

KFRI Research Report No. 371

Identification of Satyrine Butterflies of Peninsular India through DNA Barcodes

Component: Morphological and taxonomic studies

George Mathew



Kerala Forest Research Institute

*An Institution of Kerala State Council for Science, Technology and Environment
(KSCSTE)*

Peechi – 680 653, Thrissur, Kerala, India

November 2010

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(Final Report of the Project KFRI/535/2006: Project sponsored by the Department of Biotechnology, Government of India, New Delhi)

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Forest Health Division

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ABSTRACT OF PROJECT PROPOSAL

Project No. KFRI/535/2006

1. Title of the project:” Identification of Satyrine Butterflies of Peninsular India through DNA Barcodes”
2. Objectives:

Component for CES, IISc, Bangalore:

- (i) Determination of appropriate markers for DNA barcoding of satyrine butterflies.
- (ii) Identification of cryptic species.
- (iii) Verification of DNA Barcoded specimens.
- (iv) Molecular systematics of satyrines.

Component for KFRI, Peechi:

- (i) Field sampling of populations of target butterflies.
- (ii) Taxonomic identification of butterflies in the field and lab.
- (iii) Collection of representative specimens and preservation for DNA extraction.

3. Date of commencement: July 2006
4. Scheduled date of completion: June 2010
5. Project Team:
Principal Investigator (of KFRI component): Dr. George Mathew
Research Fellow: Shri. Pramod S. (from March 2008- Nov. 2009)
Smt. Soumya.K.C. (from Jan. 2010- Jun. 2010)
6. Study Area: Kerala part of the Western Ghats.
7. Duration of the study: 2007- 2010
8. Project Budget: Rs. 8.01 Lakhs
9. Funding Agency: Department of Biotechnology, Government of India, New Delhi

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Abstract

Studies pertaining to morphology of the external genitalia of twenty-five species of satyrine butterflies collected from different locations in the Kerala part of Western Ghats were made. Based on an evaluation of resemblances of genitalial parts, these species were categorised under five separate groups. The first group contained *Melanitis leda*, *Melanitis phedima*, *Mycalesis anaxias*, *Mycalesis oculus*, *Lethe drypetis*, *Lethe rohria* and *Zipoetis saitis*. Of these, *Mycalesis anaxias*, *Mycalesis oculus* and *Lethe rohria* formed a subgroup distinct from the others. The second group contained *Mycalesis perseus* and *M. igilia*. These species shared resemblance with *Lethe rohria*, *Mycalesis oculus*, *Mycalesis perseus*, *Mycalesis subdita*, *Mycalesis igilia* and *Mycalesis adolphei*. Each of the remaining species viz., *Mycalesis patina*, *Mycalesis subdita* and *Ypthima baldus* showed distinctness in their identity. Among these, *Ypthima baldus* stood out separately from all the rest in the structure of valvae, uncus and phallus.

The component pertaining to the determination of appropriate markers for DNA barcoding and molecular systematics of satyrine butterflies was carried out by CES, IISc, Bangalore and hence omitted from this report. The work carried out at KFRI alone is presented here.

1. INTRODUCTION

Satyrids, popularly known as Browns are usually dull-colored, brown or blackish brown butterflies having eye spots (ocelli) and white or tawny bands on the wings. Usually, their fore legs are very small and non-functional. In many species, the males possess secondary sexual characteristics in the form of a brand which is simply a tuft of hairs on the basal part of the costa of the hind wing, that is correlated with a similar one on the under side of the fore wing. There are variations in the general structure of the brands displayed by various species. For instance, in some Meadow browns and Tree browns, the brand on the upper side of fore wings consists of whip-like scales ending in tassels. There may also be a peculiar brush called the Julian organ on the abdomen in a few Meadow browns. Usually, in males, the fore tarsus bears only one joint while the females have several joints. Except for the above secondary sexual characters, sexes are almost the same in appearance.

Satyrids are shade loving butterflies generally confined to thick evergreen forests. They prefer to remain in cool, dense vegetation, seldom venturing out in open places. The Tree Browns (*Lethe*), the Bush Browns (*Mycalesis*), Cats' Eyes (*Zipoetis* and *Coelites*), the Owls (*Neornia*), the Palmflies (*Elymnias*) and the Niggers (*Orsotrioema*) are examples of satyrids preferring shady areas. However, certain species like the Meadow Browns (*Maniola*), the Walla (*Pararge*), and the Rock Browns (*Eumenis*) and most of the Rings (*Ypthima*) prefer openings with sunshine. Certain species like the Evening browns (*Melanitis*) are generally active during dawn or in the evenings. Their flight is weak and jerky, keeping close to ground level and flying to a short distance. They have a definite preference for sap exuding from trees, toddy and rotting fruits lying on the forest floor. The immature stages of almost all species (except *Elymnias* which feed on palms) develop on grasses or bamboos.

The eggs of satyrids are white, melon-shaped, sometimes flattened on top and grooved (covered with minute cells). Their caterpillars are brown, green, pink or yellow in colour and well camouflaged and have two long horns or conical projections on the head and two tails at the rear. Larvae develop on members of Graminae or Palmaceae. The young larvae that feed on the tender shoots during the wet season rapidly complete their early stages. The butterflies

that hatch out are typically small, dark with prominent ocelli on the under sides. When the ocelli are reduced, they may appear as white dots. Protective colouration may be present on the under side of wings so as to harmonize against the background of the habitat in which they occur. During the dry season, duration of the larval stages is generally longer and the adults that come out are larger, pale with much less pronounced markings. Pupae are usually suspended from the cremaster or may sometimes pupate within a silken cocoon either within leaves or below ground.

Studies on the Indian satyrids have been made by Wynter Blyth (1957), D' Abrera (1985), Sathyamurthy (1994), and Kunte (2000). Classification of this family is mainly based on wing venation at higher taxonomic levels and on colouration and wing pattern at species level. Recent investigations have shown the usefulness of external genitalial morphology in resolving species identity. For instance, Sharma, Narender and Rose (<http://www.indian>) segregated the satyrids *kalinda* Moore and *shallader* Marshall & de Niceville of the genus *Paralasa* Moore based on a study of the external genitalia. However, current morphological schemes of classification have not been very successful in resolving the sub specific status of satyrine butterflies since many species show variations in the general colouration and wing pattern in response to vegetation types or seasons which render species identification rather difficult. As a result, several authors have pointed out inconsistency in the assemblage of species necessitating detailed investigations.

Establishment of the exact species identity of a species is essential for making a proper judgment of its phylogenetic relationships. This information is also essential for assessing the survival status of the species and for developing appropriate conservation strategies. Since all differences that we notice at specific or sub specific levels are genetically impressed, molecular studies will help in segregating species showing very little or no morphological difference. In order to bridge the gap in information on the identity and phylogenetic relationships of various species, it was proposed to combine morpho taxonomical methods with molecular studies. It was in this context that the present study was undertaken as a collaborative project with IISc, Bangalore and KFRI. The inter generic and inter specific relationships of satyrine butterflies of southern Western Ghats, as revealed in the morpho-taxonomical analysis carried out in this study, are presented in this Report.

2. MATERIALS AND METHODS

2.1. Collection of butterflies

Samples of butterflies required for the morphological and taxonomical studies were collected by conducting a field survey in the Kerala part of Western Ghats. The locations covered in this study included Peechi-Vazhani, Vazhachal, Palappilly, Sholayar, Kattlapara, Nelliampathy Malayattoor, Thattakkad, Kothamangalam, Rajmala, Thenmala, Wynad, Parambikulam, Rockwood, Pandimatta, Muthanga, Wayanad and Chembra peak. Specimens collected were properly labeled and curated.

2.2. Processing of specimens for morphological and taxonomical studies

Immediately on collection, one of the forelegs was detached and preserved in 70% alcohol for molecular studies. Preliminary identification of species was done with the help of available literature. For confirmation of species identity and for determining diagnostic characteristics, detailed studies involving examination of external genitalial morphology were carried out. For dissecting out the external genitalia, the abdomen was detached from the body by means of micro needles and transferred to a test tube containing a small quantity of 10% potassium hydroxide (KOH). It was then gently boiled in a water bath over a spirit lamp flame till the material looked clear enough in transmitted light. When cooled, the KOH with the material was transferred to a watch glass. The material was then gently sponged with the tip of a 'paper pencil' (paper roll) to remove excess KOH solution. It was then transferred to acetic acid containing the stain Acid-Fuschin. After about 10 minutes, it was treated with carbol-xylol for clearing and then mounted in Canada balsam. Illustrations of slide mounts were made using a Camera Lucida fitted to a stereomicroscope.

3. RESULTS

3.1. *Satyrids collected in this study*

Altogether, 25 species of satyrids were recorded as listed below.

1. *Melantis leda* Drury

Collection data: Parambikulam, 30 April, 2009; Vazhachal, 1, 5 May, 2009;
Kattlapara, 14 Oct. 2009; Vazhani, 3 May, 2010.

2. *Melantis zitenius* Moore

Collection data: Parambikulam, 30 April, 2009; Nelliampathy, 13 May, 2009.

3. *Melantis phedima* Cramer

Collection data: Parambikulam, 1 May, 2009; Vazhchal, 5, May, 2009;
Rockwood, 15 Oct. 2009; Kattlapara, 14 Oct. 2009; Thattakkad,
22 Nov. 2009; Chimmony, 3 Nov. 2009.

4. *Lethe europa* Fb.

Collection data: Palappilly, 3 Nov. 2009.

5. *Lethe drypetis* Moore

Collection data: Wayanad, 5 May, 2010.

6. *Lethe rohria* Fb.

Collection data: Thattakkad, 5 Nov. 2009.

7. *Mycalesis anaxias* Hewitson

Collection data: Pandimatta, 14 Oct.2009, Thattakkad; 5 Nov.2009.

8. *Mycalesis perseus* Fruhstorfer

Collection data: Vazhachal; 5, 6 May, 2009; Pandimatta, 14 Oct. 2009; Palappilly,
3 Nov. 2009; Chimmony, 3 Nov. 2009; Thattakkad, 5 Nov. 2009;

Vazhani, 3 May, 2010.

9. *Mycalesis mineus* Cramer

Collection data: Vazhachal, 1 May, 2010.

10. *Mycalesis visala* Moore

Collection data: Nelliampathy, 12 & 13 May 2009, Vazhachal, 6 May, 2009.

11. *Mycalesis subdita* Moore

Collection data: Parambikulam, 1 & 2 May, 2009, Palappilly, 3 Nov. 2009; Vazhani, 3 May, 2010.

12. *Mycalesis igilia* Fruhstorfer

Collection data: Chembra, May, 2010.

13. *Mycalesis adolphei* Guerin-Meneville

Collection data: Chembra, May, 2010.

14. *Mycalesis patnia* Moore

Collection data: Vazhchal, 5 & 6 May, 2009; Pandimatta, 14 Oct. 2009; Rockwood, 15 Oct. 2009; Thattakkad, 15 Nov. 2009.

15. *Mycalesis oculus* Marshall

Collection data: Pambadum Shola, 29 April, 2009.

16. *Mycalesis* sp.

Collection data: Wayanad, 5 May, 2010.

17. *Orsotrianea medus* Moore

Collection data: Thattakkad, 5 Nov. 2009; Vazhani, 3 May, 2010, Chembra, 6 May, 2010.

18. *Zipoetis saitis* Hewitson

Collection data: Nelliampathy, 13 May, 2009; Kattlapara, 14 Oct. 2009; Pandimatta, 14 Oct. 2009.

19. *Ypthima baldus* Fabricius

Collection data: Vazhachal, 6 May, 2009; Pandimatta, Oct. 2009; Chimmony, 3 Nov. 2009; Rockwood, 15 Oct. 2009; Thattakkad, 5 Nov. 2009.

20. *Ypthima huebneri* Kirby

Collection data: Kattlapara, 14 Oct. 2009; Rockwood, 15 Oct. 2009; Chimmony, 3 Nov. 2009; Thattakkad, Nov. 2009; Vazhachal, May, 2010; Wayanad, May, 2010.

21. *Ypthima chenui* Guerin-Meneville

Collection data: Parambikulam, 1 May, 2009.

22. *Ypthima philomela* Marshall & de Niceville

Collection data: Chembra, 6 May, 2010.

23. *Yapthima ypthimoides* Moore

Collection data: Rajmala, 30 April, 2010; Mannavan Shola, 30 April, 2010.

24. *Ypthima* sp.

Collection data: Wayanad, 5 May, 2010

25. *Abisara* sp.

Collection data: Parambikulam, 2 May, 2009

3.2. Morphology and ecology of satyrid butterflies collected in this study

A general description of satyrid butterflies collected in this study along with notes on their description, genitalial morphology, distribution, habits, hosts and status is presented herein.

1. *Melanitis leda* Drury (The Common Evening Brown)

(Linnaeus, 1758. Syst. Nat. 1(2): 773).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 410.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 122.

Description: (Plate VIII, Figs. 1 & 2)

The COMMON EVENING BROWN measuring 60-80 mm in expanse is dark brown in colour. Fore wing with 2 parallel ocelli having orange inner borders. Hind wing with 3 ocelli. Seasonal forms present. In the wet season form, there is a large, black spot at vein 3 of fore wing and another smaller one on vein 4. Under side is greyish with striae and black lines. In the dry season form, the colour is brownish and the black spots have a short yellow bar above them. Under side blotched or spotted with black.

Genitalial morphology: (Plate I, Fig.1)

Male: Uncus with an elongate, slender, blunt lobe, borne on an expanded basal part. Tegumen and vinculum with narrow, elongate arms. Valvae short, swollen in the basal and middle part and narrowed at the apical 1/3rd portion. There is a slight sub-apical constriction. The apex is blunt and rounded. Inner margin of valva fringed with a row of short, stiff hairs. Saccus with an exceptionally elongate lobe having a blunt tip. Phallus short, stout, slightly curved in the middle; proximal part broad and appearing like the handle of a sword. Distal end broadly blunt. Ductus ejaculatorius enters the phallus through the proximal end.

Female: Bursa vesicular and appearing as a hood-shaped structure. Ductus long, narrow and of uniform width; basal portion swollen.

Habits: It is common on the hills up to an altitude of 4000 feet. It is also found near agricultural farms and in countryside. Its flight is rather weak, and it keeps close to the ground, frequenting both thick forest and open country. It comes out more in the open sunshine. The wet season form is as a rule more heavily ornamented with markings. Visits flowers of Lantana.

Hosts: Larvae develop on Graminae. It is a minor pest of paddy, sorghum, wheat, grasses, bamboos etc.

Distribution: The range of the species extends over Sri Lanka, Peninsular India, Assam, Burma, Andamans and even into the Malayan Sub-region. Reported from the Nilgiris, Peechi, Sholayar, Silent Valley, Nelliampathy, Nilambur and Parambikulam.

Status: Very common.

2. *Melanitis zitenius* Moore (The Great Evening Brown)

(Herbst, 1796. *Naturs. Bek*, Schmett. 8:5).

D'Abrera, 1985, *Butterflies of the Oriental Region*, Part II: 410.

Wynter-Blyth, 1957. *Butterflies of the Indian Region*, Bombay nat. Hist. Soc., p. 124.

Description: (Plate VIII, Fig. 3)

The GREAT EVENING BROWN measuring 75-85 mm in expanse has a general resemblance to the Common Evening Brown, but larger. The costa of the fore wing is more rounded, and the apical markings on the upper side of the fore wing are generally more luxuriant than in *M. leda*. The dry season form is pale brown below with a few black patches. Fore wing more prominently angled. In the wet season forms, the dark discal line is prominent and the ground colour is reddish brown. Seasonal forms present.

Habits: Found only in deep jungle up to 4000 ft., usually hiding under bushes.

Hosts: Graminae.

Distribution: The distribution covers South India and from Kumaon to Indo China. It is mostly confined to dense forests up to 4000 feet elevation. It has been recorded from the Coonoor Ghat, Kallar and the Nadgani Ghat.

Status: Extremely rare.

3. *Melanitis phedima* Moore (The Dark Evening Brown)

(Cramer, 1780. Papillons. Exot. IV: pl. 292).

D'Abrera, 1985. Butterflies of the Oriental Region, Part II: 412.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 123.

Description: (Plate VIII, Fig. 4)

The DARK EVENING BROWN measuring 60-85 mm in expanse is blackish brown in colour and without prominent marks. Seasonal forms present. In the wet season form, the upper side is blackish brown without markings. The termen of the Fore wing is straight and not produced. The black sub-apical markings are either reduced or absent. The hind wing is uniformly dark brown, without ocelli, and its margin bears a prominent tooth-like projection at vein 3 and streaked with pale purplish lines.

The dry season form is distinguished from the wet season form by the upper side of the fore wing being pale purplish towards the terminal margins. The general ground colour is dark above. On the under side, the general ground colour is darker and the ocelli are reduced to pale spots.

Genital morphology: (Plate I, Fig.2)

Male: Uncus narrow, slightly narrowed basally and sub-basally swollen, apex blunt. Arms of tegumen and vinculum narrow. Valvae short, spindle-shaped, sub-epically narrowed with a blunt apex, fringed with short, stiff hairs on the inner margin. Saccus elongate, stout and bluntly pointed at the tip. Phallus short, stout, basal 1/3rd portion demarcated and appearing like the handle of a knife; apical half narrow, apex flat.

Habits: It is confined to dense, evergreen forests and is rarely found in low forests. This species resembles the preceding one closely in its habits, except that its flight is weaker and it keeps more to the jungles. This species is readily distinguished from the preceding one by the ground colour of its upper side which is much darker.

Hosts: Graminae.

Distribution: The distribution covers Sri Lanka, Myanmar, South India, the Himalayas, Kashmir to Sikkim, Assam and Naga Hills. It has been recorded from Kallar, Mukkali and the Nadgani Ghat.

Status: Rare.

4. *Elymnias caudata* Butler (The Common Palmfly) *

(Linnaeus, 1763. Amoen. Acad. 6: 407).

D'Abrera, 1985. Butterflies of the Oriental Region, Part II: 475.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 126.

**Could not be located during the present survey*

Description: (Plate VIII, Figs. 5 & 6)

The COMMON PALMFLY measuring 65-80 mm in expanse is brightly coloured. The male is blackish brown, with a purple gloss. The upper side of the fore wing bears a bluish band and a series of bluish white spots along the margin. The upper side of the hind wing has a broad chestnut border. The female is reddish brown with the apex and margins tinged with dark brown and having white spots. Fore wing with broad white band below apex. Sexual dimorphism is very strong, the female mimicking *Danaus genutia* and *D. chrysippus*.

Genitalia morphology: (Plate VII, Figs.2&3)

Male: Uncus long, narrow, rod-shaped and pointed at the tip, borne on a broad basal plate bearing a narrow, curved lobe on either side. Valvae of medium length and of more or less uniform width throughout; bearing an elongate, narrow lobe on the inner margin, slightly

projecting beyond the apex which is broad, fringed with short, stiff hairs. Saccus pronounced, V-shaped, vinculum with elongate, narrow arms. Arms of tegumen short. Transtilla broad with a median curve. Phallus long, narrow with a slight constriction, apex flat. Ductus ejaculatorius enters the phallus sub-basally.

Habits : These are the commonest and the most widely distributed palm flies usually found in cane and palm plantations. They are shade-loving butterflies. Their flight is weak and the male may be often seen sitting for long periods on palm trees with the wings closed.

Hosts: Larvae develop on canes and palms. *Cocos nucifera*, *Areca catechu*, *Arenga wightii*, *Calamus rotang*, *Phoenix* sp. and ornamental palms are some of the recorded host plants.

Distribution: The range covers Peninsular India and Sri Lanka. It is rather scarce in the Nilgiris and it has been collected from Travancore to Mysore covering the Nadgani Ghat, Silent Valley, Sholayar and Nelliampathy.

Status: Rare.

5. *Lethe europa ragalva* Fruhstorfer (The Bamboo Treebrown)

(*Lethe europa*, Fabricius, 1775. Syst. Ent.: 55).

D' Abrera, 1985, Butterflies of the Oriental Region, Part II: 416.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 92.

Description: (Plate VIII, Fig.7)

The BAMBOO TREEBROWN measuring 65-75 mm in expanse is brown above. Hind wing caudate at vein 4. Ocelli on the under side of hind wing more or less disintegrated and no markings inside basal line (line that runs from the costa through mid cell towards dorsum). Fore wing fringe chequered. Female always with a continuous white band on the upper side of fore wing. Under side of hind wing with no discal band. Male without brands.

Habits: Visit damp areas, rotting fruits and fresh cowpats. Can be trapped using bait traps with rotting crabs.

Hosts: Bamboos.

Distribution: Southern India, Madhya Pradesh, Assam and Myanmar.

Status: Rare.

6. *Lethe drypetis todara* Moore (The Tamil Treebrown)

(Hewitson, 1868 ?= *todara* Moore. Illustr. Exot. Butts. III: 76).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 418.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 93.

Description: (Plate VIII, Fig.8)

The TAMIL TREEBROWN measures 65 – 70 mm in expanse. Under side of hind wing with discal band and with ocelli in 3, 4 and some times 5, all of which are equal in size. The male is dark brown. The hind wing bears a post-discal series of three or four black ocellar spots. The female is similar to the male but paler, with a broad, oblique white discal bar and two white pre-apical spots on the upper side of the Fore wing. The markings on the under side are relatively more sharply defined than in the male.

Genitalia morphology: (Plate II, Fig.1)

Male: Uncus short, conical with a bluntly pointed apex. Tegumen and vinculum with narrow arms of uniform width. Valvae short, with the apical 1/3rd portion constricted and appearing as a blunt lobe. Basal part of valva swollen. A fringe of short hairs present on the inner margin of the valva extending from about 1/3rd distance from base to the apex. Saccus elongate, stout and blunt at the tip. Phallus short, of uniform length throughout and with the basal 1/3rd portion appearing as the handle of a dagger. Apex broad. Ductus ejaculatorius enters the phallus sub-basally.

Habits: It is generally found in forests having bamboo breaks on which their larvae develop. As a result, they are found both in plains as well as in forests to altitudes above 7000 feet in the Western Ghats. The flight is very erratic. They are attracted to toddy, sugar or sappy exudations of trees and are also reported to frequent animal (leopard) droppings.

Hosts: Its larvae feed mostly on bamboos (*Bambusa arundinacea*) but they also seem to feed on grasses. The eggs are laid singly on the under side of leaves.

Distribution: Sri Lanka, South India to Pachmarhi, Kashmir to Assam and Burma. It has been reported from Kotagiri in the Nilgiris, the moist-deciduous forests in Biligiriranga and Wynad, the Nadgani Ghat and Silent Valley.

Status: The species is endemic to Sri Lanka and South India. Common.

7. *Lethe rohria neelgheriensis* Guerin-Meneville (The Common Treebrown)

(*Lethe rohria*, Fabr. 1787. Mantissa Ins.: 45).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 418.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 93.

Description: (Plate VIII, Fig.9)

The COMMON TREEBROWN measures 58-70 mm in expanse. The male is dark brown. On the upper side of the fore wing have apical and costal white spots. In the hind wing, the ocelli of the under side are seen as black spots. The under side of the fore wing has a broad and a narrow discal bands arranged in the form of a V. On the under side of the hind wing with a basal white line and with ocelli in 3, 4 and some times 5, all elongated and distorted; the apical ocellus is much larger. The antennae and the head, thorax and abdomen are brown.

Genital morphology: (Plate II, Fig.2)

Male: Uncus with a pointed stout, pointed process. Tegumen and vinculum with narrow, elongated arms. Saccus stout, basally broad, blunt at the proximal end and appearing as the handle of a dagger. Valvae short, apical half narrowed, ending is a blunt lobe-like portion. Phallus short, slightly narrowed in the middle, with a slight sub-apical notch.

Habits: It is an inhabitant of subtropical, evergreen and moist-deciduous forest.

Distribution: The distribution of this species extends from Sri Lanka and south India to Kashmir to Kumoan, Sikkim, Assam and Myanmar. It has been reported from the Nilgiris, Malabar and Silent Valley.

Hosts: Feeds on grasses.

Status: Rare.

8. *Mycalesis anaxias anaxias* Hewitson, 1864 (The White Bar Bushbrown)

(Illust. Exot. Butts. III: 86).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 452.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 83.

Description: (Plate.IX.Fig.10)

The WHITE BAR BUSHBROWN Measures 48-55 mm in expanse. It is dark brown in colour with a sub-apical white bar on the Fore wing. No ocelli. Male with a black brand each on the upper side of fore and hind wings.

Genitalia morphology: (Plate III, Fig.1)

Male - Uncus conical with a long, pointed lobe. Tegumen and vinculum short with narrow arms. An elongate, slender, apically pointed, curved lobe on either side of the base of uncus. Saccus short w-shaped, with a notch in the middle. Valvae short, more or less of uniform width throughout, the apical portion narrow with a sub-basal hump, the distal end of valva drawn out into a narrow, pointed lobe; fringes of short, stiff hairs present apically. Outer margin of valvae uneven and curved. Phallus long and slender, slightly curved, of uniform width; distal end narrow and blunt, proximal part distinctly resembling the handle of dagger.

Distribution: Distribution covers hills of south India, Sikkim to Assam and Myanmar.

It has been recorded from Coorg, Coonor, the Nadgani Ghat, and Silent Valley.

Habits: It is a hill species confined to the wet evergreen forests up to 6000 feet elevation. Flies low, close to ground.

Status: Common.

9. *Mycalesis perseus typhlus* Fruhstorfer (The Common Bushbrown)

(*Mycalesis perseus* Fabr. 1775. Syst. Ent.: 488).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 458.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 85.

Description: (Plate IX, Fig.11)

The COMMON BUSHBROWN measuring 38-55 mm in expanse is brownish in colour. Upper side of Fore wing with an ocellus which is not ringed. The male can usually be recognised by the brand on the under side fore wing tornus which is very small and black. On the hind wing under side the eye-spot in space 3 is usually out of line with the others normal eye-spots, a condition slightly approached in some other species. Seasonal forms present.

Genital morphology: (Plate III, Fig.2)

Male- Uncus conical, dorsally broad, distal end long, narrow, slightly curved and sharply pointed at the tip. Tegumen and vinculum with narrow arms. Arms of tegumen elongate, extended distally, sinuous and sharply pointed at the tip. Phallus of medium length, slender, curved in the middle with a linear sclerotized patch in the center.

Habits: It is found in wet, dense forests. Usually keeps to low elevations although it may ascend to 3000 or 4000 feet elevation. Usually found in shady places. It is a weak flier. Can be attracted to sugar and rotting fruit. Rarely found to visit flowers. The males are occasionally found on damp places.

Hosts: Grasses.

Distribution: The species is found in Sri Lanka and most of India and Malaysia. It has been recorded from the Nilgiris, Nadgani and Silent Valley.

Status: Common.

10. *Mycalesis mineus* Cramer (The Dark-Brand Bushbrown)

(*Mycalesis mineus* Linnaeus, 1758. Syst. Nat. 1(2): 768).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 458.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 85.

Description: (Plate IX, Fig.12)

The DARK-BRAND BUSHBROWN measures 40-50 mm in expanse. Brown in colour with the ocellus on the upper side of fore wing situated in a more or less pale area. Under side with a sub marginal white line across the wing, a series of ocelli and a broad white band.

Hosts: Grasses

Distribution: It is found on the hills and plains at low elevations. Recorded from Nadgani and Mukkali. The range covers Sri Lanka, most of India, the Philippines, Taiwan and Malaysia.

Status: Common.

11. *Mycalesis visala* Moore, 1857 (The Long- Brand Bushbrown)

(Cat. lep. Ins. Mus. East India Coy.1:230).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 457.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 86.

Description: (Plate IX, Fig.13)

The LONG-BRAND BUSHBROWN measuring 45-55 mm in expanse is dark brown above with a prominent eye in 2 on the upper wing. Seasonal forms present. Fore wing sharp, pointed in Dry Season Form and rounded in Wet Season Form.

Habits: Scarce in north-west of its range, fairly abundant elsewhere at low elevations.

Distribution: South and central India, Sikkim, Assam, Myanmar, Thailand, Indo China.

Status: Locally abundant.

12. *Mycalesis visala subdita* Moore, 1857 (The Tamil Bushbrown)

(Cat. lep. Ins. Mus. East India Coy.1:230).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 457.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 86.

Description: (Plate IX, Fig.14)

The TAMIL BUSHBROWN measuring 45-55 mm in expanse is dark brown above with a prominent eye with narrow well defined ring in 2 on the upper side of the wing and with a prominent pale marginal line followed by two black lines. Seasonal forms present. The wet season form is very dark below which has an ocellus in 1 on under side of hind wing.

Genitalia morphology: (Plate IV, Fig.1)

Male: Uncus long, narrow and apically pointed. A long, narrow, apically pointed lobe present basally, on either side of the uncus. Arms of tegument and vinculum narrow. Valvae ovate with a constriction in the middle. Apical portion of valva bearing a fringe of short, stiff hairs and with a sub basal notch, leading to the formation of a distinct apical lobe. Saccus short V-shaped. Phallus short, narrow, curved in the middle. Proximal part of phallus stout, curved on one side and appearing as the handle of a knife. Apex of phallus distinctly broad.

Habits: Common in low elevations in hills to about 3000 ft.

Distribution: Sri Lanka, Southern India: Nilgiris, Madras to Orissa, Bangalore. Common in Kallar, Nilgiris.

Status: Locally common.

13. *Mycalesis igilia* Fruhstorfer (The Small Long-Brand Bushbrown)

(*M. igilia* Fruhstorfer, 1909. In Seitz, Macrolep. of the World 9: 346).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 457.

Description: (Plate IX, Fig.15)

The SMALL LONG-BRAND BUSHBROWN measuring 40-48 mm in expanse is brownish in colour and it can be easily identified by its very long brand on the Fore wing which extends beyond the white discal line which is often angled towards the tornus at vein 1b. Seasonal forms present.

Genitalia morphology: (Plate IV, Fig.2)

Male- Uncus narrow, long with a sharply pointed apex which is slightly bent to one side; basal part broad bearing an elongate, apically curved and pointed lobe on either side. Saccus short, U- shaped, with a flat tip. Valvae elongate, narrow, basal 2/3rd portion lanceolate and with a constriction; apical part deeply notched and humped sub-apically; with an apical blunt lobe-like tip. A fringe of short, stiff hairs present for nearly 1/3rd length from apex along the inner margin. Phallus long, narrow, slightly curved, distal end swollen, basal portion appearing as the handle of a sword.

Habits: It is commonly found in dense moist deciduous forests, usually in bamboo area up to 3000 feet elevation. Commonly found in the Nilgiri Biosphere Reserve at about 3000 feet during the months September to October.

Distribution Recorded from Coorg, the Nilgiris, Wynad and Silent Valley.

Status: Common. It is endemic to south India.

14. *Mycalesis khasia* Evans (The Pale-Brand Bushbrown) *

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 87

* *Could not be located in the present survey*

Description: The PALE-BRAND BUSHBROWN measuring 42-55 mm in expanse is brownish with a white and broad discal band. Seasonal forms present. Ground color pale in wet season forms. Brand on the upper side of hind wing yellowish brown. The brand does not go beyond the white discal line.

Habits: It is found in dense, moist deciduous or evergreen forests.

Distribution: The range covers South India and Assam up to Myanmar. It has been reported from Palnis, Shevaroyis, Coorg, the Nilgiris and Waynad.

Status: Common.

15. *Mycalesis adolphe* Guerin-Menville, 1843 (The Red Eye Bushbrown)

(In Deless, Voy. Ind. II: 76.)

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 457.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 88.

Description: (Plate IX, Fig.16)

The RED EYE BUSHBROWN measuring about 60 mm in expanse is chocolate brown above, with small ocelli from 2 to 4 on hind wing and in 2 and 5 in Fore wing and with a reddish brown ring in 5. Male with no brand on under side of fore wing.

Genitalia morphology: (Plate V, Fig.1)

Male- Uncus conical, distal end curved, pointed hook-shaped. Tegumen and vinculum with narrow arms. Arm of tegumen elongated, pointed at the tip and distally. Saccus short, stout and blunt resembling the handle of a knife. Valvae short, narrow, basal 2/3rd swollen and the apical part narrow, apically broad, bearing short hairs. Phallus long, very slender, curved in the middle, apex blunt and basal part resembling the handle of a sword.

Habits: Generally found along forest tracts between 4000 to 7000 ft. Flies at the edges of sholas. Recorded from May to December.

Distribution: Southern India: Coorg, Nilgiris.

Status: Common in sholas in the Nilgiris above 1900 ft.

16. *Mycalesis patnia* Butler (The Glad Eye Bushbrown)

(*M. patnia* Moore, 1857, Cat. Lep. ins. Mus. East India Coy. I: 232).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 457.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 91.

Description: (Plate IX, Fig.17)

The GLAD-EYE BUSHBROWN measuring 40-45 mm in expanse is characterized by the pupilled ocellus in 2 on the upper side of Fore wing which is set on the lower and outer edge of a circular white or yellow patch. Wings are rounded and the under side variegated.

Genitalia morphology: (Plate.V, Fig.2)

Male: Uncus long, slender, slightly curved, apically narrow and bluntly pointed at the tip. Tegumen and vinculum with narrow, slender arms. Saccus 'V'- shaped with a blunt apex. Valvae with an outer elongate, narrow lobe with an apically round lobe and fringed with short, stiff hairs on the distal ½ portion; an inner, basally swollen lobe having a narrowed, wavy, curved apical half ending in a pointed apex. Phallus long, narrow with the basal 1/3rd part stout with wavy margins and appearing as a tool handle; the remaining part of uniform width, slightly curved and with the apex blunt.

Habits: Tropical and subtropical evergreen forests and bamboo jungle. Rarely found in disturbed forests. Observed in large numbers on fruits (Figs) lying on the forest floor. Attracted to toddy or sugar.

Distribution: South India and Sri Lanka. Recorded from Kotagiri and upto 6000 ft. in Nilgiris.

Status: Endemic to south India and Sri Lanka. Common.

17. *Mycalesis oculus* (The red disc Bushbrown)

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p.

Description: (Plate IX, Fig.18)

It is rich brown above. There are prominent ocellus in 2 on upper side of fore wing placed on broad and deep yellow area. Small ocellus in 5 and small ocelli in 2 to 4 on upper side of hind wing. In males, black colour brand seen in under side of fore wing and black brand with brown tuft in the upper side of hind wing.

Genitalia morphology: (Plate VI, Fig.1)

Male- Uncus short, stout, apically with a conical part resembling the head of a bird, with a pointed tip. An elongate, slender, pointed process present basally on either side. Arms of tegumen and vinculum narrow. Valvae swollen in the basal part with a sharp constriction at about 1/3rd length from the apex producing a stout apically flat lobe fringed with short, stiff hairs. Phallus long, slender, slightly curved pointed at the apex. Basal portion of phallus, curved, stout and pointed proximally.

Habits: It is high elevation *Mycalesis* in hills to south Nilgiris. Generally found in jungle country above 3,000 feet.

Distribution: Hills of South India. (South of Nilgiris)

Status: Common.

18. *Orostriane medus* Moore (The Nigger)

(*O. medus* Fabricius, 1775, Syst. Ent.: 448).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 446.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 120.

Description: (Plate X, Fig.19)

The NIGGER measuring 45-55 mm in expanse is dark brownish, unmarked above except for two very narrow pale line on the termen. The discal band from below shows through faintly. Below, there is a white discal band across both wings. Underside of fore wing with very prominent ocelli in 2 and 5 and under side of hind wing in 2, 5 and a smaller one in 6.

Hosts: Grasses

Distribution: Southern India, Sri Lanka and up to Australia. Recorded from Kallar in Nilgiris.

Habits: Prefers low level wet forests. Generally seen during the monsoon season.

Status: Monobasic genus, fairly common.

19. *Zipoetis saitis* Hewitson, 1863 (The Tamil Catseye)

Illustr. Exot. Butts. 3: 100

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 472.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 119.

Description: (Plate X, Fig.20)

The TAMIL CATSEYE measurs 60-65 mm in expanse. The upper side is velvety black. The fore wing bears a broad, oblique, white band from the middle of the costa to nearly the margin on the termen. The hind wing bears a similar broad, white band extending almost parallel to the posterior portion of the terminal margin. The outer margin of this band is concavely excavated between the veins.

The under side is similar, but paler. The white bands are as on the upper side. There is a sub-terminal wavy line on both the fore and hind wings on the under side. The under side of the fore wing is without ocelli, but the under side of the hind wing bears a row of five large, prominent ocelli. The head, thorax and abdomen are dark brown and the antennae reddish brown.

Genital morphology: (Plate VI, Fig.2)

Uncus with elongate, slender, blunt lobe, borne on an expanded basal part bearing an elongate apically pointed lobe on either side. Tegumen and vinculum with narrow, elongate arms. Saccus basally U- shaped bearing an elongated narrow process. Phallus elongate, narrow, more or less of uniform width, slightly curved sub-apically, the proximal part appearing like the handle of a sword, slightly narrowed and blunt at the proximal end.

Habits: Its flight is weak and seldom comes out into the open. It is attracted to sugar solution and over-ripe fruits.

Hosts: *Ochlandra* sp.

Distribution: It is found along the slopes of the Western Ghats between 1000 and 3000 feet elevation. It has been reported from Mettupalayam, the Nadgani Ghats, Mukkali and Silent Valley. It is endemic to south India and the range covers western and southern India, the Nilgiris, Anamalais, Cochin and Travancore.

Status: Common.

20. *Ypthima asterope* Moore (The Common Threering) *

(*Y. asterope* Klug, 1832. Symb. Phys. Pl.29).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 464.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 115.

* *Could not be located in the present survey*

Description: (Plate X, Figs.21 & 22)

The COMMON THREERING measures 30-37 mm in expanse. Seasonal forms present. In the wet season form, the upper side is dull brown with a whitish fringe. The fore wing bears a white-centred black sub-apical ocellus. The hind wing is uniform with a single small sub-tornal ocellus. The under side is greyish white with very fine transverse striations. On the

under side of the fore wing a discal and sub terminal dark brown bands are present, meeting below the ocellus to form a loop. Three ocelli present on the under side of the hind wing- one apical and two tornal. Upper side of hind wing with an ocellus on 2 only. The antennae, head, thorax and abdomen are dull brown. In the dry season form, the ground colour is paler and the ocelli on the under side are reduced to minute specks or absent altogether.

Habits: It is generally found in the plains and rarely found at higher elevations. Abundant all the year round in the plains and in forest where it is generally found among bushes flying at low levels.

Distribution: The distribution covers the whole of India and Baluchistan and Myanmar.

It has been reported from the Nilgiris and the Nadgani Ghat.

Status: Common.

21. *Ypthima baldus* Evans (The Common Fivering)

(*Y. baldus* Fabricius, Syst. Nat.:829).

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 466.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 117.

Description: (Plate X, Figs.23 & 24)

The COMMON FIVERING measures 32–48 mm in expanse. Seasonal forms are present. In the wet season form, the upper side is brownish, with the terminal margin of wings more dark. The fore wing bears a double-pupillated, yellow-ringed, black ocellus and two smaller, single-pupillated ocelli on the hind wing.

The under side is brownish white, with transverse brown striations. The fore wing has a large ocellus as on the upper side and the hind wing bears six smaller ocelli arranged in three pairs. There are also distinct sub-terminal, discal and sub-basal transverse brown bands on both the wings on the under side. There is a prominent sex brand.

The area surrounding the ocellus on the upper side in both wings are paler in the female. The ground colour on the under side of wings is also paler and the transverse bands are more sharply defined. The dry season form is paler. In this, the ocelli on the under side of the hind wing are reduced and appear as dots. The antennae, head, thorax and abdomen are dull brown.

Genitalia morphology: (Plate VII, Fig. I)

Male-Uncus basally broad, distally narrowed and pointed. Tegumen elongate with narrow arm. Vinculum short. Saccus short, U- shaped. Valvae short, apically broad and with a notch in the middle; sub-apically with a deep constriction on the inner margin; fringe of short, stiff hairs confined to the apical part. Phallus short, basal 1/3rd portion appearing as the handle of a knife and having a hump-shaped portion at about the middle; apical portion sharply pointed.

Habits: The flight is stronger. Frequent visitor to flowers and often basks in the sun with the wings three-fourths open.

Distribution: It is a very common and widely distributed species found all over India from the Himalayas to southern India. It is extremely common in south India, being found in all seasons of the year both in the plains and in the hills up to an altitude of about 7000 feet. It inhabits both open country and forest regions of tropical, subtropical and mixed deciduous types. It has been collected from Silent Valley and Sholayar. Its distribution covers the whole of India and then east to Japan. It is not reported from Sri Lanka.

Status: Common.

22. *Ypthima ceylonica* Hewitson, 1864 (The Ceylon / white Fourring) *

Trans. Ent. Soc. Lond. 1864: 288.

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 464.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 115.

* *Could not be located in the present survey.*

Description: (Plate X, Figs.25 & 26)

The CEYLON / WHITE FOURRINGD measuring 30-35 mm in expanse has three tornal and one apical ocellus on the under side of hind wing. Upper side of hind wing with ocelli in 2 and 3 and not on a dark band unlike in *Y. chenui* in which the ocelli are on a dark band. Tornal half of upper side of hind wing white. Seasonal forms present.

Habits: Found in clearings, along roadsides and in open hill country up to 3000 ft.

Distribution: North Western India to Peninsular Malaysia, Sri. Lanka, Singapore, Thailand. Reported from Palnis, Coorg, Nilgiris, Travancore, Orissa and Bengal.

Status: Locally common.

23. *Ypthima huebneri* Kirby (The Common Fourring)

(*Ypthima huebneri huebneri* Kirby)

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 464.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 116.

Description: (Plate X Fig. 27 & Plate XI Fig. 28)

The COMMON FOURRING measuring 30-40 mm in expanse has three tornal and one apical ocellus on the under side of hind wing. Upper side of hind wing with ocelli in 2 and 3 and not on a dark band unlike in *Y. chenui* in which the ocelli are on a dark band. Tornal half of upper side of hind wing not white. Seasonal forms strongly marked. Seasonal forms present.

Habits: Found both in open hill country and forest. Prefer tropical evergreen forests up to 4000-5000 ft. Generally found in bamboo areas.

Hosts: Adults generally visit fallen fruits.

Distribution: Himalayas, India, Sri Lanka and Myanmar.

Status: Common.

24. *Ypthima avanta* Hampson (The Jewel Fourring) *

(=*Y. lisadra*)

(*Y. avanta* Moore, 1875. Proc. Zool. Soc. Lond. 1874: 567).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 466.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 118.

* *Could not be located during the present survey*

Description: (Plate XI, Fig.29)

The JEWEL FOURRING measuring 30-45 mm in expanse has three tornal ocellus in a straight line and two apical ocellus in 5,6.

Distribution: Peninsular India, Sri Lanka. Recorded at 3000 ft. elevation in Nilgiris during August, December and January, also from Burnside Estate at 1400m.

Status: Rare.

25. *Ypthima chenii* Guerin-Meneville, 1843 (The Nilgiri Fourring)

(in Deless. Voy. Ind.II:77).

D'Abbrera, 1985, Butterflies of the Oriental Region, Part II: 466.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 115.

Description: (Plate XI, Fig.30)

The NILGIRI FOURRING measures 36-46 mm in expanse. They are brownish. Under side of hind wing whitish with prominent white and chestnut bands and three tornal and one apical ocellus. Ocellus on the upper side of hind wing prominent. Seasonal forms not present.

Habits: It inhabits the open plateaux, above 6000 ft in Nilgiris, above 4000 ft. in Coorg and at about 800 ft. in Travancore.

Distribution: It is endemic to the highest mountains north of the Palghat gap. It has been reported from Coorg, the Nilgiris and the Anamalai hills. It inhabits the open plateau above 6000 feet in the Nilgiris and also at as low as 800 feet in Travancore.

Status: Endemic to southern India (Nilgiris). Common.

26. *Ypthima philomela tabella* Marshall & de Niceville (The Baby Fivering)

(*Y. philomela* Linnaeus, 1763. Amoen. Acad. 6:404)

D'Abrera, 1985, Butterflies of the Oriental Region, Part II: 465.

Wynter-Blyth, 1957. Butterflies of the Indian Region, Bombay nat. Hist. Soc., p. 117.

Description: (Plate XI, Fig.31)

The BABY FIVERING is a small brown butterfly measuring 23-25 mm in expanse. They have a prominent double-pupillated ocellus below the apex of the Fore wing. Under side of hind wing with three tornal ocelli not in line. Below, with the only marginal band which is obscure. Male with no brand.

Habits: Prefers clearings in forest and on grassy hill tops fluttering close to the ground.

Distribution: The distribution covers North Burma, Vietnam, Malaysia, Sumatra, Java, Bali and Sulawesi. It is reported from the Nilgiris and Wynad.

Status: Extremely rare.

4. DISCUSSION

4.1. A comparison of genitalial features of species studied herein

Species belonging to *Melanitis*, *Lethe*, *Mycalesis*, *Zipoetis*, *Ypthima* and *Elymnias* were studied. Under *Melanitis*, two species viz., *M. leda* and *M. phedima* were studied. The male genitalia were apparently similar except for the structure of the saccus which was more slender and elongated in the former. The phallus also showed slight differences: more slender and slightly arched in *M. leda* whereas it was stout and more or less straight in *M. phedima*. In *Lethe*, two species were studied viz., *L. drypetis* and *L. rohria*. The general structure of the male genitalia was more or less the same in both the species except that in *L. rohria*, there was a sub-basal, slender, finger-like lobe, one on either side of the uncus. The saccus was relatively short and narrowed basally and the phallus was apically narrowed. In *L. drypetis*, saccus and the phallus were stouter. In *Mycalesis*, seven species have been studied viz., *M. anaxias*, *M. perseus*, *M. subdita*, *M. igilia*, *M. adolphei*, *M. patina* and *M. oculus*. Of these, *M. anaxias*, *M. oculus* and *M. adolphei* showed more resemblance on the basis of valvae which were basally broad and apically narrowed. The latter was quite distinct in possessing valvae with the apical half being uniformly narrow, fringed with short hairs and appearing as a distinct lobe. *M. perseus*, *M. igilia* resembled closely in possessing valvae with a wavy margin appearing as curled. In *M. subdita*, valvae were sharply constricted in the middle giving the appearance of two lobes. *M. patina* also possessed valvae with an uneven margin, but there were two elongate, slender, apically round lobes beset with short hairs, arising from one on either side of the base of the valvae. With regard to the uncus, excepting *M. patina*, all species possessed the sub uncus lobes. The saccus also showed difference, being w-shaped in *M. anaxias* and *M. perseus*, V-shaped in *M. subdita*, *M. patina* and *M. oculus* and handle-shaped with a flat base in *M. igilia* and *M. adolphei*. *Elymnias caudata* resembled *M. Anaxias*, *M. perseus*, *M. subdita*, *M. igilia* and *M. adolphei* in possessing the subuncul lobes. The valvae were however different. In the case of *Ypthima baldus*, the structure was quite different from all the others.

4.2. Resemblance of genitalial parts among different species

Melanitis leda, *M. phedima*, *Mycalesis anaxias*, *M. oculus*, *Lethe drypetis*, *L. rohria* and *Zipoetis saitis* showed resemblance in possessing valvae which were broad in the basal half and narrowed in the distal half. Except for *Melanitis leda*, *M. phedima* and *Lethe drypetis*, all the remaining species resembled in possessing sub-uncus lobes and all these species can be considered as forming one group. Similarly, *Mycalesis perseus* and *M. igilia* showed resemblance in possessing valvae having a wavy margin. These species resembled *L. rohria*, *M. oculus*, *M. perseus*, *M. subdita*, *M. igilia* and *M. adolphei* in possessing sub-uncus lobes. *M. patnia* and *M. subdita* were quite different from the others.

Based on an evaluation of resemblances shared by various species, the following species groups were identified:

Group I: Seven species viz., *Melanitis leda*, *M. phedima*, *Mycalesis anaxias*, *M. oculus*, *Lethe drypetis*, *L. rohria* and *Zipoetis saitis* were included under this group. Of these, *Mycalesis anaxias*, *M. oculus* and *L. rohria* formed a subgroup within Group I. *Elymnias caudata* also shared some resemblance to this subgroup.

Group II: *Mycalesis perseus* and *M. igilia* formed a distinct group. These species shared resemblance with *L. rohria*, *Mycalesis oculus*, *M. perseus*, *M. subdita*, *M. subdita*, *M. igilia* and *M. adolphei*.

Each of the species *Mycalesis patina*, *Mycalesis subdita*, *Ypthima baldus* was quite distinct from all others. Of these, *Ypthima baldus* stood out separately from all the rest in the structure of valvae, uncus and phallus.

5. CONCLUSIONS

Investigations made in this study have shown that except for a few species, most of the satyrids reported from the southern Western Ghats are well represented in this area. Although most of these are easily identifiable using colour/wing pattern, investigations on the genitalial morphology has shown clear cut affinities among various species and genera.

Melanitis leda, *M. phedima*, *Mycalesis anaxias*, *M. oculus*, *Lethe drypetis*, *L. rohria*, *Elymnias caudata* and *Zipoetis saitis* showed overall resemblance on the basis of the morphology of valvae. Among these, *Mycalesis anaxias*, *M. oculus*, *Elymnias caudata* and *L. rohria* shared some resemblance on the basis of the structure of sub uncus lobes.

With regard to *Mycalesis*, *M. perseus* and *M. igilia* showed more resemblance. These species also showed resemblance to *L. rohria*, *Mycalesis oculus*, *M. perseus*, *M. subdita*, *M. subdita*, *M. igilia* and *M. adolphei*. Each of the species *Mycalesis patina*, *Mycalesis subdita*, *Ypthima baldus* was quite distinct from all the others. Of these, *Ypthima baldus* stood out separately from all the rest in the structure of valvae, uncus and phallus.

Altogether, nearly 1500 of butterflies have so far been recorded from the Indian region, of which, about 340 species are known to occur in southern India. However, the number of species of butterflies that are exclusively found in southern India is only about 45 and most of these butterflies are found in the hilly tracts of Nilgiris, Palni and the southern Western Ghats. Of these areas, the latter extending from north of Nagarcovil (Tamil Nadu) to the Palaghat Gap is the most important with respect to faunistic diversity with the largest number of species, as well as the endemics. Among satyrids, several unique species such as *Mycalesis oculus*, *Ypthima ypthimoides* and *Mycalesis davisoni* are confined to this region. The second region of high diversity is the central Western Ghats, extending north of the Palaghat gap from Nilgiri-Wynad area to South Goa. The only butterfly unique to this area is *Mycalesis adolphei*. Information generated in this study has shown very good survival of most of the species mainly due to protection of the natural habitats. The morpho-taxonomical analysis carried out in this study has brought out the congeneric nature of different satyrid species. The evolutionary relationships and species boundaries among the

satyrine butterflies of Peninsular India may be further clarified by the molecular studies being undertaken by the IISc, Bangalore.

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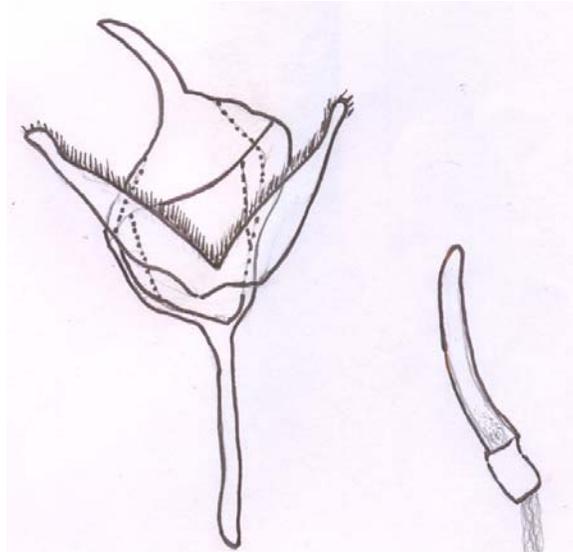


Fig.1

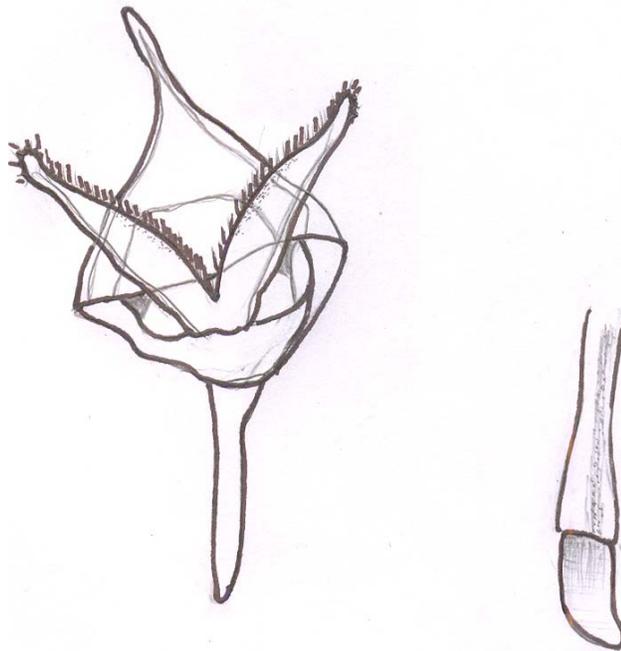


Fig. 2

Plate I. Male external genitalia of Satyridae

Fig.1: *Melantis leda*

Fig.2: *Melantis phedima*

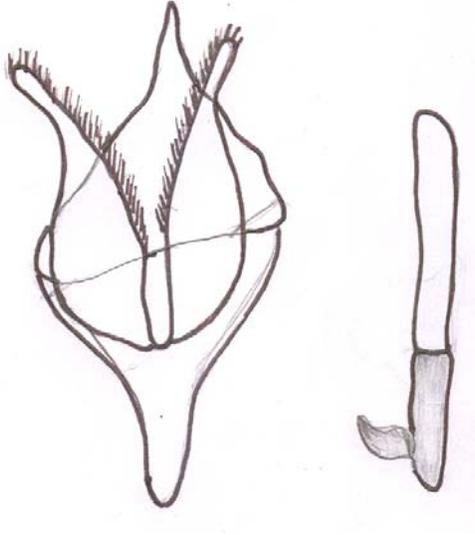


Fig. 1

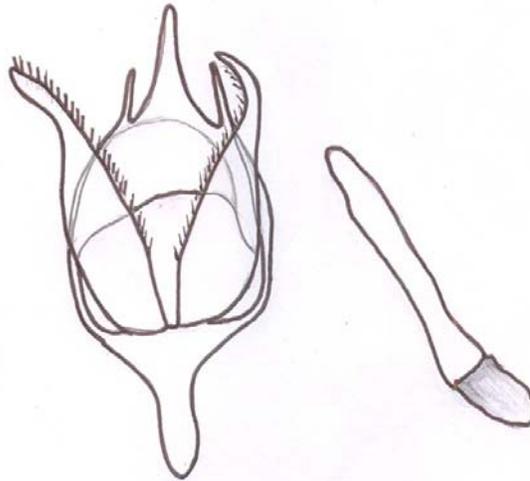


Fig. 2

Plate II. Male external genitalia of Satyridae

Fig.1: *Lethe drypetis*

Fig.2: *Lethe rohria*

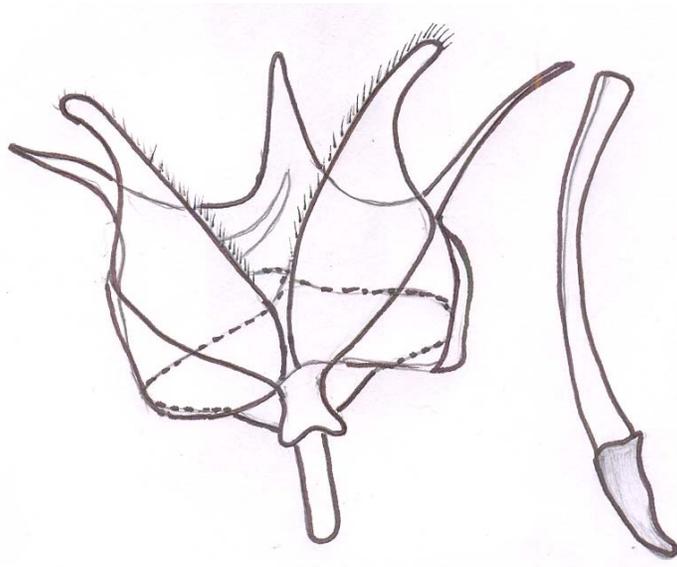


Fig.1

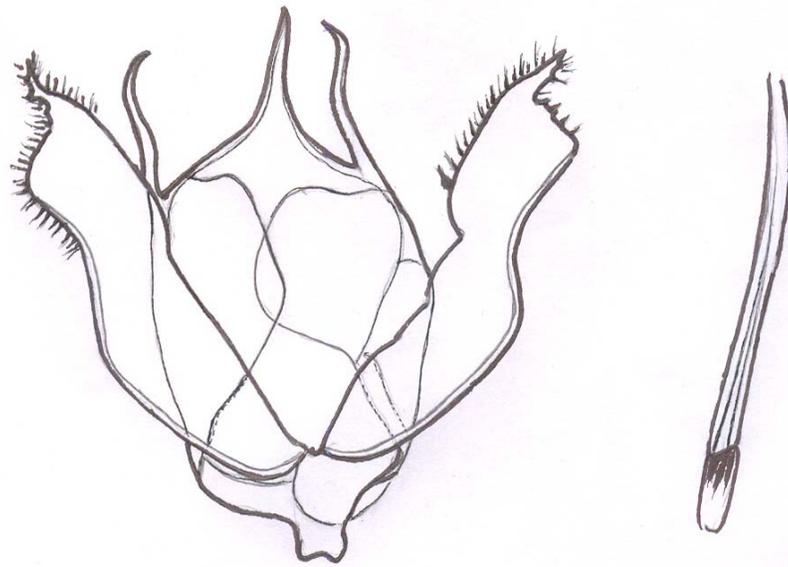


Fig.2

Plate III. Male external genitalia of Satyridae

Fig.1: *Mycalesis anaxias*

Fig.2: *Mycalesis perseus*

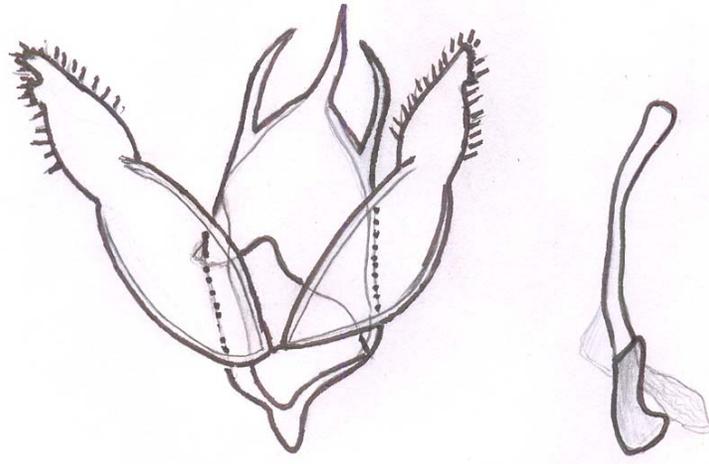


Fig.1

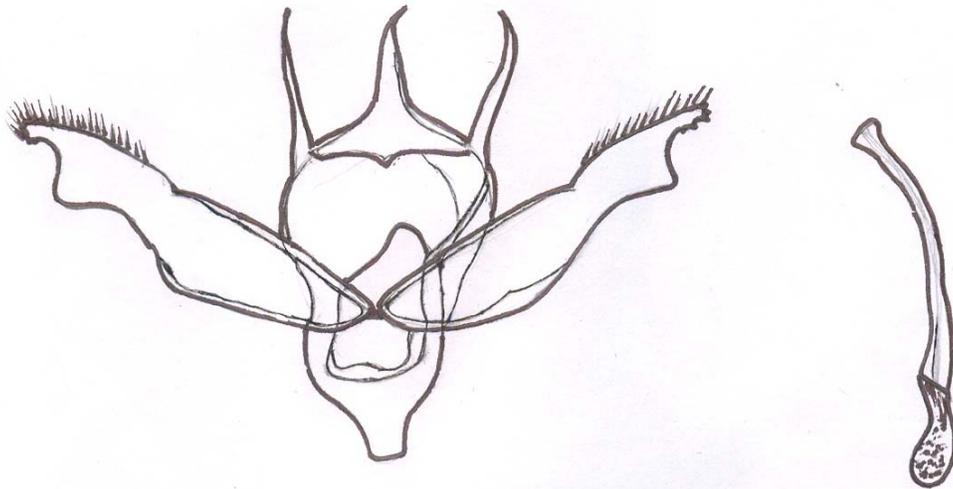


Fig.2

Plate IV. Male external genitalia of Satyridae

Fig. 1: *Mycalesis subdita*

Fig.2: *Mycalesis igilia*

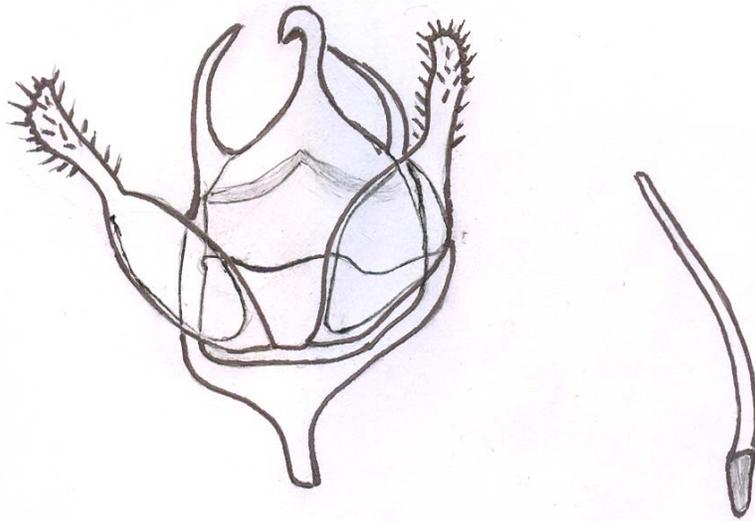


Fig.1

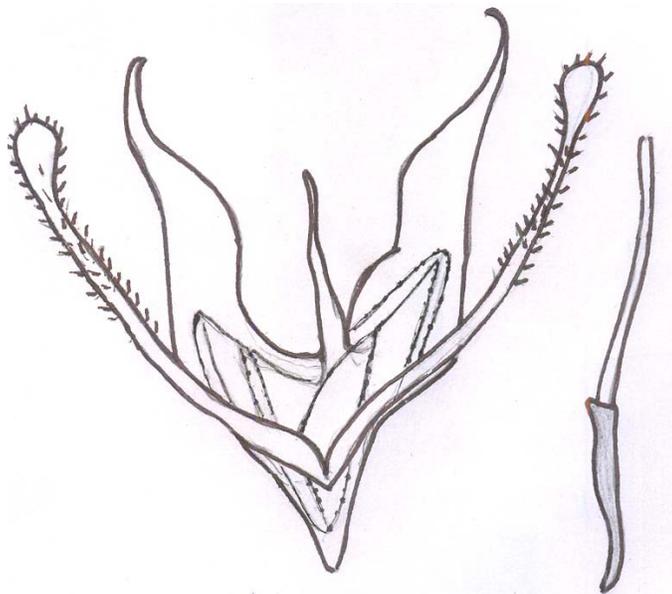


Fig.2

Plate V. Male external genitalia of Satyridae

Fig.1: *Mycalesis adolphei*

Fig.2: *Mycalesis patnia*

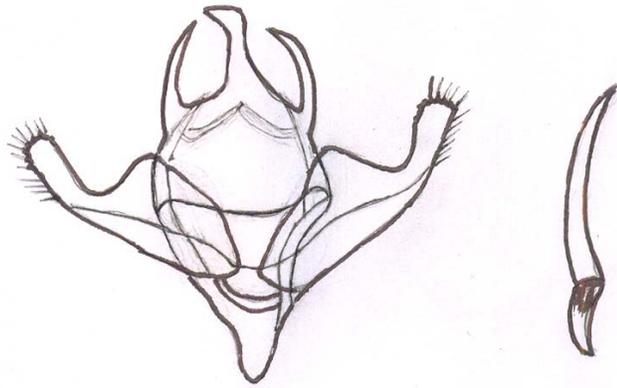


Fig.1

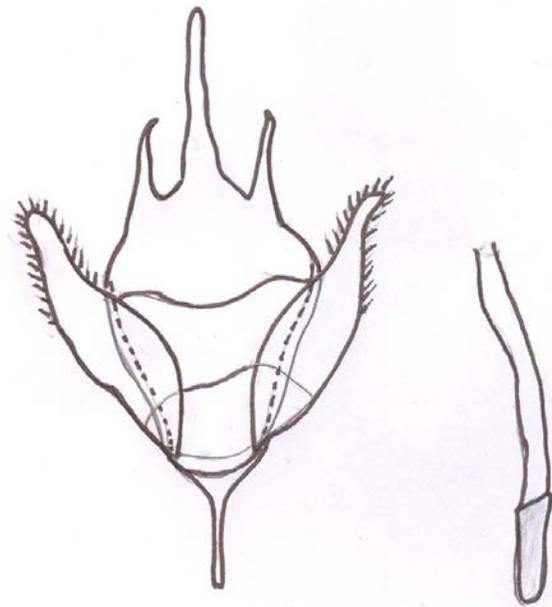


Fig.2

Plate VI. Male external genitalia of Satyridae

Fig.1: *Mycalesis oculus*

Fig.2: *Zipoetis saitisi*

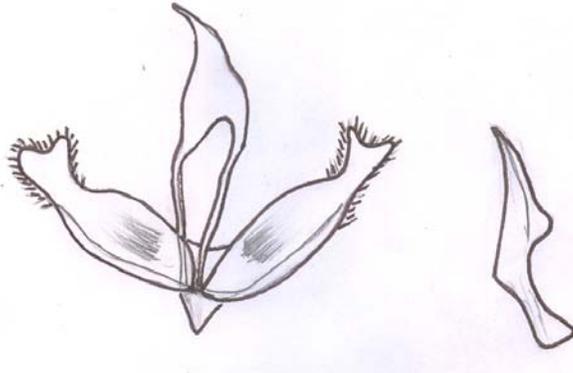


Fig.1

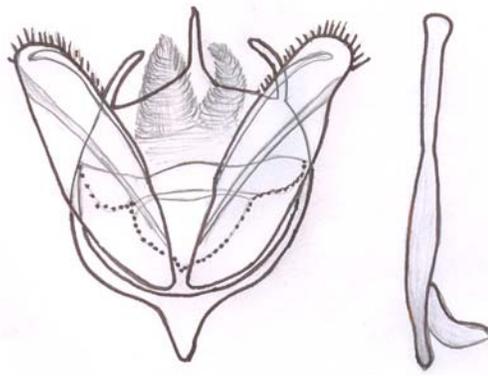


Fig.2

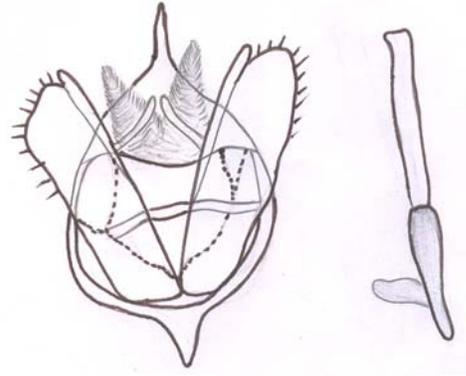


Fig.3

Plate VII. Male external genitalia of Satyridae

Fig.1: *Ypthima baldus*

Fig.2&3: *Elymnias caudata*

Plate. VIII



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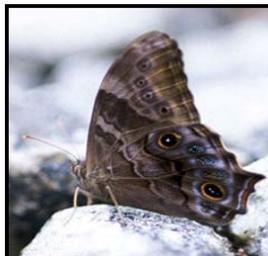
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Fig. 1. *Melantis leda* Upperside; Fig. 2. *M. leda* Underside; Fig. 3. *M. zitenius*; Fig. 4. *M. phedima*; Fig. 5. *Elymnias caudata* Upperside; Fig. 6. *E. caudata* Underside; Fig. 7. *Lethe europa*; Fig. 8. *L. drypetis*; Fig-9. *L. rohria*.

Plate. IX



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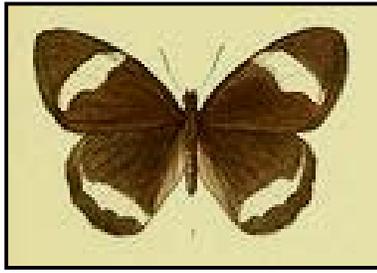
18

Fig. 10. *Mycalesis anaxias*; Fig. 11. *M. perseus*; Fig. 12. *M. mineus*; Fig. 13. *M. visala*; Fig.14. *M. visala subdita*; Fig.15. *M. igilia*; Fig. 16. *M. adolphei*; Fig. 17. *M. patnia*; Fig.18. *M. oculus*.

Plate. X



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Fig. 19. *Orostriane medus*; Fig. 20. *Zipoetis saitis*; Fig. 21. *Ypthima asterope* Upperside; Fig. 22. *Y. asterope* Underside; Fig. 23. *Y. baldus* Upperside; Fig. 24. *Y. baldus* Underside; Fig. 25. *Y. ceylonica* Upperside; Fig. 26. *Y. ceylonica* underside; Fig. 27. *Y. huebneri* Upperside.

Plate. XI



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Fig. 28. *Ypthima huebneri* Underside ; Fig. 29. *Y. avanta*; Fig. 30. *Y. chenui*; Fig. 31. *Y. philomela*.