



The first and oldest record of Issidae from the Lower Cretaceous of Lebanon (Hemiptera, Fulgoromorpha)

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Abstract

Libanissus bkassinensis Azar, Maksoud & Nel, **gen. et sp. nov.** is illustrated and described from the Lower Cretaceous dysodile (oil papershales) of Bkassine, South Lebanon, and its taxonomic position discussed. *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** is characterized by its banded legs and body, a hind wing with two lobes, RA and RP very short, M with only two very short apical branches, CuA with two branches, and a small but distinct apical furcation of PCu close to the incision of the wing margin. *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** represents the earliest record (lower Barremian) of the Issidae. Prior to this discovery, the oldest known record was from the Paleocene of France.

Key words: Insecta, Fulgoromorpha, Issinae, Barremian, first occurrence

Introduction

Dysodiles are sedimentary rocks characterized by finely laminated (micrometric) layers (oil papershales), with high organic content (Cordier 1808) and well-preserved fossils (Fraas, 1878). Lebanese dysodiles were formed

in different lacustrine deposits in different areas during the lower Barremian and Albian. Some outcrops were mentioned in nineteenth century publications in the Lower Cretaceous sandstones of Mount Lebanon (Botta 1831), and in the South (Fraas 1878) and Centre of Lebanon (Janensch 1925). Fraas (1878) was the first to point out their richness in fossils, including fish and plant debris, and identified some plant species that were later reviewed by Edwards (1929). Then, since the 1930s, dysodiles were forgotten until their recent rediscovery through the extensive geological fieldwork by one of us (DA), which resulted in the finding of seven localities, five of them in the lower Barremian and two in the Albian. Among those dysodile outcrops, two lower Barremian ones (Jdeidet Bkassine and Sniyya) and one Albian (Qnat, where dysodiles are associated with cinerite, unpublished data) produced fossil insects (Maksoud *et al.* 2022).

Issidae is a rather large family of Fulgoromorpha with uncertain systematics, that once included approximately 1000 species with 215 genera, but many subfamilies have recently been reclassified as separate families (Gnezdilov 2003), including Caliscelidae, Nogodinidae and Tropiduchidae. The fossil record of Issidae is very scarce, with only nine described taxa, some of which may be dubious. The oldest fossil is *Cubicostissus palaeocaeni* Bourgoin, Wang & Nel, 2020 from the Paleocene of Menat, France, *ca.* 60–61 Ma (Bourgoin *et al.* 2020). Song & Liang (2013: fig. 3) dated the emergence of the Issidae in the Jurassic, whereas Bucher *et al.* (2023: fig. 4) proposed that Issidae emerged at *ca.* 140 Ma ago and Issinae at *ca.* 130 Ma ago.

Here we study *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** a compression fossil of a bug that can be attributed to the subfamily Issinae within the Issidae family, from the dysodile originated from Jdeidet Bkassine sampling locality (South of Lebanon) from the Lower Barremian sandstone (Maksoud *et al.* 2022; El Hajj *et al.* 2019, 2021). These dysodiles are found near volcanic deposits, suggesting a close relationship between volcanism and their deposition and/or preservation (Maksoud *et al.* 2022; El Hajj *et al.* 2019, 2021a). The rediscovery of Lower Cretaceous dysodiles, unusual continental deposits in Lebanon, brought important and exceptional palaeontological assets (El Hajj *et al.* 2019, 2021a, b; Azar *et al.* 2019; Azar & Nel 2023). *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** is the third fossil insect to be studied from Jdeidet Bkassine dysodile after a bizarre ephemeropteran larva (Azar *et al.* 2019) and a tipulid wing (Azar & Nel 2023).

Material and methods

The material described herein was collected by one of us (DA) during two weeks of very productive fieldwork conducted by our team in October 2023 in Jdeidet Bkassine, Caza (District) Jezzine, Mouhafazet (Governorate) South Lebanon, from the lower Barremian dysodile. To date, these layers allowed the collection of several tetrapods (turtles, squamates, frogs), a rich and diverse fish assemblage (actinopterygians, coelacanth), pulmonate gastropoda, diverse aquatic related insect assemblage, ostracods, plant fragments (macroflora and palynomorphs) including ferns, algae and spermatophytes, and a high abundance of various coprolites.

The studied material examined with an Olympus SZX7 stereomicroscope and photographed with a digital camera attached to a Zeiss AxioZoom V16 stereomicroscope. Line drawing was made using camera lucida attached to a Zeiss Discovery V12 stereomicroscope. The figures and illustrations were processed with Helicon Focus 8 and Adobe Photoshop CC 2019 softwares. The studied specimen is deposited in the collections of the Natural History Museum of the Lebanese University, Faculty of Sciences II, Fanar, Lebanon.

We follow the wing venation terminology of Dworakowska (1988) for fore wing and Gnezdilov (2020) for hind wing.

Systematic palaeontology

Order Hemiptera Linnaeus, 1758

Infraorder Fulgoromorpha Evans, 1946

Family Issidae Spinola, 1839

Genus *Libanissus* Azar, Maksoud & Nel gen. nov.

Type species. *Libanissus bkassinensis* Azar, Maksoud & Nel, **sp. nov.**

Etymology. Named after a combination of Λίβανος (Libanos = Lebanon in Greek) and *Issus*, the type genus of Issidae.

Diagnosis. Hind wing RA and RP very short; M with only two very short apical branches; CuA with two branches; a small but distinct apical furcation of PCu close to incision of wing margin.

***Libanissus bkassinensis* Azar, Maksoud & Nel, sp. nov.**

(Figs 1–4)

Material. Holotype F-INS-63124/6, body almost complete with thorax, wings, legs and abdomen in connection, only head is not distinctly visible (Fig. 1), stored in the Natural History Museum of the Lebanese University, Faculty of Sciences II, Fanar, Lebanon.

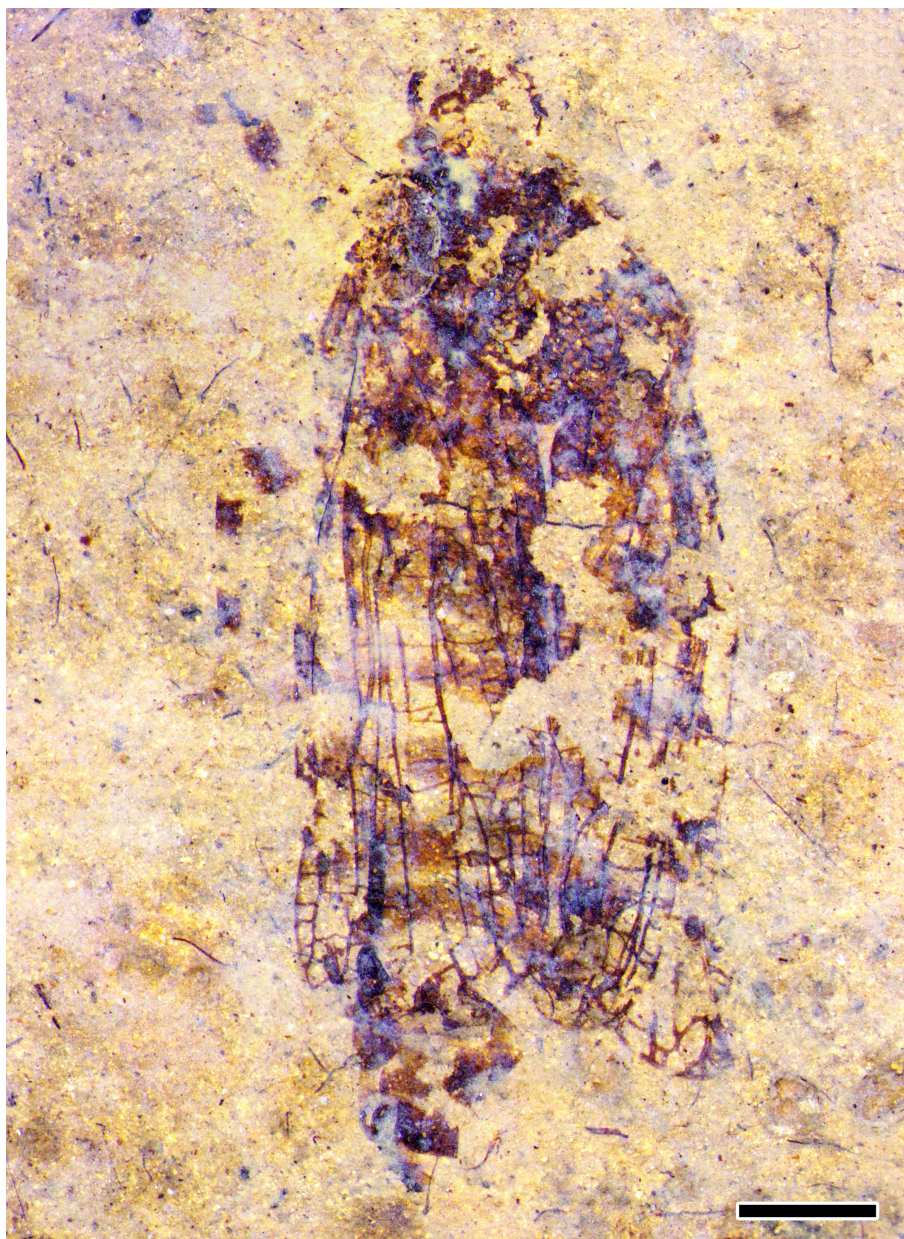


FIGURE 1. *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** Holotype F-INS-63124/6, microphotograph of dorsal habitus. Scale bar = 1 mm.

Etymology. Named after Bkassine, the village where the studied specimen originated.

Diagnosis. As for the genus (*vide supra*). Presence of brown bands on the wings and legs.

Locality and horizon. Jdeidet Bkassine, Caza (District) Jezzine, Mouhafazet (Governorate) South Lebanon (for map and outcrop illustrations see Azar *et al.* 2019: 193, fig. 1; Maksoud *et al.* 2022: 712, fig. 11A and 716, fig. 15B); lower Barremian.

Description. Body visible in dorsal view; pronotum, nearly triangular shape, 0.75 mm long, 2.41 mm wide, with anterior margin with obtuse angle (Fig. 2A); scutellum with pustules (Fig. 2A), 1.16 mm long, 2.32 mm wide; abdomen poorly preserved, 5.4 mm.

Legs. Fore femur 0.3 mm long, 0.25 mm wide; fore tibia banded aside the two proximal and distal extremities, 0.55 mm long, 0.19 wide (Fig. 2B); middle femur *ca.* 0.9 mm long (Fig. 2C), hind femur *ca.* 1.04 mm long, 0.35 mm wide; hind tibia, 1.57 mm long, with two transverse coloured bands (Fig. 2D) and one spur visible on shaft (Fig. 3B); tarsi three-segmented (Fig. 3A).

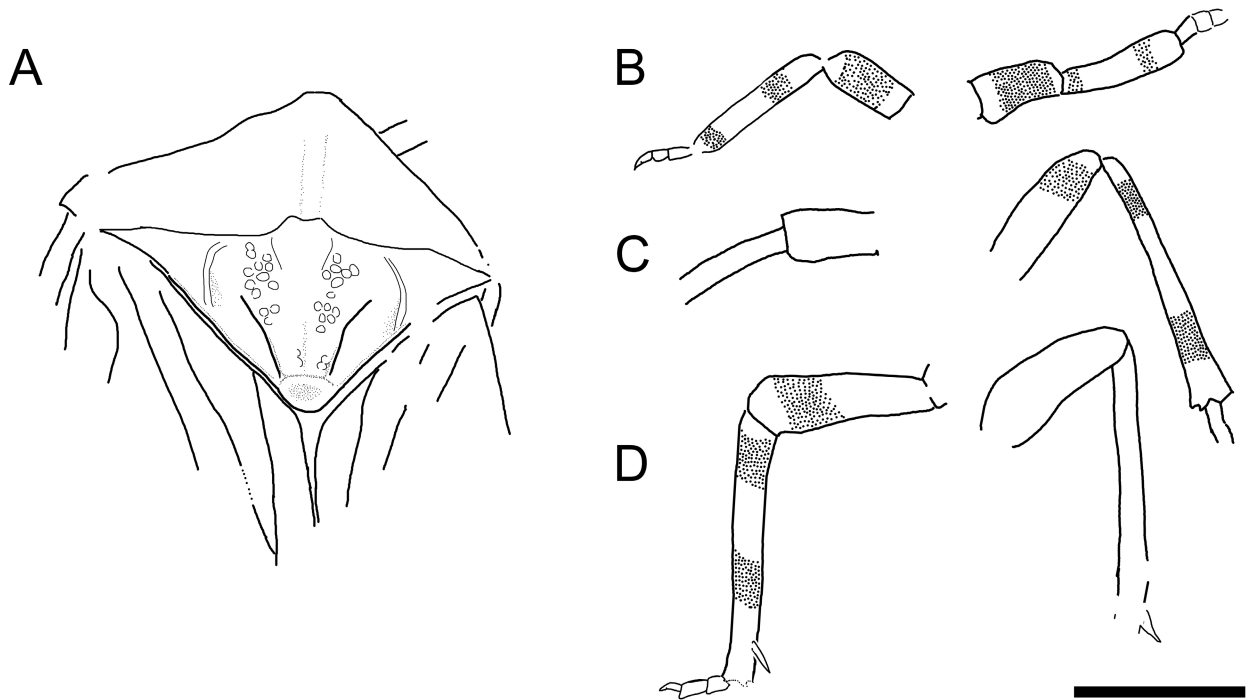


FIGURE 2. *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** Holotype F-INS-63124/6, line drawings. **A**, Thorax. **B**, Left and right fore legs. **C**, Left and right mid legs. **D**, Left and right hind legs. Scale bar = 1 mm.

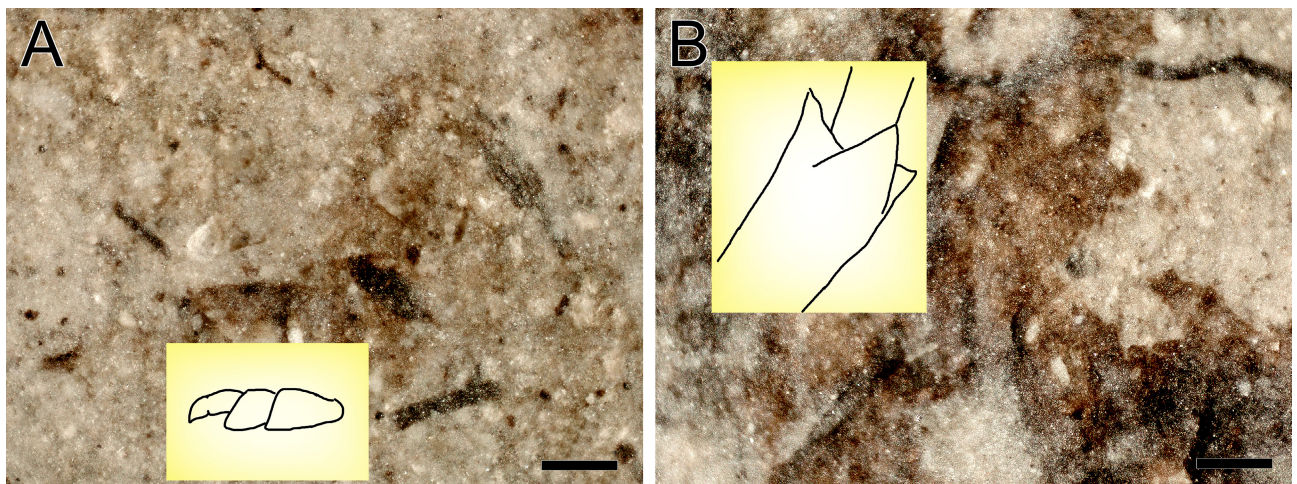


FIGURE 3. *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** Holotype F-INS-63124/6. **A**, Microphotograph of hind tarsi; the yellow box represents the line drawing of the hind tarsi. **B**, Distal tip of middle tibia; the yellow box represents the line drawing of the tip of middle tibia. Scale bars = 0.1 mm.

Wings. Wings with brown transverse bands and several straight crossveins; forewing 5.42 mm long, 1.9 mm wide, no parallel crossveins in precostal area; RA and RP rather long separating from ScP+R at 3.46 mm from wing base (Fig. 4); M with two branches MA and MP separating from M at 1.19 mm from wing base; CuA with two branches; Y-shaped AA-AP veins; hind wing 4.64 mm long (Fig. 4), at least clearly bilobed with an incision on wing margin; RA and RP very short; M with only two very short apical branches; CuA with two branches bifurcating at 3.97 mm from wing base; a small but distinct apical furcation of PCu close to the incision.

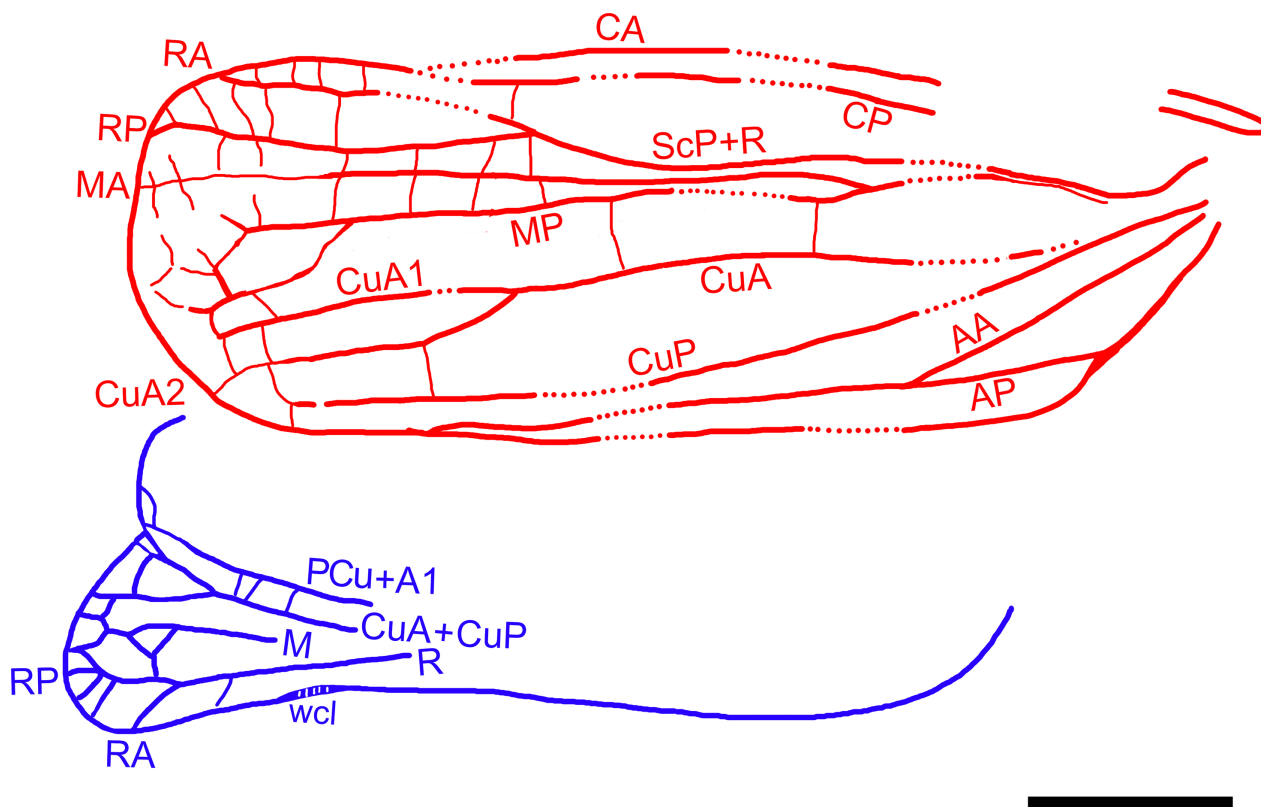


FIGURE 4. *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.** Holotype F-INS-63124/6. Wings. In red left forewing; in blue right hind wing, wcl = wing coupling mechanism. Scale bar = 1 mm.

Discussion

After Dworakowska (1988), only some Issidae among the Fulgoromorpha have well-developed bi- or three-lobed hind wings. Gnezdilov (2012: 48) proposed a diagnosis of the Issidae mainly based on the characters of the terminalia and only the ‘compact, with a predominance of subbrachyptera-submacroptera (box-shaped) forewings’ as other apomorphy. Gnezdilov *et al.* (2022: 562) proposed this character as a synapomorphy of the Issinae. In *Libanissus bkassinensis* Azar, Maksoud & Nel, **gen. et sp. nov.**, the hind wing is at least clearly bilobed with an incision on the wing margin. The new fossil also exhibits a small but distinct apical furcation of PCu in the hind wing, a character present in some Issidae (Gnezdilov 2020). Thus, it can be considered as belonging to this group. The forewing of the new fossil is similar in shape, venation, and cross-venation to those of some extant Issidae (*e.g.*, *Paguinella ramosa* Gnezdilov, 2020).

Conclusion

Libanissus bkassinensis Azar, Maksoud & Nel, **gen. et sp. nov.** represents the oldest record of both the family Issidae and the subfamily Issinae. Its age of *ca.* 130 Ma fits well with the proposal of dating of Bucher *et al.* (2023), pushing occurrence of the group by about 70 Ma earlier than the previously oldest known fossil from Menat, France.

Nevertheless, it would be interesting to make a new analysis that includes this fossil to better estimate the possible age of the family. Modern Issidae are feeding on a range of woody plants, including most common deciduous trees. It would be rather motivating to know on what type of vegetations this earliest fossil issid was nourishing on, knowing that different conifers, ferns, algae and even angiosperms (evidenced through various pollen grains of angiospermian affinity) were occurring in the associated depositional environment: a freshwater lake aside volcanic edifices, surrounded by a typical Early Cretaceous flora (open forest and savanna-like environment).

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