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Sabellaria tottoriensis n. sp. (Annelida: Polychaeta: Sabellariidae) from Shallow Water off Tottori, the Sea of Japan

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ABSTRACT—A new species of the genus *Sabellaria* Lamarck, 1812 (Annelida: Polychaeta: Sabellariidae), is described from shallow water off Tottori, the Sea of Japan. *Sabellaria tottoriensis* n. sp., is gregarious with tubes constructed of sand and shell debris. The new species is distinguished by the character combination of 1 or 2 pairs of nuchal spines, two forms (long and short) of opercular paleae in the middle row, with the slender blades of long ones recurved outward. Detailed morphological features of the species are described and compared with other Japanese and worldwide congeners.

Key words: new species, *Sabellaria*, paleae morphology, nuchal spine, taxonomy

INTRODUCTION

Species of the genus *Sabellaria* (Annelida: Polychaeta: Sabellariidae) are distributed worldwide from shallow waters to great depths. Some *Sabellaria* species are known as reef-builders making them the subject of ecological and paleontological interest as well as of systematic and biogeographical importance (e.g., Caline *et al.*, 1992; Pandolfi *et al.*, 1998; Wood, 1999).

Kirtley's (1994) monograph deals with the systematics of the family Sabellariidae, referring to all valid species and available names at that time, comprising 33 presently known species of *Sabellaria*. From Japanese waters, 2 species of the genus have been reported: *Sabellaria ishikawai* Okuda, 1938 and *S. cf. chandrae* de Silva, 1961 (Nishi and Kato, 2002). We here describe a new species of the genus *Sabellaria*, as the third species of the genus from Japan.

This species abruptly appeared in 2001 as an explosive population together with a serpulid polychaete, *Hydroides ezoensis* Okuda, 1934, both densely attaching on the shell of living turbo *Turbo torquatus* Gmelin, 1791 (Fig. 1).

MATERIALS AND METHODS

The worms were collected off the Tottori Prefectural Fisheries

Research Center, Ishiwaki, Tomari, Tohaku, Tottori Prefecture, at 2–6 m depth.

Worms and tubes were fixed in 10% seawater formalin together with the *Turbo* shell, on which the tubes of the worms were tightly attached. Some tubes were broken and about 25 worms removed. Another 10 or more specimens were preserved inside their tubes in order to conserve tube morphology. All specimens were preserved in 70% Ethanol.

The external morphology of the specimens was examined using a stereomicroscope. For detailed observation of the fine structure, chaetae and paleae were dissected, mounted on glass slides, and examined using a phase-contrast microscope.

The specimens were compared to the following specimens of Japanese *Sabellaria*, deposited in the Coastal Branch of Natural History Museum and Institute, Chiba (CMNH):

Sabellaria ishikawai Okuda, 1938. CMNH-ZW00904, 00905, 00997; Shimoda, Shizuoka Prefecture, 40m deep, 20 October, 1999, by dredge, coll. by R. Ueshima.

Sabellaria cf. chandrae de Silva, 1961. CMNH-ZW01201; Ubara-Island, Katsuura, Chiba Prefecture, 10–15 m deep, 14 August, 1997, coll. by CMNH.

The following abbreviations are used in the text:

AM	Australian Museum, Sydney, Australia
CBM	Natural History Museum and Institute, Chiba, Japan
CMNH	Coastal Branch of the Natural History Museum and Institute, Chiba, Japan
LACM-AHF	Natural History Museum of Los Angeles County, Allan Hancock Foundation Polychaete Collection, U.S.A.
MNHN	Muséum national d'Histoire naturelle, Paris, France
MNCN	Museo Nacional de Ciencias Naturales, Madrid, Spain
NHM	The Natural History Museum, London, U. K.
NTM	Museum & Art Gallery of the Northern Territory, Australia
RBCM	Royal British Columbia Museum, Canada

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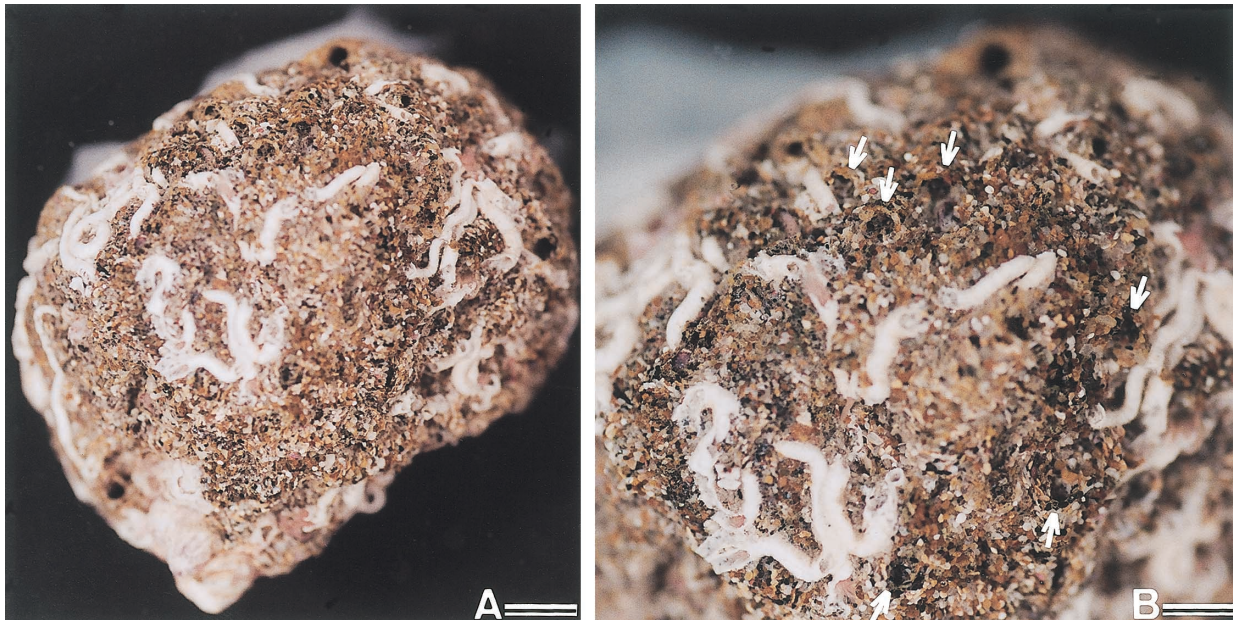


Fig. 1. Tubes of *Sabellaria tottoriensis* n. sp. attached to shell of *Turbo torquatus*, together with the white calcareous tubes of *Hydroides ezoensis*. Opening of the tubes of *S. tottoriensis* indicated by arrows in B. Scales 1 mm.

SAM	South Australian Museum, Sydney, Australia SABL Seto Marine Biological Laboratory, Kyoto University, Wakayama, Japan
SMF	Senckenberg Museum, Frankfurt, Germany
SMRC	Shimoda Marine Research Center, Tsukuba University, Shimoda, Shizuoka, Japan
USNM	The Smithsonian Institution, National Museum of Natural History, Washington D. C., U. S. A.
ZIHU	Zoological Institute, Hokkaido University, Hokkaido, Japan
ZMH	Zoological Museum of Hamburg, Germany

RESULTS

Systematics

Family Sabellariidae Johnston, 1865

Genus *Sabellaria* Lamarck, 1812

Sabellaria tottoriensis n. sp.

Figs 1–3

Material examined. HOLOTYPE—CMNH-ZW01515, on shell of living *Turbo torquatus*, with tube constructed of sand and shell debris, collected off Tottori Prefectural Fisheries Research Center, Ishiwaki, Tomari, Tohaku, Tottori Prefecture, Japan, 2–6 m, 20 March 2002, by SCUBA-diving, coll. N. Matsuda. PARATYPES, 25 specimens (AM W29058; CBM-ZW-946; CMNH-ZW01507-01514; LACM-AHF POLY 2127; MNCN 16.01/9952; MNHN POLY TYPE 1436; NTM W18657; NHM 2003.815-816; RBCM 003-00142-001; SAM E3346, E3347; SABL Type No. 415; SMF 12898–12902; SMRC-POL-002; USNM 1017840; ZIHU -3065; ZMH P-24533), collection data same as for holotype.

Description: Holotype immature specimen, lacking distal

end of cauda, 6.0 mm long, 0.9 mm wide at widest part of opercular crown, 1.0 mm wide at parathoracic chaetigers. Paratypes 5.0–13.0 mm long, 0.8–1.2 mm wide at parathoracic chaetigers. Anterior end of opercular stalk completely divided into 2 bilaterally symmetrical lobes. Lobes narrowing anteriorly, sloping posteriorly toward dorsal midline (Fig. 2A, C). Opercular paleae in three concentric rows. Paleae bright yellow, with light pink or colorless bases (embedded in tissue). Outer row with 20–25 flattened, rectangular paleae on each side (Fig. 3B, G).

Outer paleae ca. 0.5 mm long and ca. 0.1 mm wide, curved slightly outward from longitudinal axis of shaft. Inner surface of blade with ca. 50 fine, closely-spaced thecal bands (Fig. 3G). Distal ends of outer paleae with single median plume and 3–4 pairs of distal lateral teeth with sharp tips ($N=18$, average=3.27, $SD=0.46$: paratype CMNH-ZW01508; Fig. 3B, G). Median plume extended, ca. 0.15 mm long, denticulate with 8–12 small lateral teeth on each side ($N=18$, average=10.8, $SD=1.1$: paratype CMNH-ZW01508), decreasing in size distally (Fig. 3G). Distal lateral teeth and lateral teeth of plume occasionally continuous and difficult to separate from each other resulting in a total number 11–17 for distal lateral and lateral teeth of plume ($N=18$, average=14.5, $SD=1.40$: paratype CMNH-ZW01508).

Middle paleae including two forms, i.e. long and short. Long form 4–6 pairs, with blade erect, tapering slowly to blunt tip, recurved outward towards outer margin of crown (Figs. 2A, B, C and 3C). Short form 5–6 pairs, geniculate, with thick, wide blade terminating distally in blunt tip (Fig. 3D). Inner surface of short form excavate in basal part (Fig. 3C, D). Blades of long and short form with thecal bands (Fig. 3D, F)

Inner paleae with 10–14 pairs, similar in shape to short

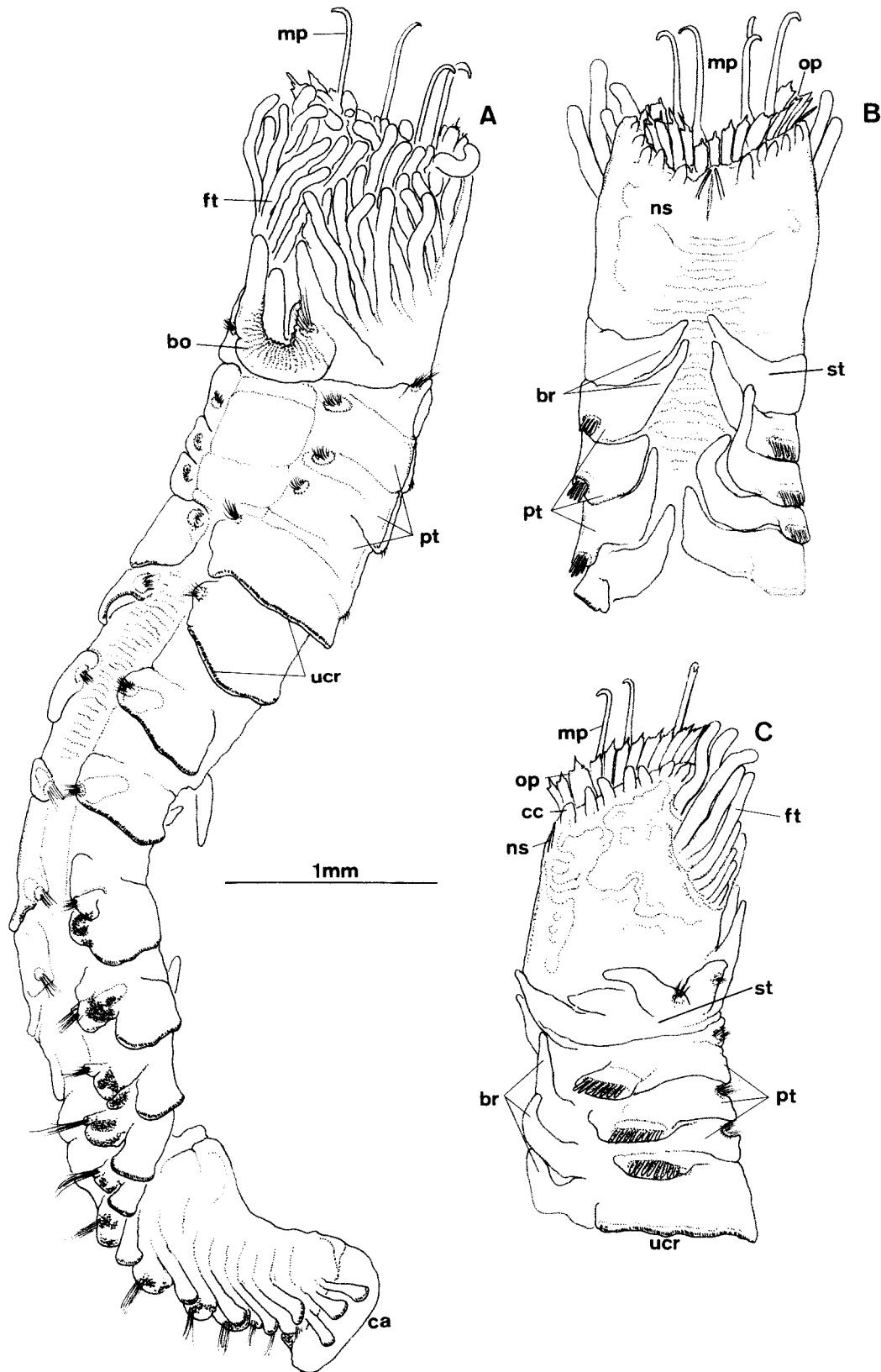


Fig. 2. *Sabellaria tottoriensis* n. sp. Holotype. A, Whole animal, ventro-lateral view; B, anterior part, ventral view; C, same, lateral view. bo, building organ; br, branchiae; ca, cauda; cc, conical cirri; ft, feeding tentacle; mp, middle palea; ns, nuchal spine; op, outer palea; pt, parathoracic chaetiger; st, second chaetiger; ucr, uncinal row of abdominal chaetiger.

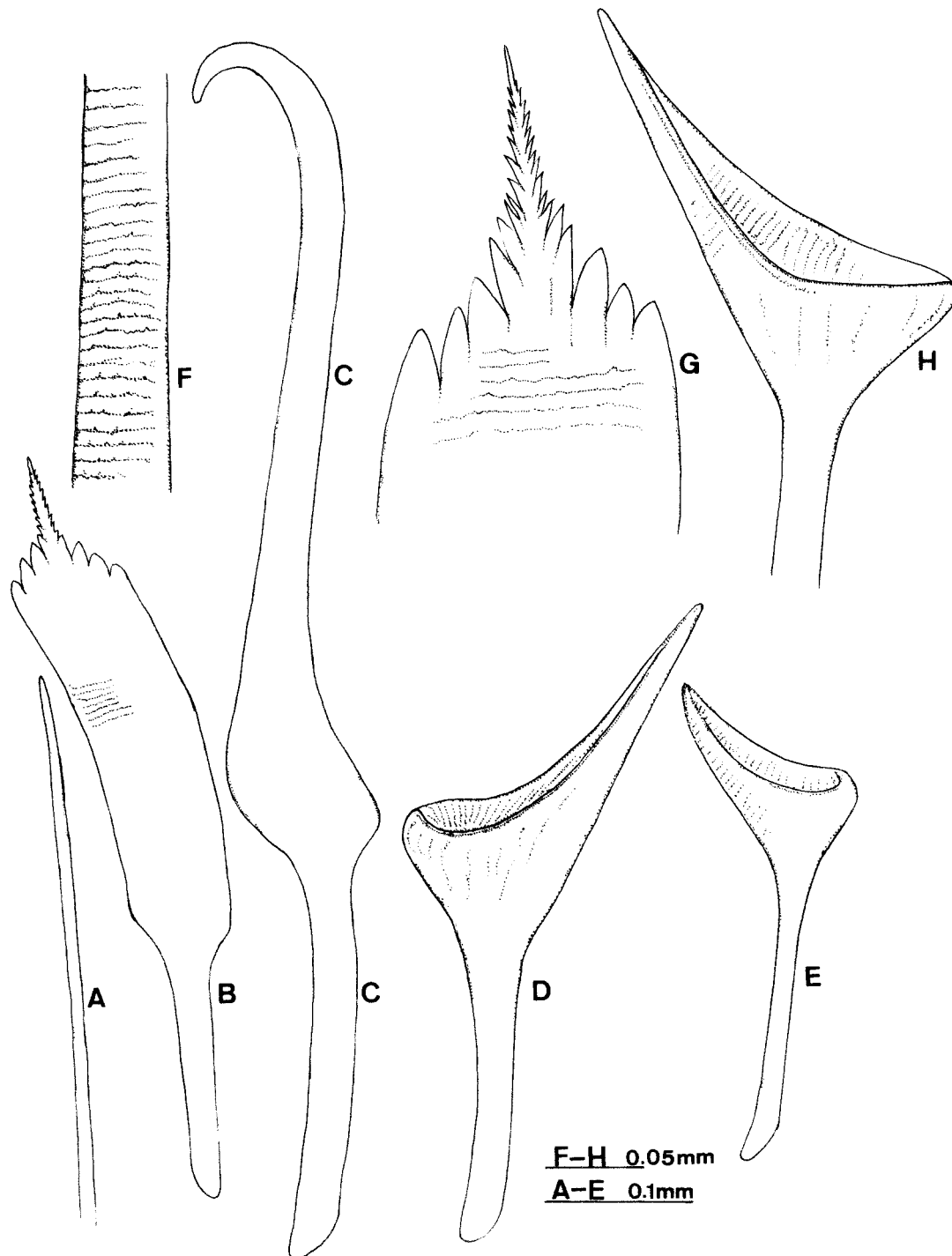


Fig. 3. Paleae of *Sabellaria tottoriensis* n. sp. Paratype CMNH-ZW01507. A, nuchal spine; B, outer palea; C, middle palea, long form; D, middle palea, short form; E, H, inner palea; F, middle part of blade of middle palea (long form) showing thecal bands; G, anterior part of outer palea, showing median plume and lateral distal teeth.

form of middle paleae, but usually smaller in size with shorter blades (Fig. 3E, H). Surface of excavated blade with thecal bands (Fig. 3H). One or 2 dorsal nuchal spines arising from each side of dorsal midline (Fig. 2B), usually crossing each other. Blades semi-transparent, colorless, slender, straight, with blunt tips (Fig. 3A).

Anterior outer margin of opercular crown with 8–10

fleshy conical papillae in single row on each side (Fig. 2B, C). Ventral margin of buccal cavity with 10–15 longitudinal rows of feeding tentacles on each side (Fig. 2A). Building organ U-shaped, with conical cirri, forming upper lip on ventral side (Fig. 2A).

Inferior lobes of second chaetiger with fascicle of ca. 7 bipinnate, capillary chaetae and conical lateral cirrus (Fig.

2C). Superior lobes with achaetous conical cirri along lateral margin of opercular lobe, with dorsal conical branchiae (Fig. 2C).

Three parathoracic chaetigers with 8–10 stout, oar-shaped chaetae and spine-like companion chaetae in 2 or 3 rows on each of neuropodia and ca. 10 chaetae on each of notopodia.

Abdominal part with 17 chaetigers in holotype, 10–30 in paratypes, with bundles of 10–15 long simple capillaries and finely serrate neurochaetae, and elongate conical ventral cirri with an uncinigerous tori. Anterior-most 5–10 abdominal chaetigers with dorsal branchiae, diminishing in size posteriorly (Fig. 2A).

Cauda long and bent back on ventrum. Tube constructed of sand and shell debris, with inner side coated with thin membrane. Tube orifice 1.0 to 1.5 mm in diameter.

Etymology: The species epithet *tottoriensis* is chosen for the type locality.

Remarks: The species of *Sabellaria* are distinguished mainly by the features of their opercular crown, i.e. morphology and the number of paleae in each row and the presence or absence of nuchal spines (Kirtley, 1994). *Sabellaria tottoriensis* n. sp. differs from all other members of the genus in having both straight nuchal spines and long middle paleae

with the tip curved toward periphery of crown.

Among the 33 species of *Sabellaria* described from all over the world, 9 species are known to have both nuchal spines and long middle paleae (Kirtley, 1994), however all of these species are different from *S. tottoriensis* n. sp. in having the long form of middle paleae with tips straight (e.g., *S. floridensis* Hartman, 1944).

When the morphology of middle paleae (long form) is considered, the present species resembles *S. chandrae* de Silva, 1961 from Sri Lanka (de Silva, 1961), *S. cf. chandrae* from Boso Peninsula, Japan (Nishi and Kato, 2002) and *S. ranjhi* (Hasan, 1960) from Pakistan, in having tip recurved toward the periphery of the crown. However, 1 or 2 nuchal spines are present on each side in *S. tottoriensis* n. sp., while absent in *S. chandrae* and *S. ranjhi*.

Sabellaria tottoriensis n. sp. is also distinguished from other species with regard to the feature of outer paleae (Fig. 4). The present new species have a median plume and a row of distal lateral teeth on outer paleae (Fig. 4D), in contrast to the condition in *S. javanica* Augener, 1934, lacking distal lateral teeth and having only a hairy median plume (Fig. 4A). *Sabellaria tottoriensis* n. sp. is also clearly distinct from *S. bellani* Kirtley, 1994 having no median plume characteristically (Fig. 4B). All other 33 species of *Sabellaria*, including *S. tottoriensis*, have outer paleae possessing both distal lateral teeth and a median plume, however, are differ-

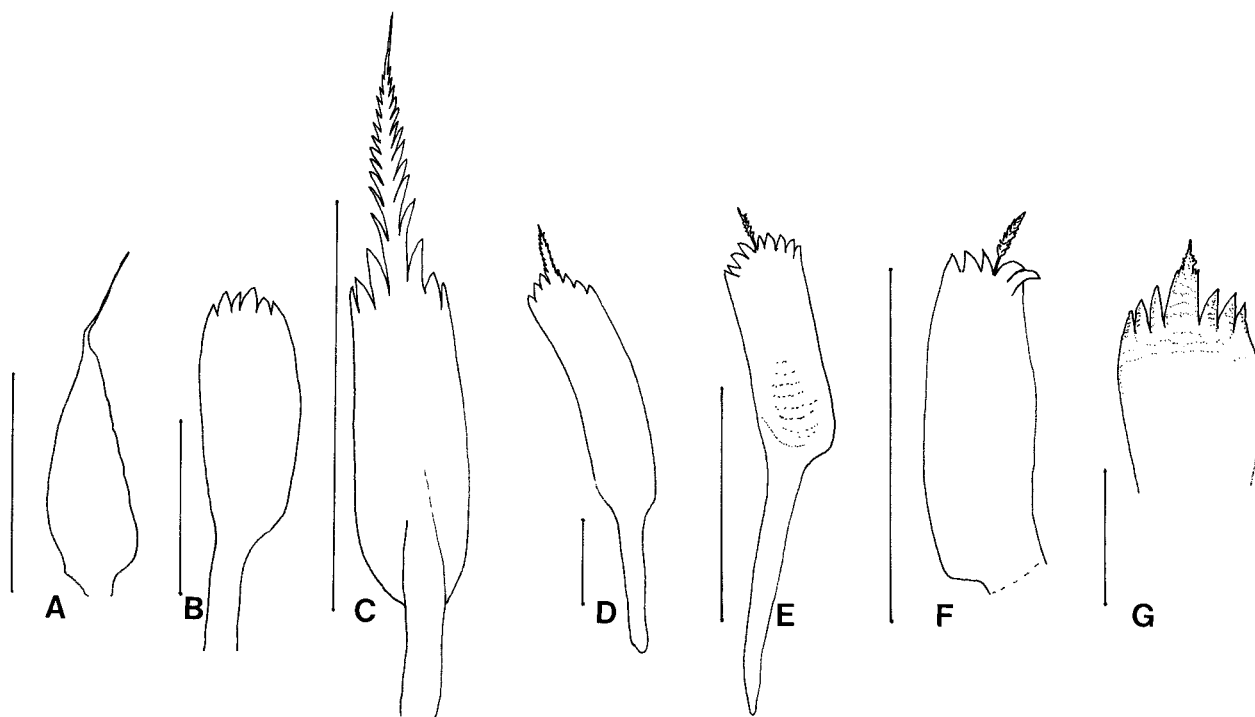


Fig. 4. Outer paleae in *Sabellaria*. A, *S. javanica* Augener, 1934, having hairy median plume and no distal lateral teeth; B, *S. bellani* Kirtley, 1994, having distal lateral teeth and no median plume; C, *S. alcocki* Gravier, 1906, with distal lateral teeth and median plume; D, *S. tottoriensis* n. sp.; E, *S. ranjhi* Hasan 1960 having penicillate median plume and distal lateral teeth; F, *S. chandrae* de Silva, 1961 having pilose median plume and distal lateral teeth; G, *S. cf. chandrae* (*sensu* Nishi & Kato, 2002) having pilose median plume and distal lateral teeth. A–C, E, F: after Kirtley (1994), D: Fig. 3B of this study, G: after Nishi & Kato (2002). Scale bar 500 μ m in A, C, F, 200 μ m in E, 150 μ m in D and G, and 100 μ m in B.

Table 1. Comparison of morphological characteristics among the Japanese species of *Sabellaria*.

Species	Locality	Outer paleae		Middle row of paleae		Nuchal spine	Body length	Source of information
		Number of distal lateral teeth	Median plume	Forms of paleae	Shape of long form			
<i>S. tottoriensis</i> n. sp.	Tottori prefecture	3–4 pairs	denticulate with 10–12 teeth	long and short	curved outward	1 or 2 pairs	5–13 mm	present study
<i>S. ishikawai</i> Okuda, 1938	Amakusa, Shimoda	5–10 pairs	denticulate	short	absent	absent	3–12 mm	Okuda (1938), Nishi and Kato (2002)
<i>S. cf. chandraae</i> de Silva, 1961	Boso Peninsula, Chiba	2–3 pairs	pilose	long and short	curved outward	absent	6 mm	Nishi and Kato (2002)

entiated into several sorts in the detailed morphology. *Sabellaria ranjhi* and *S. chandraae*, bearing a close resemblance to *S. tottoriensis* in middle paleae, are also belonging to this group. Our present new species *S. tottoriensis*, however, has a median plume rather continuous with lateral teeth (Fig. 4D), while *S. chandraae* has pilose median plume (Fig. 4F) and *S. ranjhi* penicillate (Fig. 4E). These three species differ also with regard to the distal lateral teeth of the outer paleae, with 2 or 3 pairs of teeth in *S. chandraae*, 3 or 4 pairs in *S. tottoriensis*, and 5 pairs in *S. ranjhi* (Hasan, 1960; de Silva, 1961; Kirtley, 1994), although *S. tottoriensis* has a median plume indistinctly separated from lateral teeth (Fig. 3B, G).

From the China Sea, Yang and Sun (1985) reported *S. alcocki* Gravier, 1906, which resembles *S. tottoriensis* n. sp. in having outer paleae with 3 pairs of distal lateral teeth and a long denticulate median plume. However, *S. tottoriensis* n. sp. possesses 10–12 lateral teeth on the each side of median plume (Fig. 3B, G, and Fig. 4D), in contrast to the more numerous teeth (18–20) of *S. alcocki* (Fig. 4C). A nuchal spine is present in *S. tottoriensis* n. sp., while absent in *S. alcocki*.

DISCUSSION

Sabellaria tottoriensis n. sp. described here brings the number of species known for this genus to 34 worldwide and to 3 for Japanese waters. It represents the 11th species of Sabellariidae known from Japan. Nishi and Kirtley (1999) and Nishi and Kato (2002) summarized and reviewed the Japanese Sabellariidae, and provided a key. This key is revised as follows:

A Key to the Japanese Sabellariid species

- 1a Four parathoracic segments
 - 2 (genus *Lygdamis*)
- 1b Three parathoracic segments
 - 3
- 2a Outer palea straight, with pointed tip
 - *L. japonicus* Nishi and Kirtley, 1999
- 2b Outer paleae curved distally, with stout rounded tips

- *L. curvatus* (Johanssen, 1922)
- 3a Paleae in two rows ----- 4 (genus *Idanthyrus*)
- 3b Paleae in three rows ----- 7
- 4a Outer paleae stout and straight, with a small number (1–15) of lateral teeth
 - *I. saxicavus* (Baird, 1863)
- 4b Outer paleae stout or thin, bent at tip, with 25 or more lateral teeth ----- 5
- 5a Outer paleae with thin lateral teeth, surface of paleae shaft marked by straight transverse lines at intervals about equal to shaft radius ----- *I. okudai* Kirtley, 1994
- 5b Outer paleae with stout lateral teeth ----- 6
- 6a Inner paleae shafts marked by fairly straight transverse lines at intervals below 0.1 of shaft radius ----- *I. okinawaensis* Nishi and Kirtley, 1999
- 6b Transverse lines in inner paleae shafts indistinct ----- *I. boninensis* Nishi and Kirtley, 1999
- 7a Opercular lobes fused to each other ----- 8 (genus *Neosabellaria*)
- 7b Opercular lobes separated ----- 9 (genus *Sabellaria*)
- 8a Middle paleae all of long form ----- *N. cementarium* (Moore, 1906)
- 8b Middle paleae short and long forms ----- *N. uschakovi* Kirtley, 1994
- 9a Middle paleae all of short, lacking long form; nuchal spines absent; median plume of outer paleae denticulate ----- *S. ishikawai* Okuda, 1938
- 9b Middle paleae two forms; long form erect and recurved toward periphery of crown; nuchal spines absent; outer paleae with pilose median plume ----- *S. cf. chandraae* de Silva, 1961
- 9c Middle paleae two forms; long form erect and recurved toward periphery of crown;

nuchal spine 1 or 2 pairs; median plume of outer paleae indistinctly separated from lateral teeth
 ----- *S. tottoriensis* n. sp.

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