

**A new fossil mosquito, with notes on the morphology and taxonomy
of other species reported from Eocene Baltic amber
(Diptera: Culicidae)**

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ABSTRACT. Males of *Culiseta gedanica* **sp. n.** and *Culex erikae* SZADZIEWSKI & SZADZIEWSKA, 1985 are described, and an incomplete male of *Coquillettidia* is reported from Baltic amber for the first time. *Aedes perkunas* PODENAS, 1999 is recognized as a junior synonym of *Culex erikae*, **syn. n.** *Aedes serafini* SZADZIEWSKI, 1998 is transferred to the genus *Ochlerotatus*, **comb. n.** Mosquitoes are rare fossils in Baltic amber. They represent six species of extant genera with a worldwide distribution: *Culiseta*, *Ochlerotatus*, *Coquillettidia*, *Culex* and *Aedes*. A key to the identification of males is also provided.

KEY WORDS: Diptera, Culicidae, Eocene, Baltic amber, Gulf of Gdańsk.

INTRODUCTION

The Culicidae is a well-known family of nematoceros flies. Over 3,200 species are known in the extant world fauna. They are frequent parasites of mammals and birds as females feed on their blood. Mosquito larvae and pupae inhabit exclusively shallow stagnant waters.

Despite the fact that the phylogenetic history of mosquitoes goes back to the Mesozoic era, they are rarely preserved as fossils. The oldest true mosquito is reported from Upper Cretaceous Canadian amber (POINAR et al. 2000). Fossil mosquitoes from the Cenozoic are reviewed by EDWARDS (1923), STATZ (1944), EVENHUIS (1994) and SZADZIEWSKI (1998). Mosquitoes are very rare in Eocene Baltic amber (SZADZIEWSKI 1998, PODENAS 1999), while they are more common in younger Miocene Dominican amber (SZADZIEWSKI & GROGAN 1994, POINAR 2005).

This paper presents the results of an examination of mosquitoes from the private collection of Christel and Hans Werner Hoffeins of Hamburg and the Museum of Amber Inclusions of the University of Gdańsk.

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MATERIAL, METHODS

Four male mosquitoes from Baltic amber were examined. They are embedded in artificial resin. For an explanation of general morphological terminology and abbreviations, see DAHL (1997), SZADZIEWSKI (1998) and BECKER et al. (2010).

SYSTEMATICS

Subfamily Culicinae

Genus *Culiseta* FELT, 1904

***Culiseta gedanica* sp. n.**

(Figs 1-3)

Diagnosis

The male of the species is characteristic in having prespiracular setae, a larger claw on the fore and mid legs with a basal and median tooth, and a smaller claw with a basal tooth. The gonocoxite is simple, not modified, and the gonostylus bears an apical expansion and distinct tooth (see key).

Description

Male. Body length (without proboscis) 4.6 mm; thorax and abdomen 4.2 mm (Fig. 1A). Wing length 4.17 mm. Eyes touching, flagellum distorted. Proboscis 2.06 mm long. Palpus 2.63 mm long (Fig. 1B,C); fourth palpomere stout, 0.59 mm long, fifth palpomere slender, 0.48 mm long. Scutellum trilobed. Prespiracular (=spiracular) setae present, postspiracular absent. Wing vein R_3 2.0 times longer than R_{2+3} ; veins with slender scales (Fig. 2A). Legs incomplete: right fore and hind legs missing; left mid leg without tarsus; hind tarsi absent. Fifth tarsomere of fore leg with strong basal horn-like expansion ventrally (Fig. 2B). Larger

claw of fore and mid legs with basal and median tooth, smaller claw with basal tooth (Figs 2B,C). For length of leg segments, see Table 1.

Table 1. Lengths (in mm) of leg segments in male *Culiseta gedanica* sp. n.

| | fe | ti | ta ₁ | ta ₂ | ta ₃ | ta ₄ | ta ₅ |
|----|------|------|-----------------|-----------------|-----------------|-----------------|-----------------|
| p1 | - | - | 1.03 | 0.37 | 0.24 | 0.12 | 0.20 |
| p2 | 1.77 | 1.89 | 1.42 | 0.63 | 0.40 | 0.15 | 0.21 |
| p3 | - | 1.89 | - | - | - | - | - |

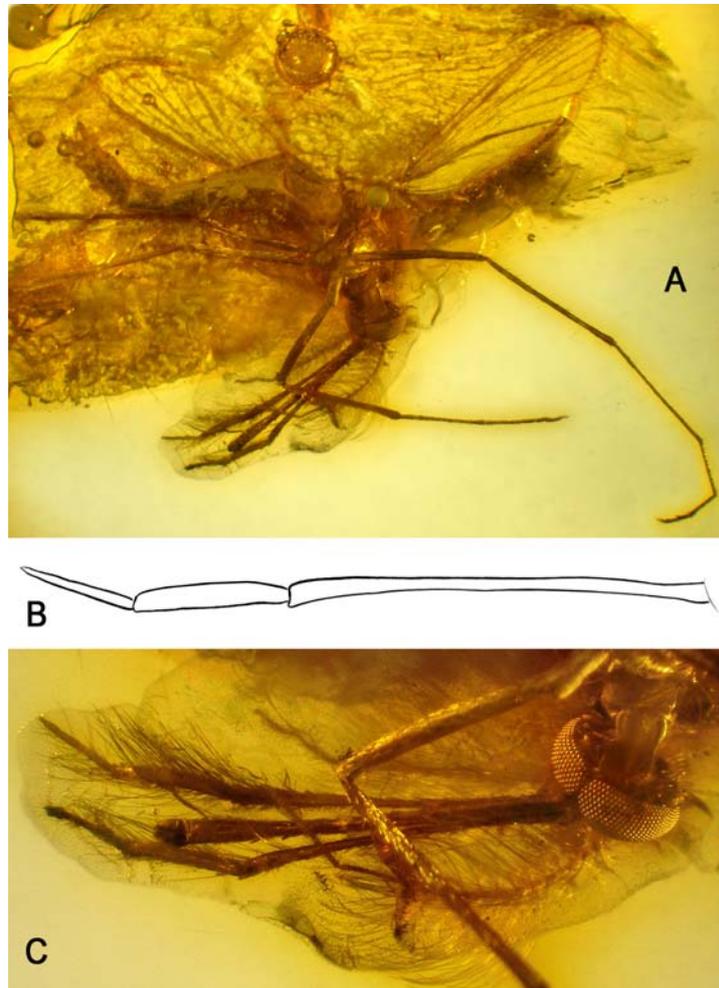


Fig. 1. *Culiseta gedanica* sp. n., male: A – total habitus, B – palpus, C – head.

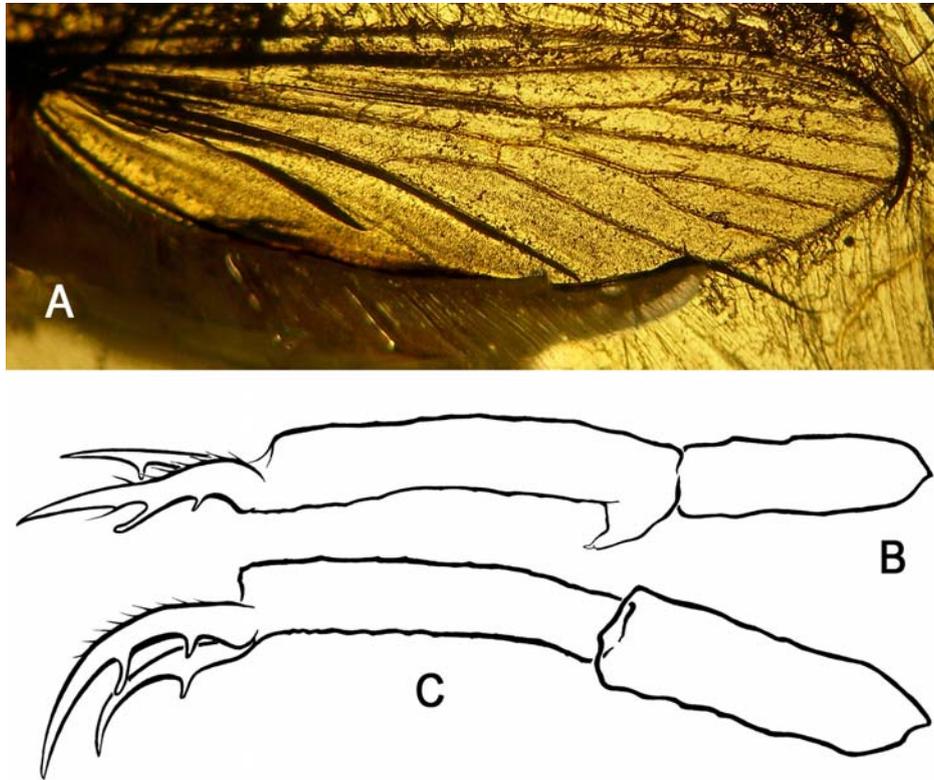


Fig. 2. *Culiseta gedanica* sp. n., male: A – wing, B – distal tarsomeres of fore leg, C – distal tarsomeres of mid leg.

Genitalia (Fig. 3A, B) well preserved. Tergite IX with group of strong short posteromedian spines. Gonocoxite simple, not modified, slender. Gonostylus distinctly bent at apex, armed with apical expansion and distinct tooth (Fig. 3C). Claspettes curved with serrated margins and pointed apices.

Female. Unknown.

Material examined

Holotype male. Hoffeins' collection #981.3. Syninclusions: two collembolans. The holotype will be deposited at the Senckenberg Deutsches Entomologisches Institut (SDEI, Germany).

Etymology

The specific name refers to the Gulf of Gdańsk, where the largest deposits of Eocene Baltic amber are to be found.

Discussion

The new species is included in the extant genus *Culiseta* as the adult has well visible prespiracular setae. The new fossil species is distinctly smaller than extant *Culiseta* and has unique gonostyli with an apical expansion. This is the first report of a fossil in the genus.

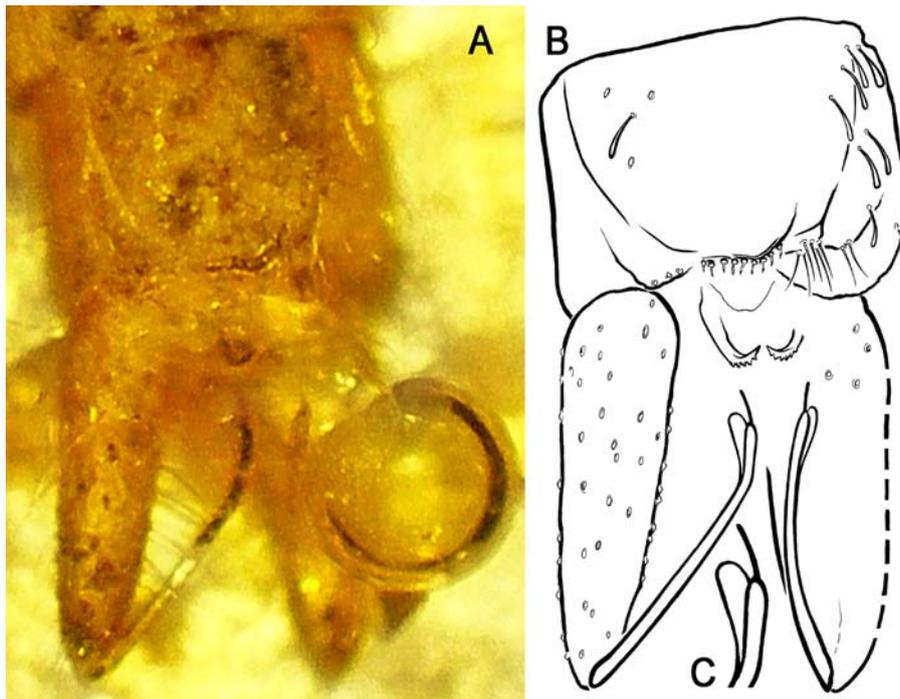


Fig. 3. *Culiseta gedanica* sp. n., male genitalia, photo (A) and drawing (B, C), C – apex of gonostylus.

Genus *Ochlerotatus* LYNCH ARRIBALZAGA, 1891

Ochlerotatus serafini (SZADZIEWSKI, 1998), comb. n.

(Fig. 4)

Aedes serafini SZADZIEWSKI, 1998: 240 (male, Baltic amber).

Notes on morphology

The present re-examination of the holotype resulted in new morphological details, which were not shown in the original description of the species. They are: Fifth tarsomere of fore leg with strong basal expansion ventrally. Larger claw of fore and mid legs with

median tooth, smaller claw with basal tooth, claws of hind leg small equal, each with basal tooth. Tergite IX with group of four setae placed on a spatulate process in caudomedian position. Base of gonocoxite with distinct ventral swelling; subtriangular expansion at mid length of inner margin of gonocoxite bearing three stout spine-like setae directed ventrally, and apical inner lobe (Fig. 4). Gonostyli invisible. Claspettes barely visible.

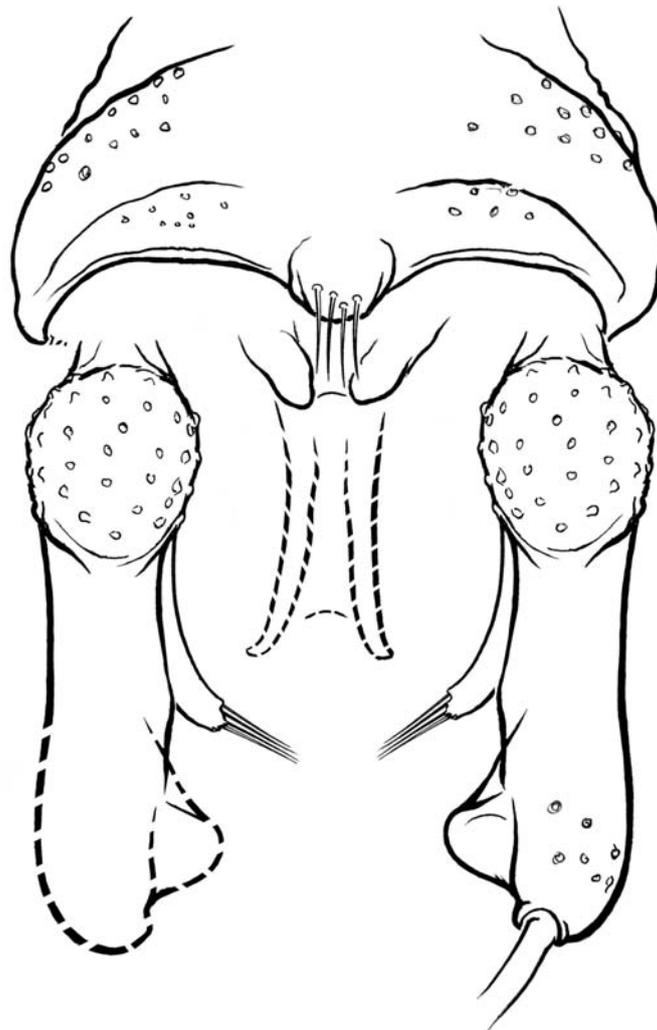


Fig. 4. *Ochlerotatus serafini* (SZADZIEWSKI), male genitalia (gonostyli not visible).

Material examined

Holotype male of *Aedes serafini*, Museum of Amber Inclusions, University of Gdańsk, MAI #112.

Discussion

REINERT (2000) suggested dividing the composite genus *Aedes* MEIGEN into two genera *Aedes* and *Ochlerotatus*; this proposition was widely accepted, and all subgenera subsequently received generic status (HARBACH 2011).

The gonocoxite in *Ochlerotatus* is characteristic in having a distinct apical inner lobe. Such a lobe, as observed in *serafini*, is very similar to that found in extant *O. excrucians* (WALKER) (present examination), which indicates that this fossil species can be placed in the extant genus *Ochlerotatus*.

Two other species of the genus *Aedes*, described by SZADZIEWSKI (1998) from Baltic amber (*A. hoffeinsorum* and *A. damzeni*), are left in the genus of traditional concept, and need further materials and studies. They were originally placed in the subgenus *Finlaya* THEOBALD, which now is a distinct genus. However, *A. hoffeinsorum* and *A. damzeni* cannot be placed in *Finlaya*, because in this genus the males have bigger claws on the fore and mid legs armed with a basal and median tooth, whereas the smaller claw has a basal tooth (HARBACH 2011). In *A. hoffeinsorum* all claws are simple, and in *A. damzeni* the claws have no basal tooth (SZADZIEWSKI 1998).

Genus *Coquillettidia* DYAR, 1905***Coquillettidia* sp. indet.**

(Fig. 5)

Description

Male (Fig. 5A). Hind legs, right wing and genitalia missing. Wing length 2.7 mm. Fourth palpomere stout (0.47 mm), fifth palpomere slender (0.44 mm). Prespiracular and postspiracular setae absent. Fifth tarsomere of fore leg with strong basal expansion ventrally. Scales on wing veins broad (Fig. 5B). Larger claw of fore and mid legs with basal and median tooth, smaller claw simple, without teeth. For length of legs segments, see Table 2.

Table 2. Length (in mm) of legs segments in male *Coquillettidia* sp. indet.

| | ta ₁ | ta ₂ | ta ₃ | ta ₄ | ta ₅ |
|----|-----------------|-----------------|-----------------|-----------------|-----------------|
| p1 | 0.92 | 0.29 | 0.20 | 0.09 | 0.13 |
| p2 | 1.37 | 0.56 | 0.31 | 0.12 | 0.15 |



Fig. 5. *Coquillettidia* sp. indet., male: A – total habitus, B – wing veins with broad scales.

Material examined

Hoffeins' collection, male. #1719-1.

Discussion

The subgenus *Coquillettidia* was recently removed from the genus *Mansonia* BLANCHARD and elevated to a distinct genus (DAHL 1997, BECKER et al. 2010, HARBACH 2011). In the extant European fauna *Mansonia* is absent, while *Coquillettidia* is represented by one species *C. richiardii* (FICALBI). Larvae and pupae of species from both genera pierce water plants and take air from plant tissues. They are able to inhabit lakes and ponds with fish, hiding from predators among plants in the littoral zone. This is the first record of the genus in Eocene Baltic amber.

Genus *Culex* LINNAEUS, 1758***Culex erikae* SZADZIEWSKI & SZADZIEWSKA, 1985**

(Figs 6, 7)

Culex erikae SZADZIEWSKI & SZADZIEWSKA, 1985: 515 (female, Baltic amber, Eocene).

Aedes perkunas PODENAS, 1999: 113 (male, Baltic amber, Eocene), **syn. n.**

Description

Male. Almost complete (Fig. 6A). Only distal portion of right flagellum missing. Left side of thorax covered with milky fog. Body length about 5.0 mm (without proboscis). Flagellum 1.77 mm long, plume well developed; distal flagellomeres 12 and 13 elongated, each 0.48 mm. Terminal flagellomere armed with cylindrical apical prolongation. Proboscis 2.06 mm. Palpus 2.74 mm; fourth palpomere 0.53 mm long, fifth palpomere 0.45 mm long, both slender, combined length of 4th and 5th palpomeres 1.56 times longer than 3rd palpomere (Fig. 6B). Wing length measured from basal arculus 2.98 mm. Vein R₂ 4.1 times longer than vein R₂₊₃. Wing scales slender (Fig. 6C). Fifth tarsomere of fore leg with strong basal expansion ventrally. Larger claw of fore and mid legs with median tooth, smaller claw with basal tooth, claws of hind leg equal, simple (Fig. 7A-F). For length of legs segments, see Table 3.

Table 3. Length (in mm) of leg segments in male *Culex erikae*.

| | Fe | ti | ta ₁ | ta ₂ | ta ₃ | ta ₄ | ta ₅ |
|----|------|------|-----------------|-----------------|-----------------|-----------------|-----------------|
| p1 | - | - | 1.37 | 0.40 | 0.21 | 0.09 | 0.20 |
| p2 | - | - | 1.77 | 0.68 | 0.38 | 0.14 | 0.18 |
| p3 | 1.71 | 1.94 | 2.19 | 1.14 | 0.78 | 0.43 | 0.25 |

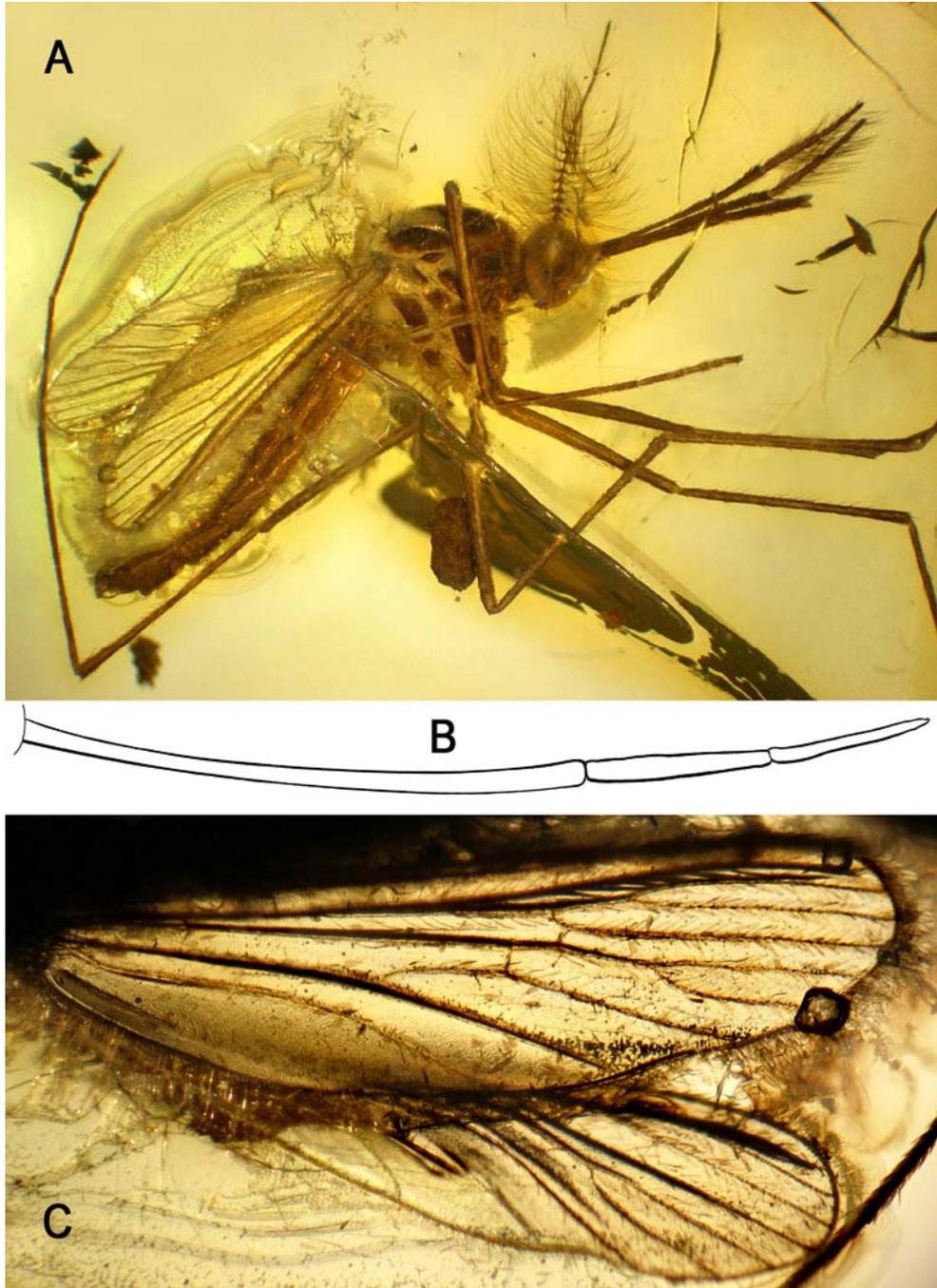


Fig. 6. *Culex erikae* SZADZIEWSKI & SZADZIEWSKA, male: A – total habitus, B – palpus, C – wings.

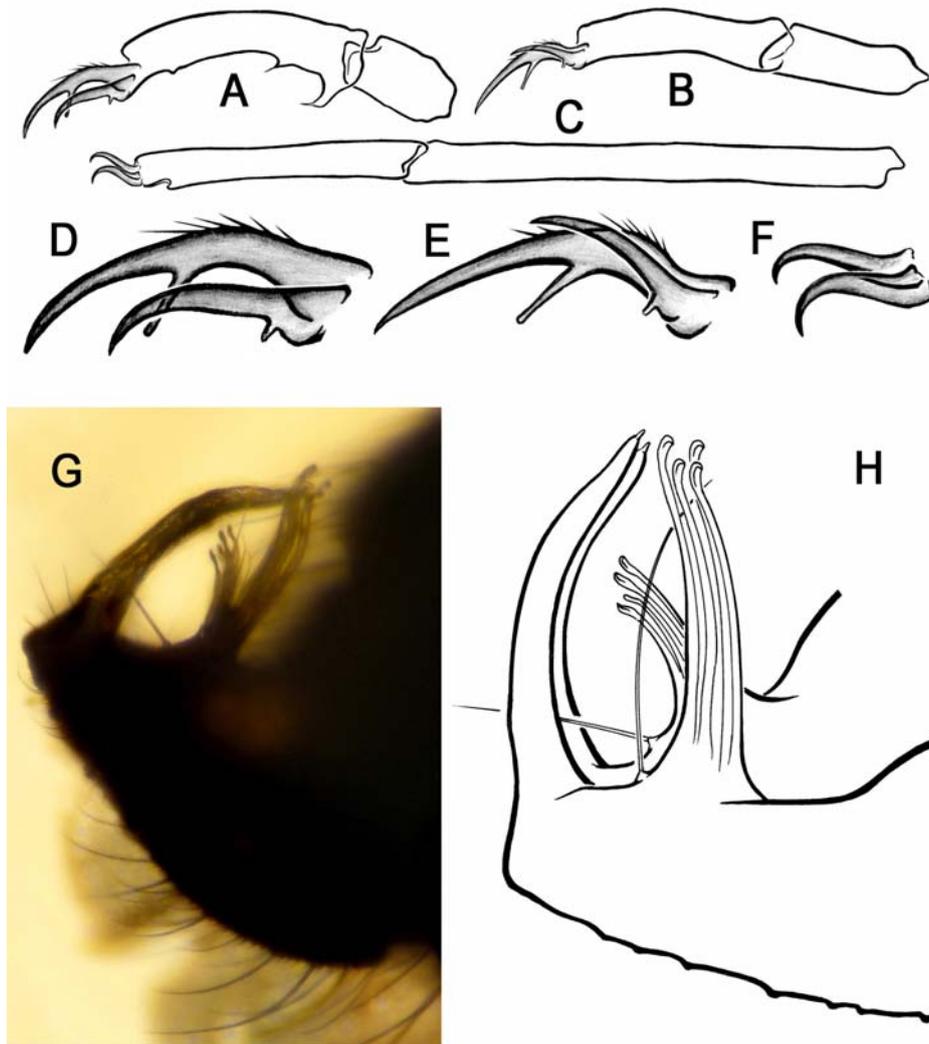


Fig. 7. *Culex erikae* SZADZIEWSKI & SZADZIEWSKA, male: A-C – distal tarsomeres of fore (A), mid (B) and hind leg (C); D-F – tarsal claws of fore (D), mid (E) and hind leg (F); G, H – lateral aspect of genitalia.

Genitalia (Fig. 7G, H). Observable in lateral aspect. Base of gonocoxite barely visible; a ventromedian group of four long spatulate spines placed subapically, well visible. Gonostylus evenly bent, tapering to pointed apex armed with short tooth.

Material examined

Hoffeins collection, #981-2a. male. Syninclusions in amber piece 2b: Mycetophilidae and Hymenoptera.

Discussion

The holotype male of *Aedes perkunas* is not complete: it lacks a hypopygium and hind legs. According to the original description, the male of this mosquito has the claws of the fore and mid legs unequal, and the larger one is armed with a median tooth. This character is usually present in extant and fossil *Culex*, *Ochlerotatus* and *Aedes*. However, in the examined males of these genera, the smaller claw has a basal tooth. We suspect that this character was overlooked in the species described by PODENAS (1999), as was the basal-ventral tubercle on the fifth tarsomere of the fore leg, which is usually present in male mosquitoes. The male of *Aedes perkunas*, devoid of genitalia, is similar to *O. serafini* and *Culex erikae*. We took into consideration the proportions of the palpomeres ($3^{\text{rd}} / 4^{\text{th}} + 5^{\text{th}}$), which in *A. perkunas* and *C. erikae* are the same (1.6), whereas they differ distinctly from that found in *O. serafini* (1.9). Thus we propose to treat *A. perkunas* as a junior synonym of *C. erikae*.

Key to male mosquitoes from Baltic amber

1. Wing veins with broad scales (Fig. 5B) *Coquillettidia* sp. indet.
- Wing veins with slender scales (Fig. 2A) 2
2. Prespiracular setae present. Larger claw of fore and mid leg with basal and median tooth (Fig. 2B, C) *Culiseta gedanica* **sp. n.**
- Prespiracular setae absent. Larger claw of fore and mid leg simple or with median tooth, basal tooth absent (Fig. 7D, E) 3
3. Gonocoxite with a group of subapical spatulate spines on ventromedian surface (Fig. 7G, H) *Culex erikae* SZADZIEWSKI & SZADZIEWSKA, 1985
- Gonocoxite simple, without modifications 4
4. Palpus shorter than proboscis *Aedes hoffeinsorum* SZADZIEWSKI, 1998
- Palpus longer than proboscis 5
5. Fourth palpal segment slender, fifth one short *Aedes damzeni* SZADZIEWSKI, 1998
- Fourth palpal segment stout, fifth one long ... *Ochlerotatus serafini* (SZADZIEWSKI, 1998)

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