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ZOOLOGICAL SCIENCE **18**: 1291–1301 (2001) © 2001 Zoological Society of Japan

A new distinctive species of pagurid hermit crab (Crustacea: Decapoda: Anomura) from Japan

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ABSTRACT—A new species of pagurid hermit crab, *Pagurus decimbranchiae*, is described and illustrated based on 20 specimens collected from shallow waters of the Pacific coast of Japan ranging from Boso Peninsula to Tanegashima Island. It is quite distinctive in having the rudimentary arthrobranch on the third maxilliped represented by a single bud, however close morphological similarity is found between the new species and *P. moluccensis* Haig and Ball. Comparisons are also made among other species, including *P. boriaustraliensis* Morgan, *P.* sp. cf. *boriaustraliensis sensu* Rahayu and Komai (2000) and the members of the *P. anachoretus* group. The present generic assignment of the new species should be considered provisional, as more extensive study is needed to investigate phylogenetic relationships of the new species and the other species of *Pagurus*.

Key words: Crustacea, Anomura, *Pagurus*, new species, Japan

INTRODUCTION

While examining specimens of shallow water hermit crabs taken at several locations of the Pacific coast of Japan, we found a species of pagurid hermit crab that could not be identified as any known species. The undescribed species is characterized by a rudimentary arthrobranch on the third maxilliped represented only by a single bud (thus there are ten pairs of gills in total) and the lack of secondary sexual characters. The reduction of the arthrobranch of the third maxilliped and other characteristics initially led the authors to propose a new genus. Subsequent examination, however, has shown that the undescribed species shares a number of characteristics with three species currently assigned to *Pagurus* Fabricius, 1775, *P. moluccensis* Haig and Ball, 1988, *P. boriaustraliensis* Morgan, 1989 and *P.* sp. cf. *boriaustraliensis sensu* Rahayu and Komai (2000) (being described as a new species by McLaughlin, in press). Therefore, the present new species is provisionally assigned to *Pagurus*.

MATERIALS AND METHODS

The specimens examined in this study are deposited in the following institutions: Natural History Museum and Institute, Chiba (CBM, with a code of ZC); National Science Museum, Tokyo (NSMT, with a code of Cr); Showa Memorial Institute, National Science Museum, Tsukuba (NSMT-R, with a code of Cr); Indonesian National Institute of Oceanology, Jakarta (NIOJ). The shield length, abbreviated as sl, measured from the tip of rostrum to the midpoint of the posterior margin of the shield. For detailed observation of the surface structure on the integument, the specimens (including removed appendgages) were stained with methylen blue solution. The general terminology used in the description is that of McLaughlin (1974), with exception of the posterior carapace (see Lemaitre, 1995), fourth pereopod (see McLaughlin, 1997) and gill structure (see McLaughlin and de Saint Laurent, 1998). The submedian grooves on the shield is herein termed "paragastric grooves". The paragastric groove may be homologous with "linea d" *sensu* Boas (1880: 189, fig. 141), but it does not appear as a suture in the present new species, *P. moluccensis* and *P.* cf. *boriaustraliensis* sensu Rahayu and Komai (2000). The drawings were made with the aid of a drawing tube mounted on a Leica MZ8 stereomicroscope.

For comparative purpose, the following specimen has been examined:

Pagurus moluccensis Haig and Ball, 1988: 1 male (sl 2.1 mm, holotype), Alpha Helix Expedition, station 5b, North side of Banda Besar, 04°32.2'S, 129°53'E, 7 April 1975 (NIOJ A.009).

TAXONOMY

***Pagurus decimbranchiae* sp. nov.** (Figs 1–6)

Pagurus pilosipes - Miyake, 1978: 91 (part). Not *Pagurus pilosipes* (Stimpson, 1858). See "Remarks".

Material examined: Holotype: male (sl 2.7 mm), Futo, Izu Peninsula, Sagami Bay, 5–10 m, rocky bottom, 21 June 1996, SCUBA diving, coll. E. Nishi (CBM-ZC 5894).

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Fig. 1. *Pagurus decimbranchiae* sp. nov. Paratype male (sl 1.4 mm; NSMT-Cr 14183). Entire animal in dorsal view.

Paratypes: 1 ovig (sl 2.7 mm), Mosaki, Kamegisho, Sagami Bay, 14 m, 25 July 1960, dredge, coll. Showa Emperor, identified with *Pagurus pilosipes* by Miyake (1978, det. no. 398) (NSMT-CrR 1816); 2 males (sl 2.6, 2.8 mm), same data as holotype (CBM-ZC 5895); 1 male (sl 2.5 mm), 1 female (sl 2.5 mm), Iwa Beach, Manazuru, Sagami Bay, 35809íN, 139809íE, 29 August 1996, intertidal, hand, coll. A. Asakura (CBM-ZC 5896); 1 male (sl 1.7 mm), Hasama Beach, Tateyama, Boso Peninsula, intertidal, 4 June 2000, hand, coll. T. Komai (CBM-ZC 5897); 2 males (sl 1.9, 2.1 mm), Kami-Nishinoomote Fishing Port, Tanegashima Island, subtidal, 1 June 1996, coll. T. Komai (CBM-ZC 5898); 2 males (sl 1.6, 1.7 mm), Usa, Tosa Bay, subtidal, November 2000, coll. S. Wada (CBM-ZC 5899); 1 male (sl 2.3 mm), Heda Fishing Port, Suruga Bay, Izu Peninsula, 2–3 m, 20 March 2001, trap, coll. T. Komai (CBM-ZC 5900); 1 male (sl 2.6 mm), 1 ovig. female (sl 2.6 mm), Shikkake, Manazuru, Sagami Bay, 16 August 1994, subtidal, under rock, hand, coll. M. Osawa (NSMT-Cr 14180); 1 male (sl 2.7 mm); Okinoshima, Tateyama, Boso Peninsula, 29 August 1995, 1–2 m deep, under rock, coll. M. Osawa, (NSMT-Cr 14181); 1 male (sl 3.0 mm), 2 females (sl 2.8, 2.8 mm); Banda, Tateyama, Boso Peninsula, 14 August 1996, subtidal, on table rock, coll. R. Sato (NSMT-Cr 14182); 2 males (sl 1.4, 2.4 mm); Yahatano, Ito, Izu Peninsula, 12 July 1998, 2 m deep, coll. M. Mitsuhashi (NSMT-Cr 14183).

Description of males: Ten pairs of biserial phyllobranchiate gills; arthrobranch on third maxilliped greatly reduced to single rudimentary bud (Fig. 3H).

Calcified parts of integument of body and appendages with low, blister-like protuberances or tubercles of various shape and size, well stained by methylen blue.

Cephalothorax fairly depressed dorsoventrally. Shield (Fig. 2A) approximately as long as broad or slightly longer than broad; anterior margin between rostrum and lateral projections concave; anterolateral margin slightly terraced; posterior margin truncate or slightly notched; dorsal surface almost flat, with numerous low, blister-like tubercles; central part of shield only weakly calcified; paragastric grooves conspicuous, accompanied by few tufts of stiff setae; rostrum broadly rounded, extending as far as lateral projections; lateral projections blunt, with or without terminal submarginal spinule. Posterior carapace (Fig. 2B) membranous except for weakly calcified submedian parts either side of posteromedian plate provided with numerous small, low blister-like tubercles; branchial region with few seta; posteromedian plate not calcified; cardiac sulci strongly sinuous, posteriorly

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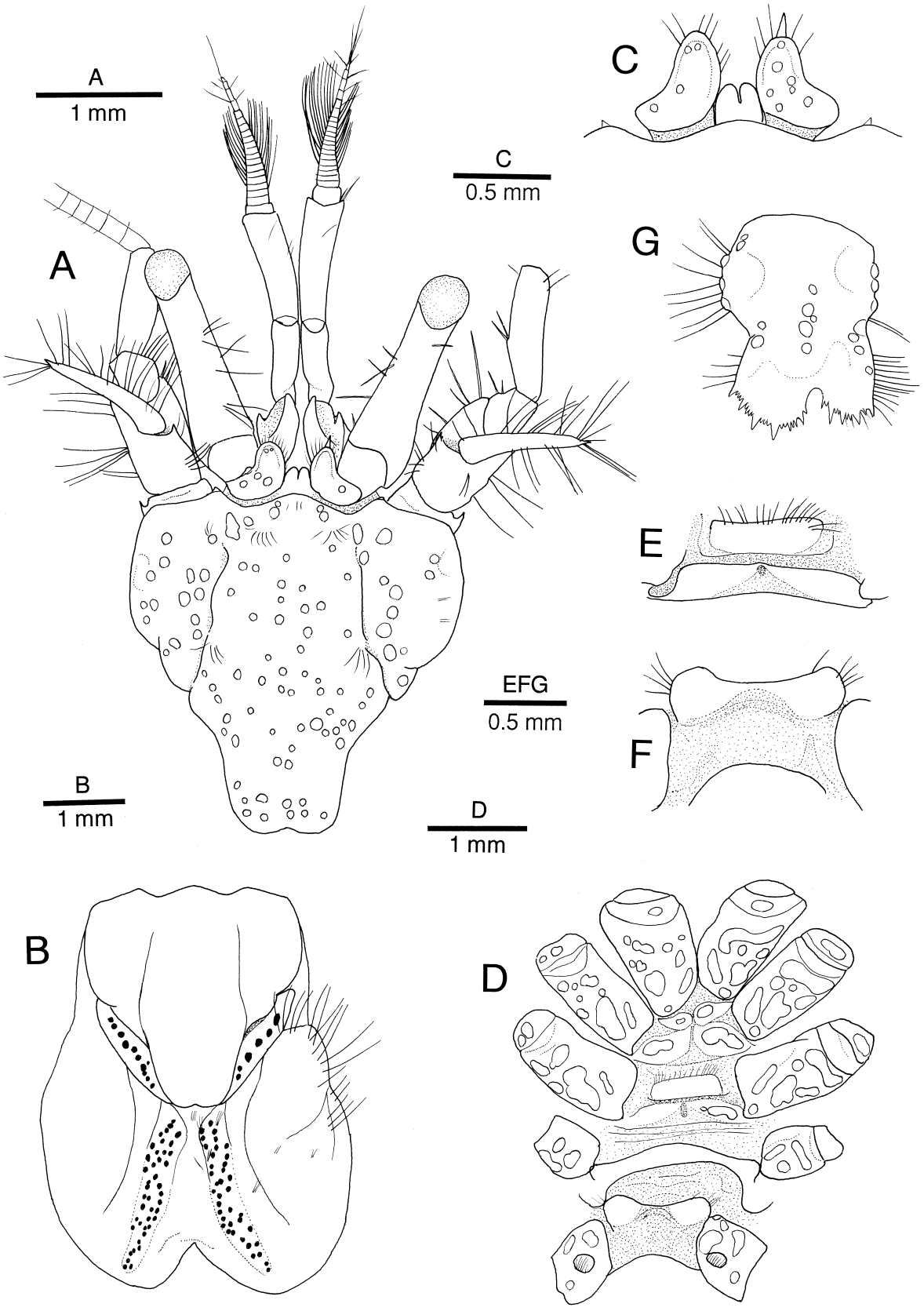


Fig. 2. *Pagurus decimbranchiae* sp. nov. Holotype male (sl 2.7 mm; CBM-ZC 5894) from Futo, Izu Peninsula. A, shield and cephalic appendages, dorsal, open circles on shield indicating blister-like tubercles; B, carapace, dorsal, setae omitted from left, blister-like tubercles on posterior carapace indicated as solid dots; C, ocular acicles and interocular lobe, dorsal; D, coxae of first to fifth pereopods and thoracic sternum, ventral, setae partially omitted; E, anterior lobe of sixth thoracic sternite, ventral; F, eighth thoracic sternite, ventral; G, telson, dorsal.

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approximate; sulci cardiobranchiales short, but distinct; linea anomurica reaching level of midlength between posterior margin of shield and posteromedian margin of carapace.

Ocular peduncles (Fig. 2A) 0.6–0.7 times as long as shield, relatively slender, noticeably inflated basally, corneal region weakly dilated; dorsal surface with row of tufts of stiff setae mesially. Ocular acicles subovate, distally with small submarginal spine; dorsal surfaces slightly concave.

Interocular lobe (Fig. 2C) small, distinctly bilobed, each lobe terminating bluntly.

Antennular peduncles (Fig. 2A) moderately stout, overreaching distal margins of corneas by 0.3–0.5 length of ultimate segment; ultimate segment 0.3–0.4 times as long as shield and 1.3–1.6 times longer than penultimate segment, becoming somewhat deeper distally, with few setae on dorsal surface; basal segment with distolateral margin produced as blunt projection, ventromesial distal margin produced but unarmed, statocyst lobe with 1 small spine on lateral face.

Antennal peduncles (Fig. 2A) reaching or slightly overreaching distal margins of corneas. Fifth segment moderately stout, with few short setae. Third segment with ventromesial distal angle unarmed or armed with minute spinule and some long setae. Second segment with dorsolateral distal angle produced, reaching midlength of fourth segment, terminating in acute spine; mesial margin minutely denticulate; dorsomesial distal angle with spinule, mesial surface with few tufts of long setae. First segment with small spine on lateral face; ventrodistal margin produced, laterally with 1 small spine. Antennal acicle arcuate, reaching or slightly overreaching base of cornea, terminating acutely, with row of long setae on mesial margin. Antennal flagellum long, far overreaching extended right cheliped; articles short, somewhat flattened, each with convex lateral and mesial margins, distal margin bearing few very short setae.

Mandible (Fig. 3A) without sharp ridge on molar process. Maxillule (Fig. 3B) with moderately broad coxal endite; endopod broad, inner lobe weakly produced, bearing 1 apical seta, outer lobe small, not recurved, not basally articulated. Maxilla (Fig. 3C) with endopod reaching distal margin of scaphognathite. First maxilliped (Fig. 3D) with endopod not reaching anterior margin of distal endite; exopod strongly expanded proximolaterally. Second maxilliped (Fig. 3E) with endopod short and stout; exopod broad. Third maxilliped (Fig. 3F) stout; ischium (Fig. 3G) with crista dentata composed of row of acute corneous teeth and with 1 accessory tooth; merus without dorsodistal or ventromesial spine; carpus without dorsodistal spine; exopod overreaching distal margin of carpus.

Chelipeds unequal, right slightly longer and much more robust than left. Right chela (Fig. 4A–C) subovate in dorsal view, 1.8–2.1 times longer than greatest width at base of dactylus. Dactylus 0.8–1.0 times as long as palm; dorsal surface convex, with row of small spines or tubercles on somewhat mesial to midline and 3 rows of tufts of long stiff setae; dorsomesial margin not distinctly delimited, but with row of small spines or tubercles in proximal half; mesial and ventral surfaces smooth, but bearing tufts of long setae; cutting edge with row of calcareous teeth of various size (proximal second tooth largest), terminating in large corneous claw. Palm somewhat longer than carpus; dorsal surface slightly convex, mostly smooth, with few small spinulose tubercles distally, and with tufts of long setae arranged in 4–5 rows; dorsolateral margin (including fixed finger) with single row of small spines, becoming smaller distally and proximally; dorsomesial margin not distinctly delimited, with single row of small to moderately large spines or blunt tubercles; lateral and mesial faces without spine or tubercle, but with some tufts of long setae; ventral surface without spine or tubercle, but with tufts of long setae distally. Fixed finger with few, small spinulose tubercles or row of small spines and tufts of setae on dorsal surface; cutting edge with row of calcareous teeth of various size, terminating in large corneous claw. Carpus slightly shorter than merus, noticeably broadened distally; dorsal surface smooth, but with few tufts of setae; distal margin with few small spines laterally; dorsomesial margin with single row of 3–4 small to moderately large spines and tufts of setae; dorsolateral margin with 3–4 tiny spines or spinulose tubercles and tufts of long setae; lateral and mesial faces smooth, with tufts of short to long setae; ventral surface with some low tubercles distally. Merus with dorsal surface smooth but with few tufts of setae proximally; dorsodistal margin with row of long setae; lateral and mesial faces smooth, with few tufts of short setae; ventral surface with scattered low tubercles and row of tufts of setae along distal margin. Ischium lacking row of small teeth on ventromesial margin; ventral surface with low tubercles, those along mesial margin larger than others; all surfaces with few setae. Coxa (Fig. 2D) with irregular shaped low elevations darkly stained by methylen blue.

Left cheliped (Fig. 5A–C) reaching midlength to nearly tip of dactylus of right cheliped. Chela 2.1–2.3 times longer than greatest width at level of base of dactylus, elongate suboval in dorsal view. Dactylus 1.4–1.8 times longer than palm; dorsal surface weakly elevated in midline, with short row of 2–5 small spines or tubercles somewhat mesial to midline and 2 rows of tufts of short to long setae; dorsomesial margin not delimited, but with few small spines or tubercles proximally; mesial surface with few small spines proximally and tufts of setae; ventral surface smooth, with 2 rows of tufts of setae; cutting edge with row of small, blunt to acute calcareous teeth in proximal 0.6 and row of small corneous teeth in distal 0.4, terminating in large corneous claw. Palm shorter than carpus; dorsal surface slightly convex, smooth, but with tufts of long setae arranged in 4 or 5 rows (lateral 2 rows extending onto fixed finger); dorsolateral margin not delimited, but with row of minute spinules or tubercles on fixed finger; dorsomesial margin with single row of small spines; lateral, mesial and ventral faces all smooth, but with tufts of long setae. Fixed finger with few tiny spines on dorsal surface; cutting edge with row of small, acute calcareous teeth entirely , interspersed by small corneous teeth in distal half, terminating in large corneous claw. Carpus shorter than merus, somewhat broadened distally; dorsal surface smooth, but with

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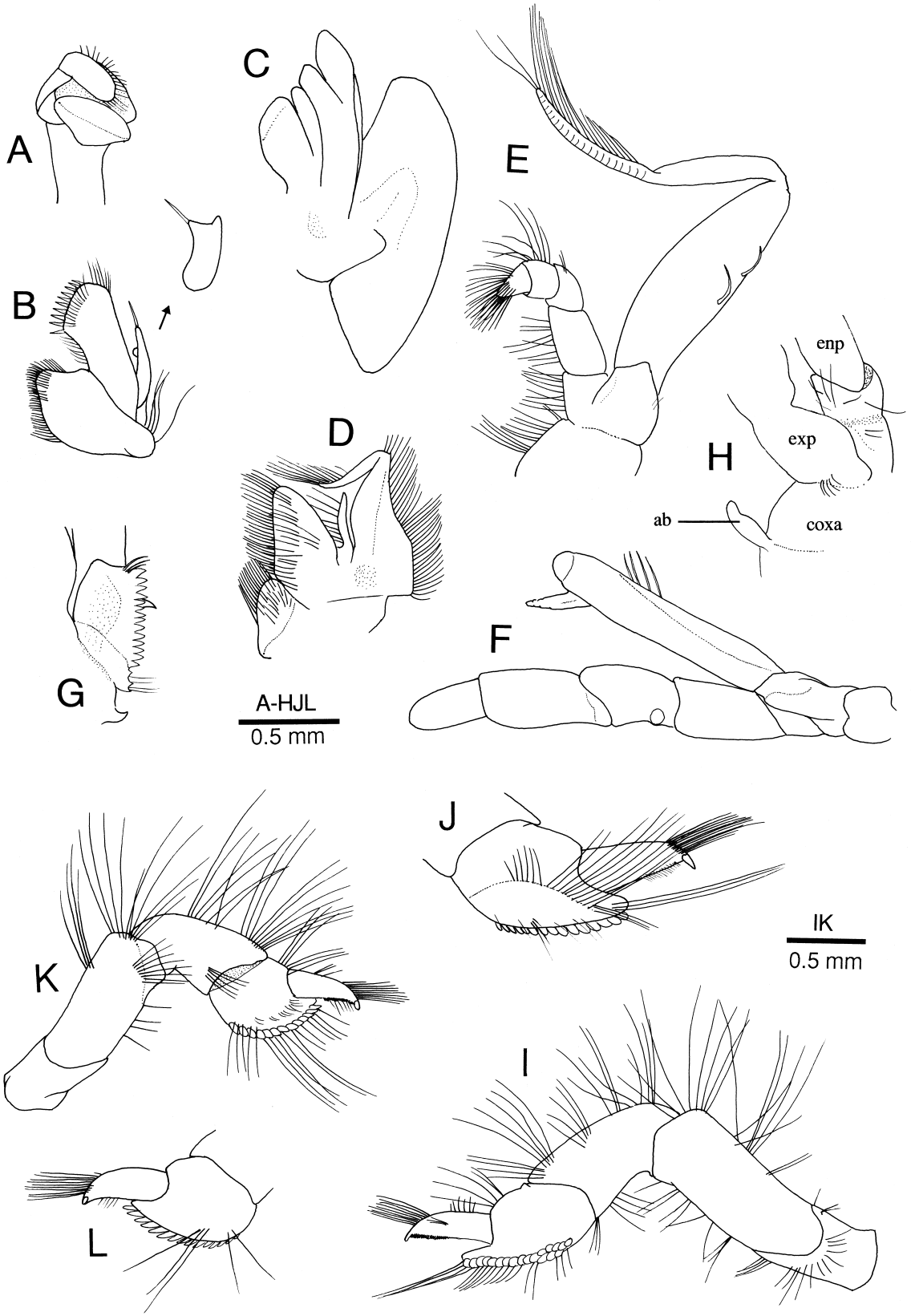


Fig. 3. *Pagurus decimbranchiae* sp. nov. Holotype male (sl 2.7 mm; CBM-ZC 5894) from Futo, Izu Peninsula. A, left mandible, internal; B, left maxillule, external; inset, endopod, lateral; C, left maxilla, external, setae omitted; D, left first maxilliped, external; E, left second maxilliped, external; F, left third maxilliped, lateral, setae omitted; G, same, ischium, dorsal; H, basal part of right third maxilliped, showing arthrobranch (ab=arthrobranch; enp=endopod; exp=exopod); I, left fourth pereopod, lateral; J, same, dactylus and propodus, mesial, setae partially omitted; K, right fourth pereopod, lateral; L, same, dactylus and propodus, mesial, setae partially omitted.

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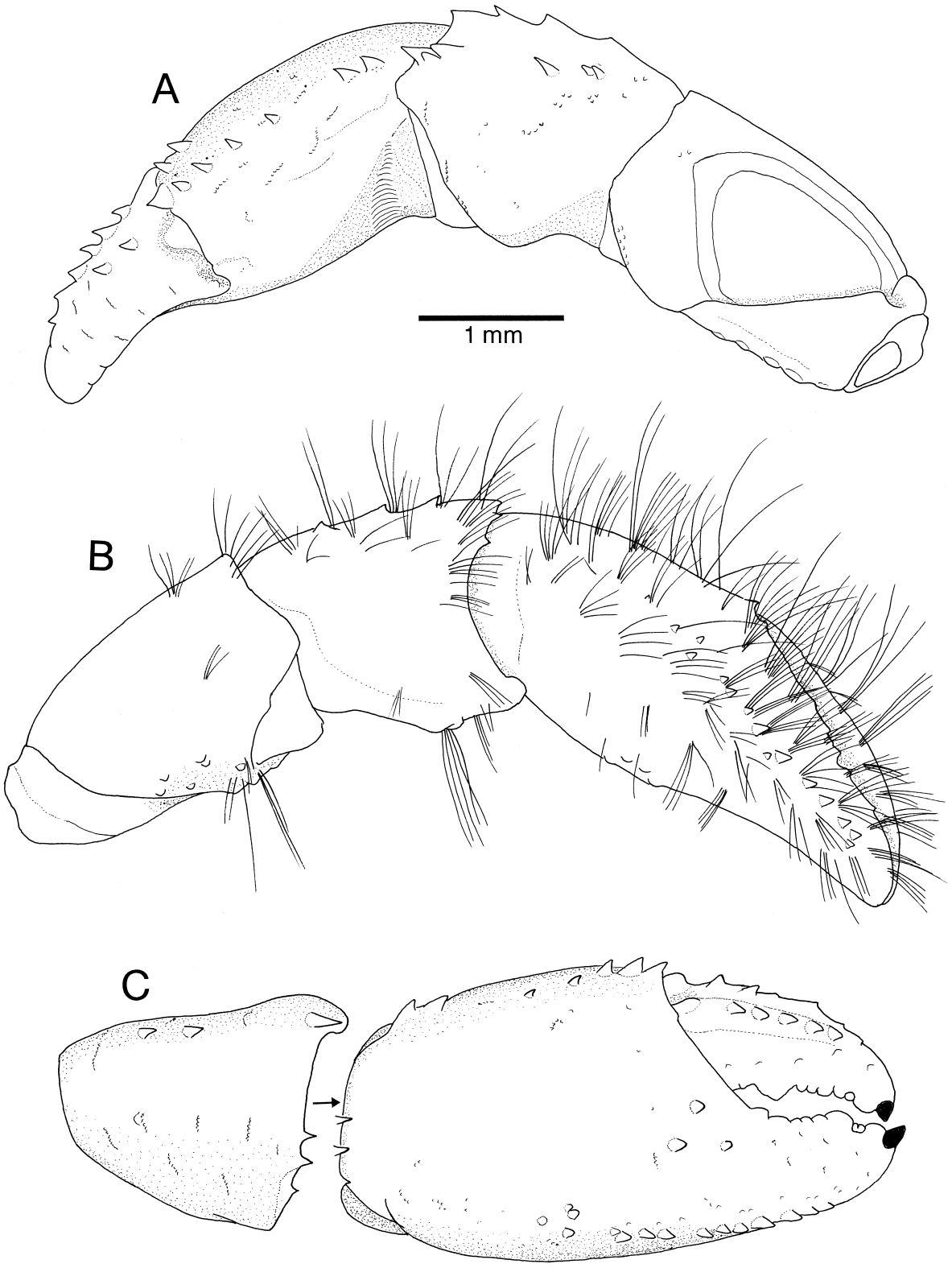


Fig. 4. *Pagurus decimbranchiae* sp. nov. Holotype male (sl 2.7 mm; CBM-ZC 5894) from Futo, Izu Peninsula. Right cheliped. A, entire right cheliped, mesial, setae omitted; B, same, lateral; C, chela and carpus, dorsal, setae omitted.

few tufts of long setae, distal margin with 1–2 spines laterally; dorsolateral margin not delimited or weakly delimited with distal small spine and few low protuberances; dorsomesial margin with 2–4 large spines; lateral and mesial faces smooth, but with tufts of long setae; ventral surface with few low tubercles and tufts of setae. Merus with dorsal surface smooth, but with

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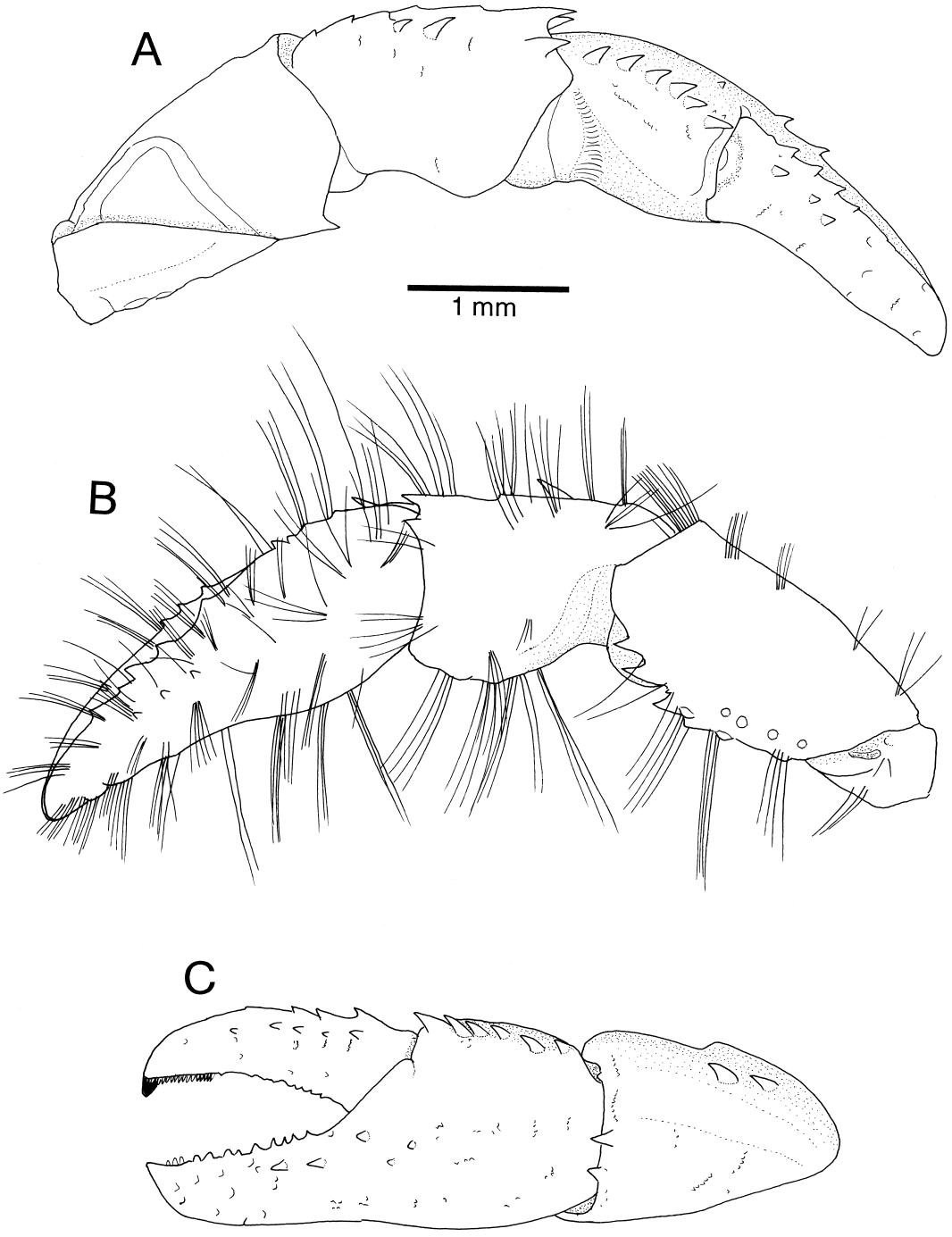


Fig. 5. *Pagurus decimbranchiae* sp. nov. Holotype male (sl 2.7 mm; CBM-ZC 5894) from Futo, Izu Peninsula. Left cheliped. A, entire left cheliped, mesial, setae omitted; B, same, lateral; C, chela and carpus, dorsal, setae omitted.

few tufts of long setae; dorsodistal margin without spine; lateral and mesial faces smooth, with few tufts of short setae; ventrolateral distal margin with 2 large spines; ventromesial distal margin with 1–2 small spines; ventral surface with some low tubercles and tufts of long setae. Ischium without row of teeth on ventromesial margin; ventral surface with scattered low tubercles. Coxa (Fig. 2D) with irregular shaped low elevations darkly stained by methylen blue.

Second (Fig. 6A, B) and third (Fig. 6C, D) pereopods generally similar from right to left, right second overreaching outstretched right cheliped by 0.3–0.5 length of dactylus. Dactyli 0.9–1.1 times as long as propodi, weakly curved ventrally in lateral view and nearly straight in dorsal view, terminating in large corneous claws; dorsal surfaces each with row of tufts of long setae; lateral and mesial faces each with rows of tufts of long setae dorsally and ventrally, lacking longitudinal sulcus, mesial faces without corneous spinules; ventral margins each with 6–9 small corneous spines. Propodi distinctly longer

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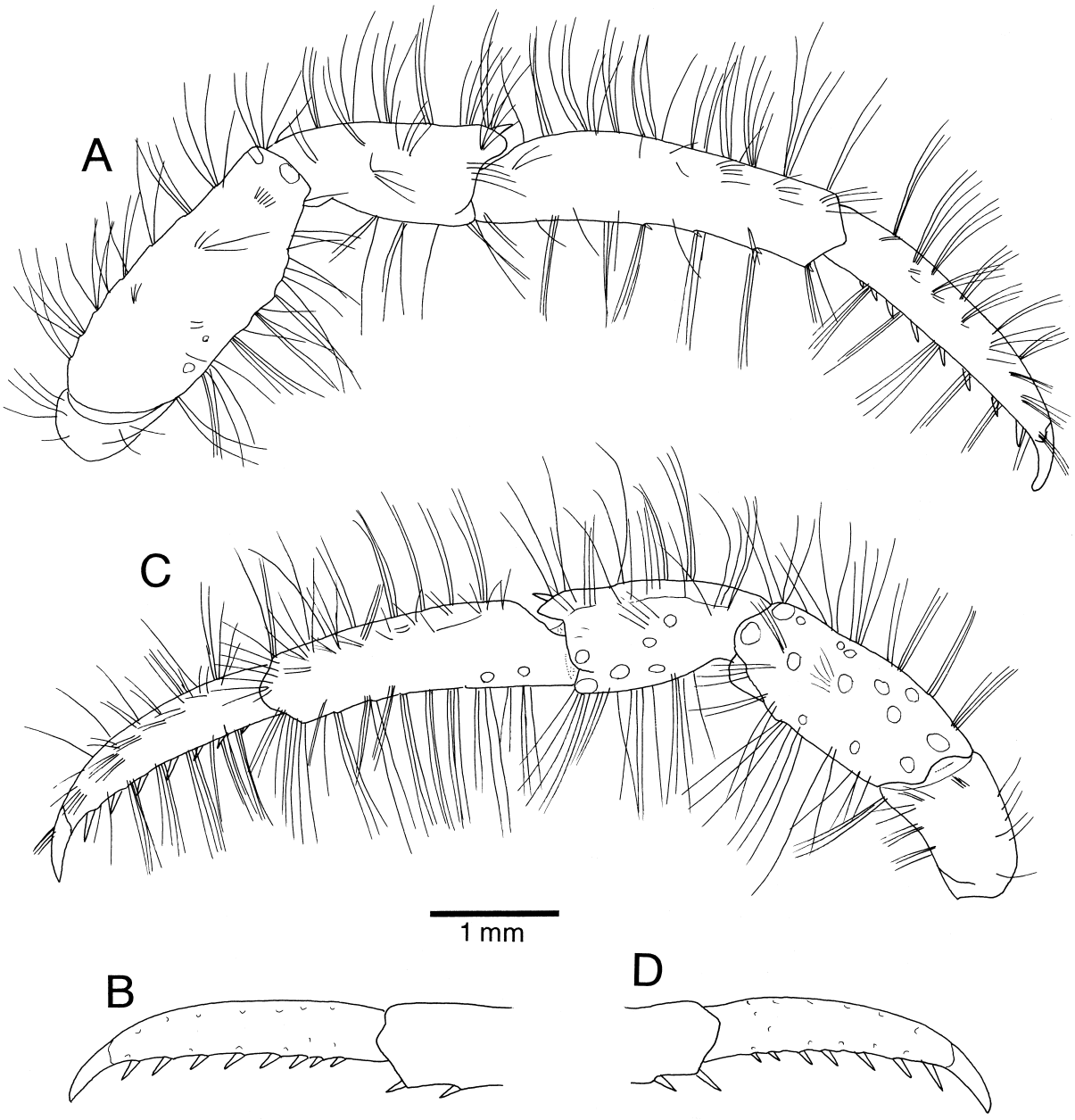


Fig. 6. *Pagurus decimbranchiae* sp. nov. Holotype male (sl 2.7 mm; CBM-ZC 5894) from Futo, Izu Peninsula. A, right second pereopod, lateral; B, dactylus of right second pereopod, mesial, setae omitted; C, left third pereopod, lateral; D, dactylus of left third pereopod, mesial, setae omitted.

than carpi, slightly curved ventrally; dorsal surfaces without spines, but with row of numerous tufts of long setae; lateral faces with tufts of short setae dorsally and ventrally; ventral surfaces each with 3–5 small corneous spines in distal half, including 1 on distal margin, and single or double row of numerous tufts of long setae. Carpi each with small dorsodistal spine; dorsal surfaces unarmed (except for dorsodistal spine), but with row of tufts of long setae; lateral faces convex, with 2 rows of tufts of long setae; ventral surfaces each with few tufts of long setae, ventrodistal margin not produced. Meri each with row of tufts of long setae on dorsal and ventral surfaces; lateral faces smooth, but with few tufts of short to long setae; ventrolateral distal margins lacking distal spine. Ischia with setae on each dorsal and ventral surfaces. Coxae (Fig. 2D) each with low elevations darkly stained by methylen blue.

Fourth pereopods (Fig. 3I-L) noticeably unequal, semichelate, with left larger than right. Dactyli moderately broad, nearly straight in left, slightly curved in right, each terminating in small, strongly curved, corneous claw; dorsal margins convex, each with row of tufts of setae (subdistal tuft composed of numerous long setae); ventral margins each with row of small corneous teeth; preungual process absent. Propodi with long setae on dorsal surfaces; mesial face with submedian row of long setae and distinct ventral facet in left, smooth and flattened on right; ventral margins convex, but on left distal 0.6–0.7 almost straight or slightly convex; propodal

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rasp composed of single row of small corneous scales (proximally becoming double row). Carpi each with dorsodistal margin produced in acute spinule; mesial faces with row of long setae in left, without long setae in right; dorsal margins of carpi and meri with tufts of long setae.

Fifth pereopods chelate, similar from right to left; coxae (Fig. 2D) relatively large, each with gonopore partially obscured by tufts of short setae.

Anterior lobe of sixth thoracic sternite (Fig. 2E) broadly subrectangular, slightly skewed to left; posterior lobe much broader than anterior lobe. Seventh thoracic sternite very broad, with 2 broadly separated, subovate lobes just mesial to coxae of fourth pereopods. Eighth thoracic sternite (Fig. 2F) very broad, with clearly delineated, subovate, flattened anterolateral lobes.

Abdomen (Fig. 1) coiled, with 3 (third to fifth) unpaired left pleopods, each having well-developed exopod and rudimentary endopod.

Telson (Fig. 2G) with distinct transverse indentations; anterior lobe with row of low tubercles on convex lateral margins. Posterior lobes slightly unequal (left slightly larger than right), separated by moderately broad, deep median cleft; lateral margins slightly to somewhat convex, with row of setae; terminal margins broadly rounded, each with 2–6 prominent spines and interspersed spinules.

Differences in females: Right chela shorter than in males, subequal in length to or slightly longer than left cheliped; armature generally similar to that in males.

Paired gonopores on coxae of third pereopods. Abdomen without paired first pleopods, but with 4 unpaired (second to fifth) pleopods; second subequally biramous, third and fourth unequally biramous, fifth as in males.

Coloration (Fig. 1): Shield generally light yellowish brown, with mottling of dark brown anteriorly; lateral parts anteriorly with irregular spots of dark brown; posterior part also with irregular spots. Posterior carapace generally blue-gray; anterior branchiostegite darker, with narrow white longitudinal stripe dorsally. Ocular peduncles dorsally with 3 longitudinal dark brown stripes in proximal half and with 2 short stripes proximal to base of corneas. Antennular peduncles with ultimate segment blue in distal 0.6, orange in proximal 0.4; penultimate segment blue in distal 0.5–0.6, yellowish orange in proximal 0.4–0.5; dorsal flagellum orange, ventral flagellum brown. Antennal peduncle with fifth segment having elongate dark brown spots arranged in longitudinal row on lateral and mesial faces; fourth segment with 2 spots on dorsal surface; second segment with 3 longitudinal stripes of dark brown on dorsal surface; antennal acicle with row of some spots of brown on mesial margin; antennal flagellum banded with brown and white every 3 and 1 articles respectively. Right cheliped generally cream; dactylus with 2 longitudinal stripes on dorsal surface and 2 short stripes basally on mesial face; dorsal surface with 6 longitudinal stripes of pale gray, partially darkened with brown; lateral face of palm with single row of spots, mesial face with 2 longitudinal stripes of pale brown-gray and dark brown; ventral surface mottled with pale gray and with spots of dark brown; carpus with some short longitudinal stripes and spots on dorsal surface, lateral and mesial faces respectively with 2 and 3 longitudinal stripes; merus with 3 or 4 longitudinal stripes of dark brown on each lateral and mesial faces. Left cheliped with similar marking as right cheliped, but number of spots fewer. Second and third pereopods generally cream; dactyli of second and third pereopods each with 2 aligned elongate spots of dark brown on each dorsal, lateral and mesial surfaces; propodi and carpi each 3 longitudinal stripes alternated by pale yellow-gray and dark brown (dark brown areas showing as spots or short stripes) on lateral and mesial faces; meri each with 4 longitudinal stripes alternated by pale yellow-gray and dark brown; ischia each with spots or short stripes of dark brown on lateral face, aligned with stripes on meri. Fourth pereopods generally cream, spotted with dark brown.

Etymology: The specific name is derived from the Latin, *decim* (ten) and *branchiae* (gills), referring to the presence of ten pairs of gills in the new species. It is a noun in apposition.

Habitat: Found usually living in narrow-mouthed gastropod shells, such as *Euplica scripta* (Lamarck), *Pyrene punctata* (Bruguière) and *P. testudinaria tylerae* (Gray).

Distribution: So far known only from the Pacific coast of Japan from Boso Peninsula to Tanegashima Island, shallow water from intertidal to 14 m.

DISCUSSION

The present generic assignment of this new species should be considered provisional. The genus *Pagurus* is diagnosed by the possession of 11 pairs of biserial phyllobranchiae and the lack of secondary sexual modifications (cf. McLaughlin, 1997). In this new species, there are only 10 pairs of biserial phyllobranchiate gills; this condition is due to the considerable reduction of the arthrobranch on the third maxilliped, which is represented only by a single, non-lamellate bud. The tendency toward reduction and/or disappearance in the paired arthrobranchs of the third maxilliped, without complete loss of pleurobranchs on the seventh thoracic somite, has been reported in coenobitids and some pylochelids (Forest, 1987), but until this report was known in the Paguridae, only in *Enneobranchus* García-Gómez, 1988, *Enneophyllus* McLaughlin, 1997 and *Enneopagurus* McLaughlin, 1997 (García-Gómez, 1988; McLaughlin, 1997). The new species shares with the two species currently assigned to *Pagurus*, *P. moluccensis* and *P.* sp. cf. *boriaustraliensis sensu* Rahayu and Komai (2000), several characters. It should be noted that *P. moluccensis* was only provisionally assigned to *Pagurus* by the original authors (see Haig and Ball, 1988). These characters include: (1) the calcified integument of the body parts and appendages are provided with low, blister-like tubercles or protuberances, which are darkly stained by methylen blue; (2) the cephalothorax is somewhat to strongly depressed dorsoventrally; (3) the shield of the carapace is provided with conspicuous paragastric grooves; (4) the interocular lobe is weakly to strongly bilobed; (5) the fourth

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pereopods are dissimilar from right to left, with the left larger than the right and the mesial face of the propodus of the left has distinct two facets, separated by row of long setae; (6) the thoracic sternum is broad; (7) the eighth thoracic sternite is provided with two widely separated, subovate lobes each having a flat ventral surface. Most of the shared characters are presumably apomorphic assumed from preliminary comparison with other pagurid genera, although it has been confirmed that the latter two species have typically 11 pairs of biserial gills (cf. Rahayu and Komai, 2000). Future study may eventually reveal that more species currently assigned to *Pagurus* have a set of the above enumerated characters. It remains uncertain that the true *P. boriaustraliensis* Morgan, 1990 possesses all the characters enumerated above, because the original description by Morgan (1990) does not permit adequate evaluation for them and no specimen of the species has been available for examination. Morgan (1990) did not mention the presence of the blister-like tubercles on the calcified integument and the unequal fourth pereopods. No great attention has been paid for these characters in the pagurid taxonomy, and thus it is possible that Morgan did not make an observation for them. Nevertheless, from the close similarity between the true *P. boriaustraliensis* and *P*. sp. cf. *boriaustraliensis*, we presume that the true *P. boriaustraliensis* also exhibits the two features mentioned above.

It may be noteworthy to mention the affinity between the four species discussed above and the members of the *P. anachoretus* group, which includes the following nine species (Forest, 1978; Forest and Ngoc-Ho, 1992; McLaughlin and Forest, 1999): *P. anachoretus* Risso, 1827 from the Mediterranean, *P. anachoretoides* Forest, 1966, *P. gordonae* (Forest, 1956), *P. laurentae* Forest, 1978 and *P. souriei* (Forest, 1952) from the tropical eastern Atlantic, *P. emmersoni* McLaughlin and Forest, 1999 and *P. liochele* (Barnard, 1947) from South Africa, and *P. headleyi* (Grant and McCulloch, 1906) and *P. kulkarnii* Sankolli, 1961 from the Indo-West Pacific. In addition to these species, McLaughlin and Forest (1999) indicated that the other four species from the tropical eastern Atlantic fit the definition of the *P. anachoretus* group except for the form of chelipeds. These include: *P. alcocki* (Balss, 1912), *P. dartevellei* (Forest, 1958), *P. fimbriatus* Forest, 1966 and *P. triangularis* (Chevreaux and Bouvier, 1892). The former four species from the Indo-West Pacific (*P. decimbranchiae* sp. nov., *P. moluccensis*, *P. boriaustraliensis*, and *P*. sp. cf. *boriaustraliensis*) and the latter 13 species including 9 species of *P. anachoretus* group share a set of the following two features: the propodal rasp of the fourth pereopod is composed of a single row of corneous scales; and the terminal margins of the telson are usually armed with some spines interspersed by smaller spines or spinules. The living color is also a specific characteristic for those species. Most often the color patterns consist of patches and/or longitudinal stripes of pigment, continuous or not, covering part or all of the segments of the chelipeds and ambulatory legs. It is possible that these species of *Pagurus* form a homogenous group. However, extensive study is needed to assess more precisely the phylogenetic relationships of these species, but it is beyond scope of the present paper.

Pagurus decimbranchiae is most similar to *P. moluccensis*, particularly in having the deeply bi-lobed interocular lobe, but it is immediately distinguished from the latter by a number of characters other than the gill formula. The lateral projections of the cephalothoracic shield are more strongly produced in *P. decimbranchiae* than in *P. moluccensis*, thus the margin between the lateral projections and the rostrum is deeply concave in the new species. The ischium of the third maxilliped is armed with one accessory tooth in the new species, rather than two in *P. moluccensis*. The palms of the chelipeds are nearly smooth in *P. decimbranchiae*. Haig and Ball (1988) described the dorsal surfaces of the palms are “granular”, but the reexamination of the holotype of *P. moluccensis* has shown that in fact the mentioned surfaces are covered with small, distinct tubercles. The dorsolateral margins of the palms are not clearly delimited in *P. decimbranchiae*, but they are distinctly delimited with a single row of spines or tubercles in *P. moluccensis*. The ambulatory pereopods are much more setose in *P. decimbranchiae* than in *P. moluccensis*.

The deeply bilobed interocular lobe and the structure of the chelipeds immediately distinguish the new species from *P. boriaustraliensis*, *P*. sp. cf. *boriaustraliensis* and the species of the *P. anachoretus* group. In *P. boriaustraliensis* and *P*. sp. cf. *boriaustraliensis*, the interocular lobe is only weakly bilobed with a shallowly concave anterior surface (cf. Morgan, 1990; Rahayu and Komai, 2000); in the species of the *P. anachoretes* group, the anterior surface of the interocular lobe is slightly concave to slightly convex, and thus the interocular lobe is not bilobed (Forest, 1978; Haig and Ball, 1988; Forest and Ngoc-Ho, 1992; McLaughlin and Forest, 1999). In the new species, the dorsal surface of the right palm is convex and its dorsolateral margin is not distinctly delimited. In *P. boriaustraliensis* and *P*. sp. cf. *boriaustraliensis*, it is strongly uneven, with a broad, highly elevated ridge extending onto the fixed finger and bearing tufts of long densely plumose setae; the dorsolateral margin is distinctly delimited with a single row of spines or tubercles. In the species of the *P. anachoretus* group (except for *P. alcocki*, and *P. dartevellei*, in which the right palm exhibits a specialized operculate form), the right palm is generally similar to that of the present new species, but there is a distinct delineation of the dorsolateral margin with a row of small spines or tubercles (Forest, 1978; Ball and Haig, 1988; Forest and Ngoc-Ho, 1992; McLaughlin and Forest, 1999). The ventromesial margins of the merus and carpus of the right cheliped develop into wing-like projections in *P. boriaustraliensis*, *P*. sp. cf. *boriaustraliensis* and many species of the *P. anachoretes* group (except for *P. emmersoni* and the two species having an operculate right palm) (Morgan, 1990; McLaughlin and Forest, 1999; Rahayu and Komai, 2000), but such wing-like projections are not developed in *P. decimbranchiae*, as well as in *P. moluccensis*.

The presence of the low, blister-like tubercles or protuberances on the calcified integument of the body and appendages in the new species, *P. moluccensis* and *P*. sp. cf.

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boriaustraliensis is remarkable. The presence of similarly blister-like tubercles is known in some species of Parapaguridae (see Lemaitre, 1996), but the occurrence of the tubercles appears to be restricted to the dorsal surface of the telson in parapagurids. These structures are easily overlooked without dyeing with methylen blue. Future study may eventually reveal the presence of the blister-like tubercles on the integument of the body and/or appendages in other species of the genus. The function of these tubercles remains unknown.

Reexamination of the material referred to as *Pagurus pilosipes* (Stimpson, 1858) by Miyake (1978) has shown that seven species are confounded, of which none represents the true *P. pilosipes*. The ovigerous specimen (Miyake det. no. 398, NSMT-CrR 1816) actually represents *P. decimbranchiae*.

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