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HOSTPLANT RECORDS AND DESCRIPTIONS OF JUVENILE STAGES FOR TWO RARE SPECIES OF *EUEIDES* (NYMPHALIDAE)

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ABSTRACT. New hostplant records are presented for two species of *Eueides*. *E. lineata* feeds on an as yet undescribed species of *Passiflora* in southern Mexico, and *E. vibilia* feeds on old leaves of *Passiflora pittieri* on the Osa Peninsula of Costa Rica. Behavioral observations are given and juvenile stages described for the two *Eueides* species. Larval mimicry is suggested for *E. vibilia* and two sympatric species of *Heliconius*, and an evolutionary mechanism for the mimicry is discussed.

Heliconiine butterflies are the best known group of Neotropical Lepidoptera. Their taxonomy has been unusually well worked out (Emsley, 1963, 1964, 1965; Brown & Mielke 1972; Brown 1976, 1979). This work has provided a firm basis for biological study on the species (reviewed by Brown, 1981). One of the most important features of the work on heliconiines has been their hostplant specialization (Gilbert, 1975; Benson et al., 1976; Benson, 1978; Smiley, 1978). All known species of Heliconiini use hostplants in the closely related families Passifloraceae (Benson et al., 1976) or Turneraceae (D. H. Janzen, pers. comm.), and are usually specialized within particular subgenera of the Passifloraceae (Benson et al., 1976). Relationships between *Heliconius* and *Passiflora* have proved to be useful tools in the taxonomy of both groups. We here describe the hostplants and larval stages of two little known species of *Eueides* (Nymphalidae: Nymphalinae: Heliconiini): *E. lineata* and *E. vibilia*, respectively. The young stages of *Eueides lineata* Salvin & Godman and its hostplants were previously unknown. Although the young stages of *Eueides vibilia* Godart are known (Brown, 1981) they have not been described in detail, and there are no hostplant records north or west of Guyana (Benson et al., 1976). We have used a method for description of young stages which allows direct comparison with the descriptions of Beebe et al. (1960).

Localities

In Mexico we found *E. lineata* at Playa Escondida near Catemaco, Veracruz (18°30′N, 95°0′W) and at Laguna Encantada above San Andres Tuxtla, Veracruz (18°30′N, 95°10′W). Playa Escondida is on the Gulf coast, and we made our observations at altitudes of between 50 and 100 m above sea level where there is some forest and recently cut pasture. At Laguna Encantada there are the scrubby remains of forest around the Laguna, which now acts as a rather eroded watering hole for cattle; the altitude was approx. 600 m.

The larvae and adults of *Eueides vibilia* were found at San Pedrillo, Parque Nacional Corcovado, Costa Rica (8°38′N, 83°44′W). They were not found at Sirena, which is also within the park (8°28′N, 83°35′W). Both of the Corcovado sites are on the Pacific coast at sea level. All four of the sites have tropical lowland rainforest, but of a type with a moderately pronounced dry season.

Eueides lineata

A. Distribution and Mimicry

E. lineata is an exclusively Central American and Mexican butterfly. It is usually found at altitudes below 1000 m (Brown, 1979) and participates in the common "orange" mimicry ring in this area, which includes *Dryas julia* (Fab.), *Eueides aliphera* (Godart), *Eueides lybia* (Fab.), *Eueides vibilia*, and *Dione juno* (Cramer). *E. lineata* is illustrated in color, together with its co-mimics, in Lewis (1974, pls. 43–44) and Smart (1976, pl. 87). The adult *Eueides* that have been tested are distasteful to birds, although they are not rejected as much as *Heliconius* (Brower et al., 1963); so, the mimicry involved here is probably Müllerian.

B. The Hostplant

The hostplant of *E. lineata* at Playa Escondida and Laguna Encantada is a new species of *Passiflora*. It was found in 1978 by L. E. Gilbert, and he is in the process of describing it. In the remainder of the paper it will be referred to as *Passiflora*, sp. nov. It is an aberrant species which has a sticky puberulence on both the leaf surfaces. The species produces flowers from the tendrils, which is a characteristic of old world genera of Passifloraceae, such as *Adenia*, and some members of the new world subgenus of *Passiflora*, *Astrophea*. Most *Passiflora* produce flowers directly from leaf axils. There is a pronounced difference in the juvenile and mature vegetation: juvenile leaves have filiform petiolar nectaries and variegated leaves; leaves on older plants are unvariegated, less puberulent, and have large saucer-shaped petiolar nectaries. The vine can grow into the canopy of tall trees, but we were able to search only small plants in newly felled pastures. Adults seemed rare, but a concentration of adults occurred around a single canopy-level liana in a tree on the edge of a pasture. On 13 March 1980 a larva and pupal skin were discovered on the plant at Laguna Encantada. On 14 March we carefully searched leaves of young plants of *Passiflora*, sp. nov. at Playa Escondida and discovered one third-instar larva, three first-instar larvae, and three eggs of *E. lineata*. We also searched *P. serratifolia* Linn., common at the site, and found many eggs and larvae of *Eueides isabella* (Cramer) (young stages similar to those described by Beebe et al., 1960), but we found neither *E. isabella* on *Passiflora*, sp. nov. nor *E. lineata* on *P. serratifolia*. L. E. Gilbert (pers. comm.) has reared *E. lineata* at Monteverde (1300 m), Costa Rica, on an undetermined *Passiflora*. The association of *E.*

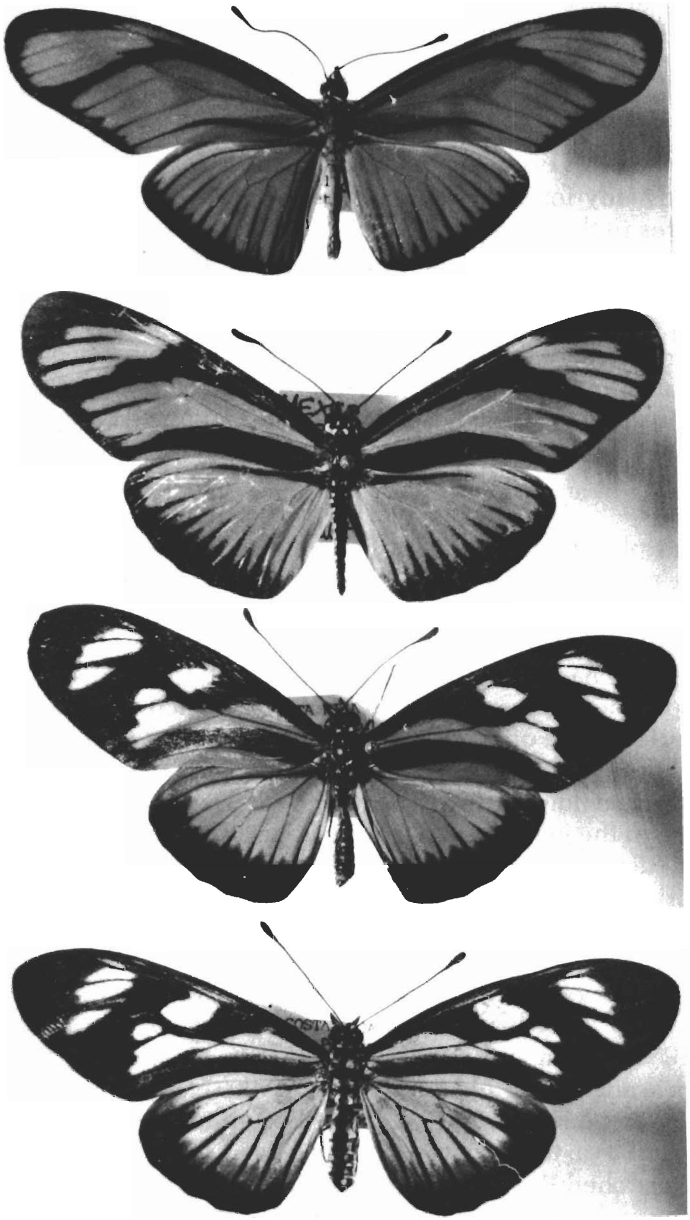

FIG. 1. Adults, top to bottom: *Eueides aliphera, E. lineata, E. vibilia* (male), *E. vibilia* (female).

lineata with such an atypical *Passiflora* in Mexico makes the discovery of *E. lineata*'s hostplants in lower Central America an exciting prospect.

C. The Egg

The egg of *E. lineata* is laid singly on the undersides of fully expanded, full-size leaves of the hostplant, a behavior common to many *Eueides*. The egg is greenish white, dome-shaped, and measures 0.83–0.84 mm high by 0.77–0.83 mm wide. It is similar in general shape to that of other *Eueides* spp. (Beebe et al., 1960), having indentations caused by the nurse cells during oogenesis and ridges between them. There are 10–11 horizontal ridges in total and 19–20 vertical ridges (n = 3).

D. The Larva

Larvae were reared in the laboratory on cut leaves (fresh daily) after being collected at Playa Escondida. Detailed measurements were made of fifth-instar larvae and pupae. Larval periods were measured (sample sizes in parentheses): egg to pupa, 21–22 days (n = 3); first-instar larva to pupa, 18–19 days (n = 3); third instar to pupa, 13 days (n = 1); fifth instar to pupa, 6 days (n = 1). The prepupal period lasts one day (n = 2), during which time the larva constructs a pad, changes to a pale yellow color, and hangs from the pad.

The fifth-instar larva (n = 1) (Fig. 2) has a maximum length of 24 mm. The head is 2.5 mm high and of the same width, is colored orange with black spots and white markings. The posterior dorsal and lateral border of the head capsule is black. A pair of black backwardly curved scoli, 3 mm in length, top the head. Dorsally, segments T1 to A7 are black and white in transverse stripes, four to a segment, A8 is dorsally orange, A9 and A10 are again black and white. Laterally there is a creamy-yellow line on T3–A8 that includes the spiracles. The underside is transparent greenish yellow, except the tips of the prothoracic legs, which are black. Dorsal scoli are black, paler medially; T2 = 2.5 mm, T3 = 2.75 mm, A1–A7 = 3.00 mm, A8–A9 = 2.75 mm. Lateral scoli are black, T2–T3 = 2.0 mm. Supralateral scoli are black, paler medially; A1 = 2.0 mm, A2–A5 = 3.0 mm, A6–A7 = 2.75 mm, A8 = 2.5 mm. Sublateral scoli are pale-translucent; A1 = 1.25 mm, A2 = 2.0 mm, A3–A6 = 2.25 mm, A7 = 2.0 mm, A8 = 1.75 mm. Anal scoli are black, 2.25 mm. The prothoracic plate is in the form of two hourglass-shaped plates placed transversely, one each side of the midline.

In the hanging prepupal stage, all body and head color is lost, the larva becoming pale greenish yellow. The black scolus color remains with black transversely oblong bases of the dorsal and supralateral abdominal scoli, except on A8 (scolus bases are here orange in the mature larva). The black head markings also remain.

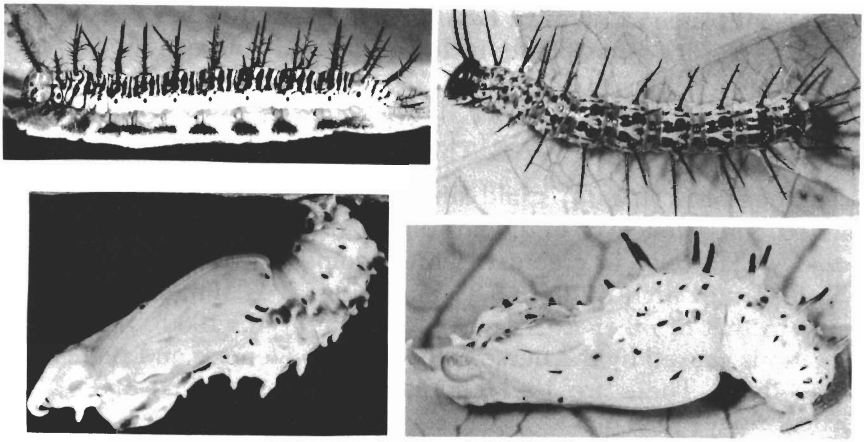

FIG. 2. Juvenile stages, clockwise from upper left: *Eueides lineata* (fifth-instar larva), *E. vibilia* (fifth-instar larva), *E. vibilia* (pupa), *E. lineata* (pupa).

E. The Pupa
(Fig. 2)

The pupal period seems variable in this species. We recorded periods of 9, 8, 8, 8, 7, 6, 6, and 5 days. In general outline the pupa of *E. lineata* is typical for *Eueides,* being bent ventrally so that it hangs horizontally.

The cephalic projections are 2.0 mm long, about the same as the diameter of the eye, without projections or scallops, smooth compressed laterally, curved dorsally and posteriorly, distally tapered and pointed. Antennae are without spines. Gold spots are absent. T2 has a median crest. The paired dorsal projections on T1 are about 0.5 mm long, on T2 nearly absent, and on T3 about 0.25 mm. There are no postmedian tubercles on the forewing. The three submarginal tubercles are well developed, the posterior two connected to the wing margin by a stripe of black pigment. The veins of the pupa are not marked with pigment. The profile of the antennae and wings projects little ventrally. The abdomen has paired dorsal projections as follows: A1 = 0.25 mm, A2 = 0.5 mm, A3–A7 = 1.0 mm. Tubercles on A3–A7 are directed anteriorly; evidence of bifidy is limited to a small bump on the posterior part of the stem. The general color is white marked with brown and olive green, especially a dorsal brown spot on A2–A3, and brown-marked scoli on the abdomen. There are some details in black, especially around the cremaster. The silk pad color is white. The total length is 15.5–17.0 mm (N = 5). The pupa differs from other *Eueides* in having dorsal paired tubercles A3–A7 short, homogeneous, anteriorly directed, and not darkly pigmented.

Eueides vibilia

A. Distribution and Adult Mimicry

In Central America the sexually dimorphic *E. vibilia* occurs as far North as the Sierra de Tuxtla in Mexico (Ross, 1967) and has the subspecies name *vialis* Stichel. The orange and black male might loosely be described as a mimic of the "orange" mimicry group (see above under *E. lineata*). The female is yellower on the forewing medial region and has black ray markings on the hindwing, resembling *Actinote anteas* Doubleday (Acraeinae), with which it is sympatric in some areas of Costa Rica (P. DeVries, pers. comm.). We did not, however, find *A. anteas* in Corcovado. *E. vibilia* is a widespread species and is found south to Rio de Janeiro, Brazil, where *E. v. vibilia* females, *E. pavana* Menetries, and *Actinote* spp. participate in a mimicry ring (Brown and Mielke, 1972). The species is rare in Costa Rica, only being known from a handful of specimens. These specimens are all from lowland localities on both the Pacific and Atlantic drainages of Costa Rica.

B. The Hostplants

The three reported hostplants of *E. vibilia* in South America are *Mitostemma glaziovii* Mast., *Passiflora* (*Astrophea*) *costata* Mast., and *P.* (*A.*) *mansii* (Mart.) (Benson et al., 1976). In Costa Rica we discovered larvae on old leaves of another *Astrophea* species, *Passiflora pittieri* Mast., while searching at San Pedrillo for larvae of *Heliconius hewitsoni* Staudinger on 13 June 1980. *P. pittieri* is quite common at San Pedrillo and Sirena.

Although Sirena is only 24 km down the coast from San Pedrillo, we have found neither larvae nor the distinctive old-leaf skeletonizing damage of *E. vibilia* at Sirena. There is evidence that *P. pittieri* has a more or less continuous distribution between the two sites. This indicates great patchiness of *E. vibilia*, which clearly does not result from its hostplant distribution. *P. pittieri*, judging from the number of herbarium specimens available, is as rare as *E. vibilia*. *P. pittieri*'s rareness is an artifact of its growth form and reproduction (Longino, unpub. data). It flowers rarely, usually in the forest canopy, and it is vegetatively very cryptic, juveniles looking more like understory tree seedlings than *Passiflora*. *E. vibilia*'s rareness is no doubt real, since the Osa Peninsula has been visited for many years by lepidopterists and students of heliconiine biology (L. E. Gilbert, W. W. Benson, P. DeVries, J. Smiley), and this is the first report of *E. vibilia* on the Osa.

C. The Egg

A batch of 74 eggs is figured by Benson et al. (1976) which was laid on a mature *Passiflora mansii* leaf underside in Mato Grosso, Brazil. We have not observed oviposition, but assume from the gregarious larvae that *E. vibilia* lays eggs in batches in Costa Rica also. According to Brown (1981) the eggs are red and white, measure 1.0 mm high by 0.8 mm wide, and have 14 vertical and 8 horizontal ridges.

D. The Larva

Larvae were reared on cut leaves after collection at San Padrillo. The larval periods were: third instar, 3 days, fourth instar, 3 days (n = 1 batch), fifth instar, 5–7 days (n = 2 batches). First-instar larvae were not observed. Second to fourth instar had shiny black head capsules and black head scoli, with pale yellowish-green bodies and pale body scoli. In this way they resembled the larvae of the sympatric *H. hewitsoni,* that also feed gregariously on *P. pittieri* in the same habitat. The young larvae of *E. vibilia* can be distinguished from those of *H. hewitsoni* by the larger head scoli of the former and their habit of skeletonizing older leaves, rather than eating young shoots. This is probably an example of larval mimicry. During the fourth instar the scoli and upper body surface begin to darken, and the fifth instar is non-mimetic.

The fifth instar (n = 1) (Fig. 2) extends to about 23 mm long. The head is 3 mm high and broad, is black and has a pair of black dorsal scoli about 4 mm in length. Dorsally, the larva is olive green with black patches. Laterally, there is a creamy-yellow line that includes the spiracles; ventrally, the color is translucent greenish yellow. The prolegs are: T1 = black, T2 = translucent with black tips, T3 = translucent. The dorsal scoli are black with large black (approx. 0.7 mm) tumescent bases. The supralateral, lateral, and anal scoli are also black but lack the tumid bases. Dorsal and supralateral scoli vary between 3–5 mm, the anal and lateral scoli are 3 mm. Sublateral scoli A1–A8 are colorless and measure 1.5–2.5 mm. The prothoracic plate is large, black and elliptical, divided into two by a pale line through the short diameter which is at the dorsal midline.

E. The Pupa
(Fig. 2)

The pupa is similar to that of *E. lineata* and other *Eueides* in its ventrally bent position and general outline. It differs in the following characteristics.

Paired dorsal projections: T1 = 0.3 mm long, T2–A1 = 0.2 mm, A2 = 0.5 mm, A3–A4 = 2.0 mm, A5–A6 = 1.5 mm, A7 = 1.0 mm. Supralateral projections A3–A4 minute, 0.1 mm. There is no evidence of bifidy and these tubercles project out at right angles to the body surface. All three submarginal tubercles of the wing connect to the wing margin by a black pigmented region.

The general color is creamy-white marked with black spots. The dorsal scoli on T2–A6 are black-tipped, the rest are white. Silk pad color is white. Total length is 16–17 mm (n = 6). It differs from other *Eueides* in having simple dorsal projections on A3 and A4 that are not very different in length from those of A5 and A6.

DISCUSSION

Comparison of the young stages of *E. vibilia* and *E. lineata* with other published accounts reveals little in the way of taxonomic significance, but this is partly caused by the dearth of larval descriptions available. The pupal morphology of *E. vibilia* and *E. lineata* differs from other described *Eueides* pupae in having almost homogeneous dorsal projections, rather than having giant dorsal projections on A3 and A4 as do *E. isabella*, *E. aliphera*, and *E. tales* Cramer (Beebe et al., 1960; Brown & Holzinger, 1973). Otherwise, the pupa of *E. lineata* is similar to that of *E. isabella* in having the dorsal projections partially bifid and by its mottled color pattern, and *E. vibilia* is more similar to that of *E. aliphera* in having simple spines and a black-spotted color pattern.

Benson (1978) presented evidence that heliconiines partition larval resources. The new hostplant data presented here are concordant with this hypothesis. We saw no other heliconiine using *Passiflora* sp. nov. in the Sierra de Tuxtla region. New growth and old leaves on *P. pittieri* are very different resources with respect to toughness, availability through time, and type and abundance of predators (Longino, unpub. data). Two allopatric species of *Heliconius* in Costa Rica feed on the new growth: *H. hewitsoni* on the Pacific side, and *H. sapho* Drury on the Atlantic side. *E. vibilia* feeds on the old leaves.

The possibility of larval mimicry is intriguing. At San Pedrillo three heliconiine species have gregarious larvae that look extraordinarily similar from a human perspective: *E. vibilia*, *H. hewitsoni*, and *H. sara* (Fab.). Their yellow and black larval color pattern is very different from all the solitarily feeding heliconiine larvae. Why the gregarious larvae should share one pattern and the solitary larvae have other patterns is not easily explained. One possibility is that gregarious and solitary larvae have exclusive sets of predators; thus, there is no selection for a common pattern. We have some data suggesting that vespids and predacious pentatomids are more detrimental to gregarious than to solitary larvae, but there is no indication that these predators are the least bit deterred by toxins or other defenses of the larvae. Alternatively, what is obvious to the human eye may be cryptic to a vespid or pentatomid eye, and the larvae may be converging on the pattern most cryptic to these generalized predators. *E. vibilia* and *H. hewitsoni* larvae occur at very low densities, but by occurring on the same hostplant they are, in effect, being concentrated with respect to the predators they experience. Thus, there could be selection for convergence to a common pattern if, when a bird ate one yellow caterpillar on a plant, it avoided all other yellow caterpillars on that plant. *H. sara*, however, is often much more abundant in a habitat, feeding on a more common, weedy *Passiflora*. Possibly, *H. sara* originally evolved the yellow and black pattern as a general aposematic display, and they were abundant enough to provide a communitywide selective force for the evolution of similar patterns in the rare, gregariously feeding heliconiines.

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