Sorbus portae-bohemicae and *Sorbus albensis*, two new endemic apomictic species recognized based on a revision of *Sorbus bohemica*

Sorbus portae-bohemicae* a *Sorbus albensis*, dva nové endemické apomiktické druhy rozlišené na základě revize *Sorbus bohemica

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Two new apomictic triploid (2n = 3x = 51) species from the *Sorbus latifolia* group, *S. portae-bohemicae* M. Lepší, P. Lepší, P. Vít et K. Boublík and *S. albensis* M. Lepší, K. Boublík, P. Lepší et P. Vít, putative hybridogenous species originated from a cross between *S. danubialis* and *S. torminalis*, are distinguished and described based on a taxonomic and chorological revision of *Sorbus bohemica* (a hybridogenous triploid species from the same parental combination). A number of contemporary biosystematic techniques, including molecular (nuclear microsatellite markers), karyological (chromosome counts, DAPI flow cytometry) and multivariate and geometric morphometrics were used to assess the variation of the species and justify their independent taxonomic status. All three species occur sympatrically in the České středohoří Mts (NW Bohemia). *Sorbus bohemica* is recorded from 31 localities, based on a revision of herbarium vouchers and field research. Recent field studies failed to verify five of these localities. *Sorbus portae-bohemicae* is a stenoendemic in the Porta bohemica gorge (situated ca 7 km WNW of Litoměřice) where it grows in open oak forests (*Luzulo-Quercetum* and transition vegetation type to *Melampyro nemorosi-Carpinetum*) on ENE-facing slopes and rocks. The only known population of *S. portae-bohemicae* consists of 14 adult individuals. *Sorbus albensis* occurs at 12 localities W to NW of Litoměřice. The total number of individuals is estimated at 600. Most are in acidophilous oak forests (*Luzulo-Quercetum* and its mesic derivatives), scree forests (*Aceri-Carpinetum*) or shrubby slopes (*Pruno-Ligustretum*, *Antherico-Coryletum*). Populations of the new taxa show little genetic variation and are phenotypically homogenous and well separated from other Bohemian hybridogenous *Sorbus* species. A distribution map of the three species is provided. Photographs of the type specimens and in situ fructiferous individuals of the new species are presented.

K e y w o r d s: apomixis, chorology, Czech Republic, endemic, hybridization, karyology, morphometrics, *Rosaceae*, *Sorbus latifolia* agg., SSR markers, taxonomy

Introduction

Sorbus bohemica is a hybridogenous species of *S. danubialis* × *S. torminalis* parentage, which is included in the *S. latifolia* aggregate (Jankun & Kovanda 1987). It is an endemic to the České středohoří Mts (NW Bohemia). It has the largest distribution range and the highest number of localities of all the Czech hybridogenous *Sorbus* species. In addition, *S. bohemica* is the first species of the *Sorbus latifolia* agg. described from the Czech Republic and perhaps the most intensively investigated *Sorbus* species in this country. This species is accepted in the majority of floras and taxonomic checklists (e.g., Warburg & Kárpáty 1968, Kutzelnigg 1995, Kovanda 1992, Čeřovský et al. 1999, Holub & Procházka 2000). Due to its limited distribution and high national significance (i.e., being an endemic species), it is considered to be strongly endangered and is a protected species (Holub & Procházka 2000).

Sorbus bohemica was most probably first recognized by Klika (Klika 1937) who erroneously determined the species as *S. franconica*, which is a taxon endemic to Germany. Klika (1937) provided the first brief account of its hybrid origin, morphology and distribution. Kovanda (1961) realized its endemic status and described the taxon formally from Lovoš hill near the town of Lovosice. In addition, he corrected some of Klika's chorological and morphological inaccuracies. Later, the species was studied chemotaxonomically, which indicated that *S. bohemica* originated from a back-cross between the F1 hybrid *S. torminalis* × *S. danubialis* and *S. danubialis* (Challice & Kovanda 1978). Subsequent embryological and karyological studies revealed apospory, diplospory and pseudogamy in this species and that it was an apomictic triploid (Jankun & Kovanda 1987). Its distribution, ecology, morphology and ecobiology was studied by Jankun & Kovanda (1987). Between 2000 and 2001, a detailed field study of this species throughout its distribution area revealed new data on its distribution, ecology and phytosociology (Boublík et al. 2002). This study indicated that some populations of *S. bohemica* were morphologically heterogeneous and in need of taxonomic evaluation. Additional field research in 2007 revealed that *S. bohemica* occurs sympatrically with two other still undescribed apomictic taxa. This paper presents a formal description of these two newly recognized taxa based on the results of field observations, molecular techniques, karyology and multivariate and geometric morphometrics. The phenotypic aspects in the original description of *S. bohemica* are revised and completed. Based on a revision of voucher specimens of this species in major Czech herbaria and detailed field work an updated distibution map of *S. bohemica* is also provided.

Material and methods

Plant material and field work

Only mature and well developed individuals of the taxa were selected for studying phenotypic and genetic variation. For the molecular analyses (nuclear microsatellite markers), 35 individulas of *S. albensis*, 10 of *S. portae-bohemicae*, 45 of *S. bohemica*, 5 of *S. danubialis* and 5 of *S. torminalis* were sampled; while for the multivariate morphometric analyses, 84 individuals of *S. albensis*, 13 of *S. portae-bohemicae* and 111 of *S. bohemica* were used (see Table 1 for locality details). In addition, four other hybridogenous taxa,

Table 1. – Locality details for the *Sorbus* species included in morphometric and molecular analyses.

Species	Locality	Geographical coordinates	Altitude (m a.s.l.)	Number of individuals analysed		
				Nuclear microsatellite markers	Classical morphometry	Geometric morphometry
S. albensis	calcareous marl slopes near Knobloška (locus classicus)	50°33'01.6"N, 14°05'15.3"E	270	15	55	15
	Deblík hill near Církvice	50°35'07.8"N, 14°02'40.4"E	380	1	7	2
	Plešivec hill near Kamýk	50°33'30.0"N, 14°05'25.2"E	370	2	4	3
	Porta bohemica gorge near Litochovice nad Labem	50°32'44.1"N, 14°02'15.5"E	270	5	6	3
	Třešňovka hill near Velké Žernoseky	50°32'22.7"N, 14°04'07.7"E	200	5	5	11
	Strážiště hill near Libochovany	50°33'12.6"N, 14°03'45.5"E	350	2	2	1
	Bídnice hill near Litoměřice	50°32'55.3"N, 14°05'40.6"E	350	5	5	8
S. portae-bohemicae	Porta bohemica gorge near Litochovice nad Labem	50°33'07.6"N, 14°02'10.8"E	220	10	13	14
S. bohemica	Porta bohemica gorge near Litochovice nad Labem	50°33'07.6"N, 14°02'10.8"E	220	–	–	5
	Velká Vendula hill by Velké Žernoseky	50°32'54.3"N, 14°03'22.2"E	250	–	–	1
	calcareous marl slopes near Knobloška	50°33'01.6"N, 14°05'15.3"E	270	–	–	6
	Kalvárie hill by Velké Žernoseky	50°32'51.0"N, 14°02'54.7"E	230	–	–	1
	small hill NW of Strážiště hill by Libochovany	50°33'23.8"N, 14°03'13.5"E	250	–	–	1
	Deblík hill near Církvice	50°35'07.8"N, 14°02'40.4"E	260	6	10	2
	Plešivec hill near Kamýk	50°33'30.0"N, 14°05'25.2"E	370	–	–	3
	Debus hill by Prackovice nad Labem	50°34'45.1"N, 14°00'57.0"E	390	4	6	1
	calcareous marl slopes by Libochovany	50°33'34.5"N, 14°03'23.7"E	240	–	–	1
	Boreč hill near Boreč	50°30'49.8"N, 13°59'14.4"E	420	11	31	–
	Výsluní hill by Prackovice nad Labem	50°35'10.6"N, 14°01'29.5"E	360	4	4	–
	Oparenské údolí valley near Oparno	50°32'27.1"N, 14°01'18.3"E	240	3	6	–
	Hradiště hill by Hlinná	50°34'06.3"N, 14°06'50.0"E	530	2	3	–
	Krkavčí skála hill near Sebuzín	50°35'07.1"N, 14°05'33.8"E	350	5	24	–
	Lovoš hill near Lovosice (locus classicus)	50°31'43.0"N, 14°01'04.6"E	570	11	27	–
S. torminalis	Lovoš hill near Lovosice	50°31'43.0"N, 14°01'04.6"E	560	2	–	–
	Deblík hill near Církvice	50°35'07.8"N, 14°02'40.4"E	370	3	–	–
S. danubialis	Lovoš hill near Lovosice	50°31'43.0"N, 14°01'04.6"E	560	3	–	–
	Oparenské údolí valley near Oparno	50°32'27.1"N, 14°01'18.3"E	250	2	–	–

belonging to the *S. latifolia* agg., which occur in Bohemia were included in the multivariate morphometric analyses used to assess phenotypic variation in the group of taxa closely related to the newly described *Sorbus* species and determine species-specific characters. They were *S. eximia* (45 individuals), *S. gemella* (10), *S. rhodanthera* (12) and *S. milensis* (15) (see Lepší et al. 2008 for locality details). Geometric morphometric analyses were used to reveal species-specific characters of leaves of three sympatrically occurring species: *S. albensis* (30 individuals), *S. bohemica* (21) and *S. portae-bohemicae* (14) (see Table 1 for locality details). Specimens were collected during 2000–2007, following the recommendations of Kutzelnigg (1995) and Meyer et al. (2005); in particular sampling the same stage (generally, flowering and fructiferous plants were collected in early May – middle June and September, respectively). The colours of generative parts were recorded at each locality, and flower parts were stored in 70% ethanol.

To describe the phytosociological affinities of the newly described species and *S. bohemica* at some newly discovered localities, relevés were recorded in subjectively selected plots using the Braun-Blanquet approach. The relevés are stored in the Czech National Phytosociological Database (Chytrý & Rafajová 2003) under the relevé numbers 203553–203570. Altitudes and geographic coordinates (WGS-84) were determined using Garmin eTrex instruments.

A taxonomic revision of the relevant *Sorbus* material kept in the following herbarium collections was undertaken: BRNM, BRNL, BRNU, CB, CHEB, CHOM, Herbarium of museum of Ústí nad Labem, HOMP, HR, LIM, LIT, MP, PL, PR, PRA, PRC, ROZ, SOKO, ZMT. For abbreviations of public herbaria, see Holmgren et al. (1990). Revised herbarium specimens were sorted by locality and then according to the year of collection. Information on herbarium labels was translated into English. Localities were classified according to the regional-phytogeographical division (Skalický 1988) and in terms of quadrants of the Central European grid mapping (Ehrendorfer & Hamann 1965). Each locality is numbered and named. Coordinates missing on herbarium sheets were obtained from maps (http://www.mapy.cz). The locality numbers were used for displaying localities on the distribution map. Names of the most frequent collectors are abbreviated: KB = K. Boublík, KK = K. Kubát, ML = M. Lepší, PL = P. Lepší, PV = P. Vít.

Species nomenclature is unified according to Kubát et al. (2002) except for *S. franconica*, *S. milensis* and *S. latifolia*, which follow Kutzelnigg (1995) and Lepší et al. (2008). Phytosociological nomenclature follows Chytrý et al. (2001).

Karyology

Three samples of short, two-year old branches with well-developed leaf buds of each species were collected from the type localities of *S. albensis* and *S. portae-bohemicae* in January 2007 and February 2008, respectively. Of the material for *S. albensis* only one sample (specimen CB 65345, see the list of localities) was used because of lack of cell division in the other samples. All the samples of *S. portae-bohemicae* were successfully karyologycally analysed (specimens CB 65306 – type tree, CB 65297, CB 65298). Meristematic tissues were prepared and chromosomes were counted according to Lepší et al. (2008).

Chromosome and ploidy level variation

DAPI flow cytometry was applied to assess ploidy variation in seeds of *S. albensis* (*S. portae-bohemicae* was not analysed because the seeds were damaged by insects). Bulked seed samples were analysed (i.e., five seed simultaneously) from 16 different trees of *S. albensis,* which included the type tree. *Bellis perennis* (2C = 3.38 pg; J. Suda et al., unpubl.) was selected as a suitable internal reference standard as it has a genome size close to, but not overlapping that of the new taxon. Nuclei were isolated using a two-step Otto procedure (Otto 1990), stained with DAPI fluorochrome and analysed according to Lepší et al. (2008).

Morphometric data and analyses

Seventeen quantitative characters were measured and scored for all of the hybridogenous apomictic *Sorbus* species studied (for summary of the measured characters see Lepší et al. 2008). Two new characters were established: "style length" and "length of the fused part of the style", while the character "distance between the insertion of the petiole" and "the tip of the 1st lamina lobe" was excluded as it is redundant. The character set was chosen on the basis of published determination keys, floras and our own observations. The dataset was analyzed using the SAS package (version 9.1; SAS Institute, Cary, NC, USA) with CANDIS and DISCRIM procedures, following the methodology described in Klecka (1980). For details see Lepší et al. (2008).

Nuclear microsatellite markers (SSR)

Total genomic DNA was extracted from silica-dried leaves (100 samples in total) following the CTAB-protocol (Doyle & Doyle 1987) with minor modifications as described by Pfosser et al. (2005). Microsatellite primers developed for the genera *Sorbus* (Mss1, Mss5, Mss6, Ms6g and Ms14; Oddou-Muratorio et al. 2001, Nelson-Jones et al. 2002) and *Malus* (CH02D11 and CH01H10; Gianfranceschi et al. 1998) were used for the determination of intraspecific genetic variation, following the methodology provided by the original authors. For details see Lepší et al. (2008). Final visualization of fluorescently-labelled fragments (NED, 6-FAM, HEX; Applied Biosystems, Foster City, CA, USA) was carried out using an automatic sequencer Avant Genetic Analyser 3100 (Applied Biosystems, Foster City, CA, USA). According to different ploidy levels in analyzed samples, microsatellite pattern was scored as "allele phenotype" (Becher et al. 2000), data set converted to a binary matrix and analyzed with procedures recommended for dominant markers. Intraspecific variation was detected using Arlequin ver. 3.01 computer program (Excoffier et al. 2005), which computed the average gene diversity of all loci (AGD, Nei 1987).

Digitalization and geometric morphometric analysis

Well developed, mature and intact leaves from the middle part of short fertile shoots were collected, carefully flattened and dried, and subsequently scanned at 300 dpi using Epson scan 1.11E software. The method of elliptic Fourier approximation (Kuhl & Giardina 1982) incorporated in the SHAPE 1.2 software package (Iwata & Ukai 2002) was employed to describe the variation in leaf shape of the three hybridogenous sympatric

species. The chain-coded contour of each leaf was approximated using the first 20 harmonics, and the elliptic Fourier descriptors (EFDs) normalized to avoid variations related to size, rotation and starting point of the contour trace. Subsequently, principal component (PC) scores for each specimen were calculated from the standardized EFDs, and the shape variation associated with each PC was visualized using the procedure described by Furuta et al. (1995).

A cross-validated linear discriminant analysis, using principal component scores (from the above mentioned PCA analysis) as discriminating variables, was performed in R, version 2.0.0 (R Core Development Team 2004) of the MASS package (Venables & Ripley 2002). Only the scores of selected PCA axes were used for the discriminant analysis. These axes were selected by a forward selection algorithm in the CVA analysis in Canoco (Lepš & Šmilauer 2003), using the Monte Carlo permutation test (999 permutations; only axes with p–level < 0.05 were considered).

Results

Sorbus bohemica Kovanda Acta Univ. Carol. – Biol. 1961/1: 77, 1961

D e s c r i p t i o n: Trees or shrubs up to 9 m high, often with several trunks. Trunk up to 0.5 m in circumference. Bark grey to dark grey, smooth when young, with vertical fissures (particularly at the trunk base) at maturity, with scattered (3–) 5–9 (–11) mm long and (3–) 4–5 (–8) mm wide lenticels. Branches at an angle of (25–) 30–40 (–60)° to the trunk; twigs brownish-grey; young shoots brown, sparsely tomentose when young and almost glabrous at maturity, with numerous elliptical or subrotund pale brown to ochraceous lenticels. Buds 6–12 mm long and 3–5 mm wide, narrowly ovoid to turbinate; scales green, with narrow brown sparsely tomentose margins. Leaves (of short fertile shoots) simple; laminas (oblong) elliptical, rarely ovate, more or less flat, somewhat glossy, dark green above, yellowish-greyish-green beneath, usually flat at margins, more or less broadly triangular and acuminate at apex, usually cuneate, straight or slightly arcuate and partly serrate at base, upper surface almost glabrous, lower surface evenly tomentose, (5.1–) 7.0–8.4 (–10.7) cm long and (3.4–) 4.9–6.1 (–8.3) cm wide, widest at (32–) 39–47 (–58)% of the lamina length (from the tip), regularly shallowly lobed (double serrate apically); lobes acuminate, serrate or doubly serrate with acuminate teeth terminating the main veins, other teeth smaller, acute; sides of lobes more or less straight; the third lobe (from the base) (0.6–) 0.8–1.1 (–1.5) cm broad; incision between the second and the third lobe (0.2–) 0.4–0.6 (–0.9) cm; lobes broader than 1 cm (1–) 2–3 (–4) on each side; veins (7–) 8–9 (–11) on each side; petioles (1.2–) 1.6–1.9 (–2.5) cm long, more or less tomentose. Inflorescences with (23–) 31–43 (–62) flowers, (5–) 7–9 (–11) cm in diameter, compact, convex; branchlets tomentose. Hypanthium turbinate, tomentose. Sepals (1.8–) 2.4–2.6 (–4.2) mm long and (2.0–) 2.6–2.7 (–3.2) mm wide, triangular, acute rarely acuminate, densely tomentose on both surfaces, patent, reclinate after anthesis, persistent, dry, erect. Petals (5.6–) 6.2–6.5 (–8.2) mm long and (3.7–) 4.7–4.9 (–5.5) mm wide, usually broadly elliptical, concave, whitish, patent, sparsely hirsute at the base of upper surface, with a short claw. Stamens ca 20; filaments whitish; anthers pale rose at the beginning of anthesis, later pale yellow, (1.2–) 1.3 (–1.6) mm long. Ovary semi-inferior. Styles 2 (–3), greenish-cream, (2.2–) 3.6–3.7 (–4.6) mm long, hairy at the base, connate up to (18–)

39–45 (–63)%. Stigma greenish-cream, more or less flat, (0.5–) 0.6–0.7 (–0.8) mm wide. Fruits (8.9–) 10.3 (–14.2) mm long and (9.1–) 11.4–11.5 (–14.8) mm wide, broadly ellipsoid to subglobose, orange-red at maturity, glabrous or almost glabrous, glossy, with (16–) 22–32 (–39) ochraceous lenticels per 0.25 cm^2, mesocarp heterogeneous; endocarp stony. Seeds fuscous. Somatic chromosome number 2n = 51 (triploid). Reproduction tentatively considered as apomictic. Flowering V.

Diagnostic characters

Leaf laminas are (oblong) elliptical, rarely ovate, relatively small, (5.1–) 7.0–8.4 (–10.7) cm long and (3.4–) 4.9–6.1 (–8.3) cm wide, more or less broadly triangular and acuminate at apex, cuneate, straight or slightly arcuate at base, regularly and shallowly lobed – incisions between the second and the third lobes are only (0.2–) 0.4–0.6 (–0.9) cm long; lobes acuminate with acuminate teeth terminating the main veins. Styles connate up to (18–) 39–45 (–63)% of their total length. Fruits are broadly ellipsoid to subglobose, orange-red at maturity.

Geographic distribution

So far, *S. bohemica* has been found in three phytogeographical subdistricts (sensu Skalický 1988). It occurs at 27 localities in the Labské středohoří Mts, three localities in the Verneřické středohoří Mts and one site in the Milešovské středohoří Mts. The area lies approximately between the settlements of Brná nad Labem, Litoměřice, Lovosice, Třebenice and Milešov (NW Bohemia). The distance between the two most remote localities is almost 16.5 km (see Fig. 1). Some populations consist of more than 100 individuals (localities 2, 16, 18, 19). The total number of individulas is estimated at 1100 (Boublík et al. 2002). With respect to the number of localities and size of population, *S. bohemica* is the most widely spread hybridogenous *Sorbus* species in the Czech Republic.

Our field research and revision of major Czech herbaria revealed seven new localities (nos. 20–24 and 30–31). However, we failed to find specimens at five historical localities. They included Milešovka hill (herbarium specimen from 1933), Ovčín hill (1934), Kubačka hill (1937), Matrý hill (1947) and Košťálov hill (1933) (localities 25–29). All localities at which the occurence of the species was not confirmed are situated at the periphery of the species area (Fig. 1), and perhaps only a few individuals grew there in the past, making exctinction plausible. Nevertheless, considering the extent of the localities, we cannot exclude an alternative explanation, i.e., that the species was overlooked and is still present there.

Some herbarium specimens that are cited in contributions dealing with the distribution of the species were misidentified. Kovanda (1961) corrected Klika's erroneous records from Bezděz hill (leg. Podpěra 1894, 1897, BRNU 51321, 51322; Klika 1937), which belongs to *S. danubialis*. In addition, records from Kletečná hill (leg. Klika 1935, PR 174587; Klika 1937, Kovanda 1961, 1987) and the Vrkoč rock (leg. Hrabětová 1973, BRNU 454791; Jankun & Kovanda 1987) belong to *S. danubialis*. The specimen from Malíč (leg. Kubát 1967, LIT; Jankun & Kovanda 1987) belongs to *S. albensis*, which is described below. We did not revise any of Kovanda's specimens deposited in PR (Jankun & Kovanda 1987) because they are probably lost; nevertheless, we confirmed the determination of the species in the field.

Herbarium specimens:

The first specimen of *Sorbus bohemica* was probably collected in 1848 in the surroundings of the town of Litoměřice (Fl. de Leitm. leg. Schmidt 1848, PR). Because of the poor description of the locality, it is not included in the following list.

Czech Republic. North Bohemia, 4b. Labské středohoří Mts: 1. Havraní skála hill (50°35'33.1"N, 14°04'39.0"E): Ústí nad Labem, Havraní skála rock by Sebuzín village (leg. PL, ML & KB 23. 6. 2001, CB 39792); Boublík et al. 2002. **2. Deblík hill** (50°35'05.7"N, 14°03'11.3"E): Deblík hill (9. 5. 1943, herb. of Muzeum of Ústí nad Labem B665). – Under the summit of Deblík hill, on rocks, 380 m a.s.l. (leg. J. Klika 9. 5. 1946, PR). – Deblík hill, the slope opposite Církvice village (leg. KK 3. 6. 1964, LIT 3891); Jankun & Kovanda 1987. – Církvice, the slopes of the hills above the weekend house village (in the direction of "Hauberge" hill), scrubby slopes (leg. KK 1. 7. 1983, LIT 41865); Jankun & Kovanda 1987. – Církvice, Deblík hill, the margin of the steppe grassland of Hauberge hillock, a small sterile scrub (leg. KK 14. 6. 1991, LIT 83171). – Církvice, the scruby margin of the oak forest and the steppe on the summit of Hauberge hill by the locality of *Dracocephalum* (leg. KK 31. 5. 1995, LIT). – Sebuzín, the slope above the railway station (leg. ML & KB 29. 5. 2000, CB 39789); Boublík et al. 2002. – Církvice, on the margin of the quarry wall SE of the village (leg. KK 18. 7. 2000, LIT). – Církvice, Deblík hill, the hillock ca 0.5 km W of the summit of the hill, the margin of steppe grassland (leg. K. Nepraš 13. 6. 2007, LIT 83430). **3. Krkavčí skála hill** (50°35'12.7"N, 14°05'06.0"E): Sebuzín, Krkavčí skála hill (leg. PL, ML & KB 29. 8. 2000, herb. P. Lepší 825), Boublík et al. 2002. – Tlučeň village, the margin of a scree below a rock on the S slope of Krkavčí skála hill, a scrub ca 3 m high (leg. KK 8. 10. 2004, LIT). **4. Výsluní hill** (50°35'10.6"N, 14°01'29.5"E): the N slopes of Výsluní hill by Prackovice nad Labem village, *Querceto-Carpinetum primuletosum veris* (leg. K. Preis 11. 6. 1939, PRC); Kovanda 1961, Jankun & Kovanda 1987. – Prackovice nad Labem, Výsluní hill (leg. KB 12. 10. 2000, CB 65401); Boublík et al. 2002. The specimen Kovanda 1985 PR (Jankun & Kovanda 1987) is probably lost. **5. Debus hill** (50°34'34.3"N, 14°00'54.4"E): Prackovice nad Labem, the hill S of Debus hill ca 1.5 km NW of the village (leg. KB & PL 29. 9. 2000, CB 65395); Boublík et al. 2002. – Prackovice nad Labem, the quarry on Debus hill (leg. PL, ML & KB 24. 8. 2001, CB 39793, 39791); Boublík et al. 2002. **6. Trabice hill** (50°34'46.3"N, 14°04'19.2"E): Tlučeň, Trabice hill, the NE slope under the hilltop (leg. KB 9. 10. 2000, CB 65396); Boublík et al. 2002. – Libochovany, the S slope of Trabice hill NE of the village, below the forest road with the blue tourist mark, a deciduous forest, 1 individual (leg. KB 22. 4. 2007, CB 65402). **7. The hill 0.6 km NE of Kubačka hill** (50°34'29.3"N, 14°00'44.8"E): Prackovice nad Labem the hill above the railway line ca 0.6 km NE of Kubačka hill, 5450a (leg. KB & PL 29. 9. 2000, CB 65394); Boublík et al. 2002. **8. Hradiště hill** (50°34'06.3"N, 14°06'50.0"E): Hlinná, Hradiště hill (leg. PV 18. 8. 2005, PRC, CB 65586). Kovanda (1987) mentioned the first record from this locality but the herbarium specimens (Kovanda 1976 PR, 1985 PR) are probably lost. **9. Plešivec hill**: Plešivec hill in the České středohoří Mts (leg. J. Polívka 18. 7. 1961, PR). – Plešivec hill by Kamýk village, screes on the base of the hill (leg. KK 6. 6. 1969, LIT 21862); Jankun & Kovanda 1987. – Litoměřice, ca 1.3 km W of the centre of Kamýk village, rarely in an oak forest, 5450b: 50°33'35.2"N, 14°05'43.7"E, 410 m a.s.l. (leg. ML 19. 6. 2007, CB 65254). The specimens Kovanda 1976 PR and Kovanda 1985 PR (Jankun & Kovanda 1987) are probably lost. **10. Calcareous marl slopes by Libochovany**: A calcareous slope by Libochovany village (leg. K. Preis 9. 9. 1934, PRC); Kovanda 1961, 1987. – Libochovany, ca 1 km NW of the summit of Strážiště hill, on the small ridge salient to the NW direction from the massive of Strážiště hill, the scruby calcareous marl slopes and the adjacent oak forest, ca 40 individuals, 5450a: 50°33'34.5"N, 14°03'23.7"E, 240 m a.s.l. (leg. ML 20. 6. 2007, CB 65262). **11. Porta bohemica gorge, the right-hand bank** (50°33'05.5"N, 14°02'34.2"E): Hrádek hill by Velké Ženoseky village (leg. Prinz 11. 10. 1936, PR). – Libochovany, Porta bohemica, the slopes on the right-hand bank of the Labe river between Kalvárie hill and Libochovany village (leg. KB & PL 4. 10. 2000, CB 65399); Boublík et al. 2002. – Libochovany, below the upper margin of the porphyry slopes of the Porta bohemica gorge on the right-hand bank of the Labe river, rarely (leg. KK 20. 5. 2005, LIT). **12. Strážiště hill**: – Scrubs on Strážiště hill (leg. R. Missbach VI., IX. 1911, BRNU 21352, 21353); Klika 1937, Kovanda 1961, 1987. Strážiště hill, near Velké Žernoseky village (leg. M. Deyl 20. 5. 1960, PR 532895, 532896). – Libochovany, in the summit part of Strážiště hill, scrubs and an oak forest, scattered to rarely, 5450a: 50°33'11.9"N, 14°03'46.1"E, 340 m a.s.l. (leg. ML 12. 5. 2007, CB 65286). The specimens Kovanda 1976 PR and Kovanda 1985 PR (Jankun & Kovanda 1987) are probably lost. **13. Calcareous marl slopes by Knobloška**: Knobloška, the calcareous marl slopes N of the village (leg. KB & PL 4. 10. 2000, CB 65397); Boublík et al. 2002. – Knobloška, the calcareous marl slopes (leg. PL, ML & KB 29. 5. 2000, CB 39790); Boublík et al. 2002. – Litoměřice, the calcareous marl slopes by Knobloška village, rarely, 5450b: 50°33'02.1"N, 14°05'24.2"E, 310 m a.s.l., tree No B223 (leg. ML 18. 9. 2006, CB 65340), 50°33'01.3"N, 14°05'26.2"E, 330 m a.s.l., tree No B227 (leg. ML 18. 9. 2006, CB 65350), 50°33'01.9"N, 14°05'25.6"E, 340 m a.s.l., tree No B206 (leg. ML 18. 9. 2006, CB 65351). **14. Kalvárie hill**: Velké Žernoseky, Kalvárie hill, an oak

forest on the N slope in front of the first gneiss small ridge (leg. KK 9. 6. 1972, LIM 13847, LIT 24471). – Velké Žernoseky, Kalvárie hill, the woody N(E) slope (leg. KK 20. 6. 1973, LIT 24478); Jankun & Kovanda 1987. – Velké Žernoseky, the slopes on the left-hand bank of the Labe river (the Porta bohemica gorge), near the place called Kalvárie, 5450c: 50°32'51.0"N, 14°02'54.7"E, 230 m a.s.l. (leg. ML 12. 5. 2007, CB 65325). **15. Porta bohemica gorge, the left-hand bank**: Litoměřice, The Porta bohemica gorge, above the left-hand bank of the Labe river, between the villages Litochovice nad Labem and Malé Žernoseky, 5450c: 50°32'21.5"N, 14°02'13.1"E, 200 m a.s.l. (leg. KB & PL 29. 9. 2000, CB 65357); Boublík et al. 2002. – Prackovice nad Labem, ca 1.2 km SSE of the centre of Litochovice nad Labem village, the slopes on the left-hand bank of the Labe river (the Porta bohemica gorge), 5450c: 50°32'50.1"N, 14°02'13.4"E, 250 m a.s.l. (leg. ML 11. 5. 2007, CB 65310). – Prackovice nad Labem, ca 1.5 km SSE of the centre of Litochovice nad Labem village, the slopes on the left-hand bank of the Labe river (the Porta bohemica gorge), 5450c: 50°32'40.5"N, 14°02'17.1"E, 250 m a.s.l. (leg. ML 11. 5. 2007, CB 65311). – Prackovice nad Labem, ca 0.7 km SSE of the centre of Litochovice nad Labem village, slopes on the left-hand bank of the Labe river (the Porta bohemica gorge), 5450a: 50°33'06.3"N, 14°02'08.8"E, 220 m a.s.l. (leg. ML 11. 5. 2007, CB 65314). **16. Oparenské údolí valley**: Above the Oparenské údolí valley above Malé Žernoseky village (leg. J. Klika IX. 1951, PR). – The Oparenské údolí valley, ca 1 km E of Oparno village, 50°32'24.0"N, 14°01'21.6"E (leg. PV 2. 6. 2005, CB 65587, PRC). The specimen Kovanda 1984 PR (Jankun & Kovanda 1987) is probably lost. **17. Malý Lovoš hill** (50°31'50.9"N, 14°01'29.9"E): Lovosice, on the summit of Malý Lovoš hill, 5450c, 480 m a.s.l. (leg. KB & ML 22. 5. 2001, CB 33265); Boublík et al. 2002. **18. Lovoš hill** (50°31'39.7"N, 14°01'04.9"E): Lovoš hill by Litoměřice town (leg. J. Podpěra X. 1902, BRNU 51320); Klika 1937, Jankun & Kovanda 1987. – Lovosice, Lovoš hill, in a dry forest on the W faced slopes of the hill, 400–500 m a.s.l., no. 35782 (leg. J. Dostál 10. 5. 1953, PR). – Lovoš hill, N faced slopes of the hill, in a forest (near the road to Oparno village) (leg. Z. Pouzar & V. Skalický 12. 9. 1956, PR 569216). – Lovosice, the NW slopes of Velký Lovoš hill, ca 450 m a.s.l. (leg. V. Zelený 3. 7. 1957, PRC). – In scrubs near the summit of Lovoš hill near Lovosice town, between the parents, 572 m a.s.l. (leg. M. Kovanda 17. 7. 1958, PRC – the type specimen). – Near the summit of Lovoš hill near Lovosice town, ca 572 m a.s.l. (leg. M. Kovanda 12. 5. 1959, PRC). – On woody slopes of Lovoš hill near Lovosice town, ca 400 m a.s.l. (leg. M. Kovanda 12. 5. 1959, PRC). – Bílinka, the margin of the arrival road on the NW base of Lovoš hill, not so far from *S. domestica*, one scrub (leg. KK 8. 5. 1992, LIT 83181). – Lovosice, Lovoš hill (leg. KB 24. 5. 1999, CB 65393); Boublík et al. 2002. – Lovoš hill, the summit, the margin of an oak forest by the view point, 5450c (leg. K. Nepraš 8. 9. 2007, LIT 83421). The specimens Kovanda 1984 PR and Kovanda 1985 PR (Jankun & Kovanda 1987) are probably lost. **19. Boreč hill** (50°30'51.4"N, 13°59'19.1"E): The rocky slopes of Boreč hill near Lovosice town, the SW slopes, ca 400 m a.s.l. (leg. M. Kovanda 12. 5. 1959, PRC). – Boreč hill (leg. M. Kovanda 1966, PRA). – Režný Újezd, Boreč hill, a thermophilous oak forest in the summit part of the hill (near the "view point"), abundant (leg. KK 27. 8. 1999, LIT). – Režný Újezd, the E slope of Boreč hill, ca 0.5 km SSW of the chapel in the village, a stony slope, 430 m a.s.l. (leg. O. Rotreklová 31. 5. 2004, BRNU 573806). The specimens Kovanda 1978 PR and Kovanda 1985 PR (Jankun & Kovanda 1987) are probably lost. **20. Balks E of Kundratice** (50°34'04.8"N, 14°06'41.6"E): Kundratice by Litoměřice, balks among meadows ca 1 km E of the village, scattered (leg. KK 11. 5. 2005, LIT). A new locality. **21. Holý vrch hill** (50°34'51.1"N, 14°06'52.0"E): Hlinná, Holý vrch hill, near the road by the SE margin of the plateau, 1 big scrub (leg. KK 11. 5. 2005, LIT). A new locality. **22. Small hill NW of Stráziště hill**: Libochovany, ca 0,8 km NW of the summit of Stráziště hill, the W slope, a subacidophilous oak forest, ca 10 individuals, 5450a: 50°33'23.8"N, 14°03'13.5"E, 250 m a.s.l. (leg. ML 20. 6. 2007, CB 65257). A new locality. **23. Velká Vendula hill**: Velké Žernoseky, W slopes of the summit part of Velká Vendula hill, clearings and their margins, abundant, 5450c: 50°32'54.3"N, 14°03'22.2"E, 250 m a.s.l. (leg. ML 12. 5. 2007, CB 65293). A new locality. **24. Hillock on W margin of Deblík hill** (50°35'04.2"N, 14°02'28.8"E): Církvice, the slope ca 0.7 km SE of the village (leg. ML & KB 27. 4. 2000, CB 65391). – Církvice, an oak forest below the summit of the hill S of the weekend house village, 1 individual (leg. KK 16. 6. 2005, LIT). A new locality. **25. Kubačka hill** (50°34'14.7"N, 14°00'32.0"E): Kubačka hill by Malé Žernoseky village (leg. J. Klika 13. 9. 1934, PR 174785, 250331); Klika 1937, Kovanda 1961, 1987. A locality with unconfirmed occurrence (Boublík et al. 2002). **26. Ovčín hill** (50°30'19.1"N, 14°00'17.5"E): Ovčín hill by Lovosice town (leg. J. Klika & Svoboda 29. 6. 1934, PR 174786); Klika 1937, Kovanda 1961, 1987. A locality with unconfirmed occurrence (Boublík et al. 2002). **27. Košťálov hill** (50°29'25.6"N, 13°59'07.1"E): On basalt rocks of Košťálov hill near Třebenice village, S slopes, 450 m a.s.l., No. 10533 (leg. J. Dostál & F. A. Novák 14. 6. 1933, PRC); Jankun & Kovanda 1987. A locality with unconfirmed occurrence (Boublík et al. 2002). **44. Milešovské středohoří Mts: 28. Milešovka hill** (50°33'18.2"N, 13°56'06.9"E): The eastern slope of Milešovka hill (leg. Wettstein V. 1894, PRC); Kovanda 1961, 1987. – In a forest of Milešovka hill near Milešov village, phonolite, 600 m a.s.l., No. 10532 (leg. J. Dostál & F. A. Novák 15. 6. 1933, PRC); Jankun & Kovanda 1987. A locality with unconfirmed occurrence (Boublík et al. 2002). **45a. Lovečkovické středohoří Mts: 29. Matrý hill** (50°36'19.1"N, 14°06'01.1"E): Matrý hill above Sebuzín village,

380 m a.s.l. (leg. Klika 1. 6. 1947, PR); Boublík et al. 2002. ML and KB did not confirm the occurrence of the species at the locality in 2006 in the field. **30. Průčelská rokle gorge**: Brná nad Labem, the southern part of the Průčelská rokle gorge, the N slopes of Skřiváňčí vrch hill, 50°36'58.9"N, 14°06'07.4"E, 580 m a.s.l. (leg. KB 13. 7. 2006, CB 51361). A new locality. **31. Martinská stěna rock**: Čeřeniště, the Martinská stěna rock, 5450b: 50°35'41.2"N, 14°06'39.2"E, 590 m a.s.l., in an oak-hornbeam forest (*Carpinion*), 1 individual (not. J. Novák 2005, leg. ML & KB 8. 9. 2006, CB 51344); 50°35'47.0"N, 14°06'43.2"E, 600 m a.s.l., on a rock, 1 individual (not. J. Novák 2005, leg. ML & KB 8. 9. 2006, CB 51368). A new locality.

Sorbus portae-bohemicae M. Lepší, P. Lepší, P. Vít et K. Boublík, **spec. nova** (Figs 2–3)

D e s c r i p t i o: Arbores (vel frutices) usque 7 m alti; foliis (in brachyblastis fertilibus) simplicibus, laminis ambitu fere late ellipticis usque (late) ovatis, regulariter pinnato-lobatis (lobis acuminatis, serratis), in parte superiore tantum duplicato-serratis, (7.5–) 8.6–9.7 (–11.5) cm longis et (5.1–) 5.9–6.8 (–8.5) cm latis, ad basin rotundatis (raro late cuneatis), subintegris vel remote serratis, dilute usque obscure viridibus, subtus ochro-griseo-viride tomentosis, nervis ab utroque latere (10–)11–12(–13) in numero; petiolis (1.2–) 1.6–1.8 (–2.2) cm longis; corymbothyrsis multifloris, compactis, convexis, ramis plus minusve tomentosis. Dentibus calycinis triangularibus, acuminatis usque acutis, (2.7–) 3.2–3.8 (–3.9) mm longis et (1.9–) 2.2–2.5 (–2.6) mm latis, patentibus usque reclinatis, post anthesin reclinatis, dense tomentosis, tempore fructificationis siccis, persistentibus; petalis late ovatis usque late ellipticis, breviter unguiculatis, (6.3–) 6.7–7.4 (–7.7) mm longis et (3.6–) 4.8–5.2 (–5.5) mm latis, albidis, superne ad basin sparse villosis, patentibus; staminibus ca 20, antheris primo pallide rosaceis postea pallide luteis, (1.0–) 1.1–1.2 (–1.3) mm longis; ovario semi-infero; stylis 2 ad (37–) 41–54 (–60)% coalescentibus, ad basin villosis, albo-viridis, (3.2–) 3.3–3.5 (–3.6) mm longis, stigmatibus plus minusve planis; fructibus obovoideis vel ellipsoideis usque subglobosis, (12–) 15–16 (–17) mm longis et (10–) 12–13 (–17) mm latis, maturitate rubris, glabris vel fere glabris, nitidis, cum (5–) 9–12 (–18) lenticellis parvis, ochraceis ad 0.25 cm^2; mesocarpio heterogeneo; endocarpio cartillagineo, seminibus atro-fuscis. Numerus chromosomatum triploideus 2n = 51. Planta apomicta. Floret V.

H o l o t y p u s: Bohemia septentrionalis, distr. Litoměřice, pagus Litochovice nad Labem (5450a): ca 0.65 km situ austro-orientali a pago, in declivibus orient.-sept.-orientali angustiae Porta bohemica dictae, ad ripam sinistram fluminis Labe, in querceto, solo gneissiaceo; 220 m s. m., 50°33'07.8"N, 14°02'10.6"E; disperse; arbor no. 22; 11. 5. 2007 leg. M. Lepší; CB, No. 65306 (Fig. 3). – I s o t y p i: CB, Nos., 65298, 65299, 65304, 65305, 65307, 65308; PR, No. 65306/a; PRC, No. 65299/a; PRA, No. 65304/a; LIT, No. 65305/a; LI, 65298/a.

D e s c r i p t i o n: Trees (or shrubs) up to 7 m high. Trunk up to 0.7 m in circumference. Bark grey to dark grey, smooth when young, with vertical fissures (particularly at the trunk base) at maturity, with scattered (3–) 4–6 (–10) mm long and (3–) 4–5 (–6) mm wide lenticels. Branches at an angle of (25–) 30–40 (–60)° to the trunk; twigs brownish-grey; young shoots brown, sparsely tomentose when young and almost glabrous at maturity, with numerous elliptical or subrotund pale brown to ochraceous lenticels. Buds 7–14 mm long and 3–6 mm wide, narrowly ovoid to turbinate; scales green, with narrow brown sparsely tomentose margins. Leaves (of short fertile shoots) simple; laminas more or less broadly elliptical to (broadly) ovate, more or less flat, somewhat glossy, pale to dark green above, yellowish-greyish-green beneath, usually flat at margins, more or less triangular and acute at apex, usually rounded rarely broadly cuneate and partly serrate at base, almost glabrous on upper surface, evenly tomentose on lower surface, (7.5–) 8.6–9.7 (–11.5) cm long and (5.1–) 5.9–6.8 (–8.5) cm wide, widest at (39–) 51–58 (–64)% of the lamina length (from the tip), regularly shallowly lobed (double serrate apically); lobes acuminate, serrate or doubly serrate with sharply acuminate teeth terminating the main veins, other teeth smaller, acute; sides of lobes more or less straight; the third lobe (from the base) (0.7–) 0.9–1.2 (–1.8) cm broad; incision between the second and the third lobe (0.2–) 0.4–0.5 (–0.6) cm; lobes broader than 1 cm 1–2 (–3) on each side; veins (10–) 11–12 (–13) on each side; petioles (1.2–) 1.6–1.8 (–2.2) cm long, more or less tomentose. Inflorescences with (17–) 22–30 (–33) flowers, (4.0–) 5.0–6.0 (–7.5) cm in diameter, compact, con-

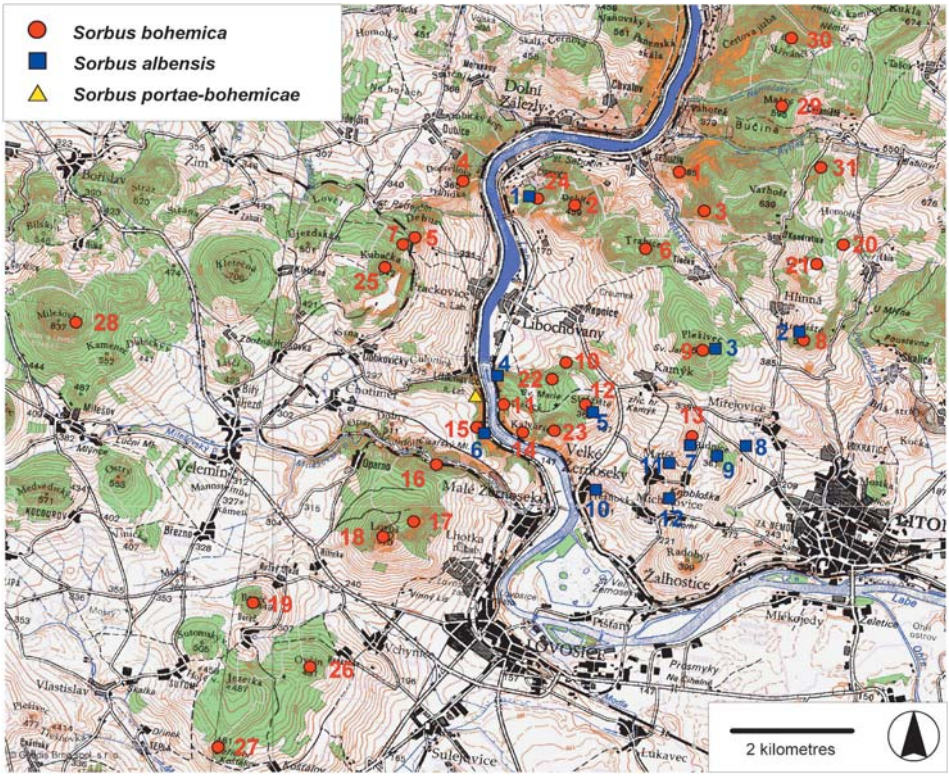

Fig. 1. – Map of the distribution of *Sorbus bohemica*, *S. albensis* and *S. portae-bohemicae*. The numbers on the map correspond to the locality numbers in the list of revised herbarium specimens and recorded localities (the use of the map was approved by the Ministry of Environment of the Czech Republic).

Fig. 2. – Fructiferous individual of *Sorbus portae-bohemicae* at the type locality (photo M. Lepší 2007).

Fig. 3. – Holotypus of *Sorbus portae-bohemicae* M. Lepší, P. Lepší, P. Vít et K. Boublík.

vex; branchlets more or less tomentose. Hypanthium turbinate, tomentose. Sepals (2.7–) 3.2–3.8 (–3.9) mm long and (1.9–) 2.2–2.5 (–2.6) mm wide, triangular, acuminate or acute, densely tomentose on both surfaces, patent, reclinate after anthesis, persistent, dry, erect. Petals (6.3–) 6.7–7.4 (–7.7) mm long and (3.6–) 4.8–5.2 (–5.5) mm wide, broadly ovate to broadly elliptical, concave, whitish, patent, sparsely hirsute at base of upper surface, with a short claw. Stamens ca 20; filaments whitish; anthers pale rose at the beginning of anthesis, later pale yellow, (1.0–) 1.1–1.2 (–1.3) mm long. Ovary semi-inferior. Styles 2, greenish-cream, (3.2–) 3.3–3.5 (–3.6) mm long, hairy at the base, connate up to (37–) 41–54 (–60)%. Stigma greenish-cream, more or less flat, (0.3–) 0.4–0.5 (–0.6) mm wide. Fruits (12–) 15–16 (–17) mm long and (10–) 12–13 (–17) mm wide, obovoid or ellipsoid to subglobose, orange-red at maturity, glabrous or almost glabrous, glossy, with (5–) 9–12 (–18) ochraceous lenticels per 0.25 cm^2, mesocarp heterogeneous; endocarp cartilaginous. Seeds fuscous. Somatic chromosome number 2n = 51 (triploid). Reproduction tentatively apomictic. Flowering V.

Etymology

The name "*portae-bohemicae*" refers to the Porta bohemica gorge in the České středohoří Mts where the *locus classicus* is located. The authors propose the epithet "soutěskový" for the Czech name.

Diagnostic characters

Leaf laminas are more or less broadly elliptical to (broadly) ovate, (7.5–) 8.6–9.7 (–11.5) cm long and (5.1–) 5.9–6.8 (–8.5) cm wide, more or less triangular and acute at apex, usually rounded, rarely broadly cuneate at base, regularly and shallowly lobed – incisions between the second and the third lobe are only (0.2–) 0.4–0.5 (–0.6) cm long; lobes acuminate with sharply acuminate teeth terminating the main veins. Styles connate up to (37–) 41–54 (–60)% of their length. Fruits are obovoid or ellipsoid, rarely subglobose, orange-red at maturity (Fig. 2).

Ecology

Sorbus portae-bohemicae inhabits east-north-east facing slopes and rocks (one locality in shallow ravine) of the Porta bohemica gorge. It occurs on mesotrophic soils developed on gneiss or migmatites. It grows in open slope oak forests (*Luzulo-Quercetum* and transition vegetation type to *Melampyro nemorosi-Carpinetum*). It occurs sympatrically with *S. bohemica*, *S. danubialis* and *S. torminalis*. *Sorbus albensis* grows on the same slope of the gorge ca 500 m S of the type locality of *S. portae-bohemicae*.

Geographical distribution

Sorbus portae-bohemicae is confined to the ENE slopes of the Porta bohemica gorge on the left-hand bank of the Labe river near the village of Litochovice nad Labem (quadrant 5450a of the Central European mapping grid; Ehrendorfer & Hamann 1965), ca 7 km WNW of Litoměřice in the České středohoří Mts (NW Bohemia) (Fig. 1). The only known specimens occur in an area of ca 400 m^2 and consists of 14 individuals of different ages (no seedlings and juveniles were recorded). The species has the smallest population of all

known Czech hybridogenous *Sorbus* species (cf. Kovanda 1999, Lepší et al. 2008). The locality occurs in the colline vegetation belt in the phytogeographical sub-district of Labské středohoří Mts, belonging to the Lounsko-labské středohoří Mts district (Skalický 1988). It is in a warm climatic region (Quitt 1971). The mean annual temperature is about 8–9 °C and mean annual precipitation reaches 550–600 mm (Tolasz et al. 2007). Its altitudinal range spans from 210 to 220 m a.s.l.

Herbarium specimens:

Czech Republic. North Bohemia, 4b. Labské středohoří Mts: Malé Žernoseky, the porta Bohemica gorge, the left-hand bank of the Labe river, 5450a (leg. PL, ML, KB 29. 9. 2000, CB 39796, leg. ML & KB 19. 5. 2001, CB 39476). – Prackovice nad Labem, ca 0.6 km to 0.7 km SE of the chapel in Litochovice nad Labem village, the slopes of the Porta bohemica gorge on the left-hand bank of the Labe river, oak forests and rocks, scattered, 210–220 m a.s.l., 5450a: 50°33'08.3"N, 14°02'11.3"E, tree No. 23 (leg. ML 11. 5. 2007, CB 65307); 50°33'08.1"N, 14°02'10.6"E, tree No. 24 (leg. ML 11. 5. 2007, CB 65308); 50°33'07.6"N, 14°02'10.8"E, tree No. 25 (leg. ML 11. 5. 2007, CB 65303, 19. 9. 2007 CB 65326); 50°33'07.6"N, 14°02'10.3"E, tree No. 27 (leg. ML 11. 5. 2007, CB 65299); 50°33'08.8"N, 14°02'10.2"E, tree No. 28 (leg. ML 11. 5. 2007, CB 65304); 50°33'07.8"N, 14°02'10.3"E, tree No. 26 (leg. ML 11. 5. 2007, CB 65305); 50°33'09.5"N, 14°02'10.2"E, tree No. 29 (leg. ML 11. 5. 2007, CB 65300); 50°33'10.0"N, 14°02'09.4"E, tree No. 31 (leg. ML 11. 5. 2007, CB 65297, 21. 6. 2007 CB 65251); 50°33'10.3"N, 14°02'09.6"E, tree No. 34 (leg. ML 11. 5. 2007, CB 65298). – The Porta bohemica gorge, Litochovice, 1 km SSE of the village, an open oak forest by the upper margin of rocks, by the tourist path, one small tree (leg. K. Nepraš 8. 9. 2007, LIT 83422).

Sorbus albensis M. Lepší, K. Boublík, P. Lepší et P. Vít, **spec. nova** (Figs 4–5)

Description: Arbores (vel frutices) usque 13 m alti; foliis (in brachyblastis fertilibus) simplicibus, laminis ambitu fere ovatis usque late ellipticis, irregulariter vel regulariter duplicato-serratis usque leviter pinnato-lobatis (lobis acutis, serratis), (6.0–) 7.4–8.5 (–10.2) cm longis et (3.7–) 4.8–5.6 (–7.8) cm latis, ad basin rotundatis usque late cuneatis, subintegris vel remote serratis, nitidis, obscure vel dilute viridibus, subtus ochro-griseo-viride tomentosis, nervis ab utroque latere (9–) 11–12 (–15) in numero; petiolis (1.1–) 1.6–1.9 (–2.4) cm longis; corymbothyrsis multifloris, compactis, convexis, ramis plus minusve tomentosis. Dentibus calycinis triangularibus, acuminatis usque acutis, (2.0–) 2.7–3.4 (–4.5) mm longis et (1.7–) 2.4–2.8 (–4.1) mm latis, patentibus, post anthesin reclinatis, tomentosis, tempore fructificationis siccis, persistentibus; petalis late ovatis usque subrotundatis, breviter unguiculatis, (5.0–) 5.9–6.9 (–8.6) mm longis et (4.2–) 5.0–5.4 (–6.0) mm latis, albiusculis, superne ad basin sparse villosis, patentibus; staminibus ca 20, antheris primo pallide rosaceis postea pallide luteis, (1.1–) 1.2–1.3 (–1.6) mm longis; ovario semi-infero; stylis 2(3) ad (9–) 20–40 (–58)% coalescentibus, ad basin villosis, luteo-viridis, (3.9–) 4.2–4.7 (–5.3) mm longis, stigmatibus plus minusve planis; fructibus subglobosis, (9.9–) 13.0–15.0 (–17.0) mm longis et (11–) 14–15 (–17) mm latis, maturitate rubris, glabris vel fere glabris, cum (5–) 8–11 (–18) lenticellis ochraceis ad 0.25 cm^2; mesocarpio heterogeneo; endocarpio cartillagineo, seminibus atro-fuscis. Numerus chromosomatum triploideus 2n = 51. Planta apomicta. Floret V.

Holotypus: Bohemia septentrionalis, distr. Litoměřice, pagus Knobloška (5450d): declivia occidentalia dumetosa ca 0.7 km situ sept.-sept.-occidentali a pago, solo calcifero-schistaceo; 290 m s. m., 50°32'57.9"N, 14°05'17.5"E; disperse; arbor ca. 6 m alta cum aliquot truncis; arbor no. 210; 22. 6. 2007, leg. Martin Lepší et Karel Boublík; CB, No. 65263 (Fig. 4). – Isotypi: PR, No. 65263/a; PRC, No. 65263/b; PRA, No. 65263/c; LIT, No. 65263/d; LI, No. 65263/f.

Description: Trees (or shrubs) up to 13 m high, often with several trunks. Trunk up to 1 m in circumference. Bark grey to dark grey, smooth when young, with vertical fissures (particularly at the trunk base) at maturity, with abundant (3–) 6–8 (–12) mm long and (3–) 6–8 (–11) mm wide lenticels. Branches at an angle of (15–) 30–40 (–60)° to the trunk; twigs brownish-grey; young shoots orange-brown to brown, tomentose when young and almost glabrous at maturity, with numerous elliptical or subrotund pale brown to ochraceous lenticels. Buds 10–14 mm long and 5.0–6.5 mm wide, narrowly ovoid to

Fig. 4. – Holotypus of *Sorbus albensis* M. Lepší, K. Boublík, P. Lepší et P. Vít.

Fig. 5. – Fructiferous individual of *Sorbus albensis* at the type locality (photo M. Lepší 2007).

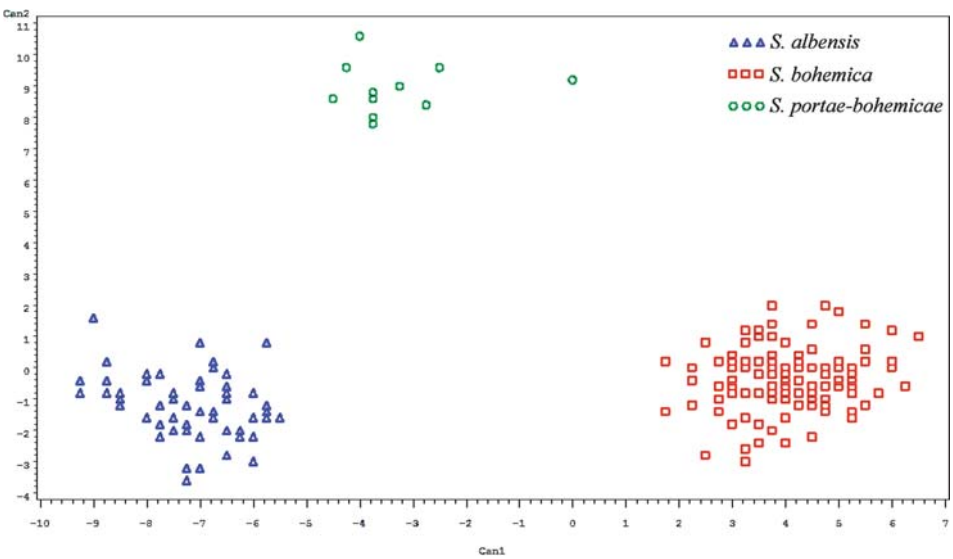

Fig. 6. – Canonical discriminant analysis of *Sorbus bohemica*, *S. albensis* and *S. portae-bohemicae*. All quantitative characters (see methods for details) were used. The first two axes explain 79.3% and 20.7% of the variation, respectively.

turbinate; scales green, with narrow brown sparsely tomentose margins. Leaves (of short fertile shoots) simple; laminas more or less ovate (rarely broadly ovate) or broadly elliptical, usually concave, somewhat glossy, dark to pale green above, yellowish-greyish-green beneath, usually flat at margins, more or less triangular acute to slightly acuminate at apex, usually rounded or rarely broadly cuneate and partly serrate at base, almost glabrous on upper surface, evenly tomentose on lower surface, (6.0–) 7.4–8.5 (–10.2) cm long and (3.7–) 4.8–5.6 (–7.8) cm wide, widest at (36–) 52–58 (–73)% of the lamina length (from the tip), irregularly or regularly double serrate, rarely shallowly lobed at base, teeth terminating the main veins or lobes acute or rarely acuminate, other teeth smaller, acute; sides of main teeth or lobes convex to straight; the third lobe (from the base) (0.4–) 0.8–1.1 (–1.5) cm broad; incision between the second and the third teeth (or lobe) terminating the main veins (0.1–) 0.2–0.3 (–0.6) cm; lobes broader than 1 cm 0–1 (–4) on each side; veins (9–) 11–12 (–15) on each side; petioles (1.1–) 1.6–1.9 (–2.4) cm long, more or less tomentose. Inflorescences with (22–) 32–41 (–57) flowers, (5.0–) 6.0–7.0 (–9.5) cm in diameter, compact, convex; branchlets more or less tomentose. Hypanthium turbinate, tomentose. Sepals (2.0–) 2.7–3.4 (–4.5) mm long and (1.7–) 2.4–2.8 (–4.1) mm wide, triangular, acuminate to acute, tomentose on both surfaces, patent, reclinate after anthesis, persistent, dry, erect. Petals (5.0–) 5.9–6.9 (–8.6) mm long and (4.2–) 5.0–5.4 (–6.0) mm wide, broadly ovate to subrotund, concave, whitish, patent, sparsely hirsute at the base of upper surface, with a short claw. Stamens ca 20; filaments whitish; anthers are pale rose at the beginning of anthesis, later pale yellow, (1.1–) 1.2–1.3 (–1.6) mm long. Ovary semi-inferior. Styles 2(3), greenish-cream, (3.9–) 4.2–4.7 (–5.3) mm long, hairy at the base, connate up to (9–) 20–40 (–58)%. Stigma greenish-cream, more or less flat, (0.5–) 0.6–0.7 (–0.8) mm wide. Fruits (9.9–) 13.0–15.0 (–17.0) mm long and (11–) 14–15 (–17) mm wide, broadly ellipsoidal to subglobose, orange-red at maturity, glabrous or almost glabrous, somewhat glossy, with (5–) 8–11 (–18) ochraceous lenticels per 0.25 cm^2, mesocarp heterogeneous; endocarp cartilaginous. Seeds fuscous. Somatic chromosome number 2n = 51 (triploid). Reproduction tentatively apomictic. Flowering V.

Diagnostic characters

Leaf laminas are more or less ovate (rarely broadly ovate) or broadly elliptical, relatively small, (6.0–) 7.4–8.5 (–10.2) cm long and (3.7–) 4.8–5.6 (–7.8) cm wide, triangular and acute to slightly acuminate at apex, usually rounded or rarely broadly cuneate at base, often irregularly double serrate (i.e., along the regularly double serrate margin, a simply serrate zone occurs), rarely shallowly lobed, incision between the second and the third teeth (or lobe) terminating the main veins (0.1–) 0.2–0.3 (–0.6) cm long; teeth (or lobe) terminating the main veins acute or rarely acuminate. Anthers are pale yellow. Styles connate up to (9–) 20–40 (–58)% of their length. Fruits are subglobose, orange-red at maturity (Fig. 5).

Etymology

The name "*albensis*" is derived from the Latin name of the river Labe: Albis. This species occurs in the valley of the river and its vicinity. The authors propose the epithet "labský" for the Czech name.

Ecology

Sorbus albensis appears generally tolerant of a range of soil and light conditions (analogous to *S. bohemica*), occurring on both acidic (gneisses, migmatites) and base-rich (basalts, calcareous marls, colluvial sediments, sandstones, sandy marls and siltstones) soils and in open (wood margin, grasslands, shrublands, screes and rocks) and (semi-)shaded habitats (forests). In grasslands on calcareous marls by the village of Knobloška (locality 7), it spreads. It produces plenty of fruit and seedlings and is able to form monospecific closed stands. In the undergrowth of forests, *S. albensis* is very often sterile and only produces fruits when there are gaps in the canopy or it reaches the tree layer. It was recorded on slopes of all aspects. Most localities are situated on northeast or northwest slopes. A majority of individuals occur in human-affected semi-natural forests or man-made grasslands or shrublands. Only twice has it been found in relic habitats such as rocks and screes (localities 3, 6). The species grows sympatrically with *S. bohemica*, *S. danubialis* and *S. torminalis* at most localities. Its ecological requirements are nearly identical to those of *S. bohemica*. *Sorbus danubialis* is a little more heliophilous and xerothermophilous while *S. torminalis* is a more mesophilous species.

Sorbus albensis inhabits acidophilous oak forests (*Luzulo-Quercetum*) and transition vegetation types from *Luzulo-Quercetum* to mesic oak forests (*Melampyro nemorosi-Carpinetum*) on gneisses and sandstones, scree forests (*Aceri-Carpinetum*) on basalts and shrubby slopes (*Pruno-Ligustretum*, *Antherico-Coryletum*) on marls. Rarely, this species occurs in xerothermophilous oak forests (*Corno-Quercetum*, *Potentillo albae-Quercetum*) situated on basalts and marls, and relic shrub communities on rocky outcrops (*Junipero communis-Cotoneastretum integerrimae*) (locality 6). On cretaceous marl slopes, it is also found in semi-dry grasslands with *Sesleria caerulea* (*Cirsio pannonici-Seslerietum calcariae*). It is rarely recorded in forest plantations of *Fraxinus excelsior* or *Pinus sylvestris* and once in an abandoned cherry orchard (locality 1). *Sorbus albensis* was recorded in nine vegetation types and *S. bohemica* in 16 (Boublík et al. 2002). This is probably due to the wider distribution of *S. bohemica* than its broader ecological amplitude.

Geographical distribution

Sorbus albensis was recorded at 12 localities W to NW of Litoměřice in the České středohoří Mts (NW Bohemia). The distribution area of the species is situated approximately in the centre of the range of *S. bohemica*. The distance between the furthest apart localities is nearly 6 km. The northernmost locality is by the village of Církvice, the southernmost by Malíč, the westernmost by Litochovice nad Labem and the easternmost by Hlinná (Fig. 1). The largest populations, consisting of several hundred individuals, occur on Plešivec hill, on calcareous marl slopes by Knobloška and on Bídnice hill (localities 3, 7, 9). At other localities, this species is rather scattered or occurs in small populations. *S. albensis* grows in four quadrants (5548a–d) of the Central European mapping grid (Ehrendorfer & Hamann 1965). Considering the number of localities and the size of populations, *S. albensis* is the second most abundant endemic *Sorbus* species in the Czech Republic (cf. Kovanda 1999, Lepší et al. 2008). The localities are situated in the colline vegetation belt in the phytogeographical sub-district of Labské středohoří Mts, belonging to the Lounsko-labské středohoří Mts district (Skalický 1988). They are in a warm climatic

region (Quitt 1971) with a mean annual temperature of about (7–) 8–9 °C and mean annual precipitation of 550–600 mm (Tolasz et al. 2007). Its altitudinal range spans from 180 m a.s.l. (near Velké Žernoseky village) to 540 m a.s.l. (Hradiště hill).

Herbarium specimens and recorded localities:

Czech Republic. North Bohemia, 4b. Labské středohoří Mts: 1. The Hillock on the W margin of Deblík hill: Církvice, the slopes of the hills above the weekend house village (in the direction of "Hauberge" hill), scrubby slopes (leg. KK 1. 7. 1983, LIT 41865). – Církvice, the W slopes of Deblík hill, in an abandoned cherry orchard, 5450a (leg. KB 9. 10. 2000, CB 65400). – Církvice, a slope above the gardens, 5450a (leg. ML & KB 21. 5. 2001, CB 39475). – Libochovany, ca 0.8 km SE of the chapel in Církvice village, 5450a: 50°35'05.0"N, 14°02'29.9"E, 260 m a.s.l., *Carpinion*, scattered in the low tree layer, tree No. C78 (leg. ML & KB 22. 6. 2007, CB 65245); 50°35'03.8"N, 14°02'28.6"E, 270 m a.s.l., *Carpinion*, scattered in the low tree layer, tree No. C77 (leg. ML & KB 22. 6. 2007, CB 65246); 50°35'02.9"N, 14°02'35.0"E, 270 m a.s.l., in a *Fraxinus excelsior* stand, 2 individuals, tree No. C76 (leg. ML & KB 22. 6. 2007, CB 65247); 50°35'00.9"N, 14°02'33.5"E, 280 m a.s.l., in the low tree layer of planted stand of *Pinus sylvestris*, 10 individuals, tree No. C75 (leg. ML & KB 22. 6. 2007, CB 65248); 50°35'07.8"N, 14°02'40.4"E, 260 m a.s.l., abandoned cherry orchard, scattered in the tree layer, tree No. C74 (leg. ML & KB 22. 6. 2007, CB 65249); 50°35'07.3"N, 14°02'39.9"E, 250 m a.s.l., an abandoned cherry orchard, scattered in the tree layer, tree No. C73 (leg. ML & KB 22. 6. 2007, CB 65250). – Libochovany, ca 0.9 km SE of the chapel in Církvice village, 5450a (leg. KB 22. 4. 2007, CB 65398). **2. Hradiště hill** (50°34'06.3"N, 14°06'50.0"E): Litoměřice, Hradiště hill near Hlinná village, the summit plateau, 540 m a.s.l., 5450b (leg. KB 15. 5. 2001, CB 65361). **3. Plešivec hill**: Litoměřice, Plešivec hill near Kamýk village, 5450b (leg. KB 15. 5. 2001, CB 65359). – Litoměřice, Plešivec hill near Kamýk village, the E slope, 450 m a.s.l., 5450b: 50°33'40.4"N, 14°05'32.0"E (leg. KB 15. 5. 2001, CB 65358). – Litoměřice, the NW periphery of Kamýk village, in the scrub layer of an oak forest, scattered to abundant, 5450b: 50°33'30.0"N, 14°05'25.2"E, 370 m a.s.l., tree No. 69 (leg. ML 19. 6. 2007, CB 65255); 50°33'31.1"N, 14°05'23.5"E, 380 m a.s.l., tree No. 68 (leg. ML 19. 6. 2007, CB 65256). – Litoměřice, ca 0.7 km SE of the summit of Plešivec hill near Kamýk village, in an acidophilous oak forest, scattered, 410 m a.s.l., 5450b: 50°33'43.4"N, 14°05'40.5"E (leg. ML 19. 6. 2007, CB 65253). – Litoměřice, the S slopes of Plešivec hill, 5450b: 50°33'33.4"N, 14°05'20.3"E, 430 m a.s.l., the road margin in an oak forest, tree No. SPB87 (leg. ML & PV 20. 6. 2007, CB 65260); 50°33'36.2"N, 14°05'23.8"E, 420 m a.s.l., the road margin in an oak forest, tree No. SPB89 (leg. ML & PV 20. 6. 2007, CB 65261). – Litoměřice, ca 0.8 km E of the church in Kamýk village, the S slopes of Plešivec hill, 380 m a.s.l., 5450b: 50°33'33.4"N, 14°05'20.3"E, tree No. 87 (leg. ML 18. 9. 2007, CB 65354). **4. Porta bohemica gorge, the right-hand bank**: Libochovany, below the upper margin of the porphyry slopes of the Porta bohemica gorge on the right-hand bank of the Labe river, rarely, 5450a (leg. KK 20. 5. 2005, LIT). – Libochovany, ca 1.2 km S of the church, the slopes of the Porta bohemica gorge on the right-hand bank of the Labe river, near the upper margin of the gorge, acidophilous oak forest, rarely, 220 m a.s.l., 5450a: 50°33'21.4"N, 14°02'24.2"E (leg. ML, PL & KB 20. 9. 2007, CB 65271). **5. Strážiště hill**: Velké Žernoseky, Strážiště hill N of the village, the N slope near the summit, 5450a (leg. KB 17. 5. 2001, CB 65360). – The N slopes of Strážiště hill, near the summit, 5450a: 50°33'12.6"N, 14°03'45.5"E, 350 m a.s.l., scrubs, 1 individual, tree No. STR43 (leg. ML 12. 5. 2007, CB 65283); 50°33'12.1"N, 14°03'45.5"E, 340 m a.s.l., an oak forest, 2 individuals, tree No. STR42 (leg. ML 12. 5. 2007, CB 65285, 18. 9. 2007, CB 65352). **6. Porta bohemica gorge, the left-hand bank**: Prackovice nad Labem, the Porta bohemica gorge on the left-hand bank of the Labe river, 5450a (leg. PL, ML & KB 29. 9. 2000, CB 39798). – Prackovice nad Labem, ca 700 m SSE of the chapel in Litochovice nad Labem village, the slopes of the Porta bohemica gorge on the left-hand bank of the Labe river, near the upper margin of the gorge, oak forest, 270 m a.s.l., 5450c: 50°32'44.1"N, 14°02'15.5"E, tree No. 38 (leg. ML 11. 5. 2007, CB 65302). – Prackovice nad Labem, ca 1.2 km SSE of the chapel in Litochovice nad Labem village, the slopes of the Porta bohemica gorge on the left-hand bank of the Labe river, near the upper margin of the gorge, 250 m a.s.l., 5450c: 50°32'50.1"N, 14°02'13.4"E, tree No. 35 (leg. ML 11. 5. 2007, CB 65309). – Prackovice nad Labem, ca 1.3 km SSE of the chapel in Litochovice nad Labem village, the slopes of the Porta bohemica gorge on the left-hand bank of the Labe river, near the upper margin of the gorge, 240 m a.s.l., 5450c: 50°32'45.8"N, 14°02'15.8"E, tree No. 36 (leg. ML 11. 5. 2007, CB 65327, 19. 9. 2007, CB 65324). – Prackovice nad Labem, ca 1.4 km SSE of the chapel in Litochovice nad Labem village, slopes of the Porta bohemica gorge on the left-hand bank of the Labe river, near the upper margin of the gorge, 270 m a.s.l., 5450c: 50°32'44.1"N, 14°02'15.5"E, tree No. 37 (leg. ML 11. 5. 2007, CB 65301). **7. Calcareous marl slopes by Knobloška**: Litoměřice, Knobloška, the calcareous marl slopes N of the village (leg. KB 11. 5. 2000, CB 65389, 65390, 65392). – Litoměřice, the calcareous marl slopes near Knobloška village, 5450b (leg. PL & ML 14. 6. 2000, CB

39799-39803, leg. PL, ML & KB 21. 9. 2000, CB 39797, leg. PL 12. 5. 2001, CB 39473-39474). – Litoměřice, the calcareous marl slopes N of Knobloška village, scattered to abundant, 5450b: 50°33'01.1"N, 14°05'24.9"E, 330 m a.s.l., tree No. B226 (leg. ML 18. 9. 2006, CB 65344); 50°33'02.2"N, 14°05'27.2"E, 320 m a.s.l., tree No. B221 (leg. ML 18. 9. 2006, CB 65345); 50°33'01.6"N, 14°05'25.9"E, 340 m a.s.l., tree No. B222 (leg. ML 18. 9. 2006, CB 65346); 50°33'06.6"N, 14°05'22.5"E, 280 m a.s.l., tree No. B235 (leg. ML 18. 9. 2006, CB 65347); 50°33'07.3"N, 14°05'20.3"E, 260 m a.s.l., tree No. B236 (leg. ML 18. 9. 2006, CB 65348); 50°33'01.2"N, 14°05'15.6"E, 260 m a.s.l., tree No. B228 (leg. ML 18. 9. 2006, CB 65341); 50°33'04.8"N, 14°05'21.1"E, 290 m a.s.l., tree No. B234 (leg. ML 18. 9. 2006, CB 65349); 50°33'05.4"N, 14°05'20.8"E, 280 m a.s.l., tree No. B233 (leg. ML 18. 9. 2006, CB 65334); 50°33'03.1"N, 14°05'14.3"E, 260 m a.s.l., tree No. B230 (leg. ML 18. 9. 2006, CB 65329); 50°33'02.3"N, 14°05'.6"E, 310 m a.s.l., tree No. B224 (leg. ML 18. 9. 2006, CB 65330); 50°33'01.6"N, 14°05'24.8"E, 320 m a.s.l., tree No. B207 (leg. ML 18. 9. 2006, CB 65331); 50°33'.2"N, 14°05'25.9"E, 330 m a.s.l., tree No. B225 (leg. ML 18. 9. 2006, CB 65333); 50°33'04.2"N, 14°05'15.1"E, 260 m a.s.l., tree No. B231 (leg. ML 18. 9. 2006, CB 65339); 50°33'01.6"N, 14°05'15.3"E, 270 m a.s.l., tree No. B229 (leg. ML 18. 9. 2006, CB 65332); 50°33'01.5"N, 14°05'24.8"E, 300 m a.s.l., tree No. B207 (leg. ML, PL & KB 20. 9. 2007, CB 65270). – Litoměřice, the scrubby calcareous marl slopes N of Knobloška village, scattered to abundant, 5450d: 50°32'57.9"N, 14°05'17.5"E, 290 m a.s.l., tree ca 6 m high, with several trunks, tree No. 210, type tree! (leg. ML & PV 12. 1. 2006, CB 65377, leg. ML 18. 9. 2006, CB 65343); 50°32'55.5"N, 14°05'23.2"E, 310 m a.s.l., tree No. B237 (leg. ML 18. 9. 2006, CB 65355); 50°32'56.9"N, 14°05'20.4"E, 290 m a.s.l., tree No. B209 (leg. ML 18. 9. 2007, CB 65328); 50°32'58.5"N, 14°05'16.6"E, 290 m a.s.l., tree No. B211 (leg. ML 18. 9. 2006, CB 65342); 50°32'45.5"N, 14°05'19.7"E, 310 m a.s.l., tree No. B239 (leg. ML 18. 9. 2006, CB 65337); 50°32'51.6"N, 14°05'27.4"E, 320 m a.s.l., tree No. B238 (leg. ML 18. 9. 2006, CB 65338). **8. Small forest by Bídnice**: Litoměřice, ca 0.6 km NE of the summit of Bídnice hill, an oak forest, 270 m a.s.l., 5450b: 50°32'59.9"N, 14°06'11.0"E, 1 juvenile individual (not. ML 20. 6. 2007). **9. Bídnice hill**: Litoměřice, the NE slopes of Bídnice hill, the wood margin above gardens, abundant, 310 m a.s.l., 5450b: 50°33'02.2"N, 14°05'51.5"E (leg. ML, PL & KB 20. 9. 2007, CB 65269). – Litoměřice, the N slopes of Bídnice hill, scattered, 5450d: 50°32'55.3"N, 14°05'40.6"E, 350 m a.s.l., tree No. 305 (leg. ML 13. 5. 2007, CB 65315); 50°32'55.5"N, 14°05'40.5"E, 350 m a.s.l., tree No. 304 (leg. ML 13. 5. 2007, CB 65318); 50°32'56.3"N, 14°05'45.3"E, 300 m a.s.l., tree No. 307 (leg. ML 13. 5. 2007, CB 65316); 50°32'56.3"N, 14°05'44.2"E, 310 m a.s.l., tree No. 306 (leg. ML 13. 5. 2007, CB 65317). – Litoměřice, the W slope of Bídnice hill, an oak forest, abundant in the scrub layer, 370 m a.s.l., 5450d: 50°32'56.7"N, 14°05'44.9"E, tree No. SPB86 (leg. ML & PV 20. 6. 2007, CB 65259). **10. Třešňovka hill**: Velké Žernoseky, a woody slope on the E periphery of the village, an oak forest, abundant in the tree and scrub layer, 5450c: 50°32'22.7"N, 14°04'07.7"E, 200 m a.s.l., tree No. 294 (leg. ML 12. 5. 2007, CB 65296); 50°32'22.5"N, 14°04'08.5"E, 200 m a.s.l., tree No. 295 (leg. ML 12. 5. 2007, CB 65288, 18. 9. 2007, CB 65353); 50°32'22.8"N, 14°04'06.7"E, 200 m a.s.l., tree No. 293 (leg. ML 12. 5. 2007, CB 65292, 12. 5. 2007, CB 65295); 50°32'24.3"N, 14°04'01.8"E, 190 m a.s.l., tree No. 297 (leg. ML 12. 5. 2007, CB 65294); 50°32'24.4"N, 14°04'03.0"E, 180 m a.s.l., tree No. SPB85 (leg. ML & PV 20. 6. 2007, CB 65258). **11. Small oak forest by Malíč**: Litoměřice, ca 350 m NE of the centre of Malíč village, an oak forest, 290 m a.s.l., 5450d: 50°32'44.9"N, 14°05'08.2"E, 1 individual, tree No. B240 (leg. ML 18. 9. 2006, CB 65336). **12. Calcareous marl slopes by Malíč**: Malíč (leg. KK 1967, LIT, det. Kovanda as *S. bohemica*, Jankun & Kovanda 1987, rev. ML & KB 2001, the specimen was not found in LIT in 2008 and is probably lost). – Litoměřice, the calcareous marl slope SE of Malíč village, 280 m a.s.l., 5450d: 50°32'24.9"N, 14°05'11.3"E, 2 trees, tree No. B241 (leg. ML 18. 9. 2006, CB 65335).

Discussion

Phenotypic variation and species-specific characters

The populations of all three species are fertile and the plants produce fully developed seeds, and are morphologically homogenous both in vegetative and generative characters. There are no records of morphologically intermediate types between the species despite their frequently occur sympatrically.

Like *S. bohemica*, the new taxa belong to the *S. latifolia* aggregate (parental combination *S. aria* s. lat. × *S. torminalis*). Because *S. danubialis* (*S. aria* group) co-occurs commonly with the new taxa and is morphologically close to them, we consider it to be one of the parents. For morphological differences between *S. danubialis* and the three species

studied see the key in Appendix 1. The second putative parental species, *S. torminalis*, quite often also occurs with the hybridogenous taxa. *Sorbus aria* s. lat., the second member of the *S. aria* group growing in the same region, was not recorded at the same localities as either *S. portae-bohemicae* or *S. albensis*. Plants intermediate between the hybridogenous species and their putative parents have not been observed.

The newly discovered species are relatively similar to *S. bohemica* but differ in a number of distinct and stable characters. *Sorbus albenis* has, unlike *S. bohemica*, an irregularly and usually only double serrate leaf margin and an ovate leaf lamina (*S. bohemica* has a regularly lobed and elliptical to oblong elliptical leaf lamina). *S. portae-bohemicae* differs from *S. bohemica* in having obovoid to ellipsoid fruits and a broadly ovate to broadly elliptical leaf (fruits of *S. bohemica* are broadly ellipsoid or subglobose) (for details see the key in Appendix 1). The three species studied differ from other Bohemian members of the *S. latifolia* agg. (i.e., *S. eximia*, *S. gemella*, *S. rhodanthera* and *S. milensis*) in having orange-red fruits and shallowly lobed to serrate leaves. *Sorbus gemella* and *S. eximia* differ in having orange fruits and *S. rhodanthera* and *S. milensis* in their rhomboidal and more deeply incised leaf laminas.

Chromosome variation

Cells of the samples from *S. albensis* and *S. portae-bohemicae* had a the triploid chromosome number (2n = 3x = 51). Other hybridogenous species of the Bohemian *S. latifolia* agg. (P. Vít et al., unpubl. results), including *S. bohemica* (Jankun & Kovanda 1987) and *S. milensis,* have the same number of chromosomes (Lepší et al. 2008). Screening of DNA ploidy levels of *S. albensis* using DAPI flow cytometry did not detect any intraspecific variation (P. Vít & J. Suda, unpublished). It is therefore concluded that all three species studied are triploids.

Genetic variation

Sorbus albensis and *S. portae-bohemicae* showed no infraspecific genetic variation at seven nuclear microsatellite loci, indicating a monotopic origin (i.e., each species is a single evolutionary lineage). This phenomenon is recorded in several other agamospermous *Sorbus* taxa occurring in the Czech Republic (e.g., *S. rhodanthera*, *S. milensis*) (Lepší et al. 2008, P. Vít et al., unpublished). While intraspecific variation was not revealed or was low (in the case of *S. bohemica*), interspecific differentiation is considerable – all species studied have distinct microsatelite patterns. Fragment length of each analyzed loci and average gene diversity are presented in Table 2 (in the case of *S. bohemica, S. danubialis* and *S. torminalis* only typical and prevailing genotypes were chosen). Endemic species differ in six of the seven loci analyzed. Average gene diversity of hybridogenous species is considerably (about tenfold) lower than that of putative parental species reproducing sexually. This observation supports the independent status of each of the endemic *Sorbus* species as unique evolutionary units.

The predominant, if not sole, mode of reproduction of the new taxa, inferred from the low morphological and genetic variation, is apomixis. These observations are consistent with results for several other apomictic *Sorbus* taxa of hybrid origin (Liljefors 1953, Jankun & Kovanda 1986, 1987, 1988, Meyer et al. 2005).

Table 2. – Fragment length of microsatellite loci (in bp) and average gene diversity over all loci (AGD) for the *Sorbus* species studied.

Taxon	N	Locus Mss1	Locus CH01H10	Locus Mss6	Locus CH02D11	Locus Ms14	Locus Mss5	Locus Ms6g	AGD	S.E.
S. albensis	35	170	78	230, 252	112, 122	120, 128	112, 124, 132	126	0.000	0.000
S. portae-bohemicae	10	174	78	230, 252	114, 122	112, 120	112, 124, 136	126	0.000	0.000
S. bohemica	45	174	78	230, 250	114, 122	112, 120	112, 124, 130	118, 126	0.022	0.016
S. torminalis	5	160, 170	78	250	112, 122	120, 128	124, 126	118, 126	0.223	0.137
S. danubialis	5	162, 74	78, 82	248	112, 120	118, 132	112, 126	126	0.274	0.175

Morphometric analyses

Both described species (*S. albensis* and *S. portae-bohemicae*) were well separated from other Bohemian *Sorbus* species of the *Sorbus latifolia* agg. (i.e., *S. bohemica*, *S. eximia, S. gemella*, *S. milensis*, and *S. rhodanthera*) in the canonical discriminant analysis (results not shown). In separate analyses of *S. bohemica*, *S. albensis* and *S. portae-bohemicae* (see Fig. 6), *S. portae-bohemicae* was well separated from the two other species along the second discriminant axis; stigma width, style length and leaf lamina width were the variables most closely correlated with the second axis. The remaining species (*S. bohemica* and *S. albensis*) were separated along the first discriminant axis; number of lateral leaf veins, fruit length and fruit width were the variables most closely correlated with the first axis. In further analysis, *S. albensis* and *S. portae-bohemicae* were also well separated by stigma width, style length and the incision between the 2nd and 3rd lobe of the leaf lamina (data not shown). When all of the 17 characters measured were used in a classificatory discriminant analysis all of the specimens of *S. portae-bohemicae*, *S. albensis* and *S. bohemica* were correctly classified (data not shown).

Geometric morphometric analysis of leaf laminas

While descriptive morphometrics separated the species mostly on the basis of reproductive characters, a geometric morphometric analysis (based on elliptic Fourier descriptors) allowed us to distinguish the species by using the overall shape of leaf lamina as the diagnostic character (leaves from the middle part of short fertile shoots were the most appropriate). Different mean shapes of the leaf laminas of the three species are presented in Fig. 7.

Principal component analysis (PCA) performed on standardized Fourier coefficients revealed distinct differences among the species (Fig. 8). A morphological shape trend associated with the first principal component separates the two newly described species (*S. albensis* and *S. portae-bohemicae*) from *S. bohemica*. Variation along the second axis revealed a clear difference in the shape of lamina between *S. portae-bohemicae* and *S. albensis* and also demonstrated a tendency towards differentiation between *S. albensis* and *S. bohemica*. No clear pattern was observed along the other PCA axes (data not shown).

A useful aspect of geometric morphometric analyses is the easy "backward" visualization of the shape variation associated with a particular principal component. In our case, the reconstructed shapes (Fig. 8) indicate that the first principal component is a good proxy of the shape of the curve of the lamina base and apex, which separates *S. bohemica* (cuneate, straight or slightly arcuate at the base and a broadly triangular apex of the lamina) and *S. portae-bohemicae* (usually rounded, rarely broadly cuneate at the base and

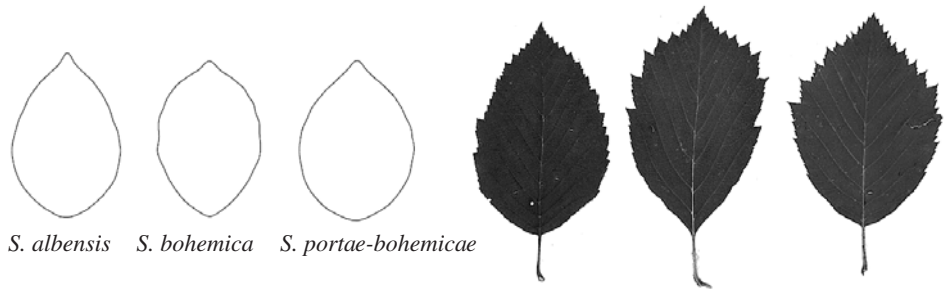

Fig. 7. – Left: Mean leaf lamina shapes of the three species reconstructed from mean values of standardized Fourier coefficients (20 harmonics used). Right: photographs of the leaves of the same species.

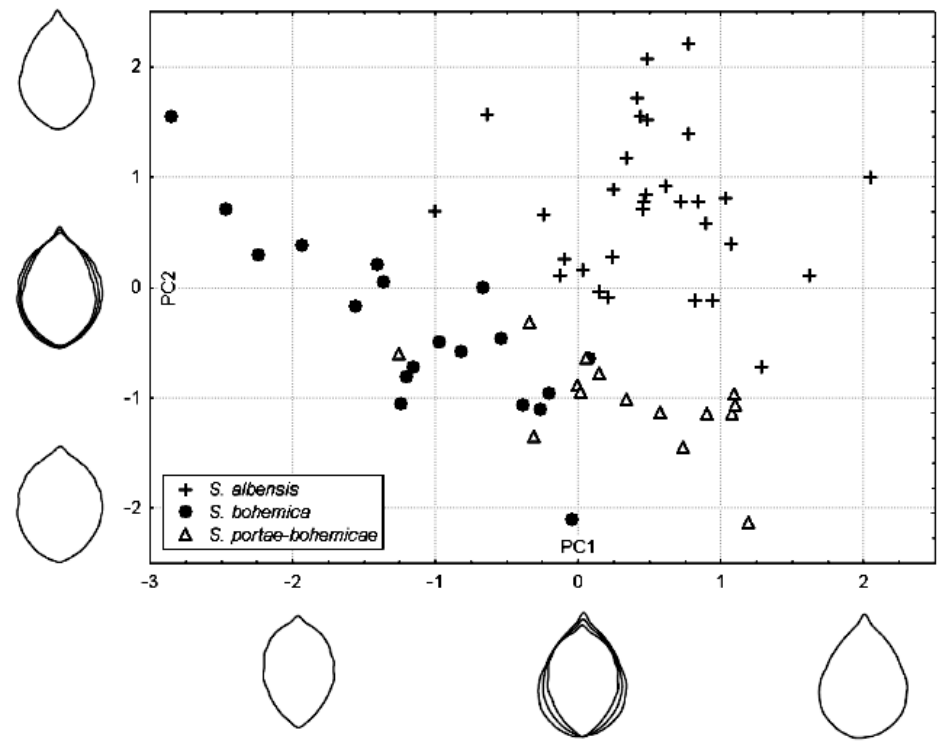

Fig. 8. – PCA of Fourier coefficients describing the total leaf lamina shape of the three apomictic *Sorbus* species from the České středohoří Mts. The first and second ordination axes are displayed, which explain 37.4% and 24.7% of the overall variation, respectively. Reconstructed contours corresponding the –2 and +2 SD positions on both axes are visualized along the particular axes (the scale of the plot is in SD units). In the middle, these two contours are superimposed on the mean leaf shape (corresponding the [0.0] point of the plot).

a triangular apex of the lamina). The second principal component describes the overall shape of the lamina, which separates *S. albensis* (ovate lamina) from *S. portae-bohemicae* [broadly elliptical lamina to (broadly) ovate] and partly also from *S. bohemica* (elliptical or rarely ovate lamina). Within the three species, individuals of *S. albensis* form the most distinct group. However, for the delimitation of this group, both PC1- and PC2-connected variation (i.e., both variation in lamina base, lamina apex and overall lamina shape) must be taken into account. Discrimination between the two remaining species is more challenging – the most important character is the shape variation associated with the first component (i.e., shape of the lamina base). The results of these analyses confirmed our field observations.

A cross-validated discriminant analysis was performed on the principal component scores of the first four PCA axes (explaining 77.8% of the total variability). In total, six axes were found to significantly improve the discriminant power of the CVA analysis during forward selection in Canoco, of which the PCA axes 12 and 14 were rejected because of their negligible contribution to the explained variance. Only once did the discriminant analysis result in a incorrect classification (one individual of *S. bohemica* was assigned to *S. portae-bohemicae*).

Although the geometric Fourier-based treatment and subsequent analyses were able to discriminate between the three species, only variation connected with the overall laminar shape gave a meaningful result. Neither the relative position nor the shape of the laminar lobes contributed to the discrimination among the species, even when the shape of the lobes was more accurately described by using a greater (40) number of harmonics (data not shown).

Conservation status

The main threat to these hybridogenous species stems from the cessation of traditional forest management, which maintained open forests. The currently grown, so-called high forests, are too shady for the long-term survival and regular reproduction of light-demanding *Sorbus* species. Moreover, growth of seedlings is hindered by browsing of ungulates. Considering the endemic status of the taxa and relatively small number of individuals and localities, the species should be included among the endangered plants of the Czech flora and added to the list of species protected by law. *Sorbus bohemica* is already regarded as a strongly endangered species (Holub & Procházka 2000). We propose to include *S. albensis* among the strongly endangered and *S. portae-bohemicae* among critically endangered taxa (sensu Holub & Procházka 2000). According to IUCN (2001), *S. portae-bohemicae* and *S. albensis* rank among critically endangered species [criterium – B2a;D and B1b (i,iii,iv,v), respectively] and *S. bohemica* among endangered species [B1b (i,iii,iv,v);C2a (i)]. Great attention should be paid to the protection of these species in the future. Appropriate forest management, which would facilitate reproduction of the endemics, should be implemented at selected localities. Supposed parental species growing at the same localities as the endemics should also be protected because they may generate (by hybridization and introgression) new taxonomic diversity and play an important role in ongoing evolutionary processes (cf. Ennos et al. 2005). Considering the biological value and abundant occurrence of these endangered and endemic species, the type localities deserve special conservation status (e.g., as part of a protected area).

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Souhrn

V příspěvku jsou popsány dva nové apomiktické triploidní (2n = 3x = 51) druhy jeřábů *S. portae-bohemicae* M. Lepší, P. Lepší, P. Vít et K. Boublík (jeřáb soutěskový) a *S. albensis* M. Lepší, K. Boublík, P. Lepší et P. Vít (jeřáb labský), náležející do skupiny *Sorbus latifolia* agg. (rodičovská kombinace *S. aria* agg. × *S. torminalis*). Byly rozlišeny na základě taxonomické a chorologické revize jeřábu českého (*Sorbus bohemica*), hybridogenního druhu stejné rodičovské kombinace, který byl popsán již v roce 1961 z vrchu Lovoš (Kovanda 1961). Všechny tři studované druhy rostou společně v Českém středohoří. Studiem herbářů a terénním výzkumem bylo zjištěno, že jeřáb český byl doposud zaznamenán na 31 lokalitách, pouze 5 historických lokalit se nám nepodařilo v terénu ověřit. *Sorbus portae-bohemicae* je stenoendemitem soutěsky Porta bohemica (ca 7 km ZSZ od Litoměřic), kde roste ve světlých dubových lesích (*Luzulo-Quercetum* s přechody k *Melampyro nemorosi-Carpinetum*) vyvinutých na VSV orientovaných svazích a skalách. Jediná známá populace čítá 14 dospělých exemplářů. *S. albensis* se vyskytuje na 12 lokalitách Z až SZ od Litoměřic. Celkový počet jedinců odhadujeme na 600. Nejčastěji roste v acidofilních dubových lesích (*Luzulo-Quercetum* a přechodných vegetačních typech k *Melampyro nemorosi-Carpinetum*), suťových lesích (*Aceri-Carpinetum*) a na křovinatých stráních (*Pruno-Ligustretum*, *Antherico-Coryletum*). Oprávněnost hodnocení obou taxonů na druhové úrovni byla potvrzena pomocí moderních molekulárních a morfometrických metod. Populace nově popsaných druhů vykazují malou genetickou a morfologickou variabilitu a jsou dobře diferencované od ostatních v Čechách se vyskytujících hybridogenních jeřábů.

Všechny tři studované jeřáby jsou nejvíce ohroženy mizením jejich hlavního biotopu, kterým jsou světlé lesy vzniklé díky historickému managementu v lesích. Navrhujeme oba nové taxony zařadit do červeného seznamu taxonů ČR – *S. portae-bohemicae* do kategorie kriticky ohrožených druhů (C1 podle Holub & Procházka 2000) a *S. albensis* do kategorie silně ohrožených druhů (C2). Na obou „klasických" lokalitách doporučujeme vyhlášení maloplošných chráněných území.

K odlišení společně se vyskytujících jeřábů v Labském středohoří poslouží následující klíč (čepel listů musí pocházet ze střední části fertilních brachyblastů):

1a Čepel listu víceméně kosočtverečná až zaokrouhleně kosočtverečná, na rubu šedozelá, pouze v horní části zastřihovaně dvakrát pilovitá (někdy až mělce laločnatá), plody (korálově) červené, čnělky volné ..... ***S. danubialis***

1b Čepel listu eliptická, široce eliptická nebo vejčitá, na rubu nažloutle šedozelená, mělce laločnatá nebo hrubě dvakrát pilovitá, plody oranžovočervené, čnělky srostlé **2**

2a Čepel listu široce vejčitá až široce eliptická, zuby, ve kterých končí postranní žilky, ostře zašpičatělé, plody obvejčité nebo eliptické ..... ***S. portae-bohemicae***

2b Čepel listu eliptická nebo vejčitá, zuby, ve kterých končí postranní žilky špičaté nebo zašpičatělé, plody téměř kulovité **3**

3a Čepel listu (podlouhle) eliptická, vzácněji vejčitá, na bázi klínovitá nebo slabě obloukovitá, pravidelně mělce laločnatá, zuby, ve kterých končí postranní žilky zašpičatělé ..... ***S. bohemica***

3b Čepel listu vejčitá nebo široce eliptická, na bázi široce klínovitá až zaokrouhlená, často nepravidelně dvakrát pilovitá (tj. v pravidelně dvakrát pilovitém okraji se nachází jednoduše pilovitá zóna), zuby, ve kterých končí postranní žilky, špičaté až mírně zašpičatělé ..... ***S. albensis***

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Appendix 1. – Key for determining the species of the *Sorbus latifolia* agg. and *S. danubialis* occurring in the Labské středohoří Mts.

1a Leaf lamina more or less rhomboidal to round rhomboidal, greyish-green beneath, coarsely double serrate (to shallowly lobed) distally; fruits red, styles free ..... ***S. danubialis***
1b Leaf lamina elliptical, broadly elliptical or ovate, yellowish-greyish-green beneath, shallowly lobed or coarsely double serrate; fruits orange-red, styles coalesced **2**
2a Leaf lamina broadly ovate to broadly elliptical, teeth terminating the main veins sharply acuminate, fruits obovoid or ellipsoid ..... ***S. portae-bohemicae***
2b Leaf lamina elliptical, ovate or broadly elliptical teeth terminating the main veins acute or acuminate, fruits breadly ellipsoid to subglobose 3
3a Leaf lamina (oblong) elliptical, rarely ovate and cuneate straight or slightly arcuate at base, regularly shallowly lobed, teeth terminating the main veins acuminate ..... ***S. bohemica***
3b Leaf lamina ovate to broadly elliptical and rounded or rarely broadly cuneate at base, often irregularly double serrate (i.e., along the regularly double serrate margin, a simply serrate zone occurs) rarely shallowly lobed, teeth terminating the main veins acute or to slightly acuminate ..... ***S. albensis***