

## HISTORICAL AND CURRENT DISTRIBUTION OF *PLANTAGO TENUIFLORA* IN SLOVAKIA

Pavol ELIÁŠ<sup>1\*</sup> jun., Daniel DÍTĚ<sup>2</sup> and Zuzana DÍTĚTOVÁ<sup>1</sup>

<sup>1</sup>Department of Botany, Slovak University of Agriculture

Tr. A. Hlinku 2, SK-949 76 Nitra, Slovakia, \*pavol.elias.jun@gmail.com

<sup>2</sup>Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 9, SK-845 23, Bratislava, Slovakia,  
daniel.dite@savba.sk, zuzana.meleckova@savba.sk

Eliáš, P. jun., Dítě, D. & Dítětová, Z. (2016): Historical and current distribution of *Plantago tenuiflora* in Slovakia. – *Studia bot. hung.* 47(1): 151–162.

**Abstract:** Historical and current occurrences of the obligate halophyte *Plantago tenuiflora* were studied in Slovakia during 2001–2015. The species occurs in the Podunajská nížina and Východoslovenská nížina lowlands; 34 localities were documented including historical and current sites as well. Although the species was confirmed in both above-mentioned lowland areas, the number of localities decreased markedly and we recorded only 13 localities recently. The species was observed most frequently in the associations *Artemisia santonici-Festucetum pseudovinae* and *Camphorosmetum annuae*. As our data showed, *Plantago tenuiflora* belongs to the endangered plant species of the Slovak flora, since more than 60% of known localities were not confirmed recently. Due to the re-introduction of grazing in some locations, its populations are expected to grow.

**Key words:** distribution, endangered species, halophytes, Slovakia

### INTRODUCTION

*Plantago tenuiflora* Waldst. et Kit. (Plantaginaceae) is a continental-Eurasian species with large distribution range. In Europe, it occurs in the central and eastern part: Austria, Hungary, Slovakia, Romania, Croatia, and Serbia, to the south it reaches Bulgaria. An isolated occurrence is known in Northern Europe (the island of Öland, Sweden). In Eastern Europe, the distribution range of *P. tenuiflora* continues to the Crimean Peninsula, the Caucasus, and to the Volga region and the northern coast of the Caspian Sea, hence the occurrence extends to southern Siberia and the Altai Mts in Central Asia (CASPER 1975, КМЕТОВА 1997, MAGLOCKÝ 1999).

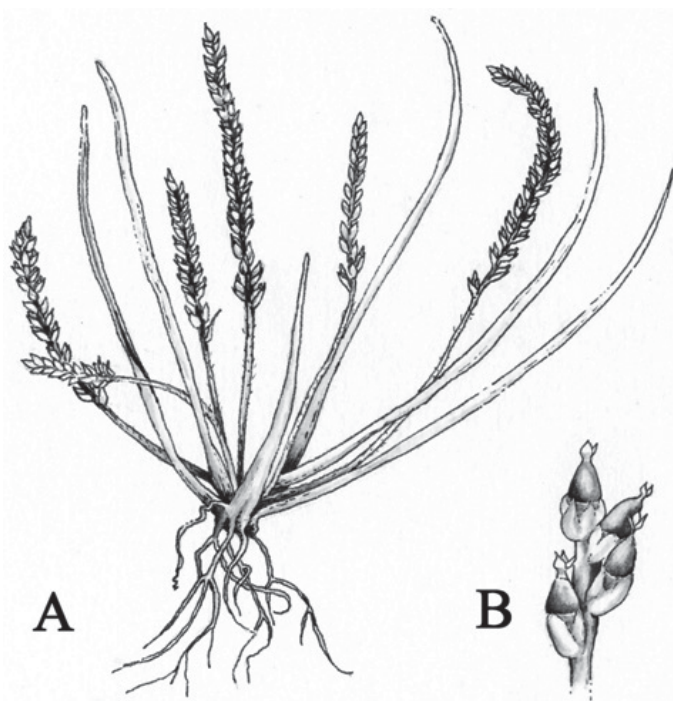
In Slovakia, *Plantago tenuiflora* occurs in two regions representing the north-western limit of its distribution range. Most localities are concentrated in the Podunajská nížina lowland (the upper part of the Little Hungarian Plain or Kisalföld north of the Danube River in the Hungarian literature), especially in its central and eastern part (DÍTĚ *et al.* 2010a, KRIST 1940, VICHÉREK 1973). Few sites were

also recorded in the Východoslovenská nížina lowland (the NE edge of the Great Hungarian Plain) (DÍTĚ *et al.* 2010a, VICHEREK 1973). Although several works were published on *P. tenuiflora* in Slovakia (KMEŤOVÁ 1997, KRIST 1940, MAGLOCKÝ 1999), a detailed survey of its historical and recent occurrences are still lacking. Therefore, the aim of our contribution is to clarify the historical and current distribution of *P. tenuiflora* in Slovakia, and also to provide current information about its population size, management, and survival prognoses for all existing sites.

## MATERIAL AND METHODS

### The studied species

*Plantago tenuiflora* (Fig. 1) is an annual, 50–200 mm high plant. Stems (scapes) are erect or ascending, simple, usually slightly longer than the leaves, rounded, bare or appressed hairy. Leaves are in basal simple rosette, linear, up to 150 mm long, flat, margins are entire or dentate, 1- or 3-veined, glabrous with scattered hairs. Flowers are bisexual, actinomorphic, sessile, aggregate to linear



**Fig. 1.** *Plantago tenuiflora* Waldst. et Kit.: A = habit of the plant, B = detail of inflorescence (original drawing by R. Grošaftová).

or oblong-ovate, spikes are often intermittent on the basis. Sepals are 1.5 to 2 mm long, green, glabrous, margin membranous. Petals are 2 mm long, lobes are 1 mm, ovate lanceolate, acuminate, green, glabrous. Capsules are conical, 3–4 mm long, with 6–15 seeds. Seeds are dark brown, oblong-ovoid, 1.5 mm long.

#### Data acquisition and processing

The field study was carried out during the years 2001–2015 in the Podunajská nížina and Východoslovenská nížina lowlands. Data concerning the distribution of the species were obtained from herbaria BP, BRA, BRNU, BRNM, LTM, MMI, MZ, NI, KO, OLM, PMK, PR, PRC, SAV, SLO, and ZV. Herbarium acronyms are according to THIERS (2015) and VOZÁROVÁ and SUTORÝ (2001).

Results of this study are presented on a grid map based on grid mapping units of 10' longitude × 6' latitude according to the methodology published by NIKLFELD (1971). The map was designed using ArcGis, version 9.2 based on data from herbarium specimens, literature sources, and own field research. Localities recorded after 2000 are considered recent, all others are considered historical.

Nomenclature of flowering plants follows MARHOLD and HINDÁK (1998). Names of syntaxa are according to DÍTĚ *et al.* (2014). Phytogeographical divisions of FUTÁK (1984) are used.

List of localities (Appendix 1) is processed according to the rules of the Flóra Slovenska project (GOLIAŠOVÁ and MICHÁLKOVÁ 2012). Data from herbarium specimens and literature sources are included and localities within particular districts are listed in W–E direction. Names of municipalities are according to the work of MAJTÁN (1972). If names of settlements given by authors are different from the list of localities in the above work, original names are noted in square brackets.

## RESULTS

Studies of herbarium material and literature showed that *Plantago tenuiflora* had been observed at 34 localities in the lowlands of Podunajská nížina and Východoslovenská nížina before 2001. Although the species was recently confirmed again in both above-mentioned areas, the number of localities markedly decreased and we documented only 13 localities, which is a 62% decrease (Fig. 2, Appendix 1).

We provide below the brief characteristics of *P. tenuiflora* populations in the recently confirmed sites (2001–2015).

1. Hájske, Michalova jama site. – Small population includes about 30 individuals located in terrain depressions (small periodical pools) on the remnants of abandoned salt pastures surrounded by fields, south of the village Hájske. Between 2013 and 2015 the plants were not found again.

2. Močenok, Siky farmstead and abandoned pastures SW of the site. – Micro-populations of *P. tenuiflora* are on saline pastures around the farmstead. It occupies disturbed and open areas with low vegetation cover, strongly overgrazed and trampled patches in pastures, field depression and margins. In one exceptional case, we recorded the species in fragments of the association *Artemisio santonici-Festucetum pseudovinae*, however, its cover was low (< 5%). Abundance of the species varies significantly year after year, while the pattern of micro-sites is changing due to human activities. Several dozens of individuals of *P. tenuiflora* survived in the track of a dirt road passing the site SW from the farmstead. In 2015, the locality was mulched completely and more open areas were created. We expect an increase in population size here.

3. Jatov, Čierny vršok site. – This occurrence was recorded in 2005 on a damaged (shallowly ploughed) saline meadow. *Plantago tenuiflora* has grown in shallow depressions in species-poor vegetation on the exposed soil with a cover of up to 25%. In the next years we have not confirmed the species here (2010, 2015) due to advanced secondary succession.

4. Jatov, abandoned saline meadows south from the village. – The site with an area of circa 10 ha was a residual of the saline pastures extending to Tvrdošovce settlement in the past. The predominant type of vegetation was sub-halophytic grassland. Salt steppes of the association *Artemisio santonici-Festucetum pseudovinae* are preserved only at the southeast part. We recorded *Plantago tenuiflora* right in this association. In 2012 the entire site was ploughed, but the populations were observed even after this disturbance.

5. Tvrdošovce. – Between 2001 and 2013 we observed three micro-populations around the village: i) on a cart-road leading through the reclaimed saline pasture north of the village (2005), ii) in a deep track on a cart-road northwest of the railway station (2009) and iii) in low abundance on salt meadows named “Panské lúky” (2010). Similarly as in the site near Jatov, a small part of the micro-locality “iii” was ploughed in 2012. In the next year we found relatively large populations of the species here. We assume that *P. tenuiflora* persists here permanently, especially on the disturbed patches.

6. Palárikovo, Malé Čiky farmstead. – The locality is a relatively large complex of drained and abandoned meadows with remnants of halophytic vegetation. *P. tenuiflora* is situated between fields and meadows, in an area which has been ploughed irregularly. A very rich population of the species persists in an area of approximately 0.1 to 0.15 ha. This is the richest population currently known in Slovakia including thousands of individuals in years with optimal climatic conditions, due to the occasional disturbance of the saline soil. The current “management” on the site supports its persistence.

7. Palárikovo, abandoned saline meadows near the railway station. – In 2004, we found a relatively large population of *P. tenuiflora* on degraded saline meadows. It grew on the most saline sites in stands of the association *Artemisio santonici-Festucetum pseudovinae* surrounded by monodominant stands of *Elytrigia repens*. In the following years halophytes gradually vanished due to secondary succession. In the next years we have not confirmed *Plantago tenuiflora* here.

8. Šurany, Akomán farmstead. – Until 2008, there was a relatively large population of *P. tenuiflora* and we recorded here also the last-known natural occurrence of the association *Plantagini tenuiflorae-Pholiuretum pannonici* in Slovakia. The community has disappeared quickly due to degradation; later we have not found *Plantago tenuiflora* at this site. In 2014 cattle grazing was introduced and we expect that *P. tenuiflora* appears here again.

9. Veľké Kosiň, Mostové Nature Reserve. – The site was known as one of the last preserved saline habitats in Slovakia in the past. It has also been facing with strong degradation since the late 1980s because of the termination of sheep grazing. Currently, only a small remnant of halophytic vegetation exists there. Populations of *Plantago tenuiflora* occupy only tracks of the cart-road leading along the edge of the nature reserve, where it occurs together with *Heleochoa schoenoides* and very rarely with *Lythrum tribracteatum*. Under favourable conditions several hundreds of individuals are present and the area yields the second most vital population of the species known in Slovakia.

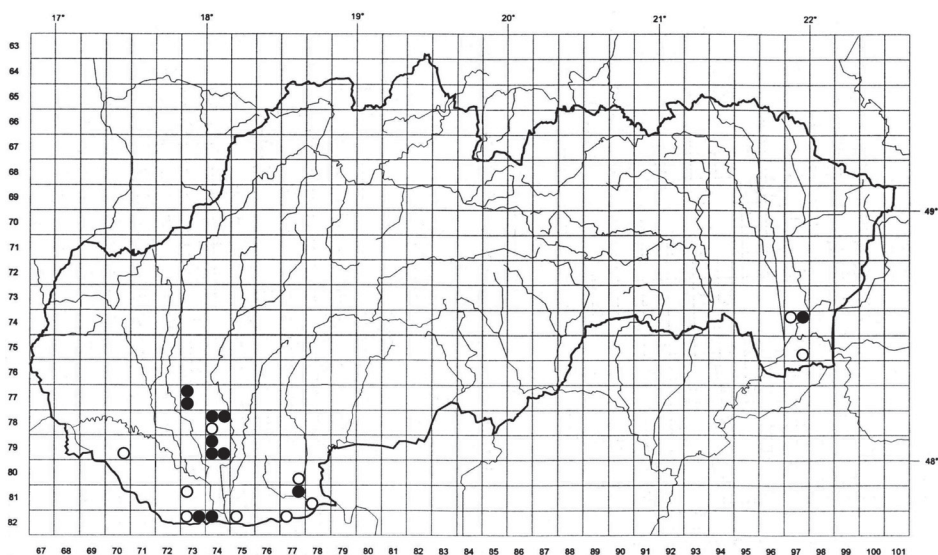


Fig. 2. Distribution of *Plantago tenuiflora* in Slovakia: o = historical localities, ● = recently confirmed localities.



10. Zlatná na Ostrove, Pavol farmstead. – On this once large saline pasture we found only remnants of halophytic vegetation, several halophytes have disappeared during the last 10 years. In 2010, when high precipitation was measured, *Plantago tenuiflora* was recorded in a sparse population on the field margin, in ruderal stands, where *Heleochloa schoenoides* dominated.

11. Kamenín, Kamenínske slanisko Nature Reserve. – The site represents one of the most interesting and diverse Pannonian saline habitats in Slovakia. In the recent past, only remnants of the halophytic vegetation were found and several halophytic plant communities entirely disappeared. In 2010 we recorded here a small population of *Plantago tenuiflora* together with *Pholiurus pannonicus* covering an area less than 1 m<sup>2</sup>. Since the re-introduction of grazing by mixed herd in 2013, the species has grown rarely on bare soil trampled by cattle.

12. Kamenný Most, Čistiny Nature Reserve. – The species grows in the stands of the association *Artemisio santonici-Festucetum pseudovinae*. In 2011 we recorded relatively large populations of the species in the tracks of the card-road. Extensive grazing by grey cattle was restored in 2015 and in 2016 a relatively large population was observed.

13. Zemplínske Kopčany, Kopčianske slanisko Nature Reserve. – This site represents the last existing locality of the species in SE Slovakia and of halophytic vegetation, as well. Among the mosaic of mesic and ruderal grasslands, small patches of the association *Artemisio santonici-Festucetum pseudovinae* are present. In these stands, small populations of *P. tenuiflora* were observed in 2005 by S. Zlacká. After 10 years the species was not confirmed.

As shown by our data, *Plantago tenuiflora* occupies also sites with disturbed vegetation cover, for instance margins of ploughed fields where it may occur temporarily in large populations. Such occurrence was recorded in Malé Čiky farmstead near Šurany town. Disturbance and stripping of vegetation cover are necessary to maintain the species, otherwise it vanishes rapidly. We have documented nearly all the occurrences in secondary habitats in Slovakia, mainly in tracks of rural roads and disturbed field margins mentioned above. Consequently, current population size of *P. tenuiflora* is unstable with large fluctuations in all the localities. The local re-introduction of grazing since 2013 (Mostové Nature Reserve, Pavol site, Kamenínske slanisko Nature Reserve, Čistiny Nature Reserve) has increased population size of the species. Trampling and grazing creates appropriate micro-patches without competition of perennial species where *P. tenuiflora* seedlings can survive. This method of management is necessary in the other localities as well.

From the phytosociological point of view, we found the species mostly in the association *Artemisio santonici-Festucetum pseudovinae*. As a subdominant

element, it can also be found in the association of *Camphorosmetum annuae* together with *Matricaria recutita*. At present these low-herb stands provide the most suitable conditions for *P. tenuiflora* in Slovakia.

## DISCUSSION

*Plantago tenuiflora* is considered as a phytogeographically important element of the Slovak flora (MAGLOCKÝ 1999); it is known only from the Pannonian region. The species was first documented by S. Feichtinger in the 19th century near Kamenný Most (herbarium vouchers sampled in 1861 and 1862 are deposited in BP and in BP and BRNU, respectively; see Appendix 1), and also from Mužla and Nána (FEICHTINGER 1899). Detailed distribution of the species has not yet been processed, although at least four older works provided many valuable data. KRIST (1940) documented the distribution of the species in the Podunajská nížina lowland. He found 9 localities between Nitra and Nové Zámky towns, in the surroundings of Komárno, and northwards from Štúrovo. Much later VICHEREK (1973) published phytosociological relevés also from 9 sites in the same area. KMEŘOVÁ (1997) summarised its distribution, ecology, and coenology. She published 18 localities based on herbarium and literature data. The latest work from the same period with brief chorological, coenological, and ecological notes was published in the Red data book of Slovakia by MAGLOCKÝ (1999).

Several data on its occurrence were also published in some phytosociological and floristical studies, for example VICHEREK (1964) documented the first occurrence of *P. tenuiflora* in eastern Slovakia, KLIKA and VLACH (1937) in Komjatice and Dolný Jatov settlements, and KRIPPELOVÁ (1965) near Veľké Kosihy. Later DOSTÁL (1989, 1991) provided brief information about the occurrence of the species in the Podunajská nížina lowland north of Nové Zámky and near Kráľovský Chlmec in the Východoslovenská nížina lowland.

Since publishing the first chorological data (FEICHTINGER 1899, KRIST 1940) the number of recorded sites had increased until the end of the 1960s when floristic and phytosociological research had been intensive. During that period due to contemporary technologies saline habitats were not that much disturbed by human activities as nowadays. Many sites were preserved thanks to the traditional land use (grazing, occasional mowing). Significant disturbance occurred only locally, such as extraction of clay for bricks from saline soils near the village of Iža (KRIPPELOVÁ 1965). The situation has sharply changed at the turn of the 1960s and 1970s, when massive land use changes began; reclamation, water regulation, conversion of pastures to arable land or afforestation (SÁDOVSKÝ *et al.* 2004b, FEHÉR 2007). It has resulted in salt leaching in the soil, eutrophication, and loss of saline vegetation. This negative trend was observed in other parts of

the Pannonian Basin, e.g. near the city of Győr in Hungary (SCHMIDT 2007), in northwestern Austria (KÄSTNER and FISCHER 2008), and South Moravia (DANIHELKA and HANUŠOVÁ 1995, GRULICH 1987). In Slovakia, destruction of saline habitats resulted in the significant decrease of the number of sites with *P. tenuiflora*. We verified the species at 13 localities; however, this is much less than the total number of sites. Moreover, *P. tenuiflora*, as a poor competitor, is under the pressure of secondary succession or often restricted to secondary habitats (wheel-tracks or field margins). Therefore, its IUCN category listing “EN” (endangered) is correct (ELIÁŠ *et al.* 2015). For the survival of the species in the Slovak flora it is necessary to maintain active grazing.

The occurrence of *Plantago tenuiflora* is linked to solonetz soils, where it occupies shallow depressions filled with stagnant water in the first part of the vegetation season. The vegetation optimum of the species is in the association *Plantagini tenuiflorae-Pholiuretum pannonici* from the alliance Puccinellion limosae. This community is known only in the Pannonian Basin. It has been reliably documented in Austria, Croatia, Hungary, Romania, Serbia, and Slovakia (BORHIDI 2003, DÍTĚ *et al.* 2010a, SOÓ 1929, VICHEREK 1973, WENDELBERGER 1950). On the margins of its distribution range – in Croatia (Dítě, Melečková and Eliáš jun. 2015 ined.), Austria (MUCINA 1993), Romania (POPESCU 2005), and Serbia (IVEZIĆ *et al.* 1995) the association belongs to the rare vegetation units. In Slovakia, the association is currently missing (DÍTĚ *et al.* 2014) and we have found the species more often in the association *Artemisio santonici-Festucetum pseudovinae* and *Camphorosmetum annuae* as pointed out already by VICHEREK (1973). Similarly, the appearance of *Plantago tenuiflora* has been documented in other communities of the class Puccinellion limosae, particularly in the association *Puccinellietum limosae* (BORHIDI 2003). Those low-herb and open halophytic vegetation units provide also acceptable conditions for *P. tenuiflora*.

\*\*\*

*Acknowledgements* – We are indebted to Marek Sádovský (Úľany nad Žitavou, Slovakia), Róbert Šuvada (Rožňava, Slovakia), and Alžbeta Szaboová (Komárno, Slovakia) for their help on the field and Zoltán Barina (Budapest, Hungary) for excerpt of herbarium data in herbarium BP. We are grateful also to Renata Grošaftová (Plzeň, the Czech Republic) for her illustrations and to two anonymous reviewers for critical comments to the manuscript. This paper was supported by the Slovak Grant Agency for Science “VEGA” (grants No. 1/0083/16 and 2/0001/16).

**Összefoglaló:** Tanulmányunk a vékony útifű (*Plantago tenuiflora* Waldst. et Kit.) múltbeli és jelenlegi előfordulását dolgozza fel a mai Szlovákia területén. A terepi vizsgálatot 2001–2015 között végeztük. Ez az obligát sótűrő faj csak a sík vidékeken fordul elő. Összesen 34 településről van történelmi adatunk, de a közelmúltban csak 13 helyszínt sikerült megerősítenünk. A mai lelőhelyek a legtöbb esetben degradált szikes növényzetben fordulnak elő, gyakran másodlagos, bolygatott termőhelyen. Cönológiai szempontból leggyakrabban ürmöspusztákon található meg, emellett a



tavasszal vízjárta padkás szikeseken is előfordul. A jellegzetes alföldi szikér vegetációban kényes fajok kiséretében azonban nem találtuk meg. A legtöbb szlovákiai szikésen újból beindult a legeltetés, így a faj várhatóan kedvezőbb feltételekhez jut a közeljövőben.

## REFERENCES

- BORHIDI, A. (2003): *Magyarország növénytakarásai*. (Plant communities of Hungary). – Akadémiai Kiadó, Budapest, 610 pp.
- CASPER, S. J. (1975): *Plantaginaceae* Juss. – In: HARTL, D. and WAGENITZ, G. (eds): Hegi G., Illustrierte Flora von Mitteleuropa, VI (1). Verlag Paul Parey, Berlin and Hamburg, pp. 559–608.
- DANIHELKA, J. and HANUŠOVÁ, M. (1995): Poznámky k současnému stavu slanomilné flóry a vegetace v okolí Nesytu u Sedlce. [Notes on the current state of saltmarsh flora and vegetation around Nesyt at Sedlec]. – *Zprávy Čes. bot. společn., Suppl.* **1995**(1): 135–146.
- DÍTĚ, D., ELIÁŠ, P. jun. and ŠADOVSKÝ, M. (2008): *Camphorosmetum annuae* Rapaics ex Soó 1933 – vanishing plant community of saline habitats in Slovakia. – *Thaiszia, J. Bot.* **18**: 9–20.
- DÍTĚ, D., ELIÁŠ, P. jun., ŠUVADA, R. and SZOMBATHOVÁ, N. (2010a): Ecology and coenotic characteristics of the Pholiuro pannonici-Plantaginetum tenuiflorae Wendelberger 1943 in the Pannonian Basin. – *Phyton (Horn)* **49**(2): 293–313.
- DÍTĚ, D., ELIÁŠ, P. jun., ŠUVADA, R., PETRÁŠOVÁ, A. and MELEČKOVÁ, Z. (2010b): Current distribution and stage of community *Artemisio santonici-Festucetum pseudovinae* Soó in Máthé 1933 corr. Borhidi 1996 in Slovakia. – *Thaiszia, J. Bot.* **20**: 77–86.
- DÍTĚ, D., MELEČKOVÁ, Z. and ELIÁŠ, P. jun. (2014): *Festuco-Puccinellietea*. – In: HEGEDŮŠOVÁ VANTAROVÁ, K. and ŠKODOVÁ, I. (eds): Rastlinné spoločenstvá Slovenska. 5. Travnobylinná vegetácia. [Plant communities of Slovakia. 5. Grassland vegetation]. Veda, Bratislava, pp. 481–510.
- DOMIN, K. (1933): Poznámky o květeně okolí Parkáně a Kováčova v nejjižnější Slovénii. [Notes on the flora around Parkán and Kováčov in the southernmost Slovakia]. – *Věda Přír.* **14**: 246–247.
- DOSTÁL, J. (1989): *Nová květena ČSSR 1*. [New flora ČSSR 1]. – Academia, Praha, 758 pp.
- DOSTÁL, J. (1991): *Velký klíč na určování vyšších rostlin 1*. [Big key to determining of vascular plants 1]. – Slovenské pedagogické nakladatelstvo, Bratislava, 1567 pp.
- ELIÁŠ, P. jun., DÍTĚ, D., KLIMENT, J., HRIVNÁK, R. and FERÁKOVÁ, V. (2015): Red list of ferns and flowering plants of Slovakia. 5th ed. (October 2014). – *Biologia* **70**: 218–228. <http://dx.doi.org/10.1515/biolog-2015-0018>
- FEHÉR, A. (2007): Origin and development of the salt steppes and marshes in SW Slovakia. – *Flora Pannonica* **5**: 67–94.
- FEICHTINGER, S. (1899): *Esztergom megye és környékének flórája*. [Flora of Esztergom county and the surrounding]. – Az Esztergom-Vidéki Régészeti és Történelmi Társulat kiadása, Esztergom, 456 pp.
- FUTÁK, J. (1984): *Fytogeografické členenie Slovenska*. [Phytogeographical division of Slovakia]. – In: BERTOVIČ, L. (ed.): *Flóra Slovenska* IV/1. Veda, Bratislava, pp. 418–419.
- GOLIAŠOVÁ, K. and MICHÁLKOVÁ, E. (eds) (2012): *Flóra Slovenska* VI/3. – Veda, Bratislava, 712 pp.
- GRULICH, V. (1987): *Slanomilné rastliny na južnej Moravě*. [Saltmarsh plants in the South Moravia]. – Okresní výbor Českého svazu ochránců přírody, Brno, 76 pp.
- HOLUBIČKOVÁ, B. and KROPÁČOVÁ, A. (1958): *Vegetační poměry okresu Štúrovo*. [Vegetation conditions of the Štúrovo district]. – SAV, Bratislava, 345 pp.
- HUMEŇANSKÝ, Š. (1984): Maloplošné chránené územia vo Východoslovenskom kraji. [Small protected areas in the Východoslovenský kraj region]. – *Pamiatky Príroda* **1984**(1): 35.

- IVEZIĆ, J., MERKULOV, L. and KNEŽEVIĆ, A. (1995): Eco-morphologic investigations of the species *Pholiurus pannonicus* Trin. 1820 (Poales, Poaceae). – *Zb. Rad. PMF*, ser. Biol. **24**: 81–88.
- KÄSTNER, A. and FISCHER, M. A. (2008): Porträts ausgewählter seltener österreichischer Gefäßpflanzenarten (III) (16) bis (30). – *Neulreichia* **5**: 131–172.
- KLIKA, J. and VLACH, V. (1937): Pastviny a louky na szikách jižního Slovenska. [Saline pastures and meadows on the southern Slovakia]. – *Sb. Čs. Akad. Zeměd.* **12**: 407–417.
- KMEŤOVÁ, E. (1997): *Plantago* L. – In: GOLIAŠOVÁ, K. (ed.): Flóra Slovenska V/2. Veda, Bratislava, pp. 137–263.
- KRIPPELOVÁ, T. (1965): Solné stepi na Žitnom ostrove. [Salt steppes in the Žitný ostrov area]. – *Českoslov. Ochr. Přír.* **2**: 121–133.
- KRIST, V. (1940): Halofytyní vegetace jz. Slovenska a severní části Malé Uherské nížiny. [Halophytic vegetation of SW. Slovakia and northern part of the Small Hungarian lowland]. – *Práce moravské přírodovědecké společnosti* **12**(10): 1–100.
- MAGLOCKÝ, Š. (1999): *Plantago tenuiflora* Waldst. et Kit. – In: ČEŘOVSKÝ, J., FERÁKOVÁ, V., HOLUB, J., MAGLOCKÝ, Š. and PROCHÁZKA, F. (eds): Červená kniha ohrozených a zánčných druhů rostlin a živočichů SR a ČR. Vol. 5. Vyššie rastliny. Příroda, Bratislava, 284 pp.
- MAJTÁN, M. (1972): *Názvy obcí na Slovensku za ostatných dvesto rokov*. [Names of municipalities in Slovakia over the past two hundred years]. – Vydavateľstvo SAV, Bratislava, 672 pp.
- MATUŠICOVÁ, B. and ČERNUŠÁKOVÁ, D. (2005): Chránené a ohrozené druhy cievnatých rastlín z okolia obcí Hájske, Horná Kráľová a Močenok na Podunajskej nížine. [Protected and endangered species of vascular plants from the surrounding villages of Hájske, Horná Kráľová and Močenok on the Podunajská nížina Lowland]. – *Bull. Slov. Bot. Spoločn.* **27**: 71–76.
- MELEČKOVÁ, Z., DÍTĚ, D., ELIÁŠ, P. jun. and GALVÁNEK, D. (2013): Flóra a vegetácia Prírodnej rezervácie Čistiny – minulosť a súčasnosť. [Flora and vegetation of the Nature reserve Čistiny – Past and Present]. – *Bull. Slov. Bot. Spoločn.* **35**(1): 61–75.
- MUCINA, L. (1993): *Puccinellio-Salicornietea*. – In: MUCINA, L., GRABHERR, G. and ELLMAUER, T. (eds): Die Pflanzengesellschaften Österreichs, Teil 1. Fischer, Stuttgart and New York, pp. 522–549.
- NIKLFIELD, H. (1971): Bericht über die Kartierung der Flora Mitteleuropas. – *Taxon* **20**: 545–571. <http://dx.doi.org/10.2307/1218258>
- OSVAČILOVÁ, V. (1955): Príspevek ke květene Nitranského kraje. [Contributing to the flora of the Nitra Region]. – *Preslia* **27**: 285–286.
- POPESCU, A. (2005): *Comunități vest-pontice Pholiurus pannonicus i Plantago tenuiflora*. – In: DONIĂ, N., POPESCU, A., PAUCĂ-COMĂNESCU, M., MIHĂILESCU, S. and BIRIS, I. A. (eds): Habitatele din România, Edit. Tehnică Silvică, București, pp. 43–44.
- SÁDOVSKÝ, M., ELIÁŠ, P. ml. and DÍTĚ, D. (2004a): Poznámky k rozšíreniu a cenológii vybraných druhov halofilných rastlín na juhozápadnom Slovensku. [Notes on the distribution and coenology of selected halophilic plant species in southwest Slovakia]. – *Bull. Slov. Bot. Spoločn., Suppl.* **10**: 122–126.
- SÁDOVSKÝ, M., ELIÁŠ, P. ml. and DÍTĚ, D. (2004b): Historické a súčasné rozšírenie slaniskových spoločenstiev na juhozápadnom Slovensku. [Historical and present distribution of salt-marsh communities in southwest Slovakia]. – *Bull. Slov. Bot. Spoločn., Suppl.* **10**: 127–129.
- SCHMIDT, D. (2007): A Győr környéki szikések növényzete. (Alkali vegetation fragments in the surroundings of Győr (NW Hungary)). – *Flora Pannonica* **5**: 95–104.
- SVOBODOVÁ, Z. (1989): Nové nálezy cievnatých rastlín na Slovensku II. [New records of vascular plants in Slovakia II]. – *Bull. Slov. Bot. Spoločn.* **11**: 16–24.
- SVOBODOVÁ, Z. and ŘEHOŘEK, V. (1985): Súčasný stav flóry a vegetácie štátnej prírodnej rezervácie Kamenínske slanisko a problematika jeho ochrany. [The current state of flora and vegeta-

- tion of the State Nature Reserve Kamenínske slanisko and the problems of its protection]. – *Spravod. Oblast. Podunaj. Múz. Komárno, Sci. Natur.* 5: 67–74.
- SVOBODOVÁ, Z. and ŘEHOŘEK, V. (1992): Príspevok k flóre slanísk Podunajskej nížiny. [Contribution to the flora of salt marshes of the Podunajská nížina Lowland]. – *Spravod. Oblast. Podunaj. Múz. Komárno, Sci. Natur.* 10: 49–69.
- THIERS, B. (2015–): *Index Herbariorum: A global directory of public herbaria and associated staff*. – New York Botanical Garden's Virtual Herbarium, New York. <http://sweetgum.nybg.org/ih/> (accessed on 21.01.2016).
- VICHEREK, J. (1964): K rozšíření halofytní květeny na jihovýchodním Slovensku (Košícká kotlina, Potiská nížina). [To occurrence of halophytic flora in southeastern Slovakia (Košice Basin, Potiská nížina Lowland)]. – *Biológia* 19: 555–557.
- VICHEREK, J. (1973): Die Pflanzengesellschaften der Halophyten und Subhalophytenvegetation der Tschechoslowakei. – *Vegetace ČSSR, ser. A, Praha*, 5: 1–200.
- VOZÁROVÁ, M. and SUTORÝ, K. (eds) (2001): Index herbariorum Reipublicae bohemicae et Reipublicae slovacae. – *Bull. Slov. Bot. Spoločn., Suppl.* 7: 1–95.
- WENDELBERGER, G. (1943): Die Salzpflanzengesellschaften des Neusiedler Sees. – *Wiener Bot. Z.* 3: 124–144.
- WENDELBERGER, G. (1950): Zur Soziologie der kontinentalen Halophytenvegetation Mitteleuropas. – *Abh. Akad. Wiss. Wien, Math.-Nat. Kl.* 108: 1–180.
- ZLÍNSKA, J. (2003): Flóra a vegetácia slaniska Derhídja na Podunajskej rovine. [Flora and vegetation of Derhídja at the Podunajská nížina Lowland]. – *Biosozológia* 1: 9–28.

(submitted: 27.02.2016, accepted: 30.05.2016)

### Appendix 1. List of localities of *Plantago tenuiflora* in Slovakia (localities are listed in W–E direction)

Phytogeographical district 6. Podunajská nížina Lowland: Horná Potôň [Felsőpatony] (KRIST 1940, FUTÁK 1957, KMEŤOVÁ 1997). – Veľké Kosihy (VICHEREK 1962 BRNU, KRIPPELOVÁ 1965, VICHEREK 1973). – Veľké Kosihy, NE from the village (POKLUDA 1963 BRNM). = Veľké Kosihy, Mostové Nature Reserve [Dérhídja] (GRULICH 1987 MMI, SVOBODOVÁ 1989, SVOBODOVÁ and ŘEHOŘEK 1992, MAGLOCKÝ 1999, ZLÍNSKA 2003, ELIÁŠ jun., DÍTĚ and ŠUVADA 2008 NI, DÍTĚ *et al.* 2010a). = Okánikovo, Dérhídja (GRULICH 1986 MMI). – between settlements of Okoličná na Ostrove [Ekel] and Zemianska Olča (KRIST 1938 BRNU, KRIST 1940). – Okoličná na Ostrove [Ekel], saline meadows S from the train station (KRIST 1940, POKLUDA 1963 BRNM, KMEŤOVÁ 1997). – Zlatná na Ostrove (WEBER 1935 BRNM, KRIST 1937 BRNU, KAVKA 1950 PR). – between settlements of Zlatná na Ostrove and Nová Stráž (KRIST 1940, WEBER 1950 BRNM, ČERNOCH 1956 BRNM). = Nová Stráž, slanisko Pavol (SÁDOVSKÝ *et al.* 2004). = Zlatná na Ostrove, Nová Stráž (VALENTA 1936 BRA, MÁJOVSKÝ 1967 SLO, KMEŤOVÁ 1997). – Hájske, S from the village [Kepežd] (KRIST 1937 BRNU, KRIST 1940, VALENTA 1937 BRA, VICHEREK 1973, GRULICH 1988 MMI, KMEŤOVÁ 1997, MAGLOCKÝ 1999). = Hájske, Michalova jama site (SÁDOVSKÝ *et al.* 2004). – Močenok [Sládečkovce], Siky farmstead (KRIST 1937 BRNU, KRIST 1940, GRULICH 1988 MMI, SVOBODOVÁ and ŘEHOŘEK 1992, MAGLOCKÝ 1999, SÁDOVSKÝ *et al.* 2004, MATUŠICOVÁ and ČERNUŠÁKOVÁ 2005, ELIÁŠ jun. and DÍTĚ 2010, 2011 NI, DÍTĚ *et al.* 2010a, b). = Močenok, Siky farmstead, depression in alfalfa field W from pastures (ELIÁŠ jun. 2005 NI, ELIÁŠ jun., DÍTĚ and KOLNÍK 2006 NI). – Močenok, Siky farmstead, abandoned saline habitats ca 1.5 km SW from the farmstead (ELIÁŠ jun., DÍTĚ and ŠUVADA 2009 NI). – Rastislavice (VICHEREK 1973). – Komjatice, Ružový Dvor farmstead (VLACH 1935 PRC, KMEŤOVÁ 1997). – Mojmírovce, Jozefov dvor farm-

stead – Polný Kesov, Čierny vršok site (both data OSVAČILOVÁ 1955 NI). = Jatov, Čierny vršok site (sine collector 1959 PRC, GRULICH 1988 MMI, ELIÁŠ jun., DÍTĚ and SÁDOVSKÝ 2005 NI, ELIÁŠ jun., DÍTĚ and ŠUVADA 2009 NI, DÍTĚ *et al.* 2010a). – Jatov, inundation in salt meadow 0.5 km east from the train stop (GRULICH 1988 MMI). – Dolný Jatov [Alsójobbó] (SCHEFFER 1923 BRA, VLACH 1936 PRC, KLIKA and VLACH 1937, KMEŤOVÁ 1997, MAGLOCKÝ 1999, ELIÁŠ jun., DÍTĚ and ŠUVADA 2010 NI). = Jatov, abandoned saline pastures S from the village near the Jatovský kanál canal (GRULICH 1988 MMI, ELIÁŠ jun., DÍTĚ and ŠUVADA 2009 NI, ELIÁŠ jun. and DÍTĚ 2013 NI). – Tvrdošovce [Tardosked], saline pastures near train stop (SCHEFFER 1923 BP, BRNU, SLO, KRIST 1936 BRNU, KRIST 1940, GRULICH 1986, 1987, 1988 MMI, SVOBODOVÁ 1989, SVOBODOVÁ and ŘEHOŘEK 1992, KMEŤOVÁ, GOLIAŠOVÁ and HODÁLOVÁ 1995 SAV, KMEŤOVÁ 1997, MAGLOCKÝ 1999, DÍTĚ *et al.* 2008, DÍTĚ *et al.* 2010a). = Tvrdošovce, Panské lúky site, rural road near railway lines (ELIÁŠ jun. 2008 NI, ELIÁŠ jun. and DÍTĚ 2013 NI). – Tvrdošovce, saline pasture behind the pub in north edge of the village (ONDRÁŠEK 1986 MMI, NI, GRULICH 1987 MMI). – Palárikovo, near train station (SOUČKOVÁ and ŠMARD 1950 BRNM, ŠMARD 1951 BRNM, GRULICH 1986, 1988 MMI, SÁDOVSKÝ *et al.* 2004, DÍTĚ *et al.* 2010, locality destroyed). = saline habitat near Palárikovo (SOUČKOVÁ 1952 BRNM). = Palárikovo (KRIST 1936 BRNU, KRIST 1940, VALENTA 1936 BRA, VICHÉREK 1973, MAGLOCKÝ 1999). = Palárikovo, 2 km E from the village (HEJNÝ 1953 PR). – Palárikovo, Veľké Čiky farmstead (DVOŘÁK 1954 BRNM, 1966 BRA). – Palárikovo, Čiastka farmstead (GRULICH 1988, 1989 MMI). = Šurany, Čiastka farmstead (KRIST 1937 BRNU, KRIST 1940, VALENTA 1937 BRA, KLOKNER 1955 BRA). = Šurany, Malé Čiky (WEBER 1950 BRNM, DEYL 1954 PR, ELIÁŠ jun., DÍTĚ and SÁDOVSKÝ 2003 NI, SÁDOVSKÝ *et al.* 2004, ELIÁŠ jun. 2008 NI, DÍTĚ *et al.* 2010a, b). – Šurany, Bačala farmstead (Weber 1935 BRNM, KRIST 1940, KRIST 1936 BRNU). – Šurany, Akomán farmstead [Okomán] (GRULICH 1988 MMI, SVOBODOVÁ 1989, ELIÁŠ jun. and SÁDOVSKÝ 2004 NI, SÁDOVSKÝ *et al.* 2004, ELIÁŠ jun. 2008 NI, DÍTĚ *et al.* 2010a). – Iža (OSVAČILOVÁ, ŽERTOVÁ and CHRTEK 1954 NI). – Čenkov (HOLUBIČKOVÁ and KROPÁČOVÁ 1958). = Mužla [Muzsla] (FEICHTINGER 1899, HOLUBIČKOVÁ and KROPÁČOVÁ 1958, KMEŤOVÁ 1997). – Nána (FEICHTINGER 1899, DOMIN 1933, HOLUBIČKOVÁ and KROPÁČOVÁ 1958). – Kamenný Most [Kőhidgyarmath], Irtoványi rétek site (FEICHTINGER 1861 PB, 1862 BP, BRNU, PRC, FEICHTINGER 1899, JÁVORKA 1939 BP, SKŘIVÁNEK 1953 BRNM, ČERNOCH 1953 PR, KRIST 1936 BRNU, KLIKA 1937 NI, ŠOUREK 1951 PR, CHRTEK 1959 PRC, POKLUDA 1959 BRNM, MÁJOVSKÝ 1961 SLO, DEYL 1963 PR, BERTOVÁ 1965 SAV, SMEJKAL 1972 BRNU, VICHÉREK 1973). = Kamenný Most, Čistiny Nature Reserve (SVOBODOVÁ 1989, ELIÁŠ jun. and DÍTĚ 2011 NI, MELEČKOVÁ *et al.* 2013). – Kamenín [Kamendín], Alsó rétek (NÁBĚLEK 1927 SAV, KRIST 1935 BRNU, KRIST and UNZEITIG 1936 BP, BRNM, BRNU, NI, PRC, PR, ZV, SKŘIVÁNEK 1936 BRNM, VALENTA 1937 BRNM, JÁVORKA 1939 BP, KRIST 1940). = Kamenín, Kamenínske slanisko Nature Reserve (ŠMARD 1951 BRNM, DEYL 1951 PR, DVOŘÁK 1954 BRNM, CHRTEK 1959 PRC, MÁJOVSKÝ 1965 SLO, VICHÉREK 1973, SVOBODOVÁ and ŘEHOŘEK 1985, DÍTĚ *et al.* 2010b). – Kamenín, 1 km N from the village (ČERNOCH 1953 BRNM). = Bíňa, S from the village (DOMIN 1933, HOLUBIČKOVÁ and KROPÁČOVÁ 1958, VICHÉREK 1973).

Phytogeographical district 8. Východoslovenská nížina Lowland: Malčice, 2 km E from the village (VICHÉREK 1963, 1973) = between settlements of Malčice and Veľké Raškovce (KÜHN 1962 BRNU, VICHÉREK 1964). – Veľké Raškovce (VICHÉREK 1973) – Zemplínske Kopčany, Kopčianske slanisko Nature Reserve (HUMEŇANSKÝ 1984, GRULICH 1988 MMI, ZLACKÁ 2005 NI). – Kráľovský Chlmec [Királyhelmeccz] (MARGITTAI 1924 BRNU, 1927 BRA, PRC, 1929 PR, KMEŤOVÁ 1997).

Doubtful data (not mapped): Štúrovo (HOLUBIČKOVÁ and KROPÁČOVÁ 1958). Saline habitats have not been found in this area, it is probably an inaccurate localisation of some above mentioned site.