

Pseudosphyrapus cuspidiger sp. nov. from the Nansei Islands, Japan, with a Supplementary Description of *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007 (Crustacea: Tanaidacea: Apseudomorpha: Sphyrapodidae)

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Abstract We describe a new species of apseudomorphan tanaidacean, *Pseudosphyrapus cuspidiger*, based on specimens collected from the Minami-Ensei Knoll, Nansei Islands, Japan. It is morphologically similar to *P. quintolongus* Kakui, Kajihara and Mawatari, 2007 and *P. vladimiri* Guțu, 1989, but can be distinguished from these species by the shape of the pleonite epimera and the setation pattern on pereopods 1 and 4. In addition, we present a complementary description of *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, in order to supplement the morphology of males and manca, and discuss sexual dimorphism in the genus *Kudinopasternakia*. As with the previously reported mancas of congeners, the manca of *K. balanorostrata* bears exopods on pereopods 4 and 5.

Key words: Tanaidacea, Apseudomorpha, Sphyrapodidae, *Pseudosphyrapus*, *Kudinopasternakia*, new species, manca, Japan.

To date, 13 species of tanaidaceans have been described as new from the Nansei Islands and surrounding waters. Among these, nine species were based on specimens procured from the depths of about 100–700 m during a series of research cruises of TR/V *Toyoshio-maru*, Hiroshima University (Larsen and Shimomura, 2006, 2007; Kakui *et al.*, 2007). The other four were described from samples from shallower localities, including Okinawa Island (Nunomura, 2005; Kakui *et al.*, 2010) and Aka-jima Island in the Kerama Group (Larsen and Shimomura, 2008). In addition, two unidentified taxa have been recorded from the area. Saito and Higashi (2000) reported a species they identified as *Sinelobus* sp., which occurred in large density on walls of a dolphin pool at the Okinawa Expo Aquarium (now Okinawa Churaumi Aquarium). Kakui *et al.* (2010) reported *Sinelobus* sp. from brackish

water of Noha River in Okinawa Island.

In this study, we report on two species of the family Sphyrapodidae Guțu, 1980 represented by two subfamilies, six genera, and 21 species (Kakui *et al.*, 2007; Santos, 2007). A new species of the genus *Pseudosphyrapus*, *P. cuspidiger*, is described on the basis of material collected from Minami-Ensei Knoll. We also provide a supplemental description of *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, which was originally described on the basis of only a single female specimen, because two males and one manca undoubtedly referred to the species are available for study.

Material and Methods

Material examined in this study is deposited in the Zoological Institute, Faculty of Science,

Hokkaido University, Japan (ZIHU), and in the National Museum of Nature and Science, Tokyo, Japan (NSMT). Specimens were preserved in 99% ethanol, and subsequently dissected with chemically sharpened tungsten wire needles under a Nikon SMZ 1500 microscope. Appendages were mounted on glass slides in glycerin and observed with an Olympus BX51 microscope; after observations, preparations were sealed with Canada balsam. Drawings were made with Adobe Illustrator ver. 10 from draft line drawings made with a camera lucida and/or from digital images taken with a digital camera system (Hiruta and Kakui, 2010). Morphological terminology is as in Larsen (2003). Detailed setal terms are defined in Kakui *et al.* (2007). Here we propose the term ‘pinnate serrate seta’ for what was represented by Kakui *et al.* (2007: 42, fig. 3f1) as “dendrite seta”, so that the term can more precisely express its shape. Also, we newly propose the term ‘bladed serrate seta’ to refer to an elaborate seta found on the propodus of the pereopod 4 in *K. balanorostrata* (see *Description* and *Remarks* of that species). Measurements were made axially: dorsally on the body, antennae, and uropod; laterally on pereopods and pleopods. The suffixes in the newly proposed Japanese names, viz., ‘-ka’, ‘-aka’, and ‘-zoku’, represent the taxonomic ranks, family, subfamily, and genus, respectively, in the Japanese language.

Taxonomy

Family **Sphyrapodidae** Guțu, 1980

[New Japanese name: Ashinaga-apuseudesu-ka]

Subfamily **Pseudosphyrapodinae** Guțu, 1980

[New Japanese name: Hige-ashinaga-apuseudesu-aka]

Genus ***Pseudosphyrapus*** Guțu, 1980

[New Japanese name: Hige-ashinaga-apuseudesu-zoku]

Pseudosphyrapus cuspidiger sp. nov.

[New Japanese name: Tongari-ashinaga-apuseudesu]

(Figs. 1–6)

Material examined. Holotype: ZIHU-3893, non-ovigerous female (2.90 mm), TR/V *Nagasa-*

ki-maru, N295 cruise, stn Q1, north of Minami-Ensei Knoll, East China Sea, 29°19.350’N, 127°37.374’E to 29°20.519’N, 127°37.958’E, 1042–1018 m, mud, 21 November 2009, beam trawl with inner net (see Akiyama *et al.*, 2008), dissected, 6 slides.

Allotype: ZIHU-3894, 1 male (2.22 mm), same data as for holotype, dissected, 6 slides.

Paratype: NSMT-Cr 21252, 1 ovigerous female (2.61 mm), 5 eggs in marsupium, same data as for holotype, dissected, 6 slides.

Diagnosis. *Pseudosphyrapus* species with rostrum projecting anteriorly, apex acute. Pleonites with acute lateral processes, those on pleonites 3 and 4 slightly larger than others. Outer flagellum of antennule 4- or 5-articled. Article 3 of mandibular palp with 4–6 setulate setae. Pereopod 1 basis with 1 ventrodistal thick seta; carpus as long as merus, with 2 ventral spiniform setae, without dorsal row of simple setae; propodus with 4 ventral spiniform setae. Pereopod 4 propodus with 12–16 serrate setae.

Description. *Non-ovigerous female holotype.* Body (Fig. 1A, a1, B) dorsoventrally flattened, 4.9 times as long as wide, white in life, without any pigmentation.

Cephalothorax 0.23 times total body length, with 1 pair of lateral simple setae. Eye-lobes well defined but small, without any ommatidia or visual pigmentation. Rostrum projecting anteriorly, apex acute.

Pereon typical for genus.

Pleon 0.28 times total body length. Pleonites all wider than long, as wide as pereonite 6; each pleonite with laterally projected acute epimeral process bearing 1 posterior small seta on each side; each pleonite with mid-ventral keel; epimeral processes on pleonites 3 and 4 slightly larger than others. Pleotelson narrower than pleonites, gradually tapering posteriorly, with 1 pair of posterior simple setae.

Antennule (Fig. 2A) 1.05 times as long as cephalothorax. Article 1 thick, almost as long as remaining articles and outer flagellum combined, with 4 outer and 3 inner simple setae, and several broom setae. Article 2 0.32 times as long as arti-

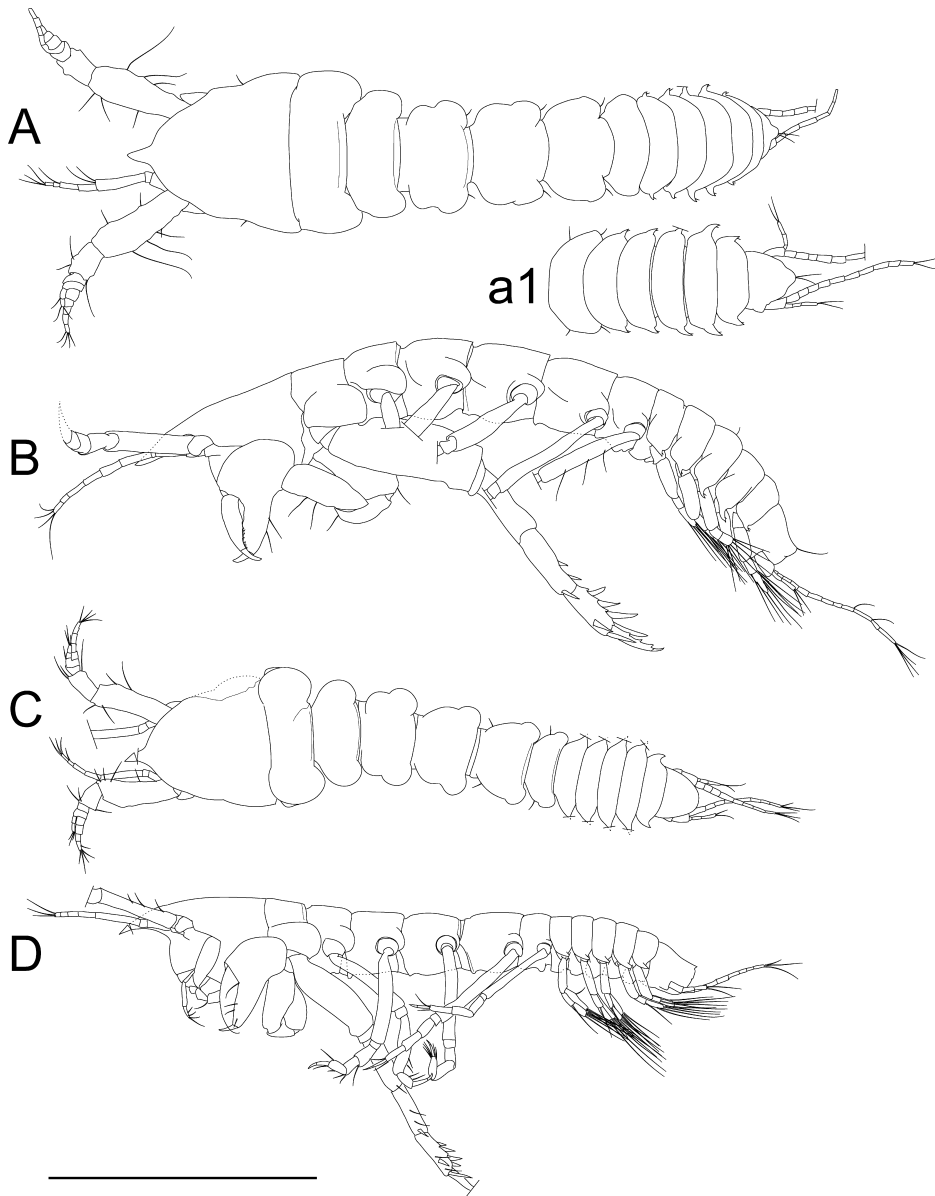


Fig. 1. *Pseudosphyrapus cuspidiger* sp. nov. A, a1, B, holotype, non-ovigerous female (2.90 mm), ZIHU-3893; C, D, allotype, male (2.22 mm), ZIHU-3894. A, body, dorsal view; a1, pereonite 6 and pleon, dorsal view; B, body, lateral view; C, body, dorsal view; D, body, lateral view. Scale bar: 1 mm.

cle 1, with 1 outer and 2 inner simple setae, and several broom setae. Article 3 0.25 times as long as article 2, with 1 outer and 2 inner simple setae. Article 4 (common article) with 1 simple seta at insertion of inner flagellum, and 1 broom seta. Outer flagellum 5-articled; articles 1 and 2 naked; article 3 with 1 ventrodiscal aesthetasc;

article 4 with 1 dorsodistal and 1 ventrodiscal simple setae, and 1 ventrodiscal aesthetasc; article 5 with 4 simple and 1 broom setae at tip, and 1 medial simple seta. Inner flagellum biarticulate; article 1 with 1 simple and 1 broom setae; article 2 with 3 simple and 1 broom setae at tip.

Antenna (Fig. 2B) 8-articled, thin, 0.83 times

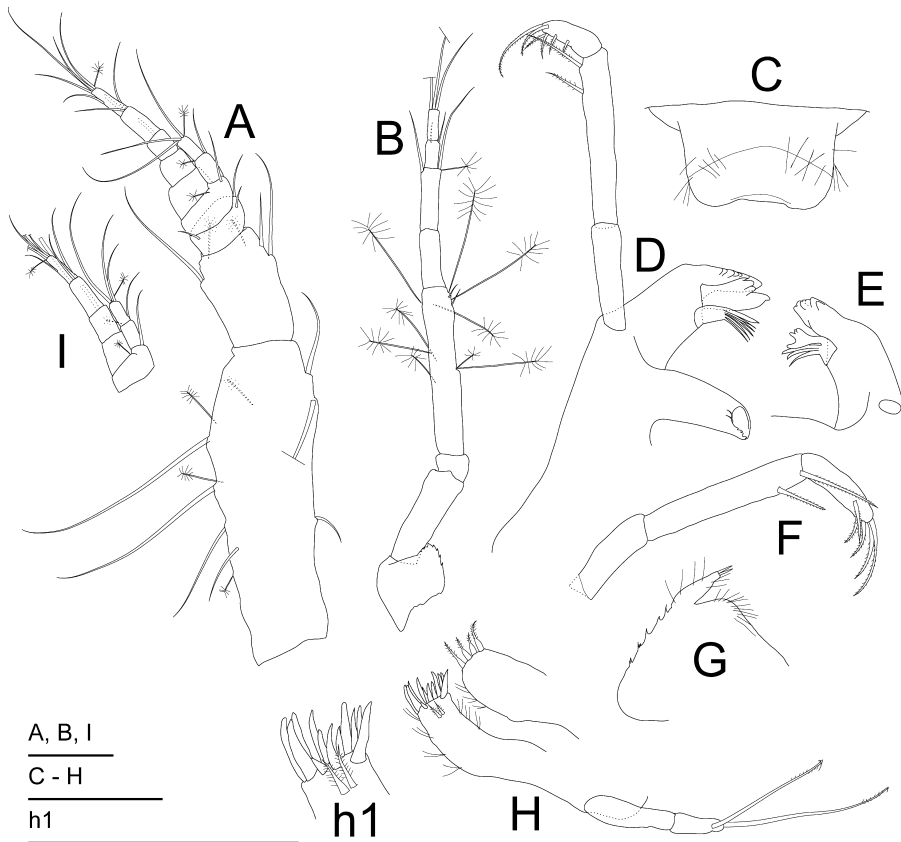


Fig. 2. *Pseudosphyrapus cuspidiger* sp. nov. A–H, h1, holotype, non-ovigerous female (2.90 mm), ZIHU-3893; I, paratype, 1 ovigerous female (2.61 mm), NSMT-Cr 21252. A, left antennule, dorsal view; B, left antenna, dorsal view; C, labrum; D, left mandible; E, right mandible; F, right mandibular palp; G, labium; H, right maxillule; h1, same, distal region of outer endite; I, antennule article 4, outer and inner flagella, dorsal view. Scale bars: 0.1 mm.

as long as antennule. Article 1 with inner distal serration. Articles 2 and 3 naked. Article 4 longest, with 2 inner distal short setae and several broom setae. Article 5 naked. Article 6 with 2 simple and 1 broom setae. Article 7 with 2 simple setae. Article 8 with 3 simple setae.

Labrum (Fig. 2C) transversely oblong-rectangular, with slight distal concavity; labrum unipartite, with transverse line and several setae.

Mandibles (Fig. 2D, E, F) with molar processes well developed, each bearing distal row of small denticles. Left mandible (Fig. 2D) with incisor bearing several distal denticles; setiferous lobe with 1 thick and 5 thin setae; lacinia mobilis well developed, with 4 teeth. Right mandible

(Fig. 2E) with incisor bearing several distal denticles; setiferous lobe with 1 multi-pronged seta much stronger than others, and 3 setae; lacinia mobilis absent. Palp (Fig. 2F) triarticulate; article 1 naked; article 2 about 1.8 times as long as article 1, with 2 setulate setae; article 3 half as long as article 2, with 5 (on right) or 6 (on left) setulate setae.

Labium (Fig. 2G) with lobe denticulate on outer margin, and setulate on inner margin; labial process setulate, with 2 setae at tip.

Maxillule (Fig. 2H, h1) with palp biarticulate, having 1 subdistal harpoon-tipped seta and 1 terminal hook-tipped seta. Outer endite with 12 distal spiniform setae, 2 subdistal setulate setae

(Fig. 2h1), and several outer and inner clumps of setae. Inner endite with 4 distal setulate setae, 1 small outer process, and several outer clumps of setae.

Maxilla (Fig. 3A, a1–3) with outer lobe of movable endite (Fig. 3a1) bearing 5 simple setae. Inner lobe of movable endite (Fig. 3a2) with 4 simple and 3 pinnate setae. Outer lobe of fixed endite (Fig. 3a3) with 5 simple setae, 1 dorsal and 2 ventral setulate setae, and 3 trifurcate spiniform setae. Inner lobe of fixed endite with 2

biserrate setae and 20 bifid-tipped setae.

Maxilliped (Fig. 3B, C, c1–4, D) with coxa bearing 5 circumplumose setae at articulation with cephalothorax. Basis naked. Endite (Fig. 3C) distal margin with 4 distally-flattened setulate setae (Fig. 3c1), and 4 marginal and 1 dorsal setulate setae; inner margin with 4 basally setulate setae (Fig. 3c2), 1 distally serrate seta (Fig. 3c3), 2 setulate bifid-tipped setae (Fig. 3c4), and 2 coupling hooks. Palp (Fig. 3D) 4-articled; article 1 with 1 inner simple seta; article 2 with 1

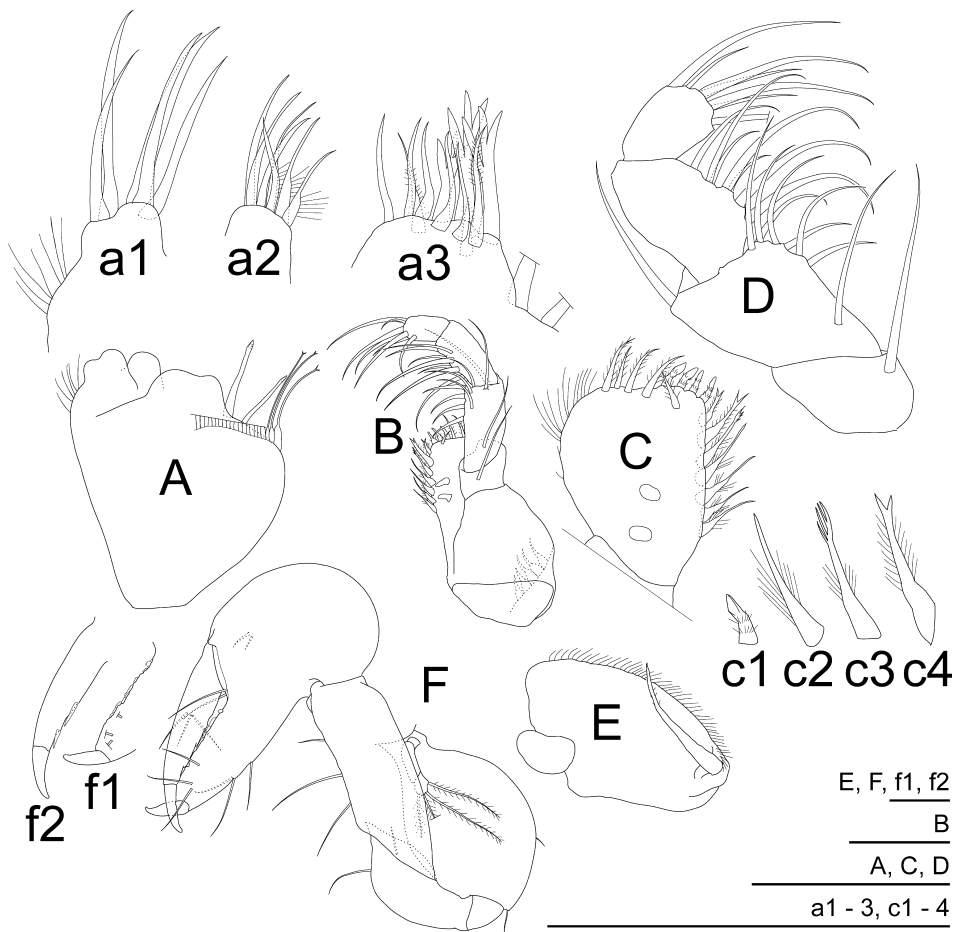


Fig. 3. *Pseudosphyrapus cuspidiger* sp. nov., holotype, non-ovigerous female (2.90 mm), ZIHU-3893. A, left maxilla, dorsal view, most ornamentation not shown; a1, same, outer lobe of movable endite; a2, same, inner lobe of movable endite; a3, same, outer lobe of fixed endite; B, left maxilliped, ventral view; C, endite of right maxilliped, ventral view; c1, same, distally-flattened setulate seta; c2, same, basally setulate seta; c3, same, distally serrate seta; c4, setulate bifid-tipped seta; D, palp of right maxilliped, ventral view; E, left epignath; F, left cheliped, outer view; f1, same, fixed finger; f2, same, distal portion of dactylus. Scale bars: 0.1 mm.

outer and 8 or 9 inner simple setae; article 3 with 7 inner simple setae; article 4 with 7 distal simple setae.

Epignath (Fig. 3E) with lobe being cup-shaped, setulate; terminal seta with minute setulation.

Cheliped (Fig. 3F, f1, f2) hammer-shaped. Basis 1.5 times as long as wide, with 1 ventromedial and 1 distal simple setae. Merus shorter than basis, with 1 ventromedial and 1 inner distal simple setae. Carpus almost as long as basis, with 3 ventral simple setae. Propodus longer than carpus; anterior region protuberant. Propodal palm with 2 inner simple setae, and 1 outer and 1 inner simple setae at insertion of dactylus. Fixed finger as long as palm; ventral margin with 3 simple setae; cutting surface with 3 simple setae and row of lamellae (Fig. 3f1). Dactylus longer than fixed finger, with 3 inner medial simple setae; cutting surface with 2 lamellae (Fig. 3f2). Exopod triarticulate; distal article with 4 plumose setae.

Pereopod 1 (Fig. 4A) 0.52 times as long as body, and longest and widest among pereopods. Coxa with 2 simple setae. Basis 0.35 times as long as total length of pereopod 1, with 1 ventral thin seta and 1 ventrodiscal thick simple seta. Ischium wider than long, with 1 ventrodiscal simple seta. Merus with 2 dorsodistal, 1 distal, and 2 ventral simple setae, and 1 ventrodiscal spiniform seta. Carpus as long as merus, with 3 dorsal and 3 ventral simple setae, and 1 dorsal and 2 ventral spiniform setae. Propodus shorter than carpus, with 2 dorsal and 2 distal simple setae, and 2 dorsal and 4 ventral spiniform setae. Merus, carpus, and propodus with several small tubercles at insertion of ventral spiniform setae. Dactylus-unguis longer than propodus. Dactylus with 2 ventral denticles. Unguis 0.33 times as long as dactylus, naked. Exopod relatively minute, triarticulate; distal article with 4 plumose setae.

Pereopod 2 (Fig. 4B) about 0.75 times as long as pereopod 1 and more slender. Coxa with 1 simple seta. Basis with 1 ventromedial and 1 ventrodiscal simple setae, and several broom setae. Ischium slightly wider than long, with 1

ventrodiscal simple seta. Merus with 2 ventrodiscal simple setae. Carpus as long as merus, with 4 dorsal and 3 ventral simple setae, and 1 outer distal and 1 ventrodiscal spiniform setae. Propodus slightly shorter than carpus, with 1 dorsal and 1 ventrodiscal simple setae, 1 dorsodistal and 3 ventral spiniform setae, and 1 dorsal broom seta. Dactylus-unguis as long as propodus. Dactylus with 2 simple setae. Unguis 0.3 times as long as dactylus, naked.

Pereopod 3 (Fig. 4C) shorter than pereopod 2. Coxa naked. Basis with 1 ventrodiscal simple and several broom setae. Ischium and merus similar to those of pereopod 2. Carpus 1.2 times as long as merus, with 3 dorsal and 2 ventral simple setae, and 1 distal and 1 ventrodiscal spiniform setae. Propodus shorter than carpus, with 1 dorsal and 1 ventrodiscal simple setae, 1 dorsodistal and 2 ventral spiniform setae, and 1 dorsal broom seta. Dactylus-unguis longer than propodus. Dactylus with 1 simple seta. Unguis 0.35 times as long as dactylus, naked.

Pereopod 4 (Fig. 4D, d1) slightly longer than pereopod 3. Coxa, basis, ischium, merus, and dactylus-unguis similar to those of pereopod 3. Carpus 1.8 times as long as merus, with 2 dorsodistal and 2 ventral simple setae, and 1 ventrodiscal spiniform seta. Propodus shorter than carpus, with 2 ventral spiniform setae, 1 dorsal broom seta, and 13 (5 subdistal and 8 distal) serrate setae (Fig. 4d1).

Pereopod 5 (Fig. 4E) as long as pereopod 4. Coxa and ischium similar to those of pereopod 4. Basis with 2 ventral simple setae, and several broom setae. Merus with 1 dorsodistal and 2 ventrodiscal simple setae. Carpus 1.4 times as long as merus, with 1 distal and 3 ventral simple setae. Propodus shorter than carpus, with 3 distal spiniform setae, 1 distal serrate seta, and 4 inner pinnate serrate setae. Dactylus-unguis longer than propodus. Dactylus with 1 dorsal and 1 ventral simple setae. Unguis 0.4 times as long as dactylus, naked.

Pereopod 6 (Fig. 4F) shorter than pereopod 5, otherwise similar to pereopod 5, except for carpus bearing 1 distal and 2 ventrodiscal simple

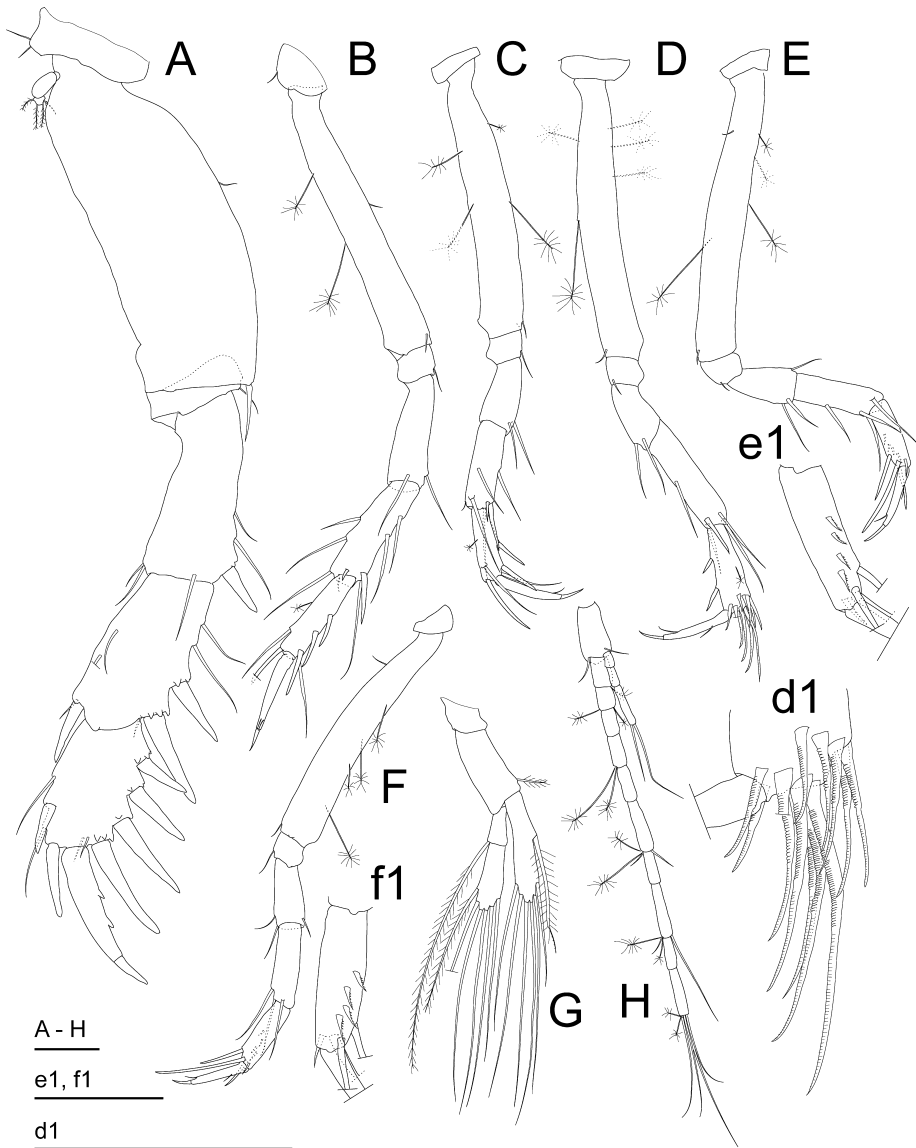


Fig. 4. *Pseudosphyrapus cuspidiger* sp. nov., holotype, non-ovigerous female (2.90 mm), ZIHU-3893. A–F, left pereopods 1–6, outer view; d1, distal portion of pereopod 4 propodus, outer view; e1, pereopod 5 propodus, inner view; f1, pereopod 6, inner view; G, left pleopod 1, most setal ornamentation not shown; H, left uropod. Scale bars: 0.1 mm.

setae.

Pleopods (Fig. 4G) biramous, in five pairs; all similar in shape, except for pleopod 5 slightly shorter than others. Basal article biarticulate; article 1 naked; article 2 with 1 inner distal plumose seta. Exopod biarticulate; article 1 with 1 outer distal plumose seta; article 2 with 6 distal

plumose setae. Endopod uniarticulate, with 6 distal plumose setae and 1 inner distally hooked plumose seta.

Uropod (Fig. 4H) basal article and endopod combined shorter than pleon. Basal article with 2 simple setae. Exopod triarticulate; articles 1 and 2 naked; article 3 with 2 simple setae at tip. En-

dopod consisting of 10 serially repeated articles, with simple setae and broom setae as illustrated; distal article with 4 simple and 2 broom setae at tip.

Female paratype. The holotype and paratype are generally similar in morphology, but the latter differs from the former in the following points

(the character states observed in the holotype are indicated in parentheses): outer flagellum of antennule (Fig. 2I) 4-articulated (5-articulated); article 2 of left mandibular palp with 3 (2) setulate setae; inner lobe of fixed endite of maxilla with 21 or 22 (20) bifid-tipped setae; maxillipedal endite with 3 (4) basally setulate setae on inner

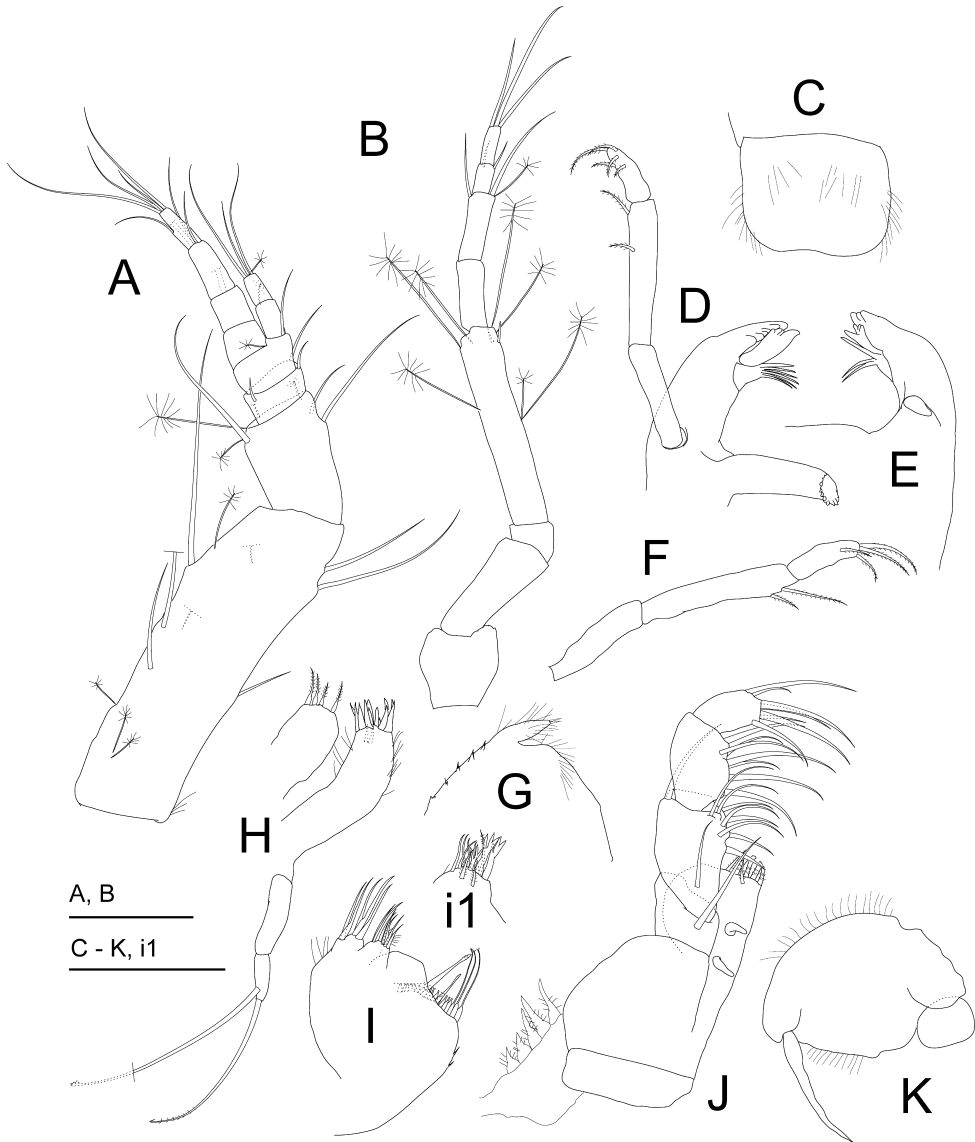


Fig. 5. *Pseudosphyrapus cuspidiger* sp. nov., allotype, male (2.22 mm), ZIHU-3894. A, left antennule, dorsal view; B, left antenna, dorsal view; C, labrum; D, left mandible; E, right mandible; F, right mandibular palp; G, labium; H, right maxillule; I, right maxilla, ventral view, ornamentation of inner lobe of movable endite not shown; i1, same, inner lobe of movable endite; J, right maxilliped, ventral view; K, right epignath. Scale bars: 0.1 mm.

margin; pereopod 3 propodus with 3 (2) ventral spiniform setae; pereopod 4 propodus with 3 (2) ventral spiniform setae, and 6 (5) subdistal and 10 (8) distal serrate setae; pereopod 6 propodus with 5 (4) inner pinnate serrate setae, and 0 (1)

distal serrate seta; pleopodal exopod and endopod with 4 or 5 (6) plumose setae on distal margin. In addition, the numbers of simple setae are different between the holotype and paratype with regard to pereopod 1 merus and carpus, pereopod

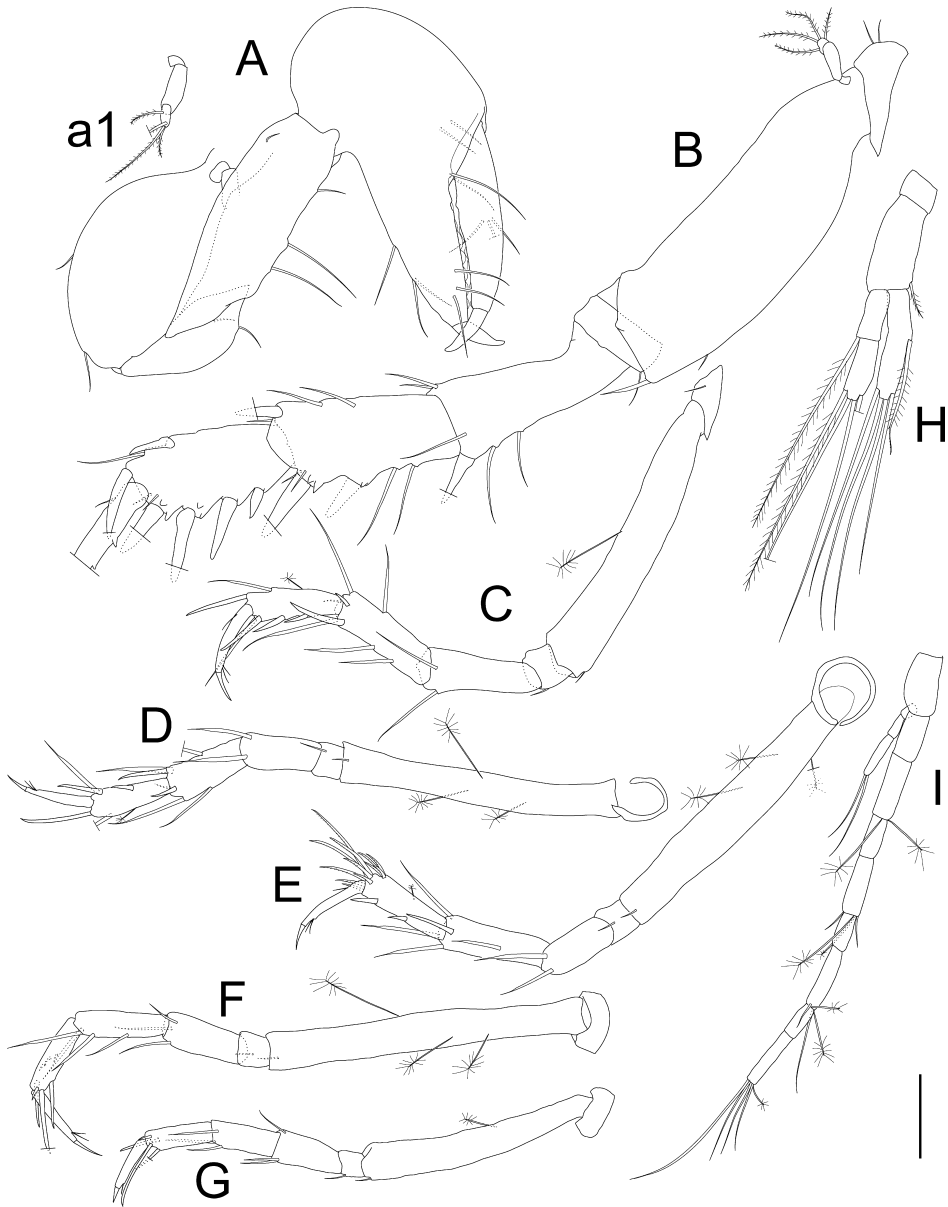


Fig. 6. *Pseudosphyrapus cuspidiger* sp. nov., allotype, male (2.22 mm), ZIHU-3894. A, right cheliped, outer view; a1, same, exopod; B, left pereopod 1, outer view; C, left pereopod 2, outer view; D, right pereopod 3, ventral view; E, right pereopod 4, ventral view for coxa to carpus, outer view for propodus and dactylus; F, right pereopod 5, dorsal view for coxa to merus, outer view for carpus to dactylus; G, right pereopod 6, outer view; H, right pleopod 2, most setal ornamentation not shown; I, right uropod. Scale bar: 0.1 mm.

2 merus, carpus, and propodus, pereopod 3 merus, pereopod 4 carpus, and pereopod 5 carpus.

Male allotype. Body (Fig. 1C, D) generally similar to that of female, except for body 0.48 times as long as wide, somewhat narrower than female; pereonite 6 with genital cone.

Antennae (Fig. 5A, B) and mouthparts (Fig. 5C–K) generally similar to those of female, except for labrum (Fig. 5C) without transverse line halfway; mandibular palp (Fig. 5F) article 3 with 4 (on right) or 5 (on left) setulate setae; and maxilla with 18 bifid-tipped setae on inner lobe of fixed endite.

Cheliped (Fig. 6A, a1) and pereopods 1–6 (Fig. 6B–G) like those of female, except for pereopod 2 (Fig. 6C) carpus having 3 dorsal simple setae; pereopod 4 (Fig. 6E) carpus 1.3 times as long as merus, and propodus has 12 (4 subdistal and 8 distal) serrate setae; pereopod 5 (Fig. 6F) carpus as long as merus, and propodus with 3 inner pinnate serrate setae; and pereopod 6 (Fig. 6G) carpus as long as merus, and propodus with 1 inner pinnate serrate seta.

Pleopods (Fig. 6H) and uropod (Fig. 6I) generally similar to those of female, except for pleopod exopod article 2 with 4 distal plumose setae; pleopod endopod with 4 distal plumose setae; and uropod endopod consisting of 8 serially repeated articles.

Distribution. At present, known only from the type locality.

Remarks. *Pseudosphyrapus cuspidiger* sp. nov. is the seventh species known in the genus.

Among the congeners, *P. quintolongus* Kakui, Kajihara and Mawatari, 2007 and *P. vladimiri* Guțu, 1989 are close to the new species in having 1) the rostrum terminating in an acute point and 2) laterally projected epimeral processes. Differences among these three species are summarized in Table 1.

Although in some congeneric species [i.e., *P. anomalus* (G. O. Sars, 1869), *P. quintolongus* and *P. serratus* (G. O. Sars, 1882)] notable sexual dimorphism is seen in the structure of the antennule and cheliped (G. O. Sars, 1885, 1899; Kakui *et al.*, 2007), no variation in these appendages is found in the present new species. However, it is difficult to conclude if the new species does not exhibit sexual dimorphism in these appendages, as only a single male specimen is available at present.

Pseudosphyrapus cuspidiger sp. nov. possesses pinnate serrate setae on the inner surface of the propodi of pereopods 5 and 6. Incidentally, Kakui *et al.* (2007) reported that these setae occur on the outer surface of the propodi in *P. quintolongus* and *Kudinopasternakia balanorotrata*; however, our re-examination of the type specimens (ZIHU 3252–3254) reveals that, as with *P. cuspidiger*, the two species indeed have these setae on the inner surface.

Etymology. The specific epithet is a Latin adjective referring to the acute rostrum and laterally projected epimeral processes on the pleonites.

Table 1. Comparison among three species of *Pseudosphyrapus*, *P. cuspidiger* sp. nov., *P. quintolongus*, and *P. vladimiri*.

Items	<i>P. cuspidiger</i> sp. nov.	<i>P. quintolongus</i>	<i>P. vladimiri</i>
Lateral processes on pleonites	slightly larger on pleonites 3 and 4 than those on others	significantly larger on pleonite 5 than those on others	almost equal length on all pleonites*
Dorsal row of simple setae on pereopod 1 carpus	absent	absent	present
Cluster of serrate setae on pereopod 4 propodus	present	present	absent*

* after Guțu's (1989) figures, although not clearly mentioned in the text.

Genus *Kudinopasternakia* Guţu, 1991

[New Japanese name: Edasu-ashinaga-apuseudesu-zoku]

Kudinopasternakia balanorostrata Kakui,
Kajihara and Mawatari, 2007

[New Japanese name: Edasu-ashinaga-apuseudesu]

(Figs. 7–11)

Kudinopasternakia balanorostrata Kakui, Kajihara and Mawatari, 2007: 38–43, figs. 1–3.

Material examined. Non-types: ZIHU-3896, 1 adult male (4.77 mm), TR/V *Toyoshio-maru*, stn 9, north of Nagannu Island, Okinawa Islands,

26°23.150'N, 127°30.090'E to 26°23.560'N, 127°30.390'E, 730–728 m, mud, 26 May 2007, sledge net, dissected, 6 slides; ZIHU-3897, 1 adult male (5.09 mm), same data as for ZIHU-3896, dissected, 2 slides (dissected cheliped and pereopods preserved in glass vials); ZIHU-3898, 1 manca (2.84 mm), same data as for ZIHU-3896, partly dissected, 2 slides.

Amended diagnosis. *Kudinopasternakia* species with small, acute rostrum, sides concave. Epimera rounded. Outer flagellum of antennule 8- or 9-articulated in male, 4-articulated in fe-

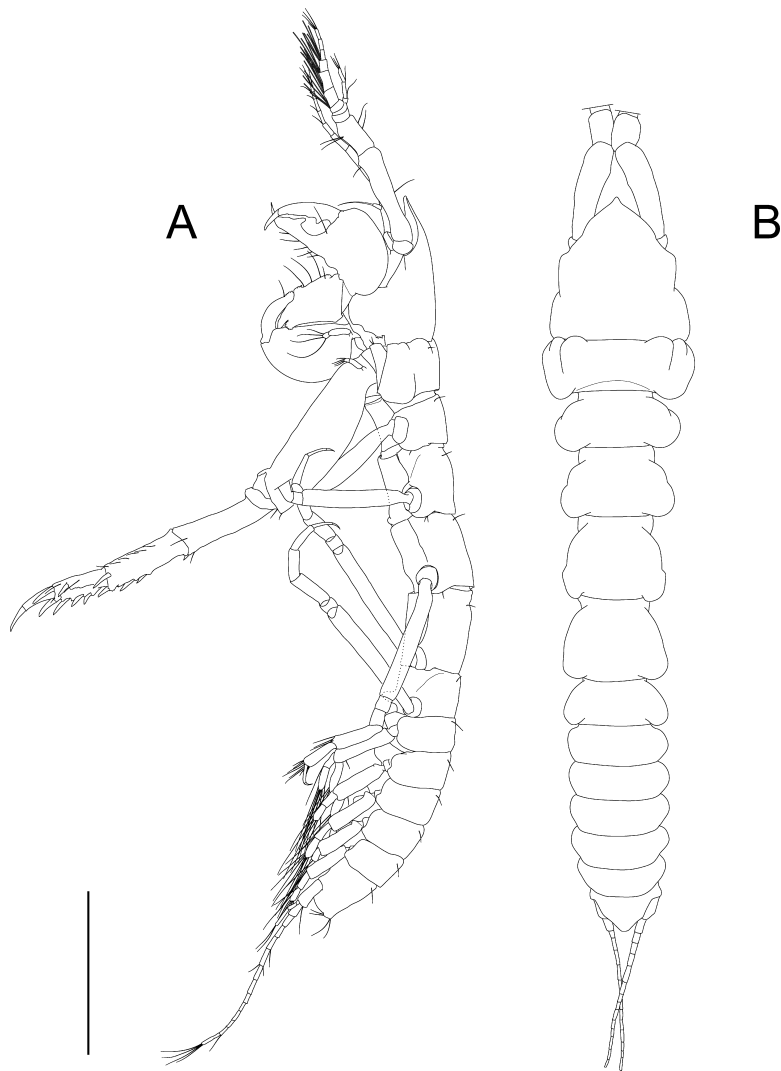


Fig. 7. *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, non-type, adult male (4.77 mm), ZIHU-3896. A, body, lateral view; B, body, dorsal view. Scale bar: 1 mm.

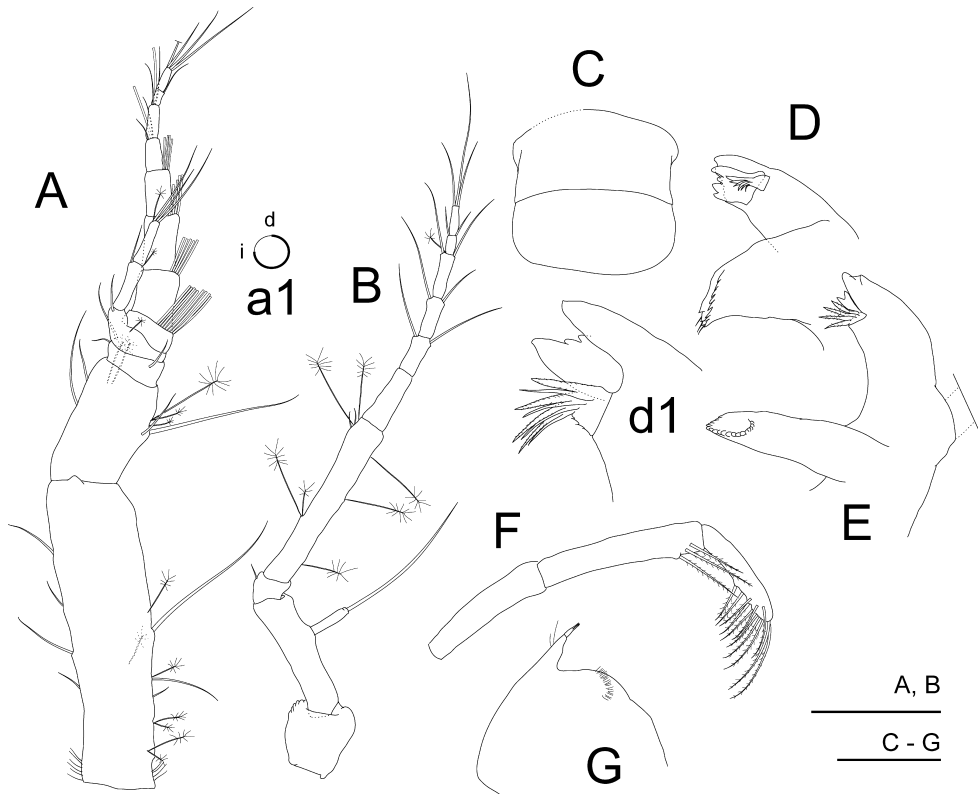


Fig. 8. *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, non-type, adult male (4.77 mm), ZIHU-3896. A, right antennule, dorsal view; a1, diagrammatic cross section through articles 1–4 of antennular outer flagellum, with region bearing row of aesthetascs indicated by heavy solid line (i, inner; d, dorsal); B, right antenna, dorsal view; C, labrum; D, left mandible; d1, same, incisor, lacinia mobilis, and setiferous lobe (different angle from D); E, right mandible; F, right mandibular palp; G, labium. Scale bars: A, B, 0.25 mm; C–G, 0.1 mm.

male. Articles 2 and 3 of mandibular palp with 3 and 10–12 setulate setae, respectively. Male cheliped carpus with 1 dorsodistal bifurcate process, and 1 dorsoproximal and 3 ventral crenulate processes; fixed finger and dactylus with 1 medial and 1 proximal triangular processes on cutting surface, respectively. Female cheliped carpus without dorsodistal projection. Pereopod 1 carpus and propodus with 3 and 4 ventral spiniform setae, respectively; propodus with 1 dorsal simple seta proximal to dorsomedial spiniform seta. Pereopod 4 propodus with 17 or 18 serrate setae. Uropodal exopod triarticulate.

Description. Adult male. Body (Fig. 7A, B) white in life, generally similar to that of female, except for body about 5.6 times as long as wide,

somewhat narrower than in female; pereonite 6 with genital cone; pleon 0.32 times total body length.

Antennule (Fig. 8A, a1) 1.55 times as long as cephalothorax. Article 1 thick, almost 0.4 times as long as articles 1–4 and outer flagellum combined, with 3 outer and 3 or 4 inner simple setae, and several broom setae. Article 2 0.36 times as long as article 1, with 1 or 2 outer and 2 inner simple setae, and several broom setae. Article 3 0.17 times as long as article 2, with 1 outer and 2 inner simple setae. Article 4 (common article) with 1 simple seta at insertion of inner flagellum, and 1 broom seta. Outer flagellum 8- or 9-articulated (the article numbers of 9-articulated flagellum is indicated in parentheses); articles 1–4

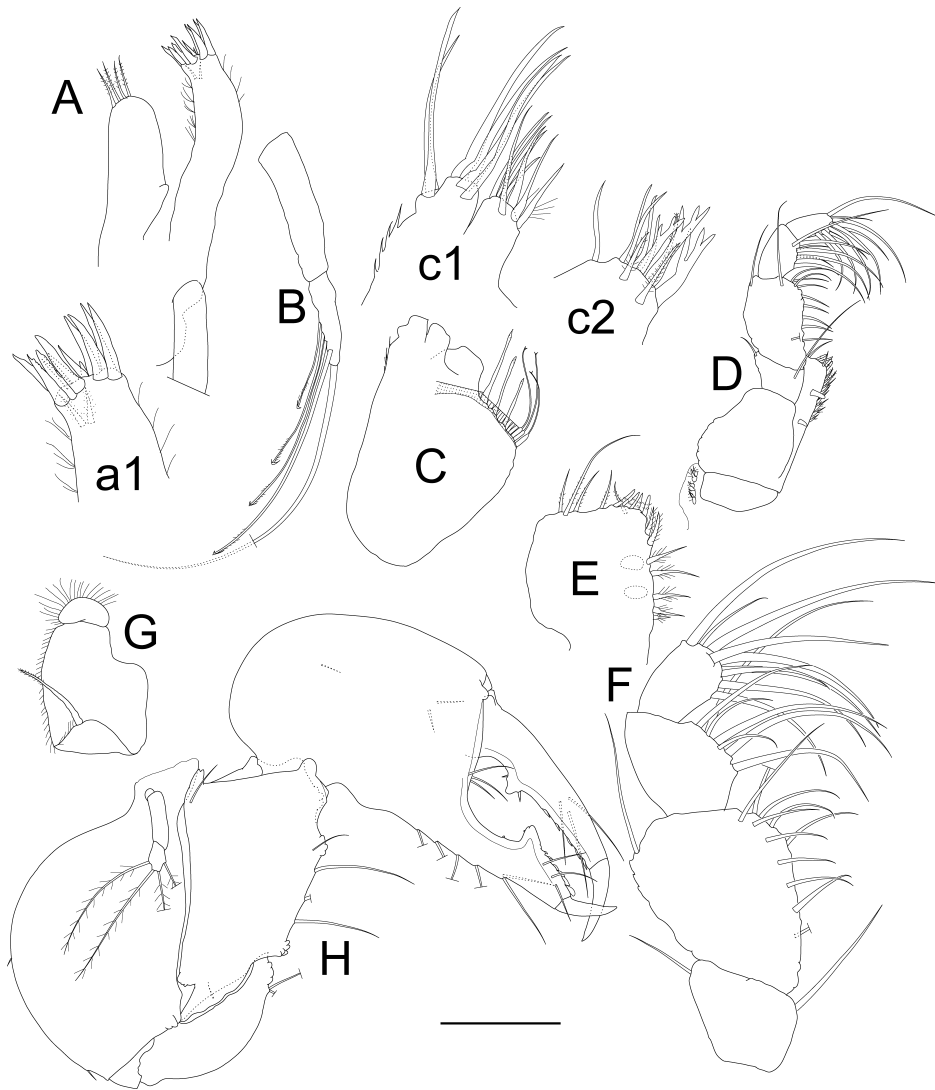


Fig. 9. *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, non-type, adult male (4.77 mm), ZIHU-3896. A, right maxillule; a1, same, distal portion of outer endite; B, left maxillular palp; C, right maxilla, ventral view, most ornamentation not shown; c1, same, movable endite; c2, same, outer lobe of fixed endite; D, right maxilliped, ventral view; E, endite of left maxilliped; F, palp of left maxilliped; G, right epignath; H, right cheliped, outer view. Scale bar: A–C, E, F, 0.1 mm; D, G, 0.2 mm; H, 0.25 mm; a1, c1, c2, 0.05 mm.

(1–5) each with a row of aesthetascs at distal end, along arc commencing from dorsal side, running along outer surface, and terminating on inner side, i.e., no aesthetascs in inner dorsal region (see Fig. 8a1); articles 5 and 6 (6 and 7) with 1 dorsodistal and 1 ventrodistal simple setae, and 1 ventrodistal aesthetasc; article 7 (8) with 1 outer distal simple seta; article 8 (9) with 4 simple

setae at tip. Inner flagellum biarticulate; article 1 with 1 simple and 1 broom setae; article 2 with 3 simple and 1 broom setae at tip.

Antenna (Fig. 8B) 10-articulated, thin, 0.84 times as long as antennule. Article 1 with inner distal serration. Article 2 with pseudosquama. Article 3 with 1 inner distal simple seta. Article 4 longest, with 2 inner distal short setae and sever-

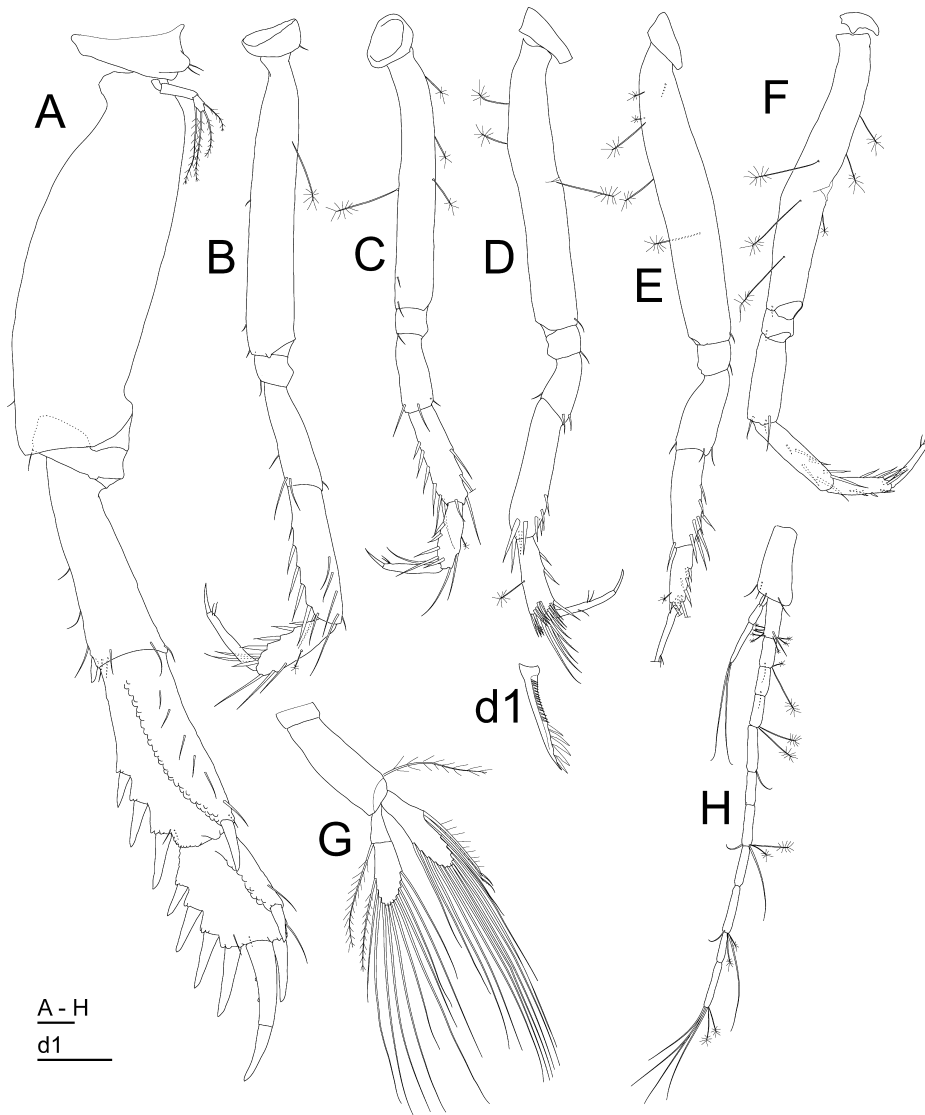


Fig. 10. *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, non-type, adult male (4.77 mm), ZIHU-3896. A–F, right pereopods 1–6, outer view; d1, bladed serrate seta on pereopod 4 propodus; G, left pleopod 2, most ornaments of setae not shown; H, right uropod. Scale bars: A–H, 0.1 mm; d1, 0.05 mm.

al broom setae. Article 5 naked. Articles 6 and 7 with 2 simple setae. Article 8 with 2 simple and 1 broom setae. Article 9 with 2 simple setae. Article 10 with 3 simple setae.

Mouthparts (Figs. 8C–G, 9A–G) similar to those of female, except for the following: setiferous lobe of right mandible (Fig. 8E) with 3 or 4 setulate setae; article 3 of mandibular palp (Fig. 8F) with 10–12 setulate setae; maxillular palp

(Fig. 9B) with 4 subdistal harpoon-tipped setae and 1 terminal hook-tipped seta; outer lobe of fixed endite of maxilla (Fig. 9c2) with 5 simple setae, 1 dorsal and 2 ventral setulate setae, and 3 trifurcate setae; inner lobe of fixed endite of maxilla (Fig. 9C) with 27 or 28 bifid-tipped setae and 3 or 4 biserrate setae; maxilliped endite (Fig. 9E) with 2 setulate setae, 5 or 6 basally setulate setae, and 2 coupling hooks on inner margin; ar-

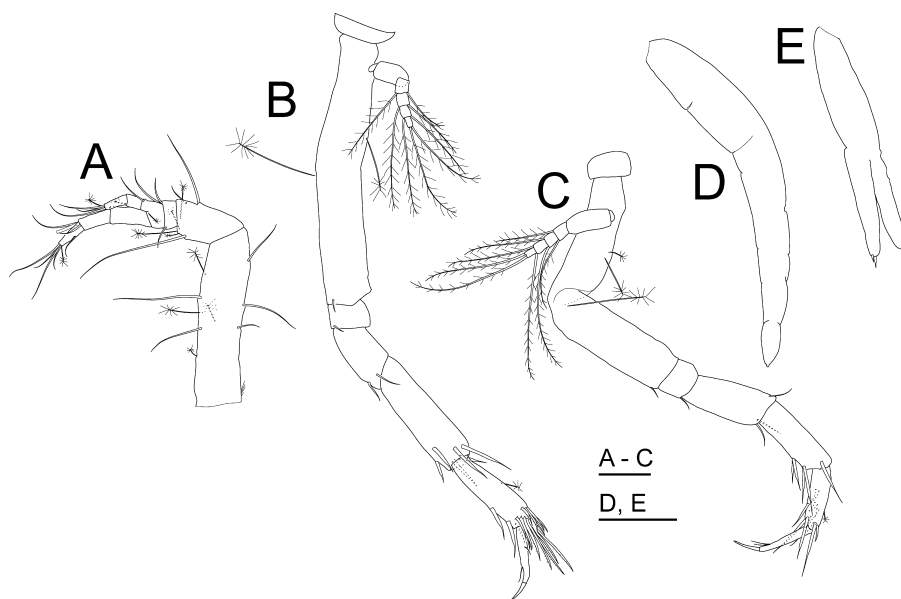


Fig. 11. *Kudinopasternakia balanorostrata* Kakui, Kajihara and Mawatari, 2007, non-type, manca (2.84 mm), ZIHU-3898. A, left antennule, dorsal view; B, left pereopod 4, outer view; C, left pereopod 5, outer view; D, left pereopod 6; E, left pleopod 1. Scale bars: 0.1 mm.

ticle 2 of maxilliped palp (Fig. 9F) with 1 outer and 11 inner simple setae; article 4 of maxilliped palp with 9 distal setae.

Cheliped (Fig. 9H) hammer-shaped. Basis 1.67 times as long as wide, with 2 ventral minute setae, and 1 dorsodistal crenulate process. Merus shorter than basis, with 2 ventrodistal and 1 inner distal simple setae, and 1 ventrodistal crenulate process. Carpus almost as long as basis, with 1 dorsodistal and 4 ventral simple setae, 1 dorsodistal bifurcate process, and 1 dorsoproximal, 1 ventroproximal, 1 ventromedial, and 1 ventrodistal crenulate processes. Propodus longer than carpus; anterior region protuberant. Propodal palm with 3 inner simple setae, and 1 outer and 2 inner simple setae at insertion of dactylus. Fixed finger shorter than palm; ventral margin with 5 or 6 simple setae; cutting surface with 3 simple setae, 1 medial triangular process, and row of lamellae. Dactylus longer than fixed finger, with 3 inner medial simple setae; cutting surface with 1 proximal triangular process bearing 2 spiniform setae, and row of lamellae. Exopod triarticulate; distal article with 4 plumose setae.

Pereopods 1–6 (Fig. 10A–F) generally similar to those of female, except for the following: pereopod 1 0.6 times as long as body, carpus as long as merus, and dactylus without dorsoproximal process; pereopod 2 0.73 times as long as pereopod 1, carpus longer than merus; pereopod 3 carpus longer than merus; pereopod 4 propodus with 17 or 18 (5 or 7 subdistal and 12 or 11 ventrodistal) serrate setae and 0 or 2 ‘bladed serrate setae’ (Fig. 10d1); pereopod 5 carpus longer than merus, and propodus with 1 dorsodistal serrate and 6 inner pinnate serrate setae; pereopod 6 propodus with 0 or 1 dorsodistal serrate and 8 or 9 inner pinnate serrate setae; and the numbers of simple and broom setae on pereopod 1 merus and carpus, pereopod 2 carpus and propodus, pereopod 3 merus and carpus, pereopod 4 carpus and propodus, pereopod 5 carpus and propodus, and pereopod 6 carpus and propodus.

Pleopods (Fig. 10G) and uropod (Fig. 10H) generally similar to those of female, except for pleopod exopod article 2 and endopod with 11–14 and 10–13 distal plumose setae, respectively; pleopod endopod with 2 (1 on pleopod 5)

inner distally hooked plumose setae; uropod basal article and endopod combined shorter than pleon; uropod basal article with 4 simple setae.

Manca. Body shape resembles that of adult female, except pereonite 6 proportionally smaller.

Antennule (Fig. 11A) with triarticulate outer flagellum and biarticulate inner flagellum. Antenna 8-articled.

Pereopod 1 merus with 1 ventrodiscal spiniform seta. Carpus with 1 dorsodistal and 2 ventrodiscal spiniform setae. Propodus with 2 dorsal and 3 ventral spiniform setae. Dactylus with 2 ventral denticles. Exopod lost.

Pereopod 4 (Fig. 11B) coxa naked. Basis with 1 ventrodiscal simple and 2 broom setae, and exopod. Ischium with 1 ventrodiscal simple seta. Merus with 2 ventrodiscal simple setae. Carpus with 4 outer and 2 inner simple setae. Propodus with 2 ventral simple and 14 (5 subdistal and 9 ventrodiscal) serrate setae. Dactylus with 1 dorsal and 1 ventral simple setae. Exopod 6-articled, consist of 1 short article attaching to basis, 1 long article, and 4 short articles. Articles 1 and 2 naked. Articles 3–6 each with 2 plumose setae.

Pereopod 5 (Fig. 11C) coxa naked. Basis broken medially, with 1 ventrodiscal simple and 3 broom setae, and exopod. Ischium like that of pereopod 4. Merus with 1 dorsodistal and 2 ventrodiscal simple setae. Carpus with 1 dorsodistal and 4 ventral simple setae. Propodus with 4 distal simple setae, 1 dorsal broom seta, 1 dorsodistal serrate seta, and 5 inner pinnate serrate setae. Dactylus with 1 dorsal and 2 ventral simple setae. Exopod like that of pereopod 4.

Pereopod 6 (Fig. 11D) present but rudimentary, without obvious articulation or setae; with 1 tiny projection at tip.

Pleopods (Fig. 11E) present but rudimentary, without obvious articulation; all five pairs biramous, similar in shape. Exopod and endopod uniaarticulate, with 2 short setae and 1 short seta at tip, respectively.

Uropod exopod triarticulate, with 2 simple setae at tip; endopod consist of 10 (on right) or 8 (on left) serially repeated articles.

Distribution. So far known from the East

China Sea, at depths of 646–1058 m (Kakui *et al.*, 2007; K. Kakui, unpublished data).

Remarks. Among the known species of *Kudinopasternakia*, sexual dimorphism has been reported only for *K. trispinosa* Santos, 2007 (Santos, 2007: 39). The newly collected specimens enable us to assess sexual dimorphism in *Kudinopasternakia balanorostrata*. Several sexually dimorphic characters reported by her are also seen in *K. balanorostrata*: 1) the number of articles in the outer flagellum on the antennule, 2) the shape of the chelipedal carpus, fixed finger, and dactylus, and 3) the pereopod 1/body length ratio. The other characters being dimorphic in *K. trispinosa* are not dimorphic in *K. balanorostrata*: 1) the number of articles in the inner flagellum on the antennule, 2) the number of ventral spiniform [“cuspidate” in Santos (2007)] setae on pereopod 1 carpus, and 3) the number of ventral simple [“cuspidate” in Santos (2007)] setae on pereopod 4 propodus. Furthermore, the body proportion, and pleopodal exopod and endopod are dimorphic in *K. balanorostrata*, whereas these characters were only mentioned for females of *K. trispinosa* by Santos (2007); therefore, whether or not these characters exhibit sexual dimorphism is uncertain. No sexual differences in the mouthparts were observed in *K. balanorostrata*, unlike in two confamilial species, *Pseudosphyrapus quintolongus* and *Pseudosphyrapus* sp. A (cf. Larsen, 2005; Kakui *et al.*, D-22); Santos (2007) did not describe the morphology of the mouthparts in the male of *K. trispinosa*. Sexual dimorphism observed in *K. balanorostrata* is summarized in Table 2.

A ‘bladed serrate seta’ (Fig. 10d1), considering its position, appears to be homologous with a seta that has been variously described as a “thick seta, ramified in five foliaceous lobes, terminally” in *K. bispinosa* Guțu and Heard, 2002 (Guțu and Heard, 2002); a “thick seta ornamented ventrally, serrate on proximal half and with eight spines on distal half” in *K. amazonica* Santos, 2007 (Santos, 2007); and a “bifurcated setae, with tiny spiniform setae on its proximal half” in *K. trispinosa* (Santos, 2007). One male (ZIHU-

Table 2. Sexual dimorphism observed in *Kudinpasternakia balanorostrata*.

Items	Male	Female
Body proportion		
Body length/width ratio	5.6	5.3
Pleon/body length ratio	0.32	0.25
Outer flagellum of antennule	8- or 9-articled; articles 1 to 4 (5 in 9-articled flagellum) with row of aesthetascs	4-articled, without row of aesthetascs
Cheliped carpus	with 1 dorsodistal bifurcate, and 1 dorsoproximal and 3 ventral crenulate processes	without any process
Cutting surface of cheliped fixed finger	with 1 medial triangular process and row of lamellae	with row of lamellae
Cutting surface of cheliped dactylus	with 1 proximal triangular process and row of lamellae	with row of lamellae
Pereopod 1/body length ratio	0.6	0.54
Pleopod exopod article 2	with 11–14 plumose setae	with about 9 plumose setae
Pleopod endopod	with 10–13 plumose and 2 distally hooked plumose setae	with about 8 plumose and 1 distally hooked plumose setae

3896) has this type of seta, but the other specimens (male, ZIHU-3897; manca, ZIHU-3898; and female, ZIHU-3252) do not possess it. Consequently, it is possible that the presence or absence of the bladed serrate setae represents an individual variation in this species.

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