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THE LIFE HISTORY OF *NOCTUANA HAEMATOSPILA* (HESPERIIDAE: PYRGINAE) IN ECUADOR

HAROLD F. GREENEY[1]
Yanayacu Biological Station and Center for Creative Studies, Cosanga, Ecuador,

AND

ANDREW D. WARREN[2]
Department of Zoology, Oregon State University, Corvallis, Oregon, 97331 USA

Noctuana Bell is a genus of about 6 medium-sized, rather similar pyrgine species, all of which are confined to the Neotropics. The genus was described primarily on the basis of its rather unique, "distinctly swollen" antennal clubs (Bell 1937:7). These skippers have rather long palpi, narrow wings with a pointed forewing apex, slightly to prominently scalloped wing margins, and are mottled on top with contrasting dark bands and indistinct smears. This mottled dorsal pattern gives these skippers a somewhat noctuid-like appearance, reflected in their generic name. Two species in the genus have striking, red to yellow markings contrasting against otherwise dark ventral hind-wings. One of these species, *Noctuana stator* (Godman & Salvin), has one or two rows of red to orange spots along the ventral hind-wing margin; this species has recently been reported from south Hidalgo Co., Texas, USA (from a photograph), presumably as a stray individual (see Anonymous 2000). The other *Noctuana* species with red to yellow hindwing markings against an otherwise dark background is *N. haematospila* (C. Felder & R. Felder), the subject of this report.

Arguably the showiest of the *Noctuana* species, *N. haematospila* has been illustrated in color by Draudt in Seitz (1924:pl. 177), Lewis (1987:84) and Piñas & Manzano (1997:59), and was illustrated in great detail (although not in color) in its original description (C. Felder & R. Felder [1867:pl. 73]); also see Fig. 1 herein. *Noctuana haematospila* is distributed through the northern Andes Mountains, from Venezuela (its type locality) to Bolivia (Evans 1953), it is widely distributed at elevations above 1000 m in Ecuador (Williams & Hawyard 1944). To date, no reports on adult behavior, larval food plants, or larval ecology have been published for any *Noctuana* species. Below we present notes on the adult and larval behavior and ecology of *N. haematospila* in an eastern Ecuadorian cloud forest.

FIG. 1. Adult *N. haematospila* basking along roadside, at study site in Napo Province.

MATERIALS AND METHODS

All collections and observations of adults and immatures of *N. haematospila* were made at the Yanayacu Biological Station and Center for Creative Studies, located at an elevation of 2200 meters in the Quijos Valley of Napo Province in eastern Ecuador. The study site is situated approximately five kilometers west of the town of Cosanga, in Napo Province, and is composed of over 1500 hectares of primary cloud forest bordered by pastures, roads, farmland, and other disturbed habitats.

On 29 July 2000, 23 early instar larvae and one fourth instar larva were collected from *Rubus* L. (Rosaceae) plants along road margins adjacent to a disturbed habitat and cattle pasture at the study site. Larvae were transported in plastic bags to the Yanayacu Station and reared in separate, glass containers. Fresh food plant leaves were added daily and old leaves and frass were removed. The jars were wiped dry periodically to prevent build-up of pathogenic bacteria and fungi. Subsequently, numerous larvae were collected from similar situations at the study site, and observations

[1] c/o Carrion No. 21-01 y Juan Leon Mera, Quito, Ecuador

[2] Research Associate, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Apdo. Postal 70-399, México, D.F. 04510 México

were made on larvae of all instars in the field and in the lab. To avoid potential laboratory artifacts affecting shelter construction, all observations on shelter building behavior were made in the field prior to collection. A total of over 200 larvae of *N. haematospila* were observed and tracked for this study, and great effort was made to study individual larvae in nature throughout their development. No oviposition events were witnessed, but over 100 partial egg shells and 17 eggs were encountered in the field. Two first instar larvae, newly hatched, were observed during shelter construction. Terminology for discussion and descriptions of larval shelters follows Greeney & Jones (2003). All voucher material is deposited in the collection of the senior author.

RESULTS

Adult *N. haematospila* are found sporadically throughout the year at our site. They are always associated with disturbed areas and are most common along road cuts where males guard low perches up to 1.5 m above the ground. Adults were active throughout the day during periods of sun, often sitting with wings spread in particularly sunny areas (Fig. 1). They evidently visit flowers only infrequently, and to date only one unsexed adult has been seen feeding at flowers of *Erato* sp. (Asteraceae). Most commonly, adults visit moist soil, dung, and carrion.

Larvae of *Noctuana haematospila* were found feeding on two species of *Rubus* L. (Rosaceae) at our study site in eastern Ecuador. These plants are common along roadsides, in pastures, and other disturbed areas. First instar larvae were found from June to November. Larvae appeared to feed more frequently around dusk and dawn, but detailed periodicity of feeding has not been well documented. While not feeding, larvae rest in leaf shelters, and pupate in the last larval shelter constructed. All instars were observed to forcibly expel frass from the anus, later instars achieving a distance of over a meter. The one individual that was successfully followed from egg to eclosion took 134 days from the time the egg was found to complete development. Newly molted larvae have pale cream to bone colored head capsules prior to hardening.

Description of Early Stages: Egg. (n = 17, 1 mm diameter, Fig. 2c). Laid singly on dorsal surface of new or old and damaged leaves; brown, dome shaped with 14 irregular vertical ridges, darkening to nearly black before hatching.

Larva. First instar (n = 78) larva with head roughly heart shaped, shining black with sparse, short, pale setae visible under a dissecting scope; body dull, dark-orange, darkening to orange-brown or orange-green once feeding begins, sparsely covered with short, pale setae; pronotal shield poorly developed, distributed dorsally, shining black, elliptical when viewed from above. **Second instar** (n = 65) larva with head as described for first instar; body as described for post-feeding first instar, setae slightly denser, skin appearing granular with tiny pale spots; pronotal shield well developed, extending subdorsally, shining black, rectangular when viewed from above. **Third instar** (n = 35) larva with head similar to first instar but more angular, heart shape more pronounced, setae more evident; body as described for second instar but faint, thin, orange spiracular line running from A1 to A7 appearing as it nears molt. **Fourth instar** (n = 26) larva as described for third instar but thin spiracular line more evident, especially late in instar; pronotal shield extending to edge of subdorsal area. **Fifth instar** (n = 23, 48-50 days, Fig. 3) head (Fig. 2e) and body as described for fourth instar, spiracular line now more prominent but still thin, body turning dirty orange before pupation, making small pale spots more apparent; anal comb (Fig. 2d) broad basally, noticeably longer in the center than on the sides; central spines rounded and lateral spines sharper.

Pupa. (n = 8, 22-35 days, Fig. 2a). Robust with blunt head, all shining dark brown, intersegmental areas on abdomen bright orange-brown, dorsum with short, sparse, pale orange-brown setae.

Larval shelters. **First instars** (n = 78, Fig. 2b) begin shelter construction by making a roughly round or oval shaped cut starting away from the leaf margin. This man-hole cover-like section of leaf is then flipped onto the dorsal surface of the leaf and tightly silked. This shelter type has been described as a Group II, type five, center-cut fold (Greeney & Jones 2003). During construction of the first shelter, larvae appear not to ingest any leaf material. Small pieces of leaf were observed along the cut leaf edge and the gut did not darken with ingested material. Sealing silk was first laid down along the shelter bridge. This caused the lid to begin flipping towards the dorsal leaf surface. Subsequently, a series of multi-stranded ties were attached to the lid and the leaf surface, progressing away from the bridge along the lid margin as it was drawn closer to the leaf surface. In all, five such ties were used to seal the shelter. Once the shelter was constructed, resting silk was laid down in a circular pattern around the inside of the lid. Larvae rest on this while not feeding. **Second instar** (n = 47) larvae remain in the shelter built by first instars. Most **third instar** (n = 28) larvae built a second shelter as described for the first instars, but larger. Five larvae built roughly trapezoidal shelters cut from the edge of the leaf using two major cuts and folded along a broad bridge onto the dorsal surface of the leaf. This shelter type is known as a Group III, type nine, two-cut unstemmed fold. Early **fourth instar** (n = 16) larvae remain in the shelter built during the third stadium. Sometime during this stadium, larvae build a third shelter. In all observed larvae, late fourth instars built two-cut unstemmed folds as described for third instars. For this third shelter, however, the midvein at the base of the leaflet with the shelter was chewed so as to allow it to sag down, out of the plane of the leaf (Fig. 2f). Pale brown positioning silk was then laid along the ventral portion of this cut to hold the leaflet and shelter in a near vertical position. The portion of the leaf on which the shelters were built eventually died. Larvae left the shelters at night to feed on the remaining green parts of the leaf. Molting to **fifth instar** (n = 12) occurs within the third shelter. Sometime during the fifth instar, larvae build a fourth shelter. Based on observations in the field, it is suspected that fifth instar larvae often build a fifth, and even sixth shelter, all as described for fourth instars. In eight instances, the leaf petiole was cut and silked rather than the midvein of a single leaflet. This caused the entire three-part leaf to hang downward in a nearly vertical position. In one case, the main stem of the plant was severed near the apex, causing a cluster of three to four leaves to hang vertically. Eventually, the section of the plant severed turns brown and dries out. A few small, irregular perforations are cut in the lid and floor of the shelter. Resting silk is laid irregularly inside the shelter lid and floor, and larvae rest on both. All pupae (n = 3) encountered were found in shelters as described for fifth instars. The one larvae followed in the field from egg to eclosion pupated in its last larval shelter.

DISCUSSION

One proposed function of shelter building has been

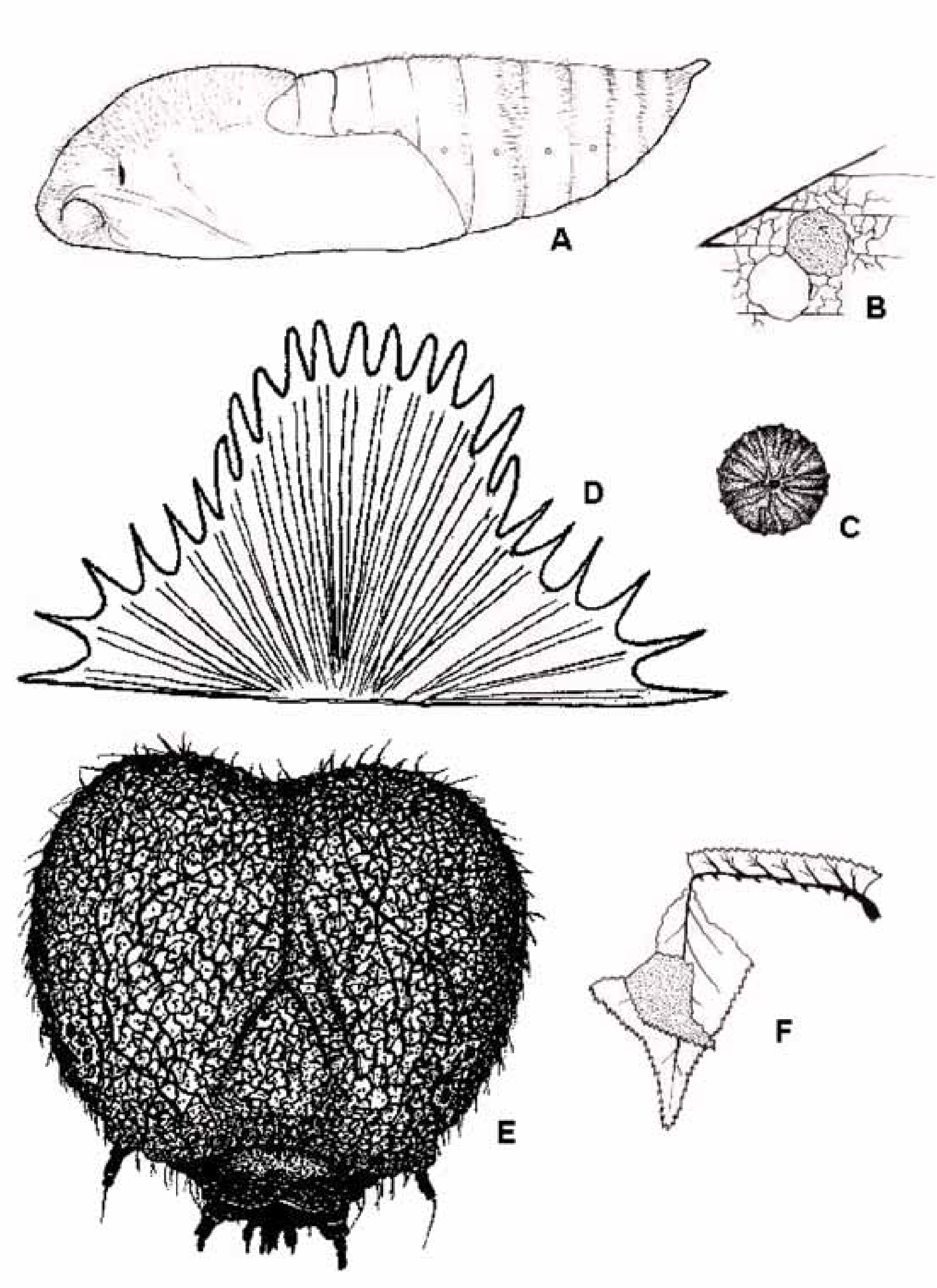

FIG. 2. Early stage morphology of *N. haematospila* and larval shelters from study site. A, Pupa; B, First instar shelter; C, Egg; D, Anal comb; E, Fifth instar head capsule; F, Fifth instar shelter before death of surrounding plant tissue.

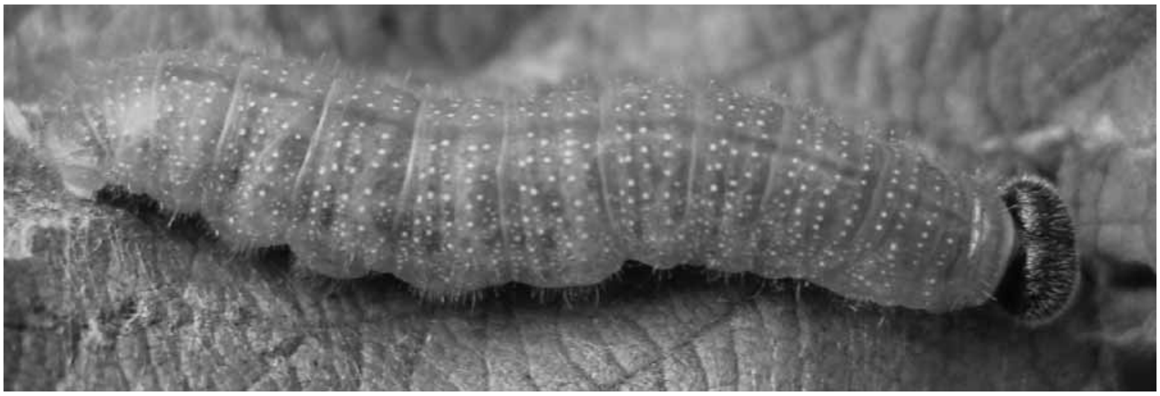

FIG. 3. Fifth instar larvae of *N. haematospila* at study site, resting on *Rubus* foodplant.

the chemical modification of leaf tissue by changing its exposure to sunlight (Sandberg & Berenbaum 1989). *Noctuana haematospila* larvae do not ingest leaf material during construction of their first shelter. While this suggests the possibility that unmodified leaf tissue may be unpalatable to young larvae, the fact that they soon commence feeding on nearby (and unmodified) leaf tissue, provides an alternative hypothesis which we feel is more likely. It is possible that ingesting material rather than simply cutting the leaf would take more time and thus delay the shelter construction and the covering of the larva. All hatched eggs found in the field were partially consumed, and the energy provided by this first meal likely aids in allowing the young larva to avoid the need to feed during initial shelter construction. The center-cut fold shelter built by first instar larvae is similar to that built by many early instar pyrrhopygines, but is infrequently seen in the pyrgines (HFG unpubl. data). Across all hesperiids, in fact, this is an infrequently observed shelter type (Greeney & Jones 2003). As the initial cut does not begin from a leaf margin, and instead the larva's mandibles must pierce the leaf to initiate cutting, we suspect that accommodating modifications of the mandibles have accompanied the evolution of this shelter type. Detailed observations and careful comparisons of larval morphology across a wide taxanomic range are needed to elucidate this idea.

The additional modification to the basic shelter plan seen in later instars of *N. haematospila* includes a positioning cut with corresponding positioning silk. The use of a positioning cut to modify the overall position of the shelter is widely used among the hesperiines (Greeney & Jones 2003, HFG unpubl. data). Its function remains unknown, but at least in the case of *N. haematospila*, such a modification caused the death of plant tissues surrounding the shelter and made the overall structure much better camouflaged.

We hope this brief note encourages others to report findings on this and other increasingly threatened tropical species.

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