Cricula andamanica JORDAN, 1909 (Lepidoptera, Saturniidae) — an endemic wild silk moth from the Andaman islands, India

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Abstract: *Cricula andamanica* JORDAN, 1909, a wild silk moth endemic to the Andaman islands, has so far been known from a few adult specimens. For the first time we detail the life history and describe and illustrate in colour the preimaginal stages of this moth. The following species of plants were used as host plants by the larvae: *Pometia pinnata* (Sapindaceae), *Anacardium occidentale* (Anacardiaceae), and *Myristica* sp. (Myristicaceae). The mature larvae are similar to those of the related *C. trifenestrata* (HELFER, 1837), aposematic in black and reddish, but exhibiting a larger extent of red colour pattern and less densely covered with secondary white hairs. A species of the genus *Xanthopimpla* (Hymenoptera, Ichneumonidae) and an unidentified tachinid (Diptera) were found to parasitize the pupae.

Cricula andamanica JORDAN 1909 (Lepidoptera, Saturniidae) — eine endemische Saturniidenart von den Andamanen (Indien)

Zusammenfassung: *Cricula andamanica* JORDAN 1909, eine endemische Saturniide von den Andamanen, war bisher nur von wenigen Museumsbelegtieren bekannt. Wir beschreiben hier zum ersten Mal die Biologie und die Präimaginalstadien der Art und bilden die Raupe farbig ab. Die folgenden Pflanzen wurden als Futterpflanzen genutzt: *Pometia pinnata* (Sapindaceae), *Anacardium occidentale* (Anacardiaceae) und *Myristica* sp. (Myristicaceae). Die ausgewachsenen Raupen sind ähnlich aposematisch gefärbt wie die der verwandten *C. trifenestrata* (HELFER, 1837), jedoch mit einem größeren Rotanteil und geringerer sekundärer weißer Behaarung. Eine Schlupfwespe der Gattung *Xanthopimpla* (Hymenoptera, Ichneumonidae) und eine unidentifizierte Tachinide (Diptera) wurden als Puppenparasiten nachgewiesen.

Introduction

The Andaman and Nicobar islands, lying approximately between 6° and 14° North latitude and 91° and 94° East longitude, are true oceanic

[1] 44th Contribution to the knowledge of the Saturniidae.

islands in the southeastern half of the Bay of Bengal in the Indian Ocean. They consist of about 572 islands, islets and rocks (Anon. 1986) separated into two groups – the Andaman group to the north and the Nicobar group to the south, separated by the 150 km wide Ten Degree Channel. The islands are also separated from the surrounding land masses by stretches of sea varying from ca. 190 km (from Sumatra in the South) to 1330 km (from the Indian mainland in the Northeast) (Ripley & Beehler 1989).

These islands were uplifted in late Eocene or early Oligocene times (Curray et al. 1979) as a consequence of the approach and subduction of the Indian plate beneath the Eurasian plate (Moore et al. 1980, Curray 1989). The opening of the Andaman sea to the east of the islands some time prior to 10.8 m.y. B.P. in the middle Miocene (Curray et al. 1979) is supposed to have resulted in the migration of the Andaman-Nicobar arc away from the Malay Peninsula (Hamilton 1979). The islands have since their formation retained their insular identities. Even during times of lowered sea levels in the Pleistocene no land bridges connected these islands to any of the surrounding continental land masses. Though some of the islands formed larger conglomerates during this period, the Andamans and the Nicobars were always separated by varying widths of the Ten Degree Channel (Boden Kloss 1902, Ripley & Beehler 1989).

Incessant rain (exceeding 3000 mm) during the Southwest and Northeast monsoons, spread out over 8 months of the year, and the effect of the surrounding seas have a profound or determining effect on the climate of these islands. Temperatures vary between 20° and 34° C with the mean minimum and mean maximum temperatures being 23° and 30° C, respectively. January to April are progressively hotter and drier months with the maximum temperatures being attained in April (about 34° C).

The vegetation of these islands is dominated by evergreen species interspersed with deciduous elements. Almost all islands were at one time covered with these forests from the shore line to the peaks of the highest hills (the highest being the 732 m high Saddle peak on North Andaman island) (Parkinson 1923, Anon. 1994). It was only since the mid-nineteenth century that these islands were extensively cleared of their vegetation to make way for an expanding human population.

Six species of Saturniidae belonging to five genera have been reported from the Andaman islands (Schüssler 1933–1936): *Attacus mcmulleni*

WATSON, 1914, *Samia fulva* JORDAN, 1911, *Actias ignescens* MOORE, 1877, *Actias callandra* JORDAN, 1911, *Antheraea andamana* MOORE, 1877 (most likely a yellow ♀-form of this species was described as *A. frithi insularis* WATSON 1914, see NÄSSIG 1992), and *Cricula andamanica*. *Actias* is the only one among these genera which has two different species on these islands. WATSON (1913) mentioned the presence of a second species of *Cricula*. However, he did not formally describe this species, nor is there any specimen of the species in any of the museums around the world. Presumably, this species will be a member of the North Indian *andrei* group, closely related to *C. sumatrensis* JORDAN, 1939 from Sumatra, Indonesia (NÄSSIG 1989, 1995). Attempts by two of the authors (K.V, P.M.) to find a second species have thus far proved futile.

Cricula trifenestrata andamanica was first described in 1909 by K. JORDAN from Port Blair on South Andaman island. This subspecies was later elevated to the status of a species by NÄSSIG (1989) based on a study of the type specimens; it differs in external morphology and in the structure of the genitalia.

Long periods of isolation on these islands have resulted in the evolution of insular endemics at both the species and the subspecies levels. Most of the Andaman saturniid taxa have been regarded as endemic species by PEIGLER (1989). In spite of this level of endemicity the saturniids of these islands have not received much attention, probably due to the lack of material available in museum collections and the problematic accessibility of these islands. All the Andaman saturniids were described between 1877 and 1914 and virtually nothing was known about them except that they occurred there.

The only studies on the biology and immature stages of these saturniids are on *Attacus mcmulleni* and *Actias callandra* (VEENAKUMARI et. al. [1996], PRASHANTH MOHANRAJ et al. 1996). We here report on the life history and larval host plants of *Cricula andamanica*, which was the third saturniid species to be described from the Andaman islands.

Materials and methods

Live cocoons of *C. andamanica* were located 9–13 m above the ground among the foliage of *Pometia pinnata* (Sapindaceae) in December 1995 in the Mount Harriet National Park (South Andaman). These cocoons were collected, brought to the laboratory and kept in cages for the emergence of moths. Care was taken to see that moths of both sexes were present in each cage when they began emerging from the cocoons. To ensure this, freshly emerged moths had at times to be transferred from one cage to another to ensure the presence of both sexes and to facilitate mating and the laying of fertile eggs.

Since both mated and unmated females were confined in the cages, the eggs laid were a mixture of fertile and infertile eggs. We therefore collected them in plastic containers and observed all eggs daily for hatching. All larvae that emerged were transferred to separate transparent plastic containers in groups of 12–20 per container, as *Cricula* larvae are known to be gregarious in nature.

The initial instars were reared in small, transparent plastic containers. Later instars were transferred to branches or bouquets of leaves kept in containers of water. Since *P. pinnata* leaves were not readily available in sufficient quantities in the vicinity of our laboratory we tried feeding the larvae on leaves of *Anacardium occidentale* (Anacardiaceae). The newly hatched larvae readily fed on the tender leaves of both plant species. Later instars fed on the older, leathery leaves. *C. andamanica* successfully completed its life cycle on both of these plants.

The rearing containers and cages were cleaned daily. The larvae were then fed fresh leaves. Once transferred to the larger cages with sprigs in water it was found that providing fresh food every alternate day was sufficient.

Observations on moulting were taken once in 24 hours when the containers/cages were cleaned. The presence of empty head capsules was taken as the index of moulting. Measurements of each larval instar were taken after each moult. All descriptions were made under a stereobinocular microscope.

Results

Female moths confined in cages laid eggs randomly on the floor and the sides of the cages both individually and in clumps of 6–10 glued together. All eggs were glued to the substrate. On hatching the first instar larvae did not eat their egg shells.

All larval instars were gregarious in captivity. They pupated both individually and in small groups of 4–5. Cocoons collected in the wild were also found to occur in numbers varying from one to six on the undersurfaces of leaves of *P. pinnata, A. occidentale* and *Myristica* sp. (Myristicacae). Six cocoons under one leaf was the maximum number observed in any one cluster (Fig. 1). At times adjoining leaves were woven together when the cocoons were spun beneath them. About 30 to 40 cocoons were obtained from the leaves of a single branch of a tree. Individual cocoons were also found on non-host plants in the vicinity of a host plant, presumably because late instar larvae which lose their foothold and drop off their hosts, pupate on any available foliage at much lower heights than the trees on which they feed.

Table 1: Duration (in days) of the preimaginal stages of *Cricula andamanica*.

	Egg	Larval instars						Pupa	Total
		L_1	L_2	L_3	L_4	L_5	L_6		
Duration [d]	6	6–7	5–6	5–6	5–6	6–7	7–12	24–26	64–75

We obtained cocoons on many occasions on *A. occidentale, Myristica* sp. and *P. pinnata* in the months June to December. They always occurred in groups on the branches of these trees. On all occasions, except the one in late December 1995, we obtained empty cocoons from which the adults had already emerged. All cocoons obtained by us were from the Mount Harriet National Park in South Andaman.

C. andamanica takes 64 to 75 days to complete its life cycle (Table 1). With the exception of the sixth instar, all other stages showed little variability in the number of days required to complete their respective stages.

In captivity all instars were gregarious. Even the large sixth instar larvae (Table 2) stayed together. The later instars appeared to be more active, moving about a lot on the sprigs in their cages.

Description of immature stages

Egg (Fig. 2): Creamish or off-white in colour; smooth; broad at one end and tapering towards the opposite end. It is dorsoventrally compressed with a hemispherical depression of variable depth on the dorsal surface.

First instar (Fig. 3): The head is glossy brown while the rest of the body is creamish in colour. The prothoracic plate is deep brown to black all along the periphery with an off-white centre. The anal plate is of the same colour as the body with brown spots. Legs golden with brown claws. Prolegs of the same colour as the rest of the body with brown crotchets. The head, legs, prolegs and anal plate are sparsely clothed with fine short golden setae. Clypeus and labrum are deep brown while the palpi and the distal end of the antennae are golden in colour. The bases of the antennae are creamish and the mandibles are deep brown. Dorsal, subdorsal and lateral scoli are present. Setae on dorsal scoli golden along basal two-thirds while the top one-third is brown. The setae on the lateral scoli are more uniformly golden in colour. They are finer and not as robust as those on the dorsal scoli. Spiracles yellow in the center with a distinct brown rim.

Table 2: Dimensions of the preimaginal stages of laboratory-reared *Cricula andamanica.*

	Egg [mm]	Larval instars [cm]						Cocoon [cm]
		L_1	L_2	L_3	L_4	L_5	L_6	
n	9	13	13	11	12	9	9	15
Range	1.9–2.0× 1.4–1.5	0.5–0.6	0.7–0.9	1.6–1.8	2.5–2.9	3.0–3.7	4.8–5.3	3.9–6.0× 1.6–2.5
Mean	1.98× 1.45	0.55	0.8	1.7	2.7	3.5	5.0	4.9× 2.0
± S.D.	0.03× 0.07	0.07	0.06	0.08	0.14	0.24	0.19	0.64× 0.29

Second instar (Fig. 4): The head is glossy brown with creamish clypeus. The dorsal surface of the larva is deep green to black while the ventral surface commencing from below the spiracular line is off-white in colour. The legs are golden brown in colour with brown claws. The prolegs are off-white/creamish and the crotchets brown in colour. All scoli and the warty hair-bases on the body surface are off-white. This makes the dorsal surface appear deep green to black with white spots. The dorsal scoli are the largest. The subdorsal and lateral scoli are of about the same size. The setae on the top of each dorsal scolus form a circle and each seta is tipped with black. Spiracles are off-white in the center with a narrow black rim.

Third instar (Fig. 5): The head is pale brown in colour with long whitish setae interspersed with shorter setae. Anal plate and prolegs creamish in colour. The prothoracic shield is golden in colour. With this instar the dorsal surface of the larva above the spiracular line takes on a distinct dark green to black colour, while below the spiracular line it is whitish in colour. The dark dorsal surface is dotted with yellow hair bases. The scoli are in the midst of a yellowish band. On the tip of each scolus there is a more or less annular ring of setae, golden at the base and tipped with black. At the centre of each annular ring there is a long, slender white seta. Around the large dorsal, subdorsal and lateral scoli there are scattered much smaller "warts" (= hair bases) with raised glistening white centres, each with a slender, white seta.

Fourth and fifth instar (Fig. 6): These two instars look more or less alike except for their size and the colour on the prothoracic shield, the dorsal scoli, the anal plate and the anal prolegs which are deeper brown and tinged with pink in the fifth instar. The head capsule is also a little deeper tan in colour in the latter instar. The rest of the larva is a very deep green tending to black. All setae are grey or off-white in these instars. The legs are a translucent gold with brown claws; while prolegs and crotchets are brown. The setae forming the annular ring at the top of the scoli are golden yellow and tipped with black, while the central seta is grey all along its length. The ventral surface is dirty white with yellow dots (= hair bases) spilling over the margins from the lateral surface. As the fifth instar progresses, the brown areas become more pronounced and the dorsal, subdorsal and lateral scoli stand out prominently as pink, thumb-like stubs. The difference in colour between the scoli and the brown bands is very marked, especially under magnification. In the fifth instar the pink scoli are interspersed with numerous, small yellow "warts" (= hair bases) which are shining white terminally, on each of which is situated one grey seta. One other striking difference in the fifth instar is that on each segment the setae anterior to the dorsal scoli are directed towards the center from either side forming a setal mat. In both these instars the brown prothoracic shield is very large covering the whole of the dorsal surface of the prothorax when the larva is motionless; when it stretches, however, the off-white region behind the shield is exposed. The head is tan with long white setae and the clypeus is off-white in the fifth instar. The spiracles are black.

After moulting the cast skins are not eaten by any of the instars and may be seen shrivelled and stuck to the surface of the leaf (Fig. 7) or other substrate.

Sixth instar (Fig. 8): The head is paler brown than in the previous two instars. The anal prolegs, anal plate, legs and prolegs are reddish brown in colour, otherwise this instar is identical to the fourth and fifth instars.

Cocoon: The larvae spin their characteristic reticulated cocoons individually or in groups of two to six on the undersurfaces of leaves. Even the individual cocoons are, however, on leaves that are close to the other cocoons on a single branch. They are a brilliant gold in colour (later fading to a shiny brown) and are made up of a loosely woven, open network of silk through which the brown pupa within can be seen.

Table 3: Measurements of the diameter of the head-capsule (in mm) of *Cricula andamanica*.

	1st instar	2nd instar	3rd instar	4th instar	5th instar
n	5	5	5	6	5
Mean [mm]	0.86	1.28	2.02	2.53	4.08
± S.D.	0.05	0.04	0.04	0.05	0.10
Range	0.8–0.9	1.2–1.3	2.0–2.1	2.5–2.6	4.0–4.2

Pupal Parasitoids

A large species of *Xanthopimpla* (Hymenoptera: Ichneumonidae) and an unidentified tachinid (Diptera) were two parasitoids that were found to emerge from the pupae of these moths. The hymenopteran by far outnumbered the tachinid from our pupal collection.

Discussion

Cricula is an Oriental genus with just one species extending as far east as the islands of Buru and Seram along the northwestern margins of the Australian region and possibly to West Irian. *C. andamanica* is derived from a *C. trifenestrata*-like ancestor, the most widely distributed species-complex of the genus with several subspecies, many of which are isolated, insular populations (Nässig 1989, 1995). Since characters of the pre-imaginal stages are often useful in clarifying taxonomic status problems (Lampe 1985) and since they have been used to distinguish *C. trifenestrata* *treadawayi* Nässig, 1989 from other subspecies of *C. trifenestrata* (Nässig 1989, Nässig et al. 1996) we feel that this study could be helpful in contributing towards a better understanding of the evolution of species in the genus *Cricula*.

A. occidentale is one of ten host plants of continental Indian populations of *C. trifenestrata* recorded by Arora & Gupta (1979). This plant was introduced into both the Andaman and the Nicobar groups of islands by the British and so is certainly not among the original foodplants of *C. andamanica*. Both *Pometia pinnata* and *Myristica* sp. are native to these islands and so are among the original larval host plants of this moth. However, it is quite likely that there are further plants being used as larval foodplants, as *Cricula* species are known to be polyphagous. These two plant species are also new additions to the host plant records of *Cricula* in general (see Holloway 1987). As they are evergreen trees that are common on these islands, there is every likelihood that *C. andamanica* is polyvoltine on these islands. The long rainy period on these islands should be an advantage rather then a disadvantage to this species, as Cotes (1891–1893) says for *C. trifenestrata* – which may be the sister-species of *C. andamanica* – ". the rain broods [are] the strongest and [produce] the most silk".

In Malaysia and on the Philippines, the larvae of *Cricula trifenestrata* are often encountered on understorey bushes or young trees (Treadaway 1986, Nässig et al. 1996) below the tree canopies along clearings or treefalls. There the larvae are rarely found higher than 2 or 3 m. It is therefore interesting to encounter the larvae of *C. andamanica* much higher up in the trees.

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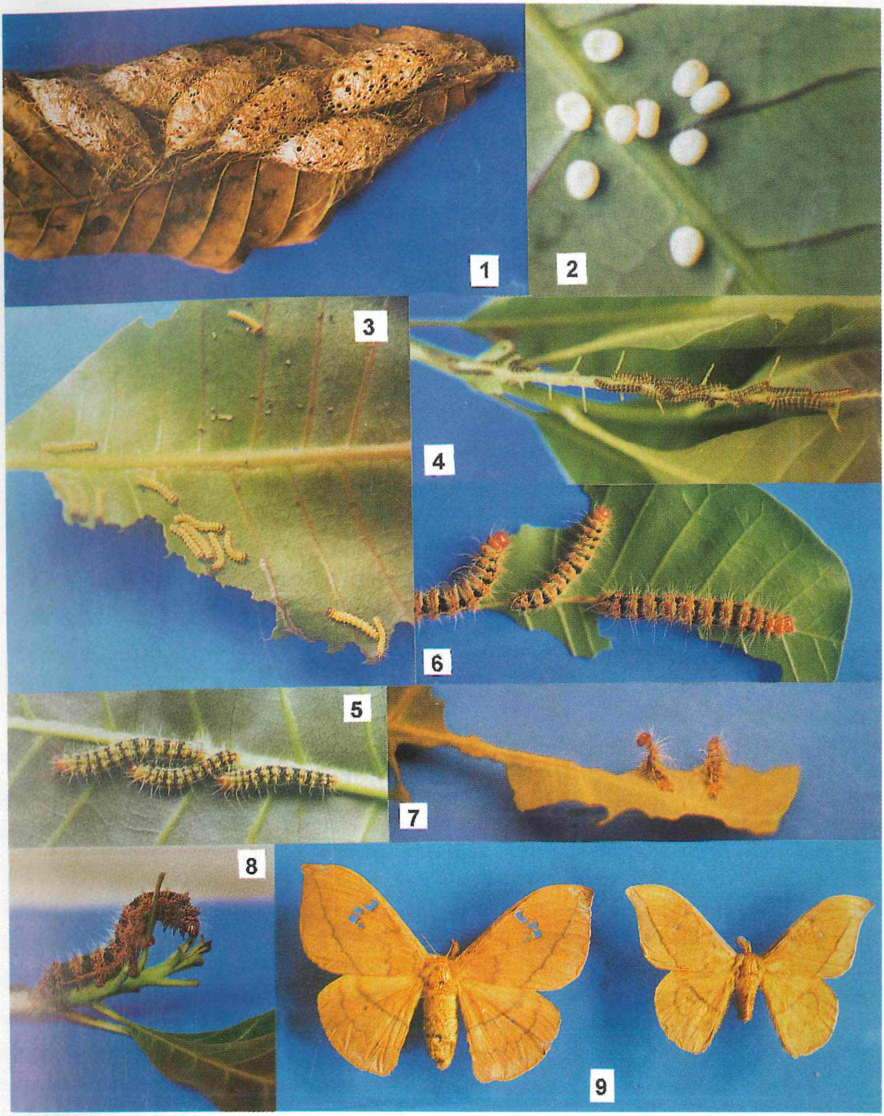

Colour plate: *Cricula andamanica*. **Fig. 1:** Cocoons on the underside of a leaf of *Myristica* sp. (Myristicaceae). **Fig. 2:** Eggs. **Fig. 3:** First instar larvae on *Anacardium occidentale*. **Fig. 4:** Second instar larvae. **Fig. 5:** Third instar larvae. **Fig. 6:** Fourth instar larvae. **Fig. 7:** Moulted exuviae (larval skins) adhering to the surface of a leaf of *Anacardium occidentale*. **Fig. 8:** Sixth instar larva (ultimate instar). **Fig. 9:** Imagines (left side ♀, right side ♂).

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