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EARLY STAGES AND NATURAL HISTORY OF *CITHAERIAS P. PIRETA* (SATYRINAE) FROM COSTA RICA

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ABSTRACT. The early stages of *Cithaerias pireta* are described from a Costa Rican lowland rain forest on the Caribbean slope. The host plant is *Philodendron herbaceum* (Areaceae), which grows in the dark understory areas in very humid habitats. Implications for palatability and mimicry are discussed with respect to the bright colors of the adults of this and related genera. The caterpillars had five instars and the total cycle from egg to butterfly eclosion lasted 66 days. Photographs and descriptions are provided of the larvae and pupa, and observations on behavior, habitat and host plants are discussed.

Additional key words: *Cithaerias menander*, *Pierella helvetia*, *Dulcedo polita*, *Haetera macleannania*, *Philodendron herbaceum*, Batesian mimicry, Mullerian mimicry.

The genus *Cithaerias* Hübner (1819) is a neotropical group of Satyrinae which is recognized by their largely transparent wings (DeVries 1987). According to Lamas *et al.* (2004) there are five species, and only one occurs in Central America. This genus is found from Mexico through the Amazon basin where it is more diverse. In Costa Rica, *Cithaerias pireta pireta* (Stoll 1780) occurs in all rain forest habitats from sea level to 1000m on the Caribbean and the Pacific side (DeVries 1987 as *C. menander*). They usually fly around small light gaps in the forest understory associated with trails, river sides and hills. Both sexes fly around areas where their food plants are growing, from early morning until afternoon if there is sunshine. However, in a study done in Corcovado, Costa Rica (Whittaker 1983), most of the individuals showing this behavior were females, and individual butterflies did not stay more than one day in the same area. This behavior is opposite to that described by Young (1972) where the same individuals returned to the same place day after day. All the host plants reported by DeVries (1987) for the Satyrinae are in the families Poaceae, Marantaceae, Arecaceae and Cyperaceae, all of which are monocots, and Selaginellaceae and Neckeraceae (clubmosses and mosses). The host plants of this subfamily are generally thought to have relatively few secondary compounds and the generally cryptic color patterns of adult Satyrinae may result from an inability to sequester toxic compounds (Whittaker 1983). Larval food preference among monocot feeders does not appear to have evolved in line with plant defenses as it has in other groups (Ehrlich & Raven 1964). However, *Cithaerias*, feeding on Araceae, generally found to be highly toxic monocots, provides an interesting exception on which I elaborate.

MATERIALS AND METHODS

An extensive search for butterfly larvae was carried out on 18 November 2006, at the Rain Forest Aerial Tram property (450m), on the border of Braulio Carrillo National Park, Limón, Costa Rica, 10° 10' 47.76" N, 83° 55' 07.66" W. The climate of the locality is defined as Tropical Wet Forest, Premontane Belt Transition (Tosi 1969). According to the butterfly species composition of the area it is defined as swamp forest (DeVries 1987). In this habitat I followed dozens of females of *C. pireta*. At 1300 h. in a dark hilly area one butterfly finally laid an egg on the host plant. The egg was collected by removing the leaf of the host plant and placing it in a plastic jar, which was then transported and reared in the Museo de Insectos at the Universidad de Costa Rica, with an average room temperature of 23–24°C. The caterpillar was put into a plastic bag and fed with leaves of the host plant which were brought every week from the place where the egg was found. The host plant identification was done by the botanist Carlos O. Morales. The adult obtained from this study and the empty pupae are deposited in the author's collection. The photographs were taken with a Cannon camera model Rebel G.

RESULTS

Host Plant: *Philodendrom herbaceum* Croat & Grayum (Araceae). This plant is a vine that grows in dark areas in the understory, climbing rocks, trees and vines to a height of one or two meters. The plant is very abundant in the study area.

Egg (Fig. 1a): 0.8 mm diameter, spherical, creamy white, chorion smooth. Laid singly on the underside of the leaf at 15cm height in a dark forest area. The female flew slowly around the plant and selected a place close to the central vein of the leaf. The egg hatched eight days later.

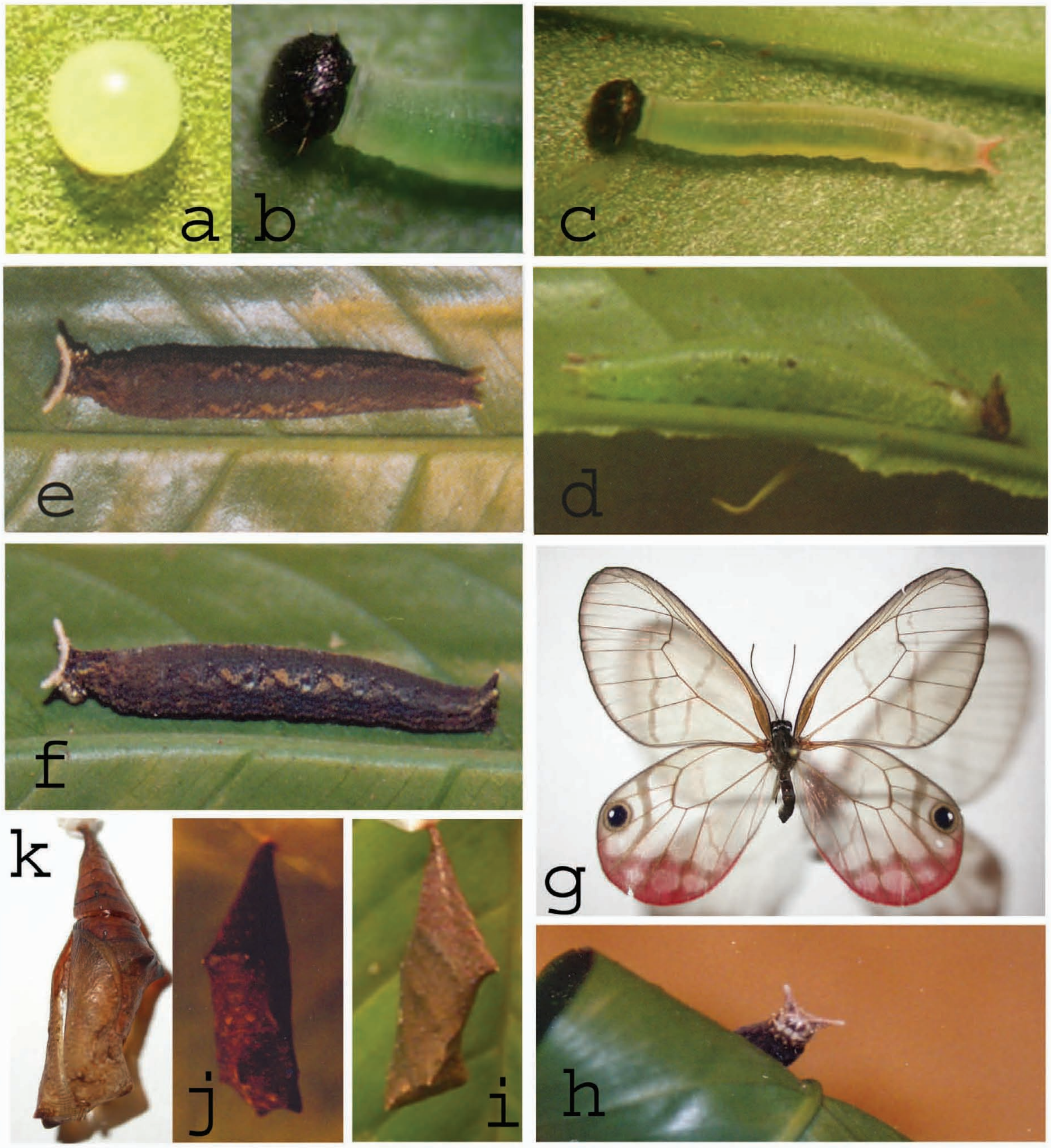

FIG. 1. **a**: egg, **b & c**: first instar, **d**: fourth instar, **e, f & h**: fifth instar, **g**: adult of *C. p. pireta*. **i, j & k**: pupa

First instar (Fig. 1b, c): 0.75–2mm. Head capsule black, stemmata black. Two small dorso-laterally projecting horns on each side of the epicranium and a few long black setae on each side. Body light green, spiracles same color, no setae covering the body. The larva has a bifurcate suranal plate half as long as A9 segment, the same color as the body. Time: 8 days to molt.

Second instar: 2–4.5mm. Head capsule same as previous instar but with longer head horns. Body light green, with a black dot on the dorsal part of T1 segment. A3 has a dorso-lateral black dot on each side of the body, and the same is repeated on A4. A smaller black dot is situated in A5 but closer to the spiracles. Another black dot, the same size as the previous one on A8 in lateral position. Bifurcate suranal plate conically elongated backward. Similar to fourth instar but smaller. Time: 12 days to molt.

Third instar: 4.5–12.5mm. Head capsule same as previous instar but with longer head horns. Bifurcate suranal plate conically elongated backward. Body similar to fourth instar but smaller. Time: 10 days to molt.

Fourth instar (Fig. 1d): 12.5–21mm. Head capsule same as previous instar but the dorso-lateral horns are as long as half the head diameter. Body light green, same as second and third instars. Time: 7 days to molt.

Fifth instar (Fig. 1e, f, h): 21–32mm. Head capsule same shape as previous instars but frons with upper half black and lower half white, clypeus black, stemmatal area black and mandibles white. Dorso-lateral horns same as previous instar but white. Four creamy yellow conical protuberances on lateral area of the epicranium. Body dark brown with two dorso-lateral bands of triangular light brownish-orange spots highly accentuated from A3 to A6 segments, and with very small white spots in dorso-lateral position, one per segment from A2 to A7. Bifurcate suranal plate same as previous instars but light brownish-orange and with white tip. Time: 6 days to molt.

Pupa (Fig. 1i, j, k): 17mm. Dark brown. Abdomen with conical shape, and two dorsally projected conical horns on segment A3. The thorax has a dorsal conical projection. The angle between the ventral cremaster and the abdomen is almost 180°. Duration of pupal stage: 14 days.

DISCUSSION

In Costa Rica, *C. p. pireta* (Fig. 1g) is abundant in places that lack a marked dry season (DeVries 1987). Its habitat is the shade of the wet understory where plants are adapted to little light, and the host plant of *C. p. pireta* is one of these plants.

The external morphology of the larvae of *C. p. pireta* follows the typical form of Satyrinae, which have a pair of cephalic horns and a bifid tail (Scoble 1992). The head capsule is similar to the illustration of *Cissia confusa* in DeVries (1987) and as displayed at Janzen *et al.* (2005). The first four instars are light green and last instar is dark brown, which coincides with the larval behavior of always resting on the undersides of leaves in the first 4 instars and on tree trunks in the last instar (Janzen pers. comm.). The pupae have a brown cryptic pattern, and the two dorsal projections are rare in this subfamily, although other species of Satyrinae that resemble *Cithaerias* pupae in basic shape include *Cissia usitata* and *Cissia alcinoe*. In Satyrinae, there are two basic pupal shapes, one with a ventral 110° angle between cremaster and abdomen, as in *Manataria* (Murillo & Nishida 2003), and the other with a 180° angle (Fig. 1i, j, k).

Young (1972) reported small, close demes with the same individuals of *Cithaerias* returning to the same place day after day. This territorial behavior may be coupled with structures that help males protect the place from other males.

Cithaerias possesses a swelling of the sub-costal vein. The function of this structure in this species is still unknown, but it may be used to produce sounds to attract mates or to fight with others individuals, as has been described in species of Satyrinae from South America (Murillo-Hiller 2006), and it is probably the source of the acoustic signals found by Kane (1982) in another south American satyrine species.

All known host plants for other neotropical Satyrinae are thought to lack dramatically toxic secondary compounds and, as a consequence, the species are always palatable to predators and the group does not show mimicry rings (DeVries 1987). Viloria (2004) argued that there is no direct evidence that species of Pronophilina (and other groups in Satyrinae) are unpalatable and therefore classical Batesian or Mullerian mimicry does not offer an appropriate explanation for the resemblance between these satyrine species.

In the case of this recently recorded family of satyrine host plants, many secondary compounds are known (Laurito *et al.* 2005). It is possible that there is Mullerian or Batesian mimicry among species of *Cithaerias* and *Haetera*, especially now that it has been found that the host plant of the latter genus also is a toxic Araceae plant (Constantino 1993). *Dulcedo polita* is a related species similar to *C. pireta*, but even when sympatric it does not show any red or rose colors on its wings. This makes sense since the host plants of *Dulcedo* are *Geonoma* and *Welfia* (Arecaceae) (DeVries 1987), which probably do not have secondary compounds that can be used as defense by the butterfly. Another species related to and sympatric with *Cithaerias* is *Pierella helvetia*, which also has bright red coloration on the hind wings, and whose host plants are species of Heliconiaceae and many other monocots (Janzen *et al.* 2005). More research should be done to find out if they are aposematic or if, on the other hand, these markings are for directing bird attacks to that area, as proposed by Hill & Vaca (2004).

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