

# A phantom midge from Lower Cretaceous Lebanese amber (Diptera, Chaoboridae)

Dany AZAR, Alain WALLER & André NEL

**Abstract:** *Libanoborus lukashevichi* nov.gen., nov.sp., the oldest Chaoboridae known from amber, is described from the Lower Cretaceous amber of Lebanon. Although it has probably a phylogenetic position more inclusive than the clade [(Eucorethrinae + Chaoborinae) & *Genadoborus* & *Taimyborus*], it has only few morphological differences with the Cenozoic to Recent genus *Chaoborus*, suggesting a strong morphological stability in this family for the past 130 Myr.

**Key words:** Insecta, nov.gen., nov.sp., taxonomy, phylogeny.

**Santrauka:** Publikacijoje aprašomas seniausias Chaoboridae (Diptera) šeimos vabzdys *Libanoborus lukashevichi* nov.gen., nov.sp., užsikonservavęs Libano gintare. Nors šis vabzdys filogenetiškai tikriausiai priklauso platesnei grupei negu klada [(Eucorethrinae + Chaoborinae) & *Genadoborus* & *Taimyborus*], tačiau jis skiriasi tik keliais morfologiniais skirtumais nuo *Chaoborus* genties, egzistuojančios nuo kainozojaus iki dabar. Tuo pagrindu daroma prielaida, kad šiai šeimai būdingas didelis morfologinis stabilumas, trunkantis jau 130 milijonų metų.

**Raktiniai žodžiai:** Insecta, nov.gen., nov.sp., taksonomija, filogenija.

## Introduction

Phantom midges (Chaoboridae) are a small family of culicomorphan flies known from the Jurassic to the Recent. The family is currently divided into three subfamilies: Eucorethrinae EDWARDS, 1932 (one extant genus), Chaoborinae EDWARDS, 1912 (five extant genera plus Cenozoic species), and the Mesozoic Chironomapterinae KALUGINA, 1974. BORKENT (1993) considered the latter group to be paraphyletic. Besides Chaoboridae sensu stricto is the family Corethrellidae EDWARDS, 1932 that contains a Recent genus plus few Mesozoic taxa (POINAR & SZADZIEWSKI 2007). The exact affinities of many of the genera currently attributed to the Chironomapterinae remain uncertain. Some could well be related to Corethrellidae. They should be re-examined after the recent advances of the systematics of these flies. LUKASHEVICH (2000) and SZADZIEWSKI & GILKA (2007) listed and discussed the fossil taxa currently attributed to Chaoboridae. SÆTHER (1992) proposed a phylogenetic analysis of the family, but if SZADZIEWSKI & GILKA (2007) noticed that some new characters could be useful for such future analysis, it remains to be done.

The present study concerns the description of the oldest known phantom midge in amber from the Lower Cretaceous of Lebanon. It can be useful for future re-analysis of the phylogeny of the whole group.

We follow the wing venation nomenclature of SZADZIEWSKI & GILKA (2007).

## Systematic account

### Family Chaoboridae EDWARDS, 1912

### Genus *Libanoborus* nov.gen.

**Type species:** *Libanoborus lukashevichi* nov.sp.

**Etymology:** Named after a combination of the Latin name for Lebanon and *Chaoborus*.

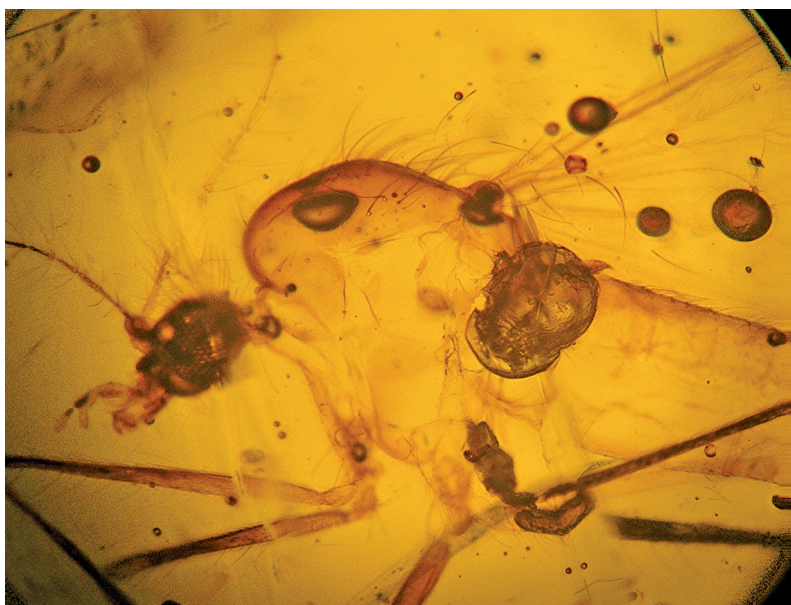
**Diagnosis:** Female characters only (♂ unknown). Convex clypeus with numerous long setae, as long as broad, much shorter than head capsule length; 13 flagellomeres; first flagellomere twice as long as the others; flagellomeres distinctly longer than wide with a distinct row of setae; a differentiate row of postocular setae present; eyes well separated; mid femora not larger than fore and hind femora; absence of tibial spurs; first tarsomere distinctly longer than the second; absence of a subbasal ventral swelling of tarsomeres 5; claws not armed with long basal inner tooth; presence of only one seta on haltere pedicel; microtrichia on wing membrane inconspicuous, not visible; no scales on wing veins; vein R<sub>5a</sub> absent; R<sub>2</sub> very short touching R<sub>1</sub> at its apex; vein R<sub>3</sub> very short; vein M<sub>2</sub> present; veins R<sub>2</sub> and R<sub>3</sub> and veins M<sub>1</sub> and M<sub>2</sub> distinctly shorter than their respective stems; additional CuA<sub>2a</sub> absent.



**Fig. 1:** *Libanoborus lukashevichi* nov.gen., nov.sp., holotype 1448A, photograph of habitus, left side.



**Fig. 2:** *Libanoborus lukashevichi* nov.gen., nov.sp., holotype 1448A, photograph of habitus, right side.



**Fig. 3:** *Libanoborus lukashevichi* nov.gen., nov.sp., holotype 1448A, photograph of head and thorax, left side.

## *Libanoborus lukashevichi* nov.sp. (Figs 1-6)

**Material:** Holotype 1448A (♀), AZAR coll., provisionally deposited in the collection of the Muséum National d'Histoire Naturelle, Paris, France.

**Etymology:** Named after Dr Elena LUKASHEVICH, specialist of these midges.

**Type locality and horizon:** Early Cretaceous, Barremian-lower Aptian, Hammana/Mdeirij, Caza Baada, Mouhafazit Jabal Loubnan, Lebanon.

**Diagnosis:** As for the genus.

**Description:** ♀. Well preserved, but lateral sides of thorax partly destroyed and mid tibia and tarsi missing. Body uniformly clear brown, wing hyaline.

Head 0.3 mm long (Figs 3, 5); eyes widely separated, no ocelli; flagellum composed of 13 flagellomeres; total length of antenna 1.4 mm; first flagellomeres 0.19 mm long, more than twice as long as the others, second 0.08 mm long; basal flagellomeres with elongate setae restricted to basal ring; apical flagellomere not longer than preceding one; pedicel 0.08 mm long, scape 0.02 mm long, both bearing some setae; proboscis, including short and convex clypeus, 0.22 mm long, but longer than distance from its base to vertex, clypeus with numerous setae of equal length; palpus five-segmented; third palpal segment 0.09 mm long, fourth 0.06 mm long, fifth 0.06 mm long.

Thorax 0.76 mm long, 0.80 mm high (Fig. 3); lateral lobes of postpronotum separated medially by scutum and antepnotum; acrostichals and dorsocentrals present; at least four long setae on scutellum present; lanceolate scales on thorax absent.

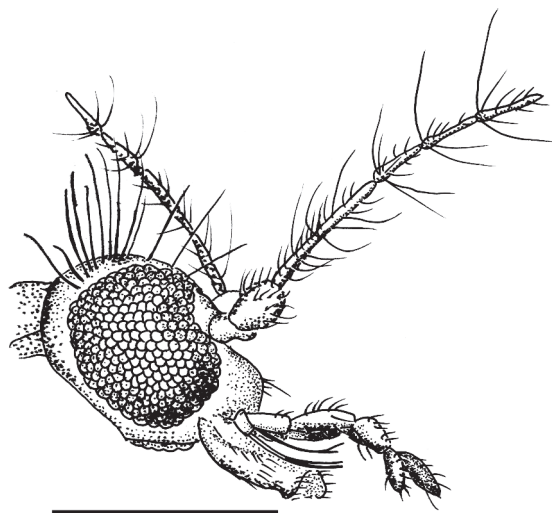
Legs unmodified, without lanceolate scales; tibiae without apical spurs; fore coxa 0.29 mm long, trochanter 0.08 mm long, femur 0.89 mm long, 0.05 mm wide, tibia 0.90 mm long, first tarsomere 0.51 mm long, second 0.25 mm long, third 0.16 mm long, fourth 0.1 mm long, fifth 0.09 mm long; mid coxa 0.20 mm long, trochanter 0.13 mm long, femur 0.90 mm long, 0.065 mm wide, tibia 1.11 mm long, first tarsomere 0.68 mm long, second 0.30 mm long, third 0.19 mm long, fourth 0.14 mm long, fifth 0.08 mm long; hind coxa 0.20 mm long, trochanter 0.08 mm long, femur 0.91 mm long, 0.045 mm wide, tibia 0.88 mm long, first tarsomere 0.83 mm long, second 0.31 mm long, third 0.22 mm long, fourth 0.16 mm long, fifth 0.12 mm long; first tarsomere 3-4 times longer than second tarsomere; one pseudospur present at apex of each tarsomere; absence of a subbasal ventral swelling of tarsomeres 5; claws similar on all legs, simple, equal; presence of two small pulvilli at the base of the claws.



Wing 1.63 mm long, 0.47 mm wide (Figs 4, 6); veins with slender hairs; no scale like setae on wing veins and membrane; microtrichia on wing membrane not visible; humeral vein present; vein Sc short reaching anterior wing margin 0.81 mm from wing base; R1 long, 1.4 mm; vein Rsa absent; R2 very short touching R1 at its apex; vein R3 very short; vein M2 present; veins R2 and R3 and veins M1 and M2 distinctly shorter than their respective stems; additional CuA2a absent; basal stem of Rs oblique; cross-veins cu-m and r-m not aligned; vein An apically strongly curved, 0.8 mm long; a vein without setae along posterior margin of wing base, circa 0.35 mm long; cell br 0.67 mm long; cell bm 0.75 mm long; presence of only one seta on haltere pedicel.

Abdomen without lanceolate scales; cercus short.

**Discussion:** Following the key to families of MCALPINE (1981), *Libanoborus* nov.gen. falls in the Chaoboridae sensu lato (= Chaoboridae plus Corethrellidae sensu BORKENT 1993) for the following characters: vein A2 absent; R with four branches; C continuing around wing; first tarsomere longer than second; ocelli absent; antenna very long; Sc complete; M with two branches; cells br and bm more than half as long as wing; scales absent on wings; proboscis short; wing veins with long dense conspicuous hairs, stem of R2+3 straight, antenna with long hairs in distinct whorls. Following COOK (1981), *Libanoborus* would fall in the Chaoborinae rather than in the Eucoethrinae or the “Corethrellinae” for the characters: clypeus short, less than two-thirds height of rest of head capsule; lateral lobes of postpronotum separated medially by scutum and anteppronotum; R1 terminating in C near wing apex, nearer to R2 than Sc, clypeus with numerous long setae.



**Fig. 5:** *Libanoborus lukashevichi* nov.gen., nov.sp., holotype 1448A, drawing of head (scale bar represents 0.3 mm).

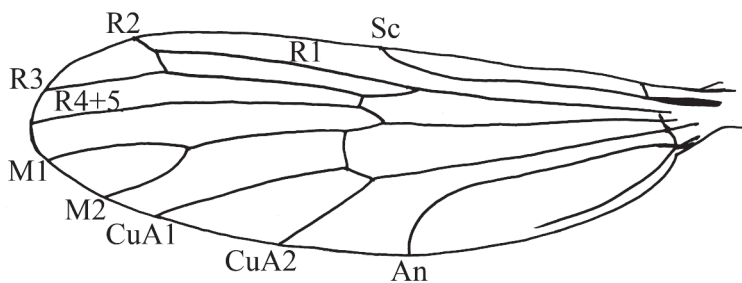


**Fig. 4:** *Libanoborus lukashevichi* nov.gen., nov.sp., holotype 1448A, photograph of wings, right view.

COLLESS (1986) proposed a key to Recent “chaoborid” genera. Following COLLESS’ key, *Libanoborus* would fall near *Chaoborus* LICHTENSTEIN, 1800 for the following characters: R1 terminating in C near wing apex, nearer to R2 than Sc; first tarsomere longer than second; clypeus as long as broad; tarsal claw small and simple; tibiae without spurs.

WOOD & BORKENT (1986) first proposed that the genus *Corethrella* be removed from the Chaoboridae and recognized it as a separate family, the Corethrellidae.

SÆTHER (1992) considered that the “first tarsomere longer than second” is a plesiomorphy in Chaoboridae. Furthermore, this character is variable even in the genus *Chaoborus* (SÆTHER 1997). SÆTHER (1992) considered the “clypeus much shorter than head capsule length” and “presence of only one seta on the haltere pedicel” as apomorphies of the Chaoborinae. *Libanoborus* has also the “scales of wing not visible by light microscope” and a “differentiate row of postocular setae present” as apomorphies of *Chaoborus*.



**Fig. 6:** *Libanoborus lukashevichi* nov.gen., nov.sp., holotype 1448A, drawing of wing (scale bar represents 0.5 mm).

BORKENT (2008: 206) separated the clade (Chaoboridae + Culicidae) from the Corethrellidae on the basis of two larval and pupal apomorphies, and indicated that “no adult synapomorphies are known for this family”. OOSTERBROEK & COURTNEY (1995) supported the same clade on the same larval and pupal characters plus the synapomorphy of the adult “pulvilli present”, character shared by *Libanoborus*. *Libanoborus* does not have the synapomorphies of the Culicidae in the modified mouthparts (see BORKENT & GRIMALDI 2004).

Concerning the other characters that have been used to separate Chaoboridae and Corethrellidae, BORKENT (2008: 208) indicated that the “female wing with vein R1 elongate” is a plesiomorphy present in Chaoboridae. POINAR & SZADZIEWSKI (2007) considered that the position of the termination point of R1 closer to R2 than Sc in chaoborids and closer to Sc than R2 in corethrellids is not very accurate. They prefer to consider the enlarged mid femora and tibiae longer and thicker than those of the fore and hind legs together with the closely approximate eyes as characters typical of Corethrellidae. BORKENT (2008: 208) added that the “midfemur thicker than those of fore- and hind legs” is an apomorphy of the Corethrellidae. In *Libanoborus* the mid femora are as wide as the fore and hind femora and the eyes are well separated, which are not characters of Corethrellidae. BORKENT (2008) considered “the clypeus with numerous setae of equal length”, and “the basal flagellomeres with elongate setae restricted to basal ring”, characters present in *Libanoborus*, as plesiomorphies present in Chaoboridae and absent in Corethrellidae.

SZADZIEWSKI & GILKA (2007) considered that the presence of an additional CuA2a could be a synapomorphy of the Chaoborinae, but secondarily reduced in some Recent species. They also considered that the presence of a vein Rsa is an apomorphy of the clade [(Eucoethrinae + Chaoborinae) & *Genadoborus* & *Taimyborus*], but reversed in some Recent taxa, such as some *Chaoborus* or *Cryophila* (SÆTHER 1997). Lastly they considered the clypeus elongate and flat as a synapomorphy of the clade Eucoethrinae + Chaoborinae. BORKENT (2008: 227) also considered that an elongate clypeus is an apomorphy present in Chaoboridae. The absences of these structures in *Libanoborus* are important differences with the Recent Chaoborinae and *Chaoborus*, suggesting that *Libanoborus* could be in a more inclusive position than the clade [(Eucoethrinae + Chaoborinae) & *Genadoborus* & *Taimyborus*], and thus in a more inclusive position than that suggested above after the characters proposed in the works of SÆTHER (1992) and previous authors on the taxonomy of the extant phantom midges.

A new phylogenetic analysis of the Chaoboridae that would include the new characters proposed by SZADZIEWSKI & GILKA (2007) should be performed before any conclusion on the phylogenetic position of *Libanoborus* can be made.

Among the Mesozoic corethrellids, *Libanoborus* can be separated from *Corethrella* (*Fossicorethrella*) *cretacea* SZADZIEWSKI, 1995 from the Lebanese amber on the basis of the absence of a sub-basal ventral swelling of tarsomeres 5, claws not armed with long basal inner tooth, and microtrichia on wing membrane inconspicuous, not visible (SZADZIEWSKI 1995; BORKENT 2008). A further difference could be the presence of 14 flagellomeres in *Libanoborus* (♀), instead of 13 in *C. cretacea* (♂). Unfortunately the wing venation of *C. cretacea* is incompletely preserved. The second Cretaceous *Corethrella andersoni* POINAR & SZADZIEWSKI, 2007 from the late Albian Burmese amber shares with *Libanoborus* the presence of short veins R2 and R3, character not present in other *Corethrella* species, except *C. brevivena* BORKENT, 2008. *Libanoborus* differs from *C. andersoni* in the shape of the mid femora and the absence of scales on the wing veins and legs.

Among the extinct genera currently included into the Chaoboridae, *Libanoborus* also shares with the late Albian Burmese amber genus *Chaobormus* LUKASHEVICH, 2000, “a candidate to represent an early lineage of Corethrellidae (or Culicidae)” after BORKENT (2008), the presence of short veins R2 and R3, and veins M1 and M2, distinctly shorter than their respective stems. *Libanoborus* differs from it in the absence of tibial spurs and eyes well separated (LUKASHEVICH 2000). *Libanoborus* differs from *Taimyborus* LUKASHEVICH, 1999 from the Late Cretaceous Taymir amber in the first tarsomere distinctly longer than the second (LUKASHEVICH 1999). *Libanoborus* differs from *Chachotosha* LUKASHEVICH, 1996 from the Early Cretaceous of Mongolia in the absence of tibial spurs and very short R2 and R3 (LUKASHEVICH 1996a). Among a series of taxa described on the basis of lacustrine fossils, whose attributions to the Chaoboridae are less accurate, the Early Cretaceous *Astrochorethra* KALUGINA, 1986, and the Jurassic *Praechaoborus* KALUGINA, 1985 and *Hypsochorethra* KALUGINA, 1985 differ from *Libanoborus* in the shape of the antennal flagellomeres, very short and compact except for the two apical ones (KALUGINA 1985: figs 32-34, 1986: figs 90-91). *Helokrenia nana* KALUGINA, 1985 and “*Chaoborites*” *argillaceus* KALUGINA, 1985 are based on wing characters only. Both differ from *Libanoborus* in the shape of vein R2 directed towards wing apex instead of apex of R1 (KALUGINA 1985: figs 38-39). The Late Jurassic-Early Cretaceous *Mesocorethra* KALUGINA, 1993 and *Baleiomyia* KALUGINA, 1993 [probably not a Chao-

boridae after SZADZIEWSKI & GILKA (2007), see also BORKENT (2008: 208)], *Dixamima* ROHDENDORF, 1962, *Rhaetomyia* ROHDENDORF, 1962, *Chironomaptera* PING, 1928 (maybe a Chorethrellidae after BORKENT, 2008: 208), and *Mesochaoborus* ZHANG et al., 1986 all differ from *Libanoborus* in the same character plus the very long R2 and R3 (ZHANG et al. 1986; ZHANG 1989, 1990; KALUGINA 1980, 1993; LUKASHEVICH 1996b).

*Libanoborus* differs from the Eocene Baltic amber *Gedanoborus* SZADZIEWSKI & GILKA, 2007 in the presence of vein M2 and absence of vein Rsa (SZADZIEWSKI & GILKA 2007).

In conclusion, the new fossil represents a new extinct genus that could be in a more inclusive position than the clade [(Eucoethrinae + Chaoborinae) & *Genadoborus* & *Taimyborus*], but its exact affinities remain uncertain because of the lack of phylogenetic analysis that would integrate all the other Mesozoic chaoborid taxa.

## Zusammenfassung

Als das älteste Bernstein-Fossil der Familie Chaoboridae (Büschelmücken) wird aus der Unterkreide Libanons als *Libanoborus lukashevichi* nov.gen., nov.sp. beschrieben. Die Ähnlichkeit zu der känozoischen bis rezenten Gattung *Chaoborus* unterstreicht die vorherrschende morphologische Stabilität dieser Gruppe während der letzten 130 Millionen Jahre. Obwohl die exakte systematische Stellung momentan noch unklar bleiben muss, dürfte dieses Fossil für zukünftige phylogenetische Arbeiten von Bedeutung sein.

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