

A new serphitid wasp (Hymenoptera: Serphitidae) from the Early Cretaceous Lebanese amber

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Abstract

Serphitoids are a group of proctotrupomorph wasps that, together with mymarommatoidea, are characterized by a bipetiolate metasoma and grouped in the clade Bipetiolarida. The internal relationships of Serphitoidea and Mymarommatoidea are still unresolved, and their biology is poorly known. The fossil record of serphitoids is restricted to Cretaceous, ranging from Barremian to Campanian and is limited to specimens in amber so far. The family Serphitidae encompasses more than 30 species within the subfamilies Microserphitinae, Serphitinae, and Supraserphitinae. The subfamily Microserphitinae is well supported, but the distinctions between serphitines and supraserphitines are somewhat ambiguous. We describe *Axioserphites obscurus* n. gen. n. sp. from the Barremian (Early Cretaceous) Lebanese amber, belonging to the subfamily Supraserphitinae. We comment on the characters defining this subfamily and discuss its systematic validity.

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Keywords: Bipetiolarida; Serphitoidea; Supraserphitinae; Lebanon; Barremian; diversity

1. Introduction

Proctotrupomorph wasps with a two-segmented petiole are considered members of the clade Bipetiolarida, consisting of the superfamilies Mymarommatoidea and Serphitoidea (Engel, 2015). Mymarommatoidea wasps, commonly known as false fairy wasps, are an enigmatic family characterized by the peculiar head capsule and wings whose oldest record is from the Barremian (Lower Cretaceous), and today they are represented by several species

(Gibson et al., 2007; Villemant et al., 2023; Álvarez-Parra et al., 2024). Mymarommatoidea are grouped with the Cretaceous families Gallorommatoidea, Alavarommatoidea, and Dipterommatoidea in Mymarommatoidea (Gibson et al., 2007; Ortega-Blanco et al., 2011b; Rasnitsyn et al., 2019). The biology of the representatives of the entire superfamily is still obscure and there is evidence of only one extant mymarommatoidea species that is an egg parasitoid of lepidopsocid barklice (Honsberger et al., 2022). Serphitoidea are composed of the families Archaeoserphitidae and Serphitidae, both restricted to Cretaceous (Engel, 2015). Only two species from Lebanese amber and Burmese amber are included in the family Archaeoserphitidae (Engel, 2015; Rasnitsyn and Öhm-Kühnle, 2020a). In contrast, 31 species

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in eight genera within three subfamilies are grouped in Serphitidae, spanning from Barremian to Campanian (Kozlov and Rasnitsyn, 1979; Engel et al., 2011; McKellar and Engel, 2011; Ortega-Blanco et al., 2011a; Engel and Perrichot, 2014; Rasnitsyn and Öhm-Kühnle, 2019b, 2020b; Herbert and McKellar, 2022; Rasnitsyn et al., 2022). Both Archaeoserphitidae and Serphitidae could have originated at the beginning of the Cretaceous (Valanginian–Hauterivian) and become extinct before the Cretaceous–Paleogene mass extinction (Jouault et al., 2025).

Molecular phylogenetic analyses indicated a sister relationship between Mymarommatoidea and Chalcidoidea (Gibson et al., 2007; Blaimer et al., 2023; Cruaud et al., 2024). However, considering fossil representatives, Mymarommatoidea and Serphitoidea are recognized as closely related groups mainly based on the bipetiolate metasoma (Kozlov and Rasnitsyn, 1979; Engel, 2015; Rasnitsyn and Öhm-Kühnle, 2020c). Interestingly, Gibson et al. (2007) suggested a sister relationship between Serphitoidea and Platygastroidea. No phylogenetic analyses have been carried out yet involving both Mymarommatoidea and Serphitoidea, together with other proctotrupomorph groups, and therefore, this matter is still unresolved.

The subfamily Serphitinae is the most diverse within Serphitidae with 22 described species in five genera from Albian to Campanian. In comparison, only three species in one genus compose the Microserphitinae. The subfamily Supraserphitinae was erected to include a species characterized by the high number of flagellomeres in comparison to the serphitines (ten versus six to eight), the elongate maxillary and labial palpi both with similar lengths, and the long and narrow petiolar segments (Rasnitsyn and Öhm-Kühnle, 2019b). Subsequently, five other species with variety of characters have been considered members of this subfamily. The current composition of the subfamily is formed by four species in the genus *Supraserphites* from Burmese amber and two species in the genus *Leptoserphites* from Lebanese amber (Rasnitsyn and Öhm-Kühnle, 2019a, 2019b, 2020b; Rasnitsyn et al., 2022).

Here, we describe a new genus and species of serphitid wasp from the Early Cretaceous Lebanese amber that fits into the subfamily Supraserphitinae. We compare it with the other representatives of Serphitidae and discuss the validity of Supraserphitinae.

2. Material and methods

Lebanese amber is found in more than 500 outcrops across the country, mainly related to Kimmeridgian (Late Jurassic) and Barremian (Early Cretaceous) ages (Maksoud and Azar, 2020; Vršanský et al., 2025). The studied specimen was found in an amber piece from the Hammana-Mdeyrij outcrop, Caza (= District) Baabda, central Lebanon, assigned to the Sandstone of Lebanon Unit, also known as the “Grès du Liban” Alloformation

(Maksoud et al., 2017; Maksoud and Azar, 2020). The Hammana-Mdeyrij amber-bearing outcrop belongs to the upper interval at the upper part of this alloformation, dated as late Barremian based on charophytes, foraminifers, and echinoids, while the original resin pieces are reworked, being early Barremian in age (Maksoud et al., 2017). Amber is found in dark shales rich in lignite and plant remains, and it is considered parautochthonous (Maksoud and Azar, 2020). The paleoecosystem has been interpreted as a dense resiniferous forest in a fluvial system with marine influence under a humid, warm, tropical climate (Maksoud et al., 2017; Maksoud and Azar, 2020). The Early Cretaceous Lebanese amber is renowned as the oldest amber intensively rich in bioinclusions (Maksoud et al., 2022). The described wasps in the Lebanese amber are represented by 33 species of 23 genera and 16 families (Álvarez-Parra and Azar, 2024; Álvarez-Parra et al., 2024).

The amber piece with the studied specimen was manually cut using a denticulate razor blade and separated from another syninclusion, allowing better visualization. Later, it was polished with increasing grade emery papers and with diatomite for ultimate finishing. The studied specimen was embedded in Canada balsam between two cover-slips. It was photographed using an Olympus BX53 compound microscope equipped with a digital camera Olympus DP74. The photographs were stacked and processed with Helicon Focus 8, and the figures were made with Adobe Photoshop CS6. The nomenclature used in this work follows Engel (2015) and Rasnitsyn and Öhm-Kühnle (2019b). The holotype is deposited in the Natural History Museum of the Lebanese University, Faculty of Sciences II, Fanar, Lebanon. The studied specimen was figured by Álvarez-Parra and Azar (2024).

This published work and its included nomenclatural acts are registered in ZooBank with the following LSID: urn:lsid:zoobank.org:pub:759E57EA-8D51-44B1-8C0C-D26E256B1FBB.

3. Systematic paleontology

Superfamily Serphitoidea Brues, 1937

Family Serphitidae Brues, 1937

Subfamily Supraserphitinae Rasnitsyn and Öhm-Kühnle, 2019b

Genus *Axioserphites* n. gen.

LSID: urn:lsid:zoobank.org:act:4ABC53EF-94E8-452D-86CB-D9965DE5BE36.

Etymology: The generic name is a combination of the Greek word $\alpha\chi\iota\omicron$ - (axio-), meaning valuable, noteworthy, or remarkable, and the genus name *Serphites*. The name is masculine.

Type species: *Axioserphites obscurus* n. sp. by present designation and monotypy.

Diagnosis: Female. Body stout; head globular; posterior ocelli almost touching compound eyes; antennae 11-segmented, no club; antennal attachment at the lower ante-

rior margin of head, immediately above clypeus; occiput vertical and flat; maxillary and labial palpi not distinctly elongate, maxillary palpi longer than labial palpi; mesosoma about 1.3× as long as high; pronotum gently convex; forewing with Sc+R, Rs, r-rs, M+Cu, 1M, M, and Cu present as tubular veins; pterostigma 0.1× as long as forewing length; hind wing with Rs tubular; petiolar attachment to gaster strongly frontal, petiolar segments subequal in length; gaster slightly longer than mesosoma.

Axioserphites obscurus n. sp.
(Figs. 1–4)

LSID: urn:lsid:zoobank.org:act:309D6E94-7108-455E-90D2-F8764CD6FDC0.

Etymology: The species name comes from the Latin word “obscurus”, meaning dark, referring to the dark coloration of the holotype.

Type material: Holotype 141-B; a complete female specimen; left wings are bent. Syninclusion with a possible scellionid wasp. The holotype is deposited at the Natural

History Museum of the Lebanese University, Faculty of Science II, Fanar, Lebanon.

Locality and horizon: Hammana-Mdeyrij amber-bearing outcrop, Caza (= District) Baabda, Mouhafazet (= Governorate) Mount Lebanon; lower Barremian (Lower Cretaceous), upper interval at the upper part of “Grès du Liban” Alloformation (Maksoud et al., 2017).

Diagnosis: As for the genus (vide supra).

Description: Female. Body stout (Figs. 1, 2), color black, antennae and legs dark brown to black. Homogeneous vestiture on head and dorsal part of mesosoma. Macropterous (Fig. 3A, B). Body 1.25 mm long from anteriormost part of head to ovipositor tip.

Head: Globular, 0.22 mm long, 0.28 mm high (from the base of mandibles to behind posterior ocelli), with polygonal sculpture; hypognathous (Fig. 2A, B); frons slightly convex; genae narrow, widening toward mandibles. Compound eye large, occupying more than 2/3 of lateral head, with more than 300 ommatidia. Three ocelli present, posterior ocelli almost touching compound eyes. Antenna genic-

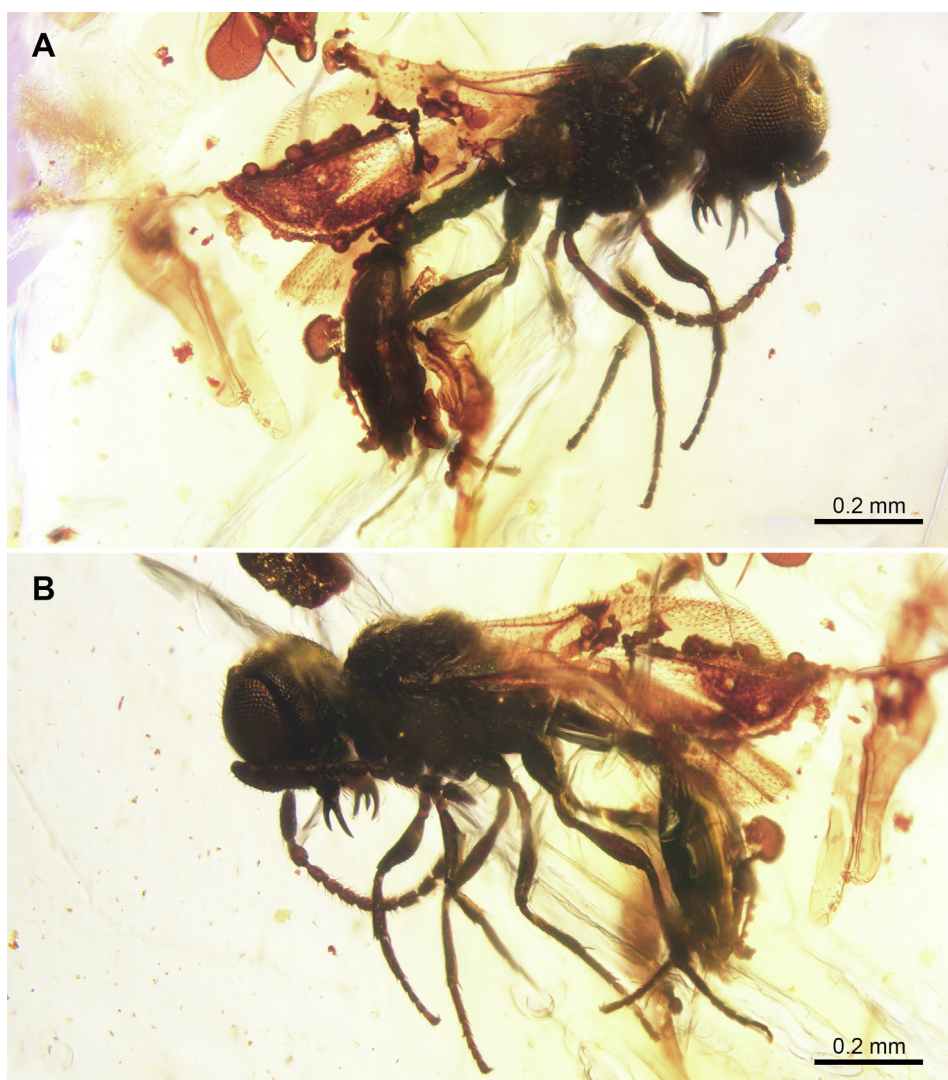


Fig. 1. *Axioserphites obscurus* n. gen. n. sp., holotype, female. (A) Habitus, right lateral view. (B) Habitus, left lateral view.

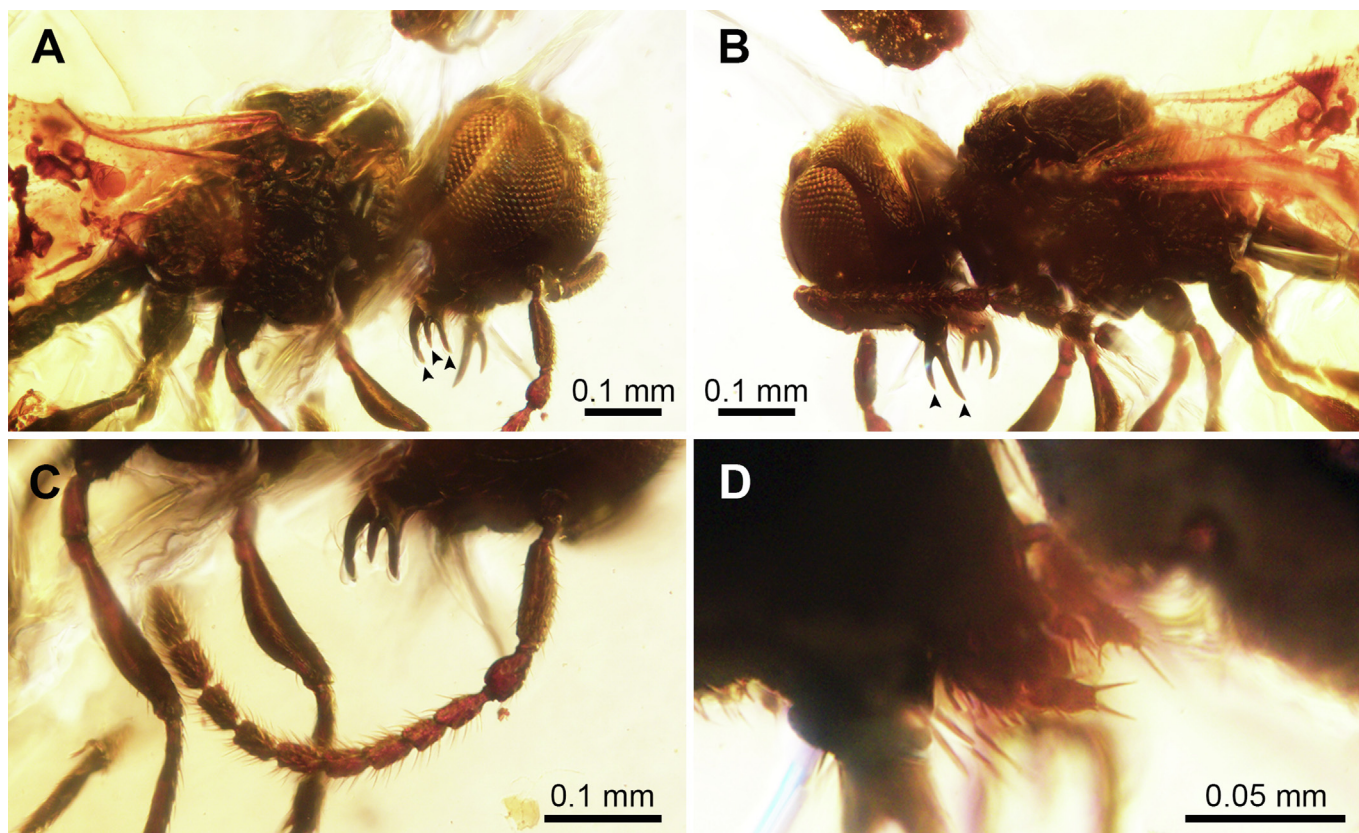


Fig. 2. *Axioserphites obscurus* n. gen. n. sp., holotype, female. (A) Head and mesosoma, right lateral view, teeth of right mandible indicated with arrowheads. (B) Head and mesosoma, right lateral view, teeth of left mandible indicated with arrowheads. (C) Right antenna. (D) Maxillary and labial palpi, left lateral view.

ulate, 11-segmented, attached immediately above clypeus (Figs. 2C, 4A); toruli prominent, subcontiguous; scape elongate, 0.11 mm long, shorter than combined lengths of pedicel and flagellomeres 1 and 2, radicle distinguishable; pedicel globular, 0.06 mm long, slightly longer than first flagellomere; flagellomeres profusely setose, subrectangular, with similar length and shape (0.04–0.05 mm long), except for distalmost flagellomere lanceolate, 0.05 mm long. Clypeus vertical, apparently similar in length and width. Malar sulcus absent. Mandible endodont (Fig. 2A, B), slightly convex, about 0.1 mm long, right mandible with three acute teeth (middle tooth shorter than lateral teeth), left mandible with two acute teeth (anterior tooth shorter than posterior tooth). Maxillary palpus shorter than mandible, four-segmented, palpomeres with similar lengths, distal palpomere bearing two prominent sensilla (Figs. 2D, 4B). Labial palpus shorter than maxillary palpus, distal palpomere bearing three sensilla (Figs. 2D, 4B). Occiput vertical and flat (Fig. 2C), lacking occipital carina; a swelling present between occiput and postoccipital groove; hypostomal carina developed.

Mesosoma: About 0.38 mm long and 0.28 mm high, 1.3× as long as high (Fig. 2A, B); pronotum visible dorsally, extending posteriorly, gently convex, posterodorsal lobes angular; tegula distinct, contact with pronotum

unclear; mesoscutum and mesoscutellum somewhat distorted, convex as preserved, with notauli indistinguishable; pronotum separated from mesopleuron by straight suture; mesopleuron with mesepisternum and mesepimeron differentiated by straight oblique suture, mesepimeron widened at lower half; scutellum obscure; axillae distinct; metanotum obscure; oblique suture between mesopleuron and metapleuron; propodeum shorter than mesoscutum, with reticulate areolate sculpture.

Forewing: About 0.66 mm long and 0.25 mm wide (Figs. 3A, 4C); not pedunculate; membrane covered by microtrichia; fringe of short setae; typical *Serphites* venation type; C nebulous; Sc+R, Rs, r-rs, M+Cu, 1M (basal vein), M, and Cu present as tubular veins; fuscous area around 1M and basal section of Cu; pterostigma small, 0.1× as long as forewing length, triangular, with anterior and posterior margins straight and of same lengths; r-rs oblique, 0.6× as long as pterostigma width; Rs and M mostly straight, reaching wing margin; Rs+M absent; Cu curved, reaching wing margin.

Hind wing: About 0.48 mm long and 0.07 mm wide (Figs. 3B, 4D); membrane covered by microtrichia; anterior margin with short setae, posterior margin with 15 long, erect setae. C lost; Sc+R and R₁ present as tubular veins; Rs extending perpendicular to Sc+R as tubular vein,

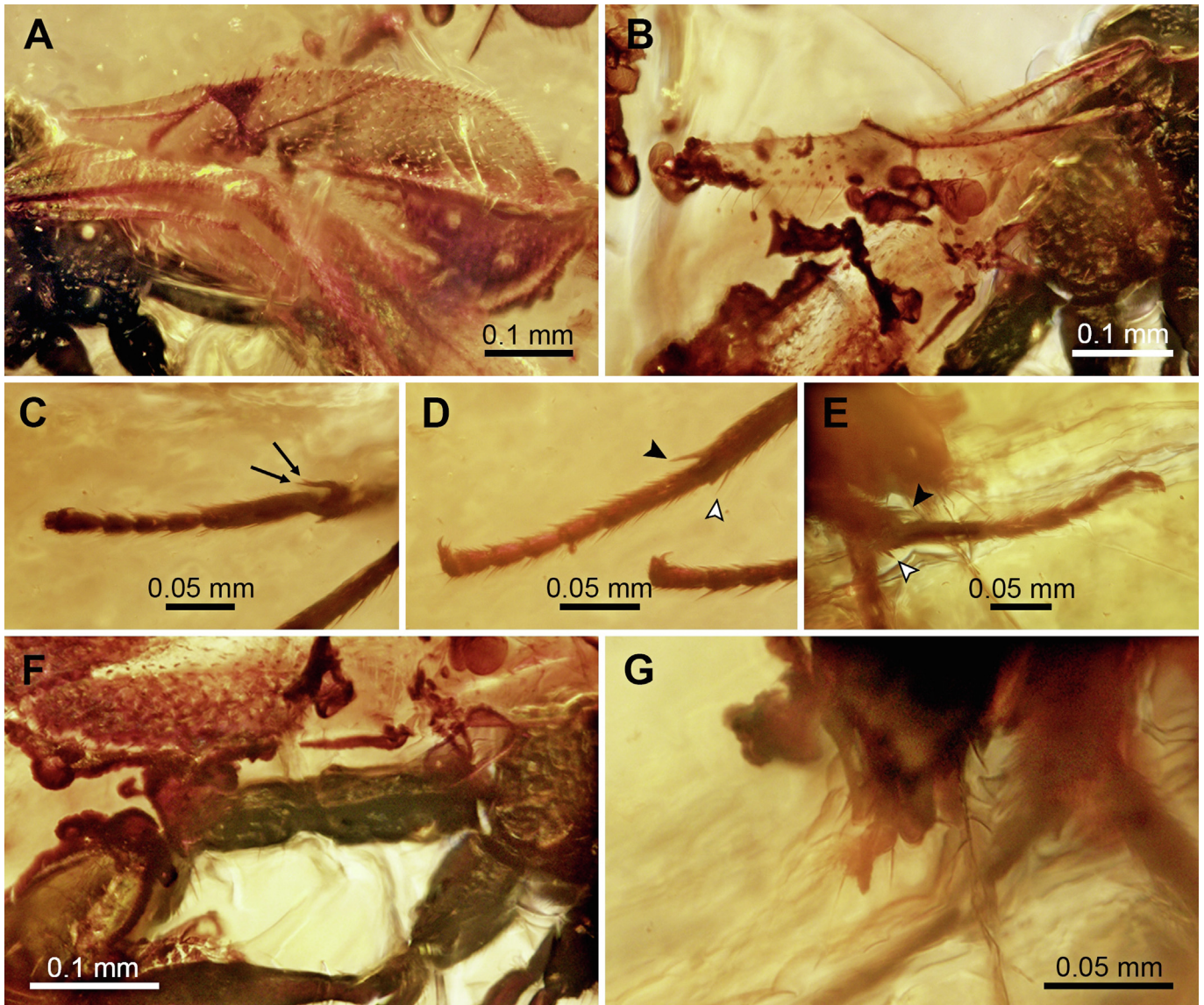


Fig. 3. *Axioserphites obscurus* n. gen. n. sp., holotype, female. (A) Right forewing. (B) Right hind wing. (C) Distal tibia and tarsus of right foreleg; the two tips of the bifid protibial calcar are indicated with arrows; the protibial calcar seems shorter than it is due to perspective. (D) Distal tibia and tarsus of right mid leg; anterior tibial spur is indicated with a white arrowhead; posterior tibial spur is indicated with a black arrowhead. (E) Distal tibia and tarsus of left hind leg; anterior tibial spur is indicated with a white arrowhead; posterior tibial spur is indicated with a black arrowhead. (F) Two-segmented petiole, right lateral view. (G) Female genitalia, right lateral view.

0.4× as long as hind wing width, vanishing in membrane. Two hamuli visible.

Legs: Slender, covered by fine setae (Fig. 3C–E); pro- and mesocoxae 1.5× as long as wide, metacoxae 2× as long as wide; trochanters thin and elongate; trochantelli present; femora slightly swollen medially; tibiae thin, slightly longer than femora (excluding trochantelli); tibial spur formula 1:2:2, protibial calcar curved and bifid, 0.5× as long as probasitarsus, meso- and metatibiae with anterior (external) spur shorter and thinner than posterior (internal) spur; basitarsi distinctly shorter than combined lengths of

tarsomeres 2–4, distal tarsomere slightly longer than each of tarsomeres 2 and 3; claws simple; arolium present.

Metasoma: Petiole two-segmented (Figs. 3F, 4E), cylindrical, 0.24 mm long; petiolar segments of subequal length, first segment wider than second, first segment with two carinae on each side; petiolar attachment to gaster strictly frontal; gaster elongate, dorsoventrally depressed, 0.41 mm long (from petiolar attachment to ovipositor tip), slightly longer than mesosoma, about 2× higher than first petiolar segment; gaster with five segments distinguishable, tergum IV apparently the longest; ovipositor exposed,

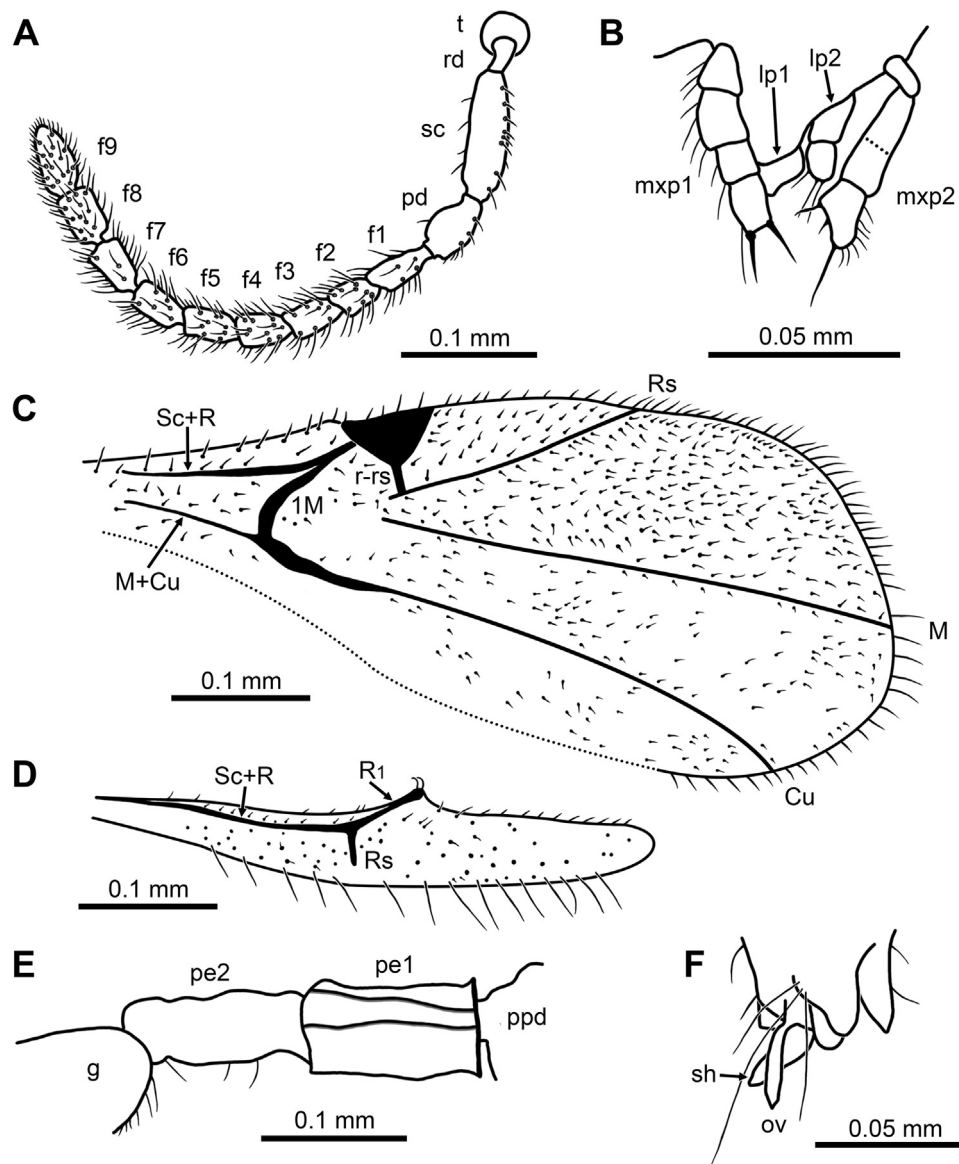


Fig. 4. *Axioserphites obscurus* n. gen. n. sp., holotype, female. (A) Drawing of the right antenna; f1–f9 – flagellomeres, pd – pedicel, rd – radicle, sc – scape, t – torulus. (B) Drawing of the maxillary and labial palpi, left lateral view; lp1 – left labial palp, lp2 – right labial palp, mxp1 – left maxillary palp, mxp2 – right maxillary palp. (C) Reconstruction of the forewing. (D) Reconstruction of the hind wing. (E) Drawing of the two-segmented petiole, right lateral view; g – gaster, ppd – propodeum, pe1 – first petiolar segment, pe2 – second petiolar segment. (F) Drawing of the female genitalia, right lateral view; ov – ovipositor, sh – ovipositor sheath.

very short, slightly curved basally (Figs. 3G, 4F); ovipositor sheath thick.

Male unknown.

4. Discussion

The studied specimen belongs to the superfamily Serphitoidea in Bipetiolarida based on its minute body size, number of flagellomeres, prominent endodont mandibles, characteristic *Serphites*-type venation with a triangular pterostigma, tibial spur formula 1:2:2, and two-segmented petiole (Engel, 2015). Within Serphitoidea, the family Archaeoserphitidae is excluded based on the absence of malar sulcus, the antennae with less than 12 flagellomeres,

the face without an angulate ridge below toruli, the sclerotized triangular pterostigma, and the tubular forewing veins (Engel, 2015). Considering the family Serphitidae, the subfamily Microserphitinae is characterized by having nine-segmented antennae and not developed forewing venation with nebulous pterostigma (Engel, 2015), thus differing from the studied specimen.

The subfamilies Supraserphitinae and Serphitinae are mainly differentiated based on the number of flagellomeres, being nine or ten in Supraserphitinae and six to eight in Serphitinae, and the relative length of the petiolar segments, which are, in general, subequal in length in Supraserphitinae, while the first segment is longer in Serphitinae (Engel, 2015; Rasnitsyn and Öhm-Kühnle,

2019b; Rasnitsyn et al., 2022). The putative subfamilial diagnostic character “maxillary and labial palpi long, subequal in length” is only present in the species *Supraserphites draculi* Rasnitsyn and Öhm-Kühnle, 2019b, and the character “tubular veins and well developed pterostigma in forewing” is also present in the representatives of the subfamily Serphitinae (Engel, 2015; Rasnitsyn and Öhm-Kühnle, 2019b; Rasnitsyn et al., 2022). The species *Supraserphites margritae* Rasnitsyn and Öhm-Kühnle, 2020b and *Supraserphites vorontsovi* Rasnitsyn and Öhm-Kühnle, 2020b have the first petiolar segment twice as long as the second, as in the genus *Serphites*. *Serphites silban* Ortega-Blanco et al., 2011a apparently has 12-segmented antennae. Furthermore, the serphitine species *Aposerphites angustus* Ortega-Blanco et al., 2011a has petiolar segments of subequal lengths. Consequently, these two characters might not be autapomorphies of Supraserphitinae and the boundaries between Supraserphitinae and Serphitinae are somewhat ambiguous. Nonetheless, we prefer to continue considering Supraserphitinae a valid subfamily, as this seems the most appropriate course of action now, until a phylogenetic analysis is carried out to better understand the limits of the families, subfamilies, and genera in Serphitoidea.

The presence of 11-segmented antennae and petiolar segments of subequal lengths in *Axioserphites obscurus* n. gen. n. sp. allows us to assign it to the subfamily Supraserphitinae. Interestingly, it shares with the serphitine *Aposerphites angustus* the elongate scape, the lengths of the maxillary and labial palpi, the propodeum with reticulate areolate sculpture, the petiolar segmented subequal in length, and the first petiolar segment with striations or carinae (Ortega-Blanco et al., 2011a), but they differ in the shape the head (globular in *Axioserphites obscurus* n. gen. n. sp. versus elongate in *A. angustus*), the number of flagellomeres (nine versus seven), the ocelli (on a protuberance in *A. angustus*), the occiput (vertical and flat versus concave), the relative proportions of the mesosoma and the gaster (mesosoma slightly shorter versus longer), and the vestiture of the gaster (glabrous versus setose). The wings are not completely preserved in *A. angustus*, thus the differences in the venation are not known. All the rest of the serphitine species have the first petiolar segment at least 1.4× as long as the second (Herbert and McKellar, 2022). *Axioserphites obscurus* n. gen. n. sp. shares the number of antennomeres with the species *Leptoserphites iriae* Rasnitsyn and Azar in Rasnitsyn et al., 2022. However, the studied specimen does not fit in *Leptoserphites* based on (Rasnitsyn et al., 2022): the stout body (versus narrow in *Leptoserphites*), the globular head (versus elongate), the vertical and flat occiput (versus convex), the mesosoma about 1.3× as long as high (versus twice as long as high), the gently convex pronotum (versus slightly convex), and the tubular forewing veins (versus only tubular R, r-rs, and pterostigma). Similarly, *Axioserphites obscurus* n. gen. n. sp. differs from the genus *Supraserphites* (Rasnitsyn and Öhm-Kühnle, 2019b) in: the 11-segmented antennae (versus 12-segmented in *Supraser-*

phites), the antennal attachment at the lower anterior margin of head (versus at the upper anterior margin), the scape shorter than the combined lengths of the pedicel and the flagellomeres 1 and 2 (versus longer), the labial palpi shorter than the maxillary palpi (versus subequal in length), the vertical and flat occiput (versus convex), the gently convex pronotum (versus slightly convex), the pterostigma 0.1× as long as the forewing length (versus longer than 0.1×), the strongly frontal petiolar attachment to the gaster (versus slightly ventral, except for *S. margritae*), and the gaster slightly longer than the mesosoma (versus gaster shorter). Furthermore, the holotype of *Axioserphites obscurus* n. gen. n. sp. is the smallest known supraserphitine wasp with body about 1.2 mm long, in comparison with the *Supraserphites* specimens that are 2.1–2.6 mm long and the *Leptoserphites* specimens being 1.4–1.5 mm long (Rasnitsyn and Öhm-Kühnle, 2019a, 2019b, 2020b; Rasnitsyn et al., 2022).

It is important to mention the high morphological disparity present among the species of the genus *Supraserphites*. As commented above, the putative diagnostic character “maxillary and labial palpi long, subequal in length” can be found only in the type species of the genus (Rasnitsyn and Öhm-Kühnle, 2019b). The general body aspect of *S. draculi* and *S. margritae* is slender, while stout in *S. sidorchukae* and *S. vorontsovi* (Rasnitsyn and Öhm-Kühnle, 2019a, 2019b, 2020b). The petiolar segments are subequal in length in *S. draculi* and *S. sidorchukae*, but the first segment is twice as long as the second in *S. margritae* and *S. vorontsovi*. The relative length of the scape and the pedicel with the flagellum and the type of petiolar attachment to the gaster are also variable in *Supraserphites*. Considering this information, it is probable that some species today included in *Supraserphites* eventually fall into other genera. Accordingly, we opt to describe a new genus for the studied specimen to avoid increasing the morphological disparity already present in the genus *Supraserphites*.

5. Conclusion

The description of *Axioserphites obscurus* n. gen. n. sp. increases the known diversity of the family Serphitidae to 32 species in nine genera. Its finding in Lebanese amber, together with other serphitids, proves that this family was already diverse during the Barremian. However, the biology of the group is still obscure. A phylogenetic analysis is required to delve into the relationships of Serphitoidea with other superfamilies and better understand the relationships between the genera in Serphitidae.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Given his role as Guest Coordinating Editor, Dany Azar had no involvement in the peer review of this article and had no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to another journal editor.

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