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**INFLUENCE OF THE SPREADING OF ROADS
ON HERBAL VEGETATION COMPOSITION
IN THE ROADS VICINITY**

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The work deals with the impact of road salting materials (de-icing salts) to vegetation composition close to roads. Very detailed qualitative and quantitative botanical analysis of the herbaceous species composition has been investigated in the same sampling points as in the preceding paper.

Introduction

The paper deals with the impact of spreading of chemicals, in particular NaCl, on the vegetation near roads. This problem has occurred when solving the issue of the proposed testing polygon operation impact in the former military territory of

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Mladá u Milovic. The direct impact of road salting on herbaceous species composition and on vegetation composition changes depending on the distance from a road has been investigated on model transects. Since the road traffic in this particular location could affect directly the cruciate gentian (*Gentiana cruciata*) populations, the following study has paid special attention to this plant.

Of the various road spreadings the most important one is salting since it impacts directly the species composition at the roadside. The first selection of salt-tolerant or intolerant species takes place at the germination phase of seeds, and species of plants indifferent to salinization survive. High salts concentration is toxic for certain plants and it disturbs osmotic balance in cells. However, a similar effect could be caused by a one-sided pre-supply by calcite carbonate or nitrates, therefore both the substances have been analyzed in the samples. Later, the less resistant species are affected by necrotic changes, which is not apparent at the beginning of the vegetation season. Necroses have been observed in the case of germinating plants, however, they could have been caused by the application of herbicides.

Methodology

A detailed botanical survey has been carried out at the locations of sampling for chemical analyses [5]. At the location of two test transects near Chýšť and Nové Město at Chlumec nad Cidlinou a survey in six belts was repeated three times, the closest one was the proper roadside and the farthest one was a belt about 8 – 12 m from the road body. Special attention was paid to those species that indicate higher concentration of salts in the soil and to ruderal species that are tolerant to slight salting. The published tabular values of the optimum pH, relations to the volume of nitrates and to ammoniac nitrogen have been allocated to the individual found taxons according to the Ellenberg's methodology [1]. Species tolerant to soil salinization were selected from available literature, since from among the facultative halophytes only one was found during the survey, viz. the reflexed poa (*Puccinellia distans*).

Next, soil samples were analyzed (from botanical and chemical viewpoint) from the locations of the cruciate gentian (*Gentiana cruciata*) close to the road. Both the locations are in east Bohemia, one of them still exists, the other has been destroyed recently due to the road reconstruction. Other two samples were taken from the roadside under optimally developed anthropogenic sub halophyte population of the reflexed poa. The aim of the above analyses was to find out the approximate tolerance of both species to the relevant chemical substances.

Border Roadside Locations

Roadsides are a refuge of many weeds since they are outside the range of agrotechnical actions. Specific location conditions allow repeated reproduction and consequent spreading of some of them.

a) Roadsides

Partially exposed and frequently mechanically disturbed anthropogenic roadside soils provide suitable conditions for ecesis (growing and consequent propagation) of many field weed species. Annual species are predominant since they can adapt to extreme soil, hydrologic and micro-climatic conditions of such locations. From among the weeds that have spread here from other locations the most frequent species that are tolerant to considerably increased amount of NaCl or KCl in the soil, these are Colt's tail (*Conyza canadensis*), (*Galinsoga* sp.), various tumbleweeds, goosefoot and oraches (*Amaranthus* sp., *Chenopodium* sp., *Atriplex* sp.), (*Erigeron annuus*), various species of cresses (*Lepidium* sp.), out of domestic perennials, e.g., coltsfoot (*Tussilago farfara*) etc.

b) Ditches, edges of ditches, edges of banks or incisions

Only a limited number of weeds can grow in this specific environment. Turf grass communities that grow on such locations resist other species penetration. Therefore, only perennials with high competitive strength remain here, e.g., *Bunias orientalis*.

Out of foreign species we can expect spreading of, e.g., *Bidens frondosa* on exposed soils of periodically flooded ditches.

c) Locations with temporarily exposed soil surface

Such locations occur during road reconstructions, and they provide very suitable conditions for temporary but mass spreading of various weeds. From among the expansive species the most frequent are again some species of tumbleweed, goosefoot and orache (*Amaranthus* sp., *Chenopodium* sp., *Atriplex* sp.). Such temporary herbaceous communities can influence vegetation much more than any spreading materials, including salting.

List and description of localities where the soils samples were taken.

1) Transect – Nové Město near Chlumec nad Cidlinou.

Southward exposed bank above a railway at a very busy road No. R...č.I/11 east of the village.

A less unstable ruderalized community on an embankment with naturally seeded woody species that are removed periodically. Free soil at the roadside

under crash barriers is 0.5 to 1 m wide. There is a thick growth of bush grass about 1 m from the roadside on several places, major part of the area is occupied by open grassy growth. There is a field under the embankment, currently with rape. The field is treated by herbicides and necrotized plants are found not only at the field edge, but they are scattered on the lower part of the slope.

2) *Transect – Chýšť*

Gentle/gradual northward grass-covered slope of a busy road No. I/36 north of the Chýšť village. Free soil at the roadside is 0.5 m wide approximately, 1 – 2 m from the roadside there is an occasionally broken turf (vehicles wheels, etc.). In the direction away from the road there is a medium-thick cultural lawn with predominant dandelion (*Taraxacum* sp.). The number of ruderal species decreases in the direction away from the road.

Indication of sub halophytes indistinct, proven occurrence of salt-tolerant and of high nitrates level-tolerant species. Their occurrence demonstrably decreases in the direction away from the roadside, together with the ascertained Na^+ and Cl^- values.

Cruciate gentian locations (*Gentiana cruciata*).

3) *Hradec nad Svitavou, a marl slope of the road near the Muzlov hamlet, in the direction of the Dlouhá village.*

The open community is typical for marl (clay slate) slopes. One of the last cruciate gentian (*Gentiana cruciata*) locations in east Bohemia. It is also the location of wood-anemone (*Anemone sylvestris*), throrowax (*Bupleurum falcatum*) and other significant species. The location is close to a medium-busy road, with natural sub halophyte indication. The substrate proper includes a large amount of calcium and of clay fractions after the clay slate weathering. Majority of the clay slate slopes has the tendency to tolerate a higher salts amount in the substrate and such locations, in particular around small water seepages and springs, have a naturally sub halophyte character.

4) *Domoradice, a marl road slope at the Domoradice – Svařeň – Popovec crossroad*

The cruciate gentian (*Gentiana cruciata*) grew in this location till late 1970's. Some turfs grew close to the roadside and their occurrence was eliminated during the road reconstruction. The conditions of this location have practically remained

without any change. It is again a marl slope just above a medium-busy road. The indication species of marl slopes remain without any changes on the micro-location proper.

Locations with a strong road salting indication

5) *Ledce, at the Ledce – Pohořelice – Medlov crossroad, south of Brno*

6) *Ledce, a side road towards the Medlov village*

Roadsides with the occurrence of reflexed poa (*Puccinellia distans*) have been selected in order to determine marginal values of Na^+ and Cl^- . The samples were taken close to the village. The first sample was taken from the side of a very busy road connecting the city of Brno with Pohořelice, south of the Ledce village. Another sample was taken from a side road.

On both the locations reflexed poa (*Puccinellia distans*) develops as much as 0.5 m wide anthropogenic sub halophyte community with typical development.

Tabular values of the found herbaceous species depending on the soil pH, to soil nitrogen and tolerance to salting – freely according to Ellenberg [1].

Explanatory notes

R = chemical soil reaction

- 1 – indicator of extreme acidity, never found on weakly acid or basic soils
- 3 – acidity indicator, mainly on acid soils, but exceptionally also on nearly neutral ones
- 5 – indicator of moderate acid soils, only occasionally found on very acid or on neutral to basic soils
- 7 – indicator of weakly acid to weakly basic conditions; never found on very acid soils
- 9 – basic reaction and lime indicator, always found on calcareous soils
- x – species indifferent to pH

N = relation to nitrogen (ammonia or nitrate)

- 1 – indicator of sites extremely poor in available nitrogen
- 3 – indicator of sites more or less poor in available nitrogen
- 5 – indicator of intermediate nitrogen availability
- 7 – plant often found in places rich in available nitrogen
- 8 – nitrogenous indicator
- 9 – indicator of extremely rich situations, such as cattle resting places or near polluted rivers
- x – species indifferent to nitrates content

S = number of sub halophytic plant species found

- 1 – salt-tolerant species – facultative halophyte (sub halophyte)
- 2 – obligate halophyte – species bound to halophytic locations
- 3 – intolerant or indifferent species

	R	N	S
<i>Achillea millefolium</i>	x	5	-
<i>Allium vineale</i>	x	7	-
<i>Alopecurus pratensis</i>	6	7	-
<i>Anthoxanthum odoratum</i>	5	x	-
<i>Anthriscus sylvestris</i>	x	8	-
<i>Arabidopsis thaliana</i>	5	4	-
<i>Arabis hirsuta</i>	8	x	-
<i>Arctium tomentosum</i>	9	9	-
<i>Arrhenatherum elatius</i>	7	7	-
<i>Artemisia vulgaris</i>	x	8	-
<i>Atriplex oblongifolia</i>	7	6	1
<i>Atriplex patula</i>	7	x	-
<i>Atriplex prostrata</i>	x	9	1
<i>Atriplex sagitata</i>	7	9	1
<i>Ballota nigra</i>	x	8	-
<i>Bellis perennis</i>	x	5	-
<i>Brassica napus</i>	x	8	-
<i>Bromus hordaceus</i>	x	x	-
<i>Calamagrostis epigeios</i>	x	7	-
<i>Camelina microcarpa</i>	5	4	-
<i>Campanula patula</i>	7	4	-
<i>Campanula rapunculoides</i>	8	4	-
<i>Capsella bursa-pastoris</i>	x	7	-
<i>Carduus acanthoides</i>	x	8	-
<i>Carum carvi</i>	x	6	-
<i>Centaurea jacea</i>	x	x	1
<i>Cerastium arvense</i>	6	4	-
<i>Cerastium holosteoides</i>	x	5	-
<i>Cichorium intybus</i>	8	5	-
<i>Cirsium arvense</i>	x	7	1
<i>Cirsium vulgare</i>	x	8	-
<i>Convolvulus arvensis</i>	7	x	-
<i>Conyza canadensis</i>	x	4	1
<i>Crepis biennis</i>	6	5	-
<i>Dactylis glomerata</i>	x	6	-
<i>Daucus carota</i>	x	4	-
<i>Elytrigia repens</i>	x	8	1
<i>Epilobium tetragonum</i>	5	5	-
<i>Equisetum arvense</i>	x	3	-
<i>Euphorbia esula</i>	8	x	-
<i>Festuca brevipila</i>	x	6	1
<i>Festuca rubra</i>	x	x	-
<i>Ficaria verna</i>	7	7	-
<i>Gagea lutea</i>	7	7	-
<i>Galium album</i>	x	x	-
<i>Galium aparine</i>	6	9	-
<i>Geranium dissectum</i>	x	5	-

<i>Geranium pratense</i>	8	7	-
<i>Geranium pusillum</i>	x	7	-
<i>Glechoma hederacea</i>	x	7	-
<i>Heracleum sphondylium</i>	x	8	-
<i>Hylotelephium julianum</i>	7	x	-
<i>Hypericum perforatum</i>	x	x	-
<i>Hypochoeris radicata</i>	4	3	-
<i>Chaerophyllum aromaticum</i>	7	8	-
<i>Chenopodium album</i>	x	7	-
<i>Chenopodium ficifolium</i>	x	7	-
<i>Juncus inflexus</i>	8	4	1
<i>Lactuca serriola</i>	x	4	-
<i>Lamium album</i>	x	9	-
<i>Lamium purpureum</i>	7	x	-
<i>Leontodon autumnalis</i>	x	5	1
<i>Leontodon hispidus</i>	x	3	-
<i>Lepidium ruderale</i>	x	x	1
<i>Leucanthemum vulgare</i>	x	3	-
<i>Linaria vulgaris</i>	7	3	-
<i>Lithospermum arvense</i>	7	5	-
<i>Lolium perenne</i>	x	7	-
<i>Lotus corniculatus</i>	7	2	1
<i>Luzula campestris</i>	3	2	-
<i>Matricaria recutita</i>	5	5	-
<i>Medicago sativa</i>	8	8	-
<i>Melilotus sp.</i>	7	3	-
<i>Myosotis arvensis</i>	x	6	-
<i>Myosoton aquaticum</i>	x	8	-
<i>Papaver rhoeas</i>	7	x	-
<i>Pastinaca sativa</i>	8	5	-
<i>Phragmites australis</i>	7	5	1
<i>Plantago lanceolata</i>	x	x	-
<i>Plantago major</i>	x	x	1
<i>Poa angustifolia</i>	x	2	-
<i>Poa compressa</i>	9	2	-
<i>Poa pratensis</i>	x	x	-
<i>Polygonum aviculare</i>	x	x	-
<i>Potentilla anserina</i>	x	7	1
<i>Potentilla argentea</i>	3	1	-
<i>Potentilla inclinata</i>	3	1	-
<i>Potentilla reptans</i>	7	5	1
<i>Puccinellia distans</i>	7	7	2
<i>Pyrus pyraister</i>	8	?	-
<i>Ranunculus acris</i>	x	x	-
<i>Ranunculus bulbosus</i>	7	3	-
<i>Ranunculus repens</i>	x	x	1
<i>Rosa canina</i>	x	x	-
<i>Rumex acetosa</i>	x	5	-
<i>Rumex crispus</i>	x	5	1

<i>Rumex obtusifolius</i>	x	9	-
<i>Rumex thyrsiflorus</i>	7	5	-
<i>Sambucus nigra</i>	x	9	-
<i>Sanguisorba officinalis</i>	x	3	-
<i>Sisymbrium altissimum</i>	x	x	-
<i>Sisymbrium loeselii</i>	7	5	-
<i>Sonchus arvensis</i>	7	x	1
<i>Sonchus oleraceus</i>	8	8	-
<i>Stellaria media</i>	7	8	-
<i>Symphytum officinale</i>	x	8	-
<i>Tanacetum vulgare</i>	x	5	-
<i>Taraxacum sect. Ruderalia</i>	x	7	1
<i>Thlaspi arvense</i>	7	7	-
<i>Trifolium pratense</i>	x	x	-
<i>Tripleurospermum inodorum</i>	6	6	-
<i>Tussilago farfara</i>	8	x	-
<i>Urtica dioica</i>	x	8	-
<i>Verbascum thapsus</i>	7	7	-
<i>Veronica arvensis</i>	6	x	-
<i>Veronica hederifolia</i>	7	7	-
<i>Veronica chamaedrys</i>	x	x	-
<i>Vicia cracca</i>	x	x	-
<i>Viola arvensis</i>	x	x	-

Discussion

In spite of the short duration of survey expected dependencies have been found. The greater the distance from a road, the lower the content of Na^+ and Cl^- in the substrate, the diversity of a plant community decreases and the number of species tolerant to a slightly salinized substrate and sub halophytic species decreases rapidly. Expected significant variations in the nitrates content (including ammoniac nitrogen) were not proven although it has been found that the nitrophilous species occupy especially the open roadsides. Practically no significant pH variations have been found in the transect, either. In comparison to thick turfs further from the roads, nitrophilous (and, simultaneously, ruderal) vegetation can grow only close to a roadside.

Taking into consideration that in comparison to a normal "district road" there will be a very limited traffic in the polygon, it would not be necessary to apply so much salt on the roads here as in the case of major routes where soil has been analyzed with the aim to determine the range of higher NaCl concentration in soil. The existing findings document that when there is a connected turf at a road, the measured residua values decrease 2 m from the roadside. Expansion of undesirable weeds and of expansive species is limited at such conditions as well. There remains the open issue of salinization impact on mycoflora. The most

valuable observed species, the cruciate gentian (*Gentiana cruciata*), is a mycotrophic species, i.e. its existence is bound to specific fungi species when the plant creates a symbiotic relation with the fungi mycelium. When the environment of the soil mycoflora is disturbed, the viability of green plants bound to fungi decreases and they gradually disappear. So far, this issue is not clear. More information exists about the impact of acid rain with high content of sulphur oxides that destroy the soil mycoflora demonstrably. This is a topic to be solved in a future potential investigation.

Average measured values "R (pH), N (nitrogen content) and S (salinization tolerance)" on individual transect locations

	Species number	R	N	S
1 – Chýšť, roadside	41 tax.	7.4	5.9	10
2 – Chýšť, 1m from a road	32 tax.	6.7	5.8	5
3 – Chýšť, 2m from a roadside	26 tax.	6.9	6.0	5
4 – Chýšť, 4m from a road	18 tax.	6.8	5.9	2
5 – Chýšť, 6m from a road	21 tax.	6.8	6.5	2
6 – Chýšť, 10m from a road	26 tax.	6.8	6.5	2
1 – Nové Město, a roadside	29 tax.	7.0	6.4	10
2 – Nové Město, 1 m from a roadside	35 tax.	6.7	5.3	5
3 – Nové Město, slope, upper part	36 tax.	6.3	5.7	2
4 – Nové Město, slope, lower part	25 tax.	6.4	6.6	5
5 – Nové Město, slope bottom	31 tax.	7.0	6.7	3
6 – Nové Město, margin of a field under the slope	34 tax.	7.0	6.7	4

Explanatory notes

R = chemical soil reaction

Average pH value of tabular values of individual species found.

N = relation to nitrogen (ammonia or nitrate)

Average value of tabular values of individual species found

S = number of found sub halophytic plant species

Conclusion

Surveys of flora in the transects and, in parallel, chemical analyses from the locations have confirmed the assumption that salts concentration would decrease significantly within a short distance from the road. It has been found that as near

as 2 m from the roadside the measured values of NaCl decrease considerably and in the distance of 10 m from the roadside the impact was not traceable. Intentionally such transects have been selected that were close to very busy highways from Hradec Králové to Chlumec nad Cidlinou and from Pardubice to Chlumec nad Cidlinou that cannot be compared to the traffic or salting intensity of the proposed polygon. Creation and maintaining of a continuous belt of thick turf, at least 5 m wide, that would prevent penetration of NaCl to the growth close to a road and penetration of foreign ruderal plants to its vicinity is an important prerequisite for maintaining of the current diversity and prevention of ruderalization in the proposed polygon vicinity. Such a grassy belt must consist of a very thick “English lawn“ lawn that would have to be mowed very often, in particular during the first years, even once a week. This would ensure strong shooting and thickening of the growth, which would then provide good protection also against weeds penetration into the road vicinity, According to the survey, this concerns about 30 weed species that endanger the most the road vicinity by their excessive propagation. A shallow infiltration ditch along the road would be important as well, however, it would have to be covered by as thick grassy growth as the mowed belt. In this case a depth of about 30 cm and width of 1.5 – 2 m would be sufficient, so that it would be possible to mow it mechanically without any difficulties. The green mass that would include an increased amount of the spreading substances would have to be removed.

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- [4] Annex II, Decree No. 395/1992 Sb. of the Ministry of the Environment of the Czech Republic (list of specially protected species of plants and fungi).
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Appendix A – A List of Plant Species Found on the Surveyed Locations

Explanatory notes

Categories of endangerment used in the Black and Red List of Vascular Plants of the Czech Republic – 2000 [3]

[C2] – Strongly threatened taxa

[C3] – Threatened taxa

[C4a] – Rare or scattered taxa, requiring further study and monitoring - insufficiently studied

§3 – Taxa protected on the basis of Regulation of the Ministry of Environment of the Czech Republic No.395/1992 in the Category threatened [4]

Nomenclature is according to [2]

Surveyed transects

Transect Chýšť

66 taxons in all

- 1 – Chýšť, a roadside
- 2 – Chýšť, 1m from a roadside
- 3 – Chýšť, 2m from a roadside
- 4 – Chýšť, 4m from a roadside
- 5 – Chýšť, 6m from a roadside
- 6 – Chýšť, 10m from a roadside

Achillea millefolium L. agg.: 1, 2, 3, 4, 5, 6; *Allium vineale* L.: 1; *Alopecurus pratensis* L.: 2, 3, 4, 5, 6; *Anthoxanthum odoratum* L.: 3, 4, 6; *Anthriscus sylvestris* (L.) Hoffm.: 1, 2, 5; *Arrhenatherum elatius* (L.) J. Presl et C. Presl: 1, 2, 3, 4, 5, 6; *Artemisia vulgaris* L.: 1; *Atriplex patula* L.: 1; *Atriplex sagitata* Borkh.: 1; *Bellis perennis* L.: 1; *Brassica napus* L.: 1; *Bromus hordaceus* L. subsp. *hordaceus*: 1, 2, 6; *Calamagrostis epigeios* (L.) Roth: 1; *Campanula patula* L.: 2, 4; *Campanula rapunculoides* L.: 2; *Capsella bursa-pastoris* (L.) Med.: 1, 6; *Carum carvi* L.: 1, 2; *Cerastium holosteoides* Fries. em. Hyl. subsp. *triviale* (Spenner) Möschl.: 1, 2, 3, 5, 6; *Cichorium intybus* L.: 1, 2; *Cirsium arvense* (L.) Scop.: 2, 5; *Conyza canadensis* (L.) Cronquist: 1; *Crepis biennis* L.: 3, 5; *Dactylis glomerata* L.: 2, 4, 5; *Elytrigia repens* (L.) Nevsky: 1, 2, 3, 6; *Equisetum arvense* L.: 1; *Festuca brevipila* Tracey: 1; *Festuca rubra* L. agg.: 1; *Ficaria verna* Huds. subsp. *bulbifera* Á. Löve et D. Löve: 2, 3, 4, 5, 6; *Gagea lutea* (L.) Ker-Gawler: 3; *Galium album* Mill.: 1; *Geranium pratense* L.: 2, 3, 4, 5, 6; *Glechoma hederacea* L.: 1, 2, 3, 4, 5, 6; *Heracleum sphondylium* L.: 2, 3, 4, 5, 6; *Chaerophyllum aromaticum* L.: 2, 3, 4, 5, 6; *Chenopodium album* L.: 1; *Juncus inflexus* L.: 3; *Lamium album* L.: 5, 6; *Leontodon autumnalis* L.: 1; *Leontodon hispidus* L.: 6; *Lepidium ruderale* L.: 1; *Lolium perenne* L.: 1; *Lotus corniculatus* L.: 2, 3, 4; *Luzula campestris* (L.) DC.: 2; *Medicago sativa* L.: 1, 6; *Pastinaca sativa* L.: 1; *Plantago lanceolata* L.: 1, 2, 3, 4, 5, 6; *Plantago major* L.: 1; *Poa angustifolia* L.: 1, 2, 4, 5; *Poa compressa* L.: 1; *Poa pratensis* L.: 1, 2, 3; *Polygonum aviculare* L. agg.: 1; *Potentilla reptans* L.: 1; *Ranunculus acris* L.: 2, 3, 4, 5, 6; *Ranunculus bulbosus* L.: 1, 6; *Ranunculus repens* L.: 1, 2, 3; *Rumex acetosa* L.: 1, 2, 3, 4, 5, 6; *Rumex obtusifolius* L.: 6; *Sanguisorba officinalis* L.: 2, 3, 6; *Taraxacum* sect. *Ruderalia* Kirschner, H. Ollgaard et Štěpánek: 1, 2, 3, 4, 5, 6; *Trifolium pratense* L.: 1, 2, 3, 5, 6; *Tripleurospermum inodorum* (L.) Schultz-Bip.: 1, 2;

Tussilago farfara L.: 3; *Urtica dioica* L.: 2; *Veronica arvensis* L.: 6; *Veronica chamaedrys* L.: 2, 3; *Vicia cracca* L.: 3, 4, 5, 6;

Transect Nové Město at Chlumec nad Cidlinou

88 taxons in all

- 1 – Nové Město, a roadside
- 2 – Nové Město, 1m from a roadside
- 3 – Nové Město, slope, upper part
- 4 – Nové Město, slope, lower part
- 5 – Nové Město, slope bottom
- 6 – Nové Město, margin of the field under the slope

Achillea millefolium L. agg.: 1, 2, 3, 6; *Anthriscus sylvestris* (L.)Hoffm.: 5, 6; *Arabidopsis thaliana* (L.)Heynh.: 3, 4, 5; *Arabis hirsuta* L. agg.: 3; *Arctium tomentosum* Mill.: 2, 6; *Arrhenatherum elatius* (L.)J.Presl et C.Presl: 2, 3, 4, 5, 6; *Artemisia vulgaris* L.: 1, 2, 3, 4, 5, 6; *Atriplex oblongifolia* W.et K. [C4a]: 1, 4, 5; *Atriplex prostrata* DC. subsp.*latifolia* (Wahlenb.)Rauschert: 1; *Atriplex sagitata* Borkh.: 1, 4; *Ballota nigra* L.: 3, 5; *Calamagrostis epigeios* (L.)Roth: 1, 2, 5, 6; *Camelina microcarpa* DC.: 3; *Capsella bursa-pastoris* (L.)Med.: 3; *Carduus acanthoides* L.: 2, 3, 4; *Carum carvi* L.: 1; *Centaurea jacea* L. subsp.*jacea*: 1, 2; *Cerastium arvense* L.: 2; *Cichorium intybus* L.: 1, 2; *Cirsium arvense* (L.)Scop.: 2, 3, 4, 5; *Cirsium vulgare* (Savi)Ten.: 6; *Convolvulus arvensis* L.: 1, 3, 4, 5; *Conyza canadensis* (L.)Cronquist: 3; *Dactylis glomerata* L.: 1, 2, 3, 5, 6; *Daucus carota* L.: 2; *Elytrigia repens* (L.)Nevsky: 1, 6; *Epilobium tetragonum* L.: 4; *Equisetum arvense* L.: 2, 5; *Euphorbia esula* L.: 2; *Festuca brevipila* Tracey: 1, 2; *Festuca rubra* L. agg.: 1; *Ficaria verna* Huds. subsp.*bulbifera* Á.Löve et D.Löve: 3; *Galium album* Mill.: 2, 3, 4, 5; *Galium aparine* L.: 3, 4; *Geranium dissectum* L.: 6; *Geranium pratense* L.: 4, 5, 6; *Geranium pusillum* Burm.fil.: 6; *Hylotelephium julianum* (Bor.)Grulich: 3, 4, 5; *Hypericum perforatum* L.: 3, 5; *Hypochoeris radicata* L.: 1; *Chenopodium album* L.: 1, 6; *Chenopodium ficifolium* Sm.: 1; *Lactuca serriola* L.: 1; *Lamium album* L.: 2, 3, 4, 5, 6; *Lamium purpureum* L.: 3, 4, 5, 6; *Leucanthemum vulgare* Lamk. agg.: 2; *Linaria vulgaris* Mill.: 2, 3; *Lithospermum arvense* L.: 6; *Matricaria recutita* L.: 6; *Melilotus* sp.: 6; *Myosotis arvensis* (L.)Hill: 3, 6; *Myosoton aquaticum* (L.)Moench: 5; *Papaver rhoeas* L.: 3, 6; *Pastinaca sativa* L.: 1, 2, 5; *Phragmites australis* (Cav.)Steud.: 6; *Plantago lanceolata* L.: 2, 3, 5; *Plantago major* L.: 1; *Poa angustifolia* L.: 2, 3; *Poa pratensis* L.: 1, 2, 6; *Polygonum aviculare* L. agg.: 1, 2; *Potentilla anserina* L.: 6; *Potentilla argentea* L.: 2, 3; *Potentilla inclinata* Vill.: 2, 3, 4; *Potentilla reptans* L.: 5, 6; *Puccinellia distans* (L.)Parl.: 1; *Pyrus pyraeaster* Burgsdorf [C4a]: 5; *Ranunculus repens* L.: 2; *Rosa canina* L.: 3, 4, 5, 6; *Rumex acetosa* L.: 2, 3, 4, 6; *Rumex crispus* L.: 4; *Rumex thyrsoflorus* Fingerh.: 1, 2, 3, 4, 5; *Sambucus nigra* L.: 4, 5, 6; *Sisymbrium altissimum* L.: 3; *Sisymbrium loeselii* L.: 2; *Sonchus arvensis* L.: 1; *Sonchus oleraceus* L.: 1; *Stellaria media* (L.)Vill. agg.: 5, 6; *Symphytum officinale* L.: 5, 6; *Tanacetum vulgare* L.: 2; *Taraxacum* sect.*Ruderalia* Kirschner,H.Ollgaard et Štěpánek: 1, 2, 4; *Thlaspi arvense* L.: 3, 6; *Tripleurospermum inodorum* (L.)Schultz-Bip.: 1, 2, 3, 5, 6; *Tussilago farfara* L.: 1, 2; *Urtica dioica* L.: 4, 5, 6; *Verbascum thapsus* L.: 2, 3, 5, 6; *Veronica hederifolia* L. agg.: 3, 4, 6; *Viola arvensis* Murray: 3, 4, 5.

Appendix B – Locations of Point Sampling

Loc. No. 1 – Domoradice, forest at Svařeň – Popovec crossroad, Faltys, surveys carried out in 1970 – 1980

Actaea spicata L.; *Aegopodium podagraria* L.; *Aethusa cynapium* L.; *Ajuga reptans* L.; *Anthriscus sylvestris* (L.) Hoffm.; *Asarum europaeum* L.; *Astrantia major* L.; *Bellis perennis* L.; *Campanula trachelium* L.; *Carex flacca* Schreber; *Carex sylvatica* Huds.; *Carpinus betulus* L.; *Cephalanthera damassonium* (Mill.) Druce [C3 §3]; *Cirsium arvense* (L.) Scop.; *Cirsium oleraceum* (L.) Scop.; *Cirsium vulgare* (Savi) Ten.; *Clinopodium vulgare* L.; *Convallaria majalis* L.; *Convolvulus arvensis* L.; *Cornus sanguinea* L.; *Corylus avellana* L.; *Crepis biennis* L.; *Cruciata laevipes* Opiz; *Cynosurus cristatus* L.; *Epilobium angustifolium* L.; *Epipactis atrorubens* (Hoffm.) Besser [C3 §3]; *Epipactis helleborine* (L.) Crantz [C4a]; *Euphorbia cyparissias* L.; *Euphorbia dulcis* L.; *Fagus sylvatica* L.; *Fragaria vesca* L.; *Frangula alnus* Mill.; *Fraxinus excelsior* L.; *Galeobdolon montanum* (Pers.) Rchb.; *Galium aparine* L.; *Galium sylvaticum* L.; *Gentiana cruciata* L. [C2 §3]; *Geranium robertianum* L.; *Geum urbanum* L.; *Glechoma hederacea* L.; *Hedera helix* L.; *Hepatica nobilis* Schreber; *Heracleum sphondylium* L.; *Chaerophyllum aromaticum* L. -; *Chelidonium majus* L.; *Impatiens parviflora* DC.; *Inula conyzae* (Griseb.) Meikle; *Knautia arvensis* (L.) Coulter; *Lathyrus niger* (L.) Bernh.; *Lathyrus vernus* (L.) Bernh.; *Leucanthemum vulgare* Lamk. agg.; *Lilium martagon* L. [C4a §3]; *Linum catharticum* L.; *Lonicera xylosteum* L.; *Maianthemum bifolium* (L.) F.W. Schmidt; *Melampyrum nemorosum* L.; *Melica nutans* L.; *Mercurialis perennis* L.; *Mycelis muralis* (L.) Dum.; *Orthilia secunda* (L.) House; *Oxalis acetosella* L.; *Picea abies* (L.) Karsten; *Pimpinella saxifraga* L.; *Plantago major* L.; *Plantago media* L.; *Polygonatum multiflorum* (L.) All.; *Potentilla reptans* L.; *Primula elatior* (L.) Hill; *Prunella vulgaris* L.; *Prunus padus* L.; *Pulmonaria obscura* Dum.; *Quercus robur* L.; *Ranunculus acris* L.; *Ranunculus lanuginosus* L.; *Ranunculus repens* L.; *Rumex acetosa* L.; *Rumex obtusifolius* L.; *Sanicula europaea* L.; *Senecio ovatus* (G., M. et Sch.) Willd.; *Stachys sylvatica* L.; *Stellaria holostea* L.; *Taraxacum* sect. *Ruderalia* Kirschner, H. Ollgaard et Štěpánek; *Thlaspi arvense* L.; *Tilia platyphyllos* Scop.; *Urtica dioica* L.; *Vaccinium myrtillus* L.; *Veronica chamaedrys* L.; *Veronica persica* Poir.; *Viburnum opulus* L.; *Vicia sepium* L.; *Vincetoxicum hirsutinaria* Med.; *Viola hirta* L.; *Viola mirabilis* L. [C4a]; *Viola reichenbachiana* Bor..

Loc. No. 2 – Muzlov, slopes along a road northwest of the village, north of a rail tunnel, 300 m south-southeast of the Banín–Radiměř–Muzlov roads crossroad, Faltys 1990, 2003

Acer platanoides L.; *Agrimonia eupatoria* L.; *Achillea millefolium* L. agg.; *Ajuga genevensis* L.; *Ajuga reptans* L.; *Ajuga x hybrida* Kerner (= *A. genevensis* x *reptans*); *Alchemilla glaucescens* Wallr.; *Anemone sylvestris* L. [C3 §3]; *Angelica sylvestris* L.; *Anthyllis vulneraria* L.; *Aquilegia vulgaris* L. [C3]; *Arrhenatherum elatius* (L.) J. Presl et C. Presl; *Artemisia vulgaris* L.; *Astragalus glycyphyllos* L.; *Atropa bella-donna* L.; *Avenula pubescens* (Huds.) Dum.; *Briza media* L.; *Calamagrostis epigeios* (L.) Roth; *Campanula persicifolia* L.; *Campanula rotundifolia* L.; *Carduus acanthoides* L.; *Carex caryophylla* Latourr.; *Carex montana* L.; *Carlina acaulis* L. subsp. *acaulis*; *Carlina vulgaris* L.; *Centaurea jacea* L. subsp. *angustifolia* Greml.; *Centaurea jacea* L. subsp. *jacea*; *Centaurea scabiosa* L.; *Cirsium oleraceum* (L.) Scop.; *Clinopodium vulgare* L.; *Colchicum autumnale* L.; *Cornus sanguinea* L.; *Crepis biennis* L.; *Cruciata laevipes* Opiz; *Dactylis glomerata* L.; *Daucus carota* L.; *Echium vulgare* L.; *Erigeron acris* L.; *Festuca rubra* L. agg.; *Fragaria viridis* (Duchesne) Veston; *Fraxinus excelsior* L.; *Galium album* Mill.; *Galium*

pumilum Murray; *Galium verum* L. s.str.; *Gentiana cruciata* L. [C2 §3]; *Gentianopsis ciliata* (L.)Ma [C3]; *Hieracium lachenalii* Suter.; *Koeleria pyramidata* (Lamk.)P.B.; *Larix decidua* Mill.; *Lathyrus pratensis* L.; *Leontodon hispidus* L.; *Leucanthemum vulgare* Lamk. agg.; *Ligustrum vulgare* L.; *Linaria vulgaris* Mill.; *Linum catharticum* L.; *Lotus corniculatus* L.; *Melilotus albus* Med.; *Melilotus officinalis* (L.)Pallas; *Onobrychis viciifolia* Scop.; *Pastinaca sativa* L.; *Picris hieracioides* L.; *Pimpinella saxifraga* L.; *Pinus sylvestris* L.; *Plantago lanceolata* L.; *Plantago media* L.; *Poa compressa* L.; *Polygala comosa* Schkuhr; *Populus tremula* L.; *Potentilla heptaphylla* L.; *Potentilla tabernaemontanii* Aschers.; *Prunus spinosa* L.; *Ranunculus bulbosus* L.; *Rhamnus cathartica* L.; *Rhinanthus minor* L.; *Robinia pseudacacia* L.; *Rosa canina* L.; *Rosa dumalis* Bechst. subsp.*dumalis*; *Rubus caesius* L. agg.; *Salix caprea* L.; *Sanguisorba minor* Scop.; *Sanguisorba officinalis* L.; *Scabiosa ochroleuca* L.; *Securigera varia* (L.)Lassen; *Sedum sexangulare* L.; *Senecio jacobaea* L.; *Silene nutans* L.; *Silene vulgaris* (Moench)Garcke; *Solidago canadensis* L.; *Solidago virgaurea* L.; *Thlaspi perfoliatum* L.; *Thymus pulegioides* L.; *Tilia cordata* Mill.; *Torilis japonica* (Houtt.)DC.; *Tragopogon orientalis* L.; *Trifolium medium* L.; *Trifolium montanum* L.; *Verbascum thapsus* L.; *Vicia cracca* L.; *Viola hirta* L..

Loc. No. 3 – Hrušovany u Brna, W, ditches and fields south of the crossroad to Medlov west of the village, Faltys 2002

Amaranthus retroflexus L.; *Anthriscus sylvestris* (L.)Hoffm.; *Arabidopsis thaliana* (L.)Heynh.; *Arrhenatherum elatius* (L.)J.Presl et C.Presl; *Atriplex oblongifolia* W.et K. [C4a]; *Ballota nigra* L.; *Brassica napus* L.; *Bromus inermis* Leysser; *Calamagrostis epigeios* (L.)Roth; *Capsella bursa-pastoris* (L.)Med.; *Carduus acanthoides* L.; *Cirsium arvense* (L.)Scop.; *Conium maculatum* L.; *Consolida regalis* S.F.Gray; *Convolvulus arvensis* L.; *Dactylis glomerata* L.; *Descurainia sophia* (L.)Prantl; *Echium vulgare* L.; *Equisetum arvense* L.; *Falcaria vulgaris* Bernh.; *Galium album* Mill.; *Galium verum* L. s.str.; *Helianthus annuus* L.; *Heracleum sphondylium* L.; *Chenopodium album* L.; *Lactuca serriola* L.; *Lamium album* L.; *Linaria vulgaris* Mill.; *Papaver rhoeas* L.; *Polygonum aviculare* L. agg.; *Potentilla reptans* L.; *Puccinellia distans* (L.)Parl.; *Rumex thyrsiflorus* Fingerh.; *Salvia nemorosa* L.; *Setaria pumila* (Poir.)R.et Sch.; *Sonchus oleraceus* L.; *Tripleurospermum inodorum* (L.)Schultz-Bip.; *Urtica dioica* L..

Loc. No. 4 – Hrušovany u Brna, W, along the road to Medlov – Ledce – Pohofelice crossroad, Faltys 2002

Acer negundo L.; *Achillea millefolium* L. agg.; *Alliaria petiolata* (M.Bieb)Cavara et Grande; *Amaranthus retroflexus* L.; *Anthriscus sylvestris* (L.)Hoffm.; *Arabidopsis thaliana* (L.)Heynh.; *Arctium lappa* L.; *Arctium tomentosum* Mill.; *Azoreum rusticum* G.M.et Sch.; *Arrhenatherum elatius* (L.)J.Presl et C.Presl; *Artemisia vulgaris* L.; *Atriplex oblongifolia* W.et K. [C4a]; *Atriplex patula* L.; *Ballota nigra* L.; *Berteroa incana* (L.)DC.; *Brassica napus* L.; *Bromus sterilis* L.; *Calamagrostis epigeios* (L.)Roth; *Capsella bursa-pastoris* (L.)Med.; *Carduus acanthoides* L.; *Cirsium arvense* (L.)Scop.; *Conium maculatum* L.; *Convolvulus arvensis* L.; *Conyza canadensis* (L.)Cronquist; *Crepis capillaris* (L.)Wallr.; *Dactylis glomerata* L.; *Descurainia sophia* (L.)Prantl; *Echinochloa crus-galli* (L.)P.B.; *Echium vulgare* L.; *Elytrigia repens* (L.)Nevsky; *Equisetum arvense* L.; *Erodium cicutarium* (L.)L'Hér.; *Erophila verna* (L.)DC.; *Eryngium campestre* L.; *Euphorbia esula* L.; *Falcaria vulgaris* Bernh.; *Fallopia convolvulus* (L.)Á.Löve;

Festuca arundinacea Schreber subsp. *arundinacea*; *Festuca rubra* L. agg.; *Galinsoga parviflora* Cav.; *Galium album* Mill.; *Galium aparine* L.; *Galium verum* L. s.str.; *Geranium pratense* L.; *Heracleum sphondylium* L.; *Holosteum umbellatum* L.; *Hypericum perforatum* L.; *Chenopodium album* L.; *Chenopodium strictum* Roth; *Inula salicina* L. [C4a]; *Knautia arvensis* (L.)Coulter; *Lactuca serriola* L.; *Lamium album* L.; *Lamium purpureum* L.; *Lapsana communis* L.; *Lathyrus tuberosus* L.; *Leucanthemum vulgare* Lamk. agg.; *Linaria vulgaris* Mill.; *Medicago sativa* L.; *Melilotus officinalis* (L.)Pallas; *Myosotis arvensis* (L.)Hill; *Papaver rhoeas* L.; *Polygonum aviculare* L. agg.; *Potentilla argentea* L.; *Potentilla reptans* L.; *Puccinellia distans* (L.)Parl.; *Rubus caesius* L. agg.; *Rumex acetosa* L.; *Rumex acetosella* L.; *Rumex crispus* L.; *Rumex thyrsiflorus* Fingerh.; *Salvia nemorosa* L.; *Salvia pratensis* L.; *Sambucus nigra* L.; *Securigera varia* (L.)Lassen; *Senecio vulgaris* L.; *Setaria pumila* (Poir.)R.et Sch.; *Setaria viridis* (L.)P.B.; *Silene latifolia* Poir. subsp. *alba* (Mill.)Greuter et Burdet; *Silene noctiflora* L. [C4a]; *Silene vulgaris* (Moench)Garcke; *Sonchus oleraceus* L.; *Stellaria media* (L.)Vill. agg.; *Thlaspi arvense* L.; *Tragopogon dubius* Scop.; *Tragopogon orientalis* L.; *Tragopogon pratensis* L. s.str.; *Trifolium arvense* L.; *Tripleurospermum inodorum* (L.)Schultz-Bip.; *Trisetum flavescens* (L.)P.B.; *Urtica dioica* L.; *Veronica hederifolia* L. agg.; *Vicia sepium* L.; *Viola arvensis* Murray.