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## Hermit Crabs from North Australian and Eastern Indonesian Waters (Crustacea Decapoda: Anomura: Paguroidea) Collected During the 1975 *Alpha Helix* Expedition

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ABSTRACT. Fifty-two species of hermit crabs of the families Coenobitidae, Diogenidae and Paguridae were collected in the Arafura Sea and in Maluku (Moluccas), Indonesia. Five of these species were previously unrecorded from the Arafura Sea and Torres Strait. At the Banda Islands, where the major part of the collecting was done, 34 out of 37 species are reported for the first time. The collection included 18 new records for Seram and 14 for Saparua. Four new species are described from Maluku. Live colour notes and information on natural history are presented for most of the species in the collection, and associations are noted with anemones, rhizocephalans, cirrolanid and parasitic isopods, copepods, a shrimp and a polychaete.

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Fig.1. Area covered by the *Alpha Helix* Expedition.

During 1975 a joint United States-Australian-Indonesian expedition visited North Australian and Indonesian waters aboard the R.V. *Alpha Helix* for the purpose of studying various aspects of bioluminescence and the distribution and physiology of midwater animals. E. Ball joined the expedition in Cairns, Australia and collected hermit crabs from otter trawls in the Torres Strait and Arafura Sea (Fig. 1) as well as during visits to the islands of Saparua and Seram in Maluku. A station was established in the Banda Islands (Figs 1, 2), where a fairly comprehensive survey was made of the distribution, abundance and some aspects of natural history of the hermit crabs of the three small islands comprising this group.

The Banda Islands are relatively isolated volcanic islands lying approximately 200 km southeast of Ambon. The inner group consists of three islands: Gunungapi, an active volcano with an elevation of approximately 655 m; the neighbouring island of Naira on which stands the town of Bandanaira; and Banda Besar, which appears to be part of the wall of an ancient crater. The arrangement of these islands is such (Fig. 2) that they provide a wide variety of habitats ranging from almost totally protected

through protected areas with strong tidal currents to completely exposed coast. Associated with this diversity in exposure is a great diversity in substratum types which include mud, sand, fine gravel and coral rubble, living coral, cobbles and solid rock. Away from the inner group of islands the bottom falls away quite sharply down the old crater walls. Sea water temperatures during the expedition were in the range  $28 \pm 1^\circ \text{C}$ , although on some calm days higher temperatures would have been reached on the reef flats and in tidepools.

#### Materials and Methods

Hermit crabs were collected by otter trawl (in the Arafura Sea) and by SCUBA diving, free diving and intertidal collecting. Relative abundance, depth of collection and substratum were routinely recorded, as were any other factors felt to be of potential significance in relation to hermit crab natural history. Low oxygen levels, produced by keeping the animals together in a small volume of water, frequently caused them to emerge partly or completely from their shells. Alternatively, or when

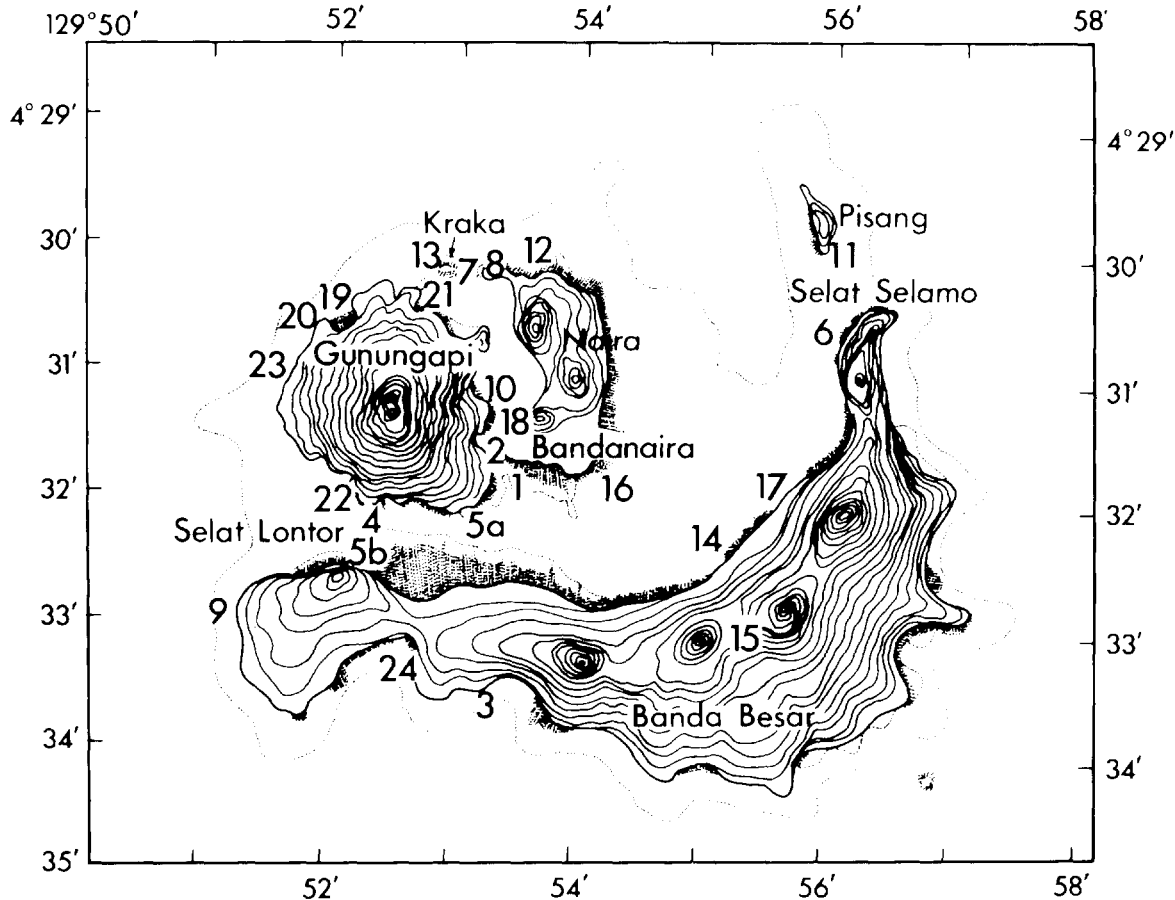


Fig.2. Map of Banda Islands, with collecting stations. Reef flats are shaded, land contours are shown at 30m intervals, outer dotted line marks 100m depth.

this method failed, animals were cracked from their shells with a vise. Colour was noted before the crabs were placed in preservative.

The collection was shipped to the Allan Hancock Foundation, where J. Haig made final identifications and prepared descriptions of new species. In general, these descriptions follow the format and terminology used in a series of papers by P.L. McLaughlin and collaborators (e.g. McLaughlin, 1974, 1975, 1984; McLaughlin & Provenzano, 1974; Haig & McLaughlin, 1984; McLaughlin & Haig, in press). Holotypes of new species are deposited in the Indonesian National Institute of Oceanology, Jakarta (NIOJ). Other material is deposited in the Crustacea collections of that institution and in those of the Australian Museum, Sydney (AM) and the Allan Hancock Foundation, Los Angeles (AHF).

For each species collected, we give the reference to its original description and to those of its junior synonyms, and to the work which first cited the name in its currently accepted combination. We also include references to other works which have important descriptive material or information on colour or behaviour. The general distribution of each species is also noted. Detailed station data are given in Table 1.

Keys are provided to the families and genera of hermit crabs that are known to occur in Maluku and to the species of certain genera (*Coenobita*, *Calcinus*, *Clibanarius* and *Dardanus*) which are common in that area. Since very little is known as yet about east Indonesian hermit crabs from deeper waters, we have included only those taxa that have been recorded in the area (previously or in the present paper) in depths of 20 metres or less. In the keys, species recorded from Maluku but not collected there during the *Alpha Helix* expedition are marked with an asterisk.

The following abbreviations are used in the text and in legends to the figures: SL – shield length; TL – total length; P – pereopod; pl – pleopod; mxp – maxilliped. Institutions other than the three cited above are abbreviated BMNH – (British Museum [Natural History], London), IM – (Indian Museum, Calcutta), MNHN – (Muséum National d'Histoire Naturelle, Paris), SMF – (Natur-Museum Senckenberg, Frankfurt am Main), and USNM – (National Museum of Natural History, Washington, D.C.). For the current spelling of Indonesian place names we have followed "Gazetteer of Indonesia" (Third Edition, 1982, Defense Mapping Agency, Washington, D.C.).

Table 1. Station data for material collected

ARAFURA SEA				
STATION (Alpha Helix)	LOCALITY	POSITION		DATE (1975)
		S	E	
1	Torres Strait	10°38.0'	141°06.5'	16 Mar
3	Torres Strait	10°39.0'	140°29.5'	16 Mar
6	Torres Strait	10°38.0'	139°27.0'	16 Mar
7	Torres Strait	10°40.2'	139°19.2'	16 Mar
8	Arafura Sea	10°29.2'	138°03.4'	17 Mar
11	Arafura Sea	10°27.5'	136°47.0'	17 Mar
12	Arafura Sea	10°26.0'	136°25.8'	17 Mar
13	Arafura Sea	10°15.2'	136°07.3'	17 Mar
15	Arafura Sea	09°32.3'	134°49.0'	18 Mar

BANDA ISLANDS				
STATION	LOCALITY	POSITION (APPROX.)		DATE (1975)
		S	E	
1	Naira, off Bandanaira town	4°32.0'	129°53.3'	25 Mar, 11,18 Apr
2	Naira, in Zonnegat off Bandanaira town	4°31.8'	129°53.2'	26 Mar
3	south side Banda Besar	4°33.7'	129°53.2'	27 Mar
4	south coast Gunungapi	4°32.3'	129°52.2'	28 Mar
5a	south side Gunungapi, north side of Selat Lontor	4°32.2'	129°53'	7 Apr, 6 May
5b	north side Banda Besar, south side of Selat Lontor	4°32.2'	129°53'	7 Apr
6	north-east tip Banda Besar	4°30.5'	129°56'	8 Apr
7	off Pulau Mati	4°30.1'	129°53'	9 Apr
8	north-west tip Pulau Naira	—	—	10 Apr
9	west end Banda Besar	4°32.6'	129°52'	12 Apr
10	east shore Gunungapi	4°31.3'	129°53.5'	13,25, 27 Apr
11	south-east end Pisang	4°30'	129°55'	18 Apr
12	north end Pulau Naira	4°30.1'	129°53.5'	21,24, 26 Apr
13	west side Kraka	4°30.1'	129°53'	22 Apr
14	off Combir on north side Banda Besar	—	—	23,24 Apr
15	Banda Besar, inland	4°33.5'	129°52'	24 Apr
16	Naira, off Pandeceru (no specimens collected)	—	—	25 Apr
17	Banda Besar (no specimens collected)	—	—	25 Apr
18	off Naira	4°31.4'	129°53.6'	27,30 Apr
19	outside of Gunungapi	4°30.3'	129°52.3'	28,30 Apr
20	outside of Gunungapi, protected bay	4°30.3'	129°52.5'	28 Apr, 4–5 May
21	shore of Gunungapi, approx. opposite Kraka	4°30.4'	129°52.8'	1 May
22	Gunungapi	4°32'	129°51.9'	3 May
23a	west side Gunungapi	4°31.2'	129°51.5'	4 May
23b	west side Gunungapi	4°31.2'	129°51.5'	4 May
24a	south-west end Banda Besar, large bay	4°33.3'	129°52.5'	7 May
24b	south-west end Banda Besar, large bay	4°33.3'	129°52.5'	7 May

SERAM, SAPARUA AND AMBON				
STATION	LOCALITY	POSITION (APPROX.)		DATE (1975)
		S	E	
Seram				
1	Village of Pohon Batu	2°57.7'	128°06.9'	30–31 Mar
2	Around Pulau Marsegu	3°00'	128°02.5'	31 Mar, 1 Apr
Saparua				
1	Pulau Saparua	3°36'	128°39.5'	29 Mar
2	Pulau Saparua	3°36.7'	128°39'	29 Mar
3	off Pulau Saparua	3°37.9'	128°38.6–39'	29 Mar
Ambon				
1	2 km east of Latu Halat, 15 km south-west of Ambon town	3°46.4'	128°08.2'	23 Mar

### Historical Review

Previous work on hermit crabs from the areas covered by this report has been rather fragmentary. For the Arafura Sea and Torres Strait the most important collections were those of the *Alert* Expedition (Miers, 1884) and the *Challenger* Expedition (Henderson, 1888). Between them these expeditions collected eight species of hermit crabs from the Arafura Sea/Torres Strait region. Four of those species were taken again by the *Alpha Helix*, and another five species are now reported from the area for the first time.

Trawls were made around Banda during the *Challenger* Expedition of 1873–1876, but the only hermit crabs from that vicinity came from a depth of about 2600 metres. Collections were made at Banda during the *Siboga* Expedition of 1899–1900, the Danish Expedition to the Kei Islands in 1922, and the Voyage of T.R.H. the Prince and Princess Leopold of Belgium to the Netherlands East Indies in 1928–1929, but shallow water hermit crabs from those expeditions have not been reported upon as yet. However, Boschma (1931a), in a report on the Rhizocephala collected by Th. Mortensen in 1914–1916, cited a parasitised hermit crab, *Pagurus deformis* H. Milne Edwards (= *Dardanus deformis*) taken at Banda during the Kei Islands Expedition. Van Baal (1937) redescribed Boschma's rhizocephalans and again mentioned the host *D. deformis* from Banda. Although *D. deformis* has been recorded several times from eastern Indonesian waters, it was not among the species collected during the *Alpha Helix* Expedition.

Reyne (1938), in an historical account of the distribution of the robber or coconut crab *Birgus latro* (Linnaeus), cited records from Banda, including early collections by G.E. Rumphius and P. Bleeker.

We know of only one other previous record of a hermit crab from Banda. De Man (1881b) discussed a specimen of *Pagurus varipes* Heller from Naira; Lewinsohn (1969) re-examined this specimen and found it to be *Dardanus pedunculatus* (Herbst). *D. pedunculatus* was not taken at Banda during the *Alpha Helix* Expedition, although we report it from Seram and Saparua.

From the latter island a single species, *Birgus latro*, has been reported (see Reyne, 1938). The hermit crab fauna of Seram was previously represented by five species. Again, Reyne (1938) cited records of *Birgus latro*. Hilgendorf (1869) mentioned material of *Coenobita cavipes* Stimpson (as *C. violaceus*). Rathbun (1910) reported *Coenobita rugosus* H. Milne Edwards among decapods collected in 1906–1907 by T. Barbour. Van Kampen & Boschma (1925) and Boschma (1931b) recorded *Dardanus deformis* from the *Siboga* Expedition as the host of a rhizocephalan. *Clibanarius longitarsus* (De Haan) was collected at Seram during the *Snellius* Expedition (Buitendijk, 1937).

*Alpha Helix* records of several species treated in this report have already been noted in the literature. Humes (1981), in a paper on harpacticoid copepods of the expedition, recorded eight hermit crab hosts from Banda and Seram, and Forest (1984) included *Alpha Helix* material of *A. retipes* from Banda in his revision of the genus *Aniculus*.

### Systematic Account

#### Key to Families of Hermit Crabs of Maluku Occurring in 20 Metres or Less

1. Antennular flagella truncated at tip; crabs terrestrial or semiterrestrial . . . Coenobitidae  
    — Antennular flagella terminating in a filament; crabs marine . . . . . 2
2. Outer maxillipeds usually contiguous at base; chelipeds equal or subequal, or left distinctly the larger . . . . . Diogenidae  
    — Outer maxillipeds widely separated at base; left cheliped never larger than right, right usually much the larger . . . . . Paguridae

#### Family COENOBITIDAE

##### Key to Genera and Species of Coenobitidae of Maluku

1. Rostrum prominent; posterior carapace greatly expanded laterally; abdomen well calcified, straight and symmetrical; animal living without shell (except in glaucothoe and young crab stages) . . . . . *Birgus latro*  
    — Rostrum almost obsolete; posterior carapace not much expanded laterally; abdomen soft and spirally coiled; animals living in shells: *Coenobita* . . . . . 2

2. Antennal acicle not fused with second segment of peduncle; ocular peduncles subcylindrical; a brush of setae on inner surface of right chela only . . . . . *C. brevimanus*  
 — Antennal acicle fused with second segment of peduncle; ocular peduncles strongly compressed laterally; a brush of setae on inner surface of both chelae . . . . . 3
3. Propodus of left pereopod 3 with outer surface flattened, this surface marked off from upper surface by a sharp ridge . . . . . 4  
 — Propodus of left pereopod 3 with outer surface convex and not separated from upper surface by a ridge . . . . . 5
4. Left chela with stridulating apparatus on upper part of outer surface; coxa of right pereopod 5 moderately produced in males . . . . . *C. rugosus*  
 — Left chela without stridulating apparatus; coxae of both pereopods 5 weakly produced in males . . . . . *C. cavipes*
5. Pereopods 2 and 3 thickly covered with small corneous spines; coxae of pereopods 5 not strongly produced in males . . . . . \**C. spinosus*  
 — Pereopods 2 and 3 granulate; coxa of right pereopod 5 produced into a long, curved tube in males . . . . . *C. perlatus*

### *Birgus* Leach

#### *Birgus latro* (Linnaeus)

*Cancer latro* Linnaeus, 1767: 1049.

*Birgus latro*.—Leach, 1815: 337.—Alcock, 1905b: 150, pl. 16.

**Remarks.** A coconut crab with a carapace length of about 16 cm was brought into camp, but was not preserved because of its size. This specimen, which was uniform black in colour, had been captured at the northwest tip of Naira (Banda Stn 8).

The distribution of *Birgus* in Maluku, as elsewhere, is probably determined mainly by human predation.

**Distribution.** East coast of Africa to Line and Gambier Islands; absent from northern Indian Ocean (except Nicobar Islands and part of Andaman Islands) and from west part of Malay Archipelago. Previously recorded from Banda (see Reyne, 1938).

### *Coenobita* Latreille

#### *Coenobita brevimanus* Dana

*Coenobita clypeata* var. *brevimanus* Dana, 1852: 473; 1855: pl. 30 fig. 4b.

*Coenobita clypeatus*.—Alcock, 1905b: 141, 142, pl. 15 figs 1, 1a.

*Coenobita brevimanus*.—Rathbun, 1910: 314.

*Coenobita hilgendorfi* Terao, 1913: 388.

*Coenobita clypeata*.—Fize & Serène, 1955: 5, 7, text fig. 1, pl. 1 fig. 1.

**Material examined.** BANDA Stn 3, 1♂ (NIOJ).

**Colour in life.** Shield and posterior carapace reddish purple with 3 dark brownish-purple,

longitudinal stripes (1 median, 2 lateral). Ocular peduncles, antennules and antennae uniform brown. Chelipeds uniform purplish brown. Pereopods 2 and 3 uniform purple.

**Remarks.** This specimen was found about 200 m inland.

**Distribution.** East coast of Africa to Line Islands and Tuamotu Archipelago.

### *Coenobita cavipes* Stimpson

*Coenobita cavipes* Stimpson, 1858: 245; 1907: 200.

*Coenobita violascens* Heller, 1862: 524.

*Coenobita cavipes*.—Alcock, 1905b: 146, pl. 14 fig. 1.—Fize & Serène, 1955: 5, 30, text figs. 3B, 5, pl. 1 figs 4–6.

**Material examined.** BANDA Stn 15, 1♂ juv (NIOJ). SERAM Stn 1, 1♂, 4♀ (NIOJ, AM P37713, AHF). AMBON Stn 1, 2♀ (NIOJ).

**Colour in life.** Shield and posterior carapace with elaborate pattern of dark brown spots and streaks on almost white background. Ocular peduncles almost white or pale brown ventrally, darker laterally; cornea brown. Antennular peduncles brown; flagellum brown or nearly orange. Antennae uniform brown. Chelipeds dark brown, with broad white area at proximal end of merus and some white at proximal end of carpus; most of palm and dactyl white. Ground colour of pereopod 2 dark brown; oblique, broad white stripe at proximal end of merus; longitudinal white stripe on carpus; white area at both ends of propodus. Pereopod 3 with patches and bands of white on dark brown background.

**Remarks.** The individual from Banda was found on a muddy trail in fairly dense rain forest, elevation ca. 300 m, at least 1.5 km from the sea. Specimens

from Seram occurred intertidally, and those from Ambon inshore on stumps and under coconut husks.

**Distribution.** East coast of Africa and Indian Ocean through Malay Archipelago to Bismarck Archipelago, and north to Ryukyu and Mariana Islands.

***Coenobita perlatus* H. Milne Edwards**

*Coenobita perlata* H. Milne Edwards, 1837: 242.

*Coenobita perlatus*.—Alcock, 1905b: 145, pl. 14 figs 2, 2a.

*Coenobita purpurea* Stimpson, 1858: 245.

*Coenobita perlata*.—Fize & Serène, 1955: 5, 24, text figs 3C, 4, pl. 1 fig. 2.

**Material examined.** BANDA Stn 6, 1♀ juv (NIOJ).

**Colour in life.** Shield with reddish orange markings on off-white background; posterior carapace pale reddish. Ocular peduncles solid red orange. Antennules and antennae uniform reddish orange. Major cheliped with merus, carpus and proximal part of chela reddish; most of palm white; dactyl almost black. Minor cheliped mostly reddish orange; upper margin of palm rimmed with black. Pereopods 2 and 3 orange red, with reddish brown area at distal end of propodus and proximal end of dactyl.

**Remarks.** This specimen was collected just inshore from the beach.

**Distribution.** Western Indian Ocean to Line and Gambier Islands.

***Coenobita rugosus* H. Milne Edwards**

*Coenobita rugosa* H. Milne Edwards, 1837: 241.

*Coenobita rugosus*.—Alcock, 1905b: 141, 143, pl. 14 figs 3, 3a.

*Coenobita rugosa*.—Fize & Serène, 1955: 5, 12, text figs 2, 3A, pl. 1 figs 3, 5, 7–10.

**Material examined.** BANDA Stn 3, 1♂ juv (NIOJ); Stn 6, 5♂, 4♀, 3 juv (NIOJ); Gunungapi, coll. A.G. Humes, 17♂, 12♀ (6 ov) (NIOJ, AM P37719, AHF). AMBON Stn 1, 5♂, 1♀ (NIOJ, AM P37732, AHF).

**Colour in life.** Carapace uniform pale brown. Ocular peduncles gray or brown, with brown cornea. Antennules and antennae uniform brown. Chelipeds pale brown or gray brown, with dark brown longitudinal streaks on carpus and chela, and dark band at distal end of merus. Pereopod 2 with merus very pale brown, dark brown ring at distal end; carpus, propodus and dactyl pale brown, carpus sometimes with longitudinal stripes. Pereopod 3 uniform pale brown, sometimes with dark brown spot at distal end of merus.

**Remarks.** Members of this species were found most abundantly on the beaches. At Ambon specimens were encountered inshore on stumps and under coconut husks.

**Distribution.** East coast of Africa to Line Islands and Tuamotu Archipelago.

**Family DIOGENIDAE**

**Key to Genera of Diogenidae of Maluku  
Occurring in 20 Metres or Less**

1. Paired pleopods in both sexes (usually 2 pairs in males, 1 in females); chelipeds usually equal or subequal in size and form ..... *Paguristes*  
 \_\_\_ No paired pleopods in either sex ..... 2
2. Fingers opening and closing horizontally; chelipeds equal or subequal ..... *Clibanarius*  
 \_\_\_ Fingers opening and closing obliquely or nearly vertically ..... 3
3. Fingertips corneous and blackened ..... 4  
 \_\_\_ Fingertips calcareous; left cheliped much larger than right ..... 6
4. Tips of fingers somewhat spooned; left cheliped usually much larger than right, the two occasionally subequal ..... *Dardanus*  
 \_\_\_ Tips of fingers hoof shaped; chelipeds equal or subequal ..... 5
5. Cardiac region of carapace with a transverse groove; no stridulating apparatus on inner surface of chelae ..... *Aniculus*  
 \_\_\_ No transverse groove on cardiac region of carapace; inner surface of chelae with stridulating apparatus ..... *Trizopagurus*
6. Telson without median transverse constriction; rostrum replaced by intercalary spine or scale between ocular acicles, this sometimes very small or obsolescent ..... *Diogenes*  
 \_\_\_ Telson with median transverse constriction; no intercalary process between ocular acicles ..... *Calcinus*



*Aniculus* Dana*Aniculus erythraeus* Forest, 1984

*Aniculus erythraeus* Forest, 1984: 21, 41, figs 12, 19, 41–45.

**Material examined.** BANDA Stn 13, 1♀ juv (NIOJ).

**Colour in life.** Carapace and abdomen reddish purple and white. Ocular peduncles reddish purple; some white spots at base of setae. Antennular peduncles reddish purple with white spots and long, red and white setae; flagellum with lighter and darker bands of purple. Antennal peduncles reddish purple with white spots; flagellum uniform reddish purple. Chelipeds reddish purple with white tubercles, latter tipped with black spines; setae red with white tips. Pereopods 2 and 3 reddish purple; propodus and, to lesser degree, carpus with white area at proximal end of segment; setae red with white tips.

**Remarks.** The crab was found under a large block of dead coral in about 3 m of water.

Dr J. Forest examined this small (SL 6.2 mm) specimen but did not mention it in his recent revision of the genus *Aniculus*, not being sure of its identity. Now, however, he is almost certain that it is *A. erythraeus* (J. Forest, personal communication to J. Haig).

**Distribution.** Red Sea and Sri Lanka; and herein recorded from Banda, Indonesia.

*Aniculus retipes* Lewinsohn

*Aniculus retipes* Lewinsohn, 1982a: 76, fig. 1.—Forest, 1984: 20, 21, 51, figs 13, 20, 51–58.

**Material examined.** BANDA Stn 9, 1♀ (NIOJ); Stn 12, 2♂, 1♀ (NIOJ, AM P37737, MNHN).

**Colour in life.** Carapace red and white. Eyescales red. Ocular peduncles green or white, with 4 longitudinal brown stripes (one each dorsal, ventral, mesial and lateral); cornea brown. Basal segment of antennular peduncles pale green, distal segment yellow with green stripe dorsally; flagellum yellow. Antennal flagella uniform transparent purple. Chelipeds mostly red; carpus and distal part of merus brown. Merus, carpus and propodus of pereopods 2 and 3 pale red in proximal half, green distally; dactyl green; all 4 segments with 2 thin, longitudinal dark red lines; setae red with white tips.

**Remarks.** These crabs were taken at depths of 5–10 m in fairly exposed areas, on coral and on a bottom of rock, coral and coral rubble. They have already been recorded by Forest (1984).

**Distribution.** Red Sea, Tanzania, western Malay Peninsula, Vietnam, Banda and Samoa.

*Calcinus* DanaKey to Species of *Calcinus* Known from Maluku

1. Right chela with upper margin smooth or granulate. Pereopods 2 and 3 with coloured longitudinal stripe on merus and carpus; dactyl with coloured subdistal ring and subproximal spot ..... *C. laevimanus*  
 — Right chela with upper margin spinous or tuberculate ..... 2
2. Pereopod 3 with dense brush of setae ventrally on dactyl and distal part of propodus ..... 3  
 — Pereopod 3 without dense brush of setae ventrally ..... 4
3. Right cheliped with 2 or more spines distally on lower outer margin of merus. Merus, carpus and propodus of pereopods 2 and 3 each with broad coloured bands ..... *C. elegans*  
 — Right cheliped with 1 spine distally on lower outer margin of merus. Pereopods 2 and 3 coloured but without bands ..... *C. gaimardii*
4. Ocular acicles simple. Dactyl of pereopods 2 and 3 with coloured band at proximal end ..... *C. latens*  
 — Ocular acicles multispinous ..... 5
5. Pereopods 2 and 3 with longitudinal stripes or streaks ..... 6  
 — Pereopods 2 and 3 without longitudinal markings ..... 7
6. Pereopods 2 and 3 with coloured longitudinal spots or streaks on all segments; carpus of pereopod 2, but not of pereopod 3, nearly covered by broad coloured band ..... *C. pulcher*  
 — Pereopods 2 and 3 with carpus and dactyl coloured but without longitudinal markings; propodus with longitudinal coloured stripes ..... *C. undescribed sp.*

7. Ocular peduncles with broad coloured band; dactyl of pereopods 2 and 3 with coloured, white-spotted band proximally ..... *C. guamensis*  
 —No coloured band on ocular peduncles; dactyl of pereopods 2 and 3 solidly coloured, other segments with small coloured dots ..... *C. minutus*

### *Calcinus elegans* (H. Milne Edwards)

*Pagurus elegans* H. Milne Edwards, 1836: 278, pl. 13 fig. 2.  
*Pagurus pictus* Owen, 1839: 83, pl. 25 figs 2, 2a.  
*Pagurus decorus* Randall, 1839: 134.  
*Calcinus elegans*.—Dana, 1852: 458; 1855: pl. 28 figs 10a–c.—Alcock, 1905b: 55, pl. 5 fig. 2.

**Material examined.** BANDA Stn 3, 1♂, 2♀ (1 ov) (NIOJ, AHF); Stn 24a, 1♂, 1♀ (AM P37746). SAPARUA Stn 3, 1♀ (NIOJ).

**Colour in life.** Carapace mottled with shades of brown and white. Ocular peduncles bright blue with narrow dark brown area at base; cornea black. Antennules and antennae uniform orange. Chelipeds dark brown with white tubercles on fingers and distal part of palm. Merus and carpus of pereopods 2 and 3 bright blue in proximal and dark brown in distal half; propodus blue at both ends, with broad, dark brown band medially; dactyl bright blue with dark brown spots, with narrow white band next to claw; dactyl and propodus with bright red setae ventrally.

**Remarks.** This species was collected in the shallow subtidal, on bottoms of coral and rock.

In the Hawaiian Islands, the brightly coloured bands on the second and third pereopods of *C. elegans* are orange instead of blue (Haig & McLaughlin, 1984: 108). This colour shift to orange has not been reported from any other locality within the range of the species.

**Distribution.** East coast of Africa to Hawaiian Islands and Tuamotu Archipelago. This species appears to have been rarely collected in the Indonesian area and it is now reported from Maluku for the first time.

### *Calcinus gaimardii* (H. Milne Edwards)

*Pagurus gaimardii* H. Milne Edwards, 1848: 63.  
*Calcinus gaimardii*.—Dana, 1852: 457; 1855: pl. 28 fig. 9.—Alcock, 1905b: 53, 56, pl. 5 fig. 3.  
*Calcinus gaimardi*.—Fize & Serène, 1955: 40, 49, text figs 7, 8, pl. 2 figs 5–8.—Humes, 1981: 5.

**Material examined.** BANDA Stn 1, 1♀ (NIOJ); Stn 3, 2♂, 1♀, 2 juv (AHF); Stn 4, 1♂ (AM P37720); Stn 5b, 1♂, 3♀ (1 ov) (NIOJ); Stn 9, 2♂ (AM P37703); Stn 12, 2♂, 5♀ (AM P37704, AM P37722, AHF); Stn 13, 1 juv (NIOJ); Stn 14, 1♀, 1 juv (AHF); Stns 16, 17 (none collected); Stn 19, 2♂, 4♀ (1 ov), 1 juv (NIOJ, AHF); Stn 21, 4 juv (AM P37727); Stn 23a, 1 juv (AHF); Stn 24a, 6♂, 4♀, 3 juv (NIOJ); Stn 24b, 1♂, 1♀, 1 juv (AM P37718); Gunungapi, coll. A.G. Humes, 1♂ (AHF). SERAM Stn 2, 7♂, 4♀ (1 ov) (NIOJ, AM P37714, AHF). SAPARUA Stn 3, 2♂, 1♀ (NIOJ).

**Colour in life.** Shield white with shadings of green and brown, or dark brown with large whitish patch posteriorly; posterior carapace mottled green and white. Ocular peduncles dark brown proximally, with varying amounts of blue distally; cornea black with white spots. Antennules brown with orange flagellum; terminal segment of peduncle orange distally, shading to brown proximally. Antennae uniform orange. Chelipeds uniform brown; tips of fingers white. Pereopods 2 and 3 uniform brown; dactyl with narrow white band next to claw. In young specimens, proximal part of propodus of pereopods 2 and 3 brown, distal part white; dactyl white; both of these segments with brown dots.

**Remarks.** This species occurred nearly everywhere, usually in depths of less than 5 m on bottoms of coral, sand, and rocks.

Several specimens were parasitised by rhizocephalans. A male from Gunungapi was the host of copepods (Humes, 1981), and a female from Seram had a pair of bopyrids, *Propseudione rhombicosoma* Shiino, in one branchial chamber.

**Distribution.** East coast of Africa to Hawaiian and Society Islands.

### *Calcinus guamensis* Wooster

*Calcinus* n.sp. 2.—Kropp *et al.*, 1981: 40.  
*Calcinus guamensis* Wooster, 1984: 127, 141, fig. 4.—Haig & McLaughlin, 1984: 107, 108, 110.  
 [?] *Calcinus latens*.—Miyake, 1956: 331, figs 20, 21. [not *C. latens* (Randall)]

**Material examined.** BANDA Stn 19, 8♂, 5♀ (2 ov), 1 juv (NIOJ, AM P37739, AM P37745, AHF); Stn 23a, 1♀ (NIOJ); Stn 24b, 1♂ (NIOJ).

**Colour in life.** Carapace white anteriorly, shading to purple posteriorly. Ocular peduncles white, with broad black or dark brown band; cornea black with white spots. Antennular peduncles with basal segment black, terminal segment greenish black to light green. Antennae solid orange. Merus of chelipeds white proximally, brown or black with white spots in distal half; carpus black or brown with white spots; palm gray or gray green; fingers white. Pereopods 2 and 3 white or grayish white, except for white-spotted black or brown band at proximal end of dactyl.

Diagnostic colour pattern lost rather quickly following preservation in alcohol.

**Remarks.** These small crabs were found mainly on cobbles in relatively exposed areas, in depths of 0–15 m.

**Distribution.** Recorded from Mariana and Hawaiian Islands; probably Ryukyu Islands (Miyake, 1956 as *Calcinus latens*, see Haig & McLaughlin, 1984: 108) and herein recorded from Maluku, Indonesia.

*Calcinus laevimanus* (Randall)

*Pagurus laevimanus* Randall, 1839: 135.

[?] *Pagurus lividus* H. Milne Edwards, 1848: 63.

*Calcinus herbstii* De Man, 1888: 437.—Alcock, 1905b: 53, pl. 5 fig. 4.

*Calcinus laevimanus*.—Rathbun in Stimpson, 1907: 208 (footnote).

*Calcinus herbsti*.—Fize & Serène, 1955: 40, 41, text fig. 6, pl. 2 figs 1–4.

**Material examined.** BANDA Stn 5b, 2♂ (AM P37717); Stn 24a, 3♂, 1♀ (NIOJ, AHF).

**Colour in life.** Carapace greenish white or gray green. Ocular peduncles with basal half blue, distal half orange; cornea blue or brown. Antennules blue except for narrow orange band at distal end of basal article; flagellum orange. Antennal peduncles with basal segment and acicle blackish green, rest of peduncle and flagellum orange. Chelipeds dark brown; fingers and distal part of palm with varying amounts of white. Pereopods 2 and 3 with ground colour of merus and carpus brown or golden, propodus brown or greenish brown; dark brown longitudinal stripe on merus and carpus; dactyl white, with brown or dark green subdistal ring and subproximal spot.

**Remarks.** The crabs were collected in the intertidal or shallow subtidal on bottoms of sand and rock.

Specimens from both stations were infected by rhizocephalan parasites. One individual from Station 5b bore a pair of abdominal bopyrids, *Parathelges weberi* Nierstrasz & Brender à Brandis.

**Distribution.** East coast of Africa to Hawaiian Islands and Tuamotu Archipelago.

*Calcinus latens* (Randall)

*Pagurus latens* Randall, 1839: 135.

*Pagurus cristimanus* H. Milne Edwards, 1848: 64.

*Calcinus latens*.—Dana, 1852: 459; 1855: pl. 28 fig. 11.—Alcock, 1905b: 55, 58, pl. 5 fig. 5.—Fize & Serène, 1955: 40, 58, text fig. 9, pl. 2 figs 9–11.—Humes, 1981: 5, 7.—

Haig & McLaughlin, 1984: 107, 108, 109.

*Calcinus intermedius* De Man, 1881a: 102.

*Calcinus terrae-reginae* Haswell, 1882: 760.—Alcock, 1905b: 53, 57, pl. 5 fig. 7.

**Material examined.** BANDA Stn 1, 1♀ (NIOJ); Stn 5a, 1 intersex (AM P37725); Stn 5b, 12♂, 6♀ (1 ov), 1 juv (AHF); Stn 10, 1♂, 1♀, 4 juv (NIOJ, AHF); Stn 12, 2♂, 1♀ (NIOJ); Stn 14, 3♂, 1♀, 2 juv (NIOJ); Stn 18, 4 juv (NIOJ); Stn 24a, 3♂, 5♀ (3 ov), 3 juv (AM P37728); Gunungapi, coll. A.G. Humes, 11♂, 4♀ (2 ov) (NIOJ, AM P37726).

**Colour in life.** Shield dark greenish black, shading off to mottled green and white. Ocular peduncles

uniform greenish pink or pale purplish brown; cornea black with white spots. Basal segment of antennular peduncles blue; distal segment orange with proximal brown streak dorsally, or brown proximally and blue distally; flagellum orange. Antennal peduncles green, flagellum uniform yellow green. Merus and carpus of chelipeds dark green or black with few scattered white tubercles; chela black proximally, gradually graying to white distally; fingers white. Merus and carpus of pereopods 2 and 3 very dark green or dark brown black, with white tubercles; propodus much lighter gray green, or brownish purple proximally and white distally; dactyl white, with deep purple band at proximal end.

**Remarks.** These hermit crabs were found essentially everywhere, usually on rocks or sand in less than 3 m, and frequently were very abundant. Rhizocephalans were found in association with them at several localities; one parasitised crab from Station 5a had both male and female gonopores. The specimens collected by A.G. Humes in 15 m were the hosts of copepods (Humes, 1981).

Haig & McLaughlin (1984: 107), in a discussion of the live colouration of *Calcinus latens* in Hawaii, noted that in those islands the proximal purple band on the dactyl of the walking legs is formed by short longitudinal stripes of blue and dark violet. This pattern is evident in preserved specimens from Maluku where the colours appear as a pale bluish purple band overlaid by short longitudinal stripes of dark red, although a solid deep purple band was noted in the living animals. Haig & McLaughlin (1984: 108) point out that several authors have reported a solid band of colour on the dactyl of the walking legs in *C. latens*. This is probably typical of live specimens in most parts of the Indo-West Pacific.

**Distribution.** Red Sea and east coast of Africa to Hawaiian and Gambier Islands.

*Calcinus minutus* Buitendijk

*Calcinus minutus* Buitendijk, 1937: 269, figs 13–15.—Forest, 1958: 185, figs 1, 6–8, 14, 18.—Nakasone, 1975: 3, fig. 2.—Humes, 1981: 5, 7.

**Material examined.** BANDA Stn 2, 2♂, 3♀ (AHF); Stn 4, 1♂, 3♀ (1 ov), 1 juv (AM P37724); Stn 7, 1♂ (AM P37729); Stn 9, 2♂, 3♀ (AHF); Stn 10, 1♂ (NIOJ); Stn 12, 1♂, 1♀ (AM P37705); Stn 13, 2♀ (NIOJ); Stn 19, 5♂, 4♀ (2 ov), 1 juv (NIOJ, AM P37706); Stn 20, 1♀, 1 juv (AHF); Stn 23a, 1♂, 2♀ (AM P37723); Stn 23b, 1♂, 2 juv (AHF); Gunungapi, coll. A.G. Humes, 4♂, 3♀, 1 intersex (NIOJ, AM P37715). SERAM Stn 2, 1♂, 2♀ (NIOJ, AHF). PULAU GOMUMU south of Obi, coll. A.G. Humes, 1 intersex (NIOJ).

**Colour in life.** Shield uniform white; posterior carapace mottled pink and yellow. Ocular peduncles uniform white; cornea black with white spots. Mouthparts black. Basal antennular segments black; distal segment black proximally and white distally;

flagellum brown. Antennal flagella transparent pale brown. Chelipeds uniform white, or rarely delicate pale purple. Merus, carpus and propodus of pereopods 2 and 3 white with scattered, small orange dots; dactyl bright orange.

**Remarks.** This species was found nearly everywhere down to depths of about 15 m, almost always on coral and was sometimes very abundant. Rhizocephalans and copepods (Humes, 1981) were associated with or parasitised this species.

**Distribution.** Red Sea; Vietnam north to Ryukyu Islands and southern Japan; eastern Malay Archipelago, north-eastern New Guinea, Palau Islands, West Caroline Islands, and Mariana Islands.

#### *Calcinus pulcher* Forest

*Calcinus pulcher* Forest, 1958: 287, figs 4, 12, 13, 16.—Baba, 1982: 65.

**Material examined.** BANDA Stn 2, 4♂ (NIOJ, AM P37755, AHF); Stn 14, 1♀ (NIOJ). SERAM Stn 2, 4♂, 4♀ (NIOJ, AM P37756, AHF).

**Colour in life.** Shield light brown, with large, median dark brown spot behind rostrum; posterior carapace light brown, dark on edges. Ocular peduncles dark brown in about proximal half, shading to white distally; cornea black with white spots. Antennular peduncles with basal segment and proximal part of terminal segment brown; distal part of terminal segment blue; flagellum orange. Antennal flagella solid orange. Chelipeds brown, fingers and distal part of palm white; large dark brown spot on outer and inner surfaces of palm, closer to proximal than to distal end of segment. All segments of pereopods 2 and 3 with many black, somewhat elongate longitudinal spots or streaks on white background; merus sometimes with median black band, incomplete on outer surface; carpus of pereopod 2, but not of pereopod 3, with very broad, bright red band covering almost entire segment;

propodus with subdistal black band; dactyl with median black band.

**Remarks.** At Banda this species was found only in protected areas at depths of about 3–8 m on coral, sand and rocks. Two specimens from Seram were parasitised by rhizocephalans.

**Distribution.** Vietnam, Palau Islands and southern Japan; now Maluku in Indonesia.

#### *Calcinus* undescribed sp.

*Calcinus* aff. *pulcher*.—Eldredge *et al.*, 1979: 18, 60.—

Kropp & Eldredge, 1982: 126.

*Calcinus* sp. 1 [aff. *pulcher*].—Kropp *et al.*, 1981: 40.

*Calcinus* sp. undescribed.—Humes, 1981: 5.

*Calcinus* sp. 1.—Wooster, 1984: 126, 138.

**Remarks.** Forty-eight specimens were found at Banda and Seram in about 3–15 m on coral and rock. Several of them were parasitised by rhizocephalans. An individual from Banda Station 9 had a pair of bopyrids, *Parapagurion calcinicola* Shiino, in one branchial chamber; another crab from the same station bore an abdominal bopyrid, an undescribed species of *Athelges*; and a specimen from Banda Station 19 was parasitised by an abdominal bopyrid, *Anathelges muelleri* Nierstrasz & Brender à Brandis. Two specimens collected by A.G. Humes were the hosts of copepods (Humes, 1981).

This species, which will be described elsewhere, is closely allied to *Calcinus pulcher* Forest but can be immediately distinguished from it by details of the colour pattern on pereopods 2 and 3. In the undescribed species the dactyl of those legs, and the carpus of both pereopods 2 and 3, are red without dark longitudinal streaks, and there are three well defined, dark longitudinal stripes on the outer and inner surfaces of the propodus.

**Distribution.** Maluku, Mariana Islands and Eastern Caroline Islands.

### *Clibanarius* Dana

#### Key to Species of *Clibanarius* Known from Maluku

1. Pereopods 2 and 3 with well-defined, longitudinal coloured stripes on merus, carpus and propodus ..... 2
- No well-defined, longitudinal coloured stripes on pereopods 2 and 3 (except on dactyl in certain species). Dactyl of pereopod 3 usually distinctly shorter than propodus, occasionally the 2 articles about the same length ..... 7
2. Dactyl of pereopod 3 distinctly shorter than propodus. Ocular peduncles and carapace shield with longitudinal coloured stripes; dactyl of pereopods 2 and 3 pale in typical variety, with longitudinal coloured stripe on outer face in var. *rhabdodactylus* ..... \**C. zebra*
- Dactyl of pereopod 3 usually longer than propodus, sometimes about same length as propodus or slightly shorter ..... 3

3. Ocular peduncles with longitudinal coloured stripe ..... 4  
 — No longitudinal coloured stripe on ocular peduncles ..... 5
4. Carapace flattened; coxae of pereopods 4 and 5 broadly separated ..... *C. eurysternus*  
 — Carapace not flattened; coxae of pereopods 4 and 5 approximated ..... \**C. padavensis*
5. Upper margin of palm with pointed tubercles. Outer face of pereopods 2 and 3 with 2 longitudinal coloured stripes, these frequently interrupted toward ends of segments ..... \**C. laevimanus*  
 — Upper margin of palm with row of distinct spines ..... 6
6. Antennular and ocular peduncles about equal in length. Outer face of pereopods 2 and 3 with median longitudinal stripe, this stripe pale with coloured margins ..... *C. longitarsus*  
 — Antennular peduncles shorter than ocular peduncles. Outer face of pereopods 2 and 3 with 2 longitudinal coloured stripes on paler coloured background .. \**C. striolatus*
7. Chelipeds and pereopods 2 and 3 with many pale blotches and spots on coloured background ..... 8  
 — No conspicuous pale blotches and spots on pereopods ..... 9
8. Propodus of left pereopod 3 with outer face flattened and densely setose ... *C. corallinus*  
 — Propodus of left pereopod 3 with outer face not much flattened and not densely setose ..... \**C. cruentatus*
9. Propodus of pereopods 2 and 3 with well-defined pale area distally on outer face ..... 10  
 — No well-defined pale area distally on outer face of propodus of pereopods 2 and 3 ..... 12
10. Propodus of pereopod 2 with pale area confined to distal end, that of pereopod 3 forming broad pale band, frequently along entire length of segment ... \**C. merguiensis*  
 — No broad pale band along entire length of propodus of pereopod 3 ..... 11
11. Propodus of pereopods 2 and 3 with pale band at both ends of segment; dactyl pale, with longitudinal coloured stripe on dorsal and ventral margins and on outer face ..... *C. boschmai*  
 — Propodus of pereopods 2 and 3 with pale band at distal end only; dactyl pale, with longitudinal coloured streak or patch on dorsal and ventral margins but not on outer face ..... *C. englaucus*
12. Ocular peduncles coloured, with narrow pale band next to cornea. Propodus of pereopods 2 and 3 solidly coloured, usually more deeply at distal end; dactyl pale, with or without submedian coloured ring ..... *C. virescens*  
 — Ocular peduncles coloured, with broad pale band distally and large pale patch proximally. Propodus of pereopods 2 and 3 pale, with dark area distally; dactyl pale, never with submedian ring ..... \**C. humilis*

***Clibanarius boschmai*** Buitendijk

*Clibanarius boschmai* Buitendijk, 1937: 261, 267, figs 10–12.—Fize & Serène, 1955: 77.

**Material examined.** SAPARUA Stn 3, 7♂, 2♀ (NIOJ, AM P37731, AHF).

**Colour in life.** Carapace cream to pale purple, with darker purple longitudinal markings. Ocular peduncles dark brown dorsodistally, mesially and

laterally, with white patch proximally on dorsal surface; cornea black with white spots. Basal segments of antennules dark brown, terminal segment of peduncle greenish brown, flagellum orange. Antennal flagella uniform orange. Chelipeds uniform dark brown; small dorsoproximal spot on chela; fingers mostly white. Merus of pereopods 2 and 3 white proximally, with rather narrow, uneven brown band distally; carpus dark brown, with uneven white band at both ends; propodus same, uneven

white bands broader than on carpus; dactyl blue except for narrow white area next to claw, blue area with dark brown longitudinal stripes (one each dorsal, ventral, mesial and lateral).

**Remarks.** The specimens were collected in 0–1 m on rocks.

**Distribution.** Reported only from Paternoster Islands (Kepulauan Tengah), Kisar and Leti in southeastern Indonesia. The Saparua record represents a small extension of range northward.

#### *Clibanarius corallinus* (H. Milne Edwards)

*Pagurus corallinus* H. Milne Edwards, 1848: 63.

*Pagurus globoso-manus* Dana, 1851: 271.

*Clibanarius corallinus*.—Dana, 1852: 468; 1855: pl. 29 figs 8a–e.—Alcock, 1905b: 43, 48, pl. 5 fig. 11.—Fize & Serène, 1955: 77, 132, fig. 20.

**Material examined.** BANDA Stn 5b, 2♀ (AHF); Stn 10, 1♂, 1♀ (NIOJ).

**Colour in life.** Shield brown; posterior carapace with 3 longitudinal white stripes on brown background. Ocular peduncles brown dorsally, orange laterally and mesially; cornea blue. Antennular peduncles brown, flagellum orange. Antennal flagella uniform orange. Chelipeds brown with white tubercles. Pereopods 2 and 3 solid brown.

**Remarks.** This species occurred intertidally or in the shallow subtidal in protected areas.

**Distribution.** Eastern Indian Ocean to Line Islands and Tuamotu Archipelago.

#### *Clibanarius englaucus* Ball & Haig

*Clibanarius englaucus* Ball & Haig, 1972: 97, fig. 5.

**Material examined.** BANDA Stn 3, 20♂, 15♀ (12 ov) (NIOJ, AM P37716, AHF); Stn 5b, 1♂ (AHF); Stn 24a, 7♂, 7♀ (2 ov) (NIOJ, AM P37709, AHF).

**Colour in life.** Carapace mottled gray green. Ocular peduncles orange, with brownish dorsal longitudinal stripe; cornea black with white spots. Antennular peduncles brownish, with tinge of blue at distal end of terminal segment; flagellum orange. Antennae predominantly red orange with most of basal peduncular segment brown. Chelipeds mostly brown; narrow zone of blue at base of fingers, latter mostly orange. Merus, carpus and most of propodus of pereopods 2 and 3 dark brown; distal end of propodus orange; dactyl with diffused, submedian blue band, white proximally and with brown area distally.

**Remarks.** These crabs occurred on rock in the intertidal or shallow subtidal, and were sometimes very abundant in exposed areas.

A few individuals were infected by rhizocephalan parasites. A female from Station 24a had a pair of bopyrids, *Asymmetrione asymmetrica* (Shiino), in one gill chamber.

**Distribution.** This species was previously known only from the type locality, Karkar Island off north-eastern New Guinea. Its range is now extended westward to the Banda Islands.

#### *Clibanarius eurysternus* (Hilgendorf)

*Pagurus (Clibanarius) eurysternus* Hilgendorf, 1879: 822, pl. 3 figs 9, 10.

*Clibanarius eurysternus*.—De Man, 1888: 447.—Fize & Serène, 1955: 76, 118, fig. 17.

**Material examined.** BANDA Stn 5b, 1♂ (NIOJ).

**Colour in life.** Carapace, ocular, antennular and antennal peduncles, chelipeds and pereopods 2 and 3 with alternating longitudinal stripes of white and dark brown or black. Antennal flagella with black and white bands. Abdomen mottled brown and white. Pattern as depicted by Fize & Serène (1955: fig. 17) and by Miyake (1956: figs 4, 5).

**Remarks.** This specimen was collected in a protected shallow water area with a current, on coral sand or rock in 0–5 m.

**Distribution.** East coast of Africa to Marshall and Gilbert Islands.

#### *Clibanarius longitarsus* (De Haan)

*Pagurus longitarsus* De Haan, 1849: 211, pl. 50 fig. 3.

*Clibanarius longitarsis*.—Dana, 1852: 464.

*Clibanarius longitarsus*.—Fize & Serène, 1955: 76, 83, text fig. 11A–C, pl. 3 figs 1, 7, 10, 13.

**Material examined.** SERAM Stn 1, 1♂ (NIOJ).

**Colour in life.** Whole animal muddy brown, appearing muddy even when clean. Carapace fairly uniform brown, lightening posteriorly. Ocular peduncles uniform, semi-transparent greenish brown. Antennular and antennal peduncles light brown dorsally, darker brown laterally. Chelipeds and pereopods 2 and 3 uniform muddy brown.

In preservative, pereopods 2 and 3 distinctly showing remains of blue longitudinal stripes with red borders, in pattern characteristic of *Clibanarius longitarsus* (Fize & Serène, 1955: 88–89).

**Remarks.** The crab was collected from a muddy shore.

**Distribution.** Red Sea, east coast of Africa, and Indian Ocean, through Malay Archipelago and north to Ryukyu Islands and Japan.

#### *Clibanarius virescens* (Krauss)

*Pagurus virescens* Krauss, 1843: 56, pl. 4 fig. 3.

*Clibanarius virescens*.—Dana, 1852: 466.—McCulloch, 1913: 346, 351, pl. 11 fig. 2.—Fize & Serène, 1955: 77, 138, fig. 21.

*Calcinus astathes* Stebbing, 1924: 239, pl. 2 (Crustacea pl. 117).

[?] *Clibanarius philippinensis* Yapchiongco in Estampador, 1937: 501.

**Material examined.** BANDA Stn 5b, 1♀ (NIOJ); Stn 24a, 1♀, 1 juv (NIOJ).

**Colour in life.** Carapace with shades of dark and light brown. Ocular peduncles solid olive drab or dark brown, except for narrow white ring just proximal to cornea; cornea black with white spots. Antennular peduncles with basal segment olive drab or dark brown, terminal segment olive drab or dark brown fading to orange distally; flagellum orange. Antennal flagella uniform blue or brown. Chelipeds olive drab or brown with white tubercles and white fingers. Pereopods 2 and 3 olive drab or dark brown, colour concentrated in darker band at distal end of propodus; dactyl white.

**Remarks.** This species was found in the intertidal or shallow subtidal on a bottom of coral, sand and rock.

Our specimens belong to the colour variety of *Clibanarius virescens* in which the dactyl of the second and third pereopods is yellow or white, without a submedian dark ring. In colour and morphology they also conform with the description of *C. philippinensis* Yapchiongco. Comparison of the description of the latter species with a good series of *C. virescens* in the Allan Hancock Foundation suggested that the two forms may be identical. The type material, along with other Philippine collections, was destroyed during World War II (Estampador, 1959: 1), and therefore we can only tentatively place *C. philippinensis* in synonymy with *C. virescens*.

**Distribution.** East coast of Africa to Ellice and Fiji Islands.

### *Dardanus* Paul'son

#### Key to Species of *Dardanus* Known to Occur in Maluku

1. Cornea not occupying more than one-third of ocular peduncles ..... 2  
 — Cornea occupying more than one-third of ocular peduncles ..... 6
2. Chelipeds covered with strong corneous spines ..... 3  
 — Chelipeds covered with small spines ..... 4
3. Left cheliped distinctly longer than right; shield and pereopods covered with pale, ocellate spots ..... *D. megistos*  
 — Left cheliped not much longer than right; no ocellations on shield or pereopods ..... *D. lagopodes*
4. Propodus and dactyl of left pereopod 3 with transverse striations on lateral surface ..... *D. guttatus*  
 — Propodus and dactyl of left pereopod 3 without transverse striations ..... 5
5. Left chela with outer face granulose, upper margin with row of spines, lower margin unarmed ..... \**D. scutellatus*  
 — Left chela decorated on outer face with small pointed spines, upper and lower margins spinulose ..... *D. woodmasoni*
6. Propodus of left pereopod 3 with dorsal and lateral faces delimited by sharp crest on dorsolateral margin ..... \**D. deformis*  
 — Propodus of left pereopod 3 without sharp crest on dorsolateral margin ..... 7
7. Left chela with small rounded tubercles over entire outer surface ..... *D. gemmatus*  
 — Left chela with small rounded tubercles on upper half and smooth on lower half of outer surface ..... *D. pedunculatus*

#### *Dardanus gemmatus* (H. Milne Edwards)

*Pagurus gemmatus* H. Milne Edwards, 1848: 60.—Forest, 1954: 557, figs 10, 11.

*Dardanus gemmatus*.—Holthuis, 1953: 48.

**Material examined.** BANDA Stn 5a, 1♂ (NIOJ); Stn 12, 1♂ (NIOJ); Stn 20, 1♂ (AHF). SERAM Stn 2, 1♂, 1♀ (NIOJ).

**Colour in life.** Shield mottled purple and white, with large patch of uniform orange brown medially, latter extending anteroposteriorly about three-quarters length of shield; posterior carapace mottled in shades of pale orange, purple and white. Ocular peduncles red, with median white band; cornea silver or greenish. Antennules dark red basally, lighter red

distally. Antennal peduncles purple; flagellum transparent reddish. Major cheliped dark orange purple or reddish purple proximally, paler distally; minor cheliped with varying shades of orange purple or reddish purple. Merus of pereopods 2 and 3 mottled purple and white; carpus, propodus and dactyl uniform pale orange with tinges of purple.

**Remarks.** All the specimens from Banda were collected in less than 2 m of water: two during the day under rocks and dead coral and one at night in the open. The crabs from Seram were found in 1–3 m.

Each of the five specimens had two species of anemones on its shell. *Calliactis polypus* (Forskål) is a large anemone with a brown and white striped column, purple and white banded tentacles, and white acontia around the base. A smaller, white species, presumably *Sagartiomorphe paguri* (Verrill), is always located near the opening of the shell. For the specimens from Banda, the number of individuals of each anemone associated with each *Dardanus* is as follows:

	<i>Calliactis</i>	<i>Sagartiomorphe</i>
Stn 5a	4	9
Stn 12	5	2
Stn 20	3	3

The association between *Dardanus gemmatus* and *Calliactis polypus* has been discussed in some detail by Ross (1970, 1975) and by Ross & Wada (1975).

**Distribution.** Western Indian Ocean to Hawaiian and Society Islands. We have found no published record of this species from the Indonesian area, although there is a single, indefinite designation "Malaysia" (Miers, 1880: 375).

#### *Dardanus guttatus* (Olivier)

*Pagurus guttatus* Olivier, 1812: 640.—Alcock, 1905b: 87, pl. 9 fig. 1.—Fize & Serène, 1955: 158, 159, 173, text fig. 26, pl. 5 figs 1–3.

*Dardanus guttatus*.—Holthuis, 1953: 48.—Humes, 1981: 3, 6, 7, 11.

**Material examined.** BANDA Stn 3, 1♂ juv (AHF); Stn 12, 1♀ ov, 1 juv (NIOJ); Stn 24a, 1♂, 1♀ juv, 1 juv (AM P37788, AHF). SERAM Stn 2, 1♂, 1♀ (NIOJ); Pulau Parang, eastern Seram, coll. A.G. Humes, 1♂ (AHF). SAPARUA Stn 2, 1♀, 1 juv (NIOJ). KARANG MIE, eastern central Halmahera, coll. A.G. Humes, 1♂ (NIOJ).

**Colour in life.** Shield with white spots on reddish purple background, anterior half with large green markings; posterior carapace mottled reddish purple and pale tan. Abdomen bright reddish purple with white spots, transparent ventrally. Ocular peduncles solid purplish brown or purplish pink, with narrow white line next to black cornea; acicles reddish purple with white spots. Antennules and antennae uniform purplish pink or transparent light brown. Chelipeds reddish purple with white spots; dorsal surface of carpus with large, dark green spot covering most of

segment; setae reddish purple with white tips. Second pereopods reddish purple with white spots; carpus with large, dark green spot like that on chelipeds. Third pereopods similar, but white spots usually elongate, forming broken band near distal and proximal ends of propodus.

**Remarks.** Most of the crabs were found in about 0–4 m on coral and rock. The specimens collected by A.G. Humes were hosts of copepods (Humes, 1981).

**Distribution.** East coast of Africa to Line Islands and Samoa.

#### *Dardanus hessii* (Miers)

*Pagurus hessii* Miers, 1884: 264, pl. 28 fig. A.—Alcock, 1905b: 93, pl. 8 fig. 4.

*Pagurus similimanus* Henderson, 1888: 59, pl. 6 fig. 6.

*Pagurus hessi*.—Fize & Serène, 1955: 158, 159, 214, text fig. 34, pl. 4.

*Dardanus hessii*.—Gordan, 1956: 314.

**Material examined.** ARAFURA Stn 7, 1♀ (AM P37708).

**Colour in life.** Ocular peduncles white dorsally, with broad purple longitudinal stripe mesolaterally; cornea green. Antennules and antennae white. Chelae white with brown fingers.

**Remarks.** Collected in 49 m; substrate unknown.

**Distribution.** Gulf of Oman, Maldives, India, Malay Peninsula, thence north to Vietnam, Taiwan and Japan; east through Malay Archipelago to Arafura Sea (the type locality) and Torres Strait.

#### *Dardanus imbricatus* (H. Milne Edwards)

*Pagurus imbricatus* H. Milne Edwards, 1848: 61.—Alcock, 1905b: 92, pl. 9 fig. 8.—Fize & Serène, 1955: 158, 159, 220, text fig. 35, pl. 6 figs 11–14.

*Dardanus imbricatus*.—Gordan, 1956: 314.

**Material examined.** ARAFURA Stn 1, 1♂, 1 juv (AM).

**Colour in life.** Ocular peduncles pale blue proximally, white distally, with narrow, reddish brown submedian band; cornea green. Antennules and antennae white. Chelae reddish, grading to white proximally; teeth on cutting edge of fingers purple. Dactyl of pereopods 2 and 3 reddish brown, other segments white.

**Remarks.** These crabs were collected in 27 m on an unknown substrate. The larger specimen had seven anemones on its shell, which was shared by a cirrolanid isopod, *Neocirrolana hermitensis* (Boone). We have not found any published records of an association of anemones with *Dardanus imbricatus*. The closely related species *D. arrosor* (Herbst) frequently bears anemones on its shell.

**Distribution.** Reported from Sri Lanka, Thailand and Vietnam; otherwise Australia (Western Australia, Northern Territory and northern Queensland), including Torres Strait.



***Dardanus lagopodes* (Forskål)**

- Cancer lagopodes* Forskål, 1775: 93.  
*Pagurus sanguinolentus* Quoy & Gaimard, 1824: 532, pl. 79 fig. 2.—Fize & Serène, 1955: 158, 159, 166, text fig. 25, pl. 4 figs 4, 5.  
*Pagurus affinis* H. Milne Edwards, 1836: 274.  
*Pagurus euopsis* Dana, 1852: 452; 1855: pl. 28 fig. 6a–c.—Alcock, 1905b: 80, 86, pl. 9 fig. 2.  
*Pagurus depressus* Heller, 1861: 22.  
*Dardanus hellerii* Paulson, 1875: 90, pl. 12 figs 4, 4a–c; 1961: 96, pl. 12 figs 4, 4a–c.  
*Dardanus lagopodes*.—Lewinsohn, 1969: 32, pl. 2.—Humes, 1981: 3, 6, 7, 11.

**Material examined.** BANDA Stn 1, 1♀ (AHF); Stn 4, 2♂, 4♀ (2 ov), 1 juv (AM P37752); Stn 5a, 1♂, 1♀ (AHF); Stn 5b, 1♂, 1♀ ov, 3 juv (NIOJ); Stn 7, 1♀ (AHF); Stn 9, 1♂, 2♀ ov, 8 juv (AM P37797); Stn 10, 2♂, 2♀, 3 juv (NIOJ); Stn 12, 1♀ (AM P37748); Stn 13, 1♂, 1 juv (AM P37751); Stn 14, 3♂, 2♀, 10 juv (NIOJ); Stn 18, 1 juv (AHF); Stn 19, 3♂, 1♀ (AM P37786, AHF); Stn 20, 1 juv (AHF); Stn 21, 1♂ (AM P37784); Stn 23a, 1 juv (AM P37738); Stn 23b, 1♂, 1♀, 1 juv (NIOJ); Stn 24a, 3♂, 1♀ (AHF); Gunungapi, coll. A.G. Humes, 5♂, 2♀ (NIOJ, AM P37787, AHF). SERAM Stn 2, 11♂, 4♀, 7 juv (NIOJ, AM P37735, AHF); Pulau Marsegu, western Seram, coll. A.G. Humes, 1♂ (NIOJ); Pulau Parang, eastern Seram, coll. A.G. Humes, 1♂, 1♀ (AM P37798, AHF). SAPARUA Stn 1, 1♂, 9 juv (NIOJ); Stn 3, 2♂, 1♀, 2 juv (NIOJ). KARANG MIE, east central Halmahera, coll. A.G. Humes, 1♂ (NIOJ). NATSEPA, Ambon, coll. A.G. Humes, 1♂ (NIOJ).

**Colour in life** (black form). Shield brownish purple, with large brown spot anteriorly; posterior carapace mottled bright red and tan. Ocular peduncles uniform purplish brown, with narrow yellow line next to black cornea. Antennules and antennae yellowish brown. Chelipeds reddish purple with white tubercles and white-tipped red setae. Pereopods 2 and 3 reddish purple; broad black band at distal end of merus and large black patch on carpus; setae reddish purple with white tips.

Black form frequently found together with red form, latter differing in having bright red patch on carpus of pereopods 2 and 3 (see Fize & Serène, 1955: 170; Ball & Haig, 1972: 92–93).

**Remarks.** This species was found everywhere, although never in really high densities, from just subtidal to at least 15 m.

At Banda Stations 1 and 5b and at Pulau Parang an alpheid shrimp, *Aretopsis amabilis* De Man, was found sharing the shell with the hermit crab. Other *Dardanus lagopodes* were parasitised by rhizocephalans or had copepods associated with them (Humes, 1981).

An individual found on dead coral in about 2 m of water at Banda Station 13 was observed feeding by scraping with both chelipeds at the mud and algae on the surface of the coral, then transferring the detritus to its mouth.

**Distribution.** Red Sea and east coast of Africa to Marshall and Gilbert Islands and Tuamotu Archipelago.

***Dardanus megistos* (Herbst)**

- Cancer megistos* Herbst, 1804: 28, pl. 61 fig. 1.  
*Pagurus punctulatus* Olivier, 1812: 641.—Alcock, 1905b: 81, pl. 8 fig. 1.  
*Pagurus spinimanus* H. Milne Edwards, 1848: 61.  
*Dardanus megistos*.—Rathbun in Stimpson, 1907: 205 (footnote).—Humes, 1981: 7, 11.  
*Pagurus megistos*.—Fize & Serène, 1955: 158, 159, 160, text fig. 24, pl. 4A.

**Material examined.** BANDA Stn 22, 1♀ ov (NIOJ). PULAU MARSEGU, western Seram, coll. A.G. Humes, 1♀ ov (NIOJ). SAPARUA Stn 2, 1♀ (NIOJ).

**Colour in life.** Not recorded. Several authors, including Fize & Serène (1955: 165), have provided information on live colouration of this species, and several photographs in colour have been published.

**Remarks.** The specimens from Banda and Saparua were found at night, on rock in 0–4 m of water. The crab collected by A.G. Humes was the host of copepods (Humes, 1981).

**Distribution.** East coast of Africa to Hawaiian Islands and Tuamotu Archipelago.

***Dardanus pedunculatus* (Herbst)**

- Cancer pedunculatus* Herbst, 1804: 25, pl. 61 fig. 3.  
*Pagurus asper* De Haan, 1849: 208, pl. 49 fig. 4.—Alcock, 1905b: 90, pl. 9 fig. 5.  
*Pagurus sigmoidalis* Zehntner, 1894: 192, pl. 8 fig. 19a,b.  
*Dardanus haanii* Rathbun, 1902: 34.  
*Neopagurus horai* Kamalaveni, 1950: 83, figs 2a–c, 3.  
*Pagurus haani*.—Fize & Serène, 1955: 158, 159, 207, text figs 32, 33, pl. 4.  
*Dardanus pedunculatus*.—Lewinsohn, 1969: 29, pl. 1 fig. 3.

**Material examined.** SERAM Stn 2, 1♂ (NIOJ). SAPARUA Stn 1, 1♀ juv (NIOJ).

**Colour in life.** Carapace mottled tan and cream; shield with median reddish brown spot near anterior margin. Ground colour of ocular peduncles white; broad red band proximally, incomplete broad red band just next to black cornea. Antennular peduncles transparent except for red stripe laterally and mesially; flagellum pale red. Antennal flagella transparent. Ground colour of chelipeds cream to light brown, with mottling of darker brown on carpus and inner side of palm. Second and third pereopods uniform orange brown.

**Remarks.** The specimen from Seram was taken in 1–3 m and, like *Dardanus gemmatus*, carried two species of anemones on its shell. Anemones were not associated with the individual from Saparua, which was collected in 6–8 m on a sandy bottom grading onto coral-covered rock.

Observations on the association of *Dardanus pedunculatus* with anemones were made by Cowles (1919) and by Ross (1975).

**Distribution.** East coast of Africa to Hawaiian Islands.

***Dardanus setifer*** (H. Milne Edwards)

*Pagurus setifer* H. Milne Edwards, 1836: 274.—Alcock, 1905b: 83, pl. 8 fig. 3.—Fize & Serène, 1955: 158, 159, 182, text figs 27, 28, pl. 5 figs 4–8.

*Dardanus setifer*.—Gordan, 1956: 316.

**Material examined.** ARAFURA Stn 6, 1♂ juv (AHF).

**Colour in life.** Carapace mottled red and white. Ocular peduncles uniform pinkish orange; cornea silvery gray. Antennules and antennae uniform pinkish orange. Chelae mottled red and white with black tips on fingers. Pereopods 2 and 3 mottled red and white with black claws, and with distinct bands of darker red on carpus and propodus.

**Remarks.** Collected in 49 m on an unknown substrate.

**Distribution.** South Africa, Madagascar, Mauritius, Pakistan, India, Sri Lanka, Vietnam, Hong Kong and Australia. Not recorded previously from Torres Strait.

***Dardanus woodmasoni*** (Alcock)

*Pagurus wood-masoni* Alcock, 1905a: 831; 1905b: 85, pl. 9 fig. 3.—Fize & Serène, 1955: 158, 159, 195, text fig. 30, pl. 6 figs 1–4.

*Dardanus wood-masoni*.—Gordan, 1956: 316.

**Material examined.** BANDA Stn 10, 1♂ (NIOJ).

**Colour in life.** Carapace mottled in various shades of gray brown; 3 dark brown blotches on anterior part of shield. Ocular peduncles solid gray brown, cornea silver. Antennules uniform transparent gray brown. Antennal flagella uniform transparent brown. Chelipeds different shades of brown with white spines and setae. Pereopods 2 and 3 mottled brown and white, with darker brown, indistinct dorsomedian band on merus, carpus and propodus; spines and setae white.

**Remarks.** This specimen was taken from a bottom of sandy mud in 2 m of water.

**Distribution.** Red Sea, Maldives and Andaman Islands, Vietnam, Philippines, Ryukyu Islands and Marshall Islands and herein recorded from Indonesia.

***Diogenes*** Dana***Diogenes avarus*** Heller

*Diogenes avarus* Heller, 1865: 83, pl. 7 fig. 2.—Alcock, 1905b: 61, 68, pl. 6 figs 6, 6a.—Forest, 1957: 524, figs 1–4.—Lewinsohn, 1969: 37, fig. 4.

**Material examined.** BANDA Stn 18, 2♂, 6♀ ov, 11 juv (NIOJ, AM P37740).

**Colour in life.** Carapace rather uniform dark brown. Ocular peduncles uniform light brown, or brown with broad, oblique white band medially; cornea golden. Proximal segment of antennular peduncles dark brown; distal segment with brown

chromatophores on white. Antennal flagella banded brown and white. Merus and carpus of large cheliped solid light brown, chela white; small cheliped solid light brown. Merus of pereopods 2 and 3 white, with 2 brown bands; carpus light brown with white band distally; propodus white medially, otherwise dark brown proximally and light brown distally; dactyl dark brown proximally and white distally.

**Remarks.** The specimens were found in 0–2 m on a fine sand and gravel beach. All of them are very small, and most, including a male with fully developed gonopores (SL 0.8 mm) and six ovigerous females (SL 0.5–0.8 mm), show juvenile characters. One somewhat larger male (SL 1.5 mm) has the elongate left cheliped that is characteristic of males of this species.

In the field, these hermits were observed making long leaps backward and running about very rapidly.

**Distribution.** Indian Ocean, from Red Sea and east coast of Africa to Mergui Archipelago; Malay Peninsula, Vietnam, Philippine Islands and northeast coast of Australia. Now reported from Indonesia for the first time.

***Diogenes jousseaumei*** (Bouvier)

*Troglopagurus jousseaumei* Bouvier, 1897: 231, fig. 6.

*Troglopagurus jousseaumi*.—Alcock, 1905b: 75, pl. 5 fig. 6.

*Diogenes jousseaumei*.—Forest, 1952a: 9 et seq., fig. 15.

**Material examined.** ARAFURA Stn 3, 1♂, 1♀ (AHF); Stn 8, 1♂ (AM P37792); Stn 11, 1♂, 2♀ (1 ov) (AM P37736); Stn 12, 1♀ ov (AM P37794); Stn 13, 1♀ ov (AHF); Stn 15, 1♂ (AHF).

**Colour in life.** Carapace mottled brown and white. Ocular peduncles white with dorsal brown stripe; cornea almost silver. Antennae transparent. Chelipeds covered with dense, whitish gray setae. Pereopods 2 and 3 banded alternately brown and white; with dense, whitish gray setae.

**Remarks.** The specimens were collected on unknown substrates in 49–99 m. In a single specimen, a male from Station 3, the rostriform process is obsolescent and scarcely visible. In the rest of the material it is very small but distinct, as depicted by Forest (1952a: fig. 15). The fixed finger and lower margin of the palm of the left cheliped form a nearly straight line in our specimens, instead of a curve with the fingers deflexed as reported by Bouvier and Alcock.

**Distribution.** Persian Gulf, Gulf of Oman, Red Sea, Gulf of Aden, India, Sri Lanka and Queensland. Not previously reported from Torres Strait and the Arafura Sea.

***Diogenes rectimanus*** Miers

*Diogenes rectimanus* Miers, 1884: 262, pl. 27 fig. C.—Alcock, 1905b: 61, 71, pl. 6 fig. 8, pl. 7 fig. 2.

**Material examined.** ARAFURA Stn 13, 1♀ ov (AM P37785).

**Colour in life.** Not noted.

**Remarks.** The specimen was collected in 64 m. There is a second spine near the apex of the rostriform process, giving it a bifid appearance; the spines on the lower margin of the palm of the left chela are reduced, taking the form of well-developed granules with rounded tips; and the propodus and dactyl of pereopods 2 and 3 are considerably more slender than those illustrated by Alcock. Otherwise, the specimen agrees well with the published descriptions and figures.

**Distribution.** Persian Gulf, Gulf of Aden, India, Sri Lanka, Malay Peninsula, Arafura Sea and Torres Strait (the type locality).

### *Diogenes serenei* Forest

*Diogenes serenei* Forest, 1957: 530, figs 12–15.—Ball & Haig, 1972: 91.

**Material examined.** BANDA Stn 10, 2♂, 1♀ (NIOJ, AM P37754); Stn 24a, 1♂ (NIOJ).

**Colour in life.** Carapace mottled brown and white; shield with submedian dark brown spot near each lateral margin. Ocular peduncles with light brown mottling proximally, white distally, with dark brown ring in white area; cornea silver. Antennular peduncles with transparent background; basal segment with subdistal dark brown band, terminal segment with similar band distally. Antennal peduncles white, terminal segment with subdistal brown band; flagellum transparent brown. Chelipeds mottled black, white and brown. Pereopods 2 and 3 mottled brown and white; submedian black spot on dorsal margin of merus and carpus.

**Remarks.** The specimens came from areas of sandy mud and rocks in 0–3 m.

**Distribution.** Gulf of Iran, Vietnam and eastern New Guinea and herein recorded from Indonesia.

### *Diogenes viridis* n.sp.

Fig. 3

**Material examined.** HOLOTYPE: BANDA Stn 20, 1♂ SL 1.8 mm (NIOJ A.019). PARATYPE: BANDA Stn 21, 1♀ SL 1.3 mm (NIOJ A.011).

**Description.** Shield flattened, approximately as broad as long; anterior margin between rostrum and lateral projections concave; posterior margin truncate; anterolateral margins strongly convex, with row of spines and with long setae; anterolateral portion of dorsal surface with numerous spines (most of them poorly developed in paratype); well-developed submarginal spine at anterolateral angle. Rostrum short, broad, obtusely triangular. Lateral projections exceeding rostrum, broad, triangular, with small terminal spine.

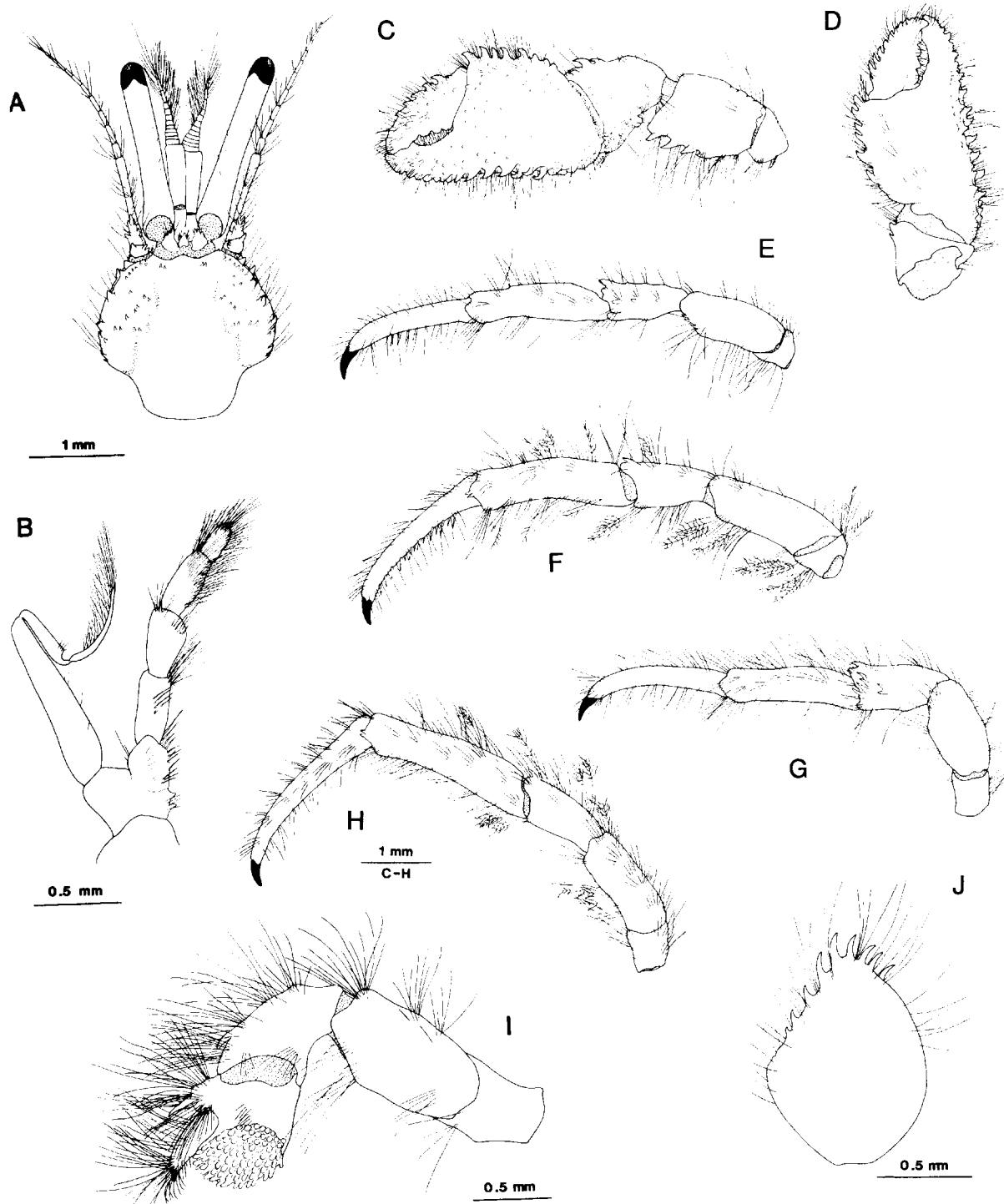
Ocular peduncles about equal to length of shield; sparsely setose. Ocular acicles with mesial margin somewhat concave, lateral margin sloping; terminating in 2 or 3 spines and with long setae distally; well separated basally. Intercalary rostral process rounded triangular, with slender spine at tip; shorter than ocular acicles; no spine on ventral surface.

Antennular peduncles stout, short, barely reaching distal half of ocular peduncles. Ultimate and penultimate segments unarmed; basal segment with spine at ventrolateral distal angle.

Antennal peduncles short, barely reaching distal half of ocular peduncles; with supernumerary segmentation. Fifth segment slender, unarmed, with long setae. Fourth and third segments unarmed and with tufts of setae. Second segment with strong spine at dorsolateral distal angle; lateral margin unarmed; dorsomesial margin with 2 well-developed spines. First segment slightly produced at dorsolateral distal angle. Antennal acicle short, slightly exceeding distal end of fourth peduncular segment; terminating in strong spine; lateral margin with 2 strong spines, mesial margin with 2 or 3 spines; margins with long setae. Antennal flagella rather short, composed of 10 articles; with long setae.

Maxillule with endopodite lacking external lobe. First maxilliped with flagellum of exopodite biarticulate. Second maxilliped with exopodite exceeding base of dactyl of endopodite. Third maxilliped with ischium unarmed (lacking crista dentata); basis with 2 well-developed spines.

Left cheliped missing in paratype. Left cheliped of holotype with dactyl approximately as long as upper margin of palm; rather strongly curved; cutting edge with well-developed calcareous teeth; terminating in small calcareous claw, latter hidden under tip of fixed finger; outer surface finely granulate, with submedian longitudinal row of spinules and with long setae; upper margin with row of strong spines decreasing in size distally; inner surface smooth. Fixed finger with small calcareous tubercles on cutting edge; terminating in small calcareous claw; outer surface with irregular rows of spinules or pointed granules and with long setae; lower margin curved, with row of spines; inner surface nearly smooth. Palm flattened; upper margin about as long as carpus, somewhat cristate, with row of 8 strong spines and with long setae; outer surface with scattered, minute granules, and with small, closely set spines near upper and lower margins; lower margin nearly straight, with long setae and with row of strong spines, latter becoming smaller proximally and distally where they pass into row on lower margin of fixed finger; inner surface smooth. Carpus slightly longer than merus; upper margin with 4 spines, proximal one poorly developed, and with scattered setae; outer surface with scattered spinules or pointed granules, outer distal margin with row of spinules; inner surface with large spine at upper



**Fig. 3.** *Diogenes viridis* n.sp. [Holotype ♂, Banda Stn 20]. **A**, shield and anterior appendages; **B**, mxp 3 (left, internal view); **C**, left cheliped (outer view); **D**, left chela (inner view); **E**, left P 2 (lateral view); **F**, right P 2 (mesial view); **G**, left P 3 (lateral view); **H**, right P 3 (mesial view); **I**, left P 4 (lateral view); **J**, telson.

distal corner. Merus with outer surface minutely granulate; upper margin obscurely crenulate in proximal half; lower margin with 4 strong spines; margins and inner surface with long setae.

Right cheliped missing in both specimens.

Left second pereopod with dactyl approximately as long as propodus; terminating in strongly curved corneous claw; all surfaces with long and short setae. Propodus nearly twice length of carpus; mesial surface with 2 small spines on median part of distal margin, small spine at ventrodistal angle; all surfaces with long and short setae. Carpus  $\frac{2}{3}$  length of merus; dorsal margin with 2 strong spines distally; lateral surface with 3 spines in median longitudinal row, most proximal one very small; long and short setae most abundant on dorsal margin and lateral surface. Merus with lateral surface armed with row of 3 small spines ventrodistally; dorsal and ventral margins with long setae.

Right second pereopod considerably longer than left. Dactyl approximately as long as propodus. Propodus about twice length of carpus; lateral and mesial surfaces each with 2 small spines on median part of distal margin. Carpus about  $\frac{3}{4}$  length of merus; dorsal margin with strong spine distally; lateral surface with median longitudinal row composed of transverse group of 3 well-developed spines near distal margin, 1 well-developed spine on middle third of segment, very small spine on proximal third. Merus armed as in left pereopod 2. Setation as in left pereopod 2.

Left third pereopod with proportional lengths of first 4 segments approximately same as in left pereopod 2. Dactyl terminating in strongly curved corneous claw. Propodus with lateral surface bearing 3 minute spines on ventral part of distal margin; mesial surface with small spine on median part, 2 or 3 minute spines or pointed granules on ventral part of distal margin. Carpus with dorsal margin armed with strong spine distally; lateral surface with distal transverse row of 4 strong spines, pair of smaller, more proximal spines on median part of segment. Merus with lateral surface armed with 2 strong spines ventrodistally. Setation as in left pereopod 2. Right third pereopod considerably longer than left. Proportional lengths of first 4 segments approximately same as in right pereopod 2. Dactyl as in right pereopod 2. Propodus armed as in right pereopod 2. Carpus with dorsal margin armed with strong spine distally; lateral surface with distal transverse row of 3 strong spines, and more proximal, much smaller spine on median part of segment. Merus armed as in right pereopod 2. Setation as in left pereopod 2.

Fourth pereopods with dactyl terminating in small corneous claw. Propodus with very prominent spine on dorsal margin; rasp well developed. Carpus with large curved spine on dorsal margin.

Sternal plastron very broad; all 5 pairs of pereopods well separated at their bases.

Uropods asymmetrical. Telson considerably longer than broad, without transverse median constriction; terminal margin entire (not bilobed); terminal and lateral margins armed with 9 spines interspersed with long setae.

**Colour in life.** Carapace white, with 2 green spots just behind shield. Ocular peduncles uniform light pink. Antennules uniform white. Antennae solid green except for white band at distal end of peduncle. Left cheliped with merus green proximally, white distally; carpus and chela white. Pereopods 2 and 3 with merus and carpus green, these segments sometimes with small, dorsodistal white patch; propodus green except for broad white band distally; dactyl white.

Pale but distinct green tint persisting on pereopods 2 and 3 after several years' preservation in alcohol.

**Remarks.** The holotype was collected on sandy mud grading onto coral, in 0–4 m; the paratype on cobbles and large boulders in about 2 m.

*Diogenes viridis* belongs to a small group of Indo-West Pacific species in which the antennal peduncles are slender and shorter than the ocular peduncles. This group includes *D. gardineri* Alcock, *D. serenei* Forest, and *D. leptocerus* Forest (Forest, 1957); *D. pallescens* Whitelegge (Ball & Haig, 1972); *D. capricorneus* Grant & McCulloch (Grant & McCulloch, 1906); and a *Diogenes* from the coast of New South Wales which is probably to be identified with *D. senex* Heller. In all those species the carapace shield is longer than broad, with its lateral margins straight instead of strongly convex, the antennular peduncles are slender and much longer in relation to the ocular peduncles than they are in *D. viridis*, and the sternal plastron is not exceptionally broadened.

**Etymology.** From Latin *viridis*, green, for the distinctive colouration of the species.

### *Paguristes* Stimpson

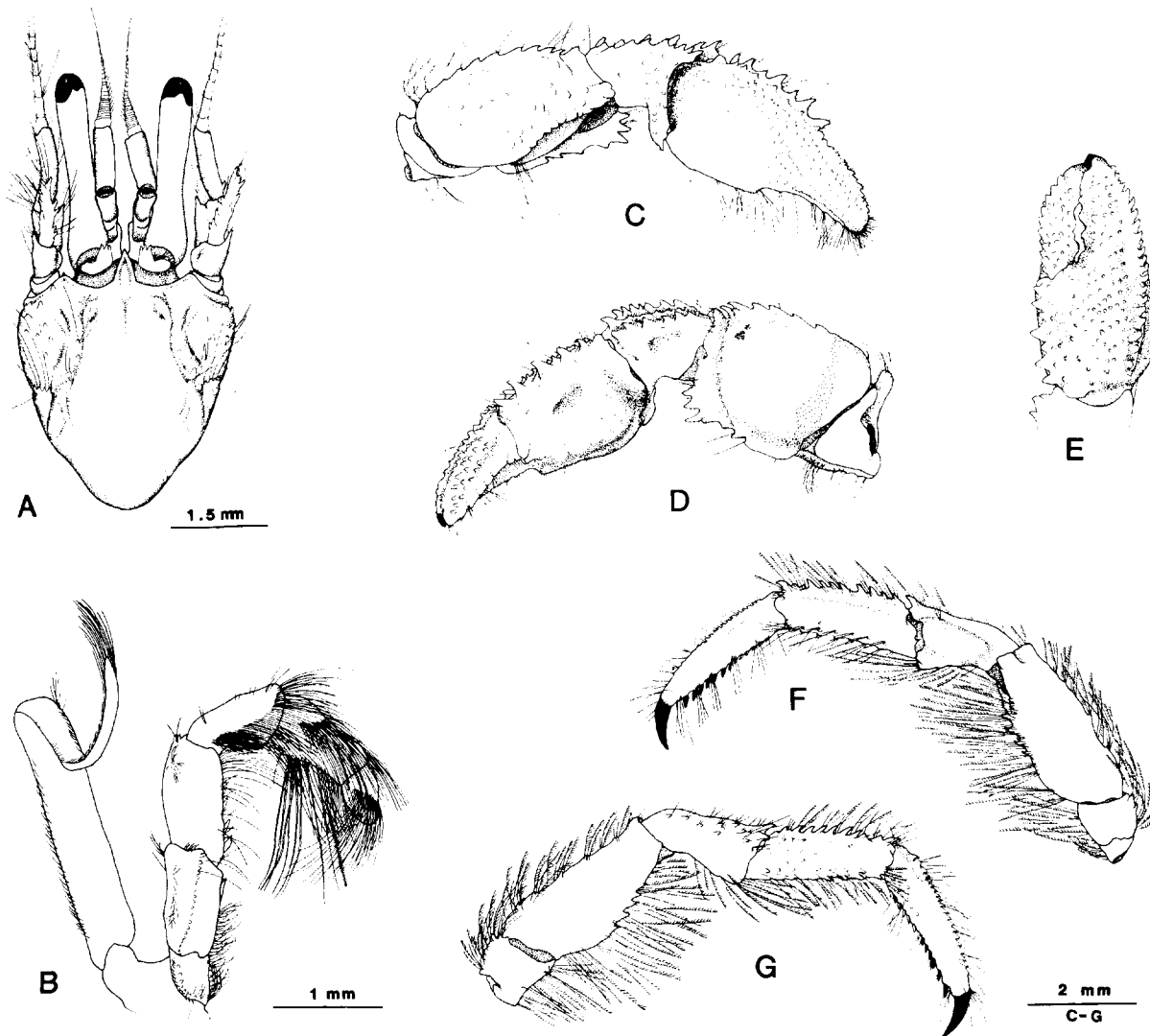
#### *Paguristes kuekenthali* De Man

Figs 4, 5

*Paguristes kükenthali* De Man, 1902: 733, pl. 24 figs 43, 43a–f.

**Material examined.** BANDA Stn 9, 1♂, 3♀ (AHF); Stn 11, 1♂ (AHF); Stn 12, 1♂, 3♀ (NIOJ); Stn 19, 1♀ (AM P37749); Stn 23b, 2♂ (AM P37734). SERAM Stn 2, 1♀ (NIOJ). SAPARUA Stn 3, 1♀ (NIOJ).

**Description.** Shield longer than broad; anterior half of dorsal surface and margins with numerous small spines. Rostrum long, considerably exceeding lateral projections; broad at base and terminating acutely. Ocular peduncles long, about  $\frac{7}{10}$  length of shield; relatively stout. Ocular acicles widely separated basally, terminating in 2–4 spines. Antennular and antennal peduncles slightly shorter than ocular peduncles. Antennal flagella of moderate length, slightly over-reaching tips of chelipeds but shorter



**Fig. 4.** *Paguristes kuekenthali* De Man. [A, ♂, Banda Stn 23b; B–G, ♂, Banda Stn 11]. A, shield and anterior appendages; B, mpx 3 (left, internal view); C, right cheliped (lateral view); D, right cheliped (mesial view); E, right chela (dorsal view); F, left P 2 (lateral view); G, left P 2 (mesial view).

than carapace; with setae of varying lengths, longest ones about equal in length to 4 articles.

Chelipeds with tufts of long setae, especially on mesial margins and ventral faces. Chela with pointed granules over dorsal surface; dorsolateral margin of palm and fixed finger with row of about 16–24 small spines; dorsomesial margin of palm with 4 or 5 strong spines. Carpus with dorsal surface nearly smooth except for few rounded granules; dorsolateral margin with 5 or 6 spines; dorsomesial margin with 4 or 5 strong spines. Merus with row of strong spines on dorsal and ventromesial margins. Second and third pereopods relatively slender, with fringe of long setae on dorsal and ventral margins of all segments. Dactyl with row of small spines or pointed granules along dorsal margin; ventral margin with row of corneous spines. Propodus with row of spines on dorsal margin of pereopod 2, this margin unarmed or with row of

minute spines in pereopod 3. Carpus with row of spines, dorsodistal one strongest.

Male paired first pleopods with short row of rather widely spaced, hooked spines on distal margin of inferior lamella. Females with gonopore on coxa of left pereopod 3 only; brood pouch absent. Female paired first pleopods slender, with very long plumose setae on margins of terminal portion.

Telson with few minute spines on terminal margin of posterior lobes.

**Colour in life.** Shield uniform white or pale orange. Ocular peduncles and corneas solid bright orange. Antennules uniform orange, flagellum transparent. Antennal flagella alternately transparent and red or purple. Chelipeds bright orange; merus with red or dark purple spot on lateral and ventral faces, 2 spots on mesial face; carpus and chela each with similar marking on dorsal, lateral and mesial faces.

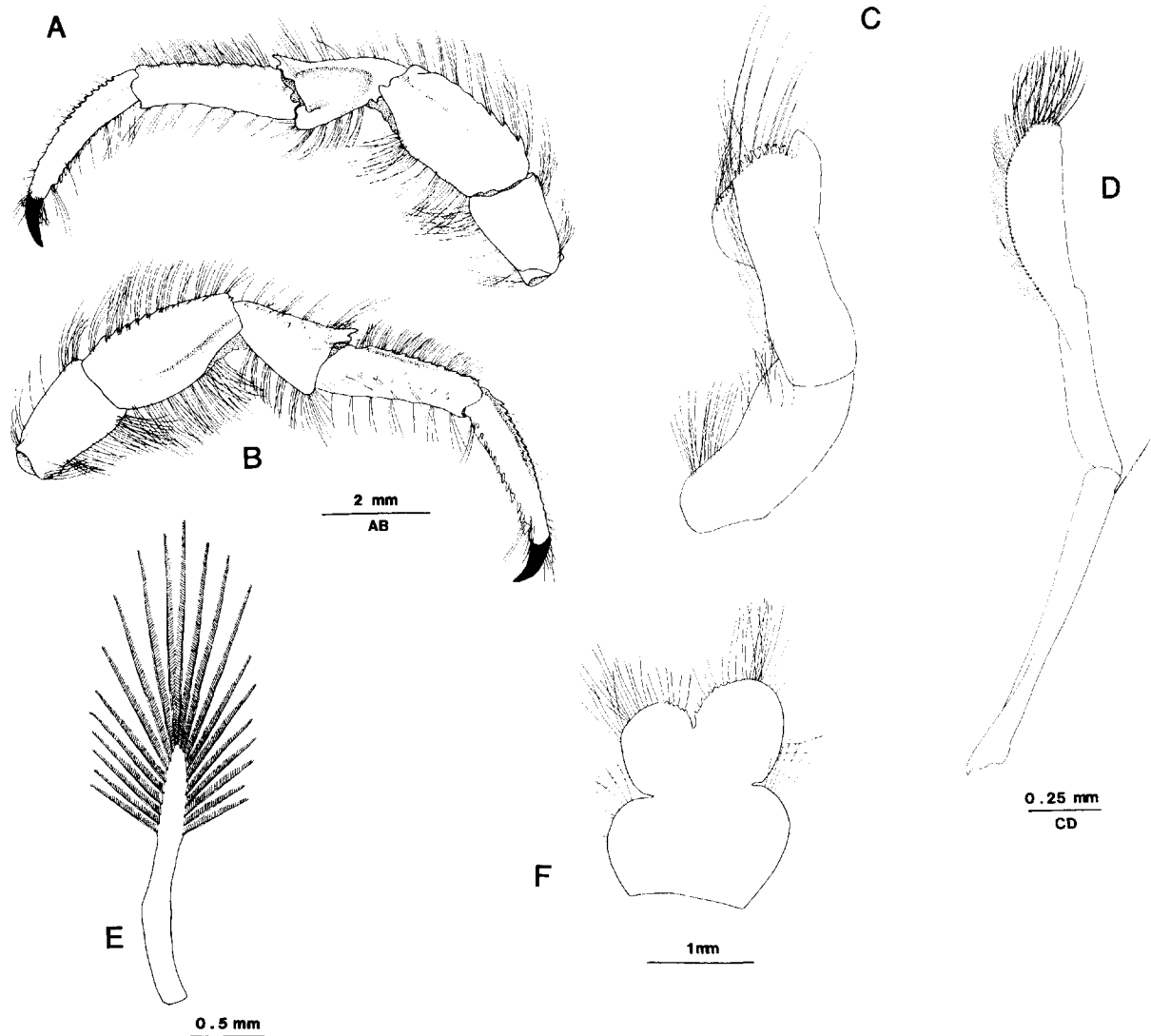


Fig. 5. *Paguristes kuekenthali* De Man. [A, B, F, ♂, Banda Stn 11; C, D, ♂, Banda Stn 23b; E, ♀, Banda Stn 12]. A, left P 3 (lateral view); B, left P 3 (mesial view); C, male pl 1 (left); D, male pl 2 (left); E, female pl 1; F, telson.

Pereopods 2 and 3 bright orange, with lateral red patch on merus and carpus.

**Remarks.** Specimens were taken from rock and coral bottoms in depths of 0–20 m.

Through the courtesy of Dr Michael Türkay, J. Haig was able to borrow the holotype and only known specimen of *Paguristes kuekenthali*, an ovigerous female (SL 3.0 mm) in the collections of the Natur-Museum Senckenberg, Frankfurt am Main (SMF 8560). Examination of this specimen confirmed the identity of our material with De Man's species. Our series of individuals of both sexes and different sizes (males SL 2.2–4.6 mm, females 2.2–4.7 mm) has made it possible to define the species more precisely.

De Man (1902) seems to have been the first to record an Indo-West Pacific species of *Paguristes*

with the right gonopore lacking in females. He noted this phenomenon when describing *P. kuekenthali*, but believed it to be an abnormality. Subsequently, unpaired female gonopores have been reported in *P. jousseaumei* Bouvier, *P. perspicax* Nobili, and *P. abbreviatus* Dechancé (Dechancé, 1963), and in *P. monoporus* Morgan (Morgan, 1987). They are now noted in *P. hians* Henderson (see below under *P. monoporus*). The type locality of *Paguristes kuekenthali* is Ternate in Maluku. The material collected by the *Alpha Helix* slightly extends the known range to Banda, Seram and Saparua in the same group of islands. While work on this report was in progress, a female *P. kuekenthali* (SL 4.5 mm) from Efate Island, New Hebrides (now Vanuatu) was donated to the crustacean collections of the Allan Hancock Foundation. This specimen, which was

taken by Alex Kerstitch in 10 m of water from rubble on a coral reef, establishes a further extension of range eastward.

**Distribution.** Maluku, Indonesia; Vanuatu.

### *Paguristes monoporus* Morgan

*Paguristes hians*.—Grant & McCulloch, 1906: 33 (in part).—McCulloch, 1913: 346. [Not *Paguristes hians* Henderson.]

*Paguristes monoporus* Morgan, 1987: 379, figs 1–3.

**Material examined.** BANDA Stn 5b, 1♂, 1♀ (AM P37796); Stn 9, 1♀ (NIOJ); Stn 12, 1♂ (AM P37791); Stn 13, 1♂ (NIOJ); Stn 14, 1♂ (NIOJ); Stn 19, 1♀ (NIOJ); Stn 23b, 1♂, 1♀ ov (AHF); Stn 24a, 1♂ (AHF). SERAM Stn 2, 2♀ (NIOJ).

**Colour in life.** Carapace mottled white and salmon or brown. Ocular peduncles longitudinally striped purple and white or purple and orange, stripes continuing onto cornea. Antennular peduncles with basal segment brown or purple, terminal segment blue or green; flagellum orange. Antennal flagella alternately banded brown and transparent. Chelipeds with merus mottled dark brownish purple through white; carpus and chela fairly uniform orange tan on white. Pereopods 2 and 3 with orange-tan or brown longitudinal stripes on white background; merus and carpus sometimes mottled brown and white. Setation white.

**Remarks.** Most specimens were collected in depths of less than 5 m, generally on corals. There was no clear correlation with exposure.

The female specimen from Banda Station 9 was infected by a rhizocephalan. One specimen from Seram Station 2 was parasitised by a branchial bopyrid, *Bopyrissa* sp., and by a pair of abdominal bopyrids, *Parathelges whiteleggei* Nierstrasz & Brender à Brandis. The same crab was further burdened with a rhizocephalan attached to the abdomen.

*Paguristes monoporus* is distinguished by the absence in males of the left gonopore and left second pleopod, together with extreme reduction in size of the left first pleopod. Because the antennal flagella are shorter than the carapace, the antennular peduncles are as long as or slightly shorter than the ocular peduncles, and the chelae are heavily setose with an hiatus between the dactyl and the fixed finger, it superficially resembles *Paguristes hians* Henderson. The latter species, which has been reported from several localities in the Indo-West Pacific, differs from *P. monoporus* by the presence of equal-sized first pleopods and paired gonopores in males, the absence of both male second pleopods, and the presence in females of a large brood pouch; as in Morgan's species, females of *P. hians* have a gonopore on the left side only (unpublished observations by J. Haig).

Reporting on a collection of crustaceans made in Queensland in 1904, Grant & McCulloch (1906: 33)

noted that *Paguristes hians* is "...fairly common in depths of 17–20 fathoms off Mast Head Island". J. Haig has examined a sample of three specimens labelled *Paguristes hians* in the collections of the Australian Museum (AM G5732). The accompanying data (Masthead Island, F.E. Grant, Feb. 1907, 17 fathoms) show that these specimens were presented to the Museum by Grant in 1907 and that they are at least part of the material identified and reported by Grant & McCulloch (1906) as *P. hians*. A female *Paguristes* (SL 1.8 mm, AM P37790) in the sample could not be identified and probably belongs to an undescribed species. It superficially resembles *P. hians* but differs from the latter in having long antennal flagella with very long setae on their ventral margin and paired gonopores on the coxae of the third pereopods, and in lacking a brood pouch. The other two specimens (♂ SL 2.8 mm, ♀ SL 2.1 mm) proved to be *P. monoporus*. At present there is no evidence that *P. hians* occurs in Australian waters.

**Distribution.** Northern Territory, Australia and herein recorded from Maluku and Capricorn Group, Queensland.

### *Paguristes runyanae* n.sp.

Figs 6, 7

**Material examined.** HOLOTYPE: BANDA Stn 1, ♂ SL 5.8 mm (NIOJ A.020). PARATYPES: BANDA Stn 1, 1♂ SL 4.8 mm (AHF 756); Stn 2, 1♀ ov SL 4.7 mm (NIOJ A.007).

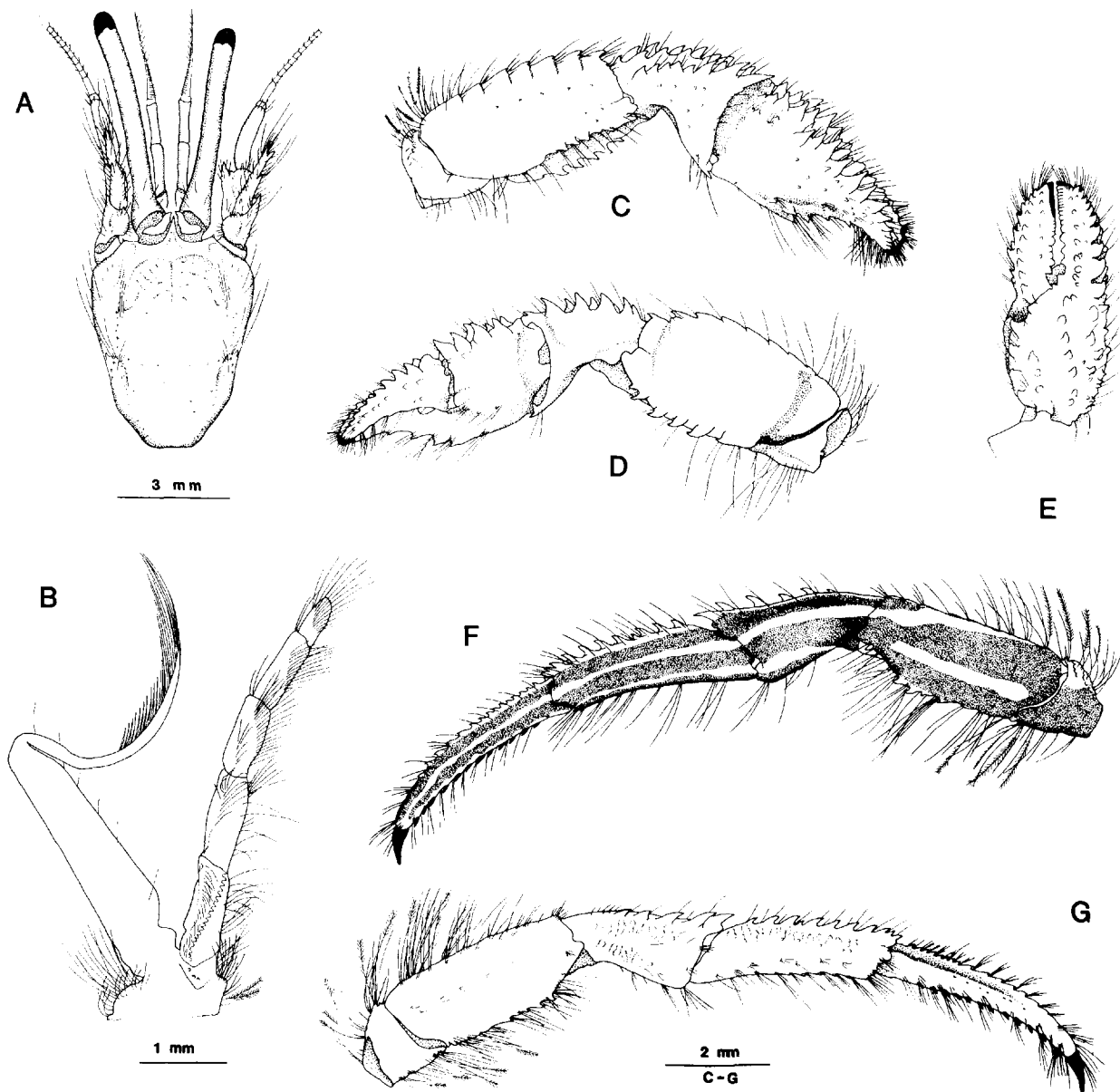
**Description.** Shield considerably longer than broad; anterior margin between rostrum and lateral projections concave; posterior margin truncate; dorsolateral surfaces and margins with small spines and long plumose setae. Rostrum long, slender, considerably exceeding lateral projections; terminating acutely. Lateral projections broadly triangular, with acute spinule at tip.

Ocular peduncles slender, very long, nearly or quite equalling length of shield; slightly inflated basally; dorsal surface with few long setae proximally. Ocular acicles with mesial margin straight or rather uneven; terminating in acute spine; widely separated basally.

Antennular peduncles  $\frac{2}{3}$  to  $\frac{3}{4}$  length of ocular peduncles. Ultimate and penultimate segments unarmed; basal segment with small spine at ventromesial distal angle and prominent spine on lateral face.

Antennal peduncles reaching distal half to distal third of ocular peduncles; with supernumerary segmentation. Fifth segment unarmed. Fourth segment sometimes with small spine on dorsodistal margin. Third segment with ventromesial distal angle produced, terminating in strong acute spine. Second segment with dorsolateral distal angle produced, terminating in acute single or bifid spine; dorsomesial distal angle with small spine; lateral and





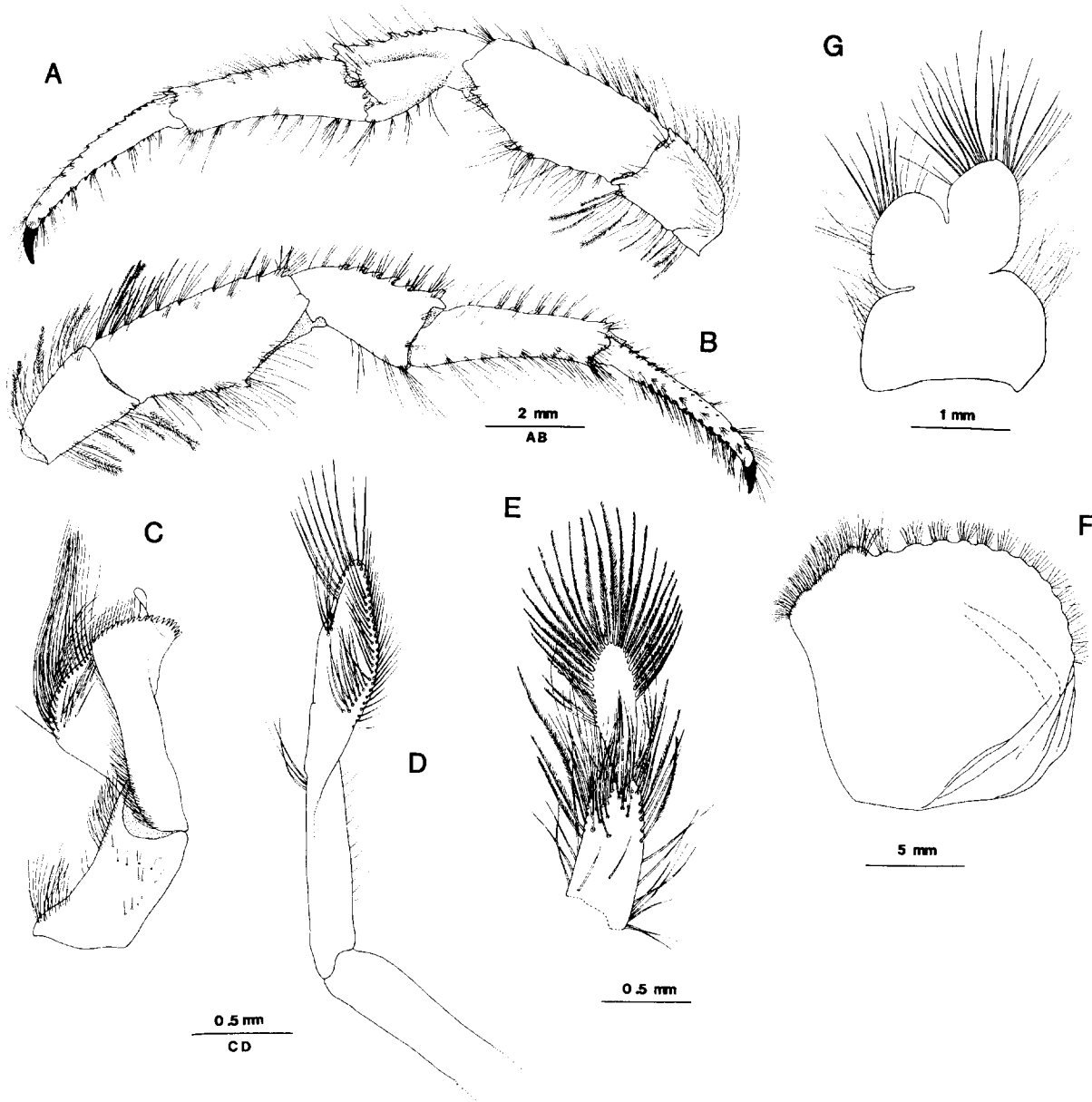
**Fig. 6.** *Paguristes runyanae* n.sp. [A, holotype ♂, Banda Stn 1; B–G, ♂, Banda Stn 1]. A, shield and anterior appendages; B, mxp 3 (left, internal view); C, right cheliped (lateral view); D, right cheliped (mesial view); E, right chela (dorsal view); F, left P 2 (lateral view); G, left P 2 (mesial view).

mesial margins unarmed; lateral margin with long setae. First segment unarmed. Antennal acicle reaching proximal half to distal fourth of ultimate peduncular segment; terminating in bifid spine; lateral margin with 1–3 spines, mesial margin with 2–4; with long setae. Antennal flagella long, over-reaching tips of chelipeds and longer than carapace; each article with several short setae.

Third maxillipeds with basis and ischium distinctly separate; basis with 3 or 4 small spines; ischium with crista dentata evenly developed, ventral margin with small spine distally; merus with 3–5 prominent spines on ventral margin; carpus with

small spine on dorsodistal margin, sometimes 1 on ventrodistal margin.

Chelipeds subequal, left slightly more slender than right. Dactyl about  $\frac{1}{3}$  longer than palm; cutting edge with calcareous teeth proximally, corneous teeth distally; terminating in small corneous claw; dorsal surface with row of small corneous-tipped spines or tubercles near cutting edge, dorsomesial margin with row of well-developed, corneous-tipped spines decreasing in size distally; mesial face with row of small corneous-tipped spines, and with scattered corneous-tipped tubercles near ventral margin; ventral face nearly smooth; all surfaces with tufts of



**Fig. 7.** *Paguristes runyanae* n.sp. [A, B, ♂, Banda Stn 1; C, D, holotype ♂, Banda Stn 1; E–G, ♀, Banda Stn 2]. A, left P 3 (lateral view); B, left P 3 (mesial view); C, male pl 1 (left); D, male pl 2 (right); E, female pl 1; F, brood pouch; G, telson.

setae. Fixed finger slightly broader than dactyl; cutting edge with calcareous teeth, forming narrow hiatus with dactyl proximally; terminating in corneous claw; dorsal surface with row of conical, corneous-tipped spines near cutting edge; lateral face with row of small corneous-tipped spines near dorsal and another near ventral margin; ventral face with tufts of setae, these more thickly set distally. Palm about  $\frac{2}{3}$  length of carpus; dorsomesial margin with 4 strong, conical, corneous-tipped spines; dorsal surface with irregular, widely spaced longitudinal rows of well-developed conical spines, and with scattered short setae; mesial face smooth except for a few spinulose tubercles near dorsomesial spine row

and along distal margin; dorsolateral margin with row of well-developed spines, these continuing to tip of fixed finger; lateral face with irregular row of small spines or spine-tipped tubercles, these continuing onto fixed finger; ventral surface with few spinulose tubercles and tufts of long setae. Carpus  $\frac{3}{5}$  to  $\frac{2}{3}$  length of merus; dorsomesial margin with 4 to 6 strong, corneous-tipped spines; dorsal surface with submedian row of small corneous-tipped spines; dorsolateral margin with row of moderately strong spines; mesial and ventral faces nearly smooth; lateral face with scattered corneous-tipped tubercles. Merus laterally compressed, with row of crenulations on dorsal margin proximally, these becoming small

spines distally, and with long setae; lateral face faintly rugose; mesial face smooth; ventrolateral and ventromesial margins each with row of spines and with scattered setae.

Second pereopods with dactyl slender, slightly longer than propodus; terminating in strong, curved corneous claw; dorsal surface with row of small spines and with tufts of setae; lateral face nearly smooth, with few scattered tufts of setae; mesial face with median row of small corneous spinules, with broad sulcus dorsoproximally and tufts of long setae ventrally; ventral margin with row of corneous spines increasing in size distally, with tufts of long setae. Propodus slender,  $1\frac{1}{3}$  to  $1\frac{1}{2}$  length of carpus; dorsal surface with row of moderately strong spines and with tufts of setae; lateral face nearly smooth, with 1 or 2 small spines on ventral part of distal margin; mesial face nearly smooth, with few small spines on ventral part of distal margin, sometimes with longitudinal row of small spines near distal row, and with scattered setae; ventral surface unarmed or with row of inconspicuous spines, and with tufts of long setae. Carpus  $\frac{2}{3}$  to  $\frac{7}{10}$  length of merus; dorsal surface with irregular row of spines, distal 2 prominent, and with tufts of short setae; lateral face with longitudinal sulcus, otherwise smooth with few scattered setae; mesial and ventral faces smooth with scattered tufts of setae. Merus laterally compressed; dorsal margin unarmed or with row of inconspicuous spines, and with long plumose setae; lateral and mesial faces with scattered short setae; ventral margin with irregular row of spines increasing in size distally. Ischium with row of small tubercles and long plumose setae dorsally; ventral margin with small spine distally and with long plumose setae.

Third pereopods with dactyl as in second pereopods. Propodus  $1\frac{1}{2}$  to  $1\frac{2}{3}$  length of carpus; dorsal surface unarmed or with row of small spines, and with tufts of setae; lateral face nearly smooth, with small spines on distal margin, 1 dorsally and 2 to 4 ventrally; mesial face nearly smooth, with 3 small spines dorsodistally and 4 or 5 ventrodistally; ventral surface unarmed or with row of inconspicuous spines, and with tufts of long setae. Carpus about  $\frac{2}{3}$  length of merus; dorsal surface with row of spines, distal one prominent; lateral face with longitudinal sulcus, otherwise smooth with few scattered setae; mesial and ventral faces smooth with scattered tufts of setae. Merus laterally compressed; dorsal margin with long setae; lateral face with spine ventrodistally; mesial face with scattered setae; ventral margin crenulate with 1 or 2 small spines distally, with long plumose setae. Ischium with long plumose setae on dorsal surface; ventral margin with small spine distally and with long plumose setae.

Male paired first pleopods with tuft of long bristles at superior mesial angle of basal segment, mesial margin with row of moderately long bristles distally; inferior lamella with band of long, closely set bristles

along lateral margin, distal margin with row of short, slightly curved spines; external lobe considerably exceeding inferior lamella in distal extension; internal lobe broad and much shorter than external lobe, mesial and distal margins with closely set, very long bristles. Paired second pleopods with basal segment glabrous; distal segment with marginal row of setae, endopodite with tuft of long bristles, appendix masculina with long setae on margins and exterior face.

Female gonopores paired. Paired first pleopods with long plumose setae on margins and interior face of basal segment; distal segment with row of long plumose setae on distal half of margins. Brood pouch large, subquadrate, distal margin scalloped and with tufts of setae.

Telson with posterior lobes asymmetrical, left longer than right; separated by deep median cleft; unarmed; terminal margins with long setae, lateral margins with short bristles; anterior lobes unarmed.

**Colour in life.** Carapace purple; shield with 3 irregularly shaped, longitudinal orange stripes (1 median, 2 sublateral), these continuing onto posterior carapace. Ocular peduncles purple, with broad white band next to black cornea; acicles orange with purple tips. Antennular peduncles purple, flagellum white. Antennal peduncles purple, distal segment with pale longitudinal stripe; flagellum purple. Chelipeds purple with bright orange longitudinal stripes, latter mostly centred over rows of spines. Pereopods 2 and 3 purple with longitudinal stripes, these mainly white but with some orange and disposed (Fig. 6F).

**Remarks.** The specimens were found in relatively protected subtidal areas in 0–8 m on coral.

In Alcock's (1905b) and Miyake's (1978) keys to Indian Ocean and Japanese *Paguristes*, *P. runyanae* would be placed with those species in which the antennal flagella are decidedly longer than the carapace and the antennular peduncles are shorter than (or equal to) the ocular peduncles. Of this group of species, *P. acanthomerus* Ortmann is distinguished by having a prominent spine on the ventral face of the merus of the chelipeds. In *P. seminudus* Stimpson and *P. mundus* Alcock the chelae are densely covered with spines. The chelae of *P. balanophilus* Alcock and *P. ciliatus* Heller are decorated with small, closely set tubercles: in the former species these tubercles are squamiform, in the latter acuminate and concealed by a dense tomentum. In *P. acanthomerus* and *P. balanophilus*, the only species of this group for which it has been recorded (Miyake, 1978), the live colouration is quite unlike that of *P. runyanae*.

**Etymology.** We are pleased to dedicate this species to our illustrator, Frances Runyan.

**Trizopagurus** Forest**Trizopagurus strigatus** (Herbst)

*Cancer strigatus* Herbst, 1804: 25, pl. 61 fig. 3.

*Pagurus annulipes* H. Milne Edwards, 1848: 63.

*Aniculus strigatus*.—Alcock, 1905b: 97, pl. 7 fig. 4.

*Trizopagurus strigatus*.—Forest, 1952b: 2; 1952c: 6, 19, figs 5, 14, 21.—Humes, 1981: 5, 7.

**Material examined.** BANDA Stn 3, 1♂ (AHF); Stn 4, 3♂, 2♀ (NIOJ); Stn 5b, 2♀ (1 ov) (NIOJ); Stn 9, 1 juv (AM P37747); Stn 19, 5♂, 3♀ (1 ov), 1 juv (AM P37753, AM P37789); Stn 20, 1♂ (NIOJ); Stn 21, 5 juv (AHF); Stn 23b, 1♀ (AHF); Stn 24b, 1♀ (AM P37793); Gunungapi, coll. A.G. Humes, 3♂, 1♀ (NIOJ, AHF). SERAM Stn 2, 3♂ (NIOJ). SAPARUA Stn 3, 1♀ (NIOJ).

**Colour in life.** Shield pure white. Ocular peduncles and antennules solid orange. Antennal flagella transparent. Chelipeds and pereopods 2 and 3 with alternating red and orange bands (each scute with red

distally and orange proximally).

**Remarks.** At Banda this species was found under all conditions of exposure; the usual depth range was 3–15 m, mostly on coral. In some areas the species was quite abundant. At Seram and Saparua it was collected in 0–5 m.

One individual from Banda Station 21 was parasitised by a rhizocephalan. The specimen from Banda Station 9 bore an abdominal bopyrid, an undescribed species of *Athelges*; the parasite, which was as large as its host, was hyperparasitised by two cabiropsid isopods, *Cabirops* sp. The specimens collected by A.G. Humes had copepods associated with them (Humes, 1981).

**Distribution.** Red Sea and east coast of Africa to Hawaiian and Society Islands. The type locality was “Ostindien”, but the present records appear to be the first precise ones for Indonesia.

**Family PAGURIDAE****Key to Genera of Paguridae Known from Maluku  
in 20 Metres or Less**

1. Right chela operculate, fingers opening obliquely; females with paired first pleopods ..... *Pylopaguropsis*  
 —Right chela not operculate, fingers opening horizontally; no paired pleopods in either sex ..... 2
2. No sexual tube present in males ..... *Pagurus*  
 —Males with sexual tube on coxa of right or left pereopod 5 ..... 3
3. Males with sexual tube on coxa of right pereopod 5; dactyl of pereopod 4 with preungual process on lateral face ..... *Catapagurus*  
 —Males with sexual tube on coxa of left pereopod 5; no preungual process on dactyl of left pereopod 4 ..... 4
4. Ischium of third maxillipeds without accessory crista dentata tooth; male sexual tube terminating in tuft of setae ..... *Anapagridentes*  
 —Crista dentata of third maxilliped with accessory tooth; no tuft of setae at tip of male sexual tube ..... 5
5. Telson with terminal margin entire; eyescales subrectangular and multispinate; males with gonopore on left pereopod 5 only ..... *Micropagurus*  
 —Telson with median cleft on terminal margin; eyescales triangular or subovate, with single distal spine; male gonopores paired ..... 6
6. Male sexual tube curved; chelipeds unequal, right much larger than left .... *Anapagurus*  
 —Male sexual tube rolled into a spiral; chelipeds subequal, right not much larger than left ..... *Spiropagurus*

**Anapagridentes** de Saint Laurent-Dechancé**Anapagridentes** sp.

Fig. 8

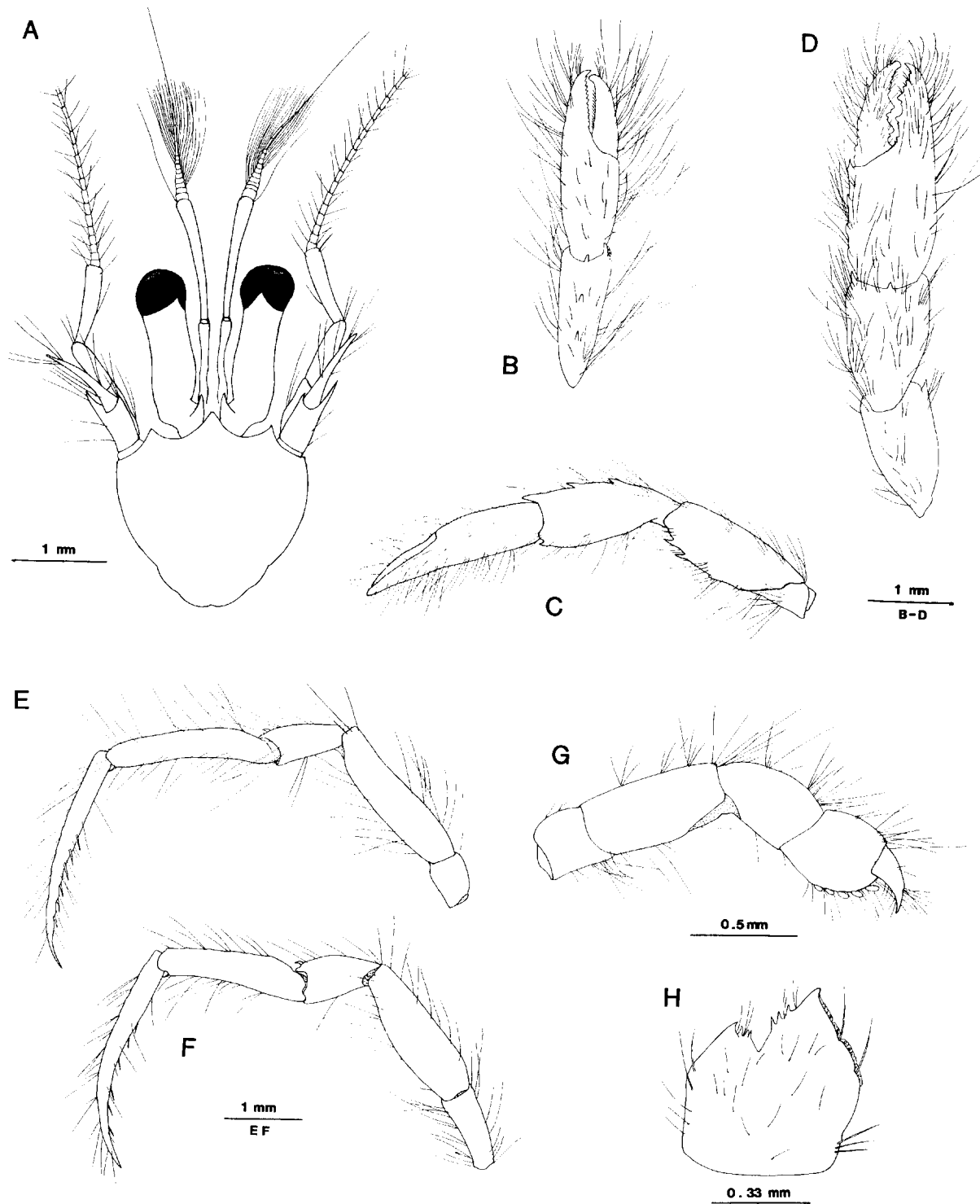
**Material examined.** SAPARUA Stn 3, 1♂ (NIOJ).

**Colour in life.** Transparent but for dark corneas and

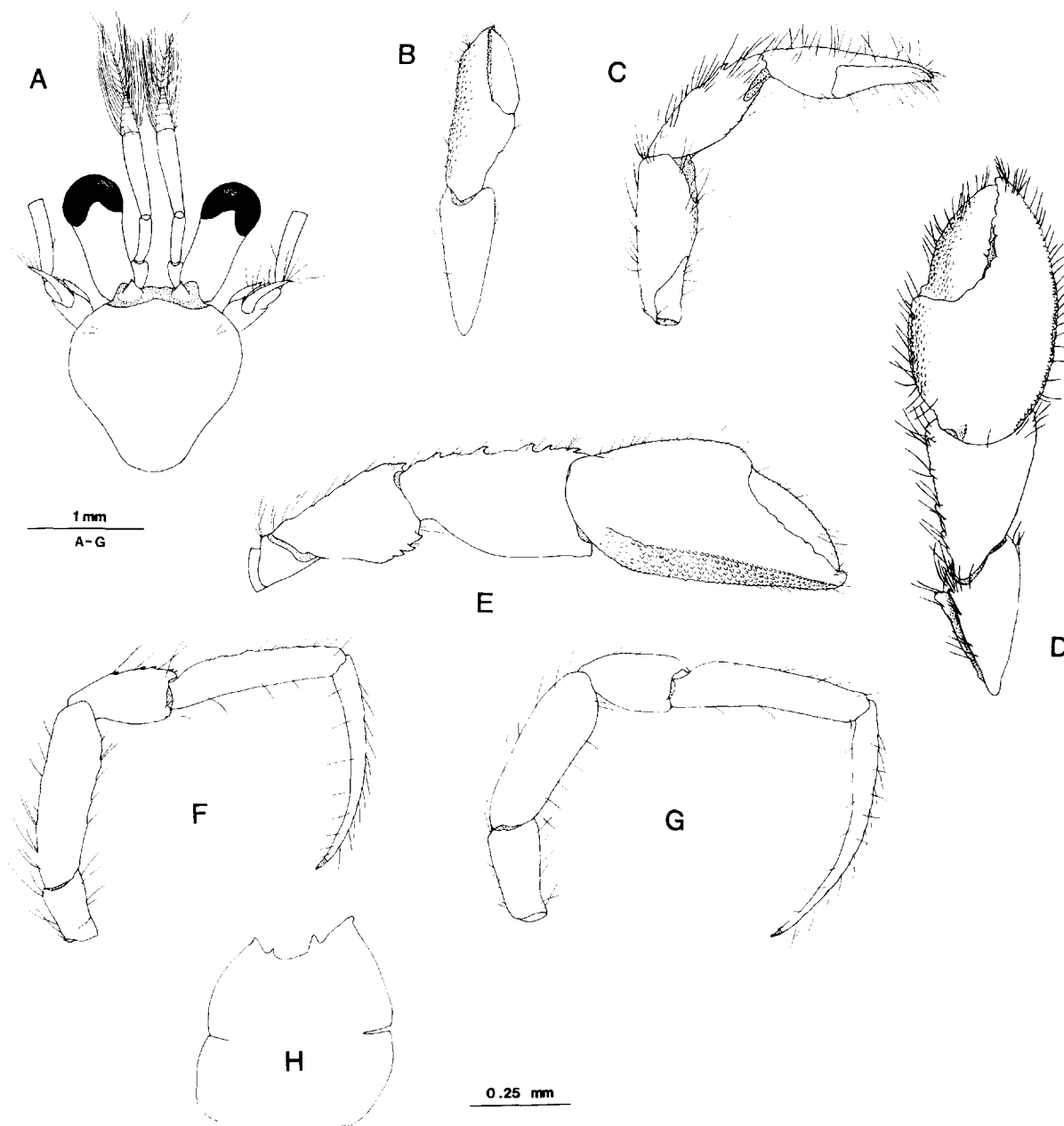
scattered red chromatophores.

**Remarks.** This hermit crab (SL 2.0 mm) was taken on a cliff face of rock and coral, in 5 m or less.

De Saint Laurent-Dechancé (1966b: 262) established the genus *Anapagridentes* for *Eupagurus* (*Spiropagurus*) *facetus* Melin from the Ogasawara (Bonin) Islands and for two other Indo-West Pacific



**Fig.8.** *Anapagrides* sp. [♂, Saparua Stn 3]. **A**, shield and anterior appendages; **B**, left chela and carpus (dorsal view); **C**, left cheliped (lateral view); **D**, right cheliped (dorsal view); **E**, right P 2 (mesial view); **F**, left P 3 (lateral view); **G**, right P 4 (lateral view); **H**, telson.



**Fig. 9.** *Anapagurus* sp. [♂, Saparua Stn 1]. **A**, shield and anterior appendages; **B**, left chela and carpus (dorsal view); **C**, left cheliped (mesial view); **D**, right cheliped (dorsal view); **E**, right cheliped (dorsolateral view); **F**, right P 2 (lateral view); **G**, right P 3 (lateral view); **H**, telson.

species which are still undescribed. Our specimen agrees with the diagnosis of *Anapagriles* and certainly belongs in that genus, but no more can be said about its status at this time.

*Anapagurus* Henderson

*Anapagurus* sp.

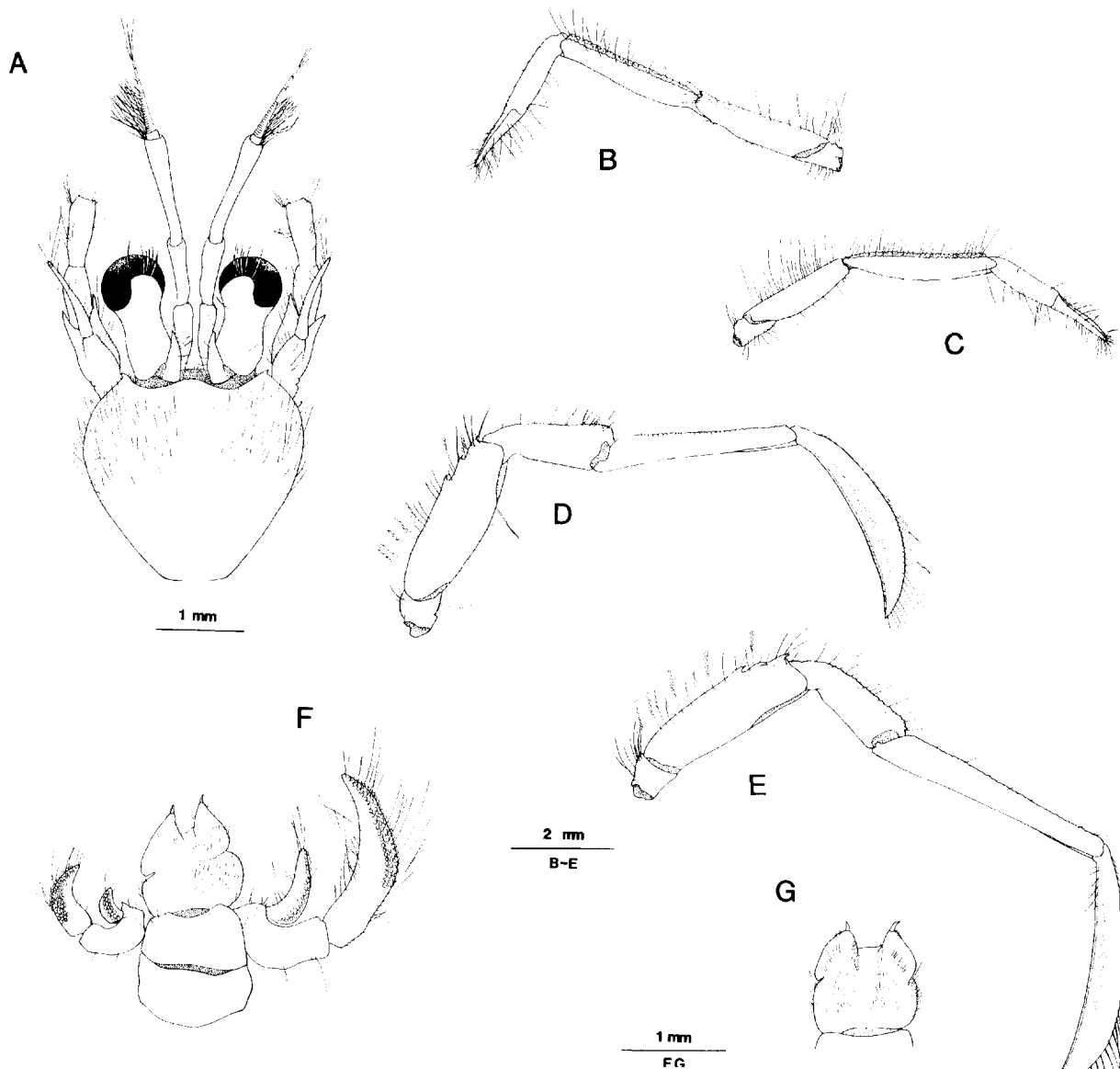
Fig. 9

**Material examined.** SAPARUA Stn 1, 2♂, 3♀ (2 ov) (NIOJ).

**Colour in life.** Basically transparent except for abundant white chromatophores.

**Remarks.** These hermits were found on white sand in 5–7 m. They can take great leaps backwards (6–8 cm) and move very rapidly over the sand when frightened.

Not much has been published on the genus *Anapagurus* in the Indo-West Pacific, and we have been able to place these small specimens (males SL 1.2 and 1.4 mm, non-ovigerous female SL 0.9 mm,



**Fig. 10.** *Catapagurus* sp. [♀, Arafura Stn 3]. **A**, shield and anterior appendages; **B**, right cheliped (mesial view); **C**, left cheliped (mesial view); **D**, left P 2 (mesial view); **E**, left P 3 (mesial view); **F**, telson and uropods; **G**, telson of *Catapagurus ensifer* Henderson. [Syntype ♀, Gulf of Martaban, Burma, BMNH 1888.34].

ovigerous females SL 1.2 and 1.4 mm) to genus only. They show similarities with *Anapagurus bonnieri* Nobili from the Gulf of Iran and the Red Sea (Lewinsohn, 1969: 87, fig. 15) and with *A. japonicus* Ortmann from Japan (Miyake, 1978: 139, fig. 55).

***Catapagurus* A. Milne Edwards**

***Catapagurus ensifer* Henderson**

*Catapagurus ensifer* Henderson, 1893: 424, pl. 38 figs 16–19.—Alcock, 1905b: 115, pl. 15 fig. 3.—Lewinsohn, 1969: 79.

**Material examined.** BANDA Stn 20, 2♂, 1 unsexed (NIOJ).

**Colour in life.** Shield pink. Antennular peduncles white or pink with red bands. Antennal peduncles banded red; flagellum uniform red or pink. Ocular peduncles uniform red, cornea golden. Chelipeds white or salmon with narrow red longitudinal stripes on carpus and chela. Second and third pereopods white, proximal segments with red bands and narrow red longitudinal stripes, dactyl with single longitudinal row of red chromatophores.

**Remarks.** These crabs were observed leaping about

on a fairly fine sand substrate in 8–15 m. Of several collected, there remain only three specimens (one SL 1.2 and two SL 1.4 mm) with their pereopods detached and abdomens missing. Several species that were originally placed in *Catapagurus* have subsequently been assigned to other genera. Currently it contains about ten species from the Indo-West Pacific, some of them not yet described (Forest & de Saint Laurent, 1968: 151; de Saint Laurent, 1970: 1456). The lack of an up-to-date revision of the genus, and the poor condition of our specimens, make identification difficult, but we tentatively assign them to *Catapagurus ensifer*. They agree closely with Henderson's and Alcock's descriptions, and with the comments of Lewinsohn.

**Distribution.** Reported only from the Indian Ocean: Red Sea, Providence Island, Cargados Carajos, Maldive Islands, Sri Lanka and Burma. The known range is now extended eastward to Banda in Indonesia.

*Catapagurus* sp.

Fig. 10A–F

**Material examined.** ARAFURA Stn 3, 1♀ ov (AM P37730).

**Colour in life.** Corneas gray; distal portion of pereopods 2 and 3 transparent; rest of body mottled with red and white chromatophores.

**Remarks.** Trawled in 49 m. This very rapidly moving crab was observed to leap backward much like a lobster. In its shell it harboured a polychaete worm, which has been identified as a juvenile *Eunice* sp. (family Eunicidae).

*Catapagurus* sp. was one of four "leaper" crabs encountered during the *Alpha Helix* Expedition. *Diogenes avarus* Heller, *Anapagurus* sp., and *Catapagurus ensifer* Henderson were all found on sandy bottoms; we have no information on the substrate at the Torres Strait locality where the unidentified *Catapagurus* was collected.

Our specimen agrees with two Indo-West Pacific species, *Catapagurus ensifer* Henderson and *C. granulatus* Edmondson, in having the dactyl of pereopods 2 and 3 broad and shaped like a sabre blade. It can easily be distinguished from those species by the shape of the telson. In both *C. ensifer* (this paper, Fig. 10G) and *C. granulatus* (Edmondson, 1951: fig. 8f) the posterior lobes of the telson are shorter and more widedset, and consequently separated by a shallower and broader notch, than in the individual from Torres Strait.

The *Catapagurus* from Arafura Station 3 probably belongs to an undescribed species. However, because of the pronounced sexual dimorphism that exists in members of the genus, it seems inadvisable to furnish it with a name and description on the basis of a single specimen.

*Micropagurus* McLaughlin

*Micropagurus vexatus* n.sp.

Figs 11, 12

**Material examined.** HOLOTYPE: SAPARUA Stn 1, ♂ SL 1.7 mm (NIOJ A.003). PARATYPES: BANDA Stn 9, 1♂ SL 1.6 mm (AHF 755), 1♀ ov SL 1.4 mm (NIOJ A.002); SERAM Stn 2, 1♀ SL 2.5 mm (NIOJ A.013).

**Description.** Shield approximately as broad as long; anterior margin between rostrum and lateral projections weakly concave; posterior margin rounded or roundly truncate; dorsal surface with tufts of moderately long setae. Rostrum slightly produced, broadly rounded. Lateral projections broadly rounded, unarmed.

Ocular peduncles about  $\frac{1}{10}$  length of shield, slender, slightly to strongly inflated basally, constricted at base of cornea; with tufts of short setae dorsomesially. Ocular acicles subquadrate, with 5–7 spines on margin and fringe of long setae just proximal to spine row; widely separated basally.

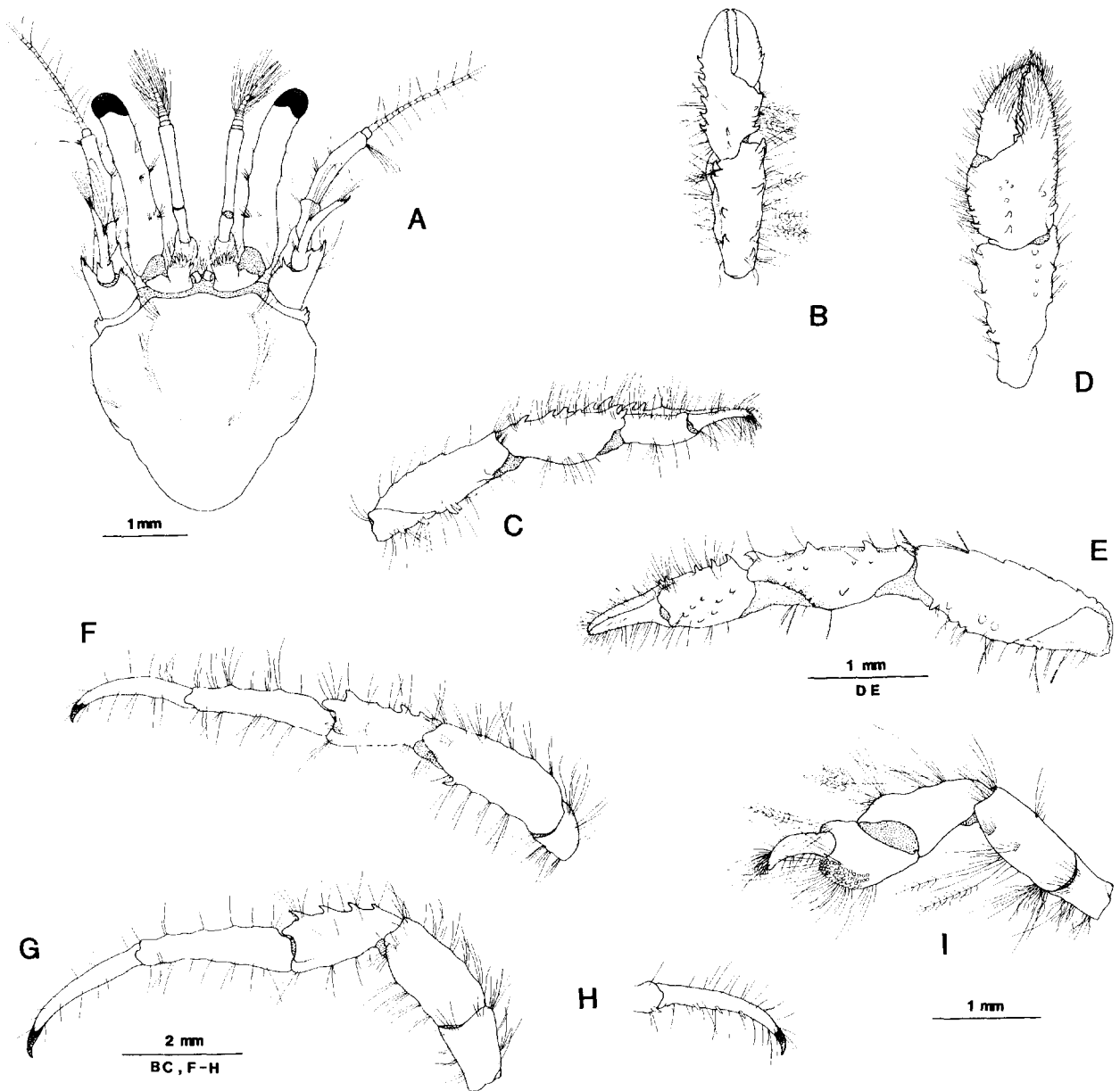
Antennular peduncles falling short of or barely reaching to base of cornea. Ultimate and penultimate segments unarmed; basal segment with strong spine at ventrolateral distal angle.

Antennal peduncles not reaching to base of cornea. Fifth and fourth segments unarmed and with tufts of setae. Third segment unarmed or with small spine at ventromesial distal angle. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine; dorsomesial angle with small spine. First segment with small, simple or bifid spine on lateral margin distally. Acicle moderately short, terminating in small spine; mesial margin unarmed or with 1 or 2 small spines, lateral margin unarmed or with spine proximally. Flagellum with few long and short setae distally on each article.

Third maxillipeds with small tooth on basis; ischium with moderately developed crista dentata and with accessory tooth; merus and carpus each with strong dorsodistal spine.

Chelipeds moderately short in comparison to their width. Right cheliped with dactyl usually slightly shorter than palm; cutting edge with 2 calcareous teeth proximally and with row of very small corneous teeth distally; terminating in small corneous claw; dorsomesial margin with 2–4 spines on proximal half, with fringe of long setae; dorsal surface unarmed, with long setae. Palm about  $\frac{2}{3}$  length of carpus; dorsomesial margin with row of spines and with long setae, mesial face with scattered tubercles; dorsal surface flattened, with longitudinal row of small spines proximally and with few small tubercles distally; dorsolateral margin with row of spines extending onto fixed finger for approximately half its length, with fringe of long setae; fixed finger with row of small calcareous teeth on cutting edge and long setae on dorsal surface; terminating in corneous claw. Carpus approximately as long as merus;





**Fig.11.** *Micropagurus vexatus* n.sp. [A–C, F–I, ♀, Seram Stn 2; D, E, holotype ♂, Saparua Stn 1]. A, shield and anterior appendages; B, left chela and carpus (dorsal view); C, left cheliped (mesial view); D, right chela and carpus (dorsal view); E, right cheliped (mesial view); F, left P 2 (lateral view); G, left P 3 (lateral view); H, dactyl of left P 3 (mesial view); I, left P 4 (lateral view).

dorsomesial margin with 3 strong, widely spaced spines; dorsolateral margin obscurely tuberculate; mesial and lateral faces with scattered tubercles. Merus with row of protuberances on dorsal margin; mesial face with few strong tubercles near ventral margin, ventromesial margin with strong spine on distal half; lateral face tuberculate ventrally.

Left cheliped (missing in holotype) with dactyl approximately  $1\frac{1}{2}$  times as long as palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; dorsomesial margin with row of

3 spines medially and with fringe of long setae; dorsal surface unarmed, with long setae. Palm slightly less than  $\frac{1}{2}$  length of carpus; dorsomesial margin with 3 or 4 spines and with long setae; dorsal surface flattened, with 2 spines in longitudinal row proximally; dorsolateral margin with row of spines extending onto fixed finger for less than half its length, and with fringe of long setae; fixed finger with row of small corneous teeth on cutting edge and long setae on dorsal surface; terminating in corneous claw. Carpus approximately as long as merus;

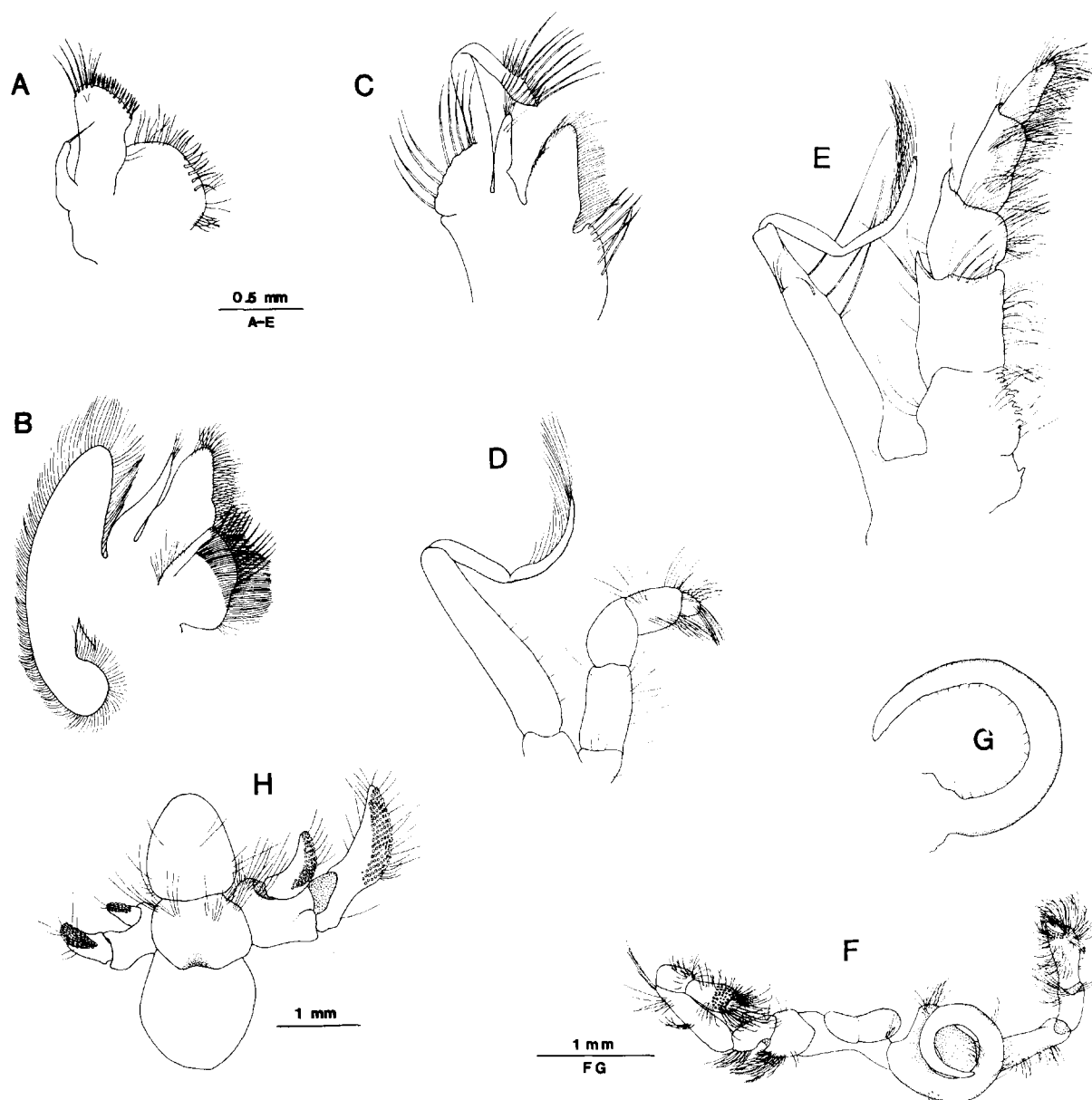


Fig.12. *Micropagurus vexatus* n.sp. [A-E, H, ♀, Seram Stn 2; F, holotype ♂, Saparua Stn 1; G, ♂, Banda Stn 9]. A, maxillule, B, maxilla, C, mxp 1, D, mxp 2, E, mxp 3 (all left, internal view); F, male coxae of P 5 and sexual tube, in situ; G, male sexual tube; H, telson, uropods, and 5th abdominal somite.

dorsomesial margin with 4 strong spines, most distal one very large and terminally bifid; dorsolateral margin with 4 spines; both margins with fringe of setae. Merus with row of protuberances on dorsal margin, mesial face with 2 spines near ventral margin, ventromesial margin with 2 narrow, closely set spines proximally; lateral face tuberculate ventrally, ventrolateral margin with median spine. Ischium with 3 spines on ventral margin.

Second pereopods with dactyl long and slender, shorter than propodus; in lateral view slightly curved ventrally, in dorsal view almost straight; terminating in strong corneous claw; ventral margin with row of 3-5 widely spaced, corneous spines. Propodus about

$1\frac{1}{3}$  times length of carpus; ventral margin with corneous spine distally; lateral and mesial faces with scattered tubercles. Carpus approximately  $\frac{2}{3}$  length of merus; dorsal margin with 3 or 4 spines; lateral face with scattered tubercles. Merus laterally compressed; dorsal and ventral margins with low protuberances, ventral margin usually with strong spine on distal half; lateral face with scattered tubercles. Dorsal and ventral margins of all segments with tufts of setae.

Third pereopods with dactyl long and slender, approximately equalling length of propodus; in lateral view slightly curved ventrally, in dorsal view almost straight; terminating in strong corneous claw;

ventral margin with row of corneous spines. Propodus about 1½ times length of carpus; ventral margin with corneous spine distally. Carpus about as long as merus, or slightly shorter; dorsal margin with 4 spines (all but anterior one broken off in holotype). Merus laterally compressed; dorsal and ventral margins with low protuberances. Dorsal and ventral margins of all segments with tufts of setae.

Fourth pereopods with propodal rasp composed of several rows of scales.

Sternite of pereopod 3 with anterior lobe broad, subrectangular. Sternite of pereopod 5 forming 2 distinct lobes, left larger than right.

Males with coxae of pereopod 5 unequal, left larger than right, with well developed, moderately elongate sexual tube directed outward then doubling back on itself, or forming complete loop; right coxa without gonopore. Uropods asymmetrical, left much larger than right. Telson longer than broad, without transverse suture; terminal margin entire, narrow and rounded, unarmed.

**Colour in life.** (Saparua and Seram) Shield mottled gray and cream or green and white. Ocular peduncles transparent with black mottlings, or mottled green and white; cornea salmon pink or off white. Antennules transparent but for black stripe or row of black dots dorsally. Antennal peduncles with green mottlings; flagellum transparent. Merus of chelipeds with brownish mottling on a white background; carpus and chela dirty white. Second and third pereopods basically transparent with mottled brown and cream; propodus and dactyl each with narrow brown longitudinal stripe on lateral face.

(Banda) Ocular peduncles uniform olive drab. Antennules white except for purple stripe dorsally. Antennal peduncles mottled red and white; flagellum transparent. Right cheliped purplish pink; left with proximal segments mottled olive drab and transparent, palm pink. Ischium and merus of pereopods 2 and 3 purplish pink; carpus with fine red mottlings on white/transparent background; propodus and dactyl with narrow dark longitudinal stripe on lateral face.

**Remarks.** The holotype was collected inshore on rocks covered with coral, the paratype from Seram in about 1 m in a sandy area near coral and eel grass, and the two specimens from Banda between 0–12 m on a bottom of rock, coral and coral rubble.

The specimens from Seram and Saparua each had a bright orange parasite attached to the abdomen. This was identified as the egg sac of an epicaridean isopod, family Cryptoniscidae. In the crab from Seram Station 2, with a total carapace length of approximately 4.8 mm, the egg sac was 6.5 mm long.

Recently McLaughlin (1986: 793–794) described a new genus and species of hermit crab, *Micropagurus devaneyi*, from the Hawaiian Islands. We describe our species as new because it differs from *M. devaneyi* in several details, notably in the shape of the telson. In the Hawaiian species this is broader than

long, widest about midway along the lateral margins, and with proximal and terminal margins approximately equal (McLaughlin, 1986: fig. 3i); in *M. vexatus* it is longer than broad, widest near the proximal end and narrow terminally. Unlike *M. devaneyi*, the new species has a fringe of long setae on the ocular acicles, these arising just proximal to the marginal spines. To judge from the small sample on which each species was based, the antennular and ocular peduncles are relatively more slender in *M. vexatus* than in *M. devaneyi*, and the ocular peduncles longer in comparison to the shield. There are also minor differences in the armature of the pereopods and in the number of rows of scales on the propodus of pereopod 4.

In her description of *Micropagurus devaneyi*, McLaughlin (1986: 797) drew attention to the presence of multispinose ocular acicles in *Anapagurus australiensis* Henderson and *A. polynesiensis* Nobili, and remarked that in this character and in general morphology those species resemble her new genus. She pointed out that de Saint Laurent (1968) had reported the absence of the right gonopore (also a characteristic of *Micropagurus*) in males of *A. polynesiensis*. For these reasons, McLaughlin suggested that *A. australiensis* and *A. polynesiensis* should possibly be assigned to *Micropagurus*.

Henderson (1888: 74, pl. 7 figs 8, 8a,b) described *Anapagurus australiensis* from Port Jackson, N.S.W. Examination of the two syntypes (♂ SL 1.9 mm, ♀ SL 2.1 mm, BMNH 1888.33) confirmed that this taxon is congeneric with the genus *Micropagurus*. The telson is of the same form and approximately the same shape as that of *M. vexatus*, but *M. australiensis* differs from our new species in having the antennular peduncles longer than the ocular peduncles, only four spines on the margin of the ocular acicles, and the carpus of pereopods 2 and 3 unarmed.

Nobili (1906: 260) published a diagnosis of *Anapagurus polynesiensis* from Rikitea in French Polynesia. The following year he presented a longer description with illustrations (Nobili, 1907: 372, pl. 1 figs 10, 10a–c) and noted its relationship to *A. australiensis*. Michèle de Saint Laurent (in communication to J. Haig) repeated her statement (1968: 549) that the male of Nobili's species lacks a gonopore on the right side, and added that the posterior margin of the telson is entire and rounded. This species is hereby transferred to *Micropagurus*. Sketches of the shield, anterior appendages, and chelipeds of *M. polynesiensis*, provided by M. de Saint Laurent, show that it differs from our new species in the greater number of spines on the chela and carpus of the chelipeds, and in lacking a fringe of setae on the ocular acicles.

**Etymology.** From Latin *vexatus* meaning molested or annoyed, in reference to the parasites, considerably larger than their hosts, that were found on two of the type specimens.

*Nematopagurus* A. Milne Edwards & Bouvier*Nematopagurus gardineri* Alcock

*Nematopagurus gardineri* Alcock, 1905a: 834, pl. 68 fig. 3; 1905b: 110, pl. 12 fig. 2.—Miyake, 1978: 129, 130.

**Material examined.** ARAFURA Stn 12, 1♂, 1♀ ov (AM P37750); Stn 13, 1♂ (AHF).

**Colour in life.** Carapace with scattered red and white chromatophores on semi-transparent background. Ocular peduncles transparent dorsally, red ventrally; cornea silvery. Antennules transparent proximally, light reddish brown distally. Antennae reddish brown. Merus and carpus of chelipeds with large red spots on semi-transparent background. Carpus, propodus and dactyl of pereopods 2 and 3 with reddish brown longitudinal stripes on semi-transparent background.

**Remarks.** These crabs were trawled in 58–64 m. One specimen from Station 12 had many anemones on its shell.

Our specimens agree with the original description except for the shape of the ocular peduncles. Alcock describes these as "...not much expanded", but in the *Alpha Helix* material they are markedly expanded at the cornea. Miyake (1978), in what is apparently the first record of this species since the two descriptions of the holotype, did not mention the form of the ocular peduncles.

**Distribution.** Reported only from the Maldiv Islands and from Sagami Bay, Japan; now Arafura Sea.

*Pagurus* Fabricius*Pagurus hedleyi* (Grant & McCulloch)

Fig. 13

*Eupagurus kirkii* Miers, 1884: 267, pl. 28 fig. C. (Name preoccupied by *E. kirkii* Filhol, 1883).

*Eupagurus hedleyi* Grant & McCulloch, 1906: 37. (New name for *E. kirkii* Miers).

*Pagurus hedleyi*.—Gordan, 1956: 330.—Sankolli, 1962: 141.

**Material examined.** ARAFURA Stn 1, 1♂ (AM P37707).

**Colour in life.** Ocular peduncles white with broad, subproximal orange band; cornea black with white speckles. Antennules bluish; penultimate segment of peduncle with broad orange band distally. Chelipeds turquoise with brown spots; setae white. Pereopods 2 and 3 turquoise with brown bands.

After a few years of preservation in alcohol, turquoise ground colour faded to white. Shield with brown spots and blotches anteriorly and laterally. Antennal peduncles and acicles spotted with brown; flagellum banded brown and white. Ocular acicles mostly brown. Bands on pereopods 2 and 3 broken up into spots similar to those of chelipeds.

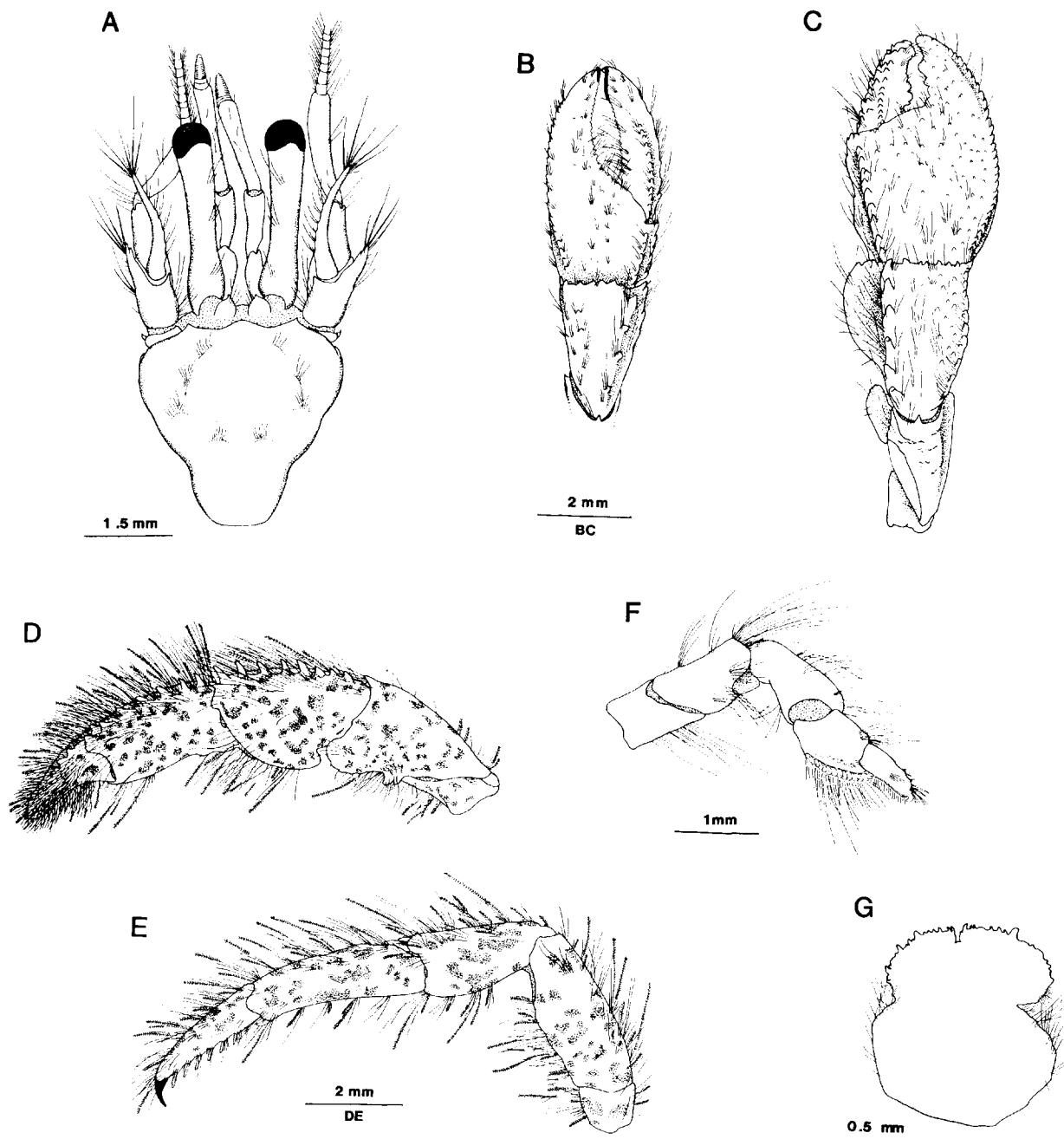
**Remarks.** Trawled in 27 m on an unspecified substrate.

Because of discrepancies between our specimen and the original description, one of us (J. Haig) examined the holotype, a male with SL 4.1 mm (BMNH 1882.7). It shows the following characters which are contrary to Miers' description and illustration: (1) the anterior margin of the carapace shield is produced medially into a short, broad rostrum. There is a small but distinct lateral projection on either side, and the anterior margin between the rostrum and these projections is slightly concave; (2) the ocular peduncles are about  $\frac{1}{2}$  the length of the shield; (3) the larger (right) cheliped has a well-developed ventromesial lobe or crest on both merus and carpus. These lobes are not mentioned in the description and they are only slightly indicated in dorsal aspect in the accompanying illustration, and (4) the second and third pereopods (only the left ones are present) have a small dorsodistal spine on the carpus and a row of movable spinules on the ventral margin of the propodus and dactyl.

The *Alpha Helix* specimen is smaller (SL 3.5 mm) than the holotype, but differs from it in only a few details. The relative proportions of the ocular, antennular and antennal peduncles are close to those of the type. Our specimen has rather long setae on the proximal part of the antennal flagella; these are not present in the holotype. The armature of the dorsal surface of the chelipeds is hidden by a dense covering of fine setae, and the setation on the second and third pereopods is considerably heavier than in the holotype. The telson of our specimen is missing.

Sankolli (1962: 141–2) pointed out that his *Pagurus kulkarnii* n.sp. is closely allied to *P. hedleyi*. He distinguished the two forms by the presence in *P. kulkarnii* of a ventromesial crest on the merus of the right cheliped, and the absence of such a crest in *P. hedleyi*. However, as noted above, *P. hedleyi* does possess a meral (and also a carpal) crest, and the two species are also similar in the form of the anterior margin of the shield, ocular and antennal peduncles and telson, and in having a single row of scales in the propodal rasp of the fourth pereopods. The description of *P. kulkarnii*, and a few specimens from India and Pakistan in the collections of the Allan Hancock Foundation, conform with the two available specimens of *P. hedleyi* except in a few minor details that could be accounted for by individual variation. Comparison of a good series of each species may be necessary before they can be definitely separated on morphological grounds.

At present, the two species are best distinguished by their live colouration. For *Pagurus kulkarnii*, this is described by Sankolli (1962: 142) as "...light brown with longitudinal stripes of chocolate brown colour on major portions of the cheliped and on the second and third pereopods." Tirmizi & Siddiqui (1982: 92) describe the pereopods of *P. kulkarnii* as being orange distally and green proximally, the green parts marked with chocolate brown longitudinal stripes. This is in sharp contrast with the turquoise



**Fig.13.** *Pagurus hedleyi* Grant & McCulloch. [A,D–F, ♂, Arafura Stn 1; B,C,G, ♂, holotype of *Eupagurus kirkii* Miers, Arafura Sea, BMNH 1882.7]. A, shield and anterior appendages; B, left chela and carpus (dorsal view); C, right cheliped (dorsal view); D, right cheliped (mesial view); E, left P 2 (lateral view); F, right P 4 (lateral view); G, telson.

blue ground colour, and the brown spots and bands on the pereopods, that were observed in our specimen of *P. hedleyi*.

**Distribution.** Arafura Sea, Torres Strait and coast of Queensland.

#### *Pagurus hirtimanus* Miers

*Pagurus hirtimanus* White, 1847: 60 (*nomen nudum*).—Miers, 1880: 375, 376.—Lewinsohn, 1969: 62.  
*Eupagurus japonicus*?.—Miers, 1880: 375, pl. 14 figs 6, 7. [not *Pagurus japonicus* (Stimpson)].

*Eupagurus hirtimanus*.—De Man, 1888: 426.  
*Eupagurus* sp. a.—De Man, 1902: 730.  
 [?] *Eupagurus* sp. B.—De Man, 1902: 730.  
*Eupagurus janitor* Alcock, 1905a: 832, pl. 68 figs 2, 4;  
 1905b: 125, 132, pl. 11 fig. 6.  
*Pagurus janitor*.—Gordan, 1956: 331.

**Material examined.** BANDA Stn 1, 1♂ (NIOJ). SERAM Stn 2, 1♀ (NIOJ).

**Colour in life.** Carapace mottled tan and white. Proximal part of ocular peduncles white, distal part blue; these areas separated by black or blue-green median band; cornea black. Antennular peduncles blue, flagellum orange or tan. Antennal peduncles pale blue, flagellum yellow orange. Chelipeds mottled brown and white. Proximal segments of pereopods 2 and 3 brown with large white areas; propodus white with median brown band; dactyl white.

**Remarks.** The specimen from Banda occurred on coral or black lava sand at 0–4 m in a relatively protected area. At Seram the species was encountered in 15 m or less.

**Distribution.** Red Sea to Fiji Islands; north to Ryukyu Islands and south to Queensland, Australia.

*Pagurus moluccensis* n.sp.

Figs 14, 15A,B,D

**Material examined.** HOLOTYPE: BANDA Stn 5b, ♂ SL 2.1 mm (NIOJ A.009).

**Description.** Shield approximately as long as broad; anterolateral margins sloping; anterior margin between rostrum and lateral projections slightly concave; posterior margin roundly truncate; dorsal surface generally smooth except for grooves defining lateral areas; anterolateral angles slightly produced, bluntly rounded. Rostrum obtusely triangular, slightly exceeding lateral projections. Lateral projections broadly rounded, unarmed.

Ocular peduncles about  $\frac{2}{3}$  length of shield; slightly inflated basally; dorsal and mesial faces with scattered short setae. Ocular acicles large, triangular, terminating in strong, apparently subterminal spine; broadly separated basally. Ophthalmic somite with prominent interocular structure, this subrectangular basally and with 2 elongate processes separated by deep, narrow median cleft.

Antennular peduncles equalling length of ocular peduncles. Ultimate and penultimate segments unarmed; basal segment with small spine at ventromesial distal angle.

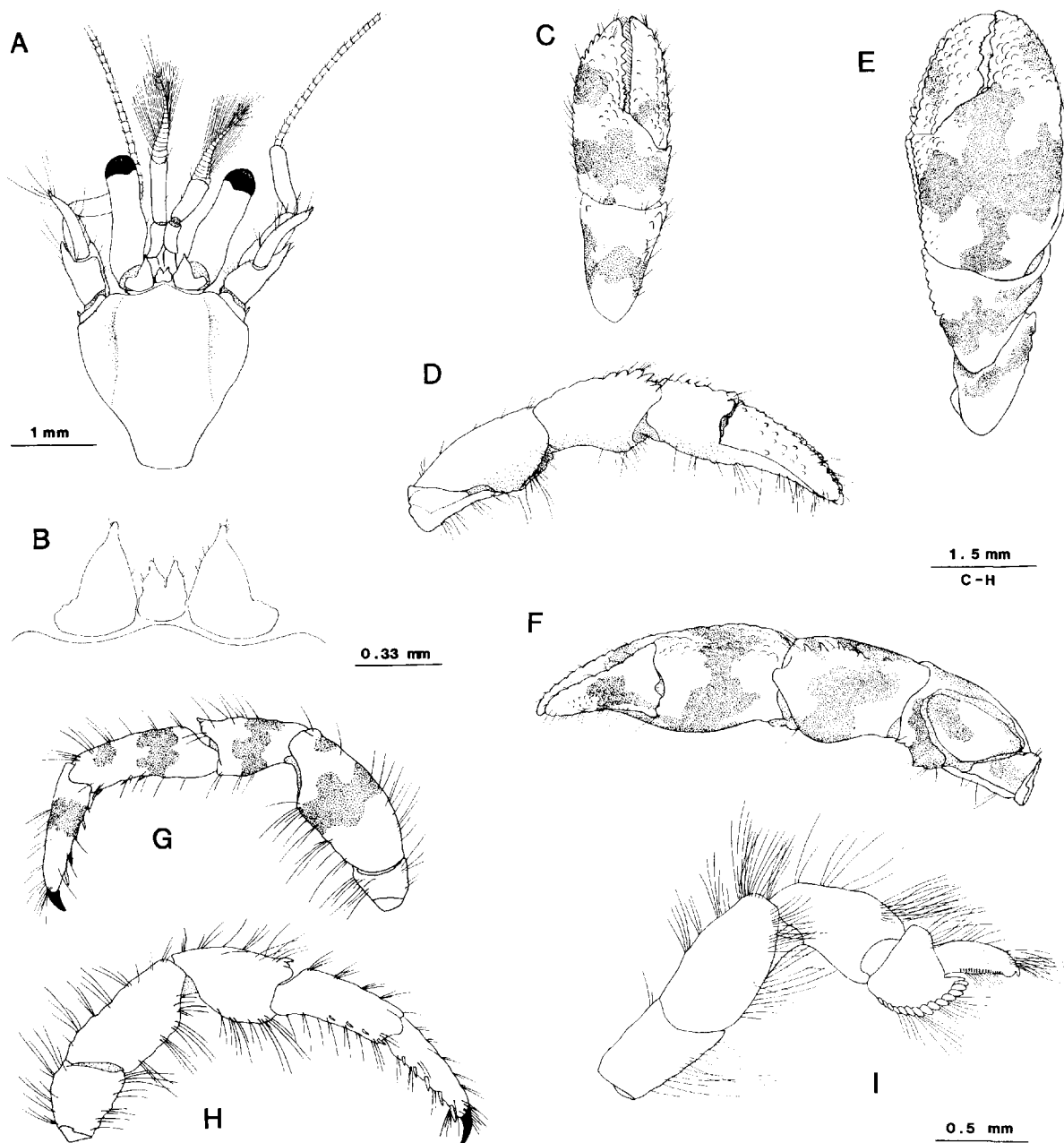
Antennal peduncles exceeding ocular peduncles by about half length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed. Third segment with tuft of long setae near distal end of ventral margin. Second segment with dorsolateral distal angle produced, terminating in simple spine; dorsomesial distal angle subrectangular, unarmed; lateral and mesial margins

with long setae. First segment with strong spine on lateral face distally; ventromesial margin inflated; ventrodistal margin with small spine. Acicle slightly exceeding distal margin of fourth peduncular segment; arcuate and terminating in simple acute spine and tuft of long setae; mesial margin with moderately long setae. Flagellum moderately long; each article with very short setae distally.

Third maxilliped with basis-ischium fusion apparently incomplete (this not evident from illustration); basis with minute spine (not shown in illustration); ischium with crista dentata moderately well developed, 2 accessory teeth; other segments unarmed. Sternite of maxilliped 3 apparently unarmed.

Dactyl of right cheliped approximately as long as palm, slightly deflexed, mesial margin strongly curved; cutting edge with row of calcareous teeth, tip calcareous; slightly overlapped and over-reached by fixed finger; dorsomesial margin delimited, with row of closely set granules; dorsal surface convex, granular; ventral surface nearly smooth. Fixed finger slightly deflexed, lateral margin strongly curved; cutting edge with row of calcareous teeth, tip calcareous; dorsal and mesial surfaces granular; ventral surface nearly smooth. Palm approximately length of carpus, dorsoventrally flattened; dorsal surface convex, covered with closely set granules; dorsomesial margin straight, delimited, with granules slightly more prominent distally; dorsolateral margin delimited, row of granules forming inconspicuous crest, latter extending to tip of fixed finger; lateral, mesial and ventral surfaces nearly smooth. Carpus approximately as long as merus, slightly inflated dorsoventrally; dorsal surface flattened, obscurely granular, distal margin unarmed; dorsomesial margin delimited, distal half with few small spines; mesial surface flattened, nearly smooth; dorsolateral margin not delimited; lateral and ventral surfaces nearly smooth. Merus subtriangular; dorsal surface nearly smooth, distal margin with 2 minute spines; mesial and lateral faces nearly smooth, distal margins with few spines or pointed tubercles; ventral surface with few flattened tubercles.

Left cheliped surpassing base of dactyl of right chela. Dactyl slightly over twice length of palm; cutting edge with row of small corneous teeth, with few small calcareous teeth proximally; terminating in small corneous claw; dorsomesial margin delimited by row of granules; dorsal and mesial surfaces granular; ventral surface nearly smooth. Fixed finger with lateral margin strongly curved distally; cutting edge with row of calcareous teeth; terminating in small corneous claw; dorsal surface granular; ventral surface nearly smooth. Palm approximately half as long as carpus, dorsoventrally flattened; dorsal surface flattened, covered with closely set granules; dorsomesial margin straight, delimited; dorsolateral margin delimited, with inconspicuous crest



**Fig.14.** *Pagurus moluccensis* n.sp. [Holotype ♂, Banda Stn 5b]. **A**, shield and anterior appendages; **B**, ocular acicles and interocular process; **C**, left chela and carpus (dorsal view); **D**, left cheliped (mesial view); **E**, right cheliped (dorsal view); **F**, right cheliped (mesial view); **G**, left P 2 (lateral view); **H**, left P 3 (mesial view); **I**, right P 4 (lateral view).

extending nearly to tip of fixed finger; lateral surface nearly smooth except for granules on distal part of fixed finger; mesial and ventral surfaces nearly smooth. Carpus approximately as long as merus; dorsal surface flattened, obscurely granulate, distal margin unarmed; dorsomesial margin delimited, distal half with few spines; dorsolateral margin not delimited; lateral, mesial and ventral surfaces nearly smooth. Merus subtriangular; dorsal, mesial and lateral surfaces nearly smooth; ventrolateral and

ventromesial margins each with few spiniform granules.

Second pereopods moderately short and stout. Dactyl shorter than propodus; straight in lateral view and slightly twisted in dorsal view; terminating in strong corneous claw; dorsal, lateral and mesial surfaces smooth; ventral margin with row of strong corneous spines increasing in size distally. Propodus exceeding length of carpus; dorsal margin obscurely granulate, lateral and mesial surfaces smooth,

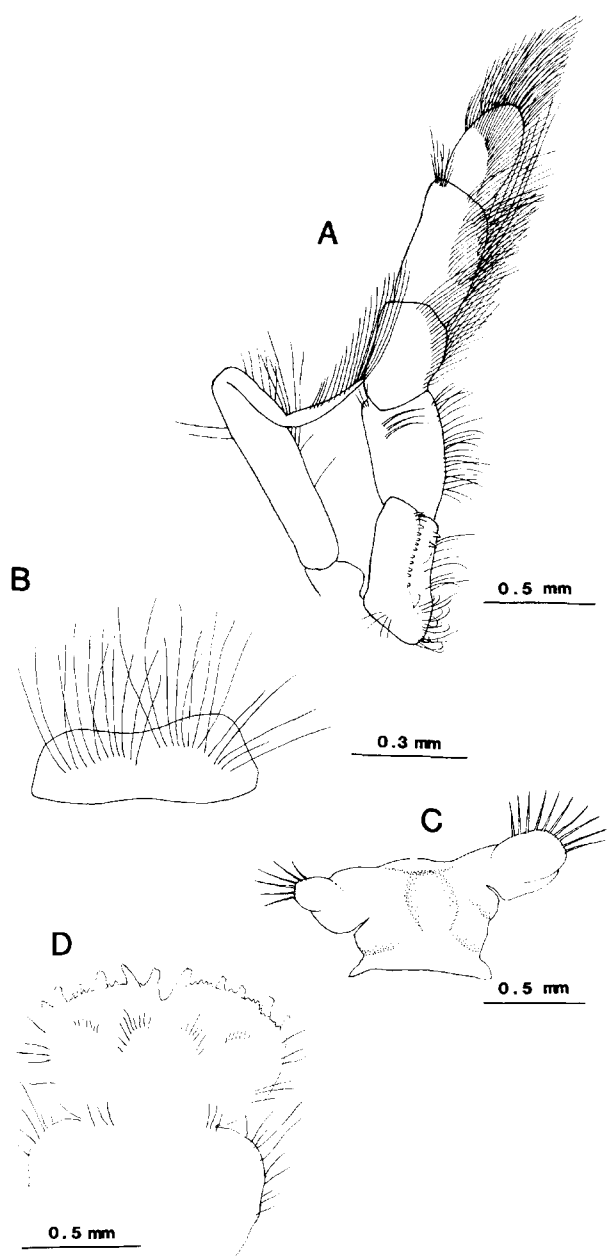


Fig. 15. *Pagurus moluccensis* n.sp. [Holotype ♂, Banda Stn 5b]. A, mxp 3 (left, internal view); B, sternite of P 3; D, telson; C, sternite of P 5 of *Pagurus* sp. [♂, Philippine Islands, USNM].

ventral surface with row of small corneous spines increasing in size distally. Carpus about  $\frac{3}{4}$  length of merus; dorsal surface obscurely granulate, with small spine distally; lateral, mesial and ventral surfaces smooth. Merus laterally compressed; dorsal and ventral margins obscurely granulate, lateral and mesial surfaces smooth.

Third pereopods approximately equalling length of second; similar to second in armature and proportional measurements.

Fourth pereopods apparently with preungual process at base of claw on lateral face of dactyl. Propodal rasp with single row of scales.

Sternite of third pereopods with anterior lobe subrectangular, considerably broader than long; with long setae. Sternite of fifth pereopods with anterolateral angles produced (right more strongly so than left), subovate, clearly delineated.

Unpaired pleopods 3–5 present in male, with exopod well developed and endopod rudimentary. Female pleopods unknown.

Telson with posterior lobes subquadrate, left slightly larger than right; separated by moderately broad, deep median cleft; terminal margins nearly straight, each with 5 prominent spines (tips broken off in holotype) and with numerous, much smaller spines.

**Colour in life.** Shield with black markings on white background. Ocular peduncles with broad, subproximal dark band. Antennular peduncles white, penultimate segment with broad, submedian dark band. Antennal peduncles with alternating black and white bands. Chelipeds with complex black pattern on white background (Fig. 14C,E,F). Pereopods 2 and 3 with black, irregular-edged bands on white background (Fig. 14G).

**Remarks.** The specimen occurred in a protected area with a fairly strong current, in 1–5 m on coral sand and rock.

This species is only provisionally assigned to *Pagurus*. It differs from all previously known members of that genus by the possession of a prominent, two-spined interocular process, a structure that has been reported only in two species of *Anapagurus* (see Dechancé & Forest, 1962). The form of the sternite of the fifth pereopods is also unusual for the genus. In *Pagurus* species of the “provenzanoi” group the sternite of pereopod 5 has strongly produced anterolateral angles (McLaughlin, 1975: 373, fig. 7), but in those species the general shape of the sternite is different from that of *P. moluccensis*.

A small hermit crab from the Philippine Islands (♂ SL 2.4 mm, USNM) was sent for comparison by Michèle de Saint Laurent. Although it does not appear to be conspecific with *P. moluccensis*, it agrees with the new species in having a bispinate interocular structure and produced anterolateral angles on the sternite of pereopod 5. Since the sternite of the holotype was damaged during study, the corresponding, almost identically shaped part was illustrated from the Philippine specimen.

The occurrence of the distinctively shaped interocular structure and sternite of pereopod 5 in our new species suggests that it may be generically distinct from *Pagurus*. We have preferred not to dissect the unique specimen to look for other characters which might support this hypothesis.

**Etymology.** From the Moluccas, the old name of the island group now known as Maluku.



***Pagurus pergranulatus* (Henderson)**

*Eupagurus pergranulatus* Henderson, 1896: 520.—Alcock & Anderson, 1897: pl. 31 fig. 1.—Alcock, 1905b: 125, pl. 11 fig. 1.

*Pagurus pergranulatus*.—Gordan, 1956: 333.

**Material examined.** SERAM Stn 2, 2♂, 1♀ ov (NIOJ).

**Colour in life.** Carapace mottled purple and white. Ocular peduncles basically white; narrow tan line at base of stalk, tan band next to cornea, and broad orange band medially; cornea mottled silver. Antennular peduncles bright orange, with narrow white band at distal end of penultimate segment and at both ends of distal segment; flagellum bright orange. Antennal peduncles white, with mottled purple basally; flagellum with alternating bands of purple and transparent. Major cheliped mottled purple and white. Merus, carpus and propodus of minor cheliped with purple lines on white background; chela with 2 irregular purple blotches on lateral face. Proximal segments (ischium through propodus) of pereopods 2 and 3 with purple lines like those of minor cheliped; dactyl with single median line and 2 broad bands (1 subdistal, 1 proximal).

Narrow lines of colour on minor cheliped and second and third pereopods usually not reaching ends of segments; somewhat irregular in form, periodically broadening and becoming thinner again on each segment.

**Remarks.** The specimens were collected in 15 m or less. One was parasitised by a rhizocephalan.

Our material (♂ SL 3.7 and 5.9 mm, ♀ SL 3.8 mm) agrees well with two specimens in the collections of the Indian Museum: the 3.9 mm female holotype from *Investigator* Station 175, off Sri Lanka (IM 1121/10), and a 4.4 mm male from the Andaman Islands (IM 9023/6) which was recorded by Alcock (1905b: 126). We have also seen a 7.5 mm female specimen in the Australian Museum (AM E4488) from 40 km south-east of Double Island Point, Queensland.

While the *Alpha Helix* material of *Pagurus pergranulatus* was collected in 15 m or less, specimens reported by Henderson & Alcock came from depths of about 36.5–58.5 m and the Australian one from 100 m.

**Distribution.** Sri Lanka; Andaman Islands; Seram; Queensland, Australia. The latter two localities are extensions of the previously known range of the species.

***Pylopaguropsis* Alcock*****Pylopaguropsis* undescribed sp. 1**

**Material examined.** SERAM Stn 2, 1♀ (NIOJ). SAPARUA Stn 1, 1♂, 2♀ (1 ov) (NIOJ, AHF). SAPARUA Stn 3, 1♂, 1♀ ov (NIOJ, AM P37795).

**Colour in life.** Chela of major cheliped white; mesial face of merus and carpus with longitudinal

(presumably purple and orange) stripes. Minor chela and second and third pereopods with longitudinal purple and orange stripes, these extending to both ends of all segments.

In preservative, longitudinal stripes red on white background.

**Remarks.** Found in 0–8 m, probably on coral.

***Pylopaguropsis* undescribed sp. 2**

**Material examined.** SERAM Stn 2, 1♂ (NIOJ). SAPARUA Stn 3, 1♀ (NIOJ).

**Colour in life.** Presumably similar to that of *Pylopaguropsis* sp. 1; both species occurred together at 2 stations, and in the field were not recognised as being distinct. Preserved specimens still show traces of longitudinal red stripes on pereopods 2 and 3, but no pattern on the mesial face of the merus and carpus of the right cheliped.

**Remarks.** Taken in 0–5 m, probably on coral.

These two species of *Pylopaguropsis* will be described in a forthcoming revision of the genus (McLaughlin & Haig, in press).

***Spiropagurus* Stimpson*****Spiropagurus fimbriatus* Lewinsohn**

*Spiropagurus fimbriatus* Lewinsohn, 1982b: 213, fig. 1.

**Material examined.** ARAFURA Stn 7, 1♂ (AHF); Stn 11, 1♂ (AHF); Stn 13, 2♂ (AM P37733). PULAU MARSEGU, off Seram, 15 May 1975, coll. A.G. Humes, 1♂, 1♀ (NIOJ).

**Colour in life.** Basically pink. Ocular peduncles transparent with scattered white chromatophores; cornea silver. Antennules and antennae transparent with scattered white chromatophores. Carpus of chelipeds with orange spines; chela with pale orange-brown longitudinal stripes on silvery white background.

**Remarks.** Trawled in 49–64 m in Arafura Sea; collected in 5 m of water at Seram.

Until recently *Spiropagurus spiriger* (De Haan) was the only known Indo-West Pacific member of the genus, as the latter was defined by de Saint Laurent-Dechancé (1966a: 158). It has been reported from a number of localities in the Indian Ocean, and eastward to Japan and the Admiralty Islands. Alcock (1905b) designated three varieties of *S. spiriger* from the Indian Ocean. Lewinsohn (1982b) described a new species, *S. fimbriatus*, from the Red Sea and compared it with Japanese specimens of *S. spiriger*. Lewinsohn commented that Alcock's varieties have certain characters which do not agree with typical *spiriger*, and suggested that some or all of them may turn out to be valid species when they become better known.

Our five male specimens of *Spiropagurus fimbriatus* are about the same size as the single female (CL 5.5 mm, CB 7.0 mm) on which

Lewinsohn's description was based, and agree very closely with it. The length of the shield varies from 75% to 79% of its breadth. The carpus of the chelipeds has five to eight spines on the dorsomesial margin and four to six on the dorsolateral margin. The merus of pereopods 2 and 3 is armed with one to four spines on the distal part of the dorsal margin. The male sexual tube looks much like that of *S. spiriger* (Alcock, 1905b: pl. 13 fig. 1a). Males have three uniramous unpaired pleopods, the most posterior one very small.

Henderson's general remarks (1888: 72) on the variations in his material of *Spiropagurus spiriger* suggest that it included more than one species or variety. An attempt was made to borrow the specimens that Henderson reported from Torres Strait and the Arafura Sea; but according to Mr Paul Clark, those specimens are not in the collections of the British Museum (Natural History) and their present whereabouts is unknown. Thus the presence of *S. spiriger* in that area still has to be confirmed.

The occurrence of *Spiropagurus fimbriatus* in shallow water at Pulau Marsegu was perhaps unusual, for its known bathymetric range in the Red Sea, Arafura Sea and Torres Strait is 49 to about 82 m.

**Distribution.** Red Sea; now Arafura Sea, Torres Strait, and Seram.

### Discussion

Of the 52 species collected during the *Alpha Helix* Expedition, 37, or about 71%, are known to inhabit the Indian Ocean. (For two of these species the Indian Ocean records are still unpublished). Thirty-two species extend to, or nearly to, the east African coast, Red Sea or Persian Gulf, three range westward as far as India and Sri Lanka, and two occur in only the eastern part of the Indian Ocean. Fourteen of these Indian Ocean species reach the eastern end of their range in eastern Indonesia, Australia/New Guinea, or the Ryukyu Islands, eight continue eastward to the islands of western or mid-Oceania, and 15 extend across the Pacific Ocean to the Hawaiian Islands, Line Islands, and/or French Polynesia.

Most of the *Alpha Helix* hermit crabs that are not known to occur in the Indian Ocean have rather restricted distributions, although one of these species occurs as far east as Hawaii. Two are known from Australia only, and seven (including four described herein) from eastern Indonesia only. One is known from Borneo, Maluku and Guam. Four have the western end of their range in Maluku, whence they extend respectively eastward to eastern New Guinea, Queensland and Vanuatu, and northward to southern Japan.

With the exception of *Spiropagurus fimbriatus* there was no overlap between the species trawled in the Arafura Sea and those collected elsewhere during

the *Alpha Helix* Expedition. However, this is more likely due to differences in collection methods and depths than to a fundamental disparity in the hermit crab fauna of the areas. Prior to the *Alpha Helix* Expedition, 30 species of hermit crabs had been recorded from Maluku in 20 m or less (Table 2). Twenty-three species were known from Ambon, a major port of call since the 1500's and the place of origin of many collections which have been referred to in at least 15 publications. It is surprising that more has not been reported on the hermit crabs of Banda, as there have been Europeans there for about the same length of time as at Ambon: for several hundred years, under the Dutch East India Company, the Banda Islands were important in international trade as the major source of the world's nutmeg. However, in contrast to the 23 species from Ambon only three were previously recorded from Banda (see Introduction). Intensive collecting at Banda during the *Alpha Helix* Expedition yielded 35 species, all but one being new for the area. Additional species were being collected up to the last day of the expedition, and still more might have been taken had there been more time.

Twenty species were collected at Seram, 18 of them new records for that area. The total of 23 species known from Seram now equals the number recorded from Ambon. The 14 species collected at Saparua bring the total number from that area to 15, exceeding the 13 recorded from Ternate, the provenance of hermit crabs that were treated by at least seven authors. The 'Other' category in Table 2 includes a number of islands in Maluku from which shallow water paguroids have been reported; most of these records are by Buitendijk (1937) from the collections of the *Snellius* Expedition.

As shown in the table, 54 species of hermit crabs are now recorded from Maluku in depths of 20 m or less, with the *Alpha Helix* Expedition providing 24 new Moluccan records. These include seven new species: the four described in this paper, two species of *Pylopaguropsis* (McLaughlin & Haig, in press), and an undescribed species of *Calcinus*.

Fize & Serène (1955: v-ix), in their study of hermit crabs of Vietnam, described several types of environment in that area and listed the species (chiefly members of *Coenobita*, *Clibanarius* and *Dardanus*) that occurred in each. Placing our species from Maluku in the same environmental categories, we found considerable agreement with Fize & Serène's results - i.e. many of the same species occurred in the same environments in both geographical areas. Thus, by combining the data of Fize & Serène with those presented here it should be possible to predict some of the commoner species to be found in various shallow water habitats over a large part of South-east Asia.

**Table 2.** Hermit crabs known to occur in Maluku in depths of 20 metres or less (+ = species recorded in earlier literature; \* = species from the *Alpha Helix* Expedition; SAPA. = Saparua; TERN. = Ternate)

	BANDA	SERAM	AMBON	SAPA.	TERN.	OTHER
<i>Birgus latro</i> (Linnaeus)	+*	+	+	+	+	+
<i>Coenobita brevimanus</i> Dana	*		+		+	+
<i>Coenobita cavipes</i> Stimpson	*	+*	+*		+	+
<i>Coenobita perlatus</i> H. Milne Edw.	*		+			+
<i>Coenobita rugosus</i> H. Milne Edw.	*	+	+*		-	+
<i>Coenobita spinosus</i> H. Milne Edw.	*		+			+
<i>Aniculus erythraeus</i> Forest	*					
<i>Aniculus retipes</i> Lewinsohn	*					
<i>Calcinus elegans</i> (H. Milne Edw.)	*			*		
<i>Calcinus gaimardii</i> (H. Milne Edw.)	*	*	+	*	+	+
<i>Calcinus guamensis</i> Wooster	*					
<i>Calcinus laevimanus</i> (Randall)	*		+			+
<i>Calcinus latens</i> (Randall)	*		+			+
<i>Calcinus minutus</i> Buitendijk	*	*				+*
<i>Calcinus pulcher</i> Forest	*	*				
<i>Calcinus</i> sp. aff. <i>pulcher</i>	*	*				
<i>Clibanarius boschmai</i> Buitendijk				*		+
<i>Clibanarius corallinus</i> (H. Milne Edw.)	*		+			+
<i>Clibanarius cruentatus</i> (H. Milne Edw.)			+			+
<i>Clibanarius englaucus</i> Ball & Haig	*					
<i>Clibanarius eurysterius</i> (Hilg.)	*		+			+
<i>Clibanarius humilis</i> Dana			+			+
<i>Clibanarius laevimanus</i> Buitendijk						+
<i>Clibanarius longitarsus</i> (De Haan)		+*	+		+	+
<i>Clibanarius merguensis</i> De Man			+		+	+
<i>Clibanarius padavensis</i> De Man						+
<i>Clibanarius striolatus</i> Dana			+			+
<i>Clibanarius virescens</i> (Krauss)	*		+			+
<i>Clibanarius zebra</i> Dana						+
<i>Dardanus deformis</i> (H. Milne Edw.)	+	+	+		+	+
<i>Dardanus gemmatus</i> (H. Milne Edw.)	*	*				
<i>Dardanus guttatus</i> (Olivier)	*	*	+	*	+	*
<i>Dardanus lagopodes</i> (Forskål)	*	*	+*	*	+	+*
<i>Dardanus megistos</i> (Herbst)	*	*	+	*	+	+
<i>Dardanus pedunculatus</i> (Herbst)	+	*	+	*		+
<i>Dardanus scutellatus</i> (H. Milne Edw.)						+
<i>Dardanus woodmasoni</i> (Alcock)	*					
<i>Diogenes avarus</i> Heller	*					
<i>Diogenes serenei</i> Forest	*					
<i>Diogenes viridis</i> n.sp.	*					
<i>Paguristes kuekenthali</i> De Man	*	*		*	+	
<i>Paguristes monoporus</i> Morgan	*	*				
<i>Paguristes runyanae</i> n.sp.	*					
<i>Trizopagurus strigatus</i> (Herbst)	*	*		*		
<i>Anapagurides</i> sp.				*		
<i>Anapagurus</i> sp.				*		
<i>Catapagurus ensifer</i> Henderson	*					
<i>Micropagurus vexatus</i> n.sp.	*	*		*		
<i>Pagurus hirtimanus</i> Miers	*	*	+		+	+
<i>Pagurus moluccensis</i> n.sp.	*					
<i>Pagurus pergranulatus</i> (Henderson)		*				
<i>Pylopaguopsis</i> sp. 1		*		*		
<i>Pylopaguopsis</i> sp. 2		*		*		
<i>Spiropagurus fimbriatus</i> Lewinsohn		*				
TOTAL SPECIES:	37	23	23	15	13	

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