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A new genus of Podonominae (Diptera: Chironomidae) in Late Eocene Rovno amber from Ukraine

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Abstract

The genus *Palaeoboreochlus* Baranov *et* Andersen, **n. gen.** is erected based on *P. inornatus* Baranov *et* Andersen, n. sp. described from a male found in Late Eocene Rovno amber. The new genus groups with *Boreochlus* Edwards in the tribe "Boreochlini".

Key words: Diptera, Chironomidae, Podonominae, *Palaeoboreochlus*, new genus, new species, Eocene, Rovno amber, Ukraine

Introduction

The subfamily Podonominae Thienemann *et* Edwards was originally proposed based on several genera from the Northern Hemisphere. The subfamily is currently represented by 14 extant genera with altogether 161 species (Ashe & O'Connor 2009, 2012; Ashe, pers. comm.). Of these, nine genera and 131 species are known from the Southern Hemisphere, while 6 genera and 30 species are known from the Northern Hemisphere with only one genus, *Parochlus* Enderlein, common to both hemispheres (though the Northern Hemisphere is represented by only a single Holarctic species, *Parochlus kiefferi* (Garrett, 1925)). Two tribes, Boreochlini and Podonomini, are traditionally recognized. However, recent molecular studies (Cranston *et al.* 2010, 2012) show that while the tribe Podonomini is monophyletic the tribe "Boreochlini" is a non-monophyletic aggregate. Podonominae is a basal subfamily of Chironomidae and is playing an important role in the understanding of the evolution of the family (Cranston *et al.* 2010). Moreover, after Brundin (1966) published his monograph on transantarctic relationships of austral genera, Podonominae also play an important role in biogeographical studies (Cranston *et al.* 2012).

For a long time *Parochlus kiefferi* was considered to be the only representative of the Podonomini in the Northern Hemisphere, until Cranston & Edward (1998) re-evaluated the placement of *Trichotanypus* Kieffer within the Boreochlini. *Trichotanypus* includes 10 boreal species, three of them Nearctic, five Palaearctic and two Holarctic. The genus *Boreochlus* Edwards includes seven species: three Nearctic, two Palaearctic and two Oriental. *Lasiodiamesa* Kieffer comprises one Holarctic, four Nearctic and three Palaearctic species, and the small genus *Paraboreochlus* is represented by two Palaearctic and one Oriental species (Ashe & O'Connor 2009). A majority of the non-austral Podonominae are inhabitants of the arctic and boreal regions, or occur in cold stenothermic biotopes (e.g. streams, springs) in temperate regions (Brundin 1966). Two of the three Oriental species, *Boreochlus burmanicus* Brundin, 1966 and *B. malasei* Brundin, 1966 (Brundin 1966), live high in the mountains (2000 m a.s.l.), but the third, *Paraboreochlus okinawus* Kobayshi *et* Kuranishi, 1999, occurs on the subtropical Okinawa Island and in the Russian Far East (Ashe & O'Connor 2009).

It is well established that the Podonominae in the Mesozoic and Early Cenozoic were much more widespread in the Northern Hemisphere. Podonominae have been recorded from Jurassic deposits in both Siberia and Germany

(Ansorge 1996; Kalugina 1985). These fossils were assigned to Podonominae based on the presence of crossvein MCu and absence of R_{2+3} on the wings. Furthermore, in Siberian deposits numerous Podonominae-like immatures have been found (Kalugina 1985). The oldest record of Podonominae from fossil resins is Early Cretaceous (Valanginian-Hauterivian) Lebanese amber from Jezzine (about 130 MYA); where *Lebanochlites neocomicus* Brundin, 1976, according to Cranston *et al.* (2010), is conspicuously close to extant representatives of the genus *Paraboreochlus* Thienemann. Three species of Podonominae (Boreochlini), *Paraboreochlus bisaetiger* Seredusz et Wichard, 2007, *Lasiodiamesa sineifoliis* Seredusz et Wichard, 2007 and *L. eocenica* Seredusz et Wichard, 2009, have been described from Late Eocene Baltic amber (Seredusz & Wichard 2011). Below we describe the first Podonominae, *Palaeoboreochlus inornatus* **gen. n., sp. n.**, from Rovno amber and place it in a new genus.

Late Eocene Rovno amber most likely represents the same amber as the Baltic amber from the Gulf of Gdańsk (Szwedo & Sontag 2013). The general scarcity of amphibiotic insects appears to be typical of Rovno amber, clearly seen from the low representation of chironomids compared to the high abundance of insects having terrestrial larvae (Perkovsky *et al.* 2003, 2010). It is difficult to be certain which habitat was exploited by Podonominae in the Rovno amber forest but it is possible that they inhabited cold springs, which probably were numerous in the Rovno amber forest area, as stated in our previous work (Zelentsov *et al.* 2012).

Material and methods

Rovno amber belongs to the succinites, as does the well known Baltic amber (Perkovsky *et al.* 2010; Zelentsov *et al.* 2012). The piece of amber containing the holotype is about 15 mm long and 8 mm wide and contains many air bubbles, which to some degree distort the view of the midge inside. The specimen itself is comparatively well preserved (Fig. 1). However, the left wing is lost and the left side of the thorax is almost absent. The apex of the right wing apparently is lacking the membrane; the costa is preserved but the apical parts of M_{1+2} , M_{3+4} and Cu_1 are missing.

The fossil was studied using a Nikon Optiphot 2 microscope. The drawings were made with the aid of a drawing tube and processed in Adobe Photoshop CS5. The photos were taken with the aid of a Leica DM 400 B LED microscope using a Leica DFC 450C compact camera. The general terminology follows Sæther (1980).

The type is housed in the I. I. Schmalhausen Institute of Zoology, National Academy of Science of Ukraine, Kiev (SIZK), Ukraine.

Palaeoboreochlus Baranov *et* Andersen, **gen. n.**

Type species. *Palaeoboreochlus inornatus* Baranov *et* Andersen, **sp. n.** (present designation by monotypy).

Etymology. Named after the related genus *Boreochlus*, using the Greek *palaios*, ancient, as a prefix.

Diagnostic characters. The new genus groups with *Boreochlus* in having a simple gonostylus; flagellum with 14 flagellomeres; a long costal extension reaching the wing tip; no pulvilli; no anal point; crossvein MCu strongly retracted; and reniform, naked eyes. It can be separated from *Boreochlus* by the comparatively long flagellomere 14, slightly shorter than half the length of flagellomere 13; palpus with palpomere five about 5 times as long as wide; slender, smoothly rounded gonocoxite lacking volsella; and gonostylus with weak, rounded basal heel with few setae on low pedestals, and conical, apical portion without megaseta.

Generic diagnosis. Male. Small species, wing length about 1.5 mm.

Antenna. Flagellum with 14 flagellomeres. Flagellomere 14 slightly less than half the length of flagellomere 13, flagellomere 13 slightly longer than the length of flagellomeres 7–11 together. Plume well developed. Apex of flagellomere 14 apparently with several sensilla.

Head. Eye reniform, naked. Orbitals present. Palp with five palpomeres, length ratio between palpomeres 2–5 as: 0.20 : 0.27 : 0.24 : 0.29.

Thorax. Scutal setation well developed, details poorly observable.

Wing. Membrane with coarse punctuation, setae not observed. Costa extended, ending near wing tip. MCu weak, strongly retracted, situated at about 1/3 the distance between arculus and RM. FCu slightly distal to RM.

Legs. LR_1 0.68. Tibial spurs with basal denticles. Tibial comb of several setae. Pulvilli absent.

Hypopygium. Abdominal segment IX well developed; without anal point. Gonocoxite slender, smoothly rounded, with setae along inner margin. Gonostylus simple, with weak, rounded basal heel with few setae on low pedestals, and conical apical portion, with distinct y-seta at base, without megaseta.

Systematics

The new genus will key to the genus *Boreochlus* in both Brundin (1966) and Brundin (1989) as it has a long costal extension reaching the wing tip; no pulvilli; no anal point; crossvein MCu strongly retracted; and reniform, naked eyes. However, it differs from *Boreochlus* in several hypopygial features. The gonocoxite is rather slender and smoothly rounded, with setae along the inner margin, but without a vertical volsella armed with a conspicuous group of numerous, more or less stout setae as in *Boreochlus*. The gonostylus is stouter than in *Boreochlus* with a much stronger basal swelling with setae sitting on low pedestals, and the apical part of the gonostylus is not as slender as in most *Boreochlus* species. The new genus is also apparently lacking a megaseta, although it seems to have a quite strong y-seta. The antennae also differ. In *Boreochlus* flagellomere 14 is very short and indistinctly separated from flagellomere 13, forming an angle against the rest of the flagellum; flagellomere 13 is also comparatively short, shorter than flagellomeres 11 and 12 together, in some species hardly longer than flagellomere 12. In the new genus both flagellomeres 13 and 14 are comparatively much longer, flagellomere 14 is slightly shorter than half the length of flagellomere 13, and flagellomere 13 is slightly longer than the length of flagellomeres 7–11 together. Further, *Boreochlus* has a 5 segmented, but short palpus with the fifth segment barely longer than wide. The new genus also has a 5 segmented palpus, but the palpus is longer and palpomere five is about 5 times as long as wide.

Brundin (1966: 24–25) provided a phylogeny for the subfamily Podonominae based on 40 morphological characters and split the subfamily into two tribes, Boreochlini and Podonomini. Cranston & Edward (1998) explored Brundin's phylogeny including more genera and adding new characters. Based on characters from both adults and immatures they found that: 1) *Trichotanypus* is the sister genus to Brundin's tribe Podonomini; 2) Brundin's tribe Boreochlini, without *Trichotanypus*, is monophyletic; 3) Brundin's tribe Podonomini is monophyletic and remains so if redefined with *Trichotanypus* as the basal clade. However, in their third analysis, they use adult-only characters and include genera added from the literature, among them *Libanochlites* Brundin based on *L. neocomicus* Brundin, from Neocomian age Lebanese amber (Brundin 1976). The analysis gave multiple trees and the strict consensus of which had minimal structure but for sister group relationships. Homoplasy is high and there are no consistent features of the phylogeny at higher level, not even the tribal ranking, irrespective of outgroup used (Cranston & Edward 1998). Further, recent molecular studies (Cranston *et al.* 2012) indicate that the "tribe Boreochlini" is a non-monophyletic aggregate.

The new genus is based on an adult male only and several of the characters used by Cranston & Edward (1998) in their phylogeny cannot be observed. However, it has a simple gonostylus, thus groups in the tribe Boreochlini as defined by Brundin (1966), and might form the sister group of the genus *Boreochlus*.

Palaeoboreochlus inornatus Baranov *et* Andersen, sp. n.

(Figs 1–6)

Type material. Holotype male, Ukraine: Pugach open-pit mine, Klesov, Rovno amber, Late Eocene (SIZK : K-27535).

Etymology: From Latin, *inornatus*, meaning unadorned, referring to the lack of megaseta or strong spines on the gonostylus.

Diagnosis. See generic diagnosis.

Description. Male (n = 1). Total length 1.88 mm. Wing length 1.51 mm. Total length / wing length 1.24. Wing length / length of profemur 4.30.

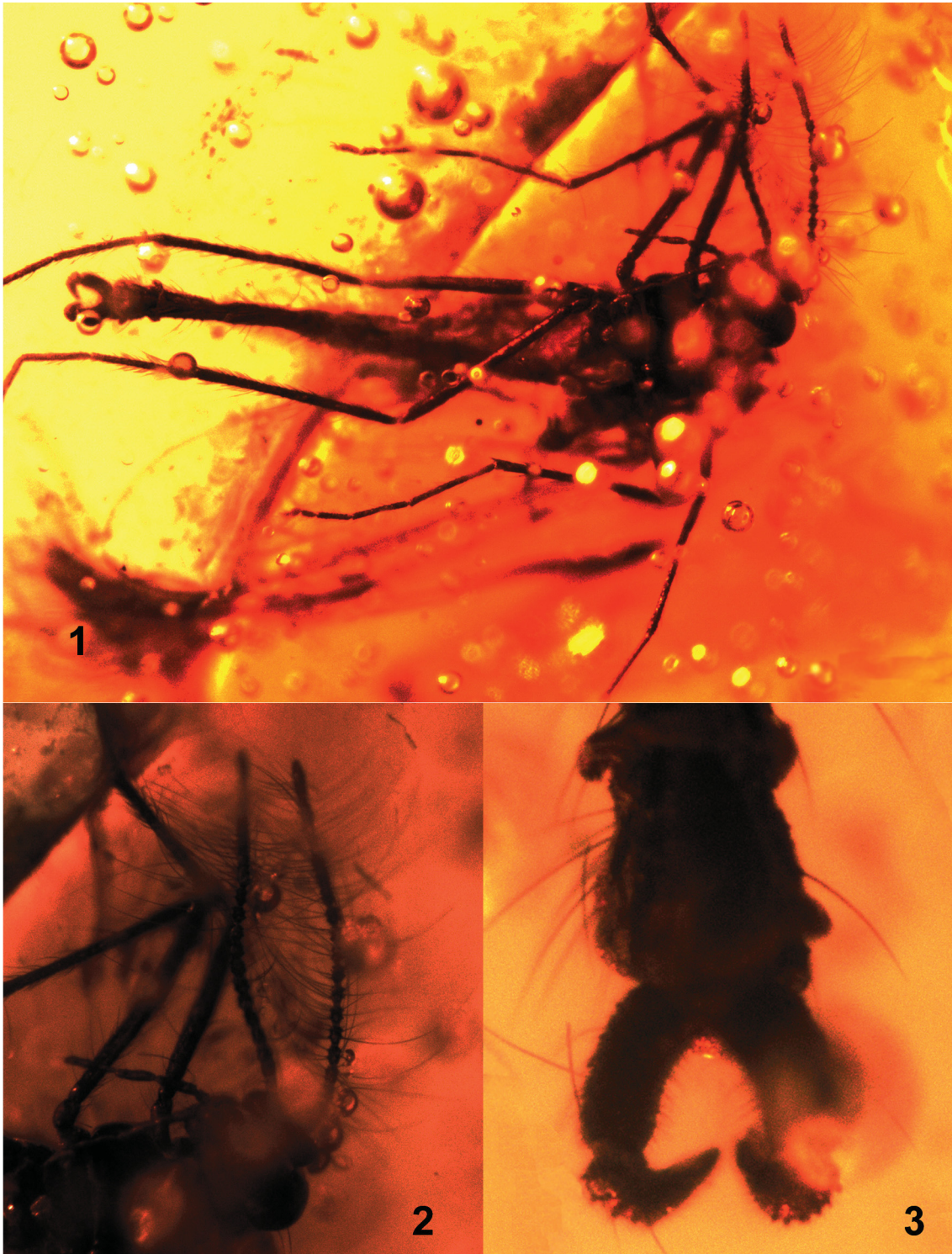
Head (Fig. 2). Eye without dorsomedial prolongation. At least 2 strong orbitals, frontals not visible. Length / width of palpomeres 2–5 (in μm): 68/20, 92/26, 80/24, 100/18. Antenna (Fig. 4). AR = 0.66, length of flagellomeres (in μm): 44, 36, 36, 36, 36, 40, 40, 40, 40, 40, 216, 92.

Thorax. With at least 14 strong dorsocentrals.

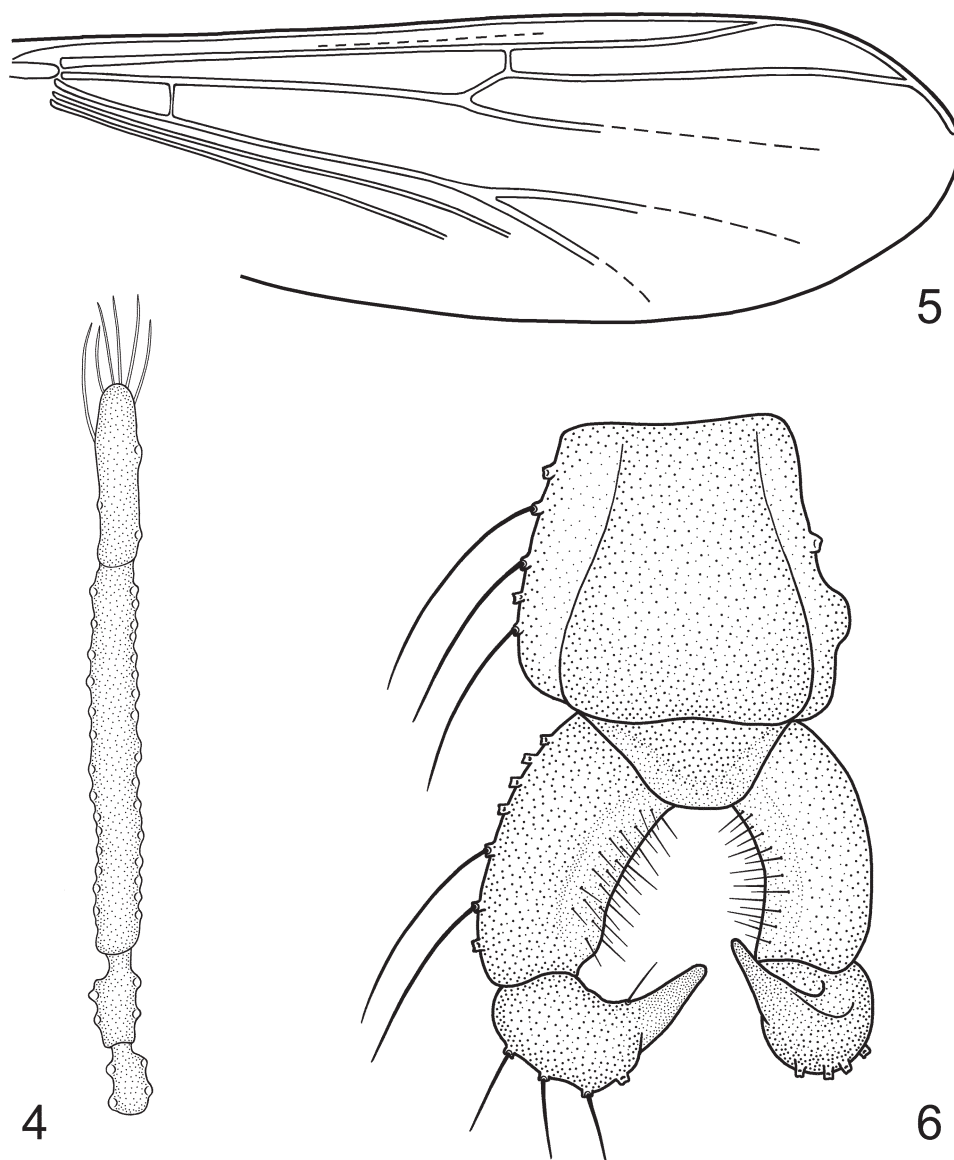
Wing (Fig. 5). VR = 1.13. Costal extension 132 μm long. Distance between arculus and crossvein MCu 192 μm .

Legs. Spur of fore tibia about 28 μm long; spurs of mid tibia about 44 μm long; spurs of hind tibia about 56 μm long. Width at apex of fore tibia 28 μm , of mid tibia 30 μm , of hind tibia 36 μm . Comb of hind tibia composed of several setae, longest about 30 μm long. Length and proportion of leg segments as in Table 1.

Hypopygium (Figs 3, 6). Tergite IX with rounded posterior margin, without anal point. Gonocoxite about 110 μm long. Gonostylus 80 μm long, 36 μm wide at base, apically conical, tapering to blunt apex.



FIGURES 1–3. *Palaeoboreochlus inornatus* Baranov et Andersen, **gen. n., sp. n.**, male. 1—holotype (SZIK : K27535); 2—head; 3—hypopygium, dorsal aspect.



FIGURES 4–6. *Palaeoboreochlus inornatus* Baranov *et* Andersen, **gen. n., sp. n.**, male. 4—antenna (flagellomeres 11–14); 5—wing; 6—hypopygium, dorsal aspect.

TABLE 1. Lengths (in μm) and proportions of legs of *Palaeoboreochlus inornatus* Baranov *et* Andersen, **gen. n., sp. n.**, male ($n = 1$).

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV
p ₁	351	384	261	163	106	45	49	0.680	2.744	2.816
p ₂	417	458	245	163	98	49	53	0.535	3.085	3.571
p ₃	547	588	286	180	98	45	57	0.486	3.739	3.968

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