

Two interesting species of Candoninae (Crustacea, Ostracoda) from Montenegro (SE Europe)

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Abstract

Two interesting species of the subfamily Candoninae, collected in Skadar Valley (Montenegro), are here presented. *Pseudocandona prespica* (PETKOVSKI) comb. nov., originally described as *Candona parallela prespica* from Lake Prespa (Macedonia), is redescribed. This species opens a new *prespica*-group in the genus *Pseudocandona* KAUFMANN. A new species, *Eucandona forma* n. sp., was collected from a spring and forms the second species in the *balatonica*-group in the genus *Eucandona* DADAY.

Key words: *Pseudocandona*, *Eucandona*, Ostracoda, Taxonomy, Montenegro

Résumé

Deux espèces intéressantes de la sous-famille des Candoninae récoltées dans la vallée de Skadar (Monténégro) sont présentées. *Pseudocandona prespica* (PETKOVSKI) comb. nov., originalement décrite sous le nom de *Candona parallela prespica* du Lac Prespa (Macédoine), est redécrite et transférée dans le nouveau groupe *prespica* du genre *Pseudocandona* KAUFMANN. *Eucandona forma* sp. nov., récoltée dans une source, est décrite; l'espèce est placée dans le nouveau groupe *balatonica* du genre *Eucandona* DADAY.
Mots-clés: *Pseudocandona*, *Eucandona*, Ostracoda, Taxonomie, Monténégro.

Introduction

The subfamily Candoninae KAUFMANN presently comprises more than 300 living and fossil species, mainly distributed in the Holarctic (MEISCH, 1996). This is very heterogeneous subfamily both in morphological and ecological sense. The representatives of this subfamily colonize all types of ecosystems, from lakes to terrestrial environments. The subfamily is divided into two tribes (MARTENS, 1992) and comprises 16 genera (MEISCH, 1996). A strongly reduced furca is the main feature of the tribe Namibcypridini, which includes only two genera: *Namibcypris* MARTENS and *Danielocandona* BROODBAKKER. The tribe Candonini generally has well developed furcae, which are to some extent reduced in two genera (*Caribecandona* BROODBAKKER and *Indocandona* GUPTA), but not as drastically as in the Namibcypridini. Almost all genera of the tribe Candonini are divided into several

species groups. Such divisions are made on the basis of the carapace shape and/or mandibular chaetotaxy. Only the genus *Caribecandona* is divided into two species groups according to the morphology of A1, A2, T2, Fu etc. (BROODBAKKER, 1983). In the genus *Mixtacandona* KLIE, the five species groups are based on the carapace shape (DANIELOPOL, 1977). The last taxonomic revision of the genus *Pseudocandona* KAUFMANN (see MEISCH, 1996) retains five groups (*zchokkei*-, *eremita*-, *rostrata*-, *caribbeana*- and *compressa*-group), based on carapace shape and chaetotaxy of mandibular palp. In addition to this, a new *prespica*-group is proposed for the species *P. prespica* (PETKOVSKI), redescribed below. This species has 2+4 setae on the inner side of the second segment of mandibular palp and therefore cannot be allocated to any formerly known group of the genus *Pseudocandona*.

Two groups of the genus *Candona* BAIRD (*candida*- and *neglecta*-group) and three groups of the genus *Eucandona* DADAY (*acuminata*-, *fabaeformis*- and *balatonica*-group) are also all divided according to the number of setae on the inner side of the second segment of the mandibular palp. The genus *Eucandona* was recently re-established by PETKOVSKI & KARANOVIC (in press). For a long time, the name "*Eucandona*" was used only as a subgenus of the genus *Candona* by SYWULA (1974a). The group *balatonica* was also recently established (PETKOVSKI & KARANOVIC, in press), and until now, this group only contained the species *Eucandona balatonica* (DADAY). In the sample from Skadar Valley we have found the species *Eucandona forma* n. sp., which, like *Eucandona balatonica*, has 2+5 setae in the bunch of setae on the mandibular palp, so it constitutes the second species in the *balatonica*-group of the genus *Eucandona*.

Material and Methods

Samples were collected with a plankton net (mesh size 0.05 mm) and preserved by adding several drops of 36 % formaldehyde. The specimens were separated in 70 % ethyl alcohol and dissected in a mixture of distilled water and glycerol (1:1), with entomological needles. Dissected appendages and valves were examined with a Leica DMLS microscope with C-PLAN achromat objectives. All drawings were prepared using a camera lucida. Chaetotaxy

of the limbs follows the model proposed by BROODBAKKER & DANIELOPOL (1982), and revised for A2 by MARTENS (1987). Terminology for the anatomy of the hemipenis is used according to DANIELOPOL (1969).

Abbreviations used in text and figures: A1- antennula; A2- antenna; a- lateral lobe; b- medial lobe; e- bursa copulatrix; Fu- furca; g- part "M"; h- distal lobe (part "D"); L- length of valves; LV- left valve; Md palp- mandibular palp; Mx- maxilla; Mxl- maxillula; RV- right valve; T1- walking leg, T2- cleaning leg.

Taxonomic descriptions

Class Ostracoda LATREILLE
Order Podocopida SARS
Superfamily Cypridoidea BAIRD
Family Candonidae KAUFMANN
Subfamily Candoninae KAUFMANN

Genus *Pseudocandona* KAUFMANN, 1900

Pseudocandona prespica (PETKOVSKI, 1959) comb. nov.
(Figs 1-18)

SYNONYMY

Candona parallela prespica n. ssp. PETKOVSKI, 1959, pp. 62, Figs: 30-39.

MATERIAL EXAMINED

1. River Zeta in village Tunjevo, Skadar Valley, Montenegro, 01 May 1997, coll. I. KARANOVIC; 1 female (0486/e/4/22). Accompanying species: *Eucandona fabaeformis* (FISCHER) - 1 female, 2 juveniles; *Pseudocandona albicans* (BRADY) - 1 juvenile female; *Cyclocypris ovum* (JURINE) - 1 female; *Ilyocypris bradyi* SARS - 1 female.
2. Periodical stream in village Tunjevo, Skadar Valley, Montenegro, 01 May 1997, coll. I. KARANOVIC; 1 female and 1 juvenile male (7/0487/d). Accompanying species: *Eucandona fabaeformis* (FISCHER) - 4 females, 3 juveniles; *Pseudocandona pratensis* (HARTWIG) - 1 male; *Candonopsis kingsleii* (BRADY & ROBERTSON) - 6 females, 3 males, 1 juvenile; *Cypria lacustris* LILLJEBORG - 6 females, 4 males, 5 juveniles; *Cyclocypris ovum* (JURINE) - 25 females, 10 juveniles; *Potamocypris fulva* BRADY - 45 females.
3. Puddle in Ljesko Polje, Skadar Valley, Montenegro, 01 May 1997, coll. I. KARANOVIC; 1 male (0488/e/4/48). Accompanying species: *Pseudocandona pratensis* (HARTWIG) - 13 females, 11 males, 6 juveniles; *Cyclocypris ovum* (JURINE) - 17 females; *Heterocypris incongruens* (RAMDOHR) - 1 female, 63 juveniles; *Cypridopsis vidua* (MÜLLER) - 1 female, 5 juveniles.
4. Spring Veliko Oko in village Sotonici, Skadar Valley, Montenegro, 29 June 1997; coll. I. KARANOVIC; 1 male (0565/e/4/27). Accompanying species: *Cypria lacustris* LILLJEBORG - 3 males, 3 females, 2 juveniles; *Heterocypris*

reptans (KAUFMANN) - 1 female, 1 juvenile female; *Ilyocypris bradyi* SARS - 15 females, 8 juveniles.

Two males (0565/e/4/27; 0488/e/4/48) and one female (0486/e/4/22) are dissected and mounted on the slides in Faure's medium, while one female and one juvenile male (7/0487/d) are preserved in a glass test tube in 70 % ethyl alcohol. Specimens are deposited in the private collection of the author; 1 male specimen is deposited in the collections of the Royal Belgian Institute of Natural Sciences, Brussels (O.C. 2290).

DESCRIPTION OF MALE

Carapace (Figs 3-5). L of LV=0.807 mm; L of RV=0.79 mm. In dorsal view (Fig. 3) LV markedly overlaps RV both on anterior and posterior ends. Greatest width around the middle, about 33.9% of length. In lateral view (Figs 4-5) the shape of LV and RV nearly identical. Dorsal margin regularly arched. Greatest height lying at two third from the front, equal to 52% of length. Ventral margin slightly convex. Both anterior and posterior margins rounded, posterior more widely than anterior. Selvage peripheral. Width of marginal zones: anteriorly 12%, posteriorly 5% of the length. Marginal pore canals dense on the anterior and sparse on the posterior end. Colour brown-white. Valves with relatively dense and long setae. A1 (Fig. 17). Seven-segmented. First segment with 3 setae, second and third with 1 seta each, fourth, fifth and sixth segments with 3 setae each, seventh segment with two setae and aesthetasc (twice as long as terminal segment). Length ratios of 5 distal segments 1 : 1.4 : 1.4 : 1.9 : 1.9.

A2 (Fig. 14). Length of aesthetasc (Y) 42% of first endopodal segment. Penultimate segment divided. Length of male bristles (Fig. 15) equal to 85% of first endopodal segment. Claws G1 1.6, G3 1.4 and GM 1.3 times as long as first endopodal segment. Claw Gm 2.8, while G2 3.5 times as long as terminal segment. Only two short z-setae present.

Md-palp (Fig. 16). Second segment with 2+4 setae on the inner side. Outer seta on penultimate segment smooth. Mxl. Penultimate segment of endopodite with 4 plumose setae. Terminal segment with 2 claws and 4 setae.

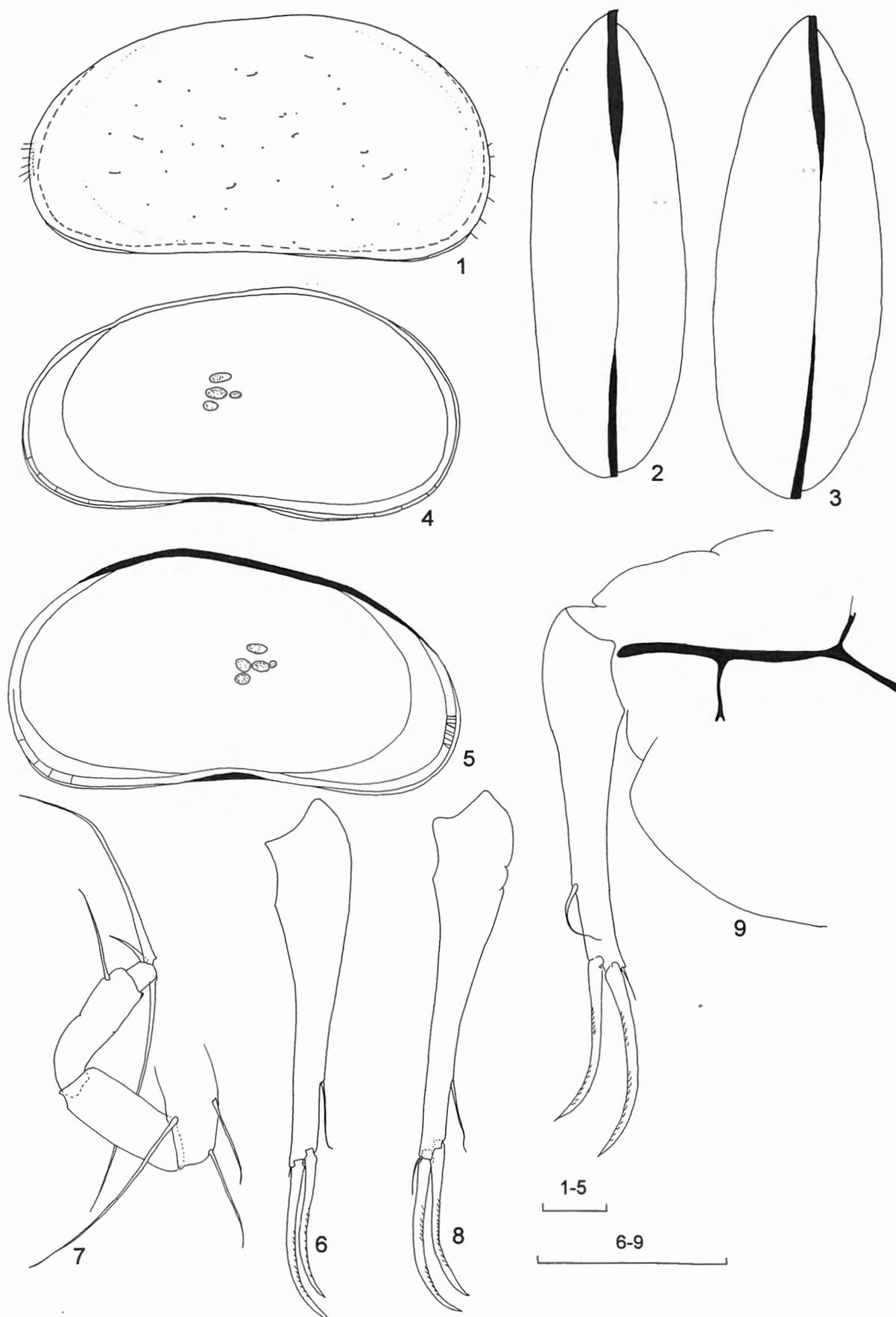
Mx (Figs 12-13). Prehensile palps asymmetrical. Left one more slender than right one.

T1 (Fig. 11). Basal segment with 1 seta. Terminal claw 1.35 times longer than three terminal segments combined. Claw not serrated.

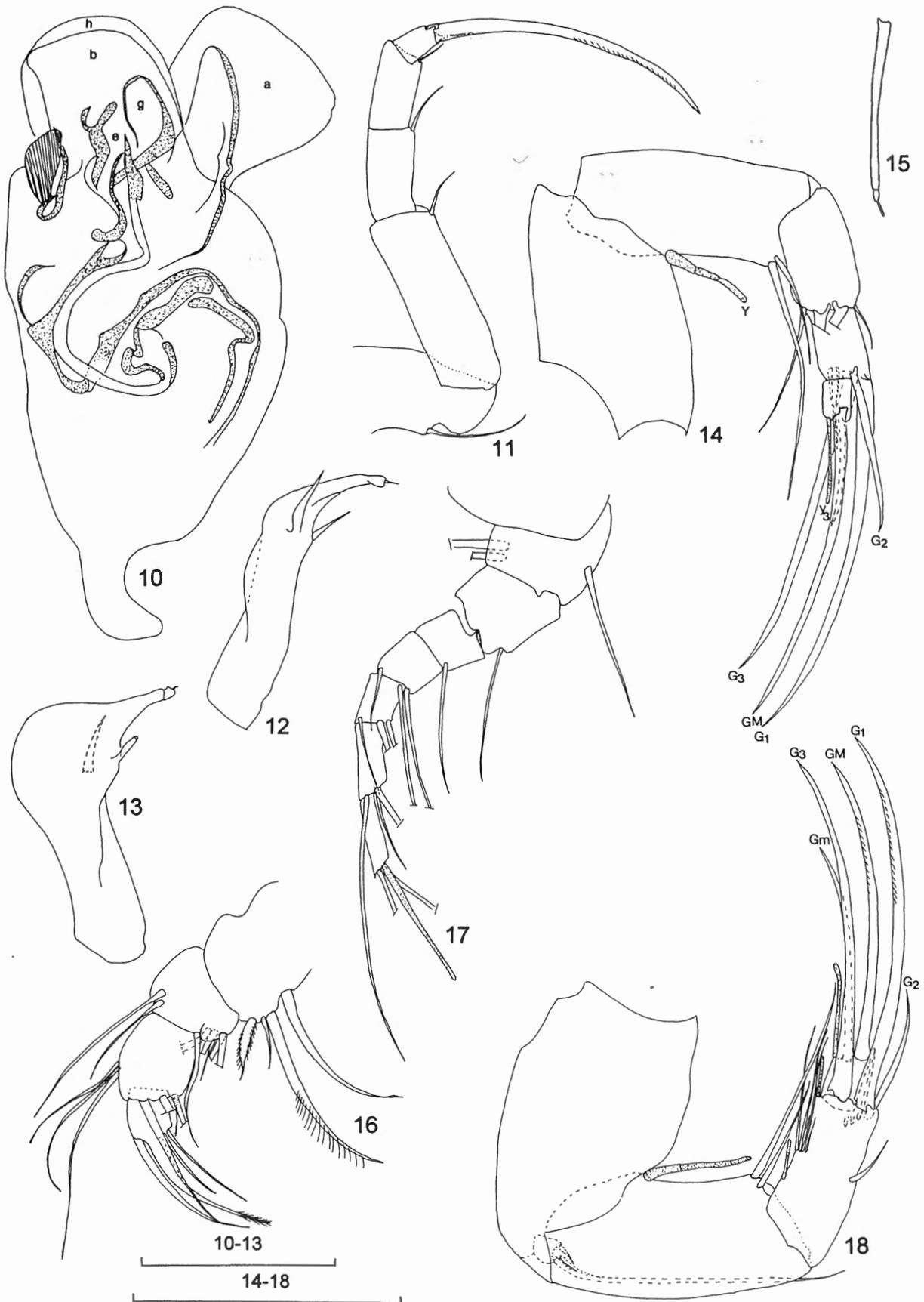
T2 (Fig. 7). Four-segmented. Basal segment with 3 setae. Penultimate segment not divided. Terminal segment with 3 setae, the shortest 1.5 times as long as terminal segment. Fu (Figs 6 and 8). Length ratios of anterior margin, anterior claw, and posterior claw 1.8 : 1.03 : 1. Length of anterior seta variable, between 24% (Fig. 8) or just 1% (Fig. 6) of that of anterior claw. Posterior seta 44% of anterior claw. Both setae smooth, claws serrated.

Zenker's organ with 7 whorls of spines.

Hemipenis (Fig. 10). Lobe "D" (h) rounded, medial lobe



Figs 1-9 – *Pseudocandona prespica* (PETKOVSKI, 1959). 1, 2, 9 female (L=0.77 mm); 3-7 male (L=0.807 mm); 8 male (L=0.729 mm): 1- carapace (general appearance from the left side); 2,3- carapace (dorsal view); 4- right valve (internal view), 5- left valve (internal view), 6- Fu, 7- T2; 8- Fu; 9- Fu with genital segment. Scales = 0.1 mm.



Figs 10-18 – *Pseudocandona prespica* (PETKOVSKI, 1959). 10-17 male (L=0.807 mm); 18 female (L=0.77 mm): 10- hemipenis; 11- T1; 12- left prehensile palp; 13- right prehensile palp; 14- A2; 15- male bristle; 16- Md-palp; 17- A1; 18- A2. a-lateral lobe; b-medial lobe; g- part “M”; e- bursa copulatrix; h- distal lobe. Scales = 0.1 mm.

(b) lower than lateral (a), somewhat both rectangular. "M" (g) - process flat and only weakly sclerotised.

DESCRIPTION OF FEMALE

Carapace (Figs 1-2). L of LV=0.77 mm, RV=0.74mm. Greatest height 51% of length. Greatest width 32.2% of length. Carapace with dorsal margin more evenly rounded than in the male. Marginal zone and line of concrescence as in male.

A2 (Fig. 18). Claw G2 twice, Gm 3.5 times as long as terminal segment. Claws G1 1.45, G3 1.4 and GM 1.2 times as long as first endopodal segment. All t-setae well-developed. One z seta somewhat stronger developed than the others. Claws slightly serrated.

Mx without special characteristics.

Fu (Fig. 9). Length ratios of anterior margin, anterior claw and posterior claw 1.5 : 1.13 : 1. Genital field (Fig. 9) without markedly appendages, widely rounded.

A1, Md-palp, T1 and T2 as in the male.

VARIABILITY

The L of males varies between 0.72 mm and 0.81 mm. The females from Macedonia (PETKOVSKI, 1959) have a more triangular carapace shape than females from Montenegro, while the shape of the carapace in the males from Macedonia and Montenegro is almost identical. There is slight variability in the shape of the male right prehensile palp: Montenegrin specimens have more rounded dorsal margin of that palp than Macedonian ones. Also, PETKOVSKI (1959) pointed out that the penultimate segment of the T2 is incompletely divided and in the drawings of PETKOVSKI (see p. 63, Fig. 39) there is slight division just on the one side of penultimate segment. Our specimens do not possess such division in that segment, but the intrusion of chitin on both sides of the penultimate segment (on the point of division) could be clearly noticed (Fig. 7).

ECOLOGY AND DISTRIBUTION

Until now, *Pseudocandona prespica* (PETKOVSKI) was found in a spring on the shore of Prespa Lake and in few localities in Skadar Valley (Montenegro). In Macedonia, the species was found only in one spring on the shore of Lake Prespa (Macedonia). In Montenegro, *Pseudocandona prespica* was found in a spring, a river, a puddle and a periodical stream. All samples contained 1 or 2 specimens only. The presence of ovigerous females and males with spermatozooids in May and June may suggest that this is spring-summer species.

REMARKS AND AFFINITIES

Pseudocandona prespica (PETKOVSKI) doubtlessly belongs to genus *Pseudocandona* KAUFMANN, because it has the following combination of characteristics: three setae on the basal segment of T2, respiratory plate of Mx with two filaments, "M" process of the hemipenis flat and weakly sclerotised, and outer seta of Md-palp smooth (DANIELOPOL, 1978; MEISCH, 1996). The genus *Pseudocandona* presently comprises about 75 extant species (MEISCH, 1996). However, some of these species are known from parthenogenetic populations only (so, the appearance of the hemipenis is unknown) and some are not properly described so that the number of seta on the basal segment of T2 remains unknown. Their generic allocation is therefore still doubtful.

Pseudocandona prespica, by the shape of carapace, is most similar to species that belong to the *compressa*- and *rostrata*-groups. The constant number of setae on the inner side of second segment of Md-palp in all groups suggests that this is an important supra-specific character. Therefore, a new *prespica* species-group for all the species that have only 2+4 setae is here formed. For now, *Pseudocandona prespica* is the only species in that group. KLIE (1938) considered that the *compressa* species-group possessed 2+4 or 2+5 setae in the bunch on Md-palp. The only species with 2+4 setae was *Pseudocandona albicans* (BRADY) (syn. *P. parallela*). Afterwards it was shown that *P. albicans* has 2+5 setae in the bunch. (SYWULA, 1974; MARTENS, 1982). Also, all specimens of *Pseudocandona albicans* in our samples from Montenegro have 2+5 setae. *Pseudocandona albicans* is more stocky than *P. prespica*, and does not have a triangular carapace shape. Also, *P. albicans* has a divided penultimate segment on the T2, and the shortest seta on the terminal segment is much longer than in *P. prespica*. The hemipenis is of the same type, while the right prehensile palp has a flatter dorsal margin than in *P. prespica*.

There are no other similar species in the *compressa*-group. *Pseudocandona prespica* is somewhat similar to the following species from the *rostrata*-group: *P. semicognita* (SCHÄFER), *P. hartwigi* (MÜLLER), *P. stagnalis* (SARS), *P. sarsi* (HARTWIG), *P. geratsi* BROODBAKKER and *P. antiliana* BROODBAKKER. In all of these species, the lateral lobe (a) of hemipenis is smaller than in *P. prespica* and all have 3+2 setae in the bunch of Md-palp. All these species, including *P. prespica*, have the shortest seta on the terminal segment of the T2 at the most twice as long as that segment (see SYWULA, 1974a; KLIE, 1938; BROODBAKKER, 1983) and have, except for *P. hartwigi* and *P. sarsi*, an undivided penultimate segment on the T2. *Pseudocandona geratsi* has a more evenly rounded dorsal margin than *P. prespica*, while *P. antiliana* has a trapezoidal shape. *Pseudocandona hartwigi* is more stocky in lateral view, while *P. semicognita* and *P. sarsi* have almost identical appearances, with more flattered dorsal margin than *P. prespica*. *Pseudocandona stagnalis* is very similar in appearance to *P. prespica*, but the shape of female's genital segment is completely different.

Genus *Eucandona* DADAY, 1900*Eucandona forma* sp. nov.
(Figs 19-41)

MATERIAL EXAMINED

Spring Malo Oko in the village Sotonici, Skadar Valley, Montenegro, 29 June 1997, collector I. KARANOVIC; 1 male - holotype (deposited in the collections of the Royal Belgian Institute of Natural Sciences, Brussels, O.C. 2289), 1 female - allotype (0566/b/4/36) and 16 juveniles-paratypes (5/0566/b). Accompanying species: *Pseudocandona albicans* (BRADY) - 2 females; *Candonopsis kingsleii* (BRADY & ROBERTSON) - 18 females, 3 males; *Ilyocypris bradyi* SARS - 1 female, 2 juveniles.

Holotype and allotype are dissected and mounted on the slides in Faure's medium, while paratypes are preserved in a glass test-tube in 70 % ethyl-alcohol. All specimens, with exception of the holotype, are deposited in the private collection of the author.

DESCRIPTION OF MALE (HOLOTYPE)

Carapace (Figs 22-24). L of LV=0.889 mm, RV=0.86 mm. In dorsal view (Fig. 24) LV slightly overlapping RV anteriorly and posteriorly. Greatest width situated around the middle, equal to 44% of L. LV with a slight lobe-like process. Shape of LV and RV in lateral view (Figs 22-23) nearly the same, subtriangular. Greatest height situated in the last third of L, equal to 52% of L. Dorsal margin inclined. Ventral margin slightly convex. Posterior margin clearly narrower than anterior. Width of marginal zones: anteriorly 13% and posteriorly 8% of the L. Selvage peripheral. Marginal pore canals dense anteriorly, sparse posteriorly. Surface densely covered with setae. Colour yellow-white.

A1 (Fig. 34). Seven-segmented. First segment with 3, second and third with 1, fourth and fifth with 3, sixth with 4 and terminal segment with 2 setae. Aesthetasc 1.5 times as long as terminal segment. Length ratios of 5 distal segments 1 : 1.3 : 1.4 : 2 : 1.7.

A2 (Fig. 36). Length of aesthetasc (Y) 36% of that of first endopodal segment. Penultimate segment divided; length of male bristles (t2, t3) (Fig. 37) equal to 70% of that of first endopodal segment. Claws G1 1.18, G3 1.06 and GM 0.9 times as long as first endopodal segment. G2 2.5 while Gm 2.3 times as long as terminal segment. Seta z1 claw-like and as long as G2, seta z3 stronger than z2, but both seta-like, aesthetasc y3 1.6 times as long as terminal segment.

Md-palp (Fig. 38). Second segment on the inner side with 2+5 setae. Outer seta on penultimate segment smooth.

Mxl. Penultimate segment of endopodite with 4 setae, terminal segment with 2 claws and 4 setae.

Mx (Figs 30-31). Palps slightly asymmetrical, left one more elongated than right one.

T1. Basal segment with one seta. Terminal claw 1.1 times

as long as three terminal segments combined. Claw not serrated.

T2 (Fig. 32). Basal segment with 2 setae. Penultimate segment divided. Terminal segment with 3 setae, the shortest one being 3.5 times longer than the terminal segment.

Fu (Fig. 35). Length ratios of anterior margin, anterior claw and posterior claw 2 : 1.26 : 1. Posterior seta, as long as anterior claw, length of anterior seta 23% of that of anterior claw. Claws serrated.

Zenker's organ with seven whorls of spines.

Hemipenis (Figs 25-29, 33) here described in erected condition (Fig. 25). Medial lobe (Fig. 26) rounded, lateral lobe (Fig. 27) squarish, distal lobe (Fig. 28) pointed, "M" process (Fig. 29) well sclerotized, bursa copulatrix (Fig. 33) foot-like.

DESCRIPTION OF FEMALE (ALLOTYPE)

Carapace (Figs 19-21). Almost without sexual dimorphism. LV=0.789 mm, RV=0.75 mm. The greatest width 41%, the greatest height 52% of L.

A2 (Fig. 41). All t-setae developed. Claws G1 1.24, G3 1.1 and GM 0.9 times as long as first endopodal segment. Claws G2 4.4 and Gm 3.1 times as long as terminal segment. One z seta more strongly developed than other two.

Mx (Fig. 40). Without special characteristics.

Fu (Fig. 39). Length ratios of anterior margin, anterior and posterior claw 1.6 : 1.15 : 1. Posterior seta very long (as long as anterior claw). Anterior seta 26% of anterior claw. Claws serrated.

Genital segment (Fig. 39). Rounded, without marked appendages, only with a few folds.

A1, Mxl, T1, T2 same as in male.

DERIVATION OF NAME

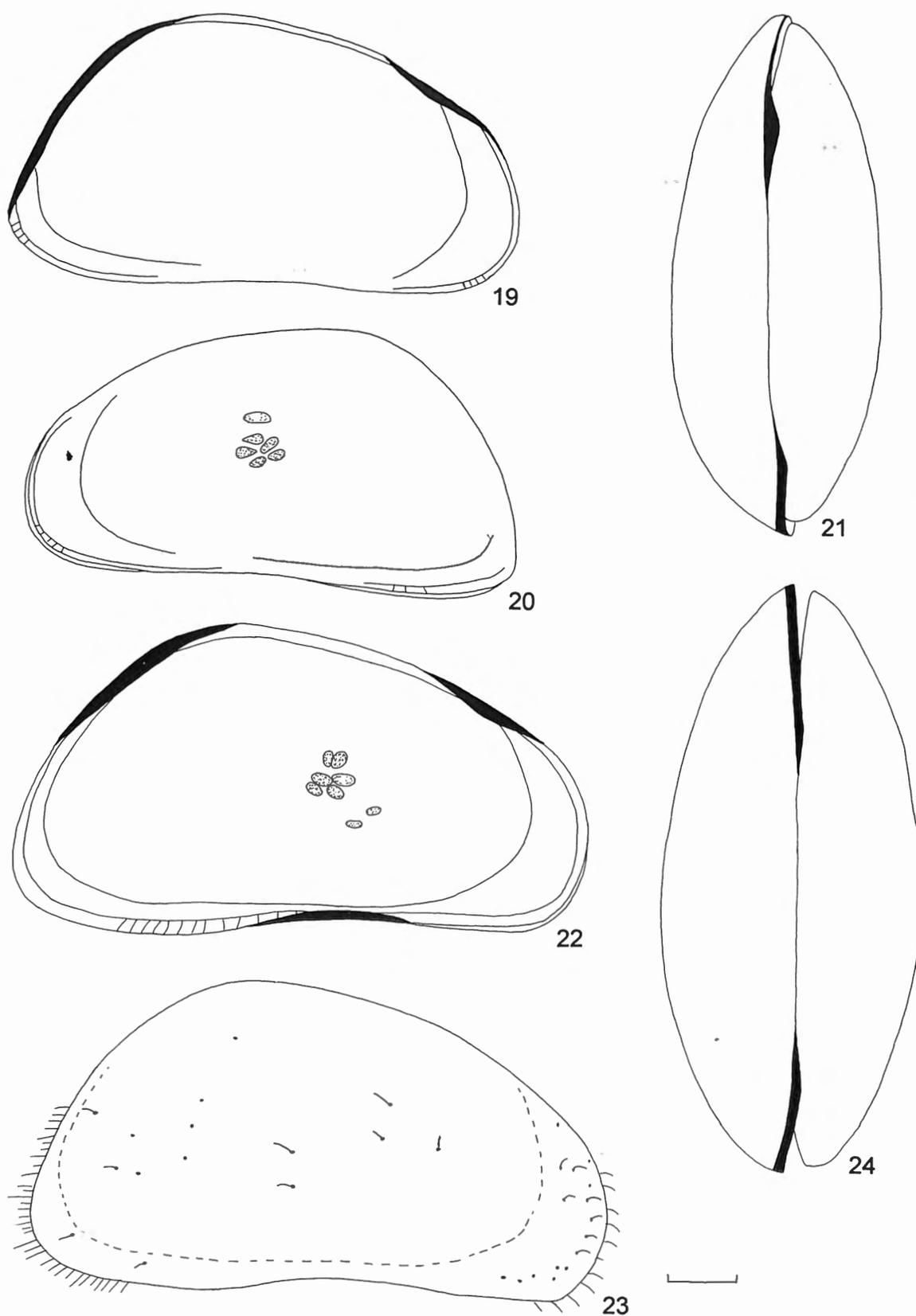
The species is named after the Latin noun *forma* (in the feminine gender)- which means the shape.

ECOLOGY

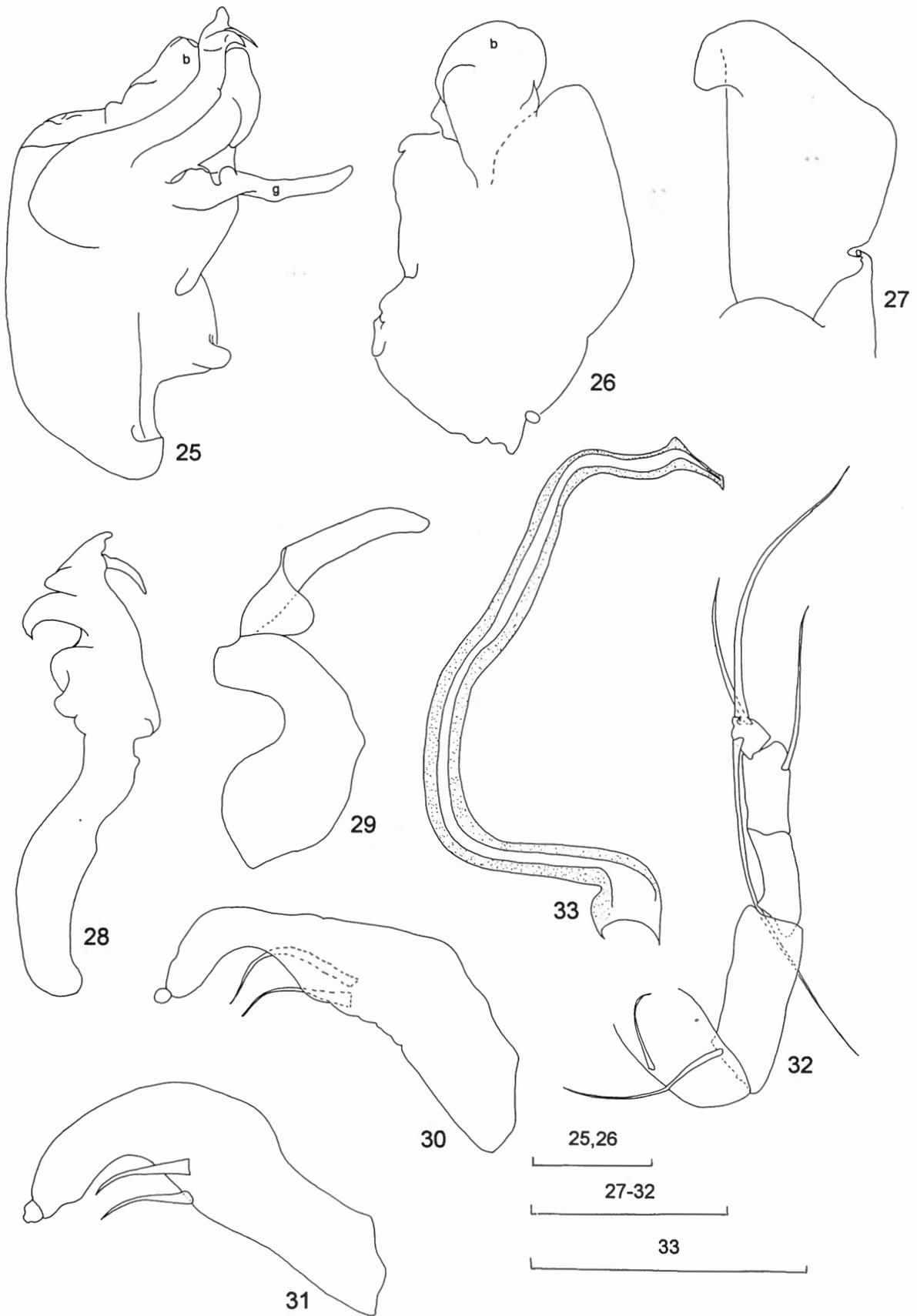
The great number of juveniles, suggests that *Eucandona forma* sp. nov. reproduced in spring-summer. Because the new species was found in one locality only, its ecology remains largely unknown.

REMARKS AND AFFINITIES

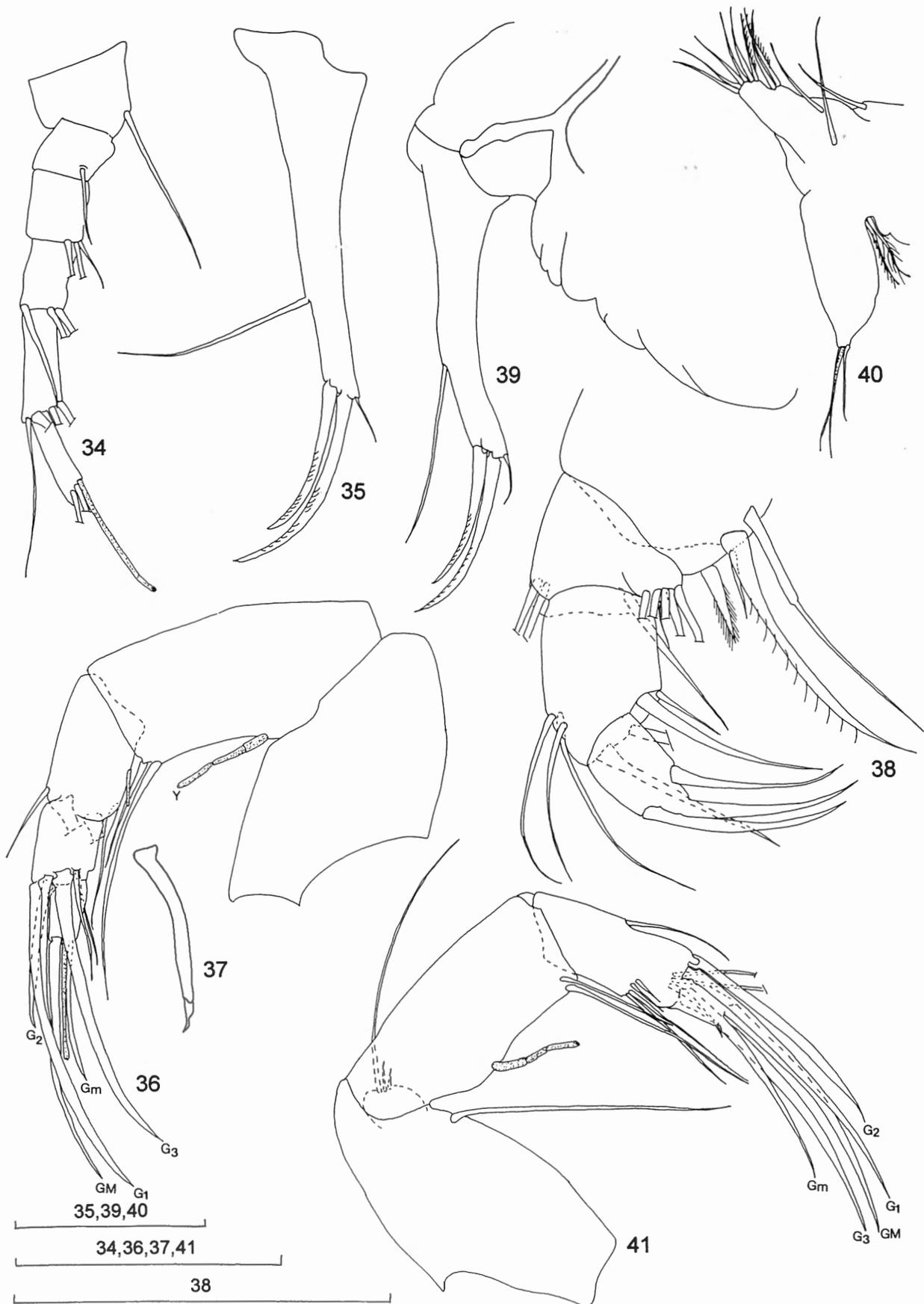
After re-establishing the genus *Eucandona* DADAY, and redescription of the rare species *Eucandona balatonica* DADAY (see PETKOVSKI & KARANOVIC, in press) it is now clear that this genus includes a great variety of species. According to MEISCH's (1996) diagnosis of the former



Figs 19-24 – *Eucandona forma* sp. nov. 19-21 allotype female (L=0.789 mm); 22-24 holotype male (L=0.889 mm): 19- left valve (internal view); 20- right valve (internal view); 21- carapace (dorsal view); 22- left valve (internal view); 23- right valve (external view); 24- carapace (dorsal view). Scale = 0.1 mm.



Figs 25-33 – *Eucandona forma* sp. nov. holotype male (L=0.889 mm): 25- hemipenis in erection, 26- hemipenis with medial lobe (b); 27- lateral lobe (a); 28- distal lobe (h); 29- part "M" (lobe g); 30- left prehensile palp; 31- right prehensile palp; 32- T2; 33- bursa copulatrix. Scales = 0.1 mm.



Figs. 34-41 – *Eucandona forma* sp. nov. 34-38 holotype male (L=0.889 mm); 39-41 allotype female (L= 0.789 mm): 34- A1; 35- Fu; 36- A2; 37- male bristle; 38- Md-palp; 39- Fu with genital segment; 40- Mx; 41- A2. Scales = 0.1 mm.

genus *Fabaeformiscandona* and the redescription of *Eucandona balatonica*, the genus *Eucandona* has the following characteristics:

1. carapace usually elongated, more rarely triangular in lateral view, usually laterally compressed, or rounded (*E. balatonica* and *E. forma*);
2. LV with a postero-dorsal lobe-like expansion which overlaps the RV. This structure may be absent (*E. balatonica*);
3. basal segment of T2 with 2 setae;
4. respiratory plate of Mx with 2 filaments;
5. outer seta on penultimate segment of Md-palp smooth and
6. M-process of hemipenis heavily sclerotized, with simple structure.

Three groups of species now exist in the genus *Eucandona*. All are defined by the number of setae on the inner side of the second segment of Md-palp: 1. *fabaeformis*-group (2+3); 2. *acuminata*-group (2+4) and 3. *balatonica*-group (2+5). The last group comprises only *E. balatonica* and *E. forma* sp. nov. The shape of the carapace of *E. forma* sp. nov. is similar to that of the female of *E. balatonica* (males have completely different appearance in the latter species), but the appearance of the genital segment and the hemipenis are different in these two species. Three further species with some similarities to *E. forma* sp. nov. are: *E. levanderi* (HIRSCHMANN); *E. hyalina* (BRADY & ROBERTSON) and *E. acuminata* (FISCHER). All these species belong to the *acuminata*-group, but they have a similar subtriangular form of the carapace and, except for *E. levanderi*, a similar appearance of the M-process of the hemipenis (see SYWULA, 1974a).

Eucandona levanderi and *E. hyalina* have different shapes of the prehensile palps, while *E. levanderi* also has a serrated postero-dorsal margin of the LV. *Eucandona acuminata* and *E. hyalina* have a more markedly developed postero-dorsal lobe-like process of the LV than *E. forma*. All three above-mentioned, species also possess a well-developed genital segment.

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