

REVISION OF THE SPECIES *Bauhinia bulgarica* Kitan. fil.
(Fabaceae) KNOWN FROM THE BULGARIAN UPPER
MIOCENE-LOWER PLIOCENE

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Abstract

A revision of the species *Bauhinia bulgarica*, which was found in the fossil macroflora of Garmen (SW Bulgaria), is presented. The fossil material originates from sediments dated as Late Miocene-Early Pliocene. The new taxonomic solution is *Smilax excelsa* L. foss. It is accepted on the basis of the close morphological structure of the fossil leaf imprint and the leaf forms of the recent *Smilax excelsa* L. (Smilacaceae), which is widespread in the SE Balkan Peninsula and SW Asia.

Key words: *Bauhinia bulgarica*, Bulgaria, Garmen, *Smilax*, Upper Miocene-Lower Pliocene, paleomacroflora

Introduction. The fossil macroflora of Garmen is extensively documented by KITANOV [1,2]. The author describes its composition of 84 taxa, and also determines the phytogeographical and ecological characteristics of this local paleoflora. Based on the correlations he makes with taxonomically and geographically close paleofloras, the author considers the age of the flora-bearing diatomaceous sediments as close to the Late Miocene-Early Pliocene. These sediments belong to the Baldevo Formation [3], which formed within the Gotse Delchev Graben (SW Bulgaria). A diatom analysis of the sediments [4] confirms this age.

Kitanov [2] singles out seven geographical elements in this paleoflora and determines their taxonomical abundance in percentages as follows: East Asian

(17.3%); North American (16%); Mediterranean (19.7%); Euro-Siberian (27.2%); Euxinian (11.1%); Subtropical (5%); Cosmopolitan (3.7%). It is in the weakly represented (quantitatively and taxonomically) subtropical element that the author places his new species *Bauhinia bulgarica* Kitan. fil. [5] (Fig. 1A). Subsequent revision of the fossil material from this site revealed that the determination of the leaf imprint as *B. bulgarica* was inaccurate. KITANOV [5] appears to have oriented the specimen upside down, thus describing its shape as critically different. This has led to incorrect results. The morphological features of the revised material have been examined and described again in this article in order to obtain a reliable identification.

Materials and methods. The studied material is stored in the paleobotanical collection of the Institute of Biodiversity and Ecosystem Research (PC-IBER), Bulgarian Academy of Sciences. It consists of two leaf imprints on sedimentary rock. These sediments are diatomites containing various admixtures of clay. We used leaves from the Collection of leaves of recent plants in the department of Paleobotany and a pollen analysis of IBER (LC-PPA) in our research for comparative plant material. Comparative leaf morphology images were also sourced from the Internet [6,7]. The determination of leaf type followed the scheme for leaf morphology of the angiosperms plants of DILCHER [8]. The photos were taken with a digital camera Pentax Optio E70L.

Results.

Systematics

Class Liliopsida

Family Smilacaceae Went.

Genus *Smilax* L.

Smilax excelsa L. fossilis (Fig. 1B)

1980. *Bauhinia bulgarica* Kitanov fil., p. 95, Pl. II, Fig. 1,2 [5].

1984. *Smilax excelsa* L. foss., Kitanov, p. 66, Fig. 15 [1].

Description:

Shape – the lamina and the base are symmetrical; lamina – very wide ovate; apex – acuminate; base – auriculate; leaf margin – entire. Venation – campylodromous; the central primary vein is straight, the first, the second and the third pairs of lateral primary veins are arcuate, converging toward the leaf apex; the primary veins are slightly undulate in their upper half; the veins that connect the primary ones are much thinner than the primary veins, they form an angle of origin type AA, type AO or type RR on the side of primary veins. Some of them branch off and others do not. Size – 4.1 cm in length, 4.9 cm in width.

Comparison:

Kitanov [5] erroneously perceived the structure of this leaf imprint and compared it to the recent species *Bauhinia faberi* Oliv. (Fig. 1E). In addition, this recent species has a different type of venation and leaf shape than those of the fossil material. This requires a revision of the material we have studied here.

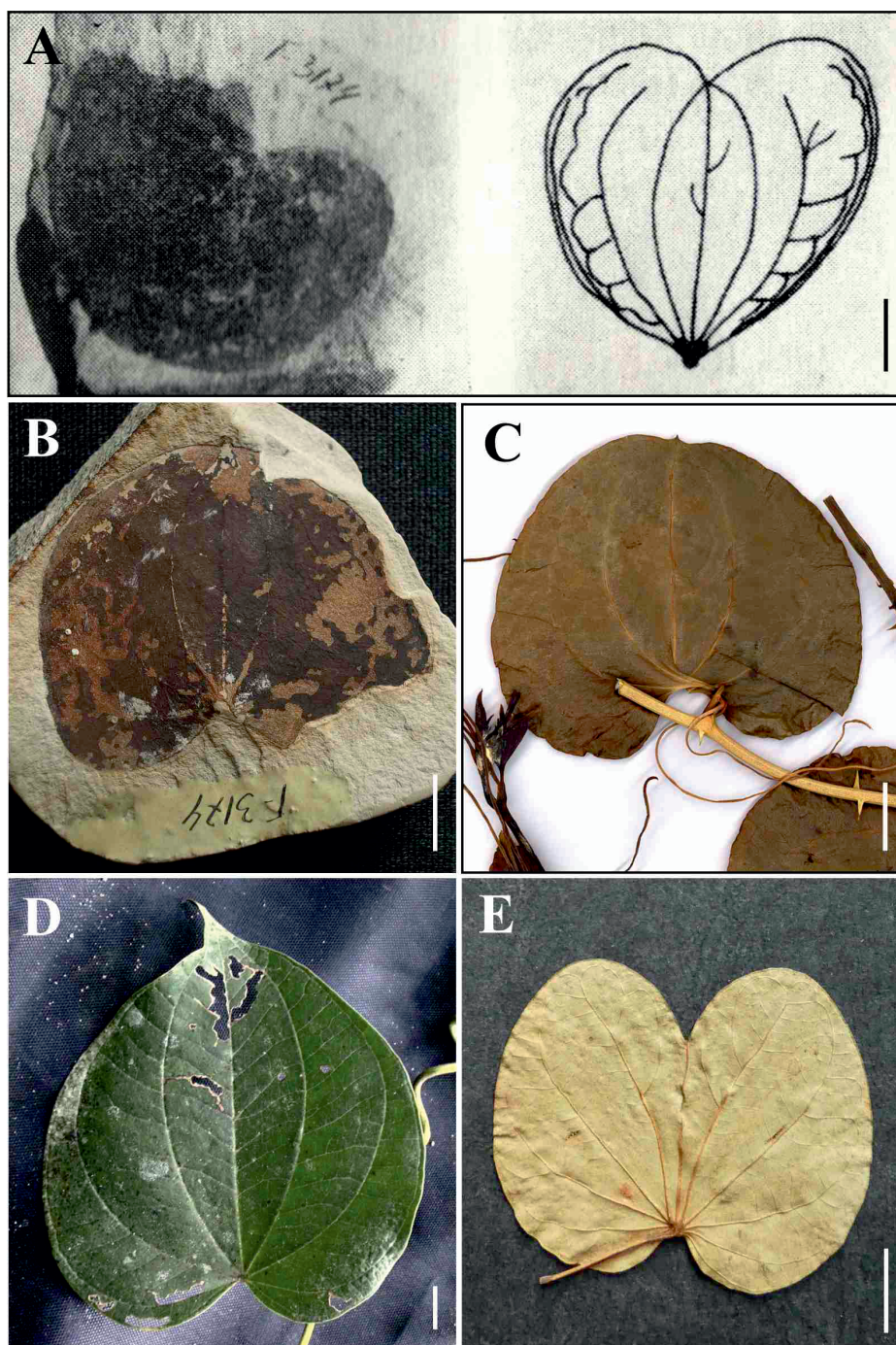


Fig. 1. Fossil and recent plant material: (A) *Bauhinia bulgarica*, after [5] (= *Smilax excelsa* foss. *hoc loco*); (B) *S. excelsa* foss. (No. G-3174, PC-IBER); (C) *S. excelsa*, after [6]; (D) *Dioscorea pubera*, after [7]; (E) *Bauhinia faberi* (LC-IBER). Measuring bar – 1 cm

The leaf imprint catalogued as No. G-3174 studied by us has very similar morphological features to those of the modern species *Smilax excelsa* L. (Fig. 1C), which is distributed in Bulgaria, Greece, Turkey, Lebanon, Syria, N. Caucasus, and Transcaucasia [9]. It is a creeping plant inhabiting moist riparian valleys up to 1000 m asl.

It is important that the fossil form of *Smilax excelsa* was found in the Garmen paleoflora [1], but the leaf imprint studied there (No. G-2890) has a distinctly different shape. It is ovate, narrowed in the middle of the leaf lamina. The leaf morphology of the modern species is very variable and there are forms that correspond to both morphological types registered in the local paleoflora of Garmen. In particular, there are transitional forms of leaves from those with very wide ovate shape to ovate and leaves that have from three to seven distinct primary veins. In the case of ovate leaf forms, there are also those narrowed in the middle of the lamina, which gives them an arrow-shaped appearance. Usually, the narrower the lamina, the smaller the number of primary veins.

Morphological features of the leaf lamina, which are similar to the fossil material studied by us, can also be present in members of *Dioscorea* (Dioscoreaceae). In this genus, leaf morphology also varies widely. According to RAZ [10], trusted European fossils records of the Dioscoreaceae have been found only in France and Hungary. Respectively, these are *Dioscoroides lyelli* (Wat.) Fritel from the Paris beds (Eocene, France) and *Dioscoreites* sp. from Mt. Kiseged (Lower Oligocene, Hungary). Our material, in addition to being of Late Miocene-Early Pliocene age (i.e. much younger), differs clearly enough in morphological features from the two Paleogene taxa. Differences are found in the shape of the leaf lamina, the base, the apex and the number of primary veins. Of the recent representatives of *Dioscorea*, the closest forms of leaf lamina exist in *D. pubera* Blume (Fig. 1D), which is widespread in Southeast Asia. The main feature in which the fossil material is closer to *Smilax excelsa* than to members of the genus *Dioscorea* is the shape of the primary veins. The primary veins are slightly undulate in their upper half in *Smilax excelsa* and the fossil form of this species, while in *D. pubera* they are stretched.

Discussion. Today the genus *Smilax* contains about 300 species widespread in tropical, subtropical, and temperate regions of both hemispheres [11]. *S. aspera* L. and *S. excelsa* are currently widespread on the territory of Bulgaria. Fossil forms of these two species have been found in the paleoflora of Garmen, albeit in very small numbers [2]. The stratigraphic range of the genus in the Bulgarian paleoflora is from the Upper Oligocene to the Upper Miocene-Lower Pliocene [12]. The two fossil species, from the Oligocene and Miocene *S. weberi* P. Wessel and *S. hastata* (Brongn.) Sap. are accepted as ancestral taxa of the recent *S. excelsa* and *S. aspera*, respectively [13]. The geohistorical distribution of the species of the genus on the territory of Bulgaria is one of the arguments for our taxonomic decision regarding the affiliation of the studied fossil material. Moreover, the

taxon identified by us has already been registered in the studied paleoflora. While the genus *Dioscorea*, with which one can look for similarities, is poorly represented only in the Paleogene of Europe and only in its western part [10]. This difference in stratigraphy and paleogeography supports the view that the material under study should rather be assigned to the genus *Smilax*.

The above-mentioned characteristic morphological features of the revised fossil material is an additional argument in our choice to place its taxonomic affiliation with the recent *S. excelsa*.

With the revision of *Bauhinia bulgarica*, one species of the subtropical element of the paleoflora of Garmen to which belong *Daphnogene bilinica* (Ung.) Kvaček et Knobl [= *Cinnamomum cinnamomeum* (Rössl.) Hollick], *D. lanceolata* Ung. [= *C. lanceolatum* (Ung.) Heer], and *Sassafras ferretianum* Mass. [2] has dropped out. According to Kitanov [2], the climatic conditions on the Late Miocene-Early Pliocene were getting closer to those of the present. The author argues that the representatives of the subtropical element and some other species that are related to recent plants from North America and East Asia are Miocene relics on the verge of extinction and were distributed in refugia, whose local microclimate provided the necessary conditions for their existence. *Smilax excelsa* foss. is a separate in Euxinian geographical element, which in quantitative terms is most widely represented in this local paleoflora and, accordingly, best outlines the parameters of the then existing climate. It was characterized by warm summers, winters without sub-zero temperatures and an average annual rainfall of not less than 2000 mm [2]. In this case, the high humidity may be due not so much to rainfall, but to the presence of a relatively large paleo-lake, into which the plant material has fossilized.

Conclusions. The revision of the species *Bauhinia bulgarica* indicates that the fossil material actually belongs to another genus, family and class. According to its morphological features, the revised material belongs to *Smilax excelsa* foss. This fossil form of the recent species *S. excelsa* has already been registered in the Garmen paleoflora. Its ancestral taxon *S. webery* was distributed during the Late Oligocene and Middle Miocene on the territory of Bulgaria. This information would be important in a future study on the evolution of the genus *Smilax* in Bulgaria during the Cenozoic.

The deletion of *Bauhinia bulgarica* from the subtropical geographical element in this local paleoflora enhances the importance of the Euxinian element represented by *Smilax excelsa* foss. The Euxinian geographical element is the most quantitative in the Garmen paleoflora and is the main determinant of the climatic parameters. Thus, it can be confirmed that the paleoflora of Garmen developed in mild winters, where there were no sub-zero temperatures, warm summers and high humidity, which contributed to the existence of a relatively large lake. A predominantly deciduous forest developed near it, but this forest also included a very small number of evergreen subtropical representatives, which were on the

verge of extinction from the territory of Bulgaria during the Late Miocene-Early Pliocene.

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REFERENCES

- [1] KITANOV G. (1984) Pliocene flora composition in the Gotse Delchev region, *Fitologiya*, **25**, 41–70 (in Bulgarian).
- [2] KITANOV G. (1984) Phytogeographic and ecological characteristics and age of the fossil flora of the vicinity of Gotse Delchev town and evolutionary trends in Pliocene floras in Bulgaria, *Fitologiya*, **27**, 40–54 (in Bulgarian).
- [3] VATSEV M. (1980) Lithostratigraphy of Neogene sediments from Gotse Delchev Valley, *Ann. High. Inst. Mining Geol., Geol.*, **25**(2), 103–115 (in Bulgarian).
- [4] TEMNISKOVA-TOPALOVA D., N. OGNANOVA-RUMENOVA (1983) Diatoms of freshwater Neogene diatomites in the Gotse Delchev region, *Fitologiya*, **22**, 29–45 (in Bulgarian).
- [5] KITANOV G. (1980) Neue Pflanzenarten aus dem Pliozän in Bulgarien, *C. R. Acad. Bulg. Sci.*, **33**(1), 93–96.
- [6] http://vanherbaryum.yyu.edu.tr/flora/azortandir/smilaxex/pages/Smilaxexcelsa_jpg.htm (accessed 14.06.2022).
- [7] <https://identify.plantnet.org/the-plant-list/species/DioscoreaPuberaBlume/data> (accessed 14.06.2022).
- [8] DILCHER D. (1974) Approaches to the identification of Angiosperm leaf remains, *Bot. Rev.*, **40**(1), 1–157.
- [9] Euro+Med (2006-): Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity (accessed 14.06.2022).
- [10] RAZ L. (2017) A review of the fossil record for Dioscoreaceae, *Bot. J. Linn. Soc.*, **183**, 495–508.
- [11] 'eFloras (2008) Published on the Internet' Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA, <http://www.efloras.org> (accessed 14.06.2022).
- [12] PALAMAREV E., V. BOZUKOV, K. UZUNOVA, A. PETKOVA, G. KITANOV (2005) Catalogue of the Cenozoic plants of Bulgaria (Eocene to Pliocene), *Phytol. Balcan.*, **11**(3), 215–364.
- [13] PALAMAREV E., A. PETKOVA (1987) La macroflore du Sarmatien. In: *Les fossiles de Bulgarie* (ed. V. Tzankov), Sofia, Bulgarian Academy of Sciences, **8**(1), 1–275 (in Bulgarian).

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