Notes

Observations on the shelter building behavior of some Asian skipper larvae (Lepidoptera: Hesperiidae)

Introduction

The larvae of many lepidopteran families modify their immediate environment by cutting, folding, rolling, and/or silking portions of their foodplant into a shelter (DeVries 1987, 1997, Scoble 1992, Stehr 1987). While only a few species have been investigated in detail, the possible functions of these structural retreats include reduced predation (Eubanks et al. 1997, Jones et al. 2002), prevention of dislodgment (Loeffler 1996), and creation of a more favorable microclimate (Henson 1958). Among the most prolific groups of shelter building larvae are the Hesperiidae, most of whom, with only a few exceptions (eg. Moss 1949, Scudder 1889), have been reported to construct shelters. A recent review of hesperiid larval shelters found there to be 10 basic shelter types constructed by skipper larvae, and pointed to the possible importance of shelter form for phylogenetic analysis (Greeney & Jones 2003). Here we use the classification and terminology proposed by Greeney & Jones (2003) to describe the shelters built by 4 species of hesperiids from China and the Philippines. Only shelters built in nature were considered.

Species accounts

Capila translucida (Leech 1893). Larvae were reared on *Cinnamomum camphora* (Lauraceae) in Ru Yang, Peoples Republic of China. Larvae of all instars rest upside down inside their shelters, attaching their crochetts to a pad of resting silk laid down on the inside of the shelter lid. No frass accumulated within the shelters, and larvae of all instars forcibly eject frass from the anus. First instars were found to build Group II Type 5, center-cut folds. These are built by cutting into the middle of the leaf, away from the margin. The cut is nearly circular, with the proximal and distal ends converging outwards from the circular portion to give the cut an overall paddle shape. This round flap is then folded over at the narrow shelter stem to create a man-hole-like retreat (Fig. 1a). Later instars build Group III Type 10, two-cut stemmed folds. These are roundly triangular portions of the leaf cut from the margin using two cuts. The cuts curve towards each other near their distal ends and finally run parallel to create a narrow shelter stem. This narrow stem is heavily silked to pull the flap over to meet the leaf surface (Fig. 1b). Often a minor cut is made on the edge of the shelter lid (Fig. 1h). Opposite sides of this small cut are then silked together to pinch the lid into slightly peaked or tented form. This modification is also occasionally accomplished without a cut, by simply laying silk along the lid margin to pinch it upwards into a peak. These modifications presumably give the larvae more room to maneuver inside the shelter. Final instars may build Type 10 shelters or may construct Group I Type 4, two-leaf shelters. Type 4 shelters are made by silking two leaves together to create a shallow pocket. The first instar shelter built by *C. translucida* is very similar to that recently reported for first instars of the pyrgine, *Noctuana haematospila* (C. Felder & R. Felder 1867), in Ecuador (Greeney & Warren 2004). The ontogenetic changes in shelter type, however, are quite different. For a description of the egg, larvae, and pupa of *C. translucida* see Young & Chen (1999).

Tagiades litigiosus litigiosus (Möschler, 1878). Larvae were reared on *Dioscorea fordii* (Dioscoreaceae) in Kau Tam Tso, Wu Kau Tan, and Tai Po, Hong Kong. Larvae of all instars rested upside down on the shelter lid, and kept their shelters clean by ejecting frass away from the shelter. First through fourth instars built Group III Type 9, two-cut unstemmed folds. These were built by making two cuts originating at the leaf margin which converged slightly towards their distal ends to create a broad shelter stem over which the resulting flap was folded onto the leaf surface. This created a broadly folded, roundly rectangular or square shelter (Fig. 1c). Heavy resting silk on the inside of the shelter lid caused the shelter to bowl slightly, giving the larvae more room inside their retreat. Often the bridge (portion where the stem is folded) was scored along the inside by cutting only through the leaf epidermis to weaken the folding point. Final instars either constructed a larger version of the Type 9 shelters described above, or made Group 1 Type 4, two-leaf shelters by silking two adjacent leaves into a shallow pocket. The ontogenetic changes in shelter type, as well as the individual shelters used by each instar were very similar to the shelters described for larvae of the pyrgine *Eantis thraso* (Hübner, 1807) in

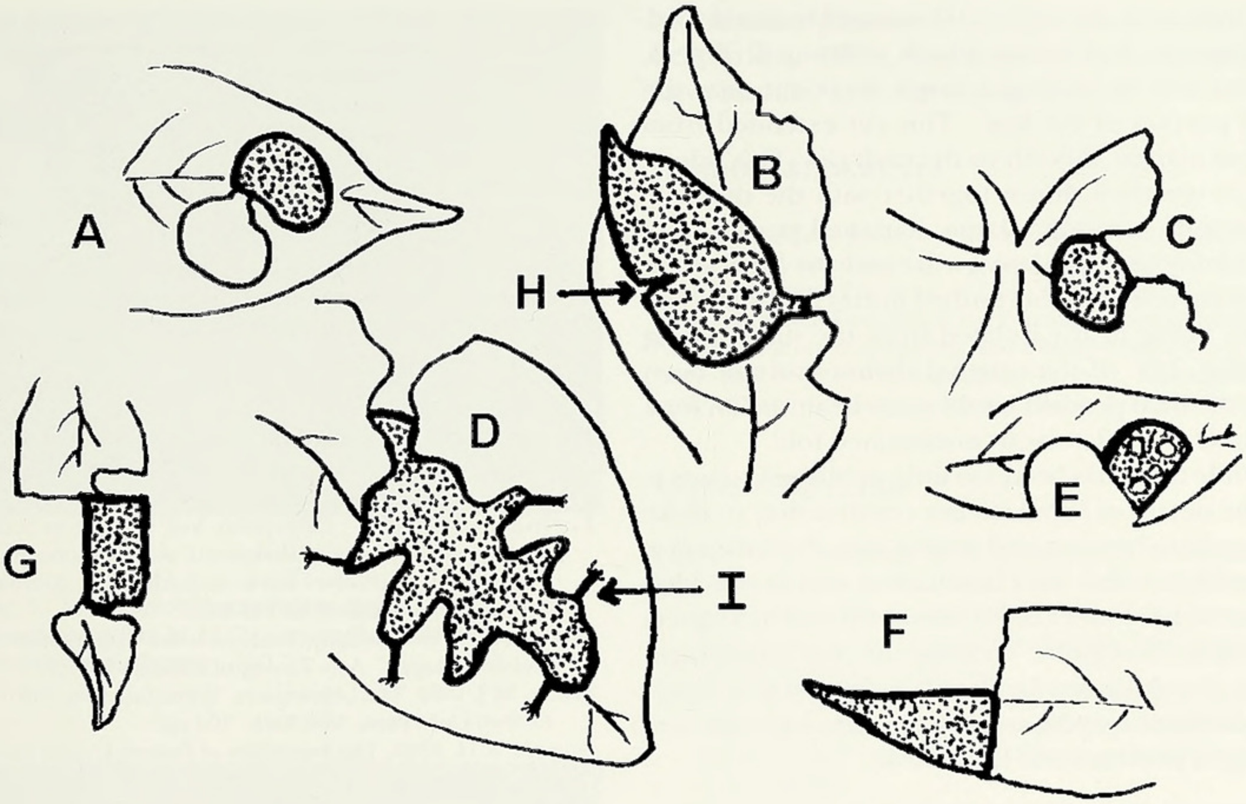

Fig. 1. Shelters built by larvae of Asian skippers: Shelters not drawn to scale, stippled areas represent the area hiding the larvae from view. A) First instar of *Capila translucida* on *Cinnamomum camphora*, Ru Yang, Peoples Republic of China. B) Fourth instar of *C. translucida* on *C. camphora*, Ru Yang, Peoples Republic of China. C) First instar of *Tagiades litigiosus litigiosus* on *Dioscorea fordii*, Hong Kong. D) Final instar of *Coladenia agnioides* on *Eriobotrya fragrans*, Ru Yang, Peoples Republic of China. E) First instar of *Bibasis sena palawana* on *Hiptage bengalensis*, Los Baños, Philippines. F) Final instar of *B. sena palawana* on *H. bengalensis*, Los Baños, Philippines. G) Final instar of *B. sena palawana* on *H. bengalensis*, Los Baños, Philippines showing isolation of shelter by feeding damage. H) Secondary cut to allow tenting of shelter lid by fourth instar of *C. translucida*. I) Externally visible tying silk, securing shelter lid of final instar of *C. agnioides*.

Ecuador (Greeney & Warren 2003).

Coladenia agnioides (Elwes & Edwards, 1897). Larvae were reared on *Eriobotrya fragrans* (Rosaceae) in Ru Yang, Peoples Republic of China. Frass was never observed to accumulate inside the larval shelters. Final instar larvae built Group III Type 10, two-cut stemmed folds. The two major cuts, initiated from the leaf margin, angled towards each other then ran parallel for some distance to create a narrow stem. At their distal ends, however, the cuts separated slightly to create a bridge which was broader than the stem. Larvae scored the inside of the bridge, presumably to facilitate folding. After constructing this long-stemmed, triangular shelter, larval feeding damage created large channels cut in from the margins of the shelter lid, giving the lid margins a jagged appearance. The final product, therefore, took on a form similar to a Christmas tree (Fig. 1d). Strong lines of tying silk attached the rim of the shelter lid to the surrounding leaf (Fig. 1i). A heavy pad of resting silk, laid in a roughly circular pattern on the inner surface of the shelter lid, caused the lid to bowl slightly. The channels, by weakening the structural integrity of the lid, likely aided in this process.

Bibasis sena palawana (Staudinger, 1889). Larvae were reared on *Hiptage bengalensis* (Malphigiaceae) at Mount Mikiling, Los Baños, Philippines. Early instars built Group III Type 9, two-cut unstemmed folds. One primary cut, beginning at the leaf margin, was long and arcing, curving back towards the leaf margin. The second primary cut was much shorter, approaching the distal end of the larger cut directly from the leaf margin, but leaving a broad shelter bridge with no stem. The resulting flap was then folded to the leaf surface. This created a distinctly shaped shelter lid, rounded on one side, and straight along the portions consisting of the leaf margin and along the shelter bridge (Fig. 1e). The lid was not bowled or tented in any way and remained tighly appressed to the leaf surface. This shelter was then modified with several perforations in the shelter lid, created by larval feeding damage. Later instars built a Group II Type 6, one-cut fold by making a single large cut near the distal portion of the leaf. This cut extended from the leaf margin, directly to the midvein. This side of the cut was then drawn together with the opposite leaf margin creating a large, flattened pocket (Fig. 1f). Heavy feeding damage around the area where the larvae rested often resulted in this portion of the shelter being nearly isolated from the surrounding leaf (Fig. 1g). If the original shelter had not been seen, the final product could easily be mistaken for a Group II, Type 9, two-cut unstemmed fold.

While there has been too little published concerning the details of larval shelter construction to make comparisons between and among taxa, these data provide evidence that the classification system provided by Greeney & Jones (2003) is a useful tool in a variety of geographic regions. We hope this note encourages others to publish similar details so that such architectural features may be used in the development and testing of phylogenetic hypothesis.

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An interspecific mating attempt between a male *Siproeta epaphus* Latreille and a female *Anartia amathea* Linnaeus (Lepidoptera: Nymphalidae).

Interspecific mating attempts between lepidopterans are not uncommon (eg. Davies *et al.* 1997, Deering & Scribner 2002). Here we report an attempted copulation between two nymphalid species, *Siproeta epaphus* (Latreille 1819) and *Anartia amathea* (Linn. 1758) in western Ecuador. Observations were made a the Sachatamia Lodge (0.01. 35 S 78.45.34 W) near the town of Mindo, Pichincha Province, at 1700 m elevation.

On 6 July 2004, at approximately 11:30 am, a male *S. epaphus* was seen and photographed in copula with a female *A. amathea* (Figure 1). Upon closer examina-