Immature stages of the Neotropical satyrine butterfly *Taygetis acuta* (Nymphalidae: Euptychiina)

André Victor Lucci Freitas[1,2]

[1] Departamento de Biologia Animal, Instituto de Biologia, Universidade Estadual de Campinas, Campinas, SP, Brazil
[2] Museu de Zoologia, Instituto de Biologia, Universidade Estadual de Campinas, Campinas, SP, Brazil

Abstract. The present paper describes the immature stages of the Neotropical satyrine butterfly *Taygetis acuta* Weymer, 1910. The solitary eggs are greenish white and round. The immature stages of *T. acuta* are morphologically similar to those of other species of the "*Taygetis virgilia* (Cramer, 1776) group", with the last instar having elongate dorsal markings resembling the yellowish-bordered, elongate blotches caused by fungus on bamboo leaves, suggesting that camouflage could be involved. The pupa is short and smooth and entirely green, with short ocular caps. Larvae passed through four solitary instars and fed on bamboo (Poaceae) offered to them in the laboratory, with the natural hostplant still unknown.

Resumo. O present trabalho descreve os estágios imaturos do satiríneo Neotropical *Taygetis acuta* Weymer, 1910. Os ovos são branco esverdeados, arredondados e isolados. Os imaturos de *T. acuta* são morfologicamente similares àqueles de outras espécies do "grupo *Taygetis virgilia* (Cramer, 1776)", com o último instar apresentando marcas dorsais alongadas alusivas às manchas alongadas com bordas amarelas causadas por fungos nas folhas de bambus, sugerindo que camuflagem pode estar envolvida. A pupa é curta e lisa, inteira verde, com capas oculares curtas. As larvas passam por quatro instares solitários e se alimentam em bambus (Poaceae) oferecidos em laboratório; a planta hospedeira na natureza é desconhecida.

Key words: Atlantic Forest, Immature stages, Satyrini

INTRODUCTION

Among the Euptychiina (Nymphalidae: Satyrinae), the "*Taygetis* clade" (*sensu* Murray & Prowell, 2005; Peña *et al.*, 2010; Matos-Maraví *et al.*, 2013) is one of five major clades, with its 11 described genera forming a robust monophyletic entity based on molecular (Peña *et al.*, 2010; Matos-Maraví *et al.*, 2013) and morphological data (Marin *et al.*, in prep.). The clade is exclusively Neotropical and has diversified mostly in the lowlands, with the exception of some species of *Taygetis* Hübner, [1819] and the montane genus *Forsterinaria* R. Gray, 1973, which occur in medium elevations in the Andean and Brazilian Atlantic Forest mountains (Peña & Lamas, 2005).

Species of *Taygetis* are associated with lowland tropical and subtropical habitats across the Neotropics, occurring from pristine forests to secondary vegetation, riparian forests in savannic habitats, and even urban parks (DeVries, 1987; Matos-Maraví *et al.*, 2013; Sant'Anna *et al.*, 2014), and some species can be locally abundant. About 30 species have been described in *Taygetis*, but several undescribed species have been recognized so far, and a considerable amount of cryptic diversity awaits proper description, especially under the "*Taygetis laches* (Fabricius, 1793) group" and "*Taygetis virgilia* (Cramer, 1776) group" species complexes of Matos-Maraví *et al.* (2013).

Although immature stages have been described or illustrated for about six species of *Taygetis* (Müller, 1886; DeVries, 1987; Murray, 2001; Janzen & Hallwachs, 2015; excluding species already transferred to different genera, such as *Taygetina kerea* (Butler, 1869)), there are few detailed descriptions and most of the published accounts are for members belonging to the aforementioned species complexes, with the life histories of most other species groups remaining unknown.

The present paper describes the immature stages of *Taygetis acuta* Weymer, 1910, one of the few montane species of the genus, and compares them with those of other species of *Taygetis*.

STUDY SITES AND METHODS

Study sites. Adults and immatures of *Taygetis acuta* were studied in two different localities in São Paulo State, southeastern Brazil: 1) Fazenda Intervales, Capão Bonito (800-950 m; 24º16'S, 48º25'W); 2) Estação Biológica de Boraceia, Salesópolis (850-950 m; 23º39'S, 45º53'W). Both places are covered by old growth, well-preserved montane forest with high annual rainfall (> 2000 mm per year) without a dry season, and with mean temperatures around 18°C. At both sites, different species of native bamboos, a common hostplant for euptychiines (Beccaloni *et al*., 2008; pers. obs.) are present inside the forest, occasionally forming dense patches.

Sampling and rearing of immature stages. Fertile eggs were obtained from wild-captured females confined in plastic bags warmed by a 40 W bulb and provided with leaves of native bamboos from the same place where the adults were found. Larvae were reared in plastic containers cleaned daily and provided with fresh plant material every two or three days (following Freitas, 2007). Data were recorded on morphology and development time for all stages. Dry head capsules and pupal cases were retained in glass vials. Immature stages were fixed

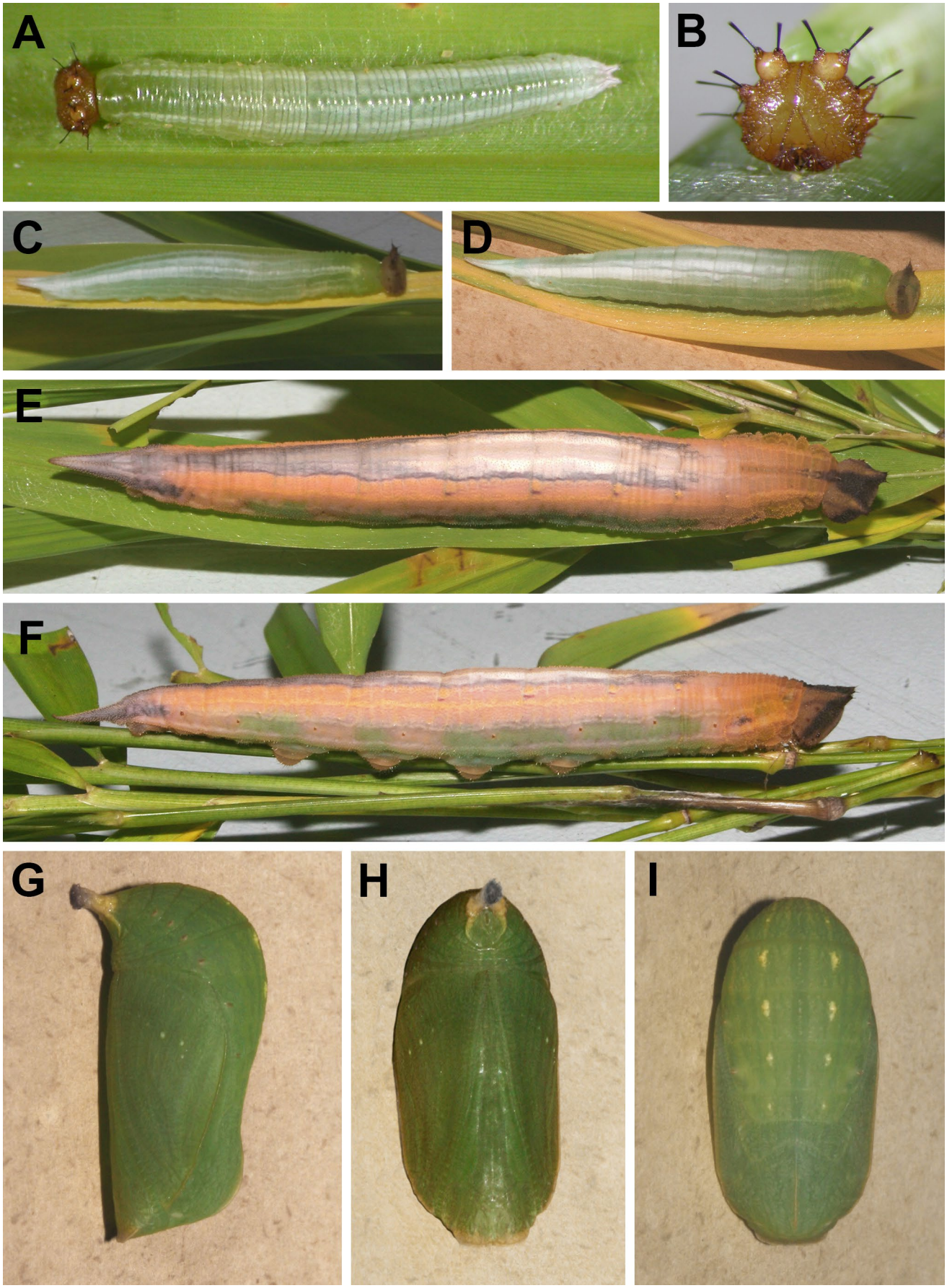

Fig. 1. Immature stages of *Taygetis acuta*. A. first instar, dorsal; B. frontal view of first instar head; C. second instar, lateral; D. third instar, lateral; E, F. Fourth (last) instar, dorsal and lateral; G, H, I. Pupa, lateral, ventral and dorsal.

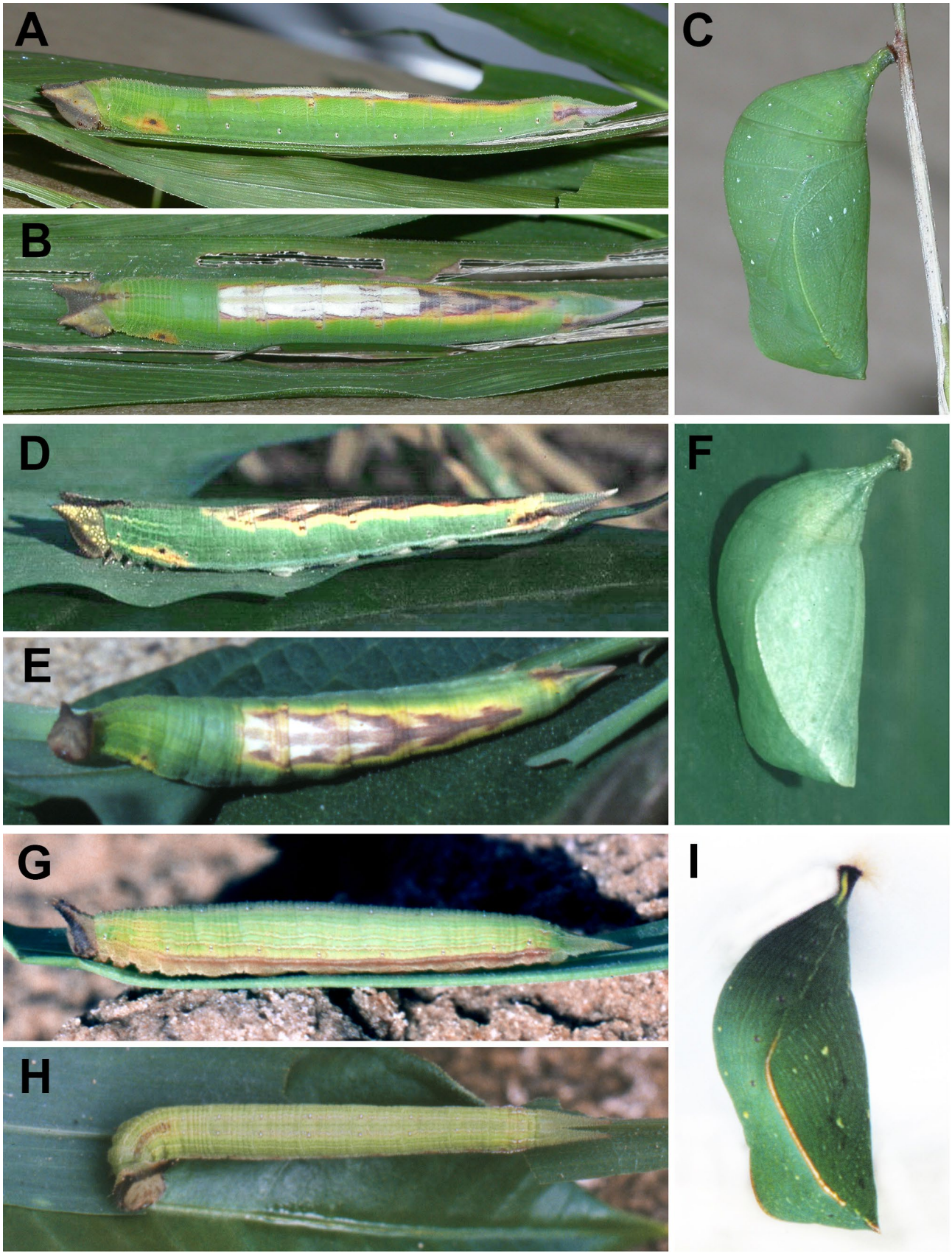

Fig. 2. Immature stages of *Taygetis* spp. from Brazil. A-C. *Taygetis* "*rufomarginata*" (DNA voucher NW129-27; see Matos-Maraví *et al.* 2013), Sete Barras, São Paulo – A, B. fourth (last) instar, lateral and dorsal; C. pupa, lateral. D-F *Taygetis* "*virgilia*", Alta Floresta, Mato Grosso – D, E. fourth (last) instar, lateral and dorsal; F. pupa, lateral. G-I *Taygetis* "*laches*", Campinas, São Paulo – G, H. fourth (last) instar, lateral and dorsal; I. pupa, lateral.

in Kahle-Dietrich solution (Triplehorn & Johnson, 2005) when the number of specimens was sufficient. Voucher specimens of the immature stages were deposited in the Museu de Zoologia "Adão José Cardoso" (ZUEC-AVLF), Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.

Morphology. Measurements were taken and general aspects of morphology were observed using a Leica®MZ7.5 stereomicroscope equipped with a micrometric scale. Egg size is presented as height and diameter, and head capsule size is the distance between the most external stemmata (as in Freitas, 2007). Terminology for early stages descriptions follows García-Barros & Martín (1995) for eggs and Stehr (1987) for larvae and pupae.

RESULTS

Description of immature stages. The following descriptions and measurements are based on material reared from the two above-mentioned localities.

Egg. Greenish white and round with hexagonal markings barely visible under magnification. Height 1.94 – 2.00 mm (mean = 1.98 mm, SD = 0.028 mm, n = 5); diameter 1.98 – 2.02 mm (mean = 1.99 mm, SD = 0.017 mm, n = 5); duration 5 - 8 days (n = 15).

First instar (Figs. 1A, B). Head capsule width 1.26 mm; head scoli 0.28 - 0.34 mm (n = 3). Head brown, with enlarged chalazae, bearing a pair of short scoli on vertex, each with two long narrow black setae (Fig. 1B). Third stemma larger than other stemmata. Body light green, with white longitudinal stripes; caudal filaments very short. Legs and prolegs light green. Setae light green, all dorsal and subdorsal setae clubbed at tip. Maximum length 11 - 12 mm. Duration 9 - 11 days (n = 9).

Second instar (Figs. 1C). Head capsule width 1.64 – 1.92 mm; head scoli 0.60 – 0.70 mm (n = 2). Head brown with two short dark brown scoli on vertex. Body green, striped longitudinally with white; caudal filaments short. Legs and prolegs light green. Maximum length 16 - 20 mm. Duration 6 - 12 days (n = 5).

Third instar (Figs. 1D). Head capsule width 2.47 – 2.77 mm; head scoli 0.89 – 0.99 (n = 2). In all aspects very similar to second instar but larger. Maximum length 25 - 30 mm. Duration 8 - 13 days (n = 5).

Fourth (last) instar (Figs. 1E, F). Head capsule width 3.69 – 3.79 mm; head scoli 0.96 – 1.08 mm (n = 2). Head dark brown, with two diverging dark short scoli on vertex. Body green at start of instar, changing to predominantly reddish later; abdominal segments with a dorsal whitish cream elongate area bordered with gray, making larva resemble a dry bamboo leaf; caudal filaments short and grayish. Legs and prolegs reddish. Maximum length 40 - 50 mm. Duration 17 – 20 days (n = 3).

Pupa (Figs. 1G,H,I). Short and smooth; entirely green; short rounded ocular caps; cremaster yellow; dorsal abdomen smooth without projections. Total length 29 - 30 mm (n = 2). Duration 16 days (n = 1).

Behavior and natural history. *Taygetis acuta* is an Atlantic Forest endemic, from the Brazilian states of Santa Catarina to Espírito Santo, occurring mostly in montane coastal forests, but reaching the interior in the region of Belo Horizonte in Minas Gerais state (J. P. Santos & A. V. L. Freitas, unpublished). The species has been recorded from 800 to 1200 m altitude, and is always locally rare (Brown & Freitas, 2000; AVLF pers. obs.). Oviposition behavior was not observed in the field. Eggs were laid singly in the laboratory and larvae easily accepted an unidentified species of native bamboo. Larvae were solitary in all instars and did not exhibit cannibalistic behavior (several larvae of different instars were reared together in small pots). Adults are crepuscular, and were recorded in areas of well preserved forests flying erratically inside large bamboo patches. Adults feed on fermenting fallen fruits, feces and several other decaying substances, never being observed visiting flowers.

DISCUSSION

The immature stages of *Taygetis acuta* are, in general, similar to those of most Neotropical Euptychiina: larvae lack body scoli, present short head horns and caudal filaments and the pupae are short and smooth. In particular, the larvae of *T. acuta* are similar in shape to those of other species of *Taygetis* of the "*T. virgilia* group", and the most remarkable characteristic is the dorsal oblong pattern of later instars, which resembles markings on old bamboo leaves (Figs. 1, 2). This color pattern is present in larvae of all reared species of the "*T. virgilia* group" and is absent from other species of *Taygetis* such as those in the "*T. laches*-group" and in *Taygetis mermeria* (Cramer, 1776) (Fig. 2; Young, 1984; Janzen & Hallwachs, 2015). The larva of "*T. virgilia*" illustrated by Murray (2001) is distinct from all known larvae of the "*T. virgilia* group", lacking the characteristic dorsal marking and presenting distinct head horns, being very similar to larvae of *Taygetina kerea* (A. Butler, 1869) (see Janzen & Hallwachs, 2015).

The remarkable resemblance of the dorsal markings described for larvae of *T. acuta* and other species of the "*T. virgilia* group" to the commonly observed yellowish-bordered elongate blotches caused by fungus on bamboo leaves suggests that camouflage could be involved. Although this is currently speculative, future field experiments could help in understanding the function of these color patterns, adding information about the defense mechanisms in larvae of satyrine butterflies and improving our knowledge of the natural history of this highly diversified group.

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