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The structure and musculature of male terminalia in the tribe Xanthorhoini Pierce and related tribes (Lepidoptera: Geometridae: Larentiinae), with particular reference to the Palaearctic and Australian regions

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Abstract

The musculature of the male genitalia was reviewed for the tribe Xanthorhoini and related tribes (Lepidoptera, Geometridae, Larentiinae). The genitalia morphology of males of 11 species was discussed and illustrated, and nine paired and unpaired genital muscles identified. Muscles m1, m2(10), m5(7), m6(5), m7(6), m8(3) and m21 have similar position in all species considered in the paper. Comparative morphology of the male terminalia and position of extensors of the valvae m3(2) and flexors m4 confirmed the previously uncertain separation of Euphyiini and Scotopterygini. Cataclysmi share musculature characters with the tribe Xanthorhoini. The generic affiliation of *Xanthorhoe biriviata* (Borkhausen) is questionable considering an unusual location of muscles m4. Generally, the places of attachment of the muscles m3(2) and m4 to the sclerites afford valuable characters for the higher classification of this group.

Key words: Cataclysmi, Euphyiini, geometrid moths, higher-rank classification, homology, labides, male genitalia, morphology, musculature, Scotopterygini, xanthorhoini moths.

Introduction

The characters of skeleton and musculature of the male genitalia have proven useful for the higher classification of Lepidoptera of the Northern Hemisphere (Kuznetsov & Stekolnikov 2001) and the tribal systems of the subfamilies Geometrinae and Ennominae (Lepidoptera, Geometridae) in the Palaearctic region have been revised on the functional morphology of abdomen (Stekolnikov & Kuznetsov 1981, 1982, Beljaev 2006, 2008a). Additionally, the phylogenetic affiliations within geometrid moth subfamilies have been discussed by Beljaev (2008b).

The tribal system of the subfamily Larentiinae (Lepidoptera, Geometridae) has been amended in recent years on detailed examination of genital characters and molecular data (Holloway 1997, Forum Herbulot 2003, Öunap *et al.* 2008, Sihvonen *et al.* 2011, Viidalepp 2011, Hausmann & Viidalepp 2012). Nevertheless, the proposed system needs refinement and further improvement since many genera are not included (see Sihvonen *et al.* 2011, Viidalepp 2011). The most comprehensive phylogeny of the Geometridae in a global context (Sihvonen *et al.* 2011) is a big step towards understanding the phylogenetic patterns within the family Geometridae. However, branch support for basal relationships of several clades within the Larentiinae is low. Therefore the conclusions regarding tribal relationships proposed by Sihvonen *et al.* (2011) remain hypothetical.

The present study is aimed to clarify the broader concept of the tribe Xanthorhoini *s. l.* (Lepidoptera, Geometridae, Larentiinae) which is based on the presence of a pair of extensile coremata associated with the eighth abdominal segment in males, by the examination of the skeleton and musculature of the male genitalia of the Xanthorhoini *s. str.*, Cataclysmi, Scotopterygini and Euphyiini. Type species or their close relatives were examined to conduct a comparative analysis of the male genitalic musculature at the tribal level. Species showing deviation were selected for the examination of intertribal relationships.