Identities of *Pagurus japonicus* (Stimpson, 1858), *P. similis* (Ortmann, 1892) and *P. barbatus* (Ortmann, 1892), with description of a new species (Crustacea, Decapoda, Anomura, Paguridae)

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ABSTRACT
A review of the species heretofore known as *Pagurus japonicus* (Stimpson, 1858), *P. similis* (Ortmann, 1892) and *P. barbatus* (Ortmann, 1892) has shown that the identity of the latter two species has been misinterpreted. Stimpson's species is identical with *P. barbatus*. Two species have been confounded under the name *P. similis*, one of which is herein described as new, *P. rubrior* n. sp. *Pagurus japonicus* and *P. similis* are fully redescribed and illustrated. *Pagurus rubrior* n. sp. can be distinguished from *P. similis* by the shorter ocular peduncle, more numerous accessory teeth on the ischium of the third maxilliped, more numerous spines and tubercles on the palm of the right cheliped, less slender dactylus of the right third pereopod, and red or reddish purple, rather than light orange, general coloration in life. The presence of slender capsules on the tubercles on the chelipeds is documented for *P. japonicus*, *P. similis* and *P. rubrior* n. sp. for the first time. Relationships among these three species and four other known species, *P. sinuatus* (Stimpson, 1858), *P. hirtimanus* (Miers, 1880), *P. pergranulatus* (Henderson, 1896) and *P. capsularis* McLaughlin, 1997, are also discussed.

KEY WORDS
Crustacea,
Decapoda,
Anomura,
Paguridae,
Pagurus,
northwestern Pacific,
new species.

RÉSUMÉ
Identités de Pagurus japonicus *(Stimpson, 1858),* P. similis *(Ortmann, 1892) et* P. barbatus *(Ortmann, 1892) et description d'une nouvelle espèce (Crustacea, Decapoda, Anomura, Paguridae).*
Une révision des espèces jusqu'alors connues sous les noms de *Pagurus japonicus* (Stimpson, 1858), *P. similis* (Ortmann, 1892) et *P. barbatus* (Ortmann, 1892) a montré que l'identité des deux dernières a été mal interprétée. L'espèce de Stimpson est identique à *P. barbatus*. Deux espèces ont été confondues sous le nom *P. similis*, dont une est décrite ici comme nouvelle, *P. rubrior* n. sp. *Pagurus japonicus* et *P. similis* sont redécrites et illustrées. *Pagurus rubrior* n. sp. peut être distinguée de *P. similis* par le pédoncule oculaire plus court, des dents accessoires plus nombreuses sur l'ischium du troisième maxillipède, des épines et tubercules plus nombreux sur la paume du chélipède droit, le dactyle du troisième péréiopode moins fin et une coloration générale sur le vivant rouge ou pourpre au lieu d'orange clair. La présence de fines capsules sur les tubercules des chélipèdes est mentionnée pour la première fois pour *P. japonicus*, *P. similis* et *P. rubrior* n. sp. Les relations entre ces trois espèces et quatre autres, *P. sinuatus* (Stimpson, 1858), *P. hirtimanus* (Miers, 1880), *P. pergranulatus* (Henderson, 1896) et *P. capsularis* McLaughlin, 1997, sont aussi discutées.

MOTS CLÉS
Crustacea,
Decapoda,
Anomura,
Paguridae,
Pagurus,
Pacifique nord-ouest,
nouvelle espèce.

INTRODUCTION

In the anomuran part of the serial paper dealing with material of decapod crustaceans deposited in the Strassburger Museum, Ortmann (1892) described a number of new species of hermit crabs, amongst which were two species from Japan, *Pagurus similis* (Ortmann, 1892) and *P. barbatus* (Ortmann, 1892) (both as *Eupagurus*). He compared his new species with *P. japonicus* (Stimpson, 1858). These three nominal taxa have been reported from warm temperate East Asian waters (e.g., Balss 1913; Miyake 1960, 1965, 1975, 1978, 1982; Kim 1963, 1970, 1973; Miyake & Imafuku 1980).

During an ongoing taxonomic study of the paguroid genus *Pagurus* Fabricius, 1798 in the northwestern Pacific, it was found that two species were confounded under the name *Pagurus similis*. The two species (called "orange" morph and "red" morph for convenience in reference to the general coloration in life) differ from each other both in some morphological particulars and coloration in life. The present study was initiated in an attempt to make clear the true identities of the two morphs of *P. similis* s.l. However, reexamination of the material studied by Ortmann (1892) deposited in the Musée zoologique, Université Louis Pasteur, Strasbourg, France, has disclosed the existence of serious taxonomic confusion in literature regarding the identities of *P. japonicus*, *P. similis* and *P. barbatus*.

The two syntypes of *P. barbatus* and specimens identified by Ortmann (1892) as *P. japonicus* (as *Eupagurus*) are still extant, but, unfortunately, the holotype of *P. similis* could not be located in the collection of the Musée zoologique. It was found that Ortmann's *P. japonicus* was conspecific with the "red" morph of *P. similis* s.l. and that the two syntypes of *P. barbatus* represented *P. japonicus*. The identity of *P. japonicus* was confirmed by an examination of the descriptions given by Stimpson (1858, 1907) and the material used in this study, as the holotype of *P. japonicus* was presumably destroyed in the Chicago fire in 1871 (Rathbun 1883; Evans 1967). *Pagurus barbatus* (Ortmann, 1892) is synonymized with *P. japonicus* (Stimpson, 1858). The original description of *P. similis* is

brief, contrasting it with *P. japonicus* sensu Ortmann (1892) (= "red" morph of *P. similis*). After comparison between the original description of *P. similis* and the abundant specimens examined in this study, I have come to the conclusion that the type of *P. similis* actually represented the "orange" morph of *P. similis* s.l. The "red" morph, corresponding to Ortmann's *P. japonicus*, is here described as *P. rubrior* n. sp. *P. japonicus* and *P. similis* s.s. are redescribed and illustrated in detail.

MATERIAL AND METHODS

One measurement, shield length (sl), measured from the tip of the rostrum to the midpoint of the posterior margin of the shield, provides an indication of size of the specimens examined. The abbreviation ovig. indicates ovigerous female(s). General terminology used in the description follows McLaughlin (1974), with exception of the paragastric grooves on the shield (see Komai & Osawa 2001), sutures on the posterior carapace (see Lemaitre 1995), structure of the fourth pereopod (see McLaughlin 1997) and gill structure (see McLaughlin & de Saint Laurent 1998). The drawings were made with the aid of a drawing tube mounted on a Leica MZ-8 stereomicroscope. For detailed observation of surface structure, the dissected appendages were stained with methylene blue; setae were removed before observation when necessary. The description of the new species is somewhat abbreviated with omission of unnecessary repetitious, because the new species is very similar to *P. similis*, which is fully redescribed and illustrated.

For comparative purpose, the following specimen was examined:

Pagurus hirtimanus (Miers, 1880): Kume-jima Island (Madomari Port), Ryukyus, 8-10 m, scuba diving, 11.VI.1995, coll. K. Nomura, 1 ♂ sl 3.6 mm (CBM-ZC 3113).

ABBREVIATIONS

CBM	Natural History Museum and Institute, Chiba;
CMNH	Coastal Branch of Natural History Museum and Institute, Chiba;
HSM	Hayama Shiosai Museum, Hayama;
MNHN	Muséum national d'Histoire naturelle, Paris;
MZS	Musée zoologique, Université Louis Pasteur, Strasbourg;
NSMT	National Science Museum, Tokyo;
NSMT-R	Showa Memorial Institute, National Science Museum, Tsukuba;
NTOU	National Taiwan Ocean University, Keelung;
OMNH	Osaka Museum of Natural History, Osaka;
ZSM	Zoologische Staatssammlung München.

SYSTEMATICS

Family PAGURIDAE Latreille, 1802
Genus *Pagurus* Fabricius, 1775

Pagurus japonicus (Stimpson, 1858)
(Figs 1-5)

Eupagurus japonicus Stimpson, 1858: 250 (type locality: Shimoda, Izu Peninsula, Japan); 1907: 226, pl. 25, fig. 2. — Alcock 1905: 177. — Terao 1913: 369 (part). — Nakazawa 1927: 203, fig. 1045.

Eupagurus japonicus? – Miers 1880: 375, pl. 14, figs 6, 7 (= *Pagurus hirtimanus* Miers, 1880). See Remarks.

?*Eupagurus japonicus* – Balss 1913: 56. — Yokoya 1933: 85. See Remarks.

Pagurus japonicus – Gordan 1956: 331 (bibliography). — Miyake 1960: 90, pl. 45, fig. 4; 1965: 648, fig. 1096; 1975: 323, pl. 115, figs 7, 10; 1978: 94 (part), fig. 35, pl. 2, fig. 2; 1982: 125, pl. 42, fig. 1; 1991: 125, pl. 42, fig. 1; 1998: 125, pl. 42, fig. 1. — Miyake *et al.* 1962: 125. — Kim 1963: 300, fig. 18; 1964: 9; 1970: 13; 1973: 239, 602, fig. 58, pl. 71, fig. 38; 1985: 74. — Suzuki 1971: 97, pl. 34, fig. 3. — Miyake & Imafuku 1980: 60. — Takeda 1982: 68, fig. 202; 1986: 124, unnumbered fig.; 1994: 228, fig. 3. — Yu & Foo 1990: 64, unnumbered fig. — Wang 1994: 570. — Asakura 1995: 362, pl. 97, fig. 3. — Kobayashi 2000: 186, unnumbered fig. — Minemizu 2000: 149, unnumbered fig. — Kato & Okuno 2001: 86 (top). — Park & Choi 2001: 138, unnumbered fig.

Eupagurus barbatus Ortmann, 1892: 311 (type locality: two syntypes came from two different locations, Tokyo Bay and Sagami Bay). — Alcock 1905: 177. — Terao 1913: 365. — Yokoya 1933: 85. See Remarks.

Pagurus barbatus – Gordan 1956: 326. — Miyake *et al.* 1962: 125. — Miyake 1978: 105, fig. 41; 1982: 197 (list), 225 (key). — Miyake & Imafuku 1980: 60.

Non *Eupagurus japonicus* – Ortmann 1892: 309, pl. 12, fig. 16 (= *Pagurus rubrior* n. sp.). See Remarks.

Non *Eupagurus barbatus* – Balss 1913: 55 (= *Pagurus similis* (Ortmann, 1892)). See Remarks.

TYPE MATERIAL. — Holotype of *Eupagurus japonicus* Stimpson, 1858: Shimoda, Izu Peninsula, ♂, no longer extant.
Syntypes of *Eupagurus barbatus* Ortmann, 1892: Tokyo Bay, 1880-1881, coll. L. Döderlein, 1 ♂ sl 16.0 mm (MZS 484); Sagami Bay, 1880-1881, coll. L. Döderlein, 1 ♂ sl 15.2 mm (MZS 485).

MATERIAL EXAMINED. — **Japan.** Boso Peninsula, Kominato, scuba diving, 5 m, 23.VI.1994, coll. K. Nomura, 1 ♂ sl 15.3 mm (CBM-ZC 2703); Hota, lobster net, 5-6 m, 20.XII.1998, coll. T. Komai, 1 ♂ sl 13.2 mm (CBM-ZC 4847). — Off Hota, gill net, *c.* 30 m, 22.VIII.1997, coll. T. Komai, 1 ♀ sl 10.7 mm (CBM-ZC 5673); Hota Fishing Port, 2-3 m, trap, 19.V.2000, coll. T. Komai, 1 ♂ sl 15.3 mm, 1 ♀ sl 13.7 mm (CBM-ZC 6211). — Tokyo Bay, 1880-1881, coll. L. Döderlein, 1 ♂ sl 16.0 mm (syntype of *Eupagurus barbatus*; MZS 484). — Sagami Bay, Misaki, Miura Peninsula, 5.XI.1988, coll. A. Asakura, 1 ♀ sl 10.0 mm (CBM-ZC 793), 1 ♂ sl 11.5 mm (CBM-ZC 794); Kamegisho, dredge, 16 m, 28.VII.1960, Miyake det. No. 413, 1 ovig. sl 15.7 mm (NSMT-CrR 1831); similar locality, dredge, 14 m, 25.VII.1957, identified by Miyake (1978) as *P. barbatus*, det. No. 192, 1 ♂ sl 15.2 mm (NSMT-CrR 1373); 1880-1881, coll. L. Döderlein, 1 ♂ sl 15.2 mm (syntype of *Eupagurus barbatus*; MZS 485). — Izu Islands, Sokodo, Hachijo Island, scuba, 5 m, 20.IX.2000, coll. S. Kato, 1 ♂ sl 9.3 mm (CMNH-ZC 520). — Kii Peninsula, Kushimoto, scuba diving, depth unknown, coll. K. Nomura, 3 ♂♂ sl 7.2-9.3 mm, 2 ♀♀ sl 7.7, 8.1 mm, 1 ovig. ♀ sl 7.6 mm (CBM-ZC 1046); Andonohana, Shionomisaki, scuba diving, 15 m, 7.IV.1985, coll. K. Nomura, 1 ♂ sl 7.9 mm (CBM-ZC 2407), 1 ♂ sl 5.3 mm, 1 ovig. ♀ sl 7.3 mm (CBM-ZC 4924). — Tosa Bay, Hane-misaki, Kochi, hand, subtidal, 26.IV.2001, coll. S. Wada, 3 ♂♂ sl 6.2-7.7 mm, 1 ♀ sl 7.2 mm (CBM-ZC 5893). — Kagoshima Bay, Shifushi, gill net, 5 m, 31.V.1997, coll. T. Kurozumi, 1 ♂ sl 8.2 mm (CBM-ZC 3610). — Sea of Japan, Nakanoshima Island, Oki Islands, scuba, 5 m, 30.IX.1993, coll. K. Nomura, 1 ♂ sl 5.7 mm (CBM-ZC 5406); Takasa Beach, Echizen, Fukui Prefecture, scuba, 2 m, 9.V.2001, coll. T. Sugimoto, 1 ♂ sl 7.0 mm, 5 ovig. ♀♀ sl 7.0-7.8 mm (CBM-ZC 6448); Sayu Beach, Echizen, Fukui Prefecture, hand, 0-1 m, 3.IX.2001, coll. T. Sugimoto, 5 ♂♂ sl 6.9-13.4 mm, 2 ♀♀ sl 7.0, 12.1 mm (CBM-ZC 6449); Yasujima, Mikuni, Fukui Prefecture, scuba, 6 m, 27.VIII.2001, coll. T. Sugimoto, 4 ♂♂ sl 5.4-13.3 mm, 1 ♀ sl 13.8 mm, 1 ovig. ♀ sl 7.4 mm (MNHN-Pg).

DISTRIBUTION. — Pacific coast of Japan from Boso Peninsula to Kyushu, including Izu Islands; Sea of Japan coast of Honshu mainland to Kyushu; Korea; northern part of China; and northeastern part of Taiwan.

HABITAT. — Rocky bottom subtidal to 30 m; using various species of gastropod shells, e.g., *Omphalius pfeifferi pfeifferi* (Philippi, 1846), *Turbo cornutus* Lightfoot, 1786 and *Cymatium parthenopeum* (Salis Marschlins, 1793).

REDESCRIPTION

Eleven pairs of biserial phyllobranchiae.
Shield (Fig. 1A) 1.20-1.25 times as long as broad; anterior margin between rostrum and lateral projections concave; anterolateral margins sloping; posterior margin truncate; dorsal surface with six or seven pairs of tufts of short to long setae; paragastric grooves inconspicuous. Rostrum triangular, terminating acutely, exceeding lateral projections. Lateral projections obtusely triangular, with marginal or submarginal spine. Posterior carapace membranous except for weakly calcified submedian areas between cardiac sulcus and sulcus cardiobranchialis; posteromedian plate delimited by subparallel cardiac sulci; sulci cardiobranchiales extending to midway between posterior margin of shield and posterodorsal margin of carapace; branchial regions with scattered tufts of short to long setae.
Ocular peduncle (Fig. 1A) 0.40-0.50 time as long as shield in adults, weakly inflated basally, with row of tufts of setae dorsomesially; cornea weakly dilated, maximum diameter 0.30-0.35 of length of ocular peduncle and not much greater than basal width of ocular peduncle. Ocular acicle narrowly triangular, slightly curved ventrally, terminating bluntly and usually with small submarginal spine, moderately separated basally; dorsal surfaces grooved.
Antennular peduncle (Fig. 1A) overreaching cornea by 0.40-0.60 length of ultimate segment. Ultimate segment subequal in length to penultimate segment, slightly broadened distally in lateral view, with few tufts of long setae on dorsal surface. Penultimate segment with tuft of setae on dorsodistal margin. Basal segment with statocyst lobe bearing strong spine on laterodistal margin.
Antennal peduncle overreaching distal margins of cornea by 0.40-0.60 length of fifth segment.

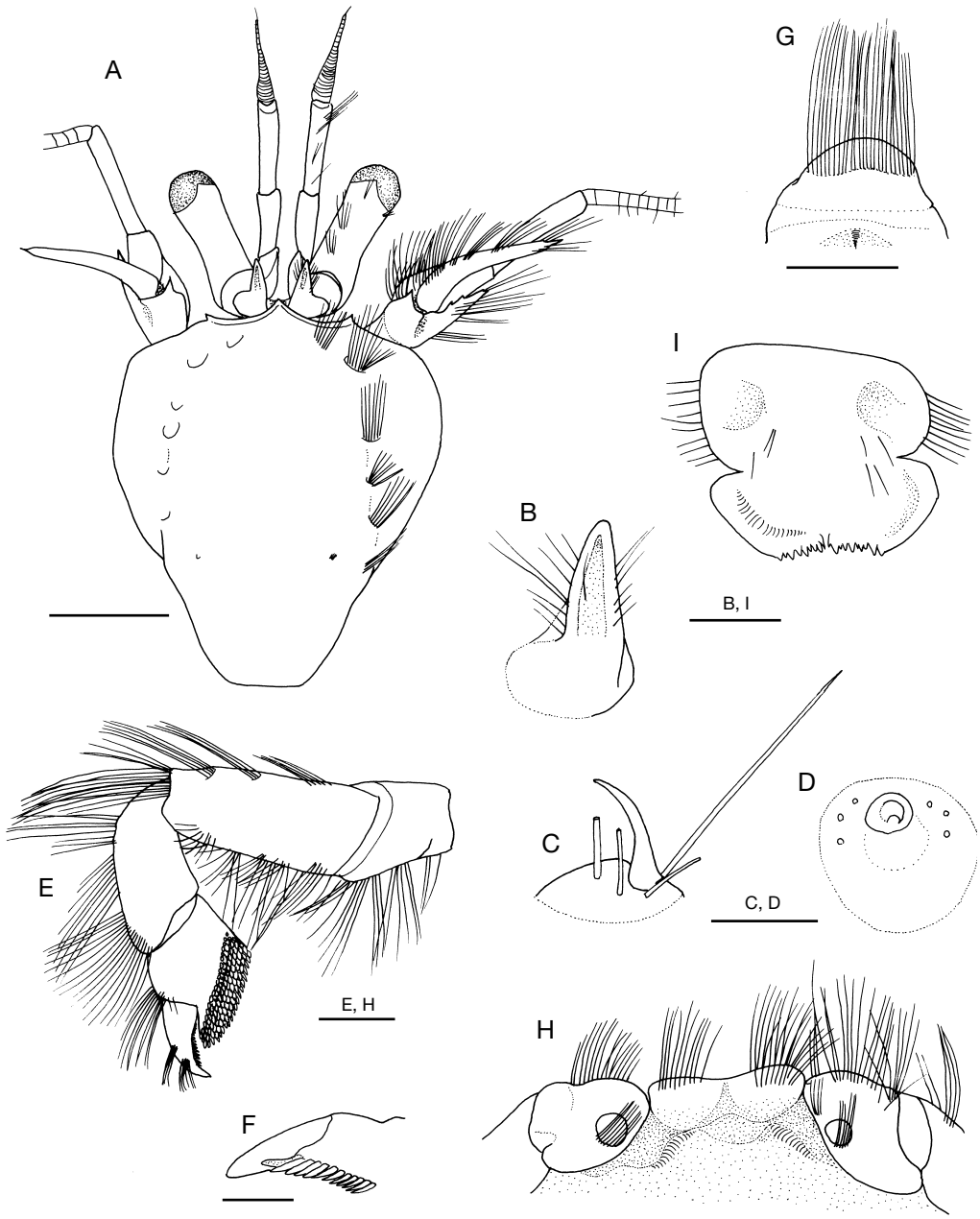

FIG. 1. — *Pagurus japonicus* (Stimpson, 1858), ♂ sl 15.3 mm, from Kominato, Boso Peninsula (CBM-ZC 2703); **A**, shield and cephalic appendages, dorsal (setae omitted from left); **B**, left ocular acicle, dorsal; **C**, capsulate tubercle on dorsal surface of palm of right cheliped, lateral (setae broken); **D**, same, dorsal (setae omitted); **E**, left fourth pereopod, lateral; **F**, same, distal part of dactylus, lateral; **G**, anterior lobe of sixth thoracic sternite, ventral; **H**, coxae of fifth pereopod and eighth thoracic sternite, ventral; **I**, telson, dorsal. Scale bars: A, 5 mm; B, 1 mm; C, D, F, 0.5 mm; E, G-I, 2 mm.

Fifth segment slender, with scattered short setae. Fourth segment stout, with few tufts of setae. Third segment with spine at ventrodistal mesial angle obscured by tufts of long stiff setae. Second segment with dorsolateral distal angle strongly produced, reaching midlength of fourth segment, terminating in simple or bifid spine partially obscured by stiff setae; dorsomesial distal angle with strong spine, several long stiff setae on mesial margin. First segment laterally with small submarginal spine, ventromesial distal margin with few spinules laterally. Antennal acicle moderately long, reaching or slightly overreaching distal margin of cornea, arcuate, terminating in acute spine; mesial margin with row of tufts of long stiff setae. Antennal flagellum shorter than fully stretched right cheliped, every article with some minute setae.

Mandible (Fig. 2A) with incisor process relatively narrow, not clearly dentate. Maxillule (Fig. 2B) with distal endite relatively narrow; endopod tapering distally, with apical seta, devoid of trace of outer lobe. Maxilla (Fig. 2C) with moderately broad scaphognathite; endopod not reaching distal margin of anterior lobe of distal endite. First maxilliped (Fig. 2D) with broad exopod. Second maxilliped (Fig. 2E) with moderately stout exopod; flagellum long. Third maxilliped (Fig. 2F, G) moderately slender; ischium with crista dentata consisting of row of blunt corneous teeth and with one to three (most frequently two) accessory teeth; merus with minute spinule on dorsodistal margin, no spine on ventromesial margin; carpus without dorsodistal spine; exopod slightly overreaching distal margin of merus.

Chelipeds grossly unequal. Right cheliped (Figs 3; 4; 5A, B) with chela about 1.60 times longer than greatest width at base of dactylus in females and small males, but noticeably elongate in large males, as much as 2.20 times longer than greatest width; dorsal surface of chela with numerous tufts of short to moderately short plumose setae, often obscuring spines and tubercles; lateral margin of chela strongly convex in females and small males, only weakly convex in large males. Dactylus shorter than palm and slightly overlapped by fixed finger; cutting edge bearing row of broad calcareous teeth and adjacent row of tufts of stiff setae, terminating in large calcareous claw; dorsal surface slightly convex, with closely-spaced, low, rounded tubercles on mesial side of midline proximally (few tubercles present near base of dactylus, each with capsule similar to those on palm), distally only with few tufts of setae; mesial margin noticeably sinuous, with row of large blunt or subacute spines; ventral face with numerous low broad tubercles and tufts of stiff setae. Palm shorter than carpus; dorsomesial margin delimited by row of small acute or subacute spines; dorsolateral margin with row of small spines decreasing in size proximally and row of tufts of stiff setae; dorsal surface slightly convex, covered with scattered, small, low tubercles frequently bearing capsules and with row of small acute or subacute spines on midline extending onto fixed finger (sometimes with additional row of small spines mesial to median row); corneous, spiniform capsules weakly curved backward, arising from anterodorsal or subcentral part of tubercle; mesial face of palm slightly concave, with row of small spines dorsally and low tubercles or protuberances ventrally, each accompanied by tuft of stiff setae; ventrolateral face (including fixed finger) with numerous scattered low tubercles accompanied by tufts of long setae; ventral surface with few low protuberances and tufts of stiff setae. Cutting edge of fixed finger with row of broad calcareous teeth, terminating in large calcareous claw. Carpus longer than merus; dorsomesial margin distinctly delimited by row of moderately small spines, and with tufts of long setae; dorsal surface with numerous capsulate tubercles and few moderately small spines, and with numerous tufts of short plumose setae; dorsolateral margin not delimited; lateral face with numerous low tubercles or protuberances accompanied by long plumose setae, ventrolateral distal margin with row of small tubercles or blunt spines; mesial face slightly concave, with numerous low protuberances accompanied by tufts of long stiff setae, mesiodistal margin with row of small spines; ventral surface with several minute to small tubercles and tufts of setae distally. Merus with short transverse rows of setae on

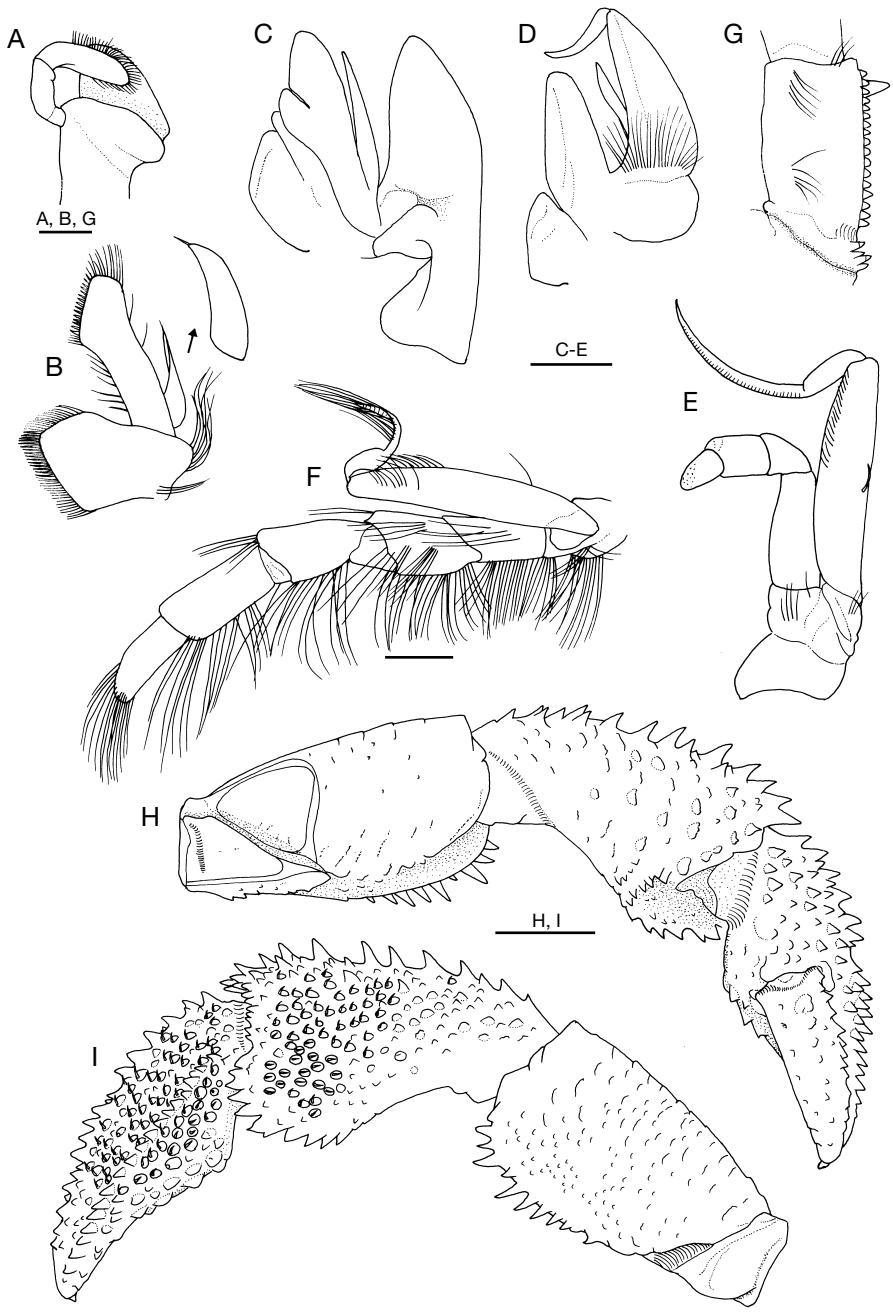

FIG. 2. — *Pagurus japonicus* (Stimpson, 1858), ♂ sl 15.3 mm, from Kominato, Boso Peninsula (CBM-ZC 2703); **A**, left mandible, dorsal; **B**, left maxillule, ventral, inset, endopod, lateral; **C**, left maxilla, ventral (setae omitted); **D**, left first maxilliped, ventral (setae partially omitted); **E**, left second maxilliped, ventral (setae omitted); **F**, left third maxilliped, lateral; **G**, same, ischium, dorsal (setae partially omitted); **H**, left cheliped, mesial (setae omitted); **I**, same, lateral (setae omitted). Scale bars: A, B, G, 1 mm; C-F, 2 mm; H, I, 5 mm.

dorsal surface; dorsodistal margin unarmed but with row of dense setae; in females and small males mesial face not particularly inflated ventrally, ventromesial margin distinct, with row of tiny spines and moderately dense long setae; in large males, mesial face strongly inflated ventrally, ventromesial part (ventromesial margin not sharply delimited) with few spinules and extremely dense cluster of long setae extending to mesial face; lateral face with scattered, small, low protuberances accompanied by short setae, ventrolateral margin with row of small spines, ventrolateral proximal corner somewhat produced in large males; ventral surface concave, with minute spinulose tubercles and numerous long setae (setae extremely dense in large males). Ischium with tufts of short setae on all faces; ventromesial margin with few small blunt tubercles; ventral surface with few large, rounded or flattened tubercles. Coxa without spines on distal margin, but with tufts of long setae ventromesially.

Left cheliped (Figs 2H, I; 4; 5C, D) slightly overreaching base of palm of right cheliped to reaching base of dactylus of right cheliped, strongly compressed laterally, setation generally similar to that of right. Chela elongate subovate in dorsal view, about 2.80 times longer than greatest width at base of dactylus. Dactylus longer than palm, slightly curved ventrally; cutting edge with row of small calcareous teeth in proximal 0.50-0.60 and with row of small corneous teeth in distal 0.40-0.50, terminating in large corneous claw; dorsomesial margin not distinctly delimited, but with row of blunt spines or tubercles decreasing in size distally; dorsal surface sloping mesially, proximally with row of spines or tubercles mesial to midline; mesial face with few low tubercles proximally. Palm about half length of carpus, triangular in cross section; dorsal surface elevated in midline but not forming distinct ridge or crest, with row of moderately large spines decreasing in size distally and extending onto proximal half of fixed finger; dorsolateral margin with row of small spines; dorsolateral and dorsomesial surfaces strongly sloping ventrally, former surface covered with numerous rounded tubercles, most provided with capsule, latter surface with scattered small, acute or subacute spines; dorsomesial margin not distinctly delimited; lateral face with closely spaced small to large blunt tubercles, several of which adjacent to dorsolateral margin provided with capsule; ventral surface somewhat inflated, with some large tubercles and few low protuberances accompanied by tufts of long setae. Carpus approximately as long as merus; dorsomesial margin with row of large acute spines; dorsolateral margin only weakly delimited, with row of four or five small spines; dorsal surface somewhat sloping with several capsulate tubercles, dorsodistal margin with row of small spines; mesial face with scattered low protuberances, mesiodistal margin smooth; lateral face with dense covering of rounded tubercles, most of which provided with capsule, ventrolateral distal margin strongly expanded, partially covering base of chela, with row of moderately strong spines; ventral surface sloping, with small spines and low protuberances. Merus with short transverse rows of setae on dorsal surface, dorsodistal margin without spine; mesial face with short transverse or obliquely transverse rows of long stiff setae dorsally and ventrally, ventromesial margin without spine; lateral face with numerous scattered low protuberances and minute, low tubercles, ventrolateral margin strongly expanded, with row of spines becoming longer distally; ventral surface weakly concave, with small low tubercles and numerous tufts of long stiff setae. Ischium and coxa similar to those of right cheliped in setation and armature.

Second and third pereopods (Fig. 5E-H) similar from right to left in armature and setation. Dactyli stout, 0.95-1.14 times as long as propodi on right second, 1.16-1.39 times as long on left third, in dorsal view straight, in lateral view slightly curved ventrally, terminating in moderately long to long corneous claws; dorsal surfaces each with tufts of setae and row of corneous spines increasing in length distally; lateral faces each with tufts of stiff setae dorsally and ventrally and with faint median sulcus proximally; mesial faces each with tufts of setae dorsally and ventrally and with short median sulcus proximally, unarmed in second, armed with two rows of cor-

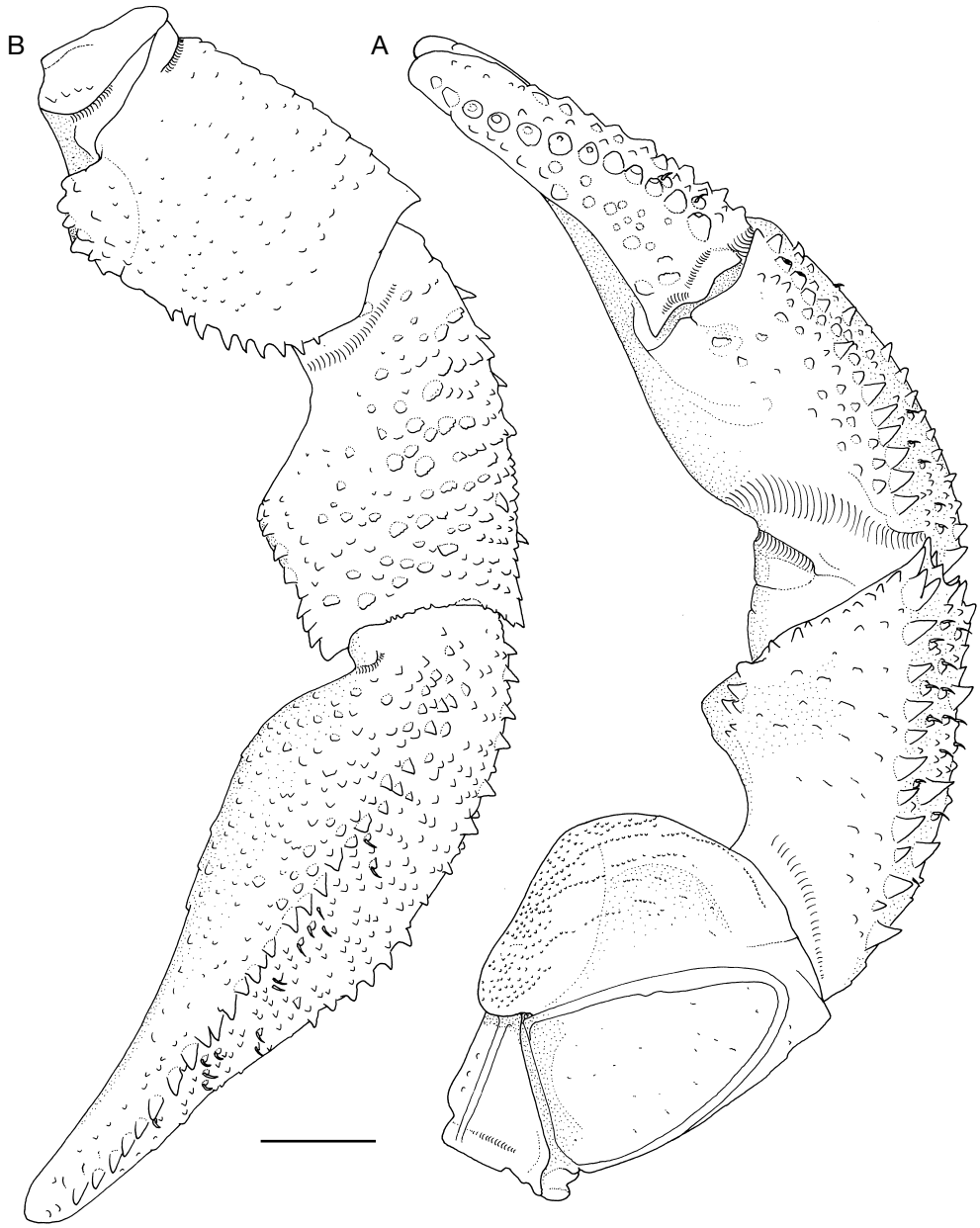

FIG. 3. — *Pagurus japonicus* (Stimpson, 1858), ♂ sl 15.3 mm, from Kominato, Boso Peninsula (CBM-ZC 2703), right cheliped; **A**, mesial; **B**, lateral. Scale bar: 5 mm.

neous spines in third; ventral margins each with seven to 10 strong corneous spines. Propodi distinctly longer than carpi; dorsal surfaces each with short transverse rows of long setae, often extending to lateral face, but without spine; lateral faces each with short obliquely transverse rows of long setae dorsally and tufts of shorter setae ventrally; ventral surface with row of widely separated tufts of setae and small corneous spines. Carpi only with dorsodistal spine; dorsal surfaces

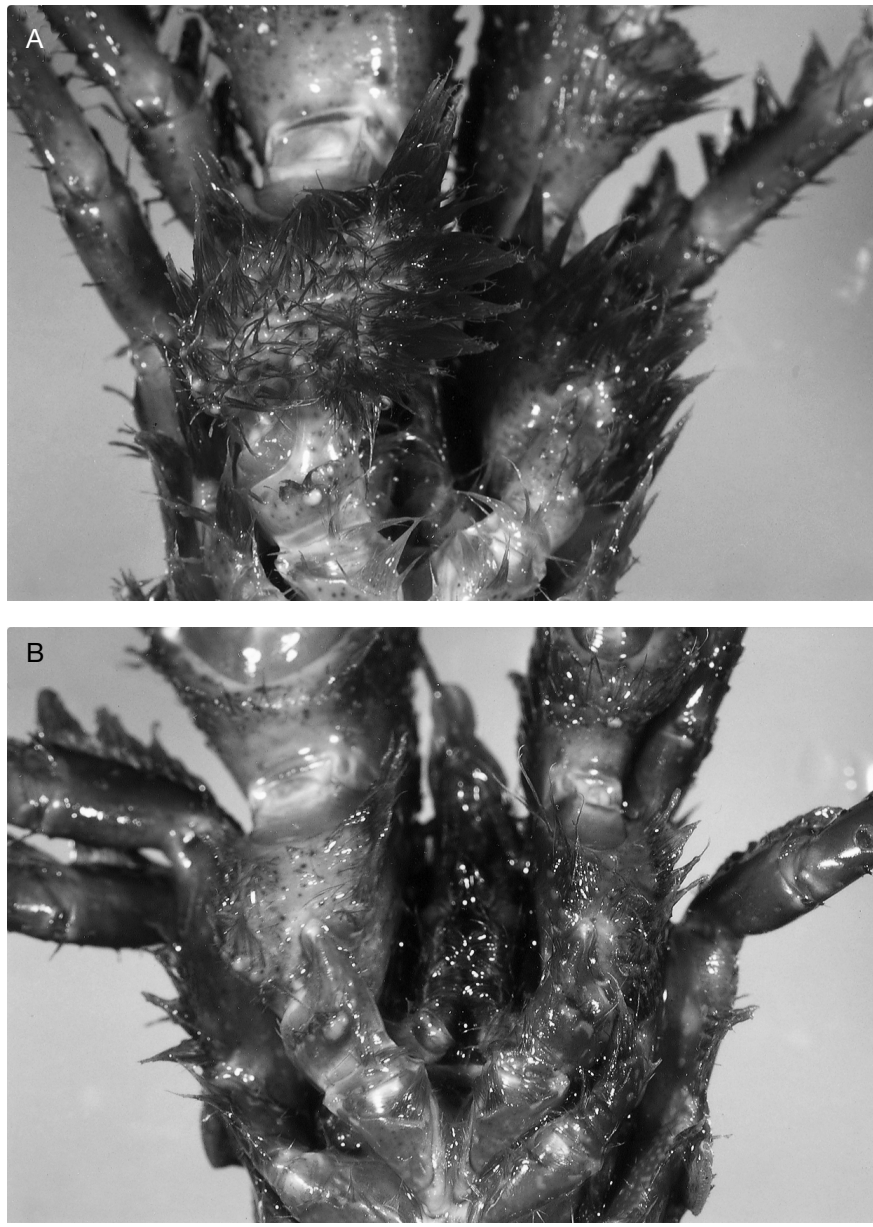

FIG. 4. — *Pagurus japonicus* (Stimpson, 1858), Hota Fishing Port, Boso Peninsula (CBM-ZC 6211), ventral surfaces of carpi of chelipeds, showing variation of setation; **A**, ♂ sl 15.3 mm; **B**, ♀ sl 13.7 mm.

each with numerous long plumose setae; lateral faces each with tufts or short rows of long plumose dorsal to midline, and scattered tufts of short setae ventral to midline. Meri broad, each with dorsal and ventral tufts of long plumose setae; lateral faces each with few tufts of short setae; ventrolateral distal margins armed with one small subdistal spine on second, unarmed on third. Ischium with dorsal and ventral tufts of setae. Female with paired gonopores.

Fourth pereopods (Fig. 1E, F) semichelate, similar from right to left, but left slightly shorter than right. Dactylus curved ventrally, terminating in long corneous claw, with row of fine corneous teeth on ventral margin; preungual process arising just distal to row of corneous teeth, flexible. Propodal rasp composed of six or seven rows of corneous scales; all segments with dorsal and/or ventral tufts of long setae.

Fifth pereopod chelate; males with paired gonopores (Fig. 1H), each partially obscured by moderately long setae.

Third thoracic sternite with pair of minute spinule on either side of shallow median notch on anterior margin. Sixth thoracic sternite with anterior lobe (Fig. 1G) subsemicircular, with numerous setae on anterior face. Eighth thoracic sternite (Fig. 1H) developed anteriorly as two somewhat flattened subrectangular lobes separated by shallow median depression, anterior margins each with row of setae.

Abdomen twisted. Males with four unpaired left (second to fifth) pleopods, all four unequally biramous (exopods well developed, endopods much shorter than exopod, but not rudimentary). Females also with four unpaired left pleopods, anterior three subequally biramous, fifth as in males. Uropods greatly asymmetrical; exopods and endopods both well developed rasps.

Telson (Fig. 1I) wider than long, with deep lateral indentations; posterior lobes slightly to somewhat asymmetrical, separated by small median cleft; terminal margins nearly transverse, each with row of four to six small spines and interspersed minute spinules, not extending to lateral margin.

Coloration

In life: shield mottled with brown and blue-gray, median part paler. Posterior carapace generally brownish gray, scattered by transparent spots. Ocular peduncle generally white with broad dark brown band submedially, and with dark brown patch at base of cornea and tinge of blue just proximal to dark brown patch. Distal two segments of antennular peduncles each with broad band of reddish brown and tinge of blue distally; flagella reddish brown. Antennal peduncle with fifth segment having brown longitudinal stripes laterally and mesially on transparent background; second segment mottled with blue-gray and brown; antennal acicle brown in distal half and blue-gray in proximal half; flagellum banded with brown and white (every four or five articles brown and one article white). Third maxilliped generally brown, with spots of light gray or light blue-gray on dorsal surface of propodus, carpus and merus. Chelipeds generally brown; capsulate tubercles on chelae and carpi light gray or blue-gray; spines or spiniform tubercles brown or yellowish brown, low tubercles on mesial faces of palms blue-gray; chelae with scattered spots of dark brown; meri generally brown, irregularly spotted by blue-gray. Dactyli of ambulatory pereopods banded with brown (in proximal 0.70) and white (in distal 0.30, except for terminal corneous claws); propodi banded with blue-gray (in distal 0.30-0.40) and brown or reddish brown (in proximal 0.60-0.70); carpi generally brown or reddish brown, with spots of blue-gray; meri gray-blue in distal half and brown in proximal half in general, distal blue-gray areas with large spot of dark brown dorsally, proximal brown area with large white patch dorsoproximally and some spots of blue-gray.

In preservative: blue gray or gray parts in life changed to light orange or yellow, and brown parts changed to darker orange or reddish brown.

Size

Males sl 5.7-16.0 mm; females sl 7.0-15.7 mm; ovigerous females sl 7.0-15.7 mm.

Variation

As is apparent from the description, this species exhibits a considerable variation in morphology of the right cheliped in males. In small males and females the ratio of "chela length/chela width" of the right cheliped is rather stable, about 1.50-1.60; the setae covering dorsal surface of the chelae and carpi of the chelipeds are short, and the surface structures are clearly visible; the mesial face of the merus is not inflated; density of setae on the ventral surface of the merus is weak to

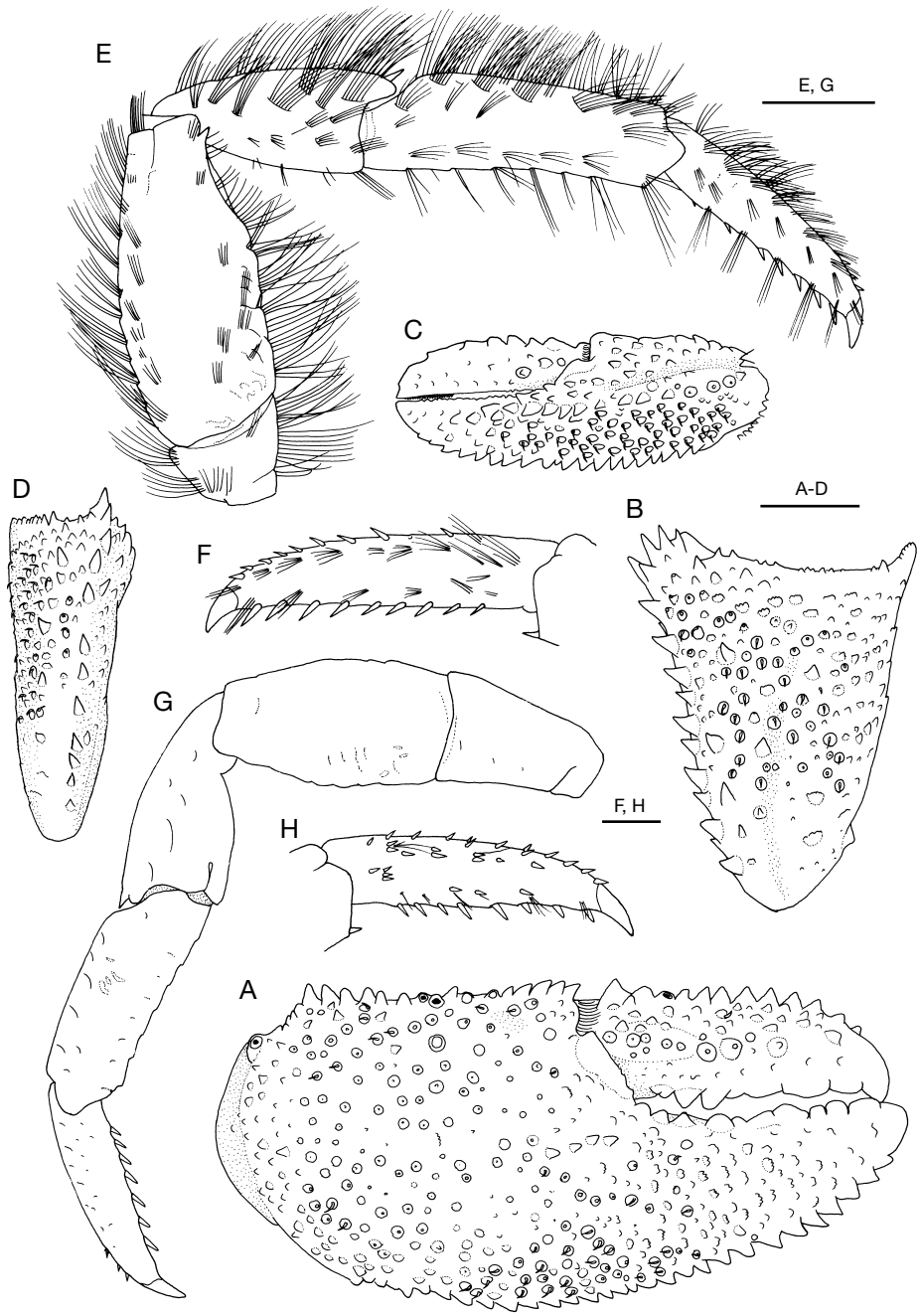

FIG. 5. — *Pagurus japonicus* (Stimpson, 1858), ♂ sl 15.3 mm, from Kominato, Boso Peninsula (CBM-ZC 2703); **A**, right chela, dorsal (setae omitted); **B**, carpus of right cheliped, dorsal (setae omitted); **C**, left chela, dorsal (setae omitted); **D**, carpus of left cheliped, dorsal (setae omitted); **E**, left second pereopod, lateral; **F**, same, dactylus, mesial (setae partially omitted); **G**, left third pereopod, lateral (setae omitted); **H**, same, dactylus, mesial (setae partially omitted). Scale bars: A-E, G, 5 mm; F, H, 2 mm.

moderate (Fig. 4, bottom). In large males (sl > 14.0 mm), the right palm is noticeably elongate, with the ratio "chela length/chela width" attaining 2.30; the setae covering the dorsal surface of the chelae and carpi are longer and more dense, thus the surface structures are at least partially obscured; the mesial face of the merus is strongly inflated and the delineation of the ventromesial margin is reduced; the setae on the ventral surface are extremely dense, and partially extend to the mesial face (Fig. 4, top).

The proportional length of the ambulatory dactyli is fairly variable. The dactylus of the right second pereopod is 0.95-1.14 times as long as the propodus; the dactylus of the left third pereopod is 1.16-1.39 times as long as the propodus.

REMARKS

Stimpson's (1858) brief original description of *Eupagurus japonicus* was based on a single male specimen. The holotype was presumably destroyed in the Chicago fire of 1871 (Rathbun 1883; Evans 1967). Nevertheless, some of the characters reported by Stimpson (1858, 1907) are sufficiently diagnostic in recognizing the species. These include the prominent, acute rostrum, the elongate ocular acicle with a grooved dorsal surface, the strongly inflated and hairy ventral surface of the merus of the right cheliped, and the ambulatory legs broadly banded with deeper red. The present specimens are assigned to *Pagurus japonicus*, as they agree entirely with Stimpson's description in those diagnostic features. Stimpson's (1907) description of the color as "inclining to orange or minutely mottled with red and yellow" rather agrees with the color of the ethanol preserved specimens.

During this study, it has been found that in the three East Asian species discussed, the tubercles on the dorsal surfaces of the chelae are provided with long slender capsules similar to those reported by McLaughlin (1997) for *Pagurus capsularis* McLaughlin, 1997 and *P. pergranulatus* (Henderson, 1896) and by de Saint Laurent & McLaughlin (2000) for *P. sinuatus* (Stimpson, 1858) and *P. hirtimanus* (Miers, 1880). No reference has been made by previous authors (e.g., Ortmann 1892; Terao 1913; Miyake 1978, 1982) to distinctive capsulate structures on the tubercles of the chelae of *Pagurus japonicus* and *Pagurus similis* s.l. Further, the seven species mentioned all possess an unpaired second pleopod in males (thus the total number of unpaired pleopods in males is four) (McLaughlin 1997; de Saint Laurent & McLaughlin 2000).

Pagurus japonicus appears closest to *P. sinuatus* known from southern Australia and Kermadec Islands (de Saint Laurent & McLaughlin 2000). Comparison with the description of *P. sinuatus* by de Saint Laurent & McLaughlin (2000) has shown that *P. japonicus* and *P. sinuatus* differ in the following respects. The shield is 1.20-1.25 times as long as broad in *P. japonicus*, but it is reportedly slightly longer than broad in *P. sinuatus*. The ocular peduncle is shorter but more slender in *P. japonicus* than in *P. sinuatus*; the length of ocular peduncle is 0.50-0.60 of the shield length in *P. japonicus*, 0.55-0.70 in *P. sinuatus*; the corneal diameter is 0.30-0.35 of the length of the ocular peduncle in *P. japonicus*, 0.38-0.45 in *P. sinuatus*. The antennal peduncle distinctly overreaches the distal margin of the cornea in *P. japonicus*, rather than just reaching or slightly overreaching it in *P. sinuatus*. The middorsal spines on the dactylus of the right cheliped are much smaller in *P. japonicus* than in *P. sinuatus*. The dorsal surface of the carpus of the right cheliped is entirely covered with low tubercles, including capsulate ones, in *P. japonicus*, but it bears a "smooth patch medially" in *P. sinuatus*. The tubercles on the lateral face of the carpus of right cheliped seem to be much more numerous in *P. japonicus* than in *P. sinuatus*. The lateral face of the carpus of the left cheliped is covered with numerous capsulate tubercles in *P. japonicus*, instead of low, flattened protuberances bearing marginal long setae in *P. sinuatus*.

Pagurus japonicus is immediately distinguished from *P. rubrior* n. sp. and *P. similis* by the elongate shield with a more strongly produced rostrum, the more strongly elevated median ridge on the left chela, the strongly compressed, deep carpus of the left cheliped, and the more robust and shorter dactyli of the ambulatory pereopods with

fewer and less elongate mesial spines. Further, in *P. japonicus*, the dactyli of the ambulatory pereopods are devoid of white patches and red median stripes on the lateral and mesial surfaces that are present in *P. similis* and *P. rubrior* n. sp.

Pagurus japonicus differs from *P. capsularis*, *P. hirtimanus* and *P. pergranulatus* in the less dilated cornea of the eye. In *P. japonicus*, the corneal diameter is not distinctly greater than the basal width of the ocular peduncle, while in the latter three species, the cornea is somewhat to strongly dilated, and its diameter exceeds the basal width of the ocular peduncle. Further, *P. capsularis* is distinguished from *P. japonicus* by the absence of tubercles on the dorsal surface of the carpus of the right cheliped, much more slender dactyli of the ambulatory pereopods, and the strongly oblique terminal margins of the telson. The more dense covering of short setae on the palm of the right cheliped separates *P. hirtimanus* from *P. japonicus*. *Pagurus pergranulatus* is characteristic in having a subacute lobe at the dorsomesial distal angle of the right palm (cf. Alcock & Anderson 1897: pl. 31, fig. 1).

Miers (1880) tentatively referred specimens from unknown locality in the Malaysian region to *Eupagurus japonicus*, although he suggested that his specimens were conspecific with a specimen from the Philippines named without description as *Pagurus hirtimanus* by White (1847), but differing from the original description of *E. japonicus* in the shape of ocular acicle and armature of the right chela. Miers' specimens represent *Pagurus hirtimanus* Miers, 1880, as previously indicated (Lewinsohn 1969).

Ortmann's (1892) report of *Eupagurus japonicus*, based on six specimens from Tokyo Bay, was brief and accompanied by rather diagrammatic illustrations. However, his illustration of the dactylus of the ambulatory leg (pl. 12, fig. 16m) clearly shows the presence of a patch and median stripe, being characteristic to *P. similis* s.l. In reference to the illustration, in his synonymy of *Pagurus japonicus*, Miyake (1978) suggested that Ortmann's *E. japonicus* might actually represent *P. similis*, but he did not comment further. As noted previously, it has been found that Ortmann's specimens of *E. japonicus* actually represent the new species *P. rubrior* n. sp. described in this paper.

Yokoya (1933) referred two males from southwest of Misaki at depth of 307 m and one ovigerous female from off Iki Island at depth of 110 m to *Eupagurus japonicus*. He gave no diagnostic information, and his specimens have not been available for study. Nevertheless, this study has shown that *P. japonicus* occurs in shallow waters from subtidal zone to about 30 m. It is likely that Yokoya was actually reporting a species other than *P. japonicus*. Thus Yokoya's reference is included questionably in the synonymy.

Ortmann's (1892) description of *Eupagurus barbatus*, based on two males, one from Tokyo Bay and one from Sagami Bay, was brief and no illustration was provided. He compared this species only to *E. japonicus* sensu Ortmann (= *Pagurus rubrior* n. sp.). Reexamination of the two syntypes has revealed that *P. barbatus* is conspecific with *P. japonicus*. The latter name has priority over the former name.

Terao's (1913: 365, 369, 370) treatment of *Eupagurus barbatus* is somewhat confusing. He (p. 365) listed *Eupagurus barbatus*, suggesting that he recognized the species as valid, however he also included *E. barbatus* in the synonymy of *E. japonicus*. In the account of *E. japonicus*, he did not give any comments on his treatment of *E. barbatus*.

Balss (1913) reported *E. barbatus* from Sagami Bay on the basis of a single female specimen. In the text, Balss clearly mentioned that he compared his specimen with the type material of *P. barbatus*. However, reexamination of Balss's specimen (ZSM 277/1) has shown that it actually represents *P. similis*, not *P. japonicus*. In the same report, Balss reported *Eupagurus japonicus* based on two specimens from Sagami Bay; however the two specimens were not located in the collection of ZSM. The misidentification of *E. barbatus* may reflect Balss' misinterpretation of the specific identities of *P. japonicus* and *P. similis*. Thus it is difficult to determine what species Balss (1913) was actually reporting. His reference to *E. japonicus* has questionably been included in the synonymy.

Yokoya (1933) recorded *Eupagurus barbatus* from off Kinkazan, Miyagi Prefecture, and northeast of Honshu. Yokoya's specimens have not been available for study. As Yokoya gave no diagnostic information, it is difficult to determine the identity of his specimens. At present, the occurrence of *P. japonicus*, *P. similis* and *P. rubrior* n. sp. in the Pacific coast of northeastern Honshu mainland northward from Boso Peninsula has not been confirmed, and it is highly likely that Yokoya's specimens represent a species other than these three.

Alcock (1905) and Gordan (1956) listed *Eupagurus barbatus* and *Pagurus barbatus* respectively; however, these were bibliographic listings.

Miyake (1978) reported *Pagurus barbatus* based on a single male specimen from Sagami Bay (NSMT-CrR 1373). He distinguished *P. barbatus* from *P. japonicus* by the following features: 1) the palm of the right cheliped is provided with long soft hairs and median row of spiniform tubercles; 2) the merus of the right cheliped is thickly ornamented with long setae on the ventral surface; and 3) the dactyli of the ambulatory pereopods are shorter than the propodi. However, as mentioned in the part Variation, examination of the present material has shown that these characters are variable within a single species, and are not reliable for species discrimination. The dactyli of the second and third pereopods are in fact not shorter than the propodi in Miyake's *P. barbatus* specimen. It must be concluded, therefore, that *P. japonicus* and *P. barbatus* sensu Miyake are conspecific. Thus, the reports of *Pagurus barbatus* by Miyake *et al.* (1962), Miyake & Imafuku (1980), and Miyake (1982) are all referred to *P. japonicus*.

One of the specimens used in his report of *P. japonicus* by Miyake (1978) (Miyake det. No. 528) differs from *P. japonicus* in the much broader, semioperculate right palm, which bears only short stiff setae. There is little doubt that this specimen represents an undescribed species. Formal description of a new species, however, is deferred until additional specimens become available for study.

Pagurus similis (Ortmann, 1892) *s.s.*
(Figs 6A; 7-11)

Eupagurus similis Ortmann, 1892: 310 (type locality: Kagoshima, Japan). — Alcock 1905: 177. — Yokoya 1933: 86. See Remarks.

Eupagurus barbatus – Balss 1913: 55. Non *Eupagurus barbatus* Ortmann, 1892 (= *P. japonicus* (Stimpson, 1858)). See Remarks.

Pagurus similis – Gordan 1956: 335 (bibliography). — Miyake 1960: 90 (part); 1978: 103 (part); 1982: 125 (part); 1991: 125 (part); 1998: 125 (part). — Miyake & Imafuku 1980: 60 (part). — Takeda 1982: 67 (part). — Yu & Foo 1990: 66, unnumbered fig. See Remarks.

?*Pagurus similis* – Kim 1964: 9; 1970: 13; 1973: 240, 603, fig. 59; 1985: 74.

Non *Pagurus similis* – Miyake 1960: pl. 45, fig. 5; 1975: pl. 115, figs 6, 9; 1978: fig. 40, pl. 2, fig. 3; 1982: pl. 42, fig. 2. — Suzuki 1971: 97, pl. 34, fig. 4. — Kim 1973: pl. 7, fig. 39. — Takeda 1986: 124, unnumbered fig.; 1994: 228, fig. 5. — Asakura 1995: 362, pl. 97, fig. 4. — Kobayashi 2000: 186, unnumbered fig. — Minemizu 2000: 149, unnumbered fig. — Park & Choi 2001: 139, unnumbered fig. (= *Pagurus rubrior* n. sp.). See Remarks.

Non *Eupagurus similis* – Doflein 1902: 646 (= *Pagurus dubius* (Ortmann, 1892)).

TYPE MATERIAL. — Holotype: Kagoshima, Kyushu, Japan, 1880, coll. L. Döderlein, ♂ (size not indicated), not located in the collection of MZS.

MATERIAL EXAMINED. — **Japan.** Boso Peninsula, off Takeoka, gill net, 80-100 m, 29.VIII.1994, coll. T. Komai, 1 ♂ sl 14.7 mm (CBM-ZC 626); off Takeoka, gill net, 50-60 m, 18.II.1995, coll. T. Komai, 1 ♂ sl 11.9 mm (CBM-ZC 1058); off Kanaya, gill net for scampi, 120-200 m, 4.IV.1995, coll. T. Komai, 1 ♂ sl 11.4 mm (CBM-ZC 1219); SW of Katsuyama Ukishima Islet, gill net for scampi, 120-200 m, 8.V.1995, coll. T. Komai, 1 ♀ sl 11.1 mm (CBM-ZC 1611); off Takeoka, gill net, 50-60 m, 1.V.1996, coll. T. Komai, 1 ovig. ♀ sl 13.7 mm (CBM-ZC 2572); off Takeoka, gill net, 30-50 m, 28.VIII.1996, coll. T. Komai, 1 ♂ sl 13.1 mm (CBM-ZC 2968); off Takeoka, gill net, 40-50 m, 9.X.1997, coll. T. Komai, 1 ovig. ♀ sl 13.0 mm (CBM-ZC 3948); off Katsuyama Ukishima Islet, gill net for scampi, 100-150 m, 10.IV.1997, coll. T. Komai, 1 ♂ sl 9.7 mm (CBM-ZC 3958); Tateyama Bay, TRV *Shin'yo-maru*, 1996 cruise, stn 16, dredge, 35°00.57'N, 139°41.45'E, 100-258 m, 24.X.1996, coll. T. Komai, 1 ovig. ♀ sl 7.7 mm (CBM-ZC 4738); off Takeoka, gill net, 80-100 m, 13.III.1997, coll. T. Komai, 1 ♂ sl 10.2 mm (MNHN-Pg 6101); off

FIG. 6. — **A**, *Pagurus similis* (Ortmann, 1892), ♂ sl 11.9 mm, from off Takeoka, Boso Peninsula (CBM-ZC 1058), entire animal in dorsal view; **B**, *Pagurus rubrior* n. sp., paratype ♂ sl 14.9 mm, from Takeoka, Boso Peninsula (MNHN-Pg 6099), entire animal in dorsal view.

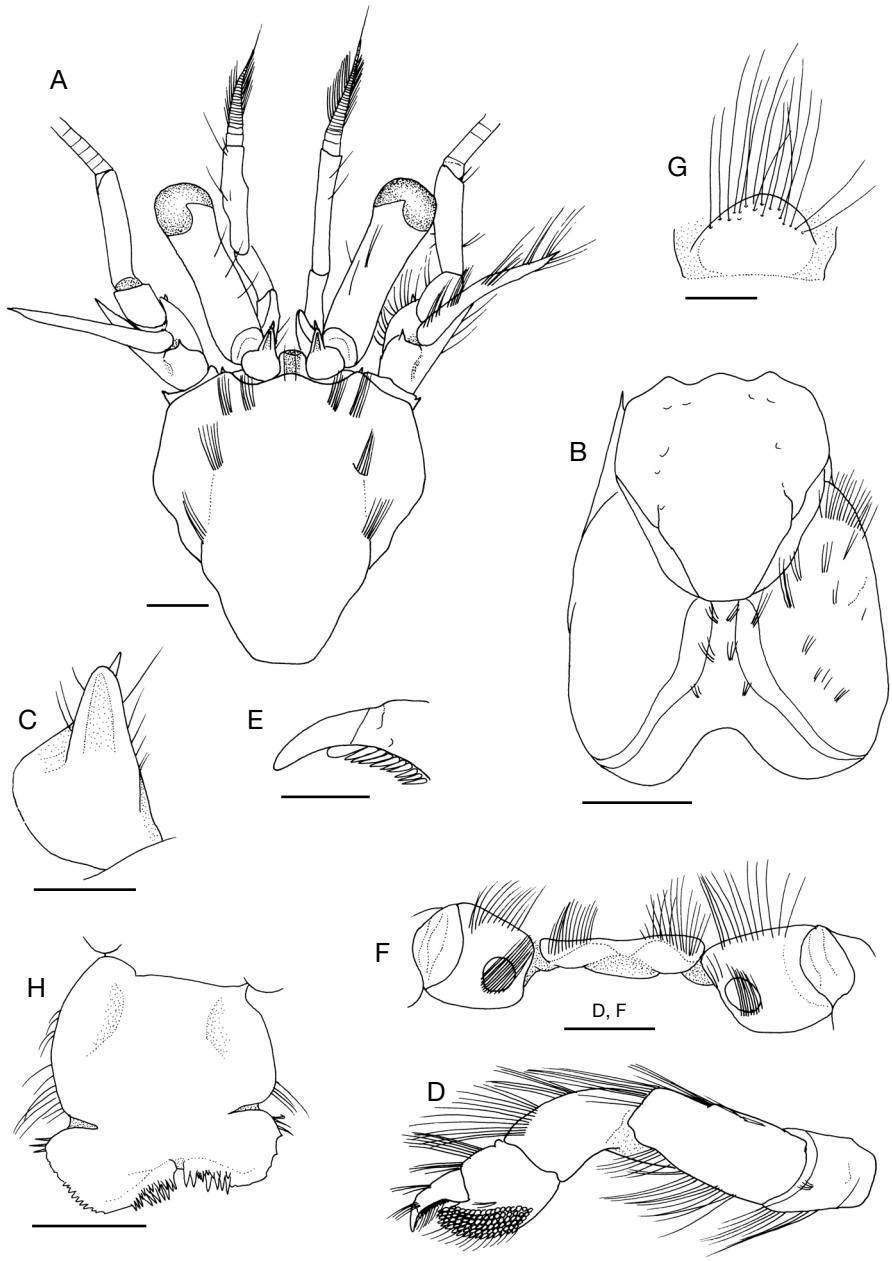

FIG. 7. — *Pagurus similis* (Ortmann, 1892), ♂ sl 9.7 mm, from off Katsuyama Ukishima Islet, Boso Peninsula (CBM-ZC 3958); **A**, shield and cephalic appendages, dorsal (setae partially omitted from left; left antennular peduncle mutilated); **B**, carapace, dorsal (setae omitted from left); **C**, left ocular acicle, dorsal; **D**, left fourth pereopod, lateral; **E**, same, distal part of dactylus, lateral (setae omitted); **F**, coxae of fifth pereopods and eighth thoracic sternite, ventral; **G**, anterior lobe of sixth thoracic sternite, ventral; **H**, telson, dorsal. Scale bars: A, D, F, H, 2 mm; B, 5 mm; C, E, G, 1 mm.

Takeoka, gill net, 50-60 m, VIII.1997, coll. T. Komai, 1 ovig. ♀ sl 13.7 mm (MNHN-Pg 6100). — Sagami Bay, Fukuura, depth unknown, 10-20.XI.1903, coll. A. Haberer, 1 ♀ sl 10.5 mm, reported by Balss (1913) as *Eupagurus barbatus* (ZSM 277/1); W of Kamegi-sho Bank, 50 m, 18.III.1964, Miyake (1978) det. No. 545 (NSMT-CrR 2220), 1 ♀ sl 9.0 mm; W of Jogashima Islet, 150 m, III.1987, coll. H. Ikeda, 2 ♂♂ sl 10.0, 10.3 mm, 1 ♀ sl 7.1 mm (HSM-Cra 0133); SW of Jogashima Islet, 120-140 m, III.1987, coll. H. Ikeda, 2 ♂♂ sl 9.3, 11.0 mm (HSM); off Kamakura, gill net, *c.* 100 m, 15.III.2001, coll. H. Namikawa, 1 ♂ sl 12.4 mm (NSMT-Cr). — Sagami-nada, Okinoyama Bank, dredge, 80 m, 25.VII.1959, Miyake (1978) det. No. 294, 1 ovig. ♀ sl 7.7 mm (NSMT-CrR 1619); 5 km off SW of Jogashima Islet, Miura Peninsula, dredge, 100 m, 7.VI.1960, Miyake (1978) det. No. 373, 1 ovig. ♀ sl 7.7 mm (NSMT-CrR 1757); Okinoyama Bank, RV *Tansei-maru*, KT95-5, stn TB18-2, 34°59'N, 139°39'E, dredge, 105-113 m, 21.IV.1995, coll. T. Komai, 2 ♂♂ sl 8.1, 9.2 mm (CBM-ZC 1987); Okinoyama Bank, TRV *Shin'yo-maru*, 1996 cruise, stn 19, 34°58.47'N, 139°34.13'E, dredge, 121-129 m, 24.X.1996, coll. T. Komai, 1 ♂ sl 8.6 mm (CBM-ZC 4739). — Izu Islands, Takase Bank, TRV *Shin'yo-maru*, 1996 cruise, stn 8, 34°27.59'N, 139°11.94'E, dredge, 104-109 m, 24.X.1996, coll. T. Komai, 1 ♂ sl 7.4 mm (CBM-ZC 4737). — Ohsumi Islands, Kuroshima Bank, TRV *Toyoshio-maru*, 1996-5 cruise, stn 10, 30°42.07'N, 130°06.27'E, sledge net, 133 m, 3.VI.1996, coll. T. Komai, 2 ♂♂ sl 13.3, 13.7 mm, 1 ovig. ♀ sl 7.7 mm (CBM-ZC 4732).
Taiwan. Off Ta-Shi, I-Lan County, NE Taiwan, depth unknown, commercial trawler, 4.XII.1997, coll. T. Komai, 1 ♀ sl 9.9 mm (NTOU).

DISTRIBUTION. — Pacific coast of Japan southward from Boso Peninsula to Ohsumi Islands, Sea of Japan coast of southern part of Honshu mainland, Korea, and northeastern part of Taiwan.

HABITAT. — Rocky or coarse sand bottom, from 30 to 200 m; using various gastropod shells, e.g., *Bolma modesa* (Reeve, 1843), *Bufonaria rana* (Linnaeus, 1758), *Semicassis bisulcata persimilis* Kira, 1959, *Tonna luteostoma* (Küster, 1857), *Cymatium parthenopeum* (Salis Marschlins, 1793), and *Siratus pliciferoides* (Kuroda, 1942).

REDESCRIPTION

Eleven pairs of biserial phyllobranchiae.

Shield (Fig. 7A) 1.00-1.10 times as long as broad; anterior margins between rostrum and lateral projections concave; anterolateral margins sloping or slightly terraced; posterior margin truncate; dorsal surface with four to six pairs of tufts of setae; paragastric grooves inconspicuous. Rostrum broadly triangular, rounded or terminating in acute or subacute spine, reaching or slightly overreaching lateral projections. Lateral projection obtusely triangular, with marginal or submarginal spinule. Posterior carapace membranous except for weakly calcified submedian areas defined by cardiac sulci and sulci cardiobranchiales; posteromedian plate defined by subparallel cardiac sulci; sulci cardiobranchiales extending to midway between posterior margin of shield and posterodorsal margin of carapace; branchial regions with few tufts of setae.

Ocular peduncle (Fig. 7A) 0.60-0.70 time as long as shield, slightly inflated basally, with row of tufts of setae dorsomesially; cornea weakly dilated, maximum diameter about 0.30-0.35 of length of ocular peduncle and slightly greater than basal diameter. Ocular acicle (Fig. 7C) narrowly triangular, slightly curved ventrally, terminating subacutely or bluntly and usually with slender submarginal spine, moderately separated basally; dorsal surfaces grooved.

Antennular peduncle (Fig. 7A) overreaching cornea by 0.20-0.40 length of ultimate segment. Ultimate segment 1.20-1.40 times longer than penultimate segment, slightly broadened distally in lateral view, with few long setae on dorsal surface. Penultimate segment with few setae on dorsodistal margin. Basal segment with small spine on laterodistal margin of statocyst lobe.

Antennal peduncle (Fig. 7A) overreaching distal margin of cornea by 0.20-0.30 length of fifth segment. Fifth and fourth segments moderately slender. Third segment with spine at ventrodistal angle obscured by tufts of setae. Second segment with dorsolateral distal angle strongly produced, reaching midlength to distal margin of fourth segment, terminating in simple or bifid spine partially obscured by stiff setae; dorsomesial distal angle with small spine, several long stiff setae on mesial margin. First segment laterally with small submarginal spine, ventromesial distal margin with few spinules laterally. Antennal acicle long, reaching or slightly overreaching distal margin of cornea, arcuate, terminating in acute spine; mesial margin with row of tufts of long stiff setae. Antennal flagellum longer than fully extended

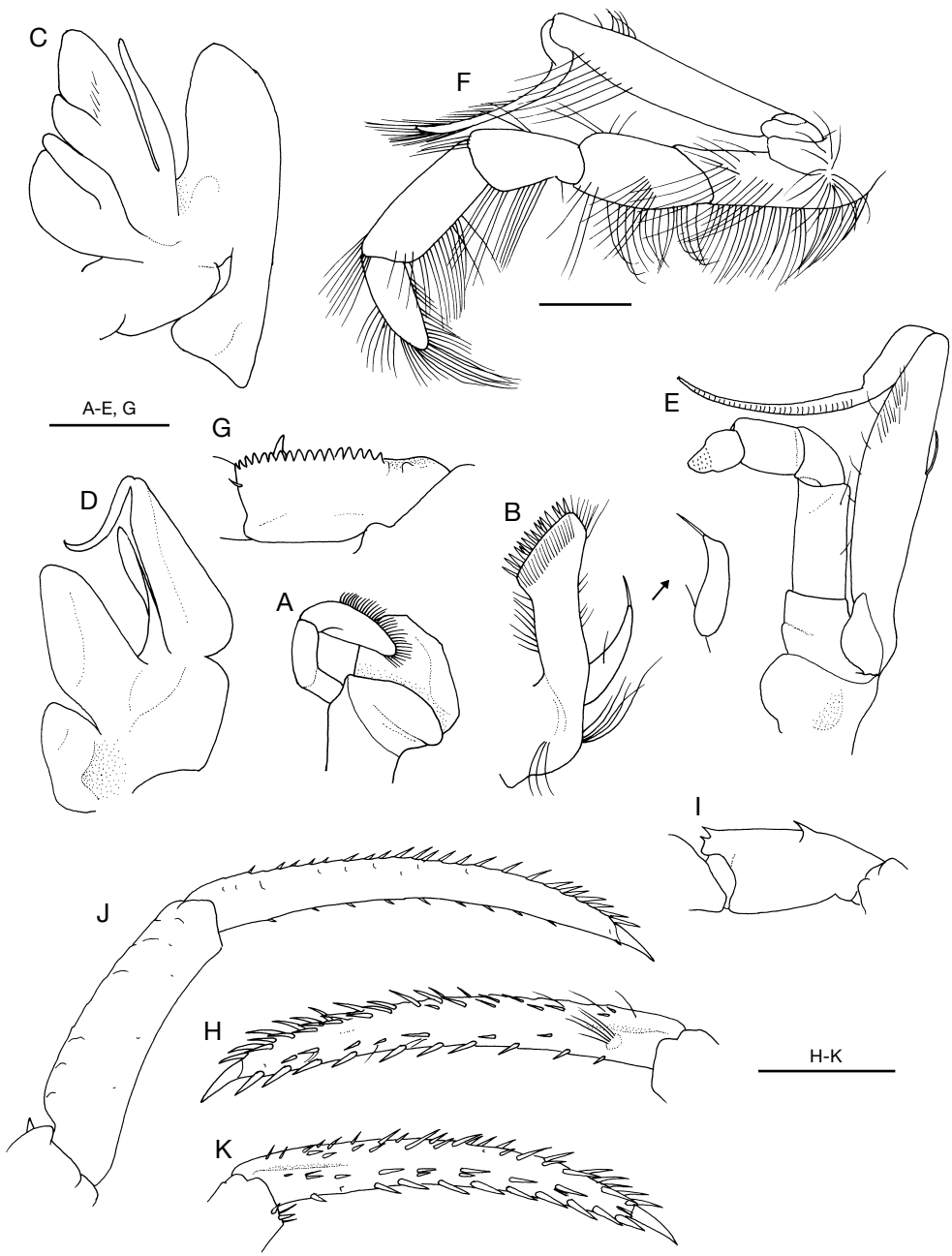

FIG. 8. — *Pagurus similis* (Ortmann, 1892), ♂ sl 9.7 mm, from off Katsuyama Ukishima Islet, Boso Peninsula (CBM-ZC 3958); **A**, left mandible, dorsal; **B**, left maxillule, ventral (proximal endite broken off), inset, endopod, lateral; **C**, left maxilla, ventral (setae omitted); **D**, left first maxilliped, ventral (setae omitted); **E**, left second maxilliped, ventral (setae partially omitted); **F**, left third maxilliped, lateral; **G**, same, ischium, dorsal (setae omitted); **H**, dactylus of right second pereopod, mesial (setae omitted); **I**, carpus of right second pereopod, mesial (setae omitted); **J**, dactylus and propodus of right third pereopod, lateral (setae omitted); **K**, dactylus of left third pereopod, mesial (setae omitted). Scale bars: A-G, 2 mm; H-K, 5 mm.

right cheliped, every article with some minute setae.

Mouthparts (Fig. 8A-E) similar to those of *P. japonicus*. Endopod of maxillule with trace of outer lobe (Fig. 8B). Third maxilliped (Fig. 1F, G) with one or two (rarely three) accessory teeth on ischium.

Chelipeds grossly unequal. Right cheliped (Figs 9A-C; 10) with chela 1.50-1.70 times longer than greatest width at base of dactylus in females and small males, but noticeably elongate in large males, length attaining twice maximum width; lateral margin of chela in dorsal view strongly convex in females and small males, only slightly convex in large males. Dactylus longer than palm and slightly overlapped by fixed finger; cutting edge with row of broad calcareous teeth and adjacent row of tufts of stiff setae, terminating in large calcareous claw; dorsal surface convex, with closely-spaced, broad spines or tubercles, showing somewhat imbricate appearance, and numerous short to long setae (some tubercles in proximal half of dactylus with capsules similar to those on palm); dorsomesial margin nearly straight, with row of moderately large, forwardly directed tubercles or spines; ventromesial face with numerous, low, broad spines and tufts of stiff setae; ventral surface with several low, squamiform tubercles and scattered tufts of moderately long stiff setae. Palm shorter than carpus; dorsomesial margin delimited by single or double row of moderately small, forwardly directed spines; dorsolateral margin with row of small spines decreasing in size proximally and row of tufts of moderately short to long plumose setae; dorsal surface convex, with sparse tufts of long setae and numerous, small, capsulate tubercles and spinules, and also with row of moderately small spines on midline of dorsal surface extending onto fixed finger; corneous, spiniform capsules weakly curved backward, arising from anterior part of tubercles, basal pores rounded or "heart-shaped"; spinules and capsulate tubercles on dorsal surface of palm each with several short plumose setae arising from anterior bases; mesial face of palm flat or slightly concave, with scattered low, squamiform protuberances accompanied by tufts of stiff setae; ventrolateral face (including fixed finger) with scattered low tubercles accompanied by tufts of short to moderately long setae; ventral surface with several low, broad protuberances and scattered tufts of long stiff setae. Cutting edge of fixed finger with row of large calcareous teeth, terminating in large calcareous claw. Carpus subequal in length to merus; dorsomesial margin distinctly delimited by row of moderately large spines and tufts of long setae; dorsal surface with numerous spinulose or capsulate tubercles and several moderately large spines adjacent to dorsolateral margin and with dense covering of short plumose setae; dorsolateral margin not delimited; lateral face with low, broad, sometimes multidenticulate protuberances dorsally, and small, low protuberances ventrally, all accompanied by tufts of setae, ventrolateral distal margin smooth; mesial face slightly concave, with several tufts of long plumose setae, ventromesial distal margin without row of spines; ventral surface with some spinulose tubercles and tufts of long setae distally. Merus with short transverse rows of setae on dorsal surface; dorsodistal margin unarmed but with row of dense setae; mesial face somewhat inflated ventrally in large males, not inflated in small males and females; in large males, ventromesial margin produced, unarmed or armed with few small spines proximally and with numerous long setae; in females and small males ventromesial margin not produced, armed with row of small spines and with sparse setae; lateral face with some short vertical rows of stiff setae dorsally and tufts of stiff setae ventrally, ventrolateral margin with row of small spines and numerous setae; in large males, ventral surface with scattered setae, more concave in large males than in females and small males. Ischium with tufts of short setae on all faces; ventromesial margin and ventral surface smooth. Coxa without spines on distal margin, but with tuft of long stiff setae ventromesially.

Left cheliped (Figs 9E; 11A, B) reaching or slightly overreaching base of dactylus of right cheliped, weakly compressed laterally; setation generally similar to that of right. Chela elongate subovate in dorsal view, 2.90-3.30 times longer

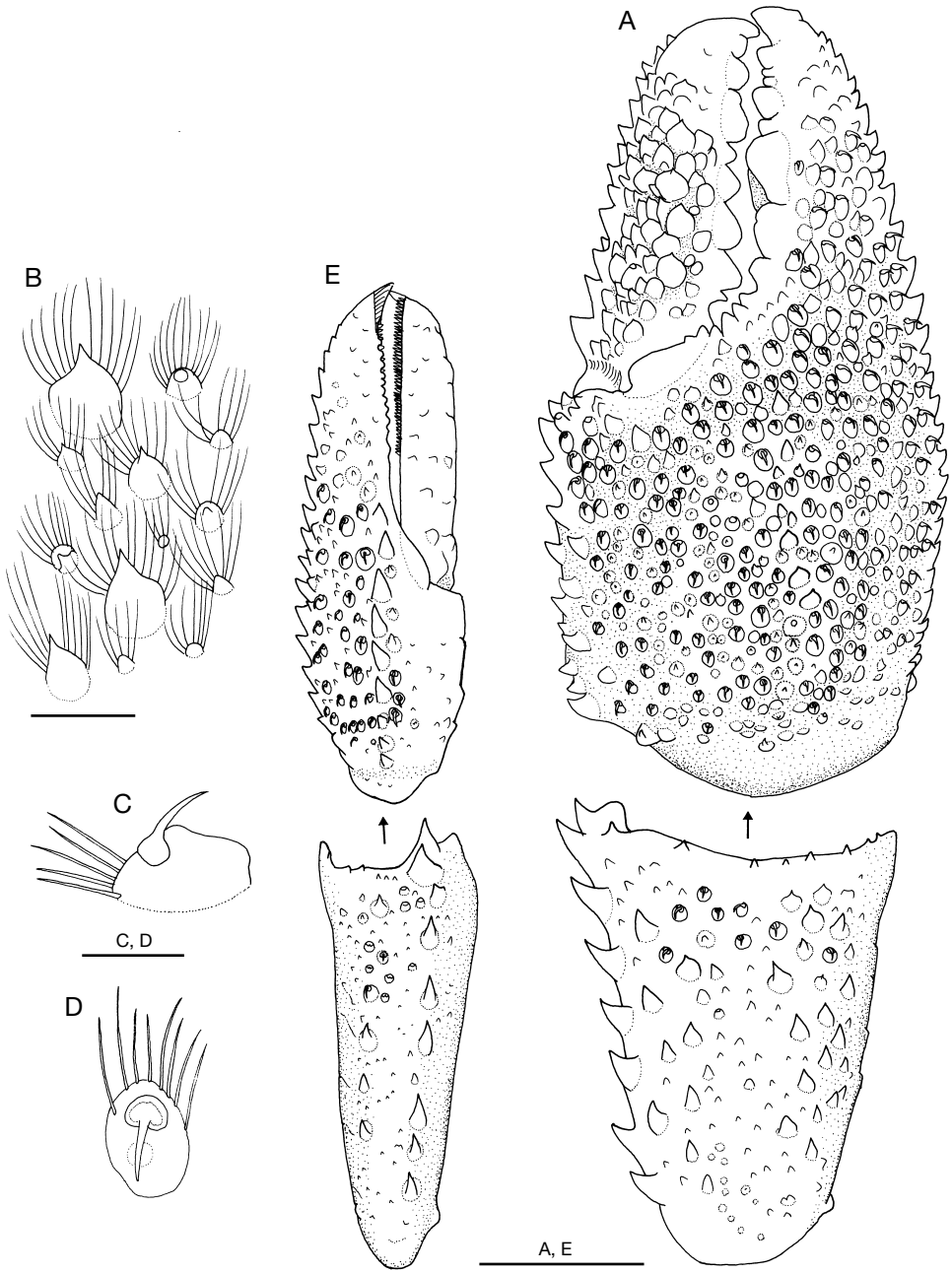

FIG. 9. — *Pagurus similis* (Ortmann, 1892), ♂ sl 9.7 mm, from off Katsuyama Ukishima Islet, Boso Peninsula (CBM-ZC 3958); **A**, chela and carpus of right cheliped, dorsal (setae omitted); **B**, spines and tubercles on dorsal surface of palm of right chela, dorsal; **C**, capsulate tubercles on dorsal surface of right chela, mesial; **D**, same, dorsal; **E**, chela and carpus of left cheliped, dorsal (setae omitted). Scale bars: A, E, 5 mm; B, 1 mm; C, D, 0.5 mm.

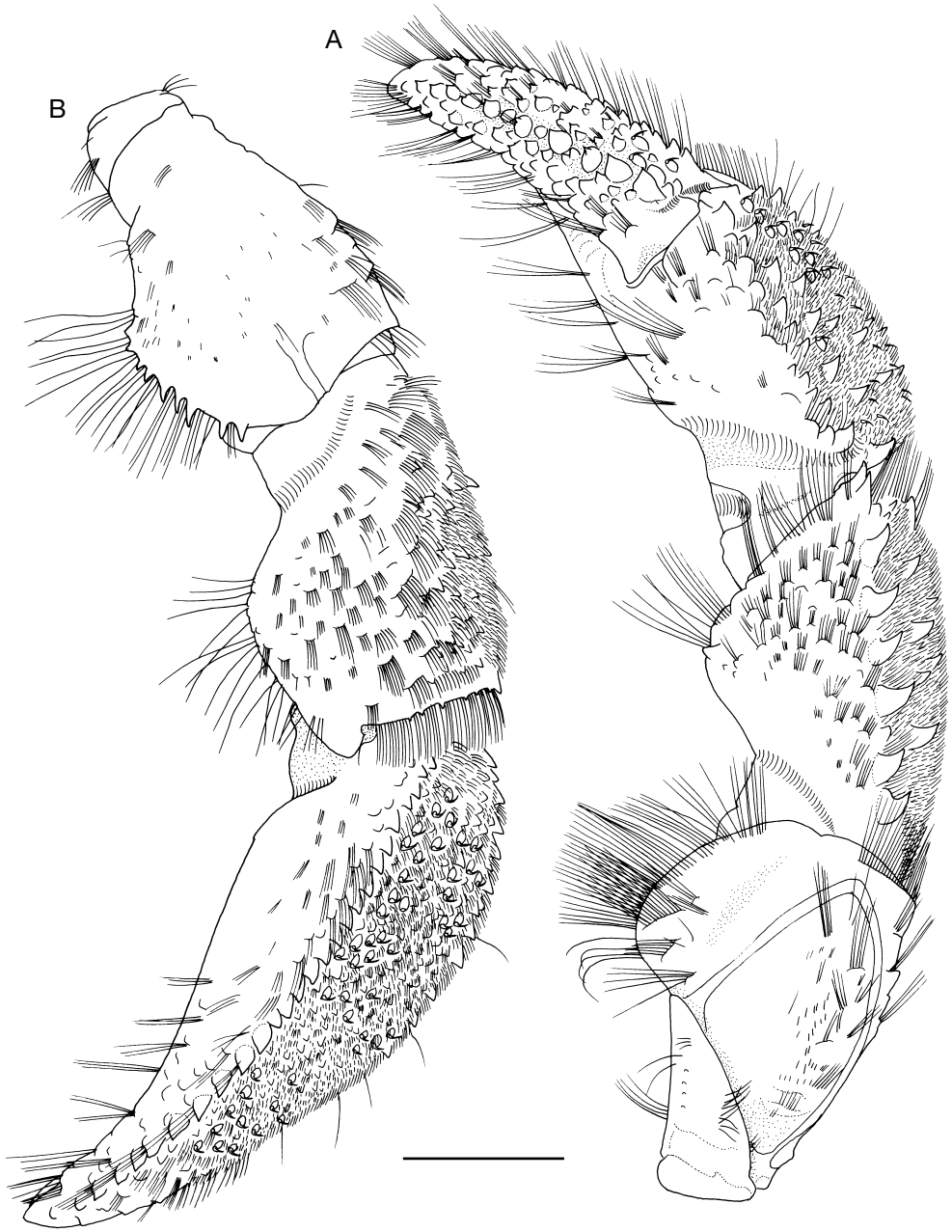

FIG. 10. — *Pagurus similis* (Ortmann, 1892), ♂ sl 9.7 mm, right cheliped, from off Katsuyama Ukishima Islet, Boso Peninsula (CBM-ZC 3958); **A**, mesial; **B**, lateral. Scale bar: 5 mm.

than greatest width at base of dactylus. Dactylus much longer than palm, slightly curved ventrally; cutting edge with row of small calcareous teeth in proximal 0.70-0.80 (several distal teeth interspersed by small corneous teeth) and with row of small corneous teeth in distal 0.20-0.30, terminating in large corneous claw; dorsal surface sloping mesially, proximally with few small spinulose

tubercles. Palm about half length of carpus, triangular in cross section; dorsal surface elevated in midline but not forming distinct ridge or crest, with row of moderately large spines decreasing in size distally and extending onto proximal 0.20-0.40 of fixed finger; dorsolateral margin with row of small spines; dorsolateral and dorsomesial surfaces strongly sloping ventrally, former surface with covering of capsulate tubercles extending to proximal half of fixed finger, and latter surface with some capsulate tubercles dorsally and also with few small spinulose tubercles; dorsomesial margin not distinctly delimited; ventrolateral face with some very low tubercles; ventral surface weakly inflated. Carpus subequal in length to merus; dorsomesial margin with row of slender spines; dorsolateral margin weakly delimited, with row of four to six small spines; dorsal surface somewhat sloping, with several capsulate tubercles and tiny tubercles; dorsodistal margin with row of tiny spines; mesial face with scattered low protuberances, distomesial margin smooth; lateral face covered with numerous low, sometimes multidenticulate protuberances, ventrolateral distal margin not strongly expanded, distally with row of small spines or tubercles. Merus without spine on dorsodistal margin; mesial face with tufts of moderately long setae dorsally, proximally and ventrally, ventromesial margin with few spinulose tubercles; lateral face ventrally with several small, low, somewhat squamous tubercles, ventrolateral margin not strongly expanded, with row of spines increasing in size distally; ventral surface weakly concave. Ischium and coxa similar to that of right cheliped.

Second and third pereopods (Figs 8H-K; 11C, D) similar from right to left in armature and setation. Dactyli 1.30-1.80 times as long as propodi, in dorsal view slightly twisted, in lateral view weakly curved ventrally, terminating in moderately long to long corneous claws; dactylus of right third pereopod 8.00-10.30 times as long as high in males, 7.20-9.16 times as long in females; dorsal surfaces each with tufts of short setae and row of corneous spines increasing in length distally; lateral faces each with tufts of stiff setae dorsally and ventrally and with faint median sulcus proximally; mesial faces each with rows of corneous spines, increasing in length distally and tufts of setae dorsally and ventrally; ventral margins each with nine to 12 long corneous spines, increasing in length distally. Propodi distinctly longer than carpi; dorsal surfaces each with short transverse ridges accompanied by rows of moderately short setae, often extending to lateral face, but without spine; lateral faces each with short transverse ridges accompanied by setae dorsally and sparse tufts of shorter setae ventrally; ventral surfaces each with row of widely separated tufts of setae and small corneous spines. Carpi with two moderately small spines on dorsal surfaces of second (dorsodistal spine and one spine arising posterior to midlength), only with dorsodistal spine in third; dorsal surfaces each with some tufts of moderately short plumose setae; lateral faces each with tufts of moderately long plumose setae on midline. Meri moderately broad, each with dorsal and ventral tufts of short to moderately short plumose setae; lateral faces each with few minute setae, ventrolateral distal margins unarmed. Ischium with dorsal and ventral tufts of setae. Female with paired gonopores.

Fourth pereopods (Fig. 7D) semichelate, similar from right to left, but left slightly shorter than right. Dactylus curved ventrally, terminating in long corneous claw, with row of fine corneous teeth on ventral margin; preungual process subequal in length to distalmost corneous spine, terminating bluntly, flexible. Propodal rasp composed of six or seven rows of corneous scales; dorsal margin of propodus with small but distinct, blunt tubercle proximally; all segments with dorsal and/or ventral tufts of long setae.

Fifth pereopod chelate; males with paired gonopores (Fig. 7F), each partially obscured by moderately long setae.

Third thoracic sternite with pair of minute spines on either side of shallow median notch on anterior margin. Sixth thoracic sternite with anterior lobe (Fig. 7G) subsemicircular, weakly to somewhat skewed to left, with numerous setae on anterior face. Eighth thoracic sternite (Fig. 7F) developed anteriorly as two somewhat flattened subrectangular lobes separated by shallow median

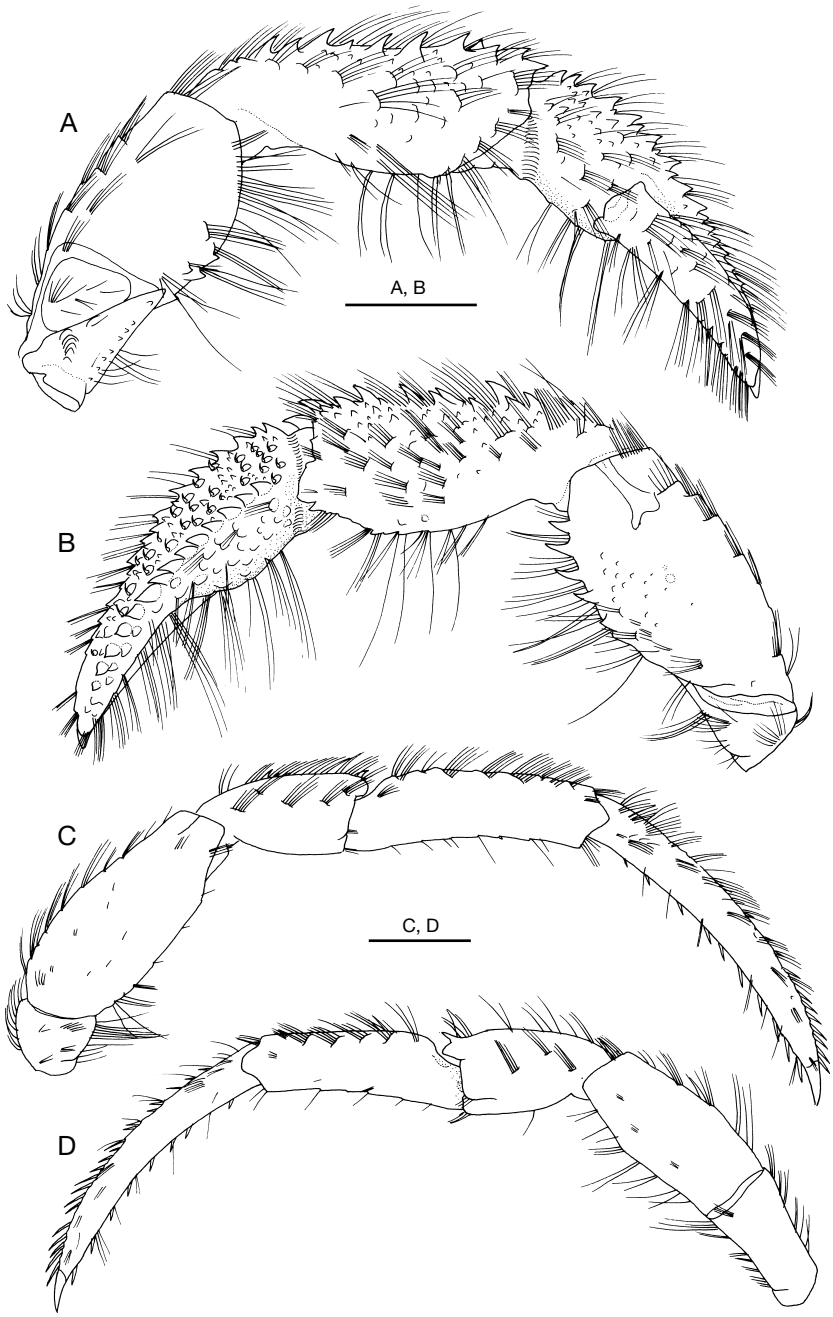

FIG. 11. — *Pagurus similis* (Ortmann, 1892), ♂ sl 9.7 mm, from off Katsuyama Ukishima Islet, Boso Peninsula (CBM-ZC 3958); **A**, left cheliped, mesial; **B**, same, lateral; **C**, right second pereopod, lateral; **D**, left third pereopod, lateral. Scale bars: 5 mm.

depression, anterior margins each with row of setae.
Abdomen twisted. Males with four unpaired left (second to fifth) pleopods, all four unequally biramous (exopods well developed, endopods much shorter than exopod, but not rudimentary). Females also with four unpaired left pleopods, anterior three subequally biramous, fifth as in males. Uropods greatly asymmetrical; exopods and endopods both well developed rasps.
Telson (Fig. 7H) wider than long, with deep lateral indentations; posterior lobes slightly to somewhat asymmetrical, separated by small median cleft; terminal margins weakly oblique, each with row of five to seven closely spaced long spines and several minute to small submarginal spines; lateral margins usually dentate or spinose.

COLORATION
In life: generally light orange or tan. Shield with blotches of orange at base of rostrum either side of midline and large purple patches laterally; posterior carapace sometimes reddish. Ocular peduncle generally white, with orange band medially and with orange patch at base of cornea. Antennular peduncle generally dark orange; ultimate segment banded with white distally and basally; penultimate segment white in distal part. Antennal peduncle generally orange; fifth segment white dorsally and ventrally. Right cheliped with dark red spot on mesial face centrally; small spines on dorsal surface of palm whitish; spines, spinules and tubercles on dorsal surface of carpus dark orange; mesial surface of carpi with tinge of dark orange proximally; lateral surface of merus with L-shaped line on lateral surface distally. Color and markings of left cheliped similar to that of right, but lacking dark red spot on mesial face of palm. Dactyli of ambulatory pereopods generally dark orange, each with white patch slightly distal to midlength and red median stripe on lateral and mesial faces; propodi each with two dark orange patches, one on proximal half of dorsal surface and one at about midlength of ventral surface; lateral face with short brown longitudinal stripe distally and short obliquely transverse ridges (accompanied with setae) colored with dark red; carpi each with large orange or red spots on lateral and ventral surfaces respectively; meri each with longitudinal white stripe on lateral face adjacent to dorsal margin and with tinge of red dorsally.

SIZE
Males sl 7.7-14.7 mm; females sl 7.2-13.7 mm; ovigerous females sl 7.7-13.7 mm.

VARIATION
See Variation for *P. rubrior* n. sp.

REMARKS
See under *P. rubrior* n. sp.

Pagurus rubrior n. sp.
(Figs 6B; 12; 13)

Eupagurus japonicus – Ortmann 1892: 309, pl. 12, fig. 16. Non *Eupagurus japonicus* Stimpson, 1858. See Remarks.

Pagurus similis – Miyake 1960: 90 (part), pl. 45, fig. 5; 1975: pl. 115, figs 6, 9; 1978: 103 (part), fig. 40, pl. 2, fig. 3; 1982: 125 (part), pl. 42, fig. 2; 1991: 125 (part), pl. 42, fig. 2; 1998: 125 (part), pl. 42, fig. 2. — Suzuki 1971: 97, pl. 34, fig. 4. — Kim 1973: pl. 7, fig. 39. — Miyake & Imafuku 1980: 60 (part). — Takeda 1982: 67 (part); 1986: 124, unnumbered fig.; 1994: 228, fig. 5. — Asakura 1995: 362, pl. 97, fig. 4. — Kobayashi 2000: 186, unnumbered fig. — Minemizu 2000: 149, unnumbered fig. — Park & Choi 2001: 139, unnumbered fig. See Remarks.

TYPE MATERIAL. — Holotype: **Japan.** Hota, Boso Peninsula, lobster net, 10 m, 18.VI.1998, coll. T. Komai, ♂ sl 13.2 mm (CBM-ZC 4778).
Paratypes: **Japan.** Tokyo Bay, exact location unknown, 1882, coll. L. Döderlein, 3 ♂♂ sl 18.9-19.0 mm, 3 ♀♀ sl 14.7-15.7 mm (MZS 481); Hota, Boso Peninsula, lobster net, 10-20 m, 21.V.1994, coll. T. Komai, 2 ♂♂ sl 10.7, 16.0 mm, 1 ♀ sl 15.1 mm (CBM-ZC 470); off Takeoka, Boso Peninsula, gill net, 20-30 m, 1.VIII.1994, coll. T. Komai, 1 ♂ sl 13.9 mm, 1 ♀ sl 15.9 mm (CBM-ZC 566); Takeoka, lobster net, 10-20 m, 29.VIII.1994, coll. T. Komai, 3 ♂♂ sl 10.3-19.3 mm, 1 ♀ sl 12.4 mm, 3 ovig. ♀ sl 10.4-16.7 mm (CBM-ZC 608); Ubara, Katsuura, Boso Peninsula, scuba diving, 3-6 m, VI.1994, coll. M. Aizawa, 1 ♂ sl 11.7 mm (CBM-ZC 892); off Takeoka, gill net, *c.* 30 m, 28.VIII.1996, 1 ♂ sl 13.1 mm (CBM-ZC 2968); Hota, lobster net, *c.* 10 m, 18.VI.1998, coll. T. Komai, 3 ♂♂ sl 16.0-21.0 mm (CBM-ZC 4779); off Takeoka, gill net, 20-30 m, 18.VI.1998, 1 ♀ sl 17.3 mm (CBM-

ZC 4780); Hota, lobster net, 5-6 m, 20.XII.1998, 2 ♂♂ sl 12.3 mm, 1 ♀ sl 17.6 mm (CBM-ZC 4848); Takeoka, lobster net, 5-10 m, II.1999, 3 ♂♂ sl 11.5-18.7 mm, 1 ♀ (sl 11.7 mm) (CBM-ZC 6288); similar locality, lobster net, 23.VIII.2000, 1 ♂ sl 16.0 mm, 1 ovig. ♀ sl 17.6 mm (CBM-ZC 6289), 1 ♂ sl 14.9 mm (MNHN-Pg 6099); similar locality, lobster net, VIII.1997, 1 ♂ sl 21.2 mm, 1 ovig. ♀ sl 14.3 mm (MNHN-Pg 6098); similar locality, lobster net, 5 m, 8.III.2002, 4 ♂♂ sl 12.1-14.7 mm (MNHN-Pg). — Sagami Bay, exact location unknown, 1903, coll. A. Haberer, 1 ♂ sl 14.7 mm, identified by Balss (1913) as *Eupagurus japonicus* (ZSM 289/1); Kamegisho, dredge, 14 m, 25.VII.1957, identified by Miyake (1978) as *P. similis*, det. No. 191, 1 ♀ not measured (NSMT-CrR 1372); Kamegisho, dredge, 13-14 m, 11.VII.1962, identified by Miyake (1978) as *P. similis*, det. No. 463, 1 ♂ sl 13.5 mm (NSMT-CrR 2012); off Hayama, Miura Peninsula, lobster net, 5-10 m, V.1993, coll. H. Ikeda, 1 ♂ sl 16.1 mm, 1 ♀ sl 16.4 mm (HSM-Cra 0132); Kaneda Bay, Miura Peninsula, 10 m, V.1993, coll. H. Ikeda, 1 ♀ 18.0 mm (HSM); Jogashima Islet, lobster net, 8 m, VIII.1993, coll. H. Ikeda, 2 ♂♂ sl 13.3, 17.0 mm (HSM). — Kii Peninsula, Izumo, Kushimoto, lobster net, depth not recorded, 23.XI.1976, coll. M. Imafuku, reported by Miyake & Imafuku (1980) as *P. similis*, 2 ♀♀ sl 6.7, 9.9 mm (OMNH-Ar 1798, 1799); off Minabe, lobster net, depth not recorded, 17.XI.1976, coll. M. Imafuku, reported by Miyake & Imafuku (1980) as *P. similis*, 1 ♂ sl 10.6 mm (OMNH-Ar 1826). — Sea of Japan, Takasa, Echizen, Fukui Prefecture, scuba, 10 m, 29.V.2001, coll. T. Sugimoto, 1 ♂ sl 15.4 mm, 1 ♀ sl 9.4 mm (CBM-ZC 6447).

TYPE LOCALITY. — Hota, Boso Peninsula, central Japan, at depth of 10 m.

ETYMOLOGY. — The name is derived from the comparative of the Latin adjective *ruber* and reflects the redder color of this new species compared to the other close relatives of *Pagurus*.

DISTRIBUTION. — Pacific coast of Japan southward from Boso Peninsula to Kyushu, Sea of Japan coast of southern part of Honshu mainland, and Korea.

HABITAT. — Rocky bottom, subtidal depth to about 30 m. Using gastropod shells, e.g., *Turbo cornutus* Lightfoot, 1786, *Tonna luteostoma* (Küster, 1857), *Cymatium parthenopeum* (Salis Marshlins, 1793), and *Charonia lampas sauliae* (Reeve, 1844).

DESCRIPTION

Shield (Fig. 12A) 1.00-1.10 times as long as broad; anterior margin between rostrum and lateral projections concave; anterolateral margins sloping or slightly terraced; posterior margin truncate; dorsal surface with four to six pairs of tufts of setae; paragastric grooves inconspicuous. Rostrum broadly triangular, rounded or terminating in acute or subacute spine, reaching or slightly overreaching lateral projections. Lateral projections obtusely triangular, with marginal or submarginal spinule. Posterior carapace similar to that of *P. similis*.

Ocular peduncle (Fig. 12A) 0.50-0.60 time as long as shield, weakly inflated basally; cornea not dilated, its maximum diameter 0.25-0.30 of length of ocular peduncle and subequal to basal diameter. Ocular acicle (Fig. 12A) narrowly triangular, slightly curved ventrally, terminating subacutely or bluntly and usually with slender submarginal spine.

Antennular peduncle (Fig. 12A) overreaching cornea by 0.30-0.50 length of ultimate segment. Ultimate segment 1.20-1.40 times longer than penultimate segment, slightly broadened distally in lateral view.

Antennal peduncle (Fig. 7A) overreaching distal margin of cornea by 0.20-0.40 length of fifth segment. Second segment with dorsolateral distal angle strongly produced, reaching midlength to distal margin of fourth segment, terminating in simple or bifid spine; dorsomesial distal angle with small spine. First segment laterally with small submarginal spine, ventromesial distal margin with few spinules laterally. Antennal acicle reaching or slightly overreaching distal margin of cornea, arcuate, terminating in acute spine; mesial margin with row of tufts of long stiff setae. Antennal flagellum longer than fully extended right cheliped, every article with some minute setae.

Mouthparts generally similar to those of *P. similis*. Third maxilliped with three to five (rarely two) accessory teeth on ischium (Fig. 12B).

Chelipeds grossly unequal. Right cheliped (Fig. 13A) with chela 1.40-1.70 times longer than greatest width at base of dactylus in females and small males, but noticeably elongate in large males, length attaining twice maximum width. Dactylus with closely-spaced, broad spines or tubercles on dorsal surface, showing imbricate appearance (some tubercles in proximal half of dactylus capsulate); dorsomesial margin nearly

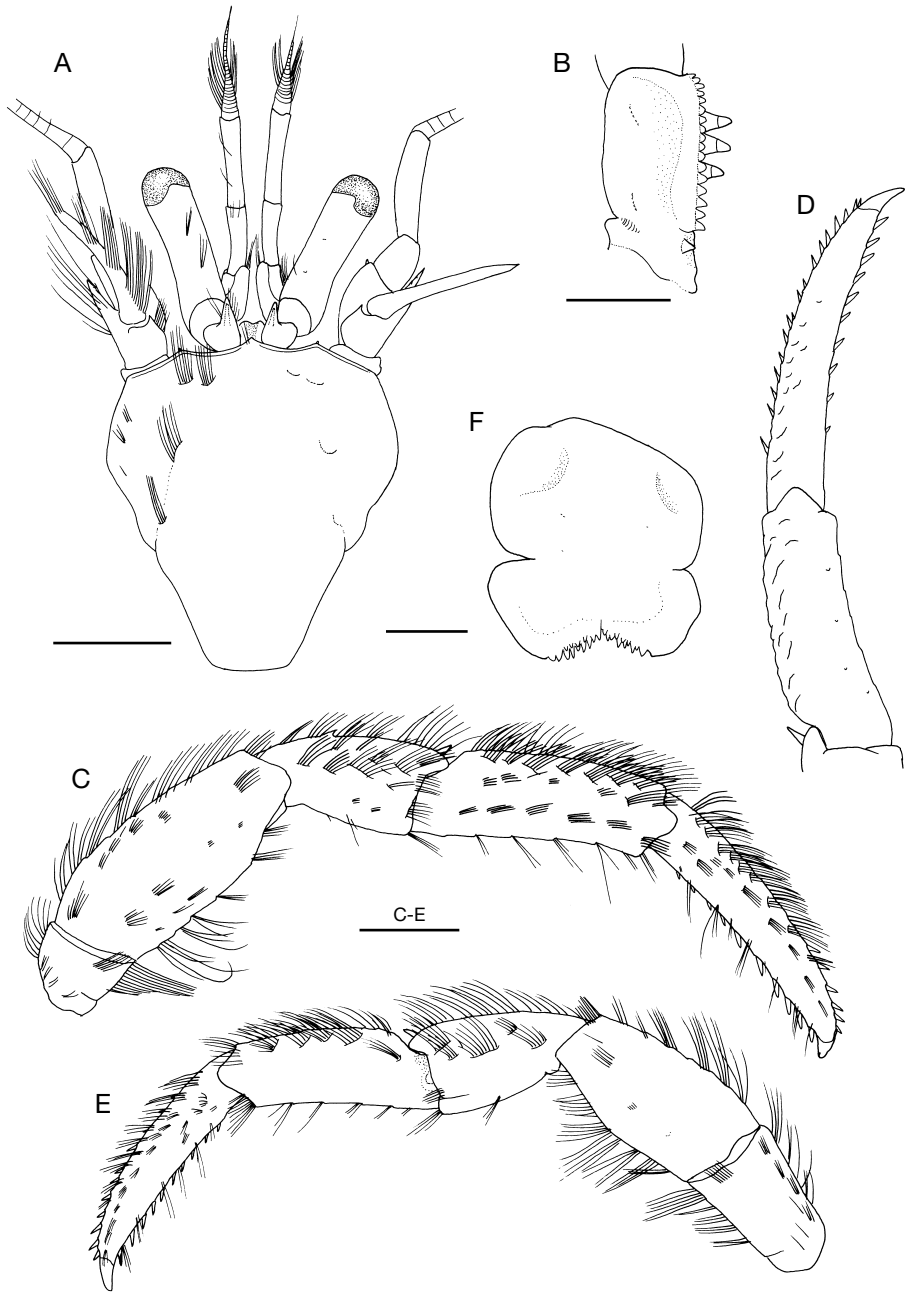

FIG. 12. — *Pagurus rubrior* n. sp., holotype ♂ sl 13.2 mm, from off Hota, Boso Peninsula (CBM-ZC 4778); **A**, shield and cephalic appendages, dorsal (setae omitted from right); **B**, ischium of third maxilliped, dorsal (setae omitted); **C**, right second pereopod, lateral; **D**, dactylus and propodus of right third pereopod, lateral (setae omitted); **E**, left third pereopod, lateral; **F**, telson, dorsal (setae omitted). Scale bars: A, C-E, 5 mm; B, F, 2 mm.

straight in lateral view, with row of moderately large, forwardly directed tubercles or spines; mesial face with numerous, low, broad spines; ventral surface with several low, squamiform tubercles and scattered tufts of moderately long stiff setae. Palm shorter than carpus; dorsomesial margin delimited by single or double row of moderately small spines; dorsolateral margin with row of small spines decreasing in size proximally; dorsal surface convex, with sparse tufts of long setae and numerous, small, capsulate tubercles and spinules, and also with row of moderately small spines on midline of dorsal surface extending onto fixed finger; corneous, spiniform capsules weakly curved backward, arising from anterior part of tubercles, basal pores rounded or "heart-shaped"; spinules and capsulate tubercles on dorsal surface of palm each with several short plumose setae arising from anterior bases; mesial face of palm flat or slightly concave, with scattered low, squamiform protuberances; ventral surface with several low, broad protuberances. Carpus subequal in length to merus; dorsomesial margin distinctly delimited by row of moderately large spines; dorsal surface with numerous spinulose or capsulate tubercles and several moderately large spines adjacent to dorsolateral margin and with dense covering of short plumose setae; dorsolateral margin not delimited; lateral face with low, broad, sometimes multidenticulate protuberances dorsally, and small, low protuberances ventrally, ventrolateral distal margin smooth; mesial face slightly concave, ventromesial distal margin without row of spines; ventral surface with some spinulose tubercles. Merus with short transverse rows of setae on dorsal surface; dorsodistal margin lacking spine; mesial face somewhat inflated ventrally in large males, not inflated in small males and females; in large males, ventromesial margin produced, unarmed or armed only with few small spines proximally, and with numerous long setae; in females and small males, ventromesial margin not produced, with row of small spines and sparse setae; ventrolateral margin with row of small spines and numerous setae; ventral surface with scattered long setae, more strongly concave in large males than in females and small males. Ischium with smooth ventromesial margin and ventral surface smooth. Coxa without spines on distal margin.

Left cheliped (Fig. 13B) weakly compressed laterally. Chela elongate subovate in dorsal view, 2.80-3.20 times longer than greatest width at base of dactylus. Dactylus much longer than palm. Palm about half length of carpus, triangular in cross section; dorsal surface elevated in midline but not forming distinct ridge or crest, with row of moderately large spines extending onto proximal 0.20-0.40 of fixed finger; dorsolateral margin with row of small spines; dorsolateral and dorsomesial surfaces strongly sloping ventrally, former surface with covering of capsulate tubercles extending to proximal half of fixed finger, and latter surface with some capsulate tubercles dorsally and also with few small spinulose tubercles; dorsomesial margin not distinctly delimited. Carpus subequal in length to merus; dorsomesial margin with row of slender spines; dorsolateral margin weakly delimited, with row of four to six small spines; dorsal surface somewhat sloping, with several capsulate tubercles and tiny spinulose tubercles; dorsodistal margin with row of tiny spines; mesial face with scattered low protuberances, distomesial margin smooth; lateral face with numerous low, sometimes multidenticulate protuberances, ventrolateral distal margin not strongly expanded, distally with row of small spines or tubercles. Merus without spine on dorsodistal margin; ventromesial margin with few spinulose tubercles; lateral face ventrally with several small, low, somewhat squamous tubercles, ventrolateral margin not strongly expanded, with row of spines increasing in size distally; ventral surface weakly concave. Ischium and coxa similar to that of right cheliped.

Second and third pereopods (Fig. 12C-E) stouter than in *P. similis*. Dactyli 1.20-1.60 times as long as propodi; dactylus of right third pereopod 6.20-7.77 times as long as high in males, 5.13-6.37 times as long in females; dorsal surfaces each with tufts of short setae and row of corneous spines increasing in length distally; ventral margins each with eight to 11 long corneous spines increasing in length distally. Propodi longer than carpi; dor-

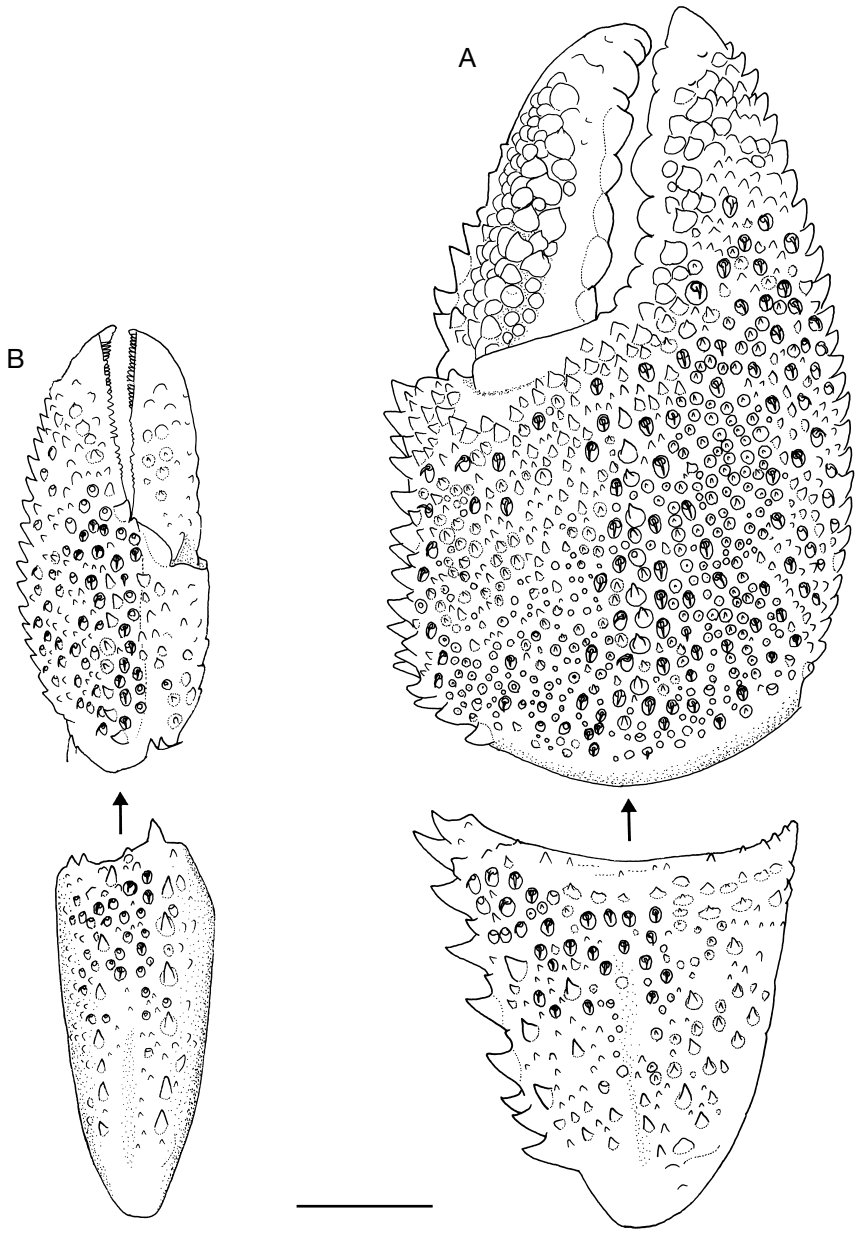

FIG. 13. — *Pagurus rubrior* n. sp., holotype ♂ sl 13.2 mm, from off Hota, Boso Peninsula (CBM-ZC 4778); **A**, chela and carpus of right cheliped, dorsal (setae omitted); **B**, chela and carpus of left cheliped, dorsal (setae omitted). Scale bar: 5 mm.

sal surfaces each with short transverse ridges accompanied by rows of moderately short setae, but without spines. Carpi with two moderately small spines on dorsal surfaces of second, only with dorsodistal spine in third. Meri broad, ventrolateral distal margins unarmed.

Fourth pereopods with dactylus bearing row of fine corneous teeth on ventral margin; preungual

process subequal in length to distalmost corneous spine, terminating bluntly, flexible. Propodal rasp composed of six or seven rows of corneous scales.
Males with four unpaired left (second to fifth) pleopods, all four unequally biramous. Females also with four unpaired left pleopods.
Telson (Fig. 12F) wider than long, with deep lateral indentations; posterior lobes, separated by small median cleft; terminal margins weakly oblique, each with row of five to nine closely spaced shot to long spines and several smaller submarginal spines; lateral margins smooth or weakly dentate.

COLORATION

In life: generally red or purplish red. Shield with patches of dark red laterally. Ocular peduncle generally white, with red band medially and with red patch at base of cornea. Antennular peduncle generally red; ultimate segment banded with white distally and proximally; penultimate segment white distally. Antennal peduncle generally red; fifth segment white dorsally and ventrally. Right cheliped with dark red or purple spot on mesial face centrally; small spines on dorsal surface of palm reddish; spines, spinules and tubercles on dorsal surface of carpus dark red; mesial surface of carpi with tinge of dark red proximally; lateral surface of merus with L-shaped line on lateral surface distally. Color and markings of left cheliped similar to that of right, but lacking dark red spot on mesial face of palm. Dactyli of ambulatory pereopods generally dark red, each with white patch slightly distal to midlength and red median stripe on lateral and mesial faces; propodi each with two dark red blotches, one on proximal half of dorsal surface and one at about midlength of ventral surface; lateral face with very short, faint, red longitudinal stripe distally, short obliquely transverse ridges (accompanied with setae) not or lightly colored with red; carpi each with large red blotches on lateral and ventral surface respectively; meri each with longitudinal white stripe and tinge of dark red dorsally.

SIZE

Males sl 10.4-21.0 mm; females sl 6.7-17.6 mm; ovigerous females sl 10.4-17.6 mm.

VARIATION

In both *P. similis* and *P. rubrior* n. sp., the right cheliped exhibits considerable variation in males, similar to that observed in *P. japonicus*. It shows a tendency of elongation, particularly in the chela, with increase of overall body size. In large males, the ventromesial margin of the merus is thickened and sometimes noticeably produced ventrally, bearing numerous long setae. In females and small males, the ventromesial margins is not expanded or thickened, with sparse setae and a row of spines.
The dactylus of the right third pereopod tends to be more elongate in males than in females in both species (Fig. 14). In *P. similis*, the proportional ratio "length/proximal depth" ranges from 8.00 to 10.30 (9.26 on average, N = 15) in males and from 7.20 to 9.16 (8.18 on average, N = 8) in females; in *P. rubrior* n. sp., the ratio ranges from 6.20 to 7.77 (6.59 on average, N = 21) in males and from 5.13 to 6.37 (6.09 on average, N = 14) in females. The difference in the mean values between male and female is significant in each species (in *P. similis*: $t = 3.7026$, d.f. = 20, $p < 0.01$; in *P. rubrior* n. sp.: $t = 2.6912$, d.f. = 34, $p < 0.02$).

REMARKS

Ortmann (1892) briefly described *Eupagurus similis* from a single male specimen collected in Kagoshima Bay, Kyushu, southern Japan, but did not illustrate his specimen. He compared this species with *E. japonicus* sensu Ortmann (1892) and separated the taxa by lengths of the antennal peduncle and antennal acicle as opposed to the ocular peduncle (longer in *P. similis* than in *P. japonicus* sensu Ortmann), acuteness of the ocular acicle (more acute in the former than in the latter), development of a median row of spines on the right palm (less distinct in the former than in the latter), shape of the right palm (more elongate in the former than in the latter) and shape of the ambulatory dactyli (more elongate and slender in the former than in the latter). It has been found that most of these characters do not provide taxonomic significance in discriminating the two morphs of *Pagurus similis* s.l., because of variation. Nevertheless, the shape of

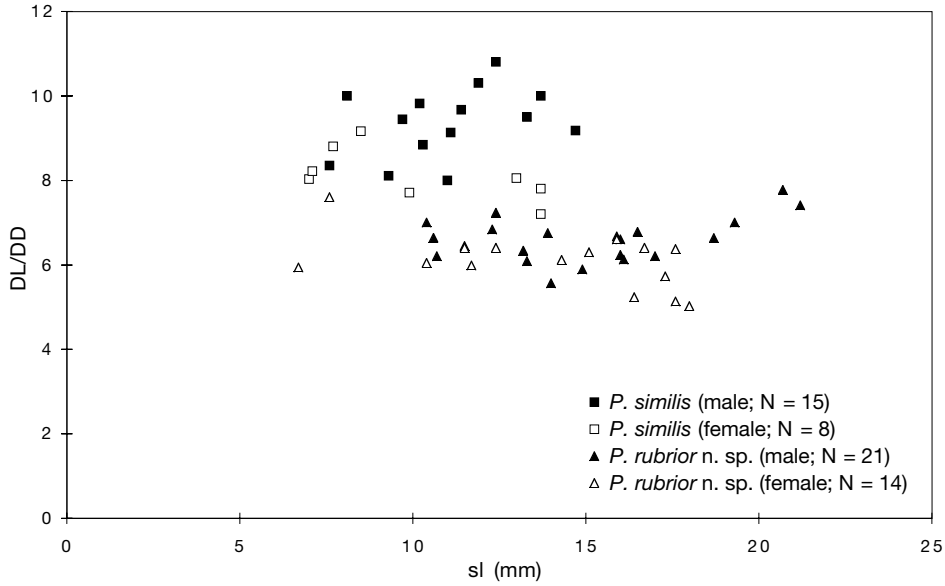

FIG. 14. — Scatter plot showing proportional length of dactylus of right third pereopod (DL/DD) against shield length (sl) of *Pagurus similis* (Ortmann, 1892) and *P. rubrior* n. sp. Abbreviations: **DL**, length of dactylus; **DD**, proximal depth of dactylus.

the ambulatory dactyli are reliable in distinguishing the two morphs (see below). The dactyli are more elongate and slender in the orange morph than in the red morph. Therefore, the orange morph is considered to represent the true *P. similis*. The red morph, corresponding to *P. japonicus* sensu Ortmann, is described as new, *P. rubrior* n. sp.

Pagurus similis and *P. rubrior* n. sp. are very similar to each other. The most useful is the shape of the dactylus of the right third pereopod. The dactylus of the right third pereopod is much more slender in *P. similis* than in *P. rubrior* n. sp. (Fig. 14). In males, the proportional ratio "length/proximal depth" ranges from 8.00 to 10.30 (9.26 on average, N = 15) in *P. similis*, from 6.20 to 7.77 (6.59 on average, N = 21) in *P. rubrior* n. sp.; in females, from 7.20 to 9.16 (8.18 on average, N = 8) in *P. similis*, from 5.13 to 6.37 (6.09 on average, N = 14) in *P. rubrior* n. sp. (Fig. 14). Further, the ocular peduncle is proportionally longer in *P. similis* than in *P. rubrior* n. sp. (0.60-0.70 time as long as the shield versus 0.50-0.60 time as long). The tubercles on the palm of the right chela are much more numerous and denser in *P. rubrior* n. sp. than in *P. similis* (cf. Figs 13A; 9A). The number of the accessory teeth on the third maxilliped is generally greater in *P. rubrior* n. sp. than in *P. similis*, though it partially overlaps (Fig. 15). The ischium of the third maxilliped is provided with three to six (most frequently three or four) accessory teeth on either side in *P. rubrior* n. sp., rather than one to three (most frequently one) in *P. similis*. The general color is bright yellow or light tan in *P. similis*, red or purplish-red in *P. rubrior* n. sp.; the short ridges accompanied with row of setae on the dorsolateral surfaces of the ambulatory propodi are dark red in *P. similis*, but not darkly colored in *P. rubrior* n. sp. In addition, *Pagurus similis* is known in deeper waters than *P. rubrior* n. sp. The present specimens of *P. similis* were collected from sublittoral depths ranging from 20 to 200 m, while the specimens of *P. rubrior* n. sp. were collected at depths of 5 to 30 m.

Pagurus hirtimanus is immediately distinguished from both *P. similis* and *P. rubrior* n. sp. by the strongly dilated corneas and the roundly convex dorsal surface of the left palm. In *P. similis* and

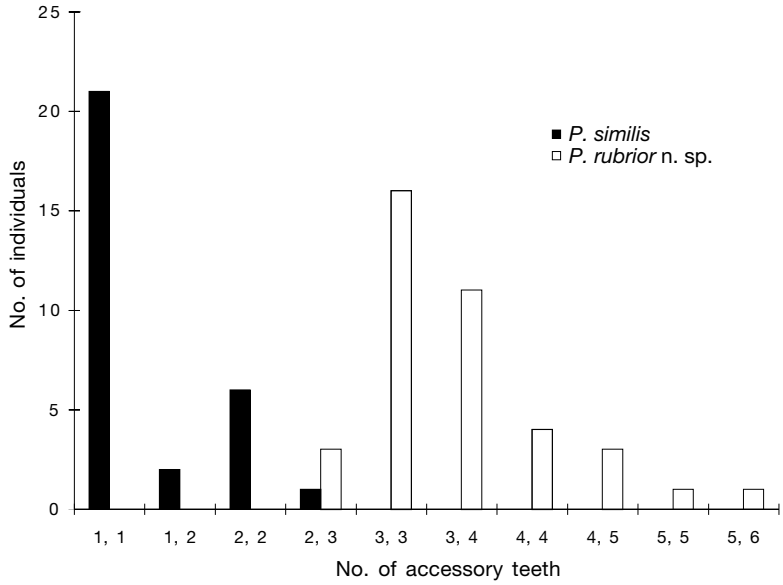

FIG. 15. — Frequency distribution of number of accessory teeth on ischia of third maxillipeds of *Pagurus similis* (Ortmann, 1892) and *P. rubrior* n. sp. The numbers of the accessory teeth are indicated by combination of numbers counted from both sides. In the case of asymmetrical number of teeth, the arrangement does not precisely represent the actual side of the appendage, but only combination of numbers.

P. rubrior n. sp., the dorsal surface of the left palm is strongly elevated in the midline. Further, the structure of the capsulate tubercles on the chela is different between *P. hirtimanus*, and the latter two species. In *P. hirtimanus*, the slender capsules arise from the central part of the tubercle, rather than the anterior slope of the tubercles in the latter two species. *Pagurus capsularis* differs from *P. similis* and *P. rubrior* n. sp. in the more dilated corneas, lack of dense dorsal covering of setae on the chelae that is seen in the latter two species, and the more strongly oblique terminal margins of the telson. As mentioned previously, *P. pergranulatus* is characteristic in the morphology of the right cheliped (see Remarks under *P. japonicus*).

Doflein (1902) reported *Eupagurus similis* from Yokohama in Tokyo Bay. The two females used by Doflein (1902) (ZSM 303/1; size not measured) were reexamined, and found that they actually represent *P. dubius* (Ortmann, 1892).

Terao (1913) placed *Eupagurus similis* in the synonymy of *E. japonicus*, but he did not comment further. However, Asian workers have accepted that *P. similis* and *P. japonicus* are distinct. A part of the specimens identified as *P. similis* by Miyake (1978) and Miyake & Imafuku (1980) have been reexamined. As expected, *P. similis* and *P. rubrior* n. sp. are mixed in the material studied by Miyake (1978). The following three specimens represent the true *P. similis*: 1 ovig. ♀ (NSMT-CrR 1619, Miyake det. No. 294), 1 ovig. ♀ (NSMT-CrR 1757, Miyake det. No. 373) and 1 ♀ (NSMT-CrR 2220, Miyake det. No. 545); the other two specimens are *P. rubrior* n. sp.: 1 ♀ (NSMT-CrR 1372, Miyake det. No. 191) and 1 ♂ (NSMT-CrR 2012, Miyake det. No. 463). The three specimens studied by Miyake & Imafuku (1980) (OMNH-Ar 1798, 1799, 1826) are *P. rubrior* n. sp. Most of the published color photographs referred to as *P. similis* (Suzuki 1971: pl. 34, fig. 4; Miyake 1975: pl. 115, figs 6, 9; 1978: pl. 2, fig. 3; 1982: pl. 42, fig. 2; Takeda 1986: unnumbered fig.; 1994: 228, fig. 5; Asakura 1995: pl. 97, fig. 4; Kobayashi 2000: unnumbered fig.; Minemizu 2000: unnumbered fig.) all actually depict

P. rubrior n. sp.; only Yu & Foo (1990) shows the true *P. similis*. In listings, such as those of Miyake (1960, 1975, 1982, 1991, 1998), Suzuki (1971), Takeda (1982), which contain brief species accounts written in Japanese, my inclusion of the author's citation as "in part" has been based on the species bathymetric range indicated. References by Alcock (1905) and Gordan (1956) are bibliographic treatments.

Kim (1964, 1970, 1973, 1985) reported *P. similis* from various locations in Korea. The photographed specimen (Kim 1973: pl. 7, fig. 39) seems to represent *P. rubrior* n. sp. because of the relatively stout ambulatory legs. However, neither sufficient diagnostic information nor depth records were given in Kim's accounts, and thus is difficult to know whether his material contained either *P. similis*, *P. rubrior* n. sp., or both, without direct examination of the material. M.-H. Kim and J.-N. Kim of Pukyon National University, Pusan, kindly provided me with a photograph depicting a specimen of *Pagurus similis* s.s. from Korean waters. The underwater photograph taken in Korean waters and published by Park & Choi (2001) clearly shows a specimen of *P. rubrior* n. sp. Therefore, there is no doubt that both species occur in Korean waters. Therefore, Kim's references are questionably referred to *P. similis*.

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