
The oldest palm bug in the Lowermost Eocene amber of the Paris Basin (Heteroptera: Cimicomorpha: Thaumastocoridae)

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ABSTRACT

The oldest fossil Thaumastocoridae, *Protodoris minusculus* n. gen., n. sp. is described from the Lowermost Eocene amber of Paris basin (France). Its phylogenetic affinities are discussed. This discovery indicates the presence of a very warm climate for the Paris basin during the Lowermost Eocene.

KEYWORDS | Insecta. Heteroptera. Thaumastocoridae. *Protodoris minusculus* n. gen., n. sp. French amber.

INTRODUCTION

The Thaumastocoridae is a small true bug family with 6 extant genera and only 3 described fossil species from the Dominican and Baltic ambers (Poinar and Santiago-Blay, 1997; Bechly and Wittmann, 2000; Slater and Baranowski, 2000). The fossil described herein is the oldest known member of this family. The Thaumastocoridae were supposed to have a relictual Gondwanian distribution, after the extant record in Australia, South India, South America, Cuba and Florida (Schuh and Slater, 1995). The present discovery supports the hypothesis of Bechly and Wittmann (2000) that 'the Gondwanian pattern of distribution (of Thaumastocoridae) is just an artefact of extinction due to climatic changes in the Tertiary.'

SYSTEMATIC PALEONTOLOGY

Order: Hemiptera LINNAEUS, 1758

Suborder: Heteroptera LATREILLE, 1810

Family: Thaumastocoridae KIRKALDY, 1907

GENUS *Protodoris* n. gen.

Type species: *Protodoris minusculus* n. sp.

Diagnosis: Thaumastocorid genus characterized as follows: no lobate appendage at the apex of fore tibia; compound eyes not protuberant; large ocelli on a line between bases of compound eyes; antenniferous tubercles apparently not strongly protuberant; no pulvilli attached to tarsal claws; apex of corium not extending near hemelytra apex; hemelytral clavus with 4-5 rows of areolae in broadest part; membrane large, without veins except for a small vein stub; veins on corium not forming cells; broad thoracic paranota with 3 irregular rows of small areolae; lateral margin of pronotum convex; tarsal segments linear, not ellipsoidal.

Etymology: After Proto and doris in reference to its strong similarities with the extant genus *Xylastodoris*.

Protodoris minusculus n. sp.
Figures 1 and 2

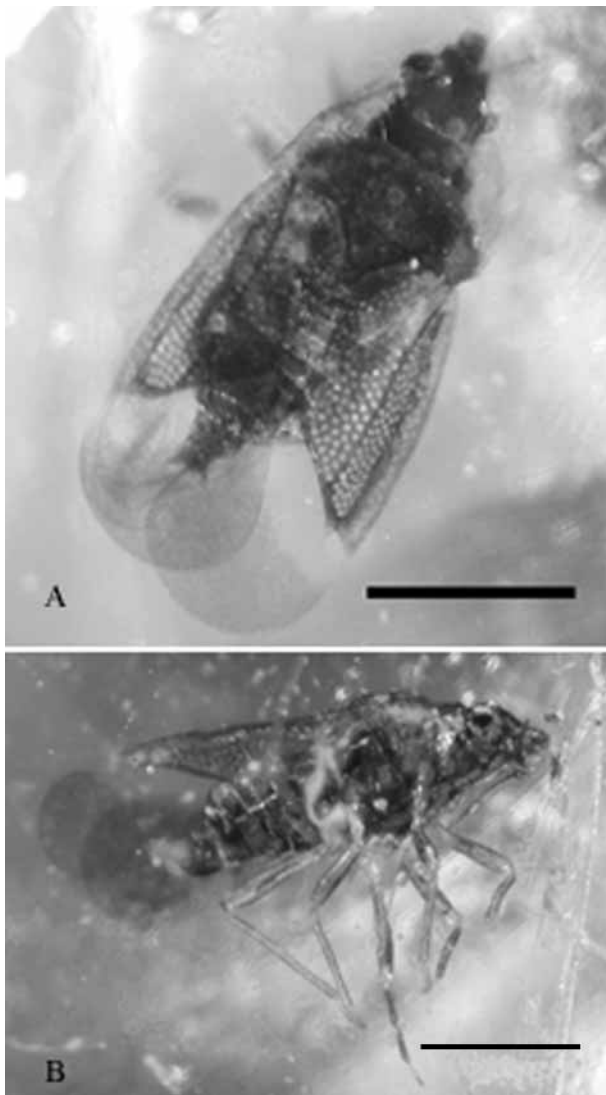


FIGURE 1 | *Protodoris minusculus* n. gen., n. sp., holotype specimen PA 86 (1/2). A) Photograph of dorsal view. B) Photograph of ventro-lateral view. Scale bar: 0,5 mm.

Material: Holotype specimen PA 86 (1/2), mounted in Canada balsam, paratype specimen PA 7024 (1/4), with three Hymenoptera: Chalcidoidea. Collection De Ploëg and Indivision Langlois-Meurine, housed in Muséum National d'Histoire Naturelle, Paris. Specimens collected in Le Quesnoy all bear the letter PA for Paris (meaning Paris Basin), the following number is the ordinal number in the collection.

Locality deposit: Le Quesnoy, Chevrrière, region of Creil, Oise department, France.

Geological age: Lowermost Eocene, Sparnacian, level MP7 of the mammal fauna of Dormaal. We have demonstrated that the amber is autochthonous and very different

from the Baltic amber in age, chemical composition and origin (Feugueur, 1963; De Ploëg et al., 1998; Nel et al., 1999; Nel et al., 2004).

Etymology: After the very small size of this species.

Diagnosis: That of the genus.

Description Dorsal surface of body and hemelytra finely to rather coarsely lacy, veinlets forming limits of areolae slightly raised; total body length, 1.36 mm; maximal width, 0.6 mm (holotype), 1.5 mm long and 0.6 mm wide (paratype).

Head: dorsum of head capsule without trichobothrium-like setae; compound eyes normal, with many ommatidia but not strongly protuberant; width between compound eyes, 80 μ m; 2 rather large and well separated ocelli, positioned on line connecting base of compound eyes; antennal segments 1 and 2 short and broad, segment 2 slightly longer than segment 1; segments 3 and 4 three times longer than basal segments, elongate, subequal, and bearing long setae; head prognathous, with large mandibular plates that are not surpassing the anteclypeus; bucculae broad but short and not protruding below or before the head, buccular bridge absent; labium inserted on ventral surface of head, rather long, reaching bases of hind coxae, 4-segmented, labial segment 1 long and slender.

Thorax: no visible channel of metathoracic scent gland; no anterior pronotal carina; paranota well developed, 0.08 mm wide, with 3 irregular rows of small areolae; lateral margin of pronotum convex; disc of pronotum flat, anteriorly produced, punctured, no collar; no visible callosities; hind pronotal margin slightly concave, not triangularly prolonged backwards; mesoscutellum large, well visible, not hidden under the pronotum, with a mucronate projection in its apical part and a row of very small spines along its lateral margins.

Forewings: macropterous; costal fracture absent; hemelytral clavus well-developed, with 4-5 rows of areolae in its broadest part; clavo-corial suture present; hyaline membrane large, without any vein and any areola, but with a small vein stub; border between corium and membrane nearly straight, corium not extending toward wing apex; corium with only one longitudinal convex vein, not divided into cells; hemelytra broadly overlapping; hemelytra areolae small and rather regular, of the same size and covering all surface except membrane area; subcostal area with 2-3 rows of areolae.

Hindwing: not visible under the hemelytra, although the abdomen is clearly visible.

Legs: tarsal claw with no basal tooth; pulvilli absent; tarsi 2-segmented, the second tarsomere being the longest, tarsal segments linear, not ellipsoidal; no lobate apical appendage on the tibiae.

Abdomen: no abdominal trichobotria; abdominal spiracle 1 present near dorsal margin of sternite; spiracles 2 to 7 ventral; ventral laterotergites not visible, probably fused with the sternites; genital appendages hardly visible, but symmetrical, thus it is probably a female specimen.

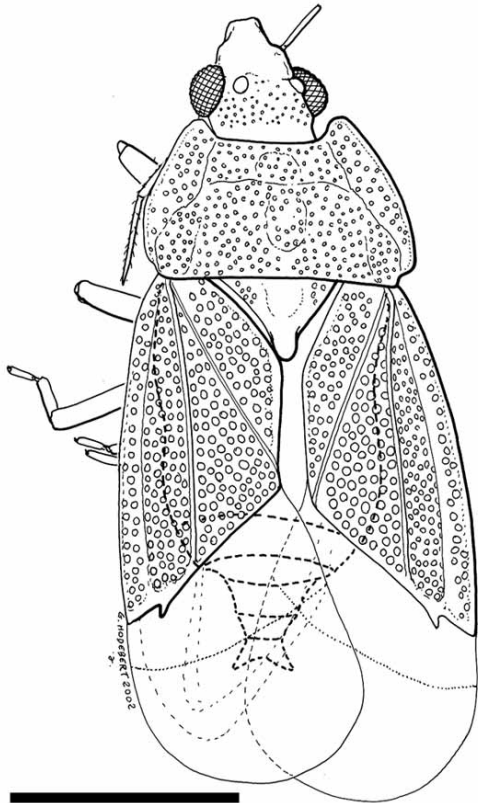


FIGURE 2 | *Protodoris minusculus* n. gen., n. sp., holotype specimen PA 86 (1/2), general habitus. Scale bar: 0,5 mm.

Discussion: The presence of distinct clavus, corium and membrane is a synapomorphy of the Panheteroptera (Wheeler et al., 1993). The Pentatomorpha should be excluded because of the absence of trichobotria on the abdominal sternites but two genera of Piesmatidae have also completely lost their trichobotria (Stys and Davidova-Vilimova, 2001, p. 123). The Piesmatidae can be excluded because of the absence of the pulvilli in *Protodoris* n. gen. (Wheeler et al., 1993).

Within the Cimicomorpha, *Protodoris* n. gen. shares with the Thaumastocoridae the buccular bridge absent and membrane with no cells (plus tarsi 2-segmented,

mandibular plates greatly enlarged, labial segment 1 long, abdominal spiracle 1 present, abdominal trichobotria absent) (Slater and Drake, 1958; Schuh and Stys, 1991). It differs from this family in the presence of a vein stub in the membrane but this character is homoplastic within the clade 'Miriformes' *sensu* Schuh and Stys (1991).

The Thaumastocoridae are currently divided into two subfamilies Thaumastocorinae Kirkaldy, 1907 and Xylastodorinae Barber, 1920. Heiss and Popov (2002) recently transferred the subfamily Thaicatorinae Kormilev, 1969 (one extant genus *Thaicatoris* KORMILEV 1969) from the Piesmatidae into the Thaumastocoridae. The Thaumastocorinae are characterized by the presence of a lobate appendage at the apex of fore tibia and the compound eyes strongly protuberant (Schuh and Stys, 1991; Bechly and Wittmann, 2000). Both these autapomorphies are absent in *Protodoris* n. gen. The Xylastodorinae would be characterized by two possible autapomorphies: 'loss of both parameres' and 'conspicuously projecting antenniferous tubercles' (Slater and Brailovsky, 1983; Bechly and Wittmann, 2000). The antenniferous tubercles of *Protodoris* n. gen. seem to be not strongly protuberant, and its male genital structures are unknown. The Xylastodorinae are also 'characterized' by: 'presence of pulvilli attached to the tarsal claws' and 'apex of corium extending near hemelytra apex' (Slater and Drake, 1958; Schuh and Slater, 1995). Both these character states are not present in *Protodoris* n. gen. but their polarities are not determined.

Furthermore, the Xylastodorinae have a very particular corium extending near hemelytra apex and divided into several cells, unlike Thaumastocorinae and Joppeicidae. Both these characters could be autapomorphies of the Xylastodorinae, but the Tingidae also have the corium divided into large cells and no membrane. Thus they could also be homoplastic within the Miriformes.

Protodoris n. gen. has none of the currently accepted autapomorphies of the Thaumastocorinae or of the Xylastodorinae. Nearly all its characters appear plesiomorphic relative to these two subfamilies. The only putative synapomorphy of *Protodoris* n. gen. with the xylastodorine genera *Xylastodoris* BARBER 1920 (Recent), *Proxylastodoris* HEISS and POPOV 2002 (fossil), and *Paleodoris* POINAR and SANTIAGO-BLAY 1997 (fossil) is the 'broad thoracic paranota', only present in these genera within the Thaumastocoridae, but clearly more developed in *Paleodoris* and *Protodoris* n. gen. The second extant and fossil xylastodorine genus *Discocoris* KORMILEV 1955 has not this structure (Barber, 1920; Drake and Slater, 1957; Poinar and Santiago-Blay, 1997; Slater and Baranowski, 2000). The ocelli of *Protodoris* n. gen. are aligned with the eyes as in *Xylastodoris*, other Thaumastocoridae and Joppeicidae, unlike what occurs in *Pale-*

odoris. This character state is probably plesiomorphic. Lastly, *Thaicoris* strongly differs from *Protodoris* n. gen. in its large and sharp anterior expansions of thorax and head (Heiss and Popov, 2002).

The relationship of *Protodoris* n. gen. within the Thaumastocoridae remains uncertain, even if it could be more closely related to the two genera *Xylastodoris* and *Paleodoris* than to any other genera.

Bechly and Wittmann (2000) included the only known Baltic amber palm bug in the genus *Xylastodoris* (*X. gerdae*) because 'it shares all six diagnostic characters' of the generic key proposed by Poinar and Santiago-Blay (1997). Nevertheless, they also indicated that its labium ('rostrum') 'reaches up to the posterior third of the metathoracic sternite'. This character does not agree with the description and diagnosis of the extant *Xylastodoris luteolus* BARBER 1920 that has a very short labium 'not reaching mid coxae' (Barber, 1920; Drake and Slater, 1957; Poinar and Santiago-Blay, 1997). After these authors, this character is one of the main differences between *Xylastodoris*, *Paleodoris* and *Discocoris*. Drake and Slater (1957) also used this character to separate the thaumastocorine genera. Although, this character seems to be rather homoplastic within the Thaumastocoridae, it is probably of great importance in the feeding habits of the various species. It clearly justifies a generic separation between *X. luteolus* and *X. gerdae* BECHLY and WITTMANN 2000, which has been proposed by Heiss and Popov (2002), who included *X. gerdae* in the new genus *Proxylastodoris*.

The present discovery suggests that the phylogenetic history of the Thaumastocoridae is much more complicated than suggested by the study of the few extant species. Also the numerous differences between *Discocoris* and *Proxylastodoris* suggest that many other extinct taxa were probably flourishing during the Early Cenozoic.

The extant Thaumastocoridae are strictly living under very warm seasonal climates, even if one species was probably introduced and adapted to the climate of Florida. Their presence in the Paris basin during the Lowermost Eocene supports the presence of such a palaeoclimate during this period in the area (Nel et al., 1999).

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