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Front: *Iolaus (Iolaphilus) trimeni* Wallengren Adult female [Photo J. Joannou]Back: *Iolaus (Iolaphilus) trimeni* Wallengren larva [Photo S. E. Woodhall]

EDITORIAL

Whenever reflecting on life, and thinking about what has been achieved and what is still to be achieved, I am invariably struck by how easily I can compartmentalise the different aspects of my life into neat little cells. One cell may be the relationship I have with my wife, or my children or my friends, another may be my career or the time spent as a student or a quest to find a certain rare geometrid. In one cell I may have been a roaring success and another a dismal failure. Certain cells have lasted the length of my life and others have been over in a day or two. I have on occasion, been tangled up in one cell and wasted years because of my inability to close that cell, or I may have closed a cell far too soon and in so doing squandered a rare opportunity. Certainly most cells have a clearly defined beginning and end. I am always busy with a number of cells at any given moment and certainly activities in one cell have influenced the others. Often, my behaviour may be radically different when operating in one cell to operating in another, which probably gives credence to the accusations referring to my wearing of different hats. All these cells, those that are active as well as those that have been closed, put together, form the whole that is me.

When I was asked, by the council of the society in 1994, to consider taking over the editorship of *Metamorphosis*, I gave it a lot of thought. I knew that should I accept the offer to open this new cell in my life, it would take up a lot of my time. I also came to the conclusion that opening this cell would have tremendous benefits to me and that the experience gained would be essential for me in order to realise goals that I have in other Lepidopteran cells in my life. I went back to the council and said that I would accept the offer for a five year term, if they would have me for that long. I have never regretted that decision. In fact the exposure has been my university. It has, and will still, open up many doors for me that would never have been available had I not entered this cell in my life. I came into contact with many other lepidopterists, some of whom have become dear friends, I learnt a tremendous amount about publishing scientific information and the human interrelationships in achieving such publications. I am truly blessed that I have been given this opportunity. In fact, time has passed so quickly that I can hardly believe that my term will expire at the end of next year. I still have a number of ambitions regarding *Metamorphosis* that I aim to achieve in my remaining time as editor. One of my responsibilities is to find a suitable successor. Someone who will continue the evolution of our journal and make it grow into something far better than what it is now. This is a rare opportunity for some member of our society. If you think that you are up to the challenge of taking over the reigns and guiding *Metamorphosis* to new heights in the next millennium, please contact me now so that we can have a period of working together next year in order to ensure a smooth transition.

Hermann Staude

PRESIDENTS COMMENT

The new season has started and the rain is falling. The rains will hopefully make this a good season. I hope your season will be as full and varied as mine threatens to be. There is great interest in the conservation of butterflies from many quarters of South Africa, the momentum from the Brenton Blue Campaign's success must be maintained. Keeping a high profile for butterflies and moths will not be easy. Some companies in South Africa are using butterflies in their marketing, this will keep the interest high but we must continue in our efforts to promote butterflies at every opportunity.

One company Zeltis Holdings Ltd, a financial management company, have found that *Zeltis* is the generic name of a long-tailed blue lycaenid from Malaysia. They have used a male *Iolaus silarus* in their marketing plan.

I wish all our members a productive season ahead and hope that you will make wonderful discoveries in whatever sphere of lepidopterology that you tackle.

Graham Henning

**NOTES ON THE GENUS *KEDESTES* WATSON (LEPIDOPTERA:
HESPERIIDAE) WITH A DESCRIPTION OF A NEW SPECIES FROM SOUTH
AFRICA**

By G.A. and S.F. Henning

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Abstract: *Kedestes sarahae* sp. n. from the Western Cape is described with notes on habits and distribution. Keys to the species groups of *Kedestes* and the *Kedestes nerva* group are also provided.

Genus *Kedestes* Watson

Kedestes Watson, 1893. *Proc zool. Soc. Lond.* 1893:96.

Type species: *Hesperia lepenula* Wallengren, 1857, by original designation.

Small to medium-sized skippers with strong bodies and narrow forewings. Antennae half length of costa, club straight and blunt or with a very short obtuse apiculus. Distal segment of palpi horizontally porrect. Fore-wing vein CuA₁ arising from midway between wing base and end of cell; vein M₂ bent down at origin. Hindwing with lower end of cell slightly bent up; vein M₂ well marked and slightly bent down at its origin; vein Rs arising almost opposite vein M₂; vein 1A+2A long.

Species recorded appear to use grass (Poaceae) as their host-plants (Henning et al, 1997).

There are twenty four species of *Kedestes* (Ackery et al, 1995), eleven species occur in South Africa. The genus *Kedestes* can be divided into four species groups, the new species described in this paper belongs to the *Kedestes niveostriga* species group (Evans, 1937, 1955).

KEY TO SPECIES GROUPS OF *KEDESTES*

1. Antennae black below, whitish under club. At least UFW with a distinct row of red, reddish-yellow or whitish submarginal markings *K. nerva* group
Antennae pale or chequered below. No submarginal markings 2
2. Antennae with pointed apiculus. LHW with black edged white spots
..... *K. callicles* group
Antennae without pointed apiculus. LHW without black edged white spots.. 3
3. UHW unicoloured dark brown or with, at most, a single white discal spot; LHW with longitudinal whitish streaks or whitish along veins
..... *K. niveostriga* group
UHW at least with one yellow spot in centre; LHW without white longitudinal streaks or white veins *K. lepenula* group

KEY TO THE *K. NIVEOSTRIGA* SPECIES GROUP

1. Cilia chequered *K. barberae* Trimen
 Cilia not chequered 2
2. Fore-wing with discal spot in area M1 *K. sarahae* sp. n.
 Fore-wing without discal spot in area M1 3
3. LHW with white longitudinal white stripe *K. wallengrenii* Trimen
 LHW without longitudinal white stripe 4
4. Fore-wing markings well developed *K. niveostriga* Trimen
 Fore-wing markings not well developed 5
5. LHW without markings 6
 LHW with faint ferruginous lines enclosing spots of ground colour
 *K. straeleni* Evans
6. Fore-wing with three subapical spots *K. brunneostriga* Plotz
 Fore-wing with two, or less, subapical spots *K. lenis* Riley

***Kedestes sarahae* sp. n. Plate 1.**

This species was discovered by Jonathan Ball flying at high altitude in the Cedarberg Mountains of the western Cape.

DESCRIPTION

Male. Fore-wing length: 15-18,5 mm, mean 17,1 mm (n=3); antenna-wing ratio 0,36-0,40, mean 0,38 (n=3). Wings, upperside. Fore-wing: dark blackish-brown with distinct white spots as follows: a narrow white spot at end of cell; a rectangular mark discally in area CuA₁; a double spot in CuA₂; three small subapical spots in R₃-R₅, with an additional spot more distal in M₁; a large postdiscal spot in M₃; cilia plain pale greyish-brown. Hind-wing: dark blackish-brown with a faint discal mark in M₁; cilia plain greyish-brown. Underside. Fore-wing: dark brown with white markings as on upperside, with spot in M₁ blending into greyish-white submarginal patch from apex to M₂; cilia plain greyish-brown. Hind-wing: dark brown crossed by two white longitudinal lines extending from subbasal area to outer margin, that in M₂ having a small break medially, while that in CuA₂ is complete; cilia plain greyish-brown. Genitalia: uncus elongate triangular flattening distally; tegumen angled anteriorly at centre, saccus small; valva broad and quadrate, bilobed, lower lobe with cornuti

distally, angled distally; gnathos with cilia and cornuti; aedeagus short and narrow, open dorsally for half of upper portion, vesica with small cornuti.

Female. Fore-wing length: 26,5-28 mm, mean 27,5 mm (n=6); antenna-wing ratio 0,28-0,30, mean 0,29 (n=6).

Female. Similar to the male but much larger with more elongated wings. Hind-wing upperside with long narrow discal streak in M₁

Material examined

Types. Holotype ♂, SOUTH AFRICA: Cedarberg, 1530 m, Western Cape Province, 20.ix.1997, Dr. J. Ball. Paratypes 1♂ 6♀ same data. Holotype in the Transvaal Museum, Pretoria. Paratypes in the collections of Dr. J. Ball and W.H., S.F. & G.A. Henning.

Habitat and habits

Dr. Ball states that *K. sarahae* was found amongst mountain fynbos at an altitude of about 1530 m in an isolated portion of the Cedarberg Mountains. They were found flying in association with fairly dense stands of what he thinks is mountain wire grass, a *Merxmuellera* species. They were not plentiful at any one place and were seen here and there over a distance of about three kilometres. Their flight was fairly fast, and they were difficult to follow due to the tall grass. The females settled on the grass but no oviposition was observed. They were probably at the end of their flight period as there were more females than males.

DISTRIBUTION

Only found at the type locality in the Cedarberg Mountains, Western Cape.

DIAGNOSIS

At first glance it would appear that this species is a subspecies of *K. barberae*, but some very important characters indicate a specific distinction.

K. sarahae differs importantly from *K. barberae* by the plain cilia and more rounded wing shape. Other differences are the dark brown ground colour, particularly on the hind-wing underside; the absence of markings on the costa of the fore-wing underside; hind-wing upperside with only a narrow white streak; white markings on hind-wing underside restricted to two regular longitudinal lines.

K. barberae has been divided into three subspecies all of which have very elongated wings, chequered cilia, similar brown ground colour on upper and undersides, a mark which is often rounded on the hind-wing upperside, arrow marked irregular white markings on hind-wing underside and a white mark on the costa at the end of the cell of the fore-wing underside. The differences evident in *K. sarahae* with regard to these features indicate that this species, while a sister species, has been isolated from *K. barberae* for a considerable time. Some of these features such as the rounder wing shape, plain cilia, lack of costal mark and regular longitudinal lines on the hind-wing underside indicate affinities with *K. wallengrenii*.

The male genitalia are similar to those of *K. barberae* indicating the close relationship between these two species. *K. sarahae* differs from *K. barberae* as follows: aedeagus 80% as long; lower lobe of valve broader, not extended ventrally, not acutely angled at apex and much smaller dorsal cornuti; upper lobe strongly angled, not rounded, with a dense tuft of hair; valve much broader and shorter; saccus larger; gnathos not as sharply angled and with cornuti present.

ETYMOLOGY

This species is named after Jonathan Ball's daughter Sarah Louise Ball.

Acknowledgements

Our thanks to Jon Ball for allowing us to describe this species and for providing comparative material and information.

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A



B



C



D

Plate 1. *Kedestes sarahae* sp. n. adults: a- male upperside, b- female upperside, c- male underside, d- female underside

**THE BEHAVIOURS AND MORPHOLOGY OF THE PRE-IMAGINAL STAGES
OF *IOLAUS (IOLAPHILUS) TRIMENI* WALLENGREN (LEPIDOPTERA:
LYCAENIDAE)**

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Abstract: Oviposition behaviours of females of *Iolaus trimeni* Wallengren were studied in the Magaliesberg, South Africa, and adults were reared from collected eggs. Pre-imaginal stages were studied by means of dissecting and scanning electron microscopy. Eggs were laid, usually singly, on *Tapinanthus rubromarginatus* (Loranthaceae), a hemiparasite of mainly *Protea caffra* (Proteaceae). Larvae took 10 days to hatch and completed four instars in 18 days. In the first two larval instars troughs were eaten out of the leaf surface, thereafter larvae fed from the edges. The pupal stage lasted 14 days. Eggs were covered with a sticky yellow substance that may protect them from parasitoid attack. Hair-like (primary) setae and discoid (secondary) setae were present in the first instar larva, but only discoid setae in subsequent larval instars. Perforated cupola organs were present in all larval instars and in pupae. The dorsal nectar organ was present from the second larval instar and tentacle organs in the third and fourth. Two specialized types of setae, not found in the larva, occurred on the pupal surface. The shape and surface sculpturing of the egg were very different from those of other subgenera of *Iolaus* for which the egg is known. The discoid larval setae were similar to those of species in the subgenera *Epamera* and *Stugeta*.

Key Words: *Iolaus*; *Iolaphilus*; host-plants; oviposition; egg; larva; pupa; immature stages; SEM, South Africa.

INTRODUCTION

The Afrotropical lycaenid genus *Iolaus* Hubner is large, containing about 120 species (Ackery *et al.*, 1995). Ten subgenera are currently recognised. *Iolaus trimeni* belongs in the subgenus *Iolaphilus* Stempffer and Bennett comprised of eight species. Apart from *I. trimeni*, the early stages of which have been briefly recorded (Henning 1983, 1984), none of the other species belonging to this subgenus appear to have had anything in regard to their early stages published. Scanning electron microscopical studies of the early stages have not been published for any species of *Iolaus*.

This paper is a detailed account of the morphology and behaviours of the preimaginal stages of *I. trimeni*, including a scanning electron microscopical study of the egg, each of the larval instars, and the pupa. Oviposition behaviours of females are also reported.

MATERIALS AND METHODS

The pre-imaginal stages of *I. trimeni* were studied in a population of the butterfly at Hornsnek (25.41 S 28.04E) in the Magaliesberg, Gauteng Province, South Africa. Oviposition behaviour of females of *I. trimeni* was observed at this locality, and eggs and larvae were collected for laboratory studies. The early stages were kept, individually, in glass or plastic containers at ambient temperatures (12° to 28°C). A dissecting microscope was used to obtain data on the morphology of the early stages and on the behaviour of the larvae. Laboratory observations were made at least once a day, and the findings recorded.

For scanning electron microscopy, specimens of the early stages were killed by immersion in hot water (approximately 75°C), after which they were cleaned, then fixed in 2,5% glutaraldehyde, buffered in 0,1 M sodium cacodylate, pH 7,3. The yellow coating on the egg was removed by means of 70% aqueous ethyl hydroxide and a fine brush. Cleaning of larvae and pupae was performed by placing the specimens in 0,5% NaOCl for 30 min., after which they were washed three times (15 min. per wash) in double-distilled water. Using fine-haired and single-haired brushes, slime and detritus were removed while in the NaOCl, as well as after each rinse in double-distilled water, under a dissecting microscope. After cleaning and fixation the specimens were dehydrated in an ascending series of ethanol (50, 70, 90, 95 and 3 x 100%). The duration for each step was 60 min. (eggs and larvae) or 120 min. (pupae). Samples were transferred to a critical point drier in 100% ethanol and dried through liquid CO₂. After critical point drying the specimens were mounted onto brass SEM stubs with Japan Gold Size (Winsor & Newton, London) and viewed under a dissecting microscope for final cleaning with a single-haired brush. Samples were then sputter-coated with gold and examined in an Hitachi S-2500 Scanning Electron Microscope, using 3 to 5 kV acceleration voltage. Electron micrographs were recorded on 120 format Ilford FP-4 and FP-4 Plus film (Ilford Ltd, Mobberly, Cheshire, England). Development was in Ilford Ilfotec-HC, using a 1:15 dilution for 4 min. 45 sec. for the FP-4 film and 1 :30 dilution for 6 min. for the FP-4 Plus film.

RESULTS

Behavioural and Temporal Aspects

On several occasions females of *I. trimeni* were observed ovipositing on *Tapinanthus rubromarginatus* (Engl.) Danser (Loranthaceae) at the study site. This hemiparasitic plant grew mainly on *Protea caffra* Meisn. (Proteaceae) but occasional clumps of the plant were also present on *Englerophytum magalismontanum* (Sond.) Heine & J.H. Hemsl. (Sapotaceae). Specimens of the immature stages of the butterfly were found mainly on larval host-plant growing on *P. caffra* but were also found, rarely, on *T. rubromarginatus* parasitising *E. magalismontanum*.

When searching for an oviposition site females hovered in and out of the branches of the proteas and appeared to use visual cues to find the bunches of larval host-plant growing on the branches of the protea trees. On encountering the

host-plant females flew around it and alighted on the twigs. Eggs were usually laid singly on the twigs and leaves of young shoots of the host-plant; rarely two eggs were laid side by side. Although the eggs were small, their bright yellow colour made them very conspicuous on the reddish shoots and young leaves of the host-plant.

Larvae took 8 to 10 days to hatch from the eggs. A circular hole, large enough to allow the larva to escape, was eaten out of the top of the egg-shell. The discarded shell was not eaten by the larva. In the first larval instar, which took about five days, larvae fed on the surface parenchyma of young leaves, leaving a small trough in the surface of the leaf as they moved backwards. When not feeding larvae usually rested in the troughs they had created. Before the first moult, as well as before subsequent moults, larvae spun a fine, silk pad on the surface of a leaf or twig, to which they clung during the moult. The discarded larval skin, including the head capsule, was consumed by the larvae, in this and subsequent larval instars.

The second larval instar lasted two to three days. As in the first instar larvae fed, initially, by forming troughs in the leaf surface. Towards the end of the second instar, and in later instars, larvae fed from the edges of the leaves. They did this by wrapping the fleshy first segment of the body around the edge of a leaf, thereby completely obscuring their heads.

The third larval instar lasted about three days. Larvae fed on the edges of the leaves, often beginning at the tip of a leaf and consuming it entirely. The fourth (final) larval instar was completed in about four days. The larvae fed on the whole leaf, as in the late second and the third larval instars. The larval stage lasted a total of 18 to 20 days. Before pupating, larvae spun a silk pad, on a leaf or twig, to which the cremastral hooks were attached; then shrank, and changed colour. The dark-brown areas on the body surface of the larva became green, and the white areas turned pale-orange, and later deep-orange, especially in the thoracic region. A silken girdle was absent. The prepupal stage took two or three days.

The duration of the pupal stage was about 14 days. The pupa was found to be partially mobile; when disturbed the anterior end was rapidly tapped against the substrate to which the pupa was attached. The generation interval in spring, (September-October), was about six weeks (egg 10 days; larva 18 days; pupa 14 days).

Morphological Aspects

Egg (figs 1-3): White, but more or less completely coated with a bright yellow, sticky substance. Minute particles of dust and dirt usually found adhering to coating when viewed under a dissecting microscope.

Shape a flattened dome, 0.88 mm in diameter at the base and 0.54 mm high (figs 1 & 2). Base of egg circular; sides curving upward and inward, terminating in a dorsal lip encircling a central depression. Margin of dorsal lip with unevenly spaced, irregular, black perforations of different sizes (figs 1 & 2). Surface of egg delicately patterned by conjoined, uneven-sided hexagonal and polygonal cells bordered by low ridges. Micropylar area (fig. 3) in centre of dorsal, circular depression. Consists of several, minute, central perforations, surrounded by ridged, petal-shaped cells;

followed by a series of concentric, rhomboid cells; finally, by a ring of scattered perforations of various sizes.

First instar larva (figs 4 - 7): On hatching 1 mm long; growing to 2.25 mm. Head black. Body, at hatching, pale cream-white. Dorsally a large, black, diamond-shaped neck-shield and a smaller, translucent, brown, circular anal-shield. During first instar one of two distinct colour morphs develops. One green, with wine-red dorsal stripe which broadens over anterior and posterior segments; other morph entirely wine-red. Rarely, some larvae with intermediate colouring, the red extensive, with green only on lateral aspects of body. Pure red morph predominant in September; green form commoner in October/November.

Viewed laterally (fig. 4) newly eclosed larva is flattened ventrally and more or less evenly curved dorsally, reaching highest point at segments 6 and 7. Viewed dorsally larva is approximately rectangular in shape, with anterior and posterior segments slightly wider than those in middle. Body surface finely verrucose (fig. 5). Nine pairs of long, backwardly-curved primary setae dorsally, in a double row, each row just lateral to dorsal midline (fig. 4). Anterior and posterior pairs of dorsal setae set further apart and projecting anteriorly and posteriorly, respectively. A row of thick, shorter primary setae along ventrolateral margin of body (fig. 4). At high magnification dorsal setae have their surfaces finely toothed. Ventrolateral setae flattened and bi-segmented; margins of longer distal segment serrate; three ventrolateral setae per body segment. Discoid, secondary setae scattered over body surface (figs 5 [arrows] & 6). Consist of a dorsally convex disc, with tooth-like projections scattered over dorsal surface, narrowing to a delicate stalk, which curves ventrally (fig. 6). Stalk arises from rounded base of a pit; a doughnut-like ring is present around base of stalk. Setal disc projects above level of raised, rounded margin of pit. Perforated cupola organs (PCO's) scattered over surface of body (figs 5 [arrowheads] & 7). Situated below cuticular surface, at base of rimmed pits (fig. 7). Sieve plates of PCO's hemispherical and with surface having a polished appearance.

Second instar larva (figs 8 - 11): Growing from about 2.25 mm to about 5 mm in length. Small, triangular, dark-brown neck-shield present but anal-shield absent. Colour morphs as for first instar larva. Shape of second instar larva very different to that of first. Lateral view (fig. 8): anterior and- posterior body segments partially fused. In outline larva rises steeply to segment 4, falling gradually to flattened anal end. Dorsal view (fig. 9): larva bluntly rounded anteriorly, widening to segment 3, narrowing to relatively broad waist at segment 7, then widening gradually to segment 11; final segment narrowing angularly to end in squared-off posterior margin. Small, slit-like dorsal nectar organ (DNO; "honey-gland") present on segment 10 (figs 9 & 10 [arrows]). Tentacle organs (TO's) could not be visualised on segment 11, but spiracles were more medially placed on this segment (fig. 10 [arrowheads]). Primary dorsal and ventrolateral setae of first instar larva absent. Body surface finely verrucose, with scattered discoid setae and PCO's (fig. 11), as in first instar larva but more numerous. Discoid setae more densely concentrated on dorsal surface.

Third instar larva (figs 12 & 13): Growing from about 5 mm to 10 mm in length. Only one colour morph apparent in third instar larval stage. Ground colour of larva brown to dark reddish brown. White pigment, in increasing amounts, extending caudally from segment 4, giving larva a pinkish brown colour, changing gradually to pinkish white more caudally. White incursion narrows in a dorso-medial direction becoming thin white streak running bilaterally in the upper third of segment 8, then broadening again on segments 9 and 10 to form roughly triangular pink marking edged with white. Irregular orange-yellow markings on dorsal tips of segments 2 and 3. Dorsal tips of segments 7 and 8 emerald green flecked with white. Dorsal tip of segment 9 with spherical deep-carmine patch.

Similar shape, viewed laterally (fig. 12), to second instar larva but more evenly curved dorsally. Dorsal view (fig. 13): larva rounded anteriorly, broadening in even curve to segment 4, then, continuing curve, narrowing to sharp waist at segment 7; gradually widening again to segment 11; final segment as for second larval instar. DNO present on segment 10 and TO's present on segment 11. Body surface thrown into fine, irregular, pitted folds. Discoid setae and PCO's as for second instar larva but more numerous.

Fourth (final) instar larva (figs 14- 17): Growing from about 10 mm to about 19 mm in length (males) or 22 mm (females). Final instar larva monomorphic. Ground colour deep brown, extensively overlaid by shiny white markings. White covers whole of segments 4 and 5 rapidly narrowing on either side of segment 6 to become narrow white streak across upper third of segment 7. Broadens again on segment 8 to cover remaining segments. Some small, irregular, orange-yellow markings present on the dorsal points of segments 2 and 3 and 7 to 9. Larva conspicuous - general colouring and shiny appearance of white areas reminiscent of bird dropping. Lateral view: shape as for third instar larva (fig. 14). Dorsal view (fig. 15): larva rounded anteriorly, slightly widened at segments 4 and 5 and again at segments 10 and 11; posterior segment tapering gradually and ending bluntly. Bilateral, short, tubercular processes on posterior free margin of last segment. Rounded, ventrolateral, flange-like extension of body-wall extending from segments 4 to 11, (figs 14 & 15) accounting for widening in dorsal profile of larva at segments 10 and 11. Discoid setae and PCO's as for third instar larva but much more numerous. DNO present on segment 10 (fig. 15 [double arrowheads]). TO's present on segment 11 (figs 14 & 15 [arrows]). Surface of TO's covered by closely-packed hydroid structures (fig. 16). Hydroid structures with cylindrical shaft, arising from coneshaped base (fig. 17). Distally shaft gives rise to irregularly-branched, radiating arms. Surface of TO's thrown into very fine crinkled folds (fig. 17).

Pupa (figs 18 - 24): Pupa attached to silken pad spun by larva on twig or branch, by cremastral hooks. Girdle absent. Anterior end of pupa almost touching substrate on which it has pupated. Pupa 12 mm (males) or 13 mm (females) long. Overall colour green, being yellow-green in posterior abdominal portion, and green with darker green, transverse stripes on wing cases and head. Pupa largely monomorphic but one pupa with ground colour brown (A. Mayer, unpubl.). Brown dorsal stripe, widest over anterior abdominal segments, narrowing anteriorly and posteriorly.

Within confines of brown stripe are four dorsomedial depressions, one on anterior margin of each of first four abdominal segments (fig. 18 [arrows]). Anterior three depressions more or less circular in outline (fig. 18) but posterior depression of complex shape, and larger (fig. 19). Scattered over surface of all depressions are variably sized, irregularly circular, light spots with dark centres, (fig. 19). At high magnification (fig. 20) the light spots appear to be membranous structures, adhering to densely-packed, pointed, conical projections that cover the floor of the depressions. Rest of surface of pupa gently undulating, with scattered ridges and protuberances (fig. 18). PCO's similar to those of larva and are scattered over surface of pupa but concentrated in vicinity of spiracles. Two specialised types of setae, not found in larva, present on pupal surface (figs 21 & 22): a) numerous, scattered, dome-shaped, umbilicate setae (fig. 21 [arrows]); b) scarcer, scattered, shafted setae (figs 21 [double arrowheads] & 22). Shafted setae broaden distally, dividing up into a number of pointed projections (fig. 22). On each dorsolateral aspect of the first abdominal segment are discrete black-spotted areas (fig. 23). At high magnification (fig. 24) black spots appear to be blebs of solidified secretory material.

DISCUSSION

The egg of *I. trimeni* appears to be unique for the genus *Iolaus* with respect to its yellow coating, the shape, and the surface sculpturing. The egg of *I. (Epamera) sidus* Trimén, however, is sometimes partially coated with a sticky, yellow substance (Clark & Dickson 1971). It would be interesting to know whether other species belonging to the subgenus *Iolaphilus* also have coated eggs. The coating appears to be insoluble in water, as attempts to wash it off with distilled water were unsuccessful. The coating was removed by means of a fine brush after submerging the egg in 70% aqueous ethyl hydroxide. The egg-coating is decidedly sticky; fine, air-borne dust particles readily adhere to it. The coating may serve to protect the egg from attack by egg parasitoids such as *Trichogramma* spp. This contention is supported by the fact that no parasitoids emerged from any of the more than 100 wild-laid eggs collected at the study site.

In species of the genus *Iolaus*, belonging to subgenera other than *Iolaphilus*, the shape and the surface sculpturing of the egg, where these are known, are very different (Clark & Dickson 1971). In the subgenera *Argiolaus* Druce, *Epamera* Druce and *Stugeta* Druce the eggs are bun-shaped, evenly convex, and there is no dorsal lip. In *I. (Iolaphilus) trimeni* the surface sculpturing of the egg is very indistinct while in *I. (Argiolaus) silas* (Westwood) the sculpturing is very clear. In species of the subgenera *Epamera* and *Stugeta* the surface of the eggs are even more deeply sculptured.

In *I. trimeni* the secondary setae on the body of the larvae, in all instars, are discoid in shape. This is also the case for all species of *Epamera* and *Stugeta*, for which the larvae are known. In *I. (Argiolaus) silas* the body setae in the larvae in all instars are hair-like and appear to be quite unlike those of other subgenera of the genus *Iolaus*.

There are brown markings on the dorsum of the pupa of *I. (Argiolaus) silas*, much like those on *I. (Iolaphilus) trimeni*. These brown markings appear to also be

present on the dorsum of the pupa of *I. (Stugeta) bowkeri* Trimen but, if they are indeed present, they are rather different in nature. It would be of interest to examine these markings by means of scanning electron microscopy and compare them to those found on the pupa of *I. trimeni*.

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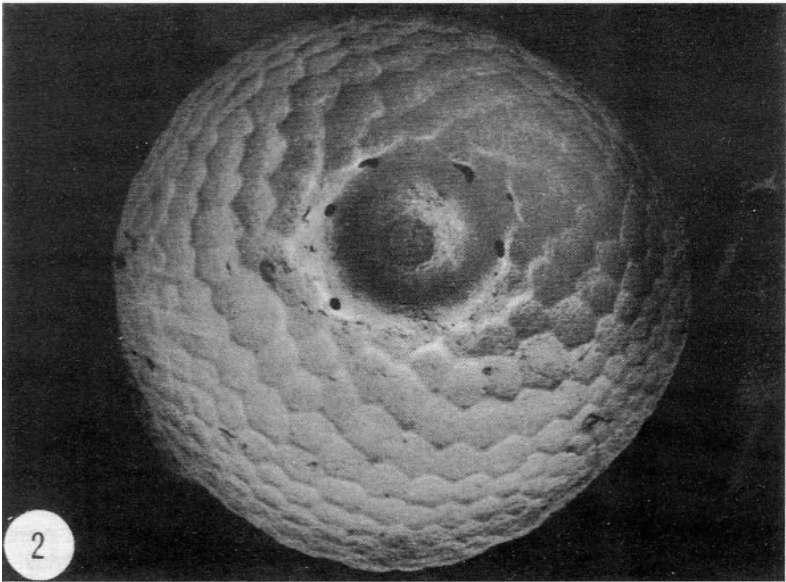
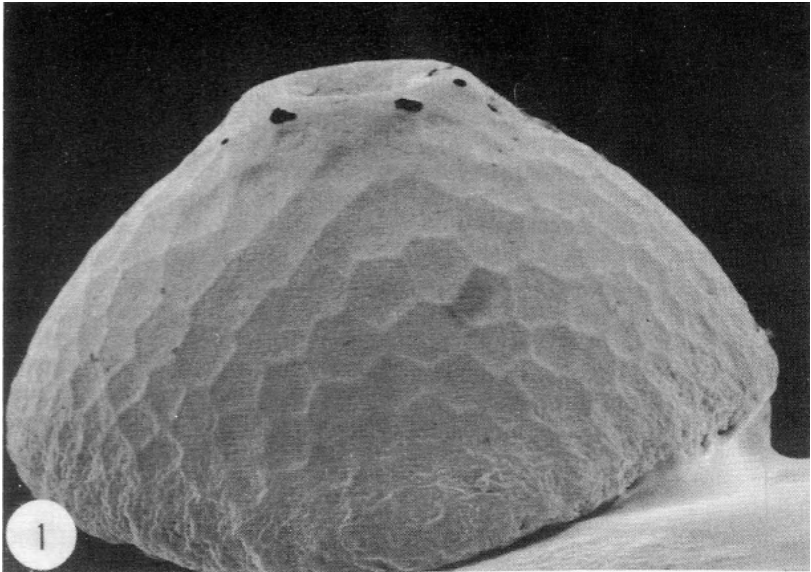


Fig. 1 Egg. Lateral view. x125

Fig. 2 Egg. Dorsal view. x90

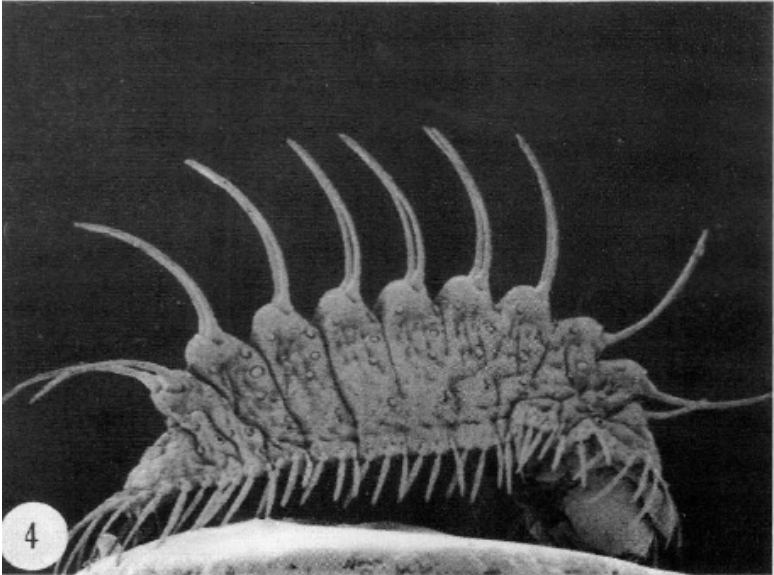
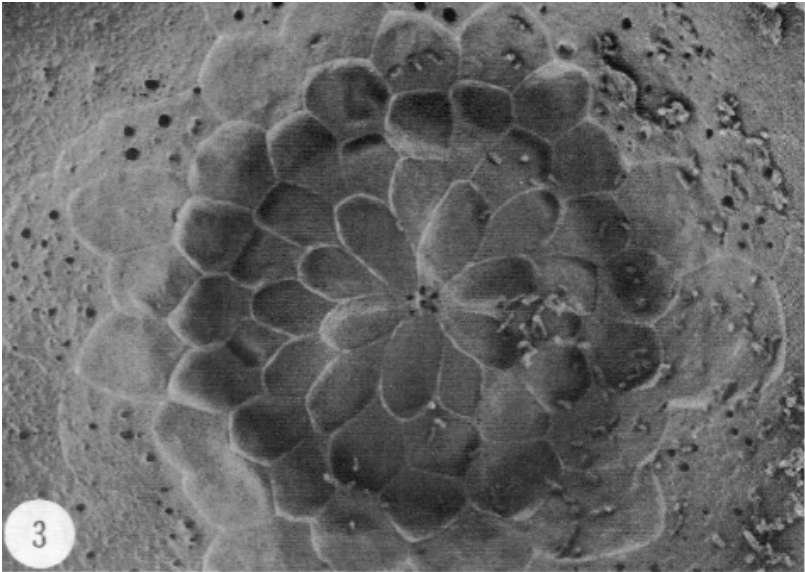


Fig. 3 Egg. Micropylar region in dorsal central depression. x900

Fig. 4 First instar larva. Lateral view (anterior end right), x80

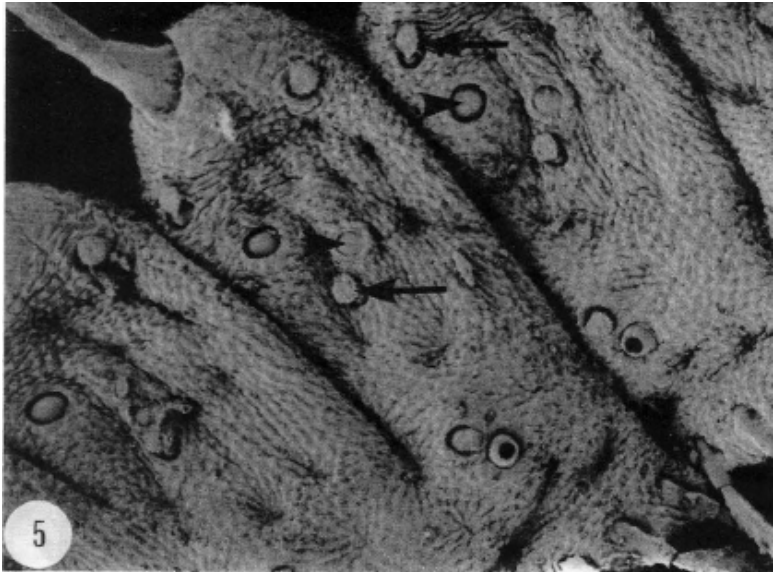


Fig. 5 First instar larva. Seventh body segment (anterior end on left). Note discoid setae (arrows) and perforated cupola organs (arrowheads). x400

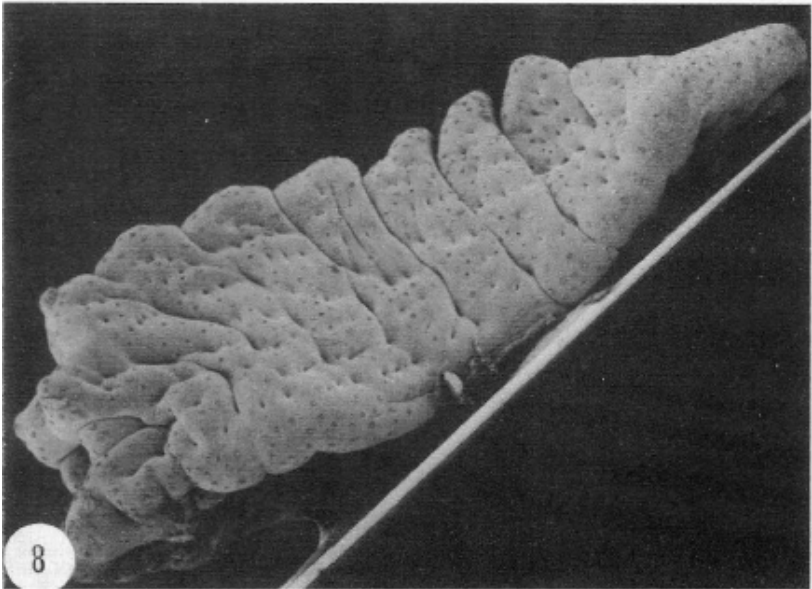
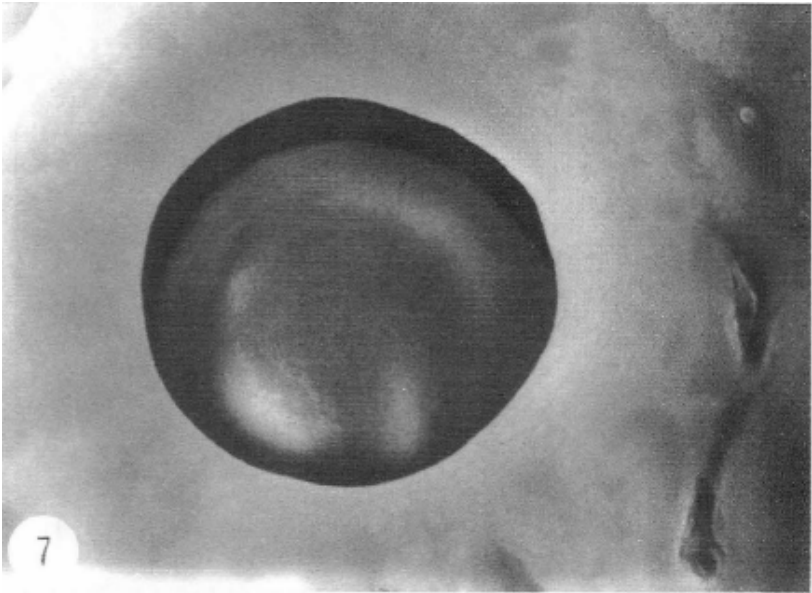


Fig. 7 Detail of perforated cupola organ (PCO) on body surface of larva. x3200

Fig. 8 Second instar larva. Lateral view (anterior end on left). x30

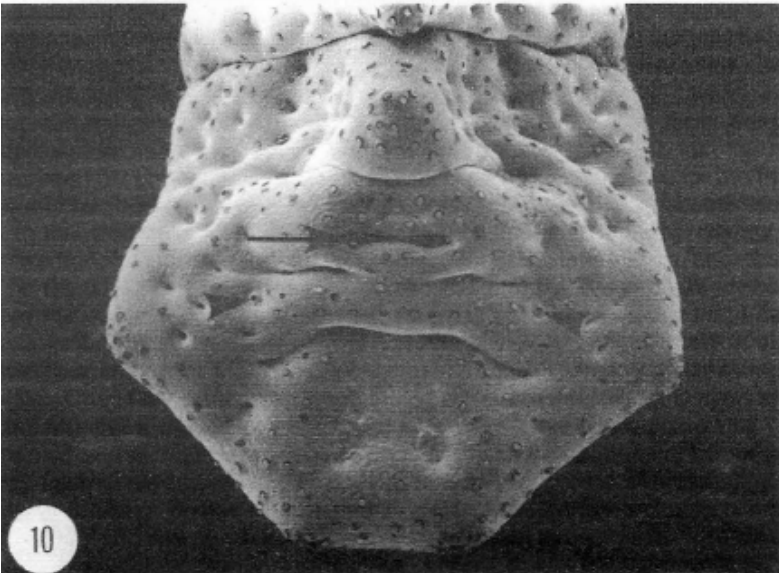
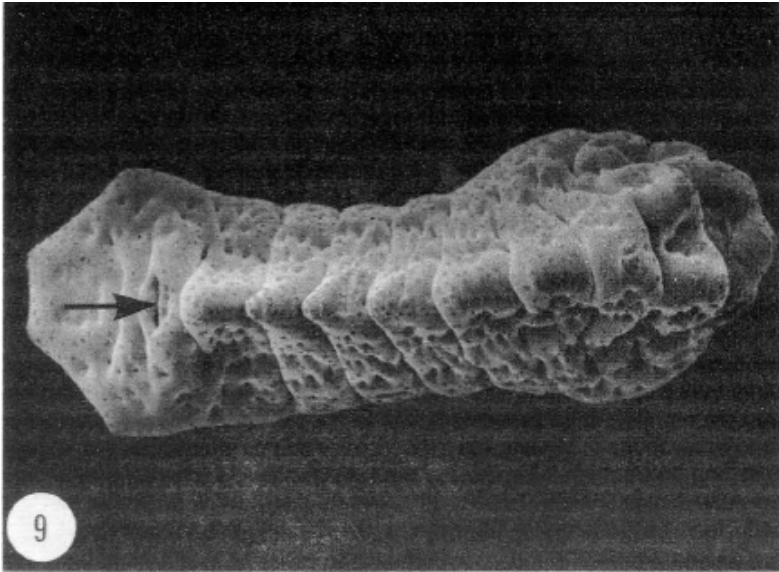


Fig. 9 Second instar larva. Dorsal view (anterior end on right). Note the dorsal nectar organ (arrow). x25

Fig. 10 Second instar larva. Posterior segments with dorsal nectar organ on eleventh body segment (arrow). Note spiracles (arrowheads). x75

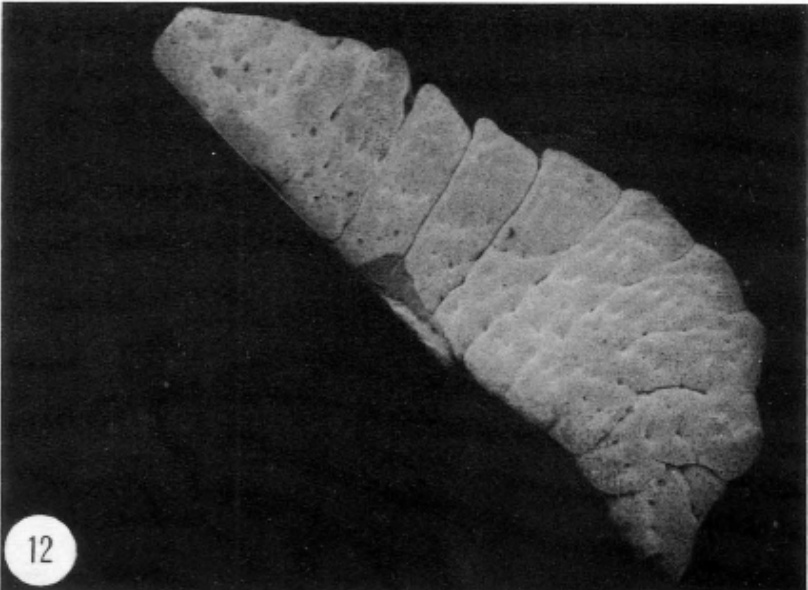
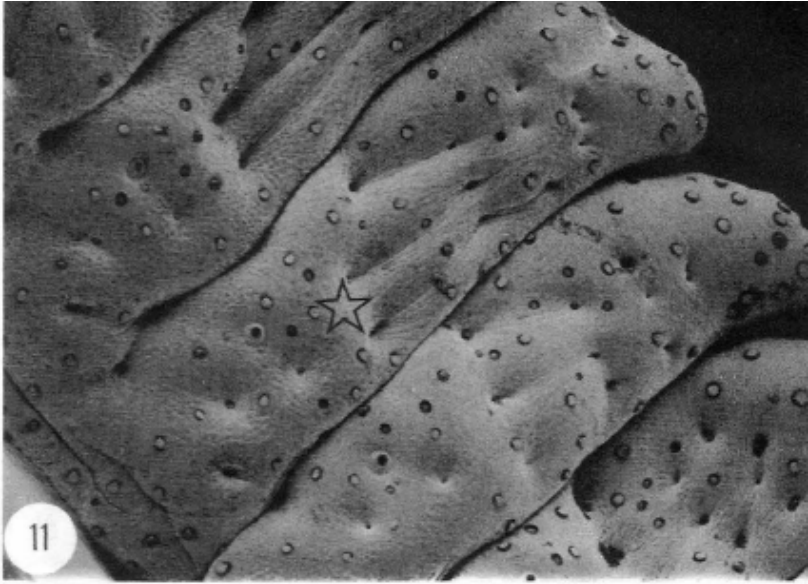


Fig. 11 Second instar larva. Lateral view (anterior end upper left), showing the seventh body segment (star). x11 O

Fig. 12 Third instar larva. Lateral view (anterior end, bottom right). x15

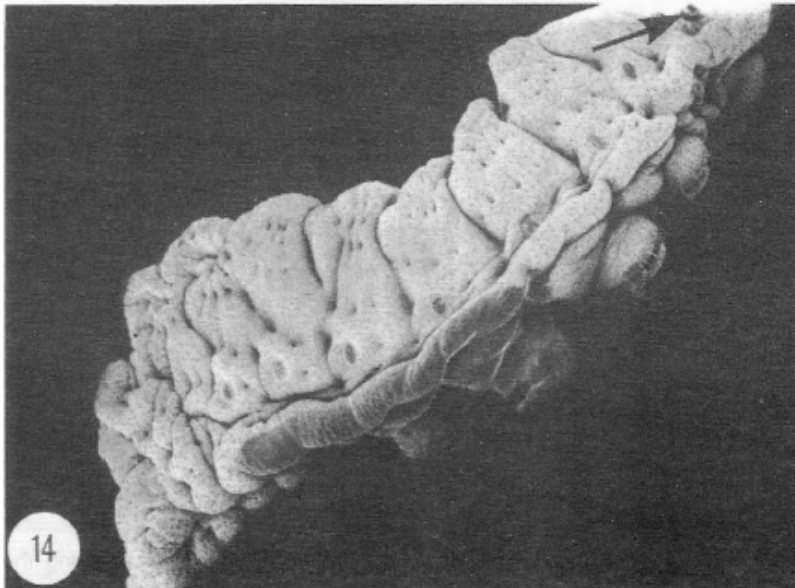
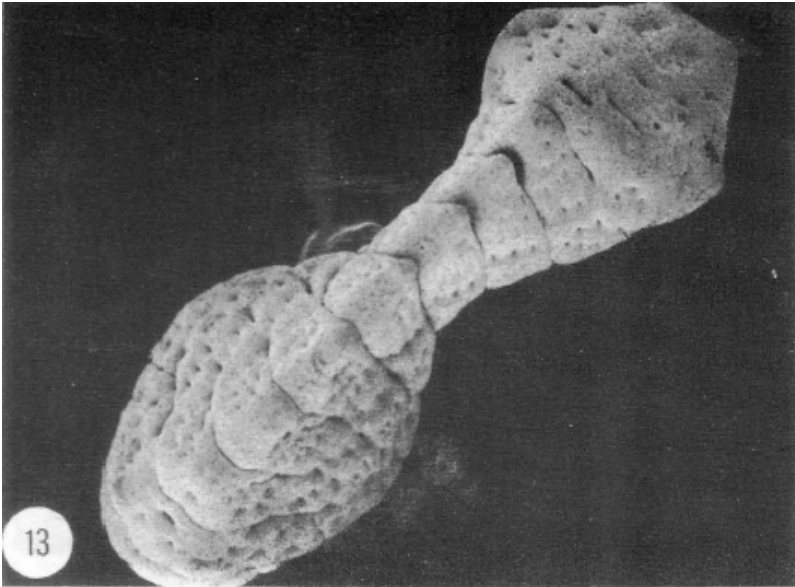


Fig. 13 Third instar larva. Dorsal view (anterior end, bottom left). x12

Fig. 14 Fourth (final) instar larva. Lateral view. Note tentacle organ (arrow). x10

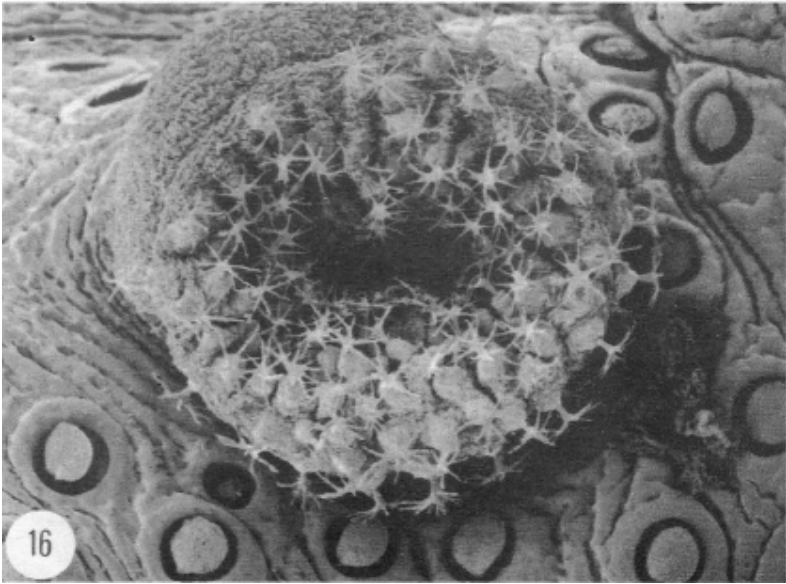
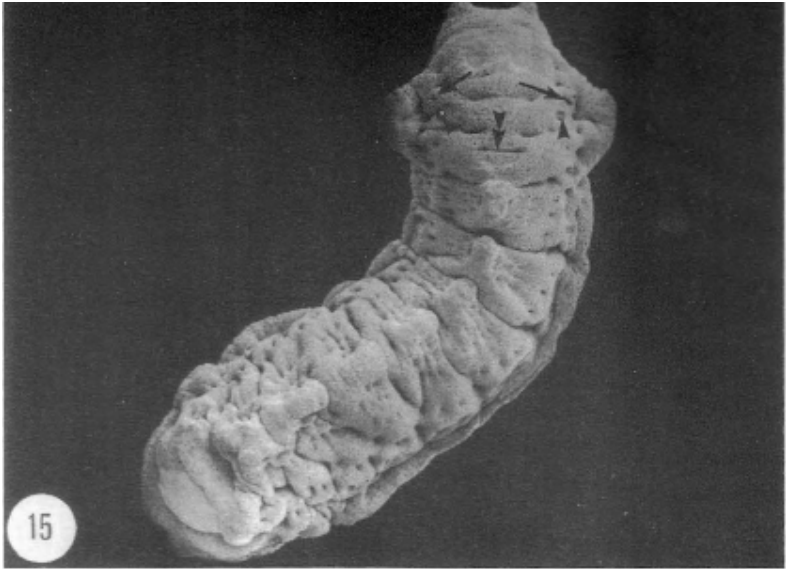


Fig. 15 Fourth (final) instar larva. Dorsal view. Note tentacle organs (arrows), spiracles (arrowheads) and dorsal nectar organ (double arrowheads). x8

Fig. 16 Fourth instar larva. Partially extruded tentacle organ on dorsolateral aspect of body segment twelve. x450

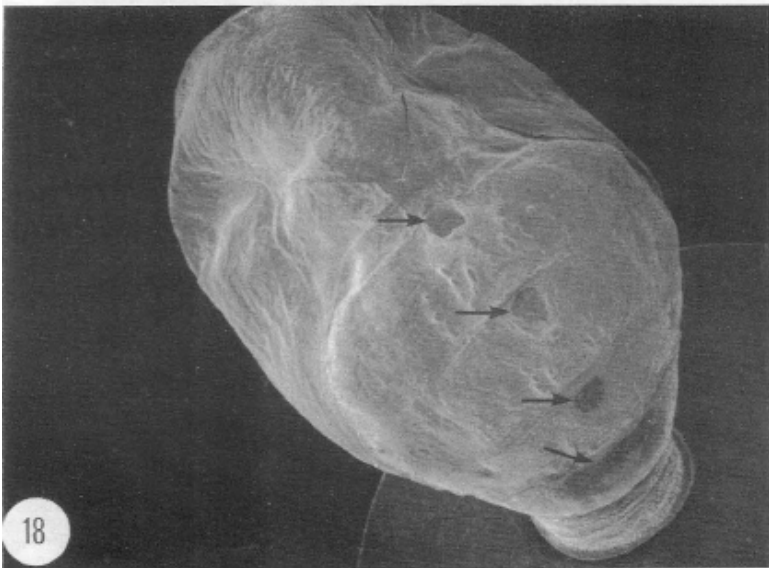
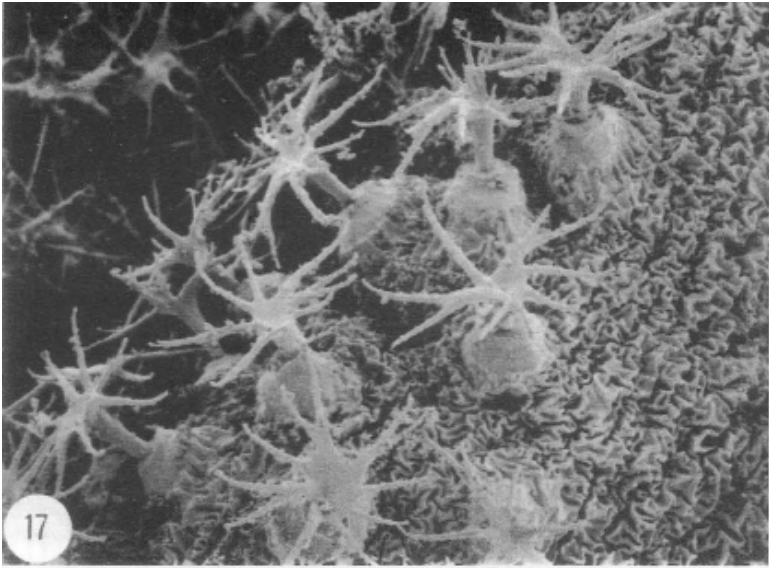


Fig. 17 Fourth instar larva. Detail of hydroid structures on surface of tentacle organ. x1500

Fig. 18 Pupa. Dorsal view showing the four dorsomedial surface depressions (arrows). x10

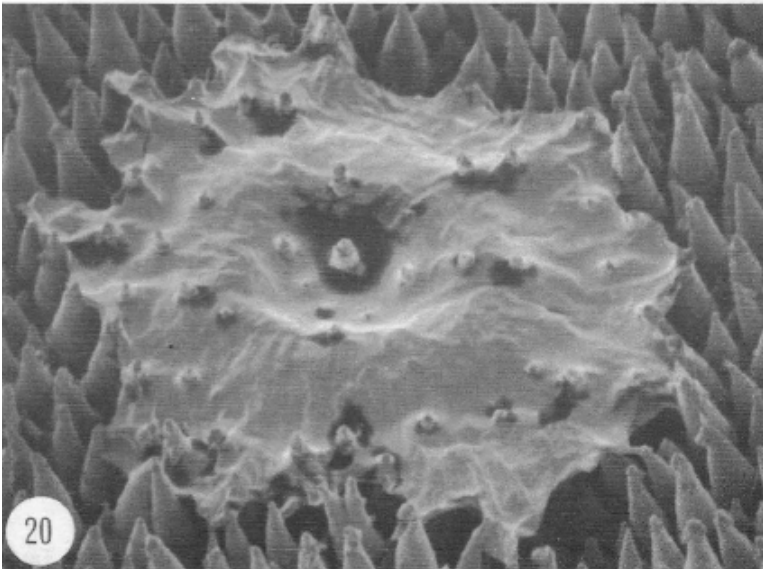
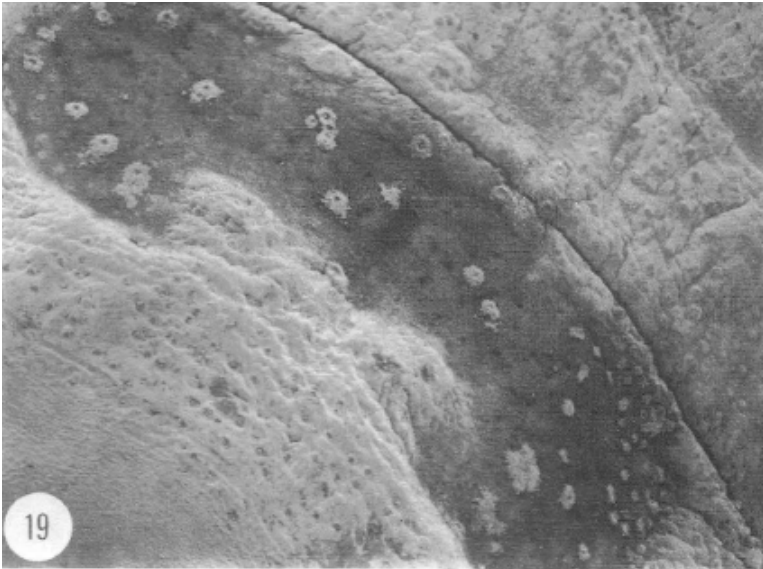


Fig. 19 Pupa. Posterior dorsomedial depression. x60

Fig. 20 Pupa. Detail of surface of a dorsomedial depression, showing membranous light patch and conical projections. x1500

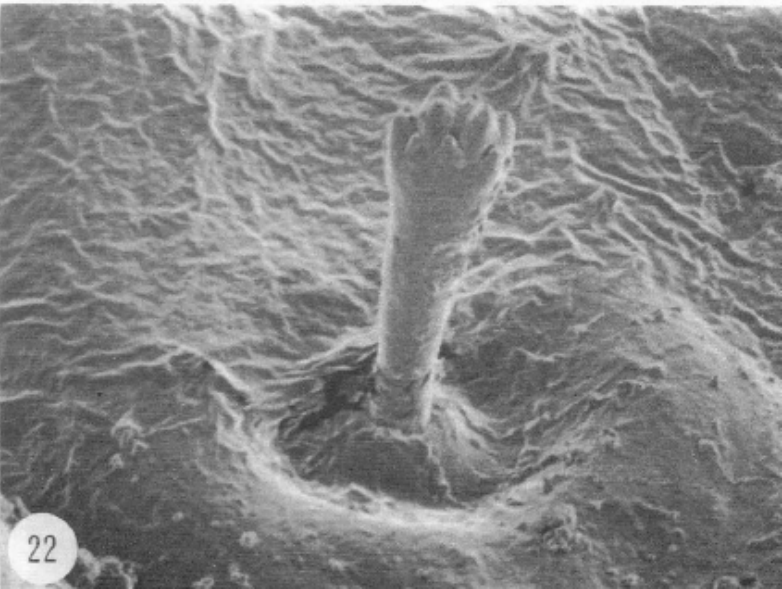
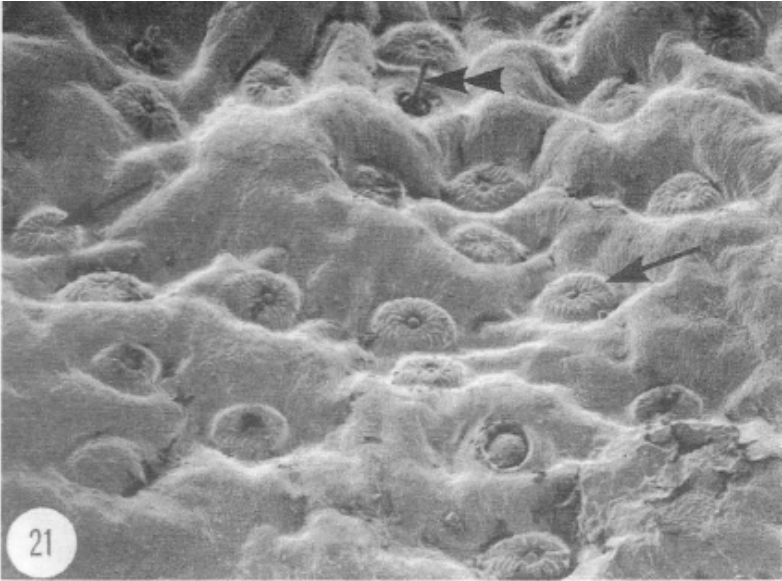


Fig. 21 Pupa. Note undulating surface, with dome-shaped umbilicate setae (arrows) and shafted seta (double arrowheads). x400

Fig. 22 Pupa. Shafted seta. x2000

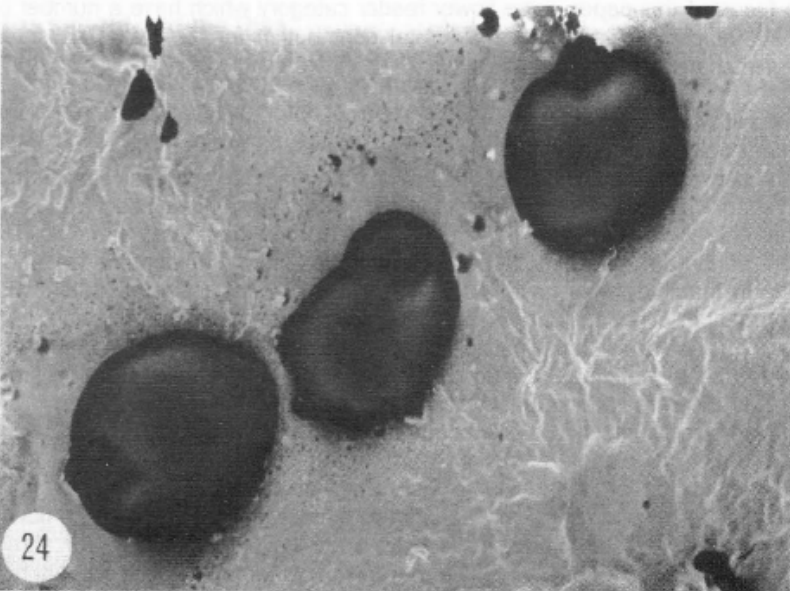
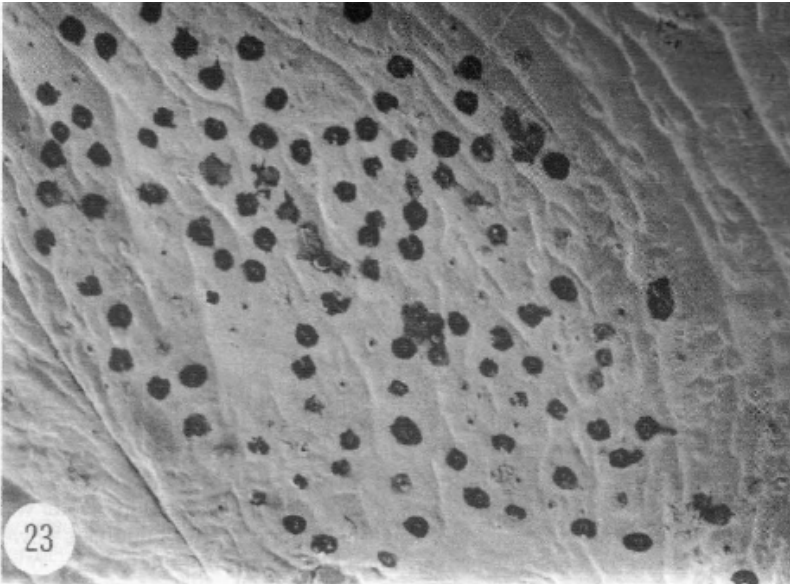


Fig. 23 Pupa. Black-spotted area on dorsolateral surface. x120

Fig. 24 Pupa. Detail of black spots illustrated in fig. 23. x1000

NOTES ON POLLINATION IN AFRICAN LEPIDOPTERA

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Abstract: Lepidoptera are the sole pollinators of a number of plant species throughout the world, in this way they have a monopoly on these food resources. In this paper some of these survival strategies are analysed.

Key words: Lepidoptera, pollination, butterflies, moths, orchids, *Oisa*.

Introduction

Many adult Lepidoptera have preferred food sources which, based on the tubular nature of the proboscis, consist of liquids. These liquids can be categorized into three groups based on the origin of the liquid. These categories can often be associated with particular genera (Henning, 1997). The categories are: 1. Fermentation feeders, which feed on liquids produced by fermenting animal or plant material. 2. Flower feeders, which feed on nectar from flowers. 3. Water feeders, which drink water with dissolved salts from damp sand or mud. It is often found that in butterflies flower feeders are also avid water feeders, while fermentation feeders appear to get enough water from fermenting materials.

The focus of this paper is the flower feeder category which have a number of survival strategies involved. There is a vital contribution for the plants as some Lepidoptera are the sole pollinators.

Bird versus insect pollinators

The primary pollinators of flowering plants are birds and insects. There is strong competition between insect pollinators and birds, and many an aggressive exchange has been seen. Birds are major pollinators of red flowers while most insect pollinated flowers are not red (Grant, 1966; Raven, 1973). In Europe the paucity of red flowers has been attributed to the lack of nectarivorous birds. Lepidoptera have an advantage in that they may have the widest visual spectrum of all animals, with perception of both ultraviolet and red light in some species (Johnson & Bond, 1994; Bernard, 1979). The ability to pollinate a flower is apparently proportionate to the size of the flower. Small Lepidoptera feed on small flowers, large Lepidoptera on large flowers. Red flowers pollinated by birds would only have competition from comparatively sized insects. There are both structural and behavioural factors which determine which Lepidoptera visit which flower. It could be energetically disadvantageous for large species to visit small flowers considering the small rewards, unless they are specifically adapted to effectively flit from flower to flower such as in the Sphingidae. Some flowers are specifically adapted to fit or attract specific species of Lepidoptera and have morphological features which prevent bird pollinators.

The Madagascan hawk-moth and the orchid

One fine example of the development of size and fit is provided by the Madagascan orchid *Angraecum sesquipedale*. It is one of the most spectacular of the world's orchids being about twelve centimetres across with a spur thirty centimetres long. At the end of the spur nectar is collected. Charles Darwin examined the flower and suggested that there must be an insect such as a large moth with a tongue long enough to probe down into the nectar and effect pollination. "This belief of mine has been ridiculed by entomologists" said Darwin. It was nearly forty years before Darwin's prediction was proved correct. A large subspecies of an African mainland sphingid was discovered on Madagascar which is the only known pollinator of this orchid. The subspecies was named *Xanthopan morgani praedicta* (Sphingidae) in honour of Darwin's prediction (Bristow, 1978).

In this kind of relationship where such monstrous adaptations are involved it is interesting to speculate as to how the two evolved. The flower, for some unknown reason, probably needed the pollinator more than the pollinator needed the flower. It is possible that the flower and the moth slowly developed to suit the needs of both. Although the moth, in all probability, feeds at other flowers it the reliance that the plant places on the single insect pollinator which is surprising. In the case of *Angraecum sesquipedale* the flower's reliance on the single pollinator requires it to remain open for weeks, its skin protected by a waxy covering. The enormous flower is also luminous white to attract the night time flyer.

The satyrid and the Disa

A similar kind of relationship is also found in the fynbos of Southern Africa where a number of orchid species, the most famous of which is the spectacular *Disa uniflora*, rely on one large satyrid butterfly, *Aeropetes tulbaghia* (Nymphalidae: Satyrinae) for pollination. Such dependence on a single species of pollinator is rare. Species pollinated by *A. tulbaghia* share several convergent characteristics including large, red flowers with straight, narrow tubes and a flowering period in late summer. The butterfly appears to be attracted primarily to the red colour of the flowers. Nectar properties of these plants have between 15% and 25% sugar concentration, which is fairly low. Similar low sugar concentrations are found in the bird-pollinated fynbos plants which are also visited by *A. tulbaghia*. Recognition of the red colour by *A. tulbaghia* may have evolved to take advantage of the large amount of nectar available to the bird pollinators, and therefore operates in direct competition. About 15 of the most spectacular endemic fynbos species depend solely on *A. tulbaghia* for pollination (Johnson & Bond, 1994). The possible adaptation of these plants away from bird pollinators indicates the favourable attributes supplied by *A. tulbaghia*. Or perhaps these were insect pollinated plants which adapted to a red colour to take advantage of the efficiency of a pollinator which visits flowers of only one colour. The structure of these plants which prevents pollination by birds, while retaining the colour and size of bird pollinated flowers, indicates the former may be the better possibility. Perhaps the fact that the butterfly is more gentle and does not damage the plant as do the vigorous activities of the birds has resulted in this scenario. The key to the survival of all these species is *A. tulbaghia*.

Mimicry in orchids to attract *A. tulbaghia*

One species, *Disa ferruginea* (Orchidaceae) from the Western Cape is one of the species solely dependent on *A. tulbaghia* for pollination. The flowers of *D. ferruginea* contain no nectar and are pollinated by mimicking flowers which are nectar sources for the butterfly. A red-flowered form of *D. ferruginea* appears to mimic the red nectar-producing flowers of *Tritoniopsis triticea* (Iridaceae), while an orange-flowered form of *D. ferruginea* appears to mimic the orange nectar-producing flowers of *Kniphofia uvaria* (Asphodelaceae). Reflectance spectra of the orchid match those of the putative models. An investigation of foraging movements of the butterfly indicate that it does not discriminate between the mimics or the models.

When visiting flowers the butterfly is firstly attracted from a distance by the red colour but does not always settle. If it settles, often upside down depending on the plant species, it will probe into the flower with its proboscis. While long distance mimicry brings the butterfly close, in fact the *A. tulbaghia* can be attracted by red clothing or paper, this does not help the mimic and only when the butterfly is ready to settle will the close mimic similarities illicit the required feeding response from the butterfly. In these species, both models and mimics, the pollinia are attached to the proboscis and the butterfly feeds upside down, when feeding on *D. uniflora* it feeds upright and carries the pollinia on its legs (Johnson, 1994; Johnson & Bond, 1994).

The unique niche occupied by *A. tulbaghia*

While *A. tulbaghia* is in direct competition with birds for their share of the red or orange fynbos flowers it has also been shown to be the sole pollinator of about 19 montane plant species with scentless red flowers. These species are morphologically adapted to this butterfly and not birds and no other butterfly in this region is known to visit red flowers. Many of the red-flowered Cape plants which were previously assumed to be pollinated by birds are actually adapted for pollination by *A. tulbaghia*.

A. tulbaghia pollinates at least four families of plants and eight genera. Nineteen South African species, fifteen endemic to fynbos, rely entirely on this butterfly for their survival. All these species, with the exception of *Crassula coccinea* (Crassulaceae) are petioled monocotyledons. These flowers cover four floral types. A narrow upright tube with inserted stamens and a flat rim; tall extended stamens projecting from a funnel-shaped flower; large and showy flowers with a broad landing surface; horizontal flowers resembling the bird-pollinated flowers except that the tube is too narrow to allow access to bird's bill. Observations of the sympatric, and similar sized, *Papilio demodocus* (Papilionoideae) show that this butterfly tends to visit blue flowers (Johnson, 1994; Johnson & Bond, 1994).

Conclusion

Red coloured flowers are the preserve of the bird pollinators in other parts of the world. To have a group of red flowered non-related species in the South African fynbos all being dependant on one butterfly species must be unique. Some of these plant species are also very rare and four are in the Red Data Book (Hall & Veldhuis, 1985). One common feature between the Madagascan and fynbos orchids with sole Lepidopteran pollinators is their spectacular size and colour. It would appear from

This evidence that if a species has a sole pollinator it needs these added attributes to attract attention.

The size of the Lepidoptera concerned are also much larger than related taxa which possibly indicates an adaptation into areas not exploited by their relatives. The value of having a monopoly of a number of food sources is extremely advantageous for the insect.

Acknowledgements

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MORE OBSERVATIONS AND THOUGHTS ON *PIERIS BRASSICAE* AND ITS INVASION OF SOUTH AFRICA.

By Bill Steele

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In October of 1997, I had to visit the Cape to attend to some business related to a book I had written, and which had just been published. I found myself with the unusual luxury of a couple of days off. I was thus determined to have some time with the Cape butterflies, and accordingly on the 20th of October made my way to Du Toit's Kloof suitably armed with location information kindly supplied by Steve Woodhall. I eventually ended up at the entrance to the road tunnel. And, having traversed the surrounding hill with some success, I returned to the car. Here I ran into my surprise of the day. The day had been good, with the expected species detailed by Steve coming to net. But here suddenly was something quite different. I was watching a large bluish-white butterfly with distinctive black apically tipped forewings. It was circling a tree, occasionally resting for a brief period before continuing its circling course. "Goodness me", I thought ... a "Cabbage White!" Being of English origin the familiar boyhood name sprang quickly to mind, and, as I watched, a very fresh specimen of *Pieris brassicae* was doing its thing thousands of kilometres from where it should be. But, in fact, that was the strangest thing, because in Europe, this circling a tree behaviour is not something I remember as being usual for this species. Later I was to find many others behaving in the same way on the Cape peninsular near Simonstown.

I had read articles on this butterfly's invasion of the Cape, but had mistakenly understood that it was being kept in check by natural parasites and predators, and was by no means common. Was I wrong! *Pieris brassicae* eventually turned out to be the commonest observed butterfly during my short stay. In the next two days, my wife and I observed these butterflies in great numbers in the Cape Town suburbs, and all over the peninsular. They were extremely common at Kirstenbosch, around Constantia, and especially so near Simonstown. I have no doubt that they are here to stay. Their natural food plants in Europe include any of the cruciferae (not just cabbage and nasturtium). In the Cape, Classens has found evidence to suggest that they are also able to use chrisanthymoides with success.

This is not the first instance of this butterfly turning-up outside its normal European/Asian distribution. It has become well established in Chile, in South America, where it has been breeding and spreading its range for at least the last fifteen years. This parallel invasion far from its area of origin (and from South Africa), suggests that the mechanism for these unusual range extensions has to be artificial, and almost certainly the result of the hand of man. I do not for a moment believe that they have arrived as a result of some amateur breeding experiment undertaken by local lepidopterists. Far more likely, is their arrival by some ship cargoing a load of cruciferan vegetables (cabbages, brussels or the like) for human consumption, or perhaps as passengers in the food manifest. However it happened, they are here to stay by the look of it, and their consequent spread up the coast northward and inland is probably inevitable. In Europe, *Pieris brassicae* is noted as a great migrant.

Although I noted no such activity in my short stay, maybe other observers have. It would be very interesting to note any migratory behaviour developing in this species. However, some authorities regard migration as a response to overpopulation, so perhaps if it does occur it may not be for some time yet.

Like the Danaidae, many Pieridae derive considerable protection from chemical defence mechanisms ... different chemicals are used by *Pieris brassicae*, but nevertheless these are effective deterrents for predators. *Pieris brassicae* uses mustard oils and derivatives of these to deter would be predators. Mustard gas (which is deadly and took many human lives during world war one) is a concentrate of mustard oil. The butterfly imago stores this oil in its body tissues, the presence of which gives off a distinctive odour. When the female lays her eggs she deposits a tiny drop of mustard oil with each egg - an interesting adaptation. The oil in all the butterfly's life stages, certainly gives protection from birds. However, in Europe, many of the insect predators and parasites seem to have no trouble handling it. In this respect it offers only a partial protection. However, such protection would certainly give the butterfly a head start in invading a new territory replete with suitable food plants, such as South Africa. As Classen proposed, the butterflies would initially get a good head start before parasites and predators had an impact on populations. From my observations of this now exceedingly common butterfly, it was even more successful than could be imagined!

I was at Simonstown the next day, where the butterfly was found in numbers everywhere. I determined to get myself a series mainly for comparison with examples I have from various parts of Europe. Unlike most South African lepidopterists, I also have a comprehensive collection of European species in which I have a keen interest, and which I use mainly to compare with sub-saharan species. Only six weeks previous to my visit to the Cape, I had been in Europe, and one of the objectives I had in mind was coincidentally to collect *Pieris brassicae* to complete my second generation (summer brood) series.

Pieris brassicae unlike many indigenous species will fly immediately there is an upgrade in light levels. As I came down the road going north into Simonstown, there was a break in the clouds, and although there was still a slight rainfall, the butterflies were out like giant snowflakes. They appeared from nowhere, and without warning were flying across the road and around the surrounding bushes and trees. I watched them for a while, before I realised that something was wrong. *Pieris brassicae* when it flies in Europe has a definite yellowish tinge about it, and in fact the hind wing upper is a distinctive pale sulphur colour. These living examples I was watching were pale blue (not yellow), odd ones were even bluish almost in the same way as *N. thalassina*, but paler. I later discovered that this colour fades completely to bright white if the butterflies are oven set, but in any event fades with time at normal room temperature.

The Large White butterfly has been used extensively in Europe in breeding experiments and a recessive variation known as form *caerulea* occasionally appears, which has a distinctive blue tinge to the hind wing upperside. This has also been taken very rarely in the wild in Europe. In 1987 in the UK, at one of the Amateur Entomologist Society get together, some of these *caerulea* (home bred examples) were on offer at a price. One can then probably conclude that they will breed true.

However, although suggesting that the blue form certainly exists, it hardly explains why all the examples I took and saw on the wing at Simonstown were all of the "blue" form. In fact, although the colour is similar to *caerulea*, there are differences between the Cape butterflies and the example I have of form *caerulea*. There are also consistent differences in the wing markings. This, of course in a species that responds with pattern changes in differing broods depending, apparently dependent on seasonal temperature fluctuations, may not mean a great deal. It does seem to suggest that the *Pieris brassicae* flying in the Cape is perhaps not the normal western European form. I have no examples of the Russian (see distribution map) *P. brassicae* to compare. Perhaps there is another sub-species (unknown to me, but perhaps familiar to our Russian and European members) which ties-up with the butterfly now flying in the Cape?

Once back in Gauteng, I was able to compare my European examples with those from the Cape and they are distinctively different. My only example of form *caerulea* is unfortunately damaged, but it appears similar, but nevertheless displays differences which cannot be ignored. My conclusion at present suggests very strongly that our *Pieris brassicae* is not the usual western European form. Input from our Eastern European readers may help to solve the problem.

THE CONSERVATION STATUS OF THE HEIDELBERG COPPER BUTIERFLY (*POECILMITIS AUREUS*) IN THE HEIDELBERG DISTRICT

By Graham Henning
17 Sonderend Street, Helderkruin, 1724.

and

Pieter Roos
68 Donnelly Street, Turffontein

A project has been launched to investigate the Heidelberg Copper, *Poecilmitis aureus* van Son.

This is a research report for the Gauteng Provincial Government Directorate of Nature Conservation. To be conducted over the season from 1998 to 1999.

We would like members of the Lepidopterists' Society of Africa to become involved in this project and we would like constructive comments and advice on the proposed plans following hereunder. Any information available from our members would be appreciated.

Introduction

The Transvaal Nature Conservation division determined that the Heidelberg Copper was one of several threatened species in the region in 1985. The new Gauteng Provincial Government have determined the need for research on this species.

Historical review

Poecilmitis aureus was discovered by C. Barrett and F. Coetzee in December 1959 at Heidelberg. The species was described by Dr Georges van Son in 1966. It was placed on the list of Protected Wild Animals of the Transvaal in 1985. The South African Red Data book - Butterflies, published in 1989, listed it as Rare.

The type colony was the only known one for some years. Additional colonies have been found in the mountains surrounding the type locality. The range was extended as far as Greylingstad with the discovery of a strong colony on the hill above the town. A single specimen was recorded in the Suikerbosrand Nature Reserve by members of the Lepidopterists' Society. In October 1998 the species was recorded in the Alice Glockner Nature Reserve.

Red Data Book status

The South African Red Data Book, 1989, gave its status as rare. No changes have been made to date. The information provided by this research may elucidate its position.

Taxonomic status

The taxonomic status of the genus *Poecilmitis* was recently altered by Heath 1997. He has synonymised the genus *Poecilmitis* into genus *Chrysoiritis*. This has not

been entirely accepted and in terms of this report we will retain the genus *Poecilmitis* until further clarification.

A distinct population of *P. aethon* (Trimen) has been found in the mountains near Morgenzon. It does not have the characteristics of *P. aureus*, but the existence of these populations indicates that *P. aureus* will almost certainly be restricted to the region to the west of this taxon. From research on other members of this genus it is unlikely that *P. aureus* will be found to be sympatric with *P. aethon*.

Research

Members of the Lepidopterists' Society of Africa are invited to assist at critical times in this project in order to monitor as many sites as possible.

Experienced lepidopterists and photographers are invited to assist in monitoring and recording at various stages during the course of this research.

An experienced botanist is required to assist in controlling the monitoring and analysis of the plant communities.

Assistance and advice on the ants is also required.

Aims and methodology

Aims

To answer the following questions for the Gauteng Provincial Government Directorate of Nature Conservation as regards the Heidelberg copper butterfly, *Poecilmitis aureus*:

1. What is the distribution and conservation status of the Heidelberg copper butterfly in the Heidelberg district?
2. Does the Alice Glockner Nature Reserve provide for adequate conservation of the species?
3. Provide a species management plan to ensure the survival of the species in the wild.

Methodology

To determine habitat and environmental requirements the following steps should be taken:

1. To observe and record the behaviour of adult *P. aureus*, including male territorial behaviour, colonial behaviour, courtship, copulation and oviposition in the study sites. Monitor population numbers and flight periods. Assess location, climate, altitude and topography of colonies.
2. To observe immature stages of *P. aureus* in the field including distribution of eggs, feeding behaviour of larvae, presence of predators and parasitoids, presence of host ants in the study sites.

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3. The selection of specimens of host plant for oviposition will be noted in detail. Biotic characteristics and growth patterns of the host plants will be analysed in the study sites.
 4. Interaction between the butterfly and its larvae with the host ants will be recorded in as much detail as possible. Comparative analysis of characteristics of ant colonies associated with the butterfly and other colonies of the ant will be undertaken. Distribution of ant colonies in the study sites will be mapped as far as possible.
 5. To map distribution of host plant, density, growth habits and comparative physical characteristics for host plants in the study sites.
 6. Monitor and map the invasion of alien plants at the study sites, as well as possible effects of Argentine ant invasion.
 7. Map possible or current pollutants or disturbances in the area which affect the well-being of the butterfly colonies.
 8. Analysis of the possibility of interbreeding in small isolated colonies weakening the genetic viability. Relocation of specimens from other colonies to strengthen the gene pool must be investigated based on the research data.

Management plan

To determine a habitat profile for a full distribution analysis to determine the conservation status:

1. The compilation of a habitat profile based on physical and biotic factors recorded from the above research will then be used to identify possible threats to the colonies of butterflies, attendant ants and host plants in the study sites.
2. The habitat profile will also be used to identify additional suitable sites for study in order to determine actual and theoretical distribution of the species in Gauteng and beyond. An extensive search for suitable habitats during the flight period of the butterfly will be undertaken to map the distribution of *P. aureus*.
3. A detailed analysis of the Alice Glockner Nature Reserve as to the adequacy of its size, suitability for the long term conservation of *P. aureus*, threats to the resident colonies of the butterfly. A management plan for the reserve and an environmental impact assessment of the site will be presented.
4. A reference search, media and interview program will be undertaken to compile a file of all previous literature and personal observations on *P. aureus*. Literature and information on similar research, local and overseas, will be analysed to ensure adequate conservation principles are applied.

5. From information gathered a management plan for the study sites will be provided. Detailed maps of the distribution of *P. aureus*, both current and historical, will be compiled. Detailed maps of suitable habitat without recorded sightings will be compiled. A comprehensive reference file detailing proposed conservation status of the species.
6. During this study additional information on the survival requirements and threats to *P. aureus* and other species of butterfly and moth will be uncovered which will assist in the control of conservation sites for other invertebrates.

Proposed study sites

Alice Glockner Nature Reserve.

Suikerbosrand Nature Reserve.

Private property.

Outline of reports

The conservation status of the Heidelberg Copper Butterfly (*Poecilmitis aureus*) in the Heidelberg district will be reported on at great length with maps.

Conclusion

This research project will be a learning curve for many of us but the rewards will be the satisfaction of knowing that we have contributed to the survival of this species.

REGIONAL ROUNDUP

The study of Lepidoptera has taken on many facets in our current research. Not only do we travel hundreds of kilometres to climb high peaks to collect a few specimens but now we expend enormous amounts of energy without any additions to our collections.

I have recently spent a number of week-ends along the Sabie near Hazeyview collecting specimens for an anti-smoking advertising campaign.

This advert was required by the Tobacco and Salt Board in Japan. The Japanese gentlemen wanted a South African company to shoot the advert, in Rome! The planet is really becoming a global village as intercontinental travel does not seem a deterrent to business at all.

The advert was about the pollution of smoking and required a young man to help a girl pack away her flea-market stall into the back of a van when it rains. They then sit on the back of the van with an antique ashtray between them, he takes out his cigarettes to smoke and a butterfly flies up and settles on the ashtray out of the rain. The man decides not to smoke and puts his cigarettes away.

The butterflies first requested were large pierids or blues. Firstly they thought the uppersides and undersides of blues were both blue. Then they rejected all the initial suggestions and finally decided on *Dixeia pigea*. Mark Williams and myself went to Hazeyview and collected a number of *D. pigea* for the film test. On delivering the specimens they were immediately rejected by the director as too small and weak. I did have a *Salamis parhassus* with me I handed that over for testing. After numerous contact with the Japanese who could not decide between *S. parhassus* and *Papilio demodocus*. They finally decided the best butterfly would be *S. parhassus*. At one time I was told through the interpreter that they thought *S. parhassus* looked like a moth!

I was required to mount a few specimens in a life-like position for the still photography and to collect twenty good specimens for the live shoot in Rome. I spent four days, seven hours a day, collecting and ended up softening some of my series of specimens for the still photography. During these four days along the Sabie river I spent a considerable time up to my knees in mud, wading across the river or falling flat on my face. Trying to run in the tangled undergrowth of the riverine forest was a nightmare and I spent almost as much time on the ground as I did on my feet. I collected one good specimen at a spot where, the day before, a two metre black mamba was seen. I ended up with so many bruises and abrasions, and stiff muscles, that I limped around for a week. I saw or caught over one hundred specimens, most of which were damaged and had to be released. From all this material I could hardly find twenty good specimens to send to Rome. My first report from Rome was that they had broken the mounted material, fortunately it was only legs and antennae. On my advice the film crew eventually tracked down an eccentric old lady butterfly specialist who stuck the legs and antennae back on for them.

What a lot of effort and I doubt if we will ever see the results. However the important thing is that the Japanese public will see South African butterflies flying in Rome.

There were plenty of forest species flying along the Sabie river and even *Neptis goochi* was on the wing.

Pieter Roos and myself have spent a number of hours in researching *Chrysoritis aureus* for Gauteng Nature Conservation. This project is ongoing and will only be completed in about eighteen months. Pieter has visited the Alice Glockner nature reserve near Heidelberg and we eventually found the species resident there during the first week of October. There is more about this project elsewhere in this journal. So far this season I have not seen a specimen which is required in our collection.

Andy Meyer has done more constructive collecting than I have. He collected the early flying *Platylesches dolomitica* near Steelpoort. Andy and Alf Curle spent the long September week-end travelling down to the Cape. They visited Lootsberg Pass and collected one fresh male *Aloeides caledoni* apiece. They travelled further south to Sutherland where they found fresh *Lepidochrysops jamesi* and *Phasis pringlei*, along with lots of other species but only in small numbers.

Another research project and conservation plan has been directed our way. The type locality, at Margate on the south coast of KwaZulu-Natal, for *Durbania amakosa albescens* and *Lepidochrysops ketsi leucomacula* is under threat from low cost housing. The KwaZulu-Natal department of nature conservation is aware of it and is requesting our support. Should anyone be interested in assisting in this project or have any other conservation ideas please contact the council.

GRAHAM HENNING

BUTTERFLY RESEARCH IN WEST AFRICA

By Torben B. Larsen
West Africa Branch, Lepidopterists' Society of Africa

Introduction

Over the past ten years our knowledge of all aspects of the 1,400 West African butterflies has increased considerably. This note attempts to summarize some salient points.

Additional species

About 300 species have been added to the West African list, mostly still unpublished. This is an increase of more than 25%. Cornes et al. (1969, 1971, 1973) recorded about 950 species from Nigeria; a working group has just compiled an updated checklist of 1,250 species for an increase of almost a third. Owen (1971) estimated the Cameroun fauna to be 1,150 species; a recent estimate by Libert (1992) is 1,550, an increase of more than a third. A significant proportion of the additional species are due to intensive investigation of the large forests of the Nigeria; many of the species new to the region the species do not go further west. But there are also some spectacular range extensions, the most amazing being Bouyer & Joly's capture of a new subspecies of *Charaxes fourmierae* in Ghana.

New species

A steady trickle of new species comes in both from the field and from museum collections, but is only a trickle. Some 50 species have already been described, and another 30 are pending. This is only 6% of the known fauna, but more than half of these are due to revisions of the *Bebearia* and *Euphaedra*. A number of taxa have also been promoted to species status.

Species struck off

A number of species have been taken off the West African list. *Papilio hesperus* was described from the Gold Coast in 1843 but has never been seen since; it was described together *Papilio charopus*, also from the Gold Coast. The latter is a montane butterfly which could not possibly be in Ghana, and both must have been from the Cameroun Highlands. Another example is *Mylothris rembina* which is consistently said to be in Gambia, despite the complete improbability of this; examination of the specimen giving rise to the record, shows it to be from Gambiu, a locality in Equatorial Guinea!

Country records

Several hundred new country records have been established, both from museum collections and newly collected material. There would have been many more if access to Guinea and Liberia had been freely available. Going from west to east along the coast, we can say that the fauna of Senegal is now well known, that of Guinea-Bissau reasonably well, Guinea not so well, Liberia poorly, Côte d'Ivoire tolerable well, Ghana well known, and Nigeria well known.

The inland countries (Mali, Burkina Faso, Niger) and the northern parts of the coastal countries are very patchily known. Though the West African savannahs are much less diverse than those of eastern and southern Africa.

Locality lists

Till recently, there were very few even moderately comprehensive locality lists, mainly Gambari and Olokemeji in western Nigeria. The following lists are now by far the most comprehensive records of invertebrates from the respective areas.

Okomu Nature Sanctuary, Nigeria (Wojtusiak and Larsen)
Bossematie, Côte d'Ivoire (Dall'Asta, Fermon, and Larsen)
Oban Hills National Park, Nigeria (Larsen)
Okwangwo National Park, Nigeria (Larsen)
Pare National du Haut Niger, Guinea (Mei)
Kyabobo, Ghana (Larsen)
Kakum National Park, Ghana (Larsen)
Ankasa National Park, Ghana (Larsen)
Aburi National Park, Ghana (Larsen)
Bia National Park, Ghana (Larsen)
Boabeng-Fiema Wildlife Sanctuary, Ghana (Larsen)
Lama Forest, Benin (Fermon)
Korup National Park, Cameroun (Larsen)
Burkina Faso country list (Gardiner)
Gashaka-Gumпти National Park, Nigeria (Knoop)
Kpalime, Togo (West)

Ecological research

A massive trapping programme is taking place in Bossematie in Côte d'Ivoire, with traps placed in a variety habitats by Dall'Asta and Fermon. Some very clear patterns are emerging, mostly consonant with field observations. The material also supports field conclusions on the relative frequency of species in *Bebearia*, *Euriphene*, and *Euphaedra*.

Constraints

A major constraint has been that access to certain countries has been almost impossible. This is especially true of Sierra Leone and Liberia where civil wars have smouldered, and Guinea where visas were almost unobtainable. Fortunately, Belcastro (1986, 1990) collected extensive in Sierra Leone before law and order broke down. Despite the massive tome on Liberian butterflies (Fox et al. (1965), only 475 species are known from that country, which is probably only half the true fauna (there are more than 1,000 species in Ghana).

The main constraint, though, is that at any given time only four or five collectors are active, most with time-constraints that do not permit them to go to far-flung places.

The lack of an authoritative book on West African butterflies is now less of a problem. The manuscript of my book *Butterflies of West Africa - origins, natural history, diversity, and conservation* is now well advanced, and anyone collecting seriously in West Africa is welcome to a copy on diskette. I hope to have the first volume, at least, ready by year 2000.

Conclusion

Despite the small number of participants, the last ten to twenty years have seen very encouraging progress in our knowledge of West African butterflies, aided by re-study of most material in museum's with large African holdings. I hope my book will lead to a much more intensive use of butterflies as indicator species for ecological, biogeographical, ethological, and biodiversity research.

Two of the provisional findings are particularly pleasing: 1) The Cross River loop in eastern Nigeria and western Cameroun has an astounding biodiversity with nearly 1, 100 species. That is a third of the entire continental African fauna and more than on the Malaysian Peninsula or the Philippine Archipelago. 2) More than 90% of all forest butterflies ever known from west of the Dahomey Gap have been recorded during the 1990s, though the forest has shrunk dramatically. Many of those missing are 'once-in-a-lifetime species' (e.g. *Pseudaletis*, rare *Micropentila*, *Leona* skippers); there are probably still some 'phantom' species on the list (according to Libert, many *Epitola* need to be excluded. I draw the conclusion that as yet there has been no extinctions. This is no grounds for complacency, but it should provide justification and encouragement for everybody involved in conservation in West Africa.

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LETTERS TO THE EDITOR

Dear Sir

Protection of lepidoptera and collection of specimens in protected areas.

The KwaZulu-Natal Nature Conservation Service (KZNNCS) wishes to respond to an editorial by Hermann Staude in the March 1998 edition of *Metamorphosis*. We value interaction with the Lepidopterists' Society of Africa and wish to give clarity from the point of view of the KZNNCS on certain issues that were taken up (either explicitly or implicitly) in the editorial. Some of our comments below relate both to the editorial and to conversations with members of the society that have arisen around these issues as far as they concern KwaZulu-Natal specifically. The pivotal role that private lepidopterists have and will play in the conservation of butterflies and moths in KwaZulu-Natal and elsewhere in South Africa is gratefully acknowledged and beyond dispute. The KZNNCS has no intention to prevent private lepidopterists from carrying on fulfilling this vital function. On the contrary, the KZNNCS has a policy of encouraging both amateur and professional lepidopterists to make their collections in a professional manner and make the data available in a form that can immediately serve their conservation (see below). Indeed, we rely on private collections to a large extent for butterfly distribution records, particularly for areas outside reserves, and these data are used for conservation purposes. Conservation research is another field in which private lepidopterists are involved in conjunction with the KZNNCS. At present there is a wide-ranging project registered with the KZNNCS looking at the role of certain reserves in the conservation of butterfly species. This work is being carried out by private lepidopterists who have built up good credentials with the KZNNCS with their high quality work and reporting of results.

The KZNNCS recognises that habitat destruction is the primary cause of reduction in numbers and extinction of plant and animal species in KwaZulu-Natal. We also recognise that private lepidopterists have an invaluable role to play in the monitoring of threatened butterfly populations, and that it is very important to nurture an interest in lepidoptera and their conservation by the public. There will certainly be no blanket ban on collection of butterflies and moths. We know of no empirical study that demonstrates that collecting has caused the extinction of colonies of butterflies. On the other hand, we do not know of any empirical studies that show that collecting has not adversely affected the numbers of any butterfly species. Here is a fruitful area of research (for further discussion of the issues of collection and habitat destruction in the conservation of butterflies see New, T.R., 1993. Introduction to the Biology and Conservation of the Lycaenidae. In *Conservation Biology of Lycaenidae (Butterflies)*, ed. T.R. New, Occasional Paper of the IUCN Species Survival Commission No. 8, pp. 1-21). Presently we are contemplating the categorisation of certain lepidopteran species (mainly species on the Red Data list) as Specially Protected or Protected in the province. This means that these species cannot be captured, donated, exported, exchanged, hunted, imported, introduced, kept in captivity, possessed, purchased, released, sold or translocated, except under the authority of a permit issued by the KZNNCS. We are also hoping that

some form of habitat protection will be afforded to Specially Protected and Protected species. The KZNNCS, as the organisation responsible for the conservation of the biodiversity of KwaZulu-Natal, has to ensure that rare or threatened species do not decline in number. Any factor or activity that may contribute to this decline, whether relatively important or not in terms of impact on population size, should be managed or controlled. Certain factors that are relatively unimportant at first in the decline of a species may become increasingly important as the population size decreases, and also if the magnitude of that factor increases with time. Again, a blanket ban on collection of these species is not intended. Rather, collecting of protected species will be allowed only in terms of a permit that will be issued according to certain criteria that have yet to be decided. That is why the input of specialists, whether professional or not, is crucial to ensure that only the species needing protection remain on the list. The whole process of developing the new Nature Conservation Act for the province has been, and will be, transparent. The KZNNCS has to rely on readily available information when determining whether a species should be listed, hence the use of the Red Data list. The "straw-dog" lists of Specially Protected and Protected lepidopteran species for KwaZulu-Natal were submitted in the latter part of 1997 to, inter alia, the committee of the Lepidopterists' Society of Africa for their comments and recommendations as to which species should or should not be on the lists. This underlines the value that we place in the Society for advice during the decision-making process. Unfortunately, to date (July 1998) we have not received an official reply from the Society. Even so, once the draft Act has been finalised, it will be open for public comment. Opportunity, therefore, still exists for individuals and organisations to provide written comments or objections to the draft Act or any parts of it. These comments should be backed where appropriate by evidence in argument of their validity. For example, new information could indicate that certain species are more widespread or common than previously known. Written comment could even include suggestions as to what types of permit could be issued if it is necessary to have any of the species listed as Protected or Specially Protected. The lists are not static, but can and will be reviewed from time to time. Species may be added or removed from a particular list, but only in response to empirical evidence indicating that the status of the species has changed.

The KZNNCS has policy dealing with the collection of specimens in reserves. In short, the collection of specimens is only permitted in reserves under certain circumstances, and collection of specimens that can easily be obtained outside reserves is prohibited unless under permit issued in terms of a registered research project. Butterfly and moth collecting is therefore generally prohibited in the province's reserves, as is reptile collecting as another example, unless the collection is necessary as part of a registered research project. The disposal of specimens collected in terms of a permit is also regulated by the policy. Reserves are areas where human pressures on wildlife resources should be minimised, especially since the habitats of many wildlife species are disappearing outside of reserves. Research is required to determine how reserves should be managed for the benefit of their wildlife, including butterflies and moths, and monitoring of populations of rare species should be carried out. However, there can be no

justification for collecting in reserves for purely private purposes or for purposes that do not improve the chances that lepidopteran species will survive over the long term. Certain species are mainly restricted to reserves in the province, partly because of destruction of habitat elsewhere. Allowing collection in reserves of butterflies and moths that are scarce outside reserves would also have the negative effect of not building public opposition to the further destruction of their habitats, because these butterflies would be readily available in reserves. Reserves also do not guarantee the survival of species in the long term. Protected areas that become islands in a human-dominated landscape are vulnerable to losing species through unpredictable events such as the introduction of disease from the outside or extreme climatic events. Re-colonisation of the protected area by these species may not be possible from the outside because of land transformation and other human activity. As an example, certain plant and animal species have become extinct, or nearly so, in one of the province's largest protected areas, the Hluhluwe-Umfolozi Park, after the devastating effects of disease or extreme climatic events. Some of these species may not naturally recolonise the park.

The question then is, how can habitat protection outside of reserves be effected? Here private lepidopterists can play a valuable role, by encouraging or lobbying landowners (whether private or the State) to protect butterfly and moth habitats to ensure the long-term survival of our lepidopteran fauna. More precise labelling of specimens (e.g. by providing precise locality, altitude, habitat and host-plant information) can also increase the quality of the contribution of private lepidopterists to the conservation of butterflies and moths. The KZNNCS would like to see the provision of these data become a condition of permits as it will allow the incorporation of this information into electronic databases for easy access by other parties, including conservation organisations.

Yours sincerely,

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Conservation Biologist (Species)
Biodiversity Division
KwaZulu-Natal Nature Conservation Service

EDITORIAL POLICY

Manuscripts dealing with any aspect of the study of Afrotropical Lepidoptera will be considered.

Manuscripts not conforming to the instructions below may be rejected and returned to the author. All manuscripts of scientific papers will be evaluated by at least one reviewer. Proofs will be returned to the author if necessary and only printer's errors may be corrected. Ten (10) offprints are provided free of charge to the author or senior author on request, and only if the manuscript has been submitted on computer diskette in a word processing format that the editors are able to convert. Authors should contact the technical editor to enquire if the software that they are using can be converted by the editors, as the situation changes constantly. Additional offprint numbers can be ordered, at cost, at the proof stage.

A hard copy of the manuscript, and the originals of illustrations, and the computer diskette must be submitted to the editor. The text should be printed on A4 paper, with double line spacing, and a margin of at least 2cm on each side. The pages should be numbered consecutively, beginning with the title page, and including those carrying references, tables and legends to figures. All figures and tables must be referred to in the text. If a computer diskette is not available, then tables are to be typed on A5 paper, exactly as found in the printed journal.

Figures must be boldly drawn in black waterproof ink, and arranged in clear and logical plates on stiff, white, preferably A4-sized board. All figures must be numbered in a common sequence in Arabic numerals, irrespective of whether they are line drawings, photographs, diagrams, graphs or maps. Magnifications should be indicated by scale bars on the figures.

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