Comparison of the structure and musculature of male terminalia in the tribe Cidariini Duponchel (Lepidoptera: Geometridae: Larentiinae) once again throws into doubt a sister relationship with the Xanthorhoini

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Abstract

The structure and musculature of the male terminalia are described and illustrated in 11 genera of the tribe Cidariini (Lepidoptera, Geometridae, Larentiinae) from the Holarctic and Oriental regions. Nine genital muscles were identified: m1, m2(10), m3(2), m4, m5(7), m6(5), m7(6), m8(3) and m21. Variation in the insertion of the muscles m1, m3(2), m4, m5(7), m6(5) and m8(3) on the sclerites in several generic groups of the tribe Cidariini is discussed, revealing that the Thera species group does not share some apparently cidariine characters. A comparative analysis of the musculature in the tribes Cidariini and Xanthorhoini questions the sister relationship of these tribes that was suggested by earlier studies. The application of the terms ‘anellus lobes’ and ‘labides’ is discussed.

Key words: anellus lobes, cidariine moths, Eupitheciini, geometrid moths, higher-rank classification, Holarctic region, homology, labides, larentiine moths, male genitalia, morphology, muscles, Oriental region, Xanthorhoini

Introduction

The structure and musculature of male terminalia proved to be beneficial for the higher-rank classification of Lepidoptera (see Kuznetzov & Stekolnikov 1986, 2001). However, the knowledge of morphology and function of the male genitalic musculature in the subfamily Larentiinae (Lepidoptera, Geometridae) remains limited. In this regard, a group of tribes formerly treated as Xanthorhoini s. l. and characterized by the presence of coremata associated with the eighth abdominal segment in males has been reviewed recently by Schmidt (2013). The male genital musculature of only a few cidariine species have been examined so far, whereby a thorough review was beyond the scope of previous studies (e.g. Razowskj & Wojtusiak 1981, Kuznetzov & Stekolnikov 2001, Valersky 2011).


The following four distinguishable groups of genera in the European Cidariini were identified and unifying characters presented by Hausmann and Viidalepp (2012): (1) Thera Stephens, 1831 and related genera (Pennithera Viidalepp, 1980, Heterothera Inoue, 1943); (2) Colostygia Hübner, 1825, Electrophaes Prout, 1923, Chloroclysta...
of membrane which closes the posterior end of the abdomen, extending from the tegumen and the anal tube dorsally to the base of the valvae and the vinculum ventrally (Klotz 1970). The aedeagal anellus was described by Pierce (1914) as a projection into which the aedeagus is withdrawn. According to Pierce (1914), “the anellus may also be extended into two lateral lobes which are termed anellus lobes”. He also introduced the term ‘labides’ as follows, “Springing from the points of union of the transtilla with the costae, there may arise two long arms, each bearing a soft hairy pad, and united together by a thin membrane”, as in the genus *Eupithecia* Curtis. However these terms are ambiguous. The eupitheciine labides are not always united together medially and the anellus lobes sensu Pierce are sometimes long and connected to the base of the costa valvae and often to the transtilla by a membranous band. These overlapping similarities confuse this terminology. Kristensen (2003) pointed out that the anellus lobes, “probably pertain morphologically to a basal valve territory”, which is apparently characteristic of the labides as well. Moreover, Holloway (1997) noted that the cidariine anellus lobes have an “almost filamentous ventral extension towards the juxta suggestive of homology with the eupitheciine labides”. The matter is even more complicated as only the dorsal arms arising from the base of the costa valvae were termed ‘the labides’ by Pierce (1914). Some authors (e.g. Holloway 1997, Choi 2002a) were using this term sensu Pierce. However, most of subsequent authors publishing on the larentiine moths (e.g. Mironov 2003, Beljaev 2008, Viidalepp 2011, Hausmann & Viidalepp 2012) were using this term in a broadened sense, defining the posterior projections (=arms) of the labides, which are congruent to the ‘labides’ sensu Pierce and, additionally, the anterior projections usually connected to the juxta. A broad application of this term is supported in this paper as the anterior projections directed towards the juxta are connected to the labides sensu Pierce and seem to be part of a compound structure.

Beljaev (2006, 2008) considered that most of the anellar structures located between the juxta and the valvae in the Geometroidea are homologous. A review of the annular structures in the Geometroidea is beyond the scope of the present paper, however, the structure and modifications of the labides in the Larentiinae will be discussed in a subsequent publication (Schmidt, in prep.).

A thorough phylogenetic analysis of this group with appropriate and sufficient taxon sampling, well chosen morphological characters and selection of relevant outgroup taxa is required for obtaining an accurate phylogenetic reconstruction and for evaluating the homologies of the genital sclerites.

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