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## IMMATURE STAGES OF THE MARBLED UNDERWING, *CATOCALA MARMORATA* (NOCTUIDAE)

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**ABSTRACT.** The immature stages of *C. marmorata* are described and illustrated for the first time, along with biological and foodplant notes.

**Additional key words:** underwing moths, Indiana, life history, *Populus heterophylla*.

The Marbled Underwing, *Catocala marmorata* Edwards 1864, is generally an uncommon species whose present center of distribution is the central and south central United States east of the Mississippi River (Fig. 1d). Historically, the range of *C. marmorata* extended somewhat farther to the north, as far as southern New England (open circles in Fig. 1d; see Holland 1903, Barnes & McDunnough 1918, Sargent 1976), but the species has not been recorded from these localities in the past 50 years, and the reasons for its apparent range contraction remain unknown.

We are not aware of any previously published information on the early stages or larval foodplant(s) for *C. marmorata*. The foodplant has long been suspected to be willow (*Salix*) or poplar (*Populus*) (Salicaceae), based on the external morphology and wing pattern of the adults. In his recent studies on this species, Willis (1991) was unable to obtain viable ova from numerous captive females, even from one female that was kept alive for 81 days. He dissected 40 females that died in captivity, and concluded that females may not regularly oviposit until September or October, which is six to eight weeks after their emergence in the field.

Here we report on the successful rearing of *C. marmorata*, from ova deposited by a wild-caught female from southern Indiana, and offer suggestions on a potential wild larval foodplant for this species.

## REARING NOTES

Ova were secured from a worn female *C. marmorata* collected at a baited tree at 2300 CST on 11 September 1994, in Point Twp., Posey Co., Indiana. The habitat is mesic lowland flatwoods, with internal swamps of two types: (1) buttonbush (*Cephalanthus occidentalis* L.) (Rubiaceae), cypress (*Taxodium distichum* L. (Richaud)) (Taxodiaceae), and swamp cottonwood (*Populus heterophylla* L.); and (2) overcup oak (*Quercus lyrata* Walt.) (Fagaceae) and swamp cottonwood. The female was confined in a large grocery bag (17.8 × 30.5 × 43.2 cm) on a shaded porch at outside ambient temperature (15–30°C). She was offered a 20% sucrose solution daily on a small piece of sponge; a new sponge piece with solution was provided every other day. The female moth lived until 4 October 1994 (24 days), during which time she deposited 404 ova on the sides and bottom of the bag, and on the sponges. Ova were removed daily and placed onto filter paper in empty plastic film containers, and slightly moistened every 2–3 days. Ova were overwintered in the film containers at ambient outside temperatures (–2 to 10°C) until 23 January 1995, when they were transferred to a refrigerator and kept at 5°C until April 1995. Refrigerated ova were removed and misted lightly once every two weeks before being returned to cold storage.

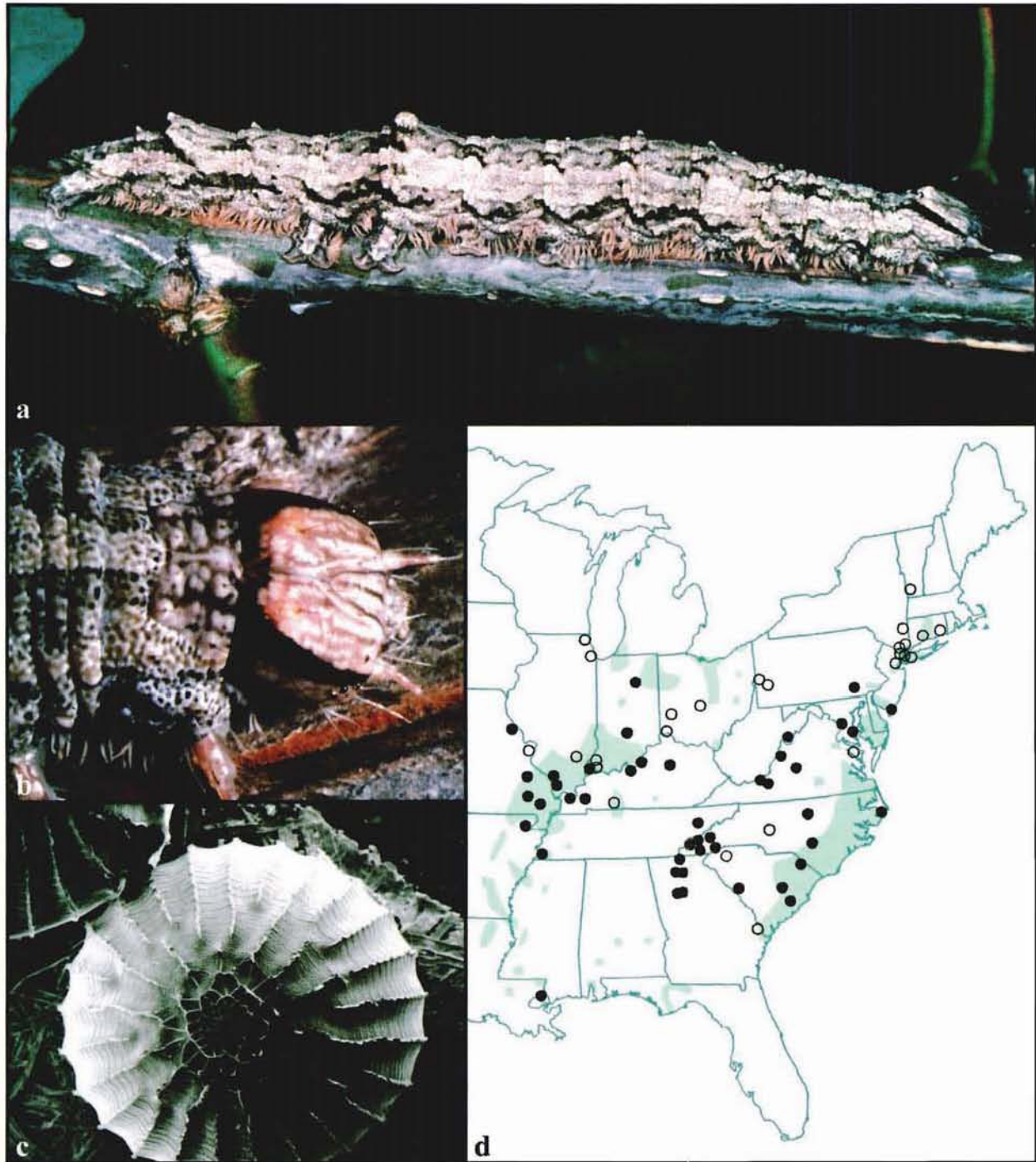


FIG. 1. Immature stages and distribution of *Catocala marmorata*. **a**, lateral view of 5th (last) instar larva. **b**, closeup of head capsule of 5th instar larva. **c**, dorsal view of egg as revealed by scanning electron microscopy (60 $\times$ ). **d**, distribution of *C. marmorata* in North America; open circles, pre-1950 records; filled circles, post-1950 records; each circle represents a county in which the species has been recorded; shading represents distribution of *Populus heterophylla* (after Little 1977 and McCormac 1993).

On 13 and 27 April 1995, batches of ova were removed from the refrigerator and held at 22°C. First instar larvae began emerging 13–19 days after the ova were removed from the refrigerator. A total of only 23

of 404 ova survived winter storage to produce larvae. The duration between 5% and 95% total first instar emergence from a single clutch of eggs, a measure to assess hatch synchronization as it pertains to life his-

tory strategies of *Catocala* (D. F. Schweitzer & L. F. Gall, unpubl. data), was 4 days for this clutch. Newly emerged larvae were placed individually in petri dishes on moistened filter paper, and presented with fresh leaves of sandbar willow (*Salix exigua* Nutt.) and cottonwood (*Populus deltoides* Bartr.). Although no precise data were kept, the larvae appeared to eat both foods equally well, and their development was comparable on both plants, with little apparent difference in the duration of larval instars and pupae, or adult size. The larvae were reared indoors at 20–24°C through the fourth instar using fresh cut foliage that was collected daily. Most of the ultimate (5th) instar larvae were placed in fine-mesh nylon sleeves on field grown willow or cottonwood saplings to complete development. Thirteen of the original 23 larvae survived to the adult stage. The average duration for each stage was as follows: ova, 15 days; 1st instar, 4 days; 2nd instar, 4.5 days; 3rd instar, 4.7 days; 4th instar, 5 days; 5th instar, 7.6 days; pupa, 26.1 days. A description of the mature larva is as follows:

**5th (final) instar larva.** Fig. 1a, b. Length 9 cm; head capsule width 4 mm; body color light mousy brown tinged with pink; dorsal tubercles pink; spiracles pinkish brown; finely dispersed black to brown specks forming interrupted but nearly complete dorsal and lateral lines along length of body, most apparent in the vicinity of the dorsal tubercles; 5th abdominal segment with slightly elevated, 2 mm wide transverse protuberance, slightly lighter than body color, with a lateral “saddle patch” slightly darker brown than body color, all lines formed by specks being darker and more prominent on this segment; 8th abdominal segment with a pair of ventrally projecting, 2 mm long tubercles; lateral filaments present along entire length of body, pink, dense, 1–2 mm in length, simple (not bifurcate or multifurcate); ventral surface of body segments dirty pink, with black spots on each abdominal segment, edged and overlaid with orange on 4th through 7th abdominal segments; capitad surface of head capsule flattened but not strongly produced ad-dorsally, with two 1–2 mm wide, dark, nearly continuous lateral stripes from antennae to dorsal margins; antennae and true legs pinkish; setae on head capsule and body pinkish, sparse.

On 16 September 1996, two additional female *C. marmorata* were captured at the Posey Co. site, and confined for ova. The protocols for handling these females and their ova and larvae were largely as described above. These two females together laid several hundred ova, with subsequent first instar hatches again of only several dozen larvae. Measures of hatch synchronization for first instar larvae from these broods

were 6 and 12 days, respectively. Larvae of each brood were reared indoors successfully on *Populus deltoides*.

#### DISCUSSION

It is unlikely that either of the laboratory foodplants, *Populus deltoides* and *Salix exigua*, is the wild larval foodplant of *C. marmorata* at the Indiana site. *S. exigua* was not located anywhere in the area where the adult females were taken, and *P. deltoides* occurs only rarely in the general vicinity, and then not in close proximity to the female collection site. However, both black willow, *S. nigra* Marsh, and swamp cottonwood, *P. heterophylla*, occur within 200 m of the female collection site. *S. nigra* is common and widely distributed in the eastern United States, as is *P. deltoides*, and both of their geographic ranges greatly exceed that of *C. marmorata*. The indeterminate foliating schedule of *S. nigra* leaves is considerably longer than that of most *Populus* species, and the egg hatch synchronization measures of 4, 6, and 12 for *C. marmorata* are comparable to *Catocala* species that are known to use the more determinate-foliating *Populus* as opposed to *Salix* as their principal wild larval foodplants (D. F. Schweitzer & L. F. Gall, unpubl. data). During 1995 and 1996, many adult *C. marmorata*, particularly females in September, rested in close proximity to *P. heterophylla* trees at the Indiana site, and the overall geographic range of *P. heterophylla* better approximates that of *C. marmorata* (Fig. 1d; but note this tree is not present in the central Appalachian Mountains). These facts suggest that *P. heterophylla* is more plausible than either *S. nigra* or *P. deltoides* as a possible wild foodplant.

Adult *C. marmorata* were fairly common at the Indiana site in 1995, with a total of 18 moths observed in 48 hours, both on baited trees and in bait traps at night, and on tree trunks during daylight hours. On warm days, adults were seen resting head up from 0.5 to 2 m above the ground on the trunks of large, gray-barked trees, especially overcup oak (*Quercus lyrata*). These observations accord well with those of Willis (1991), who collected most of his *C. marmorata* by tapping large trees with light-colored bark, including white oak (*Q. alba* L.), red oak (*Q. rubrum* L.), maple (*Acer* spp.) (Aceraceae), hickory (*Carya* spp.) (Juglandaceae), white pine (*Pinus strobus* L.) (Pinaceae) and tulip poplar (*Liriodendron tulipifera* L.) (Magnoliaceae). Although both Holland (1903) and Sargent (1976) considered *C. marmorata* “rare,” and Covell (1984) considered it “uncommon to rare,” Willis (1991) is more probably correct in describing the species as “not as rare as sometimes implied . . . but rather . . . [with] a somewhat localized distribution.”

We suspect our success in obtaining viable ova was in part the result of utilizing female *C. marmorata* collected late in the season. It is possible that female *C. marmorata* mate many weeks after emergence, and/or undergo a period of reproductive diapause from the time of initial emergence in July and August, as is true for some western willow-poplar feeding *Catocala* species (D. C. Hawks, pers. comm.). Irrespective, our poor success at obtaining hatchable *C. marmorata* eggs contrasts sharply with the more typical 90–100% hatching success with most other *Catocala* species, and suggests that at least some aspects of the handling and/or overwintering biology of *C. marmorata* remain incompletely understood.

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