

Revision of occurrence and phytosociology of *Ranunculus pedatus* Waldst. et Kit. in Slovakia

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Abstract: *Ranunculus pedatus* is a Eurasian species with a northern distribution edge in southern Slovakia. In the nineties of the 20th century, it was assumed that the species probably occurs only near Štúrovo. Occurrence in the Hron and Ipeľ basins and several localities in the Podunajská nížina lowland between Komárno and Štúrovo was considered historical. Our research was conducted in the field and herbarium collections of 15 herbaria in Austria, the Czech Republic, Hungary, and Slovakia. Except for the well-known occurrence on salt habitats north of Štúrovo, we confirmed the recent occurrence of *R. pedatus* in Štúrovo town, around Chľaba village and in Ipeľ Basin (Pastovce, Tupá). The new, easternmost Slovak locality was found near the village of Koláre. Recently, 30% of all known sites were confirmed, so we propose reclassifying the species in Slovak Red List from the category critically endangered (CR) to the category endangered (EN). It occurs in salty meadows of the alliance *Festucion pseudovinae* (class *Festuco-Puccinellietea*) and in mesic meadows of alliance *Arrhenatherion elatioris* and *Deschampsion cespitosae* (class *Molinio-Arrhenatheretea*).

Keywords: distribution, communities, *Ranunculus*, Red List.

Introduction

Genus *Ranunculus* includes, in a broad sense, more than 300 species distributed worldwide except lowland tropics (Cook 1993; Tutin & Akeroyd 1993; Whittemore 1997). About 40 taxa are known in Slovakia (Futák 1982; Husák & Slavík 1982), and a half of them belong to relatively common taxa. Twenty-one species are included in the actual Slovak Red List of ferns and flowering plants, where *Ranunculus pedatus* (Fig. 1) is evaluated in the category “critically endangered” (Eliáš et al. 2015). The species is a Eurasian perennial species, and its distribution extends from Slovakia, Hungary, Romania and Bulgaria, through the former Yugoslavia, Ukraine, southern and central Russia to Crimea, the Caucasus, Siberia and Turkey (Feráková 1999). From the taxonomical point of view, the species is included in subgen. *Ranunculus* and sect. *Ranunculastrum* (Tutin & Akeroyd 1993) or sect. *Pterocarpa* (Tzvelev 2012). Two subspecies are known to occur within the distribution area; subsp. *pedatus* is present in most of the area, whereas subsp. *trojanus* Davis is known in Turkey (Davis 1965). Two close related taxa, occurring in the eastern part of the species distribution range, have been described: *R. odesanus* Klok. fil. from W Ukraine and Moldova, and *R. silvisteppaceus* Dubovik [syn. *Ranunculus pedatus* subsp. *silvisteppaceus* (Dubovik) Elenevsky & Derv.-Sok.] from Central Russia. At present, they are evaluated only within the variability of the species (Tzvelev 2012; Hörandl & von Raab-Straube 2015).

In Slovakia, *R. pedatus* is considered a halophytic species and occurring in the *Festucion pseudovinae* and *Puccinellion limosae* communities. According to current knowledge, the species occurs currently only in the vicinity of Štúrovo, in some areas (the Ipeľ Basin), it has not been found for a long time (Futák 1982; Feráková 1999).

Two aims of our work were: 1) to revise the historical and current occurrence of the species in Slovakia, and 2) based on our phytosociological relevés, to analyse the communities with the presence of *R. pedatus*.

Material and Methods

The study was carried out during 2017–2020. The data concerning the distribution of the species was achieved from public herbaria BP, BRA, BRNM, BRNU, KO, LTM, MMI, NI, PMK, PR, PRC, SAV, SLO, W, and ZV. Abbreviations of herbaria are according to Thiers (2020+). Phytogeographical divisions of Futák (1980) are used. The map was prepared in Corel Draw using the map grid described by Niklfeld (1971).

We used only our published (relevés 2, 5, 8 in Tab. 1, Dítě et al. 2010) as well as unpublished phytosociological relevés. The phytosociological relevés were sampled according to the Zürich-Montpellier approach using the adapted nine-grade Braun-Blanquet’s scale (Barkman et al. 1964). All relevés were stored in the database, using the TURBOVEG software (Hennekens 1996). The relevés were classified by divisive cluster analysis using program Juice (Tichý 2002). The numerical classification was determined using the TWINSpan algorithm (Hill 1979). Nomenclature of the flowering plants follows Marhold & Hindák (1998) and the names of syntaxa are

according to Hegedúšová Vantarová & Škodová (2014). The syntaxa missing in the mentioned publication are provided with the authors and year of the description.

Results and Discussion

Distribution

The revision of herbarium vouchers stored in 15 public herbaria showed that the species has occurred at 33 localities (Fig. 2, Appendix) in three phytogeographical districts of the Pannonian flora (*Pannonicum*): the Podunajská nížina lowland, the Burda hills, and Ipeľsko-rimavská brázda region. For comparison, Futák (1982) listed nine localities and Feráková (1999) listed ten localities, however, she does not specify exact localities in the vicinity of Štúrovo. During our field research, we confirmed the recent occurrence of *R. pedatus* at ten localities (four of them are new): saline habitats near Kamenín and Kamenný Most, in Štúrovo town (three new localities), around Chľaba village (near Modrá ryba pub and in the alluvium of Ipeľ river), in Ipeľ Basin (Pastovce, Tupá) and near the village of Koláre (new locality). This last-mentioned site represents the easternmost Slovak locality. While *R. pedatus* has been documented continuously since the middle of the 19th century (Feichtinger 1862 BP, 1899) until today (e.g., Feráková 1999; Melečková et al. 2013) in the salt marshes around Kamenín and Kamenný Most, in the Ipeľ basin has not been confirmed more than 60 years. The first data from the lower course of the river Ipeľ near Chľaba (phytogeographical district Burda hills) are dated from the first half of the 19th century (Grundl 1855 BRA, 1861 BP; Feichtinger l. c.). However, it was recorded further north near Pastovce and Šahy (phytogeographical district Ipeľsko-rimavská brázda region) until about 80 years later (Domin 1933, 1938 ined. in Futák 1982). *R. pedatus* was relatively common in the broader vicinity of Šahy town; eleven localities were recorded from WWII to the beginning of the 1960s (David 1987, Appendix). However, most of these localities disappeared, and during field research, we confirmed only one in the village of Tupá. Considering the relative vicinity of the *R. pedatus* localities around Šahy and near Koláre and the localities in northern Hungary (Sramkó & Magos 2007; Bartha et al. 2015), we could anticipate that other sites may be discovered or confirmed in this area in the future.

Ranunculus pedatus is evaluated in category “critically endangered” (CR) in actual Slovak Red List of ferns and flowering plants (Eliáš et al. 2015). The evaluation took into account only the localities near Štúrovo (salt meadows in Kamenín and Kamenný most, Fig. 3), and other historically known localities were considered disappeared. Our research confirmed about 30% of all known localities, resulting in 10 declared localities (confirmed or newly found), and 23 localities disappeared. Based on that, we propose to reclassify the species in the category “endangered” (EN) according to IUCN methodology (IUCN 2012).



Fig. 1 *Ranunculus pedatus* Waldst. et Kit. flowers and characteristic cylindrical aggregate fruits (apocarpium).

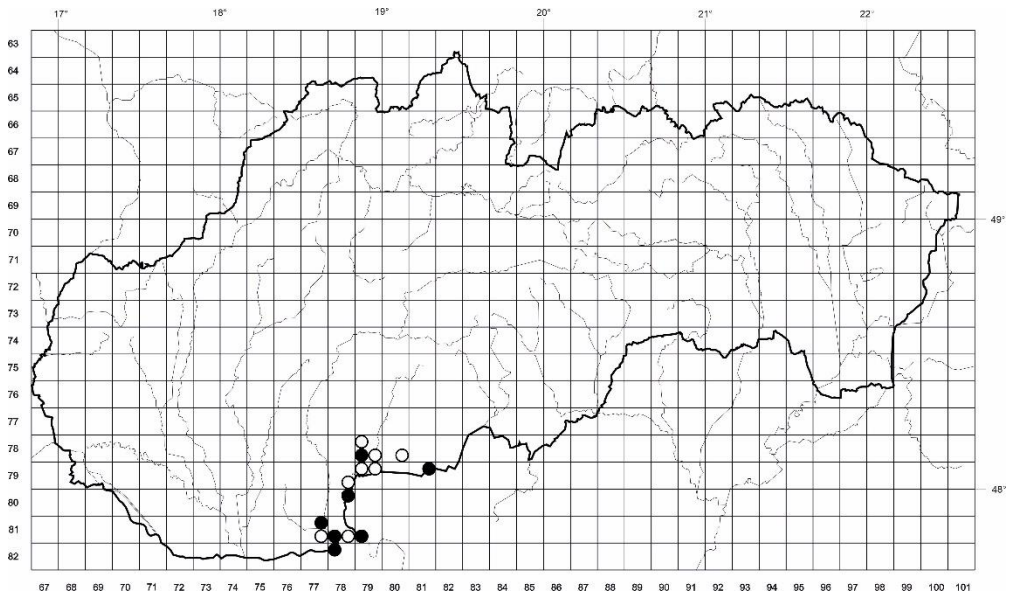


Fig. 2 Distribution of *Ranunculus pedatus* Waldst. et Kit. in Slovakia: ○ – historical localities not confirmed during field research, ● – recent localities.

Coenology

We sampled 16 phytosociological relevés in stands with presence of *Ranunculus pedatus* (Tab. 1). Results showed that the species was recorded in a larger number of phytocoenoses than previously reported. We confirmed the species in communities included to two classes of grassland vegetation: *Festuco-Puccinellietea*, and for the first time, from *Molinio-Arrhenatheretea*.

The class *Festuco-Puccinellietea* represents vegetation of inland salt steppes dominated by perennial grasses and herbaceous species (Mucina 1993; Dítě et al. 2014). Within this unit, we recorded *R. pedatus* in two associations of alliance *Festucion pseudovinae*, namely in secondary short-grass alkali steppes of *Achilleo-Festucetum pseudovinae* (Tab. 1, relevé 1) and primary plant community of the salt steppes of *Artemisio-Festucetum pseudovinae* (relevés 2-9). We have thus confirmed previously published data (Šmarda 1952; Vicherek 1973; Futák 1982; Feráková 1999).

Šmarda (l. c.) as well as Feráková (l. c.) mentioned the species also in the alliance *Puccinellion limosae* representing plant communities of open and species-poor vegetation dominated by *Puccinellia* species, developed on strongly salt-affected soils. *R. pedatus* is actually mentioned in this vegetation, e.g. from Hungary [Borhidi et al. 2012; associations *Matricario-Plantaginetum tenuiflorae* (Soó 1933) Borhidi 1996 and *Limonio-Artemisietum santonici* (Soó 1927) Topa 1939], but, we did not record the species in such stands in Slovakia. Futák (1982) also mentioned the occurrence of *R. pedatus* in stands of the alliance *Trifolio-Ranunculion pedati* Slavnić



Fig. 3 Salt steppes between Kamenný Most and Kamenín are the most famous locality of *Ranunculus pedatus* Waldst. et Kit. in Slovakia.

1948, but this vegetation is not present in our territory, because this is typical for saline habitats with variable moisture and slight soil salinity in the Balkans (Šilc et al. 2014; Dajić-Stevanović et al. 2016). Within the halophytic vegetation, *R. pedatus* is also reported from alliance *Peucedano officinalis-Asterion sedifolii* Borhidi 1996 and *Beckmannion eruciformis* Soó 1933 in adjacent Hungary (Molnár & Borhidi 2003; Borhidi et al. 2012).

According to our findings, the majority of current sites with stands of *R. pedatus*, belong to the class *Molinio-Arrhenatheretea* including moist and mesophilic meadows and pastures.

In this vegetation class, we found the species in alliance *Arrhenaterion elatioris* including various types of agronomical used mesophilic meadows with a predominance of forage-valuable grasses and dicotyledonous herbs; the association also includes high-stellar stands of flood dams, ditches, artificial railway and road embankments (Hájková et al. 2014). The latter secondary types also represent stands with the occurrence of *R. pedatus* near Chľaba and in Štúrovo and we consider them to be atypical ruderalised stages of the association *Pastinaco sativae-Arrhenatheretum* (Tab. 1, relevés 10-11). In habitats where soil was rolled up or piled up (edge of the railway line in Tupá, dam near Koláre), we recorded *R. pedatus* in stands close to the association *Alopecuro-Festucetum pseudovinae* (Tab. 1, relevés 12-13) from the alliance *Cynosurion cristati*. The community occurs in not salinized, arid habitats located on ridges or edges of river alluvia that are not flooded or affected by groundwater. This vegetation type represents transitional stands of the *Festuco-Brometea* and *Molinio-Arrhenatheretea* classes. The dominant species of association is *Festuca pseudovina*, *F. rupicola*, *F. pratensis* and *Poa pratensis* are also common (Hájková et al. 2014). Within this alliance, we also found the species in the vegetation of trampled habitats in the urban area of Štúrovo town (near Rego restaurant). In stand, *Lolium perenne* predominates and significant presence of *Cynodon dactylon*, *Erodium cicutarium*, *Medicago sativa*, *Plantago lanceolata* and *Polygonum aviculare* was found. This stand represents the association *Lolietum perennis*, according to Hájková et al. (2014) it can be considered as one from the most widespread communities in Slovakia. However, we do not have it documented by a phytocenological relevé.

R. pedatus has occupied also alluvium of the Ipel' river (Chľaba, Pastovce) where we found it in stands of the association *Poo trivialis-Alopecuretum pratensis* (Tab. 1, relevés 14-16), alliance *Deschampsion cespitosae*. In Slovakia, the occurrence of the association is concentrated in the alluvium of the lower reaches of larger rivers, especially in the Východoslovenská nížina lowland and in the Ipel' river basin (Hájková et al. 2014).

Based on herbarium data (see Appendix), it is clear that *R. pedatus* also grew in xerothermic stands of the *Festuco-Brometea* class in Slovakia, but, we did not confirm this vegetation affinity during our field research. Interestingly, Dúbravková et al (2010) recorded the species rarely in stands of the *Stipetum tirsae* association

(alliance *Festucion vallesiaceae*) near the village of Szob in Hungary (Ruzsás-hegy Mt., rel. 113), which is close to the Chľaba locality in Slovakia. In addition, the occurrence of *R. pedatus* in the alliance *Festucion valesiaceae* is already mentioned in older Hungarian literature (Soó 1980).

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Appendix: List of localities with occurrence of *Ranunculus pedatus* in Slovakia.

The records are arranged according to the phytogeographical division of Slovakia (Futák 1980). Hungarian, German and Latin names of localities are given in square brackets.

- 1. Burda hills:** Kováčov, meadows (Jos. Černý 1935 PRC, sine dato and collectore BRA; Skřivánek 1962 BRNM). – between train stops Kováčov and Chľaba, forest clearings and forest edges (Černoch 1962 BRNM). – between Kováčov and Chľaba [Helemba], meadows near train lines (Valenta 1937 BRA). – Chľaba [Helemba], (subsaline) meadows near village, 116–200 m (Skřivánek 1929, 1948, 1962 BRNM; Krist 1934, 1936 BRNU). – Chľaba, bound near forest edge upper the Modrá ryba pension (Grulich 1987 MMI). – Chľaba, W from the village, rest of meadow near road opposite to Modrá ryba pension, 111 m (Svobodová 1974 NI; Grulich 1987 MMI; Eliáš jun. 2017 NI). – Chľaba [Helemba], field limit, 115 m (Černoch 1954 BRNM). – Chľaba [Helemba] (Grundl 1855 BRA; V. Nábělek 1937 SAV). – Chľaba, grasslands at train stop, 110 m (Černoch 1962 BRNM). – Chľaba [Helemba], near the Ipeľ river, 109 m (Grundl 1861 BP; Domin et Jirásek 1938 NI, PRC). – Chľaba, alluvial meadows ca 300 m E from the village, 115 m (Eliáš jun. 2017 NI).
- 2. Ipeľsko rimavská brázda region:** Pastovce, alluvial meadows at SW edge of the village, 112 m (Eliáš jun. 2017 NI). – Ipeľský Sokolec, slopes in vineyards, 160 m (Švec

1949 LTM). – Ipeľský Sokolec, near the country road SW from the village, 140 m (Švec 1957 LTM). – Hokovce, meadow near Štiavnička stream, 150 m. – Tupá, around road to vineyards, 160 m. – Tupá, on the railway embankment, 160 m (both data Švec 1946 LTM). – Tupá, the edge of country road, 150 m (Švec 1948 LTM). – Tupá, grassland site near train lines between train stop and railroad crossing, 130 m (Eliáš jun. 2018 NI). – Slatina, near the road to the Slatina spa, 160 m. – Dolné Túrovce, meadows near the Krupinica river (both data Švec 1946 LTM). – Hrkovce, on the railway embankment, 150 m. – Tešmák, Veľký vrch [Kopasz hegy], southern steppe slope, 170 m (both Švec 1948 LTM). – Vinica, W from the village, near the country road, 270 m (Švec 1963 LTM). – Koláre, alluvial meadows and dyke of Ipeľ river from E edge of the village to Čekovský potok stream, 140 m (Eliáš jun. 2017, 2019 NI).

6. Podunajská nížina lowland: Štúrovo [Parkan], Belianske [Darmotské] kopce hills, in the bushes under the Modrý vrch hill [Kekito] (Ferd. Weber 1927 BRNM; Krist 1934 BRNU; Klokner 1970 PMK). =? Nána, steppe hills (Skřivánek 1934 PRC). – Kamenín [Kamendín], salt meadows Alsó rétek S from the village, 114–120 m (Ferd. Weber 1934 BRA, 1967 BRNU; Krist 1936 BRNU; Valenta 1937 BRA; Futák 1947 SLO; F. Šmarda 1947 BRNM, PR; Skřivánek 1948 BRA, BRNM, 1950 BRNM; Černocho 1950 BRNM; Kavka 1950 BRA; D. Novák 1950 BRNM; Součková et J. Šmarda 1950 BRNM; Šourek 1951 PR; J. Špaček 1951 BRNU; Holubičková et Ondráková 1952 PR; Chrtek 1959 PRC; Smejkal 1962 BRNU; Májovský 1965 SLO; Valentine et soc. 1965 SLO; Vicherek 1970 BRNU; Jos. Dvořák 1975 BRA; Jasenák 1976 LTM; Grulich 1987 MMI). – saline pastures between Kamenín and Kamenný Most, 126 m (Jávorka 1939 BP; Jos. Dvořák 1979 BRA; Šípošová et Peniašteková 1989 SAV). – Kamenný Most [Köhidyarmat], saline pastures N from the village, 110–125 m (Feichtinger 1862 BP, 1869 BRA; Bertová 1965 BRA; Vicherek 1970 BRNU; Saul 1979 BRNM; J. Štěpánek 1984 PR; Eliáš jun., D. Dítě et Sádovský 2004 NI). = Kamenný Most, saline pastures Čistiny, 2 km NW from the village (Grulich 1987 MMI). – Nána, meadows (Jos. Dvořák 1947 BRNM, BRNU; J. Novotný 1947 BRNM; Hejný et Opluštiová 1949 SLO; Jos. Černý 1954 PR). – meadows near road Nána – Štúrovo (Chrtek 1959 PRC). – meadows near train lines Nána – Štúrovo [Parkan] (F. A. Novák 1922 PRC). – Štúrovo [Parkáň], subsaline meadows at train station (Skřivánek 1948 BRNM). – wet meadows near the train lines Štúrovo [Parkáň] – Kamenica nad Hronom, 118 m (F. Šmarda 1947 BRNM; Hejný et Opluštiová 1949 SLO; Jos. Dostál 1954 PR). – Štúrovo (Nábělek 1932 BRA; Jos. Černý 1935 PRC). – Štúrovo, (wet) meadows near the town, 120–180 m (Jos. Černý 1929 SAV; Osvačilová 1947 NI; Hejný et Opluštiová 1948 SLO; J. Šmarda 1951 BRNM; Žertová 1952, 1959 PR; Fr. Černocho, Houfek et J. Soják 1956 PR). – Štúrovo, Dunaj river dyke, S of the Mária Valéria bridge, 107 m (Eliáš jun. 2010 NI) – Štúrovo, lawn in front of the Rego restaurant, 108 m (D. Dítě & Z. Dítě 2018 ined.). – Štúrovo, Dunaj river dyke at NE edge of the town, 107 m (Eliáš jun. 2017 NI).

Common data (not mapped): 1. Kováčovské kopce hills (Futák 1954 SLO).

Tab. 1 Phytosociological table of current *Ranunculus pedatus* vegetation in Slovakia.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Cover herb layer (%)	90	75	70	90	75	70	30	70	80	80	85	85	90	85	70	95
Cover moss layer (%)	10	10	20	70	60	80	90	80	5	10	-	30	-	60	10	-
<i>Limonium gmelinii</i>	a	a	a	3	1	1	1	b	a	.	.	.	.	.	.	.
<i>Cruciata pedemontana</i>	1	+	.	a	+	+	.	1	+	.	.	.	.	.	.	.
<i>Artemisia santonicum</i>	.	3	a	b	3	b	a	b	3	.	.	.	.	.	.	.
<i>Vicia tetrasperma</i>	.	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.
<i>Dichodon viscidum</i>	1	3	.	+	a	1	.	.	1	.	.	.	.	.	.	.
<i>Allium vineale</i>	.	1	+	+	+	.	.	1	.	.	.	.	r	.	.	.
<i>Festuca pseudovina</i>	b	3	3	a	4	a	1	b	3	.	.	1	3	.	.	.
<i>Achillea millefolium</i>	+	.	.	1	.	.	.	.	.	1	.	b	a	b	.	b
<i>Poa pratensis</i>	a	.	.	.	.	+	.	.	.	3	3	b	1	a	a	a
<i>Vicia sativa</i>	.	.	.	.	+	.	.	.	.	1	1	1	a	.	1	a
<i>Plantago media</i>	.	.	.	.	.	.	.	.	.	+	b	.	r	a	.	1
<i>Valerianella locusta</i>	.	+	.	.	.	.	.	.	.	.	+	+	1	1	.	1
<i>Cerastium holosteoides</i>	.	.	.	.	.	.	.	.	.	.	+	1	1	+	.	1
<i>Ranunculus pedatus</i>	1	1	+	1	1	b	r	+	+	+	1	a	+	1	+	+
<i>Alopecurus pratensis</i>	1	.	a	1	.	1	.	1	.	b	.	3	a	3	3	a
<i>Lamium purpureum</i>	.	+	.	a	+	.	.	+	.	+	+	1	1	+	.	+
<i>Veronica arvensis</i>	1	+	+	1	1	1	.	1	.	.	+	.	+	+	.	.
<i>Trifolium campestre</i>	1	a	1	+	+	+	.	+	.	.	.	.	.	b	.	a
<i>Erophila verna</i>	+	.	.	1	.	1	a	.	.	.	.	.	+	+	.	+
<i>Carex praecox</i>	1	.	.	.	.	.	.	.	.	a	.	a	1	.	.	.
<i>Ornithogalum umbellatum</i>	.	.	+	r	.	.	.	.	.	+	+	.	+	.	.	+
<i>Bromus hordeaceus</i>	.	.	1	.	1	+	.	.	.	.	.	.	.	3	.	3
<i>Plantago maritima</i>	.	+	.	.	1	1	a	a	.	.	.	.	.	.	.	.
<i>Myosotis ramosissima</i>	1	.	.	1	.	+	.	.	.	.	.	.	.	.	.	+
<i>Matricaria recutita</i>	.	+	.	.	.	1	1	r	.	.	.	.	.	.	.	.
<i>Galium verum</i>	.	.	+	+	.	.	.	a	.	b	.	.	.	.	.	.
<i>Taraxacum sect. Ruderalia</i>	.	.	.	.	.	.	.	.	.	.	.	1	.	1	b	1
<i>Daucus carota</i>	r	.	.	.	.	.	.	.	.	.	.	.	1	.	+	1
<i>Stellaria media</i>	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	1
<i>Tithymalus esula</i>	.	.	.	.	.	.	.	.	.	a	.	.	+	.	1	1
<i>Capsella bursa-pastoris</i>	.	.	.	+	.	.	.	.	.	.	+	.	+	+	.	.
<i>Myosurus minimus</i>	+	.	.	a	.	+	.	.	.	.	.	.	.	.	.	.
<i>Achillea collina</i>	.	.	+	.	.	.	+	a	.	.	.	.	.	.	.	.
<i>Geranium pusillum</i>	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+
<i>Festuca rupicola</i>	3	.	.	.	.	.	.	.	.	.	.	a	1	.	.	.
<i>Arabidopsis thaliana</i>	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.
<i>Rumex crispus</i>	.	r	.	.	.	.	.	.	.	.	.	.	.	1	.	1
<i>Podospermum canum</i>	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.
<i>Galatella punctata</i>	.	+	b	.	.	.	.	1	.	.	.	.	.	.	.	.
<i>Camphorosma annua</i>	.	.	.	.	.	a	1	.	a	.	.	.	.	.	.	.
<i>Bromus japonicus</i>	.	1	.	.	+	.	.	.	+	.	.	.	.	.	.	.
<i>Erigeron acris</i>	.	.	.	.	.	.	.	.	.	+	.	1	.	.	+	.

Tab. 1 - cont.

<i>Glechoma hederacea</i>	. . . . .	1 . . +	1
<i>Silene latifolia</i> ssp. <i>alba</i>	. . . . .	1 + +	
<i>Medicago sativa</i>	. . . . .	1 1 b	
<i>Convolvulus arvensis</i>	. . . . .	+ a . a	
<i>Ranunculus polyanthemos</i>	. . . . .	. . . 1 . . . 1 1	
<i>Plantago lanceolata</i>	. . . . .	. . . . . 1 + a	
<i>Lotus corniculatus</i>	. . . . .	. . . . 1 . . 1 a	
<i>Vicia hirsuta</i>	. . . . .	. . . . a + . . +	
<i>Acetosa pratensis</i>	. . . . .	a . . + . . . 1	
<i>Arrhenatherum elatius</i>	. . . . .	3 1 a	
<i>Veronica hederifolia</i> agg.	. . . . .	+ + . . . . . +

Species recorded in two relevés only: *Bromus racemosus* + (4), + (6), *Carex melanostachya* **1** (15), **1** (16), *C. stenophylla* + (3), + (9), *Cerastium subtetrandrum* + (3), + (9), *Cichorium intybus* **1** (13), **1** (16), *Cynodon dactylon* **1** (3), **1** (13), *Dactylis glomerata* **2b** (11), **1** (12), *Epilobium tetragonum* **r** (6), + (7), *Galium mollugo* agg. **2a** (12), **1** (14), *Jacea pratensis* **2a** (14), **2a** (15), *Knautia arvensis* + (11), **1** (13), *Lactuca serriola* **r** (6), + (13), *Myosotis stricta* + (2), + (8), *Ornithogalum kochii* **r** (2), + (8), *Poa angustifolia* **1** (3), + (8), *Potentilla argentea* + (2), **2b** (16), *P. reptans* **2a** (10), **2a** (15), *Puccinellia distans* agg. **1** (6), **1** (9), *Ranunculus repens* **1** (12), **2a** (15), *Salvia nemorosa* **1** (10), **1** (12), *Tanacetum vulgare* + (14), + (16), *Trifolium pratense* **1** (15), **2a** (16), *Valerianella rimosa* **1** (1), + (6), *Vicia grandiflora* **1** (10), **1** (11), *Viola arvensis* **1** (4), **1** (13).

Species recorded in one relevé only: *Acetosella vulgaris* **2a** (14), *Acosta rhenana* + (11), *Allium scorodoprasum* **1** (11), *Arenaria serpyllifolia* + (11), *Armoracia rusticana* **1** (13), *Artemisia vulgaris* **1** (14), *Atriplex patula* + (4), *Carduus acanthoides* + (13), *Carex hirta* **1** (14), *Catabrosa aquatica* **1** (6), *Ceratophyllum submersum* + (9), *Cirsium arvense* + (15), *C. canum* + (1), *Colchicum autumnale* + (15), *Draba nemorosa* + (11), *Echium vulgare* + (10), *Erodium cicutarium* **1** (11), *Eryngium campestre* **1** (11), *Falcaria vulgaris* + (12), *Galium boreale* **1** (10), *Holcus lanatus* + (8), *Holosteum umbellatum* + (13), *Inula britannica* + (1), *Jacea pratensis* **2a** (16), *Lamium amplexicaule* **1** (13), *Lathyrus pratensis* **1** (16), *Leontodon autumnalis* **2a** (13), *Lepidium perfoliatum* **2a** (4), *Papaver dubium* **r** (13), *Plantago tenuiflora* **1** (9), *Poa bulbosa* + (13), *Potentilla heptaphylla* **r** (8), *Rorippa austriaca* + (15), *Rumex patientia* **1** (10), *Securigera varia* **1** (12), *Silene vulgaris* **1** (12), *Stenactis annua* + (11), *Symphytum officinale* **1** (15), *Thlaspi perfoliatum* + (12), *Tithymalus cyparissias* **1** (11), *Trifolium angulatum* **2a** (3), *Veronica persica* **r** (13), *Veronica polita* + (12), *Vicia tenuifolia* **1** (15).

Localities of relevés (Tab. 1.)

Note: For relevés, the header data are listed in the following order: number of relevé, locality, exposition, elevation, coordinates, altitude, sampling date, and sampler.

1. Kamenný Most, remnants of the salt steppe at the railway line, -, -, 47°51'40.4"N 18°38'19.5"E, 110 m, 8. 5. 2004, P. Eliáš jun., M. Sádovský, D. Dítě.
2. Kamenný Most, relatively well preserved vegetation of the salt steppe north of the village, -, -, 47°51'42.1"N 18°38'40.6"E, 109 m, 8. 5. 2004, P. Eliáš jun., M. Sádovský, D. Dítě (Dítě et al. 2010).
3. Kamenín, Kamenínske slanisko Nature Reserve, overgrown salt pan, grazed, -, -, 47°52'39.0"N 18°38'53.3"E, 108 m, 13. 5. 2015, P. Eliáš jun., Z. Dítě, D. Dítě.
4. Kamenín, Kamenínske slanisko Nature Reserve, grassland, -, -, 47°52'44.0"N 18°38'51.5"E, 109 m, 8. 5. 2004, P. Eliáš jun., M. Sádovský, D. Dítě.

5. Kamenný Most, relatively well preserved vegetation of the salt steppe north of the village, -, -, 47°51'42.0"N 18°38'40.6"E, 109 m, 8. 5. 2004, P. Eliáš jun., M. Sádovský, D. Dítě (Dítě et al. 2010).
6. Kamenín, Čistiny Nature Reserve, remnants of salt steppe vegetation on the southern edge of the protected area, -, -, 47°51'53.1"N 18°38'08.5"E, 110 m, 8. 5. 2004, P. Eliáš jun., M. Sádovský, D. Dítě.
7. Kamenín, Kamenínske slanisko Nature Reserve, in halophytic vegetation with *Camphorosma annua*, -, -, 47°52'44.0"N 18°38'41.5"E, 109 m, 13. 5. 2005, P. Eliáš jun., D. Dítě.
8. Kamenín, Kamenínske slanisko Nature Reserve, degraded halophytic vegetation, -, -, 47°52'38.9"N 18°38'53.3"E, 109 m, 9. 5. 2009, P. Eliáš jun., D. Dítě (Dítě et al. 2010).
9. Kamenín, Čistiny Nature Reserve, remnants of salt pan, northern slope, 3°, 47°51'56.7"N 18°38'03.3"E, 110 m, 15. 5. 2011, P. Eliáš jun., Z. Dítě, D. Dítě.
10. Chřába, road edge near Modrá ryba pension, southern slope, 5°, 114 m, 28. 4. 2017, P. Eliáš jun.
11. Štúrovo, grassland near the Dunaj river, -, -, 47°48'14.9"N 18°43'37.2"E, 103 m, 28. 4. 2017, P. Eliáš jun.
12. Tupá, grassland near the train stop in village, -, -, 48°06'42.7"N 18°53'39.5"E, 129 m, 18. 4. 2018, P. Eliáš jun.
13. Koláre, dam of the Ipeř River, south-eastern slope, 45°, 48°04'24.8"N 19°15'32.3"E, 136 m, 24. 4. 2017, P. Eliáš jun.
14. Pastovce, alluvium of the Ipeř River, -, -, 47°57'51.7"N 18°45'55.8"E, 108 m, 5. 5. 2017, P. Eliáš jun.
15. Chřába, alluvium of the Ipeř River, -, -, 47°49'44.5"N 18°50'13.6"E, 105 m, 28. 4. 2017, P. Eliáš jun.
16. Pastovce, alluvium of the Ipeř River, -, -, 47°57'54.1"N 18°45'54.0"E, 108 m, 5. 5. 2017, P. Eliáš jun.