

***Tricoma (Quadricoma) jindoensis*, a New Species of
Marine Interstitial Nematoda (Desmoscolecida: Desmoscolecidae)
from Jindo Island, Korea**

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ABSTRACT

A new marine interstitial nematode species belonging to the subgenus *Quadricoma* of order Desmoscolecida is described from Jindo Island, South Korea. The new species, *Tricoma (Quadricoma) jindoensis* sp. nov., is most allied with *T. (Q.) crassicomoides* Timm, 1970 in sharing the similar cephalic setae, broadly truncated border of head, lip region including 6 labial papillae, and slender and long spicule among the seven congeners with 44 quadricomoid rings. However, *T. (Q.) jindoensis* differs from it by the globular protuberance on the penultimate ring, 7 tail rings, and 9 pairs of subdorsal setae in male. This is the first record of *Quadricoma* nematodes from East Asia.

Key words: free-living, marine Nematoda, *Quadricoma*, Desmoscolecida, new species, Korea

INTRODUCTION

Desmoscolecida is an unique nematode order in having the concretion rings and somatic setae. It mainly inhabits the marine interstitial waters from intertidal to deep-sea habitats, and currently comprises 305 species of 21 genera in 2 families (Timm, 1970; Gerlach and Riemann, 1973;

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Freudenhammer, 1975; Decraemer, 1985, 1998). The taxonomic study on the desmoscolecoid nematodes is still nearly lacking in the west Pacific including Korea.

During the commemorative joint survey (June 29-July 1, 2004) for the 20th anniversary of the Korean Society of Systematic Zoology at Jindo Island, we collected a marine free-living nematode species belonging to the genus *Tricoma*, the representative genus of the order Desmoscolecida. As the species showed somewhat characteristic features, we tried and got to obtain the additional materials from the same locality and its adjacent area in October of the same year. The species turned out to be a new species belonging to the subgenus *Quadricoma* of genus *Tricoma*, and described herein under the name of *Tricoma (Quadricoma) jindoensis* sp. nov.

MATERIALS AND METHODS

Materials were collected from seacoast of Jindo Is., South Korea in June and October, 2004. Samplings were made by gathering sublittoral bottom sands into polyethylene vinyl bag by skin divers, or by scraping the various particulate substrates on algal mats at rocky shore. Nematodes were filtered through nylon sieve with 64 μm mesh after freshwater rinsing for less than a minute for osmotic shock (Kristensen, 1989), and then fixed with 5% formalin or 95% ethyl-alcohol.

Specimens were mounted in glycerine on H-S slide (Shirayama et al., 1993), a modification of Cobb slide, after placing in a solution of 5% glycerin in distilled water for 1-2 days, and observed under a differential interference contrast (DIC) microscope (Olympus BX-51) equipped with Nomarski optics. After examination, slides were sealed with nail polish. All drawings were provided using a camera lucida.

Preparation for scanning electron microscopy was achieved with the formalin-fixed specimens. After an ultrasonic treatment (10-30 sec) to remove detritus attached to the body, the nematode specimens were prefixed overnight at 4°C in a 2.5% buffered glutaraldehyde in 0.1 M phosphate buffer (pH 7.4), followed by postfixation with 1% cold osmium tetroxide in the same buffer for 1.5-2 h. After dehydration through a graded ethanol series (20, 40, 50, 60, 70, 80, 90, 95, 100%) for 30 minutes each, the materials were critical point dried, coated with gold-palladium, and examined in a Hitachi S-4300, at 15 KV voltage acceleration.

Terminology mostly follows Decraemer (1998). Abbreviations used in the text are as follows: cs = length of cephalic setae; gub = length of apophysis of gubernaculum; hd = maximum head dimensions (width \times length); L = length of body; mbd = maximum body diameter; (mbd) = maximum body diameter, external material not included; oes = length of oesophagus; sd_n = length of subdorsal somatic setae on main ring n; spic = length of spicules measured along the median line; sv_n = length of subventral somatic setae on main ring n; t = tail length; tmr = length of terminal ring; tmrw = width of terminal ring; V = distance of vulva from anterior body end as percentage of total body length. Indices of de Man (1880): a = (L/mbd), b = (L/oes), c = (L/t). All measurements are in micrometer (μm).

TAXONOMIC ACCOUNTS

Family Desmoscolecidae Schepotieff, 1907 고리선충과(신칭)

Genus *Tricoma* Cobb, 1893 삼각고리선충속(신칭)

***Tricoma (Quadricoma) jindoensis* n. sp.** 진도사각고리선충(신칭) (Figs. 1-3)

Material examined. Holotype: male (DUB30007), Geumgab, Jindo Is., 20 Oct. 2004 (H. W. Lim and J. M. Jeon). Paratypes: three males and two females (DUB30008-30012), collection data same as in holotype. All are mounted in anhydrous glycerine on H-S slides, sealed with nail polish. Holotype and allotype will be deposited in the National Biological Resources Center, Incheon, Korea, and the remaining paratype specimens are kept in the author's research collection at the specimen room of the Department of Biology, Daegu University. Three males and three females from the type locality are gold-coated on the aluminum stub for SEM microscopy.

Additional material examined. 3 males, 2 females, Geumgab, Jindo Is., 1 Jul. 2004 (H. W. Lim and J. M. Jeon); 2 males, 1 females, Jodo Is., Jindo Is., 19 Oct. 2004 (H. W. Lim and J. M. Jeon).

Diagnosis. Body elongated and a little slender; with 44 quadricomoid rings including 7 tail rings; inversion at main ring 31; somatic setae comprising always 12 pairs of subventral setae and 9 pairs of subdorsal setae; head 1.4 times wider than long with broadly truncated anterior border; with 6 lips slightly protruding beyond anterior margin of head; cephalic setae much longer than half of maximum head width, and 1.1 times longer than head length, inserted at nearly middle of head on low peduncle, ending into open tip; amphids rounded, covering nearly whole length of head between peduncles of cephalic setae; ocelli present at main ring 8; spicules slender and long, about 141 μm long; tail with 7 main rings; penultimate ring ventrolaterally with globular protuberance with thickened cuticular mass; phasmata present on endring of male.

Holotype male. Body a little slender and elongated, 620 μm long, tapering towards both extremities; composed of 44 typical quadricomoid main rings, with desmen composed of secretion and fine foreign particles, without interzones. Inversion of direction of main rings at main ring 31 (Fig. 1A).

Head 1.4 times wider than long, tapering from level of insertion of cephalic setae towards broadly truncated anterior margin (Fig. 1C); anterior margin of head thickened and sclerotized, forming markedly rim-shaped border. Labial region with 6 lips slightly protruding beyond anterior margin of head in dorsal view.

Cephalic setae much longer than half of maximum head width, and 1.1 times longer than head length; with broad basal part, tapering into fine open tip, whole length flanked by cuticular flange, observed apparently in frontal view of head; issuing from about middle of head, each inserted on broad and low peduncle (Fig. 1C).

Amphids rounded, covering nearly whole length of head between peduncles of cephalic setae (Fig. 1C), anteriorly slightly less reaching to anterior margin of head, posteriorly a little broad constriction behind peduncles of cephalic setae, then faced to anterior margin of first main ring; amphidial canal ending in small groove near posterior margin of head.

Stoma 7 μm deep, narrow and thick-walled (Fig. 1B). Oesophagus more or less cylindrical,

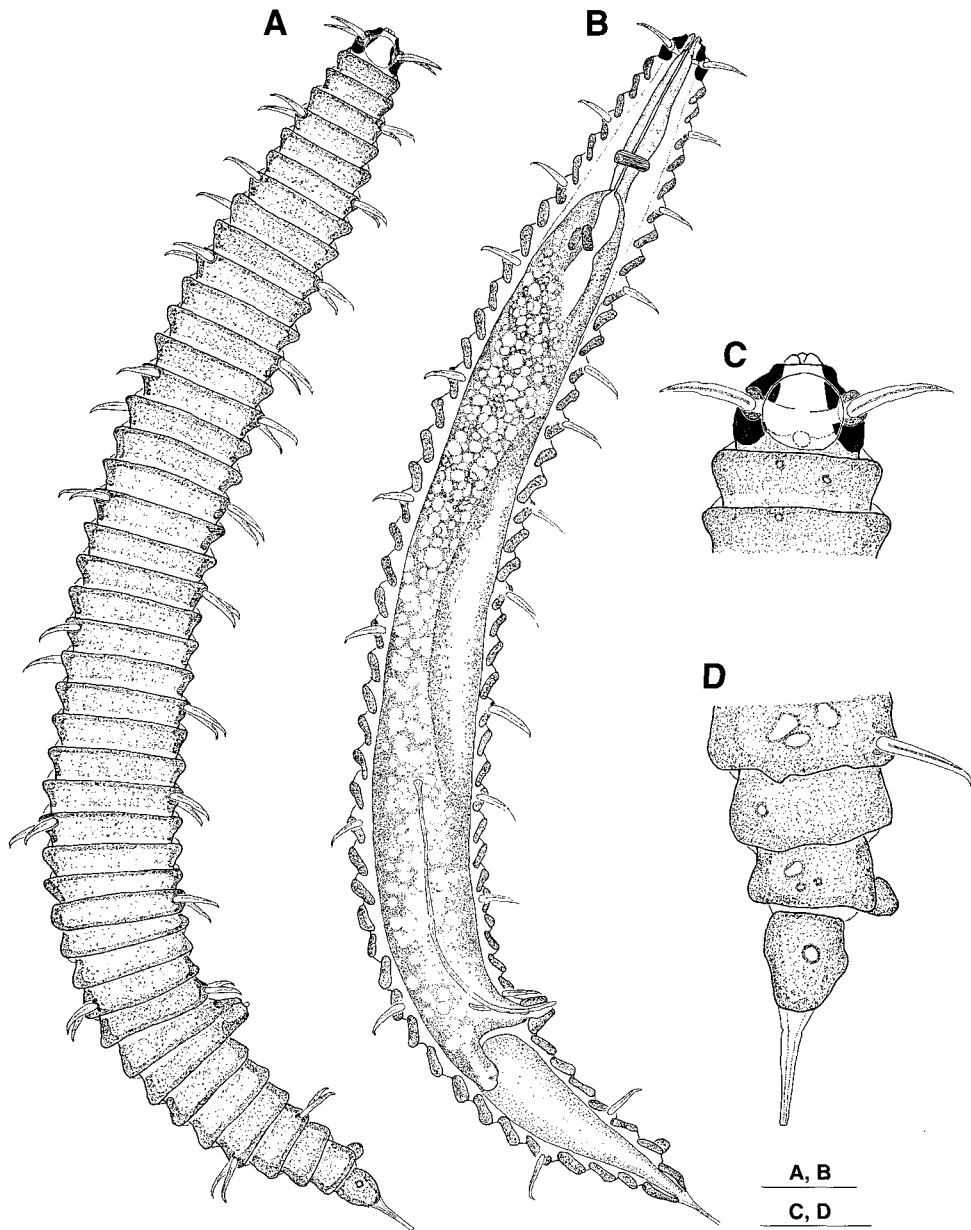


Fig. 1. *Tricoma (Quadricoma) jindoensis* n. sp., holotype male. A, habitus, lateral; B, internal view of whole mount, lateral; C, head region, lateral; D, tail region, lateral. Scale bars = 50 μ m (A, B), 20 μ m (C, D).

gradually widened anterior to nerve ring, then tapering posteriorly. Nerve ring surrounding oesophagus at level of anterior part of main ring 5. Muscular wall of nerve ring showing slight differentiations. Oesophago-intestinal junction occurred at main ring 6.

Pair of ocelli dark-yellowish, with small and rather oblong, vesicular shape (5 \times 10 μ m); situated

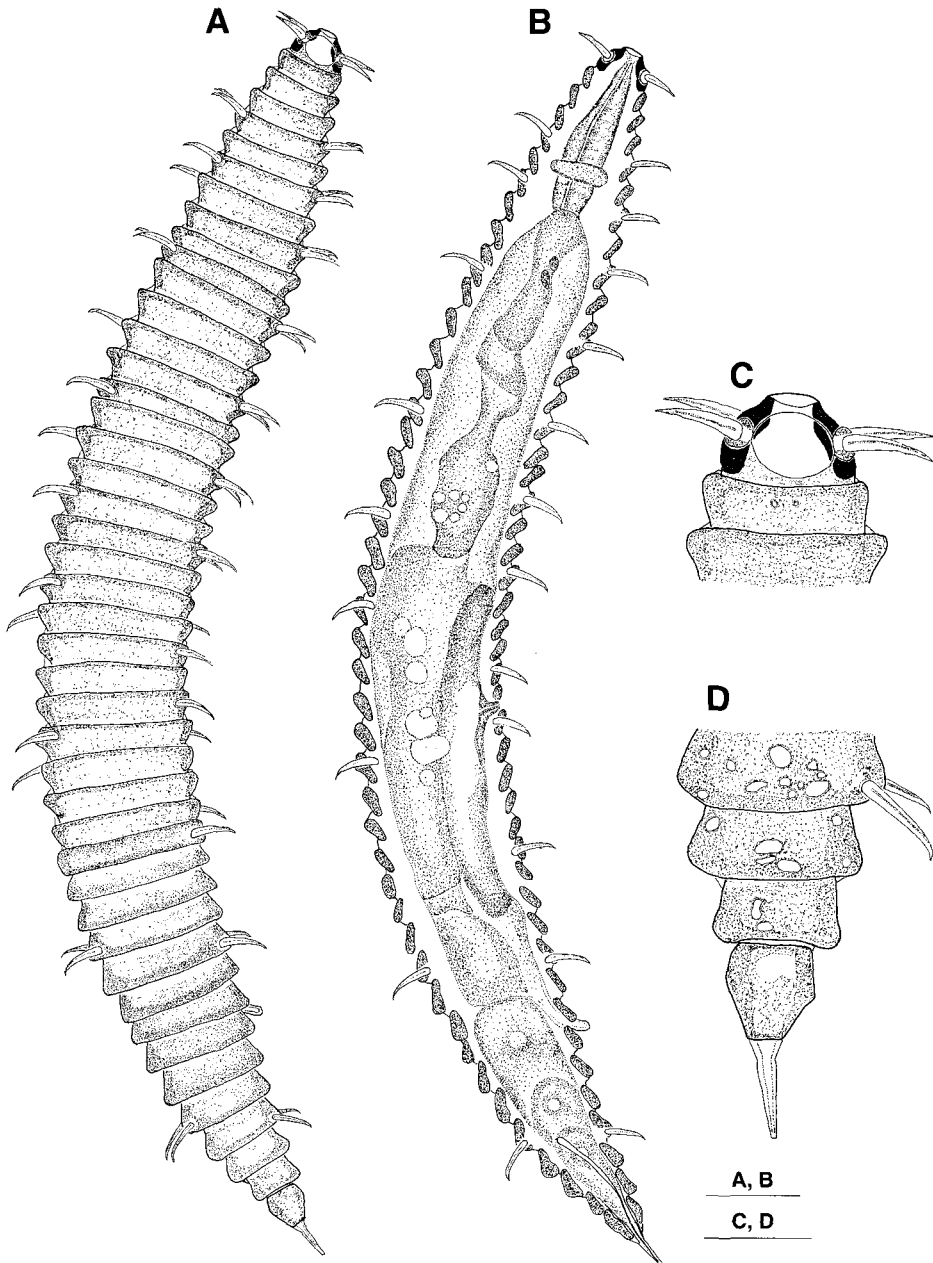


Fig. 2. *Tricoma (Quadricoma) jindoensis* n. sp., allotype female. A, habitus, lateral; B, internal view of whole mount, lateral; C, head region, lateral; D, tail region, lateral. Scale bars = 50 μ m (A, B), 20 μ m (C, D).

at posterior end of main ring 8.

Somatic setae with 9 pairs of subdorsal setae and 12 pairs of subventral setae, arranged as follows:

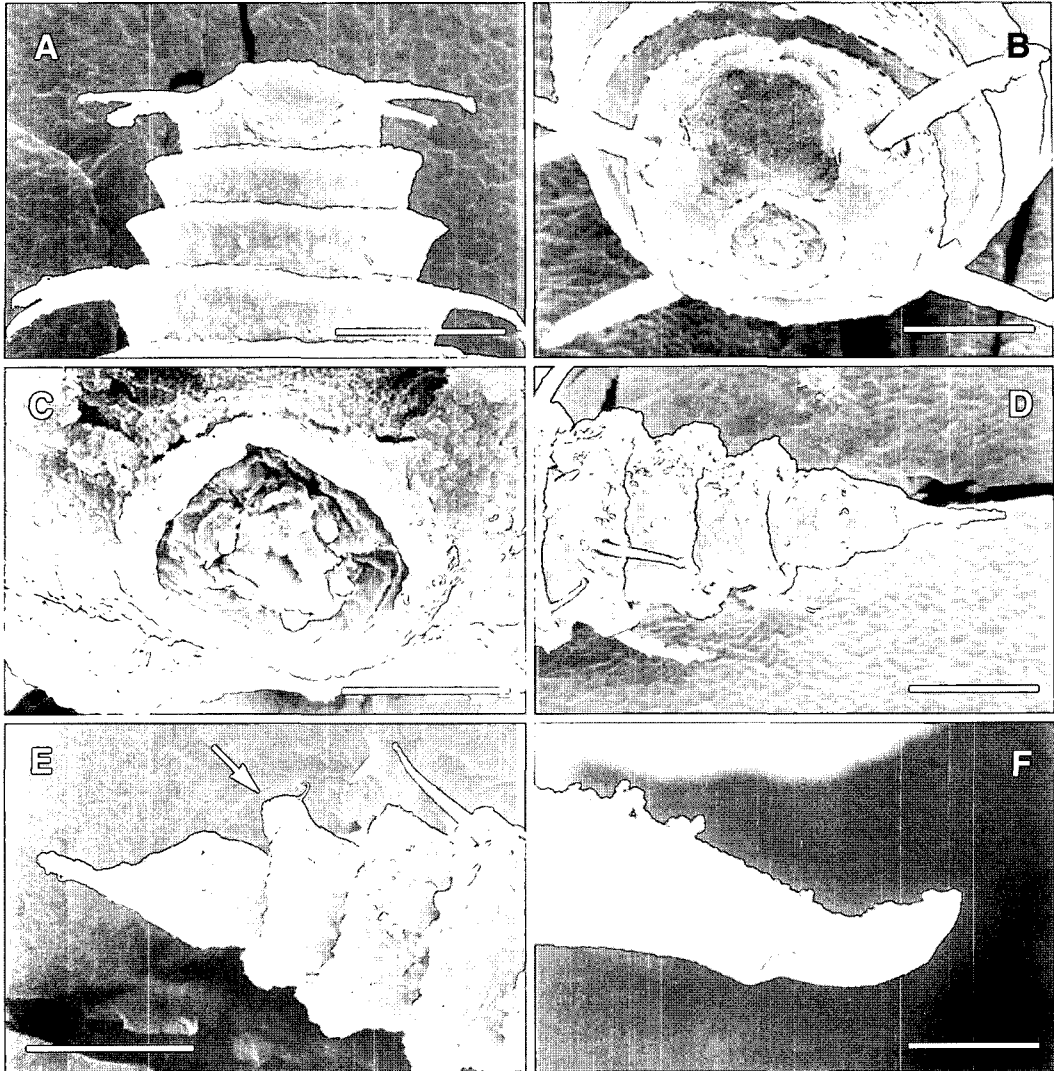


Fig. 3. SEM photomicrographs of *Tricoma (Quadricoma) jindoensis* n. sp. A-D, female: A, head and main rings 1-3, lateral; B, head, frontal; C, lip region, frontal; D, tail region, lateral. E-F, male: E, tail region, lateral; F, tip of subventral seta of main ring 31. Scale bars = 20 μ m (A, D, E), 10 μ m (B), 5 μ m (C), 1 μ m (F).

subdorsal: $\frac{\text{left } 4, 8, 10, 15, 18, 23, 28, 34, 40 = 9}{\text{right } 4, 7, 10, 14, 18, 22, 28, 34, 40 = 9}$

subventral: $\frac{\text{left } 3, 6, 9, 12, 14, 17, 20, 24, 27, 31, 35, 41 = 12}{\text{right } 3, 6, 9, 12, 14, 17, 20, 24, 27, 31, 35, 41 = 12}$

Somatic setae relatively broad, especially in lateral view, because of cuticular flange along whole length of setae, ending into small pore and hooked cuticular extension like keel (Fig. 3F); ranging from 19 (sd_4) to 23 μ m (sd_{22}) in length, gradually shortened towards both anterior and posterior

ends.

Reproductive system typical for subgenus *Quadricoma*. Spicule 141 μm long (Fig. 1B), slightly curved at its distal part, situated from ring 26 till ring 37. Muscles of spicular apparatus typical. Gubernaculum 28 μm long, narrow, with round tip; located from ring 35 to ring 37. Ventral papillae absent both pre- and post-anally.

Tail composed of 7 main rings; penultimate ring ventrolaterally with small ($5 \times 5 \mu\text{m}$), globular protuberance with thickened cuticular mass (Figs. 1D, 3E). Terminal ring 38 μm long, consisting of broad conical anterior part covered with foreign material and elongated, naked spinneret (20 μm long) (Fig. 1D); anterior covered part with slight constriction halfway its length. Phasmata small (2.5 μm in diameter) and round, situated at about middle of covered anterior part of terminal ring.

Allotype female. Body relatively plumpy in comparison that of holotype male, 600 μm long (Fig. 2A). In frontal view of labial region, 6 minute labial papillae situated near edge of oral aperture in hexagonal arrangement; outermost margin of lip region surrounded by well-developed cephalic ridge (Fig. 3B, C). Labial region little protruding beyond anterior margin of head in dorsal view (Fig. 2C). Amphid rather spherical, relatively shorter longitudinally than in male holotype.

Somatic setae with 9 pairs of subdorsal setae and 12 pairs of subventral setae, arranged as follows:

$$\begin{array}{l} \text{subdorsal: } \frac{\text{left } 4, 7, 10, 13, 17, 23, 28, 34, 40 = 9}{\text{right } 4, 6, 10, 15, 19, 22, 27, 34, 40 = 9} \\ \text{subventral: } \frac{\text{left } 4, 6, 8, 11, 14, 17, 20, 23, 27, 31, 35, 41 = 12}{\text{right } 4, 6, 8, 11, 14, 17, 20, 24, 26, 30, 35, 41 = 12} \end{array}$$

Pair of ocelli small and oval ($4 \times 10 \mu\text{m}$), situated between main rings 8 and 9 (Fig. 2B). Anal tube long and thick, located between main rings 37 and 38. Reproductive system typical for *Quadricoma*. Vulva situated between main rings 25 and 26.

Tail composed of 7 main rings; penultimate ring without any globular protuberance with thickened cuticular mass as in males (Figs. 2A, 3D); terminal ring 35 μm long, consisting of broad anterior part and narrow naked spinneret (18 μm long) (Fig. 2D). Phasmata not observed. Other characteristics nearly identical or similar to those of holotype male.

Measurements.

Holotype male: L = 620, hd = 23×17 , cs = 19, sd₄ = 20, sd₇ = 20, sd₁₀ = 20, sd₁₄ = 20, sd₁₈ = 20, sd₂₂ = 23, sd₂₈ = 22, sd₃₄ = 22, sd₄₀ = 22, sv₃ = 16, sv₆ = 17, sv₉ = 20, sv₁₂ = 20, sv₁₄ = 22, sv₁₇ = 23, sv₂₀ = 23, sv₂₄ = 23, sv₂₇ = 22, sv₃₁ = 22, sv₃₅ = 19, sv₄₁ = 20, spic = 141, gub = 28, t = 121, tnr = 38, tnrw = 15, spinneret = 20, oes = 79, mbd = 64, (mbd) = 60, a = 9.7, b = 7.8, c = 5.1.

Allotype female: L = 600, hd = 24×16 , cs = 19, sd₄ = 22, sd₆ = 22, sd₁₀ = 24, sd₁₅ = 26, sd₁₉ = 27, sd₂₂ = 27, sd₂₇ = 27, sd₃₄ = 27, sd₄₀ = 26, sv₄ = 19, sv₆ = 19, sv₈ = 21, sv₁₁ = 22, sv₁₄ = 23, sv₁₇ = 24, sv₂₀ = 23, sv₂₄ = 22, sv₂₆ = 22, sv₃₀ = 23, sv₃₅ = 23, sv₄₁ = 20, V = 50, t = 121, tnr = 35, tnrw = 17, spinneret = 18, oes = 79, mbd = 73, (mbd) = 66, a = 8.2, b = 7.6, c = 4.9.

Variability. Body lengths of 13 adult specimens mounted in glycerine range from 580 to 700 μm (mean 650 μm), and maximum body diameter from 56 to 86 μm .

Number of somatic setae consistently are 9 pairs of subdorsal setae and 12 subventral setae in

both males and females examined, but the setal arrangement is somewhat variable depending on the individuals (numbers in the parentheses mean the variable location):

in males (n = 7),

subdorsal: $\frac{\text{left } 4(3), 8(7), 10, 15(13, 14), 18(17, 19), 23(22), 28(27), 34(35), 40(41) = 9}{\text{right } 4, 7, 10, 14, 18(17), 22(21), 28(27), 34(33, 35), 40 = 9}$

subventral: $\frac{\text{left } 3, 6(5), 9(8), 12(11), 14(16), 17(16, 18), 20(19, 21), 24(23), 27(26), 31, 35, 41 = 12}{\text{right } 3(4), 6, 9(8), 12(11), 14(15), 17(18), 20(19, 21), 24(23), 27(26), 31, 35, 41 = 12}$

in females (n = 6),

subdorsal: $\frac{\text{left } 4, 7(8), 10(11), 13(15), 17(18), 23, 28, 34(35), 40 = 9}{\text{right } 4, 6(8, 9), 10(11, 12), 15(16), 19, 22(23), 27(28), 34, 40 = 9}$

subventral: $\frac{\text{left } 4(3), 6(7), 8(9), 11(10), 14(12, 13), 17(16), 20(19), 23(22), 27(25), 31(32), 35(36), 41 = 12}{\text{right } 4(3), 6, 8(9), 11(10, 12), 14(13), 17(15), 20(18), 24(23), 26(27), 30(31), 35, 41 = 12}$

Three specimens show some different position of subventral setae on rings 27 and 31, which situate rather laterally.

Ocelli usually locate on ring 8, however, in a few specimens they locate between rings 7 and 8, or between rings 8 and 9. All the male specimens examined consistently show a globular protuberance on the penultimate ring (main ring 43), which is a little different in the shape and size, that is, nearly spherical to oval (a little curved posteriorly), and size varying from 4×4 to 5×6 μm . Phasmata was shown in all males, however, not observed in the females examined.

Etymology. The specific name *jindoensis* alludes to the type locality of the new species.

Remarks. Among total 26 species currently recognized in the subgenus *Quadricoma*, 7 species are known as possessing 44 main rings: *Tricoma (Quadricoma) bahamanensis* Timm, 1970, *T. (Q.) crassicoma* Steiner, 1916, *T. (Q.) crassicomoides* Timm, 1970, *T. (Q.) lizardiensis* Decraemer, 1977, *T. (Q.) magnafenestra* Decraemer, 1998, *T. (Q.) papillata* Decraemer, 1977, and *T. (Q.) pontica* Filipjev, 1922. The new species is most allied with *T. (Q.) crassicoma* and *T. (Q.) crassicomoides* in sharing the character combination of long (over 100 μm) and narrow spicule with posterior curvature, broad head with truncated anterior border, the similar setal pattern, and inversion at main ring 31 (Timm, 1970).

Tricoma (Q.) jindoensis n. sp. is clearly distinguished from *T. (Q.) crassicoma* by relatively longer body [580–700 μm long against 475–600 μm long in *T. (Q.) crassicoma*], slender and elongated cephalic setae [16–20 μm long against 9–11 μm long in *T. (Q.) crassicoma*], far more elongated spicule [140–180 μm long against 100–107 μm long in *T. (Q.) crassicoma*], and presence of phasmata in male [against absent in *T. (Q.) crassicoma*].

Tricoma (Q.) crassicomoides evidently most resembles *T. (Q.) jindoensis* n. sp. in having the similar cephalic setae and lip region including 6 small labial papillae (Decraemer, 1977) in addition to the shared characters above. However, *T. (Q.) jindoensis* n. sp. differs from *T. (Q.) crassicomoides* by the number of tail rings in male [7 against 8 in *T. (Q.) crassicomoides*] and the setal pattern in male [9 pairs of subdorsal setae, while 8 pairs of subdorsal setae in *T. (Q.) crassicomoides*]. All the males of the present new species consistently showed a bulbous

protuberance on the ventrodistal corner of the penultimate ring (see Fig. 3E, arrow), even though the protuberances varied a little in the shape and size. Detailed morphological examination including SEM study on them comes to a conclusion that they are not the simple, transient secretion mass but a special cuticular structure possessed by all the males of this species. This globular protuberance makes the present new species discriminated easily from *T. (Q.) crassicomoides* as well as all other 44-rings congeners.

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REFERENCES

- Decraemer, W., 1977. The genus *Quadricoma* Filipjev, 1922 with a redescription of *Q. cobbi* (Steiner, 1916), *Q. crassicomoides* Timm, 1970 and *Q. loricata* Filipjev, 1922 (Nematoda: Desmoscolecida). *Cah. Biol. Mar.*, **19**: 63-89.
- Decraemer, W., 1998. On the deep-sea desmoscolecid fauna of the flat of Cap Vert (Nematoda: Desmoscolecida). *Bull. Inst. R. Sci. Nat. Belgique Biol.*, **68**: 5-22.
- De Man, J. G., 1880. Die einheimischen, frei in der Erde und im süßen Wasser lebenden Nematoden. Vorläufiger Bericht und descriptiv systemtischer Teil. *Tijdschr. Nederl. Dierk. Varen.*, **5**: 1-104.
- Filipjev, I. N., 1922. Encore sur les Nématodes libres de la Mer Noir. *Trudj Stavropol'. Sel'-khoz. Inst.*, **1**(16): 84-184.
- Freudenhammer, I., 1975. Desmoscolecida aus der Iberischen Tiefsee, zugleich eine Revision dieser Nematoden-Ordnung. "Meteor" Forschungsergebnisse, Reihe D, **20**: 1-65.
- Gerlach, S. A. and F. Riemann, 1973. The Bremerhaven checklist of aquatic nematodes. *Veröff. Inst. Meeresforsch. Bremerh., Suppl.* **4**: 1-404.
- Kristensen, R. M., 1989. Marine Tardigrada from the southeastern United States coastal waters I. *Paradoxipus orzelisoides* n. gen., n. sp. (Arthrotardigrada: Halechiniscidae). *Trans. Am. Microsc. Soc.*, **108**: 262-282.
- Shirayama, Y., T. Kaku and R. P. Higgins, 1993. Double-slided microscopic observation of meiofauna using an HS-slide. *Benth. Res.*, **44**: 41-44.
- Timm, R. W., 1970. A revision of the nematode order Desmoscolecida Filipjev, 1922. *Univ. Calif. Publ. Zool.*, **93**: 20-21.

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진도의 해양 간극 선충류 1신종, *Tricoma (Quadricoma) jindoensis*
(고리선충목: 고리선충과)

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요 약

진도의 해안 간극수에서 채집한, 고리선충목의 사각고리선충아속에 속하는 1신종을 기재한다. 이 종은 사각고리선충아속의 44개 고리를 가진 7 기록종 중에서, 두부장모의 형태가 유사하고, 머리의 전단부가 넓게 잘린 점, 6개의 유두모양 입술돌기를 가진다는 점, 가늘고 긴 교미침을 공통적으로 가진다는 점 등에서 *T. (Q.) crassicomoides* Timm, 1970과 가장 유사하다. 그러나 수컷에서, 끝에서 두 번째 고리에 구근 모양의 돌기를 가지며, 꼬리 부분이 7개의 고리로 이루어지고, 등쪽 강모가 9쌍이라는 점에서 위 종과 뚜렷이 구별된다. 이 신종은 사각고리선충아속에 속하는 해양 자유선충으로서는 동아시아 해역에서의 첫 번째 기록이다.