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Biodiversity Record: The edible shipworm, *Bactronophorus thoracites*

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Subjects: Edible shipworm, *Bactronophorus thoracites* (Mollusca: Bivalvia: Teredinidae).

Subjects identified by: Chan Sow-Yan and Lau Wing Lup.

Location, date and time: Singapore Island, Pasir Ris, Sungei Api Api; 18 May 2019; around 1612 hrs.

Habitat: Mangrove. Within a rotten tree trunk on mud during low tide.

Observer: Lau Wing Lup.

Observation: Many live individuals and the calcareous tubes of dead ones were found exposed together in a decaying and disintegrating tree trunk (Fig. 1). The shipworm's body is vermiform (Fig. 2), up to about 40 cm in length, and protected within a calcium tube (Fig 3). The tube is papery thin and those of smaller lumens (interior of tubular structure) have a septum dividing its cavity into half (Fig. 4). At the front end of the body is a pair of shell valves (Fig. 5), which remain in place after the animal dies and decomposes (Fig. 6). The shell valves have a combination of crowded, fine, denticulate ridges and smooth ridges (Fig. 7). The anterior part of the body (Fig. 2) is thicker and darker than the posterior. The rear end of the body ends in a pair of calcareous pallets, which flanks the animal's siphons and acts like a plug to seal the tunnel entrance at low tide (Fig. 8). These pallets are left intact after the animal rots away. They are asymmetric and non-segmented, with a basal cup bearing a long, dagger-like extension (Fig. 9). The longest pair of pallets observed was 19 mm in length. The siphon area where the pallets are attached is dark grey.

Found within the hollow calcareous tubes of *Bactronophorus thoracites* were a larva of an unidentified arthropod (possibly a beetle grub), two empty shells of the spike awl snail (*Allopeas clavulinum*), and two live shiny assiminid snails (*Angustassiminea nitida*) (Fig. 10).

Remarks: Although the edible shipworm *Bactronophorus thoracites* is often mentioned in local literature (e.g., Roch, 1955; Turner, 1966; Tan, 1970; Tan & Chou, 2000, as *Bactronophorus* sp.; Lee et al., 2019), it is seldom illustrated, and can be easily misidentified as a worm instead of a mollusc. It is one of the longest bivalves in Singapore waters, and although gregarious and common, is seldom seen due to its cryptic behaviour of tunnelling in wood. *Bactronophorus thoracites* is monotypic and occurs throughout the Indo-West Pacific. It is regarded as a delicacy by several ethnic groups in Southeast Asia (Nateewathana, 1995) and is considered highly nutritious, especially when eaten raw (Lee et al., 2019). This species is a known mangrove specialist that inhabits the low intertidal zones, and infests both dead and living mangrove tree roots (Tan, 1970; Singh & Sasekumar, 1994). The blade-like extensions on its pallets are diagnostic of the species, but this extension can be damaged or missing altogether. Specimens with pallets without the extensions can resemble *Dicyathifer mannii*, a common shipworm described from Singapore (see Wright, 1866; Moll & Roch, 1931). However, *Dicyathifer mannii* has pallets with a centre ridge with rib-like features lining the entire length of its basal cup, which is lacking in *Bactronophorus thoracites* (see Loo et al., 2019).

Shipworms are known for xylotrophy (wood-eating) and xylotrepesis (wood-boring). The existence of nitrogen-fixing bacterial symbionts situated on the gill of these bivalves supplies the host with enzymes needed for wood digestion. Teredinid valves are specially modified with rows of tooth-like projections for drilling into wood, and are pests to wooden ships, harbours and other wooden marine structures because of their wood-boring habits (Turner, 1959; Velásquez & Shipway, 2018). However, they have a vital ecological role in converting energy and breaking down nutrients locked within wood cellulose, making these accessible to the ecosystem.

Fig. 1. Decaying tree trunk infested and damaged by shipworms. Calcareous tubes are exposed after the surrounding wood has disintegrated. (Photograph by: Lau Wing Lup).

Fig. 2. Anterior portion of a live *Bactronophorus thoracites* with its pair of shell valves (indicated (by arrow). (Photograph by: Lau Wing Lup).

Fig. 3. Large intact calcareous on top half of image overgrown with algae due to long exposure after the surrounding wood has decomposed. Note that the broken sections of large tubes lack a dividing septum. (Photograph by: Lau Wing Lup).

Fig. 4. Transverse section views of the siphonal ends of two empty tubes, showing the septum that divides each tube into two sections. (Photograph by: Lau Wing Lup).

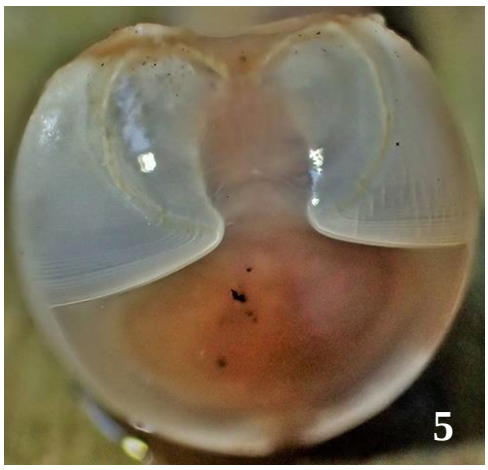

Fig. 5. Anterior end of a live *Bactronophorus thoracites* showing the opposed shell valves. (Photograph by: Lau Wing Lup).

Fig. 6. View of the anterior end of a shipworm tube with shell valves in place after the animal has decomposed. Note large pedal gape between the two valves. (Photograph by: Lau Wing Lup).

Fig. 7. Pair of valves of *Bactronophorus thoracites* ex situ: external surfaces (left) and internal surfaces (right). Space between black bars = 1 mm. (Photographs by: Lau Wing Lup).

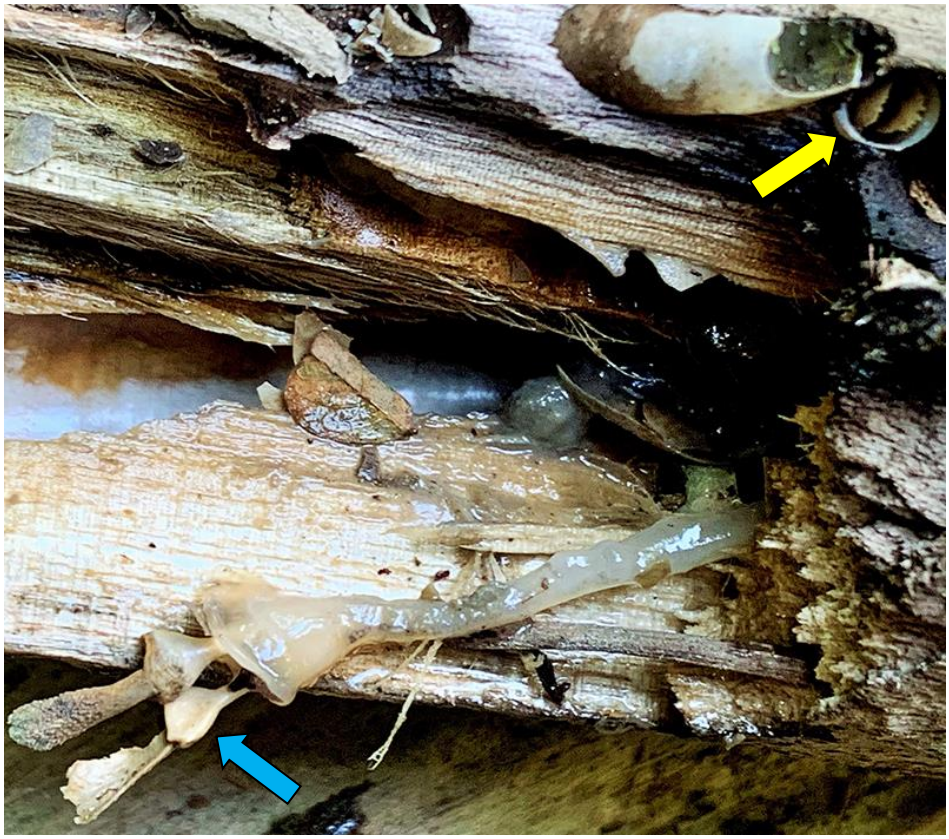

Fig. 8. *Bactronophorus thoracites* in decaying wood. A pair of pallets is retracted into the calcareous tube on the top right corner (indicated by yellow arrow), sealing the animal in the tube. On the bottom half of the picture, the posterior part of a live shipworm is exposed with its pallets showing (indicated by blue arrow). (Photograph by: Lau Wing Lup).

Fig. 9. A relatively intact pair of *Bactronophorus thoracites* pallets with diagnostic blade-like extensions at the end to the left (of the picture) and basal cups in the centre. Space between black bars = 1 mm. (Photograph by: Lau Wing Lup).

Fig. 10. Some organisms found in the empty calcareous tubes of *Bactronophorus thoracites*: an unknown arthropod larvae, possibly a beetle grub (left); a live *Angustassiminea nitida* snail (centre); and two shells of dead *Allopeas clavulinum* land snails (right). Space between black bars = 1 mm. (Photographs by: Lau Wing Lup).

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