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Taxonomic Study of the Kinorhyncha in Japan. III. *Echinoderes sensibilis* n. sp. (Kinorhyncha: Cyclorhagida) from Tanabe Bay

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ABSTRACT—A new species of echinoderid kinorhynch, *Echinoderes sensibilis*, is described and illustrated using light and electron microscopy. The specimens were collected from masses of the red algae *Corallina pilulifera* growing in intertidal pools in Tanabe Bay, Honshu Island, Japan. Diagnostic characters of *E. sensibilis* include the presence of middorsal spines on segments 6–10; lateral spines/tubules on segments 4, 7–12; remarkable trapezium-like subventral fields of minute cuticular hairs on segments 5-12. The positions of numerous sensory spots, large sieve areas, glandular tubes and the shape of terminal tergal and sternal extensions are also diagnostic. All taxonomic characters used for this description are illustrated by SEM. *Echinoderes sensibilis* constitutes the fifty-eighths valid species of the genus *Echinoderes* and the fourteenth species described from the Pacific Ocean. This is the third representative of Pacific kinorhynchs found only in the intertidal zone and the first Pacific *Echinoderes* living on red macroalgae in intertidal pools.

Key words: Kinorhyncha, taxonomy, *Echinoderes*

INTRODUCTION

The Kinorhyncha constitute a taxon of meiobenthic, free-living, segmented and spined marine invertebrates, generally less than 1 mm in length. Previously, the taxon has been considered as a class of the phylum Aschelminthes (see Hyman, 1951), but currently is considered an independent phylum with close relationships to aschelminth worms (see Higgins, 1971; Kristensen and Higgins, 1991). Recently, the Kinorhyncha has been included as a class of the phylum Cephalorhyncha (see Adrianov and Malakhov, 1994, 1999).

Since the first description (Dujardin, 1851), about two hundred species of kinorhynchs have been described; of these 145 are valid/recognizable, others remain nomina dubia, species indeterminata or have been synonymized. According to the last taxonomic review on the Kinorhyncha (see Adrianov and Malakhov, 1999) and the most recent description (Sørensen *et al.*, 2000), the genus *Echinoderes* consists of 57 valid species. Thirteen valid species of *Echinoderes* have been reported from the Pacific Ocean (see Adrianov and Malakhov, 1999).

A few studies have reported the presence of kino rhynchs (otherwise unidentified) from Japanese waters, and most of them were dealing with the ecology of subtidal meiofauna. The first report of Kinorhyncha from Japan was *Echinoderes sp*. (Kawamura, 1927) collected by Komai in 1925 at Misaki Marine Biological Station near Tokyo (see Kawamura, 1927, 1947; Tokioka, 1949). Years later, Abe (1930) described a new species, *Echinoderes masudai* Abe, 1930, found at Gogoshima Island near Hiroshima. The description of the species was however too poor to do comparisons practically, and *E. masudai* is not currently designated as a valid species and considered as a "species indeterminata" (Higgins, 1983; Adrianov and Malakhov, 1999). In 1949, Tokioka reported another species of *Echinoderes*, *E. dujardinii* Claparède, 1863, from Ago Bay, Honshu Is. (Tokioka, 1949). Some years later, this species was listed by Sudzuki (1976a, b) from meiobenthic samples around Kasado Island in the Seto Inland Sea of Japan. The finding of *E. dujardinii* in Japan is however highly questionable because the species has been known only from European waters, and the reports of Tokioka (1949) and Sudzuki (1976a, b) seem to be misidentifications (see Higgins, 1983; Adrianov and Malakhov, 1994). Because of these facts, still no valid species of the genus *Echinoderes* has been reported from Japan.

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The second genus reported from Japan was *Kinorhynchus*, listed and illustrated by Sudzuki (1976a) from the Seto Inland Sea of Japan and later identified as *Kinorhynchus yushini* Adrianov, 1989 (see Adrianov and Malakhov, 1999). Recently, Higgins and Shirayama (1990) described a new genus and new species, *Dracoderes abei* Higgins and Shirayama, 1990 from the Seto Inland Sea of Japan. Quite recently, the representative of the fourth genus, *Pycnophyes tubuliferus* Adrianov, 1989 was reported from Tanabe Bay in the vicinity of the Seto Marine Biological Laboratory of Kyoto University (Murakami *et al.*, 2001).

This is the description of the fourteenth species of *Echinoderes* in the Pacific ocean. This is also the first detailed morphological study of *Echinoderes* from Japan using Nomarsky light microscopy and scanning electron microscopy (SEM).

MATERIALS AND METHODS

About one hundred specimens of the genus *Echinoderes* were collected in the washing of calcareous red algae, *Corallina pilulifera* Postels and Ruprecht, collected in March 2001 from intertidal pool in Tanabe Bay, located at Kii peninsula of Honshu Island (33°42.2' N and 135°22.9' E), in the vicinity of Seto Marine Biological Laboratory of Kyoto University (Fig. 1). All specimens were fixed in 10% buffered formalin in seawater. Specimens were transferred into a 70% ethanol - 5% glycerol - 25% deionized water solution. Letting ethanol and water evaporate, the material was preserved in anhydrous glycerol. Twenty specimens then were mounted individually in Hoyer's-125 mounting medium between two cover slips, and positioned on Higgins-Shirayama plastic slide frames for further examination using differential interference contrast optics (Nomarsky optics). About 30 specimens were selected for scanning electron microscopy (SEM). These specimens were transferred by an Irwin Loop from 10% formalin to a vessel of distilled water and washed using a detergent to clean the body surface. The cleaned specimens were transferred to a minimal volume of distilled water and ethanol was added slowly until the concentration became close to 100 percent. Thereafter, the specimens were washed in absolute ethanol several times, and finally replaced by tertiary-butyl alcohol.

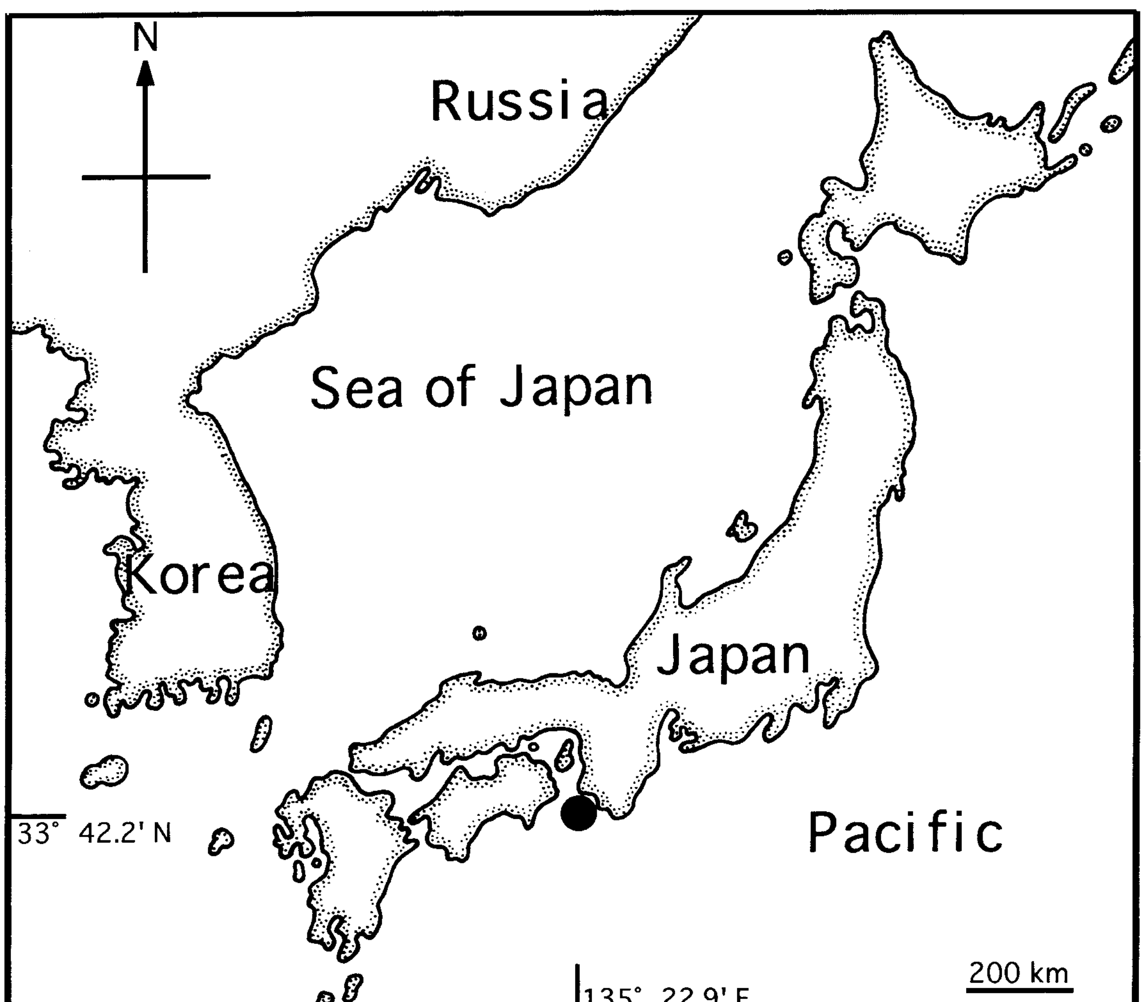

Fig. 1. Map showing the place (black spot) where *Echinoderes sensibilis* n. sp. was collected (Tanabe Bay, Kii-Peninsula, Honshu Island, Japan).

The specimens were dried in a freeze dryer, mounted on stubs, coated with Platinum-Palladium, and observed using a SEM (Hitachi S-4300).

In the examination procedures, we followed the standard protocol described by Higgins (1983). Measurements are given in micrometers. Ratios are expressed in percent of the Trunk length (TL) measured on the midline, from the anterior margin of segment 3 (first trunk segment) to the posterior margin of segment 13, exclusive of spines. Maximum sternal width (MSW) is measured at the anteroventral margin of the widest pair of sternal plates as first encountered in measuring each segment from anterior to posterior. Standard width (SW), or sternal width of segment 12, is measured at the anteroventral margin of 12th sternal plates. Measurements are given for length of trunk segments (L), lateral terminal spines (LTS), lateral terminal accessory spines (LTAS), middorsal spines (DS) and lateral spines/tubules (LS). The locality data from material examined are referred to the collector's initials (AVA and CM). The specimens in the code CM have been deposed in the meiofaunal collection of the Seto Marine Biological Laboratory of Kyoto University, and those in AVA in the meiofaunal collection of the Institute of Marine Biology in Vladivostok, Russia.

In the examination of taxonomic characters such are the nature, location and distribution of cuticular structures we followed the reevaluated interpretation of dorsal, lateral and ventral surface of the trunk that was proposed by Pardos, Higgins and Benito (see Pardos *et al*., 1998, Fig. 2) to achieve a more accurate approach to the descriptions of *Echinoderes* species. Specific terminology used in this paper mainly based on that developed by Higgins (1983) and Pardos *et al*. (1998). All diagnostic cuticular structures used in this description are illustrated by SEM to avoid misinterpretations of the characters.

Positions of cuticular structures on the trunk segments are termed as follows: middorsal (MD) - located on the middorsal line of the segment; paradorsal (PD) - located adjacent to the middorsal line of the segment; subdorsal (SD) - located lateral to the paradorsal position, closer to the middorsal line than to the maximum width of the segment; dorsolateral (DL) - located on the dorsal surface, closer to the point of maximum width of the segment than to the middorsal line; midlateral (ML) - located at the maximum width of the segment; sublateral (SL) - located between lateral accessory position and midlateral position; lateroventral (LV) - located on the tergal plate adjacent to the tergal-sternal articulation (position of lateral spines/tubules); lateral accessory (LA) - located on the tergal plate dorsally adjacent to the lateroventral position (position of lateral accessory spines/tubules); ventrolateral (VL) - located on the sternal plate adjacent to the tergal-sternal articulation; subventral (SV) - located on the sternal plate, between midvental articulation of sternal plates and ventrolateral position.

Abbreviations used in the figures

cf trapezium-like subventral fields of cuticular hairs
ch cuticular hair
cr transverse cuticular ridge
dls lateral spine of segment 12
ds middorsal spine
go gonopore
gp glandular pore
mp midventral placid
pa ventral pachycycli
pf pectinate fringe
pl placid
po sieve area (pore sieve)
pr transverse pectinate ridge
ps penile spine followed by number of spine
s prefix followed by segment number
sp slit-like glandular pore
ss sensory spot
te tergal extensions of segment 13
vt basal plates of subventral trichoscalids

RESULTS

Systematics

class Kinorhyncha (Reinhard, 1881) Pearse, 1936
order Cyclorhagida (Zelinka, 1896) Higgins, 1964
suborder Cyclorhagae (Zelinka, 1896) Zelinka, 1928
family Echinoderidae Bütschli, 1876
genus *Echinoderes* Claparède, 1863
Echinoderes sensibilis n. sp.
(Figs. 2–7)

Diagnosis: *Echinoderes;* basal plates of trichoscalids centered above subventral and subdorsal placids with incised anterior margin; middorsal spines on segments 6–10, short, less than half length of corresponding segment; lateral spines/tubules on segments 4, 7–12, lateral tubules on segment 12 slightly shifted dorsally to midlateral position; lateral spines on segment 8 clearly shorter than other lateral spines; terminal tergal extensions (furcae) pointed, with minute mesial projection bearing sensory spot; sternal plates of segments 5–12 with subventral trapezium-like fields of minute cuticular hairs; lateral terminal spines 43–47% of trunk length.

Type locality: Masses of red algae, *Corallina pilulifera* Postels and Ruprecht, intertidal pools, Tanabe Bay, Kii-Peninsula, Pacific coast of Honshu Island, Japan (33°42.2' N and 135°22.9' E) (Fig. 1).

Type material:- Holotype, adult male (CM-A-JAP-E04) (Fig. 2, 4A); allotype, adult female (AVA-C-JAP-E07) (Fig. 3, 4 B); paratypes - four adult males (AVA-C-JAP-E03; AVA-C-JAP-E08; CM-A-JAP-E01; CM-A-JAP-E05) and four adult females (AVA-C-JAP-E09; AVA-C-JAP-E02; AVA-C-JAP-E05; CM-A-JAP-E08).

Etymology: From the Latin "sensibilis" - sensitive; named after the remarkably large number of sensory spots on segment 3.

Description

Holotype: Adult male (CM-A-JAP-E04) (Fig. 2, 4A); TL 339 µm; MSW-7 64 um, 19% of TL; SW 74 µm, 22% of TL; LTS 155 µm, 46% of TL.

Segment 1: Head; with 91 scalids arranged in 7 circlets; scalid formula 10,10, 20, 10, 20, 6, 15(6+9); enlarged basal plates of two subventral trichoscalids centered above subventral placids with deeply incised anterior margin.

Segment 2: Neck; with 16 placids, midventral placid largest, 18 µm high, 11 µm wide at top, 13 µm wide at base; subventral placids 16 µm high, 7 µm wide at base; middorsal placid 16 µm high, 8 µm wide at base.

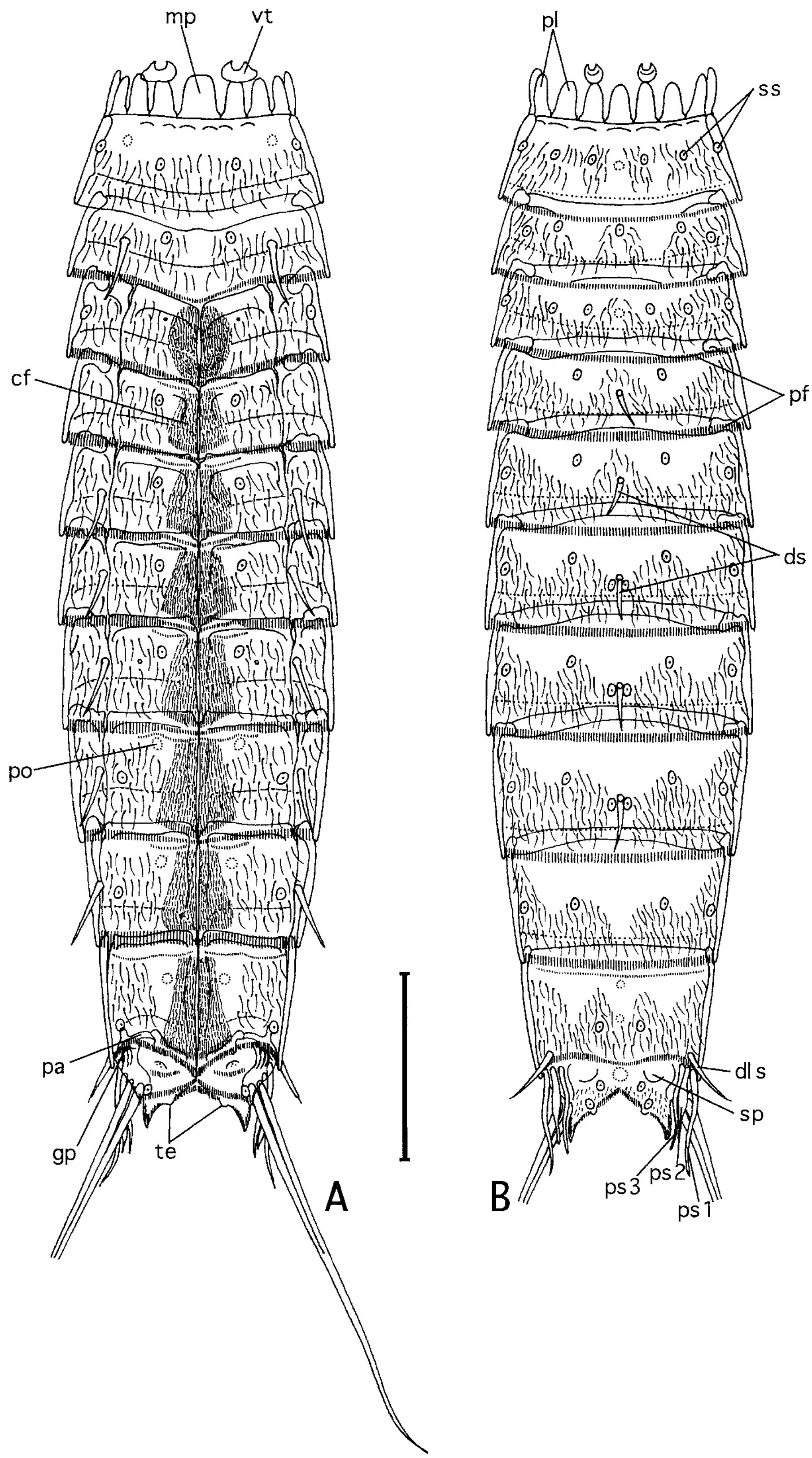

Fig. 2. *Echinoderes sensibilis* n. sp., holotypic male (CM-A-JAP-E04). A: ventral view; B: dorsal view. Bar 50 μm. Dotted circlets indicate sieve areas; circlets with central dot indicate sensory spots; smallest circlets indicate glandular tubes.

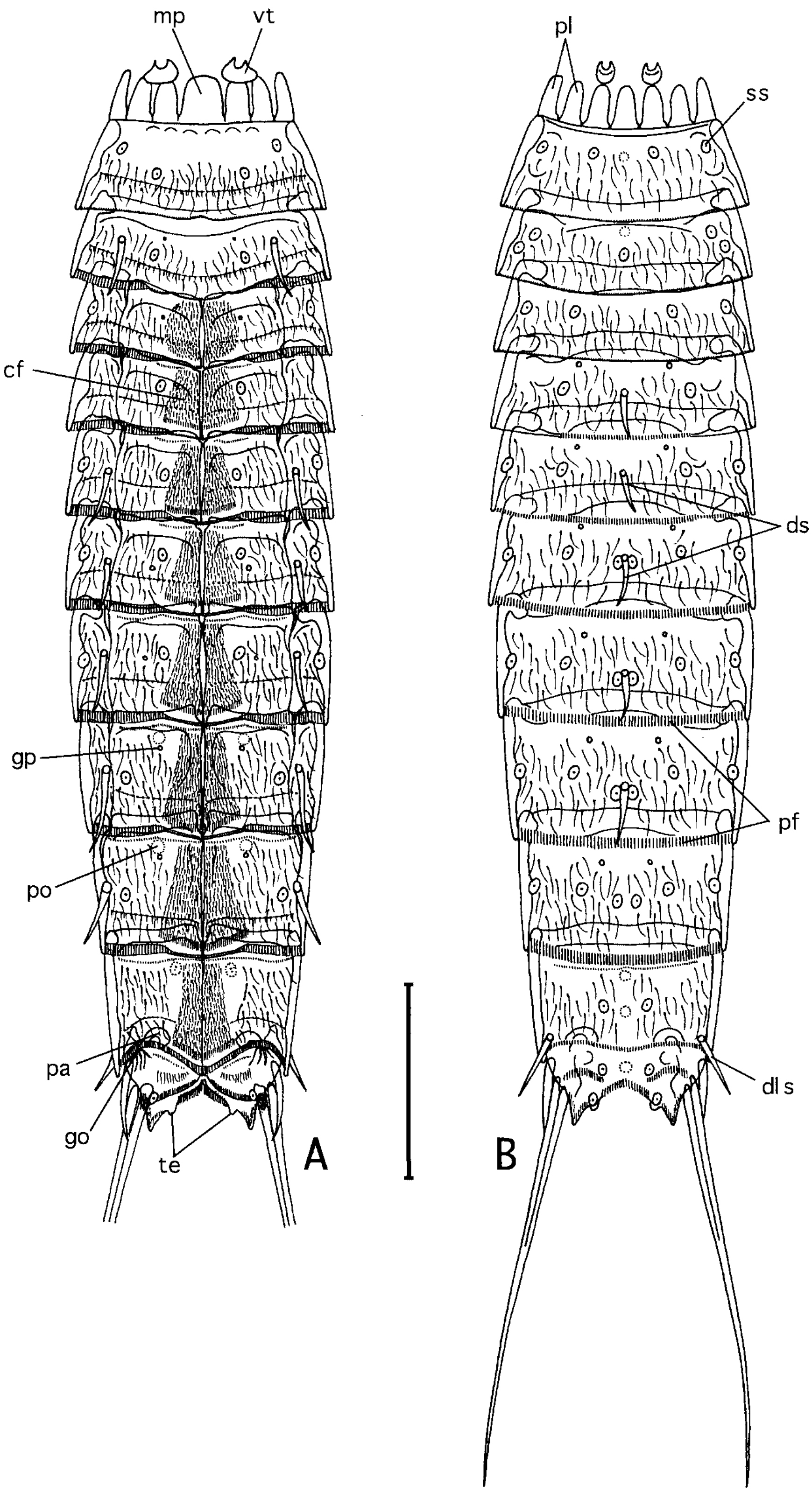

Fig. 3. *Echinoderes sensibilis* n. sp., allotypic female (AVA-C-JAP-E07). A: ventral view; B: dorsal view. Bar 50 µm. Dotted circlets indicate sieve areas; circlets with central dot indicate sensory spots; smallest circlets indicate glandular tubes.

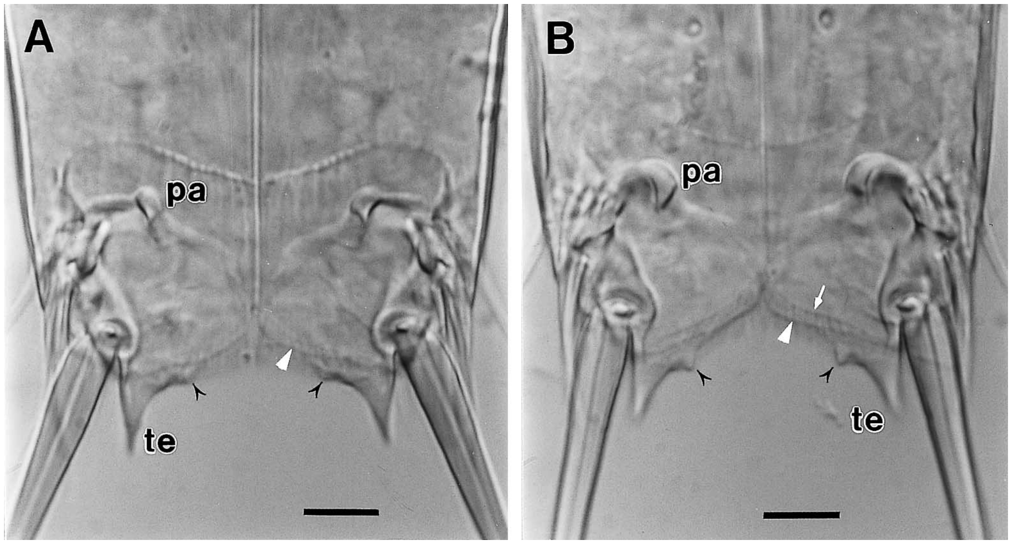

Fig. 4. *Echinoderes sensibilis* n. sp., ventral view of segments 12–13. A: holotype male (CM-A-JAP-E04); B: allotype female (AVA-C-JAP-E07). Bar 10 µm. Black arrowheads indicate mesial projections of tergal extensions; white arrowheads indicate margin of sternal plates; white arrow indicates base of posterior fringe of sternal plate.

Segment 3: First trunk segment; 35 µm in length; at anterior margin 69 µm wide; with dorsal pectinate fringe, ventral pectinate fringe undeveloped; with middorsal sieve area; with pair of ventrolateral sieve areas; with five pairs of sensory spots, in subdorsal, dorsolateral, midlateral, sublateral and subventral positions.

Segment 4: Length 34 µm; with dorsal and ventral pectinate fringe, with minute subventral units and enlarged ventrolateral and lateral units; with pair of lateral spines/tubules, 21 µm long; with middorsal sensory spot; with 2 pairs of sensory spots in dorsolateral position and one pair in subventral position.

Segment 5: Length 34 µm; with two sternal plates; maximum sternal width 53 µm; with dorsal and ventral pectinate fringe; sternal plates with rounded subventral field of minute cuticular hairs; with middorsal sieve area; with pair of subventral glandular pores; with 4 pairs of sensory spots, in subdorsal, dorsolateral, midlateral and sublateral positions.

Segment 6: Length 37 µm; maximum sternal width 58 µm; well developed pectinate fringe with minute subventral elements; middorsal spine short, 11 µm long; sternal plates with trapezium-like subventral field of minute cuticular hairs; sternal plates with transverse pectinate ridge of minute cuticular elements anterior to subventral field; with two pairs of sensory spots, in subdorsal and subventral positions.

Segment 7: Length 40 µm; maximum sternal width 64 µm; middorsal spine 12 µm long; with pair of lateral spines/tubules, 23 µm long; similar to segment 6 except for presence of one pair of midlateral sensory spots.

Segment 8: Length 42 µm; maximum sternal width 69 µm; middorsal spine 13 µm long; lateral spines/tubules 18 µm long; similar to segment 7 except for presence one pair of paradorsal sensory spots at base of middorsal spine.

Segment 9: Length 45 µm; maximum sternal width 71 µm; middorsal spine 16 µm long; lateral spines/tubules 23 um long; similar to segment 8 except for presence of pair of subventral glandular pores.

Segment 10: Length 48 µm; maximum sternal width 72 µm; middorsal spine 19 µm long; lateral spines/tubules 23 µm long; similar to segment 9 except for arrangement of cuticular elements on sternal plates; with pair of ventrolateral sensory spots, with pair of subventral sieve areas slightly posterior to transverse pectinate ridge of cuticular elements.

Segment 11: Length 52 µm; maximum sternal width 71 µm; lateral spines/tubules 24 µm long; similar to segment 10 except for lack of middorsal spine and pair of paradorsal sensory spots.

Segment 12: Length 55 µm; sternal width 69 µm; lateral tubules 27 µm long, shifted dorsally, between midlateral and dorsolateral position; ventral pectinate fringe with uniform cuticular elements; tergal and sternal plates with transverse pectinate ridge of minute cuticular elements at anterior margin; with two middorsal sieve areas, with pair of subventral sieve areas; with two pairs of sensory spots in subdorsal and ventrolateral position.

Segment 13: Length 37 µm; maximum sternal width 63 µm; terminal tergal extensions long, extending well beyond sternal plates, pointed, slightly fringed, with mesial projections at base; terminal sternal extensions slightly pointed, with pectinate fringe; sternal plates with transverse pectinate ridge of minute cuticular hairs, with pair of subventral cuticular scars slightly anterior to pectinate ridge; tergal plate with large sieve area in middorsal position; with three pairs of sensory spots, in subdorsal position, on mesial projections of terminal tergal extensions and at points of terminal sternal extensions; lateral terminal spines 155 µm long, 46% of trunk length; with three pairs of penile spines dorsally to gonopore at arthrocorium between segments 12 and 13, PS-1 35 µm, PS-2 24 µm, PS-3 32 µm.

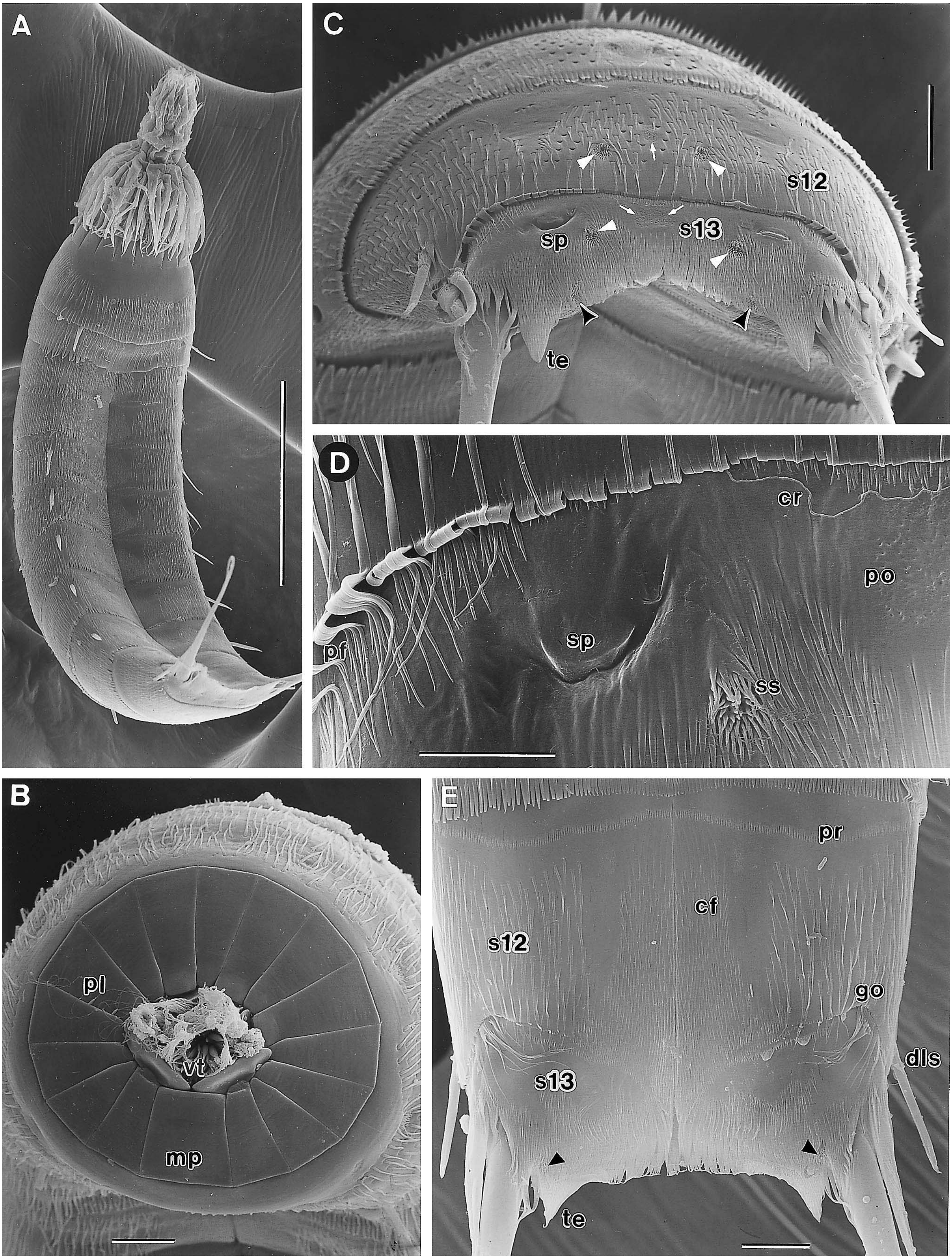

Fig. 5. *Echinoderes sensibilis* n. sp.; SEM photographs. A: ventrolateral view of female with everted head; B: neck placids (closing apparatus); C: male, segments 12–13, dorsal view; D: the same male, tergal plate of segment 13; E: female, segments 12–13, ventral view. Bar A 100; B–C, E 10, D 5 µm. Black-and-white arrowheads indicate sensory spots on mesial projections at base of tergal extensions; black arrowheads indicate sensory spots at points of sternal extensions; white arrowheads indicate sensory spots; white arrows indicate sieve areas.

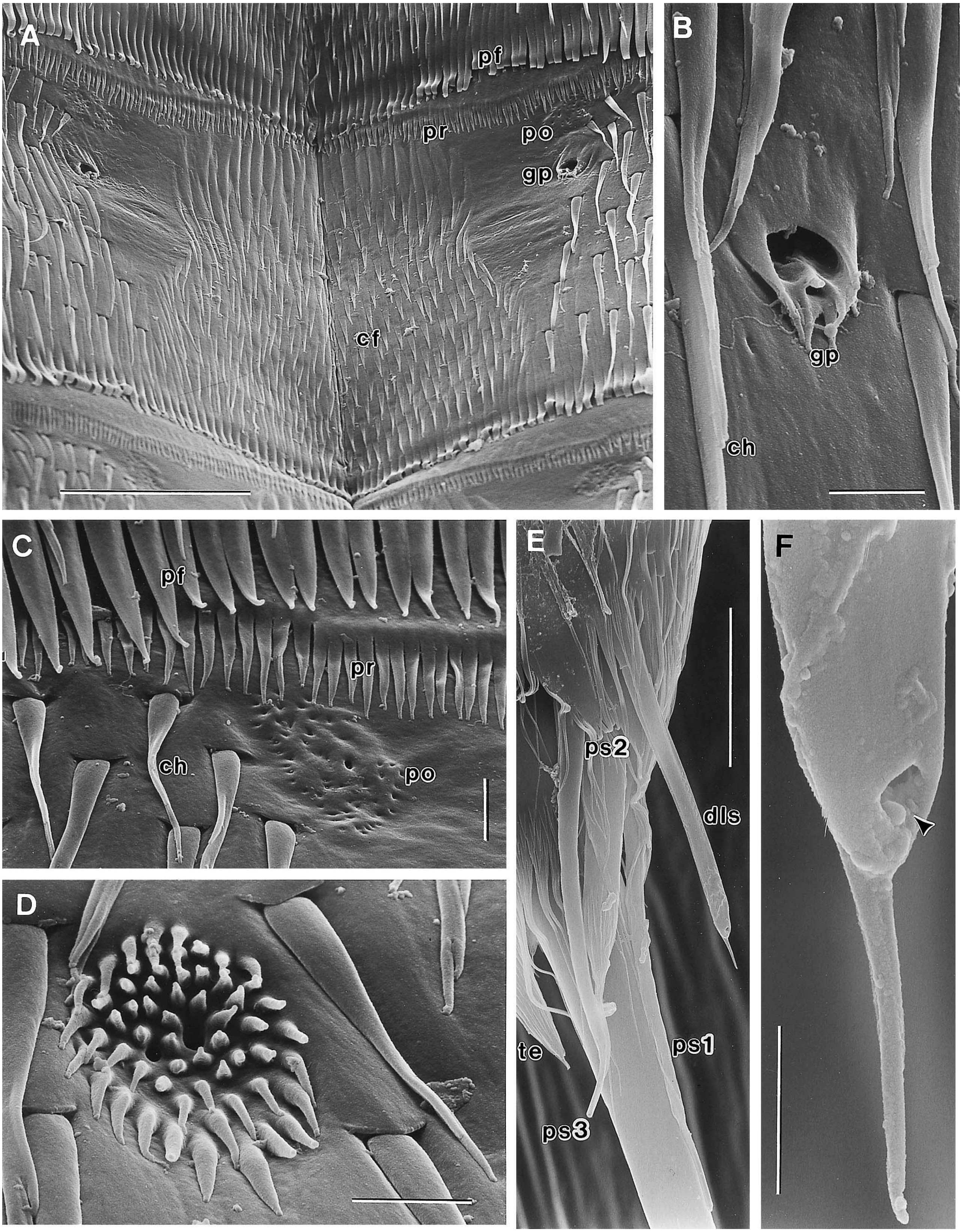

Fig. 6. *Echinoderes sensibilis* n. sp.; SEM photographs. A: segment 10 of female, ventral view; B: glandular tube on sternal plate of segment 9, female; C: sieve area on sternal plate of segment 10, male; D: sensory spot on sternal plate of segment 9, male; E: penile spines of male, dorsal view; F: lateral tubule of segment 12, male. Bar A, E 10; B–D, F 1 µm. Black-and-white arrowhead indicates the subterminal pore of lateral tubule of segment 12.

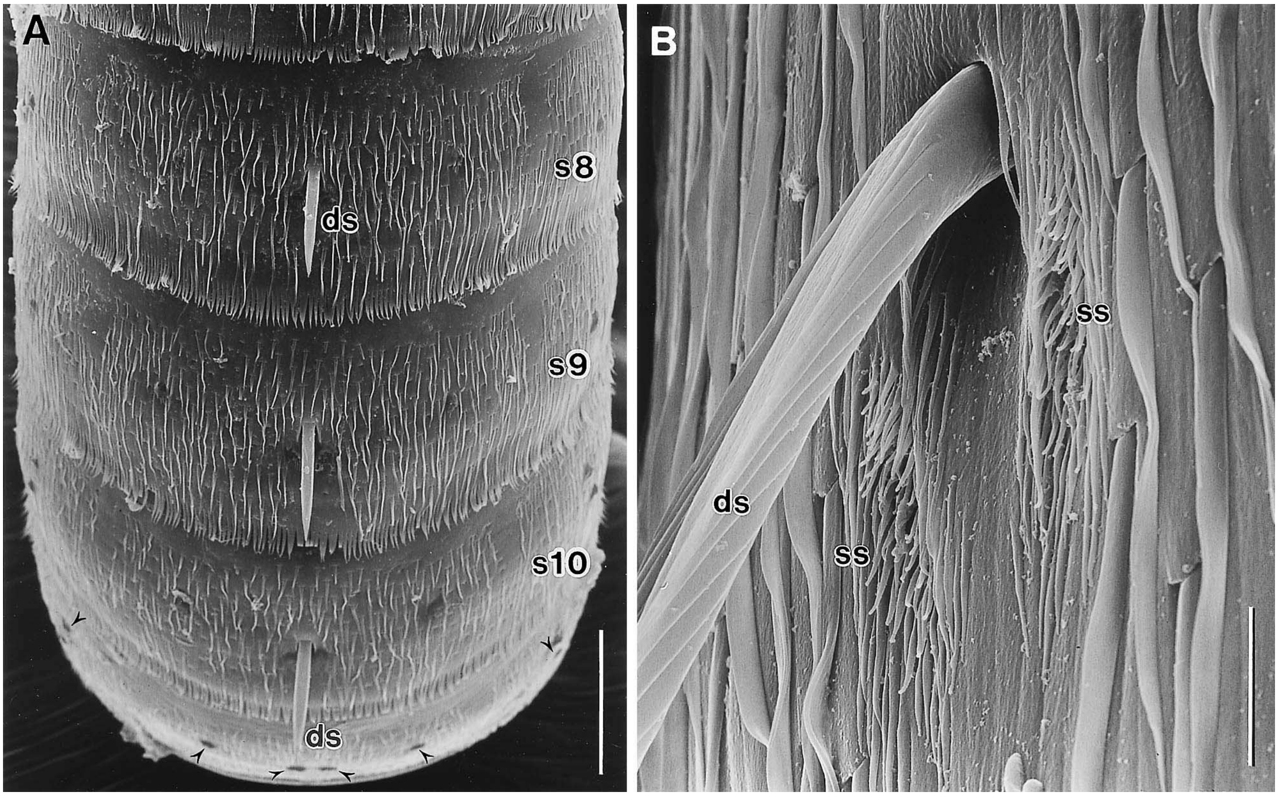

Fig. 7. *Echinoderes sensibilis* n. sp.; SEM photographs. A: segments 8–10, dorsal view, female; B: middorsal spine and paradorsal sensory spot on segment 9, female. Bar A 20, B 2 μm. Black arrowheads indicate sensory spots.

Allotype: Adult female (AVA-C-JAP-E07) (Fig. 3, 4B); TL 346 μm; L-3 34 μm, L-4 32 μm, L-5 34 μm, L-6 37 μm, L-7 40 μm, L-8 43 μm, L-9 45 um, L-10 48 μm, L-11 52 μm, L-12 55 μm, L-13 39 μm; anterior margin of first trunk segment 64 μm; MSW-5 52 μm, MSW-6 58 μm, MSW-7 64 um (19% of TL), MSW-8 71 μm, MSW-9 71 μm, MSW-10 71 μm, MSW-11 71 μm, SW 71 μm (21% of TL), MSW-13 58 um; DS-6 11 μm, DS-7 13 μm, DS-8 15 μm, DS-9 18 μm, DS-10 19 μm; LS-4 26 μm, LS-7 23 μm, LS-8 18 μm, LS-9 19 μm, LS-10 19 μm, LS-11 23 μm, LS-12 26 μm; LTS 148 μm, 43% of TL; LTAS 31 μm, 21% LTS.

Males differ from females in having three pairs of long penile spines (PS) and by slightly different arrangement of sensory spots, sieve areas and glandular tubes (Figs. 2–3, 6E). Females are also distinguished from males by the shape of anterior ventral pachycycli of segment 13 (Fig. 4). In contrast to males, females have more glandular pores scattered on segments 4–11 (Fig. 3).

DISCUSSION

Thirteen valid species of *Echinoderes* have been described from the Pacific Ocean: *E. tchefouensis* Lou, 1934 from the Yellow Sea (north-east China); *E. pennaki* Higgins, 1960 and *E. kozloffi* Higgins, 1977 from San Juan Archipelago (north-west of USA); *E. newcaledonicus* Higgins, 1967 from south-west Pacific (New Caledonia); *E. pacificus* Schmidt, 1974 from Galapagos Islands (east Pacific); *E. nybakkeni* Higgins, 1986 from the coast of California; *E. filispinosus* Adrianov, 1989, *E. multisetosus* Adrianov, 1989, *E. koreanus* Adrianov, 1999 and *E. ulsanensis* Adrianov, 1999 from the Sea of Japan; *E. malakhovi* Adrianov, 1999 from New Zealand; *E. teretis* Brown in Adrianov et Malakhov, 1999 and *E. cavernus* Sørensen, Jørgensen and Boesgaard, 2000 from Australia.

Echinoderes masudai Abe, 1930 and *E. dujardini* Claparède, 1863 reported from the Pacific coast of the mainland of Japan (Abe, 1930; Tokioka, 1949; Sudzuki, 1976 a, b) are currently designated as “species indeterminata” and “misidentification” (Higgins, 1983; Adrianov and Malakhov, 1999). *Echinoderes dujardini* Claparède, 1863, very common in European waters, was carefully re-described by Higgins (1977). Like the new species, *E. dujardini* possesses very short middorsal spines on segments 6–10. However, this species is easily distinguished from *E. sensibilis* by the presence of lateral accessory spines on segment 10 and terminal setae on pointed sternal extensions of segment 13 (see Higgins, 1977).

Echinoderes sensibilis n. sp. resembles to *E. multisetosus* Adrianov, 1989 in having remarkable trapezium-like subventral fields of cuticular hairs on segments 5–12. However, *E. multisetosus* differs from the new species by the absence of middorsal spines. In addition, *E. multisetosus* is characterized by the presence of large oval paradorsal fields of cuticular hairs on segments 6–11, accessory lateral spines on segments 9–10 and a pair of subventral tubules

Table 1. Measurement (mm) and indices (%) for *Echinoderes sensibilis* adults

	Holotype	paratypic male	Allotype	paratypic female
TL	339	326–339	346	320–358
Anterior margine	69	64–68	64	61–71
MSW-7	64	63–66	64	64–68
MSW-7/TL	19	19–20	19	18–20
SW	74	68–72	71	71–72
SW/TL	22	20–21	20	20–22
DS-6	11	10–11	11	11
DS-7	11	11–13	13	13
DS-8	13	13–14	14	14–16
DS-9	16	14–19	18	14–19
DS-10	19	19–21	19	18–21
LS-4	21	23–24	26	24–26
LS-7	23	21–24	23	23–24
LS-8	18	16–18	18	16
LS-9	23	19–21	19	1–21
LS-10	23	21–23	19	21–24
LS-11	24	21–24	23	23–24
LS-12	27	26–27	26	24–29
LTS	155	142–155	148	145–161
LTS/TL	46	43–47	43	44–47
LTAS			31	27–45
LTAS/TL			9	8–14
PS-1	35	29–35		
PS-2	24	24–27		
PS-3	35	32–32		

on segment 11 (see Adrianov and Malakhov, 1999). *Echinoderes filispinosus* also is easily distinguished from the new species by the absence of middorsal spines like *E. multisetosus*, as well as the presence of remarkably elongated and sharp terminal tergal extensions and lateral spines/tubules only on segments 7 and 10. The only other Pacific *Echinoderes* without middorsal spines is *E. malakhovi* Adrianov, 1999 from New Zealand (see Adrianov and Malakhov, 1999). This species differs from *E. sensibilis* n. sp. by the presence of large subventral spines/tubules on segment 11. The most easily observed feature distinguishing *E. teretis* from Australia from *E. sensibilis* n. sp. is the presence of a single middorsal spine/tubule on segment 6 (see Adrianov and Malakhov, 1999). *Echinoderes newcaledonicus* Higgins, 1967 is easily distinguished from the new species by the presence of remarkably long middorsal spines on segments 6, 8 and 10 (see Higgins, 1967).

Like the new species, eight other Pacific species of *Echinoderes* have middorsal spines on segments 6–10. *Echinoderes koreanus* Adrianov, 1999 from the south of the Sea of Japan well differs from *E. sensibilis* n. sp. by the size of middorsal spines which are clearly longer than the corresponding segments (see Adrianov and Malakhov, 1999). In contrast to the new species, the second Korean species, *E. ulsanensis* Adrianov, 1999 is characterized by remarkably short and thick lateral terminal spines (see Adrianov and Malakhov, 1999). *Echinoderes tchefouensis* Lou, 1934 from the Yellow Sea is distinguished from the new species by the presence of lateral spines/tubules only on segments 7, 10–11 (see Lou, 1934). Four species from the east Pacific, *E. pennaki* Higgins, 1960, *E. kozloffi* Higgins, 1977 from San Juan Archipelago, *E. nybakkeni* Higgins, 1986 from California and *E. pacificus* Schmidt, 1974 from Galapagos Islands, differ from *E. sensibilis* n. sp. by the size of the middorsal spines which are only slightly shorter or clearly longer than the corresponding segments (see Higgins, 1960, 1977, 1986; Schmidt, 1974). In contrast to the new species, all three species from the north-east Pacific have relatively long lateral terminal accessory spines. *Echinoderes pacificus* Schmidt, 1974 also differs from *E. sensibilis* n. sp. by the presence of long terminal setae on the pointed sternal extensions of segment 13 (see Higgins, 1977). *Echinoderes cavernus* Sørensen, Jørgensen and Boesgaard, 2000 from Australia is very similar to *E. sensibilis* n. sp. by the presence of very short middorsal spines on segments 6–10. However, *E. cavernus* is easily distinguished from the new species by the presence of remarkably short and thick lateral terminal spines and rounded tergal and sternal extensions of segment 13 (see Sørensen *et al.*, 2000).

Echinoderes sensibilis n. sp. is the third Pacific species described only from the intertidal zone. *Echinoderes kozloffi* Higgins, 1977 was found in muddy sediments rich with detritus (see Higgins, 1977). *Echinoderes nybakkeni* Higgins, 1986 was described from the high-energy coarse beach sand (see Higgins, 1986). *Echinoderes sensibilis* n. sp. is the first Pacific species found in the washings of intertidal red algae.

Echinoderes sensibilis n. sp. constitutes the fourteenth valid species of *Echinoderes* in the Pacific and the first valid species of the genus described from Japan.

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REFERENCES

Abe Y (1930) Das Vorkommen von *Echinoderes* in den japanischen Gewaessern. J Sci Hiroshima Univ B-1 1: 39–44

Adrianov AV, Malakhov VV (1994) Kinorhyncha: Structure, Development, Phylogeny and Classification. Nauka Publ, Moscow (in Russian)

Adrianov AV, Malakhov VV (1999) Cephalorhyncha of the World Ocean. KMK Scientific Press Ltd., Moscow (Bilingual: in Russian and English)

Claparède E (1863) Beobachtungen über Anatomie und Entwick-

lungsgeschichte wirbelloser Tiere an der Küste der Normandie angestelly. Leipzig, Wihelm Englemann
Dujardin F (1851) Sur un petit animal marin, l' Echinodère, formant un type intermédiaire entre les crustacés et les vers. Ann Sci Natur Zool, ser 3 15: 158–160, 172–173
Higgins RP (1960) A new species of *Echinoderes* from Puget Sound. Trans Amer Micros Soc 79(1): 85–91
Higgins RP (1967) The Kinorhyncha of New Caledonia. Expédition francaise sur Recifs Coralliens de la Nouvelle Calédonie Fond Singer-Polignac 2: 75–90
Higgins RP (1971) A historical overview of kinorhynch research. Smith Contr Zool 76: 25–31
Higgins RP (1977) Redescription of *Echinoderes dujardini* (Kinorhyncha) with description of closely related species. Smith Contr Zool 248: 1–26
Higgins RP (1983) The Atlantic barrier reef ecosystem at Carrie Bow Cay, Belize. II: Kinorhyncha. Smith Contr Mar Sci 18: 1–131
Higgins RP (1986) A new species of *Echinoderes* (Kinorhyncha, Cyclorhagida) from a coarse-sand California beach. Trans Amer Micros Soc 105: 266–273
Higgins RP, Shirayama Y (1990) Dracoderidae, a new family of the Cyclorhagid Kinorhyncha from the Inland Sea of Japan. Zool Sci 7: 939-946
Hyman LH (1951) The Invertebrates: Vol. 3. Acanthocephala, Aschelminthes and Entroprocta. McGraw Hill, New York
Kawamura T (1927) Kinorhyncha. In "Illustrated Encyclopedia of the Fauna of Japan" Ed by K Uchida *et al*, Hokuryukan Ltd., Tokyo, p 1621 (In Japanese)
Kawamura T (1947) Kinorhyncha. In "Illustrated Encyclopedia of the Fauna of Japan" Ed by K Uchida *et al*, revised edition, Hokuryukan Ltd., Tokyo, p 1419 (In Japanese)
Kristensen RM, Higgins RP (1991) Kinorhyncha. In "Microscopic Anatomy of Invertebrates. Vol. 4. Aschelminthes." Ed by E Harrison, Wiley-Liss, New York, pp 377–404
Lou TH (1934) Sur la presence d'un nouveau kinorhynque à Tchefou: *Echinoderes tchefouensis* sp. nov. Contr Lab Zool Acad Nat Peking 1(4): 1–9
Murakami C, Adrianov AV, Shirayama Y (2001) Taxonomic Study of the Kinorhyncha in Japan. 1. *Pycnophyes tubuliferus* Adrianov, 1989 (Kinorhyncha: Homalorhagida) in Japan. Publ Seto Mar Biol Lab 39: 2–6
Pardos F, Higgins RP, Benito J (1998) Two new *Echinoderes* (Kinorhyncha, Cyclorhagida) from Spain, including a revaluation of kinorhynch taxonomic characters. Zool Anz 237: 195–208
Schmidt P (1974) Interstitielle Fauna von Galapagos. 10. Kinorhyncha. Microfauna Meeresbodens 43: 1–15
Sørensen MV, Jørgensen A, Boesgaard TM (2000) A new *Echinoderes* (Kinorhyncha: Cyclorhagida) from a submarine cave in New South Wales, Australia. Cah Biol Mar 41: 167–179
Sudzuki M (1976a) Microscopical marine animals scarcely known from Japan. I. Micro- and meio-faunae around Kasado Island in the Seto Inland Sea of Japan. Proc Jap Soc Syst Zool 12: 5–12
Sudzuki M (1976b) Recent portraits of wild biota in Japan. II. The Inland Sea of Japan around Kasado Island, Yamaguchi Prefecture. Obun Ronso 7: 11–32 (In Japanese)
Tokioka T (1949) II. Notes on *Echinoderes* found in Japan. Publ Seto Mar Biol Lab 1: 67–69

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