RAFFLES BULLETIN OF ZOOLOGY **63**: 448–453
Date of publication: 9 October 2015
http://zoobank.org/urn:lsid:zoobank.org:pub:A7DA557E-5E0D-4629-B715-6BE88124DCB7

Sundathelphusa spelaeophila, a new species of cavernicolous crab from Samar, Philippines (Decapoda: Brachyura: Gecarcinucidae)

G. Stasolla*, A. Abbarchi and G. Innocenti

Abstract. A new species of *Sundathelphusa* Bott, 1969, from Samar Island in the Philippines, is described. The new species, collected from two caves, differs from the other species collected in Samar principally for the lack of troglobitic morphological features and for the different shapes of the carapace and G1.

Key words. *Sundathelphusa*, Philippines, cave fauna, freshwater crab

INTRODUCTION

A speleological expedition to the island of Samar, in the central Philippines, was conducted in 1991 by a team whose members came from the Italian National Council of Research, together with the Natural History Museum of Florence University, Verona Natural History Museum, and the French speleological club "Aven Club Valettois". The main goal of the expedition was the mapping and description of Samar caves, following the first mission conducted in 1987 (Rossi et al., 1987), however invertebrates were noted and in some instances collected. In 1993, the French club visited the island again and collected additional material.

The expeditions were planned in collaboration with relevant Philippine authorities such as the Department of Environment and Natural Resources (Piccini & Rossi, 1994) and resulted in numerous decapod crustaceans being collected from the caves there (Cai & Anker, 2004; Ng & Ng, 2009; Stasolla & Innocenti, 2014).

The Philippines host a great number of freshwater crabs belonging to the genus *Sundathelphusa*, from rivers, streams and from caves. Out of the 36 known species, 28 are present in the Philippine archipelago (see Ng et al., 2008; Husana et al., 2009; Mendoza & Naruse, 2010; Ng, 2010; Husana et al., 2014; Husana et al., 2015).

This paper reports the description of a new species of *Sundathelphusa*, collected from Samar province.

MATERIAL AND METHODS

Samar Province is one of the three provinces on Samar Island (the others being Eastern Samar and Northern Samar), which is located in the eastern Visayas region in the central Philippines.

The specimens were hand-collected in the municipality of San Jorge, Barangay Matalud, from Can Gortio cave (also known as Cangortillo) (11°59'00" N, 124°53'00" E) and in a cave, named by the speleologists "SNAZ 1", as it is located near the local National School of Agriculture and Zootechnics (12°00'00" N, 124°54'00" E).

Can Gortio is a complex cave with several levels, the lower partially invaded by still water, while the higher is dry and well concretionated. The entrance gallery floor is softly covered by guano, and the cave develops for nearly 300 m. The air temperature inside the cave is around 20°C. "SNAZ 1" is a well concretionated cave that develops for nearly 200 m, with the air temperature inside the cave of 23–25°C. In both cases, the crabs were collected not far from the cave entrance (A. Gobetti, pers. comm.).

Material examined are deposited in the Zoological Museum of Florence University (MZUF) and in the National Museum of the Philippines, Manila (NMCR), while the comparative material was borrowed from the Museum für Naturkunde, Berlin (ZMB). The systematic order follows Cumberlidge & Ng (2009).

G1 and G2 refer to the male first and second gonopods, respectively. Articles of the ambulatory legs are referred to as follows: 3M, 3P and 3D, for the merus, propodus and dactylus of the third ambulatory leg, respectively.

Sezione di Zoologia "La Specola", Museo di Storia Naturale dell'Università di Firenze, via Romana 17, I-50125 Firenze, Italy; Email: stasollag@gmail.com (*corresponding author); andreabbarchi@yahoo.it (AA); gianna.innocenti@unifi.it (GI)

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

TAXONOMY

Gecarcinucidae Rathbun, 1904

***Sundathelphusa spelaeophila* n. sp.**
(Figs. 1A–C, 2A–E)

Material examined. Holotype: male (15.9 × 14.1 mm) (MZUF 3920); Philippines, Samar province, San Jorge municipality, Barangay Matalud, Can Gortio Cave, coll. C. Ferron, 19 March 1991. Paratypes: 1 male (11.7 × 10.6 mm) (MZUF 4273) Samar province, San Jorge municipality, Barangay Matalud, Can Gortio Cave, coll. C. Ferron, 19 March 1991; 1 male (15.4 × 12.9 mm) (NMCR 40102) Samar province, San Jorge municipality, Barangay Matalud, Can Gortio Cave, coll. P. Marcel, 20 March 1991. Other material: 1 male (16.8 × 14.7 mm) (MZUF 3927), Samar province, San Jorge municipality, Barangay Matalud, "SNAZ 1" Cave (1 km from the local National School of Agriculture and Zootechnics), coll. C. Ferron, 26 May 1993.

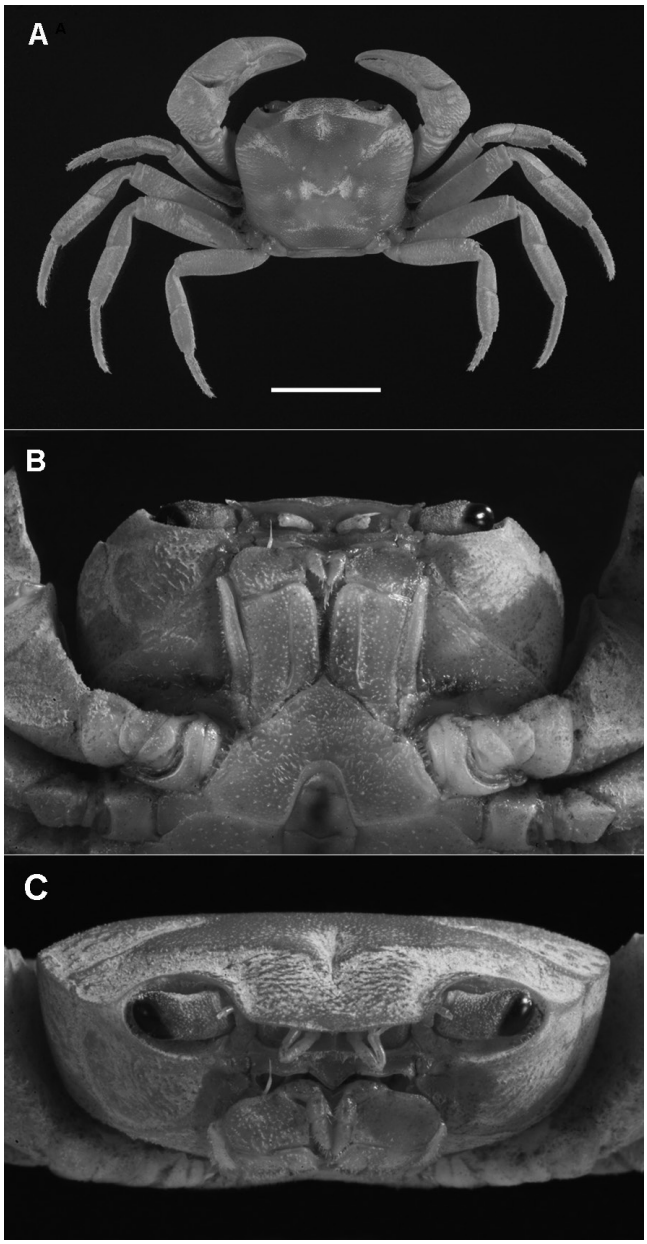

Fig. 1. *Sundathelphusa spelaeophila* n. sp., holotype, male (15.9 × 14.1 mm) (MZUF 3920). A, dorsal view (Scale bar = 10 mm); B, ventral view; C, anterior view.

Comparative material. The specimens were compared with the descriptions of *Sundathelphusa waray* Husana, Naruse & Kase, 2009 and *S. lobo* Husana, Naruse & Kase, 2009, as well as with the direct observation of the specimens of *S. philippina* (von Martens, 1868) deposited in the Museum für Naturkunde, Berlin (ZMB), a *Sundathelphusa* species collected in Samar Island. These last specimens are presently catalogued as *S. grapsoides*, possibly following Balss (1937) (O. Coleman pers. comm.). *Sundathelphusa philippina* were collected in Samar in the following localities: Calbiga river and Loquilocum (= Ulut) river (Bott, 1970). As the ZMB specimens were presently identified as *S. grapsoides* (H. Milne Edwards, 1853), the original descriptions of this latter species were also carefully compared, following A. Milne Edwards (1869) and Rathbun (1904).

Description. Carapace (Fig. 1A) subquadrate, broader than long (width-to-length ratio ca. 1.1) quite flat; dorsal surface with distinct rugosity in frontal, hepatic regions; branchial region rugose, striated; regions poorly defined, cervical, gastric grooves shallow; epigastric cristae low but distinct, continuous with postorbital cristae; postorbital cristae low but distinct, gently curving toward anterior, converging toward and connecting epibranchial teeth; frontal margin slightly convex; anterolateral margins slightly convex, granular; external orbital angle not very broad; single epibranchial tooth acutely triangular, developed, anteriorly directed, separated from exorbital tooth by V-shaped notch; posterolateral margins slightly concave before converging towards posterior carapace margin; supraorbital margin smooth, parallel with frontal margin; infraorbital margins granular, complete, congruent with anterolateral margin; suborbital region rugose, extending to sub-branchial region. Antennules slender. Eyes well-developed, cornea pigmented.

Epistome narrow (Fig. 1C), posterior margin with one lateral cleft, median part sub-triangular, margin smooth. Third maxilliped (Figs. 1B, 2A) with slender, sinuous exopod, narrower than ischium, flagellum well developed; merus broad, antero-external margin rounded.

Male thoracic sternum (Fig. 1B) broad and generally smooth, with scattered granularities, lateral margins setose; sternites 1–4 fused, with traces of sutures between 3–4 sternites; sterno-abdominal cavity deep; press button on sternite 5, near to the suture between sternites 4 and 5.

Male chelae (Fig. 1A) distinctly unequal, relatively long, surface punctuated, with scattered rugosities, fingers shorter than palm; distal region of fingers with pointed, chitinous tooth; margin of merus irregularly granular. Carpus rounded, rugose, inner distal angle with well-developed tooth and with 1 or 2 smaller teeth in inner margin.

Ambulatory legs (Fig. 1A) sub-triangular in cross section; second, third ambulatory legs longest; anterior dorsal margin

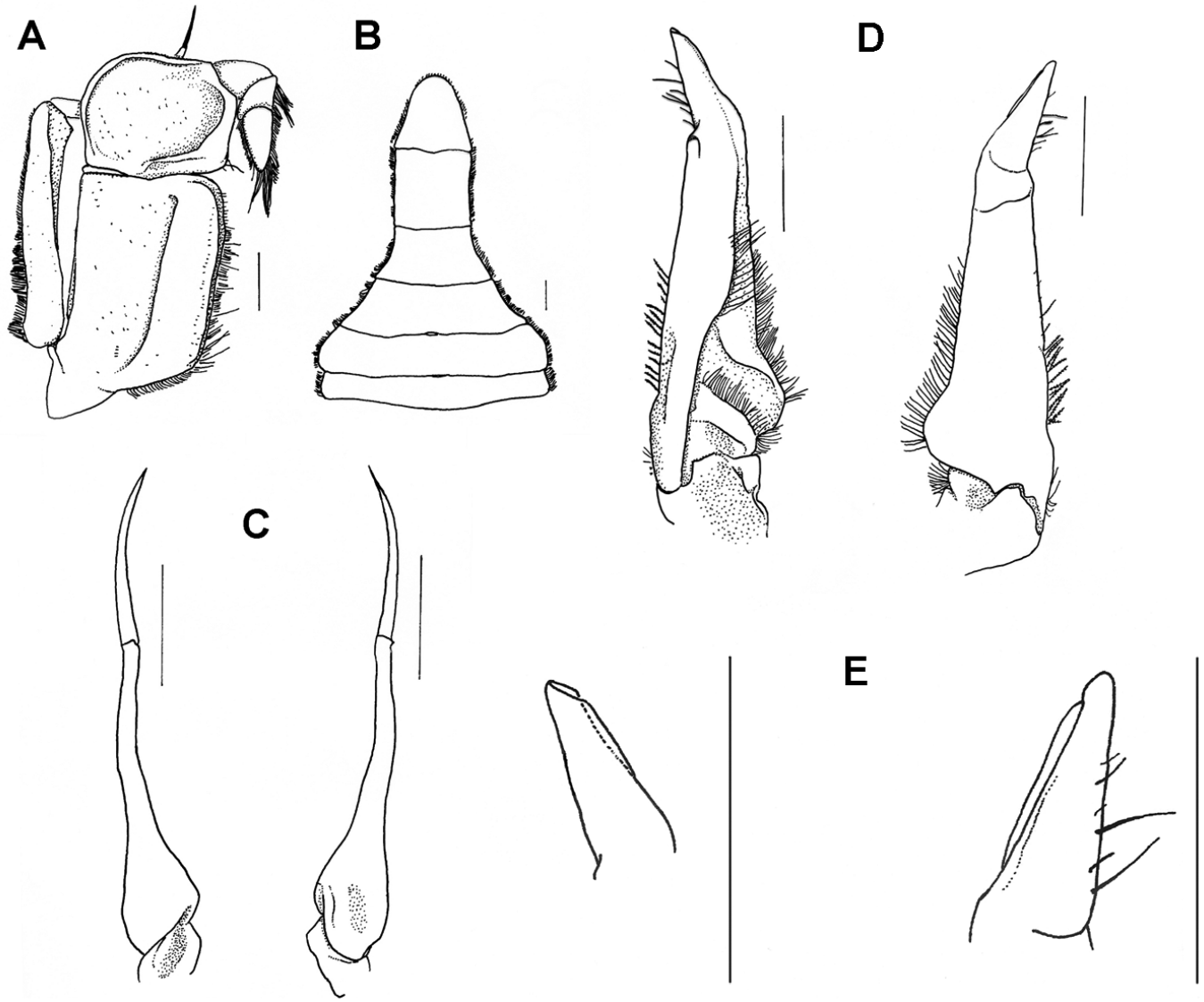

Fig. 2. *Sundathelphusa spelaeophila* n. sp., holotype, male (15.9 × 14.1 mm) (MZUF 3920): A, right third maxilliped; B, abdomen; C, right G2, respectively ventral and dorsal view; D, right G1, respectively ventral and dorsal view; E, tip of right G1, respectively ventral and dorsal view. Scale bars = 1.0 mm.

of merus (M) smooth; propodi (P) with spines, all dactyli (D) bearing spines; 3M long (length to width ratio 3.3), 3P long (length to width ratio 2.3), 3D long (length to width ratio 6.4); 4M short (length to width ratio 2.9), 4P long (length to width ratio 2), 4D relatively short (length to width ratio 3.8).

Male abdomen (Fig. 2B) T-shaped; lateral margins covered with short setae; Telson slightly shorter than somite 6, narrow, with lateral margins converging to rounded distal margin. G1 (Fig. 2D, E) relatively stout, basal part swollen, terminally curved, subterminal segment straight with outer margin distinctly concave; proximal part evenly cylindrical, terminal part occupying about 0.2 times total length, nearly straight, conical, with fairly fluted tip. G2 (Fig. 2C) relatively long, slightly longer than G1, distal segment long, sinuous, about 0.5 times length of basal segment.

No females were collected, thus it is not possible to give any detail of female morphology.

Etymology. From the composition of *spelaeo* (Latin: spēlaeum, i) cavern and *phila* (Latin: -philus, -phila) lover, as it has been collected in a cave.

Remarks. At present, only three species of *Sundathelphusa* are known for Samar: *S. philippina*, *S. lobo* and *S. waray*.

However *S. spelaeophila* clearly differs from *S. philippina* in: (a) the subquadrate shape of the carapace (versus subexagonal, inflated and broader in *S. philippina*); (b) poorly defined regions in the carapace (versus well defined regions in *S. philippina*); and (c) G1 subterminal segment almost straight with outer margin distinctly concave (versus curved with outer margin convex in *S. philippina*).

The other two species, described from caves, *S. waray* and *S. lobo*, are both regarded as obligate cave inhabitants by Husana et al. (2009). *Sundathelphusa spelaeophila* sp. nov. can be separated from these two species by the absence

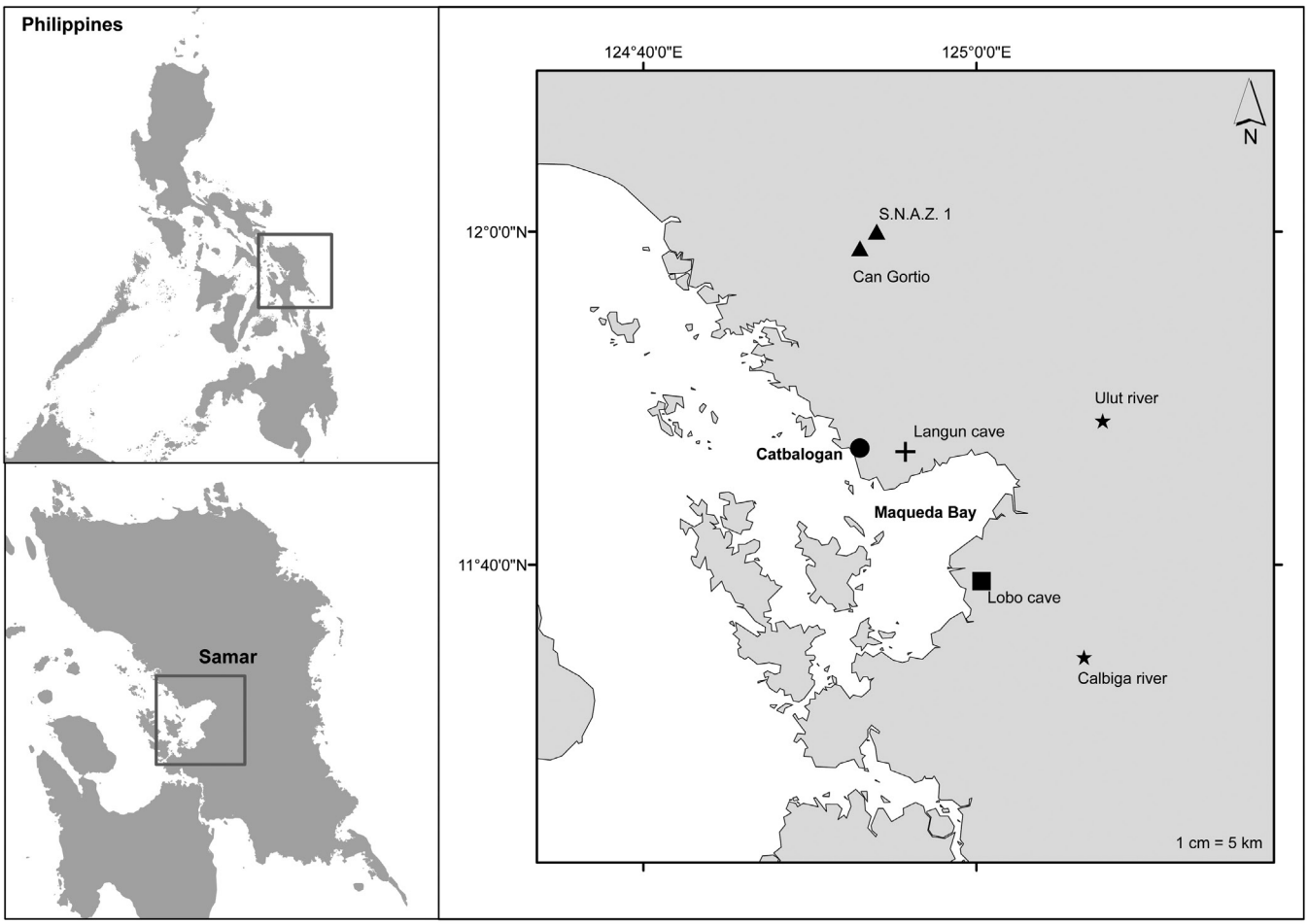

Fig. 3. Map of the localities of the four *Sundathelphusa* species collected in western Samar: ▲ *S. spelaeophila* n. sp.; ★ *S. philippina*; + *S. waray* (Langun cave); ■ *S. lobo* (Lobo cave).

of evident troglobitic traits (e.g., reduced cornea pigment; absence of body pigment; length of legs and spines, see Husana et al., 2009) clearly present in *S. waray* and *S. lobo.*

Sundathelphusa spelaeophila sp. nov. can apparently resemble *S. grapsoides* (H Milne Edwards, 1853). Even if this species is reported from Luzon (Pampanga and Bulacan; Mendoza & Naruse, 2010), an island quite distant from Samar (Ng & Sket, 1996; Ng, 2010), it also shows remarkable morphological differences. *Sundathelphusa spelaeophila* differs from *S. grapsoides* descriptions reported in A. Milne Edwards (1869) and Rathbun (1904) by: (a) the subquadrate shape of the carapace (versus rounded shape of the carapace in *S. grapsoides*); (b) the anterior side of the merus of the ambulatory legs smooth (versus numerous teeth in the anterior side of the merus of the ambulatory legs in *S. grapsoides*); and (c) poorly defined regions of the carapace (versus well defined regions of the carapace in *S. grapsoides*).

DISCUSSION

The diagnostic characters of *Sundathelphusa spelaeophila* sp. nov. clearly show differences from the other *Sundathelphusa* species described from Samar: *S. philippina* (von Martens, 1868), *S. waray* and *S. lobo* (Husana et al., 2009) and from *S. grapsoides*, a morphologically similar species, described from Luzon (Rathbun, 1904). Even if the new species does not show any troglobitic features, such as reduced eyes or loss in eye pigmentation (as in *S. waray* and *S. lobo*, strictly troglobitic), it was collected only at the entrance of the caves, suggesting that it is perhaps a facultative cave resident or at least adapted to the epigean–hypogean transitional ecosystem (as defined by Prous et al., 2004). These findings highlight the high ecological versatilities of this genus, particularly in the Philippine islands (Klaus et al., 2013; Husana et al., 2014). Most species have very particular habitat requirements and have very localised distributions (Ng & Rodriguez, 1995; Yeo et al., 2008; Mendoza & Naruse, 2010).

The Philippine Islands comprise ca. 7,000 islands ranging up to 100,000 km^2 of land area. With the exception of the Palawan group, all the other islands have an oceanic origin, having emerged from a complex and well-documented set of tectonic events. During the many Pleistocene 'ice ages', periods of lowered sea level brought some current islands to coalesce into larger ones, but others remained separated, with channels ranging from 1 to 25 km (Hall, 1996, 1998, 2002). These geological events could have contributed to the diversification of *Sundathelphusa* genus (Husana et al., 2010; Husana & Yamamuro, 2013), with its 37 species, 29 of which described only from the Philippines (Ng et al., 2008; Mendoza & Naruse, 2010; Ng, 2010; Husana et al., 2014; Peter K.L. Ng, pers. comm.; Husana et al., 2015; present paper).

For the archipelagic nature of the Philippines and their peculiar biogeography and ecology, the taxonomy of Philippine freshwater crabs, particularly that of the genus *Sundathelphusa* is quite complicated. Moreover, mismatch and the lack of accurate information from the material collected in historical times (H. Milne Edwards, 1853, von Martens, 1868; Bürger, 1894) increase the difficulties in understanding the evolution of this group (Husana et al., 2015). The discovery of more new species can be expected if one considers the number of unexplored habitats (Chia & Ng, 2006) and the cryptic diversity in certain habitats (e.g., caves) due to the selection of similar specialised morphologies or adaptations (Klaus et al., 2013). Our considerations agree with Husana et al., (2015) that draw attention to the need of an extensive field research in the Philippines archipelago, possibly joined with genetic analyses, in order to give a better comprehension of the biogeography and phylogeny of *Sundathelphusa*.

ACKNOWLEDGEMENTS

We wish to thank Saulo Bambi (Natural History Museum of Florence University) for the photographs. We are grateful to Paul Marcel and Andrea Gobetti for their help in locating data on the caves. Thanks are due to Oliver Coleman (Naturkunde Museum, Berlin) for the loan of the von Martens holotypes. Anna Kraczyna kindly revised the text.

LITERATURE CITED

Balss H (1937) Potamoniden (Dekapoda Brachyura) der Philippinen und des Malayischen Archipels. Internationale Revue der gesamten Hydrobiologie und Hydrographie, 34: 143–197.

Bott R (1969) Flüsskrabben aus Asien und ihre Klassifikation (Crustacea, Decapoda). Senckenbergiana Biologica, 50: 359–366.

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

Bürger O (1894) Beitrage zur Kentniss der gattung *Telphusa*. Zoologische Jahrbüche Systematik, 8: 1–7.

Cai Y & Anker A (2004) On a collection of freshwater shrimps (Crustacea Decapoda Caridea) from the Philippines, with descriptions of five new species. Tropical Zoology, 17: 233–266.

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 Bulletin of Zoology, 54(2): 381–428.

Cumberlidge N & Ng PKL (2009) Systematics, evolution and biogeography of freshwater crabs. In: Martin JW, Crandall KA & Felder D (eds.). Decapod Crustacean Phylogenetics, Crustacean Issues, Vol. 18. CRC Press, Leiden. Pp. 491–504.

Hall R (1996) Reconstructing Cenozoic SE Asia. In: Hall R & Blundell D (eds.) Tectonic Evolution in Southeast Asia. Geological Society of London, London. Pp. 153–184.

Hall R (1998) The plate tectonics of Cenozoic SE Asia and the distribution of land and sea. In: Hall R & Holloway JD (eds.) Biogeography and Geological Evolution of SE Asia. Backhuys, Leiden. Pp. 99–132.

Hall R (2002) Cenozoic geological and plate tectonic evolution of SE Asia and the SW Pacific: computer-based reconstructions, model and animations. Journal of Asian Earth Sciences, 20: 353–431.

Husana DEM & Yamamuro M (2013) Groundwater quality in karst regions of the Philippines. Limnology, 14: 293–299.

Husana DEM, Naruse T & Kase T (2009) Two new cavernicolous species of the genus *Sundathelphusa* from western Samar, Philippines (Decapoda: Brachyura: Parathelphusidae). Journal of Crustacean Biology, 29(3): 419–427.

Husana DEM, Yamamuro M & Ng PKL (2014) Two new species of freshwater crabs of the genus *Sundathelphusa* Bott, 1969 (Decapoda: Brachyura: Gecarcinucidae) from caves in Luzon, Philippines. Zootaxa, 3815(4): 565–574.

Husana DEM, Kase T & Mendoza JCE (2015) Two new species of the freshwater crab genus *Sundathelphusa* Bott, 1969 (Crustacea: Brachyura: Gecarcinucidae) from Negros Island, Philippines. Raffles Bulletin of Zoology, 63: 226–236.

Husana DEM, Haga T, Kase T & Yamamuro M (2010) Phylogeography, cave invasion and diversification of the Philippine *Sundathelphusa* (Decapoda: Brachyura: Parathelphusidae) American Geophysical Union, Fall Meeting 2010, abstract #B33F–0450.

Klaus S, Mendoza JCE, Liew JH, Plath M, Meier R & Yeo DCJ (2013) Rapid evolution of troglomorphic characters suggests selection rather than neutral mutation as a driver of eye reduction in cave crabs. Biology Letters, 9: 2012.1098.

Martens E von (1868) Über einige neue Crustaceen. Monatsberichte der Königlichen Preussischen Akademien der Wissenschaften zu Berlin, 1868: 608–615.

Mendoza JCE & Naruse T (2010) A new species of riverine crab of the genus *Sundathelphusa* Bott, 1969 (Crustacea: Brachyura: Gecarcinucidae) from Northeastern Luzon, Philippines. Philippine Journal of Science, 139(1): 61–70.

Milne-Edwards A (1869) Révision du genre *Thelphuse* et description de quelques espèces nouvelles faisant partie de la collection du Muséum. Nouvelles Archives du Muséum d'Histoire naturelle, Paris, 5: 161–191.

Milne Edwards H (1853) Mémoire sur la famille des Ocypodides. Annales des Sciences Naturelles, (3)20: 163–228.

Ng NK & Ng PKL (2009) *Orcovita holthuisi*, a new species of anchialine crab (Brachyura, Varunidae) from Coron Island, Palawan, Philippines. Crustaceana, 82(9): 1097–1108.

Ng PKL (2010) On the identity of *Para-Bary-Thelphusa grapsoides longipes* Balss, 1937, with description of a new species from the Philippines (Brachyura, Gecarcinucidae). In: Fransen CHJM, De Grave S & Ng PKL (eds.) Studies on Malacostraca: Lipke Bijdeley Holthuis Memorial Volume, Crustaceana Monographs, Vol. 14. Brill, Netherlands. Pp. 561–571.

Ng PKL & Rodríguez G (1995) Freshwater crabs as poor zoogeographical indicators: a critique of Banarescu (1990). Crustaceana, 68(5): 636–645.

Ng PKL & Sket B (1996) The freshwater crab fauna (Crustacea: Decapoda: Brachyura) of the Philippines. IV. On a collection of Parathelphusidae from Bohol. Proceedings of the Biological Society of Washington, 109(4): 695–706.

Ng PKL, Guinot D & Davie PJF (2008) Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. Raffles Bulletin of Zoology, Supplement 17: 1–286.

Piccini L & Rossi G (1994) Le esplorazioni speleologiche italiane nell'isola di Palawan, Filippine. Speleologia, 31: 5–61.

Prous X, Ferreira RL & Martins RP (2004) Ecotone delimitation: Epigean–hypogean transition in cave ecosystems. Austral Ecology, 29(4): 374–382.

Rathbun MJ (1904) Les crabes d'eau douce (Potamonidae). Nouvelles Archives du Muséum d'Histoire naturelle, Paris, 4e série, 6: 225–312.

Rossi G, Dal Cin F, De Vivo A & Mouret C (1987) SAMAR 1987 Prima speleologica nel più grande carso delle Filippine. Speleologia, 17: 4–8.

Stasolla G & Innocenti G (2014) A new species of cavernicolous crab from Coron Island, Palawan, the Philippines (Decapoda: Brachyura: Varunidae). Raffles Bulletin of Zoology, 62: 591–599.

Yeo DCJ, Ng PKL, Cumberlidge N, Magalhães C, Daniels SR, & Campos MR (2008) Global diversity of crabs (Crustacea: Decapoda: Brachyura) in freshwater. Hydrobiologia, 595: 275–286.