

A New Species of Riverine Crab of the Genus *Sundathelphusa* Bott, 1969 (Crustacea: Brachyura: Gecarcinucidae) from Northeastern Luzon, Philippines

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A new species of riverine freshwater crab of the genus *Sundathelphusa* Bott, 1969, is described from Cagayan Province in northeastern Luzon Island, Philippines. *Sundathelphusa cagayana*, a new species, is most similar morphologically to other Philippine species with a subquadrate carapace such as *S. antipoloensis* (Rathbun, 1904), *S. grapsoides* (H. Milne Edwards, 1853) and *S. wolterecki* (Balss, 1937) but differs from each by characters of the carapace, epibranchial teeth, ambulatory legs, male abdomen, and gonopods. This discovery brings to 22 the total number of species of *Sundathelphusa* found in the Philippines. A list of the *Sundathelphusa* species presently known from the Philippines and their known localities is also provided.

Key Words: biodiversity, Cagayan, freshwater crab, new species, Pinacananan River, taxonomy, Philippines

INTRODUCTION

The Philippines has a wide diversity of true freshwater crabs belonging to the families Potamidae and Gecarcinucidae (Takeda 1983; Ng 1991; Ng & Takeda 1992, 1993a, b; Ng & Sket 1996; Takeda & Ng 2001; Freitag & Yeo 2004; Tan & Ng 2004; Husana et al. 2009). Although a considerable number of new genera and species have been discovered from the Philippines over the last several years, many more still remain to be described (Chia & Ng 2006). It is estimated that the number of species of freshwater crabs will double from present levels (1,280 species worldwide) once ongoing studies, in the region and elsewhere, have been completed (Cumberlidge et al. 2009). Freshwater crabs are unique among brachyuran crabs in that they can complete their entire life cycle without the need for

either brackish water or sea water. All freshwater crabs undergo direct development (whereby all larval stages are lacking), where the ovigerous female broods a few large, lecithotrophic eggs that hatch into tiny hatchling crabs (Ng 1988). This reproductive strategy effectively restricts freshwater crabs to habitats in or adjacent to freshwater, and limits their ability to disperse across geographical barriers such as mountain ranges or large expanses of salt water. As such, this also makes them interesting subjects for biogeographic and phylogeographic studies (e.g., Ng & Rodríguez 1995; Daniels et al. 2002, 2006; Yeo et al. 2007; Cook et al. 2008; Schubart & Ng 2008; Cumberlidge & Ng 2009; Klaus et al. 2009; Shih et al. 2009). Freshwater crabs also bear some socio-economic significance because they are an occasional source of food in some parts of the Philippines. Furthermore, in Asia several species of freshwater crabs serve

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as the second intermediate host of the lung fluke, *Paragonimus* spp., which causes a serious lung disease (paragonimiasis) when crabs infected with *Paragonimus* metacercariae are eaten raw or insufficiently cooked (e.g., Cabrera 1973, 1984; Liu et al. 2008).

Sundathelphusa Bott, 1969, is one of the most diverse and well represented genera in the Philippines, with 21 out of 29 known species (Ng et al. 2008; Husana et al. 2009) found in and endemic to the Philippines. Most of the Philippine species occur in Luzon, with some in the Visayan islands and in Mindanao (Table 1), while the remaining species are found in Sulawesi, eastern Borneo, and the Moluccas Islands (Chia & Ng 2006). Bott (1969) erected *Sundathelphusa* (type species: *Potamon* (*Geothelphusa*) *cassiope* De Man, 1902) and seven other genera (i.e., *Perbrinckia*, *Rouxana*, *Archipelothelphusa*, *Sendleria*, *Perithelphusa*, *Mainitia* and *Holthuisana*) for numerous species in the Indo-Australian region, and placed them in a new family, Sundathelphusidae Bott, 1969. Ng & Sket (1996), however, synonymized Sundathelphusidae Bott, 1969, under Parathelphusidae Alcock, 1910, and also considered *Archipelothelphusa* Bott, 1969, a junior synonym of *Sundathelphusa* Bott, 1969, arguing a lack of sufficient and dependable characters to distinguish between these taxa (Ng et al. 2008). More recently, Parathelphusidae Alcock, 1910 has been considered a junior subjective synonym of Gecarcinucidae Rathbun, 1904 (Cumberlidge et al. 2009; Klaus et al. 2009).

The present work reports on the discovery of a new species of *Sundathelphusa* obtained from the Pinacanauan River, in southeastern Cagayan province in the course of a faunal survey of Brachyura in northern Luzon Island.

MATERIALS & METHODS

The present species was collected from the Pinacanauan River, at the foothills of the Sierra Madre Mountains in southeastern Cagayan and meandering westward before joining the Cagayan River which flows northward for about 100 km before emptying into the Babuyan Channel. Crabs were caught by hand by overturning large stones submerged in shallow, slow-moving portions of the river. Live coloration was recorded by photography before the crabs were preserved in 70% ethanol. Detailed examination and illustrations were made using a Nikon SMZ800 stereomicroscope equipped with a camera lucida.

The new species was compared with the types of other species of *Sundathelphusa* from the Philippines, particularly *S. antipoloensis* (Rathbun, 1904),

MNHN-B5031, and *S. grapsoides* (H. Milne Edwards, 1853), MNHN-B4358. Here we have relied largely on unpublished camera lucida pencil drawings and photographs of the types, with accompanying notes, kindly provided by Professor Peter K. L. Ng (National University of Singapore) as well as on published figures and descriptions. Other material examined is listed below in the Taxonomy section of this paper.

The abbreviations G1, G2 and P2–P5 are used for the male first and second gonopods and the second to fifth pereopods, respectively. Measurements shown are indicated as carapace width at the widest extent by carapace length at the midline, in millimeters. The terminology used essentially follows that of Ng & Sket (1996) and Takeda & Ng (2001). Specimens used in this paper are deposited in the crustacean reference collections of the following museums: National Museum of the Philippines, Manila (NMCR); Muséum national d'Histoire naturelle, Paris (MNHN); Ryukyu University Museum, Fajukan, Okinawa (RUMF); and the Raffles Museum of Biodiversity Research, Singapore (ZRC).

TAXONOMIC ACCOUNT

Family Gecarcinucidae Rathbun, 1904

Sundathelphusa Bott, 1969

Sundathelphusa cagayana, new species

Diagnosis. – Carapace subquadrate, carapace width about 1.2 times carapace length; dorsal surface depressed transversely and longitudinally; epigastric and postorbital cristae low, distinct; frontal margin slightly sinuous; anterolateral margins slightly convex, cristate; single epibranchial tooth acutely triangular, well-developed, anteriorly directed, separated from exorbital tooth by deep U-shaped notch. Orbits and eyes well-developed. Ambulatory legs moderate in length, longest coxa-to-dactylus length about 1.6 times carapace width. Male abdomen T-shaped; sixth abdominal somite subquadrate, median length equal to greatest width. G1 short, filling less than half length of abdominal cavity, sub-cylindrical, slightly curving outward, tapering distally; with distinct suture between terminal and subterminal segments; terminal segment slender, conical, slightly curved outward, about 0.4 times length of subterminal segment, tip not dilated; G2 subequal in length to G1, slender except for abruptly wider base; flagellum filiform, relatively long, about 0.5 times length of basal segment.

Material examined. – Holotype: male, 25.8 by 21.7 mm (NMCR 30064), Pinacanauan River, Callao, municipality

Table 1. *Sundathelphusa* species of the Philippines, with their known localities.

Species	Locality
<i>Sundathelphusa antipoloensis</i> (Rathbun, 1904)	Luzon: Rizal (Antipolo)
<i>Sundathelphusa boex</i> Ng & Sket, 1996 ^a	Bohol: Batuan, Ginguyuran, Jagna
<i>Sundathelphusa cagayana</i> , new species	Luzon: Cagayan
<i>Sundathelphusa cavernicola</i> (Takeda, 1983)	Bohol: Antequerra
<i>Sundathelphusa celer</i> (Ng, 1991)	Luzon: Laguna
<i>Sundathelphusa grapsoides</i> (H. Milne Edwards, 1853)	Luzon: Pampanga, Bulacan
<i>Sundathelphusa hades</i> Takeda & Ng, 2001	Mindanao: Agusan del Sur, Surigao del Sur
<i>Sundathelphusa jagori</i> (von Martens, 1868)	Luzon (no specific locality)
<i>Sundathelphusa lobo</i> Husana, Naruse & Kase, 2009	Samar: Jiabong (Lobo Cave)
<i>Sundathelphusa longipes</i> (Balss, 1937) ^b	Luzon: central Luzon (Agno River), Quezon
<i>Sundathelphusa mistio</i> (Rathbun, 1904)	Mindanao (no specific locality)
<i>Sundathelphusa montana</i> (Bürger, 1894)	Luzon: Mountain Province (Mount Data)
<i>Sundathelphusa montanoanus</i> (Rathbun, 1904)	Mindanao (no specific locality)
<i>Sundathelphusa philippina</i> (von Martens, 1868) ^c	Cebu, Leyte & Samar
? <i>Sundathelphusa philippina</i> (Bürger, 1894) ^d	Luzon?
<i>Sundathelphusa picta</i> (von Martens, 1868)	Luzon: Camarines Sur
<i>Sundathelphusa sottoae</i> Ng & Sket, 1996	Bohol: Batuan
<i>Sundathelphusa sutteri</i> (Bott, 1970)	Luzon: Baguio (?)
<i>Sundathelphusa urichi</i> Ng & Sket, 1996	Bohol: Batuan
<i>Sundathelphusa vedeniki</i> Ng & Sket, 1996	Bohol: Antequerra
<i>Sundathelphusa waray</i> Husana, Naruse & Kase, 2009	Samar: Calbiga (Langun Cave)
<i>Sundathelphusa wolterecki</i> (Balss, 1937)	Mindanao: Lanao del Sur (Lake Lanao)

^a Ng & Sket (1996) have discussed that Bürger's (1894) record of *Telphusa leschenaulti* H. Milne Edwards, 1837, from Bohol Island was likely to be a misidentification of the species they were describing then, *Sundathelphusa boex*. Ng et al. (2008) had erroneously included this record in the Systema Brachyurorum as *Sundathelphusa leschenaultii* (Bürger, 1894). However, this species name was deleted in the subsequent Corrigenda & Errata (8 August 2008) published on the online website of the Raffles Bulletin of Zoology (<http://rmbz.nus.edu.sg/research/cotw/Corrigenda-5.pdf>). *Telphusa leschenaultii* H. Milne-Edwards, 1837 (often spelled as "*leschenaultii*" as incorrectly changed by H. Milne Edwards, 1853) is now considered a junior synonym of *Oziotyelphusa senex* (Fabricius, 1798).

^b The record of this species from Balinsayo, Negros by Balss (1937) is here considered dubious as Negros Island is too distant and separated by the Sibuyan and Visayan seas from the type locality in Luzon Island. Furthermore, this record is not mentioned in Ng (1991). It is, therefore, not included pending a re-examination of the specimens.

^c The range of this species has been restricted by Ng & Sket (1996) to the indicated range above, including specimens recorded from Samar and Leyte and identified as *S. grapsoides* by Balss (1937).

^d This record is not of *S. philippina* (von Martens, 1868) (see Ng et al. 2008).

of Peñablanca, Cagayan province, Luzon Island, Philippines, coll. J.C.E. & C.M. Mendoza, 6 Apr 2008.

Paratypes: 1 female, 21.3 by 18.5 mm (NMCR 30065), 6 males, 11.0 by 9.2 mm – 26.0 by 21.1 mm, 4 females, 17.5 by 14.6 mm – 22.6 by 18.8 mm (ZRC 2008.0453), 4 males, 8.8 by 7.6 mm – 25.5 by 20.9 mm, 2 females, 20.0 by 16.8 mm, 21.0 by 17.2 mm (MNHN-B31981), same data as holotype; 2 males, 9.5 by 8.1 mm, 21.5 by 18.0 mm, 2 females, 12.4 by 10.6 mm, 12.5 by 10.4 mm (NMCR 30066), 3 males, 8.1 by 6.9 mm – 26.3 by

21.9 mm, 3 females, 10.5 by 9.0 mm – 28.6 by 24.3 mm (RUMF-ZC-910), 3 males, 11.1 by 9.7 mm – 13.3 by 11.1 mm, 2 females, 13.7 by 11.8 mm, 13.0 by 10.8 mm (ZRC 2009.0793), 40 m asl, Pinacanauan River, Quibal, municipality of Peñablanca, Cagayan province, Luzon Island, Philippines, coll. J.C.E. Mendoza & T. Naruse, 25 Apr 2007.

Description. – Carapace (Figures 1, 3A) subquadrate, carapace width 1.15–1.23 times carapace length (mean = 1.19, n = 28); dorsal surface mostly smooth, glabrous,

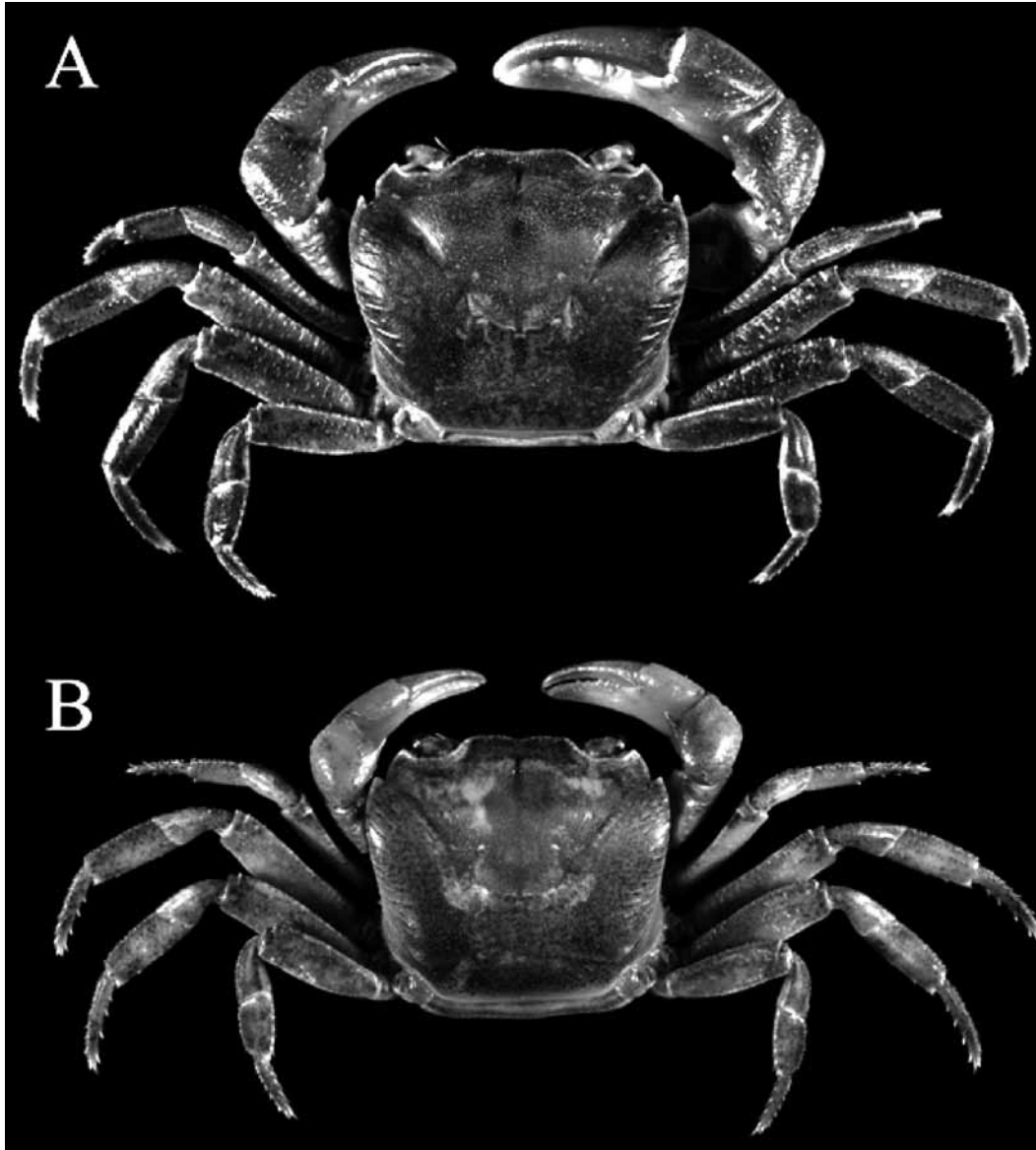


Figure 1. *Sundathelphusa cagayana*, new species, **A**) male holotype, 25.8 by 21.7 mm (NMCR 30064), **B**) female paratype, 21.3 by 18.5 mm (NMCR 30065).

gently convex transversely and longitudinally; anterolateral regions with rows of separate or fused granules of varying sizes; posterolateral regions covered with oblique striae consisting of rows of fused granules; cervical grooves distinct, H-shaped median groove shallow; epigastric cristae low, consisting of a few discrete ridges, not confluent with postorbital cristae; postorbital cristae low, terminating just before cervical groove, not reaching epibranchial tooth. Frontal margin slightly sinuous, deflexed; frontal median triangle (Figures 2A, B, 3D) well defined, with dorsal and lateral margins cristate. Anterolateral margin (Figures 1, 3A) cristate, slightly convex, not clearly demarcated from posterolateral margin, merging with it; epibranchial tooth

acute, well-developed, anteriorly directed, well-separated from broad external orbital tooth by deep, U-shaped notch; posterolateral margins gently convex, gradually converging towards straight posterior carapace margin. Suborbital and subhepatic regions (Figure 2A) with several rows of fused granules of varying lengths; suborbital region demarcated by distinct, semi-circular groove originating at base of internal orbital tooth and terminating just beneath notch between external orbital and epibranchial teeth. Pterygostomial region (Figure 2B) with few, rows of small fused granules; anterior margin demarcated by long ridge. Orbit (Figure 2A) well developed, supra- and infraorbital margins cristate, converging at external

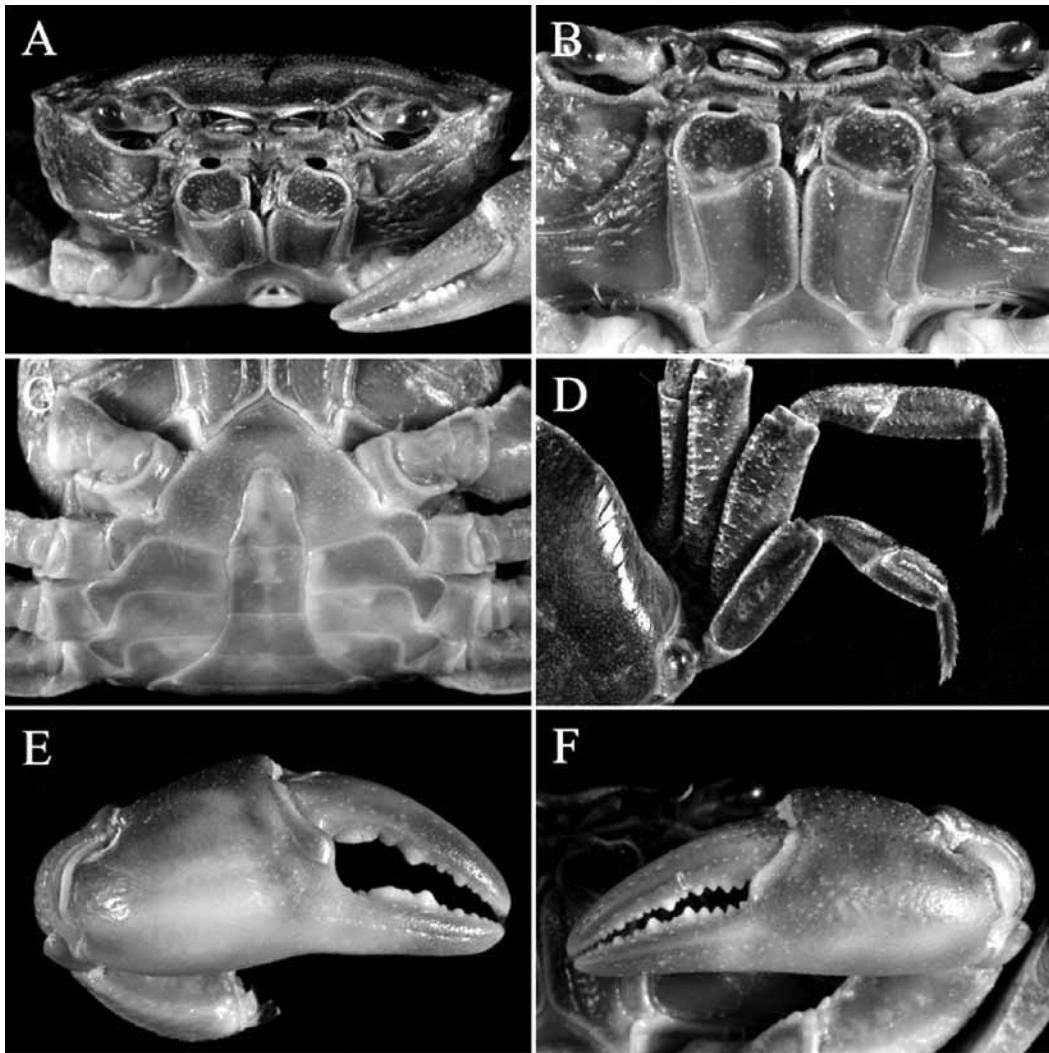


Figure 2. *Sundathelphusa cagayana*, new species, male holotype (NMCR 30064): A) frontal view; B) eyes, antennae, antennules and third maxillipeds, ventral view; C) sternum, abdomen and telson, ventral view; D) right P4, P5, dorsal view; E) major chela, external view; F) minor chela, external view.

orbital tooth, infraorbital margin with internal orbital tooth; eye occupying almost entire orbit, ocular peduncle and cornea well developed. Posterior margin of epistome (Figure 3E) with well-developed, triangular, median lobe, separated from sinuous lateral lobes by distinct cleft. Third maxillipeds (Figures 2B, 3B) with ischium rectangular, bearing distinct submedian sulcus closer to mesial margin; merus subquadrate, anterolateral margin rounded, anterior margin with slight median depression; tip of exopod reaching midpoint of lateral margin of merus, flagellum reaching just beyond mesial margin of merus in situ. Mandibular palp bilobed distally.

Chelipeds (Figures 1, 2E, F, 3C) unequal in mature males (equal in females); merus lightly striated, with blunt distal tooth on ventral margin; carpus lightly striated,

inner margin with one large conical tooth subdistally and similar, smaller tooth proximally; outer and inner surfaces of palm smooth, upper margin shorter than fingers; in major chela, cutting margin of fingers lined with large and small teeth, with low molariform tooth near base of moveable finger with large, irregularly trifold tooth in middle of fixed finger; in minor chela, teeth smaller, more-or-less uniformly sized. Ambulatory legs (Figures 1, 2D, 3G) moderate in length, P2 longest, about 1.6 times carapace width, P5 shortest; meri (P2–P5) about 3.0 times longer than broad, anterior border cristate; carpi (P2–P4) with submedian crest on dorsal surface; propodi shorter than (P3, P4) or subequal to (P2, P5) dactyli; dactyli slightly curved, rectangular in cross section, each margin armed with a row of spines, terminating distally in a simple claw.

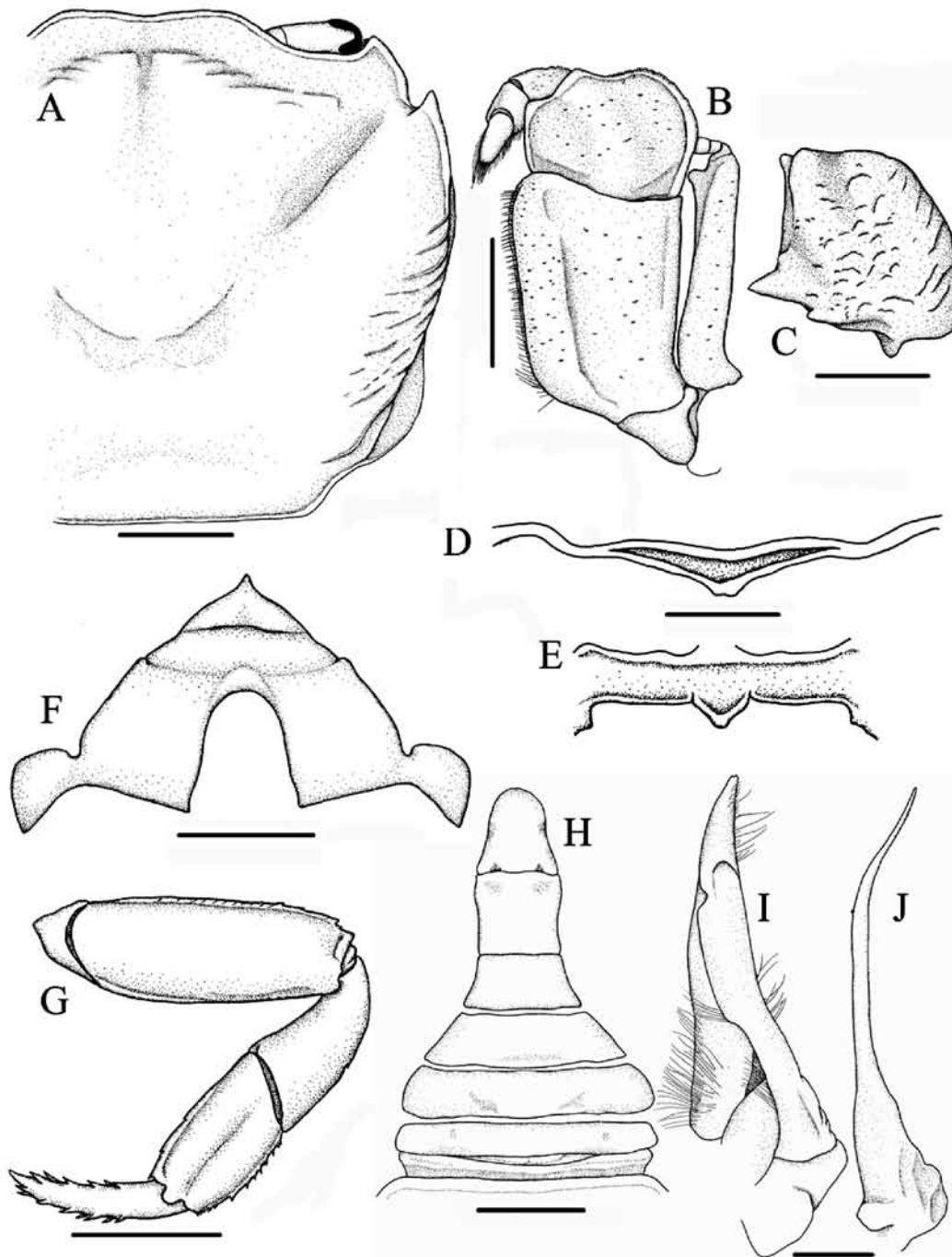


Figure 3. *Sundathelphusa cagayana*, new species, male holotype (NMCR 30064): **A**) right half of carapace; **B**) left third maxilliped, external view; **C**) carpus of right cheliped, dorsal view; **D**) frontal triangle, anterior view; **E**) epistome, anterior view; **F**) anterior thoracic sternum, ventral view; **G**) right P5, dorsal view; **H**) abdomen and telson, ventral view; **I**) left G1, ventral view; **J**) left G2, ventral view. Scales: A, C, F–H = 5 mm; B, D, E = 3 mm; I, J = 1 mm.

Male thoracic sternum (Figures 2C, 3F) smooth, sternites 1 and 2 fused, separated from sternite 3 by deep furrow, not reaching edges; sternite 3 separated from sternite 4 by shallower furrow, not reaching edges; sternites 4 to

8 separated from each other by distinct sutures; male abdominal cavity reaching level of midpoint of coxae of chelipeds. Male abdomen (Figures 2C, 3H) T-shaped; first and second abdominal somites much wider than long,

sinuous; third to fifth somites trapezoidal, third somite widest, lateral margins concave in fifth somite, straight in fourth somite and convex in third somite; sixth somite subquadrate, lateral margins sinuous, median length equals greatest width; telson subtriangular, tip rounded, lateral margins sinuous, median length and basal width equal. G1 (Figure 3I) short, filling less than half length of abdominal cavity, sub-cylindrical, slightly curving outward, tapering distally; with distinct suture between terminal and subterminal segments; terminal segment slender, conical, slightly curved outward, about 0.4 times length of subterminal segment, tip not dilated. G2 (Figure 3J) subequal to length of G1, slender except for abruptly wider base; flagellum well developed, filiform, about 0.5 times length of basal segment.

Type locality, Pinacanauan River, Callao, municipality of Peñablanca, Cagayan province, Luzon Island, the Philippines.

Ecological notes, Crabs were collected in a stretch of the Pinacanauan River about 10 m wide with substrate consisting of rounded or flattened stones and gravel, that is adjacent to a well-known karst area (the Callao Caves). During the day crabs were found resting under large stones, in submerged leaf litter or filamentous green algae (Chlorophyta). Syntopic organisms included several gastropod species (Mollusca), *Macrobrachium* prawns (Palaemonidae), and *Rhinogobius* gobies (Gobiidae). No other freshwater crab species were observed.

Color in life. The carapace of adult males (Figure 4) is green-gray and is mostly overlain with numerous dark brown or reddish brown mottling; the area of the H-shaped

depression is light brown, and there are a few dark brown spots mesial to the cervical grooves and the tips of the anterolateral teeth. The outer surfaces of the chelipeds are distinctly reddish brown. The ambulatory legs have the same green-gray basal color as the carapace, but with fewer scattered dark brown spots giving it a mottled appearance. Females generally have a similar but lighter color pattern.

Etymology. The new species is named after Cagayan Province, in which the type locality is found; used as a noun in apposition.

Comparative material. *Sundathelphusa antipoloensis* (Rathbun 1904): holotype male, 34.7 by 29.1 mm (MNHN-B5031), Antipolo, Luzon Island, Philippines, coll. E. Simon, probably 1897 (R. Cleva pers. comm.).

Sundathelphusa grapsoides (H. Milne Edwards 1853): holotype male, 16.8 by 14.2 mm (MNHN-B4358), Pampanga, Luzon Island, Philippines, no collector/date indicated; 2 males, 21.4 by 17.7 mm, 22.3 by 18.6 mm, 3 females, 9.5 by 8.2 mm – 23.9 by 19.7 mm (ZRC 2008.1226), river pool inside Bahay Paniki Cave, San Miguel, Bulacan, Luzon Island, Philippines, ~100 m asl., coll. H. Freitag, 10 Apr.1995, det. P.K.L. Ng 2006.

Sundathelphusa philippina (von Martens 1868): 2 males, 23.5 by 19.4 mm, 39.3 by 31.2 mm, 2 females, 13.3 by 11.2 mm, 17.4 by 14.1 mm (ZRC 2006.0055), Caufipla (= Cantipla) Village, near Cebu City, Cebu Island, Philippines, coll. Y. Cai, 14 Dec.2000, det. P.K.L. Ng 2006; 2 males, 32.8 by 26.2 mm, 38.7 by 31.0 mm (ZRC 2009.0102), Camp 7, Cebu Island, Philippines, 450 m asl., coll. S.I. Ueno, 22 Jun.1977; det. P.K.L. Ng 1992.



Figure 4. Live coloration of *Sundathelphusa cagayana*, new species. Male holotype (NMCR 30064).

Remarks. *Sundathelphusa cagayana*, new species, clearly conforms to the definition of the family Gecarcinucidae on account of the bilobed mandibular palp and the very slender distal abdomen of the adult male (telson and fifth and sixth abdominal somites) followed by the dramatically wider proximal somites (first to fourth), giving the abdomen a distinctive inverted-T shaped outline (Bott 1968; Klaus et al. 2009). This species is placed in the genus *Sundathelphusa* and excluded from other Philippine gecarcinucid genera primarily due to the lack of teeth or lobes posterior to the epibranchial tooth (Bott 1969; Chia & Ng 2006); the low postorbital cristae (never sharp or cristate); and the short and stout, distally tapering, gently curving G1, with a suture clearly demarcating the terminal and subterminal segments.

Sundathelphusa cagayana, new species, differs from most Philippine *Sundathelphusa* on account of the following: its flatter, less inflated carapace and less convex anterolateral margins, compared with species such as *S. philippina* which has a higher, inflated carapace and strongly convex anterolateral margins; its relatively shorter ambulatory legs, compared with species such as *S. longipes* (Ng 1991: Figures 1, 3B); or its well-developed eyes, compared with species such as *S. cavernicola* which has much reduced corneas and shorter ocular peduncles (Takeda 1983: Figure 2). *Sundathelphusa cagayana*, is morphologically most similar to *S. antipoloensis* (Rathbun 1904) and *S. grapsoides* (H. Milne Edwards 1853), both of which are also found on the island of Luzon, and share the following features: 1) a subquadrate carapace, with a width to length ratio of about 1.2 (Figure 1); 2) a distinct epibranchial tooth (Figures 1, 3A); 3) relatively short ambulatory legs (Figure 1); and 4) a subquadrate, relatively short male sixth abdominal somite (Figure 3H). P. K. L. Ng (pers. comm.) is currently revising the Philippine species of *Sundathelphusa* and these will be redescribed as part of a much larger exercise.

However, *S. cagayana*, new species, differs from *S. antipoloensis* as follows. *Sundathelphusa cagayana* has 1) a less sinuous frontal margin (Figures 1, 3A) (vs. frontal margin with a deep median depression in *S. antipoloensis*); 2) a narrower epibranchial tooth, which is separated from the external orbital tooth by a deeper U-shaped notch (Figures 1, 3A) (vs. broader epibranchial tooth and shallower U-shaped notch in *S. antipoloensis*); 3) a shorter and more stocky G1 (Figure 3I) (vs. longer and more slender in *S. antipoloensis*; and 4) a G2 with a longer flagellum (Figure 3J) (vs. a shorter G2 flagellum in *S. antipoloensis*) (Rathbun 1904: 301, pl. XIII, Figure 4; Ng in prep.). The new species also differs from *S. grapsoides* (H. Milne Edwards 1853) in having: 1) a more pronounced epibranchial tooth and notch separating it from the external orbital tooth (Figures 1, 3A) (vs. smaller,

wider tooth and shallow V-shaped notch in *S. grapsoides*); 2) a wider frontal triangle (Figure 3D) (vs. narrower in *S. grapsoides*); 3) a median concavity on the anterior margin of the merus of the third maxilliped (Figure 3B) (vs. absent in *S. grapsoides*); 4) a shorter, more stocky and less curved G1 (Figure 3I) (vs. longer, more slender and more curved in *S. grapsoides*); and 5) the G2 has a longer flagellum (Figure 3J) (vs. a short G2 flagellum in *S. grapsoides*) (A. Milne-Edwards 1869: 169, pl. VIII, Figure 2, 2a; Rathbun 1904: 300, pl. XIII, fig. 9; Ng in prep.). Furthermore, the type locality of *S. cagayana* is further north on Luzon Island than those of *S. grapsoides* (Pampanga) and *S. antipoloensis* (Antipolo), which are at least 300 km to the south. Furthermore, the Cagayan Valley, of which Cagayan province is a part, is hemmed in by three mountain ranges: the Cordilleras to the west, the Sierra Madres to the east and the Caraballos to the south. The latter of these three creates an additional geographical barrier between the northeastern region and the central and southern regions of Luzon Island.

Sundathelphusa cagayana is also somewhat similar to *S. wolterecki* (Balss 1937) (cf. Balss 1937: 158, figs. 17, 18). Both species share a subquadrate carapace and a prominent epibranchial tooth, but the two differ in the following features: the external orbital tooth is lower and wider in *S. cagayana* (Figure 3A) and more pronounced and acute, anteriorly directed in *S. wolterecki*; the lateral regions of the carapace are less rugose in *S. cagayana* (Figures 1, 3A) and more rugose in *S. wolterecki*; and the ambulatory legs are short in *S. cagayana* (Figure 1) and long in *S. wolterecki*. Furthermore, it is unlikely that these two species are conspecific as they are both restricted to different biogeographical regions in the Philippines (i.e., Luzon vs western Mindanao).

ACKNOWLEDGEMENTS

For assistance rendered during fieldwork, we wish to thank Chris & Josie Mendoza, Danny & Joy Escaño, and Pastor Rey Cortez & family. Peñablanca Chief of Police, Jerry Aglugub, provided assistance and security. Marivene Manuel-Santos (National Museum) and Ian K.C. Fontanilla (University of the Philippines) provided valuable support in Manila. We are grateful to Peter K.L. Ng (National University of Singapore) for his comments on the manuscript and for generously sharing with us his notes and material of Philippine *Sundathelphusa*, and to Neil Cumberlidge and Darren Yeo for their help in improving this paper. This study was supported by a MOE/NUS Academic Research Fund grant (No. R-154-000-334-112).

REFERENCES

- ALCOCK A. 1910. Brachyura I. Fasc. II The Indian Freshwater Crabs—Potamonidae. Catalogue of the Indian Decapod Crustacea in the collection of the Indian Museum. Calcutta, p. 1–135, pls. 1–14.
- BALSS H. 1937. Potamoniden (Dekapoda Brachyura) der Philippinen und des Malayischen Archipels. Internat Rev Hydrobiol Hydrogr 34:143–197.
- BOTT R. 1968. Parathelphusiden aus Hinterindien (Crustacea, Decapoda, Parathelphusidae). Senckenbergiana Biol 49(5):403–422.
- BOTT R. 1969. Flussskrabben aus Asien und ihre Klassifikation (Crustacea, Decapoda). Senckenbergiana Biol 50:359–366.
- BOTT R. 1970. Die Süßwasserkrabben von Europa, Asien, Australien und ihre Stammesgeschichte. Eine Revision der Potamoidea und Parathelphusoidea (Crustacea, Decapoda). Abh Senckenb Naturf Ges 526:1–338.
- BÜRGER O. 1894. Beiträge zur Kenntnis der Gattung *Telphusa*. Zool Jahrb Syst 8:1–7.
- CABRERA BD. 1973. Studies on *Paragonimus* and paragonimiasis in the Republic of the Philippines. I. *Paragonimus metacercariae* infection in *Parathelphusa grapsoides*. Southeast Asian J Trop Med Pub Health 4(1):55–62.
- CABRERA BD. 1984. Paragonimiasis in the Philippines: current status. Arzneimittelforschung 34(9B):1188–1192.
- CHIA OKS, NG PKL. 2006. The freshwater crabs of Sulawesi, with descriptions of two new genera and four new species (Crustacea: Decapoda: Brachyura: Parathelphusidae). Raffles Bull Zool 54(2):381–428.
- COOK BD, PRINGLE CM, HUGHES JM. 2008. Phylogeography of an island endemic, the Puerto Rican freshwater crab (*Epilobocera sinuatifrons*). J Hered 99(2):157–164.
- CUMBERLIDGE N, NG PKL. 2009. Systematics, evolution, and biogeography of freshwater crabs. In: Crustacean Issues: Decapod Crustacean Phylogenetics. Martin JW, Crandall KA, Felder D. eds. Boca Raton, Florida: Taylor & Francis/CRC Press. p. 491–508.
- CUMBERLIDGE N, NG PKL, YEO DCJ, MAGALHÃES C, CAMPOS MR, ALVAREZ F, NARUSE T, DANIELS SR, ESSER LJ, ATTIPOE FYK, CLOTILDE-BA F-L, DARWALL W, MCIVOR A, BAILLIE JEM, COLLEN B, RAM M. 2009. Freshwater crabs and the biodiversity crisis: Importance, threats, status, and conservation challenges. Biol Conserv 142:1665–1673.
- DANIELS SR, STEWART BA, GOUWS G, CUNNINGHAM M, MATTHEE CA. 2002. Phylogenetic relationships of the southern African freshwater crab fauna (Decapoda: Potamonautidae: *Potamonautes*) derived from multiple data sets reveal biogeographic patterning. Mol Phylo Evol 25(3):511–523.
- DANIELS SR, GOUWS G, CRANDALL KA. 2006. Phylogeographic patterning in a freshwater crab species (Decapoda: Potamonautidae: *Potamonautes*) reveals the signature of historical climatic oscillations. J Biogeog 33(9):1538–1549.
- FREITAG H, YEO DCJ. 2004. Two new species of *Parathelphusa* H. Milne Edwards, 1853, from the Philippines (Crustacea: Decapoda: Parathelphusidae). Raffles Bull Zool 52(1):227–237.
- HUSANA DEM, NARUSE T, KASE T. 2009. Two new cavernicolous species of the genus *Sundathelphusa* from western Samar, Philippines (Decapoda: Brachyura: Parathelphusidae). J Crustacean Biol 29(3):419–427.
- KLAUS S, BRANDIS D, NG PKL, YEO DCJ, SCHUBART CD. 2009. Phylogeny and biogeography of Asian freshwater crabs of the family Gecarcinidae (Brachyura: Potamoidea). In: Crustacean Issues: Decapod Crustacean Phylogenetics. Martin JW, Crandall KA, Felder D. eds. Boca Raton, Florida: Taylor & Francis/CRC Press. p. 509–531.
- LIU Q, WEI F, LIU W, YANG S, ZHANG X. 2008. Paragonimiasis: an important food-borne zoonosis in China. Trends Parasitol 24(7):318–323.
- MARTENS E VON. 1868. Ueber einige neue crustaceen. Monatsber Akad Wiss Berlin 1868:608–615.
- MAN JG DE. 1902. Die von Herrn Professor Kükenthal in Indischen Archipel gesammelten Dekapoden und Stomatopoden. In W. Kükenthal (ed.) Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. Abh Senckenb Naturf Ges 25:467–929, pls. 19–27.
- MILNE-EDWARDS A. 1869. Révision du genre *Telphuse* et description de quelques espèces nouvelles, faisant partie de la collection du Muséum. Nouv Arch Mus Hist Nat Paris 5:161–191, pls. 8–11.
- MILNE EDWARDS H. 1853. Mémoire sur la famille des ocyподiens. Ann Sci Nat Zool (3)20:163–228, pls. 6–11.

- NG PKL. 1988. The Freshwater Crabs of Peninsular Malaysia and Singapore. Department of Zoology, National University of Singapore & Shing Lee Publishers, Singapore. p. i–viii, 4 color plates, 1–156.
- NG PKL. 1991. On two species of *Archipelothelphusa* Bott, 1969 (Crustacea: Decapoda: Brachyura: Sundathelphusidae) from Luzon, Philippines. *Zool Meded* 65:13–24.
- NG PKL, GUINOT D, DAVIE PJF. 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bull Zool, Suppl No 17*:1–286.
- NG PKL, RODRÍGUEZ G. 1995. Freshwater crabs as poor zoogeographical indicators: a critique of Bănărescu (1990). *Crustaceana* 68(8):636–645.
- NG, PKL, SKET B. 1996. The freshwater crab fauna (Crustacea: Decapoda: Brachyura) of the Philippines. IV. On the collection of Parathelphusidae from Bohol. *Proc Biol Soc Washington* 109:695–706.
- NG PKL, TAKEDA M. 1992. The freshwater crab fauna (Crustacea: Brachyura) of the Philippines. I. The family Potamidae Ortmann, 1896. *Bull Nation Sci Mus Ser A Zool* 18(4):149–166.
- NG PKL, TAKEDA M. 1993a. The freshwater crab fauna (Crustacea: Brachyura) of the Philippines. II. The genus *Parathelphusa* H. Milne Edwards, 1853 (family Parathelphusidae). *Bull Nation Sci Mus Ser A Zool* 19(1):1–19.
- NG PKL, TAKEDA M. 1993b. The freshwater crab fauna (Crustacea: Brachyura) of the Philippines. III. The identity of *Telphusa cumingii* Miers, 1884, and its placement in the genus *Ovitamon* Ng et Takeda, 1992 (family Potamidae). *Bull Nation Sci Mus Ser A Zool* 19(3):111–116.
- RATHBUN MJ. 1904. Les crabes d'eau douce. *Nouv Arch Mus Hist Nat Paris* (4)6:225–312, pls. 9–18.
- SCHUBART CD, NG PKL. 2008. A new molluscivore crab from Lake Poso confirms multiple colonization of ancient lakes in Sulawesi by freshwater crabs (Decapoda: Brachyura). *Zool J Linn Soc* 154(2):211–221.
- SHIH HT, YEO DCJ, NG PKL. 2009. The collision of the Indian plate with Asia: molecular evidence for its impact on the phylogeny of freshwater crabs (Brachyura: Potamidae). *J Biogeogr* 36(4):703–719.
- TAKEDA M. 1983. A new cavernicolous crab from Bohol, the Philippines. *Bull Nation Sci Mus Tokyo Ser A* 9:169–173.
- TAKEDA M, NG PKL. 2001. The freshwater crab fauna (Crustacea, Brachyura) of the Philippines: VI. A new cavernicolous crab from Mindanao. *Zool Sci* 18:1123–1127.
- TAN SH, NG PKL. 2004. The freshwater crab fauna (Crustacea: Brachyura) of the Philippines. V. On a new genus and species of potamid from Palawan Island, Philippines. *Hydrobiologia* 379(1–3):93–96.
- YEO DCJ, SHIH HT, MEIER R, NG PKL. 2007. Phylogeny and biogeography of the freshwater crab genus *Johora* (Crustacea: Brachyura: Potamidae) from the Malay Peninsula, and the origins of its insular fauna. *Zool Scripta* 36(3):255–269.