Zprávy Čes. Bot. Společ., Praha, 32, Mater. 15: 131–176, 1997

The present state of meadow vegetation (*Molinio-Arrhenatheretea*) in the Morava river floodplain (Hornomoravský úval area)

Současný stav luční vegetace třídy *Molinio-Arrhenatheretea* aluvia Moravy v prostoru Hornomoravského úvalu

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Introduction

River valleys have a long history of human influence. Deforestation of floodplains and subsequent regulation of rivers was accomplished as early as the 12th century (Petts 1989). Up to the 19th century the formation of floodplain vegetation was a relatively slow process. The rapid technological development and the intensification of agriculture during the 20th century (Rychnovská et al. 1985), which has lead to increased pollution (van Dijk et al. 1994), has increasingly influenced this habitat.

The crucial point in the use of agricultural land occurred in the second half of the 20th century with the change from local to large-scale intensive agricultural production with a high input of energy and material. This change mainly influenced the large river valleys in former Czechoslovakia (Labe, Morava, Dyje rivers). Between 1950–1985 ca 20 % of meadows were removed from the landscape (Halva 1985). Most floodplain meadows were ploughed and transformed into arable fields or were intensively managed. Prognosis from 1988 (Petřík 1988) forecast a gradual decrease in the area of grassland to 813,000 ha up to 1995 and an increase in yield to 3.7 t/ha. This would be achieved by (1) complex improvements and cultivation and (2) increased use of fertilizers.

The Morava river floodplain belongs to the most valuable floodplains in the Czech Republic (Banásová et al. 1994a, b, Straškrabová et al. 1996). Detailed phytosociological research was undertaken between 1956 and 1968 in the Hornomoravský úval area, mostly at the beginning of a period of substantial river regulation and agricultural intensification (Balátová-Tuláčková 1977, Balátová-Tuláčková in Rybníček et al. 1984, Bednář 1976, Bednář et Velísek ms., 1962, Holubičková 1960, Jílek et Velísek 1964). Important changes in diversity and species

M. Chytrý & Z. Neuhäuslová (eds.): Fytocenologický výzkum České republiky

composition of vegetation types were recorded during a survey of the study area between 1992–1994 (Duchoslav 1994, 1996). The aims of this study were:

(1) to determine the main factors influencing diversification of the present floodplain meadows in the area of Hornomoravský úval;
(2) to review the area and character of floodplain meadows after a period of intensive agricultural exploitation in the past 40 years.

Study area

The study area is a part of the Morava river floodplain between the villages of Bohutín (northern part, where the narrow river valley starts to develop a floodplain) and Tlumačov (southern part, an extensive floodplain). It belongs to the Hornomoravský úval region (Fig. 3).

Hornomoravský úval belongs to the complex of the Outer-Carpathian depression and is divided into three parts: northern, middle and southern (Demek et al. 1965). The northern part (Zábřežská sníženina) is a narrow valley, reaching a width of ca 3–5 km. The Morava river floodplain is composed of gravel covered by flood sediments. Sandy-loam and sandy soils dominate in this part. The middle part (Olomoucko-litovelská sníženina) is characterised by a flat or gently undulating landscape of erosion-prone sediments. The southern part from the line Kojetín-Přerov is formed mainly of clayey-loam soils (Pelíšek et Sekaninová 1975).

The Morava river floodplain was created during the Würm glacial and consists of three layers of substrate: (a) 1.0–1.5 m, (b) 1.5–2.5 m, (c) 2.5–4.5 m. The lower layers are composed of sand and gravel deposits and the higher of flood loams. Intensive colonization and deforestation since the Middle Ages has triggered frequent floods.

The general pattern of the hydrological conditions is characterised by a fluctuating water table and by floods. The highest level of the ground water table (close to the soil surface), or floods, occurs in March and April, the lowest in September and November.

The northern part of the study area belongs to the moderately warm region with higher annual rainfall (600–700 mm) (e.g. Zábřeh climatic station: 696 mm). The middle and lower parts of the Hornomoravský úval floodplain belong to the warm region with mean annual temperature 8–9.5 °C and mean annual rainfall about 600 mm (e.g. Olomouc climatic station: 8.4 °C, 612 mm) (Čvančara 1962, Vesecký et al. 1958).

Methods

The range of sampled stands includes all types of semi-natural grasslands of the class *Molinio-Arrhenatheretea* (i.e. mesophilous to wet meadows), even those on artificial substrata. The classical Zürich-Montpellier approach (Braun-Blanquet 1964) was used.

Where it was not possible to classify stands using the Zürich-Montpellier approach, a "deductive method" (Kopecký et Hejný 1978) was used, using basal communities (b.c.) and derived communities (d.c.). Ground layer (E_0) was not estimated. Nomenclature of taxa follows Neuhäuslová et Kolbek (1982), of the higher syntaxa Moravec et al. (1995). The species were assigned to the appropriate syntaxonomic units according to Balátová-Tuláčková (in Rychnovská et al. 1985). Life strategies according to Grime (1979) were taken from Frank et Klotz (1990).

For numerical analysis the species data were transformed using the ordinal transformation (van der Maarel 1979): –+ 12345 → 1235789. A total of 99 relevés were subjected to detrended correspondence analysis (DCA) (Jongman et al. 1987) using program CANOCO 3.1 with the default options (ter Braak 1993). Several environmental variables were related to the ordination axes after analysis. The following variables were used: (1) intensity of mowing (IM), estimated on an ordinal scale: 0 – without mowing for at least 5 years, 1 – irregularly mown, 2 – regularly mown; (2) habitat naturalness (HN): a – natural habitat: traditionally managed habitat on soils created by nature itself with a natural surface, b – semi-natural habitat: habitat with increased human exploitation, e.g. fertilization, c – anthropogenic habitat: newly established habitat without a natural surface, e.g. flood-dikes, drainage channels; (3) altitude (A; m a. s. l.); (4–6) moisture (M_c), soil reaction (R_c) and nitrogen (N_c) – indicator values by Jurko (1990) were used to express the relationship of the vegetation to the basic ecological factors (calibration sensu Jongman et al. 1987). Mean values were calculated for each relevé without species weighting.

The species diversity H' was computed using the Shannon formula (Magurran 1988), evenness *e* was expressed according to Pielou's formula (Pielou 1969).

The FAO soil classification was used for naming soil types. Soil samples were taken from the topsoil (0–20 cm) of selected samples in September 1993. Soil analyses were made according to Kubíková (1970) and Králová et al. (1990). pH value was measured in water and 0.1M KCl extraction potentiometrically. Janka's calcimeter was used for the determination of the calcium carbonate concentration, and base saturation (BS) was estimated using the Mehlich method. Carbon content (C_{ox}) was determined by titration of redundant dichromate by Mohr's salt after oxidation by chrome-sulfur mixture. Total nitrogen (N) was determined by the Kjehldahl method.

Ordination

Fig. 1 presents the ordination of species in the sample area. In the diagram the following trends are evident:

(1) Mesophilous species (*Arrhenatherum elatius, Knautia arvensis, Avenastrum pubescens*), species of semi-dry habitats (*Bromus erectus, Ranunculus polyanthemos*) or of intermittently wet sites (*Serratula tictoria, Betonica officinalis, Molinia caerulea*), and ruderals (*Artemisia vulgaris, Myosotis arvensis*), often

Fig. 1. – Ordination diagram (DCA) of species in the sample space. Only species with higher weight are presented.
Obr. 1. – Ordinační diagram (DCA) druhů v prostoru snímků. Jsou zobrazeny pouze druhy s vyšší váhou.

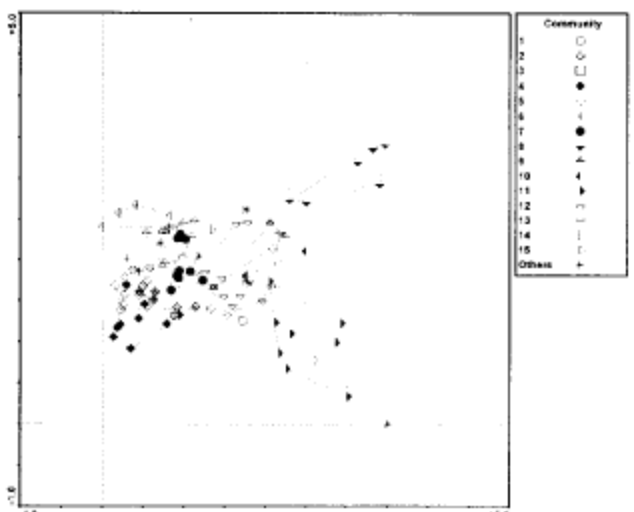

Fig. 2. – Sample points plotted in a two-dimensional DCA diagram. Final classification of relevés into appropriate phytosociological units is presented by different symbols.
Obr. 2. – Ordinační diagram snímků (DCA). Příslušná společenstva jsou vymezena různými symboly.

encountered on the elevated floodplain terraces or slopes, are concentrated in the left part, and those of flooded habitats (*Alopecurus pratensis*) or habitats with a high ground-water table for nearly the whole year (*Scirpus sylvaticus, Filipendula ulmaria, Cirsium rivulare, Phragmites australis*) in the right part.

(2) Species of nitrogen-rich and mostly unmown habitats belonging to the C-strategy (*Artemisia vulgaris, Urtica dioica, Chaerophyllum aromaticum*) and some R, SR and CR-strategists (*Convolvulus arvensis, Equisetum arvense*) are concentrated in the lower (right) part while those of traditionally managed meadows (mostly CRS and CS-strategists: *Scirpus sylvaticus, Juncus conglomeratus, Galium boreale*, etc.) are concentrated in the upper part.

(3) Grassland species with a wide ecological range (e.g. *Festuca rubra, Dactylis glomerata, Poa pratensis*) occur in the centre of the diagram.

Fig. 2 shows an ordination of the samples. The eigenvalue of the first axis is 0.447, that of the second 0.273. The first axis can be interpreted as a moisture gradient from both the irregularly and regularly mown habitats of the highest elevations in the floodplain without (or with only very occasional) flooding or those with a greatly fluctuating ground water table, through flooded ones to the unmown wet habitats with a high ground-water table. The second axis represents a composite ruderalization/fertility gradient where the intensity of human disturbance (excl. mowing) decreases from the lower to the upper part of the diagram. The diversity indexes (S, H′, e) show highly significant negative correlations with the first axis and positive correlations with the second axis (Tab. 1).

These trends were confirmed by a comparison of mean indicator values and measured values of selected environmental variables with sample scores for the first two axes. Moisture (M_c) shows a high positive correlation with the first axis, while nitrogen (N_c) shows a close positive/negative correlation with the first/second axis (Tab. 1). Reaction (R_c) shows no clear pattern. Intensity of mowing clearly cuts off stands in the left (upper) part – (ir)regularly mown meadows – from that of unmown in the right part (one-way ANOVA, $F_{AX\ 1\ (2,96)} = 10.76$, $P < 0.01$; $F_{AX\ 2\ (2,96)} = 2.90$, $P = 0.06$). Classification of stands on the basis of habitat naturalness shows a gradient from the anthropogenic stands in the lower part (drainage channels, flood dikes) to semi-natural ones in the upper part of the diagram ($F_{AX\ 1\ (2,96)} = 3.51$, $P = 0.03$; $F_{AX\ 2\ (2,96)} = 24.04$, $P < 0.01$). Altitude shows a negative

Explanations (Fig. 2) / vysvětlivky (obr. 2): 1. *Alopecurus pratensis-[Arrhenatheretalia]*; 2. *Arrhenatherum elatius-[Arrhenatherion]*; 3. *Festuca rubra-[Arrhenatherion]*; 4. *Aegopodium podagraria-[Arrhenatherion]*; 5. *Arrhenatheretum elationis*; 6. *Trifolio-Festucetum rubrae*; 7. *Holcetum lanati*; 8. *Scirpetum sylvatici*; 9. *Cirsietum rivularis*; 10. *Angelico-Cirsietum oleracei*; 11. *Lysimachio vulgaris-Filipenduletum*; 12. *Alopecuretum pratensis*; 13. *Sanguisorbo-Festucetum commutatae*; 14. *Molinietum coeruleae*; 15. *Deschampsia cespitosa-Festuca nigrescens-[Molinietalia]*, *Alopecurus pratensis-Phalaris arundinacea-[Molinietalia]*

Tab. 1. – Spearman rank correlations among scores of the first two ordination axes, indexes of diversity, environmental factors and ecological indicator values for the whole relevé set. Significant correlations (at $P \leq 0.05$) are indicated by bold type. Degrees of freedom are different for some pairs due to lower numbers of soil samples. AX 1 - first axis, AX 2 - second axis, S - species richness, e - equitability, H' - diversity, A - altitude, IM - intensity of mowing, M_C - moisture, R_C - soil reaction, N_C - nitrogen, BS - base saturation, C_{OX} - carbon content in soil, N - nitrogen content in soil.

Tab. 1. – Spearmanovy koeficienty korelace mezi ordinačními osami, indexy diverzity, faktory prostředí a průměrnými indikačními hodnotami pro celý snímkový soubor. Průkazné korelace ($P \leq 0,05$) jsou vyznačeny tučným písmem. Stupně volnosti se liší pro jednotlivé páry z důvodu nižšího počtu půdních vzorků. AX 1 - první osa, AX 2 - druhá osa, S - počet druhů ve snímku, e - vyrovnanost, H' - diverzita, A - nadmořská výška, IM - intenzita sečení, M_C - vlhkost, R_C - reakce, N_C - dusík, BS - nasycenost sorpčního komplexu, C_{OX} - obsah uhlíku v půdě, N - obsah dusíku v půdě.

	AX 1	AX 2	S	e	H'	A	IM	M_C	R_C	N_C	pH (H_2O)	pH (KCl)	BS	C_{OX}	N
AX 2	0.09														
S	**-0.47**	**0.22**													
e	**-0.48**	0.18	**0.67**												
H'	**-0.47**	**0.23**	**1.00**	**0.73**											
A	0.05	**-0.42**	-0.08	-0.13	-0.10										
IM	-0.28	**0.31**	**0.55**	**0.43**	**0.55**	0.10									
M_C	**0.91**	**0.25**	**-0.37**	**-0.42**	**-0.38**	0.02	**-0.24**								
R_C	**-0.30**	**-0.39**	-0.04	0.03	-0.05	0.13	-0.01	**-0.35**							
N_C	**0.45**	**-0.54**	**-0.25**	**-0.24**	**-0.27**	**0.32**	-0.13	**0.28**	**0.33**						
pH(H_2O)	-0.22	**-0.30**	-0.06	-0.03	-0.06	**-0.34**	-0.10	**-0.33**	0.17	0.00					
pH(KCl)	-0.11	-0.17	-0.17	-0.12	-0.17	-0.26	-0.12	-0.19	0.19	-0.01	**0.84**				
BS	**-0.28**	**-0.40**	-0.10	0.05	-0.09	-0.15	-0.04	**-0.46**	0.08	0.00	**0.83**	**0.62**			
C_{OX}	**0.33**	**0.58**	0.12	-0.10	0.10	-0.21	-0.09	**0.51**	-0.17	-0.14	**-0.48**	**-0.29**	**-0.64**		
N	**0.31**	**0.43**	0.02	-0.08	0.01	-0.14	-0.20	**0.50**	-0.05	-0.06	**-0.34**	-0.21	**-0.49**	**0.80**	
C/N	-0.02	0.23	0.10	-0.09	0.09	-0.06	0.06	0.08	-0.08	-0.17	-0.09	0.09	-0.23	0.28	-0.23

Tab. 2. – Differences in position of Grime's strategy types in the ordination diagram (Fig. 1). The differences were tested using Kruskal-Wallis One-Way ANOVA on Ranks and medians were compared using Kruskal-Wallis Multiple-Comparison Z-Value Test (d.f.=4). Medians not significantly different ($P \geq 0.05$) are marked by the same letter in row.

Tab. 2. – Rozdíly v pozicích Grimových typů strategií v ordinačním diagramu (obr. 1). Rozdíly byly testovány neparametrickou analýzou variance (Kruskal-Wallisův test) (stupně volnosti 4). Mediány byly porovnávány Z-testem (neprůkazně odlišné mediány ($P \geq 0.05$) jsou označeny stejným písmenem).

	R	C	CR	CS	CSR	H	P
AXIS 1	-0.67^{a}	1.19^{abc}	1.31^{bcd}	3.14^{cd}	0.98^{ac}	17.08	= 0.002
AXIS 2	0.93^{abc}	1.31^{b}	0.15^{a}	3.47^{c}	2.22^{c}	19.86	< 0.001

Tab. 3. – Mean species richness (S), diversity (H') and evenness (e) (± s.d.) of the communities described.

Tab. 3. – Průměrná druhová bohatost (S), diverzita (H') a vyrovnanost (e) (± směrodatná odchylka) rozlišených společenstev.

Community	n	S	H'	e
Alopecurus pratensis-[Arrhenatheretalia]	1	19.0	2.85	0.970
Arrhenatherum elatius-[Arrhenatherion]	9	35.4 ±3.5	3.47 ±0.10	0.974 ±0.004
Festuca rubra-[Arrhenatherion]	1	30.0	3.31	0.972
Aegopodium podagraria-[Arrhenatherion]	6	34.2 ±4.9	3.44 ±0.13	0.976 ±0.009
Arrhenatheretum elatioris	14	36.7 ±3.1	3.52 ±0.09	0.976 ±0.010
Trifolio-Festucetum rubrae	2	38.5 ±0.7	3.57 ±0.01	0.976 ±0.002
Holcetum lanati	9	39.6 ±6.7	3.58 ±0.20	0.977 ±0.003
Scirpetum sylvatici	6	18.3 ±4.9	2.73 ±0.29	0.947 ±0.020
Cirsietum rivularis	3	37.3 ±3.4	3.52 ±0.09	0.976 ±0.002
Alopecuretum pratensis	14	34.4 ±5.8	3.43 ±0.18	0.973 ±0.006
Alopecurus pratensis-Phalaris arundinacea-[Molinietalia]	1	19.0	2.79	0.949
Lysimachio-Filipenduletum	8	24.0 ±8.3	2.98 ±0.44	0.957 ±0.015
Angelico-Cirsietum oleracei	2	32.0 ±5.7	3.39 ±0.20	0.981 ±0.009
Sanguisorbo-Festucetum	10	43.3 ±3.7	3.69 ±0.09	0.981 ±0.002
Molinietum coeruleae	5	38.8 ±6.9	3.55 ±0.18	0.974 ±0.003
Deschampsia cespitosa-Festuca nigrescens-[Molinietalia]	1	18.0	2.81	0.971

correlation with the second axis, but this pattern is artificial and reflects different human influences in different parts of the river valley (Tab. 1). pH(H_2O) shows a weak significant negative correlation with the second axis. Base saturation (BS) is negatively correlated with both the first and the second axis. Both C_{ox} and N show positive significant correlations with both axes but their correlations with the second axis are much closer. Soils of moister habitats are more acidic and have a higher amount of C_{ox} and N (Tab. 1).

Relationships between ordination axes and Grime's strategy types (only C, R, CR, CS and CSR strategies were used) were tested. Species scores on both axes were significantly affected by the type of strategy (Tab. 2). The median score of CS strategists on the first axis exhibited significantly higher values than species with C, R and CSR strategies. The median score of CR strategists on the second axis were found to be significantly lower than the median score of C, CS and CSR strategists. The median score of C strategists were found to be significantly different from the median score of CS and CSR strategists.

Vegetation

In total, 16 communities (associations or association-level communities) were identified in the study area. Ninety-three of the 99 relevés were classified at this level, the rest of the group (6 relevés) was excluded due to its transitional species composition.

Syntaxonomical synopsis

Class: *Molinio-Arrhenatheretea* Tx. 1937
- Order: *Arrhenatheretalia* Tx. 1931
  - b.c. *Alopecurus pratensis*-[*Arrhenatheretalia*]
  - All.: *Arrhenatherion* Koch 1926
    - b.c. *Arrhenatherum elatius*-[*Arrhenatherion*]
    - b.c. *Festuca rubra*-[*Arrhenatherion*]
    - d.c. *Aegopodium podagraria*-[*Arrhenatherion*]
    - ass. *Arrhenatheretum elatioris* J. Braun 1915
      - subass. *typicum* Oberd. 1952
      - subass. *galietosum borealis* Bednář et Velisek 1962 prov.
    - ass. *Trifolio-Festucetum rubrae* Oberd. 1957
      - subass. *alopecuretosum* Neuhäusl 1972
    - ass. *Holcetum lanati* Issler 1936
      - subass. *arrhenatheretosum elatioris* Kovář 1981
      - subass. *cirsietosum cani* Kovář 1981
- Order: *Molinietalia* Koch 1926
  - b.c. *Deschampsia cespitosa-Festuca nigrescens*-[*Molinietalia*]
  - b.c. *Alopecurus pratensis-Phalaris arundinacea*-[*Molinietalia*]

  - All.: *Calthion* Tx. 1937 em. Lebrun et al. 1949
    - Suball.: *Calthenion* Balátová-Tuláčková 1978
      - ass. *Scirpetum sylvatici* Ralski 1931
        - subass. *typicum* Knapp 1945
      - ass. *Cirsietum rivularis* Nowiński 1927
        - subass. *arrhenatheretosum* Balátová-Tuláčková 1977
        - subass. *typicum* Balátová-Tuláčková 1977
      - ass. *Angelico-Cirsietum oleracei* Tx. 1937
        - subass. *caricetosum gracilis* Ellenberg 1952
    - Suball.: *Filipendulenion ulmariae* (Lohm. in Oberd. et al. 1967) Balátová-Tuláčková 1978
      - ass. *Lysimachio vulgaris-Filipenduletum* Balátová-Tuláčková 1978
        - subass. *typicum* Balátová-Tuláčková 1979
  - All.: *Alopecurion pratensis* Passarge 1964
    - ass. *Alopecuretum pratensis* (Regel 1925) Steffen 1931
      - subass. *typicum* Soó 1957
      - subass. *arrhenatheretosum* Špániková 1969
  - All.: *Molinion* Koch 1926
    - ass. *Sanguisorbo-Festucetum commutatae* Balátová-Tuláčková 1959
      - subass. *geranietosum pratensis* Balátová-Tuláčková 1965
    - ass. *Molinietum coeruleae* Koch 1926
      - subass. *typicum* Koch 1926
      - subass. *brometosum erecti* Klika 1946

Description of the communities

Alopecurus pratensis-[*Arrhenatheretalia*]

Species-poor stands with a cover of 90 %, dominated by *Alopecurus pratensis* (Tab. 3, 4). This community differs from the others by the absence of *Arrhenatherion* species. Ruderals (*Urtica dioica, Cirsium arvense*) are rather over-represented in the community which inhabits unmown slopes of railway embankments and well-drained habitats, usually on artificial substratum (anthroposoils). It has a scattered distribution along the railway in the northern part of the region (Fig. 3).

Arrhenatherum elatius-[*Arrhenatherion*]

This rather open community (70–100 % cover) is characterized by dominant *Arrhenatherum elatius* and a high abundance of ruderals (*Equisetum arvense, Convolvulus arvensis, Tanacetum vulgare*) (Tab. 4). The group of typical species includes some species of the *Arrhenatherion* and higher units (*Galium mollugo,*

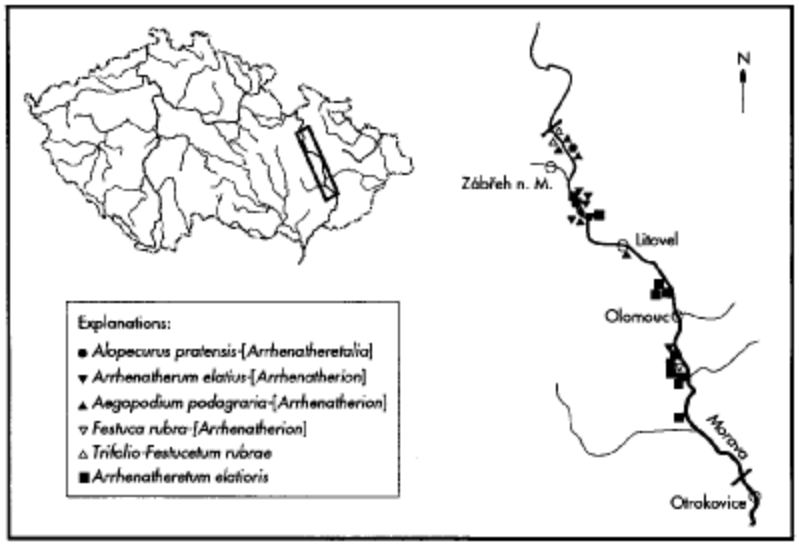

Fig. 3. – Distribution of communities (*Arrhenatheretalia* order) in the Morava river floodplain (Hornomoravský úval area).
Obr. 3. – Rozšíření společenstev ř. *Arrhenatheretalia* v nivě Moravy (Hornomoravský úval).

Heracleum sphondylium, Campanula patula, Geranium pratense, Leucanthemum vulgare); the mean number of species per relevé is high (Tab. 3). This community represents cultural meadows with many species of adjacent semi-natural grasslands.

The community inhabits slopes of the dikes on anthropogenic substrata in the central part of the region (surroudings of the villages of Lukavice and Dub n. M.) (Fig. 3). Anthroposoils are only 15–50 cm deep and mixed with ballast and rock debris. The soil reaction greatly varies from slightly acidic to slightly basic; base saturation is high with the presence of carbonates. The carbon content is low or medium, the C/N ratio is medium (Fig. 4).

Festuca rubra-[Arrhenatherion]

Festuca rubra is a dominant species of the community (Tab. 4). The group of typical species includes those of the *Arrhenatherion* and higher syntaxonomic units (*Geranium pratense, Arrhenatherum elatius*). Facultative acidophytes (*Luzula campestris, Agrostis tenuis*) are often present. The stands are moderately diverse and not fully closed (Tab. 3).

This community inhabits anthropogenic substrata dominated by sand on the convex landforms of regulated river banks (anthroposoils). It occurs only near the village of Trní in the central part of the study area (Fig. 3).

Aegopodium podagraria-[Arrhenatherion]

This species-rich community is characterized by closed stands (90–100 %) with *Aegopodium podagraria* and *Arrhenatherum elatius* as dominants (Tab. 4). The basic floristic composition includes 15 species of the *Arrhenatherion* and higher syntaxa. The occurrence of *Molinietalia* (*Lychnis flos-cuculi, Angelica sylvestris*) and *Galio-Urticetea* (*Anthriscus sylvestris*) species is typical of the community.

The community occurs in irregularly cut and often shaded habitats such as marginal stands along river banks, dikes, field roads or gardens. As a result of shading the stands have a favourable moisture regime and do not dry out in summer. The soil is slightly acidic or neutral with a favourable C/N ratio (Fig. 4). The community is sparsely distributed in the northern and central parts of the region (Fig. 3). The stands are irregularly mown.

Arrhenatheretum elatioris

Relatively homogeneous stands with a high presence and dominance of the *Arrhenatherion* species: *Arrhenatherum elatius, Pastinaca sativa, Campanula patula, Geranium pratense*, etc. (Tab. 5). The cover of the herb layer usually exceeds 80 %. The community is composed mainly of grasses and has a high species-diversity (Tab. 3). Within this community it is possible to distinguish two subassociations: *typicum* and *galietosum borealis*. The former has no differential species and inhabits slightly moist to semi-dry plains and gentle slopes out of reach of flood waters. The *galietosum* subass. is differentiated by *Molinion* and *Molinietalia* species: *Galium boreale, Selinum carvifolia, Betonica officinalis, Colchicum autumnale*, etc. Its habitats are characterized by a fluctuating ground water table.

The *Arrhenatheretum elatioris* colonizes brown, loamy or sandy-loamy soil, in some places with clay. Gley soils of the *galietosum* subass. contain a G_o horizon with flecks of rust. Chemical characteristics of the soils are rather varied. Soils have a wide range of pH from acidic (*galietosum* subass.) to basic and are fully base-saturated. The carbon content is medium to high in the *galietosum* subass. compared with the *typicum* subass. The C/N ratio is medium (Fig. 4). The *Arrhenatheretum elatioris* is distributed rather frequently in the central and southern parts of the region, mostly on the periphery of villages. The subass. *galietosum* only occurs near the village of Moravičany (Fig. 3). The stands are regularly managed and mown twice a year.

Trifolio-Festucetum rubrae

The community represents regularly mown meadows of slightly moist habitats (Tab. 5). *Trifolio-Festucetum* is a closed community, very rich in species (Tab. 3), in which mostly *Trifolium pratense, Festuca rubra* and *Holcus lanatus* predominate. The association is differentiated by *Campanula patula* and *Hypochoeris radicata* (cf. Neuhäusl 1972). In addition species of the class *Molinio-Arrhenatheretea* and subordinate units, and species of the *Nardo-Callunetea* (*Luzula campestris, Viola canina, Polygala vulgaris, Potentilla erecta*) occur. From the syntaxonomic point of

Tab. 4. – *Alopecurus pratensis*-[*Arrhenatheretalia*] (rel. 1), *Arrhenatherum elatius*-[*Arrhenatherion*] (rels. 2–10), *Aegopodium podagraria*-[*Arrhenatherion*] (rels. 11–16), *Festuca rubra*-[*Arrhenatherion*] (rel. 17).

Relevé number	1	2	3	4	5	6	7	8	9	10	%	11	12	13	14	15	16	%	17
Date	2/6	5/6	5/6	5/6	5/6	10/6	10/6	10/6	11/6	12/6		2/6	2/6	2/6	24/5	24/5	25/5		11/6
Year	92	92	92	92	92	92	92	92	92	92		92	92	92	93	93	93		92
Relevé size (m^2)	24	16	16	16	16	25	25	25	25	25		15	15	25	16	25	25		25
Aspect	–	ENE	ESE	SW	E	WSW	NNE	–	–	–		–	–	S	–	–	–		–
Inclination (°)	0	25	25	25	25	25	25	0	0	0		0	0	10	0	0	0		0
Altitude (m a.s.l.)	285	260	260	260	260	260	260	250	200	250		285	285	290	250	250	235		200
Cover E_1 (%)	90	85	95	95	100	95	85	100	70	100		100	85	100	95	90	100		95
Dominants																			
Alopecurus pratensis	5	.	.	.	1	+	–	2	+	+	67	1	.	4	1	1	1	83	+
Arrhenatherum elatius	.	2	4	3	5	3	3	3	3	3	100	3	3	3	4	4	2	100	1
Aegopodium podagraria	.	.	.	.	.	.	1	.	–	1	33	2	3	2	3	2	1	100	.
Festuca rubra subsp. *rubra*	.	2	2	2	2	2	2	2	2	2	100	1	2	2	1	2	2	100	5
Ch.– *Arrhenatherion*																			
Galium mollugo	2	1	1	1	1	2	2	2	2	1	100	1	1	2	2	1	1	100	1
Heracleum sphondylium	1	+	+	.	+	1	+	1	.	1	78	1	1	2	1	1	+	100	+
Campanula patula	.	1	1	1	+	+	+	1	.	1	89	1	1	1	1	1	.	83	+
Geranium pratense	.	1	1	1	+	3	.	2	1	1	89	2	2	1	1	1	1	100	2
Knautia arvensis	.	.	.	.	1	.	+	1	.	+	44	.	.	.	.	1	.	17	.
Crepis biennis	.	.	.	.	.	.	.	.	.	+	11	.	.	.	.	.	2	17	.
Pastinaca sativa	.	.	.	1	.	.	.	+	.	1	33	.	.	.	2	.	1	33	.
Ch.– *Cynosurion*																			
Leontodon autumnalis	.	2	1	.	1	.	.	.	.	.	33	.	.	.	.	.	.	0	.
Trifolium repens	.	.	.	.	.	.	.	.	.	.	0	1	.	.	.	.	1	33	.
Ch.– *Arrhenatheretalia*																			
Dactylis glomerata	1	.	.	1	2	2	.	3	1	+	67	2	2	2	2	+	1	100	1
Trisetum flavescens	.	1	1	2	2	1	2	3	1	2	100	2	2	2	.	+	2	83	.
Achillea millefolium	.	1	1	1	1	1	1	.	1	1	89	1	1	.	+	1	1	83	1
Centaurea jacea	+	.	.	.	+	.	1	.	2	+	44	+	1	.	–	.	.	50	+
Leucanthemum vulgare	.	.	2	3	1	2	2	+	.	3	78	.	1	.	–	.	.	33	.
Anthriscus sylvestris	+	.	.	.	.	.	.	+	–	+	33	+	1	.	+	.	2	67	.
Lotus corniculatus	.	.	.	1	.	.	+	.	2	.	33	2	1	.	.	.	.	33	+
Pimpinella major	.	.	1	1	+	.	.	.	1	.	44	.	1	.	1	.	.	33	1
Avenula pubescens	.	.	.	.	.	.	.	.	1	+	22	1	2	.	.	1	.	50	.
Vicia sepium	1	.	.	.	.	.	.	.	.	1	11	1	.	.	.	.	1	33	+
Trifolium pratense	.	.	.	.	1	.	.	.	+	+	33	.	1	.	.	.	.	17	.
Alchemilla sp.	.	.	.	.	1	+	+	.	.	.	33	.	1	.	.	.	.	17	.
Daucus carota	.	+	.	1	.	.	+	.	1	.	44	.	.	.	+	.	.	17	.
Tragopogon orientalis	.	+	.	+	.	.	.	.	.	.	22	.	.	.	.	.	.	0	.
Ch.– *Molinion*																			
Selinum carvifolia	1	.	.	.	.	.	.	.	.	.	0	.	1	.	.	.	.	17	.
Galium boreale	.	.	.	.	.	.	.	.	.	1	11	.	.	.	.	.	.	0	2
Ch.– *Calthion*																			
Cirsium oleraceum	.	.	.	.	.	.	.	+	.	.	11	.	.	2	.	.	1	33	.
Filipendula ulmaria	.	2	.	.	.	.	.	.	.	.	11	.	.	1	.	.	.	17	.
Cirsium canum	.	.	.	.	+	.	.	.	.	+	22	.	.	.	.	.	.	0	.
Ch.– *Molinietalia*																			
Symphytum officinale	+	–	+	–	–	+	+	+	.	.	78	–	.	.	.	+	+	50	.
Angelica sylvestris	1	+	.	.	.	.	–	+	.	.	33	+	.	+	.	+	1	67	.
Lychnis flos-cuculi	.	.	.	+	–	.	+	1	.	.	44	2	1	+	.	+	.	67	.

Tab. 4. – Continued/pokračování

Relevé number	1	2	3	4	5	6	7	8	9	10	%	11	12	13	14	15	16	%	17
Sanguisorba officinalis	2	.	.	.	+	+	+	.	.	1	44	.	1	.	.	.	.	17	1
Deschampsia cespitosa	.	1	.	1	.	1	1	1	1	.	67	.	.	.	+	.	1	33	.
Ranunculus auricomus	.	.	.	.	.	+	.	1	.	+	33	.	.	.	.	.	.	0	.
Ch.– *Molinio-Arrhenatheretea*																			
Poa pratensis	2	2	2	2	2	2	2	1	1	1	100	1	.	2	3	3	3	83	+
Plantago lanceolata	.	2	1	1	.	+	1	1	1	1	89	1	1	.	+	.	1	67	+
Ranunculus acris	.	.	+	1	+	.	.	1	.	1	56	2	2	2	2	2	1	100	+
Rumex acetosa	.	.	.	.	+	+	+	1	1	.	56	+	.	1	1	1	2	83	1
Holcus lanatus	.	+	+	.	+	.	1	2	.	.	56	.	2	3	.	1	.	50	1
Festuca pratensis	.	.	.	.	.	+	1	1	+	.	44	.	1	2	.	1	2	67	1
Vicia cracca	.	+	.	1	1	1	1	+	+	.	78	.	.	.	.	+	.	17	+
Cerastium holosteoides	.	+	+	.	.	+	.	1	.	+	56	.	.	+	1	1	1	67	.
Lathyrus pratensis	2	.	.	.	+	1	1	.	.	.	33	2	1	.	+	.	.	50	.
Poa trivialis	.	.	.	.	.	.	.	2	.	.	11	.	.	2	2	.	.	33	.
Prunella vulgaris	.	.	.	.	+	.	.	.	.	.	11	.	.	.	.	.	.	0	.
Ch.– *Agropyro-Rumicion crispi*																			
Ranunculus repens	.	.	.	.	.	.	.	.	.	.	0	.	.	1	1	.	.	33	.
Elydrigia repens	.	.	.	.	.	.	.	–	.	+	22	.	.	.	.	.	.	0	.
Ch.– *Nardo-Callunetea*																			
Luzula campestris	.	1	1	.	+	.	.	.	.	.	33	.	1	.	.	1	.	33	1
Ch.– *Festuco-Brometea*																			
Bromus erectus	.	.	.	.	.	.	.	.	.	3	11	.	.	.	.	.	.	0	1
Others																			
Veronica chamaedrys	.	1	1	1	1	2	1	1	1	1	100	1	1	1	2	2	2	100	1
Taraxacum officinale	.	1	1	1	2	1	.	1	.	1	78	1	1	1	1	1	2	100	.
Equisetum arvense	1	1	2	.	2	+	1	1	.	1	78	.	+	.	.	.	+	33	+
Leontodon hispidus	.	2	1	2	1	.	.	.	.	1	56	.	.	.	+	.	1	33	.
Urtica dioica	2	.	.	–	.	–	.	–	.	.	33	.	.	–	.	.	+	33	.
Anthoxanthum odoratum	.	.	.	.	.	.	.	.	.	.	0	.	2	2	1	.	2	67	2
Convolvulus arvensis	.	1	1	.	.	1	2	1	1	.	67	.	.	.	.	.	.	0	.
Lysimachia nummularia	.	.	.	.	.	.	.	1	.	.	11	1	.	1	+	.	1	67	.
Glechoma hederacea	.	.	.	.	.	+	.	1	.	.	22	.	.	+	.	.	1	33	.
Briza media	.	.	.	.	+	.	.	.	.	.	11	.	1	.	.	.	.	17	+
Melandrium album	+	.	.	.	+	.	.	2	.	.	33	.	.	.	1	.	.	17	.
Ajuga replans	.	.	.	+	.	.	.	.	.	.	11	.	.	.	–	1	1	50	.
Lamium album	.	.	.	.	.	+	.	+	1	.	33	.	.	.	+	.	.	17	.
Linaria vulgaris	+	.	.	+	.	+	.	.	+	.	33	.	.	.	.	.	.	0	.
Cirsium arvense	1	.	.	.	.	+	+	1	.	.	33	.	.	.	.	.	.	0	.
Thymus pulegioides	.	2	.	.	1	.	1	.	1	.	44	.	.	.	.	.	.	0	.
Carex hirta	+	.	1	.	.	.	+	.	.	.	22	.	.	.	.	.	.	0	.
Tanacetum vulgare	.	+	.	.	.	.	+	.	1	.	33	.	.	.	.	.	.	0	.
Silene vulgaris	.	1	.	.	.	.	1	.	1	.	33	.	.	.	.	.	.	0	.
Knautia kitaibelii	.	.	.	.	.	.	.	+	.	.	11	2	1	.	.	.	.	33	.
Carduus crispus	.	.	.	.	.	.	.	–	.	.	11	.	.	1	.	–	.	33	.
Hieracium umbellatum	.	2	.	2	.	.	.	.	.	.	22	.	.	.	.	.	.	0	.
Myosotis arvensis	.	.	.	.	.	+	.	1	.	.	22	.	.	.	.	.	.	0	.
Betonica officinalis	.	.	.	.	.	.	.	.	.	2	11	.	.	.	.	+	.	17	.
Galium aparine	1	.	.	.	.	.	.	.	.	.	11	.	.	.	–	.	.	17	.
Medicago sativa	.	.	.	1	.	.	.	.	+	.	22	.	.	.	.	.	.	0	.
Coronilla varia	.	.	2	.	.	.	3	.	.	.	22	.	.	.	.	.	.	0	.
Artemisia vulgaris	.	.	.	+	.	.	.	.	.	.	11	.	.	.	.	–	.	17	.

Species recorded in one relevé only:
Agrostis stolonifera 15:+, *Agrostis capillaris* 17:2, *Ajuga genevensis* 13:1, *Arenaria serpyllifolia* 3:–, *Ballota nigra* 15:+, *Bellis perennis* 3:+, *Brachypodium sylvaticum* 3:+, *Bromus sterilis* 9:+, *Cardamine pratensis* 13:–, *Carduus acanthoides* 6:+, *Carex pallescens* 14:1, *C. praecox* 16:2, *Cerastium arvense* 17:+, *Chaerophyllum hirsutum* 13:2, *C. aromaticum* 15:2, *Colchicum autumnale* 10:–, *Crepis succisifolia* 11:+, *Cruciata glabra* 6:1, *C. laevipes* 4:+, *Euphorbia esula* 2:+, *Festuca arundinacea* 16:1, *Fragaria vesca* 9:2, *Fraxinus excelsior* 15:+, *Geranium phaeum* 16:+, *Hieracium piloselia* 2:2, *Humulus lupulus* 15:–, *Hypericum perforatum* 15:+, *Loltum perenne* 8:+, *Melandrium rubrum* 13:–, *Moehringia trinervia* 15:1, *Phyteuma spicatum* 11:–, *Potentilla reptans* 9:1, *P. argentea* 9:1, *Rumex obtusifolius* 13:–, *R. acetosella* 12:+, *Sedum sexangulare* 3:1, *S. maximum* 9:+, *Stellaria media* 5:+, *Symphytum tuberosum* 13:–, *Valeriana officinalis* 2:2, *Veronica persica* 12:1, *V. serpyllifolia* 16:+, *Vicia* sp. 15:+, *V. tetrasperma* 3:2, *Viola hirta* 9:2, *V. arvensis* 6:–

view the relevés belong to the *alopecuretosum* subass.

The *Trifolio-Festucetum* occurs on habitats with brown soils. The A-horizon is a yellow-grey, sandy loam, containing numerous roots. It lies on the B-horizon with the sporadic presence of pebbles. Under the influence of ground water, a semi-gley horizon is sometimes present. Soils are acidic, base saturated, with a medium carbon content and a medium C/N ratio (Fig. 4). The community occurs in the northern part of the region near the village of Bludov (290 m a.s.l.) (Fig. 3).

Holcetum lanati

Species-rich stands (Tab. 3) (90–100 % in cover) dominated by *Holcus lanatus* belong to this association (Tab. 6). Species of the *Arrhenatheretalia* and *Molinietalia* prevail in the community, within which it is possible to distinguish two subassociations: *arrhenatheretosum* and *cirsietosum cani*. The former is differentiated by the higher presence of *Arrhenatherion* species (*Galium mollugo, Campanula patula, Arrhenatherum elatius*) and occurs in slightly moist habitats. The *cirsietosum* subass. is differentiated by *Cirsium canum, Galium boreale, Betonica officinalis* and *Galium verum* and occurs in moist habitats with a fluctuating ground-water table.

The community colonizes brown loamy, sandy-loamy or clayey-loamy soils (semi-gley soils). The A-horizon is yellow-brown and lies on the sandy-loamy or clayey-loamy G_o horizon. Soil reaction varies from strongly acidic (pH 4.3) to slightly acidic (pH 5.9); soils are highly base saturated. Carbon contents and C/N ratio are medium (Fig. 4). Soils of samples recorded in the northern part of the region show lower values of pH and BS compared with those in the central part. The *Holcetum lanati* occurs near the village of Bludov-lázně in the northern part of the region with some fragments being recorded in the central part of the region (the villages of Horka n. M. and Háje) (Fig. 5). The community is regularly mown twice a year.

Scirpetum sylvatici

Stands with an almost closed canopy are dominated by *Scirpus sylvaticus* (Tab. 7). The group of typical species includes some *Calthion* (*Filipendula ulmaria, Caltha palustris*) and *Molinietalia* species (*Sanguisorba officinalis, Deschampsia cespitosa*).

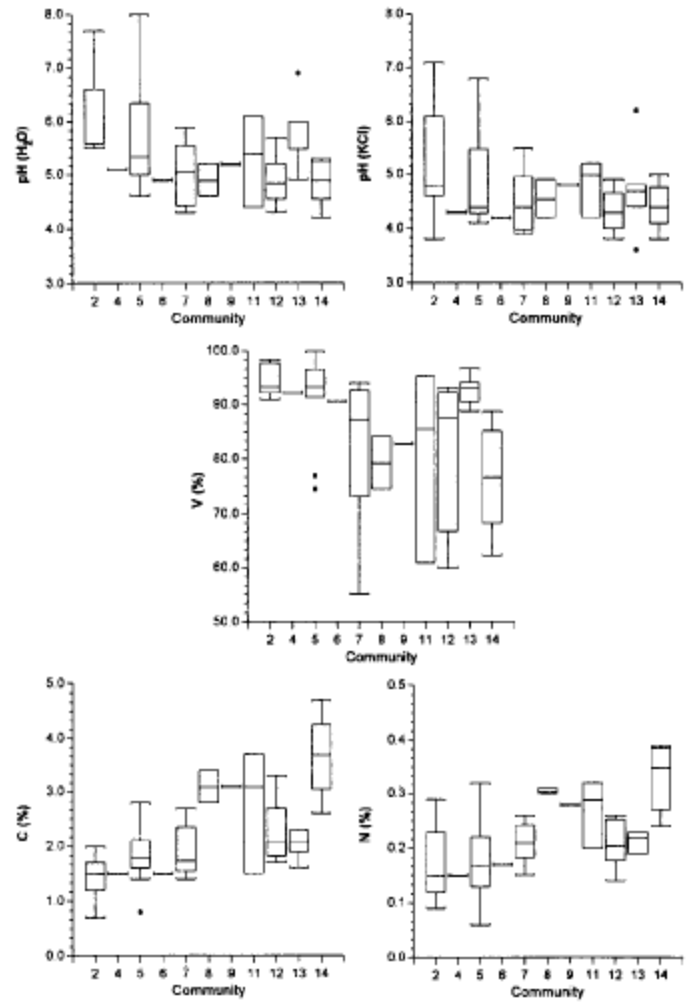

Fig. 4. – Box and Whisker multiple plots of selected chemical properties of soils of selected communities (for community number see Fig. 2).
Obr. 4. – Krabičkové diagramy vybraných chemických charakteristik půd studovaných společenstev (číslo společenstva viz obr. 2).

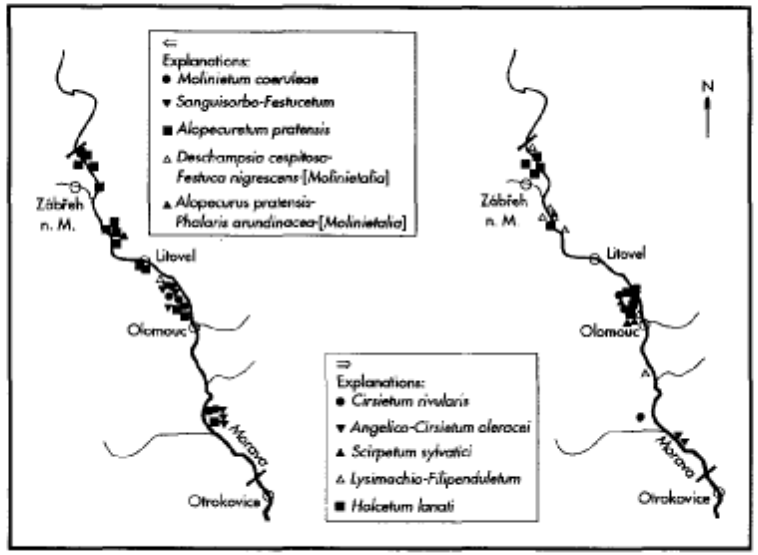

Fig. 5. – Distribution of communities (*Molinietalia* order) in the Morava river floodplain (Hornomoravský úval area).
Obr. 5. – Rozšíření společenstev ř. *Molinietalia* v nivě Moravy (Hornomoravský úval).

The presence of wetland species of the *Magnocaricetalia* (*Carex vulpina, C. gracilis, Galium palustre*) is typical of the community. Species diversity and evenness (Tab. 3) are low. A number of accidental species with very low presence is typical of the community. Community structure is closely related to the water regime and type of management. Long-term unmown stands are characterized by prevailing *Scirpus sylvaticus*, high amounts of litter and very low diversity. Irregularly mown stands are characterized by a higher diversity and by increased abundance of grasses.

The *Scirpetum sylvatici* inhabits depressions which are waterlogged for a long period in spring and have a high ground water table for the rest of the year. Gley soils (or pseudogleys) have a shallow G_o-horizon (< 10 cm) with flecks of rust lying on a loamy or clayey-loamy G_r-horizon. Soils are acidic, carbonate-free, base saturated, and the C/N ratio is medium (Fig. 4). The *Scirpetum sylvatici* occurs only in Plané loučky Nature Reserve near the town of Olomouc (Fig. 5). Stands are mostly unmown.

Cirsietum rivularis

Species-rich stands dominated by *Cirsium rivulare* (Tab. 3, 8). The group of typical species includes *Calthion* and *Molinietalia* species (*Myosotis palustris, Filipendula ulmaria, Angelica sylvestris, Sanguisorba officinalis, Lychnis flos-cuculi*). Species of

the *Arrhenatheretalia* (*Pastinaca sativa, Heracleum sphondylium*) are present in mesic habitats. Two subassociations were identified in the study area: *typicum* and *arrhenatheretosum*. The former is without differential species and occurs in wet habitats regularly waterlogged for a short time in spring and with a high ground-water table for almost throughout the year. The *arrhenatheretosum* subass. occurs in moist habitats.

Gley soils (semigley) with a shallow A-horizon (20 cm) lying on a G_o-horizon with flecks of rust over a clayey-loamy G_r-horizon. The soils are acidic, carbonate-free, base saturated, C/N ratio is medium (Fig. 4). Subassociation *typicum* occurs in the Plané loučky Nature Reserve near the town of Olomouc; the *arrhenatheretosum* subass. was identified in the southern part of the region between the towns of Kojetín and Chropyně. Some remnants were recorded in the northern part near the village of Bludov (Fig. 5). Stands are regularly mown once or twice a year.

Angelico-Cirsietum oleracei

The community is characterized by a group of *Calthenion* and *Calthion* species (*Cirsium oleraceum, Caltha palustris, Scirpus sylvaticus, Lysimachia vulgaris, Filipendula ulmaria*) (Tab. 8). *Molinietalia* and *Molinio-Arrhenatheretea* species (e.g. *Angelica sylvestris, Festuca pratensis, Alopecurus pratensis, Holcus lanatus*) are typical of the community. The canopy is closed and species diversity is medium (Tab. 3). The subassociation *caricetosum gracilis* with the differential species *Carex vulpina, C. gracilis, Polygonum amphibium* and *Phalaris arundinacea* was also identified in the region.

The *Angelico-Cirsietum* inhabits the littoral zone of fishponds with frequent waterlogging and with a high ground-water table for almost throughout the year. The community occurs in the southern part of the study area near the village of Záhlinice (Záhlinické rybníky) (Fig. 5). It is only irregularly mown.

Lysimachio vulgaris-Filipenduletum

Filipendula ulmaria has a dominant role in the species-poor stands with a closed canopy (Tab. 3, 9). The differential species *Lysimachia vulgaris* occurs with medium presence only. The most prominent group includes the species of *Molinietalia* (*Symphytum officinale, Sanguisorba officinalis*) and *Molinio-Arrhenatheretea* (*Rumex acetosa, Poa trivialis, Vicia cracca*). High numbers of accidental species, often ruderals (*Urtica dioica, Equisetum arvense*) are typical of the community. The subassociation *typicum* without differential species was identified in the region.

The *Lysimachio-Filipenduletum* inhabits unmown edges of wet meadows along the floodplain forests, old drainage channels, etc. Gley and semi-gley or anthropogenic soils are typical of the community. The O-horizon with a high amount of litter from preceding years overlays a loamy, loamy-clayey or sandy-loamy A_h-horizon, full of roots of *Filipendula ulmaria*. Loamy or clayey-loamy G_o and G_r-horizons lie under

Tab. 5. – *Arrhenatheretum elatioris typicum* (rels. 1–10), *galietosum* (rels. 11–14), *Trifolio-Festucetum* (rels. 15–16)

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	%	15	16	17
Date	4/6	4/6	9/6	11/6	11/6	11/6	11/6	11/6	11/6	16/6	12/6	12/6	24/5	24/5		2/6	2/6	25/5
Year	92	92	92	92	92	92	92	92	92	92	92	92	92	93		92	92	93
Relevé size (m^2)	25	25	25	25	25	25	25	25	25	25	25	25	25	25		25	25	25
Aspect	–	–	–	E	–	–	–	–	–	–	–	–	–	–		–	–	–
Inclination (°)	0	0	0	15	0	0	0	0	0	0	0	0	0	0		0	0	0
Altitude (m a.s.l.)	220	220	220	200	200	200	200	200	200	195	250	250	250	250		290	290	225
Cover E_0 (%)	100	100	75	80	100	100	100	100	100	80	100	90	75	65		100	100	100
Ch.– ass. *Arrhenatheretum elatioris*																		
Arrhenatherum elatius	4	4	3	3	4	4	5	3	2	3	3	3	3	3	100	1	1	2
Pastinaca sativa	.	.	+	1	1	.	1	1	+	1	.	+	1	1	71	.	.	.
D. – subass. *galietosum borealis*																		
Galium boreale	.	.	.	.	.	.	1	.	.	.	2	2	3	1	36	.	.	.
Selinum carvifolia	.	.	.	.	.	.	.	.	.	.	1	.	1	.	14	+	+	1
Betonica officinalis	.	.	.	.	.	.	.	.	.	.	2	1	1	1	29	.	.	.
Ch.– ass. *Trifolio-Festucetum*																		
Campanula patula	1	+	1	1	1	1	1	+	1	.	1	1	1	1	93	1	2	–
Lotus corniculatus	1	2	+	.	.	1	.	+	.	2	+	.	+	.	57	1	1	3
Alchemilla sp.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	7	1	1	.
Hypochoeris radicata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	+	.
Ch.– *Arrhenatherion*																		
Heracleum sphondylium	+	+	+	1	1	1	1	1	1	.	1	1	1	1	93	.	+	.
Geranium pratense	2	1	2	2	2	2	2	1	.	+	1	2	2	2	93	1	.	.
Galium mollugo	1	1	1	1	2	1	2	2	1	2	1	.	.	2	86	1	.	.
Knautia arvensis	2	2	1	.	1	1	1	–	.	.	1	1	1	1	79	.	.	.
Crepis biennis	.	+	.	1	.	+	.	–	+	1	+	.	.	1	57	.	.	.
Trifolium dubium	.	2	.	.	.	1	.	+	.	2	1	.	+	.	43	.	.	.
Ch.– *Cynosurion*																		
Trifolium repens	1	1	.	.	.	.	.	1	.	2	.	.	.	.	29	1	1	2
Leontodon autumnalis	.	2	2	1	1	.	.	.	.	1	.	.	.	.	36	2	2	.
Ch.– *Arrhenatheretalia*																		
Centaurea jacea	1	+	+	2	+	1	1	1	.	1	+	1	1	1	93	+	2	1
Trisetum flavescens	2	2	2	1	3	2	2	1	.	3	2	3	2	1	93	2	1	.
Achillea millefolium	1	1	1	1	+	1	1	+	.	1	1	+	1	.	86	1	1	1
Dactylis glomerata	1	1	.	.	2	2	2	1	1	2	.	1	1	2	79	1	.	1
Trifolium pratense	1	2	.	1	.	.	.	1	1	1	+	.	+	1	64	2	3	2
Leucanthemum vulgare	1	.	.	+	.	.	.	.	.	1	+	1	2	+	50	+	+	1
Vicia sepium	.	+	1	+	.	+	+	.	2	1	.	+	.	.	57	.	.	+
Anthriscus sylvestris	.	–	+	–	–	.	+	–	+	.	.	.	.	+	57	.	.	.
Avenula pubescens	1	1	+	.	.	.	.	.	.	.	.	.	1	1	36	.	+	1
Pimpinella major	.	+	1	1	.	.	1	.	.	.	1	1	.	.	43	.	.	.
Daucus carota	.	.	+	1	.	.	.	.	.	.	.	.	.	.	14	.	.	.
Ch.– *Molinietalia*																		
Sanguisorba officinalis	+	.	.	–	.	.	+	+	.	+	.	1	.	2	50	2	1	1
Lychnis flos-cuculi	+	.	.	.	.	.	1	.	.	.	+	+	1	.	36	+	+	3
Deschampsia cespitosa	.	.	1	1	1	1	2	.	.	.	1	1	.	+	57	.	.	.
Colchicum autumnale	.	.	.	.	.	.	.	.	.	.	+	+	+	+	29	.	.	.
Symphytum officinale	.	–	–	.	.	.	.	.	1	.	.	.	.	.	21	.	.	.
Ch.– *Molinio-Arrhenatheretea*																		
Ranunculus acris	1	1	1	+	1	1	1	1	+	.	1	1	2	2	93	2	2	2
Plantago lanceolata	2	1	1	1	1	1	.	1	1	1	1	1	1	1	93	2	2	2

Tab. 5. – Continued/pokračování

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	%	15	16	17
Holcus lanatus	2	2	2	.	1	1	1	1	4	1	2	2	1	1	93	3	3	3
Rumex acetosa	1	1	.	1	1	1	1	1	+	1	1	1	1	1	93	1	1	+
Festuca rubra subsp. *rubra*	2	2	1	2	2	2	2	3	.	1	2	1	2	1	93	3	3	.
Festuca pratensis	1	.	1	.	2	2	1	1	+	1	2	1	.	.	71	2	1	2
Poa pratensis	3	2	1	1	2	.	.	.	2	.	1	2	3	3	71	1	.	1
Vicia cracca	+	.	.	+	+	1	+	1	.	.	1	1	+	1	71	+	1	.
Cerastium holosteoides	1	1	+	.	1	1	.	.	.	.	+	1	+	1	64	1	1	–
Lathyrus pratensis	2	.	+	1	+	1	.	1	.	.	.	1	.	1	57	.	1	.
Alopecurus pratensis	.	.	.	.	+	+	1	+	.	.	1	+	.	+	50	.	.	1
Prunella vulgaris	.	.	.	.	.	+	.	1	.	.	.	.	.	.	14	1	.	.
Ch.– *Agropyro-Rumicion crispi*																		
Elytrigia repens	.	.	.	.	.	1	.	.	+	.	.	.	.	.	14	.	.	.
Ch.– *Nardo-Calluneteu*																		
Luzula campestris	+	+	1	+	.	1	+	1	.	.	1	.	1	1	71	1	1	2
Carex pallescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	3	.
Polygala vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	+	+
Ch.– *Festuco-Brometea*																		
Filipendula vulgaris	.	.	.	.	.	.	.	.	.	.	+	1	.	.	14	.	.	.
Others																		
Anthoxanthum odoratum	1	2	3	1	1	2	2	3	2	1	1	1	2	3	100	3	3	3
Taraxacum officinale	1	2	1	1	1	1	.	.	1	1	1	1	1	1	86	2	1	1
Veronica chamaedrys	1	1	1	1	1	1	1	2	1	.	1	1	1	1	93	+	.	.
Leontodon hispidus	1	2	2	2	.	1	1	.	.	.	2	.	1	.	57	2	2	.
Lysimachia nummularia	1	1	+	.	.	+	1	1	.	.	.	.	.	.	43	.	+	.
Equisetum arvense	+	1	.	.	.	.	.	.	.	.	1	+	+	+	43	.	.	.
Glechoma hederacea	+	.	.	.	.	.	.	+	2	.	+	+	.	.	36	+	.	.
Stellaria graminea	.	.	.	1	+	+	1	.	.	.	.	1	.	.	36	.	.	.
Bromus mollis	1	+	.	.	.	.	.	.	.	.	2	1	.	.	29	.	.	.
Vicia tetrasperma	.	.	+	.	1	2	.	.	.	2	.	.	.	.	29	.	.	.
Agrostis capillaris	.	.	+	.	.	.	.	3	.	.	2	2	.	.	29	.	.	.
Cirsium arvense	.	–	.	.	.	.	.	.	–	+	.	.	.	.	21	.	.	.
Aegopodium podagraria	.	.	.	.	.	.	2	.	2	.	.	.	.	.	14	.	1	.
Medicago lupulina	1	1	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.
Ajuga genevensis	.	.	+	.	.	.	+	.	.	.	.	.	.	.	14	.	.	.
Myosotis arvensis	.	.	+	.	.	.	.	.	.	+	.	.	.	.	14	.	.	.
Tanacetum vulgare	.	.	.	+	.	.	.	.	.	–	.	.	.	.	14	.	.	.
Ajuga reptans	.	.	.	.	.	.	.	.	+	.	.	.	.	+	14	.	.	.
Carex hirta	.	.	.	.	.	.	.	.	.	.	.	+	.	.	7	.	.	3
Briza media	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	2	.
Crepis succisifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	2	.
Knautia cf. *kitaibelii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	1	.

Species recorded in one relevé only:
Agrostis stolonifera 9:2, *Angelica sylvestris* 15:+, *Arabidopsis thaliana* 7:+, *Bellis perennis* 1:1, *Carex spicata* 7:+, *C. panicea* 17:+, *Cerastium arvense* 4:+, *Cirsium canum* 17:2, *Convolvulus arvensis* 10:1, *Cruciata glabra* 3:1, *Fallopia dumetorum* 9:1, *Festuca nigrescens* 10:3, *Filipendula ulmaria* 9:+, *Galium aparine* 9:+, *G. verum* 3:+, *Geum urbanum* 9:1, *Hypericum perforatum* 5:+, *Lamium album* 5:+, *Lathyrus tuberosus* 10:+, *Ornithogalum umbellatum* 14:1, *Phleum pratense* 1:1, *Plantago major* 10:+, *P. media* 4:+, *Poa trivialis* 9:2, *Polygonum bistorta* 17:+, *Potentilla erecta* 16:1, *Ranunculus bulbosus* 3:+, *R. repens* 9:1, *R. polyanthemos* 10:1, *Rumex obtusifolius* 9:+, *Silene vulgaris* 10:+, *Tragopogon orientalis* 11:+, *Trifolium campestre* 5:+, *Urtica dioica* 9:1, *Veronica serpyllifolia* 12:+, *Vicia hirsuta* 2:+, *Viola hirta* 4:1, *V. canina* 16:1

these horizons. The chemical properties of the soils are rather varied and depend on the type of substratum. Soils on artificial substrata and near fishponds are slightly acidic, base saturated and with an occurrence of carbonates. Soils on "natural" substrata have lower pH and BS, but higher amounts of C and N (Fig. 4). The *Lysimachio-Filipenduletum* was recorded in the whole region, mostly on long-term unmanaged meadows (Fig. 5).

Alopecuretum pratensis

This community with a closed canopy is dominated by *Alopecurus pratensis* (Tab. 10). The most common species are those of the *Molinietalia* (*Symphytum officinale, Lychnis flos-cuculi, Deschampsia cespitosa, Sanguisorba officinalis*) and the *Molinio-Arrhenatheretea* (*Rumex acetosa, Festuca rubra, Poa pratensis, Cerastium holosteoides*). Species of the *Agropyro-Rumicion* (*Ranunculus repens, Agrostis stolonifera*) and the *Magnocaricetalia* (*Phalaris arundinacea, Carex vulpina*) are also typical of this community. The community has a medium diversity (Tab. 3) and a high number of accidental species. Two subassociations were distinguished in the region: *arrhenatheretosum* and *typicum*. The former is differentiated by species of the *Arrhenatheretalia* and its subordinate syntaxa (*Arrhenatherum elatius, Geranium pratense, Pastinaca sativa*) and comprises the stands of moist habitats with shorter periods of flooding. The *typicum* subassociation represents the stands of regularly flooded (winter – spring, sometimes again in summer), moist to wet habitats on lower floodplain surfaces. Two variants can be distinguished in the region: *typicum* and the var. with *Selinum carvifolia*.

The sandy-loamy A-horizon (25 cm) lies on the yellow-brown G_0-horizon with gravel and flecks of rust (semi-gley soil or fluvisol). The soils are acidic or slightly acidic, base saturated with medium amounts of C and N (Fig. 4). There are no substantial differences between the subassociations in soil-chemical properties, except for a higher amount of N in the former. The *Alopecuretum pratensis* is scarcely distributed along the Morava river between the villages of Bludov and Chropyně. The most typical stands were recorded in the Plané loučky Nature Reserve near the town of Olomouc (Fig. 5). Stands are mown twice a year.

Alopecurus pratensis-Phalaris arundinacea-[Molinietalia]

In *Alopecuretum* meadows that are unmanaged for about 5 or more years, rapid changes in plant species composition and diversity take place. Species diversity decreases, and dominant *Alopecurus pratensis* is replaced by *Phalaris arundinacea* and *Urtica dioica* that dominate the uncut stands. Diagnostic species of *Molinio-Arrhenatheretea* and its subordinate syntaxa have a low presence (Tab. 3, 10).

This scarce community was recorded in habitats similar to the *Alopecuretum pratensis*; it occurs along the Morava river on the border of cut stands, or it occupies abandoned *Alopecurus*-meadows (Fig. 5).

Tab. 6. – *Holcetum lanati arrhenatheretosum* (rels. 1–6), *cirsietosum cani* (rels. 7–9)

Relevé number	1	2	3	4	5	6	7	8	9	%
Date	2/6	2/6	4/6	10/6	27/5	27/5	26/5	26/5	26/5	
Year	92	92	92	92	93	93	92	92	92	
Relevé size (m^2)	25	25	25	25	25	25	25	25	25	
Inclination (°)	0	0	0	0	0	0	0	0	0	
Altitude (m a.s.l.)	290	290	220	250	290	290	215	215	215	
Cover E_1 (%)	100	100	100	90	100	100	90	80	100	
Ch.– *Arrhenatherion*										
Heracleum sphondylium	+	+	+	.	2	1	1	1	.	78
Trifolium dubium	.	.	1	.	.	.	2	2	1	44
Crepis biennis	.	.	+	.	–	.	.	.	+	33
D. – subass. *arrhenatheretosum*										
Trisetum flavescens	3	2	+	2	2	1	+	1	1	100
Galium mollugo	1	+	1	1	1	1	1	1	1	100
Campanula patula	1	1	1	1	1	+	+	.	+	89
Geranium pratense	2	2	2	1	.	1	2	2	1	89
Arrhenatherum elatius	1	.	.	+	+	.	.	.	.	33
D. – subass. *cirsietosum cani*										
Cirsium canum	.	.	.	.	.	.	2	2	2	33
Galium boreale	.	.	.	.	.	.	1	2	2	33
Betonica officinalis	.	.	.	.	.	.	1	.	2	22
Galium verum	.	.	.	.	.	.	.	1	1	22
Ch.– *Cynosurion*										
Trifolium repens	.	.	1	.	1	1	1	.	3	56
Cynosurus cristatus	.	.	+	+	.	.	.	.	.	22
Phleum pratense	.	.	+	+	.	.	.	.	.	22
Ch.– *Arrhenatheretalia*										
Dactylis glomerata	3	2	2	1	3	2	1	1	2	100
Leucanthemum vulgare	+	.	.	.	+	1	+	+	+	67
Achillea millefolium	.	.	1	.	1	1	2	1	1	67
Alchemilla sp.	1	+	.	1	1	1	.	.	.	56
Centaurea jacea	.	.	1	.	.	1	1	1	1	56
Vicia sepium	.	.	+	.	.	1	1	1	2	56
Lotus corniculatus	.	.	1	.	1	1	.	1	.	44
Trifolium pratense	.	.	.	.	.	1	2	1	2	44
Pimpinella major	1	1	.	.	.	.	.	.	.	22
Anthriscus sylvestris	+	+	.	.	.	.	.	.	.	22
Ch.– *Molinion*										
Selinum carvifolia	.	.	.	.	.	1	–	–	.	33
Ch.– *Calthion*										
Filipendula ulmaria	1	.	.	–	.	+	.	.	.	33
Cirsium oleraceum	.	.	.	.	2	1	.	.	.	22
Cirsium rivulare	.	.	.	.	.	.	+	+	.	22
Ch.– *Molinietalia*										
Sanguisorba officinalis	2	2	.	1	2	3	1	1	1	89
Lychnis flos-cuculi	1	.	1	+	2	1	1	.	+	78
Polygonum bistorta	+	1	.	.	.	1	1	+	1	67

Tab. 6. – Continued/pokračování

Relevé number	1	2	3	4	5	6	7	8	9	%
Deschampsia cespitosa	.	.	3	2	.	1	1	1	2	67
Angelica sylvestris	.	+	1	.	1	2	.	.	.	44
Ranunculus auricomus	.	.	.	+	+	.	.	1	1	44
Symphytum officinale	.	.	.	–	.	+	.	.	.	22
Colchicum autumnale	.	.	.	.	.	.	.	–	–	22
Ch.– *Molinio-Arrhenatheretea*										
Holcus lanatus	3	4	4	3	3	3	3	2	1	100
Festuca rubra subsp. *rubra*	2	1	2	2	2	3	2	3	3	100
Alopecurus pratensis	2	1	3	2	2	1	2	1	2	100
Ranunculus acris	1	1	2	1	2	2	3	1	3	100
Plantago lanceolata	2	2	1	1	1	1	2	2	2	100
Cerastium holosteoides	1	1	1	1	+	1	1	1	1	100
Rumex acetosa	1	1	2	.	1	1	2	.	1	78
Poa pratensis	2	2	2	.	+	.	1	2	2	78
Lathyrus pratensis	1	.	1	1	1	.	2	1	2	78
Festuca pratensis	.	1	+	2	.	1	3	4	3	78
Poa trivialis	.	.	.	2	.	.	1	1	2	44
Prunella vulgaris	.	.	.	.	1	1	.	1	.	33
Cardamine pratensis	+	.	+	.	.	.	.	.	.	22
Vicia cracca	1	.	.	+	.	.	.	.	.	22
Ch.– *Nardo-Callunetea*										
Luzula campestris	.	.	.	1	1	1	.	.	.	33
Hypericum maculatum	.	.	.	+	+	1	.	.	.	33
Carex pallescens	.	.	.	.	1	1	.	.	.	22
Ch.– *Agropyro-Rumicion crispi*										
Ranunculus repens	.	.	1	1	1	.	1	1	1	67
Ch.– *Phragmito-Magnocaricetea*										
Phragmites australis	.	.	.	.	.	.	+	+	–	33
Others										
Taraxacum officinale agg.	1	1	1	+	1	.	2	2	1	89
Veronica chamaedrys	+	.	1	.	1	1	1	1	+	78
Anthoxanthum odoratum	2	2	2	2	3	3	.	.	.	67
Lysimachia nummularia	1	1	1	+	.	.	1	.	.	56
Ajuga reptans	.	.	.	+	1	1	1	.	.	44
Stellaria graminea	.	.	1	2	.	1	.	.	.	33
Equisetum arvense	.	.	1	+	.	+	.	.	.	33
Rumex obtusifolius	.	.	+	.	+	+	.	.	.	33
Aegopodium podagraria	.	.	.	+	+	+	.	.	.	33
Plantago major	.	.	.	.	.	.	2	1	2	33
Bromus mollis	.	.	.	.	.	.	1	2	1	33
Carex hirta	.	.	.	.	.	.	1	1	1	33
Leontodon hispidus	1	.	2	.	.	.	.	.	.	22
Glechoma hederacea	1	.	.	+	.	.	.	.	.	22
Carex ovalis	.	.	.	.	2	1	.	.	.	22
Ficaria bulbifera	.	.	.	.	1	1	.	.	.	22

Species recorded in one relevé only:
Agrostis capillaris 4:3, *Ajuga genevensis* 1:–, *Anemone nemorosa* 5:1, *Avenula pubescens* 5:+, *Bellis perennis* 4:1, *Briza media* 5:1, *Carex panicea* 5:–, *Chaerophyllum hirsutum* 6:+, *Crepis succisifolia* 1:2, *Knautia arvensis* 3:1, *Leontodon autumnalis* 3:1, *Lysimachia vulgaris* 3:+, *Phalaris arundinacea* 4:+, *Poa angustifolia* 9:2, *P. palustris* 4:2, *Potentilla erecta* 5:+, *Scirpus sylvaticus* 6:+, *Urtica dioica* 4:–, *Veronica serpyllifolia* 9:+, *Viola canina* 9:+

Sanguisorbo-Festucetum commutatae

Floristically homogeneous stands (36 % of the species in Tab. 11 is in the IV and V presence class) are dominated by *Holcus lanatus, Festuca pratensis, Deschampsia cespitosa, Poa pratensis* and *Festuca nigrescens*. An important diagnostic group of species of this association includes the species of the *Molinion*: *Selinum carvifolia, Galium boreale, Succisa pratensis*. In the region the subassociation *geranietosum* was distinguished by the differential species *Geranium pratense, Arrhenatherum elatius, Trifolium pratense, Dactylis glomerata* and *Trisetum flavescens*. The community has a high species-richness and diversity (Tab. 3). The *Sanguisorbo-Festucetum* is confined to the higher levels of the floodplain and is subject to only very occasional flooding. The soils are semi-gleys. The loamy or clayey-loamy A-horizon is shallow (20 cm) and lies on the G_0-horizon with flecks of rust. The soils are acidic or slightly acidic, base saturated, with a medium content of C and N and with a medium C/N ratio (Fig. 4). The *Sanguisorbo-Festucetum* is known to occur in the meadow complex between the town of Kojetín and Chropyně and near the village of Horka n. M. (Daliboř complex) (Fig. 5). Stands are mown twice a year.

Molinietum coeruleae

The community is dominated by *Festuca nigrescens, Deschampsia cespitosa, Holcus lanatus* and/or *Bromus erectus* (Tab. 12). An important diagnostic species group of this association includes species of intermittently wet soils – *Galium boreale, Selinum carvifolia, Succisa pratensis, Serratula tinctoria, Molinia caerulea* – belonging to the *Molinion*. Stands with a closed canopy have a medium diversity (Tab. 3). Two subassociations were distinguished in the territory: *typicum* and *brometosum*. The former subassociation, without differential species, comprises the stands of the intermittently wet habitats on flat land. The *brometosum* subass. is differentiated by an absence of *Molinia caerulea* and by the presence of *Bromus erectus*. Species of the *Festuco-Brometea* (*Ranunculus polyanthemos, Trifolium montanum, Filipendula vulgaris*) are typical of this subassociation which is confined to the highest and most infrequently flooded parts of the floodplain, where the water table fluctuates considerably.

The soils are semi-gleys. The A_h-horizon is yellow-brown or grey, loamy or sandy-loamy and lies on a G_0-horizon. Soil reaction is slightly acidic or acidic. The soil is base saturated. C and N contents reach the highest values among the communities examined (Fig. 4). The *Molinietum coeruleae* is a rare community in the study area. It

is known to occur in the Daliboř complex near the village of Horka n. M. (*typicum* subass.) and in the Plané loučky Nature Reserve near the town of Olomouc (*brometosum* subass.) (Fig. 5).

Deschampsia cespitosa-Festuca nigrescens-[Molinietalia]

The community is dominated by *Festuca nigrescens* and *Deschampsia cespitosa* (Tab. 12). Diagnostic species of the *Molinietum* association and *Molinion* alliance are absent. On the other hand the presence of *Cirsium arvense* indicates long-term unmanaged meadows. Stands with a closed canopy have low diversity (Tab. 3).

The community is known to occur in the Daliboř complex near the village of Horka n. M. (Fig. 5) and is a type that developed from the *Molinietum* association after abandonment.

Discussion

Variation in species composition, diversity and environmental factors

Three major gradients controlling meadow vegetation in the Morava river floodplain were suggested by the ordination: (a) water regime, (b) intensity of human influence and (c) soil conditions.

The water regime is the most important environmental factor influencing variations in the species composition of floodplain communities (Balátová-Tuláčková 1968, Day et al. 1988, Prach 1992, Rychnovská et al. 1985). This is shown by a high positive correlation of the sample score for the first axis with the mean indicator values for moisture (Tab. 1). Along this gradient it is possible to arrange alliances as follows: *Arrhenatherion* < *Molinion* < *Alopecurion* < *Calthion*. The elevation is often used as a measure of the moisture gradient (Day et al. 1988). The elevation is the best explanatory variable in those floodplains with permeable sediments (Prach 1992). However, the water regime of the Morava river floodplain is influenced by impermeable layers of clay at different depths under the soil surface and by fluvial deposits of sands and gravels (Jílek et Velísek 1964, Velísek 1968). Stands on the soils with impermeable layers of clay (e.g. *Calthion* or *Magnocaricetalia*) often form small patches inside stands of different communities and their soils are partially saturated by (stagnant) rain water (Kovář 1981, 1983). In contrast the highest parts of the floodplain (terraces) usually dry out in summer due to the high amount of sand in the soil. Communities with species of semi-dry grasslands (*Bromus erectus, Ranunculus polyanthemos*) are typical for these stands.

A high negative correlation of species diversity with the first ordination axis (~ moisture) shows that communities of habitats with greatly fluctuating water tables (*Sanguisorbo-Festucetum, Molinietum*) have the highest species diversity in contrast to communities of habitats with a high ground water table, dominated by one species

Tab. 7. – *Scirpetum sylvatici*

Relevé number	1	2	3	4	5	6	%
Date	8/6	8/6	8/6	26/5	26/5	26/5	
Year	92	92	92	92	92	92	
Relevé size (m^2)	8	8	8	25	25	25	
Inclination (°)	0	0	0	0	0	0	
Altitude (m a.s.l.)	220	220	220	215	215	215	
Cover E_1 (%)	85	100	100	80	80	100	
Dom.– ass.							
Scirpus sylvaticus	4	5	5	5	5	5	100
Ch.– *Calthion*							
Filipendula ulmaria	.	–	–	1	+	1	83
Caltha palustris	.	1	–	.	2	.	50
Cirsium canum	+	.	.	.	.	1	33
Cirsium rivulare	.	.	.	1	.	2	33
Ch.– *Molinietalia*							
Sanguisorba officinalis	+	+	+	2	+	.	83
Deschampsia cespitosa	1	1	.	.	.	2	50
Juncus effusus	2	1	.	.	.	.	33
Polygonum bistorta	+	.	.	+	.	.	33
Lychnis flos-cuculi	.	.	+	.	.	1	33
Juncus conglomeratus	.	.	.	+	+	.	33
Ch.– *Arrhenatheretalia*							
Achillea millefolium	.	.	.	+	.	+	33
Ch.– *Molinio-Arrhenatheretea*							
Alopecurus pratensis	1	+	+	+	.	1	83
Holcus lanatus	1	.	+	.	.	1	50
Poa trivialis	.	3	1	.	.	2	50
Poa pratensis	.	.	.	1	+	2	50
Lathyrus pratensis	.	.	.	1	+	1	50
Rumex acetosa	+	.	.	.	.	1	33
Ch.– *Agropyro-Rumicion crispi*							
Ranunculus repens	2	1	2	+	+	3	100
Ch.– *Magnocaricetalia*							
Carex gracilis	1	.	.	1	+	1	67
Carex vulpina	1	.	–	.	.	2	50
Galium palustre	.	1	1	.	+	.	50
Eleocharis cf. *palustris*	+	.	.	.	+	.	33
Carex vesicaria	1	.	.	.	.	1	33
Others							
Lysimachia nummularia	+	+	–	.	.	2	67
Glyceria fluitans	1	2	2	.	.	.	50
Stellaria palustris	3	1	1	.	.	.	50
Alopecurus aequalis	.	2	2	.	.	.	33
Taraxacum officinale agg.	.	+	.	.	–	.	33

Species recorded in one relevé only:
Agrostis stolonifera 1:2, *Bromus mollis* 6:–, *Carex cespitosa* 1:2, *C nigra* 5:+, *C. ovalis* 6:1, *C. panicea* 6:2, *Cerastium holosteoides* 6:+, *Festuca rubra* subsp. *rubra* 4:1, *F. pratensis* 6:1, *Ficaria bulbifera* 6:1, *Galium verum* 1:+, *Geranium pratense* 4:+, *Iris pseudacorus* 5:+, *Lysimachia vulgaris* 3:+, *Lythrum salicaria* 5:–, *Poa palustris* 1:2, *Ranunculus acris* 6:1, *Rumex hydrolapathum* 1:+, *Selinum carvifolia* 1:–, *Trifolium pratense* 2:+, *Vicia sepium* 6:1

(*Lysimachio-Filipenduletum, Scirpetum sylvatici*) (Tab. 3; Prach 1992). This phenomenon is partly influenced by higher above-ground biomass (ca. two times, Duchoslav 1994) and high amounts of litter (ca. two to three times, Duchoslav 1994) of the latter communities compared with the former. In particular, different types of management (i. e. frequency of mowing) are responsible for this variation in species diversity (see also van der Maarel 1993).

Although most of the studied environmental factors are more closely correlated to the second ordination axis (Tab. 1), their effects are probably different in different parts of the coenocline. Generally, the effect of type of habitat connected with human activities is responsible for this pattern. Direct activities, including river regulation, drainage and manuring, have a decisive influence on the floristic composition of meadows (Kučera 1996, Prach 1992). Large parts of the Morava river floodplain have been abandoned or transformed into intensively managed meadows and these influences induced an expansion of robust and strongly competitive species (e.g. *Phalaris arundinacea, Alopecurus pratensis, Urtica dioica, Aegopodium podagraria*) and are responsible for the appearance of ruderals in newly established habitats due to the mass effect from the surroundings. The species diversity of such stands decreases.

Nutrient availability is considered to be another important factor responsible for vegetation patterns (Rychnovská et al. 1985). The intensive input of nitrogen by water, air pollution and by manuring (Vavroušek et Moldan 1990) is mainly responsible for the strong eutrophication and ruderalization of meadows (Krahulec 1996, Prach 1993). This is shown by the significant negative correlations between N_c and indexes of diversity for analysed relevé sets (Tab. 1) and agrees with the results of previous studies (Prach 1993, Traczyk et al. 1984). This pattern also corresponds with the pattern of Grime's strategy types in the ordination diagram (see Tab. 2). Euthrophication is probably responsible for the disappearance of several oligotrophic vegetation types recorded in previous studies in the area (see below and Duchoslav 1996).

Along the gradient of soil nitrogen content (N) it is possible to arrange the alliances as follows: *Arrhenatherion* < *Alopecurion* < *Calthion* ~ *Molinion*. Both C and N reach their highest values in the wettest and intermittently wet habitats with low pH (cf. Kovář 1983). Nitrogen concentration in the soil (N) is not correlated with species diversity (cf. Wassen et al. 1990). It is due to different effect of nitrogen content and nitrogen availability, i.e. the impact of flooding or ground water on soil processes (e.g. nitrification) (Blažková 1996, Moravec 1965). Low amounts of N in soils of anthropogenic habitats are probably due to shallow soils (Haken et Kvítek 1986).

Tab. 8. – *Cirsietum rivularis typicum* (rels. 1–2), *arrhenatheretosum* (rel. 3), *Angelico–Cirsietum oleracei* (rels. 4, 5)

Relevé number	1	2	3	4	5
Date	8/6	8/6	16/6	17/6	17/6
Year	92	92	92	92	92
Relevé size (m^2)	16	16	25	25	25
Inclination (°)	0	0	0	0	0
Altitude (m a.s.l.)	220	220	195	190	190
Cover E_1 (%)	100	100	100	100	100
Ch.– ass.					
Cirsium rivulare	3	3	3	.	.
Cirsium oleraceum	.	.	.	1	3
D. – subass.					
Arrhenatherum elatius	.	.	1	+	2
Dactylis glomerata	.	.	2	.	.
Phalaris arundinacea	.	.	.	1	1
Carex gracilis	.	.	.	.	1
Ch.– *Calthion*					
Filipendula ulmaria	2	1	1	1	1
Cirsium canum	+	+	.	1	.
Scirpus sylvaticus	+	1	.	.	2
Lysimachia vulgaris	.	+	1	+	.
Ch.– *Molinion*					
Galium boreale	1	.	+	.	.
Ch.– *Molinietalia*					
Angelica sylvestris	1	+	–	+	1
Sanguisorba officinalis	3	2	1	.	.
Juncus effusus	2	2	.	3	.
Deschampsia cespitosa	2	2	.	.	1
Lotus uliginosus	1	1	.	.	1
Lychnis flos-cuculi	1	1	.	.	1
Symphytum officinale	.	.	1	1	2
Polygonum bistorta	3	3	.	.	.
Juncus conglomeratus	2	3	.	.	.
Ch.– *Arrhenatherion*					
Geranium pratense	+	1	2	.	.
Galium mollugo	.	.	2	+	1
Pastinaca sativa	.	.	2	.	1
Heracleum sphondylium	.	.	1	.	+
Ch.– *Arrhenatheretalia*					
Centaurea jacea	1	+	+	.	+
Achillea millefolium	1	1	.	.	1
Alchemilla sp.	+	+	.	.	.
Ch.– *Molinio-Arrhenatheretea*					
Festuca pratensis	1	2	3	2	2
Holcus lanatus	1	3	3	1	2
Alopecurus pratensis	1	1	2	+	1

Tab. 8. – Continued/pokračování

Relevé number	1	2	3	4	5
Lathyrus pratensis	1	2	+	1	1
Rumex acetosa	1	2	1	+	.
Poa trivialis	1	2	3	.	.
Vicia cracca	1	1	.	1	.
Festuca rubra subsp. *rubra*	2	2	.	.	2
Cerastium holosteoides	1	1	.	.	1
Ranunculus acris	.	1	1	.	.
Poa pratensis	.	.	2	.	1
Ch.– *Agropyro-Rumicion crispi*					
Ranunculus repens	2	2	2	1	2
Agrostis stolonifera	.	+	.	1	.
Ch.– *Magnocaricetalia*					
Carex vesicaria	.	+	.	2	+
Others					
Aegopodium podagraria	1	.	2	+	.
Carex nigra	2	1	.	.	.
Taraxacum officinale agg.	.	+	.	.	1
Cirsium arvense	.	.	+	+	.
Glechoma hederacea	.	.	2	.	1
Veronica chamaedrys	.	.	1	.	1

Species recorded in one relevé only:
Allium scorodoprasum 3:+, *Anthriscus sylvestris* 3:1, *Caltha palustris* 4:+, *Campanula patula* 3:+, *Cardamine pratensis* 1:+, *Carex pallescens* 2:1, *C. panicea* 5:1, *C. vulpina* 4:3, *C. hirta* 4:1, *C. spicata* 5:1, *C.* sp. 4:+, *Cnidium dubium* 1:+, *Colchicum autumnale* 3:1, *Equisetum arvense* 5:2, *Galium aparine* 5:1, *Glyceria maxima* 1:+, *Iris pseudacorus* 4:+, *Juncus inflexus* 4:1, *Lysimachia nummularia* 5:1, *Myosotis palustris* 1:+, *Pimpinella major* 3:+, *Plantago lanceolata* 2:+, *Plantago major* subsp. *intermedia* 1:1, *Polygonum amphibium* 5:1, *Rumex obtusifolius* 3:+, *R. hydrolapathum* 1:2, *R. crispus* 5:+, *Selinum carvifolia* 3:1, *Silaum silaus* 1:1, *Trifolium pratense* 5:1, *T. hybridum* 4:+, *Trisetum flavescens* 3:2, *Valeriana officinalis* 3:2, *Vicia sepium* 3:1

A negative correlation between species diversity and soil acidity (pH) previously reported (Rey Benayas et Scheiner 1993, Vermeer et Berendse 1983) was not found. It appears that the range of pH is not so wide as to suppress plant performances at either end of the pH gradient.

Relationships between calibration and directly measured factors

Although the application of indicator values proposed by Jurko (1990) (sensu Ellenberg et al. 1992) can help with the interpretation of pattern in ordination (Persson 1981) or in phytosociology (Balátová-Tuláčková 1955, Klimeš 1987), the results presented show several discrepancies which limit their application. These limitations are as follows: (a) Many species have unknown indicator values or values with a wide

range (more than two levels) for a particular factor. For the analysed data set more than 50 % of species have unknown values for soil reaction. The reasons for these may be the wide range of soil pH tolerated by many grassland species (Balátová-Tuláčková in Rychnovská et al. 1985) and/or different types of species response (e.g. bimodal) to this factor (Mucina 1985); (b) There are weak positive, no or negative correlation between mean tabulated indicator values and directly measured values (Tab. 1). Several studies (for comparison see Ellenberg 1979, Ellenberg et al. 1992) show high positive significant correlations between measured factors (pH, nitrogen availability or N) and their estimations by calibration (R_c, N_c). The present study shows in the case of reaction (R_c) only weak (insignificant) positive correlations between R_c and pH (H_2O, KCl). A possible explanation was discussed above. Probably the most striking are the opposite correlations of N and N_c with the second ordination axis, although there is no correlation between these two (Tab. 1). This fact is due to differences in the values estimated by calibration and those measured directly (Ellenberg et al. 1992, Klimeš 1987, Krajčovič 1985, ter Braak et Gremmen 1987).

Plant communities

Communities with dominant *Arrhenatherum elatius* represent the most common type of grassland in the Morava river floodplain. Although these communities are widespread throughout the Morava river floodplain, they only occupy small areas on the periphery of villages because of the impact of intensive agriculture (ploughing). Stands with *Arrhenatherum elatius* replaced communities of the *Molinietalia* (e.g. *Molinietum coeruleae, Alopecuretum pratensis*) at several localities after river regulation and consequent lowering of the ground water table (see Tab. 5: *galietosum* subass., cf. Bednář 1976, Bednář et Velísek 1962). The secondary communities on river banks and dikes dominated mostly by *Arrhenatherum* are known to occur in similar habitats (roadsides) in East Bohemia (Kopecký 1978).

In contrast, *Trifolio-Festucetum rubrae* is a rare community in the region. Its distribution in the northern part of the territory only is in a good agreement with the observation of Balátová-Tuláčková (1981) that the optimum of the community is in submontane and montane belts on poor substrata.

Probably the most complicated association from the syntaxonomic point of view is the *Holcetum lanati*. It is composed of species with a wide ecological range and its stands occur in intermediate site conditions (see Fig. 2, 3). The community is assigned by different authors (Blažková 1992, Kovář 1981, Moravec et al. 1995) to different alliances. In the Morava river floodplain the community shows an intermediate position between the *Alopecurion* and *Arrhenatherion*.

Communities of the *Molinietalia* order recorded in the Hornomoravský úval area belong to the common types of grasslands in the Czech Republic (cf. Balátová-Tuláčková 1985, Rybníček et al. 1984). Due to the presence of a clay layer in the heterogeneous sediments, the *Scirpetum sylvatici*, an atypical component of large

Tab. 9. – *Lysimachio–Filipenduletum*

Relevé number	1	2	3	4	5	6	7	8	%
Date	5/6	12/8	10/6	26/5	27/5	24/5	11/6	5/6	
Year	92	93	92	92	93	93	93	92	
Relevé size (m^2)	10	10	20	25	8	4	25	15	
Aspect	SW	NE	–	–	–	–	–	–	
Inclination (°)	15	25	0	0	0	0	0	0	
Altitude (m a.s.l.)	260	255	260	215	295	250	200	260	
Cover E_1 (%)	100	100	100	100	100	100	100	100	
Ch.– Ass., *Filipendulenion*									
Filipendula ulmaria	4	5	5	5	5	5	5	5	100
Lysimachia vulgaris	2	+	.	.	2	.	+	.	50
Valeriana officinalis	1	1	.	.	.	1	.	.	38
Ch.– *Calthion*									
Myosotis palustris	1	.	1	.	.	.	.	+	38
Cirsium oleraceum	.	.	.	+	+	+	.	.	38
Scirpus sylvaticus	.	.	.	.	+	.	+	1	38
Ch.– *Molinion*									
Selinum carvifolia	.	.	.	+	.	+	.	.	25
Ch.– *Molinietalia*									
Symphytum officinale	+	+	+	.	+	+	+	.	75
Sanguisorba officinalis	.	1	.	1	+	+	+	.	63
Deschampsia cespitosa	.	2	1	1	1	.	.	.	50
Angelica sylvestris	.	.	+	–	.	.	.	.	25
Ch.– *Arrhenatherion*									
Geranium pratense	+	1	+	2	.	+	+	.	75
Galium mollugo	1	+	+	.	.	+	.	+	63
Heracleum sphondylium	+	+	.	+	.	.	.	.	38
Arrhenatherum elatius	+	.	+	.	.	.	.	.	25
Ch.– *Arrhenatheretalia*									
Trisetum flavescens	1	.	+	.	.	.	.	.	25
Alchemilla sp.	.	+	.	+	.	.	.	.	25
Vicia sepium	.	.	+	1	.	.	.	.	25
Ch.– *Molinio-Arrhenatheretea*									
Vicia cracca	1	+	+	.	.	+	+	.	63
Rumex acetosa	+	.	+	+	+	–	.	.	63
Poa trivialis	2	.	2	1	.	1	+	.	63
Festuca rubra subsp. *rubra*	1	2	.	+	.	.	.	.	38
Holcus lanatus	1	.	1	+	.	.	.	.	38
Alopecurus pratensis	.	.	.	+	1	.	.	.	25
Ch.– *Agropyro-Rumicion crispi*									
Agrostis stolonifera	.	.	.	.	+	.	+	.	25
Ch.– *Magnocaricetalia*									
Phalaris arundinacea	1	+	.	.	+	.	1	2	63
Poa palustris	2	1	.	.	.	.	.	.	25
Galium palustre	.	+	.	.	+	.	.	.	25

Tab. 9. – Continued/pokračování

Relevé number	1	2	3	4	5	6	7	8	%
Others									
Urtica dioica	1	1	–	2	+	1	1	+	100
Equisetum arvense	1	.	1	.	.	+	+	2	63
Lycopus europaeus	1	.	1	.	+	.	.	.	38
Galium elongatum	1	.	2	.	.	.	.	+	38
Linaria vulgaris	+	.	1	.	.	.	.	2	38
Lysimachia nummularia	1	.	.	2	.	+	.	.	38
Veronica chamaedrys	.	.	1	1	.	–	.	.	38
Cirsium arvense	+	+	.	.	.	.	.	.	25
Tanacetum vulgare	+	–	.	.	.	.	.	.	25
Carex hirta	.	+	+	.	.	.	.	.	25
Carex sp.	.	.	2	.	2	.	.	.	25
Impatiens noli-tangere	.	.	.	+	+	.	.	.	25

Species recorded in one relevé only:
Alnus glutinosa 4:+, *Anemone nemorosa* 5:+, *Anthoxanthum odoratum* 3:+, *Anthriscus sylvestris* 6:+, *Callitriche* cf. *palustris* 2:+, *Caltha palustris* 5:1, *Campanula patula* 1:+, *Cardamine pratensis* 1:+, *Carex gracilis* 7:+, *C. elongata* 5:+, *C. brizoides* 5:+, *Centaurea jacea* 2:–, *Cirsium rivulare* 4:1, *C. canum* 2:+, *Epilobium palustre* 2:–, *Equisetum palustre* 5:+, *Fallopia dumetorum* 7:+, *Festuca pratensis* 4:+, *Ficaria bulbifera* 4:1, *Fraxinus excelsior* 5:1, *Galeopsis* sp. 2:+, *Galium rivale* 6:+, *G. aparine* 7:1, *G. uliginosum* 2:+, *G. verum* 4:1, *Geum urbanum* 1:1, *Glechoma hederacea* 5:+, *Hypericum tetrapterum* 1:1, *H. perforatum* 2:–, *Iris pseudacorus* 1:2, *Juncus effusus* 3:+, *Knautia arvensis* 6:+, *Lathyrus pratensis* 2:+, *Leontodon hispidus* 3:+, *Lotus uliginosus* 8:+, *L. corniculatus* 2:+, *Lychnis flos-cuculi* 5:+, *Naumburgia thyrsiflora* 3:+, *Polygonum bistorta* 4:+, *Potentilla anserina* 3:1, *Pseudolysimachion longifolium* 2:+, *Ranunculus auricomus* 5:+, *R. repens* 4:1, *R. acris* 5:+, *Rubus caesius* 2:+, *Rumex aquaticus* 2:–, *R. hydrolapathum* 2:+, *Sium latifolium* 3:+, *Stellaria palustris* 3:2, *S. media* 3:+, *Taraxacum officinale* agg. 4:+, *Typha angustifolia* 7:–, *Valerianella locusta* 1:+, *Veronica beccabunga* 3:+, *Vicia tetrasperma* 1:+

floodplains (Neuhäuslová-Novotná et Neuhäusl 1972), was recorded in the study area. On the other hand, the *Cirsietum rivularis*, the most common meadow community with *Cirsium* spp. in Moravia (Balátová-Tuláčková 1985, Rybníček et al. 1984), is very rare in the study area. Ploughing and drainage have a decisive influence on the disappearance of wet subassociations of this community recorded by Balátová-Tuláčková (1977) in the Hornomoravský úval. *Angelico-Cirsietum oleracei* has not been previously recorded from the study area. Another community with *Cirsium canum* (*Scirpo-Cirsietum cani valerianetosum officinalis* Balátová-Tuláčková 1984), recorded by one relevé only in the study area in 1975 (Balátová-Tuláčková in Rybníček et al. 1984), was not found again in 1992–1994.

Unmown stands with dominant *Filipendula ulmaria* (*Lysimachio-Filipenduletum*) were not previously mentioned for the Morava river floodplain. This community is confined to the unmanaged edges of the meadows which implies high floristic heterogeneity and low presence of its indicator species in contrast with relevés recorded by Balátová-Tuláčková (1979, 1984, 1991).

Tab. 10. – *Alopecuretum pratensis arrhenatheretosum* (rels. 1–6), *typicum* (rels. 7–14 [var. with *Selinum carvifolia* rels. 11–14]), *Alopecurus pratensis-Phalaris arundinacea-*[*Molinietalia*] (rel. 15)

Relevé number	1	2	3	4	5	6	%	7	8	9	10	11	12	13	14	%	%	15
Date	2/6	2/6	25/5	25/5	27/5	27/5		5/6	12/6	16/6	24/5	24/5	24/5	26/5	26/5			24/5
Year	92	92	93	93	93	93		92	92	92	93	92	92	92	92			93
Relevé size (m^2)	25	25	25	25	25	25		25	25	25	25	25	25	25	25			25
Inclination (°)	0	0	0	0	0	0		0	0	0	0	0	0	0	0			0
Altitude (m a.s.l.)	290	290	235	235	295	295		265	250	195	250	250	250	215	215			250
Cover E_1 (%)	100	100	100	100	90	100		100	100	90	100	100	100	100	100			100
D. – ass.																		
Symphytum officinale	+	1	.	.	1	+	67	+	+	+	.	+	+	.	.	63	64	+
D. – subass. *arrhenatheretosum*																		
Geranium pratense	3	2	2	2	2	1	100	.	1	.	1	.	.	.	1	38	64	1
Arrhenatherum elatius	+	+	+	.	.	.	50	.	.	.	.	.	.	.	.	0	21	+
Pastinaca sativa	.	.	1	.	2	.	33	.	.	.	.	+	.	.	.	13	21	.
D. – var. with *Selinum carvifolia*																		
Selinum carvifolia	.	.	+	.	.	.	17	.	.	.	.	2	2	.	+	38	29	.
Galium boreale	.	.	.	.	.	.	0	.	.	.	.	.	.	+	.	13	7	.
Ch. – *Molinietalia* and subordinated syntaxa																		
Deschampsia cespitosa	1	1	2	1	2	1	100	+	1	2	.	.	1	2	2	75	86	.
Lychnis flos-cuculi	.	1	.	1	1	1	67	.	+	–	+	3	2	2	.	75	71	+
Sanguisorba officinalis	2	2	.	.	3	1	67	+	.	1	2	.	.	2	.	50	57	.
Cirsium oleraceum	2	+	.	.	1	+	67	+	.	.	+	.	.	.	.	25	43	+
Ranunculus auricomus	.	.	+	1	1	1	67	.	.	.	.	.	.	2	2	25	43	.
Filipendula ulmaria	.	.	.	.	1	+	33	.	.	.	+	+	–	1	.	50	43	1
Polygonum bistorta	.	.	.	.	.	+	17	+	.	.	.	.	.	.	2	25	21	.
Equisetum palustre	.	.	.	.	.	+	17	.	.	.	1	+	.	.	.	25	21	.
Cirsium canum	.	.	.	.	.	.	0	.	.	–	.	.	.	+	2	38	21	.
Lythrum salicaria	.	.	.	.	.	.	0	.	.	.	.	1	.	+	+	38	21	.
Angelica sylvestris	.	.	.	.	1	+	33	.	.	.	.	.	.	.	.	0	14	.
Lysimachia vulgaris	.	.	.	.	.	+	17	.	.	.	.	.	+	.	.	13	14	1
Juncus conglomeratus	.	.	.	.	.	.	0	.	.	.	.	1	.	.	1	25	14	.
Pseudolysimachion longifolium	.	.	.	.	.	.	0	.	.	.	.	.	1	.	.	13	7	+
Ch.– *Arrhenatherion*																		
Campanula patula	.	1	+	1	+	+	83	1	+	.	+	.	.	.	.	38	57	.
Galium mollugo	1	+	+	.	+	1	83	1	.	.	.	.	1	.	.	25	50	.
Heracleum sphondylium	+	1	2	2	.	.	67	+	.	.	.	.	.	.	.	13	36	.
Crepis biennis	.	.	1	+	.	.	33	.	.	.	.	.	.	.	.	0	14	.
Ch.– *Cynosurion*																		
Trifolium repens	.	.	2	2	.	.	33	.	+	.	.	2	2	2	1	63	50	.
Leontodon autumnalis	.	.	+	.	.	.	17	.	1	.	.	.	.	.	.	13	14	.
Phleum pratense	.	.	.	.	.	.	0	.	+	+	.	.	.	.	.	25	14	.
Ch.– *Arrhenatheretalia*																		
Dactylis glomerata	2	2	2	1	3	2	100	2	1	.	2	.	.	.	.	38	64	.
Achillea millefolium	.	+	.	1	–	.	50	.	+	.	.	1	1	1	1	63	57	.
Alchemilla sp.	+	1	.	.	1	.	50	.	.	.	.	.	.	.	+	13	29	.
Vicia sepium	.	.	1	.	+	1	50	.	.	.	.	.	.	.	+	13	29	.

Tab. 10. – Continued/pokračování

Relevé number	1	2	3	4	5	6	%	7	8	9	10	11	12	13	14	%	%	15
Centaurea jacea	.	.	1	.	2	.	33	.	.	–	.	.	.	+	.	25	29	.
Leucanthemum vulgare	.	.	.	.	+	1	33	.	+	+	.	.	.	.	.	25	29	.
Anthriscus sylvestris	+	1	.	+	.	.	50	.	.	.	.	.	.	.	.	0	21	2
Trisetum flavescens	.	.	2	1	1	.	50	.	.	.	.	.	.	.	.	0	21	.
Ch.– *Molinio-Arrhenatheretea*																		
Alopecurus pratensis	4	5	4	3	3	4	100	4	4	4	4	5	5	4	4	100	100	4
Rumex acetosa	1	2	1	1	1	1	100	1	.	1	2	1	1	1	1	88	93	.
Cerastium holosteoides	1	1	1	1	1	1	100	2	1	.	1	1	+	.	1	75	86	.
Poa pratensis	2	3	3	3	2	1	100	3	2	.	.	3	2	2	2	75	86	.
Festuca rubra subsp. *rubra*	1	.	2	3	2	2	83	2	2	.	.	1	.	3	2	63	71	.
Holcus lanatus	.	.	2	2	1	1	67	.	2	1	.	2	2	2	2	75	71	.
Poa trivialis	.	.	2	3	.	.	33	2	3	2	3	3	3	2	2	100	71	3
Ranunculus acris	1	2	2	2	2	2	100	.	.	1	.	.	.	2	2	38	64	.
Festuca pratensis	.	.	2	1	.	1	50	2	3	2	3	.	.	2	2	75	64	.
Cardamine pratensis	.	.	1	1	.	.	33	+	.	1	.	+	+	2	1	75	57	.
Plantago lanceolata	.	.	1	1	.	.	33	.	1	.	.	–	1	.	.	38	36	.
Prunella vulgaris	.	.	2	2	1	.	50	.	.	.	.	.	.	.	.	0	21	.
Lathyrus pratensis	.	.	.	.	+	1	33	.	.	.	.	.	.	.	1	13	21	.
Ch.– *Agropyro-Rumicion crispi*																		
Ranunculus repens	1	1	3	3	2	2	100	.	2	2	2	3	3	3	3	88	93	+
Agrostis stolonifera	3	2	.	.	.	1	50	.	2	3	1	3	3	2	1	88	71	.
Elytrigia repens	.	.	.	.	+	+	33	1	.	.	.	.	.	.	.	13	21	.
Ch.– *Nardo-Callunetea*																		
Hypericum maculatum	.	+	.	.	.	+	33	.	.	.	.	.	.	.	.	0	14	.
Carex pallescens	.	.	.	.	1	.	17	.	.	.	.	.	.	.	1	13	14	.
Ch.– *Magnocaricetalia*																		
Phalaris arundinacea	1	+	.	.	.	+	50	+	2	1	2	3	2	.	.	75	64	3
Poa palustris	.	.	2	.	.	.	17	2	.	.	1	.	.	.	.	25	21	.
Galium palustre	.	.	.	.	.	.	0	.	.	1	.	2	2	.	.	38	21	.
Carex vulpina	.	.	.	.	.	.	0	.	.	1	.	.	.	1	+	38	21	.
Carex panicea	.	.	.	.	.	.	0	.	.	.	.	.	.	2	1	25	14	.
Others																		
Taraxacum officinale	1	2	2	2	1	1	100	+	1	+	1	1	1	+	1	100	100	+
Lysimachia nummularia	1	.	2	1	1	2	83	.	.	+	1	2	2	2	+	75	79	.
Veronica chamaedrys	.	.	.	1	1	1	50	.	1	.	2	1	+	.	+	63	57	.
Glechoma hederacea	.	+	1	2	+	+	83	.	2	.	1	.	.	.	.	25	50	.
Urtica dioica	+	–	.	.	.	+	50	1	.	.	2	.	+	.	.	38	43	2
Aegopodium podagraria	2	2	.	.	1	+	67	.	.	.	1	.	.	.	.	13	36	.
Rumex obtusifolius	.	+	.	+	.	1	50	+	1	.	.	.	.	.	.	25	36	.
Veronica serpyllifolia	.	.	2	1	.	.	33	.	.	.	.	1	+	1	.	38	36	.
Anthoxanthum odoratum	.	.	1	.	1	1	50	.	1	.	.	.	.	2	.	25	36	.
Plantago major	.	.	.	.	.	.	0	.	1	.	.	+	1	2	1	63	36	.
Stellaria graminea	1	.	.	.	.	+	33	.	.	.	1	.	1	.	.	25	29	.
Cirsium arvense	+	.	.	.	.	.	17	+	+	+	.	.	.	.	.	38	29	.
Anemone nemorosa	.	1	.	.	1	1	50	.	.	2	.	.	.	.	.	13	29	.
Fraxinus excelsior	.	.	.	+	2	1	50	.	.	.	.	.	.	.	.	0	21	.

Tab. 10. – Continued/pokračování

Relevé number	1	2	3	4	5	6	%	7	8	9	10	11	12	13	14	%	%	15
Stellaria palustris	.	.	.	.	.	.	0	.	.	2	.	1	.	–	.	38	21	.
Equisetum arvense	+	.	.	.	.	.	17	.	+	.	.	.	.	.	.	13	14	.
Veronica persica	.	1	.	.	.	.	17	1	.	.	.	.	.	.	.	13	14	.
Ficaria bulbifera	.	.	.	.	1	1	33	.	.	.	.	.	.	.	.	0	14	2
Bellis perennis	.	.	2	1	.	.	33	.	.	.	.	.	.	.	.	0	14	.
Myosotis sp.	.	.	.	.	1	1	33	.	.	.	.	.	.	.	.	0	14	.
Melandrium rubrum	.	.	.	.	–	.	17	.	.	.	+	.	.	.	.	13	14	.
Ajuga reptans	.	.	.	.	1	.	17	.	.	.	.	.	.	.	1	13	14	.
Lamium album	.	.	.	.	.	.	0	+	.	.	.	.	1	.	.	25	14	.
Oxalis acetosella	.	.	.	.	.	.	0	.	.	.	.	2	1	.	.	25	14	.
Scrophularia nodosa	.	.	.	.	.	.	0	.	.	.	.	+	+	.	.	25	14	.
Bromus mollis	.	.	.	.	.	.	0	.	.	.	.	1	.	.	1	25	14	.
Carduus crispus	.	.	.	.	.	.	0	.	.	.	.	.	+	.	.	13	7	–
Galium rivale	.	.	.	.	.	.	0	.	.	.	.	.	+	.	.	13	7	3

Species recorded in one relevé only:
Agrostis capillaris 9:2, *Alnus glutinosa* 3:+, *Alopecurus geniculatus* 13:2, *Armoracia rusticana* 8:+, *Calamagrostis canescens* 13:+, *Carduus acanthoides* 7:+, *Carex praecox* 13:2, *C. brizoides* 6:1, *C. hirta* 14:2, *Chaerophyllum aromaticum* 1:1, *Cirsium rivulare* 13:+, *Convolvulus arvensis* 7:+, *Fallopia convolvulus* 12:+, *F. dumetorum* 15:2, *Festuca nigrescens* 14:+, *Iris pseudacorus* 9:+, *Leontodon hispidus* 12:+, *Lolium perenne* 8:1, *L. multiflorum* 8:1, *Lotus corniculatus* 9:1, *Lycopus europaeus* 12:+, *Melandrium album* 7:+, *Mentha aquatica* 13:+, *Molinia coerulea* 11:1, *Myosoton aquaticum* 8:+, *Pimpinella major* 12:1, *Plantago major* subsp. *intermedia* 9:+, *Primula elatior* 5:+, *Pseudolysimachion longifolium* 12:+, *Stellaria media* 8:+, *Thalictrum lucidum* 12:1, *Trifolium pratense* 8:1, *T. hybridum* 9:1, *Tripleurospermum maritimum* 12:+, *Vicia cracca* 1:1

Alopecuretum pratensis was a widespread community type in the Morava river floodplain until the 1970s (Balátová-Tuláčková 1977, Bednář 1976) when most stands were transformed into improved grassland. Locally, after abandonment, degradation stages of the community develop, with a high dominance of *Phalaris arundinacea* and *Urtica dioica* (see Tab. 10; cf. Prach 1993).

The *Sanguisorbo-Festucetum* belongs to the most common grassland types within the *Molinion* in the Czech Republic (Moravec et al. 1995). Balátová-Tuláčková (1977) described three subassociations in the study area. Following the high input of nutrients (manuring) two oligotrophic types probably disappeared here. However, stands of this community show the highest species-richness and diversity of all the grassland types in the Hornomoravský úval area (see Tab. 3).

Molinietum coeruleae was also a widespread community around the town of Olomouc until the 1970s (Bednář 1976, Otruba 1945). River regulation, drainage (incl. extraction of drinking water) and manuring were responsible for the strong decline of this community (Bednář et Velísek 1962) in the 1970s. At present the community is only known to occur in two localities in the Morava river floodplain (Fig. 5). From the

Tab. 11. – *Sanguisorbo-Festucetum commutatae*

Relevé number	1	2	3	4	5	6	7	8	9	10	%
Date	4/6	9/6	9/6	9/6	9/6	16/6	16/6	16/6	29/5	29/5	
Year	92	92	92	92	92	92	92	92	92	92	
Relevé size (m^2)	25	25	25	25	16	25	25	25	25	25	
Inclination (°)	0	0	0	0	0	0	0	0	0	0	
Altitude (m a.s.l.)	220	220	220	220	220	195	195	195	220	220	
Cover E_1 (%)	100	100	95	95	100	100	100	100	90	90	
Ch.– *Molinion*											
Selinum carvifolia	4	2	2	2	1	3	2	2	2	2	100
Galium boreale	3	2	2	2	2	2	2	1	2	1	100
Succisa pratensis	.	3	1	.	.	–	1	2	1	2	70
D. – subass. *geranietosum pratensis*											
Geranium pratense	2	+	.	.	2	2	2	2	1	+	80
Arrhenatherum elatius	1	2	.	.	1	1	1	1	1	1	80
Trifolium pratense	.	1	1	+	+	.	+	.	.	+	60
Dactylis glomerata	.	.	+	.	.	1	2	3	+	1	60
Trisetum flavescens	.	2	.	.	.	2	2	2	.	.	40
Ch.– *Molinietalia* and subordinated syntaxa											
Deschampsia cespitosa	2	2	2	2	1	1	1	+	2	1	100
Cirsium canum	2	1	1	+	+	1	.	+	1	+	90
Sanguisorba officinalis	.	.	1	2	1	1	1	2	1	2	80
Lychnis flos-cuculi	1	+	.	.	.	1	1	.	+	+	60
Ranunculus auricomus	.	.	.	1	.	1	1	1	1	+	60
Juncus conglomeratus	+	1	+	1	.	.	.	.	.	.	40
Colchicum autumnale	.	.	.	.	1	+	1	1	.	.	40
Filipendula ulmaria	.	.	.	.	+	+	+	+	.	.	40
Lysimachia vulgaris	.	.	+	.	.	.	.	.	.	+	20
Ch.– *Arrhenatherion*											
Campanula patula	+	+	+	1	.	1	1	+	1	+	90
Knautia arvensis	1	+	.	.	.	1	1	1	.	.	50
Galium mollugo	.	1	.	.	.	1	1	1	.	.	40
Pastinaca sativa	.	.	.	.	.	2	1	1	.	.	30
Trifolium dubium	.	1	+	.	.	.	.	.	.	.	20
Heracleum sphondylium	.	+	.	.	.	.	1	.	.	.	20
Ch.– *Cynosurion*											
Trifolium repens	.	.	2	1	2	.	.	.	.	.	30
Ch.– *Arrhenatheretalia*											
Centaurea jacea	+	2	2	2	2	1	+	+	2	2	100
Alchemilla sp.	1	+	1	1	1	.	+	.	1	1	80
Leucanthemum vulgare	1	1	.	.	+	1	+	+	+	+	80
Achillea millefolium	1	1	1	1	1	.	.	.	1	1	70
Festuca nigrescens	.	3	3	2	.	3	.	.	3	3	60
Lotus corniculatus	.	1	.	1	1	.	1	.	1	.	50
Pimpinella major	1	+	.	.	.	.	+	.	.	.	30
Vicia sepium	1	.	.	.	.	1	1	.	.	.	30
Avenula pubescens	.	.	.	.	.	.	.	.	+	+	20
Ch.– *Molinio-Arrhenatheretea*											
Festuca pratensis	3	1	2	3	3	2	3	3	2	2	100

Tab. 11. – Continued/pokračování

Relevé number	1	2	3	4	5	6	7	8	9	10	%
Holcus lanatus	2	3	2	2	3	3	3	2	2	2	100
Plantago lanceolata	1	1	1	1	1	1	1	1	2	2	100
Ranunculus acris	1	1	1	1	+	2	1	1	1	1	100
Rumex acetosa	1	2	1	1	1	+	1	1	1	1	100
Lathyrus pratensis	1	1	1	1	1	+	1	1	1	1	100
Cerastium holosteoides	1	1	1	1	1	1	+	+	1	1	100
Poa pratensis	2	1	2	2	1	.	.	1	2	3	80
Vicia cracca	+	+	.	+	+	+	+	+	.	.	70
Alopecurus pratensis	.	.	+	1	.	1	1	1	1	2	70
Prunella vulgaris	1	1	+	.	.	.	+	.	1	1	60
Festuca rubra subsp. *rubra*	2	.	.	.	3	.	.	3	.	.	30
Poa trivialis	.	.	2	.	2	1	.	.	.	.	30
Cardamine pratensis	.	.	+	.	.	.	+	.	+	.	30
Ch.– *Nardo-Callunetea*											
Luzula campestris	1	1	.	.	.	1	1	1	1	1	70
Carex pallescens	1	1	1	1	.	.	.	.	.	1	50
Ch.– *Agropyro-Rumicion crispi*											
Ranunculus repens	1	1	1	2	1	2	.	+	1	1	90
Potentilla anserina	+	.	.	.	1	.	.	.	1	1	40
Agrostis stolonifera	.	.	.	.	.	2	.	1	.	.	20
Ch.– *Magnocaricetalia*											
Carex panicea	1	.	+	+	.	.	.	.	1	.	40
Others											
Veronica chamaedrys	1	1	1	+	2	1	1	1	1	1	100
Anthoxanthum odoratum	2	1	1	1	.	1	2	2	2	1	90
Lysimachia nummularia	+	.	–	+	.	1	1	+	+	1	80
Stellaria graminea	.	1	2	1	1	1	.	1	1	1	80
Taraxacum officinale agg.	.	.	2	1	1	2	1	1	1	1	80
Carex hirta	.	+	.	+	2	1	+	.	1	1	70
Carex ovalis	1	+	1	1	.	.	.	.	1	1	60
Betonica officinalis	3	2	1	.	.	.	.	2	2	.	50
Briza media	2	1	.	.	.	.	.	.	1	1	40
Agrostis capillaris	.	1	2	1	1	.	.	.	.	.	40
Carex spicata	.	+	+	1	.	.	.	.	.	.	30
Plantago major	.	.	1	.	+	.	.	.	.	+	30
Veronica serpyllifolia	.	.	+	.	.	.	.	.	+	+	30
Cirsium arvense	+	.	.	.	.	.	.	.	.	+	20
Allium scorodoprasum	.	.	.	.	.	+	.	1	.	.	20
Poa angustifolia	.	.	.	.	.	.	.	.	2	1	20

Species recorded in one relevé only:
Agrostis canina 10:1, *Ajuga reptans* 3:+, *Bellis perennis* 3:+, *Bromus erectus* 1:1, *Carex vulpina* 10:1, *Chenopodium album* agg. 2:–, *Cirsium oleraceum* 5:–, *Cnidium dubium* 5:1, *Coronilla varia* 3:+, *Euphorbia esula* 9:+, *Glechoma hederacea* 8:1, *Phleum pratense* 4:+, *Polygonum bistorta* 5:2, *Potentilla erecta* 10:2, *Ranunculus polyanthemos* 8:+, *Rubus caesius* 9:–, *Rumex crispus* 4:+, *Senecio erucifolius* 7:+, *Thalictrum lucidum* 6:+

point of view of syntaxonomy the stands with an absence of *Molinia coerulea* dominated by *Bromus erectus* on elevated terraces (Tab. 12) are the most complicated. The floristic composition of the relevés shows an intermediate position between the *Molinion* and *Bromion*. Both Bednář (1976) and the current study assigned these stands to the *Molinietum coeruleae brometosum erecti* that was recorded from other parts of the Czech Republic (Kopecký 1960, Kovář 1981, Válek 1956) and Slovakia (Špániková 1978). A different view was presented by Balátová-Tuláčková (1977). She assigned this type to the *Silaetum pratensis potentilletosum albae* Balátová-Tuláčková 1977. A similar community (*Potentillo albae-Festucetum rubrae*) was described by Blažková (1979) in the Berounka river floodplain. Because of the total lack of phytosociological data from the study area, it is impossible to solve this problem adequately.

The species of continental inundated meadows (*Cnidium dubium, Carex praecox, Pseudolysimachion longifolium, Serratula tinctoria, Iris sibirica, Allium angulosum*) indicating the *Cnidion venosi* alliance typical of the lower Morava and Dyje rivers (Balátová-Tuláčková 1965, Grulich et Danihelka 1996) occur in the study area only as a component of the *Molinion* and *Filipendulenion* communities.

Acknowledgements

I would like to express my thanks to Milan Chytrý for his valuable comments on the manuscript and the language correction. The final English text was corrected by John Cross.

Souhrn

Článek se zabývá polopřirozenou luční vegetací (*Molinio-Arrhenatheretea*) aluvia Moravy v prostoru Hornomoravského úvalu. Provedený výzkum navazuje na cca 35 let staré údaje o aluviálních loukách v Hornomoravském úvalu. Práce si klade za cíl zodpovědět tyto otázky: (a) jaké hlavní faktory ovlivňují současné složení aluviálních luk v prostoru Hornomoravského úvalu a (b) jaký je současný stav aluviálních luk po období intenzivního zemědělského obhospodařování v uplynulých 35 letech. Ordinace (obr. 1, 2, tab. 1, 2) ukazuje, že řídícími faktory, které způsobují diferenciaci luční vegetace aluvia Moravy jsou (a) vodní režim (vlhkost) a (b) složený gradient typu stanoviště, fertility a ruderalizace. První ordinační osu lze interpretovat jako vlhkostní gradient od sečených i nesečených porostů na vyvýšených místech nivy (mimo záplavy) přes zaplavované louky po nesečené porosty s vysoko položenou hladinou podzemní vody po celý rok. Druhá osa reprezentuje složený gradient ruderalizace a fertility stanoviště, kde intenzita lidského narušování (mimo sečení) klesá a indikační hodnota pro dusík stoupá od spodní směrem k horní části ordinačního diagramu. Indexy diverzity jsou průkazně negativně korelovány s 1. ordinační osou a slabě průkazně pozitivně se 2. osou (tab. 1). Toto je s souladu s výsledky korelační analýzy mezi ordinačními osami a faktory prostředí měřenými (půdní rozbory apod.) nebo spočítanými na základě kalibrace (tab. 1).

Půdy vlhčích stanovišť mají nižší pH a vyšší obsah C_{ox} a N. Porovnání skutečně naměřených a kalibrací vypočítaných hodnot půdní reakce (pH – R_c) a obsahu půdního dusíku (N – N_c) ukazuje na velmi slabou až žádnou korelaci. Důvodem je patrně široká valence nebo indiferentnost řady druhů k pH v případě R_c a rozdíly ve významu naměřených a kalibrací vypočítaných hodnot v případě N a N_c (tab. 1).

Ve studovaném území bylo celkem rozlišeno 16 jednotek na úrovni asociace, popř. bazálního nebo odvozeného společenstva, z toho z řádu *Arrhenatheretalia* 7 a z řádu *Molinietalia* 9 jednotek (viz Syntaxonomical synopsis).

Nejrozšířenějším typem řádu *Arrhenatheretalia* jsou ve studovaném území porosty s *Arrhenatherum elatius*. Asociace *Arrhenatheretum elatioris* tvoří druhově bohaté homogenní porosty s častou prezencí druhů *Arrhenatherum elatius, Pastinaca sativa, Campanula patula, Geranium pratense* aj. (tab. 3, 5). V území byly rozlišeny dvě subasociace: *typicum* a *galietosum borealis*. První typ bez diferenciálních druhů osídluje čerstvě vlhké až vysýchavé roviny či svahy mimo dosahu záplav, druhý typ, diferencovaný druhy *Galium boreale, Betonica officinalis* aj., osídluje stanoviště s kolísající hladinou podzemní vody. V minulosti hojně rozšířené porosty as. *Arrhenatheretum elatioris* byly buď rozorány, nebo na ruderalizovaných místech nahrazeny bazálními či odvozenými společenstvy s *Arrhenatherum elatius, Aegopodium podagraria, Festuca rubra*. V současnosti se vyskytují jen jako fragmenty v intra- a extravilánech obcí (obr. 3). Bazální a odvozená společenstva na úrovni svazu *Arrhenatherion* (popř. řádu *Arrhenatheretalia*) (*Alopecurus pratensis*-[*Arrhenatheretalia*], *Arrhenatherum elatius*-[*Arrhenatherion*], *Festuca rubra*-[*Arrhenatherion*], *Aegopodium podagraria*-[*Arrhenatherion*]; tab. 3, 4) zastupují ovsíkové louky na ruderalizovaných či nově vytvořených stanovištích (protipovodňové valy, neudržované sady, opuštěné louky apod.) s antropickými půdami. Jsou charakterizovány výraznou dominantou (*Arrhenatherum elatius, Alopecurus pratensis, Aegopodium podagraria, Festuca rubra*) a řadou průvodních, často ruderálních druhů. Dosahují většinou nízké až střední druhové bohatosti. Vyskytují se roztroušeně v celé nivě (obr. 3).

V severní části Hornomoravského úvalu byly zaznamenány porosty as. *Trifolio-Festucetum rubrae* s dominantními druhy *Trifolium pratense, Festuca rubra* a *Holcus lanatus* (tab. 3, 5, obr. 3). Společenstvo je typické výskytem druhů třídy *Nardo-Callunetea* (*Viola canina, Luzula campestris, Polygala vulgaris, Potentilla erecta*). Porosty asociace osídlují středně vlhká stanoviště s hnědými půdami, popř. semigleji.

Ze syntaxonomického pohledu se jeví nejproblematičtější as. *Holcetum lanati* (tab. 3, 6). Floristicky bohaté porosty s dominancí *Holcus lanatus* ekologicky leží na přechodu mezi čerstvě vlhkými a vlhkými typy luk (mezi svazy *Arrhenatherion* a *Alopecurion*). V jednotce se přibližně vyrovnaně uplatňují indikační druhy řádů *Arrhenatheretalia* a *Molinietalia*. V rámci asociace lze rozlišit 2 typy: subas. *arrhenatheretosum* na čerstvě vlhkých stanovištích a subas. *cirsietosum cani* na vlhkých stanovištích s kolísající hladinou podzemní vody. Půdním typem je semiglej. Asociace byla zaznamenána v severní a střední části Hornomoravského úvalu (obr. 5).

Většina společenstev řádu *Molinietalia* zaznamenaná v Hornomoravském úvalu náleží k běžně rozšířeným typům luk. Z netypických společenstev velkých úvalů byla zaznamenána přítomnost asociace *Scirpetum sylvatici* s dominantním druhem *Scirpus sylvaticus*. Vedle skřipiny se v druhově chudých porostech (tab. 3, 7) uplatňuje řada druhů svazu *Calthion* (*Caltha palustris, Filipendula*

Tab. 12. – *Festuca nigrescens*-[*Molinietalia*] (rel. 1), *Molinietum caeruleae typicum* (rels. 2, 3), *brometosum* (rels. 4–6)

Relevé number	1	2	3	4	5	6	%
Date	4/6	12/10	12/10	26/5	26/5	26/5	
Year	92	92	92	93	93	92	
Relevé size (m^2)	25	25	25	25	25	25	
Inclination (°)	0	0	0	0	0	0	
Altitude (m a.s.l.)	220	220	220	215	215	215	
Cover E_1 (%)	100	80	80	80	95	85	
Ch.– *Molinion*							
Galium boreale	.	2	1	1	1	1	100
Selinum carvifolia	.	1	1	.	1	+	80
Succisa pratensis	.	1	1	–	.	.	60
Serratula tinctoria	.	.	.	1	2	2	60
Molinia caerulea	.	3	3	.	.	.	40
D. – subass. *brometosum*							
Bromus erectus	.	.	.	3	2	3	60
Galium verum	.	.	.	1	+	1	60
Ch.– *Molinietalia* and subordinated syntaxa							
Deschampsia cespitosa	3	2	3	2	1	1	100
Colchicum autumnale	1	+	+	1	1	1	100
Sanguisorba officinalis	1	1	1	.	2	1	80
Cirsium canum	.	.	.	1	2	+	60
Ranunculus auricomus	.	1	+	.	.	.	40
Lychnis flos-cuculi	.	.	.	1	+	.	40
Angelica sylvestris	.	.	.	.	+	+	40
Ch.– *Arrhenatherion*							
Geranium pratense	.	.	.	1	+	2	60
Campanula patula	.	.	.	1	1	+	60
Arrhenatherum elatius	.	+	1	.	.	.	40
Galium mollugo	.	.	.	.	1	+	40
Ch.– *Arrhenatheretalia*							
Festuca nigrescens	3	3	2	3	3	2	100
Dactylis glomerata	.	1	2	3	1	1	100
Centaurea jacea	.	+	.	1	1	+	80
Achillea millefolium	.	-	+	.	1	.	60
Alchemilla sp.	.	.	+	+	1	.	60
Leucanthemum vulgare	.	.	.	1	+	+	60
Trisetum flavescens	.	.	.	1	.	1	40
Pimpinella major	.	.	.	+	.	+	40
Ch.– *Molinio-Arrhenatheretea*							
Plantago lanceolata	+	2	2	2	2	1	100
Poa pratensis	.	1	1	2	2	+	100
Rumex acetosa	.	1	1	1	1	+	100
Holcus lanatus	1	.	1	2	3	2	80
Vicia cracca	.	1	1	+	.	+	80
Ranunculus acris	.	1	+	.	2	+	80
Lathyrus pratensis	2	1	+	+	.	.	60
Festuca rubra subsp. *rubra*	.	.	3	3	.	3	60

Tab. 12. – Continued/pokračování

Relevé number	1	2	3	4	5	6	%
Cerastium holosteoides	.	.	.	+	1	+	60
Festuca pratensis	1	.	.	2	2	.	40
Alopecurus pratensis	+	.	.	1	.	.	20
Ch.– *Nardo-Callunetea*							
Potentilla erecta	.	1	1	.	–	.	60
Ch.– *Festuco-Brometea*							
Filipendula vulgaris	.	.	.	2	2	2	60
Ch.– *Agropyro-Rumicion crispi*							
Ranunculus repens	1	1	1	+	1	.	80
Ch.– *Phragmito-Magnocaricetea* and *Phragmitetalia*							
Phragmites australis	.	.	.	+	+	.	40
Others							
Veronica chamaedrys	2	+	1	+	1	1	100
Cnidium dubium	2	1	1	.	+	.	60
Taraxacum officinale agg.	.	1	.	1	.	1	60
Potentilla alba	.	.	.	1	2	2	60
Betonica officinalis	.	.	.	1	2	1	60
Ranunculus polyanthemos	.	.	.	1	1	1	60
Cirsium arvense	2	1	1	.	.	.	40
Viola persicifolia	.	2	2	.	.	.	40
Carex hirta	.	1	.	.	2	.	40
Plantago major	.	+	.	.	+	.	40
Bromus mollis	.	.	.	1	1	.	40
Phyteuma orbiculare	.	.	.	+	.	1	40
Anthoxanthum odoratum	.	.	.	.	2	2	40
Rumex obtusifolius	+	.	.	+	.	.	20

Species recorded in one relevé only:
Agrostis canina 4:3, *Arctium tomentosum* 3:-, *Cardamine pratensis* 3:+, *Carex praecox* 5:+, *C. acutiformis* 4:+, *C. vesicaria* 5:+, *Dianthus carthusianorum* 5:+, *Equisetum arvense* 6:–, *Euphorbia villosa* 4:1, *Galium rivale* 1:1, *Heracleum sphondylium* 6:+, *Iris sibirica* 1:1, *Knautia arvensis* 6:+, *Leontodon autumnalis* 3:–, *L. hispidus* 6:+, *Lotus corniculatus* 4:+, *Luzula campestris* 6:+, *Phleum pratense* 2:+, *Pimpinella saxifraga* 3:+, *Poa angustifolia* 1:1, *Polygonum bistorta* 1:+, *P. aviculare* 2:+, *Potentilla anserina* 2:+, *Trifolium montanum* 5:+, *T. pratense* 4:+, *T. dubium* 5:1, *Veronica* sp. 3:1, *Vicia sepium* 5:+, *Viola canina* 6:1

ulmaria) a řádu *Magnocaricetalia* (*Carex vulpina, C. gracilis, C. cespitosa, Galium palustre*). Společenstvo osídluje terénní deprese s jílovitým neprostupným horizontem, zaplavené dlouhou dobu na jaře a saturované dešťovými srážkami v létě. Půdním typem je glej nebo pseudoglej. Asociace se vyskytuje pouze v PR Plané loučky u Olomouce (obr. 5).

Naopak nejtypičtější společenstvo s *Cirsium* spp. na střední a východní Moravě (asociace *Cirsietum rivularis*) je ve studovaném území velmi vzácné. Druhově bohaté porosty s dominantou *Cirsium rivulare* (tab. 3, 8) a druhovou garniturou vlhkých luk (*Sanguisorba officinalis, Lychnis flos-cuculi* aj.) osídlují stanoviště s vysokou hladinou podzemní vody po celý rok (gleje nebo

semigleje). V území byly identifikovány dvě subasociace: *typicum* a *arrhenatheretosum*. Porosty asociace byly zaznamenány ve střední a jižní části Hornomoravského úvalu (obr. 5).

Vzácně se v litorální zóně rybníků vyskytují středně bohaté porosty asociace *Angelico-Cirsietum oleracei* (tab. 3, 8) s indikačními druhy *Cirsium oleraceum, Caltha palustris, Scirpus sylvaticus, Lysimachia vulgaris* aj. Ve studovaném území byla zjištěna subas. *caricetosum gracilis* s diferenciálními druhy *Carex vulpina, C. gracilis, Phalaris arundinacea*. Asociace byla zaznamenána v okolí Záhlinických rybníků (obr. 5).

Častým typem okrajů lužních lesů nebo delší dobu opuštěných vlhkých luk je asociace *Lysimachio-Filipenduletum* (tab. 3, 9). Vedle dominantního tužebníku *Filipendula ulmaria* se v druhově chudších porostech uplatňují druhy řádové (*Symphytum officinale, Sanguisorba officinalis*), třídní (*Rumex acetosa, Poa trivialis*) a ruderální (*Urtica dioica, Equisetum arvense*).

Psárkové louky (asociace *Alopecuretum pratensis*) patřily v minulosti k nejrozšířenějším porostům nivy Moravy. V současnosti jsou plošně velmi omezené. Středně druhově bohaté společenstvo je typické dominancí *Alopecurus pratensis* a dále přítomností řady druhů řádu *Molinietalia* a třídy *Molinio-Arrhenatheretea* (*Symphytum officinale, Lychnis flos-cuculi, Deschampsia cespitosa* aj.) (tab. 3, 10). V území byly rozlišeny dvě subasociace: *typicum* a *arrhenatheretosum*. Společenstvo osídluje zaplavované polohy podél řeky. Půdy jsou fluvisoly nebo semigleje. Asociace je roztroušeně rozšířena podél Moravy od severní po jižní část studovaného území (obr. 5). Zanedbané porosty psárkových luk přecházejí po jisté době do druhově chudých porostů s dominantní psárkou, lesknicí a/nebo kopřivou (tab. 3, 10).

Porosty společenstev sv. *Molinion* jsou ve studovaném území již velmi vzácné. Asociace *Sanguisorbo-Festucetum* a *Molinietum coeruleae* byly zaznamenány pouze na dvou místech v okolí Olomouce (obr. 5).

Sanguisorbo-Festucetum je floristicky nejbohatším a nejhomogennějším lučním typem studovaného území (tab. 3, 11). V porostech dominují druhy *Holcus lanatus, Festuca pratensis, Deschampsia cespitosa, Poa pratensis* a *Festuca nigrescens*. Společenstvo osídluje vyšší polohy nivy mimo dosah běžných záplav. Půdním typem je semiglej. Asociace byla zaznamenána poblíž Horky n. M. a v lučním komplexu mezi Kojetínem a Chropyní (obr. 5).

Současné rozšíření *Molinietum coeruleae* je pouhým zbytkem původně rozsáhlých porostů v širším okolí Olomouce. Druhově bohaté porosty jsou tvořeny dominantními druhy *Festuca nigrescens, Deschampsia cespitosa, Holcus lanatus*. Střídavě vlhká stanoviště indikují druhy *Galium boreale, Selinum carvifolia, Succisa pratensis* aj. V území se vyskytují 2 typy: subas. *typicum* a *brometosum erecti*. První je charakterizován dominancí *Molinia caerulea*, druhý její absencí a dominancí *Bromus erectus*. Typ s *Bromus erectus* je vázán na nejvyšší partie nivy se silně kolísající hladinou podzemní vody. Půdním typem je semiglej. Porosty společenstva se vyskytují v okolí Horky n. M. a v PR Plané loučky u Olomouce (obr. 5). Zanedbané porosty bezkolencových luk se mění v druhově chudé porosty s dominantními druhy *Deschampsia cespitosa* a *Festuca nigrescens* (tab. 3, 12, obr. 5).

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Appendix

Localities of relevés

Tab. 4. – **1.** Bludov: railway drain 1 km SW of the village; **2, 3, 4.** Lukavice: flood dike between Lukavice and Bohuňovice villages; **5.** Výtěšov: dike 1 km SW of the village; **6, 7.** Lukavice: flood dike between Lukavice and Bohuslavice villages 0.5 km SE of the village; **8.** Moravičany: meadow complex 0.3 km ESE of the railway station near the Morava; **9.** Dub n. M.: right bank of the Morava 1 km E of the village; **10.** Bílá Lhota: meadows near the Nové Mlýny village; **11, 12.** Bludov: meadow between railway and a field 1 km S of the village; **13.** Chromeč: meadows near left bank of the Morava, 1 km SE of the village; **14.** Moravičany: meadow between railway and a brook 2 km E of the railway station; **15.** Moravičany: left bank of the Morava 0.8 km E of the village; **16.** Litovel: meadow complex Hvězda 0.1 km S of the railway station; **17.** Trní: right bank of the Morava 0.5 km W of the village.

Tab. 5. – **1, 2.** Horka n. M.: meadow along the road Horka – Chomoutov in the village; **3.** Horka n. M.: meadow near a forest margin along the road Horka – Daliboř, 1 km NW of the village; **4.** Dub n. M.: right bank of the Morava 1 km E of the village; **5, 6.** Dub n. M.: meadow 2 km SE of the bridge near the village; **7.** Věrovany: meadow 2 km SE of the village; **8.** Trní: right bank of the Morava 1 km W of the village; **9.** Tovačov: Hradecký pond – terrain depression near the southern edge of the pond; **10.** Kojetín: shallow terrain depression on the right side of the road Kojetín – Chropyně 1 km WSW of the town; **11, 12, 13.** Moravičany: meadow complex 0.3 km ESE of the railway station near the Morava river; **14.** Nové Mlýny: meadow between the bridge and the pub

near the village; **15, 16.** Bludov-lázně: meadow near the railway crossing; **17.** Štěpánov: terrain depression along the railway 1 km SW of the railway station.

Tab. 6. – 1, 2. Bludov-lázně: meadow near the Morava river 0.5 km S of the village; **3.** Horka n. M.: meadow on the periphery of the village near to road Horka – Daliboř; **4.** Háj: meadow between flood dikes N of the village; **5, 6.** Bludov-lázně: meadow complex near the railway station; **7, 8, 9.** Olomouc-Řepčín: meadow tract (Plané loučky Nature Reserve) N of the town.

Tab. 7. – 1–6. Olomouc-Řepčín: meadows (Plané loučky Nature Reserve) N of the town.

Tab. 8. – 1, 2. Olomouc-Řepčín: meadows (Plané loučky Nature Reserve) N of the town; **3.** Chropyně: meadows 3 km W of the town near the railway Kojetín – Chropyně; **4, 5.** Záhlinice: meadow between Pláňavský pond and the village.

Tab. 9. – 1. Lukavice: drainage channel between Lukavice and Bohuňovice villages; **2.** Mohelnice: drainage channel 1 km NW of the railway station; **3.** Lukavice: flood dike between Lukavice and Bohuslavice villages 0.5 km SE of the village; **4.** Olomouc-Řepčín: meadow tract (Plané loučky Nature Reserve) N of the town; **5.** Bohutín: meadow complex between the Morava and the railway 1.5 km SE of the village; **6.** Nové Mlýny: drainage channel 1 km SW of the village; **7.** Tovačov: Hradecký pond – terrain depression near the southern edge of the pond; **8.** Lukavice: drainage channel 1 km SE of the village.

Tab. 10. – 1, 2. Bludov: left bank of the Morava river along the road Bludov – Postřelmov; **3, 4.** Litovel: meadow complex Hvězda 0.1 km S of the railway station; **5, 6.** Bohutín: meadow complex between the Morava and the railway 1 km SE of the village; **7.** Leština: a bank of the Morava near the bridge; **8.** Moravičany: meadow complex 0.3 km ESE of the railway station near the Morava river; **9.** Chropyně: meadows 3 km W of the town near the railway Kojetín – Chropyně; **10.** Nové Mlýny: meadow between the bridge and the pub near the village; **11, 12.** Moravičany: meadow complex 0.3 km ESE of the railway station near the Morava river; **13, 14.** Olomouc-Řepčín: meadows tract (Plané loučky Nature Reserve) N of the town; **15.** Moravičany: meadow 2 km E of Doubravice village.

Tab. 11. – 1–5, 9, 10. Daliboř: meadow complex 2 km NW of the village of Horka n. M.; **6–8.** Chropyně: meadow complex 3 km W of the town near the railway Kojetín-Chropyně.

Tab. 12. – 1–3. Daliboř: meadow complex 2 km NW of the village of Horka n. M.; **4, 5.** Olomouc - Řepčín: Plané loučky meadow complex – a terrace in the central part of the complex; **6.** Olomouc-Řepčín: meadow complex (Plané loučky Nature Reserve) N of the town.