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Xenopsychoda harbi, a new psychodoid fly from the Lower Cretaceous amber of Lebanon (Diptera; Psychodoidea)

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Abstract

Xenopsychoda harbi gen. et sp. nov. is described from the Lower Cretaceous amber of Tannourine (North of Lebanon) and is attributed to an *incertae sedis* family or subfamily. The discovery of this psychodoid fly shows a grate diversity of this group in the Early Cretaceous. ***Pour citer cet article : D. Azar, K. Ziadé, C. R. Palevol 4 (2005)***.

Résumé

Xenopsychoda harbi, une nouvelle mouche psychodoïde dans l'ambre du Crétacé inférieur du Liban (Diptera; Psychodoidea). *Xenopsychoda harbi* gen. et sp. nov. est décrit de l'ambre du Crétacé inférieur de Tannourine (Liban nord) et est attribué à une famille ou sous-famille *incertae sedis*. La découverte de ce psychodoïde montre la grande diversité de ce groupe au début du Crétacé. ***To cite this article: D. Azar, K. Ziadé, C. R. Palevol 4 (2005)***.

Keywords: Insecta; Diptera; Psychodoidea; New species; Lower Cretaceous; Lebanon; Amber

Mots clés : Insecta ; Diptera ; Psychodoidea ; Nouvelle espèce ; Crétacé inférieur ; Liban ; Ambre

Version française abrégée

Les psychodoïdes sont bien diversifiées dans l'ambre libanais et, à ce jour, 13 taxa ont déjà été étudiés de ce matériel. Hennig [5] a décrit deux phlébotomes (*Phlebotomites brevifilis* et *Phlebotomites longifilis*) de l'ambre libanais (localité de Jezzine, Liban sud). Azar et al. 1999 [2] ont décrit deux phlébotomes additifs (*Mesophlebotomites hennigi* et *Libanophlebotomus lutfallahi*) et six psychodes (*Paleopsychoda solignaci*, *Paleopsychoda jacquelinea*, *Protopsychoda nadiae*, *Protopsychoda hammanaensis*, *Libanopsychoda abillamai* et *Cretapsychoda inexpectata*) de l'ambre libanais (localité de Mdeyrij/Hammana, Liban central); et Azar et Nel (2002) [3], ont décrit deux psychodes de plus (*Paleopsychoda inexpectata* et *Paralibanopsychoda agnieszkae*) de la même localité antérieure. Finalement, en 2003, Azar et al. [4] ont publié un article

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concernant un nouveau taxon (*Eophlebotomus gezei*), appartenant à une famille *incertae sedis* de psychodoïdes. D'autres recherches récentes de terrain au Liban ont mené à la découverte d'autres nouveaux psychodoïdes, qui seront le sujet de prochaines publications. Dans le présent papier, nous décrivons *Xenopsychoda harbi* gen. et sp. nov., de l'ambre du Crétacé inférieur de Tannourine (Liban nord).

Or, d'après les clés des familles modernes de Psychodidae et de Phlebotomidae proposées par Quate et Vockeroth (1986) [7] et Williams (1993) [8], *Xenopsychoda harbi* gen. et sp. nov. peut être attribuée aux Psychodidae à cause des caractères suivants : (1) présence d'un pont oculaire ; (2) palpes avec quatre palpomères ; (3) nervure anale A1 présente et bien développée. Par ailleurs, *Xenopsychoda harbi* gen. et sp. nov. partage avec les Phlebotomidae des pièces buccales bien développées et hématophages. Nous pensons qu'utiliser ces clés fondées uniquement sur les taxa modernes n'est pas suffisant pour une attribuer correctement notre fossile.

Enfin, *Xenopsychoda harbi* gen. et sp. nov. partage avec *Libanopsychoda abillamai* Azar et al. 1999 [3] et *Cretapsychoda inexpectata* Azar et al. 1999 [3] le nombre d'antennomères et l'organisation de la nervation alaire, y compris le trait très particulier et unique de convergence de CuA2 et A1, sans cependant se rencontrer ; ce caractère n'existe pas du tout dans les psychodoïdes en dehors de ces trois taxa ; néanmoins, ce caractère existe aussi chez quelques Tanyderidae. *Xenopsychoda harbi* partage aussi avec ces deux derniers taxa la présence d'une nervure transverse entre M2 et M3, ce caractère existant seulement (en plus de ces trois taxa) chez *Paralibanopsychoda agnieszkae* Azar et Nel 2002, chez *Tanypsycha connexa* Ansorge 1994 [1], au sein des psychodoïdes, et chez les Tanyderidae. *Libanopsychoda abillamai* Azar et al. 1999 et *Cretapsychoda inexpectata* Azar et al. 1999 [3] ont une nervure transverse entre R1 et R2+R3 et, étrangement, *Xenopsychoda harbi* possède une accumulation de pyrite qui ressemble à une nervure transverse au même endroit, comme chez *L. abillamai* et *C. inexpectata* ; ce trait pourrait être vu sur seulement une aile, parce que l'autre aile est tordue et donc difficile à observer. Est-ce que cette nervure existe vraiment, ou bien est-ce juste un artefact ? Seules d'amples recherches de terrains et la découverte d'autres spécimens qui appartiennent à notre espèce pourraient résoudre ce problème.

Azar et al. 1999 [3], ont placé *Libanopsychoda abillamai* et *Cretapsychoda inexpectata* dans les Psychodinae d'après l'usage clés fondées uniquement sur les taxa modernes. Nous pensons que ces taxa doivent être, comme *Xenopsychoda harbi*, attribués à une nouvelle famille ou sous-famille au sein des psychodoïdes. Donc, comme nous manquons d'espèces plus nombreuses qui pourraient être assignées à ce groupe, nous proposons d'attribuer pour le moment ces trois taxa à une famille ou sous-famille incertae sedis. Cette dernière plutôt apparentée aux Psychodinae *sensu stricto* et partageant quelques caractères avec les Tanyderidae. En tout cas, cette proposition reste une supposition aussi longtemps qu'une bonne phylogénie cladistique comprenant les taxa modernes et fossiles n'aura pas été réalisée. Cette situation indique aussi que les clefs doivent dorénavant prendre en considération les taxa fossiles.

Conclusions

Cette découverte augmente notre connaissance de la biodiversité de la superfamille de Psychodoidea pendant le Crétacé inférieur. La présence d'approximativement 20 espèces de Psychodoidea dans l'ambre libanais, suggère que le Crétacé inférieur ait été une période cruciale pour la diversification de ce groupe, et que l'histoire évolutive de ce dernier soit, de loin, beaucoup plus complexe qu'on pourrait l'imaginer en étudiant uniquement les espèces modernes.

1. Introduction

Psychodoid flies are well diversified in the Lebanese amber and 13 taxa have been already studied from this material. Hennig [5] described two phlebotomid flies (*Phlebotomites brevifilis* and *Phlebotomites longifilis*) from the Lebanese amber (locality of Jezzine, southern Lebanon). Azar et al. [3] described two additive phlebotomid flies (*Mesophlebotomites hennigi* and *Libanophlebotomus lutfallahi*) and six psychodid flies (*Paleopsychoda solignaci*, *Paleopsychoda jacquelinea*, *Protopsychoda nadiae*, *Protopsychoda hammanaensis*, *Libanopsychoda abillamai* and *Cretapsychoda inexpectata*) from the Lebanese amber (locality of Mdeyrij/Hammana, central Lebanon); and Azar and Nel (2002) [2] described two more psychodids (*Paleopsychoda inexpectata* and *Paralibanopsychoda agnieszkae*) from the same previous locality. Finally, in 2003, Azar et al. [4] published a paper dealing with a new fly (*Eophlebotomus gezei*) belonging to an incer-

tae sedis psychodoid family. Other recent field researches in Lebanon led to the finding of other new psychodoids that will be the subject of forthcoming publications.

We follow below the wing venational nomenclature of McAlpine [6] and the nomenclature of genital appendages proposed by the Computer-aided Identification of Phlebotomine sandflies of America (CIPA group project, University of Paris-6, Jussieu), available on the web site http://cipa.snv.jussieu.fr/

2. Systematic palaeontology

Superfamily Psychodoidea
Family incertae sedis
Genus *Xenopsychoda* gen. nov.

Derivatio nominis. From xenos (*ξένος*) = strange in Greek + *Psychoda*

Diagnosis. Antenna with 15 flagellomeres, the last one being reduced and drop-like. First flagellomere as long as the 13 flagellomeres that follow the first one. Eye-bridge well developed. Palps longer than the head, 4-segmented. Mouth parts as long as head. Wings with all veins reaching wing margin. Presence of a cross-vein between M2 and M3. CuA2 converging toward the anal vein (A1) without however reaching it. Anal vein and area well developed. Legs much longer than the body.

Xenopsychoda harbi sp. nov.

Derivatio nominis. This species is named in honor of Dr Faouzi Harb who discovered the amber outcrop of Tannourine where *X. harbi* has been found.

Material. Holotype specimen No. T 1, female, Azar collection, provisionnaly deposited in the 'Muséum national d'histoire naturelle' of Paris, France.

Type locality and horizon. The studied material comes from a locality between the Tannourine El-Faouqa and Laqlouq villages (Fig. 1), just on the boundary between Caza Jbeil and Caza (department) El-Batroun, between Mouhafazit Jabal Loubnan (Mount Lebanon) and (destrict) Mouhafazit Loubnan Esh-Shemali (North of Lebanon). The material is found in Lower Aptian geological layers, but its age must be older, as the amber has been reworked and redeposited. Other inclusions are shared with the other amber outcrops of Lebanon with biological inclusions and thus indicate a similar age.

Diagnosis. As for the genus.

Description(Figs. 2–9). Antenna 1.03 mm long, with 15 flagellomeres, the last one being reduced and drop-like. Scape cylindrical shape, 0.05 mm long and 0.04 mm wide. Pedicel globular, 0.06 mm long and wide. First flagellomere 0.06 mm long, nearly as long as the 13 flagellomeres that follow the first one. All flagellomeres bearing long curved setae. (Fig. 3,4). Eye-bridge well developed. Eyes separated by a space of 0.04 mm. Area between eyes covered by few long setae. Palps longer than the head, 0.776 mm long, 4-segmented, all palpomeres setose (Figs. 4–6). First palpomere 0.177 mm long, 0.027 mm wide. Second palpomere 0.161 mm long, 0.038 mm wide. Third palpomere 0.172 mm long, 0.038 mm wide. Last palpomere much longer than the remaining palpomeres, 0.266 mm long, 0.022 mm wide, presenting a very strange structure characterized by 10 constrictions or secondary annulations that give impression of presence of 11 segments. The first constriction is 0.04 mm far from the base of the last palpomere, then the second one at 0.08 mm from the base of the palpomere, the third at 0.12 mm, finally the remaining constrictions are very close one to other separated each by a mean of nearly 0.01 mm. Mouth parts nearly as long as head. Wing 2.05 mm long, 0.84 mm wide, hyaline (Figs. 7,8). Humeral vein (h) reaching the wing margin at 0.28 mm from the wing base. Subcostal

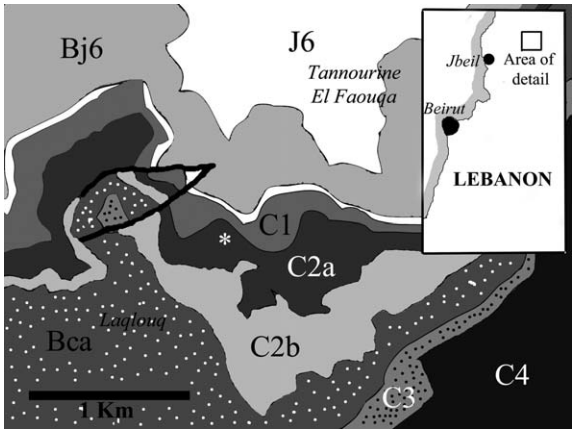

Fig. 1. Geological map of the Tannourine amber outcrop. The asterisk shows the placement of the outcrop; J6 = Kimmeridgian (Late Jurassic); Bj6 = basaltic Late Jurassic (Kimmeridgian); C1 = Neocomian; C2a = Lower Aptian; C2b = Late Aptian; C3 = Albian; C4 = Cenomanian; Bca = basaltic Cretaceous; the scale bar represents 1 km.

Fig. 1 Carte géologique de l'affleurement à ambre de Tannourine. L'astérisque indique l'emplacement de l'affleurement; J6 = Kimméridgien (Jurassique terminal) ; Bj6 = Jurassique basaltique terminal (Kimméridgien); C1 = Néocomien; C2a = Aptien inférieur ; C2b = Aptien terminal; C3 = Albien; C4 = Cénomanien; Bca = Crétacé basaltique; la barre d'échelle représente 1 km.

Fig. 2. *Xenopsychoda harbi* gen. et sp. nov., holotype, female, specimen No. T 1, Azar collection.
Fig. 2. *Xenopsychoda harbi* gen. et sp. nov., holotype, femelle, spécimen n° T 1, collection Azar.

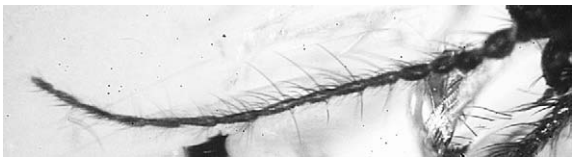

Fig. 3. Antenna of *Xenopsychoda harbi* gen. et sp. nov.
Fig. 3. Antenne de *Xenopsychoda harbi* gen. et sp. nov.

vein Sc distally fused with R1 in a strong angle, 1 mm from wing base, and has a crossvein reaching the costal margin. R1 reaching the costal margin 1.61 mm from wing base. Rs separated from R1 0.53 mm from the wing base, 0.22 mm basal of fork of M into M1+2 and M3. Rs four-branched, with all its branches extending to wing margin. Branching of R2+3 0.39 mm distal of base of Rs, and 0.17 mm distal of fork of M. R2 and R3 separated 1.53 mm distally. R2 and R3 reaching costal margin. R4 and R5 separating 0.22 mm distal of base of R2+3. R4 nearly straight, reaching wing apex. R5 with a strong angle in its basal part and distally nearly straight. Crossvein r–m 0.59 mm distal of base of Rs. Fork of M into M1+2 and M3 0.76 mm distal of the wing base. Fork of M1+2 into M1 and M2 0.55 mm distal of base

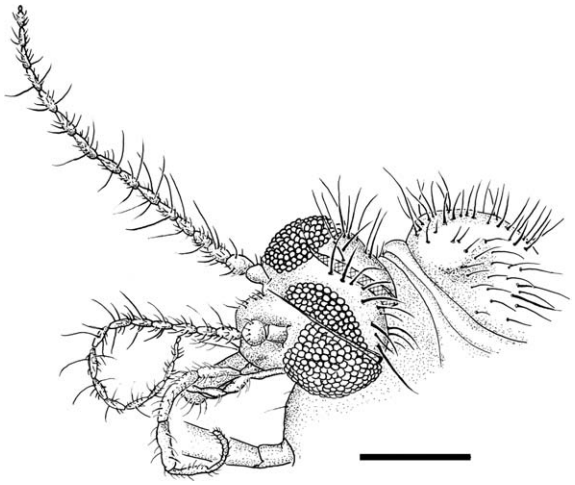

Fig. 4. Drawing of the head of *Xenopsychoda harbi* gen. et sp. nov. (scale bar is 0.3 mm).
Fig. 4. Dessin de la tête de *Xenopsychoda harbi* gen. et sp. nov. (barre d'échelle : 0,3 mm).

Fig. 5. Head and palpes of *Xenopsychoda harbi* gen. et sp. nov.
Fig. 5. Tête et 'palpi' de *Xenopsychoda harbi* gen. et sp. nov.

of M1+2. M1 distally nearly straight. M2 slightly shorter than M1. Basal part of M3 rather long. Presence of a short crossvein between basal part of M3 and basal part of CuA1. Presence of a crossvein between M2 and M3. CuA1 separating from CuA 0.73 mm distal of the wing base. CuA2 rather long, 0.28 mm long, converging toward A1 without however reaching it. A1 well developed, 0.82 mm long, and reaching posterior wing margin. Anal area well developed and forming a small lobe.

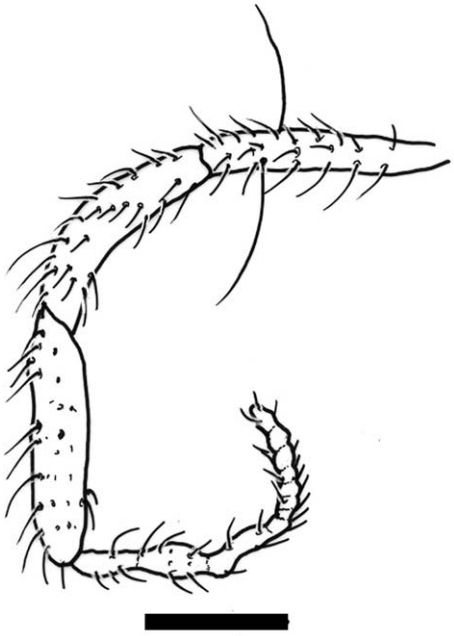

Fig. 6. Drawing of the palpes of *Xenopsychoda harbi* gen. et sp. nov. (scale bar is 0.1 mm).
Fig. 6. Dessin des 'palpi' de *Xenopsychoda harbi* gen. et sp. nov. (barre d'échelle : 0,1 mm).

Fig. 7. Wing of *Xenopsychoda harbi* gen. et sp. nov.
Fig. 7. Aile de *Xenopsychoda harbi* gen. et sp. nov.

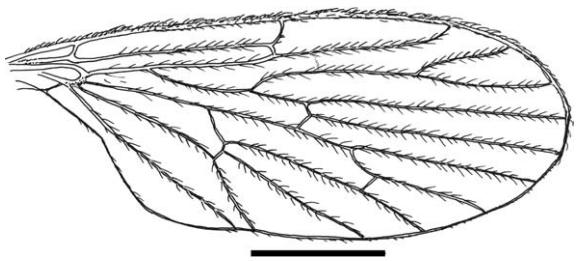

Fig. 8. Drawing of the wing of *Xenopsychoda harbi* gen. et sp. nov. (scale bar is 0.5 mm).
Fig. 8. Dessin de l'aile de *Xenopsychoda harbi* gen. et sp. nov. (barre d'échelle : 0,5 mm).

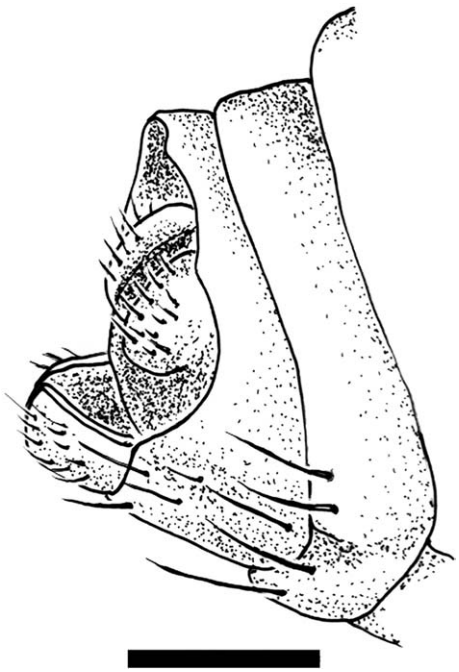

Fig. 9. Drawing of the female genitalia of *Xenopsychoda harbi* gen. et sp. nov. (scale bar is 0.1 mm).
Fig. 9. Dessin des organes génitaux femelles de *Xenopsychoda harbi* gen. et sp. nov. (barre d'échelle : 0,1 mm).

Halteres 0.42 mm long. Knob 0.12 mm long and 0.07 mm wide. Stem 0.3 mm long. Thorax 0.68 mm long, 0.42 mm high. Legs very long, distinctly longer than the whole body. Foreleg 4 mm long, midleg 4.2 mm long and hindleg 4.5 mm long. Abdomen 0.92 mm long excluding genital appendages, and 0.56 mm wide. Female genital appendages (Fig. 9): the two subgenital plates (Sub) elongated, 0.06 mm long, 0.03 mm wide, rectangular-shaped with a central concavity, bearing relatively dense setae. Cerci (Cer) ellipsoid with spoon-like central concavity, small diameter parallel to the longitudinal axe of the insect 0.03 mm long, large diameter perpendicular to the longitudinal axe of the insect, 0.06 mm long.

3. Discussion

After the keys to the families Psychodidae and Phlebotomidae proposed by Quate and Vockeroth [7] and Williams [8], *Xenopsychoda harbi* gen. et sp. nov. falls into the Psychodidae because of the following characters: (1) presence of an eyebridge; (2) palps with four palpomers; (3) anal vein A1 present and well devel-

oped. *Xenopsychoda harbi* gen. et sp. nov. shares with the phlebotomidae the well-developed blood-sucking mouthparts. We think that using these keys is not sufficient to give an attribution to our fossil.

Xenopsychoda harbi gen. et sp. nov. shares with *Libanopsychoda abillamai* Azar et al. 1999 [3] and *Cretapsychoda inexpectata* Azar et al. 1999 [3] the number of antennomeres, the wing venation organization, including the very peculiar and unique feature of convergence of CuA2 and A1, without however meeting each other; this character does not exist in any psychodoid fly, except those three taxa; nevertheless it exists also in some tanyderid flies. *Xenopsychoda harbi* shares also with those two latter taxa the presence of a crossvein between M2 and M3; this character is only known within psychodoids (in addition to those three taxa) in *Paralibanopsychoda agnieszkae* Azar and Nel 2002 and in *Tanypsycha connexa* Ansorge 1994 [1], and in tanyderid flies. *Libanopsychoda abillamai* Azar et al. 1999 [3] and *Cretapsychoda inexpectata* Azar et al. 1999 have a crossvein between R1 and R2+R3, and bizarrely *Xenopsychoda harbi* gen. et sp. nov. has a pyrite accumulation that looks like a crossvein in the same locality as in the two elderly cited taxa; this feature could be seen on only one wing, because the other one is twisted and thus difficult to observe. The question remains to discriminate whether *Xenopsychoda harbi* has really this feature or whether this is just an artifact. Only more findings of other specimens belonging to this same species could resolve this problem.

Azar et al. [3] have placed *Libanopsychoda abillamai* and *Cretapsychoda inexpectata* in Psychodinae after using the keys that are usually used for recent psychodoids. We think that those taxa as well as *Xenopsychoda harbi* must be placed in a new subfamily or even in a new family within psychodoids. Thus, as we lack more species that could be attributed to this group, we propose to attribute for the moment these three taxa to an incertae sedis subfamily or family. This later would be close to Psychodinae *sensu stricto* and share some features with Tanyderidae. Anyway, this proposition remains an assumption as long as a good cladistic phylogeny, including the recent and fossil taxa, is not done. This situation indicates also that keys must consider fossil taxa as well.

4. Conclusions

This discovery greatly increases our knowledge on the biodiversity of the psychodoid superfamily during the Lower Cretaceous. The presence of about 20 species of Psychodoidea in the Lebanese amber, representing a sample of the palaeofauna of a very small area, suggests that the Lower Cretaceous was a crucial period for the psychodoid diversification, and that the evolutive history of this group is much more complex than one could imagine by studying the only recent species.

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