

The Indo-Pacific Pilumnidae I. Description of Four New Species of the Genus *Pilumnus* Leach, 1815, and Definition of a New Genus, *Bathypilumnus*

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INTRODUCTION

Of all extant crab groups, the Pilumnid or 'Hairy crabs' is one of the largest and least understood, with its taxonomy still in a state of uncertainty. Hence, there is a general reluctance by carcinologists to work on this group. The excellent series of papers by Takeda and Miyake (1968, 1969, 1970) on the Pilumnids of the West Pacific deposited in the National Science Museum of Tokyo, have already made a significant contribution in clarifying their systematics, but even then, a great many of the Indo-Pacific Pilumnids still remain poorly known.

In recent years, the authors have made extensive collections in and around Singapore, and together with the excellent material that has been deposited in the Zoological Reference Collection, National University of Singapore (the former Raffles Museum collection) including the large collection of the late Professor D.S. Johnson, it was felt that a comprehensive study of the Pilumnids based on this and related material would be highly relevant to a better understanding of the family.

As the study continued, it became clear that to do all this in one report would take far too long due to the size and complexity of the group. It was thus decided to write up the results in parts, each with a group of species and/or genera. It is hoped that eventually, it would be possible to prepare a monographic review of the entire family.

In this series, the authors are adopting the broad classification proposed by Guinot (1977, 1978) in which the Pilumnids are recognised as a distinct family within the superfamily Xanthoidea, and includes the Rhizopinae of the now dissolved family Goneplacidae. In a preliminary study on Pilumnid systematics (Ng 1983), several other Xanthid genera (eg. *Parapanope* de Man, 1985) were also transferred to the Pilumnidae.

In this first report, four new species of the genus *Pilumnus* Leach, 1815 are described, and a new genus, *Bathypilumnus* is also defined. The abbreviations 'cb' and 'cl' used in the text stand for carapace breadth and carapace length respectively. All measurements are in millimetres. Types are deposited in the Zoological Reference Collection (ZRC), the Paris Museum (PM) (Museum Nationale d'Histoire Naturelle), the Australian Museum (AM), Sydney, and the United States National Museum (USNM), Washington.

Description of Species: *Pilumnus* Leach, 1815.
Pilumnus pileiferus sp. nov. (Pl. IA, B; Fig. 1)

Male Holotype Description:

Carapace squarish, and covered with thick, long and silky hairs. Surface smooth, except for minute granules near the antero-lateral margin and the front. Regions not defined very clearly. Front bilobed with distinct median cleft and furrow. Lateral lobule sharp, and distinct from the inner supra-orbital angle, but not separated as a notch. Supra-orbital margin with two notches. Infra-orbital margin lined with small rounded granules, but without spines or teeth. Eye peduncle with hairy tuft. Endostomial ridges strong.

Antero-lateral margin with three teeth, excluding the external orbital angle, and each covered with small granules at the base. First tooth rather rounded, the second being the longest and almost like a spine. External orbital angle extended into a distinct tooth. Sub-hepatic region smooth. Sub-hepatic and sub-branchial regions without hair. Postero-lateral margin converging but not distinctly convex.

Chelae unequal. Outer surface of manus covered with small, rounded granules which are hidden by the same kind of fur found on the carapace. Hair extends up to the base of the propodus, and halfway down the dactylus. Inner surface of the manus smooth and without hair. Carpus with small granules as on manus, with an enlarged blunt granule on the dorsal external angle.

Legs smooth, without spines or granules, and covered with the same kind of fur as on carapace.

Abdomen seven segmented, with last segment approximately equal to the sixth. Thoracic sterna and abdomen covered with short, dense tomentum.

Pleopod 1 S-shaped, with the pleopod 2 very short.

Allotype Description:

Generally similar to the holotype, but larger in size, with granules on the antero-lateral margin stronger.

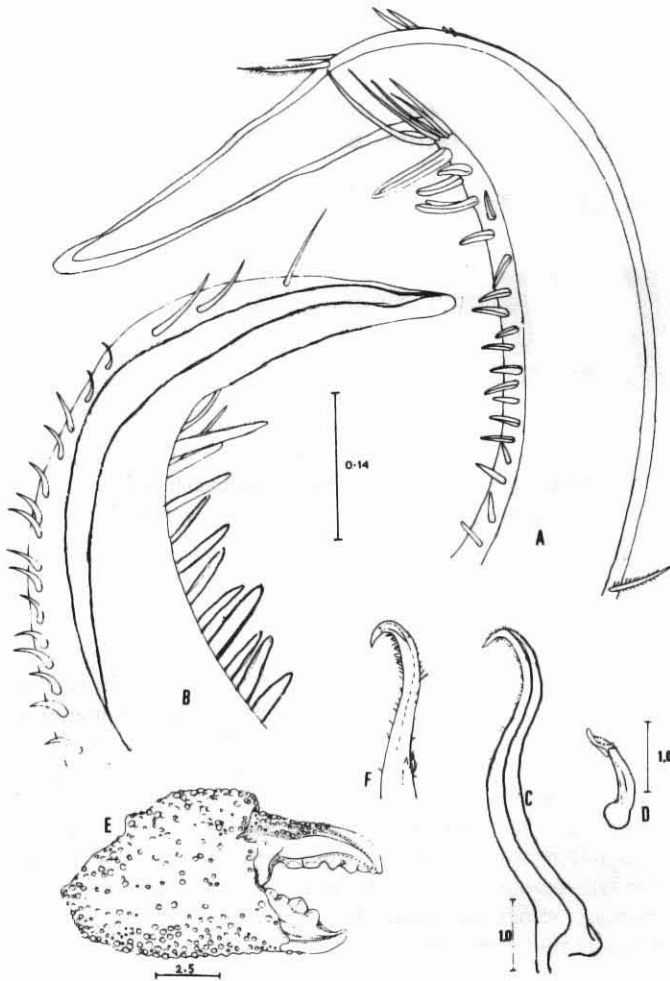


Fig. 1. (A – E) *Pilumnus pileifera* sp. nov. (Male Holotype). A, B, C, Left Pleopod 1; D, Left Pleopod 2; E, Major Chela; F, Pleopod 1 of *Pilumnus contrarius* Rathbun (after Campbell & Stephenson 1970).

Materials Examined:

Holotype: ♂ cb 13.5 cl 11.0 ZRC 1983. 10.11.1, coll. by M.W.F. Tweedie in 1938 in Singapore.

Allotype: ♀ cb 16.5 cl 13.0, ZRC 1983.10.11.2, coll. by C.M. Yang in South China Sea in 1983.

Paratypes: 2♀ (ovig.) cb 17.6 cl 14.5, cb 21.7 cl 18.0; 2♀ cb 20.5 cl 16.8, cb 17.1 cl 13.9, ZRC 1983.10.11.3–6, coll. in 1/1956 by Fish. Res. Coll.; 1 ♂ cb 15.5 cl 13.5, 1♀ cb 18.1 cl 15.5, PM, coll. on cable 80–90m. deep on 21/10/1933 in Selangor, Malacca Straits, Lat. 3°48' 10" N & Long. 100° 14'50" E, det. as *Pilumnus vespertilio*; 1 ♀ cb 18.8 cl 15.7, USNM, coll. by M.W.F. Tweedie at 18 fms. on 11/2/1933 near Johore, Malacca Straits, Lat. 1° 25' 3" N & Long. 102° 58' E; 1 ♀ (ovig.) cb 14.0 cl 11.4, coll. by J.R. Hendrickson on muddy sand at 10–18 fms. on 12/6/1953 by seine at Johore Shoals, off Tanah Merah Besar, Singapore, det. as *Pilumnus trichophoroides*, AM.

Remarks:

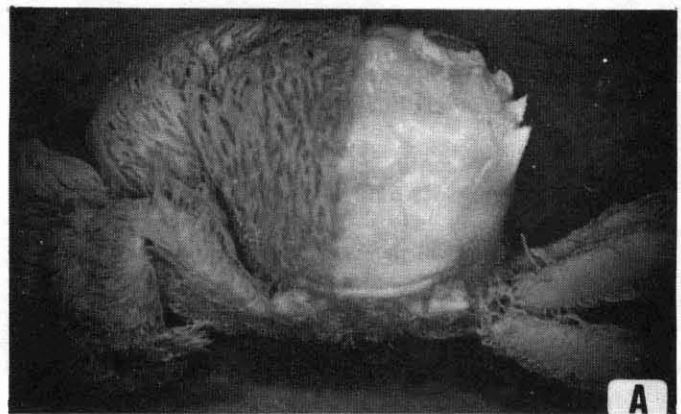
The very thick, soft fur of *P. pileifera* distinguishes it from all the other known Pilumnids. *P. vespertilio* Fabricius is the only other Pilumnid in these waters with

such thick fur, but in this species, the hairs are coarse and stiff, and not silky as in *P. pileifera*. The carapace of *P. vespertilio* is also heavily granulated with a distinct sub-hepatic tooth.

P. pileifera is closest to *P. contrarius* Rathbun, 1923 and *P. granti* Montgomery 1931 with regards to the general morphology. It can however easily be distinguished from them by:

1. a generally thicker fur;
2. having less granules on the antero-lateral margin and at the base of the spines,
3. no granules on the branchial region of the carapace;
4. absence of a sharp tooth on the infra-orbital margin;
5. having the manus of the chelae less strongly granulated,
6. cutting edge of the major chela distinctly toothed, especially that of the dactylus;
7. fur covers the entire outer surface of the manus, reaching halfway down the dactylus.

Comparison of the original descriptions of *P. contrarius* and *P. granti* indicate that the characters used by Montgomery to separate is not clear cut. The relatively close proximity of the two localities of collection also suggest that these two species may prove to be the same, with Rathbun's species having priority.



Pl. 1A *Pilumnus pileifera* sp. nov. (Holotype Male) (Right half of carapace denuded).



Pl. 1B *Pilumnus spinifrons* sp. nov. (Allotype Female).

Specimens of *P. pileiferus* in the ZRC have been mis-identified as *P. vespertilio* and *Heteropilumnus trichophoroides*, and the authors were probably misled by the thickness of the fur and the structure of the antero-lateral margin.

P. pileiferus and its two sister species are generally found in deeper waters, being rare in inter-tidal and tidal areas Rathbun (1923) recorded *P. contrarius* from depths of 19 to 25 fathoms. The present species was collected from a wide range of habitats, mostly from the Malacca Straits and the South China Sea. It is apparently a very common species in deeper waters on both sides of the Malay peninsula.

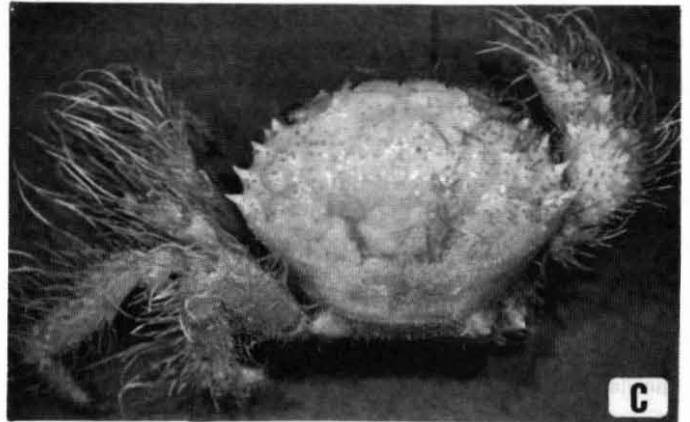
Campbell & Stephenson (1970) figured the male pleopod 1 of *P. contrarius*, but it was not detailed enough for comparisons of the hair patterns. The tapered end of the male pleopod 1 of *P. contrarius* is however distinctly curved downwards whereas that of *P. pileiferus* curves upwards.

This species is named for its thick, silky fur.

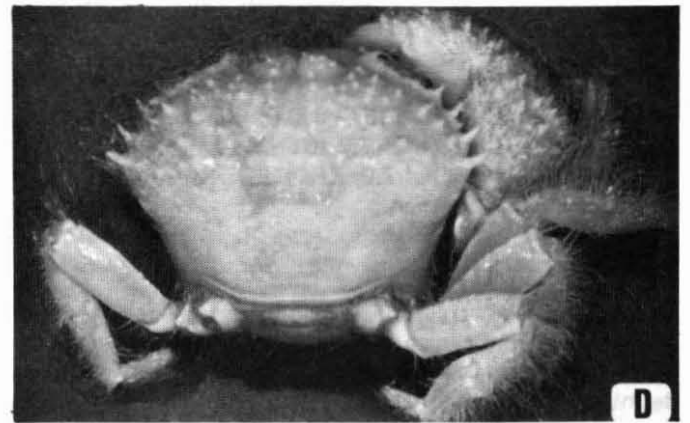
***Pilumnus parableekeri* sp. nov. (Pl. 1C, D, Fig. 2)**

Male Holotype Description:

Carapace covered with long and scattered hairs. Surface covered with rounded, pearl-like granules, each with three



Pl. 1C *Pilumnus parableekeri* sp. nov. (Holotype Male).



Pl. 1D *Pilumnus parableekeri* sp. nov. (Allotype Female).

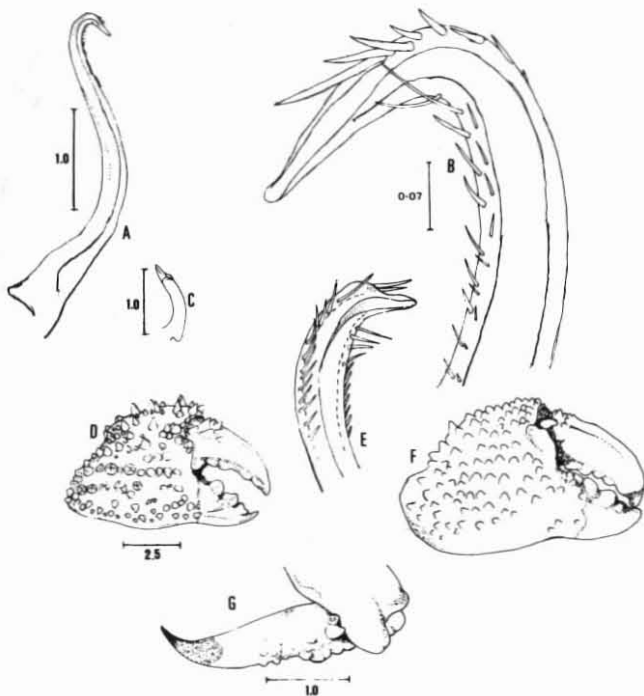


Fig. 2. (A – D, G) *Pilumnus parableekeri* sp. nov. (Male Holotype), A, B, Left Pleopod 1; C, Left Pleopod 2; D, Major Chela; (E – F) *Pilumnus terraereginae* Haswell; E, Pleopod 1; F, Major Chela; G, Dactylus of *P. parableekeri*, last leg

to six strands of stiff hair. The granules are distributed all over the carapace. Front is truncated, with a deep V-shaped notch, and lined with small granules. Lateral lobule small and is confluent with the internal supra-orbital angle. Infra- and supra-orbital margins lined with small granules, the former having one of these extended into a broad tooth, which does not extend beyond the front. Supra-orbital margin without distinct notches. Endostomial ridges extend both anteriorly and posteriorly.

Antero-lateral margin with three sharp spines. External orbital angle produced into a sharp spine. Sub-hepatic region with a prominent tooth, surrounded by small granules.

Manus of chelae covered with large pearl-like granules and same kind of fur as on carapace. Dorsal margin of the manus with three large spines, and one large granule near the distal end. Hair extends halfway down dactylus and to base of propodus.

Ventral and pterygostomial regions smooth, and without hair.

First three pairs of ambulatory legs covered with hair and small granules throughout, with a small but distinct terminal spine on the merus and a larger vertical terminal spine on the carpus. Last pair of legs unarmed. Dactylus with unusual knob that locks onto the propodus.

Abdomen seven segmented.

Pleopod 1 sinuous, the tip being slim and tapered. Pleopod 2 short.

Allotype & Paratypes:

Allotype female generally similar to holotype, but the anterior part of the sub-hepatic region is more granulous. The dorsal margin of the larger chela also has four large spines, with the hairs covering only the upper oblique half of the manus. The lateral lobule is also clearly separated from the inner orbital angle, and the supra-orbital margin has a distinct notch. The merus of the first three pairs of ambulatory legs are unarmed. Paratypes (all female) similar to the allotype.

Materials Examined:

Holotype: ♂ cb 10.0 cl 6.5, ZRC 1965.11.2.64, coll. in Labuan, Sabah, Borneo.

Allotype: ♀ cb 14.0 cl 10.0, ZRC 1965.11.2.65, coll. in Labuan, Sabah, Borneo.

Paratypes: 1 ♀, cb 10.9 cl 8.9, PM, 1 ♀, cb 14.0 cl 10.6, AM, 1 ♀, cb 9.9 cl 7.9, USNM, 2 ♀, cb 10.6 cl 8.6 cb 8.5 cl 7.3, cb 8.9 cl 7.0, ZRC 1965. 11.2.66-67, coll. in Labuan, Sabah, Borneo.

Remarks:

This species is closest to *Pilumnus terraereginae* Haswell, 1882, from which it differs in having a prominent vertical terminal carpal spine on its ambulatory legs, a terminal meral spine (in the holotype male), different arrangement of tubercles on the chelae, the different shaped cutting teeth on the fingers, and having the pearl-like granules extend all over the carapace. In *P. terraereginae*, these granules are absent from the cardiac and branchial regions. In the ZRC are four specimens of *P. terraereginae* collected from Australia, including juveniles, although all are females. Comparisons of the male pleopod 1 with *P. terraereginae*, as figured by Griffin (1970) shows distinct differences. It must be admitted that these two species are very close, and may eventually prove to be only a geographical variant of *P. terraereginae* when more specimens become available.

P. parableekeri is also superficially similar to *P. bleekeri* Miers, 1880, and Dr. Serene who first studied and suspected it to be a new species, named it 'parableekeri', a name which has never been published, and the present authors have retained. It differs from *P. bleekeri* mainly in having the carapace covered with pearl-like granules. In *P. bleekeri*, the carapace is covered only with very small granules, and also possesses a single, sharp sub-hepatic spine, and not one large and several small granules as in *P. parableekeri*. *P. parableekeri* also has a spine on the merus and carpus of the first three pairs of ambulatory legs, which are absent in *P. bleekeri*.

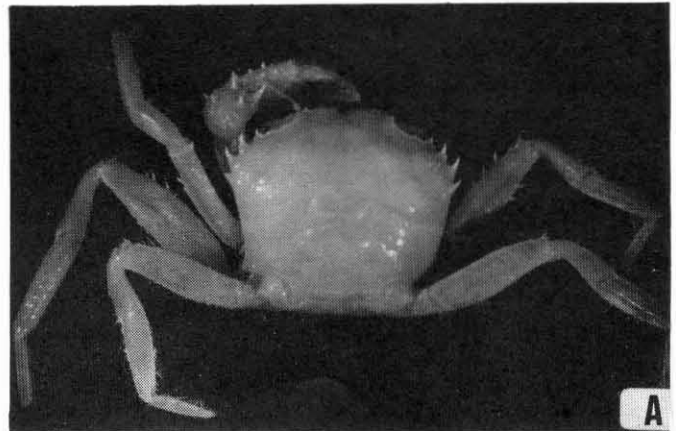
Pilumnus demani sp. nov. sp. nov. (Pl. 2A, Fig. 3).

Male Holotype Description:

Carapace quadrilateral, with the surface smooth, and the regions poorly defined. Surface glabrous, but may have been due to prior denudation by earlier workers. Front truncate, margins granulated, bilobed with deep

median sinus. Lateral lobule small but distinct. Internal orbital angle distinct. Infra-orbital margin with one main spine near region of the eye peduncle, and just visible from above and two smaller ones. Supra-orbital margin with two distinct notches. Subhepatic, Pterygostomial and Sub-branchial regions granulated. Endostomial ridges prominent, with both the anterior and posterior portions well developed.

Antero-lateral margin with three spines, the first two procurved and the last one sharp but smaller. The



Pl. 2A *Pilumnus demani* sp. nov. (Holotype Male).

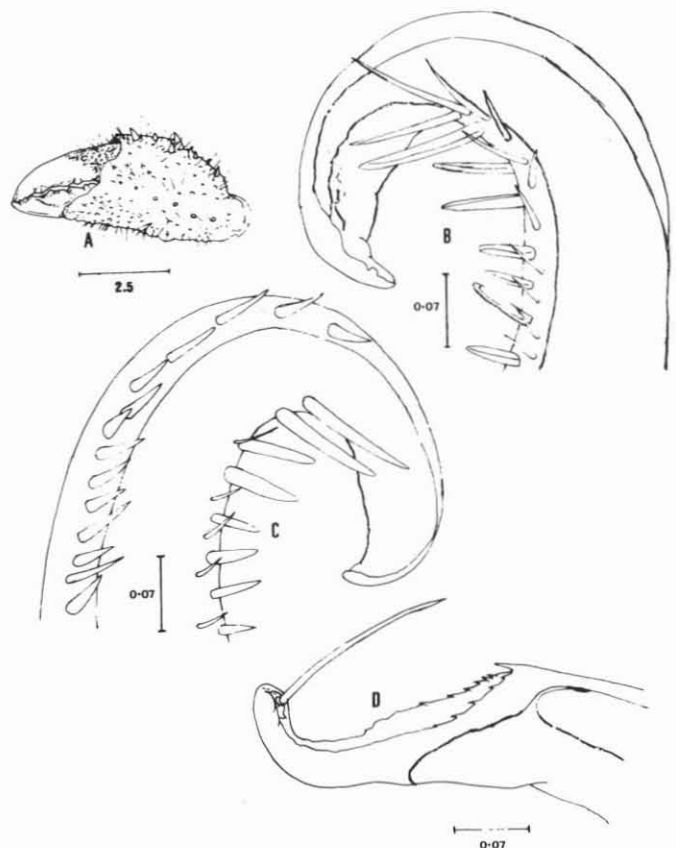


Fig. 3. *Pilumnus demani* sp. nov. (Male Holotype). A, Minor Chela; B, C, Left Pleopod 1; C, Left Pleopod 2.

first and second spines have accessory spines or granules. The external orbital angle is developed into a short distinct spine.

One chela missing. Chela present covered with sharp granules and scattered stiff hairs. The carpus has a very sharp and distinct spine.

Ambulatory legs long and glabrous. Merus of first three pairs with two or three spines on the dorsal margin and three smaller ones on the ventral margin. Prominent terminal spines also present on each merus. Merus of last leg only with terminal spine, the margin being unarmed.

Abdomen seven segmented.

Pleopod 1 sinuous, with the tip hooked downwards. Pleopod 2 short, with a terminal flagellum.

Material Examined:

Holotype: ♂, cb 10.5 cl 9.0 ZRC 1969. 12.26.1, coll. by R. Serene in Nhathrang Bay, Vietnam in 1958, det. as *Pilumnus* aff. *striatus* by R. Serene on 26/12/1969.

Remarks:

This species is closest to *P. striatus* de Man, 1888, but can be easily separated by:

1. the external orbital angle is a spine, not a tooth,
2. the last antero-lateral spine is well developed and not a mere stump;
3. the ventral margins of the merus of the first three pairs of ambulatory legs lined with spines and not smooth;
4. a distinct lateral lobule which is absent in *P. striatus*.

P. demani has the long legs characteristic of the *P. cursor* A. Milne Edwards, 1873 complex of species but can be separated by the armature of the legs and the nature of the antero-lateral margin.

This species is named after the late Dr. J. G. De Man.

Pilumnus spinifrons sp. nov. (Pl. 2B, Fig. 4)

Female Holotype Description:

Carapace completely covered with short dense pubescent fur and scattered short stiff hairs. Regions indistinct. Front bilobed, with deep medial notch. Lateral lobule not well developed. Supra-orbital margin with one notch, infra-orbital margin lined with granules which become more spine-like near the eye peduncles. Transparent rim borders the front, antero-lateral margin, supra- and infra-orbital margins. Both anterior and posterior portions of the endostomial ridges very well developed.

Antero-lateral margins with three sharp, forward pointing spines. External orbital angle produced into a very distinct spine. Subhepatic region with several small granules, one of which is large enough to be visible from above. Pterygostomial regions covered with small granules.

Chelae unequal. Manus of major chela obliquely covered with stiff hairs, beneath which the surface is strongly granulated. Glabrous regions are smooth. Three short spines are present on the dorsal margin. Manus of minor chela completely covered with stiff hair and large spiniform granules. Carpus with dorsal terminal spine. Both chelae are not covered by short pubescence.

Ambulatory legs without granules or spines, and only covered by short stiff hairs.

Abdomen seven segmented.

Material Examined:

Holotype: ♀, cb 6.3 cl 5.0. ZRC 1983. 11.11.1, coll. by P. Ng from 9/5/1983 at Pulau Hantu, Singapore at base of colony of *Pocillopora* coral.

Remarks:

This species can be differentiated from all congeners by the complete absence of spines or granules on its legs, a granulated pterygostomial region and the spinous front.

The colour in life was generally beige, with patches of dark greyish brown all over the carapace, especially on the frontal regions. The legs are also reticulated with dark, greyish brown lines which tend to concentrate into vertical bands.

The frontal margin is similar to several species of *Pilumnids*, but notably *P. tuantaoensis* Shen, 1948, *P. integifrons* Shen, 1932 and *P. spinulus* Shen, 1932. It can be distinguished from *P. tuantaoensis* in not having brush-like hairs on the carapace and having spines on the front instead of rounded granules. In *P. integifrons*, the front is continuous, without a median notch. This present species is closest to *P. spinulus*, and their fronts are extremely close. This present species differs however in lacking the small spinules lining the main antero-lateral spines, having a more pronounced external orbital angle, pubescent fur on the carapace and a less well developed lateral lobule and unarmed legs.

The holotype female was ovigerous when collected, and the zoeae 1 were obtained in the laboratory. Their characters are of the *Pilumnus*-type, with the rostrum short and the antennal exopod equal in length to the spinous process.

This species is named for its spiniform frontal margin.

Bathypilumnus gen. nov.

This genus is erected to accommodate two species of *Pilumnids* that have been originally placed in the genus *Pilumnus*:

Bathypilumnus sinensis (Gordon, 1931) (Type species).
B. nigrispinifer (Griffin, 1970).

The primary diagnostic generic characters are:

1. Male pleopod 1 straight, and not sinuous, tip not curved or sharply tapered,
2. Male abdomen slender, with the last segment much longer than the preceding one.

Secondary features are the possession of a high carapace, outer surfaces of the chelae extremely spiniferous, and the base of the fingers bearing strong molariform teeth, especially in the type species. These features are occasionally found in some other Pilumnids, but never developed to such an extent. Both species in this genus are large in comparison to the other Pilumnids, and *B. nigrispinifer* is the largest known Pilumnid, with a carapace breadth of 60mm (Griffin 1970). They have never been collected from littoral or sub-littoral areas, preferring deeper water with sandy and/or muddy bottoms.

In general form, this genus resembles *Galene* de Haan, 1833 with regards to the high carapace and the narrow male abdomen. Its male pleopod 1 is closer to that of the genus *Halimede* de Haan, 1833, being straight, long and slender. Unlike that genus however, the male pleopod 1 of *Bathypilumnus* is sharply bent at the base before straightening out.

The name of the genus refers to the tendency for both its species to be found in deeper coastal waters.

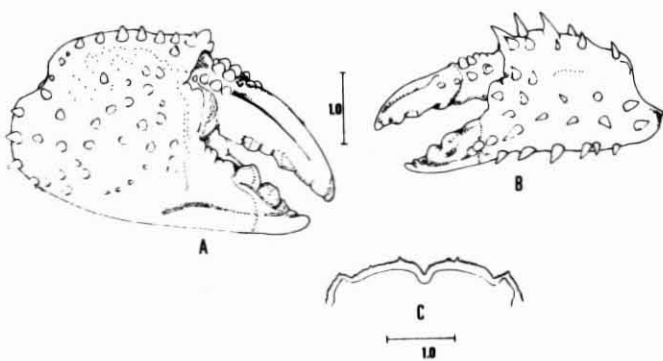
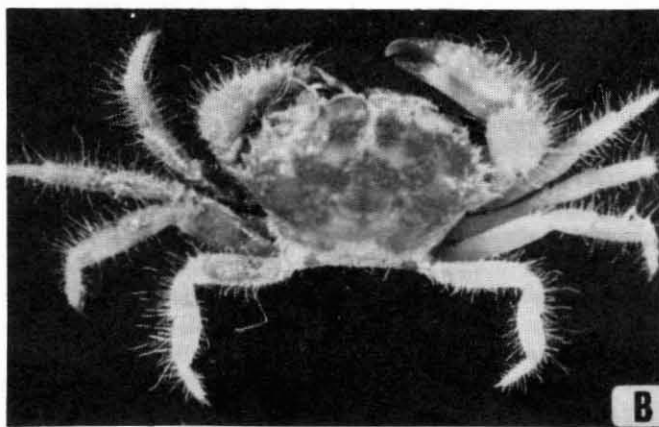


Fig. 4. *Pilumnus spinifrons* sp. nov. (Female Holotype). A, Major Chela; B, Minor Chela; C, Shape of front.



B. *Pilumnus spinifrons* sp. nov. (Holotype Male).

Bathypilumnus sinensis (Gordon, 1931) comb. nov.
(Pl. 2 C, D; Fig. 5)

Pilumnus dorsipes Alcock 1898, Borradaile 1902, Rathbun 1910

Pilumnus sinensis Gordon 1930, Gordon 1931, Balss 1933, Balss 1938, Shen 1940

This is a very common species in the South China

Sea and is frequently caught by trawlers. In the ZRC are numerous specimens from the South China Sea mostly collected by the late Prof. D. S. Johnson and Mrs. C. M. Yang. There are only some additional points that both Alcock and Gordon omitted in their otherwise excellent original descriptions which the present authors will now detail.

The chelae are unequal, both bearing strong molariform teeth at the base of their fingers, which are presumably used for crushing hard-shelled prey. The carpus of the chelae are covered with short, spiny tubercles, and there is no pronounced angular spine. There are a group of small granules below the inner supraorbital angle, and the subhepatic region bears three small granules. The endostomial ridges are very strong, but the posterior and anterior portions are not connected, with the former appearing rather 'swollen'.

The species prefers depths of between 12 to 70 fathoms, on substrates of sand, shell and mud. The range is from the Laccadive Archipelago, Andamans to the Gulf of Thailand, Hong Kong and the South China Sea.

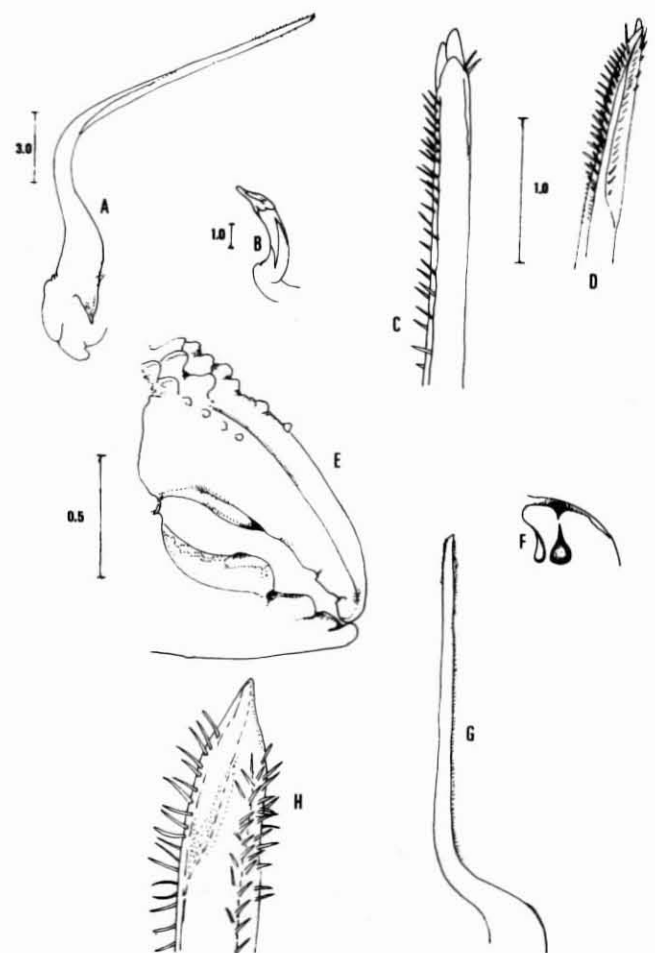
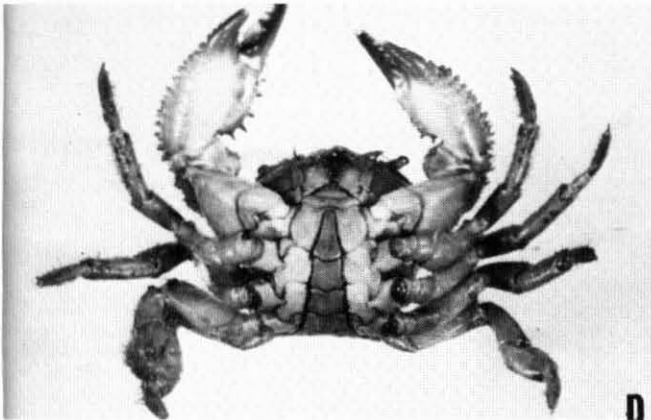


Fig. 5. (A - F) *Bathypilumnus sinensis* (Gordon 1931) gen. et comb. nov. A, C, D, Left Pleopod 1; B, Left Pleopod 2; E, Fingers of Major Chela; F, Structure of the endostomial ridges; (G - H) *Bathypilumnus nigrispinifer* (Griffin 1970) gen. et comb. nov., Pleopod 1 structure (after Griffin 1970).



C. D. *Bathypilumnus sinensis* (Gordon 1931) gen. et comb. nov. (Dorsal and Ventral Aspects) (cb 31. O cl 26.5 mm).

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