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TWO DIFFERENT CRETACEOUS WORLDS: TAIMYR AND KACHIN AMBER TRICHOPTEROFAUNAS

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Two Different Cretaceous Worlds: Taimyr and Kachin Amber TrichopteroFaunas. Perkovsky, E. E. — Polycentropodidae constitute 60 % of Taimyr amber caddisfly species with known males, and only 4.8 % of caddisfly species with known males in Kachin amber. Micro-caddisflies obviously dominate in Taimyr amber (*Archaeopolycentra*, Polycentropodidae), Kachin (Burmese) amber (*Palerasnitsynus*, Psychomyiidae) and New Jersey amber (Hydroptilidae); both Psychomyiidae and Hydroptilidae are absent in Taimyr amber, Polycentropodidae are absent in New Jersey amber and rare in Kachin amber. The domination of Polycentropodidae was proposed as a new characteristic of *Baeomorpha* Realm, their rarity proposed as a new characteristic of Isoptera Realm.

Key words: Insecta, Trichoptera, Polycentropodidae, Hydroptilidae, Taimyr amber, burmite, Rovno amber.

Introduction

Santonian Taimyr amber trichopteroafauna with 11 species was “on the 1st place among all Cretaceous deposits counting also the rock imprints” (Ivanov & Melnitsky, 2017, p. 131) in 2017; three species and species were added in 2021 and 2022 (Melnitsky & Ivanov, 2021, 2022 a, b). It put Taimyr trichopteroafauna on the second place after fauna of burmite (earliest Cenomanian Kachin amber) with 45 species versus 7 species in 2017 (Ivanov & Melnitsky, 2017, 2021; Wichard et al., 2022). Latest great advances in the burmite studies were reviewed and checklisted by A. Ross (2019, 2020, 2021); recent results in the Taimyr amber studies were summarized by E. E. Perkovsky & D. V. Vasilenko (2019). The goal of the paper was to compare some characters of the two biggest Cretaceous trichopteroafaunas.

Material and methods

Twelve species of Taimyr amber caddisflies were collected in Yantardakh (Santonian) in 1971 by the expedition of V. V. Zherikhin and I. D. Sukacheva and in 2012 by expedition of the D. S. Kopylov, E. A. Sidorchuk, and D. D. Vorontsov that collected more than 60 kilograms of retinite (Rasnitsyn et al., 2016; Perkovsky & Vasilenko, 2019). All trichopterans found by the latter expedition except the holotype of *Siberoclea parapolaria* Ivanov et Melnitsky, 2017 were selected by V. V. Martynov (Slavyansk), primary cutting and polishing was done by A. P. Vlaskin (Rovno). All specimens were finally polished by E. A. Sidorchuk. It is very interesting that only one species appears to be common for both 1971 and 2012 Yantardakh collections (Ivanov & Melnitsky, 2017, 2021). Single assumed calamoceratid species was described from Santonian of Ugolyak from the material, collected by I. D. Sukacheva in 1973 (Botosaneanu & Wichard, 1983); assumed philopotamid was reported, but not named from Santonian of Bulun (Botosaneanu & Wichard, 1983; Perkovsky & Vasilenko, 2019). All the Taimyr material is housed in the Paleontological Institute, Moscow (PIN). The Kachin amber ('Burmese amber', or burmite in the nearly all papers published before 2020) is mined in Hukawng Valley (Kachin State, Myanmar) (Rasnitsyn et al., 2016).

Results

Thirty-eight percent of the reported Taimyr species (Ivanov & Melnitsky, 2021) as well as at least 47 % of the reported specimens (Botosaneanu & Wichard, 1983; Ivanov & Melnitsky, 2017, 2021) belong to Polycentropodidae; in Yantardakh their share reaches 42 % of species and at least half of specimens; genus *Archaeopolycentra* Botosaneanu et Wichard, 1983 with five species in Yantardakh comprises 42 % of all species and half of specimens and even 67 % of all species and 78 % of specimens in the new (2012) collection. Three Kachin polycentropodid species from three genera (Wichard, 2021) constitute only 6.7 % of all the named Kachin trichopterans, while Kachin *Wormaldia* McLachlan, 1865 (Philopotamidae) are represented by nine species as well as *Palerasnitsynus* Wichard, Ross et Ross, 2011 (Psychomyiidae); *Palaeopsilotreta* Wichard et Wang, 2017 (Odontoceridae) is represented by five species and *Cretapsyche* Wichard et al., 2018 (Cretapsychidae) by four species; these four genera constitute 60 % of all known Kachin trichopteran diversity. Micro-caddisflies obviously dominate both in Taimyr (Ivanov & Melnitsky, 2021) and Kachin (Wichard et al., 2018; Wichard, 2021) amber, but these micro-caddisflies belong to the different families (table 1). The share of polycentropodid species in Yantardakh is 6.3 times higher than in Kachin amber.

Comparable share of polycentropodid species is known only in Priabonian European ambers and Florissant (Ivanov et al., 2016): e. g., in the Baltic amber their share constitutes 34.8 % of species (Ivanov et al., 2016) and 80 % of specimens (Wichard, 2021). The ratio between polycentropodid share in equable Baltic (Archibald & Farrell, 2003; Radchenko & Perkovsky, 2021) and tropical Dominican amber (two from 32 Dominican species, 6.25 %; Wichard, 2007; Wichard & Neumann, 2021) equals 5.6, so it is nearly the same as the ratio between Yantardakh and Kachin polycentropodid share. Moreover, a male of Kachin polycentropodid *Neucentropus* (*Hnamadawgyia*) *macularis* (Wang et al., 2019) is unknown, although “the description of extinct polycentropodid species embedded in amber should consider only the males” (Wichard, 2021, p. 3); Polycentropodidae comprise 4.8 % of Kachin species with known males. Four Taimyr species (both hydrobiosids, leptocerid and calamoceratid) are known only based on the holotypes which are females or specimens of unknown sex, thus, Polycentropodidae include 60 % of Taimyr species with known males.

Table 1. Caddisflies from Taimyr and Kachin amber (the dagger symbol † indicates taxa known only as fossils)

Family	Genera (number of species)	
	Kachin amber	Taimyr amber
Philopotamidae	<i>Wormaldia</i> (9)	—
Dipseudopsidae	—	† <i>Taymyrodipseudon</i> (1)
Psychomyiidae	† <i>Palerasnitsynus</i> (9)	—
Kambaitipsychidae	† <i>Myanpsyche</i> (1)	—
Pseudoneureclipsidae	† <i>Amberclipsis</i> (3)	—
Polycentropodidae	† <i>Electrocentropus</i> (1), <i>Neucentropus</i> (1), <i>Neureclipsis</i> (1)	† <i>Archaeopolycentra</i> (6)
Superfamily Psychomyioidea Family <i>incertae sedis</i>	† <i>Protoclipsis</i> (3)	—
Rhyacophilidae	—	<i>Rhyacophila</i> (1)
Hydrobiosidae	—	† <i>Palaeohydrobosis</i> (1), † <i>Kliganigadukia</i> (1)
Hydroptilidae	† <i>Burminoptila</i> (1), † <i>Cretacoptila</i> (1)	—
Helicopsychidae	† <i>Cretahelicopsyche</i> (1)	—
† <i>Taymyrelectronidae</i>	—	† <i>Taymyrelectron</i> (1)
† <i>Burmapsychidae</i>	† <i>Burmapsyche</i> (2)	—
† <i>Cretapsychidae</i>	† <i>Cretapsyche</i> (4)	—
Calamoceratidae	† <i>Bipectinata</i> (1) † <i>Cretaganonema</i> (1)	† <i>Calamodontus</i> (1)
Odontoceridae	<i>Psilotreta</i> (1), † <i>Palaeopsilotreta</i> (5)	—
Leptoceridae	—	† <i>Praeathripsodes</i> (1) † <i>Siberoclea</i> (1)

Domination of Polycentropodidae is even more evident at the level of specimens: 69 % of males belong to Polycentropodidae.

Hydrobiosidae is unknown from all Cretaceous deposits, except Taimyr amber (Ivanov & Melnitsky, 2017). Larvae of Hydrobiosidae are free-living active predators under stones in clean rapid streams (Ivanov & Melnitsky, 2017). Their larvae, as well as larvae of Rhyacophilidae (Ivanov & Melnitsky, 2017), are dependent on cool and fast moving water for their development, preferably that of the smaller rivers. As it was assumed by Ivanov & Melnitsky (2017), the richness of Hydrobiosidae in the Taimyr deposits might indicate at the cool climate and relatively low water temperatures in streams. This reason may explain the polycentropodid domination in the Taimyr trichopteroFauna.

Polycentropodidae is a single family known from both Kachin amber and Yantardakh (16.7 % of all families) vs. five Yantardakh families (83.3 %) common with the Baltic amber; all Taimyr amber trichopteroFauna has 3 from 8 families (37.5 %) common with Cenomanian Burma (table 1; third common family is Philopotamidae). The Taimyr and Kachin amber faunas do not have any common caddisfly genera; one of Yantardakh genera (*Rhyacophila*) is known from Baltic amber. Half of the extant Kachin genera belong to Polycentropodidae.

As we indicated earlier (Perkovsky et al., 2018), the right tributaries of the Kheta and left tributaries of Kotuj run mainly along the Putorana Plateau, which was present in the Cretaceous, bounded by granite canyons, creating a narrow area for the small freshwater streams surrounded by the amber forest. The Ugolyak (Perkovsky & Vasilenko, 2019) is the only known important retinite locality of the Kheta Formation of the river catchment area in the flat Khatanga lowland (Perkovsky et al., 2018) where the Cretaceous river valleys were not bounded by granite canyons. There is not much space for small tributaries and lakes in the granite canyons, however, the flat area surely allow them to exist, so the finding of the single assumed Taimyr calamoceratid species in Ugolyak and the absence of

polycentropodids in the taphocoenosis could be not accidental.

In the Northern Hemisphere two Cretaceous zoogeographic realms (“*Baeomorpha*” and “Isoptera”) were recognized (Gumovsky et al., 2018). The *Baeomorpha* Realm, with a temperate or warm temperate climate, is characterized, in addition to the presence of numerous parasitic wasps of the genus *Baeomorpha* (Rotoitidae), by very abundant aphid fossils (eight families from four superfamilies are known from this realm only), few termites and no webspinners. The Isoptera Realm, which had a warmer climate, contained very few Rotoitidae, few aphids (often with strongly reduced hind wings), whereas termites and webspinners (Perkovsky et al., 2020) were abundant and diverse (webspinners at least in the south of the realm). Water insects were not used in the characterization of the realms; 70 species of Cretaceous amber caddisflies (Ivanov & Melnitsky, 2017, 2021; Wichard & Azar, 2018; Wichard et al., 2022) appear instrumental in it.

Archaeopolycentra is the only not monotypic genus of caddisflies in *Baeomorpha* Realm; at the same time all three Polycentropodidae Isoptera Realm genera are monotypic versus half of monotypic genera in all other families. It is noteworthy to mention a diversity of Burmese Pseudoneureclipsidae which is the family closest to Polycentropodidae (Chamorro & Holzenthal, 2011). There are reasons to believe that *Protoclipsis* Wichard et al., 2022 also belongs to Pseudoneureclipsidae, in particular because the structure of the inferior appendages of different species of *Protoclipsis* is similar either to *Antillopsyche* Banks, 1941 or *Amberclipsis* Wichard et al., 2022 (Wichard et al., 2022). Nominative extant genus *Pseudoneureclipsis* Ulmer, 1913 inhabits large southern parts of the Old World including southeastern, eastern, and southern Asia; the Bismarck Archipelago; Central Africa and Madagascar; and the Mediterranean Region; the second extant pseudoneureclipsid genus *Antillopsyche* has been found only on Cuba, Hispaniola, and Puerto Rico (Malicky, 2020); extinct species of *Antillopsyche* reported from Miocene Dominican and Mexican amber. Some genera belonging to thermophile Psychomyiodea families were even three times more diverse in Kachin amber forest (table 1). Micro-caddisflies from the genus *Palerasnitsynus* have forewings with lengths of 1.8–2.6 mm and account at present for almost 60 % of all caddisflies in Kachin amber (Wichard et al., 2018). Often they can be found in aggregations with 20 to 100 specimens in one piece of amber, thus indicating swarming activities of the adults (Wichard et al., 2018, fig. 12). Kachin *Wormaldia* with wing lengths of half of the species 2.5–2.8 mm (Wichard et al., 2020; Wang et al., 2021) are “about 25 % smaller than their recent relatives and, like the psychomyiids, can be considered to be extinct “microcaddisflies” (Wichard, 2021, p. 6). Compared with *Palerasnitsynus* the *Wormaldia* specimens occur sporadically in Kachin amber and do not seem to swarm (Wichard et al., 2020). Taimyr philopotamid from Bulun with wing length 5.5–5.7 mm (Botosaneanu & Wichard, 1983) is two times bigger. New Jersey and Tennessee amber species are as big as recent philopotamid species as well. Except for burmite, more than two species of caddisflies of Isoptera Realm were found only in Turonian New Jersey amber, where 4 out of 9 species (44.4 %) belong to Hydroptilidae; endemic subgenus *Nanoagrayscale* Botosaneanu, 1995 (3 species) and genus *Novajerseya* Botosaneanu et al., 1998 are characterized by very small sizes. Hydroptilidae comprise 3.8 % of species in well-studied Baltic amber (Ivanov et al., 2016) versus 11.4 % in more southern (Mitov et al., 2021) and less studied Rovno amber (Melnitsky et al., 2021 a, b) and 25 % in tropical Dominican amber (Wichard, 2007; Wichard, Neumann, 2021); polycentropodid/hydroptilid species ratio equals 9.3 in Baltic amber (Ivanov et al., 2016; Melnitsky & Ivanov, 2019) and 4.5 in Rovno amber (Perkovsky, 2017; Melnitsky et al., 2021 a, b, c) versus 0.25 in Dominican amber. Eskov with co-authors assumed that hydroptilids “initially, from the time of their origin, were related to the tropical and subtropical regions avoiding the temperate ones” (Eskov et al., 2004, p. 43). It is quite probable that this assumption is also true with regard to the thermophile forms of other trichopteran families as well. Hydroptilidae comprises 10.5 % from all caddisfly species of the Isoptera Realm; Philopotamidae (19.3 % of species), Psychomyiidae (15.8 %) and Hy-

droptilidae constitute nearly a half of the known diversity of its trichopterofauna.

To conclude, the above evidence implies that domination of Polycentropodidae (40 % of all species) could be added to the characteristics of the *Baeomorpha* Realm, whilst their rarity (5.3 % from all species of the realm) could supplement the characteristics of the Isoptera Realm.

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