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# Two New Species of *Spiochaetopterus* (Annelida: Polychaeta) from Sagami Bay and Tokyo Bay, Central Japan with a Comparative Table of Species from Japanese and Adjacent Waters

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**ABSTRACT**—Two new species of *Spiochaetopterus* (Chaetopteridae: Polychaeta), *S. sanbanzensis*, from Sanbanze, off Ichikawa and Funabashi Cities, Tokyo Bay, and *S. izuensis* from the shallow waters of Sagami Bay, were described. The most obvious difference is the number of segments in region A: 9 in *S. sanbanzensis* and 10 in *S. izuensis*. In addition, *Spiochaetopterus sanbanzensis* has elliptical light brown or blackish eye-spots, asymmetrical cordate specialized A4 chaetæ, and a color pattern consisting of many dispersed brown spots on both ventral and dorsal faces of region A. In *Spiochaetopterus izuensis*, a brown band extends from each eye-spot to the level of the A1 chaetæ; the convex ventral edge of the head of the specialized A4 chaeta has an oblique section and the color pattern of the body is absent. A comparison is established between these two new species and other known species from Indo-Pacific Ocean

**Key words:** Polychaeta, Chaetopteridae, new species, Japanese waters

## INTRODUCTION

The genus *Spiochaetopterus*, among the smallest chaetopterid polychaetes, is well known as a common taxon in bottom fauna on mud or sand (Rouse and Pleijel, 2001). The number of species in this genus has increased dramatically over the last few decades. From single species in the 19th century when the genus was erected (Sars, 1856; Claparède, 1870) it increased gradually to reach 4 species and 3 subspecies after the revision work by Gitay (1969). More recently Bhaud *et al.* (1994), Nishi *et al.* (1999), Nishi and Bhaud (2000), Bhaud and Petti (2001), Bhaud *et al.* (2002), Bhaud *et al.* (2003) erected 6 new species, modified some of the subspecies and varieties of Gitay with promotion at species level, giving a total of 13 species. This paper adds 2 new species in the preceding list of the same genus.

Five species of *Spiochaetopterus* are already described from Japan: *S. okudai* Gitay, 1969; *S. sagamiensis* Nishi *et*

*al.*, 1999; *S. okinawaensis* Nishi and Bhaud, 2000; *S. sesokoensis* Nishi and Bhaud, 2000; *S. koreana* Bhaud *et al.*, 2002. In addition, Okuda (1935), Imajima and Hartman (1964), Imajima (1982, 1997) and Nishi (1996) reported *Spiochaetopterus costarum* (Claparède, 1868) as *Telepsavus costarum* Claparède, 1868 from Japanese waters. However the voucher specimens of these records need to be re-examined as the geographical distribution of the species is now restricted to the Mediterranean Sea and the European Atlantic coast (see Bhaud, 1998a). Paik (1989) reported *S. costarum* from the Korean Sea but this record probably belongs to *S. koreana* Bhaud *et al.*, 2002. Generally speaking, *S. costarum* is still mistakenly reported from all around the world (cf Méndez, 2002). In the far eastern seas of the U.S.S.R., *S. typicus* Sars, 1856 was recorded by Uschakov (1955), without the proofs for the identification such as detailed morphology of specialized chaeta on A4 and shape of uncinal plates. The present paper, with descriptions of two new species from Middle Japan, completes the local marine fauna as a contribution to the knowledge of the specific biodiversity. In addition, it supplies elements that clarify the links between mobility of larvae, geographical distribution of adults and adaptive radiation over an evolutionary timescale.

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## MATERIALS AND METHODS

The collection site of each new species is shown in Fig. 1. The same figure indicates the type locality for other species: *S. okudai*, *S. okinawaensis*, *S. sesokoensis* and *S. koreana*.

Samples were collected by dredging, using a Smith-McIntyre grab, or by hand using scuba gear in shallow water when bottom was less than 20 m deep. When collecting was done by hand, gently digging into the sandy bottom, tubes and live worms were transferred to the laboratory. Samples were fixed with 10% formaldehyde for 1–2 days and then preserved in 70% ethanol. One or two worms of each species were prepared for scanning electron microscope (SEM) observation after gradual alcohol series, 80%, 90%, 95%, 99%, 100%, 10 to 20 minutes in each and air-dried, coated with palladium by Hitachi E-1030 Ion Sputter, examined in Hitachi S520 and S4500, University of Perpignan, France or JEOL S in the Chiba Museum. In some worms, A4 chaetae were dissected out and prepared for SEM observation. The tubes were also cut into fragments and parts of articulations were observed. All the samples were deposited in the Natural History Museum and Institute, Chiba (catalog number, CBM-ZW) and Coastal Branch of the Natural History Museum and Institute, Chiba (catalog number: CMNH-ZW). For the terminology of modified chaetae of the fourth segment of the anterior part, we refer to and follow Bhaud *et al.* (1994). With the report on detailed body characters of *Spiochaetopterus*, in particular hard structures, and the test of additional structural characters such as the number of A segments (Bhaud, 1998b) and tube structures (Nishi and Arai, 1996; Nishi *et al.*, 1999), a precise image of the

number of species in *Spiochaetopterus* should soon be available.

## RESULTS: DESCRIPTION OF TWO NEW SPECIES

Family Chaetopteridae Audouin and M. Edwards, 1833

*Spiochaetopterus* Sars, 1856

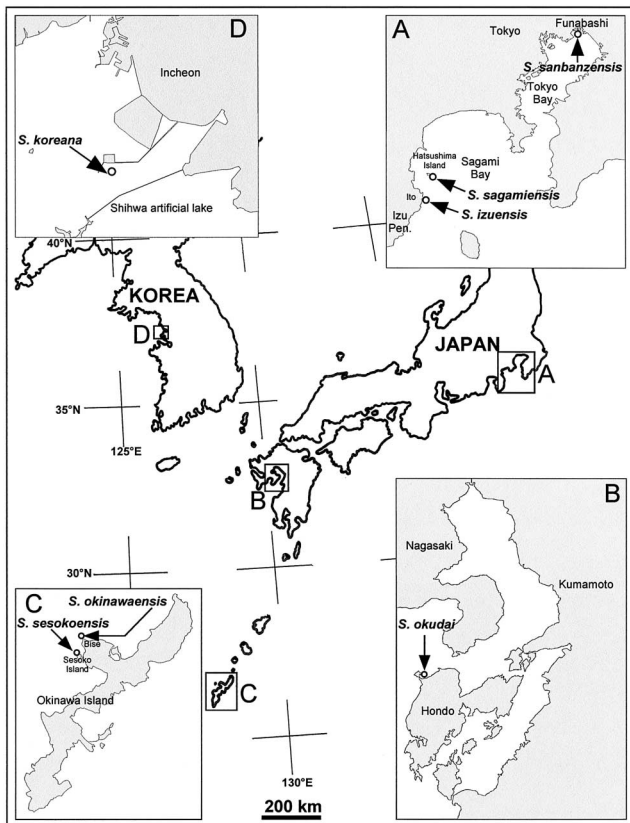
*Spiochaetopterus sanbanzensis* n. sp.

(Figs 1A, 2–3, 6 E)

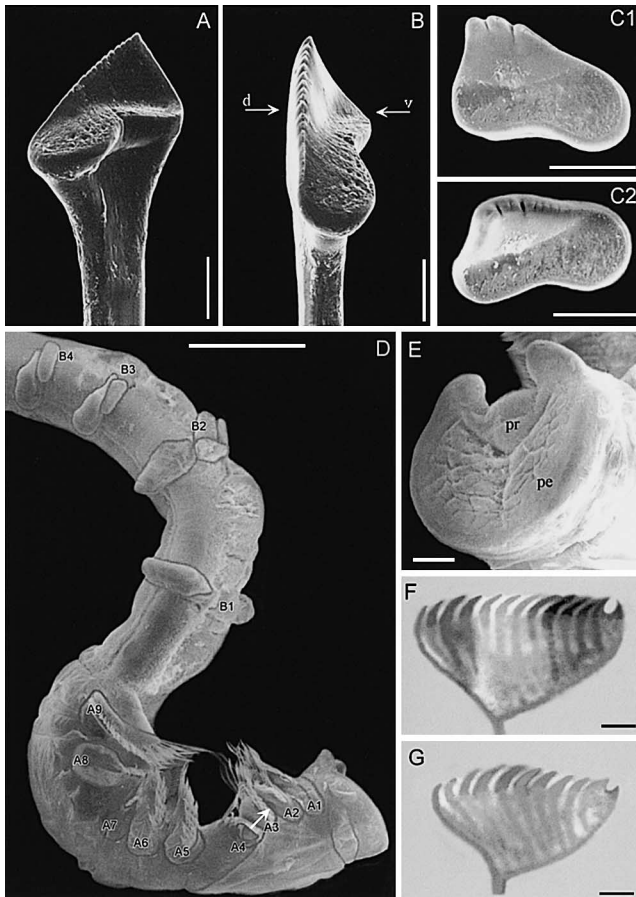
**Material examined.** Holotype, CBM-ZW-0263: Paratypes, CBM-ZW-0313 to -ZW-0316 (4 specimens) and CMNH-ZW-01531 to -ZW-01533 (3 specimens); mud bottom, about 2 m deep, Sanbanze, Ichikawa and Funabashi, Tokyo Bay, Japan, 26 August 1985; collected by T. Furota.

**Description.** Body length of holotype reaching 8 mm long with only A and B region, C region lacking; for 7 paratypes, 5–13 mm (all types lacking posterior part of C region). Body width about 0.5–0.8 mm (0.5 mm in holotype; 0.6 mm in paratype -ZW-313; 0.8 mm in paratype ZW-1531). Body slender and fragile; incomplete fixed worms with up to 30 chaetigers; posterior parts of C regions lacking in all type specimens; segment number formula as follows: 9A + 3 or more B + unknown C in holotype; 9A + 5–10B + 10 or more C in paratypes.

Region A (Figs. 2D,E, 3) long and narrow, includes 9 segments ( $n=6$ ) without exception. The prostomium is small; the peristomium wide, covering prostomium, with the two lateral ends close to contact (Fig. 2E). All region A chaetigers have pointed bordered or slender leaf- or oar-like chaetae; bundles from A1–A3 and A5–A9 wider than those from A4. The specialized A4 chaeta, one on each side of A4 chaetiger, is accompanied by a low number of chaetae in the previous pattern. As a general feature of the genus, ventral surface of region A carries a long, slender shield (Fig. 2D), widest anteriorly and posteriorly, and narrowest at A4–A5. The most marked section consists in a light brown gland area on A6–A7 followed by a whitish glandular crescent on A8–A9. The shape of specialized A4 chaetae (Fig. 2A–C) is consistent with the pattern known in other representatives of the genus: with an inflated, obliquely truncated head forming an approximately triangular surface; but in detail, the oblique section is specific with a heart-shaped, dorsally swollen, asymmetrical area; this oblique section is not flat but concave. The stout shaft is deeply overhung by the upper part of the chaeta (Fig. 2A). Measurements of the specialized chaeta are following (in  $\mu\text{m}$ ): total length 460, shaft length 340, length of head 120, diameter of the shaft 45, ventral width of head 120, lateral width 60. The section of the shaft shows a ventral groove. When observed on the body, the oblique and slightly heart-shaped section faces both toward the middle line of the body, and the fore part of the body indicated by an arrow on Fig. 2D. Still more precisely from one side to the other, the two specialized chaetae are disposed symmetrically; the longer side of the oblique section of the head is external and ventral. This edge is crenelated. Given an isolated chaeta, it is possible



**Fig. 1.** Map showing collection sites of species dealt within the present paper. *Spiochaetopterus sanbanzensis* n. sp. and *S. izuensis* n. sp. were collected in part A, as was *S. sagamiensis*; *S. okudai* is from part B; *S. okinawaensis* and *S. sesokoensis* are from part C, and *S. koreana* from the Yellow Sea (part D).

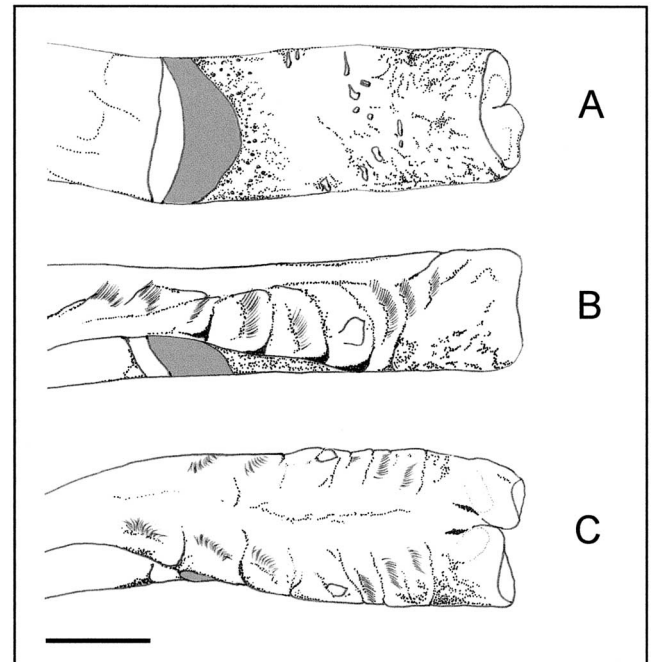


**Fig. 2.** *Spiochaetopterus sanbanzensis* n. sp. paratype CBM-ZW 314. A: specialized A4 chaeta, ventral view; B: specialized A4 chaeta, lateral view of the same chaeta from right side of body; d: dorsal face, v: ventral face. C1-C2: specialized A4 chaeta, two apical views from left side. Comparison of these illustrations indicates the importance of the point of observation: ventral lobes of the oblique section of the head differ in size. D: SEM micrograph of regions A and B, with emphasis of parapodia borders; specialized A4 chaeta is seen from its dorsal side and the ventral face is directed as shown by the white arrow. E: prostomium (pr) and peristomium (pe), showing the prolongation of lateral sides of peristomium. F: uncinal plates from first segment of region B. G: same from region C. Scale bars, 50  $\mu$ m for A–C, 500  $\mu$ m for D, 100  $\mu$ m for E, 2.5  $\mu$ m for F and 3  $\mu$ m for G.

to determine in all *Spiochaetopterus*, its origin: right or left side of the body.

Region B (Fig. 2D) includes 5–10 segments ( $N=4$ ); B1–B3 segments are longer than the following ones; notopodia of region B are elongated, trilobed, ciliated, longer in anterior segments than in posterior segments and neuropodia formed with 1 or 2 lobes bear uncinal plates. Neuropodia, on B1 and B2, are unilobed, curving towards the dorsal side, and from B3 onward, become bilobed. Teeth on the uncinal plates are directed backwards on the smaller anterior dorsal lobe, and forwards on the larger ventral lobe; as a consequence, the rows of teeth on the two lobes are face to face. Each uncinal plates of B1 (Fig. 2F) provides 12–13 teeth ( $N=15$ ) for a length of 18–20  $\mu$ m (average  $19.2 \pm 0.83$ ,  $N=15$ ).

Region C consists of more than 10 segments ( $N=4$ ); all



**Fig. 3.** *Spiochaetopterus sanbanzensis* n.sp., paratype CBM-ZW 314. Coloration pattern of region A. A: ventral side; B: lateral side; C: dorsal side. Scale bar, 0.5 mm. Notice the marks of palps on C.

lacking posterior part. No specimens are complete, so no pygidiums are observed. Notopodia were unilobed knob-like, with single long, lanceolate chaeta. Neuropodia were bilobed. The ventral lobe was larger, with more than 100 uncinal plates; this number is far lower than that on B1. The dorsal lobe was smaller with an orientation towards the fore part of the body. Uncinal plates are not arranged in a line, but orderless; they are similar to those of region B in shape, but smaller and with fewer teeth: 10–12,  $N=10$  (Fig. 2G); length: 14–16  $\mu$ m (average  $14.9 \pm 0.67$ ,  $N=15$ ) from observation of C2 to C5 of two paratype worms.

The coloration is noteworthy (Fig. 3 A–C). Many brown or blackish spots are visible on the ventral part of the peristomium and of A2 and A3 segments (Fig. 3A). The peristomium and A1–A2 segments are slightly brownish with many spots; A3–A6 segments are cream colored, slightly brownish (partly with spots); A7 segment is brownish with many small brown spots, as from the peristomium to A2 segment, and the central part of the body has a brown belt: A8 and A9 segments are clear white or cream colored, and longer than the anterior segments. Ventral glandular shield on A8 and A9 is separated into two or more parts, probably caused by fixation or damaged by sampling. Each segment of region A is separated by a continuous brown oblique line of small crescent-shaped brown dots. These dots attached to the plastron, are visible in the ventral and lateral views. The shape of the pair of light brown or blackish eyes, elliptical spots on the inner lateral side of the prostomium, seems specific to this species. The two long grooved palps arising dorsally just posterior to the eye-spots are also speckled with brown spots.

Tubes translucent, annulated, with rings at intervals of 0.8 to 1.5 mm (usually about 1.2 mm) do not carry serrations on the mouth part; tube partition inside the tube is observed, with a single pore on the central part. Diameter of the tube (Fig. 6 E): 0.6–1 mm.

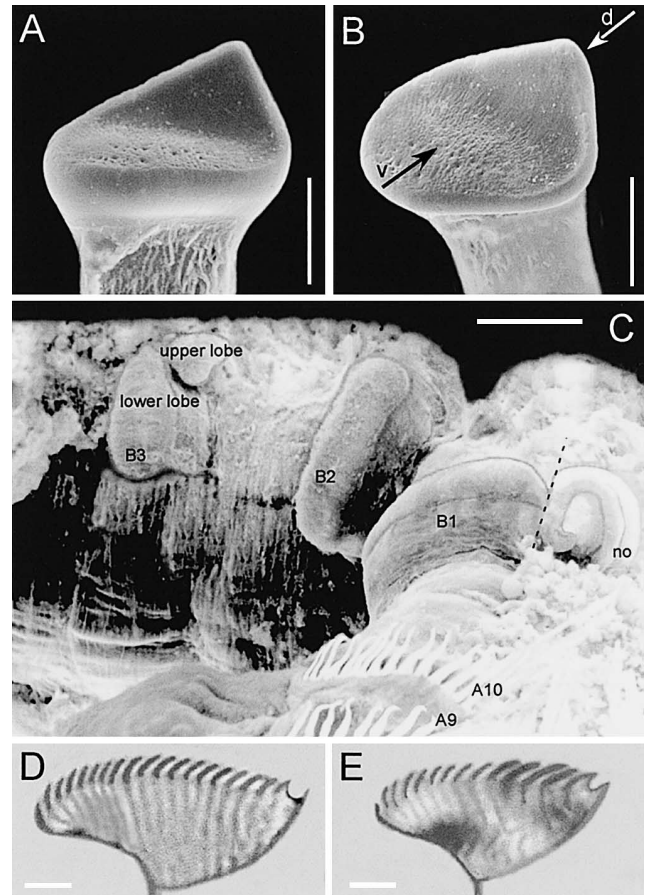
**Etymology.** The species name, *sanbanzensis* is a reference to the type locality: Sanbanze tidal flat located near Ichikawa and Funabashi, Chiba Prefecture.

*Spiochaetopterus izuensis* n. sp.  
(Figs. 1A, 4–5, 6 F–G )

**Material examined.** Holotype, CBM-ZW-317, complete, without tube, without coloration, Futo, Izu Peninsula, central Japan, sandy bottom, 12m deep, 1996, November 1, collected by E. Nishi, by hand, Paratype: CBM-ZW-318 (2 worms, one complete, and one separated into two parts on the middle region), -ZW-319 (1 worm), ZW-320 (1 worm), -ZW-321 (1 worm), -ZW-322 (1 worm), collection data same as holotype.

**Description.** Body length 20 to 40 mm long (18mm A+B, 7 mm C, total 25mm long in ZW-317; 2 mm A, 16mm B, 9 mm C, total 27 mm long in -ZW-318; 2mm A+4.8 mm B+7mm C in -ZW-319), body width 0.4–0.8 mm (tube width about 0.5–1 mm); body slender and fragile; complete fixed worms with up to 97 segments; segment number formula as follows: 10A+20B+13C in -ZW-317 (holotype); 10A+30B+40C in -ZW-318; 10A+15B + 50C on -ZW-322; 10A+22B+65C in -ZW-319.

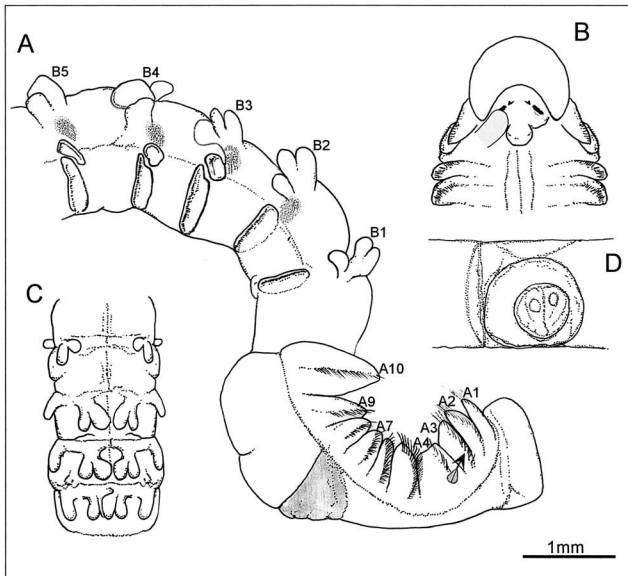
Region A (Figs. 4C, 5A,B) long, narrow, consists of 10 segments ( $n=6$ ) without exception. Prostomium laterally extended with peristomium, in fixed specimens, strongly contracted with lateral ends nearly fused on the dorsal side. A pair of brown eye-spots is disposed on the dorso-lateral sides of the prostomium, and visible in the dorsal view when the palps are removed (Fig. 5B). A brown band extends from the lower part of each eye-spot on the lateral dorsal side. A long, grooved palp protrudes dorsally just posterior to each eye-spot. The ventral surface of region A carries a long, slender shield (Fig. 5A), widest anteriorly and posteriorly, and narrowest at A4–A5. The most marked section is a light brown gland area on A7 followed by a whitish glandular crescent from A8 to A10. Single specialized A4 chaeta (Fig. 4A,B), present on each side of A4 chaetiger, is consistent with the pattern known in *Spiochaetopterus* with an inflated, obliquely truncated, light brown or yellowish head forming an approximately triangular surface. But in detail, the oblique section is specific. Its ventral edge is not cordate but convex, without a notch, and slightly asymmetrical. The swollen head, with a well-marked dorsal careen, takes the general aspect of a tear-drop. Measurements of the specialized chaeta are following (in  $\mu\text{m}$ ): total length 300, length of shaft 210, length of head 90, diameter of the shaft 50, ventral width of head 75, lateral width 70. The section of the shaft is without a ventral groove. As in other species and



**Fig. 4.** *Spiochaetopterus izuensis* n.sp. from paratype CBM-ZW-320. A: specialized A4 chaeta ventral view; B: specialized A4 chaeta both ventral and apical view of the same chaeta, d: dorsal direction, v: ventral direction. C: Transition from regions A to B of the body observed on a specimen lying on its left side; the right side of the body is shown with segments A9 and A10 then B1, B2 and B3; only segment B3 with neuropodia formed with two lobes, upper and lower, carrying uncinal plates; on B1, “no” is a part of notopodium, the dotted line is the border between neuropodium and notopodium. D: uncinal plates from first segment of region B. E: same from region C. Scale bars, 50  $\mu\text{m}$  for A–B, 100  $\mu\text{m}$  for C and 2  $\mu\text{m}$  for D–E.

when observed on the body, the ventral side of the head faces both the middle line of the dorsal side and the fore part of the body, as indicated by an arrow on Fig. 5A. From one side of the body to the other, the two specialized chaetae are disposed symmetrically, the longer side of the oblique section of the head being external and ventral. A difference is observed relatively to *S. sanbanzensis*: neither side of the upper oblique section is crenulated.

Region B (Figs 4C, 5A,C) consists of 15 to 30 segments ( $N=4$ ) elongated and dorsally glandular; B1 and B2 are longer than the following segments. The cupule is not seen in fixed specimens. Parapodia of region B are biramous, and both rami subdivided. Notopodia are trilobed, with a bilobed, Y-shaped inner part, and a short unilobed, cirriform outer part, on the side of body. On posterior notopodia of region B, lobes are smaller with Y-shaped inner lobe widely separated from the lateral one. Neuropodial fleshy lobes are

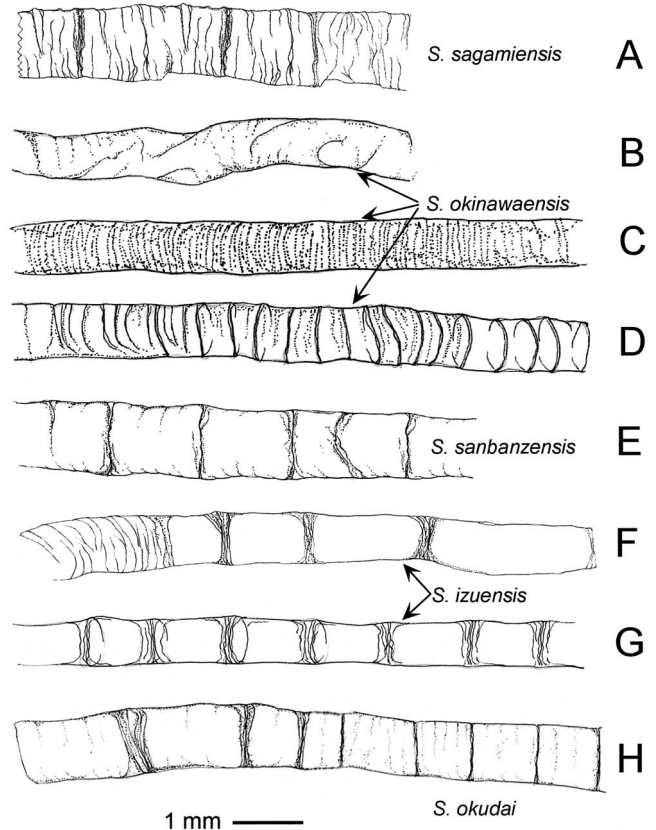


**Fig. 5.** *Spiochaetopterus izuensis* n.sp. from paratype CBM-ZW-320. A: lateral view of anterior region giving coloration pattern with brown pigmentation on lateral side; on A4 the specialized chaeta is seen from its dorsal side and its ventral face is directed as shown by the arrow. B: dorsal view of anterior region showing prostomium and eye-spots; notice the marks of palps. C: anterior part of region B with notopodia; observe, as a general rule in *Spiochaetopterus*, the separation between dorsal bifid part of notopodia and single lobe on the ventral part of notopodia. D: part of tube showing an internal septa with two perforations.

characterized by the presence of uncinial plates. They are biramous throughout region B except on B1 and B2 (Figs. 4C, 5A) where they are unilobed. The upper lobe is short and anteriorly oriented, whereas the lower lobe is elongated transversely or dorso-ventrally, and posteriorly oriented. Uncinial plates are bluntly triangular with a single row of minute teeth (Fig. 4D). Uncinial plates from B1 reached 12–14  $\mu\text{m}$  long, (average  $12.7 \pm 0.47$ ,  $N=15$ ) with 19–20 teeth.

Region C is composed of 20 to 65 segments ( $N=4$ ). Parapodia all biramous: notopodia unilobed, digitiform, distally swollen and containing 1 to 3 slightly enlarged lanceolate chaetae; neuropodia subdivided into two lobes, as in region B: upper lobe anteriorly oriented, and lower lobe posteriorly oriented. Uncinial plates (Fig. 4E) are similar to those of region B, but smaller and with fewer teeth: number of teeth on ventral lobe of C2 of paratype ZW-319 reaches 14 to 16 ( $N=55$ ) for a length of 11–12.5  $\mu\text{m}$  (average  $11.9 \pm 0.87$ ,  $N=15$ ). The simple pygidium bears a slight dorsal notch; the terminal anus being surrounded by several pygidial lobes.

The coloration of the body seems characteristic even on preserved specimens. A pair of lateral brown spots may be present on each segment between B2 to B20 (Fig. 5A); position and number of spots vary greatly, from B4 to B7 in Holotype -ZW-317, from B11 to B20 in -ZW-318, from B2 to B5 in -ZW-320, from B2 to B8 in -ZW-321; from B4 to B18 in -ZW-322. The coloration of region C, brown or dark brown, partly greenish brown, is a characteristic of the gut



**Fig. 6.** Different aspects of tubes of Japanese *Spiochaetopterus*, all approximately at the same scale. The aspect of the wall is not completely differentiating. For instance, tube of *S. okinawaensis* presents several aspects linked with the rate of secretion of mucus by the ventral shield of the worm. Notice that the tube of *S. sesokoensis* is not known. Mean actual size of tube diameter when drawing was for these 5 species close to 1 mm, but 0.8 for *S. okinawaensis*.

and not the tegument; it is general and is observed in Mediterranean specimens of *S. costarum*, *S. solitarius* and even in *Phyllochaetopterus socialis*.

Tubes were oriented vertically in the substratum, with the opening at the uppermost end and the greater part of the tube below the sandy surface of the substratum. Many tubes were attached to small rocks (about 10 cm long); the highest density found was 10–20 individuals per 100  $\text{cm}^2$ . Tubes are straight, long, slender, fragile or partly tough, with many periodical growth rings, usually 1 to 2 mm intervals; several serrations at the tube opening and internal septa with 2–4 holes (Fig. 5D) are observed; diameter of the tube (Fig. 6F,G) reaches 1 mm.

**Etymology.** The species name, *izuensis* shows the type locality, Izu Peninsula, Shizuoka Prefecture; its eastern side borders Sagami Bay and its western side borders Suruga Bay.

**Remarks.** These two new species, although collected in a common area, are differentiated by the number of A



segments (9 for *S. sanbanzensis*, and 10 for *S. izuensis*), the pattern of body coloration, the maximum number of teeth on uncinal plates on B1 (12 on *S. sanbanzensis* and 19 on *S. izuensis*), and the morphology of the specialized chaetae on A4: ventral edge of the triangular section cordate in *S. sanbanzensis*, but convex in *S. izuensis*.

These two new species from the Central part of Japan (part A in Fig. 1) must also be differentiated from other Pacific or Indian *Spiochaetopterus*: *S. sagamiensis* (type locality in part A of Fig. 1), *S. okinawaensis*, *S. sesokoensis*

(type locality in part B of Fig. 1), *S. okudai* (type locality in part C of Fig. 1), *S. koreana* from the Yellow Sea (type locality in part D of Fig. 1), and *S. creoceanae* (from the Persian Gulf). Comparative morphological characters of these two new species and congeners distributed around Japan are given in Table 1. *Spiochaetopterus izuensis* is characteristic in having 10 segments in region A. Among the valid species in the genus only *S. creoceanae* and *S. izuensis* have 10 segments, all other species have just 9 segments. However *S. okudai* may have 10 A segments. *Spiochaetopterus cre-*

**Table 1.** Comparison of 8 species of *Spiochaetopterus* distributed in Pacific-Indian Oceans: six species from Japan, one from the Yellow Sea and one from Persian gulf. Colorations are based on preserved specimens. In line 5 “Shape of the specialized chaeta”, three patterns are given for the oblique section of the head; 1: with only one lobe, 2: with two equal lobes and 3: with two lobes of different size.

1	species	<i>S. creoceanae</i>	<i>S. koreana</i>	<i>S. okinawaensis</i>	<i>S. sesokoensis</i>	<i>S. sanbanzensis</i> n.sp.	<i>S. izuensis</i> n.sp.	<i>S. sagamiensis</i>	<i>S. okudai</i>
2	locality	Persian Gulf	Yellow Sea	Bise	Sesoko Island	Tokyo Bay	Izu Peninsula	Sagami Bay	Amakusa Bay
3	authors	Bhaud, Martin, Koh and Gil, 2003	Bhaud, Koh and Hong, 2002	Nishi and Bhaud 2000		Nishi, Bhaud and Koh (this paper)		Nishi, Miura and Bhaud, 1999	Gitay, 1969 + pers. obs
4	ocular spots	+	+	+	–	+	+	–	+
5	shape of the specialized chaeta on A4:	3	2	3	3	3	1	1	1
6	crenulated external edge of head	–	–	–	–	+	–	–	–
7	dorso-lateral grooves on shaft	–	–	–	–	–	–	+	–
8	number of A segments	10	9	9	9	9	10	9	9–11
9	number of lobes on neuropodia B1	1	1	1	1	1	1	1	1
10	number of lobes on neuropodia B2	2	1	2	2	1	1	2	2
11	number of lobes on neuropodia B3	2	2	2	2	2	2	2	2
12	shape of uncinal plates	the shape of these plates is homogeneous: bluntly triangular with a single row of minute teeth, insertion area slightly convex, dorsal edge as S shaped, line of teeth convex at the dorsal end							
13	size of uncinal plates on B1 (μm)	22	14	16.5	unknown	18	20	30–35	22–25
14	number of teeth on uncinal plates of B1	15–16	17–18	12–13	14–15	12–13	19–20	>40	12–14
15	coloration of the ventral secreting shield on A region	large brownish crescent at A7–A8, white shield on A8–A9 not very marked	very marked black crescent at A7, contrasting with white shield of A7–A8	very marked black crescent at A6–A7	pale dark or brownish crescent at A6–A7	peristomium, A1–A2 and A7: vivid brownish, A8–A9: clear white or cream colored	A7 with light brown gland belt; A8–A10 with whitish glandular area	dark-brown on A5–A6 then with crescent on A6–A9	light brown crescent between A6–A7 then white from A7 to A9 in several parts
16	coloration and pattern body spots	no coloration, no spots	no coloration, no spots	brown spots on lateral side of B and C regions; no spots on peristomium and ventral side of A1–A3	no coloration, no spot	brown or blackish spots on ventrum of peristomium and of A1–A3, no brown spots on lateral side of B and C regions	brown spots on lateral sides of region B from B2	no coloration, no spots	2 brown bands along the D and V parts of A podia
17	habitat	bottom with white coral sand, 2–30 m deep	silt with sand, sheltered areas	in seagrass beds with rubble, 1–2m deep	sandy beach, in coral sand, 1–2m deep	subtidal to shallow water	sandy bottom, 12 m deep	800–1100m deep cold methane seep	sandy bottom, 20–22 m deep

*oceanae* and *S. izuensis* are distinguished by the detailed morphology of specialized A4 chaetae: the ventral edge of the head in apical view is convex in *S. izuensis* but cordate in *S. creoceanae* with asymmetry of the two lobes (Bhaud *et al.*, 2002). *S. okudai* may have 10 segments in region A but is differentiated from *S. izuensis* and *S. creoceanae* by a strong coloration in region A and by a low number of teeth (12–14) on uncinal plates of B1 in contrast with body size. *Spiochaetopterus sanbanzensis* is differentiated in several steps. Through the shape of specialized A4 chaetae a homogeneous cluster of 4 species may be identified by the oblique section of the head, with two asymmetric lobes, (pattern 3 in Table 1, line 5). Among these species, *S. creoceanae* is isolated by having 10 segments in region A. *S. sanbanzensis* has specialized A4 chaetae with one lateral edge of the upper triangular section of the head crenelated like a mountain ridge. Neuropodia of B2 is formed with only one lobe. These two characters are strong differences from *S. okinawaensis* and *S. sesokoensis* and these two species are differentiated from the coloration pattern of secreting ventral crescents.

In spite of tube illustrations presented in this work (Fig. 6) these descriptions are not used for species differentiation. Observation of living specimens shows that the tube structure is often linked with the rate of construction. Consequently different aspects of tube walls may be described for the same species. The situation of *S. okinawaensis* is demonstrative and three patterns are observed: 1) the tube presents no complete, regularly disposed rings: it seems to have no ornamentation (Fig. 6B); 2) rings are present but always incomplete and their density is high (Fig. 6C); and 3) rings are present, complete and clearly separated (Fig. 6D). In all these cases, tubes are characterized by the absence of successive, equal articles. Serrations on the mouth part of the tube are probably present on all species; they are the mark of the cross cutting of the tubes with the use of specialized chaetae of A4; however they have been observed in only 3 species, *S. okinawaensis*, *S. izuensis*, and *S. sanbanzensis* at present. More careful observation is needed in other species.

## DISCUSSION

The interest of this family arises from the presence of a long planktonic stage in the life cycle of its representatives. However detailed data on larvae were obtained only from the Atlantic Ocean (Bhaud, 1998a), and ecological information about the life cycle in the Indian and the western Pacific Ocean are sparse. For a long time, it was believed that larval transport played an important role in dispersal, gave the species a large geographic range, and that the gene flux had a conservative action on the long time-scale of evolution. These views, at least in the precise case of the Chaetopterids in the Atlantic Ocean have not been corroborated (Bhaud, 1998a; Bhaud and Fernandez-Alamo, 2000; Bhaud, 2003). The high number of described species shows that the

founder species was subjected to intense adaptive radiation and that in spite of the ability of the larvae to disseminate, each species now inhabits only a limited geographical area. It is probable, as developed previously (Bhaud, 2000, 2003), that mobility through larval dissemination increases the chance of encountering a new environment which, through new selective factors, will stimulate a new subdivision. So, an area characterized by a large range of ecological parameters, such as the hydroclimate and its variation during the year, by the presence of frontal borders or by a large sedimentary diversity, could be propitious to the emergence of new species. In this framework, the rich fauna of Japanese waters may be explained by ecological conditions. For instance during winter, the sea surface temperature (SST) is 10°C in the Yellow Sea and around the north-west coast of Central Japan, but at the same time the SST reaches 20°C on the south-east coast of the same area, and off Okinawa Island. In the same way primary production may be also a differentiating factor as well as level of organic pollution or nature of sediment. This large range developed in space of ecological parameters could be the source of a strong differentiation and of the high number of described species. Although we do not yet know each specific distribution precisely, no species was reported in several widely separate locations. It may put forward that this type of distribution is probably common in not-well-studied organisms. However each collection area furnishes not more than two species (Fig. 1) and as for *Spiochaetopterus* in other oceans (cf for instance the situation of Atlantic Ocean in Bhaud, 1998a), differentiation of Japanese species seems important. In other words teleplanic larvae do not promote geographical homogeneity. The new proposals imply that individuals from widely separate areas belong to species other than *Spiochaetopterus costarum*. Although larvae of each species are capable of covering long distances, larval transport may be interrupted at various stages of the life cycle for a variety of reasons. The most powerful causes of failure are not linked to the lifespan of planktonic larvae, but rather to constraints on the ability of adults to realize physiological functions, including fecundation. The putative cosmopolitanism of *S. costarum*, before new species were described, was the result of both inadequate morphological examination and the use of questionable ecological arguments linked to larval dispersal.

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