

Plant community succession in old fields in the Chelčice region (Southern Bohemia)

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Abstract

The study of secondary succession was carried out since 1985 within the framework of the project Succession on abandoned fields in the Chelčice region that was processed at the Institute of Soil Biology. The study of vegetation on selected research plots is ongoing to year 2021. In this paper, the development of vegetation on four plots is presented: cultivated field - herbaceous old field (plot F), succession with later development of *Salix caprea* (plot AF), abandoned meadow (plot G), and production forest with *Quercus robur* (plot W). Based on the constrained classification (the HSCA method) of repeated phytosociological relevés, stages of vegetation development with different species composition of communities were identified. The speed of succession was calculated using CCA ordination as change of the score along first ordination axis. The most noticeable changes are associated with woody species invasion and associated changes in shading of the soil surface. On the plot F there was no significant development of the tree species in the community. On the AF plot, a continuous growth of *Salix caprea* has developed due to the time window where the soil surface was not covered by vegetation (after dead of the annual weeds after the first year of succession). Individual trees enter in community on the plot G within small gaps after the local damage of the continuous grasshopper (the so-called space-window model of succession). Minimal changes in plant communities were observed on the plot W. Main drivers of the succession were aging of the stand, tracheomycous damage of oaks and cuttings that affected the light conditions in the undergrowth.

Keywords: CCA, classification, Chelčice, old fields, *Quercus robur*, *Salix caprea*, secondary succession, woody species

The study of secondary succession was carried out since 1985 within the framework of the project Succession on abandoned fields in the Chelčice region that was carried out at the Institute of Soil Biology of the Czechoslovak Academy of Sciences in České Budějovice, today part of the Biological Centre of the Academy of Sciences of the Czech Republic, v. v. i. The aim of the initial study was to include research activities focused on soil biology parameters as comprehensively as possible. Therefore, the attention of soil microbiologists, chemists and soil zoologists was focused on the selected series of study plots, while the effort was to pay attention to additional pedological parameters and, last but not least, the development of vegetation conditions during the secondary succession.

The study of vegetation on selected research plots is ongoing to date. In this paper, the development of vegetation on four plots is presented: cultivated field - herbaceous old field

(plot F), succession with later development of shrub and tree layers with *Salix caprea* (plot AF), abandoned meadow (plot G), and production forest with *Quercus robur* (plot W).

Methods

Research plots

Information on the old-field project located near Chelčice vicinity are collected in the web pages <https://infodatasys.cz/proj003/dynveg-cz.htm>, including plot localization, photos and previous data processing (see also Matějka 1998, 2018).

Research plots in southern Bohemia, in the area between Netolice and Chelčice, were selected. Monitoring results on the following research plots (localities) are processed:

Plot F - The geographical coordinates of the centre of the site are 14° 7' 57.1" E, 49° 6' 9.2" N, altitude 568 m. It is located in the cadastral territory of Truskovice, about 800 m west from the settlement of Dlouhá Ves near Chelčice. At the beginning of the research in the 1980s, it was a ploughed field, which was subsequently abandoned. The experimental plot is located on the edge of a former field unit, with contact to a man-made needle forest with prevailing Norway spruce. The sequence of crops between 1985 and 1990 was: corn for silage (1985), spring wheat (1986), potatoes (1987), barley (1988), forage mixture (oats, peas, broad beans) with an underseeding of meadow clover (1989), clover without agrotechnical intervention from the previous year (1990). After spontaneous succession, the locality was ploughed again between 2015 and 2019.

Plot AF - The geographic coordinates of the centre of the site are 14° 7' 57.9" E, 49° 6' 11.8" N, altitude 568 m. Abandoned field (fallow), which together with above-mentioned plot F was part of the aforementioned field unit. It was abandoned after a prematurely ploughed maize crop in the summer of 1985. Due to the application of triazine herbicides when sowing corn, a strong development of vegetation was recorded only in 1986.

Plot G - Located near the two previous ones (centre of the site 14° 7' 55.8" E, 49° 6' 15.4" N, altitude 565 m). It is a formerly ploughed field abandoned around 1973. Until 1985, the entire area was regularly mowed, so that it acquired the character of a species-rich meadow. In 1985, only the northern part of the site was mowed. In the spring of 1986, the remains of the old grass biomass was mechanically removed (raked) from the entire study plot in order to achieve a higher homogeneity of the habitat at the beginning of the following monitoring. Compared to the two previous plots located on a slope, this one is located in a wide terrain depression with the occurrence of a groundwater level extending for most of the year to the strongly rooted surface soil horizons. Now the location is heterogeneous in terms of moisture conditions and light (sunshine/shadow) availability regarding to sparse tree recruitment.

Plot W - Located by the road Netolice-Krtely, 1.7 km from the railway crossing in Netolice (centre of the site 14° 11' 17.0" E, 49° 4' 4.4" N, altitude 489 m). Observations were made on the right north-east side of the road. It is a man-influencing deciduous forest with a dominant oak (*Quercus robur*) with a more or less natural species composition. The age composition of the stand does not correspond to the natural state (Matějka 1994). Forest management is carried out by the state enterprise Lesy ČR.

Data collection and processing

Plant coenological relevés were recorded using Braun-Blanquet cover scale with transition grades (e.g. +1, 1-2, 2-3, ...). The relevés were stored in the DBreleve database (Matějka 2022). The last updated datasets are available via internet page

www.infodatasys.cz/proj003/chelcice/releves.htm. The species cover grades of the used scale were transformed to average percentage cover as a value of species representation before any calculation. Data of species representation were standardized on the sum of representations of all species in the etage (E₃ - tree etage, E₂ - shrub etage and E₁ - herb etage; the moss etage E₀ was not analysed) to be equal to the total cover of the etage in percentages. Transformed data were exported for further calculations for etages E₁ and E₂ in the plots F and W, for etages E₁ + E₂ + E₃ in the plots AF and G, where woody plants take place during succession and the same species can participate in all etages. The resulting species representation is equal to sum of transformed species representations in all included etages.

The constrained classification of relevés (= years of sampling) was processed by the procedure HSCA with Sq distance indices (Matějka 1993). In case that more than one relevé is available in one year, "average relevé" with average species representation over all such relevés was used.

The succession trends were evaluated using CCA ordination in the Canoco software (Lepš et Šmilauer 2003). The sampling year was used as an environmental variable. The succession speed was calculated using regression between year of sampling and respective CCA score along first ordination axis. In each case that more than one relevé was recorded in the year, the arithmetical average of values for such relevés was used.

The Shannon-Wiener's index of total diversity (H') and equitability (e) were calculated using the E₁ data in the DBreleve database.

The Ellenberg's bioindication indices (Ellenberg et al. 1991) were calculated in the DBreleve software using species composition of the herb etage.

Results

All relevés are collected in tables 2-5, where information on species richness and diversity are too. The field - herbaceous old field (locality F) had maximal species richness (52 species) in 2007, 17 years after abandonment. The maximal diversity (H' = 4.53) was recorded at 2009. The classical old field with willow succession (locality AF) had maximal species richness later, at 2018 (57 species), it was 33 years after abandonment, but the first maximum was at first year after abandonment (1986) with 51 species) when segetal species prevailed. Total species diversity was growing to the observation end (H' = 4.39). The grassland without moving (plot G) had maximal species richness (59 species) at 2018, 33 years after last moving. Maximal value of total species diversity was found slater earlier, at 2007 (H' = 4.50). Succession in the cultivated oak forest (locality W) had no important changes in the vegetation structure and parameters of species richness / diversity vary only.

Variability of the plant communities in the individual localities was evaluated using two first CCA axes. The plot F (Fig. 1) shows vegetation continuum between 1991 and 2014, slightly distinct were relevés of years 1988-1990 of ploughed field. Very different was segetal communities of newly cultivated field with high doses herbicides. On the plot AF (Fig. 4) is visible different position of the initial community immediately after abandonment (1986). Nevertheless, two spatial gradients in the vegetation (first one along the slope, second one from border of the former field block to its centre; Fig. 13), the vegetation is spatially homogenous. The next development shows one gap between 1994 and 1997. The initial relevés at the locality G were very variable, mainly relevé 1985a located in the not mowed part is different. It brings info about initial heterogeneity of the locality (Fig. 7). It is possible to compare visual variability of the stand in the second year of succession (Fig 14), which is

drive mainly by soil wetness. Similar situation is in the locality W (Fig. 10), where relevé 1985b is distinct.

Speed and paths of the succession

If the speed of the vegetation change is evaluated as the CCA₁ score change, a nonlinear development is visible in the plot F (Fig. 2). It can be modelled with 2nd order polynomial equation

$$\text{CCA}_1 = -13179.25 + 13.0917 Y - 0.00325107 Y^2 \quad (r^2 = 0.9786)$$

Approximately up to 1997 is succession speed high (average CCA₁ change was 0.1650; $r = 0.9664$) and between 1997 and 2014 is slow only. Two last relevés (2020 and 2021) was made in segetal vegetation of the ploughed field, which is completely distinct.

The CCA₁ score for the plot AF (Fig. 5) is related to year with different coefficients distinctly for two intervals:

$$1986-1997: r = 0.9607 \text{ (} p < 0.001 \text{), increment} = 0.1939 \text{ year}^{-1}$$

$$1997-2021: r = 0.9365 \text{ (} p < 0.001 \text{), increment} = 0.0380 \text{ year}^{-1}$$

This shows approximately 5-times higher speed of vegetation change during first interval comparing to second one. The first speed is comparable with equivalent variable at the F locality.

If the speed of the vegetation change at the locality G is evaluated as the CCA₁ score change, a nonlinear development is visible (Fig. 8). It can be modelled with 2nd order polynomial equation

$$\text{CCA}_1 = -7468.81 + 7.38775 Y - 0.00182665 Y^2 \quad (r^2 = 0.9824)$$

Change of the CCA₁ score at the locality W shows a linear trend with parameters $r = 0.9785$ ($p < 0.001$) and increment = 0.0708 year⁻¹ (Fig. 11).

Dendrograms of constrained clustering are in Figs. 3, 6, 9 and 12). Extent of the vertical axis is identical in all graphs that compare temporal β -diversity is possible among plots. The highest vegetation dynamics during succession was found in the F locality ($S_q = 0.156$) as result of the most distant relevés at end of observation, when the field was plough again. Without the last two relevés, index S_q was smaller (0.080) (Fig. 3). This community is herbaceous during whole observed period. The highest vegetation dynamics was at the AF locality ($S_q = 0.122$) where changes are connected with woody species succession over whole area of the locality (Fig. 6). More stable community was at the G locality ($S_q = 0.034$; Fig. 9), where big part of the area has still meadow character, approximately one third is covered by individual woody succession. The most stable community was found in the forest - W locality ($S_q = 0.021$; Fig. 12).

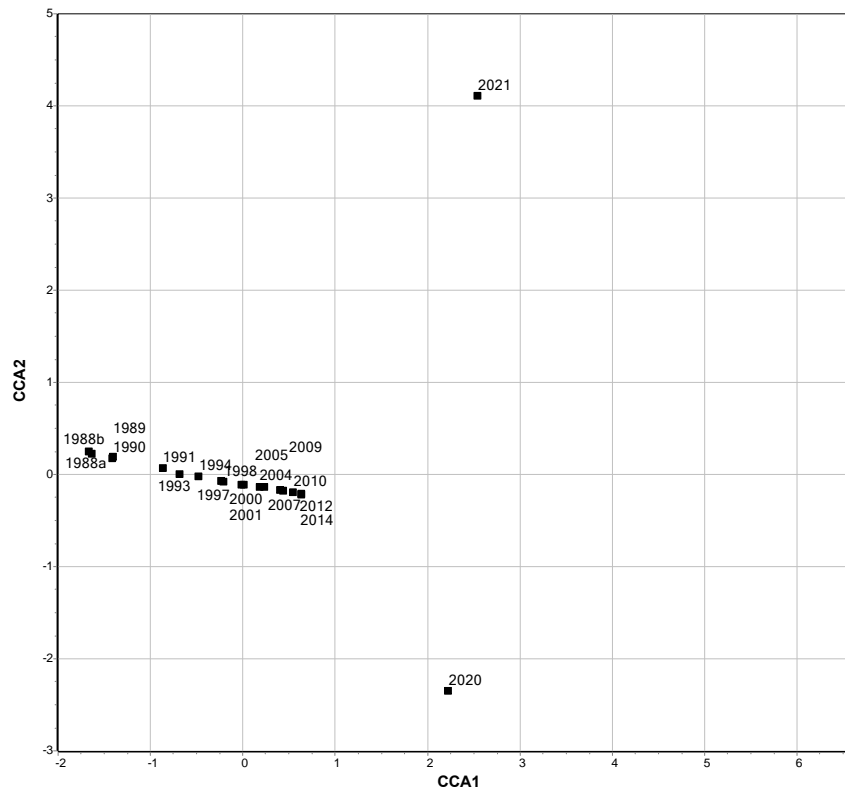


Fig. 1. CCA ordination of relevés at the plot F. The sampling year as first environmental variable, two first axis was drawn

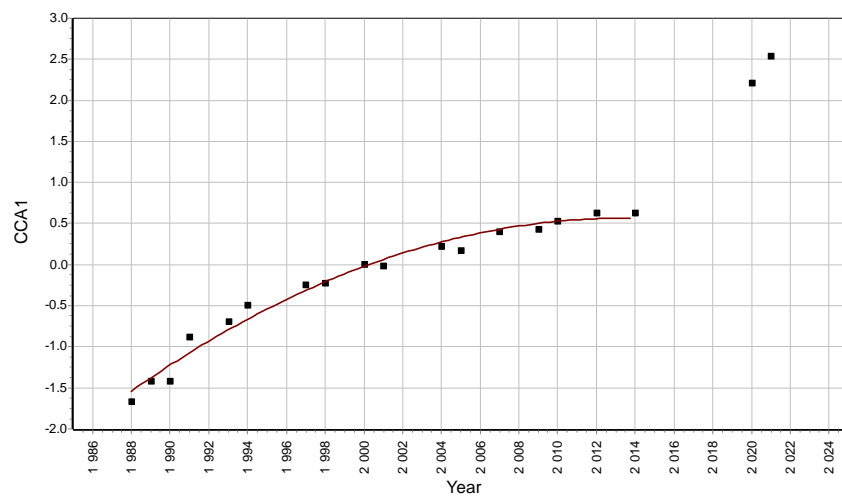


Fig. 2. The CCA ordination score along the first axis at the plot F

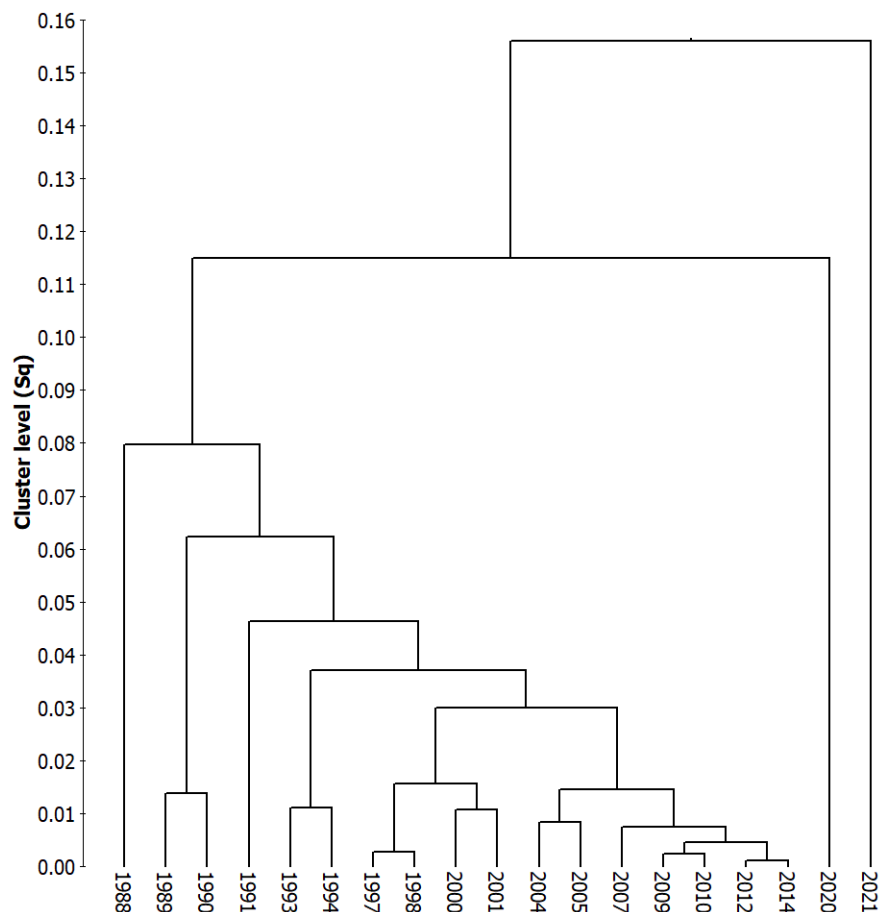


Fig. 3. The HSCA/Sq classification of relevés (years of sampling) at the plot F

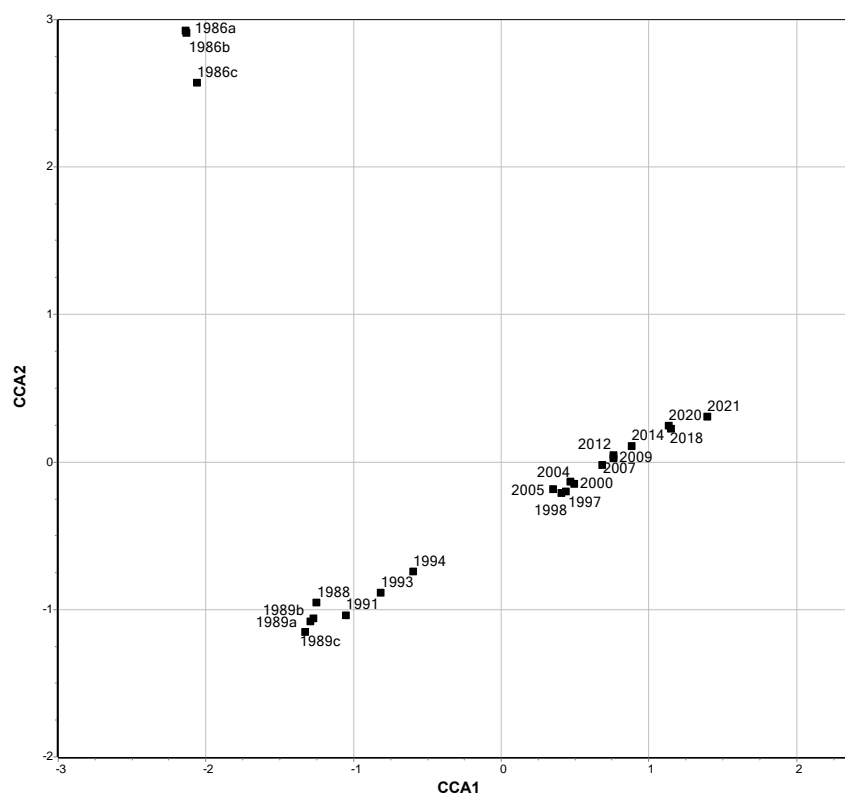


Fig. 4. CCA ordination of relevés at the plot AF. The sampling year as first environmental variable, two first axis was drawn

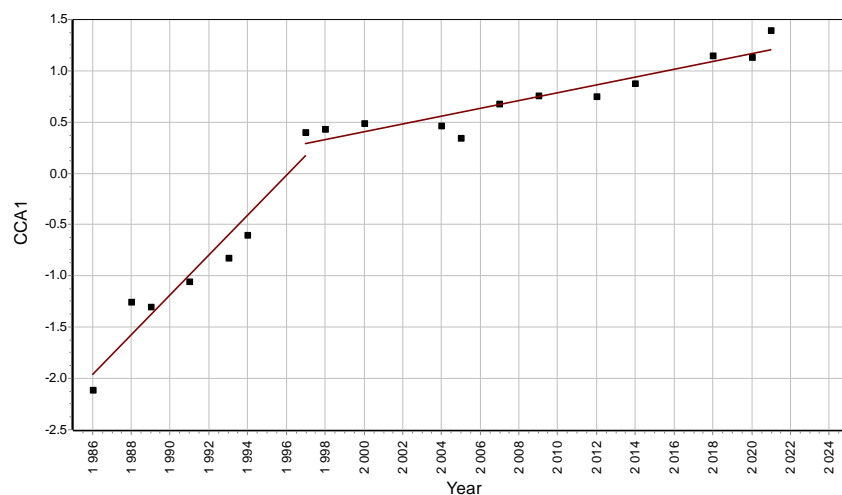


Fig. 5. The CCA ordination score along the first axis at the plot AF

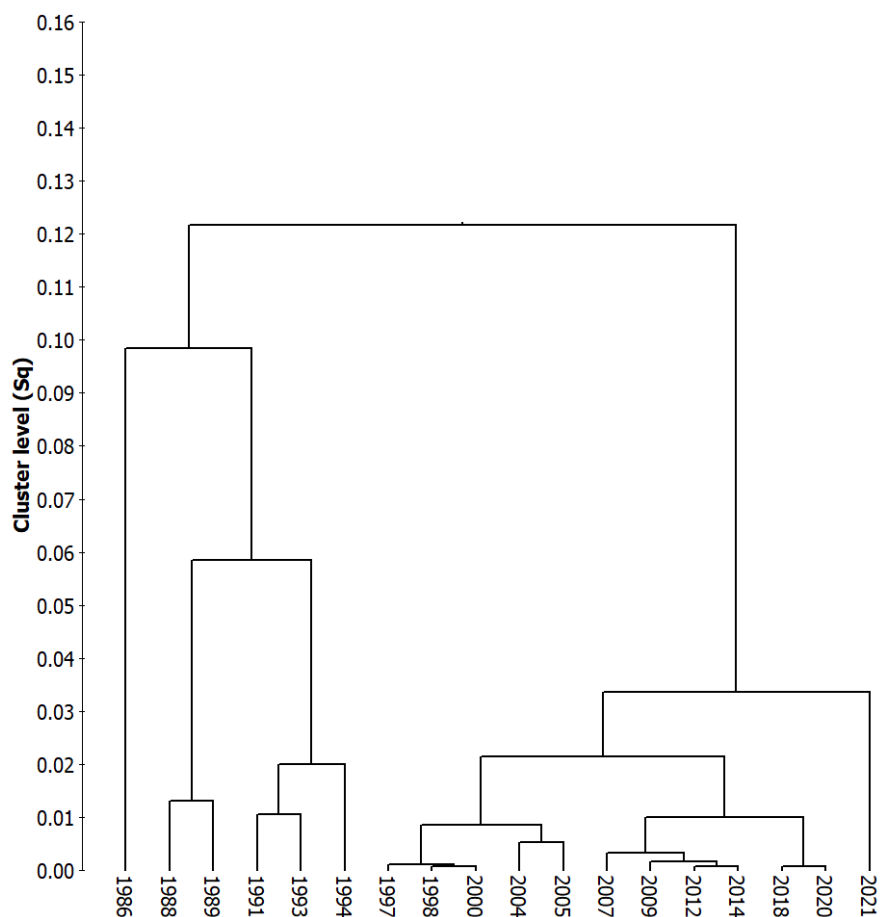


Fig. 6. The HSCA/Sq classification of relevés (years of sampling) at the plot AF

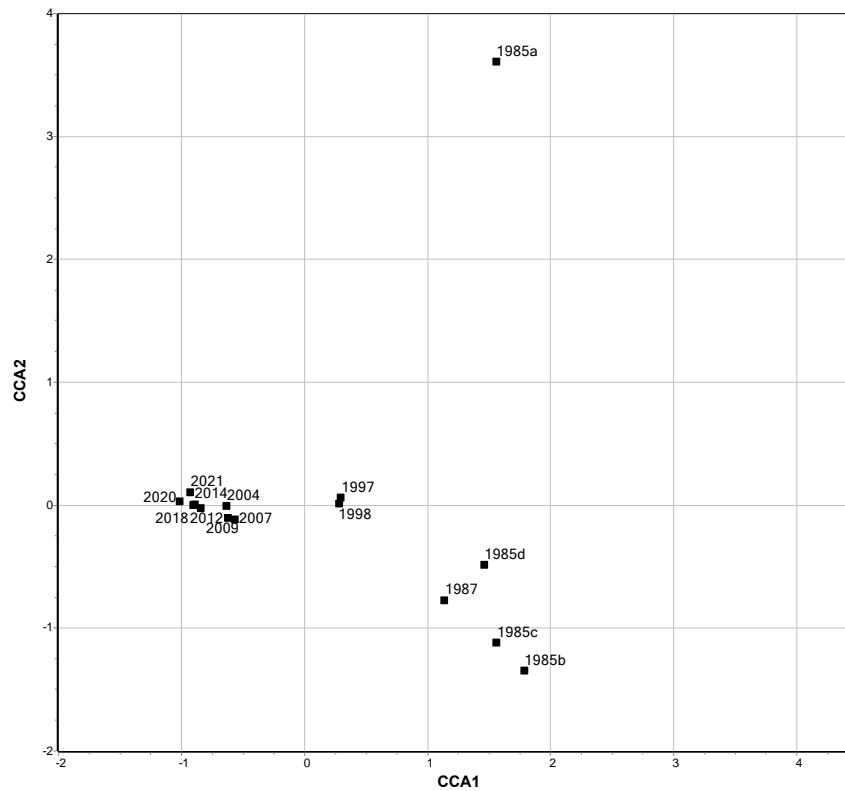


Fig. 7. CCA ordination of relevés at the plot G. The sampling year as first environmental variable, two first axis was drawn

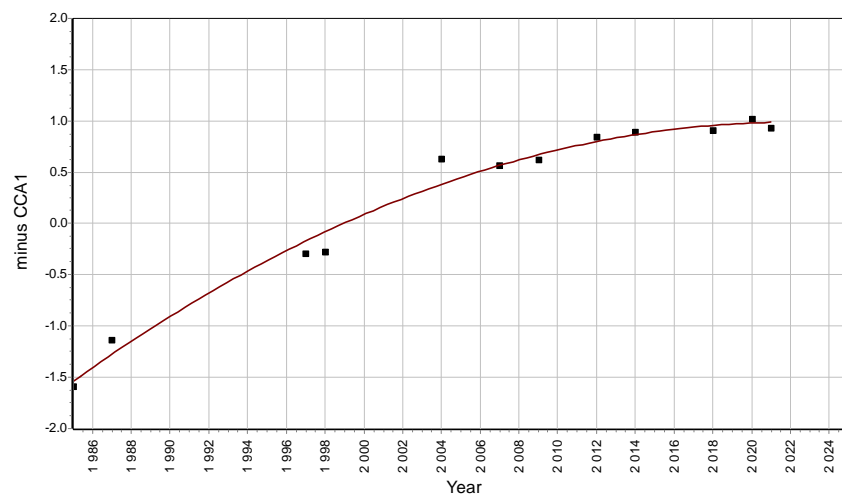


Fig. 8. The CCA ordination score along the first axis at the plot G

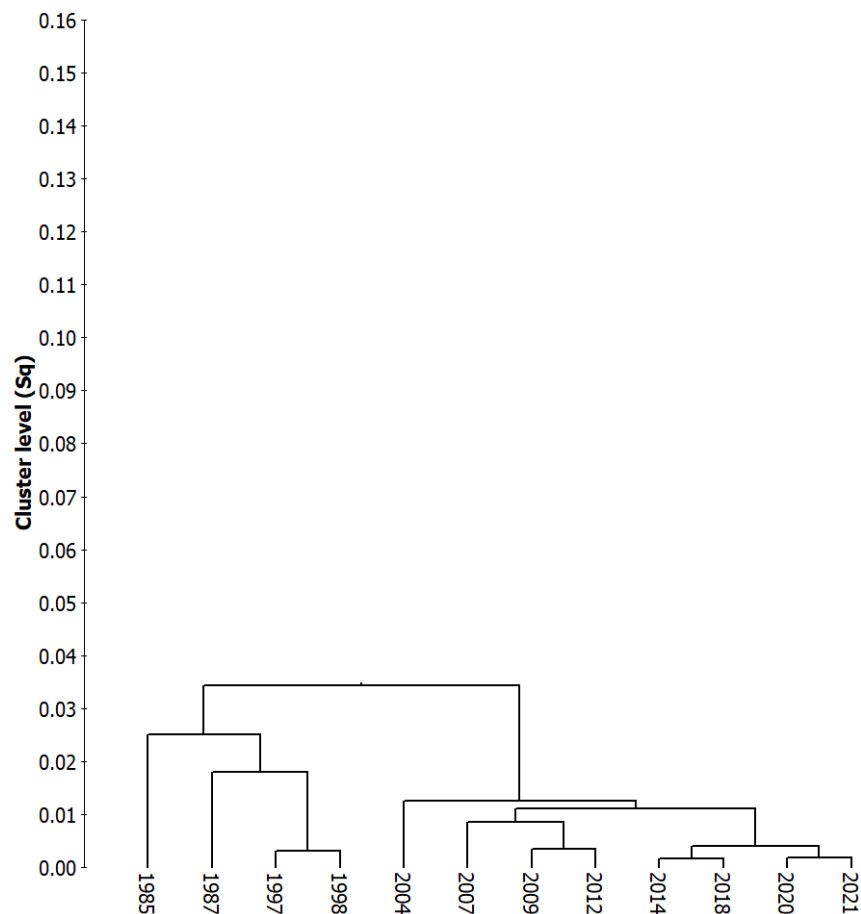


Fig. 9. The HSCA/Sq classification of relevés (years of sampling) at the plot G

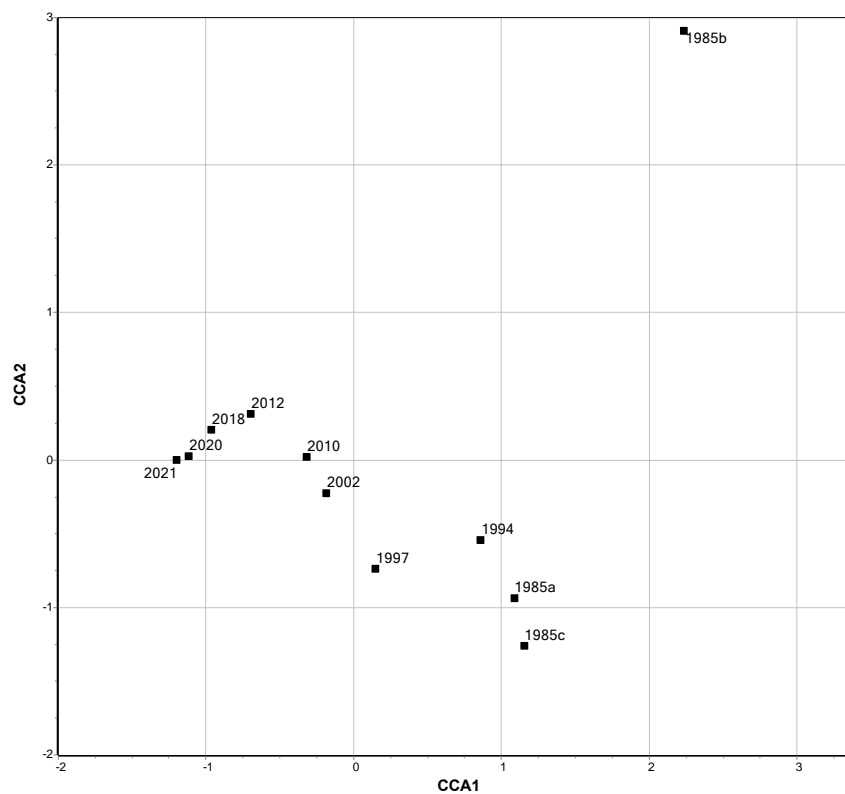


Fig. 10. CCA ordination of relevés at the plot W. The sampling year as first environmental variable, two first axis was drawn

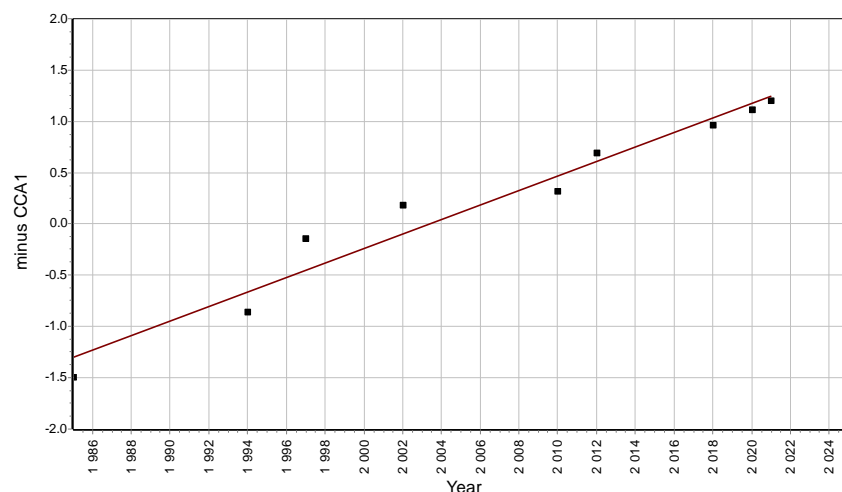


Fig. 11. The CCA ordination score along the first axis at the plot W

If the speed of the vegetation change is evaluated as the CCA₁ score change, a linear trend is visible: $r = 0.9785$ ($p < 0.001$), increment = 0.0708 year^{-1} .

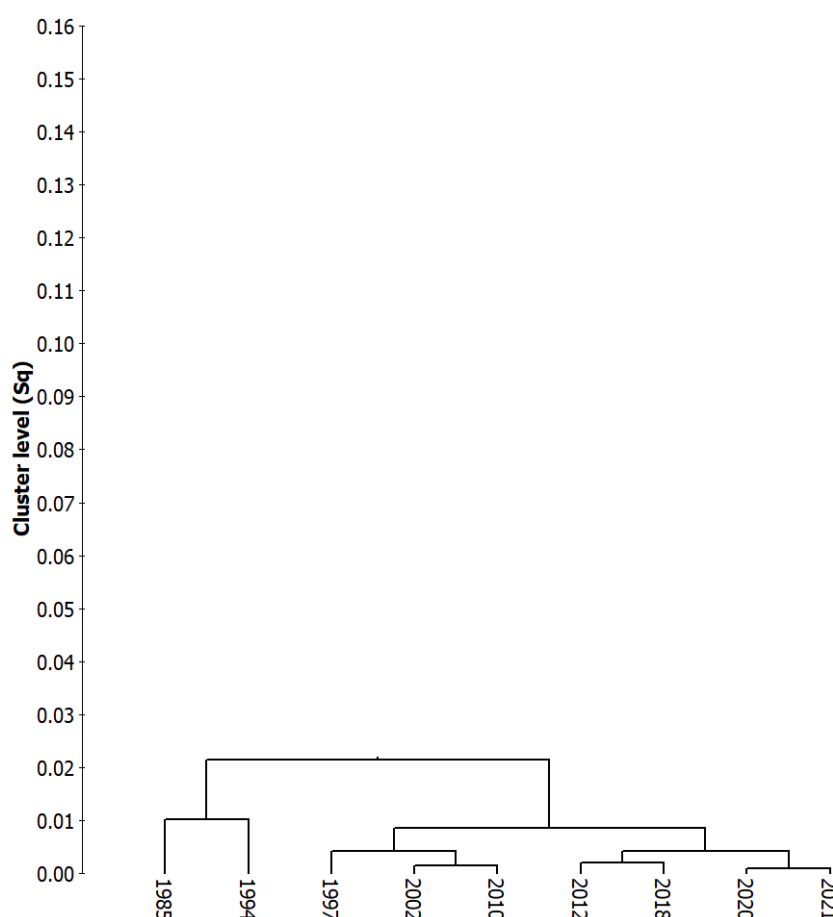


Fig. 12. The HSCA/Sq classification of relevés (years of sampling) at the plot W

The Ellenberg's bioindication

All values are summarized in Table 1. The highest temperature is indicated in the locality F with direct sun radiation during whole succession, the lowest temperature is possible in the forest (W). Values for light are comparable in three localities F - AF - G. The

highest nitrogen activity value was recorded in plots F and G, the lowest value in the plot W. Soil reaction was comparable in all plots, similar situation was by soil wetness.

Table 1. Range of the average Ellenberg's indication values in all phytocoenological relevés during succession according observed localities. T - air temperature, L - light, N - nitrogen activity (nutrients), R - soil reaction, W - wetness

Plot	T	T	L	L	N	N	R	R	W	W
	min	max	min	max	min	max	min	max	min	max
F	5.13	6.03	6.10	7.39	5.69	7.47	4.33	6.96	4.21	6.89
AF	5.01	5.88	6.21	7.26	5.22	6.59	4.59	6.66	4.99	6.82
G	5.00	5.92	6.35	7.06	4.76	7.84	4.87	6.83	4.95	6.14
W	4.95	5.63	4.22	5.29	4.41	5.16	4.46	5.06	4.93	5.14

The light conditions in herb layer were analysed using the Ellenberg's indices in two localities where changes were visually observed (F and AF; Fig. 13). The highest values were recorded in short time after abandonment (F: 1991; AF: 1989). Rapid decrease of indices corresponds to increase of density and height of herb layer. A break was occurred between 2001 and 2004 in both sites. It was in the time of the coverage increase of *Calamagrostis epigejos* in the F plot and at the first damage (self-thinning) in the mature shrub layer with dominant *Salix caprea* in the AF plot.

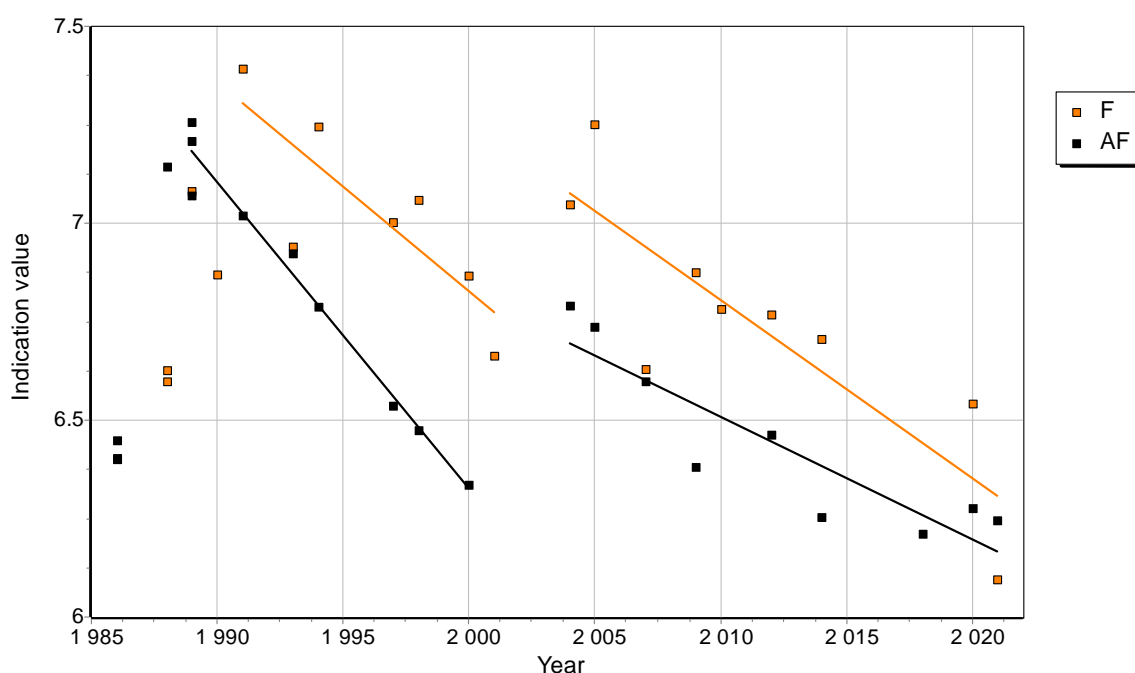


Fig. 13. The Ellenberg's bioindication of light in the plots F and AF

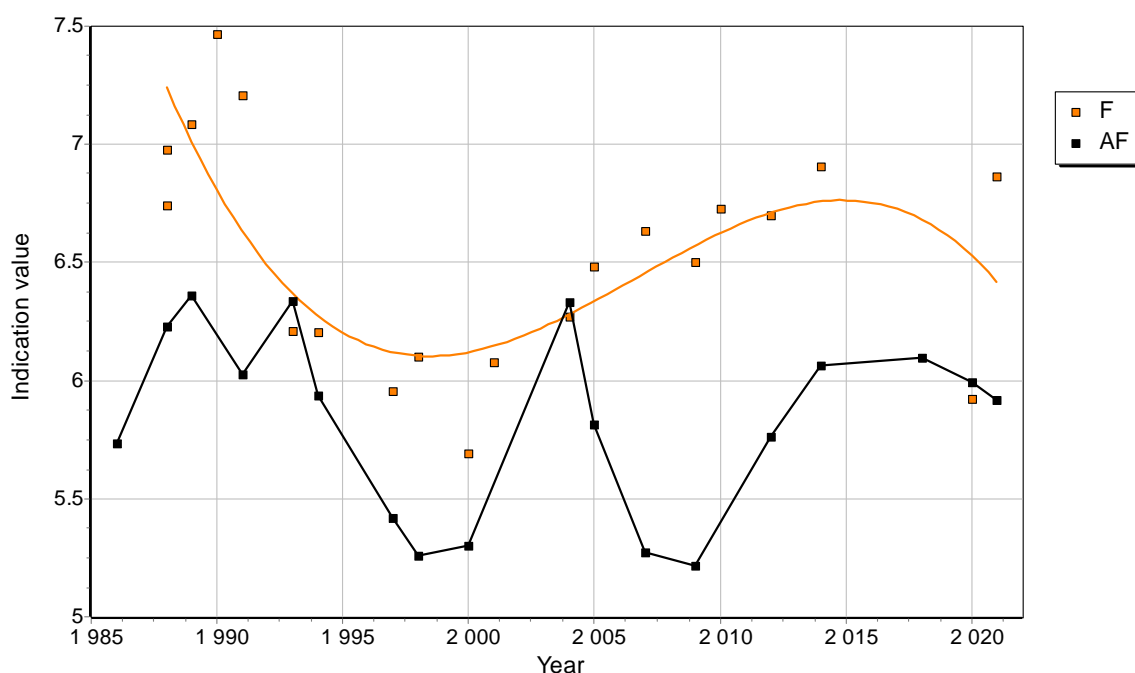


Fig. 14. The Ellenberg's bioindication of nitrogen activity in the plots F and AF

The nitrogen activity (also named as soil nutrients) shows interesting dynamics (Fig. 14). In the F plot, it was very high in the last crops with clover (1990). The minimum was achieved after ten years. It was followed with gradual increase in the nitrogen activity. The second plot AF shows three maxima of the nitrogen activity: the first one was placed in first decennium of the succession, followed by a decrease during rapid growth of willows. Next rapid increase of the nitrogen activity was probably connected with the stand self-thinning. This peak was only during short time, followed by a decrease. The last increase of the nitrogen activity (since 2012) was more stabile. The plot G had initial nitrogen activity value under 5 in the prevailing mowed part. During the succession up to 2007 was values of the index increased in the range 5.2 and 5.7. The minimum 4.7 was observed at 2009 and it was followed by an increase up to 6.2.

Conclusion

The succession is not continuous process, distinct periods can manifest different speed of the species composition change in the plant community.

Main driver of the succession in abandoned fields is development of woody etage. Woody species can establish in a short time window regularly at whole area (example of the plot AF) or in a long time in set of small spatial windows (gaps; plot G), as described by Matějka (2018). The originally small gaps lead to increase of spatial heterogeneity of the stand. Development of the shrub and tree etages is connected with light accessibility in the undergrowth. Soil properties are influenced by the biomass accumulation and are manifested as changes in nitrogen activity.

References

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Table 2. Phytocoenological relevés in the F plot. Cultivated species, typical species combination.

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year	1988 a	1988 b	1989	1990	1991	1993	1994	1997	1998	2000	2001	2004	2005	2007	2009	2010	2012	2014	2020	2021
Area (m ²)	50	50	50	50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
E ₂ cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0
E ₁ cover (%)	85	85	60	75	100	95	90	98	98	98	99	98	100	99	99	100	100	100	98	75
E ₀ cover (%)								15	70						0				0	0
Total species count	30	33	23	24	23	28	28	48	45	47	38	38	44	52	48	46	49	40	11	7
E ₁ species count	29	33	23	24	23	28	28	48	45	47	38	38	44	52	48	44	48	38	11	7
E ₁ diversity (H')	2.610	2.378	2.915	3.475	3.078	4.030	3.710	4.137	3.797	3.943	4.292	4.208	4.269	4.379	4.530	4.239	4.014	3.851	0.972	0.316
E ₁ equitability (e)	0.537	0.472	0.644	0.758	0.680	0.838	0.772	0.741	0.692	0.710	0.818	0.802	0.782	0.768	0.811	0.777	0.719	0.734	0.281	0.113
E ₂ :																				
<i>Picea abies</i>																+	+	+		
<i>Rosa dumalis</i>																+	r	+		
<i>Populus tremula</i>																	(r)	(r)		
<i>Betula pendula</i>																		(r)		
E ₁ :																				
<i>Cirsium arvense</i>	+	1	2	1	4	1-2	2	1	+	+	+	2-3	3	1-2	2	1	1-2	1-2	r	r
<i>Taraxacum sect. Ruderalia</i>	r	r	+	2	1	1	r	2-3	3	1	2-3	1	1	+1	+1	+	+			
<i>Mentha arvensis</i>	+	1	+	1	+	1	+	r	+	+						r	r	r		
<i>Agropyron repens</i>	r	+	+	1	1	3-4	2-3	+		r	1	1	+	1		r		+		
<i>Plantago uliginosa</i>	+	+	+	+	+	1	+	+												
<i>Poa annua</i>	1	+	+	1	1			+												
<i>Stellaria media</i>	2	2	1	2																
<i>Veronica arvensis</i>	+	+	+	+																
<i>Stachys palustris</i>	2	+	1		2	1	1	+					+	+		r	+		r	r
<i>Matricaria discoidea</i>	+	+	+		+															
<i>Raphanus raphanistrum</i>	r	+	+		r															
<i>Fallopia convolvulus</i>	+1	+1	+																	
<i>Polygonum hydropiper</i>	+1	+	+																	
<i>Spergula arvensis</i>	+	+	r																	
<i>Galium aparine</i>	1	+		+	1	+		1	(+)	+	+1	+1		+	+1	1	1	1-2		
<i>Myosotis arvensis</i>	+	1		+		2	+	r	+	+1		+		+			r	r		
<i>Viola arvensis</i>	+	+		+					(r)										1	r
<i>Lapsana communis</i>	1	+		+																
<i>Vicia hirsuta</i>	1	+			+1	2	+1	2	2	1-2	1-2	1			1	1	1	1	+1	r

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year	1988 a	1988 b	1989	1990	1991	1993	1994	1997	1998	2000	2001	2004	2005	2007	2009	2010	2012	2014	2020	2021
<i>Galeopsis tetrahit</i>	+	1																	r	
<i>Hordeum vulgare</i>	5	5																	+1	
<i>Chenopodium album</i>	+	+																		
<i>Chenopodium strictum</i>	+	+																		
<i>Solanum tuberosum</i>	1	1																		
<i>Tripleurospermum inodorum</i>	+		1	1	+	+1	r		(r)											
<i>Polygonum arenastrum</i>	+		+																	
<i>Cerastium holosteoides</i>	r			r				+1												
<i>Gnaphalium uliginosum</i>	+1				+															
<i>Vicia tetrasperma</i>	+											+1		2	1					
<i>Atriplex patula</i>	r																			
<i>Veronica persica</i>		r	+1	1-2		+														
<i>Sonchus asper</i>		+	+																	
<i>Calamagrostis epigejos</i>		+						+	+	+1	+	2-3	3	2	3	3	3-4	3		
<i>Trifolium repens</i>		r						+	+	1	1			+	1	r				
<i>Triticum aestivum</i>		+																		4
<i>Anagallis arvensis</i>		r																		
<i>Apera spica-venti</i>		+																		
<i>Galinsoga ciliata</i>		+																		
<i>Lycopsis arvensis</i>		+																		
<i>Achillea millefolium</i>			1	1	+	2-3	3	2-3	3	+	+	1	3	+1	1	1	+	r		
<i>Rumex obtusifolius</i>			+1	1-2	2		r	1-2	1	+	+		+1				r			
<i>Lolium multiflorum</i>			2	2	2															
<i>Trifolium pratense</i>			3-4	3-4						r					+	r				
<i>Ranunculus repens</i>			1		r	1-2	+	1-2	2	+1	1-2		1	+1	1	+1	r			
<i>Urtica dioica</i>				+	1	+	+	1	1-2	1-2	2	2-3	2-3	2-3	3	3	3	3		
<i>Epilobium ciliatum</i>				+	1	2	2	+	+1	+	+						r			
<i>Rumex crispus</i>				+	+	1														
<i>Plantago lanceolata</i>				+1		2	1-2	1	+1	1	+	+	1	+						
<i>Capsella bursa-pastoris</i>				1-2																
<i>Sonchus arvensis</i>					r	1	+	+	1	+	+	+	1	+1	+1	+	+			
<i>Agrostis gigantea</i>					2	2	3	1-2	+1	1			1	1-2	2	1-2	1	1		
<i>Conyza canadensis</i>					r															
<i>Dactylis glomerata</i>						1-2	2	3	3	3	3	2	2	3	2	2	1-2	1-2		

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year	1988 a	1988 b	1989	1990	1991	1993	1994	1997	1998	2000	2001	2004	2005	2007	2009	2010	2012	2014	2020	2021
<i>Galium album</i>						+1	+	1	1	2	1	+	1-2	1-2	2	1-2	2	1-2		
<i>Phleum pratense</i>						2	1-2	2-3	3	1-2	1	3	3	2	2-3	2-3	2-3	2		
<i>Senecio ovatus</i>						+	1-2	+1	1	+1	+1	1	1-2	+	+	r	+	+		
<i>Veronica chamaedrys</i>						1	+	1	1	1	2	+	1-2	1	1	1	+1	+		
<i>Artemisia vulgaris</i>						+	+	+	+	+		+1	2	1-2	1-2	1	+1	+1		
<i>Poa angustifolia</i>						1	1	1		+	1-2									
<i>Heracleum sphondylium</i>						r		r		r				r		+	r	r		
<i>Myosotis micrantha</i>						+														
<i>Arrhenatherum elatius</i>							2	1	+	+	1	1	+	1-2	1-2	2-3	2	2		
<i>Holcus mollis</i>							+1	+	+	+	1-2	1	+	+	+		+1		r	
<i>Agrostis tenuis</i>							1	2-3	3	3	2	1	1							
<i>Leucanthemum ircutianum</i>							+1	+	+						+					
<i>Aegopodium podagraria</i>								+	+	1-2	2	+1	1	3	2-3	3	3	3		
<i>Galium verum</i>								+	+	+	+	1-2	1	+	+1	1	+1	1		
<i>Fragaria vesca</i>								r	r	+	1	+	+	+	+	+	r			
<i>Pimpinella major</i>								+	+	+	+	+	+	+			r			
<i>Astragalus glycyphyllos</i>								r	r	r	r		+	+	+	+	+1	+		
<i>Campanula patula</i>								r	r	+	+1		+	+	r	r		r		
<i>Crepis biennis</i>								+	+	r		+	2	r	1	+1				
<i>Daucus carota</i>								r	+	1		1	1	1	+	+				
<i>Vicia angustifolia</i>								r	r		+	1		1	+1	1	+	+1	+	r
<i>Alchemilla vulgaris</i> agg.								r	r		+									
<i>Stellaria graminea</i>								1-2	+			1	+	1	1-2	1-2	1	1	r	
<i>Medicago lupulina</i>								r	r											
<i>Selinum carvifolia</i>								+		r	1	1	+	+	+	+	+	r		
<i>Prunus avium</i>								r		r	r									
<i>Plantago major</i>								r												
<i>Tussilago farfara</i>									1	+	+	+1	3	+1	1-2	1-2	1			
<i>Rubus idaeus</i>									r	+		+	r	1	+1	+1	2	2		
<i>Trisetum flavescens</i>									1	1		1-2	+	1	1-2	1-2	+1	+1		
<i>Holcus lanatus</i>									+				+	+						
<i>Thlaspi arvense</i>									(r)											
<i>Euphorbia cyparissias</i>										+	1	+	+	+	r	r	r			
<i>Calamagrostis arundinacea</i>										r	1									

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year	1988 a	1988 b	1989	1990	1991	1993	1994	1997	1998	2000	2001	2004	2005	2007	2009	2010	2012	2014	2020	2021
<i>Poa pratensis</i>										+	+1									
<i>Knautia arvensis</i>										r		+	+	+	+	+	+			
<i>Deschampsia cespitosa</i>										r				+	r					
<i>Anthriscus sylvestris</i>											+1	+	1-2	1	1	1-2	+1	+1		
<i>Epilobium collinum</i>												r	+		r		r			
<i>Trifolium medium</i>												+					r	r		
<i>Chaerophyllum aromaticum</i>													+	r	+1	1	1	1		
<i>Galium mollugo</i>													1		r		r	r		
<i>Leontodon hispidus</i>													+							
<i>Quercus robur</i>													r							
<i>Rubus fruticosus</i> agg.													r							
<i>Hypericum perforatum</i>														+	1-2	+	+1	r		
<i>Lathyrus pratensis</i>														+	+1	+1	1	+		
<i>Picea abies</i>														+	+		+	+		
<i>Rosa dumalis</i>														+	+		r	r		
<i>Festuca rubra</i>														+	+					
<i>Alopecurus pratensis</i>														+				+		
<i>Avenula pubescens</i>														+						
<i>Potentilla erecta</i>														+						
<i>Dryopteris filix-mas</i>															+	+		+		
<i>Torilis japonica</i>																r				
<i>Angelica sylvestris</i>																	r			
<i>Cuscuta epithymum</i>																	r			
<i>Vicia cracca</i>																		r		
<i>Brassica napus</i>																			5	
<i>Elytrigia repens</i>																			1	
<i>Poa trivialis</i>																				+1

Comments:

2009 *Picea abies* grows mainly at border of the locality, where disturbances can be occurred

2010 Begin of the shrub layer development (at border of the locality)

2014 Community of upper (lower stand, drier soil) and lower parts begin to be differentiated

2021 Strong herbicide application

Table 3. Phytocoenological relevés in the AF plot.

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Year	1986 a	1986 b	1986 c	1988	1989 a	1989 b	1989 c	1991	1993	1994	1997	1998	2000	2004	2005	2007	2009	2012	2014	2018	2020	2021
Area (m ²)	40	36	36	200	25	25	25	30	100	100	100	100	100	100	100	100	100	100	100	100	100	100
E ₃ cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	80	80	73	60	60
E ₂ cover (%)	0	0	0	0	0	0	0	0	0	0	90	98	90	85	85	80	2	2	2	4	5	10
E ₁ cover (%)	75	80	80	95	100	100	100	100	100	100	45	45	40	50	50	40	60	60	60	75	75	80
E ₀ cover (%)											5	20		3		5	5	5	5	5	5	5
Total species count	40	51	39	34	21	25	24	21	37	32	37	36	30	31	37	35	42	48	48	57	54	53
E ₁ species count	39	51	39	34	21	25	24	21	37	32	33	32	27	27	34	32	39	45	46	54	52	52
E ₁ diversity (H')	3.523	3.160	3.166	3.712	3.170	3.573	3.740	2.272	2.859	3.148	3.254	3.007	2.685	3.130	3.249	3.931	3.549	3.824	3.798	3.958	4.077	4.387
E ₁ equitability (e)	0.663	0.557	0.599	0.730	0.722	0.770	0.816	0.517	0.549	0.630	0.645	0.601	0.565	0.658	0.639	0.786	0.671	0.696	0.688	0.688	0.715	0.770
E ₃ :																						
<i>Salix caprea</i>																	90%	90%	90%	80%	80%	45%
<i>Populus tremula</i>																	8%	8%	8%	15%	15%	50%
<i>Betula pendula</i>																	2%	2%	2%	5%	5%	5%
E ₂ :																						
<i>Salix caprea</i>											5	5	5	5	5	80%	35%	35%	30%	30%	30%	30%
<i>Salix cinerea</i>											+	+	+	+	+	8%	35%	35%	35%	30%	30%	10%
<i>Populus tremula</i>											+	+	+	+	+	7%	30%	30%	30%	30%	30%	40%
<i>Betula pendula</i>											+1	+	r	r	r	5%						
<i>Picea abies</i>																			5%	10%	10%	20%
<i>Sambucus nigra</i>																				+		
<i>Fraxinus excelsior</i>																						+
E ₁ :																						
<i>Vicia hirsuta</i>	+	+	1						+	1-2	1	+	+	+		1	+1	+	+	+	+	+
<i>Vicia angustifolia</i>	+	+	+	+1	+		+						r	+					r	r	+	+
<i>Galeopsis tetrahit</i>	+	+	+1																		+	
<i>Vicia cracca</i>	+								+1		r									+		
<i>Achillea millefolium</i>	+	+	+	2	1	1-2	2		+1		+								r			
<i>Stachys palustris</i>	+			1		1				+	r	r	r		+				r			
<i>Viola arvensis</i>	1	+	+											r								
<i>Cirsium arvense</i>	+	+	+1	2-3	3	2-3	3	+1	+	+1		r										
<i>Epilobium ciliatum</i>	+	+	+	3	1-2	2	3		+	+												
<i>Sagina procumbens</i>	+1	+	+	+																		
<i>Myosotis arvensis</i>	2	1	+			+			r													

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Year	1986 a	1986 b	1986 c	1988	1989 a	1989 b	1989 c	1991	1993	1994	1997	1998	2000	2004	2005	2007	2009	2012	2014	2018	2020	2021
<i>Poa annua</i>	1	1	+1					+														
<i>Rumex obtusifolius</i>	+		+1	1-2		+																
<i>Trifolium repens</i>	r					+																
<i>Trifolium hybridum</i>	r			+																		
<i>Anagallis arvensis</i>	+1	+	+																			
<i>Apera spica-venti</i>	3-4	4	4																			
<i>Aphanes arvensis</i>	+	+	+																			
<i>Capsella bursa-pastoris</i>	+	+	+																			
<i>Fallopia convolvulus</i>	2	+	+1																			
<i>Gnaphalium uliginosum</i>	1	1	1																			
<i>Chenopodium album</i>	+	+	+																			
<i>Juncus bufonius</i>	+	+1	+1																			
<i>Lapsana communis</i>	+	+	+																			
<i>Matricaria discoidea</i>	+	1	+																			
<i>Persicaria maculosa</i>	r	+	+																			
<i>Plantago uliginosa</i>	2	1-2	1-2																			
<i>Polygonum arenastrum</i>	+	+	+																			
<i>Raphanus raphanistrum</i>	1	+1	+																			
<i>Scleranthus annuus</i>	+	+	+																			
<i>Spergula arvensis</i>	1	+1	1																			
<i>Stellaria media</i>	+1	+	+																			
<i>Thlaspi arvense</i>	+	+	r																			
<i>Tripleurospermum inodorum</i>	1	1	1-2																			
<i>Veronica arvensis</i>	+	+	r																			
<i>Anthemis arvensis</i>	+	+																				
<i>Veronica serpyllifolia</i>	+	+																				
<i>Atriplex patula</i>	+		+																			
<i>Persicaria hydropiper</i>	r		+																			
<i>Chenopodium suecicum</i>	+																					
<i>Urtica dioica</i>		r	r	+1	1	+1	1-2	+	2	1	1-2	1-2	1	1-2	1-2	+1	+1	+1	+	r	r	r
<i>Galium aparine</i>		r	r						+		r	+	+	3		+1	1	1	1	1	1	+1
<i>Pimpinella major</i>		r					1	+	+	+	+	+	r	+1	+	+	+	+	+	+		+
<i>Picea abies</i>		r									r	r	(r)			+	+	+1	1	1	1	1-2
<i>Artemisia vulgaris</i>		r		+	1	1	1	+	+1	1	r	r	r			+	r			(r)	r	

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Year	1986 a	1986 b	1986 c	1988	1989 a	1989 b	1989 c	1991	1993	1994	1997	1998	2000	2004	2005	2007	2009	2012	2014	2018	2020	2021
<i>Mentha arvensis</i>		r				+	+		+1	+	+			+								
<i>Elytrigia repens</i>		+	1	1	1	1																
<i>Daucus carota</i>		+	r																			
<i>Cerastium holosteoides</i>		r																				
<i>Galinsoga quadriradiata</i>		r																				
<i>Leontodon autumnalis</i>		r																				
<i>Leontodon hispidus</i>		+																				
<i>Persicaria lapathifolia</i>		+																				
<i>Rumex acetosa</i>		+																				
<i>Rumex crispus</i>		+																				
<i>Sonchus asper</i>		r																				
<i>Sonchus oleraceus</i>		+																				
<i>Veronica hederifolia</i>		r																				
<i>Veronica persica</i>		+																				
<i>Chenopodium polyspermum</i>			+																			
<i>Senecio viscosus</i>			+																			
<i>Calamagrostis epigejos</i>				2	2	3	3	4	5	5	1		+	2	2-3	1	1	1-2	1-2	1	1	1
<i>Salix caprea</i>				1-2	1-2	1	+	1	2	3-4									r	+	+	+
<i>Agrostis capillaris</i>				3	1-2	1	+1	1			2	2	1-2	+1	1	1-2	1	1	1	+	1	1
<i>Taraxacum sect. Ruderalia</i>				1	+	+		+	+	r	1			r	r		r	r	r	r	r	+1
<i>Selinum carvifolia</i>				1	1			r	1	2	+	1	+	2	1-2	1	1	1	+	+1	1	1
<i>Trifolium medium</i>				+		1				+	1	+1	+	+1	+	1	1-2	+1	+	1	1	1
<i>Senecio ovatus</i>				r			2	+1	1	2	+	r			+	+	+	+	+			r
<i>Heracleum sphondylium</i>				r					+		r	r		1	+		+	+	+	+	+1	1
<i>Alopecurus pratensis</i>				+							+	+						+		+	+	1
<i>Hypericum perforatum</i>				+		1-2	1	+	+	1					r	+	+	+	r	r	+	
<i>Vicia tetrasperma</i>				1				r	1	+											+	
<i>Festuca rubra</i>				+	1			2							+	+		+	r			
<i>Ranunculus repens</i>				+1			2	r		+	+	+	r					r				
<i>Equisetum sylvaticum</i>				r					+	1-2	+	+			r							
<i>Agrostis gigantea</i>				2	3-4	2-3	2	2	2-3	2				+								
<i>Salix cinerea</i>				r	r	r	r	+	+	+												
<i>Juncus effusus</i>				+								r										
<i>Holcus lanatus</i>				+		+1			+													

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Year	1986 a	1986 b	1986 c	1988	1989 a	1989 b	1989 c	1991	1993	1994	1997	1998	2000	2004	2005	2007	2009	2012	2014	2018	2020	2021
<i>Sonchus arvensis</i>				+					+													
<i>Cirsium palustre</i>				+																		
<i>Crepis biennis</i>				+																		
<i>Tussilago farfara</i>				+																		
<i>Vicia sativa</i>				r																		
<i>Populus tremula</i>					+				+	+			+		r	+1	+	+	+	2	2	2
<i>Galium mollugo</i>					+												+	+	+	r		r
<i>Stellaria graminea</i>					+	+			+											+	+	
<i>Poa trivialis</i>					+		1															
<i>Rumex acetosella</i>					+																	
<i>Silene latifolia</i>					+																	
<i>Dactylis glomerata</i>						1	1								+	+	+	+	+	+	+1	1
<i>Holcus mollis</i>						+	1			1	r	r			+	+			r	+	+	
<i>Juncus conglomeratus</i>						+																
<i>Trifolium campestre</i>						+																
<i>Aegopodium podagraria</i>							+1			+	+	+	+		+1	1	1	1	2	2-3	2-3	2-3
<i>Galium album</i>							+		+	+1						r		r	r	r	+	+1
<i>Poa angustifolia</i>							1-2			+1			+				+1	+	+	+		
<i>Poa palustris</i>							1									r						+
<i>Myosoton aquaticum</i>							+															
<i>Veronica chamaedrys</i>								+	+	+	1	1	1		+	+	2	2	2	1-2	+	1-2
<i>Arrhenatherum elatius</i>								r		+							r	+	1	1-2	1-2	1-2
<i>Centaurea jacea</i>								r														
<i>Galium pumilum</i>								+														
<i>Scrophularia nodosa</i>									+1			r	r	+1	+	+	+	+	+	+	+	+
<i>Campanula persicifolia</i>									r				r	+	+	+	1	+	+	+1	1	1
<i>Anthriscus sylvestris</i>									r			r							+		+	+1
<i>Lathyrus pratensis</i>									+					+			+	r	r	+	+	+
<i>Campanula patula</i>									+					r							+	
<i>Galium verum</i>									+											r		
<i>Hypericum maculatum</i>									r		+	r										
<i>Phleum pratense</i>									r	+											r	
<i>Luzula multiflora</i>									r													
<i>Fragaria vesca</i>										r	+	+	+	+1	1-2	2	2-3	2-3	2-3	2-3	2-3	2-3

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Year	1986 a	1986 b	1986 c	1988	1989 a	1989 b	1989 c	1991	1993	1994	1997	1998	2000	2004	2005	2007	2009	2012	2014	2018	2020	2021
<i>Poa pratensis</i>										+	+										r	
<i>Torilis japonica</i>										+					+	+	+	+1	+			
<i>Leucanthemum ircutianum</i>										+												
<i>Calamagrostis arundinacea</i>											2-3	2	2	1-2	1	1	3	2	2	2	2	2
<i>Prunus avium</i>											r	+	r	+	+	+	+	+	+	r	r	r
<i>Rubus idaeus</i>											+	+	r	+	+	+		+	+	r		
<i>Sorbus aucuparia</i>											r	r				+	+	+	+1	+	+	+
<i>Acer pseudoplatanus</i>											r							r				
<i>Lychnis flos-cuculi</i>											r	+	r									
<i>Viola reichenbachiana</i>											r											r
<i>Quercus robur</i>												r	r	+	+	+	+	+1	+1	1-2	1-2	1-2
<i>Lamium album</i>												r										r
<i>Alchemilla vulgaris</i> agg.												r										
<i>Fraxinus excelsior</i>													r							r	+1	+
<i>Larix decidua</i>													(r)									
<i>Geranium robertianum</i>														r			+	+				+
<i>Impatiens parviflora</i>														r			r				r	r
<i>Vaccinium myrtillus</i>														r								
<i>Vicia sepium</i>														r								
<i>Euphorbia cyparissias</i>															+	+		r	+		+	+1
<i>Fagus sylvatica</i>															r		r	r	+	+	r	+
<i>Luzula luzuloides</i>															r		r	r	+	+1	+	1
<i>Ranunculus acris</i>															r					r		+
<i>Abies alba</i>															r		r			+	r	
<i>Campanula rotundifolia</i>															r	+		+				
<i>Sambucus racemosa</i>															r			r+				
<i>Pinus sylvestris</i>															r							
<i>Poa nemoralis</i>																+1			1	+	+	+
<i>Astragalus glycyphyllos</i>																	+	r	+	+	+	+1
<i>Knautia arvensis</i>																	+			r	r	r
<i>Actaea spicata</i>																	r		r	+	+	
<i>Chaerophyllum aromaticum</i>																	r					
<i>Rubus fruticosus</i> agg.																		r		r	r	+
<i>Crataegus</i> sp.div.																		r		r		

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Year	1986 a	1986 b	1986 c	1988	1989 a	1989 b	1989 c	1991	1993	1994	1997	1998	2000	2004	2005	2007	2009	2012	2014	2018	2020	2021
<i>Rosa dumalis</i>																		+		+		
<i>Corylus avellana</i>																			r			
<i>Epilobium collinum</i>																			r			
<i>Tilia cordata</i>																				+	+	
<i>Dryopteris filix-mas</i>																				r		r
<i>Ranunculus auricomus</i>																				+		r
<i>Acer platanoides</i>																				r		
<i>Carex pairae</i>																				r		
<i>Epilobium angustifolium</i>																					r	
<i>Epipactis helleborine</i>																					r	
<i>Prunus spinosa</i>																					r	
<i>Avenula pubescens</i>																						r
<i>Betula pendula</i>																						r
<i>Digitalis grandiflora</i>																						(+)
<i>Geum urbanum</i>																						r
<i>Milium effusum</i>																						r

Comments:

2004 lot of shrubs is died, E₂ grow into E₃, height approximately 10 m; E₁ increases vitality

2012 woody species are visibly died, coarse woody debris is accumulated

2018 E₃ disintegration is continuing, new young individuals of woods take place in the community

Table 4. Phytocoenological relevés in the G plot.

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	1985 a	1985 b	1985 c	1985 d	1987	1997	1998	2004	2007	2009	2012	2014	2018	2020	2021
Area (m ²)	20	30	30	20	50	100	100	150	150	150	150	150	200	200	200
E ₃ cover (%)	0	0	0	0	0	0	0	0	0	20	20	25	30	30	30
E ₂ cover (%)	0	0	0	0	0	5	5	15	20	0	2	1	1	1	1
E ₁ cover (%)	100	95	98	100	100	100	100	100	98	98	96	96	98	98	98
E ₀ cover (%)	0	20	20	50						0					r
Total species count	12	38	32	31	38	44	44	43	51	51	55	54	59	53	46
E ₁ species count	11	38	32	31	38	43	43	41	50	50	54	53	58	51	45
E ₁ diversity (H')	2.142	4.089	4.199	4.120	4.375	4.131	4.064	3.898	4.499	4.329	4.167	4.170	4.234	3.739	3.729
E ₁ equitability (e)	0.598	0.779	0.840	0.832	0.834	0.761	0.749	0.728	0.797	0.767	0.724	0.728	0.723	0.659	0.679
E ₃ :															
<i>Salix caprea</i>										90%	90%	90%	90%	90%	90%
<i>Picea abies</i>										10%	10%	10%	10%	10%	10%
E ₂ :															
<i>Salix caprea</i>						+1	1	2	90%						
<i>Picea abies</i>								+	10%				1	1	1
<i>Salix cinerea</i>											+	+			
<i>Crataegus laevigata</i>													+	+	
<i>Quercus robur</i>															+
E ₁ :															
<i>Anthriscus sylvestris</i>	+	+			+	+1	+	r	+	+	r	r	+	+	+
<i>Arrhenatherum elatius</i>	+	+			+	1	1	3-4	1-2	2	2	2	2-3	3	3
<i>Stellaria graminea</i>	+	1-2	2	2	+	1	2	2	1	2	+1	+1	+1	+	+
<i>Pimpinella major</i>	+1	+	+		1	1-2	1	3	2	2	2-3	2	2	2	2
<i>Lathyrus pratensis</i>	1		2		1	1	1	1	1	+1	+1	+1	1-2	1	1
<i>Alopecurus pratensis</i>	2		+			1	1	1	+	+	+	+1	1	1	2
<i>Galium aparine</i>	+							+		+	+	+	r	r	+
<i>Equisetum arvense</i>	1			+				r	+	+	+	+			
<i>Urtica dioica</i>	5							+		+	+	+	+	+	r
<i>Elytrigia repens</i>	3	+1	1	3-4	1	2-3	2-3	1							
<i>Cirsium arvense</i>	2		+		+	+									
<i>Viola arvensis</i>	+														

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	1985 a	1985 b	1985 c	1985 d	1987	1997	1998	2004	2007	2009	2012	2014	2018	2020	2021
<i>Veronica chamaedrys</i>		1	1	1	1-2	1	1-2	+	2	+	+	+	+	+	1
<i>Achillea millefolium</i>		2	1-2	1	2	+	+	1	1	1			+	+	+
<i>Campanula patula</i>		2	2	1	r	r	r		+	+1	r	r	r	r	r
<i>Rumex crispus</i>		r	+1	+	+	+	+			r				r	r
<i>Lychnis flos-cuculi</i>		+	1	+	1	r		r	+	r	r	r	r	+	+
<i>Rumex acetosa</i>		+	+		+										r
<i>Poa pratensis</i>		2	2	2									+	+	+
<i>Taraxacum sect. Ruderalia</i>		1	1	1									r	r	r
<i>Holcus mollis</i>		+1	2	1-2	3	1	2	1	1	1-2	1-2	1	1	+	
<i>Hypericum perforatum</i>		+1	+		2	1	+1					+	+	+	
<i>Trisetum flavescens</i>		+	+				+	1	1	+		+		1	
<i>Poa trivialis</i>		1	1	1	1-2	2	2		+	+	+	+	+		
<i>Prunella vulgaris</i>		2	2	2	2-3	+									
<i>Trifolium repens</i>		2	2	2	+				r	+		+	+	+	
<i>Plantago major</i>		1	1	+	+										
<i>Leucanthemum ircutianum</i>		3	3	2					r						
<i>Cerastium holosteoides</i>		+1	+	+											
<i>Trifolium pratense</i>		1	1		+	+	r								
<i>Holcus lanatus</i>		3	2-3		2	+		+				r	+		
<i>Leontodon hispidus</i>		1	1		+1										
<i>Plantago lanceolata</i>		2	2		2										
<i>Hypochaeris radicata</i>		+	+												
<i>Leontodon autumnalis</i>		1	+												
<i>Agrostis capillaris</i>		+		2	1-2	2	2	2	+1	2	2	2	2	2	2
<i>Galium verum</i>		r		+			+	1	+1	+	+	+	+	+	+1
<i>Agrostis gigantea</i>		+		+	2	2-3	2	+1	1-2	+	+	+			
<i>Lotus corniculatus</i>		+		1	1-2		r		r						
<i>Avenula pubescens</i>		+			1	2	2	1	1	+	+		+	+	1
<i>Dactylis glomerata</i>		+			1-2	+	+		+		r	+	+	+	+1
<i>Anthoxanthum odoratum</i>		1			1-2	+	+		+						
<i>Luzula campestris</i>		+			1		r								
<i>Galium album</i>		+				+1	+	1	1	1	+	+	1	1	1
<i>Trifolium dubium</i>		+													
<i>Ranunculus repens</i>			1-2	2	2	+1		+	+	+		+	+1	+	+

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	1985 a	1985 b	1985 c	1985 d	1987	1997	1998	2004	2007	2009	2012	2014	2018	2020	2021
<i>Carex ovalis</i>			+	+		+	r	(+)		r					
<i>Myosotis arvensis</i>			r												
<i>Mentha arvensis</i>				2	1	+	+			+	r				
<i>Cirsium palustre</i>				+		+	+		+1	1	1	+1	1	1	+1
<i>Lysimachia vulgaris</i>				+		+1	1	(+1)	+1	1	1-2	+1	1	1	+
<i>Equisetum sylvaticum</i>				2		r	+	(+)	+	+	+	+	+	r	
<i>Crepis biennis</i>				1		r									
<i>Rumex obtusifolius</i>				2					r						
<i>Stachys palustris</i>				+						r	+	+			
<i>Trifolium hybridum</i>				1											
<i>Knautia arvensis</i>					r	r		+	+	+	+	+	+	r	+
<i>Deschampsia cespitosa</i>					+	+		+	+	+1	1	+1	+	+	
<i>Festuca pratensis</i>					1				+		+	+	+1		
<i>Alchemilla vulgaris</i> agg.					+		+								
<i>Briza media</i>					+										
<i>Centaurea jacea</i>					+										
<i>Aegopodium podagraria</i>						+	+	1-2	2	1	1-2	2	2-3	2-3	2-3
<i>Heracleum sphondylium</i>						1	1	+1	+	+	+	+	+	+	+1
<i>Phleum pratense</i>						1	1	+	+	+1	+1	+		r	r
<i>Trifolium medium</i>						r		+		+	+		+	+	+
<i>Festuca rubra</i>						+	+	r	1	1	1-2	1	+1	1	
<i>Juncus effusus</i>						+	+	(+)	r	+	r	+1	+		
<i>Scrophularia nodosa</i>						r	r		+	+	r		r		
<i>Carex pallescens</i>						+			+			+	+		
<i>Carex pairae</i>						+			+						
<i>Quercus robur</i>							r	r	+	+	+	+	1	+	+
<i>Selinum carvifolia</i>							+	1	1	+	+1	+	+	+1	+1
<i>Carex hirta</i>							+		+	1	+1	+1	+1	+	+1
<i>Picea abies</i>							r		+	+	+	+	+	r	r
<i>Galeopsis bifida</i>							+	1	r		r			r	
<i>Hypericum maculatum</i>							+	2-3	1	1	1				
<i>Angelica sylvestris</i>								+	1-2	2	1-2	1	1	+	+
<i>Chaerophyllum aromaticum</i>								+		+	+	+	+	+	+1
<i>Senecio ovatus</i>								+1	r		r	r		r	

Column no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Year	1985 a	1985 b	1985 c	1985 d	1987	1997	1998	2004	2007	2009	2012	2014	2018	2020	2021
<i>Galium uliginosum</i>								(+)			+	r	+		
<i>Carex vesicaria</i>									+1				r		
<i>Vicia angustifolia</i>									r					r	r
<i>Rubus idaeus</i>										+	+	r	+1	+1	+
<i>Fragaria vesca</i>										+	+		+	r	+
<i>Poa palustris</i>										+	+	+1		+	
<i>Betula pendula</i>										r					
<i>Ranunculus acris</i>											(r)	r	+		+
<i>Campanula persicifolia</i>											(r)		r	r	
<i>Salix caprea</i>											r	r	r		
<i>Vicia tetrasperma</i>											r	+	r		
<i>Fagus sylvatica</i>											r		r		
<i>Epilobium ciliatum</i>											r				
<i>Populus tremula</i>												+	r		r
<i>Epipactis helleborine</i>												r			
<i>Lythrum salicaria</i>												+			
<i>Potentilla erecta</i>													+	+	+
<i>Carex nigra</i>													+		
<i>Hieracium sabaudum</i>													r		
<i>Rubus fruticosus agg.</i>													r		
<i>Calamagrostis epigejos</i>														+	+
<i>Rosa dumalis</i>														r	r
<i>Fraxinus excelsior</i>															r
<i>Tragopogon sp.</i>															r

Comments:

2004 former differences of distinct parts of the locality are less visible, willow height approximately > 10m

2012 the plot is heterogenous with several partial communities, main environmental variable is availability of sun radiation

Table 5. Phytocoenological relevés in the G plot.

Column no.	1	2	3	4	5	6	7	8	9	10	11
Year	1985 a	1985 b	1985 c	1994	1997	2002	2010	2012	2018	2020	2021
Area (m ²)	400	400	400	400	400	400	400	400	400	400	400
E ₃ cover (%)	80	70	80	70	60	60	65	70	65	80	85
E ₂ cover (%)	0	0	0	0	15	15	18	20	20	25	25
E ₁ cover (%)	80	90	80	90	85	90	80	80	80	80	85
E ₀ cover (%)	5	1	5					5	5	5	5
Total species count	32	34	36	36	39	36	33	37	27	34	33
E ₁ species count	31	34	34	35	38	36	33	37	27	34	33
E ₁ diversity (H')	4.073	3.294	4.258	3.975	4.149	3.640	3.578	3.465	3.532	3.625	3.789
E ₁ equitability (e)	0.815	0.648	0.837	0.775	0.791	0.704	0.709	0.665	0.743	0.713	0.751
E ₃ :											
<i>Quercus robur</i>	60%	100%	80%	95%	95%	95%	95%	91%	88%	92%	92%
<i>Tilia cordata</i>	20%		10%					2%	5%	2%	2%
<i>Acer pseudoplatanus</i>	15%			5%	5%	5%	5%	5%	5%	5%	5%
<i>Tilia platyphyllos</i>	5%										
<i>Fagus sylvatica</i>			10%								
<i>Picea abies</i>								2%	2%	1%	1%
E ₂ :											
<i>Tilia cordata</i>					100%	95%	93%	88%	93%	95%	95%
<i>Fraxinus excelsior</i>						5%	5%	5%	5%		
<i>Picea abies</i>							r	2%	r	1%	1%
<i>Sorbus aucuparia</i>							2%	2%	2%	1%	1%
<i>Acer pseudoplatanus</i>								3%			
<i>Frangula alnus</i>										3%	3%
E ₁ :											
<i>Calamagrostis arundinacea</i>	1	4	1	2	1-2	2	2	2	1-2	1	1
<i>Fragaria moschata</i>	2	+	2	1	2	2	2	2	2	2	2
<i>Galium rotundifolium</i>	1	+ -1	2	1	1-2	1	1	+ -1	+ -1	+	r
<i>Melampyrum pratense</i>	2-3	1	2	2	1	1-2	1	+ -1	1	1-2	1-2
<i>Melica nutans</i>	1	+	1-2	1	2	1-2	1-2	+	+ -1	r	r
<i>Oxalis acetosella</i>	2	2	2	+ -1	1-2	2	2	2	1-2	1-2	1-2
<i>Picea abies</i>	+	1	1	+	+	r	r	r	+	r	r

Column no.	1	2	3	4	5	6	7	8	9	10	11
Year	1985 a	1985 b	1985 c	1994	1997	2002	2010	2012	2018	2020	2021
<i>Poa nemoralis</i>	3	+	1	2	3	3-4	3	3	3	3	3
<i>Sorbus aucuparia</i>	1	1	1	+	1	+1	+	1	+1	+1	+
<i>Vaccinium myrtillus</i>	2	+1	2	1	1	1	1	1-2	1-2	2	2
<i>Viola reichenbachiana</i>	2	+1	1-2	1	1	1	1	+1	+	+	1
<i>Quercus robur</i>	1	1	+	+		r	r	+	+	+	+
<i>Fraxinus excelsior</i>	1	1		+1	+	+	+	+	+1	+1	+1
<i>Rubus fruticosus</i> agg.	+	+		1	+1	+	+	+1	+	+1	1
<i>Acer pseudoplatanus</i>	+	r			r	r	r	+	+	+	+
<i>Dryopteris filix-mas</i>	r	+					r	r	r		r
<i>Frangula alnus</i>	1		1	+	1	+	1	+1	1	1	1
<i>Luzula luzuloides</i>	1-2		2	2-3	1-2	1-2	1-2	+	+	+1	1
<i>Tilia cordata</i>	1			+1	+1	+1	1	1	1-2	1-2	1-2
<i>Luzula pilosa</i>	+		1	1	r	r	r	r	+	+	+
<i>Hieracium murorum</i>	1		1						+	+	+1
<i>Veronica chamaedrys</i>	2	1		1	1	+	+			+	
<i>Senecio ovatus</i>	r	+	+	+	+			r			
<i>Viola riviniana</i>	1	+	+		+	+	r				
<i>Campanula persicifolia</i>	+		+	r	+	+	+				
<i>Viola canina</i>	+	+	+	r	+	r					
<i>Mycelis muralis</i>	1-2		1	+	1	+					
<i>Festuca rubra</i>	1	+				r					
<i>Epilobium montanum</i>	r	+									
<i>Digitalis grandiflora</i>	r										
<i>Galeopsis bifida</i>	r										
<i>Tilia platyphyllos</i>	+										
<i>Sanicula europaea</i>		1	2	2	1-2	1-2	1-2	1-2	2	2	2
<i>Geum urbanum</i>		+		+	+	+	+			+	+
<i>Moehringia trinervia</i>		+	+		2	1				+	
<i>Ranunculus nemorosus</i>		+	1							+	
<i>Dactylis glomerata</i>		r		+1	+			r			
<i>Clinopodium vulgare</i>		1		+		+		+			
<i>Euphorbia cyparissias</i>		+		+	r	+					
<i>Agrostis capillaris</i>		+	1		1						
<i>Galeopsis speciosa</i>		+			+						

Column no.	1	2	3	4	5	6	7	8	9	10	11
Year	1985 a	1985 b	1985 c	1994	1997	2002	2010	2012	2018	2020	2021
<i>Avenella flexuosa</i>		+									
<i>Poa pratensis</i>		r									
<i>Rubus idaeus</i>		2									
<i>Festuca altissima</i>			+	+1	+1	+	+	+1	+	1	1
<i>Anemone nemorosa</i>			+			+			1	+	1-2
<i>Ajuga reptans</i>			+					r			r
<i>Hieracium sabaudum</i>			+					r			r
<i>Rosa dumalis</i>			+	r				r			
<i>Prunus spinosa</i>			+					r			
<i>Calamagrostis epigejos</i>			+1								
<i>Deschampsia cespitosa</i>			+								
<i>Platanthera bifolia</i>			r								
<i>Dryopteris dilatata</i>				r					r		r
<i>Prunus avium</i>				+			r	r		r	
<i>Maianthemum bifolium</i>				+	r		r	+			
<i>Ribes alpinum</i>				+				r			
<i>Urtica dioica</i>				r							
<i>Impatiens parviflora</i>					+	+					
<i>Anthriscus sylvestris</i>					r	r	r				
<i>Hieracium lachenalii</i>					r		r				
<i>Galium aparine</i>					+1	+1				+	+
<i>Acer platanoides</i>					r		r	r		r	+
<i>Aegopodium podagraria</i>						r	r	r	r	+	+
<i>Angelica sylvestris</i>							+				
<i>Fagus sylvatica</i>								r	r	r	r
<i>Juglans regia</i>								r			
<i>Pimpinella major</i>								r			
<i>Quercus rubra</i>										r	r
<i>Ulmus glabra</i>										r	

Comment:

2018 significant vegetative *Tilia cordata* regeneration

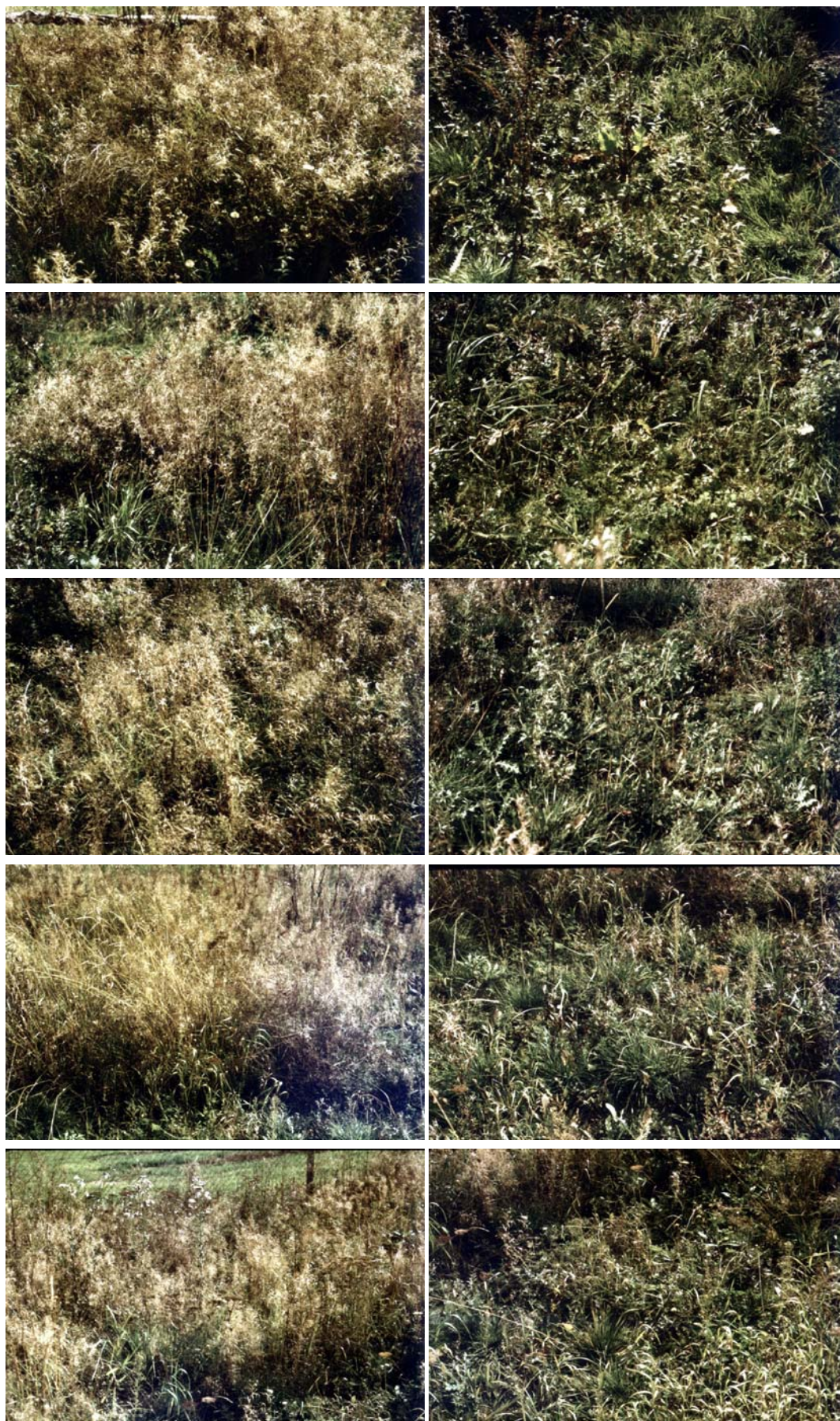


Fig. 15. Visual comparison of the vegetation structure variability in the locality AF at 20.9.1987 (2nd year of the succession).

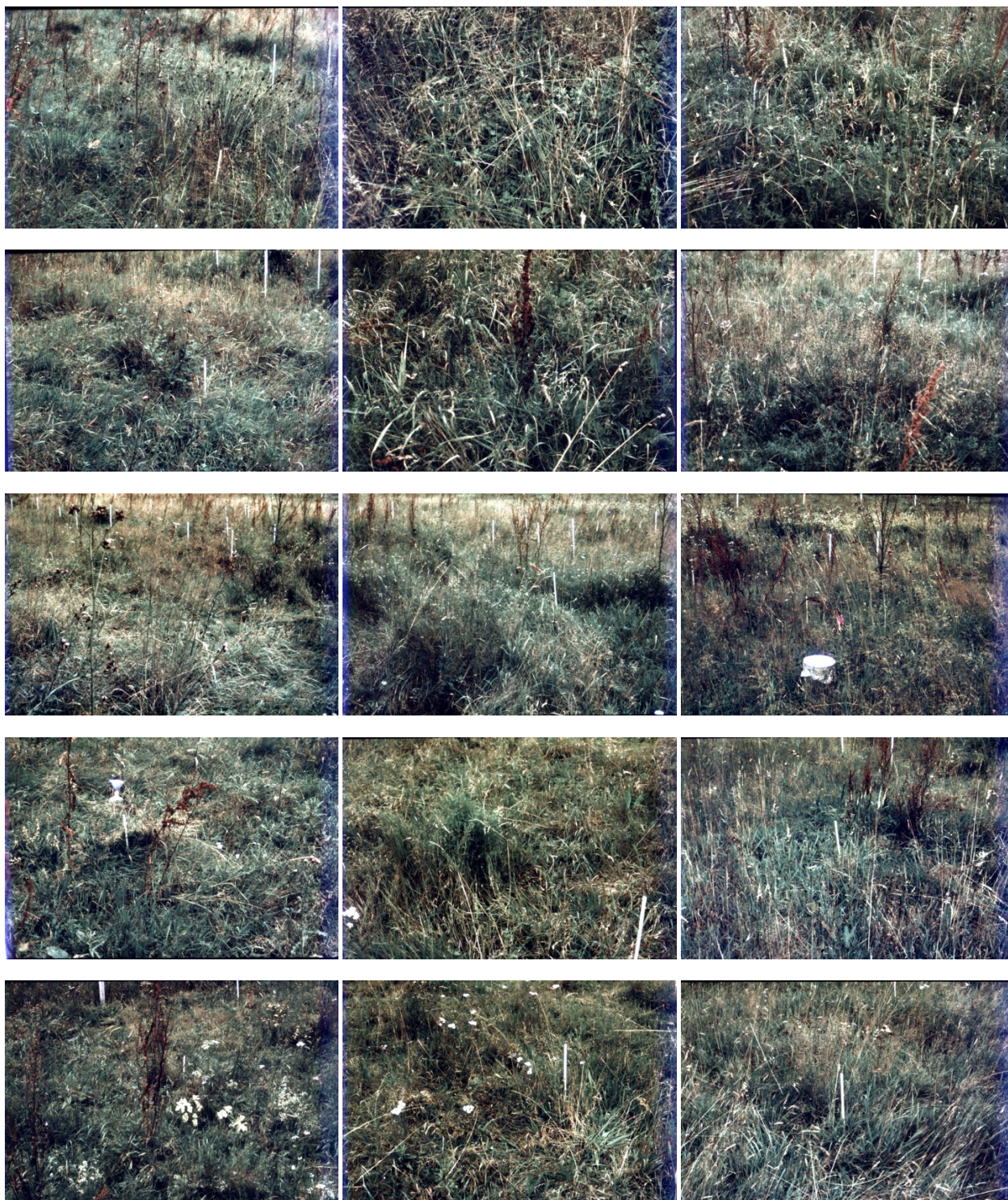


Fig. 16. Visual comparison of the vegetation structure variability in the locality G at 19.8.1987 (2nd year of the succession) within permanent quadrat grid (each partial plot 5 × 5 m in size).

Numbers of the plots

13	14	15
10	11	12
7	8	9
4	5	6
1	2	3