

A New Gastrotrich Species of the Genus *Ptychostomella* (Macrodasysida, Thaumastodermatidae) from South Korea

Ji Min Lee, Ui Wook Hwang¹, and Cheon Young Chang^{2,*}

Institute of Basic Science, Daegu University; ¹Department of Biology, Teachers College, Kyungpook National University, Daegu 702-701, Korea; ²Department of Biological Science, College of Natural Sciences, Daegu University, Gyeongsan 712-714, Korea

Abstract: A new marine gastrotrich species, *Ptychostomella jejuensis* n. sp. belonging to the family Thaumastodermatidae, is described on the basis of the specimens from subtidal sand bottom at about 6-7 m depth of Jeju Island, South Korea. *Ptychostomella jejuensis* n. sp. is distinguished from its congeneric species with smooth cuticular armature by the character combination: (1) small body up to about 160 μ m in length; (2) presence of knob-like cephalic tentacles; (3) absence of dorsal and ventral adhesive tubes; (4) bifid pedicles; (5) pyriform copulatory organ. Under scanning electron microscopy, numerous epidermal gland openings were observed in the new species, characteristically flanking a bristle. Taxonomic accounts on the affinities, some brief remarks on the epidermal gland openings and the co-occurrence with *P. orientalis* Lee and Chang, 2003 are also presented with detailed illustrations and scanning electron photomicrographs.

Key words: Gastrotricha, Korea, Macrodasysida, new species, *Ptychostomella*, SEM, Thaumastodermatidae, taxonomy

INTRODUCTION

A total of 16 species have been recorded by the serial researches on the marine gastrotrich fauna from South Korea (Chang, Lee and Clausen, 1998a, b; Chang and Lee, 2001; Lee and Chang, 2002, 2003, 2004, 2006, 2007), including two species belonging to the genus *Ptychostomella* (Thaumastodermatidae), *P. orientalis* Lee and Chang, 2003 and *P. papillata* Lee and Chang, 2003.

Recently, during a faunistic study on the marine meiofauna of Jeju Island, South Korea, we found a gastrotrich species belonging to the genus *Ptychostomella* with minute body size among sandy sediments containing lots of shell

crumbles from subtidal bottom at about 6-7 m depth. By the detailed scanning electronic microscopy, we confirmed that this species is characteristic in having the numerous cuticular gland openings mostly flanking a bristle on the dorsal and dorsolateral surfaces. As the character is consistent throughout the specimens examined, and the species shows the clear discrepancy with the related congeners in the combination of several macro-characters, we determine it a valid species.

We provide the description of the new species based on the morphological characters and a discussion on the taxonomic affinities, with illustrations and scanning electron photomicrographs.

MATERIALS AND METHODS

Materials were collected from the sublittoral sandy bottom containing fine to coarse shell fragments at about 6-7 m depth around Saeseom islet, just 20-30 meters off Seogwipo Harbor at the southern coast of Jeju Island the largest and southernmost island in South Korea.

Samplings were taken by scooping the top sediments into a polyethylene vinyl bag or 700 mL volume plastic bottles by SCUBA diving. The process of extracting gastrotrich specimens and preparation of whole mounts follows Lee and Chang (2003). Formalin-fixed specimens were mounted in glycerin on H-S slide, and then observed under a differential interference contrast microscope (Olympus BX-50) equipped with Nomarski optics. All drawings were carried out with the aid of a camera lucida. Measurements were made using a digital camera for microscope (Cool SNAP 5.0M, Roper Scientific Co., USA) and a calibration software QCapture Pro (ver. 5.0, Media Cybernetics Inc., USA).

Materials for scanning electron microscopy were prefixed with 2.5% glutaraldehyde in 0.1 M phosphate buffer (pH

*To whom correspondence should be addressed.
Tel: +82-53-8506454; Fax: +82-53-8506459
E-mail: cychang@daegu.ac.kr

7.4) for 4-6 hours at 4, followed by rinsing with 0.1 M phosphate buffer (pH 7.2-7.4) three times for 10 minutes each. Specimens were postfixed in 2% cold osmium tetroxide in 0.1 M phosphate buffer for 2 hours, and left in phosphate buffer overnight. After dehydration through a graded series of ethanol (50-100% at 10% interval) for 30 minutes each, the material was critical point dried using a freeze-dryer, and coated with gold-palladium in a high evaporator, and then examined using a scanning electron microscope (Hitachi S-4800) operated at 10 kV.

Type specimens are kept in the authors' collection at the specimen room of the Department of Biology, Daegu University (DB) and deposited in the National Institute of Biological Resources (NIBR), Incheon, Korea.

Terminology mostly follows Ruppert (1991) and Clausen (2000). Abbreviations used in the text are as follows: Lt=total length, from anterior tip of head to posterior tip of pedicles including adhesive tubes; U=percentage unit of Lt, used for the location (U-) from anterior to posterior, or for the relative length (-U); PhJIn=junction between pharynx and intestine; TbA=anterior adhesive tubes; TbD=dorsal adhesive tubes; TbL=lateral adhesive tubes; TbP=posterior adhesive tubes; TbV=ventral adhesive tubes; TbVL=ventrolateral adhesive tubes.

SYSTEMATIC ACCOUNTS

Family Thaumastodermatidae Remane, 1926
Subfamily Thaumastodermatinae Ruppert, 1978
Genus *Ptychostomella* Remane, 1926
***Ptychostomella jejuensis* new species**
(Figs 1-3)

Type specimens: Holotype (DBG1301) and 10 paratypes (DBG1302-1111), mounted in glycerin on H-S slides, *leg.* C. Y. Chang, J. M. Lee and S. H. Kim, 24 April 2006. Another two paratypes (NIBRIV0000131151, 0000131159), mounted in glycerin, collection data same as in the holotype.

Additional material examined: Eight specimens with the same collection data are mounted on aluminum stub for SEM observation.

Type locality: Saeseom islet, Seogwipo, Jeju Island, South Korea (33°14'04"N, 126°33'56"E), in sublittoral sandy sediments containing shell crumbles at about 6-7 m depth.

Etymology: The specific name *jejuensis* alludes to the type locality of the present new species, Jeju Island, South Korea.

Diagnosis: Small *Ptychostomella* with short, bilobed caudum; body up to 164 µm long; PhJIn at about U34;

eyespot lacking; bearing paired knob-like tentacles dorsolaterally; dorsal cuticular armature smooth; numerous gland openings scattered on dorsal, dorsolateral and ventrolateral surfaces, among which nearly half of the dorsal and dorsolateral ones flanking a bristle; adhesive tubes: 3 TbA per side in a horizontal row; 5 TbVL per side, including a small tube behind TbA; 4 slender TbVL evenly spaced in intestinal region; 2 TbL per side, in the middle and at outer posterior edge of body, respectively; 5 TbP forming a pedicle, comprising 2 distal, 1 lateral and 2 medial tubes; copulatory organ pyriform.

Description of the holotype: Body (Figs. 1, 2) minute, Lt 149 µm long; semi-rectangular, with a short, bilobed caudum; dorsal surface somewhat uneven with undulating dorsolateral sides; both lateral sides of body nearly parallel, with slight constriction in the middle of pharyngeal region. Pharynx 36 µm long (measured from ventral border of oral opening to pharyngo-intestinal junction); PhJIn located at U33, with paired pharyngeal pores, opened ventrally at U32. Widths of oral opening/neck/PhJIn/trunk/caudal base 33/23/24/29/23 µm at U06/U25/U33/U69/U93, respectively.

Oral hood broad and a little swollen anteriorly, with slightly undulating border (Fig. 1A). Six to 8 long sensory hairs (ca. 10-15 µm long) implanted along dorsal margin of oral hood; more than 13 hairs (ranging 4-7 µm long) along anterior edge of oral hood both dorsally and ventrally; a pair of cilia tufts consisting of 3 sensory hairs (ca. 15-16 µm long) situated on anterolateral part of oral hood at U04; at least 11 pairs (ca. 9-14 µm long) of hairs located on subdorsal, dorsolateral and lateral sides along entire body length posterior to knob-like tentacle (U10-U93); 4-6 pairs of sensory hairs aligned dorsolaterally per side, each pair composed of a long (5-8 µm) and a short (1-3 µm) hair at U24-U81 (Fig. 3C). Eyespot lacking. Paired knob-like tentacles (pestele organs) (Fig. 3A, arrow) small (ca. 3 µm diameter) and protruding dorsolaterally at U08.

Oral opening (Figs. 1B, 2B) (ca. 33 µm in diameter) a little undulating ventrally, bearing numerous hairs (ca. 2-5 µm long) along its posterior rim.

Dorsal cuticular armature smooth, lacking embossed hemispherical elevations or papillae. Numerous epidermal glands irregularly scattered at dorsal, dorsolateral, and ventrolateral surfaces, along nearly whole body length (U10-U89); with generally circular shape, mixed in various size (from 2 to 7 µm in diameter). Numerous elliptical gland openings or 'stomata' (Figs. 1A, 3B-D) with cuticularized lips (from 1 to 3 µm in diameter), some paired, but mostly scattered asymmetrically on dorsal and dorsolateral surfaces; 4-5 pairs of openings (Fig. 3E, F, arrows) sparsely distributed on ventrolateral side ranging from behind TbA to middle of pharyngeal region (U23); about half of the gland openings each flanking a short bristle (Fig. 3B, D, arrow), excluding

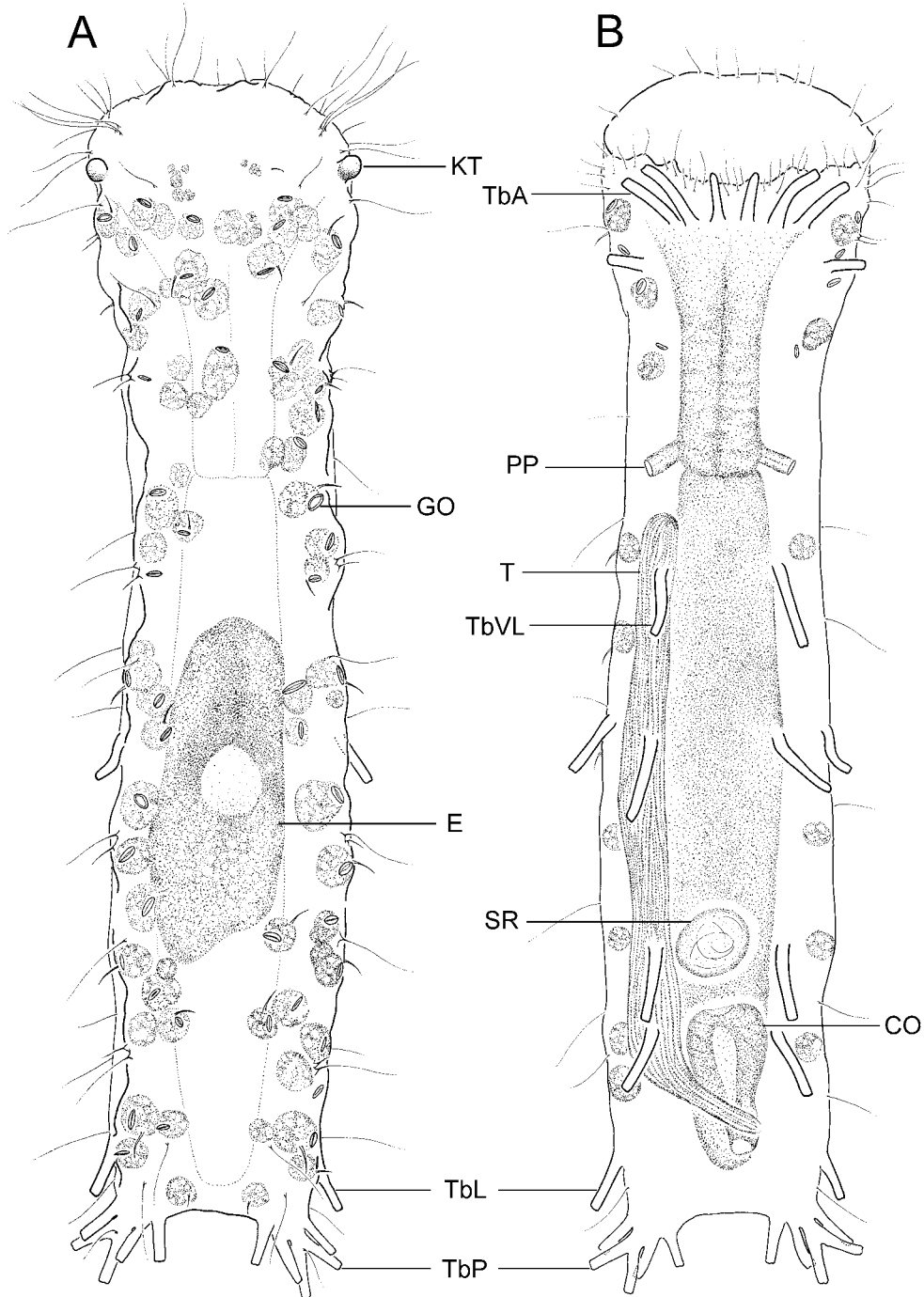


Fig. 1. *Ptychostomella jejuensis* new species. A, habitus, dorsal; B, habitus, ventral. Scale bar=20 μ m. CO, copulatory organ; E, egg; GO, gland opening; KT, knob-like tentacle (pestle organ); PP, pharyngeal pore; SR, seminal receptacle; T, testis; TbA, anterior adhesive tubes; TbL, lateral adhesive tubes; TbP, posterior adhesive tubes; TbVL, ventrolateral adhesive tubes.

ventrolateral openings.

Ventral cilia (Fig. 2B) covering mid-ventral surface, just behind TbA to base of caudum.

Adhesive tubes: TbA 3 per side (Figs. 2B, 3A), evenly spaced and distributed in a nearly horizontal row behind oral opening at U13, composed of 1 short medial tube (ca. 6 μ m long) and 2 lateral ones (ca. 9-10 μ m long) per side; 5

TbVL per side (Fig. 2B), foremost one rather short, ca. 5 μ m long, situated a little behind TbA at U16; the others somewhat slender and long (ranging ca. 9-11 μ m long), distributed a little more ventrally in intestinal region (at U40, U54, U71 and U78, respectively), last 2 TbVL close to each other; 2 TbL (Fig. 1A, B) per side, the former 9 μ m long, located a little ventrolaterally nearly in the middle of

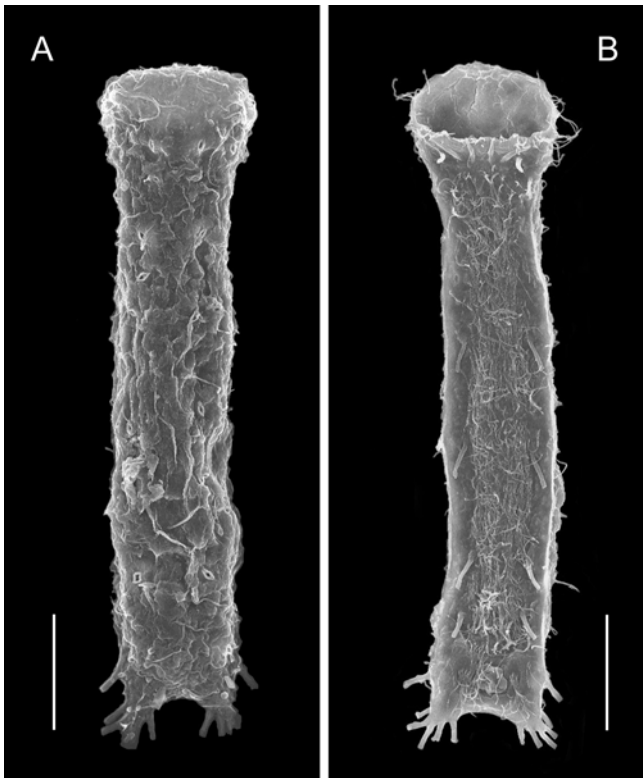


Fig. 2. *Ptychostomella jejuensis* new species, SEM micrographs. A, habitus, dorsal; B, habitus, ventral. Scale bars=20 μ m.

lateral margin of body at U53, the latter 7 μ m long, at lateroposterior edge of body (U91); 5 TbP per side, each forming a pedicle, comprising 2 distal tubes (7 μ m long), flanked by 1 lateral (6 μ m) and 2 medial ones (5-6 μ m).

Reproductive system: testis (Fig. 1B) single on right side (in dorsal view), its tip at U36 not reaching PhJIn; vas deferens apparently not coiled but gently curved medially, ending at U87 toward posterior part of copulatory organ. Copulatory organ (Fig. 1B) pyriform, located at U76-U93. Seminal receptacle (Fig. 1B) oval (9 μ m \times 8 μ m), in front of copulatory organ at U68-U74, containing spermatozoa. A single suboval egg situated dorsally in mid-intestinal region, maximum size ca. 16 μ m \times 40 μ m.

Occurred from the sandy sediments mixed with fine to coarse shell fragments on sublittoral bottom about 6-7 m depth, with *Ptychostomella orientalis* Lee and Chang and an unrecorded species of *Platydasys*.

Taxonomic affinities: Eleven species are currently recognized in the genus *Ptychostomella* Remane, 1926: *P. pectinata* Remane, 1926, *P. ommatophora* Remane, 1927, *P. mediterranea* Remane, 1927, *P. helana* Roszczak, 1939, *P. brachycephalus* (Lévi, 1954), *P. tyrrhenica* Hummon, Todaro and Tongiorgi, 1993, *P. bergensis* Clausen, 1996, *P. lepidota* Clausen, 2000, *P. orientalis* Lee and Chang, 2003, *P. papillata* Lee and Chang, 2003 and *P. higginsii* Clausen, 2004.

The ordinary dorsal cuticular armature in the genus *Ptychostomella* has been known as ‘smooth’, lacking the usual three- to five-pronged cuticular sculptures which are typically shown among thaumstodermatid gastrotrichs and regarded as the important taxonomic characters. However, recently three species equipped with the embossed hemispherical elevations or papillae as the dorsal cuticular armature have been found: *P. lepidota* from Norway (Clausen, 2000), and *P. orientalis* and *P. papillata* from Korea (Lee and Chang, 2003). So, now the members of *Ptychostomella* are divided into two groups by the state of the cuticular armature.

Among the eight species, sharing the smooth cuticular armature, the new species is closely similar to *P. mediterranea* and *P. tyrrhenica* in having a small body length (less than 200 μ m), a pair of knob-like tentacles, 2 TbL, and absence of ‘foot-type’ TbV. However, *P. jejuensis* n. sp. is distinguished from *P. mediterranea* by the absence of TbD (against 6 TbD in *P. mediterranea*) and bifid pedicles (against trifid in *P. mediterranea*), and from *P. tyrrhenica* by 2 medial TbP per side between the bilobed caudum (against the absence of medial TbP in *P. tyrrhenica*) and a pyriform copulatory organ (against a bladder-like copulatory organ in *P. tyrrhenica*). Moreover, the knob-like cephalic tentacles occur dorsolaterally in *P. jejuensis* n. sp., while it is evidently depicted as protruding ventrolaterally just from the posterolateral corner of oral opening in the original description of *P. mediterranea* (see Hummon et al., 1993, Fig. 9B, C).

Ptychostomella jejuensis n. sp. is also allied with *P. higginsii* in sharing the presence of a pair of knob-like tentacles, 2 TbL, bifid pedicle and pyriform copulatory organ; however, the new species differs from it by smaller size (up to 164 μ m vs. 240 μ m in total body length) as well as lower number and different arrangement of TbA, TbVL and TbP. Furthermore, *P. jejuensis* was collected from the sublittoral bottom at 6 m depth, while *P. higginsii* from deep sea at about 160 m depth.

Although *P. orientalis* belongs to the other group with the dorsal cuticular armature of embossed hemispheres, it is somewhat similar to the new species in bearing 3 TbA and 2 TbL per side, and paired knob-like tentacles. However, besides the dorsal cuticular armature, it is different from *P. jejuensis* by having more TbV(L) and TbP, and an oblong copulatory organ. Moreover, all of the epidermal gland openings of *P. orientalis* are simple, not flanking a bristle as shown in the new species.

Remarks: All of the specimens examined were fully mature, and pre-mature individuals were not found. Body lengths of thirteen type specimens ranged from 125 μ m to 164 μ m (mean 144 μ m, standard deviation 12), and maximum widths 26-35 μ m (20U-24U), measured in glycerin mount.

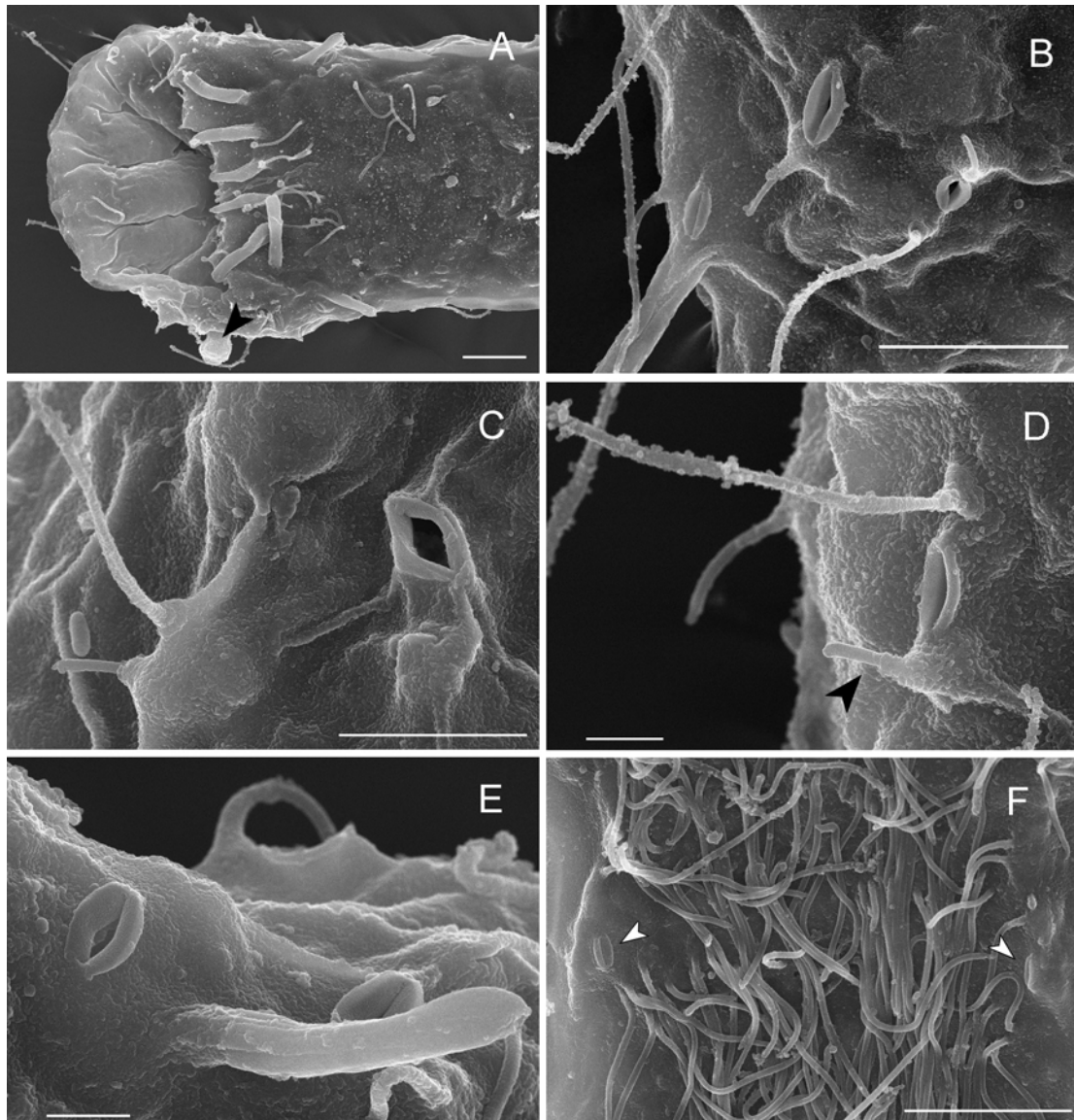


Fig. 3. *Ptychostomella jejuensis* new species, SEM micrographs. A, head, ventral view, showing anterior adhesive tubes (TbA) and knob-like tentacle (arrow); B, cuticular openings of epidermal glands and sensory hairs near lateral adhesive tubes (TbL) on the posterolateral edge of trunk, dorsal view; C, a gland opening and paired sensory hairs on the dorsolateral side of trunk; D, a gland opening flanking a bristle (arrow) and a sensory hair on the lateral trunk region; E, gland openings near ventrolateral adhesive tube (TbVL) on the anterior pharyngeal region, ventral view; F, gland openings (arrows) in the middle of pharyngeal region, ventral view. Scale bars=5 μm (A, B, F), 3 μm (C), 1 μm (D, E).

Those are the smallest members known in the genus *Ptychostomella* so far.

The arrangement and number of adhesive tubes were rather consistent throughout the specimens examined. Among total 21 specimens examined, including SEM material, two specimens were variable: one specimen had an additional lateral TbP and TbVL in the intestinal region (second TbVL consisting of two tubes as ‘foot-type’ in the left side, asymmetrically); the other specimen possessed two additional TbP laterally and medially.

The cuticular openings of epidermal glands were observed on the dorsal, dorsolateral and ventrolateral surfaces. They

appear identical to the strongly cuticularized lips or ‘stomata’, referred to in the description of *Tetranchyroderma weissi* Todaro, 2002 (see Todaro, 2002, Fig. 2A, B, E). The similar cuticular openings have been already observed by scanning electron microscopy in *T. heterotentaculatum* (see Chang and Lee, 2001, Fig. 3G) and *Ptychostomella papillata* (see Lee and Chang, 2003, Fig. 6B) from Korean coasts, although they have not been described in detail. In the previous species, the openings were generally simple and arranged in two columns symmetrically, while nearly half of the openings on the dorsal and dorsolateral surfaces are flanked each by a bristle in the new species, showing

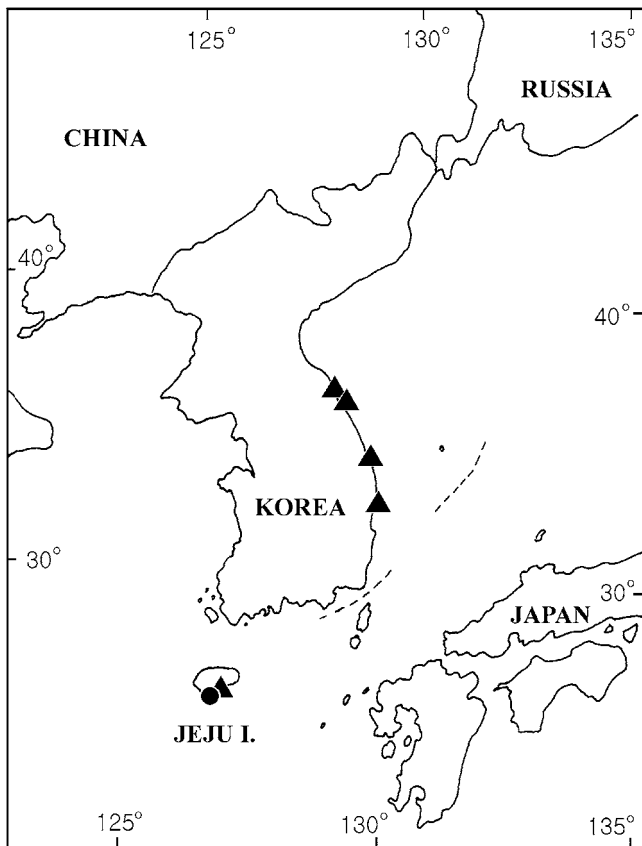


Fig. 4. A map showing the localities of *Ptychostomella orientalis* (▲) and *P. jejuensis* (●).

somewhat irregular disposition. The presence of the cuticular openings on the ventrolateral side has been rarely reported, that is, only mentioned in *T. weissi* and *Platydasys ruber* Swedmark, 1956 *sensu* Todaro, 2002 (Fig. 2F). In the new species, the cuticular openings on the ventrolateral surface are also present but rare (only 4-5 openings on each side), restricted to the anterior part of pharyngeal region behind the oral opening. In addition, they lack the bristle flanking the openings unlike those on dorsal and dorsolateral surfaces.

Ptychostomella jejuensis n. sp. co-occurred with *P. orientalis* in the present type locality, Jeju Island (Fig. 4). This is the second record of the co-occurrence of *Ptychostomella* congeners, next to the case of *P. brachycephalus* with *P. higginsii* from Faroe Bank, the northeastern Atlantic (Clausen, 2004). The ratio of co-occurring individuals between the species from Korea was 21 (*P. jejuensis*):8 (*P. orientalis*). *Ptychostomella orientalis* had been reported from four localities along the eastern coast of South Korea (Lee and Chang, 2003). Comparing with those of the populations from the eastern coast of Korea, the individuals from Jeju Island show relatively larger embossed hemispherical elevations as the dorsal

cuticular armature, seemingly as a reinforcement of the reproductive isolation or a character displacement between the two sympatric congeneric species.

ACKNOWLEDGMENTS

We are grateful to Dr. Sa Heung Kim of the INTHESEA KOREA Inc. for his help in collecting samples, and thankful to Mr. Byung-Chan Lee (Nano Practical Application Center, Daegu, Korea) for providing the facilities in which scanning electron microscopy was conducted. Authors also appreciate three reviewers for their critical comments that greatly improved the manuscript. This research was partly supported to CYC by Daegu University Research Grant, 2006.

REFERENCES

- Chang CY, Lee JM, and Clausen C (1998a) Description of two new species thaumastodermatids (Gastrotricha, Macrodasysida) from Korea. *Korean J Biol Sci* 2: 315-321.
- Chang CY, Lee JM, and Clausen C (1998b) Two new species of *Thaumastoderma* (Gastrotricha, Macrodasysida) from Korea. *Sarsia* 83: 329-336.
- Chang CY and Lee JM (2001) Two new *Tetranchyroderma* gastrotrichs (Macrodasysida Thaumastodermatidae) from South Korea. *Korean J Biol Sci* 5: 187-194.
- Clausen C (2000) Gastrotricha Macrodasysida from the Tromsø region, northern Norway. *Sarsia* 85: 357-384.
- Clausen C (2004) Gastrotricha from the Faroe Bank. *Sarsia* 89: 423-458.
- Hummon WD, Todaro MA, and Tongiorgi P (1993) Italian marine Gastrotricha: II. One new genus and ten new species of Macrodasysida. *Boll Zool* 60: 109-127.
- Lee JM and Chang CY (2002) *Pseudostomella* gastrotrichs (Macrodasysida, Thaumastodermatidae) from South Korea, with a brief review of the genus. *Korean J Biol Sci* 6: 207-213.
- Lee JM and Chang CY (2003) Two new marine gastrotrichs of the genus *Ptychostomella* (Macrodasysida, Thaumastodermatidae) from South Korea. *Zool Sci* 20: 481-489.
- Lee JM and Chang CY (2004) Gastrotrichs of genus *Halichaetonotus* (Chaetonotida: Chaetonotidae) from Korea. *Korean J Syst Zool* 20(1): 55-62.
- Lee JM and Chang CY (2006) Marine gastrotrichs of the genus *Diplodasys* (Macrodasysida: Thaumastodermatidae) from Korea. *Korean J Syst Zool* 22(1): 109-115.
- Lee JM and Chang CY (2007) Two new marine gastrotrichs of the genus *Tetranchyroderma* (Macrodasysida: Thaumastodermatidae) from South Korea. *Zool Stud* 46(4): 474-482.
- Ruppert EE (1991) Gastrotricha. In: Harrison FW and Ruppert EE (eds), *Microscopic Anatomy of Invertebrates, IV: Aschelminthes*, John Wiley & Sons, New York, pp 41-109.
- Todaro MA (2002) An interesting new gastrotrich from littoral meiobenthos (Long Beach Island, USA), with a key to species of *Tetranchyroderma* (Gastrotricha: Macrodasysida). *J Mar Biol Assoc UK* 82: 555-563.

[Received February 4, 2009; accepted February 28, 2009]