Egg morphology of *Mydaea lateritia* (Rondani, 1866) (Diptera: Muscidae)

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Several specimens of *Mydaea lateritia* (Rondani, 1866) were collected during studies of arthropod succession on pig carrions in western Poland. This is the first record of this species in Poland and the northernmost occurrence of the species. Scanning electron microscopy documentation of egg morphology of *M. lateritia* is presented for the first time. Hexagonal chorionic network, foliate hatching pleats, short lateral respiratory horns, dorsomedian flange and median area with smooth hexagonal network and craters are described. The egg could be classified as *Mydaea*-type with short respiratory horns.

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1. Introduction

The genus *Mydaea* Robineau-Desvoidy, 1830 currently contains 108 species (Bisby *et al.* 2009). Of these, 20 are recorded as occurring in Europe (Pont 2004) and 10 in Poland (Draber-Mońko 2007). *Mydaea lateritia* (Rondani, 1866) was originally described from Italy, and for almost a century it was known only from Italy and France (Hennig 1956).

Recently it was recorded from Bulgaria, France, Germany, Greece, Hungary, Italy, Slovenia and Spain (Pont 2004), and with its eastward limit of distribution at Iraq (Gregor *et al.* 2002). A yellow abdomen and predominantly yellow thorax will allow the identification of *M. lateritia* adults among other *Mydaea* species from Central Europe (Gregor *et al.* 2002).

Eggs of Muscidae have traditionally been classified in two main groups. Eggs with broadly foliaceous hatching pleats are known as *Phaonia*-type or 'simple flanged type', and those without such hatching pleats are known as *Musca*-type or 'unflanged type' (Hinton 1960, Skidmore 1985, Ferrar 1987). Eggs of most Mydaeinae genera and some Coenosiinae (*Limnophora* Robineau-Desvoidy and *Lispe* Latreille of the Limnophorini) are classified as a modification of the *Phaonia*-type, with elongated hatching pleats which sometimes form a long respiratory horn anterodorsally (Skidmore 1985, Ferrar 1987). The respiratory horns have evolved independently in various insect families and are treated as an adaptation for oviposition under water or in wet or waterlogged habitats (Hinton 1969). Besides in *Mydaea*-type eggs, respiratory horns are found in Muscidae also in some *Musca* Linnaeus.

The main aim of this paper is to describe, document and discuss the morphology of the egg of *M. lateritia*.

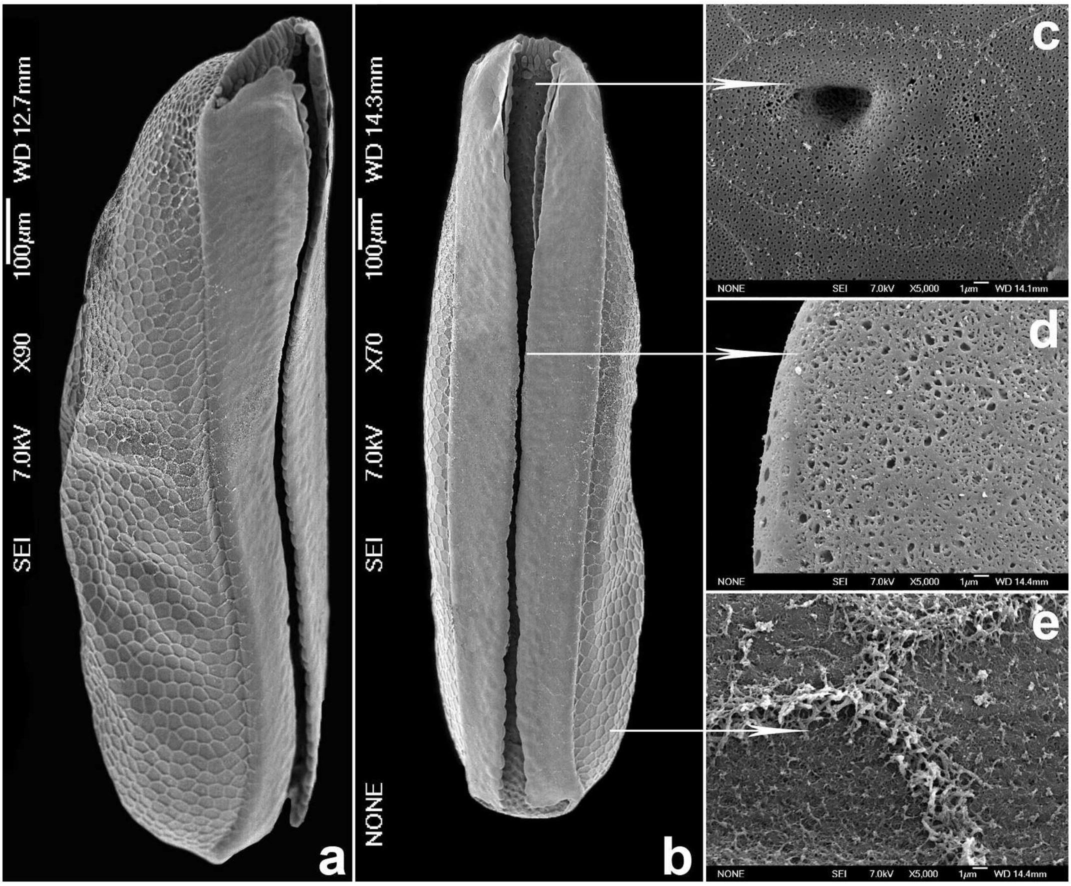

Fig. 1. Egg of *Mydaea lateritia*. – a. Lateral view. – b. Dorsal view. – c. Hexagonal pattern with smooth boundaries of median area near apex. – d. Margin of outer surface of dorsal flange. – e. Chorion hexagonal pattern with elevated boundaries.

2. Material and methods

In 2006 and 2007, a large-scale experiment on arthropod succession on decomposing pig carrions was undertaken. The research was carried out in the Biedrusko military range localized in western Poland (52°31'N, 16°54'E; UTM: XU22). In total 36 dead pigs were deployed in three different habitats (pine-oak, hornbeam-oak and alder forest) in spring, summer and autumn. Adult insects were collected using an aerial sweep net. For a full description of the experiment, see Matuszewski *et al.* (2010). During two years of the experiment, 12 adult female specimens of *M. lateritia* were collected (leg. S. Matuszewski & D. Bajerlein):

Pine-oak forest 22.X.2006, ♀; 21.IX.2007, ♀; 4.XI.2007, 2♀♀; 11.XI.2007, ♀;

Alder forest 4.XI.2006, ♀; 24.X.2007, ♀; 29.X.2007, 3♀♀; 11.XI.2007, ♀;

Hornbeam-oak forest 7.XI.2006, ♀.

Reference specimens are deposited in the Department of Animal Ecology, Nicolaus Copernicus University, Poland. Eggs were obtained by dissection from the abdomen of adult female flies and preserved in 70% ethanol.

Eggs (n = 3) were prepared for SEM by cleaning with a fine brush, dehydration through 80, 90 and 99.5% ethanol, critical-point drying in CO_2 and coating with platinum. SEM images were taken with a Jeol Scanning Microscope JSM-6335F in the Zoological Museum, University of Copenhagen. For light microscopy, material (n = 5) was stained with 1% of potassium permanganate solution (Sukontason *et al.* 2004). The photograph was taken with a digital Nikon 8400 cam-

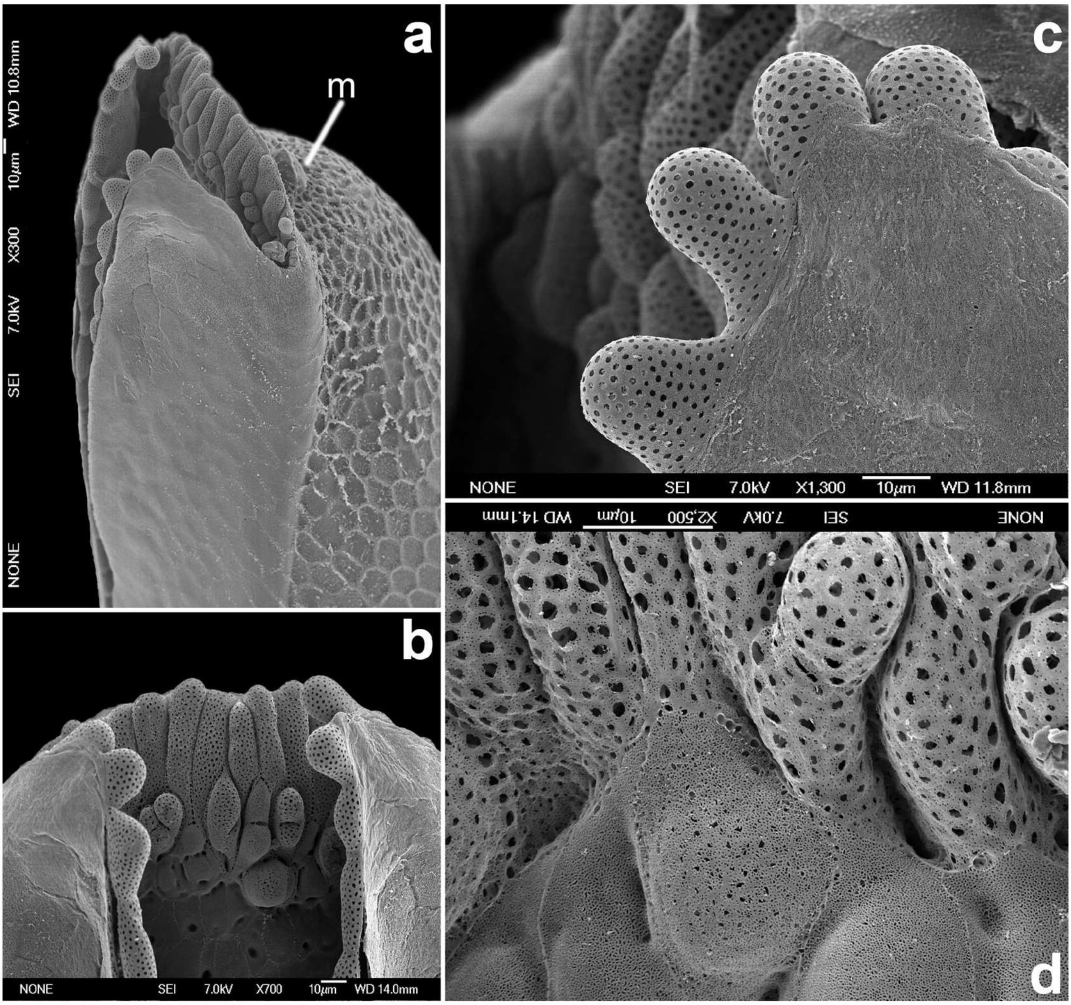

Fig. 2. Egg of *Mydaea lateritia*. – a. Lateral view of anterior part; m: micropyle. – b. Dorsal view of anterior part. – c. Apical part of dorsal flange. – d. Base of median flange.

era mounted on a Nikon Eclipse E200 microscope. Terminology follows Hinton (1981), Skidmore (1985) and Ferrar (1987).

3. Egg morphology

Egg creamy white, elongated, rounded at both ends (Figs 1a, b, 2a). Hatching pleats broadly foliate throughout, attached to the dorsolateral surface of the egg and folding inwards so as to almost meet medially half way between the poles (Fig. 1b). Pleats denticulate along the entire margin, with more distinct papillae in anterior part (Figs 2a–c), lateral respiratory horns short (Figs 1a, b). Median respiratory horn developed at the anterior egg pole as a short, collar-like flange with numerous papillae (Fig. 2b). The foliate hatching pleats project beyond apex as much as the dorsomedian flange, thereby forming two almost parallel-sided bands (Figs 2a, b). Inner surface of hatching pleats, papillae on their margin and median flange with plastron network (Figs 2c, d). Inner surface of broadened hatching pleats with hexagonal pattern (Fig. 3).

A hexagonal pattern on the chorion on entire lateral and ventral surface with elevated boundaries, contrasting to the outer surface of the hatching pleats, which are almost smooth (Figs 1a, b, e). Dorsomedian area with smooth hexagonal network and craters more distinct along first 0.1 mm of anterior part (Figs 1b, c, 2b). Micropyle behind and below the median flange at the egg apex (Fig. 2b), the chorionic hexagonal network reaches the micropyle.

4. Discussion

Apart from Hinton (1981), who described the eggs of several Muscidae using SEM, this method was used only recently for differentiating eggs of forensically important Muscidae. Examples are *Synthesiomya nudiseta* (van der Wulp) (Alencar & Leite 1992), *Muscina levida* (Harris) (Liu & Greenberg 1989), *M. stabulans* (Fallén) (Liu & Greenberg 1989; Alencar & Leite 1992), and *Hydrotaea* (=*Ophyra*) *aenescens* (Wiedemann) (Mendonça *et al.* 2008). Description of egg morphology of *M. lateritia* is presented for the first time in the present paper. Within species of *Mydaea*, SEM egg data is otherwise available only for *M. corni* (Scopoli) and *M. urbana* (Meigen) (Hinton 1969, 1981).

In eggs obtained by dissection from the female abdomen, the dorsal flanges are often poorly visible because they are wrapped around the egg (Ferrar 1987). Probably during passage through the ovipositor, flanges fold outwards (Ferrar 1987). Very similar egg shell, shape and size of flanges were described previously for *M. corni* (Hinton 1981). However, figures of the egg of *M. corni* presented by Hammer (1941, as *M. pagana* (Fabricius)) and Skidmore (1985) differ slightly, especially in the proportions of lateral and dorsomedian flanges. In the figures presented by Skidmore (1985, fig. 98a), the hatching pleats extend further beyond the egg apex and are more tapering. The egg shell of *M. lateritia* is more similar to the figure of *M. corni* presented by Hammer (1941, fig. 26b).

The eggs of *M. lateritia* and *M. urbana* differ markedly in the size of the respiratory horns, which in *M. urbana* project beyond the egg apex as three long, tapering processes (Hammer 1941, Skidmore 1985). Hinton (1969, 1981) published a SEM-based description of the structure of papillae on the respiratory horn of *M. urbana*, which is very similar to that of *M. lateritia* presented in this paper.

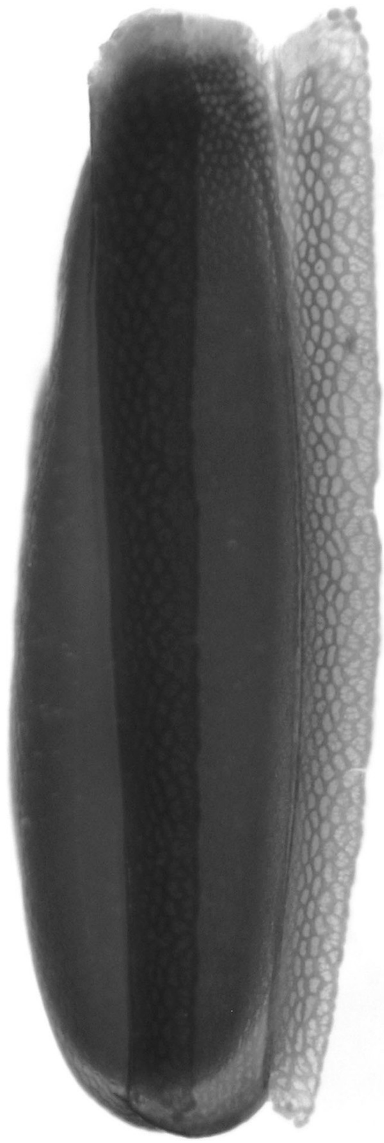

Fig. 3. Egg of *Mydaea lateritia* (dorsal surface with view of inner surface of broadened hatching pleat).

The hexagonal pattern of the exochorion found in *M. lateritia* (imprints from the maternal follicular cells) has not previously been documented for other species of *Mydaea*. A hexagonal network with elevated boundaries is present in species of other muscid genera, e.g., *Azelia* Robineau-Desvoidy, *Hebecnema* and *Hydrotaea* Robineau-Desvoidy (Hinton 1981), *Eginia* Robineau-Desvoidy (Michelsen 2006), and it occurs in most other calyptrate families, e.g., Anthomyiidae (Ferrar 1987; Gaponov 2003), Calliphoridae (Ferrar 1987, Erzinçlioğlu 1989, Mendonça *et al.* 2008), Rhinophoridae (Draber-Mońko 1997), Tachinidae (Ferrar 1987, Gaponov 2004). The hexagonal pattern in the *Musca*-type egg of *H. aenescens* has less distinct boundaries (Mendonça *et al.* 2008). The *Phaonia*-type egg of *Muscina levida* and *M. stabulans* have longitudinal ridges and a polygonal pattern limited to the median area and surroundings of the micropyle (Greenberg & Kunich 2002).

Pits found on the median area in *M. lateritia* (Figs 1c, 2b) are larger and not as numerous as in *M. corni* (Hinton 1981). Median area surface differs distinctly from *Musca*-type eggs in which the median zone is covered with plastron (Hinton 1969, 1981) and sometimes does not reach the posterior egg pole (Sukontason *et al.* 2004, Sukontason *et al.* 2007, Mendonça *et al.* 2008). Surface of the median area (Fig. 1b) in the posterior part is similar to that of *M. urbana* presented by Hinton (1981), however pits in the anterior part (Figs 1b, c) are deeper and less numerous. The polygonal pattern on the median area is not as distinct and without numerous pits as in, e.g., *Myospila meditabunda* (Fabricius) and *Haematobia stimulans* (Meigen) (Hinton 1981).

A lateral plastron crater as in *Musca vetustissima* Walker and *M. sorbens* Wiedemann (Hinton 1966, 1981) was not found.

The broad hatching pleats of the *Phaonia*-type egg are not produced anteriorly and do not reach the anterior pole. Based on the length of the respiratory horns within the *Mydaea*-type eggs, two groups of eggs can be distinguished: long-horned eggs, e.g., *M. urbana* and *Hebecnema umbratica* (Meigen), and short-horned eggs, e.g., *M. corni*, *H. vespertina* (Fallén) and all species of *Brontaea* Kowarz (Skidmore 1985). The egg of *M. lateritia* should be classified as a *Mydaea*-type egg because of the short lateral respiratory horns and short dorsomedian flange. The present grouping system is a practical one and is most likely not in agreement with a cladistic classification. However, muscid phylogeny is still far from stable (Kutty *et al.* 2008), and our knowledge of egg morphology is too sparse to allow a rigorous character optimization.

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