Hydrobiologia **436:** 73–80, 2000.

Morariopsis dumonti n.sp. (Crustacea: Copepoda: Harpacticoida) – a new species from an unsaturated karstic zone in Slovenia

Anton Brancelj
National Institute of Biology; Večna pot 111, 1000 Ljubljana, Slovenia
E-mail: anton.brancelj@uni-lj.si

Received 20 April 2000; accepted 20 June 2000

Key words: Harpacticoida, ground water, interstitial, taxonomy, Slovenia

Abstract

The genus *Morariopsis* has a disjunct distribution. It has been found in south-eastern Europe and in the Baikal region in Russia. In Europe two species are known, both from the Dinaric region. They have been found in three caves only, but always in puddles filled with percolating water. This indicates that they inhabit an unsaturated karstic environment. A third species, *Morariopsis dumonti* n.sp has now been found, in the same type of habitat, on several dates, in a small cave in central Slovenia. Males were recorded for the first time in this genus.

The new species is related to *Morariospsis kieferi* Petkovski, 1959 from Dalmatia. The main differences are in the ornamentation of the furca and of the abdominal segments. P5 and particularly endopodite of P4 in males suggest a close relation between *Moraria* and *Morariopsis.*

Introduction

Ground water and karstic caves all over the world appear to be an inexhaustible source of new taxa of Copepoda, particularly Harpacticoida (Schminke & Notenboom, 1990; Brancelj, 1991; Galassi & Pesce, 1991; Rouch, 1991, 1991a; Pesce & Galassi, 1994; Reid, 1995; Galassi & De Laurentiis, 1997; Karanovic, 1997, 1998, 1999; Stoch, 1997; Karanovic & Bobic, 1998; Galassi et al., 1999). Some genera, like *Elaphoidella*, *Moraria* and *Bryocamptus* have many representatives in subterranean environments. In contrast, there are also genera with limited numbers of taxa, like *Ceuthonectes*, *Paramorariopsis* and *Lessinocamptus*, all of which are stygobites with restricted distribution. Among them, the genus *Morariopsis* holds a special position. It belongs to the group with a small number of species. In total, five taxa are known to date. The genus has two peculiarities. In all taxa but the most recent one (*M. dumonti*), only females have been found. The second remarkable point is its disjunct distribution, viz. lake Baikal and south-eastern Europe. Two species inhabit the benthic (profundal?) zone of lake Baikal (Russia) (Borutskii, 1964). Another three species have been found in the Dinaric region (Kiefer, 1930; Petkovski, 1959, Brancelj, this paper). Here, they were always found in caves, but at few locations. In fact, only *M. scotenophilla* (Kiefer, 1930) is known from more than one location (Brancelj, 1986 and in press). Baikalian species are clearly distinguished from European species by the ornamentation of their furcal rami.

A new species, *Morariopsis dumonti,* is described in this paper. Of particular interest is the first record of males in the genus. Up to now, the close relation of genera *Morariopsis* and *Moraria* has been established by the similar structure of the female genital field (Borutskii, 1964). The characteristic transformation of the terminal spine on the endopodite of P4 in males of *M. dumonti* additionally supports the close relation between these genera.

Site description

Mala Pasjica is a small karstic cave in central Slovenia, which has a 75 m long horizontal gallery. The entrance, 1 m by 0.7 m, is at the bottom of a steep,

approximately 10 m deep depression. At the entrance, daylight penetrates only few metres into the cave. There are three small halls, up to 5 m high, connected by corridors about 1 m in height. The ceiling above the cave is thin, between 2 and 12 m. There is no surface or subterranean running water in the area. All the water in the cave originates from drippings, dependent on precipitation. Water collects in small basins on calcareous sinter or in puddles on the clay deposits. In basins on the wall, there is no organic material. In contrast, some floor basins and puddles are filled with fragments of wood or humus. Both were transported into the cave by visitors and, to a limited extent, through crevices in the ceiling. Roots of trees pierce the cave ceiling at some points.

Material and methods

Water from three different types of waterbodies as described above (for details see Brancelj, in prep.) was filtered through a net with mesh size of 40 μm on four occasions between January 28 and April 4, 2000. Water from basins and puddles was collected separately in 5 litres plastic bottle by means of a suction pump. Small basins were sampled with a 10 ml pipette. In total about 200 litres of water was filtered from 18 puddles. Water samples for chemical and physical analysis were collected at four different locations along the gallery. Water temperature was measured at two locations, in the entrance hall and in the most distant hall at the end of the gallery (for details see Brancelj, in prep.).

Samples were stored in plastic bottles immediately after sampling and formalin was added to a final concentration of about 4%. Within one week animals from samples were sorted under a stereomicroscope and stored in 70% alcohol. Nine hundred and twenty specimens of 12 different taxa were collected. Thirty-seven belonged to the new species described here (25 females and 12 males).

Before dissection, animals were placed into a mixture of glycerol and 70% alcohol (ratio 1:1 v/v), replaced within one hour by pure glycerol. They were dissected at 100× magnification (Olympus SZH2 stereomicroscope). Examination of all appendages and postabdomens was done under a magnification of 1000×. All drawings, except the whole female specimen, were made at the same magnification (1000×) with a drawing attachment tube on the Olympus microscope (BHS40).

Descriptive part

Material examined

Twenty-five females and 12 males from different pools filled with percolating water in cave Velika Pasjica (*loc. typ.*) (15 km south of Ljubljana; Slovenia); collected on four occasions between February 28 and April 4 2000.

Type material

Holotype. An adult female (total length of 417 μm), completely dissected and mounted on a slide in polyvinyl lactophenol, deposited in the British Museum, Natural Hisotry, under accession number 2000.1472.

Paratypes. 24 females and 12 males (5 females and 4 males completely dissected and mounted in polyvinyl lactophenol). The rest of material is preserved in 70% ethanol. 8 paratypes (5 females; 3 males) in 70% ethanol are deposited in the British Museum, Natural History; Accession No.: 2000.1053-1060. 8 paratypes (5 females; 3 males) in 70% ethanol are deposited in the Smithsonian Museum, Accession No.: USNM- 291486. The remaining material is deposited in the author's collection.

Female: body length 346–437 μm (mean 391 $\pm$ 36.7 μm; n = 9); elongated, cylindrical, colourless (Figure 1a). Naupliar eye absent. Hind margins of all abdominal segments smooth, both ventral and dorsal (Figures 1b, c). Hairs on lateral side of genital and third abdominal somite as well as head capsule and third thoracical segment. Anal segment with a row of spines on ventral side, at a base of furcal rami (Figure 1c). Anal operculum large, semicircular, with smooth margins, not reaching distal end of anal segment. A row of fine spinules close to the free margin of operculum (Figure 1b).

Receptaculum seminis (Figure 1c) resembling that in the genus *Moraria*. A claw-like spine laterally with small accompanied seta.

Furca distinctively divergent. Caudal ramus about 1.5 times as long as wide, tapering to the posterior end (Figures 1a, b, c). Inner margin completely smooth. Outer margin with two strong, spine-like setae, positioned at about 1/3 and 2/3 along outer margin. Anterior seta with one small spine at the base. Dorsal side of ramus with hyaline ridge along the whole length. Seta on dorsal side at about 2/3 from the base of ramus, as long as caudal ramus. Ventral side of ramus on distal part with about 5 small spines. Outer terminal seta spiniform, as long as ramus. Inner ter-

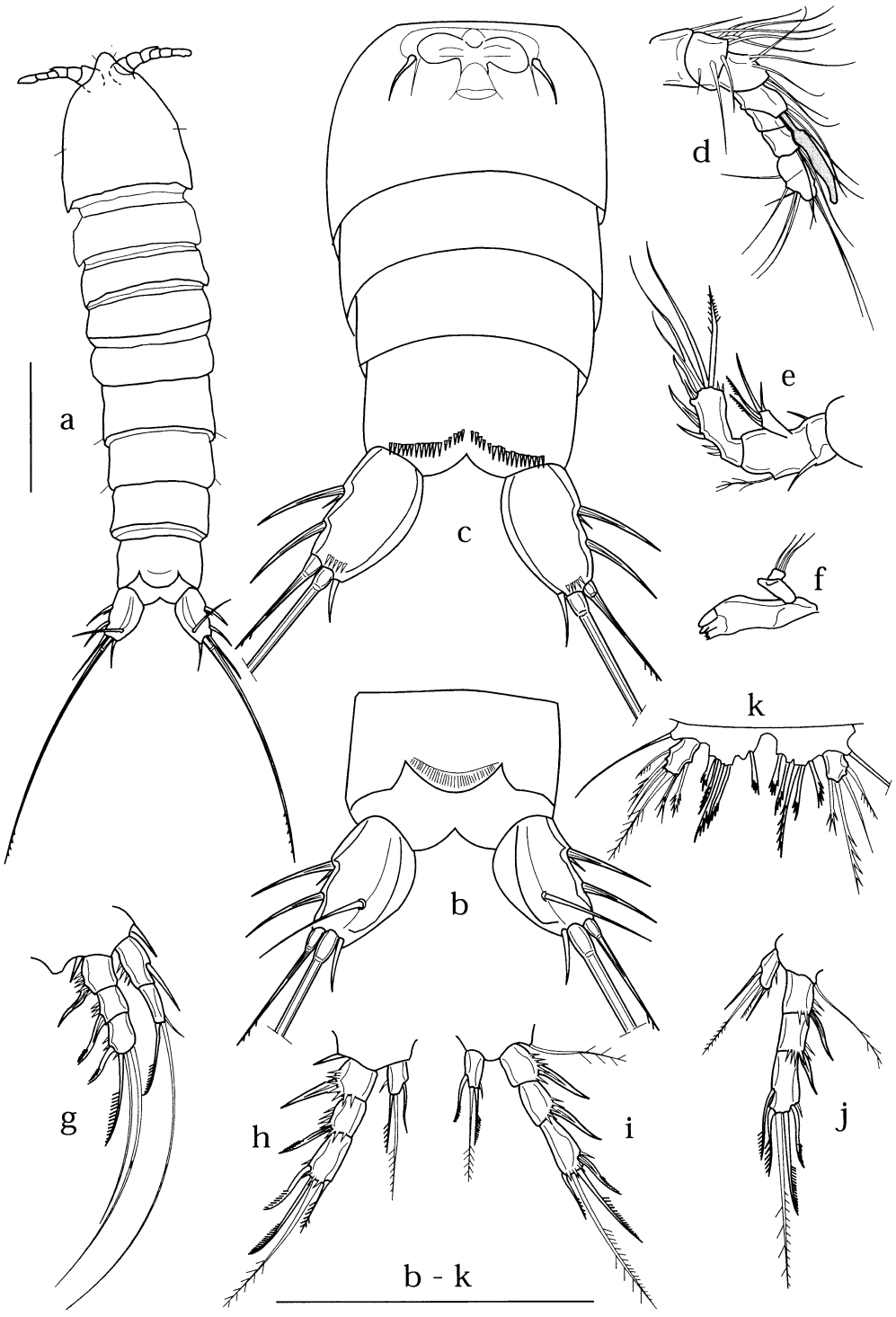

Figure 1. Morariopsis dumonti n. sp.; cave Velika Pasjica, (15 km south of Ljubljana; Slovenia); female: a – total; b – postabdomen dorsally; c – postabdomen ventrally; d – antennula; e – antenna; f – mandible; g – P1; h – P2; i – P3; j – P4; k – P5. Scale bars: 100 μm.

minal seta short, spiniform. Middle terminal seta as long as abdomen, with few spines at the tip.

Antennule (A1): (Figure 1d) short and stout, seven-segmented, with 7th segment incompletely separated. Aesthete on the 4th segment cylindrical, reaching the end of antenna, with rounded tip.

Antenna (A2): (Figure 1e) three segmented (including allobasis), short and robust. Exopodite 1-segmented with four spine-like setae.

Mandible (Figure 1 f) short and robust, with strong teeth on gnathobase. Mandibular palp 2-segmented, with three long, equal setae.

Paragnaths 2-segmented. Proximal one (= basipodite) with two setae on inner side. Distal one long, beak-like with one long seta externally.

Maxillule with five strong and robust spines on gnathobasic endite and additional strong seta, originating from the dorsal side of the segment. Basis with two strong, beak-like outgrowth, with several short bristles on distal part and four setae at the base.

Maxilla three segmented; middle segment with 3–4 short and strong spines on inner margin. Distal segment with long spine slightly curved inward.

Rostrum well developed, triangular, with two small bristles near the tip.

P1 (Figure 1g) with 3-segmented exopodite and 2-segmented endopodite. Endopodite slightly shorter than exopodite. Basipodite with a strong spine at the inner side of endopodite. Inner side of endopodite with one strong spine-like seta on proximal segment and 4–5 strong short spines on outer margin. Distal segment with three setae; innermost small and inconspicuous, median seta long, outer one spiniform with strong spines unilaterally at tip. Exopodite with one strong spine and several small spines on proximal and median segment. Distal segment with one strong spine laterally and two long setae terminally. Outer terminal seta shorter and spine-like, with several small spines unilaterally on distal-half part.

P2 (Figure 1h) with 3-segmented exopodite and 1-segmented endopodite. Endopodite slightly shorter than proximal segment of exopodite. Proximal and medial segments of exopodite about as long as wide, with one strong spine each on outer margin. Distal segment with sub-terminal outer spine and three terminal setae. Innermost seta shortest and spine-like. Endopodite with two terminal setae, inner one about twice as long as outer one. Short spine on outer lateral margin and long seta in the middle of inner margin.

P3 (Figure 1i) similar to P2 but setae on endopodite more robust and spine-like.

P4 (Figure 1j) with 3-segmented exopodite and 1-segmented endopodite. Proximal and medial segments of exopodite about as long as wide, with one strong spine each on outer margin. Terminal segment with 5 spines and setae. Outer spine and two innermost setae positioned sub-terminally. Two setae terminally, inner one about twice as long as outer one. Endopodite with 4 (in some cases 5) setae; two innermost sub-terminally.

P5 (Figure 1k): basipodite short, with five short and strong spines, the middle one the longest. Exopodite short, about twice as long as wide, with 4 to 6 (normally 4) setae and spines. Terminal seta about twice as long as next one.

Male

Body length 342–419 μm (mean 371 $\pm$ 28.8 μm; n = 6); elongated, cylindrical, colourless. Naupliar eye absent. Hind margins of all abdominal segments smooth, both ventral and dorsal (Figures 2a, b). Anal segment with a row of spines on ventral side, near a base of furcal rami (Figure 2b). Anal operculum big, semicircular, with smooth margins, not reaching distal end of anal segment. A row of fine spines close to the free margin of operculum (Figure 2a).

Furca and furcal rami identical to those in female (Figures 2a, b). Outer terminal seta spiniform, about twice as long as ramus. Inner terminal seta short.

P1 (Figure 2c) with 3-segmented exopodite and 2-segmented endopodite. Armature identical to those in female.

P2 (Figure 2d) with 3-segmented exopodite and 2-segmented endopodite; endopodite slightly longer than proximal segment of exopodite. Exopodite similar to those in female. Proximal segment of endopodite laterally with strong spine on inner margin and sub-terminally hyaline outgrowth on outer side. Distal segment with two terminal setae, inner one about one third longer than outer one.

P3 exopodite similar to P2 (Figure 2e). Endopodite 2-segmented. Proximal one as long as wide with small spine on outer margin. Distal segment with three short and robust spines, equal in length and positioned terminally (two of them) and one laterally on inner side of endopodite.

P4 (Figure 2f) with 3-segmented exopodite and 2-segmented endopodite. Exopodite similar to those in female. Proximal segment of endopodite with a long spine-like seta on inner margin. Distal segment with two spines laterally and one long seta sub-terminally

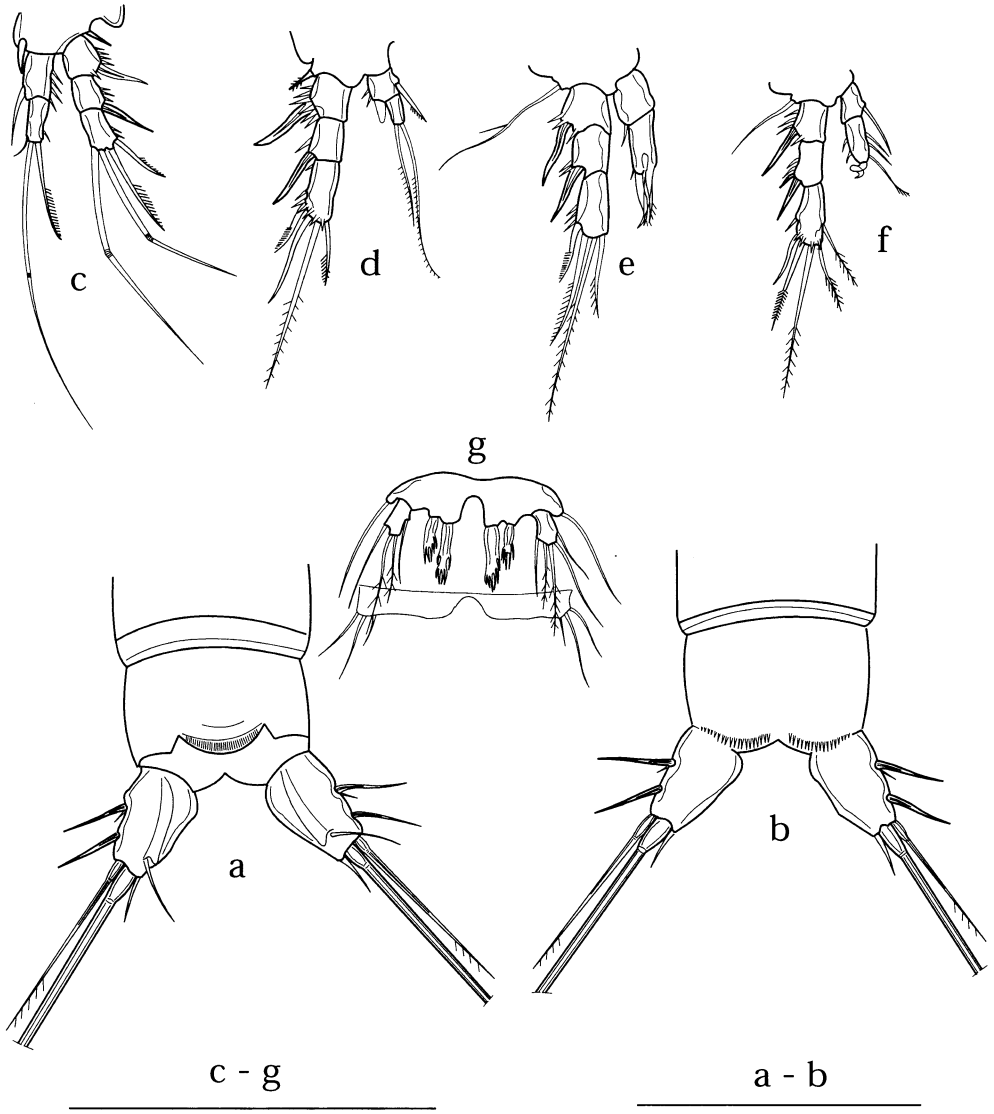

Figure 2. Morariopsis dumonti n. sp.; cave Velika Pasjica, (15 km south of Ljubljana; Slovenia); male: a – postabdomen dorsally; b – postabdomen ventrally; c – P1; d – P2; e – P3; f – P4; g – P5 & P6. Scale bars: 100 μm.

on inner margin. Apically a short spine, twisted as a spiral. Outer margin with two short spines.

P5 (Figure 2g): basipodite short, with two short and strong pinniform spines, the inner one longer than outer one. Exopodite short, about twice as long as wide, with 4 or 5 (normally 5) setae. Terminal seta longer than others.

Variability

Strong variability was found on the female endopodites P2-P5, where reduction or multiplication of one spine or seta was frequent. Different numbers of spines and setae occurred in the same female on the left and right appendage. The same occurred in males, particularly on P5. In one specimen (Figure 4) an incomplete moult was observed with terminal spine strongly invaginated into both furcal rami.

Etymology

The new species is dedicated to Prof. Dr Henri Dumont from Ghent who helped me greatly in my scientific work.

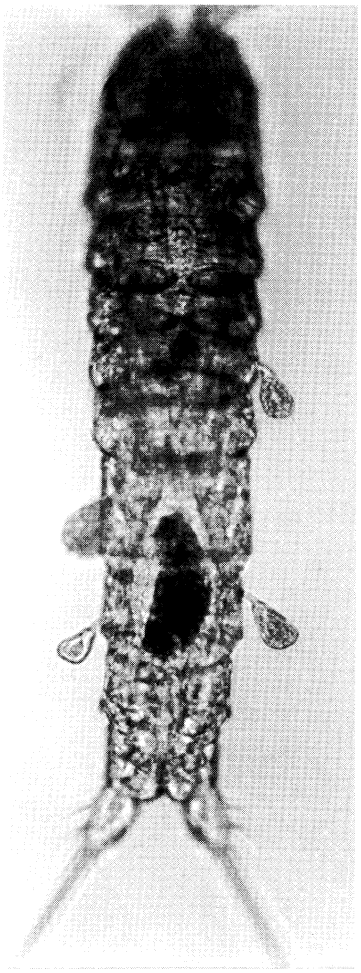

Figure 3. Morariopsis dumonti n. sp.; cave Velika Pasjica, (15 km south of Ljubljana; Slovenia); female with four attached epizoic Ciliates.

Figure 4. Morariopsis dumonti n. sp.; cave Velika Pasjica, (15 km south of Ljubljana; Slovenia); female with incompletely developed furcal setae.

Discussion

Distribution

The species is known from the type locality only. Poor knowledge on the distribution of the taxon is probably due to the very specific environment that it occupies. As the unsaturated zone in the karstic environment in Slovenia has been sampled only occasionally (Kiefer, 1930; Petkovski, 1983; Brancelj, 1986, 1991), we can expect a wider distribution of this taxon along the Dinaric area.

Ecology

Lack of pigment and an absence of eyes indicates a stygobytic environment whilst elongated and slim body shape indicates chasmobiont or interstitial habitats. Ornamentation (particularly spinulation on abdomen and furcal setae) is reduced, probably as the result of small interstitial space and cracks in dolomite geology. Inhabitation of small and narrow spaces is supported by relatively short appendages P2–P4. Beside *Speocyclops infernus* (Kiefer, 1930), which was found in most waterbodies of the cave, *Morariopsis dumonti* was the most numerous species and was found in all three types of habitats, particularly after rain. This indicates that the species is transported into the cave adventitiously and has no particular habitat preference in the cave.

The body-surface of about 17% of specimens of *M. dumonti* was inhabited by epizoic ciliates (Figure 3). The number of epibionts varied from 1 to 5, and we found no preference for invasion in terms of sex or body part. They were attached on the head capsule, between the swimming legs or on the dorsal or ventral part of the abdomen. *M. dumonti* and *Moraria poppei* were the only two species (out of 12) which were heavily invaded by epibionts. Two more species (*Moraria varica, Bryocamptus typhlops*) were found to be invaded by epibionts but much less intensely both in the number of hosts and the number of invaders. No specimens of *Speocyclops infernus* (in total 622 adults and

juveniles) were hosts to epibionts (more details on species composition and microdistribution of Copepoda see in Brancelj, in prep.).

Revised genus diagnosis (after Borutskii, 1964)
Body elongate, slightly tapering distally. Rostrum more or less clearly defined. Posterior margins of segments smooth or fine serrated. Operculum smooth, semicircular. Caudal branches elongate; in European species distinctly divergent. Only median apical setae well developed, other apical setae much reduced. Antennules 7-segmented; 7th segment frequently incompletely segmented. Antennal appendage small, composed of one segment, with 2 or 4 setae. Exopodites P1–P4 three segmented. Endopodite of P1 2-segmented, shorter than exopodite. Endopodites P2–P4 1-segmented, with 2–3 setae. Basipodite P5 in females with 4–6 strong spines, exopodite with 3–4 or 4–6 setae. Structure of genital field as in the genus *Moraria.* In males exopodites P1–P4 similar to those in female. Endopodites P1–P4 2-segmented. Terminal spine on endopodite P4 spiral twisted. Basipodite of P5 small, with two robust spines. P5 exopodite small, with 4–5 setae.

Affinities
Morariopsis dumonti n.sp. clearly differs from *M. scotenophila* (Kiefer, 1930) described from a puddle in cave Škocjanske Jame and later found in Postojnska Jama (Brancelj, 1986). In *M. scotenophila* endopodites P2–P4 are 1-segmented with two apical setae. There are differences on ventral side of abdominal segments as well as details on furcal rami. The outer terminal seta in *M. scotenophila* is similar to the lateral ones in the female. In *M. dumonti* the outer terminal seta is different from lateral ones (Figures 1b, c).

M. kieferi Petkovski, 1959 from cave Vranjača (Dalmatia) is much closer to the new species, but there are obvious differences. Endopodite of A2 in *M. kieferi* has two spines but four in *M. dumonti*. Endopodites P2–P4 in *M. kieferi* have four spines and setae, but 3, 3 and 4 in *M. dumonti*. High variability of setation in *M. dumonti* partly reduces the difference between the taxa. The most obvious differences between the taxa are ornamentation and setation on the abdomen and furcal rami. Hind margins of abdominal segments in *M. kieferi* serrated, smooth in *M. dumonti*. In *M. kieferi* the ventral part of the abdominal segments (excluding the anal one) bears one row of spines, while spines are completely absent in *M. dumonti*. The furca and terminal outer seta are longer in *M. kieferi* than those in *M. dumonti*. Ornamentation of P5 in females of both taxa is similar.

Acknowledgement

I would like to thank my colleagues from the Institute who helped me during the field work and Dr Roger Pain for language advice. Work was supported by Slovenian Ministry of science and technology within national program on structure and function of the ecosystems.

References

Borutskii, E. V., 1964. Fauna of U.S.S.R., Crustacea, Vol. 3 (4): Freshwater Harpacticoida. Israel Program for Scientific Translations, Jerusalem, 396 pp.

Brancelj, A., 1986. Rare and lesser known harpacticoids (Copepoda Harpacticoida) from the Postojna – Planina cave system (Slovenia). Biol. Vestn. 2: 13–36.

Brancelj, A., 1991. *Paramorariopsis anae* gen.n., sp.n. and the female of *Ceuthonectes rouchi* Petkovski, 1984 – two interesting harpacticoids from caves in Slovenia (NW Yugoslavia). Stygologia 6: 193–200.

Brancelj, A., in press. Male of *Moraria radovnae* (Brancelj, 1988) (ex *Moraria pectinata radovnae* Brancelj, 1988) (Copepoda: Crustacea), and notes on endemic and rare species from Slovenia and neighbouring countries. Hydrobiologia.

Galassi, D. M. P., G. L. Pesce, 1991. *Elaphoidella mabelae* n. sp., a crenobiont Harpacticoid from Italy (Copepoda, Canthocamptidae). Crustaceana 60: 1–6.

Galassi, D. M. P. & P. De Laurentiis, 1997. Two new species of *Nitocrella* from groundwaters of Italy (Crustacea, Copepoda, Harpacticoida). Ital. J. Zool. 64: 367–376.

Galassi, D. M. P., M. J. Dole-Olivier & P. De Laurentiis, 1999. Phylogeny and biogeography of the genus *Pseudectinosoma*, and description of *P. janineae* sp. n. (Crustacea, Copepoda, Ectinosomatidae). Zool. Scr. 28: 3–4.

Karanovic, T., 1997. Two new species of Harpacticoid Copepods (Copepoda, Harpacticoida, Canthocamptidae) from Montenegro (Balkan Peninsula). Bull. zool. Mus. Univ. Amsterdam 16: 1–9.

Karanovic, T., 1998. Two interesting species of the genus *Elaphoidella* Chappuis, 1929 (Crustacea, Copepoda) from Balkan peninsula. Mém. Biospéol. 25: 25–33.

Karanovic, T., 1999. *Ceuthonectes petkovskii*, a new species of Harpacticoid copepod from Montenegro (Crustacea, Canthocaptidae). Bull. Zool. Mus. 16: 97–102.

Karanovic, T. & M. Bobic, 1998. Two new species of Copepoda Harpacticoida from East Serbia (Balkan peninsula): *Parastenocaris serbica* sp. n. and *Bryocamptus* (*R.*) *borus* sp.n. Crustaceana 71: 171–184.

Kiefer, F., 1930. Neue höhlenbewohnende Ruderfußkrebse. Zool. Anz. 9/10: 222–228.

Pesce, G., L. & D. M. P. Galassi, 1994. *Elaphoidella plesai* n. sp., from ground waters of Australia (Copepoda Harpacticoida: Canthocamptidae). Ann Limnol. 30: 91–94.

Petkovski, T. K., 1959. *Morariopsis kieferi* n.sp., ein neuer Höhlenhapacticide (Crustacea, Copepoda) aus Dalmatien. Fragm. balcan. 25: 197–200.

Petkovski, T. K., 1983. Neue höhlenbewohnende Harpacticoida (Crustacea, Copepoda) aus Slovenien. Acta mus. Maced. Sci. nat. 16: 177–205.

Reid, J. W., 1995. Redescription of *Parastenocaris brevipes* Kessler and description of a new species of *Parastenocaris* (Copepoda: Harpacticoida: Parastenocarididae) from the U.S.A. Can. J. Zool. 73: 173–187.

Reid, J. W. & T. Ishida, 1993. New species and new records of the genus *Elaphoidella* (Crustacea: Copepoda: Harpacticioda) from the United States. Proc. Biol. Soc. Wash. 106: 137–146.

Rouch, R., 1991. *Parastenocaris mangini* n sp., nouvel Harpacticoide (Copépodes) stygobie des Pyrénées. Crustaceana 63: 306–312.

Rouch, R., 1991a. Un nouveau genere d'Ameiridae (Copepoda, Harpacticoida) dans le milieu hyporhéique d'un cours d'eau de d'Arizona. Stygologia 7: 149–157.

Schminke, H. K. & J. Notenboom, 1990. Parastenocaridae (Copepoda, Harpacticoida) from The Netherlands. Bijdr. Dierk. 60: 299–304.

Stoch, F., 1998. A new genus and two new species of Canthocamptidae (Copepoda, Harpacticoida) from caves in northern Italy. Hydrobiologia 350: 49–61.