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A new genus and species of anchialine Hymenosomatidae (Crustacea, Decapoda, Brachyura) from Samar, Philippines

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Abstract

A new genus and species of brachyuran crab, *Samarplax principe* (family Hymenosomatidae) is described from an anchialine cave in Samar Island, Philippines. This cavernicolous species lacks rostrum and has degenerated eyes, possesses two small spines at the lateral margin of the carapace, has a proportionally shorter projected merus of the third maxilliped, an almost flat epistome and brush-like setae instead of teeth along the cutting edges of the chelae. The complete loss of visual organs and pigmentation, the long but slender ambulatory legs and large egg size suggest a completely hypogeal lifestyle for this species. This is the first species of Hymenosomatidae recorded from an anchialine cave in the Philippines exhibiting true troglomorphic adaptations.

Key words: *Samarplax principe* **new genus, new species**, taxonomy, Philippines, Samar, Principe Cave, anchialine cave, troglobite

Introduction

The Philippine archipelago consists of over 7,000 islands, most of which are composed of Paleozoic to Tertiary limestone and fringed with Pleistocene uplifted coral reefs. Many limestone caves are known from the region, particularly a number of anchialine caves, (Fig. 1) i.e., those with no surface connection with the sea and containing saline or brackish water that fluctuates with the tides (cf. Holthuis 1973; Stock *et al*. 1986; Sket 1996).

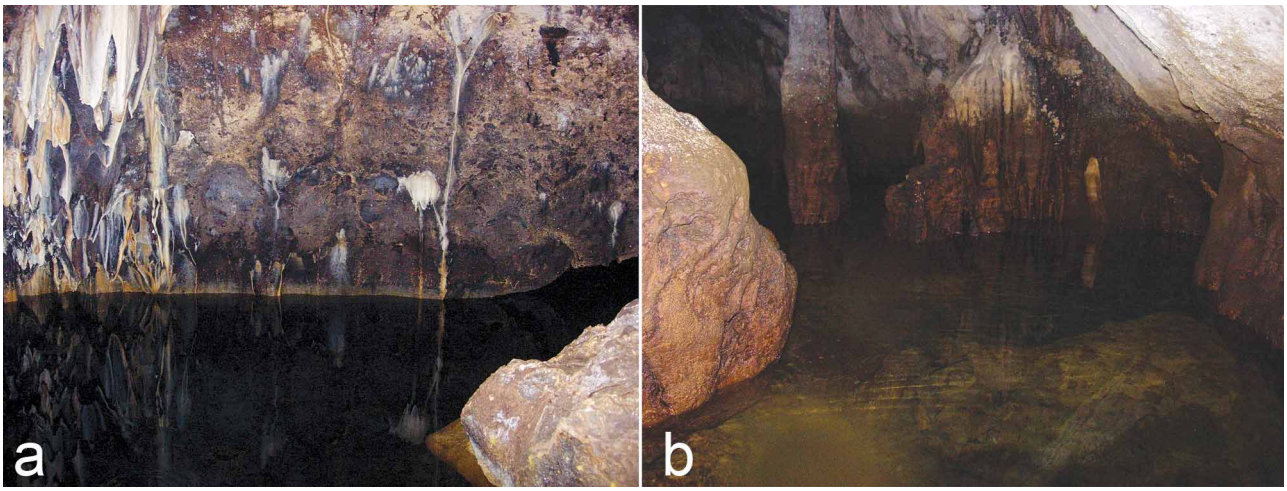

FIGURE 1. Type locality of *Samarplax principe* **new genus**, **new species**, Principe Cave, Guiuan, Eastern Samar, Philippines: a, discolored rock surface due to guano deposits; b, high tide marks on the walls..

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Samar Island is located on the east-central Philippines facing the western Pacific Ocean (Fig. 2). Most of the caves in this island have not been explored. Principe Cave is one of the least disturbed anchialine caves where this new genus and species of Hymenosomatidae was discovered (Fig. 1). Although some tourism development in adjacent beaches has occurred, this cave has not experienced severe anthropogenic disturbance as yet, and can be considered to be relatively pristine.

During the past decades, numerous cavernicolous animals have been described from caves in the Philippines (e.g., Fosshagen & Iliffe 1989; Ng *et al*. 1996; Ng & Sket 1996; Kano & Kase 2004; Ng & Guinot 2001; Takeda & Ng 2001; Ng 2002; Sawicki *et al.* 2005; Husana *et al*. 2009, 2010). Some belong to new higher taxa (e.g., a new copepod family Boholiniidae Fosshagen & Iliffe, 1989), suggesting that caves in this archipelago probably contain a highly diverse and interesting assemblage of taxa.

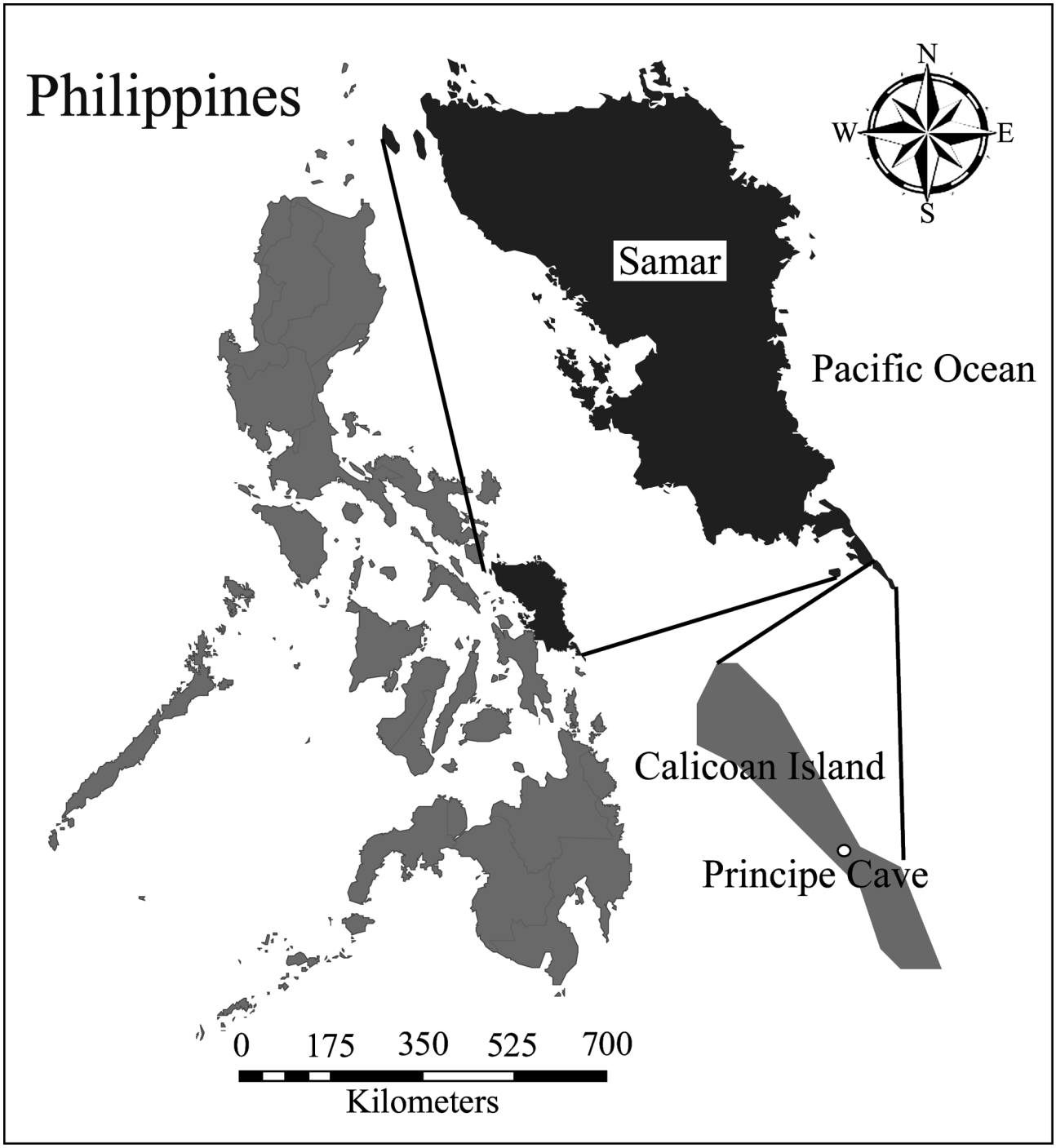

FIGURE 2. Map of the Philippines showing the type locality of the species.

This paper describes a new genus and new species belonging to the family Hymenosomatidae. This family currently consists of 111 species in 19 genera that inhabit freshwater to marine environments, and includes three troglobitic freshwater species, all from Indonesia (Lucas 1980; Ng 1991; Ng *et al*. 2008; Chuang & Ng 1994; Ng & Chuang 1996; Naruse *et al.* 2008). The new species described here is the first species of hymenosomatid formally recorded from an anchialine cave and exhibiting true troglomorphic adaptations (see Husana *et al*. 2009). Three other cavernicolous hymenosomatids are known, all from Indonesia - *Cancrocaeca xenomorpha* Ng, 1991, *Guaplax denticulata* Naruse, Ng & Guinot, 2008, and *Sulaplax ensifer* Naruse, Ng & Guinot, 2008. Of these three, the type localities of *Guaplax denticulata* and *Sulaplax ensifer* suggest that they may also be anchialine taxa (see Naruse *et al.* 2008) but this cannot be determined from the original paper.

Material and methods

Eight specimens of this new genus and species were hand-collected while sampling from submerged rock surface or sunken wood inside the cave with a water depth of up to 1 meter. The cave is completely dark and is situated approximately 200 m from the nearest shoreline. Salinity ranged from 1.5 to 3.5 ‰ during the survey in November 2006.

Measurements provided for the carapace length and width (in mm), respectively. Terminologies as well as abbreviations follow those by Ng & Chuang (1996). The G1 refers to the male first pleopod and P2–5 to the first to fourth ambulatory legs, respectively. Specimens are deposited at the National Museum of the Philippines, Manila, Philippines (NMCR); National Museum of Nature and Science, Tokyo (NSMT); and Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore (ZRC).

Systematic account

Hymenosomatidae Macleay, 1838

Samarplax new genus

Type species. *Samarplax principe* **new species**, by present designation.

Diagnosis. Carapace sub-polygonal, as long as wide to slightly longer than wide; dorsal surface uneven due to regions, surrounded by continuous rim, regions slightly inflated, separated by deep grooves. Rostrum absent; frontal margin gently bilobed. Posterolateral margin entire. Antennular fossa very shallow. Epistome almost flat, not visible from dorsal view. Eyes strongly reduced, visible as vestigial structure only under scanning electron microscopy (SEM) (Fig. 7); cornea absent. Male sterno-abdominal cavity relatively narrow; abdominal locking button indistinct. Male abdomen-pleotelson with somites 3–5 fused; somites 1, 2 with rounded lobes on disto-lateral angle on both sides; fused somites narrowed distally; pleotelson distinctly narrower than half width of abdomen; tip of pleotelson reaching to mid-point of abdominal somite 4. Female abdomen dome-shaped, with undivided plate formed by fusion of somite 2 to pleotelson, somite 2 and pleotelson marked by shallow suture on outer side. G1 slender, slightly sinuous, twisted at base, tapering at tip, curving inwards, distal portion with long stiff setae. G2 short, about half length of G1.

Etymology. The genus name *Samarplax* is derived from the locality, Samar province and *plax* for “plate”, the suffix of the cavernicolous genera, *Sulaplax* and *Guaplax*, alluding to their superficial resemblance. Gender feminine.

Remarks. *Samarplax* **new genus**, differs from other epigean genera of Hymenosomatidae in having several troglobitic features such as the extreme reduction of eyes, the absence of pigment and the disproportionately long legs. Otherwise, it resembles the epigean genus *Neorhynchoplax* Sakai, 1938, in having well defined dorsal surface regions and the eggs being held in the brood cavity (see Ng & Chuang 1996; Naruse *et al.* 2005). However, in addition to the above-mentioned troglobitic features, *Samarplax* **new genus**, also differs from *Neorhynchoplax* in having no rostrum, the lateral walls of the carapace are not laterally expanded and the ambulatory dactyli are unarmed (see Naruse *et al.* 2008: Table 1). Externally, the new genus most closely resembles *Sulaplax* Naruse, Ng & Guinot, 2008, and *Guaplax* Naruse, Ng & Guinot, 2008, from Indonesia in possessing unpigmented eyes that are fused to

the orbit, absence of a subterminal tooth on the ambulatory dactylus; having the dorsal carapace regions well defined, eggs contained in a brood cavity, a four-segmented pleotelson, and a G1 which is straight, tapering and having simple tip. The form of the third maxilliped is closer to that of *Guaplax* but overall, *Samarplax* **new genus**, appears to be more similar to *Sulaplax*, sharing characters such as the basal antennal article not been positioned directly below the base of the eye stalk but offset to the outer edge (versus directly below in *Guaplax*) and in having very long chelipeds, with the merus especially elongate.

Samarplax **new genus**, nevertheless differs from *Sulaplax* in the following aspects: the inner distal edge of the ischium of the third maxilliped is slightly projected outwards and not as long as that observed on *Sulaplax* (Fig. 4e, versus Naruse *et al.* 2008: fig. 4c); the epistome is almost flat (Fig. 7) (versus relatively long with produced posterior margin in *Sulaplax*, Naruse *et al.* 2008: fig. 4b); and the fused abdominal piece consisting of somites 3-pleotelson is prominently triangular in shape with the lateral margins of somite 4 converging towards the telson (Fig. 5a) (versus with fused piece not subtriangular, with the lateral margins of somite 4 subparallel in *Sulaplax*, Naruse *et al.* 2008: fig. 5d). In addition, *Samarplax* **new genus**, has a sub-polygonal carapace the length and width subequal (versus wider than long, Naruse *et al.* 2008: figs. 3, 4a), a simple straight, tapering distal part of the G1 that is gently curved towards the midline (versus more prominently twisted, Naruse *et al.* 2008: fig. 5e, f), and a relatively long chela armed with brush-like setae along the inner margin of its fingers instead of cutting teeth (Fig. 7) (versus lined with low teeth and without brush-like setae, Naruse *et al.* 2008: fig. 5b, c). This chela structure is not known in other hymenosomatids so far. The G2 of *Samarplax* **new genus**, also differs from that of *Sulaplax* in that it is only about half the G1 length with a stout distal tip (versus about three-quarters of the G1 length with a slender and tapering tip in *Sulaplax*, present observation).

Overall, the absence of rostrum and eyes, well-defined dorsal surface of the carapace with two small spines or sharp teeth on its lateral margin, proportionally shorter projected merus of the third maxilliped, an almost flat epistome, long chelipeds without cutting teeth but lined instead with brush-like setae, a four-segmented pleotelson, relatively simple G1 and eggs that are held in the brood cavity are diagnostic characters of this new genus.

Samarplax principe **new species**
(Figs. 3–8)

Material examined. Holotype. Male, 3.52 x 3.69 mm (NMCR-39033), Principe Cave, Guiuan, Eastern Samar, Philippines, 10˚58.637´N, 125˚48.373´E coll. E. Husana, 2 Nov. 2006.

Paratypes. 3 males [3.64 x 3.63 mm (ZRC 2011.0880; ex. NSMT-Cr 2007-0003); 4.09 x 3.98 mm, used for SEM (NSMT-Cr 2007-00040); 3.22 x 3.25mm (NSMT-Cr 2007-0005)] same data as holotype. 4 females [5.35 x 5.68 mm, ovigerous (ZRC 2011.0879; ex. NSMT-Cr 2007-0002); 4.81 x 4.78 mm, ovigerous (NSMT-Cr 2007-006); 4.08 x 4.06 mm, immature (NSMT-Cr 2007-0007); 4.72 x 4.69 mm, used for SEM (NSMT-Cr 2007-0008)], same data as holotype.

Description. Carapace sub-polygonal, about same length or longer than wide; surrounded by continuous rim. Gastrocardiac, thoracic and cervical grooves deep, distinct; thoracic grooves diverging and converging posteriorly but not reaching posterior border; cervical groove long converging anteriorly towards frontal region. Gastric, cardiac and epibranchial regions inflated, epibranchial slightly lower than gastric and cardiac regions. Rostrum absent; frontal, anterolateral, midlateral, posterolateral and posterior edges clearly demarcated. Frontal margin weakly bilobed, 2 longitudinal fissures present just below frontal margin parallel to edge; anterolateral, midlateral and posterior margins cristate; anterolateral margin entire; posterolateral margin entire. Epistome relatively broad. Branchiostegal region swollen laterally.

Eyes not visible dorsally; eyestalk very short, immovable, cornea absent, orbits incomplete. Antennular fossa very shallow, medially separated by thin, very low septum, basal article swollen, protruding from fossa. Antennal fossae absent, antenna well developed, basal article relatively narrow, not positioned directly below base of eye stalk, offset to outer edge.

Third maxillipeds narrow, with wide gape when closed; ischium with broad distal inner lobe; merus inner and outer margins divergent distally; merus twice length of ischium along lateral margin; medial margins of merus and ischium lined with strong setae; palp long; exopod short, reaching about two-thirds of merus, with distinct flagellum.

Chelipeds equal, slender, long; surfaces smooth; inner margins of merus lined with simple setae and submedian dorsal tooth. Carpus smooth, short, lined with setae along inner edge. Palm and finger equal in length relatively long, without teeth, lined with short setae along cutting edges.

Ambulatory legs slender, long, with short scattered setae; P3 length about 4 times carapace width, slightly longer than P2, P5 not clearly shorter than rest; P2 to P5 meri slightly longer to longer than carapace length, cross-section elliptical, diameter constant throughout length; propodi shorter than respective meri; dactyli shorter than respective propodi, curved inwards slightly, margins entire.

Male abdomen with 4 parts; somite 1 with proximal part below carapace posterior margin, disto-lateral ends lobiform; somite 2 shorter than somite 1, proximal part below carapace posterior margin, disto-lateral ends lobiform; somites 3–5 fused, triangular, proximal one-third of lateral margins convex, middle portion concave, distal one-third narrowed. Pleotelson lingulate, elongated, slightly wider proximally, tapering towards rounded distal end (Fig. 5).

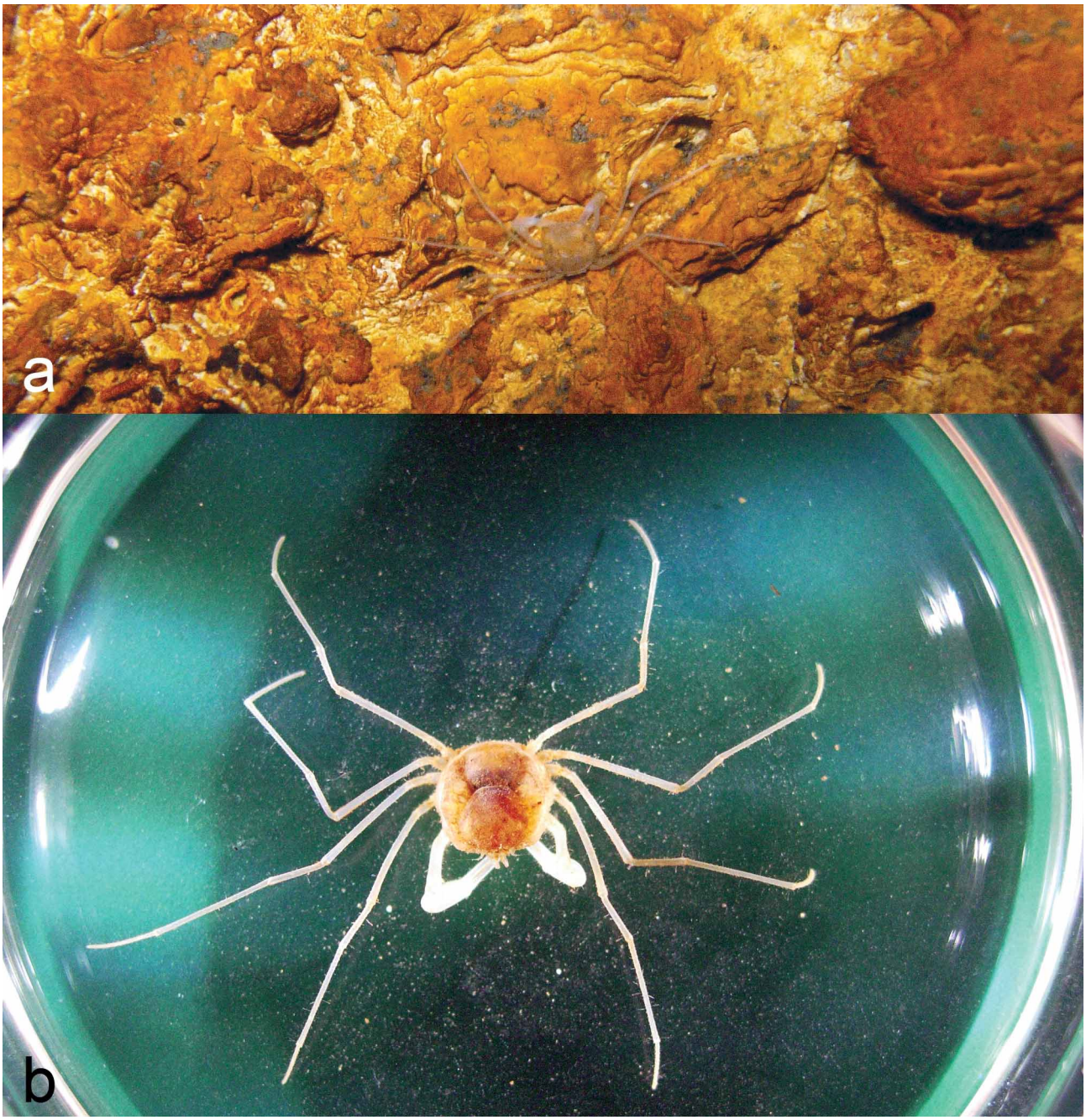

FIGURE 3. Colour images of *Samarplax principe*, **new genus**, **new species**, from the type locality: a, specimen on surface of rock; b, specimen on petri dish at site of collection.

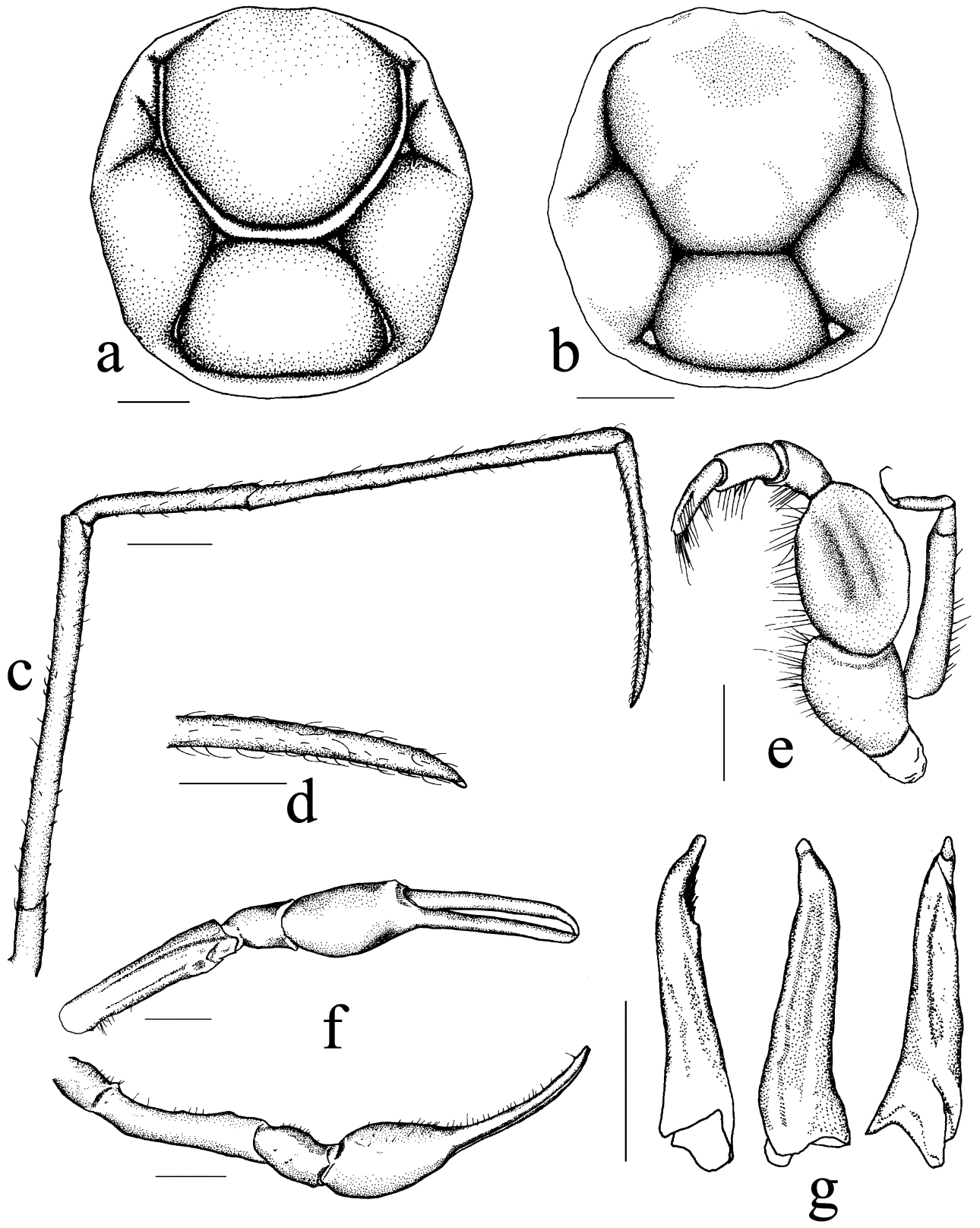

FIGURE 4. *Samarplax principe* new genus, new species. a, paratype female (ZRC 2011.0879; ex. NSMT-Cr 2007-0002), carapace. b–g, holotype male (NMCR-39033): b, carapace; c, right fourth walking leg; d, tip of dactylus of right fourth walking leg; e, left third maxilliped; f, right cheliped; g, various angles of left G1. Scale bars: a, b, d, g and e = 0.5 mm; c and f = 1 mm.

G1 slender, gently twisted at base, distal 2/3 with groove lined with numerous setae, gently curved distally towards midline. G2 short, about half length of G1; tip blunt, slightly expanded laterally.

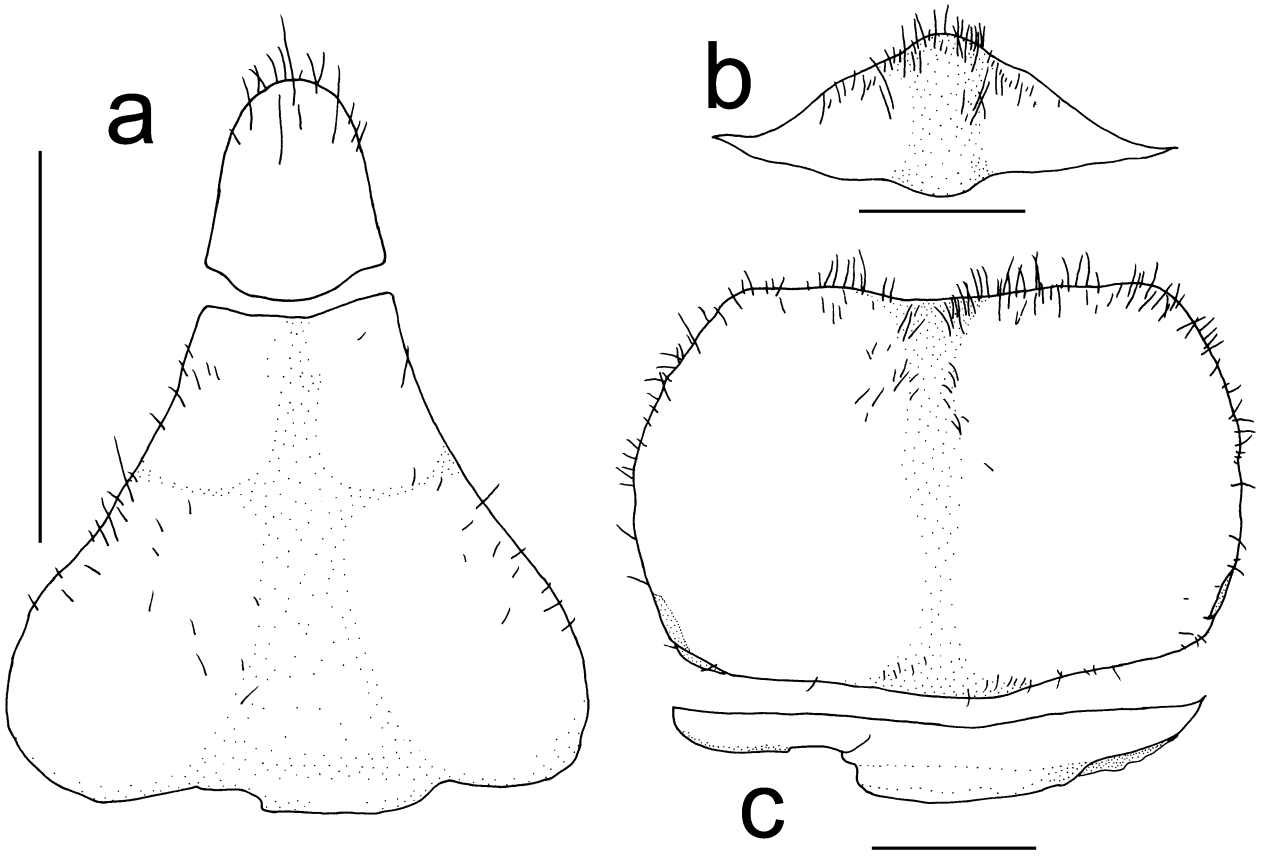

FIGURE 5. *Samarplax principe* **new genus**, **new species**. a, holotype male (NMCR-39033), abdomen, ventral view. b-c, paratype female (ZRC 2011.0879; ex. NSMT-Cr 2007-0002), abdomen: b, pleotelson; c, abdomen. Scale bars = 1 mm..

FIGURE 6. *Samarplax principe* **new genus**, **new species**. Overall view, paratype male, 3.64 x 3.63 mm (ZRC 2011.0880; ex. NSMT-Cr 2007-0003).

Colour. This species has completely lost its body pigmentation. However, the sediments from its surrounding environment adhere to their body, giving the animal a yellowish-brown colour.

Etymology. This species, *principe,* was named after the cave locality, Principe Cave. The name is used as a noun in apposition.

Habitat. *Samarplax principe* **new species**, was discovered in Principe Cave, an anchialine cave, located approximately 200 meters away from the shoreline, with the surface salinity ranging from 1.5 to 3.5‰.

Distribution. *Samarplax principe* **new species**, is currently known only from Principe Cave, Calicoan Island, Guiuan, Eastern Samar, Philippines.

Remarks. *Samarplax principe* **new species**, is the first reported anchialine cave species of Hymenosomatidae exhibiting true troglomorphic characters (see Husana *et al*. 2009). Ng (1991) described *Cancrocaeca xenomorpha*,

the first true cavernicolous hymenosomatid crab but from a completely freshwater cave system in Sulewesi, Indonesia. The colour of *C. xenomorpha* in life has been described as ranging from pale yellow to brown (Ng 1991; Deharveng *et al.* 2002), while *S. principe* **new species**, is totally colorless although it appears yellowish-brown owing its coloration to the background sediments that adhere to its body surface.

FIGURE 7. *Samarplax principe* **new genus**, **new species**. SEM micrograph of the frontal region showing the vestigial eyestalk. Paratype male, 4.09 x 3.98 mm (NSMT-Cr 2007-00040).

Non-sexual features of female *S. principe* **new species**, generally agree with the males, but in general, they are larger than males. The abdomen of females is dome-shaped and forms a brood cavity that covers the entire thoracic sternum reaching up to the base of the legs. The thoracic sternum has a longitudinal median groove and numerous short setae that are scattered over the surface. In young non-brooding females, the sternum is slightly narrower. The vulvae are oval in shape, sternal in position, elevated and relatively large.

Eggs. A small number of large-sized oval eggs (only 2–7 eggs measuring about 0.96 x 0.76 mm) is present in the female brood cavity. The small diameter of the female vulvae (about 0.32 x 0.21 mm), however, will not allow the eggs to pass through that opening. This suggests that *S. principe* **new species**, may undergo ovoviviparous development similar to euryhaline hymenosomatids like *Neorhynchoplax mangalis* Ng, 1988 (cf. Ng & Chuang 1996: 59, fig. 26) and *N. yaeyamaensis* Naruse, Shokita & Kawahara, 2005 (cf. Naruse *et al.* 2005) (see also Naruse *et al*. 2008). Furthermore, the small number of eggs of this species may suggest a direct or semi-abbreviated development (P.K.L. Ng, personal communication).

Remarks. Many cave animals have evolved similar features as a result of their adaptation to the cave habitat, like the loss of eyes and possessing long legs (see Culver & Fong 1986; Coineau 2000). The brush-like setae along the inner margin of palm and finger in the chelipeds (instead of cutting teeth) of *Samarplax principe* **new species**, is an unusual character, suggesting that it uses its cheliped to brush/scrape off objects to obtain food such as epilithic biofilm (P.K.L. Ng, personal communication). Takeda & Murai (2003) have suggested that fiddler crab *Uca*

panamensis Stimpson, 1859 (Ocypodidae), uses such a structure to scrape off particles from the rock surface. Although the feeding habit of this species has not been observed, this structure could also possibly function as has been reported for the cavernicolous shrimp *Typhlatya mitchelli* Hobbs & Hobbs, 1976, and other atyids. Pohlman *et al.* (2000) observed that the tufts of setae on the distal end of first and second pereopods of *Typhlatya* are utilized for grooming and capturing particles from the water. Such setae can be effective because they increase the efficiency in foraging for minute food particles in a food-limited and dark cave environment, and it is not surprising that both the shrimp and crab possess this feature (see also Culver & Fong 1986). Other attributes possessed by cave-adapted crustaceans include the retention of young in the brood cavity to prevent them from drifting too far (see Parzefall 1986) and/or having large but fewer eggs which have energy-richer yolk to help the larvae develop in a more advanced state (see Hüppop 2000). Such life-strategies are useful in a food-limited environment because it increases the survival chances of the young (Hüppop 2000).

Conservation. Many members of the family Hymenosomatidae are small in size, cryptic in habits and known to inhabit littoral to sublittoral zones that are sensitive to human activities (Chuang & Ng 1994; Guinot 2011). In the case of *Samarplax principe* **new species**, the conservation challenges are associated with the cave environment. In the Philippines, land conversion, development and other associated human activities cause pollution as well as pose problems and threats to natural cave habitats, especially along coastal areas. Clements *et al.* (2006; 2008) commented that karst areas are rich in biodiversity with high endemism but are threatened by many anthropogenic disturbances. The apparent rarity of the new species described here, its low natality, restriction to the cave habitat and endemism to the island poses an immediate conservation concern.

FIGURE 8. *Samarplax principe* **new genus, new species**. SEM micrograph of the chelipeds showing the structure of dactylus and propodus. Inset shows the enlarged portion of the inner margin lined with (denuded) brush-like setae. Paratype male, 4.09 x 3.98 mm (NSMT-Cr 2007-00040).

Comparative material

Sulaplax ensifer Naruse, Ng & Guinot, 2008: Paratypes, 1 male, 2.7 × 3.5 mm, 1 ovigerous female, 5.0 × 6.5 mm (ZRC 2007.0119), station SULT-020, Air Mahambia, Lasori, Muna Island, Sulawesi Tenggara, Indonesia, coll. F. Bréhier & L. Deharveng, 25 Aug. 2001.

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