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A SINGAPORE TRILOBITE LARVA, *DULITICOLA* SPECIES

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INTRODUCTION

There are two trilobite larva species in Singapore, one of which has been described by Wong (1996) as *Duliticola hoiseni* while the other, *Duliticola* species (Figs. 1, 2 & 3), has yet to be described. The two species of trilobite larvae belong to the phylum Arthropoda, class Insecta, order Coleoptera, suborder Cantharoidea and family Lycidae. *Duliticola* species occur throughout Southeast Asia, and in Singapore, they are found in the Bukit Timah and the Central Catchment Nature Reserves. Both are nationally endangered because of the threat of forest loss and over-collection by beetle hobbyists (Ng & Wee, 1994). These beetles are popularly known as trilobite larvae owing to their superficial resemblance to the extinct trilobites (phylum Arthropoda, class Trilobita). The family Lycidae (net-winged beetles) is interesting in that, for many species in the family, the adult males and females are morphologically very different. The males resemble the typical lycid beetle and are less than 5 mm long, while the females are neotenous—remaining larviform throughout their lives and are approximately 4–6 cm long (Ng & Wee, 1994).

Neoteny in the Coleoptera occurs mainly in the superfamily Elateroidea (click beetles and allies), in some soft-bodied groups such as the Lampyridae (fireflies) and the Lycidae (Bocak et. al., 2008). It is also postulated that neotenous lycids, specifically the Southeast Asian *Duliticola* and *Lyropaeus*, are members of primitively neotenous lineages that might share a common ancestor with the Lampyridae that also includes many neotenous forms (Bocak et. al., 2008). This is particularly interesting because a larval form of an unknown taxon (probably of family Lampyridae) resembling a female *Duliticola* species, was observed displaying bioluminescence in Krabi, Thailand (see Chan, 2007; K. W. Chan, pers. comm.). It is uncertain why neoteny arose, but is presumably favoured under conditions of slow growth rates in stable environments that remove the need for a dispersive adult stage and high production of offspring (Bocak et. al., 2008).

The taxonomy of the Lycidae is based on the males, with emphasis on the morphology of the genitalia. Descriptions of females and larvae are seldom available. Although there are a large number of trilobite larvae in Southeast Asia, very few have been described, because the males are usually unknown (Wong, 1996). Although the females are frequently encountered, obtaining males of the same species is very difficult because the males, unlike many other beetle species, do not respond to light traps and the only way to ascertain that the two sexes are conspecific is to capture them while they are mating (Wong, 1996). With the current advances in DNA barcoding or DNA taxonomy, matching female and male specimens could become a less daunting task and shed more light on lycid taxonomy.

SPECIMEN DETAILS

The undescribed *Duliticola* species, which is the more elongate and worm-like of the two species found in Singapore, is also found in Johore in Peninsular Malaysia, and Pulau Lingga, and Java in Indonesia, and can be found in secondary forests (Wong, 1996). This species was collected on 30 Oct. 2008 at the Sime Road swamp forest area, beside a braided stream system (Fig. 4), where it was found crawling over a rotting simpoh air (*Dillenia suffruticosa*) stump. This specimen (ZRC.6.20969) has been deposited in the Zoological Reference Collection (ZRC), Raffles Museum of Biodiversity Research, National University of Singapore. This species was previously collected in 1993 by A. T. C. Wong at Bukit Timah Nature Reserve (female specimen, ZRC.1993.7277), by C. Lee at Sime Road (female specimen, ZRC.1993.7278) and by D. H. Murphy at both Bukit Timah Nature Reserve and Sime Road. The other more leaf-like species, *Duliticola hoiseni*, also occurs throughout Peninsular Malaysia, including Pulau Tioman, but is restricted to more pristine forests and is found in Bukit Timah Nature Reserve in Singapore (Wong, 1996).

Duliticola hoiseni was collected in the past by D. H. Murphy at Bukit Timah in 1973 (female specimen, ZRC.6.18601) and by A. T. C. Wong in 1993 along the Tiup Tiup Trail, Bukit Timah Nature Reserve (female specimen, ZRC.6.8634). Both species are found on rotting logs and in the leaf litter in lowland forest. The stage of decomposition does seem to matter and no larvae were found on logs with advanced decay, but rather intact logs were preferred. Larvae were also found on the surface of logs and no evidence of burrowing was noted (Wong, 1996).

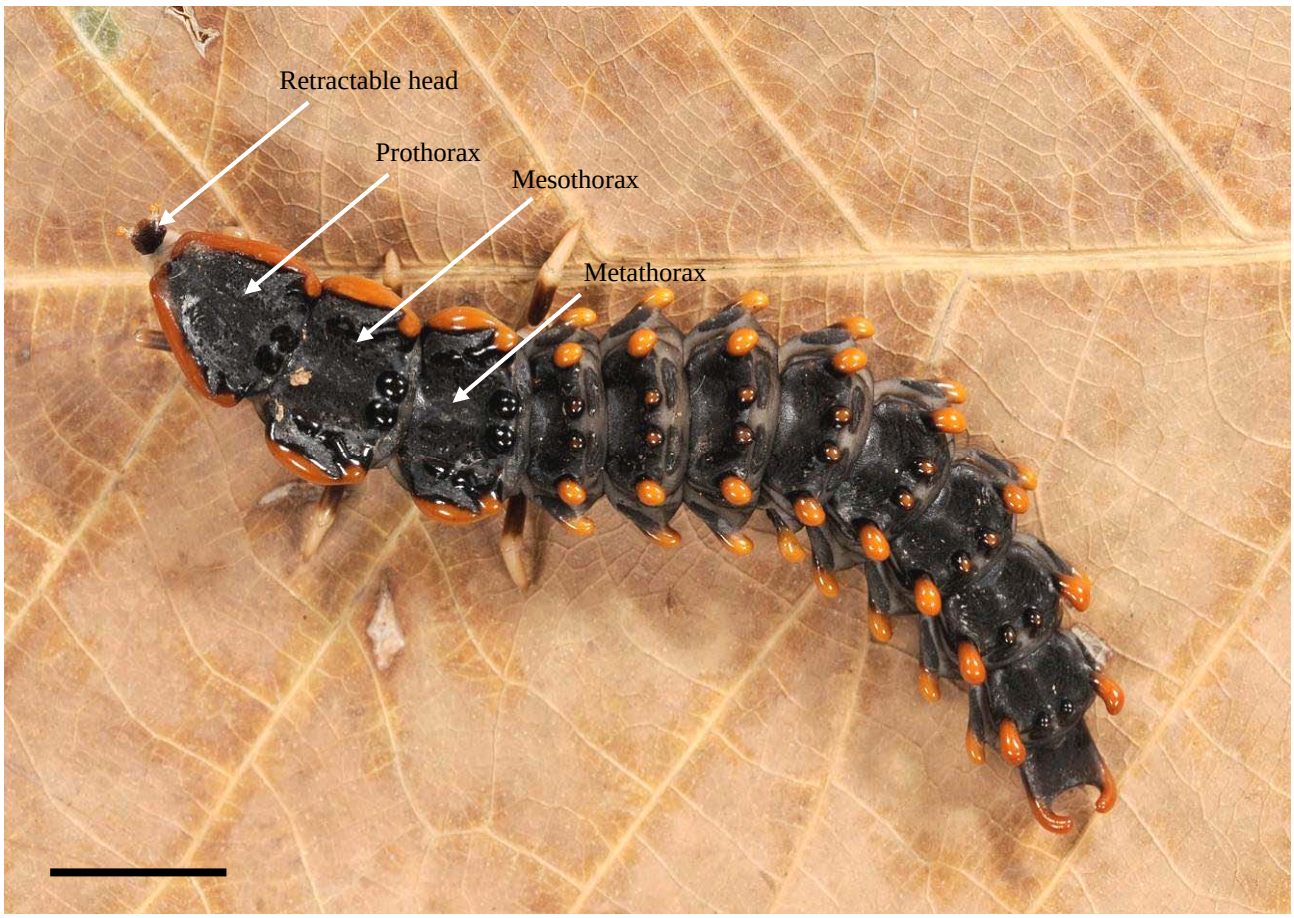

Fig. 1. Dorsal view of the still undescribed *Duliticola* species collected from the Sime Road swamp forest. Scale bar = 5 mm. (Photograph by: Tan Heok Hui).

Fig. 2. Ventral view of the specimen. Scale bar = 5 mm. (Photograph by: Tan Heok Hui).

Fig. 3. Lateral view of the specimen. Scale bar = 5 mm. (Photograph by: Tan Heok Hui).

Fig. 4. Habitat in the Sime Road swamp forest where the undescribed local *Duliticola* species was collected on 30 Oct.2008. (Photograph by: Ng Ting Hui).

The diet of trilobite larvae is highly controversial, and has been reported to include fungi, slime moulds, or juices from rotting plant matter such as logs and branches (Wong, 1996). Ng & Yong (1991) observed specimens grazing on Basidiomycetes fungi, growing on rotting wood. After examining a drop of liquid squeezed from a piece of wood collected with *Duliticola hoiseni* using a microscope, Wong (1996) speculated that trilobite larvae actually fed on micro-organisms within the juices of the rotting wood. Contents of the collected wood juices, revealed a wide spectrum

of organisms including protozoa, rotifers, nematodes, copepods, nauplii larvae, and mites, and the same organisms were isolated from the guts of several *Duliticola hoiseni* specimens (Wong, 1996).

The life cycle of the genus *Duliticola* is also very poorly understood. To date, our knowledge of the life cycle of the genus *Duliticola* is extremely patchy and based on observations made on several *Duliticola* species. In his paper describing *Duliticola hoiseni*, Wong (1996) reported the larvae moulting after five months, with none undergoing a second moult, leading him to conclude that the time between moults could be more than five months. From his studies and observations, Wong (1996) was, however, not able to ascertain the number of instar stages the *Duliticola hoiseni* larva undergoes before the terminal moult, and so assumed the life span to be a year or longer. He was, however, able to trap a male *Duliticola hoiseni* specimen using a female specimen as bait at the Gombak Field Station in Ulu Gombak, Selangor, Peninsular Malaysia, where a male beetle was found tightly attached to the female's gonopore via its long curved genitalia for five hours before releasing the female. The male died 3–4 hours later. The female later laid a batch of approximately 200 eggs the following day, before dying a week later (Wong, 1996). Wong (1996) also observed a female *Duliticola hoiseni* specimen attracting males by raising its abdomen above its thorax exposing its gonopore, presumably dispersing pheromone(s). Mjöberg (1925) also observed similar behaviour in *Duliticola paradoxa*, except that a clear drop was observed from the genital opening unlike *Duliticola hoiseni*, where no clear fluid was observed.

CONCLUSIONS

Locally, trilobite larvae are restricted to the Bukit Timah and Central Catchment Nature Reserves and have patchy distributions, probably because not every fallen log is at a suitable stage of decomposition. Their localised and patchy distribution also makes these two *Duliticola* species very vulnerable to local extinction. Any small changes in an area could lead to changes in micro-climates that could lead to unviable populations and isolation between populations. Some species are however more resistant to habitat disturbance than others. The undescribed *Duliticola* species that occurs here is able to adapt to conditions in secondary forest in the Central Catchment Nature Reserve, but *Duliticola hoiseni* is only found in Bukit Timah Nature Reserve, in patches of primary forest. The undescribed *Duliticola* species, however, has so far, never been collected in secondary forest outside the Central Catchment Nature Reserve, showing perhaps, that this species also has limits to how adaptable it is and that the two species of *Duliticola* are indeed dependant on good forest.

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