. Material and methods

The material studied was collected in September 1975 by Prof. Dr. Boris Sket (University of Ljubljana, Slovenia) and some of his colleagues from three caves and one interstitial river site in Herzegovina (Fig. 1).

The material is stored in the collection of the Zoological Museum Hamburg (ZMH) under the numbers ZMH K-42040 – K-42072. A few specimens of *Pseudocypridopsis sywulai* n.sp. are stored together with the other material in the collection of Burkhard Scharf under the numbers 05-5-1 to 05-13-1.

3. Results

3.1. Localities and species recorded

a) Baba Pecina cave near the village Strujici, at the northern edge of the Popovo Polje karst field, side siphon (a small cave lake without a surface outlet within the cave).

Candona sp.: 9 valves of instars.
Ilyocypris sp.: 2 valves of adults, 1 valve of instar
Cypridopsis vidua (O.F. Müller, 1776) (Pl. 2:. 24): 2 valves (see also the remark on *C. parva*)
Pseudocypridopsis sywulai n. sp.: 2 carapaces and 9 valves of adults; 2 carapaces and 22 valves of instars.

b) Baba Pecina cave near the village Strujici, at the Northern edge of the Popovo Polje karst field, side siphon.

Candona sp.: 1 fragment.
Cypria sketi Petkovski, 1976: 1 carapace.

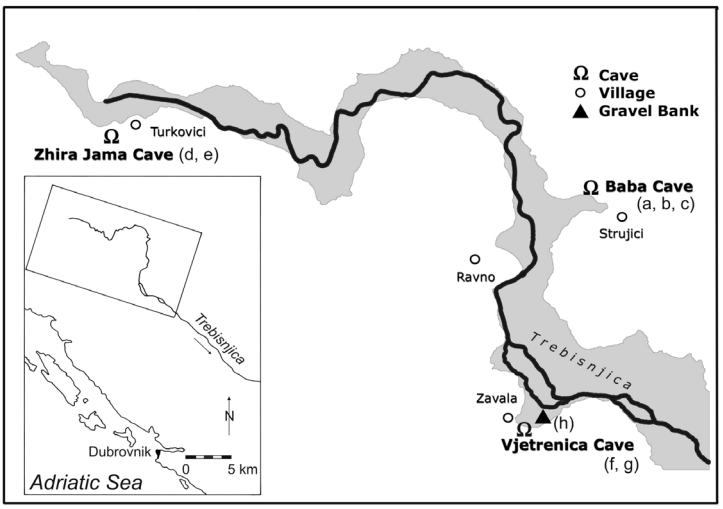


Fig. 1. Map of the study area. The study area is located at the NW end of the karstfield Popovo Polje. The valley around the river Trebisnjica is drawn in gray.

Pseudocypridopsis sywulai n. sp. (Pl. 2: 38, 39, 40, 41, 42, 43, 46, 47): 22 carapaces, 12 valves. Within the carapaces 40 and 41 of Plate 2, sperms were found.

c) Baba Pecina cave near the village Strujici, at the Northern edge of the Popovo Polje karst field, pools.

Candona cf. *lindneri* Petkovski, 1969 (Pl. 2: 3): 1 adult female valve, 1 carapace and 2 valves of instars.
Pseudocypridopsis sywulai n. sp. (Pl. 2: 44): 1 carapace.

d) Zhira Jama cave near the village Turkovici, at the Southern edge of the Popovo Polje karst field, between clusters of *Congeria* sp. (Bivalvia) and *Marifugia* sp. (Polychaeta), the clusters being found on the walls and the ceiling of the cave (Wesenberg-Lund 1939).

Candona sp.: 3 carapaces and 1 valve, all instars.
Ilyocypris inermis Kaufmann, 1900 (Pl. 1: 19): 1 adult carapace.
Heterocypris sp.: 1 carapace.
Pseudocypridopsis sywulai n. sp.: 1 carapace and 4 valves.

e) Zhira Jama cave near the village of Turkovici, at the southern edge of the Popovo Polje karst field, underwater rocky bottom without *Congeria*.

Candona cf. *lindneri* Petkovski, 1969 (Pl. 1: 4, 5, 6): 1 valve of an adult male, 2 carapaces of adult females, 7 carapaces and 2 valves of instars.
Schellencandona cf. *aemonae* (Klie, 1935) (Pl. 1: 9, 10): 2 valves.
Cypria ophtalmica (Jurine, 1820) (Pl.. 1: 12): 1 carapace.
Cypria sketi Petkovski, 1976 (Pl. 1 13, 14, 15, 16): 38 carapaces, 9 valves.
Cyclocypris cf. *globosa* (Pl. 1: 17): 2 valves.
Ilyocypris cf. *gibba* (Ramdohr, 1808) (Pl. 1: 18): 1 carapace.
Pseudocypridopsis hartmanni n. sp. (Pl. 2: 26): 1 carapace, 1 valve.
Pseudocypridopsis sywulai n. sp. (Pl. 2: 45): 1 valve, 1 juvenile carapace and 2 valves.

f) Vjetrenica Pecina cave near the village Zavala, at the Southern edge of the Popovo Polje karst field, the first puddle at the entrance to Donja Vjetrenica (a side corridor of Vjetrenica cave).

Pseudocypridopsis hartmanni n. sp. (Pl. 2: 33, 34): 1 carapace.

g) Vjetrenica Pecina cave near the village Zavala, at the southern edge of the Popovo Polje karst field, rimstone pools, loamy underground.

Pseudocypridopsis hartmanni n. sp. (Pl. 2: 25, 27, 28, 29, 30, 31, 32, 35, 36): 2 carapaces, 1 valve.
Pseudocypridopsis sywulai n. sp. (Pl. 2: 37): 3 adult valves and 1 juvenile valve.

h) Interstitial habitat of the gravel bank along the river Trebisnjica. Trebisnjica River is flowing into the open field, not far from the Vjetrenica Pecina cave near the village of Zavala, at the southern end of the Popovo Polje karst field.

Darwinula stevensoni (Brady & Robertson, 1870): 1 carapace.
Candona cf. *neglecta* Sars, 1887 (Pl. 1: 7, 8): 1 carapace.
Pseudocandona cf. *albicans* (Brady, 1864) (Pl. 1: 11): 1 valve.
Cypridopsis vidua (O.F. Müller, 1776) (Pl. 2: 20, 21, 22, 23): 5 carapaces and 3 valves.
Pseudocypridopsis hartmanni n. sp.: 1 adult valve (fragment) and 1 juvenile carapace.
Potamocypris variegata (Brady & Norman, 1889) (Pl. 2: 48): 1 carapace and 1 valve.

3.2. Taxonomic remarks

Cypridopsis vidua. The authors have discussed especially the Fig. 24 of *Cypridopsis vidua* and came to the conclusion that the variability of the shells of *C. vidua* is so large that Fig. 24 should be assigned to *C. vidua* O.F.Müller, 1776 instead of *C. parva* G.W.Müller, 1900.

Typhlocypris schmeili. O. Schmeil (1894) mentioned that he had collected ostracods in the Zhira Jama cavern and that he had handed them over to G.W. Müller who gave one of the species the working name *Typhlocypris schmeili*. He also mentioned that the species would be described later by G.W.Müller. However, this never hap-

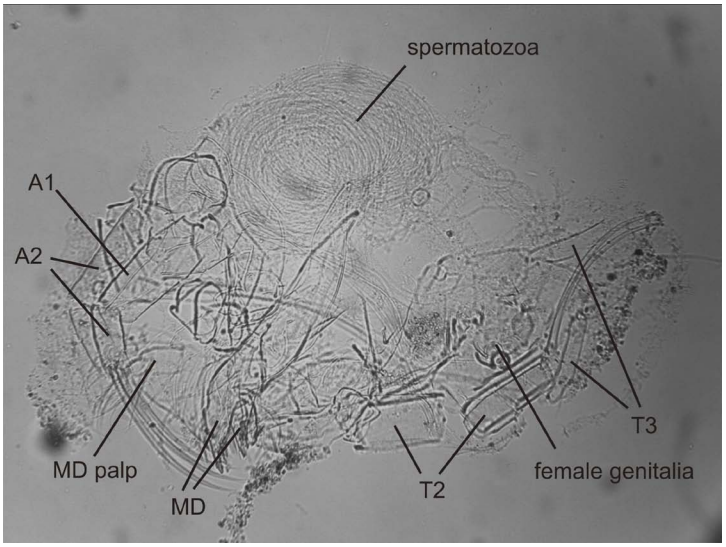


Fig. 2. Soft parts of *Pseudocypridopsis sywulai* n. sp. Holotype (microscopic slide: Scharf 05-10-1-3). Figs 40 and 41 show the valves of the same animal. Location b. A1 = antennule, A2 = antenna, MD = mandibular, T2 = walking leg, T3 = cleaning limb.

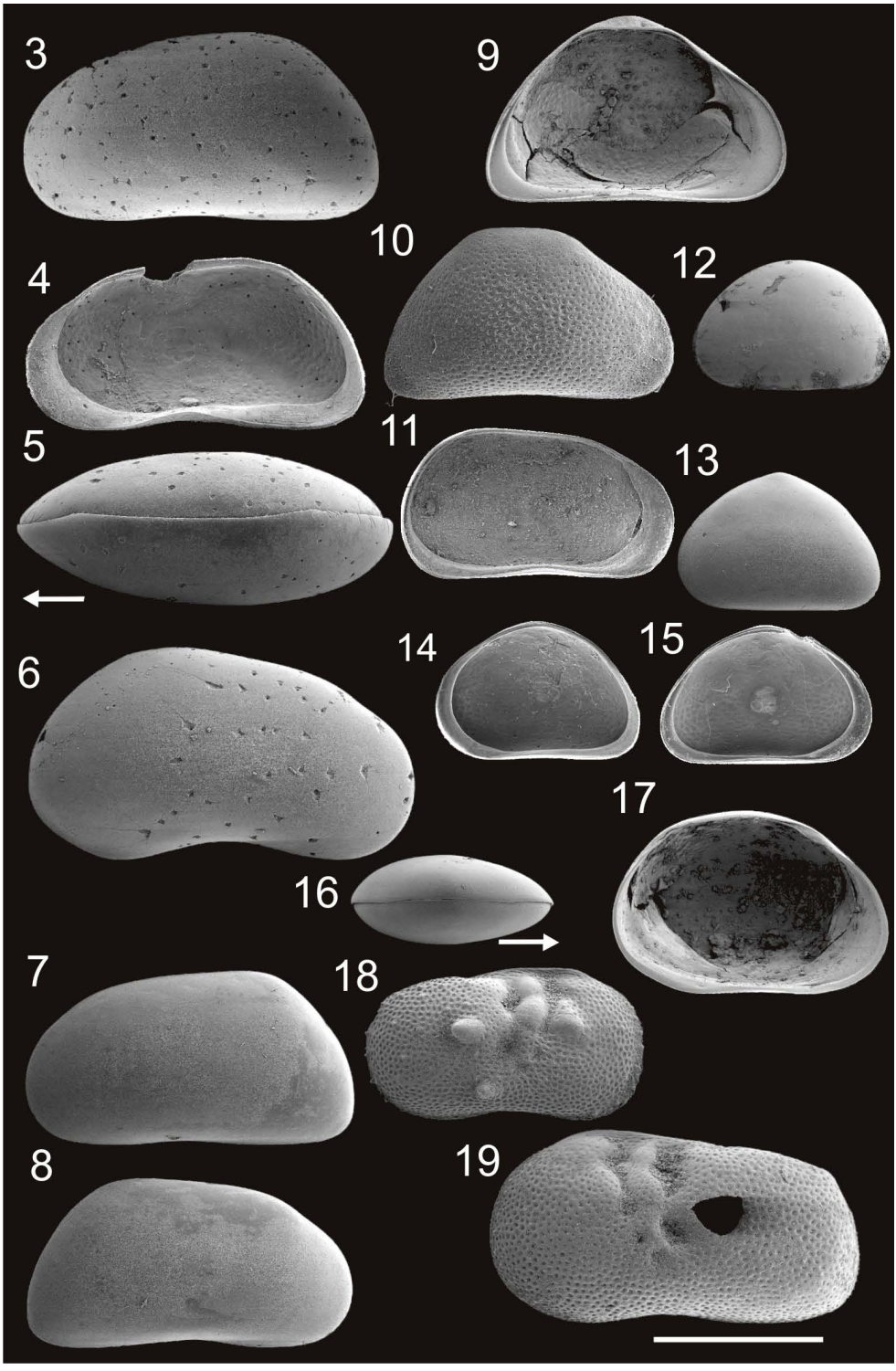
pened. Therefore *Typhlocypris schmeili* is a nomen nudum and should not be used any more.

3.3. The genus *Pseudocypridopsis*

Pseudocypridopsis Karanovic, 1999 was erected for *Cypridopsis clathrata* Klie, 1937, which became the type species of the genus. *Pseudocypridopsis petkovskii* Karanovic, 2000 was the second species to be included in the genus. Both species are so far only recorded from the western Balkan. We here describe two additional species belonging to that genus.

Although only macerated soft parts of the new species were found (Fig. 2), we readily could assign the valves and carapaces to *Pseudocypridopsis,* this because of the following features that define the genus: the ovoid form of the carapace with the left valve overlapping the right one. The surface of the valves bears a strong and characteristic ornamentation. The main generic feature is the missing of a double folded inner list at the posterior of the left valve.

Plate 1: figures 3-19. Arrows point to the anterior end of the animal. Scale bar 0.5 mm. 3: *Candona* cf. *lindneri* Petkovski, 1969, ♀, LV, lateral view, length: 1.04 mm, height: 0.32 mm, location c; (ZMH K-42040). 4: *Candona* cf. *lindneri* Petkovski, 1969, ♀, LV, lateral view, length: 0.99 mm, height: 0.31 mm, location e; (ZMH K-42041). 5: *Candona* cf. *lindneri* Petkovski, 1969, ♀, dorsal view, length: 1.10 mm, height: 0.32 mm, location e; (ZMH K-42064). 6: *Candona* cf. *lindneri* Petkovski, 1969, ♂, RV, lateral view, length: 1.15 mm, height: 0.65 mm, location e; (ZMH K-42065). 7: *Candona* cf. *neglecta* Sars, 1887, juv ?, LV, lateral view, length: 0.96 mm, height: 0.52 mm, location h; (ZMH K-42042). 8: *Candona* cf. *neglecta* Sars, 1887, juv ?, RV, lateral view, length: 0.95 mm, height: 0.50 mm, location h; same animal as that in Fig. 7 (ZMH K-42042). 9: *Schellencandona* cf. *aemonae* (Klie, 1935), LV, lateral view, length: 0.88 mm, height: 0.57 mm, location e; (ZMH K-42043, carapace broken). 10: *Schellencandona* cf. *aemonae* (Klie, 1935), RV, lateral view, length: 0.85 mm, height: 0.50 mm, location e; (ZMH K-42043 shell broken). 11: *Pseudocandona* cf. *albicans* (Brady, 1864), LV, lateral view, length: 0.79 mm, height: 0.44 mm, location h; (ZMH K-42044). 12: *Cypria ophtalmica* (Jurine, 1820), carapace, lateral view, LV: length: 0.58 mm, height: 0.39 mm, location e; (ZMH K-42045). 13: *Cypria sketi* Petkovski, 1976, LV, lateral view, length: 0.59 mm, height: 0.41 mm, location e; (ZMH K-42046a). 14: *Cypria sketi* Petkovski, 1976, RV, lateral view, length: 0.60 mm, height: 0.40 mm, location e. The same animal as shown in Fig. 15; (ZMH K-42046b). 15: *Cypria sketi* Petkovski, 1976, LV, lateral view, length: 0.62 mm, height: 0.41 mm, location e; (ZMH K-42046c). 16: *Cypria sketi* Petkovski, 1976, carapace, dorsal view, LV: length: 0.60 mm, location e; (ZMH K-42046d). 17: *Cyclocypris* cf. *globosa* (Sars, 1863), LV, lateral view, length: 0.81 mm, height: 0.56 mm, location e; (ZMH K-42047). 18: *Ilyocypris* cf. *gibba* (Ramdohr, 1808), RV, lateral view, length: 0.82 mm, height: 0.45 mm, location e; (ZMH K-42048, shell broken). 19: *Ilyocypris inermis* Kaufmann, 1900, LV, lateral view, length: 1.08 mm, height: 0.58 mm, location d; (ZMH K-42049).


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***Pseudocypridopsis hartmanni* n. sp.** (Pl. 2: 25-36)

Holotype: Two valves of one carapace (Pl. 2: 27-32, 35), ZMH 42054.
Paratypes: ZMH K-42051-53, K-42055, K-42066-68; Scharf (pers. collection) 05-5-1, 05-7-1, 05-8-1, 05-12-1, 05-9-1.
Material examined: sampling sites e, f, g, h.
Type locality: location g.
Etymology: The species is named in honour of Prof. Dr. Gerd Hartmann.

Description

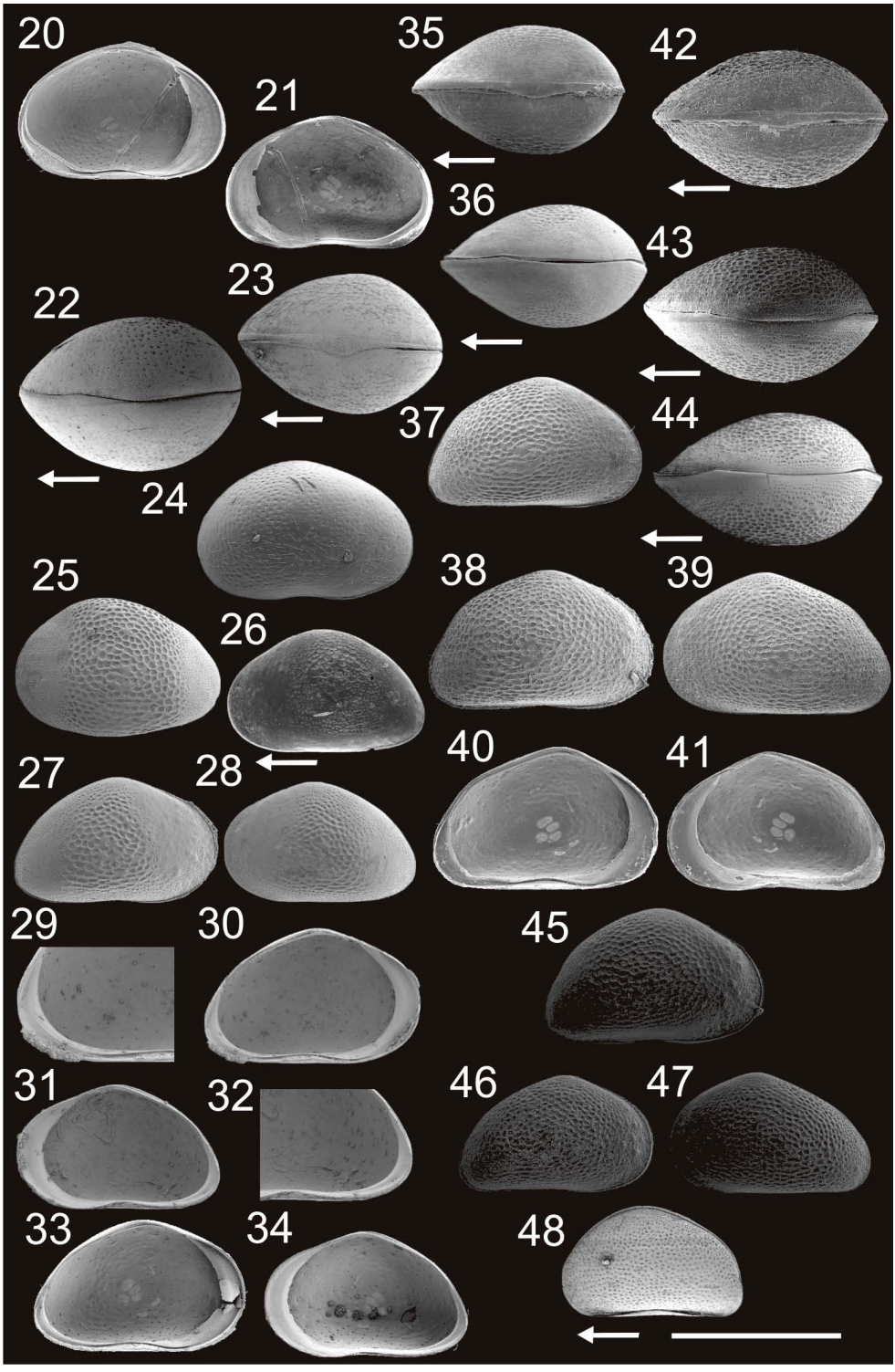
Carapace in dorsal view ovoid, anteriorly pointed, posteriorly rounded. Left valve overlapping right valve ventrally and at both ends, nearly subtriangular in lateral view. Dorsal margin rounded, sloping in an almost straight line towards the broadly rounded frontal margin. Posterior dorsal margin steeper, descending to a more pointed and low lying margin. Ventral side concave, LV showing ventrally an elevated list on the marginal zone. Marginal zone anteriorly wide, posteriorly narrow. Inner list absent on both valves. Fused zone very small. Only 4 well developed muscle scars.

Surface of valves covered in the center with a rather large hexagonal mesh-like ornamentation, peripherally fainting into punctual ornaments. Colour grey–white, scarcely translucent. Bristles in the central valve area numerous, otherwise scarce.

Length 0.60-0.62 mm, height 0.37-0.40 mm.

Only strongly macerated softparts were present. Male not found.

Plate 2: figures 20-48. Arrows point to the anterior end of the animal. Scale bar 0.5 mm. 20: C*ypridopsis vidua* (O.F.Müller, 1776), LV, lateral view, length: 0.61 mm, height: 0.39 mm, location h; (ZMH K-42050a). 21: *Cypridopsis vidua* (O.F.Müller, 1776), RV, lateral view, length: 0.61 mm, height: 0.39 mm, location h. The same animal as shown in Fig. 20; (ZMH K-42050a). 22: *Cypridopsis vidua* (O.F.Müller, 1776), carapace, dorsal view, LV: length: 0.65 mm, location h; (ZMH K-42050b). 23 : *Cypridopsis vidua* (O.F.Müller, 1776), carapace, ventral view, LV: length: 0.60 mm, location h; (ZMH K-42050b). 24: *Cypridopsis vidua* (O.F.Müller, 1776), RV, lateral view, length: 0.63 mm, height: 0.42 mm, location a; (ZMH K-42051). 25 : *Pseudocypridopsis hartmanni* n. sp., LV, lateral view, length: 0.60 mm, height: 0.40 mm, location g; paratype, (ZMH K-42052). 26: *Pseudocypridopsis hartmanni* n. sp., carapace, lateral view, LV: length: 0.58 mm, height: 0.37 mm, width: 0.38 mm, location e; paratype, (ZMH K-42053). 27: *Pseudocypridopsis hartmanni* n. sp., lateral view, RV, length: 0.60 mm, location g. The same animal as shown in figs 28 to 33, holotype; (ZMH K-42054). 28: *Pseudocypridopsis hartmanni* n. sp., lateral view, LV, length: 0.62 mm, location g, holotype; (ZMH K-42054). 29: *Pseudocypridopsis hartmanni* n. sp., lateral view, LV, location g. Part of Fig. 30, holotype; (ZMH K-42054). 30: *Pseudocypridopsis hartmanni* n. sp., lateral view, LV, length: 0.62 mm, location g, holotype; (ZMH K-42054). 31: *Pseudocypridopsis hartmanni* n. sp., lateral view, RV, length: 0.60 mm, location g, holotype; (ZMH K-42054). 32: *Pseudocypridopsis hartmanni* n. sp., lateral view, RV, part of Fig. 31, holotype; (ZMH K-42054). 33: *Pseudocypridopsis hartmanni* n. sp., lateral view, LV, length: 0.62 mm, height: 0.38 mm, location f; paratype, (ZMH K-42055). 34: *Pseudocypridopsis hartmanni* n. sp., lateral view, RV, length: 0.60 mm, height: 0.37 mm, location f. The same animal as shown in Fig. 33; (ZMH K-42055). 35: *Pseudocypridopsis hartmanni* n. sp., carapace, ventral view, length: 0.62 mm, width: 0.39 mm, location g, holotype; (ZMH K-42054). 36: *Pseudocypridopsis hartmanni* n. sp., carapace, dorsal view, length: 0.61 mm, width: 0.37 mm, location g; paratype, (ZMH K-42052). 37: *Pseudocypridopsis sywulai* n. sp., RV, lateral view, length: 0.63 mm, height: 0.39 mm, location g; paratype, (ZMH K-42056). 38: *Pseudocypridopsis sywulai* n. sp., RV, lateral view, length: 0.66 mm, height: 0.42 mm, location b; paratype, (ZMH K-42057). 39: *Pseudocypridopsis sywulai* n. sp., LV, lateral view, length: 0.67 mm, height: 0.42 mm, location b. The same animal as shown in Fig. 38; paratype, (ZMH K-42057). 40: *Pseudocypridopsis sywulai* n. sp., ♀, LV, lateral view, length: 0.66 mm, height: 0.42 mm, location b. Figs 40 and 41 belong to the soft parts of the animal of Fig. 2, holotype; (ZMH K-42058). 41: *Pseudocypridopsis sywulai* n. sp., ♀, RV, lateral view, length: 0.64 mm, height: 0.42 mm, location b, holotype; (ZMH K-42058). 42: *Pseudocypridopsis sywulai* n. sp., carapace, ventral view, LV: length: 0.69 mm, location b. The same animal as shown in Fig. 43; paratype, (ZMH K-42059). 43: *Pseudocypridopsis sywulai* n. sp., carapace, dorsal view, LV: length: 0.69 mm, location b; paratype, (ZMH K-42059). 44: *Pseudocypridopsis sywulai* n. sp., carapace, dorsal view, LV: length: 0.67 mm, location c; paratype, (ZMH K-42060). 45: *Pseudocypridopsis sywulai* n. sp., RV, lateral view, length: 0.64 mm, height: 0.39 mm, location e; paratype, (ZMH K-42061). 46: *Pseudocypridopsis sywulai* n. sp., juv., RV, lateral view, length: 0.57 mm, height: 0.35 mm, location b; paratype, (ZMH K-42062). 47: *Pseudocypridopsis sywulai* n.sp., juv., LV, lateral view, length: 0.59 mm, height: 0.36 mm, location b. The same animal as shown in Fig. 46; paratype, (ZMH K-42062). 48: *Potamocypris* cf. *variegata* (Brady & Norman, 1889), carapace, lateral view, LV: length: 0.53 mm, height: 0.33 mm, location h; (ZMH K-42063).


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Remarks

Pseudocypridopsis hartmanni n. sp. is about the same size as *Pseudocypridopsis clathratra* (Klie, 1936) but has a distinct ornamentation in the centre of each valve with is indicative for this species. Also the carapace in *Pseudocypridopsis hartmanni* is clearly cuneiform, while in *P. clathratra* it is only short pointed. Also other species are differentiated by their different carapaces and shell structure. As e.g. the marginal zone is wide at the anterior and narrow at the posterior in *Pseudocypridopsis hartmanni*. *P. petkovskii* Karanovic, 2000 is much smaller than *Pseudocypridopsis hartmanni* and has a less ornamented carapace, which is only covered by small pits. It has additionally also a more stout body.

***Pseudocypridopsis sywulai* n. sp.** (Pl. 2: 35-47)

Holotype: Two valves of one carapace (Figs. 2, 40, 41); number: ZMH K-42058.
Paratypes: ZMK K-42056, K-42057, K-42059 – 62, K-42069 - 72; Scharf (pers. collection) 05-9-1, 05-10-1, 05-11-1, 05-12-1, 05-13-1.
Material examined: Sampling stations a, b, c, d, e, g.
Type locality: location b.
Etymology: To honour Prof. Dr. Tadeusz Sywula who died at the Ohrid Lake.

Description

Carapace ovoid in dorsal view, anterior end cuneiform, posterior end only faintly inflated. Left valve overlapping right valve ventrally and at both ends. Left valve subtriangular, dorsal margin angled, frontal part descending to a broadly rounded anterior margin. Posterior dorsal margin equally descending but forming an angle before extending to a rather pointed posterior. Ventral margin slightly indentated in the middle. Marginal zone anterior broad, posterior narrow. Inner list only anteroventral visible. Fused zone very narrow. One of the five muscle scars very tiny, all others big.

Surface of valves covered with a rather large hexagonal mesh-like ornamentation. Bristles scarce on carapace.

Left valve: length 0.67-0.69 mm, height: 0.42 mm; right valve: length 0.64-0.66 mm, height 0.42 mm. Width of carapace: 0.38 mm.

Soft parts deteriorated but sperms observed (Fig. 2).

Remarks

The size of *Pseudocypridopsis sywulai* n. sp. surpasses that of all other known species of *Pseudocypridopsis*. The valve is angulated at the dorsal margin and the ornamentation covers the whole shell.

4. Key to the species of *Pseudocypridopsis* Karanovic, 1999

1a Size over 0.56 mm; surface of valves with lattice ornamentation.....2

1b Size barely reaching 0.52 mm, surface of valves with small punctations, natatory setae long .....*P. petkovskii*

2a Size over 0.65 mm, natatory setae very short or missing..... *P. sywulai* n.sp

2b Size up to 0.62 mm.....3

3a Anterior end of carapace in dorsal view roundly pointed; lattice ornamentation covers entire valve; dorsal margin with a well developed angle, ventral margin straight to slightly concave, natatory setae very short.... .....*P. clathrata*

3b Anterior end of carapace in dorsal view cuneiform; lattice ornamentation restricted to the central area of valves, dorsal margin with smooth transition into posterior margin, ventral margin straight to slightly convex, natatory setae very short ....*P. hartmanni* n. sp.

Acknowledgments

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References

Culver, D.C. & B. Sket, 2000. Hotspots of subterranean biodiversity in caves and wells. *Journal of Cave and Karst Studies* 62 (1): 11-17.

Danielopol, D.L., 1969. Un nouvel ostracode des eaux souterraines de l'ile de Hvar. *Ann. de Spéléol.* 24 (1): 125-128.

Hartmann, G., 1964. Asiatische Ostracoden, systematische und zoogeographische Untersuchungen. *Int. Rev. Ges. Hydrobiol., Syst. Beiheft* 3: 1-155.

Hubault, E., 1937. *Monolistra hercegovinensis* Absolon. *Sphéromien cavernicole* d'Herzegovine et *Sphaeromicola stammeri* Klie son commensal. *Arch. Zool. Exp. et Gén.* 78: 357-373.

Hubault, E., 1938. *Sphaeromicola sphaeromidicola* nov. spec. commensal de *Sphaeromides virei* Valle en Istrie et considerations sur l'origine de diverses espèces cavernicoles periméditerranéennes. *Arch. Zool. Exp. et Gén.* 80: 11-24.

Karanovic, T., 1999. A new stygobiotic Calanoida (Crustacea,Copepoda) of the Genus *Stygodiaptomus* Petkovski,1981 from the Balkan Peninsula. *Proceed. Biol. Soc. Washington* 112: 628-686.

Karanovic, I., 1999a. On *Pseudocypridopsis* n. gen., with a redescription of *Pseudocypridopsis clathrata* (Klie, 1936)) and a first description of the male (Ostracoda, Cypridopsinae). *Bull. Zool. Mus. Univ. Amsterdam* 17: 1-8.

Karanovic, I., 1999b. A new genus and two new species of Candoninae (Crustacea, Ostracoda) from Montenegro (SE Europe). *Mém. de Biospéol.* 26: 47-57.

Karanovic, I., 2000. *Pseudocypridopis petkovskii* sp. nov., a stygobiont freshwater ostracod (Crustacea, Ostracoda, Cypridopsinae) from Montenegro (SE Europe). *Mitt. Hamb. Zool. Mus. Inst*. 97: 59-66.

Klie, W., 1930. Über eine neue Art der Ostracodengattung *Spaeromicola*. *Zool. Anz.* 88: 272-276.

Klie, W., 1931. Zwei neue Arten der Ostracoden-Gattung *Candona* aus unterirdischen Gewässern im südöstlichen Europa. *Zool. Anz.* 96: 161-168.

Klie, W., 1937. Neue Ostracoden aus Jugoslavien. *Glasnik Skopskog Nauchnog Drustva (= Bulletin de la Société Scientifique de Skopje)* 17: 143-150.

Klie, W., 1937a. Zur Kenntnis der Ostracoden-Arten *Eucypris reptans* (Kaufmann) und *Loxoconcha pusilla* Brady and Robertson. *Zool. Anz*. 118: 44-51.

Klie, W., 1940. Zur Kenntnis der Ostracodenarten *Candona eremita* Vejdovsky und *Cryptocandona reducta* Alm. *Mitt. Höhlen- und Karstforsch.* 1940: 24-29.

Petkovski, T.K., 1976. Zwei neue und eine seltene Ostracoden-Art der Gattung *Cypria* Zenker aus Jugoslawien. *Acta Mus. Maced. Sci. Nat., Skopje* 14: 173-192.

Petkovski, T.K. & C. Meisch, 1994. *Cypria bicolor* n.sp. a new crenobiont freshwater ostracod (Crustacea, Ostracoda) from Slowenia. *Bull. Soc. Nat. luxemb*. 95: 229-236.

Schmeil, O., 1894. Die Höhlenfauna des Karstes. *Zeitschrift für Naturwissenschaften in Sachsen und Thüringen* 66: 339-353. Leipzig.

Sket, B., 1970. Über Struktur und Herkunft der unterirdischen Fauna Jugoslawiens. *Biol. Vestnik* 18: 69-78. Ljubljana.

Sket, B., 2004. Dinaric Karst: biospeleology. In: Gunn, J. (ed.). Encyclopedia of Cave and Karst Science. Fitzroy Dearborn, New York, London, pp. 289-291.

Sket, B., 2005. Diversity in the Dinaric Karst. In D. C. Culver & W. B. White (eds): Encyclopedia of Caves, pp. 158-165, Elsevier Academic Press.

Wagenleitner, H., 1990. Morphology and evolution of *Cypria cavernae* n.sp. (Ostracoda, Crustacea). *Bull. Soc. Nat. luxemb*. 90: 199-226

Wesenberg-Lund, C., 1939. Biologie der Süßwassertiere. Wirbellose Tiere. Wien, Julius Springer Verlag, 817 pp.