

Monitoring of Selected Threatened Species in Bohemia

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Abstract: The monitoring was based on 6 localities selected from within different regions of the Czech Republic. The vegetation was monitored during 2005 to 2008. Plant checklists have been made for each locality. Permanent plots of 9 m² in size have been marked and the phytosociological relevés have been recorded. The standard Braun-Blanquet scale of abundance/dominance was used. Biological diversity was evaluated using the Shannon, Simpson, and Evenness indexes. While some localities were stable and no threat was found (Radobýl), other localities were (to an extent) disturbed (Grado, Václavka, and Děčín); seriously damaged (Zbraslav), or permanently lost (Jílovský potok). Collecting seeds for the Gene Bank *ex-situ* conservation can serve as a backup for *in situ* conservation. Protection of two localities is suggested.

Keywords: conservation; *in situ*; monitoring; phytosociological relevés; plant genetic resources; threatened species

Wild species, which are related to or ancestral forms of cultivated crops (crop wild relatives, CWR), are a valuable genepool for plant breeding or for introduction as a new crop. In a wider sense, MAXTED *et al.* (2008) considers any wild taxon, belonging to the same genus as the crop, as a CWR. If the European and Mediterranean floras are taken as examples, approximately 80% of species can be considered as a CWR (KELL *et al.* 2007). There are not many CWR of the main crops in the Czech Republic; however, there are many of them belonging to other crops. Many agriculturally interesting species are within the families *Poaceae*, *Fabaceae*, and *Alliaceae*, which were the subject of our work. Among them, there are many species which have either a limited occurrence, are endangered, or are critically endangered. Within *Poaceae*, there are 63 threatened grass species in the Czech flora, 23 of them are registered in the Red Data Book, and 6 species are registered in the Black List of Extinct Species (DOSTÁL 1989; PROCHÁZKA 2001). Some 27 critically and severely endangered species are protected by law (ANONYMOUS 1992). CWR are conserved *ex situ* in the Gene Bank, together with

agricultural crops. The Convention of Biological Diversity (CBD 1992) fundamentally changed the practise of plant conservation by placing a much greater emphasis on *in situ* conservation; that is, the natural diversity of ecosystems, species, and genetic variation. It also stressed the direct link between conservation and use (MAXTED *et al.* 2007). In order to set up *in situ* conservation of the target species, it is important to collect data from herbaria, the literature, and to visit and monitor localities.

The objectives for this study were to select model localities with threatened plants, set up monitoring on permanent plots, and to assess threats to particular localities/populations. In addition, it was expected to collect seeds for *ex situ* conservation, for cultivation, and regeneration.

MATERIAL AND METHODS

Threatened or rare species of agricultural importance from the families *Poaceae*, *Fabaceae*, and *Alliaceae* were considered, based on a her-

barium search in both of the main Prague Herbaria (PR and PRC). The model species chosen were *Hierochloë odorata* (L.)Wahlbg., *Astragalus excapus* L., *A. onobrychis* L., and *Allium schoenoprassum* L. ssp. *schoenoprassum*. Altogether, 7 localities were selected for monitoring. This monitoring is intended at investigating both the qualitative and quantitative changes in biodiversity, over time. Each locality was visited in the optimum season (May to June), and again at the end of the growing season in October every year from 2004 to 2008. All plant species on the locality were recorded. For nomenclature and plant determination, current botanical publications were used (SLAVÍK *et al.* 1988–2004; DOSTÁL 1989; KUBÁT *et al.* 2002). Phytosociological data were checked in accordance with Vegetation of the Czech Republic (CHYTRÝ 2007).

At the beginning of the project, a plot 3 × 3 m in size was permanently marked on a representative part of the locality where the target species occurs. The phytosociological relevé was noted using the Braun-Blanquet combined scale of dominance and abundance (PRACH 1994). This scale enables one to estimate the share of species as well as their fluctuations within time with an acceptable accuracy.

The data received were used to calculate the botanical diversity by the following characteristics: Shannon index H and its standardized version Evenness Eh (ZVÁROVÁ & MAZURA 2002):

Shannon diversity index:

$$H = - \sum_{i=1}^s p_i \ln(p_i)$$

where:

s – total number of species,

Dominance of i -species:

$$p_i = \frac{i - \text{species} - \text{frequency}}{\text{total} - \text{frequency}}$$

Evenness (Shannon) is defined:

$$Eh = \frac{H}{\ln(s)}$$

Because $\ln(s)$ gives maximum H (for current number of species), it is a standardized version of H .

Simpson diversity index:

$$D = \frac{1}{\sum_{i=1}^s p_i^2}$$

Evenness (Simpson) is defined as:

$$Eh = \frac{1}{n \sum_{i=1}^s p_i^2}$$

and it is again a standardized version of D .

The biodiversity indices are presented graphically.

RESULTS AND DISCUSSION

Hierochloë odorata (L.)Wahlbg.

Locality Grado

The locality Grado is within a recreational resort along the Elbe River cut-off meander. *Hierochloë odorata* grows on a site greater than 100 m², on an open sandy flat about 8 m from the cut-off bank. The stand is in very good condition and is dominant on that site. It has a dense net of interlocked stolons in sand to a depth of 5 to 15 cm. There are a high proportion of floriferous stems. It was evaluated as 3, according to the abundance/dominance scale (Table 1). The number of species on the locality is high; 42 species/9 m². The botanical diversity

Table 1. Botanical diversity for plots of *Hierochloë odorata* in two localities, 2008

Abundance/dominance	Grado	Václavka
Botanical diversity (n)		
3	2	2
2a	5	
1	5	6
+	23	24
r	7	
n	42	32
Total dominance (%)	133.7	92.4
H	2.11	1.495
Eh	0.565	0.431
D	5.539	2.995
Es	0.132	0.094

H – Shannon index; Eh – Evenness Shannon; D – Simpson index; Es – Evenness Simpson; n – No. of species

evaluated by the Shannon index $H = 2.11$, reflects the high number of species and a high dominance level. Evenness $Eh = 0.57$ expresses more than an average diversity.

The locality is strongly affected by tourists, fishermen, and residents of summer cottages. They often make bonfires in the middle of the locality. There is usually a mound of branches beside the bonfire site. Even if the locality is strongly disturbed, the *Hierochloë* stand seems stable and the plants are vigorous.

Locality Václavka

The stand of *Hierochloë* is found here on the steep slope of the cut-off bank. The site's size is about 12×3 m. It provides undergrowth to open woodland, with prevailing *Populus nigra*, *Quercus robur*, as well as the shrubs *Prunus spinosa* and *Cornus sanguinea*. It can be seen that the woodland is increasing, due to the many seedlings. The stand of *Hierochloë* was evaluated as 3 on the scale, in the middle of the site. The *Hierochloë* has a lower proportion of fertile stems, probably due to shade from the phanerophytes. The number of species per plot was 32, with a 92% total dominance. Botanical diversity evaluated by the Shannon index was 1.49; in the standardized version of Evenness it was 0.43. This means it was less than the mean value, reflecting a lower dominance of the species. The Simpson index $D = 2.99$ reflects mainly lower species numbers.

Allium schoenoprasum L. ssp. *schoenoprasum*

While the subspecies *Allium schoenoprasum* L. ssp. *alpinum* (DC.) Čelak. rarely occurs in the mountains (Krkonoše Mts, Jeseníky Mts), the nominate subspecies of chive occurs along lowland rivers and in open woodlands. The latter subspecies used to be more common, but with bank regulations it is also becoming rare.

Locality Zbraslav

The lowland chive occurs here on a pier parallel with the bank of the Vltava River, within the Zbraslav Prague district. Its occurrence was found by Pavel Havránek in 2001, in the bank pavement among diatomite rocks. The pavement on the bank slopes down to the river, at an angle of approximately 45° . The chive population was not large, being about 5 m in length; the number of plants numbered about 100–200. An important factor was the major phenotypic diversity, especially noticeable in the flower colour from regular rose to pure white and dark rose. There was also variation in other morphological characteristics, patch form, and leaf shape. In 2002, the locality was damaged by a disastrous flood. The end of the pier was washed-out, including a part of the chive population. The surviving chive population had recovered and phenotypic variation was confirmed in 2003. We marked up a permanent 3×3 m plot for monitoring in the middle of the

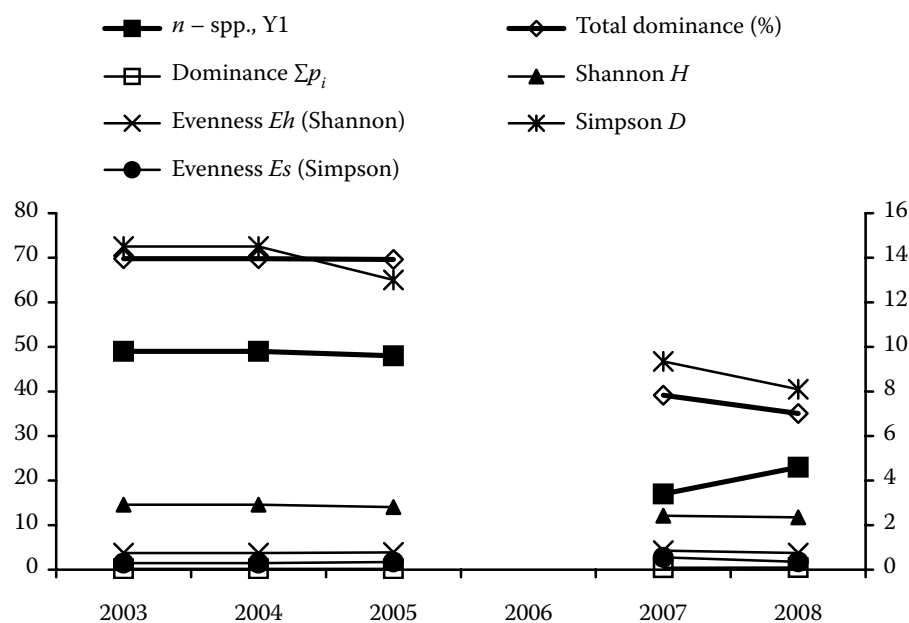


Figure 1. Monitoring of *A. schoenoprasum*, Zbraslav locality

site. The number of recorded species was 48; the chive was evaluated as a 1 on the Braun-Blanquet scale. The total dominance was 69%. The chive population had a slowly increasing tendency in the following years. Species composition was nearly constant. In 2006, the locality was faced with another disastrous flood, which washed the site out completely, and the relevé was not recorded. The subsequent bank reconstruction caused the pier to be cut, and a new stone pavement was constructed on the bank. The next visit to the locality, in spring 2007, revealed three patches of chive, and a new plot was marked in a similar place. These patches have set up a new population, seeded, and new seedlings were found in the open pavement in the autumn. In 2008, the only plants that were flowering were pink, and it is questionable if the white-flower form will appear among the seedlings again. However, seeds from the white form were collected in previous years; therefore, the form is saved in an *ex situ* collection and can be repatriated. Figure 1 shows a monotonous state and an abrupt decrease of the Shannon and Simpson indexes after the last flooding.

Locality Jílovský potok

The localities of Jílovský and Luční potok represent small occurrences of chive in woodlands. The former is in disturbed deciduous maple forest, with prevailing *Acer pseudoplatanus* and *A. platanoides*. The site of the chives is near a golf course, and

it was heavily disturbed by the depositing of cut grass. The latter locality is in a floristically rich beech forest margin, with no threat. The site of Jílovský potok hosted a small population of chives, about 50 individuals, with a very low phenotypic variation. The number of species per plot was 21, stable since 2005. The total dominance was 105% due to dense ruderal vegetation. A high Shannon index ($H = 2.2$) shows a high dominance of ruderal species and Simpson index ($D = 5.6$) shows uniformity of dominance (6 species evaluated with 2a or 3). During the autumn of 2007, the site of chives was covered by grass compost. The locality damage reflected a drop in species numbers, and in Shannon and Simpson indexes (Figure 2). The chive locality disappearance was confirmed in spring 2008.

Locality Děčín

The chive occurrence was found in 2006 on the left bank of the Elbe. It is about 50 m downstream behind a railway bridge, about 10 × 10 m in size, 8 m from the river, on a flat bank among the stones of the pavement, and in grass. The population is morphologically quite variable, including flower colour (from common pale rose to red). It is a strong population, which is expanding, with more than 100 adult plants and a number of seedlings. The species number per plot varied from 21 to 25 during the monitored years of 2006–2008. The total dominance was 80%. The dominance of the

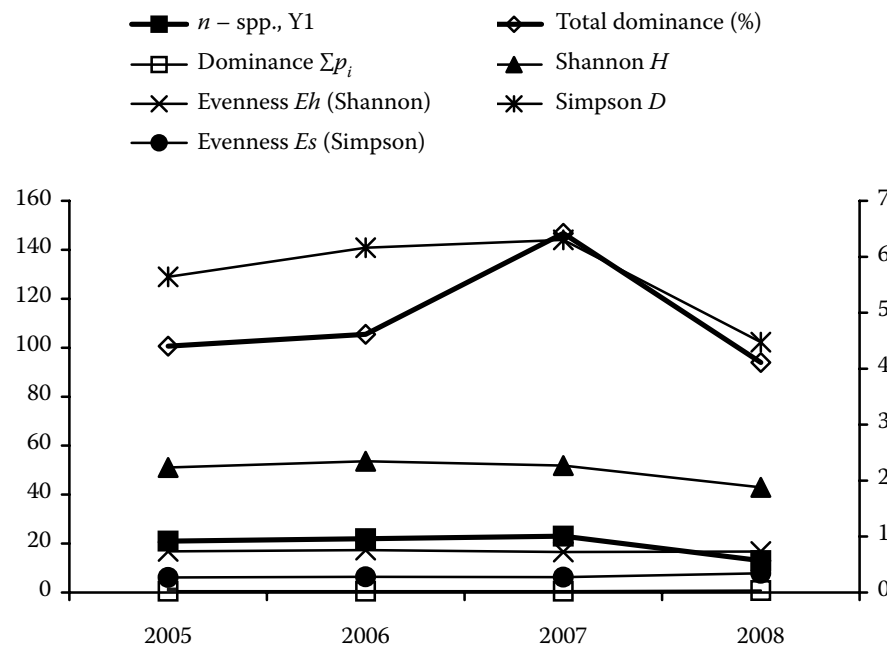


Figure 2. Monitoring of *A. schoenoprassum*, Jílovský potok locality

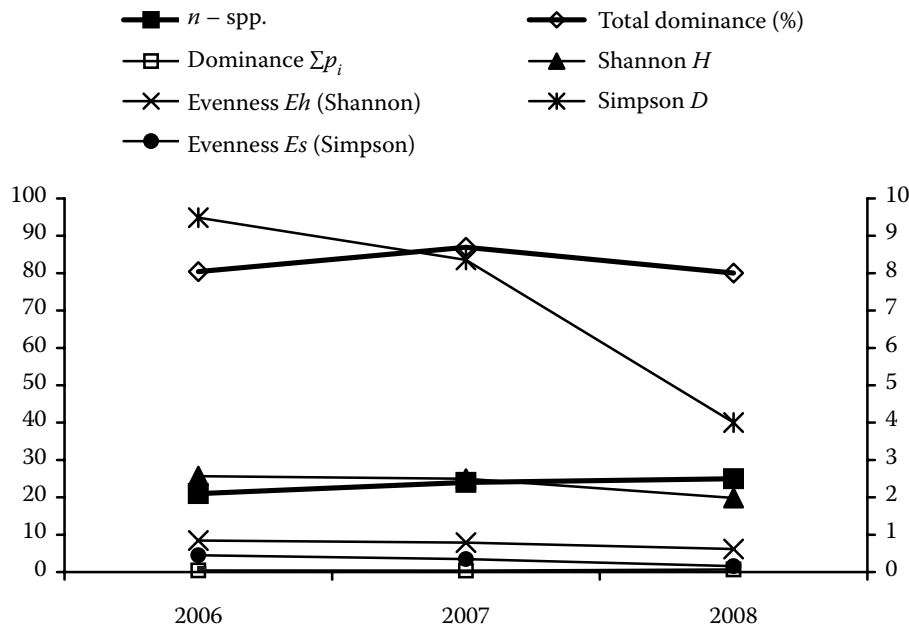


Figure 3. Monitoring of *A. schoenoprasum*, Děčín locality

target species, the chive, was 2a. The value of the Simpson index decreased in 2008, due to differentiation of dominances (Figure 3). The share of *Agrostis stolonifera* is increasing, and the share of dicotyledons is decreasing (probably in connection with nitrification and ruderalization from the mouth of a nearby waste water pipe). It is surely a negative tendency, but surprisingly, not affecting the chive stand.

Astragalus excapus L.

Locality Radobýl

The locality of Radobýl is a protected National Reserve with a stable vegetation cover. While the volcanic summit is heavily trampled by tourists, the steep slopes seem to be conserved. *Astragalus excapus* occurs quite extensively on the rim of the

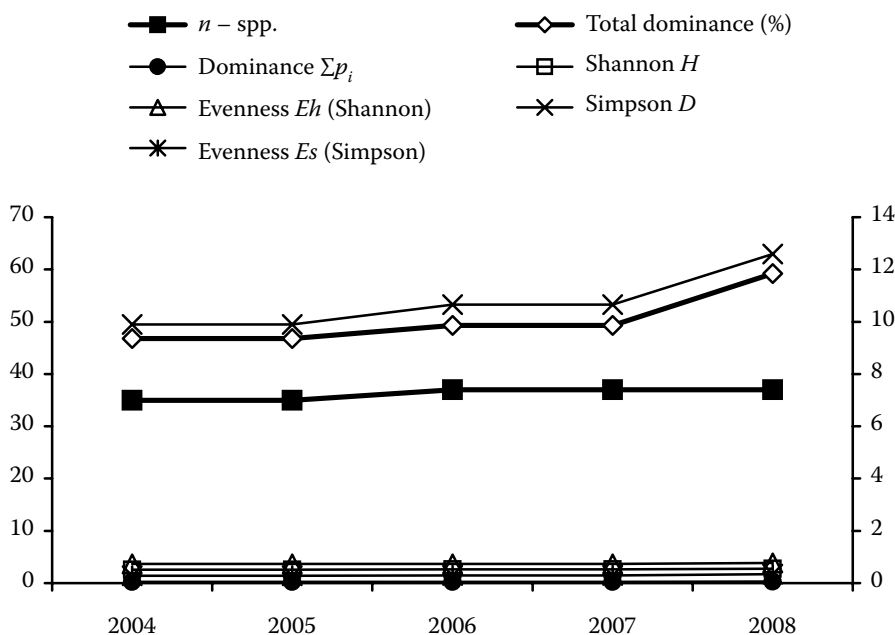


Figure 4. Monitoring of *Astragalus excapus* and *A. onobrychis*, Radobýl locality

basalt quarry (dominance grade 2 m); its population is stable or expanding with plenty of young seedlings. *Astragalus onobrychis* forms larger populations on the stepped slopes (dominance grade 1 on the same plot). The total dominance of the plot is 59%, including stones and an open ground surface with mosaic plant cover. The Shannon index is high (2.77); however, the Simpson index is very high (12.6, Figure 4), because of the presence of many species with the same dominance value.

CONCLUSIONS

While some localities were stable, and no direct threat (except tourist trampling) was found to the target species (Radobýl), other localities were disturbed by human activities (Grado, Václavka), by nitrification (Děčín); or they were seriously damaged (Zbraslav) or permanently lost (Jílovský potok). In the collecting of seeds for the Gene Bank, *ex situ* conservation can serve as a backup for *in situ* conservation. Localities Děčín and Zbraslav should be included into the network of protected reserves for their presence of the agriculturally important species *Allium schoenoprasum* L. The chive population in Zbraslav should be strengthened by repatriation of *Allium schoenoprasum* from original seeds stored in the Gene Bank.

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References

- ANONYMOUS (1992): Regulation No. 395/1992, implementing certain provisions of Act No. 114/1992 of the Czech National Council, on nature and landscape protection. Ministry of the Environment of the Czech Republic, Praha.
- CHYTRÝ M. (2007): Vegetation of the Czech Republic. Vol. 1, Grassland and Heathland Vegetation. Academia, Praha.
- DOSTÁL J. (1989): New Flora of Czechoslovakia. Academia, Praha. (in Czech)
- KELL S.P., KNÜPFER H., JURY S.L., FORD-LLOYD B.V., MAXTED N. (2007): Crops and wild relatives of the Euro-Mediterranean region: making and using a conservation catalogue. In: MAXTED N., FORD-LLOYD B.V., KELL S.P., IRIONDO J.M., DULLOO M.E., TOROK J. (eds): Crop Wild Relative Conservation and Use. CAB International, Wallingford.
- KUBÁT K., HROUDA L., CHRTEK J. Jun., KAPLAN Z., KIRSCHNER J., ŠTĚPÁNEK J. (2002): Key for Determination of the Czech Republic Flora. Academia, Praha. (in Czech)
- MAXTED N., KELL S.P., FORD-LLOYD B. (2007): Crop wild relative conservation and use: establishing the context. In: MAXTED N., DULLOO M.E., FORD-LLOYD B., KELL S.P., IRIONDO J.M. (eds): Crop Wild Relatives Conservation and Use. CAB International, Wallingford.
- MAXTED N., IRIONDO J.M., DULLOO M.E. (2008): Introduction: the integration of PGR conservation with protected area management. In: IRIONDO J.M., MAXTED N., DULLOO M.E. (eds): Conserving Plant Genetic Diversity in Protected Areas: Population Management of Crop Wild Relatives. CABI, Wallingford, 1–22.
- PRACH K. (1994): Monitoring of Vegetation Changes, Methods and Principles. Český ústav ochrany přírody, Praha. (in Czech)
- PROCHÁZKA F. (ed.) (2001): Black and Red List of Vascular Plants of the Czech Republic – 2000. Příroda, Praha, 18: 1–166.
- SLAVÍK B. *et al.* (1988–2004): Flora of the Czech Republic. Vol. I–VII, Academia, Praha. (in Czech).
- ZVÁROVÁ J., MAZURA I. (2002): Biometric Statistics II. Stochastic Genetics. Nakladatelství Karolinum, Praha. (in Czech)