

## Distribution and ecology of the genus *Bassia* in Slovakia 2: *Bassia laniflora* (S. G. Gmel.) A. J. Scott

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Abstract: The paper is aimed to describe the occurrence and ecology of *Bassia laniflora*. The study showed that the species occurred in 57 localities at all in five Slovak phytogeographical districts (Ipeľsko-rimavská brázda region, Devínska Kobyla hills, Borská nížina lowland, Podunajská nížina lowland and Východoslovenská nížina lowland); only 14 sites have been recently confirmed (19 %), therefore, current status of the species should be reviewed in the Slovak Red list of ferns and flowering plants. Due frequent confusion with other taxa of the genus the determination key is also published. The species occupied sandy dunes exclusively where is a component of pioneer vegetation in the association *Bassia laniflorae-Brometum tectorum*, alliance *Bassia laniflorae-Bromion tectorum*, which are here recorded as new vegetation units to Slovakia.

Keywords: *Bassia*, Central Europe, coenology, distribution, habitats.

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### Introduction

This work represents the second contribution of a series referring to the genus *Bassia* All. in Slovakia (the first paper was devoted to *Bassia prostrata*, see ELIÁŠ

et al. 2015a) and it deals with *Bassia laniflora* (S. G. Gmel.) A. J. Scott [= *Salsola laniflora* S. G. Gmel., *S. arenaria* Maerkl]. Similarly as *Bassia prostrata* (L.) Beck, *B. laniflora* is also rare in Central Europe: it is evaluated as critically endangered in Austria (NIKLFELD & SCHRATT-EHRENDORFER 1999; FISCHER et al. 2005), vulnerable in Slovakia (ELIÁŠ et al. 2015b) and probably extinct in the Czech Republic (GRULICH 2012), while in Hungary it is not regarded as rare nor threatened (KIRÁLY 2007).

*Bassia laniflora* has a wide distribution area which extends from north-eastern Spain, southern France, central and northern Italy through south-western Germany, Austria, Czech Republic, Slovakia, Hungary, Poland, Serbia and Ukraine to central and southern Russia, the Caucasus, Minor and Central Asia to western Mongolia (AELLEN 1979; JALAS & SUOMINEN 1980; TOMŠOVIC 1990). In Slovakia, the species has been recorded in lowland areas (HLAVAČEK 1988; DOSTÁL 1989; DOSTÁL & ČERVENKA 1991) but detailed occurrence was not given up to now. As a consequence, we clarify the historical and current occurrence of *B. laniflora* and its coenological and ecological requirements in Slovakia.

## Material and methods

The study was carried out during the years 2004–2015 including both field survey and herbarium data excerption.

Only revised herbarium specimens were used in the study of *B. laniflora* distribution in Slovakia. Data concerning the historical and recent distribution of the species were obtained by the examinations of specimens preserved at the herbaria BP, BRA, BRNU, BRNM, GM, KO, LTM, MMI, NI, OL, OLM, PMK, PR, PRA, PRC, SAV, SLO and ZV; acronyms according to VOZÁROVÁ & SUTORÝ (2001) and THIERS (2016). The distribution map (grid follows NIKLFELD 1971) was prepared using ArcGis 9.2. A list of localities was compiled according to *Flóra Slovenska VI/1* (cf. GOLIAŠOVÁ & MICHALKOVÁ 2012) and it is attached in Appendix 1. Localities are considered as recent when the species was recorded/confirmed within 25 years (ELIÁŠ et al. 2015b), all other locations being considered as historical.

Phytosociological relevés were sampled according to the Zürich-Montpellier approach using the adapted nine-grade Braun-Blanquet's scale (BARKMAN et al. 1964) and were stored in the TURBOWIN database (HENNEKENS & SCHAMINÉE 2001); localities of relevés are included in Appendix 2.

Nomenclature of flowering plants follows MARHOLD & HINDÁK (1998). Names of syntaxa are according to references cited in the text. The phytogeographical division of Slovakia is in accordance with FUTÁK (1980). Categories and criteria of threat were applied according to the methodology of IUCN (2016).

## Results and discussion

### Determination, morphology and taxonomy

The study of herbarium specimens showed frequent confusion of *Bassia laniflora* plants (Fig. 1) especially with *Bassia prostrata*, *B. scoparia* as well as

*Camphorosma annua*. Therefore, we have decided to publish the following identification key, where we take into account both the morphological differences but also different ecological requirements of individual taxa included here.

- 1a Subshrubs, stem bases woody; saline, sandy and loess habitats ..... *Bassia prostrata*
- 1b Annual herbs occupying saline; sandy or ruderal habitats ..... 2
- 2a Perianth segments and stamens 4, fruiting perianth without membraneous wings; only saline habitats ..... *Camphorosma annua*
- 2b Perianth segments and stamens 5, fruiting perianth developing horizontal, membraneous wings ..... 3
- 3a All leaves 1-veined, semicylindric; only sandy habitats ..... *Bassia laniflora*
- 3b Leaves 1–3-veined, blades flattened; different ruderal habitats .. *Bassia scoparia*

From the taxonomical point of view, our plants represent exclusively nominate var. *laniflora* which is characteristic by bracts as long as perianth. Within this variety, forma *major* (Moq.) Aellen representing massive high individuals with lots of stems and woody lower part caused above mentioned identification problems and confusions with *Bassia prostrata* (HLAVÁČEK 1988; TOMŠOVIC 1989; ELIÁŠ jun. et al. 2015a). Individuals with woolly hairy stems, leaves and inflorescences (hairs exceeding length of 10 mm) were found in the Záhorská nížina and Východoslovenská nížina lowlands, those plants were described by MARGITTAI (1935) as forma *villosissima*. AELLEN (1979) published also var. *brevifolia* (W. D. J. Koch) Aellen with short bracts and dense inflorescences; we have not confirmed it in Slovakia.

#### Distribution in Slovakia

On the basis of the floristic survey and examination of herbarium materials, *Bassia laniflora* occur in the south part of Slovakia in five phytogeographical districts: Ipeľsko-rimavská brázda region, Devínska Kobyla hills, Borská nížina lowland, Podunajská nížina lowland and Východoslovenská nížina lowland (Fig. 2). The older herbarium specimens are dated in the half of the 19th century (KRZISCH 1854 PR, 1856 SLO; S. COLL. 1858 BRA; HOLUBY 1860 BRA, PR, SLO) and highlight that *B. laniflora* occurred also in W and SW of Slovakia. In to this time period may be also included undated collection of G. REUSS (he died in 1863) from the phytogeographical district Ipeľsko-rimavská brázda region. In eastern Slovakia, the species is recorded until in the first third of the 20th century (MARGITTAI 1917 BP, 1926 BRNU). We can conclude that the species occurrence was restricted to aeolian sandy habitats (MIKLÓS & HRNČIAROVÁ 2002; BEDRNA 2008).

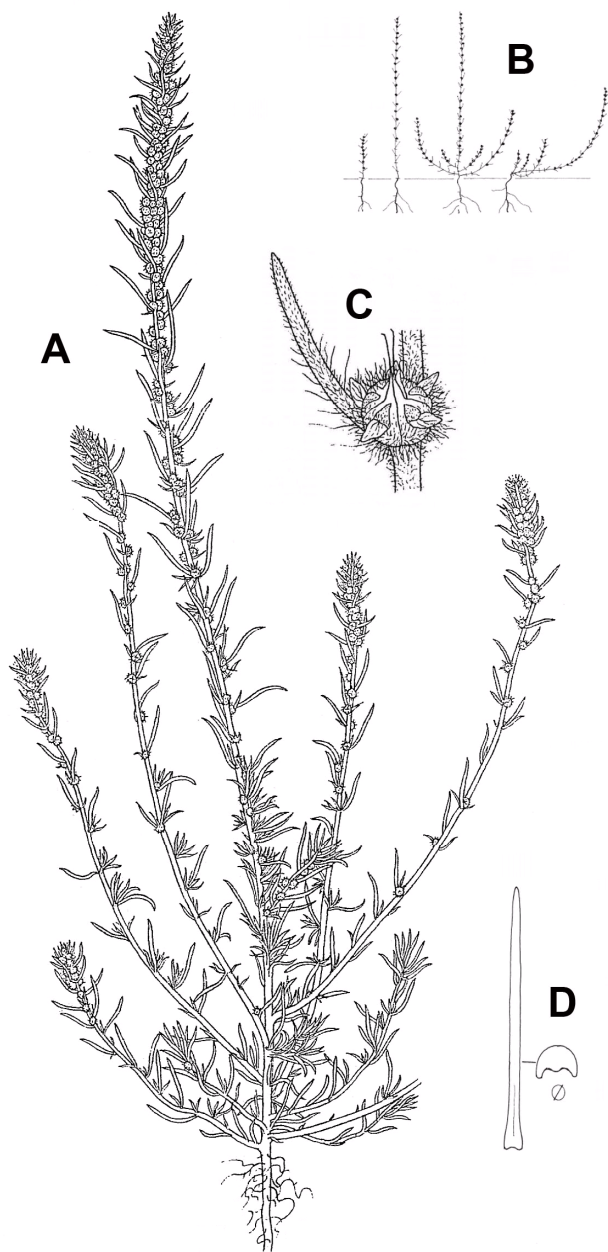
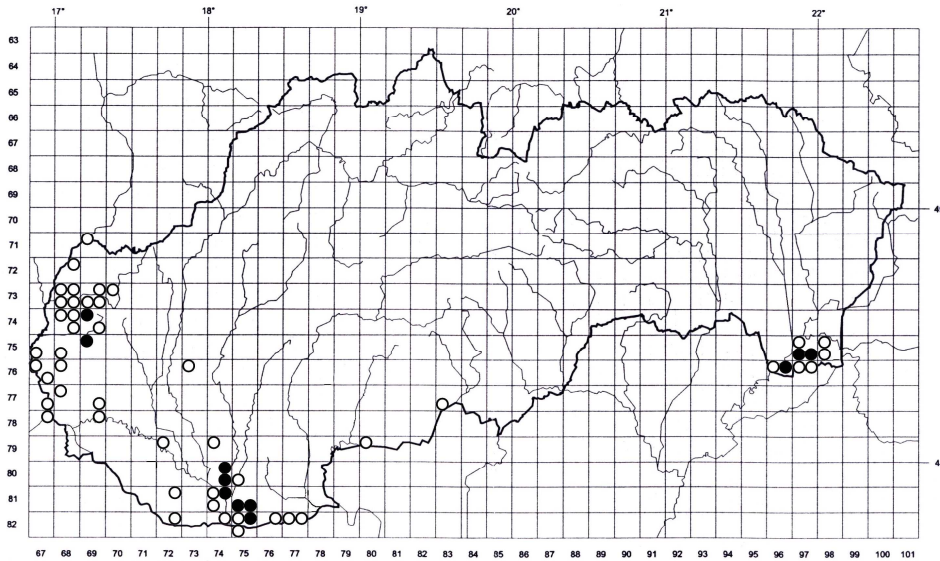


Fig. 1. *Bassia laniflora*: A – habitus of the plant, B – growth forms schema, C – fruit, D – leaf shape (modified from TOMŠOVIĆ 1990 and KÄSTNER & FISCHER 2011).



**Fig. 2. Occurrence of *Bassia laniflora* in Slovakia: ○ – historical localities, ● – recently confirmed localities.**

Comparing recent and historical herbarium data, there is a clear decrease trend in the number of localities found for *B. laniflora*. Among the 76 sites, 62 localities were not confirmed [23 were lost before the Second World War (30%) and 39 before 1990 (51%)]. As a consequence, only 14 sites have been recently confirmed (19%). The main reason for this decrease is human effect on landscape (e.g. afforestation of sand dunes, sand mining). Neither the declaration of several sites of psamphytic vegetation as protected areas failed to stop the decline in the number of sites, e. g. it was not confirmed recently in the Čenkovská step Nature Reserve, the Mašan Nature Reserve (ELIÁŠ jun., DÍTĚ, MELEČKOVÁ 2015 ined.), the Tomášikovský presyp Natural Monument near Tomášikovo settlement (BACSA & MELEČKOVÁ 2014) etc. The greater decrease was recorded in the Ipeľsko-rimavská brázda region (both sites were destroyed) and the Borská nížina lowland [29 sites (96%) out of 31 were destroyed]. Overall, more than 80% of the *B. laniflora* sites were destroyed in Slovakia in the past. Therefore, the current conservation status of the species should be reviewed in the Slovak Red list (ELIÁŠ et al. 2015b) according to IUCN categories guide (IUCN 2012).

A further important question concerning the occurrence of *B. laniflora* in Slovakia, is the confusion in the identification of the species especially in comparison with *Bassia prostrata* (ELIÁŠ et al. 2015a). For instance, REUSS (1853) mentioned it from the surroundings of Komárno settlement and in the Novohrad region near Lučenec town in the first survey of the Slovak flora. Also KNAPP (1865) mentioned a few locations from W Slovakia (Cunín, Senica, Čáčov, Borský Mikuláš, Šaštín and Rišňovce). A few years later, KNAPP (1879)

published 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 showed (ELIÁŠ et al. 2015a) that both cases refer to *B. laniflora*. So, the Reuss' and Knapp's records are actually the first published evidences of *B. laniflora* in Slovakia and they fall within the time period of the first herbarium collections (e.g. KRZISCH 1854 PR, 1856 SLO; s. COLL. 1858 BRA; HOLUBY 1860 BRA, PR, SLO). In the period between the world wars, the species is reported as general occurrence ["sandy areas; JÁVORKA (1924 –1925) or "southern Slovakia" (POLÍVKA et al. 1928)]. After the World War II, all the basic publications on the flora of the former Czechoslovakia (DOSTÁL 1948–1950, 1954, 1958) published correctly the occurrence of *B. laniflora* in Slovakia (more detailed data were given by DOSTÁL 1948–1950), and the species is mentioned from three phytogeographical districts: Borská nížina, Podunajská nížina and Východoslovenská nížina lowlands. Likewise it was not changed in more recent publications (DOSTÁL 1989; DOSTÁL & ČERVENKA 1991); only sites in the Ipeľsko-rimavská brázda region are not mentioned in none of these works.

### Ecology and Coenology

*Bassia laniflora* has narrow ecological niche in comparison with *B. prostrata* and *B. scoparia* – the other two species of the genus known from Slovakia. While *B. prostrata* occupies sandy, salty and loess sites (DONIŤÁ et al. 2005; KIRÁLY 2009; ELIÁŠ et al. 2015a) and *B. scoparia* various ruderal habitats (TOMŠOVIC 1990; JEHLÍK 1998), *B. laniflora* is restricted exclusively to the sandy habitats throughout its distribution range (AELLEN 1979). These habitats in which *B. laniflora* occurs, were originated during the glacial periods and there are no direct data on the forest cover, thus this vegetation ale likely to be continuous from the late glacial and early postglacial (KRIPPEL 1986; MOLNÁR et al. 2012). While in prehistoric times the species occupied natural habitats of wind exposed sand dunes, the situation is markedly different at present. Based on our field surveys, *B. laniflora* mostly occurs at exposed slopes and bottoms of shortly abandoned as well as still exploited sandy pits. The species occurrence in the open sand dunes is rare (e. g. sand dunes near Věč settlement, Tab. 1, rels. 4, 5), because this habitat has been almost destroyed in Slovakia (afforestation, secondary succession, sand mining etc.). As showed Tab. 1, some of the recent stands were considerably ruderalised (e. g. rels. 1, 10, 12), but the species can grow also in this weedy vegetation as it is evidenced already by archaeobotanical findings from the 13th century in Ukraine (BEZUSKO et al. 2009) and recently for example in the Borská nížina lowland (ZLINSKÁ 1990).

From the phytosociological point of view, we regarded stands with dominance of *Bassia laniflora* recorded in the Podunajská and Východoslovenská nížina lowlands as the association *Bassio laniflorae-Brometum tectorum* (Soó 1938) Borhidi 1996 (Tab. 1, rels. 1, 2, 3, 5, 7, 8, 9, 10, 12) which is not still mentioned from Slovakia. These types of stands were included especially to the association *Brometum tectorum* Bojko 1934, alliance *Koelerion arenariae* R. Tx. 1937 corr. Gutermann et Mucina 1993 up to now (VALACHOVIČ et al. 1995; STANOVÁ & VALACHOVIČ 2002). However, *Brometum tectorum* is characteristic by

co-dominance of *Bromus tectorum* and *Psyllium arenarium* and absence of *Bassia laniflora* and species of *Festucion vaginatae* Soó 1929 in contrary to *Bassia laniflora*-*Brometum tectorum* according to BORHIDI (2003).

Tab. 1. Synoptic table of vegetation with presence of *Bassia laniflora* in Slovakia.

Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12
Relevé plot size	15	16	16	16	16	16	16	16	10	12	16	16
E <sub>0</sub>	0	0	0	0	0	0	0	0	0	0	60	0
E <sub>1</sub>	60	30	50	15	10	45	20	30	45	35	80	40
Number of species	15	18	17	13	9	26	13	19	17	11	22	14
<i>Bassia laniflora</i>	2m	+	2a	+	+	2a	+	2a	1	2a	1	+
<i>Bromus tectorum</i>	2a	2a	2b	+	1	+	+	1	2a	2a	1	.
<i>Cynodon dactylon</i>	1	1	+	+	+	1	2a	2a	+	.	2a	+
<i>Tithymalus cyparissias</i>	+	+	2a	+	1	2a	.	+	.	.	2b	+
<i>Erysimum diffusum</i>	+	.	1	r	+	1	.	+	1	.	.	+
<i>Crepis foetida</i>	+	+	+	.	.	.	.	+	+	+	.	.
<i>Festuca vaginata</i>	.	1	.	1	.	1	+	.	.	.	3	+
<i>Silene conica</i>	+	.	2a	.	r	.	.	.	+	.	+	.
<i>Cota austriaca</i>	1	.	1	.	.	1	+	.	1	.	.	.
<i>Conyza canadensis</i>	.	1	+	.	.	.	.	.	+	.	1	1
<i>Chenopodium album</i> agg.	1	r	.	.	.	.	.	+	.	1	.	1
<i>Psyllium arenarium</i>	+	+	+	.	.	.	.	+	1	.	.	.
<i>Salsola kali</i>	3	.	.	.	.	.	.	+	+	+	.	.
<i>Acetosella vulgaris</i>	.	.	.	.	.	2a	+	1	2a	.	.	.
<i>Ambrosia artemisiifolia</i>	.	.	.	.	+	.	+	+	.	1	.	.
<i>Silene otites</i> agg.	.	+	.	.	.	+	.	.	.	.	1	+
<i>Poa bulbosa</i>	+	.	.	+	.	+	.	.	.	.	+	.
<i>Polygonum arenarium</i>	.	2a	.	.	.	.	.	.	.	.	1	2a
<i>Echium vulgare</i>	1	.	.	.	.	.	.	+	.	.	2a	.
<i>Acosta rhenana</i>	.	.	+	.	.	.	.	.	.	.	2a	+
<i>Chondrilla juncea</i>	.	.	.	+	.	1	.	.	.	.	+	.
<i>Berteroa incana</i>	.	.	.	.	.	+	.	.	+	.	+	.
<i>Elytrigia repens</i>	.	.	+	.	+	+	.	.	.	.	.	.
<i>Petrorhagia prolifera</i>	.	.	.	.	.	+	.	+	.	.	+	.

Species recorded in two relevés: E<sub>1</sub> – *Carex hirta* 1 (4), + (5), *Eryngium campestre* 1 (6), + (7), *Polygonum aviculare* 1 (7), + (8), *Trifolium arvense* 1 (9), + (3), *Vicia villosa* 1 (9), + (10), *Tribulus terrestris* 1 (9), r (12), *Alyssum alyssoides* + (2, 8), *Arenaria serpyllifolia* + (1, 8), *Gypsophila paniculata* + (7, 10), *Medicago minima* + (3, 11), *Potentilla arenaria* + (4, 6), *Setaria pumila* + (2, 10), *Stipa capillata* + (11, 12), *Syrenia cana* + (8, 12), *Tithymalus seguierianus* + (2, 11), *Tragus racemosus* + (6, 7), *Xeranthemum annuum* + (2, 10), *Robinia pseudoacacia* juv. + (11), r (3).

Species recorded in one relevé only: E<sub>0</sub> – *Ceratodon purpureus* 4 (11), E<sub>1</sub> – *Thymus pannonicus* 2a (6), *Thymus praecox* 2a (11), *Bromus squarrosus* 1 (2), *Corispermum nitidum* 1 (12), *Papaver rhoeas* 1 (1), *Silene latifolia* subsp. *alba* 1 (3), *Achillea pannonica* + (6), *Anchusa officinalis* + (9), *Artemisia campestris* + (4), *Bromus hordeaceus* + (6), *Carex praecox* + (6), *Digitaria sanguinalis* + (7), *Erodium cicutarium* + (6), *Erysimum repandum* + (2), *Festuca rupicola* + (6), *Gypsophila muralis* + (6), *Hordeum murinum* + (4), *Lappula squarrosa* + (10), *Lolium perenne* + (3), *Poa angustifolia* + (11), *Potentilla argentea* agg. + (6), *Trigonella monspeliaca* + (9), *Verbascum phlomoides* + (6), *Veronica arvensis* + (6), *Carduus acanthoides* r (2).

The association *Bassio laniflorae-Brometum tectorum* was described by BORHIDI (1996) on the base of relevés published by SOÓ (1938) from SW Hungary (Nyírség area). Stands were developed as secondary semi-natural vegetation on steeper slopes in sandy pastures. According to SOÓ (l. c.) they are characterized by co-dominance of *Bassia laniflora* and *Bromus tectorum* (coverage 5–75%). Other species as *Anthemis ruthenica*, *Acetosella vulgaris*, *Botriochloa ischaemum*, *Cynodon dactylon* and *Polygonum arenarium* were present with higher cover (5–25%). As mentioned above, the occurrence of species from the alliance *Festucion vaginatae* such as *Festuca vaginata*, *Gypsophila paniculata* and *Alyssum montanum* was also often recorded (SOÓ l. c.). BORHIDI (1996, 2003) included this community to annual sandy grasslands vegetation of the alliance *Bassio laniflorae-Bromion tectorum* (Soó 1957) Borhidi 1996, which is actually regarded as a part of the class *Koelerio-Corynephoretea* Klika in Klika et Novák 1941 (BORHIDI et al. 2012; KRSTIVOJEVIĆ ČUK et al. 2015). This alliance is also new to Slovakia (see JAROLÍMEK et al. 2008).

Comparing to original relevés of SOÓ (1938), Slovak stands show almost identical species composition (including ruderal species and weeds) but the cover of both dominants is lower (5–25%). The next succession stage is the vegetation with dominance of *Festuca vaginata* which belongs to the alliance *Festucion vaginatae* and associations *Festucetum vaginatae* Rapaics ex Soó 1929 in the Podunajská nížina lowland (Tab. 1, rel. 11) and *Diantho serotini-Festucetum vaginatae* Klika 1934 in the Východoslovenská nížina lowland (Tab. 1, rel. 4.), respectively.

Distribution range of the association *Bassio laniflorae-Brometum tectorum* is not exactly known. It is reliably documented only from Hungary (BORHIDI 1999; 2003; TÖRÖK et al. 2008; BORHIDI et al. 2012). However, it is likely to be present also in other countries in the area of the Pannonian Basin (e. g. Romania, Austria), taking into account the presence of some associations (*Brometum tectorum*, *Secali sylvestris-Brometum tectorum* Hargitai 1940) belonging to the alliance *Bassio-Bromion tectorum* which comprises of annual pioneer vegetation of calcareous sands in the Pannonian Basin (RODWELL et al. 2002, SANDA et al. 2008; WILLNER 2016 in verb.). In contrary, *Bassio laniflorae-Brometum tectorum* is not known in NW part of the Pannonian Basin, where pioneer communities of inland and coastal sandy dunes of the alliance *Corynephorion canescentis* Klika 1931 are present which have rather Subatlantic and Atlantic origin (MUCINA & KOLBEK 1993; VALACHOVIČ et al. 1995; CHYTRÝ & SÁDLO 2007; VALACHOVIČ 2012).

In Slovakia, *Bassia laniflora* is reported also in other pioneer sandy vegetation in both classes: *Koelerio-Corynephoretea* (*Thymo angustifolii-Corynephoretum canescentis* Krippel 1954) and *Festucetea vaginatae* (*Festucetum vaginatae*, *Diantho serotini-Festucetum vaginatae*, *Helianthemo fumanae-Festucetum vaginatae* and *Rumex acetosella* community) but its presence here is only supplementary (KRIPPELOVÁ & KRIPPEL 1956; VALACHOVIČ et al. 1995). The species was occasionally found also in ruderal stands of order *Eragrostielalia* J. Tx. ex Poli 1966 developed on sandy and very dry soils (ZLINSKÁ 1990).



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**Appendix 1. The list of revised herbarium specimen and localities of *Bassia laniflora* in Slovakia.**

**Pannonicum: 2. Ipeľsko-rimavská brázda region:** Ipeľské Predmostie [Hidvég] (F. WEBER 1934 PR; KRIST 1937 BRNU; V. VALENTA 1937 BRA; CHRTEK et SOJÁK 1957 PRC). – Rároč, sandy grasslands (G. REUSS s. d. BRA). **4. Borská nížina lowland:** Stupava (KRIST 1938 BRNU; GREBENŠČIKOV 1954 SAV; VARTÍKOVÁ 1968 SLO). – Zohor (F. A. NOVÁK 1920 PRC; BÍLÝ 1922 BRNM; PODPĚRA 1922 BRNU; SKŘIVÁNEK 1922 BRNM; MÁČEL 1936 BRNU; V. VALENTA 1938 BRA). – Závod, train stop (ČERNOCH 1950 BRNM; SKŘIVÁNEK 1950 BRA). – Plavecký Štvrtok, Sípolt site (KMEŤOVÁ 1980 SAV). – Láb (NÁBĚLEK 1935 BRA; PTAČOVSKÝ 1936 SAV). – Plavecký Štvrtok, train stop (GAYER 1916 BP; PTAČOVSKÝ 1929 SAV; KLIKA 1933 PR; KLÁSKOVÁ 1956 PRC; SCHIDLAY 1957 SAV; SLAVOŇOVSKÝ 1958 BRNU). – Rohožník (ELIÁŠ jun. 2010, 2011 NI). – between Jakubov and Gajary (SCHEFFER 1930 BP). – between Malacky and Kuchyňa (FUTÁK 1943 SLO). – Malacky (SKŘIVÁNEK 1924 BRNM; FUTÁK 1943 SLO). – Malacky, in the wall of the castle (SLAVOŇOVSKÝ 1958 BRNU). – Záhorská Ves (KELLER 1909 BP, BRNU; SPREITZENHOFER s. d. PRC; G. BECK 1879 PRC; SCHEFFER 1922 BP). – Plavecký Mikuláš (MÁČEL 1936 BRNU). – Veľké Leváre (STANĚK 1920 BRNU; Č. DEYL 1936 OLM; KAVKA 1950 BRA; ČERNOCH 1950 BRNM; SKŘIVÁNEK 1958 BRA). – Studienka, former lodge (GRULICH 1985 MMI; ŘEPKA 1985 BRNM). – Lakšárska Nová Ves, Lakšárske kopce hills (PTAČOVSKÝ 1935 SAV; SLAVOŇOVSKÝ 1957 BRNU; CHRTEK et KŘÍSA 1964 PRC; GRULICH 1979, 1981, 1988 MMI; SOMOGYI 1994 BRA; ELIÁŠ jun. 2008 NI). – Hlboké (ČERNOCH 1951 BRNM). – Borský Mikuláš, „Pieskovište“ site (HLAVAČEK 1970 SAV; KMEŤOVÁ 1970 SAV; GRULICH 1983 MMI). – Borský Mikuláš, NW from the village (SLAVOŇOVSKÝ et BLECHA 1972 BRNU, PRC). – Borský Peter, south from the village – Borský Mikuláš, train stop SSW from the village (both data GRULICH 1988 MMI). – Borský Mikuláš (SKŘIVÁNEK 1935 BRNM). – Moravský Svätý Ján (KRIST 1935 BRNU; KOTLABA et HOLUB 1954 PR). – Šaštín (SKŘIVÁNEK 1947 BRA, BRNM; KURKA 1949 PR; SLAVOŇOVSKÝ et BLECHA 1972 BRNM, NI; GRULICH 1986 MMI). – Šaštín, SE from the village (SLAVOŇOVSKÝ 1957 BRNU; TRÁVNÍČEK 1987 OL). – Šaštín-Stráže (ŠMARDA 1947 BRNM; J. MICHALKO 1951 SAV, SLO; SLAVOŇOVSKÝ et BLECHA 1972 BRA, OL, PR, SAV, SLO). – Šajdíkové Humence, Šranecký revír site (ŠMARDA et J. DVOŘÁK 1958 BRNM). – Sekule (s. COLL. 1930 PR; KRIST 1935 BRNU). – Čáry (J. MICHALKO 1951 SLO; MÁJOVSKÝ 1967 SLO). – Kúty (F. WEBER 1924 BRNM, 1933 PR; SILLINGER 1929 PRC; KRIST 1935 BRNU; MÜLLER 1946 BRNU). – Cunín (KRZISCH 1854 PR, 1856 SLO). – Skalica, near the Morava river (HOLUBY 1860 BRA, PR, SLO). **5. Devínska Kobyla Hills:** Bratislava, Devínska Nová Ves city part (HROBAŘ 1934 PR, PRC). – Devínska Kobyla, Sandberg site (WIESBAUR 1867 BRNU; ČERNÝ 1930 BRA; F. WEBER 1924 OLM, 1927 PR, 1934 OLM, PRC, 1935 BP, BRNU, BRNM, MZ, NI, OLM, PR, PRC, SLO, ZV; V. VALENTA 1938 BRA; SKŘIVÁNEK 1945 BRA; PTAČOVSKÝ s. d. PRC, 1923 SAV). – Devínska Kobyla (FUTÁK 1945 SLO). – Devínske jazero (ČERNÝ 1924 BRA). **6. Podunajská nížina lowland:** Ivanka pri Bratislave (V. VALENTA 1938 BRA; F. NÁBĚLEK 1941 SLO). – between Ivanka pri Bratislave and Bernolákovo (V. VALENTA 1938 BRA). – Veľký Meder (FUTÁK 1949 SAV). – between Tôň and Klížska Nemá (MÁJOVSKÝ 1951 SLO). – Tomášikovo (MÁJOVSKÝ 1956 SLO). – Palárikovo (FUTÁK 1949 SLO). – Kameničná, Balvany farmstead (KLOKNER 1958 PMK). = Komárno, Veľké Písky farmstead (F. WEBER 1933 PR). = Komárno, Malé Písky farmstead (F. WEBER 1935 PR, 1936 BRNM, OLM). – Nesvady, calvary (ELIÁŠ jun. et SZABÓOVÁ 2006 NI; ELIÁŠ jun. 2015 NI). – Nesvady, near cemetery (TAKÁČ 1950 BRA; ELIÁŠ jun. et al. 2001 NI; ELIÁŠ jun. et SZABÓOVÁ 2006 NI; ELIÁŠ jun. 2013 NI). – Nesvady, Líščie diery nature reserve (OSVAČILOVÁ 1954 NI; Jos. DOSTÁL 1955 PR, PRC, 1966 PR; KLOKNER 1965 PMK; LHOŠKÁ 1973 PR; SVOBODOVÁ 1984 NI; ELIÁŠ jun. et SZABÓOVÁ 2006

NI; LETZ 2011 SAV; ELIÁŠ jun. 2012 NI, SAV). – Imeľ, abandoned sand pit in N edge of the village (ELIÁŠ jun. et SZABÓOVÁ 2006 NI). – Imeľ, forest clearing NE from the village (ŽERTOŤOVÁ et CHRTEK 1954 NI; CHRTEK et al. 1970 PRC; ČVANČARA et NEVRLÝ 1971 OLM; ELIÁŠ jun. 2014 NI). – Hurbanovo, Abov hill (JOS. DOSTÁL 1954 PR, 1955 PRC; ELIÁŠ jun. et SÁDOVSKÝ 2004 NI; ELIÁŠ jun. et SZABÓOVÁ 2006 NI). = Hurbanovo, Sesíleš (OSVAČILOVÁ 1954 NI). – Martovce, Fenyeri földék site (OSVAČILOVÁ 1954 NI; JOS. DOSTÁL 1966 PR). – Komárno (s. COLL. 1858 BRA). – Svätý Peter, ruin of Dolný Peter farmstead (ŠOUREK 1961 PR; ELIÁŠ jun. et SZABÓOVÁ 2006 NI; ELIÁŠ jun. et ELIÁŠ sen. 2011 NI). – Chotín (F. WEBER 1934 PR; KRIST 1935 BRNU; V. VALENTA 1937 BRA; FUTÁK et MAGIC 1948 SLO; ŠMARDA 1948 BRNM; SKŘIVÁNEK 1950 BRNM; OSVAČILOVÁ 1954 NI; FUTÁK 1957 SLO; JOS. DOSTÁL 1955, 1966, 1970 PR; ČVANČARA et SÝKORA 1970 PR; ČVANČARA 1971 PR). – Marcelová, NW edge of the village (MÁJOVSKÝ 1958 SLO; Č. DEYL 1977 OLM; FABIANKOVÁ 1978 SAV, JEHLÍK et SVOBODOVÁ 1982 PRA; GRULICH 1987 MMI; TRÁVNÍČEK 1989, 1995 OL; VOZÁROVÁ 1994 BRA; LETZ 1995 SAV; ELIÁŠ jun. 2004, 2012 NI; DUCHÁČEK 2005 PR; E. MICHÁLKOVÁ et LETZ 2012 SAV). – Rišňovce (OSVAČILOVÁ, CHRTEK et ŽERTOŤOVÁ 1953 NI). – Iža, bank of Dunaj river (JOS. DOSTÁL 1966, 1968 PR). – Kravany nad Dunajom, Svätá Mária farmstead (KRIST 1938 BRNU). – Kravany nad Dunajom (TUZSON 1908 BP; JOS. DOSTÁL 1947 PR; OSVAČILOVÁ 1957 NI). – Virt, Mašan nature reserve (CHRTEK et al. 1970 PRC; KLOKNER 1980 PMK). – Virt, Bašov kopec hill (CHRTEK et al. 1970 PRC; ELIÁŠ jun. 2009 NI). – Čenkov, Čenkovský les nature reserve (MENCL 1925 PRC; F. WEBER 1935 BRNM, 1936 PR; KRIST 1938 BRNU; V. VALENTA 1938 BRA; ČERNOCH 1951 BRNM; SMEJKAL 1951 BRNU; KNEBLOVÁ 1951 PR; ŠOUREK 1954 PR; CHRTEKOVÁ 1968 PR; KUČERA 1968 PR; VICHEREK 1972 BRNU). – Mužla (SILLINGER et M. DEYL 1930 PRC). **8. Východoslovenská nížina lowland:** Streda nad Bodrogom, sand pit (ŠOUREK 1954 PR). – Streda nad Bodrogom, sandy sites ENE from the village (JEHLÍK 1976 PR; MÁJOVSKÝ et KYTKA 1980 SLO; GRULICH 1988 MMI). – Streda nad Bodrogom, elevation point 104 m (JEHLÍK 1968 PR, PRA). – Streda nad Bodrogom, Roháč hill SEE from the village (TRÁVNÍČEK 1991 OL; BOGOLY 1994 ined.). – Streda nad Bodrogom, Tarbučka hill (JOS. DOSTÁL 1952 PR; ŠOUREK 1959 PR; ČERNOCH 1961 BRNM; GRULICH 1988 MMI). – Somotor, E from the village (MARGITTAI 1926 BP, BRNU, PRC, 1930 BRNU, OLM, 1931 BP, PRC; ELIÁŠ jun., DÍTĚ et MELEČKOVÁ 2014 NI). – Hrušov (M. DEYL 1958 PR; ČERNOCH 1965 BRNM; ŽERTOŤOVÁ 1965 PR). – Leles, Kapoňa farmstead (MARGITTAI 1928 BRNU). – Strážne (MARGITTAI 1926 BP). – Veľký Horeš (MARGITTAI 1926 BP). – Malý Horeš (HEJNÝ 1948 PR; ČERNOCH 1957 BRNM; Ľ. DOSTÁL 1967 MPS; ELIÁŠ jun. 2014 NI). – Kráľovský Chlmec (MARGITTAI 1917 BP, 1924 BRNU, 1927 BP, BRNU, PRC; MARVAN et MARVANOVÁ 1958 BRNU). – Kráľovský Chlmec, elevation point 260 m (OPLUŠTILOVÁ 1948 SLO; VICHEREK 1962 BRNU). – Kráľovský Chlmec, Malý vrch hill (HEJNÝ 1948 PR).

**Common data:** Záhorská nížina lowland (KRIPPELOVÁ 1976 SAV).

**Doubtful data (not mapped):** Kamenný Most, saline vegetation (ŠOUREK 1954 PR). Probably the exchange of herbarium labels, the species do not grow on saline soils.

**Appendix 2. List of relevés localities (for relevés, the header data are listed in the following order: number of relevé, locality, coordinates, altitude, sampling date):**

1. Nesvady, dune with the chapel, exp. SW, elevation 20°, 47°55'37.89" N, 18°7'29.29" E, 110 m, 26. 6. 2015
2. Nesvady, Líščie diery Nature Reserve, open sand, exp. -, elevation -, 47°55'25.83" N, 18°9'29.07" E, 112 m, 26. 6. 2015
3. Imeľ, bottom of abandoned sandy pit, exp. -, elevation -, 47°54'42.50" N, 18°8'20.84" E, 111 m, 26. 6. 2015
4. Věč, sandy dune, exp. S, elevation 5°, 48°24'16.40" N, 21°50'33.01" E, 97 m, 3. 7. 2015
5. Věč, sandy dune, exp. SE, elevation 15°, 48°24'16.64" N, 21°50'31.87" E, 97 m, 3. 7. 2015
6. Malý Horeš, Horešské lúky site, exp. W, elevation 30°, 48°24'46.66" N, 21°56'43.29" E, 123 m, 3. 7. 2015
7. Marcelová, Marcelovské piesky Nature Reserve, open sand, exp. -, elevation - , 47°47'59.59" N, 18°16'5.68" E, 119 m, 13. 7. 2015
8. Svätý Peter, Briežky farmstead, mined site, exp. -, elevation - , 47°49'26.52" N, 18°11'56.22" E, 111 m, 13. 7. 2015
9. Svätý Peter, Briežky farmstead, mined slope, exp. SE, elevation 25°, 47°49'26.45" N, 18°11'55.56" E, 111 m, 13. 7. 2015
10. Hurbanovo, Abov hill, sandy dune, exp. SE, elevation 50°, 47°52'15.78" N, 18°9'28.21" E, 116 m, 13. 7. 2015
11. Nesvady, top of the dune near the cemetery, exp. NW, elevation 5°, 47°55'56.55" N, 18°7'34.54" E, 112 m, 13. 9. 2015
12. Nesvady, dune near the cemetery, mined slope, exp. NE, elevation 50°, 47°55'56.87" N, 18°7'35.55" E, 111 m, 26. 8. 2007.

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