

DESCRIPTION OF A NEW SPECIES OF CEPHALOCARIDA, *SANDERSIELLA KIKUCHII*, AND REDESCRIPTION OF *S. ACUMINATA* SHIINO BASED UPON THE TYPE MATERIAL

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A B S T R A C T

A new species of cephalocarid, *Sandersiella kikuchii*, is described from central Japan, 300 m depth. It differs from congeners primarily based on the following points: 5-9 hooks on each ventrolateral side of cephalon; exopod proximal segment of thoracopod 6 with long finger-like lateral process (with narrow base) on the dorsal margin; exopodal distal segment of thoracopod 6 pointed distally, not divided into 2 lobes; exopodal proximal segment and pseudopipod of thoracopod 8 furnished with 2 and 2-3 setae respectively. *Sandersiella acuminata* Shiino, 1965 is redescribed and illustrated based on the holotype.

KEY WORDS: Cephalocarida, *Sandersiella*

INTRODUCTION

Cephalocarida is a small class that includes ten species in five genera. The genus *Sandersiella* Shiino, 1965 contains three species: *S. acuminata* Shiino, 1965, from Japan, northwest Pacific, *S. calmani* Hessler and Sanders, 1973, from off the coast of Peru, Pacific Ocean, and *S. bathyalis* Hessler and Sanders, 1973, from off the coast of Walvis Bay, southwest Africa.

As for their habitats, Cephalocarida occur mostly in shallow water bottoms less than 100 m deep (Hessler and Wakabara, 2000). Only two records have been from deep-sea habitats: *Hutchinsoniella* sp. from 300 m deep off Massachusetts (Hessler and Sanders, 1964), and *Sandersiella bathyalis* from 1227 to 1559 m deep (Hessler and Sanders, 1973). From Japanese waters, *S. acuminata* has been recorded from the warm temperate Ariake Bay, Seto Inland Sea, and Tanabe Bay, at less than 30 m depth (Shiino, 1965; Kikuchi, 1969; Itô, 1985).

During the survey of benthic fauna off the Boso Peninsula, central Japan by R/V Tansei-Maru of the Ocean Research Institute, University of Tokyo in 2001 (cruise KT-01-8), seven specimens of an undescribed species of *Sandersiella* were collected from a single sampling site, 300 m deep. The present paper describes the new species. Additionally, the type and three additional specimens of *Sandersiella acuminata* were examined for comparative purposes, and the holotype is redescribed herein.

MATERIALS AND METHODS

The gear used for the collection was a biological dredge of 1 m span. On board, muddy sediment samples were suspended in sea-water, and the suspensions containing light particles, such as small organisms, were decanted through a sieve with a pore size of 0.5 mm. The processed sediment samples were fixed in 5% borate buffered sea-water formalin immediately. Thereafter, the cephalocarid specimens were sorted out under a stereomicroscope and preserved in 70% ethanol.

We borrowed the type specimen of *Sandersiella acuminata* from the Amakusa Marine Biological Laboratory, Kyushu University and obtained

additional specimens from Dr. M. J. Grygier of the Lake Biwa Museum for our study.

Each specimen was dissected and prepared for observation under a differential interference contrast microscope (Nikon E600) equipped with a camera lucida. Total length as indicated in "Material examined" was measured from the tip of the head to the end of the telson. Terminology follows Hessler and Sanders (1973). The following abbreviations are used in the text: AMBL = Amakusa Marine Biological Laboratory, Kyushu University, KMNH = Kitakyushu Museum of Natural History and Human History, OMNH = Osaka Museum of Natural History.

SYSTEMATICS

Genus Sandersiella Shiino, 1965

Type Species.—*Sandersiella acuminata* Shiino, 1965, by monotypy.

Species Included.—*Sandersiella calmani* Hessler and Sanders, 1973; *S. bathyalis* Hessler and Sanders, 1973; *S. kikuchii* n. sp.

Sandersiella kikuchii, n. sp.

Figs. 1-3

Material Examined.—Holotype: 2.5 mm (dissected) (KMNH IvR 700,236), 6 paratypes: 2.6 mm, 2.6 mm (dissected), 2.5 mm (dissected), 2.4 mm (dissected), 1.5 mm (KMNH IvR 700,237-700,241), 2.1 mm (OMNH Ar 7660). Kamogawa Canyon, off Boso Peninsula, central Japan 35°05'N, 140°09'E, 248-316 m depth, (KT-01-8, St. KG-3), 21 June 2001.

Description.—Holotype adult specimen. Body (Fig. 1A, B, C). Cephalon with 7 and 6 hooks on right and left ventrolateral sides; all hooks directed anteriorly (Fig. 1B). Abdominal segments (including telson) approximately 2.8 times as long as combined length of first to eighth thoracic segments. Pleura of seventh thoracic segment narrower than that of sixth and moderately bent posteriad. Telsonic comb row (Fig. 1C) narrowly rounded; width of row 0.56 that of telson. Length of furcal rami 1.8 width of telson.

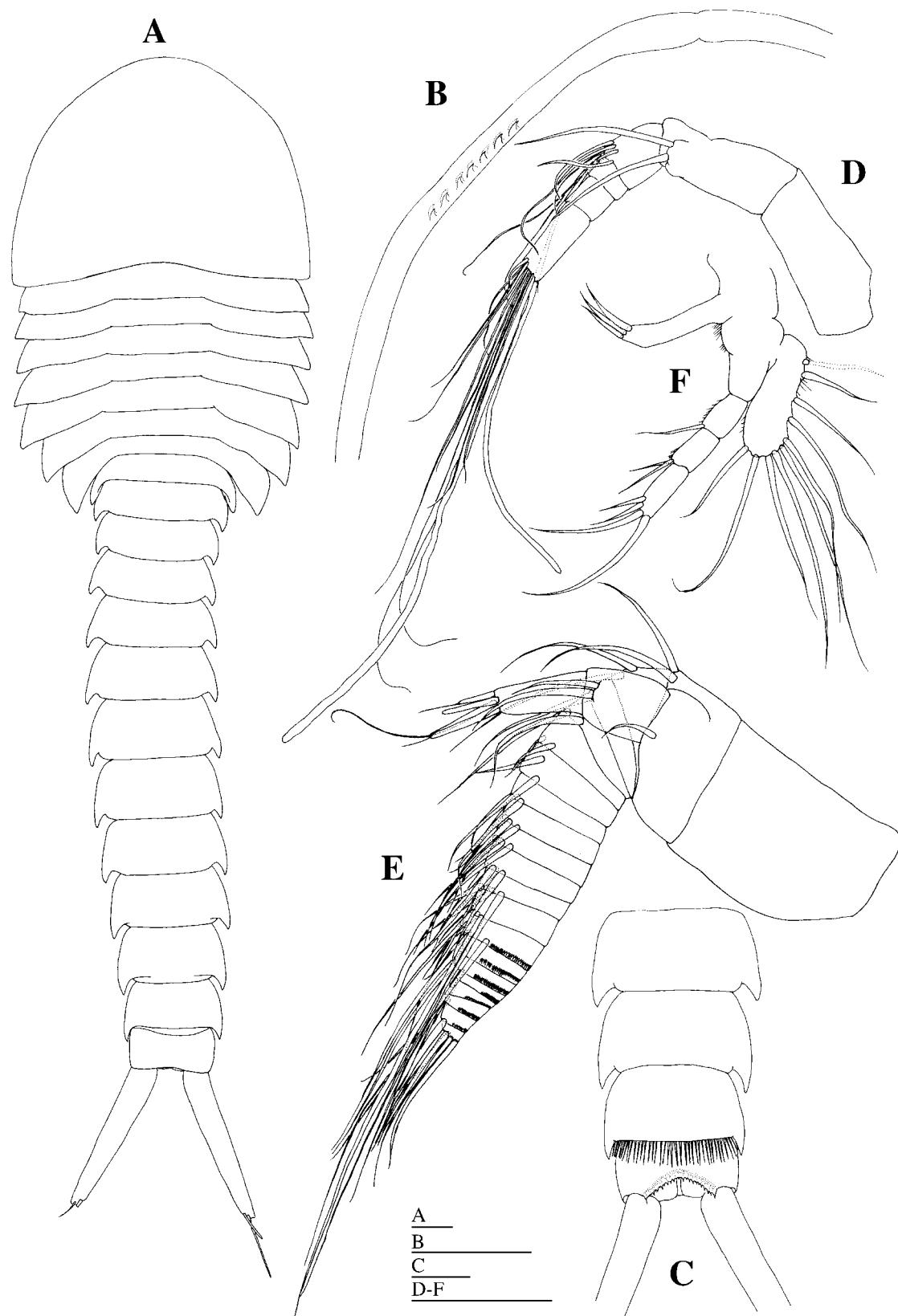


Fig. 1. *Sandersiella kikuchii*, n. sp., holotype. A, habitus, dorsal; B, right margin of cephalon, ventral; C, trunk segments 17-19 and telson, ventral; D, right antenna 1, ventral; E, right antenna 2, ventral; F, right maxilla 1, dorsal. Scales, 100 μm .

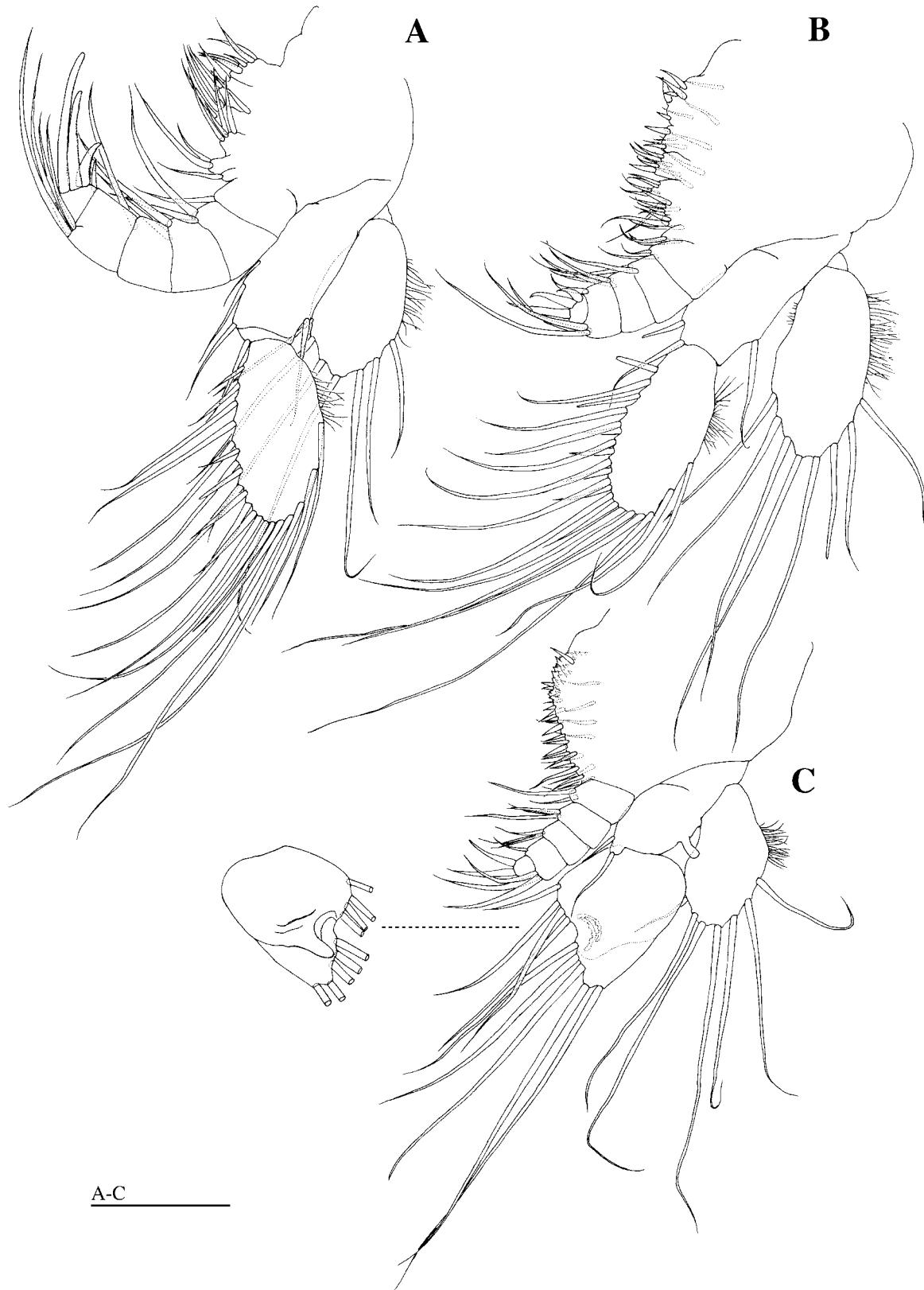


Fig. 2. *Sandersiella kikuchii*, n. sp., holotype. A. right maxilla 2, dorsal; B, right thoracopod 5, dorsal; C, right thoracopod 6, dorsal (broken line is showed ventral surface of exopodal segment 2). Scale, 100 μm .

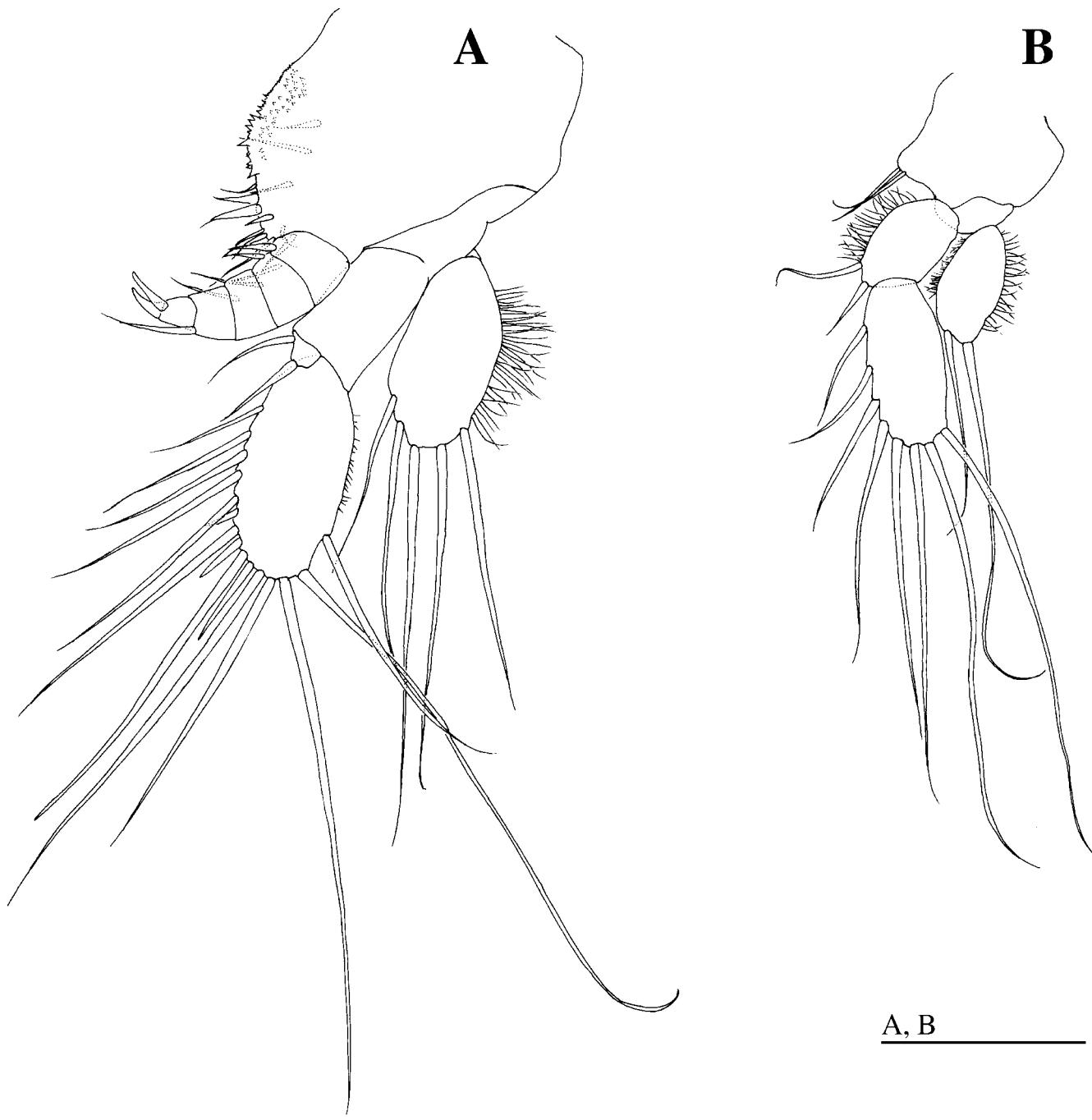


Fig. 3. *Sandersiella kikuchii*, n. sp., holotype. A. right thoracopod 7, dorsal; B, right thoracopod 8, dorsal. Scale, 100 μm .

First antenna (Fig. 1D). Setation from base to tip, 0, 2, 5 + 1 aesthetasc, 0, 0, 10 + 1 aesthetasc, respectively.

Second antenna (Fig. 1E): exopod with 2, 1, 2, 2, 2, 3, 3, 4, 4, 4, 4, 3, 1, 3, 1, 1, 1 and 4 setae, respectively; endopod with two terminal claw-like setae.

First maxilla (Fig. 1F): setation from base to tip, 1, 2, 4 on the 3 endopodal segments, respectively; exopod with 10 marginal setae.

Second maxilla (Fig. 2A): setation from base to tip: 1, 2, 2, 1, 5 on endopodal segments 1-5, respectively.

Fifth thoracopod (Fig. 2B): endopodal segments normal, with nearly straight lateral margins; 3 normal claws on distal segment; setation from base to tip: 2, 2, 2, 4 on endopodal segments 2-5, respectively; pseudopipid tapered distally; dorsal and ventral margins much alike, evenly convex.

Sixth thoracopod (Fig. 2C): protopodal endites 1-3 merged, with reduced setation, but bearing numerous small spines. Endopodal segments: from base to tip, 2, 3, 3, 4 setae on segments 2-5, respectively. Pseudopipid approx-

Table 1. Setation of maxilla 2 and thoracopods 5-8 of *S. kikuchii* (N = 4).

	Maxilla 2	Thoracopod 5	Thoracopod 6	Thoracopod 7	Thoracopod 8
Endopodal					
segment 1	1	—	—	—	—
segment 2	2	2-3	2-3	2	—
segment 3	2-3	1-3	3-4	2-3	—
segment 4	2	2-3	3	1-2	—
segment 5					
medial	0-1	1	0-1	0	—
segment 6					
lateral	3-4	3	3	1	—
segment 7					
(claws)	3	3	2	2	—
Exopodal					
segment 1					
medial	4-5	1-2	1-2	2	2
segment 1					
lateral	1	1	0	0	0
segment 2	20	20-23	9	14-17	8-10
Pseudopipod	7-8	8-9	7	5-6	2-3

imately 1.9 times as long as broad, tapered distally, widest near midpoint; distal margin almost rounded. Lateral process on proximal exopodal segment long, with narrow base and finger-like outline. Exopodal distal segment, not divided into 2 lobes by deep notch; distal margin pointed at acute angle; medial margin strongly convex at medial part, slightly concave at one-third from apex.

Seventh thoracopod (Fig. 3A): proximal protopodal endite with dense mat of small spines; from base to tip, 1, 2, 1, 1, 1 setae on endopodal segments 2-5, respectively; pseudopipod rather symmetrical, widest near midpoint, tapered distally; setae all along distal fourth.

Eighth thoracopod (Fig. 3B): protopod with 2 setae on medial margin; proximal exopodal segment with 2 setae medially; distal exopodal segment large, with 8 setae medially and distally; pseudopipod subequal in length with proximal exopodal segment, approximately 1.9 times as long as wide, with 2 setae distally.

Variation.—The paratypes agree with the holotype in most characters. However, some variations were observed in the number of ventrolateral hooks on the cephalon and the setal pattern on appendages, which is summarized in Table 1 based on the holotype and 3 paratype specimens (2.4-2.6 mm in length, presumably adults).

Etymology.—The species is named after Emeritus Professor Taiji Kikuchi of Kyushu University, who first found this cephalocarid in Tomioka Bay.

Remarks.—Shiino's (1965) original diagnosis of *Sandersiella* was emended by Hessler and Sanders (1973) based on detailed comparative study on *S. acuminata* (from Japan), *S. calmani* (from off the coast of Peru), and *S. bathyalis* (from off the coast of Walvis Bay, southwest Africa), the latter two species were described as new species. The present new species is confidently assigned to the Hessler and Sanders' definition of *Sandersiella*, having a set of the following characters: eighth thoracic segment with limbs and pleura; pleura of eighth thoracic segment much smaller than those of preceding segments; ventral comb on telson less than telson's width; distal endopodal segments of second maxilla and first five thoracopods with 3 claws; sixth and seventh thoracopods with 2 claws; penultimate endopodal segments of second maxilla and first six thoracopods with single distomedial seta; pseudopipod of first five thoracopods with 7-8 setae; sixth thoracopod with strongly modified exopod; pseudopipod of sixth thoracopod slightly modified; eight thoracopod without endopod; caudal rami long, 1.8 times as long as width of telson.

Sandersiella kikuchii n. sp. differs from all congeners primarily in having 5-9 hooks on each ventrolateral side of cephalon; exopod proximal segment of thoracopod 6 with long finger-like lateral process (with narrow base) on the dorsal margin; exopod distal segment of thoracopod 6 pointed distally, not divided into 2 lobes by deep notch; exopodal proximal segment and pseudopipod of thoracopod 8 furnished with 2 and 2-3 setae, respectively. More detail differences among all four species of the genus are shown in the discussion and Table 2.

Sandersiella acuminata Shiino, 1965

Fig. 4

Sandersiella acuminata Shiino, 1965: 182-190, figs. 1-5; Kikuchi, 1968, 1969; Hessler and Sanders, 1973: 192-193, figs. 1, 2, 4-6.

Material Examined.—Holotype: 2.1 mm (dissected) (AMBL, unnumbered), Shioiri, Tomioka Bay, Kumamoto Prefecture, a small inlet located on the south side of the entrance of Ariake Bay, muddy bottom covered with Zostera, 2.1 m depth, collected by Dr. T. Kikuchi, 9 September 1963. Additional specimens, collected by Dr. T. Itô: 2.7 mm (dissected) (KMNH IvR 700,242), Mukaishima,

Table 2. Comparison among four species of *Sandersiella*.

Species	Ventral hooks of cephalon	Telsonic comb row	Pleurae of thoracic segment 7	Pleurae of trunk segments 9-19	Distal margin of exopodal segment 2 of thoracopod 6	Setation on proximal exopodal segment and pseudopipod of thoracopod 8
<i>Sandersiella kikuchii</i> , n. sp.	5-9	narrowly rounded	moderately bent posteriad	narrow	gradually tapered	2 + 2 or 3
<i>S. acuminata</i> Shiino, 1965	13-16	narrowly rounded	strongly bent posteriad	well-projected postero-laterally	broadly rounded	1 + 1
<i>S. calmani</i> Hessler & Sanders, 1973	11-12	broadly rounded	moderately bent posteriad	narrow	strongly projected	1 + 1
<i>S. bathyalis</i> Hessler & Sanders, 1973	0	narrowly rounded	normal	moderately broad	indistinct	1 + 1

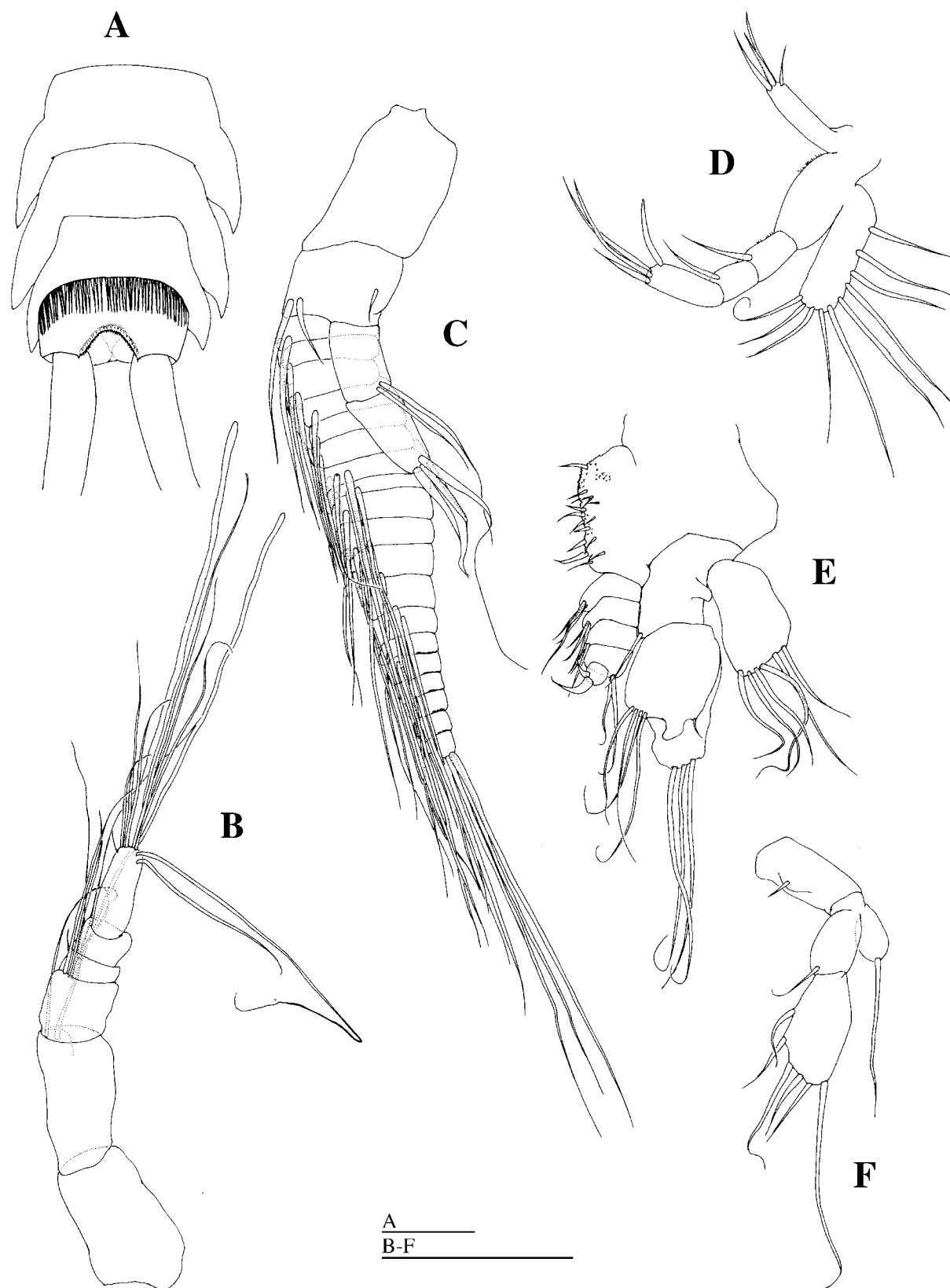


Fig. 4. *Sandersiella acuminata* Shiino, 1965, holotype. A, trunk segments 17-19 and telson, ventral; B, right antenna 1, dorsal; C, right antenna 2, ventral; D, left maxilla 1, ventral; E, left thoracopod 6, ventral; F, left thoracopod 8, ventral. Scales, 100 μ m.

Hiroshima Prefecture, muddy bottom, 30 May 1985; 2.3 mm, 2.2 mm (dissected) (KMNH IvR 700,243; 700,244), Hiuchi-nada, off Shikoku, muddy bottom, 18-20 m depth, 11 December 1967.

Description of Holotype.—Telsonic comb row (Fig. 4A) narrowly rounded; width of row 0.4 that of telson.

First antenna (Fig. 4B). Setation from base to tip, 0, 2, 5 + 1 aesthetasc, 0, 0, 9 + 1 aesthetasc, respectively.

Second antenna (Fig. 4C): exopod with 2, 2, 2, 2, 2, 3, 4, 4, 4, 3, 4, 3, 1, 3, 1, 1, 1, 1 and 4 setae, respectively.

First maxilla (Fig. 4D): from base to tip, 1, 1, 4 setae on the 3 endopodal segments, respectively; exopod with 10 marginal setae.

Sixth thoracopod (Fig. 4E): protopodal endites 1-3 unmerged, with reduced setation and small spines; endopodal segments: from base to tip, 3, 3, 2, 2 setae on endopodal segments 2-5, respectively; pseudopipod 1.7 times as long as broad, tapered distally, widest at nearly distally; distal margin almost pointed. Lateral process on proximal exopodal segment of sixth thoracopod long, with moderately thick base and finger-like outline; distal exopodal segment separated into two lobules; distal margin of distal exopodal segment broadened; medial margin strongly convex, slightly concave approximately 2/3.

Eighth thoracopod (Fig. 4F): protopod with 1 seta on medial margin; proximal exopodal segment with 1 seta medially; distal exopodal segment large, with 6 setae medially and distally; pseudopipod 1.6 times as long as wide, with 1 long seta distally.

Remarks.—Hessler and Sanders redescribed *Sandersiella acuminata* based on newly collected specimens in their comprehensive study of *Sandersiella* (Hessler and Sanders, 1973). There is a discrepancy between Shiino's original and Hessler and Sander's description: the exopodal distal margin of thoracopod 6 is truncate, and there is no protruding part in the original figure; however, this exopodal protrusion is shown in Hessler and Snader's description. This discrepancy may be due to omission in the original description. Shiino's illustration of thoracopod 6 is superb, but he drew it without dissecting it from its trunk. Observation of appendages is normally difficult on an undissected specimen because they are overlapping each other. We removed thoracopod 6 from the type material and observed it in detail. Our results agree with Hessler and Sander's description.

DISCUSSION

The present study revealed some morphological characteristics on which the 4 species of the genus *Sandersiella*, *S. acuminata*, *S. calmani*, *S. bathyalis*, and *S. kikuchii*, can be discriminated. Species discrimination in the genus is summarized in Table 2. The noteworthy points of each characteristic are as follows.

Thoracopod 6: Hessler and Sanders (1973) pointed out that exopod and pseudopipod of thoracopod 6 are the "best tool for species discrimination in the genus *Sandersiella*". Results of the present study, especially examination of the exopods, support their idea. In *S. kikuchii*, the exopod of this appendage

is characterized for the most part by the distal segments being pointed distally, not separated into two lobules, which is different from those of the other three species. The proximal segment has a long finger-like lateral process whose basal region is narrow, which is common only with *S. acuminata*.

Thoracopod 8: whereas diagnosis of the genus *Sandersiella*, based on the 3 species known to Hessler and Sanders, 1973, includes a definition of thoracopod 8 whose protopod and pseudopipod are furnished with single seta respectively, in *S. kikuchii*, the protopod and pseudopipod of this appendage are furnished with 2 and 2-3 setae, respectively. Because other morphological characteristics support the present new species' inclusion in the genus *Sandersiella*, diagnosis of the genus is emended to include that the protopod and pseudopipod of thoracopod 8 are beset with 1-2 and 1-3 setae, respectively. Another feature is that the exopod of this limb's distal segment is relatively large in the 4 species, 1.8 times as long as proximal segments.

Second maxilla: whereas the diagnosis of *Sandersiella* by Hessler and Sanders (1973) included that the penultimate endopodal segment of this appendage is as long as or longer than wide, in *S. kikuchii*, inter-individual variation of this feature was observed; in 2 specimens, it is wider than long, in one specimen as long as wide, and in the other specimen slightly longer than wide. On this point, inter-individual variation of this segment should be considered in further examination of the genus.

Cephalic hooks: although the number of cephalic hooks on each ventrolateral side shows considerable variation in each species, they are obviously useful for discrimination of the 4 species.

Thoracic segment 7: compared with the preceding thoracic segments, the pleurae of thoracic segment 7 are somewhat modified in all 4 species. In *S. kikuchii*, the pleurae of this segment are moderately bent posteriad, as also in *S. calmani*.

Trunk segments: pleurae differ in the 4 species of *Sandersiella*; they are bent moderately posteriad and are narrow in *S. calmani* and *S. kikuichii*, while being bent strongly posteriad and broad in *S. acuminata*. The pleurae of *S. bathyalis* are similar to those of *S. calmani*, however, being more well developed and broader.

Setal patterns of appendages, especially antenna 2, have been examined in the genus *Sandersiella*. The arrangement of setae on antenna 2 in *S. kikuchii*, especially on segments 4-12 of the main flagellum, differs from those of the other 3 species. Although the arrangement of setae on other appendages show considerable inter-individual variation (Table 1), the arrangement on some legs such as thoracopod 8 would be useful to discriminate the present new species.

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