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## New and Little Known Ostracods of the Genus *Heterocypris* (Crustacea, Ostracoda) from the Balkan Peninsula

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With 51 Figures, one Plate and one Table

Key words: Freshwater Ostracoda, Balkan peninsula, systematic, *Heterocypris*

### Abstract

Two new species of *Heterocypris*, a bisexual population of *H. bosniaca* and a parthenogenetic population of *H. gevgelica*, are described from Bosnia. While *H. bosniaca* seems to be fully isolated, *H. gevgelica* has close links to *H. exigua* GAUTHIER. Additional descriptions of *H. vitrea* SYWULA, *H. bulgarica* SYWULA, *H. salina* (BRADY), *H. fretensis* BRADY and ROBERTSON, *H. inequivalvis* BRONSTEIN, and *H. maura* MASI are given. The latter three are thought to be congeneric with *H. salina* by several authors. Molecular genetical investigations are suggested to solve this problem.

### 1. Introduction

Species of the genus *Heterocypris* are well represented in the sampling area of the south-central part of the Balkan Peninsula. Several of them occur also in bisexual populations. It is therefore not surprising that Prof. BORIS SKET from Ljubljana found in a well in Prijidor (NW-Bosnia) an additional bisexual population of *Heterocypris bosniaca* n. sp. This species obviously has no closer relationship to any known species of this genus. The sample contained male as well as female specimens. The second species, *H. gevgelica* n. sp., which was recently discovered in a periodic water-body near Gevgelija in S-Macedonia, was represented by female individuals only. It is related to the North African *H. exigua* GAUTHIER, 1928, although it is longer and less tumid.

Additionally, in Macedonia and in the district Banat in Wojwodina two other populations of *H. bulgarica* SYWULA and *H. vitrea* SYWULA were discovered, rare species which SYWULA (1968) has already reported on from Bulgaria.

On Crete, we were able to catch a bisexual population of the widely spread *H. salina* (BRADY, 1862). For the first time specimens of both sexes could be investigated and described.

*H. fretensis* BRADY and ROBERTSON, 1870, *H. inequivalvis* BRONSTEIN, 1947 and *H. maura* MASI, 1932, which are often confused with *H. salina*, are also described. We will not specify their morpho-taxonomical positions, as this would involve genetical investigations.

All the investigation material is kept in the Hydrobiological Collection of the Prirodonaucen Muzej na Makedonija, Skopje (PMMS) (see Table 1).

### 2. Taxonomical descriptions and observations

#### 2.1. *Heterocypris bosniaca* n. sp. (Figs. 1–27)

**Material examined:** Several female and male animals at different stages of growth, collected on August 2nd, 1986, by Prof. Dr. BORIS SKET, Biological Institute, University of Ljubljana.

**Type locality:** Village Buseni near Prijidor in NW-Bosnia: a well at the house of Cika Nadj.

**Etymology:** Named after the country Bosnia, where the species was found.

#### Short diagnosis

Characteristic species of *Heterocypris* of medium size (1.28 mm), amphigenously occurring.

Carapace in dorsal view almost elliptical and both valves approximately of same length. In lateral view valves with a slightly arched dorsal margin and both ends broadly rounded. Right valve shows no signs of tubercles. Selvage situated in the narrow, fused zone. At both ends, inside lamella of valves close to outside edges. Swimming bristles of second antenna almost reaching to the tip of distal claws. Both pre-

**Table 1.** List of collection numbers of the investigated material.  
(PMMS = Hydrobiological Collection of the Prirodonaučen Muzej na Makedonija, Skopje).

Species	Type	Material	Number
<i>Heterocypris bosniaca</i> sp.n.	Holotype	1 Female	PMMS Ostr. 98/1
	Paratypes	Several individuals	PMMS Ostr. 99/1
<i>Heterocypris gevgelica</i> sp.n.	Holotype	1 Female	PMMS Ostr. 100/1
	Paratypes	Several females	PMMS Ostr. 101/1
		Additional Material	PMMS Ostr. 102/1–6
<i>Heterocypris bulgarica</i> SYWULA		Investigated	PMMS Ostr. 103/1–8
<i>Heterocypris vitrea</i> SYWULA		Investigated	PMMS Ostr. 64/1–6
<i>Heterocypris salina</i> (BRADY)		Males and Females	PMMS Ostr. 68/1
<i>Heterocypris fretensis</i> BRADY and ROBERTSON		Females	PMMS Ostr. 104/1–7
<i>Heterocypris inequivalvis</i> BRONSTEIN		Females	PMMS Ostr. 65/1–3
<i>Heterocypris maura</i> MASI		Females	PMMS Ostr. 105/1–2

hensil hooks of male with a thick basal joint and a heavily swollen, short finger, especially on left side. Hemipenis developed as in most species of the genus.

#### Description

• **Female:** Carapace in dorsal view almost elliptical; slightly beaklike, extended at the front end with a relatively narrow rounding at the back end. Valves at both ends with roughly the same length. Lateral edges regularly arched. Maximal width found approximately in the middle of the body. Surface of valves smooth, with relatively few lateral setae. Animal of pale brownish colour, eye present.

Left valve 1.28 mm long and maximal height of 0.71 mm in the middle of the body. Dorsal margin only slightly arched and to some degree inclined towards the very broadly rounded front edge, into which it gradually merges. Towards the back it is more clearly inclined and reaches the narrowly rounded rear edge without a transition. Bottom edge with shallow indentations. Inner edge appears as a double line which approaches the valve's edges at both ends and almost

touches the bottom margin. Front edge bordered with a hyaline lamella which is displaced inwards at the rear end. Fused zone very narrow.

Right valve 1.27 mm long with a maximal height of 0.68 mm. Dorsal margin slightly more arched, rear end more narrowly rounded and bottom edge more deeply indented than on the left side.

Extremities. – Antennules with long swimming bristles, which are more than twice as long as all 7 limbs of the antennules together. Ratio of length of last 5 limbs (of the flagellum) 36:25:20:17:16. Ratio length:width of first limb 36:20 and of last limb 16:5.

The second limb of the antenna has a L:W-ratio of 93:33, measured at the point where the aesthetasck originates, whose length is 18 units of measurement. The penultimate limb has a L:W-ratio of 52:17, measured at the point where the t-bristles are inserted. The distal claws of this limb have a ratio of 68:91:50; all of them have coarse spines in the last two thirds of the claw until just below the tip. L:W-ratio of the distal limb is 20:8. Its distal claws have a ratio of 50:28. The bigger claw is spiny like the claws of the penultimate

#### Figs. 1–17. *Heterocypris bosniaca* n. sp., female.

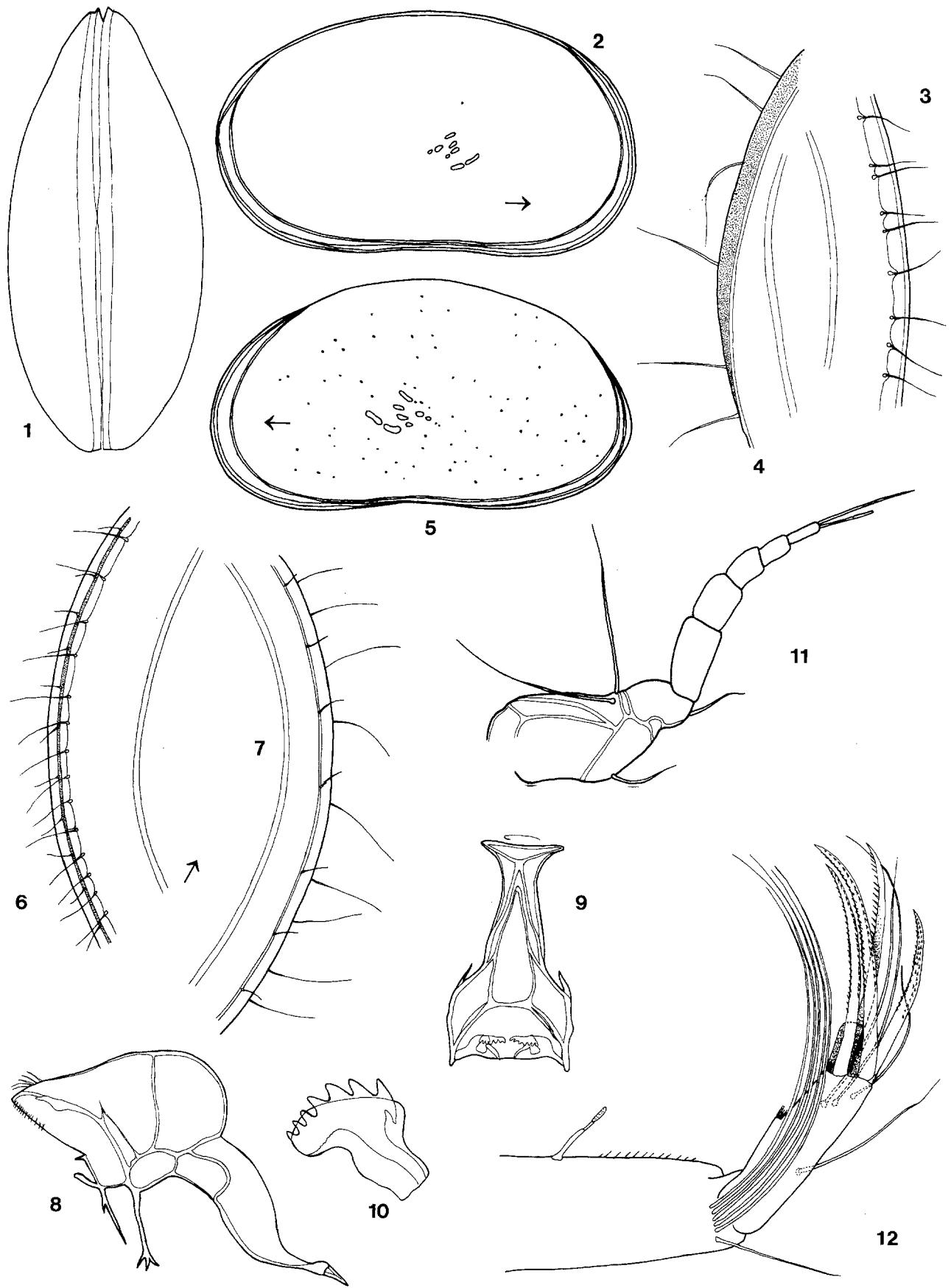
1. Carapace dorsally; 2. Left valve from the inside; 3. Left valve, anterodorsal edge from the inside; 4. Left valve, posterodorsal edge from the inside; 5. Right valve from the inside; 6. Right valve, anterodorsal edge, from the inside; 7. Right valve, posterodorsal edge from the inside; 8. Forehead with epistome laterally; 9. Hypostome from below; 10. Rakeform organ; 11. Antennule (A1); 12. Antenna (A2); 13. (a) Mandibular palpus: alpha-, beta- and gamma-bristle, (b) Maxillar palpus and third masticatory process; 14. First thorakopod (walking leg); 15. Second thorakopod (cleaning leg); 16. Chitinous support of the furcae; 17. Furcal ramus.

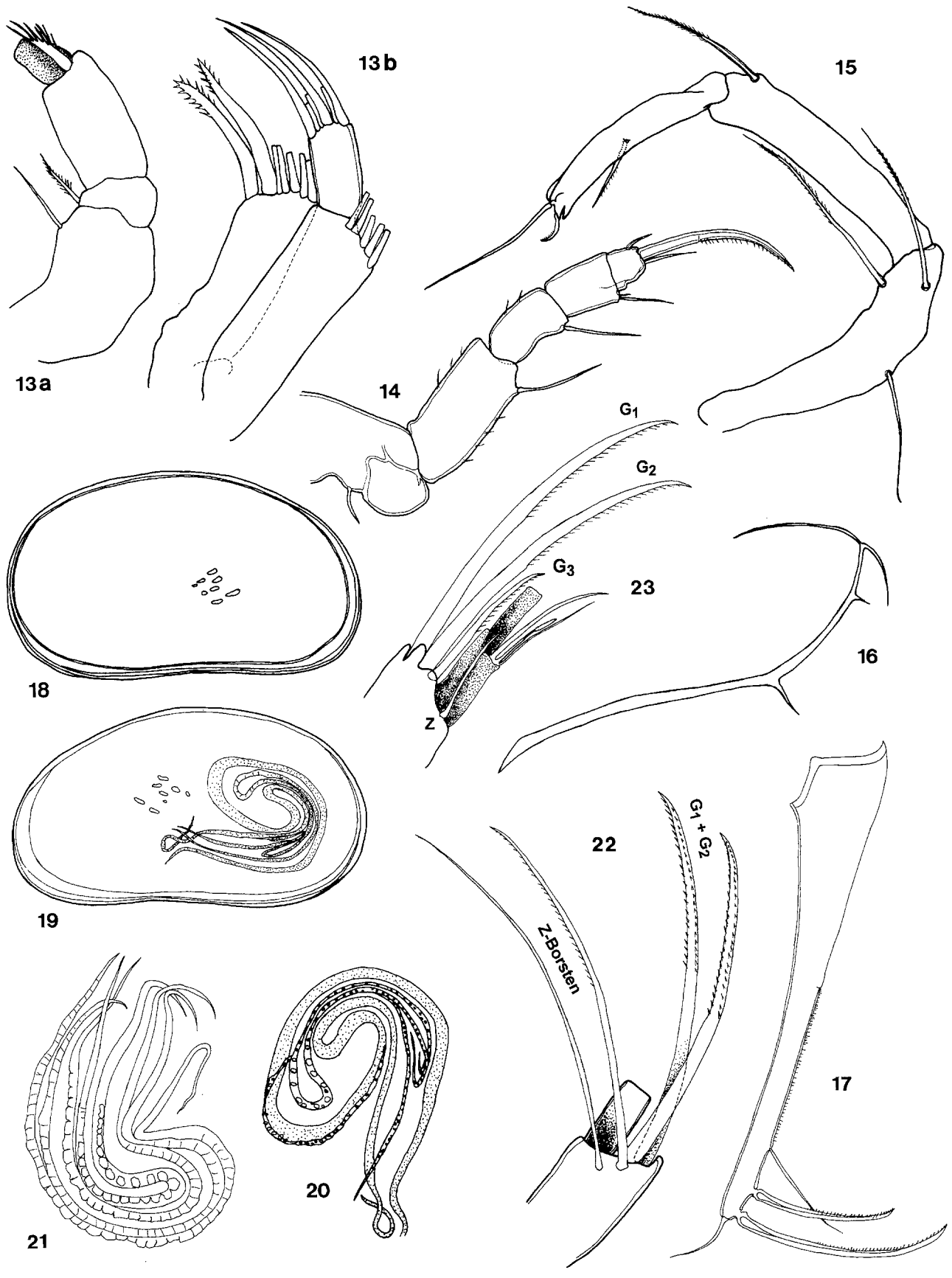
#### Figs. 18–27. *Heterocypris bosniaca* n. sp., male animal.

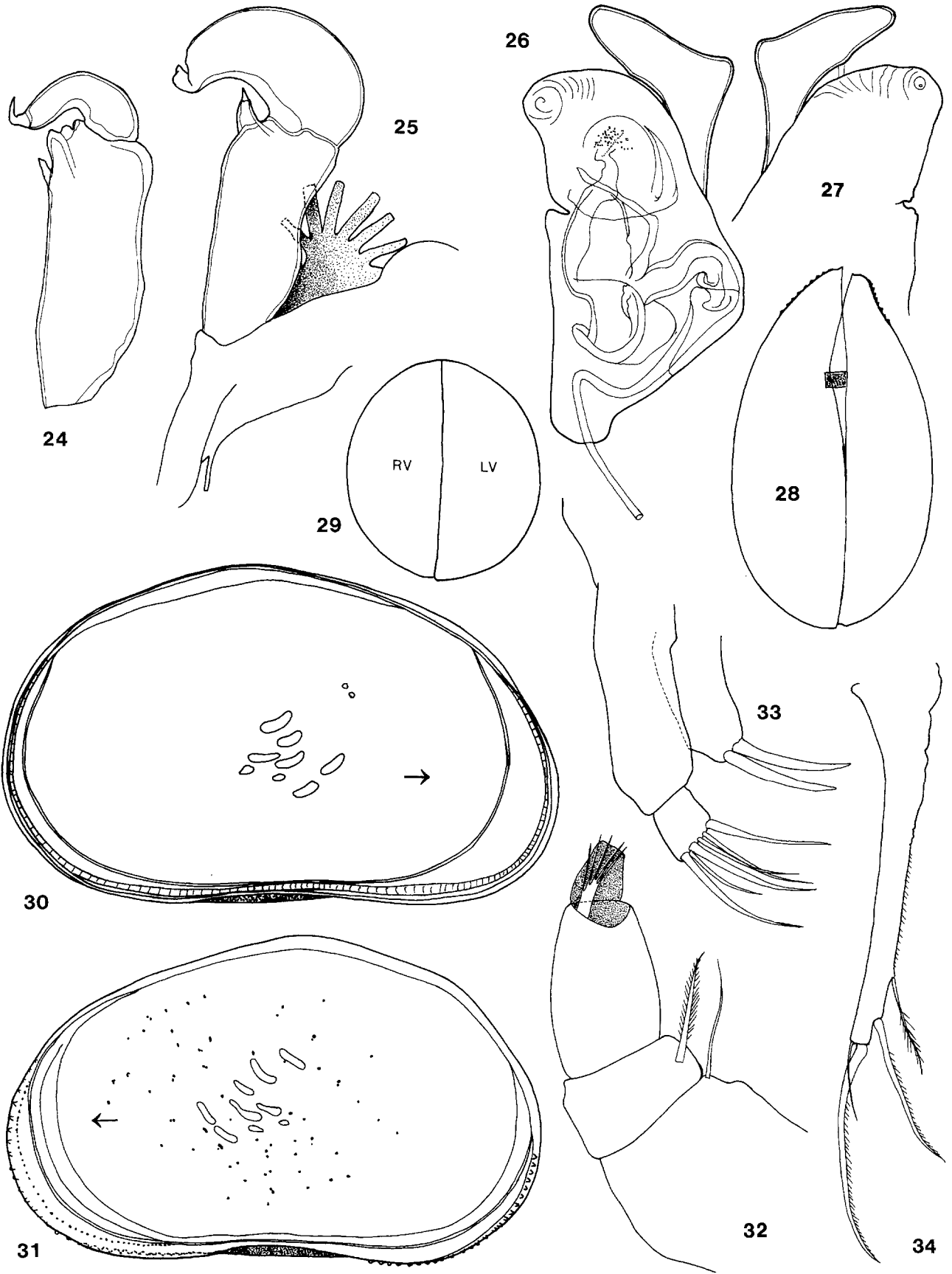
18. Left valve from the inside; 19. Right valve from the inside; 20.–21. seminiferous tubules, isolated and magnified; 22. Antenna (A2): Claws of the penultimate limb, from the outside; 23. Antenna (A2): Claws of the two last limbs, from the medial side; 24.–25. Right and left prehensil hook; 26. Hemipenis; 27. Terminal lobes of the hemipenis.

#### Figs. 28–34. *Heterocypris gevgelica* n. sp., female animal.

28. Carapace dorsally; 29. Carapace frontally; 30. Left valve from the inside; 31. Right valve from the inside; 32. Mandibular palpus: sensory bristles alpha, beta and gamma; 33. Maxilla: palpus and third masticatory process; 34. Furcal ramus.







limb, whereas the additional claw is very slim and without spines. The swimming bristles are all thin and smooth, they end just below the tip of the distal claws.

Head with upper lip, hypostome and rakeform organ as in Figs. 9 and 10. The mandibular palp has a bunch of 3 plumose bristles at the 2. limb. Of the sensory bristles of this palpus, the alpha-bristle is delicate and smooth, the beta-bristle somewhat shorter, thicker and finely feathered, and the gamma-bristle finally almost reaches the last third of the distal limb, but only with its long feathers it exceeds the end of this limb.

The maxillar palpus has a cylindric distal limb which is well twice as long as it is wide. Both dentiform reinforced bristles of the third masticatory process are coarsely toothed.

The first pair of legs has a respiratory plate with six rays.

The second pair of legs (walking legs) has a relatively stubby basal limb with only one d-bristle inserted. Its second limb is cylindrical and approximately twice as long as wide. Taken together, the three other limbs are significantly longer than the terminal claw (ratio 68:58). The terminal claw itself is spiny in its distal half until just below the tip. The spinules appear to be increasing in length distally.

The first three limbs of the third pair of legs (cleaning legs) are extremely stretched. Three bristles are attached to the basal limb. The claw of the rather short distal limb is relatively poor developed. Both branches of the furca are parallel and almost straight. Their stem, measured at the front edge, is approximately 13 times as long as its width at the point where the posterior bristle attaches. The ratio of length of this edge and the furcal claws is 117:28:63:42:31, beginning with the terminal bristle. The rear edge of the furca is finely ciliated in its distal third. In their distal thirds, both claws have a comb of spines reaching to the tip, where the spinules are biggest. The posterior bristle of the furca is not plumose.

The chitinous support of the furca is distally bent downwards and dorsally indistinctly branched at two points.

• **Male:** Somewhat smaller than the female. The left valve is 1.10 mm long and 0.61 mm wide. Its front edge is more narrowly rounded than that of the female. The dorsal margin is slightly arched and more steeply bent towards the front. The right valve has a more broadly rounded rear edge than the female; otherwise it is exactly alike, lacking tubercles at the front as well as at the postero-ventral edge. Its length is 1.08 mm and its maximal height 0.58 mm. The two big claws of the penultimate limb of the antenna are slimmer and longer than those of the female, whereas the small claw has hardly half the length of the main claws. The two z-bristles on the outside are strongly developed, one of them appears to be claw-like. The z-bristle inserted on the inside is poorly developed and only slightly exceeds the distal limb.

Both prehensil hooks have thick basal limbs and short, stiff sensory bristles. The finger of the left palpus is peculiarly crooked and heavily swollen, its terminal sensory tip short. The finger of the right prehensil hook is also relatively short and crooked, although its terminal sensory tip is signif-

icantly longer than that of the left finger. The hemipenis has no morphological peculiarities, it is built like in most species of the genus *Heterocypris*.

#### Taxonomical position

The absence of tuberculate lines at both ends of the right valve connects *H. bosniaca* to the species *H. reptans* (KAUFMANN, 1900), *H. barbara inermis* (GAUTHIER, 1929), *H. persica* (GHETTI, 1972) and *H. vitrea* SYWULA, 1968, otherwise there are not any closer phylogenetic relations within this group.

The outline of the carapace in dorsal view and of the valves in lateral view, combined with the peculiar shape of the left prehensil hook of the male animal, assigns *H. bosniaca* a special taxonomical position. It is isolated from the species mentioned above as well as from all other species of *Heterocypris* of the W-Palaeartic region.

#### Further taxonomical remarks

According to MEISCH (1993) and MARTENS (1996), *Heterocypris reptans* (KAUFMANN) is a circummediterranean species with extensive areal expansions to E-Europe. These authors comprise *H. reptans limbata* MASI, 1905 and *H. brteki* PETKOVSKI, 1966 within *H. reptans*. In dorsal view, all individuals of *H. reptans* have a oblong-ovale carapace and a short, extended front end. In lateral view, the valves have a clearly angulate dorsal edge transitioning into a discernible arch towards the rear edge. The swimming bristles of the antenna reach to the middle of the distal limb at most. Male animals of *H. reptans* from Dalmatia have been described by KLIE (1937a). We have been able to recollect them in the same area near Nin. The left prehensil hook of these animals has a relatively short and less swollen finger. MARTENS (1996) reports the same on a bisexual population of *H. reptans* from Israel, West of Jerusalem.

*Heterocypris barbara inermis* (GAUTHIER 1929), known from N-Africa is a stubbier, untuberculate species of *H. barbara* (GAUTHIER & BREHM, 1928). The latter, as well as *H. reptans*, turns out to be a holomediterranean element with a predominance in E-Europe. Both mentioned species of *H. barbara* are bigger than *H. bosniaca* (1.40–1.55 mm) and have a carapace which, seen from above, is strongly beaked. The left valve strikingly exceeds the right one. In lateral view, the valves have an angulate dorsal margin and differently shaped ends. The finger of the prehensil hook also turns out to be more stretched within *H. barbara* and *H. barbara inermis*.

*Heterocypris persica* (GHETTI, 1972), known from a paddy-field in N-Iran, has an oblong-ovale carapace, seen from above. The right valve is dented at the front end. In lateral view, both valves remind of those of *H. bosniaca*; however, dorsally they are more arched and have more steeply falling away lateral flanks. The rear bristle of the furca is plumose. The body length is 1.4 mm.

## 2.2. *Heterocypris gevgelica* n. sp. (Figs. 28–34; Plate 1, Figs. 1–3)

**Material examined:** Several females in a sample from a temporary water-body near Gevgelija, Macedonia, collected by one of the authors (T.P.).

**Type locality:** Fields at the eastern outskirts of the town Gevgelija in S-Macedonia. A ground water pond with additional supply of precipitation. The associated fauna is rich in ostracodes.

**Etymology:** Named after the near town Gevgelija.

### Short diagnosis

One of the small species of *Heterocypris* with a body length around 1.00 mm. In dorsal view, the carapace is oblong-ovale. At the front end, the right valve is slightly denticulated and both valves have little tubercles. Seen from the front, the valves are not displaced against each other. The right valve has a very broad selvage and tuberculate lines at the front and postero-ventral edge. The maxillar palpus has a slightly spatulate terminal limb and smooth “Zahnborsten” at the third masticatory process. The swimming bristles of the second antenna are well developed and exceed the tips of the terminal claws.

### Description

The carapace of the female is oblong-ovale in dorsal view, it has a slightly acuminate front end and a broadly rounded rear end. The maximal width is found approximately in the middle of the body. The left valve shows a slight overlap of the right one on the whole free edge. The right valve is slightly dented at the front end. At this end, both valves are amply covered with little tubercles. The surface of the valves is finely reticulated and has a moderately dense cover of setae.

In lateral view, the left valve is subtriangular and broadly rounded on both ends. Its length is 1.02–1.04 mm, its maximal height 0.57–0.59 mm. Just behind the middle, the dorsal margin is only slightly angulate. It merges into the low front end without a transition, whereas it reaches the rear edge in a slight arch. At the front, the inside edge is rather far away from the outside edge, but at the back end it is rather close. The ventral edge is slightly indented. Only ventrally the fused zone is somewhat broader. A fine hyaline lamella borders the whole free edge of the valve, very obvious at the front end and displaced inwards at the rear end. The right valve is even more distinctly subtriangular than the left one, but otherwise of similar shape. Its length is 0.98–1.00 mm and its maximal height 0.54–0.57 mm. The front edge is covered with about 30 tubercles. The rear edge has less tubercles, of which only the ventral ones are marginal, the remaining ones are more lateral. The selvage is situated between the inner and the outer list. The selvage reaches the valve's edge, antero-ventrally it even exceeds it. Between the selvage and the inner list a poorly developed additional list can be detected.

**Extremities:** The antennule is relatively poor developed; still, its swimming bristles are very long. The antenna has very long distal claws at the penultimate limb. The main terminal claw of the final limb is strong, whereas the additional claw is very slim. The mandibular palpus has 3 plumose bristles in a bunch at the second limb. The alpha- and beta-bristles have roughly the same length, although the first is fine and not plumose and the latter thicker and very plumose. The gamma-bristle is very short and thick, it hardly reaches the middle of the final limb, whereas its feathers insignificantly exceed it. The maxillar palpus has a slightly spatulate terminal limb which is as wide as it is long. Both “Zahnborsten” of the third masticatory process are completely smooth.

The first pair of legs has 6 well developed rays at the respiratory plate.

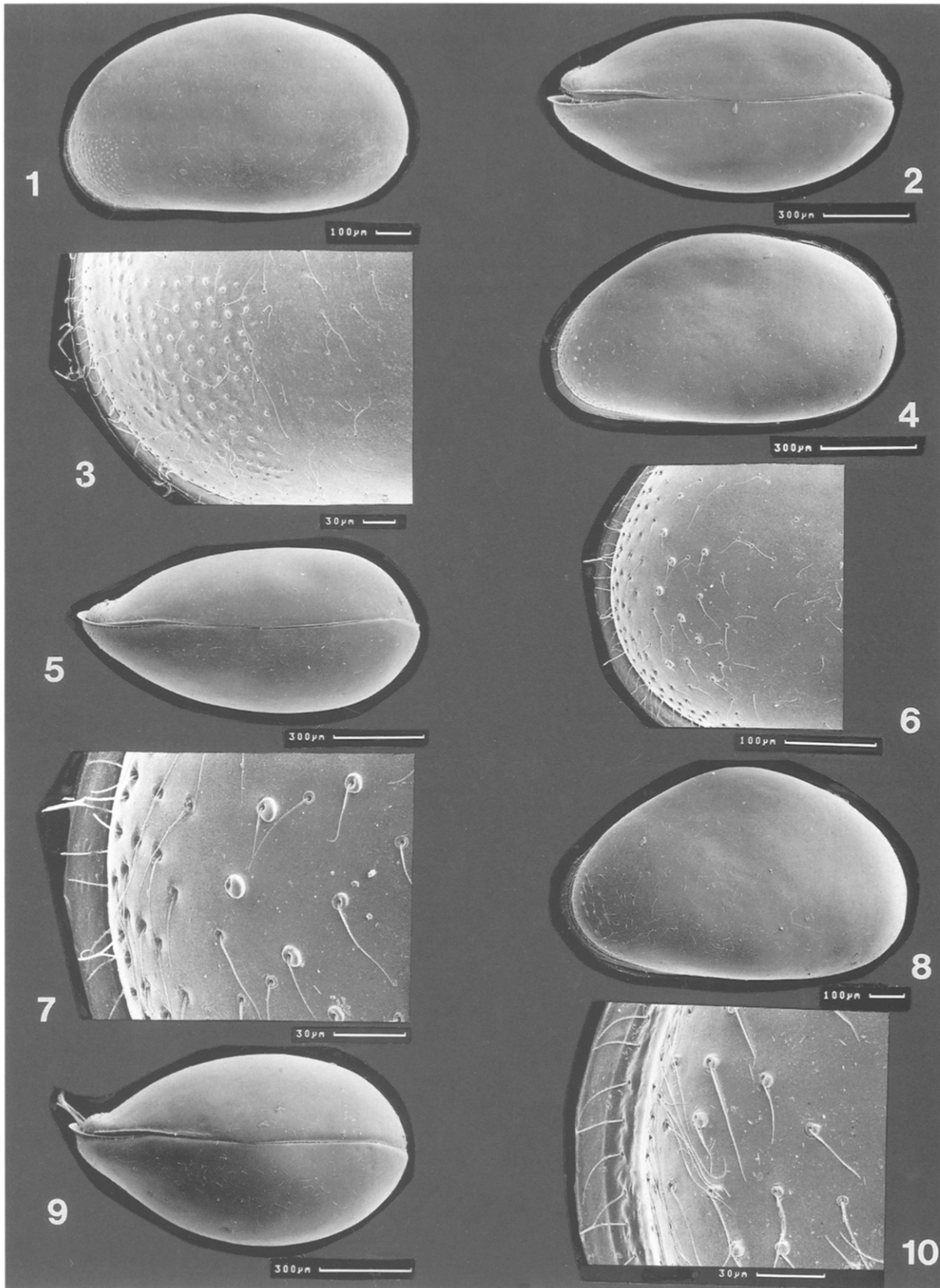
The second pair of legs (walking legs) has a short d-bristle. Its terminal claw is longer than the other three limbs taken together (ratio 76:56), it is significantly bent in last two fifths and spiny in the penultimate fifth.

The third pair of legs (cleaning legs) has 3 bristles attached to the basal limb. Its second limb is extremely long. The main bristle of the third limb is longer than the penultimate limb (ratio 54:36). The furcal rami are almost straight; the ratio of their stem, measured at the front edge, to the base of the terminal claws is 92:18:52:39:26 starting with the terminal bristle. The stem itself is approximately 11.5 times as long as it is wide at the point of attachment of the posterior bristle.

### Further taxonomical remarks

*H. turcica* from the central Anatolian dry steppes (SCHÄFER 1952) has a carapace that in dorsal view is more strongly extended at the front end than in *H. gevgelica*. The dorsal edge of both valves shows some signs of a peak in front of their middle. The right valve displays only a posteroventrale tuberculate line. The shape of the maxilla is completely different: the terminal limb of the palpus is cylindric and both “Zahnborsten” are plumose. The outline of the carapace and the valves of *H. sabirae* from W-Anatolia (GÜLEN 1985) has not been mentioned in the original description so that we cannot make any systematical comparisons. Still, the terminal limb of the mandibular palpus has been described as cylindric and the “Zahnborsten” as plumose. These two characters of *H. sabirae* give us enough reasons for not synonymizing *H. gevgelica* with this species. It remains the question if *H. sabirae* really is a different species from *H. turcica*. GÜLEN did not compare his species with *H. turcica*.

*H. exigua*, up to now only known from Algeria and Tunisia (GAUTHIER & BREHM 1928), has a more stretched carapace in dorsal view (maximal width only 40% of the length) and a more extended front end. The body length is somewhat smaller (0.9 mm) and the dorsal edge is more strongly levelled than in *H. gevgelica*.



**Plate 1.** **Figs. 1–3.** *Heterocypris gevgelica* n. sp. **1.** Lateral view of left valve; **2.** Dorsal view of the whole carapace; **3.** Close-up of the ventral anterior. **Figs. 4–7.** *Heterocypris bulgarica* SYWULA. **4.** Lateral view of left valve; **5.** Dorsal view of the whole carapace; **6.** Anterior lateral view; **7.** Close-up of anterior, showing nodes with bristles. **Figs. 8–10.** *Heterocypris rotundata* BORUTZKY. **8.** Lateral view of left valve; **9.** Dorsal view of whole carapace; **10.** Close-up of anterior margin.



Because of the morphology of the maxilla, *H. exigua* and *H. gevgelica* form a separate species group from *H. turcica* (and possibly similar forms) within the framework of the third class of size of *Heterocypris*-species. The shape of the terminal limb of the maxillar palpus, *H. exigua* and *H. gevgelica* resembles the one of the two species of the exotic genus *Hemicypris* from the paddy-fields of Macedonia, *H. anomala* KLIE, 1938 and *H. nonstriata* LINDROTH, 1953.

### 2.3. *Heterocypris bulgarica* SYWULA, 1968 (Plate 1, Figs. 4–7)

*H. bulgarica* n. sp.: SYWULA 1968. Bull. Soc. Amis Sci. et lett. Poznan, ser. D, 8:

This ostracode from the pools around the lakes of the Bulgarian Black Sea coast has been described by SYWULA (1968). It has also been found particularly often in the bicarbonate of soda-containing periodic pools of the plain (400–600 m altitude above sea level) in Macedonia. This species strongly reminds of the also quite frequent *H. rotundata* BORUTZKY, 1947, from which it can be clearly distinguished by the dorsal outline of the carapace. In this view, *H. bulgarica* appears more stretched and not as broadly rounded at the rear end as *H. rotundata*.

*Cyprinotus dextrodepressus* MORONI (1961) from the N-Italian paddy-fields, also seems to belong to the species group of *H. rotundata*.

### 2.4. *Heterocypris vitrea* SYWULA, 1968 (Figs. 35, 36)

*H. vitrea* n. sp.: SYWULA 1968. Bull. Soc. Amis Sci. et lett. Poznan, ser. D, 8:

This species was found by SYWULA (1968) in a helocrene stream in the meadows of the Witoscha mountains (1520 m altitude above sea level) in Bulgaria. We have been able to recollect *H. vitrea* in periodic spring pools in low altitudes of Macedonia (Petrovec and Mralino near Skopje and Cesinovo near Kocani) and in a semi-permanent, soda containing pond in the district Banat in Wojwodina (Rusanda near Melenci). At all these places, *H. vitrea* was well represented by numerous parthenogenetic populations, so that the male animals of this species still remain unknown. In all other aspects our animals fully correspond with those from the original locality in Bulgaria.

*H. vitrea* can be easily distinguished from related species by the dorsal outline of the carapace, the untuberculate edge of the right valve and the broad selvage, especially at the front end of this valve. The left valve reaches a length of 1.36–1.38 mm and a maximal height of 0.80–0.81 mm. The corresponding measurements of the right valve are 1.31–1.37 mm and 0.76–0.77 mm, respectively.

### 2.5. *Heterocypris salina* (BRADY, 1862) (Figs. 37–47)

Bibliography see MEISCH & BROODBAKER (1993)

**Material examined:** Several individuals have been collected by one of us (B. SCHARF) from a periodic pool in Crete. The following ostracodes have been caught as associated fauna: *Eucypris kerkyrensis* STEPHANIDES 1937, *Tonnacypris lutaria* KOCH 1838, *Heterocypris incongruens* RAMDOHR 1808 and *Herpetocypris chevreuxi* SARS 1896.

#### Description

• **Female:** In dorsal view, the carapace is oblong-ovale and retracted at both sides of the front end. Its maximal width is found approximately in the middle of the body.

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**Figs. 35–36.** *Heterocypris vitrea* SYWULA, 1968 (Sokolarci near Kocani).

**35.** Carapace dorsally; **36.** Right valve from the inside (6.3×10 ).

**Figs. 37–39.** *Heterocypris salina* (BRADY, 1862), female (isle of Crete).

**37.** Carapace dorsally; **38.** Left valve from the inside (6.3×10 ); **39.** Right valve from the inside (6.3×10 ).

**Figs. 40–47.** *Heterocypris salina* (BRADY, 1862), male (isle of Crete).

**40.** Carapace dorsally; **41.** Right valve from the inside; **42.** Antenna (A2) from the outside; **43.** Terminal part of the antenna (A2) from the medial side; **44.–45.** Right and left prehensil hook; **46.–47.** Hemipenis.

**Figs. 48–49.** *Heterocypris fretensis* BRADY and ROBERTSON, 1870, female.

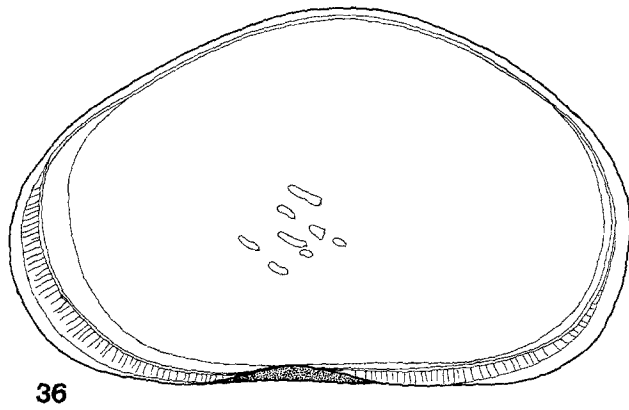
**48.** Left valve from the inside (Bogorodica near Gevgelija, Macedonia); **49.** Left valve from the inside (Taor near Skopje, Macedonia).

**Fig. 50.** *Heterocypris inequivalvis* BRONSTEIN, 1947, female.

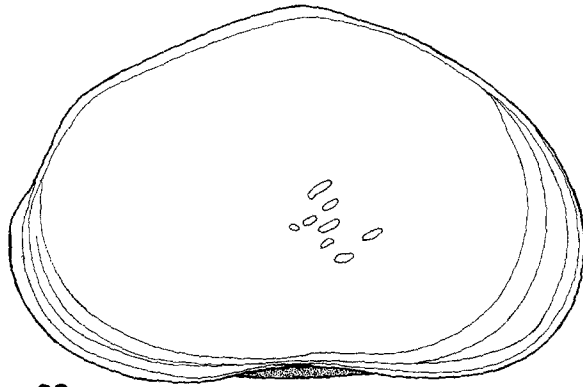
Left valve from the inside (Crnicino near Lake Dojran, Macedonia).

**Fig. 51.** *Heterocypris maura* MASI, 1932, female.

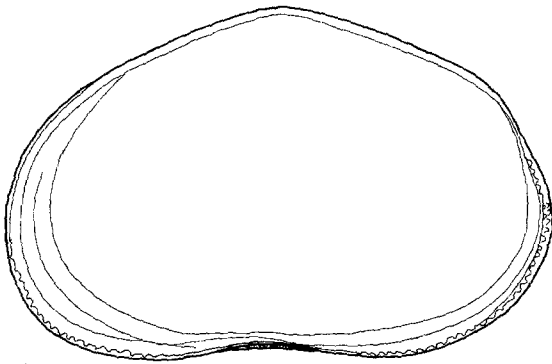
Left valve from the inside (Beluska near Weles, Macedonia).



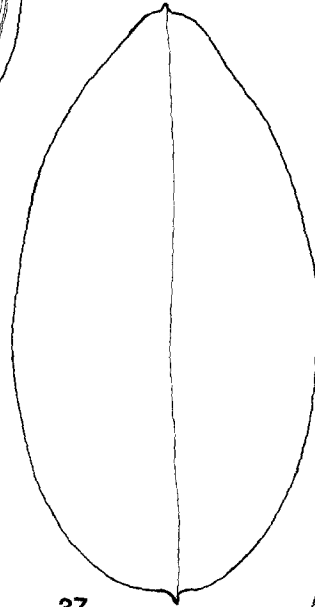
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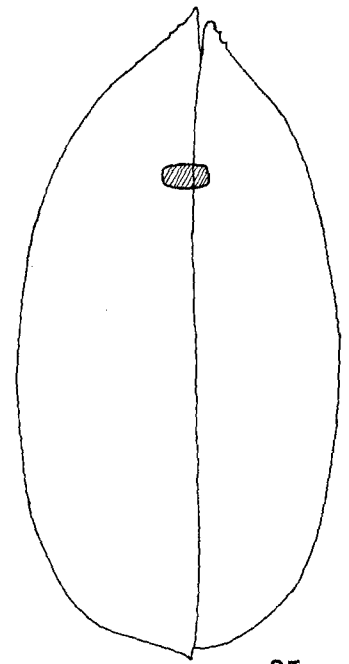
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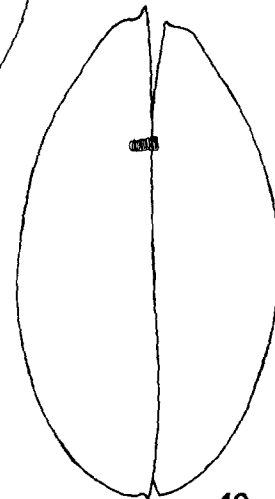
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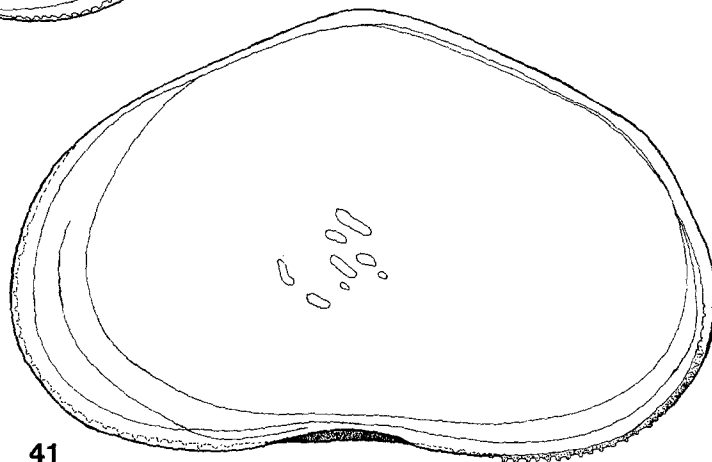
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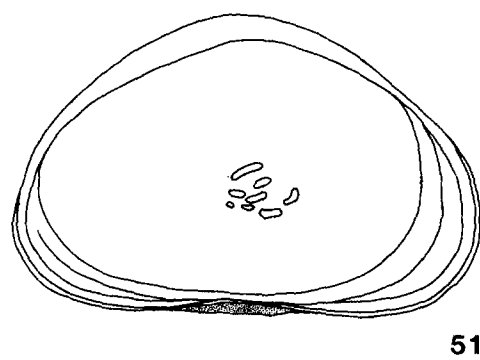
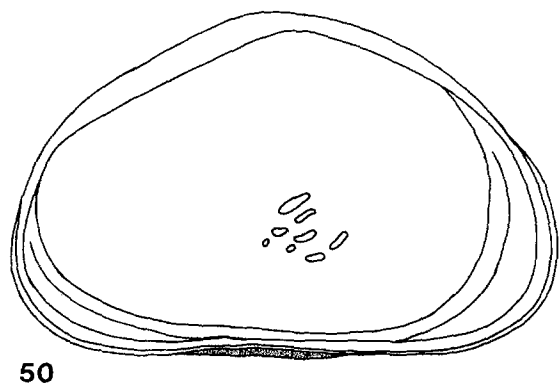
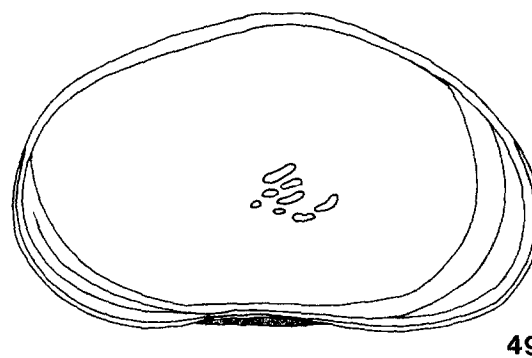
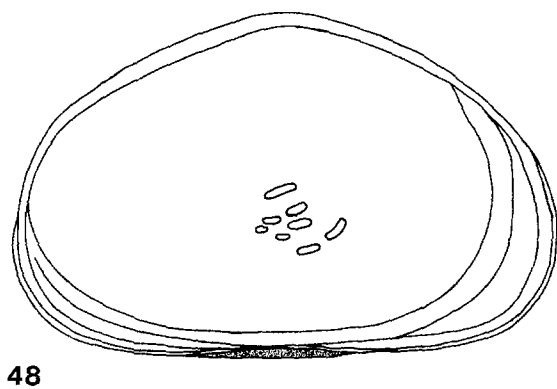
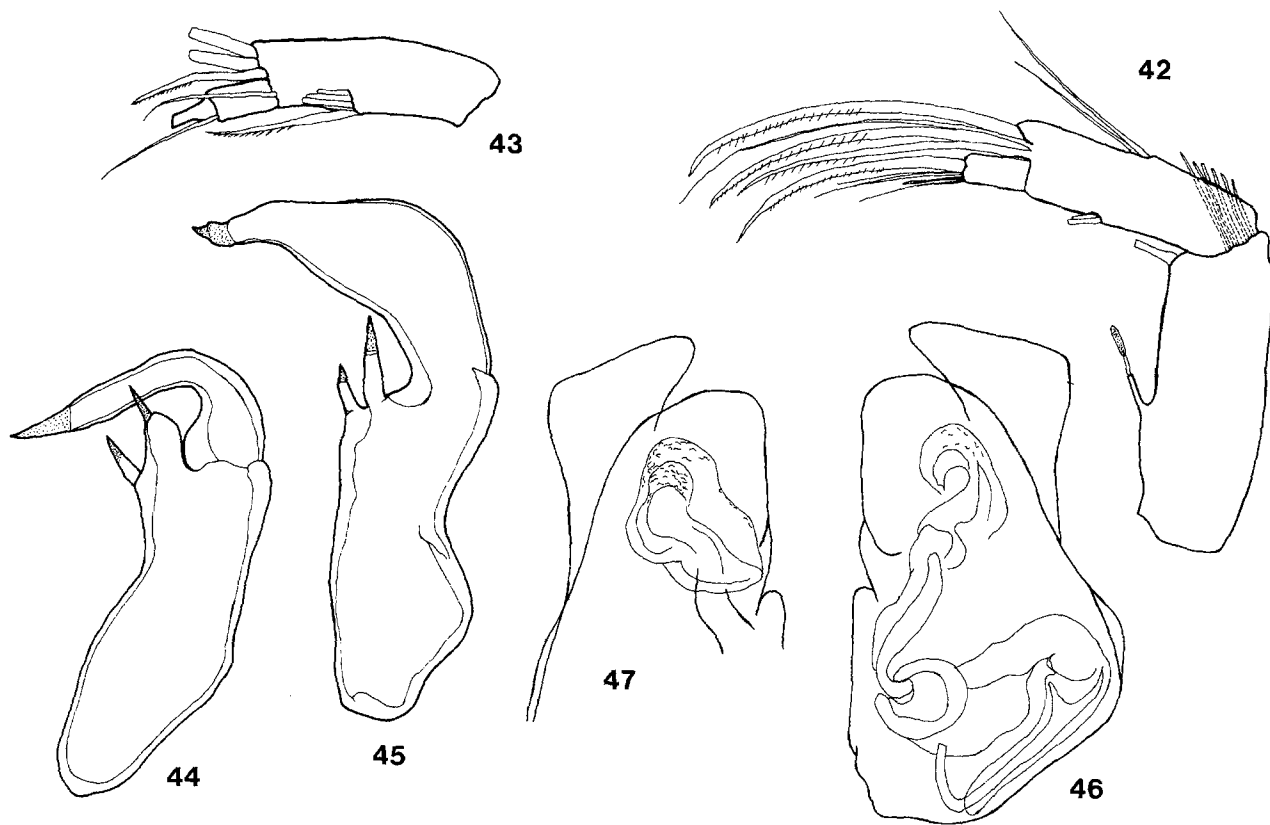
35



40



41



The left valve is up to 1.27 mm long. The dorsal margin is angulate in the middle of its length, where the valve reaches its maximal height of up to 0.79 mm. A hyaline lamella is bordering the whole free margin of the valve. At the rear end of the valve there is a very characteristic attachment, which is less developed in other forms.

The right valve has about 20 tubercles at the front edge and about 30 at the rear, of which some may merge into the selvage in the postero-dorsal area. Its maximal length is up to 1.23 mm and its maximal height up to 0.74 mm. The translucent seam and the tuberculate line at the rear end are displaced inwards.

• **Male:** The carapace is shaped roughly as in the female, just somewhat smaller. The left valve is also similarly shaped as that of the female. The maximal body length is up to 1.11 mm and the maximal height 0.66 mm. The right valve is about 0.99 mm long and about 0.59 mm high. The dorsal edge of this valve is clearly angulate, both flanks are almost straight, although the front flank is more steeply falling away. The rear flank merges into the broadly rounded rear edge after a clearly visible arch.

The swimming bristles of the second antenna exceed the tip of the terminal claw. The two big distal claws of the penultimate limb are long, whereas the third is very short. The z-bristle at the medial side is slim, whereas one of the z-bristles on the outside is claw-like and roughly as long as the two big claws of the penultimate limb, but significantly slimmer. The main claw of the terminal limb distally reaches the tips of the distal claws of the previous limb. The additional claw of the terminal limb is very slim; distally it exceeds half of the main claw.

#### Further taxonomical remarks

According to MEISCH & BROODBAKER (1993) *H. salina* settles in sublittoral and saline inland waters all over Europe and in the adjoining areas of Asia and N-Africa. This applies to the typical form with a body length of up to 1.30 mm and a maximal height of 0.80 mm. Its yellowish brown colour has darker laminations. The hyaline attachment at the back end of the left valve is widely sticking out. Some deviating forms, that cannot be clearly separated from *H. salina*, occur in different small water-bodies of Macedonia and certainly also in other regions of Europe. Three of these aberrant forms have already been described as independent species: *H. fretensis* BRADY and ROBERTSON, 1870 (Figs. 48, 49), *H. inequivalvis* BRONSTEIN, 1947 (Fig. 50) and *H. maura* MASI, 1932 (Fig. 51). Some authors regarded these species as to be only subspecies or even forms of *H. salina* (STEPHANIDES 1948; PETKOVSKI 1964; SYWULA 1974).

A short additional ecological characteristic is given:

The form known as *H. fretensis* (BRADY and ROBERTSON, 1870) often settles in Macedonia in small helocrene streams and periodic bogs. It is of a plain yellowish brown colour and slightly smaller than the typical *H. salina*. Its hyaline attach-

ment at the back is narrower. The main character of this form is the vaguely developed asymmetry of the valves.

In some helocrene streams, often of temporary nature, the form reported on from Russia as *H. inequivalvis* BRONSTEIN, 1947 can be found. This form is approximately as big as *H. fretensis*, with a similarly narrowly extended hyaline attachment. The main character of *H. inequivalvis* is the strongly asymmetrical valve and the slightly darker colour of the body.

Much more seldom we were able to find *H. maura* MASI, 1932. This form, known from Marrakech in N-Africa, was recollected by KLIE (1937b) at the Black Sea coast in Bulgaria. It is the smallest form of this group and also has asymmetrical valves, a plainly coloured body and a narrow hyaline attachment at the rear end of the left valve.

*Cyprinotus sobrianus* MASI (1932) from the Oasi di Kufra in N-Africa, also seems to belong to the relatives of *H. salina*.

PETKOVSKI (1964) reported *H. fretensis* as well as *H. maura* from Macedonia and pointed out the difficulties involved in distinguishing these forms. However, the taxonomical positions of all these forms remains unsolved. Only special morpho-genetical investigations could decisively help to find a solution.

### 3. General taxonomical position of the investigated species

The *Heterocypris*-species from the east-mediterranean faunal region can roughly be grouped into three classes of size, typical representatives of these classes are: *incongruens*, *reptans* and *exigua*.

1. *H. incongruens* (RAMDOHR, 1909) class: with a body length of more than 1.30 mm.

With a tuberculate right valve *H. incongruens* (RAMDOHR, 1909), *H. hartwigi* LINDNER, 1920, *H. barbara* (GAUTHIER and BREHM, 1928) and *H. erikae* PETKOVSKI and KEYSER, 1995.

With an untuberculate right valve *H. barbara inermis* (GAUTHIER, 1929), *H. vitrea* SYWULA, (Figs. 35, 36) 1968 and *H. persica* GHETTI, 1972.

2. *H. reptans* (KAUFMANN, 1900) class: with a body length of more than 1.10 mm.

• Oblong-ovale species without tubercles on the right valve: the coastal form *H. reptans* and its parthogenetic inland form *H. limbata* MASI, 1905;

• *Cyprinotus*-like forms with asymmetrical valves: *H. salina* (BRADY, 1862), *H. fretensis* BRADY and ROBERTSON, 1870 (Figs. 48–49), *H. inequivalvis* BRONSTEIN, 1947 (Fig. 50) and *H. maura* MASI, 1932 (Fig. 51);

• Ovale to oblong-ovale species with valves which, in frontal view, are displaced against each other: *H. rotundata* BORUTZKY, 1947 (Plate I, Figs. 8–10), *H. bulgarica* SYWULA, 1968 (Plate I, Figs. 4–7), and perhaps *H. dextrodepressus* (MORONI, 1961);

- With an untuberculate right valve and an elliptical carapace in dorsal view: *H. bosniaca* n. sp.

3. *H. exigua* GAUTHIER, 1928 class: with a body length of up to 1.10 mm: *H. turcica* SCHÄFER, 1952 and *H. gevgelica* n. sp. If the Turkish *H. sabirae* GÜLEN, 1985, really is a different species from *H. turcica*, it also has to be considered in this class.

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