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Description of the third instar of *Hygrobia nigra* (Clark, 1862) (Coleoptera: Paelobiidae), with a key for the identification of mature larvae of *Hygrobia* Latreille, 1804 and phylogenetic analysis

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Abstract

The mature larva of the squeak beetle *Hygrobia nigra* (Clark, 1862) (Paelobiidae) is studied for the first time based on detailed descriptions and illustrations of selected structures, with special emphasis on morphometry and chaetotaxy. A key for the identification of mature larvae of four of the six species of *Hygrobia* Latreille, 1804 known worldwide is presented. The phylogenetic relationships of the species are analyzed based on a cladistic analysis of a combined data set including larval and adult characters. *Hygrobia nigra* shares with the other known species of the genus several larval apomorphies including the presence of paramedian lip-like lobes on the epipharynx, a well-developed gula, gills on thoracic and first three abdominal sterna, and the maxillary stipites inserted into submental pouches, and is unique in the presence of a larger number of secondary setae on the metacoxa. The presence of a compact group of minute sensilla in the place where the galea is commonly located suggests that members of *Hygrobia* lost the galea, a condition independently evolved in some dytiscid lineages. The Australian species form a well-supported clade characterized by the presence of a short nasale, fewer natatory setae on the metatibia, and a marked shortening of the antennal sensorial appendage and the last abdominal segment. However, no larval characters were discovered to resolve relationships within that clade. The Palearctic *H. hermanni* (Fabricius, 1775) lacks a distinct nasale and is resolved as sister to the clade formed by the Australian species.

Key words: Coleoptera, Paelobiidae, *Hygrobia*, mature larva, morphometry, chaetotaxy, phylogenetic relationships

Introduction

The monotypic family Paelobiidae is a small group of aquatic coleopterans commonly known as squeak beetles (Alarie *et al.* 2004; Hawlitschek *et al.* 2012). All species occur in lowland areas and live in the mud, silt, and detritus of ponds (Dettner 2005). Both adults and larvae are predators, specialized on oligochaet worms, though adults were also observed feeding on chironomid larvae (Balfour-Browne 1922). *Hygrobia* Latreille, 1804, the only genus within the family, is comprised of six species worldwide (Nilsson 2005): *H. hermanni* (Fabricius, 1775) relatively common and widespread in the Western Palearctic, *H. davidi* Bedel, 1883 only found in Southeastern China, and *H. watsi* Hendrich, 2001, *H. australasiae* (Clark, 1862), *H. maculata* Britton, 1981 and *H. nigra* (Clark, 1862) endemic to Australia (Britton 1981; Hendrich 2001; Hawlitschek *et al.* 2012).

In terms of phylogenetic relationships, there is a general agreement that Paelobiidae is part of the adepagan clade Dytiscoidea along with Dytiscidae, Aspidytidae and Amphizoidae, and within this grouping it has been hypothesized to share a sister group relationship with Dytiscidae (Ruhnau 1986; Beutel & Haas 1996; Shull *et al.* 2001; Ribera *et al.* 2002; Alarie & Bilton 2005, Alarie *et al.* 2011) or with a clade formed by the families Dytiscidae, Aspidytidae and Amphizoidae (Balke *et al.* 2005; Hawlitschek *et al.* 2012). With respect to the relationships among the species of *Hygrobia*, a recent phylogenetic analysis based on adult morphological and molecular characters suggested a sister group relationship between *H. hermanni* and a clade formed by the Australian species, with *H. nigra* sister to *H. australasiae* (Hawlitschek *et al.* 2012).

suborder (Alarie *et al.* 2004; Alarie & Bilton 2005). The galea is lacking within *Hygrobia* (Alarie *et al.* 2004). However, the presence of a compact group of minute sensilla in the place where the galea is commonly located (Figs. 9–10) is suggestive that the galea is lost. Such a loss is a likely explanation given the derived condition of this family within Adephaga (Ruhnau 1986; Beutel & Haas 1996; Shull *et al.* 2001; Ribera *et al.* 2002; Balke *et al.* 2005; Alarie & Bilton 2005, Alarie *et al.* 2011; Hawlitschek *et al.* 2012). Other adephagan groups in which the larvae lack a galea are the diving beetle subfamily Hydroporinae (most of the species) (Alarie & Michat 2007; Michat *et al.* 2007) and the tribe Cybistrini (Michat 2006, 2010). The absence of a galea in these three groups is most likely the result of independent evolution.

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