ACTION PLAN FOR THE SPRING GENTIAN (*GENTIANA VERNA L. SUBSP. VERNA*) IN THE CZECH REPUBLIC

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Action Plan Summary for *Gentiana verna* subsp. *verna*

Gentiana verna L., *Sp. Pl.* 228 (1753), subsp. *verna* – Spring Gentian is a plant species protected in the Czech Republic in the critically endangered category and is also listed under the same level of threat in the Red List of the Czech Republic.

The centre of distribution of the species lies in central Europe (especially in the Alps and foothills of the Alps, Northern Apennines, Carpathians), isolated occurrences range as far as the Pyrenees as well as England and western Ireland. It survives in relic habitats north of the Alps. Its occurrence in the Czech Republic lies on the northern boundary of the range. This is probably an opposite migration in both directions: southern (so-called Alpine migration to Bohemia) and eastern (Carpathian course to northern Moravia).

Today's occurrence of the species in the Czech Republic represents but a fragment of the historically documented occurrence in the Czech Republic. Of the indigenous ca. 43 metapopulations throughout the Czech Republic only 3 totally isolated populations have survived:
1. Rovná (NNM), currently the last locality in Bohemia. The plants flower and are fertile (17 flowering stems, 2 developed capsules in 2007), the total number of plants (or polycormones) fluctuates in the long-term to around 20. However the seedlings have not been recorded in recent years and the population is not recovering.
2. Malá kotlina Fold (Jeseníky NNR), a smaller population of *Gentiana verna* subsp. *Verna* (175 flowering stems in 2007, plants in 23 groups)
3. Velká kotlina Fold and vicinity (Jeseníky Protected Landscape Area - PLA), several micropopulations, 47 groups in 2007 ca. 2600 flowering stems counted.

The biotope of the spring gentian is most short-culm loosened biotopes in mineral-rich moist to fresh soils of an alkaline to neutral reaction. This is a heliophilous and hygrophilic species; so slight disturbance of the vegetation and a moist environment are the essential conditions for ecesis and development of the species.

The main causes contributing to the extinction of the population of *Gentiana verna* subsp. *verna* are: destruction of the species' habitat, absence of appropriate management of the localities (disappearance of extensive grazing in the Czech Republic), drainage, application of nitrogen fertiliser and increased nitrogen emissions.

Objectives of the Action Plan

Long-term objectives:

1. Increase the population of lowland forms of *Gentiana verna* subsp. *verna* in the Rovná NNM at least to 200 plants which will be capable of self-reproduction verified for at least a period of 5 years.

2. Extend the area occurrence of the lowland forms of *Gentiana verna* subsp. *verna* in the Rovná NNM by at least 100%.

3. Establish at least three new populations of lowland forms of *Gentiana verna* subsp. *verna*, capable of self-reproduction, verified at least for a period of 5 years.
4. Preserve the existing condition of the population of the mountain form of *Gentiana verna* subsp. *verna* in the Jeseníky PLA.

Medium-term objectives:

1. Ensure suitable conditions for the existence of the *Gentiana verna* subsp. *verna* species in the Rovná NNM.
2. Strengthen the population of *Gentiana verna* subsp. *verna* in the Rovná NNM.
3. Add to the knowledge about the biology and ecology of the *Gentiana verna* subsp. *verna* species and about the potentially related populations within and on the boundaries of the range.
4. Ensure the minimum size of the population of *Gentiana verna* subsp. *verna*, which is capable of existing on its own under the conditions of the habitat.
5. Create a list of localities potentially suitable for the establishment of new populations of the *Gentiana verna* subsp. *verna* species.
6. Better inform people about the importance of protecting the species at regional level.

Main groups of measures

The main management measure proposed in the Action Plan (AP) is extensive grazing (primarily of goats or goats in combination with sheep) together with further interventions – cutting and removal of competing and non-indigenous plants, fallen leaves and waste matter. The modification of hydrological conditions of the Rovná NNM locality (retention of water by damming the drainage channel, especially in the spring season) will increase the probability of the seedlings taking root, improve the moisture conditions during the entire season and will contribute to the enrichment of surface layers of soil with mineral nutrients and basic ions.

The most significant measure for creating or renewing new localities of the species in the Czech Republic is to draw up a list of localities that are potentially suitable for repatriation of the species, and based on this list renew the management of the selected localities and subsequent sowing and planting of *Gentiana verna* subsp. *verna* plants.

It is also proposed strengthening the latest population of the lowland form of *Gentiana verna* subsp. *verna* by sowing and planting using tried and tested methods. *Ex situ* cultivation of the species is proposed for ensuring planting and sowing.

Annual monitoring of all existing populations of *Gentiana verna* subsp. *verna* supplemented by the monitoring of the level of groundwater in the Rovná NNM and regular phytosociological relevés in the Rovná NNM and (in future) also in newly established localities has been proposed in order to secure sufficient information about the condition of the species in the Czech Republic.

Research within the RP focuses on monitoring the success rate of sowing, research of the genotype variability of the species populations and determining of the minimum size of the population which is capable of surviving in the long-term in the conditions of the habitat.

The ZP's education focuses on the intensive promotion of the Rovná NNM locality at regional level.

1. Initial Information for the Implementation of the Action Plan

1.1 Taxonomy

1.1.1 Nomenclature

Gentiana verna L., *Sp. Pl.* 228 (1753), subsp. *verna* – hořec jarní

[syn. *Calathiana verna* (L.) DELARBRE, *Calathiana verna* subsp. *aestiva* (F. W. SCHMIDT) DOSTÁL – hořepníček jarní]

English - Spring Gentian

German - Frühlings Enzian

Note: The origin of the type material is important in order to ascertain which intraspecific taxon this Czech material belongs to. What is clearly stated in the protologue is "*Habitat in alpibus Helvetiae*". Linnaeus did not himself collect the plant and refers to authors of alpine flora. Of these authors two (Haller and Bauhin) had acquired the material from Switzerland. The best candidate for the ecotype is the material in Burser's herbarium (Juel 1936). Burser was an expert in and interpretator of Bauhin's names and according to his herbarium ended up in Uppsala, Linnaeus also interpreted Bauhin's names. If Linnaeus (1753) quotes Bauhin's phrase *Gentiana alpina verna major*, the plant under the appropriate designation in Burser's herbarium in UPS (inaccurately stated their as *Gentianella alpina verna major* in horto) is a clear syntype for the selection of a lecotype (also available on microfiche).

1.1.2 Description

The Spring Gentian is a low-growing, perennial, evergreen herb with an up to 20 cm long roots. Based on a primary rosette numerous thin trailing shoots (up to 50 cm long) form shallowly situated beneath the soil surface and sometimes are branched. Shoots terminate in tiny sterile or fertile secondary foliate rosettes. Once the stem flowers its foliate rosette also dies and the remaining short rhizome again sprouts heads with adventive roots. The leaves are tiny, sessile, elliptical to ovate in shape, with blunt tips. The caulescent stem bears a quinate, azure blue flower, short at first (max. 3 cm), which extends during flowering. Up to 250 tiny seeds normally ripen in a cylindrical capsule.

(For a detailed description see KIRSCHNER et KIRSCHNEROVÁ 2000).

1.1.3 Variability

Outside our territory the species is considerably varied and breaks up into several subspecies. The focal point of this diversity lies in the Mediterranean. GREUTER et al. (1986) list seven subspecies from the Mediterranean and only the subsp. *verna* occurs outside this region.

Only the nominal subspecies grows in the Czech Republic which is still represented in two different ecotypes (forms). Both forms, with the exception of the period of flowering and ecological demands, differ more significantly from each other. The first (mountain form) flowers usually from mid June (even earlier in years with a warmer spring) from July and grows in mountain spring meadows in a subalpine spring area above the forest line (*Cardamino-Montion, Swertio-Anisothecion squarrosi* alliance) in rock communities of cirques *Agrostion alpinae* (avalanche paths) and subalpine Nardus grasslands (*Thesio alpini-Nardetum*). We can no longer find the second (lowland) form already flowering in late April and early May. It grew in lowland fen pastures in moderately disturbed short-culm communities of the *Molinion* alliance or more frequently with the transition to the *Arrhenatherion* alliance.

Although morphological differences cannot be found among the mountain, later, and earlier form, the mountian form (although typified) was described as a separate taxon, subsp. *aestiva* (or even as a separate species). A possible type of the name *Hippion aestivum* Schmidt is an item from Dobrá Voda (St. Gunther) according to the data in sched perhaps collected by F.W. Schmidt himself. However according to Tausch, who saw Schmidt's herbarium when it was still whole, the herbarium item *G. verna* subsp. *verna* certainly comes from the Alps.

Plants from south Bohemia differ considerably from the Jesenik one in the isozymic spectrums. This documents their different migratory origin (new indigenous findings).

1.1.4 Karyology

2n=28 (extra fines)

1.1.5 Hybridisation

Hybrids crossed with other species have not been found. There is not reproductive barrier between the various subspecies or geographically remote genotypes within the species. In view of the fact that Balkan and geographically remote forms are often cultivated as alpine plants, the genetic contamination of these sources cannot be excluded.

1.2. Distribution

1.2.1 Overall distribution

The mountain species has a range encompasses the Alps, Appenines, Carpathians and Balkan Peninsula. Its occurence is known to be isolated in the Pyrenees, western Ireland and England. It is found growing north of the Alps in habitats as a dealpine plant (lowland form). Its range in Bohemia is the northern boundary of the distribution of the species. The occurrence in the Czech Republic follows on from two main central European ranges, the Alpine and Carpathian, and is an example of accommodating migration. Maps: MEUSEL et al. 1978: 353 (Annex 1), HULTÉN et FRIES 1986: 749. Min.: 250 m ASL (Czech Republic, V. Vřešťov), 300 m ASL (West. Ireland, Ballyvaghan, ELKINGTON 1963), max.: 3550 m ASAL (Switzerland, Alps, HEGI 1909). The range encompasses the following countries: Spain and France (Pyrenees and the south-west promontories of the Alps concerns *G. verna* s. str., but literature on this subject differs), England and Ireland, Germany, Austria, Switzerland, Slovenia and Italy (Alps, foothills of the Alps, Appenines), Poland (where it is not considered extinct), Slovakia, Romania, Ukraine (Carpathians), Croatia, Serbia and Montenegro, Macedonia, Bulgaria (Stara Planina), Czech Republic. A separate range lies in northern Russia (in the Arctic region and the Pechora and Pinega Catchment Area); literature now agrees that subarctic plants cannot be earmarked as a separate taxon within *G. verna*. Data from the vicinity of Minsk in Belarus applies to reintroduced plants. The phytogeographic conditions for *G. verna* s. l. in the Balkans are considerably complex and different subspecies can occur locally and sympatrically.

1.2.2 Distribution in the Czech Republic

1.2.2.1 Historical distribution in the Czech Republic

Formerly the Spring Gentian occurred as a dealpine mostly in lower positions of south and central Bohemia, continuously in the region between the Vltava River and Brdy Hills (cf. SLABA et al. 2002) to the districts of Český Krumlov and Karlovy Vary. A more continuous occurrence in Moravia is in the range of around Hrubý Jeseník where the species spreads from Carpathia (mountain form). Elsewhere in Bohemia and Moravia there are only isolated localities (for more detailed information see KIRSCHNER et KIRSCHNEROVÁ 2000). Maps: HENDRYCH 1987, Kirschnerová et Kirschner in PODHAJSKÁ et STRUNZ 1998, Kirschnerová et Kirschner in MLČOCH et al. 1998, KIRSCHNEROVÁ et ALBRECHT 2003. Occurrence at lowest ground above sea level in the Czech Republic was recorded near Velký Vřešťov (250 m), today extinct, while the maximum has been found on the slope of Vysoká hole in Hrubý Jeseník Mt. (1,410 m).

The main causes of the decline of localities was that grazing stopped, the habitats were destroyed, meadows were drained and ploughed and there was a change or absence of management. Once extensive grazing ended, especially such that damaged soils, the possibility of plant germination and maintenance in habitats decreased. The historical distribution and dynamics of the occurrence of the Spring Gentian are illustrated in Annex 2. An overview of all documented occurrences in the Czech Republic is listed in Annex 3.

1.2.2.2 Recent distribution

The present distribution represents a mere small fragment of the former occurrence in our country. There is only one locality of the occurrence of the lowland form of Spring Gentian which has survived in the Rovná NNM in the Strakonice district and two localities of the occurrence of the mountain form of Spring Gentian in the Jeseníky PLA (cf. map: Kirschnerová et Kirschner in PODHAJSKÁ et STRUNZ 1998, see Annex 2).

37f. Strakonické vápence (Strakonice limestone) – in the Rovná NNM

6749b Rovná u Strakonic

The species was found here for the first time in a communal pasture in 1957 (Moravec). The number of plants estimated at the time was 1,000 specimens. Since that time the frequency of the occurrence here is monitored irregularly, however the number of plants has fallen gradually. In 2007 two spaces were found of a total of 27 polycormones growing here. This higher number compared with 2006 probably does not mean a rise in the population, but this was due to the fact that some originally large polycormones broke up into several small ones.

97. Hrubý Jeseník – in the Jeseníky PLA

5969a Velká kotlina Fold and the vicinity

The occurrence here has been known since the mid 19th century however nobody has monitored the numbers of the population here more closely. The numbers dating back to the 1970s and 1980s record several individuals to several hundred plants while more detailed monitoring did not begin until 2005. In 2007 the occurrence of the Spring Gentian was found in several microlocalities in variously numerous groups ranging from several individuals to hundreds of plants totalling about 2,600 plants. The biggest concentration of plants is in the upper part of the locality (the “Formánkova stráň” (Formánek Slope) segment).

5969c Malá kotlina Fold

Occurrence of the Spring Gentian in this locality has been known since the early 20th century (Čoka 1904), and the total population in Malá kotlina is smaller while a more detailed count was not made until 2007 when 175 plants were found. Numbers from earlier years are inaccurate fluctuating from 10 individuals to several hundred (see historical distribution).

1.2.2.3. Distribution trends

The decline of the species began at the turn of the 20th century. About 60 localities were known to exist in our territory whereas in south Bohemia the occurrence of the species was more or less continuous. A further decline in the size and number of the population was recorded in the second half of the 20th century. Today the species is on the verge of extinction. Currently only three localities exist in south Bohemia: one locality in south Bohemia with a residual population and two localities in Hrubý Jeseník; here the frequency of individual populations may fluctuate considerably, however they are stable in the long-term (as far as this can be judged from existing data)

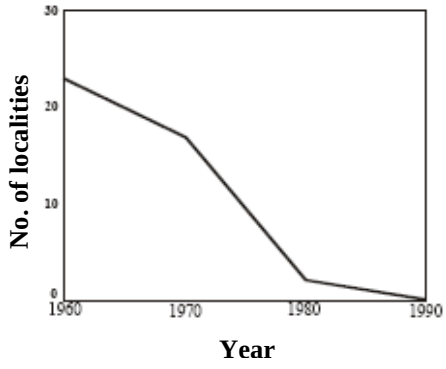

Fig. 1. – A sharp decline of the species localities from the 1960s until the recent past (Münzbergová & Herben, not published, according to SLABA et al. 2002).).

Most of the populations in the Czech Republic have become extinct due to the destruction of habitats, especially the transformation of localities into fields and the change of management, especially the abandonment of grazing. The causes of the disappearance of individual localities, provided they are known, are listed in chapter 1.2.2.1.

In terms of total distribution this resulted in a distinct decline of the species in Europe in the peripheral part of the original range.

1.2.2.3.1 Trends in the abundance of the population of lowland forms of Spring Gentian in the locality of the Rovná NNM

The occurrence of the species here was discovered by J. Moravec at the end of the 1950s. The number was estimated at 500 to 1,000 flowering plants in an area of about 35 ares. According to the data in the reserve book (ALBRECHT 1984) 500 flowering plants were still recorded in 1981 by V. Žíla, however despite a ban, recurring damage to the biotope resulted due to considerable use of artificial fertilisers. Since the time when protection was declared and in view of socio-economic changes in the municipality, the intensity of grazing fell rapidly until grazing was stopped entirely and grass was cut regularly once a year. This led to the development of grasses and the gradual further decline of the Spring Gentian.

The places with remaining growth of gentians were demarcated into two areas (see Annex 3), cut by hand and the growth of the population was trial enhanced by the distribution of seeds. However the condition of the residual population in the first half of the 1990s did not exceed 10 caulescent stems.

In 1997 only two flowering plants were found growing in the locality which disappeared in the following year. New individuals of Spring Gentian were discovered in the following year in the area and an action plan for the rescue of the species was launched.

In 1998 monitoring areas were established in the place of occurrence of *G.*verna* in which grazing was replaced by tilling and disturbance of the turf. In the years to follow the number of plants gradually increased five-fold as compared with previous years and the number of caulescent stems increased sixteen times. During the four-year experiment the number and vitality of the individuals rose. Experimental interventions replaced the missing traditional method of management. Since 1999 regulated horse grazing in combination with cutting was gradually introduced in the Rovná NNM. Unfortunately grazing has not been secured since 2002. Detailed information about the population can be found in Annexes 4 and 5.

Changes in the frequency during the experimental interventions are shown in Tab. 1 and Fig. 2.

TABLE 1: TREND OF OCCURRENCE OF GENTIANA VERNA L. SUBSP VERNA IN THE ROVNÁ NNM UP TO 2007

years	**No.of flowers**	**No. of polycormones**	**Interventions in the locality and management**
1959	500-1000*	no record	grazing
1981	500*	no record	decline of grazing/disturbed by artificial fertilisation
1984	75*	no record	cutting
1990-1995	5-10	no record	cutting
1997	5	1	cutting
1998	4	2	cutting + turf disturbance
1999	20	3	cutting + turf disturbance
2000	31	7	horse grazing around the areas, cutting + turf disturbance
2001	46	9	horse grazing around the areas, cutting + turf disturbance
2002	63	10	cutting + turf disturbance
2003	50	no record	cutting
2004	27	7	cutting
2005	15	15	cutting + turf disturbance

Note 1: *) It is not entirely clear from the historical documents what was recorded – whether the flowers or polycormones;

The unit “number of flowers” was allocated to the historical data for illustrative purposes, which, according to the authors, is a lesser error than using polycormones.

Note 2: All data about the number of flowers and groups of flowers apply only to natural occurrences of *G. *verna* besides data from 2005 when the number includes the planting from the seeds of 2003. Three plants were cultivated from seeds of plants from the Rovná NNM, and all three plants survived until 2005, of which 1 plant flowered in that year (1 flower, see monitoring square G). A capsule did not form.

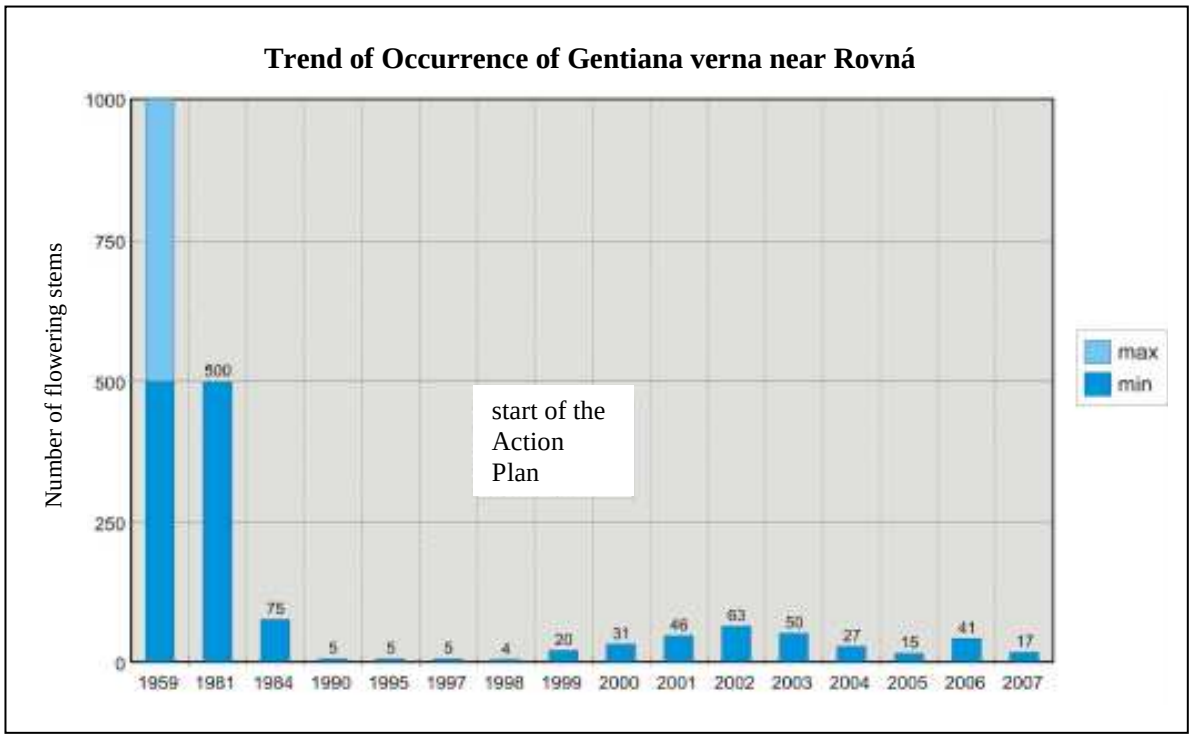

Fig. 2. – The results of the monitoring of changes in the vitality of the population *Gentiana verna* subsp. *verna* in the Rovná NNM. Before 1981 the locality was used for grazing; in 1981 the population was damaged by artificial fertilisers. In years 1998-2003 and 2005 there were experimental interventions in supporting the growth of the Spring Gentian in the locality.

1.2.2.3.2 Trends in the abundance of the population of the mountainous form of the Spring Gentian in the localities of Malá kotlina Fold and Velká kotlina Fold in the Praděd NNR

In Hrubý Jeseník there was no detailed monitoring of individual populations there is no accurate data available up to 2005 when a count was made of the size of the populations and their measurement. Four flowering plants were last observed in 1999 on the slope below Petrovy kameny, right next to the water tank of the Ovčárna chalet. The size of the populations in both folds fluctuate year on year and the most abundant population of Spring Gentian is at "Hořcový potok" in Velká kotlina (slope of Vysoká hole) where about 1800 plants flowered in 2005, 2006 and 2007 (for more detail see Annexes 10 to 13)

1.3 Biology and Ecology of the Species

1.3.1 Life cycle, phenology, life form and strategy

Life cycle: the plant is a perennial, its seeds require stratification. In the first year a sterile rosette of leaves appears and then flowers in the second year, and after the seeds ripen the caulescent rosette disappears, but further ones grow from an underground rhizome. This vegetative method allows the cloning of "colonies" and the plant can flourish in one habitat for several years.
Phenology: the mountain form flowers mostly from mid June (exceptionally from the end of May) to mid July, the capsules ripen at the end of July and in August. The lowland form flowers usually at the end of April until mid May, the capsules ripen in the second half of June and In July.
Life form: Hemicryptophyte (Hkf). Herbal chamaephyte (Chf, ELLENBERG et al. 2001).
Entire plants hibernate.
Strategy: Strong adaptation to disturbance will allow it to successfully compete with other plants;
r- strategy. It is tolerant to frost and probably to short-term flooding.

1.3.2 Generative reproduction

Plants grown from seeds normally flower in the second year. The method of reproduction was studies in Bulgarian populations (KOZHUHAROVA et ANCHEV 2002). Their research shows that the plant uses a sexual and asexual method of reproduction. Allogamy (cross-pollination) is prevalent in the plants. However in certain cases there may be autogamy by self-pollination), if the stigmas and anthers ripen together and the anthers and stigmas are at the same altitude (or the anthers are even higher); moreover the plants are capable of receiving their own pollen (are self-compatible). The reproduction depends on the variability of the flower morphology and behaviour of the pollinators.
Pollination by insects was observed at a locality in Teesdale (Great Britain) where the flowers were visited by bees. In the Rovná NNM the probable pollinator observed was the Budd-tailed Bumblebee or Large Earth Bumblebee, *Bombus terrestris* (A. Pavlíčko, written report). In both cases this is probably only a random visit because the sting of bees and bumblebees is too short and does not reach the bottom of the corolla trumpet to the nectar (KOZHUHAROVA et ANCHEV 2002). According to entomologists, possible pollinators in the Rovná NNM may also be members of two-winged insects (MÁCA 1999). At mountain altitudes pollinators could be butterflies (*Lepidoptera*) and hoverflies of flowerflies (*Syrphidae*).

The share of entomogamy and autogamy has not been studied at our localities.

The success of creating seeds is considerably dependent on the weather during flowering which is relatively short, about 2 weeks. Up to 250 tiny seeds ripen in a well-developed capsule (ELKINGTON 1963). The production of seeds in the Rovná NNM changes in individual vegetative seasons. The average number of developed seeds in the capsule in years 1999-2002 is constantly falling. In the Rovná NNM reduced genetic variability was discovered for the residual population of *G. verna* (KIRSCHNEROVÁ et PLAČKOVÁ 2005). The narrowing genetic base of the population is being shown in signs of inbreeding depression, e.g. the decrease in the number of seeds in a capsule.

TABLE 2: AVERAGE PRODUCTION OF *GENTIANA VERNA* SUBSP. *VERNA* SEEDS IN THE LOCALITY OF ROVNÁ U STRAKONIC IN YEARS 1999-2002 (MORAVCOVÁ 2002).

Collection year	1999	2000	2001	2002
Average number of well-developed seeds per one capsule	144.8	83.9	74.33	49.13

Number of seeds from capsules acquired in 2005 at the Vysoká hole locality - Hořcový potok ranges from 70 seeds to 120 (from 5 collected capsules). The capsules began to open in early September, evidently due to low summer temperatures, the capsules were mouldy and some evidently did not even open.

1.3.3 Biology of germination and ecesis

After pollination, the stem during the ripening of the capsule extends from 3 cm to about 8-13 cm in height. The ripened capsule remains erect, it opens at the top and by swaying in the wind or by touch the seeds are gradually released and often remain near the mother plant.

The seeds germinate only after stratification. Light and changing temperature have the strongest effect on germination. Seeds germinated less in a constant temperature. Most seeds germinated after six-month cool stratification (1-4 °C) in light at a changing temperature of 22 and 5 °C.

The life-cycle of seeds is short. Overall there is a relatively low percent of the emergence of seedlings *Gentiana verna* subsp. *verna*. Some 8-32% of seedlings from seeds sown in the autumn emerged in the first year and 4-12% of seedlings in the second year in the spring. In the third year no further seedlings emerged in the tested land lot (MORAVCOVÁ 2002).

The condition for germination in the locality is an open space with sufficient moisture. Moisture, soil conditions and disturbance of vegetative cover effect the further development of seedlings. The plants are too weak to compete with other plants.

1.3.4 Vegetative reproduction

The vegetative reproduction is possible due to the good regenerative abilities. In the first year the plant forms a thin rhizome in the rhizosphere which can be several centimetres long. Further rosettes of leaves grow from it on the surface. Often, especially in lowlands, colonies appear (ELKINGTON 1963) of one or more genotypes in view of the fact that the seeds often germinate close to the mother plant (e.g. Rovná, KIRSCHNEROVÁ et PLAČKOVÁ 2005). Vegetative reproduction allows plants to survive on a locality for several years.

1.3.5 Ecological requirements

This is a heliophilous species. The seeds germinate in the light (NIKOLAJEVA et al. 1985) and individuals do not tolerate the compact participation of vegetation.

Tolerance at low temperatures: the species is resistant to frost and it photosynthesises during the winter season.

Critical conditions arise during drought and a hot summer when seedlings usually dry up (cf. MORAVCOVÁ 2002) or in a cool and damp summer when the capsules are not able to open due to mould (KAVALCOVÁ 2005).

Tolerance can be expected to the changing or constantly waterlogged rhizosphere or flooding (e.g. snow beds, meadows flooded in the past), but this precondition has not been studied in detail as yet.

It grows in mineral-rich, changing to constantly moist to freshly moist soils with an alkaline to natural (reaction (cf. table 3.).

TABLE 3: ANALYSIS OF SOIL SAMPLES THE ROVNÁ NNM

sample	pH[H_2O]	pH[KCl]	Ca	Mg	K	Na
25.3.1998			mg/100g	mg/100g	mg/100g	mg/100g
I	7,52	6,90	991,00	21,71	12,97	22,70
II	7,40	6,73	823,83	23,64	12,08	22,42
III	7,52	6,95	1052,73	22,42	15,35	20,89
IV	7,70	7,12	1448,75	49,95	20,05	18,02
V	7,60	7,10	1397,53	40,31	14,95	15,23
VI	7,58	7,03	1406,88	50,41	17,85	24,23
VII	7,68	7,05	1329,93	46,32	12,37	16,01
VIII	7,65	7,03	1349,23	48,46	18,11	20,23

sample	C	N	CN	NO3	NH4	P	SO4
25.3.1998	[%]	[%]		[µg/g]	[µg/g]	[µg/g]	[µg/g]
I	6,025	0,598	10,08	33,63	15,671	8,904	27,47
II	5,770	0,571	10,11	22,77	17,084	7,260	25,30
III	6,315	0,612	10,32	21,30	15,065	8,108	24,70
IV	8,335	0,694	12,01	39,90	16,088	11,661	41,33
V	6,455	0,544	11,87	30,03	13,163	6,942	29,23
VI	8,314	0,748	11,11	29,03	14,639	13,729	122,67
VII	6,696	0,582	11,51	23,77	16,323	6,968	44,63
VIII	6,905	0,656	10,53	31,53	15,137	10,203	51,50

Note: The places of soil sampling are marked in Annex 8 in small letters: sample I - b, sample II - a, sample III - c, sample IV - d, sample V - e, sample VI - f, sample VII - g, sample VIII - h.

1.3.6 Biotic factors

Arbuscular mycorrhizal symbiosis (ABM) – is an association of individuals of *G. v.* subsp. *Verna* with other green plants with the help of hypha in the rhizosphere allowing their specific interaction (SÝKOROVÁ, RYDLOVÁ et VOSÁTKA 2003).

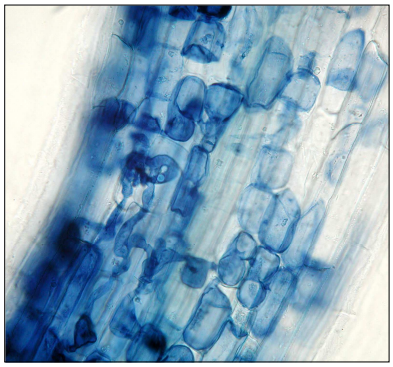

Fig. 3. – Mycorrhizal colonisation of roots of *Gentiana v. subsp.* verna cultivated in a compartment with hypha of the *Arrhenatherum elatius*. Enlarged. (SÝKOROVÁ 2002).

By ABM the delicate plants of *G. verna* are supplied (especially during critical periods of drought, etc.) with water and nutrients even from considerably remote places because the hypha can be up to several tens of metres long.

1.3.7 Link to communities

The lowland ecotype is linked to fen pasture in slightly disturbed short-culm communities of the alliance *Molinion*, or *Caricion davallianae,* or the transition between the alliances *Molinion* and *Arrhenatherion (*Annex 6). In Germany it used to grow in hilly country meadows – and the focal point of the occurrence in poor short-culm meadows entering cut spurrey-free meadows (STEIN 1999). Phytosociological relevés taken in 1998 and 2002 in the Rovná NNM are found in Annex 9.

The mountain ecotype in the Czech Republic grows in subalpine spring areas above the tree line incommunities of the alliance *Swertio-Anisothecion squarrosi* and the alliance *Cardamino-Montion*, in bare slope soils (avalanche paths) in substrates with basic rock veins in folds in Hrubý Jeseník in communities of *Agrostion al pinae*, in subalpine Nardus grasslands of the alliance *Nardion (Thesioalpini-Nardetum).*

In the central Alps it grows in communities of *Seslerion caeruleae*, in the Slovak Carpathians it is surprisingly mentioned in communities of the alliance *Mesobromion*, otherwise in the order *Seslerietalia calcariae*. It is known from the association of *Caricetum sempervirentis* in the eastern Carpathians growing with *Sesleria coerulans*.

1.4 Causes of Threat to the Species

Most causes of threat apply to the lowland ecotype of the species. The localities of the mountain ecotype are affected only by the excessive intake of nitrogen emissions or by the direct destruction of habitats.

Destruction of habitats

A number of lowland and sub-mountain localities disappeared due to the removal of the biotype by ploughing. For example, the localities in the area of Džbán (near Ročov), in the Karlovy Vary district (Tašovice) and Podbrdy area (Malčice, Cerhonice) were turned into fields.

Absence of appropriate management (farming) of localities

At all originally managed (farmed) localities the stopping of grazing or cutting led to negative changes in vegetative, chemical and light conditions of the Spring Gentian's habitat. The end of extensive grazing which had led to local disturbance of the soils meant a decrease in the possibility of plants germinating and remaining in their habitats. The subsequent changes accompanied by the appearance of more vigorous and expansive species meant a further threat to the populations of the Spring Gentian.

Drainage of localities

Drainage by surface grooves was used in the past to utilise spring and alternating moist habitats and allow small grazing. This sensitive method of drainage was totally abandoned in the second half of the 20th century by farmers. The drying up of localities as a result of spatial drainage and the related decline of the level of groundwaters is one of the most serious causes of the threat to the species.

Application of artificial fertilisers

The repeat (prohibited) application of artificial fertilisers in the Rovná locality in the early 1980s and the end of grazing resulted in the dramatic decline of the species (of the original ca. 500 detected caulescent stems in 1981 to the last two flowering plants in 1997).

Excessive input of nitrogen emissions

The excessive input of nitrogen emissions in the localities is threatening the species just as the direct application of artificial fertilisers. The increased quantity of nitrates in the soil results in the enormous formation of biomass and therefore the tiny weak species of *G. verna** is giving way to competitively stronger species.

Fallen leaves from hybrid poplars

The specific threatening factor in the Rovná NNM is the planting of hybrid poplars on the boundary of this protected area. Poplar leaves cover the surface of the soil in the autumn and the spaces where the Spring Gentian grows. The leaves decay badly and if they are not removed on time, they prevent the germination and growth of seedlings as well as altering the chemism of the soil (the decaying biomass acidifies the top layer of the soil).

Damage to plants by rodents

Recurring damage to spaces where the Spring Gentian is found in the Rovná NNM was also discovered caused by moles and direct damage of some emerged plants by rodents. However it is not possible to prevent this negative impact by animals.

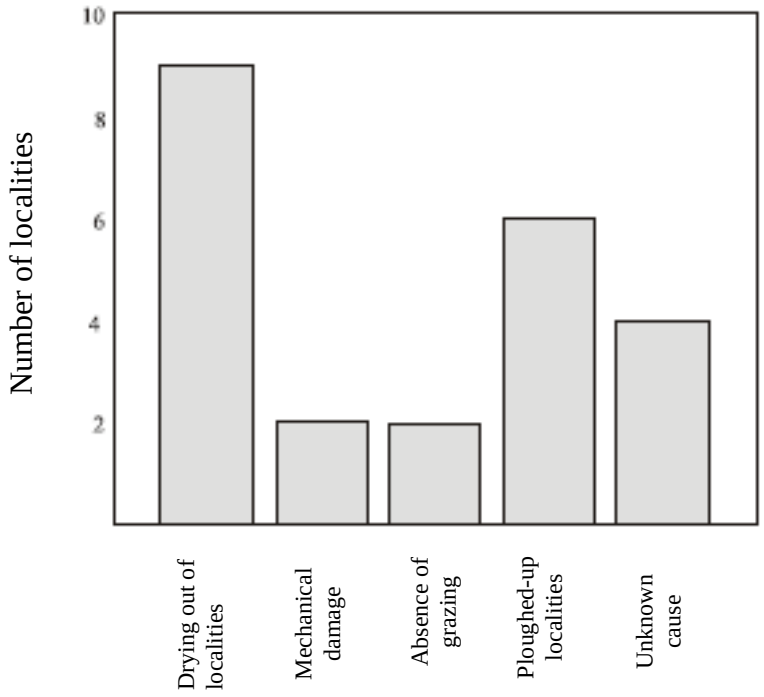

Fig. 4. – Causes of the disappearance of localities of the species in south Bohemia (Münzbergová et Herben, not published, according to SLABA et al. 2002).).

1.5 Status of Protection

1.5.1 Status of protection at international level

The species is not found in the IUCN Red List and is not the subject of any international treaties.

1.5.2. Legislative aspects of protection of the species in the Czech Republic

In accordance with the provision of Section 48 of the Czech National Council Act No. 114/1992 Coll., on Nature and Landscape Protection, as amended, the Ministry of Environment has declared by Regulation No. 395/1992 Coll. the Spring Gentian to be a specially protected species of plant and has included it in the category of a critically endangered species.
Under the Red List of Vacular Plants of the Czech Republic (Procházka et al. 2001) the Spring Gentian is one of the critically endangered species of plants.

1.5.3 Status of protection in other countries with recent occurrence of the species

The species is fast disappearing on the peripheries of the range – according to the Red Lists and similar documents (commented atlases of distribution, etc.) the Spring Gentian is considered to be an extinct species in Poland (ZAJĄC A. et ZAJĄC M. 2001), it is critically endangered in Bulgaria and in Great Britain and is endangered in Slovakia. It survives in the centre of the range (the Alpine region) in high-mountain regions, but is in decline for example in Germany (ROTHMALER 2005), in Austria it is listed as a regionally endangered species to a various extent in various regions (NICKELFELD 1999).

1.6 Existing Measures for the Protection of the Species

1.6.1 Non-specific protection

1.6.1.1 Non-specific protection of the species abroad

Detailed data about measures abroad are not available with the exception of Great Britain, where the occurrence of *G. verna* is monitored at the only 2 localities and the localities are grazed, BRADSHAW 1981. However at these localities the grazing is too intensive and the situation is entirely different than in the Czech Republic.

1.6.1.2 Non-specific protection of the species in the Czech Republic

Rovná NNM

Measures for the rescue of the lowland ecotype of *G. verna* subsp. *verna* (Rovná NNM) rightfully differ from the measures for the population in the Jeseníky PLA.

The biotope in the Rovná NNM continues to survive and plays host to a number of further endangered and protected species: *Carex distans* (Bristly Oak Fern, C2), *C. disticha* (Two-ranked Hedge, C4), *C. hartmanii* (Club Hedge, C3), *Centaurium pulchellum* (Branched Centaury, C2), *Dactylorhiza majalis* (Western Marsh Orchid, C3/ protected in the endangered category), *Gentianopsis ciliata* (Fringed Gentian, C3), *Ophioglossum vulgatum* (Southern Adderstongue, C2/ protected in the endangered category), *Taraxacum* sect. *Palustria* (5 species of Marsh Dandelion, C1,2) protected in the endangered category: *T. bavaricum, T. indigenum, T. madidum, T. paucilobum, T. intermedium* agg. and *T. pauckertianum*, *Valeriana dioica* (Marsh Valerian, C4). *Gentiana verna* subsp. *verna* is the main subject of the protection of the Rovná NNM. The occurrence of the species in the Rovná locality has been known since the 1950s. The area was used formerly as communal pasture for cattle and water fowl, partly as a football pitch (MORAVEC 1959). Since 1972 the locality has been a specially protected territory, today in the NNM category. This method of land management by grazing was to have been preserved after Rovná was declared a specially protected territory however the intensity of grazing decreased and stopped entirely. Gradually the mechanised form of cutting was adopted on a regular basis once to twice a year. The further timetable of management was not enforced until after the approval of the plan for the management of the Rovná NNM applicable for the period of 2000 – 2009 (ALBRECHT 2000, Annex 16):

a) 2000–2001: The locality in the vicinity of the occurrence of the species was extensively used for grazing a group of four horses at various degree of intensity for 2 years. Grazing began every time in June after the ripening of the achenes of *Taraxacum* sect. *Palustria*. The areas not grazed were cut.

b) 2002–2007: Grazing could not be ensured and the locality was cut (twice a year, the first cutting after the ripening of the achenes of *T.* sect. *Palustria*).

c) 2005: In the spring the surface of vegetative cover was disturbed by the pulling of gates (PALOUDOVÁ written report)

d) 2000–2007: The fallen poplar leaves were raked up and removed (every year).

e) 2007: Hybrid poplars were felled in the north-western part of the Rovná NNM

The ANCLP CR – České Budějovice centre – was in charge of the management of the Rovná NNM until 2003 and from 2004 the ANCLP CR – the Administration of the Blanský les PLA. The hitherto results of the Action Plan for the rescue of the species is summed up in the work of KIRSCHNEROVÁ et ALBRECHT (2003). The results were presented at an international working seminar in the form of a poster.

Based on the results of the first stage of the review of the Specially Protected Territory (SPT) of national categories, the adjustment of the boundaries of the Rovná NNM is proposed by incorporating the entire land lot number 461/7 into the SPT.

Praděd NNR

All existing localities of the Spring Gentian (mountain form) in Hrubý Jeseník lie in the Praděd NNR. According to the plan for the management of the Praděd NNR for the period of 2006 - 2015 (KAVALCOVÁ, KAVALEC et CHLAPEK 2005, Annex 17) its long-term and constant objectives is the active renewal of the non-forest biotope of the NNR. Of the already implemented management interventions the greatest importance for this renewal and the preservation of the endangered species of non-forest biotopes is the removal of the Green Alder and experimental cutting.

1.6.2 Specific protection

1.6.2.1 Measures implemented abroad

These are not known.

1.6.2.2 Measures implemented in the Czech Republic

Measures in the locality

Rovná NNM

a) Areas I and II with the occurrence of the gentian were hand cut three times a year (already begun before 2000).
b) 1998-2003, 2005-7: In the monitoring squares within areas I and II the vegetative cover was disturbed 3(-4) times a year (except in 2004) by the raking and slight removal of the top soil layer. The uncovered patches were an average of 10 cm^2 in size (with the exception of monitoring area G).
c) 1988-2007: In a period of drought the plants were watered.
d) 1999: Some 29 plants were repatriated, *in vitro* propagated on both marked areas. This method was chosen because no seeds ripened in 1997 at the locality and the species was in danger of dying out. Plants survived in the locality for a maximum of 5 years, see further. For documentation on the cultivated plants and plantings see Annexes 6 and 7.
e) 2003: Three plants were repatriated that had been grown from seeds of 2000 and cultivated in the experimental garden at the Institute of Botany in Průhonice (area I, monit. square G). These plants were in good condition in 2005: 1 specimen flowered, 2 remained sterile, however they did not spread significantly in growth (see Annex 5).
f) 1998-2005: Seeds were sown from indigenous plants on naked areas near the mother plants, always in the autumn or winter. Seeds sown on a naked area 1×1 m, or 10 × 10 cm (1999 and 2000) did not see the emergence of adult plants.

They either did not germinate or the seedlings dried up in an area that was too exposed. In other years the sowing of seeds was spontaneous in loosened growth or in places of molehills and was not recorded in more detail.

Praděd NNR

The specific management of the Jeseník populations of Spring Gentian was not proposed in the plan for the management of the Praděd NNR and so far there has been none. It was only the numbers that were monitored and the individual populations measured and drawn into the maps.

Cultivation and the gene bank

Rovná NNM

Plants from the Rovná NNM have been cultivated and reproduced by micropropagation in the Jílovitě-Strnady Forestry and Game Management Research Institute (FGMRI) since 1998 (MALÁ, BYLINSKÝ et KIRSCHNEROVÁ 2001). The plants were used for further study (SÝKOROVÁ, RYDLOVÁ et VOSÁTKA 2003). Some 29 plants were repatriated in 1998. Part of the plants was inoculated before planting with arbuscular fungi. The inoculated plants were more vigorous (SÝKOROVÁ 2002).

The plants were cultivated from the seeds at the Institute of Botany of the AC CR in Průhonice, and thegermination and development of the seedlings was studied which were replanted in the original locality (MORAVCOVÁ 2002).

Seeds are not stored in the gene bank due to low production.

Five plants were left in the gene fund explant bank at the Jílovitě- Strnady FGMRI (MALÁ, BYLINSKÝ et KIRSCHNEROVÁ 2001).

Praděd NNR

On 28 August 1997 180 seeds were collected from Malá kotlina and 250 seeds from Velká kotlina. The germination test showed limited germination, some seeds did not germinate even after cold stratification. A positive reaction to the application of GA3 (gibberellic acid) was found in a specimen from Malá kotlina where 30% germination was achieved (Situation as at 22 March 2001, David Cigánek, verbal report). No germination was carried out on the specimen from Velká kotlina. Seeds from the Jeseník populations were stored in the gene bank of endangered species in Olomouc.

Note: An exemption was granted by the Ministry of Environment in 1998 under ref. no. 1916/98-OOP/785/98 from the protective conditions of the specially protected species of *Gentiana verna* (*Calathiana verna*).

An exemption from the protective conditions for *G. verna* – collection of seeds and cultivation up to 2012 (for the Institute of Botany) ref. 389/BL/07 of 13.03.2007.

2. ACTION PLAN OBJECTIVES

The main object of the Action Plan is to preserve the lowland and mountain form of *Gentiana verna* subsp. *verna* as growing wildly in the Czech Republic. This plan should be achieved if the following objectives are met:

Long-term objectives

1. Increase the populations of lowland forms of *Gentiana verna* subsp. *verna* in the Rovná NNM at least to 200 plants which will be able to self-reproduce, checked at least for a period of 5 years.
2. Extend the area of occurrence of the lowland form of *Gentiana verna* subsp. *verna* in the Rovná NNM by at least 100%.
3. Establish at least three new populations of the lowland form of *Gentiana verna* subsp. *verna*, able to self-reproduce, checked at least for a period of 5 years.
4. Preserve the existing conditions of the populations of mountain forms of *Gentiana verna* subsp. *verna* in the Jeseníky PLA.

Medium-term objectives

The following objectives have been determined for the period of the first decades after the adoption of the Action Plan:

1. Ensure suitable conditions for the existence of the species *Gentiana verna* subsp. *verna* in the Rovná NNM.
2. Strengthen the population of *Gentiana verna* subsp. *verna* in the Rovná NNM.
3. Add to the knowledge about the biology and ecology of the species *Gentiana verna* subsp. *verna* and about the potentially related populations inside and on the boundaries of the range.
5. Ensure a minimum size of the population of *Gentiana verna* subsp. *verna* which is able to exist independently in the conditions of the habitat.
6. Create a list of localities potentially suitable for establishing new populations of the species *Gentiana verna* subsp. *verna*.
7. Improve public information about the importance of protecting the species at regional level.

3. SCHEDULE OF MEASURES UNDER THE ACTION PLAN

3.1 Biotope Management

3.1.1 Extensive grazing

Motivation

Extensive grazing (primarily goat or in combination with goats and sheep) is a more appropriate type of management of the Spring Gentian localities. However not even one locality was used for grazing. All other methods of management are alternative or temporary. Grazing leads to selective and continuous removal of the biomass, creation of open spaces for the germination and trapping of seedlings of *Gentiana verna* subsp. *verna*. Competing herbs are therefore restricted in growth in favour of the Spring Gentian.

Measure contents

Introduce the extensive grazing of goats (or a combination of goats and sheep) of the entire area of the Rovná NNM, as yet with the exception of enclosures where gentians grow. Introduce strictly regulated grazing in these areas (direct supervision of grazing animals) only after the condition of the population improves. Before the introduction of extensive grazing in the locality of the Rovná NNM fixed fencing needs to be reinstalled which will protect the plants against direct damage from grazing animals or further areas will need to be fenced off.

The introduction of extensive grazing of selected areas (outside the Velká kotlina amphitheatre) in the Jeseníky PLA is proposed according to the approved management plan over a period of 10 years.

3.1.2 Cutting

Motivation

An alternative method of biotope management at a time when grazing cannot be ensured, and also an addition to grazing on less or temporarily non-grazed areas.

Measure contents

Cutting is proposed twice a year, the first cutting after the gentian's seeds ripen. Only hand cutting accompanied by more considerate interventions is proposed in close vicinity to individual gentian plants (with the exception of the plant *G.*verna* without mowing) in order to prevent possible damage. Perform this throughout the area of the Rovná NNM (until the start of grazing when a system will be established in combination with grazing).

It is being considered to begin cutting in selected areas in Velká and Malé kotlina in the Jeseníky PLA (Cimrmanova zahrádka) once every two years.

3.1.3 Elimination of competing plants and disturbance of the turf

Motivation

The removal of competing plants and disturbance of soil in close vicinity to gentians allows individual gentian clusters to spread in growth, seeds to fall on open space and their successful germination.

Measure contents

Open space of 10 x 10 cm to be created close to individual gentian plants every year in the spring before the seeding of gentians so the existing plants and seedlings are not damaged. This is to be carried out in the Rovná NNM.

3.1.4 Removal of redundant biomass

Motivation

Fallen leaves and waste matter prevents the germination and growth of the Spring Gentian. Their removal is management additional to cutting and grazing. Besides the removal of excessive biomass this results in the disturbance of turf.

Measure contents

The leaves and waste matter need to be removed by raking in the Rovná NNM locality. The work must be carried out in such a way to prevent damage to the gentian plants.

3.1.5 Improvement of the locality's water regime

Motivation

The overall drying out of the biotope in the Rovná NNM is taking place which was supported in the past by the building of drainage channels on the NE and SW boundary of the protected area. A lack of precipitation has contributed to drying out in the last few years. The effect of drying out is having a negative impact on the fertility and vitality of individual plants.

Measure contents

There is the recurring damming of the drainage ditch which runs along the northern boundary of the Rovná NNM. The rising level of groundwater during its fall (ascertained by the monitoring of the level of groundwater, see 3.3.2) is important especially in the spring during the period of germination and intensive growth of the Spring Gentian plants. Moreover, the individual Spring Gentian plants must be watered during the dry spring and summer months.

3.1.6 Removal of non-indigenous and expansive species

Motivation

The shading of localities, spread of the growth of invasive species and fall of leaves and pine needles inhibit the germination and growth of Spring Gentian plants which is heliophilous and a competitively weak species.

Measure contents

The felling of hybrid poplars in the Rovná NNM and their replacement by suitable autochthonous woody plants. The removal of the growth of expanding Wood Small-Reed in the Rovná NNM. The cutting out of non-indigenous Dwarf Pine and invasive Green Alder throughout the entire localities of Malá and Velká kotlina in the Jeseníky PLA.

The continuous removal of the further natural seeding from all localities.

3.1.7 Restoration of the localities selected for repatriation of the species

Motivation

The renewal of the biotopes of the Spring Gentian in these localities must precede the repatriation of the species by planting and sowing in localities selected from the list of localities potentially suitable for the repatriation of the species (see 3.6.1).

Measure contents

To renew an adequate area of suitable Spring Gentian biotopes and ensure their long-term management before and after species repatriation. Localities will be selected based on the output of measure 3.6.1. List of localities potentially suitable for repatriation of the species.

3.2 Species Management

3.2.1 *Ex situ* cultivation

Motivation

The only population of the lowland form of *G. *verna* in the Rovná NNM is small and with a low success rate of self-reproduction. This fact is one of the main causes of the threat to the lowland form of the species in this country. Hence, the population in the Rovná NNM must be strengthened by sowing and planting of plants. The sowing and planting and of plants will also establish further populations of *G. verna* subsp. *verna* (see 3.2.3, 3.2.4, 3.6.1). Therefore plants for sowing and planting will be obtained by cultivation in a culture.

Measure contents

Propagation of at least 150 - 200 plants of *Gentiana verna* subsp. *verna* taken from the Rovná NNM locality.
Currently artificial propagation of a greater number of individuals of *Gentiana verna* subsp. *verna* in the explant bank at the Jíloviště-Strnady FGMRI appears to be a necessary step for the Rovná locality (MALÁ et al. 2001). The genotypes of *in vitro* cultivated plants will be controlled by isozymic analysis (see 3.4.2).
Plants will be propagated from seeds (generative reproduction) according to the number of seeds which will be obtained from plants in the Rovná locality. The propagation method will be worked out at the Institute of Botany of the AS CR. The number of newly obtained plants using this method cannot be estimated at the present time.
Plants will not be cultivated at all for the localities of Malá and Velká kotlina in the Jeseníky PLA.

3.2.2 Sowing seeds

Motivation

The only residual population of the lowland form of *G. *verna* in the Rovná NNM has a low success rate of self-reproduction. Hence its reproduction will be supported by the sowing of seeds on a specially treated space where the success rate of germination and growth is higher.

This method will also be applied for establishing new populations of *G. *verna* in localities selected from the list of localities potentially suitable for repatriation of the species (see 3.6.1).

In the Praděd NNR sowing will be carried out experimentally as part of the study of the method of reproduction and reproductive ecology (see 3.4.1). In case of the success of sowing, the plants will be left at the locality and new populations of Spring Gentian will be established.

Measure contents

The seeds of Spring Gentian will be sown on a space devoid of vegetation of about 15 × 15 cm in size.
In the Rovná NNM seeds for sowing will be obtained from *ex situ* and collection in the locality.
Seeds will be removed as a max. from 30% of ovaries by random collection from flowering plants in the Rovná locality for sowing, the rest will be left to natural dissemination.

Seeds obtained by *ex situ* cultivation together with seeds collected at the Rovná locality will be sown on newly established localities of the lowland form of *G. v.* subsp. *verna*.
Seeds collected from large strong and vigorous populations from Malá and Velká kotlina (e.g. "Hořcový potok" in Velká kotlina) will be sown in newly established localities of the mountain form of *G. verna* subsp. *verna* intended primarily for research. Seeds will be sown in sufficiently moist places, for example in the spring area below Petrovy kameny.

3.2.3 Planting plants

Motivation
The only residual population of the lowland form of *G. verna* subsp. *verna* in the Rovná NNM has a very low number of plants and needs to be strengthened. The planting of plants pre-cultivated in a culture is a further method suitable for strengthening the population. This method will also be applied for establishing new populations of *G.*verna* at localities selected from the list of localities potentially suitable for repatriation of the species (see 3.6.1).

Measure contents
The gradual repatriation of plants from an *in vitro* culture at the Jílovitě-Strnady FGMRI in a locality in the Rovná NNM and in newly established localities.

3.2.4 Storing plants in the gene bank

Motivation
Preserving the genetic variability of populations and maintaining plants for possible sowing and planting.

Measure contents
Seeds from the localities in the Jeseníky PLA will be stored in the gene bank in Olomouc. Storage is not recommended for the Rovná NNM as yet because of low seed production.
The explant bank at the Jílovitě-Strnady FGMRI will be maintained for at least the duration of the Action Plan.

3.3 Monitoring

3.3.1 Monitoring the population in the Rovná NNM

Motivation
The objective of the detailed monitoring of the population of the lowland form of *G. *verna* is to follow the annual changes in the numbers of the populations, distribution of the plans and the success rate of reproduction. The information obtained will serves as a basis for the implementation of other measures of the Action Plan (see 3.1, 3.2).

Measure contents

In two demarcated areas in the field (areas I and II) during flowering and formation of seeds of the Spring Gentian within the permanently demarcated squares of an area of 1 x 1 the following population parameters will be monitored annually:

1. size and distribution of individual polycormones of (drawings made in micromaps)
2. plant mortality/vitality (numbers of individuals, numbers of flowering stems, numbers of developed capsules)
3. seed production

3.3.2 Monitoring the groundwater level in the Rovná NNM

Motivation

The long-term sub-average condition of groundwater level has a negative effect on the vitality and fertility of plants in the Rovná NNM.

Measure contents

The monitoring of the level of groundwater using cased probes during the vegetation season every month. The monitoring of the level of groundwater will provide data for determining the intensity and frequency of measures for improving the water regime of the locality (see 3.1.5).

3.3.3 Phytosociological relevés of the Rovná NNM locality and localities with newly created populations

Motivation

Plant communities and their dynamics rightly affect the population of the Spring Gentian, so it is important to secure data about this development from the existing locality of the Rovná NNM and from localities newly established during the Action Plan.

Measure contents

Phytosociological relevés in the Rovná NNM will be repeated in the same areas in five-year intervals (in the period from May to June). Relevés will be made using the same method and in these localities once further localities of *G. *verna* are established.

3.3.4 Analysis of the soil samples of the Rovná NNM locality

Motivation

Obtaining accurate data about the character of the Spring Gentian habitat in the Rovná NNM is important especially for a comparison of the existing locality and localities for potential species repatriation which will be evaluated when the list is created of localities potentially suitable for the repatriation of the Spring Gentian (see 3.6.1).

Measure contents

An analysis of soil samples in the Rovná NNM will take place 1×/10 years, sampling will be carried out in places where the first soil samples were taken in 1998. The pH, content of Ca, Mg, K and Na, C, N, NO_3, NH_4, P and SO_3 will be ascertained.

3.3.5 Monitoring populations in the Pradĕd NNR

Motivation

Detailed monitoring of the condition of the population of the mountain form of *G. *verna* is necessary for monitoring annual changes in the number and success of reproduction and distribution of plants. The information obtained will serve as data for implementing other measures of the Action Plan (see 3.1, 3.2).

Measure contents

The size and fertility of the population will be monitored – after locating the individual groups of plants using GPS in years 2005 and 2007, and after comparing their distribution, it was shown how to efficiently divide the entire area of Velká kotlina for the purpose of monitoring into segments which correspond to the topographical segmentation of Velká kotlina – see Annex 14. All the groups of Spring Gentians found to date in Malá kotlina were incorporated into one segment. The number of flowering individuals will be monitored at an interval of 1 year for a period of five years, then (if no drastic changes in the populations arise) in three-year intervals.

Seed production and germination will also be monitored in the spaces in newly established populations of the mountain form of *G. verna* subsp. *verna* (see 3.2.2 and 3.4.1).

3.4 Research

3.4.1 Study of the reproduction method and reproductive ecology at localities in the Czech Republic

Motivation

Insufficient knowledge about the stages of the development cycle which are key points for maintaining and spread of populations of the Spring Gentian.

Measure contents

The sowing of seeds in newly established localities (see 3.2.3) will be monitored and evaluated in detail in terms of the success rate of this sowing. The spaces with the sowing seeds (cca 15 × 15 cm) will be marked, their typography will be drawn up (in micromaps). The following parameters of the spaces will be monitored and evaluated:

- number of plants
- seed production
- seed germination
- ability of seedlings taking root in the habitat

3.4.2 Determining the minimum size of populations capable of independent existence

Motivation

The establishment of new populations of the species *G.*verna* only makes sense if they are able to exist on their own in the long-term, i.e. the populations will reproduce and the self-reproduction processes will take place here. The limiting factors are not just the conditions of the habitat, but also the initial size of the population. Therefore when establishing new populations of the species a minimum size of the population needs to be ensured so it is able to reproduce on its own in the long-term.

Measure contents

Based on the results of a study of reproductive biology and ecology (especially the rate of reproduction, generation period and rate of population growth) a population model will be drawn up with the aid of mathematical methods which can be stable in the long-term at a certain initial size (with regard to survival and fertility, and the natural fluctuation in size and population density).

3.4.3 Comparison of the genotype variability of isolated populations inside the range

Motivation

Genetic analyses will help to explain the origin of our populations, find the differences between the individual populations and within them, and possibly exclude genetic contamination of plants coming from geographically remote forms cultivated in this country as rock plants.

Measure contents

Monitoring the genotype variability of the populations of the Spring Gentian in the Czech Republic and newly established plants. A comparison of the genotype variability of isolated populations with populations inside the range. A comparison of the genetic variability of populations in Hrubý Jeseník and populations in the Carpathians, or in the Alps.

3.5 Education

3.5.1 Promotion of the Rovná NNM locality at regional level

Motivation

In case of the species *G.* verna* educational measures must focus on the situation in the Rovná NNM with sufficient information and interest of the management of the municipality (as the owner of the land lots) and individual residents as a precondition for the success of implementing the series of measures and protection of the locality as a whole.

As for the localities in Hrubý Jeseník educational measures are not proposed separately in view of the fact that the PLA Administration works here to educate and the occurrence of the Spring Gentian needs to be presented here in relation to the entire territory and other significantly rare species.

In the context of establishing new populations farmers and land managers need to be sufficiently informed as well as the other residents in the locality about the conditions and methods of protecting the species and its importance.

Measure contents (in the Rovná NNM)

1. a campaign aimed at school children in the municipality and its vicinity (nature walks with distribution of an information pamphlet and a lecture),
2. the issue of an information pamphlet and its distribution in the municipality and its close and wider vicinity (in Strakonice and the neighbouring municipalities),
3. an educational campaign (lecture) for agricultural workers farming the environs of the locality,

4. promotion of the protection of the Spring gentian in the regional press (educational articles and annual information articles) by the regional radio and on the Internet,
5. information signboards in the municipality, at the locality and in Strakonice,
6. motivate local (i.e. district) parties interested in nature to form an association helping to manage and conserve the locality (as is already informally the case now).

Measure of a similar character such as in the case of the Rovná NNM will be applied to the newly established populations but the range will be specified depending on the character and needs of each locality.

3.6. Other Measures

3.6.1. Creating a list of localities potentially suitable for repatriation of the species *G.* verna*

Motivation

This material will form the basis for establishing new populations of *G. *verna (see 3.1.7, 3.2.2, 3.2)*. Sufficient information about these localities needs to be gathered so these measures can be implemented.

Measure contents

Localities suitable for repatriation of the species will be selected preliminarily from the overview of the historical localities of the lowland and mountain form of *G. *verna (*see Annex 3). Subsequently the situation of these localities will be verified in the field and where the appropriate biotope has survived, phytosociological relevés will be taken, the level of groundwater measured, a soil analysis carried out and the overall conditions of the locality evaluated. Likewise, an analysis of the proprietary relations will be conducted and the possibilities of how to secure the appropriate management. The results will be summarised in a clear list of the localities.

4. ACTION PLAN IMPLEMENTATION TABLE

TABLE 4: SPRING GENTIAN ACTION PLAN IMPLEMENTATION TABLE.

Number and type of measure	Priority	Implementation period	Measure frequency	Follow-up to other measures	comment
3.1 Biotope Management					
3.1.1 Extensive grazing	1	continuously for the project duration	annually	will be supplemented by measure 3.1.1 3.1.2?	management start period cannot be accurately determined
3.1.2 Cutting	1	continuously for the project duration	annually	additional measure to measure 3.1.1	Applies to the Rovná locality, in the Jeseníky PLA only in selected localities once every two years
3.1.3 Elimination of competing plants and disturbance of turf	1	continuously for the project duration	2-3 × annually		
3.1.4 Removal of redundant biomass	1	as required	1 × annually (X – IX)		
3.1.5 Improvement of the water regime	1	2009, then by the condition of the level of groundwater	repeat measure	frequency will be adjusted by results 3.3.2	Only NPP Rovná
3.1.6 Removal of non-indigenous and expansive species	2	from 2008	repeat measure		
3.1.7 Restoration of localities selected for repatriation of the species	1	from 2012	repeat measure	subject to measure implementation 3.6.1	
3.2 Species Management					
3.2.1 *Ex situ* cultivation	1	continuously for the project duration	annually		
3.2.2 Sowing seeds	1	from 2009	repeat measure	Subject to measure implementation 3.2.1	
3.2.3 Plantting plants	1	from 2010	repeat measure	Subject to measure implementation 3.2.1	
3.2.4 Storing plants in the gene bank	2	continuously for the project duration			

3.3 Monitoring					
3.3.1 Monitoring the population in the Rovná NNM	1	continuously for the project duration	annually		
3.3.2 Monitoring the groundwater level in the Rovná NNM	1	continuously for the project duration	1 x per month during veget. season, further to fluctuation of water level and flooding		
3.3.3 Phytosociological relevés of the Rovná NNM and localities with newly created populations	2	continuously for the project duration	repeat measure, every 5 years		
3.3.4 Analysis of soil samples of the Rovná NNM locality	2	continuously for the project duration	repeat measure, every 5 years		
3.3.5 Monitoring populations in the Praděd NNR	1	continuously for the project duration	first 5 years annually, then once every 3 years		
3.4 Research					
3.4.1 Study of the reproduction method and reproductive ecology at localities in the Czech Republic	1	2008-2018			
3.4.2. Determining the minimum size of populations capable of independent existence	2	2009-2018		Follow-up from section to 3.2.2, 3.2.3 and 3.4.1	
3.4.3 Comparison of genotype of variability of isolated populations with populations inside the range	2	2008-2012			
3.5 Education					
3.5.1 Promotion of Rovná NNM locality at regional level	2	continuously for the project duration	repeat measure		
3.6 Other measures					
3.6.1 Creating a list of localities potentially suitable for repatriation of the species *G.* verna*	1	2008-2012	one-off measure		

Note: Individual measures and a work timetable is proposed based on the experience gained during the implementation of the rescue work in year 1999-2007. In accordance with the management plans it is expected that the Action Plan will be organised nature conservation bodies. Individual work will be assigned to a specialised workplace, to workers of non-profit organisations, or volunteers. The numbers of the measures correspond to the numbering in Chapter 3, priority 1 - highest, priority 2 - moderate, priority 3 - lowest.

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6. ANNEXES

Annex 1: *Gentiana verna* range (Meusel 1978: 353)

Annex 2: Dynamics of the occurrence of *Gentiana verna* L. subsp. *verna* in the Czech Republic

Annex 3: Overview of documented occurrences of *Gentiana verna* L. subsp. *verna* in the Czech Republic

Annex 4: Orthophoto map of the Rovná National Nature Monument with marked areas of occurrence of *Gentiana verna* L. subsp. *Verna* plants

Annex 5: Questionnaire for monitoring *Gentiana verna* L. subsp. *verna* in the Rovná NNM

Annex 6: Documentation for cultivated *Gentiana verna* L. subsp. *Verna* plants

Annex 7: Site of the plantation of *Gentiana verna* L. subsp. *verna* plants *in vitro* propagated (1999)

Annex 8: Site of the soil sampling and localisation of phytosociological relevés in the Rovná NNM

Annex 9: Phytosociological relevés in the Rovná NNM

Annex 10: Orthophoto map of Velká kotlina Fold in the Praděd NNR with marked occurrence of *Gentiana verna* L. subsp. *verna* in years 2005-2007

Annex 11: Questionnaire for monitoring *Gentiana verna* L. subsp. *verna* in Velká kotlina Fold

Annex 12: Orthophoto map of Malé kotlina Fold in the Praděd NNR with marked occurrence of *Gentiana verna* L. subsp. *verna* in years 2005-2007

Annex 13: Questionnaire for monitoring *Gentiana verna* L. subsp. *verna* in Malá kotlina Fold

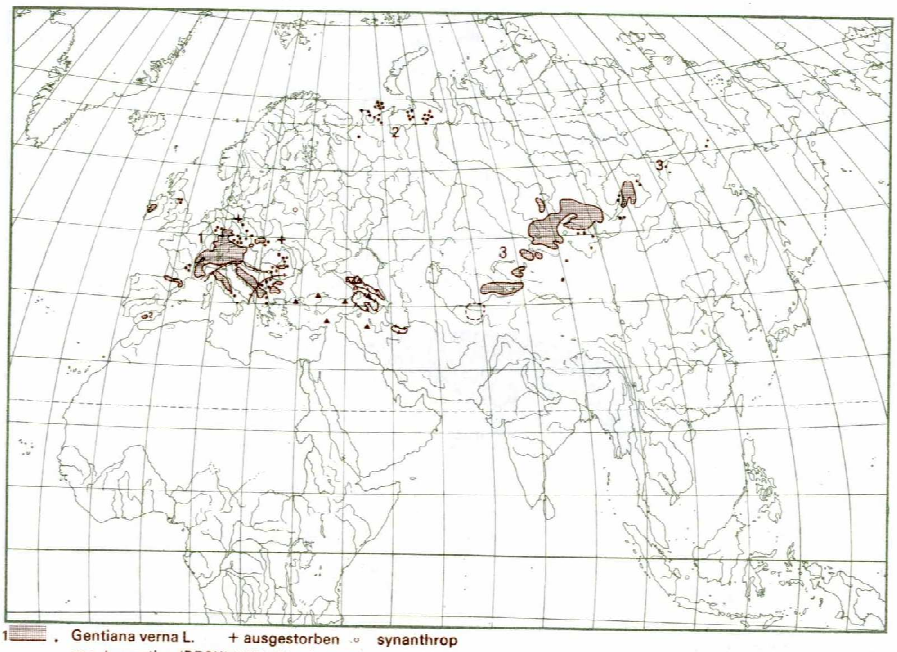
Annex 14: Orthophoto map of Velká kotlina Fold with local topographical names

Annex 15: Contour map of Velká kotlina Fold with topographical names

Annex 16: Rovná NNM management plan for the period of 200-2009 (selection)

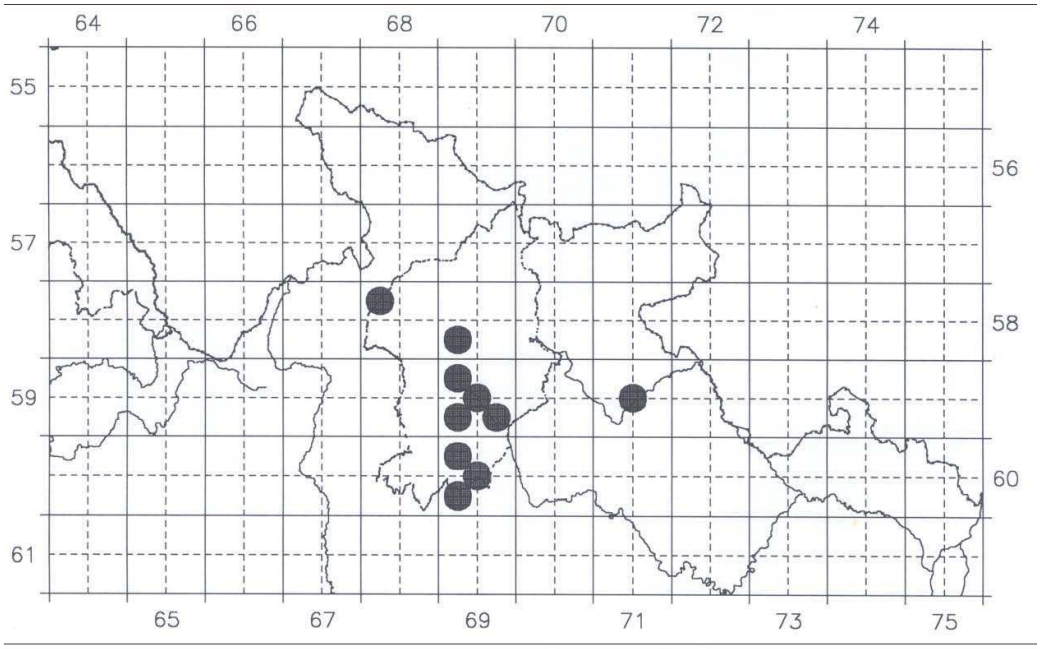
Annex 17: Praděd NNR management plan for the period of 2006-2015 (selection)

ANNEX 1: *GENTIANA VERNA* RANGE (MEUSEL 1978: 353)

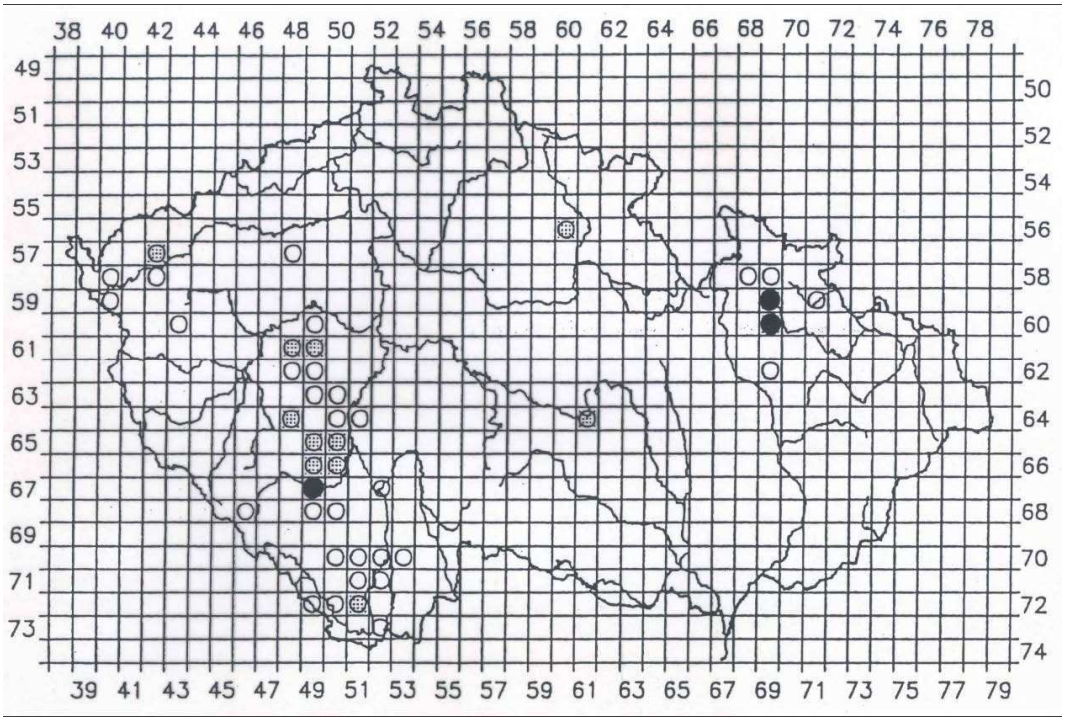


1 . Gentiana verna L. + ausgestorben ○ synanthrop
ssp. tergestina (BECK) HAY. (Nordgrenze)
G. pontica SOLT.
G. oschtenica (KUSN.) WORON.
G. angulosa BIEB.
2 . G. arctica GROSSH.
3 . G. uniflora GEORGI

ANNEX 2: DYNAMICS OF THE OCCURRENCE OF GENTIANA VERNA L. SUBSP. VERNA IN THE CZECH REPUBLIC



Historical distribution of Gentiana verna L. subsp. verna in north Moravia.



Dynamics of distribution of Gentiana verna L. subsp. verna in the Czech Republic. ringed – historical occurrence, screened – occurrence after 1940, circled – present occurrence

ANNEX 3: OVERVIEW OF DOCUMENTED HISTORICAL OCCURRENCE OF *G. VERNA* SUBSP. *VERNA* IN THE CZECH REPUBLIC

The localities were recorded according to the available herbarium specimens, literature, manuscripts materials, field research and with the help of local florists. The Spring Gentian grew in 34 phytogeographical districts and sub-districts. Today it is found only in two of these: 97. Hrubý Jeseník and 37f. Strakonické vápence.

The findings were classified primarily according to phytogeographical units (SKALICKÝ 1997), and according to the numbers of squares of the grid mapping of the central European mapping network:

Abbreviations:

DM: Domin's herbarium material (specimens), Institute of Botany of the ASCR, Průhonice, magazine abbreviations have been adopted from the DM Herbarium collection: BRNM – Moravian Museum, Brno, BRNU – Masaryk University Faculty of Science, Brno, CB – South Bohemian Museum, Č. Budějovice, OLM – National Science Museum Olomouc, OP – Silesian Museum, Opava, PL – West Bohemian Museum, Plzeň, MP – East Bohemian Museum, Pardubice, PR - Department of Botany of the National Museum in Prague, Průhonice, PRC - Charles University, Natural Science Faculty, Prague, ROZ – Central Bohemian Museum, Roztoky u Prahy, SUM – District National Science Museum, Šumperk

6. Džbán

5748b

near Ročov ("formerly at Džbán u Renčova where there is now a field"), Hohbach, 1883, DM: Čelak. Prodr. IV. p. 807 (1883);

this was the only finding in the Džbán area. It became extinct as early as the end of the 19th century.

15a. Jaroměřské Polabí

5660b

Miletín, in a fen meadow west of the forester's lodge near Velký Vřešťov, 250 ASL., Šourek, 1940, PRC & PR; meadows near M. Vřešťov, Traxler, 1930, PRC; near Vřešťov, Traxler, 1932, PRC; meadow about 1 km southwest of Velký Vřešťov, Krčan, 1930, MP; Dvůr Králové, in the Trotina valley in a fen meadow called "Na Svatých" west of Lužany, B. Válek, 1942, DM: K.N.D. 34. p. 177 (1942); in the vicinity of Vřešťov in the meadows, growth highly abundant, A. Kobrle, 1936, DM: Kobrle, Květ. Jaroměřska, ms 129 (1936); near Vřešťov growth quite sparse, H. Hártle, 1940, DM; in a meadow near Vřešťov, Traxler, 1936, Krčan, DM: Rohlena, ČNM 52 p. 22 (1928); it has become extinct in the vicinity of V. and M. Vřešťov.

24a. Chebská pánev (Cheb Basin)

5940

Chebsko, in a meadow, Schwanenwiese [Swan Meadow], rare occurrence, Chr. Jaksch, 1878, DM: Lotos 27. p. 48 (1878); it has become extinct.

5840c

Near Františkovy Lázně (450 m), Dalla Torre, 1878, DM: Lotos 27. p. 48 (1878); it became extinct.

24b. Sokolovská pánev (Sokolov Basin)

5742d

Karlovy Vary, on the western slopes of Hornberg Hill [near Tašovice], Šterneck, 1936, CB, PRC, Podhajská, 1922, PRC, 1927, BRNU; Hornberg [near Karlovy Vary], Všetečka, sine dato, PR, Güttler, 1929, PRC, Hory, near the municipality, from the volcano in the direction of Loket, growth scattered, BENETKA et NECHANICKÝ, Report of the Czechoslovak Botanical Society 5/1970, p. 38-41; Hornberk u Lokte, basalt, eastern slope, E. Güttler, 1931, DM: V.P. 12. p. 240 (1931); it became extinct.
Tašovice near Karlovy Vary, wet meadow west of the municipality, Pyšek, 1958, 1959, PL; Tašovice near Karlovy Vary), Jelínek, 1982, JELÍNEK (1987);
in 1982 the meadow was ploughed and it became extinct.

5842a
Staré Sedlo [Sokolov], A. Ortmann, 1842, DM: Fl. Elbogner Kr. 91 (1842);
it became extinct.

28d. Toužimská vrchovina

6043a
Teplá, Konrad, 1873, DM: Čelak. Prodr. II. (1873) p. 289-290;
it became extinct.

32. Křivoklátsko

6148b
Forest meadow near Zbiroh, Tausch, sine dato, PR, Herb. Fl. Bohem. n. 1012; Zbiroh, meadow Okrouhlík next to the road from Líšná to Žebrák, growth scattered, Hostička, 1964, Hofman, 1964, PL, Okrouhlík, Pešek, sine dato, PRC, Cibulka, 1937, PRC, Líšná, growth abundant, Jindra, 1948, PRC; Okrouhlík, 2 km southeast of the municipality of Líšná, 490 m, Pálek, 1960, MP; Zbiroh, in the clearing on the right side of the road from Žebrák to Líšné, Fr. Wurm, 1903, DM: Bot. Přísp. Rakovn. II. 13 (1903); growing in large numbers beyond Líšná in the forest meadow at the crossroads, beautiful specimens, Fr. L. Karas, 1896, DM: Karas, Květ. around Zbiroh stream, Ms. 28-29;
Last record from Křivoklátsko comes from Hostička and from Hofman 1964. It has become extinct.

6148b
Svatá Dobrotivá, in a wet meadow near Cerhovice, M. Moerkenstein, sine dato, PRC; near Cerhovice, [Tausch], PRC & BRNU, Tausch Pl. Select., sine no, also [Tausch], PRC, Tausch Herb. Fl. Bohem. n. 1012; near Cerhovice mountain meadows, Tausch, 1851, PR, also DM: Tausch, Herb. Fl. Bohem, n. 1912 ex J. Ott. 32 (1851); Cerhovice, Moerk, sine dato, Tausch, DM; in moist mountain meadows near Cerhovice, Jan Krejčí, 1852, DM: from Prague, 23 (1852); Studánky u Cerhovic, Hošek, 1976, herb. J. Hošek ("last specimen found near the road, place of occurrence today is the field");
PP Studánky u Cerhovic is the last locality where the plant species was found growing. It became extinct in 1976.

6148b
Drozdov, in a meadow, Marešová, 1957, PR;
it became extinct.

6049d

Zdice, in meadows around the municipality, J. Ch. Neumann, 1854, DM: ex Reichardt Verh. Z.-B. Ver. Wien IV. Abh. 375 (1854);

it became extinct.

6149a

vicinity of Točník, Fassati M., 1959, PR, see also the report of the Czechoslovak Botanical Society 3/1968;
it became extinct.

32.-35a. Křivoklátsko - Holoubkovské Podbrdsko

6148b-6149a

in mountain meadows, proceeds from the Třemošná mountain range to the Vltava River, northernmost near Cerhovice, Hellwich, 1903, DM: Domin, Brdy 52 (1903) ("in the Brdy Hills from the period");
inaccurate data, it has become extinct.

34. Plánický hřeben

6448a

Železný Újezd, in a mesophilous meadow (*Molinion* alliance passing into the *Arrhenatherion* alliance) at the southeast boundary of the fishpond "V uličkách" close to the hut camp, ca 1 km SE of the municipality, about 40 flowering individuals, ca 620 m ASL. Leg. B. Křísa, 18.05.1991, PRC, see SLABA et al. (2002).
No growth has been confirmed at this locality since the finding.

35a. Holoubkovské Podbrdsko

6249a

Brdy, at the rise between Prague and Plzeň from Jablečno through Třenice to Cerhovice (and in Sv. Dobrotivá), V. Los, 1828, DM: Mon. Hoř. and Ber. I. 115;
it became extinct.

6248b

Královka in Zbiroh, Sittenský, 1891, see Štěpán (1974);
it became extinct.

35b. Hořovická kotlina Fold

6149c

Hořovice, Smolař, 1959, PR;
it became extinct.

35c. Příbramské Podbrdsko

6350a

Příbram, only in one wet meadow near the city, Záběhlický, 1883, DM: Čelak. Prodr. IV. p. 807 (1883); meadows near Příbram, growing rarely, Domin, 1895, PRC; near Příbram in meadows beyond the city in the direction of Flusárna, growing abundantly, Domin, 1902, DM: ex Domin, study about vegetation of Brdy 260 (1920), also VKČSN (Royal Bohemian Society of Sciences), 1902, 22. p.13; beyond Příbram in meadows in the direction of Flusárna (from here south to Mirovice), B. Brabenec, 1903, DM: Domin, Brdy 52 (1903); near

Příbram between the fishponds Nový and Fialový, J. Roubal, 1915, DM: ex Domin, study about vegetation of Brdy 260 (1920); it became extinct.

35c.-87. Příbramské podbrdsko-Brdy

6349b

near Příbram below Třemošná, B. Brabenec, 1903, DM: Domin, Brdy 52 (1903); Domin, 1903, DM: ex Domin, Study about vegation of Brdy 260 (1920); moist meadows below Třemošná, Moerk, no date of finding given, Tausch, DM: see also Fr. Stejskal, 1893, DM: J. Hrabák, Prův. Příbr. 64 (1893); it became extinct.

35d. Březnické Podbrdsko

6549d

Lom u Blatné, in meadows north of the municipality, growing fairly abundantly, Machovec, 1959, PRC; a quarry with pasture on the left bank of the brook 400 m north of the municipality (the pasture disappeared with the building of a playground, the growth of the gentian has not been recorded since 1967) SLABA R. et al. (2002); quarry, moor below the fishpond dam on the eastern boundary of the Neradov settlement north of the municipality, 450 m above seal level (in 1968 2 plants were recorded, last occurrence in 1972) SLABA R. et al. (2002); quarry, moist meadow on the banks of the brook 300 m WNW of the municipality, 460 m ASL (after the meadow was dried out in 1966 the Spring Gentian disappeared) SLABA R. et al. (2002); not recorded since 1972, it became extinct.

6550a

Malčice, in a moist meadow between forests on a hillock, 1.7 km ENE of the municipality, 420 m ASL (in 1967 the meadow stopped being flooded with the deepening of the bed resulting in the decrease of the population, in 1977 there were only 27 flowering specimens, later the gentian disappeared) SLABA R. et al. 2002; Malčice, marshy pasture east of the road in the direction of Mirotice ca 1 km north of the municipality, 430 m ASL (a small remainder of the moor in the cultural meadow, 40 flowering individuals were recorded in 1970, in 1976 the meadows was transformed into a field) SLABA R. et al. (2002); it became extinct in the 1980s.

6550a

Obora u Cerhonic, in a pasture on the south bank of Kacovice (Žákov) fishpond ca 1 km southeast of the settlement, 420 m ASL (in 1974 the fishpond was drained, the number of gentians fell, in 1977 they were found only on the boundary of the forest and later they became extinct) SLABA R. et al. (2002); Obora u Cerhonic, moist meadow on the western bank of the Kacovice (Žákov) fishpond south of the settlement, 420 m ASL (found abundantly up to 1967 on an area of 1 ha, in 1971 only 24 plants were found after the deepening of the drainage ditch, in 1974 the fishpond was drained and only 4 specimens were found, it gradually became extinct) SLABA R. et al. (2002); Obora u Cerhonic, steep pasture 1.2 km sourtheast of the settlement, 430 m ASL, (found abundantly on an area of 20×50 m, in 1977 only 54 specimens and later it became extinct); Obora u Cerhonic, moist meadow on the left bank of the Jesenický potok stream south of the hermitage of Nový Dvůr southeast of the settlement, 420 m above seal level (in 1977 there were 137 specimens flowering in a field wave where they were conserved after the drainage of the meadow, later it became extinct); it became extinct.

6550b

Lažiště, east-north of Čimelice, in a wet meadow between the forests 400 m west-north-west of the municipality, 430 m ASL (abundantly found until 1968 when the bed of the stream was deepened, in 1977 35 specimens were found, in 1977 there were only 8 flowering plants, later none were recorded) SLABA R. et al. (2002); it became extinct.

6550c

Boudy u Mirotic ["Budy"], Brabenec, 1891, ROZ, also 1902, CB, BRNU, MP and PL; Boudy u Mirotic, a spring area in a meadow alongside the field path in the direction of Rakovice 800 m north-north-east of the municipality, 480 m ASL (abundantly with a growth of globe flowers, after drainage of the spring area only 20 individuals were found in 1964, it became extinct in 1966) SLABA R. et al. (2002); it became extinct in 1966.

6550c

Mirotice, J. Dvořáček, 1880, BRNU; Mirotice, a steep meadow with a spring area on the right bank of Lomnice 400 m southeast of the municipality, 420 m ASL, Slaba 1971 (formerly growing abundantly, drained in 1969, only 6 individuals in 1971, in 1975 ploughed so the locality disappeared) SLABA et al. (2002); Mirotice, old orchard 700 m southeast of the municipality, 430 m ASL, Slaba 1973 (154 individuals, in 1977 there were only 26 individuals, later the gentian disappeared) SLABA R. et al. (2002); it became instinct.

6550c

Cerhonice, in a meadow beyond the Mirotice estate garden, J. Kubín 1897, DM: 18 plants in the district of Písek 18; Cerhonice, near the municipality, J. Veselý 1922, DM: V. P. III. 186; Cerhonice, marshy meadow on the northern boundary of Cerhonice forest southeast of the municipality, 1 km east of the Na Pařezu hermitage, 430 m ASL, Slaba 1965 (area of 2×3 m, in 1965 the locality disappeared when it was transformed into a field) SLABA R. et al. (2002); Cerhonice, boulder pasture and willow herb growing on the west bank of the fishpond, ca 400 m east of the Na Pařezu hermitage, 430 m above seal level, Slaba 1972 (area of 1/2 ha, in 1972 the grazing was stopped, in 1977 there were only 36 flowering individuals, in 1989 only 1 plant, then it became extinct) SLABA R. et al. (2002); Cerhonice, pasture between the left bank of the Jesenický potok stream and right bank of the Luční potok stream at the mouth of the Nový fishpond southeast of the municipality, 420 m ASL, Slaba 1967 (after the Jesenický potok steam was regulated in 1967 the gentian was found only at the bank, in 1976 the pasture was transformed into a field and the gentian became extinct SLABA R. et al. (2002); Cerhonice, a meadow west of the Na Pařezu hermitage, 430 m ASL (the extensive complex of meadows was ploughed in 1974 into a field and the gentian became extinct) SLABA R. et al. (2002); it became extinct.

6550c

Obora u Cerhonic, in a boulder pasture below the dam of the Pulec fishpond northwest of the boundary of the settlement, 420 m ASL (on an area of 10×30 m, there were only several individuals after the stream was regulated in 1969, in 1977 there were only 3 flowering specimens, later none were observed) SLABA R. et al. (2002); Obora u Cerhonic, pasture on the eastern boundary of the road to Cerhonice, on the right bank of the Luční potok, 420 m ASL. (The locality destroyed by the pulling up of gentians, in 1974 transformed into a field and the gentian became extinct), SLABA R. et al. (2002); it became extinct.

6550c

Radobytce, in a cultural meadow on the left bank of the Luční potok below the dam of the Pančár fishpond south of the municipality, 430 m ASL (formerly abundant but after drainage in 1961 the gentian gradually became

extinct, the last occurrence of the gentian here was in 1966) SLABA R. et al. (2002); it became extinct.

6650a

Křešice u Podolí II, in a forest meadow ca 500 m east of the dam of Skaličný fishpond 1.5 km north-north-east of the municipality (*Molinion*, in 1977 there were 87 flowering specimens) SLABA et al. (2002), in 1984 1 specimen was recorded (the locality became overgrown and the gentian disappeared) Knížetová 1984 (verbal report); it became extinct.

6450c-6550a

from the Vltava to Čimelice and Mirovice (from here right to the foot of the Třemošná mountain range), Domin, 1902, DM: Sb. Č. Sp. Zem. 7. p. 291 (1902); it became extinct.

6550

Příbramsko, in the game park near Čimelice, Schustler, 1920, PR; it became extinct.

6550b

near Nové Dvory between Čimelice and Orlík, Prokeš, 1928, DM: Rohlena, ČNM 52 p. 22 (1928);
it became extinct.

All occurrence of *G. *verna* disappeared throughout the region, in 1989 (Slaba 2002) the last plant was recorded in Podbrdsko (close to the Na Pařezu hermitage near Cerhonice).

36a. Blatensko

6549b

Myštice, in a meadow near the Labuť fishpond beneath the settlement of Nevželice, Machovec, 1957, PR; a moist meadow on the northeast bank of the Labuť fishpond southwest of the settlement of Nevželice, 460 m ASL (formerly abundant but after the deepening of the drainage ditches and application of artificial fertilisers the gentian gradually disappeared, and 6 individuals were last recorded in 1977) SLABA R. et al. (2002); it became extinct.

6549b

Sedlice, in a meadow on the southern boundary of the forest east of the Staroborský fishpond ca 200 m south of the close locality, in SKALICKÝ et al. (1961); Sedlice, a moist meadow between the road and the Staroborský fishpond opposite the forester's lodge near the Obora forest Obora, Toman et Chán, 1958 in SKALICKÝ & TOMAN (1958); it became extinct.

37d. Čkyňské vápence

6849a

Volyně, Sittenský, 1876, PR; Volyně [Strunkovice], Keller, 1873, DM: Čelak. Prodr. II. (1873) p. 289-290;
very old data, the gentian has not been found in the locality since the end of the 19th century.

37f. Strakonické vápence

6749b

Strakonice, in a pasture on the western bank of the fishpond west near the municipality of Rovná, ca 420 m, Moravec, 1957, also Rivola, 1967, CB; Chán 1997 (ca 10 flowering stems – verbal report); the only (2005) existing locality in Bohemia.

37i. Chvalšinské Předšumaví

7250b

Černá Hůrka, vz. [Černá - Hůrka u Černé v Pošumaví], Hirsch, year of finding not given, CB; Lhenice, growing abundantly in the vicinity, Kačírková, 1907, PR; it became extinct.

37j. Blanský les

7151b

Krasetín ("from here often on the market") T. Marek, 1911, DM: T. Marek, Květ. District of Č. Bud. ms (1911); it became extinct.

7151d

Below Schoeninger [evidently on the south foot of Kleť Mt.], the collector is not given (ex herb. J. Veselý), 1905, CB, data about the herbarium item comes from the notes of S. Kučera (non vidimus); it became extinct.

37k. Křemžské hadce

7051d

near Křemže, 523 ("from here often to the market"), T. Marek, 1910, DM: T. Marek, Květ. District of Č. Bud. ms (1911); near Křemže, L. Sýkora, 1930, DM: Roč. Č. Bud. 64 (1930); it became extinct.

37l. Českokrumlovské Předšumaví

7151d

Český Krumlov, vicinity ("auf der Spitalwiese and elsewhere"), Jungbauer, 1829, DM: in Opiz Naturalientausch Nro 12 p. 683; between (disppeared) Turkovický hamr and Chvalšinský potok stream, Jungbauer, 1873, DM: Čelak. Prodr. II (1873) p. 289-290; Český Krumlov, moist meadow near Rozsyp u Vltavy, 500 m, Jar. Mikuláš, 1893, DM; it became extinct.

7151d

Kvítkův dvůr, Květnice beyond the chateau garden ("1. Favoritenhof b. Krumau"), Jungbauer, sine dato, PR, together in the item "2. St. Gunther (Schmidt)"; it became extinct.

7151c-d

Kájov, south of the municipality, Kneblová, 1952, PR; near Kájov in meadows (564), Leonard Thuer?, 1917, DM (verbal report 20.8.1917); it became extinct.

7l51

At the foot of Blanský les near Kremže ("Krenau"), Čelakovský, 1870, PR; foot of Blanský les near Křenový, Pfund, 1873, DM: Čelak. Prodr. II. (1873) p. 289-290; Blanský les u Č. Krumlov (Krumau), collector not given, sine dato, PR; it became extinct.

7251a-b

near Slavkov (near Č. Krumlov) in meadows, ca 700-720 m, abundantly, Leonard Thuer?, 1917, DM; it became extinct.

37m Vyšebrodsko

7352a

wet meadow near Rožmberk, 680 m, Topitz, 1887, PR, also DM: (se *Soldanella m.*), Čelak. Res. 1887, p. 655; it became extinct.

37p. Novohradské podhůří

7152

Prostřední Svince u Římova, collector not given, 1923, CB; it became extinct.

38. Budějovická pánev

7053a

Suché Vrbné on the eastern outskirts of Č. Budějovic, Jechl dle Mardetschl., 1873, DM: Čelak. Prodr. II (1873) p. 289-290 (38-37p); near Č. Budějovice, Beneš, 1876, PR; it became extinct as early as the first half of the 20th century (cf. Houfek 1952, dissertation work).

7052c

near Slavče ("from here often to the market"), T. Marek, 1911, DM: T. Marek, Květ. district Č. Bud. ms (1911); it became extinct.

6850b

Skočice u Vodňan, abundantly, Duda, 1887?, DM: Čelak. IV;

40a. Písecko-hlubocký hřeben

6752

Týn nad Vltavou ("Vltavotýn"), Pfund, 1873, DM: Čelak. Prodr. II. (1873) p. 289-290;

41. Střední Povltaví

6451c

near Orlík, V. Bezpalec, 1903, DM: Domin, Brdy 52 (1903); it became extinct.

6550d

Ostrovec u Písku, Prokeš, DM: Rohlena, ČNM 52 p. 22 (1928); it became extinct.

6550d

Nová Vráž, marshy pasture on the right bank of Jesenický potok at the mouth of the Landa fishpond NNW of the municipality, 410 ASL (isolated and irregular, 1977 only 2 specimens found) SLABA R. et al. (2002), F. Slavík, 1936, DM; it became extinct.

72. Zábřežsko-uničovský úval

6269b

Hlásnice u Šternberka, Hruby, 1914, DM: Hruby, Ostsud. 123 (1914) [?“Grund”];
it became extinct.

74b. Opavská pahorkatina

5971

Krnov (“Jaengerndorf”), Spatzier, sine dato, PR; it became extinct.

75. Jesenické podhůří

6069c

Stará Ves, Pstruží potok, Koňaříková [Kavalcová], 1960;
it became extinct.

6069c

Janušov u Rýmařova, peat meadow in the no longer existing municipality of Růžová, Koňaříková [Kavalcová] 1958; meadows in “Johndorfer Koppe” [Janušov] and “Bruennelsteines” near Rýmařov, Simboeck, 1890, DM: ex Oborny OeBZ 40 p.206 (1890);
it became extinct.

6069c

Rocky peatland southwest of Rýmařov, Grulich & Smejkal, verbal report; since the 1990s occurrence has not been confirmed.

6069c

Rýmařov, marshy and peat sites south of the road between the municipalities of Hor. Město and Dobřečov, 750-800 m, Soják, 1965, PR; near “Neufunk” [=Dobřečov], 700 m, Hruby, 1914, DM: Ostsudeten 116 (1914);
it became extinct.

86. Slavkovský les

5842c

close to Vranov u Sokolova, J. Kabeš, 1904, DM; it has become extinct.

87. Brdy (all documented data applying to the boundary of the phytochorions 87 and 35c, or their localisation is inaccurate)

6448

Brdy, Třemšínské lesy, Hille, 1913, DM: J. P. Hille, Třemšín 22 (1913);

Brdy, grows more abundantly on mountain meadows, proceeds from the Třemošná mountain range (to the Vltava River northernmost at Cerhovice), Ing. Hellwich, 1903, DM: Domin, Brdy 52 (1903) “Presl’s old data is confirmed, in Brdy from the glacial period”; “it no longer grows in Brdy”, Z. Pilous, 1939, DM: Z. Pilous, K.N.D. 31.4 (1939);

88b. Šumavské pláně

6846b

Dobrá Voda (“St. Gunther”), Schmidt, sine dato, PR;

not completely certain data. The name of Schmidt was added to the sched by someone else.

88e. Trojmezenská hornatina

7249a

Šumava, Ploeckenstein, Nábělek, 1907, BRNU, in the bank of Plekenštejn Lake (past flowering), Purkyně, 1855, DM: Purkyně, Živa 3. p. 53 (1855);

very old data, it has become extinct.

91. Žďárské vrchy

6461a

Žďár n. Sáz., Smejkal, 1955, BRNM; between Žďár and Veselka, Kovář, 1896, BRNU, 1897, OLM and 1898, PR; PRC, in Veselka forest, 575 m, Kovář et Hanáček, 1898, BRNU; Kovář, 1999, PRC, in Veselka forest, ca 570 m, about 35 flowering specimens (confirmed 60-year-old record of Kovářův), Smejkal, 1949, Czechoslovak Botanical Newsletter 1949/5-6, p. 86; beneath the railway track embankment near the Veselky forest SW of Žďár, Smejkal, 1948 and 1955, BRNU; between Žďár n. Sáz. and the ŽĎAS factory in a wet meadow closer to the railway track, Růžička, 1965, MJ; near Žďár, Grulich & Smejkal, 1970 (verbal report); Žďár, on the right side of the road in the direction of Budeč, Vitoušek, 1886, BRNU;

it has become extinct.

97. Hrubý Jeseník

5868a

Šerák, Wimmer, 1832, DM: Wimm. Fl. Schles. 119 (1832); it has become extinct.

5869c

Vysoký vodopád (Jeseníky Falls), Rohrer, sine dato, PRC, also Wimmer 1832, DM: Wimm. Fl. Schles. 119 (1832); it has become extinct.

5969a

Velká Kotlina Fold, Spatzier, 1847, BRNU, Oborny, 1867, BRNU, PRC, Bubela, 1884, PRC, Horák, 1884, MP, Hora, 1889, PRC, Hruby, 1904, BRNU, Picbauer, 1911, BRNU, Suza,

1911, Velká Kotlina Fold in Jeseník, Pavlík, 1928, OLM, Otruba, 1931, 1932 OLM, Laus 1933, PRC, Preis, 1933, PRC, Pohl, 1934, PRC, Laus, 1935, OLM, L.[Laus], 1937, MNJ, Kvapilík, 1936, OLM, Novotný, 1946, BRNM, Černoch, 1949, BRNM, Roztomilý, 1949,

1955, OLM, Leneček, 1936, PRC; BRNU, Fuhrman, 1950, SUM, 1400 ASL, collector not

given, 1884, MP and Dostál, 1947, PRC, ca 1300 m above sel level, Laus, 1932, OP, 1250 m above seal level, Duda, 1947, OP, 1200-1300 m ASL, Dostál, 1960, PR, Schreiber, sine dato, PRC, dále W. Hans, 1868, DM: W. Hans, Oe.BZ. 18. p. 358 (1868); Velký Kotel - Sněžná jáma, David, 1946, OP, Prameny Moravice, 1300 m ASL, Anders, 1893, PRC, MP, Velká Kotlina Fold including springs Moravice, Kavalcová, ms., 1970 and 1980 (several hundred), 1996 (ca 10 individuals) also Burešová, Kirschnerová & Klaudisová, ms, 1997 (ca 30 flowering individuals); upper boundary of V. Kotel, R. Muencke, 1855, DM: R. Muencke, Oe.BW.V. 227 (55), also A. Makowsky, 1863, DM: A. Makowsky, Verh. Nat. Ver. Bruenn II. 1863, Sitzb. 77 (1864);

There is still a rich population here (2005 several hundred individuals).

5969a

Vysoká hole, Lukas, 1884, 1887, SUM, Laus, 1933, OLM, spring area at the south hillside of Vysoké hole (1464), ca 1350 m, Pokluda, 1955, BRNM, Burešová, Kirschnerová et Klaudisová 1997 (ca 30 flowering individuals);
There is still a rich population here (2005 several hundred individuals).

5969a

Vysoká hole, Mezikotlí ("Altvatergeb., Abh. d. Hohen Heide Mittlerer Kessel"), Laus, 1937, BRNU;
no longer grows here.

5969a

Petrovy kameny, Formánek, 1884, BRNU, Krischke, 1912, OP, Spatzier, sine dato, OP, Petrovy kameny and V. Kotlina Fold, Wimmer, 1840, DM: Wimm. Fl. Schles. 2nd edition p. 254 (1840), 3rd edition p. 344 (1857);

road from Ovčárna to Praděd, Benešová, 1930, MP, Kvapilík, 1935, OLM, Bubela, 1888, DM: J. Bubela, Oe. BZ. 18. p. 172 (1888);

near Ovčárna, W. Hans, 1868, DM: W. Hans, Oe. BZ. 18. p. 358 (868), below Ovčárna water line, Kavalcová, 1996 (4 individuals, no record has been made here since that time);
below Praděd Mt., 900 m, Trapl, sine dato, PRC; No longer grows near Ovčárna (2005).

5969a

Karlova Studánka, 800 m, Schuber, 1912, DM: Jahresb. Schles. Ges. vaterl. Cult. 1911, II b.; old data, not reconfirmed later.

5969c

Malá Kotlina Fold, Čoka, 1904, 1905 BRNU, Laus, 1905, OLM, also Koňaříková [Kavalcová], 1971 (several hundred individuals), Kavalcová, 1996, (ca 10 individuals), rockeries and spring area, Kirschnerová & Klaudisová, 1997, (ca 90 flowering individuals); about a dozen individuals still grow here.

5969d

Karlov below Praděd Mt., southeast of the hillside of Kopřivná, Janáčková, 1962 (verbal report);
does not grow here anymore.

6069a

Žďárský Potok stream, peatland in the forest south of the gamekeeper's lodge, 1 km from the road, 700 m, Šula, 1965, OLM, also Kavalcová, 1973 [verbal report];
last recorded in 1973.

6069a

Stará Ves n. Rýmařov, southwest of the meadow below Ptačí vrch hill [Ptáčník], Koňaříková [Kavalcová], 1958.
Last time in 1971 (6 specimens), after that the locality was ploughed and it became extinct.

6069a

meadows near Janovice and Hanksstein, Schierl, 1891, DM: ex Oborny Oe.BZ 41 p. 181 (1891);
very old data which was not reconfirmed.

Data not included

- Veldes, Kastner, sine dato, Prachatice, CB
- Horner Berg bei Krumau, Froehlich, 1920, BRNU
- Schafberg [ČR-záp. ?], Weber, 1900, BRNU
- Karlsbad, Westseite des Horner Berges, forma violacea unterm typus recht zahlreich, Sterneck, 1936, CB, [purple-blue colour among typical specimens]
- b. Krumau, Jechl, sine dato, BRNU
- um Karlsbad, Hargas... [?], sine dato, PRC
- Nové Dvory, Vodák, sine dato, PRC [Bohdaneč]
- Nízký Jeseník, "Grund" u Šternberku, Hruby, 1914, DM: Hruby, Ostsud. 123 (1914)
- allein in den Sudeten, Beck, 1924, DM: G. Beck, Pflanzend. Tschechosl. 19 (1924)
: at Nízk. Jeseník, ca distrib., Hruby, DM: J. Hruby, Ostsud. 98 (1914)
- Rýmařov, Wiesen um dem Braunelstein, Simböck, 1988, PRC
- Im Quellen in der Baeren ... u. ..[Ho]herberg, Rohrer, 1829, PRC
- Wiesen gegen den Kahlenberg, Rohrer, 1827, PRC
- Hungerberg b. Waldenburg, sběratel neuveden, sine dato, BRNM
- Šumava without closer specification, name of collector or year of collection not given, CB [from older herb., probably applies to Český Krumlov, perhaps to the Mikuláš collection: "Šumava, Český Krumlov, near Rozsyp at the Vltava River, 500 m, Mikuláš J., 1893" DM]
- Krkonoše, Bílá louka (ca 1420), Th. Haenke 1986, in Jirasek et al. 1791, Bot. Beob. Riesengebirge. 82 (1791)
- Kamenicko nad Lipou, Nováček, NOVÁČEK (1952): Phytogeographic study of flora of Kamenice, 51 [probably a mistake]
- M., circulus Znaimensis, Schmidt, DM: F.W.Schmidt, in Mayers Samml. Phys. Aufs. I. 211 (1791)

ANNEX 4: ORTHOPHOTO MAP OF THE ROVNÁ NNM WITH MARKED AREAS OF OCCURRENCE OF *GENTIANA VERNA* L. SUBSP. *VERNA* (AREAS I AND II)

ANNEX 5

ANCLP CR QUESTIONNAIRE FOR MAPPING AND MONITORING ENDANGERED PLANT SPECIES, 2007

SPECIES NAME (Latin)	*Gentiana verna* L. subsp. *verna* syn. *Calathiana verna* (L.) Delarbre subsp. *verna*
SPECIES NAME (English)	Spring Gentian
LOCALITY (name – abbreviated for database)	Rovná u Strakonic
MORE ACCURATE LOCALISATION (municipality, meadow 300 m NW of municipality, spot heights, etc.)	meadow, former pasture on the west bank of the fishpond west of the municipality of Rovná
LOCALITY LOCATION DESCRIPTION (in case of a cabe or close to some distinct field point - tree, boulder etc.)	two rectangular areas (I and II) are fenced off, monitoring squares are marked in them by metal spikes in plastic tubes, a metal rod is aligned in the corner of area I
ACCURACY OF DRAWING IN MAP, AERAIL IMAGE (good, moderate, bad)	good
REGION	České Budějovice
OKRES	Strakonice
CATEG. OF SPT AND NAME	NPP Rovná
GRID REFERENCE (only if known)	49° 17′ 16″ N, 13°56′ 52″ E (area I)
MAP NUMBER 1:10 000	ZM 22-32-15
MONITORING AREA	8 monitoring squares, each 1 m^2 in size are divided into 100 fields 10x10 cm in size
ABOVE SEA LEVEL (minim., maxim)	420 m ASL
EXPOSURE, GRADIENT	flat area
POPULATION SIZE (enter number expressing total number of individuals)	2005 (15 polycormones), 2006 (20 polycormones) **2007 (27 polycormones**, some indigenously large polycormones fell apart into several small ones)
POPULATION SIZE UNIT (individuals, clusters, ramets, polycormones)	polycormones / clumps and flowering stems
POPULATION AREA (m2, ha, enter especially if the number cannot be determined)	area I: ca 10 m^2 , area II: 5 m^2
SIZE DATA QUALITY [good (accurate total), moderate (qual. estimate), bad (gross estimate)]	mostly sterile, smaller part fertile
PARTIAL NUMBERS (number of flowering or fertile plants, or their share of the total population – where it is not possible to determine numbers, the number of mature plants and seedlings, share of clusters and individuals etc.)	2005 (15 flowering stems, 3 capsules) 2006 (41 flowering stems, 3 capsules), **2007** (17 flowering stems, 2 mature capsules, 1 inadequately developed) seedlings in the field not ascertained
FERTILITY (sterile, fertile, unknown)	partly fertile, partly sterile
PLANT VITALITY (good, moderate, bad, unknown)	**bad**
PHENOPHASE (formation of shoots, foliage, flowering, ripening of fruits, ripening of seeds, dry plants)	evergreen, irregular flowering (weather changes) April to May, ripening of capsules June to July
DAMAGE, INFESTATION (% of damaged plants, e.g. by insects, eaten away, diseases)	plants are usually attacked by pests or diseases, but their vitality depends on the weather and level of shade

SOCIABILITY (1- continuous growth, 2 – clumps or clusters, 3 – individually)	2 – mostly clumps
POPULATION TYPE/ VITALITY (invasive, stable, senile – if can be determined)	sooner sterile, production of vital seeds is falling, inbreeding
POPULATION DEVELOPEMNT TREND (stable, increasing, decreasing, unknown)	**decreasing**
MAIN EFFECTS ON THE POPULATION (present and past) -	past 1. Threat by artificial fertilisers present and past 2. Main causes of decline were the end of grazing, change or absence of management. After the end of extensive grazing especially during which there was local damage to the soils, the possibility of germination and growth of new plants decreased. 3. Drying out of the locality by a drainage ditch and growing trees - poplars 4. Waste poplar leaves that slowly decay and shading of the soil surface prevents the germination of the seeds
THREAT AND EFFECTS (future)	Points 2-4 apply. 5. Likewise, there is a threat from climate changes (extremely drought and temperatures in spring and summer affecting seed production, and threatens that the seedlings will not be able to take root) 6. Isolated population and the resulting extremely reduced genotype variability (inbreeding depression)
BIOTOPE (biotope code and name)	T1.1/T1.9 Transition between mesophilous oat-grass and alternately damp spurrey-free meadow
HABITAT CIONSERVATION LEVEL (good, moderate, bad, unknown)	good
PHYTOCENOLOGY (where possible, enter at least alliance)	*Arrhenatherion* alliance locally moderate transition to the *Molinion* alliance

FURTHER SIGNIFICANT SPECIES:
C. distans (Bristly Oak Fern, C2), *C. disticha* (Two-ranked Hedge, C4), *C. hartmanii*, (Club Sedge, C3), *Centaurium pulchellum* (Branched Centaury, C2), *Dactylorhiza majalis* (Western Marsh Orchid, C3/§3), *Gentianopsis ciliata* (Fringed Gentian, C3), *Ophioglossum vulgatum* (Southern Adderstongue, C2/§3), *Taraxacum* sect. *Palustria* (5 species of Marsh Dandelion, C1,2/§3: *T. bavaricum, T. indigenum, T. madidum, T. paucilobum , T. intermedium* agg. and *T. pauckertianum*), *Valeriana dioica* (Marsh Valerian, C4).

EXISTING LOCALITY MANAGEMENT (type and period):

- 2000-2001: Regulated grazing – extensive overgrazing began in both years in June after ripening of achenes of *Taraxacum* sect. *Palustria*. The locality was overgrazed by 4 horses in various degree of intensity. A combination of cutting once a year (June)
- 2002-2007: cutting twice a year
- 2004: surface of vegetative cover was disturbed by the pulling of gates

Annex 6

DOCUMENTATION FOR CULTIVATED GENTIANA VERNA L. SUBSP. VERNA PLANTS

Plant origin: Rovná u Strakonic NNM - a mesic meadow on the bank of a fishpond

Sampling site: monitored area I (49° 17'19.2"N, 13°56'48.3"E)

Sampling date: 28.04.1998 – H1, H2, H3 (from polycormone in monit. square D)

06.10.1998 – H4 (from polycormone in monit. square A)

20.05.1999 – H5 (from polycormone in monit. square C)

Sampling for *in vitro* cultivation carried out by: L. Kirschnerová, ANCLP CR Prague

Sampling method: non-destructive, i.e. sampling of parts of plants – ca. 10 mm of big stems, plants were not seriously damaged

***In vitro* cultivation** (see Malá et al., 1998, 1999, 2001)

Cultivation site: Jíloviště-Strnady FGMRI, J. Malá

Propagation methods: micropropagation of explant cultures

Explant bank: H1, H2, H3, H4 (1998-2005 and further)

H5 (1999-2005 and further)

Number of propagated and additionally cultivated individuals: 356 (1999) provided the possibility for further research – isozymic analysis (Kirschnerová et al. 1999) and mycorrhizal study (Sýkorová 2002, Sýkorová et al. 2003); thereof 29 plants were retransplanted back in the locality. 15 were planted at the southeast boundary of area I, 14 individuals at the northwest boundary of area II. Further research was carried out on the planted plants – ABM colonisation and the effect of ABM of fungi on the vitality of *G *verna* specimens.

Mortality of *Gentiana verna* individuals in Rovná NNM propagated using explant cultures and planted in 1999 on areas I+ II			
year	total number of individuals	Number of flowering stems	Number of sterile plants
1999	15+14	no record	no record
2000	14+11	no record	no record
2001	12+8	46+6	2+6
2002	12+4	53+1	3+3
2003	5+0	0	5+0
2004	0	0	0

An exemption was granted by the Ministry of Environment in 1998 under ref. no: 1916/98-OOP/785/98 from the protective conditions especially of the *Gentiana verna* subsp. *verna (Calathiana verna)* protected species

KIRSCHNEROVÁ et al. (1999): Variabilita gentiana verna L. na lokalitě Rovná u Strakonic využitím metody isoenzymové analýzy. – 5 str., ms. [výzkum. Zpráva, depon. in ANCLP CR Praha].

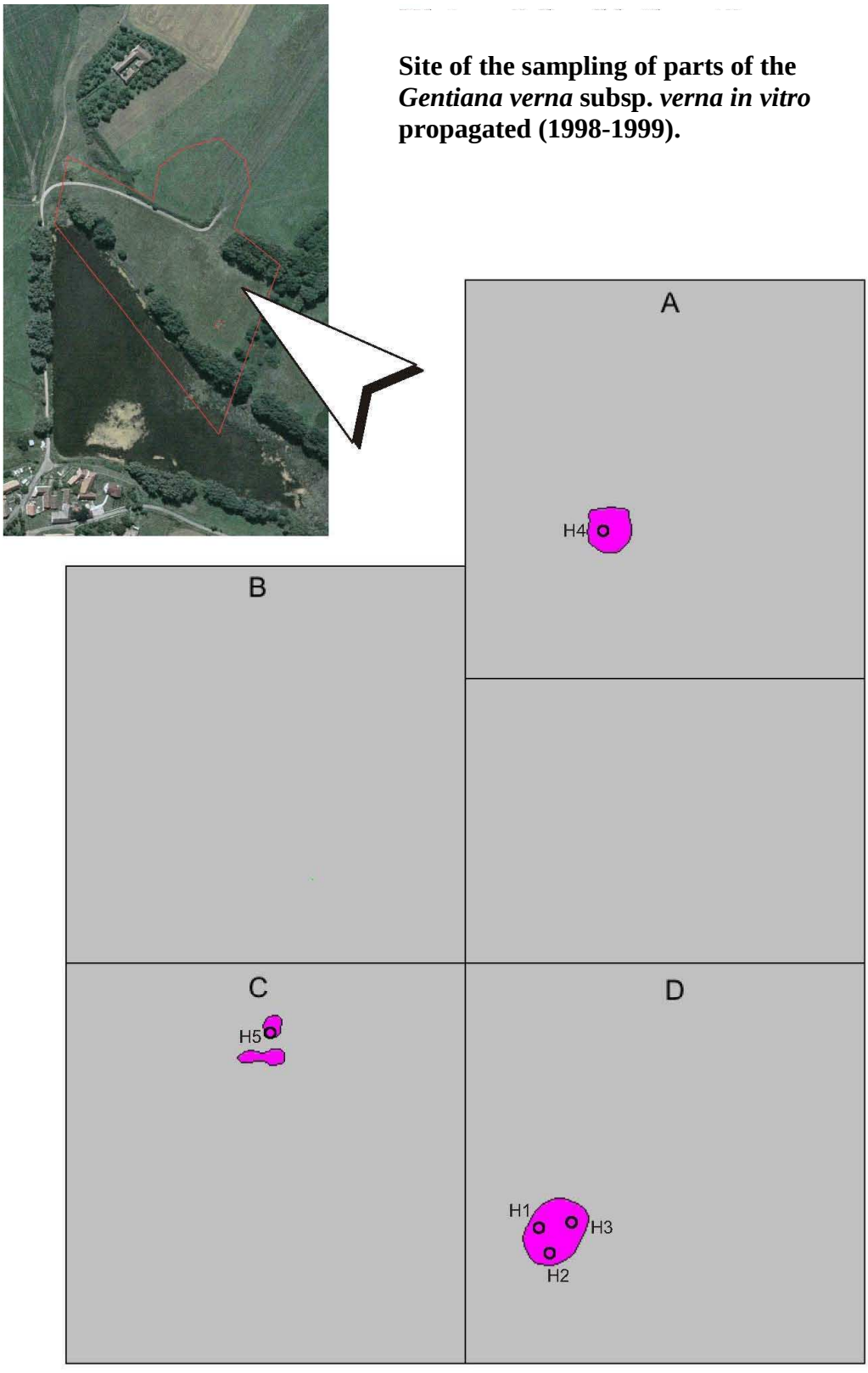
MALÁ J. et al. (1998, 1999): Mikropropagace hořepníčku jarního explantátovými kulturami. [I.], [II.] – 2p., 3p., ms. [výzkum, zpráva, depon. in ANCLP CR Praha].

MALÁ J. et al. (2001): Mikropropagace pro záchranu hořce jarního a lýkovce vonného. – Příroda 19: 55-58.

SÝKOROVÁ Z. (2002): Ecophysiology of arbuscular mycorrhiza associated with gentiana verna L. – Ms. [Dipl. Thesis, depon. in Přír. Fak. UK Praha (Charles University Natural Science Faculty, Prague)]

SÝKOROVÁ Z., RYDLOVÁ J. et VOSÁTKA M. (2003): establishment of mycorrhizal symbiosis in Gentiana verna. – Folia Geobotanica 38: 177 – 189.

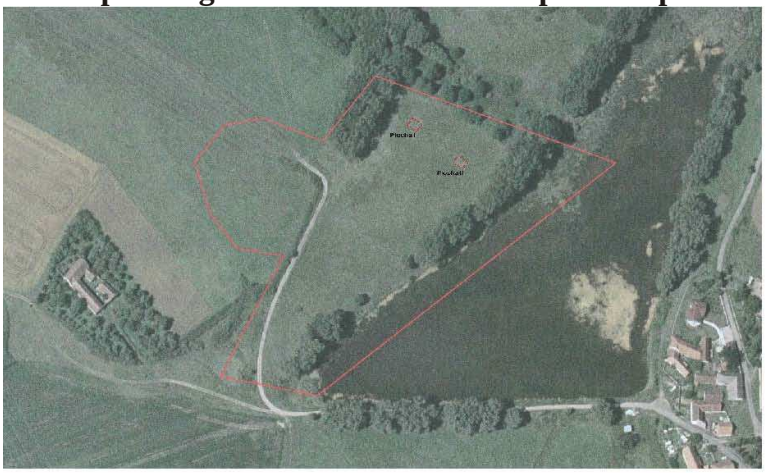
Annex 7A

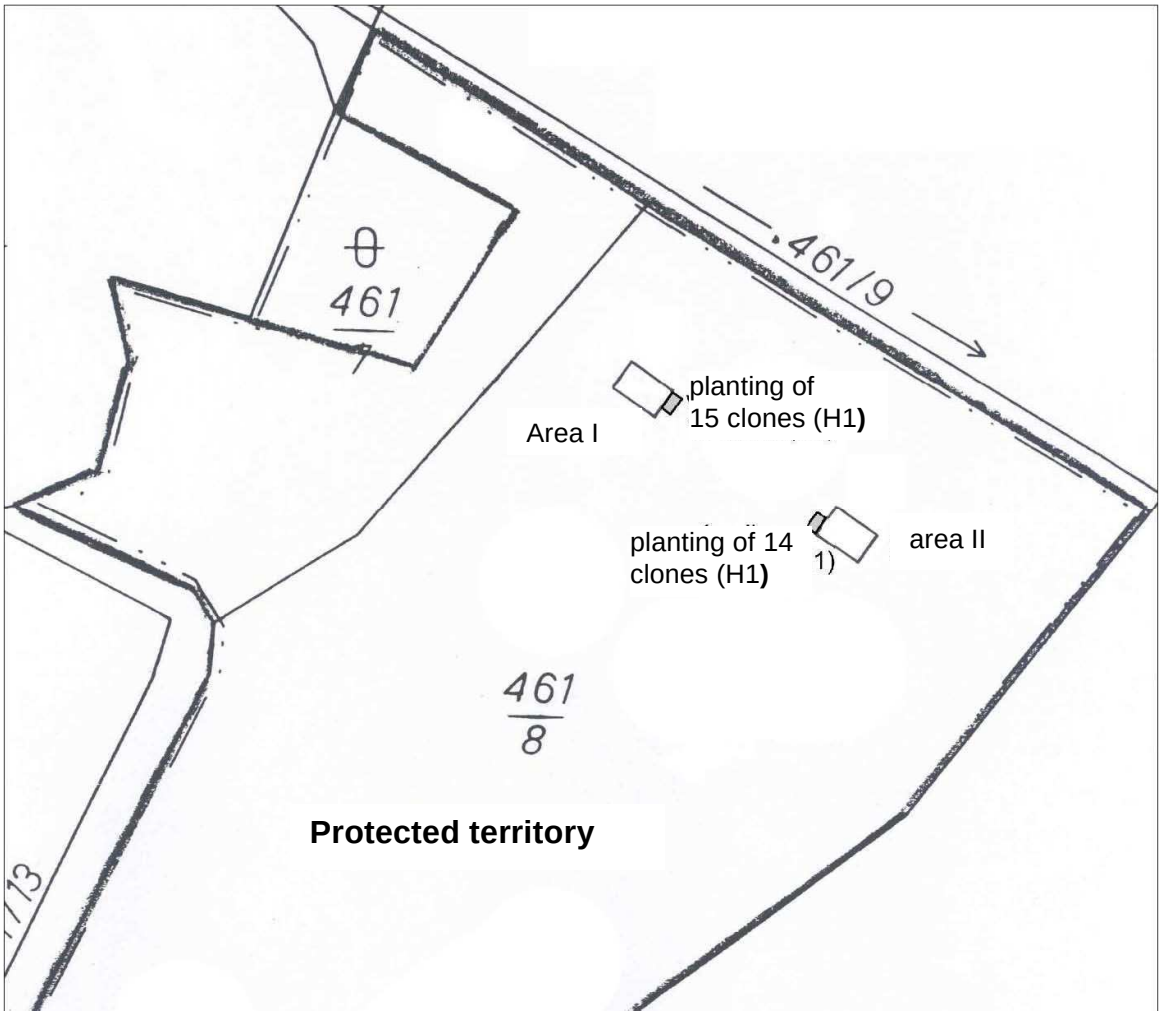


Site of the sampling of parts of the *Gentiana verna* subsp. *verna in vitro* propagated (1998-1999).

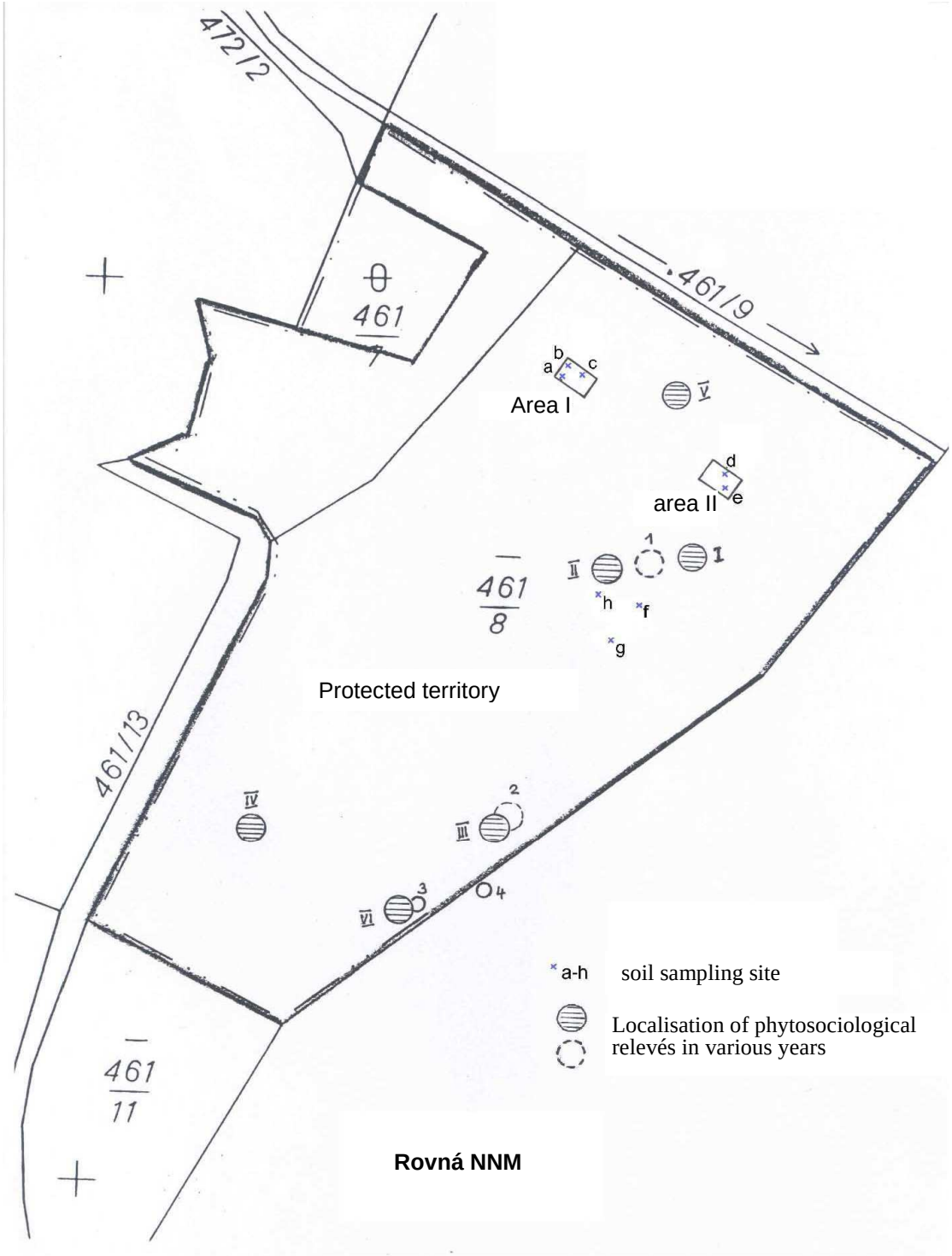
ANNEX 7B

Site of the planting of Gentiana verna subsp. verna plants in vitro propagated (1999).





ANNEX 8: SITE OF SOIL SAMPLING AND LOCALISATION OF PHYTOSOCIOLOGICAL RELEVÉS

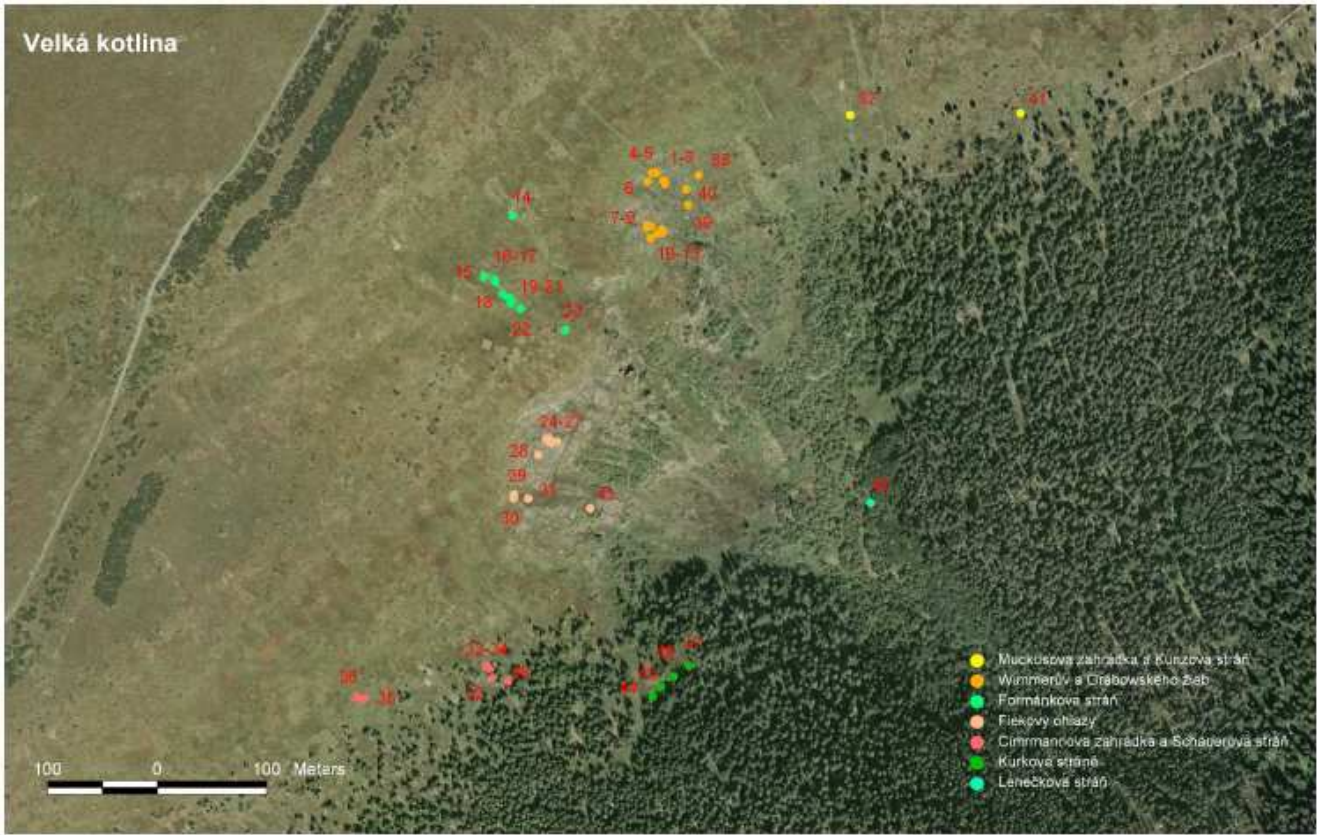


ANNEX 9: PHYTOSOCIOLOGICAL RELEVÉS IN ROVNÁ NNM, 1998 AND 2002 (J. LBRECHT).

Relevé number	I		II		III		IV		V	
Year	1998	2002	1998	2002	1998	2002	1998	2002	1998	2002
E_0 total cover (%)	10	<5	3	5	5	<5	5	<5	10	15
E_1 total cover (%)	80	90	85	95	85	90	85	90	80	85
Festuca pratensis	3	2a	3	2a	3	2a	3	1	2b	+
Holcus lanatus	1	+	2b	2m	2a	2b	1	1	+	2b
Deschampsia caespitosa	2a	.	2a	.	1	.	2b	.	.	.
Carex panicea	2a	2b	2	1	1	+	+	.	.	+
Carex flacca	1	2a	r	+	2a	1	1	+	r	1
Plantago lanceolata	2a	3	2a	3	1	1	2a	3	2a	2m
Briza media	1	2m	+	2b	+	2m	2a	2a	1	2b
Leontodon hispidus	+	2a	r	.	2a	2a	2a	2a	1	3
Festuca rubra	+	+	.	.	.	.	1	2a	.	.
Poa pratensis	.	2a	.	1	.	.	1	1	.	.
Jacea pratensis	+	.	+	+	+	r	+	2a	+	.
Ranunculus acris	1	1	1	+	r	+	1	1	.	1
Cerastium holosteoides	+	1	+	1	+	1	+	1	+	+
Lotus corniculatus	+	2m	+	2a	1	2a	1	2m	+	2a
Leucanthemum ircutianum	1	1	r	+	+	2a	+	1	1	1
Dactylis glomerata	r	1	.	+	1	1	+	1	1	2a
Linum catharticum	+	1	r	.	1	+	+	+	1	+
Achillea millefolium	+	.	.	.	+	1	+	.	+	.
Ranunculus repens	2a	1	2b	2m	2a	1	+	.	.	.
Trifolium pratense	+	2b	+	2a	+	2a	+	2a	r	1
Galium verum	+	1	+	.	.	2a	+	2b	2a	2a
Galium album	.	+	+	2m	+	2a	r	2a	+	+
Lathyrus pratensis	r	.	.	1	+	.	+	.	.	.
Lychnis flos-cuculi	r	.	+	.	.	.	+	.	.	.
Taraxacum sect. Ruderalia	2m	1	2m	1	+	.	.	.	.	+
Anthoxanthum odoratum	.	.	.	.	.	+	2m	1	1	+
Cynosurus cristatus	+	2a	.	1	.	1	+	2m	+	1
Trisetum flavescens	+	.	.	+	+	.	.	1	3	2a
Potentilla reptans	.	.	+	.	.	.	.	.	+	.
Sanguisorba officinalis	.	.	r	r	.	.	+	r	.	R
Alchemilla sp. (monticola)	.	.	.	.	+	.	.	+	+	.
Equisetum arvense	+	.	+	.	+	.	.	.	.	.
Cardamine pratensis	+	.	r	.	.	.	.	.	.	.
Acetosa pratensis	.	.	.	.	.	.	r	.	+	.
Carex caryophyllea	r	.	.	.	.	+	+	.	.	.
Luzula multiflora	.	.	r	.	.	+	+	.	+	+
Medicago lupulina	.	+	.	.	+	1	.	1	.	+
Carex disticha	.	.	1	2a	+	.	.	.	.	.
Carex hirta	.	.	+	.	.	.	.	+	.	.
Potentilla anserina	.	.	+	.	.	.	.	.	.	+
Juncus compressus	.	.	+	.	.	.	.	.	.	.

Relevé number	I		II		III		IV		V	
Year	1998	2002	1998	2002	1998	2002	1998	2002	1998	2002
Arrhenatherum elatius		.				.		.	2b	2m
Rhinanthus minor	.	.	.	.	+	.	.	.	.	.
Veronica chamaedrys	.	.	.	.	.	.	.	.	+	.
Trifolium repens	.	.	.	.	.	.	.	.	+	.
Succisa pratensis	.	.	.	.	.	.	.	.	r	.
Potentilla erecta	.	.	.	.	.	.	.	.	r	.
Carex distans	.	.	.	r	.	.	r	.	.	.
Phleum pratense	.	.	.	.	.	.	r	.	.	.
Calamagrostis epigejos	.	.	.	.	.	.	.	.	+	.
Cirsium arvense	.	.	.	.	r	+	.	.	.	.
Pastinaca sativa	.	.	.	.	+	r	.	.	.	.
Matricaria maritima	.	.	.	.	r	.	.	.	.	.
Species which newly appeared in 2002										
Crepis biennis	.	1	.	.	.	.	.	+	.	+
Rumex acetosella	.	+	.	+	.	.	.	.	.	+
Pimpinella major	.	.	.	+	.	.	.	.	.	r
Angelica sylvestris	.	.	.	+	.	.	.	.	.	.
Ranunculus bulbosus	.	.	.	.	.	.	.	.	.	+
Campanula patula	.	.	.	.	.	r	.	.	.	.
Heracleum sphondylium	.	.	.	.	.	r	.	.	.	.
Sieglingia decumbens	.	.	.	.	.	r	.	.	.	.
Plantago media	.	r	.	.	.	.	.	.	.	.
Dactylorhiza majalis	.	.	.	r	.	.	.	.	.	.

ANNEX 10: ORTHOPHOTO MAP OF VELKÁ KOTLINA FOLD WITH MARKED OCCURRENCE OF *GENTIANA VERNA* L. SUBSP. *VERNA* IN YEARS 2005-2007



Legend: Muckus allotment and Kunz slope, Wimmer and Grabowský dry valley, Formánek slope, Fieke smooth rocks, Cimrmann allotment and Schauer slope, Kurka slope, Leneček slope

ANNEX 11:

ANCLP CR QUESTIONNAIRE FOR MAPPING AND MONITORING ENDANGERED PLANT SPECIES

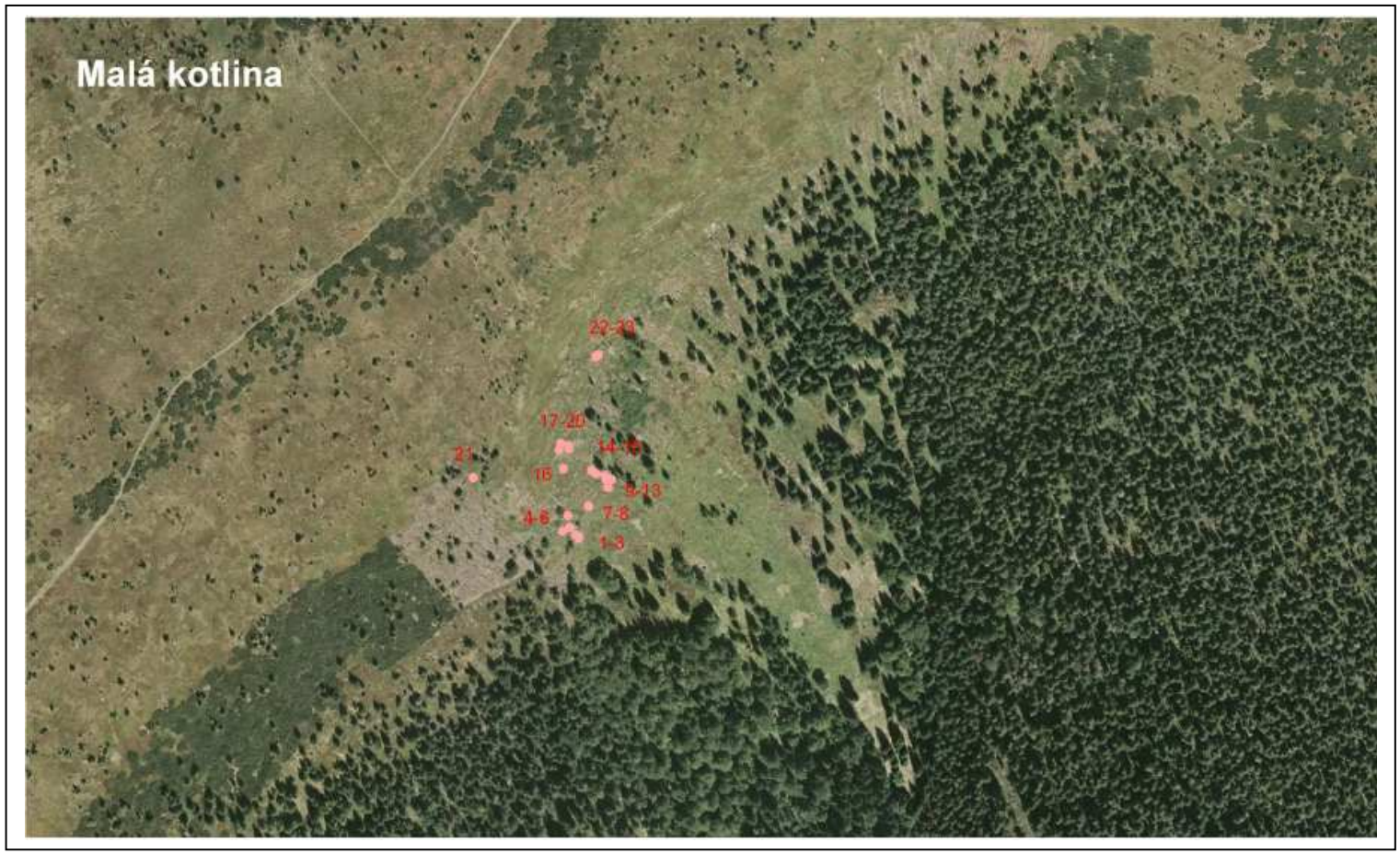
SPECIES NAME (Latin)	*Gentiana verna* L.
SPECIES NAMES (English)	Spring Gentian
LOCALITY (name – abbreviated for database)	Praděd NNR, Velká kotlina
ACCURATE LOCALISATION (municipality, meadow 300 m SW of municipality, spot heights etc.)	cad.terr. Malá Morávka, municipality Malá Morávka, SE slope Vysoké hole, spot height 1464 m, about 2 km below the spot height
POPULATION LOCATION DESCRIPTION WITHIN LOCALITY (close to a distinct field point - tree, boulder, corner of meadow etc.)	Amphitheatre of Velká kotlina and adjacent surroundings, see map drawing in appendix. Locality is divided into 7 monitoring segments: 1) Kunzova stráň (Kunz slope) 2) Wimmerův a Grabowského žleb (Wimmer and Grabowský dry valley 3) Formánkova stráň (Hořcový potok) Formánek slope (Gentian stream) 4) Fiekovy ohlazy (Fieke smooth rocks) 5) Cimrmanova zahrádka (Cimrman allotment) 6) Smrkový potok (Spruce stream) 7) Rathsburgův břeh (Rathsburg bank)
ACCURACY OF DRAWING IN MAP, AERIAL IMAGE (good, moderate, bad)	good
REGION	Moravian-Silesian
DISTRICT	Bruntál
CATEG. OF SPT AND NAME	Praděd NNR
GRID REFERENCE (only if known)	see appendix
MAP NUMBER 1:10 000	14- 24-24
MONITORING AREA	
ABOVE SEA LEVEL (minim., maxim)	1,140–1,410 m ASL
EXPOSURE, GRADIENT	SE, 5° – 40°
POPULATION SIZE (enter number or data expressing total number of individuals)	ca 2,600
POPULATION SIZE UNIT (individuals, clusters, ramets, polycormones; in case of ambiguity in determining the pop. size unit attach its word description)	flowering stems
POPULATION AREA (m^2, ha, enter especially if the number cannot be determined)	not ascertained
PARTIAL NUMBERS (number of flowering or fertile plants, or their share of total population – where it is not possible to determine numbers, the number of mature plants and seedlings, share of clusters and individuals etc.)	
SIZE DATA QUALITY [good (accurate total), moderate (qual. estimate), bad (gross estimate)]	1moderate
SOCIABILITY (1 continuous growth, 2 – clumps or clusters, 3 – individually)	1, 2 and 3
FERTILITY (sterile, fertile, unknown)	Sterile and fertile
PLANT VITALITY (good, moderate, bad, unknown)	Good

PHENOPHASE (condition on the date of verifying the population: formation of shoots, foliage, flowering, ripening of fruits, maturing of seeds, dry plants)	flowering
DAMAGE, INFESTATION (% of damaged plants, e.g. by insects, eaten away, diseases)	undamaged
POPULATION DEVELOPMENT TREND (stable, increasing, decreasing, fluctuating, unknown)	unknown
BIOTOPE (biotope code and name)	Seg. 1–4, 6,7: R.1.5 Subapline spring area, stream banks with loosened subapline vegetation A5 (damp rocky scree and avalanche paths) Seg. 5: A1.2 Closed alpine grasses
PHYTOCENOLOGY (where possible, enter only alliance for example)	
FURTHER SIGNIFICANT SPECIES AND CHARACTER OF VEGETATION (word description): Subalpíne spring area and stream banks with loosened vegetation: *Allium schoenoprasum* subsp. *alpinum, Carex echinata, Carex flava, Carex palescens, Drosera rotundifolia, Eriophorum vaginatum, Huperzia selago, Molinia caerulea, Parnassia palustris, Salix hastata, Trichophorum alpinum* Damp rocky scree and avalanche paths: *Bartsia alpina, Campanulla barbata, Epilobium alsinifolium, Galium boreale,Poa alpina, Phyteuma orbiculare* subsp. *montana, Scorzonera humilis,* Closed alpine grasses: *Botrychium lunaria, Campanula barbata, Gymnadenia conopsea, Hieracium aurantiacum, Phyteuma orbiculare* subsp. *montana, Thymus pulcherrimus subsp. sudeticus,Coeloglossum viride Hypochaeris uniflora, Crepis conyzifolia, C. mollis, Dianthus superbus subsp. alpestris, Cerastium fontanum, Euphrasia stricta, Scabiosa lucida subsp. lucida*	
HABITAT CONSERVATION LEVEL (good, moderate, bad, unknown)	unknown
THREAT AND EFFECTS (negative): Excessive input of nitrogen immissions causes increased formation of biomass – rate of harmfulness of this effect is still unknown	
MAIN EFFECTS OF THE POPULATION (positive): Stripping by trailing snow or avalanche (esp. seg.) forms naked areas suitable for make-up and growth of competitively weak gentian Seg. 5: cutting – regular removal of biomass creates more suitable conditions for the existence of the species	
EXISTING LOCALITY MANAGEMENT (type and period): Seg. 1–4 and 6,7: none Seg. 5 cutting	
PROPOSED LOCALITY MANAGEMENT: Seg. 1–4 and 6–7: none Seg. 5 cutting can also be replaced by grazing	
EXISTING SPECIES MANAGEMENT AND RESEARCH (type and period – enter only interventions applying direclty to species population to strengthen the population, seed collection and their ex situ cultivation, protective cage over the plants, etc.): This has not taken place.	

PROPOSED SPECIES MANAGEMENT AND RESEARCH: 1) Study of the method of reproduction and reproductive ecology 2) Detailed population monitoring	
AUTHOR OF FIRST FIND, DATE (only if known)	
VERIFIED BY, DATE	Radek Štencl, 04. and 13.06.2007
RECORDED BY, DATE	Martina Fialová and Radek Štencl, 01.02.2007
NOTE (literature quotations, photo, data specification, credibility, etc.)	

ANNEX: aerial image

ANNEX 12: ORTHOPHOTO MAP OF MALÁ KOTLINA FOLD IN PRADĚD NNR WITH MARKED OCCURRENCE OF *GENTIANA VERNA* L. SUBSP. *VERNA* IN YEARS 2005 – 2007



ANNEX 13:
ANCLP CR QUESTIONNAIRE FOR MAPPING AND MONITORING ENDANGERED PLANT SPECIES

SPECIES NAME (Latin)	*Gentiana verna* L.
SPECIES NAME (English)	Spring Gentian
LOCALITY (name – abbreviated for database)	Praděd NNR, Malá kotlina Fold
MORE ACCURATE LOCALISATION (municipality, meadow 300 m NW of municipality, spot height etc.)	Cad.terr. Malá Morávka, municipality Malá Morávka, SE slope below saddle between the peaks Jelení hřbet and Velký Máj
POPULATION LOCATION DESCRIPTION WITHIN LOCALITY (close to a distinct field point - tree, boulder, corner of meadow etc.)	Amphitheatre of Malá kotlina Fold and adjacent surroundings
ACCURACY OF DRAWING IN MAP, AERIAL IMAGE (good, moderate, bad)	good
REGION	Moravian-Silesian
DISTRICT	Bruntál
CATEG. OF SPT AND NAME	Praděd NNR
GRID REFERENCE (only if known)	See Annex
MAP NUMBER 1:10 000	14-42-04
MONITORING AREA	
ABOVE SEA LEVEL (minim., maxim)	1,200–1,310 m ASL
EXPOSURE, GRADIENT	SE, 5° – 40°
POPULATION SIZE (enter number or data expressing total number of individuals)	ca 175
POPULATION SIZE UNIT (individuals, clusters, ramets, polycormones; in case of ambiguity in determining the pop. size unit attach its word description)	polycormone
POPULATION AREA (m2, ha, enter especially if the number cannot be determined)	not ascertained
PARTIAL NUMBERS (number of flowering or fertile plants, or their share of total population – where it is not possible to determine numbers, the number of mature plants and seedlings, share of clusters and individuals etc.)	
SIZE DATA QUALITY [good (accurate total), moderate (qual. estimate), bad (gross estimate)]	accurate total
SOCIABILITY (1 continuous growth, 2 – clumps or clusters, 3 – individually)	1, 2 and 3
FERTILITY (sterile, fertile, unknown)	sterile and fertile
PLANT VITALITY (good, moderate, bad, unknown)	good
PHENOPHASE (condition on the date of verifying the population: formation of shoots, foliage, flowering, ripening of fruits, maturing of seeds, dry plants)	flowering
DAMAGE, INFESTATION (% of damaged plants, e.g. by insects, eaten away, diseases)	undamaged
POPULATION DEVELOPMENT TREND (stable, increasing,	unknown

decreasing, fluctuating, unknown)	
BIOTOPE (biotope code and name)	R.1.5 Subapline spring area of stream banks with loosened subapline vegetation A5 (damp rocky scree and avalanche paths)
PHYTOCENOLOGY (where possible, enter only alliance for example)	
FURTHER SIGNIFICANT SPECIES AND CHARACTER OF VEGETATION (word description): Subalpine spring area and stream banks with loosened subalpine vegetation *Allium schoenoprasum* subsp. *alpinum, Bartsia alpina, Galium boreale, Molinia caerulea, Pinguicula vulgaris, Trichophorum alpinum, Trollius altissimus, Viola palustris,* Damp rocky scree and avalanche paths: *Bartsia alpina, Campanulla barbata, Epilobium alsinifolium, Galium boreale, Trichophorum alpinum, Viola biflora…*	
HABITAT CONSERVATION LEVEL (good, moderate, bad, unknown)	unknown
THREAT AND EFFECTS (negative): Excessive input of nitrogen immissions causes increased formation of biomass – rate of harmfulness of this effect is still unknown	
MAIN EFFECTS OF THE POPULATION (positive): Stripping by trailing snow or avalanche (esp. seg. 1–4) forms naked areas suitable for make-up and growth of competitively weak gentian	
EXISTING LOCALITY MANAGEMENT (type and period): none	
PROPOSED LOCALITY MANAGEMENT: none	
EXISTING SPECIES MANAGEMENT AND RESEARCH (type and period – enter only interventions applying to interventions in the species population to strengthen the population, seed collection and their ex situ cultivation, protective cages over the plants, etc.): This has not taken place.	
PROPOSED SPECIES MANAGEMENT AND RESEARCH: 1) Study of the method of reproduction and reproductive ecology 2) Detailed population monitoring	
AUTHOR OF FIRST FIND, DATE (only if known)	

VERIFIED BY, DATE	Radek Štencl, 05.06.2007
RECORDED BY, DATE	Martina Fialová and Radek Štenc, 01.02.2007
NOTE (literature quotations from bibliography, photo, data specification, credibility, etc.)	

ANNEX: aerial image

ANNEX 14: ORTHOPHOTO MAP OF VELKÁ KOTLINA FOLD WITH LOCAL TOPOGRAPHICAL NAMES

Velká kotlina Fold – local topographical names

ANNEX 15: CONTOUR MAP OF VELKÁ KOTLINA FOLD WITH TOPOGRAPHICAL NAMES