

irrigated zones in association with naturalized weedy hosts (Shapiro, unpublished data). It is not known if this butterfly is native to the region or is itself naturalized; it is the only member of its genus in the Southern Cone of South America.

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Arthur M. Shapiro, Center for Population Biology,  
University of California, Davis, CA 95616; e-mail:  
amshapiro@ucdavis.edu

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#### COMMENTS ON LARVAL SHELTER CONSTRUCTION AND NATURAL HISTORY OF *URBANUS PROTEUS* LINN., 1758 (HESPERIIDAE: PYRGINAE) IN SOUTHERN FLORIDA.

**Additional key words.** Egg stacking, hostplant, oviposition, clutch size.

The Bean Leaf Roller (*Urbanus proteus* Linn.) is a common and widespread skipper (Hesperiidae) found from southern United States south to Argentina (Smith *et al.* 1994). Early observations on its natural history (Scudder 1889) have been supplemented with details from various parts of its range (Greene 1970, 1971a; Kendall 1965; Moss 1949; Riley 1975; Skinner 1911; Smith *et al.* 1994; Young 1985), particularly in Florida (Quaintance 1898), where it is a pest on leguminaceous crops (Green 1971b; Quaintance 1898; Watson & Tissot 1942) and where there exist documented seasonal movements (Urquhart & Urquhart 1976). Like most skippers (Greeney & Jones 2003), the larvae of *U. proteus* construct and live in shelters made from the leaves of the food plant, but only two authors have described or pictured these shelters in any detail (Quaintance 1898; Young 1985). In fact, detailed knowledge of larval shelter construction for most skippers is weak or nonexistent for all but one widely distributed North American species, *Epargyreus clarus* Cramer, 1775 (Jones *et al.* 2002; Lind *et al.* 2001; Weiss *et al.* 2003). As shelters may prove useful in resolving phylogenies (Greeney & Jones 2003), here we present our observations of shelters from a population of *U. proteus* in southern Florida.

We made observations at Burns Lake Campground (25°53'N, 81°13'W) in Big Cypress National Preserve, Collier County, Florida. On 30 December 2005, at 14:15, we observed a female *U. proteus* ovipositing on the under surface of a leaflet of *Vigna luteola* (Jacq.) Benth (Leguminaceae). She laid three dull yellow eggs in an evenly spaced row, and then flew out of sight.

This observation prompted us to search foliage of other *V. luteola* plants, and resulted in the discovery of 26 additional clutches of hatched and unhatched eggs.

At hatching, larvae consume only the top portion of the eggs (pers. obs.), and we were able to use the remaining egg fragments to determine clutch size from all 27 clutches (mean = 2, SD = 1.1, range = 1–5). Most clutches were located on the under surface of mature leaves (n = 24), but occasionally on leaf petioles (n = 3). Within a clutch, eggs were placed adjacent to (touching) or up to 1 mm from other eggs. One exception was a clutch of three eggs found stacked end to end such that only the bottom egg was attached to the leaf surface (Fig. 1). Similarly, Quaintance (1898) reported a clutch size of 1–6 and noted that eggs were frequently laid in a stacked fashion, 3–4 eggs high. Young (1985), however, recorded only single egg clutches in Costa Rica.

In addition to the eggs, we found a total of 50 larvae representing the following instars: 36 first, 8 second, 3 third, 2 fourth, and 1 fifth. We removed larvae from their shelters and carefully determined their ages using the prior experience of HFG with the larvae of related species. We also watched as 3 first-instars constructed new shelters after removal from their original shelters. By examining shelter construction and comparing our observations to previously constructed shelters, we determined that larvae build 3–5 shelters as they develop, and that these belong to three shelter types. First through third instars were found inside shelters built by excising a small triangular portion of the leaf margin and creasing it into a tent-shaped lid (Greeney & Jones 2003; group III, type 10, two-cut stemmed



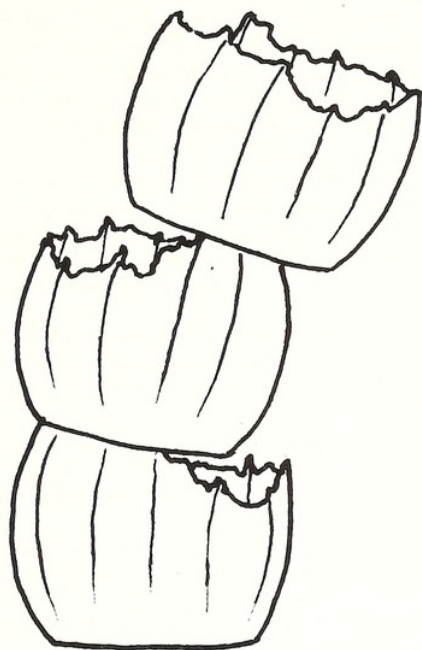


FIG. 1. Three *Urbanus proteus* egg shells found on the under side of a leaf, Burns Lake Campground, Collier County, Florida, December 2005.

shelters). These *U. proteus* shelters were, in fact, very similar to shelters described for *E. clarus* (Weiss *et al.* 2003), and would be considered the same type under the classification of Greeney & Jones (2003). Like *E. clarus*, the shelter cuts of *U. proteus* were always oriented in a distinct fashion in relation to the leaf base; the longest cut always being distal. The most obvious and consistent difference we found was the lack of a “notch” in the cut closest to the leaf petiole in shelters built by *U. proteus* larvae (Fig. 2). Early instar shelters were still “tented” into a distinct peak, however, by pinching together (using multiple silk ties) a small section along the margin of the shelter lid. The result was a shelter similar in appearance to that built by *E. clarus*, but arrived at by slightly different means (i.e. without the notch). Fourth instars were found, one each, inside a shelter created by silking two leaves together (group I, type 4, two-leaf shelter) and one formed by silking several leaves together (group I, type 3, multi-leaf shelter). We found the single fifth instar feeding adjacent to several leaves silked together (group I, type 3 shelter) at around 17:45.

Our observations bring to light several important aspects of egg laying and larval shelter building. Firstly, species building superficially similar shelters may use slightly different cut patterns or construction techniques to arrive at the finished product. Therefore, shelters

will prove useful in testing phylogenetic hypotheses (Greeney & Jones 2003) only if we examine shelters and their construction in much more detail than previously reported (but see Greeney & Warren 2003, 2004; Lind *et al.* 2001; Weiss *et al.* 2003).

Secondly, our observations, and observations of late instars of other pyrgines (HFG unpublished) and coeliadines (Common & Waterhouse 1972), suggest that there may be little difference between the “type 3” and “type 4” shelters distinguished by Greeney & Jones (2003); these shelter types being defined by the number of leaves included in the shelter. In later larval stadia, *U. proteus* silks together two or more leaves or leaflets into a silk-lined pocket (this study, Quaintance 1898). Young (1985), however, observed only two leaves used in late instar shelter construction. We conclude, therefore, that the number and arrangement of the various leaf parts used is likely related to the relative size and shape of the host plant leaves rather than to any innate shelter building behavior. In other words, larvae simply spin silk, pulling leaves (or parts thereof) around themselves until they are sufficiently covered. Similarly, *E. clarus* shows variation in the number of leaves used in late instar shelters, varying with size of the host plant leaf (M. Weiss pers. comm.). Based on these observations, we suggest that “type 3” and “type 4” shelters, as defined by Greeney & Jones (2003), should be merged into one “multi-leaf” shelter type, regardless of whether the shelter includes two or more leaves or leaflets.

Finally, the three egg shells we found stacked end to end showed a different emergence pattern than described in previous observations of lepidopteran oviposition. Several species of the nymphalid genus *Hamadryas* Hübner are also known to deposit eggs one on top of another, sometimes in chains of more than 10 eggs (Muyschondt & Muyschondt 1975b, 1975c). To

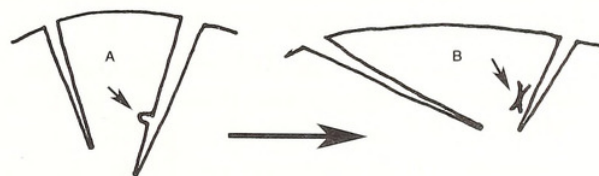


FIG. 2. Comparison of cut patterns for first instar shelters of (a) *Epargyreus clarus* (redrawn from Weiss *et al.* 2003) and (b) *Urbanus proteus*. Large arrow points towards the base of the foodplant leaf to show orientation of shelters. Small arrows point to (a) position of notch made by *E. clarus* to aid in tenting the shelter and (b) position of silk laid down to pinch shelter into a tented peak by *U. proteus*.



emerge from the eggs, *Hamadryas* larvae create an opening in the side of the egg. Previous discussions on patterns of egg laying and larval emergence in nymphalids suggest an evolutionary significance to the correlation between side emergence and egg stacking: side emergence being necessary to avoid damaging eggs laid above (Muyschondt & Muyschondt 1975a). Our observation of egg stacking in *U. proteus* showed emergence from the top, suggesting that emergence from the side of the egg is not a necessary adaptive response to eggs laid in stacks. While we were unable to clearly illustrate top-emergence in Figure 2, our direct observations show that this was indeed the case. Figure 2 also shows that the eggs of *U. proteus* were not laid directly centered above the egg below, as illustrated in Muyschondt & Muyschondt (1975b, 1975c) for *Hamadryas*. It is possible that this means of attaching stacked eggs represents an alternative adaptation allowing eggs to be laid in stacks.

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HAROLD F. GREENEY & KIMBERLY S. SHELDON,  
Yanayacu Biological Station & Center for Creative  
Studies, Cosanga, Ecuador c/o 721 Foch y Amazonas,  
Quito, Ecuador; email: revmmoss@yahoo.com.

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