Mites Inhabiting a Lepidopteran Egg

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Lepidopteran eggs are highly variable in morphology, showing different shapes and sizes according to family, genus and/or species (Stehr 1987). After hatching, many species eat their egg shells (see examples in Braby & Nishida 2007), while others open a hole through which they hatch and leave the rest of the chorion intact (see examples in Kaminski et al. 2013). In some cases, the empty egg shell can remain for days or weeks in a shape similar to the original (e.g. egg shells of *Parrhasius polibetes* (Stoll, 1781) (Lycaenidae) may endure on the inflorescences of their hostplants for several weeks; L. L. Mota, pers. obs)

In April 2013, a lepidopteran egg shell was found attached to the lateral of a Myrtaceae leaf, in an area of Cerrado savanna belonging to the Laboratório Nacional de Luz Síncrotron (22º48'S, 47º03'W), in Campinas, Southeast Brazil. The egg was elongated (1.3 mm long and 0.4 mm wide), with longitudinal ribs, and one extremity was open with irregular edges, suggestive of biting marks left by the caterpillar while hatching (Fig. 1). It was attached to the leaf longitudinally, so the structure resembled a tunnel with one side closed. Its shape and position in the leaf are similar to the described for the Mimallonidae genus *Lacosoma* Grote, 1864 (Dyar 1900, Peterson 1961; 1966). A caterpillar was found on a nearby leaf on the same branch, and was possibly the one which hatched from this egg. It was under a net constructed of silk and frass, also similar to that described for early and mid-instar larvae of a *Lacosoma* species (Dyar 1900). These evidences strongly suggest the egg belonged to the family Mimallonidae.

With stereomicroscopy observation, four unidentified mites (Acari) were found inside the egg, at the opposite extremity to the opening (Fig. 1a). Feces and at least six elliptical mite eggs (0.09 mm long) were also present at this region (Fig. 1b). The mites stayed in the same position even with intense hand and pin manipulation. Under stereomicroscope light they started to move and only one of them left the egg, walked around the chorion and the leaf and entered the egg shell a few minutes later (Fig. 1c–d). Previously, no mites were found walking in the leaf outside the egg shell.

The presence of the mites, their feces and eggs inside this lepidopteran egg shell suggests they were consistently using the chorionic structure as a shelter and reproduction site. Mites use many leaf structures as shelters, such as acaridomatias (O'Dowd & Willson 1989, Willson 1991), former lepidopteran shelters (Lima et al. 2013), rolled leaves (Fournier et al. 2003), and even adhesive traps of carnivorous plants (Antor & García 1995). Some mites tend to establish preferentially near wall structures, especially in gaps between two walls (Kawasaki et al. 2009), so the egg shell of this Mimallonidae seems to be a perfect site for them, representing a long structure with two parallel walls. The benefits proportioned by the egg shell could be related to diminishing predation risk and maintaining microclimatic conditions (which could prevent them from desiccating), as found for other kinds of shelters used by mites (Kawasaki et al. 2009, Lima et al. 2013). The mites and eggs were positioned as far as possible from this aperture, where it would be most difficult for a predator larger than the opening of the egg to reach, and where they were in contact with a third wall structure, possibly providing optimal microclimate conditions. It is interesting to note that egg shells with other shapes, such as round or flat, or with hatching apertures positioned in a different place, could differ as well in the conditions provided for mites.

Even though this is a single record, it is, as far as we know, the first record of opportunistic use of a lepidopteran egg shell as a shelter, and offers evidence that empty eggs can increase the environmental complexity of leaves or other substrates. This effect would be possibly more intense in the case of eggs oviposited aggregately, or in plants that host a high abundance of eggs. Organisms that change the availability of resources to others are considered ecosystem engineers (Jones et al. 1994). It is known that some lepidopterans act this way by leaving leaf shelters (Vieira & Romero 2013) after caterpillar use, and by the vacant space left by mining species (Kagata & Ohgushi 2004). We suggest that another way through which lepidopterans—and other insects as well—could act as ecosystem engineers is through the differentiated microhabitat created by egg shells left empty after hatching. This would apply for systems in which some small arthropod species largely use these structures, and is an interesting, yet unrecorded, possibility.

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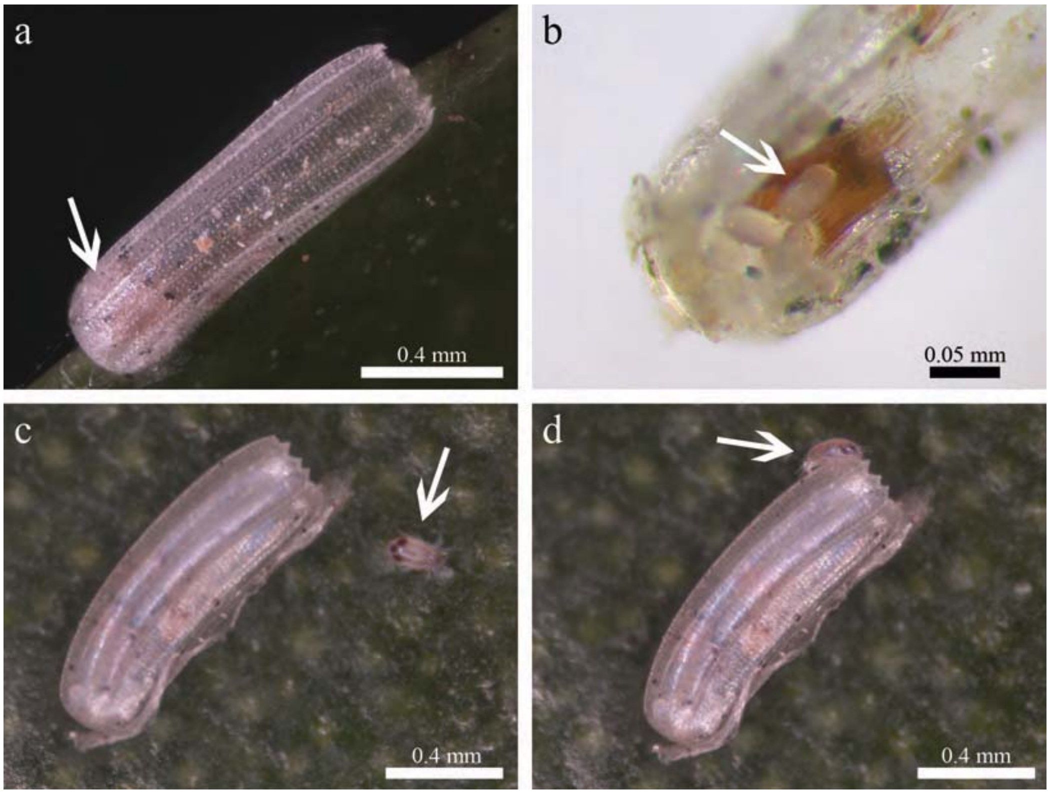

FIG. 1. **a)** Hatched Mimallonidae egg in dorso-lateral view, with mites (arrow) at the opposite extremity to the egg opening; **b)** Mite eggs (arrow) inside the Mimallonidae egg; **c)** Lateral view of the Mimallonidae egg after heating and hand manipulation, with a mite (arrow) that exited the egg interior; **d)** The same mite (arrow) close to the egg aperture.

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