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Distribution and ecology of the genus *Bassia* in Slovakia 1: *Bassia prostrata* (L.) Beck

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Abstract: Three species of the genus *Bassia* are known in Slovakia, the paper is aimed to describe occurrence and ecology of *Bassia prostrata*. The present study shows that the species occurred in three locations (Okoč, Komárno, Virt) in the Podunajská nížina lowland (SW Slovakia); data published from W and SE Slovakia are erroneous. All those three reliably documented sites were already destroyed and *B. prostrata* is evaluated as regionally extinct (RE) species of the Slovak flora. The species occupied both saline and sandy habitats, but it was not recorded in loess steppe grasslands, the most common habitat of *B. prostrata* in Central and South-eastern Europe. Coenological affinity of *B. prostrata* in the surrounding countries is briefly discussed.

Keywords: *Bassia*, habitats, occurrence, Central Europe.

Introduction

The genus *Bassia* includes about 10–15 annual and perennial species with occurrence in temperate regions of North Africa, Europe, Asia and the south-west of North America. Some species are invasive and spread beyond the original distribution range (e.g. *Bassia scoparia*) (AELLEN 1979; JEHLÍK 1998). From the taxonomical point of view, SCOTT (1978) included species of traditionally accepted genus *Kochia* into the more broadly understood genus

Bassia on the basis of the structure of pendants in perianth. This concept of *Bassia* genus was not generally accepted, but molecular analysis of KADEREIT & FREITAG (2011) later confirmed its justification.

In Central Europe, five *Bassia* species are known: three alien *B. hyssopifolia*, *B. scoparia* and *B. indica* and two native ones *B. laniflora* and *B. prostrata* (AELLEN 1979; UOTILA 2011). Recently, among the two native species, *B. prostrata* [syn. *Salsola prostrata* L., *Salsola toseffii* Urum., *Kochia prostrata* (L.) C. Schrad.] is the more rare and endangered (Fig. 1). The species is evaluated as critically endangered in Austria (NIKLFELD & SCHRATT-EHRENDORFER 1999) and the Czech Republic (GRULICH 2012), while in Hungary it is rated as near threatened (KIRÁLY 2007).

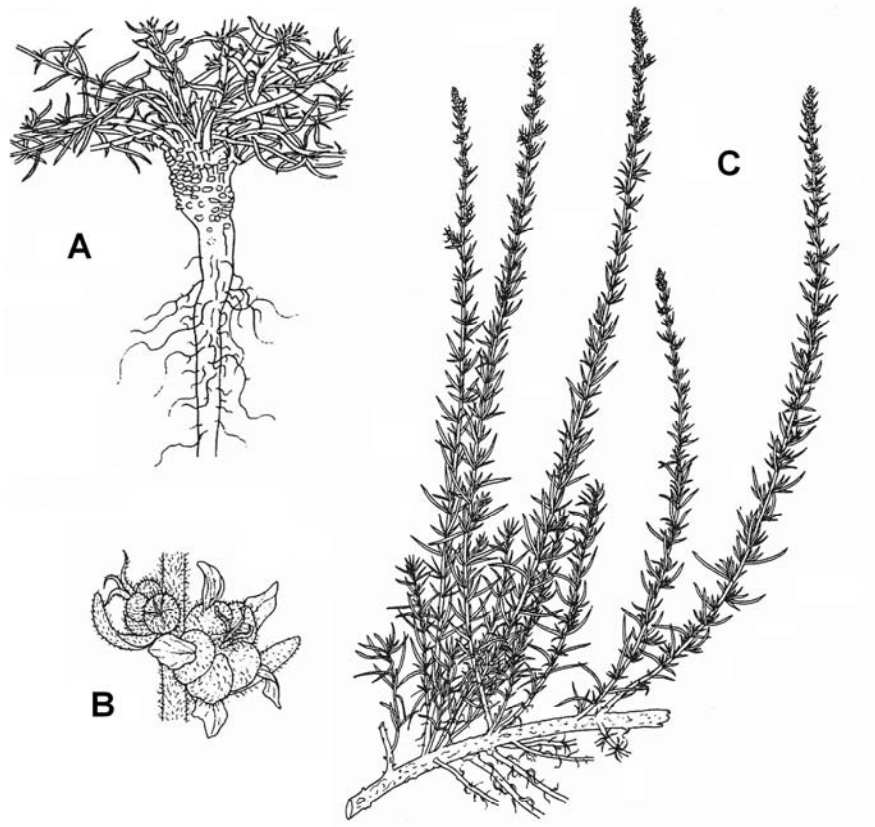

Fig. 1. *Bassia prostrata* (L.) Beck: A – lignified basal part of stem and root, B – fruits, C – terminal part of stem (modified from TOMŠOVIC 1989, 1990).

According to TOMŠOVIC (1989, 1990) and TOMŠOVIC & ČEŘOVSKÝ (1999), *B. prostrata* is native to South and South-Eastern Europe (Fig. 2), Southern Caucasus, Iran, Central Asia east to Mongolia, northern China and Tibet. In Slovakia, *B. prostrata* has been reported especially in Podunajská nížina lowland, but some authors mentioned it also in W and SE Slovakia although relevant data are missing (e.g. HLAVAČEK 1988; DOSTÁL 1998). For this reason, the paper aims to clarify the detailed occurrence of *B. prostrata* and its ecological requirements in Slovakia.

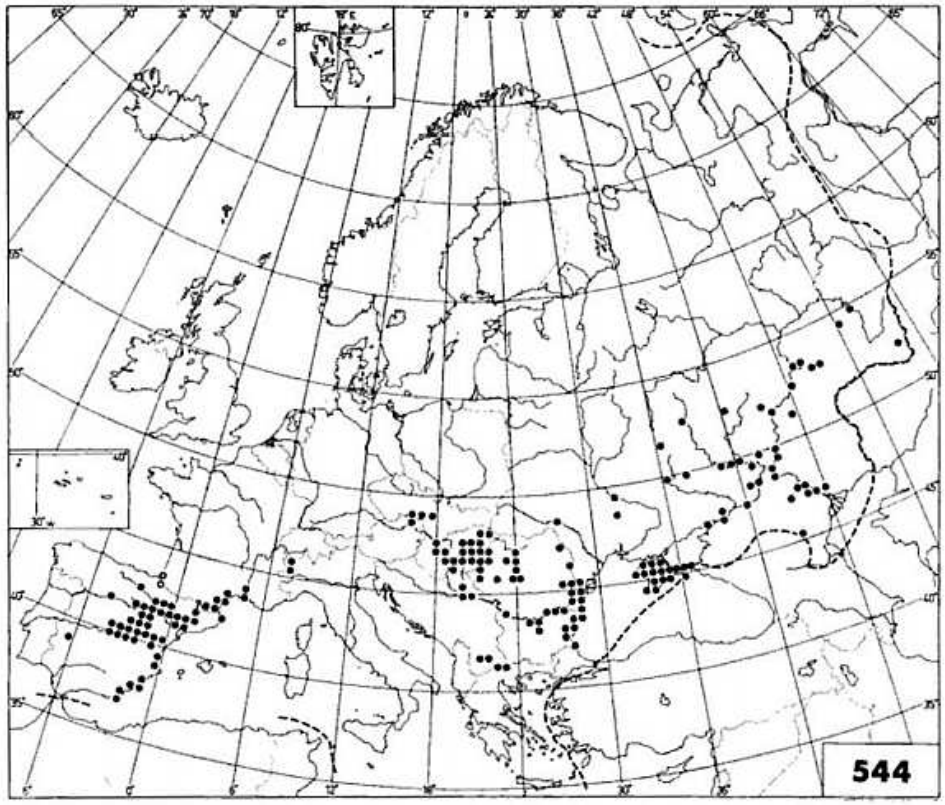

Fig. 2. European distribution range of *Bassia prostrata* (L.) Beck (JALAS & SUOMINEN 1980).

Material and methods

The study was carried out during the years 2004–2014. Data concerning the historical distribution of the species were obtained from herbaria BP, BRA, BRNU, BRNM, GM, KO, LTM, MMI, NI, OL, OLM, PMK, PR, PRA, PRC, SAV, SLO and ZV. Herbarium abbreviations are according to VOZÁROVÁ & SUTORÝ (2001) and THIERS (2015). Results of this study are presented on the dot map.

The map was designed by program ArcGis, version 9.2. The grid on the map follows that described by NIKLFELD (1971). A list of localities was compiled according to the directives of Flóra Slovenska VI/1 (cf. GOLIAŠOVÁ & MICHALKOVÁ 2012).

Nomenclature of flowering plants follows MARHOLD & HINDÁK (1998). Names of syntaxa are according to cited references. The phytogeographical division of Slovakia is in accordance with FUTÁK (1980). Categories and criteria of threat were applied according to the methodology of IUCN (2012).

Results and discussion

Distribution in Slovakia

As our study of herbarium vouchers showed, *B. prostrata* was reliably recorded at three locations in Slovakia: Okoč, Komárno and Virt (Fig. 3). All those locations are situated in southern part of the Podunajská nížina lowland along the border with Hungary. As elsewhere in Europe, our plants represent subsp. *prostrata* while the second subsp. *grisea* Prat. occurs exclusively in the Asian part of the distribution range (PRATOV 1971; TOMŠOVIC 1990).

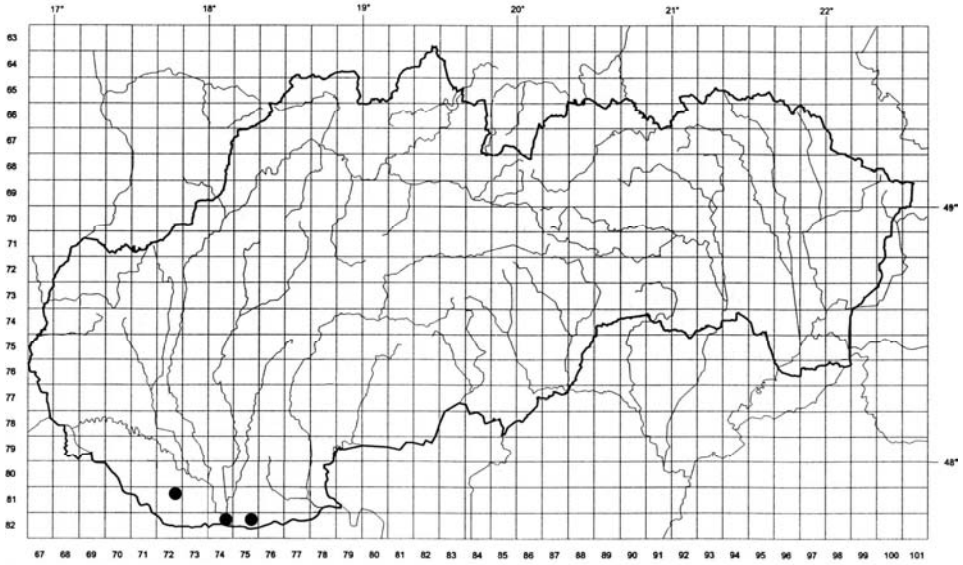

Fig. 3. Occurrence of *Bassia prostrata* (L.) Beck in Slovakia.

List of localities of *Bassia prostrata*:

6. Podunajská nížina lowland: Okoč [Ekécs puszta] (JEDLIČKA 1937 GM; TOMŠOVIC 1989). – Komárno (NÁBĚLEK 1936 SAV; HLAVAČEK 1988). – Virt (F. WEBER 1936 OLM, 1969 BRNM, TOMŠOVIC l. c.).

Doubtful data (not mapped):

6. Podunajská nížina lowland: Nesvady, Líščie diery Nature Reserve (ONDRÁŠEK 1996 ex verb.). – Bernolákovo (ONDRÁŠEK 2006).

In the historical botanical works, knowledge on the occurrence of *B. prostrata* is mostly lacking (e.g. REUSS 1853; NEILREICH 1866) or it is mentioned only very vaguely as "*most of the territory of Hungary except Carpathians*"(JÁVORKA 1924 – 1925) or "*southern Slovakia*" (POLÍVKA et al. 1928). Only KNAPP (1879) published an information on the exact occurrence of *B. prostrata* near Hradište pod Vrátnom (Borská nížina lowland) and Nové Mesto nad Váhom (Podunajská nížina lowland); however, we believe that it is a confusion with *B. laniflora* in both cases. Nothing has changed even after the World War II, almost all the basic publications on the flora of the former Czechoslovakia mentioned *B. prostrata* only from SE Moravia (DOSTÁL 1948–1950, 1954, 1958) and Hungarian authors only repeated old data from the 1930s (CSAPODY et al. 1980).

First paper dedicated to the occurrence of *B. prostrata* in Slovakia was published at the end of the eighties of the 20th century by A. HLAVAČEK (1988). He mentioned the species from all lowland areas of Slovakia. However, as showed our revision, most of the given data represent confusion with *B. laniflora* (S. G. Gmel.) A. J. Scott [syn. *Kochia arenaria* (P. Gaertn., B. Mey. et Schreb.) Roth, *Kochia laniflora* (S. G. Gmel.) Borbás] except a single specimen collected in Komárno (NÁBĚLEK 1936 SAV). The reason of those classical identification problems and confusions is that *Bassia laniflora*, especially in favourable conditions, create massive and high individuals with many stems and lignified basal part [f. *major* (Moq.) Aellen]. Therefore we can conclude that the distribution of *B. prostrata* in Slovakia was accurately processed only by TOMŠOVIC (1989), wherein he mentioned two locations: Okoč and Virt. Interestingly, although the Slovak *B. scoparia* sites are connected with its presence in NE Austria (FISCHER et al. 2005), S Moravia and W Hungary (SOÓ 1970; LENDVAI & HORVÁTH 1994, 2010), TOMŠOVIC & ČEŘOVSKÝ (1999) considered the occurrence of *B. prostrata* as secondary ("a permanently naturalized allochthonous species"). We disagree with this opinion and believe that *B. prostrata* is a native glacial relict (sensu TOMŠOVIC 1990) and border element of the Slovak flora. All three reliable documented locations represent the north-western limit of its distribution range.

Under the influence of the above mentioned knowledge, the last published determination keys already indicate the occurrence of the species in SW Slovakia and also in SE Slovakia (DOSTÁL 1989; DOSTÁL & ČERVENKA 1991). The occurrence of *B. prostrata* in SE Slovakia was based, first, on the data of HLAVAČEK (1988), and also on older data of *B. prostrata* in NE Hungary in Zempléni-hegység Hills (e.g. PAWLOWSKI 1856; HAZSLINSZKY 1864; HULJÁK 1935 BP), but this occurrence has not been verified for a long time (KIRÁLY 2009). On the other hand, MARGITTAI (1929, 1933, 1935) as the greatest expert at the flora of SE Slovakia before the WW II did not mention *B. prostrata* in any of his works. Therefore it is obvious that the species in this area never occurred.

Since 1996, two new locations of the species were given by I. ONDRÁŠEK (1996 ex verb., 2006). When reviewing sites (the latter one we visited together with the above mentioned author), we found that there were confusions with *B. laniflora* (Imeľ) and even with *B. scoparia* (Bernolákovo).

As showed our data, the species was always very rare in SW Slovakia and its locations Okoč and Komárno were destroyed already before the WW II. We support this finding with the fact that there were not found other herbarium specimens of *B. prostrata* and the species is not listed in any of the flora and vegetation studies of these sites (e.g. KRIST 1935, 1937, 1940; ŠMARDA 1952; HOLUBIČKOVÁ & KROPÁČOVÁ 1958; KRIPPELOVÁ 1965; VICHEREK 1973; ČVANČARA 1974). The location near Virt ceased to exist as the last one, because Weber collected there the species even in 1969 (WEBER 1969 BRNM). At present, we have not confirmed the above mentioned sites: saline habitats near Okoč and Komárno were completely destroyed due land reclamation (SÁDOVSKÝ et al. 2004) and sandy dunes around Virt were partially mined, converted to vineyards and partly afforested. Finally, we can conclude that *B. prostrata* is an extinct species of the Slovak flora and evaluation of the species in IUCN category RE (regionally extinct) in the fifth version of Red list of ferns and flowering plants (ELIÁŠ et al. 2015) is correct.

Ecology

Habitat types of the species can be determined only secondarily based on data from herbarium labels and knowledge of the vegetation composition in the area where vouchers were collected, respectively. In the case of Virt location is not dubious, because the collector F. WEBER literally stated "*in locis arenosis*" = on sandy areas. Virt is located in a large area of sand dunes along the Danube River, which reach up to 15 km eastwards to Čenkov farmstead (BEDRNA 2008).

Herbarium labels of the two remaining vouchers contain no data on habitat; only the name of location is given. Since alkaline and saline soils often occur in this area (MIKLÓS & HRNČIAROVÁ 2002), we believe that *B. prostrata* grew there probably in saline pastures. In the Komárno site, halophytic vegetation was developed in the town near the railway station and several rare halophytes as *Acorellus pannonicus* and *Crypsis aculeata* occurred there (KRIST 1940; ČVANČARA 1974) – so here the species found conditions for its existence. On the contrary, data on halophytic flora and vegetation in the surroundings of Okoč are missing, probably because it was destroyed already before the WW II.

In Central and south-eastern Europe, the species is present in three types of habitats: i) saline pastures, ii) xerothermic vegetation on sands and iii) loess xerothermic vegetation (TOMŠOVIC 1989; FISCHER et al. 2005; KIRÁLY 2009). While the species was recorded on sandy and saline habitats in Slovakia, it is not known in the latter type of habitat, although it is present in SW part of the country.

All Slovak sites were located in lowland at an altitude of 109–113 m; the region is characterised by warm and mostly warm lowland climate with mild temperature inversion, the average annual air temperature is around 10℃, the average

annual rainfall is 550–600 mm (MIKLÓS & HRNČIAROVÁ 2002). Hot and dry climate during the vegetation season is important to ensure a high success of pollination and fruiting of *B. prostrata* (TOMŠOVIC 1989).

Finally, we briefly mention the coenotic affinity of the species based on data from neighbouring countries because such information from Slovakia is completely lacking.

B. prostrata occurs most often as a dominant species on open loess steppe vegetation in Central Europe developed on steep loess slopes, e.g. on loess cliffs and terraces, on the concave, sunken dirt roads and in the surroundings of wine cellars in rural areas. Species composition is dominated by relic species of the Pleistocene cold steppes such as *Agropyron pectinatum*, *Taraxacum serotinum* and *Kraschenninnikovia ceratoides* (CHYTRÝ 2009). Those stands were described as association *Agropyro cristati-Kochietum prostratae* Zólyomi 1958 within the alliance *Artemisio-Kochion* Soó 1964 (TOMŠOVIC 1989; BORHIDI 2003). While stands of the association are still relatively well preserved in Hungary, Voyvodina (N Serbia) and Romania (STOJANOVIĆ 1983; BORHIDI 2003; DONIȚĂ et al. 2005), only small fragments have survived in SE Austria (NIKLFELD 1964; MUCINA & KOLBEK 1993) and the Czech Republic (CHYTRÝ 2009). In the last mentioned country, however, typical stands did not develop, because the characteristic species *Agropyron pectinatum* is lacking there (TOMŠOVIC 1989). Since these species are poor competitors that can grow only in an open vegetation, ruderalization and secondary succession can result in fatal consequences (TOMŠOVIC & ČEŘOVSKÝ 1999) because it can develop to xerophilous ruderal vegetation with biennial and perennial species of the class *Artemisietea vulgaris* (CHYTRÝ 2009). On the other hand, TOMŠOVIC & ČEŘOVSKÝ (1999) mentioned *B. prostrata* as a member of the annual vegetation of arable land and ruderal habitats of the alliance *Sisymbrion officinalis* (class *Stellarietea mediae*).

Within saline habitats in Hungary and Serbia, the species is mentioned as a component of the alliance *Salicornion prostratae* Soó 1933 corr. Borhidi 1996, especially in association *Lepidio crassifolii-Camphorosmetum annuae* Rapaics ex Soó (1947) 1957 (BORHIDI 2003). The above mentioned association is also placed into the alliance *Puccinellion peisonis* Wendelbg. 1943 corr. Soó (MUCINA 1993; BORHIDI 1996). KNEŽEVIĆ & BOŽA (1988) mentioned *B. prostrata* also as characteristic species of the association *Suaedeto-Kochietum prostratae* KNEŽEVIĆ & BOŽA 1988, nom. prov. The authors found it only on several places in Slano Kopovo Lake (Voyvodina, N Serbia); the community created small-scale and species-poor stands in drying sandy bottom of this alkaline lake. However, we did not record *B. prostrata* on Slano Kopovo site or elsewhere in this habitat during the survey of salt lakes vegetation within Pannonia (DÍTĚ et al. in litt.).

B. prostrata has been recorded also in the stands of association *Artemisio santonici-Festucetum pseudovinae*, alliance *Festucion pseudovinae* Soó 1933 (BODROGKÖZY 1965; SZUJKÓ-LACZA 1982; SIPOS & VARGA 1993). In Romanian part of Pannonia, the species is mentioned from a wider range of halophytic communities. Except the above mentioned ones, it was found also in *Achilleo-*

Festucetum pseudovinae Soó (1933) corr. Borhidi 1996 (alliance *Festucion pseudovinae*) and *Hordeetum hystricis* (Soó 1933) Wendelberger 1943 (alliance *Puccinellion limosae*) (POP 2002; DONIȚĂ et al. 2005). ELIÁŠ et al. (2013) in their comprehensive study of halophytic vegetation of South-eastern Europe including Pannonia published the rare occurrence of the species in the stands of pannonian steppe halophytic grasslands (ass. *Achilleo-Festucetum pseudovinae*) and continental halophytic steppe grasslands (ass. *Artemisio santonici-Festucetum pseudovinae*). They found *B. prostrata* also partly in stands of Pannonian low production halophytic steppe grasslands (ass. *Plantagini tenuiflorae-Pholiuretum pannonici* Wendelberger 1943, alliance *Puccinellion limosae* Soó 1933). In all these associations, the species occurs only incidentally with a coverage of about 1%, only occasionally up to 15%.

The species is also mentioned in sandy habitats (TOMŠOVIC 1989) occupying communities of alliance *Festucion vaginatae* Soó 1957 (SOÓ 1970). Its presence here is only accessory and detailed data are lacking in Central Europe. Exact data on the presence of *Bassia prostrata* in psammophytic communities (e.g. in *Koelerio glaucae-Stipetum borysthenicae* Popescu et Sanda 1987) are available in SE and E Europe in Ukraine, Romania and Bulgaria (DONIȚĂ et al. 2005; ASSYOV et al. 2006; KUZEMKO 2009).

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