

A review of Japanese species of *Pylopaguropsis* Alcock, 1905 (Decapoda: Anomura: Paguridae)

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Abstract.—The Japanese species of *Pylopaguropsis* Alcock, 1905 are reviewed. The genus is rediagnosed, and the gill structure within the genus is discussed. Seven species are recognized, including two species new to science, *P. furuset*, new species and *P. granulata*, new species and one species new to the Japanese fauna, *P. keijii* McLaughlin & Haig, 1989. Taxonomic problems concerning Japanese representative of *P. zebra* (Henderson, 1893) are discussed. Detailed descriptions and illustrations of the two new species and brief diagnoses and illustrations of the other species are included, together with a key to the Japanese species of *Pylopaguropsis*.

Introduction

The pagurid genus *Pylopaguropsis* Alcock, 1905 was reviewed by McLaughlin & Haig (1989), and their truly elaborate and extensive work clarified the taxonomic position of the genus within the family Paguridae Latreille, 1803 and identities of the species. McLaughlin & Haig characterized species of this genus as having thirteen pairs of "trichobranchiate" gills, females with paired first pleopods modified as gonopods, a massive operculate or semioperculate right cheliped, and typically brilliant color patterns. They recognized 11 species worldwide, three of which, *P. zebra* (Henderson, 1893), *P. speciosa* McLaughlin & Haig, 1989 and *P. laevispinosa* McLaughlin & Haig, 1989 were recorded from Japanese waters at that time. Recently, Nomura *et al.* (1996) recorded *P. fimbriata* McLaughlin & Haig,

1989 from Kerama Group, Okinawa.

Recently, a number of specimens of *Pylopaguropsis* collected from shallow waters of several localities in Japan were made available for the authors, in some cases, along with color photographs of the living animals. Examinations also have been made of *Pylopaguropsis* specimens deposited at several museums and institutions. As a result, seven species are recognized from Japanese waters, including two species that are new to science and one species previously unknown from the Japanese fauna, reported herein.

The first actual record of *Pylopaguropsis* from the Japanese waters was Miyake's (1975) *Pagurus zebra* (incorrect generic assignment) from the Kii Peninsula in central Japan, with a color photograph and a brief description. He subsequently again provided a short description and illustration of this species in his large monograph of the anomuran crustaceans from the Sagami Bay (Miyake, 1978). Later, Miyake & Imafuku (1980) also reported *Pagurus zebra* from the Kii Peninsula. However, McLaughlin & Haig (1989) noted a number of inconsistencies between specimens of *Pylopaguropsis zebra* that they examined and the Miyake's (1978) description and illustration of his *Pagurus zebra*, such as the armature of ambulatory legs and number of pleopods. McLaughlin & Haig (1989) examined a male of the Miyake's (1978) taxon and confirmed that it was *Pylopaguropsis zebra*, but they suggested that Miyake's diagnosis was based on specimens that did not represent *Pylopaguropsis zebra*. The present reexamination of the specimens

upon which Miyake's (1978) and Miyake & Imafuku's (1980) diagnoses were based, as well as the type material have enabled me to reevaluate generic and specific status of the Japanese taxon and provide a more detailed diagnosis and morphological variation.

Pylopaguopsis speciosa was described by McLaughlin & Haig (1989) from Okinawa, based only on male specimens. The authors were confident that its generic assignment was correct and that females, when found, would possess paired first pleopods. The material used in this study contains an ovigerous female of this species and indeed has paired first pleopods, confirming its generic placement. Herein the first description of the female is presented.

In addition, *Pylopaguopsis keijii* McLaughlin & Haig, 1989 is recorded for the first time from Japanese waters. This species has been known from Hawaii, Guam, Yap, Caroline Islands and Zanzibar. The discovery of this species in Japan represents a significant extension of their ranges toward the north (ca. 3000 km).

The two new species described herein, *Pylopaguopsis furusei* new species and *P. granulata* new species are assignable to species of McLaughlin & Haig's (1989) *teevana* group.

Material and Methods

The collected specimens were fixed in 10% formalin solution, preserved in 75% alcohol solution and deposited at the Natural History Museum and Institute, Chiba, Japan (CBM-ZC). Specimens deposited in the following museums and institutes have also been examined; Osaka Museum of Natural History (OMNH Ar); Kitakyushu Museum of Natural History (ZLKU); National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); and Natural History Museum, London (NHM, formerly British Museum, Natural History). In ad-

dition to the Japanese material, the following species were also examined for comparative purposes: *Pylopaguopsis magnimanus* Henderson, 1896: lectotype, ♀, SL = 6.9 mm, "Investigator" sta. 166, off Madras, India, NHM 1765/7; other material, 5 ♀, SL = 3.4–6.1 mm, "Investigator" sta. 166, off Madras, India, NHM 1766/7; 1 ♂, SL = 6.0 mm, 119 m, Bay of Bengal, "Investigator," USNM 52504. *Pylopaguopsis atlantica* Wass, 1963: 1 ♂, SL = 6.5 mm, "Oregon" sta. 4915, 91 m, west of Cabo de la Vela, Colombia, 12°07.5'N, 72°40'W, 1 June 1964, USNM 127203.

Specimens were examined with the aid of a stereoscopic microscope OLYMPUS SZH, and figures were drawn using a camera lucida attachment. Shield length (SL) measured (in mm) from the tip of the rostrum to posterior margin of the shield provides an indication of animal size. Lengths of segments of the chelipeds were measured from the dorsomesial distal to the dorsomesial proximal angle of each segment. Lengths of segments of the second and third pereopods were measured along each lateral midline.

In general, terminology used follows McLaughlin (1974), and McLaughlin & Haig (1989). Special terminology used are: 1) posterior gastric pits on the dorsal face of the shield: a shallow pit on either side of the posterior region of the shield (Lemaitre, 1995); 2) accessory portions of the shield: well calcified region on either posterolateral side of the shield, each bordered by anterior prolongation of the cervical groove (Lemaitre, 1995); 3) semi-chelate condition of the fourth pereopods: ventral margin of the propodus is produced beneath the dactyl to such an extent that flexion of the dactyl becomes much more akin to the action of a dactyl against a fixed finger of a chelate appendage (McLaughlin, 1997).

I have followed McLaughlin & Haig's (1989) division of the genus into two

groups: the *teevana* group, including species with the second and third pereopods morphologically similar, and the *magnimanus* group, including species with dissimilar third pereopods: the dactyl and propodus of right are broader and more elongate, the dorsodistal margins are prominently angular, and the lateral face of the propodus is flattened or with one to three deep longitudinal sulcus.

Systematics

Genus *Pylopaguropsis* Alcock, 1905

Pylopaguropsis Alcock, 1905: 133. — de Saint Laurent-Dechancé, 1966: 259. — McLaughlin & Haig, 1989: 125. — McLaughlin, 1997: 542.
Galapagurus Boone, 1932: 12.

Type species: *Pylopaguropsis magnimanus* (Henderson, 1896)

Gender: Feminine

Emended diagnosis.—Thirteen pairs of biserial phyllobranchiate gills, lateral branches narrow: 2 arthrobranchiae on each third maxilliped and first through fourth pereopods, plus single pleurobranchia on each pleural plate of fifth through seventh thoracic somites (above second through fourth pereopods). Shield with well developed rostrum. Ocular acicles triangular, sometimes slender. Antennal peduncles with supernumerary segmentation; acicles well developed. Maxillule with external lobe of endopod very weakly to moderately well developed. Maxilla with scaphognathite narrow to exceptionally broad. Ischia of third maxillipeds each with crista dentata well developed, and 1 accessory tooth.

Right cheliped usually massive, chela operculate or semioperculate; dactyl frequently articulating obliquely with palm; dactyl and fixed finger opening obliquely. Left cheliped moderately elongate, slender; propodal-carpal articulation usually rotated counter-clockwise 30–70° from perpendicular when viewed dorsally. Right third pereopods with dactyl and

propodus frequently dissimilar. Fourth pereopods semichelate; with or without preungual process; propodal rasp of 1–4 rows of corneous scales. Fifth pereopods chelate; rasps of dactyls and propodi well developed. Females with coxae of third pereopods each with gonopore; paired first pleopods, modified as gonopods, and second to fifth left pleopods. Males with coxae of fifth pereopods each with gonopore; no paired pleopods or sexual tubes; with 3 unequally biramous left pleopods. Telson with lateral constriction; posterior lobes often asymmetrical, separated by median cleft; terminal margin oblique, concave or horizontal, usually armed with 1 to many spines; lateral margins unarmed or with 1–3, or sometimes row, of small spines.

Remarks.—McLaughlin & Haig (1989) stated that the gills of *Pylopaguropsis* were trichobranchiate. Later, McLaughlin & de Saint Laurent (1998) redefined trichobranchiate gills as having the tubular lateral branches inserted around the main branchial axis and, in contrast, true phyllobranchiate gills as having the lateral branches always inserted biserially in regular pairs along the axis. My reexamination has shown that gills of *Pylopaguropsis* have narrow lateral branches in regular pairs along the axis (Fig. 1). Therefore, they are biserial phyllobranchiate gills. McLaughlin & Haig misinterpreted the gill structure, when they reported the gills as being trichobranchiate in *Pylopaguropsis* (McLaughlin, personal communication).

Besides the generic diagnosis, all of the Japanese species of *Pylopaguropsis* as well as the two non-Japanese material that I examined (*P. atlantica* and the type species of the genus, *P. magnimanus*) share the following characters, seemingly unusual in other pagurid species: the fixed finger of the left cheliped terminates in a bifid spine or a pair of spines, and the mandible has three or four distinct teeth on the incisor process. In

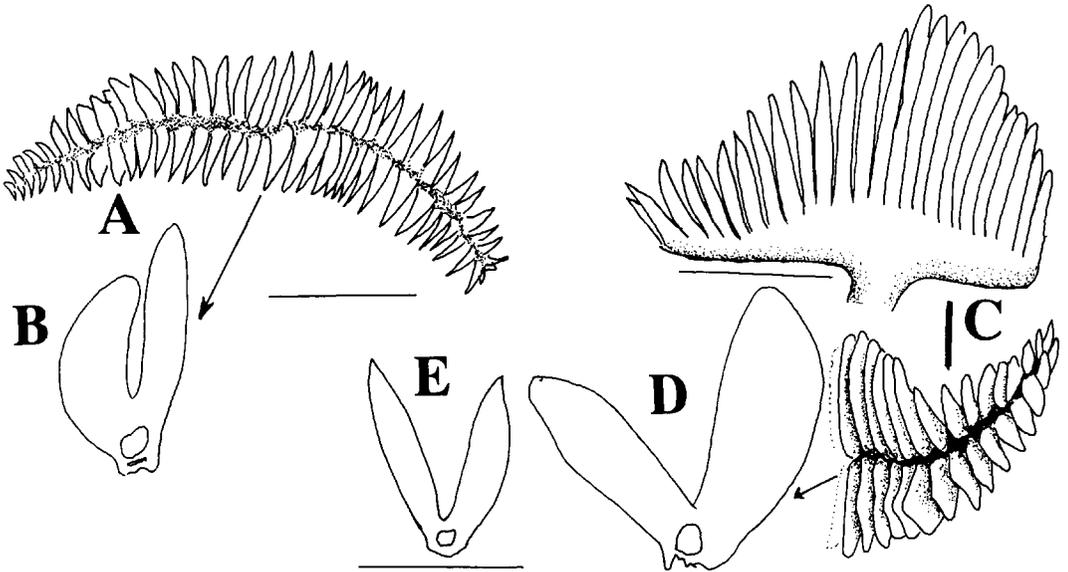


Fig. 1. Structure of gills. A, B: *Pylopaguopsis speciosa* McLaughlin & Haig, 1989 (*magnimanus* group), ♀, SL = 3.15 mm, Kume-jima, Okinawa, CBM-ZC 5643. C–E: *Pylopaguopsis fimbriata* McLaughlin & Haig, 1989 (*teevana* group), ♂, SL = 4.65 mm, Kerama Group, Okinawa, CBM-ZC 5647. A–D: arthrobranch on fourth pereopod (posterior one). E: pleurobranch above fourth pereopod. B, E, D: cross section. Scales = 0.5 mm

pagurids, the fixed finger of the chelipeds usually terminates in a simple corneous claw, and no distinct teeth are present on the mandible.

Key to the Japanese species of *Pylopaguopsis*

- 1. Dactyls and propodi of left and right third pereopods dissimilar, right distinctly sculptured (*magnimanus* group) 2
 - Dactyls and propodi of left and right third pereopods similar, right not distinctly sculptured (*teevana* group) .. 4
- 2. Right cheliped with dactyl, fixed finger and palm covered with closely-spaced, flattened, plate-like tubercles encircled by small pits; right third pereopod with propodus bearing 2 prominent, broad sulci on lateral face *P. speciosa* McLaughlin & Haig
 - Right cheliped with dactyl and fixed finger bearing scattered small spines, sometimes in row on dorsal surfaces; right third pereopod with propodus bearing 1 prominent, broad sulcus on lateral face 3
- 3. Dorsal face of carpus of left cheliped with 1 or 2 longitudinal rows of spines. *P. zebra* (Henderson)
 - Dorsal face of carpus of left cheliped unarmed, or with at most 1–3 small spines distally. *P. keijii* McLaughlin & Haig
- 4. Palm of right cheliped fringed with dense long setae. *P. fimbriata* McLaughlin & Haig
 - Palm of right cheliped not fringed with dense long setae 5
- 5. Right cheliped with mesial margin of dactyl and lateral margin of palm bearing small granules, dorsal faces of dactyl and palm covered with small granules; dorsal face of dactyl of left cheliped unarmed *P. granulata* new species

— Right cheliped with mesial margin of dactyl and lateral margin of palm armed with very strong spines, dorsal faces of dactyl and palm with numerous strong spines; dorsal face of dactyl of left cheliped with scattered spines, often in rows 6

6. Right cheliped with ventral face of carpus unarmed; ambulatory pereopods with propodi each bearing longitudinal row of 4–12 corneous spines on ventral face *P. furusei* new species

— Right cheliped with ventral face of carpus bearing prominent tubercles; ambulatory pereopods with propodi each bearing 2 or 3 widely-spaced, corneous spines on ventral face

.. *P. laevispinosa* McLaughlin & Haig

Remarks.—Basically, these keys are based on those in McLaughlin & Haig (1989). However, according to their keys, the dorsodistal angle of the carpus of the fourth pereopod is unarmed in the all of the species except for *P. fimbriata*, which has a dorsodistal spine (couplet 1). The present examination revealed that all of the seven Japanese species including the two new species actually have a blunt-tipped spine similar in shape to that of *P. fimbriata* at the dorsodistal angle mesially on the carpus. This carpal spine is somewhat difficult to recognize, as it is invisible in lateral view.

Pylopaguropsis zebra

(Henderson, 1893)

Figs. 2, 3

Restricted synonymy (See McLaughlin & Haig (1989) for additional synonyms)

Eupagurus zebra Henderson, 1893: 425, pl. 39, figs. 12–15.

Pagurus zebra: Miyake, 1975: 260, pl. 116, fig. 2. — Miyake, 1978: 108, fig. 43. — Miyake & Imafuku, 1980: 60 (in part, see Remarks). — Miyake, 1982: 197 (list), 225 (key).

Pylopaguropsis zebra: McLaughlin, 1997: 542,

figs. 30a, c, 43e, f.

Material examined.—Lectotype (designated by McLaughlin & Haig, 1989): ♀, SL = 4.90 mm, Holothuria Bank, Australia, 26 Mar. 1892, NHM 342. JAPANESE MATERIAL: 1 ♀, SL = 4.00 mm, gill net, 150 m, off Tosa-shimizu, Tosa Bay, 27 Aug. 1960, coll. Kazuo Kurohara, ZLKU 8169; 1 ♂, SL = 4.15 mm, 150–180 m, Okezoko, off Tosa, Tosa Bay, 30 Aug. 1961, coll. Kazuo Kurohara, ZLKU 8436; 1 ♂, SL = 3.30 mm, dredge, 50–80 m, Kushimoto, Kii Peninsula, 33°30'N, 135°45'E, 1978, coll. Seiji Nagai, OMNH Ar 2015; 1 ♂, SL = 3.60 mm, dredge, 70–110 m, Kushimoto, Kii Peninsula, 33°30'N, 135°45'E, 1978, coll. Seiji Nagai, OMNH Ar 2014; 1 ♂, SL = 4.30 mm, off Shiwono-misaki, Kii Peninsula, 33°25'N, 135°45'E, 6 May 1978, coll. Seiji Nagai, OMNH Ar 2019; 1 ♂, SL = 4.20 mm, lobster gill net, Sakai, Nanbu, Kii Peninsula, 34°45'N, 135°20'E, 17 Jan. 1976, coll. Naoko Utsubo, OMNH Ar 1887.

Type locality.—Holothuria Bank, Australia.

Redescription.—Corneas slightly dilated; antennular peduncles with basal segments each bearing slender spine laterally and acute spine at ventrodistal angle; antennal peduncles with ventrodistal margins of first segments produced, each bearing 3–6 (6 on left and 5 on right in lectotype) spines laterally; antennal acicles strongly arcuate, blunt-tipped, slightly shorter to slightly longer (slightly longer in lectotype) than ocular peduncles. Mandible with incisor process bearing 4 blunt-tipped teeth; maxillule with endopod bearing moderately well-developed external lobe; maxilla with moderately broad scaphognathite; first maxilliped with basal portion of exopod moderately broad; third maxilliped with merus bearing strong spine on dorsodistal margin, ischium with crista dentata composed of 17–22 corneous teeth, proximal tooth prominent, and with strong acces-

sory tooth, basis with 2 or 3 acute, corneous-tipped teeth. Sternite of third maxillipeds with strong spine and setae on either side of midline.

Right cheliped with dactyl terminating in corneous claw, dorsal face with numerous spines mesially and faint depression medially, dorsomesial margin armed with row of spines; fixed finger terminating in bifid, corneous claw; palm with dorsal surface bearing numerous spines, dorso-lateral margin with row of strong tooth-like spines extending onto fixed finger; carpus with scattered conical spines on dorsal surface; merus with ventromesial margin bearing row of strong conical spines. Left cheliped with dactyl terminating in strong corneous claw; fixed finger terminating in strong, bifid, corneous claw; palm unarmed or very slightly tuberculate; carpus with dorsal surface bearing single or double (double in lectotype) row of strong spines mesially and few spines distally; merus with ventromesial and ventrolateral margins each bearing row of spines.

Second and left third pereopods similar; dactyls each with ventral row of 7–9 (9 in lectotype) (second) or 7–10 (10 in lectotype) (left third) strong corneous spines, mesial face with row of 5–8 (6 in lectotype) (second) or 8–11 (8 in lectotype) (left third) strong corneous spines proceeding obliquely from midline proximally to close to dorsal margin distally and, on left third, additional row of 3–5 (5 in lectotype) strong corneous spines ventrally; propodi each with corneous spine at ventrodistal margin; carpi each with dorsodistal spine and 1–5 (1 in lectotype) [second] or 0–3 (1 in lectotype) (left third) variously-sized spines on dorsal face; meri of second each with ventrolateral margin bearing 2–4 (4 in lectotype) spines; merus of left third unarmed. Right third dissimilar; dactyl with ventral margin bearing row of 11–15 (15 in lectotype) strong corneous spines, lateral face with prominent, broad, longitudinal sulcus,

mesial face strongly convex, with row of 7–11 (10 in lectotype) strong corneous spines proceeding obliquely from midline proximally to close to dorsal margin distally and additional row of 4–8 (8 in lectotype) strong, corneous spines ventrally; propodus with distinct dorsolateral margin, lateral face with broad longitudinal sulcus dorsally, ventromesial margin with row of 4–7 (7 in lectotype) corneous spines in distal half; carpus and merus similar to left. Fourth pereopod with dactyl bearing small preungual process; propodal rasp composed of single or double rows of strong corneous scales; carpus with dorsodistal spine. Sternite of third pereopods long, narrow, with slight protrusion medially.

Uropods (missing in lectotype) with protopods unarmed (left) or sometimes with few spinules (right). Telson (missing in lectotype) with posterior lobes separated by shallow, small, median cleft; terminal margins slightly oblique, each with 2–4 spines.

Coloration [based on the color photograph in Miyake (1975: 260, pl. 116, fig. 2) and material preserved in 75% alcohol, Fig. 3N–S]. — Shield mottled faint orange and white, with dark red area on either anterolateral side; antennal peduncles with red and white stripes; right cheliped with chela generally red but mottled red and white distally, carpus and merus striped red and white; left cheliped with red and white longitudinal stripes; second and third pereopods with red and white longitudinal stripes.

Shell.—*Lophiostoma notata* (Sowerby) (Mollusca: Gastropoda: Turridae).

Remarks.—Miyake (1978: 11) stated for his *Pagurus zebra* that all of the ambulatory legs were smooth and similar in structure and that four unpaired pleopods were present in both sexes. I reexamined a male and a female of Miyake's (1978) specimens (ZLKU) and have confirmed that they are *Pylopaguropsis zebra*; they have dissimilar third pereopods and

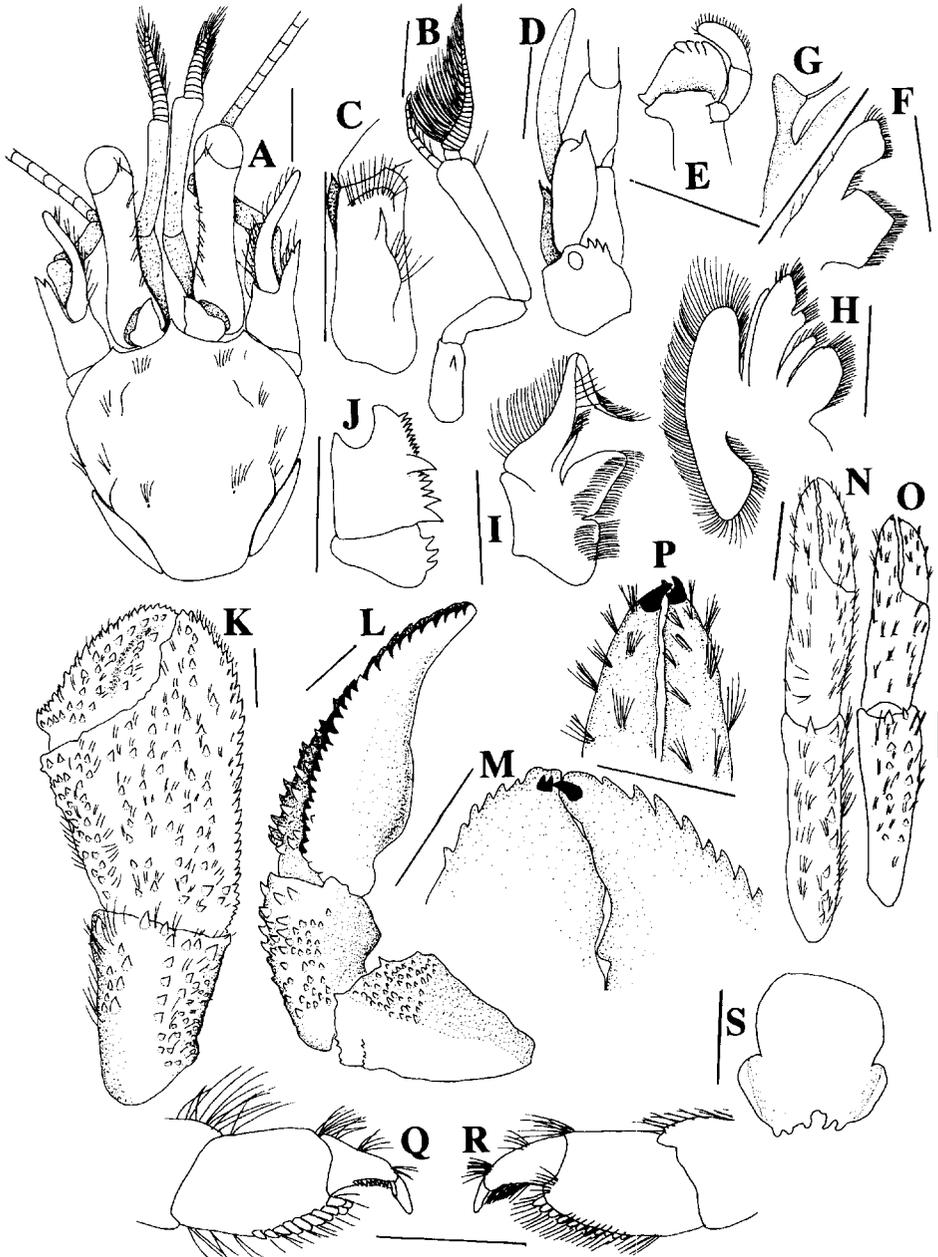


Fig. 2. *Pylopaguropsis zebra* (Henderson, 1893). A–N, P–S: ♂, SL = 3.3 mm, Kushimoto, Kii Peninsula, OMNH Ar 2015. O: Lectotype ♀, SL = 4.9 mm, Holothuria Bank, Australia, NHM 342. Shield and cephalic appendages: A, dorsal view; B, left antennule (lateral view); C, same, basal segment (lateral view); D, left antenna (ventral view). Mouthparts (right): E, mandible (internal view); F, maxillule (external view); G, same, endopod; H, maxilla (external view); I, first maxilliped (external view); J, ischium and basis of third maxilliped (external view). Right cheliped: K, dorsal view; L, lateral view; M, distal portions of dactyl and fixed finger (ventral view). Left cheliped: N, O, dorsal view; P, distal portions of dactyl and fixed finger (ventral view). Distal portion of right fourth pereopod: Q, lateral view; R, mesial view. Telson: S, dorsal view. Scales = 1 mm.

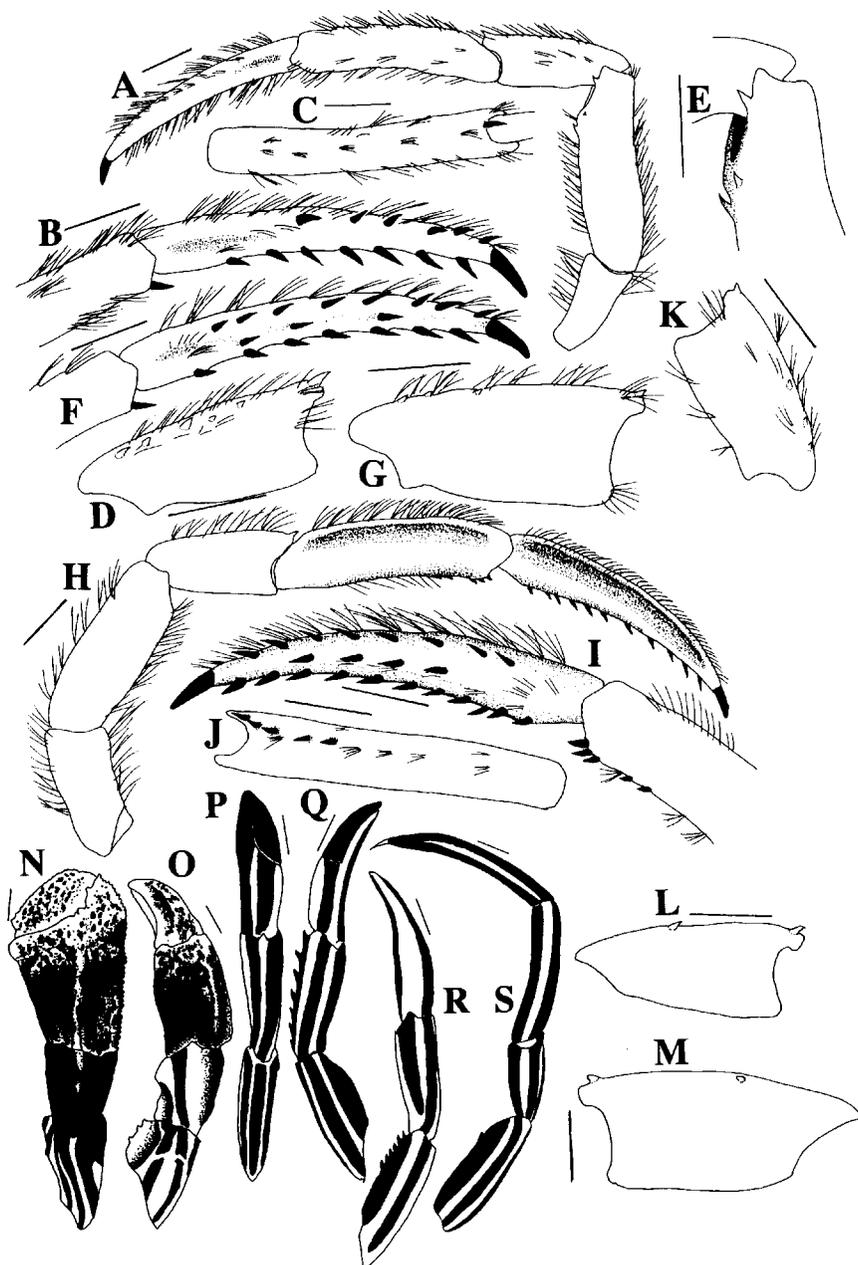


Fig. 3. *Pylopaguopsis zebra* (Henderson, 1893). A–K: ♂, SL = 3.3 mm, Kushimoto, Kii Peninsula, OMNH Ar 2015. L, M: Lectotype ♀, SL = 4.9 mm, Holothuria Bank, Australia, NHM 342. N–S: ♂, SL = 3.6 mm, Kushimoto, Kii Peninsula, OMNH Ar 2014. Left second pereopod: A, lateral view; B, dactyl and distal portion of propodus (mesial view); C, propodus (ventral view); D, carpus (mesial view); E, merus (lateral view). Left third pereopod: F, dactyl and distal portion of propodus (mesial view); G, carpus (mesial view). Right third pereopod: H, lateral view; I, dactyl and distal portion of propodus (mesial view); J, propodus (ventral view); K, carpus (mesial view). Carpus: L, left second pereopod (mesial view); M, right third pereopod (mesial view). Right cheliped: N, dorsal view; O, mesial view. Left cheliped: P, dorsal view; Q, mesial view; R, lateral view. Left third pereopod: S, lateral view. Color patterns indicated in N–S. Scales = 1 mm.

paired first pleopods in the female. So, Miyake's aforementioned statements were incorrect.

Further, McLaughlin & Haig (1989) pointed out that Miyake's illustration of the second right pereopod of his *Pagurus zebra* disagreed with *Pylopaguropsis zebra* in having a spine on the posterior half of the dorsal margin of the carpus, as *Pylopaguropsis zebra* has the unarmed carpi (except for a dorsodistal spine). My examination of the six Japanese specimens have proved that spination of the carpi of the ambulatory legs is subject to variation, the number of spines varying from none to six. My observations of the lectotype also revealed that it has a spinule on the carpus of each ambulatory leg, which is difficult to observe due to its tiny size. Thus, the armature of the carpi is variable in this species.

We reexamined Miyake & Imafuku's (1980) specimens and confirmed that four (Ar 1887, 2014, 2015, 2019) of the five specimens identified as *Pagurus zebra* by these authors are *Pylopaguropsis zebra*. The remaining specimen (Ar 2016) has been identified as *Pylopaguropsis laevispinosa* McLaughlin & Haig.

A few minor differences are seen between the lectotype of *Pylopaguropsis zebra* and the Japanese material. The lectotype has the antennal acicles overreaching the ocular peduncles and has the carpus of the left cheliped bearing double rows of spines dorsally. In contrast, the Japanese specimens have the antennal acicles as long as or shorter than the ocular peduncles and have the carpus of the left cheliped with only a single row of spines. Further, the lectotype has greater numbers of spines on the ventral margins of the dactyls and ventrodistal lateral margins of the first segments of the antennae than the Japanese specimens. However, I consider these differences attributable to intraspecific ontogenetic variation, because the lectotype is a large individual (SL = 4.9 mm) in comparison

with the Japanese material (SL = 3.3–4.3 mm).

Distribution.—Holothuria Bank, northwest Australia; Indonesia; off Sri Lanka; Agulhas Bank, South Africa. Japan: Sagami Bay; Tosa Bay (off Tosa-shimizu and off Tosa); southern coast of Kii Peninsula (Kushimoto, off Shiwonomisaki, Nanbu); Korea Strait, off Tsutsuzaki, Tsushima Islands; East China Sea. 50–180 m.

Pylopaguropsis speciosa McLaughlin & Haig, 1989

Figs. 1A, 1B, 4, 5, 19A

Pylopaguropsis speciosa McLaughlin & Haig, 1989: 132 (key), 153, figs. 1c, 1i, 3e, 5e, 7f, 9e, 13e. — Asakura, 1995: 366, pl. 97–12.

Material examined.—Japanese material: holotype, 1 ♂, SL = 3.20 mm, 61 m, RFB sta. 922, 1 km WNW Onna Village, Okinawa-hontou, 23 Sep. 1981, coll. R. Bolland, USNM 231411; paratype, 1 ♂, SL = 2.10 mm, data same as holotype, USNM 231412; other material: 1 ovi. ♀, SL = 3.15 mm, 35 m, Imazuni, coral reef at northern side of Kume-jima Island, Okinawa, 26°20'N, 126°50'E, 4 Sep. 1993, coll. Show Hirayama, CBM-ZC 5643; 1 ♂, SL = 3.90 mm, data same as the former, CBM-ZC 5644; 1 ♂, SL = 3.70 mm, 10–15 m, Hiyataru-kaigan, Kume-jima Island, Okinawa, 26°20'N, 126°50'E, 13 Aug. 1993, coll. Show Hirayama, CBM-ZC 5645; 1 ♂, SL = 3.70 mm, 10 m, south of Hatenuhama, Kume-jima Island, 26°20'N, 126°50'E, Okinawa, 30 May 1993, coll. Show Hirayama, CBM-ZC 2066.

Type locality.—One km off western north west of Onna Village, Okinawa, 26°30.0'N, 127°59.9'E.

Diagnosis.—Corneas slightly dilated; antennular peduncles with basal segments each bearing acute spine laterally; antennal peduncles with ventrodistal margins of first segments produced, each

bearing 3–6 spines laterally; antennal acicles somewhat arcuate, unarmed. Mandible with incisor process bearing 4 teeth; maxillule with endopod bearing moderately well-developed external lobe; maxilla with moderately broad scaphognathite; first maxilliped with basal portion of exopod moderately broad; third maxilliped with merus bearing blunt-tipped dorsodistal spine. Sternite of third maxillipeds with single spine on either side of midline.

Right cheliped with dactyl terminating in corneous claw (often worn down); fixed finger terminating in bifid, or simple corneous claw (often worn down); dorsal and ventral surfaces of dactyl and fixed finger and ventrolateral and dorsolateral surfaces of palm covered with closely-spaced, flattened, plate-like tubercles encircled by small pits; palm with dorsal surface bearing scattered, very strong spines and dorsomesially with irregular rows of spines or spiniform tubercles, ventral face with scattered spines and tubercles on mesial half; carpus with dorsal face bearing scattered strong spines, lateral face covered with numerous small tubercles; merus with 1 or 2 acute spines at ventrolateral distal angle and 2–4 spines on ventromesial margin distally, lateral face covered with numerous small tubercles. Left cheliped slender; dactyl terminating in corneous claw; fixed finger terminating in bifid, corneous claw; palm unarmed; carpus with dorsomesial margin bearing row of spines and few dorsodistal spines; merus with ventrolateral margin bearing row of strong spines on distal half, ventromesial margin with row of few subacute spines or tubercles proximally.

Second and left third pereopods generally similar; dactyls each with ventral and mesiodorsal rows of strong corneous spines, left third with additional row of few corneous spines ventrally on mesial face and with faint longitudinal sulcus on lateral face; propodi each with strong corneous spine ventrodistally; carpi each

with dorsodistal spine; meri each with acute subdistal spine ventrolaterally (second) or unarmed (left third). Right third dissimilar; dactyl with mesial face strongly convex, bearing row of strong corneous spines dorsally and ventrally, ventral margin with row of strong corneous spines, dorsolateral margin distinct and with row of tufts of long setae, lateral face flattened, with broad, moderately deep longitudinal sulcus, ventrolateral surface longitudinally concave; propodus with dorsolateral margin clearly delineated and with row of tufts of long setae, lateral face flat, with 2 broad, moderately-deep longitudinal sulci, ventrolateral surface longitudinally concave, ventral face with row of corneous spines; carpus and merus similar to left. Fourth pereopods without preungual process; propodal rasp with single moderately short row of corneous scales; carpus with blunt-tipped dorsodistal spine. Sternite of third pereopods with oblong anterior lobe. Telson with posterior lobes separated by shallow median cleft; terminal margins oblique, each with 4–7 spines, sometimes not equidistantly spaced.

Coloration (Fig. 19A) — Shield mottled yellow and white. Ocular peduncles and antennules reddish purple. Antennal peduncles and antennal acicles yellow; flagella reddish purple, with yellow longitudinal stripes. Right cheliped with chela generally reddish purple; carpus generally reddish purple, with yellow longitudinal stripe on mesial face; merus yellow. Left cheliped generally gold. Ambulatory legs gold, with longitudinal white stripes. See also McLaughlin & Haig (1989) for detailed color description.

Remarks.—This is the first record of a female of this species, which has paired first pleopods. The female has slightly smaller right cheliped compared to its body size than the male, although the morphological structure is very similar.

Distribution.—Okinawa, Japan; 10–61 m.

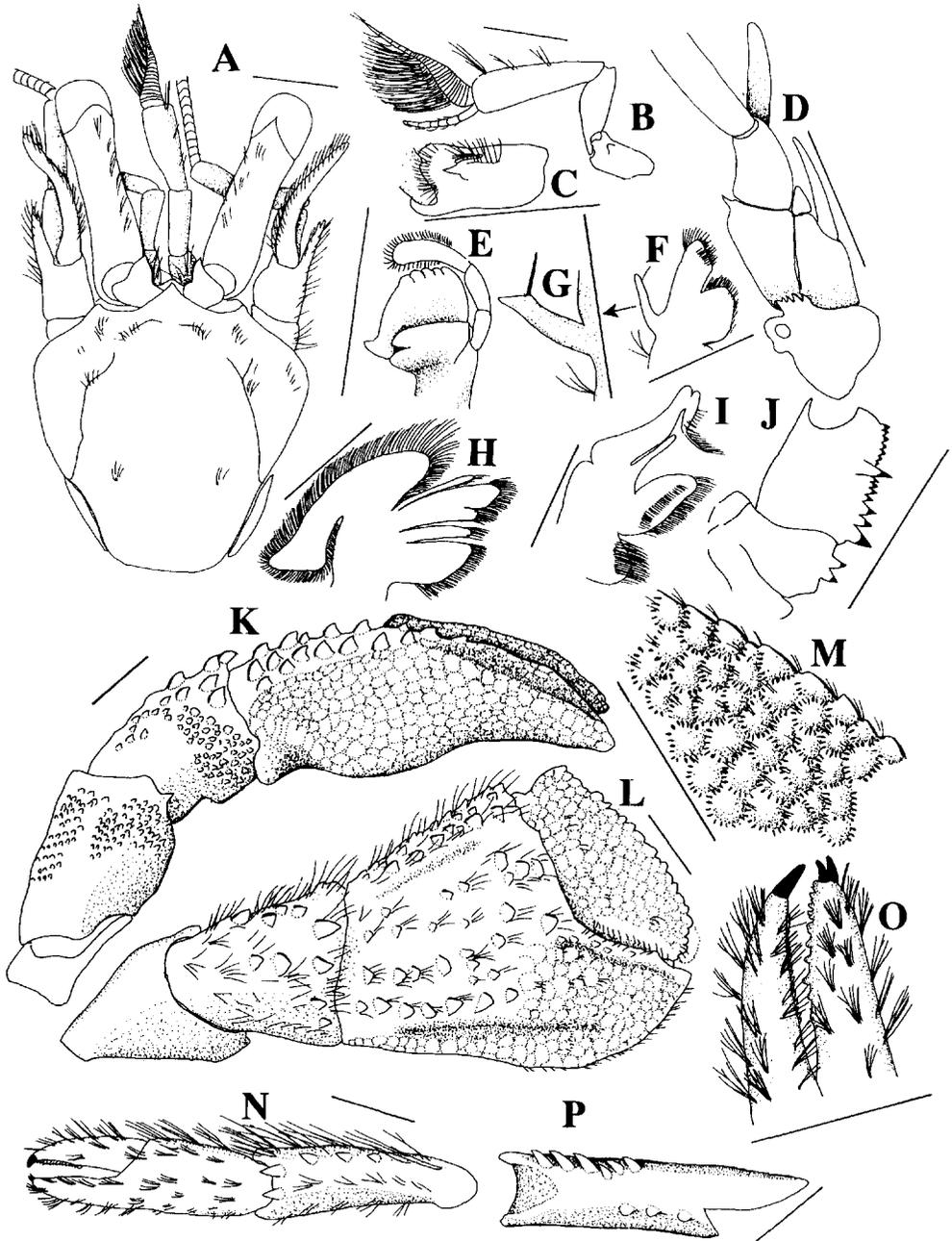


Fig. 4. *Pylopaguropsis speciosa* McLaughlin & Haig, 1989: ♀, SL = 3.15 mm, Kume-jima, Okinawa, CBM-ZC 5643. Shield and cephalic appendages: A, dorsal view; B, left antennule (lateral view); C, same, basal segment (lateral view); D, left antenna (ventral view). Mouthparts (right): E, mandible (internal view); F, maxillule (external view); G, same, endopod; H, maxilla (external view); I, first maxilliped (external view); J, basis and ischium of third maxilliped (external view). Right cheliped: K, lateral view; L, dorsal view; M, closely-spaced, flattened, plate-like tubercles encircled by small pits covered on the dactyl, enlarged (ventral view). Left cheliped: N, dorsal view; O, distal portions of dactyl and fixed finger (ventral view); P, merus (ventral view). Scales = 1 mm.

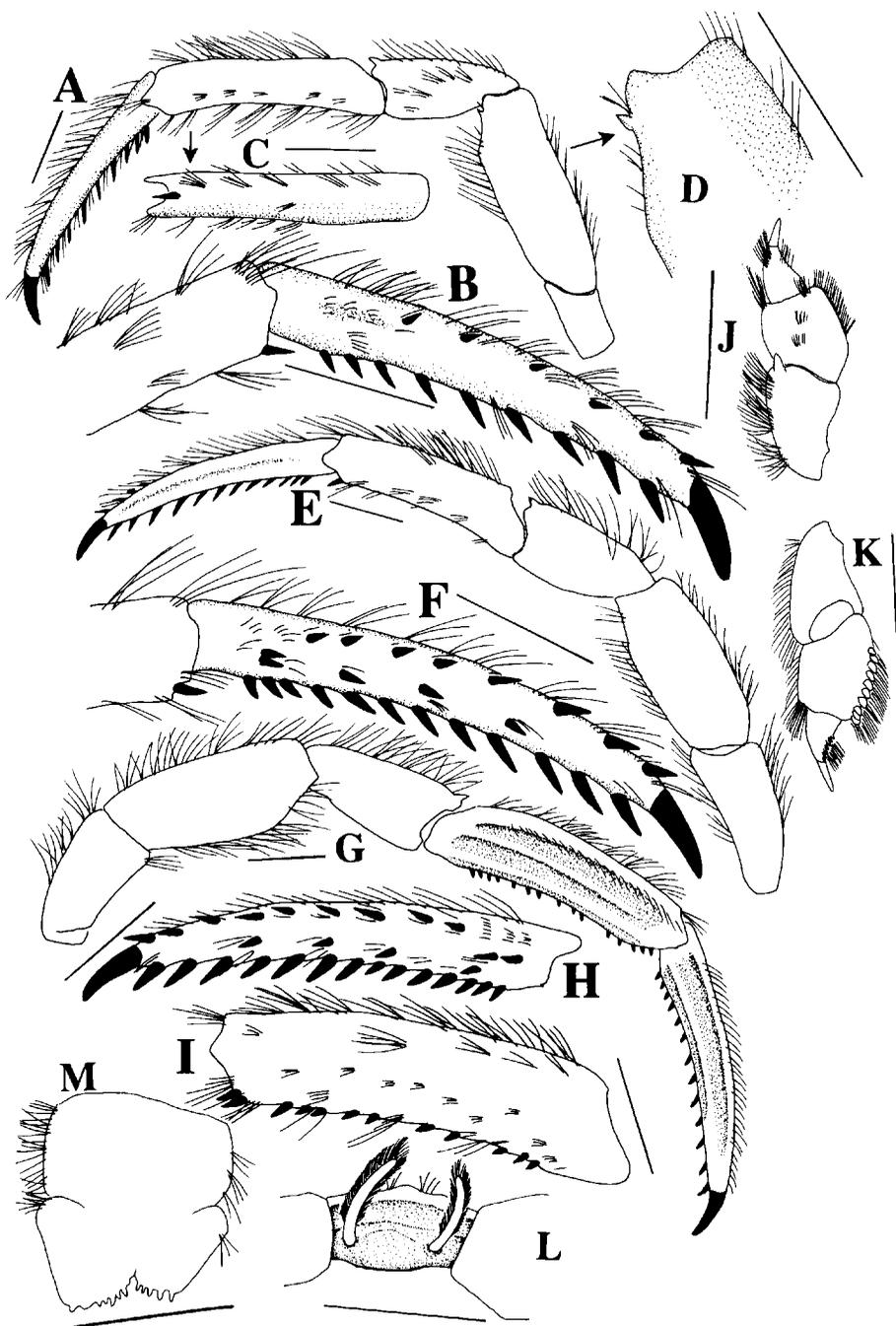


Fig. 5. *Pylopaguopsis speciosa* McLaughlin & Haig, 1989: ♀, SL = 3.15 mm, Kume-jima, Okinawa, CBM-ZC 5643. Left second pereopod: A, lateral view; B, dactyl and distal portion of propodus (mesial view); C, propodus (ventral view); D, distal portion of merus (lateral view). Left third pereopod: E, lateral view; F, dactyl and distal portion of propodus (mesial view). Right third pereopod: G, lateral view; H, dactyl (mesial view); I, propodus (mesial view). Left fourth pereopod: J, mesial view; K, lateral view. Gonopods (= first pleopods) and sternite of fifth pereopods of female: L, ventral view. Telson: M, dorsal view. Scales = 1 mm.

Pylopaguropsis keijii McLaughlin &
Haig, 1989

Figs. 6, 7, 19B, 19C.

Pagurus zebra: Edmondson, 1925: 29; 1933: 228; 1946: 265 [not *Pagurus zebra* (Henderson, 1893)].

?*Pylopaguropsis magnimanus*: Baba, 1982: 67, fig. 2 [not *Pylopaguropsis magnimanus* (Henderson, 1896)].

Pylopaguropsis keijii McLaughlin & Haig, 1989: 150, figs. 2i, 3d, 5d, 7e, 9d, 11d, 13d. — Hogarth *et al.*, 1998: 168.

Material examined.—Paratype: 1 ♀, SL = 3.20 mm, GUM St. 119D, 13–17 m, Uruno Point, Guam, Mariana Islands, 13°37'N, 144°48'E, 4 May 1984, coll. V. Tyndzik, USNM 231415. JAPANESE MATERIAL: 1 ♂, SL = 3.45 mm, 10 m, Tonbarazashi, Kume-jima Island, Okinawa, 26°20'N, 126°50'E, 16 May 1997, coll. Shinji Ogawa, CBM-ZC 5646.

Type locality. — Kahe Point, Oahu, Hawaii, 22°22'N, 158°08'W.

Diagnosis.—Corneas slightly dilated; ocular peduncles appreciably broader proximally; antennular peduncles with basal segments each bearing acute spine laterally; antennal peduncles with ventrodorsal margins of first segments produced, each bearing 2–5 spines laterally; antennal acicles somewhat arcuate, unarmed. Mandible with incisor process bearing 4 teeth; maxillule with endopod bearing moderately well-developed external lobe; maxilla with moderately broad scaphognathite; first maxilliped with basal portion of exopod moderately broad; third maxilliped with carpus and merus each bearing dorsodistal spine. Sternite of third maxillipeds with single spine on either side of midline.

Right cheliped with dactyl terminating in small corneous claw, dorsal face with scattered small spines, dorsomesial margin with row of spines; fixed finger terminating in small, bifid, corneous claw; palm with dorsal surface bearing scattered small spines, dorsolateral margin

with irregular rows of spines or spiniform tubercles, mesial face covered by variously-sized spines; carpus with dorsal face bearing scattered spines; merus with ventromesial margin bearing row of spines. Left cheliped slender; dactyl terminating in corneous claw; fixed finger terminating in bifid, corneous claw; surfaces of dactyl, fixed finger and palm unarmed; carpus with 0–3 small spines dorsally; merus with ventrolateral distal angle bearing acute spine.

Second and left third pereopods generally similar; dactyls each with ventral and mesiodorsal rows of strong corneous spines, left third with additional 1 or 2 corneous spines on mesial face ventrally and faint longitudinal sulcus on lateral face; propodi each with strong, corneous spine ventrodorsally; carpi each with dorsodistal spine; meri each with acute subdistal spine ventrolaterally (second) or unarmed (left third). Right third dissimilar; dactyl with flat lateral face bearing broad, moderately deep, longitudinal sulcus, strongly convex mesial face bearing dorsal and ventral rows of strong corneous spines, ventral margin with row of strong corneous spines; propodus with flat lateral face bearing prominent broad, moderately deep, longitudinal sulcus, ventral face with row of corneous spines on distal half; carpus and merus similar to left. Fourth pereopod with small preungual process; propodal rasp with single short row of corneous scales; carpus with blunt-tipped dorsodistal spine. Sternite of third pereopods with anterior lobe subrectangular. Telson with posterior lobes separated by shallow median cleft; terminal margins horizontal to oblique, each with 5–9 spines, sometimes extending onto lateral margins.

Coloration (Figs. 6O–P, 7I, 19B–C). — In life: Shield whitish with some yellow flecks. Ocular peduncles light purple, with longitudinal dark purple stripes on major portion, red band near base of corneas and narrow white band proximally;

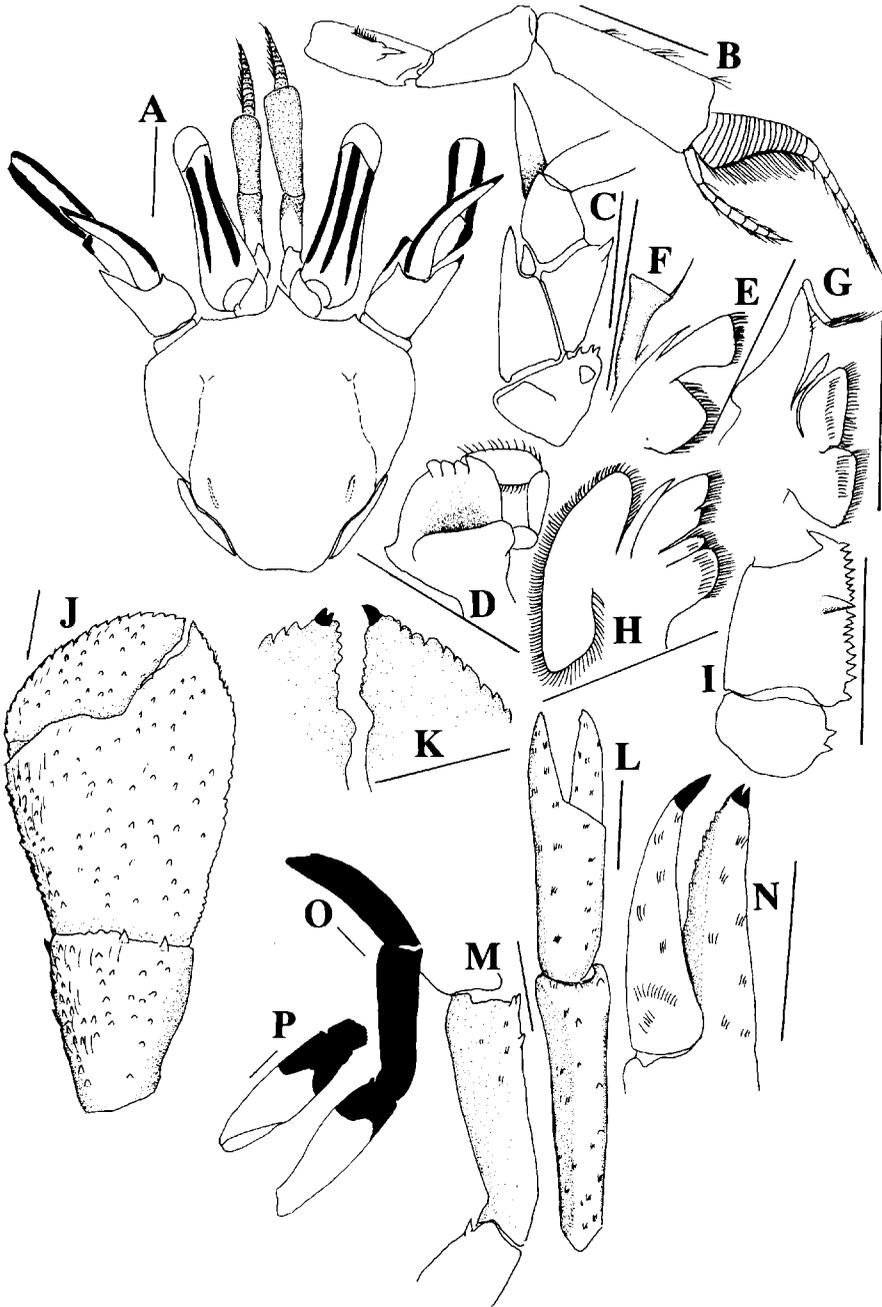


Fig. 6. *Pylopaguopsis keijii* McLaughlin & Haig, 1989: ♂, SL = 3.45 mm, Kume-jima, Okinawa, CBM-ZC 5646. Shield and cephalic appendages: A, dorsal view; B, right antennule (lateral view); C, right antenna (ventral view). Mouthparts (right): D, mandible (internal view); E, maxillule (external view); F, same, endopod; G, maxilla (external view); H, first maxilliped (external view); I, basis and ischium of third maxilliped (external view). Right cheliped: J, dorsal view; K, fixed finger and dactyl (ventral view). Left cheliped: L, dorsal view; M, carpus (lateral view); N, fixed finger and dactyl (ventral view). Color patterns of left cheliped: O, lateral view; P, merus (mesial view). Scales = 1 mm.

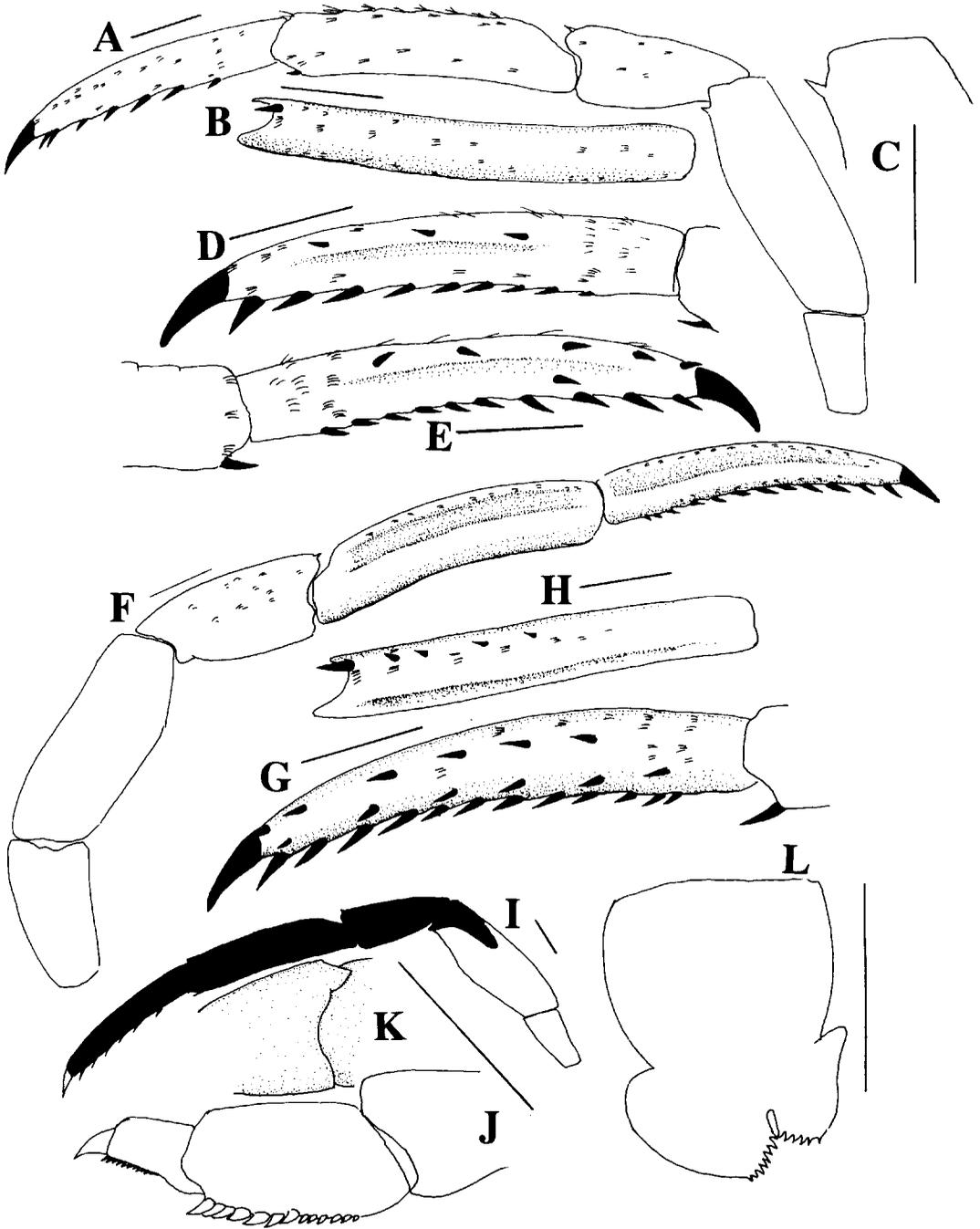


Fig. 7. *Pylopaguropsis keijii* McLaughlin & Haig, 1989: ♂, SL = 3.45 mm, Kume-jima, Okinawa, CBM-ZC 5646. Left second pereopod: A, lateral view; B, propodus (ventral view); C, distal portion of merus (lateral view). Right second pereopod: D, dactyl and distal portion of propodus (mesial view). Left third pereopod: E, dactyl and distal portion of propodus (mesial view). Right third pereopod: F, lateral view; G, dactyl (mesial view); H, propodus (ventromesial view). Color pattern of left second pereopod: I, lateral view. Left fourth pereopod: J, lateral view; K, distal portion of carpus (merus view). Telson: L, dorsal view. Scales = 1 mm.

corneas silver-white. Antennular peduncles with ultimate segments and distal thirds of penultimate segments light purple; flagella light purple. Antennal peduncles with fifth, fourth and third segments and antennal acicles bearing longitudinal dark purple stripes; flagella with thin longitudinal purple stripes. Right cheliped generally fawn, gradually becoming white on both fingers. Left cheliped and ambulatory legs deep magenta on dactyls, propodi, carpi, and distal margins of meri; remainder white.

Distribution.—Hawaii, Guam, west Caroline Islands, Zanzibar, Maldives, and now Okinawa. 10–17 m.

***Pylopaguopsis fimbriata* McLaughlin & Haig, 1989**

Figs. 1C–E, 8, 9, 19D

Pylopaguopsis zebra: Wooster, 1979: 173 [not *Pylopaguopsis zebra* (Henderson, 1893)]

Pylopaguopsis undescribed sp. 2: Haig & Ball, 1988: 190.

Pylopaguopsis fimbriata McLaughlin & Haig, 1989: 131 (key), 164, figs. 1f, 1l, 2f, 4d, 6d, 8e, 10d, 12d, 13i. — Rahayu, 1994: 76 (list). — Nomura *et al.*, 1996: 14, 19 (lists).

Material examined.—Holotype: ovi. ♀, SL = 2.90 mm, 15 m, GUM St. 102-A, Fafai Beach, Guam, Mariana Islands, 13°31'N, 144°48'E, 12 Apr. 1984, coll. R. Kropp, USNM 213413; paratypes: 2 ♂, SL = 2.40, 3.40 mm, 1 ♀ (SL = 2.3 mm), GUM St. 104, Orote Cliffs, Guam, Mariana Islands, 13°26'N, 144°38'E, coll. R. Kropp and V. Tyndzik, USNM 213414. JAPANESE MATERIAL: 1 ♂, SL = 4.65 mm, 10 m, under stone, coral reef edge, Nishihama, Akajima Island, the Kerama Group, Okinawa, 26°10'N, 127°17'E, 22 April 1994, coll. Keiichi Nomura, CBM-ZC 5647; 1 ♂, SL = 3.15 mm, data same as the former, CBM-ZC 5648; 1 ovi. ♀, SL = 3.40 mm, 10 m, under stone, coral reef edge, Yakabi-jima Island, the Kerama Group, Okinawa, 26°13'N, 127°15'E, 25 Apr. 1994, coll. Keiichi Nomura, CBM-ZC

5649; 1 ♀, SL = 3.00 mm, 20 m, northern reef edge, Shichowgama, Kume-jima Island, Okinawa, 26°20'N, 126°50'E, 4 Jan. 1997, coll. Yuishow Sakamoto, CBM-ZC 5650.

Type locality.—Fafai Beach, Guam, Mariana Islands, 13°31'N, 144°48'E.

Diagnosis.—Corneas slightly dilated; antennular peduncles with basal segments each bearing acute spine laterally; antennal peduncles with ventrodiscal margins of first segments produced, bearing spine laterally; antennal acicles somewhat arcuate, unarmed. Mandible with incisor process bearing 3 or 4 teeth; maxillule with endopod bearing well developed external lobe; maxilla with narrow scaphognathite; first maxilliped with basal portion of exopod very narrow; third maxilliped with merus and carpus each with dorsodistal spine. Sternite of third maxillipeds with 1 spine on either side of midline.

Right cheliped with dactyl terminating in corneous claw, dorsal and mesial faces covered with tubercles or small spines; fixed finger terminating in simple or bifid, corneous claw, dorsal face with small spines; palm with dorsal face bearing scattered, variously-sized spines or tubercles, margin fringed with row of dense long setae, dorsomesial margin with irregular single or double rows of strong spines, mesial face tuberculate; carpus with dorsal surface bearing row of strong spines in midline, dorsolateral, dorsomesial, and ventromesial margins each with row of strong spines; merus with ventromesial margin bearing row of spines. Left cheliped slender; dactyl terminating in corneous claw, dorsal surface with irregular rows of small spines, dorsomesial margin with row of few spines; fixed finger terminating in strong, bifid, corneous claw or double spines; palm with irregular rows of small spines on dorsal and lateral faces, dorsal face with sulcus in midline; carpus with dorsal face bear-

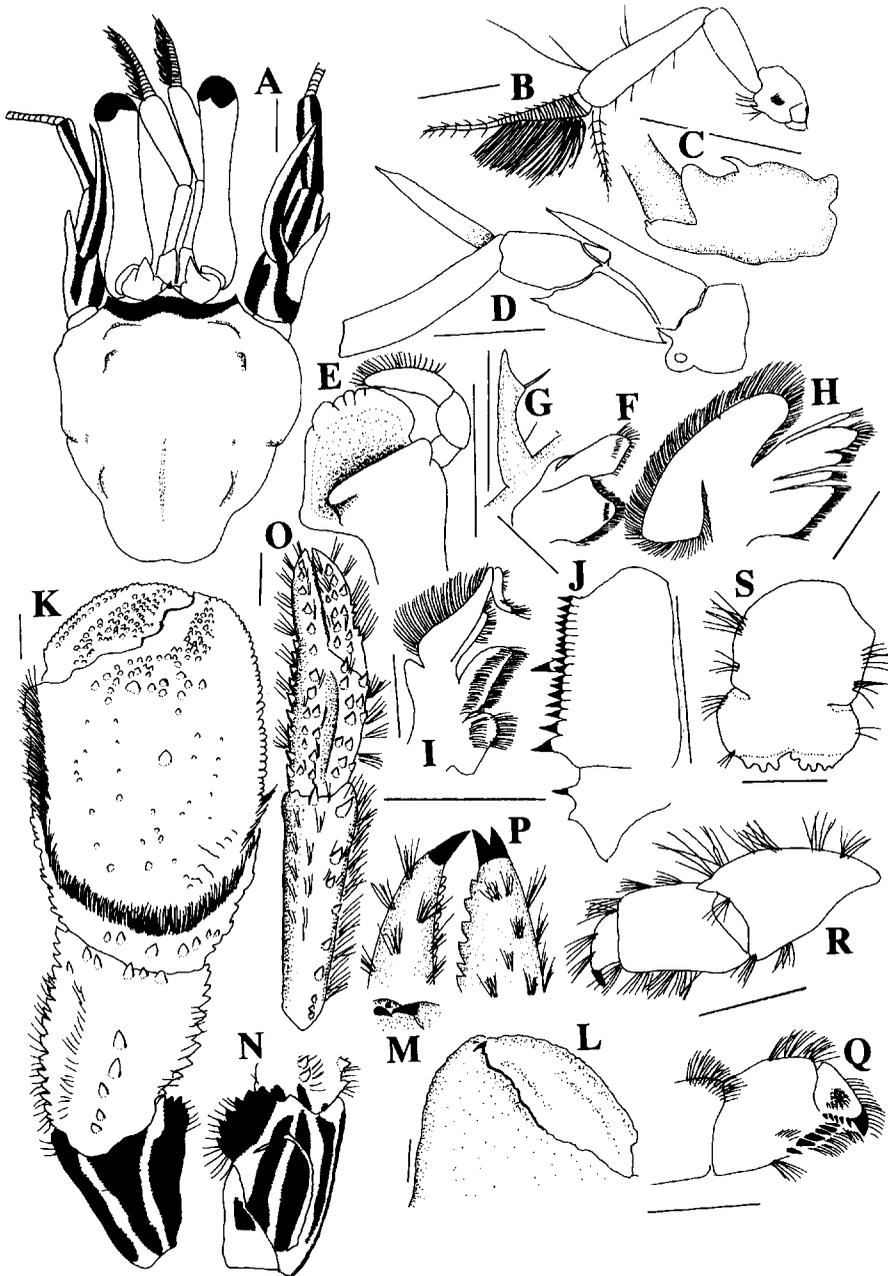


Fig. 8. *Pylopaguopsis fimbriata* McLaughlin & Haig, 1989: ♂, SL = 4.65 mm, Kerama Group, Okinawa, CBM-ZC 5647. Shield and cephalic appendages: A, dorsal view; B, left antennule (lateral view); C, same, basal segment (ventral view); D, left antenna (ventral view). Mouthparts (right): E, mandible (internal view); F, maxillule (external view); G, same, endopod; H, maxilla (external view); I, first maxilliped (external view); J, basis and ischium of third maxilliped (internal view). Right cheliped: K, dorsal view; L, fixed finger and dactyl (ventral view); M, tips of fixed finger and dactyl, enlarged (ventral view); N, merus (mesial view). Left cheliped: O, dorsal view; P, distal portions of dactyl and fixed finger (ventral view). Distal portion of right fourth pereopod: Q, lateral view; R, mesial view. Telson: S, dorsal view. Color patterns indicated in A, K, N. Scales = 1 mm.

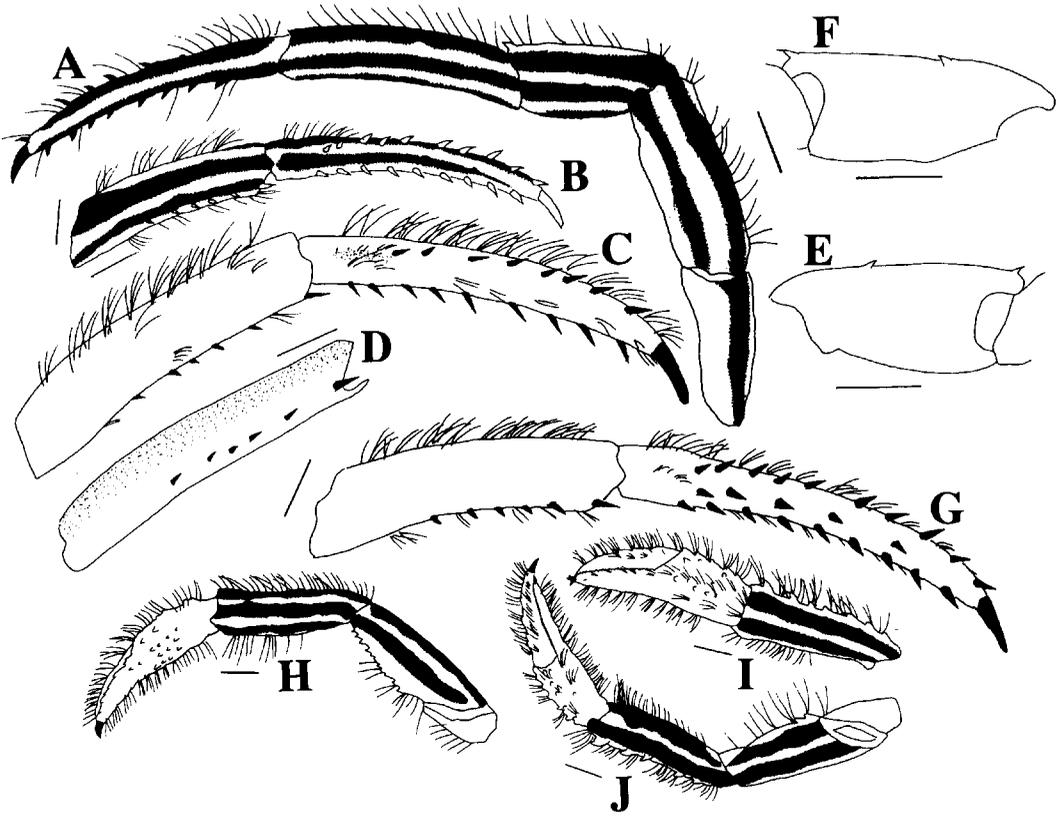


Fig. 9. *Pylopaguopsis fimbriata* McLaughlin & Haig, 1989: ♂, SL = 4.65 mm, Kerama Group, Okinawa, CBM-ZC 5647. Left second pereopod: A, lateral view; B, dactyl and propodus (mesial view); C, dactyl and propodus (mesial view); D, propodus (ventromesial view); E, carpus (mesial view). Right second pereopod: F, carpus (mesial view). Left third pereopod: G, dactyl and propodus (mesial view). Left cheliped: H, lateral view; I, dorsal view; J, mesial view. Color patterns indicated in A, B, H–J. Scales = 1 mm.

ing row of strong spines mesially and acute spine distally; merus with few tubercles at ventromesial proximal angle, ventrolateral margin bearing row of spines.

Second and third pereopods generally similar; dactyls each with ventral and mesiodorsal rows of strong corneous spines, dactyls of third each with additional row of few corneous spines on mesial face ventrally and faint longitudinal sulcus on lateral face; propodi each with ventral row of few corneous spines, distal-most strong and acute; carpi each with dorsodistal spine and, second with addi-

tional dorsal row of small spines or spinules; meri unarmed. Sternite of third pereopods with anterior lobe subsemicircular. Fourth pereopods with prominent preungual process; propodal rasp with single short row of corneous scales; carpus with dorsodistal spine. Telson with posterior lobes separated by shallow median cleft; terminal margins horizontal, each with 3–5 small spines, often extending onto lateral margins.

Coloration (Figs. 8A, K, N; 9A, B, H–J; 19D).—In life: Shield white, with transverse brown band on anterior margin; rostrum white, with brown tip. Ocular pe-

duncles whitish yellow; corneas yellow; ocular acicles white. Antennular peduncles and flagella pale bluish purple. Antennal peduncles with second to fifth segments and antennal acicles bearing parallel red and white stripes; first segments white; flagella red dorsally, lighter ventrally. Right cheliped with terminal corneous claws of both fingers brown; merus with parallel red and white stripes extending onto proximal portion of mesial face of carpus; palm with dorsal face bearing few yellow spots; other surfaces whitish. Left cheliped with terminal corneous claws of both fingers brown; dactyl and palm slightly-reddish white; carpus and merus with parallel red and white stripes. Ambulatory legs with parallel red and white stripes; spines light brown; setae yellow.

Distribution.—Guam, east Malaysia, Indonesia, and Okinawa. 10–20 m

Pylopaguropsis laevispinosa

McLaughlin & Haig, 1989

Figs. 10, 11.

Pylopaguropsis laevispinosa McLaughlin & Haig, 1989: 166, figs. 4e, 6e, 8f, 10e, 12e, 13j, 21. — McLaughlin, 1997: 545, figs. 30b, d, 44a, b.

Pagurus zebra: Miyake & Imafuku, 1980: 60 (in part, see remarks).

Material examined.—Japanese material: paratype: ♀, SL = 4.20 mm, 70.1 m, st. RFB 898, 1 km WNW Onna Village, Okinawa, 26°30.0'N, 127°50.9'E, 16 Aug. 1981, coll. R. Bolland, USNM 231410; other material: 1 ♂, SL = 2.80 mm, 50–80 m, dredge, Kushimoto, Kii Peninsula, 33°30'N, 135°45'E, 1978, coll. Seiji Nagai, OMNH Ar 2016.

Type locality.—One km off western north west, Onna Village, Okinawa, 26°30.0'N, 127°50.9'E.

Diagnosis.—Corneas slightly dilated; antennular peduncles with basal segments each bearing acute spine laterally

and spinule at ventrodistal margin; antennal peduncles with ventrodistal margins of first segments produced, each bearing single spine laterally; antennal acicles strongly arcuate, unarmed. Mandible with incisor process bearing 4 teeth; maxillule with endopod bearing well developed external lobe; maxilla with narrow scaphognathite; first maxilliped with basal portion of exopod very narrow; third maxilliped with merus unarmed. Sternite of third maxillipeds with single spine on either side of midline or unarmed.

Right cheliped with dactyl terminating in small corneous claw, dorsal face densely covered with spines; fixed finger terminating in small, bifid, corneous claw; palm with dorsal face densely covered with strong spines; carpus with dorsal face bearing irregular rows of strong spines; merus with ventrolateral and ventromesial margins each bearing row of acute spines, ventromesial proximal angle bearing prominent tubercle. Left cheliped slender; dactyl terminating in small corneous claw, dorsal face with irregular rows of small spines; fixed finger terminating in bifid, corneous claw, dorsal face with 1 or 2 irregular rows of small spines; palm with dorsal face bearing rows of strong spines, dorsolateral margin armed with row of spines; carpus with dorsal face bearing 2 or 3 rows of spines; merus with ventrolateral and ventromesial margins each with row of spines, ventromesial proximal angle bearing prominent tubercle.

Second and third pereopods generally similar; dactyls each with ventral and mesiodorsal rows of strong corneous spines, third with additional row of few corneous spines on mesial face ventrally; propodi each with strong corneous spine at ventrodistal angle and 2 (second) or 1 (third) additional corneous spine on ventral margin; carpi each with acute dorso-distal spine, second with few, additional small spines dorsally; meri unarmed.

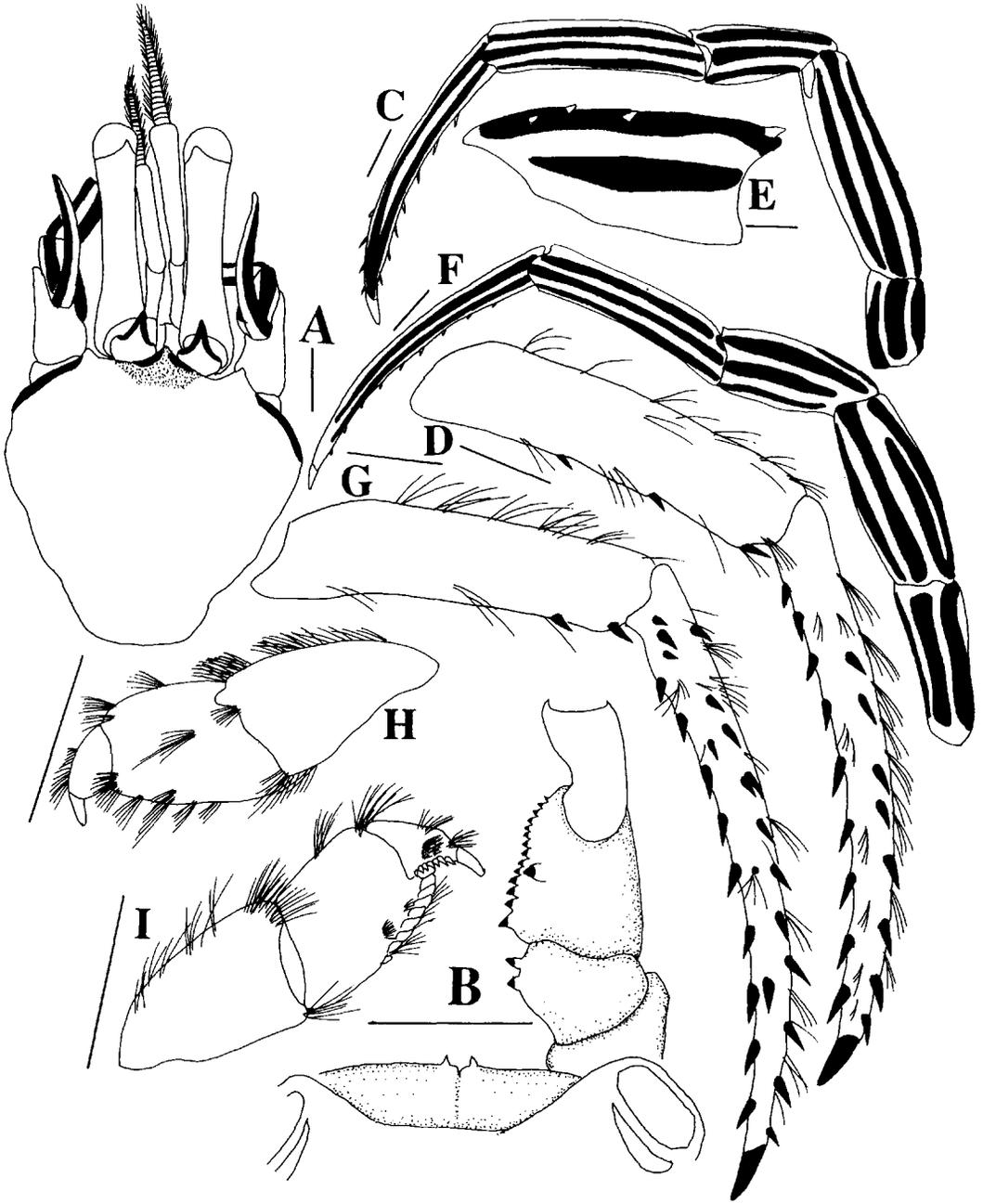


Fig. 10. *Pylopaguopsis laevispinosa* McLaughlin & Haig, 1989: Paratype ♀, SL = 4.2 mm, Onna Village, Okinawa, USNM 231410. A, shield and cephalic appendages. B, sternite of third maxillipeds and proximal portion of left third maxilliped (ventral view). Left second pereopod: C, lateral view; D, dactyl and propodus (mesial view); E, carpus (mesial view). Left third pereopod: F, lateral view; G, dactyl and propodus (mesial view). Right fourth pereopod: H, mesial view; I, lateral view. Color patterns indicated in A, C, E, F. Scales = 1 mm.

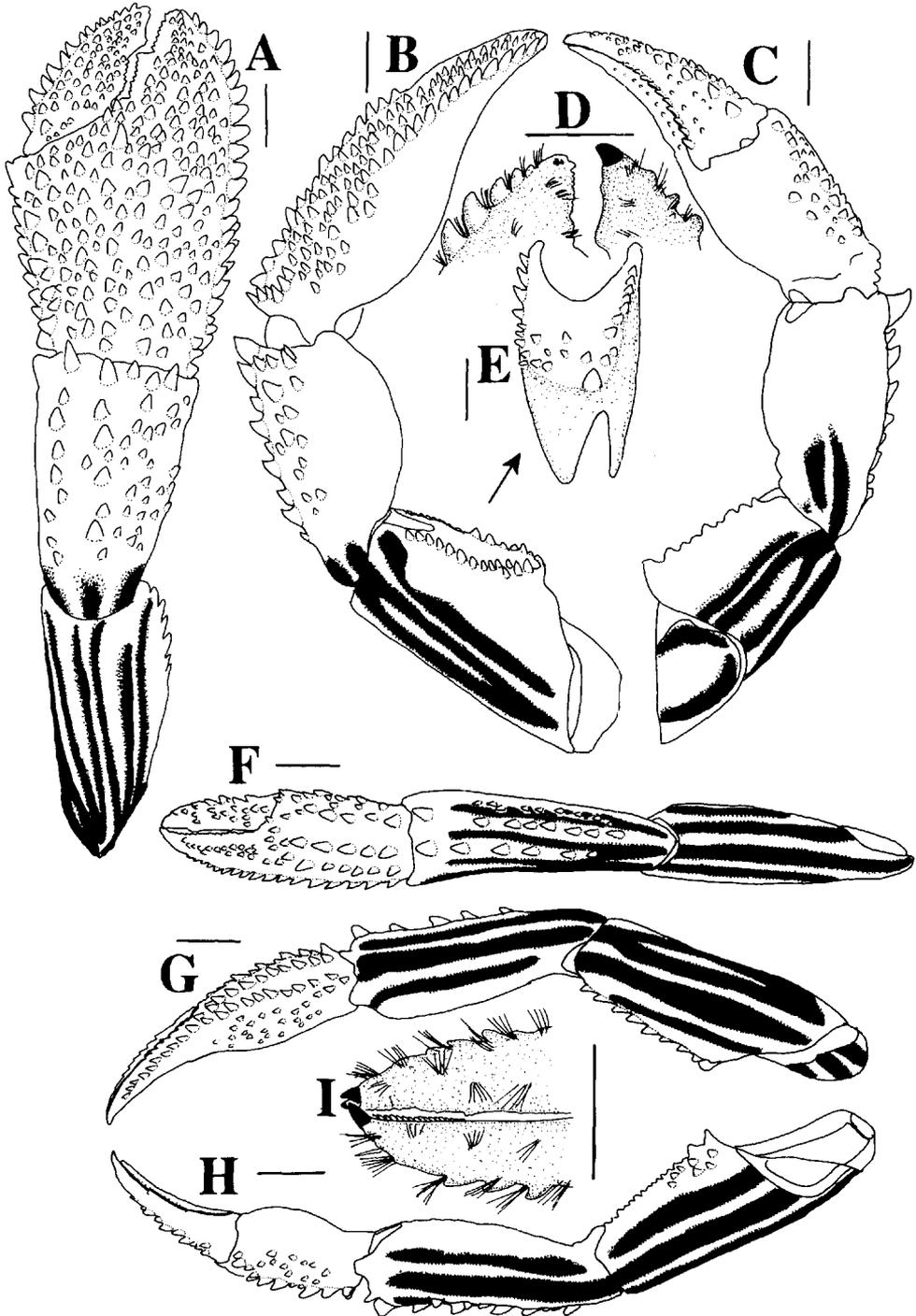


Fig. 11. *Pylopaguropsis laevispinosa* McLaughlin & Haig, 1989: Paratype ♀, SL = 4.20 mm, Onna Village, Okinawa, USNM 231410. Right cheliped: A, dorsal view; B, lateral view; C, mesial view; D, distal portions of dactyl and fixed finger (ventral view); E, merus (ventral view). Left cheliped: F, dorsal view; G, lateral view; H, mesial view; I, distal portions of dactyl and fixed finger (ventral view). Color patterns indicated in A–C and F–H. Scales = 1 mm.

Sternite of third pereopods with anterior lobe subsemicircular. Fourth pereopods without preungual process; propodal rasp with single short row of corneous scales; carpus with large blunt-tipped spine at dorsodistal angle. Telson with posterior lobes separated by shallow median cleft; terminal margins oblique, each with row of small spines, extending onto lateral margin, particularly on left.

Coloration (Figs. 10A, C, E, F; 11A–C, F–H).—In life: Shield whitish and orange tinged, anterolateral margins of shield and rostral margin accentuated in dark orange, rostral lobe orange. Ocular peduncles cream-colored; corneas brown; ocular acicles with margins accentuated in orange. Antennular peduncles whitish; distal third of ultimate segment yellowish brown. Antennal peduncles with orange and white stripes on fifth and fourth segments and antennal acicles. Right cheliped with dactyl and palm cream-colored; carpus light orange; merus with longitudinal orange and white stripes extending onto proximal portion of carpus and distal portion of ischium. Left cheliped with dactyl and palm cream-colored; carpus, merus, and ischium with orange and white longitudinal stripes. Ambulatory legs with orange and white longitudinal stripes.

Remarks.—As mentioned before, one specimen (OMNH Ar. 2016) among the five specimens identified as *Pagurus zebra* by Miyake & Imafuku (1980) from the Kii Peninsula, central Japan, actually is *Pylopaguropsis laevispinosa*. The other four specimens are *Pylopaguropsis zebra*.

Although McLaughlin & Haig (1989) stated that the sternite of the third maxillipeds in *P. laevispinosa* was unarmed, one of the paratype specimens that I examined (USNM 231410) has one acute spine on each side of the midline. Thus, this character is subject to variation.

Distribution.—Indonesia, Okinawa, and now Kushimoto, Kii Peninsula. 50–80 m.

Pylopaguropsis furusei new species

Figs. 12–15, 19E

Material examined.—Holotype: ♀, SL = 4.40 mm, 6 m, off Takino-ura, Ani-jima Island, Ogasawara Islands, 27°06'N, 142°10'E, 19 February 1995, coll. Hiroyuki Tachikawa, CBM-ZC-5651; paratypes: ♂, SL = 5.40 mm, 5 m, off Manjyu-misaki, Chichi-jima Island, Ogasawara Islands, 27°06'N, 142°10'E, 27 Sept., 1995, coll. Hiroyuki Tachikawa, CBM-ZC 5652; ovi. ♀, SL = 3.70 mm, 3 m, off west of Hakidashi-hana, Ani-jima Island, Ogasawara Islands, 27°06'N, 142°10'E, 9 Apr. 1995, coll. Hiroyuki Tachikawa, CBM-ZC 5653; ovi. ♀, SL = 5.00 mm, 13 m, on rock wall, Sokodo, Hachijyo-jima Island, Izu Islands, 33°10'N, 139°45'E, 3 Aug. 1994, coll. Koji Furuse and Hideyuki Takasu, CBM-ZC 5654; ovi. ♀, SL = 4.10 mm, 30 m, in rock crack, off Akino-hama, Oh-shima Island, Izu Islands, 34°45'N, 139°20'E, 30 Oct. 1994, coll. Hideyuki Takasu, CBM-ZC 5655; 1 ♂, SL = 4.90 mm, 25 m, in rock crevice, Tatamine, Hachijyo-jima Island, Izu Islands, 33°10'N, 139°45'E, 28 Apr. 1996, coll. Hideyuki Takasu, CBM-ZC 5656.

Type locality.—Off Takino-ura, Ani-jima Island, the Ogasawara (Bonin) Islands, 27°06'N, 142°10'E, 6 m.

Description.—Shield 1.0–1.1 times longer than broad; anterior margin between rostrum and lateral projections concave; anterolateral margins rounded; lateral margins convex; posterior margin truncate; dorsal surface slightly rugose, convex, with scattered very short setae anteriorly, 2 pairs of indistinctly curved sulci present anteriorly, pair of short sulci posterolaterally, pair of posterior gastric pits distinct; rostrum triangular, slightly overreaching lateral projections, terminating in small spinule; lateral projections obtusely triangular, each terminating in small, acute marginal spinule. Accessory portions of shield well calcified,

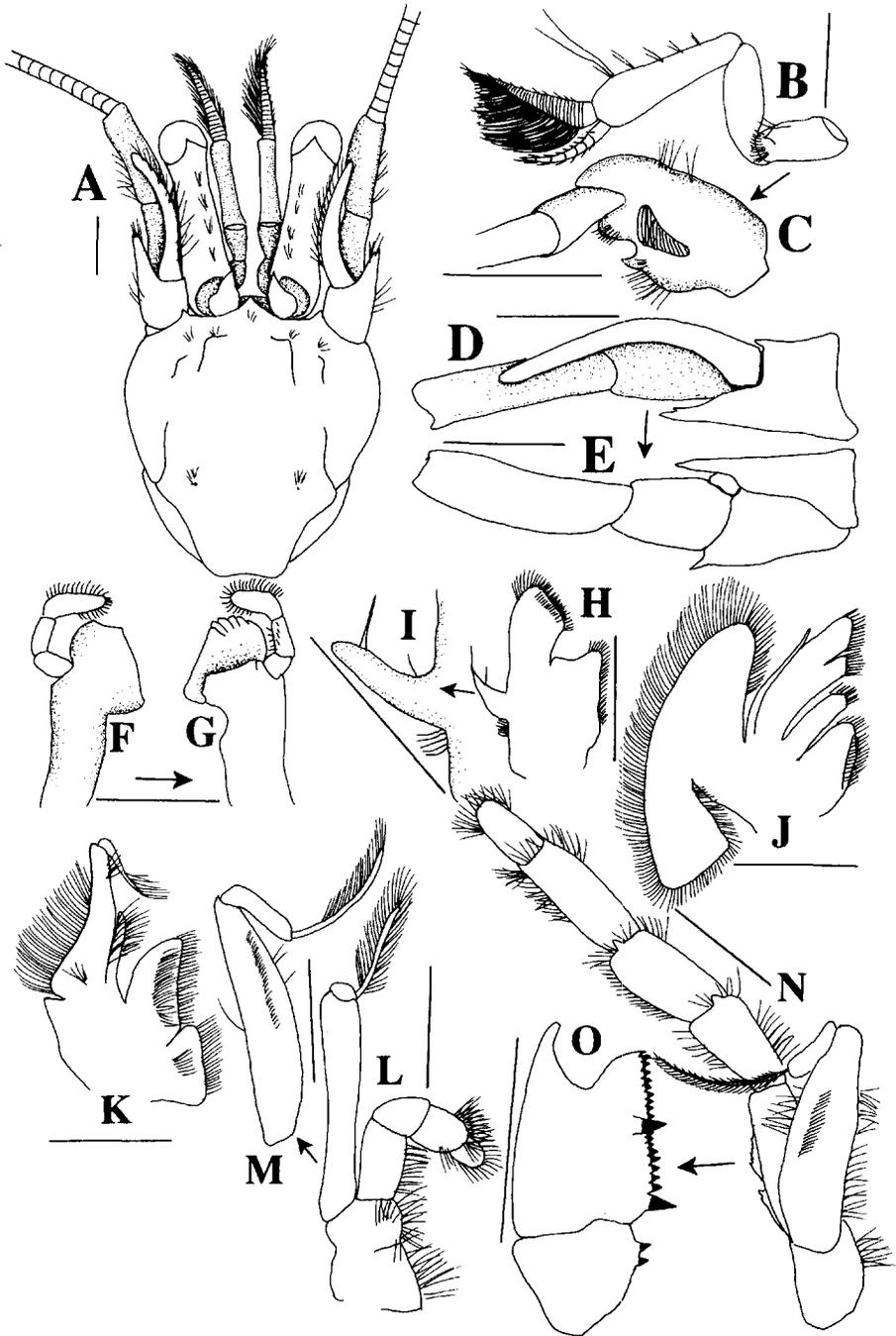


Fig. 12. *Pylopaguropsis furusei* new species: Holotype ♀, SL = 4.40 mm, Ani-jima Island, Ogasawara Islands, CBM-ZC 5651. Shield and cephalic appendages: A, dorsal view; B, left antennule (lateral view); C, same, basal segment (dorsal view); D, left antenna (dorsal view); E, same (ventral view). Mouthparts (right): F, mandible (external view); G, same (internal view); H, maxillule (external view); I, same, endopod; J, maxilla (external view); K, first maxilliped (external view); L, second maxilliped (external view); M, same, exopod; N, third maxilliped (dorsal view); O, same, basis and ischium (external view). Scales = 1 mm.

unarmed. Branchiostegites not calcified; anterior margins unarmed, produced, with fringe of setae.

Ocular peduncles moderately long, 0.6–0.7 length of shield; slender, slightly inflated basally, with row of tufts of short setae dorsomesially. Corneas only very slightly dilated. Ocular acicles triangular, simple, acute; separated by slightly more than basal width of 1 acicle.

Antennular peduncles long, when fully extended, exceeding ocular peduncles by 0.4–0.7 length of ultimate segments; ultimate segment with row of tufts of setae dorsally, longest subdistally; penultimate segment unarmed; basal segment with acute spine laterally, ventrodiscal margin unarmed or with tiny spinule. Antennal peduncles moderately long, when fully extended exceeding ocular peduncles by 0.2–0.4 length of ultimate segments; fifth segment with row of tufts of setae ventrolaterally and mesially; fourth segment with few scattered setae; third segment with strong spine at ventrodiscal margin; second segment with dorsolateral distal angle produced, terminating in strong spine accompanied mesially by small submarginal spine, dorsomesial distal angle with acute spine; first segment with ventrodiscal margin produced, bearing acute spine laterally. Antennal acicles moderately long, strongly arcuate, terminating in blunt-tipped spine; dorsomesial margins with row of moderately long setae. Antennal flagella comprised of about 80–100 articles, with 2–4 long setae every 2 or 3 articles, interspersed by short setae.

Mandible with incisor process bearing 4 teeth. Maxillule with endopod bearing moderately well-developed external lobe; internal lobe with 1 apical bristle. Maxilla with moderately broad scaphognathite. First maxilliped with basal portion of exopod moderately broad. Second maxilliped unarmed. Third maxilliped with carpus and merus each bearing blunt-

tipped spine on dorsodistal margin; ischium with crista dentata well developed, composed of 20–33 acute corneous teeth, larger proximally (occasionally, proximal one very strong), and with strong accessory tooth; basis with 2–4 acute corneous teeth. Sternite of third maxillipeds with median suture; unarmed, or occasionally with small spine, accompanied laterally by thick seta on either side of midline.

Right cheliped massive, sparsely setose; chela somewhat dorsoventrally compressed. Dactyl 0.6–0.8 length of palm, terminating in small corneous claw; dorsal surface with scattered strong spines, dorsomesial margin fringed with row of very strong spines; cutting edge with row of several low, sometimes obscure, blunt-tipped calcareous teeth; ventromesial margin with row of spines. Fixed finger terminating in small, bifid, corneous claw, overlapping terminal claw of dactyl; cutting edge with row of several low, sometimes obscure, calcareous teeth. Palm approximately equaling carpus in length; dorsal surface covered with very strong, conical-shaped spines, sometimes forming irregular longitudinal rows, dorsolateral margin with row of strong spines; ventral surface strongly convex, tuberculate; dorsomesial margin with irregular single or double row of very strong spines. Carpus 0.8–1.0 length of merus; dorsal surface with numerous strong spines, sometimes forming irregular longitudinal rows, dorsolateral margin not clearly delimited; ventral surface weakly tuberculate. Merus triangular; dorsal margin unarmed; ventrolateral margin with row of few acute spines distally, ventromesial margin with row of short spines distally; ventral surface weakly tuberculate. Ischium unarmed.

Left cheliped slender; propodal-carpal articulation rotated counter-clockwise 50°–60° from perpendicular when viewed dorsally. Dactyl 1.1–1.2 length of palm, terminating in strong corneous claw; dor-

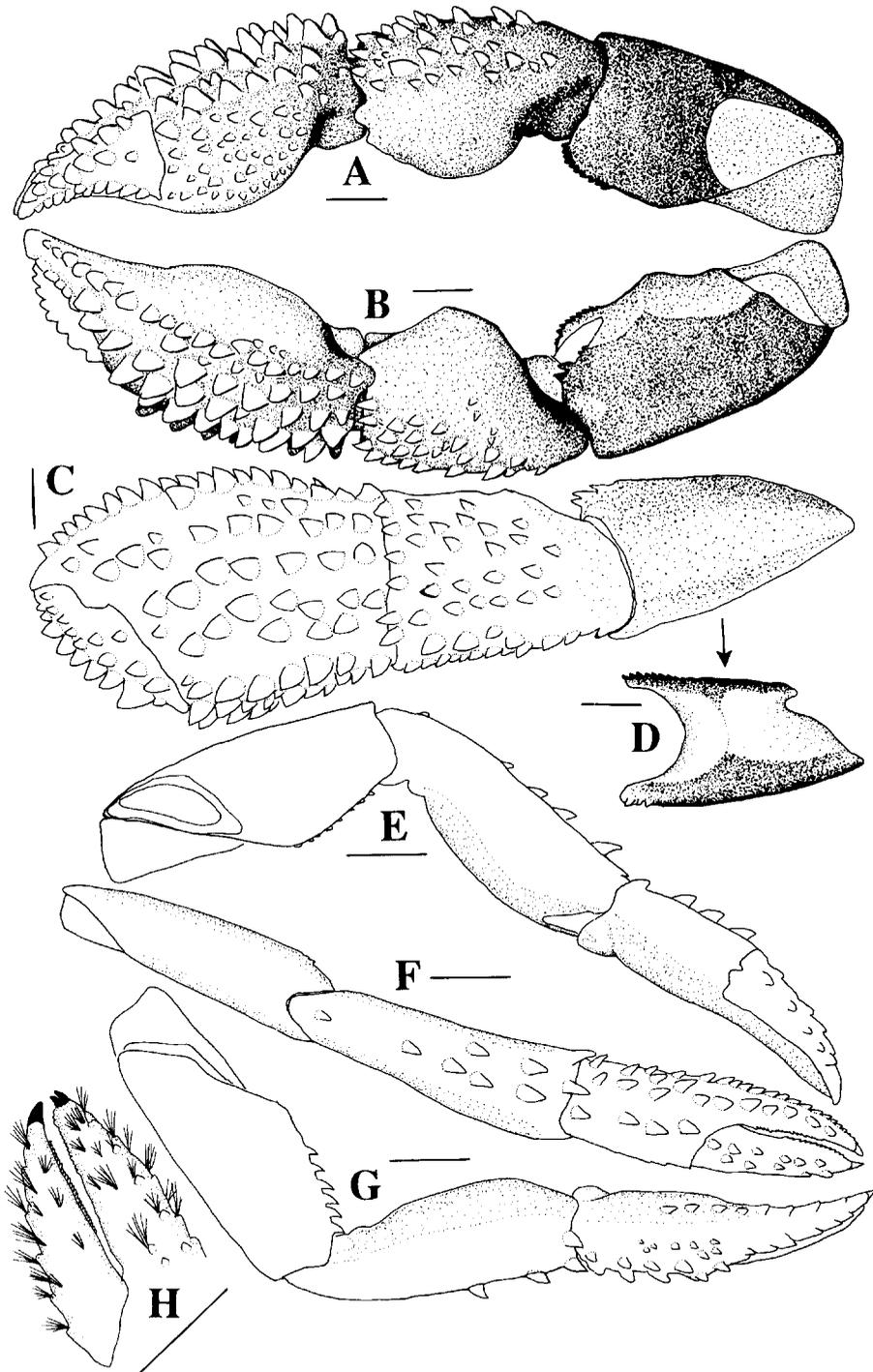


Fig. 13. *Pylopaguropsis furusei* new species: Holotype ♀, SL = 4.40 mm, Ani-jima Island, Ogasawara Islands, CBM-ZC 5651. Right cheliped: A, mesial view; B, lateral view; C, dorsal view; D, merus (ventral view). Left cheliped: E, mesial view; F, dorsal view; G, lateral view; H, distal portions of dactyl and fixed finger (ventral view). Scales = 1 mm.

sal surface with row of strong spines and long setae, dorsomesial margin tuberculate; cutting edge with row of small corneous teeth. Fixed finger terminating in strong, bifid, corneous claw, overlapping terminal claw of dactyl; cutting edge with row of small calcareous teeth. Palm 0.4–0.5 length of carpus; dorsal face with 3 irregular longitudinal rows of strong spines, 1 extending onto fixed finger as small spinulose tubercles, dorsolateral margin with row of strong spines; lateral face with row of few small spines or tubercles; mesial face glabrous; ventral surface with low protuberances and tufts of setae. Carpus 1.0–1.1 length of merus; dorsal surface with 2 rows of strong spines and long setae; dorsodistal margin armed with few strong spines. Merus with ventrolateral and ventromesial margins each with row of strong spines and long setae. Ischium unarmed.

Second and third pereopods similar; second right 1.0–1.1 length of second left; third right as long as third left; third right 1.1–1.2 length of second right, third left as long as second left. Dactyls long, slender, 1.1–1.3 (second) or 1.3–1.4 (third) length of propodi; each terminating in strong corneous claw; lateral faces convex, each with faint longitudinal sulcus, deeper proximally; ventral margins each with row of 9–12 (second) or 8–14 (third) corneous spines; mesial faces flat, each with faint longitudinal sulcus proximally and row of 9–13 (second) or 10–14 (third) corneous spines proceeding from midline proximally to close to dorsal margin distally; mesial faces of third pereopods each with 0–1 additional subproximal corneous spine dorsally and additional row of widely-spaced 5–7 (left) or 6–9 (right) corneous spines ventrally. Propodi 1.4–1.6 (second) or 1.2–1.4 (third) length of carpi; ventral surfaces each with row of 5–12 (second) or 4–8 (third) corneous spines flanked by row of tufts of short setae and, on left, accompanied mesially by 1–4 corneous spines; ventrodistal margins each

with strong corneous spine accompanied mesially by 0–2 small spines; lateral faces evenly convex, unarmed. Carpi 0.5–0.7 (second) or 0.6–0.7 (third) length of meri; dorsal surfaces slightly indented or with 2–3 very small spinules, with scattered long setae; dorsodistal angles each bearing acute spine. Meri and ischia unarmed.

Sternite of third pereopods with anterior lobe subsemicircular.

Fourth pereopod semichelate; dactyl moderately short, terminating in strong corneous claw, with preungual process, ventral margin with short row of corneous spines; propodal rasp of single row of corneous scales; carpus with small dorso-distal spine. Fifth pereopod chelate; dactyl and propodus with well developed rasp.

Abdomen dextrally twisted. Female with paired first pleopods fringed with setae; left second to fourth each with exopod slightly longer than endopod, fringed with long finely-plumose setae, endopod and protopod with few tufts of setae; left fifth with very elongate endopod fringed with long finely-plumose setae and short exopod with setae laterally. Male with left third to fifth pleopods each with very elongate endopod fringed with long finely-plumose setae and short exopod with setae laterally. Tergite of first abdominal somite small, chitinous, unarmed, fringed with setae dorsolaterally; sixth well calcified, subrectangular, unarmed, divided into anterior and posterior lobes by shallow transverse groove, short curved row of setae on each anterior lobe. Uropods strongly asymmetrical, left distinctly larger than right; rasps of exopods and endopods well developed; protopods unarmed. Telson asymmetrical, left posterior distinctly larger than right; posterior lobes distinctly wider than anterior lobe, partially calcified marginally, median cleft very shallow, lateral margins unarmed, posterolateral angles slightly or strongly produced, each bearing 2–3 blunt-tipped spines ventrally (not visible

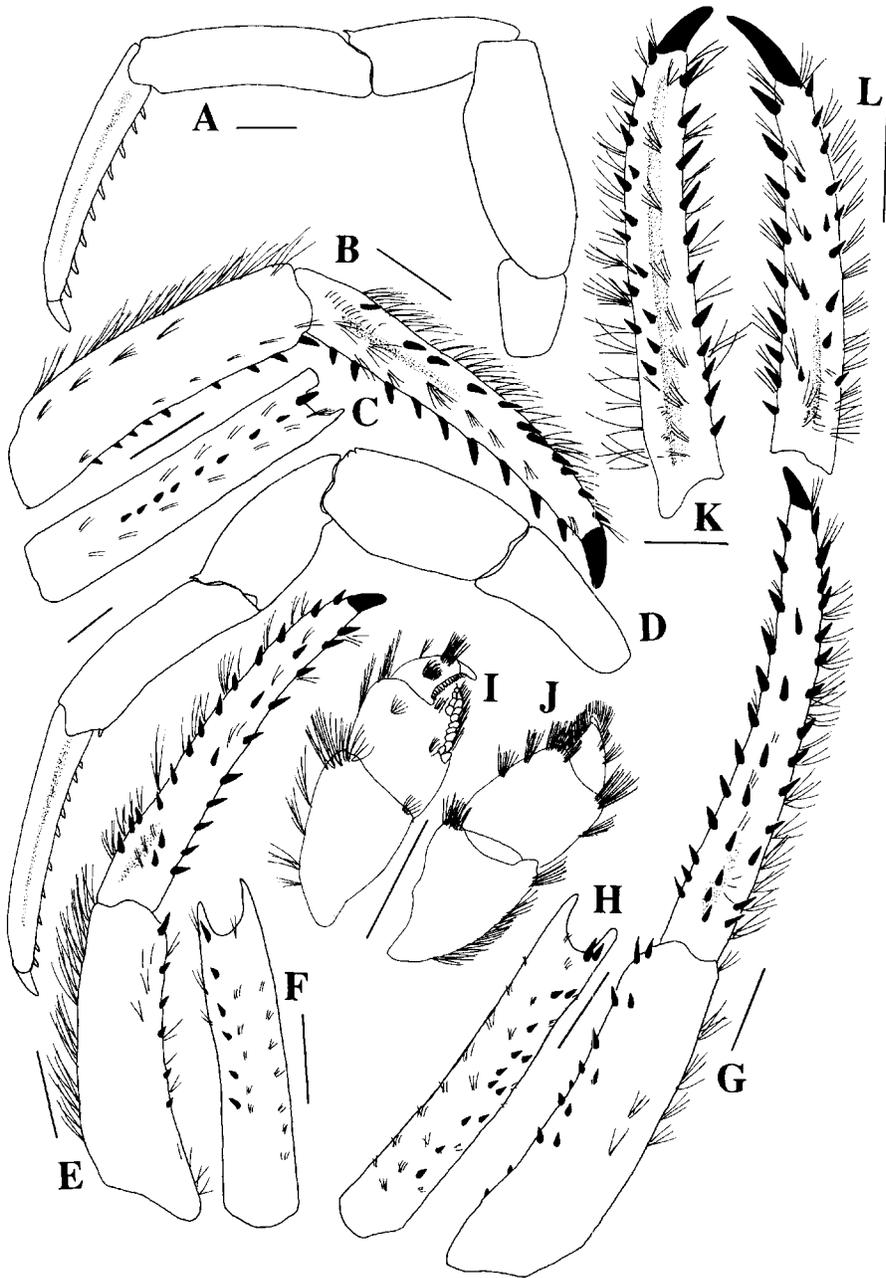


Fig. 14. *Pylopaguropsis furusei* new species. A–J: Holotype ♀, SL = 4.40 mm, Ani-jima Island, Ogasawara Islands, CBM-ZC 5651. K: Paratype ♂, SL = 5.40 mm, Chichi-jima Island, Ogasawara Islands, CBM-ZC 5652. L: Paratype, ovi. ♀, SL = 3.70 mm, Ani-jima Island, Ogasawara Islands, CBM-ZC 5653. Left second pereopod: A, lateral view; B, dactyl and propodus (mesial view); C, propodus (ventral view). Left third pereopod: D, lateral view; E, dactyl and propodus (mesial view); F, propodus (ventral view). Right third pereopod: G, dactyl and propodus (mesial view); H, propodus (ventral view). Right fourth pereopod: I, lateral view; J, mesial view. Variation in spinations of dactyls of second pereopods: K, left (mesial view); L, right (mesial view). Scales = 1 mm.

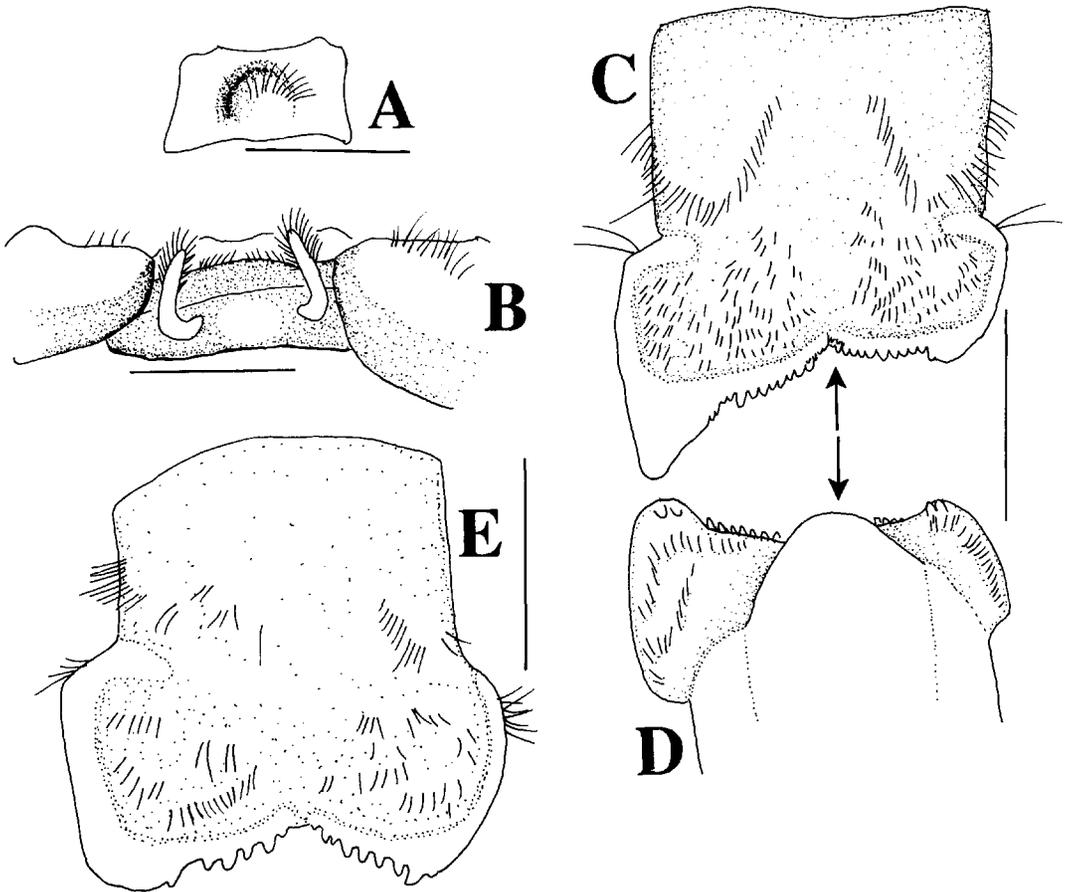


Fig. 15. *Pylopaguopsis furusei* new species. A–D: Holotype ♀, SL = 4.40 mm, Ani-jima Island, Ogasawara Islands, CBM-ZC 5651. E: Paratype ♀, SL = 5.40 mm, Chichi-jima Island, Ogasawara Islands, CBM-ZC 5652. A, sternite of the third pereopods; B, gonopods (=first pleopods) and sternite and coxae of fifth pereopods of female. Telson: C, E, dorsal view; D, ventral view. Scales = 1 mm.

dorsally), terminal margins slightly oblique, each with row of 5–12 (left) or 6–9 (right) spines marginally and, occasionally, with several additional submarginal spinules.

Variations.—Spination on the mesial faces of dactyls of second pereopods is subject to variation. In CBM-ZC 5652: mesial faces each bearing double rows of 8 (upper row) and 6 (lower row) corneous spines proceeding obliquely from midline to dorsal margin distally, right pereopod with additional subproximal corneous spine dorsally. In CBM-ZC 5653: mesial

faces each with single oblique row of 7 (left) or 8 (right) corneous spines proceeding obliquely from midline to dorsal margin distally, additional subproximal corneous spine dorsally, and additional row of widely-spaced 2 (left) or 4 (right) corneous spines ventrally.

Coloration (Fig. 19E).—In life: shield and its accessory portions and rostrum faint orange, with pair of irregular orange areas anteriorly, posteriorly and each area between posterolateral sulcus and lateral margin; anterolateral margins and proximal portion of posterolateral

sulci accented by reddish orange; lateral projections with terminal spines orange. Posterior carapace generally semitransparent; pair of irregular orange splotches on lateral sides of cardiac sulci; anterior portions of branchiostegites light orange. Ocular peduncles pale orange; corneas black; ocular acicles faint orange, rimmed with red, terminal spinules white. Antennular peduncles and flagella and antennal peduncles and acicles reddish purple; antennal flagella reddish orange. Setae on ocular, antennular and antennal peduncles as well as antennal acicles and flagella red. Second and third maxillipeds faint orange, setae reddish orange except short purple setae on mesial faces of second segments of exopods.

Right cheliped with setae red or reddish purple; dactyl cream-colored; propodus gradually changing from cream-colored distally to faint orange proximally, ventrolateral and ventromesial faces dark orange proximally; carpus orange, more reddish proximally; merus orange, more reddish distally; ischium orange. Left cheliped generally uniform orange, with setae red or reddish purple. Terminal corneous claws of both fingers of chelipeds semitransparent brown. Second and third pereopods generally uniform orange, with setae reddish orange; terminal corneous claws semitransparent dark brown; dorsodistal spine on each carpus faint orange or cream-colored. Fourth pereopods orange except cream-colored distal area on each segment. Fifth pereopods faint orange, darker centrally in each segment.

Pleopods semitransparent, each with endopod and exopod rimmed with light orange, protopod faint orange. Tergites of second to fifth abdominal somites semitransparent, each with faint orange area on either side, setae orange; tergite of sixth cream-colored, anterior and posterior lobes each with faint orange area centrally and broad longitudinal stripe on midline, setae dark orange. Uropods faint

orange, with irregular orange splotches on central part of dorsal surface of protopods. Telson with anterior lobe mottled cream and faint orange; posterior lobes cream-colored, with white calcified areas posteriorly and laterally.

Etymology.—This species is named for Mr. Koji Furuse who first collected it and made the specimens available for this study.

Affinities.—In the general morphological similarity between right and left third pereopods, *P. furusei* new species belongs to the *teevana* group of *Pylopaguropsis*, which currently contains *P. teevana* (Boone, 1932), *P. pustulosa* McLaughlin & Haig, 1989, *P. garciai* McLaughlin & Haig, 1989, *P. fimbriata* McLaughlin & Haig, *P. laevispinosa* McLaughlin & Haig and *P. granulata* new species. *Pylopaguropsis furusei* differs from all other members of the group except *P. laevispinosa* in possessing strongly spinose right and left chelae. *Pylopaguropsis furusei* is immediately distinguished from *P. laevispinosa* by the following morphological characters: the ventroproximal margin of merus of the right cheliped is unarmed in *P. furusei* but armed with many tubercles in *P. laevispinosa*; the ventral margins of propodi of the third pereopods each bears row of 8 to 14 corneous spines (except ventrodistal spine) in *P. furusei*, but it bears only a single spine in *P. laevispinosa*; the antennal peduncles overreach the ocular peduncles in *P. furusei*, but they are distinctly shorter than the ocular peduncles, reaching only to the bases of corneas in *P. laevispinosa*; spines on the dorsal face of the palm of the right cheliped are fewer and much stronger in *P. furusei* than in *P. laevispinosa*. Coloration is distinctly different; *P. laevispinosa* has clear red and white stripes on ambulatory legs that are lacked in *P. furusei*.

Distribution.—Izu Islands, Ogasawara Islands, hard bottom, 3–30 m.

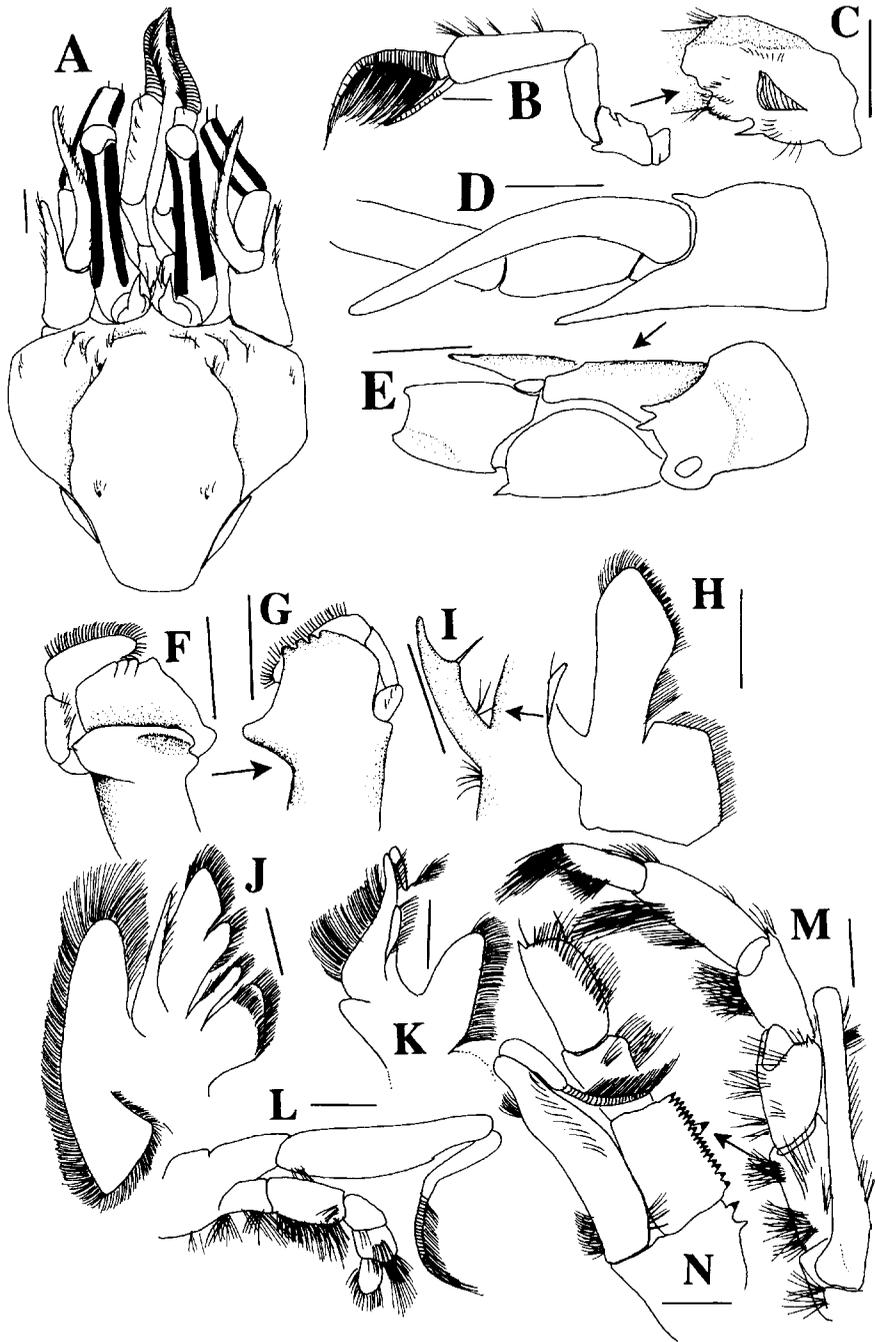


Fig. 16. *Pylopaguopsis granulata* new species: Holotype ♀, SL = 6.85 mm, Kume-jima, Okinawa, CBM-ZC 5657. Shield and cephalic appendages: A, dorsal view; B, left antennule (lateral view); C, same, basal segment (dorsal view); D, left antenna (dorsal view); E, same (ventral view). Mouthparts (left): F, mandible (internal view); G, same (external view); H, maxillule (internal view); I, same, endopod; J, maxilla (internal view); K, first maxilliped (internal view); L, second maxilliped (internal view); M, third maxilliped (dorsal view); N, same, (internal view). Color pattern indicated in A. Scales = 1 mm.

Pylopaguropsis granulata
new species

Figs. 16–18, 19F

Material examined.—Holotype: ♂, SL = 6.85 mm, 10 m, south of Hatenohama, Kume-jima Island, Okinawa, 26°20'N, 126°50'E, 30 June 1993, coll. Yuishow Sakamoto, CBM-ZC 5657.

Type locality.—South of Hatenohama, Kume-jima Island, Okinawa, 26°20'N, 126°50'E, 10 m.

Description.—Shield distinctly expanded laterally, 1.1 times longer than broad; anterior margin between rostrum and lateral projections concave, anterolateral margins angular; lateral margins nearly straight; posterior margin truncate; dorsal surface of shield slightly rugose, convex, with scattered tufts of short setae, 2 pairs of shallow curved sulci anteriorly, pair of distinct sulci extending from posterolateral portion toward anterior portion of shield, pair of posterior gastric pits distinct; rostrum prominent, acute, terminating in small spinule; lateral projections triangular, each with small terminal spinule. Accessory portions of shield small, well calcified, unarmed. Branchiostegites not calcified, anterior margins produced, unarmed, with fringe of setae.

Ocular peduncles moderately long and slender, 0.8 length of shield; slightly broader distally and proximally. Corneas slightly dilated. Ocular acicles slightly elongate, triangular, acute; separated basally by breadth of rostrum.

Antennular peduncles long, when fully extended, exceeding ocular peduncles by 0.4 length of ultimate segments; ultimate segment with row of tufts of setae dorsally, longer distally; penultimate segment unarmed; basal segment with acute spine laterally and small spine at ventrodistal angle. Antennal peduncles moder-

ately long, when fully extended, exceeding ocular peduncles by about half length of ultimate segment; fifth segment with row of tufts of setae mesially and ventrolaterally; fourth segment with scattered setae; third segment with strong spine at ventrodistal margin; second segment with dorsolateral distal angle produced, terminating in strong spine, dorsomesial distal angle with acute spine; first segment with ventrodistal margin produced, bearing 2 spines laterally. Antennal acicles moderately long, strongly arcuate, blunt-tipped; dorsomesial margins each with row of moderately long setae. Antennal flagella comprised of about 90 articles, with 2–4 long setae every 2 or 3 articles interspersed with short setae.

Mandible with incisor process bearing 3 blunt-tipped teeth. Maxillule with endopod bearing well-developed external lobe; internal lobe with 1 apical bristle. Maxilla with moderately broad scaphognathite. First maxilliped with basal portion of exopod moderately broad. Second maxilliped unarmed. Third maxilliped with carpus and merus each bearing acute dorsodistal spine; ischium with well-developed crista dentata, composed of 18 corneous teeth and with strong accessory tooth; basis with 2 acute teeth. Sternite of third maxillipeds unarmed, with few setae on either side of midline.

Right cheliped massive, chela operculate; both fingers bent downward. Dactyl 0.2 length of palm; terminating in tiny corneous claw; dorsal face convex, densely covered with granules. Fixed finger very short, terminating in blunt tip. Palm 2.1 length of carpus; dorsal surface slightly convex, densely covered with granules or granular tubercles; mesial face with row of widely-spaced strong spines; ventral surface convex, densely covered with granules. Carpus as long as merus; dorsal margin with row of strong spines slightly mesially, dorsolateral face with scattered strong spines; mesial margin armed with

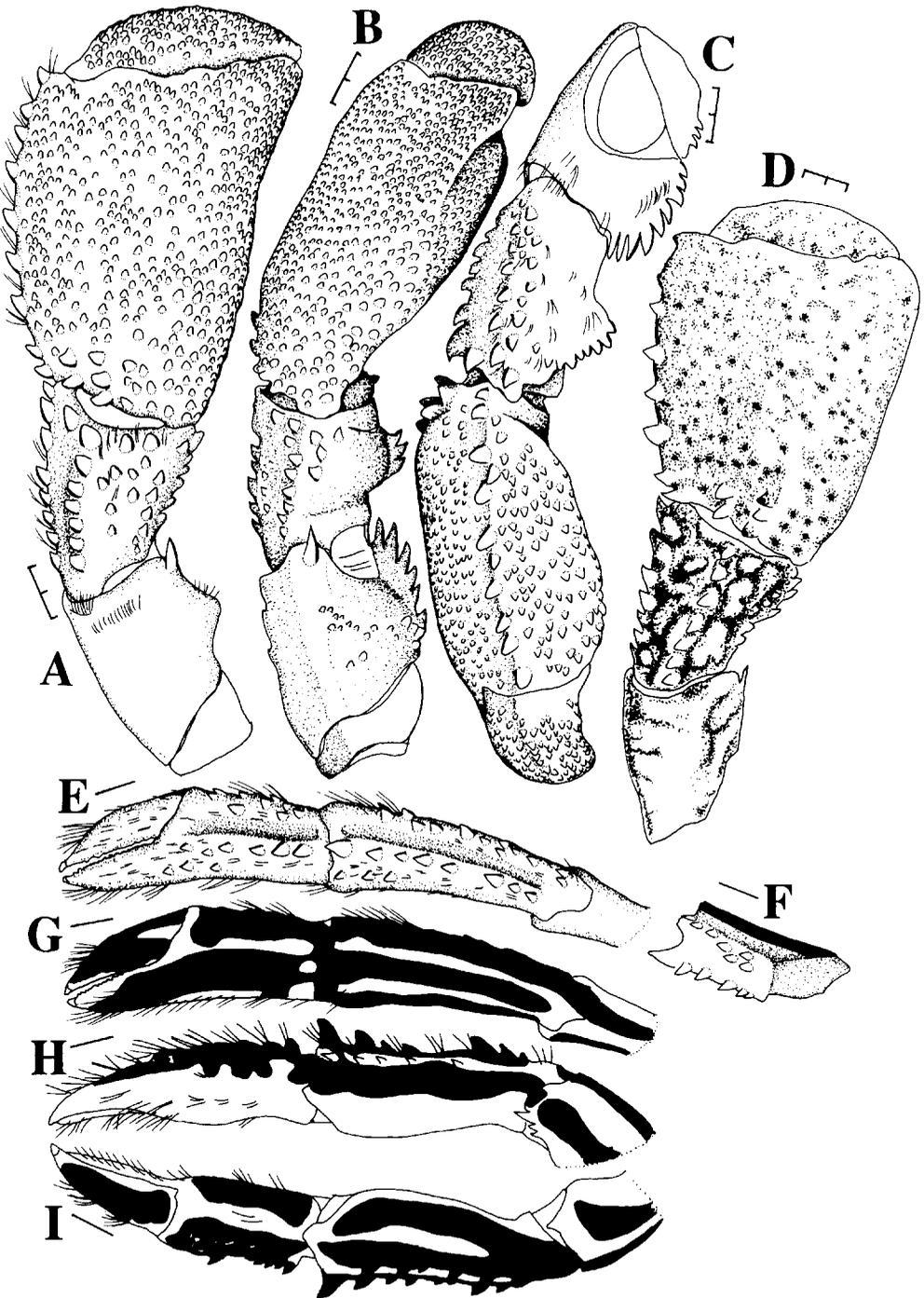


Fig. 17. *Pylopaguopsis granulata* new species: Holotype ♂, SL = 6.85 mm, Kume-jima, Okinawa, CBM-ZC 5657. Right cheliped: A, dorsal view; B, lateral view; C, mesial view; D, dorsal view (slightly lateral). Left cheliped; E, dorsal view; F, merus (ventral view); G, dorsal view; H, lateral view; I, mesial view. Color patterns indicated in D, F-I. Scales for A-D = 2 mm. Scales for E-I = 1 mm.

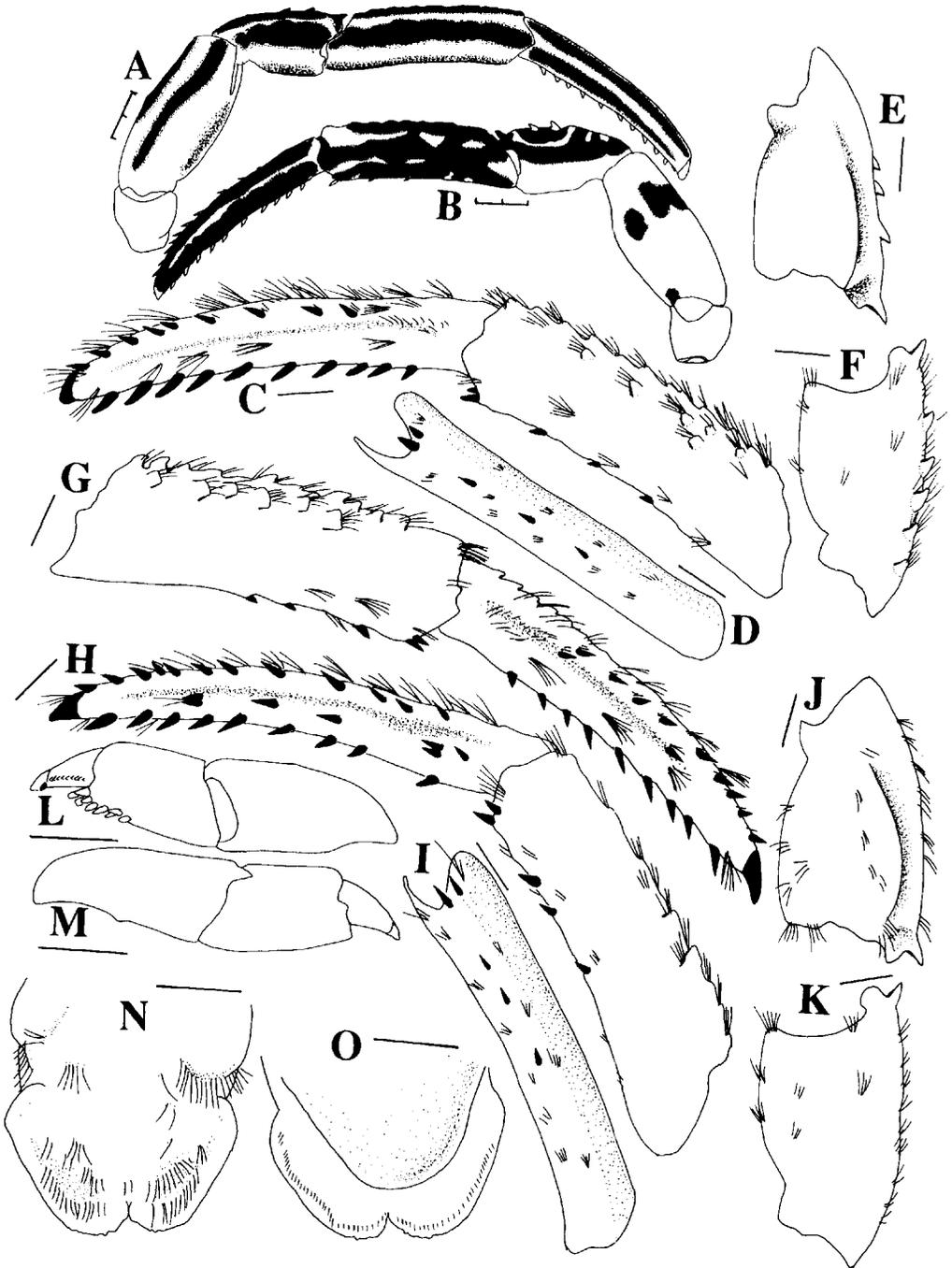


Fig. 18. *Pylopaguropsis granulata* new species: Holotype ♂, SL = 6.85 mm, Kume-jima, Okinawa, CBM-ZC 5657. Right second pereopod: A, lateral view; B, mesial view; C, dactyl and propodus (mesial view); D, propodus (ventral view); E, carpus (lateral view); F, carpus (mesial view). Left second pereopod: G, dactyl and propodus (mesial view). Right third pereopod: H, dactyl and propodus (mesial view); I, propodus (ventral view); J, carpus (mesial view); K, carpus (lateral view). Left fourth pereopod: L, lateral view; M, mesial view. Telson: N, dorsal view; O, ventral view. Color patterns indicated in A and B. Scales = 1 mm.

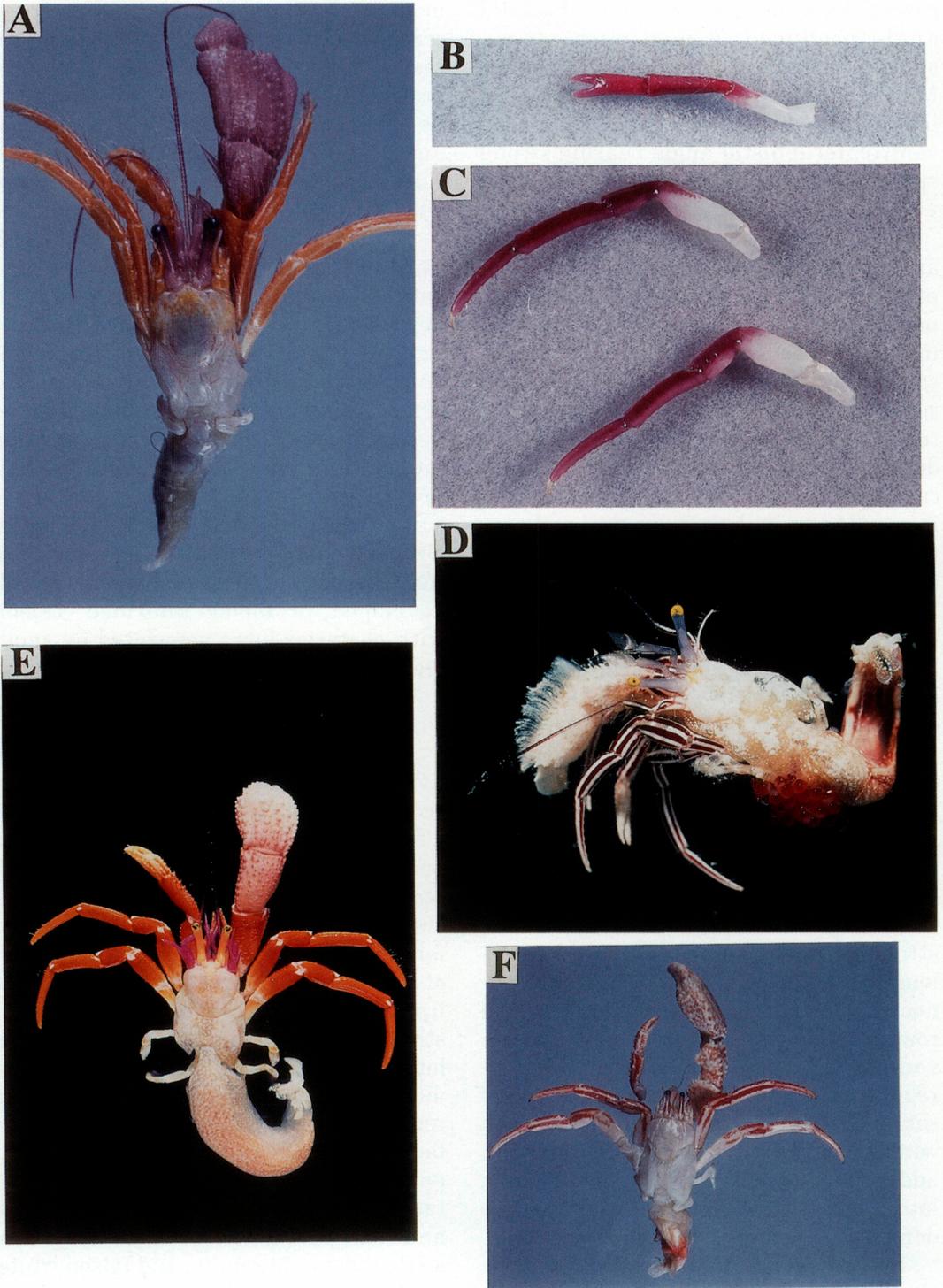


Fig. 19. Color photographs of *Pylopaguopsis*. A, *P. speciosa* McLaughlin & Haig; B, right cheliped; C, left second and third pereopods, *P. keijii*; D, *P. fimbriata* McLaughlin & Haig (photo by Keiichi Nomura); E, *P. furusei* new species (photo by Hiroyuki Tachikawa); F, *P. granulata*.

row of strong spines; ventrodiscal mesial angle produced, armed with strong spines; ventrolateral margin with spines. Merus with ventral face produced subproximally, armed with large tubercles, ventrolateral distal angle bearing strong spine, ventromesial margin armed with very strong, elongate spines.

Left cheliped slender; propodal-carpal articulation rotated counter-clockwise approximately 45°. Dactyl 0.8 length of palm, unarmed. Fixed finger terminating in bifid corneous claw. Palm 0.6 length of carpus; dorsal face with deep longitudinal sulcus and scattered very large spines, often in row. Carpus 1.5 length of merus; dorsal surface with deep longitudinal sulcus and scattered very large spines, often in row. Merus with ventromesial and ventrolateral margins each bearing row of spines.

Second and third pereopods similar; third 1.1–1.2 length of second. Dactyls 1.1 length of propodi, each terminating in strong corneous claw; mesial faces flat, each with row of 9–11 (second) or 11–12 (third) strong corneous spines proceeding from midline proximally to close to dorsal margin distally, longitudinal sulcus in midline, third with additional row of strong corneous spines ventrally; lateral faces each with longitudinal sulcus; ventral margins each with row of 9 or 10 strong corneous spines. Propodi 1.9–2.1 length of carpi, each with 2 or 3 acute corneous spines at ventrodiscal margin and row of 3 widely-spaced corneous spines on ventral face; dorsal faces each with irregular row of protuberances and tufts of setae. Carpi 0.5–0.7 length of meri, each with strong dorsodistal spine, second with additional row of several spines dorsally; lateral face with deep longitudinal groove dorsally. Meri and ischia unarmed.

Sternite of third pereopods with anterior lobe long, narrow, with slight protrusion medially.

Fourth pereopod semichelate; dactyl

moderately short, terminating in strong corneous claw, with small preungual process and ventral row of corneous spines; propodal rasp of 1 or 2 rows of strong corneous scales; carpus with large dorso-distal spine slightly directed mesially. Fifth pereopod chelate; dactyl and propodus with well-developed rasps.

Abdomen dextrally twisted. Male with third to fifth pleopods each bearing elongate endopod fringed with long finely-plumose setae and short exopod with setae laterally. Male with tergite of first abdominal somite small, chitinous, unarmed, sparsely setose; sixth well calcified, subrectangular, unarmed, divided into anterior and posterior lobes by shallow transverse groove, pair of short curved rows of setae on anterior lobes. Uropods asymmetrical, left larger than right; rasps of exopods and endopods well developed; protopods unarmed. Telson with posterior lobes separated by small median cleft, lateral margins sloping, terminal margins nearly horizontal, only slightly indented.

Coloration (Fig. 19F).—In preservative (1 month in 75% alcohol): Shield, rostrum, antennules, ocular acicles uniformly white. Ocular peduncles and fifth peduncular segments of antennae with red and white longitudinal stripes. Right cheliped with dactyl and palm mottled faint red and white; carpus and distal half of merus mottled red and white. Left cheliped with red and white longitudinal stripes. Second and third pereopods with lateral faces of dactyls, propodi, carpi and meri and mesial faces of dactyls bearing red and white longitudinal stripes; mesial faces of propodi and carpi with irregular patterns of mottled red and white; mesial faces of meri speckled with red; fourth and fifth pereopods, uropods, tergite of sixth abdominal somite, and telson white.

Shell. — *Colubrellina granularis* (Röding) (Mollusca: Gastropoda: Bursidae).