

BIOLOGY OF *ANTHERAEA ANDAMANA* (SATURNIIDAE)
ON THE ANDAMAN ISLANDS, INDIAN OCEAN

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ABSTRACT. *Antheraea andamana* was collected from the forests of South Andaman and Little Andaman, two islands in the Bay of Bengal, Indian Ocean. This is the first time that a saturniid is being reported from an island other than S. Andaman in this archipelago. The immature stages are described and illustrated for the first time.

Additional key words: Andamans, immatures, *Ficus*.

Antheraea Hübner (1819) is the largest saturniid genus in the Oriental Region, with species occurring from northeastern India to the western Moluccas and the eastern portion of Palaearctic Asia (Nässig et al. 1996a). In the Andaman islands this genus is represented by just one endemic species, *Antheraea andamana* Moore (Moore 1877, Watson 1911, Peigler 1989) (Fig. 1). Along with *Actias ignescens* Moore (another endemic species) and *Actias selene* (Hübner 1806) (now *A. callandra* Jordan, 1911; see Prashanth Mohanraj et al. 1996), it was among the first saturniids to be reported by Moore (1877) from the Andaman and Nicobar islands.

Here we report on the first captures of the immature stages of *A. andamana* from South and Little Andamans, and provide information on the natural history of this poorly known insular taxon.

METHODS

Both adults and immatures were collected from South Andaman and Little Andaman. The two islands are separated by the 46 km wide Duncan Passage in the Bay of Bengal, Indian Ocean.

On South Andaman all stages of the moth were collected from *Ficus* trees, at three sites: (1) in the evergreen forest at Mount Harriet, (2) along the roadside at Homfraygunj where the original forest has been cleared and is now being cultivated, and (3) in the back mangals at Chiriyatapu. Mt. Harriet rises from sea level to a height of 365 m. A large *Ficus arnottiana* Miq. grows at the summit, from which larvae of *A. andamana* were collected. Eggs, larvae and pupae were also collected from *Ficus altissima* Blume at lower elevations along the Mt. Harriet range. A few *F. altissima* trees growing on roadsides in Homfraygunj yielded eggs, larvae and cocoons of *A. andamana*. Larvae and cocoons were taken from a group of *F. ?retusa* L. trees in a stand of mangroves which had their bases periodically submerged by the rising tide.

At Little Andaman moths, eggs, larvae and cocoons were collected from the foliage of a stand of *Ficus ?retusa* growing in a swampy area (Fig. 2) close to the sea.

All the material was collected from their host plants in forests and clearings. Several collecting methods were used. First, groups of 4 to 6 people inspected the foliage of trees manually with a pair of binoculars. Second, the ground beneath the canopy was searched for fecal pellets. Since the larvae apparently do not move large distances during their larval period the presence of feces, if fairly fresh, is a clear indication of their presence. Third, a long nylon rope with a stone tied to one end was thrown over high branches, and these were pulled down and scanned leaf by leaf. Lastly, trees were climbed and their foliage searched manually.

The largest number of *A. andamana* individuals was obtained by the fecal pellet method. This was also the most efficient in terms of number of individuals obtained per unit of search time. The primary disadvantage of this method was that only larvae were located. It also yielded a greater number of older than younger instars, as the larger fecal pellets of the later instars are more easily spotted.

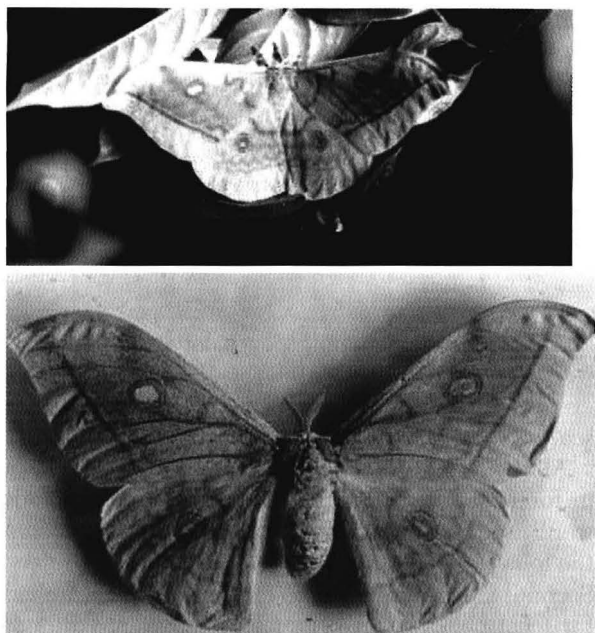
All material collected was brought to the laboratory in individual plastic containers of various sizes (in keeping with the size of the stage caught). Eggs and larvae were then transferred onto bouquets of their food plants in flasks of water whose openings were tightly secured with cotton plugs. Each larva was then placed in a separate cage. Observations were made daily in the morning when the cages were cleaned and larvae provided with fresh food.

NATURAL HISTORY

From our rearing experiences, the following descriptions of the immature stages of *A. andamana* can be offered (Table 1 and Fig. 3):

Egg. Dorsoventrally flattened, with an irregular brown patch on top. Chorion mottled, mostly brown with small irregular dirty white patches. Chorionic surface honey-combed with shallow depressions. No

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FIG. 1. Adult females of *Antheraea andamana* Moore.

brown bands encircling the eggs. Inner surface pale brown, smooth and highly reflective. The eggs were laid singly or in batches of 2 or 3 on the ventral surfaces of leaves. Some were laid about 1 cm apart while others were laid in contact with each other.

FIG. 2. Brackish water swamp habitat of *A. andamana* at Little Andaman. A freshly emerged female moth was collected from the over hanging branches of *Ficus ?retusa* on the left of the picture.

First instar. Head deep brown to black, glossy with sparse white setae; clypeus, labrum and labium white; antennae/palp semitransparent golden brown or honey colored arising from a whitish base. Prothoracic shield glossy and of the same color as the head. Thoracic and abdominal segments creamish-yellow dorsally, tending towards white or pale yellow ventrally. A narrow brown band or line is present towards the anterior and posterior margins of each segment. The scoli are located between these bands. These bands take on a deeper hue a little above the lateral

TABLE 1. Developmental time and dimensions of the immature stages of *Antheraea andamana* on the Andaman islands.

Time of development (days)	Egg	Larval instars					Pupa	Total
		1	2	3	4	5		
All individuals	8.7 ± 0.8 n = 12	3.9 ± 0.6 n = 17	3.5 ± 0.5 n = 17	4.2 ± 0.8 n = 20	5.9 ± 1.4 n = 20	9.1 ± 0.9 n = 17	25.1 ± 3.0 n = 13	60.7
Males only	—	3.8 ± 0.5 n = 5	3.6 ± 0.6 n = 5	3.6 ± 0.9 n = 5	5.2 ± 0.5 n = 5	8.4 ± 0.9 n = 5	25.0 ± 1.4 n = 4	49.5*
Females only	—	3.8 ± 0.5 n = 5	3.6 ± 0.6 n = 5	4.6 ± 0.6 n = 5	5.2 ± 0.5 n = 5	9.0 n = 5	27.4 ± 2.7 n = 5	53.6*
Dimensions (cm)								
All individuals	3.7 ± 0.2 [†] x 3.3 ± 0.2 n = 30	0.7 ± 0.1 n = 30	1.6 ± 0.1 n = 18	2.8 ± 0.2 n = 20	3.8 ± 0.2 n = 20	5.2 ± 0.4 n = 19	5.3 ± 0.3** x 2.3 ± 0.3 n = 3	—
Males only	—	0.7 ± 0.1 n = 5	1.5 ± 0.1 n = 5	2.9 ± 0.2 n = 5	3.7 ± 0.2 n = 5	5.0 ± 0.2 n = 5	—	—
Females only	—	0.7 n = 4	1.7 ± 0.1 n = 4	2.8 ± 0.3 n = 4	3.7 ± 0.2 n = 4	5.4 ± 0.3 n = 4	—	—
Head capsule width (mm)		1.8 ± 0.1 n = 17	2.9 ± 0.1 n = 20	4.1 ± 0.1 n = 21	5.9 ± 0.2 n = 21	—	—	—

[†] Measurements in mm.

* Exclusive of incubation period.

** Dimensions of cocoon, not of pupa.

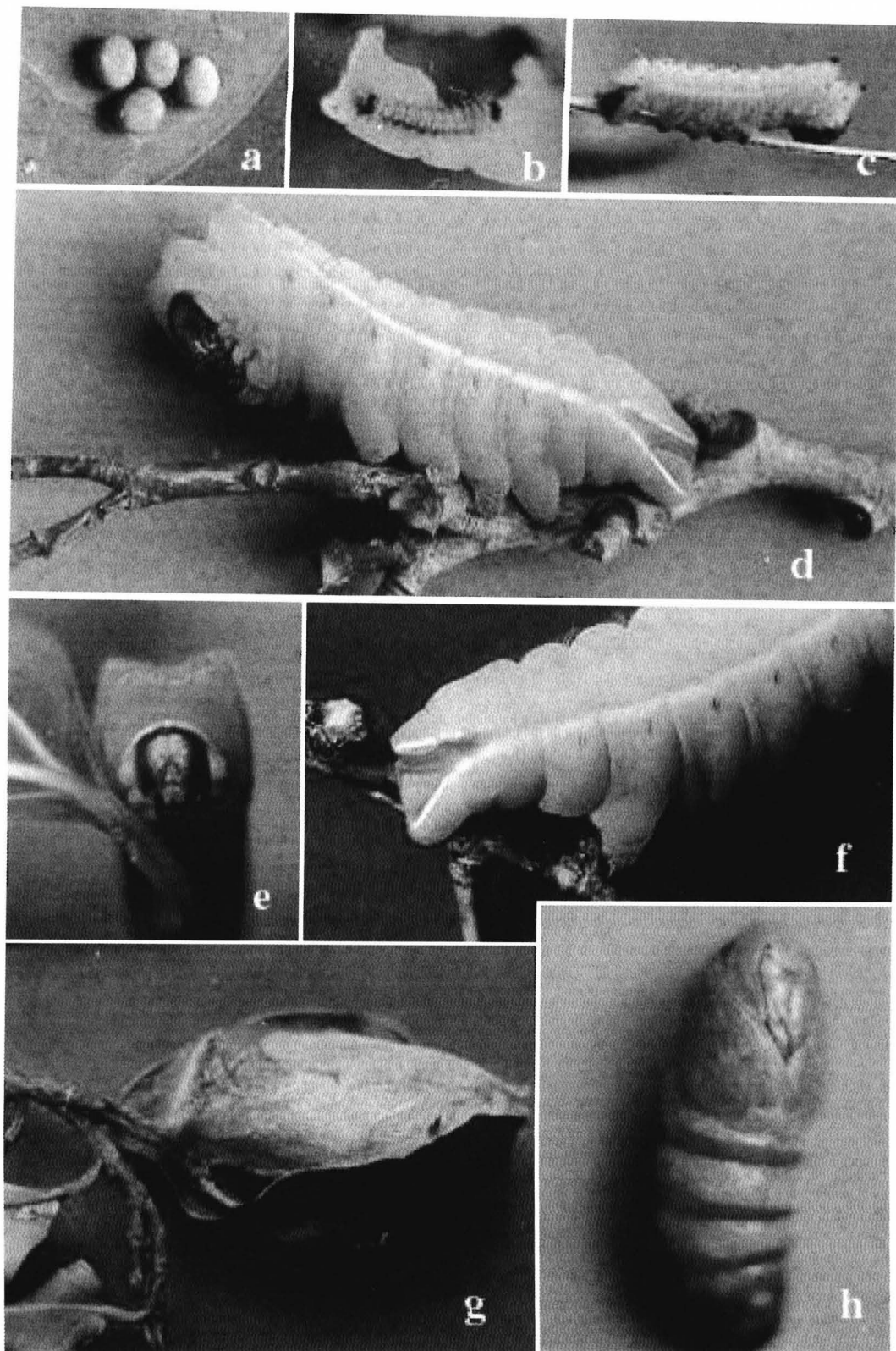


FIG. 3. Immature stages of *Antheraea andamana* Moore. **a**, Eggs. **b**, First instar larva. **c**, Second instar larva. **d**, Fifth instar larva. **e**, Fifth instar larva—close up of head. **f**, Fifth instar larva—anal proleg. **g**, Cocoon. **h**, pupa in ventral view.

scoli on the first to seventh abdominal segments *while they retain the same intensity of brown throughout their length on the remaining segments.* All scoli, with the exception of the dorsal scoli on the prothorax, basally yellow (of the same color as the rest of the body); terminally bulbous and transparent yellow from which arise five transparent, whitish setae tapering, towards their terminal ends and arranged in a rough circle from the center of which arises another seta. The dorsal scoli on the prothorax are very short and appear to have two conjoined heads with eight long whitish setae. Single, dorsal scolus on the eighth abdominal segment. Anal plate and outer lateral surface of anal prolegs deep brown. Spiracles on prothorax internally of the same color as the rest of the body with a narrow brown rim. Abdominal spiracles also brown rimmed, but with brown striations arising from the rim and running towards the center. Legs black with sparse, short, white setae and brown claws. Prolegs black distally with nine transparent white setae in the black region and brown crochets.

Second instar. Head deep brownish-black, with thin black sparsely distributed setae. Frons and outer margins of frontal and epicranial sutures pale brown; antennae brown, set in a white base; maxillary palp and labium partly white and partly black; labrum golden brown; clypeus white. Thoracic and abdominal segments yellow-green with small white, club-shaped setae. Prothoracic shield brown in the center of the anterior margin, becoming progressively paler laterally and posteriorly. Dorsal scoli on prothorax short, situated more towards anterior margin and with about 7 to 8 setae. The largest scoli are the dorsal scoli on the meso- and meta-thoracic segments. They are also the only tri-colored scoli being black terminally, followed by an orange-brown band and yellow basally. All other dorsal scoli are small with an orange brown ring/band. On the eighth abdominal segment the dorsal scoli are fused but distinctly bifurcated on top with 8 brownish setae (6 forming a rough circle with 2 in the center). Subdorsal and subspiracular scoli are small, orange-brown with terminal crown of black or brown setae. Prothoracic spiracle yellowish; all other spiracles deep brown to black except for that on the eighth abdominal segment which is brownish-white. Subspiracular line faint yellow anteriorly and more prominent posteriorly particularly on segments 7 and 8 where it gradually turns brown. It is narrow anteriorly, becoming broader towards the rear. The anal plate is black and fringed with brown setae along the outer margins. The lateral surface of the anal prolegs have a deep brown to

black triangle with a basal yellow patch. Ventral surface is yellowish-green with short white and longer brown fine setae on first and second abdominal segments. Legs are black with brown claws while the prolegs are yellowish brown distally with black setae arising from the center of small, black, circular spots. Crochets are brown.

Third instar. Head brown to black in color with white clypeus and white and brown labrum. Bases of antennae a rich cream to yellow. The rest of the larva is greenish yellow. Prothoracic shield yellow, tinged with brown anteriorly. Scoli very small and brown with one long and 5 to 6 short, spiny, brown setae. Dorsal scoli on meso and meta thorax terminally deep brown to black with an annular brown ring beneath them and the basal two-thirds distinctly yellow (more intense than the rest of the body). The subspiracular scoli in this instar are blue on all the segments, the blueness being most pronounced on the first three abdominal segments. Spiracles on the first seven abdominal segments are black while that on the eighth abdominal segment is pale brown with a silvery-white longitudinal line in the center. The lateral yellow line is prominent. It is darker and broader towards the anal end becoming progressively narrower and less distinct as it approaches the first abdominal segment where it terminates. Though greenish-yellow overall, the "green-ness" is more pronounced below the lateral line than above it. Ventrally, all the thoracic segments and the posterior abdominal segments from seven to the anal tip are yellow. The remainder of the ventral surface is green with a mid-ventral yellow line. Legs deep brown to black with brown claws. Prolegs distally brown and yellow proximally. In the yellow area are circular brown spots of variable size and each has a brown seta in the center—most are long, a few are short. Laterally, the anal prolegs have a brown triangle.

Fourth instar. Head and mandibles deep burnt brown; frons and labrum cream, clouded with brown. The rest of the body (including the ventral surface) is pale green—of the same shade as the under surface of the leaf on which it feeds. (The dorsal surface of the leaf is a deeper green). Short brown setae are sparsely distributed over the entire body surface. Prothoracic shield is cream anteriorly and brown posteriorly. The yellow supraspiracular line is broad posteriorly and narrows progressively towards the anterior end to terminate abruptly above the first abdominal spiracle. It does not extend onto the thoracic segments. Dorsal scoli on thorax not prominent but visible as pale yellow circular patches with brown centers. Spiracles deep brown and ringed with a narrow pale yellow band.

Fifth instar. Head burnt brown in color with labrum, clypeus, frons and broad regions on either side of the epicranial suture pale dirty brown. The rest of the larva is pale green, becoming a shade darker below the spiracles. Prothoracic shield also burnt brown. Supraspiracular line yellow and enclosing the top one-third of the eighth abdominal spiracle. This line passes above the seventh abdominal spiracle and keeps going progressively higher up to the first abdominal segment where it abruptly stops. The row of black setae on the lateral scoli below the spiracle on each abdominal segment arises from a small, pale blue patch on segments one to six, with the last two patches being very small and very faintly blue.

Cocoon. Stalked and spun between leaves such that it is almost totally covered with leaves. It is brown in color, greying as it ages; and the opening from which the adult emerges faces the petiole.

Biology. Eggs, larvae and cocoons were found on *Ficus altissima* Blume, *Ficus amottiana* and *Ficus Pretusa* (Moraceae). The larvae completed their life cycles when reared on the foliage of all these species of trees in the laboratory. We observed various stages of the moth on their host plants in the months of January, February, March, September, October, November and December. Two species of hymenopterous parasitoids emerged from eggs collected at various times from the field: both species exhibited superparasitism with all individuals of one species emerging from a single exit hole while all individuals of the second species emerged by making multiple exit holes in the chorion of the eggs. Some larvae succumbed to attack by the nuclear polyhedrosis virus while being reared in the laboratory.

DISCUSSION

Moore (1877) described *A. andamana* from specimens in the Natural History Museum, London. He neither illustrated nor furnished characters to distinguish it from other members of the genus. Cotes (1891–1893) was unable to verify its status as he could not access the specimens in London and there were no specimens in the Indian Museum (now the Zoological Survey of India, Calcutta). This led him to list this species along with four others as requiring confirmation of their specific status. It is also significant that Arora and Gupta (1979) do not even list it among the seven species of *Antheraea* that they deal with in their study of Indian non-mulberry silk moths. Apparently the Z.S.I. had failed to procure specimens from the Andaman islands in the 100 years since its first description.

It is pertinent to state here that since sericulture was not practised on the Andaman islands genetic contam-

ination of the native saturniids is unlikely to have occurred by release of cultivated stock.

Antheraea andamana belongs to the *frithi* subgroup of the *paphia/frithi* group of the subgenus *Antheraea* (Nässig et al. 1996b). So far the immatures of only a few species in this subgroup are known and, of these, most are only partially known (Nässig et al. 1996b, Holloway et al. 1996 and references therein). Only the life history of *A. rumphii rumphii* C. Felder from Ambon, Indonesia has been fully worked out (Paukstadt et al. 1996).

The only preimaginal character that Nässig (1991) and Nässig et al. (1996a) currently use in defining the *paphia/frithi* group is the usual presence of “a double ring of brownish color around the top and bottom of the flattened egg”; also known as “equatorial lines” (Jolly 1980). These lines are obsolete in *A. andamana* though present in its sister taxon *A. rumphii* (Paukstadt et al. 1996). If this is found to be a useful character when the ova of more species in the *frithi* subgroup are described then perhaps the presence/absence of this character would serve to further subdivide this large and diverse subgroup. Nevertheless, until more information is generated on the biology and preimaginal morphology of species in the *paphia/frithi* group it will remain difficult to characterise the “limits of the different species” (Nässig et al. 1996a).

As reported by Paukstadt et al. (1996), we also did not find silvery patches encircling the dorsal and supraspiracular scoli in any of the instars. Though Nässig et al. (1996b) say that the presence of these patches or rings is only facultative, they qualify their statement, saying that their total absence varies individually. We found no traces of these patches in over 30 larvae bred in the laboratory. Nässig et al. (1996b) state that the dorsal scoli on A8 are at least basally fused, even if not totally fused, in the known mature caterpillars. In mature larvae of *A. andamana* these scoli on A8 maintain their distinct identities; it is only in the early instars that they are basally fused in *A. andamana*.

Antheraea paphia L. is the only species in the genus *Antheraea* so far known to utilize species of *Ficus* as larval food plants (Stone 1991). *Ficus* spp. have now been found by us to be fed on by *A. andamana*, a species in the *frithi* subgroup, but in the same group as *A. paphia*. *Antheraea moultoni* Watson and *Antheraea brunei* Allen and Holloway are the only species in this genus that have been collected in or close to mangroves (Holloway 1987). The life histories of these species remain unknown, though first instars of *A. brunei* were obtained from eggs by Naumann (1994); these did not take any of the food plants he offered; *Ficus* was not included among them. Nässig et al. (1996a) however infer that *A. brunei* is a mangrove specialist. One of the habi-

tats from which *A. andamana* has been collected by us is from brackish water *Ficus* swamps behind coastal mangroves in Little Andaman. It was also bred on this species of *Ficus*. These *Ficus* swamps are much drier in summer than during the monsoon, making them seasonal as opposed to permanent swamps. In South Andaman, on the other hand, we have found them breeding in the back mangals where the bases of the trees are submerged throughout the year during high tide.

Rumphius (1627–1702) was the first to describe and illustrate the larva and cocoon of a species of *Antheraea* (namely *A. rumphii* C. Felder) along with its larval food plant (*Sonneratia caseolaris* L.: Sonneratiaceae) (Diakonoff, 1959). Paukstadt et al. (1996), referring to the 'Herbarium Amboinense' misinterpreted the host plant 'Mangium Caseolare Rubrum' as *Rhizophora caseolaris* L. This error may also be found in Arora and Gupta (1979) and Stone (1991). 'Mangium' is a generic name that Rumphius applied to all mangrove plants (Tomlinson 1986). 'M.C. Rubrum' as mentioned and illustrated in 'Herbarium Amboinense' is *S. caseolaris* L. (de Wit 1959). *A. rumphii* also belongs to the *frithi* subgroup like *A. andamana*.

We note here that the Italian zoologist-cum-anthropologist Cipriani (1966) apparently had earlier made some observations on *A. andamana* (he called it *A. paphia*) when he was residing on Little Andaman studying the *Onge*, one of the four negrito tribes of these islands. He mentions *Ficus* as the larval food plant and describes how the larvae spin their stalked/petiolated cocoons. He says there are two broods, with the adults appearing in mid September and mid February. The adults, after emerging from their cocoons and spreading their wings, were observed by him to 'sleep for two days, to wake up on the second night' when the 'active males seek and mate with the near sedentary females.' He also noted that 'virgin females attracted males from many kilometers away as is the case with *Saturnia pyri*.' This is an observation that we have so far not been able to repeat with any of the saturniids from the Andaman islands.

ACKNOWLEDGMENTS

We are grateful to A.K. Bandyopadhyay, Director, CARI, for encouragement. We are indebted to W.A. Nässig and R.S. Peigler for initiating us into the world of saturniids and for literature on this group of moths. Special thanks to J.D. Holloway for help in a myriad ways including comments on this paper. S. Naumann helped with literature and discussion. We thank B. Pardasaradhi for the photographs and P.V. Sreekumar for identifying the plants. The assistance rendered by Om Prakash, Bikas Mondal, T. Das and Kinoo Ram in the field is gratefully acknowledged. We also thank the Department of Forests, Andaman and Nicobar Islands, for permission to collect insects from the National Parks and Wildlife Sanctuaries of these islands for scientific study.

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Received for publication 20 September 2000; revised and accepted 23 November 2001.