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Development and early stages of *Mylothris rhodope* (Fabricius, 1775) (Lepidoptera: Pieridae)

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Abstract: In this paper, the full life-history of *Mylothris rhodope* is discussed with a morphological description of its early stages including multiple photo illustrations, as documented in Liberia, West Africa.

Key words: Pre-imaginal stages, life-cycle, Loranthaceae.

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INTRODUCTION

Information on the development of the early stages of species in the genus *Mylothris* is scarce (Braby, 2005; Larsen, 2005; Williams, 2020), probably because most species actually breed in the canopy of forest trees which are usually inaccessible to lepidopterists. The development of the most common open habitat species are usually known, however, proper description and photographic documentation of the early stages are rarely available. Not even the most common and widespread *Mylothris chloris* was comprehensively documented until recently (Sáfián, 2020). The revision of the genus *Mylothris* (Warren-Gash, in press) includes information and illustrations of the early stages of some East African species, but many gaps remain. Based on rearing studies carried out in Liberia (West Africa), this paper documents the full life-history and pre-imaginal stages of the widespread *Mylothris rhodope* (Fabricius, 1775) for the first time, including multiple photographic illustrations.

MATERIAL AND METHODS

Captive rearing was performed using 3L air-tight tupperware containers, kept indoor at room temperature (24–25°C). Fresh mistletoe leaf shoots were supplied every second day or sometimes earlier, when the amount of food was critically low. The containers were cleaned of frass and leaf-litter every day to avoid the appearance of mould or infections. After eclosion, freshly emerged specimens were placed on a bamboo stand in open air for drying.

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THE LIFE-HISTORY OF *M. RHODOPE*

A cluster of approximately 104 whitish-green *Mylothris* eggs were observed on the 4th August 2020, during the collection of fresh shoots from an unidentified Loranthaceae plant for larvae (caterpillars) of *Mylothris chloris chloris* (Fabricius, 1775) (Sáfián, 2020), and were collected two days later. The eggs were laid on the upper surface of a younger leaf hanging in the shade of the plant. All larvae hatched eight days after collection on the 14th August. The tiny yellow larvae ate their eggshells before consuming the softer tissue, skeletonising the already brown, but still soft leaf. During movement, they spun a silk line, creating a small, invisible web on the surface of the leaf and also on the tupperware. They probably had their first moult after just one day because they appeared almost twice of their original size already on the 17th August. They also changed colour from light yellow to darker bi-coloured glossy green-yellow (see detailed morphological description for each larval stage below). To move to a new feeding area before feeding, they always moved in a single line, in nose-to-tail processions (Fig. 1), similar to various species of Processionary Moth (Thaumetopoeidae), *M. chloris chloris* as described in Sáfián (2020), as well as larvae of *M. agathina* (Williams, 2020, quoting Trimen & Bowker, 1889). During their entire life they spun a silk line, which they also used to climb back to the food plant, as in the case of disturbances when larvae regularly jumped off the food plant with a sudden, twisting movement.

Initially, the larvae did not grow quickly, staying about 10 mm long until the third instar, when they changed their colour and pattern, still keeping the glossiness of the younger instars. In the fifth instar they grew from 20 to 26 mm in just 24 hours, and after another two days they started changing colour again, moving around the rearing pot as a sign of preparation for pupation. To position themselves, they spun a silk girdle across the middle of the body, which kept the pupa in position. They remained in this pre-pupation stage for about one and a half days before the last moult.

Figure 1 – *Mylothris rhodope* second instar larvae moving to the feeding site in a line.

The first larvae pupated on the 30th August and the majority of specimens completed pupation by the 1st September. A few underdeveloped larvae continued to feed for a few more days before pupating. Four days before eclosion, the bright orange pigmentation on the females' forewing was already visible through the pupal case, however other features of the wing pattern (also of the males) appeared only one day before eclosion (Figs 2–3).

Figure 2 – *Mylothris rhodope* male right before eclosion.

Figure 3 – *Mylothris rhodope* female right before eclosion.

The pupal stage lasted 8–10 days and the first few butterflies eclosed during the night of the 7th September (Figs 4–5) with the emergence of adults continuing on the 8–9th September. Unexpectedly, the vast majority of specimens that eclosed on the first day and the morning of the second day were females, with only one male that eclosed on the first day and three in the morning hours of the second day (overall a total of 41 males eclosed, with the vast majority emerging in the afternoon on the second day). On the first day approximately nine females eclosed, followed by over twenty in the morning of the second day (overall a total of 32 females eclosed), leaving the last ones to eclose on the fourth day. Altogether 73 *M. rhodope* specimens eclosed from the pupae, resulting in 70% rearing success, despite unexpected mortality of a few pupae caused by physical damage due to inappropriate handling by the author. The majority of the freshly emerged butterflies flew their first flight on the same day as eclosion, some of them in the late afternoon to seek a hide for the night. The following day, several specimens were observed flying around the canopy of the mistletoe-infested trees in the garden.

Figure 4 – Freshly emerged *M. rhodope* female pumping its wings right after eclosion.

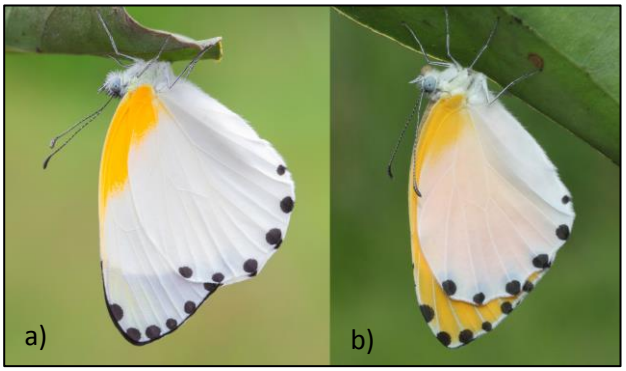

Figure 5 – Freshly eclosed *M. rhodope* drying their wings: a) Male and b) female.

DESCRIPTION OF EARLY STAGES

Eggs: Height approximately 0.8 mm, width 0.5–0.6 mm, shiny milky, whitish light green, barrel-shaped with a glossy light green hump on one side, longitudinal ribs (best visible with magnifying glass) and eight or nine warts of lighter yellow colour, forming a circle on the edge of the plate of the micropyle (Fig. 6). They were laid on the mistletoe leaves (the collected eggs were on the upper surface) in clusters (very close to each other, many even touching) of approximately 100 eggs.

Larvae:
1st instar: Body length approximately 1.2–1.5 mm (when newly hatched), width 0.3–0.4 mm. Body shape evenly cylindrical. Colour light greenish-yellow, slightly glossy, covered by short white hairs. The head capsule is black, slightly broader than the body (Fig. 7).
2nd instar: Body length approximately 8–10 mm width 1.2 mm, when fully grown (measurements were not taken after the first moult) tri-coloured, darker glossy green and anteriorly, greenish-yellow posteriorly with the last two segments being light brown. This could be a result of a yet semi-transparent body, filled with green parenchymal tissue of the food plant in roughly two-thirds of the body,

being digested and converted into frass towards the posterior section of the tract; the fresh frass is also brown (Fig. 8). The head capsule remains black, its width is slightly narrower than its body (Figs 1, 8).

Figure 6 – The egg cluster of *M. rhodope*.

Figure 7 – *Mylothris rhodope* freshly hatched first instar larvae.

Figure 8 – *Mylothris rhodope* second instar larvae.

3rd instar: Body length approximately 12–15 mm, width 1.8–2 mm. The body is still glossy, tri-coloured but the green colour is lighter, and two yellow longitudinal lines appear dorso-laterally, as well as two prominent white ones laterally. The white hairs that cover the entire body are rather inconspicuous, except on the 1.5–1.6 mm wide, black head-capsule (Fig. 9).

4th instar: Body length approximately 16–20 mm, width 2–2.5 mm, head capsule 2 mm. The colour is grass-green speckled with tiny greenish-whitish-yellowish dots. The two yellow longitudinal lines present dorso-laterally and the white ones laterally are very prominent, the dorsal ridge also appears to be darker, forming an inconspicuous dark green line. The first segment has a prominent shield-shaped black spot dorsally, while a smaller one appears on the anal plate. The entire body is covered by fine white 1–2 mm hairs. The head capsule is mainly black with white specks and hairs, with brown area dorsally (Fig. 10).

Figure 9 – Cluster of *M. rhodope* third instar larvae before moult.

Figure 10 – *Mylothris rhodope* fourth instar larvae.

5th instar: Body length approximately 20–26 mm, width 3–4 mm. Head capsule 3 mm wide. Its appearance does not change much after the moult (Figs 11–12). Before pupation the larva shrinks in size to 18–20 mm and changes colour to first light grass green then to light lemon yellow with white dots, only the lateral white line and some black on the first segment and the anal plate remain of its original pattern (Figs 13–14).

Figure 11 – Freshly moulted fifth instar larvae of *M. rhodope* and a few still in fourth instar.

Figure 12 – *Mylothris rhodope* fifth instar larva.

Figure 13 – *Mylothris rhodope* fully grown fifth instar larvae and their colour change before pupation.

Figure 14 – *Mylothris rhodope* larva, pre-pupation stage.

Pupae: Length approximately 18 mm, excluding a 2–2.5 mm long straight or sometimes strongly upcurving cephalic projection/horn. Width 4.5 mm across the thorax, 3 mm across the middle of the abdomen. In shape, the pupae of *M. rhodope* are very similar to other *Mylothris* pupae, with the characteristic cephalic projection, two protrusions on the dorsal ridge of the mesothorax, four approximately 1 mm long dorso-lateral tubercles/protrusions as well as one smaller vestigial protrusion along each side of the median ridge and a strongly tapering slim abdomen. The colour of the pupa is glossy greenish-yellow, speckled with whitish dots across the entire body (Fig. 15). The tip of the second protrusion on the metathorax is black, there is also black on the cephalic horn. Some pupae also show black colouration of one or more of the dorso-lateral protrusions, or the dorsal surface is partially or completely overlaid with a black or blackish-brown pattern (Fig. 16). Ventrally, the colour is lighter milky greenish-white, similar to the cremaster.

Numerous other illustrations of each stage are also available online following the link: https://abdb-africa.org/species/mylothris_rhodope

Figure 15 – Colour and pattern of *M. rhodope* pupae, dorsal view.

Figure 16 – Colour and pattern variations of *M. rhodope* pupae.

DISCUSSION

The full life-history of *M. rhodope*, from finding the eggs to the first flight of the newly emerged imagos, lasted 33–35 days, roughly 5 days shorter than in *M. agathina* as described in Williams (2020) quoting Clarck (1949, 1994) and 1–3 days longer than in *M. chloris chloris* as observed by Sáfián (2020). Captive rearing provided constantly favourable conditions of 24–26ºC, not affected by the variable weather of the high rainy season. This probably shortened the development cycle of the butterflies and possibly also had a positive effect on their rearing success, which under natural conditions highly depends on weather, food quality and availability (e.g. Gupta *et al.*, 2005; Lytan & Firake, 2012), predation, the abundance of parasitoids and even on fungal or viral infection.

All life stages of *M. rhodope* are recognisably different from those of *M. chloris chloris* (Sáfián, 2020), however, structurally all stages are easily associated with the genus *Mylothris*. Both species utilise the same food plant. Marked differences in the size of the larvae and pupae appear between *M. rhodope* and *M. chloris chloris*, with those of *M. chloris chloris* being larger and more robust in appearance. This difference develops mainly during the second instar, when the larvae of *M. rhodope* grow very slowly. In *M. chloris chloris* both sexes emerged together, whereas in *M. rhodope* there was a clear distinction with females emerging mostly during the first two days and males starting mass eclosion at about noon on the second day. The eclosion period was slightly more prolonged than in *M. chloris chloris*, which was observed under similar conditions (Sáfián, 2020), with a few specimens eclosing on the third day and the last three on the fourth day.

It is interesting to mention that there was virtually no visible colour and pattern variation or size variation among the 73 reared adults.

The food plant of *M. rhodope* in Liberia was not identifiable to the genus level because during the rearing no flowers were present to aid identification.

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