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Preliminary observations on the life history and behaviour of the enigmatic lycaenid 'Warrior Silver-spotted Copper' *Argyraspodes argyraspis* (Trimen, 1873), with detailed descriptions and illustrations of the egg and first instar larva

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Abstract: The egg and first instar larva of *Argyraspodes argyraspis* are described and illustrated in detail for the first time, together with observations on ovipositing behaviour. Morphological characteristics of the egg and first instar larva are discussed and comparisons are drawn between the early stages of this butterfly and those of *Trimenia* Tite & Dickson, to which it is known to be similar. Indications inferred from larval morphology and behaviour suggest that it has an aphytophagous life history and may be a predator of ant brood or Hemiptera during early instars. Strong, albeit circumstantial evidence is presented that it has an obligate association with the Brown Cocktail Ant (*Crematogaster melanogaster* Emery), but that this interaction is unlikely to be mutualistic initially. Further research into this butterfly is proposed; also into whether it is a pollinator of Bokhoring (*Microloma sagittatum*).

Key words: Lepidoptera, Lycaenidae, Aphnaeinae, *Crematogaster melanogaster*, oviposit, cocktail ants, life history, aphytophagous, mutualistic, obligate, myrmecophily, predator, pollinator, *Microloma sagittatum*

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INTRODUCTION

Argyraspodes argyraspis (Trimen, 1873) is a large and robust lycaenid of the subfamily Aphnaeinae in which all known life-histories indicate obligate myrmecophily (Heath & Claassens, 2003). It is bright orange with black borders on the upperside and has silvery-white spots beneath. It is very similar in size and wing markings to species of *Trimenia* Tite & Dickson, 1973, to which, it is closely related (see Heath, 1997: 21, Heath & Claassens, 2003: 11; Boyle *et al.,* 2014: 12). It is widely distributed in the western half of South Africa; it also occurs in Namibia and Botswana. The Nama- and Succulent-Karoo Biomes are its usual habitats in South Africa and it has been assessed as "wide range and common" (Edge *et al*., 2013).

Several years ago the first author observed two females of *A. argyraspis* hovering about a *Roepera teretifolia* (Schltr.) Beier & Thulin (Zygophyllaceae) plant at the base of which was a nest of ants, later identified as the Brown Cocktail Ant *Crematogaster melanogaster* Emery, 1895. This was in an area where *Crematogaster peringueyi* Emery, 1895 ants were predominant, yet this butterfly showed no interest in plants with those ants.

It is difficult to understand why nothing has so far been published on the life history of *A. argyraspis* bearing in mind its conspicuous appearance and widespread distribution. The first author has for several years hoped to discover the life history of this butterfly, so in 2015 a few short trips to Namaqualand were made to find out more.

METHODS AND MATERIALS

Four field trips were made to a site (1) about 4 km north of Kotzesrus, Northern Cape Province (coordinates: 30°56.19'S; 17°51.47'E, elevation 213 m). Later, another nearby site (2) was visited (coordinates: 30°54.984'S; 17°52.649'E, elevation 163 m). Both sites are in the Namaqualand Sandveld, (red sand).

Camera kit in the field included an Olympus OM-D E-M5 camera and M.Zuiko Digital ED 12-50mm 1:3.5-6.3 EZ lens. At home in Pinelands an Olympus M.Zuiko Digital ED 60mm F2.8 macro lens was also used and an OM-System Zuiko Auto-macro 20mm 1:2 lens, Auto-macro 50mm lens and bellows were used. The stacking software used for the egg was Photoshop.

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Identification of the *Crematogaster* ants was conducted by the first author based on their morphology, as tutored by Dr Hamish Robertson, Iziko South African Museum, Cape Town.

RESULTS

First field site

Following three unsuccessful visits to the first site in September 2015 where the weather was cold and unsuitable for research, a fourth visit was made on 5 October at ~11:00 am. An area approximately 25 m^2 was located where the butterfly had been seen on earlier occasions. A female and three males were present and seemed to be strongly attracted to this small site. In the centre of this area a small climbing plant with pink flowers seemed to be the focus of attention. It attracted *A. argyraspis* far more than the small yellow and white flowers of *Helichrysum gariepinum* DC. (Asteraceae) in the site area. The plant with the pink flowers (Fig. 1) was later identified as Bokhoring, *Microloma sagittatum* (L.) R.Br. (Apocynaceae).

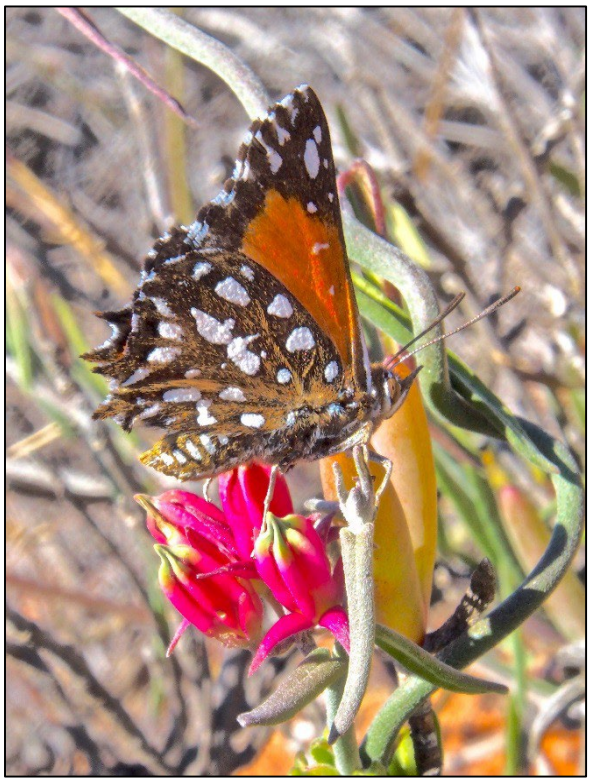

Figure 1 – Male *A. argyraspis* and flowers of *Microloma sagittatum*

The female was often followed but oviposition was not seen. She sometimes went into shade beneath a shrub where oviposition was probably taking place but could not be confirmed; at times, she flew well away from the site, too fast to follow. By 2:00 pm the wind had become stronger and the *A. argyraspis* were less often seen.

Examination of the other plants within the site revealed several *Hermannia trifurca* L. (Malvaceae) plants that had *C. melanogaster* ants (Fig. 2) nesting in the sand beneath or near the plant. Despite an intensive search, no butterfly larvae were found inside the site area. Immediately outside the site area *C. thysbe bamptoni* (Dickson, 1976) larvae were encountered on *R. teretifolia* and these were all associated with *C. peringueyi* ants.

Figure 2 – Brown Cocktail Ants *C. melanogaster*

Figure 3 – Female *A. argyraspis* ovipositing on dead twigs

Second field site

A visit was made to the second site that was also sandy but rather more arid, where two *A. argyraspis* were seen nectaring on the pink flowers of *M. sagittatum* and where again, this plant appeared to be at the centre of attention within another small area about 20 m^2; it was in fact the only flowering plant present in or surrounding this small area. Eventually a female was

seen and followed. She remained in the site area and was shortly observed to oviposit on a twig of a dead plant. Examination of the nearest live plant (about 1.25 m away) revealed some *C. melanogaster* ants beneath a *Hermannia trifurca* plant. The female was repeatedly observed to oviposit in similar circumstances, e.g. singly or two eggs on dead twigs near a *H. trifurca* plant with *C. melanogaster* ants present nearby. A total of four eggs were collected and placed in a small container. Photographs were taken of the female ovipositing (Fig. 3).

The following day a female was again followed and two more eggs were collected. In one case, the female walked under the *Hermannia* plant and seemed to be ovipositing on dead twigs that were lying beneath the plant although this could not be verified.

In captivity

At home in Pinelands, Cape Town, photographs were taken of one of the six eggs that were kept in a petri dish. After two weeks, five of the six eggs hatched and photographs were taken of the first instar larva. On emergence the larva ate a hole at the top large enough to permit its exit but the rest of the egg was not eaten. Two *C. melanogaster* ants were introduced to a petri dish with one larva present to observe the interaction. The larva approached one ant and the ant responded aggressively by raising its gaster but then backed away. Subsequently each ant, on approaching the larva would change direction to avoid contact. The first instar larvae were then placed in a vial of ethanol for later study.

Parasites

A week after the five eggs hatched and three weeks after oviposition, four parasitic wasps emerged from the sixth egg. Two of the four wasps were deposited with the Iziko South African Museum, Cape Town.

Description of the egg

The *A. argyraspis* egg is bun-shaped, 1.28 mm diameter and 0.85 mm high (Figs 4 & 5). The eggs are ivory to straw-coloured and have a pattern of rounded nodes with six or more radial spokes, each of which doubles as a spoke for a neighboring node. The pattern becomes progressively compressed and distorted as it nears the bottom of the egg and similarly as it nears the micropyle. The eggs hatched 14 days after they were laid.

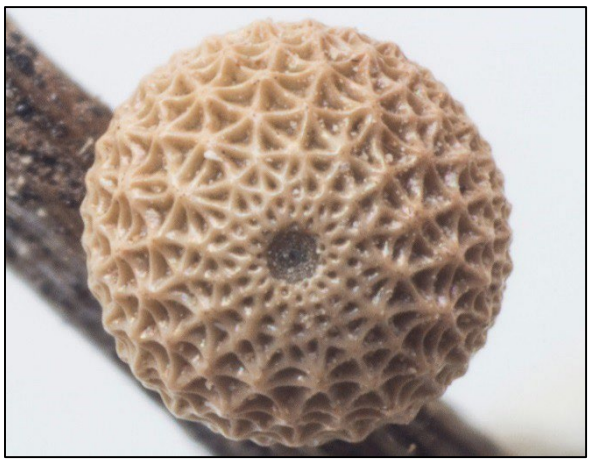

Figure 4 – Egg of *A. argyraspis* dorsal view

Figure 5 – Egg of *A. argyraspis* lateral view

Description of first instar larva

The larva at rest is 2.9 mm long (Figs 6 & 7). The TOs (a pair of tubercle organs located on the eighth abdominal segment) have the appearance of fleshy stumps as the casings are not chitinised. The DNO (dorsal nectary organ) is absent. The markings are dull pink on a creamy background. The head, thoracic segments and legs are unusually large and robust in relation to the rest of the larva. The black neck-shield is more than twice the size of the anal-shield.

Figure 6 – Lateral view of *A. argyraspis* first instar larva

Fine and white/translucent setae emanate from a lateral mound either side of each abdominal segment. Each segment also has a pair of dorso-lateral mounds that house clusters of setae; most of these setae are very robust, black with translucent tips, recurved distally and strongly armed with barbs along most of their length. Most of these mounds also have one or two finer translucent setae that are very long. There are similar setae on the thoracic segments but these are recurved proximally. There are also two dorsal rows of fairly short black setae; one pair to each segment. The sturdy legs are black and relatively large. The head is black and is adorned with some fine translucent setae. The distal end of the larva is rounded (viewed dorsally) and distally flattened (viewed laterally) with 18–20 long black setae (also barbed) with fine translucent ends radiating from the rounded termen.

Figure 7 – Dorsal view of *A. argyraspis* first instar larva

DISCUSSION

Morphology: Despite being closely related to *Trimenia*, the egg pattern of *A. argyraspis* is not similar to eggs of that genus and instead it is somewhat closer to the egg of *Tylopaedia sardonyx* (Trimen, 1868) as depicted in Clark & Dickson (1971: 218). Conversely, the first instar larva of *A. argyraspis* is nevertheless very similar to those of *Trimenia* species, depicted in Clark & Dickson (1971: 218–219).

Behaviour: When the first instar larva of the aphytophagous *Chrysoritis dicksoni* (Gabriel, 1947) first met their associated ant, the ants were attracted to the larva, touching it gently with their antennae (Heath, 2014). In this study the *A. argyraspis* first instar larva had the opposite effect and appeared to repel the ant. Observations over the years and during this study indicate that *A. argyraspis* has some form of association with *C. melanogaster* ants (Myrmicinae); however, the closely related *Trimenia* species associate with *Anoplolepis* ants (Formicinae) (Heath & Brinkman, 1995; Heath & Claassens, 2003). So, not only a different species of ant is involved but a different subfamily too. There was no sign of *Anoplolepis* ants at either site, nor do *Trimenia* species and *A. argyraspis* normally occur together (AH, pers. obs.). Interestingly, *Tylopaedia sardonyx peringueyi* (Dickson, 1969) does associate with *C. melanogaster* (Schlosz & Brinkman, 1991).

Figure 8 – Two *A. argyraspis* adults nectaring on *M. sagittatum*

Nectaring: It was noted that *A. argyraspis* was very strongly attracted to the pink flowers of *M. sagittatum*; often two, and occasionally as many as three *A. argyraspis* would be intensively nectaring on this one plant at the same time (Fig. 8). The recorded pollinators of *M. sagittatum* are Sunbirds; the bird picks up a tiny "parcel of pollen" on its tongue after forcing the tip of its bill into the flower (Pauw, 1998). It is not known if the pollen parcel might adhere to the butterfly's proboscis as it is withdrawn from the flower and similarly serve as a pollinator. Note that these flowers do not open naturally on their own (Pauw, pers com.), so nectar can only be obtained through brute force. No other butterfly was seen to nectar at these flowers at either site. *Phasis clavum* Murray, 1935 is similar in size to *A. argyraspodes* and was fairly common around each of the sites but was not seen at *M. sagittatum* but nectared instead on nearby *Mesembryanthemum* flowers. Although *A. argyraspodes* also nectars on *Mesembryanthemum* flowers along with many other butterfly species it was not observed to do so at either of the two small sites studied.

CONCLUSIONS

It was noted that the adult butterfly did not oviposit on live plant material at either site during this study. This lends further support for it being aphytophagous, which is not altogether surprising if it is closely related to species of *Trimenia* whose species are believed to

be aphytophagous (Cottrell, 1984; Heath & Brinkman, 1995; Heath & Claassens, 2003).

The structure of the first instar larva suggests that it is a predator, e.g., the large head and powerful legs, proportionally larger than first instar larvae of phytophagous species. Its long and barbed setae could act as a scaled-down version of razor-wire, acting as a deterrent against the approach of other insects of comparable size. With this degree of protection and the observed reaction of the two ants it is unlikely that initial symbiosis with *C. melanogaster* ants would be mutualistic.

Based on these conclusions a couple of hypotheses emerge; an unwelcome first instar larva - entering an ant nest and feeding on brood or alternatively, feeding on Hemiptera attended by ants.

This study has revealed some clues to the life history of *A. argyraspis* but it has also left several questions unanswered. What does the first instar really feed on? What do later instars feed on? Where does this take place? Are they univoltine or multivoltine? Why were the eggs laid on dead vegetation and not on a live stem or leaf, closer to an ant nest or to Hemiptera? Was *C. melanogaster* the only ant in the vicinity? Note that no *Anoplolepis* or other genera of ants was observed at either site. Further research is planned and in progress to answer some of these questions.

Further research is also necessary to determine if the association between *M. sagittatum* and *A. argyraspis* is more than a mere nectaring convenience for the butterfly.

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