

## Alien weed *Xanthium spinosum* in Slovakia I: distribution and habitats

### Nepôvodná burina *Xanthium spinosum* na Slovensku I: rozšírenie a biotopy

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#### ABSTRACT

*Xanthium spinosum* is a naturalized neophyte of agricultural land, its distribution and habitats have not yet been studied in detail in Slovakia. The aim of the work was to collect all floristic data of this weed species, to present its current and historical distribution, and to characterize its typical habitats in Slovakia. As shown in analysis, *Xanthium spinosum* occurs mainly in the Pannonian region; in the Carpathians it was more frequent only in the 19<sup>th</sup> century and in connection with the transport of diaspores by sheep wool. The number of localities increased gradually until the 1970s, but then fell sharply due to the intensification of agriculture. Consequently, it is currently not considered to be a significant weed in Slovakia. *X. spinosum* mostly occupies open and sunny ruderal habitats (road edges, manure pits, field roads, abandoned fields and places) and especially pastures, rarely river banks. Both in the past and today, the species rarely occurs in fields.

**Keywords:** Central Europe, neophytes, occurrence, spreading

#### ABSTRAKT

*Xanthium spinosum* je naturalizovaný neofyt vyskytujúci sa prevažne v oblastiach s intenzívnou poľnohospodárskou činnosťou, avšak jeho rozšírenie a biotopy na Slovensku ešte neboli podrobne študované. Cieľom práce bolo zhromaždiť všetky floristické údaje o tomto burinnom druhu, predstaviť súčasné a historické rozšírenie a charakterizovať jeho typické biotopy. Analýza údajov o výskyte *Xanthium spinosum* na Slovensku ukázala, že sa vyskytoval a vyskytuje hlavne v panónskej oblasti; v Karpatoch bol častejší len v 19. storočí v súvislosti s transportom diaspór ovčou vlnou. Počet lokalít sa postupne zvyšoval až do 70-tych rokov minulého storočia, potom však prudko poklesol v dôsledku intenzifikácie poľnohospodárstva. Z týchto dôvodov druh *Xanthium spinosum* v súčasnosti nepovažujeme na Slovensku za významnú burinu. *X. spinosum* osídľuje otvorené a výslnné ruderálne biotopy (okraje ciest, hnojiská, poľné cesty, opusteniská) a predovšetkým pasienky, zriedkavejšie i brehy riek. V poľných kultúrach sa vždy vyskytoval skôr ojedinele.

**Kľúčové slová:** stredná Európa, neofyty, šírenie sa, výskyt

## INTRODUCTION

The genus *Xanthium* is taxonomically problematic as it includes, according to different authors, from 11 to c. 50 species that originated in tropical and subtropical zones of Central and Southern America, but are secondary widespread in warm areas worldwide (Löve and Dansereau, 1959; The Plant List, 2019).

*Xanthium spinosum* L. Sp. Pl. 987, 1753, a noxious weed, has a native range in subtropical South America which includes Argentina, Bolivia, Chile, Ecuador, Peru, Uruguay and southern Brazil. In South America, the species has spread over the continents north and southward (Löve and Dansereau, 1959; Holm et al., 1977). It is secondary widely distributed in the Mediterranean region, in Europe, Australia, in northern and southern Africa, South and North America, mainly in sub-tropical, semi-arid and arid environments and temperate areas, though is only rarely found in the tropics (Holm et al., 1977; Meusel and Jäger, 1992). Pitcher (1989) stated that *X. spinosum*, as a highly invasive weed, had been introduced to at least 39 countries, though records for many more in Europe, Australia, Africa, America are available and the real figure may be higher still (Holm et al., 1977).

In most European countries as well as in Slovakia, it is considered a naturalised alien non-native species (Greuter, 2006; Medvecká et al., 2012). The species prefers ruderal and disturbed warm grasslands and weedy places, roadsides, railway stations and places with disposal and laundering of wool (Havlíček, 2004). In Central Europe, it is reported mainly in southern and central Poland (Zajac and Zajac, 2001), in eastern part of the Czech Republic (Havlíček, 2004), in central and eastern Hungary (Bartha et al., 2015) and rare in Trans-Carpathian Ukraine (Dudáš et al., 2018).

A complete survey of the occurrence and a habitat analysis of *X. spinosum* has not yet been carried out in Slovakia. The objectives of this study were to (a) collect all floristic data (herbarium, published and unpublished) of the species, (b) present the current and historical distribution and (c) characterize its typical habitats in Slovakia in different time periods.

## MATERIALS AND METHODS

The study was carried out during the years 2015 – 2019. The mapping of the species distribution in Slovakia was based on herbarium specimens deposited in public herbarium collections in Slovakia (BRA, KO, LTM, NI, PMK, POP, SAV, SLO, SMBB, ZV), Czechia (BRNM, BRNU, MMI, OL, OLM, PR, PRC), Hungary (BP) and Ukraine (UU). Acronyms of herbaria follow Thiers (2020) and small local collections Vozárová and Sutorý (2001). Available published sources (drawn from the database of locations of higher plants maintained by the Plant Science and Biodiversity Centre, Slovak Academy of Sciences, Bratislava, Slovakia) were also used and online virtual herbarium sources (Virtual herbaria JACQ). The field survey carried out by the authors was realized. The map was designed in the program ArcGis, version 9.2. The mapping grid follows grid template described by Niklfeld (1971). The phytogeographical division in Slovakia follows Futák (1980). Flowering plant nomenclature follows Marhold and Hindák (1998).

The time periods of occurrence as well as habitat preferences of *Xanthium spinosum* were chosen in the 25-year interval, except for the period before 1900 due to lack of data. Furthermore, these intervals allowed significant changes (WWI, WWII, collectivization of agriculture during communist era in former Czechoslovakia, disintegration of agricultural cooperatives after 1990) to be included, which could affect the occurrence and spread of the species in Slovakia as well as the intensity of floristic research. Habitat data were obtained from published works as well as from data on herbarium labels.

## RESULTS AND DISCUSSION

### *Distribution*

The presence of *Xanthium spinosum* was recorded in all eight phytogeographical districts in the area of the Pannonian flora (*Pannonicum*) and it has been occasionally introduced in 14 districts (and subdistricts) in the area of the Carpathian flora (*Carpaticum*). The largest number of sites was found in south-western and south-eastern Slovakia (Figure 1, 2).

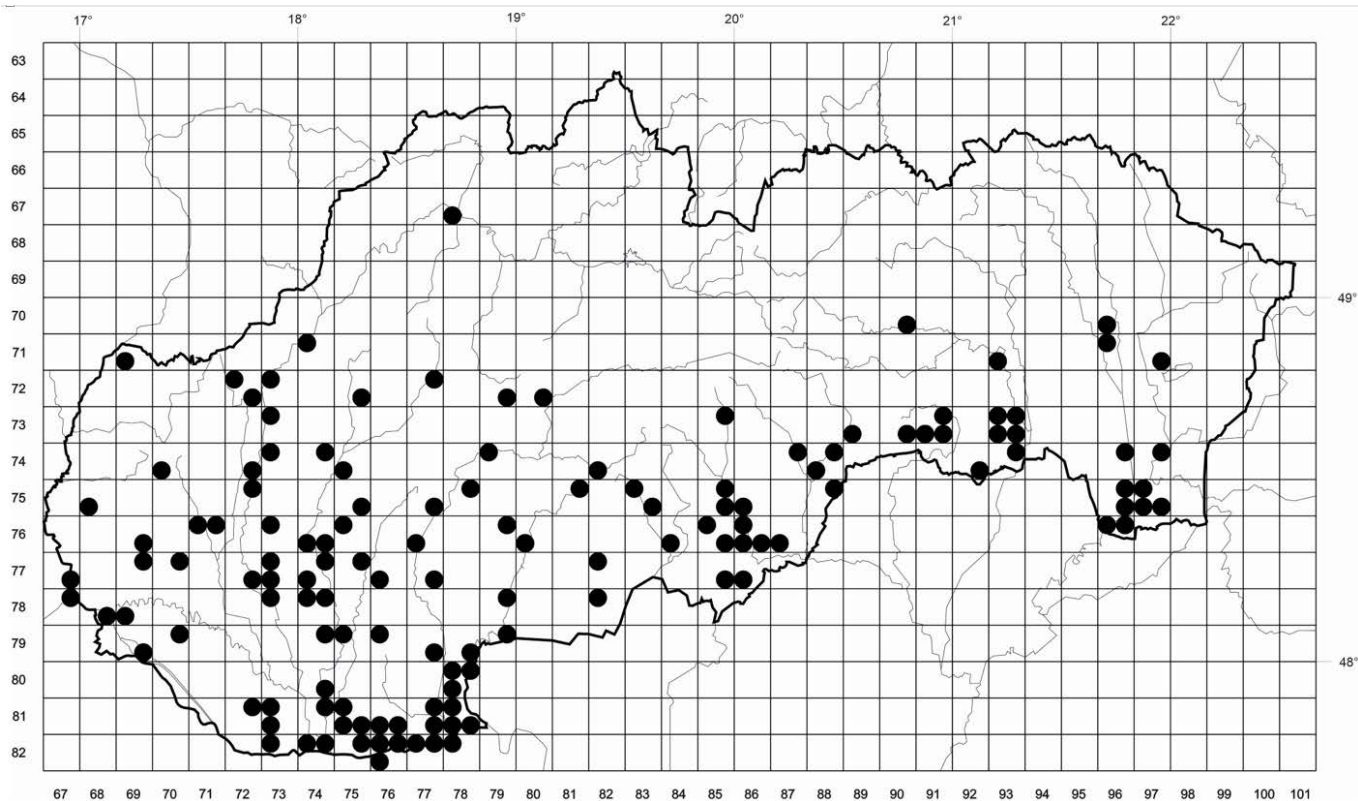


Figure 1. Overall distribution of the of *Xanthium spinosum* L. in Slovakia

Data before 1900 show that *Xanthium spinosum* occurred more frequently in the Carpathian region (especially in lower mountains in West and Central Slovakia) than in the Pannonian region (Figure 2, 3). The species reached the territory of Slovakia sometime in the middle of the 19<sup>th</sup> century in connection with the import of wool (Holuby, 1871), as the opinion of its introduction by Russian troops from the east in 1849 (Resely, 1867) is doubtful. The Pannonian way of *X. spinosum* introduction was described by Kerner (1872).

The species appeared in the southern part of the Austro-Hungarian Empire in the early 19<sup>th</sup> century from Serbia, it had grown around Bratislava and Zvolen in the middle of the 19<sup>th</sup> and advanced north through the river valleys (Reuss, 1853; Resely, 1867). It became a common weed in some areas (Szontagh, 1864; Kerner, 1872; Feichtinger, 1899). However, the number of recorded sites in period 1900 – 1925 is quite low (Figure 2, 3), although Jávorka (1925) reported *Xanthium spinosum* as a widely spread weed in the whole area of the former Austrian-Hungary Empire. It was due to the decline of

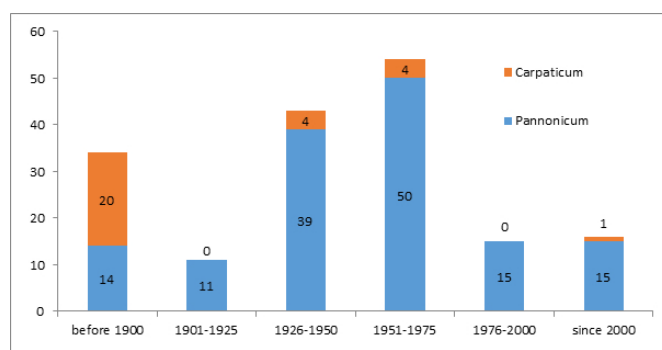


Figure 2. Number of localities of *Xanthium spinosum* L. in two main phytogeographical areas of Slovakia during the selected time periods

botanical activities connected with significant political events (World War I, the collapse of the Austro-Hungarian Monarchy) rather than the retreat of the species from already populated territory.

This consideration is well illustrated by the occurrence of the species recorded in the subsequent period 1926 – 1950 when more than 40 localities were found (Figure 2, 3). The reasons are obvious – after the establishment of Czechoslovakia and the consolidation of conditions, mainly Czech botanists (e.g., Karel Domin, Vladimír Krist)

participated on intensive floristic research in Slovakia in the interwar period (Hendrych, 1996). As a result, a relatively accurate picture of the expansion of *X. spinosum* has been established – it occupied primarily the south-western part of Slovakia and was rarely found in the south and southeast of Slovakia. It was also rarely found in the adjacent lower parts of the Western Carpathians.

The largest distribution reached the species in the following period (1951 – 1975), almost 50 localities were found (Figure 2, 3, Appendix). It is almost identical to the previous period; it differs only in the increase in the number of sites in the south (surrounding of Rimavská Sobota town) and southeast of Slovakia (localities around Rožňava and Kráľovský Chlmec settlements).

A significant change in the distribution of *X. spinosum* happened in the period 1975 – 2000. The number of detected localities decreased by more than half (15 sites were found) (Figure 2, 3, Appendix). The reason was most probably the synergistic effect of several factors related to the intensification of agriculture in former Czechoslovakia: the application of herbicides, improved methods of soil cultivation, new effective methods of seed cleaning, quarantine measures, changes in land use etc. These measures were so effective that the species is missing from the 1970s in the Czech Republic (Havlíček, 2004). They caused also a significant retreat of several segetal archaeophytes such as *Agrostemma githago*, *Lolium temulentum* or *Vaccaria hispanica* (David and Dudich, 1997; Eliáš, 2006; Eliáš et al., 2010). Likewise, the intensification has led to the conversion of pastures to arable land, for example, the area of salt pastures in SW Slovakia has decreased from 8300 ha to about 500 ha in 50 years (Sádovský et al., 2004).

Currently, the occurrence of *X. spinosum* is the same as in the previous period. After 2000, only 15 sites were identified and no significant expansion is expected in the future. It spreads only locally, for example in connection with sheep grazing on dikes in the lower reaches of the river Ondava in south-eastern Slovakia. The species has inhabited mainly lowland areas in south-western and south-eastern Slovakia (Figure 3).

### Habitats

The knowledge of most favourable habitat type of *X. spinosum* was based on literature sources (published as well as unpublished data) and data on labels of herbarium sheets. Although in the earlier periods (before 1900 and 1901 – 1925) most data were without habitat type, gradually, however, the number of data with the missing habitat type has been decreasing and since 1975 all *X. spinosum* localities have included the habitat type. The analysis of *Xanthium spinosum* habitat preferences showed occurrence of the species in four main types of habitats: ruderal habitats, pastures, river banks and fields (Figure 4). Ruderal habitats were found as the most typical for the species – roadsides, waste areas, marketplaces in settlements, embankments of railway tracks etc., in the other types, *X. spinosum* occurred rarely. However, the main habitat type of the species has also changed over the last 50 years in connection with the intensification of agriculture described above. Nowadays, the species survives especially on (usually sheep) pastures where there is no mechanical or chemical eradication of the species and the animals provide spreading of diaspores (Figure 4).

Literature sources from the 19<sup>th</sup> century have mentioned the species' attachment to ruderal habitats. Holuby (1871) mentioned the survival of *X. spinosum* in garbage dumps around the Lubina willage (W Slovakia). The seeds of the species came here after cleaning the wool imported from the southern regions of the Austro-Hungarian Empire. *X. spinosum* has also been frequently found in marketplaces and urban areas (Szontagh, 1864; Márkus, 1865; Resely, 1867). Later, in the first half of 20<sup>th</sup> century, data of pasture habitats have also begun to appear more frequently (Krist, 1937, 1940). In general, *X. spinosum* occupies the same habitats both in Slovakia and in other areas of its secondary occurrence: cultivated land, pastures, meadows and riverbanks (Holm et al., 1977; Pitcher, 1989; Havlíček, 2004).

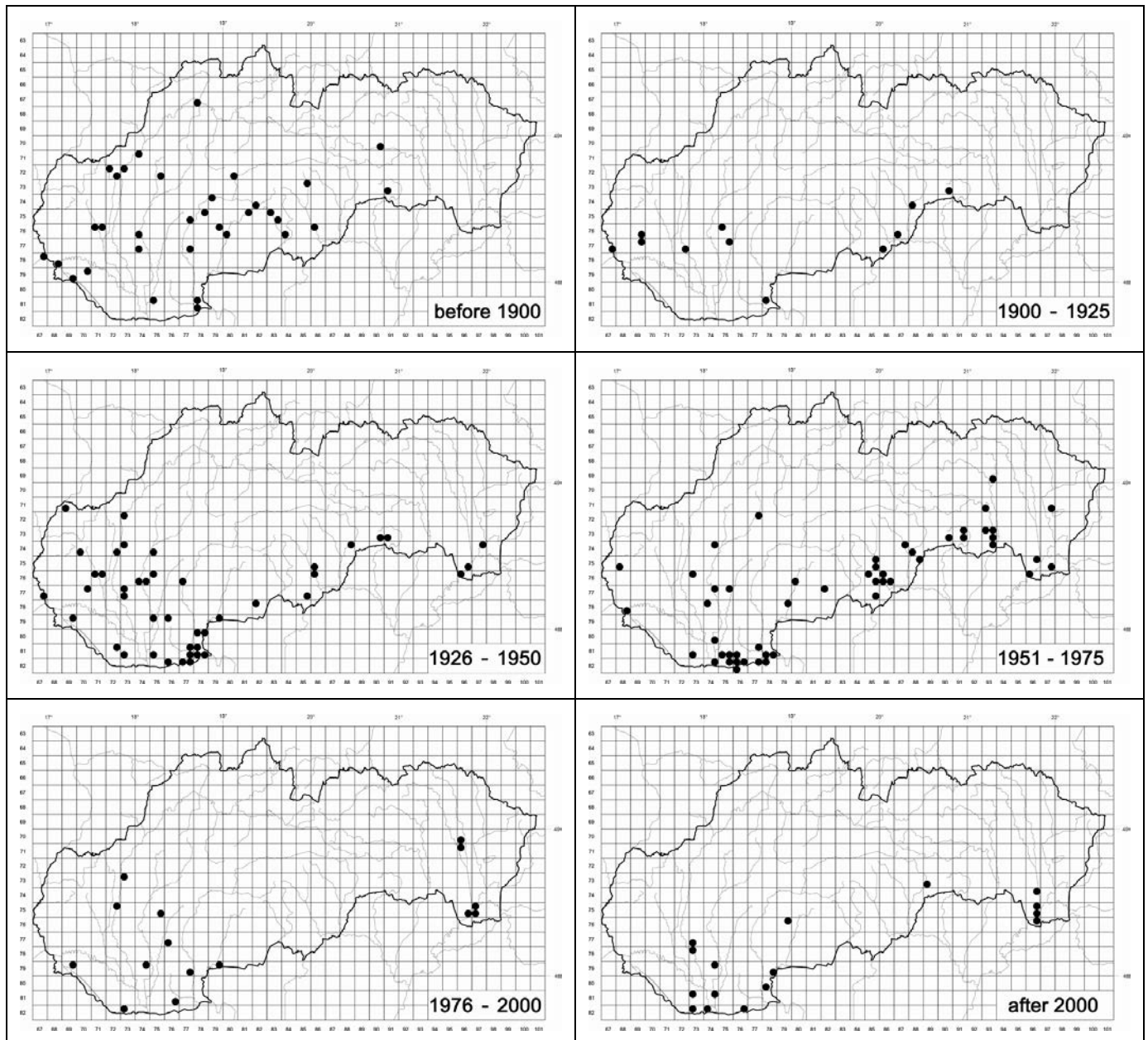


Figure 3. Distribution of *Xanthium spinosum* L. during the selected time periods in Slovakia



Figure 4. Ratio (%) of habitats occupied by *Xanthium spinosum* L. in Slovakia in the selected time periods

## CONCLUSIONS

As shown the study, the species occurs mainly in southern, warm parts of Slovakia in the lowlands, basins and low hilly areas (*Pannonicum*). In the past, it was temporarily introduced in central and northern Slovakia (*Carpathicum*), mainly near railway stations where the disposal of wool acted as a contaminant in wool due to its hooked spines, around factories processing and laundering wool, as well as in pastures grazing mainly by sheep. Here the species occurred only for a short period and later disappeared. The number of localities increased gradually until the 1970s, but then fell sharply due to the intensification of agriculture. Thus, at present, the species does not pose a risk to agricultural crops in Slovakia. *X. spinosum* mostly occupies open and sunny ruderal habitats and pastures, rarely river banks. Both in the past and today, it rarely grows in the fields.

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## Appendix 1. List of localities of *Xanthium spinosum* L. in Slovakia

The records are arranged according to the phytogeographical division of Slovakia (Futák, 1980). Historical and foreign language names of localities (Hungarian, German, Latin) are given in square brackets. Published data are given with an abbreviated title of the publication. Abbreviations: S (south), N (north), E (east), W (west) and its combinations.

### *Pannonicum*

Matricum. **1. Burda Hills:** Kováčov, over station, 120 m (Krist 1934 BRNU; M. Deyl 1952 PR). – Kováčov, pastures and roadsides (Domin 1928 ined.). – Kováčovské kopce Hills, 300 m (Kneblová 1951 PR; David 1967 LTM). – Kováčovské kopce Hills, mouth of Hron River, near bridge, 113 m (Domin 1929 ined.). – Kováčovské kopce Hills, fields and cart-roads (Domin, Sborn. Muz., Bratislava 1931: 21). – Kováčov-Kamenica, Danube River, gravel bank (Domin 1929 ined.). – Kováčovské kopce, valley Veľká dolina [Nagy völgy], pasture, 140 (Domin 1930 ined.). – Chľaba [Helemba] (Valenta 1935 BRA). – Chľaba, roadside in village (Jehlík 1973 PR; Eliáš sen. 1981 ined.). **2. Ipel'sko-rimavská brázda Region:** Bielovce, hill Rúbanisko (226,6 m), abandoned pastures and field edge, 190-220 m (Eliáš jun. 2013 NI; Eliáš jun. in Eliáš jun. Bull. Slov. Bot. Spoločn. 35/2: 216, 2013). – Čata, Malé Ludince, Horný vrch hill [Felső hegy], 235 m (Jirásek 1936 PRC). – Pastovce, SSE, steppe (Krist, Spisy Přír. F. Masaryk. Univ. 238: 56, 1937). – Sikenička [Kisgyarmat] (Barina and Pifkó 2003 BP). – Plášťovce, Šípka hill, SW slope, 185 m (Manica 1962 ZV). – Šahy, 227 m (Domin and Jirásek 1936 PRC). – Šahy, Šahovské kopce hills, S slopes, 140-200 m (Domin 1932 ined.). – Šahy, Kalvária, 130 - 200 m (Domin 1936 ined.). – Tešmák, Kopasz hegy, on bank of Berinčok canal, loess, 140 m (David 1984 LTM). – Horné Strháre, dry rocky pasture (Bohúňová 1953 SMBB). – Modrý Kameň, Veľké Straciny [Veľký Stračin], elevation point 288 m, clay (Kláštorský 1938 PR). – Lučenec [Losoncz] (Kunszt 1865 BRA). – Hajnáčka, roadside (Kláštorský 1938 PR; Futák, Přír. Zborn. III: 226, 1948; Č. Deyl 1972 OLM). – Gemerské Dechtáre [Détér], under

Ragačské kopce Hills, often, 217 m (Domin 1921 ined.). – Oždany – Hodejov – Hrachovo – Čerenčany (all data Hendrych, Preslia 31, p. 187, 1959). – Rimavská Sobota [Rimaszombat] (Fábry 1863 BRA, 1867 POP; Hendrych, Preslia 31, p. 187, 1959). – between Rimavská Sobota and Nižná Pokoradz, 208-334 m. – Vyšná Pokoradz, mass occurrence (both Domin 1921 ined.). – Pokoradz [Pokorázy] (s. coll. 1946 BRA). – Rimavské Jánovce – Bottovo (both data Hendrych, Preslia 31, p. 187, 1959). – Rimavská Seč [Siač] (Domin 1921 ined.). **3. Slovenský kras Karst:** Šivetice, 300 m (Hendrych 1954 PRC). – Vidová, nitrophilous places (Klika 1932 PR). – Plešivec (Domin 1921 ined.; Trapl 1922 PRC). – Ardovo, in village, 300 m (F. Dvořák 1967 BRNU). – Kečovo, 350 m (F. Dvořák 1967 BRNU). – ponds Brzotínske rybníky (Karasová 2002 not. sec. biomonitoring.sk). – Hrhov, abandoned site (Krippelová, Acta Instituti botanici Academiae scientiarum Slovacae. Series A Taxanómica, Geobotanica, p. 229, 1974). – Zádielska kotlina Basin (Unar 1958 BRNU). = Zádiel [Szádelő], pastures and ruderal sites, 220-300 m (Thaisz 1908 KO, BP; Domin 1919 PRC; Hendrych 1928 PR; M. Deyl 1934 PR; Krippelová 1972 SLO).

*Eupannonicum*. **4. Záhorská nížina Lowland:** Devínska Nová Ves, ruderal site, 150 m (Ptačovský 1924 SLO; Schidlaj 1933 BRA). – Malacky, castle wall (D. Slavoňovský 1958 BRNU). – Skalica, abandoned places and fallows (M. Béňa 1926 BRNU). **5. Devínska Kobyla Hills:** Devínska Nová Ves, near houses near Sandberg (V. Valenta 1938 ined.). – Devínska Nová Ves (Kláštorský 1922 PR; Duriš 1922 PR). – Devín [Devény] (s. coll. 1898 BP). **6. Podunajská nížina Lowland:** Bratislava [Pressburg] (Schneller 1856 BP). – Bratislava, Podhradie [an der Donau beim Zuckermandel] (Bäumler s. anno BP). – Bratislava, main station. – Bratislava, Lafranconi, ruderal site. – Bratislava, Petržalka, stubbles. – Bratislava, Petržalka, swimming pool (all Opluštilová 1953). – Podunajské Biskupice [Biskupice pri Dunaji], roadside (Opluštilová 1953). – Modra, roadside (Holuby, Sozn. Ok. Pez. (ms), p. 152, 1920). – Viničné [Schweinsbach, Švajnsbach] (Holuby 1913 PRC, BRNU; Zigmundík 1913 BRA; Holuby, Příroda XIV: 79, 1919; Domin 1920 PRC; Holuby, Sozn. Ok. Pez. (ms.), p. 152, 1920). – Šamorín

(Resely, Oesterr. Bot. Z., p. 52, 1867). – Blatné [Šarfia], 242 m (Domin 1931 ined.). – Maslovce [Vajas Vatta] (Mergl 1900 SLO). – Trnava, ruderal sites – Trnava, dump – Trnava, midden – Trnava, road ditches – Trnava, freight station (all data Frantová, Prír. Zborn. II, p. 207, 228, 1947). – Trnava (Szontagh, Oesterr. Bot. Z. XII, p. 265, 1862). – Čachtice, gardens in the village (Szontagh, Oesterr. Bot. Z. XIV, p. 271, 1864). – Jalšové, Hill 180 (Domin 1931 ined.). – Kplotovce, near football pitch (Mucina, Zpr. Čs. Bot. Společ., Praha 15: 65, 1980). – Šoporňa, clay slopes over Váh River (Domin 1920 ined.). – Okoč [Ekeč], saline soils, 111 m (Krist, Halof Veg. Slov., p. 80, 1940). – Beckov, ruderal site (Schidlay 1939 BRA). – Nové Mesto nad Váhom, Mnešice [Mísicz], in gravel (Knapp, Oesterr. Bot. Z. XIV, p. 342, 1864b). – Horná Streda, abandoned yard in village (Mucina, Zpr. Čs. Bot. Společ., Praha 15, p. 62, 1980). – Piešťany, near Váh River (Hrobař 1931 PR; Křístecký 1936, 1937 PRC). – Velké Kosihy, NW, field (Pluhař 1988 OL; Trávníček 1988 OL; Ducháček 2007 PR). – Okánikovo, Mostové, PR Derhídja (nature reserve), saline soil (Grulich 1986 MMI; Szabóová 2002 not. sec. biomonitoring.sk; Zlínska 2003 not. sec. biomonitoring.sk). – Sasinkovo, roadside (s. col. 1960, 1967, 1968 BRA). – Rišňovce, roadside (s. col. 1957 BRA). – Hájske [Kepežd] (Krist, Halof Veg. Slov., p. 48, 1940). – Močenok, Síky [Szík] farmstead, saline pasture (Šourek 1950 PR; Ducháček 2007 PR). – Trnovec nad Váhom, Sik farmstead, saline site (Weber 1935 PR). – Močenok, field roadside towards farmstead Síky, 120 m (Eliáš jun. 2001 NI; Eliáš sen. 2019 ined.). – Močenok, site Široké ca 2,5 km SW from the village, midden, 115 m (Eliáš jun. 2013 NI). – Žitavská Tôň, ruderal place (Chrtek et al., Zpr. čs. bot. Společ., Praha, 7, p. 67, 1972). – Zemianska Olča, saline site, near road to Gúta (Krist, Halof. Veg. Slov., p. 71, 1940). – Bodzianske lúky W, pasture (sheep), 108 m (Eliáš jun. 2013 NI; Eliáš, Dítě, Melečková 2013 NI; Eliáš jun. in Eliáš jun. Bull. Slov. Bot. Spoločn. 35/2, p. 216, 2013). – Topolčany, Nový Mlyn-Záhrady, right slope (F. Dočolomanský 1957 BRA). – Mojmírovce [Urmín], roadsides and gardens (Schiller, Oesterr. Bot. Z. XV, p. 378, 1865). – Polný Kesov (Jos. Dostál 1955 PRC). – Šurany, Okomáň, salt steppe (Grulich 1987 MMI; Muránsky 2002 not. sec. biomonitoring.sk). – Šurany, farmstead Akomáň, ruderal site, 117 m (Eliáš jun. 2013 NI). – Nesvady, ruderal place. – Imeľ, ruderal place (both Chrtek et al., Zpr. čs. bot. Společ., Praha, 7, p. 67, 1972). – Martovce, Detvice settlement (Szabóová 2003 not. sec. biomonitoring.sk). – Martovce, Gamota (Szabóová 2002 not. sec. biomonitoring.sk). – Zlatná na Ostrove, Pavel [Pavol] saline soil (Szabóová 2001, 2002, 2003 not. sec. biomonitoring.sk). – Komárno, Hadovce, saline site near former Secondary agricultural technical school (=SPŠT) (Klokner 1958 PMK). – Komárno, stubbles (s. col. 1958 BRA). – Bánovce nad Bebravou [Baáner] (Holuby, Flora des Trencsiner Comitatus, p. 55, 1888). – Uhrovec (Zay-Ugrócz) (Holuby, Flora des Trencsiner Comitatus, p. 55, 1888). – Nitrianska Streda, Hradovička, pasture, 250 m (Schidlay 1944 BRA). – Veľký Kýr [Milanovce] (Žertová 1953 PR). – Nitra, sandy banks of river (Schiller, Oesterr. Bot. Z. XIV, p. 52, 1864). – Nitra, bank of Nitra River, E (F. Kvapilík 1929 OLM). – Nitra, around the roads near Dolné Krškany, 140 m (Chrtek et Žertová 1953 NI). – Koliňany [Koleňany] (Domin 1920 ined.). – Velčice, ruderal site (Eliáš, Acta Ecol., 16, p. 16 1978). – Vieska nad Žitavou, roadside, on sand, 300 m (Domin 1920 ined.; Tomášek 1957 BRNU). – Šurany, roadside (Maloch 1935 KO). – Hurbanovo [Ó-Gyalla], ruderal places (Schiller, Oesterr. Bot. Z. XV, p. 382, 1865). – Chotín, sandy meadows (Kaleta 1961 BRA). – Chotín [Hetín], sandy dunes (Krist, Příroda XXX, p. 294, 1937). – Šrobárová, ruderal place – Marcelová, ruderal place (both data Chrtek et al., Zpr. čs. bot. Společ., Praha, 7, p. 67, 1972). – Marcelová, in the farm area (Eliáš sen. 1982 ined.). – Velké Lovce, Mariánska Čalad, monastery courtyard (Domin 1930 ined.). – Moča [Dunamoč], ruderal places (Weber 1935 BRA). – Mužla ruderal site, 120 m (Chrtková 1968 PR). – Mužla, pastures (Weber 1936 PR). – Kamenín, saline site (Domin 1936 ined.; Hodoval 1969 BRA). – Čifáre, pasture on right bank of stream Telinský potok, loess, 180 m (David 1984 LTM). – Modrany, ruderal place (Chrtek et al., Zpr. čs. bot. Společ., Praha, 7, p. 67, 1972). – Búč, pastures near crossroad (Grulich 1988 MMI). – Moča, ruderal place (Chrtek et al., Zpr. čs. bot. Společ., Praha 7, p. 67, 1972). – Búč, Búcske slanisko saline site (Szabóová 2002 not.;

Zlínska 2003 not.; Szabóová 2013 not., all sec. biomonitring.sk). – Búč SW, ruderalized saline pastures (Eliáš jun. and M. Sádovský 2003 NI). – Kravany nad Dunajom, ruderal place (Chrtek et al., Zpr. čs. bot. Společ., Praha, 7, p. 67, 1972). – Radvaň nad Dunajom, ruderal place (Chrtek et al., Zpr. čs. bot. Společ., Praha 7: 67, 1972). – Kozárovce, rock Kozárovská skala, foothill, pig pasture (Domin 1936 ined.). – Levice, ruderal places in town (Knapp, Oesterr. Bot. Z. XIV, p. 106, 1864). – Hronovce, Vozokany nad Hronom, N from collective farm, field side, loess, 130 m (David 1993 LTM). – railway track Štúrovo – Mužla, 125 m (Domin 1929 ined.). – Ďarmotské kopce Hills, between Hegyfarok and Kapitolský dvor, edge of corn field, 124 m. – Ďarmotské kopce Hills, Belá, Dubník hill, eastern slope, roadside (both Domin 1936 ined.). – Čenkov, Hill 110, sands (Krist, Příroda XXX, p. 295, 1937). – Štúrovo [Párkány] (Kerner, Oesterr. Bot. Z. XXII, p. 382, 1872). – Štúrovo [Párkaň], Ďarmotské kopce hills (Domin 1929 PRC). – Štúrovo [Párkaň], Danube river, sandy banks (Domin 1920 ined.). – Štúrovo [Párkaň], field, 110-125 m (Domin 1921 ined.). – Nána, roadside and in the field (Kerner, Oesterr. Bot. Z., p. 382, 1872; M. Deyl and J. Soják 1964 PR). – Štúrovo (J. Palásek 1955 OL). **7. Košická kotlina Basin:** Turňa nad Bodvou [Torna], 200 m (Životský 1880 PRC; Jos. Dostál 1927 PRC). – Valley of Turňa (Brym, Krásy Slovenska XI, p. 104, 1932). – Drienovec, desert site – Budulov, road margin – Kechnec, desert site – Geča, abandoned site – Haniska, desert site – Trstené pri Hornáde, junkyard – Krásna nad Hornádom, junkyard (all data Krippelová, Acta Instituti botanici Academiae scientiarum Slovacae. Series A Taxanómica, Geobotanica, p. 229, 1974). – Vyšný Lánec, dug ground – Košice, part Šaca, (both data Krippelová, Synanthrope Vegetation des Beckens Košická kotlina. Vegetácia ČSSR, B4. Bratislava, Veda, p. 100, 1981). **8. Východoslovenská nížina Lowland:** Vranov nad Topľou, Čemerné (L. Dostál, Biológia 28/7: 592, 1973). – Vranovské Dlhé, roadside ditch (L. Dostál, Zborn. Východoslov. Múz., ser. AB, XVII: 82, 1976). – Hencovce, abandoned places and roadsides (L. Dostál, Zborn. Východoslov. Múz., ser. AB, XVII: 82, 1976). – Podčičva, alluvium of Ondava River, near bridge (L. Dostál, Zborn. Východoslov. Múz., ser. AB, XVII: 82,

1976; Dudáš in 2019 not confirmed). – Zemplínske Hradište, Ondava River, pasture under dam near mouth of canal Julov kanál, mass occurrence (Dudáš 2016 SAV). – Brehov, Veľký vrch hill, over Ondava River, 200-257 m (Manica 1969 ZV). – Brehov, Ondava River, pasture under bridge (Dudáš 2017 BRNU, KO). – Zemplín, abandoned pasture at farmyard (Dudáš 2017 KO, 2018 BRNU). – Ladmovce, SE, saline site (Trávníček 1992 OL). – Somotor, dead oxbow, littoral (Zaliberová 1979 OLM). – Somotor, pasture on hills (Margittai, Bot. Köz. 26: 31, 1929). – Viničky [Seleška], 100 m (Šourek 1954 PR). – Streda nad Bodrogom, Veterné piesky site (Mikoláš 1989 KO; Dudáš 2018 KO). = Streda nad Bodrogom, Tarbucka hill, NW foothill (Grulich 1988 MMI). = Tarbucka, foothill, sandy oversift, 110-150 m (Margittai, Sborn. Přír. Kl. Košic II: 86, 1935). – Vojany, 100 m (Jos. Dostál 1947 PR). – Rad, cutoff of Latorica River (Mikoláš 1984 KO). – Pavlovo, Kerestúr farmstead, pasture (P. Kusák 1990 OLM). – Slovenské Nové Mesto, pig pastures, 100-110 m (Domin 1932 ined.). – Kráľovský Chlmec, Vysoká hora hill, pasture, 200-250 m (Manica 1969 ZV). – Vinné (V. Pospíšil 1958 BRNM).

### *Carpathicum*

Praecarpathicum. **9. Biele Karpaty Mts. (southern part):** Lubina, ruderal places (Holuby, Kvetena Javor. 24, 1871). – Trenčianske Bohuslavice [Bohuslavice], farmstead, roadside (Holuby 1895 PR, 1896 BRA). **10. Malé Karpaty Mts.:** Buková [Jablonica, Biksard settlement], pasture, 320 m (Krist 1936 BRNU; Valenta 1936 BRA). – Smolenice, valley under Wetterlin hill, 200 m (J. Nevole 1948 BRNU). **12. Tribeč Mts.:** Jelenec, Gýmešský Kostol, pasture (Vlach 1927 PRC). – Nitra, Zoborské vrchy Mts. (Vlach, Věda přír. X, 1929). **13. Strážovské and Súľovské vrchy Mts.:** Trenčín (Szontagh, Oesterr. Bot. Z. XIV: 273, 1864). – Prievidza (S. Magdolenová 1968 BRA). **14a. Pohronský Inovec Mts.:** Nová Baňa, Hron [Gran] River, bank (Knapp, Oesterr. Bot. Z. XIV: 116, 1864a). – from Rudno nad Hronom towards Nová Baňa (Knapp, Oesterr. Bot. Z. XIV: 115, 1864a). **14b. Vtáčnik Mts.:** Žiar nad Hronom [Garam Keresztúr] (Abaz 1895 BP). – Kremnica (Zechenter s. dato BRA). **14c. Kremnické vrchy Mts.:** Banská Bystrica, Radvaň, roadside

(Márkus, Oesterr. Bot. Z. XV: 308, 1865). **14d. Poľana Mts.:** Detva (Reuss, Května Slovenska, p. 275, 1853). **14e. Štiavnické vrchy Mts.:** Prenčov [Prenčow] (Kmeť 1897 BRA). – Žibritov, under Krompach hill, near pasture, 470 m, only one plant (Schieber in Dudáš (ed). *Thaiszia* – J. Bot. 29/2: 236, 2019). – Hodruša [Hodris], towards Žarnovica nad Hronom [Zsarnovisc] (Knapp, Oesterr. Bot. Z. XIV: 115, 1864a). **14f. Javorie Mts.:** Krupina, Biely Kameň, only one plant (M. Horváthová 1969 BRA). – Krupina [Karpfen], ruderal places and train lines (Márkus, Oesterr. Bot. Z. XV: 360, 1865). – Kalinka (Vitoušek 1896 BRNU). – Divín (Reuss, Května Slovenska, p. 275, 1853). **15. Slovenské rudohorie Mts.:** Lučenec, Píla (Freyn, Verh. Z.-B. Ges. Wien XXII. Abh 1872: 349). – Cinobaňa (Reuss, Května Slovenska, p. 275, 1853). **15. Slovenské rudohorie Mts. / 16. Muránska planina Plateau:** Tisovec (Szontagh, Oesterr. Bot. Z. XVI: 149, 1866). **18. Stredné Pohornádie valley:** Malá Vieska, under Vápenica hill (Jurko, Veg. Stred. Pohornádia 1951: 80).

*Intracarpaticum*. **26b. Spišské kotliny Basins:** Spišské Vlchy [Wallendorf in der Zips] (Sagorsky and Schneider, Fl. der Zentralkarpathen II: 224, 1891).

*Beschidicum occidentale*. **28. Západné Beskydy Mts.:** Žilina, railway embankment (Holuby, Oesterr. Bot. Z. XXIV: 321, 1874). – between Bytča [Bicsitz] and Žilina [Sillein], road edge (Rowland, Presb. Ver. III. 1, p. 22, 1858).

*Beschidicum orientale*. **30a. Šarišská vrchovina hill area:** Šebastová, roadside (Májovský, Biologia IX, p. 149, 1954).

#### **Common and unclear data (not mapped):**

Malé Karpaty Mts. (s. col. 1920 PRC). – Gemer area [Gömör] and Šariš area [Sáros] (Hazslinskyi s. anno BP). – Košice, fields, roads, vineyards (Pawlowski, Verh. Ver. Nat. Presb. I: 27, 1856). – near Poprad at Kežmarok (Hausknecht, Oesterr. Bot. Z. XIV: 208, 1864). – trough of Šajava River up to Plešivec and Vyšná Revúca (Reuss, Května Slovenska, p. 275, 1853). – Slovenský kras (Dostál, Vel. Kvet. ČSR IV: 41, 1933). – Bratislava, surroundings (Bolla, Verh. Ver. Nat. Presb. I: 10, 1856). – Tribečské kopce Mts., W foothills from Dražovce through Oponice up to Kovarce, abandoned and ruderal places (Domin 1920 ined.). – valley of Cirocha River from Humenné up to Stakčín (Behrendsen, Bot. Zeit. XXXIV: 682, 1876). – Latoricko: Oborín – Boľ (J. Malý 1996 BRNU). – from Častkovce towards Trnava (Holuby, Oesterr. Bot. Z. XX: 363, 1870). – in villages on foothills in line Smolenice – Buková [Biksard] – Jablonica (Nevole, Práce Mor. Př. Sp. VI.5, p. 120, 1931). – Starý Bar (V. Hodoval 1977 BRA). – Plášťovce? [Plášterce] (Domin 1932 ined.).