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## The new species of *Holocentropus*, *Plectrocnemia* and *Phryganea* (Insecta: Trichoptera) from Eocene Rovno amber

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### Abstract

Three new caddisfly species: *Holocentropus vottakvot* sp. nov., *Plectrocnemia pluripotencia* sp. nov. (Polycentropodidae), and *Phryganea vkoivekiraz* sp. nov. (Phryganeidae) are described and illustrated from Rovno amber (Priabonian). A list of fossil Trichoptera known from Rovno amber is represented by 46 named species; 34 species (73.9%) are endemic.

**Key words** caddisflies, Polycentropodidae, Phryganeidae, paleontology, taxonomy, Priabonian.

### Introduction

Samples of caddisflies from Rovno amber were studied for the first time more than 20 years ago (Perkovsky *et al.* 2003; Melnitsky & Ivanov 2010, 2013, 2016a, 2016b, 2023a, 2023b; Ivanov *et al.* 2016; Perkovsky 2017a; Melnitsky *et al.* 2021a, 2021b, 2021c, 2024a, 2024b, 2024c). Totally 43 species of caddisflies are known from Rovno amber until now. This number is increased with three new additions to 46 species. Two of the new species belong to Polycentropodidae, the most abundant and diverse Trichoptera family in fossil resins; the third species is a member of Phryganeidae, the family of Northern Hemisphere with limited number of finding in ambers.

The family Polycentropodidae comprises more than 940 species in the world fauna (Morse 2024). The genus *Plectrocnemia* is widespread in the Palearctic, Nearctic and Oriental realms and

contains over 160 species. This genus was represented by 34 fossil species in the European amber (Melnitsky & Ivanov 2024; Melnitsky *et al.* 2024b), seven of which are present in Rovno amber (Melnitsky *et al.* 2024b). Five species of *Plectrocnemia* are endemic to Rovno amber. The genus *Holocentropus* McLachlan, 1878 comprises 46 species including described here; it is distributed in the Palaearctic and the Nearctic realms. This genus is represented by 32 fossil species, mostly discussed in details in Melnitsky *et al.* 2024b. Now the family Polycentropodidae is represented by 25 named species among 46 named species from 10 families of caddisflies known from Rovno amber.

The family Phryganeidae includes about 120 species in the world fauna (Morse 2024), with the majority of species having the extra-tropical distribution. The genus *Phryganea* is widespread in the Palearctic and Nearctic realms and comprises about 40 species. This genus is represented by only seven fossil species in Baltic amber. Fossil monotypic genera *Wigginsiola* Melnitsky & Ivanov, 2019 and *Eotrichostegia* Melnitsky & Ivanov, 2016 are known from Baltic and Rovno amber, respectively.

## Material and methods

Rovno amber is coeval of Baltic amber, originated on Volhynian Uplift (Chemyreva *et al.* 2024).

We have used the conventional methods for studying the insects in ambers (Rasnitsyn & Quicke 2002). Photographs were made with a Nikon SMZ1500 microscope. Photographs have been postprocessed with graphics software to reveal details of the structures. The drawings were traced by these photographs with corrections based on microscope observations. The holotypes and all studied material housed in the Schmalhausen Institute of Zoology, Kiev (SIZK).

## Systematic paleontology

### Order Trichoptera Kirby, 1813

### Suborder Annulipalpia Martynov, 1924

### Family Polycentropodidae Ulmer, 1903

### Genus *Holocentropus* McLachlan, 1878

#### *Holocentropus vottakvot* Melnitsky, Ivanov & Perkovsky sp. n.

<https://zoobank.org/urn:lsid:zoobank.org:act:A1330EF4-09AE-4391-8958-AC419307FF4D>

(Figs 1, 2, 9 A)

**Type material:** Holotype. Male. SIZK CC-53, SIZK CC-53A, Stare Selo, Rovno amber, late Eocene.

**Description.** Body length 4.7 mm, forewing length 5.8 mm. Head, antennae and wings light brown. Thorax, legs and abdomen brown. Lateral sternal processes of sternum V with large basal part, apex not pointed.

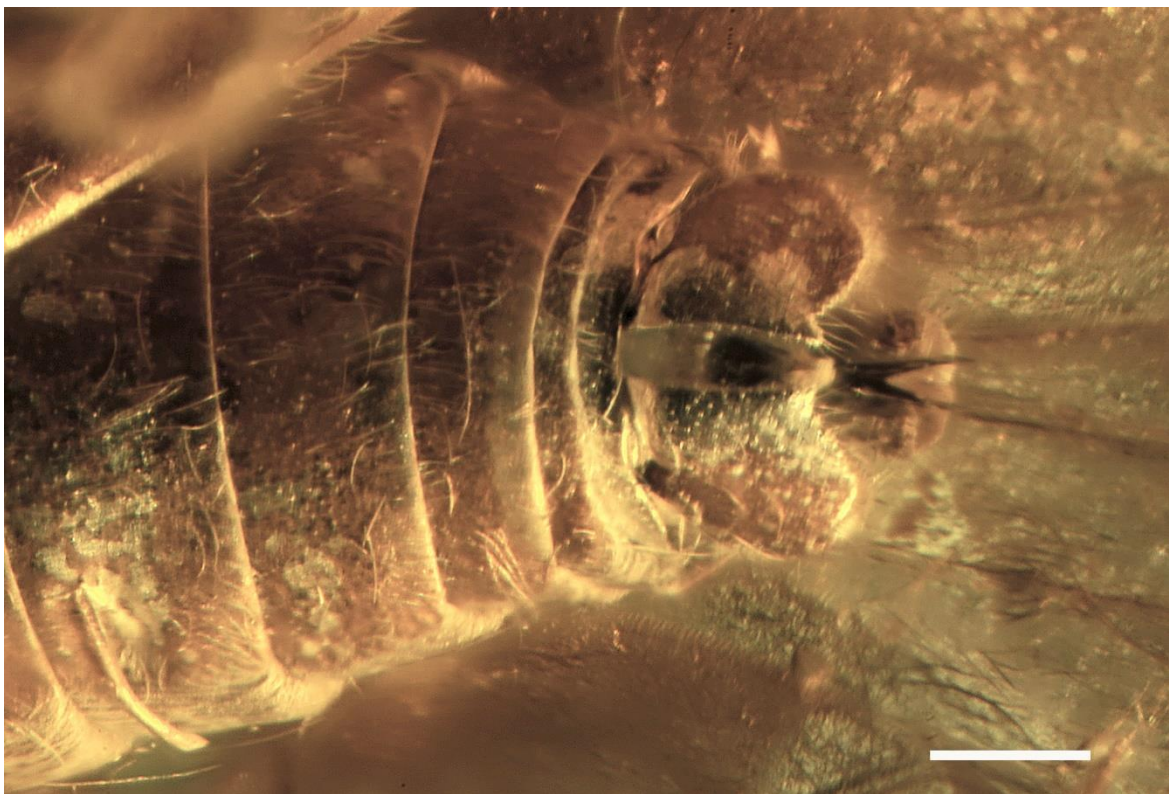
Male genitalia. Inferior appendages wide with narrowed finger-like dorsal part. Posterior ventral surface of inferior appendage slightly convex with small medial tubercle. Segment X with ventrolateral bundles of straight strong setae. Dorsal part of this segment projects backwards with small incision on the posterior margin. Ventral processes of segment X long, fused from the base to the medial part, pointed apical parts project beyond in the shape of a swallowtail. Phallobase short, endophallus with curved spine near the apex and several spine-like processes in the middle part.

**Comparison.** The new species differs from *Holocentropus scissus* Ulmer, 1912, which appears to be the closest to it, by the shape of the inferior appendages: in *H. scissus*, the medial part of inferior appendage with deep lateral incision. Thus, the inferior appendages are divided into 3 parts. *Holocentropus vottakvot* sp. nov. has the larger fused ventral processes of the segment X compared to the *H. scissus*.





**Figure 1.** *Holocentropus vottakvot* sp. nov. Male type, general view, ventral. Scale bar = 1 mm.



**Figure 2.** *Holocentropus vottakvot* sp. nov. Male type, genitalia, ventral. Scale bar = 0.25 mm.



**Etymology.** The specific name *vottakvot* is indeclinable and must not agree in gender with its generic name; it derives from Russian and means “so that is” or “there you have it”.

**Distribution.** Priabonian Rovno amber.

**Remarks.** The specimen was found in the piece of amber 8.3 g after primary treatment. Syninclusions: SIZK CC-53 – Chironomidae, SIZK CC-54 – Sciaridae.

### Genus *Plectrocnemia* Stephens, 1836

#### *Plectrocnemia pluripotencia* Melnitsky, Ivanov & Perkovsky sp. n.

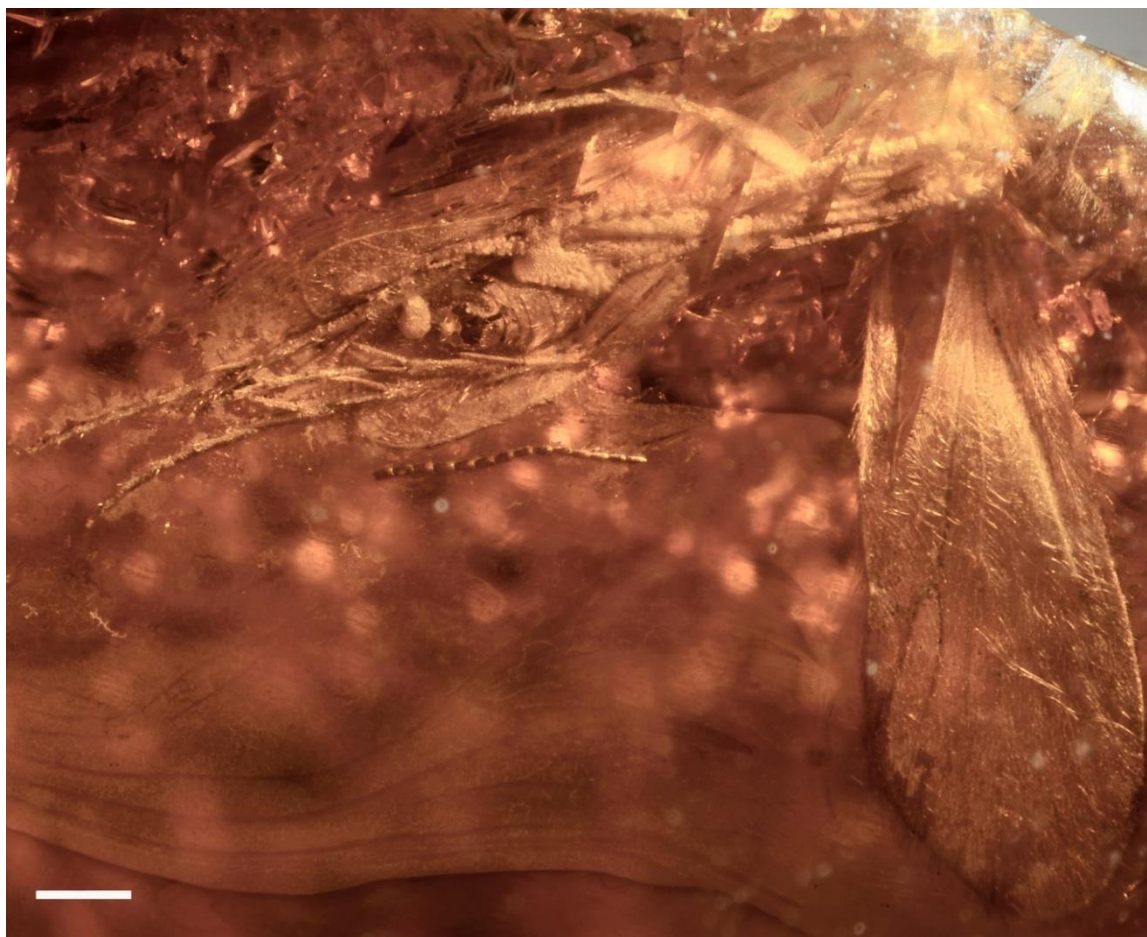
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(Figs 3, 4, 9 B)

**Type material:** Holotype. Male. SIZK K-27466, Klesov, Rovno amber, late Eocene.

**Description.** Body length 3.1 mm; forewing length 4.0 mm. Head and antennae yellowish, thorax, legs, abdomen, and wings brown with light brown hairs. Head with light hairs.

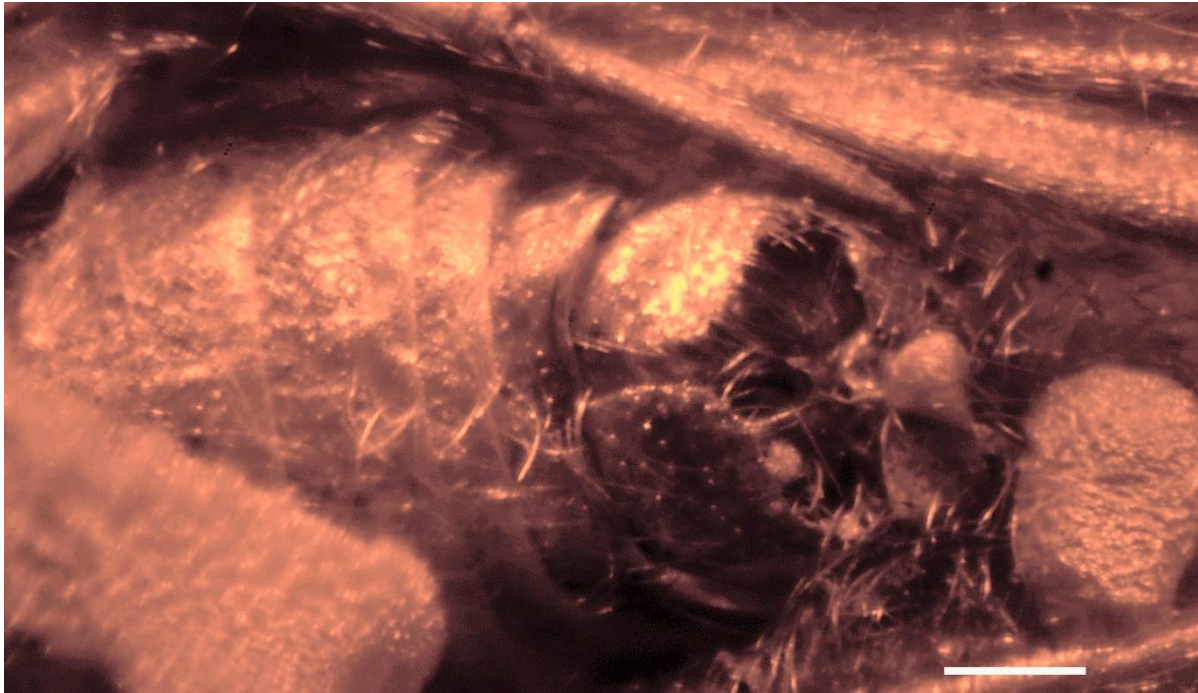
Male genitalia. Inferior appendages elongate with large lobe-shaped oval flat extension at the apex. Posterior margin of segment X on caudal view with membranous body and two small spines directed forward, there are two small sclerotized areas under this lobe. Membranous body of segment X is located near the oval extended apex of inferior appendages. The apex of the aedeagus is pointed, sclerotized, curved downwards.



**Figure 3.** *Plectrocnemia pluripotencia* sp. nov. Male type, general view, ventral. Scale bar = 1 mm.

**Comparison.** The new species has some similarity with *Plectrocnemia ventralis* Ulmer, 1912 and differs from it in the shape of dorsal complex of genitalia: *P. ventralis* has two powerful spines of segment 10 directed backwards, the new species has smaller spines directed other way. Ulmer (1912)

suggested presence of the color variation in *P. ventralis*: some specimens were black and some were amber yellow. We have the brown-tinted type specimen. The difference might be related to species distinction, although may represent different degree of preservation.



**Figure 4.** *Plectrocnemia pluripotentia* sp. nov. Male type, genitalia, ventral. Scale bar = 0.1 mm.

**Etymology.** The specific name *pluripotentia* from Latin (pluralis – multiple and potentia – possibility, ability, strength).

**Distribution.** Priabonian Rovno amber.

**Remarks.** The specimen was found in the small piece of amber (1.3 g after primary treatment) from Pugach quarry (Mitov *et al.* 2021).

## Phryganeidae Leach, 1815

### Genus *Phryganea* Linnaeus, 1758

#### *Phryganea vkoivekiraz* Melnitsky, Ivanov & Perkovsky sp. n.

<https://zoobank.org/urn:lsid:zoobank.org:act:B79DED16-A1C3-4CE8-AF3D-4AD7569622A8>

(Figs 5 – 8, 9 C, D)

**Type material:** Holotype. Male. SIZK UA–28653, Rovno Oblast, Rovno amber, late Eocene.

**Description.** Body length 9.0 mm; forewing length 9.5 mm. Head, antennae, legs, thorax and wings light brown. Abdomen yellowish. Wings with white hairs. Warts of head and thorax with long brown hairs. Hind wings with F2 in the middle part two times wider than F1.

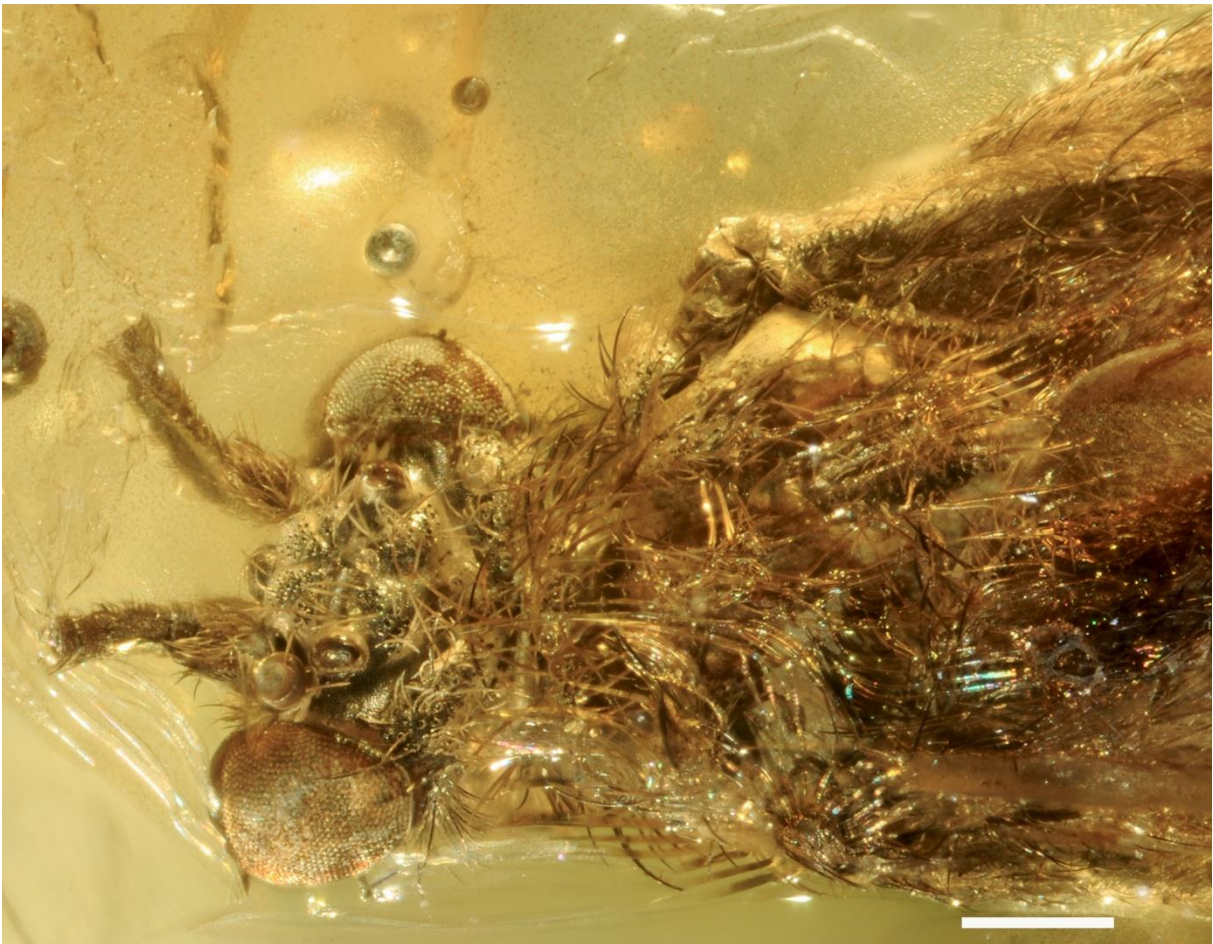
Male genitalia. Inferior appendages consist of irregularly triangular distally rounded ventral part, dorsal part absent. Two long pointed processes visible on the sides of the phallobase are associated with the segment X. The lateral appendages (Wichard 2013; lateral appendages of X segment in Wiggins 1998) strongly sclerotized and pointed. The phallobase is narrow on ventral view and very wide on lateral view.

**Comparison.** The new species is similar to *Phryganea picea* (Pictet, 1856) from Baltic amber in presence of four pointed projections in the male genitalia. The new species differs from it by the structure of the inferior appendages without deep caudal incision and in the shape of lateral appendages pointed in the new species.





**Figure 5.** *Phryganea vkoivekiraz* sp. nov. Male type, general view, ventral. Scale bar = 1.5 mm.



**Figure 6.** *Phryganea vkoivekiraz* sp. nov. Male type, head, dorsal. Scale bar = 0.5 mm.

**Etymology.** The specific name *vkoivekiraz* is indeclinable and must not agree in gender with its generic name; it derives from Russian and means “only once”.

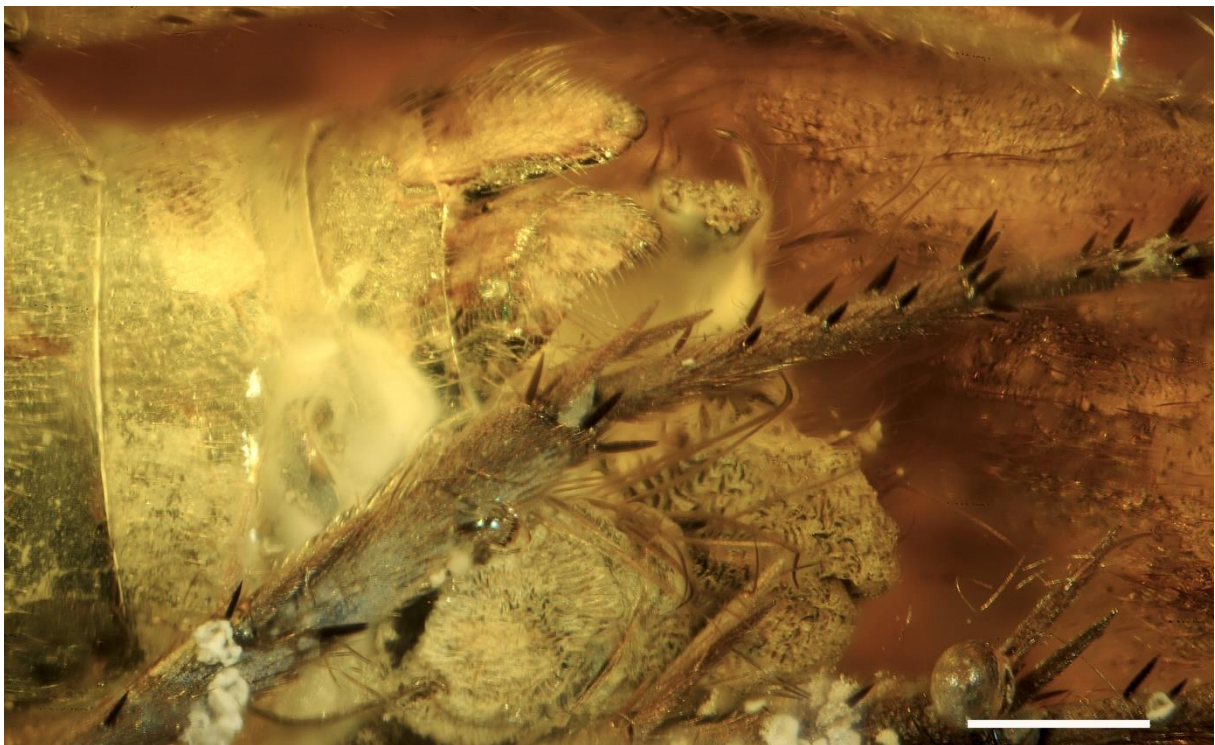
**Distribution.** Priabonian Rovno amber.

**Remarks.** The specimen is found in the piece of amber (weight 5.0 g) obtained from Mykola Khomych (Rovno).





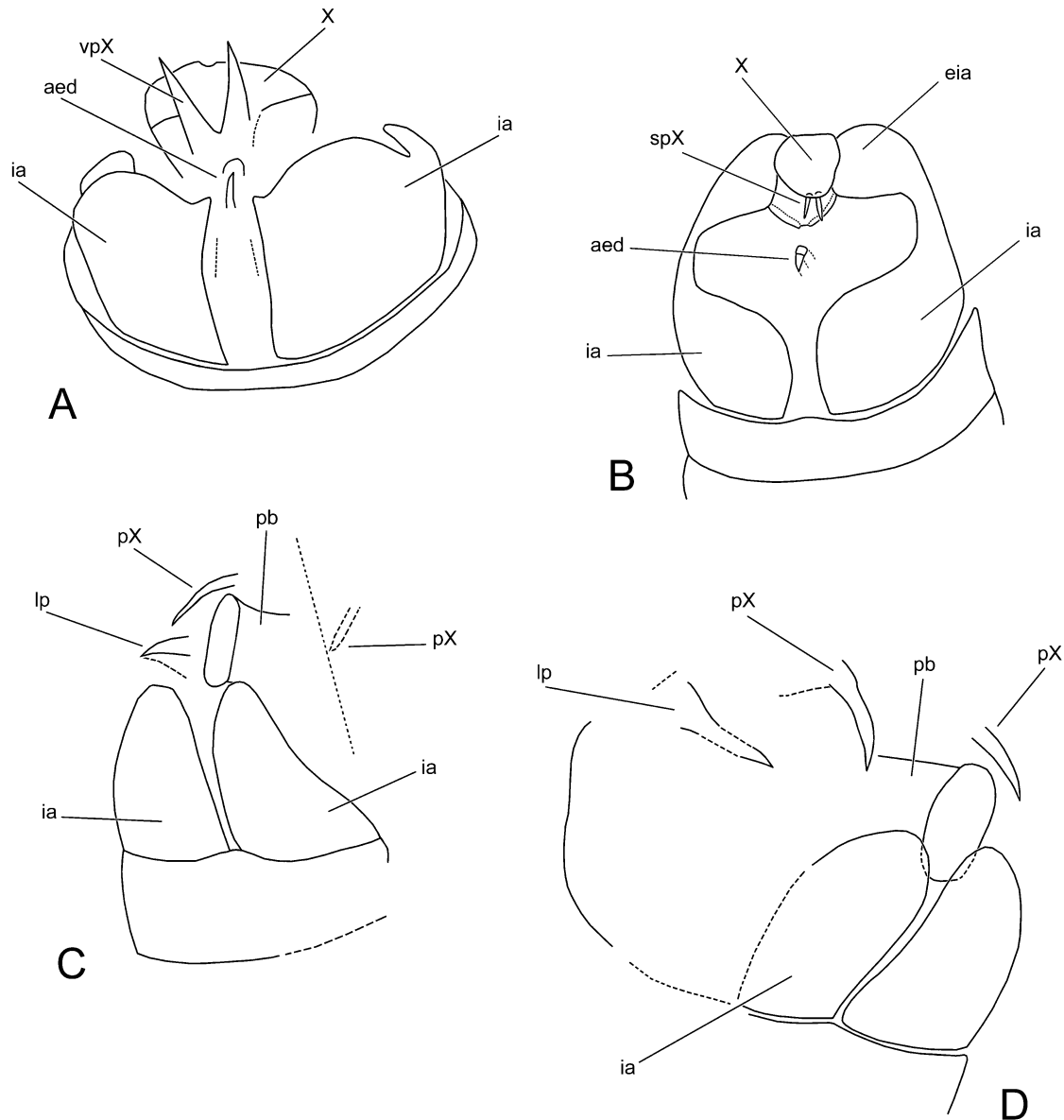
**Figure 7.** *Phryganea vkoivekiraz* sp. nov. Male type, head, lateral. Scale bar = 0.25 mm.



**Figure 8.** *Phryganea vkoivekiraz* sp. nov. Male type, genitalia, ventral. Scale bar = 0.5 mm.

Syninclusions: SIZK UA–28653 - Staphylinidae: Scydmaenitae, SIZK UA–28654 – Psychodidae, SIZK UA–28655 – Chironomidae.

Both described Rovno pieces with Phryganeidae have Scydmaenitae as syninclusions as well as dipterans from *Sciara* zone (Perkovsky 2017b, this paper), i. e. both most probably originated on the lower part of the trunk (Perkovsky *et al.* 2012).



**Figure 9.** A – *Holocentropus vottakvot* sp. nov. Male type, genitalia, ventral. B – *Plectrocnemia pluripotencia* sp. nov. Male type, genitalia, ventral. C – *Phryganea vkoivekiraz* sp. nov. Male type, genitalia, ventral. D – *Phryganea vkoivekiraz* sp. nov. Male type, genitalia, ventrolateral.

Abbreviations: X – 10<sup>th</sup> segment, *aed* – aedeagus, *eia* – flat extension of inferior appendages, *ia* – inferior appendages, *lp* – lateral appendages, *pb* – phallobase, *pX* – process of segment X, *spX* – spines of segment X, *vpX* – ventral process of segment X.

## Discussion

Caddisflies are the only group of aquatic insects from Rovno amber that has been studied in detail (e. g., Zelentsov *et al.* 2012; Perkovsky 2013, 2017a; Baranov *et al.* 2014, 2016; Perkovsky & Sukhomlin 2015; Ivanov *et al.* 2016; Gilka *et al.* 2021; Martynov *et al.* 2022). They are not directly associated with the amber forest and among them a fairly high proportion of cryophobic insects is found (Melnitsky *et al.* 2024a, 2024c). It is therefore not surprising that this fauna has a high proportion of taxa unknown



from Baltic amber (see Legalov *et al.* 2024a, 2024b). Our data suggest 5 genera of 21 (23.8%) and 34 species of 46 (73.9%) (Melnitsky *et al.* 2024b; this paper).

The prevailing family in the Rovno fauna of Trichoptera is the family Polycentropodidae, that were dominant group of caddisflies in the microthermal regions (with Mean Annual Temperature lower than 13 °C) of Eurasia and North America at least since Upper Cretaceous until end of Eocene (Ivanov *et al.* 2016; Perkovsky 2022). This family makes 54.4% of the species known from Rovno (Melnitsky *et al.* 2024b, and this paper). Some 68% species of Polycentropodidae known from Rovno were not found in the Baltic amber compared to 80.5% of species belonging to all other Trichoptera families. Hence, a half of the Rovno endemics belong to this family. Among the genus *Holocentropus*, which is most closely associated with microthermal regions, only 6 of 11 species (54.6%) are endemic, while in the genus *Plectrocnemia* known in tropics since the mid-Cretaceous (Ross 2024) five of seven species (71.4%) are endemic.

Phryganeidae is an extratropical family the only of the kind that shows obvious faunal differences in the European amber faunas at the genus level (Ivanov *et al.* 2016). The genus *Phryganea* is the first Rovno genus of its family, common with the Baltic amber. This family is represented in the Baltic amber by almost the same number of individuals (70 vs. 74), studied by Ulmer (1912), as the genus *Nyctiophylax* Brauer, 1865, the most species rich genus in Baltic amber (Melnitsky *et al.* 2024b). At the same time, 80% of the Baltic phryganeids examined by Ulmer were identified as *Phryganea picea* Pictet, 1856; contrary, only 29.7% of the individuals studied by Ulmer (1912) belong to abundant *Nyctiophylax varians* Ulmer, 1912, also the only species of the genus known from two amber faunas. Since the Baltic amber species of *Nyctiophylax* were 2–5 times smaller than the Baltic Phryganeidae, the larger caddisflies were underrepresented in the fossil resins. The fore wing length in the amber species described by Ulmer was 9–19 mm, while the Priabonian fossil imprints from Florissant Formation the wing size were 19–24 mm (Cockerell 1913, 1914), and the extant *Phryganea* imagines are sufficiently larger with wing length up to 32 mm. In Florissant, phryganeids make up 5% of all caddisflies, the same as psychomyids (Ivanov *et al.* 2016), while they make up only 1.4% of the Baltic caddisflies studied by Ulmer and 1.6% of the Rovno caddisflies identified to family (our data). Indirect evidence of their rarity in amber is also the fact that Wichard (2013) not only did not describe new phryganeids, but also did not use new finds to redescribe already known species; phryganeids are not indicated from Bitterfeld and Danish amber (Ivanov *et al.* 2016). At the same time, phryganeids are among the few families of caddisflies whose larvae are known from Baltic amber (Wichard 2013). Large, well-preserved phryganeids can only be found in large pieces of amber and are of great collection value; very few such pieces with inclusions are known from Bitterfeld and Danish amber. The only large undescribed phryganeid in a large piece of Rovno amber is kept in the private collection of Viktor Gusakov from Moscow Region (Perkovsky 2017b).

*Holocentropus vottakvot* sp. n. is the fourth caddisfly species known from the Varash District. Three of them (75%) belong to the Polycentropodidae. One of the latter species, *Holocentropus atratus* (Pictet, 1856), is known from Baltic amber, but is not recorded from the best-studied Klesov deposit; the other three species are known only from the Varash District. The peculiarity of the caddisfly fauna confirms the need for an in-depth study of inclusions from the Varash District, where numerous interesting new specimens are constantly being sampled (Anisyutkin *et al.* 2024; Vilhelmsen *et al.* 2024; Melnitsky *et al.* 2024b, 2024c and references therein).

Earlier we supposed that the warm-adapted caddisflies represent a majority of the taxa endemic for Rovno amber (Melnitsky *et al.* 2024c). However, Leptoceridae, Hydroptilidae and Helicopsychidae taken together account for only 21.7% of caddisfly species in Rovno amber. The proportion of species in these families is higher than in the Baltic amber (14.4%), and 90% of the species are endemic, but this is still not enough to absorb the majority of endemics in Rovno amber. The climate of the Rovno amber forest, although warmer than that of the Baltic, was still equable (Jenkins Shaw *et al.* 2024; Chemyreva *et al.* 2024), and temperate taxa predominated there (Perkovsky 2016, 2017a). Previously, the presence of groups in the fauna of European ambers that are boreal or cold adapted in the modern fauna was indicated, in particular, by species of the genus *Lype* McLachlan, 1878, representatives of the families Phryganeidae, Molannidae, and Beraeidae (Ivanov *et al.* 2016). These taxa include only 7.9% of the species of Baltic amber and 10.9% of the species of Rovno amber, although *Lype sericea* (Pictet, 1856) is the third most abundant amber species (Ivanov *et al.* 2016). The greatest number of new findings in European amber should be expected in the most abundant and species-rich genera of

polycentropodids. The most promising are *Holocentropus*, very species rich genus in European amber with 21 species in Baltic, 11 in Rovno, and 5 endemic species in Bitterfeld fossil resin, and *Plectrocnemia*, the most diverse genus in European amber having 35 species: 23 in Baltic, 8 in Rovno, 6 endemic in Bitterfeld amber (Ivanov *et al.* 2016; Melnitsky & Ivanov 2019, 2024; Melnitsky *et al.* 2024b).

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