

Life history of *Manataria maculata* (Lepidoptera: Satyrinae) from Costa Rica

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Abstract: The life history and early stages of the satyrine butterfly *Manataria maculata* are described and illustrated from Costa Rica. Eggs are laid on *Lasiacis* sp. (Panicoidae), a new non-bamboo host plant for the genus *Manataria*. The larval stage varied from 23 to 28 days, and the pupal duration was approximately 12 days when reared on *Bambusa vulgaris* and *Guadua angustifolia* in captivity at 23-24°C.

Key words: *Bambusa vulgaris*, *Guadua angustifolia*, *Lasiacis*, *Manataria*, Natural History, Neotropical, *Patelloa xanthura*, Tachinidae.

The genus *Manataria* Kirby is distributed from Mexico to northern Argentina, Paraguay, Uruguay, and the southeast Brazil to the south; and to French Guyana in the northeast. It is currently regarded as containing three species (Barrera and Díaz 1977, DeVries 1987, D'Abbrera 1988), but it may well be monotypic (G. Lamas, pers. comm.). In Costa Rica, only a single species, *Manataria maculata* (Hopffer, 1874), (Figs. 1-17) occurs. It is found commonly on the Pacific slope, from sea level to 2500 m elevation, although its abundance varies according to location, season, and year. The adults are attracted to rotten fruits (DeVries 1987). Stevenson and Haber (1996, 2000) reported that groups of a few to more than 50 adults were observed roosting in small caves, under overgrown cliffs, in rock outcrops and shaded areas along forest trails at Monteverde (Figs. 18-19). They also mentioned that females remain in reproductive diapause from the end of June until April-May (end of dry season), and that breeding begins

with the onset of the rainy season (May-June). The host plants for the genus belong to the Bambusoideae (Figuroa 1953, Valenzuela 1963 Young and Muysshondt 1972, Gallego and Vélez 1974). Valenzuela (1963), described the morphology of adult and last instar larva of *Manataria maculata*; however, it is misidentified as *Pronophila thelebe* Doubleday (A. Vilorio, pers. comm.). The larvae were reported to be a pest of *Guadua angustifolia* Kunth, and a sarcophagid fly was considered to be a biological control agent (Valenzuela 1963). Here, we describe the complete life history of *M. maculata* and include illustrations of the early stages. We also briefly mention its nomenclatural history, since its taxonomic composition is still uncertain.

MATERIALS AND METHODS

An extensive search for larvae was carried out on May 23rd, 1999, at the Hacienda "El

Rodeo" (750 m), San José, Costa Rica, 09°55' N, 84°16' W. The climate of the locality is defined as Tropical Wet Forest Transition to Premontane (Holdridge 1967). Eggs and larvae were found on a small bamboo-like plant. The plant and early stages were transported to, and reared in, the entomological laboratory (average room temperature 23-24°C) of the Escuela de Biología, Universidad de Costa Rica. Leaves of *Bambusa vulgaris* Schrad. ex J.C. Wendl. and *Guadua angustifolia* Kunth (Poaceae: Bambusoideae) from the University campus were substituted as food plants from mid- second instar. Larvae were reared inside plastic bags until adult emergence. Samples of eggs, larvae, head capsules of each instar, and pupae were preserved in 75% alcohol. All materials obtained from this study, including adults, are deposited in the collection of Museo de Insectos, Universidad de Costa Rica. Digital images of the early stages were recorded with Nikon Coolpix cameras.

A bait trap (Austin and Riley 1995, Shuey 1977) was placed in a *Guadua angustifolia* bamboo patch located in the Reserva Ecológica Leonel Oviedo on the University campus during April-June, 2001 and 2002, to obtain additional information on the life history and biology. Captured male and female adults were then placed in a mesh cage (approximately 2x1x1 m), with live *G. angustifolia* plants and rotten plantain bananas in the reserve. Abdomens of dead females were periodically dissected to assess reproductive condition. A fertilized egg from a live female was forcefully extracted by massaging the abdomen using fingers. The egg was also reared to adult as described above.

Host plant: *Lasiacis* (Poaceae: Panicoideae). A non-bambusoid sub-woody grass plant lacking pseudopetioles on leaf blade; fruits are usually black and round, and possess shiny fruiting spikelets (Gentry 1996).

RESULTS

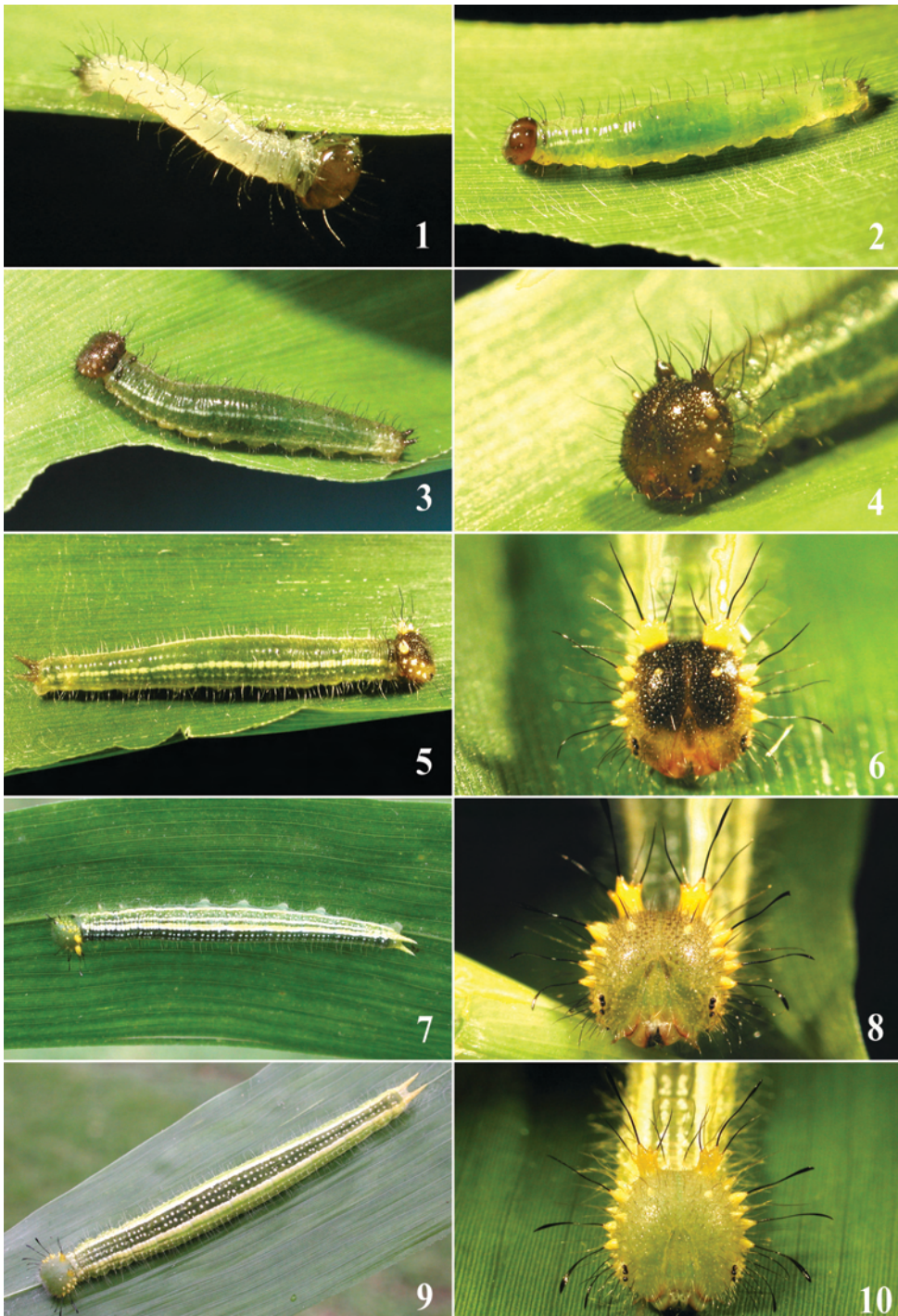
Early stages

Egg: 1.0 mm diameter; spherical, creamy white, chorion smooth.

First instar larva (Figs. 1, 2): ranging 2-6 mm long (after hatching and before molting). Head capsule 0.8 mm wide, dark brown; stemmata black, 1-3 grouped together; first and second contiguously located (same in rest of instars). Body initially white (Fig. 1), changing to light green after feeding (Fig. 2); a pair of dark brown spots on T1, *i.e.* T1 plate divided; a dark brown bifurcated suranal plate on A10; primary setae dark brown to black on chalazae, evenly scattered over body segments, head, and over bifurcated suranal plate; spiracles creamy white to light brown.

Second instar (Figs. 3, 4): 6-11 mm (after molt-before next molt). Head capsule 1.3 mm wide, dark brown, granulose except parts near fronds, stemmata, and mouth parts. A toothed-(dentated-) dark brown horn (protuberance) on apex of each epicranial robe, bearing a seta on each tooth. Six conical protuberances (or enlarged chalazae), in different sizes, on mid-dorsal to lateral area; color varies from creamy white to dark brown; bearing a single seta at apex. Body green to light green; bifurcated suranal plate conically elongated and protruding at approximately 55 degrees from body line (75 degrees in preserved larva); setae on body segments same as in first instar; a pair of pale white subdorsal and subventral lines longitudinally from T1 to A10.

Third instar (Figs. 5, 6): 11-18 mm. Head capsule 1.8 mm wide, color varies from uniform dark brown to dark brown with partially light brown areas; toothed horn and seven conical protuberances on each robe; color varies from bright yellow to dark brown;



Figs. 1-10. Early stages of *Manataria maculata*: 1) recently hatched first instar (dorso-lateral view), 2) late first instar, 3) second instar, 4) head of second instar (frontal view), 5) third instar, 6) third instar head, 7) fourth instar in resting position, 8) fourth instar head, 9) fifth instar (dorsal view), 10) fifth instar head.

a protuberance (chalaza) on each side of dorsal epicranium (vertex) with a dark brown to black seta; some spatulate setae on horns and conical protuberances (same in remaining instars). Body green with creamy white longitudinal lines; color of suranal plate has varying shades of dark brown; thoracic and abdominal setae dorsally dark brown to black and laterally to subventrally translucent; a pair of creamy white subdorsal, lateral, and subventral lines from T1 to A10; thickness of lateral line *ca.* one-third of subdorsal line; a dotted line between lateral and subventral line, located above spiracles.

Fourth instar (Figs. 7, 8): 18-35 mm. Head capsule 3.0 mm wide; color varies between black, black with pale brown, and pale greenish-creamy white (greenish color turned darker as larva matured); toothed horns bright yellow; approximately 12 conical protuberances on mid-dorsal to lateral area and protuberances on dorsal epicranium bright yellow to creamish-yellow. Spatulate setae up to 7 mm. Body dark green dorsally and bright creamish-green laterally with creamish-white longitudinal lines; T1 plate varies from creamish-white to black; suranal plate on A10 pale creamish-yellow; 4 to 5 mm long, angled at approximately 35 degrees (*ca.* 55 degrees in preserved larva); thoracic and abdominal setae translucent with dark brown to black setae intermittently on dorsal surface; creamish-white longitudinal lines same as in third instar; a pair of creamish-white dotted lines from T1 to A10 below dorsal chalazae.

Fifth instar (Figs. 9, 10, 11): 35-60 mm long. Head capsule 4.5 mm wide, color similarly varied as in the fourth instar from black with pale brown, pale greenish-creamy white, to pale greenish-creamy white with pale black (greenish color turned darker as larva matured). Body dark green dorsally and bright creamish-green laterally with creamish-white longitudinal lines (as in fourth instar); rest of pattern similar to fourth instar. In some individuals, irregular interruptions or creamish white blotches occur between T1 and A10.

Prepupa (Fig. 12): 37 mm long. Bright light green.

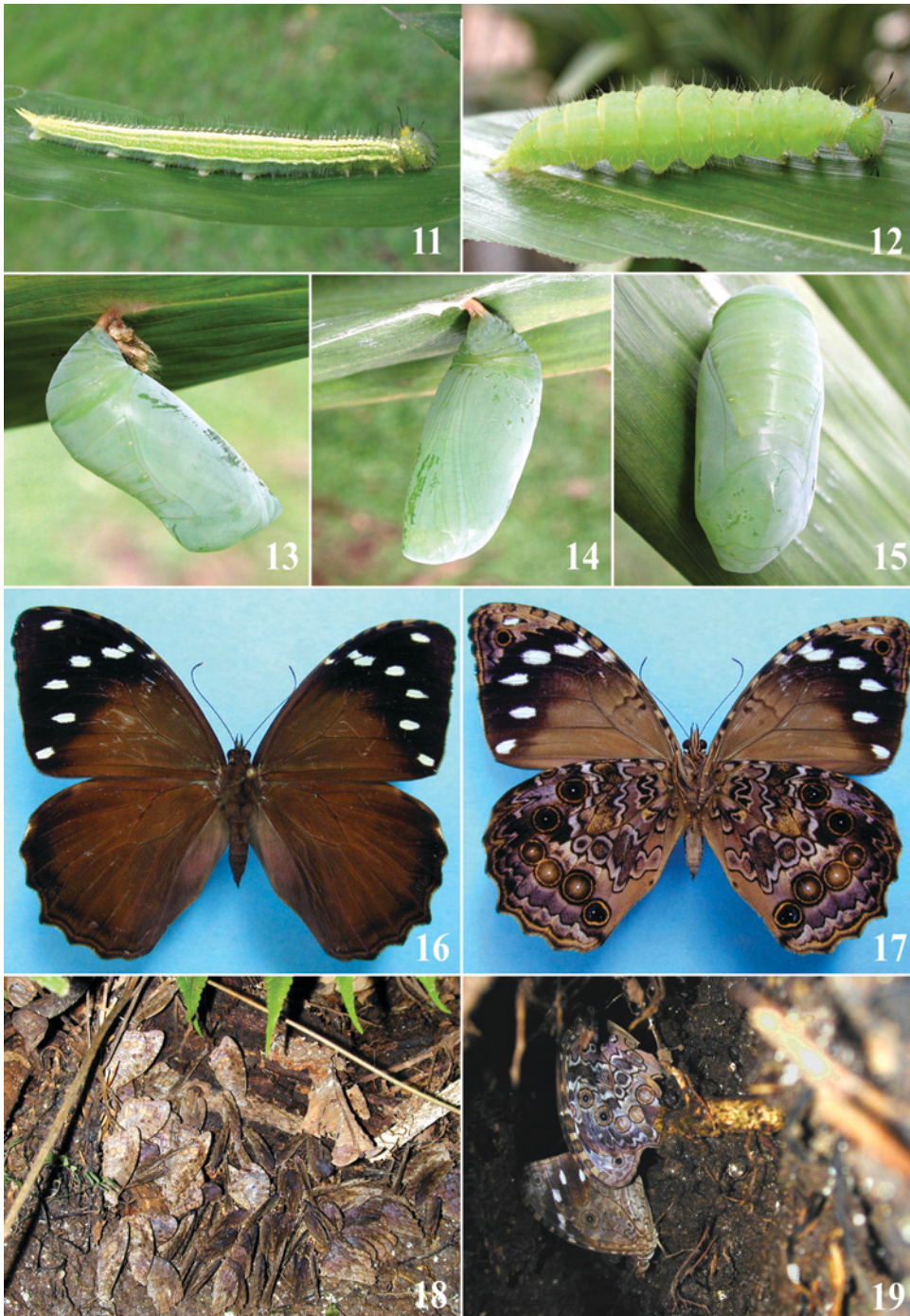
Pupa (Figs. 13, 14, 15: three-day old): 17-23 mm long, 9-10 mm wide. Light green and becoming lighter on abdominal segments; surface covered with white waxy substance; spiracles creamish-white; cremaster light orangish-pink; cremaster and ventral body surface forming a *ca.* 110° angle.

Biological observations

Egg masses and first instar larvae of *M. maculata* were found in a patch of *Lasiacis* sp. The egg masses varied from 5 to 20 eggs and were located on the underside of leaves. Usually, the early instar larvae fed and rested gregariously on the underside of leaves until the late second instar. From third instar onward, the larvae appeared to feed solitarily. Third instar larvae rested on the upper side near the leaf tip and partially fed on the basal portion of the leaf. Fourth and fifth instar larvae rested in the central part on the under side of a leaf (Fig. 7), and fed on the apical portion. Pupation occurred in the middle portion on the under side of a leaf, with the pupa suspended downward with the cremaster attached to the midrib by silk. Pupae changed from green to reddish brown about a day before eclosion. A larva of a tachinid parasitoid, *Patelloa xanthura* (Wulp), emerged from one of the pupae (in this case, the reddish brown color of the pupa persisted for five days).

From the eggs and first instar larvae collected and reared on May 23, 1999, adults emerged between June 28th and July 3rd, 1999. Total duration of the early stages varied from 35 to 40 days, the larval stage lasting between 23 and 28 days, and the pupal duration, approximately 12 days. The developmental time for the extracted egg from the female captured in the bait trap on June 1st, 2002 is as follows: egg (4 days), instar I (5 days), instar II (4 days), instar III (3 days), instar IV (5 days), instar V (9 days), pre-pupa (1 day), pupa (17 days), with adult eclosing on July 15, 2002.

At the start of the rainy season, solitary adults were observed flying eastward along the roads, wide trails and rivers, or flying from tree



Figs. 11-15. Early stages of *Manataria maculata*: 11) fifth instar (lateral view). 12) prepupa (lateral view). 13-15) pupa: 13) dorso-lateral view, 14) ventro-lateral view, 15) dorsal view. Figs. 16-19. Adult of *M. maculata*: 16-17) male adult captured at UCR, bait trap (wing span 73 mm): 16) dorsal view, 17) ventral view; 18-19) adults roosting under overgrown cliffs: 18) about 80 individuals, 19) close-up of figure 18 showing two individuals.

to tree from ground level to about 15 m in the Central Valley of San José. Occasionally they were observed perching on the side of tree trunks with the head pointing down ward.

Between April and June 2001, approximately 10 worn adults (*i.e.* several parts of wings torn off, >30 % scales on wings detached) were observed in the bait trap in the Ecological Reserve. During May and June 2002, at least seven worn males and females were captured in the bait trap. All females captured in early April of both years contained no fully developed eggs in their abdomen. By contrast, varying numbers of females captured in mid- to late April, May and June carried fully developed eggs. The adults in the mesh cage survived for nearly 10 days. No courting or mating behavior was observed in the cage. A few freshly-emerged adults (*i.e.* no parts of wings torn off, all wing scales intact) were observed flying and resting in the Reserve between the 20th and the 25th of July, 2002.

DISCUSSION

Previously recorded host plants for *M. maculata* are *Bambusa* sp. (Young and Muyschondt 1972), *Guadua angustifolia* (Valenzuela 1963), *Bambusa guadua* (Gallego and Vélez 1974), and *Guadua* sp. (Figueroa 1953). All of these plants belong to the bamboo group (Bambusoideae). However, we have recorded the food plant as *Lasiacis* which is placed in the Panicoideae. We have also recorded *Bambusa vulgaris* as a new food plant in this study. The *B. vulgaris* is non-native plant which was introduced from South-Pacific Asia (C.O. Morales, pers. comm.). These records suggest that *M. maculata* feeds on a wide range of bamboo and bamboo-like plants.

Stevenson and Haber (1996) mentioned that the larvae feed in groups until the last part of the fourth instar, but we recorded the gregarious feeding behavior only until the last part of the second instar. However, we were not able to observe thoroughly the larval

behavior of each instar, especially the gregarious feeding and resting behavior. This was because of the massive mortality of larvae in the second instar, probably due to poor conditions of the *Lasiacis* plant. Subsequently, we separated larvae into smaller groups comprising a few individuals per plastic bag, and found greater survival success.

The collection of a freshly emerged adult in the Ecological Reserve may suggest that the species breeds seasonally in the *G. angustifolia* patch on the University campus. Additionally, a fresh male was captured in the bait trap on the 15th of December, 1998, at the Reserve, and slightly worn male was captured by net at Playa Dominical in the Pacific lowland on January 1st, 1999. These additional records may suggest that there are some individuals which do not migrate to higher elevations, but are resident and breed the year round in the lower elevations. In contrast, individuals which migrate to Monteverde are univoltine and enter reproductive diapause during the non-breeding season (Stevenson and Haber 1996).

The phylogenetic relationships of *Manataria* are currently unknown (Miller 1968). Miller and Miller (1997) suggested that the genus might be closely related to *Paralethe* van Son and *Aeropetes* Billberg from southern Africa. *Manataria* is currently classified in the subtribe Parargina in the tribe Elymniini (G. Lamas, pers. comm.). Within this tribe, *Manataria* is the only member which has a Neotropical distribution (A. Vilorio, pers. comm.). The three species currently recognized in the genus are *M. hercyna* (Hübner, 1821), *M. hymethia* (Fruhstorfer, 1912) and *M. maculata* (Hopffer, 1874). All species are distinguished from other satyrines by their relatively large, rounded hind wings, dark ground color, and the presence of white spots on the forewing (DeVries 1987). The three species are possibly conspecific with *M. hymethia* and *M. maculata* being junior subjective synonyms of *M. hercyna* (G. Lamas, pers. comm.).

Manataria hercyna and *M. maculata* were originally described in the genus *Tisiphone*.

Tisiphone maculata, mentioned in some previously published works (e.g. Figueroa 1953, Young and Muysshondt 1972, Gallego and Vélez 1974), refers to the genus *Manataria* Kirby [1904]. *Tisiphone* is otherwise endemic to Australia and includes two species (Braby 2000).

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RESUMEN

Se describe e ilustran los estadios tempranos y la historia natural de *Manataria maculata* (Hopffer, 1874) de Costa Rica. Los huevos fueron encontrados en *Lasiacis* sp. (Panicoidae), una nueva planta hospedera para el género *Manataria*, y que no es un bambú. El estadio larval varió desde 23 a 28 días y el estadio pupal, aproximadamente 12 días cuando es criado con *Bambusa vulgaris* y *Guadua angustifolia* bajo condiciones de cautiverio a 23-24°C.

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