



## Notation of primary setae and pores on larvae of Dytiscinae (Coleoptera: Dytiscidae), with phylogenetic considerations

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### Abstract

An analysis of the primary setae and pores of first instars of 13 species of Dytiscinae was performed to deduce the ancestral system of primary setae and pores of the head capsule, head appendages, legs, last abdominal segment and urogomphus. One hundred and thirty-one setae, 69 pores and three setal groups have been assigned to the ground-plan pattern of the dytiscine larva, 27 setae and 20 pores on the head capsule; 30 setae, 25 pores and three setal groups on the cephalic appendages; 51 setae and 18 pores on the legs; 15 setae and three pores on the last abdominal segment; and eight setae and three pores on the urogomphus. A hypothesis of the phylogeny of the tribes of Dytiscinae is presented on a cladistic analysis of first instar chaetotaxy characters conducted using the program TNT. All tribes of Dytiscinae were included with larger tribes represented by multiple genera. Our concept of the subfamily Dytiscinae as defined on the basis of first instar chaetotaxy was found separated into three distinct clades: (1) Cybistrini, (2) Dytiscini + Hyderodini, and (3) Aubehydrini + Hydaticini + Eretini + Aciliini. The proposed relationships of the tribes of Dytiscinae are ((Cybistrini + (Hyderodini + Dytiscini)) + (Aubehydrini + (Hydaticini + (Eretini + Aciliini))))). Characters useful for phylogenetic analysis of the subfamily are described and illustrated.

**Key words:** Chaetotaxy, larval morphology, Adephaga, Dytiscinae, phylogeny.

### Introduction

The adephagan beetle family Dytiscidae (predaceous water beetles), with some 4000 described species (Nilsson 2001, 2003, 2004; Nilsson & Fery 2006) represents one of the largest and most commonly encountered groups of aquatic insects. Both adults and larvae are predaceous, and will attack a wide variety of aquatic organisms. Dytiscids are found in virtually any aquatic freshwater ecosystem. In terms of classification, Dytiscidae is separated into 10 subfamilies including the Dytiscinae (Nilsson 2001), a group of 377 species subdivided into 19 genera and seven tribes (Nilsson 2001).

Recent studies have demonstrated the taxonomic and phylogenetic value of chaetotaxy in studying larval Adephaga (e.g., Carabidae: Bousquet & Goulet 1984; Dytiscidae: cf. references below; Hygrobiidae: Alarie *et al.* 2004; Aspidytidae: Alarie & Bilton 2005; Meruidae: Alarie *et al.* 2011). There is an overall pattern of primary setae and pores (i.e., found in first instar), which is widespread among taxa, though it is modified in a variety of groups. This generalized pattern is consistent enough to be used for phylogenetic analysis and yet sufficiently variable to allow for taxonomic distinction.

Analyses of the primary setae and pores of larval structures such as the head capsule, head appendages, legs, last abdominal segment, and urogomphus have been provided for most dytiscid subfamilies except the Dytiscinae: Agabinae and Colymbetinae (Alarie 1995, 1998), Copelatinae (Michat & Torres 2009), Hydroporinae (Alarie *et al.* 1990; Alarie & Harper 1990; Alarie 1991; Alarie & Michat 2007), Laccophilinae (Alarie *et al.* 2000; Alarie, Spangler *et al.* 2002), Lancetinae (Alarie, Archangelsky *et al.* 2002), and Matinae (Alarie *et al.* 2001). Whereas most of the recent descriptions of larval Dytiscinae emphasized chaetotaxic analysis (e.g., *Notaticus* Zimmermann (Miller *et al.* 2007; Michat & Alarie 2009; *Megadytes* Sharp (Michat 2006, 2010), *Hydaticus* Leach (Michat & Torres