

Two new copepod species (Crustacea : Copepoda) from the Ohrid Lake

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Keywords: taxonomy, Copepoda, *Diacyclops*, *Bryocamptus*, Ohrid Lake.

Two new copepod species are described from Lake Ohrid (Balkan peninsula). *Diacyclops ichnusoides* n.sp. (Cyclopoida, Cyclopidae) collected from interstitial waters on the lake coast, and it belongs to the "*languidoides*"-group. *Bryocamptus* (*R.*) *mirus* n.sp. (Harpacticoida, Canthocamptidae) lives in deep water and belongs to the "*zschokkei*"-group. With this investigation, the copepod list in Lake Ohrid increases to 36 species, of which 6 are endemic.

Deux espèces nouvelles de Copépodes (Crustacea : Copepoda) du lac Ohrid

Mots clés: taxonomie, Copepoda, *Diacyclops*, *Bryocamptus*, lac Ohrid.

Deux espèces nouvelles de Copépodes du lac Ohrid (péninsule des Balkans) sont décrites. *Diacyclops ichnusoides* n.sp. (Cyclopoida, Cyclopidae) récoltée dans les eaux interstitielles de la rive du lac, appartient au groupe "*languidoides*". *Bryocamptus* (*R.*) *mirus* n.sp. (Harpacticoida, Canthocamptidae), qui fait partie du groupe "*zschokkei*" vit dans les eaux profondes. A ce jour, 36 espèces de Copépodes ont été recensées dans de lac Ohrid, six d'entre elles sont endémiques.

1. Introduction

Ohrid Lake is located in the central part of the Balkan Peninsula, between 40°54' and 41°10'N, and between 20°38' and 20°49'E. Its area is about 349 square kilometres, the maximal depth is 286 meters, while the average depth is about 145 meters (Stankovic 1989). Ohrid Lake is a tectonic lake, situated in the karst region. It is one of the oldest lakes in Europe, with very wealty and, also, endemic fauna.

The copepod fauna of the Ohrid Lake was not investigated systematically, but there are a lot of data given by Kiefer (1932, 1937a, 1937b), Chappuis (1936a, 1936b, 1937), Brehm (1939), Petkovski (1954, 1955,

1956, 1964, 1983, 1984), Herbst (1957) and Einsle (1971, 1975). Till now 32 copepod species are known from the Ohrid Lake, of which 4 ones are endemic.

Analysing some samples, collected in 1987 and 1988, we found two new copepod species. Also, were found two species which are new for the Ohrid Lake: *Bryocamptus* (s.str.) *minutus* (Claus, 1863) and *Bryocamptus* (*L.*) *echinatus* (Mrazek, 1893).

2. Methods

The samples were taken with Karaman-Chappuis method (from the interstitial waters, on the lake coast), or with a benthic net (for the pelagic ones, on a depth of 40-60 meters), and fixed by several drops of 36% formaldehyde. They were washed and copepods were sorted with a stereoscopic binocular Wild-M5 and removed into 70 % ethyl alcohol. The specimens were dissected in a mixture of distilled water and glycerol (1:1) with fine entomological needles. Dissected appendages were removed on a slide (also in a mixture of water and glycerol) and covered with a coverslip. For the larger parts (abdomen, etc.) two hairs between the

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slide and the coverslip were used, so the parts could not be smashed.

Dissected appendages were examined and figured using a binocular microscope Wild-M20 with drawing-tube attachment, and were preserved in Faure's medium. Specimens not dissected, also were examined with a microscope, in a mixture of water and glycerol, and after that removed in 70% ethyl alcohol, where they are preserved.

In the descriptions were used standard abbreviations of the characters: Gsg - genital segment; Fu - furca; Ro - rostrum; A1 - antennula; A2 - antenna; Md - mandible; Mx1 - maxillula; Mx - maxilla; Mxp - maxillipede; P1 - first leg; P2 - second leg; ...; P6 - sixth leg; Enp - endopodite; Exp - exopodite; Enp2P3 - second endopodite article of third leg.

3. Results

3.1. List of copepod species

With this investigation the list of copepod species in Ohrid Lake counts 36 species or taxa. We give the list of all known copepod species from the Ohrid Lake, where the endemic species are marked with an asterisk.

1. *Eudiaptomus gracilis* (Sars, 1863)
2. *Arctodiaptomus* (A.) *steindachneri* (Richard, 1897)
3. *Arctodiaptomus* (A.) *stephanidesi* (Pesta, 1935)
4. *Macrocyclops albidus* (Jurine, 1820)
5. *Eucyclops* (E.) *serrulatus* (Fischer, 1851)
6. *Eucyclops* (E.) *speratus* (Lilljeborg, 1901)
7. *Eucyclops* (E.) *macruroides* (Lilljeborg, 1901)
- * 8. *Eucyclops* (E.) *porrectus* Kiefer, 1932
- * 9. *Ochridacyclops arndti* Kiefer, 1937
10. *Paracyclops fimbriatus* (Fischer, 1853)
- *11. *Cyclops ochridanus* Kiefer, 1932
12. *Megacyclops viridis* (Jurine, 1820)
13. *Diacyclops bicuspidatus* (Claus, 1857)
14. *Diacyclops bisetosus* (Rehberg, 1880)
15. *Diacyclops languidus* (Sars, 1863)
16. *Diacyclops hypnicola* (Gurney, 1927)
17. *Diacyclops* cf. *languidoides*
- *18. *Diacyclops ichnusoides* n.sp.
19. *Mesocyclops leuckarti* (Claus, 1857)
20. *Thermocyclops dybowskii* (Lande, 1890)
21. *Cryptocyclops bicolor* (Sars, 1863)

22. *Ectinosoma abrau* (Kritschagin, 1877)
23. *Nitokra hibernica* (Brady, 1880)
24. *Attheyella* (A.) *crassa* (Sars, 1863)
25. *Attheyella* (A.) *wierzejskii* (Mrazek, 1893)
26. *Moraria* sp.
27. *Ceuthonectes serbicus* Chappuis, 1924
28. *Bryocamptus* (B.) *minutus* (Claus, 1863)
29. *Bryocamptus* (R.) *zschokkei* (Schmeil, 1893)
30. *Bryocamptus* (R.) *pygmaeus* (Sars, 1863)
- *31. *Bryocamptus* (R.) *mirus* n.sp.
32. *Bryocamptus* (L.) *dacicus* (Chappuis, 1923)
33. *Bryocamptus* (L.) *echinatus* (Mrazek, 1893)
34. *Elaphoidella elaphoides* (Chappuis, 1923)
- *35. *Elaphoidella bulbifera* Chappuis, 1937
36. *Paracamptus schmeili* (Mrazek, 1893)

3.2. *Diacyclops ichnusoides* n.sp.

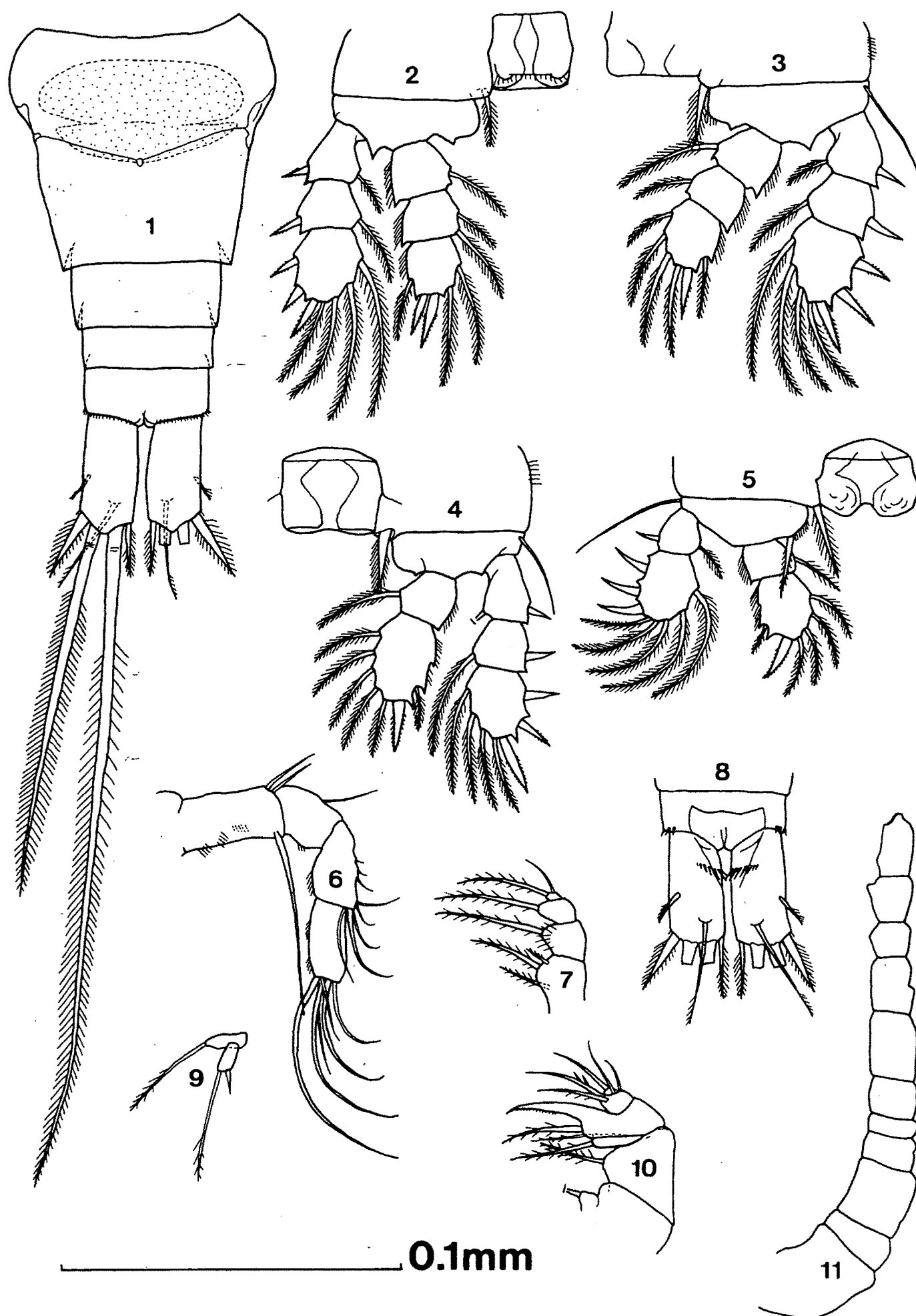
3.2.1. Type material

One female (Holotype) and one male (Allotype), from the interstitial waters in the NW coast of the Ohrid Lake, near the village Gorica, collected the 2th November 1988, by T.Petkovski. Both specimens are deposited in the Department of Biology, Faculty of Sciences, University of Montenegro.

3.2.2. Description

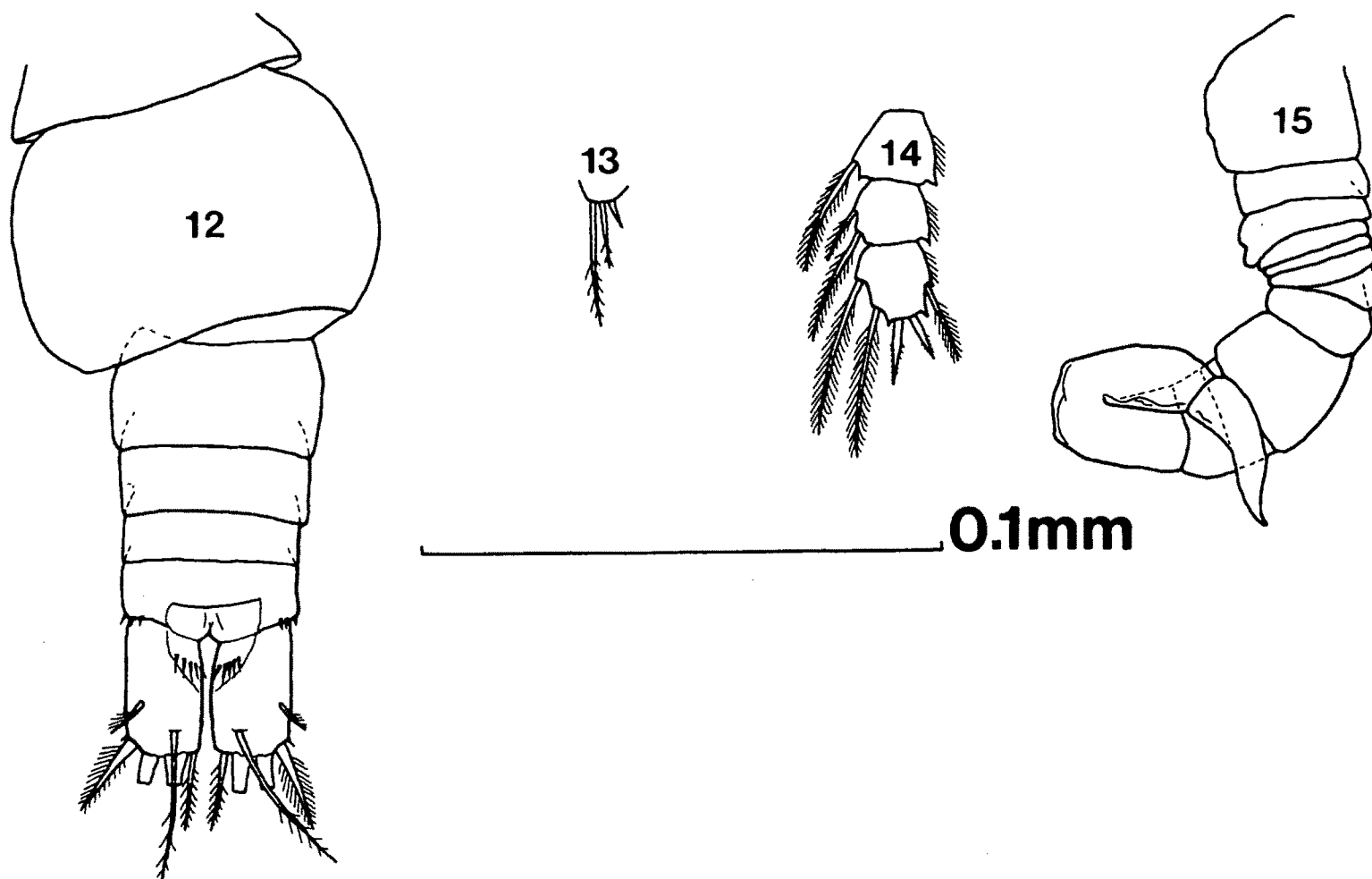
FEMALE (Holotype)

Length, including furcal rami (excluded furcal setae) is 0.36 mm. Nauplius eye absent. Hind margin of each body segment smooth and without rows of spines. Only anal segment with a row of spinules ventrally and laterally, at base of furcal rami. Anal operculum very short and broad (Fig. 8). Genital segment about 1.18 times as width as long, and very large in comparison with the rest of abdomen (Fig.1). Receptaculum seminis situated in the first half of genital segment, bipartite, and first part larger than second. On the middle of genital segment, ventrally, there is an arch chitinous suture with receptaculum's aperture on the middle. Furcal rami parallel, close, and about 1.94 times longer than wide. Apical setae with following proportion of lengths (from outside to inside): 1 / 5.3 / 9.3 / 0.76. Outer apical seta very strong, spiniform (Fig.1). Dorsal seta as long as furcal ramus, and attached at distal 1/4 of furcal length. Furcal rami with a transverse row of spines dorsally, which is unique in the genus *Diacyclops* (Fig.8). A1 11-segmented, almost reaching the end of cephalothoracic somite (Fig.11). A2 4-segmented, with well-developed exopodite seta, and three



Figs. 1-11. *Diacyclops ichnusoides* n.sp., holotype (female 0.36mm): 1 - abdomen ventral; 2 - P4; 3 - P3; 4 - P2; 5 - P1; 6 - A2; 7 - Mxp; 8 - Fu dorsal; 9 - P5; 10 - Mx; 11 - A1.

Figs. 1-11. *Diacyclops ichnusoides* n.sp., holotype (femelle 0,36 mm).



Figs. 12-15. *Diacyclops ichnusoides* n.sp., allotype (male 0.336 mm): 12 - abdomen dorsal; 13 - P6; 14 - EnpP4; 15 - A1.

Figs. 12-15. *Diacyclops ichnusoides* n.sp., allotype (mâle 0,336 mm).

groups of hairs on the first segment (Fig.6). Maxilla shown in Fig.10. Mxp 4-segmented, with reduced number of setae (7 instead of 9) (Fig.7). Articulation formula of swimming legs distinctive for "*languoides*"-group (exp/enp): 2/2; 3/2; 3/3; 3/3. Spine formula of exopodites P1-P4: 3.3.3.3; setal formula: 5.4.4.4. Enp3P4 approximately as long as width, with two apical spines of which the inner one is about 1.29 times longer than the outer, and as long as article. Outer seta reaching the tip of outer spine, while inner setae are much longer. Intercoxal plates with distinctive features (Figs. 2, 3, 4, 5), and only that on fourth leg with a transverse row of spinules. P5 with very short and laterally bulging basal article (Fig.9). Distal article about 2 times longer than wide and subapically bearing spine, which is a little shorter than article. P6 very reduced, like one short seta, and visible on the laterodorsal surface of Gsg above genital apertures.

MALE (Allotype)

Body length is 0.336 mm. A2, mouth parts, swimming legs and P5 are similar to those of female. Gsg

very large in comparison with the rest of abdomen (Fig.12). Furcal rami shorter than females (index length/width is 1.7), and bearing a little longer dorsal setae (Fig.12). A1 geniculate (Fig. 15). P6 bearing three setae with following proportion of lengths (from inside to outside): 1/2.4/4 (Fig.13).

3.2.3. Ecology

Colourless body, absence of nauplius eye, very short swimming legs, small body, and locality where material was collected lead to the conclusion that *D. ichnusoides* n.sp. is a real troglobiont, living in the interstitial waters. Small number of specimens is probably consequence of rising waters in interstitial habitats in the autumn, and of numerous specimens of troglomen or troglophil species that possible prey *D. ichnusoides* is.

3.2.4. Distribution

Known only from type locality. Probably endemic species of interstitial waters in the Ohrid Lake drainage area.

3.2.5. Etymology

The species is named *ichnusoides* after *D. ichnusae* Pesce & Galassi, 1985, because of their great similarity.

3.2.6. Remarks and affinities

D. ichnusoides n.sp. belongs to the "*languidoides*"-group. Its very short furcal rami and other morphological details makes it the most similar to *Diacyclops ichnusae* Pesce & Galassi 1985, which was described from subterranean waters of Sardinia (Pesce & Galassi 1985). However, it is evidently distinguishable from the latter by the combination of the following characters: 1) exopodite seta on A2 present; 2) furcal rami with a transverse row of spines dorsally; 3) dorsal seta on furcal ramus shorter.

D. ichnusoides has shorter furcal rami even than *D. ichnusae*. Their index (length/width) at *D. ichnusae* is 2.09-2.1, while at *D. ichnusoides* it is 1.94 (at females). More shorter furcal rami has *Diacyclops improcercus* (Mazepova, 1950) comb. nov., which was described from the Baykal Lake (Mazepova 1950). This Baykal species differs from *D. ichnusoides* as follows: 1) nauplius eye present; 2) no spines on dorsal surface of furcal rami; 3) subapically spine on distal article of P5 longer than article; 4) inner and outer apical setae on furcal ramus longer than ramus. Many other morphological details were not given in the original description of *D. improcercus* (A2, Mxp, P1-P4), so they could not be compared.

There are some similarities between *D. ichnusoides* and *D. hypnicola* (Gurney, 1927), but these two species are distinguishable by many characters (Fu, Gsg, Mxp, Mx, CoxaP4, and body length - *D. hypnicola* is almost twice as long as *D. ichnusoides*). Also, these two species were found together, which is the best indication of their specific isolation.

3.2.7. Accompanied species

Together with *D. ichnusoides* n.sp. we found the following species:

1. *Diacyclops hypnicola* - 2 females;
2. *Mesocyclops leuckarti* - 1 male, 2 females and 64 copepodids;
3. *Nitokra hibernica* - 3 males and 36 females (26 ovigerous);
4. *Attheyella* (s.str.) *wierzejskii* - 1 male;
5. *Bryocamptus* (s.str.) *minutus* - 1 ovigerous female;
6. *Elaphoidella elaphoides* - 11 males and 39 females (18 ovigerous).

3.3. *Bryocamptus* (*Rheocamptus*) *mirus* n.sp.

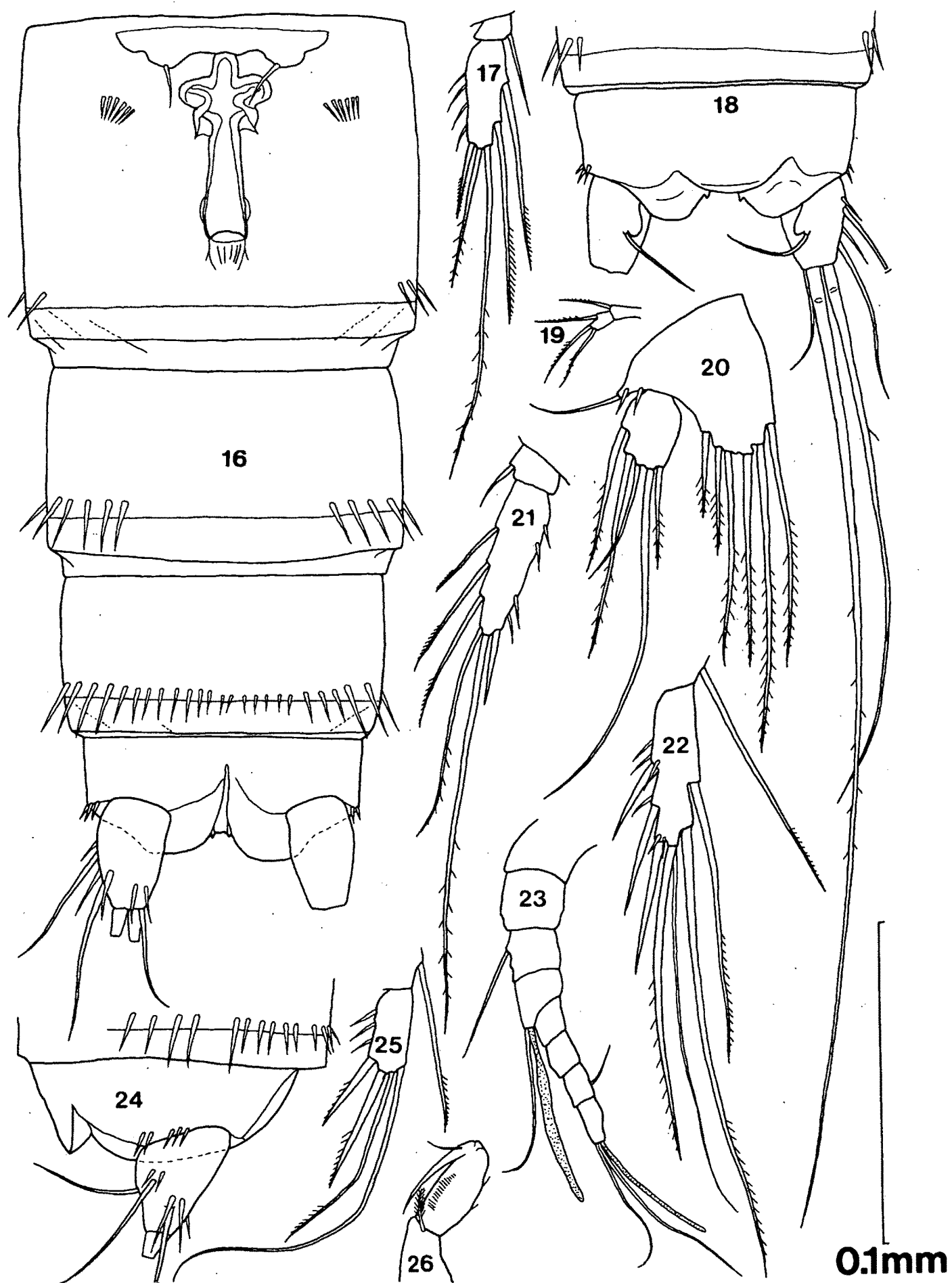
3.3.1. Type material

Holotype (ovigerous female, 0.67 mm), allotype (male) and 7 paratypes (6 ovigerous females + 1 female), from the NW part of Ohrid Lake (on depth of 40-60 meters), 16 October 1987, collected by T. Petkovski. All specimens are deposited in the Department of Biology, Faculty of Sciences, University of Montenegro. Holotype, Allotype and 2 Paratypes were dissected and mounted on a slide in Faure's medium. Other Paratypes were placed in a glass test tube in 70 % ethyl alcohol.

3.3.2. Description

Female (holotype). Length, including furcal rami (excluded furcal setae) is 0.67 mm. Rostrum small, even wellrounded. Hind margin of each body somite smooth. Genital segment with a few spines on the hind margin laterally. Genital field with characteristic pattern (Fig.16). Ovisac with 15 eggs. Second abdominal segment armed ventrolaterally with transverse row of spines. Third segment with an uninterrupted row of spines on lateral and ventral hind margins. Anal segment armed laterally (at the base of the furcal rami) with 5 small spines (Fig. 24). Anal operculum completely smooth, concave, and rather short (Fig.18). Furcal rami divergent, about 1.7 times as long as width and even narrowed (Fig.16). Armature consists of two lateral setae (each with two spines on the base) (Fig.24), one dorsal and three apical setae. On the base of the apical setae ventrally, there are another two spines. Dorsal seta attached behind well-developed chitinous ridge, at the middle of furcal length (Fig.18). Inner apical seta little longer than caudal ramus, somewhat moved on ventral side, and bent to inside. Middle apical seta little longer than abdomen (1.08 times), and about 1.7 times longer than outer apical seta (Fig.18). A1 8-segmented, with a big esthete on fourth segment, reaching beyond the top of A1 for a length of distal segment (Fig. 23). A2 3-segmented, with 2-segmented exopodite which is armed with 4 setae (Fig. 19). Md palp 2-segmented. First segment bearing one subapical seta, second armed with one lateral and four apical setae. Maxillipeda shown in Fig. 26. All swimming legs with 3-segmented exopodites and 2-segmented endopodites. The setal/spine formula of swimming legs:

	Exp	Enp
P1	0/1/1.1.2	1/1.2.0
P2	0/1/1.2.3	1/2.2.1
P3	0/1/2.2.3	1/4.1.1
P4	0/1/2.2.3	1/2.2.1



Figs. 16-26. *Bryocamptus (R.) mirus* n.sp., holotype (female 0.67 mm): 16 - abdomen ventral; 17 - EnpP4; 18 - Fu dorsal; 19 - ExpA2; 20 - P5; 21 - EnpP3; 22 - Exp3P4; 23 - A1; 24 - Fu lateral; 25 - Exp3P1; 26 - Mxp.

Figs. 16-26. *Bryocamptus (R.) mirus* n.sp., holotype (femelle 0,67 mm).

Exp2P1 bearing very strong inner seta, which considerably reaches beyond the top of distal segment (Fig. 25). P5 bearing 6 setae on distal margin of basiendopodite, and second one (from inner side) is longest. First, third and fourth setae align with tips (Fig. 20). On the lateral side of basiendopodite, at the base of epipodite seta, there are only two spines. Exopodite of P5 about 1.36 times as long as width and armed with 5 setae.

MALE (Allotype)

Body length is 0.56 mm. Genital segment armed with two hairs only, dorsolaterally. Second and third abdominal segments armed with a transverse row of spines laterally and ventrally, which are interrupted by little spaces at middle part on ventral side (Fig. 27). Fourth abdominal segment with uninterrupted row of spines on lateral and ventral side. Anal segment armed laterally with 5 small spines, at the base of furcal rami (like a female), and ventrally with an arch row of 6 spines. Anal operculum similar to female's, completely smooth (Fig. 29). Furcal rami similar to female's, just a little shorter, and bearing proportionally longer setae. A1 prehensile, bearing very long esthete (Fig. 30). A2, mouth parts, P1, P2, ExpP3 and ExpP4 similar to female's. EnpP3 characteristically modified and bearing two unequal apical setae on distal segment (Fig. 28). EnpP4 2-segmented. First segment small and unarmed, second one armed with 4 or 5 setae (Fig. 31). P5 bearing 6 setae on the distal margin of basiendopodite, like a female's, but they are much shorter and stronger than female's (Fig. 27). Distal margin of basiendopodite less extended. Exopodite of P5 armed with 6 setae and one hair on the outer margin. P6 consisting of a chitinous lamella, bearing 3 setae. Inner and outer setae of this appendage are equal, whereas the middle one is much shorter (Fig. 27).

3.3.3. Variability

Sole qualitative form of variability was recorded on male's Enp2P4, bearing 4 or 5 setae (Fig. 31). All females were very uniform, even their body lengths were similar (from 0.65 to 0.68 mm). It is very important that all females had completely smooth anal operculum and identical form of P5.

3.3.4. Ecology

The species was collected in a lake profundal at a depth of 40-60 meters. On the bodies of the most specimens it was found a few epizootic solitary *Peritricha* (Protozoa, Ciliata). Six of seven females were with ovisacs (16 eggs, on the average), what means that *B. (R.) mirus* was in the mating season at October.

3.3.5. Distribution

Known only from the type locality. Probably endemic species of the Ohrid Lake.

3.3.6. Etymology

The species is named after the Roman adjective *mirus* (what means eccentric), because of the very strange form of the male's P5.

3.3.7. Remarks and affinities

Bryocamptus (R.) mirus n.sp. is most similar to the holarctic species *Bryocamptus (R.) zschokkei* (Schmeil, 1893). Many morphological details, especially on swimming legs, are almost identical in the both species. However, *B. mirus* is evidently distinguishable from *B. zschokkei* as follows:

Female: 1) anal operculum completely smooth, 2) longest seta on distal margin of basiendopodite P5 is second one (fourth in *B. zschokkei*), 3) armature on abdominal segments quite reduced;

Male: 1) anal operculum smooth, 2) Enp2P2 bearing one spiniform seta on outer margin, 3) basiendopodite of P5 with 6 setae.

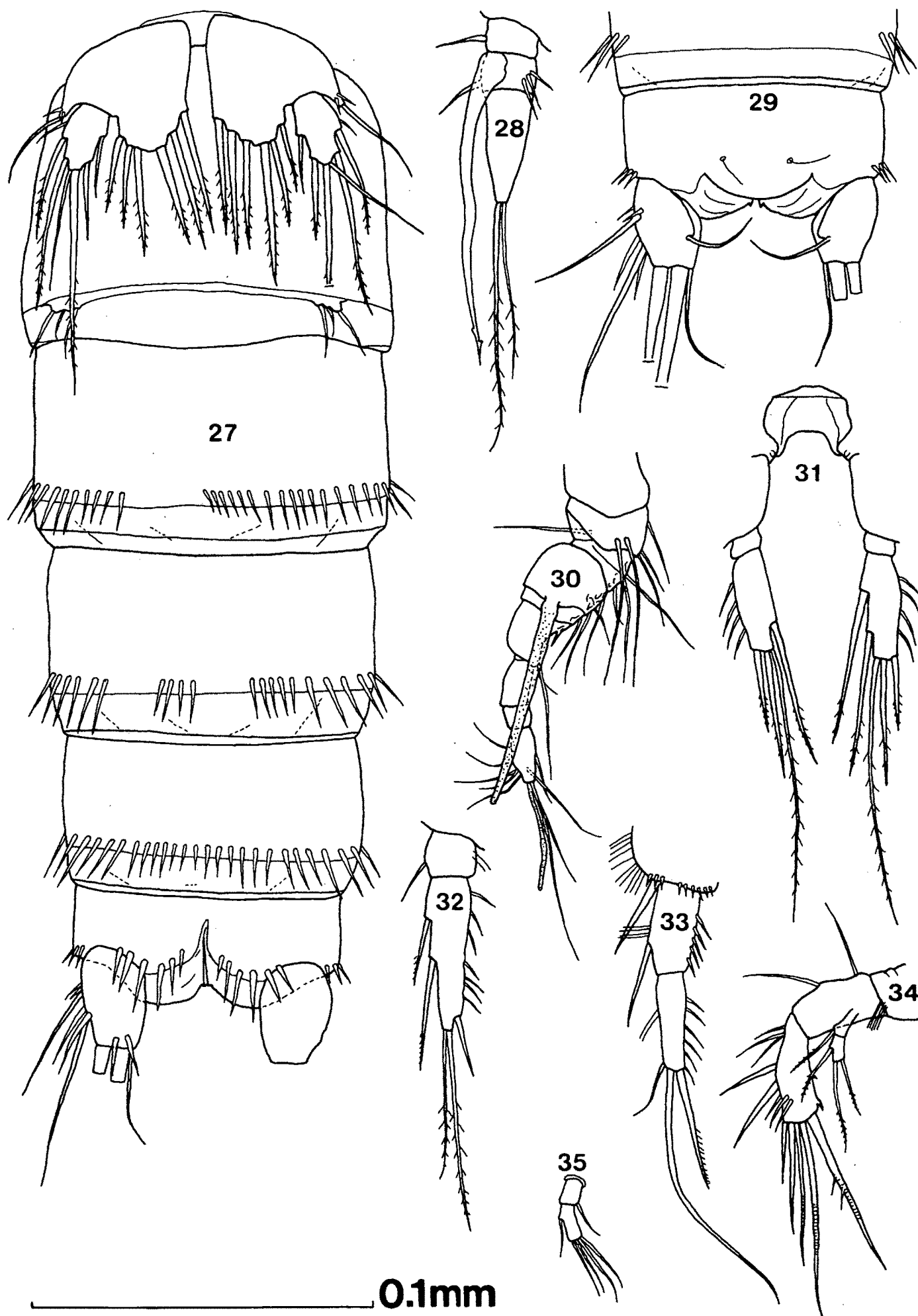
Bryocamptus (R.) gauthieri (Roy, 1924) has also a smooth anal operculum (only at female). This species is distributed in North Africa (Lang 1948), but it differs from *B. mirus* by many features (especially in swimming legs). Many other species in the genus *Bryocamptus* have a smooth anal operculum, especially those in the subgenus *Limocamptus* from the Baykal Lake (Borutzky 1952). It means that this feature is secondary and it was generated convergently.

But the basiendopodite of male's P5 with 6 setae is very strange and unknown in the genus *Bryocamptus* till now. It resembles to hermaphroditism, but all other secondary sexual features (Gsg, A1, EnpP3, EnpP4, P6) are completely normal for a male from the subgenus *Rheocamptus*. On the other side, there is a very small probability that this feature is secondary, because of all other morphological features are very similar to those of *B. zschokkei*. Probably the basiendopodite of male's P5 with 6 setae is an atavism, but a correct answer will be known only after examinations on bigger series of specimens.

3.3.8. Accompanied species

In the same sample the following species were found together with *B. (R.) mirus* n.sp.:

1. *Paracyclops fimbriatus* - 2 females;
2. *Ectinosoma abrau* - 6 ovigerous females and 21 copepodids;



Figs. 27-35. *Bryocamptus (R.) mirus* n.sp., allotype (male 0.56 mm): 27 - abdomen ventral; 28 EnpP3; 29 - Fu dorsal; 30 - A1; 31 - EnpP4; 32 - EnpP2; 33 - EnpP1; 34 - A2; 35 - Md palp.

Figs. 27-35. *Bryocamptus (R.) mirus* n.sp., allotype (mâle 0,56 mm).

3. *Attheyella* (s.str.) *wierzejskii* - 8 males, 19 females (8 ovigerous) and 8 copepodids;

4. *Bryocamptus* (*Limocamptus*) *echinatus* - 5 males, 21 ovigerous females and 6 copepodids.

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