the body of hydra[7]. Long-term exposure to waterborne iron led to a significant accumulation of metal in liver that caused tissue damage in fish[6]. Although iron depositions were not detected in mesoglea, morphometric measurement of mesoglea verified various thickness values (Figure 2), presumably due to its largely non-cellular structure. It is assumed that mesoglea represents a buffer of some sort[13]. Exposure to iron can cause the retention of water in mesoglea, due to its inability to eliminate excess water from the body by contracting[14] and can enhance synthesis of its constituents, which can thicken mesoglea.

In conclusion, non-symbiotic brown hydra exhibited greater susceptibility to iron. Symbiotic green hydra survived better in the given micro-environmental conditions. The present study may point towards the advantages of symbiosis in the living world.

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ACKNOWLEDGEMENTS. We thank Ms Nadica Vincek for technical assistance. We acknowledge the support of the Ministry of Science, Education and Sport of the Republic of Croatia (project 119-1193080-1214 'Molecular phylogeny, evolution and symbiosis of freshwater invertebrates').

Received 6 October 2015; revised accepted 6 November 2015

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Aquilaria malaccensis fruit borer in Peninsular Malaysia

Aquilaria malaccensis Lam. (Thymelaeaceae) has a natural distribution in lowland tropical forests in Peninsular Malaysia, India, Myanmar, Sumatra, Singapore, Borneo and the Philippines. The tree is highly valued for its resin, known as agarwood or popularly known as 'gaharu' in the region, which is utilized in various products such as perfumery, incense, decorative carvings and pharmaceutical products. Agarwood is produced when an agarwood-producing tree is wounded or infected with fungi, microorganisms or insect borers, whereby the borers could also act as a vector of diseases[1]. Only 10% of trees in the wild can become infected by the fungi[2] and produce the much-sought-after resin. Indiscriminate felling of agarwood-producing trees, especially *A. malaccensis*, in the forests has gone beyond control in certain countries. The harvested quantity of agarwood is, however, very low, with less than 0.2 kg per tree for a high-grade resin[3].

A. malaccensis is currently listed as vulnerable according to the IUCN Red List[4] due to overexploitation. Conservation of *A. malaccensis* is important to ensure the sustainability of resources, and this requires an understanding of its reproductive biology[5], which is lacking. Therefore, a series of phenological studies were conducted on wild *A. malaccensis* trees in the forested areas at Penang Island and Perak, Malaysia beginning 2011. The fruits and seeds were also collected from each study site by placing 10–20 square-framed nettings measuring 1 m × 1 m each under the tree prior to the fruiting season for abortion and germination studies. Damaged fruits were scrutinized for the presence of insect pests.

In Penang, one of the aborted and damaged fruits from a total of 1144 had a mature larva living inside and was seen feeding on the fleshy capsule (Figure 1), whereas in Perak a larva was found inside an aborted fruit randomly picked from the ground. A hole measuring about 3 mm in diameter was seen penetrating through the capsule into the fleshy part (Figure 2). The larvae were extracted and

Figure 1. Larva partially concealed within its feeding tunnel (arrow).

reared in a plastic container lined with tissue paper at 26–28°C and 60–80% humidity in the laboratory. The larva was yellow in colour with black knobs lining the dorsal and lateral surface of its abdomen (Figure 3 *a*). It also had fine setae protruding from the sides of its abdomen. The larvae pupated 3–6 days later underneath the fold of the tissue paper. The adult moth emerged after 14 days in pupation (Figure 3 *b*). The pupa from the larva sample collected in Penang, however, failed to emerge. The moth was identified as *Pitama hermesalis* Walker (Lepidoptera: Crambidae) according to Robinson *et al.*[6] with a wingspan of 30 mm (Figure 3 *c*). To our knowledge, there are no previous records of the moth species found infesting the fruits of wild *A. malaccensis* tree.

Figure 2. Bore hole on the surface of *Aquilaria malaccensis* fruit.

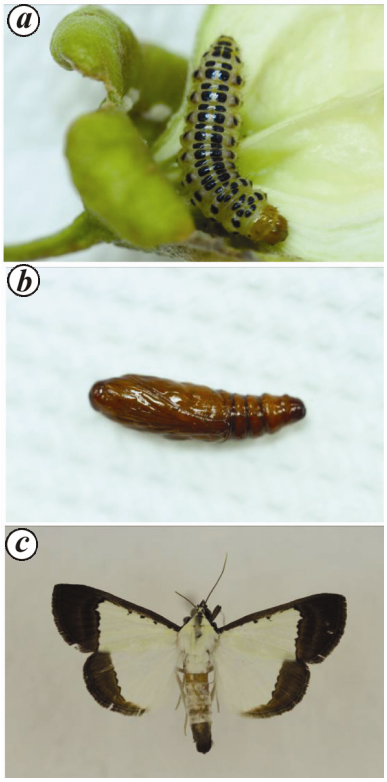

Figure 3 *a–c*. Life stages of *Pitama hermesalis*. ***a***, Mature larva. ***b***, Pupa. ***c***, Adult.

The fruits of *A. malaccensis* could be an alternative host to *P. hermesalis* as its larva is usually observed feeding on the leaves of wild and planted *A. malaccensis* in Peninsular Malaysia. The larva has a preference to live and feed between the folds of two leaves that were attached together using silk web. The green area on the leaves was scraped-off causing it to become translucent (S. P. Ong, pers. obs.). Elsewhere in Indonesia, *P. hermesalis* has also been reported feeding on the leaves of *Aquilaria* sp. trees[7].

Although the larva may not be feeding on the seed, the damage was enough to cause the fruit to abort prematurely (Figure 4), thus leading to underdeveloped seed. More studies are needed to assess the damage rate caused by *P. hermesalis*, although early observations show that fruit feeders such as macaques and squirrels have a greater impact.

Figure 4. Feeding damage and frass of *Pitama hermesalis* inside the aborted fruit.

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ACKNOWLEDGEMENTS. We thank ITTO Work Program element 'Support to ITTO–CITES Implementation for Tree Species and Trade/Market Transparency' for financial assistance, and all those who helped during the field excursion in Penang Island and Perak.

Received 16 March 2015; accepted 6 October 2015

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