

## Contribution to an understanding of the early stages of *Lythria sanguinaria* (Duponchel, 1842) (Lepidoptera: Geometridae: Sterrhinae) in Spain

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**Abstract:** Data related to morphology (including brief chaetotaxy of L5 larva) and biology are provided for the diurnal sterrhine moth *Lythria sanguinaria* (Duponchel, 1842) based on females from Madrid (Tres Cantos, 720m) for the ovum, larva (L1, L5) and pupa. A comparison is also made with two species in the related tribe Rhodometrini Agenjo, 1952.

**Key words:** Geometridae, Sterrhinae, Rhodometrini, *Lythria sanguinaria*, early stages, morphology, biology, Spain.

**Contribución al conocimiento de las fases larvarias tempranas de *Lythria sanguinaria* (Duponchel, 1842) (Lepidoptera: Geometridae: Sterrhinae) en España**

**Resumen:** Se aportan datos sobre la morfología (quetotaxia del último estadio larvario), la biología, de *Lythria sanguinaria* (Duponchel, 1842) (Geometridae: Sterrhinae) en base al estudio de los huevos, orugas y pupas obtenidos a partir de hembras capturadas en Madrid (Tres Cantos, 720m). Además, se realiza una comparación detallada con dos especies de la tribu afín Rhodometrini Agenjo, 1952.

**Palabras clave:** Geometridae, Sterrhinae, Rhodometrini, *Lythria sanguinaria*, estados inmaduros, morfología, biología, España.

### INTRODUCTION

*Lythria sanguinaria* (Duponchel, 1842) (Fig. 1) is a diurnal sterrhine moth, an Atlanto-Mediterranean element, endemic to the Iberian Peninsula reaching eastwards to the French Pyrenees (Hausmann & Viidalepp, 2012). It is one of four European species in the tribe Lythriini Herbulot, 1963 with another species in the northern half of Spain: *L. purpuraria* (Linnaeus, 1758) (Hausmann & Viidalepp, 2012). The tribe was recently transferred to the subfamily Sterrhinae from the Larentiinae (Öunap *et al.*, 2008). The biology of *Lythria sanguinaria* is well-documented. It is bivoltine according to Hausmann & Viidalepp (2012) flying late April to mid-June and again mid-June to late August. It is recorded on *Rubia peregrina* L. (Rubiaceae) (Millière, 1873; Mazel & Peslier, 1997) but has been reared on *Rumex thyrsiflorus* Fingerh. (Polygonaceae) (Gelbrecht *in* Hausmann & Viidalepp, 2012). King & Viejo Montesinos (2016) gave details on oviposition in comparison to strategies employed within the Sterrhinae. King (2014) provided data obtained from wild-caught females which included oviposition on

*Rumex acetosella* L. (Polygonaceae) and its use as a food-plant. With reference to details of the larval morphology of the L1 and L5 larva in the final instar there are 'only three SV setae on the anterior surface of the A6 pro-leg, with the anal pro-leg (A10) having the CD2 seta below the level of the L2 seta, a Sterrhine larval synapomorphy which was already recognised in the 1950s (Singh, 1951) when the Lythriini were still considered Larentiines (Öunap *et al.*, 2008). King (2014) stated that the "Larval habitus at a general level both in terms of morphology (L5) and resting position in relation to the substrate also coincides with *Rhodometra sacraria* (Linnaeus, 1767) and *Casilda consecraria* (Staudinger, 1871)" (Skule, 1980; King & Viejo Montesinos, 2017). This latter point is of importance considering the sister relationship with the tribe Rhodometrini Agenjo, 1952 (Hausmann, 2004).



**Figure 1.-** *Lythria sanguinaria* (Duponchel, 1842). ♀ Cuenca, central Spain (autor: Cecilia Díaz Martínez). **Figura 1.-** *Lythria sanguinaria* (Duponchel, 1842). ♀ Cuenca, España central (autor: Cecilia Díaz Martínez).

This present paper includes further morphological data on the larva not provided in King (2014), additional chaetotaxic information and a description of the hitherto undescribed pupa.

Chaetotaxy is described according to Hasenfuss (1963) and Ahola & Silvonen (2005); pupal morphology according to Patočka (2003).

## METHODOLOGY

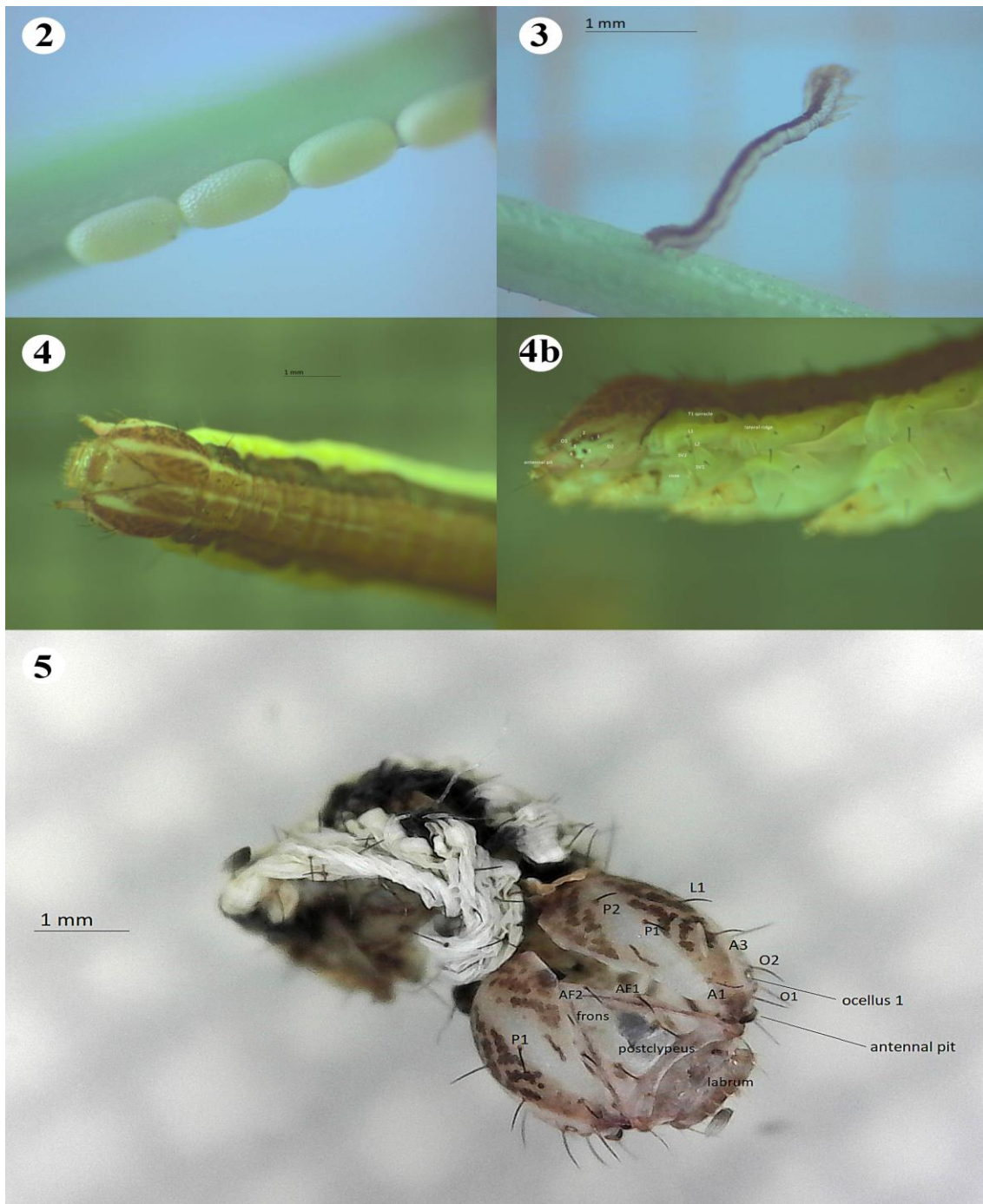
Material for the description of the moth's early stages was obtained by netting females which invariably rest on the ground after having been initially disturbed.

Details of the field study areas in the ‘transition zone’ of Madrid (700-720m) are included in King & Viejo Montesinos (2018). Females were taken between early April till early June 2011 until 2019 although the abundance of the moth is highly variable, for example, no moths were observed throughout 2015-18 and a singleton only was recorded in 2016. Females oviposited in captivity on the stems of *Rumex acetosella* provided in a small plastic container. Larvae were reared in plastic boxes until pupation (following Friedrich, 1986).

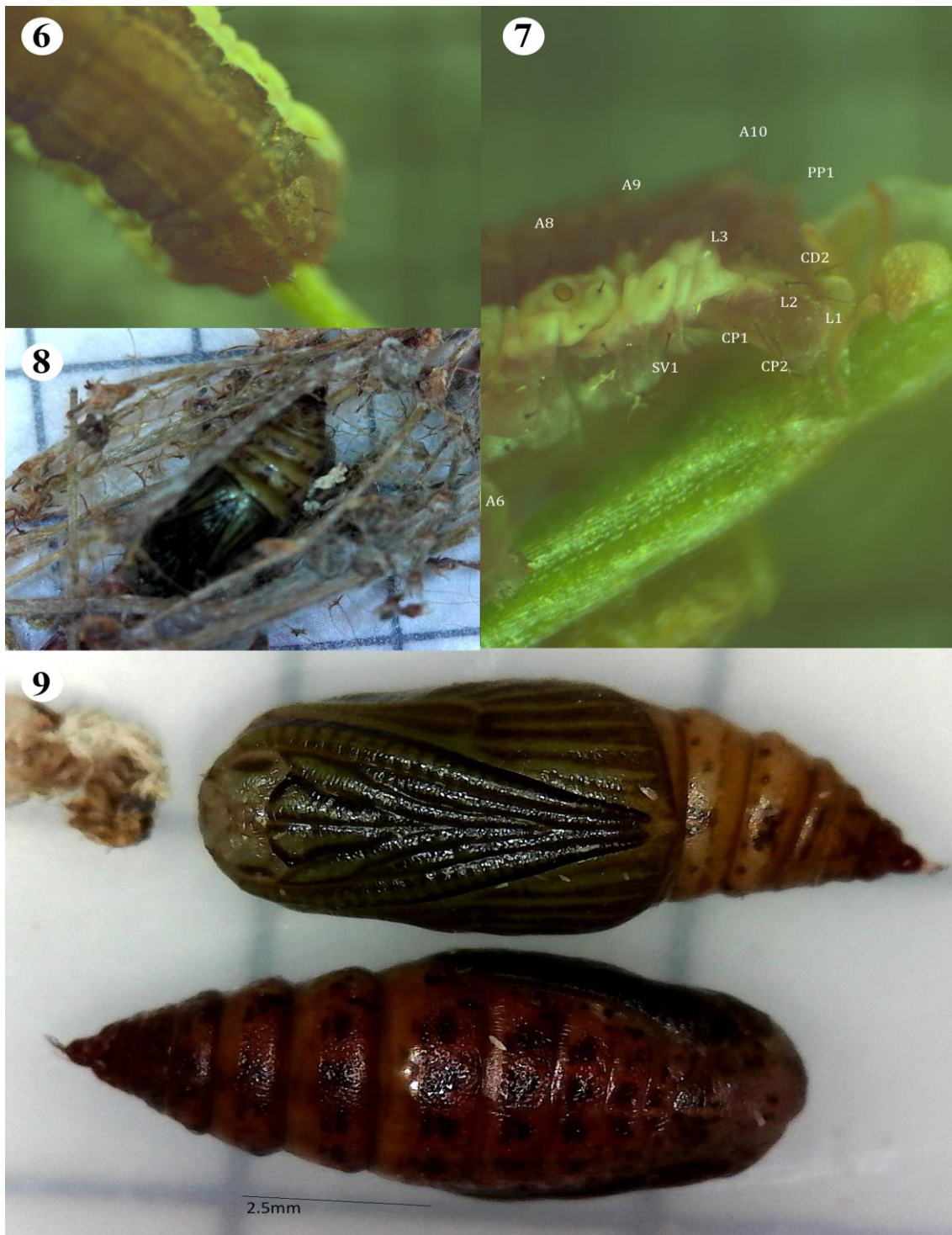
## RESULTS

**Ovum:** Ova are deposited in short rows (> 4) (Fig. 2) on dry vegetation, such as that of *Rumex acetosella* (Polygonaceae) or singly at base of container (King & Viejo Montesinos, 2016).

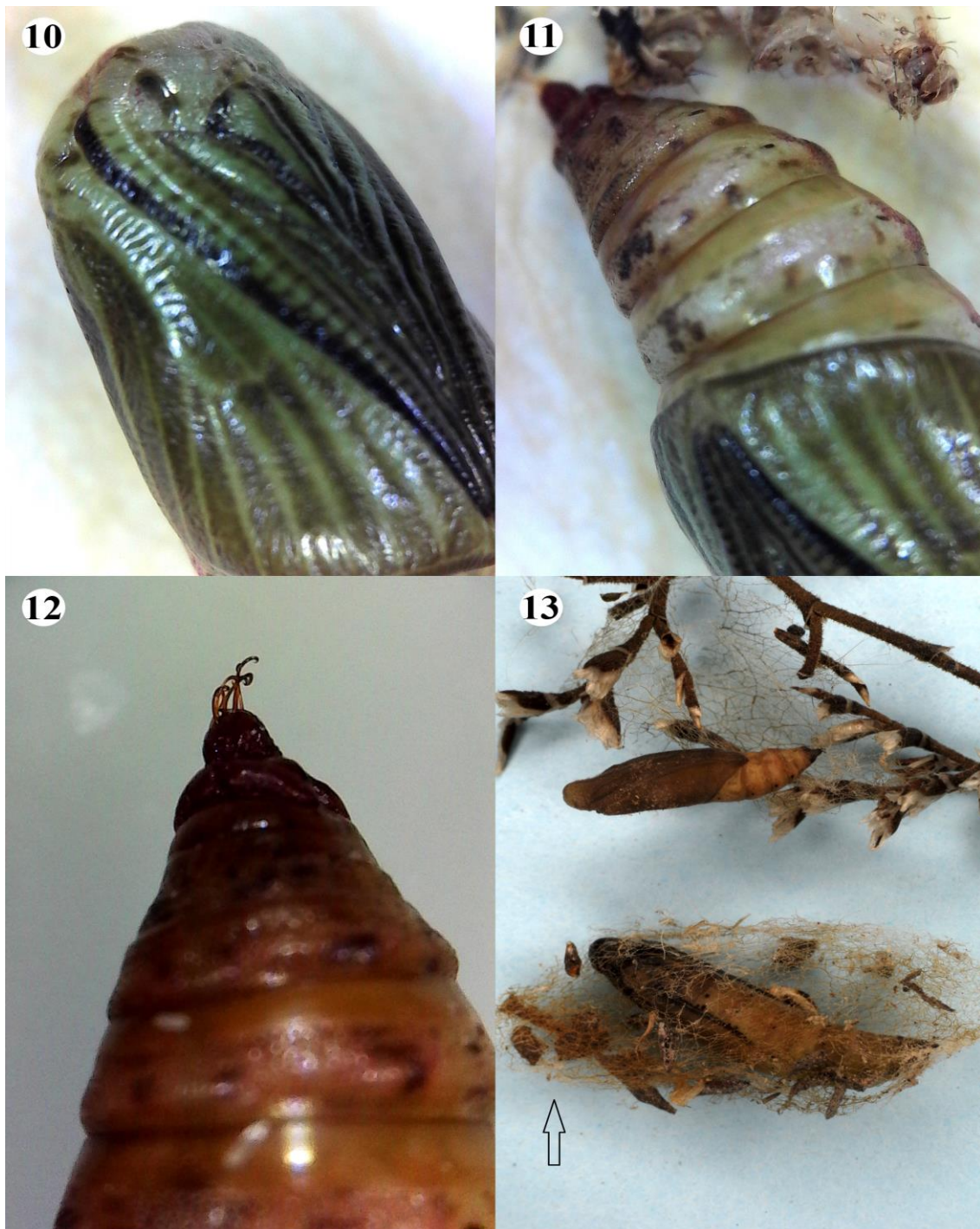
- **Larva L1:** 1.9mm (n=1) (Fig. 3): (♀ 8.V.11, Tres Cantos, Madrid): T1-A10 dorsal and ventral stripes reddish-black; laterally pale turquoise; head capsule: pale ochre.
- **Larva L5:** 15mm (n=2) (Figs. 4, 4b): (♀♀ 21.IV.13; 2.V.19): T1-A10 both laterally and ventrally: creamy-yellow; mid-dorsal stripe reddish-ochre; outer dorsal area wine-ochre; head capsule: frons, postclypeus, pale ochre, barely spotted; laterals reddish-ochre, slightly mottled dark ochre; dorsal line, transverse stripes, greenish-white; setae, blackish-ochre.
- **Chaetotaxy:** L5: hypognathous: head capsule (Fig. 5): *stemmata* almost form a complete circle (ocelli 1-5), ocellus 6 almost at base of antennal pit. Seta O2 alongside ocellus 1. Thoracic region (Figs. 4, 4b): setae are of the simple type slightly pointed apically; T1 spiracle: circular; ochre; darker outlined; positioned in lateral ridge; lateral setae L1, L2 anterior to spiracle; sub-ventrals SV1, SV2 very short at same level towards coxa. Abdominal region: (Figs. 6, 7) A6: seta L1 posterior to spiracle; L4 anterior position of abdominal pro-leg; three sub-ventral setae; SV3, SV2, SV1 on pro-leg; A7: L1, L2 posterior to spiracle; SV1, SV2 not at same level; V1; A8: sub-dorsal seta SD1 forms a ‘triangle’ with L1, L2 with latter seta not at same level as L1; A9: L1, SD1 on a descending line; A10: anal shield (small, narrow): dorsal setae D2, D1; either side of anus paraproct setae PP1; anal pro-legs: anterior zone: CP1, CP2; posterior zone: CD2 below L2, L1.
- **Pupa:** c. 9mm (n=2) (Figs. 8-12): loose, parchment-like cocoon constructed amongst vegetable matter (at least in captive conditions). Pupa glossy green anteriorly with antennae and podotecae picked out in blackish-blue; venation in lime-green; reddish-ochre anterior margins of pterotecae which do not overlap urite A5; eyes capsules not prominent; reddish-ochre dorsally; abdominal segments: yellowish-ochre; cremaster: D2 humuli are slightly longer than L1.



**Figure 2.-** *Lythria sanguinaria* (Duponchel, 1842): oviposition in relation to substrate ♀ El Goloso, Madrid (King & Viejo Montesinos, 2012). **Figura 2.-** *Lythria sanguinaria* (Duponchel, 1842): oviposición en relación al sustrato. ♀ El Goloso, Madrid (King & Viejo Montesinos, 2012). **Figure 3.-** *Lythria sanguinaria* (Duponchel, 1842): larva L1, ♀ Tres Cantos, Madrid. **Figura 3.-** *Lythria sanguinaria* (Duponchel, 1842): larva L1, ♀ Tres Cantos, Madrid. **Figure 4.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5, head, thoracic region, dorsal view, ♀ Tres Cantos, Madrid. **Figura 4.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5, cabeza, región torácica, vista dorsal, ♀ Tres Cantos, Madrid. **Figure 4b.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5, head, thoracic region, lateral view showing *stemmata*, corresponding setae, ♀ Tres Cantos, Madrid. **Figura 4b.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5, cabeza, región torácica, vista lateral mostrando el *stemmata*, correspondientes setae, ♀ Tres Cantos, Madrid. **Figure 5.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5 final *exuvium*, head capsule and corresponding setae; dorsal view, ♀ Tres Cantos, Madrid. **Figura 5.-** *Lythria sanguinaria* (Duponchel, 1842).- larva L5 *exuvium*, cápsula cefálica; quetas correspondientes; vista dorsal, ♀ Tres Cantos, Madrid.



**Figure 6.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5, dorsal view, urites A7-10; corresponding setae, ♀ Tres Cantos, Madrid. **Figura 6.-** *Lythria sanguinaria* (Duponchel, 1842).- larva L5, vista dorsal, uritos A7-10; quetas correspondientes; ♀ Tres Cantos, Madrid. **Figure 7.-** *Lythria sanguinaria* (Duponchel, 1842): larva L5, lateral view urites A8-A10, corresponding setae, ♀ Tres Cantos, Madrid. **Figura 7.-** *Lythria sanguinaria* (Duponchel, 1842).- larva L5, vista lateral uritos A8-A10, quetas correspondientes; ♀ Tres Cantos, Madrid. **Figure 8.-** *Lythria sanguinaria* (Duponchel, 1842): pupa and cocoon; ventral view; ex ♀ 2. v.19, Tres Cantos, Madrid. **Figura 8.-** *Lythria sanguinaria* (Duponchel, 1842).- pupa junto con el capullo; vista ventral; ex ♀ 2. v.19, Tres Cantos, Madrid. **Figure 9.-** *Lythria sanguinaria* (Duponchel, 1842): ♂ pupae; ventral, dorsal views; ex ♀ Tres Cantos, Madrid. **Figura 9.-** *Lythria sanguinaria* (Duponchel, 1842).- ♂ pupa; vistas ventrales, dorsales; ex ♀ Tres Cantos, Madrid.



**Figure 10.-** *Lythria sanguinaria* (Duponchel, 1842): pupa: anterior zone; latero-ventral view; ex ♀ Tres Cantos, Madrid. **Figura 10.-** *Lythria sanguinaria* (Duponchel, 1842).- pupa.- zona anterior; vista lateroventral view; ex ♀ Tres Cantos, Madrid. **Figure 11.-** *Lythria sanguinaria* (Duponchel, 1842): ♂ pupa; urites; latero-ventral view; ex ♀ Tres Cantos, Madrid. **Figura 11.-** *Lythria sanguinaria* (Duponchel, 1842).- ♂ pupa; uritos; vista lateroventral; ex ♀ Tres Cantos, Madrid. **Figure 12.-** *Lythria sanguinaria* (Duponchel, 1842): pupa: cremaster; humuli; latero-ventral view; ex ♀ Tres Cantos, Madrid. **Figura 12.-** *Lythria sanguinaria* (Duponchel, 1842).- pupa.- cremáster; humuli; vista latero-ventral; ex ♀ Tres Cantos, Madrid. **Figure 13.-** Rhodometrini.- Pupae of two species.- *C. consecraria* and *R. sacraria* (indicated by arrow) with their respective cocoons, ex larvae, Ciempozuelos, Madrid, 600m, 2006 (photograph.- José M. Martín Cano). **Figura 13.-** Rhodometrini.- Pupas: *C. consecraria* and *R. sacraria* (con flecha) junto con sus capullos respectivos, ex larvae, Ciempozuelos, Madrid, 600m, 2006 (imagen.- José M. Martín Cano).



**Figure 14.-** *Rhodometra sacraria* (L.) L1.- four days after egg hatch; larvae, El Goloso, Madrid; ex ♀ in *Polygonum aviculare* L. (photograph.- José M. Martín Cano). **Figura 14.-** *Rhodometra sacraria* (L.) L1.- cuatro días después de la puesta de huevos; larva, El Goloso, Madrid; ex ♀ en *Polygonum aviculare* L. (imagen.- José M. Martín Cano).

## DISCUSSION

In this paper further details have been provided on the early stage morphology of a sterrhine species whose biology is relatively well-known. Until recently, there were two species in the genus *Lythria* Hübner, 1823: *L. purpuraria* (Linnaeus, 1758) and *L. cruentaria* (Hufnagel, 1767) whose biology and ecology were well-studied with images provided of the L5 larvae (Häuser, 2001).

The pupa has not been described for any species in this genus so this paper has been able to provide original morphological detail on at least one species in the genus *Lythria*: *L. sanguinaria*. It has been seen that its pupa is quite dissimilar to either *R. sacraria* or *C. consecraria* in the Rhodometrini but it is not known how ‘typical’ it is in terms of its morphology with other species in this genus.

Table I provides comparative data with two species in the related tribe Rhodometrini: *R. sacraria* and *C. consecraria*. The biology and early stage morphology of these two species is well-understood (Skule, 1980; King & Viejo Montesinos, 2017). Although larvae in a very general sense between three species in *Lythria* and two species in the Rhodometrini seem to be very ‘similar’ (Table I), it is also of interest that all five species are associated with Polygonaceae species of genus *Rumex* L. (docks) or a closely-related family: Plumbaginaceae (sea lavenders) as in the case of *C. consecraria* which is also found in Spain (King & Viejo Montesinos, 2017). It should be said that the food-plant association with *Rubia peregrina* L. (Rubiaceae) (Millière, 1873; Mazel & Peslier, 1997) should be investigated further as it is at variance with these two tribes’ known relationship with two quite unrelated plant families: Plumbaginaceae, Polygonaceae. Additionally, field observations of *L. sanguinaria* in central Spain (King, personal observation) since 2011 have always seen the moth flying in proximity to extensive mats of *Rumex acetosella*.

**Table I.-** Comparisons between their early stages: Sterrhine tribes: Lythriini (*L. sanguinaria*) and Rhodometrini Agenjo, 1952: *Rhometra sacraria* (Linnaeus, 1767), *Casilda consecraria* (Staudinger, 1871). References: (Bacallado *et al.*, 2006; Gómez de Aizpúrua *et al.* 2005; Hausmann & Viidalepp, 2012; Huertas Dionisio, 2007; King, 2002; 2013 (unpublished thesis); King & Romera 2004; King & Viejo Montesinos, 2010; 2016; 2017; Mazel & Peslier, 1997; Millière, 1873; Patočka, 2003; Skule, 1980). **Tabla I.-** Estados inmaduros: una comparación: Sterrhine tribus: Lythriini (*L. sanguinaria*) y Rhodometrini Agenjo, 1952: *Rhometra sacraria* (Linnaeus, 1767), *Casilda consecraria* (Staudinger, 1871). Bibliografía: (Bacallado *et al.*, 2006; Gómez de Aizpúrua *et al.* 2005; Hausmann & Viidalepp, 2012; Huertas Dionisio, 2007; King, 2002; 2013 (tesis no publicada); King & Romera 2004; King & Viejo Montesinos, 2010; 2016; 2017; Mazel & Peslier, 1997; Millière, 1873; Patočka, 2003; Skule, 1980).

<b>Life stage</b>	<b><i>L. sanguinaria</i></b>	<b><i>R. sacraria</i></b>	<b><i>C. consecraria</i></b>
<b>Ova; oviposition strategy</b>	Laid with axis parallel to substrate; pale green; ova deposited in short rows (> 4) on dry vegetation, such as that of <i>Rumex acetosella</i> (Polygonaceae), or singly at base of container (females, n=3). Incubation period: c. 5 days (n=1 ♀).	Laid with axis parallel to substrate; laid individually; walls of container or roots of <i>Polygonum aviculare</i> L., 1753 (Polygonaceae). On being laid are intense yellow which changes to rose pink after a few days. Incubation period: 4-12 days (n = 3, ♀).	Laid with axis parallel to substrate; laid individually or in groups of variable number; on stalks, flowers of leaves of <i>Limonium dichotomum</i> or walls of container. On being laid are creamy-white which changes to intense pink after two days. Incubation: 7-11 days (n = 3, ♀).
<b>L1</b>	T1-A10 dorsal and ventral stripes reddish-black; laterally pale turquoise; head capsule: pale ochre (n=1) (Fig. 3).	Translucent reddish; two reddish lines run semilaterally; dorsal line translucent reddish (n = 4) (Fig. 14).	Dorsal line greenish-white on reddish background; runs centrally reddish line (n = 3).
<b>L5</b>	Apparently invariable (n=2 ♀). T1-A10 laterals, ventrals: creamy-yellow; mid-dorsal stripe reddish-ochre; outer dorsal area wine-ochre.	Four morphs established: commonest: overall lemon-green dorsal region with reddish spots (n = 7).	Five morphs established: two commonest: overall reddish-pink and reddish-ochre (n = 10).
<b>Head capsule</b>	<i>Stemmata</i> almost form a circle excepting <i>ocellus</i> 6 (Fig. 4b).	<i>Stemmata</i> almost form a circle excepting <i>ocellus</i> 6.	<i>Stemmata</i> almost form a circle excepting <i>ocellus</i> 6.
<b>Pupa, cocoon</b>		(Fig. 15) Cocoon is a flimsy structure of yellowish-orange silken threads; pupa much paler yellowish; overall yellowish-green opaque cuticle	(Fig. 15) Pupa within cocoon constructed of dense mesh-like silk itself within plant remains of <i>Limonium</i> ; ♀ 7mm (n=1) overall pale ochre; A1-A3 somewhat greenish-



		through which can be discerned the pharate imago. ♀ 11mm (n=1) anteriorly, eyes, proboscis bulge; podotecae protrude beyond A5-A6; spiracles A7 furrow-shaped ochre bordered in ochre; cremaster: six hook-shaped setae; D2, L1 same length; pupa: ♂ 12.2mm (n=5).	ochre; A4-A10 pale ochre; pterotecae greenish-ochre protrude beyond A5; head capsule bulges; spiracles dark ochre; cremaster: eight hook-shaped setae in a knot.
<b>Larval food-plants</b>	Oligophagous on <i>Rubia peregrina</i> (Rubiaceae) having been reared on <i>Rumex thyrsoiflorus</i> and <i>Rumex acetosella</i> (Polygonaceae).	Oligophagous in Polygonaceae.	Monophagous in <i>Limonium dichotomum</i> .

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