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First fossil larvae of Berothidae (Neuroptera) from Baltic amber, with notes on the biology and termitophily of the family

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Abstract

Four fossil larvae of Berothidae (Neuroptera) from Baltic amber are described in detail, and the main characters of a fifth larva are discussed briefly. Two first instars very probably belong to the Berothinae; the subfamilial affinities of three other (probably full-grown) larvae are unclear. The latter are characterized by features not found so far in extant taxa of Berothidae: antennae and labial palps with six to seven segments; ecdysial cleavage lines consist of only frontal and coronal sutures (the lateral suture is absent); pronotal sclerites large and very close to each other along midline. However, these larvae belong with certainty to Berothidae as indicated by the structure of their mouthparts, and their general appearance. Morphological and biological data on the larvae of Berothidae are summarized and analyzed. It is presumed that termitophily might have evolved during the Cretaceous (or in the early Cenozoic), and only in Berothinae (or in subfamilies closely related to this group). The Baltic amber berothid assemblage apparently included both termitophilous and non-termitophilous larvae.

Key words: Neuroptera, Berothidae, larvae, Baltic amber

Introduction

The small family Berothidae (including the subfamily Rhachiberothinae) today comprises little more than one hundred species distributed mainly in the tropics and subtropics, and it is most diverse in the Ethiopian and Australian biogeographical regions (Aspöck 1986). Some berothids are remarkable for the termitophily of their larvae (e.g., Johnson & Hagen 1981). The Berothidae is an ancient taxon recorded confidently from the Middle Jurassic and assumed to be much older (Winterton *et al.* 2010; Makarkin *et al.* 2011). The majority of fossil species were described from the Cretaceous (Schlüter 1978; Whalley 1980; Klimaszewski & Kevan 1986; Martins-Neto & Vulcano 1990; Makarkin 1994; Ren & Guo 1996; Grimaldi 2000; Engel 2004; Nel *et al.* 2005a,b; Engel & Grimaldi 2008; McKellar & Engel 2009; Petrulovicus *et al.* 2010). Only a few berothids are known from the Cenozoic: one species from the Early Eocene North American Hat Creek locality (Archibald & Makarkin 2004) and several species (partly undescribed) from the Late Eocene Baltic, Rovno and English ambers (Krüger 1923; MacLeod & Adams 1968; Whalley 1983; Makarkin & Kupryjanowicz 2010). A list of all known fossil Berothidae is given in Makarkin *et al.* (2011).

The larvae of only few extant berothid genera are known (Table 1). Additionally, three fossil larvae have been described from the Cretaceous (Whalley 1980; Engel & Grimaldi 2008). Hitherto, fossil berothid larvae have not been known from the Cenozoic. In this paper, we describe four berothid larvae from Baltic amber and mention a fifth larva, which we did not investigate in detail. Two of these larvae have characters similar to those of extant taxa. Some features not found, so far, in extant taxa of Berothidae distinguish the other three larvae. We summarize and analyze all available data on berothid biology, especially concerning the larval termitophily and its probable evolution.