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Observations on the Biology of Skipper Butterflies in Trinidad, West Indies: *Urbanus*, *Astraptes* and *Narcosius* (Hesperiidae: Eudaminae)

Matthew J.W. Cock
c/o CABI, Bakeham Lane, Egham, Surrey TW20 9TY, UK.
m.cock@cabi.org / mjwcock@btinternet.com

ABSTRACT
Observations are provided on the food plants, leaf shelters, early stages and parasitoids of *Urbanus proteus proteus* (Linnaeus), *U. belli* (Hayward), *U. esmeraldus* (Butler), *U. dorantes dorantes* (Stoll), *U. simplicius* (Stoll), *Astraptes talus* (Cramer), *A. fulgerator fulgerator* (Walch), *A. alardus alardus* (Stoll), *A. alector hopfferi* (Plötz), *A. anaphus* (Cramer) and *Narcosius colossus* (Herrich-Schäffer) (Hesperiidae: Eudaminae) in Trinidad (Trinidad and Tobago).

Key words (not in title): egg, caterpillar, larva, pupa, leaf shelter, parasitoid.

INTRODUCTION

This paper continues from Cock (2014b) which presented partial life histories of species of several genera of Eudaminae. Here, I document partial life histories of some Trinidad species of three further genera of Eudaminae, which were either unknown, or could not be illustrated, in my earlier treatment of these genera (Cock 1986, 1988). I have avoided duplication of information available in these earlier treatments, and they should be referred to alongside this paper.

The taxonomy used follows Cock (2014a). Two major resources are reflected throughout: the Beccaloni *et al.* (2008) catalogue of food plants of Neotropical butterflies, and Janzen and Hallwachs (2014) huge online database of Lepidoptera rearing in Costa Rica. I have not attempted to critically summarise and evaluate all food plant records from these sources (Mielke 2005), but rather establish where particular food plants dominate the available records. Hence, what I present is focussed on information for Trinidad. There is relatively little here that is not available from or differs from Janzen and Hallwachs (2014), but providing corroborative information from Trinidad for many species is also useful, and indicative of the constancy (or otherwise) between the two regions.

Urbanus Hübner [1807]

This is a rather remarkable genus because of the diversity of food plants used, and in particular pairs or groups of species with very similar adults and very different food plants. Most species feed on Fabaceae, subfamily Faboideae, particularly species of vines. Some species feed on diverse families, although some of these apparent records may be based on early misidentifications. For example, *Urbanus esmeraldus* (Hübner) is reported to feed on *Urera* spp. (Urticaceae) as well as Fabaceae, but see the treatment of this species below. The possibility of cryptic diversity should not be ignored in such cases; in the author's experience such disparate food plants have several times been an indication of more than one species confused under one name, or species that should not be congeneric.

Of the other species recorded from Trinidad (Cock 1986, 2014a) but not documented here, *U. teleus* (Hübner) and *U. procne* (Plötz) feed on grasses (Poaceae), *U. pronta* Evans feeds on *Urera* spp., and the remainder feed on Fabaceae: *U. doryssus* (Swainson), *U. esma* Evans, *U. esta* Evans (particularly on *Desmodium* spp.), *U. carmelita* (Herrich-Schäffer), and *U. velinus* (Plötz), or are of unknown biology: *U. tanna* Evans (Moss 1949; Nogueira and Habib 2002; Beccaloni *et al*. 2008; Janzen and Hallwachs 2014). S. Alston-Smith (pers. comm. 1997 in Beccaloni *et al.* 2008) has reared *U. doryssus* from *Abarema jupunba* (Fabaceae) in Trinidad, but I have not found this species myself.

Urbanus proteus proteus (Linnaeus, 1758)

Figs. 1-5.

This common and widespread species (Fig. 1) has been recorded to feed on a large number of Fabaceae (Beccaloni et al. 2008), and is known as a minor pest of cultivated beans (Greene 1971; Capinera 2011).

Cock (1986) reported finding caterpillars on bodi beans (cowpea, Vigna unguiculata, Fabaceae) at Aranguez Gardens, but did not document the early stages or rear them through. Until now, the early stages have not been reported from Trinidad, although they are well known from other parts of the wide American Range of this species (e.g. Moss 1949; Minno et al. 2005; Capinera 2011; Janzen and Hallwachs 2014).

Since then, I have reared this species from caterpillars collected on *Desmodium tortuosum* (=D. *purpureum*) at St. Benedict's (96/3) and found an identical caterpillar on a small-leaved Faboideae vine at Curepe, which was parasitised (94/36).

Fig. 1. Adult male *Urbanus proteus proteus*, collected as caterpillar on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; adult 8 August; 96/3C.

Three shelters were found on *D. tortuosum* (96/3). A stage I shelter measured 7 x 3.5mm and was a triangular two-cut shelter folded upwards, with a tuck so that one end was raised above the leaf surface; it contained a medium sized caterpillar (n-2) corpse and a single exoparasitoid larva. Greeney and Sheldon (2008) provide a more detailed account of how *U. proteus* constructs this shelter. A stage II shelter containing an n-2 caterpillar was a long two-cut flap 25 x 9mm, made by cutting a notch at each end and folding upwards. A stage III shelter containing a final instar caterpillar was formed from two partially eaten leaves, one on top of the other.

The n-2 caterpillar (Fig. 2) measured 11mm. Head rounded oval, indent at vertex; weakly rugose, except strong at apices; very short pale setae; dark brown with dull orange-brown eye-spot anterior to stemmata. T1 shiny black dorsally, dull red ventrally. Body dull green with numerous yellow speckles; darker dorsal line; yellow dorsolateral line, which is expanded and yellow-orange on A8; pale ventrolateral line. Legs T1 black, T2 dark, T3 brown; prolegs concolorous; spiracles inconspicuous.

Fig. 2. Instar n-2 caterpillar of *Urbanus proteus*, collected on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; photographed 11 July; moulted 14 July; 11mm; 96/3B.

The penultimate instar caterpillar (Fig. 3) was similar to the preceding instar, except that the head was more rugose, brown, with the eye-spots pale orange-brown.

Fig. 3. Instar n-1 caterpillar of *Urbanus proteus*, collected on Fabaceae vine, 29 September, 1994, Curepe; photographed 30 September; moulted 2 October; 13mm; 94/36A.

The final instar caterpillar (Fig. 4 below) measured 22mm eight days before it pupated. Head rounded, indent at vertex; brown, posteriorly dark, extending ventrolaterally to cover stemmata; a broad, dark oval across face, extending to top of clypeus, and ventrolaterally to mouthparts; an orange triangular eye-spot anterior to stemmata; covered with inconspicuous short pale setae. T1 shiny black dorsally, orange-red ventrally. Body dull pale green, with numerous yellow speckles; dorsal line darker, more so anteriorly; dorsolateral line yellow, or-

Fig. 4. Final instar caterpillar of *Urbanus proteus*. **Above**, collected as n-2 caterpillar on Fabaceae vine, 29 September, 1994, Curepe; moulted 2 October; photographed 4 October; parasitised; 94/36A. **Below**, collected as final instar caterpillar on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; photographed 11 July; pupated 19 July; 22mm; 96/3C.

ange from A8 around lateral margin of anal plate; dark patch below dorsolateral line on T2; white ventrolateral flange; legs black; prolegs salmon; spiracles brown. The parasitised caterpillar from Curepe (94/36) was identical, except the colouration of the head was duller (Fig. 4 above). The caterpillars of *Urbanus esta* are very similar (Janzen and Hallwachs 2014), but this species is still hardly known from Trinidad.

The pupa (Fig. 5) was formed in a shelter between a leaf and the side of the rearing container. It was fully suspended with the cremaster attached to a cross-bar of silk, and supported by a Y-shaped girdle. The pupa measured 22mm; it was brown, evenly covered with particulate white waxy powder; spiracles dark, that of T1 a large conspicuous semicircle.

Fig. 5. Pupa of *Urbanus proteus*, lateral view; collected as final instar caterpillar on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; pupated 19 July; photographed 2 August; 22mm; 96/3C.

The Hymenoptera exoparasitoid reared from the St. Benedict's collection (96/3A) was reared but has not been identified. The caterpillar from Curepe (94/36A) continued feeding and formed a pupal shelter, before larvae of an undescribed *Apanteles* sp. (*leucostigmus* species-group; Microgastrinae, Braconidae) emerged and formed cocoons, arranged irregularly in a weak matrix of silk covering the remains of the host's body. About 30 adult wasps emerged nine days later.

***Urbanus belli* (Hayward, 1935)**

Figs. 6-9.

Cock (1986) knew of no food plants, and suggested incorrectly that *U. belli* would be found to feed on legume vines. Beccaloni *et al.* (2008) include several Asteraceae food plants and one Fabaceae taken from Janzen and Hallwachs' database of Costa Rican rearings. The current version of the database (Janzen and Hallwachs (2014) includes many records of rearings of *U. belli* and similar cryptic species, all feeding on Asteraceae, so the Fabaceae record is likely to have been a corrected error. Janzen and Hallwachs (2014) show that *U. belli* itself feeds on at least 17 genera of Asteraceae, and of the 450 records, the commonest food plants are from the genera *Zexmenia* and *Melanthera*, with over 150 each, and *Calea* and *Clibadium* with over 50.

On several occasions I have found caterpillars or empty shelters of *U. belli* on *Tilesia baccata* (= *Wulffia baccata*): Palo Seco (95/40 reared), Andrew's Trace (95/24 shelters), Mt. Tabor (04/11 caterpillar, 04/21 empty shelters), Point Gourde (11/45 caterpillar). Only the first of these was reared, but the following combines information from other collections.

The early shelters are two-cut shelters (Greeney 2009), with a broad hinge, one side shorter than the other, with a tuck in the shorter side to make an elongate shelter raised well above the leaf at one end (Fig. 6). This shelter seems to be typical of *Urbanus* spp. and many other Eudaminae. I have also found a similar shelter made in the middle of a leaf lamina containing a young caterpillar (green with a dark head) on *Clibadium surinamense* (Mt. Tabor 94/39), which is likely to be *U. belli*.

Fig. 6. Leaf shelter and adjacent feeding of *Urbanus belli* on *Tilesia baccata*, Point Gourde, 16 October, 2011; not reared; 11/45.

The shelter of the penultimate and final instars is simpler. A penultimate instar caterpillar collected on Mt. Tabor (04/11, Fig. 7) made a minimal no cut shelter by pulling the edges of a leaf upwards towards each other with silk, but the top of the shelter remained open. The specimen reared (95/40) was collected as a premoult penultimate instar caterpillar in a shelter made from the distal part of a leaf; both sides of the leaf were cut to the midrib, and the distal 45mm of the leaf rolled upwards. There was some feeding distal to the shelter, and the basal half of the leaf had one half almost entirely eaten. It is not clear whether these two shelters represented stages in construction, or two different behaviours, i.e. in the former case, would the caterpillar have subsequently constructed the shelter to match the second, or was the shelter complete?

A penultimate instar caterpillar was collected on Mt. Tabor (04/11) and preserved in the final instar. No description was prepared, but photographs taken (Fig. 7) show the penultimate instar to be very similar to the final instar.

Fig. 7. Penultimate instar caterpillar of *Urbanus belli*, collected on *Tilesia baccata*, Mt. Tabor, 12 January, 2004; photographed 13 January; moulted to final instar 14 January; 22mm; 04/11B.

One day after moulting to the final instar, individual 95/40 measured 27mm long (Fig. 8) and when fully grown it measured 32mm. Head rounded, indent at vertex; rugose; dark brown; quadrate orange eye-spot anterior to stemmata; covered with scattered short recumbent setae. T1 black dorsally, red ventrally. Body matt grey-green, with yellow tint due to yellow speckles, stronger on T2-A6; narrow dark dorsal line; narrow yellow dorsolateral line, broader and orange on A8; ventrolateral flange paler; spiracles brown, inconspicuous; T1 legs red; T2-T3 legs pale red; prolegs concolorous. The instar lasted 14 days.

Fig. 8. Final instar caterpillar of *Urbanus belli*, collected as penultimate instar on *Tilesia baccata*, Palo Seco, 7 October, 1995; moulted to final instar 8 October; photographed 9 October; pupated 21 October; 27mm; 95/40.

In captivity the pupal shelter was several leaves spun together. The 22mm pupa (Fig. 9) was smoothly rounded with no projecting features; brown; covered with dense white waxy powder, more lightly on abdomen and thorax, heavier on wings, and densest on head. Spiracles T1 large, matt brown, but not projecting. The pupal stage lasted 22 days.

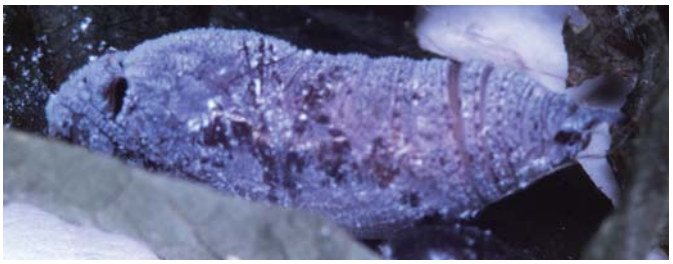

Fig. 9. Pupa of *Urbanus belli*, lateral view, collected as penultimate instar on *Tilesia baccata*, Palo Seco, 7 October, 1995; pupated 21 October; photographed 22 October; adult 11 November; 22mm; 95/40.

***Urbanus esmeraldus* (Butler, 1877)**

Figs. 10-12.

Cock (1986) was not familiar with the biology of this species. The Beccaloni *et al.* (2008) catalogue of food plants includes several records of *U. esmeraldus* from Fabaceae (*Centrosema*, *Desmodium*, *Wisteria*) and one from *Urera* sp. (Urticaceae). Janzen and Hallwachs (2014) list more than 300 rearing records in Costa Rica, nearly half from *Clitoria glaberrima*, many from *Centrosema* spp., and a few from *Desmodium* spp., *Phaseolus lunatus* and *Vigna* spp. Their photographs show that the early stages in Costa Rica are similar to that reported here from Trinidad. Kendall (1976) and Wendt and Carvalho (2001) report similar food plant species from Mexico and Rio de Janeiro, respectively.

The original record from *Urera* sp. is based on a 1992 published oviposition observation by K.S. Brown in Brazil, and there are subsequent publications by Dutra *et al.* (2006) and Moraes *et al.* (2012) of *Urbanus esmeraldus* feeding on *U. baccifera* in Brazil. The latter includes photographs of the adult and life history. Although the adult is an almost exact match to that treated as *U. esmeraldus* here (Fig. 10), the caterpillar is not, as it has a

black head with red eye-spot, and the body colouring is slightly different. They resemble the caterpillars treated as *U. pronta* by Janzen and Hallwachs (2014), which feed almost exclusively on *Urera* spp. in Costa Rica, but have a different adult. Furthermore, the shelter construction and feeding behaviour of the mature caterpillars on *Urera* spp. in Brazil are different from those observed below. It seems clear that two different species are involved: one that feeds on Fabaceae vines as observed in Costa Rica (Janzen and Hallwachs 2014), Brazil (Wendt and Carvalho 2001) and Trinidad (below), and another that feeds on *Urera* spp. as observed in Brazil (Dutra *et al.* 2006; Moraes *et al.* 2012).

Fig. 10. Adult male *Urbanus esmeraldus*, collected as final instar on *Centrosema molle*, Point Gourde, 16 May, 1999; adult 8 June; 99/5.

I have reared this species once, from a final instar caterpillar collected on *Centrosema molle* (= *C. pubescens*) (MJWC 253) at Point Gourde, 16 May, 1999 (pers. comm. in Beccaloni *et al.* 2008). The caterpillar was found in a shelter made from two leaves, one resting on top of the other. The caterpillar's colour and markings (Fig. 11) are similar to those of *U. proteus*, but even when collected it appeared different. When collected the caterpillar measured 25mm, and the body colour was dull yellow-green with yellow-orange speckles (Fig. 11 below, left), but four days later it had turned darker (Fig. 11 below, right) and the following description was prepared.

Head oval, widest at about one-third up from mouthparts; deeply indent at vertex; weak, pale, erect setae; brown, mouthparts and stemmata black; orange eye-spot anterior to stemmata; posterior margin very constricted. T1 red-brown; pronotum black. Body dark dull green, covered with tiny orange spots; dorsal line clear of spots; narrow orange slightly irregular dorsolateral line ends at anterior margin A7; orange blotch on A8, orange spot on anterior margin of A9 and orange laterally on anal plate all in line with dorsolateral line; pale ventrolateral flange; legs brown; prolegs reddish; spiracles inconspicuous.

Fig. 11. Final instar caterpillar of *Urbanus esmeraldus*, collected on *Centrosema molle*, Point Gourde, 16 May, 1999; photographed 16 May (below, left), 20 May (below, right); pupated 25 May; 25mm; 99/5.

Four days after preparing the above description, the caterpillar was preparing to pupate in a shelter formed from several leaves spun together against the side of the rearing container. Two days later it pupated, and was supported in position with the cremaster hooked on a crossbar of silk and a Y-shaped silk girdle, the remains of which are visible in Fig. 12. The pupa (Fig. 12) measured 17mm long; it was brown, paler on wings and thorax, spiracles dark; lightly covered with white waxy powder (considerably less so than that of *U. proteus* in Fig. 9). An adult male emerged after 14 days.

Fig. 12. Pupa of *Urbanus esmeraldus*, lateral view; collected as final instar on *Centrosema molle*, Point Gourde, 16 May, 1999; pupated 25 May; photographed 26 May; adult 8 June; 17mm; 99/5.

***Urbanus dorantes dorantes* (Stoll, 1790)**
Figs. 13-14.

All the records of food plants listed in Beccaloni *et al.* (2008) are Fabaceae, apart from that of Riley (1975) of *Hyptis pectinata* (Labiatae) of what Riley (1975), Smith *et al.* (1994) and some authors treat as *U. obscurus* (Hewitson), but Mielke (2004), Beccaloni *et al.* (2008) and other authors treat as *U. dorantes obscurus*; either way this record is most likely an error. Judging from more than 200 records in Janzen and Hallwachs' (2014) database of rearing in Costa Rica, *U. dorantes* is a specialist on *Desmodium* spp., with only two records from another Fabaceae. Cock (1986) describes the caterpillar and pupa found on *Desmodium incanum* in Trinidad.

In October 1993 the author observed a female ovipositing on *Desmodium tortuosum* at Point Gourde (93/36). Eggs were laid on old flowers from which the petals had dropped, and once on the hairs of the petiole of a very small leaf (Fig. 13).

Fig. 13. *Urbanus dorantes* ovipositing on *Desmodium tortuosum*, Point Gourde, 16 October, 1993, 93/36.

The egg (Fig. 14) was rounded with a flat base and the micropyle slightly indented; micropyle surrounded by eight polygons (mostly pentagons); extending from these 13 strong ribs, joined by two lateral ridges above and below the middle; the egg chorion was transparent and glossy. When newly laid, eggs are pale green and quite easy to see with the naked eye.

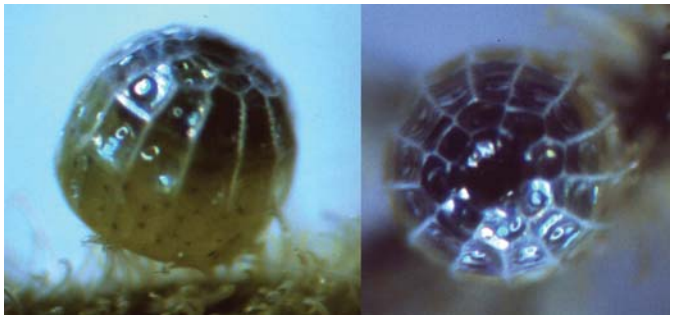

Fig. 14. Ovum of *Urbanus dorantes* laid on *Desmodium tortuosum*, Point Gourde, 16 October, 1993, 93/36; lateral view (left) and dorsal view (right).

***Urbanus simplicius* (Stoll, 1790)**
Figs. 15-17.

The food plants of this common and widespread species (Fig. 15) are Fabaceae, particularly species of *Calopogonium*, *Centrosema* and *Vigna* (Beccaloni 2008; Janzen and Hallwachs 2014).

Fig. 15. Male *Urbanus simplicius*, Rio Claro-Guayaguayare Road, 7.0-7.5km, 9 October, 2011.

Fig. 16. Penultimate instar caterpillar of *Urbanus simplicius* collected on *Vigna lasiocarpa*, Manzanilla Beach Cocal, 14 November, 1995; photographed 14 November; moulted to final instar 18 November; 18mm; 95/73.

Fig. 17. Final instar caterpillar of *Urbanus simplicius* collected on *Vigna lasiocarpa*, Manzanilla Beach Cocal, 14 November, 1995; moulted to final instar 18 November; photographed 25 November; 24mm; died; 95/73.

Cock (1986) described the biology of this species in Trinidad on kudzu, *Pueraria phaseoloides* (Fabaceae). Since then I have found a penultimate instar caterpillar (Fig. 16) on *Vigna lasiocarpa* (= *Phaseolus pilosus*; Fabaceae; MJWC 234) at Manzanilla Beach Cocal, November 1995 (95/73). Although it was not successfully reared beyond the final instar (Fig. 17), careful comparison with my earlier notes and material and with Janzen and Hallwachs (2014) convinces me it is this species.

***Astraptes* Hübner [1819]**

The early stages of the species presented here include several species with early stages similar to those of the *Urbanus* spp. presented here, i.e. with green bodies, dorsal and dorsolateral lines, a brown head and yellow, orange or red eye-spots. However, *A. talus* and *A. fulgerator* have very different caterpillars having a dark body with bright yellow bands.

All of the other species recorded from Trinidad (Cock 2014a) have been reared in Costa Rica feeding on Fabaceae: *A. apastus* (Cramer) has a red caterpillar with yellow bands, a black head with red eye-spots and feeds on *Dioclea* spp.; *A. enotrus* (Stoll) has a yellow-green caterpillar with diamond markings dorsally, a black head with red eye-spots and feeds mainly on *Lonchocarpus* spp.; and *A. janeira* (Schaus) is dull grey-green with a dorsal row of 3-4 heart shapes, a dark head with light brown eye-spots and feeds on *Lonchocarpus* and *Machaerium* spp. (Janzen and Hallwachs 2014).

***Astraptes talus* (Cramer 1777)**

Fig. 18.

Cock (1988) was not aware of the biology of this rare species in Trinidad. However, its food plants have been reported as several *Mucuna* spp. and *Canavalia ensiformis* (Fabaceae) as well as *Guarea* sp. (Meliaceae) and *Paullinia* sp. (Sapindaceae) (Beccaloni *et al.* 2008). However, Brévignon and Brévignon (2003), Resende *et al.* (2009), Turner *et al.* (2009) and Janzen and Hallwachs (2014) have only reared it from Fabaceae, notably *Mucuna* spp. and the other host plant records are considered to need confirmation (Brown and Heineman 1972). The early stages have been illustrated by Brévignon and Brévignon (2003), Resende *et al.* (2009), Turner *et al.* (2009) and Janzen and Hallwachs (2014), and on the basis of the first of these, I identified Fig. 18 as being of a young caterpillar of this species (Cock 2006).

The author collected small caterpillars on *Mucuna rostrata* (MJWC 229) on Mt. Tamana in November 1995 (95/66). Within a few hours of being detached, any damage to the food plant leaves turned black and within three days the detached leaves were completely black and the caterpillars would not accept several other Fabaceae offered and could not be reared. The leaf shelters were a simple fold under from the leaf edge, basal to where the caterpillar had fed, about 20 x 8mm long x wide, so that the original lamina edge of the flap was positioned at right angles to the leaf midrib. The caterpillars are similar in all instars (Turner *et al.* 2009); the individual in Fig. 18 measured 10mm and was probably in the third instar. The head was oval, indented at the vertex; shiny; very slightly rugose; plain black; covered with short dark setae. T1 black. Body black, with double yellow lines on the posterior margin of T2-A8.

Fig. 18. Young caterpillar of *Astraptes talus*, collected on *Mucuna rostrata*, Mt. Tamana, 12 November, 1995; 10mm; 95/66A.

***Astraptes fulgerator fulgerator* (Walch 1775)**

Figs. 19-22.

This species is reported to feed on Fabaceae and a selection of other families through its wide range in Central and South America (Beccaloni *et al.* 2008). Hebert *et al.* (2004) found that in Costa Rica this name represented a complex of at least ten look-alike species with different caterpillars and food plants. Similar investigations have yet to be reported from South America. Because of this new information, the true identity of *A. fulgerator*, which was described with no type locality, becomes uncertain. Amongst its assumed synonyms is *A. fulminator* (Sepp), which was described with its early stages on a *Cassia* sp. from Surinam (Sepp 1829-1843, plate 34). These match the early stages illustrated here from *Senna bacillaris* (=

Fig. 19. Leaf shelter of premoult penultimate instar *Astraptes fulgerator fulgerator* on *Senna bacillaris*, Point Gourde, 16 October, 2011; 11/55.

Cassia fruticosa), and since many former *Cassia* spp. are now placed in *Senna*, it seems safe to anticipate that Sepp described the same morphological and biological species. The early stages of the species treated by Moss (1949) at Belem, Brazil, also seems very similar. The types of both *A. fulgerator* and *A. fulminator* are thought to be lost (Pelham 2008), but in the interests of stability, it would seem desirable to define *A. fulgerator* as this taxon and life history.

Fig. 20. Penultimate instar caterpillar of *Astraptes fulgerator fulgerator*, collected as n-3 instar on *Senna bacillaris*, Mt. Tamana, 12 November, 1995; 19mm; 95/59A.

Fig. 21. Final instar caterpillar of *Astraptes fulgerator fulgerator*, collected on *Senna bacillaris*, above St. Benedict's, 12 October, 1993; photographed 12 October; pupated 19 October; 43mm; 93/14.

Only one food plant and one form of caterpillar has been found for this species in Trinidad, so for now it is assumed to be represented by just one species here. Cock (1988) described the early stages from *Senna bacillaris* in Trinidad. Figures from more recent rearings are now provided to support this (Figs. 20-22).

Fig. 22. Pupa of *Astraptes fulgerator fulgerator*, lateral view, collected on *Senna bacillaris*, above St. Benedict's, 12 October, 1993; pupated 19 October; photographed 19 October; 27mm; 93/14.

The young caterpillars make a two-cut shelter with a tuck, similar to those of other species presented here (e.g. Fig. 6). Later they make a simple shelter by folding over part of one-half of a leaflet (Fig. 19), or between two leaflets (Curepe, 81/19A). The final instar caterpillar may not make a shelter – the only final instar that I have found in the field had not done so (above St. Benedict's, 93/14).

***Astraptes alardus alardus* (Stoll 1790)**

Figs. 23-25.

The food plant records for this species are almost entirely of *Erythrina* spp. (Beccaloni *et al.* 2008; Janzen and Hallwachs 2014). Cock (1988) describes two forms of the caterpillar found on *Erythrina poeppigiana* in Trinidad, the normal or common form, which matches the photos of this species in Janzen and Hallwachs (2014), and a variant only seen once. In the early 1980s this species seemed to be common, and I found caterpillars repeatedly; since

Fig. 23. Adult female *Astraptes alardus*, collected as final instar caterpillar on *Erythrina poeppigiana*, Mt. Tamana, 13 July, 1997; adult 9 August; 97/203.

then I have only reared it once from a caterpillar of the common form (Mt. Tamana, 97/203), which is illustrated here (Figs. 23-25).

Fig. 24. Final instar caterpillar of *Astraptes alardus*, collected on *Erythrina poeppigiana*, Mt. Tamana, 13 July, 1997; photographed 13 July; pupated 21 July; 42mm; 97/203.

Fig. 25. Pupa of *Astraptes alardus*, collected as final instar caterpillar on *Erythrina poeppigiana*, Mt. Tamana, 13 July, 1997; pupated 21 July; photographed 23 July; adult 9 August; 27mm; 97/203.

***Astraptes alector hopfferi* (Plötz 1881)**

Figs. 26-29.

The limited food plant records for this species are of *Platymiscium* spp. in Costa Rica and *Bauhinia divaricata* (both Fabaceae) in Mexico (Beccaloni *et al*. 2008). Janzen and Hallwachs (2014) reared this species nearly 400 times from *Platymiscium* spp. and only twice from *Lonchocarpus*. The biology in Trinidad had not been reported (Cock 1988), and although the food plant record below is listed as a pers. comm. in Beccaloni *et al*. (2008), the following are new observations.

Two penultimate instar caterpillars were collected on *Platymiscium trinitatis* (MJWC 258) at Inniss Field, May 1999 (99/12). One (99/12B) was newly moulted and found in a two-cut triangular flap, similar to that shown in Fig. 6. The other, which moulted to the final instar two days later, was in a simple shelter made by rolling a flap over upwards from the edge of a leaf.

Fig. 26. Adult male *Astraptes alector*, Mt. Tamana, 14 October, 1995 (resting on the handle of my butterfly net).

The larger of the two (99/12A) measured 25mm (Fig. 27). Head oval, indent at vertex; dark shiny brown, small red eye-spots anterior to the stemmata; covered with very short, pale setae. T1 red; pronotum brown. Body dull dark green, smooth and shiny; laterally a broad longitudinal stripe of irregular spots and blotches of bright yellow, from

Fig. 27. Penultimate instar caterpillar of *Astraptes alector*, collected on *Platymiscium trinitatis*, Inniss Field, 17 May, 1999; photographed 20 May; moulted 22 May; 25mm; 99/12A.

Fig. 28. Final instar caterpillar of *Astraptes alector*, collected as penultimate instar on *Platymiscium trinitatis*, Inniss Field, 17 May, 1999; moulted 22 May; photographed 24 May; pupated 4 June; 27mm; 99/12A.

an irregular yellow dorsolateral line to just above prolegs; in line with dorsolateral line and orange marking; anal plate bordered with orange, especially strong laterally; T1-T3 red ventrally, grading to green by A8; legs and prolegs red; spiracle T1 red, other spiracles yellowish. The final instar was similar (Fig. 28).

Pupation was between two leaves, and the pupa (Fig. 29) was suspended by a Y-shaped silken girdle and the cremaster attached to a cross-bar of silk.

Fig. 29. Pupa of *Astraptes alector*, collected as penultimate instar caterpillar on *Platymiscium trinitatis*, Inniss Field, 17 May, 1999; pupated 4 June; photographed 6 June; adult 22 June; 21mm; 99/12A.

Astraptes anaphus (Cramer 1777)

Figs. 30-35.

Evans (1952) and Cock (1988) treated this species as occurring in two subspecies in Trinidad. *Astraptes anaphus anetta* Evans (Fig. 30) has more extensive yellow markings than *A. anaphus anoma* Evans (Fig. 31) and females have more extensive yellow than males (see Cock

Fig. 30. Adults of *Astraptes anaphus anetta*. **Top**, male collected as final instar caterpillar on *Mucuna* sp. (*pruriens* or *sloanei*), Point Gourde, 16 October, 1993; adult 26 November; 30mm; 93/30. **Bottom**, female at *Bidens* flowers, Palo Seco, 7 October, 1995.

Fig. 31. Adults of *Astraptes anaphus anoma*. Female, Point Gourde, 16 October, 2011; 11/52.

1988 for details). Cock (1988) suggested these might be better treated as forms than subspecies, and that breeding the two would clarify their status. Although this species has now been reared from Trinidad (below), more observations are needed to address this point.

The caterpillars of this species have been recorded from various Fabaceae vines including species of *Canavalia, Mucuna, Phaseolus, Pueraria, Vicia* and *Vigna* (Beccaloni *et al.* 2008), whereas *Phaseolus lunatus* and *Mucuna pruriens*, the two commonest food plants in Janzen and Hallwachs (2014), account for almost all of their rearings of ssp. *anetta*. Published records from Trinidad include *Amphicarpaea bracteata?* (S. Alston-Smith pers. comm. in Beccaloni *et al*. 2008).

Cock (1988) did not know the life history, but observed an oviposition event on *Chromolaena odorata* (Asteraceae) in Trinidad, and suggested that the female made an error for the Fabaceae vine growing intermingled with the *C. odorata*. Subsequent observations (above) indicate that such vines are the normal food plants.

Since then, I have reared a male of ssp. *anetta* once from a *Mucuna* sp. (*sloanei* or *pruriens*) at Point Gourde (93/30), and found a very similar caterpillar on *Centrosema plumieri* (MJWC 302) at Inniss Field (04/27). The shelter of the latter was made by moving the terminal leaflet diagonally over an

Fig. 32. Leaf shelter of final instar caterpillar of *Astraptes anaphus* (?) on *Centrosema plumieri*, Inniss Field, 16 January, 2004; 04/27.

adjacent one and tying it with silk threads as shown in Fig. 32.

The following is based on the first of these, except as indicated. The final instar caterpillar (Fig. 33) measured 30mm when collected, ten days before it pupated. Head rounded, indent at vertex; shiny, rugose; dark brown, yellow-orange eye-spot anterior to the stemmata; covered with short, pale, erect setae. T1 dark brown, red laterally. Body dark translucent green, covered with a network of fine yellow lines; narrow dorsal line clear, darker; narrow yellow dorsolateral line; all legs red.

Fig. 33. Final instar caterpillar of *Astraptes anaphus anetta*, collected on *Mucuna* sp. (*pruriens* or *sloanei*), Point Gourde, 16 October, 1993; photographed 16 October, pupated 26 October; 30mm; 93/30.

The caterpillar from *Centrosema plumieri* at Inniss Field (04/27) measured 31mm and differed in that T1 was black for the dorsal half and pale red for the ventral half; there was a rather conspicuous orange marking on the dorsolateral line at A8, and the spiracles were reddish (Fig. 34). This does not match any of the other recorded species of *Astraptes* from Trinidad, so it is assumed to be *A. anaphus*. However, whether the differences reflect individual variation, sexual dimorphism or a difference between the two subspecies of *A. anaphus* in Trinidad will have to be established by further rearing.

The pupa (Fig. 35) measured 24mm; reddish brown with a very light bloom of white waxy powder, speckled on abdomen; spiracle T1 black, arc-shaped and slightly prominent; black spots ventrally and ventrolaterally just in front of cremaster. The pupal period was 21 days.

Fig. 34. Final instar caterpillar of *Astraptes anaphus* (?), collected on *Centrosema plumieri*, Inniss Field, 16 January, 1993; photographed 17 January, preserved; 31mm; 04/27.

Fig. 35. Pupa of *Astraptes anaphus anoma*, collected as final instar caterpillar on *Mucuna* sp. (*pruriens* or *sloanei*), Point Gourde, 16 October, 1993; pupated 26 October; photographed 28 October; adult 16 November; 24mm; 93/30.

Narcosius Steinhauser, 1986

This small genus was separated from *Astraptes* by Steinhauser (1986), and subsequent observations of the early stages support this split. In addition to Celastraceae reported below for *N. colossus*, the food plants for *N. parisi*, another Trinidad species, are Sapindaceae, especially *Paullinia* spp. and *Serjania* spp. (Janzen and Hallwachs (2014).

***Narcosius colossus* (Herrich-Schäffer 1869)**
Figs. 36-37.

Moss (1949) thought this species fed on *Inga* (Fabaceae) or *Virola* (Myristicaceae), having found shelters on mingled foliage. In contrast, Janzen and Hallwachs (2014) reared this species from Celastraceae only: over 500 records from *Maytenus* spp. and two from *Gymnosporia haberiana*. The early stages of this species were not known to Cock (1988) and the following are new observations for Trinidad.

Two shelters with final instar caterpillars were found on *Maytenus tetragona* (MJWC 304) in Inniss Field, January 2004 (04/33); one was preserved, and the other reared through by S. Alston-Smith and the specimen is now in the author's collection. The shelters were formed by pulling two leaves together to partially overlap, and held in place by visible strands of silk (Fig. 36).

Fig. 36. Shelter containing final instar caterpillar of *Narcosius colossus* on *Maytenus tetragona*, Inniss Field, 16 January, 2004; 04/33.

The final instar caterpillar (Fig. 37) measured 28mm when collected. Head rounded, quite strongly indent at vertex; shiny, rugose; chestnut brown ground colour; a yellow line from apex laterally to just in front of stemmata; a second yellow line from apex, parallel to epicranial suture and overlapping dorsal part of frons; a third line branches from the first at about one-third of the distance from the apex, to end close to the lower end of the second line. T1 pale brown with orange tint; pronotum broad, translucent pale brown. Body yellow-khaki green; narrow almost black dorsal line; dorsolateral line comprising a short orange line on each segment, the anterior part dorsal to the posterior part of the preceding segment: T3 faint, A1-A7 strong, A8 thicker; spiracles yellow-brown; legs translucent pale brown-orange; prolegs concolorous; anal plate with a strong orange tint.

Fig. 37. Final instar caterpillar of *Narcosius colossus* collected on *Maytenus tetragona*, Inniss Field, 16 January, 2004; 28mm; 04/33.

DISCUSSION

In nearly all cases, the early stages documented here match those illustrated by Janzen and Hallwachs (2014) for the same species in Costa Rica. Since most of my information is based on a very small number of individuals, the fact that those of Janzen and Hallwachs (2014) are based on hundreds for each species, gives reason to think that the early stages are consistent both locally and between regions. The obvious exception is *Astraptes fulgerator*, which in Trinidad seems to be a single entity with one food plant, *Senna bacillaris*, whereas in Costa Rica the name is now known to be at least ten species with consistently different caterpillars and food plants (Hebert *et al.* 2004), none of which match the Trinidad population.

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CORRECTION TO THE 2014 ISSUE OF LIVING WORLD.

Article by Matthew J.W. Cock on "Observations on the biology of skipper butterflies in Trinidad, Trinidad and Tobago: *Phocides, Chioides, Typhedanus*, and *Polythrix* (Hesperiidae, Eudaminae)." Pp. 1–11.

On pp. 7 and 8, Figs. 18 and 19 of specimen 03/205 are *Polythrix roma*, and not *P. octomaculata* as stated. Accordingly, the food plant record of *Lonchocarpus benthamianus*, and the text on p. 7, column 2 should refer to *P. roma* not *P. octomaculata*. The remainder of the section on *P. octomaculata* remains valid. The minor differences between Fig. 19 and Fig. 26 reflect individual variation in the colouring of the pupa of *P. roma*.