

TAXONOMY OF THE GENUS *CARDAMINE* L. (*CRUCIFERAE*) IN THE CARPATHIANS AND PANNONIA. II. *CARDAMINE AMARA* L.

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Abstract: The results of a taxonomic study of *Cardamine amara* L. from the Carpathians and Pannonia are presented. Two subspecies, *Cardamine amara* L. subsp. *amara* and *C. amara* subsp. *opicii* (J. PRESL & C. PRESL) ČELAK., are shown to occur in the area studied. Full synonymy, descriptions, chromosome numbers, taxonomic history, distribution data, and ecological notes are provided.

INTRODUCTION

This paper is the second in a series presenting a taxonomic revision of the genus *Cardamine* in the Carpathians and Pannonia. It deals with two subspecies of *Cardamine amara* L.: *C. amara* L. subsp. *amara* and *C. amara* subsp. *opicii* (J. PRESL & C. PRESL) ČELAK. For an explanation of the materials used and arrangement of data see MARHOLD (1994).

Cardamine amara L.

The results of a multivariate morphometric study of *Cardamine amara* in the Carpathian and Sudeten Mts. (MARHOLD 1991, 1992) showed that two subspecies, *C. amara* subsp. *amara* and *C. amara* subsp. *opicii*, could be recognized in this area. Only diploid populations of this species were found to occur here. The presence of tetraploids, reported by HINDÁKOVÁ (1974) from the Velká Fatra Mts., has not been confirmed.

There are only diploid chromosome counts for this species from the area of Pannonia. However, recent studies (MARHOLD 1993, MARHOLD, unpubl.) of the tetraploid populations of *Cardamine amara* s.l. from the Austrian Alps indicate that some specimens of *C. amara* subsp. *amara* cited here for the Austrian part of Pannonia may belong to tetraploids. These populations may represent a new, as yet undescribed subspecies (see below), but they require further study. Morphological description of *C. amara* subsp. *amara* in this paper is based entirely on the diploid material.

Cardamine amara L. Sp. Pl.: 656, 1753.

Ind. loc.: "In Europae septentrionalis nemoribus". Lectotypus: (LINN, no. 835.17) (KHATRI 1989: 92).

Taxonomic history

RETZIUS (1779) recognized within Scandinavian populations of *Cardamine amara* two taxa based entirely on the nature of the indumentum, namely *Cardamine amara* var. *glabra* RETZ. and *C. amara* var. *hirsuta* RETZ. A similar classification can also be found in the works of other authors. The indumentum of *C. amara* is to a large extent variable and, as a consequence, any classification based solely on this character is unlikely to be natural (cf. LÖVKVIST 1957).

Morphological differences between plants from lower altitudes and those from the Sudeten Mts. were recognized, probably independently, by the Presl brothers (PRESL & PRESL 1819) and by WIMMER & GRABOWSKI (1829), and later also by KOCH (1835).

The description of *Cardamine opicii* in Flora Čechica (PRESL & PRESL 1819) is based mainly on the morphology of the cauline leaves. The character “fol[iis] ... stipulatis” in the description refers to very small leaflets near the leaf base. The description, however, does not provide reliable differentiating characters between *C. amara* and *C. opicii*, which has probably caused the misinterpretation of this taxon by later authors. PRESL & PRESL (1819) also demonstrated differences in the indumentum between plants of their *C. opicii*, dividing it into “ α Caule petiolisque hirsutis” and “ β iisdem [caule petiolisque] glabriusculis”. While the stem of *C. amara* subsp. *amara* is usually sparsely hairy at the base, that of *C. amara* subsp. *opicii* is either glabrous or densely hairy. Glabrous and densely hairy plants occur, however, within almost every population of this subspecies, and thus the nature of indumentum is here considered of no taxonomic importance.

WIMMER & GRABOWSKI (1829), when describing *C. amara* var. *umbrosa* WIMM. & GRAB. [an illegitimate name, due to the earlier validly published *C. amara* var. *umbrosa* (LEJ.) DC.], did not mention the occurrence of glabrous plants, although they did correctly stress the importance of a simple stem when distinguishing this taxon from *C. amara* var. *amara*. KOCH (1835) mentioned the importance of the difference in number of leaflets between *C. amara* var. *amara* and his *C. amara* var. *subalpina*. A detailed study of the morphological characters of *C. amara* in the Sudeten Mts. was published by UECHTRITZ (1872). He presented a taxon, corresponding with the PRESLS' *Cardamine opicii*, at the level of the geographic race as *C. amara* B. *multijuga* R. UECHTR. According to Article 35.2 of the Code (GREUTER et al. 1994) it is inoperative in questions of priority.

Populations of *Cardamine amara* s.l. in the Eastern Alps were studied by HABELER (1963). Her results were influenced by a misunderstanding of the name *C. opicii* which she tried to apply to the populations from the Alps. She concluded that *C. amara* is a highly variable species without any possibility of infraspecific classification. This influenced the authors of Flora der Schweiz (HESS et al. 1970), and the latest edition of Hegi's Illustrierte Flora von Mitteleuropa (SCHULZE-MOTEL 1986). However, studies of the present author indicate that while diploid populations from the Alps belong to *Cardamine amara* subsp. *amara*, tetraploids occurring in this area may represent a different, as yet undescribed taxon (MARHOLD 1993).

Brief description

Perennial herb, 10-60 cm tall. Rhizome long, prostrate, 1-13 mm wide. Stem erect, sometimes flexuous, simple or branched above, slightly sulcate, glabrous or sparsely to densely hairy. Leaves not in a rosette; cauline leaves 2-53, with 2-11 pairs of lateral leaflets; leaflets sessile or shortly petiolulate, oblong to suborbiculate, almost entire, or lobate, crenate, or sharply crenate, sometimes ciliate, glabrous or with appressed hairs on upper surface.

Inflorescence racemose, simple or compound, with 2-40 flowers in the main inflorescence; sepals ovate, 2.8-5.2 mm long, glabrous, margin membranous; petals white (rarely, especially in buds, reddish-violet), obovate to oblanceolate, 5.7-10.2 mm long $\times$ 2.6-6.2 mm wide, with short claw, apex truncate to emarginate; stamens 6, indistinctly tetradynamous, filaments of longer stamens 3.3-7.3 mm, anthers reddish-violet before anthesis; stigma not conspicuous. Pedicels erect-patent or patent, siliquae divergent at the same angle as pedicels or erect, 20-40 mm long $\times$ 1.0-1.5 (-2.0) mm wide.

Key to the subspecies of *Cardamine amara*

- | | | |
|----|--|----------------------|
| 1 | Stem branched, with lateral inflorescences | subsp. <i>amara</i> |
| 1* | Stem simple, without lateral inflorescences | 2 |
| 2 | Stem densely hairy | subsp. <i>opicii</i> |
| 2* | Stem glabrous or sparsely hairy | 3 |
| 3 | Stem leaves (2-) 3-14 (-24), not congested beneath inflorescence;
lower stem leaves with 2-6 (-7) pairs of lateral leaflets | subsp. <i>amara</i> |
| 3* | Stem leaves (10-) 13-46 (-53), congested beneath inflorescence;
lower stem leaves with (4-) 5-9 (-11) pairs of lateral leaflets | subsp. <i>opicii</i> |

Cardamine amara L. subsp. *amara*

- = *Cardamine amara* var. *glabra* RETZ. Fl. Scand. Prodr.: 125, 1779.
Ind.loc.: sine. Typus ignotus.
- = *Cardamine amara* var. *hirsuta* RETZ. Fl. Scand. Prodr.: 125, 1779.
Ind. loc.: sine. Typus ignotus.
- = *Cardamine umbrosa* LEJ. Fl. Spa 2: 63, 1813.
Ind.loc.: "Près de Malmédy". Typus ignotus.
= *Cardamine amara* var. *umbrosa* (LEJ.) DC. Syst. Nat. 2: 255, 1821.
= *Cardamine libertiana* LEJ. Rev. Fl. Spa: 135, 1824 (nom. illegit. superfl. - Art. 52).
- = *Cardamine bicolor* OPIZ ex J. PRESL & C. PRESL Fl. Čech.: 136, 1819.
Ind. loc.: "Glacký Schneeberg (OPIZ)". Lectotypus (**hoc loco designatus**): Auf dem Glatzer Schneeberg, VII.1815, OPIZ (PRC).
- = *Cardamine crassifolia* OPIZ Naturalientausch 11: 412, 1826.
Ind. loc.: "Boëmia in Sudetis ad rivulos im Riesengrund (OPIZ Auth. herb. no. 450, 8.1.1826)." Holotypus: Boëmia in Sudetis ad rivulos im Riesengrund, 1812, OPIZ (PR, no. 321962).
= *Cardamine amara* var. *crassifolia* (OPIZ) BECK Fl. Nieder-Österreich: 453, 1892.
- = *Cardamine amara* var. *hirta* WIMM. & GRAB. Fl. Siles. 2/1: 265, 1829.
Ind.loc.: "Bei Pollentschine am Bächen und im Gebirge hin und wieder". Typus ignotus.
- = *Cardamine amara* var. *hirsuta* KLETT & RICHT. Fl. Leipzig: 558, 1830 non RETZ. Fl. Scand. Prodr.: 125, 1779 (nom. illegit).
Ind. loc.: "[Leipzig], im Leutzscher Walde". Typus ignotus.
- = *Cardamine amara* var. *pubescens* LEJ. and COURTOIS Comp. Fl. Belg. 2: 283, 1831.
Ind. loc.: "Circa Malmundarium". Typus ignotus.

- = *Cardamine amara* var. *glabra* NEILR. Fl. Nied.-Oesterr.: 718, 1859 non RETZ. Fl. Scand. Prodr.: 125, 1779 (nom. illegit.).
Ind. loc.: "Im untern Traisenthale bei St. Pölten; in der Lachen der Wien bei Hütteldorf".
Lectotypus (**hoc loco designatus**): In Sümpfen der Hütteldorfer Au, 10.V.1840, NEILREICH (W - herb. NEILR., no. 10.109).
- = *Cardamine amara* var. *subtrisecta* SCHUR Enum. Pl. Transsilv.: 49, 1866.
Ind. loc.: "Auf dem Butsets bei Kronstadt". Typus ignotus.
- = *Cardamine amara* var. *montana* SCHUR Enum. Pl. Transsilv.: 49, 1866.
Ind. loc.: "Im Michelsberger Thal am Silberbach". Typus ignotus.
- = *Cardamine amara* var. *investita* SCHUR Enum. Pl. Transsilv.: 49, 1866.
Ind. loc.: "Auf Waldwiesen oberhalb Resinár, am Scheweschbach im Jungen Wald bei Hermannstadt". Lectotypus (**hoc loco designatus**): Scheweschbach, 24.V.1853, SCHUR (LW).
- = *Cardamine amara* var. *sarmentosa* SCHUR Enum. Pl. Transsilv.: 50, 1866.
Ind. loc.: "An quellige Orten des Árpás". Lectotypus (**hoc loco designatus**): In pascuis humidis alpium Transsilv. in monte Árpas, s. a. [collected before 1861], SCHUR (LW).
- = *Cardamine amara* var. *minor* SCHUR Enum. Pl. Transsilv.: 50, 1866.
Ind. loc.: "Am Bullafall der Kerzesorer Alpen". Typus ignotus.
- = *Cardamine amara* var. *microphylla* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 78, 1877.
Ind. loc.: "Am Tümpel im Paradieswald; oberhalb der Teufelsschlucht und bei Adamsthal nächst Brünn; bei Hermannstadt; bei N. Podhrad (IV.1872 HOLUBY)". Typus ignotus.
- = *Cardamine amara* var. *homophylla* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 78, 1877.
Ind. loc.: "Bei Podhrad in Ungarn (HOLUBY)". Typus ignotus.
- = *Cardamine amara* var. *maxima* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 78, 1877
Ind. loc.: "Am Siberbach am Fusse des Götzenberges; im Zoodthale in Siebenbürgen (VI.1868 BARTH)". Typus ignotus.
- = *Cardamine amara* var. *umbraticola* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 78, 1877.
Ind. loc.: "Auf der Preschbe bei Zood in Siebenbürgen (VI.1868 BARTH)". Typus ignotus.
- = *Cardamine amara* var. *breviflora* ZAPAE. Rozpr. Wydz. Mat.-Przyr. Akad. Umiejetn. Dział. B., Nauki. Biol., Ser. 3, 12: 6-7, 1912.
Ind. loc.: "Żary koło Krzeszowic (JABLONSKI); Piasy (Berdau); Białohorszcza pod Lwowem (BŁOCKI); Złoty Potok i cianka (ŚLEŃDZINSKI); Mizocz na Wołyniu (REHMAN); Mikołajki w Prusach Książecych". Lectotypus (**hoc loco designatus**): Koło Piasków, V-1859, BERDAU (KRAM, no. 112255).
- = *Cardamine amara* var. *sub-opizii* NYÁR. Bul. Grad. Bot. Univ. Cluj 14: 97, 1934.
Ind. loc.: "Distr. Hunedoara: in montibus Borescu prope Stâna galbina (E.I. NYÁRÁDY 12-VII-1924); In montibus Retezat: in valle Râu mare (E.I. NYÁRÁDY 14.VII.1924)".
Lectotypus (**hoc loco designatus**): In montibus Retezat: in valle Râu mare, 14.VII.1924, E.I. NYÁRÁDY (CL).
- = *Cardamine amara* var. *foliolata* PLOCEK Sborn. Severočesk. Mus., Přír. Vědy 15: 15, 1986.
Ind. loc.: "Jizerské hory, prope vicum Lučany, in loco "Krähwinkel" infra montem Bramberk, secus rivum juxta *Alnetum* (1974 PLOCEK)". Holotypus: Jizerské hory, prope

vicum Lučany, in loco "Krähwinkel" infra montem Bramberk, secus rivum juxta *Alnetum*, 1974, PLOCEK (LIM).

?= *Cardamine amara* var. *hirta* NEILR. Fl. Nied.-Oesterr.: 719, 1859 non WIMM. & GRAB. Fl. Siles. 2/1: 265, 1829 (nom. illegit.).

Ind.loc.: "An der Schwarza zwischen Riechenau und Hirschwang (K. Ettingshausen)".
Holotypus: An der Schwarza zwischen Hirschwang und Riechenau, V.1848, Ettingshausen (W - herb. NEILR., no. 10.118) (2n = 32?).

- *Cardamine amara* "A" *typica* R. UECHTR. Verh. Bot. Vereins Prov. Brandenburg 14: 65-66, 1872 (nom. invalid.).

- *Cardamine amara* subsp. *genuina* ČELAK. Prodr. Fl. Böhmen: 449, 1875 (nom. invalid.).

- *Cardamine amara* var. *typica* BECK Fl. Nieder-Österr.: 453, 1892 (nom. invalid.).

- *Cardamine amara* var. *opicii* auct. (p. p.) non (J. PRESL & C. PRESL) RCHB.: RCHB. Fl. Germ. Excurs.: 675, 1832, [ut "*opizii*"].

Exsiccata visa

Fl. Exs. Distr. Bacoviensis no. 523 (KRAM, PR) - Fl. Olten Exs. no. 234 (BM, CGE, CL, KRA, KRAM, LTR, PRC, OXF, WU) - Fl. Polon. Exs. no. 323 (BM, CL, KRA, KRAM, PR, PRC, RNG, W) - Fl. Rom. Exs. no. 1076a (BP, CL, KRA, PR, SIB, W), no. 1076b (CL, KRA, SIB, W), no. 1076c (BP, CL, KRA, SIB, W), no. 2763 (ut *C. amara* var. *umbrosa* WIMM. & GRAB.) (CL, K, KRA, SIB, W) - M. RACIBORSKI Pl. Polon. Exs. no. 634 (LW, KRA, KRAM), no. 855 (CL, LTR, LW, KRA, KRAM) - PETRAK Fl. Bohem Morav. Exs. no. 1430 (BM, PR);

Extra fines: DUFFOUR Soc. Française Exs. no. 5397 (BM) - Fl. Exs. Reipubl. Bohem. Slov. no. 1030 (CL, K, NI, OL, KRA, PRC, W, WU) - Fl. Germ. Exs. Schlesw.-Holst. no. 178 (BM, CL, KRA, PR, W) - Fl. Jutl. Exs. no. 295 (BM, CGE, KRA, PR, W), no. 313 (ut *C. impatiens* L.) (BM, CGE, CL, KRA, PR, W), no. 423 (BM, CGE, CL, KRA, PR, W) - Fl. Polon. Exs. no. 121 (BM, CL, KRA, KRAM, W) - Fl. Siles. Exs. no. 780 (CGE, CL, KRA, KRAM, PR, W) - Herb. Fl. Ingr. no. 46 (BM, CGE, K, OXF) - Herb. Fl. Loc. Fr. no. 22 (K, OXF, PRC, W) - Herb. Fl. Ross. no. 1156 (K, PRC, W, WU) - MAGNIER Fl. Select. Exs. no. 12 (W, WU) - PETRAK Fl. Bohem. Morav. Exs. no. 528 (BM, BRNU) - Pl. Britan. Exs. ser. I, no. 22 (CGE) - Pl. Českoslov. Exs. no. 114 (BM, KRAM, W) - Pl. Exs. Torunensia no. 159 (KRA, PRC) - Pl. Finl. Exs. no. 233 (K, PR, W, WU) - Pl. Ital. Exs. no. 137 (KRAM) - Pl. Vasc. Dan. Exs. no. 546 (KRA, PR, RNG, W) - M. RACIBORSKI Pl. Polon. Exs. no. 635 (KRA, KRAM, LWS) - REHMANN & WOŁOSZCZAK Fl. Polon. Exs. no. 7 (BM, CL, KRA, KRAM, LWS, OXF, W, WU), no. 7b (BM, CL, K, KRA, KRAM, LWS, W, WU) - SAMUELSSON Pl. Suec. Exs. no. 890 (BM, K, W) - SCHULTZ Herb. Norm. no. 1517 (ut *C. aequiloba* C. HARTMAN) (OXF, W) - Soc. Echang. Pl. Vasc. Eur. Occ. & Bas. Medit. no. 10234 (RNG) - TAUSCH Herb. Fl. Bohem. no. 122 (PRC), no. 122b [ut *C. amara* "b" *hirsuta* (C. *opizii* J. & C. PRESL) (sic !)] (PRC).

Icones

CLAPHAM, TUTIN & WARBURG Fl. Brit. Isl. Illustr. 1:53, fig. 206, 1957. - DOSTÁL Květ. ČSR: 291, tab. 95, fig. 3, 1948. - DOSTÁL Klíč Květ. ČSR: 201, fig. 349-I, 1954. - DOSTÁL Nová Květ. ČSSR: 359, tab. 89, fig. 1, 1989. - HEJNÝ & SLAVÍK Květ. ČR 3: 101, tab. 22, fig. 1, 1992. - JÁVORKA & CSAPODY Icon. Fl. Part. Austro-Orient. Eur. Centr.: 200, fig. 1521,

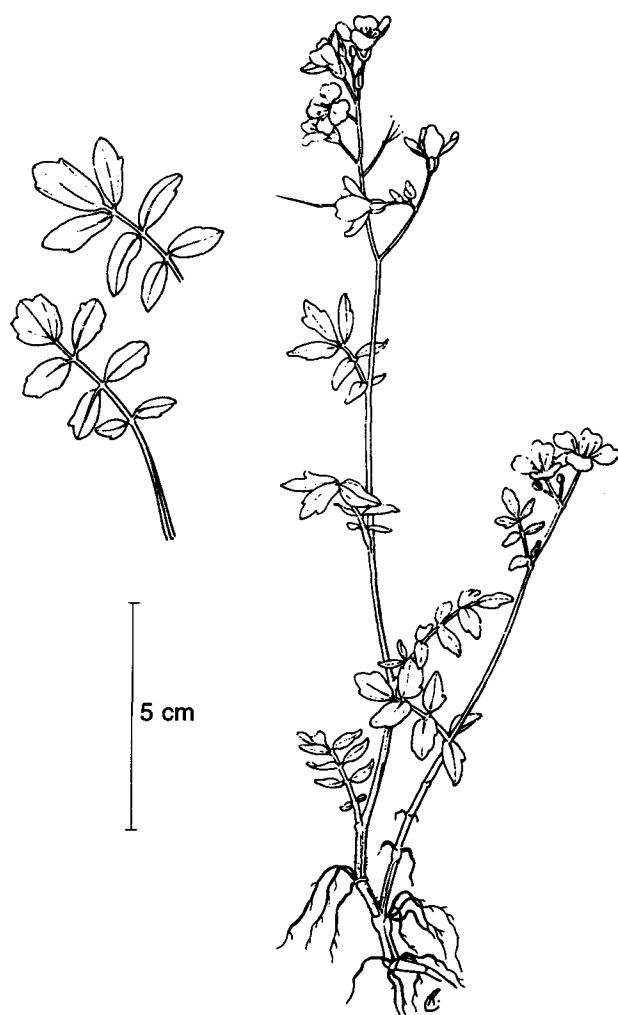


Fig. 1. *Cardamine amara* L. subsp. *amara*.

1975. - MAŁAŁSKI Fl. Polon. Terrarumq. Adiacent. Icon. 9/4: fig. 1085, 1966. - NYÁRÁDY in SÁVULESCU Fl. Reip. Pop. Roman. 3: 257, tab. 44, fig. 1, 1955. - OEDER Fl. Dan. 1: fig. 148, 1764. - POLÍVKA, DOMIN & PODPĚRA Klíč Květ. Českoslov.: 49, fig. 68, 1928. - REICHENBACH Icon. Fl. Germ. Helv. 2: fig. 4305, 1837-1838. - ROSS-CRAIG Drawings Brit. Pl., 1: fig. 19, 1979. - ROTHMALER Exkursionsfl. ed. 6, 3: 159, 1987. - SCHLECHTENDAL, LAGENTHAL & SCHENK Fl. Deutschl., ed. 5, 14: fig. 1367, 1883.

Icon nostra: Fig. 1.

Brief description

Rhizome thin. Stem stiff, erect, sometimes flexuose, usually only sparsely hairy at base, simple or branched above, 1-6 mm wide at base. Cauline leaves (2-) 3-14 (-24), thin, not congested beneath inflorescence, with 2-6 (-7) pairs of lateral leaflets. Inflorescence simple or compound, with 2-40 flowers in the main inflorescence. Sepals (2.8-) 2.9-4.2 (-4.5) mm, petals (6.1-) 6.8-9.7 (-10.2) mm long and (2.9-) 3.5-5.7 (-6.2) mm wide, filaments of longer stamens (3.8-) 4.7-6.9 (-7.3) mm, pedicels glabrous.

Flowering: April - May.

$2n = 16$

General distribution

Cardamine amara subsp. *amara* occurs throughout most of Europe, except in the North. In the South it extends as far as Spain, central Italy, and southern Romania, while in the east as far as western Siberia.

Distribution in the Carpathians and Pannonia

This subspecies is widespread in the Carpathians, except high altitudes of the West Carpathians, where it occurs only exceptionally. It is more common in higher altitudes of the South Carpathians. In Pannonia it is far rarer, and for some parts of this area it is probably absent.

Poland (Fig. 3)

Karpaty Zachodnie. 513.33. Pogórze Wielickie, 513.34. Pogórze Wiśnickie, 513.45. Beskid Śląski, 513.46. Kotlina Żywiecka, 513.48. Beskid Makowski, 513.49. Beskid Wyspowy, 513.51. Beskid Żywiecki, 513.52. Gorce, 513.53. Kotlina Sądecka, 513.54. Beskid Sądecki, 513.61. Pogórze Rożnowskie, 513.62. Pogórze Ciężkowickie, 513.64. Pogórze Dynowskie, 513.65. Pogórze Przemyskie, 513.66. Obniżenie Gorlickie, 513.69. Pogórze Bukowskie, 513.71. Beskid Niski, 514.11. Kotlina Orawsko-Nowotarska, 514.12. Pieniny, 514.13. Pogórze Spisko-Gubałowskie, 514.14. Rów Podtatrzanski, 514.52. Tatry Zachodnie, 514.53. Tatry Wschodnie. - **Beskidy Wschodnie.** 522.12. Bieszczady Zachodnie.

Moravia (Fig. 3)

Pannonicum. 16. Znojensko-brněnská pahorkatina, 18a. Dyjsko-svratecký úval, 18b. Dolnomoravský úval, 21a. Hanácká pahorkatina, 21b. Hornomoravský úval. - **Mesophyticum carpaticum.** 76a. Moravská brána vlastní, 77a. Ždánický les, 77b. Litenčické vrchy, 77c. Chříby, 78. Bílé Karpaty lesní, 79. Zlínské vrchy, 80a. Vsetínská kotlina, 81. Hostýnské vrchy, 82. Javorníky, 83. Ostravská pánev, 84a. Beskydské podhůří. - **Oreophyticum carpaticum.** 99a. Radhošské Beskydy, 99b. Slezské Beskydy.

Slovakia (Fig. 3)

Pannonicum. 2. Ipeľsko-rimavská brázda, 3. Slovenský kras, 4. Záhorská nížina, 6. Podunajská nížina, 7. Košická kotlina, 8. Východoslovenská nížina. - **Carpaticum occidentale.** 9. Biele Karpaty (južná časť), 10. Malé Karpaty, 11. Považský Inovec, 12. Trábeč, 13. Strážovské a Súľovské vrchy, 14a. Pohronský Inovec, 14b. Vtáčnik, 14c. Kremnické vrchy, 14d. Poľana, 14e. Štiavnické vrchy, 14f. Javorie, 15. Slovenské rudohorie, 16. Muránska planina, 17. Slovenský raj, 19. Slanské vrchy, 20. Vihorlatské vrchy, 21a. Malá Fatra (Lúčanská Fatra), 21b. Malá Fatra (Krivánska Fatra), 21c. Veľká Fatra, 21d. Chočské vrchy, 22. Nízke Tatry, 23a. Západné Tatry, 23b. Vysoké Tatry, 23c. Belianske Tatry, 24. Pieniny, 25. Turčianska kotlina, 26a. Liptovská kotlina, 26b. Spišské kotliny, 27a. Biele Karpaty (severná časť), 27b. Javorníky, 28. Západné Beskydy, 29. Spišské vrchy, 30a. Šarišská vrchovina, 30b. Čergov, 30c. Nízke Beskydy. - **Carpaticum occidentale.** 31. Bukovské vrchy.

Austria (Fig. 4)

There are several localities of *Cardamine amara* in the Austrian part of Pannonia documented by herbarium specimens. However, most probably a great deal of these plants are tetraploids.

Hungary (Fig. 4)

I. Matricum. 3. Borsodense, 4. Agriense. - **II. Bakonyicum.** 2. Pilisense, 3. Veszprimense. - **III. Praenoricum.** 1. Laitaicum, 2. Castriferreicum, 3. Petovicum. - **IV. Eupannonicum.** 1. Arrabonicum. - **V. Praeillyricum.** 1. Saladiense, 2. Somogyicum.

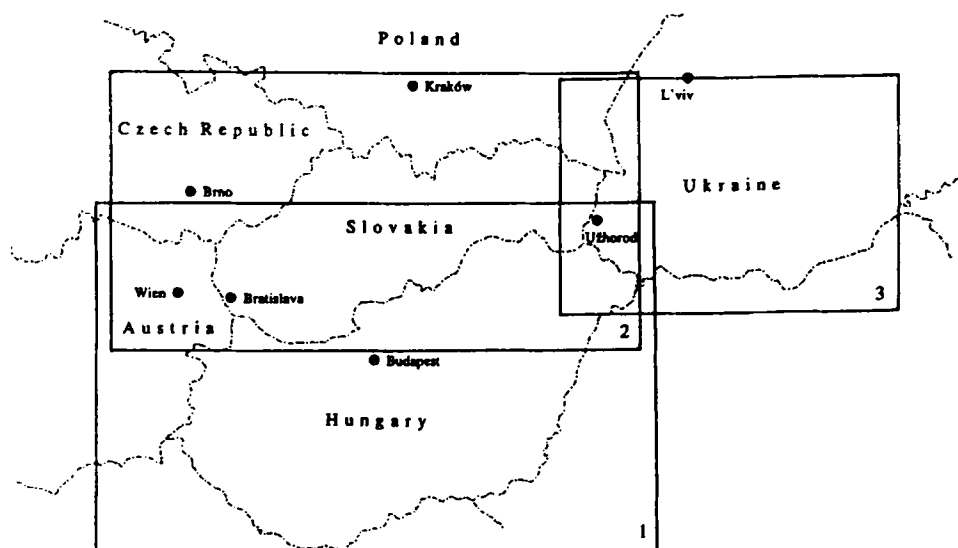


Fig. 2. Scheme of the distribution maps: 1 - Austria and Hungary; 2 - Moravia (Czech Republic), Poland, and Slovakia; 3 - Ukraine.

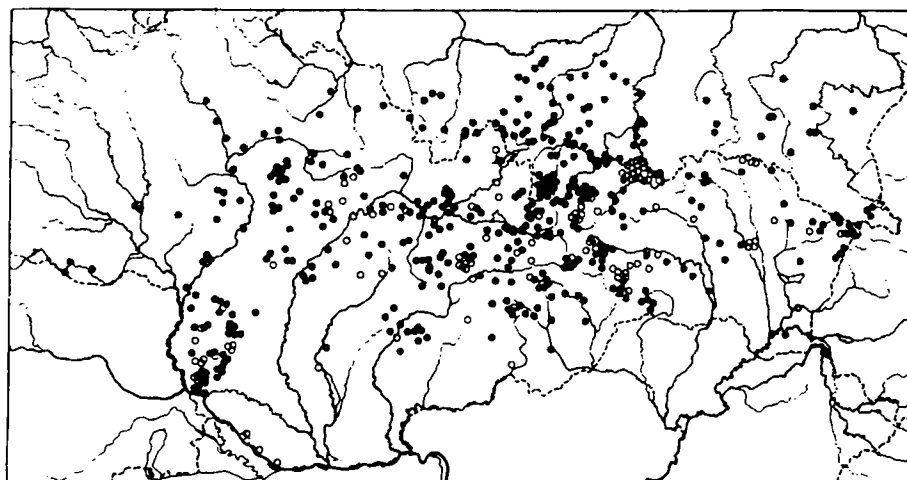


Fig. 3. Map of the distribution of *Cardamine amara* L. subsp. *amara* in the Carpathian and Pannonian part of Moravia and Poland and in Slovakia (● - herbarium specimens, ○ - data from the literature).

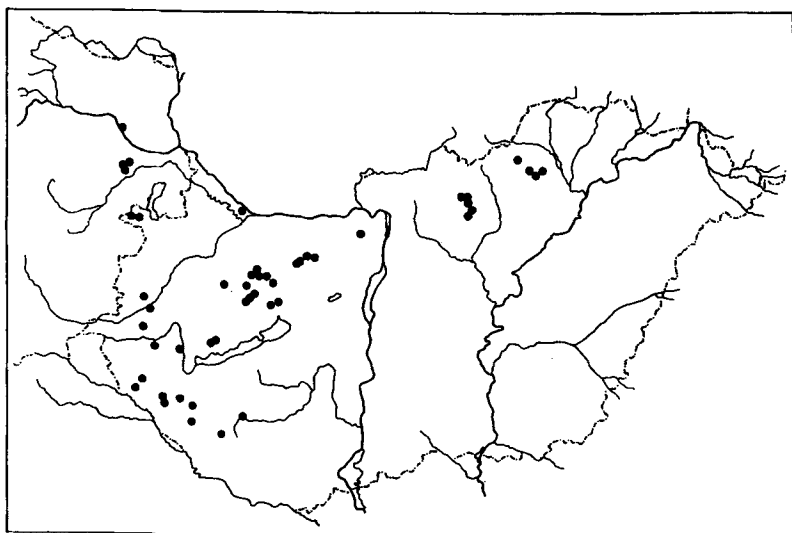


Fig. 4. Map of the distribution of *Cardamine amara* L. subsp. *amara* in the Pannonian part of Austria and in Hungary.

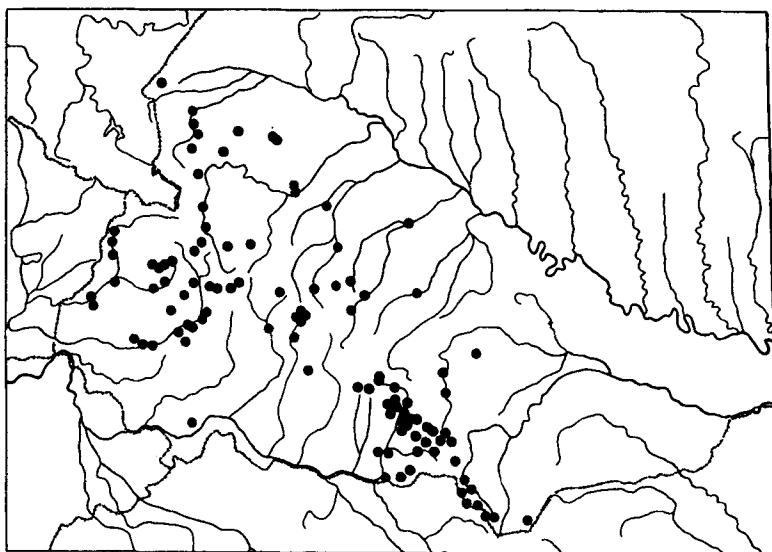


Fig. 5. Map of the distribution of *Cardamine amara* L. subsp. *amara* in the Carpathian and Pannonian part of Ukraine.

Ukraine (Fig. 5)

Carpathicum orientale. I. Prykarpattja, II. Schidni Beskydy j Nyz'ki Polonyny, III. Gorgany, IV. Svydovec', V. Čornohora, VI. Čyvčyno-Grynjav's'ki hory, VII. Marmaros'ki Al'py, VIII. Vulkanični Karpaty. - **Pannonicum.** X. Zakarpats'ka rivnyna.

Romania

Districts Maramureş, Bistriţa-Năsăud, Suceava, Mureş, Harghita, Bacău, Covasna, Dîmboviţa, Braşov, Argeş [?], Sibiu, Vîlcea [?], Hunedoara, Alba, Caraş-Severin, Bihor, Cluj, Sălaj, Dolj.

Maximum altitude: Distr. Hunedoara, Mţii Godeanu, Vf. Gugu, 2000 m, 1935, SCHEFFER (SLO).

Ecology, phytosociology

Cardamine amara subsp. *amara* occurs in forest spring communities, alder forests, ridges, wet meadows and other places with standing or slow flowing water, and prefers acid or almost neutral soils of the gleyed type. It belongs to the group of characteristic taxa of the suballiance *Alnenion glutinoso-incanae* OBERD. 1953 (which includes, for example, the association *Cardamino-Alnetum incanae* ŠOMŠÁK 1961) and alliance *Cardaminion amarae* MAAS 1959 (with the associations *Cardaminetum amarae* (BR.- BL. in BR.-BL. et al. 1926) MAAS 1959 and *Cardamino-Chrysosplenietum alternifolii* MAAS 1959). It also occurs in communities of the alliances *Alnion glutinosae* MALCUTT 1929, *Salicion cinereae* TH. MÜLLER & GÖRS ex PASS. 1961, *Salicion eleagni* MOOR 1958, *Salicion triandrae* TH. MÜLLER & GÖRS 1958, *Salicion albae* (OBERD. 1933) TH. MÜLLER & GÖRS 1958, *Caricion rostratae* BAL.-TUL. 1963, and *Caricion davallianae* KLIKA 1934.

***Cardamine amara* subsp. *opicii* (J. PRESL & C. PRESL) ČELAK.**

Cardamine amara subsp. *opicii* (J. PRESL & C. PRESL) ČELAK. Prodr. Fl. Böhmen: 449, 1875. [ut "*opizii*"]

≡ *Cardamine opicii* J. PRESL & C. PRESL Fl. Čech.: 136, 1819.

Ind. loc.: "cum priori [Glacký Schneeberg] et in Brunnberg Sudet (OPIZ)". Lectotypus (MARHOLD & HROUDA 1993: 102): Brunnberg, s.a., OPIZ (PR).

≡ *Cardamine amara* L. var. *opicii* (J. PRESL & C. PRESL) RCHB. Fl. Germ. Excurs.: 675, 1832 [ut "*opizii*"].

= *Cardamine amara* var. *umbrosa* WIMM. & GRAB. Fl. Siles. 2/1: 265, 1829 (nom. illegit.) non DC. Syst. Nat. 2: 255, 1821.

Ind. loc.: "Auf dem Schneeberge in der Grafsch. Glatz. Am Ochsenstalle auf dem Altvater, am Peterstein". Lectotypus vel neotypus (**hoc loco designatus**): Silesia, im Gesenke, s. a., GRABOWSKI (K).

= *Cardamine amara* var. *subalpina* W.D.J. KOCH Syn. Fl. Germ. Helv. 1: 44, 1835 (nom. illegit. superfl. - Art. 52).

Ind. loc.: "In scaturiginosis subalpinis Sudetorum (in Schlesien und Böhmen auf dem Schneeberge, am Ochsenstalle des Altvaters, am Peterstein)". Typus ignotus.

- = *Cardamine bielzii* SCHUR Verh. Mitth. Siebenbürg. Vereins Naturwiss. Hermannstadt 4: 64, 1853.
 Ind. loc.: "In der Gegend der Piatra Arsze südlich von Bánfi Hunyad, (A. BIELTZ)".
 Holotypus: In der Gegend von Piatra Arsze, VIII.1847, BIELTZ (LW).
- = *Cardamine amara* "b" *multijuga* R. UECHTR. Verh. Bot. Vereins Prov. Brandenburg 14: 66, 1872.
 Ind. loc.: "In den östlichen Sudeten: am Glatzer Schneeberge ...". Typus ignotus.
- = *Cardamine amara* var. *hirsutissima* SCHUR Verh. Naturf. Vereins Brünn 15/2 (1876): 78-79, 1877.
 Ind. loc.: "In Gerbirgsthälern im Zoodthale und am Fusse des Arpás in Siebenbürgen, Juni 1846." Typus ignotus.
- = *Cardamine opicii* var. *kotulana* ZAPĄŁ Rozpr. Wydz. Mat.-Przyr. Akad. Umiejetn. Dział B, Nauki Biol. Ser. 3, 12: 8-9, 1912 [ut "*opizii*"].
 Ind. loc.: "Studzienna dolina [=Roháčska dolina] w Tatrach (KOTULA)". Holotypus: Rohaczer Potok, 11 & 12-VIII-1885, KOTULA (KRAM, no. 112458).
- = *Cardamine dubia* ZAPĄŁ Rozpr. Wydz. Mat.-Przyr. Akad. Umiejetn. Dział B, Nauki Biol. Ser. 3, 12: 13, 1912 (pro hybr., nom. illegit.) non NICOTRA Prodr. Fl. Mesan. 1: 95, 1878.
 Ind. loc.: "In valle Koprowa Tatrorum (KULCZYŃSKI)". Holotypus: Tatry, dol. Koprowa, 5.VIII.1880, KULCZYŃSKI (KRAM, no. 112667).
 = *Cardamine zapalowiczii* DOMIN Pl. Čechosl. enum.: 90, 1935 (pro hybr.) [ut "*Zapalowiczii*"].
- ?= *Cardamine amara* var. *glabriuscula* SCHUR Enum. Pl. Transsilv.: 49, 1866.
 Ind. loc.: "Arpaser Gebirge; auf der Mumma und der Preschbe bei Zood; Kuhhorn bei Rodna". Typus ignotus.
- *Cardamine amara* var. *crassifolia* auct. non (OPIZ) BECK: BECK Fl. Nieder-Österreich: 453, 1892.
- *Cardamine amara* subsp. *opicii* var. *crassifolia* auct. non (OPIZ) BECK: NYÁR. in SÁVUL. Fl. Reip. Pop. Roman. 3: 264, 1955. [ut "*opizii*"].

Exsiccata visa

DOMIN & KRAJINA Fl. Čechoslov. Exs. no. 255 (BP, BRA, CGE, CL, K, KRA, LIM, NI, OL, PR, PRC, W);

Extra fines: BAENITZ Herb. Eur. no. 8428 (CL, PRC).

Icones

HEJNÝ & SLAVÍK Květ. ČR 3: 101, tab. 22, fig. 2, 1992. - MAŁAŁSKI Fl. Polon. terrarum. adjacent. icon. 9/4: fig. 1086, 1966. - NYÁRADY in SÁVULESCU Fl. Reip. Pop. Roman. 3: 257, tab. 44, fig. 2, 1955.

Icon nostra : Fig. 6.

Brief description

Rhizome thick. Stem fragile, glabrous or densely hairy, simple, 1-13 mm wide at base. Cauline leaves (10-) 13-46 (-53), fleshy, congested beneath the inflorescence, with (4-) 5-9 (-11) pairs of lateral leaflets. Inflorescence simple, with 3-39 flowers in the main inflorescence.



Fig. 6. *Cardamine amara* subsp. *opicii* (J. PRESL & C. PRESL)
ČELÁK.

Sepals (3.1-) 3.5-5.0 (-5.2) mm, petals (5.7-) 6.6-9.7 (-10.2) mm long $\times$ (2.6-) 2.8-4.9 (-5.4) mm wide, filaments of longer stamens (3.3-) 4.5-6.8 (-7.3) mm, pedicels hairy or glabrous.

Flowering: June - July.

$2n = 16$

General distribution

Cardamine amara subsp. *opicii* occurs in the Sudeten Mts., namely the Krkonoše Mts. (= Karkonosze Mts.), Mt. Králický Sněžník (= Masyw Śnieżnika Mts.), Hrubý Jeseník Mts., and also probably the Orlické hory Mts. (for a detailed distribution see HROUDA & MARHOLD 1993). It is widespread in the higher mountains of the East and West Carpathians. In the South Carpathians it is rather rare. This subspecies probably does not occur in the Alps. The data concerning its occurrence in that area most likely refer to tetraploid populations of *C. amara*.

Poland (Fig. 7)

Karpaty Zachodnie. 513.51. Beskyd Żywiecki, 513.52. Tatry Zachodnie, 513.53. Tatry Wschodnie.

Slovakia (Fig. 7)

Carpaticum occidentale. 14c.

Kremnické vrchy, 14d. Poľana, 15. Slovenské rudohorie, 16. Muránska planina, 21a. Malá Fatra (Lúčanská Fatra), 21b. Malá Fatra (Krivánska Fatra), 21c. Veľká Fatra, 21d. Chočské vrchy, 22. Nízke Tatry, 23a. Západné Tatry, 23b. Vysoké Tatry, 23c. Belianske Tatry, 28. Západné Beskydy.

Ukraine (Fig. 8)

Carpaticum orientale. II. Schidni Beskydy j Nyz'ki Polonyny, III. Gorgany, IV. Svydovec', V. Čornohora, VI. Čyvčyno-Grynjavs'ki hory, VII. Marmaros'ki Al'py.

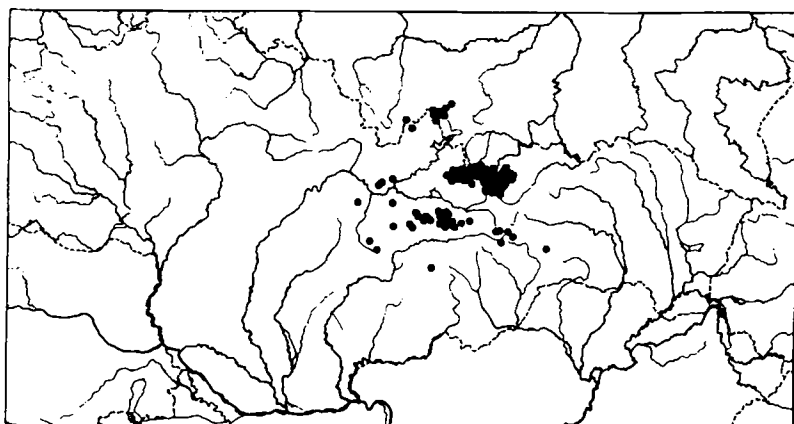


Fig. 7. Map of the distribution of *Cardamine amara* subsp. *opicii* (J. PRESL & C. PRESL) ČELAK. in the Carpathian part of Poland and in Slovakia.

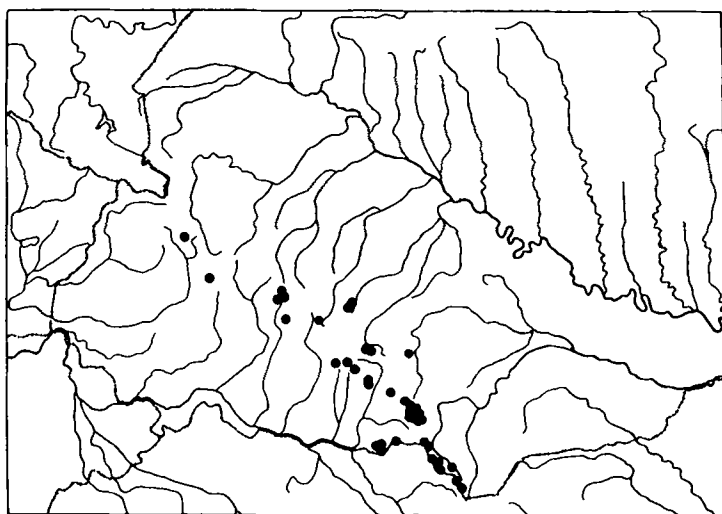


Fig. 8. Map of the distribution of *Cardamine amara* subsp. *opicii* (J. PRESL & C. PRESL) ČELAK. in the Carpathian part of Ukraine.

Romania

Districts Maramureş, Bistriţa-Năsăud, Mureş [?], Harghita [?], Braşov [?], Argeş [?], Sibiu, Hunedoara, Caraş-Severin (in the mountains of Maramureşului, Rodnei, Căliman, Făgăraşului, Retezatului, Ţarcului).

Minimum altitude: Veľká Fatra, Ľubochňianska dolina, above the Raková forester's house, 850-900 m, 1985, MARHOLD (SAV). Maximum altitude: Vysoké Tatry, Päť Spišských plies, 2013 m, 1890, 1907, SIMONKAI (BP); Vysoké Tatry, NE of the Hincove pleso, ca. 2000 m, 1955, STANĚK (BRNM).

Ecology and phytosociology

Cardamine amara subsp. *opicii* occurs in springs, on stream banks, and wet rock faces in the upper montane, subalpine, and alpine belts, on acid or almost neutral soils of the gleyed type. It belongs to the characteristic taxa combination of the associations *Brachythecio rivularis-Cardaminetum opizii* (KRAJINA 1933) HADAČ 1983 and *Calthetum laetae* KRAJINA 1933 of the alliance *Cratoneuro filicini-Calthion laetae* HADAČ 1983. It also occurs in other associations of this alliance [e.g. *Caltho-Dicranelletum squarrosae* HADAČ 1956 and *Arabido alpinae-Petasitetum kablikiani* (HADAČ in HADAČ et al. 1969) HADAČ 1983], and in communities of the alliance *Adenostylion* BR.-BL. 1926 (e.g. *Aconitetum firmi* KRAJINA 1933).

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Appendix

Selected specimens

(for numbers and names of phytogeographic districts see "Distribution")

Cardamine amara L. subsp. *amara*

Poland

Karpaty Zachodnie. 513.33. Mogilany (1957 TUMIDAJOWICZ KRA). - 513.34. Dobczyce, Czasław (1979 SZEWCZYK KRAM). - 513.45. Brenna (1967 BRODA KRA). - 513.46. Miłówka, Soła (1980 SZEWCZYK KRAM). - 513.48. Kalwaria Zebrzydowska, Brody (1965 BARADZIEJ KRA). - 513.49. Rabka (1960 SKOVROŃSKA KRA). - 513.51. Dolina Sopotni Wielkiej (1965 SZCESLIŃSKA KRAM). - 513.52. Turbacz, Kowaniec (1950 A. & J. KORNAŚOWIE KRA). - 513.53. Nowy Sącz - Stary Sącz (1936 SŁOWIKOWSKI KRA). - 513.54. Pasma Radziejowej, Roztoka Wielka (1919 PAWŁOWSKI KRAM). - 513.61. Rożnów, Ostra Góra (1946 ŚRODOŃ KRAM). - 513.62. Brzyska (s.a. WIŚNIEWICZ KRA). - 513.64. Konieczkowa (1972 BOBER KRA). - 513.65. Bircza - Cisowa (1971 JASIEWICZ & TUMIDAJOWICZ - Fl. Polon. Exs. no. 323). - 513.66. Biecz, Krolewska studnia (1873 KOTOWICZ KRAM). - 513.69. Targowiska (1914 PIECH KRAM). - 513.71. Żmigord, Folusz (1956 ZARZYCKI KRAM). - 514.11. Pieninski Pas Skalkowy, Rogoża (1968 GRODZIŃSKA KRAM). - 514.12. Czorstyn (1880 GUSTAWICZ KRAM). - 514.13. Zagrody (1955 PANCER KRA). - 514.14. Zakopane (1915 MICZYŃSKI KRAM). - 514.52. Dolina Kościeliska (1887 SAGORSKI JE). - 514.53. Morskie Oko, pod Miedzianem (1876 KOTULA W). - **Beskidy Wschodnie.** 522.12. Ustrzyki Górne (1960 JASIEWICZ KRAM).

Moravia

Pannonicum. 16. Brno, Pisárky (1879 BOHUŇANSKÝ BRNM). - 18a. Brno, Ráječek (1895 s.coll. BRNM). - 18b. Lanžhot, E (1987 MARHOLD SAV). - 21a. Předměstí u Přerova (1955 POKLUDA BRNM). - 21b. Kojetín, Včelín (1966 REITMAYEROVÁ BRNM, BRNU, PR). - **Mesophyticum carpaticum.** 76a. Bohuslávky (1905 OBORNÝ PRC). - 77a. Rusava, u Rusavy (1947 ZAVŘEL BRA). - 77b. Pačlavice, Švábsko (1956 ZAVŘEL BRA). - 78. Javořina (1929 SILLINGER PR, PRC). - 79. Březůvky (1951 STANĚK BRNM). - 80a. Veselá (1934 ŘÍČAN BRNU). - 81. Kašava, Dřevnice (1972 VYSTAVĚLOVÁ BRNU). - 82. Valašské Klobouky, pod Matkou (1940 PODPĚRA BRNU). - 83. Polanský les (1955 KNEBLOVÁ PR). - 84a. Hnojník (1972 LIBERDOVÁ BRNU). - **Oreophyticum carpaticum.** 99a. Mečůvka (1973 VONDRÁKOVÁ BRNU). - 99b. Stelma (1968 ZATLOUKAL BRNU).

Slovakia

Pannonicum. 2. Tuhár (1971 RELL W). - 3. Borka, "Nagyholökő" (1929 BOROS BP). - 4. Plavecký Štvrtok (1932 PTAČOVSKÝ SAV). - 6. Svätý Jur, Šúr (1900 MERGL SAV). - 7. Vyšné Opátske (1928 BRYM PRC). - 8. Bôľ (1962 BOSÁČKOVÁ BRA). - **Carpaticum occidentale.** 9. Lopeník (1884 HOLUBY W). - 10. Železná studnička (1965 KMEŤOVÁ SAV). - 11. Kálnica (1882 HOLUBY BP). - 12. Jelenec, Plieška (1935 DEYL PR). - 13. Horné Motešice (1879 FLEISCHER LW). - 14a. Nová Baňa, potok Majer (1947 MAGIC SLO). - 14b. Veľké Pole (1882 KMEŤ BRA). - 14c. Tajov, Suchý vrch (1954 DEYL PR). - 14d. Veľká Poľana (1951 DEYL PR). - 14e. Pukanec, Dolné lúky (1894 KUPČOK BRA). - 15. Brusno, kúpele (1922 VÁCHA PRC). - 16. Zbojská (1986 MARHOLD SAV). - 17. Kyseľ (1938 DEYL PRC). - 19. Opiná (1987 MARHOLD SAV). - 20. Kusín, Hrádok (1949 STANĚK BRNM). - 21a. Vrúcko (1910 NÓGRÁDI BRA). - 21b. Strečno (1985 MARHOLD SAV). - 21c. Staré Hory (1930 FUTÁK SLO). - 21d. Šíp (1990 KOCHJAROVÁ SLO). - 22. Kyslá (1966 MAJOVSKÝ SLO). - 23a. Zverovka (1986 MARHOLD SAV). - 23b. Temnosmrečinové plesá (1947 POSPÍŠIL BRNM). - 23c. Muráň (1929 DOMIN PRC). - 24. Lesnická Huta (1986 MARHOLD SAV). - 25. Háj (1913 MARGITTAI CL). - 26a. Liptovský Hrádok (1973 HORNÍČKOVÁ BRA). - 26b. Baba pri Svite (1902 BARTAL BP). - 27a. Červený Kameň, Babka (1926 STANĚK BRNM). - 27b. Kysucké Nové Mesto (1971 FALTANOVÁ SLO). - 28. Zakamené (1928 LEHMANN PRC). - 29. Podspády, N (1929 DOMIN PRC). - 30a. Solivar (1914 VAJDA BP). - 30b. Hradisko, W (1973 GALLO BRA). - 30c. Bardejov, Weinberg (1924 BERGANSKÝ BRA). - **Carpaticum orientale.** 31. Pčolinné (1987 MARHOLD SAV).

Austria

Mitterndorf a.d. Fischa (1897 P. HÜBL WU). - Moosbrunn (1865 BREIDLER WU). - Gramatneusiedl, Mariental (1911 KORB W).

Hungary

I. Matricum. 3. Felsőhámar, Jávorkut (1923 BOROS BP). - 4. Parádsasvár, Kiscsór hegy (1953 PAPP KRAM). - **II. Bakonycum.** 2. Pilis hegység (1834 DORNER BP). - 3. Bakonybél (1959 FEKETE BP). - **III. Praenoricum.** 1. Sopron (1845 BALLAY LWS). - 2. Vasvár (1954 NAGY BP). - 3. Pördefölde, Budnya erdő (1938 JÁVORKA & ZÓLYOMI BP). - **IV. Eupannonicum.** 1. Győr, Patkányoserdő (1921 POLGÁR BP). - **V. Praeillyricum.** 1. Nagykanizsa, Alsó városi erdő (1949 KÁROLYI BP, SZ). - 2. Lesence, Lesenceistvánd (1949 BOROS BP).

Ukraine

Carpaticum orientale. I. Oblasť L'vivs'ka, Rajon Starosambirs'kyj, Dobromyl' (s.a. REHMAN LWS). - II. Oblasť L'vivs'ka, Rajon Starosambirs'kyj, Topil'nycja (1990 MARHOLD & KAHALO SAV). - III. Oblasť Ivano-Frankivs'ka, Rajon Dolyns'kyj, Ljudvykivka (1990 MARHOLD & KAHALO SAV). - IV. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Polonyna Apšynec' (1960 TOVŠ UU). - V. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Jasynja (1961 ZYMAN KW). - VI. Oblasť Ivano-Frankivs'ka, Rajon Verchovyns'kyj, Burkut, Čornyj Čeremoš (1936 PAWŁOWSKI KRA, KRAM). - VII. Oblasť Zakarpats'ka, Rajon Rachivs'kyj, Rachiv (1875 VÁGNER BP). - VIII. Oblasť Zakarpats'ka, Rajon Perečyns'kyj, Voročeve, verch Senatorija (1946 s.coll. UU). - **Pannonicum.** X. Oblasť Zakarpats'ka, Rajon Užhorods'kyj, Onokivci (1964 HENDEJ UU).

Romania

Distr. Maramureș. Firiza (1918 ANDRASOVSKY BP). - **Distr. Bistrița-Năsăud.** Mții Rodnei, Rodna Nuova (1932 SCHEFFER SLO). - **Distr. Suceava.** Cîmpulung Moldoveanesc, Valea Doamnei (1902 WOŁOSZCZAK W). - **Distr. Neamț.** Dragomirești (1937 BURDUJA - Fl. Rom. Exs. no. 1076b). - **Distr. Mureș.** Băile Sovata (1944 E. I. NYÁRÁDY SIB). - **Distr. Harghita.** Cheile Bicazului (1964 TOMA BM). - **Distr. Bacău.** Dărmănești, Nemira (1972 BARABAS, MITTELU & BARABAS - Fl. Exs. Distr. Bacoviensis n. 523). - **Distr. Covasna.** Zagon, "Domokos patak" (1941 HARGITAI CL). - **Distr. Dîmbovița.** Pucioase, Vulcana de Sus (1955 s.coll. CL). - **Distr. Brașov.** Timișul de Jos (1930 E. I. NYÁRÁDY CL). - **Distr. Sibiu.** Mții Făgărașului, Valea Arpaș (1989 MARHOLD SAV). - **Distr. Hunedoara.** Mții Parîngului, Petroșani (1934 SCHEFFER SLO). - **Distr. Alba.** Gîrda de Sus, "Aranyosthal" (1897 PAX BP). - **Distr. Caraș-Severin.** Mții Semenicolui (1941 BORZA CL). - **Distr. Bihor.** Stîna de Vale (1965 RATIU CL). - **Distr. Cluj.** Vf. Buscat (1981 MARCU CL). - **Distr. Sălaj.** Mții Meseșului, Hurez, Valea Poenitia (1941 BALÁZS & FELDÖLDY CL). - **Distr. Dolj.** Tismana, Mînaștirea Tismana (1953 ȘERBANESCU CL).

Cardamine amara* subsp. *opicii* (J. PRESL & C. PRESL) ČELAK.*Poland**

Karpaty Zachodnie. 513.51. Rezerwat Pod Rysianką (1965 BIAŁECKA KRA). - 514.52. Dolina Chochołowska (1922 PAWŁOWSKI KRAM). - 514.53. Litworowy Staw (1989 MARHOLD SAV).

Slovakia

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