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Cover: This undescribed species of Bombyliidae of the genus *Docidomyia* is from the Goldfields Region of Western Australia. The genus belongs to the subfamily Tomomyzinae, and has closest relatives in southern Africa and North America. Adults feed on nectar and pollen and the larvae are presumably parasitoids, as are most other Bombyliidae, although nothing is known of the life history of this subfamily throughout the world. Illustration by David Yeates.

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NOTES ON THE EARLY STAGES OF *ORSOTRIAENA MEDUS MOIRA* WATERHOUSE & LYELL AND *MELANITIS CONSTANTIA* CRAMER (LEPIDOPTERA: NYMPHALIDAE: SATYRINAE) FROM TORRES STRAIT, AUSTRALIA

S.J. JOHNSON[1], I.R. JOHNSON[2] and P.S. VALENTINE[3]

[1]*Oonoomba Veterinary Laboratory, P.O. Box 1085, Townsville, Qld 4810*

[2]*26 Brodie Street, Holland Park, Qld 4121*

[3]*Tropical Environment Studies and Geography, James Cook University, Townsville, Qld 4811*

Abstract

The distinctive early stages of *Orsotriaena medus moira* Waterhouse & Lyell are described from northern Australia and compared with those of the closely allied *Mycalesis* spp. Cluster laying and larval gregariousness are recorded for the first time in *Melanitis constantia* Cramer and the early stages are described.

Introduction

Within Torres Strait *Orsotriaena medus moira* is known from Darnley, Moa, Prince of Wales (Common and Waterhouse 1981) and Mer Islands (Wood 1987) and has been taken recently by the authors on Saibai, Dauan and Thursday Islands. The life history was unknown in Australia and the early stages were presumed to resemble those of the Indian subspecies (Common and Waterhouse 1981, D'Abrera 1977).

Melanitis constantia was discovered recently on Mer Island (Johnson *et al.* 1994) and on a subsequent visit eggs were obtained from captive females in order to describe the early stages.

Orsotriaena medus moira Waterhouse & Lyell

Egg. Spherical; smooth, white, 1.0 mm in diameter.

Larva (Fig. 1). First instar: Length 4-6 mm; head pale cream with brown blotches ventrolaterally and across anterior occipital region; 7 pairs of stout curved setae with lateral and dorsal pairs arising from rounded tubercles; body translucent yellow turning green after feeding; faint dorsal and dorsolateral white lines; thorax bearing a transverse row of 6 long setae each arising from a white tubercle; abdominal segments bearing pairs of dorsal, dorsolateral, lateral and ventrolateral long pale setae; anal plate with a dorsal pair of fleshy tubercles and 3 basal setae. Second to final instars: Length 8-38 mm; head pale cream with a pair of long, pointed, anteriorly directed pink horns; maroon lateral stripe extending from tip of horn to posterior occipital margin; numerous short spines; mandibles brown; 2 pale crescentic areas from lateral margin to median sulcus; body white, covered in short pale setae with expanded tips; broad cream dorsolateral line and white lateral line extending to ventral surface; thoracic and abdominal segments with an anterior row of long curved setae; anal plate with a pair of backwardly directed pink spines.

Pupa (Fig. 3). Elongate with a small thoracic ridge; anterior end produced into a long horn; pale brown with a dark brown lateral line from dorsal wing case to tip of horn; abdominal segments with faint brown ventrolateral lines and scattered small brown dots; suspended with the ventral surface uppermost from a vertical stalk of grass. Length 20 mm.

Observations. Females were taken in April flying amongst *Imperata* sp. on Dauan Island, Torres Strait and readily laid eggs when enclosed on this grass. Eggs were laid singly beneath leaves of the grass and were taken to Townsville where larvae were reared successfully on *Panicum maximum* Jacq. The solitary larvae remained on the foliage until pupation. The prepupa (Fig. 2) differs from other satyrines by resting head upwards on a vertical stalk of the host grass and falling backwards to suspend itself with the ventral surface uppermost. The pupa resembles a dried leaf base.

The larva of *O. m. moira* differs only in colour from that of *O. m. mandata* (Moore) from southern India and Sri Lanka (Davidson and Aitken 1890). The pupae of the two subspecies appear very similar. The descriptions by Common and Waterhouse (1981) of 2 pairs of horns on the larval head and by D'Abrera (1977) of pronounced cephalic horns on the pupa appear to be errors.

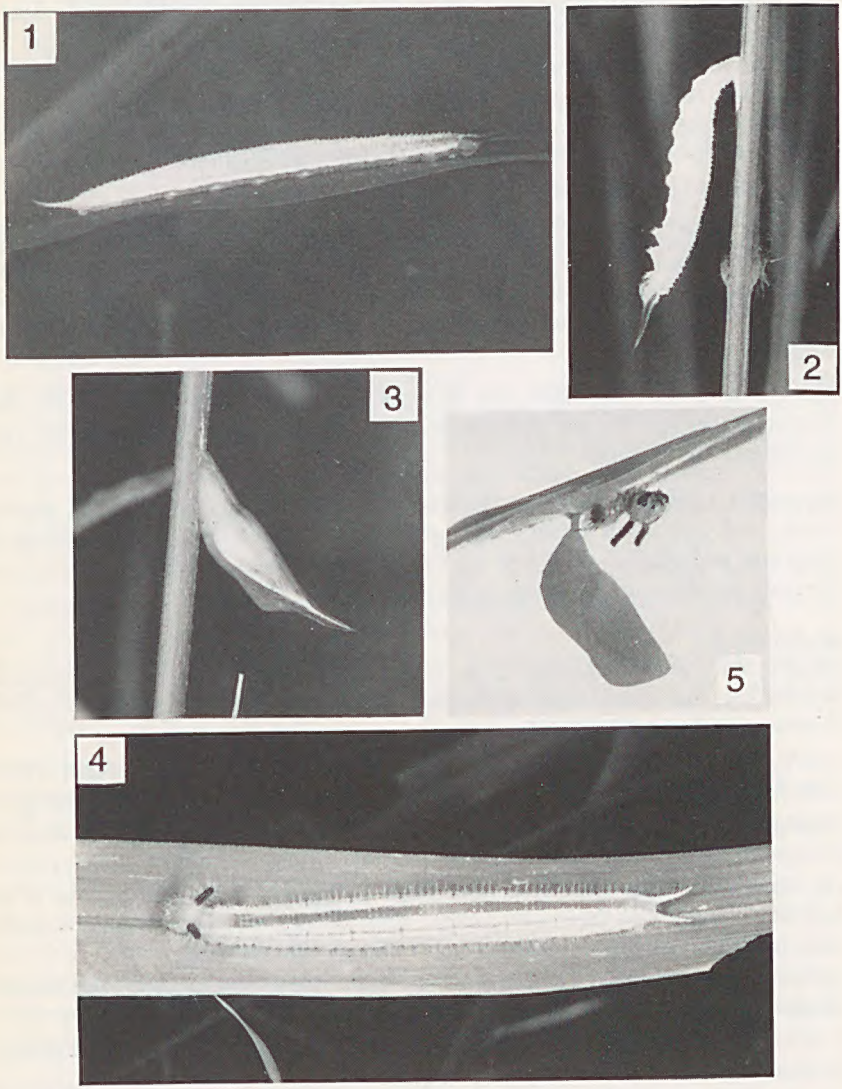
The early stages of the 3 *Mycalesis* spp. from northern Australia have been described by Braby (1994) and are similar to each other and typically satyrine in form. The larva of *O. m. moira* is also satyrine in form but differs from those of *Mycalesis* in the elongation of the anterior and posterior horns. The peculiar habit of the prepupa and the angular and elongate pupa of *O. m. moira* show marked divergence from *Mycalesis* and the usual satyrine condition. These differences support the generic separation of *Orsotriaena* Wallengren from *Mycalesis* Hübner.

Melanitis constantia Cramer

Egg. Spherical; yellow, 1.5 mm in diameter.

Larva (Fig. 4). First instar: Length 7-11 mm; head cream, covered in long dark setae; frons and mandibles brown; body pale whitish-cream becoming green after feeding; single dorsolateral white line on thorax becoming bifid on abdominal segments; thoracic segments with a row of 9-10 long pale setae; abdominal segments with pairs of dorsal, dorsolateral and lateral setae; anal plate with a pair of dorsal fleshy protuberances bearing numerous long curved setae. Second to final instars: Length 12-55 mm; head cream with a broad yellow lateral stripe; ocelli black; mandibles brown; lateral brown patches becoming black in final instar; a pair of stout dorsal horns, apically black; body green; dorsal white stripe bifid on abdominal segments; narrow lateral and ventrolateral white lines; posterior horns translucent cream.

Pupa (Fig. 5). Smooth, green. Length 15-18 mm.



Figs 1-5. Larva and pupa of *Orsotriaena medus moira* and *Melanitis constantia*. (1-3): *O. m. moira*; (1) mature larva; (2) prepupa; (3) pupa. (4-5): *M. constantia*; (4) mature larva; (5) pupa.

Observations. Captive females taken in April on Mer Island, Torres Strait, laid eggs in batches of up to 13. Larvae were reared in Townsville on *Panicum maximum* and *Imperata cylindrica* (L.) P. Beauv. The larvae were gregarious, remaining together in some instances until just prior to pupation. All larvae reared on *I. cylindrica* died in the second instar and 90% of larvae reared on *P. maximum* failed to complete development, suggesting that neither plant is likely to be used naturally.

On Mer Island the adults appeared to be restricted to rainforest and were encountered most commonly in cleared areas used as gardens. Sugar cane *(Saccharum* sp.), which is known as a host in Papua New Guinea (Parsons 1991), is grown commonly in the gardens on Mer Island and is a likely natural host.

The larvae of *M. constantia* can be separated readily from those of *M. leda bankia* (Fabricius) by the prominent white stripes. The pupae of the two species are very similar.

Mycalesis constantia is unusual amongst satyrines in the habit of cluster laying and gregarious larvae. Stamp (1980) did not record cluster laying in Satyrinae and *Neope* sp., listed by Chew and Robbins (1984), appears to be the only previous record in the subfamily.

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SORGHUM MIDGE *CONTARINIA SORGHICOLA* (COQUILLETT) (DIPTERA: CECIDOMYIIDAE) IN AUSTRALIA PRODUCES UNISEXUAL PROGENY

B.A. FRANZMANN and R.J. LLOYD

Department of Primary Industries, PO Box 102, Toowoomba Qld 4350

Abstract

All mated females of the sorghum midge *Contarinia sorghicola* from Queensland produced unisexual progenies in equal male/female proportions. Females tested originated from *Sorghum halepense* in November and April and cultivated grain sorghum *S. bicolor* in January and April. The results have implications for the possible development of resistance-breaking biotypes on midge-resistant sorghum.

Introduction

Baxendale and Teetes (1981) showed that the sorghum midge *Contarinia sorghicola* (Coquillett) in Texas, USA, produces exclusively unisexual progeny. However, in reported cases of unisexual progeny production in species with bisexual reproduction, some individuals may produce bisexual progeny, as in another cecidomyiid, the Hessian fly *Mayetiola destructor* (Say) (Painter 1930).

Grain sorghum hybrids with resistance to the sorghum midge have been developed recently and are available to Australian farmers (Henzell *et al.* 1991). A knowledge of progeny production by the sorghum midge in Australia is a prerequisite for any theoretical assessment and/or experimentation on the development of biotypes capable of 'breaking' resistance.

Materials and methods

Progeny production tests were carried out on females originating from four different collections of infested material: 1) Johnson grass *Sorghum halepense* at Gatton, south-east Queensland, November 1990; 2) grain sorghum *S. bicolor* at Gatton, January 1991; 3) grain sorghum at Kingsthorpe, south-east Queensland, April 1991; and 4) Johnson grass at Emerald, central Queensland, April 1992. Females emerging with males in the laboratory early in the morning were caged individually over flowering sorghum panicles in a glasshouse. Adult progeny emerging were sexed. Each female produces only one brood.

Results

Offspring produced by each female were either all male or all female. Of the 31 females producing offspring, 15 produced male broods and the remainder produced females (Table 1). Average size (± s.e.) of female broods was 22.6 ± 3.8 individuals and of male 23.0 ± 3.9.

Discussion

Baxendale and Teetes (1981) also found a near 1:1 ratio of female-producing females to male-producing females.

Table 1. Numbers of all male or all female broods produced by 31 *C. sorghicola* females from four collections.

Locality	Host	Date	Number of broods	
			Male	Female
Gatton	*S. halepense*	xi.1990	1	6
Gatton	*S. bicolor*	i.1991	8	5
Kingsthorpe	*S. bicolor*	iv.1991	3	3
Emerald	*S. halepense*	iv.1992	3	2

By negating the possibility of mating between siblings, the production of unisexual progeny has implications for the likelihood and rate of development of midge biotypes that are unaffected by resistance factors (Gould 1986). However, whether enforced outcrossing enhances or reduces adaptation to resistance factors is unclear. In *Mayetiola destructor* the genetics of reproduction are unusual and complex and include the elimination of paternally derived chromosomes (Stuart and Hatchett 1991). These processes have not been studied in the sorghum midge but may be assumed to be similar and, if so, would also have an influence on biotype development. For example, if resistance-breaking ability was sex-linked then the loss of paternally derived chromosomes would have an obvious influence. Discussion on other more complex aspects is beyond the scope of this paper but work is required on the reproduction genetics of sorghum midge prior to formulation of a conceptional model of the development of resistance-breaking biotypes.

Acknowledgments

We thank Dr Brad Congdon and Dr Grant Daggard for advice on genetic matters and, together with Gordon Simpson, for constructive comments on the manuscript.

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THE LIFE HISTORY OF *CANDALIDES GILBERTI* WATERHOUSE (LEPIDOPTERA: LYCAENIDAE)

P.R. SAMSON[1] and D.N. WILSON[2]

[1]*Bureau of Sugar Experiment Stations, P.O. Box 651, Bundaberg, Qld 4670*

[2]*P.O. Box 554, Palmerston, NT 0831*

Abstract

The immature stages of *Candalides gilberti* from the Northern Territory are described. *Decaisnina signata* (F. Muell. ex Benth.) Tiegh. (Loranthaceae) is recorded as a food plant.

Introduction

Candalides gilberti is recorded from north-western Australia and the Northern Territory (Common and Waterhouse 1981) and from Doomadgee in the Gulf country of northern Queensland (Puccetti 1991). Its life history has not been described, although a pupal case believed to be of this species was found under bark of *Eucalyptus* bearing mistletoe at Mt Bundey, NT (Common and Waterhouse 1981).

In July 1991, DNW collected eggs and larvae of *C. gilberti* from mistletoe parasitising *Alstonia actinophylla* (A. Cunn.) K. Schum. (Apocynaceae) at Stuart Park, a suburb of Darwin. Here we describe the immature stages, which were reared to adults by PRS at Bundaberg.

Immature stages

Egg (Fig. 1). Dome-shaped with raised nipple surrounding sunken micropyle, finely pitted, without spines; white. Average diameter 0.71 mm (n = 4).

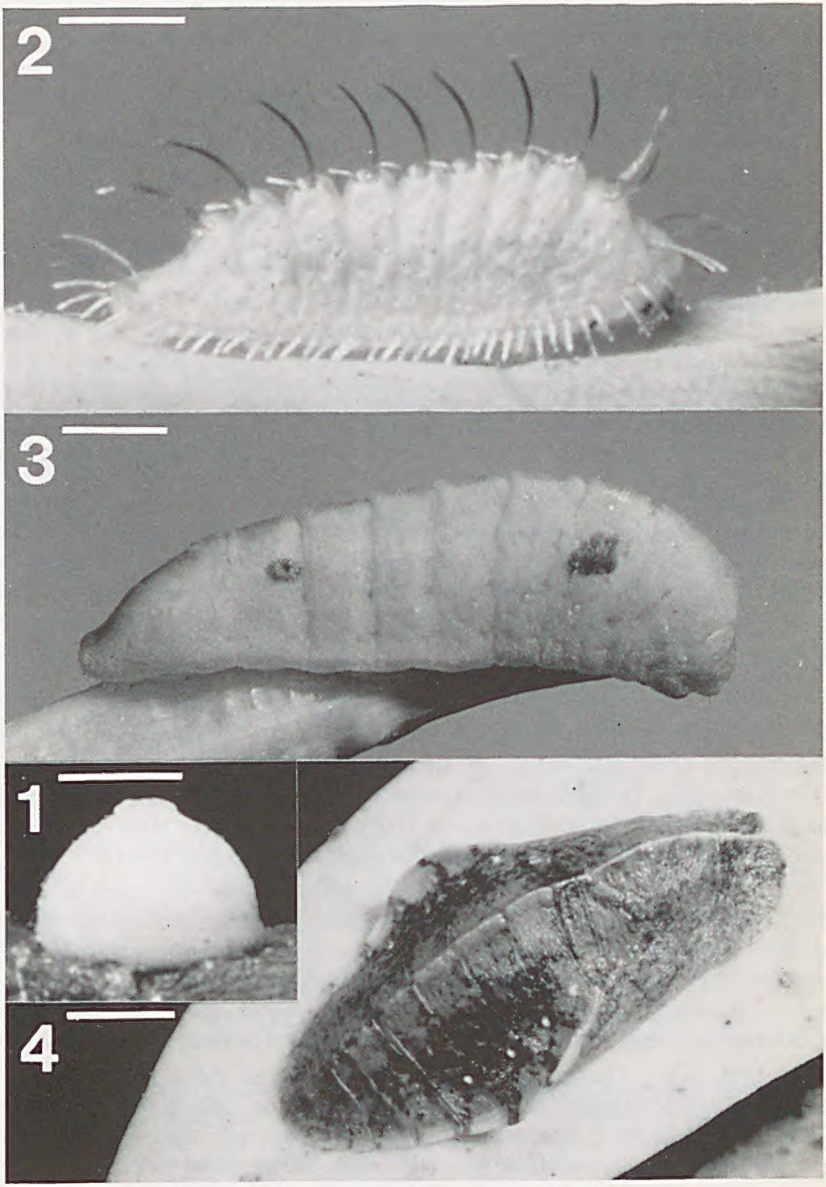
First instar (Fig. 2). Body with pronounced dorsal ridge, 2 rows of long pale dorsal hairs with brownish tips rising above 2 rows of very short pale dorsal hairs, plus short pale marginal hairs; body yellow, head pale brown.

Final instar (Fig. 3). Body laterally compressed with pronounced dorsal ridge, hairless viewed from above but with short pale hairs around the margin of the central ventral area that contains the legs and prolegs; green with variable brown dorsolateral markings, especially on abdominal segments 1 and 6, markings sometimes fused dorsally; prothoracic and anal plates sunken, green; head green. Newcomer's organ and tentacular organs present.

Pupa (Fig. 4). Thorax and abdomen with dorsal ridge, body flattened anteriorly with rounded flanges and small median indentation, abdomen flattened with lateral flanges strongly upturned anteriorly; reddish brown with variable dark brown mottling and with dark brown transverse bar on first abdominal segment, abdominal flanges and dorsal ridge paler, thoracic ridge white. Attached by anal hooks and central girdle.

Life history

The food plant at Darwin was *Decaisnina signata* (F. Muell. ex Benth.) Tiegh. (Loranthaceae).



Figs 1-4. *Candalides gilberti*: (1) egg, lateral view; (2) first instar larva (head on right); (3) final instar larva (head on right); (4) pupa. Scale bars (1, 2) = 0.4 mm, (3, 4) = 2 mm.

Eggs were laid singly, mostly on flower buds but also on young leaves. Larvae fed mainly on flower buds but also on young soft new shoots. They are well camouflaged when feeding on leaf margins, as their flattened profile follows the leaf outline and their brownish dorsolateral markings resemble necrotic areas on the plant. Several species of ants were seen on the mistletoe flowers but did not appear to be attending the larvae. Larvae were collected throughout the year at Stuart Park, but appeared more common from October to March and in June. The seasonal distribution may be different in bushland that receives only natural rainfall. Pupae were collected on bark and leaves of the mistletoe and on its host plant.

Eggs, first and final instars and pupae of *C. gilberti* conform to descriptions and photographs of those of *C. margarita margarita* (Semper) previously obtained by PRS. Larvae of *C. margarita* also feed on mistletoe (Common and Waterhouse 1981). Adult males of the two species are very similar and have identical genitalia (Tite 1963), but females of *C. margarita* differ from those of *C. gilberti* in having large white patches on the upperside of the wings. Evidently they are closely related.

Acknowledgment

We are grateful to Ian Cowie (Herbarium of the Northern Territory Conservation Commission) for identifying the food plant.

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BOOK REVIEW

Index of Economically Important Lepidoptera. Compiled by Bin-Cheng Zhang. C.A.B. International, Wallingford, U.K. 1994. 599pp. £49.95.

This is not an easy book to review as it clearly is not a book meant to be read, but rather one to be dipped into as required. It is aimed at those professional entomologists who work with species of Lepidoptera which can be considered to be in some way economic. Although most of the species included in the index are pests, those with biological control potential and silk moths are also included.

The index contains records for about 6000 species, plus about another 6000 synonyms. The names are derived from the Arthropod Name Index of CAB International which is based on records drawn since 1913, from scientific publications abstracted for the Review of Agricultural Entomology and its predecessors. The names are those preferred by CAB International for use in database indexing and information retrieval and have been derived from reputable taxonomic sources, most often specialist taxonomists at the International Institute of Entomology.

The book has three parts: a list of families and genera, the main index and an index of specific and intraspecific epithets. The main index comprises just over 75% of the book. Each record consists of the preferred name along with synonyms and misidentifications and a common English name if one exists. Host and geographical records follow, based on references cited in the Review of Agricultural Entomology. Finally there is a list of Review of Applied Entomology references (volume numbers only) in which the taxon has been cited.

I looked up various species (mainly from Australia and PNG) with which I have some familiarity and found no errors. The book is easy to use and appears reasonably comprehensive. For the professional entomologist not only is the book a nomenclatorial aid but it provides a rapid entry and guide to the literature on economic Lepidoptera.

A.P. Mackey
Centre for Biological Population Management
Queensland University of Technology
Brisbane

NEW DISTRIBUTION RECORDS OF HESPERIIDAE AND LYCAENIDAE (LEPIDOPTERA) FROM NORTHERN QUEENSLAND

R.G. EASTWOOD

50 Broadwater Terrace, Redland Bay, Qld 4165

Abstract

Range extensions in northern Queensland are given for *Toxidia inornata inornata* (Butler), *Acrodipsas myrmecophila* (Waterhouse & Lyell), *Pseudodipsas cephenes* Hewitson, *Hypochrysops miskini miskini* (Waterhouse) and *Udara tenella tenella* (Miskin).

Records

HESPERIIDAE

Toxidia inornata inornata (Butler)

A male was collected in January 1994 at the headwaters of Lankelly Creek in the southern McIlwraith Range, Cape York Peninsula, approximately 8 km NE of Coen. This locality extends the known distribution 130 km south from its previous southern limit at the Claudie River (Common and Waterhouse 1981).

LYCAENIDAE

Acrodipsas myrmecophila (Waterhouse & Lyell)

Three males were collected in October 1988 and July 1990 on a hilltop approximately 3 km north of the Palmer River Roadhouse, Cape York Peninsula. On both occasions adults were flying with *A. hirtipes* Sands. The previous northern limit in Queensland of *A. myrmecophila* is Blackdown Tableland (Dunn and Dunn 1991) and in the Northern Territory the only site known is Burrells Trig (Dunn and Dunn 1991). This new record is significant because it establishes an intermediate site some 1000 km north and 1500 km east of its nearest known localities.

Pseudodipsas cephenes Hewitson

A female collected in September 1993 at McIvor River Road, 35 km NW of Cooktown, extends the range for this species approximately 120 km north from Daintree (Dunn and Dunn 1991).

Hypochrysops miskini miskini (Waterhouse)

Three females were collected in September 1993, two at the McIvor River Road and one 6 km further south at Isabella Falls. These localities extend the known range 70 km north from Cedar Bay (Sands 1986).

Udara tenella tenella (Miskin)

In January 1994 several males were collected and several more observed at Mt Misery, some 40 km south of Cooktown. Kuranda has been regarded previously as the most northerly locality for this species (Common and

Waterhouse 1981, Dunn and Dunn 1991). Adults have also been collected recently at Cape Tribulation (an intermediate locality) by S. Lamond (J. Olive, pers. comm.). This species appears to be more widespread than previously thought.

Acknowledgment
Dr D.P.A. Sands confirmed the identity of *Acrodipsas myrmecophila*.

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ADDITIONAL RECORDS OF BUTTERFLIES TAKEN AT LIGHT IN NORTHERN QUEENSLAND

R.G. EASTWOOD

50 Broadwater Terrace, Redland Bay, Qld 4165

Abstract

Six additional butterfly species are recorded at light traps in northern Queensland: *Neohesperilla xiphiphora* (Lower), *Melanitis leda bankia* (Fabricius), *Hypochrysops ignitus chrysonotus* Grose-Smith, *Arhopala centaurus centaurus* (Fabricius), *Candalides absimilis* (Felder) and *Ogyris zosine typhon* Waterhouse & Lyell.

Introduction

Kitching and Harmsen (1992) recorded 7 species of butterflies collected at light in northern Queensland. During a 4 week field trip to Cape York Peninsula in January 1994, a mercury vapour light trap was set up most nights from dusk until around midnight. Butterflies were observed at the light sheet on 5 nights: 1, 2, 3, 14 & 21 January.

Records

HESPERIIDAE

Neohesperilla xiphiphora (Lower)

One male at the Coleman River crossing, 18 km west of Musgrave on 1.i.1994, in dry eucalypt woodland. Another male on 3.i.1994 at the Normanby River crossing on Battle Camp road, west of Cooktown.

NYMPHALIDAE

Melanitis leda bankia (Fabricius)

One male at Shipton's Flat, 30 km south of Cooktown on 21.i.1994, adjacent to rainforest.

LYCAENIDAE

Hypochrysops ignitus chrysonotus Grose-Smith

One male 13 km west of Fairview Homestead on 2.i.1994, in dry eucalypt scrub. Taken on the ground walking towards the light sheet.

Arhopala centaurus centaurus (Fabricius)

One male 13 km west of Musgrave on 14.i.1994, in dry eucalypt woodland.

Candalides absimilis (Felder)

One male at Shipton's Flat, 30 km south of Cooktown on 21.i.1994, adjacent to rainforest.

Ogyris zosine typhon Waterhouse & Lyell

One male collected by G. Daniels on the Kennedy river, 24 km west of Fairview Homestead on 14.iv.1989. Taken on the ground walking towards

the light trap some 4 metres distant.

Comments

In all cases males were collected. This is in contrast to Kitching and Harmsen (1992), in which 7 of their 8 specimens were female. All specimens were taken on the light sheet except where indicated. Adults of all species except *H. ignitus chrysonotus* were in evidence during the day and it is probable that the butterflies were attracted to the light after being disturbed from nearby resting places.

Brou (1974) recorded 607 butterflies representing 28 species taken at 3 light traps operated over a 12 month period in Louisiana. It is probable that many more species will be taken at light traps in northern Queensland, especially in areas where adult numbers are high.

Acknowledgment

I would like to thank G. Daniels for permission to publish his record of *O. zosine typhon* and for helpful comments.

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LEPIDIOTA BRITTONI, A NEW SPECIES FROM COASTAL NEW SOUTH WALES (COLEOPTERA: SCARABAEIDAE: MELOLONTHINAE)

P.G. ALLSOPP[1] and S.G. WATKINS[2]

[1]*Bureau of Sugar Experiment Stations, P.O. Box 651, Bundaberg, Qld 4670*

[2]*RMB Caparra, N.S.W. 2429*

Abstract

Lepidiota brittoni sp. n. is described from specimens of both sexes taken 10 km northeast of Wingham in central coastal New South Wales.

Introduction

Lepidiota Kirby is a large genus of white grubs which occurs from India and China, south through the Philippines, Indonesia and New Guinea to the northern half of Australia. The Australian species were last revised by Britton (1978), with another four species being described since (Britton 1985; Allsopp 1989, 1990); 58 Australian species are known.

This paper describes a further species from central coastal New South Wales. Its occurrence there extends the known distribution of the genus further to the south in eastern Australia; *L. ciliata* Britton, *L. negatoria* Blackburn, *L. picticollis* Lea and *L. squamulata* Waterhouse are all known south to about 30°S (Britton 1978).

Lepidiota brittoni sp. n.

(Figs 1, 2)

Types - NEW SOUTH WALES: *holotype* ♂, W Boundary Road, Yarrat S[tate] F[orest] [31°48'S, 152°25'E], 7.i.1994, S. Watkins and J. Stockard (in Australian National Insect Collection (ANIC), registered number 121); *paratypes*: 2♂♂, 13♀♀, same data as holotype; 2♀♀, same data except 11.i.1994; 3♂♂, 6♀♀, same data except 23.i.1994; 3♀♀, same data except 14.ii.1994; 1♂, same data except 17.ii.1994; 1♂, same data except 27.ii.1994; 1♀, same data except 5.iii.1994; 2♀♀, same locality, 30.i.1994, S. Watkins (ANIC, Australian Museum, Allsopp collection, Watkins collection, Queensland Department of Primary Industries [Mareeba]).

Description

MALE: Length 24-28 mm. Body and legs reddish brown to almost black on head, antennae and palpi brown. Labrum deeply bilobed, almost to base, anterior surface setose. Clypeus with anterior face glabrous and impunctate on median third, setose laterally; upper surface with anterior edge concave in the middle and broadly rounded on each side, maximum width 4.4 times mid length, surface punctate, near anterior margin each puncture with an elliptical white scale, scales towards posterior more circular. Frons slightly convex, coarsely punctured, each puncture enclosing an almost circular white scale, scales larger and more elongate along ocular margins; angle between lateral

edge of clypeus and ocular canthus obviously obtuse. Terminal segment of maxillary palp fusiform, elongate, 3.5-3.8 times as long as maximum width, with an elongate-elliptical, flat, minutely strigose area on upper-outer side. Antenna 10-segmented with a 3-segmented club; club 1.3-1.35 mm long, slightly longer than segments 3-7 combined. Pronotum with a narrow raised anterior margin continuous from side to side; raised posterior margin on middle half of each side, less defined laterally, very slightly interrupted in middle; disc uniformly punctured, punctures enclosing circular white scales, punctures slightly more dense along lateral margins and in posterolateral angles with scales more elongate, surface between punctures smooth and shining; maximum width 1.6-1.7 times mid length. Scutellum sparsely punctured, with white scales like disc of pronotum. Elytra punctate, the punctures each bearing a slightly ovoid scale; intervals 1, 3 and 5 slightly convex and with fewer punctures than broader intervals 2, 4 and 6. Propygidium densely setose on anterior two-thirds, posterior third with elongate white scales. Pygidium more densely punctate than elytra, about 50-60 mm^{-2}, each puncture bearing an ovoid white scale, fine long setae on margin at apex. Pronotal hypomera shining and without scales or punctures in a broad band between outer edge of coxal cavity and lateral edge of pronotum. Mesepisternum clothed with long thin setae. Mesepimeron clothed with elongate white scales, some long thin setae on outer edge and in posterolateral angles. Metepisternum with long fine setae on extreme anterior, middle and posterior clothed with elongate white scales. Metasternum clothed with dense long fine setae, without scales. Metepimeron with patch of elongate white scales and longer fine setae on outer margin, remainder clothed with long fine setae. Mid and hind coxae with elongate white scales and long setae on outer edges. Ventrites 3 and 4 with elliptical scales 3-4 times as long as wide, more crowded towards sides, central scales more ovoid; ventrites 5-8 with ovoid scales, less dense in centre than on sides, ventrites 7-8 with few scattered long setae in addition. Aedeagus with asymmetrical parameres (Figs 1-2).

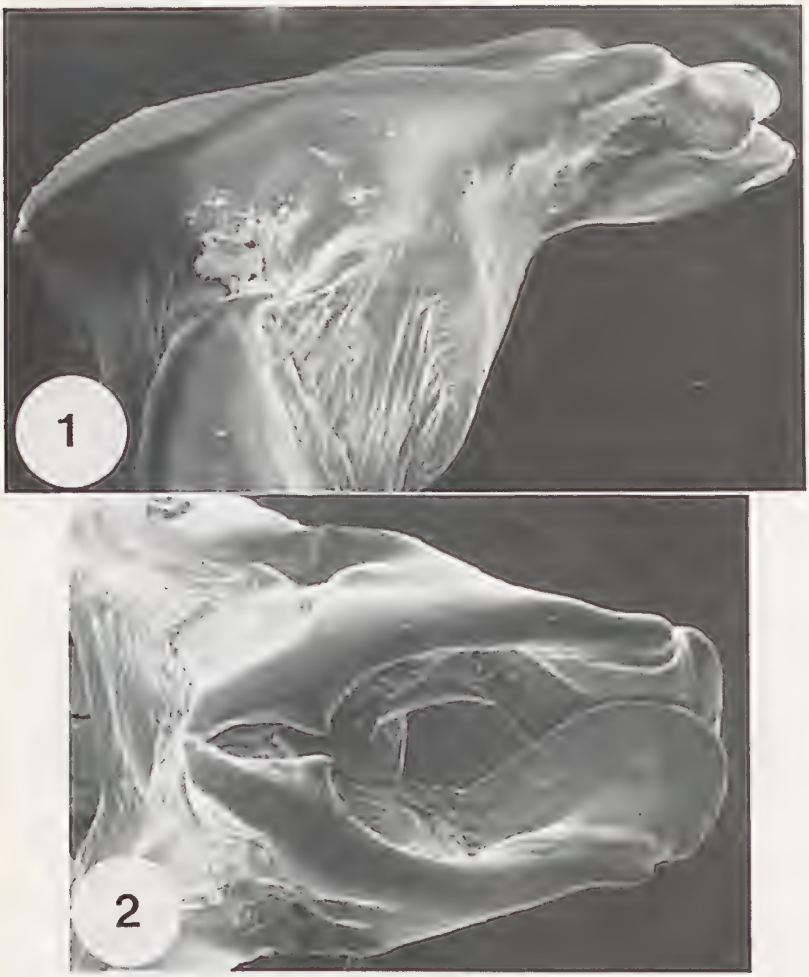
FEMALE: Length 23-27 mm. Antennal club 1.1 mm long. Pygidium with scales less dense, about 40-50 mm^{-2}. Posterior margin of ventrite 8 slightly indented. Otherwise like male.

Etymology

The species is named for Ev Britton whose studies of the Australian Melolonthini provide the foundation for this paper.

Comments

Lepidiota brittoni is the southernmost member of a group of species including *L. yorkensis* Britton (Cape York Peninsula), *L. caudata* Blackburn (in or near northeastern Queensland rainforest), *L. gibbifrons* Britton (in northeastern and central Queensland open forest), and *L. noxia* Britton (southeastern Queensland) (Britton 1978, 1985; Allsopp 1989, 1990;



Figs 1-2. *Lepidiota brittoni* aedeagus: (1) lateral view; (2) apical view.

Chandler 1989). *L. caudata* and *L. noxia* are pests of sugarcane (Allsopp *et al.* 1993), while larvae of *L. gibbifrons* are known to damage pineapples in central Queensland (R. M. Bull, pers. comm.). The type locality of *L. brittoni* is a fire break separating open forest from grazing land. The cleared areas contain immigrant *Allocasuarina* with mixed heath forbes. *Syncarpia, Eucalyptus* and *Xanthorrhoea johnsonii* dominate the forested area.

Species of the group are very similar and are best distinguished by the form of the aedeagus (compare Figs 1, 2 with Figs 1-6 in Britton (1985)); the aedeagus of *L. brittoni* is less depressed at the apex of the left side (lower side in Fig. 1), has more pronounced ridges on the upper surface (Fig. 2), has the

apex of the right side more flattened and broader and with a larger indentation on the lateral margin (Fig. 1), and has sharper inner points (Fig. 2) than in *L. noxia* (Britton 1985, Figs 3, 4). In addition, *L. brittoni* differs from *L. noxia* by having denser scales on the pygidium (35 mm^{-2} in *noxia*).

Lepidiota brittoni can be incorporated into Britton's (1978) key with the following modifications which also incorporate the changes suggested by Allsopp (1989):

11. Angle between the lateral edge of the clypeus and the ocular canthus square 12
Angle between the lateral edge of the clypeus and the ocular canthus obviously obtuse 11a

11a. Surface of the frons strongly convex, with a marked anterior declivity (Britton 1978, Fig. 280C); aedeagus as in Britton (1985, Figs 1, 2); female with a sharply defined declivity at the apex of the terminal ventrite ..... *gibbifrons* Britton
Surface of the frons less strongly convex, without a marked declivity; female with the apex of the terminal ventrite with at the most a slight indentation 11b

11b. Scales of the pygidium denser, in males 50-60 mm^{-2}, in females 40-50 mm^{-2}; aedeagus as in Figs 1, 2; female with a slight indentation of the apex of the terminal ventrite ..... *brittoni* Allsopp and Watkins
Scales of the pygidium less dense, 35 mm^{-2}; aedeagus as in Britton (1985, Figs 3, 4); female without any indentation at the apex of the terminal ventrite ..... *noxia* Britton

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A NEW SPECIES OF *MESODINA* MEYRICK (LEPIDOPTERA: HESPERIIDAE) FROM WESTERN AUSTRALIA

E.D. EDWARDS[1] and A.J. GRAHAM[2]

[1]*CSIRO, Division of Entomology, G.P.O. Box 1700, Canberra, A.C.T. 2601*
[2]*Curtin University of Technology, P.O. Box 597, Kalgoorlie, W.A. 6430*

Abstract

Mesodina hayi sp. n. is described from southern Western Australia. Adults and the male and female genitalia are figured and characters to distinguish *M. hayi* from *M. cyanophracta* Lower are listed. The number of subapical spots in *M. gracillima* Edwards is discussed and a key to the species of *Mesodina* Meyrick provided.

Introduction

The genus *Mesodina* Meyrick was reviewed by Edwards (1987), who presented evidence that *M. cyanophracta* Lower, until then regarded as a subspecies of *M. halyzia* (Hewitson), should be regarded as a separate species. At that time *M. cyanophracta* was the only species of *Mesodina* known from southern Western Australia.

In October 1987 one of us (AJG) captured a pair of skippers at Quairading, 150 km E of Perth, W. A. which could not be identified. They were believed to represent an undescribed species but their relationship to other Hesperiidae was not known. Independently, in November 1992 the other author (EDE) with E.S. Nielsen took four specimens also at Quairading. With the commencement of a project in 1994 to revise Common & Waterhouse (1981), these specimens were examined and proved to be a hitherto unrecognised species of *Mesodina*.

Key to the species of *Mesodina* Meyrick

1. Cream spots of fore wing with upstanding scales (Figs 13, 14) 2
   Cream or yellow spot(s) of fore wing with scales flattened to wing (Figs 15, 16) 4
2. Male fore wing upperside almost always without subapical spots ..... *halyzia* (Hewitson)
   Male fore wing upperside almost always with three subapical spots 3
3. Underside of hind wing reddish grey ..... *gracillima* Edwards
   Underside of hind wing bluish grey ..... *cyanophracta* Lower
4. Underside of fore wing with large orange patch in cell ..... *aeluropis* Meyrick
   Underside of fore wing without large orange patch in cell ..... *hayi* sp. n.

Mesodina hayi sp. n.

(Figs 5-8, 10, 12)

Types. WESTERN AUSTRALIA: *Holotype* ♂, 32°01'S, 117°23'E, 2 km SW of Quairading, W.A., 2.xi.1992 E.D. Edwards, E.S. Nielsen (in Australian National Insect Collection). *Paratypes*: 2♂♂, 1♀, same data as holotype but 1♂ with ANIC slide 3424 and 1♀ with ANIC slide 3427 (in Australian National Insect Collection); 1♂, 1♀, Quairading, W.A. 18.x.87, A.J. Graham (in Western Australian Museum); 6♂♂, 1♀, 2 km SW Quairading, several pupae found near eastern side of Nature Reserve, No. 16405, A.A.E. Williams, 11, 21, 24.x. & 3.xi.1994 (in W.A. Department of Conservation and Land Management Collection).

Description

Male (Figs 5, 7)

Head grey with some black scales, antennal shaft black ringed with cream, apiculus blunt, black anteriorly, cream posteriorly, nudum 17 divisions; labial palpi grey above with some black scales, white to pale grey beneath. Thorax, legs, abdomen grey-black above, grey-white beneath. Fore wing costa almost straight, apex pointed, termen almost straight; above dark brown with scattered grey scales towards base of costa and a few yellow hair scales at base and along dorsum; cream spots variable in number, one, two or three very small, one at end of cell always present, one between M3 and CuA1 and one between CuA1 and CuA2 sometimes present, subapical spots always absent, cilia grey and brown; beneath brown, apical area grey, spots as upperside, yellow hair scales in cell. Hindwing rounded, above dark brown, some yellow hair scales towards base, cilia grey and brown; beneath grey, a spot at end of cell outlined in dark grey, an outer row of similar smaller spots, anal area paler grey, cilia grey, darker at ends of veins. Fore wing length 12-14 mm.

Genitalia (Fig. 10): combined tegumen and uncus long tapering, tip down pointed, gnathos with fine sparse spicules; valva with ampulla well developed with tapering rounded tip, harpe narrow, dorsal surface with toothed projection; saccus well developed; aedeagus slender.

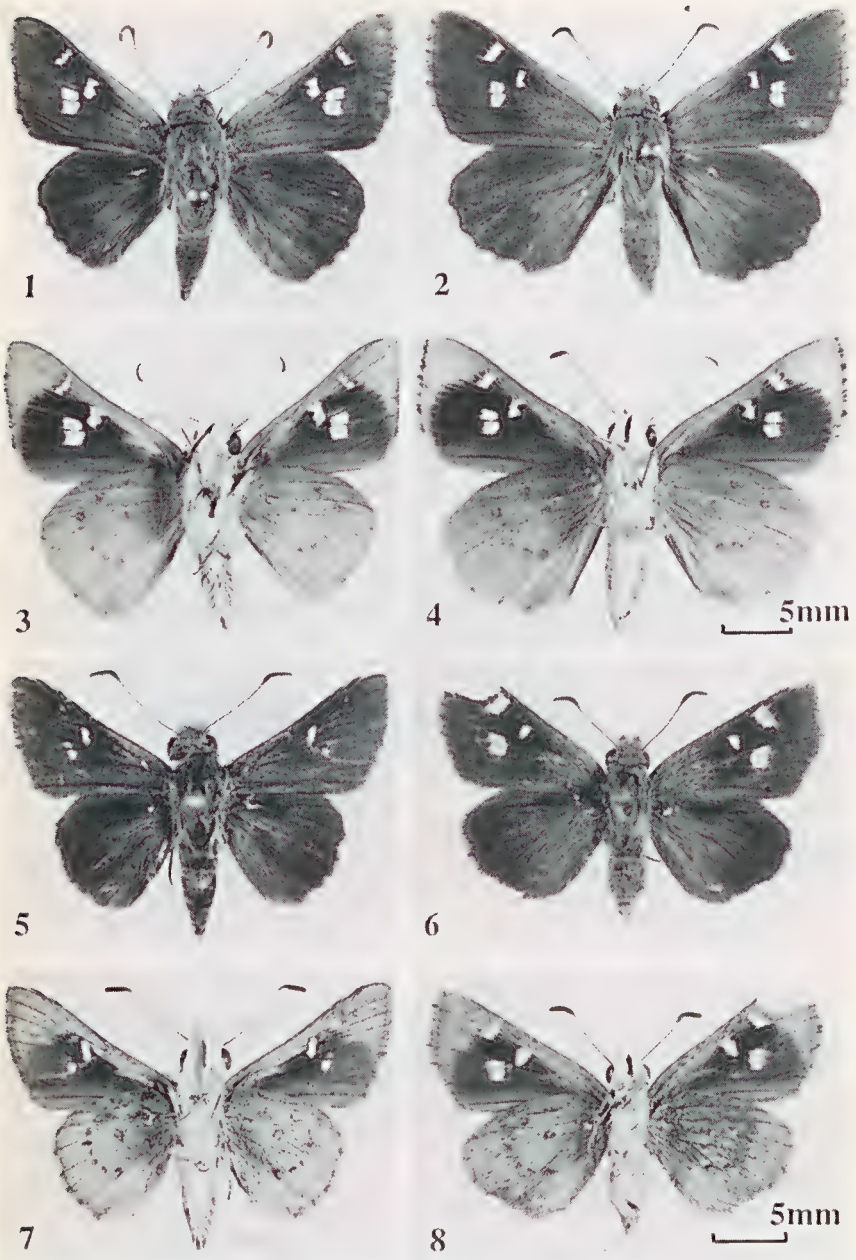
Female (Figs 6, 8)

Similar to male but fore wing with apex and termen more rounded, cream spots of fore wing larger and with three confluent subapical cream spots appearing as a single spot, distal margins of spots except cell spot ill-defined. Fore wing length 14-15 mm.

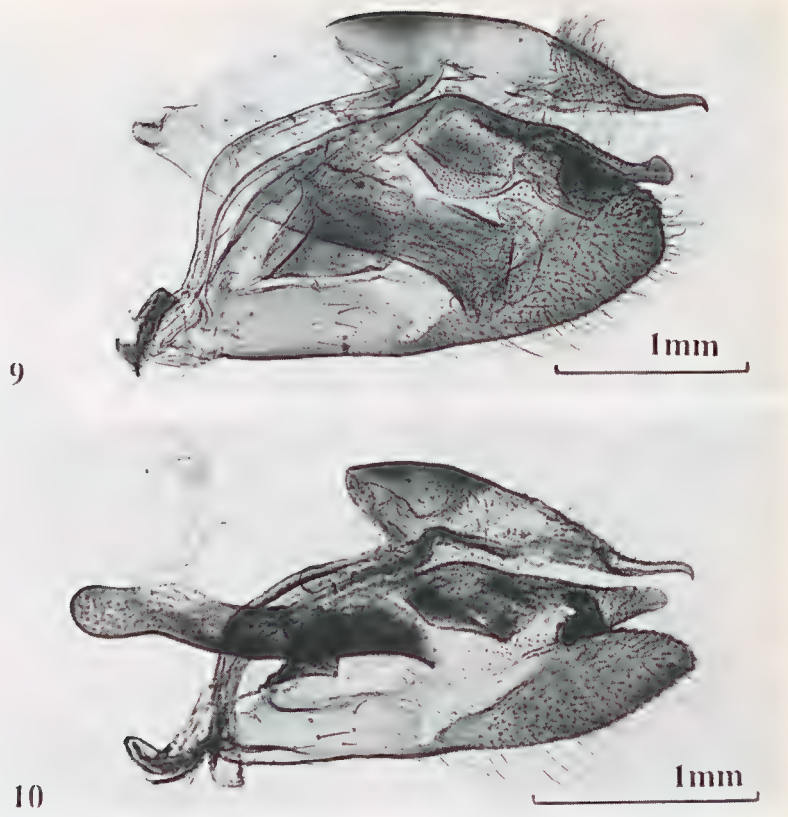
Genitalia (Fig. 12): sterigma lightly developed, corpus bursae with long narrow posterior section, accessory sac well developed.

Variation

The known specimens differ in size. In the male the fore wing cream cell spot is always present but all or some of the other spots may be absent.



Figs 1-8. *Mesodina* spp.: males odd numbers, females even numbers; upperside and underside; (1-4) *M. cyanophracta*; (5-8) *M. hayi*.



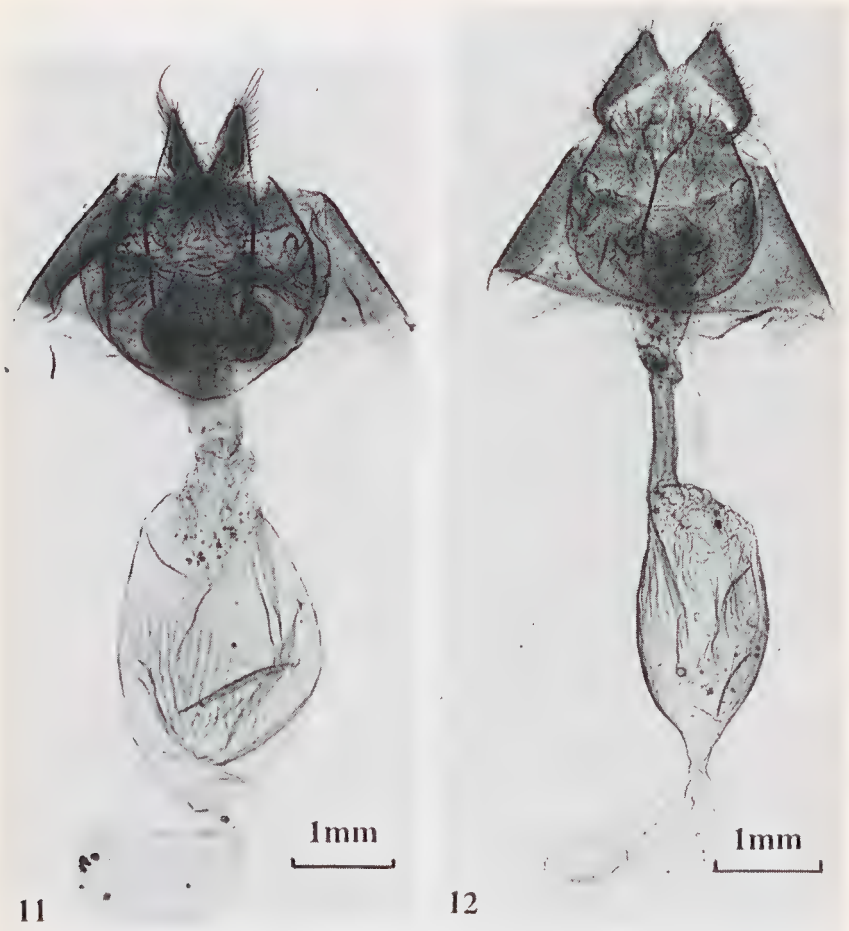
Figs 9,10. Male genitalia with left valva removed: (9) *M. cyanophracta* ANIC slide M572; (10) *M. hayi* ANIC slide 3424.

Distribution
The species is known only from the small area of native vegetation surrounding the town of Quairading, southern Western Australia.

Etymology
The species is named in honour of Mr R. W. Hay, whose efforts have kindled a resurgence of interest in the butterflies of Western Australia and who has provided generous assistance to both authors over many years.

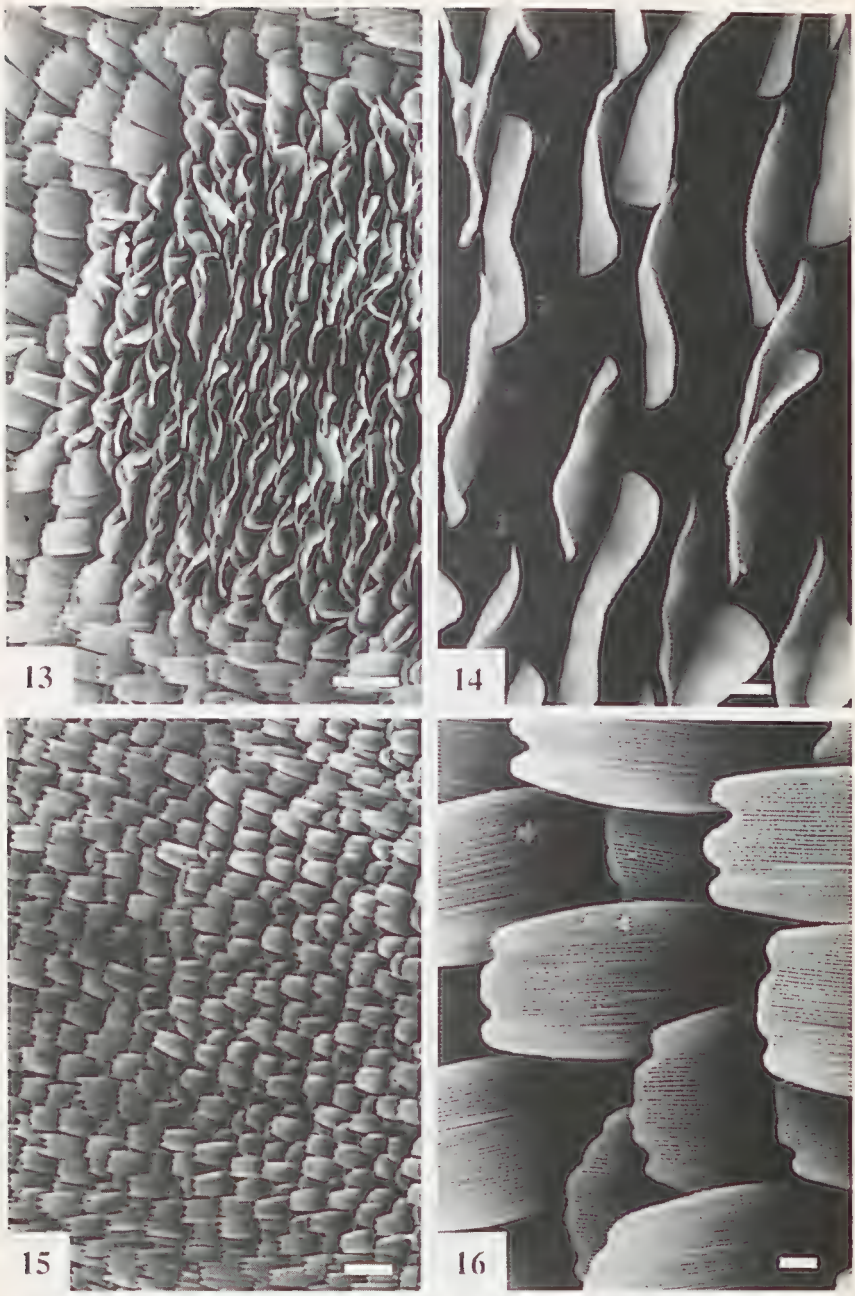
Discussion

Mesodina hayi posesses the normal characters of the genus, namely the long tapering combined uncus and tegumen, harpe with spined dorsal process, corpus bursae with accessory sac, absence of median spurs on the hind tibia and absence of a sex brand in the male. The origin of CuA1 is slightly closer to M3 than to CuA2 in the fore wing and it is much closer to M3 than to



Figs 11,12. Female genitalia: (11) *M. cyanophracta* ANIC slide M583; (12) *M. hayi* ANIC slide 3427.

CuA2 in the hind wing and in this *M. hayi* resembles the other species of *Mesodina*. The male and female genitalia have all the attributes of *Mesodina* and none of those of *Croitana* Waterhouse (Edwards, 1979). *M. hayi*, with a fore wing length of 12-14 mm, is smaller than *M. cyanophracta* which averages 15 mm. A few specimens of *M. cyanophracta* are as small as *M. hayi* but usually these may be distinguished by the three subapical spots present in *M. cyanophracta* and absent in *M. hayi*. Occasionally very small *M. cyanophracta* lack subapical spots. The grey underside of the hind wing of



M. hayi differs from the underside of *M. cyanophracta*. In *M. cyanophracta*,

M. hayi differs from the underside of *M. cyanophracta*. In *M. cyanophracta*, unless very worn, the hind wing underside has a bluish sheen and the spots are less distinct. The anal area in *M. cyanophracta* is pale brown without the bluish sheen but in *M. hayi* it is a paler grey. Another useful distinction is in the orientation of the wing scales of the cream spots. These spots are semihyaline in *M. cyanophracta* and light shines through them. Examination under a low power microscope reveals that the cream scales are erect (Figs 13, 14). This is also true of *M. gracillima* Edwards and *M. halyzia* (Hewitson). These erect scales are visible even in specimens of *M. cyanophracta* with the smallest spots. In contrast these scales in *M. aeluropis* Meyrick and *M. hayi* are not erect but flattened tile-like against the wing membrane in the normal way (Figs 15, 16) and the spots are almost opaque. Semihyaline spots composed of erect scales are found widely in the Trapezitinae and Hesperiinae and no special significance should be attached to their presence or absence but here they are useful in distinguishing the species.

In the male genitalia (Fig. 10) of *M. hayi* the tegumen-uncus has a longer tip but does not project beyond the apex of the valva, the ampulla is narrower and less rounded at the tip and the harpe is tapering and rounded without the expanded tip characteristic of *M. cyanophracta* (Fig. 9). The aedeagus of *M. hayi* is narrower than that of *M. cyanophracta*.

In the female genitalia (Fig. 12) the sterigma are arranged differently and the corpus bursae of *M. hayi* has a long narrow posterior section unlike the shorter, broader posterior section of *M. cyanophracta* (Fig. 11).

M. hayi is known only from Quairading but it possibly once had a more extensive range in the now cleared wheat belt of W.A. The distribution of *M. cyanophracta* is incompletely known. Common and Waterhouse (1981) gave a coastal and subcoastal distribution from Geraldton to the Stirling Ranges and more recently Dunn and Dunn (1991) recorded it from 36 km W of Binnu (28°02'S) to Albany and the Stirling Ranges. There are more recent specimens collected by EDE and E.S. Nielsen from near Kalbarri (27°41'S) and from the southern coast as far east as Esperance. However in the latitude of Perth the species' eastern limit is not well known but it occurs in the Darling Range and the coastal plain. We know of no specimens of *M. cyanophracta* from the Quairading area. Waterhouse and Lyell (1914) recorded a specimen of *M. cyanophracta* from Kellerberrin, 50 km NE of Quairading. There is a specimen in the Western Australian Museum labelled "Kellerberrin Nov. 1912 6403" which is probably that referred to by Waterhouse and Lyell. The register records that it was donated by L. McK. Burns. It is a specimen of *M. cyanophracta*. Further work is needed to determine if the two species are sympatric.

Figs 13-16. Wing showing margins of cream spots (13,15) and scales of spot (14,16): (13,14) *M. cyanophracta*; (15,16) *M. aeluropis*. Scale bars: (13,15) 100 microns; (14,16) 10 microns.

The biology of *M. hayi* has recently been discovered at Quairading and will be published by Williams and Atkins (in prep.).

Only two males of *M. gracillima* were known when it was described by Edwards (1987) and the normal number of subapical spots was in doubt. Since then many specimens have been taken and most of these have three subapical spots but occasionally specimens have none, one or two.

Acknowledgments

We thank Mr A. Atkins and Dr M.F. Braby for comments that stimulated us to investigate the generic identity of this species. We are grateful to Mr K.L. Dunn, Mr R.W. Hay, Mr A.A.E. Williams and Mr M.R. Williams for comments and distributional information. Dr T.F. Houston, W.A. Museum, Mr M.S. Moulds, Australian Museum, and Ms Catriona McPhee, Museum of Victoria, kindly searched for a specimen recorded by Waterhouse and Lyell. Mr C. Beaton and Ms Helen Geier took the SEM photographs and Mr J. Green and Ms K. Smith the other photographs. Valuable comments on the manuscript were received from Drs E.S. Nielsen and Marianne Horak.

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THE LIFE HISTORY OF *METAMIMAS AUSTRALASIAE* (DONOVAN) (LEPIDOPTERA: SPHINGIDAE)

H.E. (Mike) GROTH

28 Bothwell Street, Toowoomba, Qld 4350

Abstract

The life history of the hawk moth *Metamimas australasiae* (Donovan) is described and figured and observations on biology and behaviour are recorded.

Introduction

The hawk moth *Metamimas australasiae* is one of Australia's largest hawk moths, occurring from Cairns to southern coastal New South Wales (Common 1990). Larvae have been recorded previously feeding on two species of *Eucalyptus, E. elata* and *E. saligna* (Moulds 1984).

On 7.ii.1993, I was given a live female *M. australasiae* in a small cardboard box. Between its capture the previous night and delivery to me it laid 12 eggs. The following description of the life history and adult behaviour are based on larvae and adults reared from these eggs.

Methods

The eggs were removed from the cardboard on which they were laid and placed in a covered petri dish. Upon hatching the larvae were supplied with young shoots of *Eucalyptus tereticornis*, a food plant previously unrecorded for *M. australasiae*. As the larvae grew, older foliage was supplied.

The larvae were housed in a rectangular plastic container, 135 mm x 130 mm x 330 mm high. Cuttings were placed in a small bottle of water standing on the base of the container and were replaced as necessary to maintain a fresh food supply. From the beginning of the third instar, larvae were housed in a larger cage, 540 mm x 450 mm x 760 mm high, with perspex on three sides, a wooden base and gauze on one side and the top. Pupation took place in one of two rectangular plastic containers, 330 mm x 135 mm x 130 mm high, in which soil, bark chips and dead leaves were provided. One of the containers had a clear PVC base to allow the structure of the shelter to be observed. As each larva began searching for a pupation site it was transferred to one of these containers. Every few days the substrate in which the larvae had pupated was lightly misted with water.

Life History

Egg: Diameter 3 mm; spherical but with a very slightly flattened base. Green when first laid but after 11 days developed a reddish brown band roughly 0.5 mm wide which, on most, completely encircled the egg approximately 0.6 mm down from the upper surface. Seventeen days after the eggs were laid the green colour changed to a pale whitish green. The eggs hatched 22-23 days after oviposition.

First instar: Length 12 mm. Head green, produced anteriorly to a fine bifid point, apically tinged with red; apical three segments of thoracic legs tinged with red; thorax and abdomen green with a dorsolateral yellow stripe and a number of faint yellow oblique lateral stripes; numerous tiny yellow protuberances on most of body giving it a roughened appearance; posterior tip of anal prolegs tinged with red.

Second instar (Fig. 1): Length 28 mm. Head mostly green, covered with numerous tiny yellow protuberances, strongly produced to a fine bifid point, apically tinged reddish brown, yellowish towards base; apical three segments of thoracic legs tinged with red; thorax and abdomen green with a dosolateral yellow stripe, much fainter on the mid abdominal segments; numerous tiny yellow protuberances on most of body giving a roughened appearance; yellow oblique lateral stripes slightly darker than first instar.

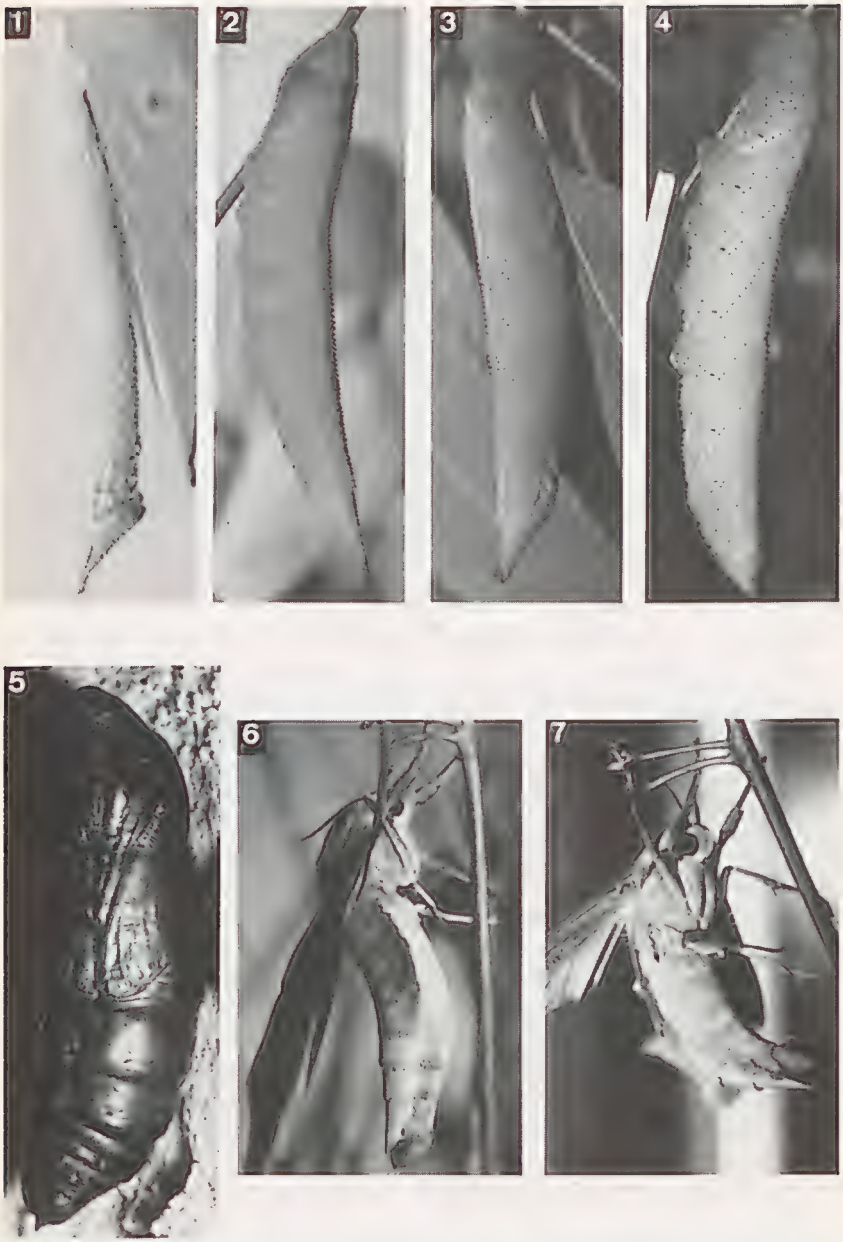
Third instar (Fig. 2): Length 48 mm. Head green, covered with numerous tiny yellow protuberances, strongly produced to a fine bifid point, apically tinged reddish brown; apical three segments of thoracic legs tinged with red; thorax and abdomen green with a dosolateral yellow stripe on thorax and first three abdominal segments; abdomen with six yellow oblique lateral stripes, the most posterior very distinct.

Fourth instar (Fig. 3): Length 65 mm. As in earlier instars, but yellow dorsolateral stripe running from near red bifid tip of head to the second abdominal segment; abdomen with six yellow oblique lateral stripes, the most posterior very distinct.

Fifth instar (Fig. 4): Length 117 mm. Head bluish green, reduced to a slightly bifid, blunt conical shape; thorax and abdomen bluish green, slightly greener on the last few abdominal segments; the posterior oblique lateral stripe very distinctly yellow, with a small purplish, irregularly shaped blotch just above it and near its dorsal end; tiny yellow protuberances on body conspicuous, giving larva a very roughened appearance.

Pre-pupal larva: As fifth instar but most of the green dorsal and dorsolateral areas of thorax and abdomen brownish green; tiny yellow protuberances unchanged.

Pupa (Fig. 5): Length 68 mm. Stout, shiny, dark brown, almost black; head and thorax fairly smooth, antennae reaching to about two-thirds length of fore wings, labial palpi and fore femora not exposed; proboscis and mesothoracic tarsi reaching to anterior margin of abdominal segment 4, fore wings to posterior margin of segment 4; abdominal segments with numerous fine transverse grooves and narrow anterior bands of punctures, segments 5 and 6 moveable, with small ventral depressions representing ventral prolegs of larva; cremaster short, deeply grooved, tapering, apically acute.



Figs 1-7. Larvae, pupa and adults of *Metamimas australasiae:* (1) Second instar larva; (2) Third instar larva; (3) Fourth instar larva; (4) Fifth instar larva; (5) Pupa; (6) Adult male at rest; (7) Adult male in defensive posture.

Behaviour

Larvae: All instars rested with their pointed heads directed anteriorly. During development they fed singly. Third and later instars twitched or slightly jerked their heads dorsally when approached or disturbed; this action continued for some minutes after the initial stimulus and nearby larvae often behaved similarly. When at rest, third and later instars rested in a head downward position, usually only grasping the support by the anal claspers and the ventral prolegs of abdominal segment 6. Just prior to pupation the larvae exhibited another remarkable behaviour, for which I have not been able to ascertain a function. This involved coating much of the body with a clear, somewhat viscous liquid from the mouth. The liquid glistened on the sides of the larvae and often contained small bubbles. Following this action the larvae rested for a period of two to three hours, by which time their colour changed to that of the pre-pupal stage, before searching for a suitable pupation site. The larval stage lasted for an average of 345 days, including a pre-pupal resting stage of 6 days after the pupal cell had been constructed. Although the five larvae reared to maturity all came from the same batch of eggs, hatched within 24 hours of each other and were reared under the same conditions, there was a variation of up to three weeks in the duration of the third and subsequent instars.

Pupa: Pupation took place in a shelter constructed of soil particles and leaf and bark litter combined with silk. Shelters measured approximately 78 mm long, 38 mm wide, 23 mm high and were irregularly oval in shape. Newly formed pupae were mostly green with some brownish areas on the ventral surface. After about 24 hours the colour changed to very dark shiny brown, almost black. The average pupal duration for larvae which pupated in February was 37 days.

Adult: Males of *M. australasiae* possess an expandable hair-pencil (Fig. 7) on each side near the base of the abdomen. By dissecting the abdomen I found that each pencil was enclosed in a pocket formed by a fold in the pleural membrane on abdominal segments 2 and 3. The base of the hair-pencil was attached to the pleural membrane of segment 2 directly ventral to the second abdominal spiracle. The dorsal margin of sternite 2 in the vicinity of the pocket and the entire dorsal margin of sternite 3 was heavily sclerotised. The pockets in the pleural membranes and the hair-pencils have not been recorded in any other species of Sphingidae. At rest (Fig. 6) adults hung from a branch and the tip of the abdomen was curved dorsally, the rest of the abdomen held ventrally and the head depressed. In this resting posture the hair-pencils were retracted. When the adult was disturbed, by gently bumping the branch on which it was resting or by touching it, the tip of the abdomen was thrust ventrally and the valvae were opened widely to expose the black inner area, which made the surrounding orange area appear more prominent. Simultaneously, the hair-pencils on the abdomen were expanded (Fig. 7);

when expanded the array of hairs measured 11 mm in diameter. This posture was held from a few to 20 seconds before the resting position was resumed. The function of the hair-pencils was not ascertained. Females exhibited a similar defensive behaviour but were without the expandable hair-pencils. Newly emerged adults of *M. australasiae* also squirted one or several 'bursts' of meconium from the anus when in the defensive position. This occurred almost every time that the defensive posture was adopted. The fluid was squirted distances of up to 15 cm and occurred up to 24 hours after eclosion, the maximum period that any of the reared specimens was kept alive. The two reared females were 15 & 30 mm smaller in wingspan than the parent female. As ample fresh food was supplied at all times during the larval development it is possible that the species of *Eucalyptus* used may have had unsuitable nutrient levels or that the cuttings, although kept as fresh as possible, were not sufficiently nutritious to permit maximum growth.

Discussion

The mature larva of *M. australasiae* is similar to that of *Coequosa triangularis* (Donovan). Both lack the caudal spine which is present in the larva of most Australian sphingids. The shining black, eye-like spot present on the anal clasper of the larva of *C. triangularis* is absent in *M. australasiae* and the yellow protuberances which give the larvae of both species a roughened appearance are much shorter in *M. australasiae* than in *C. triangularis*.

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