



A new species of Hemerobiidae (Neuroptera) from the late Eocene Rovno amber

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Abstract

Proneuronema damzeni sp. nov. (Neuroptera: Hemerobiidae) is described from late Eocene Ukrainian Rovno amber. It differs from the two other species of this Eocene genus by a combination of the following character states: forewing larger (7.3 mm long in the new species; 6.3–6.9 mm in *P. minor* Makarkin *et al.*, 2016; 5.9 mm in *P. sydorhukae* Makarkin & Perkovsky, 2020) and broader (length to width ratio is 2.14 in the new species; 2.46 in *P. sydorhukae*; 2.17–2.30 in *P. minor*), and different forewing maculation (one spot at the third ('inner') gradate series in the new species; two in *P. sydorhukae*; none in *P. minor*). The Fur Formation *Megalomus densistriatus* Henriksen, 1922 and the Baltic amber *Proneuronema gradatum* Makarkin *et al.*, 2016 are preliminary assigned to *Archibaldia* Makarkin, 2023 as *Archibaldia densistriata*, **comb. nov.** and *A. gradata*, **comb. nov.**, respectively. The species composition and distribution of *Proneuronema* and *Archibaldia* are briefly discussed.

Key words: Neuroptera, Hemerobiidae, *Proneuronema*, *Archibaldia*, Rovno amber, late Eocene

Introduction

The family Hemerobiidae has more than 550 species today, distributed globally. Its earliest fossil is Jurassic, but are rare until becoming common in the Eocene. To date, 33 fossil species have been described (Li *et al.* 2023).

The genus *Proneuronema* Makarkin *et al.*, 2016 was erected by Makarkin *et al.* (2016) to include two species from late Eocene Baltic amber (*P. minor* Makarkin *et al.*, 2016 and *P. gradatum* Makarkin *et al.*, 2016), and one species from the early Eocene of western North America, *P. wehri* (Makarkin *et al.*, 2003). Later, Makarkin & Perkovsky (2020) described another species of the genus in Rovno amber, *P. sydorhukae* Makarkin & Perkovsky, 2020, and assigned an undescribed species from the Russian Far East (Tadushi Formation) to it. Recently, Makarkin (2023) referred this Tadushi species and *P. wehri* to the new genus *Archibaldia* Makarkin, 2023, and suggested that *Megalomus densistriatus* Henriksen, 1922 from the Fur Formation of Denmark and *P. gradatum* may also belong to *Archibaldia*. Therefore, to date only two late Eocene species from Europe (*P. minor* and *P. sydorhukae*) are confidently considered as belonging to *Proneuronema*.

Here, a new species of *Proneuronema* is described from Rovno amber.

Material and methods

The specimen was photographed by Jonas Damzen using a Canon 90D camera with a MP-E-65 Canon lens. The photos were then stacked with Helicon Remote software. Wing venation drawings were made using a Leica MZ12.5 stereomicroscope with a camera lucida attachment.

Venational terminology follows Breitkreuz *et al.* (2017), except for details (*e.g.*, of spaces, veinlets, traces, and the oblique radial branches' ("ORB") concept) which follow Oswald (1993). Crossveins are designated by

the longitudinal veins to which they connect and are numbered in sequence from the wing base, e.g., 1icu is the crossvein in first gradate series between CuA and CuP; and 2r-m is the crossvein in second gradate series between RP and MA.

Abbreviations: A1–A3, first to third anal veins; CuA, anterior cubitus; CuP, posterior cubitus; MA, anterior media; MP, posterior media; ORB1–ORB3, first to third oblique radial branches; RA, anterior radius; RP, posterior radius; RP1, proximal-most branch of RP; RP2, branch of RP distad RP1; rv, recurrent veinlet; and Sc, subcosta.

Systematic paleontology

Order Neuroptera Linnaeus, 1758

Family Hemerobiidae Leach, 1915

Subfamily Drepanepteryginae Krüger, 1922

Genus *Proneuronema* Makarkin, Wedmann & Weiterschan, 2016

Type species. *Proneuronema minor* Makarkin *et al.*, 2016, by original designation.

Emended diagnosis. All character states of the original diagnosis of *Proneuronema* (see Makarkin *et al.* 2016) occur in *Proneuronema* and *Archibaldia*. *Proneuronema* may be distinguished from *Archibaldia* by a combination of the following forewing character states [those of *Archibaldia* in brackets]: relatively small species with forewing 5.9–7.3 mm long [larger, forewing 7.9–14 mm long]; crossvein 1r-m absent [present; not detected in *A. densistriata* and *A. gradata*]; no crossvein between RA and RP1 or RP2 [one to three crossveins; poorly visible in *A. densistriata*; one detected between RP1 or RP2 in *A. gradata* paratype, see Makarkin *et al.* 2016: Fig. 9A]; M forked once proximad third gradate series [dichotomously branched, *i.e.*, three or more long branches originating proximad third gradate series]; CuP forked distad first gradate series [proximad first gradate series]; crossveins between branches of CuP proximad outer (fourth) gradate series absent [these crossveins are present; absent in *A. gradata* holotype, but present in paratype: Makarkin *et al.* 2016: Fig. 10A].

Species included. *P. minor* (Baltic amber), *P. sidorchukae*, and *P. damzeni* **sp. nov.** (Rovno amber).

Proneuronema damzeni sp. nov.

Figs 1–3

Type material. Holotype: collection number MAIG 6804 (ex coll. Jonas Damzen JDC-10121R), deposited in the Museum of Amber Inclusions, University of Gdańsk, Gdańsk, Poland. A complete specimen.

Type locality and horizon. Ukraine: Rovno region (precise locality unknown); late Eocene.

Etymology. From the surname of Jonas Damzen, a collector and examiner of amber.

Diagnosis. May be distinguished from the two other species of the genus by the following character states: larger size (forewing 7.3 mm long in the new species; 6.3–6.9 mm in *P. minor*; 5.9 mm in *P. sydorhukae*), forewing broader (length to width ratio 2.14 in the new species; 2.46 in *P. sydorhukae*; 2.17–2.30 in *P. minor*), and different forewing maculation (one spot at the third (‘inner’) gradate series in the new species; two in *P. sydorhukae*; none in *P. minor*).

Description. Head cuneiform with moderately large eyes. Frons and clypeus with scarce, relatively short setae; setae on vertex denser (Fig. 2A). Postocular lobe narrow. Labrum transverse, with rounded margin. Maxillary palpi 5-segmented; first and second segments short; third and fourth segments approximately twice longer; fifth (terminal) segment largest, fusiform, whole (additional sub-segment absent) (Fig. 2B). Labial palpi probably 3-segmented; terminal segment large, fusiform. Galea relatively large, with dense short setae apically; sclerotized finger-like apical process (digitus) not detected. Antennae moderately long; scapus relatively large; pedicellus slightly broader and twice as long as first flagellomeres.



FIGURE 1. *Proneuronema damzeni* sp. nov., holotype MAIG 6804. A, left side; B, right side. Scale bars = 1 mm.

Pronotum, mesonotum covered with dense relatively long setae. Pronotum saddle-shaped, with two large dorsal protrusions; lateral projections well developed, protruding more posteriorly than anteriorly. Mesonotum: presumed prescutum narrow, divided into two halves medially, probably fused with posterior margin of pronotum laterally; anterior part of mesoscutum (anteriad parapsidal sutures) triangular, divided in two by longitudinal median suture; posterior part of mesoscutum consisting of two lateral rounded convex lobes, strongly constricted medially; mesoscutellum posteriorly rounded.

Legs: Procoxa very long; profemur relatively narrow; protibia narrow; basiprotasus longest, fourth tarsomere shortest; first to fourth tarsomeres bear several bristles ventrally arranged in transverse row; claws narrow, acute,

strongly curved; empodium large, broad, pad-like. Midleg resembles foreleg except with short, stout mesocoxa. Metacoxa short, stout; metafemur relatively narrow; metatibia long, slightly curved, thinner proximally and slightly swollen medially.

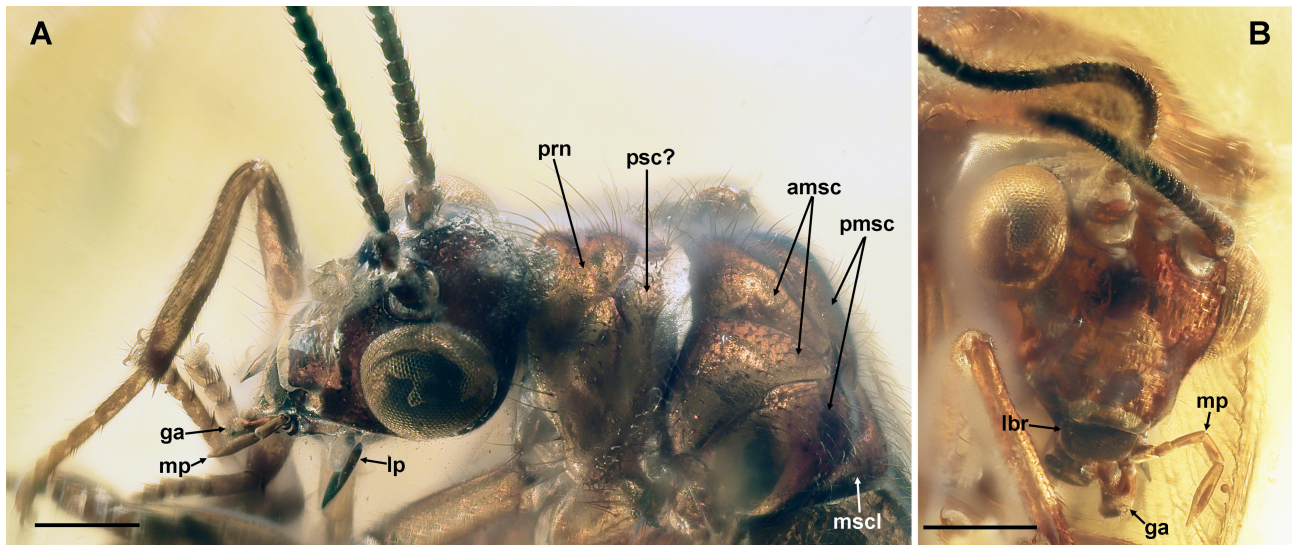


FIGURE 2. *Proneuronema damzeni* sp. nov., holotype MAIG 6804. A, head and thorax, latero-dorsal view; B, head, frontal view. amsc, anterior part of mesoscutum; ga, galea; lbr, labrum; mp, maxillary palp; mscl, mesoscutellum; pmsc, posterior part of mesoscutum; prn, pronotum; psc, prescutum. Scale bars = 0.5 mm.

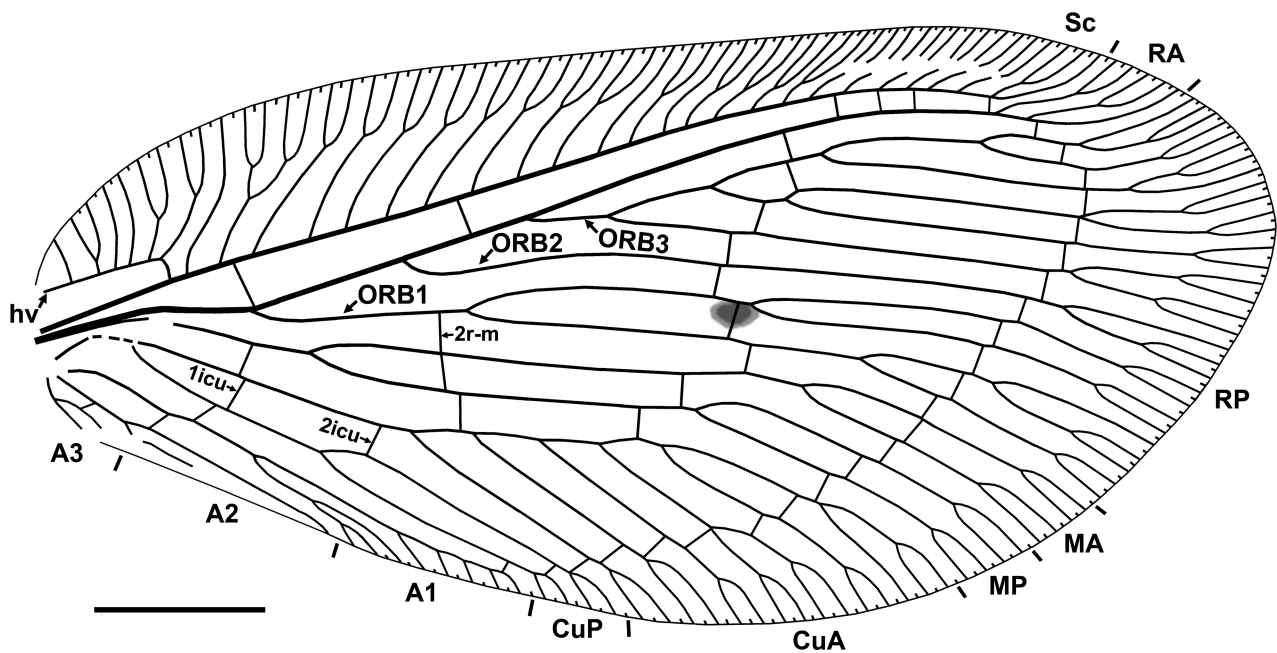


FIGURE 3. Forewing venation of *Proneuronema damzeni* sp. nov., holotype MAIG 6804 (left wing converted to standard view, with the apex to the right). Scale bar = 1 mm.

Forewing ovate, 7.3 mm long, 3.4 mm wide. Costal space broad. Most subcostal veinlets forked once including distal ones (except one in proximal portion, which is forked twice in both forewings); humeral veinlets strongly recurrent, with six branches (three simple, three forked once) in left wing, and five (two simple, four forked once) in right wing. Subcostal space moderately broad, with six crossveins (left wing): one basal, one intermediate, four distal (left wing). Posterior trace of RA distally simple with two once-forked veinlets (left wing); once forked with one simple and one once-forked veinlet (right wing). RA space (in this species between RA and ORB3) rather narrow with two crossveins belonging to third and fourth gradate series (left wing); three crossveins: one belongs

to third gradate series and two closely spaced crossveins belongs to fourth gradate series (right wing). RP with three ORBs. ORB1 deeply forked once distad second gradate series; anterior branch of ORB1 deeply forked at third gradate series; posterior trace of ORB1 deeply forked proximad fourth gradate series. ORB2 forked distad fourth gradate series. ORB3 (RP proper) with four branches originating proximad fourth gradate series (of these, one deeply forked in left wing), forked distally once to three times. M basally not fused with R, forked distad origin of ORB1. MA and MP deeply forked between third and fourth gradate series; each branch shallowly forked once. CuA with five (left wings) pectinate branches, forked distally one to three times. CuP deeply forked, both branches shallowly forked once. A1 rather deeply forked, slightly proximad mid-point; anterior branch pectinately forked with four short simple branches; posterior branch twice forked. A2 deeply forked, proximad mid-point. A3 forked near its origin. Four gradate series of crossveins present: First (basal) series consists of six crossveins, from Sc to A3 (crossvein 1r-m absent); second series of four crossveins from ORB1 to CuP; third (“inner”) series consists of nine crossveins, from RA to CuA; fourth (“outer”) series complete, consisting of 24 (left wing) from RA to A1. Three folds clearly discernible: between posterior trace of ORB1, M/MA (radiomedial flexion line or medial flexion line); between Cu/CuP, A1 (cubitoanal flexion line or claval flexion line); and between A1, A2 rather (intra-anal flexion line). Fold between M, Cu (mediocubital flexion line) indistinct. Wing membrane fuscous with distinct dark brown spot at intracubital crossvein in third gradate series.

Hind wings mostly and abdomen completely not visible, covered by forewings.

Discussion

Currently, three species of *Proneuronema* have been described from late Eocene Baltic and Rovno ambers (see above) and at least four undescribed species are known from the early Eocene Fur Formation of Denmark (pers. data VNM). One illustrated by Larsson (1975: Fig. 6) and described as “Hemerobiidae sp. nov. 1” by Rust (1999: Fig. 81) seems to be abundant. The same or a very similar species is found in the early Eocene of Greifswalder Oie Island in northern Germany (Obst & Ansorge 2012: Fig. 10).

Two additional specimens with venation similar to that of *Proneuronema* are known from the early Eocene of North America: one recently described from the Green River Formation (Colorado, USA) as *Megalomus? coloradensis* Makarkin, 2024, and another undescribed from the Okanagan Highlands Horsefly locality in British Columbia, Canada (pers. data VNM). Unfortunately, both of these specimens are incompletely preserved. Although the preserved venation of *M.? coloradensis* agrees in general with that of *Proneuronema*, it is preliminary assigned to *Megalomus* as its venation is more similar to that of this genus. The preserved venation of the Horsefly specimen is more similar to that of *Proneuronema*, and most probably belongs to it. Therefore, *Proneuronema* was probably distributed in both Europe and North America in the early Eocene.

The systematic position of the Baltic amber *Proneuronema gradatum* Makarkin *et al.*, 2016 is unclear. Its wing venation is more similar to that of *Archibaldia* than *Proneuronema*, but it lacks crossvein 1r-m and those between RA and RP1/RP2, which are in part diagnostic of *Archibaldia*. Makarkin (2023) assumed that their absence might be explained by secondary reduction. Therefore, we preliminary assign this species to *Archibaldia* as *Archibaldia gradata*, **comb. nov.**

The Eocene genera *Archibaldia* and *Proneuronema* are closely related. *Archibaldia* was widespread, known from North America, the Far East of Asia, and possibly Europe (Makarkin 2023). The wing venation of some Fur Formation hemerobiids (including ‘*Megalomus? densistriatus*’ Henriksen, 1922) are very similar to those of species of *Archibaldia*, but they have yet to be re-examined or described. We preliminary assign this species to *Archibaldia* as *Archibaldia densistriata*, **comb. nov.**

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