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A NEW POPULATION OF *ASTRAGALUS DASYANTHUS* PALL. IN THE SOUTHERN KISKUNSÁG (HUNGARY)

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A new population of *Astragalus dasyanthus* was found near the village of Dóc ("Pitricsomi-legelő"), in Southern Kiskunság. The habitat of the new population was compared to the habitat of another population near the village of Bugyi ("Kettős-hegy"), Northern Kiskunság. Both populations occur in the association *Astragalo austriaci-Festucetum sulcatae* Soó 1957. However, 20 diagnostic species can be distinguished between the habitats of the two populations. The rates of natural pioneers and generalists are higher in the habitat of Bugyi, while the rate of disturbance tolerants is higher in the habitat of the newly discovered population. Habitats of *Astragalus dasyanthus* are warm and dry, basiphilous, and very poor in nitrogen.

Key words: Astragalus dasyanthus, diagnostic species, ecological indicator values, habitat conditions, PCoA, phytocoenological relevés, social behaviour types

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INTRODUCTION

Astragalus dasyanthus Pall. (syn: *Astragalus eriocephalus* E. et K. 1800 non Willd., *Astragalus pannonicus* Schult. 1814, *Astragalus stolzenburgensis* Lerchenf. in Schur 1866, *Tragacantha dasyantha* (Pall.) Kuntze, *Tragacantha eriocephala* (Waldst. et Kit.) Kuntze) is a rare, lowland-collin, Pontic-Pannonian flora element (Soó 1966) that occurs in Bulgaria (Assyov and Petrova 2006), Hungary (Király 2009), Romania (Oprea 2005), Serbia (Josifović 1976), the States of the former Soviet Union (Moldova, Russia, Ukraine) (Yakovlev *et al.* 1996) and is extinct in Slovakia (Bertová 1988). It is a strictly-protected plant species of the Hungarian flora and placed on the IUCN Red List.

The occurrence of *Astragalus dasyanthus* in Hungary was mentioned in many works. Kitaibel found it in Bácska, Bánát, Nyírség, Tokaj-Eperjes Mountain and Mezőföld in the 18th-19th centuries (Gombocz 1945). Later, Rapaics (1916a) summarized the occurrences of *Astragalus dasyanthus* in the Carpathian Basin, and according to his opinion it was not common in Hungary. In the 20th century, many localities were found in Bácska and Bánát (Dégen 1904, Tuzson 1914, Lányi 1915 and Lengyel 1915), Hajdúság (Rapaics 1916b), Nyírség (Tamássy 1928), Zemplén Mountains (Kiss 1939, Soó 1940), Mezőföld (Zólyomi 1958, Lendvai and Horváth 1994, Horváth 1998, Szerényi 2000) and Transylvania (Prodán 1913, Soó 1940). Other populations were also found in the Kiskunság (Boros 1919, 1954). Moreover, in the 19th-20th centuries, many herbarium specimens were collected from the area of the Carphatian Basin (cf. Szujkó-Lacza 1981a). Up to now, some of the above-mentioned populations went extinct in Hungary (e.g. Nyírség) and many populations have become vulnerable or endangered and need special protection (Horváth 1997).

The aim of this study was to characterize the habitat of the new population of *Astragalus dasyanthus* near the village of Dóc ("Pitricsomi-legelő"). Moreover, the habitat of the new population was compared to the habitat of a similarly large population near the village of Bugyi ("Kettős-hegy", Northern Kiskunság).

Identification of Astragalus dasyanthus individuals

Astragalus dasyanthus is taxonomically problematic (cf. Szujkó-Lacza 1981b). Presumably, some *Astragalus dasyanthus* populations of the Danube-Tisza Interfluve are hybrids of *Astragalus dasyanthus* and *Astragalus exscapus* (Farkas 1999).

Only a small proportion of the individuals of the two investigated populations could be identified as typical *Astragalus dasyanthus* or *Astragalus exscapus* by species identification keys according to Soó and Jávorka (1951), Jávorka (1962), Heywood (1964), Soó (1966), Farkas (1999), Simon (2000) and Király (2009) as follows:

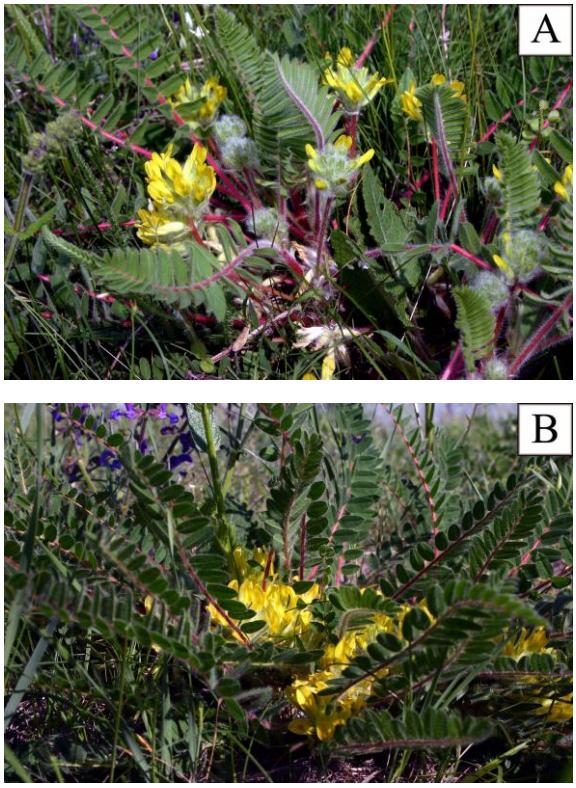


Fig. 1: *Astragalus dasyanthus* (A) and *Astragalus exscapus* (B) individuals in the association *Astragalo austriaci-Festucetum sulcatae* near Dóc (original photos of Z. Bátori).

Astragalus exscapus: Acaulescent or almost so, leaves are bunched into a ground leaf rosette, peduncles are absent (f. *excapus*) or shorter than 7 cm (f. *caulifer*). Leaflets 6-30 pairs, narrowly oblong to orbicular-ovate. The whole plant is densley covered with white hairs. Corolla yellow; standard glabrous. Plant height is 5-10(-20) cm (Fig. 1B).

Astragalus dasyanthus: Caulescent with leafy stems, peduncles are longer than 5 cm. Leaflets 8-20 pairs, ovate-oblong to elliptic-lanceolate. The whole plant is densley covered with white hairs. Corolla yellow; standard hairy. Plant height is 10-25(-45) cm (Fig. 1A).

In contrast, most of the individuals found (67% in the population of Dóc, 89% in the population of Bugyi, respectively) were varying inside the ranges specified by the standard identification keys. Since this study does not aim to determine the rate of hybridisation of the individuals but to characterize the habitat of the new population, therefore all of the hybrid-like individuals were considered *Astragalus dasyanthus*.

MATERIAL AND METHODS

In the new habitat of the *Astragalus dasyanthus*, 10 phytocoenological relevés (2 m × 2 m) were taken according to the Braun-Blanquet methodology (Mueller-Dombois and Ellenberg 1974). For comparison, 10 relevés were also taken with the same method from the sandy vegetation of Bugyi. We arranged the species in Table 1 and Tabel 2 into syntaxonomical groups according to Horváth *et al.* (1995) and Soó (1980).

Presence-absence data were analysed using Principal Coordinate Analysis (PCoA) ordination (Jaccard index) with the program package SYN-TAX 2000 (Podani 2001).

Differential species were determined by fidelity measurement with the phi coefficient (Φ) of species belonging to the different locations (Chytrý *et al.* 2002). The Φ coefficient was computed with the JUICE 7.0.25 program (Tichý 2002). Species having a high fidelity (Φ > 0,55) were considered diagnostic.

Habitat conditions were analysed by the ecological indicator values (TWRN) built on the Ellenberg system and adapted to the Hungarian flora by Borhidi (1993). Characterization of the vegetation was carried out by using the social behaviour types (SBT) of Borhidi (1993, 1995). Distributions of TWRN and SBT values were calculated using both presence-absence and cover data.

Plant community names were used according to Borhidi (2003), and plant species names according to Király (2009).

RESULTS

Phytosociological characterization

The PCoA scattergram shows a clear separation of the relevés of the two *Astragalus dasyanthus*

populations (Fig. 2). According to the cloud of points represented on the first 2 axes, habitat of the population near the village of Dóc is more homogenous.

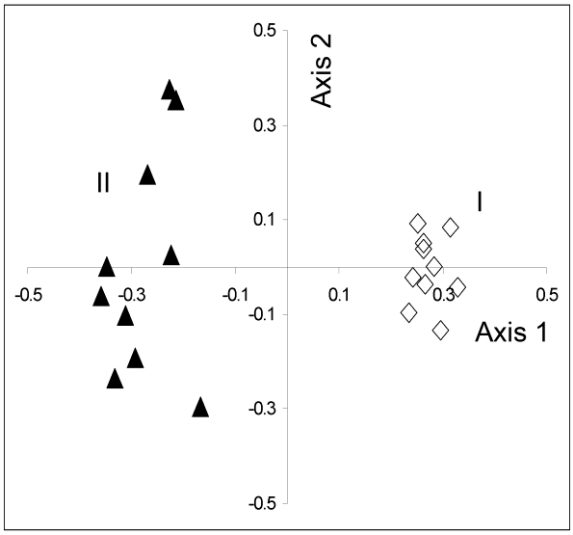


Fig. 2: PCoA ordination diagram of 20 relevés of the two investigated *Astragalus dasyanthus* populations. Notations: I: relevés of the population of Dóc; II: relevés of the population of Bugyi. Eigenvalues of the 1st and 2nd axes were 23.63% and 8.33%, respectively.

There are 20 diagnostic species between the two habitats of *Astragalus dasyanthus*. *Sonchus asper* (Polygono-Chenopodietalia), *Bothriochloa ischaemum*, *Carex tomentosa*, *Chrysopogon gryllus*, *Muscari neglectum*, *Myosotis stricta*, *Saxifraga tridactylites* (Festuco-Brometea), *Veronica prostrata* (Festucetalia valesiacae), *Ornithogalum umbellatum* agg. and *Vicia angustifolia* (indifferent) are diagnostic in the habitat of Dóc, while *Arenaria serpyllifolia*, *Galium verum*, *Koeleria cristata*, *Veronica verna* (Festuco-Brometea), *Cerastium pumilum*, *Cruciata pedemontana*, *Thymus pannonicus* (Festucetalia valesiacae), *Carex liparicarpos*, *Erysimum diffusum* (Festucetalia vaginatae) and *Bromus arvensis* (indifferent) in the habitat of Bugyi.

The new population of *Astragalus dasyanthus* (about 500-600 individuals) near the village of Dóc (CEU: 9586.4) occurs on a small sand hill, in the association *Astragalo austriaci-Festucetum sulcatae* Soó 1957, surrounded by alkaline grasslands such as *Agrostio-Caricetum distantis* Rapaics ex Soó 1938, *Lepidio crassifolii-Puccinellietum limosae* Soó (1947) 1957 and *Bolboschoenetum maritimi* Eggler 1933. So it is not surprising that a Festuco-Puccinellietalia (*Podospermum canum*) and a Festucion-pseudovinae (*Ranunculus pedatus*) species also occur in the relevés. The vegetation of the sandy grassland is dominated by Festuco-Brometea and Festucetalia valesiacae species and some common species of dry habitats. The most important grass and sedge species include *Bothriochloa ischaemum*, *Carex tomentosa*, *Chrysopogon gryllus*, *Cynodon dactylon*, *Elymus repens*, *Festuca rupicola* and *Poa angustifolia*. In springtime, some annual and geophyte species (*Cerastium semidecandrum*, *Myosotis stricta*, *Muscari neglectum*, *Ornithogalum umbellatum* and *Saxifraga tridactylites*) are also common. The most typical dicotyledons are *Euphorbia cyparissias*, *Salvia pratensis*, *Verbascum phoeniceum* and *Vicia angustifolia*. Several rare and protected species were also detected in the deeper (*Ophioglossum vulgatum*, *Orchis coriophora*) and higher (*Astragalus exscapus*, *Centaurea sadleriana*, *Onosma arenaria*, *Orchis coriophora*) parts of the sand hill, contributing to the natural value of the area. The presence of *Ambrosia artemisiifolia*, *Cannabis sativa* subsp. *spontanea*, *Conyza canadensis*, *Descurainia sophia*, *Senecio vulgaris*, *Silene alba*, *Sonchus asper* and *Taraxacum officinale* indicates a mild disturbance. On the basis of the maps of the first, the second and the third military surveys, the habitat of *Astragalus dasyanthus* near Dóc must have been out of cultivation during the last 200 years. The patches of salt marshes, marshmeadows and sandy habitats had similar pattern, size and spatial location as they have recently. However, the adjacent patches are cultivated forest plantations, farms, villages and arable lands.

Astragalus dasyanthus population of Bugyi occurs in the association *Astragalo austriaci-Festucetum sulcatae* Soó 1957 of sand hills and interdune depressions. Its vegetation is dominated by Festuco-Brometea, Festucetalia valesiacae and indifferent species. However, there are some Festucetalia vaginatae and Festucion vaginatae species (*Alkanna tinctoria*, *Euphorbia segueriana*, *Carex liparicarpos*, *Erysimum diffusum*, *Sedum hillebrandtii* and *Silene conica*) occurring mainly on the southern slopes that cannot be found in the population of Dóc. The most important grass and sedge species include *Bromus arvensis*, *Carex liparicarpos*, *Festuca rupicola*, *Koeleria cristata* and *Poa angustifolia*. The most typical dicotyledons are *Arenaria serpyllifolia*, *Cerastium pumilum* subsp. *glutinosum*, *Cruciata pedemontana*, *Eryngium campestre*, *Erysimum diffusum*, *Galium verum* and *Veronica verna*. The vascular flora of this area contains lots of protected species such as *Astragalus asper*, *Alkanna tinctoria*, *Centaurea sadleriana*, *Sedum hillebrandtii* and *Stipa pennata*. Some

disturbance tolerant and ruderal species (*Carduus nutans, Cirsium arvense, Cynodon dactylon* and *Elymus repens*) also occur in this habitat.

Vegetation features based on the social behaviour types

In the case of presence-absence data, the rate of disturbance tolerant plants (DT) is the greatest in the habitat of Dóc, while the rate of generalists (G) in the habitat of Bugyi (Fig. 3). The presence of natural pioneers (NP) is more determining in the habitat of Bugyi than in the habitat of the newly discovered population. In addition, the proportion of generalists is also important in the habitat of Dóc, and the proportion of disturbance tolerants in the habitat of Bugyi. The importance of specialists (S), competitors (C), native weed species (W) and ruderal competitors (RC) is nearly equal (5-10%) in both habitats. Introduced alien species (I) and adventives (A) occur only in the habitat of the newly discovered population.

When considering the cover data, the rate of competitors is the highest in both habitats. Nevertheless, generalists and disturbance tolerants show similar distributions to those of the presence-absence data. Specialists have a proportion of about 15% in both habitats.

Habitat conditions based on ecological indicator values

Habitats of the two investigated *Astragalus dasyanthus* populations show only small differences according to temperature (T), moisture supply (W), soil reaction (R), and nitrogen supply (N).

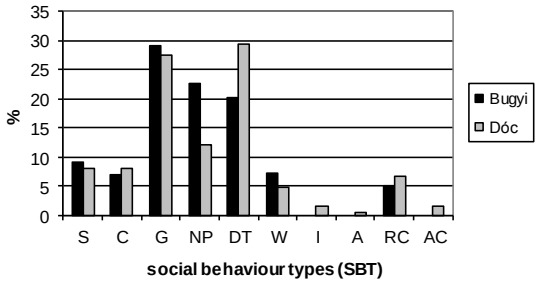
The use of T values with both presence-absence and cover data shows that the proportion of T7 (plants of thermophilous forest or woodland belt) species is the highest in the T indicator spectra, but the rates of T5 (plants of montane mesophilous broad-leaved forest belt), T6 (plants of submontane broad-leaved forest belt) and T8 (plants of sub-Mediterranean woodland and grassland belt) species are also considerable.

In the case of W indicator values, the maximum is found at W3 (xero-tolerants, but eventually occurring on fresh soils), but the proportion of W2 (xero-indicators on habitats with long dry period) species also reaches 10%. According to the presence-absence data, the rate of W1 (plants of extremely dry habitats or bare rocks) species is somewhat higher, while the rates of W5 (plants of semihumid habitats, under intermediate conditions) and W6 (plants of fresh soils) species are somewhat lower in the habitat of Dóc.

The rate of R8 (basiphilous plants) is the highest in both habitats, but R6 (mostly on neutral soils but also in acid and basic ones, generally widely tolerant, more or less indifferent plants) and R7 (basifrequent plants, mostly on basic soils) species also play an important role in the spectra.

The maximum of N spectra is found at N2 (plants of habitats very poor in nitrogen) in both habitats. The rate of N1 (only in soils extremely poor in mineral nitrogen) species is higher in the habitat of Bugyi, while the rate of N3 (plants of moderately oligotrophic habitats) is higher in the habitat of Dóc.

A



B

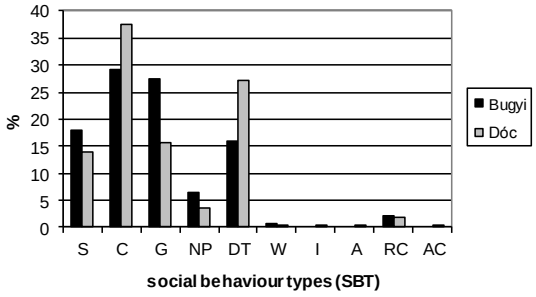


Fig. 3: Social behaviour types (SBT) based on presence-absence (A) and cover (B) data

DISCUSSION

Our paper deals with the characterization of a newly discovered population of *Astragalus dasyanthus* in the Southern Kiskunság, which is one of the most viable and most southern *Astragalus dasyanthus* population of Hungary.

According to our present knowledge, *Astragalus dasyanthus* is a rare and endangered plant species of Hungary, and occupies open or closed, and dry basiphilous habitats on loess or sand substrates, so it occures in loess or sandy grasslands (cf. Tuzson 1914, Boros 1919, Farkas 1999, Simon 2000, Király 2009). The new population of *Astragalus dasyanthus*

near the village of Dóc occurs also in the association *Astragalo austriaci-Festucetum sulcatae*, and its habitat is dominated by Festuco-Brometea and Festucetalia valesiacae species, such as the habitat near the village of Bugyi, in Northern Kiskunság. Although both populations occur in the same association, there are some differences between the species composition and vegetation texture of the two habitats. In the habitat of Bugyi, the rate of plants living in open sand habitats (Festucetalia vaginatae and Festucion vaginatae species) is higher, while the rate of plants living in disturbed, secondary and artificial habitats (adventives, alien species, disturbance tolerants and ruderal competitors) is lower than in the habitat of Dóc. However, there are some alkaline species that occur only in this latter habitat. Both habitats of *Astragalus dasyanthus* are warm and dry, basiphilous, and very poor in nitrogen. The cause of these floristic differences may be defined as follows: different landscape pattern, different land use and treatment. For example, habitat of *Astragalus dasyanthus* near the village of Dóc was burnt off during the last two autumn seasons (in 2008 and 2009), but this treatment was omitted in 2010. The habitat of the new population was visited again in 2011. We surprisingly observed that most of the individuals were very small and rate of flowering was decreased due to the shade effect of leaf litter and tall grasses. This observation suggests that proper management of the area could increase the viability of *Astragalus dasyanthus* individuals.

Our results are in good agreement with many other studies which have pointed out that *Astragalus dasyanthus* populations of Hungary are very vulnerable and need special protection (cf. Farkas 1999). More investigations are necessary to clarify the taxonomic state of *Astragalus dasyanthu*s and *Astragalus exscapus* populations of Hungary.

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Table 1: Analytical table of the habitat of *Astragalus dasyanthus* near the village of Dóc

	1	2	3	4	5	6	7	8	9	10	%	K
	Chenopodietea											
Senecio vulgaris	-	-	-	-	-	+	-	+	-	-	20	I
	Polygono-Chenopodietalia											
Sonchus asper	-	-	-	+	+	+	+	-	-	+	50	III
	Secalietea											
Cannabis sativa subsp. *spontanea*	-	-	-	-	+	-	-	-	-	-	10	I
Descurainia sophia	-	-	-	-	-	-	-	-	+	-	10	I
	Festuco-Brometea											
Arenaria serpyllifolia	-	-	-	-	-	-	-	-	+	-	10	I
Bothriochloa ischaemum	-	1	+	+	+	1	1	1	1	1	90	V
Carex praecox	-	-	-	-	-	2	-	-	1	2	30	II
Carex tomentosa	1	2	1	1	1	1	1	1	1	1	100	V
Chrysopogon gryllus	1	1	1	1	1	1	2	2	2	2	100	V
Eryngium campestre	-	-	-	-	+	-	+	-	-	+	30	II
Euphorbia cyparissias	+	+	-	-	-	+	+	+	+	+	70	IV
Falcaria vulgaris	-	-	-	-	-	-	-	+	-	-	10	I
Galium verum	-	-	+	1	-	-	-	+	-	-	30	II
Hypericum perforatum	-	-	-	+	+	+	+	+	+	-	60	III
Knautia arvensis	+	-	+	+	-	-	-	-	-	+	40	II
Koeleria cristata	+	-	-	-	1	1	2	-	1	-	50	III
Medicago falcata	-	-	+	-	-	-	-	-	-	+	20	I
Muscari neglectum	+	+	-	+	+	+	+	1	2	+	90	V
Myosotis stricta	+	+	+	1	+	+	1	1	+	+	100	V
Poa angustifolia	2	2	2	2	2	+	2	3	2	3	100	V
Potentilla arenaria	-	-	-	+	-	-	-	-	-	-	10	I
Saxifraga tridactylites	-	-	+	+	+	-	+	+	+	-	60	III
Trifolium montanum	-	+	+	-	+	-	-	-	-	-	30	II
Veronica verna	-	-	-	+	-	-	+	+	+	+	50	III
	Festucetalia valesiacae											
Centaurea sadleriana	-	-	-	-	-	-	-	-	+	-	10	I
Festuca rupicola	3	2	3	3	3	3	3	2	2	2	100	V
Salvia pratensis	1	1	1	-	2	1	-	-	1	2	70	IV
Verbascum phoeniceum	+	1	1	+	1	+	+	-	-	+	80	IV
Veronica prostrata	+	+	-	-	-	+	+	-	+	-	50	III
	Festucion valesiacae (incl. Festucion rupicolae)											
Astragalus dasyanthus	2	2	1	2	2	2	2	2	2	2	100	V
Astragalus exscapus	1	2	-	1	1	-	1	-	-	1	60	III
	Festucion vaginatae											
Cerastium semidecandrum	+	-	+	1	-	+	2	1	1	1	80	IV
Onosma arenaria	-	-	-	-	-	-	-	-	+	-	10	I
	Molinio-Arrhenatheretea											
Ophioglossum vulgatum	-	-	1	-	-	-	-	-	-	-	10	I
Orchis coriophora	+	-	+	+	-	-	-	-	-	-	30	II
Rhinanthus serotinus	-	1	+	-	-	-	-	+	+	-	40	II
	Festuco-Puccinellietalia											
Podospermum canum	1	-	-	+	-	-	-	-	-	-	20	I
	Artemisio-Festucetalia											
Achillea setacea	-	1	1	+	-	-	-	-	-	+	40	II
Carex stenophylla	-	-	-	-	-	-	-	1	-	-	10	I
	Festucion pseudovinae											
Ranunculus pedatus	-	-	-	+	+	+	+	-	-	-	40	II
	Indifferent											
Carex flacca	-	-	-	-	+	-	-	-	-	-	10	I
Crepis rhoeadifolia	-	-	+	-	+	-	-	-	-	-	20	II
Cynodon dactylon	+	+	1	+	1	+	+	+	+	-	90	V
Elymus repens	1	1	1	+	-	+	-	1	-	+	70	IV
Ononis spinosa	-	-	+	-	+	+	-	-	-	-	30	II
Ornithogalum umbellatum agg.	1	1	1	1	+	1	+	+	+	+	100	V
Silene alba	-	-	-	-	-	-	-	-	+	-	10	I
Taraxacum officinale	+	-	-	-	-	-	-	-	-	-	10	I
Trifolium campestre	+	-	-	+	-	+	+	+	1	-	60	III
Vicia angustifolia	1	1	+	1	1	1	1	2	1	2	100	V
Vicia hirsuta	+	-	-	-	-	-	-	-	-	-	10	I

	Adventives											
Ambrosia artemisiifolia	-	-	-	+	-	-	-	-	-	-	10	I
Celtis occidentalis	-	+	-	-	+	-	+	-	-	+	40	II
Conyza canadensis	-	-	-	-	-	+	+	-	+	-	30	II
Cover (%)	80	85	80	90	70	80	90	85	85	100		
Height (cm)	40	40	30	50	40	30	40	40	40	55		

Relevés 1-10 made by Z. Bátori (ined.). 2010.05.14

Table 2: Analytical table of the habitat of *Astragalus dasyanthus* near the village of Bugyi

	1	2	3	4	5	6	7	8	9	10	%	K
	Chenopodietea											
Echium vulgare	-	-	-	-	-	-	-	+	-	-	10	I
	Secalietea											
Papaver rhoeas	-	+	+	+	-	-	-	-	-	-	30	II
Rannunculus arvensis	-	-	-	-	-	+	+	-	-	-	20	I
	Convolvulo-Agropyrion											
Convolvulus arvensis	-	-	-	1	-	-	-	+	-	-	20	I
	Sedo-Scleranthetalia											
Poa bulbosa	-	-	-	-	-	-	-	1	-	-	10	I
	Festuco-Brometea											
Arenaria serpyllifolia	+	+	1	1	1	1	1	+	+	1	100	V
Carex praecox	-	-	-	-	1	-	-	-	-	-	10	I
Chrysopogon gryllus	-	-	-	-	-	-	2	2	2	-	30	II
Eryngium campestre	1	1	1	+	-	-	-	+	1	1	70	IV
Euphorbia cyparissias	1	1	-	-	+	1	-	1	-	-	50	III
Falcaria vulgaris	-	-	1	-	+	-	1	-	-	-	30	II
Filipendula vulgaris	-	-	-	-	-	2	2	-	2	-	30	II
Galium verum	1	1	1	1	2	1	1	-	1	1	90	V
Hypericum perforatum	-	-	-	+	-	-	+	1	-	-	30	II
Koeleria cristata	1	2	1	2	2	3	2	2	1	1	100	V
Medicago falcata	1	1	-	2	1	-	-	-	-	-	40	II
Medicago minima	+	-	-	-	+	-	-	1	-	-	30	II
Myosotis stricta	-	-	+	+	1	+	+	-	-	-	50	III
Nonea pulla	-	-	+	+	-	-	-	-	-	+	30	II
Phleum phleoides	-	-	-	-	-	2	2	-	-	1	30	II
Poa angustifolia	1	2	2	2	2	1	2	-	2	1	90	V
Potentilla arenaria	+	-	-	1	-	+	-	1	-	+	50	III
Salvia nemorosa	-	-	-	-	-	-	+	-	-	-	10	I
Silene otites	-	-	-	-	-	-	+	+	+	-	30	II
Veronica verna	+	+	+	+	+	1	+	+	+	+	100	V
	Festucetalia valesiacae											
Agropyron cristatum	3	1	3	-	-	-	-	-	-	-	30	II
Centaurea sadleriana	-	-	-	-	-	1	-	-	-	-	10	I
Cerastium pumilum subsp. glutinosum	1	+	1	1	-	+	1	-	1	1	80	IV
Cruciata pedemontana	+	-	+	+	+	+	+	-	+	1	80	IV
Cynoglossum officinale	-	-	-	-	-	-	-	+	-	-	10	I
Festuca rupicola	2	3	2	3	2	2	2	3	2	3	100	V
Gagea pusilla	-	-	-	+	-	-	-	-	-	-	10	I
Lithospermum arvense	-	+	+	+	-	-	-	-	-	+	40	II
Salvia pratensis	-	-	-	-	-	2	1	-	2	-	30	II
Stipa capillata	+	+	-	-	-	-	-	-	-	-	20	II
Stipa pennata	-	-	-	1	-	-	-	+	-	-	20	I
Thymus pannonicus	2	1	-	-	1	-	-	2	+	2	60	III
Verbascum phoeniceum	+	-	+	+	-	1	+	-	1	-	60	III
	Festucion valesiacae (incl. Festucion rupicolae)											
Anthemis ruthenica	-	+	-	+	-	-	-	+	+	-	40	II
Astragalus asper	-	1	-	-	2	1	-	-	-	-	30	II
Astragalus dasyanthus	2	2	4	2	2	2	2	+	2	3	100	V
Astragalus excapus	1	1	-	-	+	+	1	1	-	-	60	III
Salvia austriaca	-	-	-	-	-	-	+	+	-	-	20	I
Viola kitaibeliana	-	+	+	+	+	-	-	-	-	-	40	II

	Festucetalia vaginatae											
Carex liparicarpos	+	+	+	2	-	+	+	1	1	+	90	V
Erysimum diffusum	+	+	1	2	1	-	+	+	-	+	80	IV
	Festucion vaginatae											
Alkanna tinctoria	-	-	-	-	-	-	-	+	-	-	10	I
Cerastium semidecandrum	-	-	-	1	1	-	-	+	-	-	30	II
Euphorbia sequreiana	-	-	-	-	-	-	-	1	-	-	10	I
Sedum hillebrandtii	-	-	-	-	-	-	-	1	-	-	10	I
Silene conica	+	-	-	-	-	-	-	+	-	+	30	II
	Molinio-Arrhenatheretea											
Achillea millefolium	-	-	-	-	-	1	-	1	1	1	40	II
Linum catharticum	-	+	+	1	-	-	-	+	-	-	40	II
	Artemisio-Festucetalia											
Achillea setacea	-	-	+	2	+	1	1	-	-	+	60	III
Carex stenophylla	-	-	+	-	-	1	-	-	-	-	20	I
	Indifferent											
Anchusa officinalis	-	-	-	-	+	-	-	-	-	-	10	I
Bromus arvensis	-	+	-	+	+	-	-	+	+	+	60	III
Carduus nutans	-	-	-	-	-	-	-	+	-	-	10	I
Carex hirta	-	-	-	-	-	+	-	-	-	-	10	I
Cirsium arvense	-	+	-	-	-	-	-	-	-	-	10	I
Cynodon dactylon	+	2	-	1	-	-	-	+	-	+	50	III
Elymus repens	-	-	-	-	1	1	1	-	1	-	40	II
Erodium cicutarium	-	-	-	+	-	-	-	+	-	-	20	I
Muscari comosum	-	-	-	+	-	-	-	-	-	-	10	I
Ornithogalum umbellatum agg.	-	-	-	-	-	-	-	+	-	-	10	I
Plantago lanceolata	-	-	-	-	-	-	-	+	-	-	10	I
Potentilla argentea	-	-	-	-	-	-	+	-	-	-	10	I
Silene alba	-	-	-	+	-	-	-	-	-	-	10	I
Taraxacum officinale	-	+	-	-	-	-	-	-	-	-	10	I
Trifolium campestre	-	-	-	-	-	-	-	-	-	+	10	I
Veronica arvensis	-	-	-	+	-	-	-	-	-	-	10	I
Cover (%)	95	90	100	95	95	95	95	80	95	95		
Height (cm)	45	40	40	50	45	45	50	40	45	45		

Relevés 1-10 made by A. Kelemen (ined.). Date: 2010.05.24