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***Amphiascus kawamurai*, a New Harpacticoid Copepod
(Crustacea: Harpacticoida: Miraciidae) from Nori Cultivation
Tanks in Japan, with a Redescription of the
Closely Related *A. parvus***

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A new harpacticoid copepod, *Amphiascus kawamurai* sp. nov., is described from a tank for nori (laver) cultivation on the shore of Ariake Bay, Japan. This species belongs to the *pacificus*-group of *Amphiascus* and is most closely related to *A. parvus* Sars, 1906, which is briefly redescribed based on Sars' original material. The two species are distinguishable by spinules on the genital double-somite and by leg 5 of the female. Specimens previously described as *A. parvus* from the Red Sea and Argentina are shown to be not identical to Sars' *A. parvus*. The new species is the second member of the genus from Japan.

Key Words: Copepoda, Harpacticoida, *Amphiascus parvus*, new species, nori culture, Ariake Bay.

Introduction

Around Ariake Bay, Kyushu, Japan, a dense population of a harpacticoid copepod is sometimes found in outdoor tanks for the cultivation of conchocelis filaments of nori (laver, *Porphyra*), which grow in oyster shells. The shells usually become fouled with diatoms, and fishermen have to clean them by hand several times during the period of cultivation. According to the Saga Prefectural Ariake Fisheries Research and Development Center (SAFREDEC), when a dense population of the copepod appears in a tank, fouling diatoms on the shells are removed by grazing of the copepod, with consequent enhancement of growth of conchocelis filaments in the shells.

Following previous descriptions and keys to harpacticoid species (Lang 1948; Wells 1976), this copepod is identifiable as *Amphiascus parvus* Sars, 1906. However, the occurrence of *A. parvus* in Ariake Bay is unlikely because there have been no records of this species from the Indo-West Pacific region and anthropogenic introduction from Atlantic or Mediterranean waters to Ariake Bay is essentially unlikely; previous records of *A. parvus* are from Europe (Sars 1906; Lang 1948) and North America (Wilson 1932; Yeatman 1970). We examined G. O. Sars' specimens of *A. parvus* deposited in the Zoological Museum of the University of Oslo and compared them with our specimens. There were only a small number of specimens in

the two vials that were sent to us. We were not permitted to dissect the material, but we found apparent differences in some characters that were observable without dissection. In this paper we describe the specimens collected from an experimental tank at SAFREDEC as a new species and present additional observations on one of Sars' specimens of *A. parvus*. The new species is the second member of the genus from Japan, the first one being *A. elongatus* Itô, 1972 (*q.v.*) from Hokkaido.

Microscopic observations and dissections were made in lactophenol using bright-field and differential interference microscopes. Initial drawings were made with a camera lucida and final figures were prepared with computer software (Adobe Illustrator 10).

Taxonomy

Amphiascus parvus Sars, 1906

(Fig. 1A)

Amphiascus parvus Sars, 1906: 162, pl. CIII; Yeatman 1970: 35, figs 41–49; Wilson 1972: 221, fig. 148.

Material examined. One of 3 females in vial No. F20123 of Sars' collection deposited in the Zoological Museum of the University of Oslo.

Description. *Female.* Body length 0.49 mm. Genital double-somite with 2 transverse rows of spinules on lateral surface of each side (Fig. 1A, arrowed). First

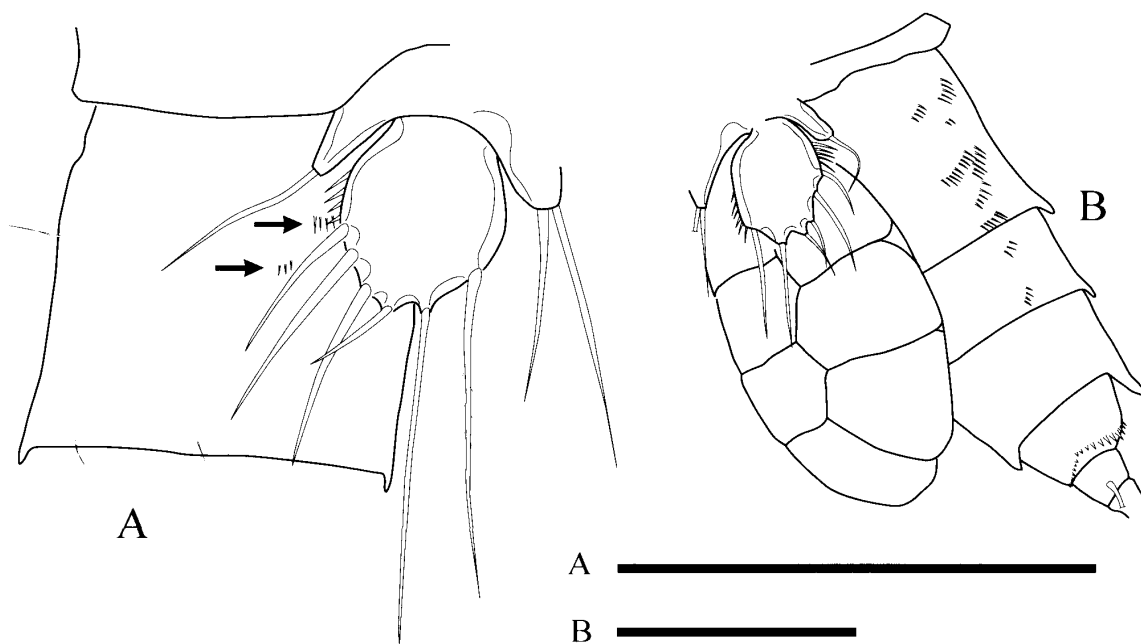


Fig. 1. *Amphiascus parvus* Sars and *A. sp.* females in Sars' collection. A, *A. parvus*, genital double-somite and leg 5, lateral (two rows of spinules arrowed); B, *A. sp.*, urosome and leg 5, lateral. Scale bars: 0.1 mm.

abdominal somite without spinules except for 4 sensilla on posterior margin. Exopod of leg 5 with smooth medial edge and spinulose lateral edge. Other characters observable without dissection as in Sars' (1906) description.

Remarks. The two vials (Lot Nos F20122 and F20123) sent to us contained five females, two males, and one copepodid instar in total. Two females do not belong to *Amphiascus* because they have four setae or spines on the third exopodal segment of leg 1 and one seta on the second endopodal segment of leg 2 (five and two setae in *Amphiascus*, respectively). Two other females are not *A. parvus* either, because they display the following combination of characters: basoendopod of leg 5 with a cylindrical lateral expansion, both sides of exopod of leg 5 spinulose, and genital double-somite and next urosomite with a number of conspicuous dorsolateral rows of spinules (Fig. 1B). The female described here is the only specimen that can be recognized as corresponding to Sars' description of *A. parvus*.

Rouch's (1962) and Noodt's (1964) *A. parvus* from Argentina and the Red Sea, respectively, are apparently different from Sars' original description because they have a seta on the second exopodal segment of the antenna (absent in Sars' *A. parvus*) and a spinulose medial edge on the exopod of leg 5. In addition, Rouch's specimen is distinguishable by the presence of ventral rows of spinules on the second abdominal somite, and Noodt's by having one seta on the medial margin of the third exopodal segment of leg 4 (three setae in Sars' *A. parvus*).

Amphiascus kawamurai sp. nov.
(Figs 2–5)

Material examined. Eleven females and five males collected from a nori cultivation tank at SAFREDEC in November, 2001, were dissected. Holotype: adult female, dissected, mounted on 3 glass slides using CMC-10, aqueous mounting medium (Masters Company, Inc., Wood Dale, IL), deposited in the National Science Museum, Tokyo (NSMT-Cr 16262). Paratypes: 20 females in 2 vials (NSMT-Cr 16263 and NSMT-Cr 16264) and 20 males in 2 vials (NSMT-Cr 16265 and NSMT-Cr 16266), undissected, deposited in NSMT.

Description. *Female.* Body length 0.55–0.72 mm (n=6; holotype 0.61 mm). Prosome (Fig. 2A) without hairs except for sensilla on dorsal surface. Urosome (Fig. 2B, C) slightly depressed dorso-ventrally. Genital double-somite without spinules on ventral surface and with 8 sensilla along distal margin and 6 sensilla along dorsal chitinous stripe. Anal somite with row of spinules along distal margin. Caudal ramus rectangular, about half as long as wide, with 2 long and 5 short caudal setae, and 1–2 larger distomedial and several smaller distolateral spinules. Long medial seta almost as long as urosome and twice longer than lateral seta. Of 5 short setae, 1 medial, 1 dorsal, and 3 lateral to long setae; one of lateral setae thicker than others.

Morphology of appendages on cephalosome typical for the genus. Antennule (Fig. 2D) 8-segmented; 4th segment 1.3 times as long as 3rd segment; setal formula 1, 10, 6, 3+1 aesthetasc, 2, 4, 3, 6+1 aesthetasc; aesthetasc on 4th segment twice longer than distal 4 segments combined. Antenna (Fig. 2E) with 3-segmented exopod and 2-segmented endopod; 1st to 3rd exopodal segments with 1, 0, 4 setae, respectively; 2nd endopodal segment with 2 setae medially, 7 setae terminally, and

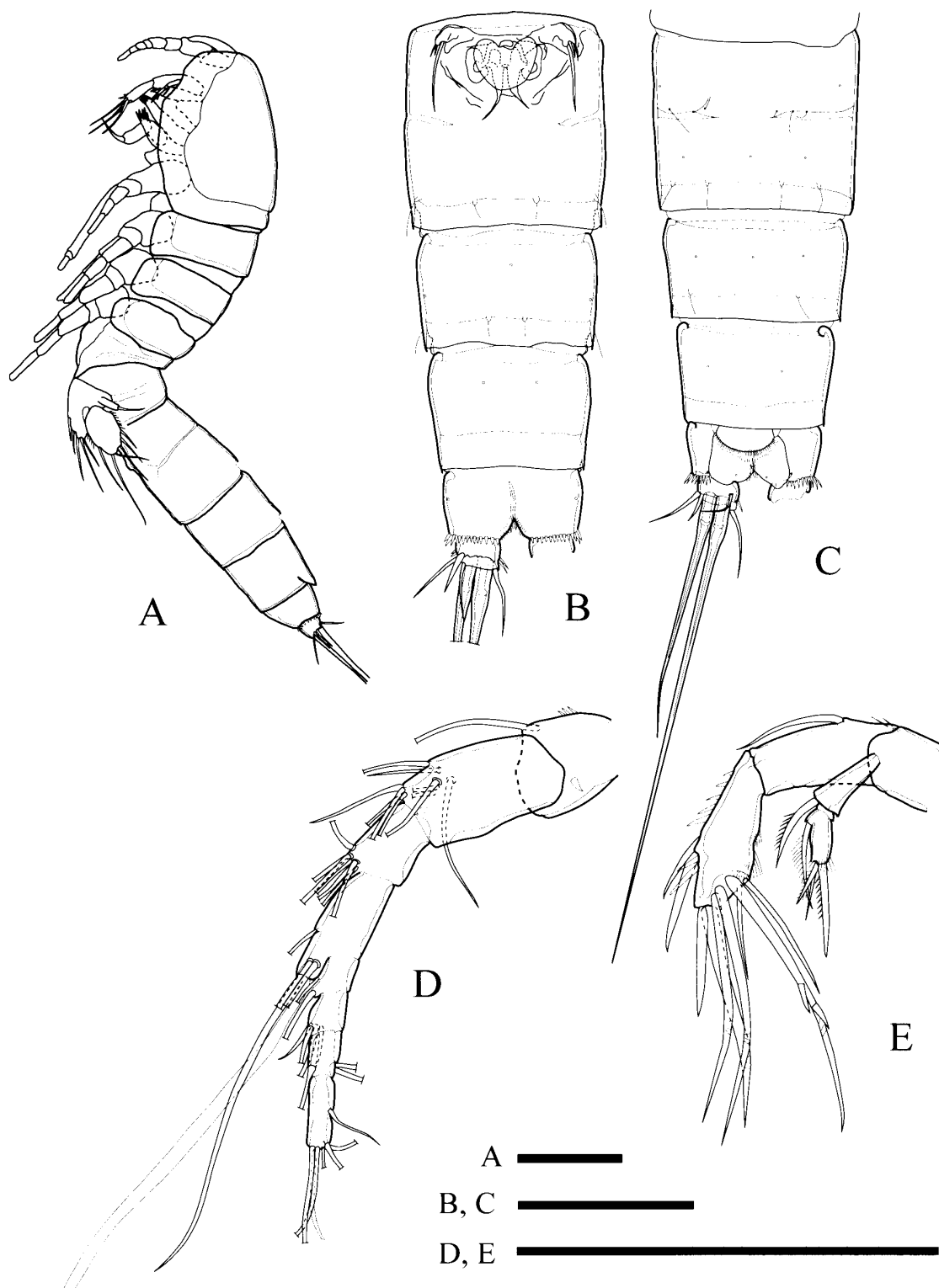


Fig. 2. *Amphiascus kawamurai* sp. nov., female. A, Habitus, lateral; B, urosome, ventral; C, urosome with caudal setae, dorsal; D, antennule; E, antenna. A, B, D, E, holotype; C, non-type. Scale bars: 0.1 mm.

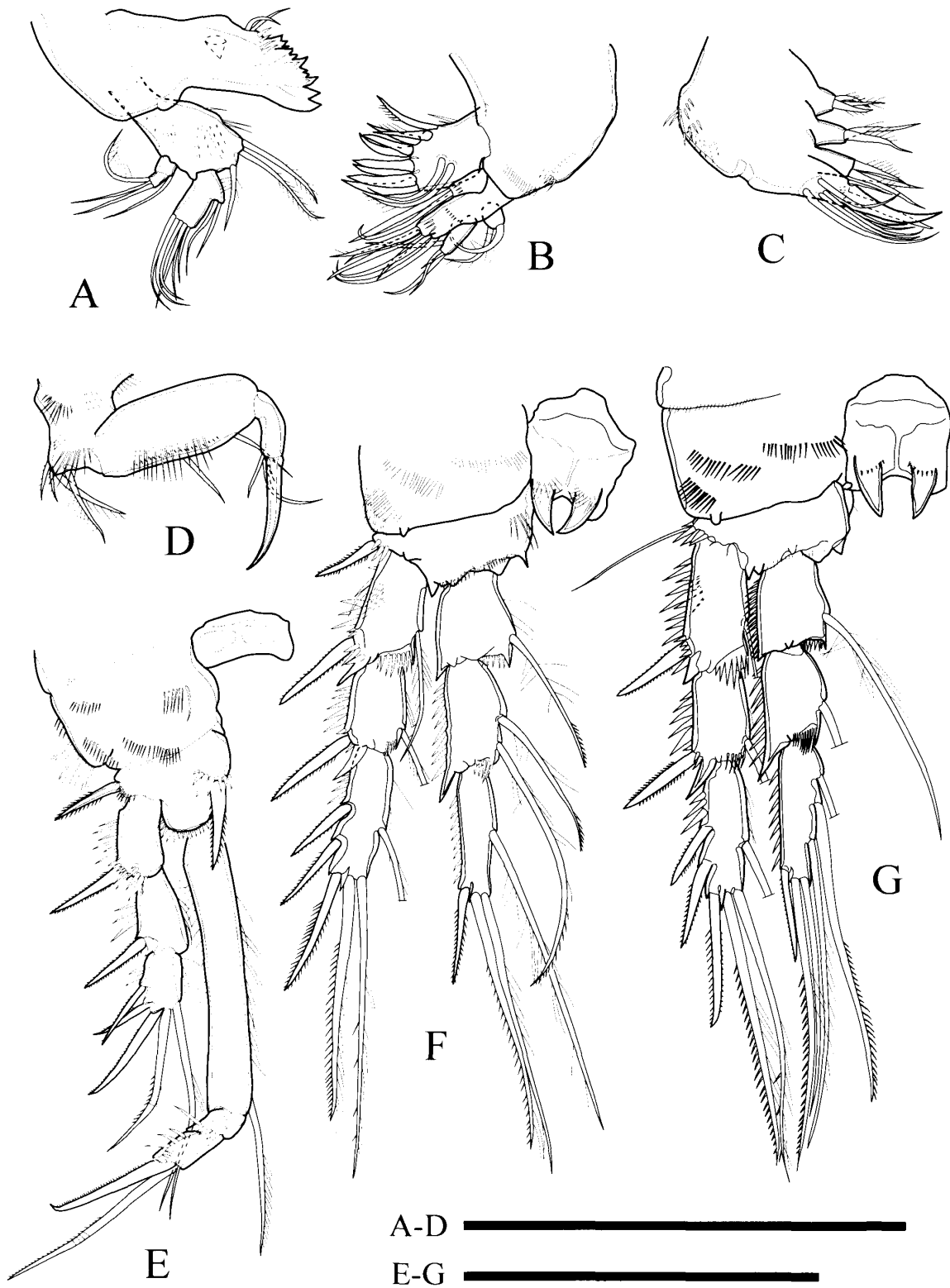


Fig. 3. *Amphiascus kawamurai* sp. nov., female, holotype. A, Mandible; B, maxillule; C, maxilla; D, maxilliped; E, leg 1, anterior; F, leg 2, anterior; G, leg 3, anterior. Scale bars: 0.1 mm.

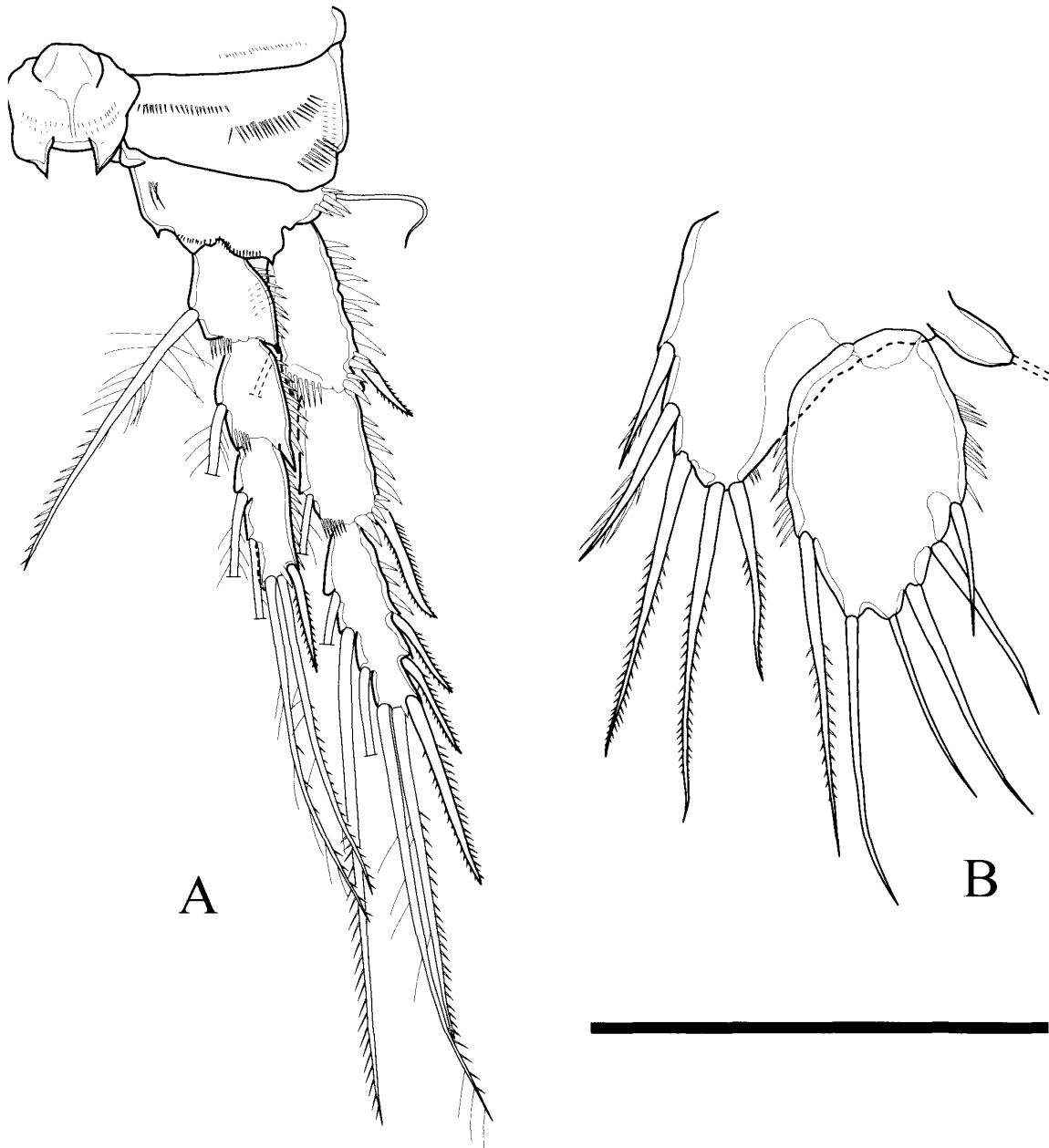


Fig. 4. *Amphiascus kawamurai* sp. nov., female, holotype. A, Leg 4, anterior; B, leg 5, posterior. Scale bar: 0.1 mm.

stout spinules on medial edge. Mandible (Fig. 3A) with chitinous projection on ventral surface of gnathobase; palp with 2-segmented exopod and 1-segmented endopod; basis with rows of long spinules; 1st and 2nd exopodal segments with 1 and 3 setae, respectively; endopod with 2 medial and 5 terminal setae. Maxillule (Fig. 3B) with rows of spinules on lateral surface of praecoxa; arthrite with 2 normal setae on anterior surface and 9 thick setae along edge; coxa with 2 setae; basis with 7 setae, one of these setae thick; exopod with 2 setae; endopod with 4 setae, one of them short. Maxilla (Fig. 3C) with 3, 2, 3 setae on 3 endites of syncoxa, respectively;

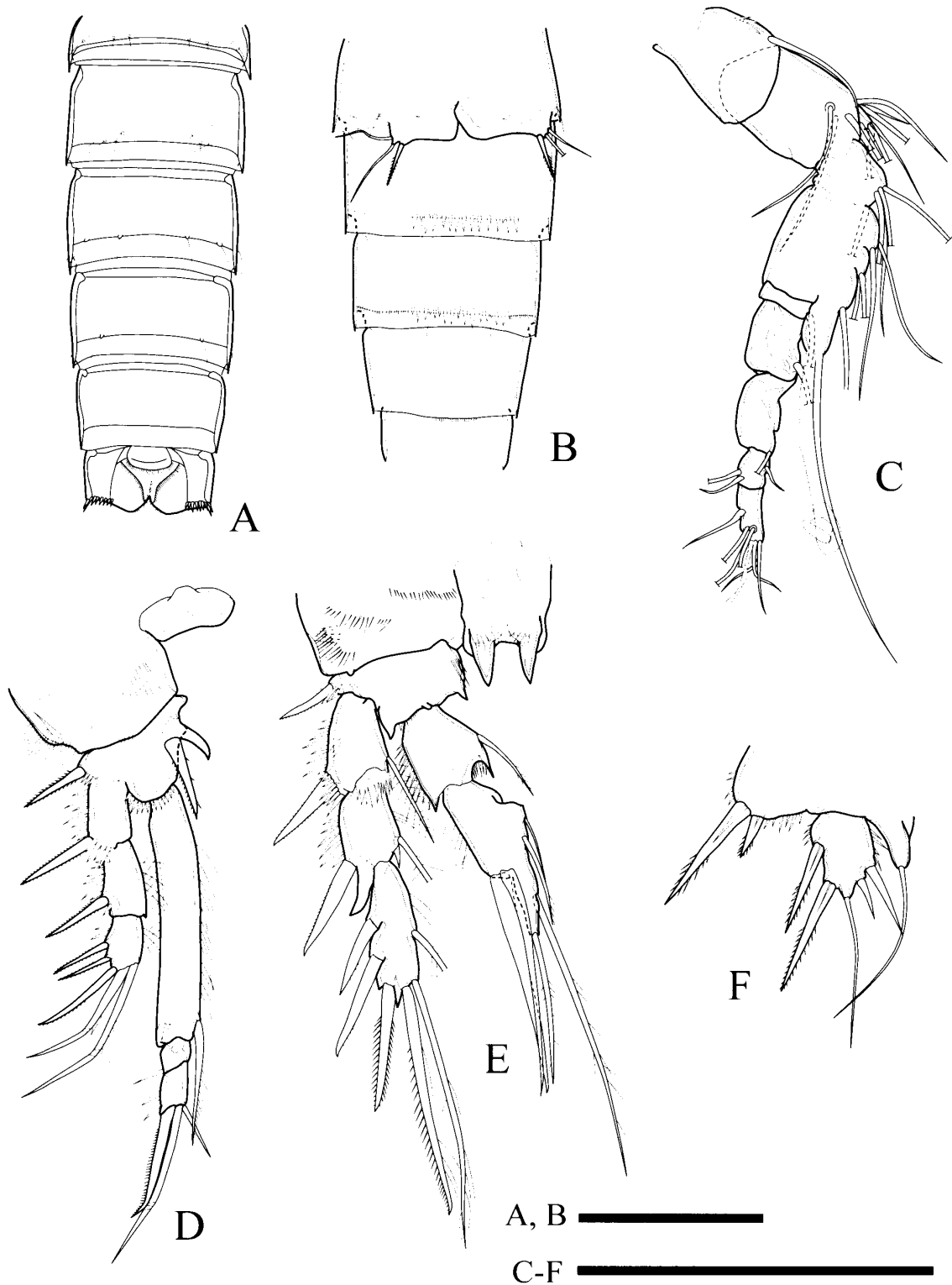


Fig. 5. *Amphiascus kawamurai* sp. nov., male, non-type. A, Urosome, anterior; B, urosome with leg 6, slightly oblique ventral; C, antennule; D, leg 1, anterior; E, leg 2, anterior; F, leg 5, anterior. Scale bars: 0.1 mm.

basis with 1 thick and 1 thin setae; endopod small, with probably 6 setae. Maxilliped (Fig. 3D) with 2 long and 2 short setae and several rows of spinules on syncoxa; basis with 2 setae and 2 rows of long and short spinules; endopod with strong terminal claw and 3 setae, one of them short.

Leg 1 (Fig. 3E) with strong medial spine on basis and conspicuous spinules around base of medial spine; 1st and 2nd exopodal segments with 1 lateral spine, lacking medial seta; 3rd segment with 2 terminal setae and 3 lateral spines; 1st endopodal segment with subterminal medial seta; 2nd segment lacking medial seta; 3rd segment with 2 setae and 1 long spine terminally and 2 spines laterally. Legs 2–4 (Figs 3F, G, 4A) with pair of pointed outgrowths on each coupler, those of leg 4 shorter than others. Seta and spine formula of exopod/endopod in leg 2 (1, 1, 123)/(1, 2, 121), in leg 3 (1, 1, 123)/(1, 1, 321), and in leg 4 (1, 1, 323)/(1, 1, 221); second of 3 setae on medial edge of 3rd endopodal segment of leg 3, and that of 3rd exopodal segment of leg 4, thicker than other two. Leg 5 (Fig. 4B) with lateral expansion of basoendopod about twice longer than wide, cylindrical in proximal half and tapering in distal half, slender seta (missing in Fig. 4B) present at tip of expansion; medial expansion with 3 medial and 2 terminal setae (some specimens with only 1 terminal seta on one of paired legs), hyaline membrane along proximal half of lateral edge, and spinules distally along lateral edge; exopod oval, 1.6 times longer than wide, bearing 6 setae and spinulose along both medial and lateral edges.

Male. Body length 0.52–0.60 mm (n=5). First and 2nd abdominal somites (Fig. 5A, B) lacking spinules on dorsal and lateral surfaces, with conspicuous spinule rows near distoventral margins. Antennule (Fig. 5C) 10-segmented. Basis of leg 1 (Fig. 5D) with claw-like projection at base of medial spine. Endopod of leg 2 (Fig. 5E) 2-segmented; 2nd segment with notch medially, long, lateral hair-like spinules, 1 terminal seta, 2 thick lateral setae, and 3 medial setae, proximal two of them much shorter than distal one. Leg 5 (Fig. 5F) with 2 setae on medial expansion, medial one of them 3 times longer than lateral one, lacking hyaline membrane; exopod smaller than that of female, with 5 setae, medial 2 of them spiniform.

Etymology. The new species is dedicated to Dr Yoshio Kawamura, SAFREDEC, who has conducted a study on the use of the present species for nori-culture as a biological cleaner of conchocelis-bearing shells and provided us with the specimens.

Remarks. The new species belongs to the *pacificus*-group of *Amphiascus*, characterized by having one seta on the second endopodal segment of leg 3, no medial seta on the second exopodal segment of leg 1, and one seta on the first exopodal segment of the antenna (Lang 1948). This group contains six species, *A. pacificus* Sars, 1905, *A. parvus*, *A. sinuatus* Sars, 1906, *A. humphriesi* Roe, 1960, *A. undosus* Lang, 1965, and *A. kawamurai* sp. nov. (cf. Lang 1948, 1965; Roe 1960). Among them, *A. humphriesi* is readily distinguishable by the absence of a medial seta on the first exopodal segment of legs 2 and 3. The new species differs from the remaining four species by the following female characters: from *A. pacificus* by the presence of a hyaline membrane on the basoendopod of leg 5; from *A. sinuatus* by the absence of a seta on the second exopodal segment of the antenna (the seta is present in *A. sinuatus*, which is unique within the *pacificus*-group); from *A. undosus* by the straight longest caudal seta, which is undulate at its base in *A. undosus*; and from *A. parvus* by the absence of ventral rows of spinules on the genital double-somite (present in *A. parvus*) and the presence of spinules on the medial margin of the exopod of leg 5

(absent in *A. parvus*). According to the limited information on males in the *pacificus*-group, the male of the new species is distinguishable from those of *A. pacificus*, *A. sinuatus*, and *A. undosus* by the extremely unequal setae on the medial expansion of the basoendopod of leg 5, the short, lateral one of which is at least half as long as the medial one in the latter three species (Sars 1905, 1906; Lang 1965).

The conchocelis culture in the experimental tank was started by adding laboratory-produced free-living conchocelis to the tank containing oyster shells and natural seawater. It is unlikely that the copepod was introduced into the tank with the shells, because the latter were stored in air for several months before being put in the tank and egg dormancy has never been recorded in harpacticoid copepods (Williams-Howze 1997). The seawater used was disinfected with sodium hypochlorite (liquid bleach) at 10 ppm for a day before the experiment, but the copepod could probably survive such bleaching treatment (Y. Kawamura, pers. comm.). This suggests that the copepods were introduced into the tank from Ariake Bay with the seawater.

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