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NOTES ON THE PECULIAR LIFE HISTORY OF *MADORYX PSEUDOTHYREUS*, A COCOON-BUILDING HAWKMOTH IN THE FLORIDA KEYS (LEPIDOPTERA: SPHINGIDAE)

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ABSTRACT.— The larvae of *Madoryx pseudothyreus* (Lepidoptera: Sphingidae), resident on Adams Key and Elliott Key, Florida, feed on the foliage of black mangrove trees, *Avicennia germinans* (Avicenniaceae), and pupate in silk cocoons spun on the branches or living leaves of the host. The last instar larva is normally cryptically colored brown and gray, but displays a pair of large eyespots on the thorax and bright colors on the prolegs when disturbed. The pupa bears a bifurcate cremaster that helps to anchor it in the cocoon.

KEY WORDS: Avicenniaceae, cocoons, cryptic coloration, hostplants, immature stages, *Madoryx oiclus*, mangrove, morphology, sphinx moth.

In a recent paper on the phylogeny of the Lepidoptera, Scott (1988) states "Sphingidae pupae occur in an earthen cell, but do any have true dense-silk cocoons?" The cocoon-building habits of a few genera of hawkmoths have been known for some time. Mosher (1918) and Hodges (1971) mention that *Hemaris* species pupate in loosely woven cocoons in leaf litter at ground level. Hodges (1971) reports *Isoparce cupressi* (Boisduval) as pupating in thin cocoons spun on the bark of cypress trees, but Dominick (1973) corrected the account, noting that the larvae pupate underground and do not spin cocoons. The genus *Madoryx* may be unique among the sphingids for sheltering the pupa in a cocoon above the ground surface. This behavior has been documented for *Madoryx oiclus* Cramer (Lichy, 1944; Cary, 1951; Kendall, 1976) and is here described for *Madoryx pseudothyreus* (Grote). The last instar larva and pupa of *M. pseudothyreus* are also described and illustrated for the first time.

HOSTPLANTS

The larval foodplant of *M. oiclus* has been reported to be *Tabebuia pentaphylla* (L.) Hemsl. (Bignoniaceae) in Venezuela (Lichy 1944) and Mexico (Kendall 1976). Hodges (1971) listed *Jussieua* as the host for an unidentified species of *Madoryx* and speculated that *M. pseudothyreus* may feed on a member of the Onagraceae as well. D'Abrera (1986) gave a brief description of the larva of *Madoryx pluto* Cramer and reported the hostplant to be *Jussieua* sp. (Onagraceae). It was quite surprising, therefore, to find immatures of *M. pseudothyreus* on black mangrove, *Avicennia germinans* (L.) L. (Avicenniaceae). We have found a last-instar larva and eight cocoons, one containing a live pupa, on small black mangroves (1-3m tall) along the coasts of Adams Key and Elliott Key, Biscayne National Park, Dade County,

Fig. 1-2. Larva of *Madoryx pseudothyreus* feeding on black mangrove: 1) lateral view showing abdominal segments 3-4 not being used; 2) the defensive posture.

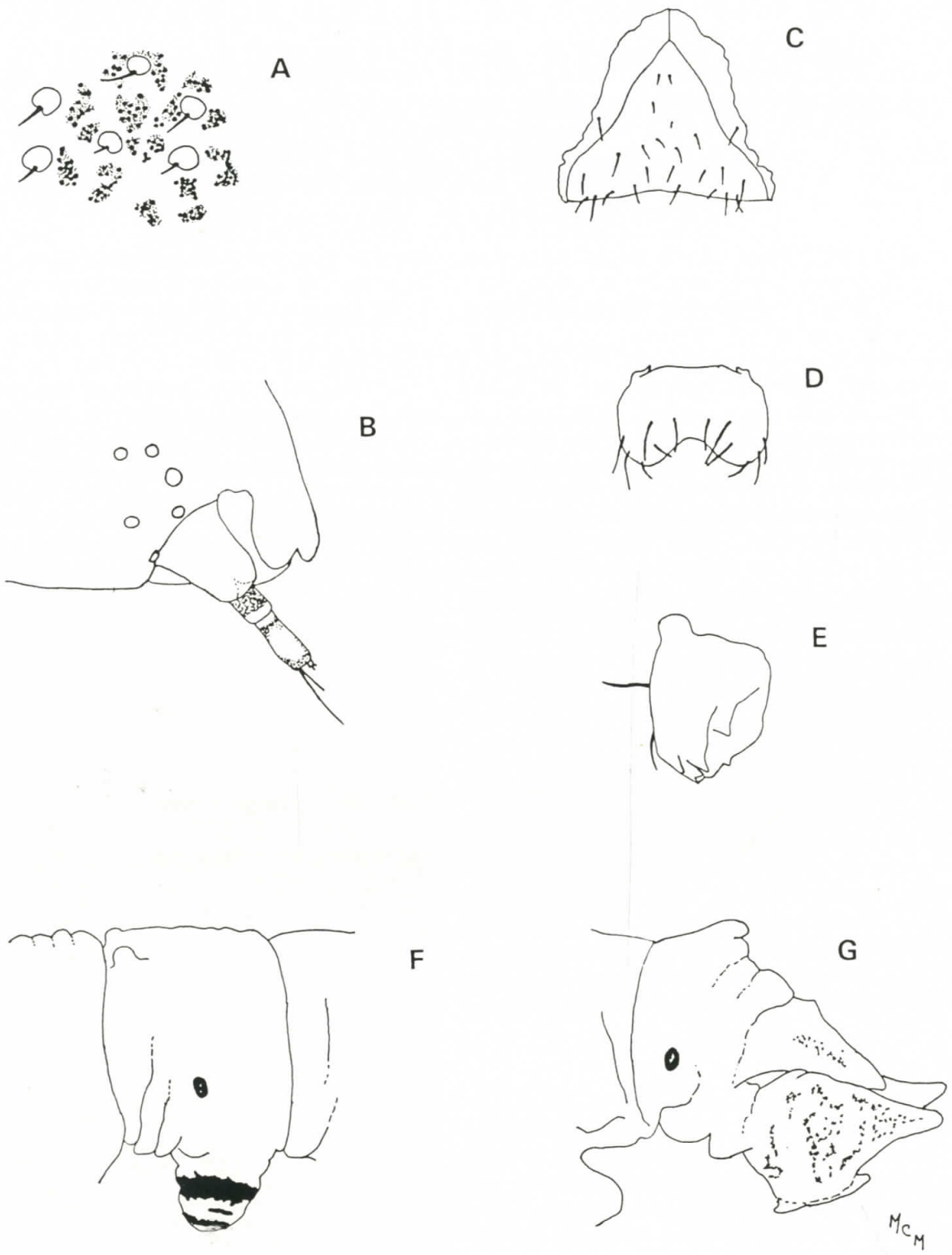

Fig. 3. Structures of the larva of *Madoryx pseudothyreus*: a) sculpturing on the upper head; b) lateral view of the head indicating the position of the stemmata and antenna (setae not shown); c) adfrontals and front; d) labrum; e) mandible f) lateral view of segment A4 showing the small tubercles; g) caudal end with short fleshy horn and triangular anal prolegs.

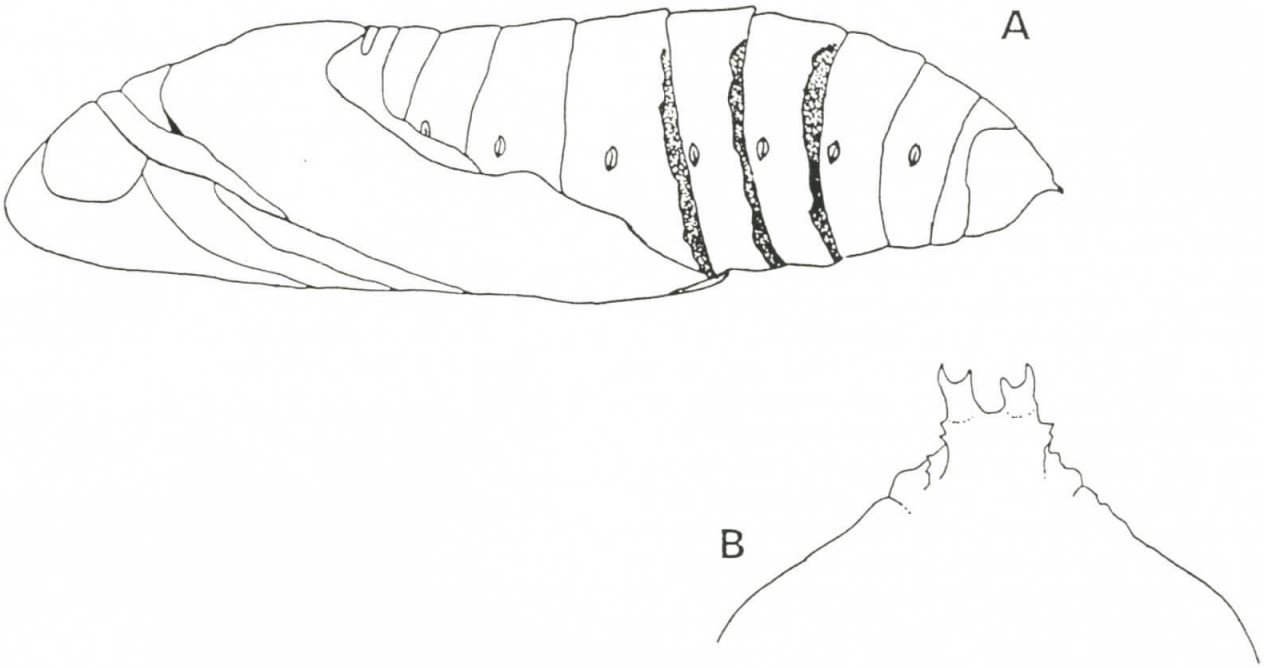

Fig. 4. The pupa of *Madoryx pseudothyreus* (A) and detail of the bifurcate cremaster (B).

Florida.

Immatures were located by searching small, and often isolated black mangroves for signs of feeding damage at the tips of the branches. Black mangroves are evergreen, and the damage may be noticeable for several years. The live pupa was found on Adams Key on 29 Jan 1988, and an adult female emerged several weeks later. Seven cocoons containing exuvia were found on the eastern side of Elliott Key from 27-30 May 1989. The mature larva illustrated in Fig. 1 and 2 was found along the Elliott Key boardwalk on 18 Feb 1990.

DESCRIPTIONS

LAST INSTAR LARVA (Fig. 1-3): Larva about 60mm in length and rather slender for a sphingid (8mm wide dorso- ventrally at segment A4). Head rounded, grayish with dark markings, and partially recessed into the prothorax. Epicranium smooth with patches of light and dark brown sculpturing in the form of tiny bumps. The colorless, simple setae arise from small knobs scattered over the epicranium. Setae range in length from 0.15-0.9mm and are longest and most numerous toward the ventral side of the head. Adfrontal sclerites with an irregular outer margin and bearing a single seta. Front triangular, about as broad as high, slightly scalloped laterally, with sparse setae. Labrum moderately notched, bearing 12 setae. Mandibles with two setae on outer surface, five teeth on the cutting edge, and a retinaculum and complex sculpturing on inner surface. The six stemmata are nearly equal in size and spacing. Antennae longer than mandibles. Anticoria, segment 2, and sensillum trichodeum about equal in length.

Thorax normally similar to the abdominal segments in size and color. Prothorax about the same size as the head. Spiracles oval in shape, about 1.1mm high and 0.5mm wide, and brown in color. Middle and hind thoracic segments slightly larger than the prothorax and with dorsal folds. When disturbed, the larva raises the anterior body and inflates the mesothorax and metathorax, displaying a pair of large eyespots and pink and blue markings. The thoracic setae are approximately the same length as on the head, longest and most numerous toward the ventral side of the body. Legs light gray with dark lines and numerous, relatively long setae. Claw simple.

Abdomen reddish brown and gray. Setae very sparse and mostly short. Prolegs on segments A3-A6 about equal in size, each with a lateral black band. In the defensive pose, the prolegs are inflated, revealing a black and bright yellow pattern. Crochets biordinal, homoideous mesoseries. The prolegs on segments A3 and A4 are often not used while the caterpillar is at rest or feeding. Anal prolegs greatly flattened, triangular in shape, and sclerotized on the lateral margin. A pair of small, dorso- lateral fleshy tubercles near the anterior margin of segment A4. Spiracles about 0.4mm wide and 0.9mm high. Caudal horn on segment A8 short, blunt, and fleshy. Suranal plate triangular and sclerotized.

PUPA: Figure 4. The pupae are dark brown and vary from 39-42mm in length (N = 4). Abdominal segments 4-6 are reddish along the posterior margin. Antennae rather short and thick. The cremaster is bifurcate and bears some small spines which seem to help hold the pupa in the cocoon.

COCOON: Cocoons range from 55-90mm long, 15-20mm wide (N = 8), and are usually attached lengthwise to branches, although one was found wrapped in the living leaves at the top of 1.5m tall black mangrove. The cocoon is grayish brown and often has bits of bark incorporated among the silk strands.

DISCUSSION

The larva of *M. pseudothyreus* is somewhat peculiar for a sphingid in both structure and behavior. At first glance, the body proportions and coloring would seem to place it among the noctuids. Hodges (1971) likened a *Madoryx* larva to that of the *Catocala* (Noctuidae) and stated that the caterpillar moved forward in a looping fashion! D'Abrera (1986) added that the larva of *M. pluto* is "Similar to a geometrid with arched body, whilst at rest." *M. pseudothyreus* is not a looper. The larva uses all of the legs in normal fashion while walking. At rest or while feeding, however, the prolegs on abdominal segments 3 and 4 are often not used, and the larva holds on with the thoracic legs and hind prolegs (Fig. 1). In this position the caterpillar does somewhat resemble a geometrid, although a very large one.

Whereas the short tubercles on segment A4, fleshy horn, and triangular anal prolegs are interesting and perhaps unique characteristics of *M. pseudothryeus* and its close relatives, the enlarged thoracic segments, eyespot pattern, and short caudal horn are features frequently shared by many species in the Macroglossinae (Hodges, 1971). Forbes (1910, 1911) and Peterson (1962) illustrate the anatomy of other sphingid larva with which the drawings in this paper may be compared. The pupa of *M. pseudothyreus* appears to be nearly identical to that of *M. oiclus* (Kendall, 1976) and is similar in shape to other macroglossines (Mosher, 1918).

The dull coloration of the larva and cocoons of *M. pseudothyreus* blends in well with the bark on the larger branches of black mangrove. However, the young branches of the host are green and the leaves are green above and whitish below. Even against this bright background, the brownish-gray caterpillar is very difficult to find when feeding, as it seems to resemble pieces of damaged or dead leaves common on black mangroves near the shore. The caterpillars must also have a specialized physiology for dealing with salt, as the leaves of the host exude salt, often becoming coated with small crystals (Tomlinson, 1980). The attachment of the cocoons to branches appears to be an adaptation to living in mangrove forests which are frequently flooded.

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