



<https://doi.org/10.11646/palaeoentomology.1.1.6>

<http://zoobank.org/urn:lsid:zoobank.org:pub:9E2DB06C-FC5D-4E6D-A9F8-7146FF588353>

## First male of *Corethrella andersoni* Poinar & Szadziewski, 2007 (Diptera: Corethrellidae) from mid-Cretaceous Burmese amber

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The family Corethrellidae, called frog-biting midges, with the single genus *Corethrella* Coquillett, 1902, is a small group of dipterans including 107 extant species (Borkent, 2017). Females of most species are haematophagous and feed on males of frogs and toads locating them by their calls (Borkent, 2008). Extant frog-biting midges have a pantropical distribution, absent in Europe, north Africa, middle and northern Asia (Gilka & Szadziewski, 2009). The genus during its phylogenetic history dated back to Lower Cretaceous (125–129 Ma) had a broader geographical distribution, and during Eocene was present in Europe. Till now nine fossil species have been described from Lower Cretaceous Lebanese amber (1), mid-Cretaceous Burmese amber (1), Eocene Baltic amber (5) and Miocene Dominican amber (2) (a complete annotated list is provided below).

The purpose of this paper is to describe the first male of *Corethrella andersoni* from mid-Cretaceous Burmese amber (99 Ma, Shi *et al.*, 2012).

### Material and methods

The male specimen in Burmese amber, MP/3878, deposited in the collection of the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Cracow, was studied. This amber piece is almost rectangular, about 13 × 6 × 2 mm, well preserved and transparent. Legs of undetermined Diptera are also embedded as syninclusions. The specimen was purchased from an amber dealer and originates from an amber mine in the Hukawng Valley in northern Myanmar (Burma). All photographs were taken using a LAS Montage multifocus with a Leica DM6000.

### Systematic paleontology

Family Corethrellidae Edwards, 1932

Genus *Corethrella* Coquillett, 1902

*Corethrella andersoni* Poinar & Szadziewski, 2007

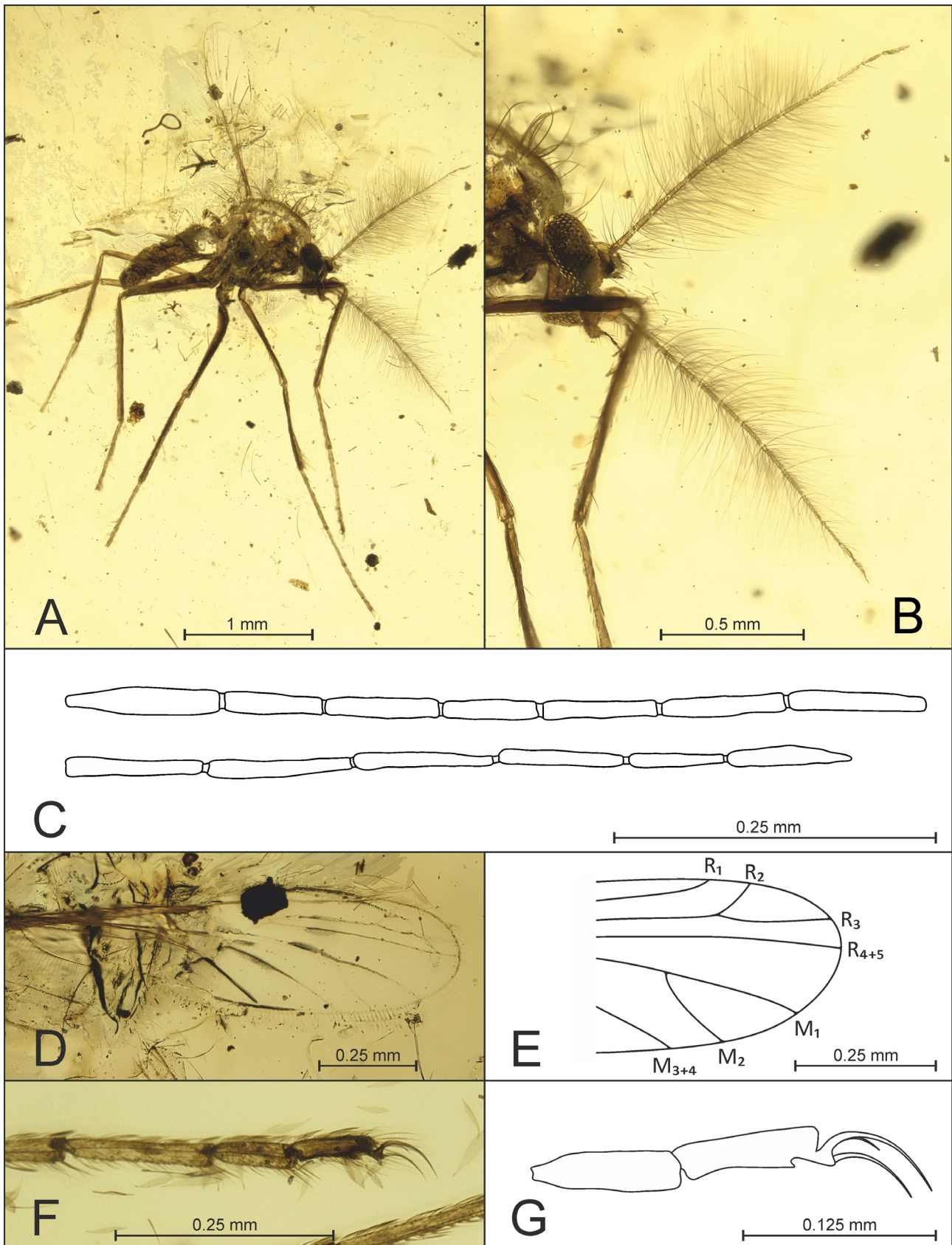
*Corethrella andersoni* Poinar & Szadziewski, 2007: 155 (female, Burmese amber).

**Revised diagnosis.** Both sexes can be readily distinguished from all previously described fossil species of the genus by short wing veins  $R_2$  and  $R_3$ . Male claws of foreleg without prong and empodium, unequal, posterior claw stronger and armed with long inner tooth, anterior claw shorter and simple.

**Description.** Male (Fig. 1A); left wing absent, tarsomeres 2–5 of mid and hindlegs absent; genitalia almost invisible. Body length (without antennae) about 1.7 mm. Eye separation not visible. Proboscis slightly elongated, palpus 5-segmented, slender, with simple setae. Clypeus not visible. Flagellum with 13 flagellomeres, plume well developed, with long setae on all flagellomeres (Fig. 1B), 1.35 mm long; pedicel large; all flagellomeres cylindrical (Fig. 1C), first flagellomere 130  $\mu$ m, flagellomeres 2–10 from 80 to 110  $\mu$ m, flagellomeres 7–9 of similar length 110  $\mu$ m; flagellomeres 11, 12, 13 100, 80, 100  $\mu$ m, respectively; apex of terminal flagellomere rather rounded, without distinct apical prolongation, bearing 2 apical setae.

Wing length 1.47 mm; venation as in Figs. 1D, E; vein  $R_1$  moderately long, ending almost at level of fork of  $R_{2+3}$ ; veins  $R_2$  and  $R_3$  short; costal vein bearing lanceolate scales, on other veins setae not preserved. Thorax with lateral sclerites barely visible; anepimeron with 1 long seta; scutum with some long setae (Fig. 1B).

Legs including tarsi bearing striated lanceolate scales (Fig. F); femur and tibia of midleg stouter than those of fore- and hindlegs; lengths of leg segments as in Table 1; mid tibia without spur; hind tibial comb not visible, fore tibial spur and hind tibial spur absent; tarsal ratio of foreleg 1.67; tarsomeres 1–4 of foreleg with apical spine, tarsomere 4 about 2 times shorter than tarsomere 3, tarsomere 5 slender, without ventrobasal swelling; tarsomere 1 of midleg without apical spine; claws of foreleg unequal, posterior claw with long



**FIGURE 1.** Male of *Corethrella andersoni* Poinar & Szadziewski, 2007. A—total habitus, B—head, C—flagellomeres 1-13, D—wing, E—venation of distal portion of wing, F—tarsomeres 3-5 of foreleg, G—tarsomeres 4 and 5 of foreleg with claws.

tooth at 1/3 length, anterior claw shorter, simple; empodium, basal prong or long basal seta absent (Figs. 1F, G).

Abdomen lacking lanceolate scales. Genitalia almost invisible.

**TABLE 1.** Length (in mm) of leg segments of male *Corethrella andersoni*

	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub> (without and with claws)
p1	0.75	0.80	0.50	0.30	0.20	0.10	0.10 (0.17)
p2	0.80	1.00	0.60	-	-	-	-
p3	0.80	0.80	0.65	-	-	-	-

## Discussion

The male is associated with the previously described female of *C. andersoni* by the similar wing venation with short and strongly divergent veins R<sub>2</sub> and R<sub>3</sub>. The fork of R<sub>2+3</sub> is located distally to fork M<sub>1+2</sub>. Among extant species, similar short veins R<sub>2</sub> and R<sub>3</sub> are present only in *C. brevivena* Borkent, 2008 from Costa Rica. In *C. andersoni* the fork of R<sub>2+3</sub> evidently is distal to the fork of M<sub>1+2</sub> (Fig. E; Poinar & Szadziewski, 2007: fig. 4) while in *C. brevivena* has slightly proximal position in female or slightly distal in male (Borkent, 2008: figs. 61K, 67F). The male now described with wing length 1.47 mm is smaller than the female previously described with wing length 1.95 mm. However, this is a normal sexual difference (Borkent, 2008).

In *C. andersoni*, like in almost all species of the genus *Corethrella*, the midlegs with swollen femora are stronger than the slender fore and hind legs (Borkent, 2008). Borkent (l.c.) suggested that they function as jumping legs, and are useful in locating calling frogs.

The male claws of the forelegs of *C. andersoni* are unequal like in all extant species of the subgenus *Corethrella* s. str. (apomorphy 13 in Borkent, 2008) while in *Fossicorethrella* Szadziewski and *Notocorethrella* Belkin they are equal. In the last two subgenera each claw is armed with inner tooth (plesiomorphy); *Corethrella* s. str. lacks an inner tooth (apomorphy 14 in Borkent, 2008); while in *C. andersoni* the anterior claw is simple but the posterior one has a long inner tooth. In the male the anterior claw of the foreleg is lacking a basal prong (apomorphy 15), and tarsomere 3 is about 2.0 times longer than tarsomere 4 (plesiomorphy 16). All extant species of *Corethrella* s. str. have a ratio of less than 1.6 (Borkent, 2008). Among four apomorphies (13–16) proposed by Borkent (2008) for *Corethrella* s. str., only two are present in *C. andersoni* (13, 15) and we conclude that the systematic position of the species is not clear and we left it outside of the current subgeneric classification of corethrellids. We hope that further fossil species with well visible male genitalia and other important characters will shed new light on its systematic position.

The systematic classification of fossil Corethrellidae is as follows:

**Genus *Corethrella*** Coquillett, 1902

Subgenus *Fossicorethrella* Szadziewski, 1995

*cretacea* Szadziewski, 1995: 178 (male, Lower Cretaceous, Lebanese amber).

**Subgenus *Corethrella*** Coquillett, 1902

*baltica* Borkent, 2008: 200 (male, Eocene, Baltic amber from Bay of Gdańsk).

*prisca* Borkent & Szadziewski, 1992: 457 (male, Eocene, Baltic amber from Bitterfeld).

*miocaenica* Szadziewski, Krzeminski & Kutscher, 1994: 87 (male, Eocene Baltic amber).

*rovnoensis* Baranov & Kvitte, 2016 in Baranov *et al.*, 2016: 536 (male, Eocene, Baltic amber from Rovno).

*sontagae* Baranov & Kvitte, 2016 in Baranov *et al.*, 2016: 533 (male, Eocene, Baltic amber from Rovno).

*nudistyla* Borkent & Szadziewski, 1992: 460 (male, Miocene, Dominican amber).

*dominicana* Borkent, 2008: 2002 (female, Miocene Dominican amber).

## Unplaced to Subgenus

*andersoni* Poinar & Szadziewski, 2007: 155 (female, mid Cretaceous, Burmese amber).

## Acknowledgments

We are indebted to Professor Wiesław Krzemiński of Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Cracow, who provided the above described inclusion for study.

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