Neilreichia **2–3**: 107–130 (2003)

Crepis pannonica (Asteraceae-Lactuceae): karyology, growth-form, phytogeography, occurrence and habitats in Austria; including *subsp. blavii* comb. et stat. nov.

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Abstract: *Crepis pannonica* s. str. = *C. pannonica subsp. pannonica* is a species of Sarmatic-Caucasian-Pontic-Pannonian distribution, reaching its westernmost border in S. Moravia and NE. Austria. Both in the Czech Republic and in Austria it is critically endangered. In Austria, two populations only, with very few individuals each, are known (in Lower Austria, just N. of Vienna). Habitats are steppe-like grassland, fallow (meso-)xerophytic meadows and edges of vineyards. – The chromosome number (first count in Austrian plants): $2n = 2x = 8$ (unlike the presumably decaploid relative *C. biennis*). – *C. pannonica* s. str. is a semirosette tap-rooted pleiocorm perennial. – The closely related illyric *"C. blavii"* is a distinct taxon, best classified on subspecific level as *C. pannonica subsp. blavii* comb. et stat. nov.

Key words: *Crepis pannonica subsp. blavii*, karyology, phytogeography.

Zusammenfassung: *Crepis pannonica*: Karyologie, Wuchsform, Areal, Fundorte und Standorte in Österreich; inklusive *subsp. blavii* comb. et stat. nov. – Englisch mit deutscher Zusammenfassung.

Crepis pannonica s. str. = *C. pannonica subsp. pannonica* ist eine sarmatisch-kaukasisch-pontisch-pannonisch verbreitete Art, deren westliche Arealgrenze in Süd-Mähren und im Weinviertel (Niederösterreich) liegt. In beiden Ländern (Tschechien und Österreich) ist sie vom Aussterben bedroht. In Niederösterreich ist sie nur noch von zwei Fundpunkten mit je einer individuenarmen Population bekannt. Standorte sind Trockenrasen, brachgefallene Trockenwiesen und Weingartenränder. – Die erstmals für Österreich festgestellte Chromosomenzahl ist $2n = 8$, die Art ist somit diploid, dies im Unterschied zur verwandten, hochpolyploiden, vermutlich dekaploiden, *C. biennis*. – *C. pannonica* s. str. ist eine perenne Halbrosetten-Rüben-Pleiokormstaude; die Angabe im „HEGI", sie sei bienn, ist offenkundig unrichtig. – Nächst verwandt ist eine illyrisch verbreitete Sippe, die teils als Art behandelt, teils überhaupt nicht als Taxon anerkannt wird; unsere Analyse zeigt, dass es sich um eine distinkte Sippe handelt, sie wird deshalb – hier erstmals – als Unterart eingestuft und benannt: *C. pannonica* subsp. *blavii* comb. et stat. nov.

Introduction

Crepis pannonica is a robust perennial species distributed mainly in E. Europe but occurring also as a very rare and endangered species in E. Central Europe.

In Austria, this species has been reported from 5 localities only since the 1920s. Nowadays it seems to be extant only in two of them. It is critically endangered (CR, "1" = "threatened to become extinct") (NIKLFELD 1999).

The first author of this paper (D. D.) has started a karyotaxonomic investigation of the Bulgarian representatives of *Crepis* (DIMITROVA 1996, 1998; DIMITROVA & GREILHUBER

2000, 2001). Among the most common *Crepis* species in Bulgaria as well as in Austria is *C. biennis* – a polyploid (2n = ca. 40) with a speculative base chromosome number $x = 4$ or $x = 5$, hence an octoploid or, presumably, a decaploid. In order to solve this problem we have tried to study the karyotype of some of its European relatives among which is *C. pannonica*. *Crepis pannonica* has been reported for the flora of Austria but has not been confirmed during the last 30 years. Our attempt to find it has resulted in the confirmation of two of its localities.

In the present study, the first author (D. D.) investigated the karyotype. – We report also on both the historical and the extant and presently known distribution of *C. pannonica* in Austria and on its habitat characteristics (M. A. F.). Study of variation and of closely related taxa led to the conclusion to accept *"C. blavii"* as a well characterised and geographically clearly separated distinct taxon, best treated at the rank of subspecies (M. A. F. and D. D.). Up to now it had been treated either as a minor variant without taxonomic value or as a separate species (see below, section 1). – Additionally, in the course of the critical contemporary evaluation of the taxa of the Austrian flora, we include a phytographical analysis (M. A. F.) and a growth form study supported by scientific drawings (A. K.). These provide new and valuable information for the multi-volume edition "Flora von Österreich" which is in progress (FISCHER & HÖRANDL 1994, FISCHER 1998, 2002).

Material and Methods

Herbarium work. The specimens in the Herbarium of the Natural History Museum (W) and those of the Institute of Botany of the Vienna University (WU) have been studied.

Field work. We (D. D., M. A. F., and Gerlinde Fischer) have visited both possible localities near Vienna from which herbarium specimens are available in both Viennese Herbaria – Bisamberg and Kronawettberg near Hagenbrunn (both localities closely N of Vienna). Although we did not find any specimens on mt. Bisamberg in 1999, a few individuals could be traced there in 2001 (see section 9).

Karyological work (by D. D.) is based on classical squash technique. For the chromosome studies, root tips were stained with Feulgen. Chromosome parameters of three well spread metaphase plates were measured on video-prints. The original data were normalised on the basis of 200% for the diploid karyotype length. These normalised values were used to calculate the mean values and the standard deviation of the length of the short (S) and long (L) arms, the satellite (Sat), and the total chromosome length (T). The centromeric index (Ci) was calculated according to the formula: $Ci = (L/T) \times 100$. The idiograms were drawn with MsPaint for Windows 95. The order of chromosome pairs in the idiograms strictly follows the values of T. Chromosomes are classified according to LEVAN & al. (1964). Voucher specimens (see sections 4 and 8) are kept in the herbaria WU and SOM.

Growth form study (by A. K.). For this purpose, plants were grown in the Botanical Garden of the University of Vienna in the years 2000 to 2002 from seeds obtained from the hill "Kronawettberg" near Hagenbrunn (see sections 8 and 9).

Results and Discussion

(1) Taxonomic position and chorology (general distribution). According to BABCOCK (1947b) and SELL (1976) it belongs to *sect. Crepis* (= *sect. Berinnia*) *subsect. Corymbiformae* and within that, BABCOCK (1947b: 416) puts it into a "subgroup" together with *C. latialis [= C. lacera], C. bertiscea*, and *C. chondrilloides* (see below). The well-known and wide-spread species *C. biennis* belongs to a different "subgroup" within the same subsection.

Crepis pannonica has been described from Hungary as *Hieracium pannonicum* by Jacquin, Coll. **5**: 148 (1796). It was transferred to *Crepis* by K. Koch, Linnaea **23** (7): 689 (1851). An important heterotypic synonym, used for long time in Central Europe, is *C. rigida* Waldst. & Kit., Descr. icon. pl. Hung.: 18, t. 19 (1802), described from near Budapest (see section 8). The name *"C. pannonica"* is mainly used with two different meanings (i. e. two taxonyms[1]): s. lat., i. e. including *C. blavii* (see below), and s. str., i. e. excluding *C. blavii*. The first taxonym is used e. g. by BABCOCK (1947a, b), GAJIĆ (1975), SELL (1976), WRABER (1999, 2002), NIKOLIĆ (2000), JOGAN (2001) and in the present paper; the second taxonym is used by STADLMANN (1908), JUSTIN (1911), FRITSCH (1922), HAYEK (1931), PIGNATTI (1982), STRGAR (1984), WAGENITZ (1987), and MEUSEL & JÄGER (1992a, b).

Closely related species are (according to MEUSEL & JÄGER 1992 a, b) *C. lacera (= C. latialis)* in Italy (PIGNATTI 1982: 275), *C. chondrilloides* (WRABER 1999: 612, PIGNATTI 1982: 275–276) in the N. Illyric Province, *C. bertiscea* in the S. Illyric Province (SELL 1976: 351 mentions one locality in N. Albania only ["NW. of Tropojë"], whereas GAJIĆ 1975: 335, arranging this species far from *C. pannonica* within *sect. "Barkhausia"*, gives „Kosovo: Klisura Sušice"), and *C. asadbarensis* in the Hyrcanian Province (N. Iran) (RECHINGER 1977: 307), the latter formerly (BABCOCK 1947b) being included within *C. pannonica*.

Chorology: According to MEUSEL & JÄGER (1992a: map 548b; 1992b: 191, 149 f., 323), *C. pannonica (subsp. pannonica)* displays a chorotype characterised as mainly sarmatic-caucasic-pontic-pannonic or, in more detail, "caucasic-montane – east to central-pontic – south-sarmatic – pannonic-colline"; i. e. the distribution range covers most part of Caucasia (extreme E. Turkey [LAMOND 1975: 822], Armenia, C. Georgia, N. Great Caucasus from Daghestan to Krasnodar and S. Crimea, only Colchis and W. Caucasus being excluded evidently due to the moist climate), E. Ukraine and S. C. and SE. Russia up to the S. Urals. In the western part of its range, i. e. the Pannonian Province, occurrences are much scattered, viz. from NE. Bulgaria to SW. Ukraine (Podolia and Bukovina), Romania, Hungary, Slovakia, Moravia and Lower Austria (see below, section 8). – The illyric *subsp. blavii*, by MEUSEL & JÄGER (1992a, b), is treated as a separate species, *C. blavii*.

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see WAGENITZ (2003: 324); — the use of nomenclatural authors, a wide-spread routine, is of no help and, very generally, should be avoided – as suggested by the ICBN – (see FISCHER 2000, 2001)!

Iconography of *C. pannonica:*

subsp. pannonica: BABCOCK (1947b: 441: fig. 106), NYÁRÁDY (1965: 175, Pl. 36/2), DOSTÁL (1989: 1133–1134), JÁVORKA & CSAPODY (1979), PIGNATTI (1982), HEGI (1929: 1140, fig. 815), HOLUB in ČEŘOVSKÝ & al. (1999), DOSTÁL & ČERVENKA (1992: 1176);

subsp. blavii: BABCOCK (1947b: 443: fig. 107), PIGNATTI (1982: 274), STADLMANN (1908: Tafel XI), WRABER (2002: 309).

(2) Phytography (description) of *Crepis pannonica subsp. pannonica.* Complete and correct descriptions are rare, the best one seems to be that in the famous monograph by BABCOCK (1947b), good ones are those by ČEREPANOV (1964: 639–641), by DOSTÁL (1989: 1133–1134) and by DOSTÁL & ČERVENKA (1992); the one in HEGI (1929) includes several mistakes[2] We try to provide a description based mainly on the two (last?) populations in Lower Austria. Essential differential characters (against other species of *Crepis*) are marked by **bold print**. These characters fit very well also with the specimens from Moravia, Slovakia, Hungary, Romania, Ukraine and Armenia, thus, variation is remarkably low (see Figs. 1–4).

Plants (40–)60–120 cm tall, perennial (see section 5). Rhizome vertical (see section 5), producing 1–6(–10) basal flowering shoots. Rosette (basal) leaves mostly partly absent in flowering time. Base of stems surrounded by short (ca. 1 cm) scales that are rigid fragments of the base of old leaves. Stem branched only above c. two thirds (lower end of capitulescence[3]), rigid, **strongly sulcate**, more deeply above, with 6–12 very unequally deep furrows, sparsely to densely setulose with short, 0.5–1(–1.5) mm long, rigid, eglandular hairs with usually stout base, above subglabrous to glabrous, often with some additional scattered arachnoid hairs, especially above. Leaves dark green, **subrigid**; basal leaves (Fig. 1A) and lowermost stem leaves (Fig. 1B) (10–)15–25(–30) cm long, 4–6(–10) cm wide, **broadly lanceolate[4] to broadly elliptical to obovate-lanceolate, coarsely dentate** (rarely shallowly dentate), base long-cuneate ("winged petiole"), sessile or rarely with a short (1 cm) winged petiole, apex usually acute, sometimes obtuse to rounded, sometimes ± acute. **Stem leafy**: cauline leaves (Fig. 1C, 4) upwardly gradually diminishing from foliar leaves to hypsophylls, altogether (6–)8–13(–20), all **sessile**, the lower ones **ovate to ovate-lanceolate to broadly elliptic, coarsely** (rarely slightly) **dentate, near base** usually **inciso-dentate** (acutely pinnatilobate) **with long teeth** (or lobes: 5–15 mm long and 2–5 mm wide); base distinctly **sagittate**, apex usually acute; middle cauline leaves oblong to ovate, dentate with 8–12 acute teeth, base ± sagittate, apex distinctly acute; upper cauline leaves (subhypsophylls closely below the capitulescence; Fig. 1D, E) narrowly triangular ("lanceolate") to linear, base slightly sagittate to cordate, acute, subentire. Indument of leaves similar to that of the stem but usually slightly shorter, i. e. sparsely **shortly setulose with 0.3–0.6(–1.0) mm long, rigid** hairs (setules) with thick base, **eglandular**, near margin usually scabrid by very short (0.1–0.3 mm), stout, conical setules; lower side usually sligthly more densely setu-

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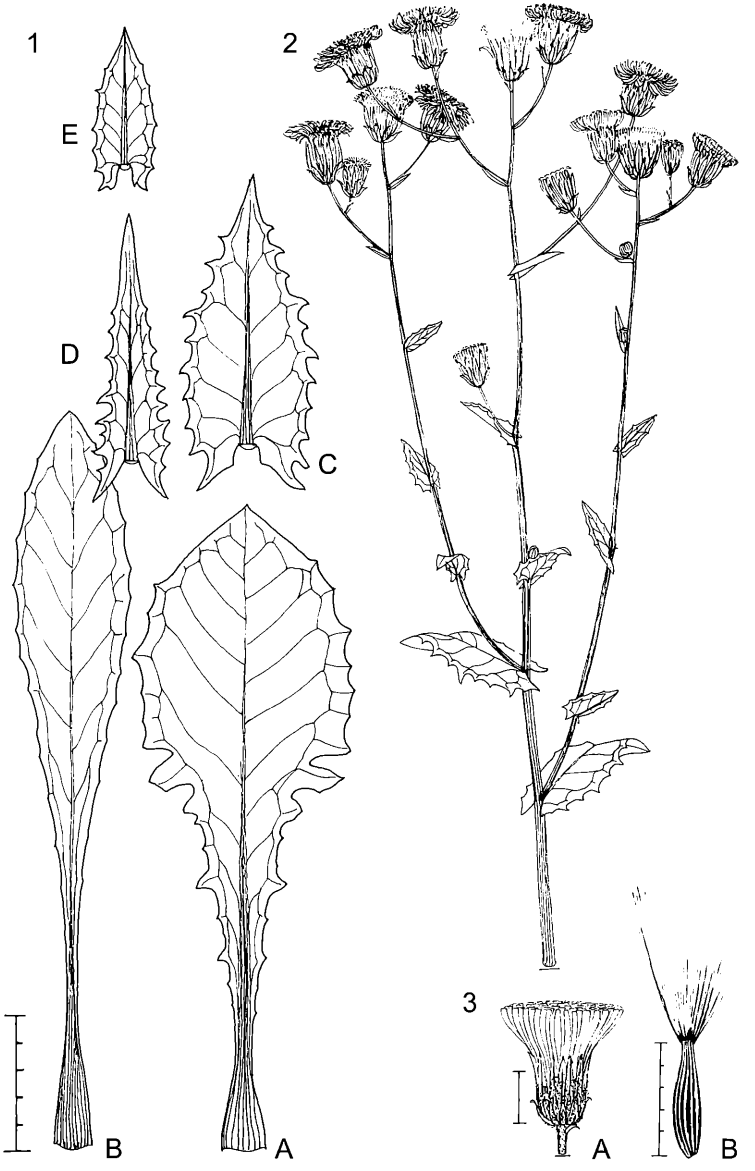
There are also contradictions between key and description.

= synflorescence composed of heads = calathides

in Linnaeus's sense



Figs. 1 to 3: *Crepis pannonica subsp. pannonica.* **Fig. 1:** Sequence of foliar leaves (scale bar 5 cm): **(A)** lowermost (rosette) leaf; **(B)** lower stem leaf; **(C)** middle stem leaf (see also Fig. 4!); **(D), (E)** uppermost stem leaves (± slightly transitional to hypsophylls). – **Fig. 2:** Capitulescence. – **Fig. 3: (A)** Flowering head (scale bar 1 cm); **(B)** fruit (scale bar 5 mm).

Abb. 1 bis 3: *Crepis pannonica subsp. pannonica*. **Abb. 1:** Blattfolge (Maßstrich 5 cm): **(A)** unterstes (Rosetten-)Blatt; **(B)** unteres Stängelblatt; **(C)** mittleres Stängelblatt (siehe auch Abb. 4!); **(D), (E)** oberste Stängelblätter (± deutliche Übergänge zu Hochblättern). – **Fig. 2:** Korbstand. – **Fig. 3: (A)** Korb (Maßstrich 1 cm); **(B)** Frucht (Maßstrich 5 mm).

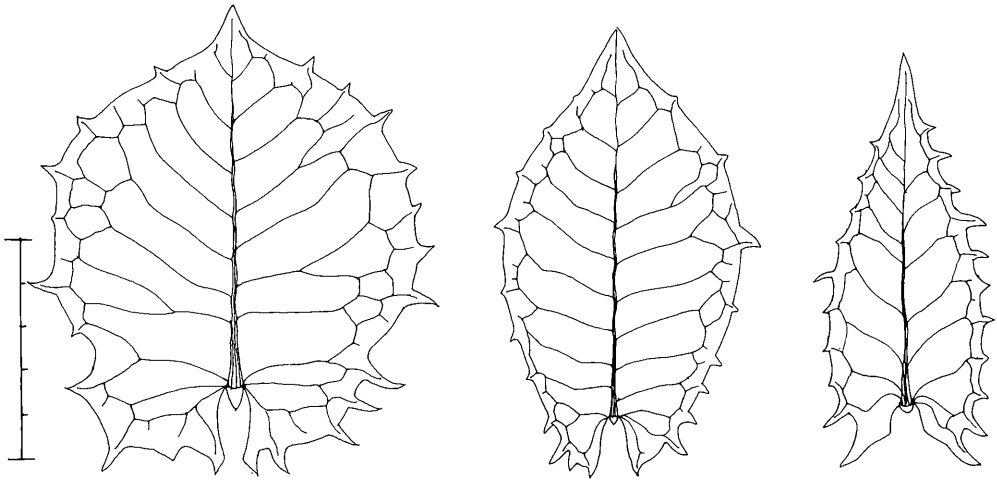


Fig. 4: *Crepis pannonica subsp. pannonica*. Three middle stem leaves to show their variation (see Fig. 1C!; scale bar 5 cm).

Abb. 4: *Crepis pannonica subsp. pannonica*. Drei mittlere Stängelblätter, ihre Variabilität veranschaulichend (siehe auch Abb. 1C!; Maßstrich 5 cm).

lose than upper side, particularly on midrib, often with scattered arachnoid hairs in between; leaves sometimes subglabrous; upper cauline leaves and hypsophylls with even shorter hairs (setules), thus almost scabrid-papillose, arachnoid hairs increasingly numerous. Capitulescence (Fig. 2) loosely **corymbose-paniculate**, rarely ± racemose-paniculate with usually (10–)15–25(–35) calathides[5], on c. 3–8 branches below the terminal calathide, lower branches 5–20 cm long, **peduncles 1–3(–4) cm** long, most of them conspicuously **patent-arcuate, stout, i. e. 1.5–2(–2.5) mm** ∅, deeply sulcate, but not thickened below the calathide, ± **arachnoid,** without setules, usually with 1(–3) hypsophylls; hypsophylls (bracts, pherophylls of branches and calathides) very narrowly triangular ("lanceolate") to subulate, entire, 3–10 mm long, sligthly arachnoid to subglabrous. Calathide (Fig. 3A) erect, 3–4 cm ∅, c. 60–80-flowered; involucrum **12–14 mm long,** 8–12 mm wide, broadly cylindrical to slightly campanulate, inner (longer) row of bracts clearly distinct from the outer ones; outer involucral bracts ¼–⅓(–½)× the length of the inner ones, narrowly triangular, acute, with a narrow or no margin; inner involucral bracts c. 12–14, all erect (appressed), very narrowly triangular ("lanceolate") to almost linear, **2–2.5 mm wide, with broad, bright** (± scarious) **margins**, apex rather acute, top ciliate with a tuft of very short arachnoid hairs, upper side (outside) **densely deciduously whitish arachnoid-tomentose** all the length (no other hairs present: no setulae, no glandular hairs), but often partially glabrous (or glabrescent?); lower (inner) side very sparsely pubescent or **glabrous** (glabrescent?), base not spongy-thickened in

[5] = capitula = heads

fruit; clinanthium **hairy**. Corolla c. 15 mm long, 1½× to almost 2× as long as the involucrum, ligule yellow, c. 2.5 mm wide; style **yellow** (also when dry). Achene (Fig. 3b) 6–7 mm long, c. 1 mm wide, fusiform, apex attenuate, with **15–20 unequal ribs**, dark brown to blackish brown, minutely papillose (BABCOCK 1947b: "muriculate under lens"); pappus 7–8 mm long, **white**, soft and flexuous.

(3) Variation: *subsp. blavii.* In the western parts of the Balkan Peninsula, i. e. the Illyric Province, the very closely related taxon called *C. blavii* is distributed. It ranges[6] from SW. Slovenia (in N. Istria, where it is very rare, probably extant in a single locality only: STADLMANN 1908, JUSTIN 1911, JOGAN 2001: 119[7], WRABER 2002; – just not reaching Italy: PIGNATTI 1982: 274, note and figure after *C. pyrenaica*) through Croatia (not mentioned by DOMAC 1994, but by VISIANI 1847, HAYEK 1931, DEGEN 1938, NIKOLIĆ 2000: 97) and Bosnia-Hercegovina to Montenegro (JUSTIN 1911). It is included within *C. pannonica* by GAJIĆ (1975), SELL (1976), WRABER (1999, 2002), NIKOLIĆ (2000), and JOGAN (2001). However, PIGNATTI (1982) and TRPIN & VREŠ (1995) as well as the older authors STADLMANN (1908), JUSTIN (1911), and FRITSCH (1922) treat it as a species *(C. blavii)* on the basis of the strictly racemosely paniculate but never corymbiform capitulescence and the strongly glandular indumentum of lower stem and foliar leaves. Also, MEUSEL & JÄGER (1992a: 548), under its species name, present a separate distribution map, mentioning both the differential characters and remarking that it perhaps merits subspecific rank as it differs from *C. pannonica* [s. str.] also by its distinctly illyric distribution (MEUSEL & JÄGER 1992b).

BABCOCK (1947b: 442–443) claims that the habit of the "aggregate inflorescence" [capitulescence, synflorescence] is variable throughout the species' range. Although he admits that synflorescence morphology, as evidenced by cultivation experiments, has a genetic basis, he finds "plenty of evidence that any population of the species may be capable of producing either type". Also, plants with a paniculate and corymbiform capitulescence intercross freely when brought together "and the hybrids are very fertile" "Variations in degree of glandulosity also occur generally throughout the range of the species" As a consequence, BABCOCK mentions *"C. Blawii"* as a "minor variant" only. Nevertheless, he dedicates a separate figure (p. 443, fig. 107) to this "minor variant" (see below). Considering the whole genus, it is true that presence or absence of glandular hairs generally is found not to be a valuable taxonomic character in *Crepis*. On the other hand, a disjunct distribution pattern with morphologically distinct local races as witnessed in *C. pannonica* is rather common in *Crepis*, and these races are treated as distinct species or subspecies (*C. foetida subspp. foetida, rhoeadifolia* and *commutata*; *C. sancta subspp. sancta, bifida* and *obovata*).

A revision of the specimens in the herbaria WU and W discloses that those differential characters are equally well developed in all the Illyric localities and never present in specimens of Pannonian, Pontic and Caucasian origin. We have found no intermediate specimens.

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[6] see also section 8!

the record from grid 0448/4 is erroneous (communication by T. Wraber)

Despite the fact that we could not study variation in Russian material, our observations in plants from Central and SE. Europe (mentioned in section 8), however, show clear association of glandulosity, shape of capitulescence and distribution. (BABCOCK's observations in crossings – reported above – concern variants with "paniculate" vs. "corymbose" habit, but he does not touch on the conspicuously racemose habit characteristic for *"C. blavii"*.) A closer investigation of the specimens from the Illyric region (western Balkan Peninsula) disclosed some further differences (see description below) highly correlated with racemose capitulescence and glandular leaves. So, we cannot confirm BABCOCK's impression that shape of capitulescence and presence of glandular hairs are characters separately emerging here and there in different populations throughout the whole range of the species and, thus, are of no taxonomic value. On the contrary, these characters are well associated and part of a taxonomically significant complex of differential characters. Moreover, variation is low within the whole range of the Illyric race from Istria to Bosnia-Hercegovina from where we could study specimens (see section 8). On the other hand, within the range of the "typical" race, in all specimens from Austria, Moravia, Hungary, Romania and even Armenia, variation proves to be low as well, the Armenian specimens e. g. are indistinguishable from Austrian ones. In view of these facts, even the re-establishment of specific rank for *C. blavii* is not completely beyond consideration as no intermediate populations are known.

The most proper taxonomic rank in such cases is the subspecific one. On the basis of the above discussion and the strong evidence for biological independance of the W. Balkan populations we would therefore classify them as a subspecies:

Crepis pannonica (JACQ.) K. KOCH ***subsp. blavii*** (ASCH.) M. A. FISCHER & D. DIMITROVA, **comb. et stat. nov.**

Basionym: *Mulgedium Blavii*[8] Asch., Bot. Z. 1879: 260. – Synonyms: *C. blavii* (Asch.) Stadlm., Österr. Bot. Z. **58**: 422 (1908); – *C. rigida* sensu Visiani, Fl. Dalm. **II**: 119 (1847); – *C. rigida var. adenophylla* Rohlena, Sitzungsber. Böhm. Ges. Wiss. **38**: 66 (1904); – probably also: *C. rigida var. viscosissima* Rohlena, Sitzungsber. Böhm. Ges. Wiss. **38**: 66 (1904). For the history of naming and for further synonyms see STADLMANN (1908) and JUSTIN (1911). – Nomenclatural type: Hercegovina: in fruticetis solo lapidoso inter Paljev dol et Pakračuža, alt. 800–1000 m s. m., leg. O. Blau; herb. SARA (fide STADLMANN 1908), n. v.

Though the Latin description by STADLMANN (1908) is very good, we try a differential description based on our own studies: ***Subsp. blavii*** differs[9] from *subsp. pannonica* mainly and conspicuously in all foliar leaves **densely glandular-pubescent on both sides:** glandular hairs 0.5–1.0(–1.5) mm long (no eglandular hairs), **stem densely glandular pilose in the lower part:** glandular hairs (0.5–)1–2 mm long (no eglandular hairs between), plant hence **sticky**; capitulescence ± cylindrical, **racemose**-paniculate, i.e. lowermost branches 2–8(–20?) cm long, not or scarcely longer than upper ones; peduncles **shorter**: **0.5–1.5(–2) cm** long; calathides slightly but consistently **smaller: involu-**

[8] named by P. Ascherson after Otto Blau, Prussian and later German Consul, who collected plants of this taxon c. 1870 between Nevesinje and Mostar in Hercegovina.

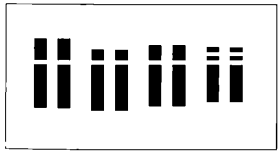
[9] for comparison with *subsp. pannonica* see description in section 2 (p. 110).

crum 9–11(–12) mm long. Furthermore, the plants seem to be generally **smaller**: 45–75(–100) cm high (we know, however, that collectors tend to adjust their specimens' size to herbarium size); the (foliar) leaves are **less rigid**, their indumentum is significantly **denser** and almost equal upside and downside, there are no short, conical setules near the margin; even size, shape and margin of the lower leaves is different on average: they are slightly **smaller**: (9–)12–20(–25) cm long and (2–)3.5–5.5(–7) cm wide, the lower stem leaves tend to be **narrower**, rather oblong, and their margins are more regularly and remotely dentate, not pinnato-lobate or inciso-dentate, the **teeth**, on average, being distinctly **shorter**: 1–5 mm long, narrower and more acute; the inner involucral bracts are slightly **narrower**: 1–1.5(–2) mm wide; the outer involucral bracts are slightly longer, often almost reaching half the length of the inner ones.

BABCOCK's (1947b) fig. 107 is not typical in all traits: the calathides are too small (like in fig. 106, *subsp. pannonica*) and too numerous; the detail *b* showing part of the capitulescence, however, demonstrates very well the short peduncles and the comparatively long outer involucral bracts (the significance of all the other details presented, in contrast, is unclear for us). – The plants studied by us (see section 8) show no glandular hairs within the capitulescence, i.e. hypsophylls, peduncles and involucra never have glandular hairs. We have not seen plants of the variant *"C. rigida var. viscosissima"* described by Rohlena (see synonymy) from Montenegro/Crnagora (near Viluša close to the border of Hercegovina; according to JUSTIN 1911) differing by glandular hairs also on the involucrum.

Hybrids *C. pannonica subsp. blavii* × *C. chondrilloides* have been found by STADLMANN (1908) (and named *C.* ×*malyi*) and by JUSTIN (1911) together with the parents, both in Bosnia and in Slovenia (we saw the obviously intermediate specimens in herb. WU).

(4) Karyology of *C. pannonica subsp. pannonica*. The karyotype of *C. pannonica* consists of eight chromosomes (Fig. 5) and corresponds to the formula $2n = 2x = 2sm+4st+2st\text{-}sat$. These results confirm the data in GOLDBLATT (1981, 1984, 1985) and GOLDBLATT & JOHNSTON (1991). We have not found B-chromosomes in the karyotype of the studied population, although they are common in *C. pannonica* from Armenia (NAZAROVA



	1	2	3	4
Sat				0.95 ± 0.04
S	9.88 ± 0.19	5.36 ± 0.43	5.61 ± 0.50	1.10 ± 0.16
L	20.24 ± 0.62	20.93 ± 0.38	18.76 ± 0.82	16.94 ± 0.51
T	30.35 ± 0.42	26.29 ± 0.62	24.37 ± 0.67	18.99 ± 0.48
Ci	67.43 ± 1.09	79.64 ± 1.23	76.98 ± 2.01	89.19 ± 0.73
KL = 6.80 ± 0.30 µm				

Fig. 5: Karyotype of *Crepis pannonica subsp. pannonica* with relevant chromosome parameters.
Abb. 5: Idiogramm und relevante Chromosomen-Parameter von *Crepis pannonica subsp. pannonica*.

1988, NAZAROVA & GOUKASIAN 1999). FROEST & OESTERGREN (1959) and FROEST (1960) also have found B-chromosomes in plants obtained from a Hungarian Botanical Garden.

The chromosomes are relatively long, the total karyotype length being 6.80 ± 0.30 µm. Chromosome pair I is the most symmetric one (Ci = 67.43 ± 1.09), pairs II and III are subtelocentrics with very similar morphology (Ci = 76.98–79.64). Pair IV bears the satellites on the short arms and is the most asymmetric pair (Ci = 89.19 ± 0.73). The karyotype of the studied accessions is very similar to that in BABCOCK's figure (1947b: 441). *Crepis pannonica subsp. blavii* has not been studied karyologically so far.

There has been no previous chromosome count of *C. pannonica* from Austrian accessions. There exists also no count of the very common *C. biennis* from Austrian material (DOBEŠ & VITEK (2000: 484–485).

Chromosome number and morphology in *Crepis* have strong taxonomic significance. These features reveal relationships between taxa and are related to the evolutionary advancement of the species within the genus. BABCOCK (1947a) and later STEBBINS (1971) have shown that in *Crepis* the relatively long karyotype corresponds to the perennial life form and certain primitive morphological features (robust plants, large heads, unbeaked long achenes). The karyotype features of *C. pannonica* correspond very well with its relatively primitive habit. In the same time, the chromosomes are smaller and more asymmetric than in *C. viscidula* (DIMITROVA 1998) and *C. conyzifolia* (DIMITROVA 1996) for instance. This supports the more advanced position of section *Crepis* in the evolutionary scheme of BABCOCK (1947a).

(5) Growth Form and Life History (Figs. 6–9). In the 2nd "revised and enlarged" edition (a reprint from 1929 with very few additions in the appendix) of HEGI's Flora (WAGENITZ 1987: 1140, 1433) the life-form of *C. pannonica* is given as biennial, this mistake being copied, unfortunately, by FISCHER (1994: 870), although BABCOCK (1947b: 439), SELL (1976: 350) and DOSTÁL (1989: 1133) correctly state that this species is a perennial. Some authors try to combine Hegi with the truth: DOSTÁL & ČERVENKA (1992: 1175): "biennial to perennial" Already FRITSCH (1922: 610, foot-note) points to the vertically elongated rootstock resembling a tap-root – in contrast to the biennial *C. biennis* the "often conspicuously branched roots" of which "resemble a rootstock" In order to clarify the situation, the third author of the present contribution (A. K.) studied the development and life history of *C. pannonica*.

Achenes from the locality Kronawettberg near Hagenbrunn were sown in spring 2000. During this first year 34 small rosette plants developed and wintered subsequently (Figs. 6A, B; 9A), all of them enhancing ("Erstarkungsphase") during 2001, thus producing ± strong rosette plants (Fig. 6C), the axis enlarging by primary growth, the vertical section between shoot top and top of the tap-root showing significant growth of the pith which indicates the presence of sufficient storage for further development. In the following year, these plants started the flowering period by developing usually more than one flowering stem of 1.2 to 1.6 m height (Fig. 9B). The flowering period lasts from end of June to mid of July, and the fruits maturation starts in August and lasts until the beginning of September when the stems gradually die. From late summer to early autumn, in some of the leaf axils, innovation buds develop (Figs. 7, 9C). In each of the

34 individuals 1–12 innovation buds or rosettes were observed. The following spring, they produce young rosettes that will develop into flowering shoots in the subsequent summer (Figs. 8, 9D). Sixteen more plants germinated only in 2001 and in 2002 developed into ± strong rosette plants.

The growth-form type is to be classified as hemirosette fleshy-root pleiocorm perennial ("Halbrosetten-Rüben-Pleiocormstaude") according to KÄSTNER & KARRER (1995).

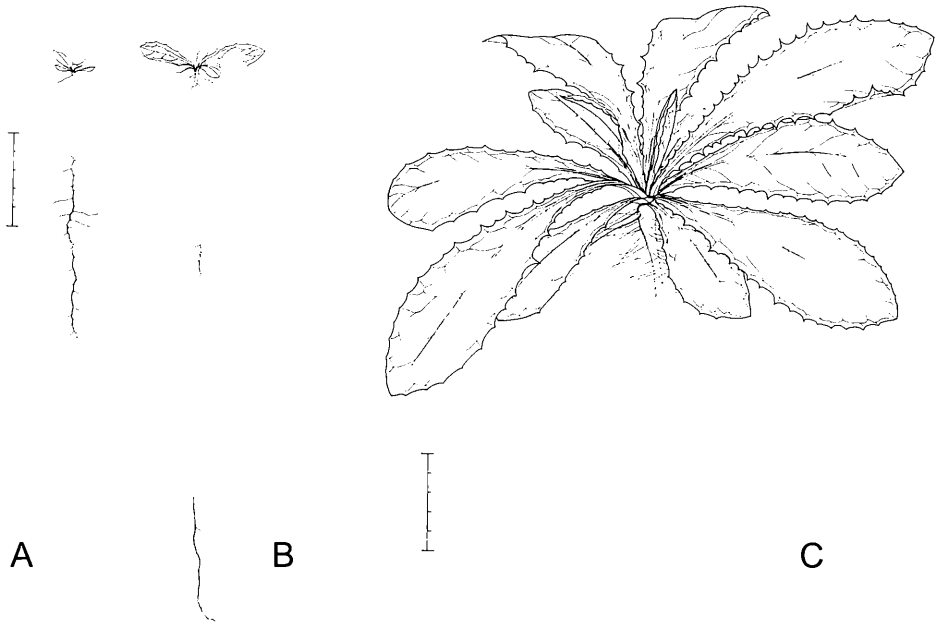
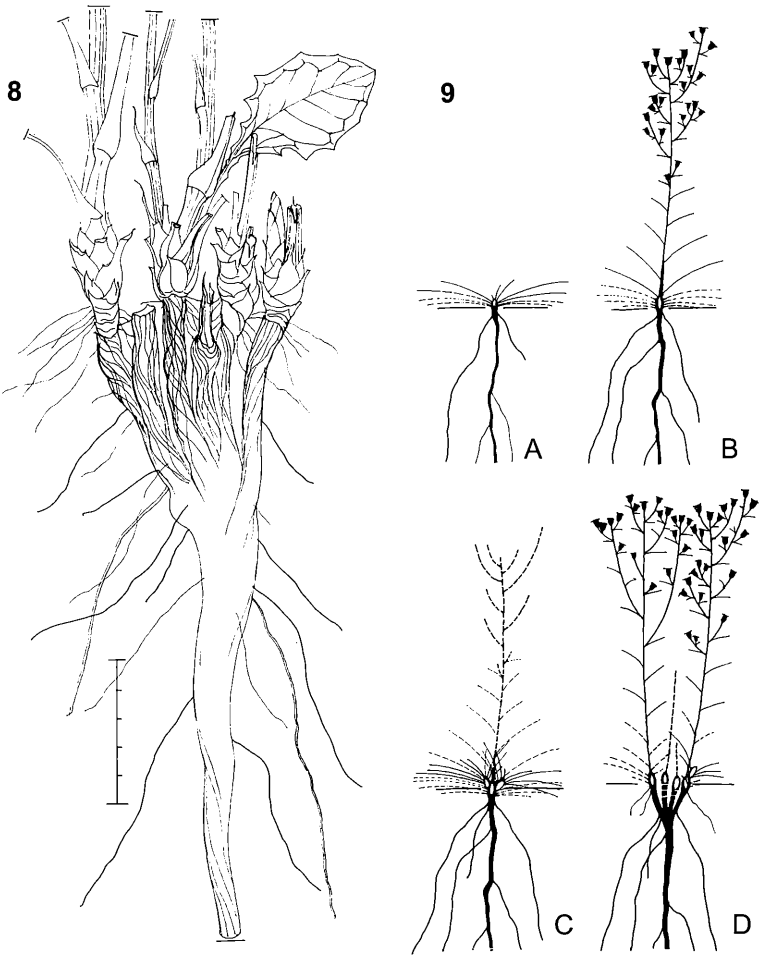


Fig. 6: *Crepis pannonica subsp. pannonica.* **(A, B)** Two young plants (sown early spring 2000) of the first year (May 2000) showing **(A)** cotyledons and initial rosette and **(B)** a rosette consisting of few leaves and a long primary tap root (scale bar 5 cm). – **(C)** Vigorous, enhanced rosette plant in the end of the 2nd year (June 2001) with many leaves and strong root system: primary root with vigorous lateral roots. Note the conspicuously long and strong uppermost lateral root (partly hidden by leaves) originating from close to the caudex. The axis of this rosette plant is strongly contracted and exhibits good primary thickening, both necessary prerequisites for starting the reproductive phase in the subsequent vegetation season (scale bar 5 cm).

Abb. 6: *Crepis pannonica subsp. pannonica.* **(A, B)** Zwei Jungpflanzen (gezogen im zeitigen Frühjahr 2000) des ersten Jahres (Mai 2000) **(A)** mit Keimblättern und den ersten Rosettenblättern und **(B)** mit einer wenigblättrigen Rosette und langer Pfahlwurzel (Maßstrich 5 cm). – **(C)** Kräftige, erstarkte Pflanze am Ende des zweiten Jahres (Juni 2001) mit vielblättriger Rosette und starkem Wurzelsystem: Hauptwurzel mit starken Seitenwurzeln. Man beachte die auffallend lange und kräftige oberste Seitenwurzel (zum Teil von den Laubblättern verdeckt), die nahe am Wurzelhals entspringt. Die Sprossachse diese Rosettenpflanze ist stark gestaucht und zeigt deutliches primäres Dickenwachstum, beides notwendige Vorraussetzungen für den Beginn der reproduktiven Phase im darauffolgenden Jahr (Maßstrich 5 cm).

Fig. 7: *Crepis pannonica subsp. pannonica.* Two specimens in late summer or early autumn after flowering and fruiting (scale bar 5 cm). At the basis of the rosette axis, axillary innovation rosettes are initiated. The number of these lateral, innovated rosettes varies depending on the quantity of storage and habitat situation (the left specimen with one, the right specimen with five innovated rosettes). In usually dry natural habitats, the number of innovated rosettes is low, often not more than one.

Abb. 7: *Crepis pannonica subsp. pannonica.* Zwei Individuen im Spätsommer oder Frühherbst nach der Blüh- und Fruchtperiode (Maßstrich 5 cm). An der Basis der Rosettenachse werden Innovationsrosetten angelegt, deren Zahl variiert in Abhängigkeit von der Menge gespeicherter Nährstoffe und den Standortsbedingungen (das linke Individuum besitzt eine, das rechte fünf Innovationsrosetten). Unter den Bedingungen der meist trockenen natürlichen Standorte übersteigt ihre Anzahl nur selten eins.



Figs. 8 and 9: *Crepis pannonica subsp. pannonica.* **Fig. 8:** Basal part of a specimen several years old with thick tap root (herbarium specimen: Hagenbrunn, O. Wittmer, 9.VIII.1934, WU). The root top has splitted, thus several short root top branches (of a multiple caudex) have been formed; see Fig. 9D! – **Fig. 9:** Life form scheme demonstrating life history by important developmental stages: **(A)** rosette stage of the 1st to 2nd year; **(B)** flowering stage in summer of 2nd or 3rd year; **(C)** autumn after 1st flowering; note the basal innovations!; **(D)** several years old (herbarium) specimen with old, strong tap root and multiple caudex (see also Fig. 8!).

Abb. 8 und 9: *Crepis pannonica subsp. pannonica.* **Abb. 8:** Basale Teile eines mehrere Jahre alten Individuums mit dicker Pfahlwurzel (Herbarbeleg: Hagenbrunn, O. Wittmer, 9.VIII.1934, WU). Der Wurzelkopf hat sich gespalten, und ein mehrköpfiges Pleiokorm hat sich gebildet; siehe auch Abb. 9D! – **Abb. 9:** Wuchsformenschemata veranschaulichen die wichtigsten Phasen der Lebensgeschichte: **(A)** Rosettenstadium des ersten bis zweiten Jahres; **(B)** Blühstadium im Sommer des zweiten oder dritten Jahres; **(C)** Phase basaler Innovation im Herbst nach der ersten Blühphase; **(D)** mehrjähriges Individuum mit alter, starker Pfahlwurzel und mehrköpfigem Pleiokorm (see also Fig. 8!).

(6) Habitats. As a consequence of the scattered occurrences in C. Europe, data on habitats of *C. pannonica* are scanty.

For *subsp. pannonica*, the Soviet Flora (ČEREPANOV 1964) records "Steppes, stony places, among shrubs, sparse forests; forest steppes and steppe zones and lower and middle mountain zones, up to 2100 m" The most detailed information is apparently provided by DOSTÁL (1989: 1134) and DOSTÁL & ČERVENKA (1992: 1175): "Sunny grasslands and shrubby slopes. Festucetalia. Soil warm, dry, loose, nutrient-rich, alkaline to neutral, humose, sandy-clayey" and by HOLUB (1999: 114)[10]: „It grows in steppes of sunny slopes, in dry meadows, in pastures, on shrubby slopes, in fallows (field balks) and abandoned vineyards; from lowlands to hilly regions, between 100 and 300 m s. m., on argillous-sabulous to sabulous, humose, nutrient-rich, basic or neutral soils. It occurs in communities of the vegetation class Festuco-Brometea and probably also of Trifolio-Geranietea; more detailed and exact coenological data from the regions of the Czech and the Slovak Republics are lacking." HOLUB finishes his account of *C. pannonica* by stating: „The species deserves special ecobiological research." – The information by HEGI (1929) "Die Pflanze ist vorzugsweise ein Bewohner von höher gelegenen Bergwaldungen" [the plant is predominantly living in forests of higher altitude] seems to be incorrect, also concerning Transsilvania, because NYÁRÁDY (1965: 177) writes: "on hills and in sunny hay-meadows, vineyards"[11]

Subsp. blavii lives in similar habitats although under submediterranean climatic conditions: edges of oak forests, rocky, stony bushy slopes on limestone, but also edges of arable land and road sides, c. 700–1300 msm. JUSTIN (1911) and WRABER (2002) give detailed descriptions of the habitat on the northern edge of the distribution range, in the karst of Slovenian Istria: southern calcareous rocky slopes, c. 800 msm, with grassland and tall herbs between bushes of *Quercus pubescens, Fraxinus ornus, Ostrya carpinifolia, Rosa rubrifolia*, together with *Verbascum lychnitis, Scorzonera hispanica, Laserpitium latifolium, Ferulago campestris ("F. galbanifera"), Opopanax chironium* and the closely related *Crepis chondrilloides* with which our taxon forms hybrids (see section 3).

(7) Distribution[12] **and threat status of *Crepis pannonica subsp. pannonica.*** The centre of distribution, as shown on map 548b in MEUSEL & JÄGER (1992a, b), is in SE. **Russia** and in **Caucasia** (ČEREPANOV 1964), we do not know, however, how abundant it is in these regions. In Central Europe, indeed, this taxon is rare, there are some scattered localities only, mainly in **Romania** and **Hungary** – see below.

The cluster of 8 dots, however, in S. Moravia and Lower Austria on map 548b in MEUSEL & JÄGER (1992c) is misleading. HOLUB in ČEŘOVSKY & al. (1999: 114) discusses the distribution in Central Europe, particularly in Czechia and Slovakia: In the **Czech Republic**, *C. pannonica* (sc. *subsp. pannonica*) has been known from 5 localities in S. Moravia (3 base squares [b. squ. = "Grundfelder"]: 6767, 7066, 7167), in the

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[10] both translated from Czech and Slovak, respectively (M.A.F.)
translated from Romanian (M. A. F.)

[12] see also section 8! (pp. 121 sequ.)

last two of them it has become extinct. Today it exists at one single locality only in a poor population mainly at the margin of the nature reserve "Stepní stráň" at Komořany near Vyškova (b. squ. 6767; see also KAPLAN 2002). It is endangered by the intensive agriculture in close vicinity. – In **Slovakia**, likewise, there is only one locality: the nature reserve „Sovie vinohrady" near Salka in S. Slovakia close to the town Štúrovo at the Danube just opposite of the (Hungarian) town Esztergom (b. squ. 8178). – Distribution in **Austria** is discussed below (see section 9, p. 125).

For **Bulgaria**, STOJANOV & al. (1967: 1176), PEEV (1992: 191) and DELIPAVLOV & al. (1992: 395) report the species from NE. Bulgaria: Dobrudzha, from where it is mentioned also by KITANOV & PENEV (1980: 619: "on dry, grassy places") but without any localities. These reports are based on some very old literature sources. No herbarium specimens have been found in the Bulgarian herbaria (information by D. Dimitrova 2002). So far the only specimen collected from Bulgaria (from the Bulgarian part of Dobrudzha) is now deposited in WU-Halácsy: Tschukul-Kujum [= Jasenkovo village, Varna district]; 1902; leg. Javaschov. Obviously, *C. pannonica* can grow in this part of Bulgaria since it is a typical steppe species. Unfortunately, no detailed floristic study has been conducted in Dobrudzha so far. In the mean time, since several decades, this part of Bulgaria has become a region of intensive agriculture and almost the whole area is converted now into arable land with very small patches of autochthonous vegetation. Thus, we cannot state definitely whether *C. pannonica* presently exists in Bulgaria or not.

In **Romania** (NYÁRÁDY 1965), the species is rather wide-spread – from Transsilvania to Bukowina and Dobrudgea, i. e. in the regions of Hunedoara, Cluj, Braşov, Suceava, Galaţi and Dobrogea. – In **Serbia** (GAJIĆ 1975: 322), our species is recorded only from one locality: Višnjica in the surroundings of Belgrade. – For **Hungary**, SIMON (1992: 542) mentions a few (c. 10) localities in the Hungarian Central Mountain Range (Magyar-középhegység) and in the Pannonian Lowlands (Alföld). It is mentioned in the list of "presently threatened vascular plants" (NÉMETH in RAKONCZAY 1990).

In the Botanical Garden of Vienna University (HBV) presently plants from seeds of one of the last localities in Austria are cultivated for ***ex-situ*-conservation**.

The distribution range of ***subsp. blavii*** is mentioned already in section 3. Obviously, this taxon is threatened as well. In Slovenia it is restricted to one population in a single locality (WRABER & SKOBERNE 1989: 118; WRABER 2002).

(8) Specimina visa: Herbarium specimens from *C. pannonica* have been studied mainly in the Viennese herbaria WU (Vienna University) and W (Natural History Museum Vienna).

Crepis pannonica subsp. pannonica

Austria:

C. pannonica; Austria inferior: in monte Bisamberg prope Viennam, in ruderatis prope hospitium cacuminis, specimum unicum; [7664/3]; 28.VI.1922; T. Vestergren; [WU]. [First record for Austria.]

C. pannonica; [Niederösterreich = Lower Austria, northern edge of Vienna:] Bisamberg: Elisabeth-Höhe; 17.VII.1924; Ludmilla Stenzel; det. Hayek; [WU]. – ibid.: Elisabeth-Höhe, in einer künstlichen Grube; 13.VII.1936; Ludmilla Stenzel; [W].

C. pannonica; Bisamberg, unter der Elisabethhöhe; IX.1937; Josef Uhlmann; [W].

C. pannonica; Bisamberg bei Wien, auf einem steinigen Vorsprung des Berges in großer Zahl; 26.VII.1963; H. Melzer; [W].

C. pannonica; [Niederösterreich, südl. Weinviertel, closely N. of Vienna:] Umgebung von Stammersdorf, Hagenbrunn, Kronawettberg, steinige trockene Hügel, kleiner Steinbruch; Sandstein; [7664/3]; 27.VIII.1933 & 9.VIII. & 26.VIII.1934; Otto Wittmer; [WU, W].

C. pannonica; Umgebung von Stammersdorf, Hagenbrunn, Kronawettberg, steinige Grube; 18.VII.1935; Otto Wittmer; [W].

C. pannonica; Korneuburg, im Schotter der Alten Schanzen auf dem Kronawettberge bei Hagenbrunn; 8.VII.1937; Ernst Korb; [W].

C. pannonica; Korneuburg, auf der Kuppe des Kronawettberges bei Hagenbrunn, auf grasigem Boden; 8.VII.1937; Ernst Korb; [W].

C. pannonica; Niederösterreich: Hagenbrunn; middle of IX.1946; F. Ehrendorfer; [W].

C. pannonica; Südseite des Kranewettberges bei Höbesbrunn nördl. des Bisambergs, Trockenrasen, zahlreich, durch Verbauung gefährdet! 20.VII.1964; H. Melzer; [W].

C. pannonica; Niederösterreich: Hagenbrunn N von Wien, Kronawettberg, 48°20'20" N / 16°24'09" E; 295 msm; [7664/3]; 26.VII.1999; Ernst Vitek 99-393; [W, SOM]; – ibid.: 17.VIII.1999 (fruiting); E. Vitek 99-415; [W].

Czech Republic:

C. rigida; Mähren [Moravia]: Hustopeč (Auspitz), pahorky u Nikolčic; Fr. Šebesta; VI.1878; [W].

C. rigida; Mähren [Moravia]: bei Nikoltschitz [= Nikolčice u Hustopečí]; 2.VII.1886; leg. A. Schierl; ex herbario Frimmel; Hb. Fr. Wettstein; rev. Cufodontis 1969: *C. pannonica*; [WU].

C. rigida; Moravia: Wischau [Vyškov]: in declivibus stepposis pr. Gundrum [=Komořany]; VII.1935; H. Laus; Herb. Mus. sc. nat. Olomuc [Olomouc]; [WU].

C. pannonica; Moravia centralis, distr. Vyškov: in pratis substepposis loco Malé strany dicto prope pagum Komořany situ septentr.-orientali ab oppodo Slavkov, ca. 290 msm; 28.VII.1976; F. Dvořák; Fl. Exs. Reipubl. Soc. Čechoslovacae, sect. bot. syst. & geobot. cat. biol. pl. Univ. J. E. Purkyně Brno (ČSSR) 1674; [WU, W].

Hungary:

C. rigida; Gran [= Esztergom], am Berg Vaskapu auf sonnigen Stellen; VIII.1859, VII.1862; Feichtinger; [WU, WU-Keck, WU-Kerner, WU-Halácsy, W].

C. rigida; Wiesen bei Raab [Györ] in Ungarn; 24.VII.1868; C. Aust; rev. D. Dimitrova, 1999: *C. pannonica*; [W].

C. pannonica; Hungaria centralis: Wolfsthal et Adlerberg [Sas hegy] prope Budam [W. Budapest] (locus class. *C. rigidae* W. & K.); VII.1883; Fl. Exs. Austro-Hung. 3409 I.; W. Steinitz; [WU, WU-Halácsy Europaeum, W]

C. rigida; in pratis mont. Budae [W. Budapest]; Herb. Endlicher; [W].

C. rigida; Adlersberg [Sas hegy] bei Ofen [W. Budapest]; 1860; Richter; [WU-Keck].

C. rigida; Adlersberg bei Ofen gegen Schwabenberg [Sváb-hegy] zu [W. edge of Budapest]; Kerner; rev. Stadlmann: *C. pannonica*; [WU-Kerner].

C. rigida; Adlersberg bei Ofen; A. J. Kerner; [W].

C. rigida; Adlersberg bei Ofen; 25.VII.1880; Steinitz; [W].

C. pannonica; Hungaria centralis: in declivibus apricis graminosis supra Ó-Buda in ditione Budapestina (loc. class. *C. rigidae* W. & K.); 14.–21.VIII.1896; Fl. Exs. Austro-Hung. 3409 II.; Simonkai; rev. Stadlmann: *C. pannonica*; [WU, WU-Halácsy Europaeum, W].

C. rigida; Wolfsthal bei Ofen [W. Budapest]; Balek; [WU-Kerner].

C. rigida; sonnige Kalkberge bei Ofen; J. Bayer; [W].

C. rigida; Buda-Pest: Wolfsthal [NW. edge of Budapest], dolomit.; VII.1876; leg. Richter; C. Baenitz: Herbarium Europaeum nr. 2986; [WU-Halácsy Europaeum].

C. rigida; in valle Wolfsthal prope Budam; 10.VIII.1879; W. Steinitz; [W].

C. rigida; Ofen; 1883; Richter; [W].

C. rigida; sonnige Kalkberge bei Ofen; Ag. [= ?] c. J. Pantosek; J. Bayer; [WU-Halácsy Europaeum].

C. pannonica, C. rigida; Hungaria centralis: in apricis montium ad Vetero Budam [Alt-Ofen] frequens [Budapest]; 20.VII.1874; Dr. Borbás Vince; [WU, WU-Halácsy Europaeum]; – id. in Baenitz Herb. Europ.; [W].

C. rigida; Umgebung von Ofen-Pest [= Budapest]; grasige Bergabhänge bei Alt-Ofen, 200 msm; 7.VII.1872; J. Freyn; [WU-Halácsy Europaeum].

C. pannonica; Budapest: in monte Táborhegy; VII.1923; G. Lengyel: Pl. exs. regni Hung.; [W].

C. rigida; Hungaria, Comit. Alba [Fejér]: e silvis ceduis prope Kutyavár [near Bicske]; VIII.1869; Julius A. Tauscher; rev. Stadlmann: *C. pannonica;* [WU].

C. rigida; Hungaria, Comit. Alba [Fejér]: e silvis montanis umbrosis (solo calcareo) prope Kutyavár [near Bicske]; 13.VII.1871 [?]; leg. Jul. Aug. Tauscher; rev. Stadlmann: *C. pannonica*; [WU-Kerner, WU-Keck].

C. rigida; Comit. Heves: in monte minore St. Aegydii territor. Agriens. [= Eger]; 17.VII.1867; Vrabélyi; rev. Stadlmann: *C. pannonica*; Vraélyi; [WU-Kerner].

C. rigida; Comit. Heves: Agria [= Eger], in monte Kis Eged; 30.VI.1869; Vrabélyi; [WU].

Romania:

C. rigida; Transsilvania centralis: in campestribus elatioribus prope pag. Sz. Gothárd [?]; 20.VII.1869; Janka; [WU-Kerner].

C. rigida = C. pannonica; Transsilvania centralis: in collibus herbidis dumosis prope pagum Sz. Gothárd; 14.VIII.1875; Janka; [W].

C. rigida; Siebenbürgen [Transsilvania:] Tekendorf bei Bistritz; trockener Hügel; 29.VII.1921; G. Cufodontis; [W].

C. rigida; Siebenbürgen [Transsilvania:] Com. Kolos: Bergwiesen bei Boos; tertiärer Tegel; 420 msm; 7.VIII.1871; J. Freyn; [W].

C. pannonica; Bucovina, distr. Suceava: in pratis „Găvăneaţa" ad rivulum Horaieţ prope pagum Găureni; alt. ca. 370 msm; 19.VIII.1935; M. Guşuleac & E. Ţopa; Fl. Roman. exs. a mus. bot. Univ. Clusiensis (in Timişoara) ed.; [W].

Bulgaria:

C. pannonica; Tschukul-Kujum [= Jasenkovo village, Varna district]; 1902; leg. Javaschov; [WU-Halácsy Europaeum].

Ukraine:

„C. rigida?"; Cherson: auf den Steppen bei Beszbarak; A. Rehmann: Exsicc. itineris chersonici Nr. 48; rev. Stadlmann: *C. pannonica*; [WU-Kerner].

C. pannonica; Podolia, prope Jampol, in quercetis; 23.VI.1857; A. Kogovitski; det. F. Hermann, 1938; [W].

C. rigida; Ucraina orientalis, distr. Luhanak, prope pag. Schterinka; 11.VIII.1928; N. Pidoplitshka; herb. Acad. Sci. Ucr.; [W].

Russia:

C. pannonica; Orenburgskaja oblast, Buguruslanskij rajon, na suhom glinisto-izvestnjakovom sklone holma po beregu r. Muravy bliz sel. Amanak [calcareous clay, dry slope of a hill at the river Murava, near the village Amanak]; 20.VII.1909; E. Ispolitvov; det. S. Čerepanov; Gerb. Flor. SSSR (Inst. Bot. im. V L. Komarov Akad. Nauk SSSR); [W].

Turkey:

C. pannonica; A8; Prov. Erzurum: ca. 70 km NW Erzurum; steile Steppenhänge; 2200 msm; 12.VIII.1982; F. Sorger & P. Buchner 82-122-10; det. J. Lamond; [W].

C. pannonica; B9; Prov. Ağrı (Armenia): inter Ağrı (Karaköse) et Horasan; 54 km E Horasan, in jugo inter Zidikan et Veli baba [Aras], ca. 2500 msm; 4.–5.IX.1957; K. H. Rechinger 15062 *(sub C. asadbarensis)*; det. [J. Lamond]; [W].

C. pannonica; B9; Prov. Ağrı: Suluçem (Musun) to Balık G., 2150 msm; sloping meadow in gully; 23.VII.1966; Davis 47254; [E, W].

Armenia:

C. pannonica; Engifisa [??], na suhih ščebnistyh mestah [in dry, schistaceous places]; 12.VII.1954; Ahvertov & [illegible]; det. Nazarova 1983; [W].

C. pannonica; Achtinskij rajon: [inter oppidula] Solak [et] Lusavak; 29.VII.1958; [?], S. Aslanjan [?] & Nazarova; Herb. Inst. Bot. Ac. sc. Armeniae; [WU].

C. pannonica; Daralagez, [inter] Karmrašek [et] Kavušug, pereval'nyj učastok, gornaja step'; 2000 msm; 29.VIII.1968; Ja. Mulkidžanijan & P. Ganabarjan; det. Nazarova; [W].

C. pannonica; Caucasus, distr. Ashtarak, in declivibus montis Arailer, in vicinitate pagi Egvart; 1300–1900 msm; 15.VII.1975; V Vašák, it. cauc. 1975; det. D. Dimitrova; [W].

Georgia:

C. rigida: In montosis, pratis elatioribus Georgiae caucasicae; T. Fr. Hohenacker; [W].

C. rigida: Tiflis [Tbilisi], bei Kadshori; L. Reichenbach; [W].

Crepis pannonica subsp. blavii

Slovenia:

C. Blavii; Istria septentr. [N. Istra]: latere australi mont. Lipnik et Kavčič [N. end of Čičarija]; 800 msm; 17.VII.1910; R. Justin; [WU].

C. Blavii; Istria [Istra]: m. Lipnic [Lipnik] prope Rachitovich [Rakitovec]; [0549/2]; 760–780 msm; VII.1918; Fl. Ital. Exs. 2597; C. Marchesetti [WU].

Croatia:

C. pannonica; Dalmatien: Otošić südöstl. von Vrlika [c. 20 km SE of Knin]; c. 430 msm; 1.VII.1907; E. Janchen & B. Watzl; [WU].

Bosnia & Hercegovina:

C. Blavii bzw. *C. pannonica;* Tušnica-Gebiet [mt. Tušnica SE of Livno]: Hang des Vitrnjak mali zw. der Quelle Smijevac u. Stipanić, gegenüber von Gradac W von Stipanić [c. 5 km W of Duvno = formerly Županjac]; c. 1400 bzw. c. 1200–1300 msm; 17.VII.1907; J. Stadlmann, F. Faltis & E. Wibiral; [WU].

C. pannonica; Dinarische Alpen: bei Crnilug [Crni Lug at the NW. end of Livansko polje, between mt. Šator and mt. Troglav]; c. 750 msm; 7.VII.1907; E. Janchen & B. Watzl; [WU].

C. pannonica; [Dinara planina:] zwischen Livno und Sinj; zwischen Han Prolog und Han Vaganj; 1000 msm; 20.VII.1904; J. Stadlmann & F. Faltis; [WU].

(9) Field studies on *subsp. pannonica* in the Austrian populations: *Crepis pannonica* has not been recorded from Austria[13] up to the beginning of the 20th century, still lacking in HALÁCSY (1896) and in HEGI (1929). NEUMAYER (1924: 219) reports the species from the hill Bisamberg ("close to the top") very closely N. of Vienna where it has been found by Tycho Vestergren in 1922 (first record for Austria) and from the hill Hillersberg SW. of Mistelbach (c. 20 km NNE. of Vienna), found by Neumayer himself. A few years later, the species was again recorded from Bisamberg (at the N. edge of Vienna) as very rare (NEUMAYER 1930: 397) and from the Kronawettberg near Hagenbrunn, 3,5 km NE. of Bisamberg. JANCHEN (1975), in his Flora of Lower Austria, mentions *C. pannonica*, growing in "sunny, dry grassland, forest edges, in the hilly zone of Weinviertel [NE. part of Lower Austria]; very rare" from 5 localities: "Bisamberg, Kranawitberg bei Hagenbrunn, Kreuttal westlich von Unter-Olberndorf [7564/4], Buschberg [7464/2], Hillersberg (oder Hochberg) [7465/1] bei Mistelbach" As to our present knowledge (M. A. F.) in only two of these localities, i. e. Hagenbrunn and Bisamberg [both in 7664/3], very few specimens have been observed in recent years up to present time. Below is the description of the two localities.

The small population on the Kronawettberg (= "Juniper hill"). Garden city "Am Kronawett" on a hill immediately W of the village **Hagenbrunn**, 5 km ESE from the centre of the town Korneuburg, 2 km N of the N. boundary of Vienna (Wien-Stammersdorf), 0,15 km ESE of the drinkwater reservoir, southern margin of street "Bergstraße"; 290 msm.; (7664/3); mesoxerophytic meadow fallow (Wiesenbrache), probab-

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[13] see section 8

ly former pasture (eutrophierter ehemaliger Halbtrockenrasen), between shrubs; 20. Juni 1999: Dessislava Dimitrova, Gerlinde Fischer & Manfred A. Fischer (WU).

We found about six small groups (clones consisting of c. 5–10 flowering stems each) of individuals with flower heads in buds, plants c. 60–120 cm high, well developed; with a few rosette plants (vegetative stage) among them.

Accompanying species[14] of *Crepis pannonica subsp. pannonica*:

Those species that grow also in the adjacent mesoxerophytic meadow (all of them as few, scattered specimens only) are marked by an asterisk (*).

Woody species of the adjacent scrub and scattered in the fallow meadow:

Clematis vitalba, Cornus sanguinea, Crataegus monogyna, Ligustrum vulgare, Prunus spinosa, Rosa canina, Rubus caesius, Ulmus minor

Abundant:

Achillea millefolium agg., *Brachypodium pinnatum**, *Bromus inermis, Calamagrostis epigejos, Centaurea jacea, C. scabiosa, Cerastium holosteoides, Cirsium arvense, Cytisus nigricans, Dactylis glomerata, Daucus carota, Erigeron annuus, Festuca pratensis, Lolium perenne, Lotus corniculatus, Medicago lupulina, Melilotus officinalis, Origanum vulgare, Plantago lanceolata, Poa angustifolia, P compressa, Potentilla anserina, Salvia verticillata, Securigera varia, Solidago gigantea, Trifolium pratense, T repens, Vicia cracca.*

Less abundant:

Agrimonia eupatoria, Artemisia vulgaris, Cichorium intybus, Crepis biennis, Echium vulgare, Euphorbia virgata, Falcaria vulgaris, Galium cf. *album, G. verum, Hieracium* cf. *umbellatum, Inula conyza, Medicago varia (sativa) × M. falcata, Pastinaca sativa, Peucedanum alsaticum, Picris hieracioides, Salvia pratensis, Silene latifolia, S. vulgaris, Trifolium hybridum.*

Species of mesoxerophytic grassland (Bromion erecti):

*Anthyllis vulneraria**, *Aster linosyris**, *Chamaecytisus austriacus**, *Dorycnium germanicum**, *Euphorbia cyparissias**, *Knautia arvensis, Linum flavum**, *Melampyrum arvense**, *Peucedanum cervaria**, *Rapistrum perenne(*), Stachys recta**.

The same locality revisited on 8. July 2001 (Gerlinde and Manfred A. Fischer): c. 10 individuals in flower, partly preanthetic; some flower-heads damaged by feeding insects. Two more specimens in flower c. 50 m further to the west, immediately at the foot of the small hill formed by the water reservoir.

Most important companions (incomplete list) (species not mentioned in the above list of 1999 are underlined):

Cytisus nigricans, Chamaecytisus austriacus, Peucedanum cervaria, Galium verum, Centaurea scabiosa, C. stoebe, C. jacea, Linum flavum, Erigeron annuus, Agrimonia eupatoria, Melampyrum arvense, Securigera varia, Origanum vulgare, Brachypodium

[14] taxonomy and nomenclature according to FISCHER (1994)

pinnatum, Salvia pratensis, S. verticillata, Daucus carota, Bupleurum falcatum, Plantago lanceolata, Achillea cf. *collina, Clematis vitalba, Calamagrostis epigejos, Inula ensifolia, Cirsium arvense, Astragalus onobrychis; Asperula cynanchica.* – Woody species (adjacent): *Ulmus minor, Crataegus monogyna, Prunus spinosa, Cornus sanguinea, Viburnum lantana, Rhamnus cathartica.*

Seven scattered (within c. 0.2 km) **specimens** were observed 10. July 2001 by G. and M. A. Fischer on the W. slope of **mt. Bisamberg** (N. of Langenzersdorf, closely N. of Vienna), [7664/3], 300 msm, edge of shrubbery and a vineyard, on roadside, and on marl scree. Accompanying species are: shrubs: *Crataegus monogyna, Cornus mas, C. sanguinea, Ligustrum vulgare, Rosa canina, R. corymbifera* agg., *Berberis vulgaris, Prunus fruticosa, Pyrus pyraster, Euonymus verrucosa, Sorbus aria, Rhamnus cathartica, Viburnum lantana;* – herbaceous species (alphabetically): *Achillea collina, Anthericum ramosum, Asperula cynanchica, Aster linosyris, Brachypodium pinnatum, Bupleurum falcatum, Campanula glomerata, C.* cf. *moravica, Carex humilis, Carlina vulgaris* agg., *Centaurea jacea, C. scabiosa, C. triumfettii, Coronilla coronata, Dorycnium germanicum, Erysimum diffusum* agg., *Falcaria vulgaris, Genista tinctoria, Geranium sanguineum, Inula ensifolia, I. salicina, Jurinea mollis, Leontodon incanus, Linum flavum, Medicago falcata, Melica ciliata, Mercurialis ovata, Peucedanum cervaria, Phyteuma orbiculare, Salvia verticillata, Sanguisorba minor, Seseli hippomarathrum, S. libanotis, Stachys recta, Verbascum chaixii subsp. austriacum, Tanacetum corymbosum subsp. corymbosum, Thesium linophyllon.*

Acknowledgements

We are thankful to prof. Tone Wraber (University of Ljubljana) for helpful information on the (only) population in Slovenia, to Ingrid Turisová (University of Banská Bystrica) for information on the only extant Slovak locality and to the Botanical Garden of the University of Vienna (= HBV) for cultivation of *Crepis pannonica subsp. pannonica*.

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