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A revision of the spider crabs of the genus *Phalangipus* (Crustacea, Brachyura, Majidae)

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Introduction

The earliest described species of the genus now known as *Phalangipus* was named and roughly figured as *Cancer aragnoides* by Rumphius (1705). In all subsequent papers the specific name was misspelt *arachnoides*. Linnaeus (1758; 1764) made reference to this when he described his *Cancer longipes*. This species was later included in the genera *Leptopus* Lamark, 1818, and *Stenopus* Leach (in Latreille, 1825). Leach (1815), however, had described a very similar species under a new genus, *Egeria*: this he named *Egeria indica*. H. Milne Edwards (1834) described a third species, '*Egeria Herbstii*', based on material in the Paris Museum and included within this species Herbst's (1803) '*Cancer longipes*'. From that time on all these species gradually came to be considered one, Miers (1884, 1886) stating that specimens before him varied widely and that it would be necessary to amalgamate *E. herbstii*, *E. indica* and *E. arachnoides*. He considered that Linnaeus's (1764) description of *Cancer longipes* differed from *E. arachnoides* in features important enough to apply the name *E. arachnoides* to this group. Alcock (1895) followed Miers in this and many authors merely excluded Linnaeus's *C. longipes* from any discussion of this group of species.

Rathbun (1897) showed that of the various generic names previously used for these species only *Phalangipus* Latreille was available, the others being preoccupied. With the rejection of names used by pre-Linnaean authors, *Phalangipus longipes* (Linnaeus) came to be generally adopted for this group and the name *P. arachnoides* lapsed (e.g. Shen, 1931; Stephenson, 1945; Griffin, 1966). Only Rathbun (1916, 1918) dissented from this and implied that *P. herbstii* was a distinct species from *P. arachnoides* and that *Cancer longipes* Linnaeus was unidentifiable.

Alcock (1895) described a new species, *Egeria investigatoris*, from off Ceylon and Rathbun (1916, 1918) added three others, *P. filiformis* and *P. retusus* from the Philippine Islands, and *P. australiensis* from eastern Australia.

Up to the present time, then, the genus *Phalangipus* has been considered to contain five species. Since Alcock (1895) the genus had been placed in the subfamily Pisinae.

From examination of a very large series of specimens from the Bay of Bengal area taken by the R.V. 'Anton Bruun' during the International Indian Ocean Expedition, it became apparent that the majority of samples included two distinct species of *Phalangipus*. One of these had a short rostrum, the orbit had an open appearance—the intercalated and suborbital lobes being flanked by broad U-shaped spaces—and the lobes of the sternum on the males were hairy. The other had a long rostrum, the intercalated and suborbital lobes were flanked by narrow slits or notches and the spines on the sternum of males were without hairs. There were, in addition, obvious differences in the

shapes of the first pleopod of males. The second of these species proved to be identifiable with the animals described as *Egeria indica* by Leach and as *Egeria herbstii* by H. Milne Edwards. The first was not grossly inconsistent with the early, much poorer, descriptions of *Cancer longipes*. With the availability of other large series it became clear that Alcock's *Egeria investigatoris* was the adult of the animal described by Miers (1886) as *Naxia hystrix* and later recorded on frequent occasions from Japan.

Finally, as a result of the examination of very large collections from throughout the Indo-West Pacific it has been possible to distinguish three additional and previously unnamed species of *Phalangipus*. The nine species are described and illustrated here. In order to stabilize the confused nomenclature of *P. longipes* and *P. herbstii* a neotype is designated for *Cancer longipes* Linnaeus and a lectotype for *Egeria herbstii* H. Milne Edwards; a lectotype is also designated for *Egeria indica* Leach.

The present study is based on an examination of more than 1200 specimens from 17 museum and expedition collections. The following is a list of the museums, material from which is dealt with here. The abbreviation given is that used in the lists of material examined. In those lists the number following the abbreviation is the registered number of the specimen(s):

Australian Museum, Sydney	AM
British Museum (Natural History), London	BMNH
Museum of Zoology, Cambridge (England)	CZM
Zoology Department, Hebrew University, Jerusalem	HUZ
Museum of Comparative Zoology, Cambridge (U.S.A.)	MCZ
Museum National d'Histoire Naturelle, Paris	MP
Macleay Museum, University of Sydney	MS
Rijksmuseum van Natuurlijke Historie, Leiden	RML
Smithsonian Institution, Washington	USNM
Western Australian Museum, Perth	WAM
Zoologisch Museum, University of Amsterdam	ZMA
Museum für Naturkunde und Zoologisches Museum, Humboldt University, Berlin	ZMB
Universitetets Zoologiske Museum, Copenhagen	ZMC
Zoologisches Institut and Zoologisches Museum, Hamburg University	ZMH
Naturhistorisches Museum, Vienna	ZMV
Zoological Survey of India, Calcutta	ZSC
Zoologische Staatssammlung, Munich	ZSM

Note: The following abbreviations are used for gear:

GMT	Gulf of Mexico Shrimp Trawl
ST	300 Sledge Trawl, 3 m wide single bag.

Systematics

Genus *PHALANGIPUS* Latreille, 1825; emend. Bathbun, 1897

Egeria Leach, 1815: 39 (type species, by monotypy, *Egeria indica* Leach, 1815) (preocc. by *Egeria* Roissy, 1804—Mollusca).

Leptopus Lamarck, 1818: 235 (type species, by monotypy, *Cancer longipes* Linnaeus, 1758) (preocc. by *Leptopus*, Latreille, 1809—Hemiptera).

Stenopus Leach in Latreille, 1825: 700 (type species, by monotypy, *Cancer longipes* Linnaeus, 1758) (preocc. by *Stenopus* Latreille, 1819—Crustacea, Decapoda, Natantia).

Phalangipus Latreille, 1825: 699 (type species, by present designation, *Cancer longipes* Linnaeus, 1758)—Rathbun, 1897: 159–160.

Description

Carapace broadly subpyriform, at least in adult, nearly as broad as long, convex, tuberculate and spinous—mesogastric region with three spines, one spine on each protogastric region opposite first mesogastric spine, cardiac and intestinal margin each with a single spine, branchial margin anterolaterally with three spines, the third, at widest part of carapace, the longest, epibranchial part elevated medially.

Rostrum of two short, dorsoventrally flattened spines fused for about basal half, the spines distally subcylindrical.

Orbit consisting above of narrow cave with a short supraorbital spine midway along lateral margin: an antorbital lobe at posterolateral angle of cave sometimes present. Post-orbital lobe laterally compressed, concave-convex. An intercalated spine dorsally and a suborbital lobe ventrally.

Basal antennal article rectangular, slightly narrower distally, lateral margin bearing a lobe at distal corner and another close to base. Antennal flagellum barely exceeding rostrum in length.

Pterygostomian region with a prominent, outwardly directed lobe for the most part visible in dorsal view.

Third maxillipeds with ischium as broad as merus, a broad shallow longitudinal groove along middle of outer surface.

First sternite of males with a small spine close to abdominal fossa and a larger spine or lobe behind.

Chelipeds of both sexes elongate and slender, chelae of adult males weakly inflated, longer than high.

Ambulatory legs cylindrical, smooth, of extreme length and slenderness, the first pair the longest, about six times carapace length, meri with a spine anteriorly on distal margin, dactyls long, weakly curved, sharp, unarmed.

Abdomen of males of 7 free segments, third the widest with laterally inflated surfaces, last segment terminally rounded. Abdomen of females of five free segments, segments 4–6 fused, widest midway along segment 5.

Key to the species of the genus *Phalangipus*

- 1 Branchial region with a subdorsal spine posteriorly in addition to three marginal branchial spines. Protogastric region with four pairs of submedial tubercles and two pairs of spines distant from midline. Chelipeds of male spinulose, a row of enlarged tubercles on outer surface of palm *P. hystrix* (Miers)
- Branchial region with tubercles dorsally but without any spines except the three marginal ones. Protogastric region usually with a pair of tubercles or spines near first mesogastric spine, sometimes with a second pair near third mesogastric spine and one pair distant from midline. Chelipeds of male smooth except for terminal spine on merus 2
- 2 (1) Supraorbital cave usually with an antorbital lobe at posterolateral angle separated from intercalated spine by a narrow V- or U-shaped hiatus (rostral spines of at least moderate length, distance between tips only slightly exceeding depth of hiatus). Suborbital lobe usually stout, separated from basal antennal article by narrow hiatus 3

- Supraorbital lobe without antorbital lobe (if lobe present, rostral spines short, distance between tips twice depth of hiatus). Suborbital lobe usually small and slender, separated from basal antennal article by broad U 6
- 3 (2) Lateral margins of rostral spines weakly convergent distally or at most subparallel. Males with numerous tubercles on sternites 2-4 *P. trachysternus* sp. nov.
- Lateral margins of rostral spines seldom subparallel, usually at least weakly divergent distally. Males with no more than 3 tubercles on sternite 2, sternites 3 and 4 usually smooth 4
- 4 (3) Ischium of maxilliped 3 with lateral ridge elevated basally as a tubercle or lobe. Suborbital lobe slender, apically subacute *P. persicus* sp. nov.
- Ischium of maxilliped 3 without lateral basal lobe. Suborbital lobe stout, apically blunt 5
- 5 (4) Rostrum 0.2 postrostral length or more. Major lobe on sternite 1 of male cylindrical, subacute *P. indicus* (Leach)
- Rostrum no more than 0.1 postrostral length. Major lobe on sternite of male weakly flattened anteroposteriorly, apically rounded *P. malakkensis* sp. nov.
- 6 (2) Rostral spines short, distance between tips twice depth of hiatus. Suborbital lobe a slender spine. Sternum of male naked in adults, major lobe of sternite 1 cylindrical, acuminate 7
- Rostral spines not especially short, distance between tips equal to depth of hiatus. Suborbital lobe a very blunt tubercle. Sternum of males pubescent in adults, major lobe of sternite 1 anteroposteriorly flattened, rounded apically 8
- 7 (6) Pterygostomial spine cylindrical; acuminate. Spines of carapace generally sharp *P. filiformis* Rathbun
- Pterygostomial spine dorsoventrally flattened, blunt apically. Spines of carapace generally blunt *P. retusus* Rathbun
- 8 (6) Ischium of maxilliped 3 generally with a strong lobe at base of lateral ridge. Male pleopod 1 short, straight *P. australiensis* Rathbun
- Ischium of maxilliped 3 generally without lobe at base of lateral ridge. Male pleopod 1 long, distally outwardly curved *P. longipes* (Linnaeus)

Phalangipus australiensis Rathbun

(Figs. 1 (a), 3 (a), (b), 6 (a), 7 (a), 8 (c), (d))

Egeria Herbstii—Haswell, 1880: 439; 1882: 12. (Not *Egeria Herbstii* H. Milne Edwards, 1834.)

Egeria arachnoides—Miers, 1884: 191-192—Ortmann, 1894: 40. (Not *Cancer aragnoides* Rumphius, 1705.)

Phalangipus australiensis Rathbun, 1918: 15-16, pl. 6—Griffin, 1966: 280—Campbell & Stephenson, 1970: 260, fig. 22.

Type material

Holotype: Male cl. 17.8 mm, Platypus Bay, Queensland, 7-9 fms (14-18 m), 28 July 1910, F.I.S. 'Endeavour'—AM E.3160.

Paratype: Female (ovig.), cl. 18.0 mm, same data as for holotype—USNM 53427.

Additional material

A total of 60 specimens—24 ♂, 36 ♀ (18 ovig.), cl. 8.5-24.7 mm, smallest ovig. ♀ cl. 17.9 mm—as follows:

Malay Archipelago: Waser Island, Wokam, 5°30'S, 134°12'E, 26-50 m, mud, 15.7.1970, Mariel King Memorial Expedition, 1 spec.

Australia: Broome, W. A., Dr. H. L. Clark, 2 specs (AM P.10227)—Delambre Island, W.A., 5.6.1960, B. R. Wilson on 'Davena', 1 spec (WAM 223-67)—Legendre Island, W.A., 46 m, sponge and rubble, dredge, 9.6.1960,

B. R. Wilson on 'Davena', 1 spec (WAM 201-67). Off Sweers I., Gulf of Carpentaria, 5-7 fms, December 1963, CSIRO Prawn Survey, 2 specs (AM P.17876)—S.E. corner, Gulf of Carpentaria, December 1963, CSIRO Prawn Survey, 2 specs (AM P.17878); June 1965, 2 specs (AM P.17874-75)—Gulf of Carpentaria, 12 fms or less, December 1963, J. C. Yaldwyn & D. F. McMichael, 5 specs (AM P.17877)—Gulf of Carpentaria, November 1964, R. W. George on 'Rama', 2 specs (WAM 60-71, 61-71)—Sir Edward Pellew Group, Gulf of Carpentaria, before 1929, W. J. E. Paradice, 1 spec (AM P.9346)—Centre Island, Gulf of Carpentaria, before 1925, Dr. K. Hudson, 2 specs (AM P.8446-47)—Centre Head, Sir Edward Pellew Group, Gulf of Carpentaria, tidal sand flat, 1925, 1 spec (USNM 64570)—Weipa, Gulf of Carpentaria, 5-8 m, dredged, 29.7.1961, G. Webster, 1 spec (AM P.13994)—Darnley Island, Torres Strait, 1 spec (MS)—Albany Island, Queensland, Dr. Coppinger, 1 spec (BMNH 81.35)—Off Lindeman Island, Queensland, 20 m, trawled, 5.9.1935, G. P. Whitley, 2 specs (AM P.12224)—Between Hayman Island and Eshelby Island, Queensland, 40-50 m, otter trawl, 14.9.1957, M.V. 'Challenge', 1 spec (AM P.12983)—Hope Island, Queensland, dredged, C. Hedley & A. R. McCulloch, 1 spec (AM P.17879)—Albany Passage, Queensland, September 1928, M. Ward, 1 spec (AM P.13993); before 1908 (old collection), 1 spec (AM P.178)—Endeavour River, Queensland, 1 spec (MS)—Cairns, Queensland, 30 m, sand and mud, 8.11.1963, W. Goode, 2 specs (WAM 62-71)—Cape Cleveland, Queensland, 32 m dredged, 24.11.1962, W. Goode on 'Dorothea', 1 spec (WAM 58-71)—Horseshoe Bay, Magnetic Island, Queensland, 10-24 m, prawn trawl, April 1967, C. Wilson, 1 spec (AM P.16667)—Bowen, Queensland, 3 specs (AM G.5109)—Fielders Reef, Port Denison, Queensland, sand bank, before 1924, E. H. Rainford, 2 specs (AM P.6956)—Port Molle, Queensland, 28 m, rock, May 1881, Dr. Coppinger on H.M.S. 'Albert', 1 spec (BMNH 81-31); 28 m, before 1905 (old collection), 1 spec (AM G.5108)—Mackay, Queensland, dredged, 24.2.1964, W. Goode, 1 spec (WAM 68-71)—Facing Island, Port Curtis, Queensland, mud flat, seine, W. MacGillivray, H.M.S. 'Rattlesnake', 1 spec (BMNH 50-112); December 1929, M. Ward, 5 specs (AM P.15241)—Between Bundaberg and Gladstone, Queensland, in nets, 1964, Mrs. C. Wright, 3 specs (AM P.17103)—Cape Moreton, Queensland, 66 m, sand, trawled, January 1963, W. Goode on 'Dorothea', 1 spec (WAM 57-71)—Southport, Queensland, 56 m, 5.2.1963, W. Goode on 'Dorothea', 1 spec (WAM 56-71)—Between Double Island Pt. and Noosa Hd, Queensland, 26°30'S, 153°15'E, 50-52 m, 26.7.1968, A. J. Bruce, 'Nimbus', 3 specs (AM P.17883)—Queensland, 1962-1963, W. Goode on 'Dorothea', 1 spec (WAM 55-71)—Port Stephens, N.S.W., 120 m, February 1969, N. Coleman, 1 spec (AM P.17873).

Material illustrated

Male, cl. 24.7 mm, Sir Edward Pellew Group, Gulf of Carpentaria, Qld (AM P.9346); female, cl. 25.5 mm, between Bundaberg and Gladstone, Qld (AM P.17103)—fig. 7(a) only.

Description

General: Spines of carapace generally blunt. A second small submedial pair of tubercles behind anterior pair and closer to midline. Two small spines, one above the other, on hepatic region. One urogastric spinule. Branchial

region with 4 dorsal spines or tubercles and 1 or 2 posterolateral spinules; epibranchial part generally with a few low tubercles towards medial margin. Cardiac and intestinal spines subequal, short, the latter upwardly directed, a pair of small submedial tubercles sometimes present in front of cardiac spine.

Rostrum: Length 0.1–0.3 postrostral length, distance between tips slightly exceeding depth of hiatus, lateral margins usually distally divergent in females, subparallel or convex in males, spines apically blunt, a low subterminal tubercle dorsally, medial margins with dense fringe of curled hairs. Hiatus more or less V-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine blunt, no antorbital lobe. Intercalated spine flattened, subtriangular, separated from both eave and postorbital lobe by broad U. Postorbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe low, conical, separated from both basal antennal article and postorbital lobe by a broad U.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Weakly flattened dorsoventrally, sub-cylindrical basally and apically blunt or cylindrical, acuminate.

Third maxilliped: Lateral ridge of ischium with a strong proximal tubercle sometimes produced as a laterally flattened lobe.

Male sternum: Surface of sternites 2–5 with scattered, short, stout hairs. Larger lobe of first sternite broad, anteroposteriorly flattened, apically rounded. Second and often third sternites each with a small tubercle centrally. A few small tubercles scattered along margin of abdominal fossa. Posterior segments otherwise smooth. Major lobes, spines and elevations tipped with long, stout hairs.

Male abdomen: Surface with scattered, short, stout hairs, without spines or tubercles. Segment 1 with a broad anteroposteriorly flattened, apically rounded or obtuse lobe with minutely crenulate edge.

Female abdomen: Segment 1 with a subtriangular lobe centrally. Segment 2 with a central, anteroposteriorly flattened, apically truncate or sometimes rounded lobe occupying about $\frac{1}{3}$ width of segment. Segment 3 centrally with a weakly produced truncate lobe, laterally with a flattened lobe with an irregularly tuberculate edge. Segments 4 and 5 each with a similar generally bilobate lateral lobe proximally. A spinule or tubercle usually present laterally about middle of segment 6. Abdomen otherwise smooth except for medial elevation, sometimes with a low medial tubercle or spinule on distal edge of penultimate segment.

Male chelipeds: Merus with distal dorsal spine, otherwise smooth. Palm widest distally. Dactyl with truncate, crenulate proximal tooth, fingers weakly gaping, proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of first leg with strong spine anteriorly on distal margin, a smaller spine on merus of second leg, a very small tubercle sometimes on third and fourth ambulatory meri. Legs otherwise smooth.

Male pleopod 1: Short, stout, distal two thirds straight; a few simple hairs on lateral surface near base, otherwise naked; aperture on medial surface elongate close to tip, elongate oval in shape.

Remarks

The first pleopod of males of *P. australiensis* is quite unlike that found in other species. Most of the other features which might be used to distinguish this species, however, are either variable or sometimes found in other species.

The expansion of the lateral ridge of the ischium of the third maxilliped into a prominent, sometimes flattened, lobe is typical of this species but the same features are sometimes found in *P. longipes*. The presence of only one or two spinules laterally on the sixth segment of the female abdomen is a feature not found in any other species except *P. longipes* but a very substantial number of the females examined in this study lack any lateral spinule. The elevated epibranchial area close to the posterior part of the mesogastric region is usually provided with a few low tubercles but this feature is not only highly variable but is also found in at least two other species. Finally, sexual dimorphism in the shape of the rostrum is by no means constant and females often possess a rostrum in which the lateral margins of the spines are subparallel, as is usual in the males, rather than strongly divergent so that the rostrum appears constricted midway along its length. The open form of the orbit both above and below and the form of the ornamentation of the sternum in males are constant features shared with several other species, notably *P. longipes*. These matters are discussed at greater length under *P. longipes*.

Differences between *Phalangipus longipes* and *P. australiensis*

Character	<i>P. longipes</i>	<i>P. australiensis</i>
Cardiac region	Only central spine or tubercle	A pair of submedial tubercles in front of central spine
Epibranchial region	Smooth	Tuberculate
Maxilliped 3 ischium	Only a lateral ridge	With a strong lateral lobe at base
Male sternite 2	A low broad elevation	A small central tubercle
Female abdomen Segment 6	Smooth	With one or more spinules laterally
Female abdomen Segment 2	Central lobe rounded	Central lobe truncate
Male pleopod 1	Long, slender, distally outwardly curved	Short, stout, distally straight

Bathymetric distribution

Upper part of continental shelf, 5–50 m (1 record at 120 m).

Substrate

Sand, sandy mud and mud, sometimes with sponge and rock fragments.

Geographic distribution

Northern Australia from Broome in the west through Gulf of Carpentaria and Queensland to Port Stephens, N.S.W. Malay Archipelago—Moluccas.

Previously known from off central Queensland coast and Moreton Bay and (under the various names) from Torres Strait area.

Phalangipus filiformis Rathbun

(Figs. 1(b), 3(e), (f), 6(b), 7(b), 8(g), (h))

Egeria arachnoides—Haswell, 1880 : 439; 1882 : 11. Miers, 1884 : 44–45 (part); 1886 : 44–45 (part—specimens from Arafura Sea only)—Borradaile, 1903 : 688—De Man, 1929 : 106–108, figs. 1, 1(a). (Not *Cancer aragnoides* Rumphius, 1705.)

Phalangipus filiformis Rathbun, 1916 : 551.

Type material

Holotype: Male, cl. 23.1 mm, East of Leyte, Philippine Is, 57 fms, 29 July 1909, 'Albatross' St. 5478—USNM 48223.

Additional material

A total of 158 specimens—73 ♂, 85 ♀ (41 ovig.), cl. 7.2–25.4 mm, smallest ovig. ♀ cl. 13.8 mm as follows.

Arabian Sea: Filidu Atoll, Maldive I., J. S. Gardiner, 2 specs (ZMC)—Mulaku Atoll, Maldive I., J. S. Gardiner, 3 specs (ZMC Cr. 727)—S. Nilandu Atoll, Maldive I., J. S. Gardiner, 2 specs (ZMC Cr. 725).

Malay Archipelago: E. Malakka, ex De Man collection, 1 spec (ZMA—) Sunda Strait, 6°22'S, 105°44'E, 30 m, mud, 29.7.1922, Dan. Kei Island Exped. St. 77, 1 spec (ZMC); 6°28'S, 105°38'E, 47 m, sand, trawl, 29.7.1922, Dan. Kei Island Exped. St. 79, 1 spec (ZMC)—5°57'S, 105°32'E, 18 m, sandy mud with pumice, sigsbee trawl, 31.7.1922, Dan. Kei Is. Exped. St. 89, 1 spec (ZMC)—5°42'S, 105°17'E, mud, sigsbee trawl, 1.8.1922, Dan. Kei Island Exped., St. 95, 1 spec (ZMC)—Madura Strait, 7°25'S, 113°16'E, 56 m, grey mud, radiolarians, trawl, 8.3.1899, 'Siboga' St. 2, 4 specs (ZMA De 100.708)—Java Sea, 4°44'N, 113°23'E, 100 m, 'Te Vega' St. 60. 1 spec (USNM 135214)—Java Sea, 'Gier' Expedition 1907–1909, 24 specs (ZMA)—6°36.5'S, 114°55.5'E, 88 m, fine yellowish grey mud, trawl, 22.2.1900, 'Siboga' St. 318, 1 spec (ZMA De 100.842)—7°25'S, 114°30'E, 11.4.1929, Th. Mortensen's Java-South Africa Exped. St. 19, 1 spec (ZMC)—6°05'S, 114°07'E, 82 m, fine grey mud, trawl, 23.2.1900, 'Siboga' St. 320, 1 spec (ZMA); S. of Doe Roa Strait, 40 m, sand, 10.4.1922, Dan Kei Is Exped. St. 14, 1 spec (ZMC)—Doe Roa Strait, 40 m, sand, trawl, 23.4.1922, Dan. Kei Island Expedition, St. 37, 1 spec (ZMC)—Makassar Strait, 1°38'S, 117°05'E, 50–60 m, mud, ST. 300, 23.8.1951, 'Galathea' St. 451, 2 specs (ZMC)—Salayer (? Salajar), 10–25 m, 'Siboga', 3 specs (ZMA De 100.840)—Bay of Badjoh, West Flores, 40 m, mud, sand and shells, dredge, 16–18.4.1899, 'Siboga' St. 50, 5 specs (ZMA De 100.809)—Off Weda Island, Moluccas 1°08.6'N, 128°01'E, 46–55 m, 'Te Vega' St. 54—Amboina Bay, Feb.–Mar. 1922, ca. 100 m, sand, Dan. Kei Island Exped., 2 specs (ZMC)—1 spec (ZMC)—Off Timor, 10°12.2'S, 124°27.3'E, 73 m, soft mud, very fine sand, trawl, 23.1.1900, 'Siboga' St. 294, 1 spec (ZMA De 100.810)—Bai Bima, Timor, 30 m, 30.4.1899, 'Siboga', 2 specs (ZMA De 100.692)—Between Du Rowa and Kai Dulah, Kai Is., 5°32'S, 132°46'E, 36–40 m, muddy sand and sponge, 11.6.1970, Mariel King

Memorial Expedition, 2 specs (WAM)—Arafura Sea, 8°56'S, 136°5'E, 98 m, green mud, trawled, 12.9.1874, 'Challenger' St. 190, 1 spec (BMNH 1884 :3).

South China Sea: Taiwan, Formosa, May 1922, M. Maki coll., 1 spec (USNM 57504)—Takao, Formosa, 3-4.12.1914, Dr. F. Baker, 9 specs (USNM 47925), 47937)—Takao, 30 specs (RML 16914, ZMB 12659, ZMHK 241)—Near Hong Kong, 68-76 m, soft blue to grey mud, 12' Agassiz trawl and 30' seine, Aug.-Oct. 1908, 'Albatross' Sts. 5302, 5304, 5305, 8 specs (USNM 49657-58, 49669).

Philippine Islands: Jolo Sea, 78 m, mud, 7.1.1909, 'Albatross' St. 5358, 3 specs (USNM 49662)—Lingayen Gulf, Luzon 6.5.1939, Guilberno L. Ablan, 2 specs (USNM acc No. 207834)—West coast of Luzon, 90 m, coral sand, 11.5.1909, 'Albatross' St. 5442, 10 specs (USNM 48668)—Off southern Luzon, 36-70 m, grey mud, sand, shells, pebbles, Jan.-July 1908, 'Albatross' Sts 5097, 5100, 5104, 5276, 3 specs and fragments (USNM 49652-53, 49655, 49661)—Off western Samar, 64-70 m, grey mud and sand, 14.4.1908, 'Albatross' Sts 5206, 5207, 2 specs (USNM) 49656, 49660—Between Samar and Leyte, 114 m, shells, 29.7.1909, 'Albatross' St. 5478, 2 specs (USNM)—Linapacan Strait, 92 m, sand and mud, 18.12.1908, 'Albatross' St. 5335, 1 spec (USNM 49659)—East coast of Mindanao, 88 m, soft mud, 9.5.1908, 'Albatross' St. 5235, 1 spec (USNM 49651)—East Palawan, 54 m, fine grey sand, 3.4.1909, 'Albatross' St. 5426, 1 spec (USNM 49667)—Off western Mindanao, green mud and coral sand, 'Albatross' St. 5131, 1 spec (USNM 49654)—Tawi Tawi Group, Sulu Archipelago, 36 m, green mud, 24.2.1908, 'Albatross' St. 5164, 1 spec (USNM 49666).

New Guinea: Roemwakon, east New Guinea, 40-50 m, 1956, Ostheimer, Orr & Powell St. 541, 1 spec (RML).

Australia: Perry Harbour, Admiralty Gulf, Western Australia, 10-12 m, 26.9.1967, 1 spec (WAM)—Admiralty Gulf, Western Australia, 6-44 m, grey mud, trawled, E. Barker, 3 specs (WAM 69-71)—Darnley Island, Torres Strait, 2 specs (MS)—New Year Island, Queensland, 60 m, dredged, November 1962, W. Goode on 'Dorothea', 4 specs (WAM 59-71)—North Keppel Island, Queensland, 56 m, August 1970, T. Nielson, 1 spec (AM P.17872).

Material illustrated

Male, cl. 20.5 mm, female, cl. 16.7 mm (fig. 7(b) only), Siboga St. 50 (ZMA De 100.809).

Description

General: Spines of carapace mostly sharp. A pair of small submedial spines or tubercles behind anterior pair and closer to midline opposite first mesogastric, and a submedial pair of low tubercles sometimes present posteriorly just forward of third mesogastric spine. Two small spines, one above the other on hepatic region. Urogastric region smooth. Branchial region with 4 spines in a shallow semicircle dorsally, 1 or 2 spines posterolaterally, marginal spines short, epibranchial elevation near posterior border of gastric region generally smooth, sometimes with a few low tubercles. Cardiac and intestinal spines subequal, short, the latter upwardly directed.

Rostrum: Length 0.1 postrostral length or slightly less, distance between tips about twice depth of hiatus, lateral margins distally weakly divergent in both sexes, spines slender, uniformly cylindrical, unarmed, apically sharp, medial margins with sparse fringe of curled hairs. Hiatus a more or less broad V.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine sharp. No antorbital lobe. Intercalated spine flattened, triangular, apically pointed, separated from eave by a broad U and from postorbital lobe by broad V. Post-orbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe tall, conical, slender, separated from both basal antennal article and postorbital lobe by broad U.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical or subcylindrical, acuminate, long, fringed with long hairs.

Third maxilliped: Lateral ridge of ischium without proximal elevation or tubercle.

Male sternum: Surface of all sternites naked. Larger lobe of first sternite a cylindrical, acuminate spine. Second and sometimes third sternite with a small tubercle centrally. A few small tubercles scattered along margin of abdominal fossa. Posterior segments smooth. All lobes, spines and elevations naked.

Male abdomen: Surface naked. Segment 1 with a broad anteroposteriorly flattened, apically rounded crenulate lobe; segment 6 with a medial spine or tubercle on distal margin. Surface of abdomen otherwise smooth.

Female abdomen: Segment 1 with small triangular, crenulate lobe or tubercle centrally. Segment 2 with a central, weakly flattened, crenulate lobe flanked on both sides by a similar lobe or tubercle, one or two small tubercles laterally. Segment 3 centrally convex, with 1 or 2 tubercles laterally. Segment 4 with a small, weakly flattened, lateral lobe or tubercle proximally, segment 5 with a similar lateral lobe or tubercle near proximal border. Abdomen otherwise smooth except for medial elevation, a medial spine or tubercle on distal edge of segment 6.

Male cheliped: Merus with distal dorsal spine, otherwise smooth. Carpus with a tubercle or spinule dorsolaterally about $\frac{2}{3}$ carpus length from base. Palm widest midway along. Dactyl with truncate, crenulate proximal tooth, fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$. Ambulatory legs. Meri of all legs with a strong anterior spine on distal margin. Legs otherwise smooth.

Male pleopod 1: Of moderate length and slenderness, smoothly tapering distally except for weakly swollen subterminal portion, uniformly but weakly outwardly curved distally; a few simple hairs at base laterally, otherwise naked; aperture close to tip on medial surface, located within elongate groove surrounded by swollen edges.

Remarks

The form of the rostrum and of the pterygostomial spine in the adult of this species are characteristic and very distinctive. Further, a slender, conical suborbital spine is found only in this species and *P. retusus*; *P. retusus* is also the only other species in which the sternum in the adult male is naked and shiny. The presence of a medial distal spine on the sixth abdominal segment is a constant feature but is sometimes found in *P. australiensis*. The number of protogastric spines or tubercles is highly variable.

The juveniles of this species have a pyriform carapace which is much narrower than that of adults. The rostrum is longer (up to $\frac{1}{3}$ postrostral length)

the carapace spines are sharper and the sternum and abdomen are usually covered by a close pubescence.

Nine specimens from northern Australia and the Arafura Sea were initially separated from the remainder of the material because of their much shorter rostrum. However, they are here considered as *P. filiformis* because they agree in almost all other characters. It is clear that only very large adult males lack hairs on the sternum and abdomen. Small males also tend to have a more slender first pleopod. Finally juveniles also lack a proximal tooth on the dactyl of the cheliped and the fingers of the chelae are hairy.

Bathymetric distribution

Upper continental shelf from 10–114 m.

Substrate

Sand and mud.

Geographic distribution

Maldive Islands, South China Sea and Philippine Islands, throughout Malay Archipelago, north-western and north-eastern Australia. Previously known only from Philippine Islands.

Phalangipus hystrix (Miers); **nov. comb.**

(Figs. 5 (a)–(e); 6 (i); 7 (i))

Naxia hystrix Miers, 1886 : 60–61, pl. 6, fig. 4—Pocock, 1890 : 79 (in key)—Ortmann, 1894 : 43 (in key)—Alcock, 1895 : 220–221—Parisi, 1915 : 293—Balss, 1924 : 32–33—Sakai, 1932 : 46–48, text fig. 4, pl. 3, fig. 1—Yokoya, 1933 : 162–163, text fig. 59A–E.

Egeria investigatoris Alcock, 1895 : 225; *nov. syn.*

Naxioides hystrix—Balss, 1929 : 14—Sakai, 1934 : 296 ; 1938 : 268, pl. 27, fig. 3; 1965 : 77–78, pl. 34, fig. 4—Takeda & Miyake, 1969 : 510–511, fig. 9 (g), (h).

Type material

The type material of *Naxia hystrix* Miers, from Amboina, was not found in the British Museum when searched for in October 1970. The type material of *Egeria investigatoris* Alcock, from Ceylon, is presumably in the Zoological Survey of India, Calcutta.

Additional material

A total of 97 specimens including 50 ♂ and 47 ♀ (12 ovig), cl. 7.0–34.6 mm, smallest ovig ♀ 22.3 mm as follows.

Red Sea: Eylath, 120 m, triangle dredge, 13.4.1969, Israel southern Red Sea Exped., 2 specs (HUZ); 40–54 m, 6.9.1966, Israel southern Red Sea Exped. Sts 4 and 7, 2 specs (HUZ).

Arabian Sea: East Arabian Sea, 17°41'N, 71°33'E, 90 m, GMT, 14.11.1963, 'Anton Bruun' St. 202B, 1 spec (USNM 135222); 18°27'N, 71°13'E, 84–97 m, 14.11.1963, 'Anton Bruun' St. 202C, 2 specs (USNM 135223).

Bay of Bengal: Ceylon, 1 spec (AM P.7698).

Andaman Sea: North Andaman Sea, 14°07'N, 97°05'E, 69–73 m, GMT, 30.3.1963, 'Anton Bruun' St. 38, 2 specs (USNM 135221)—South Andaman Sea, 9°54'N, 97°42'E, 70 m, GMT, 24.3.1963, 'Anton Bruun' St. 21, 1 spec (USNM 135220); 9°13'N, 97°51'E, 60–58, GMT, 23.3.1963, 'Anton Bruun' St. 20, 1 spec (USNM 135219)—Andaman Sea, 110 m, Marine Survey St. 239, 12 specs (ZSC 2617–30/10, 3291/10)—S.E. Andaman Sea, 8°46'N, 97°46'E, 128 m, 6' B.T., 4.11.1963, 'Te Vega' St. 80, 5 specs (AM P.17791).

Malay Archipelago: Java Sea, 7°44'S, 114°44'E, 353 m, soft, fine and grey mud, 13.3.1899 'Siboga' Exped. St. 9, 3 specs (ZMA De 100.788); 5°31'S, 116°02'E, 60 m, coral and lime clay, 25.8.51, 'Galathea' Exped. St. 454, 4 specs (ZMC); 8°23'S, 114°24'E, 50 m, rock fragments, gravel, 6.4.1929, Th. Mortensen's Java–South Africa Exped. St. 8, 1 spec (ZMC); 8°30–35'S, 114°28'E, 6.4.1929, Th. Mortensen's Java South African Exped. St. 9, 1 spec (ZMC)—Off N. coast of Borneo, 100 m, 'Te Vega' St. 60, 3 specs (USNM 135224)—Tg Ratoe Mackoor, Moluccas, 6°7'S, 133°57'E, 62–74 m, sand and rubble, 17–18.6.1970, Mariel King Memorial Exped., 5 specs; NW of Walir Island, Kai, 5°35'S, 132°15'E, 70–94 m, coral rubble and sand, 8.6.1970, Mariel King Memorial Exped., 3 specs—Amboina Bay, 50 m, sand, gravel, 3.3.1922, Dan. Kei Is. Exped. 1922, 1 spec (ZMC)—Kei Is., 5°34'S, 132°55'E, 85 m, sand trawl and dredge, 16.4.1922, Dan. Kei Is. Exped. St. 25, 1 spec (ZMC); 5°36'S, 132°55'E, 85 m, sand trawl, 9.4.1922, Dan. Kei Is. Exped. St. 53, 1 spec (ZMC).

Philippine Islands: Between Samar and Leyte, 122–152 m, sand, broken shell, gravel, green mud, 30.7.1909, 'Albatross' Sts. 5481–84, 5 specs (USNM 49674, 49677–79)—Manila Bay to Lingayen Gulf, 90 m, coral sand, 11.5.1909, 'Albatross' St. 5442, 11 specs (USNM 49675)—E. Palawan, 102 m, sand, 8.4.1909, 'Albatross' St. 5432, 1 spec. (USNM 49676).

Japan: Misaki, 1930, A. S. Pearse, 1 spec (USNM 63682)—Sagami Bay, 1904–5, Doflein, 1 spec (ZSM).

Australia: Rottneest I., W. A., 160–180 m, dredge, 14.8.1962, R. W. George on 'Bluefin', 1 spec (WAM 258–67)—Bluff Point, Geraldton, W.A., 27°18'S, 113°16'E, 108 m, triangle dredge, 9.10.1963, 'Diamantina' St. 204, 1 spec (WAM 148–67); 27°40'S and 113°03'E, 140 m, dredged, 22.8.1963, 'Diamantina' St. 13, 3 specs (WAM 47–67); 27°40'S, 113°20'E, 143 m, beam trawl, 10.10.1963, 2 specs (WAM 303–67)—Dongara, W. A., 29°50'S, 112°24'E, 140–144 m, triangle dredge, 11.10.1963, 'Diamantina' St. 214, 1 spec (WAM 51–67)—Dirk Hartog I., W.A., 25°31'S, 112°29'E, 142 m, beam trawl, 9.10.1963, 'Diamantina' St. 200, 4 specs (WAM 44–67, 100–67); 25°54'S, 112°38'E, 140–144 m, beam trawl, 3.2.1964, 'Diamantina' St. 34, 1 spec (WAM 80–67)—Carnarvon, W.A., 24°S, 112°51'E, 140–142 m, beam trawl, 2.2.1964, 'Diamantina' St. 29, 1 spec (WAM 96–67); 24°04'S, 112°52'E, 151 m, 8.10.1963, 'Diamantina' St. 192, 1 spec (WAM 99–71); 24°59'S, 112°27'E, 142 m, beam trawl, 8.10.1963, 4 specs (WAM 146–67)—Between Shark Bay and Onslow, W.A., trawled, 1964, Poole Bros, 1 spec (WAM 87–71)—Point Cloates, W.A., 22°52'S, 113°29'E, 146 m, dredge, 6.10.1963, 'Diamantina' St. 63, 1 spec (WAM 61–67); 23°39'S, 113°11'E, 150 m, 7.10.1963, 'Diamantina' St. 187, 1 spec (WAM 98–71)—North West Cape, W.A., 21°48'S, 113°50'E, 134–140 m, beam trawl, 1.2.1964, 'Diamantina' St. 24, 3 specs (WAM 97–71)—Barrow Island, N. W.A., otter trawl, 28.11.1960, 'Umitaka Maru', 1 spec (WAM 74–71).

Material illustrated

Male, cl. 25.1 mm, female, cl. 22.5 mm (fig. 7(i) only), 'Te Vega' St. 80 (AM P.17791).

Description

General: Spines of carapace shape. One anteriorly on each protogastric region opposite first mesogastric and four pairs of smaller submedial protogastric tubercles closer to midline, the first opposite intercalated spine, one opposite each mesogastric spine and another pair laterally just forward of third mesogastric spine. Two small spines, one above the other, on hepatic region. One urogastric spinule. Branchial region with 4-6 tubercles dorsally and one subdorsally forming a shallow, lateral semicircle with the 3 anterolateral marginal spines, one or two posterolateral tubercles. Epibranchial elevation near posterior border of gastric region with four or five prominent tubercles. Third mesogastric and cardiac spines upright, subequal, slightly longer than third marginal branchial spine. Intestinal spine about twice as long, backwardly directed, a pair of submedial tubercles immediately in front of intestinal spine.

Rostrum: Length about 0.1 postrostral length, distance between tips slightly exceeding depth of hiatus, lateral margins distally divergent in both sexes, spines apically blunt, a small subterminal tubercle or spinule dorsally, medial margins of spines with sparse fringe of curled hairs. Hiatus more or less V-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine sharp, erect, antorbital lobe well developed, rounded. Intercalated lobe flattened, margin rounded, separated from eave by a broad U and from postorbital lobe by a narrow V. Postorbital lobe with a small lobe posteriorly, distally weakly concave.

Suborbital lobe very very blunt, low, hiatus between basal antennal article and postorbital lobe a very broad U.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical, long, acuminate, fringed with long hairs.

Third maxilliped: Lateral ridge of ischium without proximal elevation or tubercle.

Male sternum: Surface of all sternites densely covered by very short, stout hairs and some scattered longer, stout hairs. Larger lobe of first sternite broad, anteroposteriorly flattened, apically subacute, with accessory lobes or tubercles at its base in front of posterior margin. Second and third sternites each with a similar but smaller lobe centrally. Fourth sternite with two tubercles or spines centrally, one behind the other. A few small tubercles scattered along margin of abdominal fossa. Major lobes, spines and elevations sometimes bearing some long stout hairs.

Male abdomen: Surface densely covered by very short stout hairs, longer stout hairs scattered over surface. A prominent, anteroposteriorly flattened, medial spine close to distal margin of segments 1 to 6, surface of segment 3 with 2 or 3 lateral tubercles, segments 4 to 6 with a single tubercle close to lateral margin.

Female abdomen: An anteroposteriorly flattened medial spine close to distal edge of segments 1–6. Segment 3 with a flattened, apically multispinate lobe laterally. Segments 4–6 laterally with numerous, scattered, stout spines.

Male chelipeds: Merus with distal dorsal spine. Ischium, merus and palm with numerous spinules or small tubercles on all surfaces, some enlarged tubercles on outer surface of merus, carpus with some blunt tubercles, outer surface of palm with some enlarged tubercles in a longitudinal row, small tubercles on dorsal surface of dactyl and ventral surface of fixed finger. Fingers weakly gaping proximally, dactyl strongly toothed throughout, basal teeth fused, fixed finger toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of all legs with spine anteriorly on distal margin, larger on anterior legs, legs otherwise smooth.

Male pleopod 1: Of moderate length, slender, tapering distally, very weakly outwardly curving distally, almost straight, naked except for a few simple hairs near base on medial surface; aperture simple, oval, on medial surface close to tip.

Remarks

This species differs from all other *Phalangipus* species in several more or less constant features:

(1) Suborbital lobe does not form part of the ventral border of the orbit; (2) the number of spines and tubercles on the dorsal surface of the carapace is much greater; (3) the intestinal spine is backwardly directed; and (4) the chelipeds are spinulous. Whilst the subterminal spinule of the rostral spines is generally longer than in other species the presence on each of a spinule or tubercle is not unique within the genus. In adults, the spinule is reduced to a tubercle, a feature found in *P. longipes*, *P. australiensis*, *P. malakkensis*, *P. indicus* and *P. persicus*.

In juveniles, the carapace is much narrower, the rostral spines longer and the accessory dorsal spinule is located about $\frac{1}{3}$ rostrum length from the tips. This is similar to the situation found in *P. filiformis*. However, the general appearance of juveniles is quite different from that of adults since only a few of the carapace spines are enlarged whilst many of the small spines or tubercles which are obvious in the adult are either absent or small and concealed beneath the dense tomentum. In juveniles there is a hepatic spine; other long spines are the first and third mesogastrics, the cardiac and intestinal spines, one protogastric, and two subdorsal branchial spines, most of which are longer than the marginal branchial spines. These differences are those distinguishing *Naxia hystrix* Miers and *Egeria investigatoris* Alcock and the two are considered a single species for that reason.

Bathymetric distribution

Lower continental shelf from 50–150 m and slope (1 record at 353 m).

Substrate

Sand and mud, sometimes on coral rubble or bottom of rock fragments.

Geographic distribution

Widespread in the Indo-West Pacific—Red Sea, Arabian Sea, Ceylon, Andaman Sea, Philippine Islands, Japan, Malay Archipelago and western Australia to Rottnest I. in the south; not previously recorded from the Red Sea, Philippine Islands or Australia.

Phalangipus indicus (Leach)

(Figs. 2 (a), 4 (a), (b), 6 (e), 7 (e), 9 (a), (b))

Cancer longipes—Herbst, 1790 : 231–233, pl. 16, fig. 93. (Not *Cancer longipes* Linnaeus, 1758.)

Egeria indica Leach, 1815 : 40, pl. 73—Desmarest, 1825 : 157, pl. 26, fig. 2—H. Milne Edwards, 1834 : 292—Adams & White, 1848 : 6–7.

Leptopus longipes—Guérin, 1832 : pl. 10, fig. 3—Cuvier, 1837 : pl. 34, fig. 1.

Egeria Herbstii H. Milne Edwards, 1834 : 292.

Egeria arachnoides—Alcock, 1895 : 223–224—Henderson, 1893 : 343 (part)—Laurie, 1906 : 382. (Not *Cancer aragnoides* Rumphius, 1705.)

Phalangipus herbstii—Rathbun, 1916 : 551, 552 (note only); 1918 : 15, 16 (note).

Type material

Eger indicaia Leach : Leach states that the material on which he based his description of this species was in the Museum of the Linnaean Society (London) and in the British Museum. In October 1971 I examined a specimen collected by Col. Hardwicke and labelled as *Egeria indica* in the British Museum (Natural History). This is undoubtedly one of the specimens seen by Leach. It has syntypic status. I hereby designate it as lectotype. The condition of the specimen(s) in the Linnaean Society collections are not known.

Lectotype : Male, cl. 25.3 mm, Indian Ocean, General Hardwicke BMNH 80 a. The specimen is dry and in good condition. It agrees closely with Leach's figure.

Egeria Herbstii H. Milne Edwards : Milne Edwards's description was based on material in the Paris Museum from 'les Mers d'Asie'. At the same time he mentioned specimens (under the name *Egeria arachnoides*) from 'la côte de Coromandel'. Specimens of both species, to which Milne Edwards undoubtedly had access at that time, are presently in the Paris Museum. One of the three specimens is from Coromandel and is identifiable as *P. indicus*—it bears a label '*Egeria arachnoides* Rump. = *Egeria herbstii* M. Edwards'. The other two specimens are from 'Mers d'Asie' and are identifiable as *P. longipes*; they clearly are not consistent with what Milne Edwards considered as '*Egeria Herbstii*'. Milne Edwards included under *Egeria Herbstii* references to Herbst's description and figure of '*Cancer longipes*' and Guérin's figure of '*Leptopus longipes*'. The specimen on which Herbst's figure and description was based is almost certainly the dry adult female, cl. 27.5 mm, labelled 'Egeria longipes Herbst, Indian Ocean' in the collections of the Berlin Museum (registration No. 28 in the Herbst collection). However, this would be almost impossible to prove. Herbst's figure is not completely accurate especially as to details of the

spines and the orbit. It believe that the labels on the Paris Museum's specimens have at some time been switched or rewritten so that the specimen now labelled as coming from Coromandel is actually what Milne Edwards referred to as *Egeria Herbstii* from Mers d'Asie. However, this likewise would be almost impossible to prove. The figure given by Guérin, on the other hand, is very clear; it agrees in important features with Herbst's figure and is clearly conspecific with the Berlin Museum specimen and the Paris Museum specimen from Coromandel. I therefore designate Guérin's illustration as the lectotype of *Egeria Herbstii* H. Milne Edwards.

Lectotype: The specimen illustrated by Guérin, Icon. Regne Anim, on pl. 10, fig. 3 and identified as *Leptopus longipes* Latreille. The whereabouts of the specimen on which the figure was based is not definitely known. Dr. L. B. Holthuis informs me (personal communication, 8 Oct. 1971), from consultation with Col. C. F. Cowan that it is almost certain that the date of publication of pl. 10 was 2 June 1832.

Additional material

A total of 144 specimens including 65 ♂ and 75 ♀ (14 ovig), cl. 12·8–30·2 mm, smallest ovig ♀ cl. 23·9 mm, as follows.

Indian Ocean: 2 specs (ZMB, ZMC 80 a).

Bay of Bengal: 'Bay of Bengal', K. N. Shone, 3.2.1914, 1 spec (ZSC)—Chittagong Coast, British Fisheries Trawler 'Golden Crown', 4 specs (ZSC 7063–6410)—Coromandel, M. Dussumier, 2 specs (MP)—Madras, 1 spec (BMNH 1892 : 7 : 15 : 402–411 (pt)).

Andaman Sea: North Andaman Sea, 15°04'N, 95°51'E, 29–33 m, GMT, 31.3.1963, 'Anton Bruun' St. 41A, 122 specs (USNM 135217, AM P.17790); 15°08'N, 94°54'E, 35 m, GMT, 1.4.1963, 'Anton Bruun' St. 42, 3 specs (USNM 135218)—Gulf of Manaar, 36 m, coral, W. Herdman, 1 spec (BMNH 1907 : 5 : 22 : 130).

Malay Archipelago: Kemasik, Trengganu, E. Malaya, 19.7.1961, E. Alfred, 1 spec (RML 18770)—Siglap, Singapore, 1934, don. Raffles Museum, 3 specs (RML)—West Malay Peninsula between Penang and Phuket, 7°25'N, 99°07'E, 15–18 m, otter trawl, January–April 1966, 5 Thai Danish Exped., 5 specs (ZMC).

Material illustrated

Male, cl. 31·4 mm, female, cl. (fig. 7 (e) only), 'Anton Bruun' St 41A (AM P.17790).

Description

General: Spines of carapace stout, generally sharp. A submedial pair of protogastric tubercles behind anterior pair and closer to midline. Two small spines, one above the other, on hepatic region. One very low urogastric tubercle. Branchial region with 4 spines or tubercles dorsally in a semi-circle, a low tubercle sometimes posterolaterally, epibranchial elevation near posterior border of gastric region smooth. Third marginal branchial, intestinal and cardiac spines subequal, long, acuminate.

Rostrum: Length 0.2–0.3 postrostral length or slightly more, distance between tips slightly less than depth of hiatus, lateral margins distally divergent in both sexes, spines apically sharp, a small subterminal tubercle or spinule dorsally, medial margins naked or with sparse fringe of curled hairs. Hiatus V-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine sharp. Antorbital lobe strong, rounded. Intercalated spine flattened, triangular or subtriangular, separated from eave by a narrow V-shaped notch and from postorbital lobe by a broad V- or U-shaped hiatus. Postorbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe high, stout, conical, separated from basal antennal article by a narrow slit or V-shaped notch and from postorbital lobe by narrow U or V.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical or subcylindrical, acuminate.

Third maxilliped: Lateral ridge without proximal elevation or tubercle.

Male sternum: Surface of all sternites covered by very short, stout hairs. Larger lobe of first sternite broad, weakly anteroposteriorly flattened or subcylindrical, acuminate, with 1 or 2 tubercles at its base. Second sternite with one or two blunt central tubercles, third sternite with a smaller central tubercle. A few small tubercles scattered along margin of abdominal fossa. Posterior segments smooth. Major lobes, spines and elevations naked.

Male abdomen: Surface with a dense covering of very short, stout hairs, without spines or tubercles. Segment 1 with a broad subtriangular, apically obtuse lobe.

Female abdomen: Segment 1 generally unarmed. Segment 2 with a weakly anteroposteriorly flattened, apically rounded, central lobe occupying about $\frac{1}{3}$ width of segment. Segment 3 centrally convex with a flattened, subtriangular lobe laterally. Segment 4 and 5 each with similar lateral lobes proximally. Abdomen otherwise smooth except for medial elevation.

Male chelipeds: Merus with distal dorsal spine, otherwise smooth. Palm widest distally, dactyl with truncate, crenulate proximal tooth. Fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of all legs with a strong spine anteriorly on distal margin, spine shorter on posterior legs, legs otherwise smooth.

Male pleopod 1: Of moderate length, slender, tapering rather abruptly at tip, proximal two thirds straight, remaining, distal, part bent very strongly outwards at almost a right angle to rest of pleopod; a few short simple hairs midway along lateral and medial surfaces, otherwise naked; aperture a simple elongate oval opening on medial surface at tip.

Remarks

Because of the long, generally naked or only sparsely hairy rostral spines, this is among the most distinctive of *Phalangipus* species. In addition the posterior spines of the carapace are much longer than in all other species except *P. hystrix* and the intercalated spine and suborbital lobe tend to almost fill the space between the eave and postorbital lobe and the basal antennal article and

postorbital lobe, respectively. Thus it is seldom necessary to use sexually dimorphic features to identify this species.

Bathymetric distribution.

Upper continental shelf from 17–35 m.

Substrate

No data available.

Geographic distribution

Bay of Bengal, Ceylon, Andaman Sea and north-western Malay Archipelago in the Singapore region. Previous records are confused.

Phalangipus longipes (Linnaeus)

Cancer aragnoides Rumphius, 1705 : 16, pl. 8, fig. 4.

Cancer longipes Linnaeus, 1758 : 629; 1764 : 446—Fabricius, 1793 : 466–467.

Inachus longipes—Fabricius 1798 : 358–359.

Leptopus longipes—Lamarck 1818 : 235–236—Henschel 1833 : 203—Stimpson, 1858 : 216; 1907 : 5–6—Stimpson, in Rathbun, 1893 : 95.

Egeria arachnoides (sic)—Latreille, 1818 : pl. 28, fig. 1.

Egeria arachnoides—H. Milne Edwards, 1834 : 291–292—Miers, 1886 : 44–45 (part—not specimens from Arafura Sea)—Ortmann, 1893 : 48–49—Henderson, 1893 : 343 (part)—Alcock, 1895 : 223–224 (part)—De Man, 1902 : 103—Buitendijk, 1950 : 65.

Egeria indica—Adams & White, 1848 : 6–7. (Not *Egeria indica* Leach, 1815.)

Egeria Herbstii—Heller, 1868 : 4. (Not *Egeria Herbstii* H. M. Edwards, 1834.)

Egeria longipes—Walker, 1887 : 109 (in list).

Phalangipus longipes—Rathbun, 1910 : 318—Shen, 1931 : 191–194, text figs 8–11, pl. 13—Chopra, 1935 : 471–472—Holthuis, 1959 : 68, 108–109.

Phalangipus arachnoides—Rathbun, 1916 : 552 (note only).

Type material

Since the type material of *Cancer longipes* Linnaeus is no longer extant (see Holm, 1957) a NEOTYPE is designated here in order to avoid further confusion.

Neotype

Male, cl. 18.7 mm, N. Andaman Sea, 15°04'N, 95°15'E, 29–33 m, 3 March 1963, 'Anton Bruun' St. 41A—USNM 138270.

Additional material

A total of more than 693 specimens, 289 ♂, 331 ♀ (38 ovig.), 73 'juveniles' and a number of other specimens, cl. 5.1–22.5 mm, smallest ovig. ♀ 14.5 mm as follows.

Bay of Bengal: 'Mers d'Asie', 2 specs (MP)—Northern Bay of Bengal, 21°N, 91°59'E, 23–25 m, GMT, 5.4.1963, 'Anton Bruun' St. 46, 2 specs (USNM 135228)—Northern Bay of Bengal, 20°21'N, 87°58'E, 43–52 m, St. 300, mud, 26.1.1951, 'Galathea' St. 305, 8 specs (ZMC)—Calcutta, May 1928, P. V. Fraser, many specs (ZSC 1833–34, 36, 37/1)—Madras, 12 specs (BMNH 1892 : 7 : 15 : 402–411 (pt))—Bay of Bengal, 28 m, 8–9.12.1912, 'Investigator'

St. 473, 1 spec (ZSC 8498/10)—West Bay of Bengal. 60–76 m, British Fisheries Trawler, several specs (ZSC 6764/10)—Gangetic Delta, 'Investigator', 1 spec (CZM Cr. 726).

Andaman Sea: North Andaman Sea, 15°04'N, 95°51'E, 29–33 m, GMT, 31.3.1963, 'Anton Bruun' St. 41A, 264 specs (USNM 135226, AM P.17792); 15°08'N, 94°54'E, 29 m, 1.4.1963, 'Anton Bruun' St. 42, 26 specs (USNM 135227)—Andaman Sea, 13°27'30"N, 97°37'E, 9.11.1911, Marine Survey St. 396, 2 specs (ZSC 8498/10).

Malay Archipelago: Singapore, 6°42'N, 107°00'E, 90 m, 1892–93, Farsaia Expedition, 1 spec (ZMV)—Singapore, 1934, 1 spec (RML 5394)—Singapore, 76 specs (USNM 32996, ZMB 16108 (pt.)), ZMC—West Malay Peninsula, trawl, 24.1.1966, 5 Thai-Dan. Exped. St. 1039, 2 specs (ZMC)—Near Batavia (Djakarta), otter trawl, April/May 1907, Rembang, 1 spec (ZMA)—Java Sea, 'Gier' Expedition 1907–1909, 4 specs (ZMA De 100.695, 100.844)—Sunda Strait—Java Sea, 24–40 m, sandy mud, sand, shells and pumice, July–August 1922, Dan. Kei Exped. Sts. 67, 69, 74, 83, 84, 106, 18 specs (ZMC)—North of E. Java, 50–70 m, sand and rock fragments, trawl, 5–6 April 1928, Th. Mortensen's Java–South Africa Exped., 12 specs (ZMC)—Kai Is, 6°7'S, 133°57'E, 64–74 m, sand and rubble, 18.6.1970, Mariel King Memorial Exped. 1 spec (WAM)—Amboina, 100 m, sand, trawl, 22.2.1922, Dan. Kei Is Exped., 2 specs (ZMC)—Arafura Sea, 5°37'S, 134°10'E, 94–86 m, mud and rubble, 16.7.1971, Mariel King Memorial Exped., 1 spec (WAM)—New Guinea, 9°59'S, 139°42'E, 56 m, green mud, dredged and trawled, 10.9.1874, 'Challenger' St. 188, 1 spec (BMNH 1884 : 31 (pt.))—'Dutch New Guinea', January–February 1956, 1 spec (RML).

China Sea: Takao–Formosa, 1907, 1 spec. (ZMB 12343)—Hong Kong, 7 specs (ZSC 783–92/7, ZMH K237, MP, ZMV)—Hong Kong, C. J. Shen, 1 spec (USNM 64830), 1861, Captain W. H. A. Putnam, 202 specs (USNM 64830 and unregistered, MCZ 1221, 8507)—China Sea, A. Adams, H.M.S. 'Samarang', 2 specs (BMNH 47.21)—Cambodia, 1 spec (ZSM)—Gulf of Siam, 10–60 m, shell and gravel, February–March 1900, Th. Mortensen, 11 specs (ZMC; USNM 39685).

Philippine Islands: Bohol, 1880, C. Semper, 3 specs (RML 711). Buton Strait, 48 m, sand and broken shells, 13.12.1909, 'Albatross' St. 5640, 2 specs (USNM 49665)—Vicinity of Jolo, 40 m, coarse sand, 5.3.1908, 'Albatross' St. 5174, 1 spec (USNM 49663)—Jolo, 40–60 m, sand and coral or lithothamnion, March 1914, Th. Mortensen's Pacific Exped. 1914–16, 6 specs (ZMC)—Near Basilan I., Sulu Archipelago, 50 m, fine sand, 7.2.1908, 'Albatross' St. 5134, 1 spec (USNM 49664)—Sulu Archipelago, 30–54 m, sand and rubble, 12–15.2.1964 B. R. Wilson on 'Pele', 3 specs (WAM 10–67, 149–67)—Celebes Sea, 6°54'N, 122°18'E, 20–40 m, sand, trawled and dredged, 30.1.1875, 'Challenger' Expedition St. 212, 4 specs (AM G.1622, BMNH 1884 : 31).

Australia: Broome W.A., 10.10.1962, W. Goode on 'Dorothea', 1 spec (WAM 176–67)—Adele Island, W.A., 80–100, sand and mud, 20.10.1962, R. W. George on 'Dorothea', 5 specs (WAM 194–67, 232–67)—New Year I., Queensland, 60 m, dredged, November 1962, W. Goode on 'Dorothea', 3 specs (WAM 314.67, 59.71 (pt.)).

Material illustrated

Male, cl. 22·2 mm, female, cl. 19·3 mm (fig. 7 (*d*) only), 'Anton Bruun' St. 41A (AM P.17792).

Description

General: Medial and lateral spines of carapace sharp. A second submedial pair of protogastric tubercles sometimes present behind anterior pair and close to midline. Two small spines, one above the other, on hepatic region. One urogastric spinule. Branchial region with 4–6 dorsal spines or tubercles and 1 or 2 posterolateral spinules, epibranchial part usually smooth medially but sometimes tuberculate. Cardiac and intestinal spines subequal, not especially long, the latter upwardly directed.

Rostrum: Length 0·1–0·3 postrostral length, distance between tips equal to depth of hiatus, lateral margins distally divergent in both sexes, sometimes more strongly divergent in females, spines apically sharp, a small subterminal tubercle dorsally, medial margins with dense fringe of curled hairs. Hiatus more or less U-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards, supra-orbital spine sharp, no antorbital lobe. Intercalated spine flattened, triangular, separated from both eave and postorbital lobe by a broad U. Postorbital lobe posteriorly unarmed, distally weakly concave. Suborbital lobe low, conical, separated from both basal antennal article and postorbital lobe by a broad U.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical or subcylindrical, acuminate.

Third maxilliped: Lateral ridge of ischium generally without a proximal elevation or tubercle.

Male sternum: Posterior part of surface of first sternite and all of other sternites with scattered, short, stout hairs. Larger lobe of first sternite broad, anteroposteriorly flattened, apically rounded. Second sternite usually with a broad, very low elevation centrally, sometimes with one or two tubercles centrally. A few small tubercles scattered along margin of abdominal fossa. Posterior segments otherwise smooth. Major lobes, spines and elevations tipped with long stout hairs.

Male abdomen: Surface with scattered stout hairs, without spines or tubercles. Segment 1 with a broad, anteroposteriorly flattened, subtriangular, apically rounded lobe. Segment 3 usually smooth but sometimes with one or two low tubercles centrally surmounting inflated lateral areas.

Female abdomen: Segment 1 with a central tubercle or small lobe. Segment 2 with a central, anteroposteriorly flattened, apically rounded lobe occupying about $\frac{1}{2}$ width of segment. Segment 3 centrally convex with a flattened, apically minutely crenulate lobe laterally. Segments 4 and 5 each with a similar lateral lobe proximally. Abdomen otherwise usually smooth except for medial elevation, sometimes with low medial tubercle on distal edge of segment 6, rarely with a few tubercles laterally on segments 6 and 5.

Male chelipeds: Merus with distal dorsal spine, otherwise smooth. Palm widest distally. Dactyl with truncate, crenulate proximal tooth, fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of all legs with spine anteriorly on distal margin, larger on anterior legs. Legs otherwise smooth.

Male pleopod 1: Of moderate length, slender, tapering distally, distal portion very slender, weakly curved outwards; a few short, simple hairs along proximal half of lateral surface and midway along medial surface; aperture a simple, elongate-oval opening on medial surface at tip.

Remarks

P. longipes is easily distinguished from *P. indicus* and *P. filiformis*, with which it is sympatric over much of its range, in the form of the rostrum, orbit and, in the adult male, the tuberculation of the sternum and shape of the first pleopod.

Some difficulties exist, however, in distinguishing between *P. longipes* and *P. australiensis* which are sympatric through parts of the southern Malay Archipelago-New Guinea-northern Australia area. These two species generally differ in seven or more characters (see table). Most of these are rather variable. Specimens of *P. longipes* from the China Sea-Philippines-Malay Archipelago area not infrequently have a basal lobe on the ischium of the third maxilliped. The epibranchial region is usually smooth in *P. australiensis* (although, in general, *P. longipes* does not have a strongly tuberculate epibranchial region) and less than one-third of the adult females of *P. australiensis* have a lateral spinule on the sixth abdominal segment. Except for the specimens discussed below, males are easily distinguished by the ornamentation of sternite 2. In addition, pleopod 1 of the males is so different that there would normally be no doubt about the specific distinctness of the two species.

The matter is made very complicated by a series of 16 specimens (8 males and 8 females) from the Celebes Sea-northern Australia area which possess some characters common to both species. In general, these specimens share a strongly tuberculate epibranchial region and basally lobate third maxilliped ischium. Also the abdomen of the females bears several prominent spinules or tubercles laterally on the sixth and sometimes fifth segments. The central lobe on segment 2 of the abdomen of the females is variable and none have a pair of tubercles on the cardiac region in front of the central spine. In the smaller specimens the spines of the carapace are longer and more cylindrical than in the larger ones. The females of this series would undoubtedly normally be identified as *P. australiensis*. The males of the series, however, are a much more difficult lot. The third abdominal segment of some possesses a small lateral tubercle, a feature sometimes, but only rarely, found in *P. longipes*. Also, sternite 2 possesses a central tubercle and occasionally a few extra tubercles (as is found in *P. australiensis*). The largest male (c.l. 22.9 mm) possesses a pleopod typical of *P. longipes*. This specimen comes from the same locality 'Challenger' St. 212—Celebes Sea) as two females (c.l. 22.5 mm) which clearly agree with those discussed above. A smaller (damaged) male from the same locality, and all the other males (c.l. 9–21 mm) in the series, agree with typical *P. longipes* in the details of the tip of the first pleopod but, instead of being weakly curved distally the distal part of the pleopod is very strongly curved and bent almost at right angles to the proximal two thirds. These specimens were at first considered to possibly represent a species distinct from both *P. longipes* and *P. australiensis*. This conclusion was finally discarded since it would mean that three almost indistinguishable species existed in the same general area and are

taken in the same samples. Examination of the outer mouthparts of specimens of *P. longipes*, *P. australiensis* and the present small series showed no difference in arrangement of hairs or "teeth". To consider all (except the large male) as *P. australiensis* would pose just as much difficulty. All these specimens are therefore considered as *P. longipes*, the form of the first pleopod being given more taxonomic weight than any other character.

Bathymetric distribution

Upper continental shelf from 10–100 m.

Substrate

Sand and sandy mud.

Geographic distribution

Bay of Bengal from Calcutta to Ceylon, Andaman Sea, China Sea, Gulf of Siam, Philippine Islands, throughout Malay Archipelago from Singapore to New Guinea, northwestern and northeastern Australia. Previous records are considerably confused.

***Phalangipus malakkensis* sp. nov.**

(Figs. 2 (b), 4 (c), (d), 6 (f), 7 (f), 9 (c), (d))

Type material

Holotype: Male, cl. 24.6 mm, Singapore—ZMH K240.

Paratypes: 6 males, 10 females (6 ovig) cl. 13.5–24.6 mm smallest ovig. ♀ cl. 19.5 mm as follows:

Malay Archipelago: Singapore, 3 specs (ZMH ex. K240); 2 specs (ZMB 16108 (pt))—Java Sea, 'Gier' Expedition, 1907–1908, 10 specs (ZMA De 100. 693, 100.812, 100.845 and unreg.).

Material illustrated

Holotype; female paratype cl. 24.4 mm (ZMH K240)—fig. 7 (f) only.

Description

General: Spines of carapace mostly blunt. One anteriorly on each protogastric region opposite first mesogastric and a second small, submedial pair behind this and closer to midline. One small spine on hepatic region, occasionally a small tubercle below this. One urogastric tubercle. Branchial region with 4 or 5 tubercles dorsally, usually smooth posterolaterally, elevation near posterior border of gastric region smooth. Cardiac and intestinal spines small, the latter upwardly directed.

Rostrum: Length somewhat less than 0.1 postrostral length, distance between tips slightly exceeding depth of hiatus, lateral margins distally subparallel in both sexes, spines apically subacute, a low subterminal tubercle dorsally, medial margins with a sparse fringe of curled hairs. Hiatus more or less V-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine blunt. A small, rounded antorbital lobe. Intercalated spine flattened, subtriangular, separated from eave by a narrow U- or V-shaped

notch and from postorbital lobe by broad U. Postorbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe stout, conical, separated from basal antennal article by a more or less narrow, U-shaped notch and from postorbital lobe by a narrow V.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical or subcylindrical, acuminate.

Third maxilliped: Lateral ridge of ischium without proximal elevation or tubercle.

Male sternum: Posterior part of surface of first sternite and all of other sternites densely covered by very short stout hairs. Larger lobe of first sternite broad, anteroposteriorly flattened, apically rounded or crenulate. Second sternite with one or two small tubercles centrally. A few small tubercles scattered along margin of abdominal fossa. Posterior segments smooth. Major lobes, spines and elevations tipped with a few long hairs.

Male abdomen: Surface densely covered by short, very stout hairs. No spines or tubercles. Segment 1 with a broad, very weakly anteroposteriorly flattened, subtriangular lobe.

Female abdomen: Widest midway along segment 5. Segment 1 with a narrow, subtriangular central lobe. Segment 2 with a central anteroposteriorly flattened, apically rounded lobe occupying about $\frac{1}{3}$ width of segment. Segment 3 centrally convex, a flattened, apically rounded lobe laterally. Segments 4 and 5 each with a similar lateral lobe close to proximal margin. Abdomen otherwise usually smooth except for medial elevation, without medial tubercle or spinule on distal edge of penultimate segment.

Male chelipeds: Merus with distal dorsal spine, otherwise smooth. Palm widest close to distal edge. Dactyl with truncate, crenulate, proximal tooth, fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of first two legs with strong spine anteriorly on distal margin, meri of third leg with small spinule, meri of fourth leg generally unarmed. Legs otherwise smooth.

Male pleopod 1: Of moderate length and slenderness, smoothly curved outwards distally tip very slender and weakly recurved; a few simple short hairs on proximal half of lateral and abdominal surfaces; aperture a narrow slit on sternal surface at end of groove not far from tip of pleopod.

Remarks

Although this species superficially resembles *P. longipes* it differs in that the eave bears an antorbital lobe, the suborbital lobe is much shorter and the second sternite of the adult male bears one or two small tubercles instead of a low elevation. The sinuous nature of the tip of the first pleopod immediately distinguishes males of this species.

The specific name refers to the occurrence of this species in the region of the Straits of Malakka.

Bathymetric distribution

Shallow water—5–8 m.

Substrate

No data.

Geographic distribution

Known only from Malay Archipelago.

Phalangipus persicus sp. nov.

(Figs. 2 (c), 4 (e), (f), 6 (g), 7 (g), 9 (e), (f))

Phalangipus arachnoides—Nobili, 1906 : 105. (Not *Cancer arachnoides* Rumphius, 1705.)

Phalangipus longipes—Stephensen, 1945 : 105–107, fig. 20 (B–C). (Not *Cancer longipes* Linnaeus, 1758.)

Type material

Holotype: Male, cl. 21.5 mm, Iranian Gulf—63 nautical miles W½S of Bushire, 49 m, sand, clay, 15 March 1937, Danish Iranian Gulf Exped. St. 25—ZMC.

Paratypes: A total of 30 specimens—9 ♂, 21 ♀ (5 ovig) cl. 13.1–25.6 mm smallest ovig ♀ cl. 15.2 as follows. Iranian Gulf, 12–49 m, clay, sand and stones, Dan. Iran. Gulf Exped. Sts. 4, 14, 24, 25, 26, 31, 39, 59D, 66, 78, 89, 25 specs (ZMC)—Strait of Hormuz, 15 m, soft bottom, Dan. Iran. Gulf Exped. St. 83, 1 spec. (ZMC); 25°10'N, 55°10'E, 10–15 m, bank of pearl oysters, dredged, 4 specs (MP).

Material illustrated

Holotype; female paratype, cl. 25.4 mm, Iranian Gulf, Dan. Iran. Gulf Exped. St. 59D (ZMC)—fig. 7 (g) only.

Description

General: Spines of carapace mostly blunt. A second submedial pair of protogastric tubercles behind anterior pair and closer to midline. Two small spines, one above the other, on hepatic region. One small urogastric tubercle. Branchial region with 4 small tubercles dorsally in a semicircle, 1 to 3 small spines or tubercles posterolaterally, epibranchial part medially smooth. Third marginal branchial, intestinal and cardiac spines subequal, not especially long.

Rostrum: Length slightly less than 0.2 postrostral length, distance between tips slightly exceeding depth of hiatus, lateral margins subparallel or weakly divergent in both sexes, spines apically sharp, a small subterminal tubercle dorsally, medial margins with a sparse fringe of curled hairs. Hiatus V-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine blunt. Antorbital lobe small, rounded. Intercalated spine flattened or subtriangular, separated from eave by a narrow V-shaped hiatus and from postorbital lobe by a broad U. Postorbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe high, stout, conical, separated from basal antennal article by a broad U and from postorbital lobe by a broad V.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical, stout, naked.

Third maxilliped: Lateral ridge of ischium elevated proximally as a laterally flattened lobe.

Male sternum: Surface of all sternites covered by very short, stout hairs. Larger lobe of sternite broad, anteroposteriorly flattened, apically rounded. Second sternite with 2-4 irregularly sized tubercles centrally. Third sternite with 1 or 2 small tubercles centrally. A few small tubercles scattered along margin of abdominal fossa. Posterior segments smooth. Major lobes and tubercles naked or tipped with a few very short hairs.

Male abdomen: Surface with a dense covering of very short stout hairs, without spines or tubercles. Segment 1 with a broad, anteroposteriorly flattened subtriangular lobe.

Female abdomen: Segment 1 with a broad, anteroposteriorly flattened, obtuse lobe. Segment 2 with a weakly anteroposteriorly flattened, apically rounded, central lobe occupying about $\frac{1}{2}$ width of segment. Segment 3 centrally strongly convex, with a flattened, apically crenulate lobe laterally. Segment 4 with a flattened lobe laterally near base, segment 5 with a broad elevation laterally near base. Abdomen otherwise smooth except for medial elevation.

Male chelipeds: Merus with distal dorsal spine, otherwise smooth. Palm widest distally, dactyl with truncate, crenulate proximal tooth. Fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of all legs with a strong spine anteriorly on distal margin, spine shorter on posterior legs, legs otherwise smooth.

Male pleopod 1: Of moderate length and slenderness, tapering uniformly almost to tip, apically abruptly narrowed weakly curved outwards; a few long simple hairs midway along lateral and medial surfaces otherwise naked; aperture subterminally on medial surface, small, oval to subcircular.

Remarks

This species is extremely similar in general appearance to *P. indicus*, especially in the form of the orbit and shape of the rostrum. However, it differs in the following features:

- 1 The rostrum is markedly shorter.
- 2 The antorbital lobe is smaller, the hiatus between the eave and the intercalated spine being wider.
- 3 The suborbital lobe is separated from the basal antennal article by a broader hiatus.
- 4 The lateral ridge of the ischium of the third maxilliped is elevated proximally as a lobe.
- 5 The sternum is slightly more tuberculate.
- 6 The first segment of the abdomen in both sexes is provided with a strong central lobe which is apically more sharply angled than in *P. indicus*.
- 7 The first pleopod of the male is more smoothly curved.

The specific name refers to the geographic distribution of this species in the Iranian Gulf.

Bathymetric distribution

Upper continental shelf from 12–50 m.

Substrate

Sand and sandy clay.

Geographic distribution

Known only from the Iranian Gulf.

***Phalangipus retusus* Rathbun**

(Figs. 1(d), 3(g), (h), 6(c), 7(c), 8(e), (f))

Egeria longipes—Adams & White, 1848 : 7. (Not *Cancer longipes* Linnaeus, 1758.)

Phalangipus retusus Rathbun, 1916 : 552.

Type material

Holotype: Male, cl. 24.5 mm, Tawi Tawi Group, Sulu Archipelago, 18 fms, 21 Feb. 1908, 'Albatross' St. 5157—USNM 48222.

Additional material

A total of 10 specimens—5 ♂, 5 ♀ (1 ovig.), cl. 11.6–28.1 mm, ovig ♀ 26.0 mm as follows.

Bay of Bengal: Bay of Bengal, 20°16'N, 92°32'E, 13–15 m, GMT, 5.4.1963, 'Anton Bruun' St. 47A, 1 spec (USNM 135230).

Malay Archipelago: N. coast of Sumbawa, 36 m, sand, coral and mud, 14–16.2.1900, 'Siboga' Exped. St. 313, 1 spec (ZMA De 100.841).

Philippine Is: Eastern Sea, A. Adams, 1 spec (BMNH 47.21)—Mariveles, Luzon, Albert M. Reese, 1 spec (USNM 49672)—Manilla Bay, 24 m, hard bottom, 7.2.1909, 'Albatross' St. 5360, 1 spec (USNM 49670)—Cebu, 28.3.1909, 'Albatross', 1 spec (USNM 49671)—Cebu, Cuming, 1 spec (BMNH 43.6)—Subig Bay, Olongopas, shore collecting, 7.1.1908, 'Albatross', 1 spec (USNM 49673)—Tawi Tawi Group, Sulu Archipelago, 36 m, fine sand, 21.2.1908, 'Albatross' St. 5157, 2 specs (USNM 134417).

Material illustrated

1 ♂, cl. 23.7 mm, 1 ♀, cl. 26.0 mm (fig. 7(c) only), 'Albatross' St. 5157 (USNM 134417).

Description

General: Spines of carapace blunt. A pair of small submedial tubercles behind anterior pair and closer to midline but opposite first mesogastric spine and a pair of low submedial tubercles sometimes present posteriorly just forward of third mesogastric tubercle. Two or three small spines or tubercles, one above the other, on hepatic region. One low urogastric tubercle sometimes present. Branchial region with 4 tubercles dorsally in a shallow semicircle,

1 low posterolateral tubercle sometimes present, epibranchial part smooth. Intestinal and cardiac spines subequal, short, the latter upwardly directed.

Rostrum :

Length 0.1 postrostral length or slightly less, distance between tips about twice depth of hiatus, lateral margins distally divergent in both sexes, spines slender, uniformly cylindrical, unarmed, apically blunt, medial margins with sparse fringe of curled hairs. Hiatus a more or less broad U.

Orbit : Lateral margins of supraorbital eave divergent backwards. Supra-orbital spine blunt. A small antorbital lobe usually present. Intercalated spine flattened, broad, strongly convex or apically broadly obtuse, separated from eave by a more or less narrow V and from postorbital lobe by broad V. Postorbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe tall, stout, conical, separated from both basal antennal article and postorbital lobe by a narrow U.

Basal antennal article : With one lateral basal lobe, sometimes with a small tubercle on its base anteriorly, one or two smaller lobes sometimes laterally not far from basal lobe.

Pterygostomial spine : Very broad, dorsoventrally flattened, apically rounded ; edges fringed by a few long hairs.

Third maxilliped : Lateral ridge of ischium without proximal elevation or tubercle.

Male sternum : Surface of all sternites naked. Larger lobe of first sternite broad, conical or very weakly anteroposteriorly flattened, apically blunt. Sternites 2, 3 and sometimes 4 with a small tubercle more or less centrally. A few small tubercles scattered along margin of abdominal fossa. All lobes and tubercles naked.

Male abdomen : Surface naked. Segment 1 with a broad, anteroposteriorly flattened, convex lobe produced into a small central tubercle ; segment 6 with a low medial elevation or tubercle on distal margin. Surface of abdomen otherwise smooth.

Female abdomen : Segment 1 convex or with small central tubercle. Segment 2 with an anteroposteriorly flattened, apically rounded or subtruncate lobe occupying about $\frac{1}{2}$ width of segment, a low elevation or tubercle laterally. Segment 3 centrally convex, produced into a subtriangular, weakly flattened lobe laterally. Segment 4 with a similar lateral lobe proximally, segment 5 with a broad, low elevation proximally near lateral border. Abdomen otherwise usually smooth except for medial elevation, with broad central elevation on distal edge of segment 5, sometimes with a low tubercle.

Male chelipeds : Merus smooth, without distal dorsal spine. Palm widest distally, dactyl with truncate, crenulate, proximal tooth. Fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs : Meri of all legs with anterior spine on distal margin, largest on anterior legs. Legs otherwise smooth.

Male pleopod 1 : Of moderate length, and slenderness, smoothly tapering distally except for weakly swollen subterminal portion, uniformly but weakly outwardly curved distally ; a few simple hairs midway along lateral surface,

otherwise naked; aperture close to tip on medial surface, located with elongate groove.

Remarks

The distinctive feature of this species is the strongly flattened pterygostomian lobe. In all other species the lobe is at the most flattened only near the base. The absence of a distal dorsal spine from the cheliped merus is unique. In many specimens in the present series the antorbital lobe is very weak. The other major variable feature is the ornamentation of the lateral margin of the basal antennal article. All specimens possess the usual lobe near the base. But while many specimens possess an additional, slightly more distal, lateral lobe the absence of any second lobe in some specimens and the fact that *P. trachysternus* also sometimes possess two lateral lobes prohibit this feature from being diagnostic.

Bathymetric distribution

Upper continental shelf from 15–36 m.

Substrate

Sand and mud.

Geographic distribution

Northern Bay of Bengal, Philippine Islands and Malay Archipelago. Previously known only from the Philippine Islands.

***Phalangipus trachysternus* sp. nov.**

(Figs. 2 (*d*), 4 (*g*), (*h*), 6 (*h*), 7 (*h*), 9 (*g*), (*h*))

Egeria longipes—Grant & McCulloch, 1906 : 27. (Not *Cancer longipes* Linnaeus, 1758.)

Phalangipus longipes—Griffin, 1966 : 280—Campbell & Stephenson, 1970 : 260–262, fig. 23.

Type material

Holotype: Male, cl. 30.1 mm, Gulf of Carpentaria, Queensland, Australia, 12 fms or less, J. C. Yaldwyn & D. F. McMichael, Dec. 1963, CSIRO Prawn Survey—AM P.17916.

Paratypes: A total of 37 specimens—16 ♂, 21 ♀ (7 ovig.), cl. 14.0–33.8 mm, smallest ovig. ♀ cl. 22.0 mm, as follows.

New Guinea: Sepik River, PNG, 5–20 m, trawled, August–September 1965, R. Eginton on MV 'Tagula', 1 spec (AM P.15629).

Australia: Perry Harbour, W.A., 10–12 m, 26.9.1967, R. W. George, 2 specs (WAM 66–71)—Cape Bossutt, W.A., 10 m, 9.9.1929, A. A. Livingstone, 1 spec (AM P.13992)—Broome, W.A., sand bar, 16.10.1962, R. W. George on 'Dorothea', 1 spec (WAM 64–71); 8 m, dredged, 29.8.1929, A. A. Livingstone, 1 spec (AM P.13991); dredged, before 1932, Captain R. Bourne, 1 spec (AM P.10195)—Roebuck Bay, W.A., 10–16 m, lithothamnion reef and sand flat, September 1929, A. A. Livingstone, 2 specs (AM P.13989–90)—Ashburton area, North Onslow, W.A., trawled, 1.10.1964, Poole Bros., 4 specs (WAM 67–71)—Near Darwin, N.T., 26–28 m, September 1965, E. Barker on 'Slaven', 2 specs (WAM 65–71, 70–71)—Gulf of Carpentaria, 30 m, 10.11.1964, R. W. George,

'Rama' St. 1540, 1 spec (WAM 63-71)—Gulf of Carpentaria, 24-28 m, December 1963, J. C. Yaldwyn & D. F. McMichael, 7 specs (AM P.17924, P.17926)—S.E. Corner, Gulf of Carpentaria, 16 m, 15.11.1963, CSIRO Gulf Prawn Survey, 5 specs (AM P.17927)—Chunda Bay, Townsville, Queensland, 10 m, prawn trawl, April 1967, C. Wilson, 1 spec (AM P.16666)—Gladstone, Queensland, mud, trawled, 1963, Miss J. Booth, 1 spec (AM P.16911)—Port Curtis, Queensland, don. Mrs. F. E. Grant, 1907, 2 specs (AM G.5931)—Gatcombe Head, Port Curtis, Queensland, 18-24 m, December 1929, M. Ward, 4 specs (USNM 63342, AM P.17925).

Material illustrated

Holotype: female paratype, cl. 29.6 mm Gulf of Carpentaria (AMP. 17924)—fig. 7 (h) only.

Description

General: Spines of carapace generally short, blunt. A second submedial pair of protogastric tubercles behind anterior pair and closer to midline. Two small tubercles, one above the other, on hepatic region. One very low urogastric tubercle. Branchial region with 4 tubercles dorsally in a shallow semicircle, one very low tubercle sometimes posterolaterally, epibranchial part medially smooth. Intestinal and cardiac spines subequal, very short.

Rostrum: Length slightly more than 0.1 postrostral length, distance between tips slightly exceeding depth of hiatus, lateral margins subparallel or weakly divergent in both sexes, spines apically blunt, unarmed, medial margins with dense fringe of curled hairs. Hiatus more or less V-shaped.

Orbit: Lateral margins of supraorbital eave divergent backwards. Supraorbital spine blunt. Antorbital lobe usually present, rounded or subtriangular. Intercalated spine flattened, broadly subtriangular or rounded, separated from both eave and postorbital lobe by a more or less narrow V. Postorbital lobe posteriorly unarmed, distally weakly concave.

Suborbital lobe tall, conical, very stout, separated from basal antennal article by a narrow V-shaped notch and from postorbital lobe by a broad V.

Basal antennal article: With a single lateral basal lobe.

Pterygostomial spine: Cylindrical or subcylindrical, seldom weakly dorsoventrally flattened, blunt.

Third maxilliped: Lateral ridge of ischium without proximal elevation or tubercle.

Male sternum: Posterior part of surface of first sternite and surface of all other sternites densely covered by very short, stout hairs. Larger lobe of sternite 1 a stout, conical spine with one or two small spines laterally and medially at its base. Second, third and fourth sternites with an irregular group of spines or tubercles on their medial halves. Major lobes and spines naked.

Male abdomen: Surface densely covered by very short, stout hairs, without spines or tubercles. Segment 1 with a very broad, anteroposteriorly flattened, apically rounded lobe.

Female abdomen: Segment 1 with a broad, anteroposteriorly flattened, apically rounded lobe. Segment 2 with a similar lobe occupying about $\frac{1}{3}$ width of segment. Segment 3 centrally convex with two tubercles laterally. Segment 4 with a stout tubercle laterally close to proximal margin, a low lateral elevation near proximal margin of segment 5. Abdomen otherwise usually smooth except for medial elevation, sometimes with low medial tubercle on distal edge of segment 5.

Male chelipeds: Merus with stout distal dorsal spine, otherwise smooth. Palm widest distally. Dactyl with truncate, crenulate proximal tooth, fingers weakly gaping proximally, strongly toothed for distal $\frac{3}{4}$.

Ambulatory legs: Meri of first and sometimes second leg with a spine anteriorly on distal margin, meri of posterior legs generally unarmed. Legs otherwise smooth.

Male pleopod 1: Of moderate length, stout, straight, tapering only slightly towards tip, slender; all surfaces covered by long, simple hairs which are slightly more dense near the tip; aperture apical, oval, small, at end of short, slender process.

Remarks

Males of this species are easily distinguished from those of other *Phalangipus* species by the strongly tuberculate sternum and the stout, very hairy first pleopods. An unusually variable feature is the presence of an antorbital lobe—this lobe is absent in a considerable proportion of the material examined. The suborbital lobe is stouter than most other species except *P. indicus*.

The specific name is derived from trachy (Gk) meaning rough and sternon (Gk), chest and refers to the numerous tubercles on the sternum of the adult male.

Bathymetric distribution

Shallow water, 5–28 m.

Substrate

Sand, mud and lithothamnion reef.

Geographic range

Northern Australia from the Onslow area in the west through the Gulf of Carpentaria to Gladstone in southern Queensland; New Guinea—off Sepik River.

Discussion

The genus *Phalangipus* is distributed throughout the Indian and Western Pacific Oceans from the Red Sea to the east Malay Archipelago and from Japan south to Australia. The present study has extended the known range a little to the west from the Persian Gulf to the Red Sea. Geographically, the nine species fall into three groups. One is centred around the north eastern Indian Ocean—Malay Archipelago—Philippine Islands area and includes *P. longipes*, *P. indicus*, *P. retusus* and *P. filiformis*. The second group includes *P. hystrix*

only, the range of which extends almost throughout the range of the genus. The species of the third group have a much more restricted range. Three of the species are at or near the periphery of the range—*P. persicus* in the west (Iranian Gulf) and *P. trachysternus* and *P. australiensis* in the southeast (Australia and New Guinea); these three peripheral species are either quite distinct or closely similar to those in the central part of the range of the genus; they do not form a taxonomic group of their own. The other species, *P. malakkensis*, occurs in the centre of the range, in the Java Sea area.

Taxonomically, the nine species also fall into three groups. *P. hystrix* differs markedly from all the other species in a large number of characters, most especially ornamentation of the carapace, sternum, abdomen and chelipeds. It agrees with the other eight species in general carapace shape, relative length of legs, orbital details and number of abdominal segments. In addition, the change of carapace shape with growth—from narrowly pyriform to broadly pyriform—is shared with *P. filiformis* and in the adult the presence of a sub-terminal dorsal spinule or tubercle on the rostrum is not a character confined to *P. hystrix* but is found in five other species although in these it is small. The remaining eight species may be divided into those in which the orbit is open, the eave lacking an antorbital spine and having the intercalated spine separated from the eave by a broad U-shaped hiatus—*P. longipes*, *P. australiensis* and *P. filiformis*—and those with a more or less closed orbit, the eave possessing an antorbital lobe, the hiatus between the eave and antorbital lobe being narrow. These are not clear-cut groups. *P. retusus* possesses an antorbital lobe but quite clearly is most similar to *P. filiformis* in the shortness of the rostral spines and ornamentation and lack of hairs on the sternum of the adult male; males of the two also have very similar first pleopods. *P. retusus* differs from *P. filiformis* mainly in the form of the pterygostomial spine. But, what is surprising in this group of species is the intraspecific variation in those characters usually considered taxonomically reliable, e.g., form of the orbit, ornamentation of the basal antennal article, third maxillipeds, sternum and abdomen. In *P. trachysternus* an antorbital lobe or may not be present. In *P. retusus*, and rarely in *P. trachysternus*, a second lobe may be present at the base of the lateral margin of the basal antennal article. Most of the characters of *P. longipes* and *P. australiensis* which might normally distinguish the two are so variable that in their area of overlap they usually cannot be distinguished except by the form of the male first pleopod. Throughout the genus characters such as the presence of terminal spines on the ambulatory meri and lobes on the abdomen are also variable and of little use taxonomically.

It must be emphasized that a group of specimens from the southern Indonesia—northern Australia region, quite definitely belonging to two different species, present considerable problems which this study may not have completely resolved. One group, here assigned to *P. filiformis*, consistently possesses very short rostral spines. The other, considered to belong to *P. longipes*, possesses many characters typical of *P. australiensis* but the first pleopod is most similar to *P. longipes* although of a slightly different shape except in one male in which it is exactly as in *P. longipes*.

If the species are grouped on the basis of the shape of the first pleopod of the males a rather different arrangement from that outlined above is apparent. *P. trachysternus* and *P. australiensis* possess a pleopod quite different from that

of any other species—short, straight and stout but otherwise dissimilar. The remaining species possess a rather similar pleopod—generally long, weakly curved, slender, tapering towards the apex; the aperture of the pleopod in these species is small, oval and subterminal or terminal. In *P. malakkensis* the aperture is a long slit whilst in *P. retusus* and *P. filiformis* it is within a long groove. If the form of the first pleopod is considered more conservative, in the evolutionary sense, than other characters, the conclusion could be drawn that the similarity of *P. trachysternus*, and perhaps *P. australiensis*, to the other species is a result of convergence.

Summary

Cancer longipes Linnaeus, 1758 is designated type species of the genus *Phalangipus* Latreille, 1825. A neotype is designated for *Cancer longipes*. A lectotype is designated for *Egeria Herbstii* H. M. Edwards in 1834 and *Egeria indica* Leach 1814 which is considered to be a single species distinct from *P. longipes* (*Egeria arachnoides* (auct)). *Egeria investigatoris* Alcock 1895 is considered to represent the adult of *Naxia hystrix* Miers 1886. Three new species are described, *P. persicus* from the Iranian Gulf (recorded as *P. arachnoides* by Nobili and as *P. longipes* by Stephensen), *P. malakkensis* from the Malay Archipelago and *P. trachysternus* from northern Australia and New Guinea (recorded by some authors as *P. longipes*). The number of species in the genus is thus increased from five to nine; the genus is confined to the Indo-West Pacific. A key is given to the species which are described and illustrated.

Many of the species are extremely variable morphologically. The known geographic range of *P. australiensis* is extended to western Australia and the Malay Archipelago, that of *P. filiformis* to the Indian Ocean and Australia and that of *P. hystrix* to the Red Sea and western Australia.

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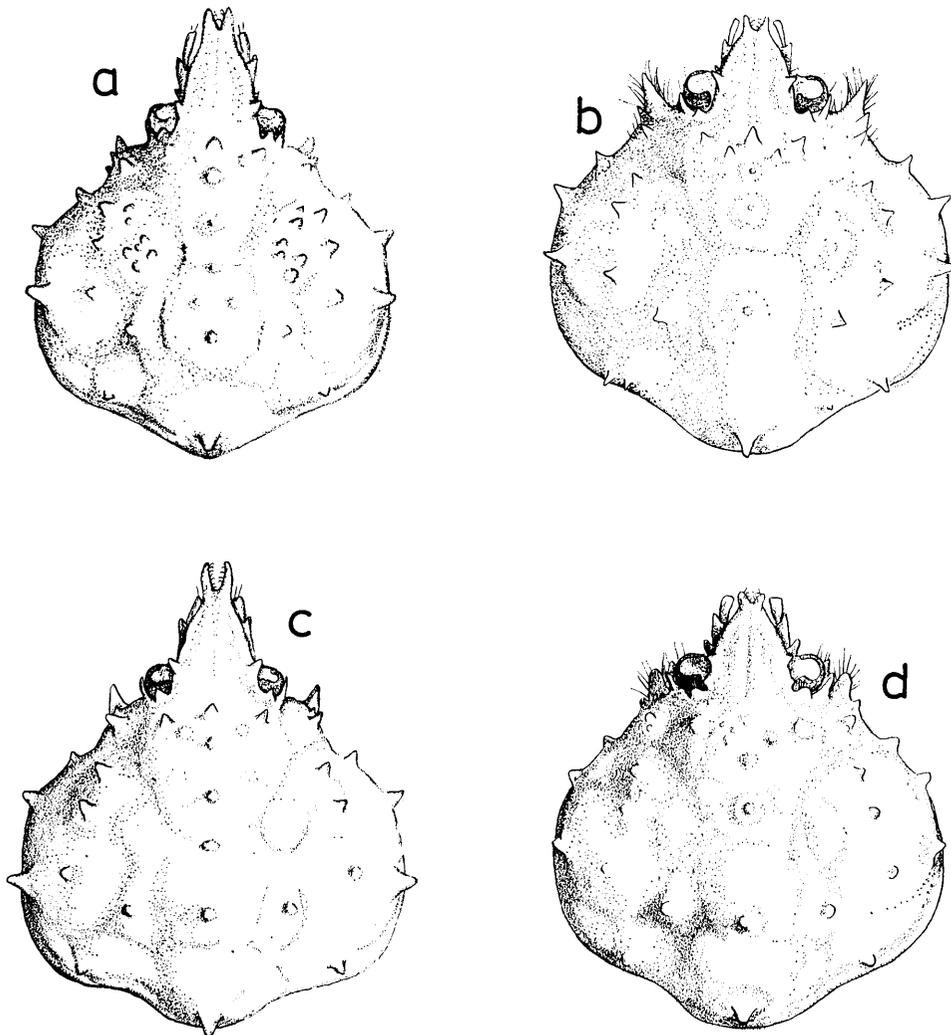


FIG. 1. *Phalangipus* species, carapace, dorsal aspect: (a) *P. australiensis*; (b) *P. filiformis*; (c) *P. longipes*; (d) *P. retusus*.

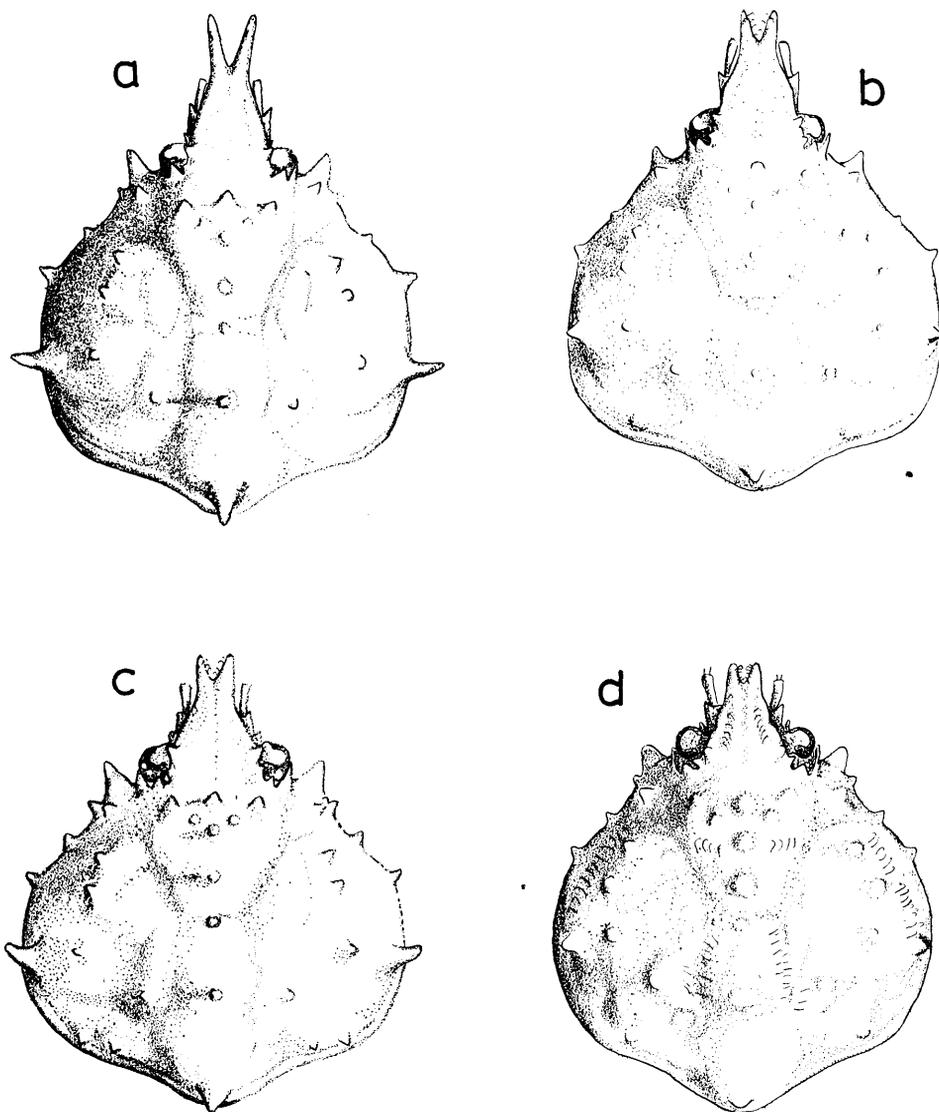


FIG. 2. *Phalangipus* species, carapace, dorsal aspect: (a) *P. indicus*; (b) *P. malakkensis*; (c) *P. persicus*; (d) *P. trachysternus*.

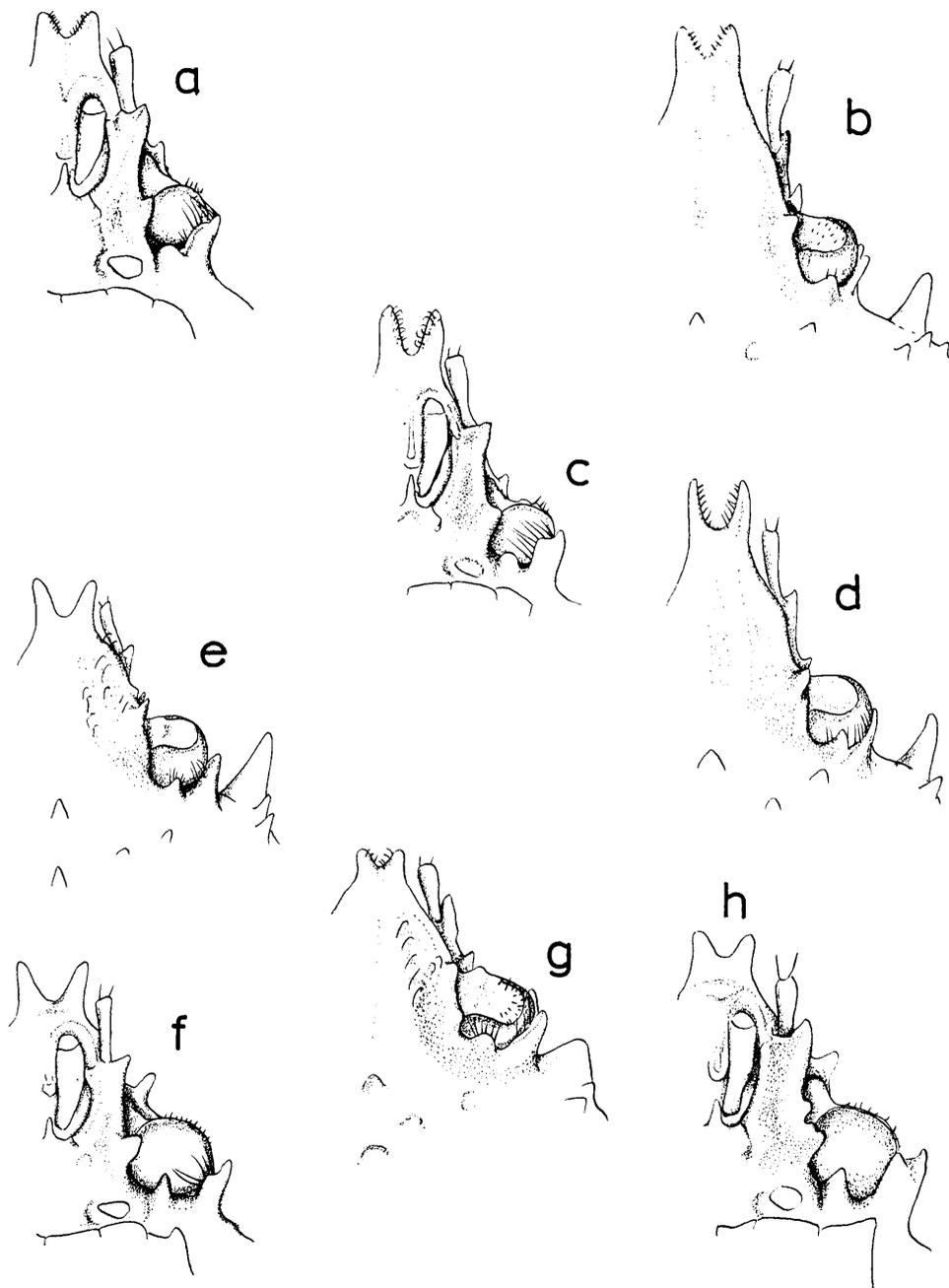


FIG. 3. *Phalangipus* species, rostrum and orbit, right side, ventral (a, c, f, h) and dorsal (b, d, e, g) aspect: (a, b) *P. australiensis*; (c, d) *P. longipes*; (e, f) *P. filiformis*; (g, h) *P. retusus*.

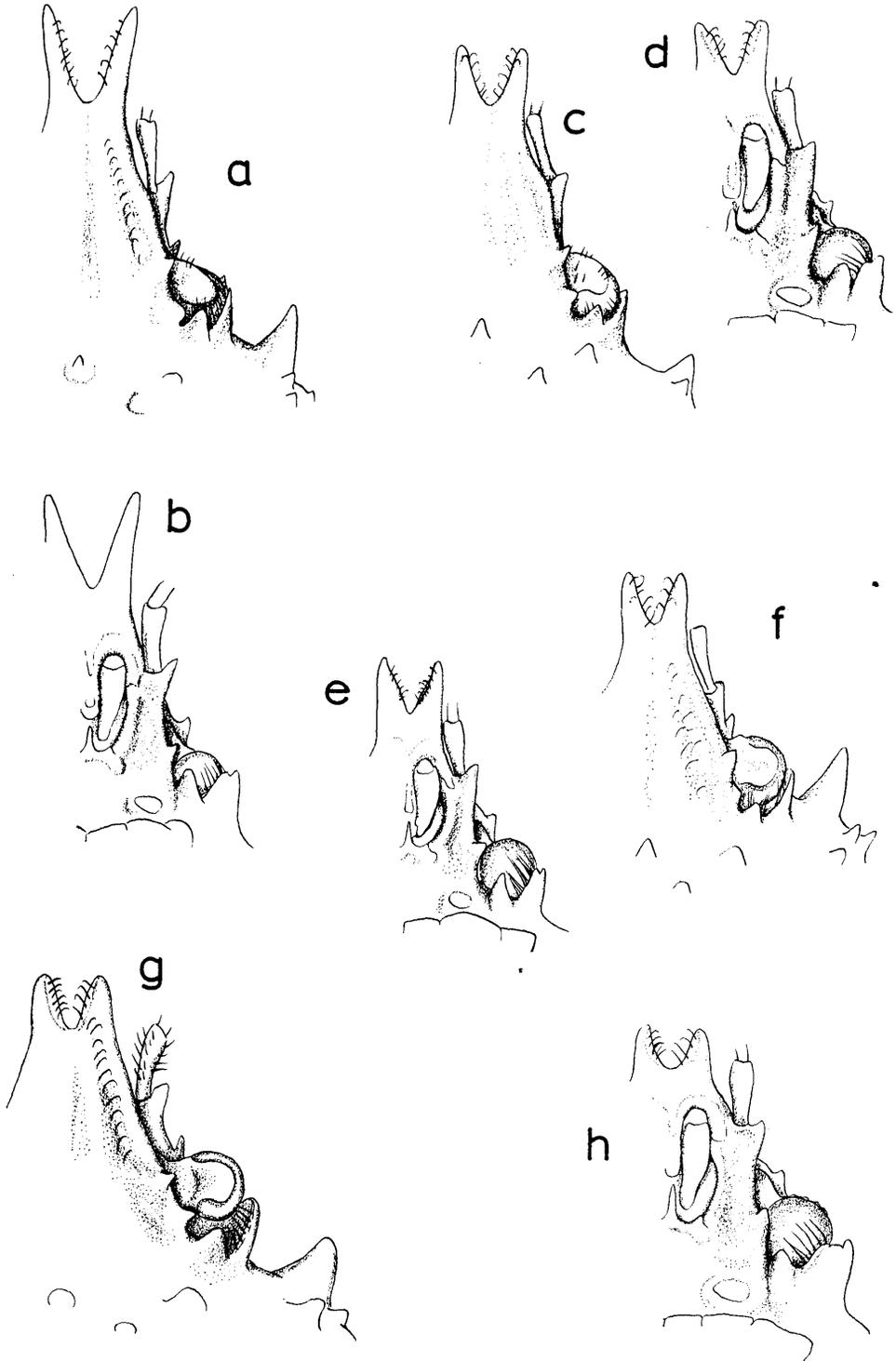


FIG. 4. *Phalangipus* species, rostrum and orbit, right side, dorsal (a, c, f, g) and ventral (b, d, e, h) aspects: (a, b) *P. indicus*; (c, d) *P. malakkensis*; (e, f) *P. persicus*; (g, h) *P. trachysternus*.

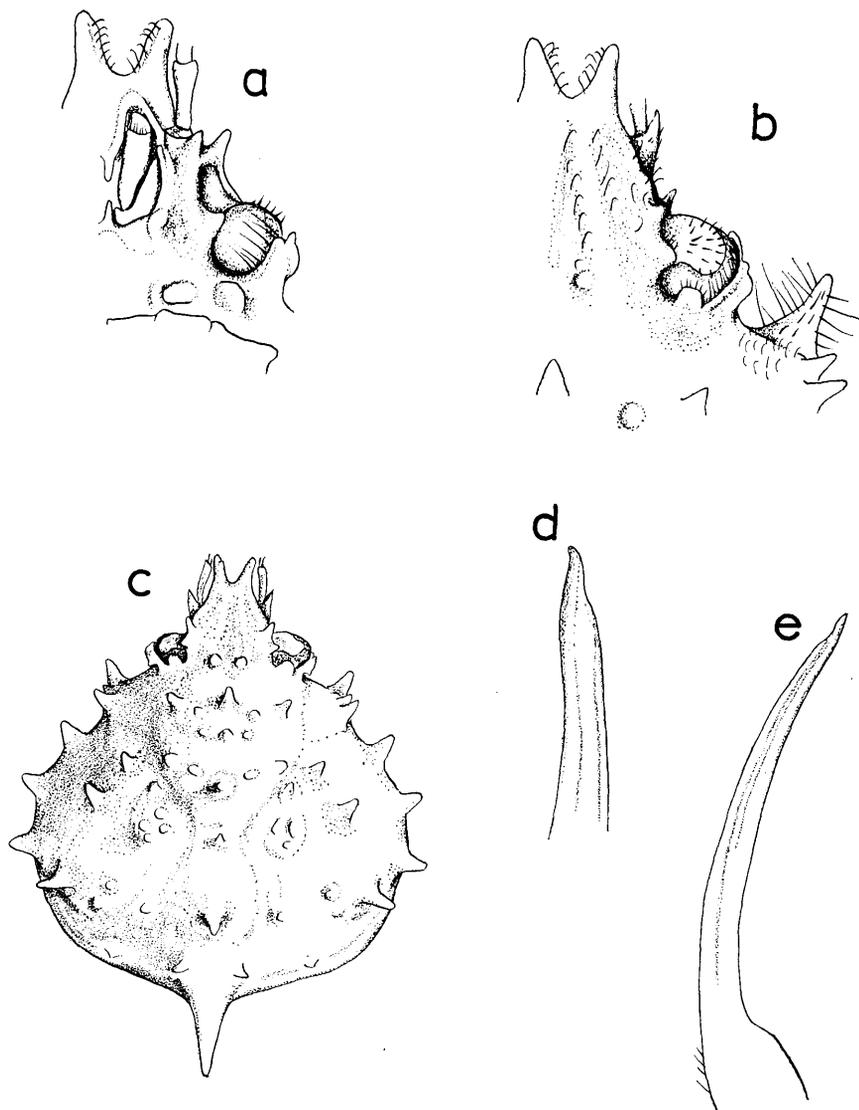


FIG. 5. *Phalangipus hystrix*: (a) rostrum and orbit, right side, ventral aspect; (b) same, dorsal aspect; (c) carapace, dorsal aspect; (d) male left pleopod 1, tip, sternal aspect; (e) male left pleopod 1, abdominal aspect.

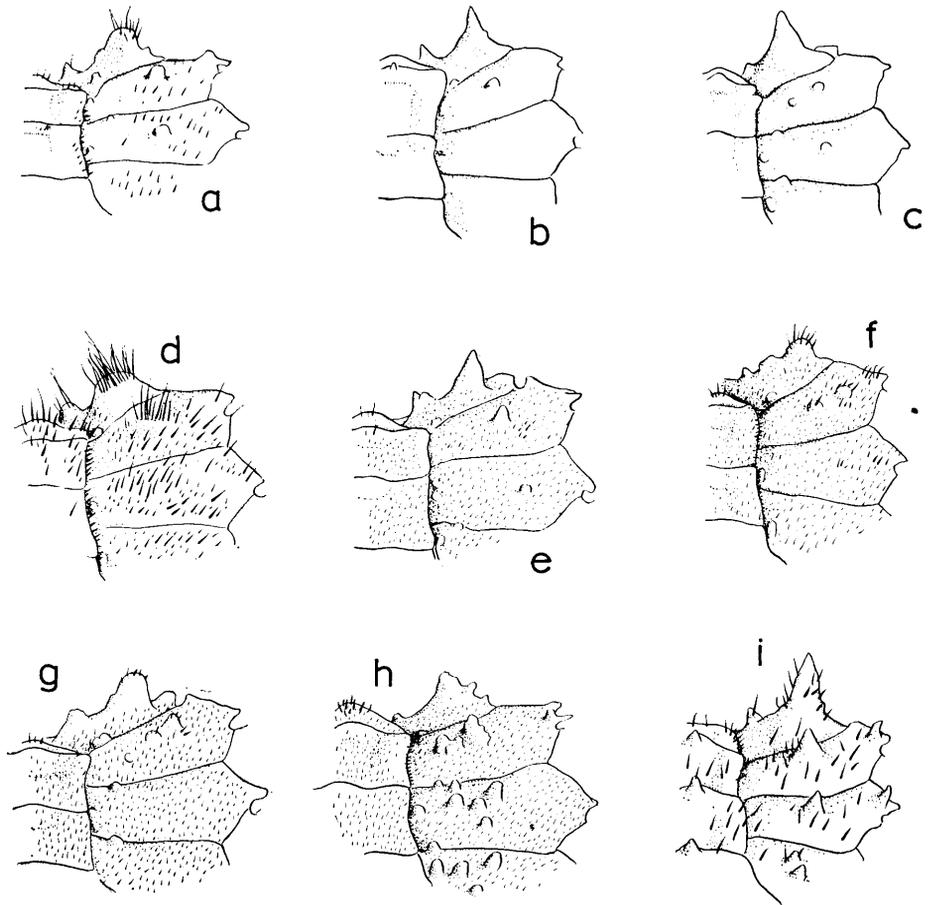


FIG. 6. *Phalangipus* species, anterior part of sternum and abdomen of males, left side: (a) *P. australiensis*; (b) *P. filiformis*; (c) *P. retusus*; (d) *P. longipes*; (e) *P. indicus*; (f) *P. malakkensis*; (g) *P. persicus*; (h) *P. trachysternus*; (i) *P. hystrix*.

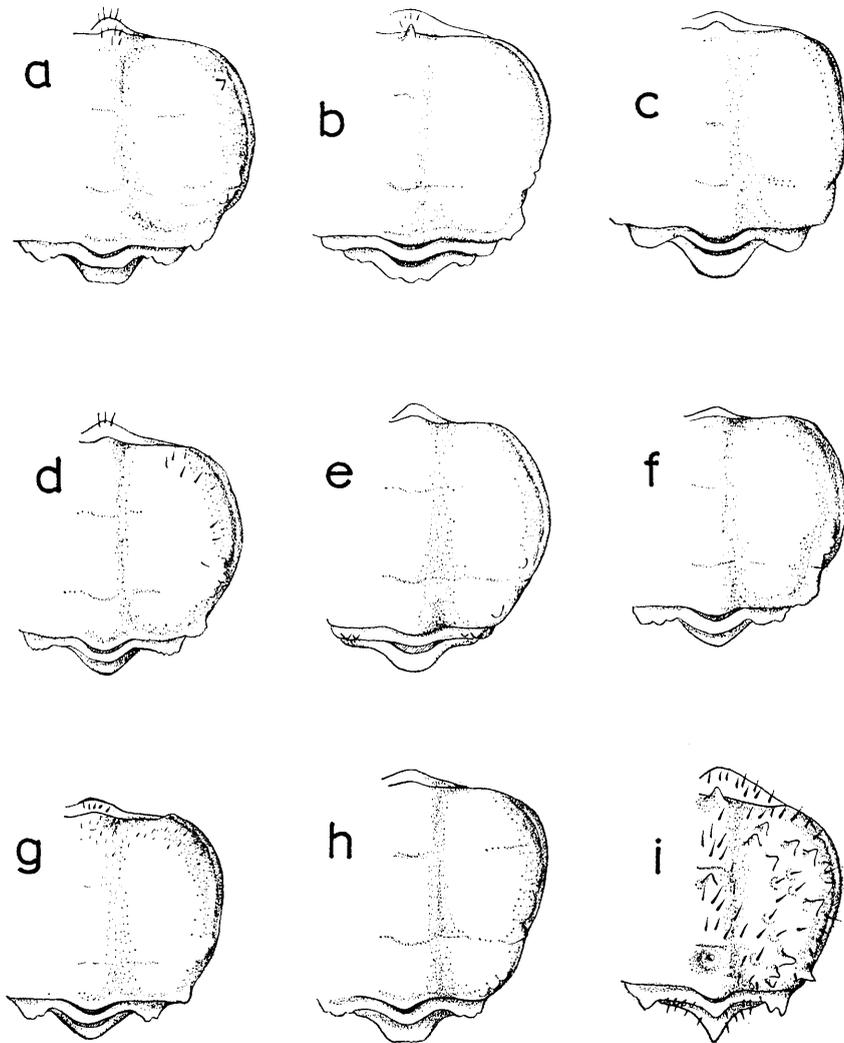


FIG. 7. *Phalangipus* species, abdomen of female, left side: (a) *P. australiensis*; (b) *P. filiformis*; (c) *P. retusus*; (d) *P. longipes*; (e) *P. indicus*; (f) *P. malakkensis*; (g) *P. persicus*; (h) *P. trachysternus*; (i) *P. hystrix*.

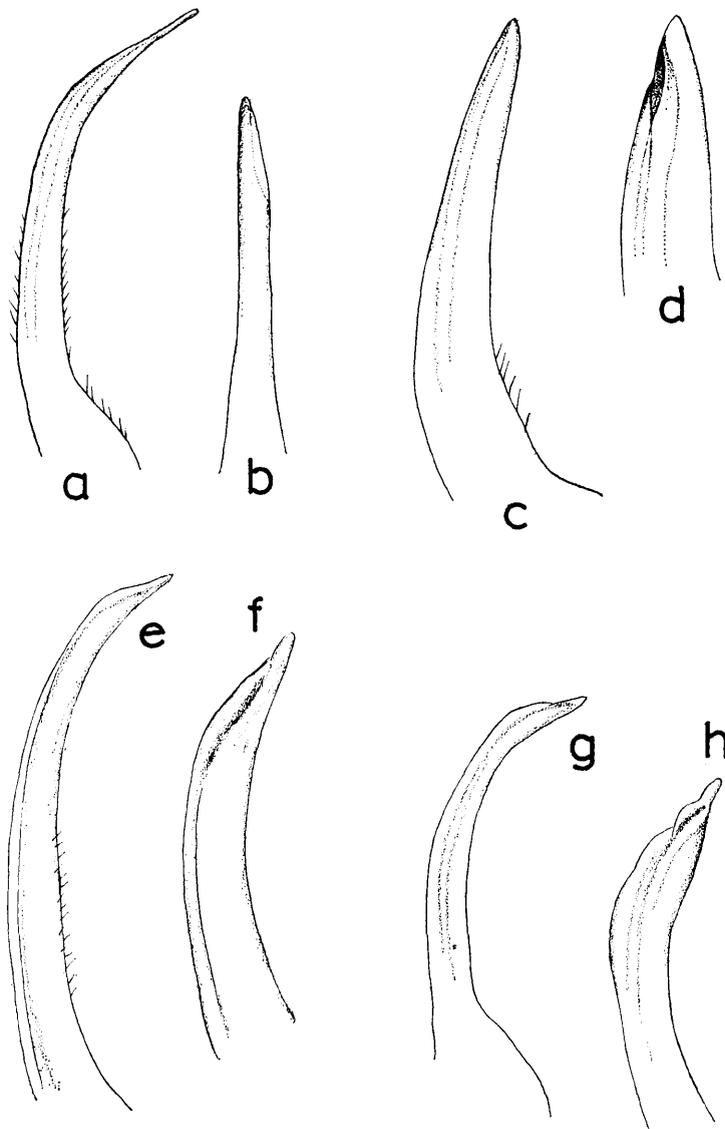


FIG. 8. Male left pleopod 1: (a) *P. longipes*, abdominal aspect; (b) same, tip, sternal aspect; (c) *P. australiensis*, abdominal aspect; (d) same, tip; (e) *P. retusus*, abdominal aspect; (f) same, tip; (g) *P. filiformis*, abdominal aspect; (h) same, tip.

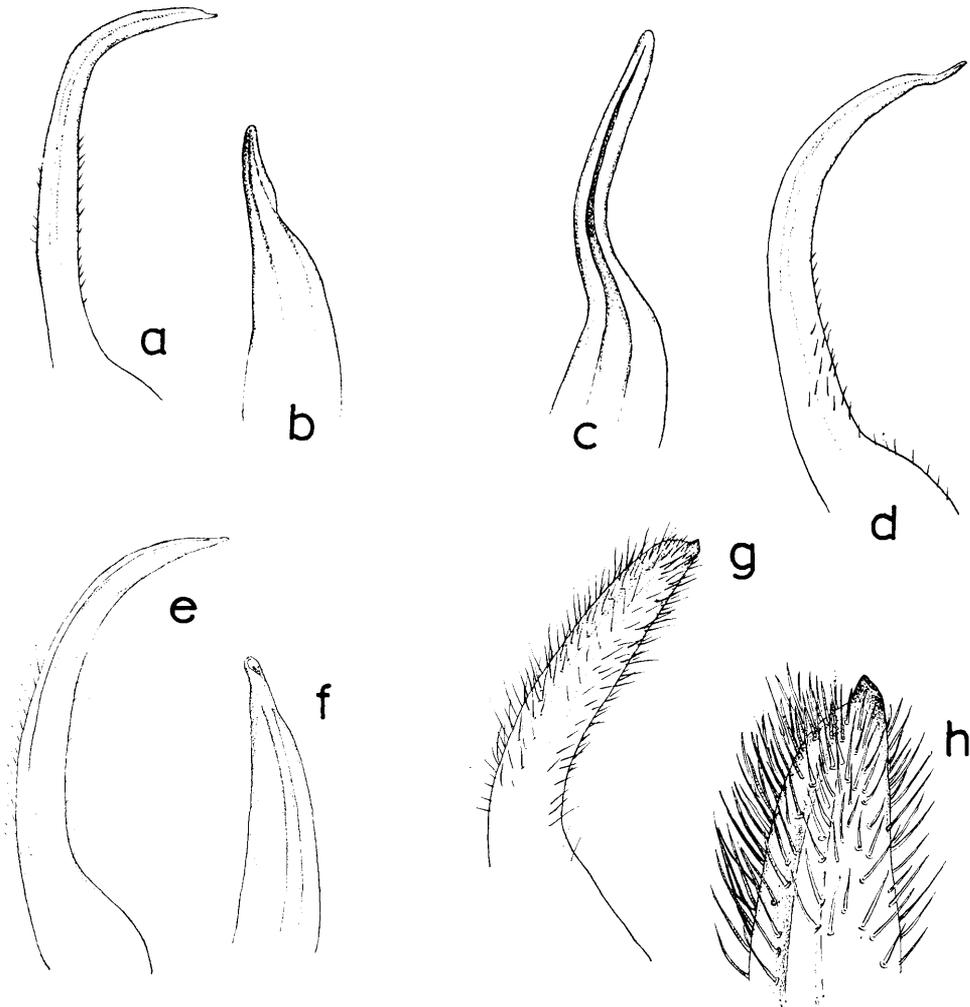


FIG. 9. Male left pleopod I: (a) *P. indicus*, abdominal aspect; (b) same, tip, sternal aspect; (c) *P. malakkensis*, tip, sternal aspect; (d) *P. malakkensis*, abdominal aspect; (e) *P. persicus*, abdominal aspect; (f) same, tip, sternal aspect; (g) *P. trachysternus*, abdominal aspect; (h) same, tip.

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