

GENERAL NOTES

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NOTES ON THE LIFE HISTORY OF *ASTEROPE MARKII* HEWITSON, 1857 (NYMPHALIDAE)

Additional key words: Ecuador, *Paullinia*, Sapindaceae.

Despite their remarkable coloration and the contention that they are among the most beautiful butterflies in the world (Jenkins 1987), there is little information on the biology of butterflies of the genus *Asterope* Hübner, 1819 (Nymphalidae). The genus is distributed throughout the Amazon Basin and is comprised of eight species, of which only three have any life history information published (Jenkins 1987). Jenkins (1987) reports that, in general, species of *Asterope* use the genus *Paullinia* (Sapindaceae) as host plants. However, nothing is published about the host plants or early stages of *Asterope markii* Hewitson, 1857. Here I report on the morphology of the penultimate and ultimate instars, and the pupa of *A. markii* from eastern Ecuador. A photograph of the ultimate instar, a drawing of its head capsule, a schematic representation of its scoli arrangement, a drawing of the pupa, and a photograph of the adult voucher specimen are provided. Host plant use and larval habits are discussed.

Asterope markii is found in the Amazon Basin of Ecuador, Peru, Colombia, Venezuela, Brazil and potentially Bolivia (Jenkins 1987). This species is associated with undisturbed lowland rainforest and is an uncommon canopy insect. In an eleven-month fieldwork period at Garza Cocha in eastern Ecuador, I observed only one adult (a male collected 7 June 1998) and seven larvae. In six years of trapping fruit-feeding nymphalids at this site, *A. markii* has never been collected in traps baited with rotten bananas, and only three adults have been collected by net (P. J. DeVries pers. com.).

The following life history observations were conducted under ambient conditions at Garza Cocha, an oxbow lake of the Rio Napo in Provincia Sucumbios, Ecuador near the settlement of Anañgu. Observations were made intermittently from November 1997 to July 1998. Larvae were reared in plastic cups cleaned daily, and kept for study in an open-air building with large wire-mesh windows. Larval and pupal specimens were killed and preserved in 70% ethanol. Nomenclature for larval morphology follows Scoble (1992), except that I combine segments A9 and A10 (A9 + 10) to reduce ambiguity between this and earlier descriptions of *Asterope* larvae (see below). Larval and pupal descriptions below are based on two individuals. The

plants bearing larvae were in undisturbed primary forest south of the Rio Napo from Garza Cocha. This habitat consists of steep ridges and hills with intervening small streams in contrast to the north side of the river, which is made up of oxbow lakes and a mix of tierra firma and varzea forest. A more thorough description of the site may be found in DeVries et al. (1999b).

Ultimate instar. (Figs. 1, 2A, C) ($n = 2$) **Head.** Head capsule (cast head capsule width = 3.4 mm; height, including head scoli = 15.2 mm, $n = 2$) and scoli dark midnight blue and sparsely covered in fine setae. Two prominent scoli arise dorsolaterally from the head capsule, approximately three times as long as the dorsolateral body scoli as described by Bates (1859:3) for *Asterope sapphira* Hübner. These scoli are adorned with whorled branches which arise at four evenly spaced places along their length (Figs. 1, 2A). From base to apex the numbers of these branches are 2-4-4-5 (not including the scoli tip) respectively (Fig. 2A). Posterior to the origin of each large dorsolateral scoli lies a pair of short scoli (not visible in Fig. 2A). A pair of short unbranched scoli lie between the dorsolateral scoli. Laterally head capsule with four scoli decreasing in length toward mandibles. Head scoli with whorled branches occur in related genera, *Epiphile*, *Nica*, *Pyrrhogyra*, and *Temenis*, whose larvae also specialize on the Sapindaceae (DeVries 1987, Aiello in litt.). **Body.** With five bands of orange alternating with metallic midnight blue (Fig. 1, color images may be obtained from the author). Segments T1, T3 and A7 entirely metallic midnight blue. Segments T2, A2, A4, A6 and A8–10 light orange dorsally, with a change in color to midnight blue below the spiracles. Dorsally, segments A1, A3, A5 midnight blue in the anterior half and light orange in the posterior half, with midnight blue below the spiracles. The dorsal orange areas are flecked with pairs of metallic blue spots. Prolegs and spiracles dark. **Scoli.** All body scoli sparsely covered by fine setae. Dorsal and dorsolateral body scoli metallic blue. Lateral scoli metallic blue fading to pale cream distally. Ventrolateral scoli pale cream. Scoli arrangement and number of branches arising from scoli are indicated in Fig. 2C. Most dorsal unbranched scoli on T1 shorter than other scoli on the segment. Lateral bifurcated scoli on T1 with anterior branch very short. Bifurcated supra-spiracular scoli on A2–A8 with anterior branch shorter than posterior branch. In contrast, lateral bifurcated scoli in similar position on T2 and T3 has anterior distal branch longer than posterior. A1–A8's bifurcated sub-spiracular scoli with anterior branch shorter than posterior branch. Bifurcated scoli located dorsal and posterior to proleg on A3–A6 with anterior branch longer than posterior. A9 + A10's dorsolateral scoli with five or six whorled branches distally. Note that Figure 2C shows only five whorled branches distally for A9 + A10's large dorsolateral scoli.

Placement and branching patterns of scoli for *A. markii* are combined into Table 1 to facilitate comparison with other *Asterope* larvae. See Table 3 in Jenkins (1987:11) for comparisons. My use of the descriptive terms "dorsal midline" and "dorsolaterally" are equivalent to Jenkins' (1987) "dorsal" and "subdorsal," respectively. In this way I omitted the terms Dorsalia Anteriora and Dorsalia Posteriora because only those scoli on the dorsal midline arise posteriorly in the segment. To facilitate comparison with Jenkins' table, and because it can be difficult to distinguish segments A9 and A10 in some

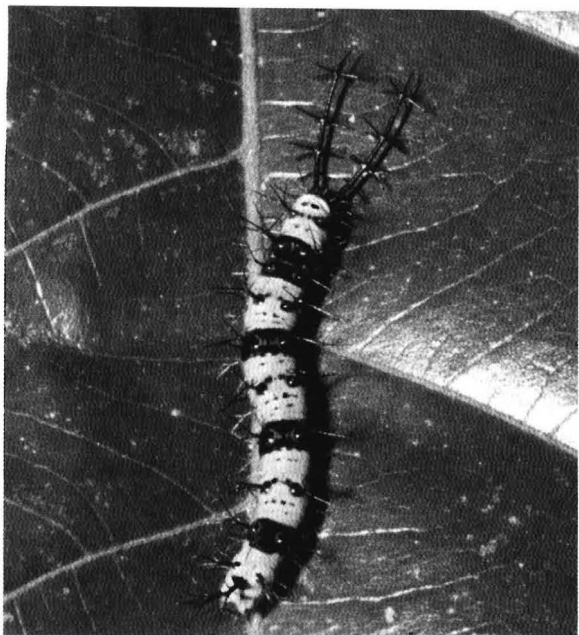


FIG. 1. Ultimate instar *Asterope markii* in characteristic resting position with head scoli directed forward.

nymphalid larvae (C. M. Penz pers. com.), I have included a combined A9 + A10 segment in Table 1. Note that A9 in Jenkins' Table 3, which contains a five-branched scoli on each side for all species listed, is analogous to A9 + 10 in Table 1. Ultimate instar duration eight days ($n = 1$).

Penultimate instar. ($n = 1$) Like the ultimate instar, banded with orange and metallic midnight blue, and with similar scoli placement and morphology. Head capsule (width = 2.19 mm; height, including head scoli = 9.6 mm, $n = 1$) lacks most ventral lateral scoli, leaving three lateral scoli, not four. Penultimate instar duration eight days ($n = 1$).

Pupa. Fig. 2B. ($n = 2$) Overall, pupa patterned with black lines and splotches on a light orange background. Cremaster black. When freshly formed, the wing pads are opaque with black wing-vein markings. By day six, the wing pads are pale yellow with distinct dark wing veins, and the terminal abdominal segments are pale yellow outlined by black. Dorsally pupa light orange with four pairs of black spikes (approximately 2 mm long, on A2–A5) and a fifth pair that are merely bumps (on A6). These pairs of spikes form two dorsolateral rows along the pupa (Fig. 2B). Thorax very light orange dorsally. Thorax with prominent and very slightly keeled dome ending abruptly before head and blending somewhat with abdomen. Thoracic dome bordered by dark lines at apex and dark broken stripe on each side laterally. Anteriorly, thoracic dome with dark blotch at base and thick elongate blotch running along base. Head area blunt with dark stripes running ventrally. Legs, proboscis, and antennae marked ventrally with distinct dark lines. Many small black splotches dorsally along the abdomen, thorax, ridge of keel and near head. Pupa pendant when attached to vertical surface. Pupal duration eight days ($n = 1$). See Fig. 3 for photographs of adult voucher specimen.

Larval habits. In total, seven solitary larvae were observed. They were found resting on top of leaves in positions ranging from slightly bent to the form of a question mark. Two individuals were observed resting along the mid-vein of the leaf. The larvae rest with their heads facing down and the head scoli pro-

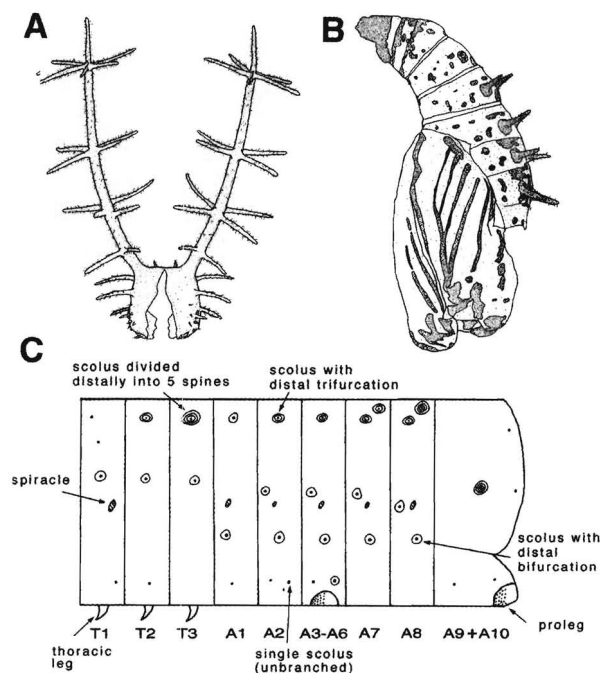


FIG. 2. *Asterope markii* ultimate instar cast head capsule (A), pupal exuvium (B), and schematic of ultimate instar scoli distribution (C). A and B not drawn to scale. C adapted from Freitas et al. (2001).

jected forward (Fig. 1). They are inactive when encountered on the topside of leaves during late morning and no observations were made at other times of the day. The larvae were observed to eat mature leaves.

The combination of contrasting orange and dark blue colors, spiny appearance, and diurnal habit of resting on the top of leaves is consistent with the hypothesis that the larvae of this species are aposematic. However, identification of the larvae's unprofitable attributes is speculative at this point. Some evidence suggests the possibility that the larvae are rendered unpalatable through use of host plant secondary chemicals. The host plant genus *Paullinia* is known to contain biologically active alkaloids and is the source of guaraná in Brazil, a stimulatory beverage (Gentry 1993), and barbasco, a fish poison (Jenkins 1987). Unpalatability among adults of taxonomically closely related species has been demonstrated for the genera *Hamadryas*, *Callicore*, and *Diaethria* (Chai 1988, 1996) and has been suggested for *Batesia hypochlora* (DeVries et al. 1999a). Interestingly, species of *Callicore* and *Diaethria* are associated with Sapindaceous host plants. I therefore tentatively suggest that larvae of *A. markii* may be unpalatable. However, the larval scoli themselves may offer protection from predators. They are reported to have caustic properties (Jenkins 1987), although no test for their caustic nature was

TABLE 1. Number of branches arising from larval scoli of ultimate instar *Asterope markii*. Adapted from Jenkins' (1987) Table 3.

Scolus location	"Head Horn"*	T1	T2	T3	A1	A2	A3	A4	A5	A6	A7	A8	A9 + 10
Dorsal midline											3	5	
Dorsolateral	2,4,4,5**	U	3 ^a	5 ^a	2	3	3	3	3	3	3	3	5-6

U = unbranched scolus (=1 of Jenkins)

Number = number of branches of a scolus

*large dorsolateral scoli of head capsule

**2 is most proximal, and 5 most distal

a = scoli with an additional small posterior spine on the shaft

performed in this study. The stout scoli may help deter predation, even without any urticating property by simple mechanical means.

Host plant use. *Asterope markii* larvae were observed feeding on low lying, compound-leaved (simply pinnate) lianas with forked tendrils (curled at tips) and milky sap. These characters positively identify the plant as belonging to the Sapindaceae (Gentry 1993). The plants were never observed with fruits, but could nonetheless be identified as *Paullinia* because simply pinnate leaves do not occur in other liana genera of the Sapindaceae (Gentry 1993). In addition, P. J. DeVries (pers. com.) has found *A. markii* larvae feeding on *Paullinia* at this site. Therefore, *Paullinia* is indeed the host of *A. markii*.

Larvae were found on two plants of different size. One large, sprawling plant (approximately 2 m tall)

had three larvae in April 1998 and two larvae in July 1998. A smaller plant (1 m) hosted one larva on 23 November 1997 and another on 22 December 1997. These limited data suggest a positive trend between host plant size and number of larvae. The females may assess plant size and adjust the number of eggs placed on the host to optimize larval survival.

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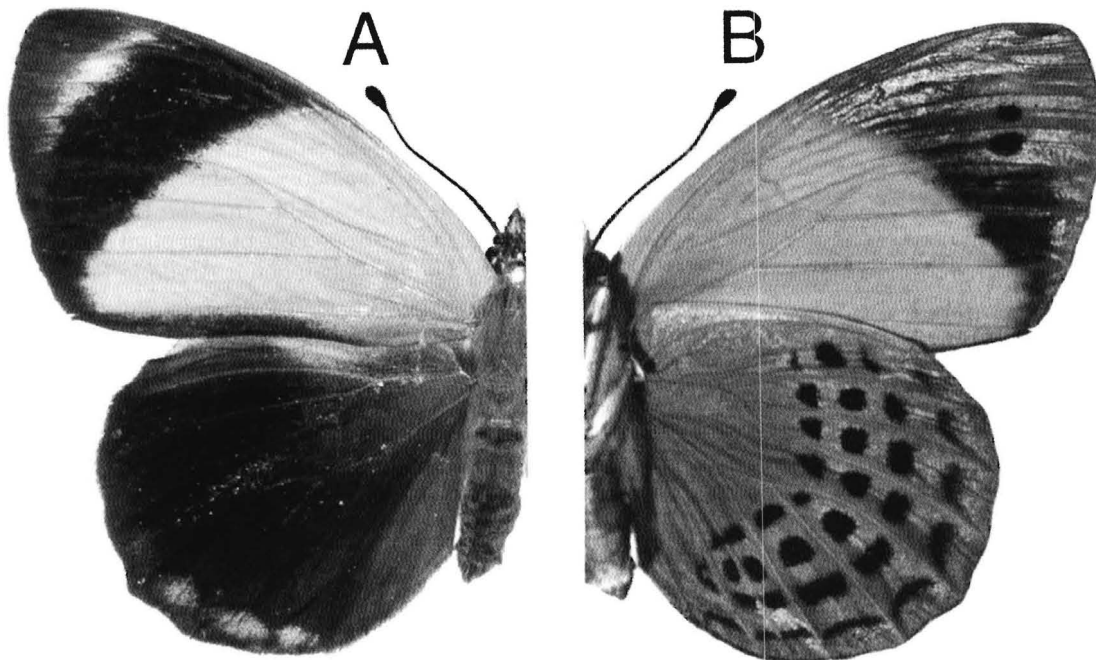


FIG. 3. Adult voucher specimen of *Asterope markii*, dorsal (A), ventral (B). The specimen is a female from Garza Cocha, Provincia Sucumbios, Ecuador.

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INTERSPECIFIC COPULATION OF A DARK MORPH *PAPILIO GLAUCUS* FEMALE AND A MALE *P. POLYXENES* (PAPILIONIDAE): OBSERVATION AND SIGNIFICANCE

Additional key words: heterospecific mating, swallowtail butterflies, pre-zygotic reproductive isolating mechanisms, sexual selection.

Pre-zygotic reproductive isolation separating species of swallowtail butterflies involves spatial (allopatric/parapatric); morphological, temporal, behavioral, physiological, and other mechanisms (such as female choice or "cryptic sexual selection" of conspecific rather than heterospecific sperm in multiply-mating species; Eberhardt 1996, Stump 2000). Post-zygotic failure of hybrid embryos, larvae, pupae or adults to survive and reproduce has been observed for laboratory hand-pairings of interspecific *Papilio* hybrids, in some cases following "Haldane's Rule," which may increase in negative impacts with increased genetic distances between the hybridized species (Haldane 1922, Hagen & Scriber 1995).

Despite the various natural reproductive isolating mechanisms maintaining species integrity among *Papilio* butterflies, there is a large amount of evidence from various laboratory interspecific hybridizations that suggests post-zygotic barriers are minimal (Ae 1995, Brown et al. 1995, Scriber et al. 1991, 1995). Natural interspecific hybridization (or any matings) among *Papilio* individuals are rarely seen in the field, however it has been estimated that more than 6% of the 200+ species of *Papilio* hybridize naturally (Sperling 1990). This suggests that the populations of these species are maintained primarily by ecological factors

rather than by strong prezygotic reproductive isolating mechanisms.

In an attempt to determine the actual field mating preferences of free-flying tiger swallowtail butterflies at critical transects of the natural hybrid zone between *P. glaucus* and *P. canadensis* (Scriber 1996), we used fresh virgin females of both species in size-matched tethered pairs at natural field sites for *P. canadensis* males in northern Michigan and *P. glaucus* males in Florida. While the free-flying Florida *P. glaucus* males selected and copulated the conspecific females in 98% of the cases, the converse was not observed. In northern Michigan, *P. canadensis* males strongly preferred the heterospecific females (*P. glaucus*; yellow morphs) rather than females of their own species in 83% of all copulations (Deering & Scriber 2002). However, in preliminary studies it was noticed that the mimetic dark morph females of *P. glaucus* (Scriber et al. 1996) were basically ignored by *P. canadensis* males in field tethering trials when paired with *P. canadensis* females (JMS et al. unpublished). This apparent failure of *P. canadensis* males to recognize or select dark morph *P. glaucus* females is part of a larger project on interspecific hybridization that led to an unexpected observation in northern Michigan involving the notable encounter with *P. polyxenes*.