

Atlas Florae Europaeae notes 24. Taxonomic interpretation and typification of *Sorbus pannonica* (Rosaceae), a presumed intermediate between *S. aria* and *S. graeca* from Hungary

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The original taxonomic circumscription of *Sorbus pannonica* was uncovered in an inventory of historical herbarium collections. The presumed original material of the name included several taxa. The selected lectotype belongs to a species with elongate leaves, which are slightly obovate and minutely lobed apically, typically with a narrowly cuneate base and a short triangular apex. This triploid, presumably apomictic species seems to be endemic to the Transdanubian Mts. (Vértes, eastern Bakony Mts., eastern Balaton Uplands) within western Hungary. A new description and a revised distribution map of *S. pannonica* are provided, and the species is compared with the most similar taxa from Hungary. The provisional IUCN conservation assessment of *S. pannonica* is Vulnerable (VU).

Introduction

During an ongoing revision of critical groups of *Sorbus s. lato* in Hungary and adjacent countries for the forthcoming volume of *Atlas Florae Europaeae* we detected many unanswered questions regarding its taxonomy and distribution. In order to achieve a more correct taxonomy and more accurate mapping of the genus, we studied the collections identified as *S. pannonica* Kárpáti (Kárpáti 1944: 10) and its published treat-

ments. That species, originally described from the Carpathian Basin (Kárpáti 1960a: 180) and then reported from a number of European countries (*see* Kurtto 2009), is currently accepted to accommodate presumed intermediates between *S. aria* (L.) Crantz and *S. graeca* (Spach) Schauer (syn. *S. cretica* (Lindl.) Fritsch) (Kárpáti 1960a, Kovanda 1962, Soó 1966, Warburg & Kárpáti 1968, Kutzelnigg 1995, Kézdy 1999, 2012, Meyer *et al.* 2005, Kurtto 2009, Németh 2009, 2011, Feulner *et al.* 2013).

Our examination revealed that those treatments include more than one morphotype, and the specimens documenting the Hungarian taxa are too variable and apparently referable to more than one taxon. In this study, we provide an analysis of the putative original material and later collections identified as *S. pannonica* and typify the name to fix its application to a certain taxon in a narrow sense.

Material and methods

The collections of *Sorbus* preserved at BP, BPU, DE and CL were examined for the taxonomically relevant material and historical collections cited by Soó (1937) and Kárpáti (1960a). Some localities were visited in the field.

A new standardised description was compiled using the available herbarium material. All measurements were made on dried and pressed collections. Figures were made from photographed herbarium specimens.

A distribution map was compiled using the R software environment for statistical computing and graphics ver. 3.0.2 (R Development Core Team 2013). Functions *contour* (raster) and *hillShade* (raster) were used to compute the altitude contours at 50 m intervals and the hill shading raster. The basemap was derived from the NASA Shuttle Radar Topography Mission (SRTM) data (public domain) via the SRTM 90m Digital Elevation Database ver. 4.1 (<http://srtm.csi.cgiar.org>). Digital elevation model (DEM) was obtained using the R package *raster* from the hole-filled CGIAR-SRTM data with 90 m resolution (<http://srtm.csi.cgiar.org/>; non-commercial use of the data allowed). Waterbody data were downloaded from NASA's SRTM Water Body Data (SWBD) (http://dds.cr.usgs.gov/srtm/version2_1/SWBD/).

Distribution data are based exclusively on herbarium specimens. Given the level of precision available from old herbarium labels, only one record per landscape unit (e.g. a single hill or valley) is displayed. Geographical coordinates were transformed to the Lambert Cylindrical Equal Area projection using the R function *spTransform* (sp, rgdal). The extent of occurrence of the species, defined as the smallest

area which can be drawn to encompass all the recorded localities (IUCN Standards and Petitions Subcommittee 2013), was inferred from a convex hull that was drawn around the points using the R function *chull*, and the area of the resulting polygon in square kilometers was calculated. The polygon was further adjusted to exclude landscapes that cannot be inhabited by the species. The area of occupancy of the species, defined as the area actually occupied by the recorded localities (IUCN Standards and Petitions Subcommittee 2013), was obtained using the grid cell method. The grid was created ad hoc with the grid cell size set at 1 km², which is deemed to match the accuracy of the data collection. The resulting grid was overlaid on the distribution map, and the occurrence cells were counted to provide the basis for a provisional IUCN assessment. A list of the specimens examined, serving for documentation of the treatment and distribution map, is provided.

The Hungarian literature on *Sorbus* was screened for protologues and further interpretations of the names involved in historical circumscriptions of *S. pannonica*. References to the *International Code of Nomenclature for algae, fungi and plants* are provided according to its Melbourne edition (McNeill *et al.* 2012).

Taxonomy

History of the species concept

Intermediate morphotypes between *S. aria* and "*S. cretica*" (= *S. graeca*) in Hungary were recognised first by Jávorka (1915) who refrained from naming them. Soó (1937) followed Jávorka (1915) and formally recognised two taxa at the rank of form between his *S. aria* subsp. *aria* and *S. aria* subsp. *cretica*, namely *S. aria* f. *pseudaria* Soó that approaches *S. aria* subsp. *aria*, and *S. aria* f. *pseudocretica* Soó that approaches *S. aria* subsp. *cretica*. Of these two, the first taxon was reported from a few extremely scattered localities in Hungary, Slovakia and Austria, whereas the second taxon was based exclusively on few specimens from the Bükk Mts. (Soó 1937).

Kárpáti (1944: 10) described *S. pannonica* to embrace "all intermediate forms" between his

broadly treated *S. aria* and “*S. cretica*”, including the forms described by Soó. Because of the collective nature of *S. pannonica*, acknowledged already in its protologue, Kárpáti provided a very brief Latin diagnosis of the taxon. According to Kárpáti (1944), *S. pannonica* differs from *S. aria* in its leaves being smaller, shorter, thicker and with less numerous lateral veins, and from *S. cretica* in its leaves being larger, longer, thinner and with more numerous lateral veins. No statement was made about the leaf shape, probably because the adopted concept included a large variability in this character.

Although Kárpáti (1944) did not cite any specimens in the protologue of *S. pannonica*, the material which he probably used can be assembled from the pre-1944 specimens revised by him. We had some difficulties in tracing those specimens. Firstly, Kárpáti’s revision labels are never dated, so our interpretation involved some guesswork. Secondly, not each specimen studied by Kárpáti was labelled by him, although some unlabelled specimens cited in Kárpáti (1960a: 182–183) may have been included in the original circumscription of *S. pannonica*. Thirdly, some specimens were identified by Kárpáti with doubts. Such specimens were also considered because they were cited in Kárpáti (1960a).

Apart from a few distant and isolated localities, the distribution range of the original *S. pannonica* is confined to the Transdanubian Mts. within the Hungarian Middle Range, specifically to the Buda, Gerecse, Vértes and eastern Bakony Mts. (corresponding to the contiguous phytogeographical regions *Pilisense* and *Vesprimense* within *Pannonicum*, see Kárpáti 1960b). The isolated records come from the Gömör–Torna Karst (phytogeographical region *Tornense* within *Pannonicum*) and the Bükk Mts. (*Borsodense* within *Pannonicum*) in the North Hungarian Mts., as well as from Slovakia (*Posonicum*, *Scepusicum*, *Cassovicum* within *Carpathicum*) and Romania (*Domugledicum* within *Moesicum*).

Later Kárpáti (1960a: 182) provided a more detailed description of *S. pannonica*, stating it has ovate or lanceolate-ovate leaves (at most one and a half times as long as wide) with a subrotund or broadly cuneate base. In the identification key he placed this species in the group of species with undivided leaves, which, however,

may be distinctly dentate or irregularly incised (Kárpáti 1960a: 146–147). At the same time Kárpáti (1960a: 184) presented a number of line drawings of leaves of *S. pannonica*, which show diverse but, except for one, non-ovate leaf shapes. Although the original circumscription of *S. pannonica* included a few specimens from the eastern part of the North Hungarian Mts. and eastern Slovakia, by citing a great amount of post-1944 specimens from the Bükk Mts. (*Borsodense*), Kárpáti (1960a: 182) eventually extended the core of the putative distribution area of the taxon in the northeastern direction. Formal taxonomic recognition of infraspecific taxa within *S. pannonica* was dropped by Kárpáti (1960a).

The putative material linked with the protologue of *S. pannonica* is highly diverse in its leaf morphology, including plants with elliptic-obovate or oblanceolate leaves with a cuneate base, those with elliptic (non-ovate) leaves, and also those with apparently ovate leaves with a subrotund base. The leaves may be minutely dentate, or distinctly dentate to slightly lobed. Since leaf shape and dentation are among the most important characters in distinguishing between apomictic taxa related to *S. aria* (e.g. Rich *et al.* 2010), Kárpáti’s material of *S. pannonica* is apparently taxonomically heterogeneous and must be evaluated very carefully, in order to select the most suitable type for this name.

Taxonomic analysis of the material linked with the protologue

All the specimens presumably linked with the protologue of *S. pannonica* were traced and studied by us, irrespective of their taxonomic identity and relevance to typification. Those specimens, grouped according to phytogeographical regions, were identified according to current taxonomic concepts.

Pilisense: From the list given by Kárpáti (1960a: 182–183), Degen’s specimen collected in 1900 in the Visegrád Mts. (Pomáz: “Dömörkapu”, BP *s.n.*) probably belongs to *S. danubialis*, whereas Boros’ sterile specimen with non-ovate (mostly elliptic) leaves

collected in 1940 in the Gerecse Mts. (Szár: “Zuppa”, BP 432448) represents *S. graeca s. lato*. The remaining pre-1944 specimens (“Hármashatár-hegy”, 1905, *S. Jávorka*, BP 702570, BP 199917); “Mátyás-hegy”, 1943, *Á. Boros*, BP 432227; “Zugliget”, 1891, *V. Borbás*, BP *s.n.*) all come from the Buda Mts. They are taxonomically conspecific, but only Jávorka’s gathering has clearly ovate leaves (nicknamed as “subdanubialis type”), in accordance with the description of *S. pannonica* in Kárpáti (1960a). The ovate shape of leaves in these specimens is most similar to that of *S. subdanubialis* (Soó) Kárpáti, which was described from eastern Hungary and neighbouring Slovakia.

Vesprimense: Almost all the traced pre-1944 specimens collected in the Vértes Mts. (Csákvár, 1929, *Á. Boros*, BP 702572, BP 720026, BP 80996, BP 432474; Vérteskozma: “Fáni-völgy”, 1932, *G. Lengyel*, BP 300029; same locality, 1933, *G. Lengyel*, BP 300027; same locality, 1933, *Z. Zsák*, BP 701424, BP 701425; same locality, 1934, *Á. Boros*, BP 432472, BP 80995; Gánt, 1936, *Á. Boros*, BP 720031, BPU 1177; Gánt-Kápolnapuszta: “Juh-völgy”, 1940, *Á. Boros*, BP 432917; Oroszlány-Mindszentspuszta: “Hajszabarna”, 1937, *Á. Boros*, BP 432490) belong to a morphotype characterised by somewhat elliptic-obovate or oblanceolate leaves with a cuneate base and often small but distinct blunt apical lobes (nicknamed as “Vértes type”), whereas Boros’ specimen collected in 1934 at Csákvár (“Badacsony-hegy”, BP 432426) represents *S. graeca s. lato*. Similarly, some of the relevant specimens collected in the eastern Bakony Mts. (Várpalota, *s.d.*, *J. Sadler*, BP 613935; Isztimér: “Burok-völgy”, 1936, *L. Vajda*, BP 390405; Eplény: “Tobán-hegy”, 1932, *S. Polgár*, DE *s.n.*) represent the “Vértes type”, whereas Boros’ specimen from Bodajk (“Gaja-szurdok”, 1938, BP 432583, BP 432584) strongly resembles the “subdanubialis type” of the Buda Mts. A few duplicates of the specimens cited above were found among the material that was not revised by Kárpáti; besides, several duplicates were identified and cited by Kárpáti

(1960a) as *S. aria*, *S. aria f. incisa*, *S. cretica*, or *S. subdanubialis*.

Tornense: Two relevant gatherings were traced. Hulják’s specimen collected in the “Szádelői völgy” (= Zádielska dolina [valley] in the present-day Slovakia) in 19 May 1907 (BP 702030) was revised and cited as *S. pannonica* by Kárpáti (1960a: 182). However, that specimen is part of a gathering, the duplicates of which were revised and cited under three (!) different names in Kárpáti’s monograph. Zádielska dolina is a classical locality of *S. subdanubialis*, and we consider Hulják’s gathering belonging to the latter species. The other relevant gathering is that of Boros from Esztramos hill (near Bódvarákó village, Hungary), collected in 18 July 1938. Three duplicates were traced, of which one (BP *s.n.*) was revised and cited as “*S. cretica f. orbiculata*” by Kárpáti (1960a: 171), the other two (BP 432525, BP 432591) as “*S. thaiszii*” (Kárpáti 1960a: 183). Although the specimen is referable to *S. thaiszii*, it was probably also cited as *S. pannonica* by Kárpáti (1960a: 182), because in Boros’s diary (unpublished manuscript stored in the library of the Hungarian Natural History Museum) the only *Sorbus* specimen mentioned from that day is named “*Sorbus cretica-aria = S. pannonica* Kárp.”

Borsodense: A few pre-1944 specimens were traced, all collected in the Bükk Mts. in Hungary. Boros’s sterile specimen (“Vöröskőbérc”, 1937, BP 432453) probably belongs to *S. bueckensis* (Soó) Soó. The specimens collected at “Ördögoldal” (*B. Zólyomi & I. Máthé*, 1932, BP 720021, DE *s.n.*), as well as those from “Örvény-kő” (*I. Máthé*, 1933, BP 720014, BP 720015, BP 720024; *R. Soó*, 1937, DE *s.n.*) display mostly elliptic-lanceolate leaves and belong to various forms of *S. aria s. lato*.

Isolated localities in the Carpathicum and Moesicum (Posonicum, Scepusicum, Cassovicum, Domugledicum): A few pre-1944 specimens collected in the present-day Slovakia (*Posonicum*: “Pressburg” [Bratislava], *s.d.* [19th century], *A. Schmeller*, BP 613937 [?]; Dévény: “Dévényi Nagytető” [Mt. Devínska Kobyla near Bratislava], 1916, *Gy. Gáyer*, BP 702568; *Scepusicum*: Dobsina [Dobšiná in

Košice Region]: “Stein”, 1929, *G. Lengyel*, BP 301836, BP 301837, BP 304227) have broadly elliptic leaves with a subrotund base. Those specimens most likely belong to *S. aria s. lato* with a lesser number of lateral nerves, or partly to *S. graeca s. lato*, and are significantly different from the main morphotypes occurring in the present-day Hungarian areas of the original *S. pannonica*. Even Kárpáti was not consistent in his identifications, because Lengyel’s gathering was revised and cited under two names (*S. cretica* f. *orbiculata*, *S. pannonica*) by him (Kárpáti 1960a: 171, 183, respectively). The two specimens with elliptic leaves from the *Cassovicum* (Slovakia. “Kassa” [Košice]: Mt. “Bankó”, 1939, *I. Máthé*, BP 720758, CL 533451) cited by Kárpáti (1960a: 183) as *S. pannonica* most probably also belong to *S. aria s. lato*. The only Romanian specimen (*Domugledicum*: Herkulesfürdő [Băile Herculane]: “Domugled”, 1911, *N. Filarszky* & *S. Jávorka*, BP 702569) has obovate-elliptic leaves, resembling those of *S. herculis* Kárpáti.

Austria: Kárpáti (1960a: 183) cited a single specimen from Austria, collected by Boros on the hill of Leopoldsberg in Vienna. We traced a specimen collected by Boros at this locality on 10 July 1923 (DE *s.n.*) that, although without Kárpáti’s revision label, was identified as verging upon *S. aria* f. *pseudocretica* by Soó. Most likely that specimen is part of the material included in the concept of *S. pannonica* by Kárpáti; because of symmetrically elliptic-lanceolate leaves, it is identified as *S. aria s. lato*.

On the basis of this analysis we can conclude that the majority of the pre-1944 material of *S. pannonica* came from the Buda, Vértes and eastern Bakony Mts. The specimens represent two rather extensive and solid areas and are referable mostly to two major morphotypes which are distinct from *S. aria s. lato* (one with obovate, the other with rather ovate leaves). Specimens from other territories belong either to *S. aria s. lato* (with elliptic leaves, mostly with fewer number of lateral nerves) or to other taxa that were occasionally misidentified by Kárpáti.

Taxonomic analysis of the later collections cited in Kárpáti (1960a)

In his monograph Kárpáti (1960a) cited a great amount of post-1944 material under *S. pannonica*. Of this material, those specimens collected in the Bükk Mts. (*Borsodense*) belong to diverse taxa (mainly *S. aria s. lato*, *S. graeca s. lato*, *S. thaiszii*, *S. bueckensis*), those from the *Pilisense* mostly belong to the “subdanubialis type”, and those from the *Vesprimense* are referable mostly to the “Vértes type”. These additions reinforced the importance of the *S. aria*-like material from the Bükk Mts., which had been much less represented in the pre-1944 material.

A series of illustrations of *S. pannonica* presented by Kárpáti (1960a: 184) was based exclusively on specimens collected in the Bükk Mts. in the 1950s. Although those illustrations were in contrast with the amended description of the species in Kárpáti (1960a: 182), they strongly influenced subsequent interpretations of this name. As evident from the traced material, the illustrations belong to different morphotypes. The pictures of leaves from “Tar-kő” (BP), “Kapu-bérc” (BP 701441, BP 701426) and “Ilus-kút” (BP 701447) are based on plants of *S. aria s. lato* (or perhaps partly *S. graeca s. lato*), whereas a picture from “Jávorka-hegy” (BP 701422) represents an undivided leaf of *S. bueckensis*.

Among the records in Kárpáti (1960a), the westernmost and remote locality on Mt. Badacsony (western Balaton Uplands, *Balatonicum* within *Pannonicum*) was new, and significantly expanded the distribution area of the species westwards. This isolated record is based on a single specimen traced (1950, *Á. Boros*, BP 432899), which seems to belong to an undescribed apomictic taxon related to *S. danubialis*.

The visualization of the distribution of *S. pannonica* in Hungary was provided recently by Kézdy (2012: 144), who mapped the localities in the Hungarian Middle Range most likely based on the records cited in Kárpáti (1960a).

Taxonomic interpretations

The name *S. pannonica* is widely used not only in Hungary (Soó 1966, Kézdy 1999, 2012,

Németh 2009, 2011), but in the European literature as well (see Bresinsky 1978, Májovský 1992, Kutzelnigg 1995, Kliment 1999, Kurtto 2009), though some authors stressed the collective nature of the taxon (Kovanda 1962, Meyer *et al.* 2005) or even assumed that different morphotypes labelled by this name represent reproductively isolated apomictic taxa (Meyer 2011, Feulner *et al.* 2013). In the absence of a type designation, and because of the broad original circumscription, subsequent authors were forced to interpret the name *S. pannonica* on the basis of published statements and illustrations in Kárpáti (1944, 1960a).

In Kárpáti (1960a), the amended description of *S. pannonica* stating “*folia ovata vel ovato-lanceolata*” (probably based on specimens from the Buda Mts.) contradicted the illustrations displaying largely elliptic leaves (based on specimens from the Bükk Mts.), and this fact caused some confusion over the interpretation of this species among later Hungarian researchers. In the illustrative supplement to his work, Kézdy (1999) illustrated a leaf of *S. pannonica* that is slightly obovate and thus referable to the “Vértes type”. At the same time, however, he reported *S. pannonica* to be widespread in the whole Hungarian Middle Range (Kézdy 1999: 184). The account by Németh (2009) copied Kárpáti (1960a), characterising the leaf shape of *S. pannonica* as “ovate or ovate-lanceolate”, whereas in the illustrative part of that book (Németh 2011) the species was presented as having elliptic (non-ovate) leaves. Nevertheless, all the Hungarian authors (Soó 1966, Kézdy 1999, 2012, Németh 2009, 2011) retained taxonomically discordant elements in the concept of *S. pannonica*, as evident from the extensive distribution area credited for this species.

A different interpretation of the name *S. pannonica* was adopted by German authors (Bresinsky 1978, Meyer *et al.* 2005, Feulner *et al.* 2013) for plants from Bavaria. Those authors did not follow the interpretative illustrations in Kárpáti (1960a) but the original taxonomic concept and diagnosis of *S. pannonica* (Kárpáti 1944), stating that it should be a species with rather rigid leaves that is intermediate (presumably a hybrid) between *S. aria* and *S. graeca*. Plants previously named *S. pannonica* in Germany (Meyer

et al. 2005) have slightly obovate leaves with a cuneate base, and are either tetraploids or triploids, whereas the triploids appear to be intermediates between the tetraploids and *S. aria s. stricto* (Feulner *et al.* 2013). In Hungary, among those that are represented in the pre-1944 material of *S. pannonica*, the most similar morphotype occurs primarily in the Vértes and eastern Bakony Mts. (“Vértes type”). The ploidy level of this morphotype is also determined as triploid.

Discussion and typification

As we can see from the analysis of the pre-1944 material of *S. pannonica*, which includes the putative original material of the name, it embraces quite many discordant elements. The validating diagnosis of *S. pannonica* is so brief and general that it agrees with almost all the specimens revised by Kárpáti, in spite of their apparent heterogeneity. Kárpáti (1960a) is the first basis for interpreting this species name through assembling the putative original material, because it is the only source in which Kárpáti’s identifications can be completely traced, as they are sometimes missing on herbarium sheets. Although Kárpáti (1960a) retained the original (Kárpáti 1944) taxonomic concept of *S. pannonica*, and we could not find any revised identifications of his own on the traced herbarium specimens, we have evidence that in some cases he changed his identifications over time. For example, Kárpáti (1944) initially included two Soó’s taxa (*S. aria* f. *pseudaria*, *S. aria* f. *pseudocretica*) into the concept of the newly described *S. pannonica*, but subsequently definitely excluded almost all of their elements. As a result, not a single element of Soó’s *S. aria* f. *pseudocretica* was left by him in the concept of *S. pannonica* at the time of his monograph (see Kárpáti 1960a: 150).

Since the putative original (pre-1944) material of *S. pannonica* is demonstrably heterogeneous, it could be practical to fix the application of this name as to preserve its current usage (Rec. 9A.4 of the ICN). However, after Kárpáti, in Hungary the name *S. pannonica* was used in the same broad sense. The German morphotypes of *S. pannonica s. lato* (Meyer *et al.* 2005,

Feulner *et al.* 2013) are also diverse and are not represented in the pre-1944 material of *S. pannonica* or in Hungary as a whole. The type choice is therefore dependent on a better match with the diagnosis and the current concept and application of the name, as well as the taxonomic knowledge of the *S. aria*-group in particular territories.

Of the material presumably linked with the protologue of *S. pannonica* we *a priori* excluded the specimens without Kárpáti's revision labels or with his uncertain identifications. Such specimens do not constitute original material because it cannot be shown that the validating diagnosis of *S. pannonica* was based on them (Art. 9.3 of the ICN). For the purpose of typification we analysed exclusively the specimens labelled by Kárpáti as *S. pannonica* and collected before publication of the protologue of that name, assuming that Kárpáti may have used some of those specimens to produce the Latin diagnosis.

We can disregard in typification the few pre-1944 specimens from the Bükk Mts. (*Borsodense*), because their leaves are rather thin and soft, which contradicts the statement in the original diagnosis of *S. pannonica* (saying that its leaves are more rigid than in *S. aria*). These specimens belong to *S. aria s. lato*, displaying elliptic and elliptic-lanceolate leaves. Moreover, attaching the name *S. pannonica* to any of the numerous and poorly known morphotypes of *S. aria* group from the Bükk Mts. would be contrary to the current concept of *S. pannonica*.

For similar reasons we also exclude from consideration a small number of pre-1944 specimens of *S. aria s. lato* (or *S. graeca s. lato*) from other territories (*Posonicum*, *Scepusicum*, *Casovicum*) that were identified as *S. pannonica* by Kárpáti. Those taxonomically poorly-known specimens have nearly elliptic leaves with a cuneate to broadly cuneate (subrotund) base, and with an almost regular dentation. Excluded are a few misadded specimens of diverse species (e.g. *S. buekkensis*, *S. danubialis*, *S. thaiszii*) too.

The remaining part of Kárpáti's specimens presumably revised before 1944 has the leaves with semirigid laminas, in a better agreement with the original diagnosis. There are two main morphotypes that are represented by a number of specimens and originate from compact and

somewhat separate areas: the "Vértes type" that seems to be confined to the Vértes, eastern Bakony Mts. and eastern Balaton Uplands, and the "subdanubialis type" from the Buda Mts. and its vicinity.

The "subdanubialis type" (Buda Mts.) shows some similarity to *S. subdanubialis*, which was described from northeastern Hungary and eastern Slovakia, and subsequently reported from a number of localities in Hungary, including the Buda Mts. (Kárpáti 1960a). Confirming the similarity, some herbarium specimens of the "subdanubialis type" from the Buda Mts. were revised as *S. subdanubialis* by Kárpáti. This morphotype represents a small fraction in the original material. Leaves of this material are in full agreement with the statement "*folia ovata vel ovato-lanceolata*" in Kárpáti (1960a), at least regarding the fertile short shoots, but this choice would be disruptive to the current application of the name *S. pannonica*. Currently *S. pannonica* is stated to be widespread (Soó 1966, Kézdy 1999, 2012) or at least sporadically present (Németh 2009) in the Hungarian Mountain Range, and restricting this name to a morphotype that seems to have a very narrow distribution range would be quite misleading. Moreover, it would be contrary to the current application of the name *S. pannonica* in Germany that is also not in agreement with the more ovate leaves of the "subdanubialis type" (see Kutzelnigg 1995, Meyer *et al.* 2005). The taxonomy of *S. subdanubialis s. lato* in Hungary is the subject of our forthcoming contribution.

The "Vértes type" is the major element of the original material of *S. pannonica*, represented by many specimens and occurring in the largest area. This morphotype is more similar to *S. aria s. lato* but readily differs from the latter in its leaves being slightly obovate and lobed only in the upper part of the lamina, whereas the leaves of the incised morphotype *S. aria f. incisa* are regularly elliptic and lobed within the apical two thirds of the lamina (e.g. Meyer *et al.* 2005, Rich *et al.* 2010). The leaves of the "Vértes type" are similar to those of *S. ulmifolia*, and these two morphotypes, sharing the same area, are apparently related; the leaves of the "Vértes type" are more elliptic, only slightly obovate, and their apical lobes (if present) are

rather obtuse, whereas the leaves of *S. ulmifolia* are broader, more clearly obovate, and their apex and serration are more acute. The latter taxon was originally established on the basis of three taxonomically heterogeneous collections (Kárpáti 1960a), and its name has been validly published only recently (Németh 2010). The leaf shape of the “Vértes type” is also similar to that of “*S. pannonica*” of Meyer *et al.* (2005) (“Tennischläger”), but it readily differs in its narrower leaves with their more acute and more distinctly lobed apical part.

The leaf shape of the “Vértes type” does not fit the identification key or the amended description of *S. pannonica* in Kárpáti (1960a), but it is not in contradiction with the original diagnosis of the taxon (Kárpáti 1944). Based on the contemporary Hungarian literature and recent herbarium collections, the “Vértes type” is widely considered belonging to *S. pannonica* in its broad sense. Being a triploid, it also agrees with the presumed derivation of *S. pannonica s. lato* from crosses between the diploid *S. aria* and the tetraploid *S. graeca* group (Meyer *et al.* 2005, Feulner *et al.* 2013).

To retain the application of the name *S. pannonica* within the group of hybrids to which it is currently applied (Meyer *et al.* 2005, Feulner *et al.* 2013), we typify it with a specimen of the “Vértes type” collected by Vajda from “Burok-völgy” [Burok valley, which belongs to three settlements but mainly to Isztimér village, Fejér county] in the eastern Bakony Mts., where several well-preserved post-1944 specimens were also collected. These collections represent the taxon in different stages (with well-developed leaves of fertile and sterile short shoots and also those of long shoots), and their identity is beyond doubts.

The name *S. aria* f. *pseudaria* is rendered a synonym of *S. pannonica s. stricto* by designating a specimen collected by Polgár in Mt. Tobán (eastern Bakony Mts.) as its lectotype. That specimen was retained in the circumscription of *S. pannonica* in Kárpáti (1960a).

***Sorbus pannonica* Kárpáti**

Borbásia Nova 25: 10. 1944. — LECTOTYPE (designated here):

Hungary. Bakony Mts.: Isztimér, “Burok-völgy”, 24 May 1936, L. Vajda *s.n.*, as *S. aria*, rev. Z. Kárpáti as “*S. pannonica* Kárp. = *aria-cretica*” (BP 390405!) (Fig. 1).

Sorbus aria f. *pseudaria* Soó, Tisia 2: 222. 1937, *syn. nov.* — *Sorbus pannonica* “positio” *pseudaria* (Soó) Kárpáti in Borbásia Nova 25: unnumbered page. 1944. — LECTOTYPE (designated here): Hungary. Bakony Mts.: “Mons Tobán, in calcareis apricis ca. 390 m s. m.”, 4 July 1932, S. Polgár 4092, as *S. cretica*, rev. R. Soó as “*S. aria* typ. – *S. cretica* typ. (*S. pseudaria* Soó)”, and Z. Kárpáti as “*S. pannonica* Kárp. = *aria-cretica*” (DE *s.n.*!) (Fig. 2).

ETYMOLOGY. The species epithet is derived from the name of Pannonia, a historical region and a province of the Roman Empire that stretched eastwards up to the city of Aquincum (situated within the present-day Budapest). Pannonia included present-day western Hungary and the distribution area of *S. pannonica s. stricto*.

Shrubs or trees. Bark grey; twigs brownish grey; young shoots brown, with numerous whitish lenticels. Buds ovoid, ± acute, with sparsely tomentose scale margins. Leaves simple, semi-rigid, dark green and glabrous above, whitish and thin tomentose beneath, petioles 10–15(–20) mm long; leaf blades on sterile short shoots (6.5–)7–11(–12.5) × (4–)4.5–7(–8) cm, narrowly elliptic-obovate to almost elliptic (ratio length/width = ca. 1.6–1.75), widest at upper third or slightly above middle of lamina length, apex subrotund with slightly convex sides, triangular at top, sometimes shortly acuminate, minutely serrate to slightly lobed (upper side of largest lobe up to 4–5 mm), base narrowly cuneate to cuneate, without teeth in lower third part, veins (8–)9–11(–12) on each side; leaf blades on short fertile shoots similar in shape but usually broader and with a more profound dentation. Inflorescence compact, corymbose, branchlets tomentose. Sepals triangular to narrowly triangular, densely tomentose on both surfaces; petals white, elliptic to broadly elliptic, 5–7 × 3.5–4.5 mm; stamens ca. 20; filaments whitish; anthers yellow to slightly pinkish. Fruits globose or subglobose, largest ones ca 10–13 mm across, red when fully ripe, with numerous small lenticels. Seeds not observed. Flowering in late April to May, fruiting in September to October.

VARIABILITY AND COMPARISON WITH SIMILAR TAXA: The apical part of leaf lamina is variably (almost indistinctly to prominently) but constantly divided into very small lobes. In general, the species may be characterised by a clear dominance of elongate leaves, which are slightly

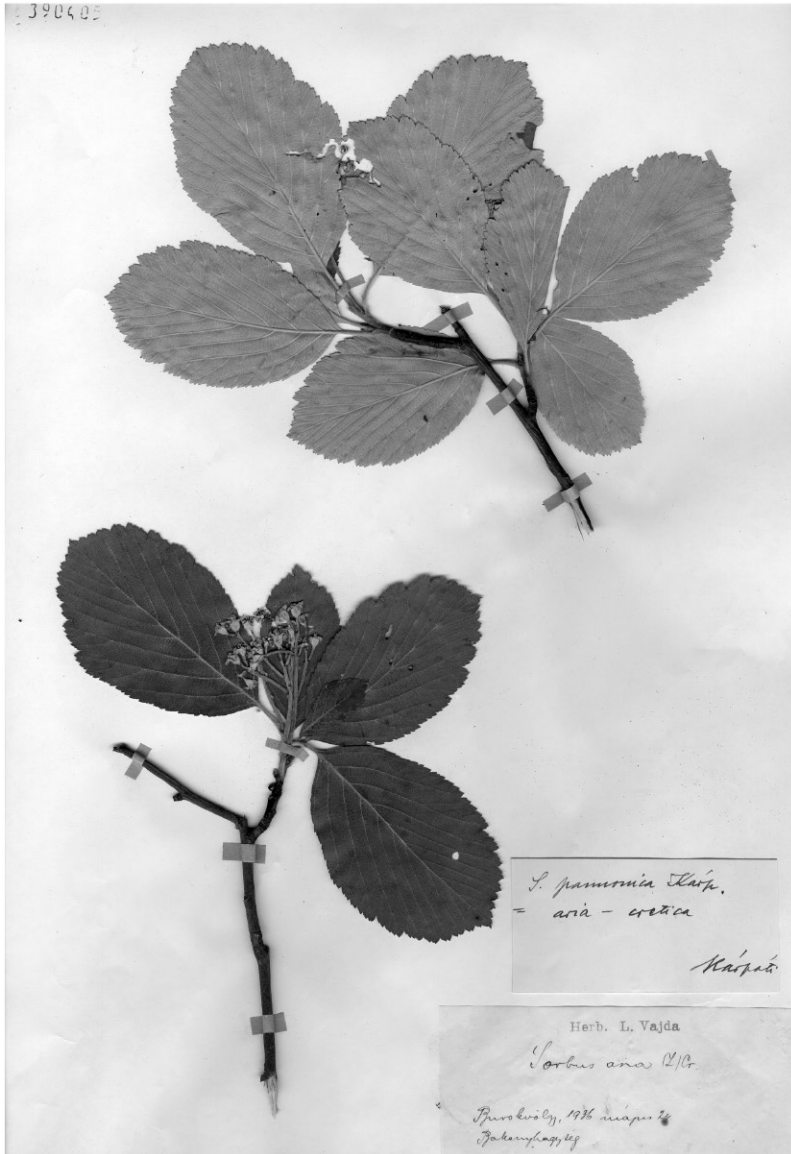


Fig. 1. Lectotype of *Sorbus pannonica* Kárpáti.

obovate with a narrow, cuneate base and short triangular apex. The variability of this species seems to be rather limited, from which, as well as from its triploid chromosome number, we assume that the species is most probably apomictic. The number of lateral veins in the leaves on sterile short shoots of *S. pannonica* is rather high (9–11 on average), approaching that in *S. aria s. lato*, from which *S. pannonica* differs in its obovate semirigid leaves which are apically lobed (Fig. 3). The most similar of the co-occurring taxa, *S. ulmifolia* differs in the more obovate

leaves with a more attenuate apex and more acute dentation (Table 1 and Fig. 3).

DISTRIBUTION AND HABITAT: Probably endemic to Hungary, restricted to the Transdanubian Mts. (Vértes Mts., eastern Bakony Mts., eastern Balaton Uplands) (Fig. 4). It grows mostly on north-facing rocky slopes of low calcareous hills, especially in mixed karst forests (*Fago-Ornetum*).

Former records of this species from other countries seem to refer to other species. The records from Austria (Kárpáti 1960a, Warburg & Kárpáti 1968, Kutzelnigg 1995, Kurtto 2009)



Fig. 2. Lectotype of *Sorbus aria* f. *pseudaria* Soó.

belong to *S. aria* s. lato. The documented reports from Slovakia (Kárpáti 1960a, Warburg & Kárpáti 1968, Májovský 1992, Kutzelnigg 1995, Kurtto 2009) are referable to *S. aria* s. lato, *S. subdanubialis*, and perhaps *S. graeca* s. lato, whereas the reports from Romania (Kárpáti 1960a, Warburg & Kárpáti 1968, Kurtto 2009) belong to *S. herculis*. The German records (Warburg & Kárpáti 1968, Kutzelnigg 1995, Meyer *et al.* 2005, Kurtto 2009, Feulner *et al.* 2013) belong to undescribed apomictic taxa of *S. pannonica* s. lato and *S. graeca* s. lato. The presence

of *S. pannonica* in Slovenia (Martinčič 1999, Kurtto 2009), in the Czech Republic (Kurtto 2009), Spain (Düll 1959, Kutzelnigg 1995, Kurtto 2009), southern France, and in Italy (Kutzelnigg 1995, Kurtto 2009) is highly unlikely.

CONSERVATION STATUS: The extent of occurrence of *S. pannonica*, calculated on the basis of available collections, is approximately 630 km² (the actual extent of occurrence can be greater because the western parts of the distribution area are probably undercollected). The adjusted extent of occurrence of the species, estimated by exclu-

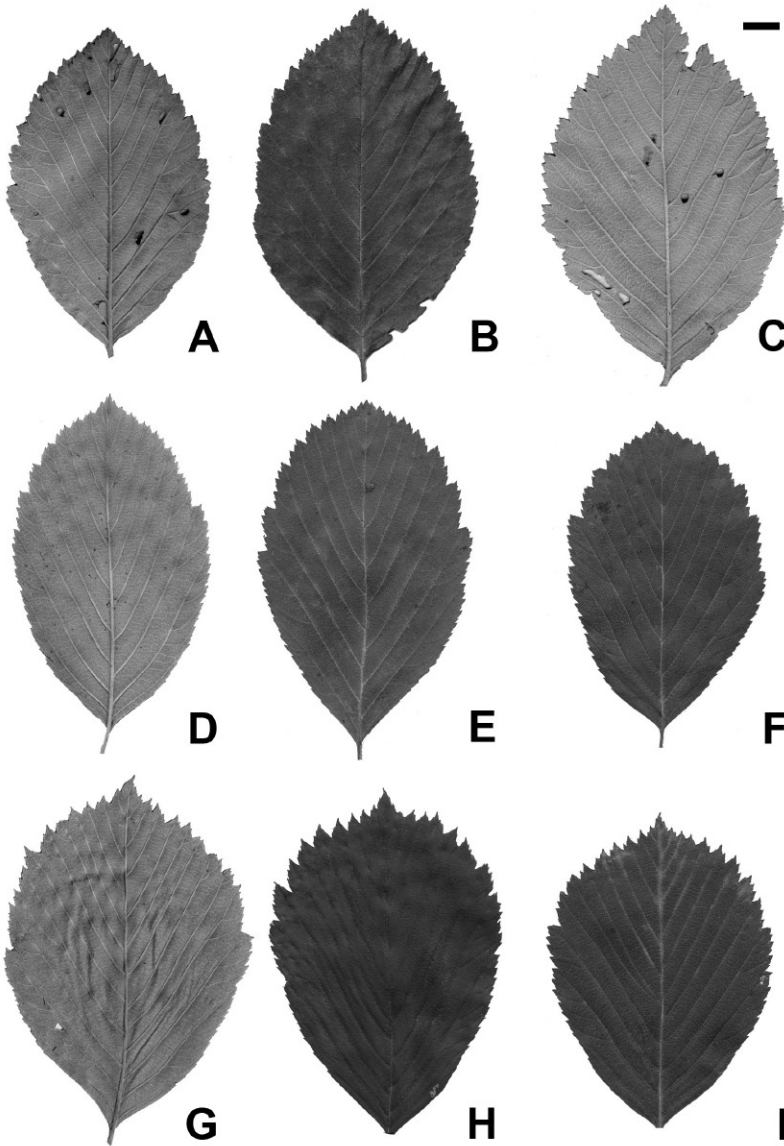


Fig. 3. Leaves of selected species of *Sorbus* in Hungary. — **A–C:** *S. aria s. lato* (Bükk Mts.). — **D–F:** *S. pannonica*. — **G–I:** *S. ulmi-folia*. — **A, B, D, E, G** and **H:** Leaves of sterile short shoots; **C, F** and **I:** Leaves of fertile short shoots. Vouchers: **A:** Kapubérc, 1951, Kárpáti (BP 701426); **B:** Látó-kövek, 1951, Papp (BP 370615); **C:** Örvény-kő, 1952, Papp (BP 478977); **D:** Burokvölgy, 2003, Németh (BP 649453); **E:** Hajszabarna, 1937, Boros (BP 432490); **F:** Lovas, 2012, Somlyay & Bauer (BP 728366); **G** and **H:** Fáni-völgy, 2002, Németh (BP 641935, holotype); **I:** Nagy-Somló, 2012, Somlyay (BP 728286). Scale (upper right corner) = 1 cm.

sion of unsuitable elements of landscape, is about 60 km². The area of occupancy of *S. pannonica*, calculated by counting the grid cells of 1 km² that contain at least one species record, is 25 km².

Although we have no knowledge on the population dynamics, in our opinion there is no apparent anthropogenic threat to the habitats of *S. pannonica*. The number of documented records and the collecting activity suggests no considerable decline of the population size inferred in the latest years and projected for the future, and the number of individuals of the spe-

cies (“population size” of the IUCN criterion D) is likely more than 250 but less than 1000.

From the calculated extent of the occurrence and the area of occupancy, as well as from the absence of any apparent and immediate threat to the taxon, we infer that the provisional conservation status of *S. pannonica* is Vulnerable (VU) according to the criterion D(1) of the IUCN (IUCN Standards and Petitions Subcommittee 2013).

POSSIBLE ORIGIN: *Sorbus aria s. lato* × *S. graeca s. lato* (Kárpáti 1960a).

CHROMOSOME COUNTS: Triploid, $2n = 3x = 51$ (Martin Lepš, pers. comm.). Voucher specimens (all as *S. pannonica* agg.): **Hungary**. Vértes Mts.: Csákberény ["Csákvár"]: Szedres-völgy, 47°22'46.85"N, 18°19'41.7"E, 19 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 82516!); Csákvár: Nagy-Vásár-hegy, 47°25'49.87"N, 18°25'6.74"E, 18 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 79973!); Gánt ["Kőhányás"]: Német-völgy, 47°26'58.34"N, 18°23'39.66"E, 19 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 79991!); same locality, 47°26'57.98"N, 18°23'40.06"E, 19 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 79994!, CB 79995!) — Bakony Mts.: Bánd ["Márkó"]: Malom-hegy, 47°6'29.38"N, 17°49'39.07"E, 20 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 82526!); same locality, 47°6'36.97"N, 17°49'1.74"E, 20 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 82525!); Várpalota: Vár-völgy, 47°13'0.7"N, 18°6'51.8"E, 19 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 82464!); Veszprém: Tekerés-völgy, 47°5'42"N, 17°51'38.27"E, 20 July 2011, M. Lepš, P. Lepš & G. Mészáros s.n. (CB 82515!).

FURTHER SPECIMENS EXAMINED: **Hungary**. Vértes Mts.: Csákberény: Csatorna-völgy, Á. Boros s.n. (BP 432471!, BP

s.n.!, as *S. aria*); Cservágás, Sz. Priszter s.n. (BPU 13762!, as *S. aria*); Köves-völgy, Á. Boros s.n. (BP 432468!, as *S. aria* f. *incisa*); Meszes-völgy, L. Vajda s.n. (BP 642580!, as *S. subdanubialis*); same locality, J. Papp s.n. (BP 376868!); same locality, J. Papp s.n. (BP 376832!, BP 478844!, as *S. aria*); Pap-irtás, Á. Boros s.n. (BP 432807!, BP 432808!, as *S. cretica*); same locality, Sz. Priszter s.n. (BPU 13763!, as *S. aria* f. *longifolia*); same locality, J. Papp s.n. (BP 376834!); Szappanos-völgy, Á. Boros s.n. (BP 432493!, as *S. aria*); same locality, Á. Boros s.n. (BP 432338!, BP 432339!, as *S. aria*); Csákvár: "supra Csákvár", Á. Boros s.n. (BP 80996!, as *S. aria*, BP 432474!, as *S. aria*, BP 720026!, BP 702572!); Balog-völgy, Á. Boros s.n. (BP 432152!, as *S. aria*); Hosszú-völgy, Sz. Priszter s.n. (BPU 13827!); Kis-tábor-hegy, Á. Boros s.n. (BP 448759!, as *S. aria* f. *incisa*); Nagy-Vásár-hegy, G. Lengyel s.n. (BP 352653!, as *S. aria* f. *incisa*); same locality, Cs. Németh 862 (BP 651996!, as *S. subdanubialis*); Csókakő: Vár-hegy, Á. Boros s.n. (BP 432799!, as *S. cretica*); same locality, Sz. Priszter s.n. (BPU 13764!, as *S. aria*, BPU 13826!); same locality, A. Péntes s.n. (BP 368721!, as *S. aria*); Gánt: same locality, Á. Boros s.n. (BP 80997!, as *S. aria*, BP 432476!, as *S. aria* f. *incisa*, BP 720031!, as *S. aria*,

Table 1. Comparison of *Sorbus pannonica* s. *stricto* and the most similar species occurring in Hungary (leaves on sterile shoots, and ripe fruits).

Characters	<i>Sorbus aria</i> s. <i>lato</i>	<i>Sorbus pannonica</i>	<i>Sorbus ulmifolia</i>
Leaf shape	lanceolate-elliptic to subrotund, sometimes slightly ovate [length/width ratio ca. (1.1)1.5–2.4], usually widest at middle (rarely below)	narrowly elliptic-ovovate to almost elliptic (length/width ratio ca. 1.6–1.75), widest at the upper third or slightly above middle	broadly obovate (length/width ratio ca. 1.5), widest at upper third, indistinctly angular (deltoid)
Leaf apex (upper third of blade)	rounded or triangular with convex sides, minutely toothed or also incised	subrotund with slightly convex sides, triangular at top, acute, sometimes shortly acuminate, minutely serrate or shallowly lobed	broadly rounded with convex sides, long acuminate, acutely serrate to shallowly lobed
Leaf base (lower part of blade)	rotund, broadly cuneate or cuneate, minutely toothed except lowest 15%	narrowly cuneate to cuneate, without teeth in lower third	cuneate to broadly cuneate, without teeth in lower third
Leaf lobes, with approximate length of upper side of largest lobe (mm)	absent, sometimes leaves incised into 4–5 (each side) short broad obtuse "lobes" in upper two thirds of lamina	up to 5 (each side) nearly indistinct to small subacute lobes in upper half of lamina; up to 4–5 mm long	up to 5 (each side) small acute lobes in upper third of lamina; up to 6 mm long
Number of lateral veins	9–14	8–12	9–12
Leaf size (cm)	5–15 × 5–9	7–12 × 4–8	7–12 × 6–8
Tomentum on lower leaf surface	whitish, thick	whitish, rather thick	whitish, rather thick
Leaf texture	thin	semi-rigid	rather thin
Fruit shape	globose or pyriform, often longer than wide	globose to subglobose	globose to subglobose
Fruit colour	scarlet-red with abundant small lenticels	scarlet-red, with numerous small lenticels	scarlet-red, with numerous small lenticels

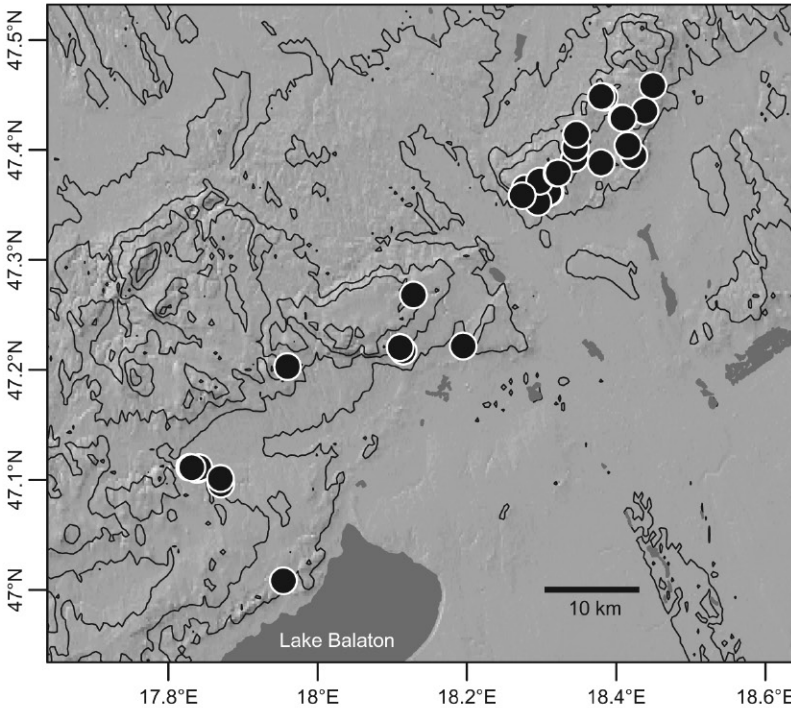


Fig. 4. Distribution of *Sorbus pannonica s. stricto* in Hungary.

BPU 1177!); Juh-völgy, Á. Boros *s.n.* (BP 432467!, as *S. aria f. incisa*, BP 432917!); “Pusztakápolna”, Á. Boros *s.n.* (BP 432881!, BP 432882!, as *S. aria*); same locality, *L. Vajda s.n.* (BP 196743!); Oroszlány-Mindszentpuszta: Hajszabarna, Á. Boros *s.n.* (BP 432490!); Vértesszőlő, Fáni-völgy: *G. Lengyel s.n.* (BP 300029!); Á. Boros *s.n.* (BP 80993!, as *S. aria*, BP 432482!, as *S. cretica*); *G. Lengyel s.n.* (BP 300027!); *Z. Zsák s.n.* (BP 701424!, BP 701425!); *S. Jávorka s.n.* (BP 211649! [?], as *S. aria* var. *incisa*, rev. Kárpáti as *S. subdanubialis*); Á. Boros *s.n.* (BP 432472!, BP 80995!, as *S. aria*); *Z. Zsák s.n.* (BP 701243!, as *S. aria*, rev. Kárpáti as *S. subdanubialis*); *Sz. Priszter s.n.* (BPU 13765!, BP 13766!, as *S. aria*); *Sz. Priszter s.n.* (BPU 13824!). — Bakony Mts.: Bánd [“Márkó”]: Malom-hegy, *S. Jávorka s.n.* (BP 339307! [?], as *S. aria*); Hajmáskér [“Eplény”], Tobán-hegy: *S. Polgár 4090* (BP 259472!, as *S. aria*); *S. Polgár 4091* (BP 259474!, as *S. cretica*); *S. Polgár 4092* (DE *s.n.*!, as *S. cretica*); *N. Bauer s.n.* (BP 727600!, as *S. aria*); Isztimér, Burok-völgy: *S. Polgár 4091* (BP 259473!, as *S. aria*); “Sárberék”, Á. Boros *s.n.* (BP 432489!, as *S. aria*); Á. Boros *s.n.* (BP 432488!, as *S. aria*); Á. Boros *s.n.* (BP 432486!, as *S. aria*); *L. Vajda s.n.* (BP 390405!); *J. Papp s.n.* (BP 376829!, BP 478843!, BP 478872!, as *S. aria*); *A. Péntes s.n.* (BP 368720!, BP 368724!, as *S. aria*); *T. Pócs s.n.* (BP 210844!, as *S. aria*); *Cs. Németh 775* (BP 649453!); Várpalota: *s.loc., s.d., J. Sadler 25 255* (BP 613935!) ?; Baglyas-hegy [above “Hideg-völgy”], *S. Jávorka s.n.* (BP *s.n.*!, as *S. graeca*); Á. Boros *s.n.* (BP 432668!, as *S. bakonyensis*); Vár-völgy, *L. Vajda s.n.* (BP 199415!, as *S. aria*, BP 199419!, as *S. subdanubialis*, BP 199434!). — Balaton Uplands: Lovas: Király-küti-völgy, *L. Somlyay & N. Bauer s.n.* (BP 728366!).

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