

## Monitoring of Selected Threatened *Fabaceae* Species in Moravia

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**Abstract:** Altogether, 17 threatened wild plant species of the family *Fabaceae*, selected in their natural localities, were included in the monitoring. They could have prospects for use in agriculture or horticulture. Most of the monitored species are well conserved within protected areas. Only occasional disturbances can be observed (caused by wild animals, human footpaths, etc.). Declines in species number were observed, especially during dry seasons (2004, 2007). On the other hand, an increase of species numbers was recorded during wet seasons (2006, 2008); this, thanks to the increased occurrence of annual species and ephemerals. For an evaluation of the state of vegetation on each locality, the Shannon diversity index, combined with species richness data, were used. Species growing on extreme (very dry, much insolated, extremely acid, etc.) localities tend to have bigger fluctuations in their population size, but are better protected against human impacts. No negative trends have been observed in the population dynamics of any of the monitored localities.

**Keywords:** biodiversity; conservation; genetic resources; *in situ*; monitoring; phytosociology

This monitoring was performed within the project “Conservation of plant biodiversity in the system of sustainable agriculture and landscaping” (2004 to 2008). The main objectives of the project were (1) to make an inventory of the current situation of domestic genetic resources; (2) to find existing fragments of traditional landraces of field and garden crops; (3) to realize their repatriation from foreign gene banks; (4) to review the possibilities of their alternative preservation by the method of *in situ* or on-farm conservation; (5) to gather the seed samples of wild species potentially utilisable in agriculture or horticulture to enlarge biodiversity; (6) to revise and find localities of selected threatened plant species of the family *Fabaceae*; (7) to obtain seed samples and to prepare proposal of sustainable preservation of the species in the countryside by the method of *in situ* conservation.

DOSTÁL (1989) mentions 287 species and subspecies of the family *Fabaceae* growing in the Czech

and Slovak Republics. Out of those, 25 species in the Czech Republic are endangered (8.7%); and another 20 species are critically endangered or close to extinction (7%). ČEŘOVSKÝ *et al.* (1999) mentioned in the Red Data Book (of endangered and rare plant and animal species of the Czech and Slovak Republics) 22 species belonging to this family. Therefore, it is highly desirable to particularly pay great attention to these species, and to ensure the preservation of these species in their natural localities, as well as conservation of their seeds in the Czech National Gene Bank.

### MATERIALS AND METHODS

Based on the available literature (DOSTÁL 1989; SLAVÍK 1995; ČEŘOVSKÝ *et al.* 1999) and results of a previous research project (VYMYSLICKÝ *et al.* 2003), the following seventeen threatened wild

Table 1. Number of localities, in which the studied species were detected; total number of visited localities was 123

Species	No. of localities	Occurrence (%)
<i>Astragalus austriacus</i>	10	8.1
<i>Astragalus excapus</i>	4	3.2
<i>Astragalus onobrychis</i>	17	13.8
<i>Cytisus procumbens</i>	7	5.7
<i>Dorycnium germanicum</i>	22	17.9
<i>Genista pilosa</i>	24	19.5
<i>Genista sagittalis</i>	1	0.8
<i>Glycyrrhiza glabra</i>	5	4.1
<i>Chamaecytisus albus</i>	1	0.8
<i>Chamaecytisus austriacus</i>	3	2.4
<i>Chamaecytisus virescens</i>	2	1.6
<i>Medicago prostrata</i>	2	1.6
<i>Medicago minima</i>	6	4.9
<i>Oxytropis pilosa</i>	11	1.6
<i>Trifolium fragiferum</i>	5	4.1
<i>Trifolium retusum</i>	2	1.6
<i>Trifolium striatum</i>	2	1.6
<i>Trigonella monspeliaca</i>	2	1.6

plant species of the family *Fabaceae*, occurring primarily in southern Moravia (Pannonian area), and which are potentially utilisable in agriculture or horticulture, were selected: *Astragalus austriacus* Jacq., *Astragalus excapus* L., *Astragalus onobrychis* L., *Cytisus procumbens* (Willd.) Spreng., *Dorycnium germanicum* (Gremli) Rikli, *Genista pilosa* L., *Genista sagittalis* L., *Glycyrrhiza glabra* L., *Chamaecytisus albus* (Hacq.) Rothm., *Chamaecytisus virescens* (Neilr.) Dostál, *Medicago prostrata* Jacq., *Medicago minima* (L.) L., *Oxytropis pilosa* (L.) DC., *Trifolium fragiferum* L., *Trifolium retusum* L., *Trifolium striatum* L., and *Trigonella monspeliaca* L.

Monitoring of this species was mostly performed in the Pannonian biogeographic province; only a few of them are also located in Central Bohemia or in other areas. Most of the localities are included in protected landscape areas or in small nature reserves. All of the localities that were found during the project were recorded into the database. The total number of localities visited was 123.

One typical locality of each species was selected. All the monitored localities are situated in the Pannonian biogeographic region, with a continental type of climate (CULEK 1996). Moni-

Table 2. Number of species recorded in relevés in the years 2004–2008

Species	2004	2005	2006	2007	2008	Average
<i>Astragalus austriacus</i>		26	19	21	18	21
<i>Astragalus excapus</i>		20	22	27	28	24
<i>Astragalus onobrychis</i>		26	27	26	31	28
<i>Cytisus procumbens</i>	37	27	24	24	33	29
<i>Dorycnium germanicum</i>		29	33	36	40	35
<i>Genista pilosa</i>	27	25	26	22	25	25
<i>Genista sagittalis</i>	30	26	27	27	38	30
<i>Glycyrrhiza glabra</i>		19	25	25	24	23
<i>Chamaecytisus albus</i>		18	21	20	23	21
<i>Chamaecytisus virescens</i>		16	20	24	25	21
<i>Medicago prostrata</i>		19	19	18	24	20
<i>Medicago minima</i>		21	19	15	18	18
<i>Oxytropis pilosa</i>		29	27	26	29	28
<i>Trifolium fragiferum</i>		19	16	17	23	19
<i>Trifolium retusum</i>		24	24	22	24	24
<i>Trifolium striatum</i>		21	19	13	21	19
<i>Trigonella monspeliaca</i>		23	21	20	24	22
Average	31	23	23	23	26	24

toring was performed once a year, from May to September, both on permanent plots of 4 m<sup>2</sup>, and on the whole population (flowering, seed production, vitality, and collecting of seeds). The following characteristics were recorded: number of plants per 4 m<sup>2</sup> plots, number of plants per locality, ontogenetic phases, the health state of the species, as well as the factors causing threatened status of the species. If possible, seeds were collected for future storage in the gene bank, as well as for possible use in the future repatriation of the species.

### Phytosociological relevés

One typical locality of each species was selected. Phytosociological relevés were recorded at 4 m<sup>2</sup> plots for each locality. The Braun-Blanquet scale was used for the recording of the relevés. The numbers of species per plot, and changes in the situation were acquired. The Shannon diversity index for each relevé and the year was calculated using a mathematical formula defined in MS Excel.

Table 3. Differences among recorded number of species in relevés in the years 2004–2008 (ANOVA)

Source of variability	df	MS
Species	16	84.39**
Years	3	57.98**
Error	48	8.43

df – degrees of freedom; MS – mean square; \*\* $P \leq 0.01$

This index includes information about both the number of species in the relevé and the population size within it. The index is increased either by having additional unique species, or by having greater species evenness.

$$H' = - \sum_{i=1}^S P_i \times \ln P_i$$

where:

$S$  – total number of species

$P_i$  – relative representation of  $i^{\text{th}}$  population = population size of the  $i^{\text{th}}$  species over sum of sizes of all populations

Table 4. Shannon diversity indices

Species	2004	2005	2006	2007	2008	Average
<i>Astragalus austriacus</i>		2.05	1.65	1.66	1.53	1.72
<i>Astragalus excapus</i>		1.72	2.05	2.25	2.24	2.07
<i>Astragalus onobrychis</i>		1.14	1.17	1.83	1.73	1.47
<i>Cytisus procumbens</i>	2.67	1.98	2.08	2.45	2.39	2.31
<i>Dorycnium germanicum</i>		1.79	2.04	2.32	2.68	2.21
<i>Genista pilosa</i>	1.54	1.41	1.40	1.67	1.18	1.44
<i>Genista sagittalis</i>	2.01	1.64	1.56	1.93	2.41	1.91
<i>Glycyrrhiza glabra</i>		1.63	1.62	1.95	2.21	1.85
<i>Chamaecytisus albus</i>		1.98	1.75	2.09	1.68	1.88
<i>Chamaecytisus virescens</i>		1.48	1.74	2.24	1.88	1.84
<i>Medicago prostrata</i>		2.02	2.13	1.79	2.16	2.03
<i>Medicago minima</i>		1.56	1.47	1.09	1.80	1.48
<i>Oxytropis pilosa</i>		1.72	2.13	2.34	2.27	2.12
<i>Trifolium fragiferum</i>		2.12	2.05	2.07	1.76	2.00
<i>Trifolium retusum</i>		2.34	2.41	1.96	1.51	2.06
<i>Trifolium striatum</i>		1.56	1.46	0.76	1.82	1.40
<i>Trigonella monspeliaca</i>		2.63	2.14	2.13	1.91	2.20
Average	2.07	1.81	1.81	1.91	1.95	1.91

## RESULTS AND DISCUSSION

Results were collected in the period from 2004 to 2008. The main results obtained are divided into separate sections.

### Number of species found in localities studied

The species *Genista pilosa* (24) and *Dorycnium germanicum* (22) had the highest number of localities that were found during the project. *Genista sagittalis* and *Chamaecytisus albus*, had only a single locality each. The numbers of localities are presented in Table 1. These numbers correspond well with the threatened status of the species; with the consequence that critically endangered species were only found at one or two localities.

### Numbers of species in relevés

The numbers of species recorded in relevés in the years 2004 to 2008 are presented in Table 2. *Medicago minima* (18), *Trifolium fragiferum*, and *Trifolium striatum* (19) had the lowest average number of species. *Dorycnium germanicum* (35) and *Genista sagittalis* (30) had the highest average number of species.

In 2008, twenty six species were recorded, on average; while in 2005, 2006, and 2007 twenty three species were recorded, respectively. The average number of species was 24, so this signifies quite rich vegetation types. Lower species numbers were recorded in the therophytic vegetation (*Medicago minima*, *Trifolium fragiferum*, *Trigonella monspeliaca*, and *Trifolium striatum*). Higher species numbers were recorded in the dense steppe vegetation of the *Cirsio-Brachypodium pinnati* alliance (*Dorycnium germanicum*, *Cytisus procumbens*, *Genista sagittalis*).

Overall, highly significant differences, both among the monitored species and years, were found. For details see Table 2; and the statistics in the Table 3.

### Shannon diversity index

Calculated values of the Shannon diversity indices are presented in Table 4. *Trifolium striatum*

Table 5. Comparison of Shannon indices and number of species

Species	Shannon Index (average)	No. of species (average)
<i>Astragalus austriacus</i>	1.72	21
<i>Astragalus excapus</i>	2.07	24
<i>Astragalus onobrychis</i>	1.47	28
<i>Cytisus procumbens</i>	2.31	29
<i>Dorycnium germanicum</i>	2.21	35
<i>Genista pilosa</i>	1.44	25
<i>Genista sagittalis</i>	1.91	30
<i>Glycyrrhiza glabra</i>	1.85	23
<i>Chamaecytisus albus</i>	1.88	21
<i>Chamaecytisus virescens</i>	1.84	21
<i>Medicago prostrata</i>	2.03	20
<i>Medicago minima</i>	1.48	18
<i>Oxytropis pilosa</i>	2.12	28
<i>Trifolium fragiferum</i>	2.00	19
<i>Trifolium retusum</i>	2.06	24
<i>Trifolium striatum</i>	1.40	19
<i>Trigonella monspeliaca</i>	2.20	22
Average	1.91	24

Only a weak correlation between the Shannon indices and the number of species was found ( $r = 0.39$ ,  $n = 17$ ,  $P \leq 0.01$ ).

(1.40), *Genista pilosa* (1.44), *Astragalus onobrychis* (1.47) had the lowest average values of the Shannon index of diversity. *Cytisus procumbens* (2.31), *Dorycnium germanicum* (2.21), and *Trigonella monspeliaca* (2.20) had the highest average values of the Shannon index of diversity. In 2008, the average value of the Shannon index of diversity was 1.95; while it was 1.81 in 2005 and 2006 and 1.91 in 2007. The average value was 1.91, and so indicates well balanced vegetation types.

The great variation between years was influenced by the varying climate in each individual year, typical of a continental climate; which influenced the number of species and the abundance of their populations.

### Comparison of Shannon indices and number of species

There was found only a weak correlation ( $r = 0.39$ ,  $n = 17$ ,  $P \leq 0.01$ ) between the Shannon index value and the number of species in a relevé (for details, see Table 5). This means that rich vegetation types do not have to have the biggest equitability evenness.

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