ERRATA

Page 10: line 12 should end :
"…ventrodistal margin."

Page 10, line 13, should start:
"Ambulatory legs unarmed except for single corneous spine at ventrodistal margin …

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A REVIEW OF THE HERMIT CRAB GENUS *PAGURITTA* (DECAPODA: ANOMURA: PAGURIDAE) WITH DESCRIPTIONS OF THREE NEW SPECIES

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ABSTRACT.- The discovery of a coral dwelling hermit crab in the Maldives prompted a critical review of the polychaete tube and coral inhabiting hermit crab genus *Paguritta* Melin, 1939. The morphological similarities among species of this genus caused several earlier authors to include several distinct taxa under the name *P. harmsi* Gordan. *Paguritta gracilipes* Melin, heretofore regarded as a junior subjective synonym of *P. harmsi*, is reinstated and the new species, *P. morgani*, *P. scottae*, and *P. kroppi* are described and illustrated. Diagnoses and supplemental illustrations of *P. corallicola* Lewinsohn, *P. gracilipes* and *P. harmsi* are included together with a key to the species of *Paguritta*.

INTRODUCTION

Paguritta Melin, 1939, is a rather atypical hermit crab genus both morphologically and ecologically. Among its morphological novelties are the complete absence of unpaired pleopods in males and loss of the left pleopod from the fifth abdominal somite in females, the similarity in the development of the ischia of the second and third pereopods, the distinctive development of the ocular acicles, and the "cast-net" structure of the antennal flagella. An attribute that *Paguritta* species share with species of certain other pagurid, diogenid and parapagurid genera is the great morphological similarity in major appendages that makes species recognition often extremely difficult. Ecological specializations are seen in the adaptation of species of *Paguritta* to living either in polychaete tubes associated with corals (Schuhmacher, 1977; Miyake, 1978) or in self-created boreholes in living coral (Lewinsohn, 1978; Dr. Paula Scott, pers. comm.), and their complete dependence upon an antennal filtering mode of feeding (Schuhmacher, 1977).

The genus *Paguritta* was proposed by Melin (1939) for two specimens of a new species, *P. gracilipes* Melin, found during Dr. Sixten Bock's expedition to the Japanese Bonin Islands in 1914. However, prior to Melin's publication, Gordon (1935) had described "*?Orthopagurus harmsi* Gordon" from a small number of specimens collected at Christmas Island in the Indian

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Ocean. Male morphology was known only from single specimens in each taxon, but a character that appeared to distinguish both *P. gracilipes* and *O. harmsi* from most other pagurids was the total absence of male pleopods. Melin (1939) cited this as a character of the genus, whereas Gordon (1935) was concerned that it might be an aberration. Also distinctive in both taxa was the complete loss of the left pleopod from the fifth abdominal somite in females.

These similarities caused Forest (1951) to question whether or not the two taxa might be conspecific. However this query appeared in a footnote to a discussion on the systematic position of *Porcellanopagurus* Filhol, 1885, and was overlooked by Serène (1957) in his review of Gordan's (1935) species. Serène (1957) confirmed the absence of pleopods in males and concluded that Gordon's (1935) taxon did not agree with Steven's (1927) diagnosis of *Orthopagurus*. Consequently, he proposed the new genus *Orthopaguropsis* for ?*O. harmsi*. Following Serène's (1957) review, Forest (1961) was convinced that Melin's (1939) description of *P. gracilipes* agreed in all respects with Gordon's (1935) description and Serène's (1957) redescription of *O. harmsi*. *Paguritta* had priority over *Orthopaguropsis*, but the specific name *harmsi* had priority over *gracilipes*. Therefore, Forest (1961) synonymized the two species in the combination *Paguritta harmsi* (Gordon). McLaughlin (1974) discounted the generic relevance of pleopod absence, and returned *P. harmsi* to the genus *Orthopagurus*. At the time, she acknowledged that her decision was based only on the descriptions given by Gordon (1935) and Melin (1939). Miyake (1978, 1982) and Baba (1989) reported on the occurrence of presumed *P. harmsi* from Okinawa, Ryukyu, and Ogasawara (Bonin) Islands, Japan.

In the interim, Lewinsohn (1978) presented a detailed review of *Paguritta*, in which he agreed with Forest's (1951, 1961) belief in the conspecificity of *P. harmsi* and *P. gracilipes*. However, when describing his new species *P. corallicola*, Lewinsohn (1978) acknowledged the similarities in many presumably diagnostic characters between *P. harmsi* (sensu lato) and *P. corallicola* Lewinsohn. In support of his conclusion that *P. corallicola* was a distinct species, Lewinsohn cited differences in habitat and in colour between the two species. *Paguritta corallicola* lived in self made boreholes in corals, and the fingers of its right chela were a reddish colour. *Paguritta harmsi* (sensu Lewinsohn) lived in polychaete tubes associated with corals, and its chelae were thought to be striped.

We experienced difficulties similar to those expressed by Lewinsohn when we first examined specimens from the Maldives, but like Lewinsohn, we had both colour and habitat differences to strengthen our decision that our taxon was distinct from *P. harmsi*. We have now had the opportunity to reassess, not only the type materials of *P. harmsi* and *P. gracilipes*, but Lewinsohn's supplemental collection from the Philippine Islands and Australia, and additional materials from Christmas Island and Madang, Papua New Guinea, the Australian Great Barrier Reef, Oshima Strait in the Ryukyu Islands, and Guam. From this review, we conclude that *P. gracilipes* is a taxon distinct from *P. harmsi*, and herein reinstate the former species. Three undescribed species, *P. morgani*, new species, *P. scottae*, new species, and *P. kroppi*, new species, also were recognized during this study.

The type habitat of *P. harmsi* was given as pier pilings, but Gordan (1935) suggested that this species might inhabit worm or "tooth" shells. *Paguritta gracilipes* had been found occupying tubes of the coral epibiont, *Spirobranchus giganteus* (Pallas) (Schuhmacher, 1977), but *P.corallicola* was discovered inhabiting the coral, *Astropora myriopthalma* (Lamarck). *Paguritta scottae* was found in living *Porites* sp., whereas *P. morgani* was collected from both worm tubes and small holes in *Montipora*. *Paguritta kroppi* was recovered from holes in coral.

MATERIAL AND METHODS

Materials used in this study include: paratypes of Gordon's (1935) *?Orthopagurus harmsi* from the Natural History Museum, formerly the British Museum (Natural History) (BMNH); the syntypes of Melin's (1939) *Paguritta gracilipes* from the Zoological Museum, University of Uppsala (ZMUU) and the Naturhistoriska Riksmuseet, Stockholm (NHRM); Schuhmacher's (1977) and Lewinsohn's (1978) Philippine Islands material identified as *P. harmsi* and Lewinsohn's type material of *P. corallicola* from the National Natuurhistorisch Museum, formerly the Rijksmuseum van Natuurlijke Historie, Leiden (RMNH); Baba's (1989) "*P. harmsi*" from Oshima Strait, Ryukyu Islands, Japan from the Zoological Laboratory, Kumamoto University (ZLKU); the specimen from Palfrey Island, Australia, identified by Lewinsohn as *P. harmsi* and supplemental material of *P. corallicola* from the Great Barrier Reef, from the Australian Museum, Sydney (AMS); additional material of *P. harmsi* from Christmas Island, and the type material of *P. morgani* from the Western Australia Museum, Perth (WAM); type material of *P. kroppi* and of *P. scottae* from the National Museum of Natural History, Smithsonian Institution (USNM). As much as possible, institutional abbreviations are those recommended by Leviton *et al.* (1985). Measurements of shield length (SL) were made with an ocular micrometer mounted in the eyepiece of a Wild M-5 microscope.

RESULTS AND DISCUSSION

Paguritta Melin, 1939

Paguritta Melin, 1939: 50; Forest, 1961: 238; Miyake, 1978: 126
Orthopagurus - McLaughlin, 1974 (in part): 361
Orthopaguropsis Serène, 1957: 108

Type species. - By monotypy, *Paguritta gracilipes* Melin, 1939. Gender feminine.

Supplemental diagnosis.- Ocular acicles long, slender, with elongate single or double marginal or submarginal spine. Antennal flagella with paired very long setae armed with prominent setules on each article. Third maxilliped with well developed crista dentata and single accessory tooth. Ischia of second and third pereopods generally similar in length. Sternite of third pereopods with subrectangular or subquadrate anterior lobe, anterior margin usually with few blunt spines. Fourth pereopods usually markedly subchelate, propodal rasp consisting of single row of corneous scales. Sternite of fifth pereopods divided into two distinct oval or ovate lobes, each with prominent anteriorly or laterally directed blunt spine. Uropods symmetrical; protopods each with one or more rows of corneous or calcareous, blunt or spinulose protuberances of spines on posterior margin. Gonopores paired in both sexes; male gonopores each partially obscured by tuft of setae; no sexual tubes, but vas deferens usually slightly protruded, at least in preserved specimens. No paired or unpaired pleopods in males; females with biramous pleopods on left side of second to fourth somites only.

Remarks.- As previously indicated, species of *Paguritta* exhibit a number of atypical, albeit not necessarily unique, morphological characters. For example, the total lack of male pleopods is seen also in Forest's (1961) monotypic genus *Paguridium*, and in the species *Pagurus prideaux* Leach, 1815, and *Anapagurus drachi* Forest, 1966. However, only in *A. drachi* is a similar reduction in female pleopods observed (Forest, 1966).

At least in one species of *Paguritta*, *P. kroppi*, new species, males appear to typically have both male and female gonopores present on the coxae of the fifth and third pereopods respectively. Although presumably aberrant specimens having both male and female gonopores have been reported in other genera as "intersex" individuals (e.g., McLaughlin, 1974), only in *Dardanus deformis* (H. Milne Edwards, 1836) has this phenomenon been regularly observed (Hilgendorf, 1879; Fize & Serène, 1955; Lewinsohn, 1982). Whether this condition might indicate functional hermaphroditism or latent sex reversal is not known. Charniaux-Cotton (1956) reported the presence of an organ analogous to the androgenic gland in *Clibanarius erythropsus* (Latreille, 1818), and proterogyny has been hypothesized in *Clibanarius zebra* Dana (Wenner, 1971; Charniaux-Cotton & Payen, 1985). In *Paguritta*, given the restricted habitats of the species, functional hermaphroditism conceivably might facilitate reproduction; however, no such ecological restrictions could explain this phenomenon in *D. deformis*.

Development of the ocular acicles is distinctive, although somewhat variable among species of *Paguritta* as is illustrated herein for the six species. The distal prolongation of the acicle is narrow and may be drawn out into a single prominent marginal spine, a pair of strong marginal spines, a prominent medial spine with one or two subterminal, lateral, blunt or acute projections, or be terminally rounded and provided with one or two strong, submarginal spines.

Uropod symmetry, at one time thought to be a primitive condition among pagurids (e.g., Russell, 1962), has been shown frequently to be related to habitat (petricolous, spongicolous, etc.), and may be strongly influenced by niche selection (McLaughlin & Gunn, 1992). Symmetrical uropods are present in all known species of *Paguritta*, but differences in development of protopods, exopods and endopods have been observed that may reflect adaptations to specialized habitats or conditions.

In all species of *Paguritta*, as in species of *Isocheles* Stimpson, 1858, and some species of *Paguristes*, each article or the antenna carries a pair of long setae provided with well developed setules. Schuhmacher (1977) demonstrated that in *P. morgani* (as *P. harmsii*) feeding is accomplished exclusively by antennal filtering. Caine (1978) reached a similar conclusion regarding feeding in the sand burrowing species, *Isocheles wurdemanni* Stimpson, 1859; however, Wicksten (1988) reported that the analogous burrowing *I. pilosus* (Holmes, 1900) was not restricted to that mode of feeding. *Paguristes setosus* (Filhol, 1885) and *P. pilosus* (H. Milne Edwards, 1836) appear to feed primarily by antennal filtering, but will resort to use of the chelipeds if starved or fed in the laboratory (Greenwood, 1972; Schembri, 1982). Antennal filter feeding has also been documented for several other hermit crabs (e.g. Orton, 1927; Boltt, 1961; Gerlach *et al.*, 1976; Caine, 1980; Schembri, 1982; Wicksten, 1988); however, most records indicate that antennal filter feeding is only one of several feeding strategies employed by the crabs. In these crabs the antennal flagellum may or may not be provided with long, but simple, setae.

KEY TO THE SPECIES OF *PAGURITTA*

1. Ventral margins of ambulatory dactyls with six to eight corneous spines; chelae with longitudinal stripes dorsally ..... *P. gracilipes*

   Ventral margins of ambulatory dactyls with five or fewer corneous spines; chelae without longitudinal stripes dorsally 2

2. Palm of left chela with dorsal surface armed with numerous small spines 3

   Palm of left chela with dorsal surface unarmed or with only few tiny spinules or tubercles 4

3. Palm of right chela encircled by moderately short, broad spines; carpus armed only with small tubercles or granules ..... *P. corallicola*

   Palm of right chela encircled by long, slender, often curved spines, strongest on dorsomesial margin; carpus with 1 or more spines ..... *P. morgani*, new species

4. Carpus of left cheliped without spines on dorsolateral margin proximal to dorsodistal marginal spine ..... *P. harmsi*

   Carpus of left cheliped with one or two spines on dorsolateral margin proximal to dorsodistal marginal spine 5

5. Dactyl of right chela with row of low tubercles or small spines in proximal half of dorsomesial margin; carpus of left cheliped with moderately short spines on distal margin ..... *P. kroppi*, new species

   Dactyl of right chela with row of acute spines on entire dorsomesial margin; carpus of left cheliped with very strong spines on distal margin, particularly medially ..... *P. scottae*, new species

Paguritta gracilipes Melin, 1939
(Figs. 1, 2)

Paguritta gracilipes Melin, 1939: 51, figs. 30, 31; Forest, 1951: 185; Gordan, 1956: 324
Orthopaguropsis harmsi - Serène, 1957: 107, figs. 1-3 [not *Orthopaguropsis harmsi* (Gordon, 1935)]
Paguritta harmsi - Forest, 1961: 238 (in part). Schuhmacher, 1977: 371, figs. 1,2 [not *Paguritta harmsi* (Gordon, 1935)]; Lewinsohn, 1978: 245 (in part, not fig. 1); Miyake, 1978: 126 (in part), ? fig. 50; 1982: 121 (in part), ? pl. 41, fig. 2 left (male), not pl. 41, fig. 2 right (female); Kizaki *et al.*, 1988: 124, unumbered colour fig.; Imafuku, 1992: 235, unnumbered colour fig. [not *Paguritta harmsi* (Gordon, 1935)].

Material examined.- Syntypes - Female (SL = 2.7mm) (ZMUU 431a-k); male (SL = 2.5mm) (NHRM Type no. 2293), Taki-ura, Bonin Islands, 28.vii.1914.

Supplemental material - 1 male (SL = 22.1 mm) (RMNH D 31935), Philippines Islands (from aquarium), 1973.

Diagnosis.- Shield longer than broad; anterior margin between rostrum and lateral projections concave. Rostrum moderately prominent, usually with terminal spinule. Lateral projections obtusely triangular, usually unarmed. Ocular peduncles moderately slender; corneae circular. Ocular acicles elongate, slender, with long terminal spine. Antennal peduncle with dorsolateral distal angle of second segment strongly produced, broad and armed with two to five strong spines, dorsomesial distal angle unarmed. Right cheliped with dorsal margins of palm and fixed finger circumscribed by row of very strong curved spines, dorsal surface armed with irregular rows of small spines accompanied by numerous long, thin setae and with few additional scattered bristles. Left cheliped apparently with dorsolateral marginal row of spines. Ambulatory legs (third) unarmed except for single corneous spine at ventrodistal margin of merus and row of six to eight corneous spines on ventral margin of dactyl. Uropods with elongate protopods armed posteriorly with series of small rubercles; exopods, slender, elongate;

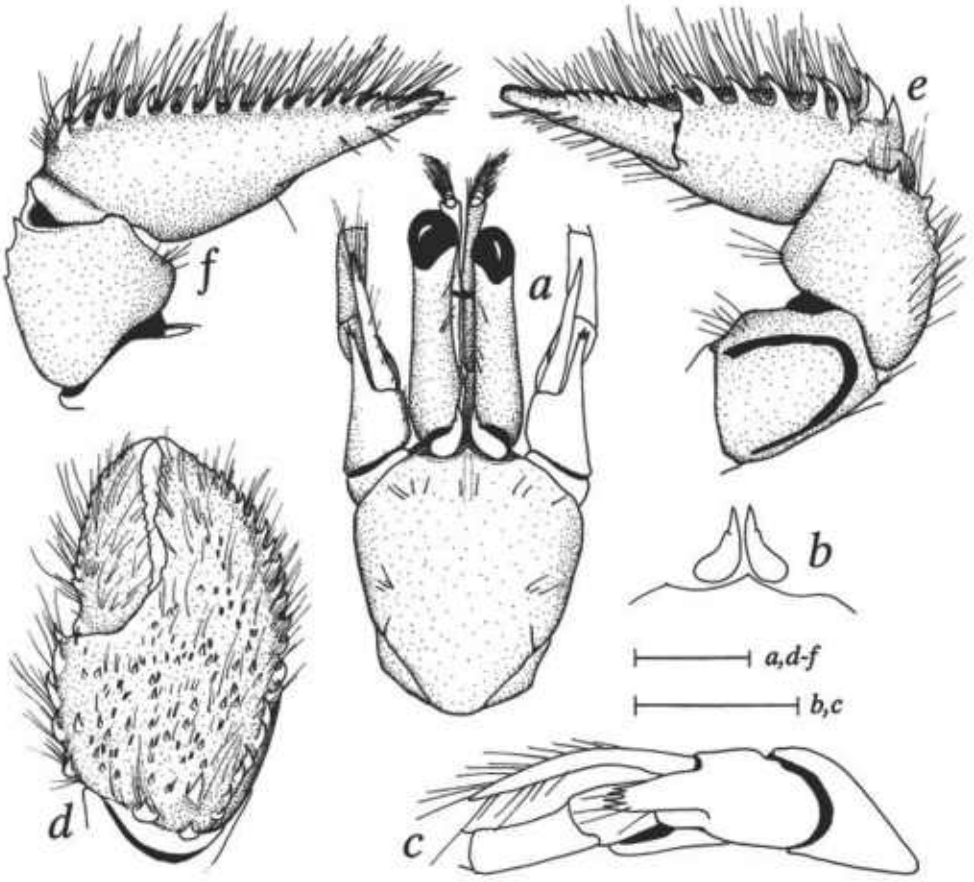

Fig. 1. *Paguritta gracilipes* Melin, 1939, male syntype (SL = 2.5 mm) (NHRM 2293), Bonin Islands. a, shield and cephalic appendages (left antennule and right antenna reconstructed, missing in syntype); b, ocular acicles and anterior portion of shield, dorsal view; c, left antennal peduncle, lateral view; d, right chela, dorsal view; e, right cheliped, mesial view; f, same, lateral view. Scales equal 1 mm.

endopods extending considerably beyond exopodal bases. Telson with terminal margins of posterior lobes each armed with several large calcareous spines interspersed with smaller spines.

Colour.- "La coloration générale de l'animal est jaune orange avec des lignes longitudinales rouge vif. Sur la carapace et la partie dorsale de l'abdomen, il y a 4 lignes longitudinales rouges; sur la carapace, chacune des deux médianes (plus faibles) continue en arrière une ligne longitudinale rouge, qui court sur le bord dorsal des pédoncules oculaires; les deux latérales continuent les lignes rouges qui marquent les pédoncules antennaires. Les chélipedes sont également rayés longitudinalement: il y a sur la paume aplatie (opercule) du droit un ligne médiane rouge et deux latérales."

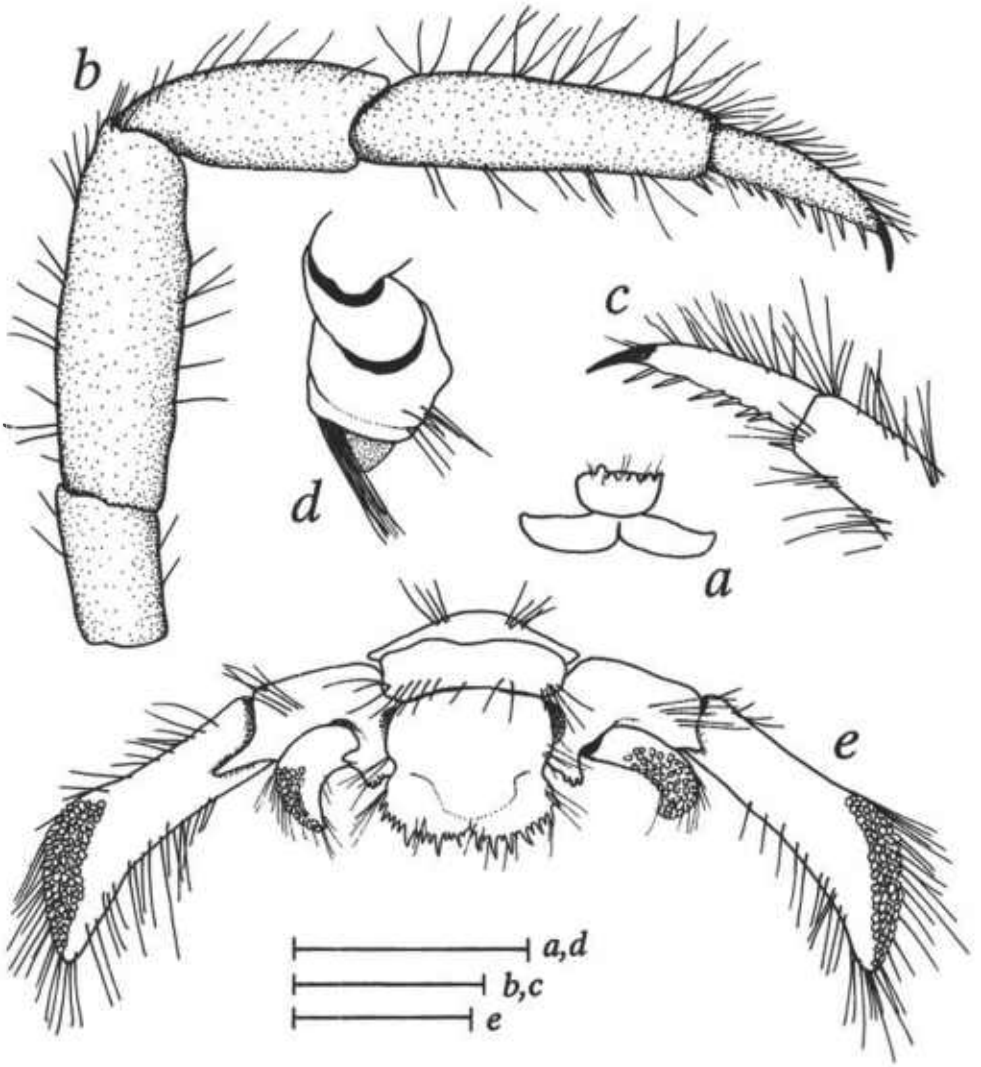

Fig. 2. *Paguritta gracilipes* Melin, 1939, Bonin Islands. a, d, e, male syntype (SL = 2.5 mm) (NHRM 2293); b, c, female syntype (SL = 2.7 mm) (ZMUU 431a-k). a, anterior and posterior lobes of sternite of third pereopods; b, right third pereopod; d, coxa and basis of right fifth pereopod, lateral view; e, telson and uropods, dorsal view. Scales equal 1 mm.

Distribution.- Japan, Philippine Islands, Vietnam; in polychaete tubes associated with corals (Schuhmacher, 1977) and in association with hydrocorals and hexacorals (Serène, 1957).

Remarks.- Melin's (1939) type material consists of two individuals, only one of which possessed the right cheliped, the other the third pereopods. The left chelipeds and second pereopods were missing from both specimens. Although Melin's description was quite detailed for the appendages he had, the incompleteness of the specimens made subsequent comparisons with Gordon's (1935) description of *P. harmsi* difficult. Forest (1951) noted the similarities in the descriptions of the right chelipeds of the two species and suggested that they might prove to be conspecific. Subsequently, he (Forest, 1961) formally placed *P. gracilipes* in synonymy.

Gordon's (1935) description of *P. harmsi*, based upon the female holotype, was generally thorough. We have examined two of Gordon's four female paratypes and the single male paratype and find that all agree well with Gordon's description. Our supplemental material from Christmas Island similarly supports that description.

Serène (1957) reported that in cephalic appendages his specimens from Vietnam agreed generally with Gordon's (1935) description and illustrations; however, he noted that while she illustrated the telson, she did not describe it or the uropods. Serène's (1957) description and figure of the telson agree more closely with Melin's (1939) specimens than with Gordon's (1935). Although Serène (1957) illustrated the ambulatory legs, he did not show or comment on any armature of the ventral margins of the dactyls.

Lewinsohn's (1978) redescription was also based on Gordon's (1935) type material and part of Melin's (1939). He (Lewinsohn, 1978) noted several of the same differences between the male of *P. gracilipes* and *P. harmsi* that we have observed; however, he believed that this own material from the Philippines demonstrated that these were unimportant intraspecific variations. For example, he found that the number of spines on the produced dorsolateral distal angle of the second antennal peduncular segment varied from two to five; the antennal acicle varied from reaching to the base of the cornea to extending the entire length of the ocular peduncle and cornea. In a number of characters there is agreement between the types of the two taxa, but there are also some differences that do not appear to be attributable to intraspecific variation. The terminal margin of the telson in *P. harmsi* is armed with a series of relatively thin corneous spines; in *P. gracilipes* there are several thick spines interspersed with one or rarely two short moderately thick spines. The dactyls of the ambulatory legs in *P. harmsi* are relatively short in comparison to the propodi (often less than half) and armed with four or five (rarely three or six) strong corneous spines. Only a single pair of third pereopods were present in Melin's (1939) material, but in these the dactyls are greater than half the length of the propodi and the ventral margin are armed with six and eight moderately strong corneous spines. Of particular significance is the difference in colour patterns between the two species. Although Gordon's (1935) material lacked all colour, Dr. Gary Morgan has provided us with colour notes taken in the field from his specimens collected at Christmas Island. These differences, in our opinion, justify the reinstatement of *P. gracilipes* as a distinct taxon.

We have found, from our examination of Lewinsohn's Philippine material, that none of those specimens are referable to *P. harmsi* sensu stricto. Schuhmacher's (1977) aquarium specimen, with its stouter ocular peduncles, marginal spinose ocular acicles and stoutly spined telson, we believe is *P. gracilipes*. Therefore the striped colour patterns he figured and reported to Lewinsohn (1978) for this taxon is applicable to *P. gracilipes* and will distinguish this species from the other taxa. Based on his described telson and colour patterns, we believe that Serène's

(1957) specimens also should be referred to *P. gracilipes*. Lewinsohn's (1978) remaining specimens from the Philippines Islands are referable to *P. morgani*, new species; however, his specimen from Palfrey Island, Australia, cannot be assigned with confidence to any taxon. This specimen is now dry and lacking all appendages.

The left cheliped was missing in both of Melin's (1935) syntypes, and while apparently present in at least some of Serène's (1957) specimens, the latter author did not describe its armature. Schuhmacher's (1977) photos of *P. gracilipes* depict specimens with the left chelipeds present; however, no left cheliped accompanied his specimen from the RMNH collection. Miyake (1978) figured and briefly described "*P. harmsi*" from the Japanese Island of Amami-Oshima; however, in a subsequent account of Japanese decapods (Miyake, 1982) presented a colour photo of two specimens (male and female) with markedly different colour patterns. He attributed both to *P. harmsi*, although he briefly acknowledged the differences in colour. Miyake's (1978, 1982) specimens are not readily accessible as the Kyushu University crustacean collections were recently moved to Kitakyushu Museum of Natural History and have not yet been cataloged (Dr. K. Baba., Dr. K. Ueda, personal communications). Miyake's figure (1982, pl. 41-2) most certainly depicts two species of *Paguritta*. We interpret the striped specimen on the left, the male, as *P. gracilipes*; the female on the right with the reddish-brown chelae and banded pereopods agrees well with the colour patterns of *P. morgani*, new species. In his description of presumed *P. harmsi*, Miyake (1978) described the left chela as bearing two rows of spines on the dorsal surface, and it is on the basis of his description that we have tentatively ascribed spines to the dorsal surface of the left chela in *P. gracilipes*. Scattered spines are also present on the dorsal surface of the chela in *P. morgani*, but in *P. harmsi* sensu stricto this surface is unarmed or has only a few very small spinules.

Paguritta harmsi (Gordon, 1935)
(Figs. 3, 4)

?Orthopagurus harmsi Gordon, 1935: 629, figs. 1,2

Paguritta harmsi - Forest, 1951: 185; 1961: 238 (in part); Lewinsohn, 1978: 245 (in part), fig. 1, see remarks

Orthopagurus harmsi - Gordan, 1956: 321; McLaughlin, 1974: 362

Not *Orthopaguropsis harmsi* - Serène, 1957: 107, figs. 1-3 [=*Paguritta gracilipes* Melin, 1939]

Not *Paguritta harmsi* - Miyake, 1978: 126, fig. 50; 1982: 121, pl. 41, fig. 2 [=*Paguritta gracilipes* Melin, 1939 and *P. morgani* new species]; Schuhmacher, 1977: 371, figs. 1, 2 [=*Paguritta gracilipes* Melin, 1939]; Baba, 1989: 132 [=*Australeremus triserratus* (Ortmann)]

Material examined.- Paratypes - 1 male (SL = 1.5mm), 2 ovigerous females (SL= 2.3, 2.5 mm) (BMNH 1935.810.5-8), Piles of pier, Flying Fish Cove, Christmas Island, 7.iv.1933.

Supplemental material - 3 males (SL = 1.3 - 1.5 mm), 1 ovigerous female (SL = 1.7 mm) (WAM 459-87), Egeria Pt, Christmas Island, 19.ii.1987.

Diagnosis.- Shield varying from approximately as broad as long to considerably broader than long; anterior margin between rostrum and lateral projections straight to somewhat concave. Rostrum prominent, acute, usually with terminal spine or spinule. Lateral projections usually with terminal spinule. Ocular peduncles long, overreaching antennal peduncle, slender; corneae oval or ovate. Ocular acicles long, narrow, terminating subacutely or bluntly and with very strong submarginal spine. Antennal peduncle with dorsolateral distal angle of second

segment strongly produced, broad and armed with three to six strong spines, dorsomesial distal angle unarmed. Right cheliped with dorsal margins palm and fixed finger circumscribed by row of slender, curved spines, strongest on dorsomesial and proximomesial margins, dorsal surface armed with irregular rows of moderate to strong spines, sometimes accompanied by prominent thick bristles and numerous long, thin setae; carpus with acute spine at dorsomesial distal angle and two or three additional smaller spines on dorsodistal margin, dorsal surface with two or three blunt or spinulose protuberances in longitudinal row near rounded dorsolateral margin. Left cheliped with propodal-carpal articulation rotated 30-45^{o} clockwise from perpendicular, dorsolateral margin of palm and fixed finger with row of prominent, curved spines, dorsal surface unarmed or with few scattered tiny granules or spinules; carpus with one very strong spine on dorsodistal margin laterally and one to three additional smaller spines on distal margin; merus occasionally with few blunt or spinulose tubercles on ventrodistal margins of propodi and row of four or five (very rarely three or six) corneous spines on ventral margins of dactyls. Uropods with moderately short protopods armed posteriorly with few small tubercles; exopods also moderately short; endopods extending well beyond exopodal bases. Telson with terminal margins of posterior lobes each armed with series of closely-spaced relatively slender calcareous spines, three to five on either side of small median cleft usually stronger. Eggs of females moderately large, approximately 0.8 mm in diameter.

Colour.- Shield orange-brown. Ocular peduncles with four orange-brown and four cream-coloured stripes, corneae deep brown; acicles also orange-brown. Antennular and antennal peduncles and flagella cream or very pale brown. Chelipeds similarly coloured. Dactyls and fixed fingers white in distal half, orange brown mosaic or reticulation proximally; palm orange-brown with varying areas of white; carpus orange-brown with some cream; merus similar but paler. Ambulatory legs very pale brown-cream. (Dr. G. Morgan, field notes)

Distribution.- At present known only from Christmas Island.

Remarks.- As we have discussed, the specimens assigned to *P. harmsi* by Serène (1957) and Schuhmacher (1977) should be referred to *P. gracilipes*. Lewinsohn's (1978) material includes both *P. gracilipes* and *P. morgani*, new species. Miyake's (1978) diagnosis agrees with *Paguritta*, but unquestionably pertains to species other than *P. harmsi* sensu stricto. In his material examined, Miyake listed a pair (male and female) of specimens from serpulid worm tubes and a pair from a crevice in madrepore coral. It is not clear whether any of these are the same specimens subsequently described and figured by Miyake (1982). We have referred these latter illustrated specimens to *P. gracilipes* (male) and *P. morgani* (female). Baba (1989) also reported "*P. harmsi*" from Amami-Oshima, remarking that the current specimens, like one of Miyake's (1978) pairs, were collected from serpulid tubes. We have examined Baba's (1989) specimens and found that none are referable to *P. harmsi* or any other species of *Paguritta*. Rather, these specimens agree completely with *Australeremus triserratus* as redescribed by McLaughlin & Gunn (1992).

We previously indicated that the great similarity in general morphology of the chelipeds among species of *Paguritta* led carcinologists to include at least three species under the name *P. harmsi*. As in species of the diogenid genus *Calcinus* whose cheliped morphology is very similar, living colour is the most diagnostic character (Haig & McLaughlin, 1983). *Paguritta harmsi* has a reticulated or mosaic colour pattern of brown and cream on the chelae; the ambulatory legs are pale brown-cream. *Paguritta gracilipes* has yellowish chelae with three black stripes. The colour patterns of the chelae of *P. harmsi* are also similar to those observed in *P. scottae*, new species from the Maldives, but in this latter species the chelae are blue with white

patches. The chelae of *P. morgani*, new species have white tipped dactyls and fixed fingers and red-brown palms with white patches; the ambulatory legs are red-brown with white distal bands on the propodi, carpi and meri. The chelae of *P. kroppi*, new species have dark-coloured dactyls and fixed fingers.

In the absence of colour, *P. harmsi*, *P. gracilipes*, and *P. kroppi* can be distinguished from *P. corallicola*, *P. morgani* and *P. scottae* by the greater number of corneous spines on the ventral margins of the dactyls of the ambulatory legs. Unfortunately, the tendency of the ambulatory

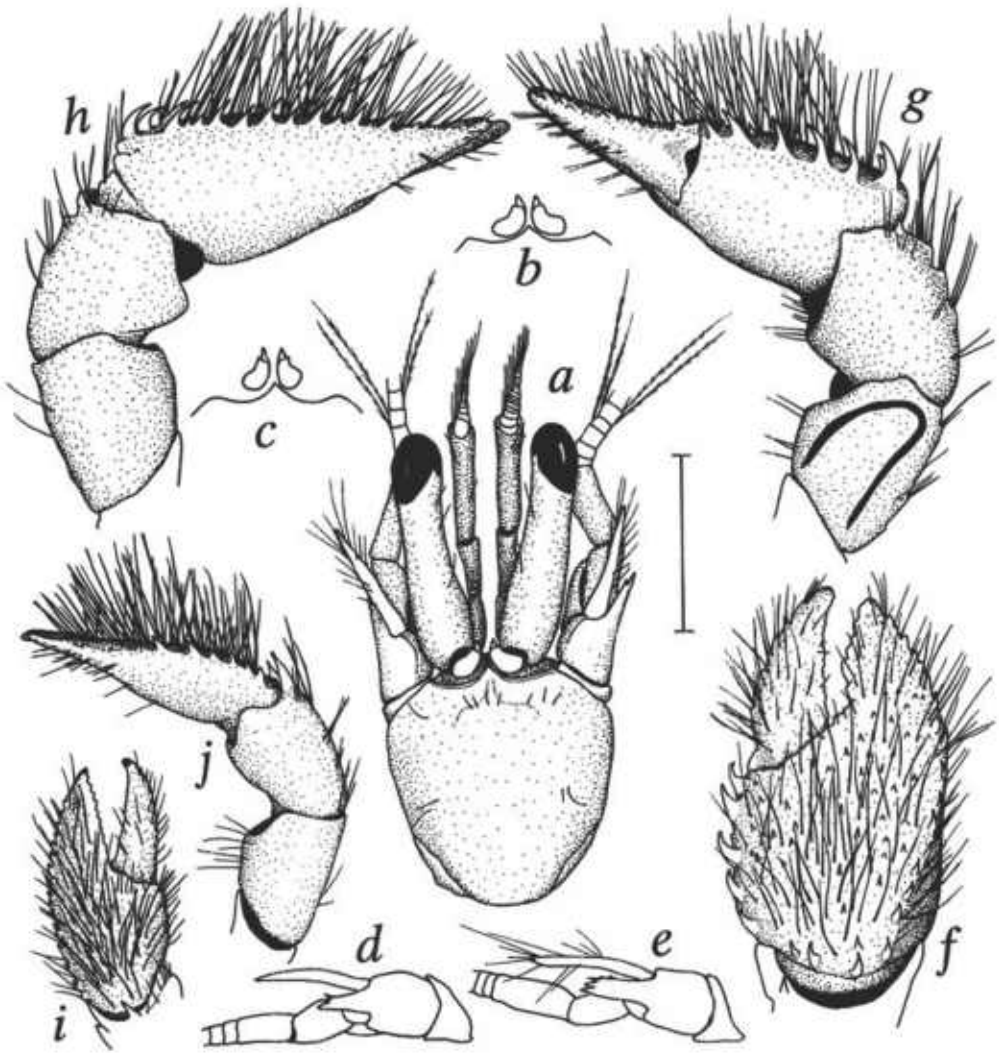

Fig. 3. *Paguritta harmsi* (Gordon, 1935) (WAM 459-87), Christmas Island. a, b, d, f-j, male (SL = 1.4 mm); c,e, male (SL = 1.3 mm). a, shield and cephalic appendages; b, c, ocular acicles and anterior portion of shield, dorsal view; d,e, left antennal peduncle, lateral view; f, right chela, dorsal view; g, right cheliped, mesial view; h, same, lateral view; i, left chela, dorsal view; j, left cheliped, lateral view. Scale equals 1 mm.

legs to readily become detached is common to all species. *Paguritta harmsi* is also distinguished from *P. morgani*, *P. kroppi* and *P. scottae* by the absence of spines on the dorsolateral margin of the carpus of left cheliped. Only in *P. kroppi* are the dorsodistal marginal spines of the carpus moderately small; these spines in *P. harmsi*, *P. morgani* and *P. scottae* are strong and at least one is very prominent. In *P. scottae* it is the median spine, whereas in both *P. harmsi* and *P. morgani* the spine at the dorsolateral distal angle is appreciably stronger. The scattered spines on the dorsal surface of the left chela will immediately distinguish *P. morgani* from *P. harmsi* in which this surface is unarmed or has only a few tiny spinules. As the armature of the left cheliped has not been confirmed for *P. gracilipes*, no comparison can be made. The ocular peduncles are more slender and the corneae more ovate in *P. harmsi* than in *P. gracilipes*, and the median cleft of the telson less clearly distinguished in the former species. When both pereopods and colour are lacking, these are probably the only recognition characters available to separate these two taxa.

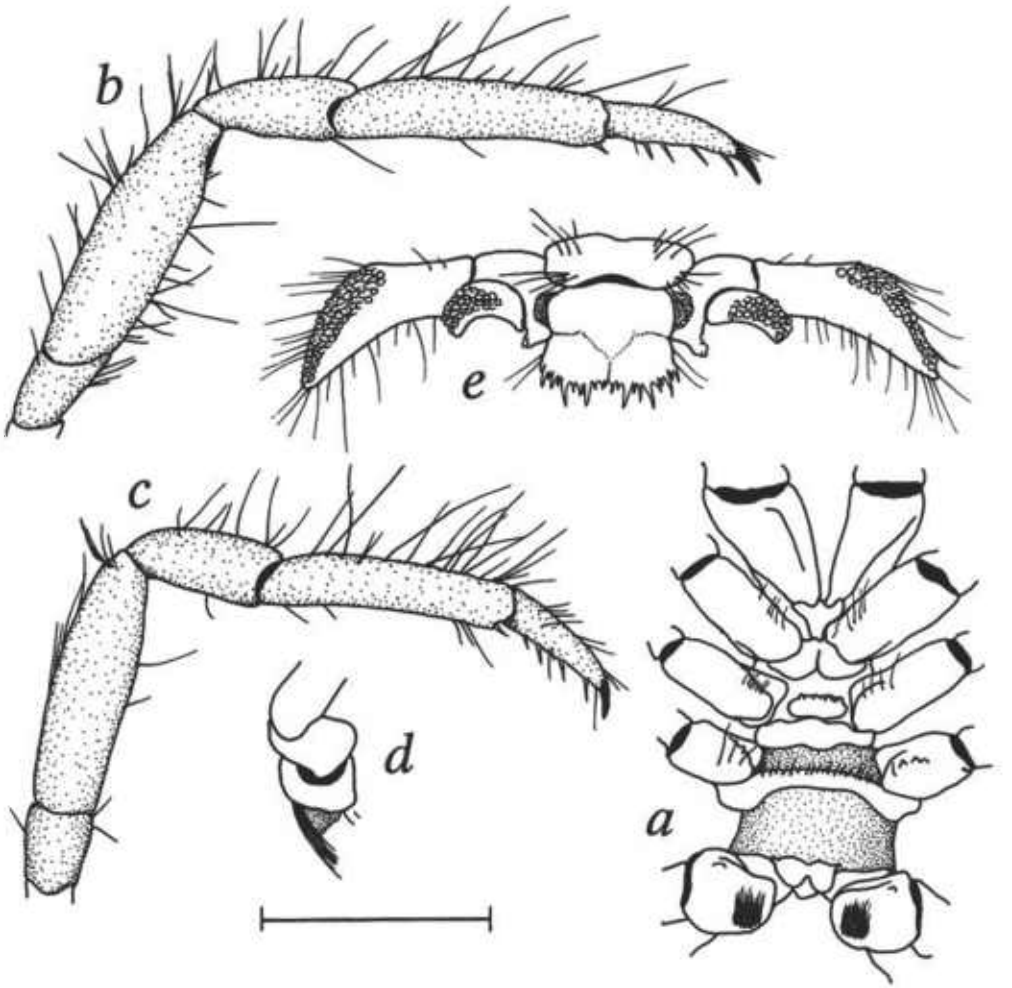

Fig. 4. *Paguritta harmsi* (Gordon, 1935), male (SL = 1.4 mm) (WAM 459-87), Christmas Island. a, thoracic sternum; b, right second pereopod, lateral view; c, right third pereopod, lateral view; d, coxa and basis of right fifth pereopod, lateral view; e, telson and uropods, dorsal view. Scale equals 1 mm.

Paguritta corallicola Lewinsohn, 1978
(Figs. 5, 6)

Paguritta corallicola Lewinsohn, 1978: 248, fig. 2

Material examined.- Holotype - Female (SL = 3.3 mm) (RMNH D 31900), Heron Island, Great Barrier reef, Australia, 10 m, coll. N. Coleman, 1.vii.1975.

Paratypes - 2 males (SL = 1.8, 2.4 mm) (RMNH D 31901), Heron Island, Great Barrier reef, Australia, 10 m, coll. N. Coleman, 1.vii.1975.

Supplemental material - 2 females, 1 ovigerous (SL = 1.6, 1.9 mm) (AMS P. 23807), Capricorn Group, Heron Island, 10m, coll. N. Coleman, 24.vii.1975.

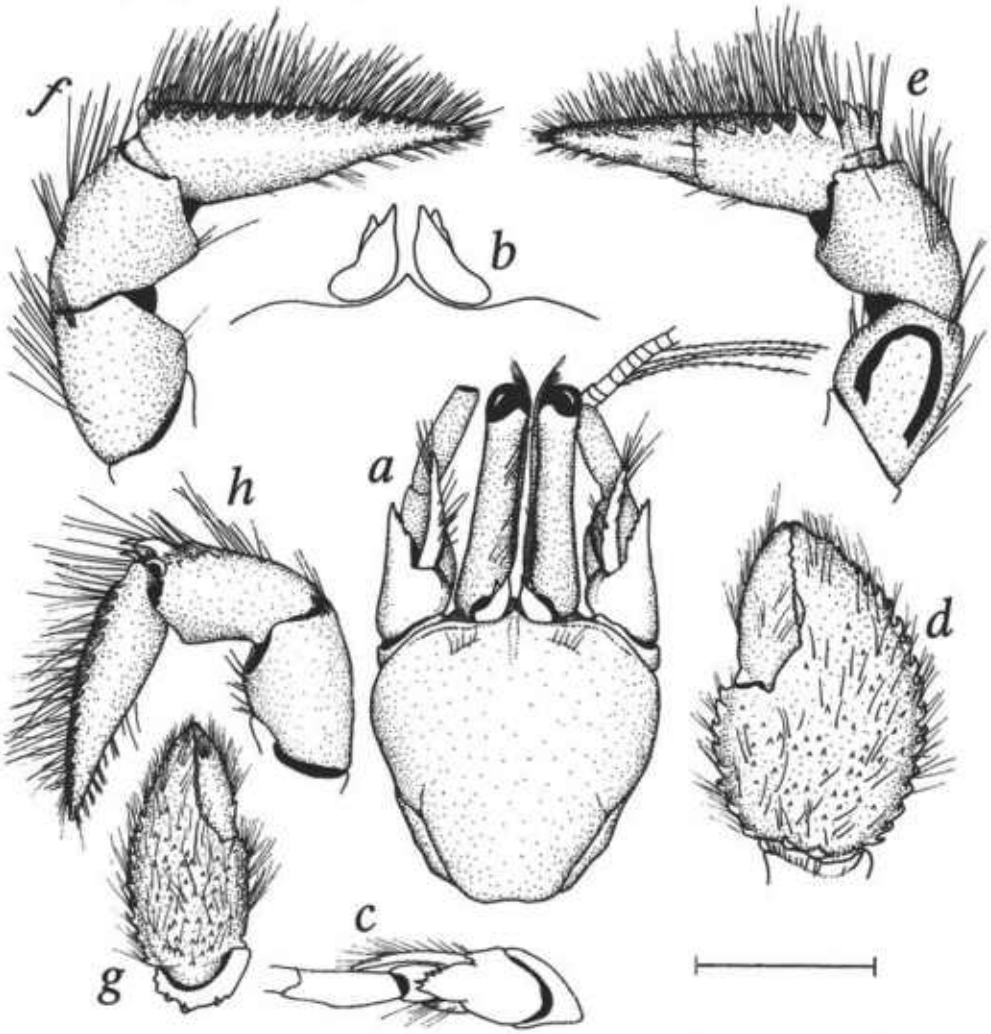

Fig. 5. *Paguritta corallicola* Lewinsohn, 1978, female holotype (SL = 3.3 mm) (RMNH 31900), Heron Island, Australia. a, shield and cephalic appendages; b, ocular acicles and anterior protion of shield, dorsal view; c, left antennal peduncle, lateral view; d, right chela, dorsal view; e, right cheliped, mesial view; f, same, lateral view; g, left chela, dorsal view; h, left cheliped lateral view. Scale equals 2 mm (a,c-h), and 1 mm (b).

Diagnosis.- Shield longer than broad; anterior margin between rostrum and lateral projections weakly to strongly concave. Rostrum triangular, acute, without terminal spinule. Lateral projections obsolete or broadly rounded, unarmed. Ocular peduncles long, equaling or overreaching antennal peduncles, slender, corneae circular or ovate. Ocular acicles long, slender, terminating acutely, or bluntly and with one or two strong submarginal spines. Antennal peduncle with dorsolateral distal angle of second segment strongly produced, broad, terminating in strong spine and armed with four or five prominent spines on mesiodistal margin; dorsomesial distal angle unarmed. Right cheliped with dorsal margins of palm and fixed finger circumscribed by row of moderately short, basally broadened spines, dorsal surface armed with numerous, small spines or spinules, sometimes forming irregular rows, and long thin setae; carpus with few tiny spinules or tubercles on dorsodistal margin, dorsal surface with one or two short, transverse rows of very small tubercles or spinules laterad of midline. Left cheliped with propodal-carpal articulations rotated approximately 45^{o} clockwise from perpendicular; dorsolateral margin of palm and fixed finger with row of acute spines, dorsal surface with numerous small tubercles or spinules, sometimes forming irregular rows; carpus with three or four prominent spines on dorsodistal margin and two or three much smaller spines on dorsolateral margin distally. Ambulatory legs unarmed except for corneous spine at ventrodistal angle of each propodus and one or two widely separated, strong corneous spines on ventral margin of each dactyl. Uropods with very short protopods armed posteriorly by one or two rows of tubercles; exopods moderately long; endopods arising adjacent to exopodal bases. Telson with posterior lobes with or without distinct median cleft, terminal margins each with row of short, closely-spaced calcareous spines. Eggs of females few in number but very large (1.0 - 1.2 mm diameter).

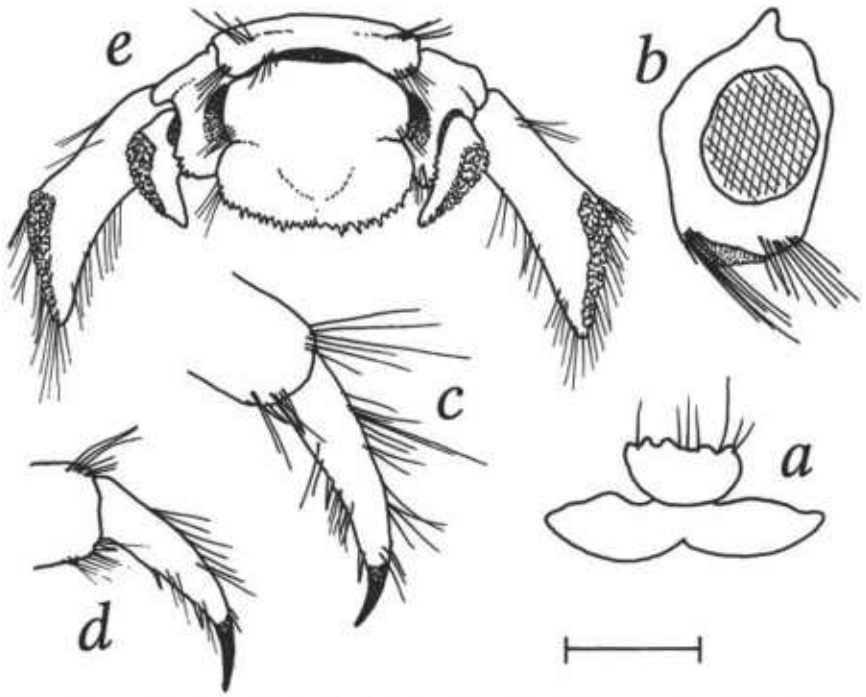

Fig. 6. *Paguritta corallicola* Lewinsohn, 1978, Heron Island, Australia. a,c-e, female holotype (SL = 3.3 mm) (RMNH 31900); b, male paratype (SL = 2.4 mm) (RMNH 31901). a, anterior and posterior lobes of sternite of third pereopods; b, coxa of right fifth pereopod, lateral view; c, dactyl of right second pereopod, lateral view; d, dactyl of right third pereopod, lateral view; e, telson and uropods, dorsal view. Scale equals 0.5 mm (a-d), and 1 mm (e).

Colour.- In a preserved specimen, no stripes but with the fingers of the chelipeds reddish (Lewinsohn, 1978).

Distribution.- Australian Great Barrier Reef, in boreholes in coral.

Remarks.- *Paguritta corallicola* is readily distinguished from *P. gracilipes* and *P. harmsi* by the short ambulatory dactyls that carry only one or two spines on the ventral margins. Of the three new species described herein, only *P. morgani* has the dorsal surface of the palm of the left chela similarly armed with small spines. However, the spines circumscribing the palm of the right chela, which are uniformly short and moderately broad, and the carpus, which is armed only with very small tubercles in *P. corallicola*, serve to distinguish this species from *P. morgani*. Additionally, *P. corallicola* is the only species in which there is a tendency for two submarginal spines to develop on the ocular acicle. The very large eggs carried by females of this species suggest that development may be abbreviated.

Paguritta morgani, new species
(Figs. 7, 8)

Paguritta harmsi - Lewinsohn, 1978: 245 (in part), not fig. 1
?*Paguritta harmsi* - Miyake, 1982: 121 (in part), pl. 41, fig. 2 right (female); not pl. 41, fig. 2 left (male) [Not *Paguritta harmsi* (Gordon, 1935)]
Orthopagurus harmsi - Morgan, 1988: 127

Material examined.- Holotype - Female (SL= 2.4 mm) (WAM 734-92), inside Sek 9, N. of Madang, Papua New Guinea, coll. G. J. Morgan, 23.xi.1987.

Paratypes - 4 males, 2 females (SL = 1.2-2.4 mm) (WAM 377-88), inside Sek 9, N. of Madang, Papua New Guinea, coll. G. J. Morgan, 23.xi.1987; 2 males, 8 females (7 ovigerous) (SL = 1.9 - 3.0 mm) (RMNH D25575), Bitago Beach, W. van Zamboanga, Philippine Islands, 10 km, 26.iii.1968.

Description.- Shield distinctly longer than broad, dorsal surface glabrous; anterior margin between rostrum and lateral projections concave; anterolateral margins sloping. Rostrum prominent, triangular, armed with terminal spinule. Lateral projections obtusely triangular or rounded, sometimes armed with minute terminal spinule.

Ocular peduncles elongate, about as long as length of shield, slightly broadened basally and weakly constricted medially; corneae slightly dilated. Ocular acicles elongate, narrow, terminating in strong spine, with acute lateral or submarginal spine; separated basally by about one-third basal width of one acicle.

Antennular peduncles reaching to distal margin of cornea or slightly beyond; ultimate and penultimate segments with scattered setae; basal segment with unarmed mesial and lateral faces.

Antennal peduncles reaching at least to base of corneae; fifth and fourth segments with few scattered setae; third segment without spine at ventrodistal margin; second segment with dorsolateral distal angle strongly produced, terminating in acute spine and with two or three additional spines on mesiodistal margin, dorsomesial distal angle unarmed; first segment with ventral margin produced, unarmed. Antennal acicle reaching to proximal or distal third of ultimate peduncular segment, terminating in small spinule and with numerous long marginal setae.

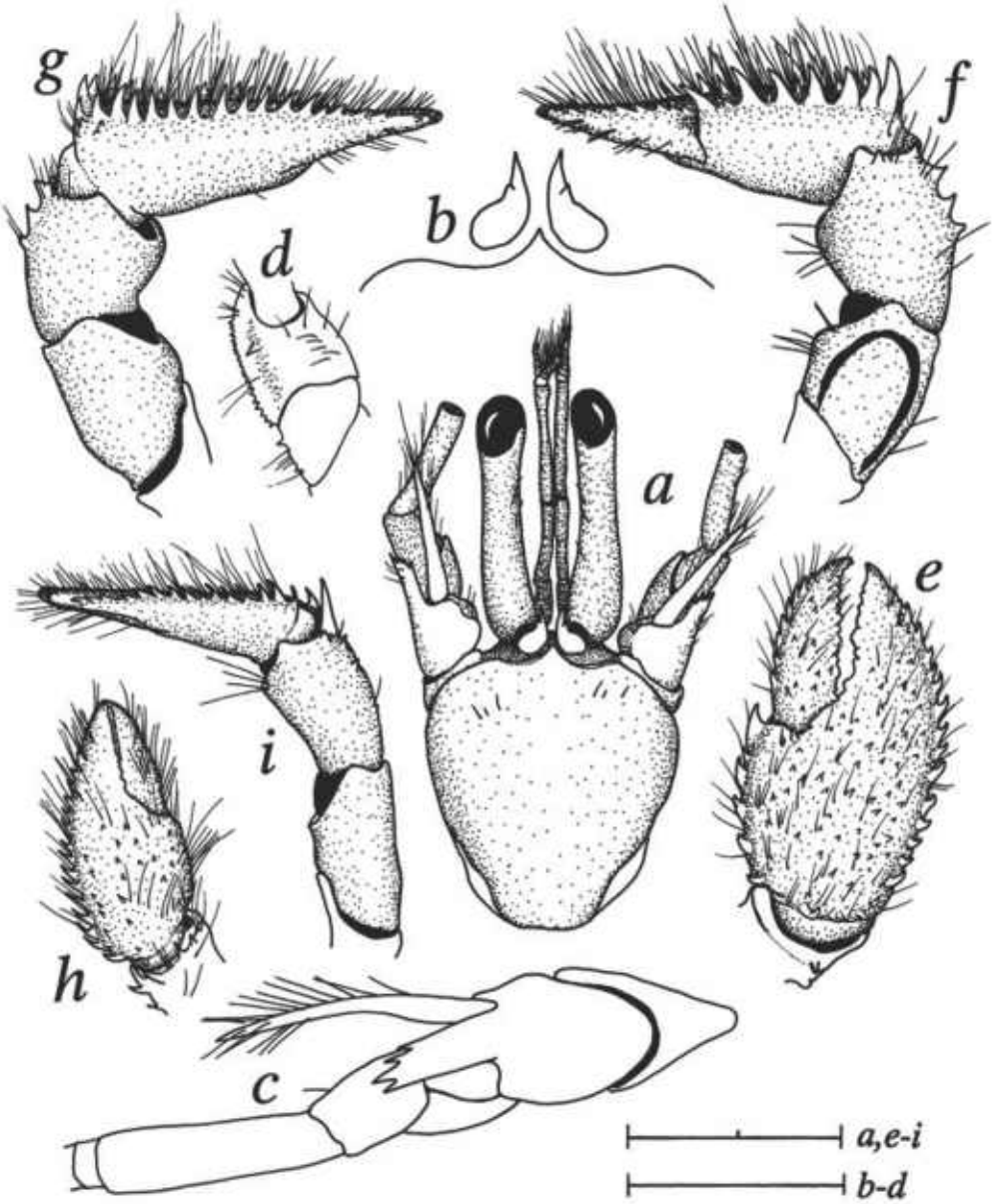

Fig. 7. *Paguritta morgani*, new species, female holotype (SL = 2.4 mm) (WAM 734-92), Madang, Papua New Guinea. a, shield and cephalic appendages; b, ocular acicles and anterior portion of shield, dorsal view; c, right antennal peduncle, lateral view; d, basis and ischium of left third maxilliped, inner view; e, right chela, dorsal view; f, right cheliped, mesial view; g, same, lateral view; h, left chela, dorsal view; i, left cheliped, lateral view. Scales equal 2 mm (a, e-i), and 1 mm (b-d).

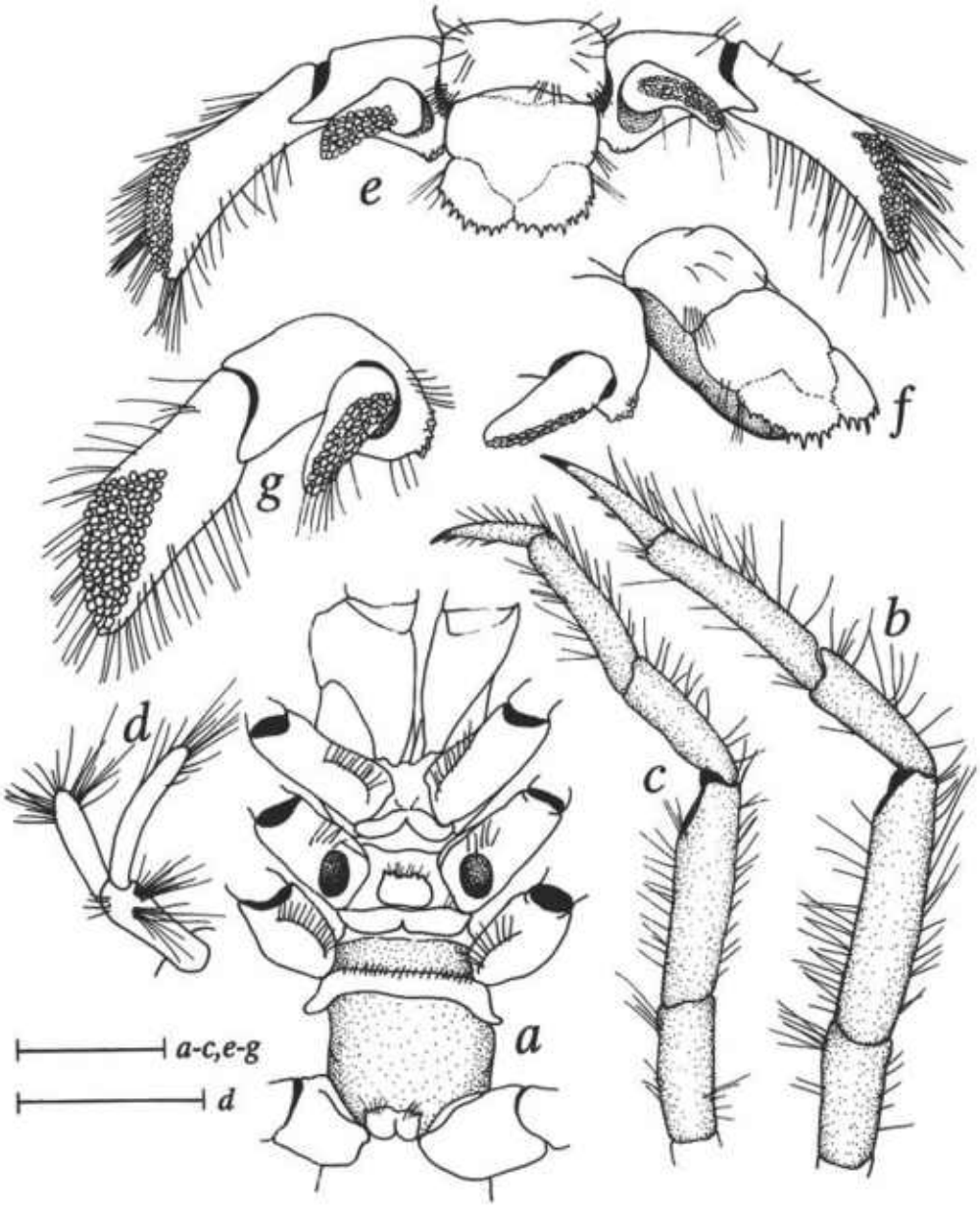

Fig. 8. *Paguritta morgani*, new species, a-f, female holotype (SL = 2.4 mm) (WAM 734-92), Madang, Papua New Guinea; g, female paratype (SL = 3.0 mm) (RMNH D25575), Philippine Islands. a, sternum; b, left second pereopod, lateral view; c, left third pereopod, lateral view; d, left fourth pleopod, lateral view; e, telson and uropods, dorsal view; f, left side of same, dorsolateral view; g, left uropod, dorsal view. Scales equal 1 mm.

Antennal flagellum long, each article with one or two short seta and pair of long setae armed with setules.

Sternite of third pereopods with anterior lobe subrectangular, anterior margin armed with four or five (occasionally only two or three) blunt spines.

Right cheliped with chela elongate, moderately slender. Dactyl approximately as long as palm, terminating in strong calcareous claw; cutting edge with row of small calcareous teeth; dorsal surface with numerous long setae and scattered small spines; dorsomesial margin with row of acute spines. Palm about as long as carpus; dorsal margins of palm and fixed finger circumscribed by row of prominent, slender, curved spines, five or six on dorsomesial margin strongest; dorsal surface flattened, armed with numerous small spines or spinules sometimes appearing as irregular rows and accompanied by short bristles, also with numerous scattered long setae; fixed finger with dorsal surface unarmed or with few small spines or spinules on proximal half, cutting edge with row of small calcareous teeth and terminating in calcareous claw; mesial, lateral and ventral surfaces of palm all glabrous, ventral surfaces of dactyl and fixed finger with scattered tufts of moderately short setae. Carpus subequal to merus in length; dorsomesial distal angle with small spine; dorsolateral margin armed with row of three spines and small dorsodistal spine; dorsal surface with scattered long setae; mesial, ventral and lateral surfaces glabrous or with few long setae. Merus and ischium unarmed but with few long setae dorsally and ventrally.

Left cheliped with dactyl slightly longer than palm, cutting edge with row of small corneous teeth and terminating in small corneous claw; cutting edge of fixed finger with row of small calcareous teeth and terminal calcareous claw; dorsomesial margin and dorsal surface of dactyl unarmed, but with scattered long setae. Palm subequal to carpus in length; propodal-carpal articulation rotated clockwise approximately 45° from perpendicular; dorsomesial margin unarmed, dorsal surface with numerous scattered small spines or spinules, dorsolateral margin with row of strong spines slightly curved upward and decreasing in size on fixed finger; ventral surface of palm, dactyl and fixed finger with scattered setae. Carpus subequal to merus in length; dorsal margin armed with one or two small spines and strong dorsodistal spine; distal margin with one or two small spines or tubercles mesially and laterally. Merus and ischium with few setae.

Second pereopods longer than third; dactyls of both second and third about two-thirds length of propodi, terminating in strong corneous claws, dorsal surfaces and mesial and lateral faces all with long setae, ventral margins each usually with two (sometimes three) corneous spines; propodi slightly longer than carpi, all surfaces with scattered long setae, ventrodistal angles each with corneous spine; carpi and meri unarmed, but with scattered long setae dorsally and shorter setae ventrally.

Uropods (Fig. 8e, g) with moderately elongated protopods armed posteriorly by numerous small tubercles; exopods elongate, usually less than three times as long as wide; endopods usually not reaching beyond exopodal bases. Telson with posterior lobes and anterior lobes separated by prominent median suture; terminal margins of posterior lobes each with five to seven moderately strong calcareous spines interspersed with one or two smaller spines.

Colour.- Shield pale brown with scattered red and orange chromatophores and three large cream-coloured patches. Ocular peduncles dark green-blue or green-blue with cream-blue longitudinal lines; corneae black with white spots. Antennular peduncles with penultimate segment blue basally and pale brown distally; ultimate segment and flagellum pale brown. Antennal peduncles pale brown with deep blue tinges in places, flagella deep coffee or red-brown, setae clear. Chelipeds generally red with white patches; dactyls white in distal third, remained red-lilac or red-brown with large mesial and lateral white patches, fixed finger white then transverse rows of white patches on red background proximally and on palm; carpi red-brown with light patches, with one particularly large dorsodistally; merus red with white band distally and proximally. Ambulatory legs with dactyls translucent red-brown; propodi, carpi and propodi each red-brown with white band distally. Fourth pereopods banded white and red-brown (Dr. G. J. Morgan, field notes).

Etymology.- This species is named for Dr. Gary J. Morgan who provided the specimens from the type locality and whose colour notes clarified the ambiguities posed by these closely allied taxa.

Distribution.- Philippine Islands, Madang, Papua New Guinea; in serpulid tubes.

Remarks.- Because Lewinsohn (1978) attributed the subtle differences he observed between the types of *P. harmsi*, *P. gracilipes*, and his own Philippine material, he confounded *P. gracilipes* and *P. morgani* with *P. harmsi* sensu stricto. Similarly, we believe that one of the two specimens figured by Miyake (1982, pl. 41, fig. 2 right) represents *P. morgani*. We have had the benefit of documented colour patterns to substantiate our morphological assessments of these species. However, in the absence of colour information, the greater number of corneous spines on the ventral margins of the pereopodal dactyls in both *P. gracilipes* and *P. harmsi* immediately separate these species from *P. morgani*. Additionally, the armature of the palm of the left chela will distinguish *P. morgani* not only from *P. harmsi*, but also *P. scottae* and *P. kroppi*.

Paguritta scottae, new species
(Figs. 9, 10)

Material examined.- Holotype - Female (SL = 1.7 mm) (USNM 259377), type locality: off Villingili, North Male Atoll, Republic of Maldives, 15 m in living *Porites* sp., coll., P. J. B. Scott, 16.vi.1991.

Paratype - Male (SL = 1.7 mm) (USNM 259378), just inside north edge of South Male Atoll, Republic of Maldives, in living *Porites*, coll. P. J. B. Scott, 20.vi.1991.

Description.- Shield considerably longer than broad, dorsal surface glabrous; anterior margin between rostrum and lateral projections concave; anterolateral margin sloping; posterior margin truncate. Rostrum triangular and armed with terminal spinule. Lateral projections obtusely triangular or rounded, no indication of terminal spine or spinule.

Ocular peduncles elongate, approximately as long as shield, slightly broadened basally and slightly constricted medially; corneae slightly dilated. Ocular acicles very elongate, narrow, terminating subacutely, and with very acute submarginal spine; separated basally by one-third to one-half basal width of one acicle.

Antennular peduncles not quite as long as ocular peduncles or reaching to distal margin of cornea; ultimate and penultimate segments with only few setae; basal segment with slight unarmed protuberance on mesial face.

Antennal peduncles reaching to bases of corneae or equal to length of ocular peduncles; fifth and fourth segments with few scattered setae; third segment without spine at ventrodistal margin; second segment with dorsolateral distal angle strongly produced, terminating in strong acute spine and with two spines on mesiodistal margin, dorsomesial distal angle unarmed; first segment with ventral margin produced, unarmed. Antennal acicle long, reaching beyond midpoint of ultimate peduncular segment, terminating in small spinule and with numerous scattered marginal setae. Antennal flagellum long, each article with one short seta and pair of long setae armed with setules.

Sternite of third pereopods with anterior lobe subrectangular, anterior margin armed with four blunt spines.

Right cheliped with chela elongate and moderately slender (male) or broad and operculate (female). Dactyl approximately as long as palm, terminating in strong calcareous claw; cutting edge with row of small calcareous teeth; dorsal surface with numerous long setae, one small spine posteriorly and usually scattered very small spinules, dorsomesial margin with row of acute spines. Palm approximately equaling length of carpus; dorsal margins of palm and fixed finger circumscribed by row of prominent, acute, slender curved spines, strongest on dorsomesial margin, dorsal surface of palm flattened and armed with numerous small spines or spinules, sometimes appearing as irregular rows and accompanied by moderately short bristles, also with numerous scattered long setae; dorsal surface of fixed finger unarmed or with scattered spinules; cutting edge with row of small calcareous teeth and terminating in calcareous claw; mesial, lateral and ventral surfaces of palm all glabrous, ventral surfaces of dactyl and fixed finger with tufts of moderately short setae. Carpus equaling merus in length; dorsomesial distal angle with small spine, dorsodistal margin unarmed or with one or two small spines, neither dorsomesial or dorsolateral margins clearly delimited, but dorsal surface with numerous long setae and with two or three spinulose protuberances laterad of midline; mesial, ventral and lateral surfaces glabrous or with only very few long setae. Merus and ischium unarmed, but with few long setae dorsally and ventrally.

Left cheliped with dactyl slightly longer than palm, cutting edge with row of small corneous teeth and terminating in small corneous claw; cutting edge of fixed finger with row of small calcareous teeth and terminal calcareous claw; dorsomesial margin and dorsal surface of dactyl unarmed or with low protuberances. Palm approximately equaling length of carpus; propodal-carpal articulation rotated clockwise 45^{o} from perpendicular; dorsomesial margin unarmed, dorsal surface also unarmed or with scattered tiny spinules or protuberances, dorsolateral margin with row of strong spines decreasing in size on fixed finger; ventral surface of palm, dactyl and fixed finger with scattered setae. Carpus subequal to merus in length; dorsodistal margin armed with one very strong spine, and one or two somewhat smaller spines on dorsodistal margin, or spines all of equal strength, one or two additional much smaller spines or tubercles usually present mesially and laterally, dorsal surface with few long setae, one or two small spines posterior to distal marginal spine on or near indistinctly delimited dorsolateral margin. Merus and ischium unarmed, ventral surfaces with few setae.

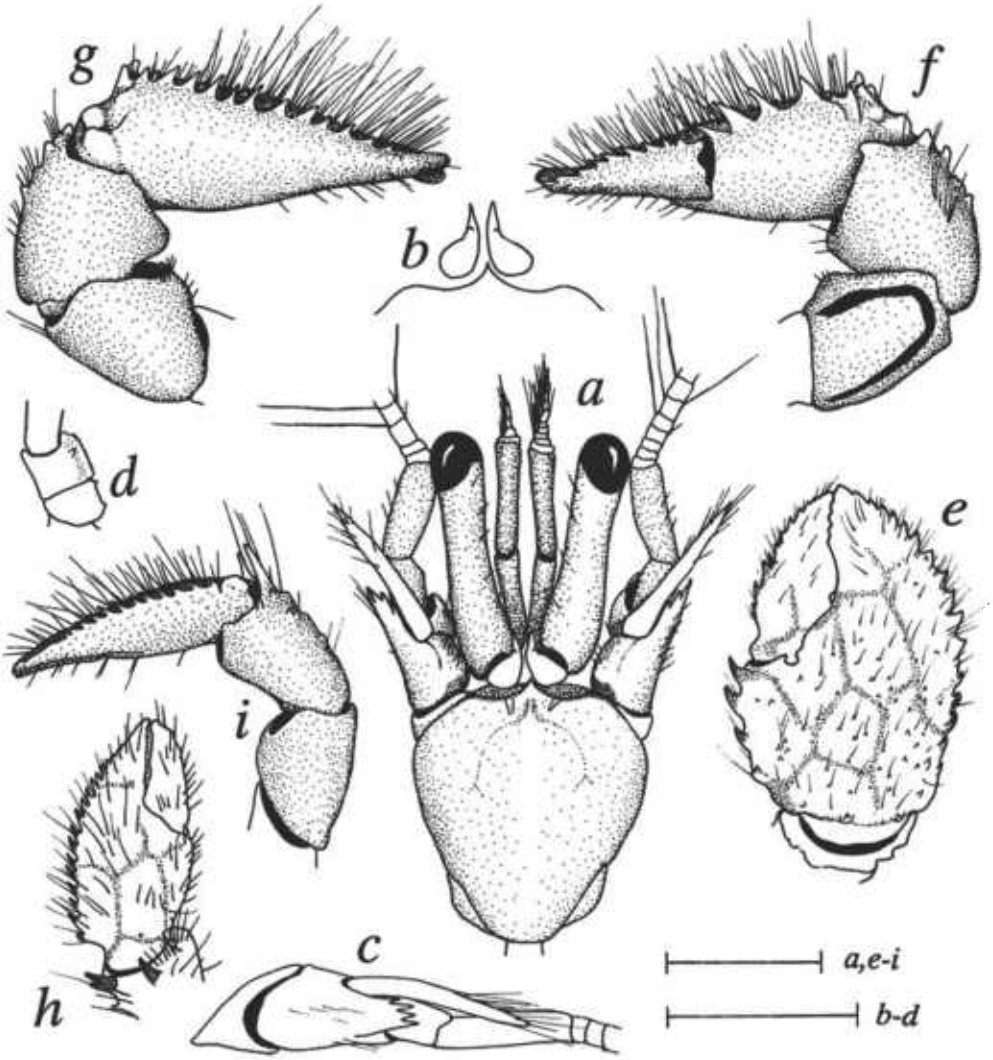

Fig. 9. *Paguritta scottae*, new species, female holotype (SL = 1.7 mm) (USNM 259377), Republic of Maldives. a, shield and cephalic appendages; b, ocular acicles and anterior portion of shield, dorsal view; c, right antennal peduncle, lateral view; d, basis and ischium of right third maxilliped, inner view; e, right chela, dorsal view; f, right cheliped, mesial view; g, same, lateral view; h, left chela, dorsal view (stippled area represents colour pattern in preservative); i, left cheliped, lateral view. Scales equal 1 mm.

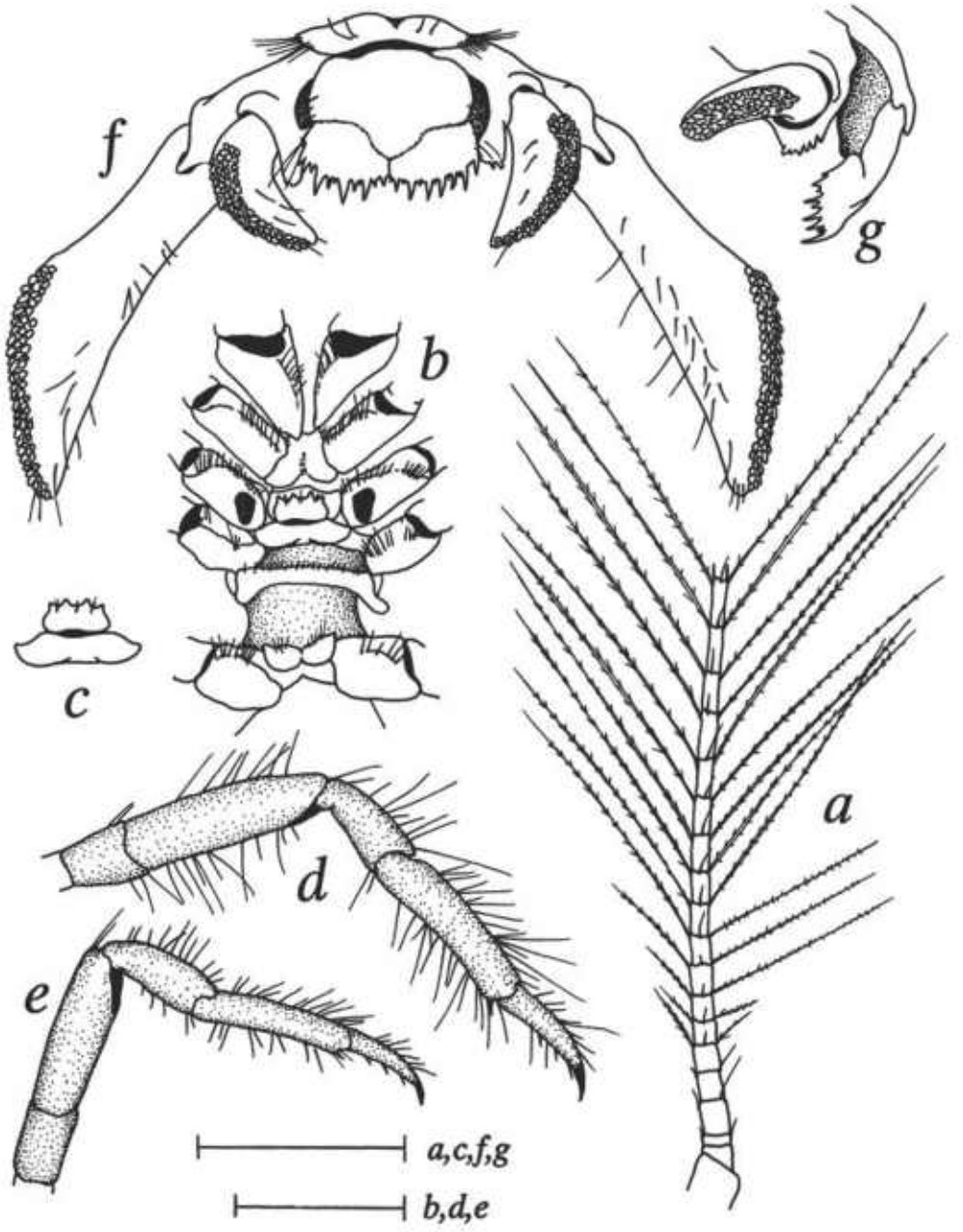

Fig. 10. *Paguritta scottae*, new species, female holotype (SL = 1.7 mm), Republic of Maldives (USNM 259377). a, proximal two-thirds of right antennal flagellum, ventral view; b, sternum; c, anterior and posterior lobes of sternite of third pereopods; d, right second pereopods, lateral view; e, right third pereopods, lateral view; f, telson and uropods, dorsal view; g, endopod and telson of same, lateral view. Scales equal 1 mm.

Second pereopods appreciably longer than third; dactyls of both second and third one-half to two-thirds length of propodi, terminating in strong corneous claws, dorsal surfaces and mesial and lateral faces all with long thin setae, ventral margins each with two to four (usually three) corneous spines; propodi somewhat longer than carpi, all surfaces with scattered long setae, ventrodistal angles each with corneous spine; carpi and meri unarmed but with scattered long setae dorsally and shorter setae ventrally.

Uropods with elongate protopods armed posteriorly by row of tubercles; exopods very elongate, length three or more times width; endopods also elongate, reaching well beyon exopodal bases. Telson with posterior lobes separated by prominent medial cleft; terminal margins each with five to seven strong calcareous spines interpersed with one or two smaller spines.

Distribution.- At present known only from the Maldives in the Indian Ocean; in *Porites* sp.

Etymology.- This species is named for its collector, Dr. Paula J.B. Scott, Toronto, Canada.

Remarks.- *Paguritta scottae* most closely resembles *P. harmsi* and *P. kroppi* in having an unarmed or only minutely armed palm of the left chela. There also is similarity in the colour patterns of the chelae of *P. scottae* and *P. harmsi* in preserved material; however, in life, the reticulated colour pattern of *P. scottae* is blue; it is reddish-brown in *P. harmsi*. The most reliable morphological character that differentiates these two species is the presence, in *P. scottae*, of one or two spines on the dorsolateral margin of the carpus of the left cheliped posterior to the distal marginal spine. No spines are present on this margin in *P. harmsi*. *Paguritta scottae* is best distinguished from *P. kroppi* by the stronger armature on the dorsomesial margin of the dactyl of the right chela and the dorsodistal margin of the carpus of the left cheliped, and absence, in males, of female gonopores in the former species.

Paguritta kroppi, new species
(Figs. 11, 12)

Material examined.- Holotype - Male (SL= 2.2 mm) (USNM 259396), Agana Bay, Guam, in worm holes in coral, coll. R. K. Kropp, 14.vi.1979.

Paratypes - 1 male (SL= 2.4 mm), 2 females (SL= 2.2-2.4 mm) (USNM 255983), Agana Bay, Guam, in worm holes in coral, coll. R. K. Kropp, 14.vi.1979.

Description. - Shield distinctly longer than broad, dorsal surface glabrous; anterior margin between rostrum and lateral projections concave; anterolateral margins sloping. Rostrum triangular, armed with terminal spinule. Lateral projections obtusely triangular, armed with minute terminal spinule.

Ocular peduncles elongate, about equal to shield length, slightly broadened basally and weakly constricted medially; corneae slightly dilated. Ocular acicles elongate, narrow, terminating subacutely and with long, strong submarginal spine; separated basally by about one-third basal width of one acicle.

Antennular peduncles approximately as long as ocular peduncles; ultimate and penultimate segments with scattered setae; basal segment with unarmed mesial and lateral faces.

Antennal peduncles reaching to base of corneae or equal to entire length of ocular peduncles; fifth and fourth segments with few scattered setae; third segment without spine at ventrodistal margin; second segment with dorsolateral distal angle strongly produced, terminating in acute spine and with three or four additional spines on mesiodistal margin, dorsomesial distal angle unarmed; first segment with ventral margin produced, unarmed. Antennal acicle reaching to about mid-length of ultimate peduncular segment, terminating in small spinule and with numerous long marginal setae. Antennal flagellum long, usually overreaching extended right cheliped, each article with one or two short setae and pair of long setae provided with setules.

Sternite of third pereopods with anterior lobe subrectangular, anterior margin armed with five or six blunt spines.

Right cheliped with chela elongate, moderately slender. Dactyl approximately as long or slightly longer than palm, terminating in strong calcareous claw; cutting edge with row of small calcareous teeth; dorsal surface with numerous long setae and scattered small spines on proximal half; dorsomesial margin proximally with row of low tubercles or spines. Palm about as long as carpus; dorsal margins of palm and fixed finger circumscribed by row of five to seven prominent, slender, curved spines strongest on dorsomesial margin; dorsal surface flattened, armed with numerous small spines or spinules sometimes appearing as irregular rows, and with numerous scattered long setae; fixed finger with dorsal surface unarmed or with few small spines or spinules on proximal half, cutting edge with row of small calcareous teeth and terminating in calcareous claw; mesial, lateral and ventral surfaces of palm all glabrous, ventral surfaces of dactyl and fixed finger with scattered tufts of moderately short setae. Carpus subequal to merus in length; dorsomesial distal angle with one or two small spines, dorsal surface laterad of midline armed with row of two or three small spines or tubercles, dorsal surface with scattered long setae and small dorsodistal spine; mesial, ventral, and lateral surfaces glabrous or with few long setae. Merus and ischium with few long setae dorsally and ventrally.

Left cheliped with dactyl slightly longer than palm, cutting edge with row of small corneous teeth and terminating in small corneous claw; cutting edge of fixed finger with row of small calcareous teeth and terminal calcareous claw; dorsomesial margin and dorsal surface of dactyl unarmed, but with scattered long setae. Palm subequal to carpus in length; propodal-carpal articulation rotated clockwise approximately 45^{o} from perpendicular; dorsomesial margin unarmed, dorsal surface unarmed or at most with one to three very small spinules proximally, dorsolateral margin with row of moderately strong spines decreasing in size on fixed finger; ventral surfaces of palm, dactyl and fixed finger with scattered setae. Carpus subequal to merus in length; distal margin with three moderately strong spines (lateral spine shortest); dorsolateral margin armed with one or two small spines. Merus and ischium with few setae.

Second pereopods longer than third; dactyls of both second and third about half length of propodi, terminating in strong corneous claws; dorsal surfaces and mesial and lateral faces all with long setae, ventral marigns each usually with four (sometimes three) corneous spines; propodi about one and one-half times longer than carpi, all surfaces with scattered long setae, ventrodistal angles each with corneous spine; carpi and meri unarmed, but with scattered long setae dorsally and shorter setae ventrally.

Uropods with moderately long protopods, armed posteriorly with numerous small tubercles; exopods elongate, about three times as long as wide; endopods extending beyond bases of exopods. Telson with posterior lobes and anterior lobes separated by prominent median suture; terminal margins of posterior lobes each with four to seven strong calcareous spines usually interspersed with one or two smaller spines.

Male with paired gonopores on coxae of both third and fifth pereopods (Fig. 12c).

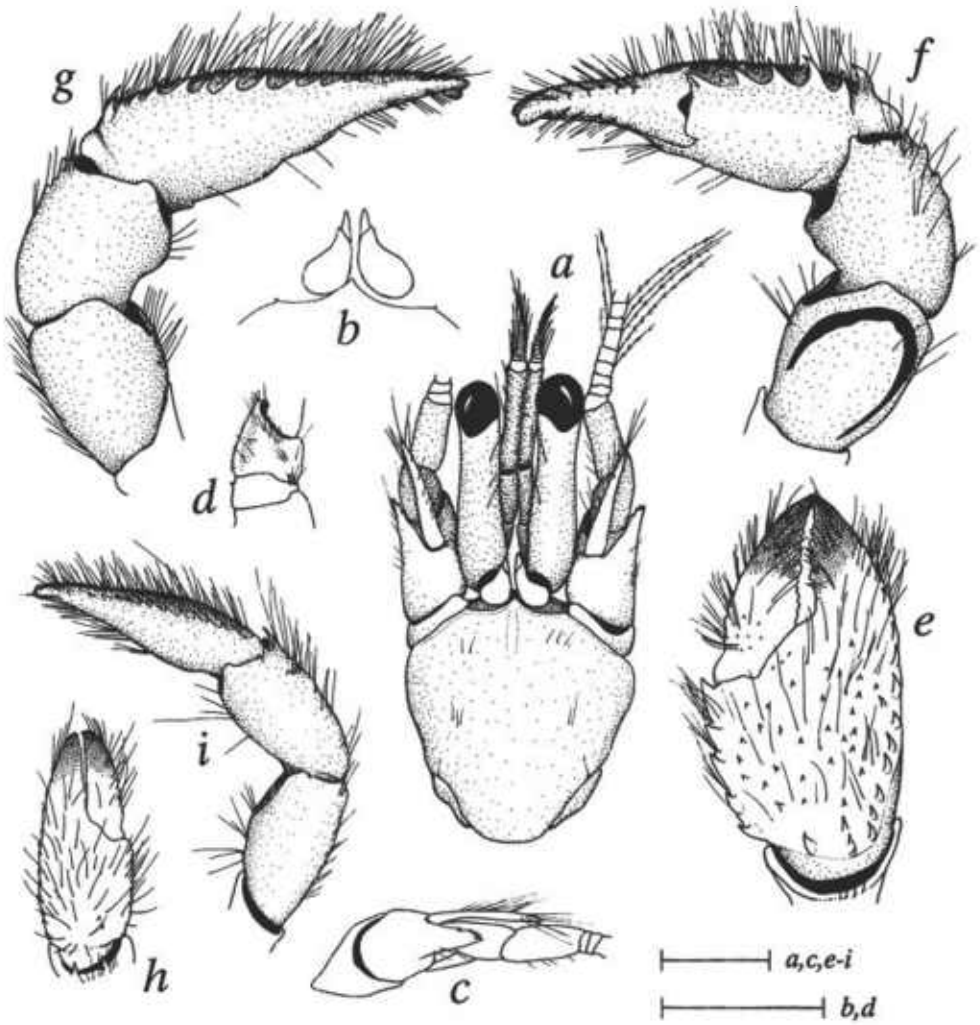

Fig. 11. *Paguritta kroppi*, new species, male holotype (SL = 2.2 mm), Guam (USNM 259396). a, shield and cephalic appendages; b, ocular acicles and anterior portion of shield, dorsal view; c, right antennal peduncle, lateral view; d, basis and ischium of left third maxilliped, inner view; e, right chela, dorsal view; f, right cheliped, mesial view; g, same lateral view; h, left chela, dorsal view; i, left cheliped, lateral view. Scales equal 1mm.

Colour.- In preserved specimens, chelipeds with fingers light orange on distal half (Fig. 11e, h).

Etymology. - This species is named for Dr. Roy K. Kropp, who collected the specimens, and in recognition of his collecting efforts in the Guam region.

Distribution.- Guam, Agana Bay; in worm holes in coral.

Remarks.- *Paguritta kroppi* resembles *P. harmsi* but differs from this species in several characters. In *P. kroppi*, the dorsal surface of the carpus of the right cheliped is armed with small

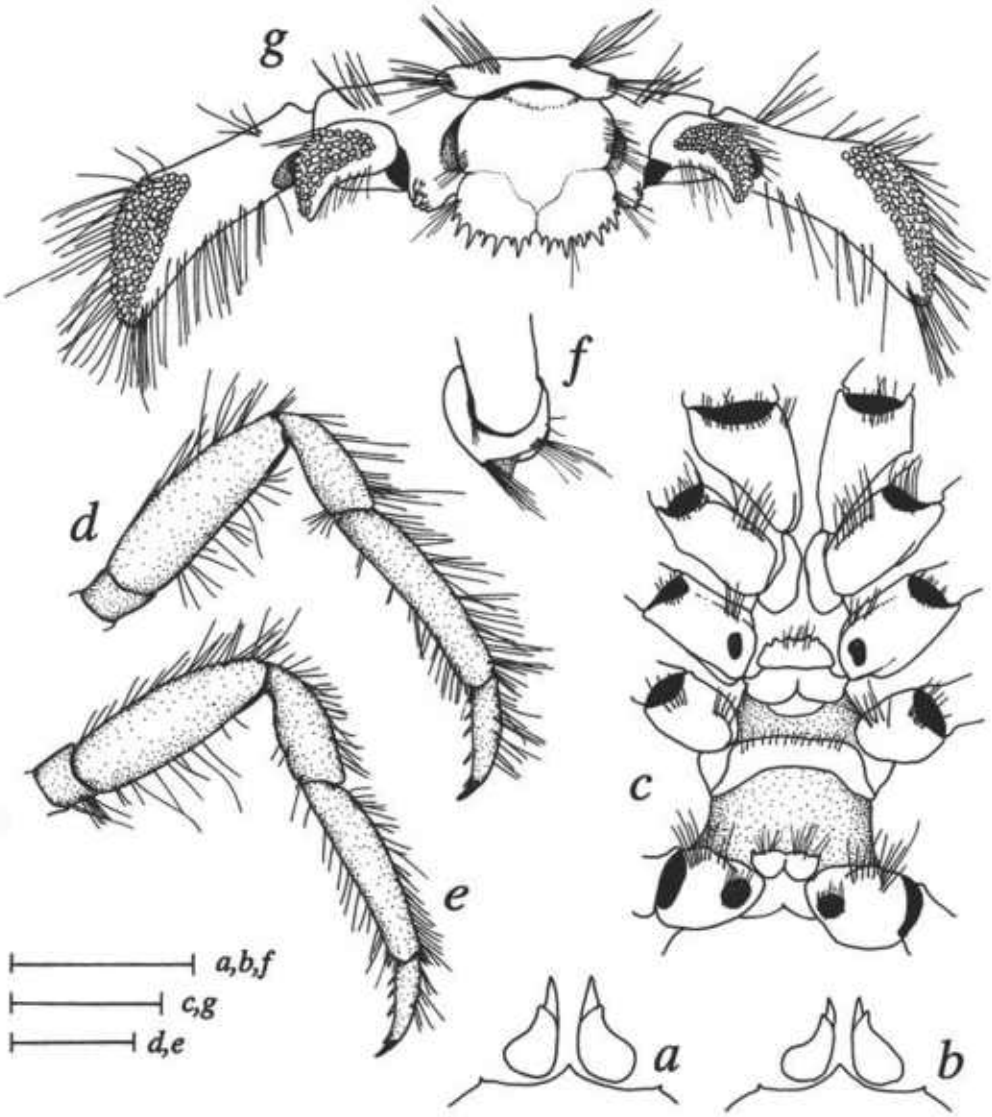

Fig. 12. *Paguritta kroppi*, new species, Guam. a, female paratype (SL = 2.4 mm) (USNM 255983); b, male paratype (SL = 2.7 mm) (USNM 255983), c-g, holotype (USNM 259396). a,b, ocular acicles and anterior portion of shield; c, sternum; d, right second pereopod, lateral view; e, right third pereopod, lateral view; f; coxa and basis of right fifth pereopod, lateral view; g, telson and uropods, dorsal view. Scales equal 1 mm.

spines lateral of the midline, whereas this margin is usually provided only with short transverse ridges in *P. harmsi*. More importantly, the dorsodistal margin of the carpus of the left cheliped is armed in *P. kroppi* with much shorter spines than in *P. harmsi* (Figs. 3i, j, 11h, i). Cheliped colouration also seems to be quite different in these two species. In *P. kroppi* the dactyls and fixed fingers presumably are darkly coloured in life (orange coloured in preserved specimens), whereas in *P. harmsi* the tips of the dactyls and fixed fingers are white distally with an orange-brown mosaic pattern proximally. The ocular acicles have a tendency in *P. kroppi* to have a well developed acute terminal spine (in addition to the strong submarginal spine), whereas in *P. harmsi* the terminal spine is subacute or blunt; however, this character is subject to variation.

Paguritta kroppi also bears considerable similarity to *P. scottae*. Although the ventral margins of the dactyls of the ambulatory legs usually are armed with four spines in *P. kroppi* and only three in *P. scottae*, these numbers do vary. The armature of the dorsomesial marign of the dactyl of the right chela in *P. kroppi* is much weaker and occurs only on the proximal half of this segment. In *P. scottae* the dorsomesial margin of the dactyl is armed with a row of spines over its entire length. The spines on the dorsodistal margin of the carpus of the left cheliped are also much stronger in this species, particularly the medial spine. The colour pattern of *P. scottae*, like *P. harmsi*, also distinguishes this species from *P. kroppi*.

The two available males of *P. kroppi* have not only the typical paired gonopores on the coxae of the fifth pereopods, but also paired gonopores on the coxae of the third pereopods. As in *Dardanus deformis*, this appears to represent a diagnostic character.

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