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A NEW SPECIES OF FRESHWATER PRAWN, *MACROBRACHIUM JOHNSONI* SPEC. NOV. (DECAPODA: CARIDEA: PALAEMONIDAE) FROM PENINSULAR MALAYSIA, AND A DESCRIPTION OF ITS FIRST ZOEA

by

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Chong, Samuel S.C., and H.W. Khoo: A new species of freshwater prawn, *Macrobrachium johnsoni* spec. nov. (Decapoda: Caridea: Palaemonidae) from Peninsular Malaysia, and a description of its first zoea.

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Keywords: Decapoda; Caridea; Palaemonidae; *Macrobrachium*; new species; Peninsular Malaysia; larval development.

A new species of freshwater prawn of the family Palaemonidae, *Macrobrachium johnsoni* spec. nov., is described from southern Peninsular Malaysia. Notes on live colouration, habitat, and larval development are provided. The first zoea of this new species is also described in detail. A comparison is made between *M. johnsoni* and a closely related species, *M. pilimanus* (De Man, 1879).

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INTRODUCTION

During a recent field-trip to Gunong Pulai in southern Johore, Peninsular Malaysia, the first author collected numerous specimens of *Macrobrachium* Bate, 1868, from the mountain's main torrent stream. Most of the specimens were clearly referrable to *M. pilimanus* (De Man, 1879), agreeing completely with the drawings and type description provided by De Man (1879, 1887).

Some of the specimens however, though closely resembling, showed subtle but consistent differences from *M. pilimanus* s. str. in both adult and larval characters. These specimens also could not be referred to any other known species of *Macrobrachium*, and the authors have therefore assigned them to a new species, *Macrobrachium johnsoni* spec. nov. A second batch of specimens collected during a later trip to other localities in southern Johore was also found to belong to this new species.

A detailed description of this new species is provided, including live colouration, habitat, and larval development. Its first zoea is also described in detail. Adult and larval differences between *M. johnsoni* and *M. pilimanus* are also highlighted.

The abbreviations bl. (body length), cl. (carapace length), and rl. (rostral length) have been used in the text. Body length of adults is measured from the tip of the rostrum to the posterior margin of the telson (to the nearest mm), carapace length from the post-orbital margin to the posterior margin of the carapace, and rostral length from the tip of the rostrum to the post-orbital margin (latter measurements to the nearest 0.5 mm). Notation for rostral formula follows that of Holthuis (1984).

Larvae were dissected in 50% glycerine using fine entomological needles. Drawings, descriptions and measurements are based on five specimens. Body length is measured from the post-orbital margin to the posterior edge of the telson, excluding setae, carapace length being the length of carapace excluding rostrum.

All structures were drawn with the aid of a drawing tube mounted on to a Nikon SMZ-10 binocular microscope, as well as a camera lucida mounted on a Leitz monocular microscope. Types are deposited in the Rijksmuseum van Natuurlijke Historie (RMNH), Leiden, Netherlands and the Zoological Reference Collection (ZRC), National University of Singapore.

DESCRIPTION OF SPECIES

Macrobrachium johnsoni spec. nov.
(Figs. 1, 2, & 3)

Macrobrachium pilimanus – Johnson, 1960a, b; 1961; 1963; 1966 (all part).
Cryphiops (Macrobrachium) pilimanus – Johnson, 1969 (part).
Macrobrachium pilimanus – Holthuis, 1979:9; 1980:102; 1984 (part).

Holotype. — 1 male (RMNH no. 36517) (bl. 58 mm, cl. 16.5 mm, rl. 10.5 mm), first landing, Gunong Palai waterfall stream, Johore, ca. 200 m asl., leg. S.S.C. Chong, P.K.L. Ng and H.P. Ng, 18.v.1985.

Paratypes. — 1 female (RMNH no. 36518) (bl. 48.5 mm, cl. 12.5 mm, rl. 8 mm), foot of mountain, Gunong Pulai waterfall stream, Johore, leg. S.S.C. Chong, P.K.L. Ng and H.P. Ng, 18.v.1985; 1 male (ZRC no. 1985.2534) (bl. 60 mm, cl. 16 mm, rl. 10.5 mm), same data as holotype; 1 female (ZRC no. 1985.2535) (cl. 11 mm, rl. 8 mm); 1 male (RMNH no. 36519) (cl. 14.5 mm, rl. 8.5 mm); 1 male (cl. 11 mm, rl. 7.5 mm), 1 juv. (cl. 7.5 mm, rl. 5.5 mm) (ZRC no. 1985.2536-2537); same data as first female paratype.

Other material. — 10 spec. (ZRC no. 1985.2538-2547), tributary of Sungei Pontian Besar, 29.7 mls. north of Johore Bahru, leg. Sharma, Benny, Hendrickson, no date; 4 spec. (ZRC no. 1985.2548-2551), stream 2-5 km before Jemaluang, from Kota Tinggi, Johore, leg. no S.C. Chong and P.K.L. Ng, 11.vi.1985; 2 spec. (ZRC no. 1985.2552-2553), stream 9 km after Jemaluang, towards Kluang, Johore, leg. S.S.C. Chong and P.K.L. Ng, 12.vi.1985; 18 spec. (ZRC no. 1985.2554-2571), 40 km after Jemaluang, towards Kluang, Johore, leg. S.S.C. Chong and P.K.L. Ng, 12.vi.1985; 3 spec. (ZRC no. 1985.2572-2574), Sungei Mupoh (Ulu), Kota Tinggi-Mawai road, Johore, no other data; 1 spec. (ZRC no. 1985.2575), Sungei Mupoh (Ulu), Kota Tinggi-Mawai road, Johore, no other data; 1 spec. (ZRC no. 1985.2576), Sungei Semalok, near Kota Tinggi, leg. D.S. Johnson, 19.vii.1963.

Diagnosis. — Rostrum extending beyond antennular peduncle; ratio of rl. to cl. between 0.6 (for specimen of cl. 16.5 mm) and 0.8 (for specimen of cl. 5.5 mm); dorsal margin of rostrum with 12-17 teeth (usually 14-15), ventral with 2-4 (usually 3); 4-6 dorsal teeth extend back onto carapace. Eyes large; ratio of widest region of cornea to cl. between 0.2 (for cl. 16.5 mm) and 0.3 (for cl. 5.5 mm). Ratio of scaphocerite length to cl. between 0.6 (for cl. 16.5 mm) and 0.7 (for cl. 5.5 mm). Second chelipeds subequal, robust; carpus conical, shorter than merus and chela; merus slightly inflated; chela slightly upcurved, dorsal margin concave and ventral convex; dense tufts of long, velvety hair present on much of chela, especially on outer surface; fingers with numerous teeth placed at regular intervals over most of cutting edges; adults with small spinules present on surface of all joints except fingers. Movable spine on exopod of uropod weak and shorter than outer fixed tooth.

Description of male holotype. — Rostrum straight, reaching beyond antennular peduncle but not end of scaphocerite. Dorsal margin almost straight, ventral margin slightly convex. Rostral formula 5)15/4, with dorsal teeth extending back over one-third of carapace. Antennal spine well developed. Hepatic spine slightly smaller than antennal, lying behind and distinctly below latter. Carapace smooth except for some small spinules in the lower antero-lateral region.

Abdomen smooth, pleura of first four somites broadly rounded, that of fifth ending in blunt postero-lateral point. Sixth somite 1.8 times as long as fifth. Postero-lateral angle of sixth somite broadly triangular and sharply pointed. Process overlapping lateral basal part of telson also triangular and

sharply pointed. Telson 1.5 times as long as sixth somite. Two pairs of dorsal spines present, anterior and posterior pairs situated slightly past the half and three-quarter marks respectively. Posterior margin of telson ends in triangular point, being overreached by more than half of the inner posterior spines. Outer spines of posterior margin very short. Numerous hairs present between inner spines.

Eyes large, cornea broader and longer than eye-stalk, with a distinct ocellus present. Widest region of cornea 0.2 times length of carapace. Basal segment of antennular peduncle with sharp, pointed stylocerite, extending from the base on one-third of the segment. Antero-lateral tooth strong, reaching slightly beyond half, but not reaching anterior margin, of middle segment of antennular peduncle. Scaphocerite 2.8 times as long as wide, reaching slightly beyond rostrum, and 0.6 times as long as carapace. Outer margin almost straight, ending in a strong tooth which fails to reach end of lamella.

Third maxilliped slender, with half of last segment extending beyond tip of antennal peduncle. Last segment about three-quarters as long as penultimate and slightly more than half as long as antepenultimate.

First pereiopods very slender, left leg longer than right. Left leg reaching with four-fifths of carpus beyond scaphocerite, right leg reaching with chela beyond scaphocerite. Palm of either chela 1.3 times as long as fingers. Carpus of left leg about 1.9 times as long as chela, and 1.2 times as long as merus. Carpus of right leg 1.5 times as long as chela, and slightly longer than merus.

Second pereiopods subequal, left leg larger and more robust than right. Carpus of left leg extends beyond scaphocerite. Chela slightly upcurved, dorsal margin concave, ventral convex. Fingers straight, with curved pointed tips, as long as palm. Proximal two-thirds of cutting edge of each finger with 7-8 evenly distributed teeth, proximal teeth generally smaller than distal ones. Cutting edges straight and almost completely closing over their full length. Fingers and most of palm covered with closely packed tufts of long velvety hair, greatly obscuring the denticulation of the fingers. Pubescence extending to tips of fingers, being denser on fingers than on palm. Inner surface of palm less hairy than outer. Palm about 2.3 times as long as high, and 1.3 times as high as wide. Both surfaces of palm with scattered, very small spinules, those on outer surface being obscured by dense pubescence. Carpus very short and conical, and 0.3 times as long as chela. Merus 2 times as long as carpus and slightly inflated, with both inner and outer surfaces somewhat convex. Middle region widest, being 1.3 times as wide as high. Ischium 0.3 times as long as merus. Spinules and some scattered, simple hairs present on carpus, merus, and ischium, but velvety pubescence absent. Right second pereiopod shorter and more slender than left, chela extending beyond scaphocerite. Pubescence

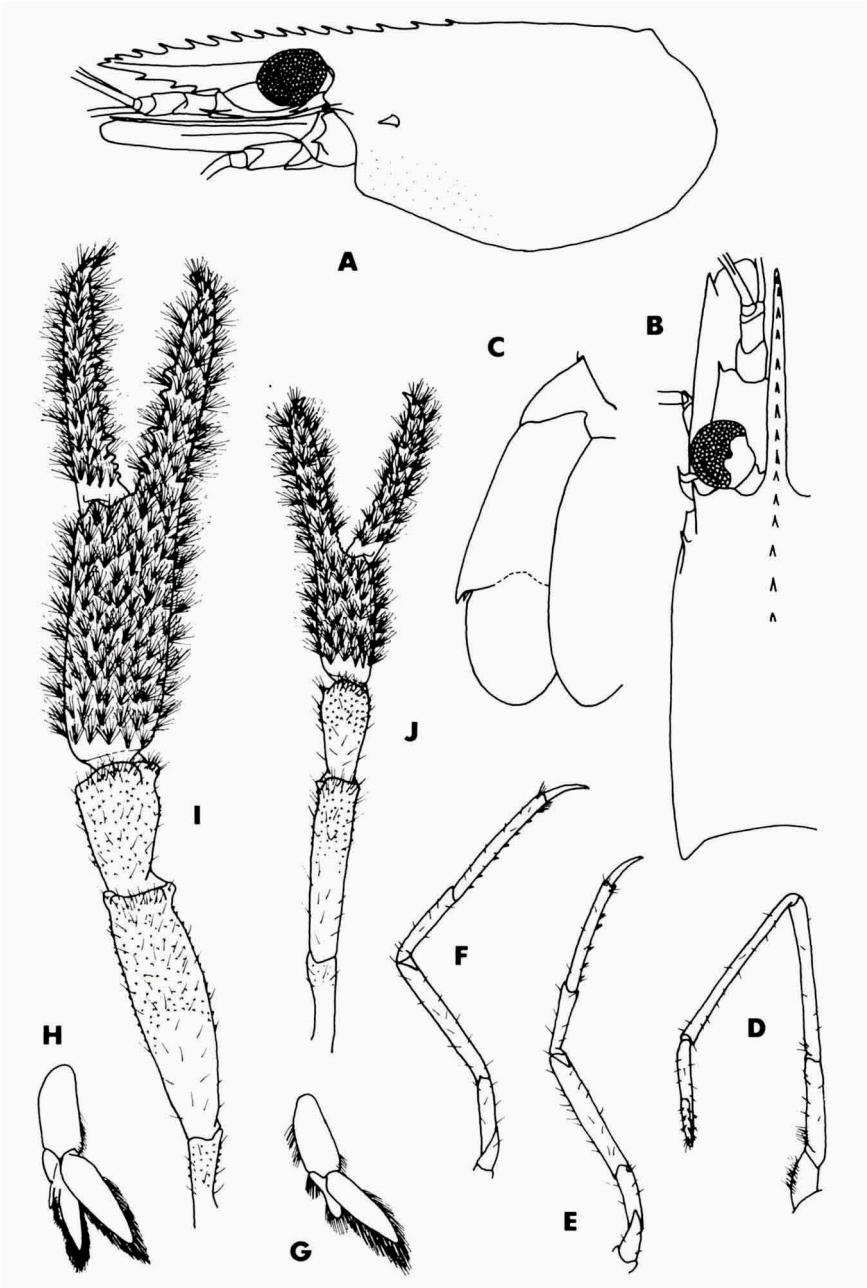

Fig. 1. *Macrobrachium johnsoni* spec. nov. Holotype male from Gunong Pulai; A, cephalothorax, in lateral view; B, left half of cephalothorax, in dorsal view; C, uropod, in dorsal view; D, first pereiopod; E, third pereiopod; F, fifth pereiopod; G, first pleopod; H, second pleopod; I, larger second pereiopod; J, smaller second pereiopod. A, B, × 2.6; C, × 4.5; D-F, I, J, × 2.3; G, H, × 3.

of right chela less dense, and carpus slightly more elongated, than in left. Fingers 1.6 times longer than palm, and teeth present only on proximal third of cutting edge. Otherwise similar to left leg.

Third pereiopod with entire dactylus extending beyond rostrum. Propodus 2.5 times as long as simple dactylus, bearing two parallel rows of 5 or 6 strong spines on posterior margin. Carpus more than half length of propodus, and less than half length of merus. Fifth pereiopod slightly slender than third, with a slightly longer propodus. inner posterior margin of propodus with 1 or 2 oblique distal rows of setae.

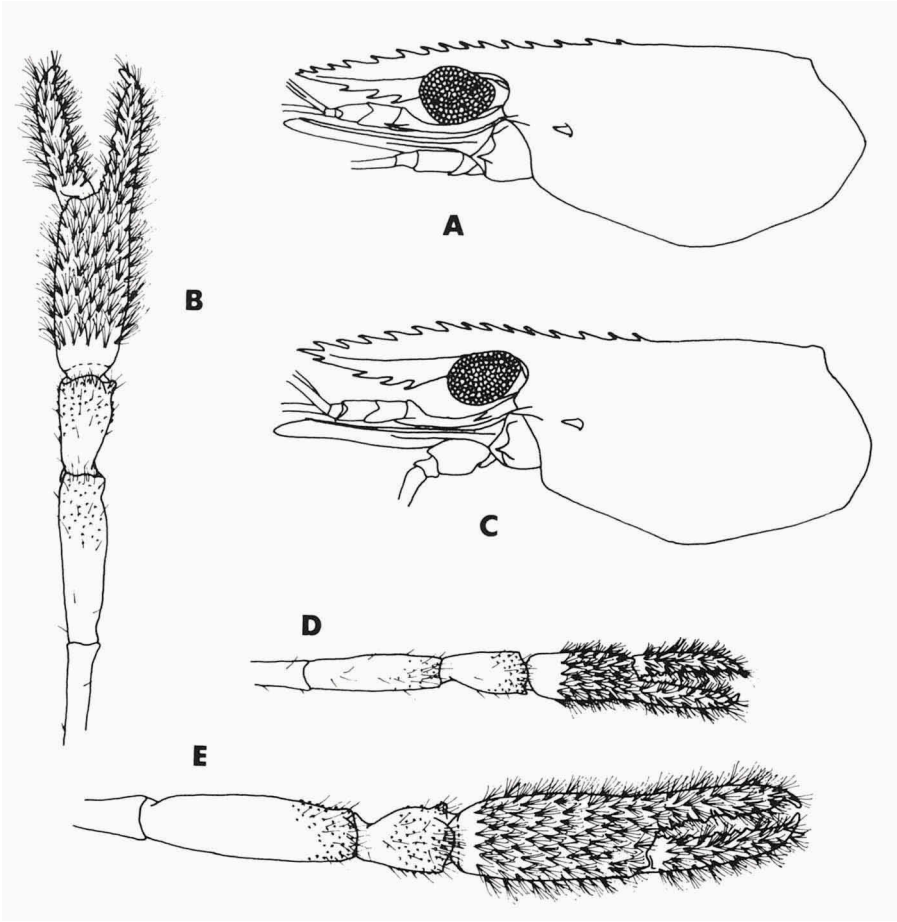

Fig. 2. *Macrobrachium johnsoni* spec. nov. A,B, Paratype female, RMNH no. 36518; C-E, Paratype male, RMNH no. 36519; both from Gunong Pulai. A,C, cephalo-thorax, in lateral view; B, (solitary) second pereiopod; D, smaller second pereiopod; E, larger second pereiopod. A-E, × 3.2.

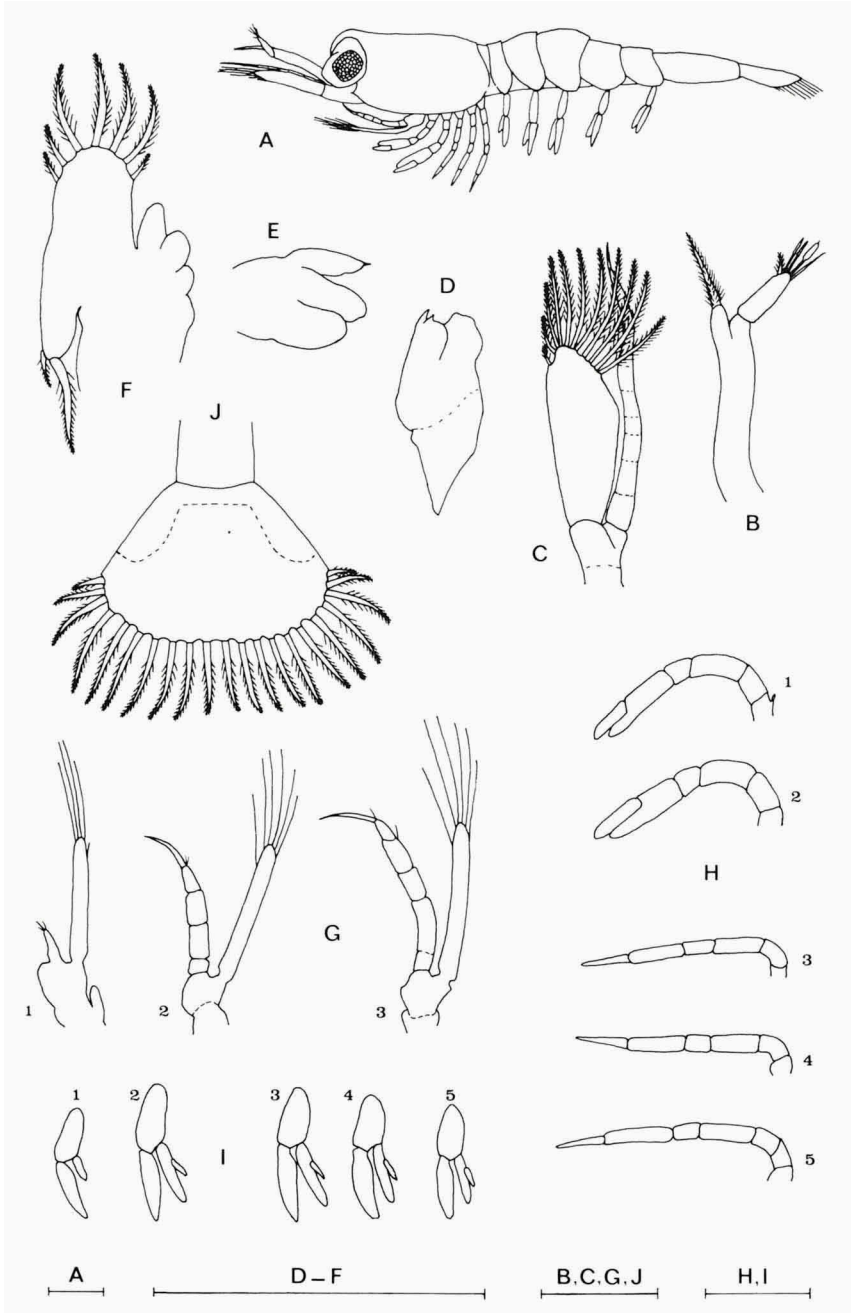

Fig. 3. *Macrobrachium johnsoni* spec. nov. First zoea (from paratype female, RMNH no. 36518. A, Lateral view; B, Antennule; C, Antenna; D, Mandible; E, Maxillule; F, Maxilla; G, Maxillipeds (1-3 = First to third); H, Pereiopods (1-5 = First to fifth); I, Pleopods (1-5 = First to fifth); J, Telson. Plumose setae of all structures except B, C, F, and J simplified. Scales represent 0.5 mm.

Endopod of first pleopod with concave inner margin, outer margin convex. Appendix masculina of second pleopod longer and stronger than appendix interna, and with numerous stiff setae.

Uropods normal in shape. Protopod ends in a blunt tooth over base of exopod, and in a broad lobe over base of endopod. Outer margin of exopod almost straight, ending in a strong tooth, which at its inner side bears a movable spine. Movable spine weak and shorter than outer fixed tooth.

Description of female paratype. — Rostral formula 5)15/3, carapace smooth throughout. First pereiopods equal in length, reaching with distal fifth of carpus beyond scaphocerite. Only left second pereiopod fully grown (right leg just partly regenerated), reaching with entire chela beyond scaphocerite. Fingers shorter than palm, with 4-5 teeth on proximal half of cutting edges. Otherwise similar to holotype in all non-sexual aspects.

Description of further paratypes. — Small spinules present on lower anterolateral margin of carapace of largest male. Carapace entirely smooth in all other paratypes. First pereiopods equal in length. In largest male, distal half of carpus extending beyond scaphocerite. In smallest paratype, only right pereiopod present, distal fifth of carpus extending beyond scaphocerite. Also, second pereiopods not as large and robust, otherwise similar to holotype.

Colour. — Live specimens show markings of a light shade on a translucent background, with a hint of pale bluish-green, especially on the second chelipeds. Markings may be distinct in some individuals, obscure in others. Cornea of eyes with a purplish brilliance when seen in close-up under bright light.

Habitat. — The holotype male and largest paratype male were collected from the Gunong Pulai waterfall at a height of about 200 m, whilst the paratypes were collected lower downstream at the foot of the mountain. The fact that only the two largest specimens were found in torrential waters whilst the rest were caught from relatively slower waters suggests that fast-flowing but not torrential streams are its preferred habitat. The specimens from the Sungei Pontian (identified as *M. pilimanus* by Johnson but now assigned to the new species), and those from the Kota Tinggi – Mersing – Kluang area, were also collected from non-torrential habitats. In all these localities, including the stretch of stream at the base of Gunong Pulai, the water was either slightly turbid or clear but with considerable sedimentation.

Larval development. — The larvae of *M. johnsoni* undergo a highly abbreviated development (*sensu* Sollaud, 1923), passing through two zoeal and one megalopal stages before moulting to the juvenile. Duration of the first zoeal, second zoeal, and megalopal stages is 1, 2, and 3 days respectively. Newly hatched larvae were already capable of horizontal swimming (as in

adults), with the pleopods fully functional. When not swimming, the larvae lay stretched out at the bottom of the container. The larvae survived even when the containers were not cleaned daily, and microscopic examination of the larvae showed little or no signs of appendage deformities.

Description of first zoea. — Body length ca. 4.15 mm. Carapace length ca. 1.05 mm. Rostrum very small, smooth, and strongly hooked downwards, partially hidden by eye when viewed laterally. Carapace with hepatic spine only. Abdomen with six somites and telson. Telson with 20 plumose setae.

Antennule simple, with unsegmented peduncle; inner flagellum of plumose seta distally; outer flagellum with one plumose seta, one long spine, and three aesthetascs (only one of which is prominent) terminally. Antenna biramous; endopod (or flagellum) indistinctly segmented, one and a half times length of exopod (or blade), terminating in a sharp spine; exopod unsegmented, convex on distal and medial margins, with 11 plumose setae distally.

Mandible without palp, rudimentary, divided into molar and incisor processes; incisor process with two teeth. Maxillule uniramous, rudimentary; endopod simple, with a spine apically. Maxilla platelike, biramous; endite three-lobed, all lobes glabrous; endopod unsegmented, glabrous; exopod (or scaphognathite) with 6-7 plumose setae distally and two plumose setae proximally.

First maxilliped biramous; protopod bilobed; endopod unsegmented, with three terminal setae; exopod three times length of endopod, with five plumose setae distally; epipod small. Second maxilliped biramous; endopod four-segmented, terminal segment with a strong spine; exopod slightly longer than endopod, with six plumose setae distally. Third maxilliped biramous; endopod five-segmented, terminal segment with a strong spine; exopod slightly shorter than endopod, with six plumose setae distally.

First and second pereiopods chelate, glabrous, and non-functional; first slightly shorter than second; cutting edges of chelae smooth; Third, fourth and fifth pereiopods non-chelate, glabrous. Except for exopod bud on first pereiopod, all pereiopods uniramous.

Pleopods biramous; endopods of pleopods 2-5 with appendices internae. Endopod and exopod of all pleopods glabrous.

Remarks. — *Macrobrachium johnsoni* shares so many characters with *M. pilimanus* that the two species cannot be separated using Holthuis' (1950) key to the Indo-Pacific species of *Macrobrachium*. However, they differ in several respects. Firstly, the rostrum of *M. johnsoni* always extends beyond the antennular peduncle, with a rostral formula of 4-6)12-17/2-4. Ratio of rl. to cl. is between 0.8 (for a specimen of cl. 5.5 mm) and 0.6 (for a specimen of cl. 16.5 mm). In *M. pilimanus*, the rostrum never extends beyond the anten-

nular peduncle, and has a rostral formula of 4-6)9-13/1-3. Ratio of rl. to cl. is between 0.6 (for a specimen of cl. 5 mm) and 0.4 (for a specimen of cl. 14.5 mm). Secondly, the eyes of *M. johnsoni* are comparatively larger than those of *M. pilimanus* for specimens of similar carapace length. In *M. johnsoni,* the ratio of the widest region of the cornea to cl. lies between 0.3 (for cl. 5.5 mm) and 0.2 (for cl. 16.5 mm), whilst the ratio of *M. pilimanus* ranges between 0.2 (for cl. 5 mm) and 0.15 (for cl. 14.5 mm). Thirdly, the scaphocerites of *M. johnsoni* specimens are comparatively longer than those of *M. pilimanus* for specimens of similar size. In *M. johnsoni,* ratio of scaphocerite length to cl. ranges between 0.7 (for cl. 5.5 mm) and 0.6 (for cl. 16.5 mm), whilst the ratio for *M. pilimanus* is between 0.6 (for cl. 5 mm) and 0.45 (for cl. 14.5 mm).

Rostral length of adult prawns may be influenced by external factors like speed of waterflow (Holthuis, pers. comm.) and this also seems to be true for *M. malayanum* (Roux, 1934) (Chong, unpublished data). However, the rostra of the two large specimens of *M. johnsoni* are distinctly longer than those of the largest specimens of *M. pilimanus*, although they were collected at the same time and place. Therefore differences in rostral length of the two species are unlikely to be explained solely by environmental factors.

The larvae of *M. johnsoni* and *M. pilimanus* also exhibit morphological and behavioural differences. The first zoea of *M. johnsoni* has 20 setae on its telson, 8-9 setae on its scaphognathite, and a short antennal flagellum. It is capable of swimming in a horizontal position and does not shown any body-arching or preference for clinging onto roughened surfaces. In contrast, the corresponding stage of *M. pilimanus* has 18 setae on its telson, 15-20 setae on its scaphognathite, and a very long antennal flagellum. It is also unable to swim horizontally, preferring to cling onto rough surfaces, and arching awkwardly when surfaces are smooth (Chong & Khoo, 1987). This fact helps justify the establishment of *M. johnsoni* as a distinct taxon since the behaviour of newborn animals is very likely to be an innate instinct (not learned) and is therefore a genetically determined character. It is thus likely to be a reliable taxonomic character.

The discovery of this new species, with characters nearly identical to *M. pilimanus*, revives the concept of a *Macrobrachium pilimanus* complex (Johnson, 1960b). De Man (1892) and Roux (1934) each documented a new subspecies of *M. pilimanus, "Palaemon (Macrobrachium) pilimanus leptodactylus"* and *"P. (M.) pilimanus malayanus"* respectively. The differences noted by these authors were later treated by Holthuis (1950, 1979) as infraspecific variations and submerged under the synonymy of *M. pilimanus.*

Johnson (1960b, 1963), on the other hand, treated De Man's and Roux's subspecies as distinct species within the *M. pilimanus* complex. Holthuis and

Johnson both agreed that the extraordinary variability within this complex is still not satisfactorily understood (see Johnson, 1963; Holthuis, 1979). However, studies by Chong & Khoo (in press) reveal that Roux's subspecies is conspecific with *M. geron* Holthuis, 1950 and does not come under the *M. pilimanus* complex as it is presently understood. Also, specimens collected and identified by Johnson as *M. malayanum* do not belong to that species, but to an undescribed form of *M. pilimanus*. Details of these findings will be discussed in a separate paper.

Etymology. — This new species is dedicated to the memory of the late Professor D.S. Johnson, whose life-time's work has contributed much to our knowledge and understanding of freshwater prawns in South-East Asia.

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