New Records of Crabs from the Caves of Gunung Mulu National Park, Sarawak, with a field key to the cavernicolous taxa of Northern Sarawak

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Freshwater crabs have undergone a significant radiation on the island of Borneo, comprising four families (Potamidae, Geocarcinucidae, Parathelphusidae, and Sesarmidae), 15 genera and at least 49 species. The group is best known from the Malaysian state of Sarawak, primarily as a result of work by the Sarawak Museum, studies at Gunung Mulu National Park, and by Peter Ng of the University of Singapore and Raffles Biodiversity Center. Ten north-Borneo taxa are known to be cavernicolous, of which four are probably true troglobites. Two of these troglobitic crabs are known from caves of Gunung Mulu National Park, and one each from the smaller, non-contiguous massifs of Niah Great Cave National Park, Sarawak, and one from Simud Puteh Cave, Gomantong Forest Reserve, Sabah.
Nevertheless, published locality records for cave dwelling species are few, and no field-expedient key to living specimens exists to facilitate further records by non-specialists. Here we summarize existing records and add new records for the caves of Gunung Mulu National Park, by far the most important and most studied cave locality in Borneo (with some 362 km of cave passage explored and mapped by March 2011; http://www.mulucaves.org).

**Cavernicolous Crabs of Mulu.** (Fig. 2)

*Cerebusa caeca* Holthuis 1979.

A colorless, blind species originally recorded (Holthuis, 1979) from Deer Cave (Crab Inlet), Green Cave (stream near north entrance); Clearwater Cave (Inflation Passage), and Mayday Cave, Gunung Mulu National Park. No epigean records.

Additional records: Lagang’s Cave, pool at north end of Fast Lane (July 2007, present authors), Gunung Mulu National Park.

*Cerebusa tipula* Holthuis 1979.

A very distinctive, colorful species with a blue-gray carapace and lemon-yellow or orange-yellow legs (Fig. 3). Originally recorded (Holthuis, 1979) from Clearwater Cave (pool 15 m inside Snake Track passage), Cave of the Winds, and Wonder Cave (pool 10 m from entrance). All three caves are located in the Gunung Api massif, Gunung Mulu National Park.

Additional records: Fruit Bat Cave, rimstone pools 150 m from the west entrance (August 2010, present authors) southwest massif, Gunung Mulu National Park.


A large, olive-gray species without obvious adaptations to hypogean life. Originally collected from the sinkhole of the Clearwater Cave river, Hidden Valley, Gunung Mulu National Park (Holthuis, 1979). No true cave records.

*Sundathelphusa tenebrosa* Holthuis 1979.

A dark-colored species known from several cave records and one surface locality adjacent to a cave entrance. Likely to be a troglobilic species (Fig. 4).

Original records: Deer Cave, Gunung Mulu National Park, near (west?) entrance; Deer Water Cave, Gunung Mulu National Park, 100 m into cave; Clearwater Cave, near River Junction; one epigean record, stream near Camp
2, Gunung Mulu National Park, “just above subterranean part” (Holthuis, 1979).

Additional record: Lang’s cave, Gunung Mulu National Park, flowstone pool 80 m from entrance (August 2010, present authors).

*Thelphusula styx* Ng 1989.

A species with a pale brownish carapace, and dirty-cream colored walking legs. Possibly a troglobitic species.

Original record: Known only from Long Pala Bat Cave, just outside the western corner of Gunung Mulu National Park (Ng, 1989).

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**Figure 2.** Sketches of the Mulu adult cave crabs, to same scale.

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**Cavernicolous crabs from non-contiguous limestone areas.** (Fig. 2)


Known only from the original record, dark zone Niah Great Cave (1978), (3.819° N, 113.775° W), northern Sarawak (Holthuis, 1979). Current status unknown but potentially highly endangered.
Arachnothelphusa (Thelphusula) rhadamanthysi Ng 1991.

Known only from Simud Hitam Cave, Gomantong Forest Reserve, Sabah, (5.534° N, 118.083° W) (Ng, 1991). Rare (only one known specimen).

Parathelphusa valida Ng and Goh, 1987

Present in large numbers in the stream of Simud Hitam Cave, (5.534° N, 118.083° W) Gomantong Forest Reserve, Sabah. Also recorded from Madai Caves (4.726° N, 118.175°W) and Baturung Caves (4.700° N, 118.016° W), Sabah (Ng and Goh, 1987).

Isopotamon sp. Ng and Goh, 1987

Known only from Madai Caves (4.726° N, 118.175°W), Sabah. Males unknown, hindering systematic identification (Ng and Goh, 1987).

Isopotamon bauensis Ng and Yussouf, 1990

Known only from Bau Caves (1.414° N, 110.136° E.), Southern Sarawak (Ng and Yussof, 1990).

Stygothelphusa (Thelphusula) bidiense Lanchester 1900.

Known only from Bidi Caves (1.399° N, 110.099° W), southern Sarawak (Ng, 1989b).

Key to the Cave Crabs of Gunung Mulu National Park (Fig. 2)

Fortuitously, all six species of cavernicolous crabs currently known from Gunung Mulu can be distinguished by their carapace shape (Fig. 2) and/or color (Fig. 3,4), without need to examine more subtle characteristics best observed in preserved specimens.

1. Carapace and legs colorless or white; eyes greatly reduced.

   Cerebusa caeca.

1a. Carapace and legs not colorless or white – 2

2a. Carapace bluish-gray, legs bright yellow or yellow-orange –

   Cerebusa tipula.

2b. Carapace brown, legs brown or dirty-cream. – 3.
3a. Carapace light brown, legs dirty-cream. – *Thelphusula styx*.

3b. Carapace and legs brown. – 4.

4a. Carapace olive-brown. Posterior margin of carapace sculpted in dorsal view, adult carapace exceeds 40 mm breadth – *Isopotamon collinsi*.

4b. Carapace dark brown, with a purplish tinge; female carapace may have orange-brown edges. Posterior margin of carapace straight in dorsal view. Carapace breadth less than 30 mm. – *Sundathelphusa tenebrosa*.
Discussion

The Gunung Mulu uplands are a relatively recent feature, having been uplifted over the past 3–4 million years (Gilleson and Clark, 2010). This karst block has been dissected into discrete massifs by river downcutting at an approximate rate of 0.19 m/ka (Farrant et al., 1995). The primary separations occur between the blocks known as The Southern Hills, Gunung Api, Gunung Benarat and Gunung Buda (Fig. 1). The separation of the Southern Hills and Gunung Api is presumed to be much more recent than the deep dissection between Gunung Api and Gunung Benarat.

The biogeographic distributions of troglobitic crabs can be expected to reflect the history of geological vicariance of these massifs, on the assumption that species differentiating post-vicariance will probably be unable to disperse across major epigean hydrological divides. *Cerebusa caeca* is present in both Gunung Api and Southern Hills caves, and is likely the species informally reported from the Terikan River Cave (Gunung Benerat massif) by the 2003 Benerat expedition. This species, which shows extreme adaptations to a troglobitic life, presumably has a long evolutionary tenure and probably diverged from its epigean ancestor before the dissection of the Mulu karst into distinct massifs. It should therefore be the more widespread troglobitic species, and can be expected in the caves of Gunung Buda.

*Cerebusa tipula* shows fewer troglobitic adaptations, and can be hypothesized to have arisen more recently. If this divergence post-dated the deep dissection of the Gunung Api and Benerat massifs by the Melinau Gorge, this species may well be absent from the caves of Gunung Benerat and Buda. The presumably more recent separation of the Southern Hills and Gunung Api would account for the presence of *C. tipula* in both areas.

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