

## SPADELLA JAPONICA, A NEW COASTAL BENTHIC CHAETOGNATH FROM JAPAN

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*Abstract.*—*Spadella japonica*, a new benthic chaetognath, is described from the coastal waters of Japan. It differs from all known species of the genus *Spadella*, mainly by the opening of the female genital orifices at the bottom of a cupel and the small number of hooks. The distribution of the three *Spadella* species living in Japanese waters is presented.

When Dr. Taichiro Goto (Mie University, Japan) gave me specimens of a new *Paraspadella* during the first workshop on chaetognaths (University of Surrey, September 1988), *P. gotoi* Casanova, 1990, there were also two individuals of a *Spadella* that he thought to be new. They were collected in Misaki on 6 August 1987. In November 1991, I received 16 additional individuals caught in Kominato on 12 September 1991 which, with the other two, differ by many characters from the species of *Spadella* hitherto described.

### *Spadella japonica*, new species Figs. 1–3, Table 1

The holotype and two paratypes are deposited with the National Science Museum Tokyo (NSMT—Ch. 20 and 21–22 respectively). Three other paratypes are deposited in the Muséum national d'Histoire Naturelle, Paris (UC 366) and three other ones in the National Museum of Natural History, Washington, D.C. (USNM 157572). All are from Kominato.

*Description.*—Eighteen specimens studied. Body stumpy when adult (Fig. 1) and transparent. Length up to 3.75 mm not including tail fin. Tail constitutes 48.6 to 51.8% of total length.

Number of hooks increasing with age, from six (small specimen: 3.25 mm) to eight (larger ones: 3.60–3.75 mm). Anterior teeth three or four, short (Fig. 2a, b). No posterior

teeth. Pigment cell of eyes more enlarged in the second set of specimens received (Fig. 3a). Corona ciliata on neck, oval and transversely elongated (Figs. 1, 3b). Collar very wide at level of posterior part of head and neck, then narrower on trunk (Figs. 1, 3b). Sensory tufts symmetrically arranged on whole body (Fig. 1). Numerous adhesive papillae on ventral part of body (Fig. 3c, d), from head to tail, and on both ventral and dorsal sides of fins. Gut with small intestinal diverticula at level of neck, not always visible on preserved specimens. Transverse musculature thin, stretching from neck almost to transverse septum. Ventral ganglion about middle third of trunk.

Lateral fins beginning on posterior part of trunk (about 15–19% of the trunk length) and reaching posteriorly to seminal vesicles (Fig. 1). Tail fin spatulate. Rayless zone wholly absent on all fins. Left lateral fin of a small specimen bearing dorsally a small area with tiny papillae (Fig. 3e) such as those found on adhesive organs of *Paraspadella gotoi*. Ovaries reach to about midlength of ventral ganglion; their aperture lateral, at bottom of brown colored elongate cupel (Fig. 3f, g), of which largest diameter (0.20–0.25 mm) is the same as that of mature ova. These cupels are the sole colored parts of the body. Ovaries with from one to five mature ova and other smaller ones. Seminal vesicles small, hook-shaped when empty, in close contact with both lateral and tail fins,

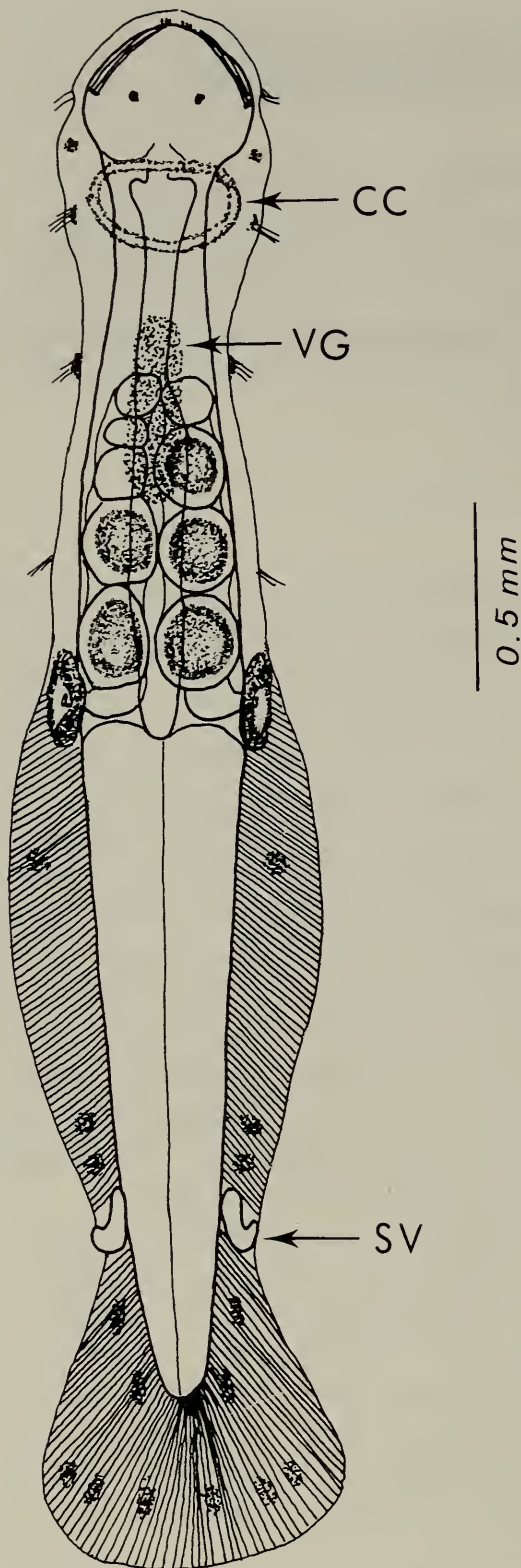


Fig. 1. Dorsal view of *Spadella japonica*, new species. CC = corona ciliata, SV = seminal vesicles, VG = ventral ganglion.

opening at posterolateral extremity (Fig. 3h, i).

*Remarks.*—Two specimens of *Spadella japonica* are interesting. One has a curious

“papillated organ” arising from the epidermis on the ventral right side of the tail, not far from the transverse septum. It is 0.15 mm long and constructed of a short stalk ending in a swelling provided with papillae (Fig. 3c, d). A second one shows two of these “organs” budding on the head and neck: the papillated swellings are visible but there are no stalks (Fig. 3j, k).

These observations are pertinent to the taxonomic position of *Spadella moretonensis* Johnston & Taylor, 1919. Indeed, since the revision of the benthic family Spadellidae Tokioka, 1965 by Bowman & Bieri (1989), the genus *Spadella* is restricted to species lacking adhesive organs, those provided with such organs constituting the genus *Paraspadella*. It has been demonstrated that these organs are modified parts of fins (Casanova 1990). *Spadella moretonensis* was described from East Australia from a single specimen having two club-shaped papillated bodies on the posterior half of the tail, situated ventrally on the right side. But the authors added: “Though they became stained like the tissues of the animal [when using haematoxylin] yet their asymmetrical arrangement and general appearance suggest that they are foreign bodies—perhaps of an algal nature.” Later on, Tokioka & Pathansali (1964) wrote: “Species of *schizoptera*-group [= *Paraspadella*] are easily distinguishable by their characteristic adherent organ, while *S. moretonensis* . . . is devoid of any complete palm-shaped adherent organ . . . It is possible this might rather be a form of *schizoptera*-group bearing no complete adhesive organs but rudimentary ones.” Alvariño (1981) agreed with this view. According to Salvini-Plawen (1986), who first proposed splitting the large genus *Spadella* into three smaller ones, some uncertainty concerns this species with respect to the asymmetry of these bodies. Nevertheless he placed it in the genus *Gephyrospadella* (now included in *Paraspadella*). Lastly, because of this uncertainty, this species was not compared with other





Fig. 2. SEM photographs of *Spadella japonica*, new species: a, Ventral part of head ( $\times 180$ ); b, Details of teeth ( $\times 500$ ).

ones in recent papers, neither with *Paraspadella* nor with *Spadella* (Casanova 1990, 1991).

It appears that the bodies described in *S. moretonensis* are the same as those found in *S. japonica*. Because in the latter they are present in only two specimens and on the head and neck of one of them, they cannot be considered rudimentary adhesive organs. Thus *S. moretonensis* is not a *Paraspadella* but a *Spadella*. According to Goto's observations (pers. comm.), during culture the epidermis of *S. japonica* sometimes changes in appearance, probably as a result of food or age. Especially when fed with *Artemia* nauplii, which are not very good for *Spadella* although they eat them, the epidermis becomes thin and seems to be deformed. Similarly, the papillae-like structures occurring in a few specimens living in the sea might be the result of bad environmental conditions.

*Comparisons with other species.*—The main differential characteristics of the eight species of *Spadella* known before the present study have been given recently (Casanova 1991). Four of them always have pos-

terior teeth: the cave species *Spadella ledoyeri* Casanova, 1986, the two deep species *Spadella birostrata* Casanova, 1987 and *S. equidentata* Casanova, 1987, and *S. antarctica* Casanova, 1991. The other four, as well as *S. moretonensis*, may or may not have posterior teeth. In addition, as they live in neritic temperate or tropical waters, comparisons will be made only with them.

The unusual structure of the area surrounding the female genital opening easily separates *Spadella japonica* from all other species of the genus. In more particular regard to those being compared: *S. cephaloptera* Busch, 1851 has a prominent cement gland close to each opening; *S. angulata* Tokioka, 1951 and *S. gaetanoi* Alvariño, 1978 are devoid of this gland; the opening is not described in *S. bradshawi* Bieri, 1974 and thus there is probably a simple orifice as in the two latter species; as for *S. moretonensis*, the aperture is trilobed and situated on a well-marked prominence. Furthermore, all these species have more numerous hooks than *S. japonica* (Table 1).

Other main features show the specificity of the new *Spadella* by comparison with



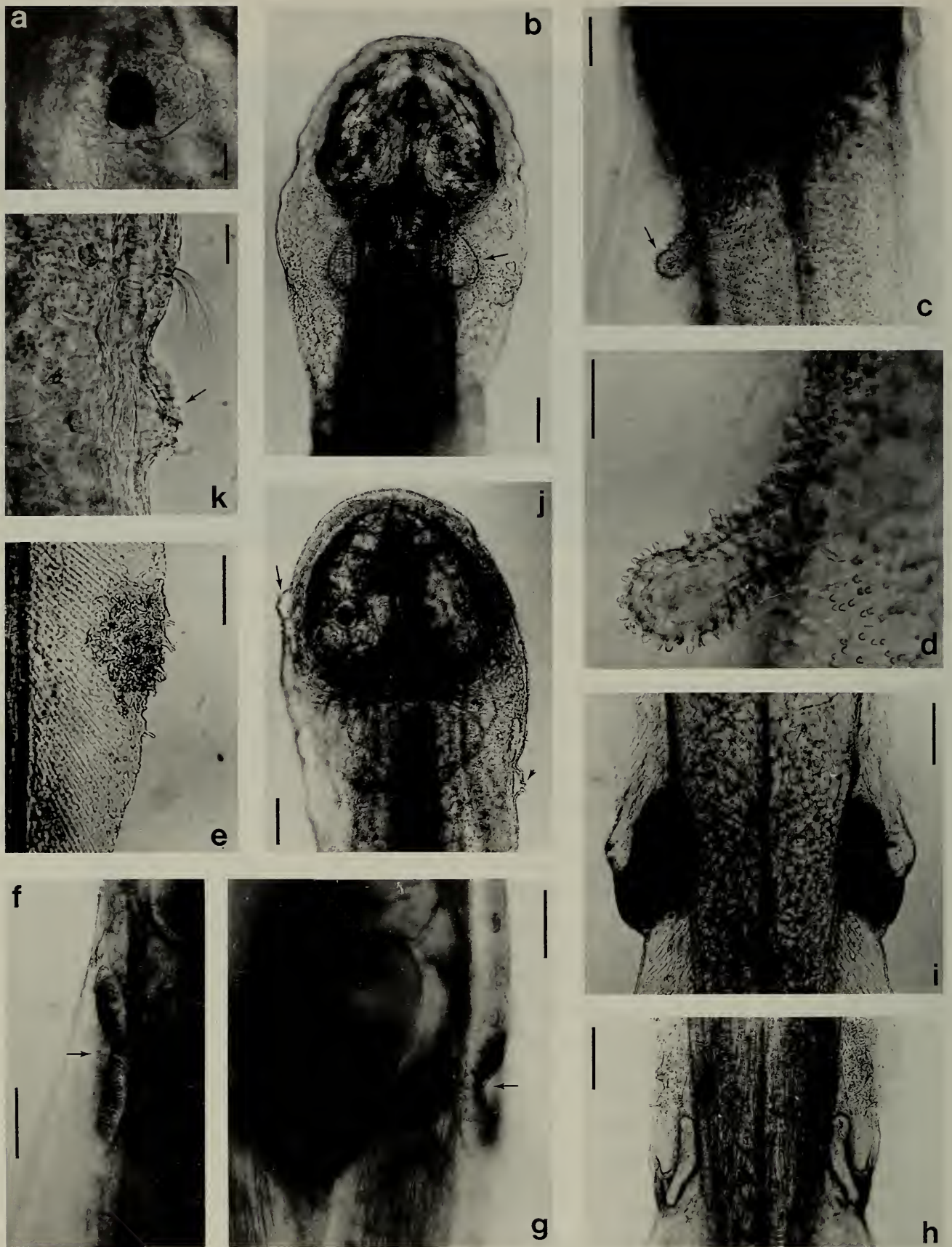


Fig. 3. *Spadella japonica*, new species: a, Right eye; b, Anterior part of body in dorsal view showing the corona ciliata (arrow); c, Anterior part of the tail of an original specimen in ventral view, showing a curious "papillated organ" (arrow) and adhesive papillae; d, Enlargement of the "papillated organ" area; e, Area with tiny papillae on the ventral side of the left lateral fin (other original specimen); f and g, Two aspects of the female genital opening (arrow) in dorsal view; h, Empty seminal vesicles; i, Mature seminal vesicles; j, Head and neck of another original specimen with two "papillated organs" (arrows) in dorsal view; k, Enlargement of the organ on neck (arrow), just under a sensory spot. Scale bars: 0.1 mm (b, c, e-j), 0.05 mm (d) and 0.02 mm (a, k).

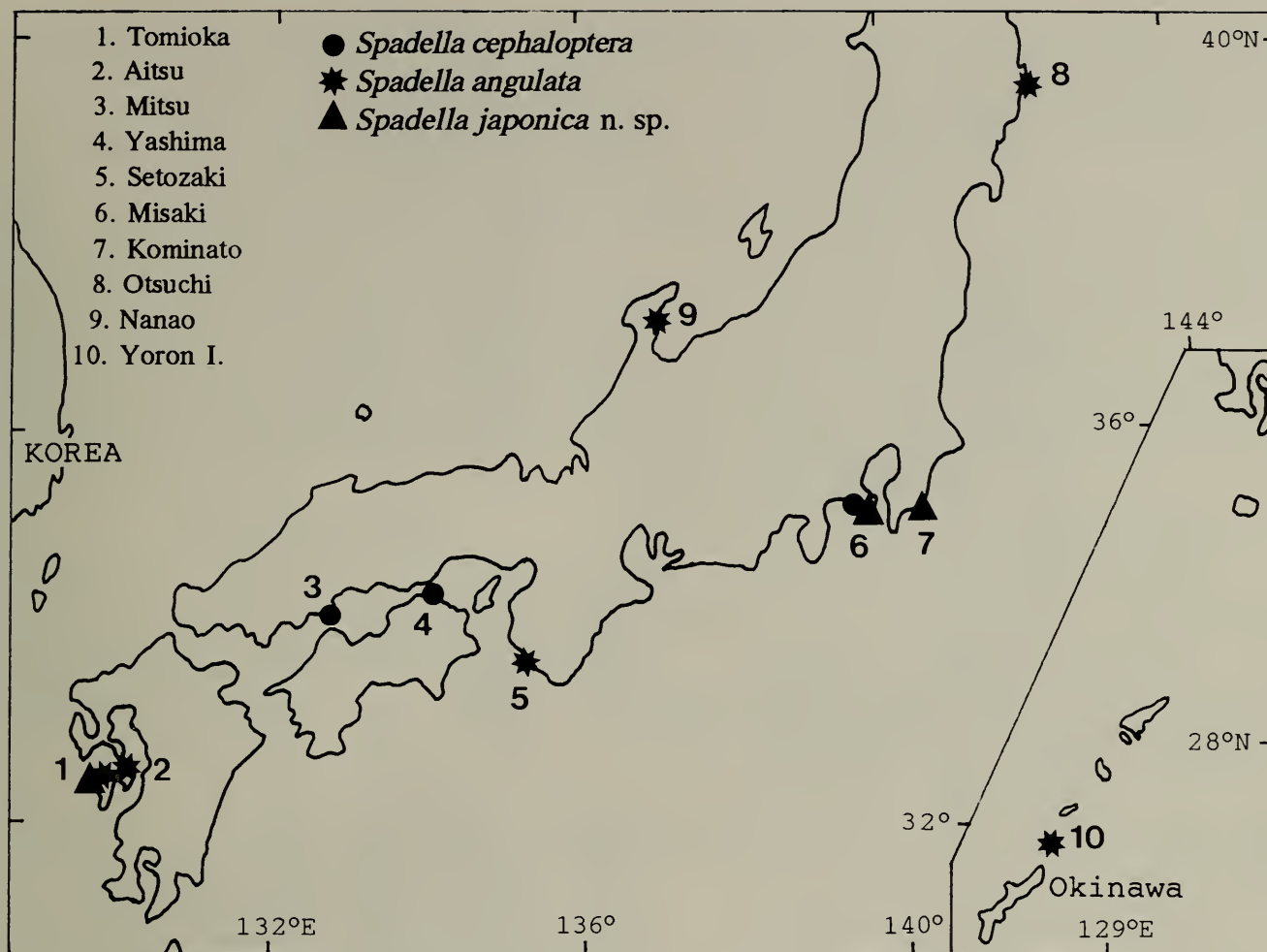


Fig. 4. Distribution of the three species of *Spadella* known from neritic waters of Japan.

each of the five species mentioned above. Indeed, it differs from:

- Spadella cephaloptera*, in which lateral fins begin at level of the transverse septum (Japanese specimens) or slightly before (some Mediterranean specimens) and seminal vesicles are more or less rounded;
- Spadella angulata*, which has a special orange-brown color pattern on the ventral and dorsal sides of the body and on the digestive tract (Tokioka & Bieri 1966, Bieri et al. 1987); according to Goto and Thuesen (pers. comm.) who observed the two species in the Japanese waters (specimens alive as well as preserved ones), *S. angulata* is opaque (creamy white) while *S. japonica* is transparent;
- Spadella bradshawi*, in which the corona ciliata is massive and lateral fins do not touch the seminal vesicles;

- Spadella gaetanoi*, which bears a pair of cup-like structures between tip of tail and seminal vesicles, and moreover, the latter are reniform;
- Spadella moretonensis*, in which the ventral ganglion is very short (less than 25% of the trunk length).

The characteristics of the six species of *Spadella* which are always or sometimes devoid of posterior teeth are summarized in Table 1.

*Distribution.*—Three species of *Spadella* live in the neritic waters of Japan (Fig. 4). *Spadella cephaloptera* has been found in Misaki, Mitsu and Yashima. According to Yosii & Tokioka (1939), the two minute tentacles on the head are found in small specimens but not on large ones, whereas in European specimens they also exist on adults. *Spadella angulata* has been men-



Table 1.—Principal differential characteristics of the six species of the genus *Spadella* which may or may not have posterior teeth.

	<i>S. cephaloptera</i> <sup>a</sup> Busch, 1851	<i>S. angulata</i> <sup>a</sup> Tokiooka, 1951	<i>S. bradshawi</i> Bieri, 1974	<i>S. gaetanoi</i> Alvarino, 1978	<i>S. moretonensis</i> Johnston & Taylor, 1919	<i>S. japonica</i> , n. sp.
Total length	7 mm	5.8 mm	6.5 mm	3 mm	3.28 mm <sup>b</sup>	3.75 mm
Tail percentage	57.1	48.6–55.4	53–54	53–55	50.5 <sup>b</sup>	48.6–51.8
Anterior teeth	2–5	3–4	3–6	4–5	3/4	3–4
Posterior teeth	usually 0 (or 1)	usually 1 (or 0)	0	0 or 4–5	0	0
Hooks	7–11	8–9	7–12	8–10	9/9	6–8
Length of ventral ganglion on trunk	1/3	1/3	1/3	1/2	<1/4 <sup>b</sup>	1/3
Lateral fins	from transverse septum to seminal vesicles	from posterior part of trunk to seminal vesicles	from posterior part of trunk to before seminal vesicles	from posterior part of trunk to seminal vesicles	from posterior part of trunk to seminal vesicles	from posterior part of trunk to seminal vesicles
Seminal vesicles	small, spherical or reniform, in contact with tail fins	small, hook-shaped, in contact with lateral and tail fins	small, hook-shaped, only in contact with tail fin	reniform, in contact with lateral and tail fins	not mature, in contact with lateral and tail fins	small, hook-shaped, in contact with lateral and tail fins
Female genital opening area	with a prominent cement gland	simple orifice	simple orifice (?)	simple orifice	aperture trilobed, on a well-marked prominence	orifice at bottom of an elongate cupel

<sup>a</sup> Data for this species are those of Japanese specimens.<sup>b</sup> These data are calculated according to the authors' drawings (the authors' measurements when given included the tail fin).

tioned in many localities: Otsuchi, Nanao, Setozaki, Tomioka, Aitsu and near Okinawa (Yoron Island, southwest of Japan). Japanese specimens, first described by Tokioka (1951) as *S. cephaloptera* forma *angulata*, differ from Malay specimens (Tokioka & Pathansali 1964) in having, usually, one posterior tooth. *Spadella japonica*, according to Goto (pers. comm.), has been collected among the *Zostera* belt in Misaki and in tide pools of Kominato and Tomioka and is more common than *S. angulata*.

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#### Literature Cited

- Alvariño, A. 1978. *Spadella gaetanoi*, a new benthic chaetognath from Hawaii.—Proceedings of the Biological Society of Washington 91:650–657.
- . 1981. *Spadella legazpichessi*, a new benthic chaetognath from Enewetak, Marshall Islands.—Proceedings of the Biological Society of Washington 94:107–121.
- Bieri, R. 1974. A new species of *Spadella* (Chaetognatha) from California.—Publications of the Seto Marine Biological Laboratory 21:281–286.
- , M. Terazaki, E. V. Thuesen, & T. Nemoto. 1987. Colour pattern of *Spadella angulata* (Chaetognatha: Spadellidae) with a note on its northern range extension.—Bulletin of Plankton Society of Japan 34(1):83–84.
- Bowman, T. E., & R. Bieri. 1989. *Paraspadella anops*, new species, from Sagittarius cave, Grand Bahama Island, the second troglobitic chaetognath.—Proceedings of the Biological Society of Washington 102:586–589.
- Busch, W. 1851. Beobachtungen über Anatomie und Entwicklung einiger wirbelloser Seethiere. Chaetognatha.—Berlin 4:93–100.
- Casanova, J.-P. 1986. *Spadella ledoyeri*, chaetognathe nouveau de la grotte sous-marine obscure des Trémies (calanques de Cassis).—Rapports de la Commission internationale pour l'Exploration Scientifique de la mer Méditerranée 30(2):196.
- . 1987. Deux chaetognathes benthiques nouveaux du genre *Spadella* des parages de Gibraltar. Remarques phylogénétiques.—Bulletin du Muséum national d'Histoire naturelle, Paris, 4<sup>e</sup> sér., 9, section A(2):375–390.
- . 1990. A new species of *Paraspadella* (Chaetognatha) from the coastal waters of Japan.—Proceedings of the Biological Society of Washington 103:907–912.
- . 1991. The first record of a benthic polar chaetognath: a new *Spadella* from the Antarctic.—Journal of Natural History 25:1355–1362.
- Johnston, T. H., & B. B. Taylor. 1919. Notes on Australian chaetognatha.—Proceedings of the Royal Society of Queensland 31:28–41.
- Salvini-Plawen, L. Von. 1986. Systematic notes on *Spadella* and on the chaetognatha in general.—Zeitschrift für Zoologische Systematik und Evolutionsforschung 24(2):122–128.
- Tokioka, T. 1951. Pelagic tunicates and chaetognaths collected during the cruises to the New Yamato Bank in the Sea of Japan.—Publications of the Seto Marine Biological Laboratory 2:1–25.
- . 1965. The taxonomical outline of Chaetognatha.—Publications of the Seto Marine Biological Laboratory 12:335–357.
- , & D. Pathansali. 1964. *Spadella cephaloptera* forma *angulata* raised to the rank of species.—Publications of the Seto Marine Biological Laboratory 12:145–148.
- , & R. Bieri. 1966. The colour pattern of *Spadella angulata* Tokioka.—Publications of the Seto Marine Biological Laboratory 14:323–326.
- Yosii, N., & T. Tokioka. 1939. Notes on Japanese *Spadella* (Chaetognatha).—Annotationes Zoologicae Japonenses 18:267–273.

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