

Diplocoelus probiphyllus n. sp., the first known fossil False Skin Beetle (Coleoptera: Biphyllidae)

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Summary. The first fossil species of the family Biphyllidae LeConte 1861, *Diplocoelus probiphyllus* n. sp., is described from Baltic amber. This species, which shows intermediate characters of antennae, sculpturing and pubescence between *Diplocoelus* Guérin-Ménéville 1844 and *Biphyllus* Dejean 1821, also suggests the presence of temperate mixed forests and a climate cooler than it has been until today hypothesised for Baltic Amber.

Résumé. *Diplocoelus probiphyllus* n. sp., le premier fossile connu de biphyllide (Coleoptera). On décrit la première espèce fossile de la famille des Biphyllidae LeConte 1861 de l'ambre baltique. Cette espèce, qui présente des caractères intermédiaires des antennes, de la sculpture et de la pubescence entre *Diplocoelus* Guérin-Ménéville 1844 et *Biphyllus* Dejean 1821, suggère aussi la présence de forêts tempérées mixtes et de climats plus frais de ceux qu'ils sont jusqu'au présent supposés.

Keywords: Coleoptera, Biphyllidae, *Diplocoelus*, fossil, Baltic amber.

False skin or false hide beetles (Biphyllidae LeConte 1861) are a poorly-known family of small-sized Cucujoidea widespread with more than 200 species throughout all the World, mostly at the tropics (Goodrich 2002).

Only few species are present in Holarctic, where the family includes only two genera and three species found both in Europe and North America. In Europe this family includes two genera: *Diplocoelus* Guérin-Ménéville 1844 and *Biphyllus* Dejean 1821. Though this family needs a complete revision, the only worldwide catalogue (Kuhnt 1911) shows that *Diplocoelus* has one species in Europe, two in Alleghenian and several other in Australia, Central America and Southern America, while *Biphyllus* has two species in Europe and many other in Far East, South-Eastern Asia, Africa and Madagascar.

Diplocoelus has been known from Baltic amber too, but the only specimen cited by Klebs (1910) and later by other authors (Bachofen-Echt 1949; Spahr 1981) seems to be lost today. Moreover, no other representative of this family is present in the most important European Museums (Hieke & Pietrzeniuk 1984). In addition, Kirejtshuk & Azar (2008) mentioned an unidentified probable biphyllid from Lower Cretaceous Lebanese amber. Though Biphyllidae might be difficult identifiable as such, the fact that Klebs (1910) cited

only one specimen among more than 15.000 amber pieces of his collection implies that this family may be one of the biggest rarity in Baltic amber.

The species described below is the first described fossil belonging to the Biphyllidae.

Materials and methods

The specimen was fossilised in an oval piece of yellowish amber measuring ~30 × 50 mm.

Besides the beetle, two thin flies, a small non-biting midge (Chironomidae) and a dark-winged fungus gnat (Sciaridae) are present. No trace of stellate hairs (rests of oak flowers), a typical component of most Baltic amber, is present, while microscopic rests of wood are clearly visible.

After purchase, the amber has been cut and successively smoothed with abrasive papers having finer and finer granulation, obtaining a prismatic piece measuring 25×14 mm and having parallel faces for a better examination of the inclusion.

Observations of the fossil were made using a stereomicroscope with 20–40× eyepieces equipped with micrometer and digital photographic system. After the examination, the pieces have been coated for preservation in viscous Araldite Epoxy.

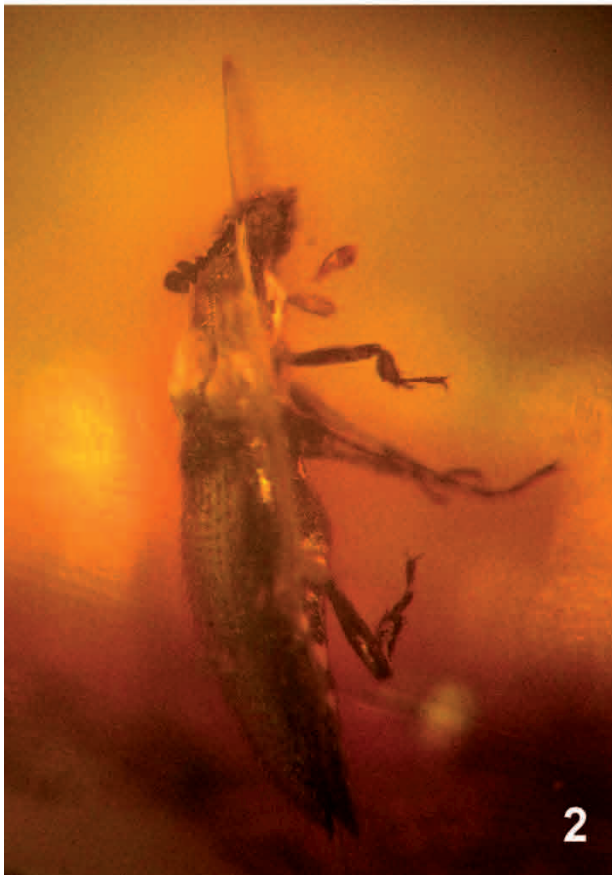
The reconstruction of the habitus has been obtained with a mixed traditional-computer graphic technique.

Results

Diplocoelus probiphyllus n. sp. (Figs. 1–3, 4b)

Holotype. Undetermined sex, Lithuania, Baltic Coast, ex. coll. M. Veta, author's coll.

Description. Body length 2.4 mm, width: 0.95 mm. Minute, elongate, flattened; body antennae and palpi pitch-black.



Figures 1–2
Diplocoelus probiphyllus n. sp., Holotype; 1, dorsal view; 2, lateral view.

Head transverse; antennal tubercles largely separated between them; eyes rounded, globose, coarsely faceted.

Antennae eleven-segmented, clubbed; covered with sparse semi-recumbent pubescence; scape short, globose, sub-triangular, with some short setae at the apex; pedicle sub-triangular, as long as and scarcely narrower than scape, with some short setae at the apex; antennomere III-VII sub-equal, triangular, close between them, scarcely but evidently shorter and narrower than pedicle; antennomere IX triangular, as wide as long and one-third wider than previous ones; antennomere X sub-triangular, strongly transverse, twice wider than long and twice wider than IX; antennomere XI elliptic, as wide as and scarcely longer than X.

Pronotum trapezoidal, transverse 1.4 times as wide as long; apex sinuate, frontward convex in the middle, finely furrowed along the margin, anterior angles strongly advanced and right; sides regularly convex, evidently converging anteriorly, scarcely and briefly converging posteriorly, flattened and coarsely crenulate along the margin, each denticule carrying a fine hair directed backward; basal angles rightly angulated; base 1.6 times as wide as apex between the anterior angles, sinuate, backward convex in the middle; disc uneven with two longitudinal furrows at each side; surface covered with short dense semi-recumbent pubescence, extremely finely punctate-reticulate and with coarse irregular sparse punctures.

Scutellum not distinguishable since covered by turbidity.

Elytra elongate, apically sub-acuminate, very slightly ovoid at the sides, their maximal width after humeri, here 1.6 times as long as wide; base slightly sinuate, anteriorly convex; humeri very feebly obtuse; surface covered by fine dense semi-recumbent pubescence, and by fine sparse points forming regular striae on the disc; distance between the points wider than the size of each point. Ventral side glabrous, inferior side of the head densely punctuated; prosternum finely furrowed along the margin and covered with a dense puncturing forming fine transverse wrinkles; meso-, metasternum and abdomen opaque, with a scarcely guessable structure; abdomen with 5 visible ventrites of decreasing length, except for the V one, as long as I.

Legs short, covered with very short semi-recumbent pubescence; protibiae stout, having two spines at the apex, one long and hooked, one-third as long as tarsus, and another right and stout; meso- and metatibiae longer and having two very fine spines at the apex; tarsi evidently shorter than tibiae, pubescent beneath except for the onychium; onychium as long previous tarsomeres together, claws simple.

Etymology

From the old Greek word *pro* (before) and the generic name *Biphyllus*.

Discussion

The systematic position of *D. probiphyllus* n. sp. appears to be questionable due to the fact that it shows “intermediate” characters between *Diplocoelus* and *Biphyllus*.

The most important difference between these genera is the structure of the antennal club: 2-segmented in *Biphyllus* (Fig. 4d) and 3-segmented in *Diplocoelus* (Fig. 4a,c) and the remaining genera of the family. In other words, the antennomere IX of *Biphyllus* is

cylindrical, as wide as preceding one and belonging to the flagellum, while the respective antennomere of most of the genera is flattened, as wide as the last two and belonging to the club.

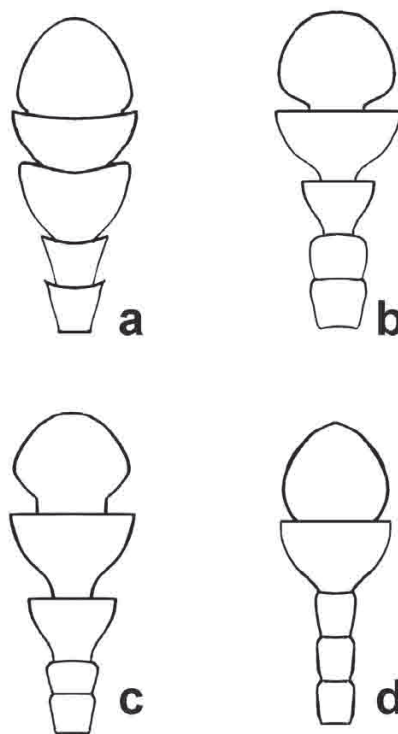
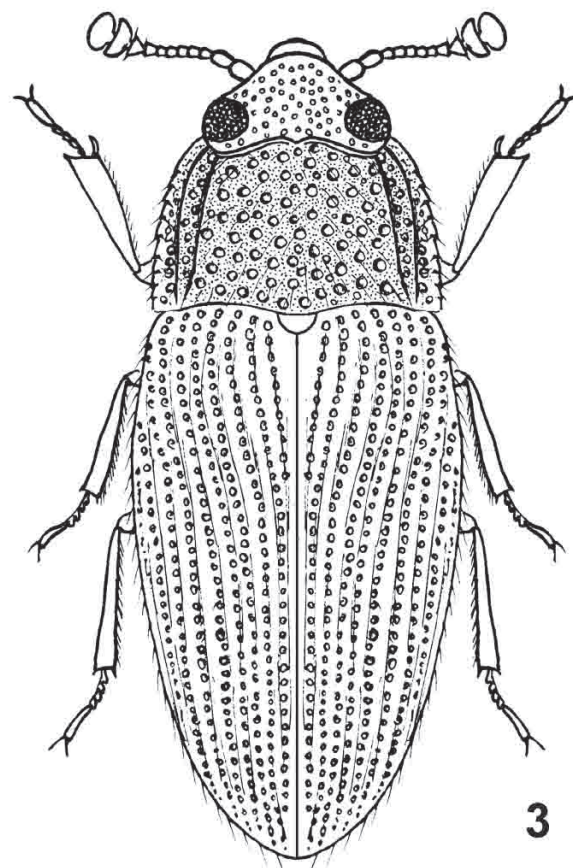
Instead, *D. probiphyllus* n. sp. has the antennomere IX (Fig. 4b) separated from the flagellum, angulated at sides and scarcely wider than the previous ones as in *Diplocoelus*, but much narrower than the last two antennomeres. Moreover, the pubescence of *D. probiphyllus* n. sp. is much less developed than that of the current *Diplocoelus* and extremely similar to that of *Biphyllus*. Its elytra are evidently striated as in *Diplocoelus* but finely and sparsely punctured as in *Biphyllus*.

Actually, the differences between *Diplocoelus* and *Biphyllus* are evident in their more extreme representatives, while other species are much more similar between them. In particular, the American *Diplocoelus rudis* (LeConte 1863) and *D. brunneus* LeConte 1863 have a compact large antennal club, strong puncturing and long pubescence (Fig. 4a), while the only European species, *Diplocoelus fagi* Guérin-Ménéville 1844, has a loose small antennal club, fine puncturing and short pubescence (Fig. 4c).

In contrast, *Diplocoelus fagi* and *Biphyllus frater* (Aubé 1850) share a double pronotal puncturing: one very fine and knurled, and another one coarser and sparse. This structure is absent from both American *Diplocoelus* but it is curiously present in *D. probiphyllus* n. sp. In fact, this character suggests a relationship among all European biphyllids (both fossil and living species, though belonging to different genera) and not between European and American *Diplocoelus*.

So, this new fossil species might also be described as belonging to the genus *Biphyllus*, nevertheless, the decision to describe it as *Diplocoelus* has seemed more correct on the basis of the next considerations: - *D. probiphyllus* n. sp. has not completely developed all typical characters of *Biphyllus* yet; - The 2-segmented antennal club of *Biphyllus* is an evident autapomorphic character, being 3-segmented club dominating in all other genera of Biphyllidae and other families of Cucujoidea (Węgrzynowicz 2002). *Diplocoelus* or other genera are in all likelihood the ancestors of *Biphyllus*; hence, *Diplocoelus* seems to be a more appropriate name for a fossil species.

The transatlantic distribution of *Diplocoelus*



Figures 3–4

3, habitus of *Diplocoelus probiphyllus* n. sp., Holotype. 4, Last five antennomeres of different False skin beetles. a, *Diplocoelus brunneus* LeConte 1863; b, *Diplocoelus probiphyllus* n. sp. c, *Diplocoelus fagi* Guérin-Ménéville 1844. d, *Biphyllus lunatus* (Fabricius 1792).

(especially the Alleghenian distribution of the Nearctic species) has a Tertiary or maybe older origin. This kind of spreading is more primitive than the Eurasian distribution of *Biphyllus* and more corresponding to that of a Baltic amber species.

On the other side, *D. probiphyllus* might have been even described as belonging to a completely new genus, but the differences between this fossil and both extant genera are actually very slight. This species seems instead to suggest that *Biphyllus* and *Diplocoelus* should be perhaps considered as two subgenera of the same genus, as already Ganglbauer (1899) noticed. Actually, the taxonomy of this family seems not enough elaborated and the diagnostics of its genera needs to be revised through further wide comparative analyses of its recent and fossil members.

Regarding the extant species, I was unable to directly confront *D. probiphyllus* n. sp. with all the representatives of the genus *Diplocoelus* but only with the Laurasian ones: the European *Diplocoelus fagi* and the Alleghenian *D. rudis* and *D. brunneus*. Both Mexican species (*D. parvus* Sharp 1900 and *D. bicolor* Sharp 1900) have been confronted only through the original descriptions and the provided drawings (Sharp 1900).

At the first look, *D. probiphyllus* n. sp. has a body shape more elongated than that of the Mexican congeners and similar to that of the Laurasian ones. This corresponds to the fact that the latter group should be more related to this new fossil species due to palaeogeographic reasons.

For other aspects, *D. probiphyllus* is closely related to the European *D. fagi*, due to the loose antennal club, the thinner pubescence and the finer puncturing. Actually, *D. fagi* seems to be even more primitive than *D. probiphyllus* n. sp. due to the completely developed antennomere IX. For this reason, *D. probiphyllus* n. sp. should not be considered as the ancestor of *Diplocoelus fagi* but might be as the one of the genus *Biphyllus*.

Conclusions

False skin beetles are rarely collected under dry barks of temperate broad-leaved trees. *Diplocoelus fagi* is associated with *Fagus sylvatica* L. (Ganglbauer 1899) and *Acer pseudoplatanus* L. (Alexander 2002); the Alleghenian *Diplocoelus* are also associated with the same genera (White 1983). The current European *Biphyllus* are associated with *Fagus* (Ganglbauer 1899) and *Fraxinus* (Alexander 2002).

The larvae and the adults are generally quoted as feeding on mycelium or spores of fungi (Goodrich 2002). In particular, *D. fagi* is associated with *Nectria cinnabarina* (Tode) Fr. (Alexander 2002), while at least

the larvae of the Australian *D. dilataticollis* Lea 1921 feed on fungi associated with damaged seed of *Acacia melanoxylon* R. Br. (Hugo *et al.* 2003). According to Ganglbauer (1899), *Biphyllus lunatus* (Fabricius 1792) was found on *Daldinia concentrica* (Bolton) Ces. & De Not (Xylariaceae), where it develops in the fruiting body (Alexander 2002).

Though a species doubtfully identified as *Diplocoelus ampliocollis* Reitter 1877 has been mentioned as host of *Araucaria angustifolia* (Bert.) Kuntze (Mecke *et al.* 2005), no Holarctic biphyllid of the Recent has been found on conifers. This fact might explain their exceptionality in Baltic Amber.

Furthermore, *D. probiphyllus* n. sp. implies the existence of temperate mixed-forests not very dissimilar to those actually present in Middle Europe or Balkans. Accordingly, this fossil species contributes to suggest that the climate of Baltic forests was much less warm than it has been until today hypothesised, as some studies on Trichoptera (Wichard 1988), Isoptera (Weidner 1995) and Cerambycids (Vitali 2005; 2006; 2009) also pointed out.

In this scenario, the subtropical or intertropical species described from Baltic Amber might be only the last relict species of an older previous climate or, much more simply, the more northern Boreal representatives of taxa widespread in sub-tropical zones.

Since Weitschat (1997) proved that Baltic amber did not include species of different altitudes (Heer 1865), the most logic explanation is that observed biocenosis must be referred to more recent ages. By confronting the supposed habitats with the temperature curve based on oxygen isotope measurement (Buchardt 1978), the Baltic amber should be dated at least to the Early Oligocene, as it was firstly hypothesised (Noetling 1883; 1888).

Bibliography

- Alexander K.N.A. 2002. *The invertebrates of living & decaying timber in Britain and Ireland. A provisional annotated checklist*. English Nature Research Reports 467, English Nature, Peterborough, 142 p.
- Bachofen-Echt A. 1949. *Der Bernstein und seine Einschlüsse*. Spinger, Wien 204 p.
- Buchardt B. 1978. Oxygen isotope paleotemperatures from the Tertiary period of North Sea Area. *Nature* 275: 121-123.
- Ganglbauer L. 1899. *Die Käfer von Mitteleuropa III. Familienreihe Staphylinidea, Familienreihe Clavicornia*. Gerolds C. Sohn, Wien, 1046 p.
- Goodrich M.A. 2002. Family 89. Biphyllidae LeConte 1861, p. 356-357 in: Arnett R.H., Thomas M.C., Skelley P.E., Frank J.H., *American Beetles II: Polyphaga: Scarabaeoidea through Curculionoidea*. CRC Press LLC, Boca Raton.
- Heer O. 1865. *Die Urwelt der Schweiz*. Schulthetz F, Zürich, XII + 622 p.
- Hieke F., Pietrzeniuk E. 1984. Die Bernstein-Käfer des Museums zur Naturkunde, Berlin (Insecta, Coleoptera). *Mitteilungen aus dem Zoologischen Museum für Naturkunde in Berlin* 60(2): 297-326.

- Hugo R. L. E., Merritt D. J., Wild C. H. 2003.** Gut content analysis to distinguish between seed feeding and mycophagy of a Biphyllid Beetle larva found on *Acacia melanoxylon*. *Biocontrol Science and Technology* 13 (3): 355-360.
- Klebs R. 1910.** Über Bernsteineinschlüsse in allgemeinen und die Coleopteren meiner Bernsteinsammlung. *Schriften der Physikalisch-ökonomischen Gesellschaft* 51: 217-242.
- Kuhnt P. 1911.** *Fam. Erotylidae*. Coleopterorum Catalogus 34. Schenkling S., Berlin 103 p.
- Kirejtshuk A. G., Azar D. 2008.** New taxa of beetles (Insecta, Coleoptera) from Lebanese amber with evolutionary and systematic comments. *Alavesia* 2: 15-46.
- Mecke R., Mille R., Engels W. 2005.** Araucaria beetles worldwide: evolution and host adaptations of a multi-genus phytophagous guild of disjunct Gondwana derived biogeographic occurrence. *Pró Araucária Online* 1: 1-18.
- Noetling F. 1883.** Über das Alter der samländischen Tertiärformation. *Zeitschrift der Deutschen Geologischen Gesellschaft* 35: 671-694.
- Noetling F. 1888.** Die Fauna des samländischen Tertiärs. Teil 2 (Gasteropoda, Pelycypoda, Bryozoa). *Abhandlungen zur geologischen Spezialkarte von Preußen und den Thüringischen Staaten* 6: 1-109
- Sharp D. 1900.** Cryptophagidae. Subfamily Biphyllinae, p. 604-626 in: **Sharp D., Matthews A., Lewis G. 1887-1905.** *Biologia Centrali-Americana*. *Insecta. Coleoptera II. Part 1*. Porter R. H., London.
- Spahr U. 1981.** Systematischer Katalog der Bernstein- und Kopal-Käfer (Coleoptera). *Stuttgarter Beiträge zur Naturkunde Ser. B (Geologie und Paläontologie)* 80: 1-107.
- Vitali F. 2005.** Notes about European fossil Lepturinae and the description of a new species (Coleoptera, Cerambycidae, Lepturinae). *Lambillionea* 105 (4): 530-538.
- Vitali F. 2006.** Taxonomic, biological and evolutionistic notes on the Spondylidinae included in Baltic amber (Coleoptera, Cerambycidae). *Entomapeiron* (P. S.) 1 (3): 29-44.
- Vitali F. 2009.** The cerambycids included in Baltic amber: current knowledge status with the description of new taxa (Coleoptera, Cerambycidae). *Denisia* 69: 231-242.
- Węgrzynowicz P. 2002.** Morphology, phylogeny and classification of the family Erotylidae based on adult characters (Coleoptera: Cucujoidea). *Genus* 13 (4): 435-504.
- Weidner H. 1995.** Die Bernstein-Termiten der Sammlung des Geologischen Staatsinstitutes Hamburg. *Mitteilungen des Geologischen Staatsinstitutes Hamburg* 24: 55-74.
- Weitschat W. 1997.** Bitterfelder Bernstein – ein eozyäner Bernstein auf miozyäner Lagerstätte. *Metalla* (Sonderheit) 66: 71-84.
- White R. E. 1983.** *A field guide to the Beetles of North America*. Houghton Mifflin Company, Boston, 368 p.
- Wichard W. 1988.** *Die Köcherfliegen. Trichoptera*. Die neue Brehm-Bücherei 512 (2. Aufl.), Ziemsen, Wittenberg, 63 p.