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Observations on *Sorbus* in Southwest Moravia (Czech Republic) and adjacent Austria I

Miloslav Kovanda

Two new *Sorbus* species are described, *S. hardeggensis* (four stations in the Thaya valley, in both Czech and Austrian parts) and *S. alnifrons* (two stations in the Jihlava valley, Czech Republic), both belonging to *S. latifolia* agg. Basic data on their karyology, morphology, variation, relationships, geographical distribution, ecology, phytocenology and ecobiology are given. *S. carpatica* BORBÁS and *S. danubialis* (JÁV.) PRODAN, not previously reported from the Thaya valley, are recorded from a number of sites on both the Czech and Austrian sides. The primary hybrid *S.* × *kitaibeliana* BAKSAY et KÁRPÁTI is shown to occur in one site in the Jihlava valley, Czech Republic. All the records are briefly commented upon.

KOVANDA M., 1996: Beobachtungen zu *Sorbus* in Südwestmähren (Tschechische Republik) und im grenznahen Österreich I.
Beschrieben werden zwei neue *Sorbus*-Arten, *S. hardeggensis* (vier Fundorte im Thayatal, sowohl auf tschechischem wie auf österreichischem Gebiet) und *S. alnifrons* (zwei Fundorte im Jihlava-Tal, Tschechische Republik). Beide gehören zu *S. latifolia* agg. Grundlegende Daten zu Karyologie, Morphologie, Variation, Verwandtschaft, geographischer Verbreitung, Ökologie, Phytozönologie und Ökobiologie werden präsentiert. *S. carpatica* BORBÁS und *S. danubialis* (JÁV.) PRODAN, bisher aus dem Thayatal unbekannt, wurden an mehreren Orten auf tschechischer und österreichischer Seite gefunden. Das Vorkommen der Primärhybriden *S.* × *kitaibeliana* BAKSAY et KÁRPÁTI an einem Fundort im Jihlava-Tal (Tschechische Republik) wird nachgewiesen. Alle Funde werden kurz erläutert.

Keywords: *Sorbus,* Southwest Moravia, Lower Austria, chromosome numbers, morphological variation, geographical distribution, ecology, phytocenology, ecobiology, interspecific hybridization.

Introduction

A survey of the valleys of the Thaya and its tributaries between Vranov nad Dyjí[1] and Znojmo on both sides of the state boundary was performed in 1991-1995. Aimed specially at the genus *Sorbus,* it indicated from the outset that the area was, in terms of taxonomic diversity, perhaps unrivalled in Central Europe (sensu HEGI). One surprising addition to the local *Sorbus* flora, *S. austriaca* (BECK) PRAIN et al. will be published elsewhere (KOVANDA, in press). The survey went on to reveal two more species not previously reported from the area, *S. carpatica* BORBÁS and *S. danubialis* (JÁV.) PRODAN, and one species of the *S. latifolia* agg., not previously recognized,

[1] See Register of German topographical names in the Appendix.

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described here under the name of *S. hardeggensis*. Investigation of the Oslava, Jihlava and Rokytná valleys, SW Moravia, yielded another new species of the *S. latifolia* agg., *S. alnifrons,* and one primary hybrid, *S.* × *kitaibeliana* BAKSAY et KÁRPÁTI *(S. danubilis* × *S. torminalis).* The role of the new species described here is that they add new combinations of characters to the genus.

Of the species similar to or related to *S. aria,* only *S. aria* (L.) CRANTZ itself has so far been reported from the Thaya valley (e.g. NIESSL 1868, OBORNY 1883-1886, HIMMELBAUER & STUMME 1923); when examining the relevant herbarium material, however, it appeared that OBORNY's report had actually been based on *S. danubialis* (JÁV.) PRODAN (see below).

In *Sorbus* it is a commonly adopted practice (e.g. WARBURG & KÁRPÁTI 1968, KUTZELNIGG 1994) to distinguish between hybrid species (usually polyploid, fertile, apomictic, forming morphologically uniform populations with their own sets of characters and amenable to taxonomic treatment at the rank of species) and primary hybrids (usually diploid, sterile, occurring rarely and only as single individuals between the parent species). The present paper follows this concept. It is complementary to my treatment of *Sorbus* in the Czech Flora (KOVANDA 1992).

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

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

Arbores usque 18 m alti; foliis simplicibus, laminis ambitu late ovatis, pinnatilobatis usque pinnatifissis (lobis ambitu acutis, serratis), in parte superiore tantum duplicato-serratis, (7.2-)7.8 - 9.6(-11.2) cm longis et (5.2-) 6.0 - 7.1(-7.8) cm latis, ad basin late cuneatis usque rotundatis (rarissime subcordatis), remote serratiusculis, subtus griseo-viride tomentosis vel tomentellis, autumno modice glabrescentibus, nervis utroque latere (7-)8 - 9 (-10), petiolis 19-32 mm longis; corymbothyrsis sat paucifloris, ramis tomentosis, postea glabrescentibus; hypanthio turbinato, tomentoso; dentibus calycinis late triangularibus, acutis, 1.3-2.2 mm longis, patentibus, post anthesin reclinatis, supra glabrescentibus, subtus tomentosis, tempore fructificationis siccis, persistentibus vel deciduis; petalis late obovatis, fere exunguiculatis, 5.1-5.8 mm longis, albis, superne ad basin sparse villosis, patentibus; staminibus 20, antheris pallide luteis; ovario infero, stylis 2 ad

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Kreuzmaiss near Hardegg, the tallest specimen of *Sorbus hardeggensis* on record.

Sorbus hardeggensis, ripe fruits.

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Ledové sluje, the type locality of *Sorbus hardeggensis*, seen from the north.

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$^1/_2$-$^2/_3$ coalescentibus, ad basin lanuginosis; stigmatibus planis; fructibus subglobosis, ellipsoideis usque pyriformibus, (9-)10 - 13(-14) mm longis et 7-8(-10) mm in diametro, maturitate ochraceis usque aeneis, glabris, modice nitidis, lenticellis ferrugineis usque fuscis, numerosis, conspicuis; mesocarpio heterogeneo, endocarpio cartillagineo; seminibus ovoideis, atro-fuscis, 4.8-5.5 mm longis.

Holotypus: Moravia austro-occid.: in locis praeruptis super antris Ledové sluje (lingua Germanica Eisleiten) dictis haud procul ab oppidulo Vranov nad Dyjí (lingua Germanica Frain); solo gneissiaco, alt. 370 m. Die 16.9. 1993 leg. M. KOVANDA. In Herbario Instituti Botanici Universitatis Vindobonensis (WU) conservatur. Isotypus et syntypi numerosi in Herbario Musei Nationalis Pragae (PR) depositi.

Etymology: Hardegg, Austria's smallest town, on the Thaya.

Morphology, variation and relationships: This species has a well-defined morphology which clearly indicates its hybrid nature, with *S. torminalis* (L.) CRANTZ and a member of subg. *Aria* as the parent species. The involvement of *S. torminalis* (L.) CRANTZ is most convincingly evidenced by the inferior ovary. Floral morphology, especially the position of the ovary in relation to the hypanthium (whether adnate or not) has been shown to be an important taxonomic character in *Sorbus* and in the Maloideae in general (e.g. KOEHNE 1890, KOVANDA 1961a), but has continued to be neglected. (KOEHNE was much criticized for his system of the subfamily, based primarily on this character; see e.g. FRITSCH 1898-1899.) It was not until recently that its merit has been re-established (ROBERTSON et al. 1992). It now seems certain that the inferior ovary is also present in some other *Aria* × *Torminaria* hybrids. (It has so far been reported only for *S. slovenica* KOVANDA; see KOVANDA 1961b.) Regrettably, authors describing these hybrids paid little or no attention to flower and fruit morphology, being concerned solely with leaf shape. For instance, KÁRPÁTI described a number of new species without ever mentioning flowers or fruits (for a summary, see KÁRPÁTI 1960).

The partly deciduous calyx of *S. hardeggensis* requires some comment. Its persistence or otherwise is a feature of much taxonomic value in *Sorbus,* dividing the genus into two unequal parts: with calyx deciduous in fruit (subg. *Torminaria*) and with calyx persistent (dry or fleshy) in fruit (the rest of the genus). Surprisingly, in *S. hardeggensis* varation within an individual was found: the calyx is generally persistent and dry (a character supplied by the *Aria*-parent), but all the individuals sampled also produced some fruits with the calyx completely deciduous.

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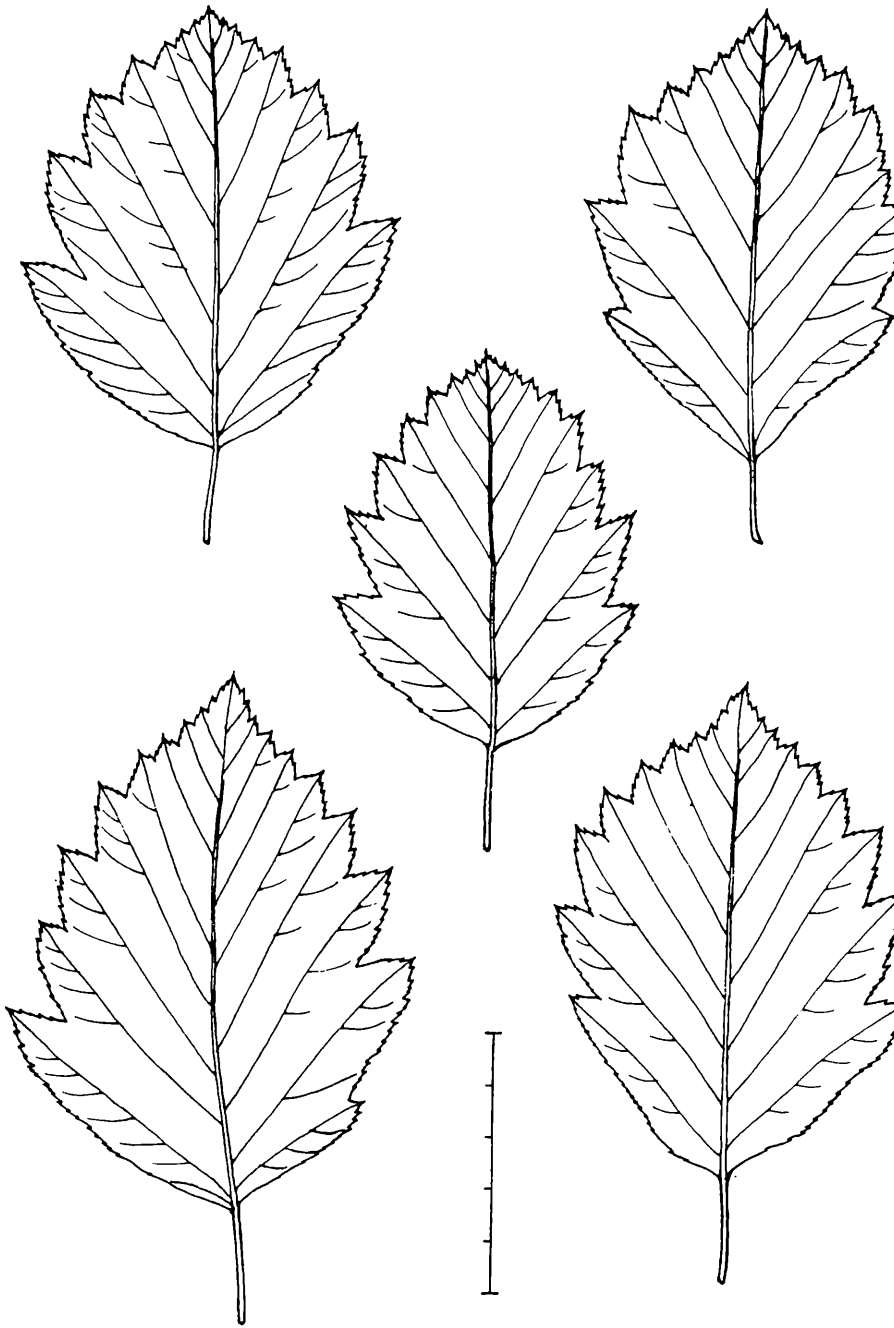

Fig. 1: *Sorbus hardeggensis,* variation in the leaf shape. Scale: 5 cm. — *Sorbus hardeggensis,* Variabilität der Blattform. Maßstab: 5 cm.

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In *Sorbus,* fruit shape is usually constant within a species. It is most interesting to see therefore that in *S. hardeggensis* it may vary even within an individual, from (sub-)globose to oblong-ellipsoid or oblong-pyriform.

In detecting the *Aria*-parent of *S. hardeggensis,* it has to be borne in mind that subg. *Aria* is represented by a minimum of three species in the study area: *S. aria* (L.) CRANTZ, *S. danubialis* (JÁV.) PRODAN and *S. carpatica* BORBÁS, a situation rather unusual for a *Sorbus* hybrid. While *S. aria* (L.) CRANTZ is present at all the four sites of *S. hardeggensis, S. danubialis* (JÁV.) PRODAN occurs at only two (Kreuzmaiss and Hardegg), and *S. carpatica* BORBÁS at three (Ledové sluje, Pašerácká stezka and Kreuzmaiss). The latter species can probably be eliminated because being the supposed hybrid *S. aria* (L.) CRANTZ × *S. austriaca* (BECK) PRAIN et al. (see below), it should contain *S. aucuparia* L. which is not known to hybridize with any member of subg. Torminaria.[2] *S. danubialis* (JÁV.) PRODAN is decidedly small-leaved thereby showing a feature that is not apparent in *S. hardeggensis*; neither are its large, sparse lenticels. Thus the *Aria*-parent of *S. hardeggensis* is highly probably *S. aria* (L.) CRANTZ.

S. hardeggensis is rather isolated among Central European *Aria* × *Torminaria* hybrids. In relation to the pinnatisect leaves it approaches some *Aria* × *Torminaria* hybrids described from Hungary such as *S. degenii* JÁV., *S. semiincisa* BORBÁS and *S. pseudosemiincisa* BOROS, none of which however occurs either in the Czech Republic or in Austria. They all have the leaves more shallowly lobed. Thus the discovery of an *Aria* × *Torminaria* hybrid with pinnatisect leaves in the Thaya region is an important addition.

Geographical distribution: At present, *S. hardeggensis* is known from three stations in the Thaya valley proper and from one in the valley of the Fugnitz rivulet close to its confluence with the Thaya, all in the vicinity of the town of Hardegg. Two of the stations are in the Czech Republic, and two in Austria, each supporting but a few individuals. Despite intense search in the Thaya region in the past five years, so far the species has not been recorded elsewhere. In an area with such a rugged relief, however, further records are likely. Suitable habitats abound.

List of localities: next page.

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[2] The only exception is the questionable triple hybrid *S. intermedia* (EHRH.) PERS. *(S. aria* × *S. aucuparia* × *S. torminalis).*

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Czech Republic:
(1) Ledové sluje[3], gneiss, 370 m (two different habitats).
(2) Pašerácká stezka trail, above the Dyje, gneiss, 380 m.

Austria:
(3) Hardegg, upper margin of cliffs above the Thaya, 1 km E of town, limestone, 350 m.
(4) Valley of the Fugnitz, W slope of Kreuzmaiss, near Hardegg, limestone, 340-370 m (two different habitats).

Ecology and phytocenology: The habitats of *S. hardeggensis* can be allocated to three groups differing considerably in their characteristics:

(1) Ledové sluje, scree wood in the upper part of the slope. Here *S. hardeggensis* occurs in Aceri-Carpinetum KLIKA 1941 with poorly developed shrub and herb layers as documented by the following relevé.

Ledové sluje, NW, 40°, gneiss, rocky boulders, 420-430 m above sea level, 100 m^2, 10.5.1995:

E_3 (90 %): *Carpinus betulus* L. 3, *Quercus petraea* (MATTUSCHKA) LIEBL. 2, *Sorbus hardeggensis* 2, *S. aucuparia* L. 2, *Tilia cordata* MILL. 2.

E_2 (15 %): *Tilia cordata* MILL. 2, *Euonymus verrucosa* SCOP. 1-2, *Grossularia uva-crispa* (L.) MILL. r.

E_1 (20 %): *Convallaria majalis* L. 2, *Galium mollugo* L. 1-2, *Polypodium vulgare* L. 2, *Luzula luzuloides* (LAM.) DANDY et WILMOTT +, *Sedum maximum* (L.) HOFFM. +, *Geranium robertianum* L. +, *Pulmonaria officinalis* L. s.l. +.

The following plant species were recorded outside the area sampled: in the tree layer *Acer platanoides* L., *A. pseudoplatanus* L., and *Pinus sylvestris* L.; in the herb layer *Actaea spicata* L., *Arabis turrita* L., *Asperula odorata* L., *Chelidonium majus* L., *Cardaminopsis arenosa* (L.) HAYEK, *Cystopteris fragilis* (L.) BERNH., *Euphorbia polychroma* A. J. KERNER, *Galeobdolon montanum* (PERS.) PERS. ex REICHENB., *Galium aparine* L., *Hepatica nobilis* SCHREBER, *Hieracium lachenalii* C. C. GMELIN, *Lilium martagon* L., *Moehringia trinervia* L., *Myosotis arvensis* (L.) HILL, *Polygonatum odoratum* (MILL.) DRUCE, *Stellaria holostea* L., *Turritis glabra* L., *Viscaria vulgaris* BERNH.; etc.

(2) Ledové sluje, summit area, and S facing slope below the Pašerácká stezka trail. Here *S. hardeggensis* is found in Sorbo torminalis-Quercetum (SVOBODA) BLAŽKOVÁ 1962. The following relevé and list characterizes the situation.

Ledové sluje, summit area, gneiss, shallow skeletal soil, 390 m above sea level, 100 m^2, 10.5.1995:

E_3 (60 %): *Sorbus torminalis* (L.) CRANTZ 2, *S. hardeggensis* 2, *Carpinus betulus* L. 2, *Quercus petraea* (MATTUSCHKA) LIEBL. 2, *Tilia cordata* MILL. 2.

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[3] This is an extensive system of rifts and clefts formed by the collapse of a gneiss rock wall at the NW side of a projection encircled by the river on all sides but the E (SE of Vranov nad Dyjí). It offers all possible directions except east; however, *S. hardeggensis* does only occur on its NW side and on the ridge.

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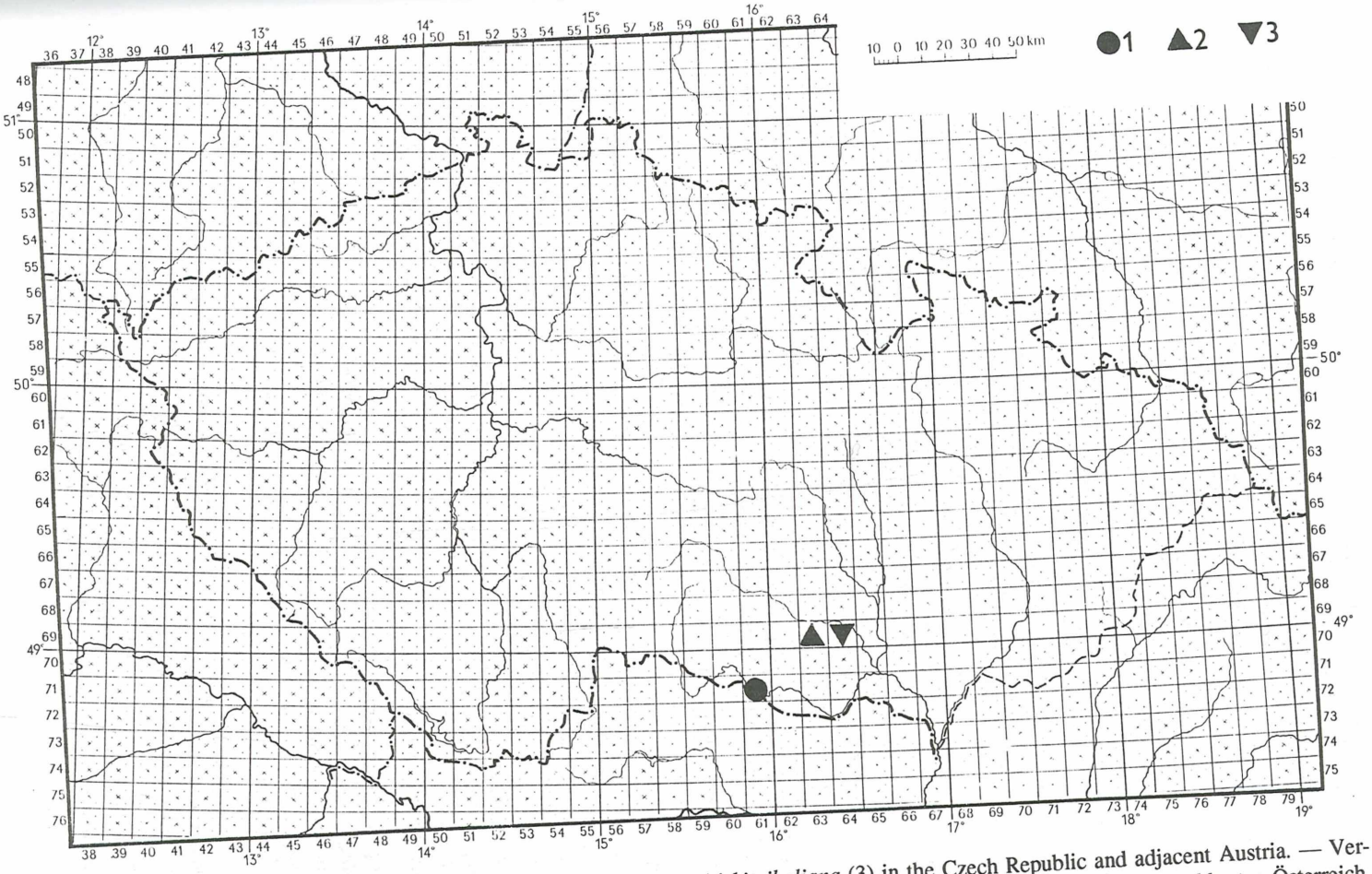

Fig. 2: Distribution of *Sorbus hardeggensis* (1), *S. alnifrons* (2) and *S.* × *kitaibeliana* (3) in the Czech Republic and adjacent Austria. — Verbreitung von *Sorbus hardeggensis* (1), *S. alnifrons* (2) und *S.* × *kitaibeliana* (3) in der Tschechischen Republik und im benachbarten Österreich.

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E_2 (70 %): *Prunus spinosa* L. s.l. 2, *Rosa canina* L. 2, *Acer campestre* L. 2, *Cotoneaster integerrimus* MED. 2, *Quercus petraea* (MATTUSCHKA) LIEBL. 2.

E_1 (65 %): *Euphorbia cyparissias* L. 2, *Fragaria vesca* L. 2, *Galium mollugo* L. 2, *Primula veris* L. s.l. 2, *Stellaria holostea* L. 2, *Achillea millefolium* L. s.l. 1-2, *Alliaria petiolata* (M. BIEB.) CAVARA et GRANDE 1-2, *Hypericum perforatum* L. 1, *Centaurea triumfettii* ALL. +, *Myosotis arvensis* (L.) HILL +, *Pulmonaria officinalis* L. s.l. +, *Sedum maximum* (L.) HOFFM. +, *Veronica chamaedrys* L. +, *Galium aparine* L. r, *Geum urbanum* L. r, *Polypodium vulgare* L. r, *Viola arvensis* MURRAY r.

On a steep, S facing slope below the Pašerácká stezka trail, *S. hardeggensis* occurs in another example of Sorbo torminalis-Quercetum (SVOBODA 1955) BLAŽKOVÁ 1962. The tree and shrub layer is formed by *Acer campestre* L., *Carpinus betulus* L., *Juniperus communis* L., *Pinus sylvestris* L., *Prunus spinosa* L. s.l., *Quercus petraea* (MATTUSCHKA) LIEBL., *Q. robur* L., *Sorbus aria* (L.) CRANTZ, *S. austriaca* (BECK) PRAIN et al. and *S. torminalis* (L.) CRANTZ whereas in the herb layer *Achillea millefolium* L. s.l., *Ajuga genevensis* L., *Alyssum saxatile* L., *Calluna vulgaris* (L.) HULL, *Bupleurum falcatum* L., *Cardaminopsis arenosa* HAYEK, *Centaurea triumfettii* ALL., *Euphorbia cyparissias* L., *E. polychroma* A. J. KERNER, *Fragaria vesca* L., *Galium glaucum* L., *Genista tinctoria* L., *Luzula campestris* (L.) DC., *Melica nutans* L., *Polypodium vulgare* L., *Primula veris* L. s.l., *Rumex acetosella* L., *Scleranthus perennis* L., *Silene nutans* L., *Tanacetum corymbosum* (L.) SCHULTZ.-BIP., and *Vincetoxicum hirundinaria* MED. predominate.

(3) Kreuzmaiss and the upper margin of cliffs E of Hardegg, examples of Melampyro-Carpinetum PASSARGE 1957.

Kreuzmaiss, near Hardegg, 10°, limestone, brown earth, 340 m above sea level, 100 m^2, 11.5.1995:

E_3 (100 %): *Carpinus betulus* L. 4, *Quercus petraea* (MATTUSCHKA) LIEBL. 2, *Sorbus hardeggensis* 2, *Tilia cordata* MILL. 2.

E_2 (50 %): *Euonymus verrucosa* SCOP. 3-4, *Acer campestre* L. +, *Berberis vulgaris* L. +, *Corylus avellana* L. +, *Crataegus laevigata* (POIRET) DC. +, *C. monogyna* JACQ. +, *Ligustrum vulgare* L. r, *Sorbus aria* (L.) CRANTZ r, *Viburnum opulus* L. r.

E_1 (55 %): *Convallaria majalis* L. 3, *Polygonatum odoratum* (MILL.) DRUCE 2, *Primula veris* L. s.l. 1, *Hepatica nobilis* SCHREBER 1, *Lathyrus vernus* (L.) BERNH., *Galium mollugo* L. +, *Melittis melissophyllum* L. +, *Phyteuma spicatum* L. +, *Arabis turrita* L. r, *Asarum europaeum* L. r, *Euphorbia cyparissias* L. r, *Lilium martagon* L. r.

In the upper part of Kreuzmaiss, a similar example of Melampyro-Carpinetum PASSARGE 1957 with *S. hardeggensis* is found, differing mainly in the presence of some xerothermous elements that thrive in the adjacent forest steppe. Examples of these include *Anemone sylvestris* L., *Euphorbia polychroma* A. J. KERNER, *Inula salicina* L., *Teucrium chamaedrys* L. and *Vincetoxicum hirundinaria* MED.

Along the rock cliffs (N facing, limestone) E of Hardegg, *S. hardeggensis* is found associated with *Carpinus betulus* L., *Acer platanoides* L., *Sorbus austriaca* (BECK) PRAIN et al., *S. danubialis* (JÁV.) PRODAN, *S. torminalis* (L.) CRANTZ and *Tilia cordata* MILL. in the tree layer. The following species were recorded in the herb layer: *Anemone nemorosa* L., *Asarum europaeum* L., *Bupleurum falcatum* L., *Convallaria majalis* L., *Cyclamen purpurascens* MILL., *Dentaria bulbifera* L., *Euphorbia polychroma* A. J. KERNER, *Fragaria vesca* L., *Hepatica nobilis* SCHRE-

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Fig. 3: Detailed distribution of *Sorbus hardeggensis* in the Thaya region (for complete map see Fig. 7). *S. hardeggensis* has so far not been found elsewhere in the region. Grid = 1 km. — Kleinräumige Verbreitung von *Sorbus hardeggensis* im Thayatal (vollständige Karte in Abb. 7). *S. hardeggensis* wurde im Gebiet bisher nur an den angeführten Stellen gefunden. Raster = 1 km.

BER, *Lathyrus vernus* (L.) BERNH., *Lembotropis nigricans* (L.) GRISEB., *Lilium martagon* L., *Melittis melissophyllum* L., *Potentilla alba* L., *Primula veris* L. s.l., *Pulmonaria obscura* DUM., *Stellaria holostea* L., *Teucrium chamaedrys* L., *Turritis glabra* L., *Vincetoxicum hirundinaria* MED., etc.

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It follows from the above sketch that *S. hardeggensis* is not confined to a definite plant community. Geological substratum is apparently of no relevance and neither is aspect.

Ecobiology: Flowering is in May but its start varies greatly (from about 6th to 18th) depending on climatic conditions. In the course of the present study (1991-1995) flowering was profuse every year except 1994 when it did not occur at all. Fruit set was prolific but the majority of seeds were shrivelled in all four fruiting years. Accordingly, seedlings are extremely rare.

All the specimens on record are trees, mostly tall and old, often forked. One dying specimen from the Ledové sluje seems to have taken recourse to vegetative propagation by layering, a feature fairly rare in *Sorbus* and never observed in the parent species.

To assess the extent of apomixis and the possible presence of pseudogamy, isolating and emasculating experiments were performed in 1993. Out of 200 isolated flowers, three set fruit, while of ten emasculated (and isolated) flowers four fruits were obtained. The fruits were however poorly developed and contained no seed.

Sorbus alnifrons KOVANDA sp. nova (Fig. 2, 4)

Arbores (raro frutices) usque 8 m alti; foliis simplicibus, laminis ambitu ellipticis, pinnato-lobatis (lobis acutis, serratis), in parte superiore tantum duplicato serratis, (6.6-)7.8 - 9.1(-10.8) cm longis et (4.5-)5.2 - 6.5(-7.8) cm latis,, ad basin cuneatis, remote serratis usque subintegris, subtus griseoviride tomentosis, nervis utroque latere (8-)9 - 10(-11), petiolis 13-27 mm longis; corymbothyrsis multifloris, compactis, convexis, ramis tomentosis; hypanthio turbinato, tomentoso, postea vix glabrescente; dentibus calycinis triangularibus, acutis usque acuminatis, 1.8-2.6 mm longis, patentibus, supra sparse pilosis, subtus tomentosis, persistentibus; petalis rotundatis vel late ellipticis, brevissime sed distincte unguiculatis, 5.2-7.1 mm longis, albis, superne ad basin villosis, patentibus; staminibus 20, antheris pallide luteis; ovario semi-infero; stylis 2 (rarissime 3), ad $^1/_3$-$^4/_5$ coalescentibus, ad basin lanuginosis; stigmatibus planis; fructibus globosis vel subglobosis, (10-)11-12(-14) mm in diametro, maturitate aurantiaco-rubris, glabris, nitidis, lenticellis parvis, pallido-fuscis, inconspicuis; mesocarpio heterogeneo, endocarpio cartillagineo; seminibus ellipsoideis, castaneis, 4.5-5.2 mm longis. Chromosomatum numerus: 2n = 68.

Holotypus: Moravia austro-occid.: in nemore mixto in declivibus septentrio-occidentalibus sub arcem Templštejn; solo granulitico, alt. 380 m. Die 27.9.

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1989 leg. M. KOVANDA. In Herbario Instituti Botanici Universitatis Vindobonensis (WU) conservatur. Isotypus et syntypi numerosi in Herbario Musei Nationalis Pragae (PR) depositi.

Etymology: Latin alnus = alder, frons = foliage.

Herbarium specimen examined: "Moravský Krumlov: u zříceniny hradu Templštýna", V. POSPÍŠIL 1946 BRNM (material from the type locality).

Morphology, variation and relationships: In its morphological characters *S. alnifrons* fits very well into the group of hybrid taxa derived from a cross of *S. danubialis* (JÁV.) PRODAN with *S. torminalis* (L.) CRANTZ. Characteristic features include: relatively small leaves with lobes only in the upper part, 9-10 nerves on each side of the blade, short calyx teeth, petals with a distinct claw, coalescent styles with flat stigmas, and orange to orange-red fruits with a persistent calyx. The parentage seems to be unambiguous in this case: of the subg. *Aria* only *S. danubialis* (JÁV.) PRODAN occurs at the site of *S. alnifrons* and in its vicinity, both upstream and downstream. *S. aria* (L.) CRANTZ is extremely rare being only recorded, in SW Moravia, from the Thaya region. *S. hardeggensis* differs from *S. alnifrons,* inter alia, in having leaves pinnatilobed to pinnatifid, inferior ovary, and ochreous to bronze fruits with (partly) deciduous calyx, to mention only the most conspicuous characters.

Morphologically the closest relative to *S. alnifrons* is probably *S. slovenica* KOVANDA (Malé Karpaty Mts., Slovakia, and Hainburger Berge, Lower Austria), in the origin of which however *S. aria* (L.) CRANTZ and *S. torminalis* (L.) CRANTZ seem to have participated and which is easily recognizable by its larger leaves usually rounded at base, petiole 15-20 mm long, 9-12 nerves on each side of the blade, longer calyx teeth and red fruits (KOVANDA 1961b).

S. alnifrons is remarkably uniform in terms of its morphology, showing little internal variation. The varying degree of coalescence of the styles has been shown to be a common feature of *Sorbus* hybrids (e.g. KOVANDA 1961b, 1984, in press; JANKUN & KOVANDA 1987, 1988; and *S. hardeggensis,* this paper). *S. alnifrons* is perhaps unique in that the coalescence may occasionally involve the entire length of the styles.

Geographical distribution: *S. alnifrons* is confined to two adjoining hills on the S side of the river Jihlava (also spelled Jihlavka in some sources, to distinguish it from the town of Jihlava lying on its upper reaches), near Ivančice, SW Moravia, Czech Republic. The majority of the 45 individuals on record at the present time occur on the NW and N slope of a nameless

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hill with two summits topped by the ruin of the 13th century castle of Templštejn, but one specimen has managed to colonize the nearby Vrabčí vrch hill (388 m), only 0.5 km to the SW In 1988-1994, the present author undertook a thorough investigation of the valleys of the rivers Oslava, Jihlava and Rokytná. The three rivers run almost parallel close to each other in NW to SE (in their lower parts W to E) direction to their confluence near Ivančice and offer a number of suitable habitats underlain by both acid (granulite, gneiss) and basic substrata (Permian conglomerates). *S. danubialis* (JÁV.) PRODAN occurs here, but no trace of *S. alnifrons* was found.

Ecology and phytocenology: *S. alnifrons* is perhaps most frequent in a drier variant of the association Melampyro-Carpinetum PASSARGE 1957 with *Vincetoxicum hirundinaria* MED. on shallow skeletal soil underlain by granulite on the NW slope of the Templštejn castle hill (inclination: 40°). The following list should give an idea of its composition:

in the tree layer *Acer campestre* L., *Betula pendula* ROTH, *Carpinus betulus* L., *Pinus sylvestris* L., *Quercus petraea* (MATTUSCHKA) LIEBL., *Q. robur* L., *Sorbus torminalis* (L.) CRANTZ; in the shrub layer *Cornus mas* L., *Cotoneaster integerrimus* MED., *Euonymus verrucosa* SCOP., *Padus avium* MILL. subsp. *avium*, *Sorbus aucuparia* L., *Swida sanguinea* (L.) OPIZ; in the herb layer *Achillea millefolium* L. s.l., *Ajuga genevensis* L., *Alliaria petiolata* (M. BIEB.) CAVARA et GRANDE, *Arabis turrita* L., *Campanula trachelium* L., *Convallaria majalis* L., *Cyclamen purpurascens* MILL., *Cystopteris fragilis* (L.) BERNH., *Deschampsia flexuosa* (L.) TRIN., *Digitalis grandiflora* MILL., *Euphorbia cyparissias* L., *Galium aparine* L., *Genista tinctoria* L., *Geranium robertianum* L., *Geum urbanum* L., *Hieracium umbellatum* L., *Impatiens parviflora* DC., *Lithospermum purpureo-coeruleum* L., *Luzula luzuloides* (LAM.) DANDY et WILMOTT, *Myosotis arvensis* (L.) HILL, *Poa bulbosa* L., *Rumex acetosella* L., *Sedum maximum* (L.) HOFFM., *Stellaria holostea* L., *Sanguisorba minor* SCOP., *Silene nutans* L., *Scleranthus perennis* L., *Tanacetum corymbosum* (L.) SCHULTZ-BIP., *Veronica chamaedrys* L., *Vincetoxicum hirundinaria* MED., *Viscaria vulgaris* BERNH.

Ecobiology: The flowering time largely coincides with that of *S. hardeggensis*. In the years of study (1980-1982, 1988-1995), *S. alnifrons* flowered and fruited regularly except in 1994 when, as in *S. hardeggensis,* not a single flower appeared. Fruit set is normal and all fruits contain a minimum of one morphologically good seed. Seedlings occur but are not particularly abundant. Nearly all the adult specimens recorded are trees.

Isolating and emasculating experiments yielded the following results: in 1992, 100 isolated flowers set three, ten emasculated flowers set six fruits. In 1995, none of 100 isolated flowers set fruit, but nine out of ten emasculated flowers did so. None of the fruit reached maturity, however, and contained no vestiges of seed.

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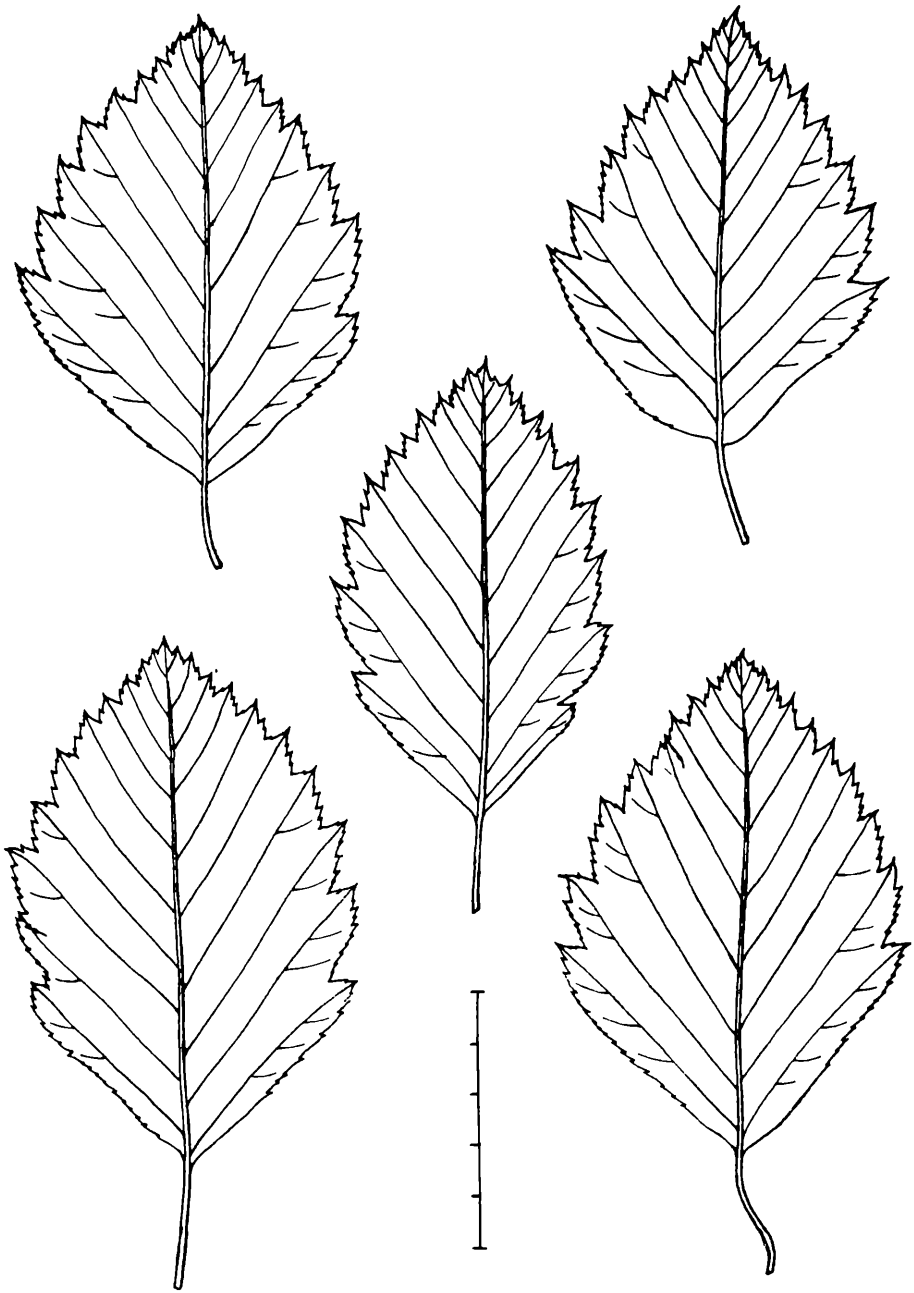

Fig. 4: *Sorbus alnifrons,* variation in the leaf shape. Scale: 5 cm. — *Sorbus alnifrons,* Variabilität der Blattform. Maßstab: 5 cm.

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Sorbus × *kitaibeliana* BAKSAY et KÁRPÁTI Feddes Repert. 62: 299, 1960 (Fig. 2, 5)

(pro hybr. *S. danubialis* × *S. torminalis*)

With leaves ovato-cordate in outline, rounded to shallowly cordate at the base, deeply cut, triangular, acuminate lobes, 6-9 lateral veins on each side of the blade and reddish-brown fruits, this rare primary hybrid comes perhaps closest to *S. torminalis* (L.) CRANTZ of all *S. danubialis* × *S. torminalis* hybrids so far on record. It has previously been known only from the type locality (Máriaremete: Remetehegy) in the Pilis Hills in N Hungary.

A solitary tree occurs in xerothermous scrub on Pekárka hill (calcium-rich Permian conglomerate, alt. ca. 300 m) in the valley of the river Jihlava, near Ivančice, SW Moravia, about 7 km as the crow flies E of the stations of *S. alnifrons*. It compares very well with the authors' diagnosis and drawing, only its leaves are somewhat smaller, not exceeding 7.4 cm in length. Seed is largely abortive; it should be pointed out, however, that it has been observed during only one growing season (1990). Both the parent species occur in the locality. *S. aria* (L.) CRANTZ is missing from much of SW Moravia (see below).

The tree was found to be tetraploid, with 2n = 68, a number rather unusual for a primary hybrid (most of them are diploid).

Herbarium specimen examined: "Ivančice: pr. pagum Alexovice: in colle conglomerat. Pekárka dicto", A. Hrabětová 1974 BRNU.

Sorbus carpatica BORBÁS in C. K. SCHNEIDER Ill. Handb. Laubh. 1: 688, 1906 (Fig. 6)

(pro hybr. *S. aria* × *S. Mougeotii*)

Trees or shrubs. Leaf blade elliptic to oval, acute, cuneate at base, doubly serrate, with 10-13 veins on each side; styles coalescent to $^1/_4$-$^1/_3$; fruits red, with sparse to dense lenticels.

This hybrid species constitutes a morphological link between *S. aria* (L.) CRANTZ and *S. austriaca* (BECK) PRAIN et al. Specimens which cannot very well be referred to either belong almost with certainty to *S. carpatica* BORBÁS. Its intermediate character is especially evident in the leaf shape where a continuous gradation can be traced from leaves irregularly serrate (*S. aria*) via doubly serrate to lobulate (*S. carpatica*) to distinctly lobed (*S. austria-*

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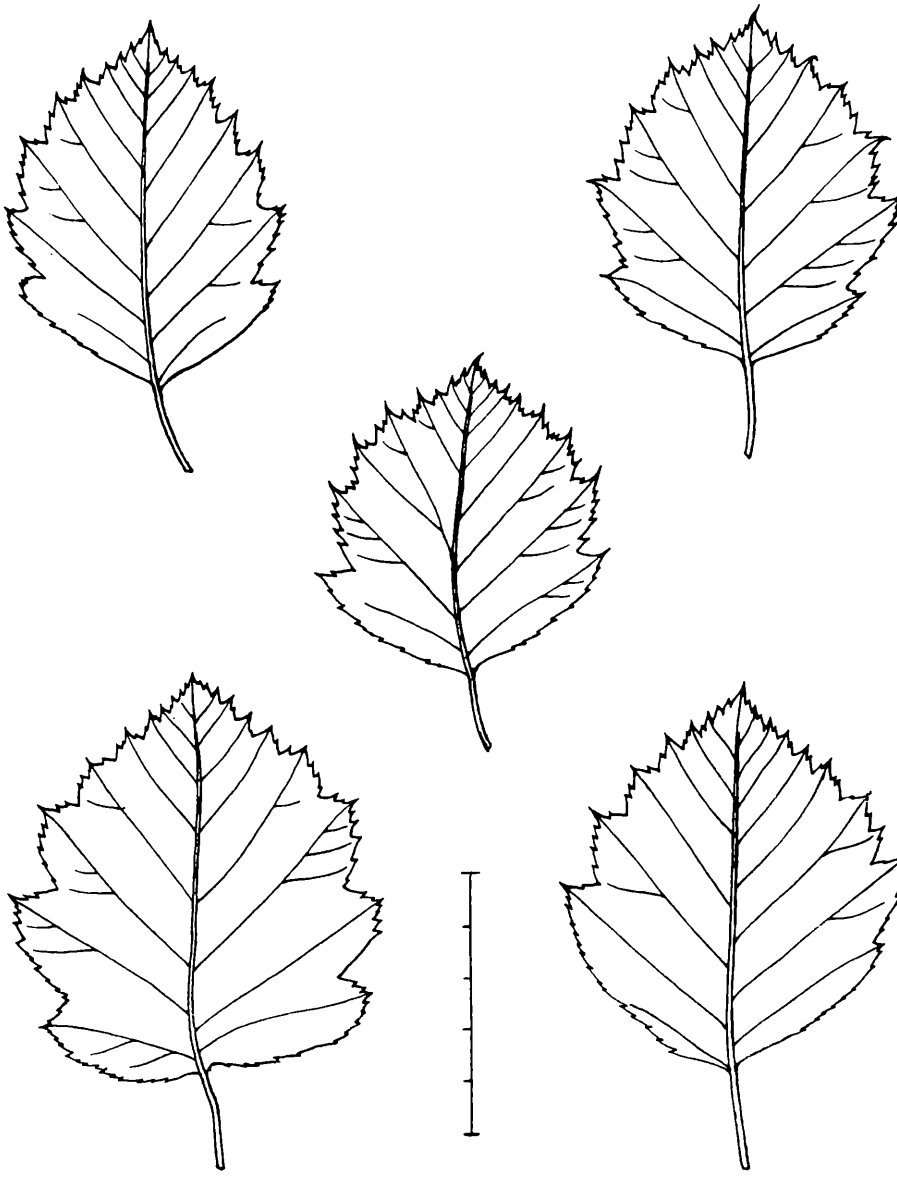

Fig. 5: *Sorbus* × *kitaibeliana,* variation in the leaf shape. Scale: 5 cm. — *Sorbus* × *kitaibeliana,* Variabilität der Blattform. Maßstab: 5 cm.

ca). However, this character can be misleading since in *S. aria* (L.) CRANTZ certain leaves (especially those of the sterile shoots) may be slightly lobed in the upper part, and in *S. austriaca* (BECK) PRAIN et al. the lobing is sometimes not very distinct (KOVANDA, in press).

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The partly connate styles of *S. carpatica* BORBÁS indicate its hybrid origin.

The geographical distribution of *S. carpatica* BORBÁS coincides, for the most part, with that of *S. austriaca* (BECK) PRAIN et al., the species having been reported mainly from the Carpathians and the Balkan Peninsula (KÁRPÁTI 1960). In Austria there have been reports only from near Wien and Sauerbrunn (KÁRPÁTI 1960) and the Voralpen of Lower and Upper Austria (KUTZELNIGG 1994). It has so far not been known to occur in the Czech Republic (KOVANDA 1992), but its occurrence in the Thaya region was suspected (KOVANDA, in press). It proved to be fairly frequent there, occurring in open woodlands and scrub, usually together with *S. austriaca* (BECK) PRAIN et al. The other parent species, *S. aria* (L.) CRANTZ, is also frequently found in its presence. *S. carpatica* is tolerant of both acid (gneiss, granulite) and basic substrata (limestone), as are its parent species. Stations include:

Czech Republic
(1) Ledové sluje, NW, 400-430 m
(2) below the Pašerácká stezka trail, 380 m
(3) Braitava, near the hunting pavillion, 470 m
(4) Braitava, on rocks opposite the Ledové sluje, 450 m
(5) above the Čížov custom-house, 350 m
(6) below the Hardeggská vyhlídka gazebo, 330 m

Austria
(7) Binderberg hill, E, 420 m
(8) confluence of the Fugnitz and the Fellingbach streams, 350 m
(9) E of Hardegg, 350 m
(10) rocks of the Kreuzmaiss, 370 m
(11) Reginafelsen, near Hardegg, 380 m
(12) Heufurth, N of the village, 390-400 m

The name *S. carpatica* BORBÁS was published without a diagnosis or description, merely with a note that it might correspond to the *S. aria* × *S. mougeotii* parental combination. This is all that SCHNEIDER (1906) has to say: "*S. aria* × *Mougeotii*: dürfte vorkommen. Aber noch nicht sicher nachgewiesen. Ich sah in Herb. DEGEN eine *S. carpatica* BORB., die vielleicht dieser Kombination ensprechen (sic!) könnte." Its concept and taxonomic rank vary greatly. JÁVORKA (1915) treats it as a non-hybrid transition between *S. aria* (L.) CRANTZ and *S. austriaca* (BECK) PRAIN et al., while KLIKA (1937) treats it as a marginal form of *S. austriaca* (BECK) PRAIN et al. SOÓ (1937) reduced it to a variety of *S. aria* (L.) CRANTZ. His diagnosis ("folia a medio apicem versus paulum lobulata, apice magis obtusa, folia laxe, rarius dense nervosa") can very well be applied to an intermediate between *S. aria* (L.) CRANTZ and *S. austriaca* (BECK) PRAIN et al., but the

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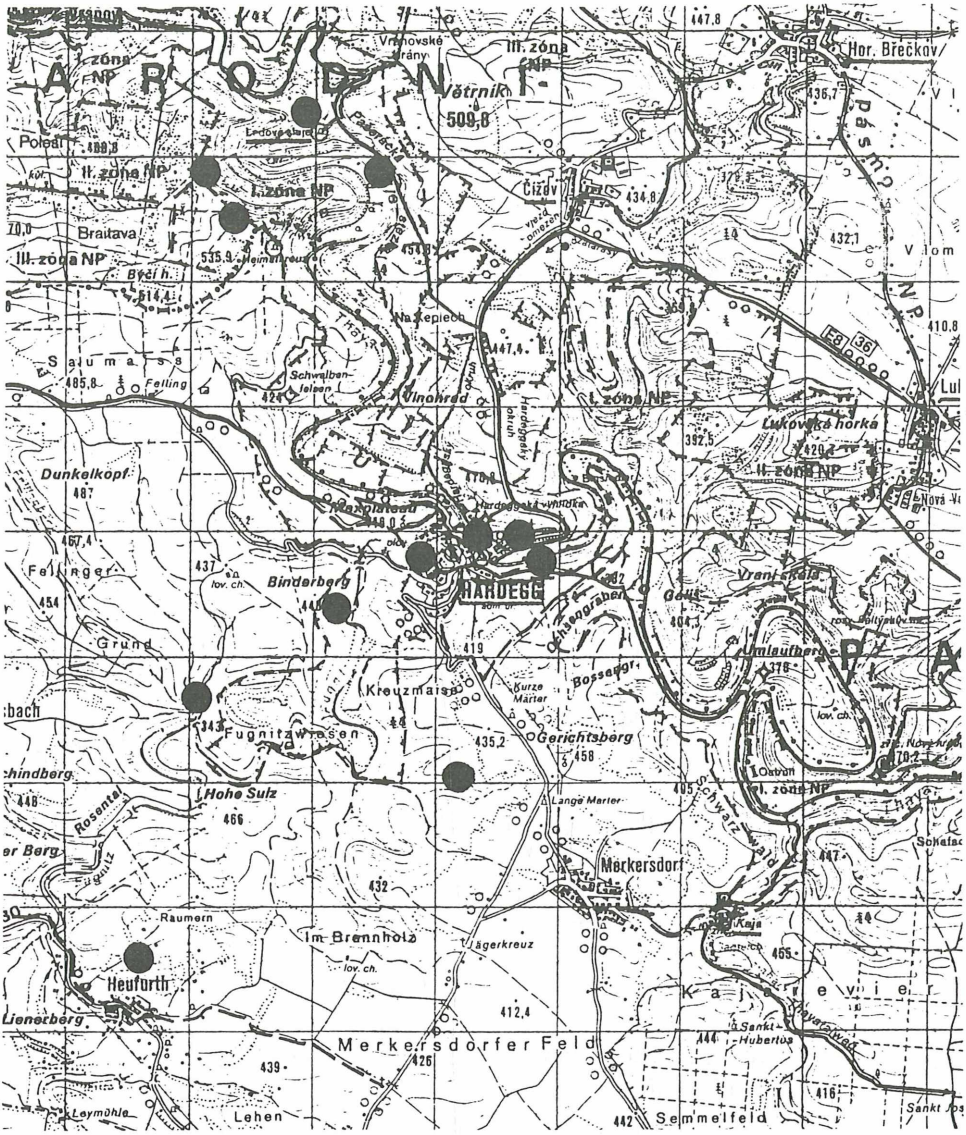

Fig. 6: Detailed distribution of *Sorbus carpatica* in the Thaya region (for complete map see Fig. 7). *S. carpatica* has so far not been found elsewhere in the region. Grid = 1 km. — Kleinräumige Verbreitung von *Sorbus carpatica* im Thayatal (vollständige Karte in Abb. 7). *S. carpatica* wurde im Gebiet bisher nur an den eingetragenen Stellen gefunden. Raster = 1 km.

illustration shows merely a form of *S. aria* (L.) CRANTZ. KÁRPÁTI (1960) lists *S. carpatica* BORBÁS as a "transitus" *S. aria* — *S. austriaca,* KOVANDA (1961b) and KUTZELNIGG (1994) treat it as a hybrid species of the *S. aria* × *S. austriaca* parentage.

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Sorbus danubialis (JÁV.) PRODAN Fl. Pentru Determ. Descr. Pl. Rom. 353, 1923 (Fig. 7)

Bas.: *S. cretica* (LINDL.) FRITSCH f. *danubialis* JÁVORKA Bot. Közlem. 14: 104, 1915

Unlike taxa discussed above, there is no reason to suspect hybrid origin for this species, a member of subg. *Aria*. It differs from *S. aria* (L.) CRANTZ in having leaves only 4-5(-6) cm long, obovoid to rhomboid in outline, acute to apiculate, incise-serrate and usually undulate at the margin in the upper part, longer calyx teeth and fruits with only a few conspicuous lenticels. It was described from near Lake Balaton in Hungary (JÁVORKA 1915). In Austria it has so far been known to occur only in the Hainburger Berge (Braunsberg, Hundsheimer Berg, Pfaffenberg), Lower Austria (KUTZELNIGG 1994) and on the Kienberg near Bernstein, Burgenland (KÁRPÁTI 1960). The distribution in Moravia, as so far known, includes the Moravian Karst, short sections of the rivers Oslava, Jihlava and Rokytná (each only with a few localities) and the vicinity of Znojmo (KOVANDA 1992). Znojmo and its vicinity was the only part of the Thaya valley from which a few herbarium specimens referable to *S. danubialis* (JÁV.) PRODAN were available ("bei Znaim", OBORNY 1871 BRNU; "Znaim", OBORNY 1918 PRC) indicating that the species might have been present elsewhere in that area. Indeed, during the present survey, a number of stations of *S. danubialis* (JÁV.) PRODAN were recorded. They include, from west to east:

Czech Republic

(1) below the Pašerácká stezka trail, SW, 360 m
(2) Kozí stezka trail, S, 370 m
(3) confluence of the Klaperův potok stream with the Thaya, SW, 260 m
(4) Vraní skála rocks, SW, 360 m
(5) the Nad Papírnou rocks, SW to S, 320 m
(6) Sealsfieldův kámen[4] rocks, N, 360 m

Austria

(7) Kreuzmaiss, calcareous rocks, 370 m
(8) Hardegg, upper margin of calcareous cliffs E of the town, N, 360 m

[4] The modern name of a rock cliff in the Thaya valley, NW of Popice, where the Austrian-American writer Karl POSTL alias Charles SEALSFIELD (1793-1864) used to sit.

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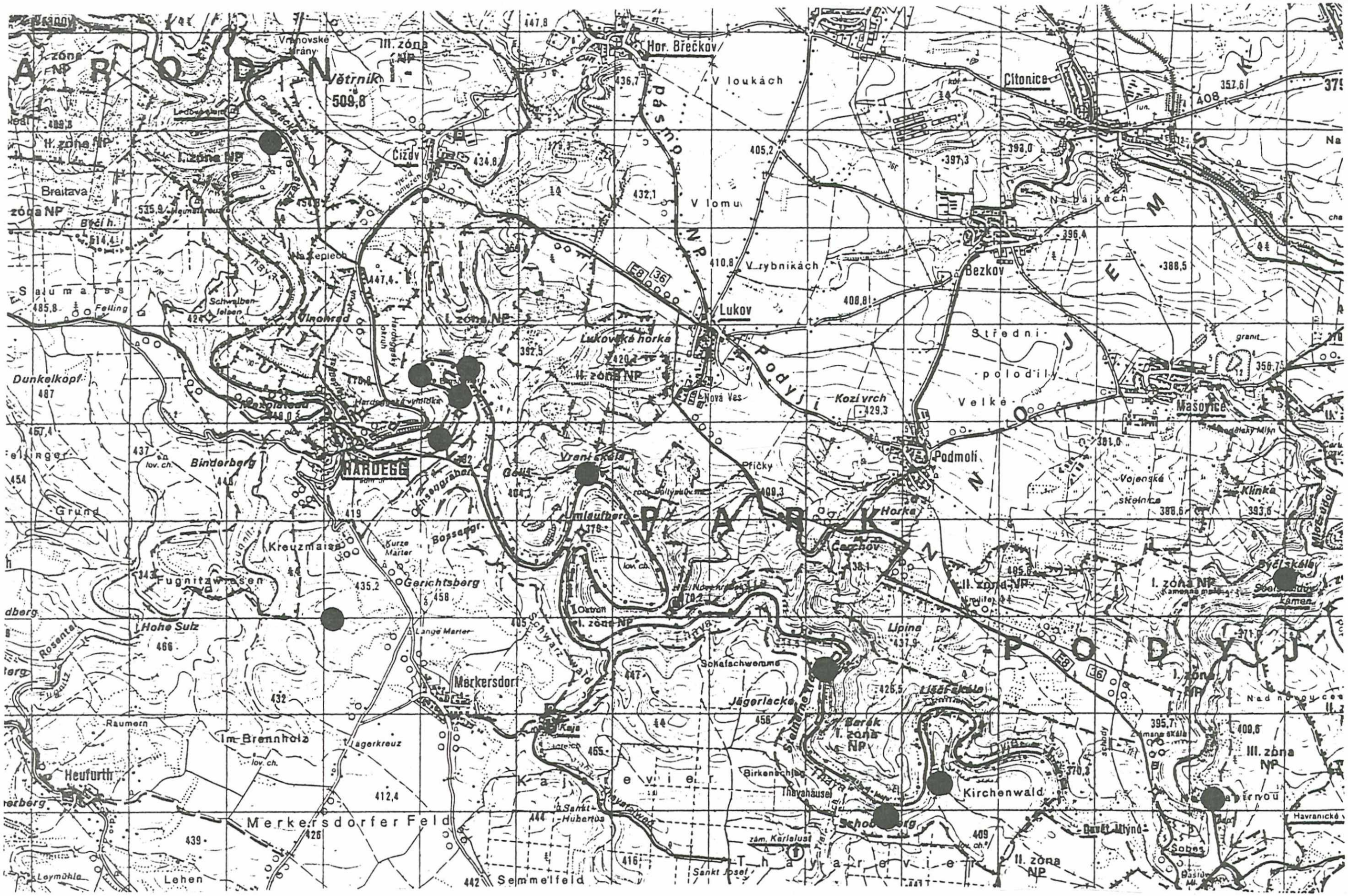

Fig. 7: Detailed distribution of *Sorbus danubialis* in the Thaya region. Grid = 1 km. — Kleinräumige Verbreitung von *Sorbus danubialis* im Thayatal. Raster = 1 km.

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(9) Einsiedelei, 320 m
(10) Steinerne Wand, rock cliff in the N part, 330 m [5]
(11) Schoberberg, relict pine wood, 350 m [6]
(12) Schoberberg, rock cliff in the N part, 360 m [7]

S. danubialis is not particularly abundant in any of these localities; indeed, in some of them, e.g. Kozí stezka, Vraní skála, Kreuzmaiss, Hardegg or Steinerne Wand, only a few specimens occur. The species obviously prefers relict habitats, such as rocky cliffs and crags in the valleys of the Thaya and its tributary, Fugnitz, both on acid (gneiss, granulite) and basic (limestone) substrata. It is usually accompanied by spontaneous pine, *Pinus sylvestris* L.

Concerning leaf shape, some individuals approach very closely to *S. umbellata* (DESF.) FRITSCH and further study is required to see whether they are referable to this Eastern Mediterranean species.

Plants of *S. danubialis* (JÁV.) PRODAN from the České středohoří Mts. proved to have 2n = 34 (JANKUN & KOVANDA 1987) which is in tune with the principle that the basic species of *Sorbus* are diploid.

Material from near Moravský Krumlov, published in Flora Exsiccata Reipublicae Bohemicae Slovenicae nos. 1131 and 1132 under the name of *S. aria* (L.) CRANTZ belongs beyond any doubt to *S. danubialis* (JÁV.) PRODAN. KÁRPÁTI (1960) referred the locality, as "Krumlov", to his Carpaticum Praemoravicum. KUTZELNIGG (1994), innocently unaware of the fact that there are two Krumlovs in the Czech Republic, Moravský Krumlov (in German "Kromau") in Moravia and Český Krumlov (in German "Krumau" or "Krummau") in Bohemia, transferred the locality (as "Krummau a. d. Moldau") to the latter where it is impossible for *S. danubialis* (JÁV.) PRODAN to occur.

It is interesting to note that none of the taxa reported here from the Thaya valley was recorded in the entire Moravian section of the river upstream of Ledové sluje as far as Podhradí nad Dyjí, a stretch largely occupied by the Vranov Dam, even though favourable habitats are available. A survey of this area was conducted in 1978-1982.

Acknowledgements

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[5 6 7] Recorded in 1996. Not shown on the map.

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Appendix

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

Braitava	Bratauer Wald
České středohoří	Böhmisches Mittelgebirge
Český Krumlov	Krumau, Krummau
Čížov	Zaisa
Dyje	Thaya
Hardeggská vyhlídka	Hardegger Warte, Luitgardenwarte
Klaperův potok	Klapperbach
Kozí stezka	Geißsteig
Ledové sluje	Eisleiten
Moravský Krumlov	Kromau
Papírna	Papiermühle
Pašerácká stezka	Schmugglersteig
Podhradí nad Dyjí	Freistein
Podyjí	Thayagebiet
Popice	Poppitz
Vraní skála	Rabenstein
Vranov nad Dyjí	Frain
Znojmo	Znaim

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