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Larval habitats of two *Coilodera* species (Coleoptera: Scarabaeidae: Cetoniinae) associated with wood feeding cockroaches

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Vietnam [N11°53'00.1",
E108°24'29.9", alt. 1410-1430m];
Kuching, Sarawak, Malaysia
[N1°31'12.1", E110°23'24.6", alt.
20m]

Abstract

Flower beetles (Cetoniinae) are a diversified group of Scarabaeidae in the Oriental region. Although the taxonomy of flower beetles is relatively well established, the ecology has remained unveiled for the majority of Oriental species. Here, the larval habitats of *Coilodera vitalisi* from South Vietnam and *C. helleri* from Borneo are reported. Cocoons of unknown cetonids were discovered from decaying tree trunks. When opened, newly eclosed adults of *C. helleri* and *C. vitalisi* emerged from the cocoons, which were found inside the galleries of wood-feeding cockroaches. It was evident that the larvae had developed inside the galleries by feeding on wood material chewed by the cockroaches. The present observations suggest that *Coilodera* during the immature stage are associated with wood-feeding cockroaches and that they can be regarded as an inquiline.

Keywords: inquiline, larval ecology, *Salganea*, Taenioderini, wood-boring cockroach

Cetoniinae is a subfamily of Scarabaeidae and contains more than 3000 species worldwide (Krajcik, 1998a, b). The Oriental region is one of the two main areas where Cetoniinae are most diversified. Although taxonomic studies have extensively been made for this group of scarab beetles, the larval habitats of most Cetoniinae in the Oriental region remain unknown.

The genus *Coilodera* belongs to the tribe Taenioderini, and is endemic to the Oriental region, with the majority of the species ranging from Indochina to Sundaland (Miksic, 1987; Krajcik, 1998a). This genus comprises nearly 20 described species including some recently described (Jakl and Krajcik, 2004; Legrand and Chew Kea Foo, 2010). Although the taxonomy of the Oriental Cetoniinae, including *Coilodera*, is relatively well established, their ecology such as larval habitat has poorly been documented except some pest species; many aspects of their ecology has remained unclear so far. In the present paper, I describe the larval habitats of *C. helleri* and *C. vitalisi* for the first time, and suggest, on the basis of field observations, that they are associated with wood-inhabiting cockroaches whose galleries are their larval habitats.

Field observations were made in two localities; Tuyen Lam Lake tour area, Da Lat, Lam Dong Province, South Vietnam [N11°53'00.1", E108°24'29.9", alt. 1410-1430m] in March, 2013, and Sama Jaya, Kuching City, Sarawak, East Malaysia [N1°31'12.1", E110°23'24.6", alt. 20m] in November, 2013. Large decaying wood was relatively abundant in the localities, which suggested that the areas were covered with rather well preserved forests.

During a survey of insect fauna in Vietnam, two cocoons of Cetoniinae, together with numerous feces, were detected from the gallery of an unknown wood-feeding cockroach in Da Lat (Fig. 1a). One cocoon was empty with a large hole, suggesting an emergence of adult beetle, while the other contained a fresh adult of *C. vitalisi* (Fig. 1b). Identification of the cockroaches was not possible because the gallery was old, and cockroaches were not found inside it.

Similarly, when a large, decaying wood in the forest area in Kuching was inspected, the wood-feeding *Salganea* cockroach was found inside the wood (Fig. 1c). The gallery of the cockroach also contained numerous pellet-like feces produced by unknown organisms. The feces appeared to be a scarab type. After careful inspection, two cocoons were detected in the gallery (Fig. 1d, e). When opened, fresh adult beetles were found inside the cocoon. The beetle species was identified as *C. helleri* belonging to *Cetoniinae* (Fig. 1f).

Thus, the cocoons of *Coilodera* were recorded for the first time in the gallery of the wood-feeding cockroaches. The cocoons were attached on the hard wood and were covered with wood material filling the gallery, causing the difficulty to recognize their presence (Figure 1d, e). Kon et al. (2004) in their report mentioned that they discovered adults of two *Coilodera* species from the galleries of *Salganea* but did not specify in what situation the adult cetonids were found. Because their main target was *Salganea* cockroaches, it is likely that they had unintentionally broken out the cocoons during excavation of the *Salganea* galleries and found

the adults of *Coilodera*. Thus, the present discovery of the cocoons of two *Coilodera* species, together with their feces, suggests that the gallery of wood-boring cockroaches is the larval habitat of the cetonids.



Figure 1. *Coilodera* spp. found in the galleries of their associated cockroaches: **a.** Cocoon of *C. vitalisi* inside the cockroach gallery; **b.** Fresh adult of *C. vitalisi* appeared from the cocoon; **c.** The wood feeding cockroach *Salganea* sp., whose gallery was the habitat of *C. helleri*; **d & e.** Cocoon of *C. helleri* inside the gallery of *Salganea* (note that, for Figure 1e, the brightness except the cocoon was lowered to highlight the cocoon, which was inconspicuous); and **f.** Fresh adult of *C. helleri* inside its cocoon.

The larvae of *Coilodera* appeared to have developed by feeding upon the woody material filling the gallery of the cockroach. It was evident that cetonid larvae could not live in hard wood, however. Instead, *C. helleri* and *C. vitalisi* during the larval stage used the gallery filled with crunched woody material, and were most likely to feed on the woody material crunched by the *Salganea* or related cockroaches. Many Lamellicorn beetles are known to feed during the larval stage on dead vegetable or animal matter. The larvae of cetonids live in rotten tree trunks, hollows of trees, heaps of debris and dung middens (Mico et al., 2000; Mico and Galante, 2003). Some groups of Cetoniinae also use termite and ant nests as their larval habitat (Puker et al., 2014).

Termites and cockroaches, which belong to the Blattodea, are major detritivores in subtropical and tropical regions. Some groups of cockroaches exclusively feed on wood and are burrowers living inside rotten woods; wood-feeding cockroaches are abundant in the subtropical and tropical regions. It is of particular significance to note that for the continental *Coilodera*, *C. penicillata*, *C. miksici*, and *C. diardi*, adults were found in the galleries of wood-feeding cockroaches in the genus of *Salganea* though it is not clear whether they were the ovipositing female or newly emerged adult (Kon et al., 2002; 2004). Taken together, it is suggested that the gallery of such wood-feeding cockroaches can provide an ideal and important

habitat for the cetonid larvae though it remains unknown whether *Coilodera* spp. exclusively depend on wood-feeding cockroaches.

The preservation of larval habitats should be a key factor impacting the conservation of insect species including Cetoniinae because larval habitats are one of the major factors determining the occurrence and abundance of the species (e.g., Oleksa et al., 2006; Chiari et al., 2012, 2013). The present study, though basing on simple field observations, provides an insight into the conservation of Oriental Cetoniinae including *Coilodera*. Association with wood-feeding cockroaches, which are abundant in forests with abundant large decaying wood, suggests the occurrence and abundance of *Coilodera* largely depend on how well the forests are preserved. Because abundance of decaying tree is a key index that can reflect productiveness and resilience of forest ecosystems, preservation of decaying wood is a significant approach to conserve or manage forest ecosystems (Apps and Price, 1996). Such an approach directly leads to preservation of insects like wood-feeding cockroaches, which indirectly helps conserving Cetoniinae like *Coilodera*. Thus, revealing larval habitats of Cetoniinae provides a clue to conserve them.

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