

THE BIOLOGY, AND MORPHOLOGY OF THE EARLY STAGES OF *MORPHO MACROPHthalmus* AND *MORPHO PELEIDES TELAMON* (NYMPHALIDAE: MORPHINAE) FROM WESTERN COLOMBIA

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RESUMEN

Los estados inmaduros de *Morpho macrophthalmus* (Fruhstorfer) and *Morpho peleides telamon* (Rober) del occidente de Colombia, son descritos y comparados por primera vez, junto con notas acerca de su morfología e historia natural.

M. macrophthalmus ha sido considerada siempre por varios autores como una buena especie, sin embargo en este estudio comparativo de estados inmaduros de las dos especies, nosotros proporcionamos evidencia morfológica y biológica que ambos taxa pertenecen a la misma especie (*M. helenor*). Incluso se tiene evidencia de que en algunos pasajes a lo largo de la cordillera Occidental como en el alto río Calima donde las poblaciones naturales de ambos taxa se encuentran y se superponen es posible encontrar híbridos naturales que producen formas intermedias. Se presentan ilustraciones y descripciones de los estados inmaduros para ambos taxa.

PALABRAS CLAVE: Historia natural, distribución, taxonomía, comportamiento, Colombia, Valle, *Morpho*, Sur America, plantas hospederas, Fabaceae, *Morpho helenor*.

ABSTRACT

The immature stages of *Morpho macrophthalmus* (Fruhstorfer) and *Morpho peleides telamon* (Rober) from Western Colombia are described and compared for the first time, along with morphological and natural history notes.

M. macrophthalmus has long been considered as a good species by several authors, however in this comparative study of immature stages between the two species we provide morphological and biological evidence that both taxa belong to the same species (*M. helenor*). Indeed, in some places along the western Cordillera such as the upper Calima river where the natural populations of the two taxa overlap it is possible to find natural hybrids that produce intermediate forms. Illustrations and description of immature stages of both taxa are provided.

KEY WORDS: Life history, distribution, taxonomy, behavior, Colombia, Valle, *Morpho*, South America, host plants, Fabaceae, *Morpho helenor*.

INTRODUCTION

Morpho macrophthalmus Fruhstorfer, 1913, often incorrectly referred as *M. microphthalmus*, is generally a very localized and endemic subspecies whose present center of distribution is along the western slope of the andes (W. Cordillera) in the Pacific rainforests of Colombia (LE MOULT & REAL, 1963; D'ABRERA, 1984; CONSTANTINO, 1997; Patrick Blandin pers.comm). *M. macrophthalmus* ranges from the Department of Chocó, W. Risaralda, Valle and Cauca, in premontane forest habitats between 800-1500 m above sea level. Sexes are similar in coloration, being entirely metallic blue on the upper side, with the basal area dark blue and the medial area light blue, except for the margin which is black, the female has an additional vertical row of white spots on the upper wings. On the other hand, *M. peleides telamon* Rober, 1903 is distributed along the the east slope of the Western Cordillera, the upper Cauca valley and the west slope of the Central Cordillera between 1000-1800 m above sea level. This subspecies has the blue coloration more extended with the entire wings completely metallic blue, being the basal and medial area light blue, with black margins and a row of marginal white dots on the upper wings. The ventral surface is very similar to *M. macrophthalmus*, only that the general background is light brown, not dark brown. According to Gerardo Lamas and Patrick Blandin (pers. comm) the "M. helenor complex" includes only two species: *M. helenor* (Cramer, 1776) and *M. achilles* (Linnaeus, 1758), both species being sympatric in the Amazon basin and Guyanas, but outside of this area only exist *M. helenor*. Thus for taxonomic convenience, in this article we treat the populations of *M. macrophthalmus* and *M. peleides telamon* as subspecies of *M. helenor* (Cramer, 1776).

Much of the work on immature stages and biology for *M. helenor* is known from Costa Rica, El Salvador and Trinidad (YOUNG & MUYSHONDT, 1973; YOUNG, 1978; DE VRIES, 1987; URICH & EMMEL, 1991), however nothing has been published about the biology or immature stages for the local populations of *M. helenor* from Colombia. Gerardo Lamas in his forthcoming list of Neotropical butterflies recognizes for Colombia the following subspecies of *M. helenor*:

1. *helenor cortone* Fruhstorfer, 1913 (cordillera central, east slope, and cordillera oriental, west slope - Magdalena valley).
2. *helenor leontius* C. Felder & R. Felder, 1867 (cordillera oriental, east slope-e.g. Villavicencio area).
3. *helenor macrophthalmus* Fruhstorfer, 1913 (= *microphthalmus* Fruhstorfer, 1913) (cordillera occidental, Pacific slope of Chocó, Valle, and Cauca).
4. *helenor peleides* Kollar, 1850 (north of Colombia, lower Cauca and Magdalena river)
5. *helenor popilius* Hopffer, 1874 (middle Cauca valley)
6. *helenor rugitaeniatus* Fruhstorfer, 1907 (south west of Colombia, Pacific slope, to the south of the distribution of *macrophthalmus*, reaching the north west area of Ecuador)
7. *helenor telamon* Röber, 1903

(upper Cauca valley) and 8. *helenor theodorus* Fruhstorfer, 1907 (south east of Colombia: Putumayo, Caquetá, Amazonas, Vaupés). About *M. achilles*, only two subspecies from Colombia are recognized: 1. *M. achilles patroclus* C. Felder & R. Felder, 1861 (zone of Villavicencio, Meta, sympatric with *M. helenor leontius*) and *M. achilles phokylides* Fruhstorfer, 1912 (SE of Colombia, sympatric with *M. helenor theodorus*).

M. helenor macrophthalmus and *M. helenor telamon* are known to meet locally and hybridize near lower passes (1500 m) in the western Cordillera of Colombia between the dry areas of the Cauca valley (east slope) and the humid forest areas of the pacific drainage (west slope) in the zone of the upper Calima river in the Department of Valle. This evidence prompted us to study the biology and interaction of these two populations in order to prove that both taxa belong to the same species, based on a comparative study of the immature stages made under laboratory conditions and in green house insectaries in the main butterfly exhibit located at the Cali Zoo in Cali (Colombia).

MATERIAL AND METHODS

Field observations were made on *Morpho macrophthalmus* from 20 November 2002 to 11 January 2003 at the upper Calima river, located at 1500 m on the pacific slope of the western Cordillera of Colombia. The place is surrounded by second-growth forest and primary rain forest. One mated wild-caught female and 3 males were collected and kept in captivity in isolation laying eggs in an insectary cage 4 x 4 m at ambient temperature (26-27°C) at the Cali Zoo during 20 days. Larvae were reared under laboratory conditions in plastic containers with fresh cuttings of the larval host plant replaced every 2 days. Field observations were made on *Morpho peleides telamon* from 21-22 November 2003 at the Natural Reserve of Yotoco, Valle located on the National road Buga-Loboguerrero-Buenaventura at kilometer 17 at 1450 m above sea level. The area is protected and conserves about 559 ha of forest. The geographic coordinates of the reserve are 3° 50' N and 16° 20' W and extend between 1200 and 1700 m above sea level in its uppermost part on the east slope of the western Cordillera. One mated wild caught female and 2 males were collected and kept in captivity under the same ambient temperature conditions and locality as the previous species.

RESULTS

Egg-placement behaviour and Larval host plant.

Between 11-20 January an old wild-caught female of *M. macrophthalmus* from Calima was induced to oviposit under artificial conditions on *Mucuna killipiana* leaves. The total egg output during induced oviposition was 9 eggs on 13 January, 10 eggs on 14 January,

4 eggs on 15 January, 4 eggs on 16 January, 8 eggs on 19 January and 2 eggs on 20 January, yielding a total of 37 eggs. The female lived for 3 more days and died on 24 January. Of these eggs, 5 were infertile and 4 were parasitized by a *Telenomus* sp. wasp (Hym: Scelionidae). Between 8 and 9 days after being laid the eggs, the caterpillars hatched.

Between 21 November to 6 December a fresh wild-caught female of *M. peleides telamon* from Yotoco was induced to oviposit under artificial conditions on *Mucuna killipiana*. The total egg output during this period was 18 eggs on 26 November, 13 eggs on 27 November, 9 eggs on 30 November, 12 eggs on 2 December, 5 eggs on 4 December and 5 eggs on 5 December, yielding a total of 62 eggs. Of these eggs, 6 were parasitized by *Telenomus* sp. wasps and 15 were infertile, especially the last batch of eggs.

Only 40% of the caterpillars of *M. macrophthalmus* and 35% of the caterpillars of *M. peleides* completed development successfully to adult, but most of the early instars that hatched from the last batch of eggs produced weak larva that were unable to feed, and died by starvation, and some late instars died by a pathogenic disease, presumably by a Baculovirus infection.

Description of early stages

The early stages are identical for *M. macrophthalmus* and *M. peleides telamon*, except that in *M. peleides* the reddish-brown band that encircles the pale green egg is distinctly broken into small dots, while in *M. macrophthalmus* the reddish-brown band is continuous.

Egg: hemispherical in shape, pale green, 2.1 mm in diameter, smooth in surface texture, laid singly on top of the leaf surface, and within one day after being deposited develops a lateral reddish-brown band which is continuous in *M. macrophthalmus* and broken into small rounded dots. Infertile eggs remain pale green in coloration and do not develop the distinct reddish-brown band, while the parasitized eggs turn black within 5 days of being deposited. 7 days after being laid, the chorion of the egg becomes semi translucent and the red hairy head capsule of the larva and the mandibles can be seen at the dome of the egg, then upon hatching the larva cuts the chorion away in a circular fashion with her mandibles, then exits the egg. The egg stage lasts 8 days in *M. macrophthalmus* and 10 days in *M. peleides telamon* under the same ambient temperature conditions (26-27°C and 80% R.H).

First instar larvae: head- reddish-brown, broader than the width of the body and hairy. The face is covered with reddish short setae; coronal and lateral setae black and projected forward. The body is dark red with two light yellow rectangles on dorsum, body covered with long dorsal and lateral black setae. Last abdominal segment bears a short sclerotized bifid tail light brown covered with short setae. The 1st instar larva last 7 days in

M. macrophthalmus and 7 days in *M. peleides telamon*. The larva attains a body length of 10.1-12.0mm.

Second instar larvae : the head capsule is wider than body and is now more densely covered with bright red short seta. Labrum black and frons brown with a sparse covering of white seta along the adfrontal area, epicranium covered with short red seta, more robust and longer along perimeter of head. All coronal setae are distally plumose and curved forward. The cervical triangle on top of the head bears two dark black sclerotized sharp spikes projected backwards. These spikes are used to comb an oily fluid that the larva secretes from a dorsal pore located on the grooming gland between the subsorsal tufts on A-1. Body bright yellow in ground color, with three dorsal dark black rectangular bands connected by two narrow lines dorsally to embrace a yellow oval on A-4 to A-5; center of dark rectangle on A-5 bears two pairs of dense tufts of red hair, the dark rectangle is connected with two narrow lines dorsally to embrace a second yellow oval on A-7 to A-8; the last dark rectangle bears a two dorsal tufts of red and white hair. Once the larva grows, the first, second and third reddish dark rectangles develop white and black spots and marks on the dorsum. Red subdorsal seta on T-1 elongated and recurved forward the head and white and red setae on T-2 recurved recurved forward. The larva attains a body length of 18.5-18.7 mm in 8 days for *M. macrophthalmus* and 7 days for *M. peleides telamon*.

Third instar larvae : head- similar to second instar but now with an additional white vertical band of seta on the face. The body is bright yellow and becomes thicker and elongated. The yellow ovals are now larger and the rectangular bands becomes densely covered with white and gray spots and lines. Tufts of hair on A-4 to A-5 and A-7 to A-8 now white and red. 3 small tufts of black and red hair on dorsum on T-3 now visible. Lateral side of body yellow with 5 transversal black lines. The larva attains a body length of 28.2-28.7mm in 9 days for *M. macrophthalmus* and 7 days for *M. peleides telamon*.

Fourth instar larvae: head is now pale redish-brown, sparsely hairy and with white hairs along the adfrontal area. Now the head capsule is less wide than the body. Body overall color light yellow with rectangular dark bands with fine filigree cream, white and pale maroon patterns and lines. A small yellow circle on dorsum of A-5 is visible. Tufts of hair on A-4 to A-5 and A-7 to A-8 composed of longer white anterior seta, and shorter red posterior setae. Bifid tail on last abdominal segment A 10 now deep maroon with red setae. The larva attains a body length of 38.2-38.5 mm in 12 days for *M. macrophthalmus* and 8 days for *M. peleides telamon*.

Fifth instar larvae : Head same width as body, brown with dark setae, adfrontal area with white setae. There is a major change in the coloration of the caterpillar in the fifth

instar. The larvae becomes shaded in rich hues of brown, pink, and white. The caterpillar began to steadily lose its deep yellow color and became more cryptic brown. Dorsal ovals are filled with fine brown lines and brown dots. Rectangular bands on dorsum now brown with black and cream dots. Tufts of hair on A-4 to A-5 and A-7 to A-8 smaller and composed of white anterior setae and reddish-brown posterior setae. Lateral tufts of white and brown hair more developed. Before pupation, all bright yellow, red and maroon body coloration has been lost and the overall body coloration becomes light green. The tufts of hair on dorsum remains white and red. The larva attains a body length of 73.5- 74.1 mm in 14 days for *M. macrophthalmus* and 13 days for *M. peleides telamon*.

Prepupa: at this stage the larva stops feeding and loses all traces of yellow and black becoming completely dark green. The body assumes a thicker profile and the caterpillar remain immobile. The prepupal stage lasts 3 days.

Pupa. pale green with a light blue hue, ovoid in shape, with head area slightly bifid with two brown short pointed projections. Three small spiracles adjacent to the wing pads are white, while the others are much smaller and pinkish. Cremaster pinkish-brown. The pupa is 36-38 mm long and with a maximal dorso-ventral width of 15 mm.

The pupal stage last 14 days for both species.

Table 1: Developmental time (days) for *Morpho macrophthalmus* and *M. peleides telamon* on *Mucuna killipiana* under laboratory conditions. Zoologico de Cali (26-27°C, 80% R.H)

	Egg	1 inst.	2 inst	3 inst	4 inst	5 inst	Prepupa	Pupa	Total
<i>M. macrophthalmus</i>	8	7	8	9	12	14	3	14	75
Body length (mm)	2.1	12.0	18.7	28.7	38.5	74.1		38	
<i>M. peleides telamon</i>	10	7	7	7	8	13	3	14	69
Body length (mm)	2.1	10.1	18.5	28.2	38.2	73.5		36	

Discussion

Caterpillars of *M. peleides telamon* and *M. macrophthalmus* were reared under identical conditions (26-27°C, 80 % R.H) in Cali, Colombia on *Mucuna killipiana*, the natural food plant in the wild. In the two major studies, there were no morphological differences on caterpillars and pupa and developmental time for both species was similar (69 days and 75 days respectively) The immature stages of both species were identical, except that in *M.*

peleides de reddish-brown band that encircles de pale green eggs is distinctly broken into small dots, while in *M. macrophthalmus* the reddish-brown band is continuous (Fig. 1-2). Such variation must be associated from specific geographic areas. *M. macrophthalmus* flies in very humid rain forests on the west slope (pacific drainage) of the western Cordillera of Colombia, while *M. peleides telamon* flies in dry premontane and montane forests on the east slope of the western Cordillera. This geographic variation in coloration of eggs has been also observed on other populations of *M. peleides* in Costa Rica (YOUNG 1982; DE VRIES, 1987).

A summary of some records for caterpillar food plants for *M. peleides* is provided by YOUNG (1978), DE VRIES (1987), YOUNG & MUYSHONDT (1973), CONSTANTINO (1997), JANZEN & HALLWACHS (2000) which includes the genera *Machaerium*, *Pterocarpus*, *Lonchocarpus*, *Platymiscium*, *Swartzia*, *Dalbergia*, *Arachis*, *Erythrina* (Fabacea) and *Inga* (Mimosaceae). The host plant of *M. helenor macrophthalmus* and *M. helenor telamon* reported here (*Mucuna killipiana*) is the natural host plant in W. Colombia, a widespread vine that grows high up into the canopy of secondary forests. However, under artificial conditions both taxa accepted *Mucuna pruriens* which suggests that *macrophthalmus* and *telamon* may feed on other plant species as well.

According to Gerardo Lamas (Museo de Historia Natural, U. Mayor de San Marcos, Perú) and Patrick Blandin (Museum of Natural History, Paris)(pers.comm), which at the moment are doing the revision of the Neotropical genus *Morpho*, both *M. macrophthalmus* and *M. peleides telamon* are members of the “helenor complex”, previously treated incorrectly by some authors in the “achilles complex”. With this study we support additional information as well that both taxa belong to the same species based on biological and morphological evidence.

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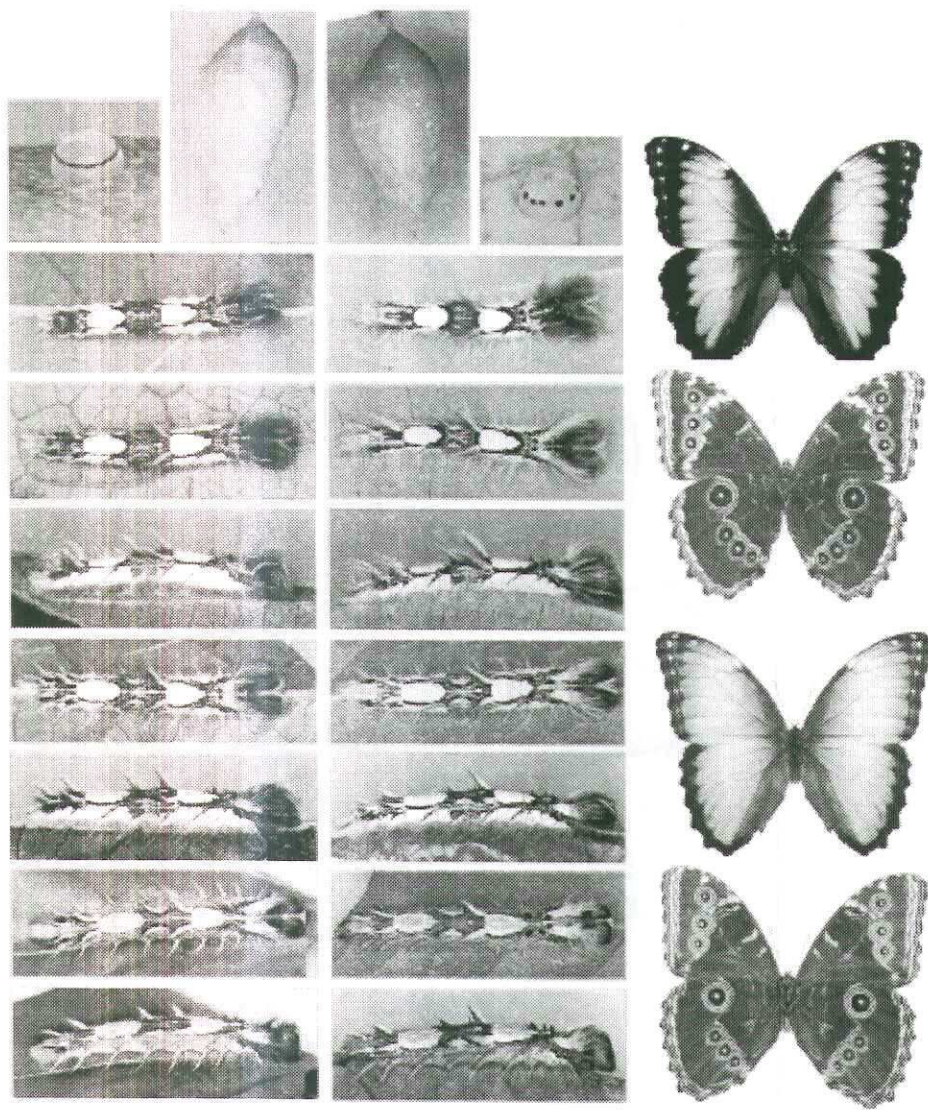


Figure legends: from left to right, first column: comparative sequence of *Morpho macrophthalmus* life cycle from egg, second to fifth instar larva and pupa; second column: sequence of *Morpho peleides telamon* life cycle from egg, second to fifth instar larva and pupa. Third column: adults of *M. macrophthalmus* male, dorsal and ventral surface (Upper Rio Calima, Valle) and *M. peleides telamon* male, dorsal and ventral surface (Yotoco Reserve, Valle). All photographs were taken by Luis M. Constantino from life history stages reared by the first author in Cali, Colombia.