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JOURNAL OF CRUSTACEAN BIOLOGY, 36(6), 823-832, 2016

Journal of Crustacean Biology

A NEW GENUS AND NEW SPECIES FOR AN UNUSUAL SEMI-TERRESTRIAL POTAMID CRAB (DECAPODA: BRACHYURA) WITH A BILOBED MANDIBULAR PALP FROM PENINSULAR MALAYSIA

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ABSTRACT

Potamid freshwater crabs are characterised by mandibular palps possessing three segments with the terminal lobe simple. A new genus and new species of semi-terrestrial crab, *Gempala bilobata*, is here described from Peninsular Malaysia that possesses a 3-segmented mandibular palp having a bilobed terminal segment, a hitherto unknown condition. In addition, the carapace of the new genus is unusually high. Comparisons with allied potamid genera from Malaysia are also made and the affinities of the genus discussed.

KEY WORDS: Potamidae, Southeast Asia, systematics

DOI: 10.1163/1937240X-00002492

INTRODUCTION

The freshwater crab fauna of Peninsular Malaysia is well known, and 44 species of Potamidae Ortmann, 1896 and Gecarcinucidae Rathbun, 1904 are now known (Ng, 2004; Ng and Yeo, 2007; Ng and Lee, 2012). Of these, 27 are potamids, all from two genera: *Johora* Bott, 1966 and *Stoliczia* Bott, 1966. The species in these two genera show a diversity in the morphology of the carapace and male first pleopods (G1), but can be separated by the condition of the flagellum on the exopod of the third maxilliped. *Johora* has a long flagellum, whereas *Stoliczia* has none or only a very short one (Ng, 1986a, 1987, 1988, 1990, 1991a, 1992a, 1993, 2004; Yeo, 2001; Yeo et al., 2006; Ng and Schubart, 2014).

Specimens of an ususual semi-terrestrial potamid was recently collected from the Sekayu area in Terengganu, a state in northeastern Peninsular Malaysia. The specimens key out to *Stoliczia* in lacking a flagellum on the exopod of the third maxilliped, but the terminal segment of the mandibular palp is bilobed and the carapace is very high, unlike any known potamid from Peninsular Malaysia. A new genus is established here for the new species.

MATERIALS AND METHODS

Specimens examined are deposited in the Zoological Reference Collection (ZRC) of the Lee Kong Chian Natural History Museum, National University of Singapore. Measurements provided (in millimetres) are of the maximum carapace width and length, respectively. The abbreviations G1 and G2 are used for the male first and second pleopods, respectively. The terminology essentially follows that by Ng (1988).

SYSTEMATICS

Superfamily Potamoidea Ortmann, 1896

Family Potamidae Ortmann, 1896

Gempala n. gen.

Diagnosis.—Carapace conspicuously high from frontal view; frontal margin with 2 lobes; external orbital tooth not clearly demarcated from convex anterolateral margin; epigastric cristae low, distinct, visible as rugose swelling; postorbital cristae almost undiscernible; cervical grooves not visible; antennae conspicuously short; posterior margin of epistome with distinct median triangle, each lateral margin with 2 distinct concavities; mandibular palp with terminal article distinctly bilobed; exopod of third maxilliped without trace of flagellum; ambulatory legs relatively slender, long; male anterior thoracic sternum (sternites 3, 4) relatively broad transversely; sternoabdominal cavity reaching to imaginary line connecting median points of edges of cheliped coxae; male abdominal locking tubercle low, round, positioned on posterior third of thoracic sternite 5; male abdomen broadly triangular, somite 6 transversely rectangular; G1 with subterminal segment relatively slender throughout length, including basal part, terminal segment gently curved outwards, submedian dorsal fold prominent; G2 longer than G1, distal segment about half length of basal segment.

Type Species.—***Gempala bilobata*** n. sp., by present designation.

Etymology.—The Latin name is derived from the Malay word *gempal* for "stocky" and "thick-set," alluding to the high carapace of the type species. The gender of the genus is feminine.

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DOI:10.1163/1937240X-00002492

Fig. 1. *Gempala bilobata* n. gen., n. sp. Colour in life. Terengganu, Peninsular Malaysia. Specimen not preserved. This figure is published in colour in the online edition of this journal, which can be accessed via http://booksandjournals.brillonline.com/content/journals/1937240x.

Remarks.—*Gempala* n. gen. is unusual in many respects, even in the Potamidae. Firstly, its mandibular palp is atypical among known potamids in that the terminal segment is distinctly bilobed (Figs. 5E-G, 7). All known potamids have a simple, single-lobed terminal segment, although the proximal parts might be fringed with dense long setae (Ng, 1988: fig. 2A; Ng, 2004: fig. 5I, J). A bilobed terminal segment is in fact a diagnostic feature of Gecarcinucidae (see Ng, 1988: fig. 2B; Ng, 2004: fig. 5M, N). All gecarcinucids, however, have a 2-segmented palp (Ng, 1988: fig. 2B; Ng, 2004: fig. 5M, N), whereas potamids have a 3-segmented one (Ng, 1988: fig. 2A; Ng, 2004: fig. 5I, J). The mandibular palp condition is 3-segmented in *Gempala* (Figs. 5E-G, 7), as for all potamids, except that the terminal segment has also become bilobed. There is precedence for this condition, not in the Potamidae but in the African Potamonautidae Bott, 1970. Almost all potamonautids have a 2-segmented mandibular palp, and the terminal segment is almost always single-lobed as well. In one potamonautid, *Seychellum* Ng, Ševčić and Pretzmann, 1995 (from the Seychelles), however, the terminal segment of the 2-segmented mandibular palp is also prominently bilobed. Ng et al. (1995) had argued that because of this, *Seychellum* was a gecarcinucid but subsequent work has demonstrated it is just an anomalous member of the Potamonautidae (Klaus et al., 2009). The bilobed mandibular palp of *Gempala* might be associated with its semi-terrestrial habits, although the function of the mandibular palp is not known. *Gempala* is certainly a typical potamid with regards to the shape of the abdomen and structure of the G1.

The physiognomy of *Gempala* is very different from that of all known species of *Stoliczia* or of any other potamid from Peninsular Malaysia, with the carapace prominently high when viewed frontally. The high carapace of *Gempala* (Figs. 1, 3B-F) most closely resembles those seen in semi-terrestrial gecarcinucids from Sri Lanka and Borneo like *Pastilla* Ng and Tay, 2001 (see Ng and Tay, 2001: figs. 117, 118B), *Thelphusula* Bott, 1969 (see Grinang and Ng, 2014: figs. 1C, 2C), and *Arachnothelphusa* Ng, 1991b (see Grinang et al., 2015: figs. 1C, 5B).

In potamids, with regards to the very short or absence of a flagellum on the exopod of the third maxilliped (Fig. 7A), *Gempala* is probably closest to *Stoliczia* Bott, 1966. Of the 16 known species of *Stoliczia* (see Ng et al., 2008), several semi-terrestrial taxa (e.g., *S. cognata* (Roux, 1936), *S. goal* Ng, 1993, *S. karenae* Ng, 1993, *S. bella* Ng and Ng, 1987, and *S. ekavibhathai* Ng and Naiyanetr, in Ng, 1986a) have relatively inflated carapaces, but while the lateral and dorsal surfaces could be gently convex (Ng and Ng, 1987: pl. 1A; Ng, 1988: figs. 27B, 31B, 32B; Ng and Ng, 1989:

Fig. 2. *Gempala bilobata* n. gen., n. sp., overall habitus. A, holotype male (17.9 × 13.5 mm) (ZRC 2016.0158), Terengganu, Peninsular Malaysia; B, paratype female (23.3 × 18.7 mm) (ZRC 2016.0159), Terengganu, Peninsular Malaysia.

83, unnumbered figure; Ng, 1992a: pls. 1B, 2C, 6B; Ng, 1993: pls. 2, 3, 4), none have high carapaces like in *Gempala* (Figs. 1, 3B-F). Another genus from southern Thailand that has a third maxilliped in which the flagellum on the third maxilliped is very short or absent is *Terrapotamon* Ng, 1986b. In species of this genus (e.g., *T. abbotti* (Rathbun, 1898)), the branchial regions are laterally expanded but the dorsal surface is only gently convex (see Ng, 1988: fig. 37A, B) but the carapace is not prominently high. *Nakhonsimon* Promdam, Nabhitabhata and Ng, 2014, from southern Thailand also lacks a flagellum on the exopod of third maxilliped (Promdam et al., 2014: fig. 2A) but this species has a flatter carapace with a distinctive short, stout, and bent G1 (Promdam et al., 2014: fig. 2B, C). The same situation with the flatter carapace is true for all known species of *Johora* (all species which have a long flagellum on the exopod of the third maxilliped), even those with semi-terrestrial habits.

The ambulatory legs of *Gempala* (Figs. 1, 2A) are distinctly longer than any known species of *Stoliczia* or *Terrapotamon* (see Ng, 1988: figs. 24-35A, 37A). Most species of *Johora* also have relatively short ambulatory legs (see Ng, 1988: figs. 13-21A), although *J. punicea* (Ng, 1985) have legs of similar length to *Gempala* (Ng, 1988: fig. 22A), with those of *J. grallator* Ng, 1988, and *J. gua* Yeo, 2001, even longer (Ng, 1988: fig. 23A; Yeo, 2001: fig. 2A). The ambulatory legs of *Gempala* are similar in proportions to those of *Nakhonsimon* (see Promdam et al., 2014: fig. 1A).

The male anterior thoracic sternum (sternites 3 and 4) are proportionately broader in *Gempala* (Fig. 5A), with the lateral borders of sternite 4 gently convex outwards (relatively narrower, with the lateral borders of sternite 4 more concave outwards in *Stoliczia* spp.; see Ng and Ng, 1989: 83, unnumbered figure; Ng, 1992a: pls. 2B, 3B, 4C, 6C; Ng, 1993: pls. 3, 4). The anterior thoracic sternum is distinctly narrower in *Terrapotamon* (see Leelawathanagoon et al., 2010: figs. 1D, 2C). This difference is also valid for *Nakhonsimon* except that in this genus there are grooves between thoracic sternites 3 and 4 (Promdam et al., 2014: fig. 1C). There are no grooves between thoracic sternites 3 and 4 in *Gempala* (Fig. 5A).

The male abdominal somite 6 of *Gempala* is also distinctive in that it is rectangular in shape (Figs. 5A, 7B), quite different from the trapezoidal shape of those from species of *Stoliczia* (see Ng and Ng, 1989: 83, unnumbered figure; Ng, 1992a: pls. 2B, 3B, 4C, 6C; Ng, 1993: pls. 3, 4). The species of *Terrapotamon* have the same male abdominal somite 6 structure (Leelawathanagoon et al., 2010: fig. 1E).

The G1 structure of *Gempala* is also very distinctive, with the basal part of the subterminal segment being very slender and the dorsal flap very prominent (Fig. 7C-J). The large size of the dorsal flap on the terminal segment

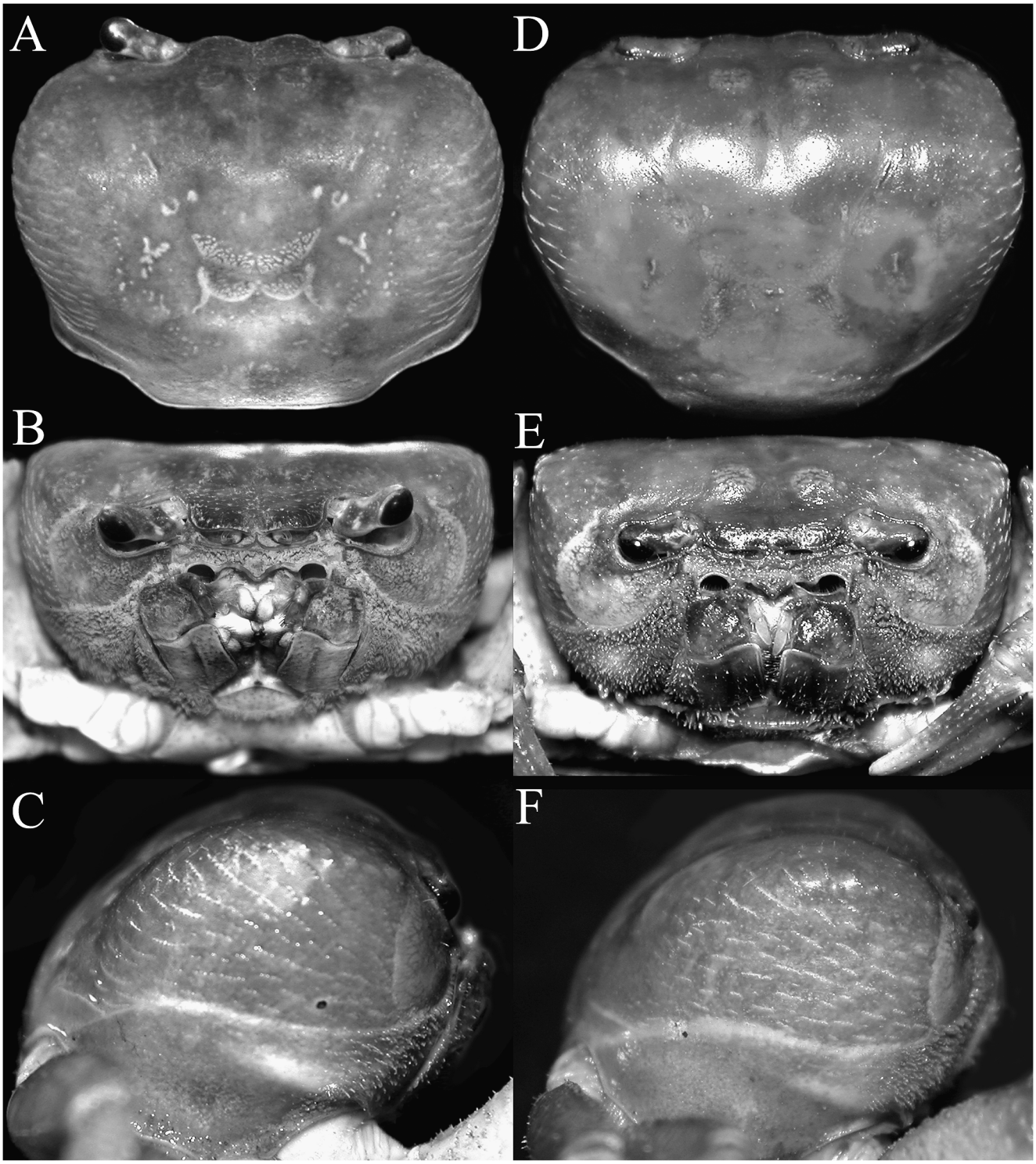

Fig. 3. *Gempala bilobata* n. gen., n. sp. A-C, holotype male (17.9 × 13.5 mm) (ZRC 2016.0158), Terengganu, Peninsular Malaysia; D-F, paratype female (23.3 × 18.7 mm) (ZRC 2016.0159), Terengganu, Peninsular Malaysia. A, D, dorsal view of carapace; B, E, frontal view of cephalothorax; C, F, lateral view of cephalothorax.

is reminiscent of the condition seen in many Indochinese genera like *Thaipotamon* Ng and Naiyanetr, 1993 and *Pudaengon* Ng and Naiyanetr, 1995 (see Ng and Naiyanetr, 1993, 1995), but these genera have quite different carapaces, third maxillipeds and male abdomens.

Most *Stoliczia* species have a G1 in which the terminal segment is long and tapering to a sharp point, without or with only a trace of a dorsal flap (see Ng and Ng, 1987: fig. 2A-E; Ng, 1988: figs. 24D-F, 25D-F, 26D-G, 27D-F, 30D-G, 31D-G, 32D-F; Ng, 1992a: figs. 1B-E, 2, 3B-E, 4B-E, 5B-F; Ng,

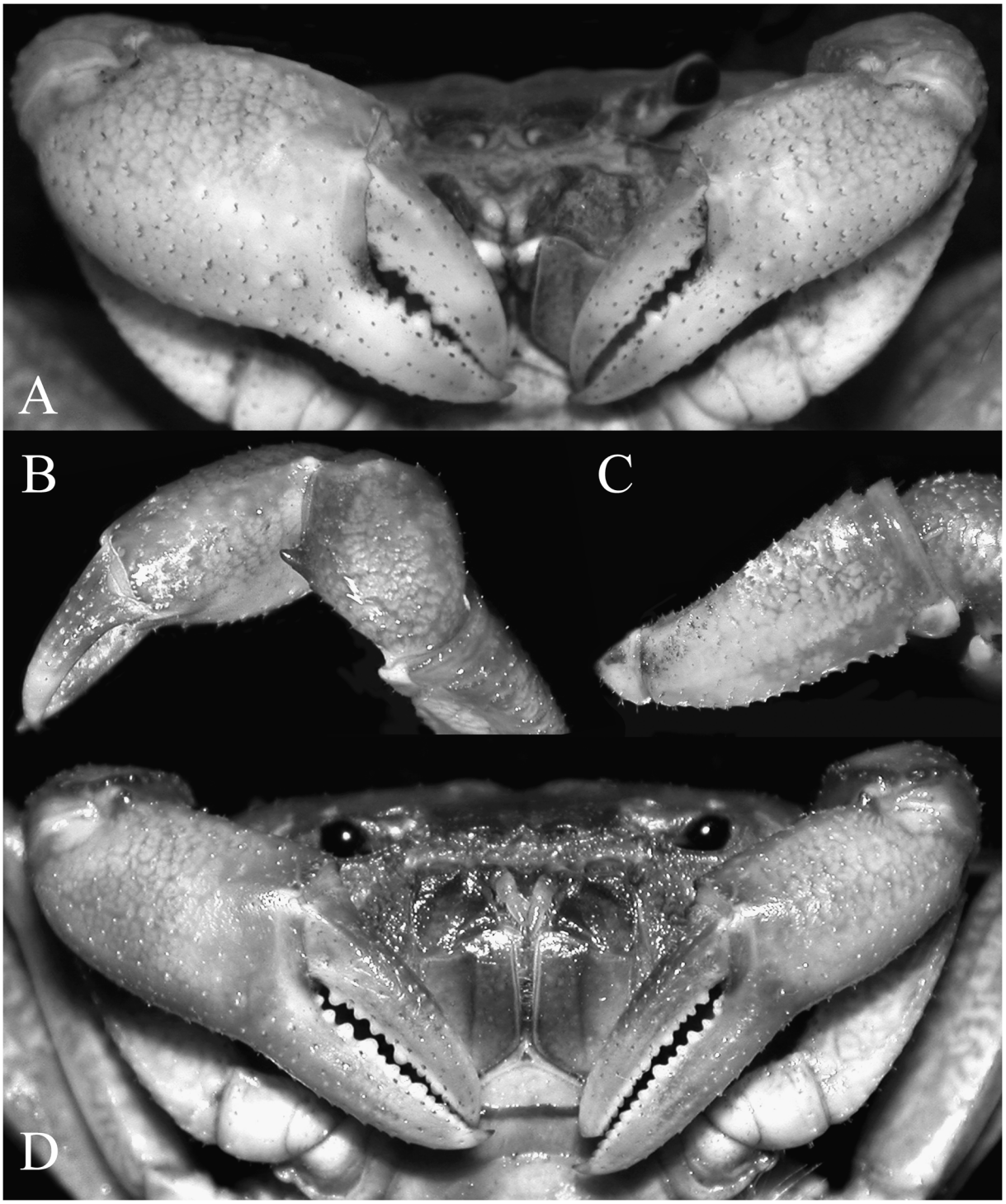

Fig. 4. *Gempala bilobata* n. gen., n. sp. A-C, holotype male (17.9 × 13.5 mm) (ZRC 2016.0158), Terengganu, Peninsular Malaysia; D, paratype female (23.3 × 18.7 mm) (ZRC 2016.0159), Terengganu, Peninsular Malaysia. A, D, outer view of chelae; B, dorsal view of right cheliped; C, outer view of right merus of cheliped.

1993: figs. 1B-F, 2B-G, J-M, 3C-F, 4B-E). In species like *S. chaseni* (Roux, 1934), *S. pahangensis* (Roux, 1936), *S. leoi* (Ng and Yang, 1985), and *S. larutensis* Ng and Schubart, 2014, the G1 is gently bent to almost straight with a small dorsal flap on the terminal segment (see Ng, 1988: figs. 28D-F, 29D-F, 35D-F; Ng and Schubart, 2014: fig. 4B-D). The G1 structures of *S. rafflesi* (Roux, 1936) and *S. changmanae* Ng, 1988, which are distinctly bent with a small dorsal flap on the terminal segment most closely resemble that of *Gempala* (see Ng, 1988: figs. 33D-F, 34D-F; Ng, 1991a: fig. 1A-D, H-K). The G1 of *Terrapotamon* is distinctive in having a short conical terminal segment, with the junction between

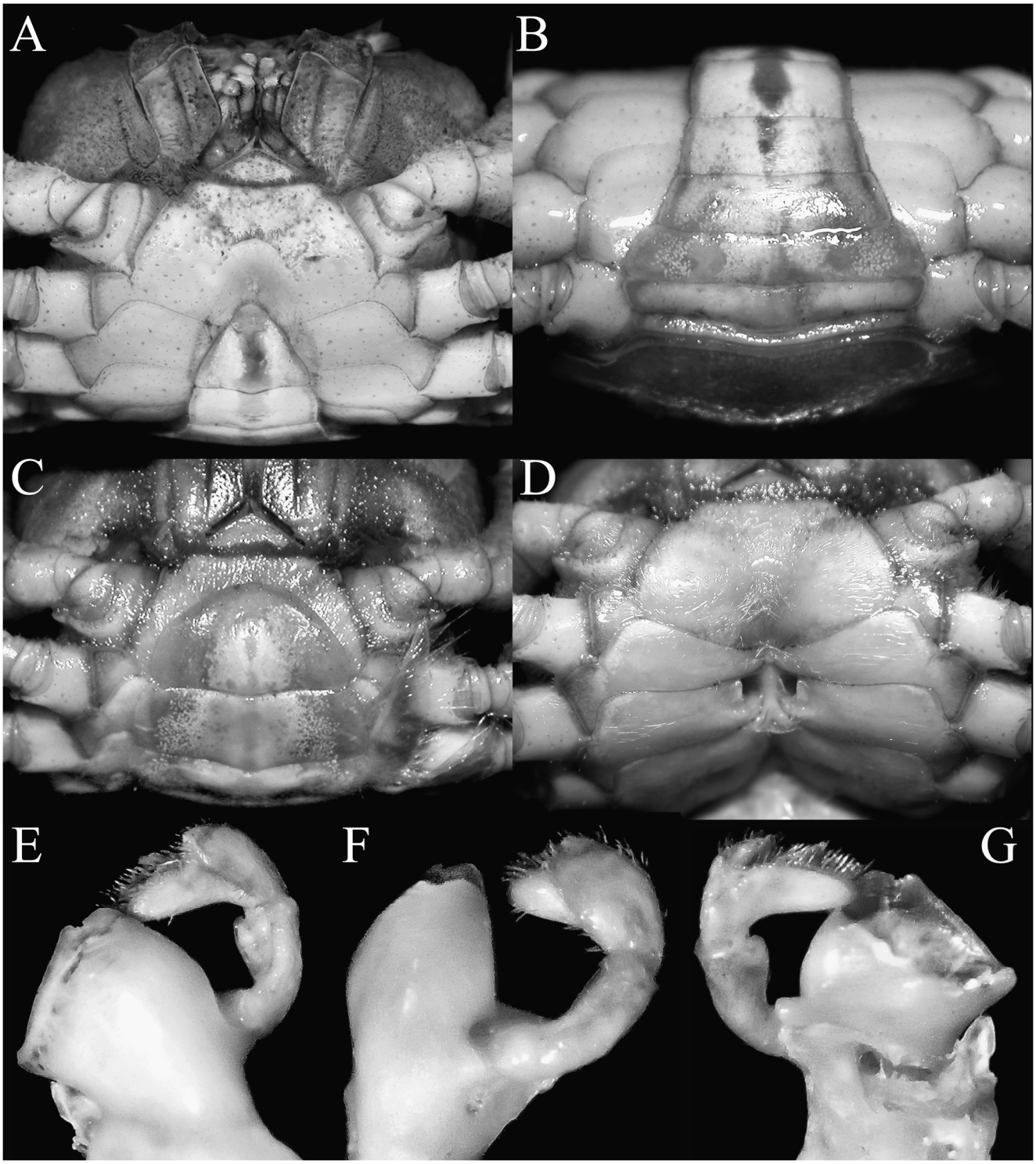

Fig. 5. *Gempala bilobata* n. gen., n. sp. A, B, E-G, holotype male (17.9 × 13.5 mm) (ZRC 2016.0158), Terengganu, Peninsular Malaysia; C, D, paratype female (23.3 × 18.7 mm) (ZRC 2016.0159), Terengganu, Peninsular Malaysia. A, C, anterior part of thoracic sternum and abdomen; B, posterior part of thoracic sternum and abdomen; D, thoracic sternum showing vulvae; E-G, left mandible and mandibular palp.

the terminal and subterminal segments separated by a large bulbous structure (Leelawathanagoon et al., 2010: fig. 1F-I; Ng, 1988: 37D-F). None of the above genera and species, however, have a G1 with a subterminal segment in which the basal part is as slender as that of *Gempala*.

Gempala bilobata n. sp.
Figs. 1-7

Type Material.—Holotype: male (17.9 × 13.5 mm) (ZRC 2016.0158), Sekayu Recreational Forest, Kuala Berang, in pitfall trap, on slope, about 5 m from small stream, tributary

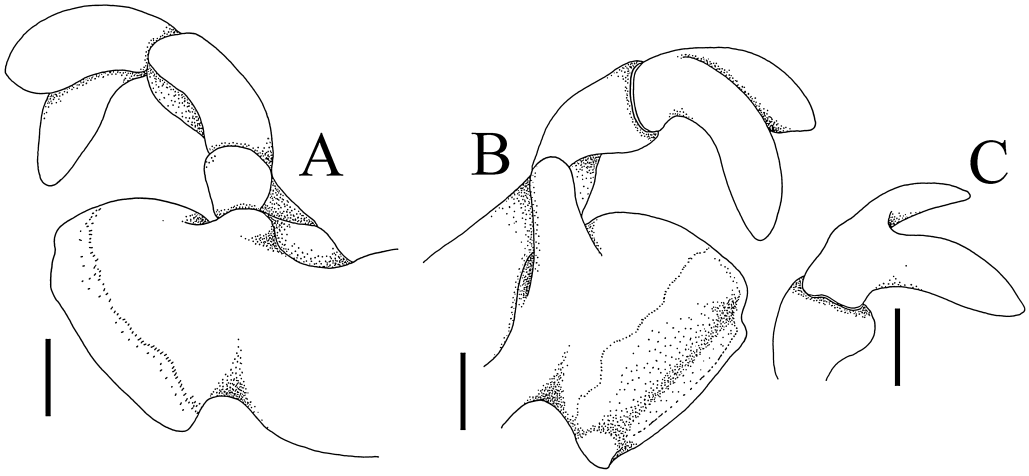

Fig. 6. *Gempala bilobata* n. gen., n. sp. Holotype male (17.9 × 13.5 mm) (ZRC 2016.0158), Terengganu, Peninsular Malaysia; left mandibular palp (setae not drawn). A, outer view of mandible and palp; B, inner view of mandible and palp; C, mesial view of distal 2 segments of mandibular palp. Scales = 0.5 mm.

of Sungai Peres, off Sungai Tersat (Terengganu Basin), Terengganu, Peninsular Malaysia, coll. M. Fatihah-Syafiq and A. Ahmad, 9 March 2016. Paratypes: 1 female (23.3 × 18.7 mm) (ZRC 2016.0159), same data as holotype; 1 young female (17.1 × 13.2 mm) (ZRC 2016.0160), same location as holotype, coll. M. F. Syafiq, 11 May 2016.

Diagnosis.—As for genus.

Description of Male Holotype.—Carapace transversely ovate, wider than long; conspicuously high in frontal view; dorsal surface convex (Figs. 1, 2A, 3A-C). Frontal region finely pitted, otherwise smooth; lateral parts of anterolateral, branchial regions covered with distinct oblique striae; mesogastric, urogastric, cardiac, intestinal regions almost smooth; orbital regions finely pitted; suborbital region almost round, surfaces with scattered short setae, covered with small granules; pterygostomial region with dense low setae, surface finely granular, separated from suborbital region by low ridge; sub-branchial region covered with prominent striae (Figs. 1, 2A, 3A-C). Epigastric cristae low, distinct, visible as rugose swelling, separated by broad, shallow Y-shaped furrow; postorbital cristae low, rounded, almost undiscernible (Figs. 2A, 3A, B). Cervical grooves not visible; H-shaped median gastric groove shallow (Figs. 2A, 3A). Frontal margin divided into 2 broad lobes, separated by shallow concavity; margin of each lobe convex, confluent with supraorbital margin (Figs. 2A, 3A). External orbital tooth low, not demarcated from rest of anterolateral margin, almost confluent, lined with striae, uneven; epibranchial tooth not discernible (Figs. 2A, 3A, B). Anterolateral margins strongly convex, subcristate, lined with prominent oblique striae (Figs. 1, 2A, 3A). Posterolateral margin convex, converging towards almost straight posterior carapace margin (Figs. 1, 2A, 3A). Orbits subovate; eye filling up most of orbital space; eye peduncle relatively short, stout; cornea large, pigmented (Fig. 3A, B). Supraorbital margin gently sinuous, entire (Figs. 2A, 3A). Suborbital margin concave, complete (Fig. 3B). Antennae very short, not reaching cornea of eyes; antennules short, folding transversely in narrow fossa (Fig. 3B). Posterior margin of epistome with distinct median triangle, each lateral margin with 2 distinct concavities (Fig. 3B). Mandibular palp distinctly 3-segmented; terminal article distinctly bilobed, inner ovate lobe slightly larger than outer lobe (Figs. 5D-E, 6).

Third maxillipeds covering most of buccal cavity when closed; ischium subrectangular, with shallow but distinct median oblique groove, surface with short setae; merus subquadrate, as wide as long, surface covered with scattered setae, anteroexternal angle not expanded; exopod relatively slender, reaching to lower third of merus, without trace of flagellum or lobe (Figs. 3B, E, 7A).

Chelipeds asymmetrical (Figs. 1, 2A). Anterior margin of basis-ischium lined with small granules; margins of merus lined with low sharp granules, appears weakly serrated (Fig. 4B, C). Outer surface of carpus slightly rugose, with scattered squamiform tubercles, inner margins granular, distal angle with distinct sharp tooth (Figs. 2A, 4B, C). Outer surfaces of chelae with low squamiform granules, denser on ventral part; major chela stouter, shorter than minor chela (Fig. 4A, B). Fingers of major chela short, stout, gently curved, shorter than palm, outer surface lined with 3 rows of pits; cutting edges of both fingers with variously sized teeth on proximal half, distal part with denticles; dorsal margin of dactylus, ventral margin of propodal finger with anteriorly directed, irregularly arranged small, sharp granules (Fig. 4A). Fingers of minor chela longer, more slender, otherwise similar to condition of major chela (Fig. 4A).

Ambulatory legs slender, long; second pair longest, last pair shortest; margins with scattered short setae (Figs. 1, 2A). Outer surface of merus slightly rugose, dorsal margin entire or weakly serrated, without subdistal spine or tooth; carpus smooth, outer surface with low submedian crista on first to third legs, that on fourth leg smooth; outer surface of propodus with low, submedian crista; dactylus relatively long, gently curved, quadrate in cross section, margins with short, sharp pectinate spines (Figs. 1, 2A).

Thoracic sternum (notably sternites 3, 4) relatively broad transversely, surface pitted (Fig. 5A). Sternites 1, 2 completely fused to form broadly triangular plate; separated

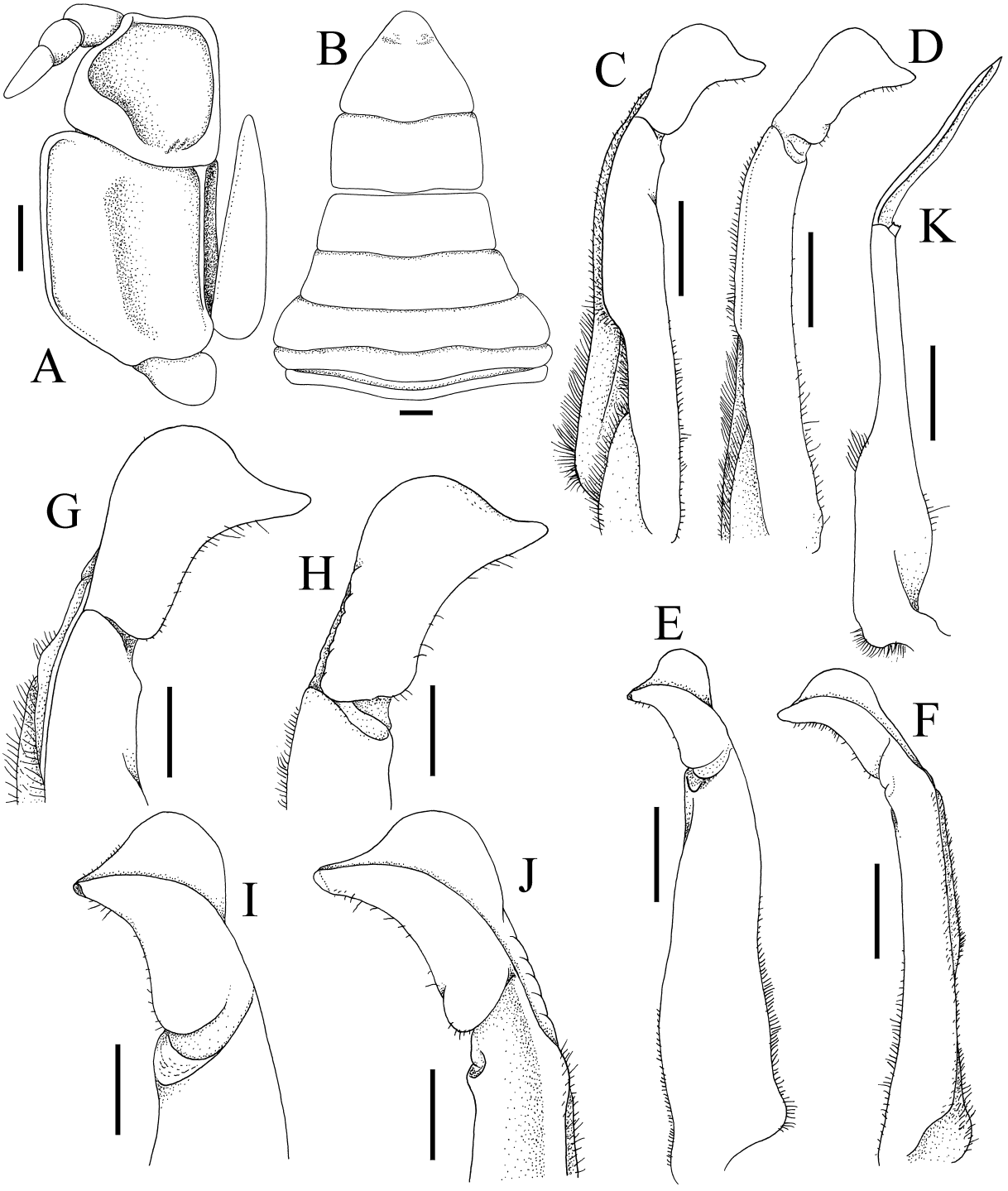

Fig. 7. *Gempala bilobata* n. gen., n. sp. Holotype male (17.9 × 13.5 mm) (ZRC 2016.0158), Terengganu, Peninsular Malaysia. A, left third maxilliped (setae not drawn); B, abdomen; C, D, ventral view of left G1; E, F, dorsal view of left G1; G, H, ventral view of terminal segment of left G1; I, J, dorsal view of terminal segment of left G1; K, left G2. Scales: A-F, K = 1.0 mm; G-J = 0.5 mm.

from sternite 3 by distinct, gently concave suture, lined with short setae; sternites 3, 4 completely fused, suture between sternites not prominent but marked by oblique shallow depression, uneven row of short setae; sutures between sternites 4/5, 5/6, 6/7 medially interrupted; suture between sternites 7, 8 complete; deep longitudinal groove on sternite 8, extending on posterior four-fifth of sternite 7. Penis coxal, on condyle of coxa of fourth ambulatory leg. Sternoabdominal cavity deep, reaching to imaginary line connecting median points of edges of cheliped coxae (Fig. 5A). Male abdominal locking tubercle low, round, positioned on posterior third of sternite 5.

Abdomen broadly triangular, all somites, telson free; telson relatively broad, lateral margins sinuous; somite 6

transversely rectangular, width almost twice length; somites 3-5 trapezoidal, gradually decreasing in width; somites 1, 2 subrectangular, very wide, reaching to bases of coxae of fourth ambulatory legs, thoracic sternite 8 not visible when abdomen closed (Figs. 5A, B, 7B).

G1 with subterminal segment relatively slender throughout length, including basal part, almost straight, distal part gradually tapering; outer lateral margin articulates with terminal segment as short membranous part; terminal segment relatively short, basal part partially swollen, structure gently curved outwards, tapering to sharp tip, dorsal fold prominent, submedian in position; opening distal; outer lateral margin with scattered short setae (Fig. 7C-J). G2 longer than G1, distal segment slender, long, about half length of basal segment (Fig. 7K).

Female.—The larger paratype female specimen (23.3 × 18.7 mm, ZRC 2016.0159) is larger than the holotype male, and resembles it in most non-sexual characters. Its carapace, however, is slightly more inflated (Figs. 2B, 3D-F) compared to the male (Figs. 2A, 3A-C). Its chelae are more symmetrical, with both chelae and fingers relatively more slender (Figs. 2B, 4D) than in the male. The female abdomen is ovate, covering most of the thoracic sternum except distal part of thoracic sternite 3 when closed (Fig. 5C). The vulvae are characteristic, being large, subquadrate, positioned adjacent to the margin with sternite 5 and with a prominent peg-like sternal cover (Fig. 5D). The smaller paratype female (17.1 × 13.2 mm, ZRC 2016.0160) is still immature, with the abdomen not expanded.

Colour in Life.—Dorsal surface of carapace and ambulatory legs reddish brown; outer surface of chela and carpus brown; dactylus with distal quarter grey, followed by short section of yellowish-white, with remaining proximal part purplish-orange; propodus with distal half grey, proximal part yellowish-white; ventral surfaces cream-white (Fig. 1).

Etymology.—The name is derived from the Latin *bilobatus* alluding to the characteristic bilobed terminal segment of the mandibular palp.

Remarks.—The specimens were collected from a pitfall trap placed near a small stream. The species is probably terrestrial in habits. The high carapace and long ambulatory legs clearly suggest this, and the species probably has similar habits to the semi-terrestrial gecarcinucid *Thelphusula cristicervix* (Ng and Grinang, 2004) from Sarawak (see also Grinang et al., 2014). Individuals of the later species were observed active at night foraging on the forest floor near the stream but quickly retreated under crevices when approached. Several surveys of freshwater animals have been conducted in and around the Sekayu area in Terengganu over the years (Kottelat et al., 1992; Ng, 1992b), and all the decapod species found so far from there are wholly aquatic.

ACKNOWLEDGEMENTS

The second author would like to thank M. Syafiq, Baizul, and Nurul Asyikin for their assistance in the field. He is also grateful to Universiti Malaysia Terengganu for logistics support and the Department of Forestry, Terengganu, for the permission to conduct the study at Sekayu Recreational Forest. Comments by Celio Magalhães (Instituto Nacional de Pesquisas da Amazonia, Manaus, Brazil) and Peter Castro (California State Polytechnic University, Pomona, CA, USA) helped improve the manuscript, for which we are grateful.

REFERENCES

Bott, R. 1966. Potamiden aus Asien (*Potamon* Savigny und *Potamiscus* Alcock) (Crustacea, Decapoda). Senckenbergiana biologica 47: 469-509, pls. 16-21.

———. 1969. Flüsskrabben aus Asien und ihre Klassifikation. (Crustacea, Decapoda). Senckenbergiana biologica 50: 359-366.

———. 1970. Die Süßwasserkrabben von Europa, Asien, Australien und ihre Stammesgeschichte. Eine Revision der Potamoidea und der Parathelphusoidea. (Crustacea, Decapoda). Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 526: 1-338.

Grinang, J., and P. K. L. Ng. 2014. Taxonomy of the freshwater crab *Coccusa cristicervix* Ng & Jongkar, 2004 (Decapoda: Brachyura: Gecarcinucidae), with description of a new species of *Thelphusula* from Sarawak, Malaysia, Borneo. Raffles Bulletin of Zoology 62: 389-395.

———, Y. M. Pui, and P. K. L. Ng. 2015. A new species of tree-hole dwelling crab of the genus *Arachnothelphusa* Ng, 1991 (Crustacea: Decapoda: Brachyura: Gecarcinucidae) from northern Sarawak, Malaysia, Borneo. Raffles Bulletin of Zoology 63: 454-460.

Klaus, S., D. Brandis, P. K. L. Ng, D. C. J. Yeo, and C. D. Schubart. 2009. Phylogeny and biogeography of Asian freshwater crabs of the family Gecarcinucidae (Brachyura: Potamoidea), pp. 509-531. In, J. W. Martin, K. A. Crandall, and D. L. Felder (eds.), Crustacean Issues 18: Decapod Crustacean Phylogenetics. CRC Press, London, UK.

Kottelat, M., P. Ng, and K. Lim. 1992. Recent collections of freshwater fishes from Terengganu, Peninsular Malaysia. Malayan Naturalist 46(2): 7-12.

Leelawathanagoon, P., V. Lheknim, and P. K. L. Ng. 2010. On a new species of freshwater crab of the genus *Terrapotamon* (Brachyura, Potamidae) from Peninsular Thailand. Crustaceana 83: 49-59.

Ng, P. K. L. 1986a. Preliminary descriptions of 17 new freshwater crabs of the genera *Geosesarma*, *Parathelphusa*, *Johora* and *Stoliczia* (Crustacea Decapoda, Brachyura) from South East Asia. Journal of the Singapore National Academy of Science 15: 36-44.

———. 1986b. *Terrapotamon* gen. nov., a new genus of freshwater crabs from Malaysia and Thailand, with description of a new species, *Terrapotamon aipooae* gen. et sp. nov. (Crustacea: Decapoda: Brachyura: Potamidae). Journal of Natural History 20: 445-451.

———. 1987. A revision of the Malayan freshwater crabs of the genus *Johora* Bott, 1966 stat. nov. (Decapoda: Brachyura: Potamidae). Malayan Nature Journal 41: 13-44.

———. 1988. The Freshwater Crabs of Peninsular Malaysia and Singapore. Department of Zoology, National University of Singapore, Singapore.

———. 1990. A new species of *Johora* Bott, 1966 (Crustacea: Decapoda: Brachyura: Potamidae) from Pulau Redang, Trengganu, Peninsular Malaysia. Journal of Natural History 24: 305-310.

———. 1991a. A note on the taxonomy of two Malayan freshwater crabs, *Stoliczia rafflesi* (Roux, 1936) and *Stoliczia changmanae* Ng, 1988 (Crustacea: Decapoda: Brachyura: Potamidae). Verhandlungen der Naturforschenden Gesellschaft Basel 100: 91-97.

———. 1991b. Bornean freshwater crabs of the genus *Arachnothelphusa* gen. nov. (Crustacea: Decapoda: Brachyura: Gecarcinucidae). Zoologische Mededelingen 65: 1-12.

———. 1992a. Crabs of the *Stoliczia stoliczkana* (Wood Mason, 1871) species complex (Crustacea: Decapoda: Brachyura: Potamidae). Malaysian Journal of Science 14: 1-25.

———. 1992b. On a small collection of freshwater crabs (Crustacea: Brachyura) from Terengganu, Peninsular Malaysia, with description of a second species of *Geithusa* (Parathelphusidae). Raffles Bulletin of Zoology 40: 95-101.

———. 1993. Freshwater crabs allied to *Stoliczia tweediei* (Roux, 1934) (Crustacea: Decapoda: Brachyura: Potamidae), with descriptions of two new species from Kedah and Perak, Peninsular Malaysia. Verhanderlingen der Naturforschenden Gesellschaft Basel 103: 81-95.

———. 2004. Crustacea: Decapoda, Brachyura, pp. 311-336. In, C. Yule and H. S. Yong (eds.), Freshwater Invertebrates of the Malaysian Region. Malaysian Academy of Sciences, Kuala Lumpur.

———, and J. Grinang. 2004. Decapod crustaceans with descriptions of three new species. In, H. S. Yong, F. S. P. Ng, and E. E. L. Yen (eds.),

Sarawak Bau Limestone Biodiversity, Sarawak Museum Journal (new series; special issue) 59: 299-325.

———, D. Guinot, and P. J. F. Davie. 2008. Systema Brachyurorum: part I. An annotated checklist of extant brachyuran crabs of the world. Raffles Bulletin of Zoology 17(Supplement): 1-286.

———, and P. K. Y. Lee. 2012. On a new species of *Phricotelphusa* Alcock, 1909, from a limestone cave in Perlis, Peninsular Malaysia (Crustacea: Decapoda: Brachyura: Gecarcinucidae). Raffles Bulletin of Zoology 60: 461-465.

———, and P. Naiyanetr. 1993. New and recently described freshwater crabs (Crustacea: Decapoda: Brachyura: Potamidae, Gecarcinucidae and Parathelphusidae) from Thailand. Zoologische Verhandelingen 284: 1-117.

———, and ———. 1995. *Pudaengon*, a new genus of terrestrial crabs (Crustacea: Decapoda: Brachyura: Potamidae) from Thailand and Laos, with descriptions of seven new species. Raffles Bulletin of Zoology 43: 355-376.

———, and H. P. Ng. 1987. The freshwater crabs of Pulau Langkawi, Peninsular Malaysia. Malaysian Journal of Science 9: 1-15.

———, and ———. 1989. Exploring the freshwaters of Pulau Langkawi. Nature Malaysiana 14(3): 76-83.

———, and C. D. Schubart. 2014. A new species of freshwater crab of the genus *Stoliczia* Bott, 1966 (Crustacea: Brachyura: Potamidae) from the summit of Bukit Larut, Perak, Peninsular Malaysia. Raffles Bulletin of Zoology 62: 484-489.

———, Z. Števčić, and G. Pretzmann. 1995. A revision of the family Deckeniidae Ortmann, 1897 (Crustacea: Decapoda: Brachyura: Potamoidea), with description of a new genus (Gecarcinucidae: Gecarcinucoidea) from the Seychelles, Indian Ocean. Journal of Natural History 29: 581-600.

———, and F. W. M. Tay. 2001. The freshwater crabs of Sri Lanka (Decapoda: Brachyura: Parathelphusidae). Zeylanica 6: 113-199.

———, and C. M. Yang. 1985. On three new species of freshwater crabs from Singapore and West Malaysia (Crustacea, Decapoda, Brachyura). Malayan Nature Journal 39: 57-73.

———, and D. C. J. Yeo. 2007. Malaysian freshwater crabs: conservation prospects and challenges, pp. 95-120. In, L. Chua (ed.), Proceedings of the Seminar on the Status of Biological Diversity in Malaysia and Threat Assessment of Plant Species in Malaysia, 28-30 June 2005. Forest Research Institute Malaysia, Kepong.

Ortmann, A. 1896. Das system der Decapoden-Krebse. Zoologische Jahrbücher, Abtheilung für Systematik, Geographie und Biologie der Thiere 9: 409-453.

Promdam, R., J. Nabhitabhata, and P. K. L. Ng. 2014. *Nakhonsimon ramromensis*, a new genus and species of freshwater crab (Crustacea: Decapoda: Brachyura: Potamidae) from Nakhon Si Thammarat, Peninsular Thailand. Raffles Bulletin of Zoology 62: 496-500.

Rathbun, M. J. 1898. Descriptions of three new species of fresh-water crabs of the genus *Potamon*. Proceedings of the Biological Society of Washington 12: 27-30.

———. 1904. Les crabes d'eau douce (Potamonidae). Nouvelles Archives du Muséum d'Historie naturelle (Paris) (Series 4) 6: 225-312.

Roux, J. 1934. New freshwater decapod crustaceans from the Malay Peninsula. Bulletin of the Raffles Museum 9: 28-38, figs. 1, 2, pl. 4.

———. 1936. Second note upon freshwater decapod crustaceans from the Malay Peninsula. Bulletin of the Raffles Museum 12: 29-43, figs. 1-12, pls. 12, 13.

Yeo, D. C. J. 2001. A new cavernicolous species of freshwater crab (Crustacea: Brachyura: Potamidae) from Pulau Tioman, peninsular Malaysia. Proceedings of the Biological Society of Washington 114: 618-623.

———, H.-T. Shih, and P. K. L. Ng. 2006. Phylogeny and biogeography of the freshwater crab genus *Johora* (Crustacea: Brachyura: Potamidae) from the Malay Peninsula, and the origins of its insular fauna. Zoological Scripta 36: 255-269.

RECEIVED: 31 July 2016.
ACCEPTED: 2 September 2016.
AVAILABLE ONLINE: 11 October 2016.