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CONTRIBUTION TO THE KNOWLEDGE OF THE FLORA IN THE AREA OF BRESTOVICA (KRAS, SLOVENIA)

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ABSTRACT

*This paper contributes to the knowledge of the flora of the surroundings of Brestovica near Komen in the south-western part of Slovenia. The inventory of 321 taxa recorded during six days of fieldwork is given, together with a commentary on some interesting findings (*Bidens subalternans, Bidens bipinnata, Carthamus lanatus, Clematis flammula, Himantoglossum adriaticum, Lathyrus setifolius, Ononis pusilla, Senecio inaequidens, Sternebergia lutea, Vicia loiseleurii*). Altogether, 19 species included in the Slovenian red list of vascular plants were recorded, of which eleven vulnerable species (V), three rare species (R), four insufficiently known species (K), and one 'extinct' species (Ex), whose presence is probably a result of past cultivations.*

Key words: flora, Kras, Natura 2000 site, land use, invasive species

CONTRIBUTO ALLA CONOSCENZA DELLA FLORA NELL'AREA DI BRESTOVICA (CARSO, SLOVENIA)

SINTESI

*Il presente articolo offre un contributo alla conoscenza della flora nei dintorni di Brestovica, vicino a Komen, nella Slovenia sud-occidentale. Durante i sei giorni di campionamento sono stati registrati 321 taxa, fra i quali alcuni ritrovamenti molto interessanti (*Bidens subalternans, Bidens bipinnata, Carthamus lanatus, Clematis flammula, Himantoglossum adriaticum, Lathyrus setifolius, Ononis pusilla, Senecio inaequidens, Sternebergia lutea e Vicia loiseleurii*). Diciannove delle specie ritrovate sono incluse nella Lista rossa delle piante vascolari della Slovenia, undici delle quali sono considerate vulnerabili (V), tre rare (R), quattro insufficientemente conosciute (K), ed una 'estinta' (Ex), la presenza della quale è probabilmente dovuta a coltivazioni passate.*

Parole chiave: flora, Carso, sito Natura 2000, uso del suolo, specie invasive

INTRODUCTION

The Adriatic Sea has a strong impact on the environment and the biodiversity of south-western Slovenia, frequently described as the 'Mediterranean' part of the country. However, due to Slovenia's northern position, the influences of the upper Adriatic Sea on its climate are weaker, resulting lessening of its Mediterranean character compared with the 'true Mediterranean' climate of the regions further south (Ogrin, 1995) resulting in lower mean temperatures and different precipitation regimes. The characteristics of the climate are also evident in the vegetation and flora of this region. M. Wraber (1969) defines this area as a Submediterranean phytogeographical region, where the vegetation has transitional characteristics between Mediterranean and continental plant communities.

Kras is a rocky region in south-western Slovenia, located between the Vipava Valley and the Gulf of Trieste. Although it is located in close proximity to the Adriatic Sea, the maritime influences on the climate are reduced as a function of the higher altitudes (200–500 m a.s.l.; Kranjc, 2005). Therefore, Zupančič *et al*. (1987) proposed a further division of the Submediterranean phytogeographical region that clearly separates Kras from the warmer climate that obtains in the Slovenian part of Istria.

The area discussed in this paper is located in the vicinity of Brestovica in Brestoviški dol, a dry river valley that continues eastwards towards Gorjansko and westwards towards Doberdob in Italy. To the north, the valley is delimited by the steep slopes of Reber, while to the south it is enclosed within a number of lower hills. Due to the lower elevations (60–200 m a.s.l.) and the openness of the lower part of the valley to the Adriatic Sea, this zone has a slightly warmer climate than the rest of the Slovenian part of Kras. As a result, a high number of termophylous plant species thrive in this area. Poldini (1984, 2009) reports a number of localities for typical Mediterranean elements such as *Quercus ilex* and *Phyllirea latifolia* on the Italian side of the area. This is also the only part of Kras where olive trees have been cultivated in the past (Kotar & Brus, 1999). The most typical forest vegetation type of the area are pubescent oak and hop hornbeam forests (*Ostryo-Quercetum pubescentis*), namely their more termophylous variety with the terebinth *Pistacietosum terebinthii* (Poldini, 1984). Those slopes most exposed to the south are dominated by thermophilous associations of *Chrysopogoni-Centaureetum cristate*. In lowland areas where soil is thicker more mesic associations of *Danthonio-Scorzoneretum* have developed (Poldini, 1984).

Due to its geographical position and consequently distinct flora, the area has stimulated the interest of many botanists. The flora of Brestovica was surveyed by Seliškar and colleagues (Seliškar *et al*., 1996), who recorded 181 taxa of vascular plants. They reported the presence of some rare species, such as *Smilax aspera* and *Clematis flammula*. Kotar & Brus (1999) also noted the abundance of *Pistacia terebinthus* in this area. Some records were given by Poldini (2006), Gogala (2005) and Jogan (in Martinčič *et al*., 2007). The first two authors reported about the presence of *Prospero elisae* from the grasslands in the proximity of Brestovica, which is the only known locality for this Mediterranean species in the Slovenian part of Kras. Jogan (in Martinčič *et al*., 2007) mentioned the occurrence of the annual grass species *Psilurus incurvus* from the vicinity of Sela na Krasu. Recently, *Cephalaria leucantha*, previously unknown to the Slovenian part of Kras, was also recorded here (Dakskobler & Vreš, 2009).

The area of Brestovica is included as one of the sampling plots within the international project Sigma 2. The main focus of this project is to estimate the biodiversity of different types of agricultural landscapes.

In order to study the plant biodiversity in the Brestovica area, we set out the following hypotheses:

(1) According to the transitional geographic position of the study area, different floral elements and ecological types, characteristic of both continental and Mediterranean flora, will be well represented.
(2) Different kinds of land use (e.g. olive groves, road construction, import of alien species) will yield obvious differences in plant diversity.
(3) Because adventitious species are more competitive in disturbed areas, they will be more abundant in those areas with a higher human impact.
(4) Some new or phytogeographically interesting taxa should be noticed for the first time in the studied area.

MATERIALS AND METHODS

The area discussed in this paper is located in the north-western part of Kras, on the border with the Republic of Italy. More precisely, the inventory of vascular plant taxa was carried out in the area of Reber between Brestovica, Sela na Krasu and the Klariči border cross (quadrant 0147/4 of the Central European floristic mapping scheme (Fig. 1). Altogether, three environments with different human impact were chosen: (1) an old olive grove above Klariči, (2) warm slopes of Reber, mainly covered with (a) overgrowing meadows and (b) scattered woods, and (3) ruderal habitats, such as (a) surroundings of buildings, (b) road margins and (c) landfills.

The surveys were conducted on the following field trips: 14.6.2008, 8.4.2010, 18.5.2010, 22.5.2010, 21.6.2010, and 14.10.2010. Taxa were determined using standard floristic literature (mostly Pignatti, 1982; Martinčič *et al*., 2007). Taxa lacking distribution data or taxonomically complicated taxa were collected and stored at the Institute for Biodiversity studies within the Science and Research Centre of University of Primorska. In order to obtain better distribution data for those taxa we revised

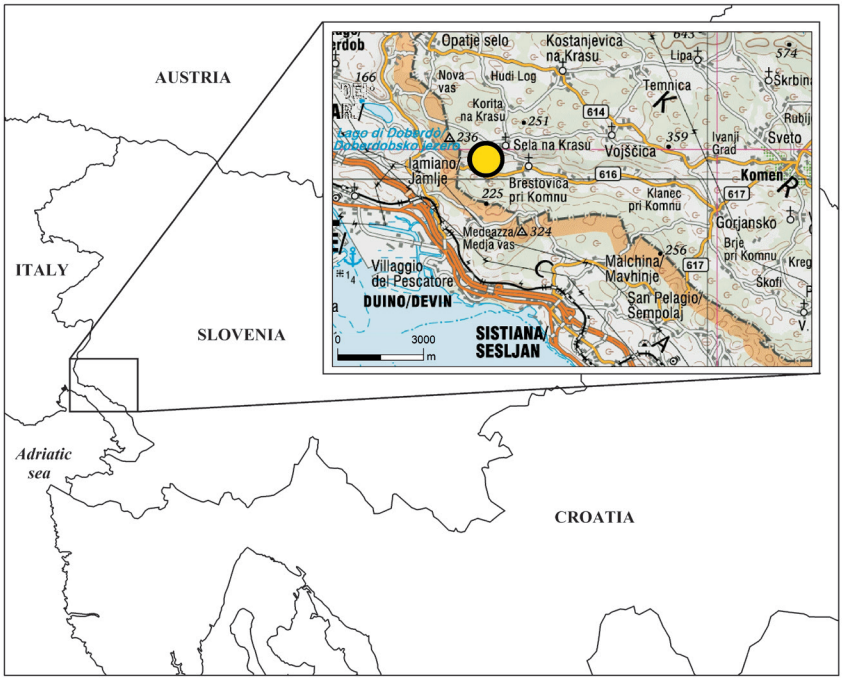

Fig. 1: Map of the studied area in Brestovica surroundings in Kras, south-western Slovenia
Sl. 1: Zemljevid raziskovanega območja v okolici Brestovice na Krasu, jugozahodna Slovenija

the available herbarium material from LJU (Department of Biology, University of Ljubljana). Moreover, occurrence data were collected from different historical and contemporary literature sources residing in private and public libraries throughout the region. Such data are important for assessments as to whether populations of certain species are increasing or decreasing in different habitat types and what are the possible impacts of development on local plant communities.

In order to determine the overall characteristic of the local flora in comparison with the flora of the neighbouring regions, we assigned to each recorded taxa the chorological type according to the floristic elements in which it is represented (according to Pignatti (1982), Poldini (1991) and Lauber & Wagner (2001)) and the life form (according to Martinčič *et al*., 2007).

RESULTS AND DISCUSSION

Fieldwork inventory yielded 321 different vascular plant taxa (see Appendix 1), of which 190 were previously unknown for the quadrant 0147/4. The overall number of known taxa of the quadrant is 512 (see also Jogan *et al*., 2001).

As many as 216 taxa (67.3 %), including one cultivated taxon and 25 alien taxa, were recorded in ruderal habitats. A smaller portion of taxa (77 or 25.7 %) was recorded along the warm slopes of Reber, among which only five were alien species. A similar number of taxa (76 or 23.7 %) was found in the abandoned olive grove, with *Olea europaea* being the only cultivated species. Twenty-seven alien taxa (including 3 cultivated/subspontaneous were found in all three types of habitats (*i.e.* 8.4 % of all species recorded in the area). The percentage of alien (including cultivated) plant taxa is much higher in ruderal habitats (11.6 %) than in warm slopes of Reber (2.2 %) or in the olive grove (1 cultivated species, 1.3%). For details on distribution of taxa according to habitats, see Figure 2.

Alien taxa represent 8.7 % of all recorded species and are mainly limited to ruderal habitats in the surrounding of human settlements. Without taking alien taxa into account, recorded representatives can be attributed to 19 different floral elements (Tab. 1). The Euri-Mediterranean floral element is the best represented with 24.3 % of recorded taxa, followed by European (11.5 %), Eurasian (9.0 %) and Paleotemperate (8.1 %) floral elements. Taxa with narrowly Mediterranean distribution (Steno-Mediterranean element) are very poorly represented (1.6 %). Kras represents the north-westernmost edge of the Dinaric mountain range, which is indicated by the small proportion of taxa with their centre of distribution in the Balkan Peninsula (South East-European, 3.4 %; South-Illyrian, 2.5 %). The presence of the Pontic floristic element (5.6 %) can be attributed to a hypothetical historical link between the flora of the East European steppe with the flora of Mediterranean and Submediterranean grassland habitats. Poldini (2009) published the chorological spectrum of the Italian part of Kras, where the European floral element predominates (10.4 %), followed

by the Euri-Mediterranean (10.4 %). Taking this data into account, we can emphasize the thermophilous character of the studied area compared to the wider Kras region. If we further compare our results with some other published data, we can observe a similar chorological spectrum to some areas from the Slovenian part of Istria (Ankaran) (Glasnović & Jogan, 2009). There is a notable difference with the flora of Cape Kamenjak (the southernmost part of the Istria peninsula), where the share of Steno-Mediterranean floristic element is very high (18.2 %) and the Euri-Mediterranean element is dominant (35.1 %) (Topić & Šegulja, 2000).

Tab. 1: The spectrum of chorological types (floral elements) in the studied area with numbers of taxa representing each type
Tab. 1: Spekter horotipov (flornih elementov) raziskovanega območja s številom pripadajočih taksonov posameznemu flornemu elementu

Chorological types	Number	Percentage (%)
Steno-Mediterranean	5	1.6
Euri-Mediterranean	78	24.3
Mediterranean-Montane	10	3.1
Medterranean-Atlantic	10	3.1
Mediterranean-Pontic	9	2.8
European	37	11.5
Eurosiberian	14	4.4
Eurasian	29	9.0
Circumboreal	9	2.8
Paleotemperate	26	8.1
Central-European	1	0.3
South East-European	11	3.4
Pontic	18	5.6
South-Illyrian	8	2.5
Alpine	1	0.3
East-Alpine	1	0.3
Sub-Atlantic	1	0.3
Subcosmopolitan	1	0.3
Cosmopolitan	23	7.2
Adventitious	25	7.8
Cultivated / Subspontaneous	3	0.9
n.a.	1	0.3

The spectrum of life forms (Tab. 2) gives an insight into the adaptation of plants to their environmental conditions. The prevailing life forms are the hemicryptophytes (42.7 %), which are typical for more mesophilous environments, followed by terophytes (25.5 %), characteristic of the dry and warm conditions typical for the Mediterranean region. As proposed by Poldini (1991), the large proportion of terophytes in Kras should be attributed more to human influences on the environment than to climatic conditions. Geophytes, which are also a life form that is well-adapted to arid conditions, represent 5.9 % of the recorded taxa.

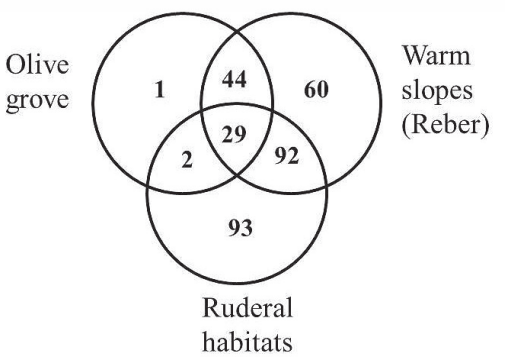

Fig. 2: Distribution of taxa according to habitats, represented by number of taxa within and between habitats
Sl. 2: Razporejenost taksonov po habitatih, predstavljeno kot število taksonov v habitatih in skupnih taksonov med habitati

During our survey, some insufficiently known taxa (*i.e.* taxa with low number of records of occurrence and taxa that in this region thrive on the possible edge of their distribution range) were recorded. As these species are important contributors to the local (and national) floral diversity or are important subjects in the understanding of biogeographical characteristics of our area, their current statuses are discussed in detail below.

Tab. 2: The spectrum of life forms in the studied area
Tab. 2: Spekter življenjskih oblik

Life form	Symbol	Number	Percentage (%)
Fanerophyte	Fa	34	10.6
Geophyte	Ge	19	5.9
Hamerophyte	Ha	22	6.9
Hamerophyte/Fanerophyte	Ha/Fa	1	0.3
Hamerophyte/Helophyte	Ha/He	2	0.6
Helophyte	He	137	42.7
Helophyte/Geophyte	He/Ge	2	0.6
Helophyte/Hamerophyte	He/Ha	1	0.3
Terophyte	Te	82	25.5
Terophyte/Helophyte	Te/He	21	6.5

Tab. 3: Identification characters of** Bidens bipinnata **and** B. subalternans**. Adapted according to Trinajstić (1993) and Lauber & Wagner (2001)
Tab. 3: Razlikovalni znaki med vrstama** Bidens bipinnata **in** B. subalternans**. Prirejeno po Trinajstiću (1993) in Lauberju & Wagnerju (2001)

Morphological character	*B. bipinnata*	*B. subalternans*
Plant dimension	30-120(-170) cm	40-200(-300) cm
Division of the leaf blade	2-3 times pinnate	1-2 times pinnate
Shape of leaflets	Wide to rhomboidal lanceolate, hairs present on margins and veins on the abaxial side	Lanceolate to linearly lanceolate – slowly tapering to a long point, margine sharply serrate, the entire surface covered with short hairs
Outer involucral bracts	3-5 mm long, narrowly linear, acuminate	4-6 mm long, acuminate to obtuse
Flower heads	Small number of flowers, cypselae (up to 10)	Mostly without ray florets. Large number of florets, cypselae (20-30)
Middle cypselae in the head	United with each other, parallel	Spread out, not parallel
Outer cypselae in the head	7-12 mm long, often thicker than the internal cypselae	6-8 mm long, flat and wider than the internal cypselae
Internal cypselae in the head	10-18 mm long	8-14 mm long
Bristly hairs on the cypselae	2-4 mm long, upwardly oriented. Number: (2-)3-4	1-2.5 mm long, straight and parallel. Number: (2-3)-4

***Bidens subalternans* DC. and *Bidens bipinnata* L.**

Bidens subalternans and *Bidens bipinnata* are two insufficiently known species of the alien flora of Slovenia. While there are quite a few occurrence data in Slovenian part of Istria for the first species (Glasnović & Jogan, 2009; Glasnović & Fišer Pečnikar, 2010), there are only two existing records so far that account for the presence of the second species in Slovenia. For the latter, one of the two records comes from Cohrs (1953-1954), who found the plant in Solkan near Nova Gorica, while the second is a herbarium specimen collected by Nejc Jogan in Branik (Slo: Primorska, Branik, at the side of the road in the village. Leg. N. Jogan, 19.10.1992, LJU10006574). Poldini (2009) reported both species as common in adjacent Trieste Kras. While, according to the herbarium specimen, there are no reasons for doubting Jogan's data on the occurrence of *B. bipinnata*, Cohrs' data (Cohrs, 1953-1954) should be treated critically. Due to the lack of adequate literature and similarities between the two species, it should be noted that *B. subalternans* has frequently been identified incorrectly as *B. bipinnata* (Trinajstić, 1993). The following table (Tab. 3), which was added in order to avoid misidentifications of the two species in the future, presents the distinguishing characters of the two species.

Both species occur in the area around Brestovica. While *B. subalternans* is very common along the roadsides in the vicinity of settlements, *B. bipinnata* was found only once in the land fill site near Sela na Krasu.

***Carthamus lanatus* L.**

Carthamus lanatus is a Euri-Mediterranean species occurring in warmer parts of Slovenia. The majority of known data are from Slovenian part of Istria but it was found also in Bela Krajina and Vipava Valley (Jogan *et al.*, 2001). Recently, Dakskobler & Vreš (2009) reported its occurrence in Kras, more precisely in Nova vas (0147/1). Moreover, they also report a recording of the species from Klanec near Komen in the quadrant 0147/3. We recorded the species on the warm slopes of Reber, between the locality Sela na Krasu and the border with Italy. It is known to be common also on the Italian side of Kras (Poldini, 2009). *C. lanatus* has a Circum-Mediterranean distribution penetrating into warmer parts of continental Europe. Its presence in this area probably represents the northern limit of its continuous distribution range.

***Clematis flammula* L.**

Clematis flammula is a common species in the Mediterranean part of Europe. It is also cultivated as a decorative species and can often be found naturalised outside the Mediterranean (Tutin *et al.*, 2001). In Slovenia (Fig. 3), the species has been attested in the Sub-Pannonian and Sub-Mediterranean phytogeographical regions (Martinčič *et al.*, 2007). All available data from eastern Slovenia originate from Hayek (1908-1914). According to his data the plant occurs in scrublands and vineyard edges in the lower course of the Drava River. It should be noted that Hayek collected these data from different authors that had found the species in the vicinity of Ptuj, in Zavrč and in Borl. However, Hayek had not found the species again in the area. In order to verify whether this Euri-Mediterranean species really occurs outside its main distribution range, we verified historical and recent literature data about its occurrence in neighbouring countries: the species is not mentioned in the modern Austrian flora (Fischer *et al.*, 2008), although Pacher (1880-1895) provided data on its occur-

rence on limestone walls in the proximity of the village Dellach in the upper Drava Valley (Oberdrautal). However, this sole location was destroyed after the opening of gravel pits for the railroad construction. Although not mentioned by Kiraly (2009), the species is also present in Hungary. Árpád Károlyi found it in Nagykanizsa close to Palin between 1948 and 1951 (Kerényi-Nagy & Nagy, 2008). The same locality is reported by Soó (1966), who considered the presence of the species in Hungary non-spontaneous. Recently, Kerényi-Nagy & Nagy (2008) published two new attestations of localities of the species' occurrence in western Hungary in the proximity of the health resort Hévíz between the towns of Keszthely and Zalaegerszeg west of Balaton Lake. There, the species is found in the grassland association *Chrysopogono-Caricetum humilis* Zólyomi (1950) 1958 and in a habitat at the foot of a dolomitic slope. In the mentioned localities, the species reproduce; hence the authors believe that its occurrence is not purely random or time-limited. In Croatia, the species is widespread in the coastal region; the only record from its continental part is from the surroundings of Ogulin (Nikolić, 2012). The first to write about its distribution in the Sub-Mediterranean region of Slovenia and adjacent regions was Mayer (1952). According to him, the species is rare and scattered throughout southern Primorska. Since the species was not known inside the present political borders of Slovenia, we should assume that Mayer's data (*ibid*.) refer to its occurrence in the Trieste and Gorizia Kras in Italy, where the species is known to be widespread at the present time (Poldini, 2009).

The occurrence of the species in the surroundings of Brestovica, reported already by Seliškar *et al*. (1996), is the only recent reliable record of the presence of this plant in Slovenia. The species is abundant in the surveyed area, being commonly found among overgrowing bushes. This may indicate that it prefers habitats that are in the process of overgrowing. We assume that further investigations may lead to new records of this species on other warm localities. The absence of the species from the Slovenian part of Istria is interesting and could be explained by the dominant flysch substrate and consequently less warm microclimatic conditions for the vegetation.

***Himantoglossum adriaticum* H. Baumann**

Himantoglossum adriaticum has two distinctive centres of occurrence, one in south-western Slovenia (especially Slovenian part of Istria) and the another in its north-eastern part (Haloze region) (Kaligarič *et al*., 2004). Recently, the knowledge about the distribution of this species in Slovenia was expanded by findings in two localities in the surroundings of Laško (Guček, 2010). As one of the species of concern in terms of European conservation, it was included in the II Annex of the Habitat Directive, which aims to establish the legal basis for maintaining or restoring natural habitats and maintaining populations of wild fauna and flora species at a favourable level. Vascular plant species of Slovenia are listed as vulnerable in the Red List of threatened species (Anonymous, 2002).

H. adriaticum is relatively common in the Slovenian part of Istria, where its status is favourable as a result of a temporarily increase in adequate habitats due to overgrowing (Kaligarič, 2004). According to existing data, this species should however be regarded as very rare in the Slovenian part of Kras. It was found in its peripheral area, near Divača – quadrant 0349/2 (Jogan *et al*., 2001) – and recently by Poldini (2009) in the proximity of Kostanjevica na Krasu (quadrant 0147/2). Lately it has been found in Podsabotin in Goriška Brda (Dolinar,

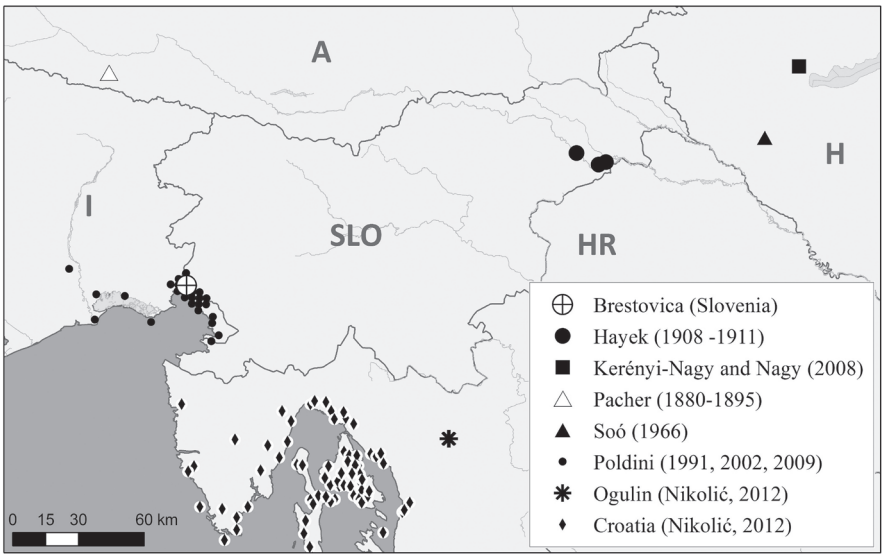

Fig. 3: Cartographic review of data on occurrence of* Clematis flammula *in Slovenia and its surroundings
Sl. 3: Kartografski pregled razširjenosti vrste* Clematis flammula *v Sloveniji in njeni okolici

2010). More data are known from the surroundings of Trieste on the Italian side of Kras (Poldini, 2009).

We found a few specimens growing among scattered olive trees and other woody species on a warm hillside in the proximity of the border with Italy above Klariči. The data indicate that the species thrives in this part of Kras; whereas its occurrence is significantly smaller than in Slovenian part of Istria.

***Lathyrus setifolius* L.**

The genus *Lathyrus* in Europe has the highest diversity of annual growing species within the Mediterranean countries (Tutin *et al*., 2001). *Lathyrus setifolius* is one among the three red flowering annual species of this genus occurring in the submediterranean phytogeographycal region of Slovenia. It thrives on stony scrublands and grasslands in warmer parts. Besides one unpublished record from Kras (quadrant 0147/2), all other existing data are from the Slovenian part of Istria (Stefani, 1895; Marchesetti, 1896-1897; Wraber, 1975; Kaligarič, 1980; Jogan *et al*., 2001). We recorded the species on grassland near Klariči. The species is common on the Italian side of Kras (Poldini, 2009), where it probably reaches the northern limit of its distribution (Poldini, 1984).

Published data:

0449/1 SLO: Istria, Črni kal, Marchesetti (1896-1897), Stefani (1895)

0449/1 SLO: Istria, Osp, Marchesetti (1896-1897)

0547/2 SLO: Istria, Dragonja – stena, Wraber (1975)

0549/2 SLO: Istria, Sočerga, Kaligarič (1980)

Unpublished data:

0147/2 SLO: Kras. Collection: Student herbarium / Študentski herbariji; Leg. Tamara Nemec, 1992 (Data Base Flora Slovenije CKFF / Podatkovna zbirka Flora Slovenije CKFF)

Specimina visa:

0449/1 SLO: *Istria: In lapidosis apricis supra vicum Osp. Solo calcareo*. 150 m s.m., Leg. M. Lovka & T. Wraber, 4.5.1973 (LJU10032957)

0547/2 SLO: *Istria: In lapidosis apricis collis Stena prope vicum Dragonja. Solo calc*. 20 m.s.m. Leg. T. Wraber, 21.5.1974 (LJU10032956, LJU10032955)

***Ononis pusilla* L.**

Among the representatives of the genus *Ononis* of Slovenia, *O. pusilla* is the most easily recognisable, since it is the only one with yellow flowers. This tiny Euri-Mediterranen perennial thrives on sunny, dry, stony habitats. When examining the distribution of the species in Slovenia (Jogan *et al*., 2001), it becomes obvious that some older data were overlooked, probably because older authors recognised the species with its synonym *O. columnae* All. Marchesetti (1896-1897), Pospichal (1897-1899) and Stefani (1895) report the species from multiple sites in Slovenian part of Istria and Kras. More recent data are rare. Maks Wraber found it in 1957 in the valley Valderniga below the village Padna (LJU10038956). Wraber (1975) reported its occurrence on limestone rocks close to Dragonja (Stena). Poldini (1980), who found the species near Veliki Dol, was the first to report its occurrence in Kras. Lately, the plant was collected by Frajman (2005) in Sočerga and by Glasnović and Jogan (2009) on few localities in the vicinity of Ankaran. In the studied area, the species was found along the path leading across Reber towards the border with Italy and along the main road connecting Sela na Krasu and Brestovica.

Published data:

0349/1 SLO, Kras, Orlek. Marchesetti (1896-1897)

0349/1 SLO, Kras, Lipica. Marchesetti (1896-1897)

0449/1 SLO, Istria, Črni kal. Marchesetti (1896-1897), Pospichal (1897-1899)

0449/4 SLO, Istria, Slavnik. Marchesetti (1896-1897), Pospichal (1897-1899)

0447/4 SLO, Istria, Izola. Marchesetti (1896-1897)

0448/3 SLO, Istria, Koper. Stefani (1895), Marchesetti (1896-1897)

0549/1 SLO, Istria, Popetre. Pospichal (1897-1899)

0548/2 SLO, Istria, Truške. Pospichal (1897-1899)

0248/2 SLO, Kras, Veliki Dol. Poldini (1980)

0549/1 SLO, Istria, Kras above Sočerga. Frajman (2005)

Specimina visa:

0548/1 SLO, valley Valderniga: bellow the village of Padna 50 m.a.s.l.. Leg. M. Wraber, 28.6.1957 (LJU10038956)

0547/2 SLO, *Istria: In lapidosis apricis collis Stena prope vicum Dragonja. Solo calc*. 20 m.s.m. Leg. T. Wraber, 12.9.1974. (LJU10038957).

0448/2 SLO, Istria, Sp. Škofije, Kolombar, Goli hrib, area between the locality Kolombar and the hill Goli Vrh (217 m a.s.l.) Glasnović & Jogan (2009)

0448/1 SLO, Istria, Hrvatini, Kolomban, graveyard in Kolomban. Glasnović & Jogan (2009)

0448/2 SLO, Istria, Sp.Škofije, Jelarji, dry meadows ± 500 m E from the locality Jelarji N of the road. Glasnović & Jogan (2009)

0448/4: Istria Bertoki, 200 m N from Bertoki, by the road to Škocjanski zatok (10 m a.s.l.). Leg. & det: I. Djurdjevič, 22.6.2008

***Senecio inaequidens* DC.**

Senecio inaequidens is a South African species rapidly increasing its areal in Slovenia and its surroundings (Glasnović & Fišer Pečnikar, 2010). Although occurrence data for this part of Kras are new they are not surprising since the species is widespread throughout the karstic areas around Trieste and Gorizia (Poldini, 2009). There are, however, more and more data for other parts of Slovenian Kras too (Glasnović & Fišer Pečnikar, 2010; Stergaršek & Jogan, 2010). Poldini (2009) drew attention to the problematic spread of the species into natural open vegetation, especially where vegetation has been exposed to fire and thus has a kind of competitive advantage over other species. The problematic occurrence of this species has been recognised also in the

surveyed area. The species is widely present within the natural vegetation. This mass occurrence in the area is probably connected to a fire in 2003, which had a great impact on this area.

***Sternbergia lutea* (L.) Ker-Gawler ex Sprengel**

Stefani (1895) and Pospichal (1897-1899) discussed the presence of *Sterbergia lutea* in the territory of Slovenia. They had found the plant near the salt stores in Lera in the Sečovlje salinas. Both authors were sceptic about the indigeneity of occurrence of the species there, although Stefani added that he did not know about any former cultivation of the species in the area. Despite doubts about its native occurrence in the Sečovlje salinas, Wraber & Skoberne (1989) listed the species in the red list of the Slovenian flora as extinct species, since it was no longer found there. It remained listed as extinct also in the new red list of the Slovenian flora (Anonymous, 2002).

According to our observations, the species is widely cultivated in gardens and sometimes present as a fugitive on their edges or even outside them. The species is regarded to be subspontaneous in a large part of Northern Italy (Pignatti, 1982), including the Trieste and Gorizia Kras (Poldini, 2009). Its presence in Croatian part of Istria is also considered to be a consequence of cultivation and later naturalisation (Pericin, 2001). The first ones to record its subspontaneous occurrence in Kras were Dakskobler & Daskobler (2010) who found the species in the vicinity of Tomaj (0249/3).

We found *S. lutea* in the undergrowth of *Celtis australis* and some other woody species around the abandoned buildings at the border crossing Klariči. The occurrence at this location suggests that its presence is a result of former cultivations, which eventually assumed a more natural look after the abandonment of the site. The extinction of this species should be associated to its adventive occurrence (Skoberne, 2001). Since there is no evidence of native occurrence, its inclusion in the red data list should be critically discussed (Dakskobler & Dakskobler, 2010).

***Vicia loiseleurii* (M. Bieb.) Litv. (*V. terronii* (Ten.) Lindb.)**

At the time of the first finding of *Vicia loiseleurii* in Slovenia, Wraber (1981) extensively discussed the history of its taxonomy and nomenclature, finally proposing the use of the actual name, which is used today in modern Slovenian floristic literature. This Mediterranean-Pontic species reaches its northern limit of distribution in Kras and its neighbourhood (Poldini, 2009; Wraber, 1995). In Slovenia it was for long time known only after two records from Wraber, who found the species in Slovenian part of Istria: in Stena near Dragonja (Wraber, 1975; LJU10059357, LJU10059358), Kubed (Wraber, LJU10059356) and Gračišče (1995). Wraber (1981) suggested that in Slovenia the species is limited only to areas with characteristic eumediterranean flora. More recent research of flora of western Slovenia showed that this species occurs also in more northern parts of the submediterranean region, since it was found also in Kras. Poldini (2006) found it in Tabor near Sežana (0249/3) and on Grdina, whitin the same quadrant as the area surveyed in this paper. Stergaršek & Jogan (2010) also reported one locality in Kras (Kosovelje, quadrant 0248/2). Although rare, the species occurs also on the Italian part of Kras (Poldini, 2009). Poldini (2006, 2009) suggests that the occurrence of the species in the proximity of gords points to its archaeophytic nature. Within the surveyed area, the species was found on a dry grassland near Klariči.

Published data

0547/2 SLO, Istria, Dragonja – stena. Wraber (1975)

0449/3 SLO, Istra, Kubed. Wraber (1981)

0549/1 SLO, Istra, Gračišče, *In silvis lucidis* (*Ostryo-Quercetum pubescentis*) *collis Brgot prope vicum Gračišče. Solo calc. 320 m.s.m.* 10.05.1994. Wraber (1995)

0249/3 SLO, Kras, Sežana, Tabor. Poldini (2006)

0147/4 SLO, Kras, Grmada Gredina. Poldini (2006)

0248/2 SLO, Kras, Kosovelje, along the road Dutovlje-Komen, about 300 m from the turning to the village of Kosovelje in the direction to Komen. Stergaršek & Jogan (2010)

Specimina visa:

0547/2 SLO, *Istria, In lapidosis apricis collis Steana prope vicum Dragonja in valle fluvii Dragonja in valle fluvii Dragonja. Solo calcareo.* 25 m a.s.l. Leg. T. Wraber, 21.4.1974 (*Vicia terroni* (Tenore) Lindberg fil.) (LJU10059357)

0547/2 SLO, *Istria: In lapidosis apricis collis Stena prope vicum Dragonja in valle fluvii Dragonja in valle fluvii Dragonja. Solo calcareo.* 25 m a.s.l. Leg. T. Wraber, 6.6.1975 (*Vicia loiseleurii* (M.B.) D.Litvinov (=*Vicia terroni* (Tenore) Lindberg fil.) (LJU10059358)

0449/3 SLO, *Istria, Kubed, in lapidosis fruticosis apricis. Solo calcareo*, 250 m a.s.l. Leg. T. Wraber, 18.6.1975 (*Vicia loiseleurii* (M.B.) D.Litvinov (=*Vicia terroni* (Tenore) Lindberg fil.) (LJU10059356).

Nature conservation importance of the area and threats to biodiversity

Natura 2000 is a network of ecologically important natural areas identified according to the European Birds and Habitats Directive. The objective of Natura 2000 is to maintain a favourable status of species and habitats and thus biodiversity. Due to the presence of various qualifying plants and animal species and their habitats, a major part of Kras was, proposed and later confirmed for the Natura 2000 site – Kras. The area is defined as having the status of Site of Community Interest (SI3000276) and Special Protected Area (SI5000023) (Kryštufek *et al*., 2001, Golob, 2004) according to both directives. The area discussed is located entirely within the SCI Kras area. The only qualification habitat that occurs in the Brestovica region is the Eastern Sub-Mediterranean dry grasslands habitat (*Scorzoneratalia villosae*). Of the plant species

listed in Annex 2, only *Himantoglossum adriaticum* occurs, although it is not included in the qualification species for this area.

Of 321 plant species recorded in the survey, 19 are listed on the Red List of threatened vascular plants of Slovenia (Anonymous, 2002). The largest part (almost one third) is represented by vulnerable species, *i.e.* species undergoing decreases in their population over a number of years, of which it is believed that changes in their habitats could lead to a critical decline in their populations. Among recorded species, eleven have vulnerable (V) status: *Anacamptis pyramidalis*, *Himantoglossum adriaticum*, *Limodorum abortivum*, *Orchis tridentata*, *Orchis purpurea*, *Smilax aspera*, *Muscari neglectum*, *Muscari commosum*, *Pistacia terebinthus*, *Centaurea rupestris*, and *Carex hallerana*. The area is particularly important for *Smilax aspera*, since this is the only known area of its occurrence in Kras (Seliškar *et al.*, 1996), and for *Pistacia terebinthus*, a rare species in Slovenia, which is very abundant here (Kotar & Brus, 1999). Three further species are recognised as rare species (R): *Cephalaria leucantha*, *Vicia loiseleurii* and *Celtis australis*. Rare species are considered to be only potentially threatened, but could fall into the category of endangered species in case of continuous threats. Insufficiently known species (K) are those for which we do not have enough data to assess their real risk of extinction (Anonymous, 2002). Four of them occur in the surveyed area: *Trifolium striatum*, *Salvia sclarea*, *Crepis taraxacifolia* and *Ballota nigra*. *Salvia sclarea* was observed in the immediate vicinity of a landfill; therefore we assume that its occurrence is connected to human activities. Since some other authors (*e.g.,* Martinčič *et al.*, 2007; Poldini, 2009) also regard the species as subspontaneous, we propose it should be excluded from the red data list. The occurrence of *Sternbergia lutea*, which has the status of extinct species (Ex), was already discussed.

The process of overgrowing of open grassland habitats is a major threat to the biodiversity of Kras area (Čarni & Kaligarič, 1991; Pipenbaher *et al.*, 2011). Despite the fact that certain species (temporarily) acquire habitats in the process of overgrowing the long-term result is loss of biodiversity due to the disappearing of taxa associated with open habitats. Although slowed down by fires in the past years, this process is also in evidence as affecting the area presented in this paper. According to the Slovenian Forest Service data from the year 2003, 58 % of the Kras surface area was covered with forest. The massive spread of the non-native black pine (*Pinus nigra*) is especially problematic. According to Kranjc (2005), the edge of pine forests extends by an average of 17 metres each year.

The emergence of invasive alien species entering from ruderal sites to natural and semi-natural habitats is another problematic issue concerning the loss of biodiversity, when these species obtain a foothold in the area and affect species communities in a long-term way (Cronk & Fuller, 2001). This topic is especially important when species characteristic of the area are negatively affected. Alien species are especially well represented in habitats under human influences. Invasive alien species recognised as particularly problematic include *Ailanthus altissima*, *Erigeron annuus*, *Robinia pseudacacia,* which have already entered into native plant communities and considerably affected the conditions obtaining in these habitats (Jogan, 2009). Another representative with a high invasive potential is the South African species *Senecio inaequidens*, whose impacts on the environment and human health are increasing due its rapid expansion in the region in the last decades (Poldini, 2009). A potential source of introduction of alien species is represented by landfills in the proximity of human settlements being used by locals for the disposal of soil and plant material from gardens. Such a landfill exists on the edge of the Sela na Krasu locality, where many taxa of alien origin have been recorded.

Due to frequent droughts and high summer temperatures, forests in Kras region are prone to fires (something that is also encouraged by highly flammable pine trees). In the summer of 2003, over 1000 hectares of land around Brestovica were affected by fire (Muhič, 2005; Ravbar, 2005). The effects of the forest fire are still visible today, almost 10 years after the fire.

CONCLUSIONS

We confirmed the transitional nature of the studied region by presence of different floral elements and ecological types, where characteristic elements for Mediterranean (Euri-Mediterranean) and continental (European) floras are well represented by 24.3 % and 11.5 %, respectively. Moreover, in different plant communities that are most affected by human actions, at least five times more alien taxa were recorded (11.6 % species in ruderal habitats versus 2.2 % and 1.1 % in warm slopes of Reber and in the olive groove, respectively). Nevertheless, the mosaic landscape with diverse habitats allowed us to record some phyto-geographically interesting taxa.

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PRISPEVEK K POZNAVANJU FLORE OKOLICE BRESTOVICE (KRAS, SLOVENIJA)

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POVZETEK

Članek prispeva k poznavanju flore okolice Brestovice pri Komnu v jugozahodnem delu Slovenije. Območje leži v kvadrantu 0147/4 srednjeevropskega sistema za kartiranje. Zaradi nižje nadmorske višine in odprtosti spodnjega dela doline proti Jadranskemu morju je za to območje značilno nekoliko toplejše podnebje kot drugod na Krasu.

Za raziskavo, ki poteka v okviru mednarodnega projekta Sigma2, Čezmejna mreža za sonaravno upravljanje okolja in biotske raznovrstnosti, smo izbrali tri območja z različnim človeškim vplivom: (1) star oljčni nasad nad zaselkom Klariči (2), topla pobočja, v glavnem prekrita z zaraščajočimi se travniki in redkimi gozdnimi sestoji, in (3) ruderalnimi habitati, kot so okolice stavb, cestni robovi in odlagališča odpadkov. Terensko delo smo izvedli na šestih ekskurzijah med junijem 2008 in oktobrom 2010. Da bi ugotovili skupne značilnosti lokalne flore v primerjavi s florami sosednjih regij, smo za vsak takson določili, kateremu floističnemu elementu pripada in življenjsko obliko.

V okviru inventarizacije smo zabeležili 321 različnih taksonov praprotnic in semenk, od katerih je bilo kar 190 neznanih za kvadrant 0147/4. Skupno število znanih taksonov v kvadrantu je tako 512. Zabeležene taksone lahko pripišemo 19 različnim flornim elementom. S 24,3 % zabeleženimi taksoni je najbolj zastopan evrimediteranski florni element, kateremu sledijo evropski (11,8 %), evrazijski (9,0 %) in ostali. Spekter življenjskih oblik daje vpogled v prilagoditve rastlin na okoljske pogoje. Na popisnem območju se kot prevladujoča življenjska oblika pojavljajo hemikriptofiti (42,7 %), sledijo terofiti (25,5 %) in geofiti (5,9 %). V raziskavi smo zabeležili nekatere taksone, ki veljajo za pomanjkljivo poznane. Ker te vrste pomembno prispevajo k lokalni (in državni) floristični pestrosti ali pa prispevajo k razumevanju biogeografskih značilnosti območja, smo njihov trenutni status obravnavali podrobneje. Na raziskovalnem območju smo zabeležili 19 vrst, uvrščenih v Rdeči seznam praprotnic in semenk. Med temi je 11 ranljivih vrst (V), tri redke vrste (R) in štiri premalo znane vrste (K). Sternbergia lutea *je na rdečem seznamu obravnavana kot izumrla vrste (Ex), vendar se pri nas neredko pojavlja v okolici človeških bivališč in tudi na raziskovalnem območju je njena prisotnost posledica gojitve v preteklosti.*

Območje Brestovice je vključeno v omrežje posebnih varstvenih območij Natura 2000 (tako SCI kot SPA). Med drugim smo tu našli tudi vrsto iz Priloge II Direktive o habitatih - Himantoglossum adriaticum, *ki pa ni navedena kot klasifikacijska vrst za to SCI območje. Med glavne grožnje biotski raznovrstnosti na tem območju sodijo širjenje tujerodnih invazivnih vrst, zaraščanje travišč zaradi opuščanja zemljišč in požari.*

Ključne besede: flora, Kras, območje Natura 2000, raba tal, invazivne vrste

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Appendix 1: List of recorded vascular plant taxa. For abbreviations of life forms see Table 2.
Dodatek 1: Seznam zabeleženih taksonov praprotnic in semenk. Za okrajšave življenjskih oblik glej Tabelo 2.

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
1	*Acer monspessulanum* L.	Fa	Euri-Mediterranean	+	+	+			
2	*Achillea millefolium* agg.	He	Eurosiberian		+		+		
3	*Acinos arvensis* (Lam.) Dandy	Te/He	Euri-Mediterranean		+		+		
4	*Aegilops cylindrica* Host	Te	Pontic						+
5	*Agrimonia eupatoria* L.	He	Cosmopolitan				+	+	+
6	*Ailanthus altissima* (Mill.) Swingle*	Fa	Adventitious		+	+	+	+	
7	*Ajuga chamaepitys* (L.) Schreb.	Te	Euri-Mediterranean		+		+		
8	*Ajuga reptans* L.	He	European		+		+	+	
9	*Allium ampeloprasum* L.	Ge	Euri-Mediterranean		+		+		
10	*Allium carinatum* L.	Ge	Mediterranean-Atlantic		+		+		
11	*Allium sphaerocephalon* L.	Ge	Euri-Mediterranean		+				
12	*Alyssum alyssoides* L.	Te	Euri-Mediterranean				+		
13	*Amaranthus hybridus* agg.*	Te	Adventitious					+	+
14	*Amaranthus retroflexus* L.*	Te	Adventitious					+	+
15	*Anacamptis pyramidalis* (L.) Rich	Ge	Euri-Mediterranean		+				
16	*Anagallis arvensis* L.	Te	Euri-Mediterranean		+		+	+	
17	*Anisantha sterilis* (L.) Nevski	Te	Euri-Mediterranean				+	+	
18	*Anthericum ramosum* L.	He	Mediterranean-Atlantic		+	+			
19	*Anthoxanthum odoratum* agg.	He	Eurasian		+				

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
20	*Anthyllis vulneraria* L.	Te/He	European		+				
21	*Arabis sagittata (Bertol.)* DC.	He	South East-European		+		+		
22	*Arenaria serpyllifolia* agg.	Te/He	Cosmopolitan		+		+	+	+
23	*Argyrolobium zanonii* (Turra) P.W.Ball	Ha	Euri-Mediterranean		+		+		
24	*Arrhenatherum elatius* (L.) J. & C.Presl	He	Eurasian		+		+	+	
25	*Artemisia absinthium* L.	Ha/He	Euri-Mediterranean				+	+	+
26	*Artemisia alba* Turra	Ha	Euri-Mediterranean		+		+		
27	*Asparagus acutifolius* L.	Ha	Steno-Mediterranean	+	+	+			
28	*Asparagus officinalis* L.	Ge	Euri-Mediterranean		+				
29	*Asperula cynanchica* agg.	He	Euri-Mediterranean		+				
30	*Asplenium ruta-muraria* L.	He	Circumboreal					+	
31	*Asplenium trichomanes* L.	He	Cosmopolitan					+	
32	*Astragalus carniolicus* A.Kern.	He	South East-European		+				
33	*Avena sterilis* L.	Te	Euri-Mediterranean				+	+	+
34	*Ballota nigra* L.	He	Mediterranean-Atlantic				+	+	
35	*Betonica serotina* Host	He	South East-European	+	+				
36	*Bidens bipinnata* L.*	Te	Adventitious						+
37	*Bidens subalternans* DC.*	Te	Adventitious				+	+	
38	*Bothriochloa ischaemum* (L.) Keng	He	Mediterranean-Pontic		+		+		
39	*Brachypodium rupestre* (Host) H.Scholz	He	European	+	+	+	+	+	
40	*Bromopsis condensata* (Hack.) Holub	He	East-Alpine		+				
41	*Bromopsis erecta* (Huds.) Fourr.	He	Paleotemperate		+	+			
42	*Bromus hordeaceus* agg.	Te	Cosmopolitan				+	+	+
43	*Buglossoides purpurocaerulea* (L.) I.M. Johnst.	He	Pontic	+	+	+			
44	*Buphthalmum salicifolium* L.	He	Mediterranean - Montane		+	+	+	+	
45	*Bupleurum prealtum* L.	Te	Pontic		+				
46	*Bupleurum veronense* Turra	Te	Euri-Mediterranean		+				
47	*Calamintha nepeta* agg.	He	Mediterranean-Montane				+	+	
48	*Campanula pyramidalis* L.	He	South-Illyrian		+		+		
49	*Campanula rapunculus* L.	He	Paleotemperate		+		+		
50	*Campanula sibirica* L.	He	Eurosiberian	+	+				
51	*Campanula trachelium* L.	He	Paleotemperate			+	+		
52	*Capsella bursa-pastoris* (L.) Medick.	Te	Cosmopolitan		+		+	+	+
53	*Carduus nutans* L.	He	Sub-Atlantic				+	+	
54	*Carex flacca* Schreb.	He	European	+	+	+	+		
55	*Carex hallerana* Asso	He	Euri-Mediterranean	+	+				
56	*Carex muricata* agg.	He	n.a.					+	
57	*Carpinus orientalis* Mill.	Fa	Pontic	+	+	+			
58	*Carthamus lanatus* L.	Te	Euri-Mediterranean		+				

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
59	*Catapodium rigidum* (L.) C.E. Hubb.	Te	Euri-Mediterranean				+	+	
60	*Celtis australis* L.*	Fa	Euri-Mediterranean					+	
61	*Centaurea rhenana* Boreau	He	Central-European				+	+	
62	*Centaurea rupestris* L.	He	South East-European	+	+				
63	*Centaurea triumfettii* All.	He	European		+				
64	*Centaurium erythraea* Rafn	He	Paleotemperate		+				
65	*Cephalaria leucantha* (L.) Schrad. Ex Roem. & Schult.	He	Euri-Mediterranean	+	+				
66	*Cerastium brachypetalum* agg.	Te	Mediterranean-Pontic		+		+		
67	*Cerastium pumilum* Curtis	Te	Euri-Mediterranean		+				
68	*Ceterach officinarum* agg.	He	Eurasian					+	
69	*Chamaecytisus hirsutus* (L.) Link	Ha	Eurosiberian	+	+				
70	*Chenopodium album* agg.	Te	Cosmopolitan				+	+	+
71	*Cleistogenes serotina* (L.) Keng	He	Euri-Mediterranean	+	+				
72	*Clematis flammula* L.	Fa	Euri-Mediterranean	+	+				
73	*Clematis vitalba* L.	Fa	European			+	+	+	
74	*Clinopodium vulgare* L.	He	Circumboreal		+		+	+	+
75	*Cnidium silaifolium* (Jacq.) Simonk.	He	South East-European				+		
76	*Commelina communis* L.	Te	Adventitious					+	+
77	*Consolida ajacis* (L.) Schur	Te	Adventitious					+	+
78	*Convolvulus cantabrica* L.	He	Euri-Mediterranean	+	+		+		
79	*Convolvulus arvensis* L.	Ge	Paleotemperate		+		+	+	
80	*Conyza canadensis* (L.) Cronquist*	Te	Adventitious				+	+	+
81	*Coreopsis lanceolata* L.*	He	Adventitious						+
82	*Cornus mas* L.	Fa	Pontic	+	+	+	+		
83	*Cornus sanguinea* L.	Fa	Eurasian			+	+	+	
84	*Coronilla coronata* L.	He	Pontic		+		+		
85	*Coronilla emerus* ssp. *emeroides* (Boiss. & Spruner) Hayek	Fa	Mediterranean-Pontic	+	+	+	+		
86	*Coronilla varia L.*	He	South East-European		+				
87	*Coronopus squamatus* (Forssk.) Asch.	Te	Euri-Mediterranean				+		+
88	*Cotinus coggygria* Scop.	Fa	Mediterranean-Pontic	+	+	+	+		
89	*Crataegus monogyna* Jacq.	Fa	Paleotemperate	+	+	+	+		
90	*Crepis neglecta* L.	Te	Euri-Mediterranean				+	+	
91	*Crepis taraxacifolia* Thuill.	He	Medterranean-Atlantic				+	+	
92	*Cuscuta epithymum* (L.) L.	Te	Eurasian	+	+				
93	*Cynodon dactylon* (L.) Pers.	He	Cosmopolitan				+	+	
94	*Dactylis glomerata* L.	He	Paleotemperate		+		+	+	+
95	*Datura stramonium* L.*	Te	Adventitious						+
96	*Daucus carota* L.	Te	Subcosmopolitan		+		+	+	
97	*Dianthus sanguineus* Vis.	He	European	+	+				
98	*Dianthus tergestinus* (Rchb.) Kerner	He	South-Illyrian	+	+				

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
99	*Dictamnus albus* L.	He	Eurosiberian	+	+	+			
100	*Digitaria sanguinalis* (L.) Scop.	Te	Cosmopolitan		+		+	+	
101	*Diplotaxis muralis* (L.) DC.	Te/He	Mediterranean-Atlantic					+	
102	*Diplotaxis tenuifolia* (L.) DC.	He/Ha	Mediterranean-Atlantic				+	+	+
103	*Dorycnium germanicum* (Gremli) Rikli	He	Pontic		+		+	+	
104	*Echium vulgare* L.	Te/He	European				+	+	
105	*Elytrigia intermedia* (Host) Nevski	Ge	Eurosiberian		+		+	+	
106	*Eragrostis minor* Host	Te	Cosmopolitan				+	+	
107	*Erigeron annuus* (L.) Pers.*	Te	Adventitious		+		+	+	
108	*Erodium cicutarium* (L.) L'Hér.	Te/He	Cosmopolitan				+	+	
109	*Eryngium amethystinum* L.	He	South East-European	+	+				
110	*Euonymus europaea* L.	Fa	Eurasian	+	+	+	+		
111	*Euphorbia cyparissias* L.	He	European	+	+	+	+	+	
112	*Euphorbia helioscopia* L.	Te	Cosmopolitan		+		+	+	
113	*Euphorbia lathyris* L.	Te	Adventitious						+
114	*Euphorbia maculata* L.*	Te	Adventitious				+	+	+
115	*Euphorbia verrucosa* L.	He	Mediterranean-Montane		+				
116	*Fallopia convolvulus* (L.) À.Löve	Te	Circumboreal		+		+	+	+
117	*Ferulago campestris* (Besser) Grecescu	He	Pontic	+	+				
118	*Festuca valesiaca* agg.	He	European		+				
119	*Ficus carica* L.	Fa	Euro-Mediterranean	+			+	+	+
120	*Foeniculum vulgare* Mill.	He	Euro-Mediterranean				+	+	
121	*Fragaria vesca* L.	He	Eurosiberian					+	
122	*Frangula rupestris* (Scop.) Schur	Fa	South-Illyrian	+	+	+			
123	*Fraxinus ornus* L.	Fa	Mediterranean-Pontic	+	+	+	+		
124	*Fumana procumbens* (Dunal) Gren. & Godr.	Ha	Mediterranean-Pontic		+				
125	*Fumaria officinalis* L.	Te	Paleotemperate		+		+	+	
126	*Galeopsis ladanum* L.	Te	Eurasian				+		
127	*Galinsoga ciliata* (Rafin.) Blake*	Te	Adventitious				+	+	+
128	*Galium aparine* agg.	Te	Eurasian				+	+	
129	*Galium corrudifolium* Vill.	He	Steno-Mediterranean	+	+		+		
130	*Genista sylvestris* Scop.	Ha	South-Illyrian	+	+				
131	*Genista tinctoria* L.	Ha	Eurasian	+	+				
132	*Geranium columbinum* L.	Te	Eurosiberian	+	+	+	+		
133	*Geranium molle* L.	Te	Eurasian		+		+	+	
134	*Geranium purpureum* Vill.	Te	Euri-Mediterranean	+	+				
135	*Geranium rotundifolium* L.	Te	Paleotemperate		+		+	+	
136	*Geranium sanguineum* L.	He	European		+		+		
137	*Geum urbanum* L.	He	Circumboreal				+	+	

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
138	*Globularia cordifolia* L.	Ha	Alpine		+				
139	*Globularia punctata* Lapeyr.	He	Mediterranean-Montane		+		+		
140	*Hedera helix* L.	Fa	Mediterranean-Atlantic			+	+	+	
141	*Helianthemum ovatum* (Viv.) Dunal	Ha	European	+	+				
142	*Helianthus annuus* L.*	Te	Adventitious					+	
143	*Hieracium hoppeanum* Schult.	He	Mediterranean-Montane			+			
144	*Hieracium piloselloides* agg.	He	European		+		+		
145	*Himantoglossum adriaticum* H. Baumann	He	Mediterranean-Atlantic		+				
146	*Hippocrepis comosa* L.	He	European	+	+				
147	*Hordeum leporinum* Link.	Te	Euri-Mediterranean		+		+	+	
148	*Hypericum perfoliatum* L.	He	Euri-Mediterranean	+	+		+		
149	*Inula conyza* DC.	He	European	+	+	+			
150	*Inula salicina* L.	He	European	+	+				
151	*Inula spiraeifolia L.*	He	Euri-Mediterranean	+	+				
152	*Ipomea purpurea Roth**	Te	Adventitious					+	
153	*Juniperus communis* L.	Fa	Circumboreal	+	+	+			
154	*Koeleria pyramidata* agg.	He	European	+	+		+		
155	*Lactuca perennis* L.	He	Euri-Mediterranean	+	+	+			
156	*Lactuca serriola* L.	Te/He	Eurosiberian				+	+	+
157	*Lactuca viminea* (L.) J. & C. Presl	He	Mediterranean-Pontic					+	
158	*Lamium maculatum* L.	He	Eurasian				+	+	+
159	*Lathyrus latifolius* L.	He	Euri-Mediterranean	+	+	+			
160	*Lathyrus niger* (L.) Bernh.	He	European			+			
161	*Lathyrus pannonicus* (Jacq.) Garcke	He	Eurosiberian		+				
162	*Lathyrus setifolius* L.	He	Euri-Mediterranean		+				
163	*Lathyrus sphaericus* Retz.	He	Euri-Mediterranean		+		+		
164	*Lathyrus tuberosus* L.	He	Paleotemperate			+			
165	*Lembotropis nigricans* (L.) Griseb.	Ha/Fa	Pontic			+			
166	*Leontodon crispus* Vill.	He	Euri-Mediterranean	+	+				
167	*Leucanthemum platylepis* Borbás	He	South-Illyrian	+	+				
168	*Ligustrum vulgare* L.	Fa	European	+	+	+	+		
169	*Limodorum abortivum* (L.) Sw.	Ge	Euri-Mediterranean			+			
170	*Linum tenuifolium* L.	He	Pontic	+	+		+		
171	*Lolium perenne* L.	He	Eurasian		+		+	+	
172	*Lonicera etrusca* Santi	Fa	Euri-Mediterranean	+	+	+			
173	*Lotus corniculatus* agg.	He	Euri-Mediterranean		+		+	+	
174	*Malva neglecta* Wallr.	Te/He	Paleotemperate					+	
175	*Medicago lupulina* L.	Te/He	Paleotemperate				+	+	+
176	*Medicago minima* (L.) L.	Te	Euri-Mediterranean				+	+	

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
177	*Medicago orbicularis* (L.) Bartal.	He	Euri-Mediterranean				+	+	
178	*Medicago prostrata* Jacq.	He	Pontic		+		+		
179	*Melica ciliata* L.	He	Euri-Mediterranean		+				
180	*Melilotus officinalis* (L.) Lam.	Te/He	Eurasian				+	+	
181	*Melittis melissophyllum* L.	He	European		+	+			
182	*Mercurialis annua* L.	Te	Paleotemperate		+		+	+	+
183	*Mercurialis perenne* L.	He	European					+	
184	*Microrrhinum minus* (L.) Fourr.	Te	Euri-Mediterranean				+	+	
185	*Mirabilis jalapa* L.*	Te	Adventitious						+
186	*Muscari comosum* (L.) Mill.	Ge	Euri-Mediterranean		+		+		
187	*Muscari neglectum* Guss. ex Ten.	Ge	Euri-Mediterranean		+		+		
188	*Myosotis arvensis* (L.) Hill	Te	European		+				
189	*Myosotis ramosissima* Rochel ex Schult.	Te	European		+				
190	*Olea europaea* L.	Fa	Cultivated / Subspontaneous	+					
191	*Ononis pusilla* L.	He	Euri-Mediterranean		+				
192	*Onosma echioides* L.	Te	South East-European		+				
193	*Ophrys apifera* Huds.	Ge	Euri-Mediterranean		+				
194	*Orchis purpurea* Huds.	Ge	Eurasian		+	+			
195	*Orchis tridentata* Scop.	Ge	Euri-Mediterranean		+				
196	*Orlaya grandiflora* (L.) Hoffm.	Te	European	+	+		+		
197	*Ornithogalum comosum* L.	Ge	Mediterranean-Montane	+	+		+		
198	*Ornithogalum pyrenaicum* L.	Ge	Euri-Mediterranean			+	+		
199	*Orobanche gracilis* Sm.	Ge	European		+				
200	*Ostrya carpinifolia* Scop.	Fa	Mediterranean-Pontic	+	+	+			
201	*Osyris alba* L.	Ha	Euri-Mediterranean	+	+	+	+		
202	*Oxalis articulata* Savign.*	He	Adventitious				+	+	+
203	*Oxalis corniculata* L.*	Te/He	Euri-Mediterranean						+
204	*Paliurus spina-christi* Mill.	Fa	Pontic	+	+	+	+		
205	*Parietaria judaica* L.	He	Euri-Mediterranean				+	+	
206	*Parietaria officinalis* L.	He	European					+	
207	*Petrorhagia saxifraga* (L.) Link	Ha	Euri-Mediterranean				+	+	
208	*Peucedanum cervaria* (L.) Lapeyr.	He	Eurosiberian		+		+		
209	*Peucedanum oreoselinum* (L.) Moench	He	European		+				
210	*Phaseolus vulgaris* L.	Te	Cultivated / Subspontaneous					+	
211	*Picris hieracioides* L.	He	Eurosiberian				+	+	+
212	*Pimpinella saxifraga* agg.	He	European		+				
213	*Pinus nigra* Arnold*	Fa	Cultivated / Subspontaneous		+				
214	*Pistacia terebinthus* L.	Fa	Euri-Mediterranean	+	+	+			
215	*Plantago holosteum* Scop.	Ha	Pontic		+		+		

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
216	*Plantago lanceolata* L.	He	Eurasian		+		+		
217	*Plantago major* L.	Te/He	Eurasian				+	+	
218	*Plantago media* L.	He	Eurasian		+		+	+	
219	*Poa angustifolia* L.	He	Cosmopolitan		+		+	+	
220	*Poa annua* agg.	Te/He	Cosmopolitan				+	+	+
221	*Poa bulbosa* L.	He/Ge	Paleotemperate		+		+		
222	*Poa compressa* L.	He	Circumboreal		+		+		
223	*Polygala nicaensis* Risso ex Koch	He	Steno-Mediterranean	+	+				
224	*Polygonatum odoratum* (Mill.) Druce	Ge	Circumboreal			+			
225	*Polygonum aviculare* agg.	Te	Cosmopolitan				+	+	+
226	*Polygonum persicaria* L.	Te	Cosmopolitan					+	+
227	*Potentilla argentea* L.	He	Circumboreal				+		
228	*Potentilla australis* Krašan	He	South-Illyrian		+		+		
229	*Potentilla recta* L.	He	Mediterranean-Pontic		+		+	+	
230	*Prunella laciniata* (L.) L.	Ha/He	Euri-Mediterranean		+		+		
231	*Prunus mahaleb* L.	Fa	Pontic	+	+	+			
232	*Pseudolysimachion barrelieri* (Schott ex Roem. & Schult.) Holub	He	South East-European	+	+				
233	*Quercus petrea* (Matt.) Liebl.	Fa	European			+			
234	*Quercus pubescens* agg.	Fa	Pontic	+	+	+			
235	*Ranunculus bulbosus* L.	He/Ge	Eurasian		+		+		
236	*Reseda lutea* L.	He	European		+		+	+	
237	*Robinia pseudacacia* L.*	Fa	Adventitious		+		+	+	
238	*Rorippa sylvestris* (L.) Besser	Te/He	Eurasian					+	
239	*Rosa blondeana* Rip. Ex Déségl.	Fa	Paleotemperate		+				
240	*Rosa sempervirens* L.	Fa	Steno-Mediterranean	+	+				
241	*Rostraria cristata* (L.) Tzelev	Te	Paleotemperate				+		
242	*Rubus fruticosus* agg.	Fa	European	+	+	+	+		
243	*Rubus ulmifolius* Schott	Fa	Mediterranean-Atlantic	+			+		
244	*Rumex crispus* L.	He	Cosmopolitan		+		+	+	+
245	*Rumex pulcher*L.	Te	Euri-Mediterranean					+	
246	*Ruscus aculeatus* L.	Ha	Euri-Mediterranean			+			
247	*Ruta divaricata* Ten.	He	European	+	+				
248	*Salvia pratensis* L.	He	Euri-Mediterranean	+	+		+		
249	*Salvia sclarea* L.*	He	Adventitious						+
250	*Sanguisorba minor* agg.	He	Paleotemperate		+		+	+	+
251	*Saponaria officinalis* L.	He	Eurosiberian		+		+		
252	*Satureja montana* subsp. *variegata* (Host) P.W.Ball	Ha	Mediterranean-Montane	+	+		+		
253	*Saxifraga tridactylites* L.	Te	Euri-Mediterranean		+		+		
254	*Scabiosa columbaria* L.	He	Eurasian		+		+	+	

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
255	*Scabiosa triandra* L.	He	Euri-Mediterranean		+				
256	*Scorzonera villosa* Scop.	He	South-Illyrian		+		+		
257	*Scrophularia canina* agg.	He	Euri-Mediterranean		+		+	+	
258	*Sedum sexangulare* L.	Ha	European		+		+		
259	*Senecio inaequidens* DC.*	He	Adventitious		+		+	+	+
260	*Senecio jacobea* L.	He	Paleotemperate		+				
261	*Sesleria autumnalis* (Scop.) F.W.Schultz	He	South East-European	+	+	+	+		
262	*Setaria pumila* (Poir.) Roem. & Schult.	Te	Cosmopolitan				+	+	
263	*Setaria verticillata* agg.	Te	Cosmopolitan					+	
264	*Setaria viridis* (L.) P.Beauv.	Te	Cosmopolitan				+	+	+
265	*Sherardia arvensis* L.	Te	Euri-Mediterranean		+		+	+	
266	*Silene italica* agg.	He	Euri-Mediterranean		+		+		
267	*Silene otites* (L.) Wibel	He	Eurasian		+		+		
268	*Silene vulgaris* (Moench) Garcke	Ha	Paleotemperate		+		+	+	
269	*Smilax aspera* L.	Ha	Steno-Mediterranean	+	+				
270	*Solanum dulcamara* L.	Ha	Paleotemperate				+	+	+
271	*Solanum nigrum* L.	Te	Paleotemperate					+	+
272	*Sonchus asper* (L.) Hill	Te	Eurosiberian				+	+	+
273	*Sonchus oleraceus* L.	Te	Eurasian		+		+	+	+
274	*Sorghum halepense* (L.) Pers.	He	Cosmopolitan				+	+	
275	*Stachys recta* agg.	He	Mediterranean-Montane	+	+		+		
276	*Stellaria media* agg.	Te/He	Cosmopolitan		+		+	+	+
277	*Sternbergia lutea* (L.) Ker Gawl. Ex Spreng*	Ge	Adventitious					+	
278	*Stipa eriocaulis* Borbás	He	Euri-Mediterranean		+				
279	*Tamus communis* L.	Ge	Euri-Mediterranean	+	+	+	+		
280	*Taraxacum officinalis* agg.	He	Circumboreal		+		+	+	
281	*Teucrium chamaedrys* L.	Ha	Euri-Mediterranean	+	+		+		
282	*Teucrium montanum* L.	Ha	Mediterranean-Montane		+		+		
283	*Thalictrum minus* L.	He	Eurasian	+	+	+			
284	*Thesium divaricatum* Jan ex Mert. & Koch	He	Euri-Mediterranean		+				
285	*Thlaspi praecox* Wulfen	Ha	Mediterranean-Montane		+				
286	*Thymus longicaulis* C.Presl	Ha	Euri-Mediterranean		+		+		
287	*Torilis arvensis* (Huds.) Link	Te	Eurasian				+	+	
288	*Torilis nodosa* (L.) Gaertn.	Te	Euri-Mediterranean				+		
289	*Tragopogon dubius* Scop.	He	Pontic		+		+		
290	*Tragopogon tommasinii* Sch. Bip.	He	South-Illyrian		+				
291	*Trifolium campestre* Schreb.	Te/He	Paleotemperate		+		+	+	
292	*Trifolium incarnatum* L.	Te/He	Euri-Mediterranean		+				
293	*Trifolium medium* L.	He	Eurasian		+		+	+	

	Taxa	Life form	Chorological types	Survayed areas (see Materials and Methods)					
				1	2a	2b	3a	3b	3c
294	*Trifolium montanum* L.	He	Pontic		+				
295	*Trifolium pratense* L.	Te/He	Paleotemperate		+		+	+	
296	*Trifolium repens* L.	He	Paleotemperate				+	+	
297	*Trifolium rubens* L.	He	European	+	+				
298	*Trifolium scabrum* L.	Te	Euro-Mediterranean		+		+		
299	*Trifolium striatum* L.	Te/He	Paleotemperate				+		
300	*Trinia glauca* (L.) Dumort.	He	South East-European		+				
301	*Ulmus minor* agg.	Fa	European	+	+	+	+	+	
302	*Urtica dioica* L.	He	Cosmopolitan				+	+	+
303	*Valerianella dentata* (L.) Pollich f. *dasycarpa* Rchb.	Te	Mediterranean-Atlantic		+				
304	*Valerianella rimosa* Van Bast.	Te	Euri-Mediterranean		+				
305	*Verbascum austriacum* Schott ex Roem. & Schult	He	European		+		+		
306	*Verbascum phoeniceum* L.	He	Eurosiberian		+				
307	*Verbena officinalis* L.	Te/He	Paleotemperate		+		+	+	
308	*Veronica arvensis* L.	Te	Cosmopolitan				+	+	
309	*Veronica hederifolia* agg.	Te	Eurasian				+	+	
310	*Veronica persica* Poir.	Te	Eurasian				+	+	+
311	*Vicia dasycarpa* Ten.	Te	Euri-Mediterranean		+		+		
312	*Vicia grandiflora* Scop.	Te	Pontic		+				
313	*Vicia loiseleurii* (M.Bieb.) Litv.	Te	Euri-Mediterranean		+				
314	*Vicia sativa* agg.	Te	Euri-Mediterranean		+		+	+	
315	*Vincetoxicum hirundinaria* Medik.	He	Eurasian	+	+	+	+		
316	*Viola hirta* L.	He	European			+	+		
317	*Viola tricolor* L.	Te/He	Eurasian				+	+	
318	*Vitis vinifera* L.	Fa	Adventitious			+	+		
319	*Vulpia ciliata* Dumort.	Te	Euri-Mediterranean				+	+	
320	*Xanthium spinosum* L.*	Te	Adventitious						+
321	*Xanthium strumarium* L.*	Te	Adventitious						+
		Total taxa		**76**	**208**	**56**	**182**	**127**	**50**