

Distribution and habitat preferences of *Tripolium pannonicum* subsp. *pannonicum* (Asteraceae) in Slovakia

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Abstract: We studied historical and recent distribution of halophytic species *Tripolium pannonicum* subsp. *pannonicum* in Slovakia. In total, 60 localities were recorded, 49 sites are documented by herbarium vouchers and 11 sites were excerpted only from the literature and unpublished data. Historical data are shortly discussed and some traduced errors are explained. Only 27 localities were confirmed recently (46%), therefore the status EN (endangered) in the actual Slovak Red list was confirmed. Map of the historical and recent distribution of the subspecies is given. Periodically flooded and dried shallow inundations in strongly saline soils have been identified as typical habitat of *T. pannonicum* subsp. *pannonicum*, but we recorded it also on various secondary habitats (field depressions, tracks in rural roads). The role of different type of management for successful survival is mentioned.

Keywords: Asteraceae, central Europe, habitats, halophytes, occurrence.

Introduction

Genus *Tripolium* (Asteraceae) includes only two species: *Tripolium sorrentinoi* (Tod.) Raimondo & Greuter [syn. *Aster sorrentini* (Tod.) Lojac, *Galatella sorrentini* Tod.], an endemics of Sicilia (PERUZZI et al. 2015) and *Tripolium pannonicum* (Jacq.) Dobrocz. [syn. *Aster pannonicus* Jacq., *Aster tripolium* subsp. *pannonicus* (Jacq.) Soó], an obligatory halophytic species occupying coastal as well as inland saline habitat in Eurasia (KOVANDA & KUBÁT 2004). This species is very variable, two subspecies were described: *T. pannonicum* subsp. *pannonicum* and *T. pannonicum* subsp. *tripolium* (Tab. 1). In Europe, the nominate subspecies is known in north-eastern Spain, central Germany, the Pannonian Basin and south-eastern Europe while subsp. *tripolium* is reported along most of the sea coasts from Europe and Central Asia as far as eastern China and Japan (MEUSEL & JÄGER 1992; GREUTER 2006+; KAPLAN et al. 2017).

Tab. 1. The major differences between *Tripolium pannonicum* subspecies

Characters	<i>Tripolium pannonicum</i>	subsp. <i>Tripolium tripolium</i>
Leaves	Moderately succulent, 1-veined, hairy or glabrous at margin	Strongly succulent, 3-veined, glabrous at margin
Inflorescences	Involucre reddish at margin, ray florets always present	Involucre green, ray florets sometimes absent
Achenes	Achenes of outer florets shorter than those of the inner	Achenes of outer florets as long as those of the inner

In Slovakia, only *T. pannonicum* subsp. *pannonicum* is known (MARHOLD & HINDÁK 1998, Fig. 1). It is rare taxon included in Slovak Red List (ELIÁŠ et al. 2015) regarded as obligate halophyte (KRIST 1940; GRULICH & MAGLOCKÝ 1999). It is a typical representative of Pannonian saline habitats (e.g. BORHIDI et al. 2012). Within the halophytic vegetation, the center of its distribution is in the communities of class *Festuco-Puccinellietea* Soó ex Vicherek 1973, and particularly the alliance *Puccinellion limosae* Soó 1933. In the latter, *T. pannonicum* subsp. *pannonicum* has an optimum occurrence in the association *Puccinellietum limosae* Soó 1933, for which it is a diagnostic species (DÍTĚ et al. 2014a). Species-poor vegetation of this association is related to depressions wet-to-flooded in spring, and very dry in the summer (DÍTĚ et al. 2009). In addition to the class *Puccinellion limosae*, *T. pannonicum* subsp. *pannonicum* occurs in other communities of the class *Festuco-Puccinellietea*, the alliance *Festucion pseudovinae* Soó 1933 at a different frequency (see DÍTĚ et al. 2014a). As part of the Pannonian region, the species is also recorded in salt marshes of the class *Scorzonero-Juncetea gerardii* (Vicherek 1973) Golub et al. 2001 and marginally in some associations of the class *Crypsieta aculeatae* Vicherek 1973 (BORHIDI et al. 2012; DÍTĚ et al. 2014b; MELEČKOVÁ et al. 2014).

The subspecies is reported from numerous localities in western, south-western and south-eastern Slovakia (KRIST 1940; GRULICH & MAGLOCKÝ 1999), however, detailed study on species distribution including revision of herbarium

material is missing. Moreover, many saline pastures have been intensified and/or transformed into arable land, but some halophytes being able to survive also under these altered conditions – e.g. annual *Heleochoa schoenoides* or perennial *Carex secalina* (ELIÁŠ et al. 2008, 2012). Therefore, the paper is aimed to describe detail distribution and recent habitat preferences of *T. pannonicum* subsp. *pannonicum* in Slovakia.



Fig. 1. Stand of *Tripolium pannonicum* subsp. *pannonicum* at the Panské lúky site near the Tvrdošovce village

Material and methods

The study was carried out during the years 2016–2018. The data concerning the historical distribution of the species were obtained from 17 herbaria in Slovakia, the Czech Republic and Hungary: BP, BRA, BRNU, BRNM, KO, LTM, MMI, NI, OL, OLM, PM, PMK, PR, PRC, SAV, SLO and ZV. Herbarium abbreviations are according to VOZÁROVÁ & SUTORÝ (2001) and THIERS (2018).

Lists of localities (Appendix 1, 2) are processed according to the rules of the Flóra Slovenska project (GOLIAŠOVÁ & MICHALKOVÁ 2016), however, data from herbarium specimens and additional literature / databases data of localities without herbarium specimens are included separately in Appendix 1 and 2. In both cases, localities within particular districts are listed in direction from west to east. Names of municipalities are according to MAJTÁN (1972). If names of

settlements given by collectors or authors are different to above work, original names are pointed out in square brackets in both lists of localities.

Results of this study are presented on the net map; the grid on the map follows one that was described by NIKLFELD (1971). The map was designed by program ArcGis, version 9.2.

Nomenclature of flowering plants follows MARHOLD & HINDÁK (1998). Names of phytogeographical division of Slovakia are according to FUTÁK (1980). Categories and criteria of threat were applied following to the methodology of IUCN (2012).

Results and discussion

Distribution in Slovakia

Tripolium pannonicum subsp. *pannonicum* was mentioned or collected from 60 localities in Slovakia. Herbarium specimens of the species were collected at 49 of them and 11 sites were only published or registered in databases (Appendix 1, 2; Fig. 2). The data showed that *T. pannonicum* subsp. *pannonicum* has occurred only in southern Slovakia in four phytogeographical districts – the Borská nížina lowland, the Podunajská nížina lowland, the Ipeľsko-rimavská brázda region and the Východoslovenská nížina lowland. This corresponds to the published data (e.g. DOSTÁL 1948-1952; DOSTÁL & ČERVENKA 1992; GRULICH & MAGLOCKÝ 1999) besides the occurrence of *T. pannonicum* subsp. *pannonicum* in the Ipeľsko-rimavská brázda region. In this area, KNAPP (1865a) found the taxon in wet meadows around mineral water springs near the Bory village together with other halophytes, *Scorzonera parviflora* and *Spergularia marina*. Nowadays the site is destroyed because the springs were taken to a plant for mineral water production; we have only recorded sub-halophytes like *Bupleurum tenuissimum*, *Chenopodium urbicum* and *Trifolium bonannii* on those wet meadows. It is very likely that this site is also reported by GRULICH & MAGLOCKÝ (1999) when they wrote about the occurrence of *Tripolium pannonicum* near the Levice town.

ENDLICHER (1830) published first localities of *Tripolium pannonicum* for the territory of today's Slovakia from Bratislava and its surroundings. However, he mentioned both subsp. *pannonicum* (as *Aster pannonicus* Jacq.) and subsp. *tripolium* (as *Aster tripolium* L.). We believe that Endlicher data of subsp. *pannonicum* (*Aster pannonicus* Jacq. sensu ENDLICHER) from Bratislava [the Pečňa island ("Potschen") and Starý háj site ("Alte Au")] are mistaken and refer to species *Galatella cana*. Our opinion is based on the fact that ENDLICHER (1830, p. 312) identified his data of *Aster pannonicus* (= *T. pannonicum* subsp. *pannonicum*) with *Aster acris* L. published earlier by LUMNITZER (1791) from this area. *Aster acris* L. is a synonym of *Galatella punctata* (MARHOLD & HINDÁK 1998), however, *G. punctata* has not been known from the surroundings of Bratislava. The closest locality was found near the Veľký Grob settlement more than 30 kilometres SE from Bratislava (MELEČKOVÁ et al. 2016). In contrary, *G.*

cana has still recently occurred in Bratislava, part Vajnory (Appendix 1) and it has been known also from adjacent regions in Austria, Hungary and Moravia while *G. punctata* was never recorded in this region (GRULICH & FERÁKOVÁ 1999; DANIHELKA 2008; KIRÁLY & PENKSZA 2009). A clear answer will, however, be given to the study of the Lumnitzer herbarium deposited in the Natural History Museum in Budapest (BUNKE & BARINA 2006).

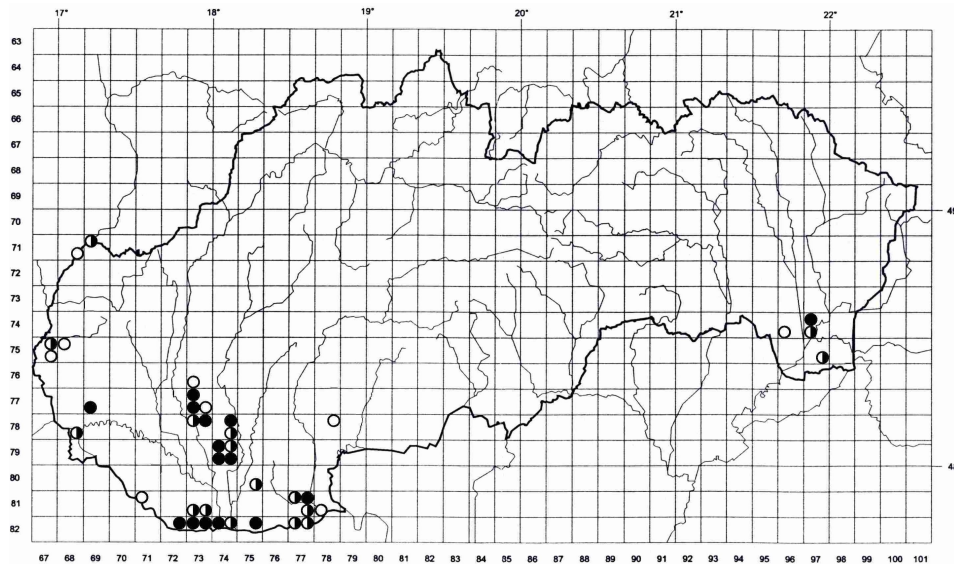


Fig. 2. Distribution of *Tripolium pannonicum* subsp. *pannonicum* in Slovakia: ● – historical localities with herbarium voucher; ○ – historical localities without herbarium voucher (published data or data from databases); ● – recent localities confirmed since 2000

REUSS (1853) later adopted mistakes mentioned above, but he also pointed out that local scientists must resolve the presence of both taxa in the vicinity of Bratislava. Finally, this error is repeated also in recent literature (GRULICH & MAGLOCKÝ 1999). On the other hand, *Tripolium pannonicum* subsp. *pannonicum* was really present in Bratislava in the past, because SCHNELLER collected it here in 1857 (SLO).

On the contrary, we accepted Endlicher data for *Aster tripolium* L. (Gabčíkovo) as locality of *T. pannonicum* subsp. *pannonicum*, because the species could be more common in this area in the past and the closest localities (Tôň, Klížska Nemá) are not far than 20–23 kilometres, respectively.

In addition, other historical literature data are doubtful. SCHILLER (1865) stated *Tripolium pannonicum* in wet meadows at Hurbanovo [Ó Gyalla], although there are no saline habitats reported (SÁDOVSKÝ et al. 2004). We find it as a confusion with some ornamental American *Astra* taxa that escaped from gardens, as KNAPP wrote about it in that period (KNAPP 1865b). ROCHEL (in KNAPP 1865b)

and KELLER (1865) mentioned *Tripolium pannonicum* from the surrounding of Nové Mesto nad Váhom (Malé Karpaty Mts., Turecký vrch = “Felsen Tureczkó”), however, already HOLUBY (1865) pointed out that he found here only *Aster amellus*.

As we mentioned above, three more or less isolated areas of *T. pannonicum* subsp. *pannonicum* distribution were present in Slovakia in the past (Fig. 2) – the Borská nížina lowland in the west, the Podunajská nížina lowland and the Ipeľsko-rimavská brázda region in south-west and the Východoslovenská nížina lowland in south-east Slovakia. Nowadays only two exist because all localities in the Borská nížina lowland were destroyed by different human activities (fish pond construction, intensification of agriculture, gas extraction etc.) during 19th and first half of 20th century, respectively. KRIST (1940) found only single locality (Kostolište) just before WWII, later it was not confirmed there (see Appendix 1, 2). The core occurrence of *T. pannonicum* subsp. *pannonicum* was found on the Podunajská nížina lowland where approximately half of localities are still preserved (24 still exist from total of 41 localities). However, its populations are very scattered, the area is less than 0.2 ha for nearly two thirds of those sites (17 localities). Sometimes even only a few individuals have been recorded (e.g. Šúr, Klížska Nemá, Veľké Kosihy, Komjatice, Jatov – Čierny vršok, Búč). Relatively large and stable populations have survived at localities where grazing – the traditional management of saline habitats was preserved or restored (Komárno – Nová Stráž, Diva, Kamenín, Kamenný Most, Siky farmstead near Močenok) and rarely also in other places with specific conditions (Hájske, Kráľová nad Váhom, see last sub-chapter).

On the contrary, the taxon is threatened by the extinction in the Východoslovenská nížina lowland (SE Slovakia) now. Although it has never been common in this area (5 localities are known), only several individuals persist today on an area of less than 1 m² in the Kopčianske slanisko Nature Reserve. The survival of this population requires immediate management intervention.

Recent status in Slovak flora

During the decades, number of *T. pannonicum* subsp. *pannonicum* localities reduced due to the increasing human pressure on contact natural saline habitats in the agricultural land. Only 27 sites documented by a herbarium specimen were confirmed, however, we have not confirmed any of the 11 sites published or stored in the databases (without a herbarium voucher). So, overall 33 localities of *T. pannonicum* subsp. *pannonicum* disappeared representing 54% decrease of its distribution in Slovakia. Our data thus confirmed the eligibility of the classification of the taxa in the EN category in the latest version of the Slovak Red List of Fern and Flowering Plants (ELIÁŠ et al. 2015). The same status of the threat has been applicable for *Tripolium pannonicum* also in Austria (NIKLFELD & SCHRATT-EHRENDORFER 1999). It is critically endangered (CR) in the Czech Republic (GRULICH 2012), only three localities were confirmed recently from nearly 40 known in south-eastern Moravia (GRULICH & MAGLOCKÝ 1999; KAPLAN et al. 2017). In Hungary, the subspecies is not rare (BARTHA et al. 2015), in the

central Alföld it has continuous occurrence, although many peripheral sites were also destroyed, e.g. around the Győr town in NW part of the country (SCHMIDT 2007).

Ecological requirements and management

At a part of currently preserved localities, *Tripolium pannonicum* subsp. *pannonicum* still has survived in optimal conditions – in depressions on strongly salted soils, which have been flooded during the spring (possibly even longer) and dried in late summer. However, we have recorded it most often on degraded saline habitats (field depressions, deep tracks in rural roads, abandoned pastures, stands of *Phragmites communis*), frequently also considerably ruderalized. It turns out that *T. pannonicum* subsp. *pannonicum* is among halophytes a strong competitor species because it can survive for a long time, for example, in stands with *Elytrigia repens* dominance (e.g. Panské lúky site near Tvrdošovce), in degraded saline vegetation enriched with ruderal or mesophilic species (Tvrdošovce, S from the train stop; Hájske) or in occasionally ploughed field depressions (Veľký Kýr, Malé Čiky).

Tripolium pannonicum subsp. *pannonicum* is tolerant to long-term flooding, too. These specific habitat conditions have allowed surviving even at abandoned sites (Okánikovo, Hájske, Kráľová nad Váhom) because other, more competitive species tolerant to relatively high salt content in the soil (e.g. *Elytrigia repens*) failed to survive long-term flooding. Burning, mowing as well as top soil removal did not promote the population size of *Tripolium* (MELEČKOVÁ et al. 2013; DÍTĚ, MELEČKOVÁ & ELIÁŠ jun. 2014 ined., PROKEŠOVÁ et al. 2017). Therefore, it seems that the best way for its long-time survival is grazing (MOLNÁR & BORHIDI 2003; ŠEFFEROVÁ STANOVÁ et al. 2008; KRYSZAK et al. 2016). Grazing and trampling formed diverse mosaic structures of grazed and non-grazed patches (TÖRÖK et al. 2011, 2018) and even provided open surfaces for *Tripolium* seedlings attachment (PROKEŠOVÁ et al. 2017). We also confirmed positive effect of grazing on *Tripolium pannonicum* subsp. *pannonicum*. ZLINSKÁ (2005) reported any larger stands of it in the Bokrošské slanisko Nature Reserve, where the grazing was ceased a long time ago (more than 40 years in 2005). In 2018, five years after the grazing began (within the implementation of the project LIFE10 NAT/SK/083 from 2013), two small patches (cca 1 × 1 m) with dominant occurrence of *Tripolium pannonicum* subsp. *pannonicum* were recorded (Eliáš jun. 2018 ined.). Thanks to the re-introduction of grazing in several other locations of natural halophytic vegetation in SW Slovakia within this restoration project (Kamenín, Kamenný Most, Komárno – Nová Stráž, Veľké Kosihy, Močenok – Siky farmstead), the continuous management promotes the re-establishment of rare halophytic species with low competition ability. Vanishing of the taxon here is not likely. However, in locations where pasture is not being practiced today (e.g. the Šúr Nature Reserve, Okánikovo, Búč), a continued retreat can be expected and complete extinction is not ruled out.

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Appendix 1. List of revised herbarium specimens (localities were arranged in direction west – east)

Distr. 4. Záhorská nížina lowland: Skalica [Skalitz] (HOLUBY 1861 SLO). – Kostolište [Kiripolec] (FERD. WEBER 1935 PR).

Distr. 6. Podunajská nížina lowland: Bratislava [Pressburg] (SCHNELLER 1857 SLO). – Bratislava, sub-saline steppes between Šúr forest and Čierna Voda [Černovodský majír] (FERD. WEBER 1926 OLM). = Bratislava, saline steppes near Svätý Jur (FERD. WEBER 1933 PR). = Šúr near Svätý Jur (FR. NÁBĚLEK 1941 SAV; FR. NÁBĚLEK et MÁJOVSKÝ 1941 SLO). = Bratislava, Šúr (PTAČOVSKÝ 1928 SAV; ŠMARD 1951 BRNM; SKŘIVÁNEK 1967 BRNM; ČERNÝ sine data PRC; FERÁKOVÁ 1964 SLO). = inter villages of Vajnory and Svätý Jur (FERD. WEBER 1932 PR, 1936 BRA; FUTÁK 1944 SLO). = Vajnory, Čierna voda, near football playground (TRÁVNÍČEK 1987 OL). = Šúr, Čierna Voda site, 130 m (HOLUBY 1911, 1914, 1916 PRC; GRULICH 1985 MMI; ELIÁŠ jun. et DÍTĚ 2008 NI). – Klížska Nemá, bank of pond in the village, (ELIÁŠ jun., DÍTĚ et MELEČKOVÁ 2015 NI). – Tôň, salt marsh near road, 110 m (FUTÁK 1949 SAV, SLO). – Okoličná na Ostrove (ŠMARD 1951 BRNM; KLOKNER 1967 PMK; GRULICH 1985 MMI). – Čalovec [Mederč], saline pastures and meadows around the village (MICHALKO 1951 SLO). – Veľké Kosihy, saline site (MÁJOVSKÝ 1963 SLO; RÁCOVÁ 1987 SAV). = Veľké Kosihy, Mostové Nature Reserve [Dérhídja] (GRULICH 1986 MMI; ELIÁŠ jun. 2003 NI; DUCHÁČEK 2007 PR). – Okoličná na Ostrove, saline sites near Ekelský dvor farmstead (KRIPPELOVÁ et ŠPÁNIKOVÁ 1962 SAV). = Okánikovo, fragment of saline site ca 0.7 NE from the village near crossroad to Komárno, 110 m (MÁJOVSKÝ 1966 SLO; GRULICH 1987 MMI; ELIÁŠ jun. 2010, 2014 NI). – Zlatná na Ostrove, saline sites between train lines and road (FERD. WEBER 1936 PR; KRIST 1936 BRNU; KRIPPELOVÁ et ŠPÁNIKOVÁ 1962 SAV). = Zlatná na Ostrove, Pavol farmstead (KLOKNER 1966, 1972 PMK; ELIÁŠ jun. 2013 NI). – Veľký Lél, Ontopa (Nový svet) farmstead, 111 m (ELIÁŠ jun. 2014, 2018 NI). =? Veľký Lél island (MIHÁLIK 1964 SAV). – Komárno, Nová Stráž site (FERD. WEBER 1933 PR). = Komárno, W from the settlement, 110 m (FUTÁK 1949 SAV, SLO). = Komárno, saline habitat near train lines to Bratislava (KRIPPEL 1951 SLO). = Komárno, W (KLOKNER 1960, 1967 PMK). = Komárno, saline habitat in fields W from the village (MAGIC 2002 BRA). = Komárno, saline depression 1 km W from the settlement, 106 m (ELIÁŠ jun. 2007; ELIÁŠ jun., DÍTĚ, ŠUVADA 2007 BRA, NI, SAV). – Komárno, near the train station (FERD. WEBER 1934 PR). – Komárno, N, pastures in Tégľaház site (KRIPPELOVÁ et ŠPÁNIKOVÁ 1962 SAV). – Komárno, saline site in direction to Kameničná village (FERD. WEBER 1934 PR). = Komárno, military training ground, pastures (KRIPPELOVÁ et ŠPÁNIKOVÁ 1962 SAV). – Iža E (FERD. WEBER 1934 PR; KLOKNER 1955 SLO, 1958 PMK). = Iža, Bokrošské slanisko Nature Reserve, 110 m (DÍTĚ 2002 NI; JOS. MALÝ 2002 BRNU; DUCHÁČEK 2005, 2007 PR; ELIÁŠ jun. et DÍTĚ 2008 NI). – Komjatice, Ružový dvor farmstead, 126 m (KLIKA 1934 PR; VLACH 1934 PRC, 1935 BRNM; ELIÁŠ jun. et SÁDOVSKÝ 2003 NI; ELIÁŠ jun. 2012 NI). – Veľký Kýr, saline site Balát ca 2 km N from the Ružový dvor farmstead, 130 m (ELIÁŠ jun. et P. MEREDA jun. 2016 NI). – Horná Kráľová, abandoned saline pastures ca 1.8 km SW from the village near small pond (ELIÁŠ jun. 2010, 2013 NI). – Horná Kráľová, fragments of saline habitats ca 3 km SW from the village (ELIÁŠ jun. 2013, 2016 NI). = Hájske, Mešterik farmstead (FERD. WEBER 1935 PR). = Močenok, Mešterik farmstead (FERD. WEBER 1935 OLM). – Hájske [Köpösd], 120 m (FERD. WEBER 1935 PR; KRIST 1936 BRNU; GRULICH 1988 MMI; ELIÁŠ jun. 2014, 2016 NI). – Trnovec nad Váhom, saline sites near the settlement (FERD. WEBER 1935 BRA). – Šafa, saline pastures N from the village (KLOKNER 1955 SLO). = Močenok, saline pastures ca 1.5 – 2 km W – SWS from the Siky farmstead, 118 m (ELIÁŠ jun. 2013, 2014 NI). – Močenok [Sládečkovce], Siky farmstead, 118 m (FERD. WEBER 1936 PR; KRIST 1936 BRNU, GRULICH 1988 MMI; GRULICH et

KOCHJAROVÁ 1988 SLO; ELIÁŠ jun. 2001 NI; ELIÁŠ jun. et DÍTĚ 2005, 2010 NI; ELIÁŠ jun. 2013 NI). = Močenok, saline pastures near the village (FERD. WEBER 1930 OLM). – Horný Jatov (KRIST 1936 BRNU). =? Dolný Jatov, Čierny Vršok site (FERD. WEBER 1936 PR; GRULICH 1988 MMI; ELIÁŠ jun. 2018 NI). – Dolný Jatov, saline sites (FERD. WEBER 1935 PR, 1936 OLM). = Dolný Jatov, saline site near the train lines in direction Nové Zámky ca 1.5 km NE from the train stop, 115 m (GRULICH 1986 MMI; ELIÁŠ jun. 2009 NI). – Dolný Jatov, saline site in field ca 0.7 km E from train stop (GRULICH 1986 MMI). – Tvrdošovce, Panské lúky site (VLACH 1935 PRC; FERD. WEBER 1929 OLM, 1935 PR; GRULICH 1985 MMI; KUSÁK 1988 OLM; VOZÁROVÁ 1994 BRA; DUCHÁČEK 2007 PR; ELIÁŠ jun. 2013 NI). = Tvrdošovce, saline site ca 1.5 km NW from the train stop in direction Šaľa (GRULICH 1986 MMI). – Tvrdošovce, saline pastures around Rázcovo jazierko pond (GRULICH 1985 MMI; ELIÁŠ jun. 2013 NI). – Tvrdošovce, the fragment of abandoned saline pastures S from the train stop near train lines, 116 m (ELIÁŠ jun. 2013 NI). – Palárikovo, Bačala farmstead (FERD. WEBER 1932 OLM, 1936 BRNM, PR). – Palárikovo, saline sites (GREBENČŠIKOV sine data SAV; FERD. WEBER 1935 BRA, 1936 OLM). – Palárikovo [Slovenský Meder], NW from railway stop, 110 m (FERD. WEBER 1935 PR, 1951 BRNM; FUTÁK 1949 SAV, SLO; GRULICH 1985, 1988 MMI; TRÁVNÍČEK 1989 OL). = Palárikovo, near train lines (JIRÁSEK 1936 PRC). – Palárikovo [Slov. Meder], saline pastures near Berchtold farmstead (FERD. WEBER 1932 OLM). – Palárikovo, Malé Čiky farmstead (FERD. WEBER 1935 OLM, PR; JASENÁK 1974 LTM; GRULICH 1986 MMI). = Šurany, Čiastka gamekeeper's house (GRULICH 1988 MMI). = Šurany, Malé Čiky farmstead (ELIÁŠ jun. et SÁDOVSKÝ 2003 NI). = Šurany, Nový dvor farmstead, 116 m (ELIÁŠ jun. 2014 NI). – Palárikovo [Slov. Meder], saline sites near Veľké Čiky farmstead (FERD. WEBER 1933 OLM). – Šurany, Veľké Čiky farmstead (FERD. WEBER 1935 PR). – Palárikovo [Slovenský Meder], salty site near Okomán farmstead (FERD. WEBER 1935 BRA, 1938 OLM). = Šurany, Akomáň farmstead (FERD. WEBER 1936 PR; GRULICH 1986, 1987 MMI; ELIÁŠ jun. 2013 NI). – Pribeta, near train stop (KLIKA 1937 PR). – Gbelce, saline pastures near train stop, 135 m (FERD. WEBER 1934 PR; SKŘIVÁNEK 1935 BRNM; KRIST 1935 BRNU). = Gbelce, just destroyed saline site (KUSÁK 1988 OLM). – Búč, Búčske slanisko Nature Reserve, 106 m (DOROTOVIČOVÁ 1996 PMK; ELIÁŠ jun. 2010 NI). – wet meadows inter villages of Búč and Čenkov [Čenke] (FUTÁK 1948 SLO). – Čenkov farmstead (BERTOVÁ 1968 BRA). = Mužla [Muzsla], saline meadows SW from the village (BOROS 1917 BP). – Diva, saline site in inundation of Paríž stream [Teknyós völgye] (FERD. WEBER 1934, 1938 PR; ELIÁŠ jun. 2011, 2013 NI). – between Kamenín and Biňa, saline pastures along the road, 120 m (JOS. DOSTÁL 1955 PR; OSVAČILOVÁ 1955 NI). – Kamenín [Kamendín], Alsó rétek site (KRIST 1935 BRNU; ŠVEC 1953 LTM; ČVANČARA 1966 OLM, 1971 BRNU). = Kamenín [Kamendín], saline meadows (FERD. WEBER 1932 PR, 1936 OLM; FR. NÁBĚLEK 1936, 1953 SAV; M. DEYL 1938 PR; FUTÁK 1948 SLO; ŠMARDA 1949, 1951 BRNM; HRABĚTOVÁ 1950 BRNU; POPOVIČ 1955 SAV; Č. DEYL 1977 OLM). = Kamenín, Kamenínske slanisko Nature Reserve (MÁJOVSKÝ 1959 SLO; FUTÁK 1961 SAV; SVOBODOVÁ 1968, 1975 NI; FERD. WEBER 1970 PR; JASENÁK 1974, 1975 LTM; F. DVOŘÁK 1976 BRNU; GRULICH 1985 MMI; KUSÁK 1988 OLM; JOS. MALÝ 1990, 1993, 2005, 2007, 2011 BRNU). – between settlements of Kamenín and Kamenný Most (DOMIN et JIRÁSEK 1936 PRC; GÁLISOVÁ 1956 SLO; MÁJOVSKÝ 1965 SLO). = Kamenný Most [Kamenné Ďarmoty], Irtoványi rétek site, 120 m (KRIST 1936 BRNU; ŠVEC 1953 LTM). = Kamenný Most, 120 m (FERD. WEBER 1933 PR; KRIST 1935 BRNU; OSVAČILOVÁ 1955 NI). = Kamenný Most, Čistiny site (Grulich 1987 MMI; ELIÁŠ jun. et DÍTĚ 2015 NI).

Distr. 8. Východoslovenská nížina Lowland: Svätušie [Plešany], meadows on foothill of Gazdovský vrch Hill (MÁJOVSKÝ et ZÁBORSKÝ 1962 SLO). – Zemplínske Kopčany, Kopčianske slanisko Nature Reserve (ELIÁŠ jun., DÍTĚ et MELEČKOVÁ 2015 NI). – between

Malčice and Malé Raškovce (KÜHN 1962 BRNU). = Malčice (VICHÉREK 1963 BRNU). = Malčice, E from the village (L. DOSTÁL 1969 PM).

Doubtful data (not mapped): Imeľ, Líščie diery [Rókalyuk puzsta] (MIHÁLIK 1964 SAV). There are only sandy dunes. – between Nitra and Vrábľa (FUTÁK et al. 1949 SLO). No saline habitats are in this area.

Appendix 2. List of published and unpublished records (only localities without herbarium specimens are included)

Distr. 2. Ipeľsko-rimavská brázda region: Bory [Bori], mineral water spring (KNAPP 1865a).

Distr. 4. Borská nížina lowland: Holíč (KRZISCH 1858). – Jakubov (GRULICH & MAGLOCKÝ 1999). = Vysoká pri Morave [Hochštetna], near Šipolt swamp (KRIST 1940). – pastures west from the road from Malacky to Veľké Leváre (KRIST 1940).

6. Podunajská nížina lowland: Gabčíkovo [Böös] (ENDLICHER 1830). – Báb farmstead (KNAPP 1965b). – Močenok, Lapoš farmstead (KNAPP 1965b). – Palárikovo, Horný Svätójurský majer farmstead E from the village (FUTÁK 1949 ined.). – Palárikovo, St. Vendelín farmstead, saline pastures (FUTÁK 1949 ined.). – Nána (KERNER 1871; FEICHTINGER 1899; HOLUBIČKOVÁ & KROPÁČOVÁ 1958). = Nána, saline grasslands along train lines SE from the village (KRIST 1940).

8. Východoslovenská nížina lowland: Novosad (GRULICH & MAGLOCKÝ 1999).

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