JOURNAL OF CRUSTACEAN BIOLOGY, 19(1): 188–205, 1999

IDENTITY OF *PAGURUS OBTUSIFRONS*, WITH DESCRIPTION OF A NEW SPECIES OF *PAGURUS* (DECAPODA: ANOMURA: PAGURIDAE)

Tomoyuki Komai and Hsiang-Ping Yu

ABSTRACT

A review of the taxon heretofore known as *Pagurus obtusifrons* (Ortmann, 1892) has shown that it is conspecific with *Pagurus yokoyai* Makarov, 1938, which has recently been transferred to the genus *Propagurus* McLaughlin and de Saint Laurent, 1998. Thus, the name *Propagurus obtusifrons* should be used for the species that has been called as *Pagurus yokoyai*. The species to which the name *Pagurus obtusifrons* has been applied represents a new species, here described as *Pagurus confusus*. These two species are described and illustrated in detail. The new species is also compared with *P. arcuatus* Squires, 1964, and *P. parvispina* Komai, 1997.

Ortmann (1892) described a number of new species of hermit crabs from Japan based on material collected by Ludwig Döderlein during his stay in Japan from 1879–1881, among them *Eupagurus obtusifrons*. This species was originally described from Sagami Bay, and subsequently reported from various localities in Japan and Taiwan (Yokoya, 1933, 1939; Miyake, 1978, 1982; Baba *et al.*, 1986; Yu and Foo, 1990; Takeda and Miyauchi, 1992).

Ortmann's (1892) description of *Eupagurus obtusifrons* was very brief, and the only characters he reported that might have been considered diagnostic were the rostrum not overreaching the lateral projections, stout ocular peduncles, and setose, spiny chelipeds. Later, Yokoya (1933) reported this species from various localities in Japanese waters. Miyake (1978, 1982) and subsequent authors (Baba *et al.*, 1986; Yu and Foo, 1990; Okutani, 1994) interpreted *Pagurus obtusifrons* similarly to Yokoya (1933). Yokoya (1933) also described a new species, *Eupagurus gracilipes*, from near Tanabe, Wakayama, Japan. Although Yokoya's *E. gracilipes* appeared similar to Ortmann's taxon, Yokoya compared his species only with *Pagurus pectinatus* (Stimpson, 1858) (as *Eupagurus pectinatus*). Makarov (1938, 1962) proposed the replacement name, *Pagurus yokoyai*, for Yokoya's taxon, since Yokoya's name was preoccupied by *Eupagurus gracilipes* Stimpson, 1858. Subsequent investigators (Miyake, 1951; Okada *et al.*, 1966; Miyake, 1978, 1982; Miyake and Imafuku, 1980; Baba *et al.*, 1986; McLaughlin, 1997) have used Makarov's name. Recently, *Pagurus yokoyai* was transferred to the newly established genus *Propagurus* McLaughlin and de Saint Laurent, 1998.

The first author has reexamined the type material of Ortmann's *Eupagurus obtusifrons*, deposited in the Musée Zoologique in Strasbourg, France, and has found that this taxon has been misinterpreted by Yokoya (1933) and others, and that it actually is a senior subjective synonym of Yokoya's *Eupagurus gracilipes*. Although Yokoya's type material has not been located, from his description and the information provided by subsequent authors there is little doubt of the conspecificity of the two taxa. In order to clarify its taxonomic status, Ortmann's taxon is redescribed and illustrated in detail. The species heretofore assigned to *Pagurus* (or *Eupagurus*) *obtusifrons* represents a new species, herein described as *Pagurus confusus*.

The specimens examined in this study are deposited in the following institutions: Natural History Museum and Institute, Chiba (CBM); Musée Zoologique, Strasbourg (MZ); and National Taiwan Ocean University, Keelung (NTOU). The general terminology used in the description is that of McLaughlin (1974), with exception of the posterior carapace (see Lemaitre, 1995), the fourth pereiopod (see McLaughlin, 1997), and the biserial or quadriserial gill structure (see McLaughlin and de Saint Laurent, 1998). The abbreviation sl indicates shield length measured from the tip of the rostrum to the midpoint of the posterior margin of the shield. The drawings were made with the aid of a drawing tube mounted on a Leica MZ8 stereomicroscope.

SYSTEMATIC ACCOUNTS

Propagurus obtusifrons (Ortmann, 1892)
Figs. 1–5

Eupagurus obtusifrons Ortmann, 1892: 313, pl. 12, fig. 8 (type locality: Sagami Bay, Japan, 270 m); Alcock, 1905: 177; Balss, 1913: 53 (key); Terao, 1913: 371.

Eupagurus gracilipes Yokoya, 1933: 89, fig. 33 (type locality: near Tanabe, Wakayama Prefecture, 192 m). [Junior homonym of *Eupagurus gracilipes* Stimpson, 1858].

Pagurus obtusifrons: Makarov, 1938: 216, fig. 70; 1962: 205, fig. 70; Gordan, 1956: 332 (part).

Pagurus yokoyai Makarov, 1938: 185 (replacement name for *Eupagurus gracilipes* Yokoya, 1933; preoccupied by *Eupagurus gracilipes* Stimpson, 1858) [new synonym]; 1962: 175; Okada *et al.*, 1966: 138, 149, 151; Miyake, 1978: 110, figs. 44, 45; 1982: 131, pl. 44, fig. 1; Miyake and Imafuku, 1980: 60; Baba *et al.*, 1986: 209, 305, fig. 154; McLaughlin, 1997: 536, fig. 27i.

Eupagurus yokoyai: Miyake, 1951: 138.

Pagurus gracilipes: Gordan, 1956: 330. [Not *Pagurus gracilipes* (Stimpson, 1858)].

Propagurus yokoyai: McLaughlin and de Saint Laurent, 1998: 181, figs. 4D, 7D, 10B, D, 11G–I, 12C, D.

Not *Eupagurus obtusifrons*: Yokoya, 1933: 85. [Partially referred either to *Pagurus confusus*, new species, or *P. parvispina* Komai, 1997; see "Remarks"].

Not *Eupagurus obtusifrons*: Yokoya, 1939: 285. [See "Remarks"].

Not *Pagurus obtusifrons*: Miyake, 1978: 106, pl. 2, fig. 4; 1982: 128, pl. 43, fig. 5; Baba *et al.*, 1986: 202, figs. 151, 203, 304; Yu and Foo, 1990: 65, unnumbered fig.; Okutani, 1994: 228, fig. 6. [=*Pagurus confusus*, new species. See "Remarks"].

Not *Pagurus obtusifrons*: Takeda and Miyauchi, 1992: 144. [?=*Pagurus parvispina* Komai, 1997. See "Remarks"].

Type Material.—See "Material examined."

Material Examined.—**Japan.** Sagami Bay, 270 m; 1881; collected by L. Döderlein; holotype (by monotypy), ♀ (sl 6.2 mm) (Fig. 1); MZ 486.—Off Kochi, Tosa Bay, Shikoku, 190 m; 10 August 1991; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 3 ♂♂ (sl 8.7–9.3 mm); CBM-ZC 189.—Same locality, 90–190 m; 7 July 1992; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 2 ♂♂ (sl 7.9, 8.5 mm), 2 ♀♀ (sl 7.9, 8.9 mm); CBM-ZC 193.—Southeast of Katsuyama Ukishima Islet, Boso Peninsula, 140–220 m; 10 May 1995; gill net; collected by T. Komai and M. Miya; 2 ♂♂ (sl 14.0, 14.8 mm); CBM-ZC 1668.—Off Shionomisaki, Kii Peninsula, Kumano-nada, 250 m; 15 January 1990; dredge; collected by S. Nagai; 1 ♀ (sl 4.4 mm); CBM-ZC 2484.—Off Kochi, Tosa Bay, 33°17.12′N, 133°40.2′E, 150–154 m; 5 March 1993; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 1 ♀ (sl 9.6 mm); CBM-ZC 3390.—Same locality, 146–150 m; 7 October 1992; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 2 ♂♂, 1 ♀ (sl 7.6–9.4 mm); CBM-ZC 3458.—Off Kochi, Tosay Bay, 33°16.02′N, 133°40.02′E, 189–190 m; 9 April 1993; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 2 ♂♂ (9.1, 11.7 mm), 4 ♀♀ (8.9–9.3 mm); CBM-ZC 3837.—Off Owase, Kumano-nada, 34°02.36′N, 136°23.66′E, 226 m; 16 December 1996; trawl; 1 ♂ (sl 13.0 mm); CBM-ZC 4039.—Same locality, 34°06.81′N, 136°27.37′E, 169 m; 16 December 1996; trawl; 2 ♂♂ (sl 11.0, 13.0 mm); CBM-ZC 4041.

Taiwan. Off Su-Aou, northeastern Taiwan, 100–200 m; 6 August 1996; commercial trawler; collected by T.-Y. Chan and T. Komai; CBM-ZC 2923.—Same data; 1 ♂ (sl 9.2 mm); NTOU.—Same locality, depth unknown; 18 November 1997; commercial trawler; collected by T.-Y. Chan; 2 ♂♂ (sl 7.1, 7.9 mm), 2 ♀♀ (sl 8.2, 9.3 mm); NTOU.—Off Ta-Shi, northeastern Taiwan, depth unknown; 30 May 1997; commercial trawler; 1 ♂ (sl 13.9 mm); NTOU.

Redescription.—Thirteen pairs of asymmetrical, quadriserial gills (Fig. 2J); two well-developed arthrobranchs on each third maxilliped to fourth pereiopod; single small pleurobranch on fifth and sixth thoracic somites, and single very well-developed pleurobranch on seventh thoracic somite.

Shield (Fig. 2A) 1.0–1.3 times longer than wide; anterior margin between rostrum and lateral projections concave; anterolateral margins sloping; posterior margin truncate; dorsal surface with tufts of setae laterally. Rostrum obtusely triangular or rounded, with or without small subterminal spine, reaching level of lateral projections, partially obscured by tufts of setae. Lateral projections triangular, very prominent, with relatively strong submarginal spine. Interocular lobe with concave anterior surface. Posterior carapace membranous except for calcified posteromedian plate, with scattered tufts of long setae on branchial region; posteromedian plate defined anteriorly by subparallel cardiac sulci, with 2 pairs of tufts of setae along cardiac sulci; sulci cardiobranchiales broader, extending to midlength between posterior margin of shield and posteromedian margin of carapace, subparallel or slightly divergent posteriorly.

Ocular peduncles (Fig. 2A) moderately short, 0.6–0.8 times as long as shield; corneal region not dilated; dorsal or dorsomesial surface with row of tufts of moderately long setae. Ocular acicles roundly triangular, terminating subacutely, and with moderately strong subterminal spine; separated basally by basal width of one acicle; dorsal surface concave, with tufts of short setae.

Antennular peduncles (Fig. 2A) overreaching ocular peduncles by 0.2–0.5 length of ultimate segment. Ultimate segment 1.2–1.3 times longer than penultimate segment, with 1 or 2 setae at dorsodistal margin and with row of short setae on dorsal surface. Basal segment with or without lateral spine.

Fig. 1. *Propagurus obtusifrons* (Ortmann, 1892). Holotype from Sagami Bay (MZ 486, female, sl 6.2 mm), entire animal in dorsal view.

Antennal peduncles (Fig. 2A) reaching or overreaching distal margin of cornea by 0.3–0.4 length of fifth segment; with supernumerary segmentation. Fifth and fourth segments with few scattered setae. Third segment with moderately strong spine at ventrodistal angle partially obscured by tufts of long stiff setae. Second segment with dorsolateral distal angle prominently produced, reaching nearly to distal margin of fourth segment, terminating in simple or bifid spine and with some spines on mesial margin partially obscured by thick setae; dorsomesial distal angle with prominent spine. First segment with or without small spine on lateral margin, ventrodistal margin produced, with 5 or 6 small spines. Antennal acicle long, reaching beyond midlength of fifth segment of peduncle and beyond distal margin of cornea; somewhat sinuous, terminating in acute spine, mesial margin with row of tufts of stiff setae. Antennal flagellum usually longer than extended right cheliped, with few short setae on each article and 1–3 longer setae on articles 8–14.

Mandible without distinctive features. Maxillule (Fig. 2B) with external lobe of endopod well developed, straight; internal lobe with 2 apical bristles. Maxilla (Fig. 2C) with endopod extending as far as distal margin of anterior lobe of scaphognathite. First maxilliped (Fig. 2D) with endopod just reaching distal margin of distal endite. Second maxilliped (Fig. 2E) with partially fused basis and ischium; basal segment of exopod moderately

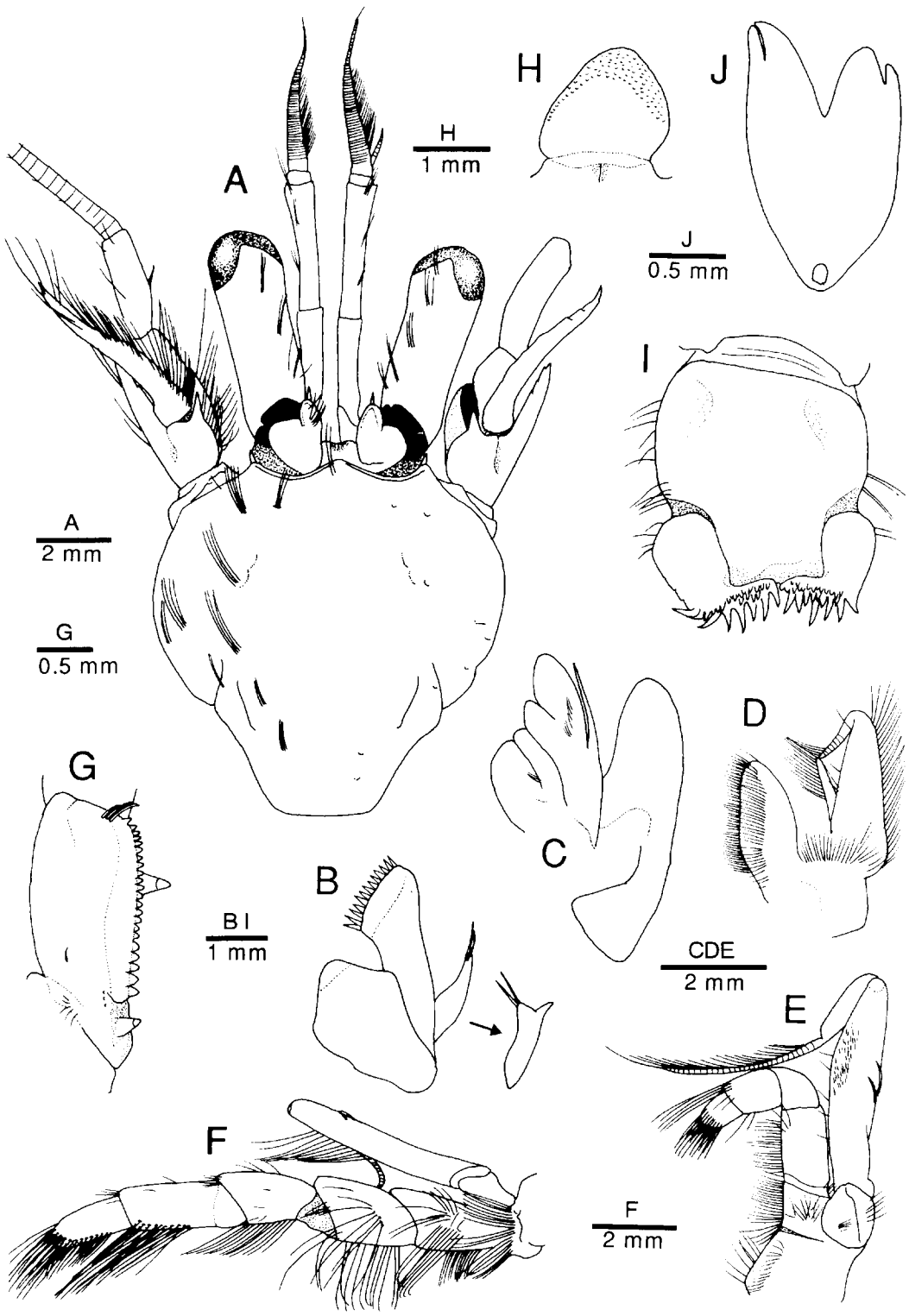

Fig. 2. *Propagurus obtusifrons* (Ortmann, 1892). Male from Tosa Bay (CBM–ZC 3837, sl 9.5 mm). Appendages dissected from left. A, shield and cephalic appendages, dorsal; B, maxillule, external; inset, endopod, lateral; C, maxilla, external, setae omitted; D, first maxilliped, external; E, second maxilliped, external; F, third maxilliped, lateral; G, same, ischium, dorsal; H, anterior lobe of sixth thoracic somite, ventral; I, telson, dorsal; J, gill element from anterior arthrobranch on fourth pereiopod.

stout, with patch of minute bristles on external surface. Third maxilliped (Fig. 2F) with merus and ischium thickly setose on lateral surface; carpus with small distodorsal spine; merus unarmed on dorsodistal margin, but with small ventromesial spine; crista dentata on ischium (Fig. 2G) composed of fine row of small corneous teeth and 1 accessory tooth; basis with 1 prominent spine on mesial surface.

Chelipeds grossly unequal; spines of chelae and carpi usually with tiny corneous tips and most practically obscured by tufts of long thick setae. Right cheliped (Fig. 3) with chela 1.6–1.8 times as long as wide; dactyl slightly longer than palm measured along mesial margin; cutting edge with row of 5 strong calcareous teeth and short distal row of corneous teeth, terminating in strong corneous claw, slightly overlapped by fixed finger; dorsal surface convex, with median row of small spines decreasing in size distally but extending nearly to tip; dorsomesial margin with row of spines also decreasing in size distally and extending nearly to base of terminal claw; mesial and ventral surfaces with scattered tufts of long setae. Dorsal surface of fixed finger with submedian row of spines decreasing in size distally and tufts of stiff setae mesially, cutting edge with 4 irregular calcareous teeth, terminating in strong corneous claw. Palm 0.6–0.7 length of carpus; dorsomesial margin with convex general profile in dorsal view, only weakly delimited by quasi-double row of strong spines, usually with 1 more prominent spine, directed backward, at dorsoproximal angle, convex dorsal surface with 7–9 irregular rows of strong spines; dorsolateral margin not distinctly delimited except on fixed finger; mesial, lateral, and ventral surfaces with low, sometimes spinulose protuberances and tufts of long setae. Carpus moderately broad and short in females and small males, but becoming elongate and slender in males with increasing size, becoming slightly broader distally; dorsomesial margin with double row of moderately strong to strong spines, dorsal surface with scattered small spines or low, sometimes spinulose protuberances and tufts of long setae, distal margin with row of small spines laterally and few larger spines mesially; dorsolateral margin not delimited, lateral face with scattered tufts of long setae and spinulose tubercles ventrally, laterodistal angle produced, denticulate, laterodistal ventral margin with row of small spines or spinulose tubercles; mesial face with few small spines or spinulose tubercles dorsally and tufts of short rows of long setae, mesiodistal margin with row of small subacute or blunt spines; ventral surface inflated, with few spinules and tufts of long setae. Merus subtriangular; dorsodistal margin with 2–4 slender spines, dorsal surface with short transverse rows of setae; lateral face minutely spinulose, with few tufts of setae, ventrolateral margin with row of small spines not extending to proximal margin; mesial face with scattered vertical or obliquely vertical short rows of setae, ventromesial margin with row of small spines, proximal 2 or 3 often prominent; ventral surface with numerous tufts of long setae, without prominent spine or tubercle. Ischium with row of small tubercles on ventromesial margin, setose on ventromesial and ventrolateral margins. Coxa with row of small spines on ventrolateral margin.

Left cheliped (Fig. 4) with chela moderately broad, greatest breadth at base of dactyl, 1.9–2.1 times as long as broad; dactyl 1.75 times to more than twice length of palm; cutting edge with row of small corneous teeth in distal 0.6–0.7 and row of small calcareous teeth proximally, terminating in strong corneous claw; dorsomesial margin not delimited, but with few small spines proximally, dorsal midline unarmed or with few spinules or spinulose tubercles proximally; dorsal, mesial, and ventral surfaces with scattered tufts of long setae. Palm nearly half length of carpus, triangular in cross section; dorsal surface with submedian row of strong spines decreasing in size distally, extending to half, sometimes nearly to tip of fixed finger; dorsolateral margin with double row of strong spines, decreasing in size and becoming single row on distal part of fixed finger; dorsolateral surface sloping, with row of strong spines decreasing in size distally; dorsomesial surface sloping, with scattered small spines, dorsomesial margin with row of spines becoming strong distally; ventral surface weakly inflated, with few low protuberances; cutting edge of fixed finger with row of small corneous teeth distally and row of small calcareous teeth proximally, terminating in strong corneous claw; all surfaces with numerous tufts of long setae. Carpus approximately as long as merus; dorsolateral

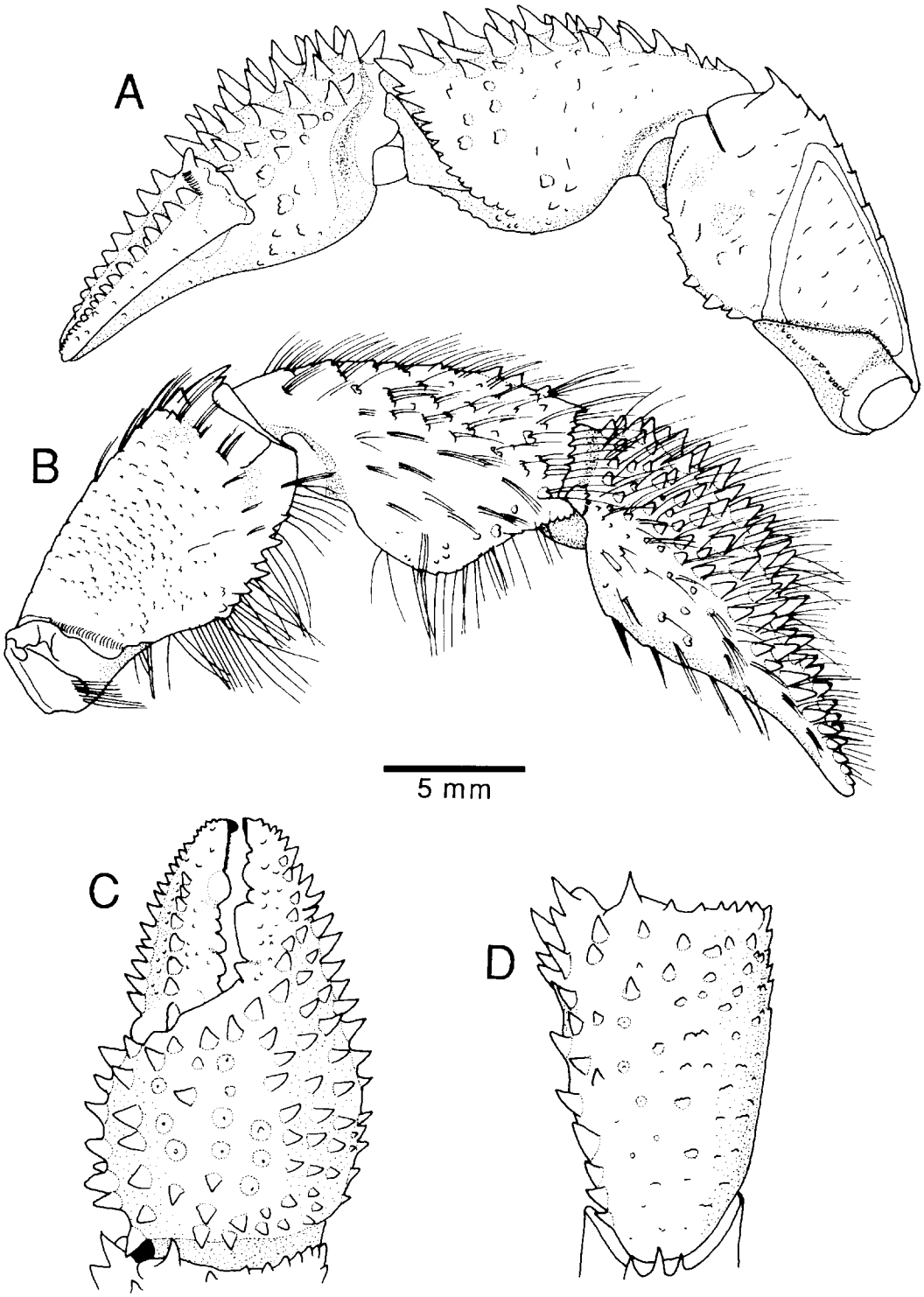

Fig. 3. *Propagurus obtusifrons* (Ortmann, 1892). Male from Tosa Bay (CBM–ZC 3837, sl 9.5 mm). A, right cheliped, mesial, setae omitted; B, same, lateral; C, same, chela, dorsal, setae omitted; D, same, carpus, dorsal, setae omitted.

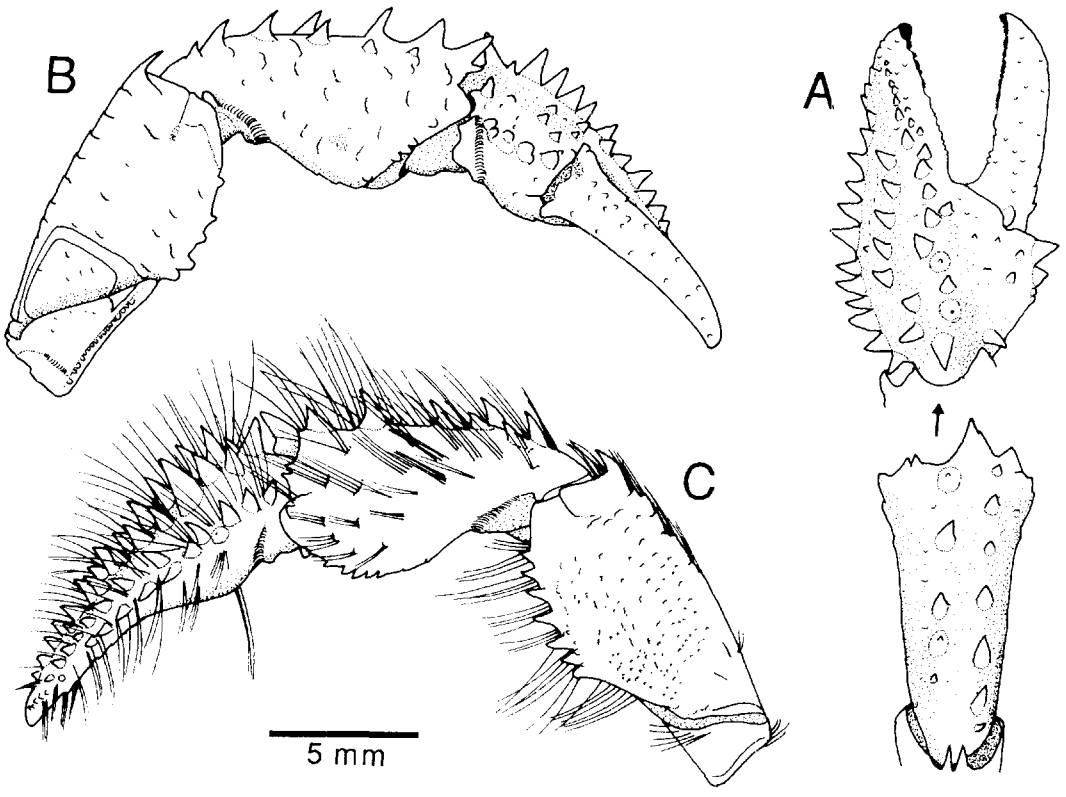

Fig. 4. *Propagurus obtusifrons* (Ortmann, 1892). Male from Tosa Bay (CBM–ZC 3837, sl 9.5 mm). A, left cheliped, dorsal, setae omitted; B, same, mesial, setae omitted; C, same, lateral.

and dorsomesial margins each with row of strong spines, becoming stronger distally, dorsodistal margin with 1 very strong spine; laterodistal margin with few spines dorsally, lateral face with low, frequently spinulose protuberances and long setae, ventrolateral margin with row of small spines and long setae; mesial face with scattered short rows of long setae, ventromesial margin with row of few blunt submarginal spines; ventral surface moderately well inflated, with scattered tufts of long setae. Merus with low, sometimes spinulose protuberances each bearing row of setae on dorsal surface; mesial face with few low protuberances and short vertical rows of setae, ventromesial margin with row of small to moderately small spines, proximal 1 or 2 often prominent; lateral face minutely spinulose, lacking setae, ventrolateral margin with row of moderately strong spines, proximal 1 or 2 prominent, and tufts of long setae; ventral surface with tufts of long setae. Ischium with row of spinules or tubercles on ventromesial margin. Coxa with row of small spinules on ventrolateral margin.

Ambulatory pereiopods (Fig. 5A–D) with dactyls 1.2–1.5 times longer than propodi; in dorsal view slightly to moderately twisted, in lateral view weakly curved ventrally, terminating in moderately strong corneous claws; dorsal margins each with 2 rows of long thick setae; lateral faces each with weak to prominent longitudinal sulcus and few setae (second and right third), dense but randomly placed long setae on left third; mesial surfaces (Fig. 5C, D) each with weak to prominent longitudinal sulcus, second pereiopods with row of tufts of stiff setae along ventral margin and single or double row of strong corneous spines on dorsal margins, third flanked by rows of strong corneous spines often interspersed with tufts of setae; ventromesial surfaces each with 7–15 strong corneous spines, increasing in length distally, and tufts of long setae. Propodi distinctly longer than carpi; dorsal surfaces each with

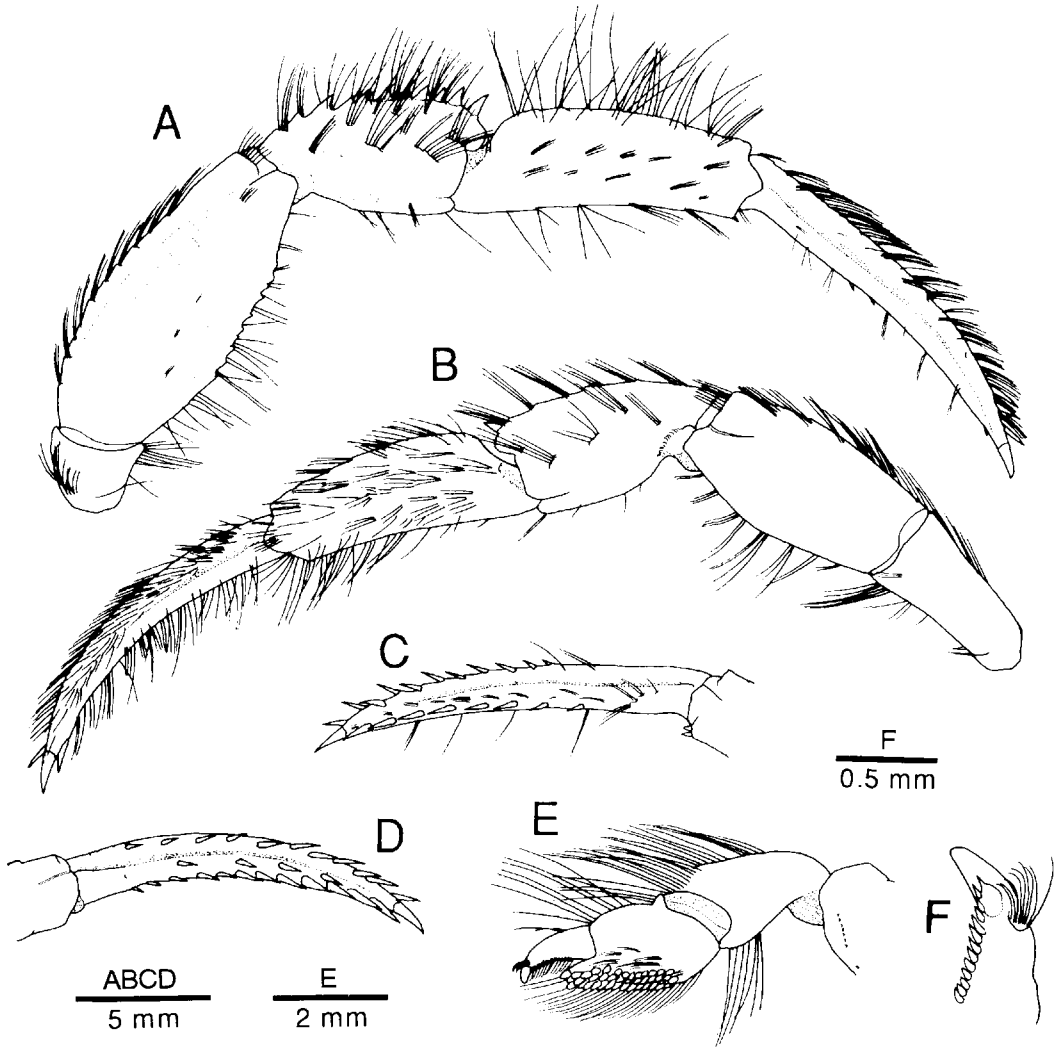

Fig. 5. *Propagurus obtusifrons* (Ortmann, 1892). Male from Tosa Bay (CBM-ZC 3837, sl 9.5 mm). A, right second pereiopod, lateral; B, left third pereiopod, lateral; C, dactyl of right second pereiopod, mesial, setae omitted; D, dactyl of left third pereiopod, mesial, setae omitted; E, distal three segments of fourth pereiopod, lateral; F, distal part of dactyl of fourth pereiopod, lateral.

row of low transverse protuberances and tufts of long setae; lateral faces each with 2 or 3 longitudinal rows of sparse tufts of setae on second and right third pereiopods, left third with entire surface covered (but not extremely densely) by short transverse rows of moderately short stiff setae; mesial faces with few scattered setae; ventrodistal margins each with 1 or 2 small corneous spinules, ventral surfaces with row of tufts of setae, more numerous on left and much denser on left third. Carpi distinctly shorter than meri; second pereiopods each with row of strong spines partially obscured by long setae on dorsal surface, third each with dorsal subdistal spine, dorsal surface unarmed or often with few small spines or tubercles partially obscured by row of tufts of setae; lateral faces also with few short, obliquely longitudinal rows of setae; ventral surfaces each with few tufts of setae. Meri each with several transverse rows of long setae dorsally and tufts of longer setae ventrally, second also with single or double row of small spines on ventral margin; ven-

trolateral distal margins unarmed; lateral and mesial faces each with few tufts of short setae. Ischia with dorsal and ventral tufts of setae, ventral margins unarmed. Paired gonopores on coxae of third pereiopods in female.

Fourth pereiopods (Fig. 5E) semichelate, thickly setose on dorsal and ventral faces of propodus, carpus, merus, and ischium; preungual process (Fig. 5F) on dactyls small, generally ovate, with small distal spinule; propodus with weakly convex ventral margin, propodal rasp well developed, with 3 rows of corneous scales.

Fifth pereiopods chelate; coxae nearly symmetrical, male gonopores obscured by tufts of setae.

Third thoracic sternite with 1 pair of submedian spines on anterior margin and 1 pair of tufts of stiff setae on ventral surface. Sixth thoracic sternite (Fig. 2H) with subsemicircular anterior lobe, with dense long setae anteriorly, but unarmed. Eighth thoracic sternite developed anteriorly as 2 somewhat flattened semirectangular lobes separated by shallow median depression, anterior margins each with row of setae.

Males with 3 unequally biramous unpaired pleopods, all with exopods moderately well developed, endopods rudimentary. Females with 4 unpaired biramous pleopods; exopods of second to fourth similarly developed, endopods successively becoming longer, that of second about 1.2 times longer than exopod, that of third about 2.0 times longer than exopod, and that of fourth elongate, attaining more than 2.5 times longer than exopod; exopod of fifth reduced, endopod nearly as long as that of third. Uropods asymmetrical; both exopods and endopods with well-developed rasps.

Telson (Fig. 2I) with distinct transverse indentations; posterior lobes asymmetrical, separated by small median cleft; dorsal surface with distinct inner demarcations of thickened, partially calcified regions; terminal margins noticeably elevated medially, slightly oblique, each with row of 4–8 strong calcareous spines occasionally interspersed with smaller calcareous spines, lateral 2 or 3 strongly curved lateroventrally, and small double or triple row of submarginal calcareous blunt spinules; lateral margins generally convex, unarmed or sometimes faintly denticulate.

Color.—In life, body and appendages generally light brown. Shield with tinge of reddish brown laterally; posterior carapace with scattered obscure pale spots. Ocular peduncle with purple dorsal surface, paler at base of cornea and base of ocular peduncle, with dark reddish brown spot near base. Antennal flagellum with alternating white and brown bands. Chelipeds generally light brown, with tinge of darker brown on dorsodistal part of each merus. Ambulatory pereiopods with tinge of reddish brown on distolateral part of each merus, ventrodistal part white. In preservative, fading to straw color.

Size.—Largest male: sl 13.9 mm; largest female: sl 9.3 mm; ovigerous female: 8.9 mm.

Distribution.—Previously known from the Pacific coast of Japan from Boso Peninsula to Kyushu. Present material extending its known geographical range to northeastern Taiwan. Occurring at depths of 38–400 m.

Affinities.—As mentioned by McLaughlin (1997) (as *Pagurus yokoyai*), the present species appears very similar to *Propagurus haigae* (McLaughlin, 1997), known from Indonesia, New Caledonia, and the Coral and Tasman Seas (McLaughlin and de Saint Laurent, 1998). The affinities between the two species has been discussed by McLaughlin and de Saint Laurent (1998). *Propagurus obtusifrons* is superficially similar to species of the *capillatus* group of *Pagurus* (cf. McLaughlin, 1974).

In the field, *Propagurus obtusifrons* is readily recognized by its purple ocular peduncles with a deep red patch proximally and banded antennal flagella.

Remarks.—Yokoya's original description of *Eupagurus gracilipes* is very brief, consisting of a few illustrations and remarks on its differences from *Pagurus pectinatus* (Stimpson, 1858). Our attempts to locate the type material of "*Pagurus yokoyai,*" consisting of three males and three females from Tanabe Bay, Wakayama, Kii Peninsula (cf. Yokoya, 1933), have been unsuccessful. This material may no longer be extant. From the original description and illustration, however, the following features of "*Pagurus yokoyai*" can be detected: the rostrum does not reach beyond the lateral projections; the ocular peduncles are relatively stout; the antennular peduncles overreach the distal margin of the corneal region of the eye by about the distal 0.6 of the length of the ultimate segment; the chelipeds

are setose and spiny; the right second pereiopod is unarmed on the dorsal surface of the carpus. These features, except for that of the second pereiopod, are consistent with those of the present material. The features of the present material agree well with Miyake's (1978, 1982) diagnosis. In addition, on the coast of the Kii Peninsula, no pagurid species has been found showing superficial resemblance with "*Pagurus yokoyai.*" Therefore, there is little doubt that the type material of "*Pagurus yokoyai*" represents the same taxon as the species that we are calling *Propagurus yokoyai.* The discrepancy found in the armature of the second pereiopod is perhaps due to an error in the illustration.

Ortmann's (1892) type material of *Eupagurus obtusifrons* consists of a single female, which is still in very good condition (Fig. 1). As indicated before, reexamination of the holotype by the senior author has shown that *Eupagurus obtusifrons* is conspecific with *Propagurus yokoyai,* and is different from the "*Pagurus obtusifrons*" described and/or illustrated by previous authors (e.g., Miyake, 1978, 1982; Baba *et al.,* 1986; Yu and Foo, 1990). Ortmann's (1892) original description of *Eupagurus obtusifrons* consisted of little more than a few, uninformative illustrations and a simple description. Therefore, it is not surprising that previous authors confused two or more similar species with obtuse rostra and setose, spiny chelae. The reports of "*Pagurus yokoyai*" (cf. Okada *et al.,* 1966; Miyake, 1978, 1982; Miyake and Imafuku, 1980; Baba *et al.,* 1986; McLaughlin, 1997) are all referable to *Propagurus obtusifrons.*

References to *Eupagurus obtusifrons* by Alcock (1905) and Terao (1913) were merely citations based on Ortmann (1892). Balss (1913) included *E. obtusifrons* in his key to species of *Eupagurus,* but appears not to have examined any material. The description of *Pagurus obtusifrons* by Makarov (1938, 1962) is merely a translation of Ortmann's German text. Neither the report by Yokoya (1993) of *Eupagurus obtusifrons* nor subsequent reports can be referred with confidence to *Propagurus obtusifrons.* Yokoya (1933) recorded *Eupagurus obtusifrons* from various localities in Japan, based upon material collected by the RV *Soyo-maru,* but he gave no morphological information about his specimens. Unfortunately, the specimens examined by Yokoya could not be located in the collection of the Kitakyushu Museum of Natural History, where the *Soyo-maru* decapod material is now deposited. From the currently available information on the taxonomy of the pagurid hermit crabs in Japan, the following can be assumed: the specimens from the *Soyo-maru* station 291 (near Omae-zaki, Shizuoka), station 325 (west of Ashizuri-misaki, Kochi), station 326 (Bungo Strait), and station 377 (south of Omae-zaki) may represent *Pagurus confusus,* new species, which is expected to occur in these areas. The specimens from station 655 (Tsugaru Strait) may actually represent a close relative of *P. confusus, P. parvispina* Komai, 1997, which is distributed in northern Japan (Hokkaido and Iwate). It remains unknown what species was represented by specimens from station 132 (between Sioya-zaki and Inubo-zaki, Kashima-nada); I have not found either *P. confusus* or *P. parvispina* from that area. It is improbable that Yokoya's (1939) record of *Eupagurus obtusifrons* from Konorihama, Onagawa, Miyagi Prefecture, northern Japan, at a depth of 15 m, can be referred to either *P. confusus* or *P. parvispina,* since his specimens were obtained from a much shallower depth than that known for *P. confusus* and *P. parvispina* (shallowest depth 100 m; the present study; Komai, 1997). All but one of recent reports of *Pagurus obtusifrons* (cf. Miyake, 1978, 1982; Baba *et al.,* 1986; Yu and Foo, 1990: 65; Okutani, 1994) are referable to *P. confusus,* new species. Based on the distribution, the specimens from Soya Strait, northern Hokkaido, referred to as *Pagurus obtusifrons* by Takeda and Miyauchi (1992), may actually represent *Pagurus parvispina.*

Miyake's (1978: text-fig. 44) illustration of *P. yokoyai* is reportedly a female, but with only three unpaired left pleopods. As McLaughlin (1997) indicated, this is either an artistic error or the determination of sex of the specimen illustrated is incorrect.

Pagurus confusus, new species
Figs. 6–9

Eupagurus obtusifrons: Yokoya, 1933: 85 (part). [Not *Eupagurus obtusifrons* Ortmann, 1892. See Remarks under *Propagurus obtusifrons.*]

Pagurus obtusifrons: Gordan, 1956: 332 (part).

Pagurus obtusifrons: Miyake, 1978: 106, pl. 2, fig. 4; 1982: 128, pl. 43, fig. 5; Baba *et al.,* 1986: 202, figs. 151, 203, 304; Yu and Foo, 1990: 65, unnumbered fig.; Okutani, 1994: 228, fig. 6. [Not *Pagurus obtusifrons*

(Ortmann, 1892). See Remarks under account of *Propagurus obtusifrons*.]

Type Material.—**Japan.** Off Kochi, Tosa Bay, Shikoku, 90–190 m; 7 July 1992; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 1 ♂ (sl 7.7 mm); CBM–ZC 191.—Same locality, 33°18′N, 133°39′E, 120–190 m; 9 September 1992; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 1 ♀ (sl 8.0 mm); CBM–ZC 3394.—Similar locality, 33°16.02′N, 133°40.02′E, 189–190 m; 9 April 1993; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 3 ♂♂ (sl 5.9–7.5 mm); CBM–ZC 3839.—Similar locality, 33°16.35′N, 133°38.32′E, 144–150 m; 11 November 1992; collected by K. Sasaki; 1 ♂ (sl 6.7 mm), 1 ♀ (sl 6.0 mm); CBM–ZC 3849.—Same locality, 140–150 m; 7 October 1992; RV *Toyohata-maru*, beam trawl; collected by K. Sasaki; 2 ♂♂ (sl 7.5, 8.7 mm); CBM–ZC 3459.—Same data; 1 ♂ (sl 10.3 mm), holotype; CBM–ZC 3938.

Taiwan. Off Su-Aou, I-Lan County, northeast of Taiwan, 100–200 m; 6 August 1996; commercial trawler; collected by T. Komai; 2 ♂♂ (sl 8.2, 9.3 mm), 1 ♀ (sl 6.9 mm); CBM–ZC 2924.—Same locality, depth unknown; 27 August 1996; commercial trawler; collected by T.-Y. Chan; 2 ♂♂ (sl 8.1, 10.3 mm); NTOU.—Same locality, depth unknown; 25 February 1997; commercial trawler; collected by T.-Y. Chan; 2 ♂♂ (sl 9.4, 11.0 mm); NTOU.—Same locality; 18 November 1997; commercial trawler; collected by T.-Y. Chan; 1 ♂ (sl 9.4 mm); NTOU.

Description.—Eleven pairs of biserial branchiae. Shield (Fig. 6A) slightly longer than or as long as wide; anterior margin between rostrum and lateral projections concave; anterolateral margins noticeably terraced; posterior margin truncate, sometimes shallowly notched medially; dorsal surface with tufts of short setae laterally. Rostrum broadly triangular, with or without small subterminal spine, reaching as far as or slightly overreaching lateral projections, obscured by paired tufts of setae. Lateral projections obtusely triangular, with relatively small submarginal spine. Interocular lobe with concave anterior surface. Posterior carapace membranous except for calcified posteromedian plate, with many tufts of long setae on branchial region; posteromedian plate defined by anteriorly subparallel cardiac sulci, with rows of paired tufts of setae along cardiac sulci; sulci cardiobranchiales broader, extending to midlength between posterior margin of shield and posteromedian margin of carapace, subparallel or slightly divergent posteriorly.

Ocular peduncles (Fig. 6A) moderately short and stout, 0.7–0.8 times as long as shield; corneal region weakly dilated; dorsal or dorsomesial surface with row of tufts of moderately long setae. Ocular acicles subovate, with moderately strong subterminal spine; separated basally by basal width of 1 acicle; dorsal surface concave, without tufts of short setae.

Antennular peduncles (Fig. 6A) overreaching ocular peduncles by 0.3–0.6 length of ultimate segment. Ultimate segment 1.3–1.5 times as long as penultimate segment, with row of tufts of long setae on dorsal surface. Basal segment with slender lateral spine.

Antennal peduncles (Fig. 6A) reaching or overreaching distal margin of cornea by 0.2–0.3 length of fifth segment; with supernumerary segmentation. Fifth and fourth segments with scattered setae. Third segment with moderately strong spine at ventrodistal angle partially obscured by tufts of long stiff setae. Second segment with dorsolateral distal angle prominently produced, reaching nearly to distal margin of fourth segment, terminating in simple or bifid spine and with some spines on mesial margin partially obscured by thick setae; dorsomesial distal angle with prominent spine. First segment with or without small spine on lateral margin, ventrodistal margin produced, with 1 prominent spine. Antennal acicle long, overreaching midlength of fifth segment of peduncle and reaching or exceeding distal margin of cornea; somewhat sinuous, terminating in acute spine, mesial margin with row of tufts of stiff setae. Antennal flagellum shorter than outstretched right cheliped, with short and long setae on each article.

Mandible without distinctive features. Maxillule (Fig. 6B) with external lobe of endopod well developed, straight. Maxilla (Fig. 6C) with endopod slightly overreaching distal margin of anterior lobe of scaphognathite. First maxilliped (Fig. 6D) with endopod not reaching distal margin of distal endite. Second maxilliped (Fig. 6E) with partially fused basis and ischium; basal segment of exopod slender, with patch of minute bristles on external surface. Third maxilliped (Fig. 6F) with merus and ischium thickly setose on lateral surface; carpus with small distodorsal spine; merus with small distodorsal and ventromesial spines; crista dentata on ischium well developed, composed of relatively large corneous teeth becoming stronger proximally and 1 accessory tooth; basis with 1 prominent spine on mesial surface.

Chelipeds grossly unequal; spines of chelae and carpi usually entirely calcareous, most of them nearly obscured by tufts of long, very thick plumose setae. Right cheliped (Fig. 7)

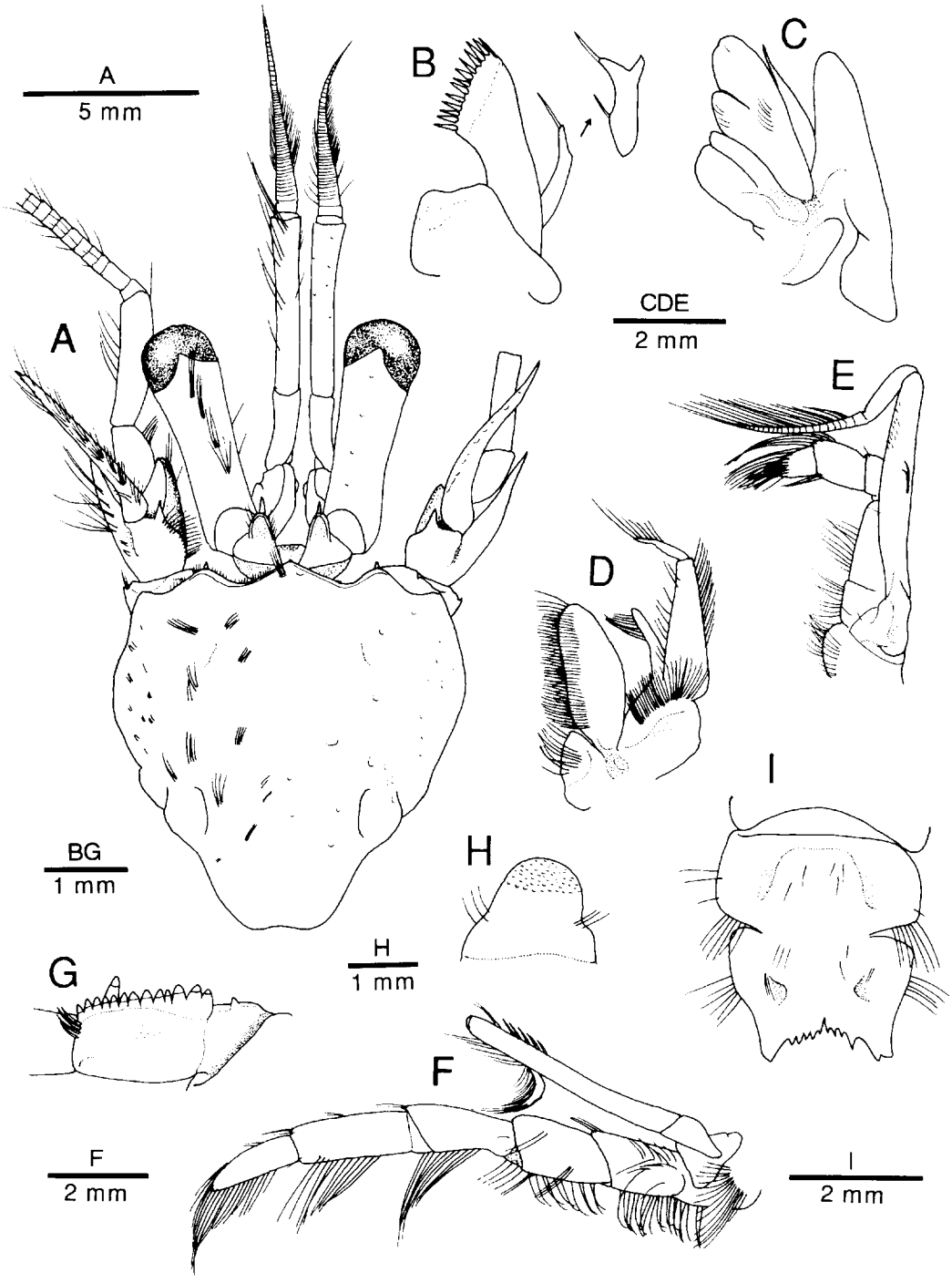

Fig. 6. *Pagurus confusus*, new species. Holotype male from Tosa Bay (CBM–ZC 3938, sl 10.3 mm). Appendages dissected from left. A, shield and cephalic appendages, dorsal; B, maxillule, external; inset, endopod, lateral; C, maxilla, external, setae omitted; D, first maxilliped, external; E, second maxilliped, external; F, third maxilliped, lateral; G, same, ischium, dorsal; H, anterior lobe of sixth thoracic sternite, ventral; I, telson, dorsal.

with chela about twice as long as broad; dactyl nearly as long as palm measured along mesial margin; cutting edge with row of 5 or 6 strong calcareous teeth and short distal row of corneous teeth, terminating in small corneous tooth and slightly overlapped by fixed finger; dorsal surface convex, with median row of small spines decreasing in size distally, not extending nearly to tip, and few smaller spines laterad to median row of spines; dorsomesial margin with row of spines also decreasing in size distally and not extending to base of terminal claw; mesial and ventral surfaces with scattered tufts of long setae. Fixed finger not strongly flattened, dorsal surface with submedian row of spines decreasing in size distally and tufts of stiff setae mesially; cutting edge with row of irregular calcareous teeth, terminating in small corneous claw. Palm 0.8–0.9 length of carpus; dorsomesial margin nearly straight in dorsal view, only weakly delimited by irregular double row of moderately strong spines, 1 spine at proximal angle strongest, convex dorsal surface with 7–9 irregular rows of moderately strong spines; dorsolateral margin delimited by row of moderately strong spines, extending nearly to tip of fixed finger; mesial and lateral faces with scattered small spines or spinulose tubercles, ventral face with low protuberances or small tubercles, but without prominent spines, all faces with tufts of long plumose setae. Carpus slightly longer than merus, becoming slightly broader distally; dorsomesial margin with single row of moderately strong to strong spines, dorsal surface with 3 or 4 rows of moderately small spines, spinulose tubercles, and tufts of long setae, distal margin with row of small spines mesially; dorsolateral margin not delimited, lateral face with scattered short vertical rows of tufts of setae and few tubercles ventrally, laterodistal angle produced but not denticulate, laterodistal ventral margin with row of moderately small blunt spines or tubercles; mesial faces with short vertical rows of long setae, mesiodistal margin unarmed; ventral surface inflated, with tufts of long setae. Merus subtriangular; dorsodistal margin with 1–3 slender spines, dorsal surface with short transverse rows of setae distally; lateral face not spinulose, with few tufts of setae, ventrolateral margin with row of small spines, becoming stronger distally; mesial face with scattered short rows or tufts of setae and small blunt spines or tubercles ventrally, ventromesial margin with row of moderately strong blunt spines and small tubercles, proximal 2 or 3 more prominent; ventral surface with moderately strong spines and tufts of setae, but no spines noticeably enlarged. Ischium with row of small tubercles on ventromesial margin, setose on ventromesial and ventrolateral margins. Coxa unarmed on ventrolateral margin.

Left cheliped (Fig. 8) with chela relatively narrow, greatest breadth at base of dactyl, 2.8 times as long as broad; dactyl more than 2.5 times length of palm; cutting edge with row of small corneous teeth on nearly entire length, terminating in strong corneous claw; dorsomesial margin with row of few small spines or spinulose tubercles, dorsal surface unarmed or with few spinules or spinulose tubercles proximally; dorsal, mesial, and ventral surfaces with rows of tufts of long setae. Palm shorter than half length of carpus; dorsal surface convex, with submedian row of strong spines decreasing in size distally, extending to half of fixed finger; dorsolateral margin with single row of small spines, decreasing in size and extending beyond midlength of fixed finger; dorsolateral surface sloping, with short row of small spines; dorsomesial surface sloping, with few small spines mesially; ventral surface weakly inflated, unarmed; cutting edge of fixed finger with row of small calcareous teeth interspersed by short row of small corneous teeth, terminating in strong corneous claw; all surfaces with numerous tufts of long setae. Carpus approximately as long as merus; dorsolateral and dorsomesial margins each with row of strong spines, becoming stronger distally, dorsodistal margin with 1 prominent spine; laterodistal margin unarmed, lateral face with short obliquely vertical rows or tufts of long setae, ventrolateral margin with row of obtuse tubercles and long setae; mesial face dorsally with scattered short rows of long setae, ventromesial margin almost unarmed; ventral surface weakly inflated, with scattered small spines and tufts of long setae. Merus with low, sometimes spinulose protuberances each bearing row of long setae on dorsal surface; mesial face with few low multispinulose protuberances ventrally and tufts of setae, ventromesial margin with row of moderately strong spines of nearly same size; lateral face with very few tufts of short setae, ventrolat-

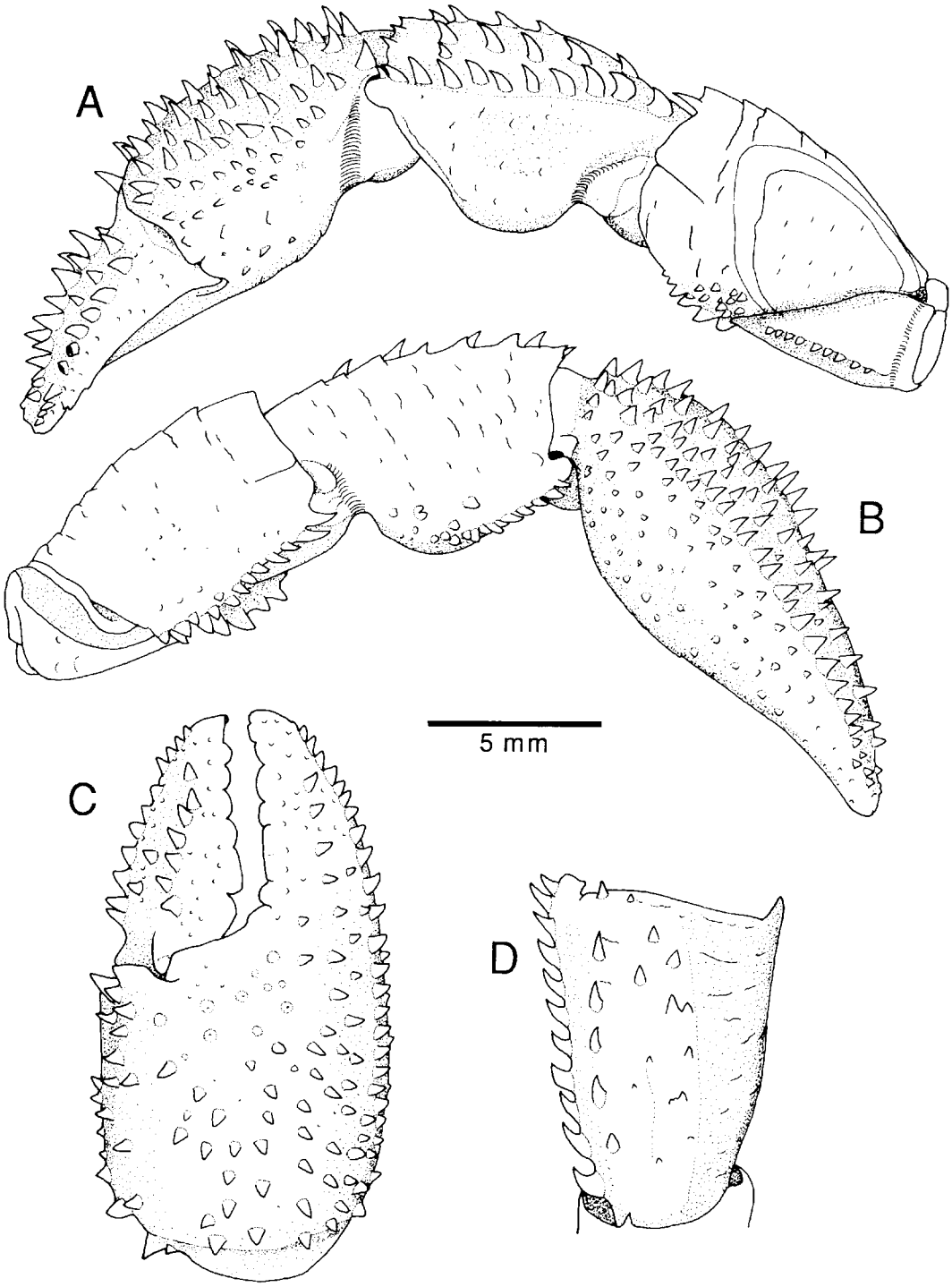

Fig. 7. *Pagurus confusus*, new species. Holotype male from Tosa Bay (CBM–ZC 3938, sl 10.3 mm). A, right cheliped, mesial, setae omitted; B, same, lateral; C, same, chela, dorsal, setae omitted; D, same, carpus, dorsal, setae omitted.

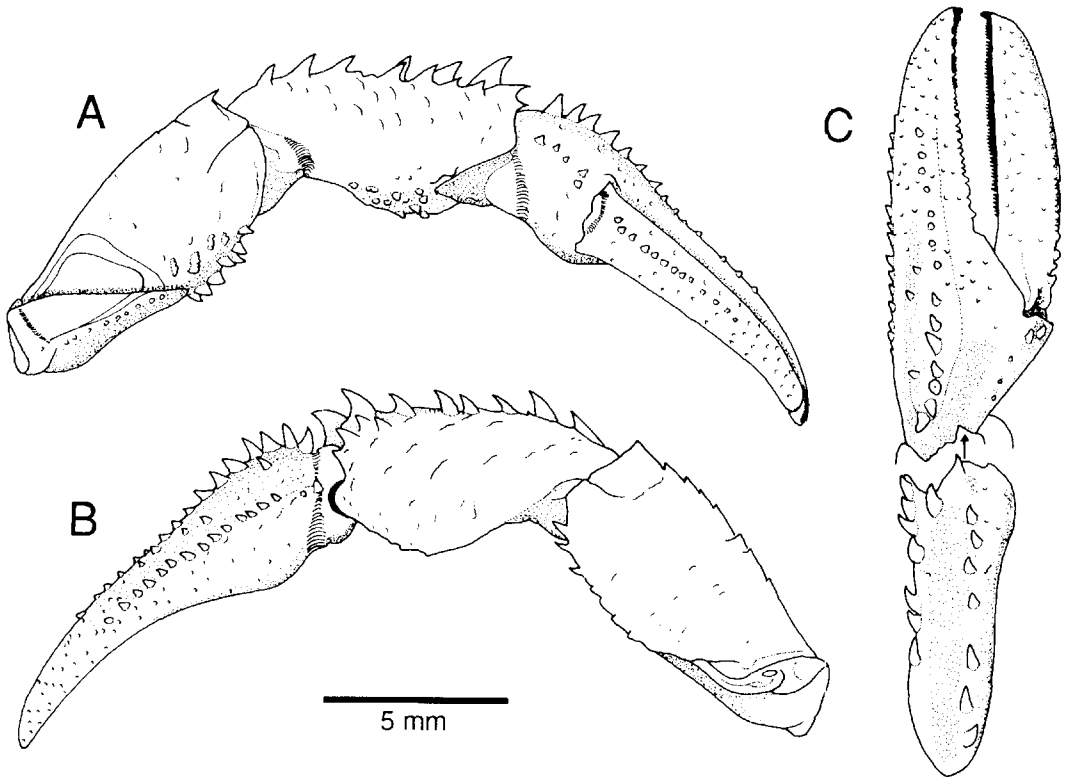

Fig. 8. *Pagurus confusus*, new species. Holotype male from Tosa Bay (CBM–ZC 3938, sl 10.3 mm). A, left cheliped, mesial; B, same, lateral; C, same, chela and carpus, dorsal.

eral margin with row of small spines or spinulose tubercles becoming stronger distally, and tufts of long setae; ventral surface with moderately strong spines and tufts of long setae. Ischium with row of spinules or tubercles on ventromesial margin. Coxa with ventrolateral margin unarmed.

Ambulatory pereiopods (Fig. 9) with dactyls 1.3–1.5 times longer than propodi; in dorsal view, slightly twisted; in lateral view weakly curved ventrally; terminating in moderately long corneous claws; dorsal surfaces each with double row of long thick setae; lateral faces with triple row of tufts of moderately long setae, submedian row confluent with ventral row distally to form dense row (second and right third), with 2 rows of tufts of setae between dorsal and ventral rows on left third, no longitudinal sulcus; mesial surfaces (Fig. 9B, D) with median row of stiff setae, broken into tufts proximally, no longitudinal sulcus; ventromesial margins each with 27–35 small corneous spinules, slightly increasing in length distally. Propodi distinctly longer than carpi; dorsal surfaces each with tufts of long setae; lateral faces each with 2 or 3 irregular longitudinal rows of tufts of setae, in addition to row of tufts of longer setae along dorsal margin; mesial faces with few scattered setae; ventrodistal margins occasionally with 1 small corneous spinule, ventral surfaces with row of tufts of long setae. Carpi distinctly shorter than meri; second pereiopods each with row of strong spines partially obscured by long setae on dorsal surface, third each with dorsal subdistal spine, dorsal surface unarmed or often with few small spines or tubercles partially obscured by row of tufts of setae, lateral faces with longitudinal rows of shorter setae; ventral surfaces each with few tufts of setae. Meri each with several transverse rows of long setae dorsally and tufts of longer setae ventrally, second also with single or double row of small spines on ventral margin; ventrolateral distal margins unarmed; lateral and mesial faces each with

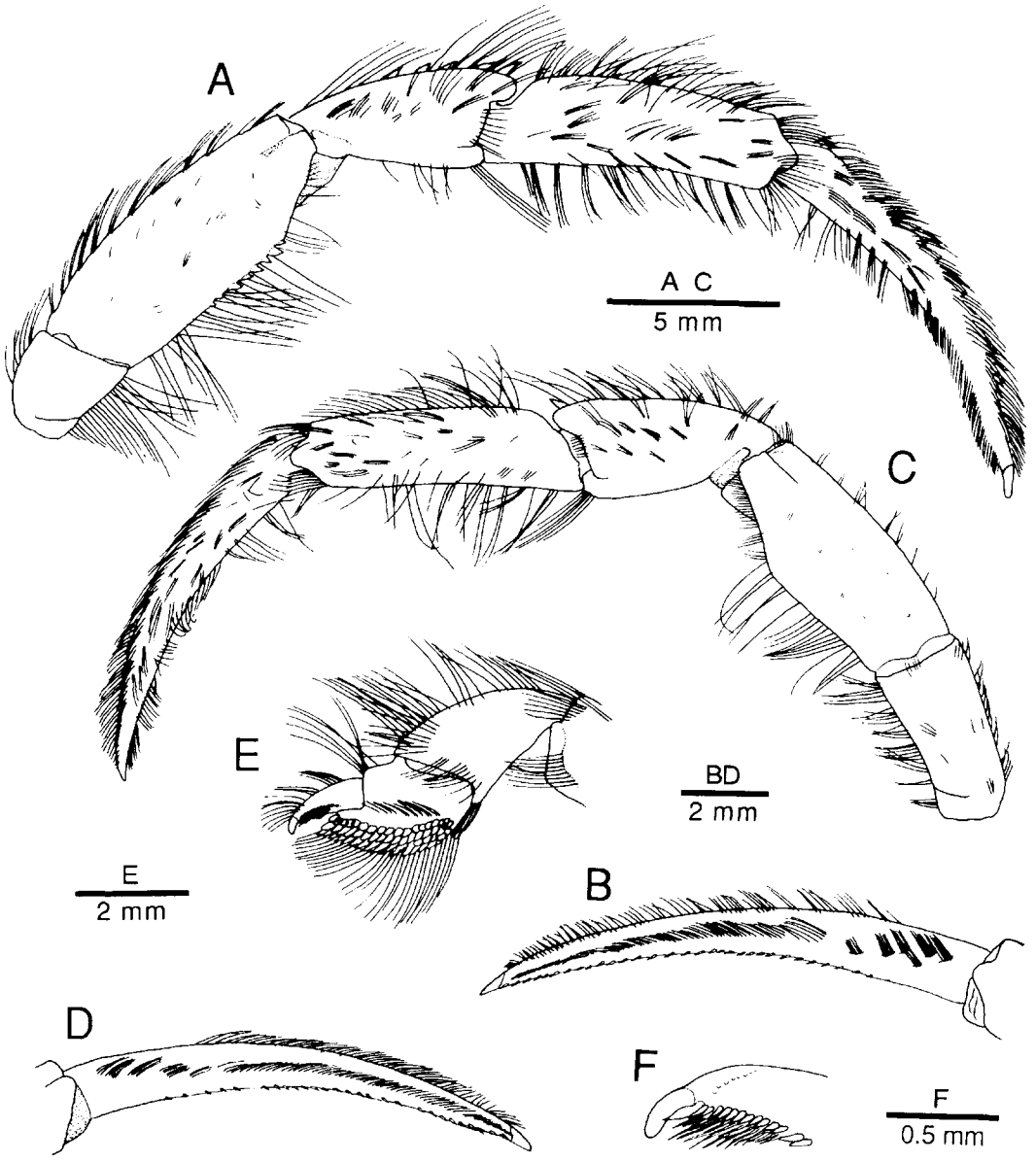

Fig. 9. *Pagurus confusus*, new species. Holotype male from Tosa Bay (CBM–ZC 3938, sl 10.3 mm). A, right second pereiopod, lateral; B, same, dactyl, mesial, setae partially omitted; C, left third pereiopod, lateral; D, same, dactyl, setae partially omitted; E, distal three segments of fourth pereiopod, lateral; F, distal part of dactyl of fourth pereiopod, lateral.

few tufts of short setae. Ischia with dorsal and ventral tufts of setae, ventral margin unarmed. Paired gonopores on coxae of third pereiopods in females.

Fourth pereiopods (Fig. 9E) thickly setose on dorsal and ventral faces of propodus, carpus, merus, and ischium; dactyl (Fig. 9F) apparently lacking preungual process, but with distalmost scale of rasp noticeably enlarged, lanceolate, bearing acutely produced tip; propodus with ventral margin moderately convex, propodal rasp well developed, with triple row of corneous scales.

Fifth pereiopods with coxae nearly symmetrical, male gonopores obscured by tufts of setae.

Third thoracic sternite with paired submedian spines on either side of median notch

on anterior margin. Sixth thoracic sternite with subsemicircular anterior lobe (Fig. 6H), with dense, very long setae anteriorly, but unarmed. Eighth thoracic sternite developed anteriorly as two somewhat flattened semirectangular lobes separated by shallow median depression, anterior margins each with row of setae.

Males with 3 unequally biramous unpaired pleopods, all with exopods moderately well developed, endopods small (third) or rudimentary (fourth and fifth). Females with 4 unpaired biramous pleopods. Uropods asymmetrical; exopods and endopods both with well-developed rasp; protopods with few small spines on posterolateral margin.

Telson (Fig. 6I) with distinct transverse indentations; posterior lobes asymmetrical, separated by small narrow median cleft; terminal margins, not particularly elevated, slightly oblique, each with row of 4–7 small marginal spines becoming stronger laterally, posterolateral angle somewhat produced posteriorly; lateral margins unarmed, noticeably sinuous.

Color.—In life, shield, chelipeds, and ambulatory pereiopods generally yellowish or light reddish brown. Ocular peduncle generally cream or white, with tinge of reddish brown proximally. Lateral surfaces of meri of ambulatory pereiopods pale medially. Antennal flagella uniformly light brown. Miyake (1982), Baba *et al.* (1986), and Yu and Foo (1990) presented color photographs of this species (as *Pagurus obtusifrons*). In preservative, fading into straw color.

Size.—Largest male: sl 9.3 mm; largest female: sl 8.0 mm; ovigerous females: sl 6.9–7.7 mm.

Distribution.—Known with certainty from southern Japan, from Tosa Bay to Bungo Strait, and northeast of Taiwan; depth 90–200 m.

Etymology.—From the Latin *confusus,* meaning confused, referring to the confused taxonomy of the new species.

Remarks.—This new species has been confused by numerous authors with *Pagurus obtusifrons* (e.g., Yokoya, 1933; Miyake, 1978, 1982; Baba *et al.*, 1986; Yu and Foo, 1990; Okutani, 1994). The new species is most similar to *P. arcuatus* Squires, 1964, from the North Atlantic, and *P. parvispina* Komai, 1997, from northern Japan, both belonging to the *capillatus* group of *Pagurus* (cf. McLaughlin, 1974). Like *P. confusus,* both species have a single row of small corneous spinules on the ventral margin of the ambulatory dactyls; the mesial surfaces of the dactyls of these pereiopods bear a median row of tufts of stiff setae. However, the terraced anterolateral margins of the shield, the absence of a row of spines on the dorsomesial margin of the left palm, and the noticeably sinuous, rather than straight, lateral margins of the posterior lobe of the telson immediately distinguish *P. confusus* from the two species. In addition, spines on the right palm seem to be weaker in *Pagurus confusus* than in *P. arcuatus* and *P. parvispina*; the dactyl of the left cheliped is more elongate in the new species than in the latter two.

In the field, this species is readily recognized by the right palm that bears very thick, dirty setae, the uniformly pale brown antennal flagella, and the ocular peduncle without markings.

Acknowledgements

We thank our colleagues who entrusted us with material: T.-Y. Chan of the Institute of Marine Biology, National Taiwan Ocean University; S. Nagai in Kushimoto; K. Nomura of the Kushimoto Marine Park Center; K Sasaki and H. Endo of the Faculty of Science, Kochi University. We are also grateful to P. A McLaughlin of the Shannon Point Marine Center, Western Washington University, and M. de Saint Laurent of the Laboratoire de Zoologie (Arthropodes), Muséum national d'Histoire naturelle, Paris, for sending us a copy of their manuscript in press; P. A McLaughlin kindly offered valuable comments on the manuscript.

The reexamination of the material studied by Ortmann was made while the senior author visited the Musée Zoologique in Strasbourg, France, in September 1997. The senior author thanks E. Lang and the staff of the Museum for their support and help, and for kind hospitality. Thanks are due also to three volunteer students from the Louis Pasteur University, J. Hering, S. Hugell, and N. Heck, for their generous help in curating the specimens. The author is also indebted to his colleagues, Drs. T. Nishikawa, S. F. Mawatari, T. Yamaguchi, and Y. Masuda, for their help in various ways. This research was supported by a Grant-in-Aid for International Scientific Research (Number 09041155) from the Japanese Ministry of Education, Science and Culture (T. Nishikawa, principal investigator), and a research grant from the National Science Council, Taiwan, R.O.C. (NSC-87-2313-B-019-010-A16).

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RECEIVED: 3 March 1998.
ACCEPTED: 5 May 1998.

Addresses: (TK) Department of Zoology, Natural History Museum and Institute, Chiba, 955–2 Aoba-cho, Chuo-ku, Chiba 260, Japan. (e-mail: j90053@simail.ne.jp); (HPY) Graduate School of Fisheries Science, National Taiwan Ocean University, Keelung, Taiwan, Republic of China.