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New taxa of *Sorbus* from Bohemia (Czech Republic)

Miloslav KOVANDA

Three species of *Sorbus* are described as new: *S. rhodanthera* (one station in W Bohemia) and *S. gemella* (one station in W Central Bohemia) belonging to the *S. latifolia* agg. and *S. quernea* (two stations in Central Bohemia) of the *S. hybrida* agg. Basic data on their karyology, morphology, variation, relationships, geographical distribution, ecology and ecobiology are provided. Also described is one primary hybrid, *S.* × *abscondita* (*S. aucuparia* L. × *S. danubialis* [JÁV.] PRODAN) of the *S. hybrida* agg.

KOVANDA M., 1996: Neue *Sorbus*-Taxa aus Böhmen (Tschechische Republik). Drei *Sorbus*-Arten werden als neu beschrieben: *S. rhodanthera* (ein Fundort in W-Böhmen) und *S. gemella* (ein Fundort in W-Mittelböhmen) der *S. latifolia* agg. und *S. quernea* (zwei Fundorte in Mittelböhmen) der *S. hybrida* agg. Grundlegende Daten zur Karyologie, Morphologie, Variation, Verwandtschaft, geographischen Verbreitung, Ökologie, Phytozönologie und Ökobiologie werden präsentiert. Weiters wird eine Primärhybride, *S.* × *abscondita* (*S. aucuparia* L. × *S. danubialis* [JÁV.] PRODAN) der *S. hybrida* agg. beschrieben.

Keywords: *Sorbus,* Bohemia, chromosome numbers, morphological variation, geographical distribution, ecology, phytocenology, ecobiology, interspecific hybridization.

Introduction

Interspecific hybridization with concomitant polyploidy and apomixis is an acknowledged vehicle of speciation in *Sorbus* (e.g. LILJEFORS 1953, 1955, KOVANDA 1961, CHALLICE & KOVANDA 1978, JANKUN & KOVANDA 1986, 1987, 1988, KUTZELNIGG 1994). Of the five subgenera of *Sorbus* (*Aria* PERS., *Torminaria* [DC.] K. KOCH, *Chamaemespilus* [MED.] K. KOCH, *Cormus* [SPACH] DUCHARTRE, *Sorbus* s. str.), all except *Cormus* are known to produce hybrids. The remaining four subgenera do not, however, interbreed freely. While *Torminaria, Chamaemespilus* and *Sorbus* s. str. hybridize with *Aria,* they are apparently isolated by a strong genetic barrier from each other. In other words, in every *Sorbus* hybrid so far on record, a member of subg. *Aria* is involved.

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Two kinds of hybrids can be distinguished:

(1) Primary hybrids, often highly sterile, occurring rarely as single individuals scattered among parent species. These are of little importance in terms of evolution but add to the phenotypic diversity of *Sorbus* populations. Segregation occurs in the progeny.

(2) Hybrid species, as a rule fertile (often prolifically so), forming morphologically clear-cut populations with their own sets of characters and little internal variation. These are neoendemics usually confined to small, sharply defined geographical areas replacing each other. They are amenable to taxonomic treatment. No segregation occurs in the progeny.

While the parent species are generally sexual and diploid, the resulting hybrid species are apomictic and polyploid (tetraploid or rarely triploid) or, exceptionally, diploid (LILJEFORS 1953, 1955, JANKUN & KOVANDA 1986, 1987, 1988, 1992, KUTZELNIGG 1994).

It is now generally adopted practice to treat the hybrid species as microspecies, components of three species aggregates grouped according to their origin and named using the oldest epithet available: *S. latifolia* agg. (hybrids *Aria* × *Torminaria*), *S. hybrida* agg. (hybrids *Aria* × *Sorbus* s. str.) and *S. sudetica* agg. (hybrids *Aria* × *Chamaemespilus*). The aggregates also accommodate primary hybrids.

In addition to *S. sudetica* (TAUSCH) FRITSCH belonging to *S. sudetica* agg., only two hybrid species have been known to occur in Bohemia until recently: *S. bohemica* (KOVANDA 1961) and *S. eximia* (KOVANDA 1984). There was a strong feeling, however, that this number was not necessarily final. Work on the Czech Flora (Květena České republiky) provided a stimulus to take up again the present author's study of the early 1960s and to conduct a detailed survey aimed at new records of hybrids and hybrid species in lesser known parts of the country (as far as *Sorbus* is concerned). This revealed the presence of three new hybrid species and one primary hybrid in Bohemia that are described here. Of these, *S. rhodanthera* and *S. gemella* belong to *S. latifolia* agg., while *S. quernea* and *S.* × *abscondita* belong to *S. hybrida* agg. It was technically not possible to incorporate these taxa into my account of *Sorbus* for the Czech Flora (KOVANDA 1992).

Herbarium material (except holotypes) will be deposited in PR (Herbarium of the National Museum, Prague).

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Sorbus rhodanthera KOVANDA, sp. nova (Fig. 1, 2, 3)

Arbores (raro frutices) usque 14 m alti; foliis simplicibus, laminis ambitu late ovatis usque fere rhombeis, pinnato-lobatis (lobis acutis vel acuminatis, serratis), in parte superiore tantum irregulariter duplicato-serratis, (7.2-)8.0 - 9.2(-10.6) cm longis et (5.8-)6.2 - 7.6(-8.5) cm latis, ad basin late cuneatis, remote serratis vel subintegris, subtus griseo-viride tomentosis, nervis utroque latere (8-)9 - 11(-12); petiolis (18-)21-29 mm longis; corymbothyrsis multifloris, compactis, convexis, ramis tomentosis; hypanthio turbinato, tomentoso, postea vix glabrescente; dentibus calycinis triangularibus, acutis, 2.5-3.2 mm longis, patentibus, post anthesin reclinatis, glabrescentibus, subtus tomentosis, tempore fructificationis siccis, persistentibus; petalis late ovatis usque rotundatis, breviter unguiculatis, (5.5-)6.5 - 8.7(-9.1) mm longis, albis, superne ad basin sparse villosis, patentibus; staminibus 20, antheris rosaceis; ovario semi-infero; stylis 2 (rarissime 3) ad $^1/_5$ usque $^2/_5$ coalescentibus, ad basin villosis, stigmatibus planis; fructibus subglobosis usque globosis, (8-)9 - 11(-13) mm in diametro, maturitate rubris, glabris, nitidis, lenticellis parvis, fuscis, numerosis; mesocarpio heterogeneo; endocarpio cartillagineo; seminibus atro-castaneis, 5.8-6.4 mm longis.

Chromosomatum numerus: 2n = 68.

Holotypus: Bohemia occid.: in fruticetis in locis praeruptis ad cacumen collis Chlumská hora prope oppidulum Manětín (distr. Plzeň —- sever); solo basaltico, alt. 651 m. Die 25.5.1992 leg. M. KOVANDA. In Herbario Instituti Botanici Universitatis Vindobonensis (WU) conservatur. Isotypi et syntypi numerosi in Herbario Musei Nationalis Pragae (PR) depositi.

Etymology: Greek rhodos = rose, rosy; anthera = anther.

Morphology, variation and relationships: *S. rhodanthera* exhibits characters of two distinct species, *S. torminalis* (L.) CRANTZ and a member of subg. *Aria,* mixed together, testifying to its hybrid nature. In leaf shape and indumentum, *S. rhodanthera* more closely resembles the latter species but differs distinctly in its fused styles, the absence of indumentum on the fruits and the hard endocarp, all these characters being typical of *S. torminalis* (L.) CRANTZ and aberrant in *S. aria* (L.) CRANTZ s.l.

While the involvement of *S. torminalis* (L.) CRANTZ is evident on morphological grounds, the other parent can only be inferred from circumstantial evidence. Both *S. aria* (L.) CRANTZ and *S. danubialis* (JÁV.) PRODAN qualify, but both are missing from Chlumská hora hill at the present time.

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The participation of the latter species is more likely on both morphological and phytogeographical grounds. Firstly, the leaves of *S. rhodanthera* are rather small and cuneate at their base, more reminiscent of *S. danubialis* (JÁV.) PRODAN than of *S. aria* (L.) CRANTZ. Second, the distribution area of *S. danubialis* (JÁV.) PRODAN in Bohemia is distinctly western and northwestern, where the species replaces *S. aria* (L.) CRANTZ which is missing or rare, being centered in Bohemian Karst, Central Bohemia. *S. rhodanthera* is characteristic of W Bohemia. *S. danubialis* (JÁV.) PRODAN has not been found on Chlumská hora hill, but since its characters are present, it probably occurred there in the past. Characteristic of *S. danubialis* (JÁV.) PRODAN is its occurrence on isolated, often volcanic hills which comprise small islands of suitable habitats in otherwise unsuitable areas. An example of one of these is the basaltic Vlčí hora hill (704 m), near Černošín, about 30 km away from Chlumská hora hill, where *S. danubialis* (JÁV.) PRODAN thrives but no trace of *S. rhodanthera* is found. *S. danubialis* (JÁV.) PRODAN extends as far as the Krušné hory Mts., where a solitary tree occurs on Mt. Plešivec near Abertamy at 940 m.

S. rhodanthera should not be confused with *S. intermedia* (EHRH.) PERS. which is commonly grown for ornament and often escapes. It also occurs on Chlumská hora hill.

The most distinctive character of *S. rhodanthera* is the colour of the anthers, which are violet-rose in the flower buds, flesh-rose at the beginning of flowering before dehiscence, and ochraceous to rusty brown after dehiscence. Their hue varies considerably even within an individual or inflorescence, but no pale yellow anthers, chacteristic of both the parent species, were noted. In European *Sorbus,* rose anthers are only encountered in *S. chamaemespilus* (L.) CRANTZ and some of its hybrids with *S. aria* (L.) CRANTZ s.l. This parental combination cannot, however, be considered as the source from which *S. rhodanthera* evolved. Morphological, ecological and phytogeographical evidence is contrary to this conjecture. The deviating colour of anthers can perhaps be attributed to a gene mutation in the early phases of origin and establishment of *S. rhodanthera.*

Outside Europe, rose anthers are reported for some Asian species of subg. *Aria,* e.g. *S. subfusca* (LEDEB.) BOISS. and *S. hajastana* GABRIELJAN from the Caucasus and *S. cuspidata* (SPACH) HEDL. and *S. hedlundii* C. K. SCHNEIDER from the Himalayas (GABRIELJAN 1978).

It is interesting to note that the degree of fusion of the styles is variable even within an individual. In this feature *S. rhodanthera* follows *S. tormina-*

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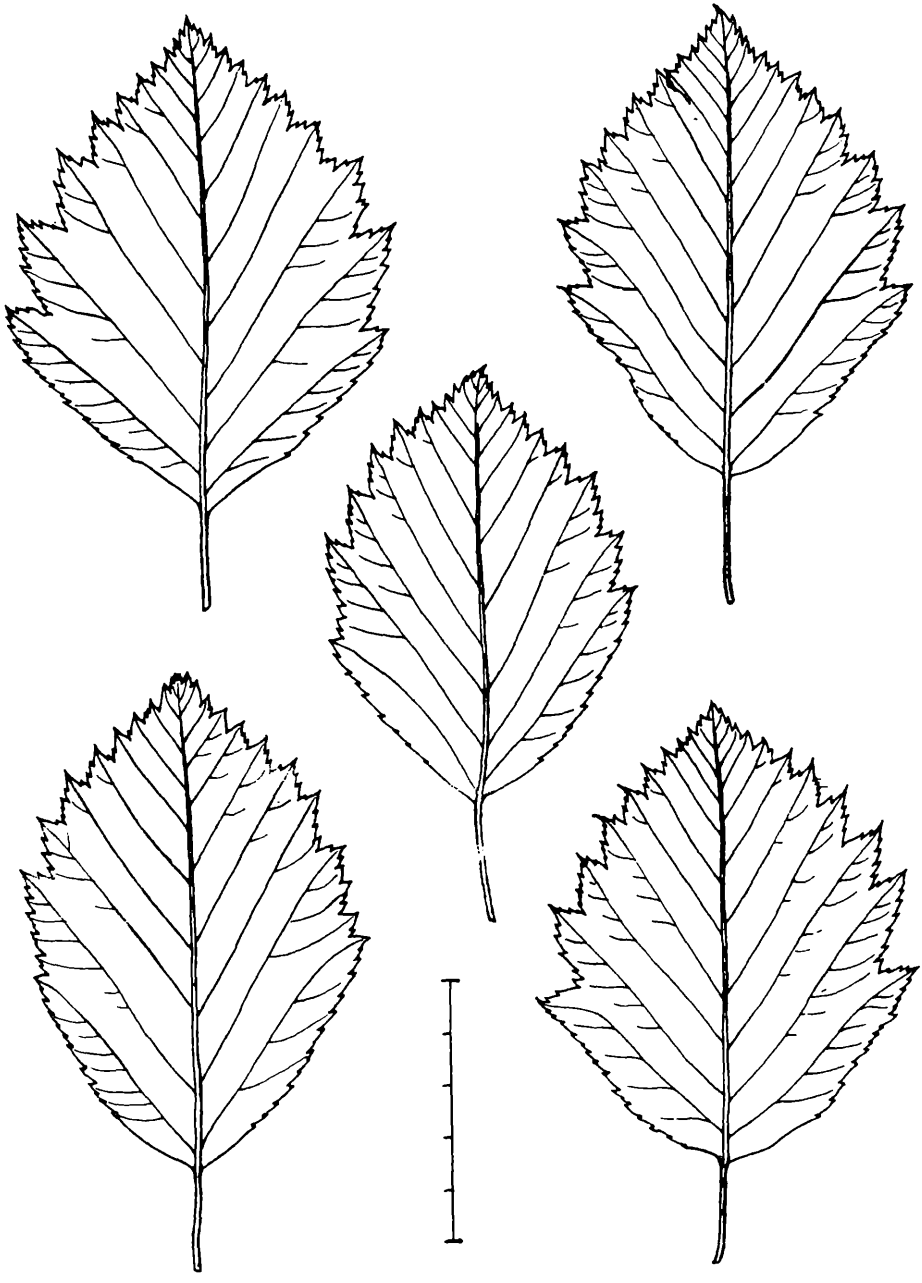

Fig. 1: *Sorbus rhodanthera,* variation in the leaf shape. Scale: 5 cm. — *Sorbus rhodanthera,* Variabilität der Blattform. Maßstab: 5 cm.

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lis (L.) CRANTZ, whose styles coalesce generally to about half way, but deviations are not uncommon. The same kind of variation is found in *S. eximia* (KOVANDA 1984, JANKUN & KOVANDA 1988), *S. bohemica* (JANKUN & KOVANDA 1987) and *S. austriaca* (BECK) PRAIN et al. (KOVANDA 1961, in press).

Two species described from Germany, *S. franconica* BORNM. ex DÜLL and *S. badensis* DÜLL, come close to *S. rhodanthera* but differ, inter alia, in having larger fruits, shorter petioles and fleshy calyx teeth in fruit; in addition, the former has orange to yellowish brown, the latter rusty-garnet red fruits (see DÜLL 1961).

Geographical distribution: *S. rhodanthera* is confined to the basaltic Chlumská hora hill (elevation, 651 m), near Manětín, Tepelské vrchy hill country, W Bohemia. This is a relatively cool area (average annual temperature, 7°C) underlain by acid rocks and strewn with massive outcrops of basalt that are refuges of thermophilous flora more characteristic of areas further NE. The hill itself is a typical table mountain about 4 km in length from NW to SE and 1.4 km in width. Natural plant cover is only preserved on parts of the SW facing side; elsewhere, including the plateau, it has been replaced by plantations of spruce (*Picea abies* [L.] KARSTEN), pine (*Pinus sylvestris* L.) and larch (*Larix decidua* MILL.). A small part of the SW side with basaltic cliffs and scree has been a state nature reserve but was recently reclassified as a natural monument. *S. rhodanthera* is distributed more or less continuously along the middle and N part of this side of the hill and in a narrow stripe on the adjoining plateau. The altitudinal range extends from about 570 m to the summit. The vast majority of specimens occur outside the protected area.

In an attempt to find further stations for *S. rhodanthera,* a systematic survey of suitable habitats in the vicinity was carried out in 1991-1994, but the result was nil in all cases. *S. rhodanthera* is missing even from the nearby basaltic Doubravická hora hill, 659 m, near Doubravice, from Špičák hill, 587 m, near Mezí, from Zbraslavský vrch hill, 675 m, near Zbraslav, from Vladař hill, 693 m, near Vladořice and from Nevděk hill, 630 m, near Žlutice, all of which support an otherwise similar flora.

Ecology and phytocenology: Besides *S. intermedia* (EHRH.) PERS., which forms stands in Småland, Sweden (KUTZELNIGG 1994) and *S. aucuparia* L., which does so locally at lower altitudes of the Polish Tatra Mts. (KOVANDA, unpublished), *S. rhodanthera* is perhaps the only European *Sorbus* able to act as a dominant in a plant community. On Chlumská hora hill it is domi-

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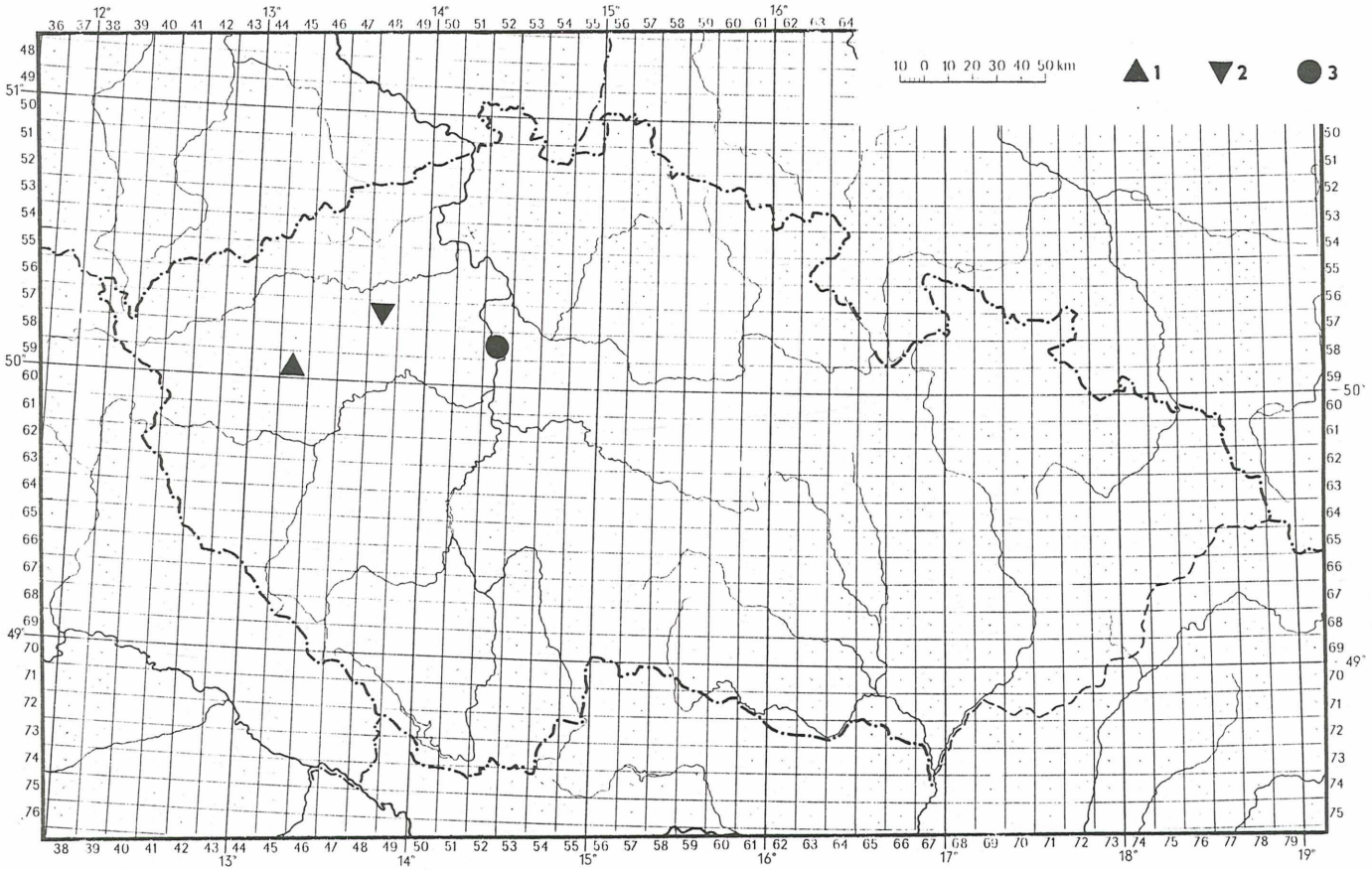

Fig. 2: Distribution in the Czech Republic of *Sorbus rhodanthera* (1), *S. gemella* (2), and *S. quernea* (3). — Verbreitung von *Sorbus rhodanthera* (1), *S. gemella* (2) und *S. quernea* (3) in der Tschechischen Republik.

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nant in communities of the Carpinion alliance on shallow, stabilized soils on steep (inclinatioin 30° and more) slopes in the N part of the locality where it occurs together with *Malus sylvestris* MILL., *Pyrus communis* L. em. GAERTN., *Sorbus torminalis* (L.) CRANTZ and *Tilia cordata* MILL. The herb layer is dominated by *Poa nemoralis* L. Of frequent occurrence are *Brachypodium pinnatum* (L.) P B., *Clinopodium vulgare* L., *Mercurialis perennis* L. and *Tanacetum corymbosum* (L.) SCHULTZ-BIP. The following are also present: *Actaea spicata* L., *Astragalus glycyphyllos* L., *Bromus benekenii* (LANGE) TRIMEN, *Calamagrostis arundinacea* (L.) ROTH, *Campanula persicifolia* L., *C. rapunculoides* L., *Carex muricata* L. s.l., *Chaerophyllum temulum* L., *Epilobium montanum* L., *Galeopsis pubescens* BESSER, *Inula conyza* (L.) DC., *Luzula luzuloides* (LAM.) DANDY et WILMOTT, *Peucedanum cervaria* (L.) LAPEYR., *Poa angustifolia* L., *Senecio ovatus* (GAERTN., MEYER et SCHERB.) WILLD., *Trifolium alpestre* L., *Urtica dioica* L., and *Viola riviniana* REICHENB. In the lower part of the slope the stand corresponds to a (hygro)mesophilous oak wood of the same alliance, without hornbeam (*Carpinus betulus* L.) but with small leaved lime (*Tilia cordata* MILL.) and beech (*Fagus sylvatica* L.); in the upper part, transitions between communities of the Carpinion alliance and the Quercion pubescenti-petraeae can be seen.

S. rhodanthera is also frequent in a scree forest, where it is accompanied by *Crataegus laevigata* (POIRET) DC., *Lonicera xylosteum* L., *Prunus spinosa* L. s.l., *Quercus robur* L., *Sorbus aucuparia* L., *S. torminalis* (L.) CRANTZ, *Swida sanguinea* (L.) OPIZ, and *Tilia cordata* MILL.

On the summit plateau *S. rhodanthera* occurs in an open oak-pine forest with *Brachypodium pinnatum* (L.) P B. dominant in the herb layer, as documented by the following relevé:

Chlumská hora hill, summit plateau near the 651 m point, 100 m^2, 24.8. 1995:

E_3 (65 %): *Pinus sylvestris* L. 2, *Sorbus rhodanthera* 2, *Larix decidua* MILL. 1, *Quercus* cf. *dalechampii* TENORE +, *Pyrus communis* L. em. GAERTN. +.

E_2 (5 %): *Corylus avellana* L. 1, *Crataegus laevigata* (POIRET) DC. +.

E_1 (100 %): *Brachypodium pinnatum* (L.) P. B. 4, *Mercurialis perennis* L. 2, *Poa angustifolia* L. 2, *Primula veris* L. s.l. 2, *Astragalus glycyphyllos* L. 1, *Geranium sanguineum* L. 1, *Poa nemoralis* L. 1, *Sorbus rhodanthera* 1, *Tanacetum corymbosum* (L.) SCHULTZ-BIP. +, *Acer platanoides* L. +, *Clinopodium vulgare* L. +, *Euphorbia cyparissias* L. +, *Grossularia uva-crispa* (L.) MILL. +, *Hepatica nobilis* SCHREBER +, *Inula conyza* DC. +, *Lilium martagon* L. +, *Rosa* sp. +, *Senecio ovatus* (GAERTN., MAYER et SCHERB.) WILLD. +, *Swida sanguinea* (L.) OPIZ +.

S. rhodanthera manages to invade plantations of conifers (pine, larch). In situations where oak-hornbeam forest would be the natural climax, it thrives

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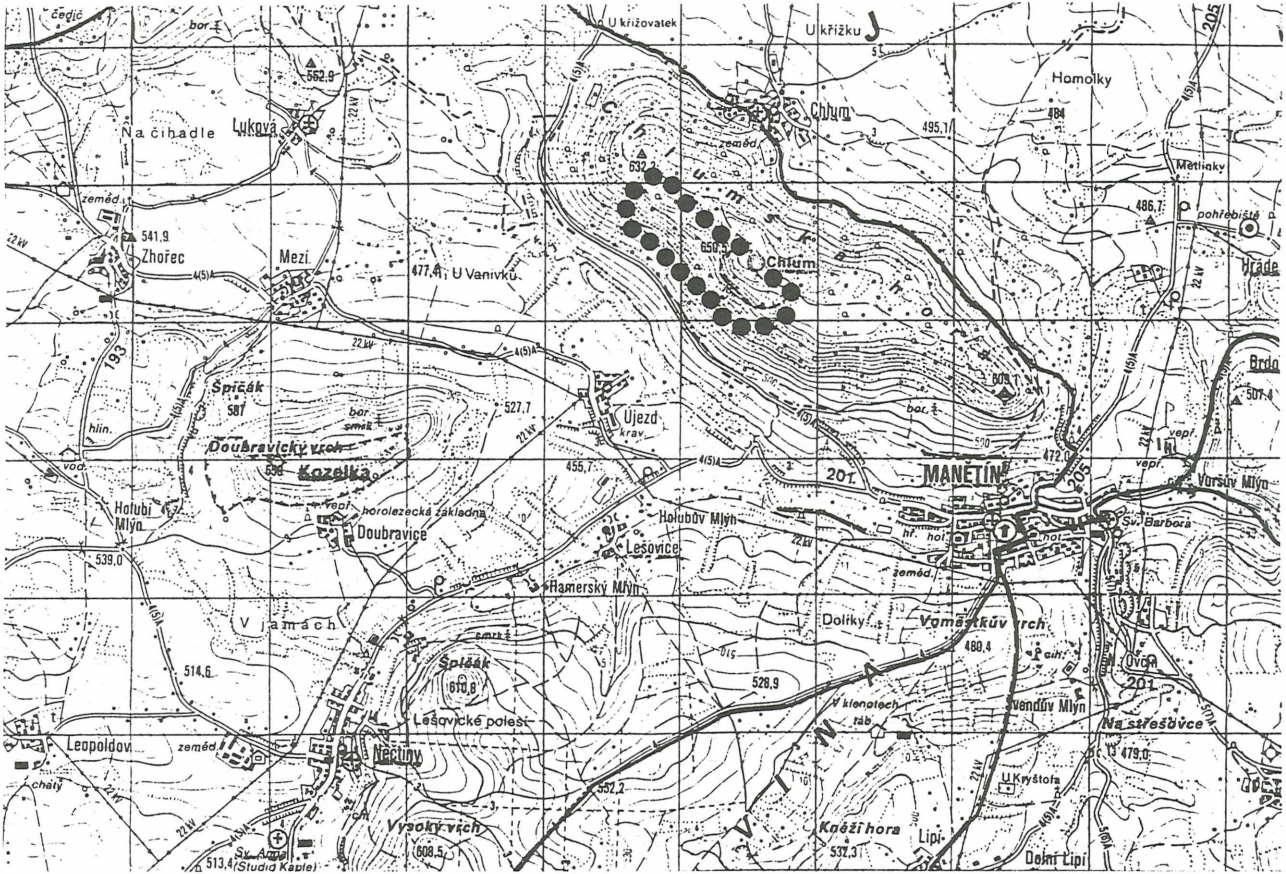

Fig. 3: Detailed distribution of *Sorbus rhodanthera*. Scale = 1 km. — Kleinräumige Verbreitung von *Sorbus rhodanthera*. Maßstab = 1 km.

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(with individuals up to 7 m tall) in pine woodland dominated by *Calamagrostis arundinacea* (L.) ROTH in the herb layer; also present are some acidophilous plants such as *Deschampsia flexuosa* (L.) TRIN., *Dryopteris carthusiana* (VILL.) H. P. FUCHS, *Pleurozium schreberi* (BRID.) MITT. and *Senecio ovatus* (GAERTN., MEYER et SCHERB.) WILLD.

Analysis of soil samples from all three main types of habitat (Carpinion alliance, rocky slope, summit plateau) gave the following results: soils, in terms of acidity, slightly acid in A horizon but acid below (range of pH_{KCl} 4.8-5.8), sorption complex almost fully saturated with exchangeable bases, considerable range of Ca^{2+} (from low to very high values).

Ecobiology: The onset of flowering varies considerably, depending primarily on the weather, but generally no flowers open before mid-May. The flowering time often extends into early June. Flowering is rather irregular, as in *S. torminalis* (L.) CRANTZ. In 1990-1992 the trees flowered every year, but in two successive years, 1993 and 1994, none flowered. Once it occurs, as it did again in 1995, flowering is prolific and so is the fruit set. Fruits ripe in early October. They are initially yellow to orange red, becoming blood-red when fully ripe, a colour suggestive of *S. aria* (L.) CRANTZ s.l. and rarely encountered among its hybrids with *S. torminalis* (L.) CRANTZ.

The percentage of morphologically good seed seems to vary greatly from one year to another. For instance, in 1991 it was virtually nil but in the following year it was up to 70 % good seed per individual. In another fruiting year, 1995, the fertility again oscillated between 70 % and 80 % per individual. As seedlings abound, it seems likely that the 1991 failure was only accidental.

On steep but not necessarily rocky slopes, rarely however on gentler slopes or on the plateau, *S. rhodanthera* commonly grows into a tall tree, with a characteristic many-stemmed (up to 9-stemmed) growth form. It is unclear whether these particular individuals (abounding especially in the N part of the SW side) are arborescent shrubs (however rare the shrub habit may be in *S. rhodanthera*), or whether the additional stems arose as secondary shoots from the root. No cases of dead main trunks surrounded by substitutes have been noted.

Past and present: I came across the first specimens of *S. rhodanthera* quite casually on a field trip to Chlumská hora hill made jointly with Dr. Z. POUZAR, then a staff member of the Institute of Botany, Academy of Sciences, in June 1968. The occurrence of *S. torminalis* (L.) CRANTZ and

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an additional taxon in that locality was quite unexpected and came as a major surprise. The hybrid nature of the latter was apparent at first sight. It was not until twenty years later, however, that I was able to visit the hill again and initiate a detailed survey. A 1992 census revealed about 140 individuals not counting hundreds of seedlings of all sizes. There are no records of *S. rhodanthera* from Chlumská hora hill in the main herbaria and only a passing notice in a floristic report (as *S. latifolia* LAMK. [PERS.]) in the available literature (see ŠEDO 1983). In the Czech flora (KOVANDA 1992) only a brief note could be added in the proofs.

A collection of *S. rhodanthera* was made by Dr. M. DEYL "ad arcem Nečtiny prope oppidum Manětín" on 9 September 1959 (PR). It is unclear how to interpret the locality "ad arcem Nečtiny" There is a castle with a small park in the village of Nečtiny, 6 km SW of Chlumská hora hill, and also the ruin of a castle on a low hill above the village commonly called Nečtiny but whose name is actually Preitenštejn. A search of both these localities and their surroundings for the source of the material was in vain. Dr. DEYL visited, in addition to Nečtiny, Chlumská hora hill (on the evidence of a collection of *S. torminalis* but not *S. rhodanthera*) and the vicinity of Lipí (on the evidence of a collection of introduced *S. intermedia* with deeply cut leaves) on the same day, 9 September 1959. Perhaps the collection of *S. rhodanthera* was ascribed to Nečtiny by a labelling error.

Sorbus gemella KOVANDA sp. nova (Fig. 2, 4, 5)

Arbores usque 10 m alti; foliis simplicibus, laminis ambitu ovatis usque rhombeis, pinnato-lobatis (lobis ambitu acutis vel acuminatis, serratis), in parte superiore tantum duplicato-serratis, (5.5-)7.2 - 8.6(-9.2) cm longis et (4.2-)5.5 - 6.8(-7.2) cm latis, ad basin late cuneatis, remote serratis vel subintegris, subtus griseo-viride tomentosis, nervis utroque latere 8-10(-11), petiolis 13-21 mm longis; corymbothyrsis multifloris, compactis, convexis, ramis tomentosis, postea vix glabrescentibus; hypanthio turbinato, tomentoso; dentibus calycinis triangularibus, acutis, tantum 1.8-2.1(-2.6) mm longis, patentibus, post anthesin reclinatis, supra pilosis, subtus tomentosis, persistentibus, tempore fructificationis siccis; petalis late obovatis usque late ellipticis, breviter unguiculatis, (5.9-)6.4 - 6.8(-7.2) mm longis, albis, superne ad basin sparse villosis, patentibus; staminibus 20, antheris pallide luteis; ovario semi-infero; stylis 2 ad $^1/_4$-$^1/_2$ coalescentibus, ad basin lanuginosis, stigmatibus planis; fructibus subglobosis usque globosis, (9-)10 - 13(-14) mm in diametro; maturitate aurantiacis, glabris, nitidis, lenticellis parvis, ochraceis, sat densis; mesocarpio heterogeneo; endocarpio cartillagineo; seminibus atro-fuscis, 5.0-5.7 mm longis.

Chromosomatum numerus: 2n = 68.

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Holotypus: Bohemia occid.-centr.: in Pineto munimenti prae-historici situ occid. a pago Konětopy (distr. Louny); solo calcifero-schistaceo, alt. 450 m. Die 13.10.1992 leg. M. KOVANDA. In Herbario Instituti Botanici Universitatis Vindobonensis (WU) conservatur. Isotypi et syntypi numerosi in Herbario Musei Nationalis Pragae (PR) depositi.

Etymology: Latin gemellus, -a, -um = twin, pair.

Morphology, variation and relationships: In its general appearance, *S. gemella* is a true copy (or, rather, a miniature) of *S. rhodanthera* and could be easily mistaken for it. On closer examination, however, clear-cut differences come to light. First, *S. gemella* has pale yellow anthers, a character it shares with *S. torminalis* (L.) CRANTZ and *S. danubialis* (JÁV.) PRODAN and their hybrids except for *S. rhodanthera*. Other distinguishing characters include smaller leaves with fewer veins, shorter petiole, larger orange fruits with pale brown lenticels, shorter calyx teeth and smaller petals (see the Latin diagnosis). Again, this combination of characters is unique and not repeated elsewhere in the genus. The orange fruits are characteristic of most *S. aria* s.l. × *S. torminalis* hybrids. As in *S. rhodanthera,* the partly fused styles and flat stigmas reveal the parentage of *S. torminalis* (L.) CRANTZ. Unlike the situation on Chlumská hora hill, both *S. torminalis* (L.) CRANTZ and *S. danubialis* (JÁV.) PRODAN are present and abundant in the locality of *S. gemella*, but no F_1 hybrids are formed. One individual in the population requires some comment. In its leaf shape it clearly approaches *S. torminalis* (L.) CRANTZ but in other characters it agrees with the rest of the population. Further study is required to decide whether this is a back-cross with *S. torminalis* (L.) CRANTZ. Otherwise the topodeme is remarkably uniform in terms of morphology. The degree of coalescence of the styles varies in the same way as in *S. rhodanthera,* but on the whole there is a lesser degree of fusion. There are also important differences in the ecology and phytocenological characteristics of *S. rhodanthera* and *S. gemella* (see below).

Geographical distribution: The sole station of *S. gemella* is the W margin of an unnamed plateau, the site of a pre-historic fortification (possibly Celtic, remnants of Celtic colonization abounding in the area) in the valley of the Hasina stream E of the village Konětopy, Džbán hill country, distr. Louny, W Central Bohemia. A sharply defined topodeme occurs along a c. 200 m long section of the margin of the plateau. Attempts to find specimens outside this site or to find any other locality were unsuccessful, even though

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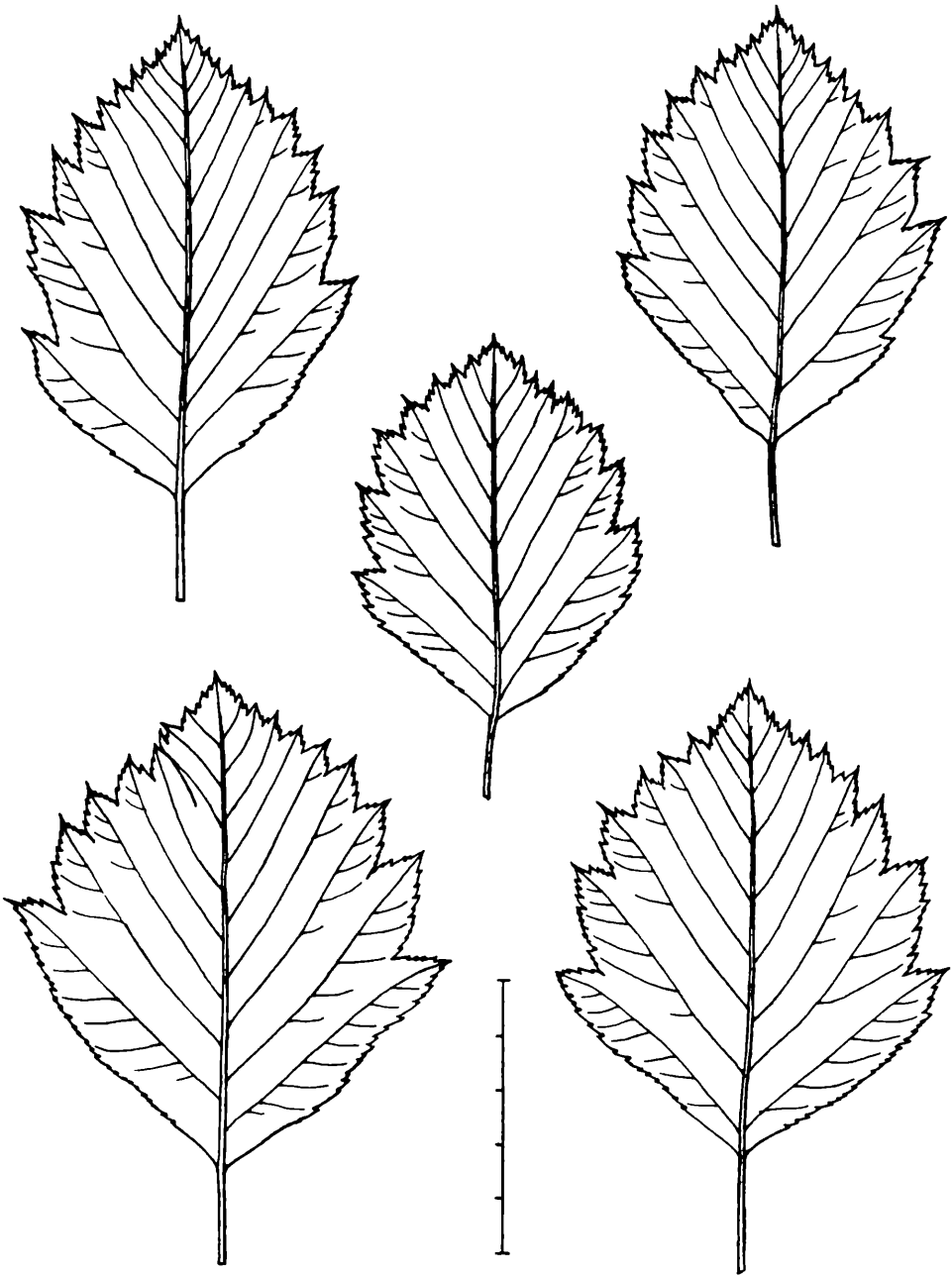

Fig. 4: *Sorbus gemella,* variation in the leaf shape. Scale: 5 cm. — *Sorbus gemella,* Variabilität der Blattform. Maßstab: 5 cm.

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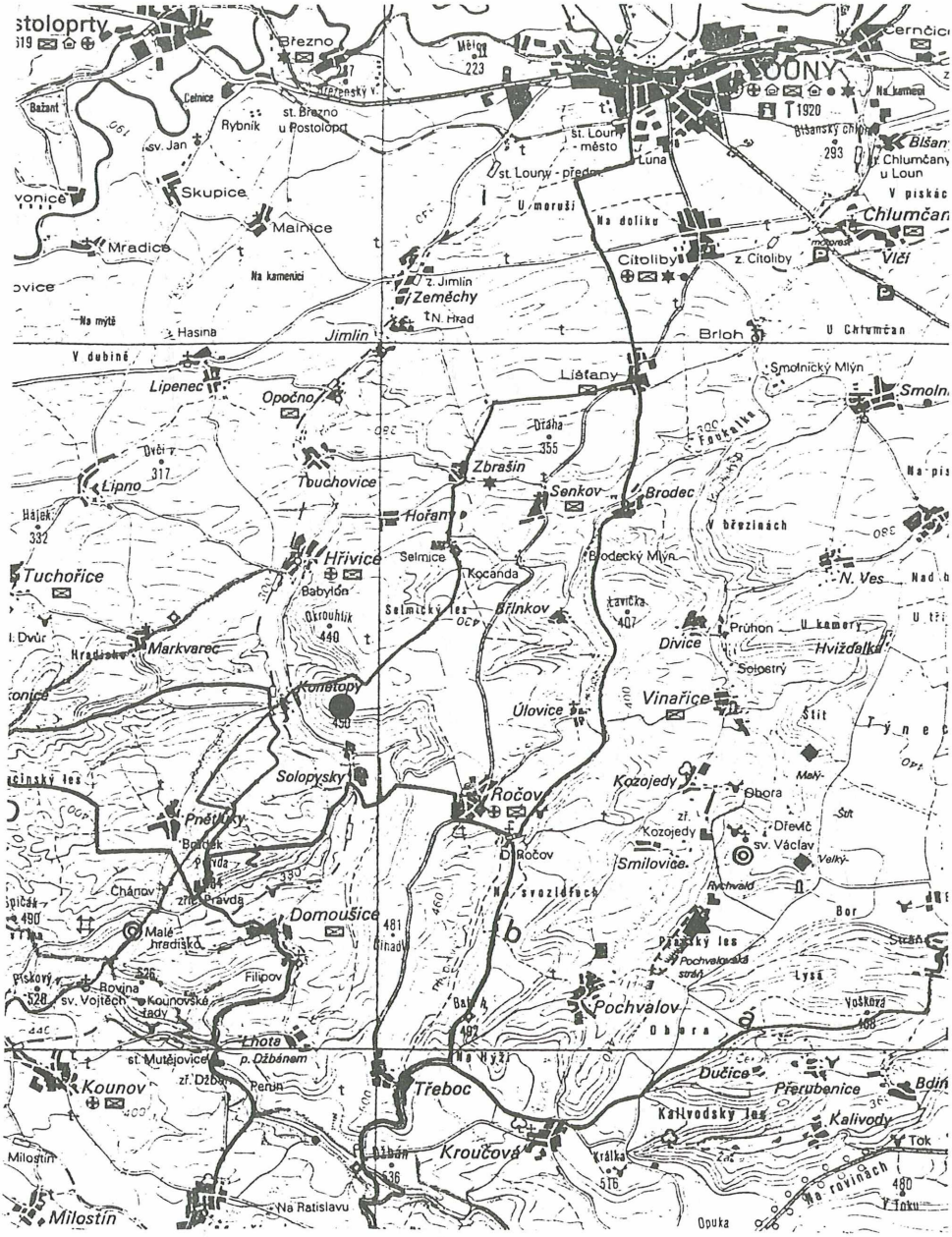

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similar habitats are present in the vicinity (e.g. Okrouhlík hill, 440 m, near Konětopy, Výrov hill, 509 m, near Třeskonice, Pravda hill, 484 m, near Pnětluky, Džbán hill, 536 m, and Babí hora hill, 492 m, near Třeboc.

The locality lies in the centre of the Cretaceous Džbán hill country (highest elevation, Džbán hill, 536 m), formed of marly limestone; here, the predominating xerothermous flora intermingles with some submontane elements penetrating from the immediate west, such as *Arnica montana* L., *Petasites albus* (L.) GAERTN., *Pleurospermum austriacum* (L.) HOFFM. and *Prenanthes purpurea* L.

Characteristic of the area are extensive plateaus with abrupt edges interrupted by rather deeply cut stream valleys. The annual average temperature is 8°C.

Ecology and phytocenology: *S. gemella* is, in the Czech Republic, exceptional in being confined to a man-made habitat. The edge of the plateau with natural low rock cliffs was modified by the building of mounds (remnants of which are still visible) by prehistoric people. In the more recent past, several minor quarries were worked by the villagers to obtain convenient and easily worked building material. (Until about 1950, all the village houses in the area were built of this particular variety of limestone, using no plaster.) The quarries are now abandoned and have become overgrown with secondary pine woodland, as are the remnants of the mounds. This disturbed part of the edge is the habitat of *S. gemella.*

A tall specimen of *S. gemella* thrives in a situation where xerothermous oak woodland would be the natural climax in one of the quarries accompanied by *Corylus avellana* L., *Frangula alnus* L., *Lonicera xylosteum* L., *Prunus spinosa* L. s.l., *Swida sanguinea* (L.) OPIZ and *Viburnum lantana* L. The following were recorded in the herb layer: *Achillea millefolium* L. s.l., *Anemone sylvestris* L., *Asperula cynanchica* L., *Astragalus glycyphyllos* L., *Brachypodium pinnatum* (L.) P. B., *Chamaebuxus alpestris* SPACH, *Clinopodium vulgare* L., *Coronilla varia* L., *Euphorbia cyparissias* L., *Hepatica nobilis* SCHREBER, *Inula salicina* DC., *Lathyrus niger* (L.) BERNH., *Lotus corniculatus* L., *Melica nutans* L., *Mercurialis perennis* L., *Origanum vulgare* L., *Pimpinella saxifraga* L., *Plantago media* L., *Pulmonaria obscura*

Fig. 5: Detailed distribution of *Sorbus gemella* (1) and *S.* × *abscondita* (2) in the Džbán hill country. Scale = 1 km. — Kleinräumige Verbreitung von *Sorbus gemella* (1) und *S.* × *abscondita* (2) im Džbán-Hügelland. Maßstab = 1 km.

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DUM., *Salvia pratensis* L., *Sanguisorba minor* L., *Scabiosa ochroleuca* L., *Tanacetum corymbosum* (L.) SCHULTZ-BIP., *Viola hirta* L., *V. riviniana* REICHENB., and low seedlings of *Euonymus europaea* L., *Ligustrum vulgare* L., *Lonicera xylosteum* L., *Sorbus gemella, Viburnum lantana* L., and *V. opulus* L. Most *S. gemella* individuals occur in a pine plantation (*Pinus sylvestris* L.) with some *Quercus robur* L., *Sorbus torminalis* (L.) CRANTZ and *S. danubialis* (JÁV.) PRODAN. The following were noted in the herb layer: *Ajuga genevensis* L., *Arabis hirsuta* L., *Asperula cynanchica* L., *Euphorbia cyparissias* L., *Galeopsis angustifolia* (EHRH.) HOFFM., *Inula conyza* DC., *Melica nutans* L., *Melittis melissophyllum* L., *Senecio ovatus* (GAERTN., MEYER et SCHERB.) WILLD., *Teucrium chamaedrys* L., *Vincetoxicum hirundinaria* MED., and low seedlings of *Lonicera xylosteum* L., *Prunus spinosa* L. s.l., and *Viburnum lantana* L. *S. gemella* manages to invade stands of the Corsican pine (*Pinus nigra* ARNOLD), but only a few individuals grow directly at the edge of the plateau.

Ecobiology: *S. gemella* starts to flower about one week earlier than *S. rhodanthera,* obviously because it occurs in a warmer region. It seems to follow the same flowering rhythm as *S. rhodanthera*: prolific flowering in 1990, 1991, 1992 and 1995, but none in 1993 and 1994. Flowering was regularly followed by prolific seed set, but the majority of seed failed to reach maturity and were stunted. It remains to be decided whether the low production of morphologically good seed (not exceeding 15 % per individual) is only accidental and temporary or whether it is a permanent feature of the species. The latter possibility would account for the apparent scarcity of seedlings.

In order to assess the extent of apomixis and the possible presence of pseudogamy, isolating and emasculating experiments were carried out in 1995. Of 100 isolated flowers, 14 set fruit; of 12 emasculated flowers, eight did so, but the development of the fruits was soon arrested and they contained no vestiges of seed. Similar results were obtained with *S. rhodanthera.*

Unlike *S. rhodanthera,* only a few specimens show a tendency towards a many-stemmed growth form; this may be due to the lack of such extreme conditions as on Chlumská hora hill.

Past and present: I discovered the Konětopy population by chance in 1980 when studying the distribution of *S. danubialis* (JÁV.) PRODAN in the Džbán hill country. No previous records or literature data are available.

At present (counted in 1993), 45 individuals of varying ages (disregarding seedlings) are on record.

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Sorbus quernea KOVANDA sp. nova (Fig. 2, 6)

Frutices vel arbores usque 9 m alti; foliis simplicibus, laminis ambitu ovatis usque (rarissime) ellipticis, in parte inferiore pinnato-lobatis usque fere pinnato-fissis (lobis ambitu rotundatis, obtusis, serratis, 5-6[-7] utroque latere), in parte superiore tantum irregulariter duplicato-serratis, (7.2-)7.8 - 9.2(-10.2) cm longis et (4.5-)5.1 - 6.0(-6.5) cm latis, ad basin cuneatis vel arcuatis, remote serratis, subtus griseo-tomentosis, nervis utroque latere (8-)9 - 10(-11), petiolis (13-)16 - 20(-22) mm longis; corymbothyrsis multifloris, compactis, planis, ramis tomentosis; hypanthio turbinato, tomentoso; dentibus calycinis triangularibus, acutis, 1.8-2.2 mm longis, patentibus, supra pilosis, subtus tomentosis, persistentibus, tempore fructificationis basi carnosis; petalis late ellipticis usque rotundatis, brevissime unguiculatis, 5.5-7.2 mm longis, albis, superne ad basin sparse villosis, patentibus; staminibus 20, antheris luteis; ovario semi-infero; pistillis (2-)3, ad $^1/_4$-$^3/_4$ coalescentibus, stylis ad basin villosis; fructibus globosis, (8-)9 - 10(-11) mm in diametro, maturitate sanguineo-rubris, glabris, nitidis, lenticellibus minutis, fuscis, sparsis; mesocarpio heterogeneo; endocarpio cartillagineo; seminibus ellipsoideis, fuscis, 5.2-5.8 mm longis.

Holotypus: Bohemia centr., Praga 7 — Troja: in nemore mixto in declivibus septentrionalibus collis Jabloňka; solo schistaceo, alt. 260 m. Die 10.10.1993 leg. M. KOVANDA. In Herbario Instituti Botanici Universitatis Vindobonensis (WU) conservatur. Isotypi et syntypi numerosi in Herbario Musei Nationalis Pragae (PR) depositi.

Etymology: Latin querneus, -a, -um = oaken, of oak.

Morphology, variation and relationships: In terms of morphology, *S. quernea* fits within the group of *S. aria* s.l. × *S. aucuparia* hybrids (*S. hybrida* agg.) in having the same type of leaf lobing, the lobes occurring in the lower part of the blade which is merely remotely serrate in *S. aria* × *S. torminalis* hybrids. The length of the petiole is intermediate between *S. aria* (L.) CRANTZ and *S. aucuparia* L. The influence of *S. aucuparia* L. is also apparent in the lenticels of the fruit: whereas in *S. aria* (L.) CRANTZ they are distinct and plentiful, in *S. quernea* they are indistinct and sparse. Also, when in fruit, the calyx is completely dry in *S. aria* (L.) CRANTZ, fleshy at the very base in *S. quernea* and fleshy throughout in *S. aucuparia* L. Variation in the height of fusion of the styles seems to be a common feature of

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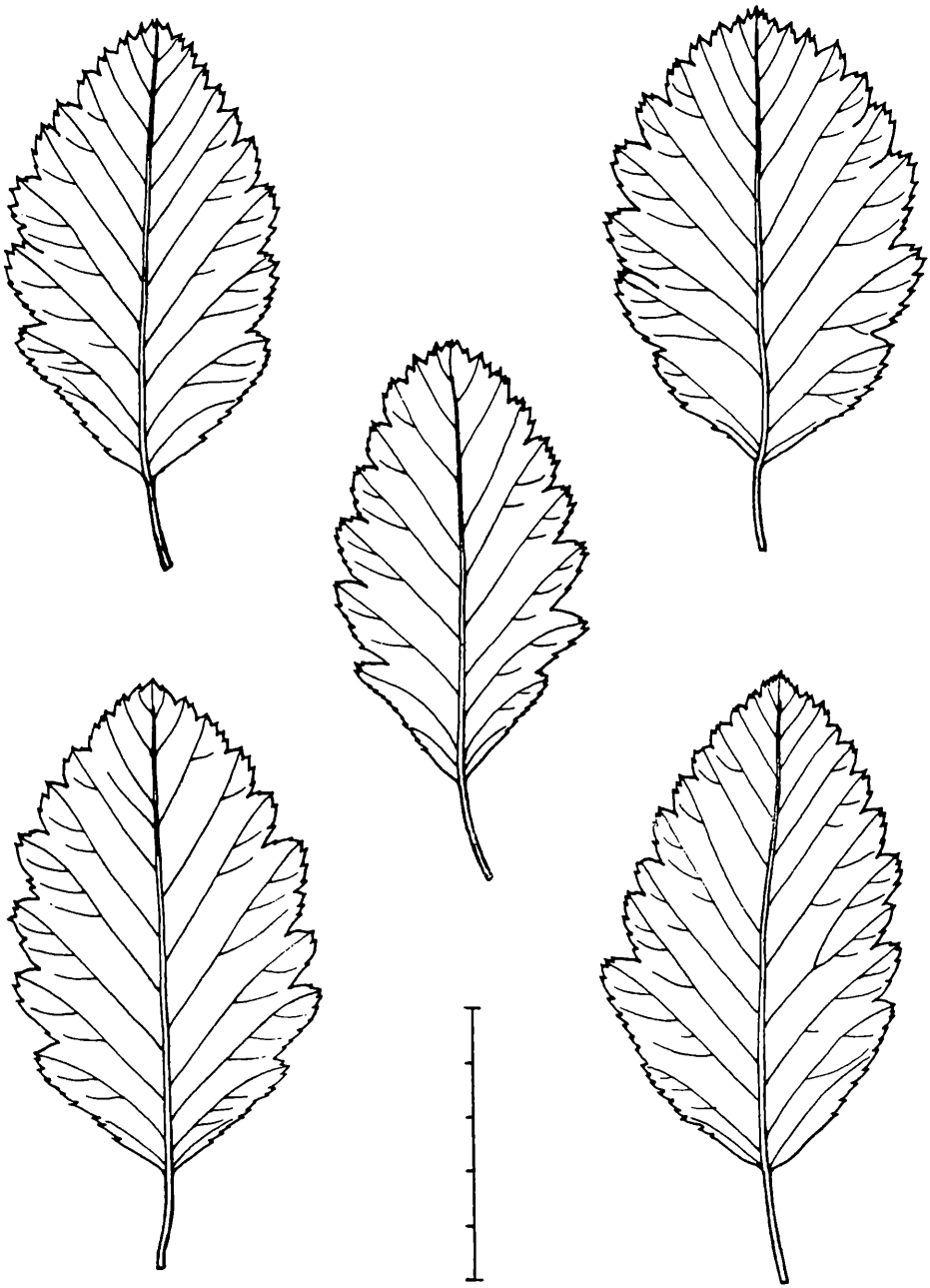

Fig. 6: *Sorbus quernea,* variation in the leaf shape. Scale: 5 cm. — *Sorbus quernea,* Variabilität der Blattform. Maßstab: 5 cm.

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Sorbus hybrids. Both parent species of *S. quernea* have free styles, the pistils being coalescent only at the base (*S. aucuparia* L.) or to $^2/_3$ (*S. aria* [L.] CRANTZ). *S. quernea* is intermediate in this respect, but the degree of fusion varies considerably even within an individual. Several cases of fusion up to the base of the styles have been recorded.

The parent combination *S. aria* s.l. × *S. aucuparia* is frequent in Scandinavia as well as in the British Isles (SW England, Wales, Arran) but is poorly represented in Central Europe (see KÁRPÁTI 1960, DÜLL 1961, KOVANDA 1961, WARBURG & KÁRPÁTI 1968). Thus, *S. quernea* is an important discovery.

Apart from the parent species, *S. quernea* has no relationships in the autochthonous flora of the Czech Republic. The primary hybrid *S.* × *pinnatifida* (SMITH) DÜLL nm. *thuringiaca* (ILSE) KÁRPÁTI is rare in cultivation and has never been recorded in the wild. This is surprising because e.g. in Bavaria and Thuringia all three nothomorphs, nm. *pinnatifida,* nm. *thuringiaca* (ILSE) KÁRPÁTI and nm. *decurrens* (KOEHNE) KÁRPÁTI have been reported (DÜLL 1961). One explanation may be that in the Czech Republic *S. aria* (L.) CRANTZ and *S. aucuparia* L. rather rarely occur together and their flowering times overlap only to a small degree. Nm. *thuringiaca* approaches *S. quernea* to some extent but differs in having leathery leaves which are more deeply cut with 11-12 veins on each side. The type nothomorph, nm. *pinnatidida* (with 1-3 pairs of separate leaflets at the base of the leaf blade), is only known, in the Czech Republic, from two old herbarium collections made in N Bohemia (Milešovka and Ústí nad Labem) and is only rarely cultivated for ornament.

S. pseudothuringiaca DÜLL, an endemic of the Fränkischer Jura, Bavaria, so far the only hybrid species of the *S. aria* × *S. aucuparia* parentage in Central Europe, differs markedly in having the leaves deeply cut (sometimes, especially on sterile shoots, as far as the midrib, a feature never seen in *S. quernea*) and larger fruits (9-11 mm in diameter). In contrast to *S. quernea,* its fruit set is extremely poor (cf. DÜLL 1961, KUTZELNIGG 1994). DÜLL (l.c.) interprets this species as a back-cross of the primary hybrid *S.* × *pinnatifida* (SMITH) DÜLL with *S. aria* (L.) CRANTZ or as the result of a segregation in the progeny of *S.* × *pinnatifida* (SMITH) DÜLL.

Geographical distribution: *S. quernea* is only known from two low hills lying 1 km apart in the valley of the river Vltava in N Prague: Jabloňka hill (260 m), Prague 7 — Troja (N slope, plentiful occurrence) and Bílá skála hill (230 m), Prague 8 — Libeň (summit plateau, twenty-one specimens).

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Both the hills (or, rather, their rocky southern sides, where *S. quernea* does not occcur) are protected as natural monuments. *S. aria* (L.) CRANTZ and *S. aucuparia* L. are present in both localities, the former species only rarely.

One can only wonder why *S. quernea* originated just here, under such adverse conditions where the ubiquitous and undemanding *S. aucuparia* L. can thrive but *S. aria* (L.) CRANTZ is poorly represented. It should, however, be borne in mind that *S. aria* (L.) CRANTZ can be unpredictable in its distribution in relation to the underlying rock. As mentioned above, in Bohemia it is centered in the Bohemian Karst, where it is fairly uniform morphologically and ecologically. Nevertheless, an extremely variable population of *S. aria* s.l. (with *S. aria* (L.) CRANTZ s. str., *S. danubialis* [JÁV.] PRODAN and all possible intermediates present) occurs on acid conglomerates of Žd'ár hill, near Rokycany, W Bohemia.

Ecology and phytocenology: The sites of *S. quernea* are found in the warmest part of Bohemia (average annual teperature, 9°C) but are underlain by extremely acid Ordovician quartzites that hinder the development of a xerothermous flora. On Jabloňka hill, *S. quernea* occurs in a species-poor plant community with a tree and shrub layer corresponding to an oak-hornbeam woodland and with a decidedly acidophilous herb layer where *Deschampsia flexuosa* (L.) TRIN. predominates, as evidenced by the following relevé:

Jabloňka hill, N slope, 30° , 240 m above sea level, 100 m^2, 9.8.1995:

E_3 (100 %): *Carpinus betulus* L. 3, *Quercus petraea* (MATTUSCHKA) LIEBL. 3, *Acer platanoides* L. 2, *Fraxinus excelsior* L. 2, *Sorbus quernea* 2, *Tilia cordata* MILL. 2, *Pyrus communis* L. em. GAERTN. +, *Robinia pseudoacacia* L. +.

E_2 (7 %): *Corylus avellana* L. r, *Cotoneaster integerrimus* MED. r, *Crataegus laevigata* (POIRET) DC. r, *Rubus fruticosus* L. coll. r, *Sorbus aria* (L.) CRANTZ r, *Sorbus aucuparia* L. r, *S. quernea* r.

E_1 (70 %): *Deschampsia flexuosa* (L.) TRIN. 4, *Hieracium umbellatum* L. 1, *Hypericum perforatum* L. 1, *Fragaria vesca* L. +, *Hieracium lachenalii* C. C. GMELIN +, *Lembotropis nigricans* (L.) GRISEB. +, *Rumex acetosella* L. +, *Sedum maximum* (L.) HOFFM. +, *Silene nutans* L.+, *Tanacetum corymbosum* (L.) SCHULTZ-BIP. +, *Vicia sepium* L. +, *Campanula rotundifolia* L. s. str. r, *Dianthus carthusianorum* L. r.

On the other hill, *S. quernea* occurs in the shrub stage of succession to an acidophilous oak-hornbeam woodland:

E_2 (70 %): *Crataegus laevigata* (POIRET) DC. 2, *C. monogyna* JACQ. 2, *Prunus spinosa* L. s.l. 2, *Swida sanguinea* (L.) OPIZ 2, *Ligustrum vulgare* L. 1, *Acer platanoides* L. +, *Fraxinus excelsior* L. +, *Rhamnus catharticus* L. +, *Rosa canina* L. +, *Sorbus aria* (L.) CRANTZ +, *Cerasus vulgaris* MILL. r.

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Ecobiology: *S. quernea* starts to flower in the first half of May, usually between the 10th and 15th In the years of this investigation (1992-1995), flowering and fruit set took place profusely every year. The production of normally developed seed oscillated greatly: while in 1991-1994 there were only a few, in 1995 they were produced in abundance. Flowering starts very early, at the age of 6-8 years, as it does also in *S. aucuparia* L. Seedlings abound on Jabloňka hill but are absent from the other site.

Past and present: Surprisingly, there are no records of *S. quernea* in Prague herbaria or in the literature even though the hills are conspicuous. An explanation may be the poor substratum, which has made them unattractive to botanists (including the present author), who have paid attention instead to the Algonkian schists only a few kilometres downstream in the Vltava valley; these are locally pervaded by minute beds of calcium carbonate and support an interesting flora. As chance would have it, I lit upon the first shrub of *S. quernea* on Bílá skála hill when attempting to check a 19th century record of *Dianthus gratianopolitanus* VILL. marked vaguely "Troja bey Prag" in 1980. As it was hitherto unrecorded, I first took it to be a primary hybrid *S. aria* × *S. aucuparia*. It was not until 1992 that (again quite accidentally) I discovered two more small trees there and, in the same year, the population on the N side of Jabloňka hill.

In the latter locality, 44 individuals (disregarding seedlings) of *S. quernea* were counted in 1994, mostly trees of various ages, but none very old. Twenty-one more specimens occurred on Bílá skála hill.

Sorbus × *abscondita* KOVANDA, hybr. nova (Fig. 5, 7, 8)

(*S. aucuparia* L. × *S. danubialis* [JÁV.] PRODAN)

Differt a *S. quernea* praecipue lobis laminarum ambitu triangularibus, acutis usque acuminatis 6-8 utroque latere, nervis (10-)12 - 14(-15) utroque latere; dentibus calycinis fructificationis tempore carnosis.

Holotypus: Bohemia occid.-centr.: in angulo clivi Pochvalovská stráň dicti situ septentr.-orient. a pago Pochvalov (distr. Louny); solo calcifero-schistaceo, alt. 490 m. Die 25.5.1992 leg. M. KOVANDA. In Herbario Instituti Botanici Universitatis Vindobonensis (WU) conservatur. Isotypi et syntypi numerosi in Herbario Musei Nationalis Pragae (PR) depositi.

Etymology: Latin absconditus = hidden, concealed, secret.

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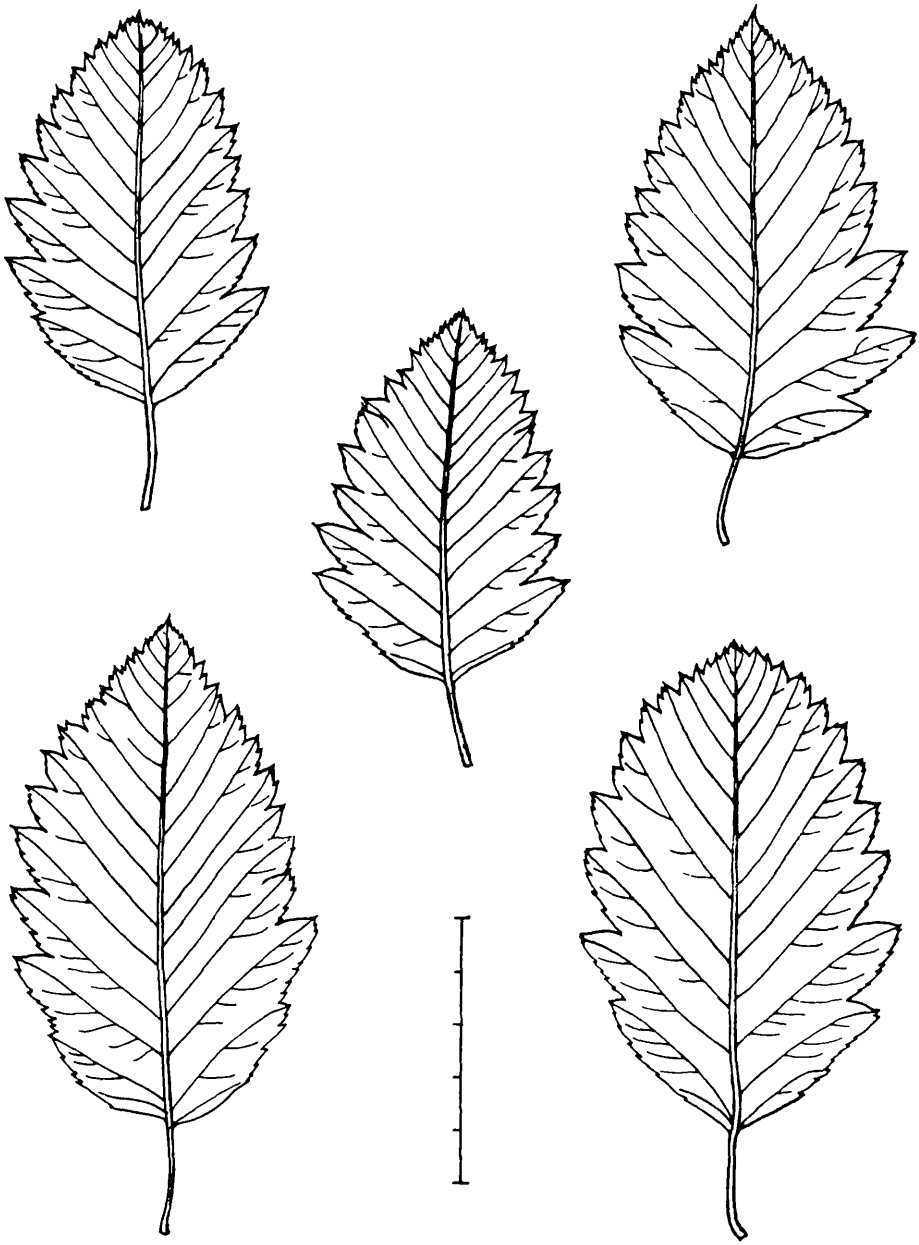

Fig. 7: *Sorbus* × *abscondita*, variation in the leaf shape. Scale: 5 cm. — *Sorbus* × *abscondita*, Variabilität der Blattform. Maßstab: 5 cm.

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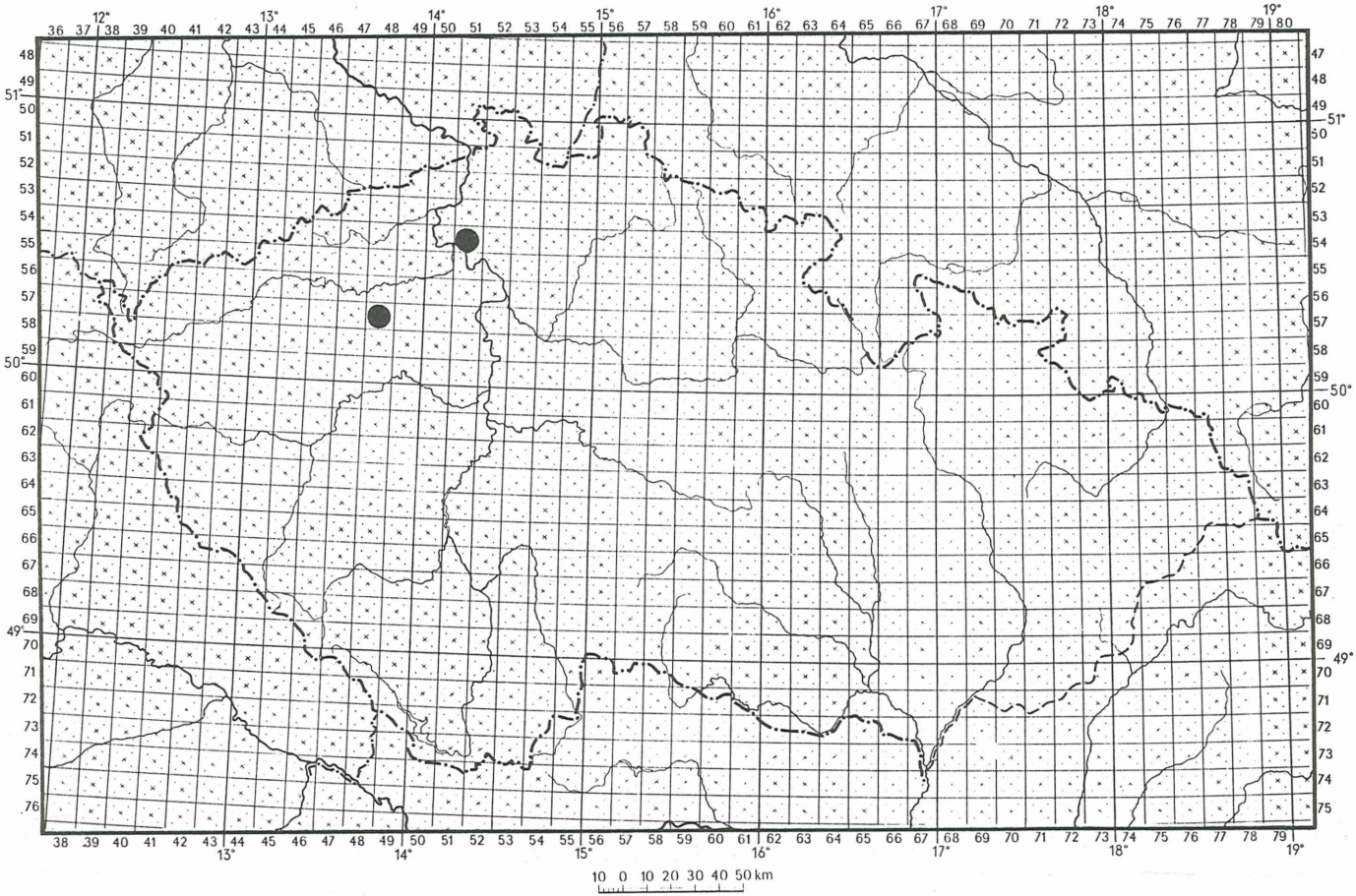

Fig. 8: Distribution in the Czech Republic of *Sorbus* × *abscondita*. — Verbreitung von *Sorbus* × *abscondita* in der Tschechischen Republik.

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This hybrid is extremely rare in the Czech Republic, being known from only two sites in Bohemia. These include the summit area of the basaltic Sedlo hill, near Liběšice, České středohoří Mts., N Bohemia, where I sampled it 27 years ago (KOVANDA 1969 PR) but have never found it since, despite repeated efforts, and the station reported here, where I have been observing it since 1991. In both sites solitary old trees occur accompanied by the parent species.

The geomorphology of the type locality is similar to that of *S. gemella*: the sharply modelled edge of a Cretaceous plateau, but, unlike Konětopy, largely natural, only locally disturbed by quarrying, and without traces of ancient civilization. The steep rocky slope (W facing, marly limestone) is overgrown with beechwood with some maples (*Acer pseudoplatanus* L., *A. platanoides* L.), small leaved lime (*Tilia cordata* MILL.) and wych elm (*Ulmus glabra* HUDS.) admixed (alliance Tilio-Acerion). The herb layer is extremely poor (but includes one rare species, *Arctostaphyllos uva-ursi* [L.] SPRENG.) and the shrub layer is virtually non-existent. The following were recorded along the edge: *Betula pendula* ROTH, *Fagus sylvatica* L., *Pinus sylvestris* L., *Quercus petraea* (MATTUSCHKA) LIEBL., *Q. robur* L., *Sorbus aucuparia* L., *S. danubialis* (JÁV.) PRODAN, *S. torminalis* (L.) CRANTZ. *S. abscondita* grows at the very edge. *S. aria* (L.) CRANTZ is missing from the site, as it is from much of the Džbán hills. The slope, including the plateau edge, has recently been made a national nature reserve. The plateau is covered by semi-natural mixed woodland. A narrow tract adjoining the edge has recently been cleared and re-planted with pine (*Pinus sylvestris* L.), so that *S. abscondita* temporarily receives more sunshine from the east. For a general characterisation of the Džbán area, see under *S. gemella*.

Oddly enough, there are no records or literature reports of *S. aucuparia* × *S. danubialis* hybrids from other countries.

S. quernea, the only species in Bohemia which could possibly be confused with this hybrid, differs in having the leaf lobes (5-7 in number) rounded and obtuse, (8-)9 - 10(-11) veins on each side of the blade and calyx teeth fleshy only at the base when in fruit.

Acknowledgements

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Appendix

List of German topographical names (in current use before 1945):

Abertamy	Abertham
Černošín	Tschernoschin
České Středohoří	Böhmisches Mittelgebirge
Chlum	Klum
Chlumská hora	Klum-Berg, Klumberg
Doubravice	Deutsch-Daubrawitz
Doubravický vrch	Daubrawitzer Berg
Krušné hory	Erzgebirge
Liběšice	Liebeschitz
Manětín	Manetin
Mezí	Mösing
Milešovka	Milleschauer
Nečtiny	Netschetin
Nevděk	Schlossberg
Plešivec	Plessberg
Preitenštejn	Preitenstein
Sedlo	Geltschberg
Špičák	Spitzberg
Tepelské vrchy	Tepler Hochland
Ústí nad Labem	Aussig
Vladař	Wladarzberg
Vladořice	Wladarz
Vlčí hora	Wolfsberg
Zbraslav	Prassles
Zbraslavský vrch	Prassleser Berg
Žlutice	Luditz

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[1] The author's translation. The Russian title reads "Zapadnoj Azii", i.e. "of Western Asia".

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