RAFFLES BULLETIN OF ZOOLOGY **70**: 572–579
Date of publication: 19 December 2022
DOI: 10.26107/RBZ-2022-0032
http://zoobank.org/urn:lsid:zoobank.org:pub:EEB11131-3D0E-49BB-B630-44DF04B9A23E

Description of a new species of *Setosamon* Yeo & Ng, 2007 (Decapoda: Brachyura: Potamidae) from Sakon Nakhon Province, northeastern Thailand

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Abstract. A new species of freshwater crab in the genus *Setosamon* Yeo & Ng, 2007, is described from Sakon Nakhon Province, northeastern Thailand. *Setosamon sakon*, new species, is most easily distinguished from congeners by differences in the male first gonopod. A key to the species of *Setosamon* is also provided.

Key words. Crustacea, Potamoidea, freshwater crabs, taxonomy

INTRODUCTION

Thailand, which is part of the Indochinese region, represents a hotspot for primary freshwater crab diversity (Yeo et al., 2014), where the family Potamidae is particularly well studied and represented (Yeo & Ng, 1998). Freshwater crabs from the family Potamidae are typically found in higher elevation areas where pristine, clear, and fast-flowing streams are typically found (Cumberlidge et al., 2009). Given that Thailand has numerous mountain ranges and highland regions (Cumberlidge et al., 2012), the corresponding abundance of suitable habitats coupled with complex topography and limited dispersal ability of the crabs could possibly account for the high diversity of potamids in Thailand (Cumberlidge et al., 2009, 2012). Up to the 1990s, numerous Thai potamid crabs were assigned to *Potamon* sensu lato, used as a "catch-all" genus for species that superficially resembled *Potamon* sensu stricto [type species: *Potamon fluvatile* (Herbst, 1785)], and defined by the presence of a distinct, well-developed third maxilliped exopod flagellum (Rathbun, 1898, 1904; Alcock, 1909a, b; Kemp, 1923; Naiyanetr & Ng, 1990; Ng & Naiyanetr, 1993; Ng, 1996; Yeo & Naiyanetr, 1999; Naiyanetr, 2001a, b). Yeo & Ng (2007) showed, however, that the genus *Potamon* sensu lato was a heterogenous group, validating their earlier assertion that *Potamon* sensu stricto is absent in Indochina and China (Yeo & Ng, 2003). In its place, Yeo & Ng (2007) established 18 new genera for various Indochinese potamid species, including taxa placed previously under *Potamon*. One of these genera was *Setosamon*, which was established for two species from northeastern Thailand, i.e., *Potamon ubon* Ng & Naiyanetr, 1993 (type species) and *P. somchaii* Ng & Naiyanetr, 1993, that were collected from mountain streams in the Thai provinces of Ubon Ratchathani and Nakhon Phanom, respectively. Here, we describe a new species of *Setosamon* from Sakon Nakhon Province in northeastern Thailand, which brings the total number of species in the genus to three.

The material examined for the present study are deposited in the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, National University of Singapore (ZRC). Included among these are numerous type specimens originally deposited in the Chulalongkorn University Natural History Museum, Bangkok, Thailand (CUMZ) that were then transferred to the ZRC. Type or comparative material in other international repositories such as the Nederlands Centrum voor Biodiversiteit Naturalis (previously the Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (RMNH), were also studied.

The morphological terminology used in the descriptive accounts follows Ng (1988, 2021), Guinot et al. (2013), and Davie et al. (2015). Measurements are of the carapace width and length, respectively. All measurements are in millimetres (mm), taken using dial calipers. The following abbreviations are used: G1 = gonopod 1 (male first pleopod); G2 = gonopod 2 (male second pleopod); cw = carapace width; cl = carapace length. Specimens were examined with a suitable stereomicroscope (Leica M80, M125C and Olympus SZX10). Camera lucida illustrations were made using the drawing tube mounted on the stereomicroscopes. Black and white photographs were taken using a Nikon D5600 digital single lens reflex (DSLR) camera with AF-S Micro NIKKOR 60mm F2.8G ED lens, mounted and illuminated with a copy stand and copy light rig.

Accepted by: Tohru Naruse

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ISSN 2345-7600 (electronic) | ISSN 0217-2445 (print)

TAXONOMY

Superfamily Potamoidea Ortmann, 1896

Family Potamidae Ortmann, 1896

Subfamily Potamiscinae Bott, 1970 (sensu Yeo & Ng, 2003)

Genus *Setosamon* Yeo & Ng, 2007

Setosamon Yeo & Ng, 2007: 293.

Type species. *Potamon ubon* Ng & Naiyanetr, 1993, by original designation.

Remarks. *Setosamon* Yeo & Ng, 2007, now includes three species, namely *S. somchaii* (Ng & Naiyanetr, 1993), *S. ubon* (Ng & Naiyanetr, 1993), and *S. sakon*, new species (see below). *Setosamon* species are characterised by the nearly confluent epigastric and postorbital cristae, shallow sternopleonal cavity, broadly triangular male pleon, coarse setae on the third maxillipeds and ambulatory legs, and broad, well developed dorsal flap on the G1 terminal segment. In this respect, *Setosamon* shares many similarities in carapace morphology with *Pilosamon* Ng, 1996. However, *Setosamon* can be easily differentiated from *Pilosamon* in the G1 terminal segment being subcylindrical with its distal tip bluntly rounded and with a relatively low and swollen dorsal flap (versus G1 terminal segment subconical, tip pointed with relatively high, flat dorsal flap in *Pilosamon*); and the groove for the G2 being dorsal (sternal) in position (versus groove for G2 marginal, mesial in position in *Pilosamon*) (Fig. 1A–D; Ng & Naiyanetr, 1993: figs. 40B–E, 41B–E; Ng, 1996: fig. 2; Yeo & Naiyanetr, 2010: fig. 2).

Distribution. Nakhon Phanom, Ubon Ratchathani and Sakon Nakhon Provinces, all in northeastern Thailand.

Setosamon sakon, new species
(Figs. 1–4)

Material examined. Holotype, male (59.6 × 47.5 mm) (ZRC 2022.0930), Phu Phan Park, Muang Sakon Nakhon District, Sakon Nakhon Province, Thailand, coll. Naluimon Sangpradaub, 23 August 1997.

Comparative material. *Setosamon ubon* (Ng & Naiyanetr, 1993): holotype, male (49.0 × 39.0 mm) (RMNH D 42349), Senangkhanikhom District, Ubon Ratchathani Province, Thailand, coll. P. Naiyanetr, 6 October 1985. *Setosamon somchaii* (Ng & Naiyanetr, 1993): holotype, male (46.8 × 37.5 mm) (RMNH D 42350), Si Songkhram District, Nakhon Phanom Province, Thailand, coll. Tangphulphon Somchai, 6 December 1975.

Diagnosis. Carapace transversely ovate, slightly broader than long, relatively low, flat, branchial regions very gently inflated, gently convex longitudinally; epigastric cristae distinct, almost confluent with, slightly anterior to postorbital cristae, separated by short, indistinct groove; postorbital cristae sharp, confluent with epibranchial tooth; frontal margin sinuous; regions behind the epigastric, postorbital cristae smooth; external orbital tooth well developed; epibranchial tooth distinct; anterolateral margin convex, cristate; anterolateral, branchial regions sparsely covered with rugae or granules; cervical grooves broad, shallow; epistome posterior margin with distinct median tooth. Third maxilliped presumed to be densely setose (as indicated by numerous deep pits for setae); with flagellum longer than width of merus. Ambulatory legs not elongate; margins of carpus, propodus, dactylus of ambulatory legs with coarse setae. Suture between anterior thoracic sternites 2, 3 complete, distinct, straight; suture between anterior thoracic sternites 3, 4 not discernible; male sternopleonal cavity barely reaching imaginary line joining posterior edge of cheliped coxae. Male pleon broadly triangular. G1 terminal segment relatively short, stout, subcylindrical, with groove for G2 on dorsal (sternal) surface, with distal part not tapered, tip rounded, with dorsal flap swollen, low, broad, extending for almost entire length, with apex on median part. G2 distal segment longer than half length of basal segment.

Description. Carapace (Fig. 2A) slightly broader than long, width to length ratio 1.25, relatively low, dorsal surface relatively flat except for gently inflated branchial regions, glabrous. Frontal regions with low granules, front gently deflexed ventrally, orbital regions narrow, smooth; anterolateral regions weakly rugose; branchial, mesogastric, urogastric, cardiac, intestinal regions smooth; suborbital region granulose; pterygostomial regions smooth, subhepatic, sub-branchial regions rugose. Epigastric cristae distinct, rugose, not cristate, separated by broad, median Y-shaped furrow; epigastric cristae just anterior to postorbital cristae, weakly separated by short furrow; postorbital cristae distinct, sharp to weakly rugose, prominently raised, subparallel to frontal margin, outer edge confluent with anterolateral margins. Cervical grooves distinct, not reaching lateral margins, connected to well-defined H-shaped gastric groove. Frontal margin gently sinuous in dorsal view, almost straight in frontal view; barely divided into two low lobes, separated by broad, very shallow concavity; margin of each lobe gently convex. External orbital tooth distinct, acutely triangular, outer margin slightly greater than length of inner margin, margins cristate, demarcated from rest of anterolateral margin by deep V-shaped cleft; epibranchial tooth small, distinct, broadly triangular. Anterolateral margins convex, cristate, lined with low, sharp granules, appears weakly serrated. Posterolateral margin straight, converging towards slightly convex posterior carapace margin.

Orbits (Figs. 2B, 3A) subovate; eye filling entire space; ocular peduncle relatively short; cornea large, ovate, pigmented. Supraorbital, suborbital margins straight, cristate. Antennules short, folding transversely into broad, subrectangular fossa; antennae very short, tip not reaching cornea of eyes. Posterior margin of epistome with distinct median triangle, lateral margin almost straight.

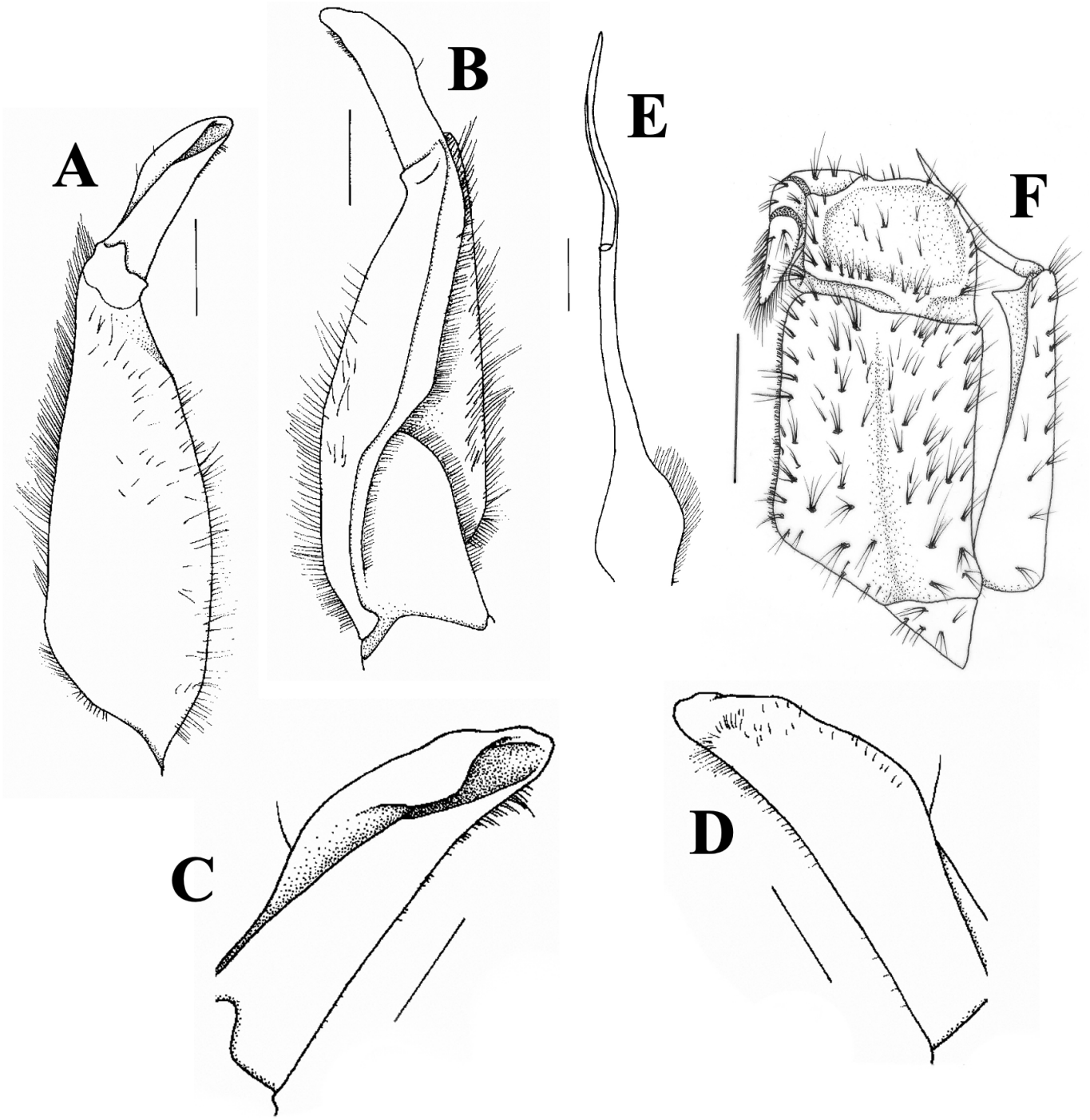

Fig. 1. *Setosamon sakon*, new species, holotype male (59.6 × 47.5 mm) (ZRC 2022.0930). A, right G1, dorsal (sternal) view; B, right G1, ventral (pleonal) view; C, terminal segment of right G1, dorsal (sternal) view; D, terminal segment of right G1, ventral (pleonal) view; E, right G2, dorsal (sternal) view; F, left third maxilliped (setae reconstructed). Scale bar = 2.0 mm.

Third maxilliped (Figs. 1F, 3A, E) covering most of buccal cavity when closed, with numerous deep pits for setae (setae detached in holotype); ischium broadly rectangular, with distinct longitudinal median sulcus; merus subquadrate, slightly wider than long, subequal to half of ischium length, with concave outer surface, margins almost smooth, weakly granulated; exopod slender, long, reaching to about half length of merus, inner distal angle angular, produced, with elongate flagellum, longer than merus width.

Chelipeds (Figs. 2B, 3C, D) slightly subequal, left cheliped slightly larger in holotype. Anterior margin of basis-ischium lined with small granules, margin of merus lined with sharp granules, appearing serrated. Outer surface of merus and carpus rugose, inner distal angle with large sharp tooth and basal tooth. Outer surface of chelae gently rugose, major chela fingers appears more elongate than minor chela. Pollex of major chela longer than palm (dactylus broken), outer surface with rows of pits, tips hooked and overlapping in minor chela; cutting edges of both fingers with variously sized sharp teeth and denticles; dorsal margin of dactylus more prominent with tubercles; fingers form slight gape when closed. Fingers of minor chela short, subequal to palm.

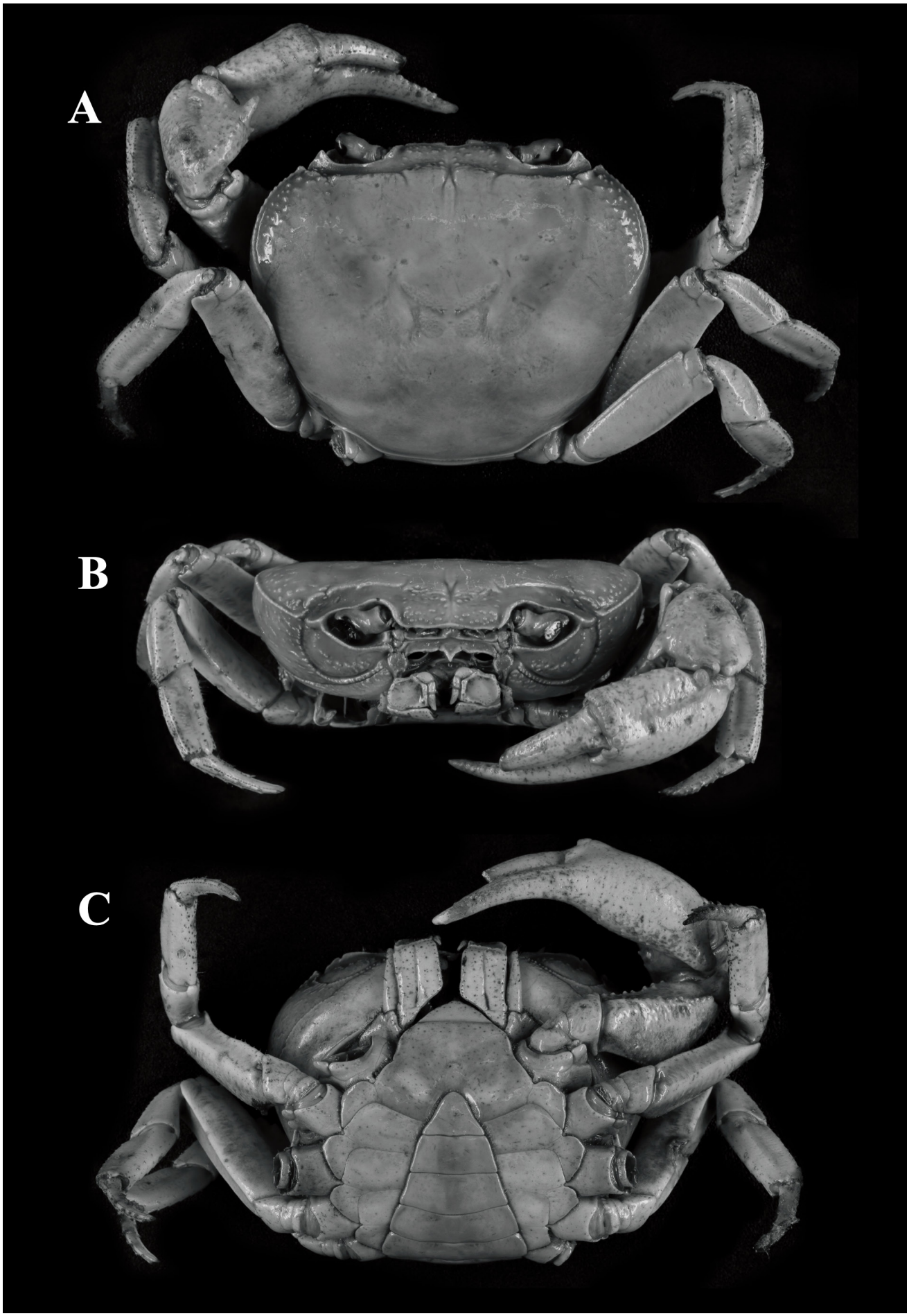

Fig. 2. *Setosamon sakon*, new species, holotype, male (59.6 × 47.5 mm) (ZRC 2022.0930). A, dorsal view; B, frontal view; C, ventral view.

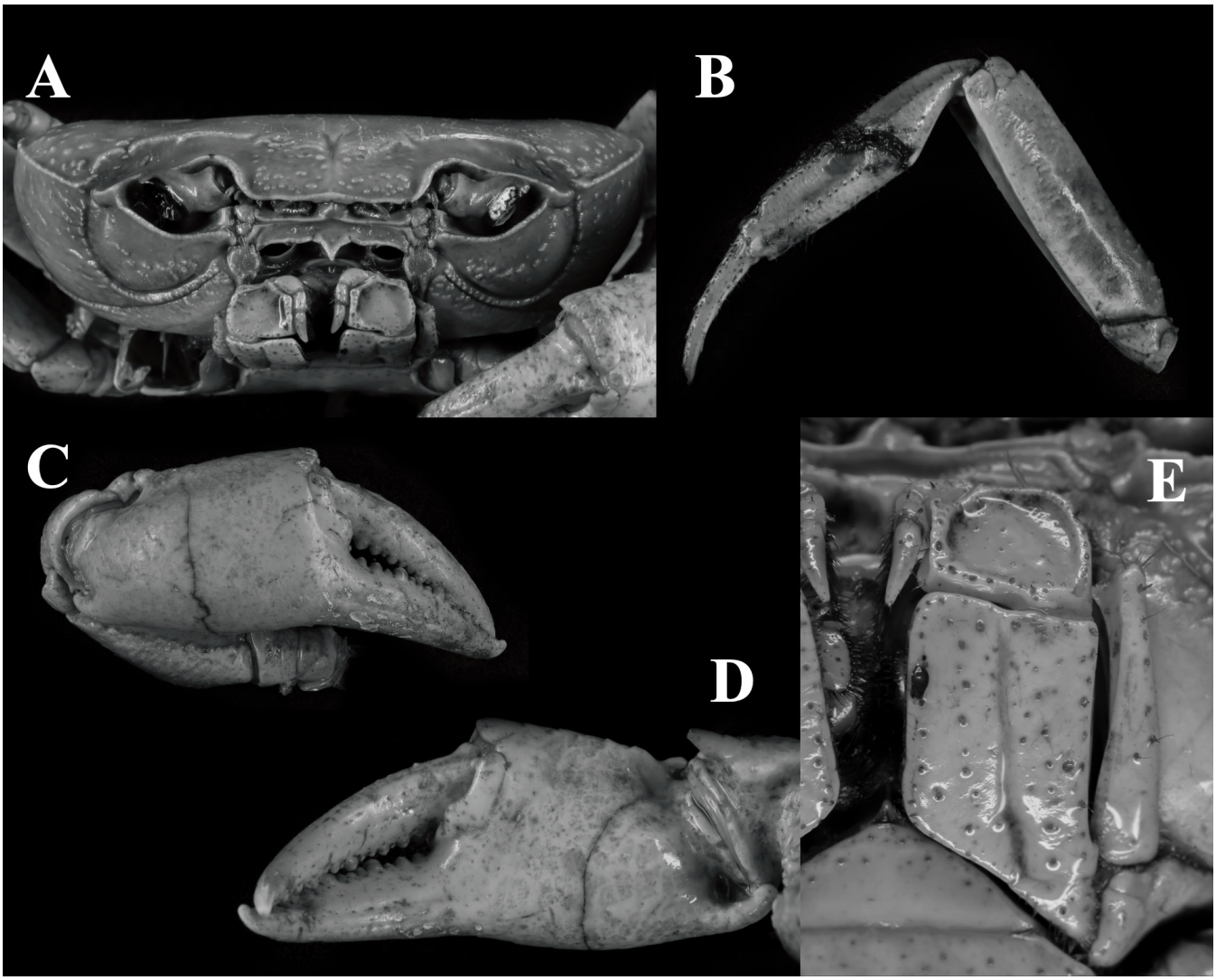

Fig. 3. *Setosamon sakon*, new species, holotype, male (59.6 × 47.5 mm) (ZRC 2022.0930). A, frontal view of cephalothorax; B, left second ambulatory leg; C, lateral view of right minor chela; D, medial view of right minor chela; E, left third maxilliped (setae detached in holotype).

Ambulatory legs (Figs. 2A, 3B) not elongate, carpi, propodi, dactyli lined with few coarse setae but with numerous pits for setae (setae detached in holotype), second pair longest, pereopod length (from merus to dactylus) to carapace width ratio 1.46, last pair shortest. Merus length to width ratio 3.38, outer surface very weakly rugose, dorsal margin distinctly smooth, without subdistal spine or tooth; carpus gently rugose, dorsal margin almost smooth, outer surface with distinct sub-median crista; dorsal margin of propodus with crista, outer surface with very weak sub-median groove; dactylus elongate, relatively straight, margins with short, sharp pectinate spines.

Thoracic sternum (Figs. 2C, 4B), notably sternites 3, 4, relatively broad, surface pitted. Sternites 1, 2 completely fused to form broadly triangular plate; separated from sternite 3 by straight suture; sternites 3, 4 completely fused, with shallow groove demarcating suture, no lateral notches on either side of sternites; sutures 4/5, 5/6, 6/7, 7/8 medially interrupted; median longitudinal groove limited to posterior end of sternite 4 to sternite 8. Male sternopleonal cavity shallow, barely reaching imaginary line joining posterior edge of cheliped coxae.

Male pleon (Fig. 4C) broadly triangular; all somites and telson free; telson broadly triangular, height to base ratio 0.73, lateral margins gently concave; somite 6 trapezoidal, much wider than long, lateral margins almost straight; somites 3–5 trapezoidal, gradually decreasing in width, increasing in length; somites 1, 2 subrectangular, very wide, reaching to bases of coxae of fourth ambulatory legs, thoracic sternite 8 not visible when pleon closed.

G1 (Fig. 1A–D) relatively broad, stout, straight; subterminal segment broad proximally, tapering distally, without cleft on outer margin, lateral margin convex, mesial margin relatively straight, distal end slightly curving laterally; terminal segment clearly separated from subterminal segment by weak dilation, relatively short, about 0.36 times length of subterminal segment, gently bent laterally, relatively stout, subcylindrical, tip appearing rounded, with distinct dorsal subdistal opening, groove for G2 positioned on dorsal (sternal) surface, without

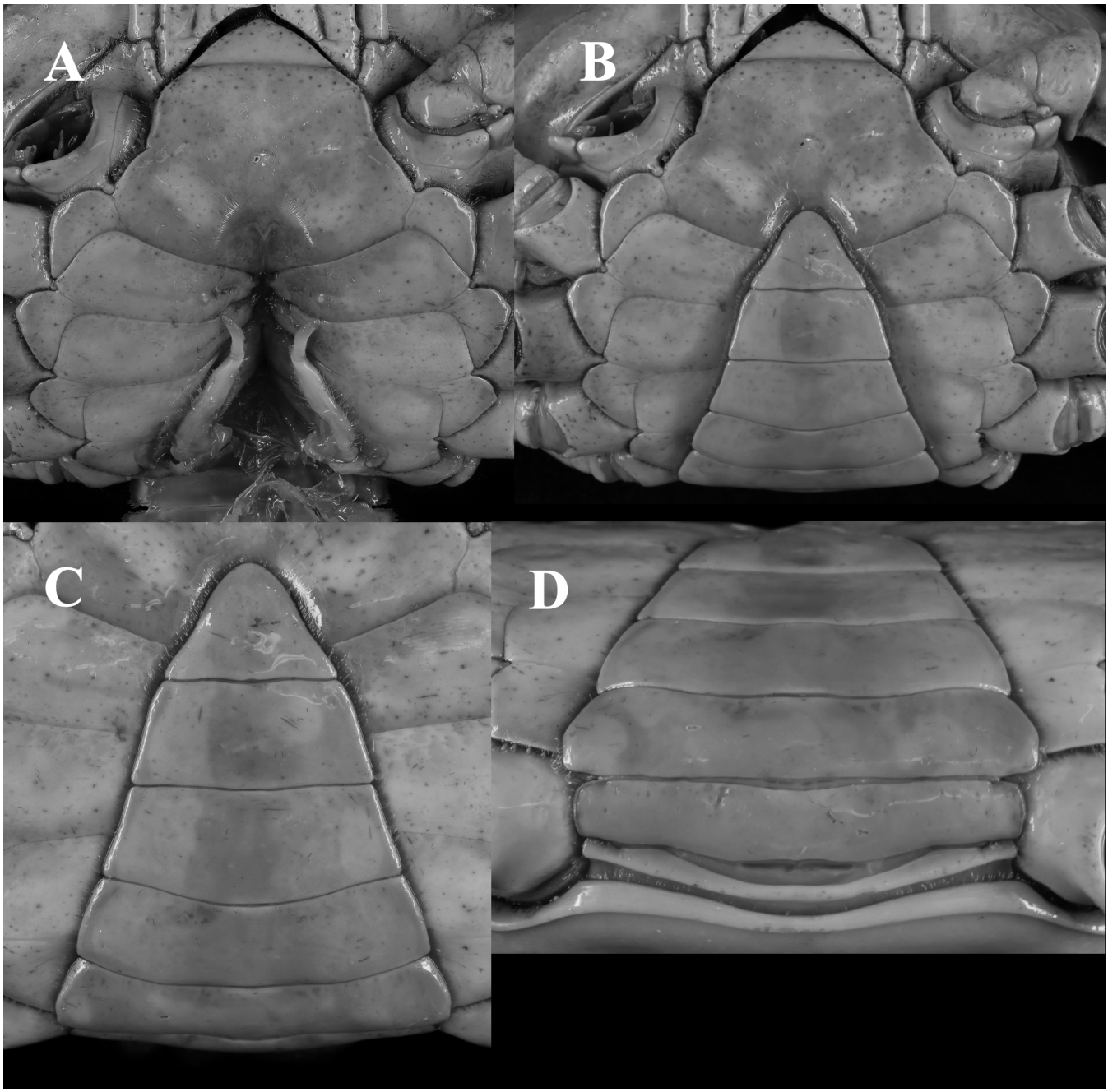

Fig. 4. *Setosamon sakon*, new species, holotype, male (59.6 × 47.5 mm) (ZRC 2022.0930). A, sternopleonal cavity showing detached G1s placed in approximate natural in situ position; B, thoracic sternum and pleon; C, close-up of pleon; D, posterior view of pleon, including somites 1 and 2.

longitudinal torsion, without swelling on inner margin, dorsal flap low, broad, extending almost entire length of terminal segment, swollen, convex, with broadly convex apex in median portion, gradually tapered proximally and distally, without subdistal notch. G2 (Fig. 1E) distal segment distinctly longer than half of basal segment, slender, tapering, without distal projection; basal segment outer margin gently convex.

Etymology. This species is named after Sakon Nakhon District in Thailand, where the holotype was collected. The species epithet, *sakon*, is used as a noun in apposition.

Remarks. In the sole specimen of *Setosamon sakon*, new species, the third maxilliped apparently lacks the distinctive long and coarse setae found in other *Setosamon* species. Nonetheless, numerous large, deep pits that mark the attachment points of these coarse setae are scattered across the surfaces of ischium, merus, and exopod (Fig. 3E), suggesting the presence of setae in the intact specimen in life. We presume that the setae were artificially detached at some point post-mortem, perhaps due to old age or improper preservation and/or handling. Furthermore, *Setosamon sakon*, new species, also displays these other characters that warrant its inclusion in the genus, namely, the almost confluent epigastric cristae and postorbital cristae; smooth dorsal carapace surface except for the slightly rugose branchial region; long third maxilliped exopod flagellum, exceeding width of merus; broadly triangular male pleon

barely reaching imaginary line joining posterior edge of cheliped coxa; ambulatory legs carpi, propodi, and dactyli lined with coarse setae; and relatively short, subcylindrical G1 terminal segment, with distinct dorsal groove for the G2, broad, rounded tip, with well developed, swollen, broad dorsal flap (Figs. 1A–D, F, 2A, 3B, E, 4B).

Setosamon sakon most closely resembles *S. ubon* (Ng & Naiyanetr, 1993) in its slightly serrated carapace anterolateral margins, slightly inflated branchial regions, and the dorsal and subdistal position of the opening of the G1 terminal segment (Figs. 1A–D, 2A, B; Ng & Naiyanetr, 1993: fig. 40D). There are, however, some significant differences in the G1 structure that separate the two species, namely, the G1 terminal segment is less strongly bent outwards (versus more strongly bent outwards in *S. ubon*); and the G1 terminal segment dorsal flap extends along the entire length of the terminal segment, with the flap's apex in the median portion (versus dorsal flap extending distal two-thirds length of terminal segment, with flap apex skewed towards distal portion, at the distal third in *S. ubon*) (Fig. 1A–D; Ng & Naiyanetr, 1993: fig. 40B–E).

Setosamon sakon can be easily distinguished from *S. somchaii* (Ng & Naiyanetr, 1993) by the weakly serrated carapace anterolateral margin (versus carapace anterolateral margin almost entire); G1 more stout, less sinuous (versus G1 appearing more slender, sinuous); and G1 terminal segment with dorsal subdistal opening, dorsal flap with broadly convex apex (versus G1 terminal segment lacking dorsal subdistal opening, dorsal flap with broad bluntly angular apex) (Figs. 1A–D, 2B, 3A; Ng & Naiyanetr, 1993: figs. 7A, B, 41B–E).

Habitat. Habitat notes were not available with the specimen; however, the sole specimen of *Setosamon sakon* was obtained from Phu Phan National Park in Sakon Nakhon Province, northeastern Thailand, and Phu Phan National Park is dominated by a limestone mountain range, dry evergreen forests, and is the source of numerous streams and waterfalls (Department of National Parks, 2015). The general morphology of *Setosamon sakon*, including the relatively low carapace, relatively stout ambulatory legs, and third maxilliped with elongated flagellum, is often associated with species with generally aquatic habits (as opposed to terrestrial or semi-terrestrial) that occur in fast-flowing hill/montane streams (Ng & Naiyanetr, 1993; Yeo et al., 1999; Yeo, 2000; Naruse et al., 2011). Future expeditions are needed, however, to verify these potential associations and better understand the ecology and distribution of this crab.

Key to the species of *Setosamon*

1. Carapace anterolateral margins entire; G1 terminal segment lacking dorsal subdistal opening, dorsal flap with broad bluntly angular apex (Ng & Naiyanetr, 1993: figs. 7A, B, 41B–E) [Nakhon Phanom, north-eastern Thailand]..... *S. somchaii*
– Carapace anterolateral margins weakly serrated; G1 terminal segment with dorsal subdistal opening, dorsal flap with broadly convex apex 2
2. G1 more strongly bent outwards, dorsal flap of terminal segment relatively narrower, extending about two-thirds length of terminal segment from tip, with rounded apex skewed towards distal portion, at the distal third (Ng & Naiyanetr, 1993: fig. 40B–E) [Ubon Ratchathani, north-eastern Thailand]..... *S. ubon*
– G1 more gently bent outwards, dorsal flap of terminal segment relatively broader, extending almost entire length of terminal segment, with rounded apex in median portion (Fig. 1A–D) [Sakon Nakhon, north-eastern Thailand]..... *S. sakon*, new species

ACKNOWLEDGEMENTS

The authors are grateful to Naluimon Sangpradaub for helping to collect the specimen of this new species and Phaibul Naiyanetr (CUMZ) for generously allowing the last author to transfer the specimen to the ZRC. Peter Ng provided comments on a much earlier version of this manuscript. This paper is part of a project funded and supported by the National University of Singapore.

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