NEW AND REVISED DESCRIPTIONS OF THE IMMATURE STAGES OF SOME BUTTERFLIES IN SRI LANKA AND THEIR LARVAL FOOD PLANTS (LEPIDOPTERA: NYMPHALIDAE). PART 2: SUBFAMILY SATYRINAE

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Abstract - The immature stages and larval food plants of 13 of the 17 species of butterflies of the family Nymphalidae, subfamily Satyrinae, in Sri Lanka are presented. The immature stages of 6 species in Sri Lanka are reported for the first time. The larval food plants of 12 species in Sri Lanka are documented for the first time while for 2 species, larval food plants previously reported in Sri Lanka are confirmed. The immature stages of 7 species that have been previously described from Sri Lankan material are compared to the findings of the current study and additional observations are presented. This study provides the basic information for further studies on the biology of these species and base information necessary to formulate conservation management programs for butterflies in Sri Lanka.

Key words: Immature stages, larval food plants, Sri Lanka, Ceylon, Nymphalidae, Satyrinae, Lepidoptera, butterflies, conservation.

INTRODUCTION

A comparison of the latest published IUCN Red List data on the butterfly fauna of Sri Lanka to historical records (e.g. Ormiston, 1924; Woodhouse, 1949) suggests that the populations of many of the 245 species known in the country have declined. The latest published IUCN Red List lists 21 species as CR (critically endangered), 29 as EN (endangered), 16 as VU (vulnerable), 53 as NT (near threatened) and 31 as DD (data deficient) (IUCN Sri Lanka, 2007). As with many other countries, the loss of habitats along with larval food plants seems to be the main cause for these declines.

To address these declines, the Biodiversity Secretariat of the Ministry of Environment of Sri Lanka is developing a Butterfly Conservation Action Plan. However, in order to assess the status of a butterfly species and to prepare conservation management plans, information on the biology of the species including the larval food plants and the resource needs of the adults as well as of the immature stages is a prerequisite.

However, the immature stages and larval food plants of the butterflies in Sri Lanka are incompletely known. Woodhouse (1949) published information of the immature stages and larval food plants of 191 of the 242 species of butterflies in the island known at that time. Of these descriptions, 80 were based on work done in Sri Lanka (mostly based on Moore (1880–81) and published and unpublished accounts of E. E. Green, Tunnard, Manders and Wiley) and 111 were based on work done in peninsular India by Bell, Marshall, de Nicéville and others. Little research has been published since then.

Knowledge of immature stages and larval food plants, as well as being important for conservation planning, is also useful in classification, elucidating broad-scale evolutionary patterns, understanding ecology at the community and population levels, and in ecological chemistry (DeVries, 1986 and references therein). Knowledge of the immature stages is also important at a more practical level since it enables the identification of larvae and pupae in the field, which can increase the accuracy of surveys even in the absence of adults.

The purpose of the current study is therefore to document the immature stages and larval food plants of the butterflies in Sri Lanka to assist in the proper documentation of the status of a particular species and to provide the baseline information necessary in conservation management planning.

In the current study (conducted from 2004 to the present and ongoing), we have documented the immature stages and larval food plants of 180 of the 245 known species of butterflies in Sri Lanka. For more details on the background and approach, see van der Poorten & van der Poorten (2011). In Part 2, we present the immature stages and larval food plants of 13 of the 17 species of the family Nymphalidae, subfamily Satyrinae, tribes Satyrini (4 genera, 12 species), Melanitini (1 genus, 2 species), Elymniini (1 genus, 2 species) and Amathusiini (1 genus, 1 species). The immature stages of 6 species and their larval food plants in Sri Lanka are documented for the first time. The immature stages of the remaining 7 species have been previously described from Sri Lankan material. These descriptions are compared to the findings of the current study and additional observations are presented. For these 7 species, new larval food plants are reported for the first time. For 2 of these species, larval food plants previously reported in Sri Lanka are confirmed.

MATERIALS AND METHODS

For rearing methods, see van der Poorten & van der Poorten (2011). For photography, all images (except for 5d–g and 12c which were obtained from a third party) were taken with either a Canon 40D or Canon 7D fitted with a Canon 100mm EF 2.8L Macro IS USM lens. Wherever possible, the images were photographed with a 1:1 magnification, f/9 to f/11 with a shutter speed between 1/200–1/250 of a second. Fill flash from the on-camera flash was used to obtain appropriate lighting. No external flash was used. Some subjects were taken in situ in the field. Others that were lab-reared were minimally disturbed while preparing them for photography: they were moved along with the plant part on which they were feeding or resting to a shady location and they were not exposed to direct sunlight. In some cases, a gray card was used for background color, but

most photographs were taken with whatever background the location offered. The images were taken hand-held or with a bean bag for camera support.

Plants were identified to species if possible, using several references (most notably, the series A revised handbook to the flora of Ceylon (Dassanayake (ed.)) and an inspection of herbarium specimens at the Herbarium of the Royal Botanic Garden in Peradeniya, Sri Lanka.

Nomenclature of butterflies follows Kunte (pers. comm.).

Where information on the duration of developmental stages is given, these data were obtained in rearings at ambient temperatures (22–34ºC) at Bandarakoswatte (07.37.01N, 80.10.57E), 70 m asl, North Western Province, Sri Lanka. Conventions used (applied to both the larva and the pupa): Segments are numbered S1 to S14 (S1—the head; S2 to S4—the 3 segments of the thorax; S5 to S14—the 10 segments of the abdomen). In the photographs, the head is on the left.

RESULTS AND DISCUSSION

Family Nymphalidae, subfamily Satyrinae, tribe Satyrini

***Mycalesis perseus typhlus* Fruhstorfer, 1908. Common Bushbrown. Figure 1.**

The immature stages and larval food plant of *M. perseus typhlus* have not been described in Sri Lanka but Sevastopulo (1945) described *M. perseus typhlus* in India. The results of the current study agree with this description except for the following: a) the egg is wider than tall and the micropylar end has a slight circular depression (Fig. 1a); b) 1st instar: the head is completely black with 5 conical projections on each side from the vertex along the lateral margin; each projection has one or two setae at its apex; the largest projection is at the apex; those below are progressively shorter and narrower (Fig. 1b); c) 2nd instar: the head has an additional set of 4 stubby white conical projections with white setae, and the abdomen has an indistinct white lateral line (Fig. 1c); d) 3rd instar: the head is marked with greenish-brown patches immediately below the apical projections; towards the end of the instar, two white conical lateral projections appear; the anal processes are light pink on the inner surfaces and white on the outside; on the body, the white markings are more distinct (Fig. 1d); e) 4th instar: clypeus is dark brown and the head appears in two color forms: —1) black with black processes except for the dorsal surface which is cream-colored and a small lateral cream-colored triangular patch posteriorly on the head and 2) shades of chestnut brown with processes the same color except for the dorsal surface which is light yellow with a slightly darker yellow line from the apex to the back of the head and pale yellow laterally; the body is light green with a subdorsal white line that continues into the outer surface of the anal processes; the subspiracular line is greenish-yellow with fewer white markings (Fig. 1e); f) 5th instar: the larva is frosted in appearance; the head is as per the 4th instar; the dorsal line on the body is dark green and indistinct; the subspiracular line is absent (Figs. 1f–i); and g) pupa: the dorsum of the forewing bud has a distinct white line and there are often two or three indistinct white spots on the forewing bud distally; the cremaster is bright red and the stalk is pale greenish-red (Fig. 1j). The description by Braby (2000) from Australia (subspecies not indicated) agrees with these findings except that we have not observed a brown form of the larva or pupa. The illustrations and description by Igarashi & Fukuda (1997) of the species from the Philippines (subspecies not indicated) also agree. Mature larvae from the Solomons (subspecies not specified) illustrated in Sourakov & Emmel (2001) are colored pink below the subdorsal stripe unlike the ones described here.

Fig. 1. *Mycalesis perseus typhlus*: (A) Egg; (B) Larva, first instar, dorsal view; (C) Larva, second instar, just after molt (head capsule and molted skin visible); (D) Larva, third instar, dorsolateral view; (E) Larva, fourth instar, brown head, lateral view; (F) Larva, fifth instar, black head, dorsolateral view; (G) Larva, fifth instar, light brown head; (H) Larva, fifth instar, black head; (I) Larva, fifth instar, brown head; (J) Pupa, lateral view.

Larval food plants: In Sri Lanka, de Nicéville & Manders (1899) stated only that it fed on "grass as usual" and Woodhouse (1949) reported grass and paddy [*Oryza sativa*] after Sevastopulo in India. The current study confirmed the use of *O. sativa* (S. Sanjeeva, pers. comm.) and showed for the first time that *Axonopus compressus* and *Leersia hexandra* (Poaceae) are used as larval food plants.

M. perseus typhlus is widely distributed in the island though it is scarce in the north. *Axonopus compressus* is naturalized and widespread up to 1900 m asl. *Leersia hexandra* is widespread over the country in wet fields, swamps and marshes at all elevations though it is not common (Dassanayake, 1994). Even though at least one of these larval food plants has been found wherever the butterfly has been recorded, it is likely that other species of the family Poaceae, particularly native species, are

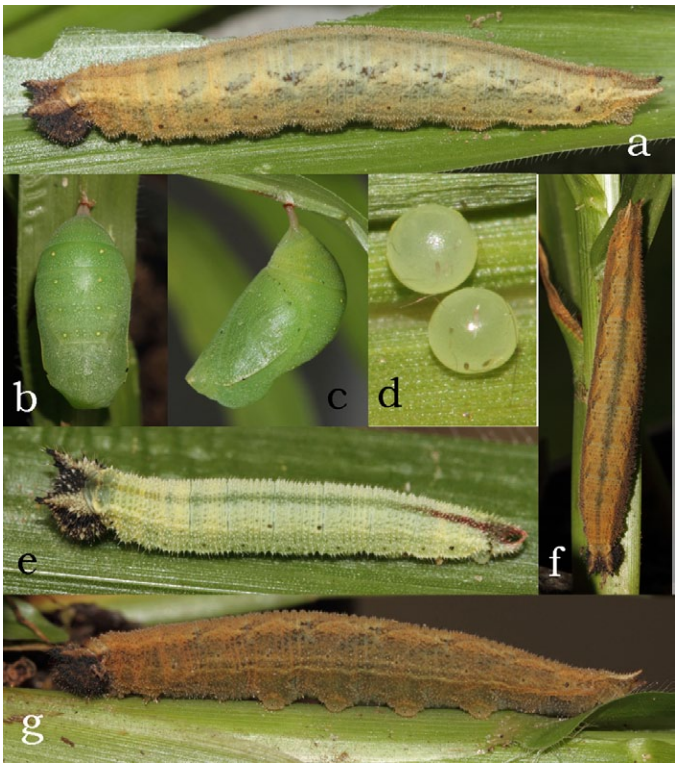

Fig. 2. *Mycalesis mineus polydecta*: (A) Larva, fifth instar, dorso-lateral view; (B) Pupa, dorsal view; (C) Pupa, lateral view; (D) Egg; (E) Larva, third instar, dorso-lateral view; (F) Larva, fourth instar, dorsal view (head down); (G) Larva, fourth instar, lateral view.

also used. Note: Kunte (pers. comm.) believes that *M. p. typhlus* is a synonym of *M. p. tabitha* which is the current name for the subspecies in India.

***Mycalesis mineus polydecta* (Cramer 1777). Dark-Brand Bushbrown. Figure 2.**

The immature stages and larval food plant of *M. mineus polydecta* have not been described in Sri Lanka. In India, Davidson & Aitken (1890) briefly described the larva and pupa of *M. mineus* while de Nicéville (1886) described them in detail. The results of the current study agree with these descriptions except for the following: a) in the final instar larva, the spiracles are dark chocolate brown and the dorsal line is a light chestnut brown from S11–S14 (Fig. 2a); b) in the pupa, the spiracles are white ringed with dark gray; the termen of forewing bud has a series of minute black dots on the vein endings, a similar black spot at the base of the wing bud and a black spot below the eye (Figs. 2b, c).

Additional notes on immature stages: Egg: round, pale yellow (Fig. 2d). 3rd instar: head dark brown speckled with white projections that carry setae, one pair of black horns with dorsal surface creamy white; body creamy white with light green dorsal band that turns brownish red from S10–S14 and that continues along the top and inside of a pair of anal projections that are creamy white below; spiracles dark brown; entire body covered with tiny white projections with setae at the apex of each (Fig. 2e). 4th: similar to 3rd but overall mottled light orange-brown with a pale creamy yellow spiracular and subspiracular line; dorsal band dark greenish-brown; obscure brownish oblique subdorsal lines (Figs. 2f, g). 5th: similar to 4th but much paler brown, obscure greenish oblique bands laterally. The illustration of the larva of *M. mineus macromalayana* from Singapore is very similar (Nature Society (Singapore), 2012a). Duration of immature stages (days): egg (4); 1st instar: (1–4); 2nd (1–3); 3rd (2); 4th (6).

Larval food plants: In Sri Lanka, the current study showed for the first time that *Panicum maximum* (in the field) and *Axonopus compressus* (in the lab) (Poaceae) are used as larval food plants.

M. mineus polydecta is widespread and common in the grasslands of the Uva, Sabaragamuwa and Central provinces from 200–750 m asl. *Panicum maximum* is naturalized and found over most of the country up to 1000 m asl. *Axonopus compressus* is naturalized and widespread up to 1900 m asl (Dassanayake, 1994). Even though at least one of these larval food plants has been found wherever the butterfly has been recorded, it is likely that other species of the family Poaceae (in particular native ones) are also used.

***Mycalesis subdita* (Moore, 1892). Tamil Bushbrown. Endemic. Figure 3.**

The immature stages and larval food plant of *M. subdita* were described in Sri Lanka by Manders (1901). The results of the

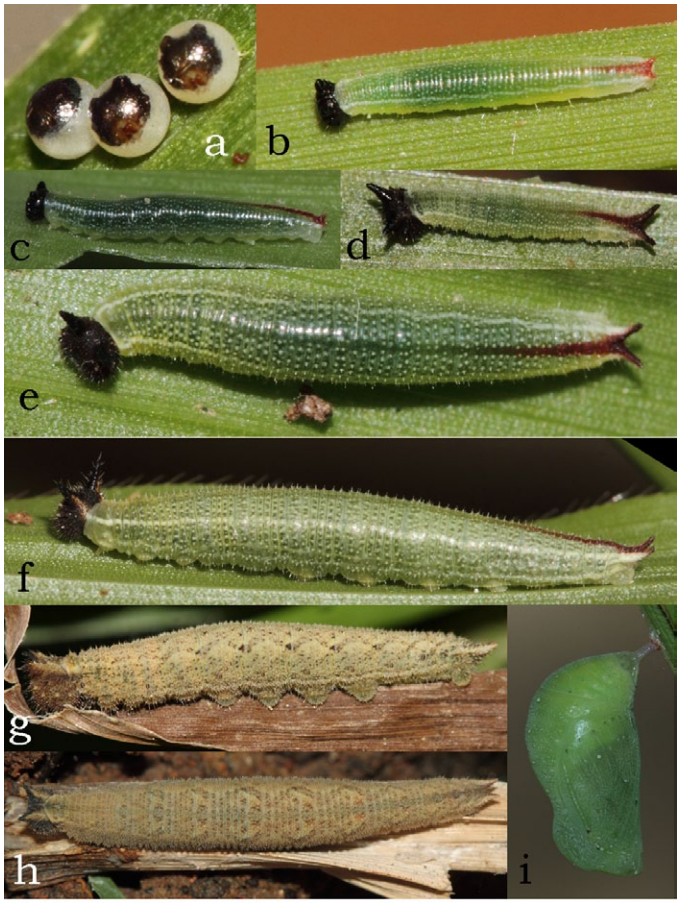

Fig. 3. *Mycalesis subdita*: (A) Eggs, larval head just visible; (B) Larva, first instar, early, dorsal view; (C) Larva, first instar, late, dorsolateral view; (D) Larva second instar, dorsolateral view; (E) Larva, third instar, dorsal view; (F) Larva, third instar, dorsolateral view; (G) Larva, fourth instar, lateral view; (H) Larva, fifth instar, dorsal view; (I) Pupa, lateral view.

current study agree with Manders though he did not clearly indicate which instar he was describing.

Additional notes on immature stages: Egg: much smaller than that of *M. perseus typhlus* (Fig. 3a). 1st instar: head black with one pair of prominent subdorsal tubercles and two pairs of small lateral tubercles; body light green, S10–S13 even lighter, S11–S14 with light red dorsal line that splits to run along the dorsal surface of the two anal processes, body covered sparsely with long setae (Figs. 3b, c). 2nd: head covered with long bristles and subdorsal tubercles longer; body light green speckled with white setae; dorsal line darker green, turning dark red from S10–S14 and along the anal processes; white lateral line from S2–S14 and along the anal processes; spiracular band pale greenish-white (Fig. 3d). 3rd: similar to 2nd except head dark brown with a few white lateral short conical projections and a pair of long conical projections at the vertex that are white at the base extending towards S2; dorsal line more prominent; spiracular band pale green and narrower; transverse ridges and the white conical projections with setae on them more prominent (Figs. 3e, f). 4th: very differently colored from 3rd; head dark brown to chestnut brown, black along the anterior side of conical processes, posterior part of conical processes and head behind pale straw-colored, head covered with minute setae that are black at the base, body buff-colored with pinkish tinge and marked with obscure oblique dark brown discontinuous lines; spiracles black; dorsal line light greenish; apex of anal processes pink (Fig. 3g). 5th: as per 4th but ground color of body much darker and markings reduced and more obscure; anal processes with pinkish line on outer edge above and significantly shorter; body appears fuzzy because of the dense covering of setae (Fig. 3h). Pupa: a pair of subdorsal white spots on each segment of the abdomen, 5 white spots distally on wing buds, and small black spots at base of costa of wing buds (Fig. 3i). Duration of immature stages (days): egg (2); 1st instar: (2–); 2nd (3); pupa (10); egg to adult (33). Length of pupa 12 mm.

Larval food plants: In Sri Lanka, Manders (1901) reported it feeding on *Panicum maximum*. The current study showed for the first time that *Axonopus compressus* is used as a larval food plant in the lab and confirmed the use of *P. maximum* in the lab.

M. subdita is widely distributed in the intermediate and the dry zone below 750 m asl but occurs sparingly in the Jaffna peninsula. *Axonopus compressus* is naturalized and widespread up to 1900 m asl. *Panicum maximum* is naturalized and found over most of the country up to 1000 m asl (Dassanayake, 1994). It is likely that there is at least one other native species of Poaceae that is used as a larval food plant.

***Mycalesis rama* (Moore, 1892). Cingalese Bushbrown. Endemic.**

The immature stages and larval food plant of *M. rama* have not been described except that Woodhouse (1949) wrote, "believed to feed on bamboo". In the course of the current study, we have not yet encountered eggs, larvae or pupae though adults have been seen on many occasions at a few locations. However, the adults have invariably been seen in habitats in which the native bamboo *Ochlandra stridula* (Poaceae) is dominant and it is likely that this is the larval food plant.

Fig. 4. *Mycalesis patnia patnia*: (A) Larva, fourth instar, dorsolateral view; (B) Larva, fifth instar, dorsolateral view; (C) Pupa, lateral view.

***Mycalesis patnia patnia* Moore, 1857. Gladeye Bushbrown. Endemic subspecies. Figure 4.**

The immature stages and larval food plant of *M. p. patnia* in Sri Lanka have not been described except for a statement in Woodhouse (1949) that it "feeds on grasses and probably paddy" [*Oryza sativa*]. In the current study, the final two instars and the pupa are described and the larval food plant identified for the first time.

Notes on immature stages: 4th instar: head chestnut brown with 2 conical projections at the vertex, which are the same color in front and back; shorter and rounder at the apex than those of *M. subdita*; body more or less spindle-shaped and broadest at S8, each segment transversely impressed to form 5 to 6 ridges; skin appears rough due to the presence of minute bristles covering entire body; body pale cream-colored with thin red subdorsal line from S2–S14 that runs along upper edge of anal processes; a series of irregular faint red lines between dorsal and subdorsal line; S2–S14 with red irregular chained lateral line; narrow white band along the flange; spiracles black and more or less circular (Fig. 4a). 5th: head reddish-brown; body light reddish-brown; a series of obscure dark bands above the spiracles from S5–S11 running obliquely backwards and terminating near the subdorsal line; a similar set of bands running forwards from above the spiracles and terminating when they intersect the obliquely running backward bands; anal processes short, blunt and lighter colored outwardly along the lateral margin (Fig. 4b). Pupa: dull green with a reddish cast on the last 3–5 segments; mesothorax with a pronounced bulge; dorsum of the abdomen highly convex with a series of small light-brown subdorsal spots from S5–S7; costal wing margin and tip of the head straw-colored; spiracles white, slit-like (Fig. 4c). All instars feed mostly at night. Early instars rest on the underside of the blade of grass. The final two instars hide at the base of the clump of grass on which it feeds during the day. Duration of immature stages (days): egg (5); 1st instar: (1–2); egg to adult (53).

Larval food plant: The current study showed for the first time that the following are used as larval food plants in Sri Lanka: *Isachne globosa* (S. Sanjeeva, pers. comm.) and *Cyrtococcum trigonum* (Poaceae). The larva refused *Axonopus compressus* in the lab.

M. p. patnia is widely distributed over the whole island at all elevations. It is commonest in grassy vegetation in forests and well-wooded home gardens. *Isachne globosa* is native and

found in marshy habitats, rice fields, stream banks and ditches up to 1800 m asl. *Cyrtococcum trigonum* is common in lightly shaded places under secondary vegetation and in forests up to 1100 m asl (Dassanayake, 1994). There may be other larval food plants used at the higher elevations, perhaps *C. deccanense* or another species of *Isachne*.

***Lethe rohria neelgheriensis* Guérin 1843. Common Treebrown.**

The final instar larva of *L. rohria neelgheriensis* in Sri Lanka was illustrated in Moore (1884–87) from a drawing by E. E. Green and described briefly in Moore (1890–92) (as *L. neelgheriensis*) and the larval food plant quoted as 'grass" after E. E. Green. Igarashi & Fukuda (1997) illustrate the egg, final instar and pupa of *L. rohria* from Taiwan. In the course of the current study, we have not yet encountered eggs, larvae or pupae though adults have been seen on many occasions at several locations.

***Lethe drypetis drypetis* (Hewitson, 1863). Tamil Treebrown. Endemic subspecies. Figure 5.**

The final instar larva and pupa of *L. d. drypetis* in Sri Lanka were illustrated in Moore (1884–87) after a drawing by E. E. Green and the larva described briefly by Tunnard (Woodhouse, 1949). In India, Bell (1909) described the immature stages of *L. drypetis* (likely *L. d. todara*). In the course of the current study, several larvae were found and raised to pupation and eclosion on *Bamboosa multiplex* in a home garden at Badulla and on *Dendrocalamus giganteus* (Poaceae) (S. Sanjeeva, pers. comm.). The authors found a single larva on *Davidsea attenuata* (Poaceae) at Riverstone in the Knuckles Range of mountains.

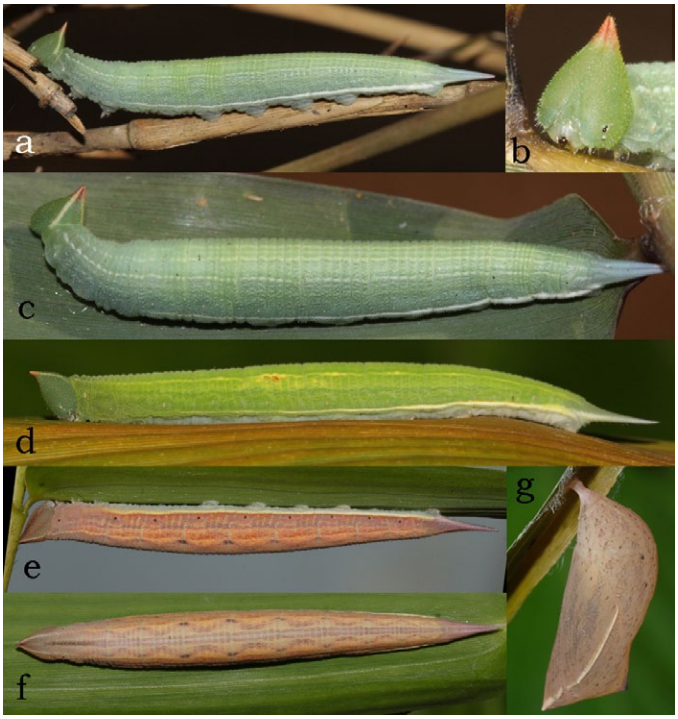

Fig. 5. *Lethe drypetis drypetis*: (A) Larva, early instar, lateral view; (B) Larva, early instar, close-up of head; (C) Larva, early instar, dorsal view; (D) Larva, final instar, green form, lateral view; (E) Larva, final instar, rosy brown form, lateral view; (F) Larva, final instar, rosy brown form, dorsal view; (G) Pupa, lateral view.

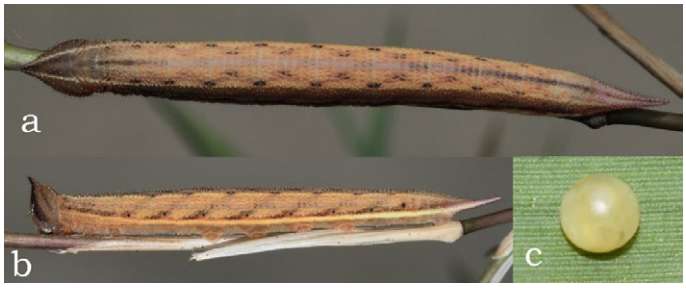

Fig. 6. *Lethe daretis*: (A) Larva, early instar, dorsal view; (B) Larva, early instar, lateral view; (C) Egg.

Unfortunately the larva died upon its next molt. Based on Tunnard's description and Sanjeeva's notes, it was not a final instar larva. The appearance of the larva agreed with Tunnard's brief description of an earlier instar except for the following: dorsal line light bluish green bordered by darker green and then by white; white lateral line; white subspiracular line along the flanges; white line dorsally from tip of projections to S2 (Figs. 5a–c). The final instar larvae raised by Sanjeeva differed from Tunnard's description in that the orange markings on the body were very slight (Fig. 5d). Since Tunnard's description was very brief, we describe the final instar larva in full from the rearings of Sanjeeva: head green, cone-shaped, with two small conical projections at the vertex that touch along their inner edge to appear as a single cone, light reddish on the anterior surface, white on the posterior surface, the white continues along the back of the head, head covered with minute white setae; body rugose, transversely impressed into 5–6 ridges and covered with minute white setae; ground color variable from light-green to bluish-green; dorsal and subdorsal lines white to yellow; some individuals with reddish blotches along the subdorsal line on S4–S8; white to yellow line along the flange from S4–S14 which widens towards the posterior end. Sanjeeva also recorded a rosy brown form, similar to that described briefly by Bell (1909) (Figs. 5e, f). Pupa: rosy brown form agrees with Bell (1909); green form not encountered (Fig. 5g).

Larval food plants: In Sri Lanka, Tunnard stated that it fed on 'bamboo' (Woodhouse, 1949). The current study showed for the first time that *Bamboosa multiplex* and *Dendrocalamus giganteus* (Poaceae) are used as larval food plants. It is likely that *Davidsea attenuata* (Poaceae) is also a larval food plant and that the larva died not because the plant was not the proper food source but because the temperature conditions under which the larva was raised were much higher than in its native habitat.

L. d. drypetis is found at the higher elevations from 1200–1500 m asl. *Bamboosa multiplex* is widely cultivated in home gardens at all elevations. *Dendrocalamus giganteus* is widely planted in the mid-country and montane areas. *Davidsea attenuata* is an endemic bamboo found only in the mountains of the south-central part of the island (Dassanayake, 1994) from 1200–1500 m asl. It is likely that *D. attenuata* is the principal larval food plant because its distribution matches very well that of the butterfly, and the butterfly has always been observed in great numbers only in forests with pure stands of *D. attenuata*. However, given its ability to use other species of bamboo (such as *B. multiplex*), it is likely that there are other larval food plants.

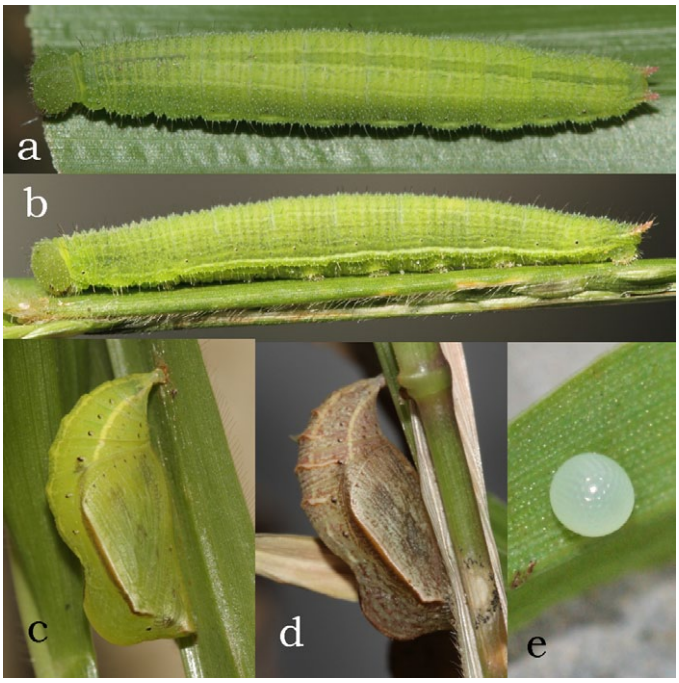

Fig. 7. *Ypthima ceylonica*: (A) Larva, final instar, dorsal view; (B) Larva, final instar, lateral view; (C) Pupa, green form, lateral view; (D) Pupa, brown form, lateral view; (E) Egg.

***Lethe daretis* (Hewitson, 1863). Ceylon Treebrown. Endemic. Figure 6.**

The immature stages and larval food plant of *L. daretis* in Sri Lanka were described by Tunnard (in Woodhouse, 1949). In the course of the current study, adults have been seen on many occasions at a few locations, and in one instance, a female was observed ovipositing on *Sinarundinaria debilis*. We encountered only two larvae which were feeding on *S. debilis* (Poaceae) in the undergrowth of a montane forest at 2000 m asl. Tunnard's description, which is quite brief, does not quite fit with the appearance of these larvae; the ground color matches but Tunnard does not describe any other markings though the larva is beautifully and intricately marked with various colors. These larvae (which died at the next molt) appeared by size to be in the 3rd instar: head pale brown with two projections at the vertex that meet at their apices; lateral margin of face with dark brown stripe that extends to the tip of the projections; narrower dark brown stripe posterior to this; white line runs dorsally from tip of the projections to S14 becoming subdorsal and yellow on S3; on the head, purplish line bordering the inside of the white lines; ground color of body pale cinnamon, dorsal line dark brown except S5–S9 which is pale blue; above the subdorsal line a series of small black markings between the septa; below the subdorsal line a series of short light red markings; yellowish markings along the flange and more prominent and wider on S11–S13; spiracles black, each with a short black irregular band anteriorly; anal projections long and slender, closely appressed, pinkish; whole larva covered with short setae giving it a frosted appearance (Figs. 6a, b). Egg as described by Tunnard (Fig. 6c). Though we were not able to raise the larva to pupation and eclosion, the larva is most likely that of *L. daretis* and not that of another *Lethe* species for which it may be mistaken. The larva is unlikely to be that of *L. dynsate* since adults of *L. dynsate* have never been recorded from the location where the larva was found. It is not likely to be the larva of *L. rohria neelgheriensis* since *L. rohria neelgheriensis* has been recorded feeding only on species of grass not bamboo; in addition, adults have not been recorded at 2000 m asl where the larva was found. The larva is also unlikely to be that of *L. d. drypetis* since this species occurs only between 1200–1500 m asl and *Sinarundinaria debilis* is not found below 1500 m asl.

Larval food plant: Tunnard (Woodhouse, 1949) recorded it feeding on bamboo. In this study, we recorded it feeding on *Sinarundinaria debilis* (Poaceae).

L. daretis is confined to bamboo forests from1500–2500 m asl. *Sinarundinaria debilis* occurs from 1500–2500 m asl (Dassanayake, 1994). Its distribution matches that of the butterfly well. The larva is unlikely to use any other species of bamboo since adults have not been recorded from forests which do not harbor *Sinarundinaria debilis*.

***Lethe dynsate* (Hewitson, 1863). Ceylon Forester. Endemic.**

The immature stages and larval food plant of *L. dynsate* have not been described. In the course of the current study, we have not yet encountered eggs, larvae or pupae though adults have been seen on many occasions at a few locations. Note: many authors (e.g. d'Abrera, 1998) have misspelled the species name as *dynaste*.

***Ypthima ceylonica* Hewitson, 1864. White Four-Ring. Figure 7.**

The immature stages and larval food plant of *Y. ceylonica* in Sri Lanka were described by Green (1910). The results of the current study agree with Green's description except for the following: a) in the final instar: the head is brownish-green the body has a green subdorsal band (paler than the ground color) that is bounded on either side by a yellowish-white line, and a yellowish-white subspiracular line (somewhat obscure anteriorly) along the flange (Figs. 7 a, b); b) in the pupa of the green form, the dorsum of the forewing bud is dark brown (Figs. 7c, d); and c) the egg is pale blue (Fig. 7e). Duration of immature stages (days): egg (5–6); 1st instar: (3); 2nd (4); 3rd (5); 4th & 5th not recorded; pupa (10); egg to adult (43).

Larval food plants: In Sri Lanka, Green (1910) reported it feeding on "ribbon grass", presumably *Phalaris arundinacea*. The current study shows for the first time that *Axonopus compressus* and *Cyrtococcum trigonum* (Poaceae) are used as larval food plants in Sri Lanka.

Y. ceylonica is one of the commonest butterflies in the island and is widely distributed below 1300 m asl though a few may be seen above this elevation. *Axonopus compressus* is naturalized and widespread up to 1900 m asl and is the most commonly used larval food plant in the intermediate zone. *Cyrtococcum trigonum* is common in shady places under secondary vegetation and in forests up to 1100 m asl, especially along footpaths (Dassanayake, 1994). We have not been able to confirm the use of *Phalaris arundinacea* which is an ornamental plant. It is likely that other native, short-statured grasses are also used.

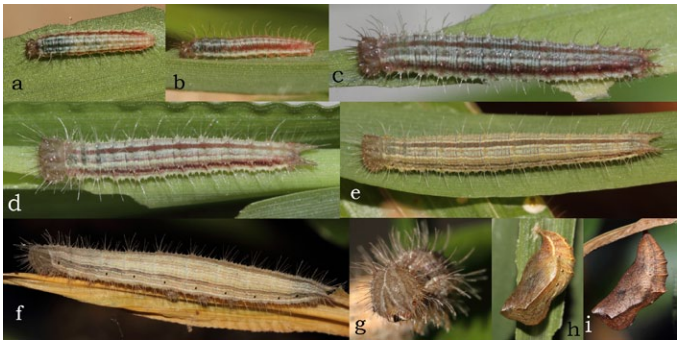

Fig. 8. *Ypthima singala*: (A) Larva, first instar, dorsal view; (B) Larva, first instar, dorsolateral view; (C) Larva, second instar, dorsal view; (D) Larva, third instar, dorsal view; (E) Larva, fourth instar, dorsal view; (F) Larva, fifth instar, lateral view; (G) Larva, fifth instar, close-up of head; (H) Pupa, light brown form, lateral view; (I) Pupa, dark brown form, lateral view.

***Ypthima singala* Felder, 1868. Jewel Four-Ring. Endemic. Figure 8.**

The immature stages and larval food plant of *Y. singala* in Sri Lanka have been described only briefly by Manders (1903): "the young larva is bright pink and covered with long white hairs" and "feeds on grasses". The results of the current study do not agree with this very brief, simplistic description; the larva is much more subtly colored and patterned.

Additional notes on immature stages: Egg: very similar to that of *Y. ceylonica*. 1st instar: head light brownish-pink with 4 pairs of rounded tubercles starting from vertex along lateral margin, one pair placed more inward towards the center of the face, each tubercle with pale brown setae at the apex; ground color of body reddish-pink except for S2–S4 which are dark green laterally with traces of light red; dorsal line dark green and well-defined to S5, fading to greenish-brown until S8; from S9–S14 dorsal line light red and somewhat obscure; broad white subdorsal band with patches of red; subspiracular band white, narrower towards S14; body covered with 6 rows of long pale brown hairs; spiracles light brown; anal processes short, stubby and light pink; prolegs light red with darker red markings (Figs. 8a, b). 2nd: similar to the 1st except: all lines and bands well-defined and richer in color; tubercles on head more conical with dark colored setae at the apex; lateral tubercles on head white and smaller than those at vertex; one or two dark shining red ocelli; small obscure bands of dark spots on head; anal processes longer and projecting out horizontally; setae mostly white in well-defined sets of 5 or 6 along the length of the body (Fig. 8c). 3rd: similar to the 2nd except: head lighter brown and bands with well-defined dark colored spots; body with fine subdorsal wavy red line; anal processes pale yellowish brown below and a darker shade above; bands and lines cream-colored rather than white (Fig. 8d). 4th: similar to the 3rd except: body pale straw colored rather than white or cream; dorsal line well-defined, dark grayish-green, bordered by a distinct red line from S4–S14; lateral band narrower, reddish-brown and with small off-white spots and continued to the outer margin of the anal processes; four fine wavy red lines between the dorsal line and the lateral band; spiracles black; spiracular line narrow, well-defined and reddish-orange (Fig. 8e). 5th: similar to the 4th except: head with coronal and adfrontal sulcus white and slightly raised; ocelli rich golden brown; body with dorsal line and lateral line pale grayish-green with numerous small brown blotches and streaks and bounded on either side by a dark brownish-red line; numerous minute reddish-brown streaks and spots between the dorsal line and the lateral line, arranged more or less parallel to the four fine wavy red lines; spiracular line light-green to grayish-yellow bordered by two fine irregular, discontinuous light reddish-brown lines; subspiracular line white (Figs. 8f, g). Pupa: very similar to that of *Y. ceylonica* but built more slenderly; abdominal ridges more pronounced; color varies from light brown to dark brown; spiracles dark brown; abdomen with light colored spots on either side of the dorsal line on S5–S6; S8–S12 usually with paired black spots on dorsal side of abdomen (Figs. 8h, i). Larvae look similar to those of *Ypthimomorpha*, supporting that supposition that these two genera are the same (Sourakov & Emmel, 1997). Duration of immature stages (days): 1st instar: (3); 2nd (3–5); 3rd (4–6); 4th (5–6); 5th (5–6); pupa (7–8).

Larval food plant: In Sri Lanka, *Y. singala* laid eggs on an unidentified species of grass (though likely a native species) that was not available at the location where the larvae were reared. The larvae were therefore offered *Axonopus compressus* (Poaceae), which they ate readily and developed successfully. All three adults that emerged were above average in size, perhaps the result of feeding on grass grown under optimal conditions.

Y. singala is uncommon in the island and found locally from 500–1500 m asl, mostly in grasslands in the southeastern hills. *Axonopus compressus* is naturalized and widespread up to 1900 m asl (Dassanayake, 1994). Although the butterfly fed on *A. compressus* in the lab, this plant is probably not the larval food plant used in the field because *Y. singala* seldom flies in grass meadows of *A. compressus*.

Note: Gaonkar (pers. comm.) considered *Y. singala* to be endemic to Sri Lanka. Many other authors, however, starting with Marshall & de Nicéville (1882–83) stated that it occurred in India as well. The genus has been subject to much confusion over the years and it is not clear if the specimens referred to in India are conspecific with those in Sri Lanka. For instance, in the research findings of Elwes & Edwards (1893), it is not clear if the genitalia of specimens from Sri Lanka (from where the type specimen was described) were compared with the genitalia of specimens from India. Shirôzu & Shima (1979) in their comprehensive study of the genus did not examine specimens from Sri Lanka nor did they compare the genitalia to the drawings of the Sri Lankan specimens in Woodhouse (1949) (Shima, pers. comm.). So it appears that the taxonomic status of *Y. singala* in Sri Lanka is still unresolved and needs further study including a detailed comparison of the genitalia of Indian and Sri Lankan specimens.

***Orsotriaena medus mandata* (Moore, 1857). Medus Brown. Figure 9.**

The immature stages and larval food plants of *O. medus mandata* in Sri Lanka have not been described. In India, the final instar larva and pupa of *O. mandata* (as *Mycalesis mandata*) were described briefly by Davidson & Aitken (1890) and in detail by Bell (1909). The results of the current study agree

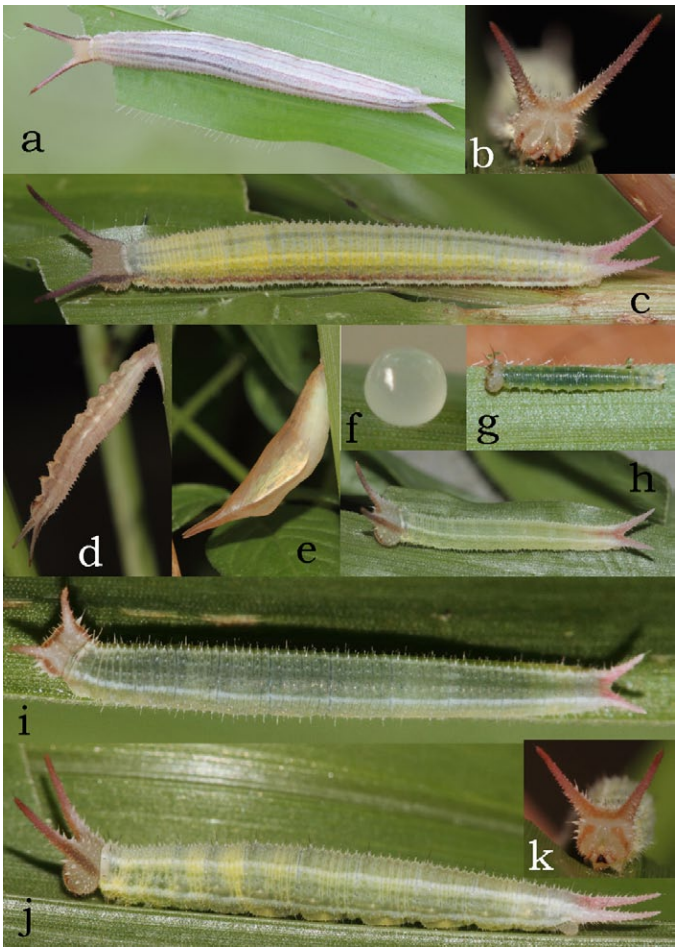

Fig. 9. *Orsotriaena medus mandata*: (A) Larva, fifth instar, pink form, dorsal view; (B) Larva, fifth instar, close-up of head; (C) Larva, fifth instar, yellowish-green form, dorsal view (D) Larva, fifth instar, prepupation, lateral view; (E) Larva, pupa, lateral view; (F) Egg; (G) Larva, first instar, dorsolateral view; (H) Larva, second instar, dorsolateral view; (I) Larva, third instar, dorsal view; (J) Larva, fourth instar, dorsolateral view; (K) Larva, fourth instar, close-up of head.

with these descriptions except for the following: a) in the larva, though both color forms (rose and whitish-green) have been recorded, the whitish-green form is more a yellowish-green (Figs. a–d) and b) the pupa is not suspended perpendicularly but at an angle of roughly 45 degrees and the color is a pale pinkish, lighter on the wing buds (Fig. 9e).

Additional notes on immature stages: Egg: spherical, slightly broader at base than apex, bluish-white, smooth (Fig. 9f). 1st instar: head pale beige with brown patches, face with long brown setae that point forwards, one pair of tubercles on vertex; body ground color green but lighter distally, covered with 6 rows of long transparent setae, anal processes short. A white subdorsal line and a white subspiracular line develop towards the end of the instar (Fig. 9g). 2nd: head light brownish-gray with two long processes that point up; processes brown except for dorsal surfaces, a brown line continues along back of head, four pairs of small cream-colored conical projections on the face, one light brown patch on each side of the clypeus; body light green anteriorly becoming yellowish and whitish posteriorly; darker green dorsal line turns red from S11–S14, the red continuing onto the inner edge of the anal processes which are long and backward-pointing; a distinct white lateral line continues onto the outer edge of the anal processes; body transversely impressed to form 5–6 ridges and covered with numerous setae; spiracles light brown and indistinct; indistinct white line along the flange (Fig. 9h). 3rd: similar to 2nd except ground color darker green, dorsal line obscure, red sometimes confined dorsally to S14 and the anal processes (Fig. 9i). 4th: similar to 3rd except brown patch on face extends to just below the vertex, S4–S6 with pale yellow transverse bands, dorsal band obscure or prominent (Figs. 9j, k). The description and illustration of a larva and pupa from the Philippines in Igarashi & Fukuda (1997) agree with these results. Larvae of *O. medus* from the Solomons (Sourakov & Emmel, 2001) appear similar to the ones described here. Duration of immature stages (days): egg (4); 1st instar: (4); 2nd (5); 3rd (6); pupation (1); pupa (10); egg to adult (30–34). Length (mm): prepupation (33 not including horns and tails).

Larval food plants: In Sri Lanka, de Nicéville & Manders (1899) stated that "like all the Indian Satyrinae", the larvae fed on rice [*Oryza sativa*] and grasses. The current study showed for the first time that *Panicum maximum*, *Leersia hexandra* and *Axonopus compressus* (Poaceae) are used as larval food plants in Sri Lanka. The use of *O. sativa* has been confirmed (S. Sanjeeva, pers. comm.).

O. medus mandata is very common in Sri Lanka and is found over most of the island below 1200 m asl and is absent from

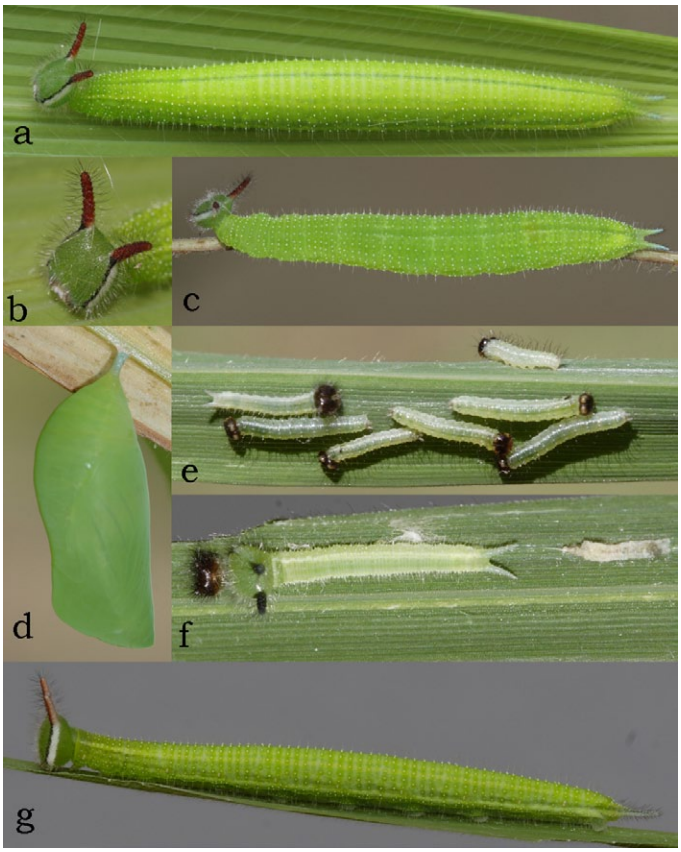

Fig. 10. *Melanitis leda leda*: (A) Larva, fifth instar, dorsolateral view; (B) Larva, fifth instar, close-up of head; (C) Larva, fifth instar, prepupation, dorsal view; (D) Pupa, lateral view; (E) Larvae, first instar, dorsal view; (F) Larva, second instar, just after molt, head capsule and molted skin visible; (G) Larva, fourth instar, lateral view.

the north. *Panicum maximum* is naturalized and found over most of the country up to 1000 m asl. *Leersia hexandra* is widespread over the country in wet fields, swamps and marshes at all elevations though it is not common. *Axonopus compressus* is naturalized and widespread up to 1900 m asl (Dassanayake, 1994). *O. sativa* is widely cultivated. Though at least one of these plants is found wherever the butterfly has been recorded, it is likely that other species of grasses are used as well.

Family Nymphalidae, subfamily Satyrinae, tribe Melanitini

***Melanitis leda leda* (Linnaeus, 1758). Common Evening Brown. Figure 10.**

The immature stages and larval food plant of *M. l. leda* in Sri Lanka were described briefly by Moore (1880–81). In India, the final instar larva and pupa of *M. leda* were described briefly by Davidson & Aitken (1890) and of *M. ismene* [now *M. l. leda*] in detail by Bell (1909). The results of the current study agree with these descriptions except for the following: a) in the larva, there are no spots on the face, and just before pupation, the larva turns bright green (Figs. 10a–c); and b) in the pupa, the veins of the wing buds appear as white lines initially (Fig. 10d), then darken.

Additional notes on immature stages: Egg: pearly white, rounded. 1st instar: head dark brown; vertex, clypeus and lateral margins lighter; vertex with two short projections; head covered with numerous black setae; body pale greenish-white with pale green dorsal line and covered with transverse rows of long hairs; with two anal processes (Fig. 10e). 2nd: head light-green with numerous whitish hairs and processes black with numerous black hairs; body pale green with faint light-blue dorsal line; lateral line white and doubled at S7–S8; S2 with green transverse band; anal processes light-blue (Fig. 10f). 4th: head green with black anterior lateral stripe and a broader white contiguous posterior stripe; processes brick red to deep chestnut and lighter dorsally; body yellowish-green covered with white tubercles, each with a short white hair; subdorsal line yellowish-white and more clearly marked from S2–S4; spiracles light brown and obscure; greenish-white line along the flange, broader posteriorly; anal processes pale blue with dark brown hairs (Fig. 10g).

Larval food plants: In Sri Lanka, de Nicéville & Manders (1899) stated that it had been frequently bred on "rice [*Oryza sativa*] and grasses". The current study confirmed the use of *O. sativa* and showed for the first time that the larval food plants in Sri Lanka include *Imperata cylindrica* (S. Sanjeeva, pers. comm.), *Setaria barbata*, *Panicum maximum*, *Leersia hexandra, Cenchrus ciliaris* and *Ischaemum timorense* (Poaceae), all of which have long, broad leaves which are needed to accommodate the long larva in its final instars.

M. l. leda is very common and widely distributed over the island from sea level to the highest elevations. *Imperata cylindrica* is a very invasive weed found up to 1200 m asl. *O. sativa* is a widely planted crop. *Setaria barbata* is found from 500–800 m asl. *Panicum maximum* is naturalized and found over most of the country up to 1000 m asl. *Leersia hexandra* is widespread over the country in wet fields, swamps and marshes at all elevations though it is not common. *Cenchrus ciliaris* is introduced and widespread. *Ischaemum timorense* is native and found up to 2000 m asl (Dassanayake, 1994). At least one of these plants is found wherever the butterfly has been recorded but it is likely that other long-leaved species of Poaceae are used as well. The larva requires a long, broad leaf to support it as it rests on the underside.

Fig. 11. *Melanitis phedima tambra*: (A) Larva, final instar, green head, dorsal view; (B) Larva, final instar, brown head; (C) Pupa, dorsolateral view.

Note: most authors consider the subspecies in Sri Lanka to be *M. leda ismene*. However this subspecies is found in China and Taiwan and it is unlikely that it is found in Sri Lanka. *M. l. leda* is found in India and the images of larvae published by Saji *et al*. (2011) match those of the larvae of the Sri Lankan subspecies more closely than those of *M. leda ismene*. We concur with K. Kunte (pers. comm.) that *M. l. leda* is likely the subspecies found in Sri Lanka as well.

***Melanitis phedima tambra* Moore 1880. Dark Evening Brown. Endemic subspecies. Figure 11.**

The final instar larva and pupa of *M. phedima tambra* in Sri Lanka were illustrated and described briefly by Moore (1880–81). In India, the final instar larva and pupa of *M. phedima varaha* (as *M. varaha)* were described briefly by Davidson *et al*. (1896) and by Bell (1909). The results of the current study agree with these brief descriptions except for the following: a) in the larva, the head has two color forms: 1) the head is green; the horns are dark reddish-brown with a band of similar color from the base of the horns to the mandibles; and 2) the head is shiny dark reddish-brown; the frons and a patch on either side of the clypeus are dull green; the labrum is white; the mandibles are bright red on the inner edge and the side of the head is bright brownish-red above and white below (Figs. 11a, b); and b) the pupa is more slender than that of *M. l. leda* (Fig. 11c).

Larval food plants: In Sri Lanka, the larval food plant has not previously been recorded. The current study showed for the first time that *Setaria barbata*, *Ischaemum timorense*, *Digitaria didactyla* and *Axonopus compressus* are used as larval food plants in Sri Lanka. Larvae were collected and raised on *S. barbata* in the field (S. Sanjeeva, pers. comm.) but in the lab, larvae ate the grasses listed above that were offered to it. *S. barbata* and *I. timorense* have broad leaves that are sufficiently long to accommodate the long larva in its final instars.

M. phedima tambra has a more restricted distribution than *M. l. leda* and occurs mostly in shady places in the wet zone up to 1200 m asl. *Setaria barbata* is found in shady places from 500 to 800 m asl. *Axonopus compressus* is naturalized and widespread up to 1900 m asl but it is unlikely that it is used in the wild

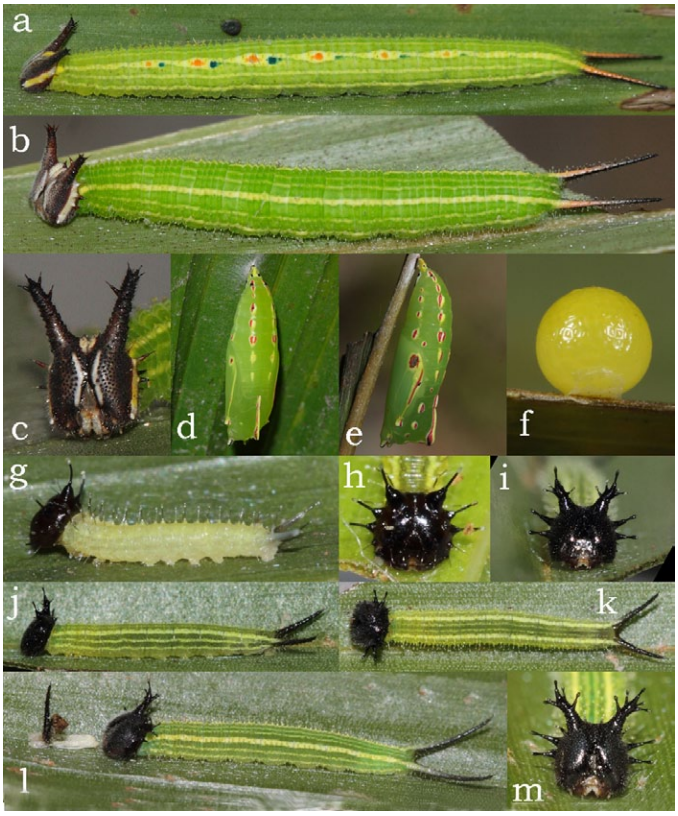

Fig. 12. *Elymnias hypermnestra fraterna*: (A) Larva, fifth instar, dorsolateral view; (B) Larva, fifth instar, red and blue markings absent, dorsolateral view; (C) Larva, fifth instar, head; (D) Pupa, dorsal view; (E) Pupa, dorsolateral view; (F) Egg; (G) Larva, first instar, dorsolateral view; (H) Larva, first instar, head; (I) Larva, second instar, head; (J) Larva, second instar, lateral view; (K) Larva, second instar, dorsal view; (L) Larva, third instar, just after molt, head capsule visible, dorsolateral view; (M) Larva, third instar, head.

since it is not shade tolerant. *Ischaemum timorense* is native and found up to 2000 m asl. *Digitaria didactyla* is widely planted as a turf grass (Dassanayake, 1994). It is likely that other species of Poaceae that grow in shady places, such as other species of *Setaria*, are used as larval food plants, particularly above 800 m asl.

Family Nymphalidae, subfamily Satyrinae, tribe Elymniini

Elymnias hypermnestra fraterna **Butler 1871. Common Palmfly. Endemic subspecies. Figure 12.**

The final instar larva and pupa of *E. hypermnestra fraterna* in Sri Lanka were described briefly by Moore (1880–81) (as *E. fraterna*). The results of the current study agree with this brief description except for the following: a) in the larva, the blue and red spots on the body are variable in number and size and are sometimes absent; the head is not small, not yellow, not surmounted by two pink pubescent processes (the head is rather large, dark brown with a pale yellow to orange lateral stripe across the face to the back and two yellow markings at the vertex; the processes on the last segment are dark chestnut brown except the front surface which is pale gray to almost white) (Figs. 12a–c); and b) in the pupa, there are two stubby projections on the head and a single or double gray spot with black streaks encircled by red at the tornus of the forewing bud; the spot is sometimes black without gray and other spots are variable; there are often black markings at the base of the stalk and on the last abdominal segment (Figs. 12d, e).

Additional notes on immature stages: Egg: spherical, shiny, yellow (Fig. 12f). 1st instar: head black with one pair of conical processes at the vertex; each process terminates in a long seta with a globular secretion at its tip; 3 smaller black conical processes with a seta ending in a globular secretion on the side of the head; body pale creamy yellow at emergence, each segment with a transverse row of 6 setae, each seta ending in a globular secretion; anal processes gray and cylindrical for most of its length ending in a seta that ends in a globular secretion (Figs. 12g, h). 2nd: head black, with numerous fine setae on the face, conical processes more elaborate; the two processes at the vertex with small conical processes arising at and near the apex, each ending in a seta that ends with a globular structure; 2 pairs of black lateral processes, each terminating in a single seta with an enlarged apex; body pale yellowish-green with dark green dorsal line flanked by yellowish-white band, and subdorsal, lateral and supraspiracular yellowish-white lines; subdorsal line continues partway into the anal processes; each segment transversely impressed to form 5–6 furrows, each of which carries a transverse row of setae; anal processes long and black, ending in a seta with a globule at its tip (Figs. 12i–k). 3rd: similar to 2nd except that dorsal surface of anal processes whitish-grayish (Figs. 12l, m). 4th: similar to the 3rd but the number of projections on the head reduced. 5th instar: head dark brown with two processes at the vertex each with 4 reddish-brown conical projections at the apex and one midway on the inner margin; each conical projection carries a short black seta at its tip, anterior surface light gray to white; white continues along the face which is heavily spotted with uniformly spaced black pits; vertex shades of orange to yellow to almost white, this color extends behind the vertex and around the processes and along the lateral margin of the face to the mandibles; lateral margin with 3 tubercles, each with a seta; pits cover the whole head taking on the color of its substrate; frons reddish-brown; adfrontal suture and anterior and posterior part of coronal sulcus black; body bright green with a faint light-yellow dorsal line; similar colored, broader subdorsal; lateral line prominent, wide, yellowish anteriorly turning white posteriorly and runs into the outer margin of anal processes; second faint and narrow lateral line below the broader one; spiracular line similar to lateral line described above; spiracles small, pale buff; body rugose, entire body covered with transverse rows of translucent or white setae with small colorless sticky droplets at the apex; anal processes long, pointing backwards and slightly above the horizontal; dorsal surface pink anteriorly but turning gray-blue towards the tip and then black at the tip. The illustrations of all the instars and pupa from India in Igarashi & Fukuda (1997) agree for the most part with the results of this study. The illustrations of the egg, an early and late instar and pupa of *E. hypermnestra agina* in Singapore also agree (Nature Society (Singapore), 2012b). Duration of immature stages (days): egg (4); 1st instar: (3); 2nd (4); 3rd: (4). Length (mm): mid 2nd instar (9.5+1.5 tails); just before 3rd molt (23+3 tails).

Larval food plants: In Sri Lanka, Moore (1880–81) reported

that it fed on Palmaceae (now Arecaceae). The current study showed for the first time that the following are used as larval food plants in Sri Lanka: *Livistona* sp. (H. D. Jayasinghe, pers. comm.), *Areca catechu* (S. Sanjeeva, pers. comm.), *Calamus thwaitesii* (C. de Alwis, pers. comm.), *Cocos nucifera*, *Phoenix pusilla*, *Caryota urens*, *Cyrtostachys renda* and *Chrysalidocarpus lutescens* (Arecaceae).

E. hypermnestra fraterna is common in many habitats below 500 m asl. *Livistona* sp. is a common garden plant in the wet zone. *Areca catechu* is native to the wet and intermediate lowlands up to 900 m asl and commonly planted elsewhere. *Calamus thwaitesii* is native to the wet and intermediate lowlands and lower montane forests. *Cocos nucifera* is a widely planted plantation crop. *Phoenix pusilla* is a native plant that is widespread in the lowlands of all climatic zones up to 500 m asl. *Caryota urens* is native in the wet lowlands of the southwest quadrant and cultivated up to 2000 m asl in the intermediate zone. *Cyrtostachys renda* and *Chrysalidocarpus lutescens* are common exotic garden ornamentals (Dassanayake, 2000). At least one of these plants is found wherever the butterfly has been recorded but it is likely that other native species of Arecaceae are used as well. There appeared to be regional differences in larval food plant use in the field: the butterfly preferred to use *Phoenix pusilla* and *Cocos nucifera* in the intermediate zone despite the availability of *Ca. urens*, *Cy. renda* and *Ch. lutescens*. In the wet zone, however, it preferred *Ch. lutescens*, an exotic introduced many decades ago, despite the wide availability of *Co. nucifera*. These observations need confirmation.

Fig. 13. *Elymnias singhala*: (A) Egg, head spines visible as dark streaks; (B) Larva, first instar, dorsal view; (C) Larva, first instar, close-up of head; (D) Larva, second instar, just starting 2nd molt, dorsolateral view; (E) Larva, third instar, close-up of head; (F) Larva third instar, dorsolateral view; (G) Larva, fourth instar, dorsolateral view; (H) Larva, fifth instar, dorsal view; (I) Larva, fifth instar, close-up of head; (J) Pupa, dorsolateral view; (K) Pupa, dorsal view.

***Elymnias singhala* Moore [1875]. Ceylon Palmfly. Endemic. Figure 13.**

The immature stages and larval food plant of *E. singhala* in Sri Lanka have not been described except for a statement in Moore (1893–96) quoted from a manuscript of Mackwood that it fed on a species of "palm-tree". In the current study, the immature stages are described and the larval food plant identified for the first time.

Notes on immature stages: Egg: pearly white when freshly laid; the dark setae of the head appear as nail-shaped streaks at the top of the egg within two days (Fig. 13a). 1st instar: head black with one conical process on either side of vertex; each conical process with a seta arising at the apex; below these processes and laterally, three smaller but similar conical projections; body more or less square in transverse section; upon emergence, body white with one pair of long gray cylindrical anal processes, each tapering and ending in a seta that ends with a globular secretion; 3 rows of white setae – subdorsal, lateral and along the flange; most setae capped with sticky droplets; within a day or two, body turns light-green and a white lateral band becomes visible (Figs. 13b, c).2nd: same as 1st except: body rugose, light green with eight longitudinal cream-colored lines of variable width; lateral bands broad and extend partway into the anal processes; lines flanking the mid-dorsal line are the narrowest; numerous setae along the body capped with small globular secretions at apex, subdorsal ones with black setae; in the lab, the larva becomes covered with its own droppings (we do not know if the larva deliberately placed its own droppings on itself for camouflage or if it is just coincidence) (Fig. 13d).3rd: same as 2nd except hairs on body more numerous, transparent and shorter; head quite different—conical processes more elaborate; the largest process on the vertex branched and club-shaped at the extremity; two unbranched smaller projections (basally cone-shaped and distally club-shaped) below and laterally; three smaller black projections on either side of the mid-dorsal line behind and more posterior to the projections; later in the instar, whitish markings develop on the head—upper part of frons whitish, vertex of head with whitish spots, x-shaped marking on front of face on either side of epicranial suture, whitish on lateral margins (Figs. 13e, f). 4th: same as 5th except: head dark brown; orange color on head a lighter shade; head shape more oval (not squared); body color same (Fig. 13g). 5th: head with two prominent processes on vertex, each with 4 spines distally; light gray frontal area studded with dark brown pits; back and side of head orange to orange-yellow with 4 spines on either side of dorsal line; orange markings oval at the vertex, extending slightly beyond horns to the front; fine dark red line and a diffuse dark reddish band separate the posterior orange area from the anterior light gray area; white patch laterally just above mandibles; body bright grass green,

rugose, and covered with setae terminating in sticky transparent droplets, as in previous instars; anal processes orange dorsally from base to midway, then gray, and finally, black distally (Figs. 13h, i). Pupa: green with bright red, yellow and white streaks; very similar to that of *E. hypermnestra fraterna* but richer in color and with a large white spot, encircled with black on the lower margin of the forewing (Figs. 13j, k). Duration of immature stages (days): egg (4); 1st instar: (1); 2nd (3); 3rd (4); 4th (7); pupation (2).

Larval food plants: The current study showed for the first time that *Caryota urens* (Arecaceae) is used as a larval food plant in Sri Lanka. Additionally, there is one record of the larva feeding on *Loxococcus rupicola* (Arecaceae) at the Forest Department Research Station at Kudawe (C. de Alwis, pers. comm.).

E. singhala was originally recorded only from the Royal Botanic Gardens in Peradeniya but by the early 1900s had begun to increase its range. From 2004 and 2008, it was recorded from Kandy, Ratnapura, Kalawana, Pitigala, Kottawa, Balangoda, Bandarawela and Haldamulla where it is confined to forests and well-wooded areas from 300–800 m asl but it appears to have disappeared from the Royal Botanic Garden where it was formerly quite abundant (Ormiston, 1924). Manders (1904) speculated that it originated from *E. lutescens* from Malaysia, brought in accidentally to the Gardens on imported palms, perhaps as larvae or eggs. Molecular studies will help to confirm this speculation. *Caryota urens* is native in the wet lowlands of the southwest quadrant and cultivated up to 2000 m asl in the intermediate zone. *Loxococcus rupicola* is endemic to Sri Lanka and is confined to rocky outcrops near streams in the forests of the wet zone in the southwest quadrant of the island from 300–1500 m asl (Dassanayake, 2000). It is not known whether or not there are populations of *E. singhala* in these steep, often inaccessible slopes. It is likely that it feeds on other species of Arecaceae.

Family Nymphalidae, subfamily Satyrinae, tribe Amathusiini

***Discophora lepida ceylonica* Fruhstorfer 1911. Southern Duffer. Endemic subspecies.**

The immature stages and larval food plant of *D. lepida ceylonica* in Sri Lanka have not been described. Those of *D. l. lepida* in India have been described by Davidson, Aitken & Bell (1896) and by Bell (1909). In the course of the current study, we have not yet encountered larvae or pupae though adults have been seen on many occasions at several locations and a female was observed on one occasion ovipositing on the underside of a leaf of *Ochlandra stridula* (Poaceae).

CONCLUSIONS

The immature stages of all of the species documented in this study exhibited some variation, particularly in the pupa and the final instar. They were, however, similar to those described from peninsular India with which Sri Lanka is zoogeographically related and to those described from other countries in the Indo-Australian region. Variation may be explained by differences expressed in different subspecies between India and Sri Lanka and/or by differences in temperature, rainfall, relative humidity and photoperiod due to geographic location as suggested by Braby (1994). Variation may also arise through the use of similar but different species as larval food plants. Further information on this variation will be useful for the identification of larvae and pupae in the field, which supports work on ecology and conservation management.

The larval food plants used by the Satyrinae in Sri Lanka are members of the Poaceae and Arecaceae and are similar or the same as those reported elsewhere (Ackery, 1988; Braby, 2000; Kunte, 2000; Igarashi & Fukuda, 1997). The members of *Mycalesis*, *Ypthima, Melanitis* and *Orsotriaena* were polyphagous within the Poaceae and *Elymnias hypermnestra fraterna* within the Arecaceae. *E. singhala*, however, has only two confirmed larval food plants. The larvae of *Lethe drypetis* and *L. daretis* are restricted to feeding on species of bamboo (Poaceae). *L. drypetis* is polyphagous, having been found on two exotic bamboos as well as a native bamboo. *L. daretis,* a Sri Lankan endemic appears to feed exclusively on the endemic bamboo, *Sinarundinaria debilis*. The regional difference in larval food plant preference observed in *E. hypermnestra fraterna* illustrates the importance for conservation management of knowing the larval food plant used by a given population in a particular area.

The list of larval food plants identified in this study is incomplete and there are several issues that contribute to this. For example, females of *Ypthima ceylonica* were observed ovipositing on dried leaves and twigs within patches of grass that contained many different grass species, an observation made by others on other members of the Satyrinae (Wiklund, 1984). This, however, makes the identification of the larval food plant more difficult. In addition, members of the Poaceae in general are difficult to identify, particularly when flowering parts are not available. Photographs of larvae of species of *Mycalesis* made available to us by naturalists show larval food plants that were obviously not the same as ones we have reported here but that we were unable to identify from the images. Finally, the fact that a larva feeds on a particular plant in the lab does not mean that it is used in the field. Further fieldwork will be required to identify other larval food plants used in the field in different climatic regions and habitats.

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