

A New Species of *Porcellidium* and Two New Genera Belonging to the Family Porcellidiidae (Crustacea, Copepoda, Harpacticoida) from Iwate Prefecture, Japan

Vernon A. Harris¹ and Nozomu Iwasaki²

¹Visiting Fellow, Division of Botany & Zoology, Life Sciences, Australian National University, Canberra, A.C.T. 0200, Australia

²Usa Marine Biological Institute, Kochi University, Usa-cho, Tosa, Kochi, 781–11 Japan

Abstract A new species of *Porcellidium*, *P. aoifuchidorum* and two new genera, *Kensakia* and *Mucrorostrum* belonging to the family Porcellidiidae are described from Kadonohama Bay, Ofunato, Iwate Prefecture, Japan. *Kensakia* females are characterized by a rhomboidal caudal ramus with apical seta, and only two terminal setae. It is represented by a single species, *K. aiiroa*. *Mucrorostrum* females are characterized by a pentagonal caudal ramus with only three terminal setae, and a maxillule with two setae on the endopod. Males have three setae on the terminal article of P2 endopod. It is represented by a single species, *M. yoroium*. The relationship of the new Japanese species to other Porcellidiidae is discussed.

Key words: Copepoda, Harpacticoida, Porcellidiidae, *Porcellidium*, *Kensakia* gen. nov., *Mucrorostrum* gen. nov., Japan.

Introduction

Samples of 17 seaweed species and a seagrass, collected by N. Iwasaki in 1993 from Kadonohama Bay on the NE coast of Honshu, Japan, yielded seven species of harpacticoid copepod belonging to the family Porcellidiidae (Harris & Iwasaki, 1996 a; Harris & Iwasaki, 1996 b). During 1994 and 1995, 40 species of seaweed and two seagrasses were sampled by N. Iwasaki from Kadonohama Bay and Hirota Bay. From the harpacticoid copepods collected, three new species belonging to the Porcellidiidae were discovered; one belongs to *Porcellidium*, the others have been assigned to two new genera. The new species bring the number of Porcellidiidae recorded for Kadonohama Bay to ten. Kito (1977), studying the fauna of the *Sargassum confusum* region, has recorded *Porcellidium ovatum* from Oshoro Bay, Hokkaido, and Ho (1986) has described a new species, *P. paguri*, associated with hermit crabs from Niigata, Ishikawa and Wakayama Prefectures, Japan. This brings our current knowledge of Japanese Porcellidiidae to twelve species.

Methods

Methods of collection, information about the physical features of the collecting stations, methods of measurements and drawing have been described (Harris & Iwasaki, 1996 a). A full list of the seaweeds sampled in the 1994–5 study, together with an analysis of the abundance, sex ratios, distribution and weed preferences of Porcellidiidae on seaweed species will be published separately.

The holotype, allotype and some paratype specimens for each new species have been deposited in the National Science Museum, Tokyo (NSMT). Paratype material has been deposited in British Museum (Natural History) (BMNH), National Museum of New Zealand (NMNZ), Australian Museum, Sydney (AMS).

Systematics

Family Porcellidiidae Sars, 1904

Genus *Porcellidium* Claus, 1860

(See Harris & Iwasaki, 1996 a, for diagnostic characters of the genus)

Porcellidium aoifuchidorum sp. nov.

(Figs. 1–2)

Type material. Holotype, adult female with egg mass removed, NSMT-Cr12033, length 0.67 mm. Allotype, adult male, NSMT-Cr12034, length 0.47 mm. Paratype specimens: 3 ♀ + 5 ♂ NSMT-Cr12035; 2 ♀ + 2 ♂ BMNH 1997.270-273; 2 ♀ + 1 ♂ AMS; 1 ♀ + 1 ♂ NMNZ.

Type material from *Hizikia fusiformis*, *Chondrus ocellatus*, and *Sargassum sagamianum* var. *yezoense*, samples 951211-2, 941007-9 and 941007-5, Kadonohama Bay, Ofunato, Iwate Prefecture, Japan. Collected by N. Iwasaki, 1994, 1995.

Diagnosis. Adult female. Brown with blue border to cephalosome, metasomal segments and P5; mean length 0.64 mm, rostrum 0.08 mm, projects beyond cephalosome, cephalosome width to rostrum ratio 5; urosome without distinct anterior and posterior lobes, pointed posteriorly, bordered with fine setules; caudal rami rectangular, widen posteriorly, not emarginate, medial corner not rounded, β seta about 2/3 down ramus, terminal setae pinnate, seta 1 larger, 2 & 3 close, 4 set in slightly from medial corner; small denticulate area on endopod of P1; P5 basis with ventral row of setules, distal article falciform with 1 dorsal and small apical seta.

Adult male. Brown with blue border to cephalosome only; mean length 0.48 mm; cephalosome truncated, shoulders square, lateral angle of antennule socket visible from above; antennule without anteriorly projecting comb, coupling denticles reduced to two spherical knobs, ventral blade absent, dactylus short.

Dimensions. Female. Mean body length (rostrum to tip of urosome) 0.64 mm (N=25, SD=0.037, range 0.57–0.73 mm), cephalosome width 0.39 mm

($N=25$, $SD=0.022$), body length to width ratio 1.6. Rostrum 0.08 mm wide, body width to rostrum ratio 4.9. Urosome width to length ratio 1.3. Caudal ramus length to width ratio 2.15. Females of this species show an unusually wide range of body length. One female and one male have been found that are much larger than any other specimens (female length 0.805 mm, width 0.45 mm, rostrum 0.11 mm; male length 0.56 mm, width 0.41 mm). This may be due to a nutritional factor.

Male. Mean length (rostrum to tip of urosome) 0.48 mm ($N=24$, $SD=0.011$, range 0.46–0.49 mm), cephalosome width 0.34 mm ($SD=0.007$), body length to width ratio 1.4.

Description. Adult female (Fig. 1 A). Pale brown, on most specimens the border of the cephalosome, metasomal epimera and P5 are blue. The ventral (sternal) edge of the cephalosome and trabeculae may be dark brown. Anterior of cephalosome semicircular, rostrum projects about 1/4 of its width. Hyaline border 8 μm , body conspicuously pitted dorsally, pits 4.5–6 μm .

Urosome (Fig. 1 H) broad, without obvious division into anterior and posterior lobes (a colourless area may indicate position of an indistinct scar), bordered with fine setules, posterior lobe not expanded, pointed posteriorly. Caudal arch about half length of urosome.

Caudal rami (Fig. 1 D) rectangular, widening posteriorly, posterior border slightly convex, not emarginate, dorsal surface with reticulate pattern, β seta about 2/3 down ramus, terminal seta 1 pinnate, larger than others, 2 & 3 close together, 4 set in slightly from medial corner, posterior border of fine setules.

Limbs typical of family. Geniculate setae of antenna strong, articulate, claw comb-like, nearly as long as first geniculate seta (Fig. 2 D). Maxillule endopod with six setae. Maxilliped (Fig. 2 J) coxal lobe rounded, fimbriate, basis fimbriate with fimbriate process. P1 with small denticulate peg field at lateral end of fimbriate crescent on endopod. Sabre-like seta on P3 endopod longer than endopod (1.4 : 1). Basis of P5 with ventral row of setules proximal to insertion of ventral seta (Fig. 1 E), blade of P5 falciform, no ventral expansion. Single dorsal seta near posterior end plus apical seta (Fig. 1 F).

Adult male (Fig. 1 C). Brown with blue border to cephalosome only. Cephalosome truncated with angular shoulders (almost square), lateral angle of antennule socket visible from above (Fig. 1 B).

Caudal rami widen posteriorly, ($L/w=1$), setation as for female (Fig. 1 G).

Antennule (Fig. 2 A) with second segment slender ($L/w=1.3$), dactylus short (less than half compound segment), coupling denticles reduced to two spherical denticles distally placed (Fig. 2 B), ventral blade and anterior comb absent. P2 with 2 plumose setae on terminal article of endopod (Fig. 2 F). Lateral row of setules on ventral side of P5 (Fig. 2 H).

Remarks. This species has been named from the distinctive blue margin to the cephalosome and metasomal epipleura, the rest of the body being khaki brown

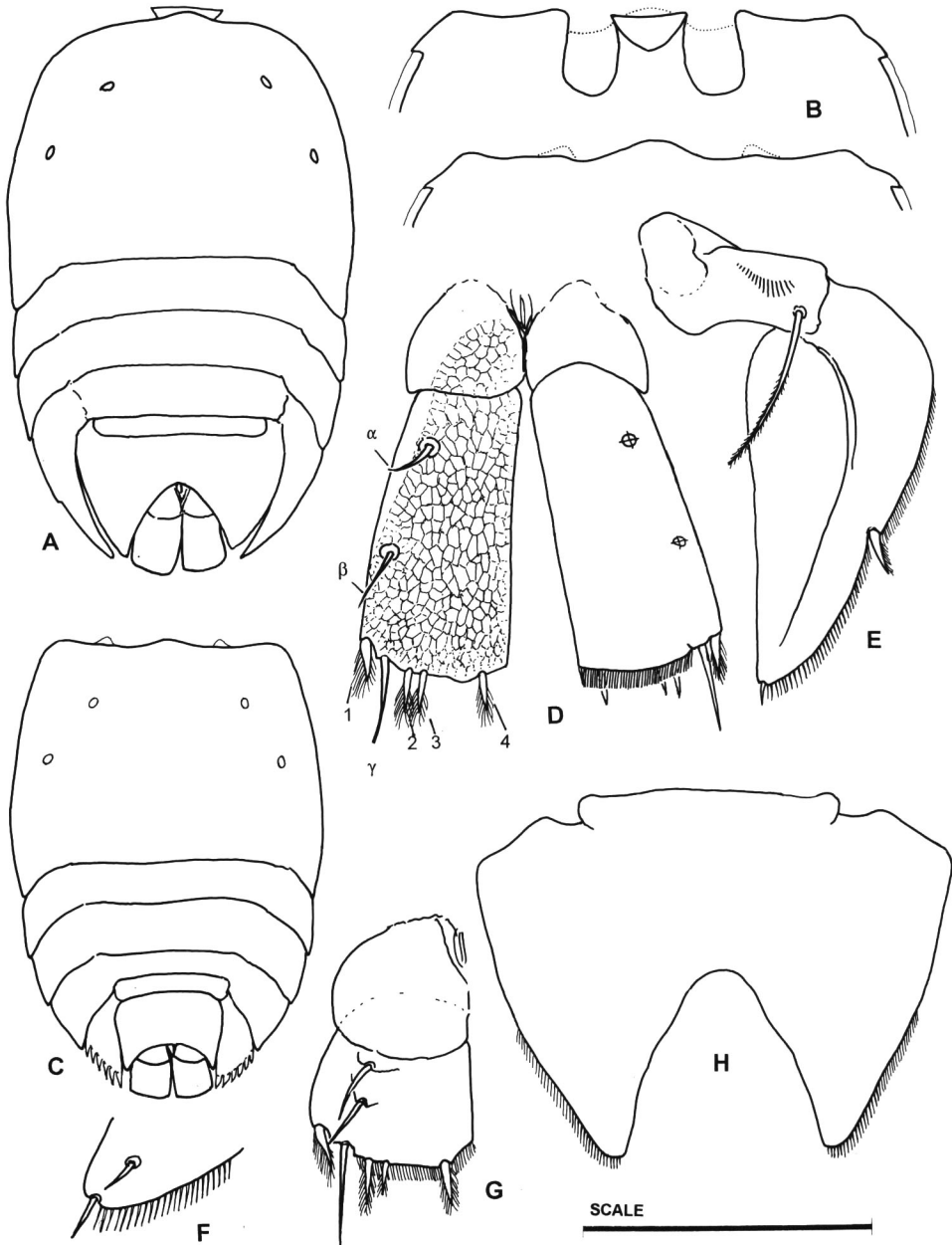


Fig. 1. *Porcellidium aoifuchidorum*. A. Adult female. B. Anterior of male cephalosome, ventral and dorsal focus. C. Adult male. D. Female caudal rami, left dorsal view showing surface reticulation, right ventral focus. E. Female P5, ventral view. F. Apex of P5, dorsal view. G. Male caudal ramus. H. Female urosome. Scale bar: A, C=0.33 mm; B, H=0.19 mm; D=0.1 mm; E=0.135 mm; F, G=0.082 mm.

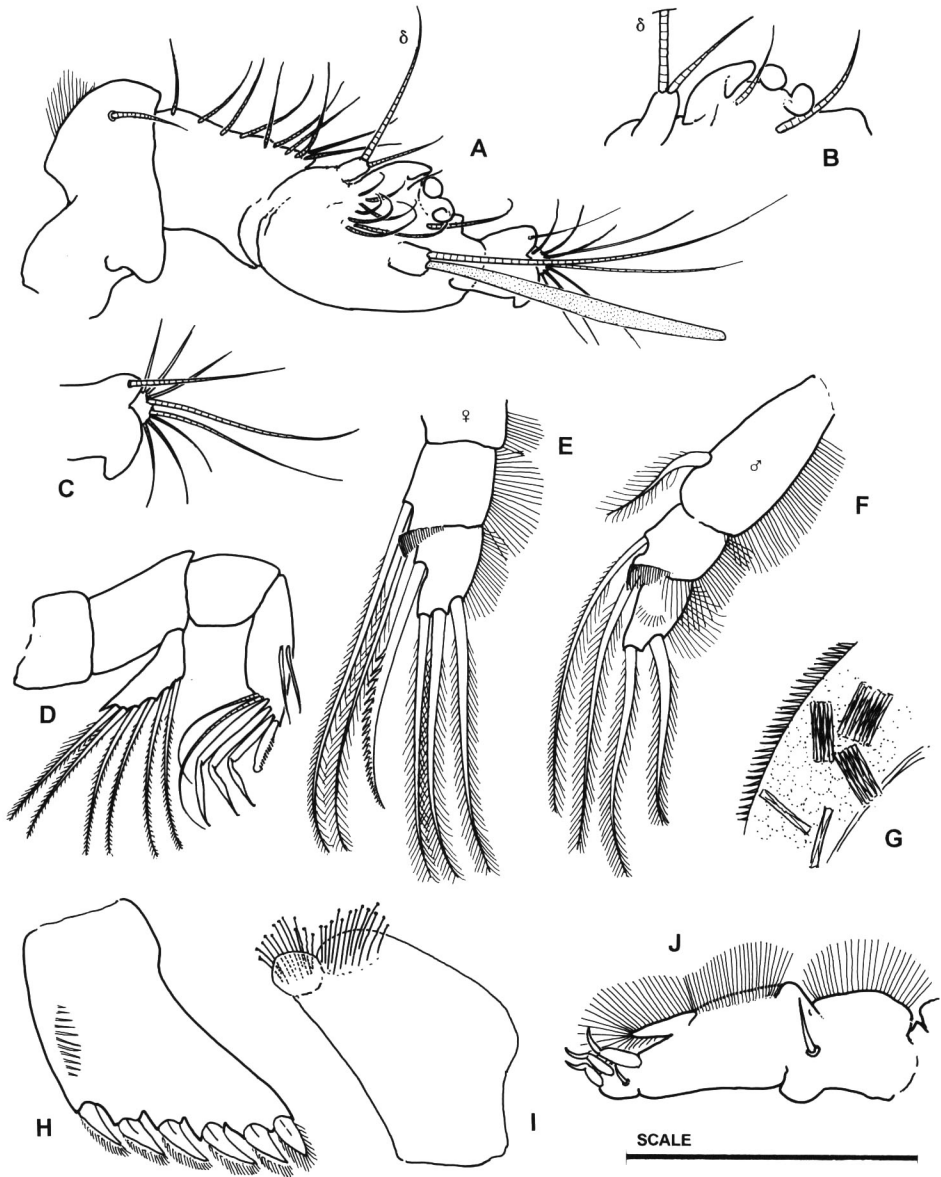


Fig. 2. *Porcellidium aoifuchidorum*. A. Left antennule of male, ventral view. B. Detail of coupling denticles. C. Detail of terminal setae on dactylus. D. Antenna. E. Terminal segment of female P2 endopod. F. Male P2 endopod. G. Diatoms on P5. H. Male P5, ventral view. I. Epi-zoic suctorian protozoan. J. Maxilliped. Scale bar: A, G, H, I, J=0.082 mm; D, E, F=0.1 mm; B, C not to scale.

(Japanese, aoi=blue+fuchidori=border, margin). Many individuals have rectangular diatoms attached to their ventral side (Fig. 2 G), and some animals have a large species of suctorian protozoa attached (Fig. 2 I). This species shows a wide variation in size (females range from 0.57 to 0.8 mm).

Distribution and abundance. Small populations of *P. aoifuchidorum* were present on *Hizikia fusiformis* (40), *Chondrus ocellatus* (24) and *Sargassum sagamianum* var. *yezoense* (28), but isolated individuals have been found on other species of *Sargassum*, *Cystoseira hakodatensis*, *Neodelsia yendoana* and *Ahnfeltia paradoxa*.

Genus *Kensakia* nov.

Diagnosis. Anterior of female cephalosome semicircular, male truncated; hyaline border present, marginal glands open dorsal to border, dorsal pits present; urosome not clearly divided into anterior and posterior lobes, posterior lobe pointed posteriorly, part of caudal rami included in caudal arch of urosome; caudal rami rhomboid, pointed posteriorly with terminal seta 4 at apex, terminal setae 2 and 3 absent in adult female, 2 present and 3 absent in adult males and juveniles; male antennule without ventral blade, no anteriorly projecting comb on accessory lobe; maxillule endopod with 6 setae, exopod with one seta; maxilliped basis with fimbriate process; denticulate peg field on P1 endopod very small or absent; male P2 endopod with 2 terminal setae; female P5 falciform, without ventral expansion, extend beyond urosome but do not touch one another posteriorly, male P5 with 6 terminal setae.

Remarks. The genus *Kensakia* (gender feminine) is characterized by the shape of the caudal rami and their unusual setation (Japanese, kensaki=point of a sword). It differs from other genera with a rhomboid caudal ramus by the absence of the third terminal seta.

Type species. *Kensakia aiiroa* sp. nov.

Kensakia aiiroa sp. nov.

(Figs. 3–4)

Type material. Holotype, adult female with egg mass removed, NSMT-Cr12036, length 0.75 mm. Allotype, adult male, NSMT-Cr12037, length 0.61 mm. Paratype specimens: 3 ♀+3 ♂ NSMT-Cr12038; 2 ♀+1 ♂ BMNH 1997.274-276; 1 ♀+2 ♂ AMS; 1 ♀+1 ♂ NMNZ.

Type material from *Laminaria religiosa*, sample number 941014-2, Kadonohama Bay, Ofunato, Iwate Prefecture, Japan. Collected by N. Iwasaki, 1994.

Diagnosis. Adult female. Pale yellow-brown with two large patches of dark purple-brown, one on cephalosome and two metasomal segments, the other on urosome, caudal rami and P 5s; mean length 0.74 mm, rostrum 0.11 mm, cephalosome width to rostrum ratio 4.5; rostrum prominent, dorsal pits conspicuous; uro-

some posterior lobe not expanded, pointed posteriorly; caudal rami rhomboid with terminal seta 4 pinnate at apex, terminal setae 2 and 3 absent; very small denticulate peg field on endopod of P1, P3 sabre-like seta longer than endopod, P5 with two dorsal setae and apical seta.

Adult male. Dark patch on back of cephalosome and 2 segments only; mean body length 0.63 mm; cephalosome truncated, shoulders rounded, caudal rami rectangular, terminal seta 2 present, 3 absent; proximal antennule coupling denticle, brush-like, medial and distal denticles tooth-like, dactylus as long as compound segment; P5 first seta thin, different from remaining five, row of 16 ventral setules.

Dimensions. Females. (Reliable measurements for this species, particularly males, are difficult to obtain because the animals roll into a ball when preserved. Straightening them usually results in distortion.) Mean length (rostrum to tip of urosome) 0.76 mm (N=36, SD=0.044, range 0.68–0.86 mm); one specimen (not included in calculation of mean) measures 0.98 mm in length. Cephalosome width, mean 0.50 mm, (SD=0.028, range 0.46–0.57 mm). Rostrum 0.116 mm (N=36, SD=0.007). Body length to width ratio 1.5. Body width to rostrum ratio 4.5. Caudal ramus length to width (maximum) ratio 2.5. Urosome width to length ratio 1.33.

Males. Mean length (rostrum to tip of urosome) 0.63 mm (N=8, SD=0.007, range 0.61–0.67 mm). Cephalosome width, mean 0.44 mm (N=8, SD=0.005, range 0.42–0.46 mm).

Description. Adult female (Fig. 3 A). Colour, pale yellow-brown with two large areas of dark purple-brown (indigo blue in some specimens) covering the dorsal part of the cephalosome plus first two body segments, and the urosome, caudal rami plus P5s. Anterior of cephalosome semicircular. Rostrum prominent, projects one quarter of its width. Hyaline border 8.0 μm wide, dorsal pits 5–6 μm .

Urosome not obviously divided into anterior and posterior lobes except for a slight indentation and cleft (Fig. 3 C), bordered with fine setules, posterior lobe not expanded, pointed posteriorly. Caudal arch about half length of urosome. Urosome plus caudal rami cordate in outline.

Caudal rami rhomboid (Fig. 3 D), widen posteriorly (maximum width 2/3 down ramus), terminal border slopes towards apex, terminal seta 4 pinnate, situated at apex. Sloping terminal edge with border of short, fine setules. Terminal setae 2 & 3 absent. Reticulate pattern on dorsal surface (Fig. 4 E, F).

Limbs typical of family. Geniculate setae of antenna articulate, plain, claw finely serrulate, as long as first geniculate seta. Maxillule endopod with six setae (Fig. 4 G). Maxilliped (Fig. 4 A) coxal lobe rounded, fimbriate, basis fimbriate with fimbriate process. Small patch of denticles at lateral end of fimbriate crescent on endopod of P1. Spinous seta on terminal article of P2 endopod serrate (Fig. 4 C). Spinous seta on terminal article of P3 endopod longer than endopod (1.6:1). Spinous setae on articles 2 and 3 of P4 endopod serrate (Fig. 4 L). Distal article of P5 lanceolate, dorsal expansion overlaps side of urosome, 3 dorsal setae plus small apical seta (Fig. 3 G).

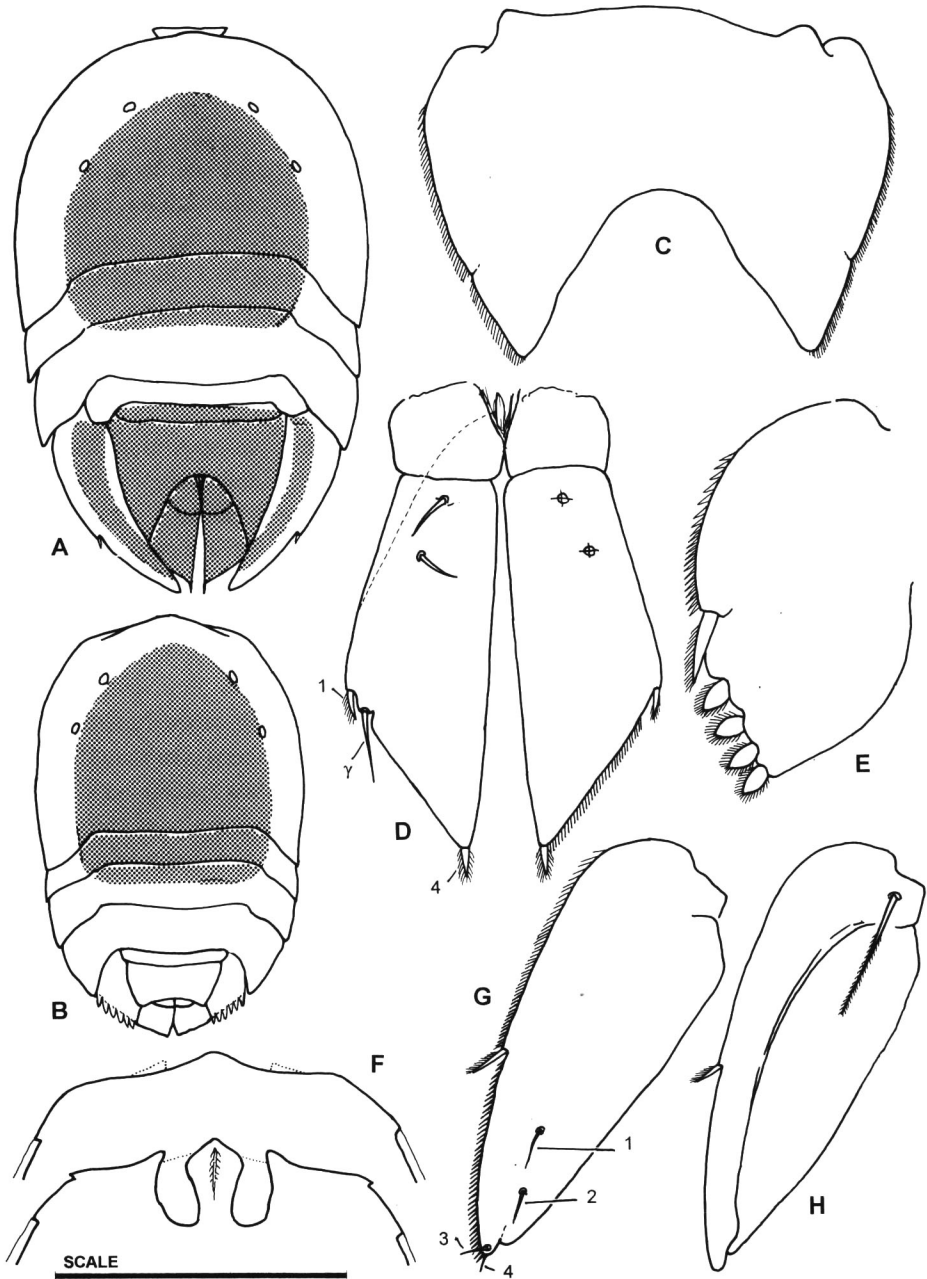


Fig. 3. *Kensakia airoa*. A. Adult female (shading indicates purple colouration). B. Adult male. C. Female urosome. D. Female caudal rami, left dorsal, right ventral. E. P5 of stage V female copepodite. F. Anterior of male cephalosome, dorsal and ventral focus. G, H. Female P5, dorsal and ventral views. Scale bar: A, B=0.45 mm; C=0.19 mm; D=0.135 mm; F=0.3 mm; G, H=0.225 mm; E not to scale.

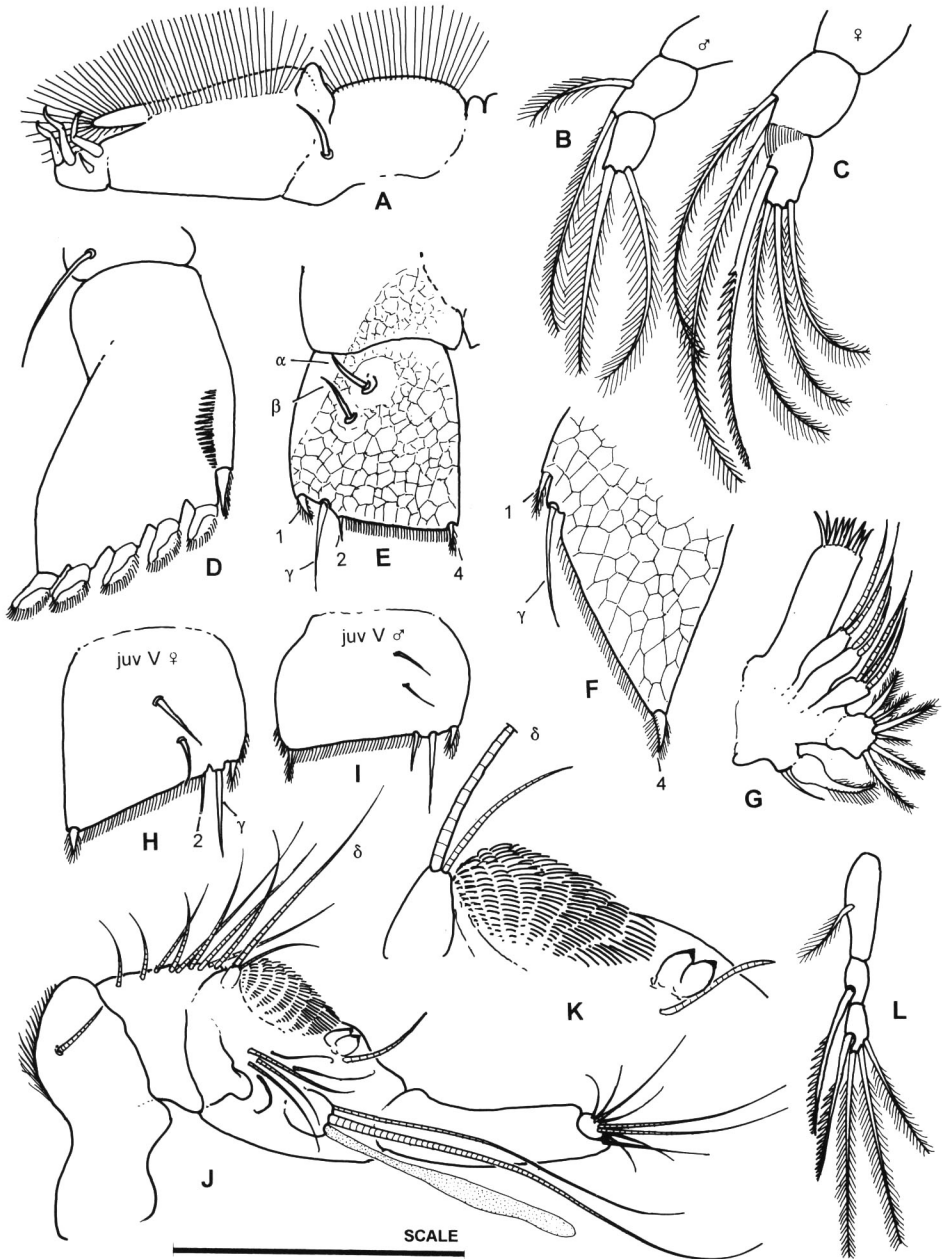


Fig. 4. *Kensakia aiioa*. A. Maxilliped. B. Terminal segment of male P2 endopod. C. Terminal segment of female P2 endopod. D. Male P5, ventral view. E. Male caudal ramus. F. Detail of terminal border of female caudal ramus, also showing dorsal reticulate pattern. G. Maxillule. H. Female stage V copepodite caudal ramus. I. Male stage V copepodite caudal ramus. J. Male antennule, ventral view. K. Detail of coupling denticles. L. P4 endopod. Scale bar: A, G, H, I=0.082 mm; B, C, L=0.135 mm; D, E, F, J=0.1 mm; K=0.06 mm.

P5s extend beyond urosome but do not touch one another posteriorly.

Adult male (Fig. 3 B). Colouration similar to female but dark dorsal patch confined to cephalosome and first two metasomal segments. Cephalosome truncated, rostrum pointed (Fig. 3 F), shoulders rounded, lateral angle of antennule socket visible from above.

Caudal ramus rectangular ($L/w=1.3$), posterior edge at right angles to medial border. Terminal seta 2 present, 3 absent, 4 at medial corner. Reticulate pattern on dorsal surface (Fig. 4 E).

Antennule dactylus (terminal segment) as long as compound segment (Fig. 4 J), first coupling denticle large, brush-like pad, second and third denticle single tooth-like (Fig. 4 K). No ventral blade. No anteriorly projecting comb on accessory lobe. P2 endopod with two plumose setae on terminal article (Fig. 4 B). First (lateral) seta on P5 thin, unlike remaining 5 setae, single ventral row of 16 setules (Fig. 4 D).

Remarks. *Kensakia aiiroa* is named after the indigo blue colour of some individuals (Japanese, ai=indigo+iro=colour). A peculiarity of the species is their ability to roll into a ball (conglobate). The size of female animals is unusually variable (range 0.68 to 0.98 mm).

Terminal setae 2 & 3 are absent from the female caudal ramus, but terminal seta 2 is present on the adult male caudal ramus as well as stage V male and female copepodites. Seta 3 is always absent (Fig. 4 H, I).

Many specimens of *K. aiiroa* carry a species of epizoid suctorian protozoan attached to the hyaline border and edge of P5s. It closely resembles the suctorian found on *Porcellidium akashimum* (see Harris & Iwasaki, 1996 a, Fig. 8 F).

Distribution and abundance. Isolated individuals have been found on many species of seaweed, but a population of 34 ♀ + 11 ♀ and juvenile stages was obtained from a sample of *Laminaria religiosa* at Kadonohama Bay.

Genus *Mucrostrum* nov.

Diagnosis. Anterior of female cephalosome semicircular; rostrum prominent; anterior of male cephalosome not truncated, male rostrum pointed with ventral keel; hyaline border present, marginal glands open dorsal to hyaline border; pits on dorsal surface, honeycomb absent; urosome not clearly divided into anterior and posterior lobes, posterior lobe pointed; caudal rami pentagonal, posterior border square to medial edge, bevelled in female with γ seta lateral, terminal seta 3 absent on both male and female; male antennule without anteriorly-pointing comb on accessory lobe; maxillule endopod with 2 setae, exopod with one seta; maxilliped with rounded coxal lobe and fimbriate process to basis; male P2 endopod with 3 setae on terminal article; female P5 without ventral expansion, male P5 with six setae.

Remarks. The presence of only two setae on the maxillule endopod and three setae on the terminal article of P2 endopod excludes *Mucrostrum* from all other

genera. The male shows two unusual features; the cephalosome is not truncated and the rostrum is pointed. The name *Mucrostrum* (gender neuter) refers to this feature (L., mucro=point).

Type species. *Mucrostrum yoroium* sp. nov.

***Mucrostrum yoroium* sp. nov.**

(Figs. 5–6)

Type material. Holotype, adult female with egg mass removed, NSMT-Cr12039, length 0.99 mm. Allotype, adult male, NSMT-Cr12040, length 0.88 mm. 1 ♀ + 1 ♂ BMNH 1997.277-278. Type material pooled from *Dilophus okamurae* and other seaweeds, Kadonohama Bay, Ofunato, Iwate Prefecture, Japan. Collected by N. Iwasaki, 1994.

Diagnosis. Adult female. Colour dark red, anterior area of cephalosome and urosome yellow; mean length 1.0 mm, rostrum 0.14 mm, body width to rostrum ratio 5; posterior part of urosome narrow, pointed, caudal arch shallow, fine border setules present; caudal rami pentagonal with conspicuous longitudinal dorsal ridge, γ seta lateral on bevelled edge, terminal seta 3 absent, 4 near medial corner; maxillule endopod with one long and one short seta; P1 exopod with C-shaped row of denticles on first article, endopod with small triangle of denticles; P5 with one dorsal and two apical setae.

Adult male. Colour as for female; mean length 0.9 mm; anterior cephalosome not truncated, rostrum pointed; caudal ramus lateral edge convex, terminal seta 3 absent; antennule accessory lobe with tooth-like denticle, cluster of four tooth-like coupling denticles, no ventral blade; third terminal seta on P2 endopod serrulate with swollen base.

Dimensions. Females. (Reliable measurements for this species are difficult to obtain because the animals roll into a ball when preserved. Straightening them usually results in distortion.) Average length (5 specimens, rostrum to tip of urosome) 1.0 mm (range 0.99–1.02 mm), cephalosome width 0.71 mm, body length to width ratio 1.4. Rostrum 0.14 mm, cephalosome width to rostrum ratio 5. Caudal ramus length to width (maximum) ratio 1.8. Urosome width to length ratio 1.45.

Males. Average length (3 specimens) 0.90 mm (range 0.88–0.92 mm), cephalosome width 0.62 mm, length to width ratio 1.45.

Description. Adult female (Fig. 5 A). Colour dark red except for an area of variable shape on front part of cephalosome which is yellow, central region of urosome yellow. Anterior of cephalosome semicircular, small bulge above rostrum, rostrum with hyaline border, projects less than 1/5 of its width. Hyaline border to cephalosome 13 μ m wide. Dorsal pits 6 μ m, not conspicuous.

No notch or scar on urosome to indicate anterior and posterior lobes (Fig. 5 G), posterior portion with straight edge, narrows to a point. Fine border setules on anteri-

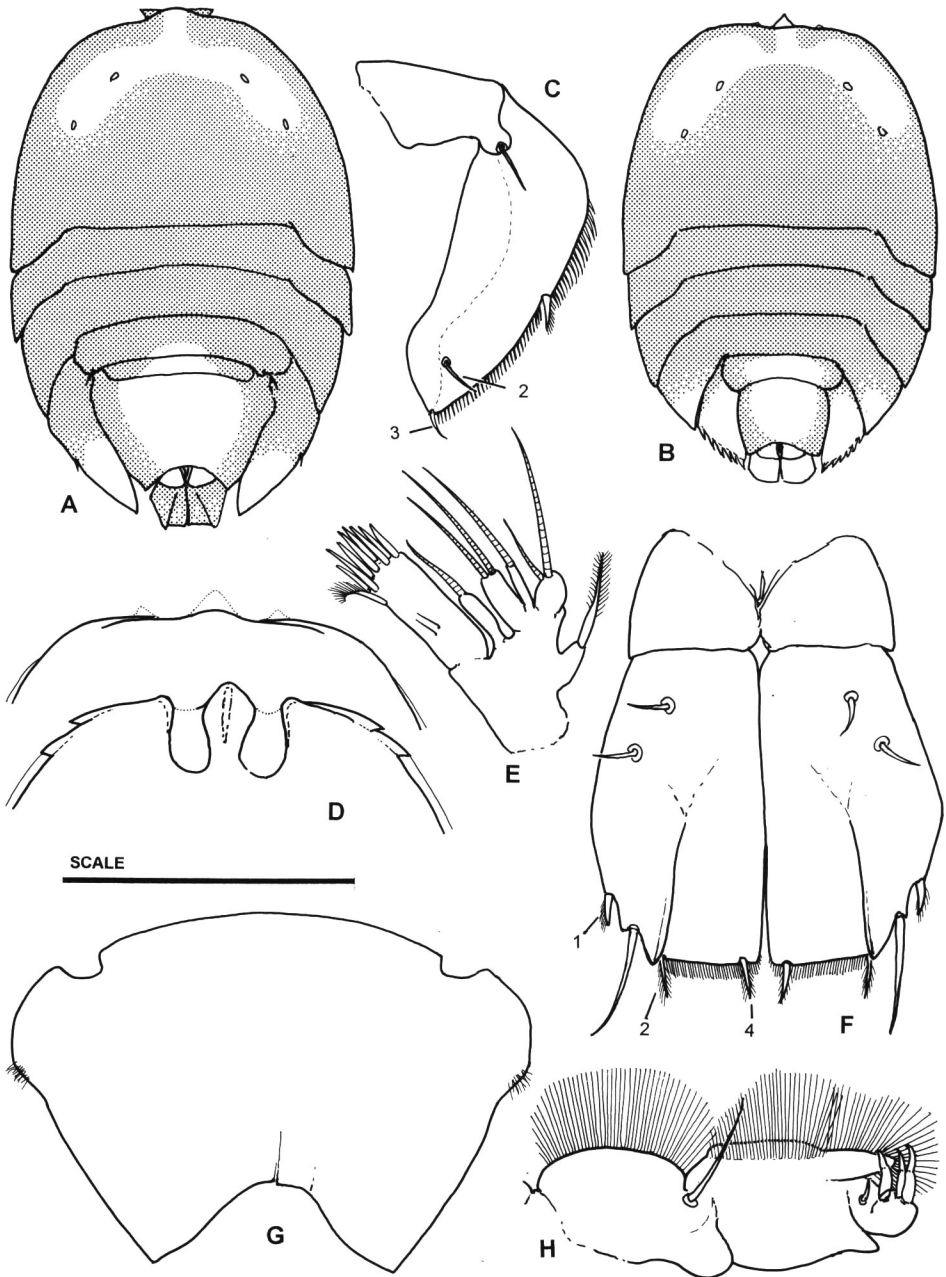


Fig. 5. *Mucrorostrum yoroium*. A. Adult female (shading indicates red colouration). B. Adult male. C. Female P5 dorsal view. D. Anterior of male cephalosome, dorsal and ventral focus. E. Maxillule. F. Female caudal rami. G. Female urosome. H. Maxilliped. Scale Bar: A, B=0.6 mm; C=0.3 mm; D=0.38 mm; E=0.082 mm; F=0.135 mm; G=0.265 mm; H=0.1 mm.

or portion, caudal arch shallow (less than 1/5 length of urosome), greater part of caudal ramus beyond urosome.

Caudal rami pentagonal with posterior edge at right angles to medial edge (Fig. 5 F), widen posteriorly, maximum width 2/3 down ramus, posterior-lateral edge bevelled. Conspicuous longitudinal ridge (carina) runs down middle of dorsal surface. First terminal seta half way and γ seta 2/3 way down bevelled edge, seta 2 on posterior edge close to carina, seta 3 absent, seta 4 set in short distance from medial corner. Terminal fringe of setules between setae 2 and 4 (Fig. 5 F).

Limbs typical of family. Genuiculate setae of antenna articulate, claw short (1/2 length of first genuiculate seta), comb-like. Maxillule (Fig. 5 E) gnathobase long, endites with 1, 2 and 1 setae respectively, one long and one short seta on endopod, one pinnate seta on exopod. Maxilliped (Fig. 5 H) coxal lobe rounded, fimbriate, fimbriate border and fimbriate process to basis. P1 with conspicuous C-shaped double row of denticles on first article of exopod (Fig. 6 C), small conspicuous triangle of denticles at lateral end of fimbriate crescent. Sabre-like seta on P3 endopod longer than endopod (1.35 : 1). P5 falciform, dorsal expansion overlaps urosome, one dorsal seta plus two setae at apex (Fig. 5 C). P5s extend beyond urosome, do not touch posteriorly beyond caudal rami.

Adult male (Fig. 5 B). Colour as for female. Anterior of cephalosome not noticeably truncated. Rostrum pointed, keeled ventrally, projects 0.025 mm beyond cephalosome (Fig. 5 D).

Caudal rami longer than wide ($L/w=1.2$), lateral edge convex, terminal seta 2 present, seta 3 absent (Fig. 6 H).

Seta on first segment of antennule plain, dactylus as long as compound segment (Fig. 6 A), δ seta on accessory lobe long (=length of compound segment+dactylus), tooth-like denticle attached to accessory lobe, group of four plain coupling denticles, each with a ridge or carina (Fig. 6 G), no ventral blade. P2 endopod (Fig. 6 D) with three setae (two long plumose setae plus one weak spinous seta with swollen base) on terminal article.

Remarks. *Mucrorostrum yoroium* can roll into a ball (conglobate). When rolled up, the epimeral plates suggest a suit of armour (Japanese, yoroi=armour).

Distribution and abundance. No population associated with a specific seaweed has been found among the Kadonohama Bay samples, but 10 specimens have been found on samples of *Dilophus okamurae*. Isolated individuals have been collected from *Spatoglossum pacificum* (4), *Neodilsea yendoana* (2), *Lomentaria catenata* (2) and *Sargassum sagamianum* var. *yezoense* (1). These animals have been pooled as type material.

Discussion

Porcellidium aoifuchidorum displays all the characters of the genus *Porcellidium*

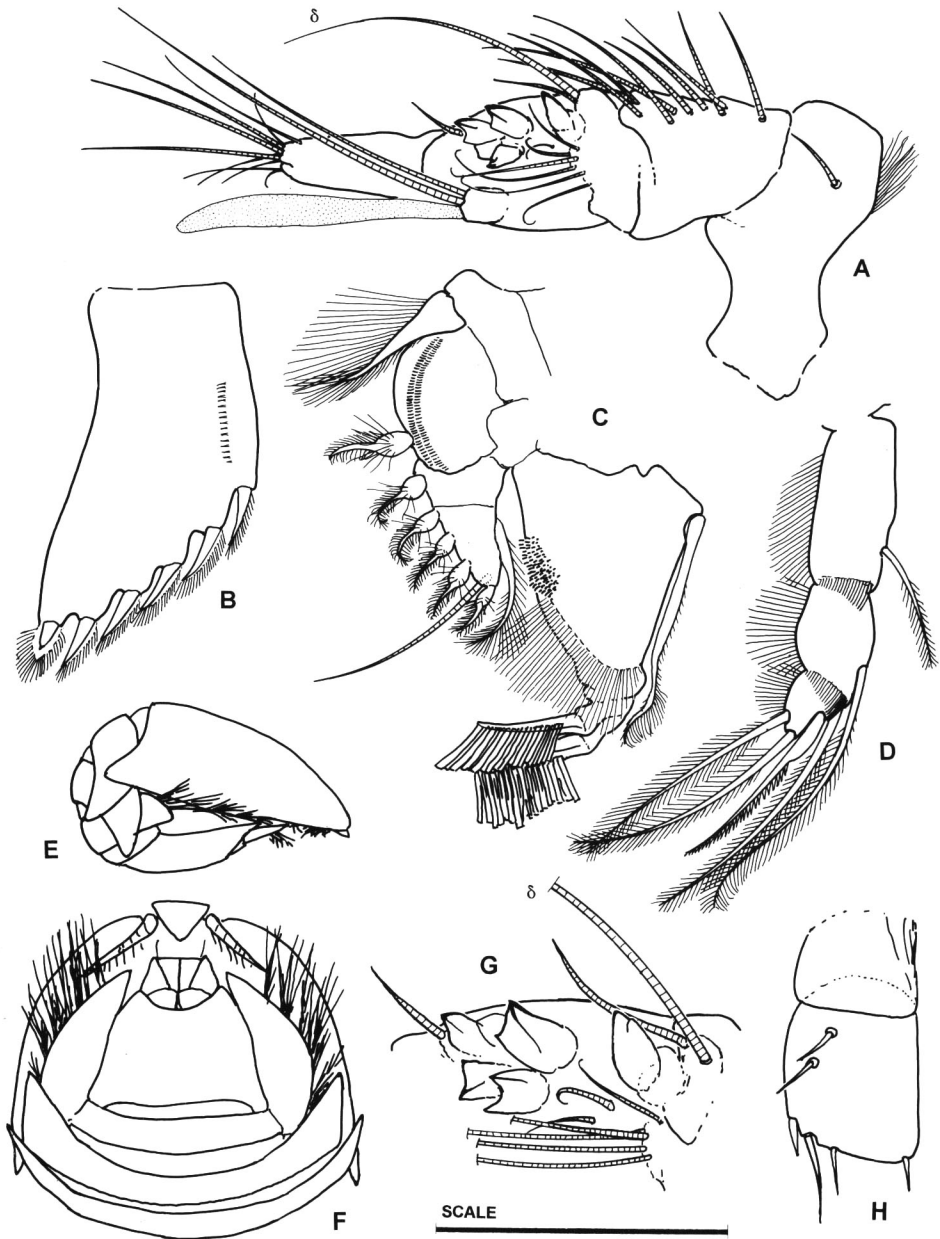


Fig. 6. *Mucrorostrum yoroium*. A. Right antennule of male, ventral view. B. Male P5, ventral view. C. P1, ventral view. D. Male P2 endopod. E, F. Female in conglobating posture. G. Details of male antennule coupling denticles. H. Male caudal ramus. Scale bar: A=0.1 mm; B, C, H=0.135 mm; D=0.15 mm; G=0.06 mm.

as defined by Harris and Iwasaki (1996 a), except for the shape of the urosome. In other species of *Porcellidium* the urosome is expanded laterally and clearly divided into anterior and posterior lobes, but in *P. aoifuchidorum* there is no such division; the posterior part is narrow and ends in a point. Although the description of *P. scotti* (originally identified as *P. fimbriatum* by Thompson & Scott (1903) but renamed *P. scotti* by Pesta (1935)) is inadequate, there are certain similarities with *P. aoifuchidorum*. The caudal rami are of the same form and the urosomes are similar in shape. With our present knowledge of the Porcellidiidae, removal of these two species from *Porcellidium* is not justified on the basis of urosome shape alone. It is suggested that they form a fourth sub-group within the genus, the 'Scotti' sub-group, distinguished by a narrow, pointed region of the urosome (see Harris & Robertson, 1994).

The four Japanese species of *Porcellidium* described so far are easily distinguished by their colouration: *P. akashimum* is yellow with a red dorsal stripe, *P. ki-irom* is yellow, *P. aoifuchidorum* has a blue border and *P. ofunatense* has distinct bands of darker orange across its back (Harris & Iwasaki, 1996 a).

The two other species described here differ significantly in their structure from all previously described genera of the Porcellidiidae and must be placed in genera of their own. Harris and Robertson (1994) have emphasized the importance of setation to the maxillule endopod, maxilliped and male P2 endopod as generic characteristics. The maxillule of *Brevifrons* (Harris, 1994) and the new genus, *Mucro-rostrum*, has two setae on the endopod, whereas all other described genera have six setae. However, *Brevifrons* has only two terminal setae on the male P2 endopod, whereas *Mucro-rostrum* has three. Other less obvious differences separate these two genera.

Typical setation of the caudal rami is shown by the genus *Porcellidium*. Here four terminal setae (usually pinnate) are situated on the posterior border of the ramus (see Fig. 1 D, also, Harris & Iwasaki, 1996 a, Fig. 2 C). A fifth seta (γ) is inserted between terminal setae 1 and 2 on the posterior border. This seta is interpreted as belonging to a dorsal series with α and β . In all described species the γ seta is plain and longer than the terminal setae.

Reduction in the number of terminal setae on the caudal ramus occurs in certain genera of Porcellidiidae. Two species, *Porcellidium trisetosum* Geddes, 1968, and *Mucro-rostrum yoroium* (described above), have only three terminal setae plus the γ seta on the posterior border of the caudal ramus. In both, terminal seta 3 appears to be lost. In many species within the family Porcellidiidae, terminal seta 3 is slender and much smaller than 2 & 4. This suggests that it is seta 3 that has been lost. The two species resemble each other in the shape of the urosome and possessing three terminal setae on the male P2 endopod. They are, however, distinct species. Table 1 lists the similarities and differences between the two species. It is clear that both *yoroium* and *trisetosum* are excluded from the genus *Porcellidium* by the reduction of terminal setae on the caudal ramus and presence of three setae on the male P2 endopod (only 2 in *Porcellidium*). Unfortunately Geddes (1968) gives no information

Table 1. Comparison of *Mucrorostrum yoroium* sp. nov. and *Porcellidium trisetosum* Geddes

<i>M. yoroium</i>	<i>P. trisetosum</i>
Similarities	
Female body outline	
Urosome pointed posteriorly	
Urosome not divided into anterior and posterior lobes	
Urosome without notch, cleft or scar	
Caudal ramus without terminal seta 3	
Caudal ramus posterior border square to medial border	
Male P2 endopod with 3 terminal setae	
Shape of male P5 similar	
Differences	
Caudal ramus with prominent longitudinal ridge	Caudal ramus plain
External corner of caudal ramus strongly bevelled	External corner slightly bevelled
Terminal seta 1 half way along bevelled edge, γ seta 3/4 down bevelled edge	Terminal seta 1 and γ seta near seta 2
Maxillule endopod with 2 setae	Number of setae on maxillule endopod not known
Conglobating	Not known
‘Tooth-shaped’ coupling denticles on male antennule	Not known

about the rostrum and antennule structure of the male *trisetosum* or number of setae on the maxillule endopod, and consequently it cannot be decided without further investigation whether *P. trisetosum* should be referred to the genus *Mucrorostrum* or placed in a genus of its own.

Setation of the caudal ramus of *Kensakia* shows a further step in reduction of the terminal series. Terminal setae 2 and 3 are absent from all adult female specimens of *K. aiiroa* examined. The gamma seta is inserted laterally on the bevelled edge. However, terminal seta 2 is present on male animals and both male and female copepodites (Fig. 4H, I). The narrow, pointed urosome and rhomboid caudal ramus resembles *Acutiramus* (Harris & Robertson, 1994), but *Acutiramus* has both setae 2 and 3 on the caudal ramus. *Kioloaria*, another genus with rhomboid caudal rami (Harris, 1994) differs from *Kensakia* in both its caudal setae (2 & 3 are present) and the presence of three terminal setae on the male P2 endopod. *Porcellidium ovatum*, described by Geddes (1968) from the Bahamas, shows a resemblance to *Kensakia aiiroa* in its general shape and colour, but differs significantly in shape of the urosome, presence of clefts on the urosome and presence of terminal setae 2 and 3 on the caudal rami. The identity of *P. ovatum* reported from Oshoro Bay, Hokkaido, by Kito (1977) needs to be checked for it is easy to misidentify *K. aiiroa* on shape and colour alone.

Acknowledgments

We wish to acknowledge the help given by staff of the Iwate Fisheries Technology Centre and Mr. Kanji Mitsugi in collecting the samples of seaweed. We also thank Mr. Kanji Mitsugi for his diligence in sorting and counting specimens extracted from the samples, Ms. Val Lyon (Cartography, Australian National University) for photographic work on the drawings and Mrs. Akemi Iwasaki for help in naming new species. One of us (N. I.) was supported in part by a Grant-in-Aid for Scientific Research (No. 08833010) from the Ministry of Education, Science, Sports and Culture, Japan.

References

- Geddes, D. C., 1968. Marine biological investigations in the Bahamas. 7. Harpacticoid copepods belonging to the families Porcellidiidae Sars, Peltidiidae Sars, and Tergestidae Sars. *Sarsia*, **35**: 9–56.
- Harris, V. A., 1994. New species belonging to the family Porcellidiidae (Harpacticoida: Copepoda) from Kioloa, New South Wales, Australia. *Rec. Aust. Mus.*, **46**: 303–340.
- Harris, V. A. & N. Iwasaki, 1996 a. Three new species of *Porcellidium* (Crustacea, Copepoda, Harpacticoida) from Iwate Prefecture, Japan. *Bull. natn. Sci. Mus., Tokyo*, Ser. A, **22**: 133–152.
- Harris, V. A. & N. Iwasaki, 1996 b. Two new genera belonging to the family Porcellidiidae (Crustacea, Copepoda, Harpacticoida) from Iwate Prefecture, Japan. *Bull. natn. Sci. Mus., Tokyo*, Ser. A, **22**: 199–218.
- Harris, V. A. & H. M. Robertson, 1994. New species belonging to the Porcellidiidae (Harpacticoida, Copepoda) from the southern coast of New South Wales, Australia. *Rec. Aust. Mus.*, **46**: 257–301.
- Ho, J., 1986. Harpacticoid copepods of genera *Sunaristes* and *Porcellidium* associated with hermit crabs in Japan. *Rep. Sado mar. biol. Stn., Niigata Univ.*, **16**: 21–38.
- Kito, K., 1977. Phytoplankton animals in the *Sargassum confusum* region in Oshoro Bay, Hokkaido: phenology of harpacticoid copepods. *J. Fac. Sci., Hokkaido Univ.*, Ser. VI, Zool., **20**: 691–696.
- Pesta, O., 1935. Marine Harpacticiden aus dem Hawaiischen Inselgebiet, II. *Zool. Jb. Syst.*, **66**: 363–379.
- Thompson, I. C. & A. Scott, 1903. Report on the Copepoda collected by Prof. Herdman at Ceylon in 1902. *Rep. Govt. Ceylon Pearl Fish.*, **1**, Suppl. (7): 227–307, pls. 1–20.

