

New records and redescriptions of three Cyprididae ostracods (Crustacea) from Turkey

by

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Abstract

Hemicypris vulgaris Okubo, 1990, *Stenocypris bolieki* Ferguson, 1962 and *Bradleystrandesia parva* (Hartmann, 1964) are reported from a tributary of the Gönen River (Balıkesir) in Turkey. *Hemicypris vulgaris* is reported for the first time from Turkey. The finding of *Bradleystrandesia parva* is especially important as its original description is brief and inadequate. This paper provides details of redetection of the three species and comments on their variability and possible cryptic speciation.

Key words: *Hemicypris*, *Stenocypris*, *Bradleystrandesia*, Gönen, taxonomy, biodiversity

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Introduction

Research on Turkish Ostracoda fauna started in the early twentieth century (Daday 1903), but there are still some areas with unknown Ostracoda diversity. According to the recently published check-list of non-marine Ostracoda of Turkey by Kulköylüoğlu et al. (2015), 143 freshwater Ostracoda species have been reported from Turkey so far. During the recent investigation of the Ostracoda fauna in Turkey, we have sampled the area around the Gönen River, located in northwest Anatolia. The sources of the river are in Mount Kaz (Ida) and its course runs through the Gönen County, with the estuary at the Sea of Marmara (Propontis) in Erdek Bay. The length of the main flow is 134 km, with the drainage area covering 2 147 km² (Kazancı et al. 1997). During our research, we have collected several Ostracoda species, but this paper presents only three of them belonging to the Cypridid genera *Hemicypris* Sars, 1903; *Stenocypris* Sars, 1889 and *Bradleystrandesia* Broodbakker, 1983.

The genus *Hemicypris* belongs to the subfamily Cyprinotinae Bronstein, 1947, and is characterized by the right/left valve overlap. Other characteristics include a partially tuberculate edge of the left valve, a slightly trapezoidal terminal segment of maxillula palp, only "b", "d" and both "a" setae present on the protopod of the fifth limb, the walking leg carries only "d1" seta on the basal segment. Sars (1903) believed that members of this genus are parthenogenetic, but subsequent descriptions by Klie (1938), Battish (1981)

and Victor and Fernando (1978) showed that several species have also bisexual as well as parthenogenetic populations. At present, this genus includes a number of species which deviate from the above-mentioned morphological diagnosis. For example, *Hemicypris mizunoi* Okubo, 1990 has tubercles on the edge of both valves. According to Savatentalinton and Martens (2008), this is an intermediate species between *Hemicypris* and *Heterocypris* Claus, 1892. In this paper, we contribute that overlapping of the right valve with the left valve in the whole free margin should not be generalized for all species of the genus, as in several species, such as *H. exigua* Broodbakker, 1983, *H. intermedia* (Lindroth, 1953) (redescription by Martens 1984), *H. malerkotlaensis* Battish, 1981, and also *H. vulgaris* Okubo, 1990, the overlapping is partial. *Hemicypris* occurs in South America, Africa, East and Southeast Asia and India (Karanovic 2012).

Stenocypris belongs to the tribe Stenocypridini Ferguson, 1964, one of the three tribes of the subfamily Herpetocypridinae Kaufmann, 1900. The most recent and complete diagnosis of this genus (Martens 2001) includes the following distinguishing characteristics: left/right valve overlap, the presence of marginal septa of various sizes, the rectangular terminal segment of maxillula palp, asymmetrical left and right uropodal rami without the posterior seta on either of them. So far 39 species have been described in this genus (Martens et al. 2013). It has a worldwide distribution, with the center of diversity in Africa and South Asia (Karanovic 2012). The first record of the

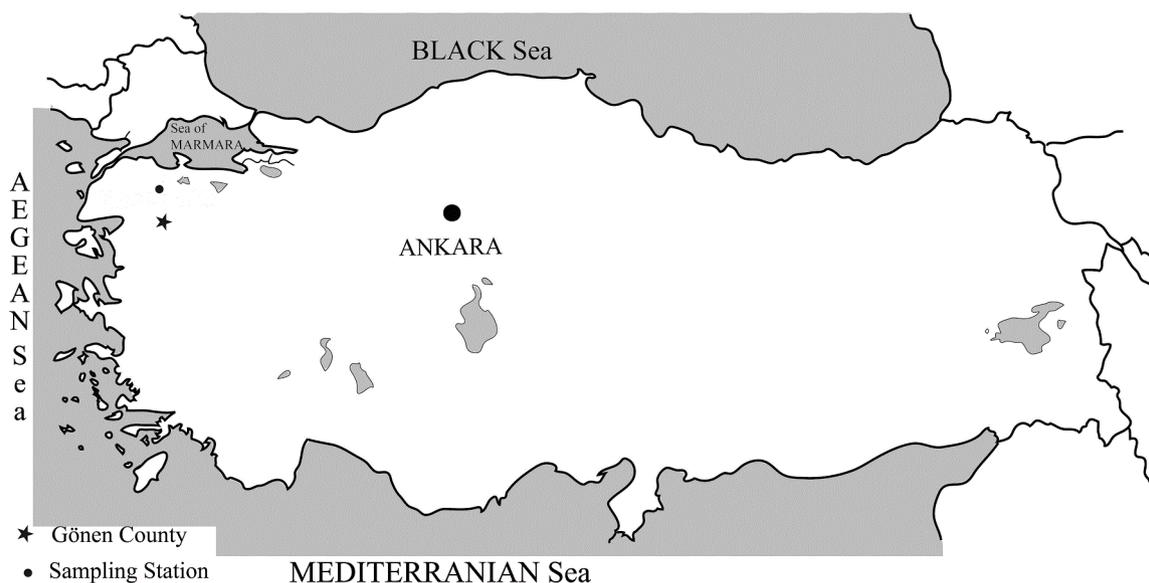


Figure 1

Location of the sampling station in Turkey

genus *Stenocypris* in Turkey referred to the description of *Stenocypris malcolmsoni lata* by Ghetti (1972) from Samsun. After that, Gülen (1977) and Altınsoğuk & Kubanç (1990) reported *S. malcolmsoni* Brady, 1886 from a hot-water spring in Günyüzü (Eskişehir) and Burhaniye (Balıkesir) regions. Today, these species are known as synonyms of *S. cylindrical major* Baird, 1859 (Martens & Savatnalinton 2011). Rasouli et al. (2014) recorded *Stenocypris* sp. from the Gönen River basin. The fifth record of this genus from Turkey is related to *S. bolieki* (Külköylüoğlu et al. 2015). The present redescription is based on the assessment of specimens from the Gönen River. The type locality of *S. bolieki* is Lake Munson in Florida.

Bradleystrandesia Broodbakker, 1983 belongs to the tribe Bradleystrandesiini Savatnalinton & Martens, 2009 of the subfamily Cypricerinae McKenzie, 1971. According to Savatnalinton & Martens (2009), the presence of Triebel's loop on the dorsal branch of the distal part of the uropodal attachment is the most important generic characteristic of *Bradleystrandesia*. Other prominent features include: the elliptical carapace in lateral view, the oval shape in dorsal view, the calcified inner lamella with one list, the uropodal ramus armed with thin and weakly serrated claws, and in bisexual species: the elongated outer lobe of the hemipenis. The "f" seta on T2 longer, sometimes exceeds the end of the terminal segment. Among 23 species described so far, the most widely distributed species are *Bradleystrandesia fuscata* (Jurine, 1820) and *B. reticulata* (Zaddach, 1844) (Karanovic 2012). Although *Bradleystrandesia parva* (Hartmann, 1964) was considered the synonym of *Strandesia minuta* Klie, 1936 by Karanovic (2005), it is now a valid species, classified in a separate genus (Victor and Fernando 1979, 1981a). In addition to the first description from its type locality, Kanhery Caves on Salsette Island near Bombay (today Mumbai), Dumont et al. (1986) reported it from South Yemen and Rasouli et al. (2014) from a paddy field in Turkey. The present redescription is related and based on specimens collected during the last study.

Materials and methods

Samples were collected from two nearby localities, a spring (which is one of the Gönen River's tributaries)

and a rice field located in the same area, close to the spring in Balıkesir, Turkey (Fig. 1). Sampling was carried out in June 2011 with a zooplankton hand net (80 µm mesh size). The maximum depth of samplings was 20 cm in both habitats. In spring, samples were collected among the aquatic vegetation. After sorting at the laboratory of the Faculty of Fisheries, Ege University, under an Olympus stereo microscope (model SZ61), animals were preserved in 70% ethyl alcohol and deposited in the collection of the Benthology Museum of the Faculty of Fisheries of Ege University (Izmir, Turkey). The environmental factors such as pH, dissolved oxygen and oxygen saturation, temperature, salinity and electrical conductivity were measured by a WTW 330 pH meter, a WTW 330 oxygen meter and a YSI 30 SCT meter. Habitat information, species occurrence, and abundance are presented in Table 1.

SEM photographs were taken at the Royal Belgian Institute of Natural Sciences. Drawings of appendages were done using a Lapazz digital table in the Adobe Illustrator CS6 software. All collected specimens were females and redescription was done according to the morphology of both soft parts and shell.

Besides the newly collected material from Turkey, we have also examined the type collection of *Hemicypris ovata* Sars 1903, deposited in the Zoological Museum in Oslo (one Lectotype female dissected on one slide: F.12293a, and numerous specimens preserved in alcohol and labeled as syntypes: F12264).

Abbreviations used in the text, table and figures:

LV= left valve; RV= right valve; A1 = antennula; A2 = antenna; Md = mandibula; Mx1 = maxillula; T1 = first thoracopod; T2 = walking leg; T3 = cleaning leg; UR = uropodal ramus; W = maximum width of carapace; L = maximum length of carapace; H = maximum height of carapace; Ga = anterior claw of uropod; Gp = posterior claw of uropod; Sa = anterior seta of uropod; Sp = posterior seta of uropod; T = Temperature; S = Salinity; EC = Electrical Conductivity; DO = Dissolved Oxygen; %S = Dissolved Oxygen Saturation; Alt = Altitude; Hv = *Hemicypris vulgaris*; Sb = *Stenocypris bolieki*; Bp = *Bradleystrandesia parva*; Hr = *Heterocypris rotundata*; Hi = *H. incongruens*; Hs = *H. salina*.

Table 1

Physicochemical factors, coordinates and altitude of habitats with their species

Habitat	T (°C)	S (PSU)	EC (µS)	DO (mg l ⁻¹)	%S (%)	pH	Coordinate	Alt (m)	Species (Numbers)
Rice field	21.6	0.3	657	5.9	67	7.75	40°11'08"N	66	Hv (34), Sb (3), Bp (5), Hr (715)
Spring	18.2	0.2	370	8.6	94	8.11	27°31'15"E		Hv (38), Sb (3), Hr (58), Hi (2), Hs (8)

Results

Systematics

Class: Ostracoda Latreille, 1802
 Subclass: Podocopa Sars, 1866
 Order: Podocopida Sars, 1866
 Suborder: Cypridocopina Jones, 1901
 Superfamily: Cypridoidea Baird, 1845
 Family: Cyprididae Baird, 1845
 Subfamily: Cyprinotinae Bronstein, 1947
 Genus: *Hemicypris* Sars, 1903

Hemicypris vulgaris Okubo, 1990 (Figs 2-5)

Abbreviated diagnoses. Sub-rectangular in lateral view. Oval shape in dorsal view, anterior end beak-shaped, LV overlapping RV. Surface of carapace smooth with one row of pits on anterior end of LV. Swimming setae long, slightly exceeding tips of terminal claws. Terminal segment of Mx1 cylindrical, only one of teeth bristles on first endite serrated. Only d1 seta presents on basal segment of T2. Sa on UR equaling about 74% of Ga. Sa short, not reaching middle of Ga.

Redescription (female). Carapace yellowish with brown patches; fused eye visible through closed carapace. Surface of carapace smooth (Fig. 2A-E). Only few sparsely distributed pore canals with weak sensory setae present (Fig. 3D-E). Anterior end of LV ornamented with a row of relatively deep pits (Fig. 2C, D and Fig. 3F). These pits visible under a light microscope with 100× magnification. In dorsal view (Fig. 2A), RV overlapping LV anterior, posterior and ventral edges. Both anterior and posterior parts bluntly rounded. Posterior end wider than anterior one. General shape of carapace sub-rectangular with gently curved outline in lateral view. W/L ratio of carapace ca. 48%. In lateral view, dorsal edge of LV not straight, protruding at first quarter of L. In ventral view (Fig. 2B), RV protruding at middle of L. In lateral view from right side (Fig. 2E), partial RV/LV overlapping clearly visible (anteriorly and ventrally). Greatest H situated middle or slightly behind. H/L ca. 63% of L. Average L of carapace 1.13 mm (n = 14).

In lateral view, anterior margin of LV (Fig. 2E-F) rounded, posteroventral margin straight. Ventral margin concave in front of mid L. Ventral, anterior, posterior and anteroventral margin denticulate (Fig. 2G-H). Dorsal margin gently sloping down from point of greatest height toward posterior end, while steeply toward anterior end. RV (Fig. 3A-C) larger than LV.

A1 (Fig. 4A) 7-segmented. Basal segment bearing

2 long setae anteriorly and 1 shorter seta posteriorly. Second segment anteriorly with one short seta barely reaching middle of next segment and ventrally with Rome organ. Third segment longest of all with 2 anterodistal setae, longer one situated more proximally and about 2 times longer than next segment; shorter plumose seta located more distally, at most reaching distal end of following segment. Fourth segment with 4 distal setae; 2 situated anteriorly and being long; other 2 situated posteriorly and being much shorter; one of short setae plumose and half as long as other short seta. Fifth segment also with 4 distal setae; two situated anteriorly and being much longer than other two posterior setae. Sixth segment also with 4 long distal setae and "α" seta situated anterodistally, twice as long as next segment. Last segment with two long setae, one thick shorter seta and aesthetasc "ya" which is equal to length of terminal segment. L ratio between distal five segments is VII:VI:V:IV:III, 1:1.12:1.25:1.54:2.62.

A2 (Fig. 4B-C); protopodite with one long slim seta. Exopodite with one long plumose seta and 2 shorter smooth setae. First endopodal segment with 2-segmented aesthetasc "Y", and 5+1 swimming setae reaching tips of terminal claws or slightly beyond. Additionally, one plumose thick seta situated ventrodistally on this segment. It is about 1.5 times longer than penultimate segment. Undivided penultimate segment containing 4 "t", 3 "z" and one "y2" setae. Additionally, stout and serrated G1, G2 and G3 claws present on penultimate segment. G1 is longest claw, as long as first endopodal segment. G2 and G3 are equal and 90% of first endopodal segment. Terminal segment with strong and serrated GM, Gm claws, "g" and "y3" setae. GM longer than Gm, 70 and 64% of first endopodal segment, respectively.

Md-palp (Fig. 4D) 4-segmented. First segment with thin, simple "α"-seta, 2 strong setulate (S1 and S2) and one slim long seta. Three long (one being shorter than others) setae present dorsally on second segment. Same segment with setal group bearing 3+2 plumose setae, "β" seta, 3 longer setae and 1 medium-sized seta, all of which are heavily pappose. "β" seta is equal to "α" seta, Penultimate segment with a ring of setulae; same segment with 3 groups of setae situated distally from dorsal to ventral side. First group consist 4 subapical setae (two long, two shorter). Stout, plumose "γ" seta with 3 other setae present apically; last group contains one slim and one shorter spin-like setae. Terminal segment bearing five stiff claws. Exopod (not shown here) with 4 setae.

Mx1 (Fig. 4E); Branchial plate with approximately 21 + 3 setae. Palp 2-segmented. First segment with group of apical setae. Terminal segment trapezoidal

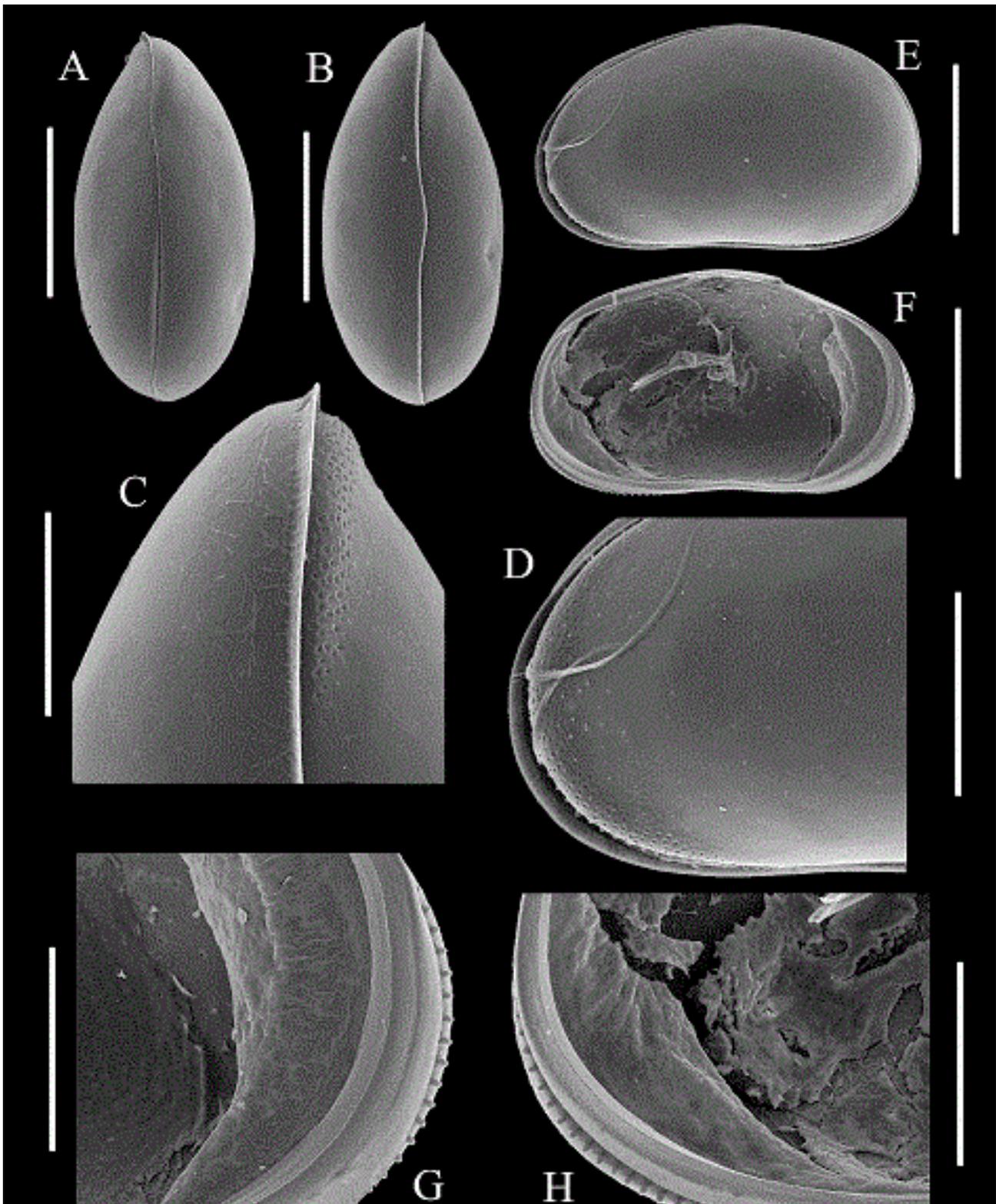


Figure 2

Hemicypris vulgaris Okubo, 1990 (Female). A: Dorsal view of carapace; B: Ventral view of carapace; C: Anterior part of carapace (ventral view); D-E: external view of the left valve (anterior – whole); F-H: Internal view of the left valve (whole – anterior – posterior) and part of the left valve; External view of the left valve. Scales (μm): A, B, E, F = 500; C, D, G, H = 200

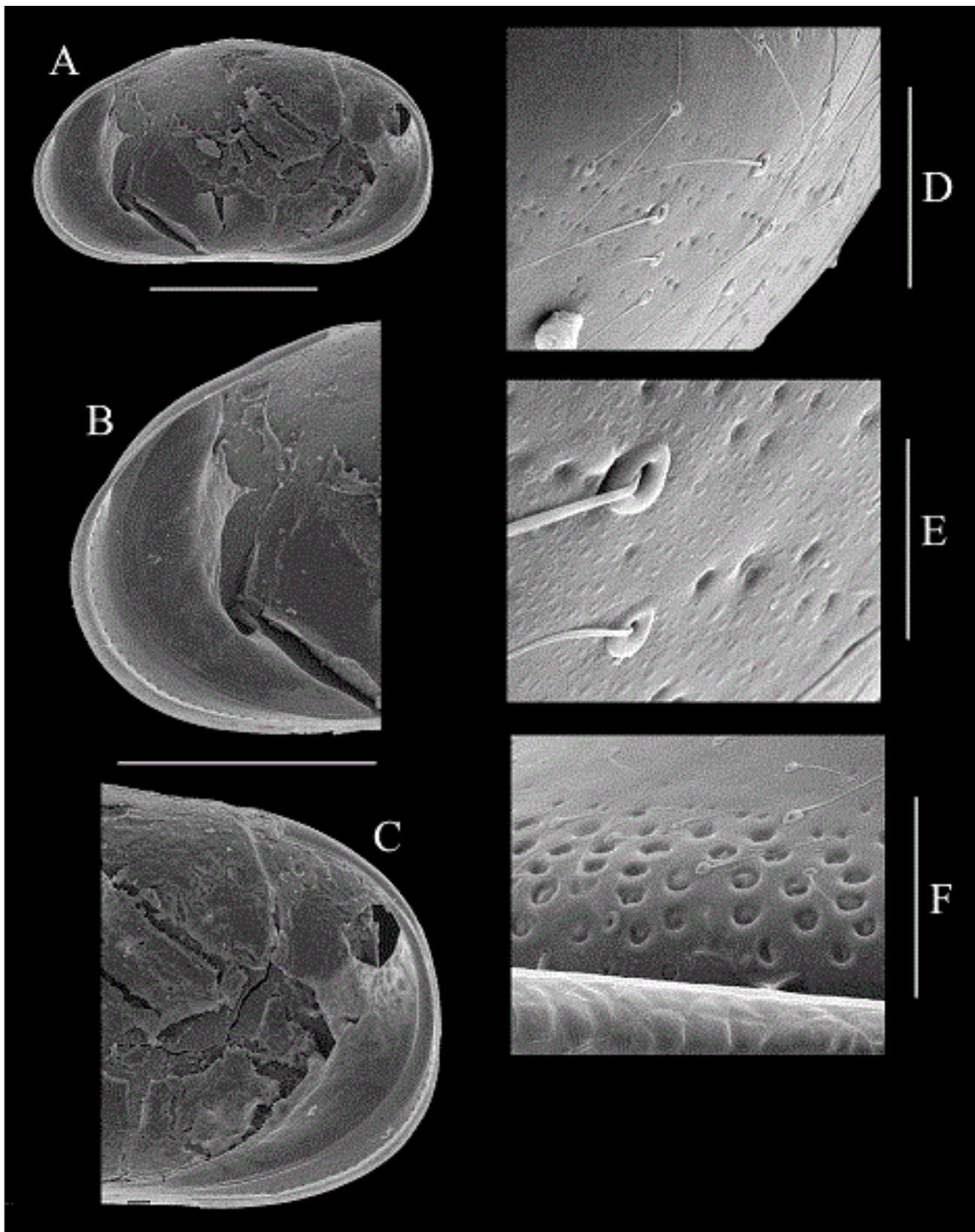


Figure 3

Hemicypris vulgaris Okubo, 1990 (Female). A-C: Interior view of the right valve (whole – anterior – posterior); D-E: Surface of carapace and pore canals; F: Pitted area of the anterior end of the left valve. Scales (μm): A = 500; B-C = 400; D-F = 40; E = 10

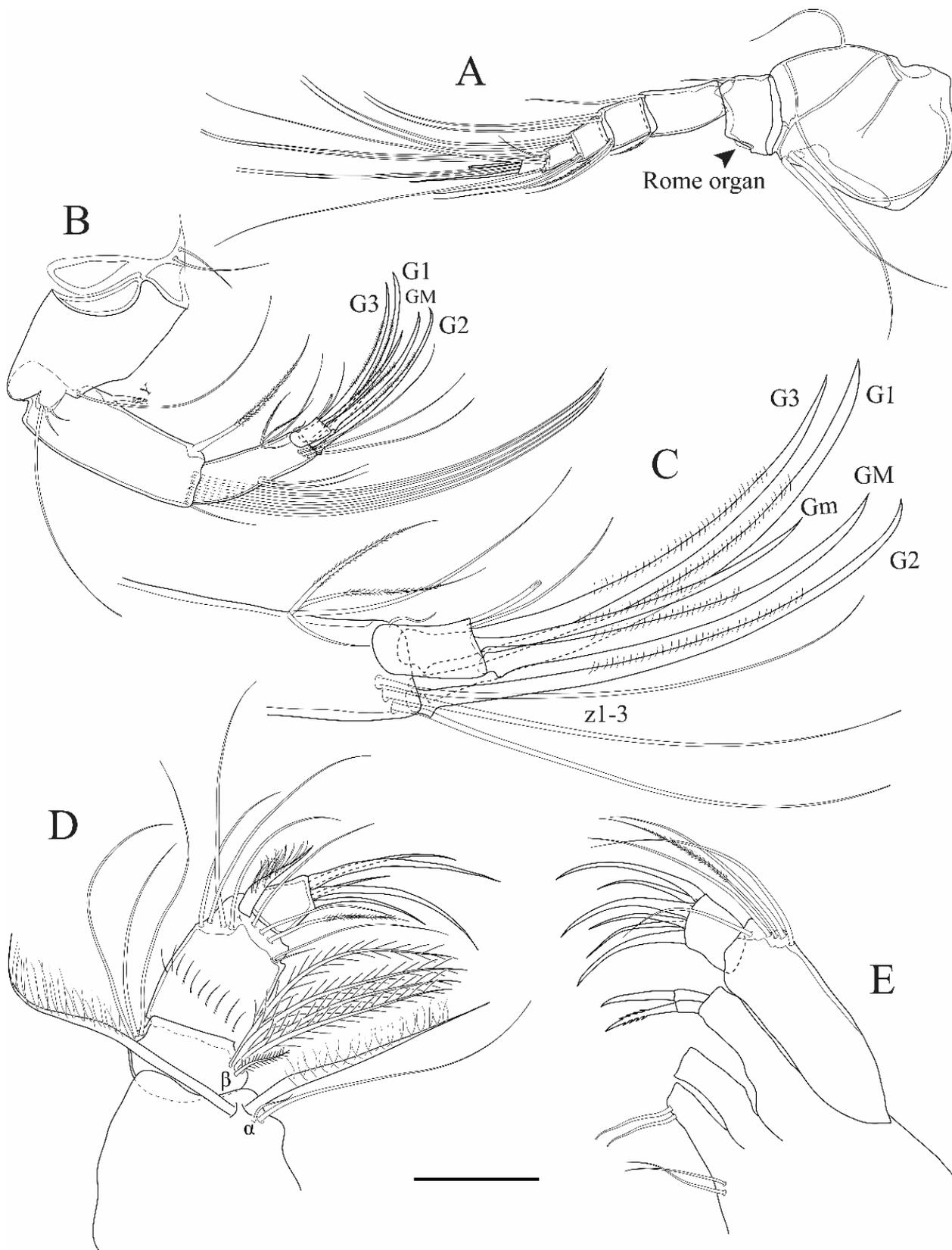


Figure 4

Hemicypris vulgaris Okubo, 1990 (Female). A: Antennula; B-C: Antenna (whole – last segments); D: Mandibula; E: Maxillula (other setae on endites omitted here). Scales (µm): A = 80; B = 110; C = 30; D-E = 140

(proximal margin 1.5 times longer than distal margin) with 2 claws and 4 relatively thick and subequal setae. First endite with 2 teeth bristles, one serrated, other smooth. Same endite with group of some weak and strong setae. Two smooth setae present proximally on first and third endite (not all setae on endites drawn in Fig. 4E).

Masticatory lobe of T1 with 8 plumose and 2 smooth apical setae, two short "a" setae, two plumose long "b" and "d" setae. Endopodite with three unequal setae. Vibratory plate with six rays (Fig. 5A).

T2 (Fig. 5B) 5-segmented (penultimate segment divided) with only "d1" seta on basal segment (d2 missing). Both second and third segments distally with one apical seta each (e and f), both as long as third segment). Fourth segment with hirsute seta (g). Terminal segment with setae "h1", "h3", and long serrated claw (h2). Claw being 85% of three distal segments' length.

T3 (Fig. 5C) 3-segmented terminally with pincer organ. Basal segment with "d1", "d2" and "dp" setae. First endopodal segment with one apical long, plumose seta (e). Following segment with single, plumose seta (f) inserted medially; this seta shorter than setae present on basal and first endopodal segments. Two curved short setae (h1, h2) and one long seta (h3) present on pincer organ.

UR (Fig. 5D) with both claws and both setae. Gp approximately 74% of Ga length. Sp shorter than Gp; Sa also shorter than Sp. Length ratio between anterior margin: Ga:Gp is 1:0.56:0.41.

Remarks and affinities

The genus *Hemicypris* contains 44 described extant species (Karanovic 2012, Al-Daamy 2010). Some of the species, such as *Hemicypris arorai* (Battish, 1981), *H. bhatiai* (Battish, 1981) and *H. gillensis* (Battish, 1981), were recently transferred to this genus from *Heterocypris* by Martens & Savatnalinton (2011). However, their checklist does not consent with the genus description by Sars (1903), because the left valve clearly overlaps the right one in all these species.

Hemicypris vulgaris is one of the most common species of this genus in the rice fields in Japan (Okubo 1990) and its finding in Turkey may be due to rice cultivation. Moreover, the existence of this species in the natural habitat (spring) probably results from the fact that the spring water is used for irrigation and drainage of the rice field (i.e. the first station).

Hemicypris ovata was originally described by Sars (1903) from Sumatra. Victor & Fernando (1981b) provided a detailed redescription of this species based on the type material and designated a lectotype.

Nevertheless, the shape of the carapace from dorsal view illustrated in their paper is slightly different from the one drawn by Sars (1903). Furthermore, the lateral view of LV (scanning electron microscope photograph) of *H. ovata* provided by Karanovic (2012) is also completely different and may represent a different species. Therefore, to ensure the accuracy and resolve ambiguities, we have decided to examine the type material from Sars' collection deposited in the Zoological Museum of Oslo. Unfortunately, all the specimens in the type series have strongly decalcified valves, so the present shape is distorted from the original state and we could only compare this species with the drawings provided by Sars (1903) and Victor & Fernando (1981b). *Hemicypris ovata* lacks the band of pits on the carapace, which are present anteriorly on LV of *H. vulgaris*. Furthermore, there are also slight differences between the shapes of the carapace – according to Sars (1903), the greatest H is situated more anteriorly and the dorsal margin is mostly straight. Another important characteristic is a clearly different UR (Fig. 5D). Although drawings of Sars (1903) and Victor & Fernando (1981b) show Sp slightly shorter than Gp, the examined material of *H. ovata* proved that Sp is longer than Gp. It may be a feature that varies a lot in this species but it is noteworthy that Sp in *H. vulgaris* is apparently shorter than Gp. Moreover, Sa in *H. ovata* reaches the middle of Ga, while in *H. vulgaris* it is much shorter and does not reach the middle of Ga (compare Fig. 5D and 5E). In *H. vulgaris*, only one of the teeth bristles on the Mxl endite is serrated, whereas in *H. ovata* – one has a strong teeth and the other one is serrated only on the distal part. This characteristic, however, needs to be considered with caution, because it was shown that the serration of these particular teeth may vary in some Cyprididae species, such as *Tonnacypris lutaria* (Koch, 1838) (see Meisch 2000). Although according to the redescription by Victor & Fernando (1981b), there are five plumose setae on the vibratory plate of T1, we can clearly observe six setae in the vibratory plate in the type material.

Hemicypris megalops Sars, 1903 in dorsal view has a symmetrical carapace and a straight ventral margin. However, posterior and anterior ends in *H. vulgaris* are asymmetrical (the posterior end is broader) and the ventral margin is concave.

Hemicypris vulgaris differs from *H. dentatmarginata* (Baird, 1859) as redescribed by Martens & Wouters (1985) in the shape of the carapace in lateral view. In *H. dentatmarginata*, the dorsal margins of both valves are evenly arched, hence the anterior and posterior ends are symmetrical. In addition, the ventral margin of both valves is straight or slightly concave, while the dorsal margin slopes in *H. vulgaris* are

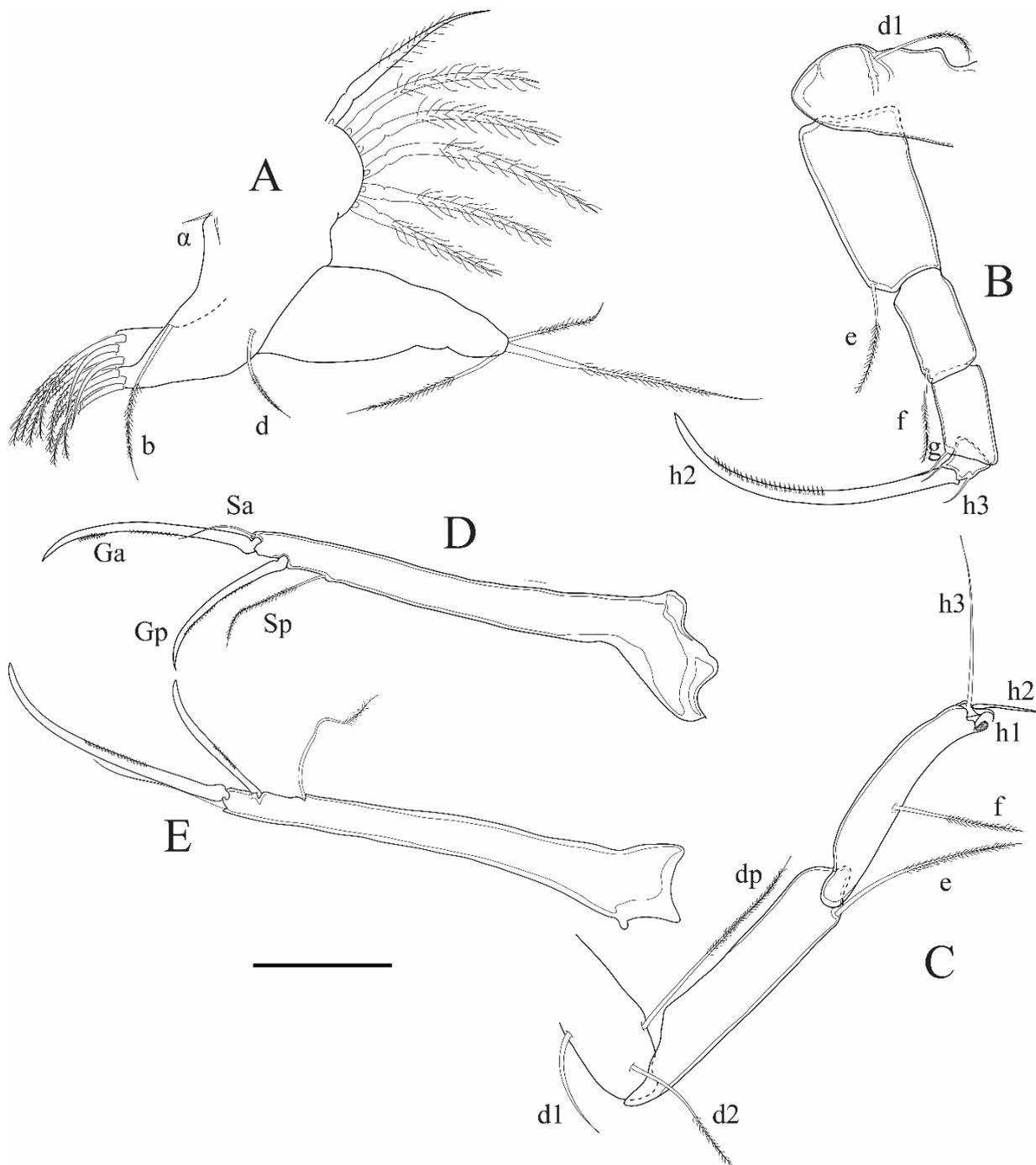


Figure 5

Hemicypris vulgaris Okubo, 1990 (Female). A: First thoracopod; B: Walking leg; C: Cleaning leg; C: Cleaning leg; D: Uropodal ramus; E: *Hemicypris ovata* Sars, 1903 (Female, Lectotype) uropodal ramus. Scales (µm): A-C = 140; D-E = 110

asymmetrical toward both the posterior and anterior ends, therefore, the anterior and posterior ends are asymmetrical in both valves (the posterior end is broader). Also, the concave part of the ventral margin is clearly visible (Fig. 2E-F and 3A). Another difference is that both teeth bristles on the first Mx1-endite of *H. dentatmarginata* are smooth (Martens & Wouters

1985), while in *H. vulgaris* one of them is serrated.

Although in lateral view, the valves of *H. vulgaris* appear similar to those of *H. malkotlaensis*, the carapace of the two species is different in dorsal view. Also, the carapace surface in *H. malkotlaensis* is more densely covered with setulae than in *H. vulgaris*. Both teeth bristles on the first endite of Mx1 of

H. malerkotlaensis are serrated, while in *H. vulgaris* one of them is smooth. The length of swimming setae on A2 can be another discriminant characteristic between these two species. *H. malerkotlaensis* has swimming setae exceeding the tips of terminal claws, while swimming setae on A2 of *H. vulgaris* reach just the tips of terminal claws.

Hemicypris reticulata has been described from a pool in Nanahua (Paraguay) by Klie (1930) and redescribed by Broodbakker (1983) from the West Indies. It differs from *H. vulgaris* in dorsal view; i.e. the point of the greatest W is clearly marked in *H. reticulata*, while lateral margins in *H. vulgaris* are gently rounded. Furthermore, the anterior end of the carapace is rounded in *H. reticulata*, and beak-shaped in *H. vulgaris*. According to Broodbakker's (1983) description, there is no concave part on the ventral margin of the valves.

Based on the outlines of the carapace in dorsal view, *H. vulgaris* resembles also *H. barbadensis* described from Barbados by Broodbakker (1983). Nevertheless, the surface of the shell in *H. barbadensis* is densely and uniformly punctate and hirsute, but in *H. vulgaris*, the surface is smooth and punctation is visible partially, only in a small area situated anteriorly on LV (Fig. 2 C-E).

The shape of *Hemicypris intermedia* carapace is very similar to that of *H. vulgaris*, but the posterior part of LV (in lateral view) is not as broad as in *H. vulgaris*.

Hemicypris anomala (Klie, 1938) and *H. exigua* are easily distinguishable from *H. vulgaris* by their distinctively arched dorsal margin of the carapace and a steeper slope toward the posterior and anterior ends (in lateral view).

Hemicypris irakensis has been recently described from Iraq (Al-Da'amy 2010) and zoogeographically represents the closest species to *H. vulgaris*. It can be distinguished from *H. vulgaris* based on the shell and the length of swimming setae on A2 – the shell of *H. irakensis* is oval in lateral view and its surface is densely covered with short setae and the swimming setae exceed tips of the terminal claws.

As mentioned previously, denticles are present on the edges of both valves in *H. mizunoi*, while they sit only on LV in *H. vulgaris*.

Subfamily: Herpetocypridinae Kaufmann 1900

Genus: *Stenocypris* Sars 1889

***Stenocypris bolieki* Ferguson 1962** (Figs 6-7)

Redescription (female). Carapace with light brown valves with soft body and fused eye visible through them. There are fine setae on carapace peripherally (not shown in Fig. 6 A-C). In dorsal view (Fig. 6A),

carapace elongated with gently convex outline. Anterior end not as broad as posterior one. L about 3 times of W (Ratio of W/L is 0.34). LV and RV symmetrical and both are bean-shaped. LV bigger than RV. There are peripheral septa all around the edge exception of dorsal margin. Septa in anterodorsal region distinctly longer than others. In lateral view (Fig. 6B, C) ventral margin has a dent in first half of length. Dorsal margin straight on top with a very slight slope toward posterior and anterior ends, however, anterior edge is broader than posterior end. Average L is about 1.62 mm (n = 6).

A1 (Fig. 6D) 7-segmented. Segments gradually become thinner toward tip of appendage. Basal segment with 2 long setae ventrally and 1 dorsally. Wouters organ not visible on first segment. Second segment with 1 small seta on dorsal margin and Rome organ on ventral margin. Third segment very long carrying two relatively short setae on both distal sides. Both fourth and fifth segments with 2 apical relatively long setae ventrally and 2 shorter apical setae dorsally. Sixth joint with four very long apical setae and "α" seta slightly exceeding tip of ultimate segment. Two long setae, aesthetasc "ya" and a shorter stout seta are present on ultimate segment. aesthetasc "ya" seta slightly shorter than stout seta.

A2 (Fig. 6E): Basal segment with one long seta and exopodite holding one long and two shorter setae. Two-segmented aesthetasc "Y", 5 + 1 swimming setae and a ventrodistally situated seta exist on second segment. Swimming setae long, reaching tip of terminal claws. Third segment with "t" and "z" setal groups, aesthetasc "y2", G1, G2 and G3 claws. G2 serrated and smaller than G1 and G3. Simple GM and serrated Gm claws present on ultimate segment.

Md-palp (Fig. 6F) 4-segmented. Except second segment, length of segments longer than width. First segment with one slim and relatively long "α" seta, one slim longer seta and two heavily plumose setae (S1 & S2). Second segment with 2 setal groups, dorsally situated group with 3 setae, ventral group with a relatively short plumose "β" seta and 4 long setae (one shorter and plumose). Third segment with 3 groups of setae, a group situated dorsally holding 4 relatively long setae, ventrodistally situated group with a long seta and a spine like seta, last group consisting 3 normal setae twice as long as ultimate segment and feathered "γ" seta. Terminal segment carries 5 claws.

Mx1 (Fig. 6G) with 2-segmented endopodite. First segment with a group of setae anterodistally. Terminal segment cylindrical, with length about 2 times of width, carrying 3 unequal smooth claws and 2 stout setae. First endite with 2 finely serrated teeth bristles. Third endite with 2 unequal setae ornamented by tiny

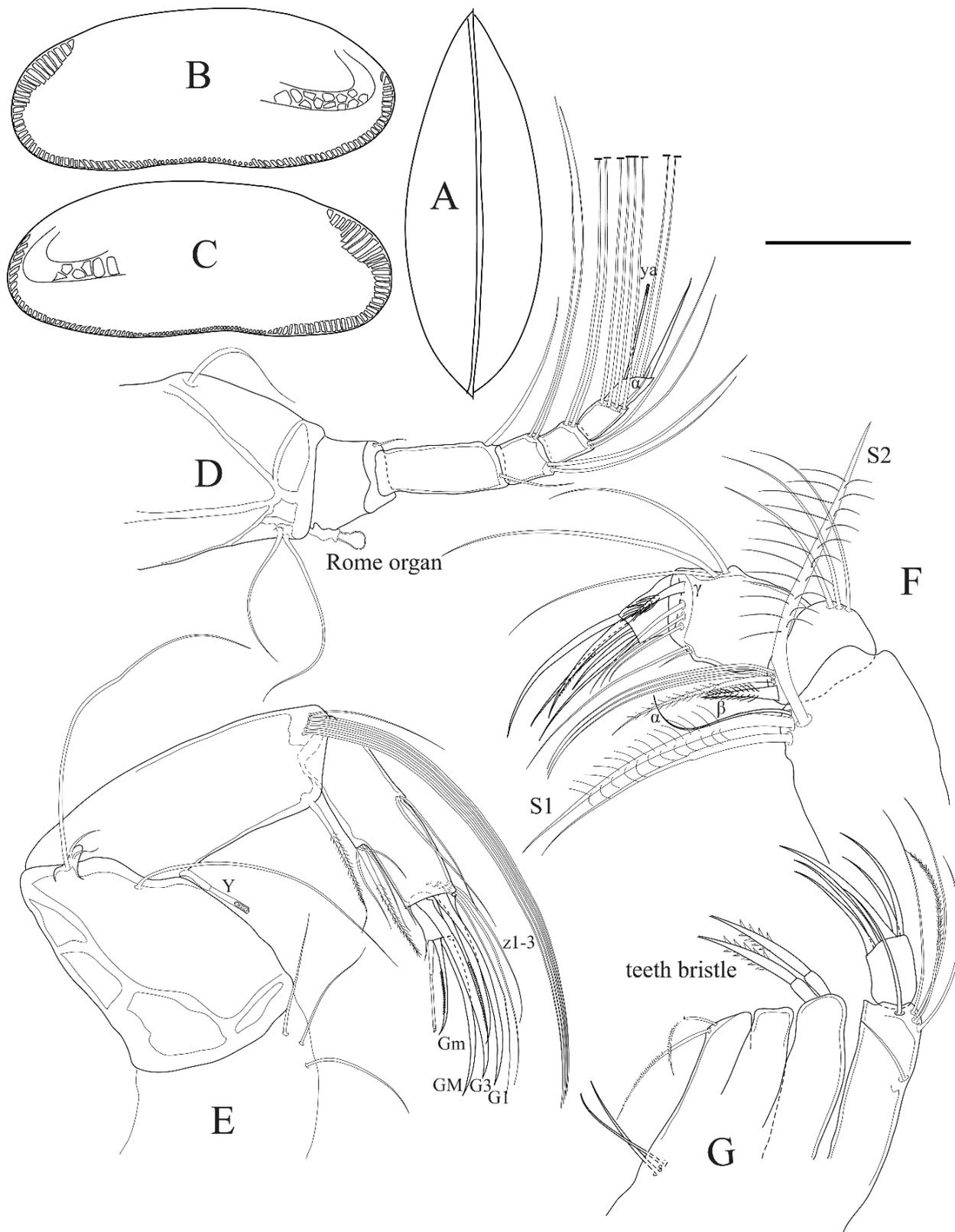


Figure 6

Stenocypris bolieki Ferguson, 1962 (Female). A: Left valve (outer side); B: Right valve (outer side); C: Dorsal view; D: Antennula; E: Antenna; F: Mandibula. G: Maxillula (other setae are omitted here). Scales (µm): A-C = 680; others: 68

serrates on outer corner. Three endites bear setae not shown here. Exopod with approximately 19 + 3 setae.

Protopodite of T1 with about 12 plumose setae on tip. Both "a" setae, as well "b" and "d" setae present. Endopodite with three normal setae. Exopodite with six rays on vibratory plate (Fig. 7A).

T2 (Fig. 7B) 5-segmented. Basal segment with both short "d1" and "d2" setae. Second segment with one plumose seta (e). "f" and "g" setae present on third and fourth segments, respectively. Ultimate segment with one stout serrated claw (h2) situated distally and 2 setae (h1 and h3). "h1" seta shorter than half of g-seta.

T3 (Fig. 7C) 3-segmented. Basal segment carrying three setae (d1, d2 and dp). "dp" seta very long, reaching distal end of second segment. Second segment with one seta (e). Third segment is a mono-block joint with one seta situated medially on segment (f). f-seta shorter than previous setae. Pincer organ comprises one straight seta (h3) equal with e-seta and two modified and curved setae (h1, h2).

Left and right UR asymmetrically developed. Both have attachment with triangular structure on proximal end. Distal end of this attachment branched simply (Fig. 7F).

Right UR (Fig. 7D). It is armed by a row of big spines on posterior margin. Sizes and numbers of these spines show differences in different individuals. Sp missing. Sa longer than half of Ga in length.

Left UR (Fig. 7E) has a cylindrical main body (somewhat thinner than right one), with some rows of barely visible tiny serration on posterior margin. Gp shorter than Ga. Both serrated roughly. Sp absent. Sa about half of Ga.

Remarks and affinities

Ferguson described two very similar species: *Stenocypris bolieki* from the USA (Ferguson, 1962) and *S. hislopi* from Asia (Ferguson, 1969). Later on, *S. hislopi* was reported several times from Asia (Victor & Fernando 1979; Kim & Min 1991; Smith et al. 2011, Chang et al. 2012), and the redescription was provided by Kim & Min (1991) on Korean specimens. According to this redescription, the ventral margin of the shell is straight, the teeth bristles on Mx1 are smooth, and the h3 seta on T2 is shorter than half of the terminal claw (h2). On the other hand, according to the original description, *S. bolieki* has a concave ventral margin, teeth bristles are finely serrated, and the h3 seta on T2 reaches the middle of the terminal claw.

It seems that *S. major* has many forms in its wide range of distribution. They were raised to the subspecies level by Petkovski & Meisch (1996), but this was later discarded by Martens (2001), who considers

the forms as the variability within *S. major*. Since *S. major* often occurs in rice paddies, it is possible that its wide distribution is a result of anthropogenic translocation with rice cultures. Martens (2001) also considered *S. bolieki* and *S. macedonica* Petkovski & Meisch, 1996 as synonyms of *S. intermedia* Klie, 1932. The author (op. cit.) also believes that *S. intermedia* may be a synonym of *S. major*. Klie (1932) did not provide any drawings of *S. malcolmsoni intermedia*, but he said that the species has swimming setae reaching only the middle of the penultimate segment, while setae in *S. major* reach the tip of terminal claws. Until such drastic variability is observed in one population or until molecular data prove that the two forms belong to the same species, we consider that not only *S. intermedia* is a valid species but also *S. bolieki* cannot be considered a synonym of *S. intermedia* because the swimming setae of the latter species are as long as those in *S. major*. There are indeed very few differences between *S. bolieki* and *S. major* and the most prominent one is the appearance of the marginal zone anterodorsally: it is much wider and sinusoidal in *S. bolieki* than in *S. major*. Although this was not noticed in our sample, we have to point out that this may be proven as an intraspecific variability as well. The genus *Stenocypris* should to be revised because, according to taxonomic descriptions, the marginal zone in a number of species does not carry the so-called septa, which is the main and the only difference between the genera *Stenocypris* and *Chrissia* Hartmann, 1957. Some examples include: *S. acuta* (Vávra, 1895), *S. bimucronata* Vávra, 1906, *S. damasi* (Kiss, 1959), *S. dybowski* Grochmalicki, 1913, *S. exsiccata* Vávra, 1897, etc. (see Vávra 1895; 1897; 1906; Grochmalicki, 1913; Kiss 1959).

Subfamily: Cypricerinae McKenzie 1971

Genus: *Bradleystrandesia* Broodbakker 1983

Bradleystrandesia parva (Hartmann 1964) (Figs 8-10)

Redescription (female). Carapace relatively hard and punctate. Surface covered with very fine setae and ornamented with color patterns. In dorsal view, close carapace (Fig. 8A) is ovate. Posterior end of carapace rounded, broader than anterior end. Valves are asymmetric; LV overlaps with RV entirely and exceeds both anteriorly and posteriorly. In lateral view of LV (Fig. 8B), dorsal margin unevenly angulate/arcuate and anterior end broader than posterior end. Ventral margin slightly straight with an extended lip-like zone in the first half. Average L 0.61 mm (n = 5).

A1 (Fig. 9A) 7-segmented. Basal segment with 3 unequal setae. Wouters organ not visible. Rome organ present ventrally on second segment along with a

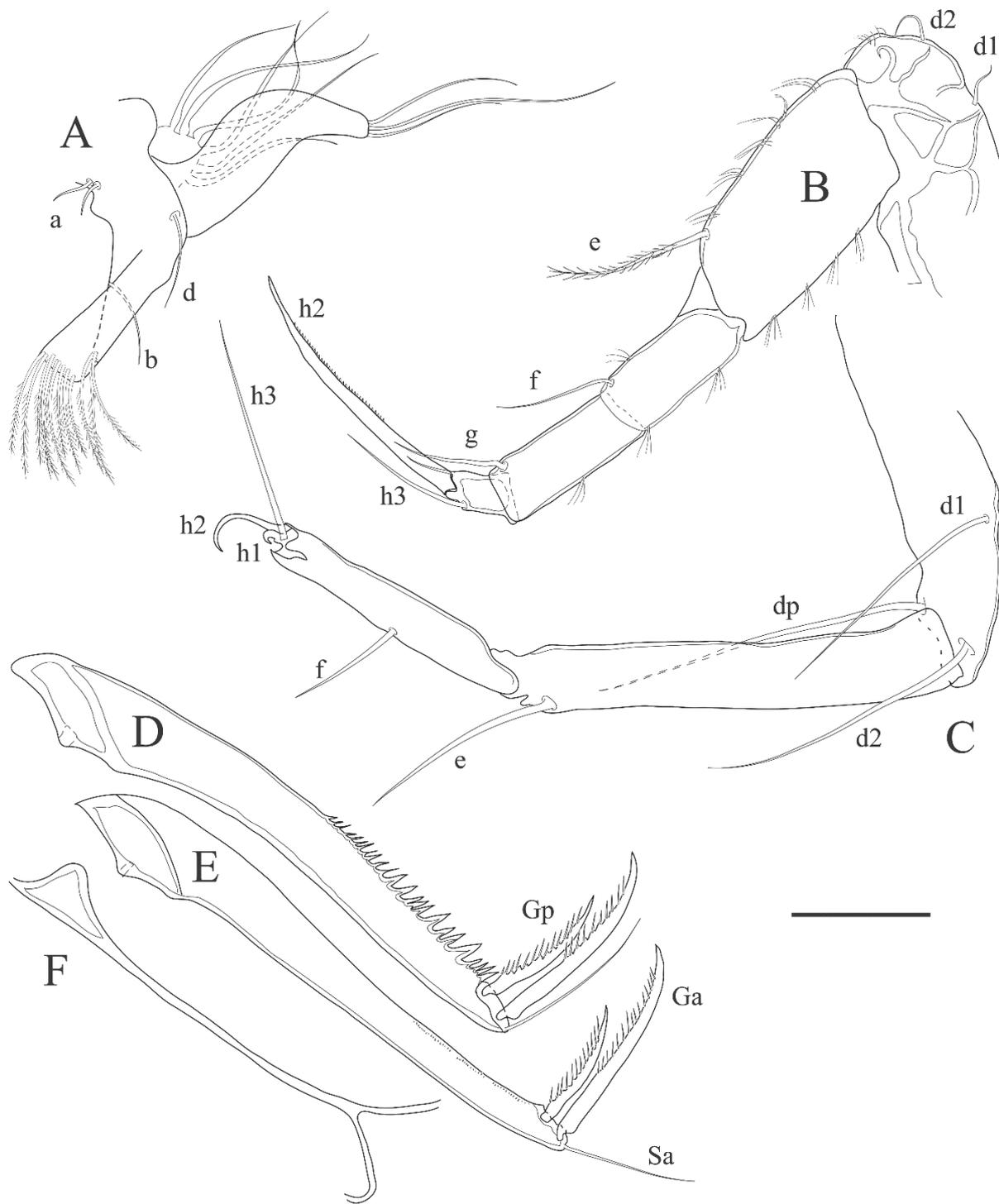
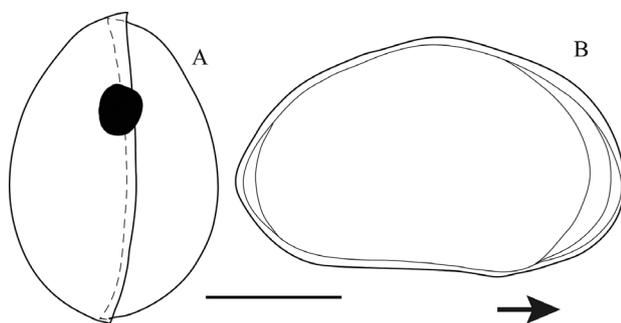


Figure 7

Stenocypris bolieki Ferguson, 1962 (Female). A: First thoracopod; B: Walking leg; C: Cleaning leg; D–E: Uropodal rami (left-right); F: Uropodal attachment. Scale: 68 μm

small apical seta dorsally (reaching up to middle of third segment). Third segment longest of all, carrying a relatively long apical seta dorsally and a shorter apical seta ventrally. Fourth segment ventrally bears

2 very long apical setae and dorsally 1 shorter apical seta. Chaetotaxy of fifth segment is similar to fourth one, dorsal seta of fifth segment is longer compared to previous one. Four setae on sixth segment are very

**Figure 8**

Bradlestrandesia parva (Hartmann, 1964) (Female).

A: Dorsal view of carapace; B: Internal view of the left valve. Scales (µm): A = 300; B = 250

long (longer than setae on ultimate segment). Besides 2 long apical setae on ultimate segment, aesthetasc "ya" and shorter stout seta present.

A2 (Fig. 9B): Basal segment with long setae and exopodite bearing 3 setae (one long, two shorter). Longest one is as long as second segment or slightly longer. Second segment with aesthetasc "Y" situated ventrally; plumose seta situated ventroapically and (5 + 1) swimming setae. Swimming setae are long reaching tip of terminal claws. Shorter swimming seta slightly longer than half of penultimate segment. "t" and "z" setal groups, "y2" seta as well as apical claws (G1, G2 and G3) present on penultimate segment. Apical claws are long, thin and serrated on tips. Ultimate segment holding serrated "GM", smooth "Gm" claws and aesthetasc "y3".

Md-palp (Fig. 9C) 4-segmented. First segment with a slim "α" seta, one slim longer seta and two heavily plumose setae (S1 & S2). Second segment with 2 groups of setae, one (3-setae) situated dorsally, another group comprises one shorter thick plumose "β" seta and 4 plumose setae (1 shorter). Third segment with 3 groups of setae, one situated dorsally holding 4 relatively long setae, ventrodistally situated long seta, last group consists 3 normal setae about twice as long as ultimate segment and feathered "γ" seta. Terminal segment carries 5 claws.

Palp of Mx1 2-segmented (Fig. 9D) with a group of setae on outer corner of basal segment. There is also a single seta medially reaching end of ultimate segment. Ultimate segment cylindrical with length of ca. 2 times width. Both teeth bristles on first endite serrated. Third endite carries two unequal serrated setae on outer corner. Vibratory plate with about 16 respiratory filaments.

T2 (Fig. 10A) 5-segmented (penultimate segment divided). d1 and d2 setae present on basal segment. d1 plumose and more than 2 times longer than d2. Second, third and fourth segments bear one subapical

seta (e, f and g, respectively). f-seta longer than others. Terminal segment holding a stout serrated claw (h2) accompanied by 2 small apical setae (h1 and h3). h3 shorter than h1.

T3 (Fig. 10B) 4-segmented. Basal segment with d1, d2 and dp setae. Second segment with apical seta (e) as long as d2 seta. Third segment bears f-seta medially. Pincer organ with a long seta (h3) and 2 modified curved shorter setae (h1 and h2).

UR (Fig. 10C) with a thin and long stem ornamented with a row of tiny serration on posterior surface carrying 2 setae and 2 claws. Sa, Sp and Gp are 59%, 16% and 62% of Ga, respectively. Triebel's loop oval, located on UR-attachment (dorsal branch of its distal part).

Remarks and affinities

There are some discrepancies between the specimens collected during our study and identified as *B. parva* and the original description by Hartmann (1964). According to Hartmann (1964), the carapace of *B. parva* in lateral view has more acutely arched anterodorsal margin and slightly broader lip-like extension on the anteroventral margin. Moreover, our type has a more massive eye visible through the carapace compared to the holotype.

Females of *B. trichurensis* (Victor et al., 1980) were collected from a paddy field in Chirackal, Trichur town, Kerala State, India. The carapace of this species is completely covered with fine setae. Moreover, there are 6 lateral spines and 2 dorsal pairs on the surface of the carapace. This kind of spines is not visible on the surface of *B. parva*. Similarly, *B. dani* (George and Martens, 1993) has a carapace that is entirely hirsute and is covered with some spine-like setae. Furthermore, Sp of UR in *B. dani* seems to be stout and hirsute, whereas the same seta in *B. parva* is simple.

According to Moniez (1892) and the illustration by Karanovic (2012), the carapace of *B. weberi* has spines on LV and RV.

Bradlestrandesia parva can be distinguished from *B. fuscata* (Jurine, 1820) and *B. reticulata* (Zaddach 1844), i.e. *B. fuscata* and *B. reticulata* have an elongated carapace in dorsal view, while *B. parva* has a globular carapace. In the types examined and drawn by Meisch (2000, see pp. 318 figures 134H-I), "Sa" is much shorter and does not reach the middle part of "Ga". As shown in Fig. 10C, "Sa" is about half the length of Ga. It should be emphasized that the setal length may prove unreliable as a taxonomic character, because UR is particularly prone to wear and tear as it protrudes from the carapace and comes into contact with a substrate (Smith, personal communications).

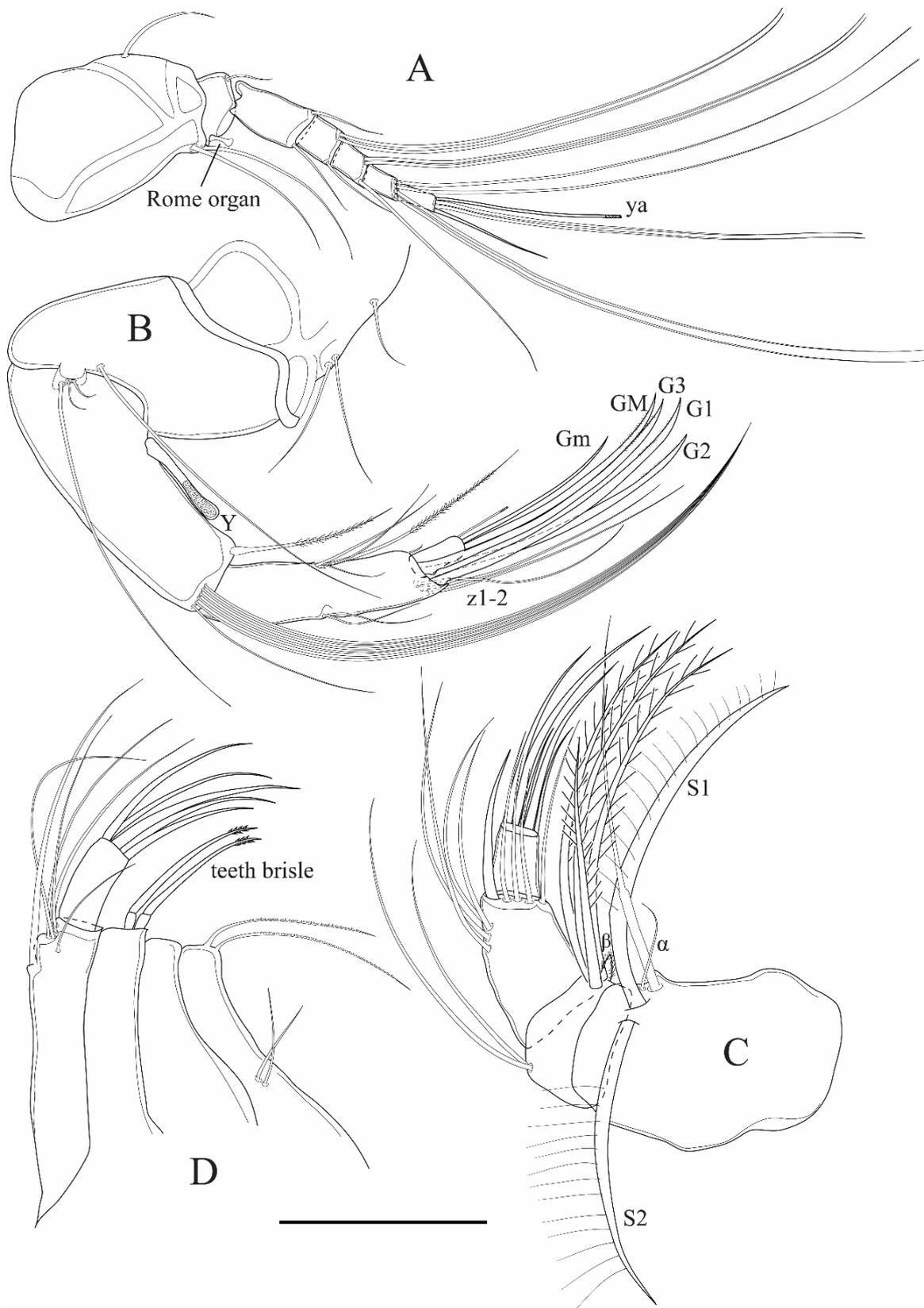
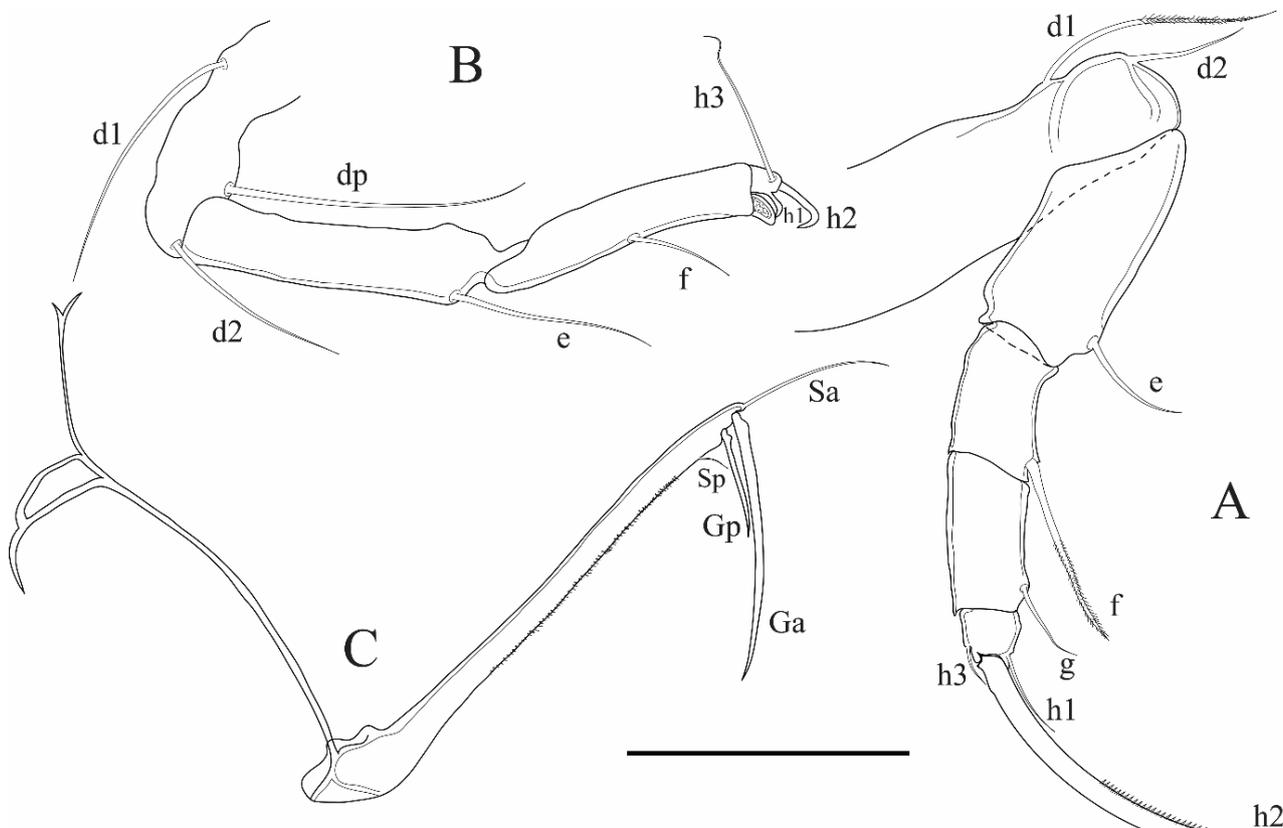


Figure 9

Bradleystrandesia parva (Hartmann, 1964) (Female). A: Antennula; B: Antenna C: Mandibula; D: Maxillula (other setae on endites are omitted here). Scales (μm): A-B = 52; C-D = 70

**Figure 10**

Bradleystrandesia parva (Hartmann, 1964) (Female). A: Walking leg; B: Cleaning leg; C: Uropodal ramus. Scales (μm): A = 52; B-C = 70

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