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Taxonomic Study on the Digonont Rotifers of Korea: Six New Records of Philodinid Rotifers

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ABSTRACT

Six bdelloid rotifers are newly recorded from Korea: *Philodina vorax*, *Philodina flaviceps*, *Philodina acuticornis odiosa*, *Didymodactylus carnosus*, *Macrotrachela multispinosa crassispinosa*, *Macrotrachela papillosa*. All these are fully redescribed and illustrated.

Key words: taxonomy, digonont rotifers, Philodinidae, new records, Korea

INTRODUCTION

Bdelloid rotifers are ubiquitous animals, capable of dwelling in lakes, streams and in the water film covering terrestrial mosses and soil. A total of 364 species of Bdelloidea are known throughout the world(Ricci, 1987; Örstan, 1995), but only seven species were recorded from Korea so far(Song and Kim, 1996). This serious paucity doesn' t mean that bdelloids are rare in Korean waters. According to Ricci(1987), in moss and soil, 95% of rotifers are bdelloids while around the shores of freshwater environments, 20-30% of rotifers are bdelloids: This means that further study on Korean bdelloids is reguired.

For this taxonomic study on Korean bdelloids, specimens were collected from various terrestrial habitats at the campus of Kangnung National University in Kangnung-city(Song and Kim, 1996) and from mosses at Uljin, Uljin-gun, Kangwon-do from Oct. 12, 1995 to May 21, 1996. In the section of "Material examined", collectors were referred when the specimens were not collected by the authors. Most samples were examined in live state. Drawings were carried out with both mounted and live

specimens. Because the specimens tend to shrink a little during the procedures of mounting, drawings of the mounted specimens are more shorter and stouter than those of the live ones.

As a result, *Philodina vorax, Philodina flaviceps, Philodina acuticornis odiosa, Didymodactylus carnosus, Macrotrachela multispinosa crassispinosa, Macrotrachela papillosa* were identified. All these are newly reported from Korea and bring the record of Korean bdelloids to 13 species. The classification scheme is based on Nogrady *et al.* (1993).

SYSTEMATIC ACCOUNTS

Class Digononta Plate, 1889 쌍소(雙巢) 강

Order Bdelloidea Hudson and Gosse, 1886 질형(蛭形) 목

Family Philodinidae Bryce, 1910 선(旋)윤충 과

Genus ***Philodina*** Ehrenberg, 1830 선(旋)윤충 속

1. *Philodina vorax* (Janson, 1893) 먹보선윤충(신칭) **(Fig. 1a-b)**

Callidina vorax Janson, 1893, p. 60, pl. 3, figs. 40, 41, 42; Brauer, 1912, p. 26, figs. 35a, b.

Philodina vorax: Murray, 1913, p. 235, pl. 9, figs. 1a-d; Bartoš, 1959, p. 190, figs. 29A, B, E; 42H; Donner, 1965, p. 226, figs. 160a-c.

Material examined. 15 females, Campus of Kangnung National Univ.(moss, lichens and forest litter), Dec. 13 1995; 22 females, Campus of Kangnung National Univ.(temporary pool after rain), Mar. 18 1996; 20 females, Campus of Kangnung National Univ.(moss, lichens and forest litter), Apr. 23 1996; 30 females, Uljin(moss), May 21 1996(Y.S. Chang and K.Y. Choi).

Description. Eye spots absent. Body 272-438㎛ long, brownish and with smooth integument. Lumen of stomach distinct, broad and pinkish. Rostrum lamella 2-lobed; each lobe semicircular and rather narrower than a half of head width. Corona 75-90㎛ wide and much broader than trunk. Upper lip concave and slightly 2-lobed medially. Sulcus shallow and wide(almost as wide as pedicel). Dorsal antenna 1/2 of antenna segment height. Unci with 2/2 strong teeth. Trunk fusiform and 51-61㎛ wide. Foot 4-segmented and about 1/4 of total body length. Spurs triangular in outline and pointing posteriorly or divergent; 4-10㎛ long and 1/2 of spur segment width; interspace between spurs very wide(2.5-3 times as wide as spur base) and flat or slightly 2-lobed. Four toes present; ventral pair longer and thicker than dorsal one. Egg oval and with 11 low bumps in lengthwise section.

Distribution. USA, Canada, Bolivia, Madeira, Great Britain, Ireland, Sweden, Germany, Switzerland, Czechoslovakia, Austria, Hungary, Rumania, Africa, India, Australia, New Zealand, Hawaii, Korea.

Remarks. The present genus *Philodina* is new to Korean fauna and present species is new to East Asia. This species is easily recognized by its wide corona and interspace between spurs. Interspace tends to be flat if spurs pointing posteriorly and slightly 2-lobed if spurs divergent. They are often found in a large numbers from moss samples.

2. *Philodina flaviceps* Bryce, 1906 황금눈선윤충(신칭) **(Fig. 1e-g)**

Philodina flaviceps Bryce, 1906 (In: Murray, 1906, p. 172, pl. 1, figs. 1a-f); Bartoš, 1959, p.

184, figs. 26A-C, F, G, K, 47G; Schulte, 1959, p. 180, figs. 3a-b; Donner, 1965, p. 203, figs. 147b-c.

Material examined. 30 females, Uljin(moss), May 21 1996(Y.S. Chang and K.Y. Choi).

Description. Body 427-525㎛ long. Corona 72-79㎛ wide and slightly broader than trunk. Sensillae rather apart from center to lateral margin of trochus disc. Sulcus as wide as trochus disc. Upper lip shallow, wide U-shaped or rather flat, and with small bulges at both ends; slightly two-lobed medially. Rostrum short and a little broader than 1/2 of neck width; lamella 2-lobed; radial tufts of long cilia present under lamella. Dorsal antenna 2-segmented and its length about 3/4 of antenna segment width. Oesophagus as long as trophi. Unci with 2/2 strong teeth. Two orange eyes present at posterior part of brain(cerebral eyes) and overlapping with mastax in ventral view. Stomach lumen distinct and pinkish. Trunk 61-75㎛ wide, fusiform on the whole but getting slender between second and third segments in locomotion; preanal segment abruptly tapered to anal segment, which almost as wide as first foot segment. Foot 4-segmented and its length about 3/10 of trunk length; cylindrical and tapering gradually to toes; its maximum width 1/2 of trunk width. Spurs thumb-shaped and often with sharp point, sometimes with small knob at end; 5-6㎛ long(1/4 of spur segment width); interspace between spurs as wide as spur base. Four toes present; ventral pair much longer than dorsal one. Oviparous. Egg lemon-shaped and with smooth surface.

Distribution. cosmopolitan.

Remarks. This species is easily recognized by its thumb-shaped spurs, which are short, parallel and with wide interspace between them. In East Asia, this species was reported from Japan(Mizuno and Takahashi, 1991).

3. *Philodina acuticornis odiosa* Milne, 1916 밉상뾰족뒷발톱선윤충(신칭) **(Fig. 1c-d)**

Philodina acuticornis odiosa Milne, 1916, p. 71, pl. 4, figs. 7-7b; Schulte, 1954, p. 609, figs. 37a-c; Bartoš, 1959, p. 183, figs. 27C, F; Donner, 1964, p. 305, figs. 43-47; Donner, 1965, p. 212, figs. 156-158.

Material examined. 20 females, Uljin(moss), May 21 1996(Y.S. Chang and K.Y. Choi).

Description. Body 201-346㎛ long. Rostrum short and narrow; rostrum lamella 2-lobed and rather small; radial tufts of long cilia present at distal area of rostrum, just under rostrum lamella. Corona 70-121㎛ wide, much broader than cingulum and slightly broader than trunk; base of sensillae rather big. Upper lip concave. Sulcus width nearly 1/2 of trochus disc width. Antenna 2-segmented and a little longer than 1/2 of antenna segment width; antenna segment with swollen lateral margin. Oesophagus very short and about 1/3 of trophi length. Two eyes with dull orange color present at posterior part of brain(cerebral eyes) and overlapping with mastax in ventral view. Unci with 2/2 strong teeth. Trunk 61-93㎛ wide, cylindrical and posterior part gradually tapering to foot. Foot rather short(2/5 of trunk length), 4-segmented and tapering gradually to spur segment. Spurs wedge-shaped and with acute points; 7.5-11㎛ long(about 3/5 of spur segment width); interspace between spurs a little shorter than spur length. Four toes present; ventral pair much longer and thicker than dorsal one, which always extended a little even during feeding.

Distribution. Austria, Rumania, Poland, South Africa, Jamaica, USA, Germany, Chile, England,

Japan and Korea.

Remarks. Partially extended dorsal toe pair during both feeding and locomotion is one of the important diagnostic characters of this species and the chief distinction between this species and *P. acuticornis acuticornis* Murray, 1902. When feeding, bdelloids usually fix their body to the bottom on spurs, with all toes and toe segment pulled in and only corona and mastax are working. Donner(1964, 1965, 1970) had some doubts about validity of extended dorsal toe pair as a diagnostic character, but admitted this subspecies tentatively. We agree with Donner. This subspecies is new to Asian fauna. *P. acuticornis acuticornis* was reported in Japan(Mizuno and Takahashi, 1991)

Genus ***Didymodactylus*** Milne, 1916 두발가락윤충 속(신칭)

4. *Didymodactylus carnosus* Milne, 1916 둔중두발가락윤충(신칭) **(Fig. 2e-g)**

Didymodactylus carnosus Milne, 1916, p. 56, pl. 2, figs. 2a-c; Bartoš, 1959, p. 254, figs. 30L-N; Donner, 1965, p. 231, fig. 170.

Material examined. 9 females, Uljin(moss), May 21 1996(Y.S. Chang and K.Y. Choi).

Description. Eye spots absent. Body 386-607㎛ long. Corona 51-75㎛ wide, much wider than cingulum but rather narrower than trunk width. Upper lip 2-lobed and its width about 1/4 of trochus disc width; each lobe circular, high and much narrower than 1/2 of upper lip width; interspace between lobes narrow(about 1/7 of upper lip width) and inverted M-shaped with convex sides. Rostrum rather short; rostrum lamella 2-lobed, each lobe located at antero-lateral corners of rostrum and interspace between them as wide as lobe and rather swollen, which making rostrum lamella look 3-lobed. Antenna thick, short(1/3 of antenna segment width) and 2-segmented(proximal segment 2 times as long as distal one); lateral margin of antenna segment rather swollen. Unci with 1+3+1/1+3+1 strong teeth. Trunk 63-99㎛ wide and with distinct longitudinal ridges; postero-lateral margins of preanal and anal segment rather squarish and past to next segments; posterior part of trunk rather swollen dorsally. Foot 4-segmented; first segment rather swollen, drooping postero-dorsally. Spur 14-15㎛ long, conical, incurved and with acute point; its base exceedingly rounded all around, especially inside like strong shoulder. Two toes present with circular sheath around them.

Distribution. South Africa, Austria, Hungary, Canary Islands, New Zealand and Korea.

Remarks. The present genus *Didymodactylus* and the present species is new to Asia as well as Korea. Milne(1916) established the present genus *Didymodactylus* based on this species, *D. carnosus*, which has only two toes. Since then, only the present species has been known in the genus *Didymodactylus*(Donner, 1965). This rare species is easily recognized by trilobate-looking rostrum lamella, rounded spur base and two toes with prominent sheath around them but they were found in small numbers. This species is very similar to *Mniobia tetraodon* in some characteristics, such as the shapes of rostrum lamella, upper lip, spurs and toes. But this species is apparently different from *M. tetraodon* by the following characteristics: (1) The foot of this species has two distinct toes but that of *M. tetraodon* two stumpy toe-like papillae, and (2) Spurs of this species have rounded bases, but the spur bases of *M. tetraodon* are not so globose, relatively smaller and swollen just inside(Milne, 1916; Donner, 1965).

Genus ***Macrotrachela*** Milne, 1886 큰관윤충 속

5. *Macrotrachela multispinosa crassispinosa* (Murray, 1907) 굵은가시큰관윤충(신칭) **(Fig. 2d)**

Callidina multispinosa var. *crassispinosa* Murray, 1907, p. 99, fig. 4.

Macrotrachela multispinosa crassispinosa: Bartoš, 1959, p. 248, figs. 41D; 57CH; Donner, 1965, p. 113, figs. 84d-e.

Material examined. 5 females, Campus of Kangnung National Univ.(forest litter), Oct. 12 1995; 20 females, Campus of Kangnung National Univ.(moss, lichens and forest litter), Dec. 13 1995; 10 females, Campus of Kangnung National Univ.(moss, lichens and forest litter), Apr. 23 1996; 12 females, Uljin(moss), May 21 1996(Y.S. Chang and K.Y. Choi).

Description. Body length 212-243㎛. Rostrum small and its width about 1/3 of antenna segment width. Integument stiff and highly granulated. Antenna segment with swollen lateral margin. Trunk 125-143㎛ long and 63-70㎛ wide; 6-segmented; many cuticular spines with variable length present at margins of trunk segments; spines long, curved and with wide bases; 2 long spines at each antero-lateral corner of first trunk segment; 2 long spines at each antero-lateral corners and one long pair at each postero-lateral margin of second segment; transverse row of ten short spines present at antero-dorsal area and two short spines at each postero-lateral margin of third segment; two short spines at each postero-lateral margin and 2-3 short spines on postero-dorsal area of fourth segment; 5 short spines at postero-dorsal margin and 3 short spines forming a triangle on dorsal area of preanal segment; 2 spines at each postero-lateral margin and 1 short pair on dorsal area of anal segment. Foot 4-segmented; postero-lateral corners of first foot segment acutely pointed; 1 small papilla present on dorsal area of third segment. Spurs conical and their points slightly incurved; about 5㎛ long(2/5 of spur segment width); inner margin rather swollen in proximal part like small shoulder; interspace a little shorter than spur base width.

Distribution. British Guiana, Czechoslovakia, Spain, Rhodes(Aegean Sea) and Korea.

Remarks. Three subspecies are present in the species *M. multispinosa: brevispinosa* Murray, *crassispinosa* Murray and *flagellata* Bartoš. *M. multispinosa crassispinosa* is distinguished from the other subspecies by its long and rather wide spines with broad bases. Spine pattern is somewhat variable both between and within subspecies. This subspecies is new to Asia. In Japan, Yamamoto(1960) reported *M. multispinosa* just as a part of species list without description. Mizuno and Takahashi(1991) contains *M. multispinosa* with short description and a figure but we couldn't figure out which subspecies it belonged to.

6. *Macrotrachela papillosa* Thompson, 1892 유두돌기큰관윤충(신칭) **(Fig. 2a-c)**

Macrotrachela papillosa Thompson, 1892, p. 60(cited from Bartoš, 1959); Bartoš, 1959, p. 242, figs. 40F-H, K-M; Donner, 1965, p. 85, figs. 86a-e.

Callidina papillosa: Janson, 1893, p. 66, pl. 4, figs. 56-57.

Material examined. 23 females, Campus of Kangnung National Univ.(moss, lichens and forest litter), Apr. 23 1996; 15 females, Uljin(moss), May 21 1996(Y.S. Chang and K.Y. Choi).

Description. Integument rather stiff and highly granulated. Rostrum lamella 2-lobed, rather big and

circular. Corona 61-66㎛ wide and rather broader than cingulum. Trochus disc circular ventrally. Pedicle rather long, about 2 times as high as upper lip and almost as wide as trochus disc ventrally. Upper lip convex and triangular. Cingulum convex and circular ventrally. Sulcus width about 1/2 of trochus disc width. Small sac-like 7 protuberances forming a rosette under distal part of rostrum ventrally, just over folded corona in ventral view. Antenna longer than rostrum and 2-segmented(proximal segment 2.5 times as long as distal one); distinct protuberances on either side of antenna. Unci with 2/2+1 strong teeth. One posteriorly curved short spine present at each antero-lateral corner of last neck segment. Trunk 108-153㎛ long and 50-101㎛ wide, 6-segmented, with 10 prominent longitudinal ridges dorsally and with many small papillae at dorsal and/or lateral margins of trunk segments; about 12-14 papillae at all lateral margins of first and second segments; 1 transverse ridge with a papilla at each end present on third segment dorsally; 2-3 papillae at each lateral margin and 3 ones at postero-dorsal margin of fourth segment, which slightly curved in; 5 papillae at postero-dorsal margin and 3 small ones forming a triangle on dorsal area of preanal segment; a pair of small papilla on anal segment dorsally. Foot highly granulated, 4-segmented and with 3 toes. Spurs about 4㎛ long, conical and rather swollen all around and with sharp points; interspace between spurs as wide as spur base and rather flat.

Distribution. cosmopolitan.

Remarks: In East Asia, this species was reported from China by Bartoš(1963)(see Wulfert, 1968).

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한국산 쌍소(雙巢) 윤충류에 대한 계통분류학적 연구: 선윤충 과의 6 미기록종

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요 약

강릉대학교 캠퍼스와 울진읍 인근의 이끼, 지의류, 부니질 등에서 채집된 쌍소 윤충류를 동정한 결과 Philodinidae 과에 속하는 4종 및 2아종의 미기록종이 확인되어 이들을 모두 재기재하고 도판을 작성하였다: *Philodina vorax*, *Philodina flaviceps*, *Philodina acuticornis odiosa*, *Didymodactylus carnosus*, *Macrotrachela multispinosa crassispinosa*, *Macrotrachela papillosa*.

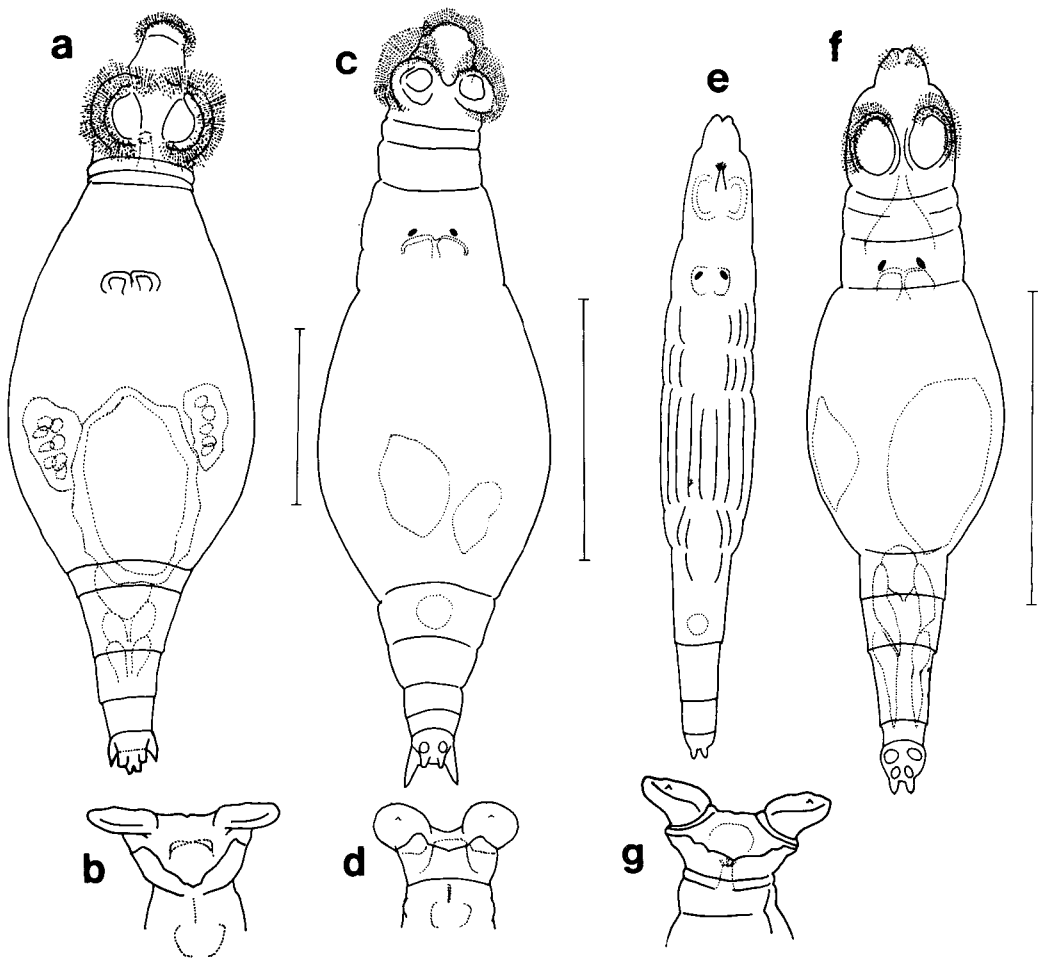

Fig. 1. a-b, *Philodina vorax* (Janson, 1893): a, ventral view; b, head of a feeding animal (ventral view). c-d, *Philodina acuticornis odiosa* Milne, 1916: c, ventral view; d, head of a feeding animal (ventral view). e-g, *Philodina flaviceps* Bryce, 1906: e, a fully extended animal (dorsal view); f, ventral view; g, head of a feeding animal (ventral view). (Scale bars: 100㎛ for all)

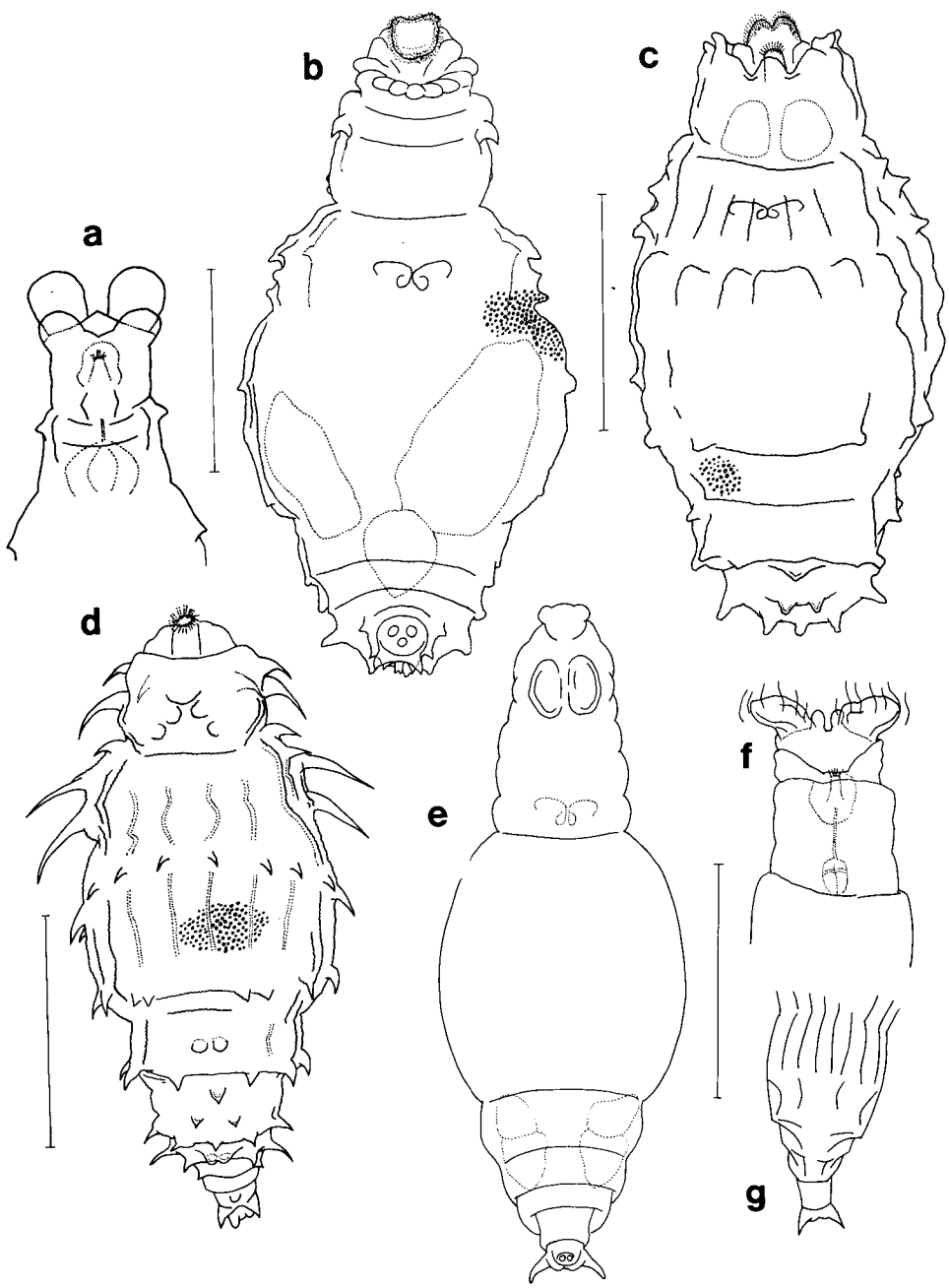

Fig. 2. a-c, *Macrotrachela papillosa* (Thompson, 1892): a, head of a feeding animal (ventral view); b, ventral view; c, dorsal view. d, *Macrotrachela multispinosa crassispinosa* (Murray, 1907), dorsal view. e-g, *Didymodactylus carnosus* Milne, 1916: e, ventral view; f, head of a feeding animal (ventral view); g, posterior part of trunk, foot and spurs (dorsal view). (Scale bars: b, c, d = 50㎛; e = 100㎛)